azbil

CM2-HGC100-2001

Heat Value Gas Chromatograph
Model: HGC303

User's Manual

Azbil Corporation

NOTICE

Safety

Safety symbols

Be sure to correctly operate the model HGC303 while strictly observing the safety precautions provided in this manual-especially the Warnings and Cautions indicated by the symbols as shown below.

The descriptions of the Warning and Caution signs used in this manual are as follows.

⚠ WARNING
The Warning sign means that serious personal injury, even death, could result if the instructions given are not strictly observed.

⚠ CAUTION
The Caution sign means that light personal injury and/or equipment damage could result if the instructions given are not correctly observed.

Hazardous Areas Certifications

The model HGC303 complies with the type of protection, which based on the following standards.

(1) ISSeP/ATEX Flameproof Certification

CE 0344

Ex II 2 GD

EEx d II C T6 -10°C≤Tamb≤+50°C IP65

ISSeP14ATEX0007X

Special conditions for safe use (symbol X)

The fastening screws of this apparatus are made of stainless steel and have a yield stress of 500 N/mm².

(2) FM Explosionproof / Flameproof Approval

Explosionproof for Class I, Division 1, Groups C and D, T4

Flameproof for Class I, Zone 1, AEx d IIB T4

Dust-ignitionproof for Class II and III, Division 1, Groups E, F and G, T4

(3) NEPSI Flameproof Certifications

Flameproof

Ex d IIC T6 Gb at -10°C≤Tamb≤+50°C

Dust-Ignition-proof

Ex tD A21 T85°C

Therefore, the model HGC303 can be installed in various hazardous locations. However, an explosion-protected electrical apparatus requires special care. Please read all instruction and safety notes before installation.

⚠ WARNING
NEVER open the terminal box cover while the model HGC303 is energized in a hazardous location.

⚠ CAUTION
Use the model HGC303 only in an ambient temperature of -10 to 50°C (14 to 122°F)

⚠ CAUTION
Take precautions to prevent corrosion, deformation or damage to the housing or terminal box cover.

⚠ CAUTION
See that all conduits are properly sealed. Otherwise, the model HGC303 cannot withstand the pressure that can result from explosion of an explosive gas inside the housing. Also, the model HGC303 cannot prevent the explosion of any external explosive gas.

(1)Installation for ISSeP/ATEX Flameproof Apparatus

1. General

1.1 **The apparatus protected by the flameproof enclosure** in accordance with EN 60079-1 can be installed in such hazardous areas, for which the apparatus has been certified, as an explosive atmosphere containing flammable substances in the form of **gas**, **vapour**, **mist** or **dust** may be present.

~Note *The apparatus has been certified to comply with EN 61241-0, EN 61241-1 (dust ignition protection).*

1.2 **The apparatus enclosure must be kept closed in the hazardous areas when the apparatus is energized** because the internal circuit of the apparatus is capable of igniting the explosive atmosphere. (Never connect any hand-held communicator to the apparatus terminals by opening the cover, except while no explosive atmosphere is present.)

1.3 It is required to connect **the external earthing terminal of the apparatus to the equipotential bonding system** which includes protective conductors, metal conduits, metal cable sheaths, steel wire armouring and metallic parts of structures, but does not include the neutral conductors of the power systems.

~Note *The protective conductor to which exposed conductive parts of equipment (machines, apparatus, devices, components and instrumentation thereof) are connected, must be separated in the hazardous area from the neutral conductor, and must be connected to the power systems earth point in the non-hazardous area, if the power system is directly earthed.*

For external earthing and bonding of the apparatus it is recommended to use a cable lug so that the conductor is secured against loosening and twisting and that the contact pressure is permanently secured.

1.4 Either **cable systems** (cable entry systems) or **conduit systems** can be employed for wiring of the apparatus in the hazardous areas (see 2 or 3).

1.5 **Non-sheathed single core cables are not permitted for live conductors** unless they are installed inside enclosures or conduit systems.

1.6 **Conduits** and, **in special cases**, **cables** (for example, where there is a pressure difference) **must be sealed** so as to prevent the passage of the explosive atmosphere.

1.7 **Further information concerning installation and maintenance of apparatus** is given by relevant clauses of the following documents.

EN 60079-14 **Electrical apparatus for explosive gas atmospheres**
Part 14: **Electrical installations in hazardous areas other than mines**

EN 60079-17 Part 17: **Inspection and maintenance of electrical installations in hazardous areas.**

EN 50281-1-2 **Electrical apparatus for use in the presence of combustible dust**
Part 1-2: Electrical apparatus protected by enclosures
-- Selection, installation and maintenance

2. Cable systems

2.1 **Thermoplastic sheathed cables, thermosetting sheathed cables**, or **elastomeric sheathed cables** can be selected for fixed wiring in the hazardous areas.

2.2 Flameproof cable entry devices (cable glands) certified to comply with EN 60079-1 and appropriate to the type of cable employed, must be used for the connection of cables to the apparatus.

3. Conduit systems

For conduit systems, relevant national standards or codes of practice are followed prior to the following recommendations.

3.1 **Screwed heavy gauge steel, solid drawn or seam welded conduit**, or **flexible conduit for protection of cables in explosive atmospheres** (see ISO 10807) can be selected for fixed wiring in the hazardous areas.

3.2 **Conduit must be threaded for connection** to permit the full engagement of five threads.

3.3 Either **conduit entry devices** or **sealing devices such as stopping boxes** are provided at the wall of the apparatus enclosure to limit the pressure piling effect and to prevent hot gases from entering the conduit system from the enclosure containing a source of ignition. **Each type of both the devices must be certified** to comply with EN 60079-1.

3.4 **The stopping boxes**, if used, **are filled with a compound** which does not shrink or setting and is impervious to, and unaffected by, chemicals found in the hazardous area. **The depth of the compound in the stopping box** is at least equal to the internal diameter of the conduit, but in no case less than 10 mm.

3.5 When the conduit contains three or more **non-seathed single or multi-core cables**, the total cross-sectional areas of cables, including insulation, are not more than 40% of the cross-sectional area of the conduit.

4. Installation in explosive atmospheres caused by air / dust mixtures

4.1 **Conduit** or **cable glands**, if employed to connect cables to the apparatus, must be selected and used in such a way that an **IP6X protection** (dust-tight) is guaranteed.

4.2 It is recommended to maintain the apparatus so that **the dust layer will not exceed a thickness of 5 mm**.

~Note *Where **the ignition temperature of a dust layer up to 5 mm thickness** is equal to, or higher than, the value that is obtained by adding **75K** to the maximum surface temperature of the enclosure "T...°C" as marked on the apparatus, the apparatus is incapable of causing ignition of the dust layer. (T...°C is based on the maximum ambient temperature)*

(2) Installation for FM Explosionproof / Flameproof Apparatus (in accordance with NEC)

⚠ CAUTION

- Install the apparatus only in hazardous (classified) locations for which the apparatus has been approved.
- Seal each conduit entering the apparatus enclosure within 18 in.(457 mm) from the enclosure.
- Do not open the apparatus enclosure when an explosive atmosphere is present.

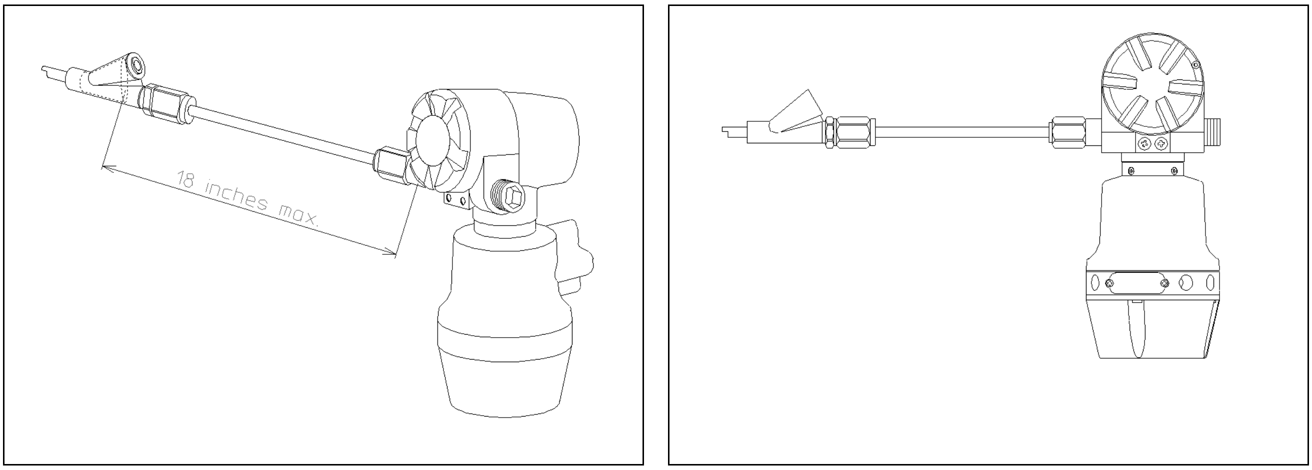

Figure S-1 An example of conduit seal (with stopping plug)

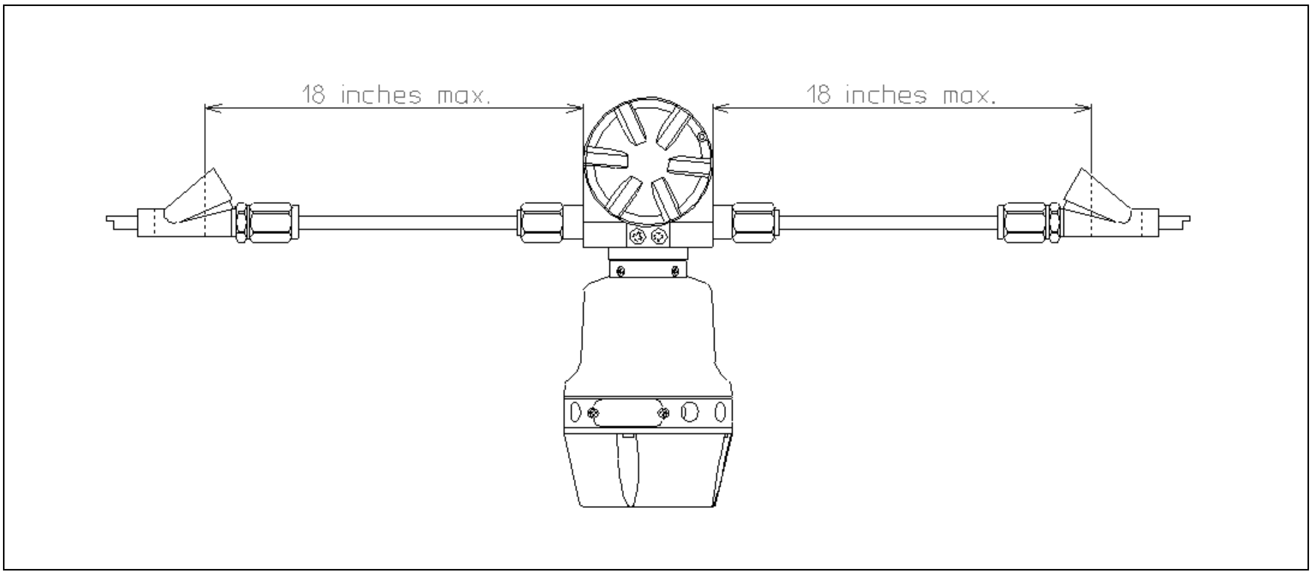

Figure S-2 An example of conduit seals (without stopping plug)

1. Class I, Division 1 locations

1.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, or Type MI cable with termination fittings approved for the location**, can be employed
- **Threaded joints** must be made up with at least five threads fully engaged.
- Boxes, fittings, and joints must be approved for Class I, Division 1.

1.2 **Sealing**

- **Each conduit entering the apparatus enclosure is required to be sealed within 18 in. (457 mm) from the enclosure.**
- The sealing of each conduit can be provided with **a sealing fitting approved for class I locations.**
- **Sealing compound must be approved** and must not have a melting point of less than 93° (200°F).
- The minimum thickness of the sealing compound should not be less than the trade size of the conduit and, in no case, less than 5/8 in.(16 mm).
- Splices and taps cannot be made in the fittings.

2. Class I, Division 2 locations

2.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, enclosed gasketed busways**, or **Type PLTC cable** in accordance with the provisions of remote-control, signaling, and power-limited circuits (see NEC, Article 725), or **Type ITC cable** in cable trays, in raceways, supported by messenger wire, or directly buried where the cable is listed for this use; **Type MI, MC, MV, or TC cable with approved termination fittings** can be employed.
- Boxes, fittings, and joints are not required to be explosionproof.

2.2 **Sealing**

- Each conduit entering the apparatus enclosure is required to be sealed as shown in 1.2.

3. Class II, Division 1 locations

3.1 **Wiring methods**

- **Threaded rigid metal conduit, threaded steel intermediate metal conduit, or Type MI cable with termination fittings approved for the location**, can be employed.
- Boxes and fittings must be dusttight.

3.2 **Sealing**

- Where **a raceway** provides communication between the apparatus enclosure and an enclosure that is not required to be dust-ignitionproof, suitable means must be provided to prevent the entrance of dust into the dust-ignitionproof enclosure through the raceway. One of the following means can be used: (1) a permanent and effective seal; (2) a horizontal raceway not less than 10 ft (3.05 m) long; or (3) a vertical raceway not less than 5 ft (1.52 m) long and extending downward from the dust-ignitionproof enclosure.
- **Seals are not required to be explosionproof.**

4. Class II, Division 2 locations

4.1 **Wiring methods**

- **Rigid metal conduit, intermediate metal conduit, electrical metallic tubing, dust-tight wireways, or Type MC or MI cable with approved termination fittings**, or **Type PLTC in cable trays**, or **Type ITC in cable trays**, or **Type MC or TC cable installed in ladder, ventilated trough, or ventilated channel cable trays in a single layer, with a space not less than the larger cable diameter between the two adjacent cables**, can be employed.
- All boxes and fittings must be dusttight.

4.2 **Sealing**

- Sealing means must be provided as shown in 3.2.

5. Class III, Division 1 locations

5.1 **Wiring methods**

- **Rigid metal conduit, rigid non-metallic conduit, intermediate metal conduit, electrical metallic tubing, dust-tight wireways**, or **Type MC or MI cable with approved termination fittings**, can be employed.
- All boxes and fittings must be dusttight.

5.2 **Sealing**

- Sealing means are not required.

6. Class III, Division 2 locations

6.1 **Wiring methods**

- Wiring methods must comply with 5.1.

6.2 **Sealing**

- Sealing means are not required.

(3)NEPSI Flameproof and Dust Certifications

Heat Value Gas Chromatograph model HGC303, manufactured by Azbil Corporation, has been approved by National Supervision and Inspection Center for Explosion Protection and Safety of Instrumentation (NEPSI) in accordance with the following standards:

GB3836.1-2010	Electrical apparatus for explosive gas atmospheres Part 1: General requirements
GB3836.2-2010	Electrical apparatus for explosive gas atmospheres Part 2: Flameproof enclosure "d"
GB12476.1-2013	Electrical apparatus for use in the presence of combustible dust Part 1: General requirements
GB12476.5-2013	Electrical apparatus for use in the presence of combustible dust Part 5: Protection by enclosure "tD"

The apparatus are approved with Ex marking of Ex d IIC T6; Ex tD A21 T85°C IP65.

The certificate number is GYJ15.1324X.

1. Requirements for safe use

1.1 The external earthing terminal shall be connected to the ground reliably at site.

1.2 The ambient temperature range is -40°C to +60°C.

1.3 The cable entry holes have to be connected by means of suitable cable entries with type of protection of Ex d IIC and Ex tD A21, which are covered by a separate examination certificate. Unwanted entry holes shall be blocked by blind plugs. After installation of the cable entry, the whole apparatus shall reach IP65.

1.4 Rated supply voltage: (24±15%)Vd.c

1.5 The warning "Do not open while the circuit is alive" must be obeyed when the product is used in the explosive gas area.

1.6 Regular cleanness shall be conducted to avoid the deposit of the dust.

1.7 The gas that may cause the corrosion effect to the aluminum alloy shall be excluded at site.

1.8 End users are forbidden to change the configuration to ensure the explosion protection performance of the product.

1.9 When installation, operation and maintenance the product, users should comply with the relevant requirements of the product instruction manual and the following standards:

GB3836.13-2013 "Electrical apparatus for explosive gas atmospheres Part 13: Repair and overhaul for apparatus used in explosive gas atmospheres"

GB3836.15-2000 "Electrical apparatus for explosive gas atmospheres- Part 15: Electrical installations in hazardous area (other than mines)"

GB3836.16-2006 "Electrical apparatus for explosive gas atmospheres Part 16: Inspection and maintenance of electrical installation (other than mines)".

GB50257-1996 "Code for construction and acceptance of electric device for explosion atmospheres and fire hazard electrical equipment installation engineering"

GB12476.2-2010 "Electrical apparatus for use in the presence of combustible dust Part A-1: Electrical apparatus protected by enclosures and surface temperature limitation-Selection, installation and maintenance"

GB15577-2007 "Safety regulations for the protection of dust explosion".

2. Special condition for safe use

The cover has at least 7.9 engaged threads.

EMC caution

1. Electromagnetic environment

   The model HGC303 is intended to be used in an industrial electromagnetic environment.

2. Electromagnetic immunity conditions

   Specification: During test, SCV deviation is less than or equal to 1MJ/m3.

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Chapter 1 : Introduction

1-1 : Definition of terms

Heat Value Gas Chromatograph (Model HGC303)

The Heat Value Gas Chromatograph measures process gases (N2, CO2, C1~C6+) that are mainly contained in natural gas, calculates heat value, density, Wobbe index and compressibility factor, and converts them into a Fieldbus signal in the field and transmits the signal to a receiver.

Parameters can all be remotely set, adjusted, and self-diagnosed by using the HGM.

Measuring and calculating methods comply with ISO 6974 Part 4, ISO 6976 and GPA2172.

HGC Data Manager (Model HDM303)

Model HDM303 is Modbus interface unit for model HGC303. Model HDM303 covers all the function of model HMU303. Model HDM303 also has a powerful functions.

The functions are local display, data storage function, multi Modbus serial port, multi stream switching, and analog output.

HMU can not be connected together with HDM in the same FB loop. Only one HMU can be connected in one FB loop with the HGC. Two or more HDM can be connected in the same FB loop. For this application, the HDM must be configured first.

Please refer to the model HDM303 User's Manual for more details.

Heat Value Gas Chromatograph Fieldbus Adaptor (Model HFA100)

HFA is an interface used to connect the HGM (HGC monitor), Windows-based PC application, to Azbil Corporation’s state of the art analyzer, HGC (Heat value Gas Chromatograph) that operates on FOUNDATION™ fieldbus H1 network. Users are able to configure, monitor and maintain the HGC all from the PC by simply connecting the HFA to the Fieldbus network.

HGC Monitor (HGM)

HGM software is provided as a standard accessory with the model HGC303.

The model HGC303 Monitor allows the user to configure and calibrate the model HGC303 as well as allowing one to monitor a heat value-trend graph.

Moreover, HGM also has a report function for concise management.

SP (Set Point)
: The set value of each variable.

PV (Process variable)
: The present value of each variable.

SCV, GCV
: Superior Calorific Value, Gross Calorific Value

  These parameters are same value of different name.

ICV, NCV
: Inferior Calorific Value, Net Calorific Value

  These parameters are same value of different name.

TCD
: Thermal Conductivity Detector

URV
: Upper Range Value

LRV
: Lower Range Value

Total (Raw)
: Total of raw concentration

Component name
: C6+: Hexane and heavier gas
  C3H8: Propane
  i-C4H10: i-Butane
  n-C4H10: n-Butane
  neo-C5H12: neo-Pentane
  i-C5H12: i-Pentane
  n-C5H12: n-Pentane
  N2: Nitrogen
  CH4: Methane
  CO2: Carbon dioxide
  C2H6: Ethane

1-2 : General

The model HGC303 is a gas chromatograph designed to analyze natural gas and is able to transmit a process variable via a Fieldbus signal.

One can easily adjust configuration data and monitor values such as the heat value by using the HGM.

The heat value monitoring system, which can be controlled from both the model HGC303 and HGM, will substantially minimize time, cost and maintenance.

This chapter first describes the measuring system and structure of the model HGC303.

After that, the characteristics and the specifications of Fieldbus are described in detail.

First time users of the model HGC303 should read this chapter carefully and thoroughly.

Components of the model HGC303 system

Before installing the model HGC303, the following components must be prepared:

Hardware

Model HGC303

Model HDM303

Model HFA100

Power supply (24 V DC, 4A min.), Power supply cable

Fieldbus cable (See “2-4-1 : Fieldbus requirements” on page 2-15)

Flow meter for process gas

(A flow meter for methane should be used scale: 0 - 100 ml/min.)

Laptop or desktop PC

(See “2-3-1 : Computer system requirements” on page 2-3 for detail)

Helium gas for carrier gas and valve operating gas

Calibration gas

1/8 or 1/4 inch stainless steel (SS) tubing

Fitting for piping (1/4 NPT male connector 5 or 6 pieces.... For HGC)*

Software

Microsoft Windows XP / 7 (32-bit type, 64-bit type)

HGM

~Note *: *For satisfying TestSafe Flameproof Certification or IP65, six 1/4 NPT male connectors are required.*

1-3 : Model HGC303 measuring system

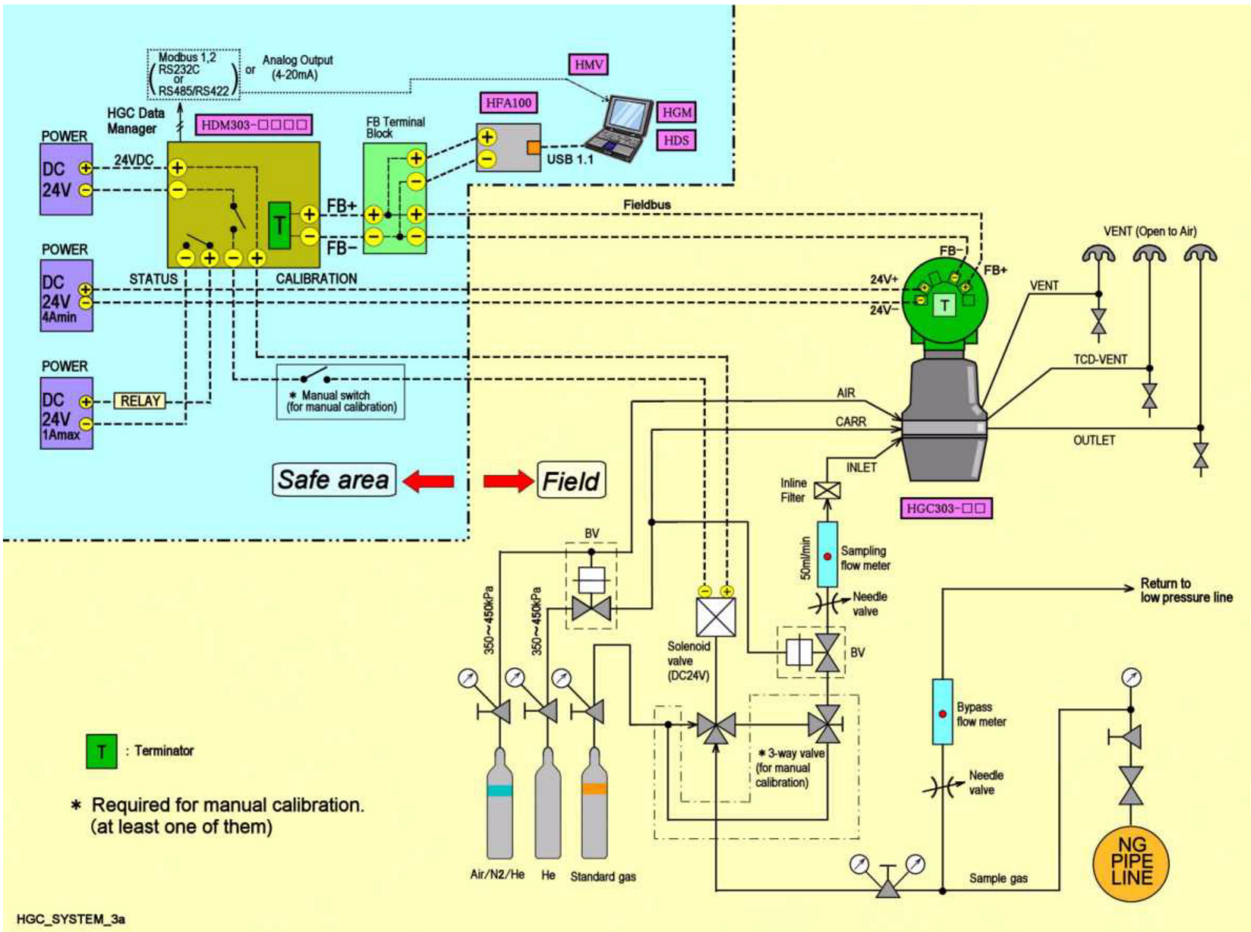


Figure 1-1 Model HGC303 measuring system diagram

⚠ CAUTION

A block valve is a kind of air actuator valve. It is used mainly for the protection of the TCD and columns.

It works as sample shut-off valve when the pressure of the carrier gas or air supply is lower than approximately 294 kPa.

Azbil Corporation recommends that it should be installed.

The Heat Value Gas Chromatograph measures process gases (N2, CO2, C1~C6+) that are mainly contained in natural gas, calculates heat value, density, Wobbe index and compressibility factor, and converts them into a Fieldbus signal in the field and transmits the signal to receivers.

Parameters can be remotely set, adjusted, and self-diagnosed with the HGM.

1-4 : Model No.

Heat Value Gas Chromatograph

HGC303-I II

I	Conduit entry	1/2 NPT female	1	
	Gas connection	1/4 NPT female		Calculation method
II	Explosion-protection	ISSeP/ATEX flameproof	E	ISO
		NEPSI flameproof	N	
		TestSafe flameproof	S	
		JIS flameproof * +	J	
		Ordinary type +	H	
		FM flameproof	F	GPA
		CSA flameproof	C	

~Note *: *Special model.*

~Note +: *Default range is suitable for High calorie LNG.*

1-5 : Model HGC303 Structure

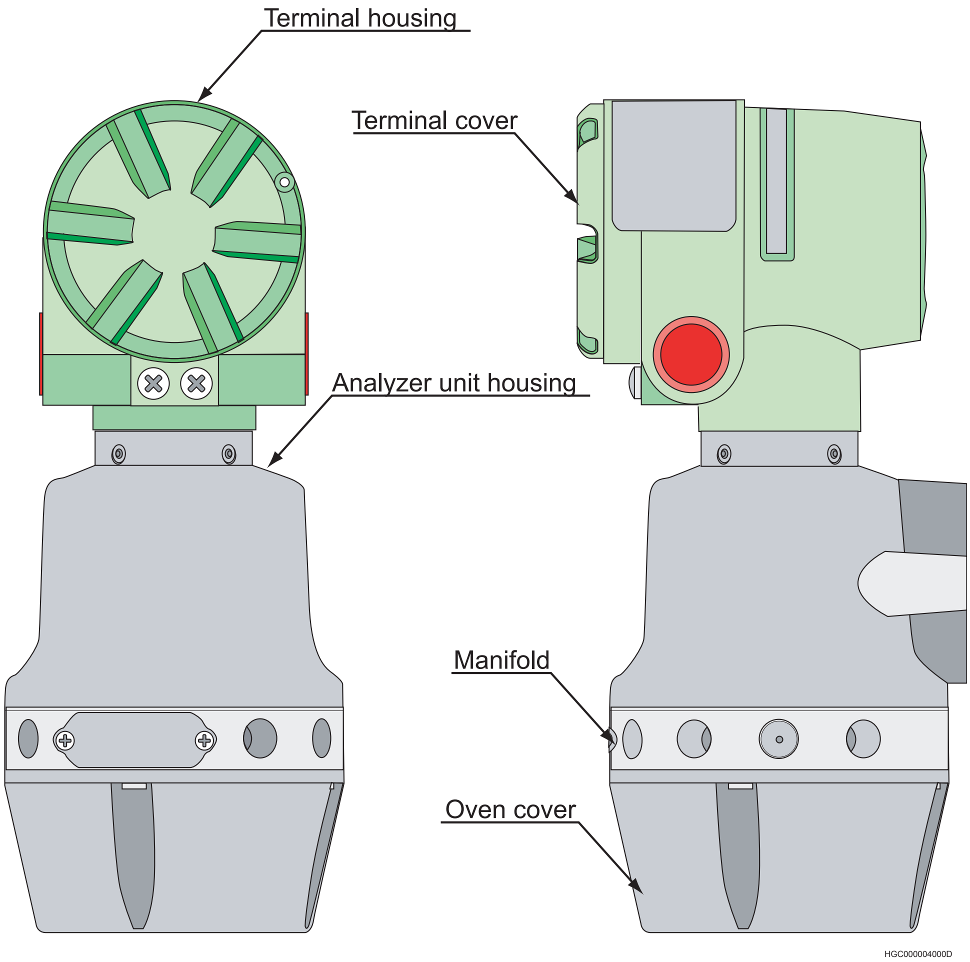


Figure 1-2 Main parts of Model HGC303

1 Terminal housing .... Terminal box for wiring.

2 Analyzer unit housing .. Proportional valve, solenoid valve, TCD sensor are located here.

3 Manifold .... Connection parts for gas inlet and outlet line

4 Oven cover .... Analyzer valve and column system are found inside the cover.

1-6 : Fieldbus communication system

The model HGC303 uses FOUNDATION™ fieldbus technology to transfer information between other devices.

The FOUNDATION™ fieldbus is an open, 2-wire, multi-drop, two-way digital communication system which interconnects field equipment such as sensors, actuators and controllers.

The FOUNDATION™ fieldbus is supported by a worldwide network of customers and manufacturers in Europe, North America and Asia Pacific.

FOUNDATION™ fieldbus http://www.fieldbus.org/

FOUNDATION™ fieldbus literature

(1) FOUNDATION™ fieldbus Technical overview (FD-043)

(2) Fieldbus Installation & Planning Guide (AG-165)

(3) FOUNDATION™ fieldbus Application Guide
31.25kbit/s Wiring and Installation (AG-140)

(4) FOUNDATION™ fieldbus Application Guide
31.25kbit/s Intrinsically Safe Systems (AG-163)

Chapter 2 : Installation

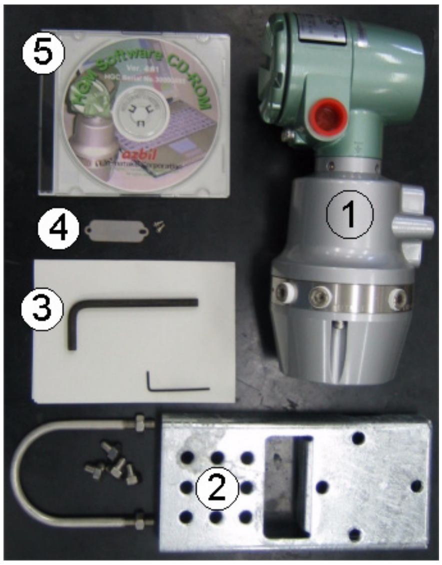
This chapter guides you through the procedures for installing of your hardware and software.

2-1 : Unpacking and storing

Unpacking the model HGC303

Your model HGC303 is a precision instrument and should be handled with care to prevent any damage to it or breaking it.

After unpacking the model HGC303, verify that the following items are included

Package items (1) Model HGC303 (2) Mounting bracket set (3) Wrench for seal plug (4) Tag number plate set (5) CD-ROM including HGM software and user's manual (6) EC declaration of conformity and safety instructions *	

~Note *: *It is packed with model HGC303-_E only.*

⚠ CAUTION

Exposing the model HGC303 to the atmosphere might cause deterioration of the column. Therefore, the model HGC303 has been packed and shipped in a protective bag with a desiccant. Install and operate the model HGC303 immediately after breaking the seal.

Inquires

If you have any questions regarding the specifications of your model HGC303, contact one of the Azbil Corporation products service offices or contact your nearest Azbil Corporation representative.

When making an inquiry, make sure to provide the model number and product number of your model HGC303.

Storing the model HGC303

The model HGC303 should be stored:

- indoor at storage temperature (-40 to 70°C); humidity (up to 95%RH)
- in a place safe from vibration or shock.
- in the same packing as it was shipped in.

Model HGC303 that has been used should be stored by following procedures below.

Step	Action
1	Makes sure no process gas remains in the model HGC303.
2	Purge the model HGC303 with helium gas.
3	Insert metal plugs into all the inlets and outlets for carrier gas, valve operating gas and process gas except VENT (valve operating gas outlet) in order to keep moisture out.
4	Pack it as it was when it was originally received.
5	Store the model HGC303 indoors at normal temperature and humidity in a place safe from vibration or shock.

2-2 : Installing the model HFA100

To collect data from HGC, HGM needs the HFA100 (Heat value gas chromatograph fieldbus adapter) as a data converter. First, for hardware installation, see the user's manual for HFA100.

~Note *This manual is for the use of HFA100 version 3.0 or later. For combinations of HFA100 versions and corresponding PC software versions, see "Software Compatibility" in the Appendix.*

2-3 : HGM Installation

2-3-1 : Computer system requirements

(1) Computer: PC/AT compatible, Pentium chip or higher

(2) System memory: 64MB minimum

(3) Disk storage: 100 MB free space

(4) CD-ROM drive

(5) Operating system: Windows XP / 7 (32bit type, 64bit type)

(6) Video Monitor: high color 16bit of higher

~Note *Install the latest service pack of Microsoft Windows.*

2-3-2 : HGM software installation

Installing the HGM.

~Note *If an old version of HDS is installed on the PC, uninstall it first.*

(1) Make sure Windows has been installed.

(2) Start PC. Be sure to Log On your PC with Administrator Account.

(3) Insert the CD-ROM that is supplied with HGC into the CD-ROM drive.

(4) Double-click the [HGMx.xx_setup] folder.

(5) Double-click the [setup.exe] file.

(6) If the User Account Control dialog box appears, click [Yes] button.

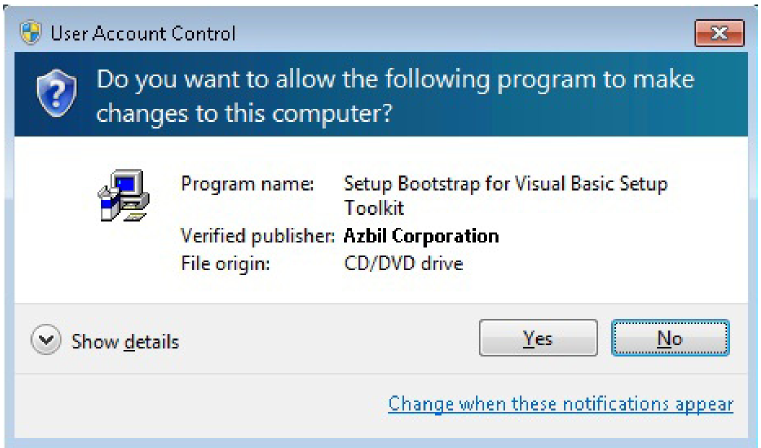


Figure 2-1 UAC dialog box

(7) HGM installer will appear, click [OK] button.

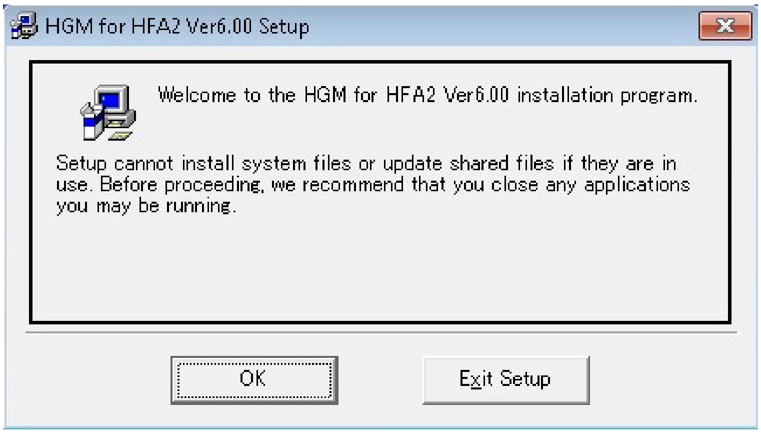


Figure 2-2 Setup message

(8) The following screen will appear, click PC figure button.

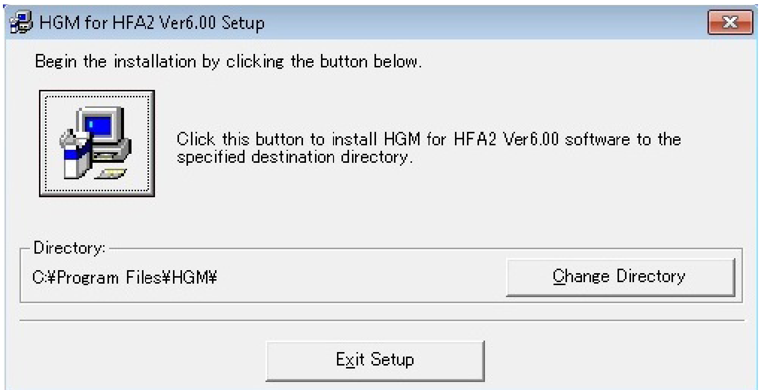


Figure 2-3 HGM installation location

(9) The following screen will appear, click [Continue] button.

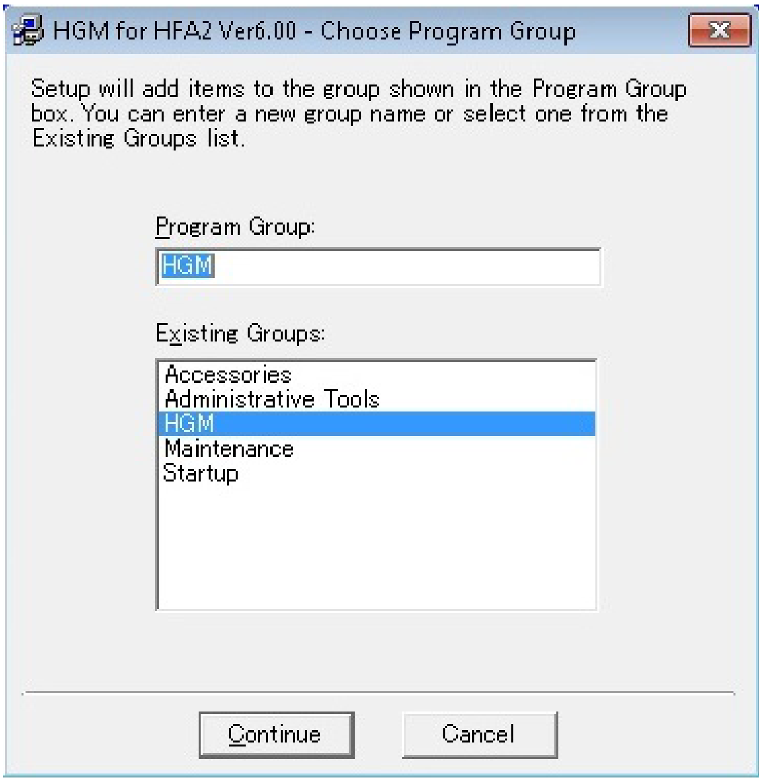


Figure 2-4 Group name

If a version conflict message appears, select [Yes].

(10)Installation is complete once the message below appears on your screen. Click [OK] button.

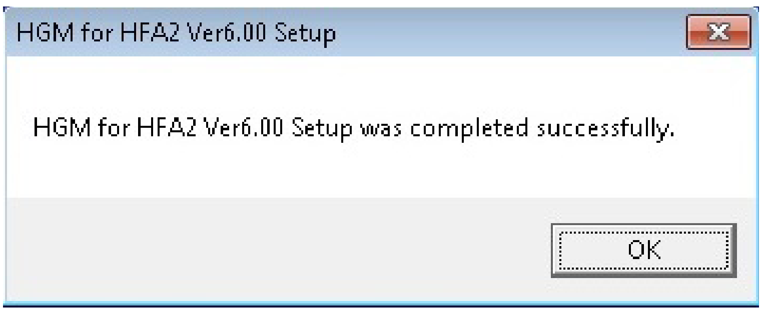


Figure 2-5 Complete installation

2-3-3 : .NET framework 4.0 installation

Microsoft .NET framework 4.0 or later is required to run HGM. If Microsoft .NET framework 4.0 or later is not installed on the PC, install it using the following procedure.

~Note *In case of Windows XP, installation of an old version of .NET Framework may be required. In that case, download the redistribution package from the Microsoft website for installation.*

(1) Make sure Windows has been installed.

(2) Start PC. Be sure to Log On your PC with Administrator Account.

(3) Insert the CD-ROM that is supplied with HGC into the CD-ROM drive.

(4) Double-click the [dotNet Framework 4.0] folder.

(5) Double-click the [dotNetFx40_Full_x86_x64.exe] file.

(6) If the User Account Control dialog box appears, click [Yes] button.

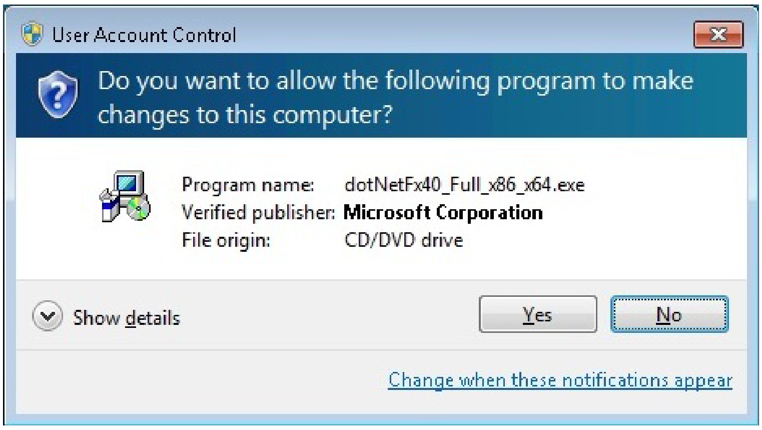


Figure 2-6 UAC dialog box

(7) Setup program will start.

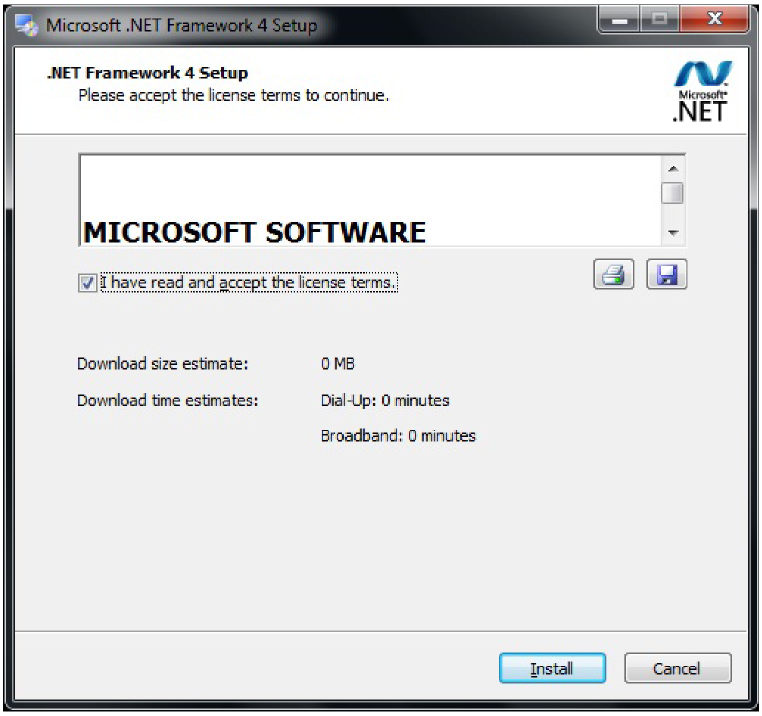


Figure 2-7 .NET framework 4.0 installation progress

Check the license acceptance check box and click the [Install] button.

(8) Installation will start. It may take a few minutes until completion.

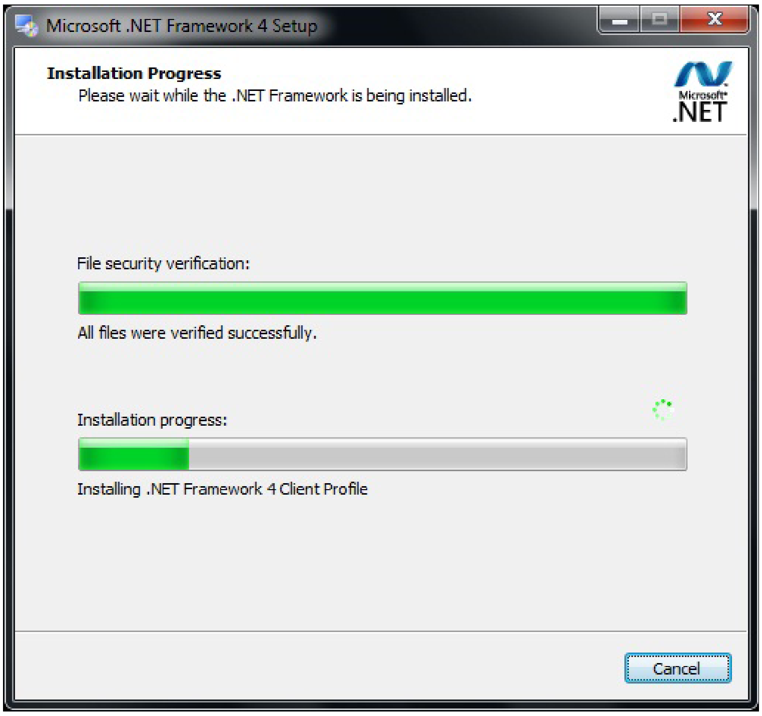


Figure 2-8 .NET framework 4.0 installation progress

(9) Installation is complete once the message below appears on your screen. Click [Finish] button.

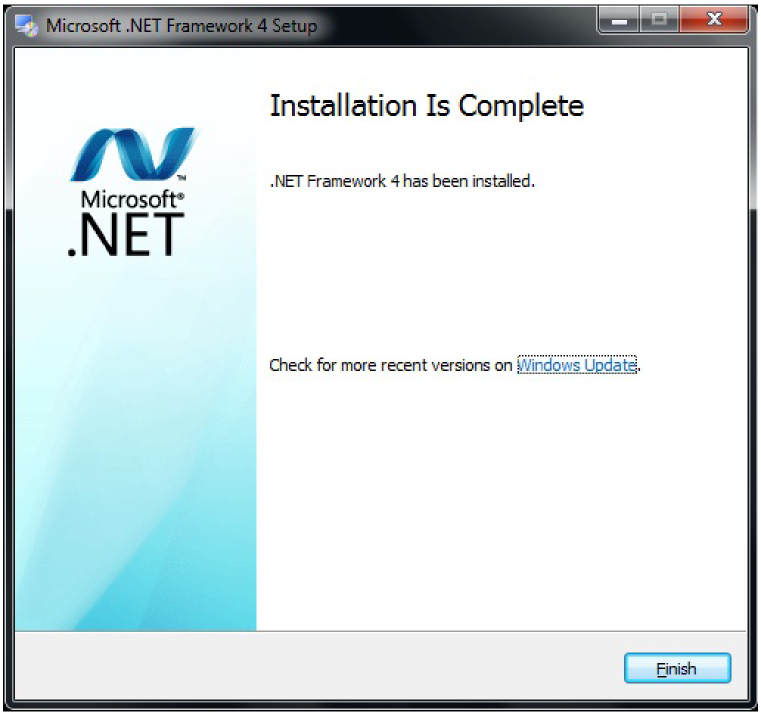


Figure 2-9 Complete installation

2-3-4 : Microsoft Visual C++ runtime installation

The runtime component for Microsoft Visual C++ 2010 is required for HGM execution. If it is not installed on the PC, install it using the following procedure.

(1) Make sure Windows has been installed.

(2) Start PC. Be sure to Log On your PC with Administrator Account.

(3) Insert the CD-ROM that is supplied with HGC into the CD-ROM drive.

(4) Double-click the [vc_runtime2010] folder.

(5) Double-click the [vcredist_x86.exe] file.

(6) If the User Account Control dialog box appears, click [Yes] button.

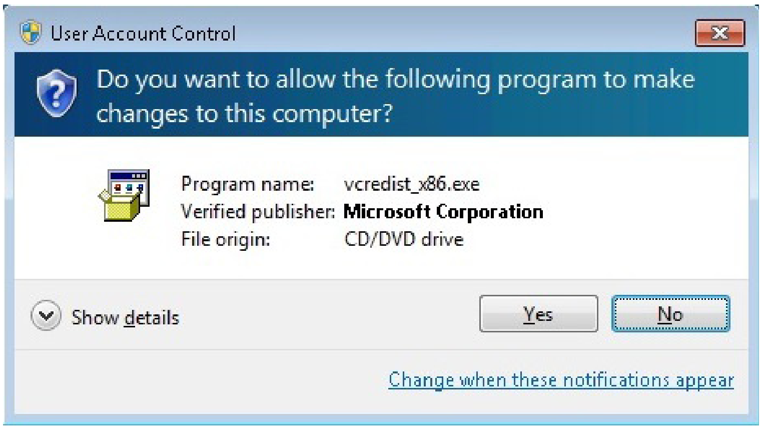


Figure 2-10 UAC dialog box

(7) Setup program will start.

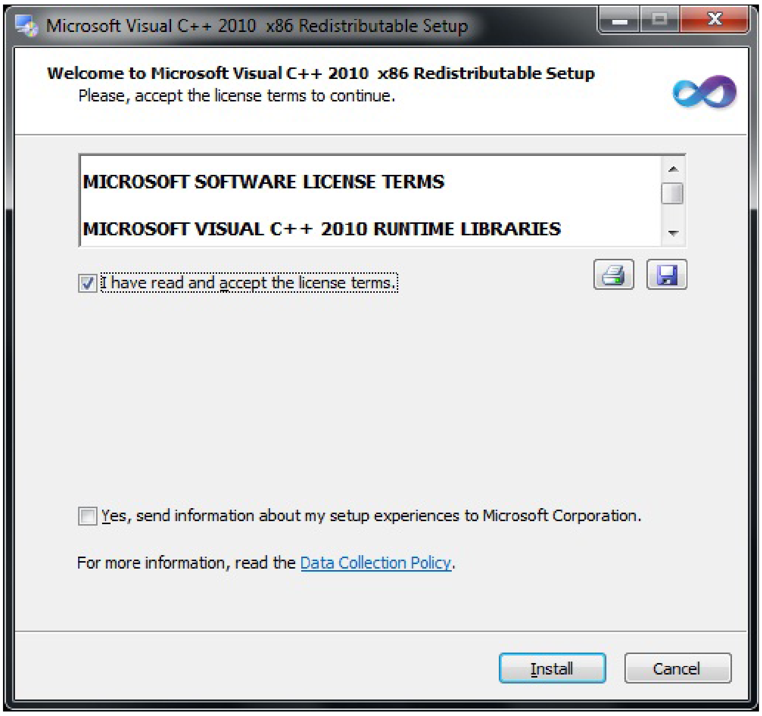


Figure 2-11 VC++2010 runtime license agreement

Check the license acceptance check box and click the [Install] button.

(8) Installation will start. Please wait a moment.

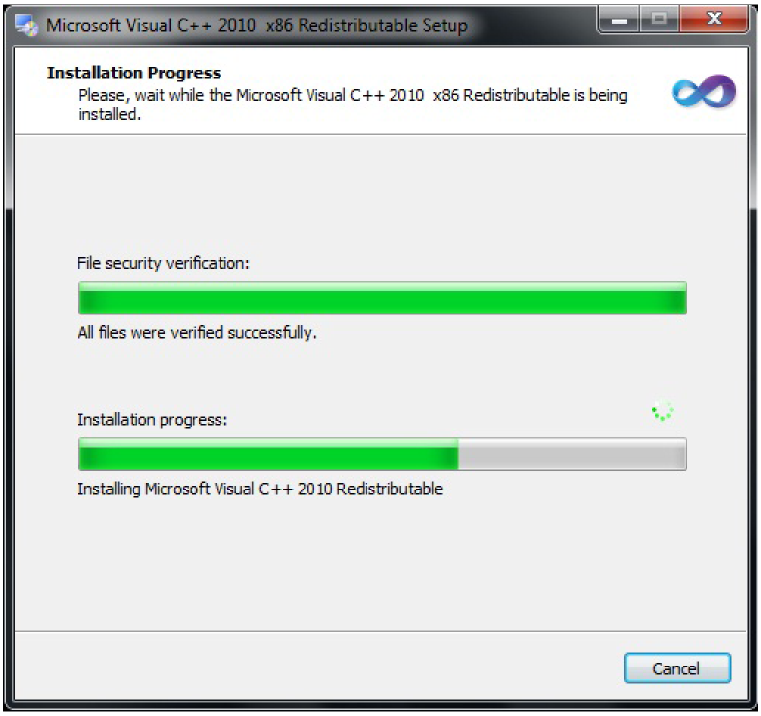


Figure 2-12 VC++2010 runtime installation progress

(9) Installation is complete once the message below appears on your screen. Click [Finish] button.

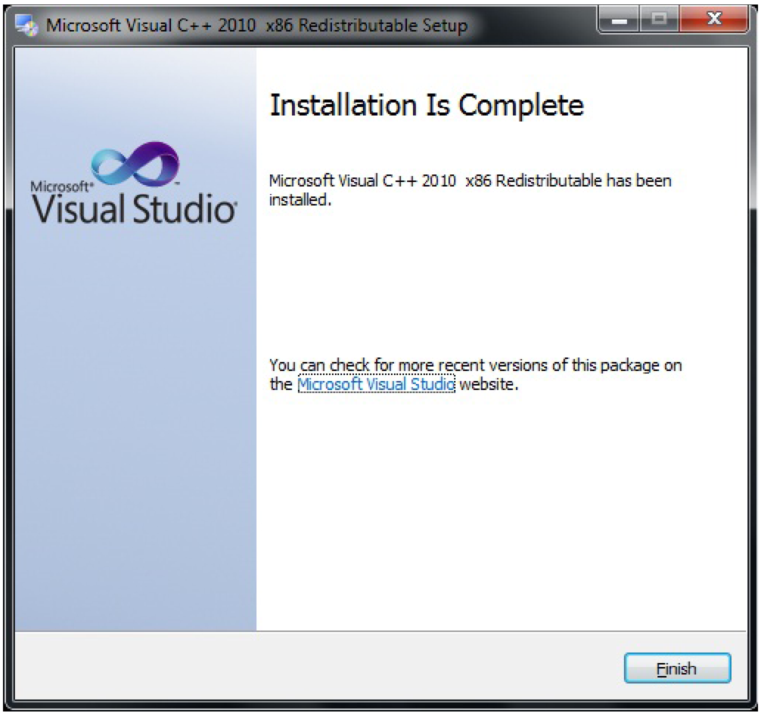


Figure 2-13 Complete installation

2-3-5 : Setting the folder access rights

When executing HGM on a Windows 7 or later PC, full access rights for the following program folders are required.

32bit type operation system: C:\Program Files\HGM

64bit type operation system: C:\Program Files (x86)\HGM

~Note *Executing the program without this setting will cause a virtual folder problem caused by Windows User Account Control (UAC). Refer to troubleshooting “5-1: Connection with PC”.*

Set the access rights by taking the following steps.

(1) Start PC. Be sure to Log On your PC with Administrator Account.

(2) Use Windows Explorer, select [HGM] folder, right click and select [Properties].

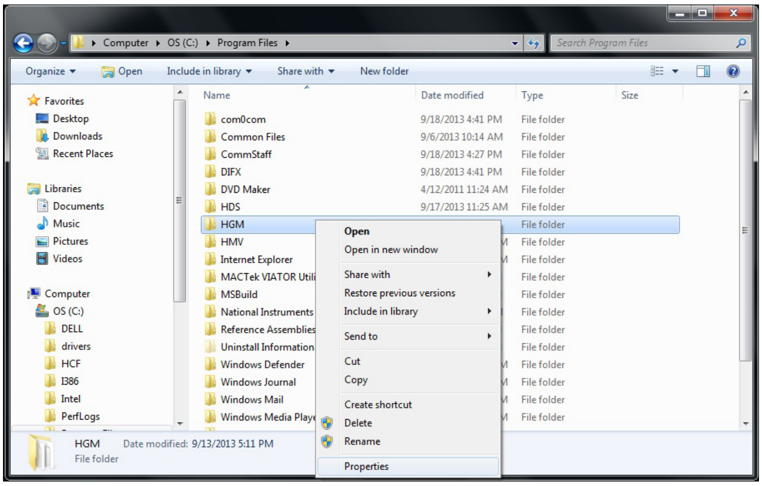


Figure 2-14 HGM folder

(3) HGM Properties, select [Security] tab and click [Edit] button.

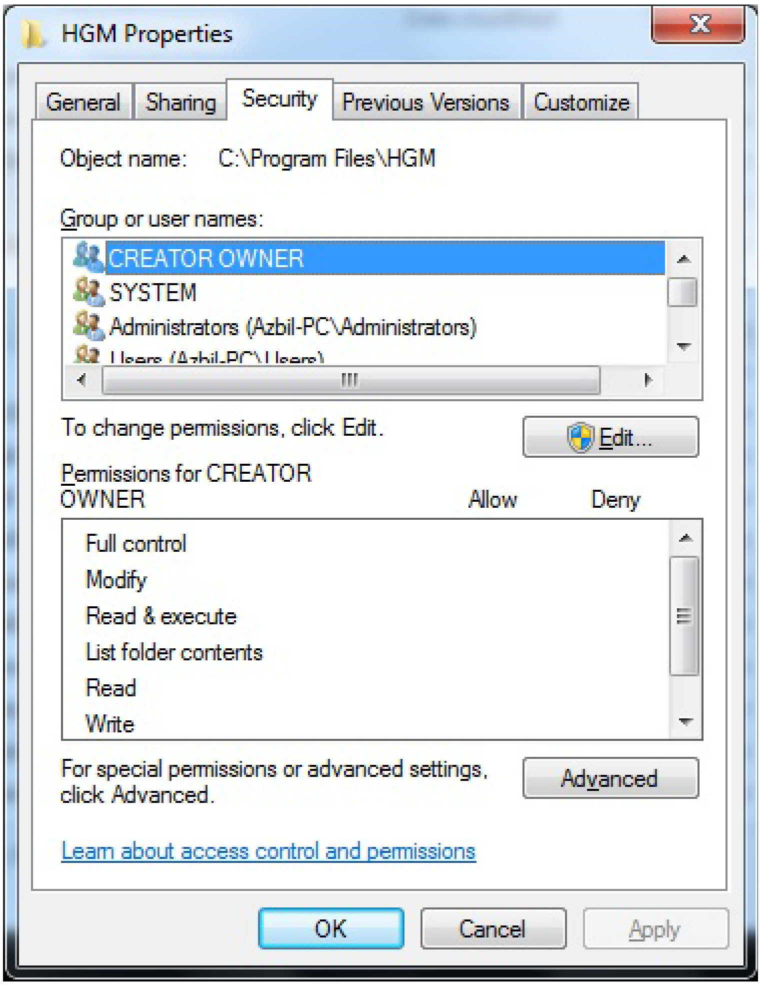


Figure 2-15 HGM folder properties

(4) Permissions for HGM, select [Users] in Group or user names.

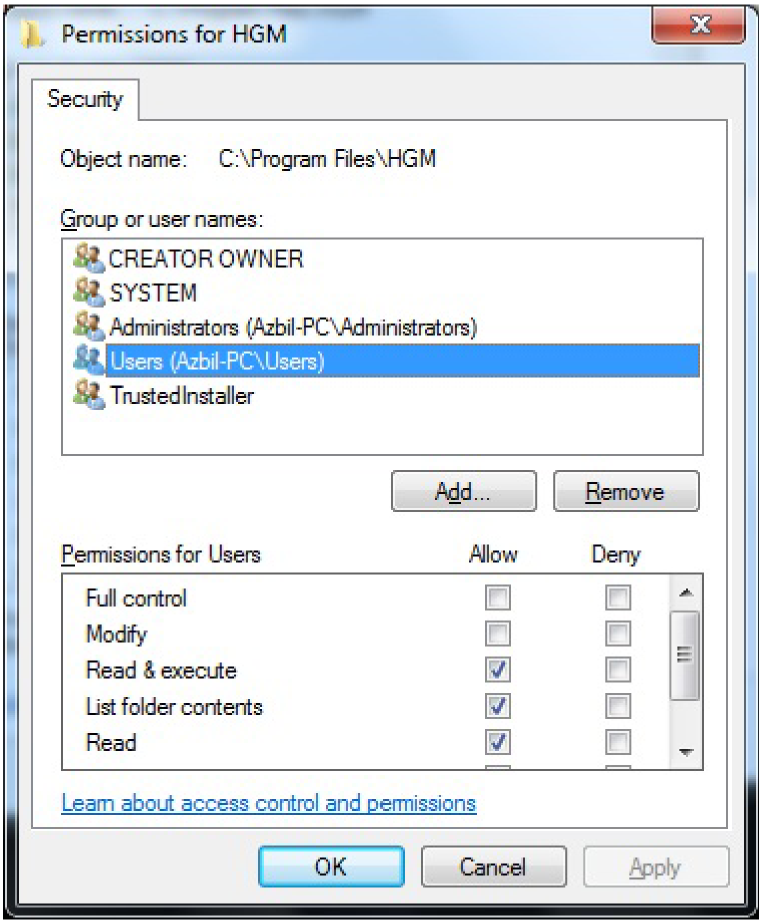


Figure 2-16 Permissions for HGM folder

(5) Permissions for HGM, check Allow Full control in Permissions for Users, then click [Apply] button and click [OK] button.

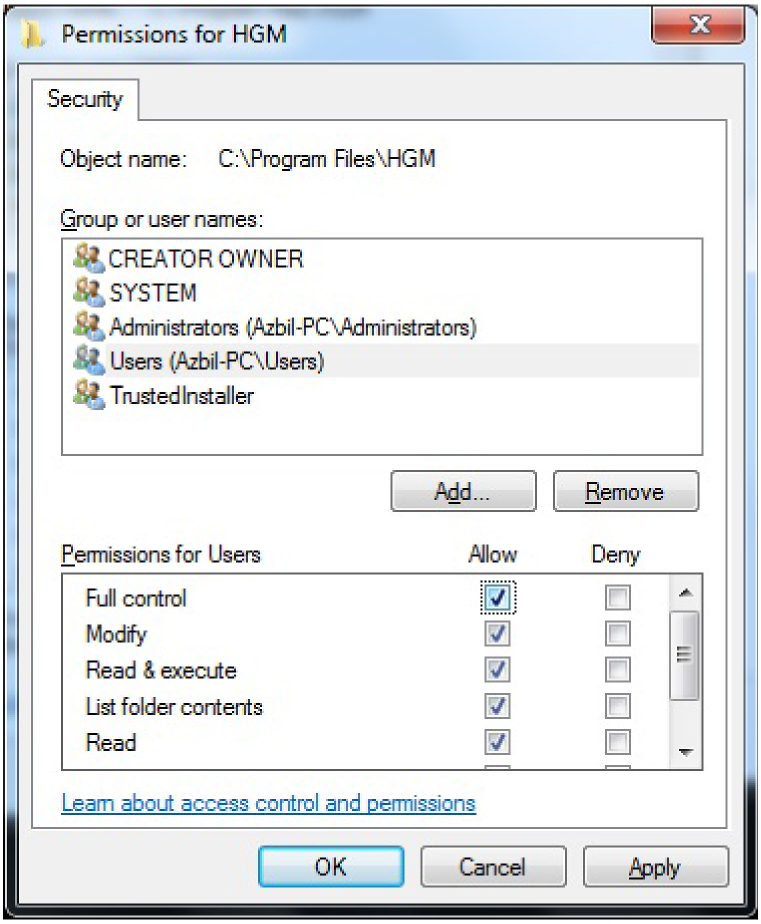


Figure 2-17 Permissions for HGM folder

(6) HGM Properties, click [OK] button.

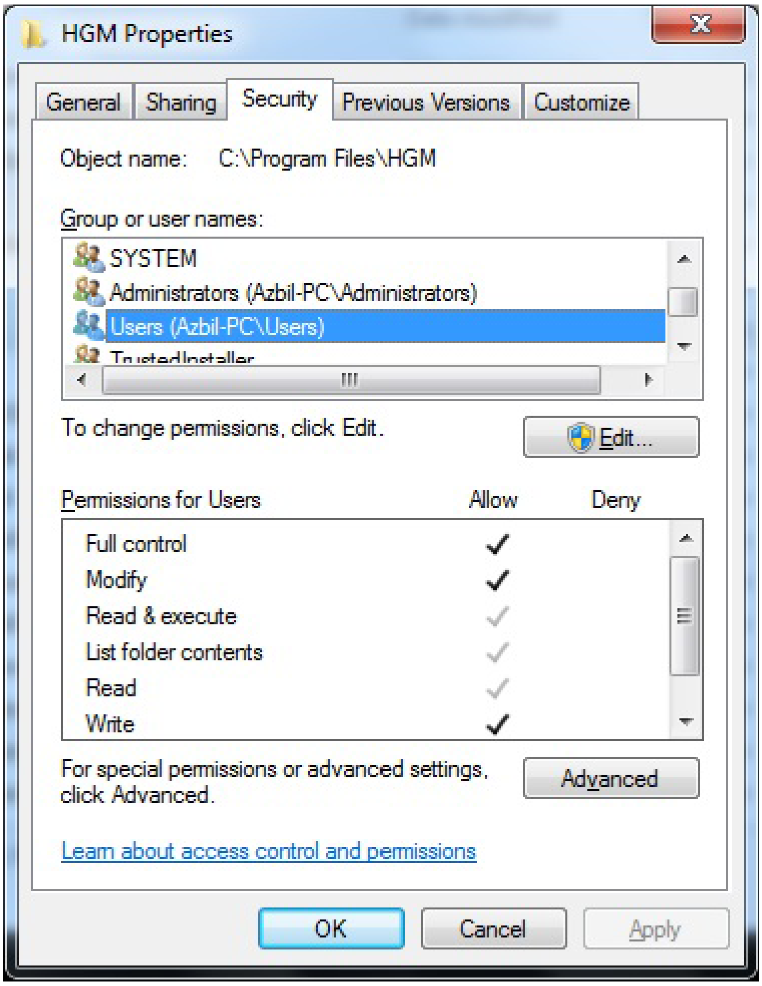


Figure 2-18 HGM folder properties

2-4 : Fieldbus installation

2-4-1 : Fieldbus requirements

Fieldbus components and characteristics

Cable

Various types cables are usable for fieldbus.

Type A is the preferred fieldbus cable.

Azbil Corporation recommends type A as the fieldbus cable to use.

The table below describes the type of cable and its maximum length, which is specified in the IEC 1158-2/ISA S50.02 Physical Layer Standard.

Table 2-1: Fieldbus cable description

Type	Cable description	Size	Maximum length
A	Shielded, twisted pair	#18 AWG (0.8 mm^2)	1900m (6232 ft.)

Structure: twisted pair cable with overall shield

Detailed specifications of the Type A cable at 25°C are as follows;

a) Characteristic impedance: Z0 at 31.25 kHz = 100 ohm +/- 20%

b) Maximum attenuation at 39 kHz = 3.0 db/m

c) Maximum capacitive unbalance to shield = 2 nF/km

d) Maximum DC resistance (per conductor) = 22 ohm/km

e) Maximum propagation delay change 7.8 kHz to 39 kHz = 1.7 us/km

f) Conductor cross-sectional area (wire size) = 0.8 mm2 (#18 AWG)

g) Minimum shield coverage shall be 90%

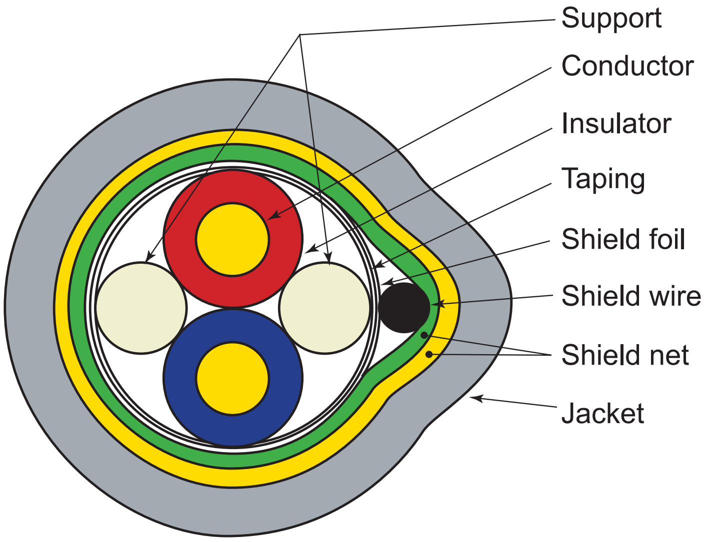


Figure 2-19 Example of Type A fieldbus cable structure

Terminators

A terminator is an impedance matching module used near or at the end of a transmission line. Terminators prevent distortion and signal loss.

A terminator shall be located at both ends of a trunk cable, connected from one signal conductor to the other.

A trunk is the longest cable path between any two devices on the fieldbus network.

ONLY TWO terminators are required per fieldbus segment.

No connection shall be made between the terminator and cable shield.

The terminator impedance value shall be 100 ohm +/- 2% over a frequency range of 7.8 kHz to 39 kHz.

The model HGC303 and model HDM303 have a terminator at the fieldbus connection port therefore an additional terminator is not required.

Terminal blocks

The terminal blocks can be the same as those used for 4-20mA.

Connectors

D-sub 9P connector is as specified for standard fieldbus connectors in the IEC/ISA Standard.

Contact No.	Signal
6	Data +
7	Data -

2-4-2 : Fieldbus wiring

Signal wire

A Fieldbus signal is transmitted via 2-wire isolated signal lines.

Please keep in mind that the Fieldbus signal has polarity, positive (+) and negative (-).

All of the (+) terminals must be connected to each other and similarly, all of the (-) terminals must be connected each other.

An important aspect of fieldbus is that neither of the signal wires are grounded.

Shielding

The preferred type of cable for fieldbus is a shielded cable.

Assemble a lugged shield wire connected to the metallized shield of each cable.

Connect all shield wires together to the terminal block.

In addition, connect the overall shield to the ground at one point in instruments room to protect against field noise.

Do not ground the shield at multiple points.

Termination

A terminator shall be connected at both ends of the signal wire pair, at the field device end and the host device end.

Connect the terminator between signal (+) and (-).

ONLY TWO terminators are needed per fieldbus segment.

Never connect a terminator between the signal (+ or -) and cable shield.

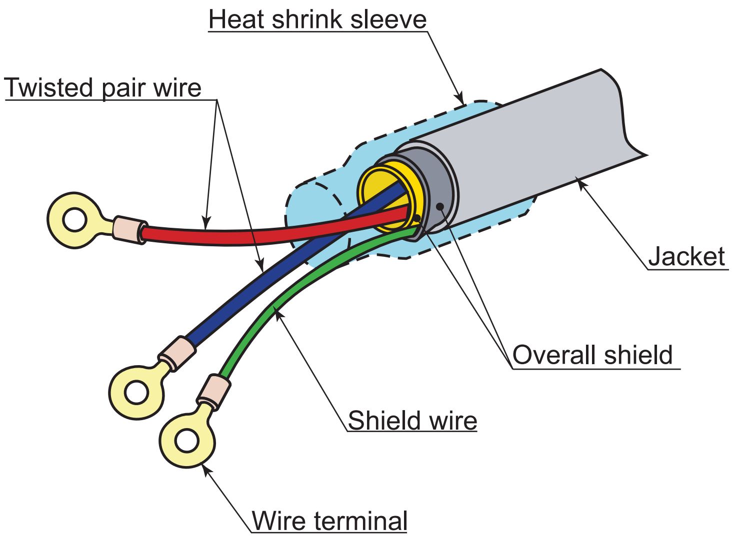


Figure 2-20 Example of cable finish

2-5 : Model HGC303 installation

2-5-1 : Installation site

Conditions for selecting a location for installation.

- A sheltered location conforming to class C as defined by IEC654-1.
  This is so to protect the model HGC303 from direct sunlight, wind, and rain.
  Select a site that allows for the installation of a housing structure or protective panels.

- A location which is free from sudden changes in temperature or humidity and which has an ambient temperature within the range of -10 to 50°C and a relative humidity range of 95% maximum.

- A location not subject to electromagnetic induction, as such as that generated by large - scale transformers and high-frequency furnaces.

- A location not subject to severe vibration.

- A location with minimal exposure to corrosive gases or dust and with good air circulation.

2-5-2 : Model HGC303 dimensions

The dimensions of the model HGC303 are given below.

[Unit: mm (inch)]

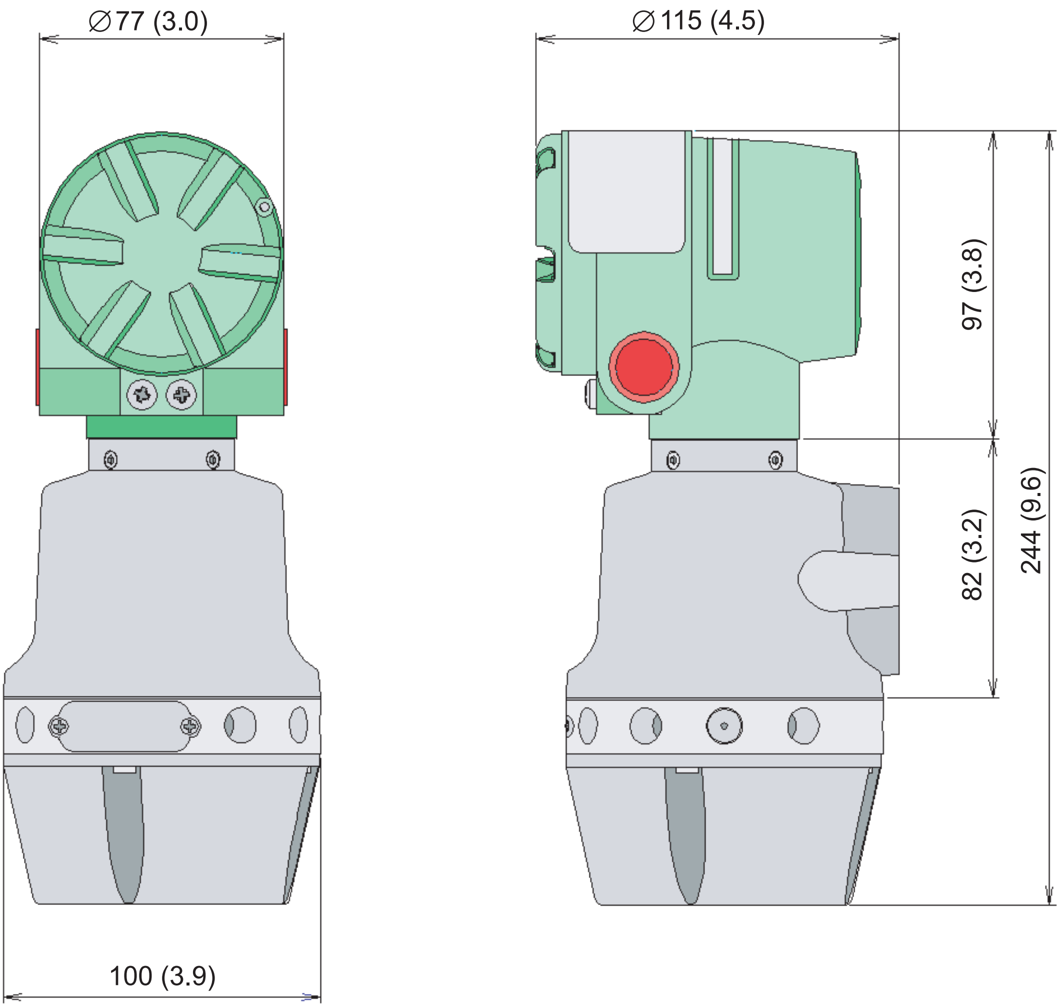


Figure 2-21 Model HGC303 dimension

A workspace should be selected taking into consideration facilitation of wiring, piping, and maintenance.

Table 2-2: Conduit type

Model No.	Gas connection	Conduit entry
HGC303-1_	1/4 NPT female	1/2 NPT female

2-5-3 : Model HGC303 installation example

Install the model HGC303 as shown in following diagrams.

The weight of the model HGC303 with mounting bracket is 5 kg / 11 lbs.

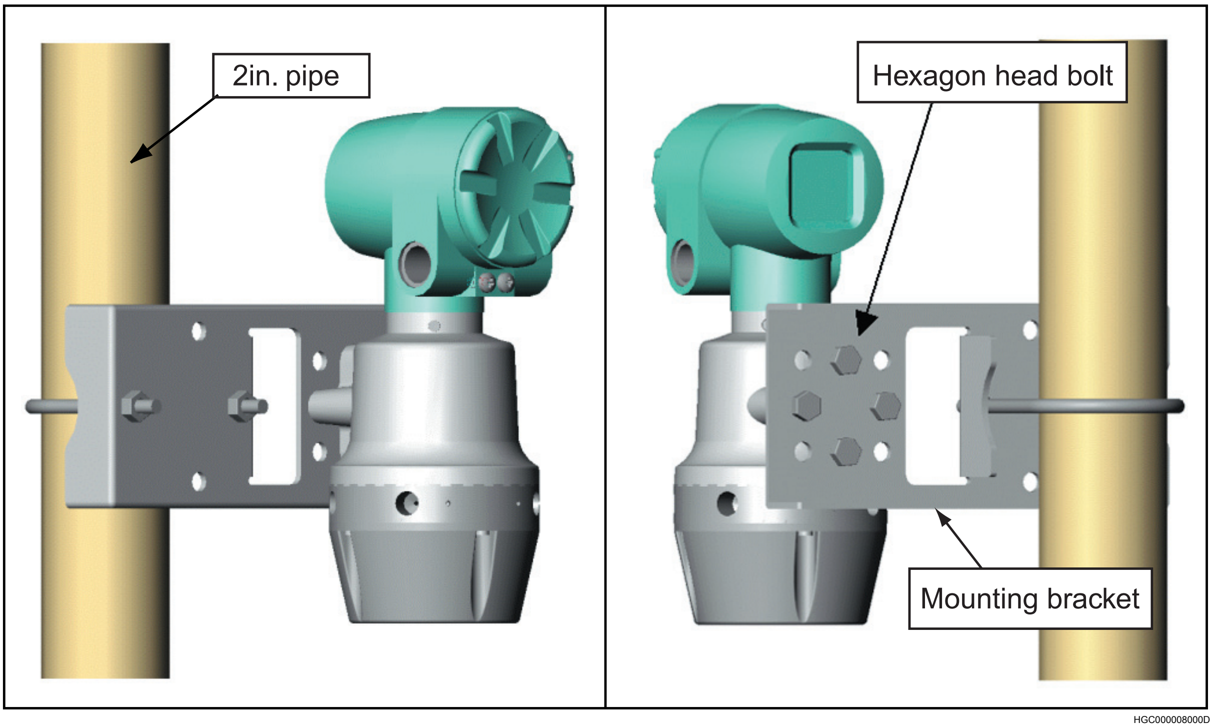


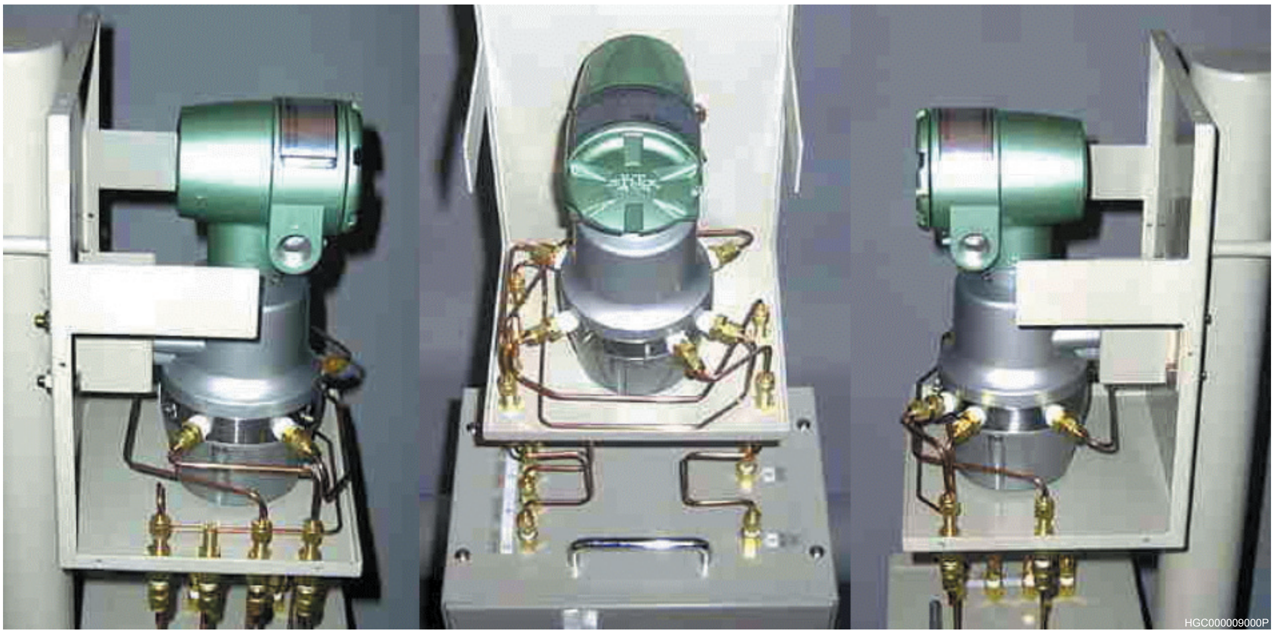
Figure 2-22 Example of model HGC303 installation with mounting bracket

Mounting position: Mount the model HGC303 horizontally.

2-5-4 : Model HGC303 piping

Refer to this section before designing and installing the gas inlet, gas outlet and vent lines.

The mark [N] on the manifold refers to 1/4 NPT connection.



Left side view Front view Right side view

Figure 2-23 Piping location

Table 2-3: Piping description

Part	Model HGC303 marking	Description
Carrier gas inlet	Carr	Inlet for introducing the carrier gas into the column of the analyzer unit.
Valve operating gas inlet	AIR	Inlet for introducing the valve operating gas into the analyzer unit.
Valve operating gas outlet	VENT	Outlet valve operating gas. **Do not remove this vent plug. ***
Process gas inlet	INLET	Inlet for introducing the process gas.
Process gas outlet	OUTLET	Outlet for process gas.
Measured gas outlet	TCD-VENT	Outlet for mixture of measured gas and carrier gas after analysis.

~Note *: *Remove the vent plug then connect the fitting and pipe when IP65 is required or when HGC model No. is 'HGC303-1S'.*

> ⚠ **WARNING**
>
> Purge the carrier gas line before performing any piping, and then verify that there is no dust remaining in the piping.
>
> Release the gas from the vent line to the air through the header.
>
> There is a possibility that back-pressure from vent line has a lot of influence.

Prepare the carrier gas and valve operating gas as specified in the table below.

Table 2-4: Gas specifications

	Gas type	Purity	Secondary supply pressure
Carrier gas	Helium	99.99% or higher	400 ± 50 kPa (58 ± 7 psi)
Valve operat-ing gas	Helium, Air, Nitrogen	99.99% or higher	400 ± 50 kPa (58 ± 7 psi)
Process gas	Natural gas	-	50 - 490 kPa (7 - 71 psi) at flow meter inlet

2-5-5 : Model HGC303 wiring

Remove the terminal cover and wiring while referring to the figure and table below.

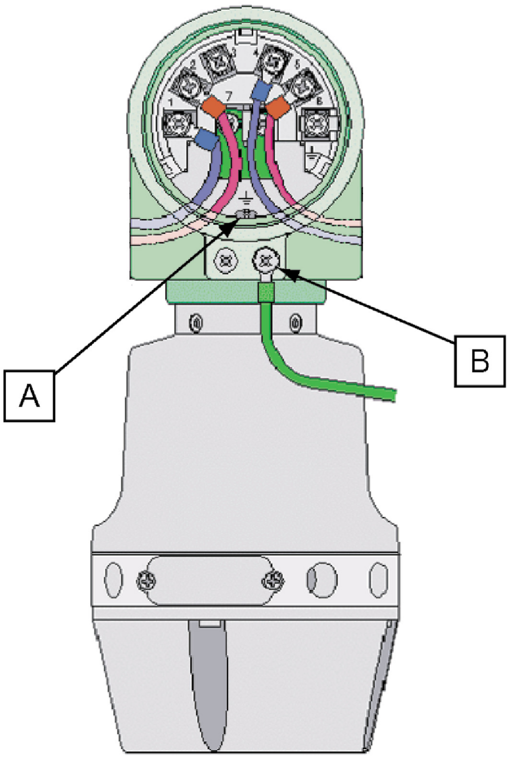


Figure 2-24 Wiring location

Either internal grounding (earthing) terminal (A) or external grounding (earthing) terminal (B) can be used.

At least one grounding (earthing) terminal connection is recommended.

Table 2-5: Wiring description

Terminal No.	Description
1	Power supply (-)
2	Power supply (+)
3	No connection
4	FB terminal (-)
5	FB terminal (+)
6	No connection
7	Terminator (-)
8	Terminator (+)
A	Internal GND
B	External GND

~Note *Azbil Corporation recommends cable of conductor cross-sectional area 2 (mm^2) or equivalent for power supply connection and GND connection.*

⚠ WARNING

Only a 24V DC supply may be used to operate the model HGC303.

⚠ CAUTION

Confirm that the supply voltage is within 24VDC+/-15% (20.4~27.4V) at the HGC terminal.

⚠ CAUTION

HGC requires the current of 4A minimum on 24VDC as the power supply.

⚠ CAUTION

Use a power supply which has overcurrent protection capability for this product.

Chapter 3 : Operation

3-1 : Starting up the model HGC303

3-1-1 : Secondary pressure and flow set

Adjust the pressure of the following gas types as specified by the corresponding pressure on the right.

Table 3-1 Gas specifications

Gas type	Secondary supply gas pressure and flow rate
Carrier gas	400 ± 50 kPa (58 ± 7 psi)
Valve operating gas	400 ± 50 kPa (58 ± 7 psi)
Process gas	50 ± 20 ml/min.

3-1-2 : Piping leak check

Before starting up the model HGC303, conduct a leak test to verify there is no leakage of gas from the piping connection.

A leak test using soap bubbles will be sufficient.

If a leak found:

(1) Tighten the fittings.

(2) Replace the fittings.

3-1-3 : Power on

Supply the power to operate the model HGC303 system according to the following action.

Table 3-2 The procedure to start up the model HGC303 system

Step	Action
1	Supply the valve operating gas
2	Supply the carrier gas pressure
3	Supply the power to the model HGC303
4	Supply the power to the model HDM303
5	Wait until the model HGC303 system becomes stable.
6	Supply the process/standard gas*+

~Note *After turning on the power, allow 2 hours for the device to warm up.*

The carrier gas pressure SP and oven temperature SP have already been factory set in the model HGC303, therefore, the user doesn't have to worry about setting this data.

Carrier gas pressure SP: less than 300 kPa (43.5 psi)
(SP differs with each model HGC303)

Oven temperature SP: 58°C (136.4°F)

Analyzing cycle: 300 sec.

~Note *When the power is supplied to the model HGC303, a model HGC303 status error will appear on HGM monitoring system (oven temperature error message etc.*

This is because of a self-diagnostic system error, not a model HGC303 system error.

The model HGC303 status will automatically return to normal once the oven temperature reaches 58°C (136.4°F).

~Note *: *Recommend supplying the standard gas if it is the first time set-up after delivery or a long-period storage.*

~Note +: *If the output value from HGC seems strange after several cycles supplying the process gas, try to do followings:*

1. Check the process/standard gas supplies properly and the vent line is not blocked. If there are problems, rectify them and check the output value again.
2. Run the HGM program, and make it "on-line", then start "User's mode".

3. Check whether the peaks are small or normal, the peak shapes are strange or not by chromatogram.
4. If the phenomena in section above are observed, stop the process gas and quite the HGM program.
5. Connect blind plugs or shut the vent lines, then connect Helium gas cylinder at the 'INLET' port of HGC.
6. Charge Helium gas at 400kPa (58psi) to 'INLET' then leave it for about one hour.
7. Return the connection normal and supply process/standard gas for checking again.

3-1-4 : Model HGC303 leak check

After turning the model HGC303 on, conduct a leak test to verify that there is no leakage of gas from the model HGC303.

The following procedures are for a simple leak test for the carrier gas line.

Carry out the leak test for the valve operating gas line in the same way.

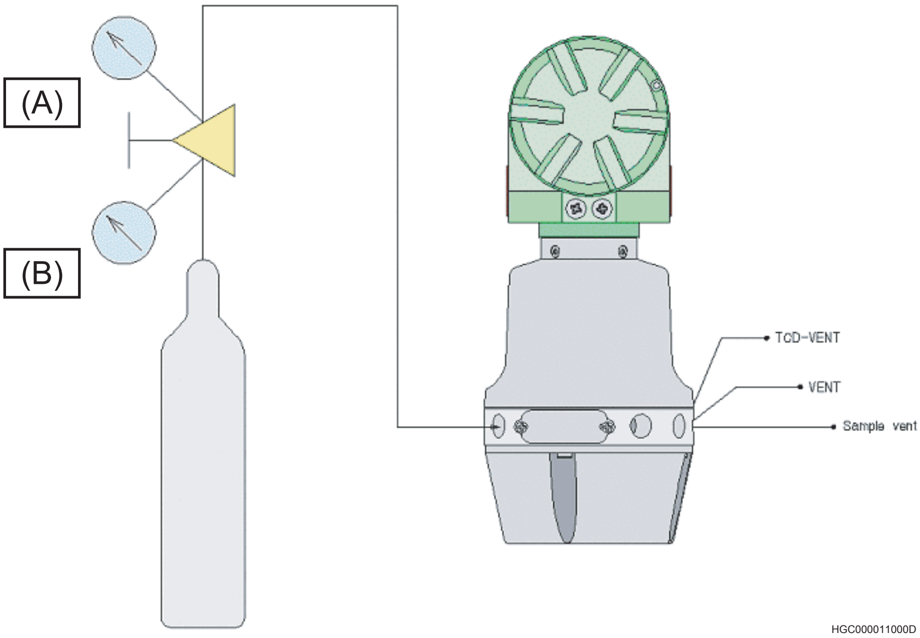


Figure 3-1 Leak check

Table 3-3 Model HGC303 leak test procedure

Step	Action
1	Check that the valve operating gas is being supplied.
2	Check the carrier gas has a secondary pressure (A) of 400 ± 50 kPa (58 ± 7 psi).
3	Verify that the carrier gas line valve off and observe the rate of fall in the indicated primary pressure (B).
4	Leak evaluation procedure. After introducing the carrier gas into the model HGC303, a normal condition is confirmed by a rate of fall of less than 1500 kPa (217 psi) per every 5 minutes.If more than 1500 kPa (217 psi) is observed, immediately contact an Azbil Corporation products service office or the nearest distributor. If the carrier gas is being used for valve operating gas at the same time, the carrier gas consumption will be doubled. (less than 3000 kPa (435 psi) per 5 minutes)

⚠ CAUTION
Verify that there is no leak from all connections.

3-2 : Stopping the model HGC303

To stop model HGC303 operation, follow the procedures listed below.

Table 3-4 Stopping model HGC303 operation

Step	Action
1	Shut off the process gas line.
2	Turn off the model HDM303 power.
3	Turn off the model HGC303 power.
4	Shut off the carrier gas line.
5	Shut off the valve operating gas line.
6	Refer to “ Storing the model HGC303” on page 2-2 when removing the model HGC303 from the field.

⚠ CAUTION

Do not leave the model HGC303 in the sampling system without plugs or seals at the connections to vent.

3-3 : HGM operation

Introduction

The functions of the HGM are described in this chapter.

The HGM is a calibration, configuration and maintenance tool for the model HGC303.

Analysis statuses, process variables and a chromatogram are displayed on its screen, and information is stored in a database to facilitate routine management and tuning.

~Note 1 *There is a possibility that this software will not function properly if another application software is used at the same time.*

~Note 2 *Please use a period "." as a decimal symbol.*
There is a possibility that analysis data will not save properly if a comma "," is used.
*Select **Start >> Settings >> Control Panel >> Regional Settings** and then click on **Number Tag***
Set decimal symbol to period ".".

Functions

(1) Monitoring heat value, chromatogram and carrier gas pressure / oven temperature control
(2) Data save (load)
(3) User report
(4) Calibration
(5) Self-diagnostics
(6) Hold model HGC303 outputs to host control system

3-3-1 : HGM connection with model HFA100 and HDM303

HGM connection is possible at any location along the FB line.

Connect the HGM as shown in the picture below.

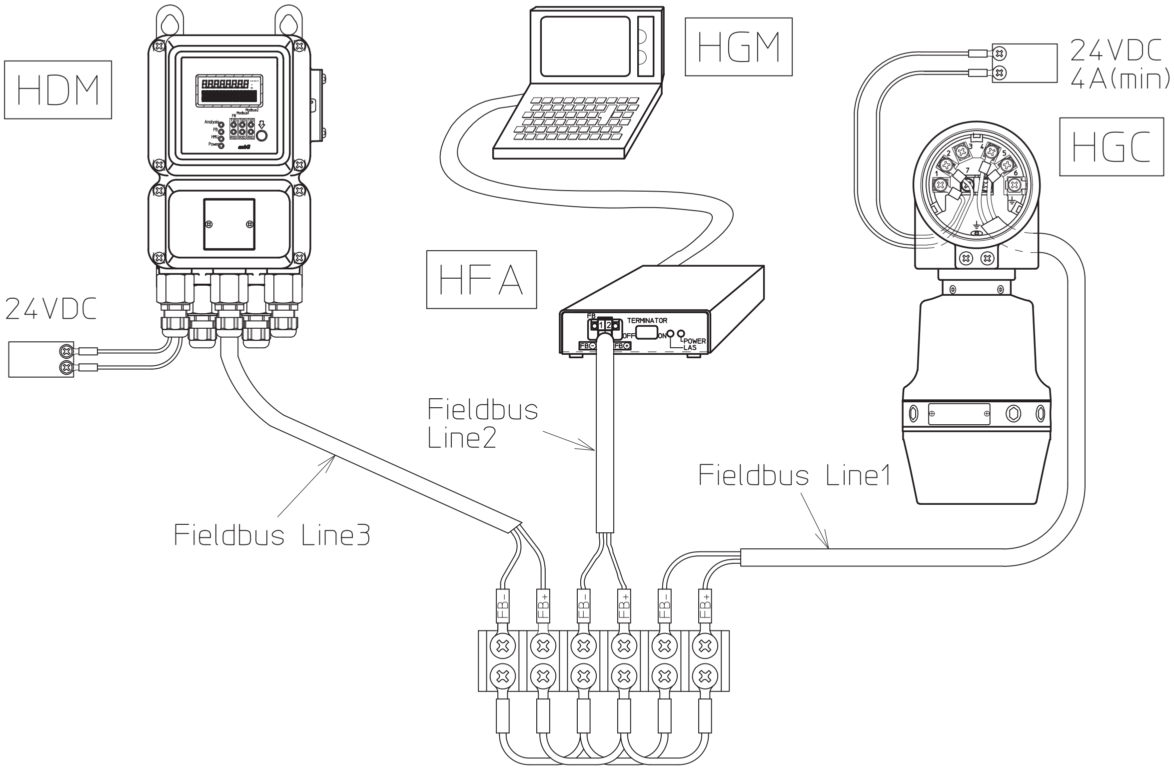


Figure 3-2 Model HGC303-HGM connection example (combination of model HGC303, model HDM303 and model HFA100)

Refer to the model HDM303 user's manual regarding the details of each part of the model HDM303.

3-3-2 : Starting up the HGM with model HFA100

The procedure to start the HGM up are given below.

(1) Make sure that both the model HGC303 and the model HDM303 are running normally.

(2) Prepare a personal computer, which has the HGM installed.

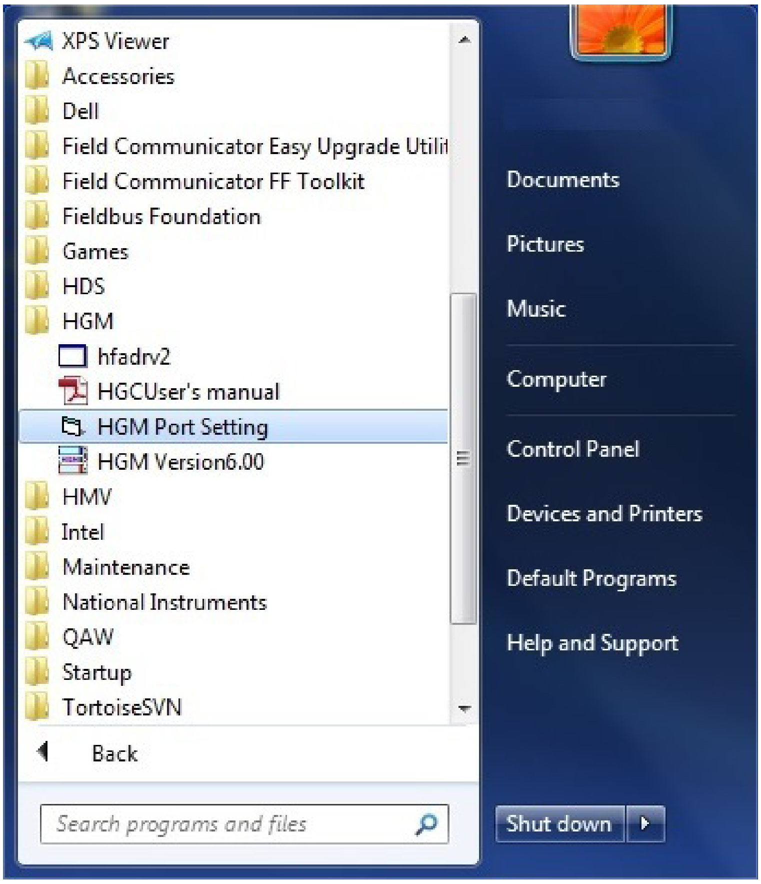
(3) Verify that font size is [Small font] and the display resolution 1024 Å~ 768 pixels.

(4) Connect the model HFA100 along the FB line. (Refer to Figure 3-2.)

(5) Connect the USB cable to the USB port of your PC.

(6) Make sure that the model HFA100 installation is correct.

(7) Run the HGM port set program [ComSetHGM.exe].
All program> HGM> HGM Port Setting



(8) Port setting combo box will appear, click [▼], and select COM port for use, and click [OK] button.

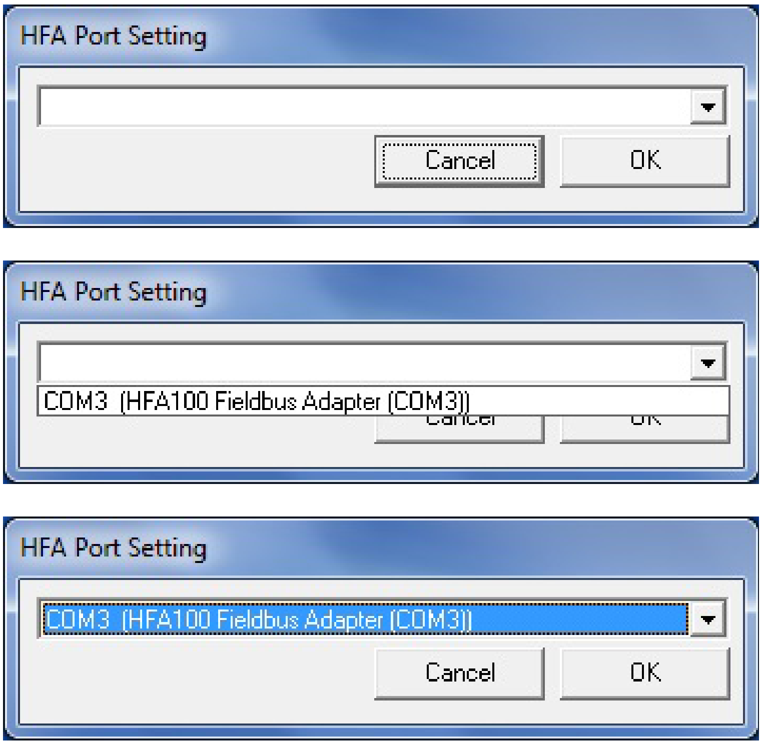
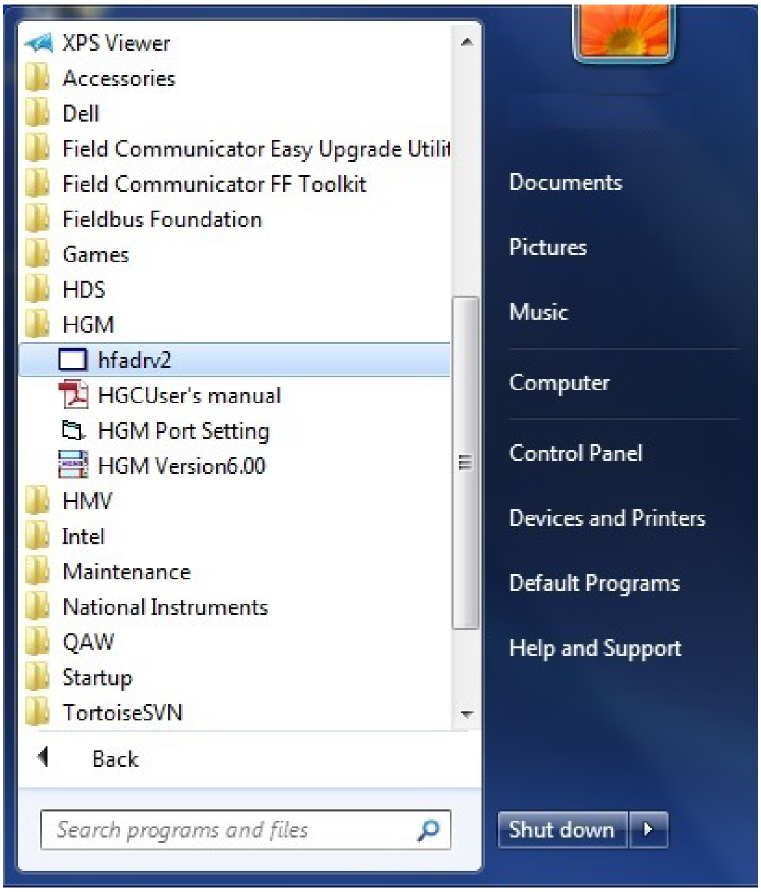


Figure 3-3 HFA Port setting

These settings will be stored in the settings file in the program folder.

(9) Run the driver program [hfadrv2.exe]
All program> HGM> hfadrv2



(10)Driver program will start, and please wait for periodical running begin.

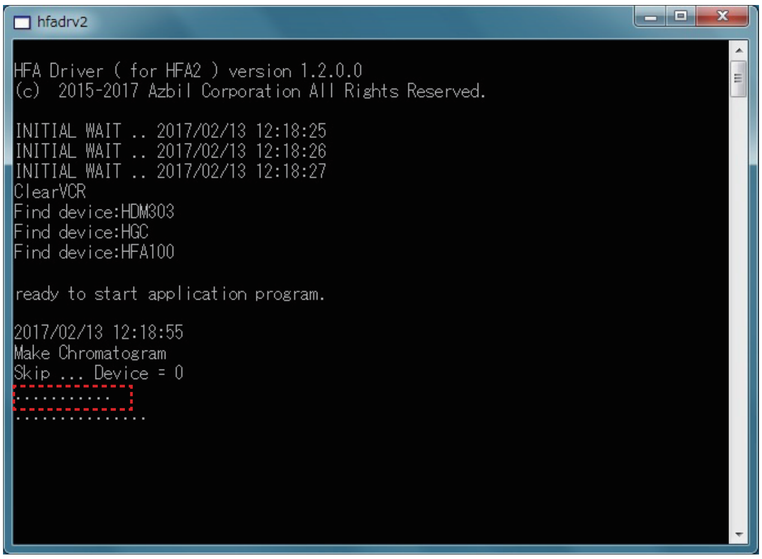
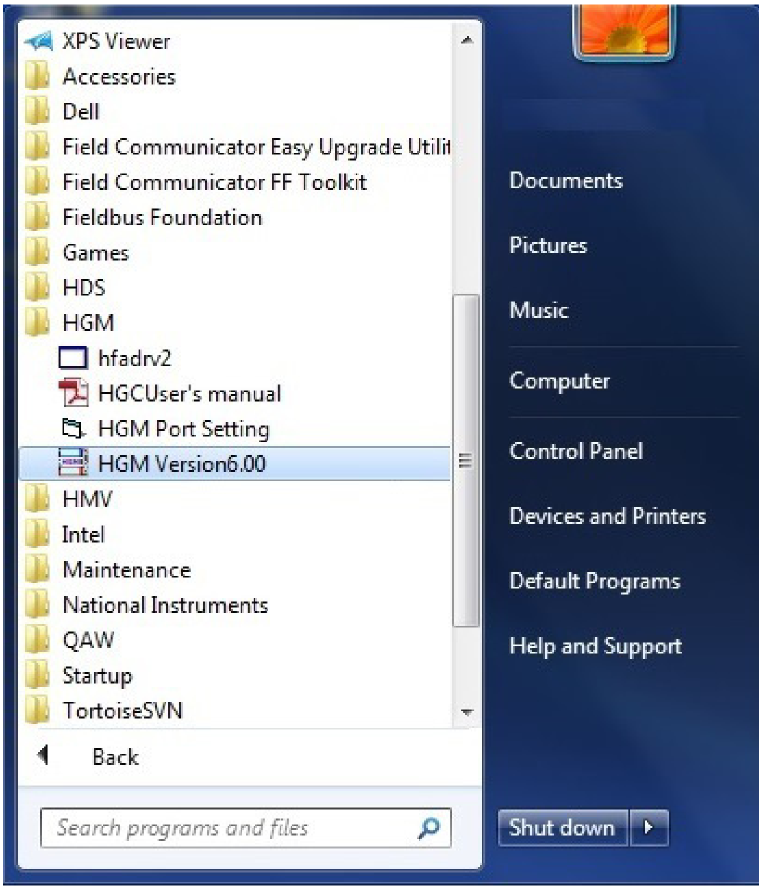


Figure 3-4 hfadrv2 comand window

~Note *When the driver program doesn't operate properly, please Refer to troubleshooting "5-1: Connection with PC".*

(11)Run the HGM program [hgmXXX.exe].
All program> HGM> HGM VersionX.XX



HGM Program will start.

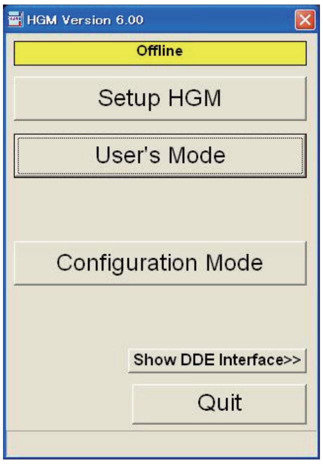
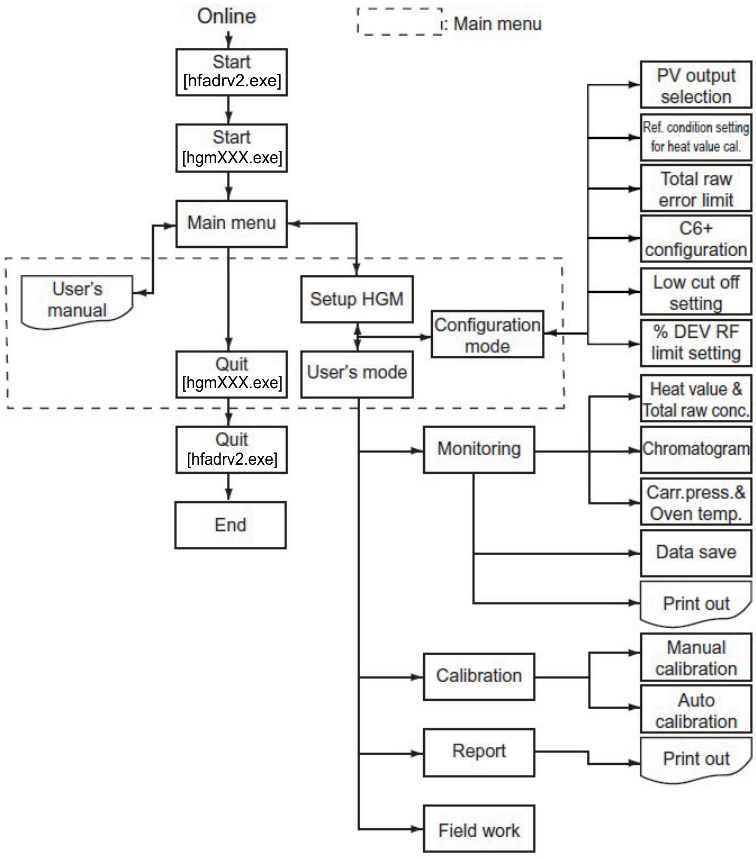


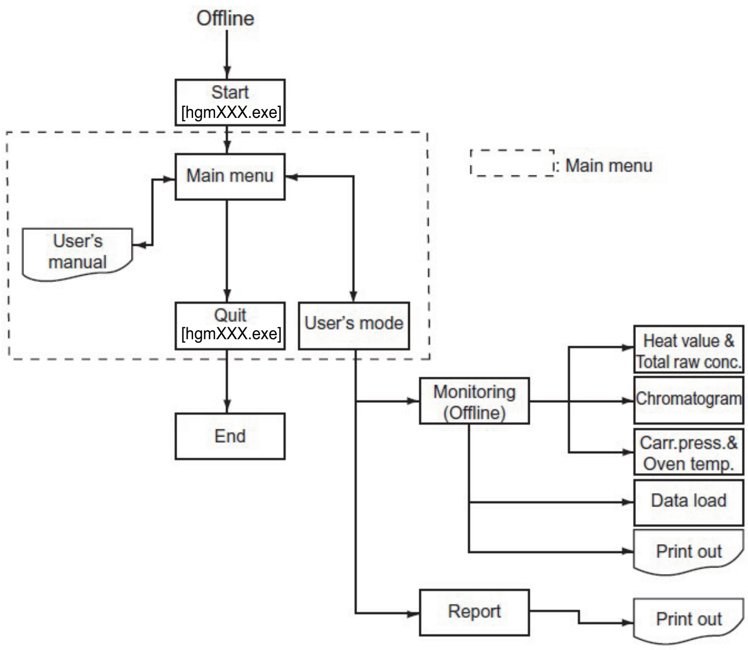
Figure 3-5 start HGM

HGM operation flow chart

Here is a flow chart showing how to get the HGM online and it also gives an overview of the HGM's functions.



Below is a flowchart showing HGM functions that are available offline.



3-3-3 : HGM Main menu

The contents of the main menu are described in this section.

The screen shown below is displayed once the HGM is started up.

(OFFLINE) (ONLINE)

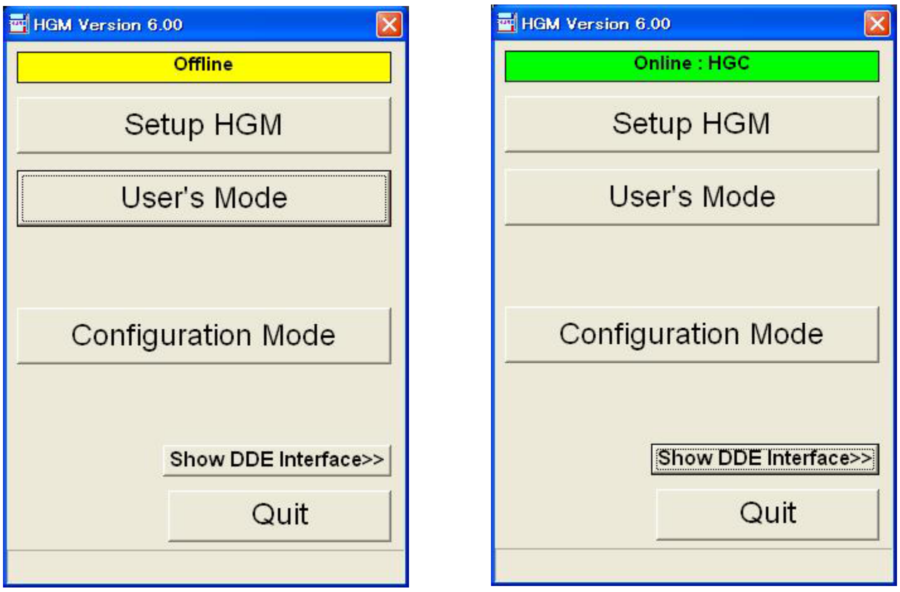


Figure 3-6 Main menu

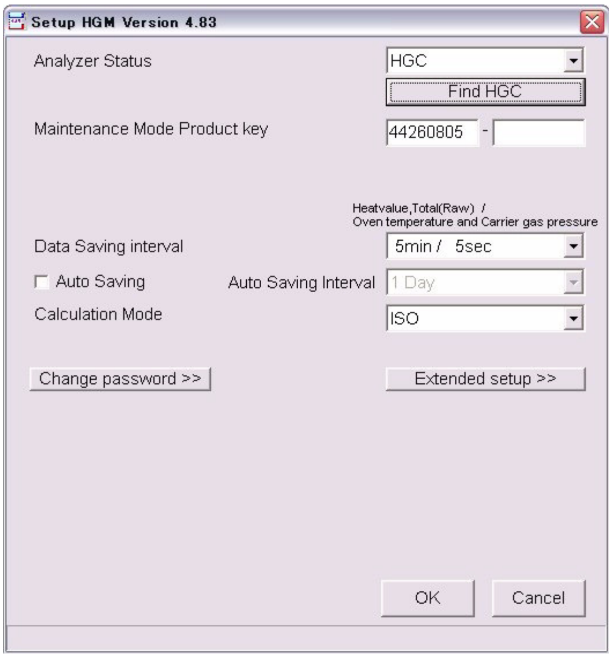
The HGM main menu is divided into six functions

Table 3-5 Main menu description

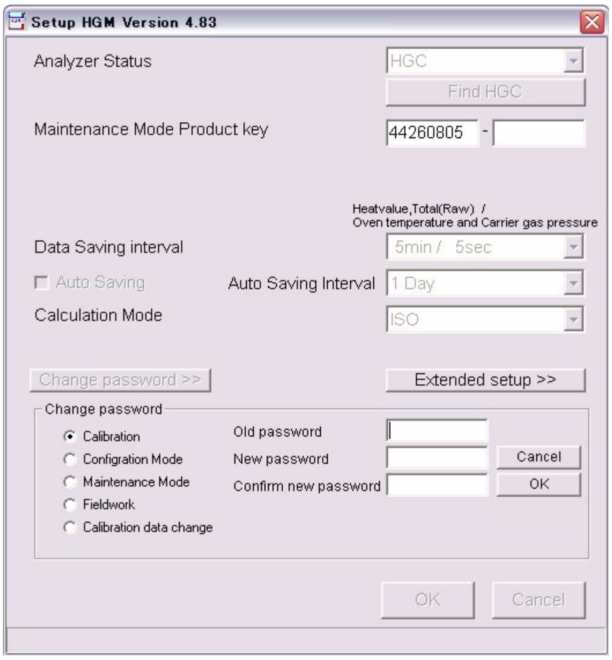
Display	Description
Offline (Online)	Displays the Online/Offline status.
Set up HGM	Select Online/Offline mode, Data saving interval.
User's Mode	Monitoring heat value trend graph and chromatogram. You can also perform calibrations using this mode.
Configuration mode	The model HGC303 can be configured from here can be done here.
Quit	Exit from the HGM application.

3-3-4 : Set up HGM

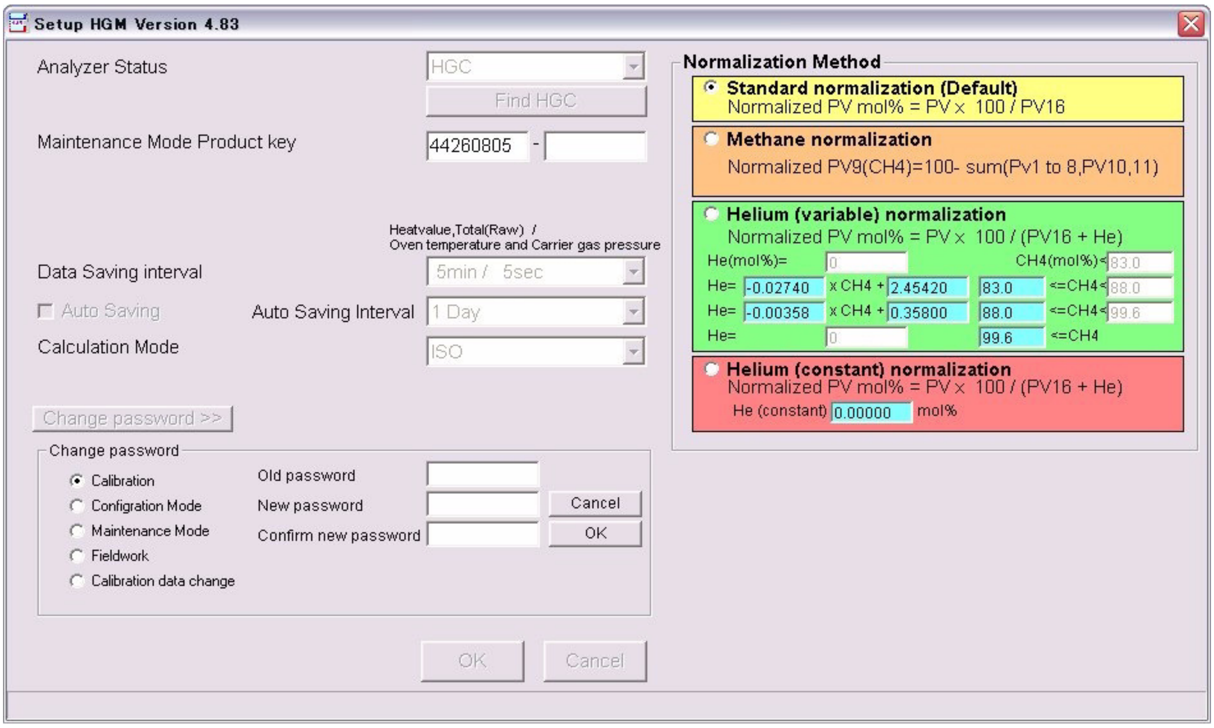
Before the HGM can communicate with the model HGC303, an initial setup must be performed as follows.



a. Initial screen



b. After clicking the [Change password] button.



c. Normalization method setting

Figure 3-7 Set up HGM display

Table 3-6 Set up HGM description

Display	Description
Analyzer Status	Analyzer Status shows whether the HGM is online or not. The HGM is online if [HGC] is shown.
Refresh	The latest update information for communication is displayed.
Maintenance mode product key	Authorized service personnel use only.
Data Saving Interval	HV1, CV1 and SV1 files are stored onto your PC according to the set data saving interval.
Auto Saving	The HGM automatically saves files according to the set auto saving interval
Calculation mode	The HGM can calculate heat values using either [ISO] or [GPA] calculation method. **~Note** *When calculation method is changed, normalization method will return to the default value.*
Normalization method	The HGM displays the value of after normalization, by following the method which has set. See section “3-3-8 : Configuration mode” to set HGM to HGC.

Follow the procedures given below in order for the HGM to communicate with the model HGC303.

Table 3-7 Set up online mode

Step	Action
1	**[Analyzer Status]** Select [HGC] in Analyzer Status If [HGC] cannot be selected from the pull-down menu, click the [Refresh] button. The HGM searches for the model HGC303 again along the Fieldbus line.
2	**[Data saving interval]** Select “data saving interval” from pull-down menu; 5 min. / 5 sec. [Default] 10 min. / 10 sec. 15 min. / 15 sec. 30 min. / 30 sec. 60 min. / 60 sec. 5 min.: Heat value and Total (Raw) data (text file extension:.hv1) 5 sec.: Oven temperature and Carrier gas pressure data (text file extension:.sv1) Refer to “ Data save” on page 3-17 and “ Editing data” on page 3-18 for details on how to save and edit the data.
3	**[Auto saving interval]** Check the box to select an interval as required. Selection: Min. 1 day, Max 10 day Refer to “ Automatic file saving” on page 3-19 for details on the auto saving mechanism.
4	**[Calculation Mode]** Select [ISO] or [GPA] from Calculation Mode. ISO [Default]
5	**[Password]** Some screens require a password to access them. However, if you want to change a password, click the [Change password>>] button. The password-setting screen appears on the setup HGM display (See “Figure 3-7 Set up HGM display” on page 3-14). Click the [specified] button, and then enter the “Old password”, which has been stored in the HGM and then enter a “New password”. The new password becomes active once you click the [OK] button in the password-setting screen. Default passwords are as follows (Maximum letters: 16): Calibration : password1 Configuration mode : password2 Maintenance mode : password3 Field work : password4 Calibration data change*: password5 **~Note** **This refers to the [Advanced>>] button in “Figure 3-17 Calibration setting panel” on page 3-49.*
6	If necessary, click the [Extended setup] button, and select normalization method. Default is “Standard normalization”.
7	Click the [OK] button to return to the main menu.
8	Click on [User's mode] in the main menu.

Table 3-8 Analyzer status and available functions

Analyzer Status	Print	Save	Load	Report	Calibration
Online	OK	OK	NA	OK	OK
Offline	OK	NA	OK	OK	NA

NA: not available

~Note *For details on [GPA mode] selected in Calculation mode, refer to “3-5 : GPA mode” on page 3-55.*

Data save

The last 4000 items of data are automatically stored in the RAM of your PC at each data saving interval.

You can also save data by using the save function (See Table 3-12 or Table 3-14).

The data are saved as text files (.hv1 or.cv1 or.sv1) in C:\program files\hgm\data (default) folder.

Table 3-9 Save data description

Text file extension	Save button	Data saving interval (Default)	Content
.hv1	Table 3-12 No.3	5 minutes (1day =288 data) 4000/288=13.8 days	for HGM version less than 4.70 Date and time, ICV(Ideal)(MJ/m3), ICV(Real)(MJ/m3), SCV(Ideal)(MJ/m3), SCV(Real)(MJ/m3), Total raw(mol%) for HGM version 4.70 or later Date and time, ICV(Ideal)(MJ/m3), ICV(Real)(MJ/m3), SCV(Ideal)(MJ/m3), SCV(Real)(MJ/m3), Total raw(mol%), ICV(Ideal)(kJ/m3), ICV(Real)(kJ/m3), SCV(Ideal)(kJ/m3), SCV(Real)(kJ/m3), ICV(Ideal)(kWh/m3), ICV(Real)(kWh/m3), SCV(Ideal)(kWh/m3), SCV(Real)(kWh/m3)
.cv1	Table 3-12 No.3		Date and time, PV1-PV20 (PV1-11; Raw data)
.sv1	Table 3-14 No.3	5 seconds (1 hour =720 data) 4000/720=5.5 hours	Date and time, PV17, PV18

Text files (.hv1 and. cv1) are saved at the same time with the save function, which is described in Table 3-12 No.3.

Editing data

If you want to edit saved data, open a saved file using to following procedure.

You can edit data using software such as Microsoft Excel™.

1 Start Microsoft Excel™

2 Select [Open]

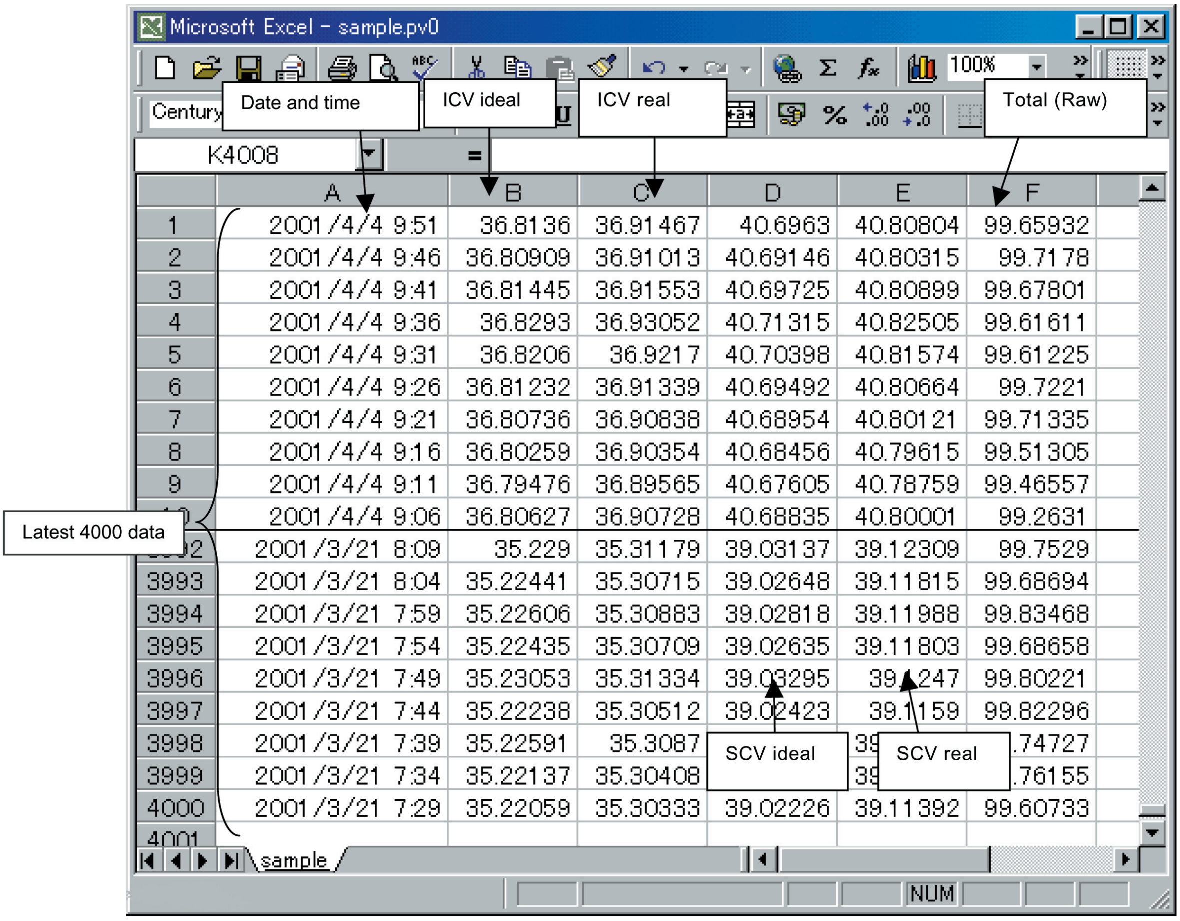
3 Select the directory where the saved file is stored.

(Default directory C:\program files\hgm\data)

4 Select [All files] in “Files of type”.

5 Select a saved file, then click [open].

6 Follow the messages that come up on screen. (Click [Comma] at “delimiters”.)



	A	B	C	D	E	F
1	2001/4/4 9:51	36.8136	36.91467	40.6963	40.80804	99.65932
2	2001/4/4 9:46	36.80909	36.91013	40.69146	40.80315	99.7178
3	2001/4/4 9:41	36.81445	36.91553	40.69725	40.80899	99.67801
4	2001/4/4 9:36	36.8293	36.93052	40.71315	40.82505	99.61611
5	2001/4/4 9:31	36.8206	36.9217	40.70398	40.81574	99.61225
6	2001/4/4 9:26	36.81232	36.91339	40.69492	40.80664	99.7221
7	2001/4/4 9:21	36.80736	36.90838	40.68954	40.80121	99.71335
8	2001/4/4 9:16	36.80259	36.90354	40.68456	40.79615	99.51305
9	2001/4/4 9:11	36.79476	36.89565	40.67605	40.78759	99.46557
10	2001/4/4 9:06	36.80627	36.90728	40.68835	40.80001	99.2631
3992	2001/3/21 8:09	35.229	35.31179	39.03137	39.12309	99.7529
3993	2001/3/21 8:04	35.22441	35.30715	39.02648	39.11815	99.68694
3994	2001/3/21 7:59	35.22606	35.30883	39.02818	39.11988	99.83468
3995	2001/3/21 7:54	35.22435	35.30709	39.02635	39.11803	99.68658
3996	2001/3/21 7:49	35.23053	35.31334	39.03295	39.1247	99.80221
3997	2001/3/21 7:44	35.22238	35.30512	39.02423	39.11159	99.82296
3998	2001/3/21 7:39	35.22591	35.3087			.74727
3999	2001/3/21 7:34	35.22137	35.30408			.76155
4000	2001/3/21 7:29	35.22059	35.30333	39.02226	39.11392	99.60733
4001						

HGM000011000S

Figure 3-8 Example of saved data files (.hv1)

Automatic file saving

The HGM can be set to automatically save data files. This is done by activating the setting from the [setup HGM] panel.

Default directory; C:\program files\hgm\data.

Files with the extensions;.hv1,.cv1, and.sv1 and.cg1(chromatogram) are saved.

All.cg1 files are saved as named YYYYMMDDHHMMas.cg1.

YYYY = year, MM = month, DD = date, HH = hour, MM = minute, as = auto saving,.cg1 = chromatogram extension file.

Data saving interval of.cg1 files is fixed to 5minutes.

Example:

Auto saving interval:1day (Selection: min. 1day, max. 10 days)

Data saving interval:5 min. and 5 sec. (Selection: min. 5 min. and 5 sec., max 60 min. and 60 sec.)

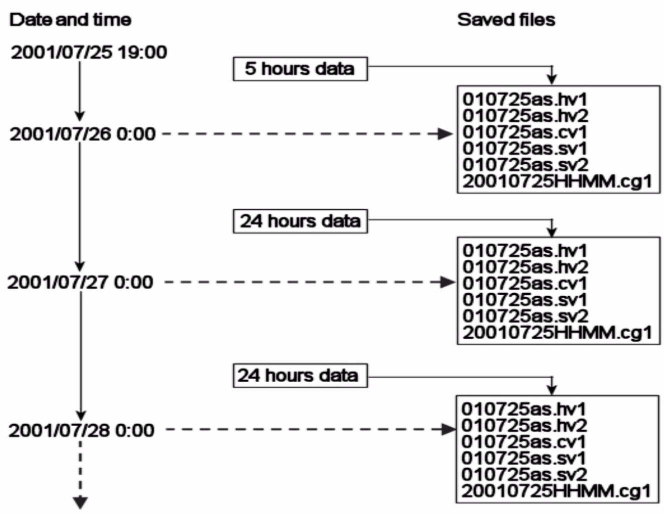
(1) HGM data saving starts at 2001/07/25 19:00.

(This function starts after checking the box in [Setup HGM] then clicking the [OK] button.)

(2) Analysis data and chromatograms (2001/07/25 19:00-2001/07/25 23:59) is saved at 2001/07/26 0:00.

Saved file names: 010725as.hv1, 010725as.hv2, 010725as.cv1, 010725as.sv1, 010725as.sv2, 20010725HHMMas.cg1.

“as” stands for auto saving.



(3) Analysis data and chromatograms (2001/07/26 0:00-2001/07/26 23:59) are saved at 2001/07/27 0:00.

Saved file names: 010726as.hv1, 010726as.hv2, 010726as.cv1, 010726as.sv1, 010726as.sv2, 20010726HHMMas.cg1.

3-3-5 : User's mode menu and commands

Click on [User's Mode] and you will see the following display.

The display size is fixed (full screen).

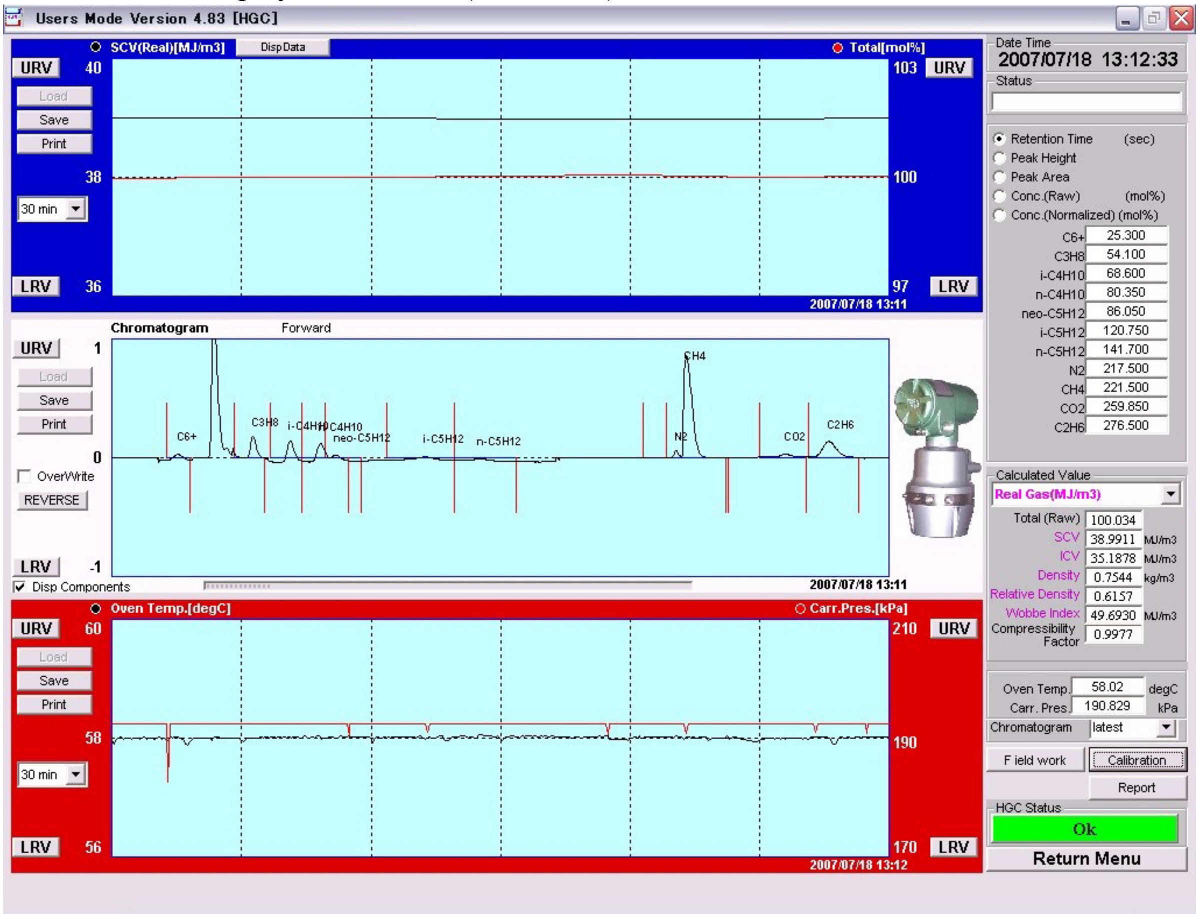


Figure 3-9 User's mode display

This screen is divided into three graphs. On the right hand side is the measurement data.

Table 3-10 Description of user's mode display

Screen	Description
Top (blue)	This graph shows heat value and the total of raw concentration
Center (white)	Chromatogram
Bottom (red)	This graph shows carrier gas pressure and oven temperature
Right panel	Process gas analysis data

3-3-6 : Main displays of HGM

Indication panel

Data is updated every 5 minutes.

Table 3-11 Description of the indication panel

No.	Panel	Description
1	Date time	Present date and time
2	Status	Communication status appears when HGM is communicating with model HGC303.
3	Data box	Select a data type. Default: Retention time (sec.)
4	Calculated Value	Select values for Ideal gas or Real gas and its unit Default: Real SCV: Superior Calorific Value ICV: Inferior Calorific Value
5	Oven Temp. and Carr. Pres.	Display oven temperature and carrier gas pressure
6	Chromatogram	The last 300 chromatograms are stored in RAM. Save the data as required. Select [previous XX] or [latest] to view the chromatogram. If [previous XX] is selected, the auto reload function stops. XX: 01-299 **Return to [latest] to monitor the latest chromatogram.** **Auto reload function starts again.**
7	[Field work]	Model HGC303 holds outputs to the host control system during field maintenance. Click the [Field work] button then [ON], to set the holding time to [24hrs]. [Field work] button blinks while performing fieldwork.
8	[Calibration]	Click the [Calibration] button to perform calibration. The [Calibration] button blinks during auto calibration. Refer to “3-4 : Calibration” on page 3-44
9	[Report]	Click the [Report] button to create a report. Refer to “3-3-7 : Report” on page 3-28.

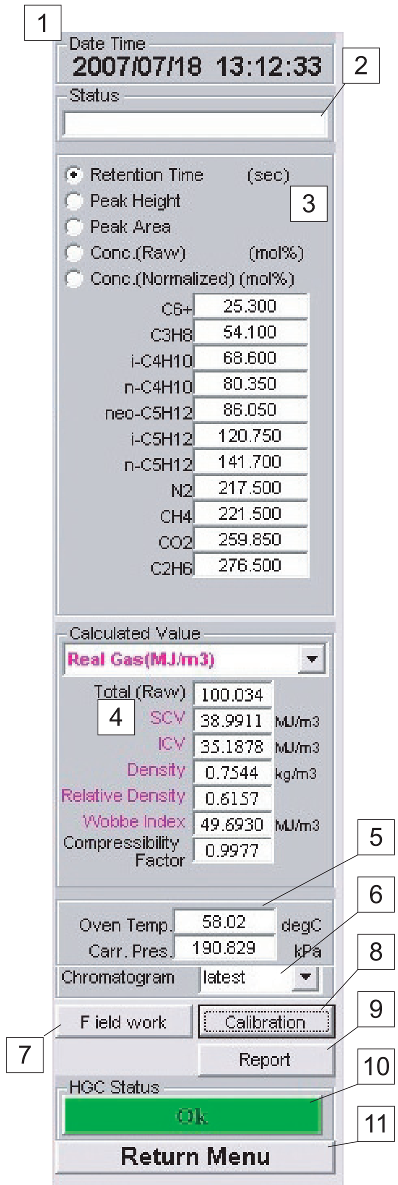
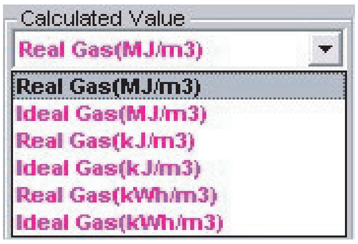


Table 3-11 Description of the indication panel

No.	Panel	Description
10	HGC Status	Green means that model HGC303 is analyzing normally. If this signal changes to red, click this button to read the error message. Refer to “Chapter 5 : Troubleshooting” on page 5-1.
11	Return Menu	Exit from User's mode Return to Main Menu

Detail of Calculated Value 4



Heat value and total raw concentration

This graph shows the heat value and the total raw concentration.

The left vertical axis represents the heat value and the right vertical axis represents the total raw concentration. The horizontal axis represents the time range.

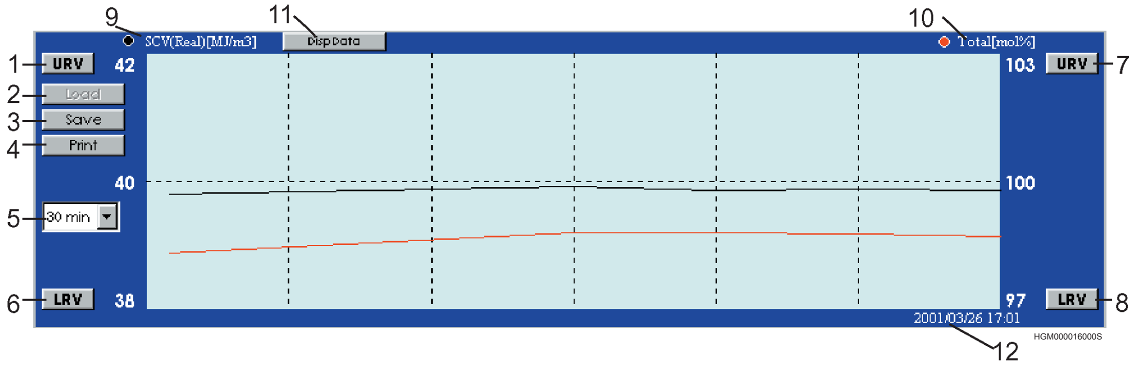


Figure 3-10 Trend graph of SCV and the total concentration (Raw)

Table 3-12 Trend graph of SCV and total raw concentration description

No.	Display	Description
1	URV (SCV)	Upper Range Value for SCV, default value: 42 MJ/m^3 Click the [URV] button to change the URV value
2	Load (Offline)	Recall saved data File name extension:.hv1
3	Save (Online)	The latest data is saved Default directory is “C:\Program files\hgm\data”.*
4	Print	Verify that your printer is connected and working properly.
5	30min. (The time range select)	This indicates the time range of the horizontal axis. Select a time range from the pull-down menu: 30 min., 60 min., 3 hour, 6 hours, 12 hours, 1 day, 2 days, 3 days, 6 days, 12 days Default: 30 min.
6	LRV(SCV)	Lower Range Value for SCV, default value: 38 MJ/m^3 Click the [LRV] button to change the LRV value
7	URV (Total raw conc.)	Upper Range Value for Total, default value: 103% Click the [URV] button to change the URV value
8	LRV (Total raw conc.)	Lower Range Value for Total, default value: 97% Click the [LRV] button to change the LRV value
9	Black circle	Black indicates SCV graph. Click the [Disp data] button (No.11) to select a data type. Default: SCV (Real)
10	Red circle	Red indicates Total raw conc. graph.
11	Disp. data	Select a data type for heat value.
12	Time	Online: Date and time of the latest data (data is reloaded every 5 min.) Offline: Date and time of when the data was saved.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

Chromatogram

Chromatogram is updated every 5 minutes.

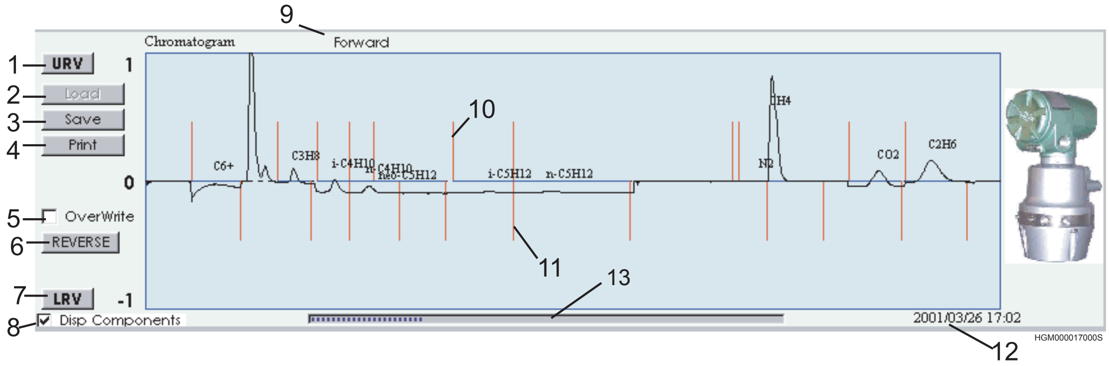


Figure 3-11 Trend chromatogram (online)

Table 3-13 Chromatogram description

No.	Display	Description
1	URV	Upper Range Value for vertical axis Click the [URV] button to change the URV value Default value is 1
2	Load (Offline)	Recall saved data. File name extension:.cg1
3	Save (Online)	The latest data is saved. Default directory is "C:\Program files\hgm\data".*
4	Print	Verify that your printer is connected and working properly.
5	Over write	Overlapped chromatograms are displayed.
6	Reverse	Click the [reverse] button to invert the display and [No.9] [Forward] changes the display to [Reverse]. Default: [Forward]
7	LRV	Lower Range Value for vertical axis Click the [LRV] button to change the LRV value. Default value: -1
8	Disp Components	When the box is checked, the name of each component will be displayed.
9	Forward-Reverse	Display [Forward] or [Reverse]
10	Upper gate marker	Gate start marker of each component.
11	Lower gate marker	Gate end marker of each component.
12	Time	Online: Date and time of the latest data (data is reloaded every 5 min.) Offline: Date and time of when the data was saved.
13	Status bar (Online)	Status bar range: 5minutes Chromatogram data is updated every 5minutes.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

Zoom function (2×2)

Click on a peak of interest to get a detailed view (display only).

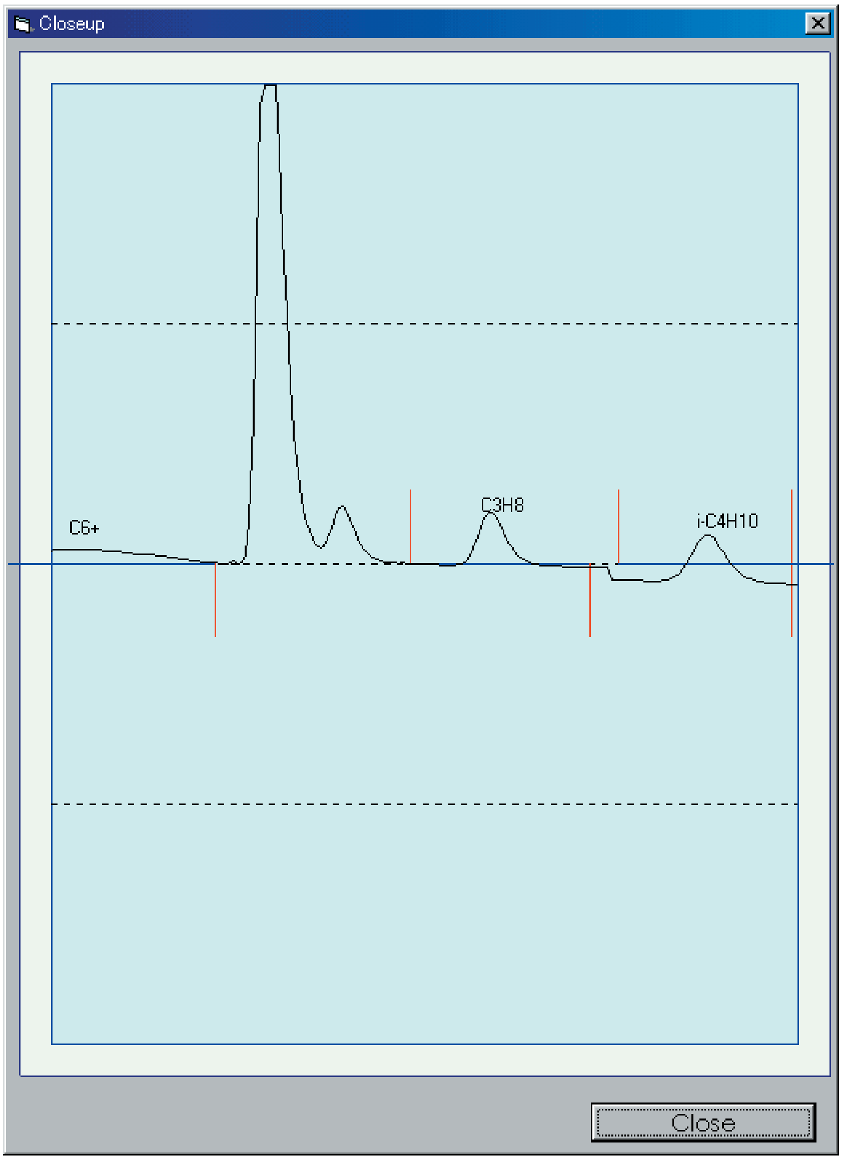


Figure 3-12 Zoom box

Trend graph of carrier gas pressure and oven temperature control

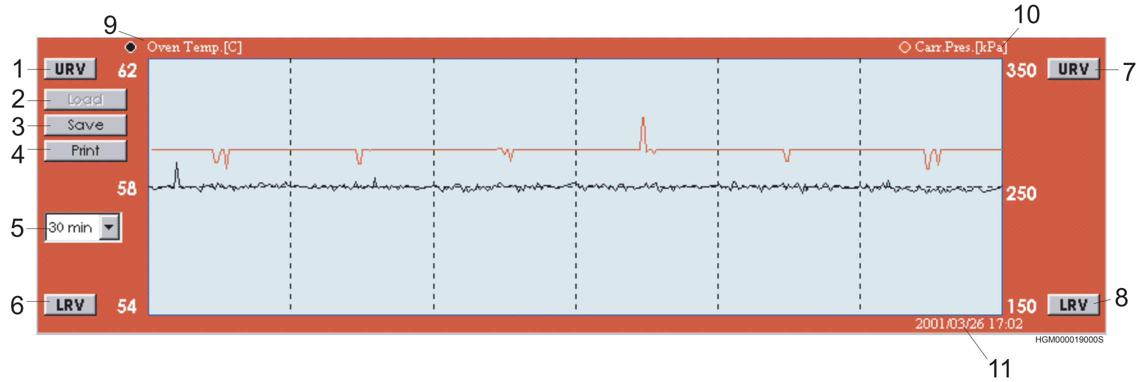


Figure 3-13 Trend graph of carrier pressure and oven temp. control

This data is displayed according to the set data saving interval (Refer to "3-3-4 : Set up HGM" on page 3-14).

Default interval: 5 sec.

Table 3-14 Description of trend graph of carrier gas pressure and oven temperature control

No.	Display	Description
1	URV (Oven Temp.)	Upper Range Value for oven temperature. Click the [URV] button to change the URV value Default value: 62 deg.C.
2	Load (Offline)	Recall saved data. File name extension:.sv1
3	Save (Online)	The latest data is saved. Default directory is "C:\Program files\hgm\data".*
4	Print	Verify that your printer is connected and working properly.
5	30min (Time range select)	This indicates the time range of the horizontal axis. Select a time range from pull-down menu:30 min., 60 min., 3 hours, 6 hours, 12 hours, 1 day, 2 days, 3 days, 6 days, 12 days Default: 30min.
6	LRV (Oven Temp.)	Lower Range Value for oven temperature Default value: 54 deg. C. Click the [LRV] button to change the LRV value
7	URV (Carr Press.)	Upper Range Value for carrier pressure Default value: 350kPa Click the [URV] button to change the URV value
8	LRV (Carr Press.)	Lower Range Value for carrier pressure. Default value: 150 kPa Click the [LRV] button to change the LRV value
9	Black circle	Black indicates oven temperature.
10	Red circle	Red indicates carrier pressure.
11	Time	Online: Date and time of the latest data Offline: Date and time of when the data was saved.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

3-3-7 : Report

To create a report, click the [report] icon in the right panel of User's mode.

The following entry form for process gas data will appear.

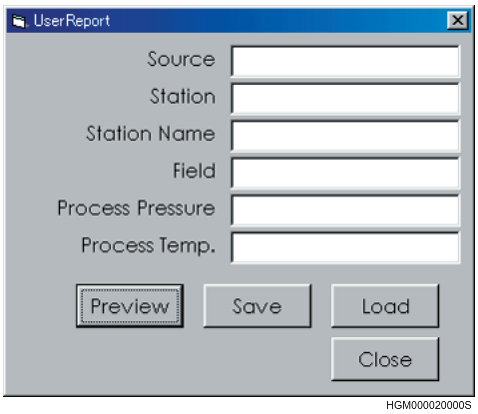


Figure 3-14 User report entry form

Enter the necessary items and click the [Preview] button.

It is not necessary to fill out all of the boxes.

When online, the latest analysis data can be viewed by clicking on [report].

When offline, the report or chromatogram that you had saved will be displayed.

To print out a report, click the [Preview] button then [print out].

~Note *File name extension of an user report is.cg1 (same as chromatogram).*

~Note *When you want to save report data, save either the report or the chromatogram.*
The chromatogram file (.cg1) includes the report data.

HGC 303 Analysis Report

Source	:		Report Date - Time	:	Oct-18-2007 13:41:50
Station	:		Analysis Date - Time	:	Jul-24-2007 11:38:00
Station Name	:		Process Pressure	:	
Field	:		Process Temp.	:	

File Name : **C:\ Program Files\ HGM_HFA\ DATA\ 07072400.CG1**

Gas Analysis by HGC 303

PV	Name	Raw mol %	Normalized mol %
PV1	C6+	0.051	0.051
PV2	C3H8	1.525	1.523
PV3	iC4H10	0.307	0.306
PV4	nC4H10	0.306	0.306
PV5	neo-C5H12	0.104	0.104
PV6	iC5H12	0.054	0.054
PV7	nC5H12	0.052	0.052
PV8	N2	3.007	3.004
PV9	CH4	91.216	91.116
PV10	CO2	0.506	0.505
PV11	C2H6	2.982	2.979
	Helium	------	------
	Total	100.110	100.000

PV16	Total (except He)	100.110

HGC Configuration data

PV outputs

PV	Configuration data
PV12	SCV (real) (MJ/m3)
PV13	Density(real) (kg/m3)
PV14	Wobbe index(real) (MJ/m3)
PV15	Compressibility Factor
PV16	Total of raw concentrations
PV17	Oven temperature
PV18	Carrier gas pressure
PV19	ICV (real) (MJ/m3)
PV20	Relative Density (real)

Reference conditions

Combustion temperature	15.00	degree C
Metering temperature	15.00	degree C
Atmospheric pressure	101.325	kPa

Helium option

Helium output (mol%)	Condition
----------	----------
----------	----------
----------	----------
----------	----------

Heat Value Calculation by HGM

	Ideal		Real	
Superior Calorific Value (SCV)	38.9022	MJ/m3	38.9927	MJ/m3
Inferior Calorific Value (ICV)	35.1078	MJ/m3	35.1894	MJ/m3
Density	0.7528	kg / m3	0.7545	kg / m3
Relative density	0.6146		0.6158	
Wobbe Index	49.6233	MJ/m3	49.6914	MJ/m3
Compressibility Factor	0.9977			

Figure 3-15 User report

Table 3-15 Description of user report

Section	Description
Data items	Display of user input data and saved file name
Gas Analysis by model HGC303	PV1 -11 outputs data from model HGC303
HGC Outputs Configuration data	Display of model HGC303 configuration data (PV12 - 20)
Heatvalue Calculation by HGM	All heat value data is calculated by the HGM and is displayed.
HGC Status	Model HGC303 status is displayed (online mode only)

3-3-8 : Configuration mode

Various configurations of the model HGC303 and the HGM can be made in this mode.

Click on [Configuration mode] in the main menu. The following screen will appear after entering the password.

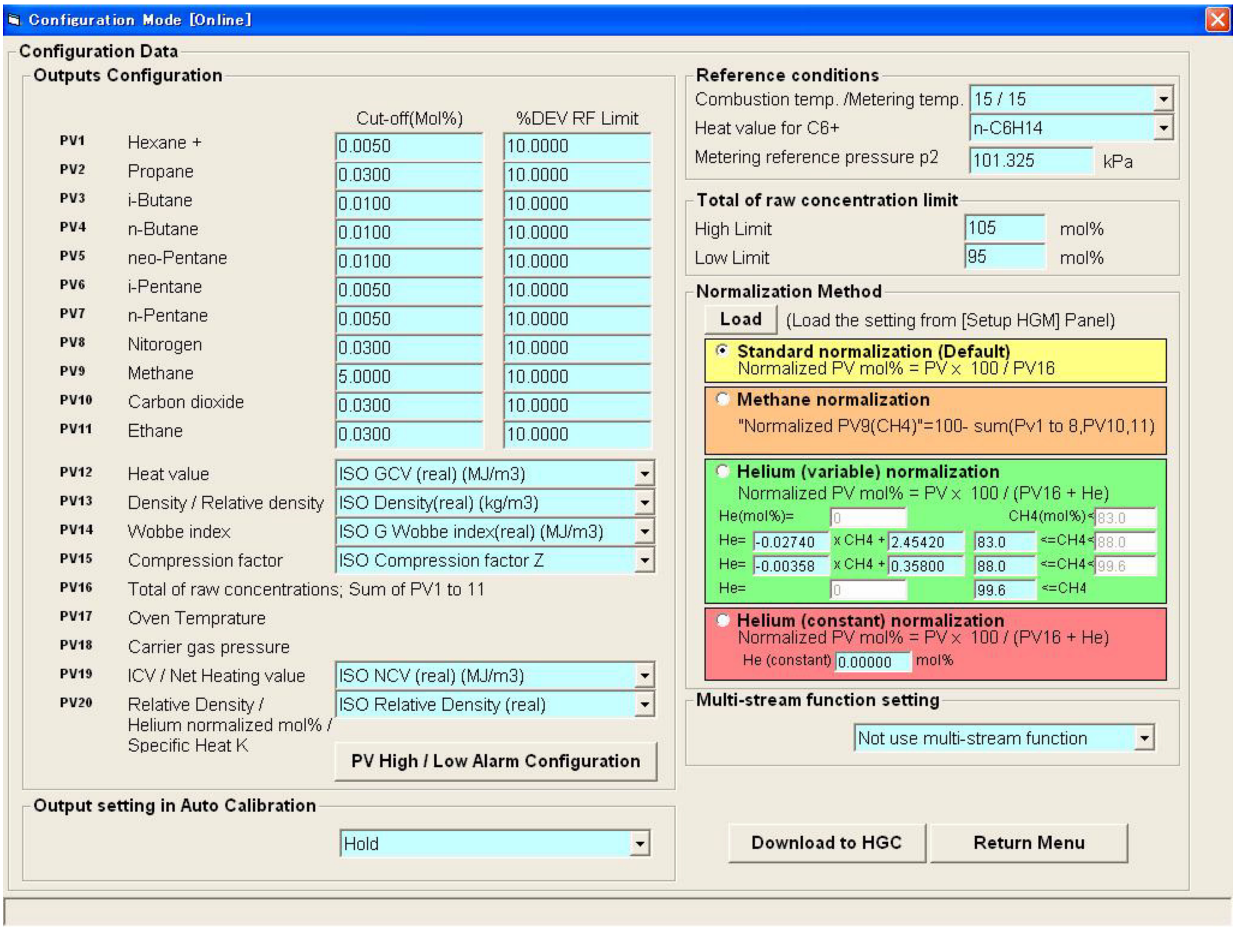


Figure 3-16 Configuration mode display

~Note *Some items of PV12-15, 19 and 20 may not be available. It depends on the software version combination of the HGC, the HGM and the HDM. Refer to the section from next page.*

~Note *Some settings as follows may not appear on the HGM screen. It depends on the software version combination of the HGC, the HGM and the HDM.*

-% DEV RF limit
-PV High/Low Alarm Configuration
-Output setting in Auto Calibration
-Normalization method
-Multi-stream function setting

Table 3-16 Description of configuration mode display

Display	Description
Outputs configuration	Low cut off: Threshold of a peak or a noise When detected value < low cut off value, output is transmitted as 0 mol%. % DEV RF limit: See “3-4-2 : Calibration procedure” on page 3-45 for description Each RF % dev limit can be set independently. PV12 to 15, 19 and 20 can be configured to set which outputs are transmitted to the host control system. PV High / Low Alarm Configuration: High / Low Alarm limit values can be entered for PV1-11, PV12-15, PV19-20. This setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination.
Output setting in Auto Calibration	Data update to the HDM during auto or semi-auto calibration can be selected after executing auto or semi-auto calibration. Hold [default] Calibration data (New RF). *~Note* When Calibration data (New RF) is selected, Total (raw) error is also send as the HGC status to the HDM with updated data. This setting is available for application of HGM (version is 4.83 or later) and HGC (version is 3.3 or later) combination.
Reference conditions	Configuration data for heat value calculation can be selected or entered manually.
Total of raw conc.	Usually, the total of raw concentration is within 95-105 mol% during process gas analysis. If these values are required to be changed, input a user defined value for both high and low limit.
Normalization method	Normalization method can be selected. Default is “Standard normalization”
Multi-stream function setting	Use or Not use of multi-stream function can be selected.This setting is only available for application of HGC (version 3.0 or later) and HDM (version 2.30 or later) combination.
Download to HGC	All configured data are downloaded to the model HGC303 by clicking this button.
Return Menu	Exit from configuration mode. Return to main menu.

(1) PV1 - 11 configuration

(1-1) Low cut off:

Threshold of a peak or a noise

If the detected value < low cut off value, the output will be transmitted as 0 mol%.

(1-2) % DEV RF limit:

See “3-4-2 : Calibration procedure” on page 3-45 for details

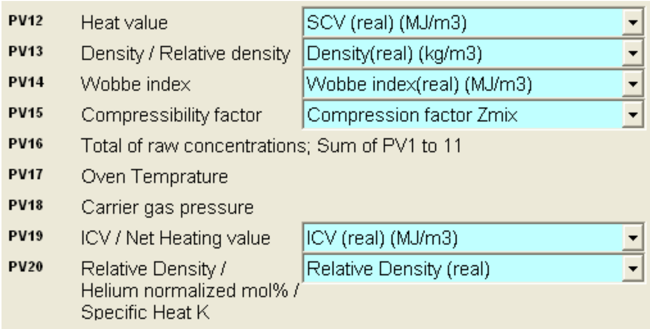
Each RF %dev limit can be set independently.

Default values are as follows:

		Cut-off(Mol%)	%DEV RF Limit
PV1	Hexane +	0.0000	10.0000
PV2	Propane	0.0000	10.0000
PV3	i-Butane	0.0000	10.0000
PV4	n-Butane	0.0000	10.0000
PV5	neo-Pentane	0.0000	10.0000
PV6	i-Pentane	0.0000	10.0000
PV7	n-Pentane	0.0000	10.0000
PV8	Nitorogen	0.0000	10.0000
PV9	Methane	0.0000	10.0000
PV10	Carbon dioxide	0.0000	10.0000
PV11	Ethane	0.0000	10.0000

(2) PV12 - 20 configuration

PV12 to 15, 19 and 20 can be configured to set which outputs are transmitted to the host control system.



Possible configurations of each PV are as follows.

Table 3-17 Possible configurations of PV12-20

PV12	Choose one from followings as a PV12 output value. ISO SCV(real) (MJ/m3) [ISO default] ISO SCV(ideal) (MJ/m3) ISO ICV(real) (MJ/m3) ISO ICV(ideal) (MJ/m3) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO SCV(real) (kJ/m3) ISO SCV(ideal) (kJ/m3) ISO ICV(real) (kJ/m3) ISO ICV(ideal) (kJ/m3) ISO SCV(real) (kWh/m3) ISO SCV(ideal) (kWh/m3) ISO ICV(real) (kWh/m3) ISO ICV(ideal) (kWh/m3) GPA Real Gross HV(dry) (BTU/CF) [GPA default] GPA Real Gross HV(sat) (BTU/CF) GPA Ideal Gross HV(dry) (BTU/CF) GPA Ideal Gross HV(sat) (BTU/CF) GPA Gross HV(dry) (BTU/lbm) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "GCV" means "Gross Calorific Value". GCV equals to SCV(Superior Calorific Value). "NCV" means "Net Calorific Value". NCV equals to ICV(Inferior Calorific Value). ISO GCV(real)(MJ/m3)[ISO default] ISO GCV(ideal)(MJ/m3) ISO NCV(real)(MJ/m3) ISO NCV(ideal)(MJ/m3) ISO GCV(real)(kJ/m3) ISO GCV(ideal)(kJ/m3) ISO NCV(real)(kJ/m3) ISO NCV(ideal)(kJ/m3) ISO GCV(real)(kWh/m3) ISO GCV(ideal)(kWh/m3) ISO NCV(real)(kWh/m3) ISO NCV(ideal)(kWh/m3) GPA Real Gross HV(dry)(BTU/CF)[GPA default] GPA Real Gross HV(sat)(BTU/CF) GPA Ideal Gross HV(dry)(BTU/CF) GPA Ideal Gross HV(sat)(BTU/CF) GPA Gross HV(dry)(BTU/lbm)

Table 3-17 Possible configurations of PV12-20

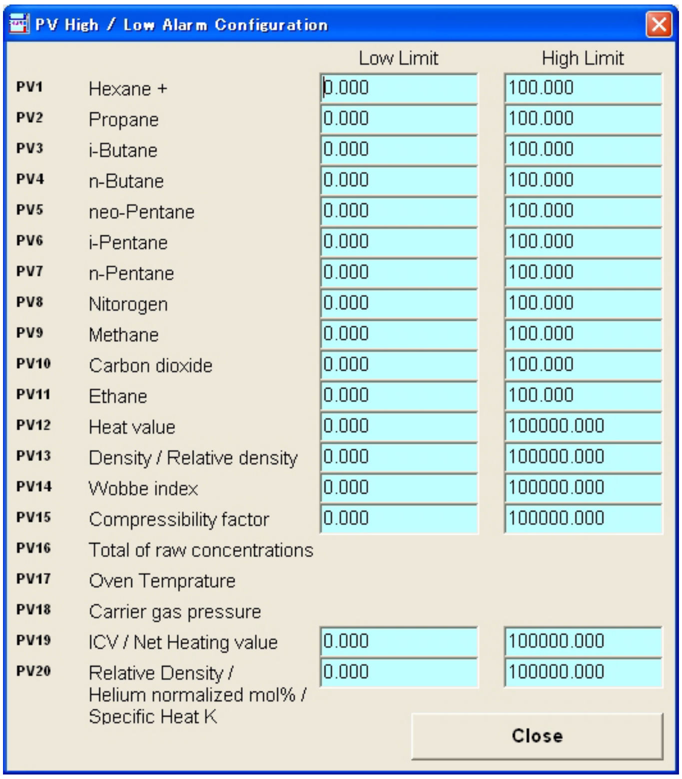
PV13	Choose one from followings as a PV13 output value. ISO Density(real) (kg/m3) [ISO default] ISO Density(ideal) (kg/m3) ISO Relative Density (real) ISO Relative Density (ideal) GPA Gas Density(lb/1000CF) [GPA default] GPA Real Relative Density (dry gas) GPA Real Relative Density (sat gas) GPA Ideal Relative Density (dry gas) GPA Ideal Relative Density (sat gas)
PV14	Choose one from followings as a PV14 output value. ISO Wobbe Index (real) (MJ/m3) [ISO default] ISO Wobbe Index (ideal) (MJ/m3) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO Wobbe Index (real) (kJ/m3) ISO Wobbe Index (ideal) (kJ/m3) ISO Wobbe Index (real) (kWh/m3) ISO Wobbe Index (ideal) (kWh/m3) GPA Real Wobbe Index (dry) [GPA default] GPA Real Wobbe Index (sat) GPA Ideal Wobbe Index (dry) GPA Ideal Wobbe Index (sat) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "G" means "Gross". "G(Gross)" equals to "S(Superior)". "N" means "Net". "N(Net)" equals to "I(Inferior)". ISO G Wobbe index(real)(MJ/m3)[ISO default] ISO G Wobbe index(ideal)(MJ/m3) ISO G Wobbe index(real)(kJ/m3) ISO G Wobbe index(ideal)(kJ/m3) ISO G Wobbe index(real)(kWh/m3) ISO G Wobbe index(ideal)(kWh/m3) ISO N Wobbe index(real)(MJ/m3) ISO N Wobbe index(ideal)(MJ/m3) ISO N Wobbe index(real)(kJ/m3) ISO N Wobbe index(ideal)(kJ/m3) ISO N Wobbe index(real)(kWh/m3) ISO N Wobbe index(ideal)(kWh/m3) GPA Real Wobbe index(dry)(BTU/CF)[GPA default] GPA Real Wobbe index(sat)(BTU/CF) GPA Ideal Wobbe index(dry)(BTU/CF) GPA Ideal Wobbe index(sat)(BTU/CF)
PV15	Choose one from followings as a PV15 output value. ISO Compressibility factor Zmix [ISO default] GPA Compressibility factor Z(dry gas) [GPA default]
PV16	Total of raw concentrations
PV17	Oven Temperature

Table 3-17 Possible configurations of PV12-20

PV18	Carrier gas pressure
PV19	Choose one from followings as a PV19 output value. ISO ICV (real) (MJ/m3) [ISO default] ISO ICV (ideal) (MJ/m3) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO ICV (real) (kJ/m3) ISO ICV (ideal) (kJ/m3) ISO ICV (real) (kWh/m3) ISO ICV (ideal) (kWh/m3) GPA Real Net HV (dry) (BTU/CF) [GPA default] GPA Real Net HV (sat) (BTU/CF) GPA Ideal Net HV (dry) (BTU/CF) GPA Ideal Net HV (sat) (BTU/CF) GPA Net HV (dry) (BTU/CF) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "NCV" means "Net Calorific Value". NCV equals to ICV(Inferior Calorific Value). ISO NCV(real)(MJ/m3)[ISOdefault] ISO NCV(ideal)(MJ/m3) ISO NCV(real)(kJ/m3) ISO NCV(ideal)(kJ/m3) ISO NCV(real)(kWh/m3) ISO NCV(ideal)(kWh/m3) GPA Real Net HV(dry)(BTU/CF)[GPA default] GPA Real Net HV(sat)(BTU/CF) GPA Ideal Net HV(dry)(BTU/CF) GPA Ideal Net HV(sat)(BTU/CF) GPA Net HV(dry)(BTU/lbm)
PV20	Choose one from followings as a PV20 output value. ISO Relative Density (real) [ISO default] ISO Relative Density (ideal) GPA Real Relative Density(dry gas) [GPA default] GPA Real Relative Density(sat gas) GPA Ideal Relative Density(dry gas) GPA Ideal Relative Density(sat gas) ISO Helium normalized mol% GPA Specific Heat K

(3) PV High/Low Alarm Configuration

Click on [PV High/Low Alarm Configuration] in the configuration mode display. The following screen will appear. To change the limit value, type the value directly to the High or Low Limit box:



Default value

PV1-11	Low 0, High 100
PV12-15, 19 and 20	Low 0, High 10000

If some values exceed the High or Low Limit, HGC status button on HGM user's mode screen changes red and blinks. (Click this button and get the error detail.)

~Note *To complete the limit value change, close the PV High/Low Alarm Configuration, then click the [Download to HGC] button on the configuration mode screen.*

(4) Output setting in Auto Calibration

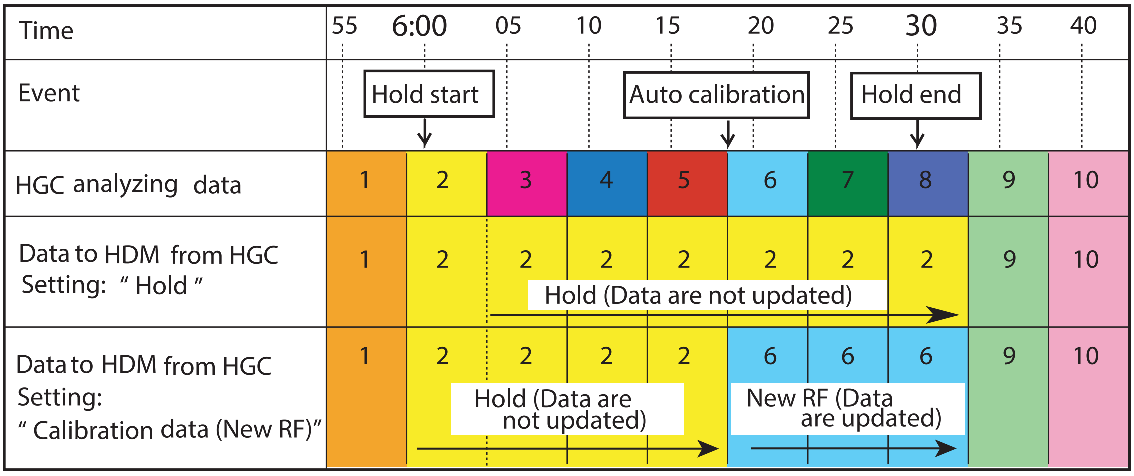
Data update to the HDM during auto or semi-auto calibration can be selected after executing auto or semi-auto calibration.

- Hold [default]
- Calibration data (New RF)

If "Hold" is selected, the HGC does not update the data to the HDM during auto/semi-auto calibration. If "Calibration data (New RF)" is selected, the HGC updates the data to HDM after the calibration. This case, HGC transmits "New Response factor (New RF)" of PV1 to 11 to the HDM instead of the components' concentration. Refer to the description of RF (response factor) in 3-4-2: Calibration procedure for the "Response Factor".

An example of a difference between "Hold" and "Calibration data (New RF)" is shown below.

Setting data: Time: 6:00   Hold time: 30 minutes



~Note *HGC also transmits the error status "Total (raw) error" with New RF of PV1 to 11 to HDM, if "Calibration data (New RF)" is selected.*

~Note *HDM LCD display of PV1 to 11 may overflow (ex: 9999.999) during outputting New RF.*

~Note *This setting is available for application of HGC (version 3.3 or later) and HGM (version 4.83 or later) combination.*

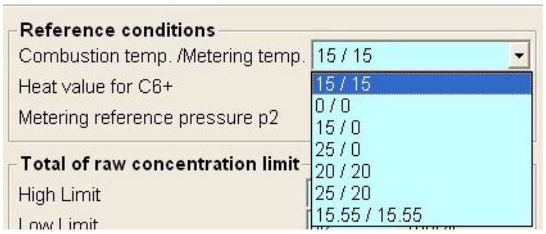
(5) Reference conditions

Configuration data for heat value calculation can be selected or input manually.

(5-1) Combustion temperature / Metering temperature

These can be selected in compliance to the ISO6976.

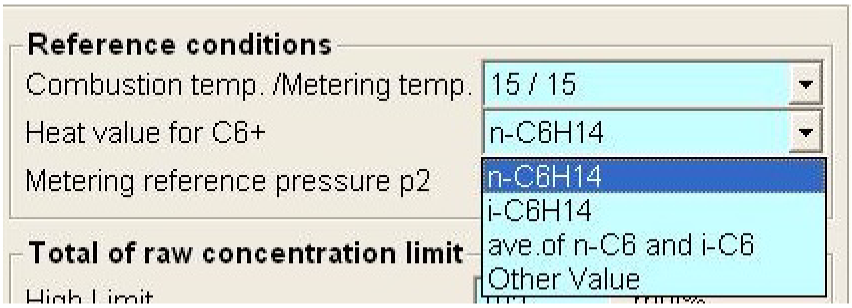
- 15/15 °C [Default]
- 0/0 °C
- 15/0 °C
- 25/0 °C
- 20/20 °C
- 25/20 °C
- 15.55/15.55 °C



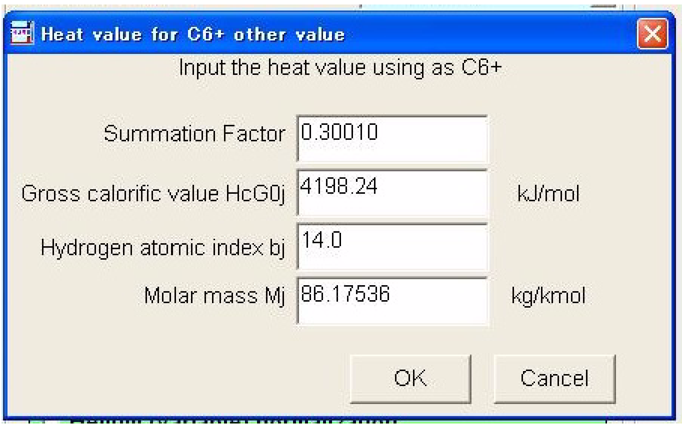
(5-2) C6+ configuration

Please select which value should be used as the C6+'s physical constant.

- n-C6H14[Default]
- i-C6H14
- ave of n-C6 and i-C6
- Other Value



~Note *If [Other value] is selected, the following screen will appear.*



Input the each value for C6+'s physical constant.

(5-3) Metering reference pressure p2

You can enter p2(kPa) value. 101.325(kPa) is default value.

(6) Total of raw concentration

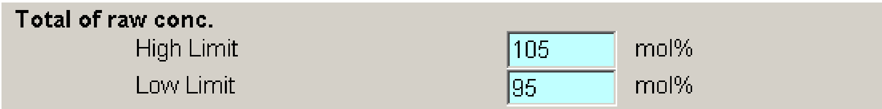
Usually, the total of raw concentration is within 95-105 mol% during natural gas analysis.

In these values are required to be changed, input a user defined value for both high and low limit.

When these values exceed the limitations, the color of the “HGC Status” box turns to red in user’s mode.

Default: High 105 mol%

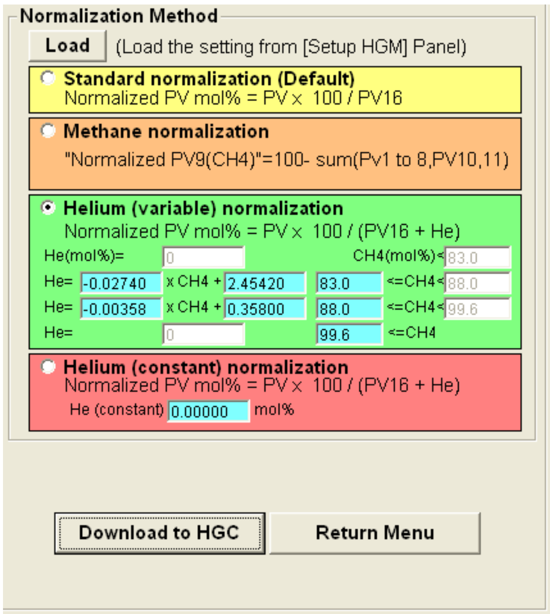
Low 95 mol%



(7) Normalization method configuration

Normalization method can be selected.Refer to the description of normalization method in Appendix for selecting.

Default is “Standard normalization”



When click the [Load] button, configuration mode loads the setting from [Setup HGM] screen.

The setting on the [Setup HGM] or on the [Configuration mode] is different. Each setting is used as follows.

-Setup HGM: Used for the internal arithmetic of HGM

-Configuration mode: Used for the internal arithmetic of HGC

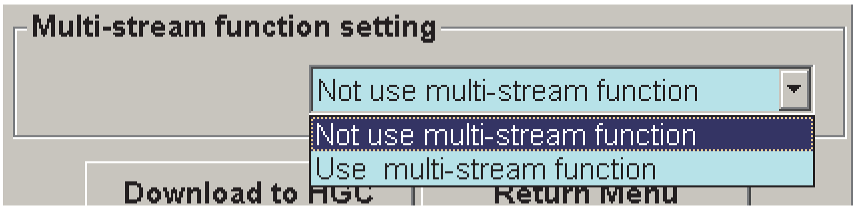
Different normalization method can be selected between HGC and HGM. Selecting the same method is highly recommended without appropriate grounds.

(8) Multi-stream function setting

When you use HGC without multi-stream function, please select "Not use multi-stream function" (default) and download to HGC to inactivate the multi stream function.

When you use HGC with multi-stream function, please select "Use multi-stream function" and download to HGC to activate the multi stream function.

This "Use multi-stream function" setting is only available for application of HGC (version 3.0 or later) and HDM (version 2.30 or later) combination.



(9) Download the change to HGC

To download the setting changed above to the HGC, click the [Download to HGC] button.

Only the settings changed are downloaded to HGC.

The following display will appear after completing the modification.

~Note *If the setting is changed, the color of the modified cell background changes from blue to red. And that color returns from red to blue after downloading to HGC.*

3-3-9 : HGM shut down

Table 3-18 Stopping the HGM

Step	Action
1	Click on [Return Menu]
2	Click on [Quit]
3	Wait until the hfadrv2 command screen closes.

3-4 : Calibration

The device has already been calibrated at the factory but we recommend that you recalibrate it with your own calibration gas to ensure the accuracy of analysis in the following cases:

1 When the model HGC303 is newly installed.

2 When an unused model HGC303 is started up again.

3 At a calibration interval decided by the user.

(Recommended calibration cycle is every 6 months.)

4 After the model HGC303 has been repaired or its parts have been replaced.

3-4-1 : Calibration gas requirement

1 It is imperative that the composition of the calibration gas should resemble the process gas.

If the process gas concentration is high and calibration was done using a low concentration gas, the chance for error may increase.

2 The unit for calibration gas concentration should be mol%.

3 Methane gas should be contained in case of N2 calibration.

4 Ethane(C2H6) should be contained in the calibration gas to avoid “Retention time lock error”.

3-4-2 : Calibration procedure

The model HGC303 has two calibration methods.

Each calibration procedure is described below.

Manual calibration

Manual calibration procedure is as follows:

Manual calibration

↓

Online HGM User's mode

↓

Change the inlet gas
from sample gas to calibration gas

↓

Wait for output stabilization

↓

Click the [calibration] button
in HGM User's mode
(Refer to "3-3-6 : Main displays of HGM" on page 3-22)

↓

Perform calibration
(Refer to "3-4-6 : Calibration methods" on page 3-53)

↓

Calibration complete

↓

Change the inlet gas
from calibration gas to sample gas

↓

Waiting for output stabilization

↓

Manual calibration procedure complete

Auto calibration

The auto calibration function will perform manual calibrations automatically at user defined cycle, which is set by operator.

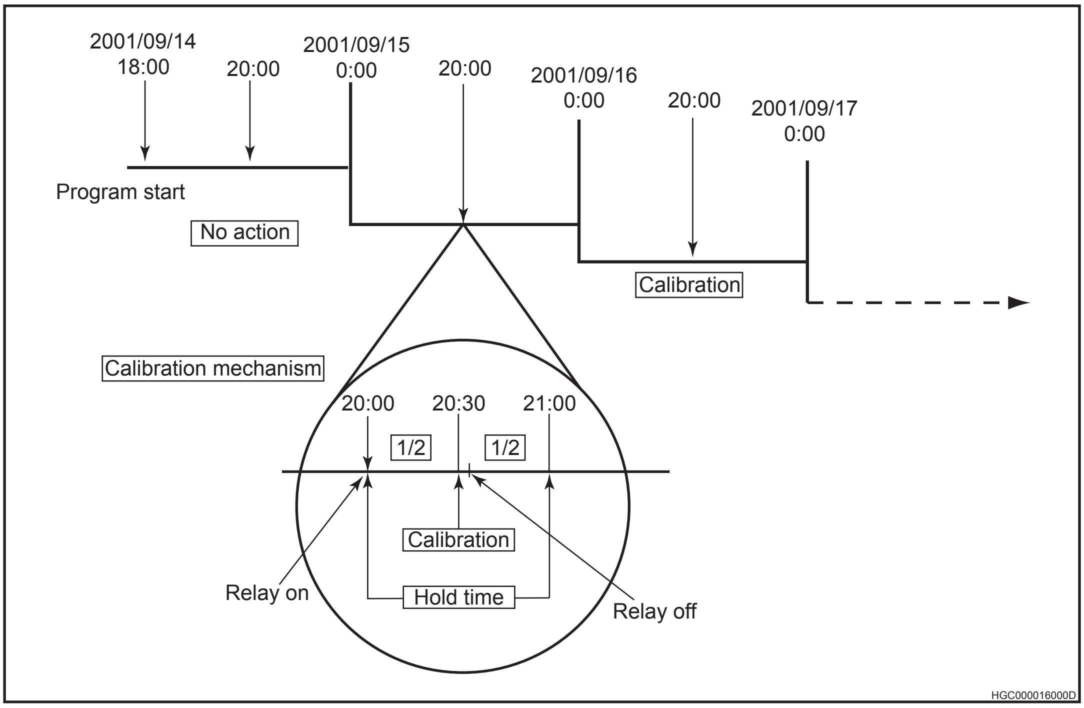
The setting is activated once the [start] button in auto calibration box is pressed. (Figure 3-17)

(It's not always necessary that the HGM is communicating with the model HGC303 after these settings have been made.)

An example of a calibration time chart is shown below.

Setting date and time 2001/09/14 18:00

Setting data: Time: 20:00 Interval: 1 day Hold time: 1 hour



⚠ CAUTION

(1) Verify that the current time is correct in the [HGC time adjusting] box. [Current] means the present time, which is being transmitted from the model HGC303.

(2) One measurement data will be used as calibration data. (not average data)

Therefore, set the enough hold time.

(3) Auto calibration will start on the day after the setting date.

(4) Model HGC303 holds the process variables to host control system during [Hold time].

The model HGC303 discerns whether a new calibration should be performed or not by using an RF (response factor) during auto calibration.

RF (Response Factor)

An RF is a correction factor used to discern whether a new calibration is correct as compared with last valid calibration. (For each component)

The model HGC303 uses peak height for RF calculation.

Equation:

$$RF_n = \frac{PH_n}{Cal_n}$$

Where:

RF_n = Response factor for component “n“

PH_n = Peak height of component “n” in calibration gas.

Cal_n = Gas concentration (Unit: mole%) of component “n” in calibration gas.

RF% DEV (Response Factor Percent Devitation)

RF% DEV is calculated by using the following equation.

$$RF\%\ DEV = \frac{RF_{new} - RF_{old}}{RF_{old}} \times 100$$

% DEV RF Limit

The model HGC303 automatically calculates a “RF% DEV” and decides whether the value is smaller than the “% DEV RF Limit” or not.

|RF% DEV| ≤ “%DEV RF Limit” => “OK“

|RF% DEV| > “%DEV RF Limit” => “NG“

If all calculation are “OK“, the checked components are calibrated and the new RF is used as the response factor.

If a NG message appears, none of the components are calibrated and the previous RF will be used as the response factor.

The user can manually change the “% DEV RF Limit” in Configuration mode.

(Refer to “3-5-5 : Configuration mode” on page 3-58)

Table 3-19 Example of calibration action

No	Calibration	OLD RF	NEW RF	Judgement	Signal to model HDM303
1	Auto	RF0	**RF1**	OK	OK
2	Auto	RF1	**RF2**	OK	OK
3	Auto	**RF2**	RF3	NG	NG
4	Manual	RF2	**RF4**	OK	NG=>OK
5	Auto	RF4	**RF5**	OK	OK
6	Auto	RF5	**RF6**	OK	OK
7	Manual	RF6	**RF7**	OK	OK
8	Auto	RF7	**RF8**	OK	OK

Bold: *Valid response factor*

Semi Auto calibration

The semi auto calibration function will perform auto calibration sequence triggered by pressing [start] button operation. The Hold time setting in auto calibration box is used.

⚠ CAUTION

(1) For manual calibration and semi auto calibration, the RF will be the new RF even if the |RF% DEV| > “%DEV RF Limit”. So the judgement is always OK.

(Example No.4 and 7)

(2) Only the checked components in calibration box are recognized and judged.

Refer to No.11 on “Table 3-20 Calibration factor setting” on page 3-50 for details on the check box of each component.

The next section describes each function in the calibration panel

3-4-3 : Calibration function

Click the [calibration] icon in User's mode.

The calibration setting panel (Refer to “ Indication panel” on page 3-22) will then appear.

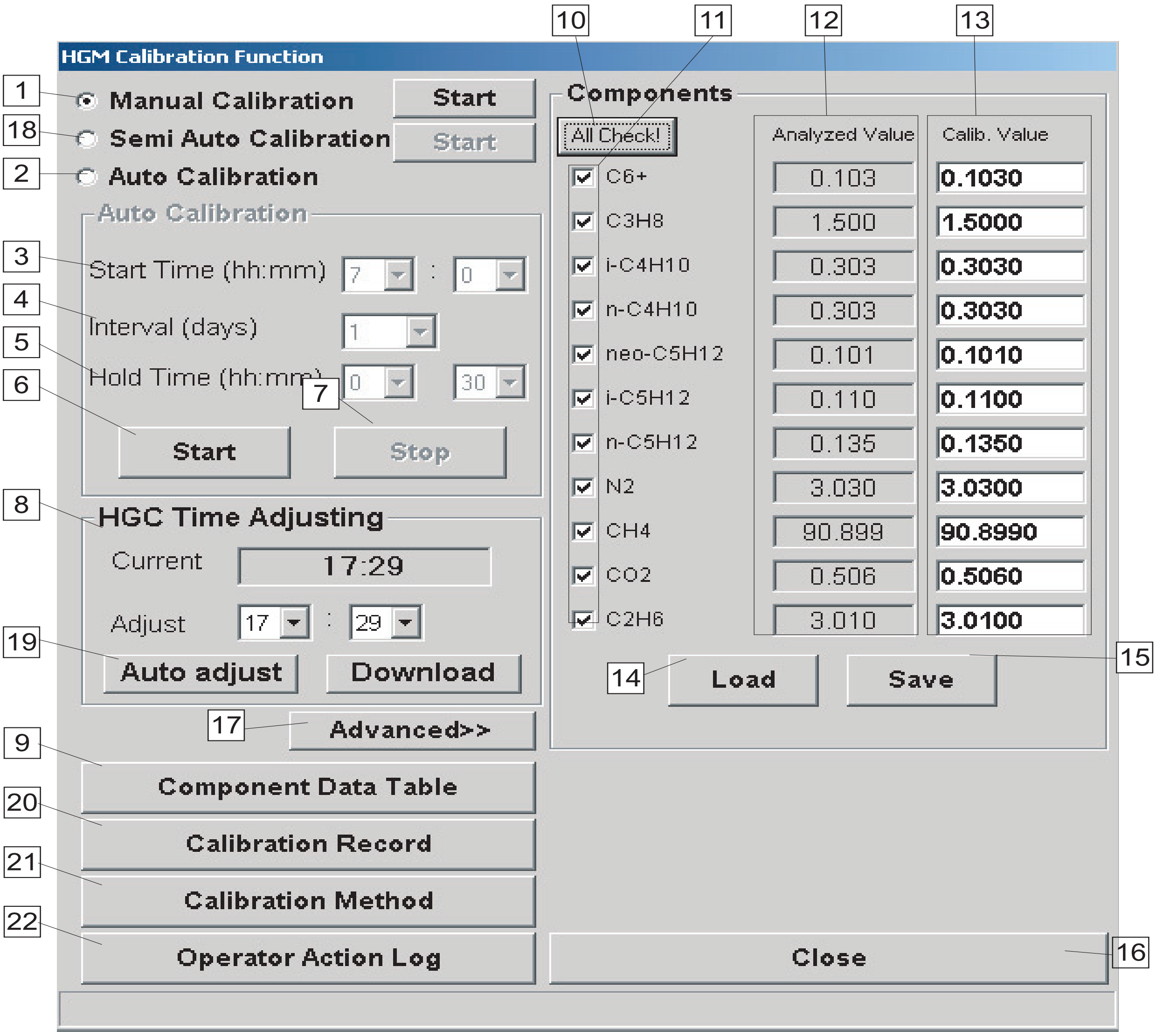


Figure 3-17 Calibration setting panel

Table 3-20 Calibration factor setting

No.	Display	Description
1	Manual Calibration	A method for specific purpose such as maintenance.
2	Auto Calibration	Model HGC303 automatically calibrates itself at user defined intervals.
3	Time (hh:mm)	The box for auto calibration start time
4	Interval (days)	Auto calibration interval Recommended calibration cycle is every 6 months.
5	Hold Time (hh:mm)	Hold time of model HGC303 outputs to host control system. The model HGC303 holds outputs while the calibration gas is replaced and the calibration is completed and process gas is replaced. The minimum hold time is 30 min. Calibration starts halfway through the set hold time. Please allow enough hold time to replace the measured gas from process gas to calibration gas.
6	Start	Start auto calibration
7	Stop	Stop auto calibration
8	HGC Time Adjusting	Set the present time of the model HGC303's internal clock, before doing auto calibration. Click the [download] button and the present time will be downloaded to the model HGC303. If the model HGC303 is turned off, the time setting will be reset to [0:00]. Please set the time again before performing auto calibration.
9	Component Data Table	Refer to "3-4-4 : Description of component data table" on page 3-51 for details.
10	All check	Check all boxes.
11	Small box	Only the selected items will be calibrated.
12	Analyzed Value	Shows the current analyzed data; component concentration.
13	Calib. Value	Concentration of calibration gas.
14	Load	When calibrating using the same gas cylinder, use a previously saved data by loading.
15	Save	Save calibration gas data Default directory; C:\Program\files\hgm\Gas*
16	Close	Exit from calibration function window Return to User's mode display
17	Advanced>>	[Calib. value] data are usually protected with a password. Click this button if it is required to change the [Calib. Value]. The password screen will then appear.
18	Semi Auto Calibration	By press [start] button, model HGC303 starts auto calibration.This function is available for HGC (version 3.0 or later)
19	HGC Time Adjusting> Auto adjust	Setting for HGC time auto adjust function after power up.This function is available for application of HGC (version 3.0 or later) and HDM (version 2.30 or later) combination.

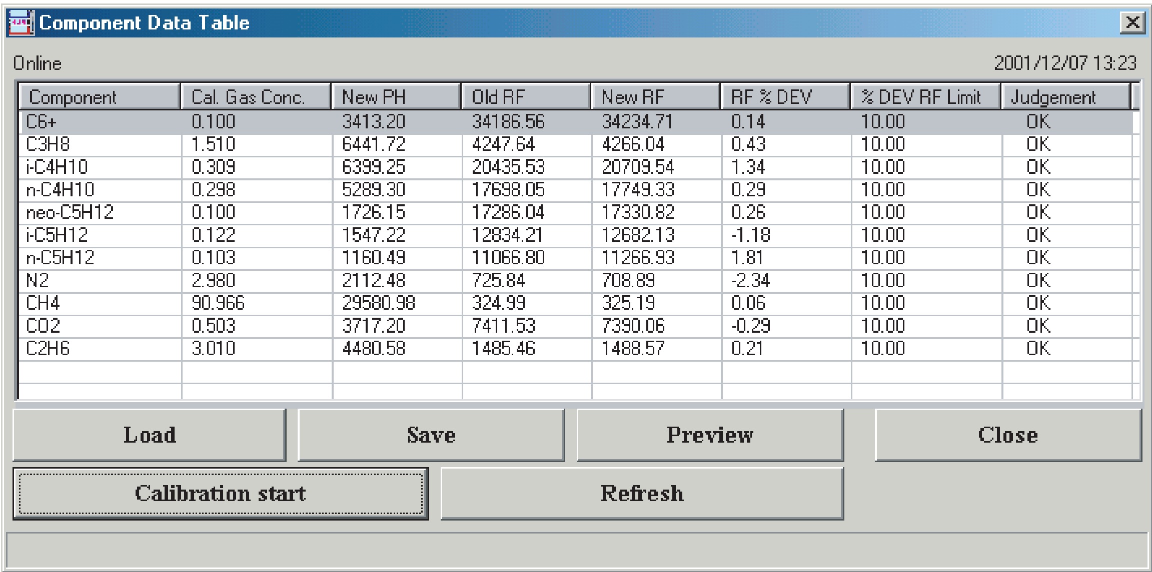
* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

Table 3-20 Calibration factor setting

No.	Display	Description
20	Calibration Record	Last ten calibration information can be seen. (Time stamp, Response Factor, Retention time) This function is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.30 or later) combination.
21	Calibration Method	1 point [default] and 3 points calibration can be selected.1 point is calibration using data of one analysis.3 points is calibration using data of last three analysis average.This function is available for application of HGC (version 3.1 or later) and HGM (version 4.70 or later) combination.
22	Operator Action Log	Last ten operator action can be seen.(Time stamp, Setting action of Configuration mode and Maintenance mode) This function is available for application of HGC (version 3.1 or later) and HGM (version 4.70 or later) and HDM (version 2.30 or later) combina-tion.

3-4-4 : Description of component data table

Select [Component data table] from the calibration setting panel, the following screen will appear.



Component	Cal. Gas Conc.	New PH	Old RF	New RF	RF % DEV	% DEV RF Limit	Judgement
C6+	0.100	3413.20	34186.56	34234.71	0.14	10.00	OK
C3H8	1.510	6441.72	4247.64	4266.04	0.43	10.00	OK
i-C4H10	0.309	6399.25	20435.53	20709.54	1.34	10.00	OK
n-C4H10	0.298	5289.30	17698.05	17749.33	0.29	10.00	OK
neo-C5H12	0.100	1726.15	17286.04	17330.82	0.26	10.00	OK
i-C5H12	0.122	1547.22	12834.21	12682.13	-1.18	10.00	OK
n-C5H12	0.103	1160.49	11066.80	11266.93	1.81	10.00	OK
N2	2.980	2112.48	725.84	708.89	-2.34	10.00	OK
CH4	90.966	29580.98	324.99	325.19	0.06	10.00	OK
CO2	0.503	3717.20	7411.53	7390.06	-0.29	10.00	OK
C2H6	3.010	4480.58	1485.46	1488.57	0.21	10.00	OK

Figure 3-18 Component data table

Table 3-21 Description of component data table

Item	Description
Component	Component name
Cal. Gas Conc	The component's concentration in the cylinder for calibration
New PH	Peak height of the last calibration
Old RF	Last valid response factor
New RF	Response factor of the last calibration

Table 3-21 Description of component data table

Item	Description
RF% DEV	The result of RF% DEV is displayed. Refer to " RF% DEV (Response Factor Percent Devitation)" on page 3-47 for more details.
%DEV RF Limit	The allowable tolerance of "RF% DEV" is displayed. Default value is 10% (absolute value) These values can be changed only in Maintenance mode.
Judgement	|RF% DEV| ≤ "%DEV RF Limit" => "OK" |RF% DEV| > "%DEV RF Limit" => "NG" If all judgements were found to be "OK", the checked components will be calibrated and the New RF will be used as the response factor. If an NG message appears, no components will be calibrated and the Old RF will be used as the response factor and the model HGC303 will transmit an "RF error" to the host control system via the model HDM303.
Load	Recalls saved data. File name extension:.cdt
Save	The latest component data table is saved. Default directory is C:\program files\hgm\data *
Preview	Latest response factor data is displayed. The report can also be printed out.
Calibration start	For manual calibration. This button only appears when in Manual calibration mode.
Refresh	HGM recalculates "new RF" and "RF%DEV". This button only appears when in Manual calibration mode.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data

3-4-5 : Report

Click the [Preview] button and the following preview screen will appear.

HGC Calibration

Report Date Dec-07-2001
Time 18:30:00
File Date Dec-07-2001
Filename 01120701.cdt Time 13:23:30

PV	COMP NAME	CAL CONC	NEW PH	OLD RF	NEW RF	RF% DEV	JUDGE
1	C6+	0.100	3413.20	34186.56	34234.71	0.14	OK
2	C3H8	1.510	6441.72	4247.64	4266.04	0.43	OK
3	i-C4H10	0.309	6399.25	20435.53	20709.54	1.34	OK
4	n-C4H10	0.298	5289.30	17698.05	17749.33	0.29	OK
5	neo-C5H12	0.100	1726.15	17286.04	17330.82	0.26	OK
6	i-C5H12	0.122	1547.22	12834.21	12682.13	-1.18	OK
7	n-C5H12	0.103	1160.49	11066.80	11266.93	1.81	OK
8	N2	2.980	2112.48	725.84	708.89	-2.34	OK
9	CH4	90.966	29580.98	324.99	325.19	0.06	OK
10	CO2	0.503	3717.20	7411.53	7390.06	-0.29	OK
11	C2H6	3.010	4480.58	1485.46	1488.57	0.21	OK

Figure 3-19 Preview screen of report

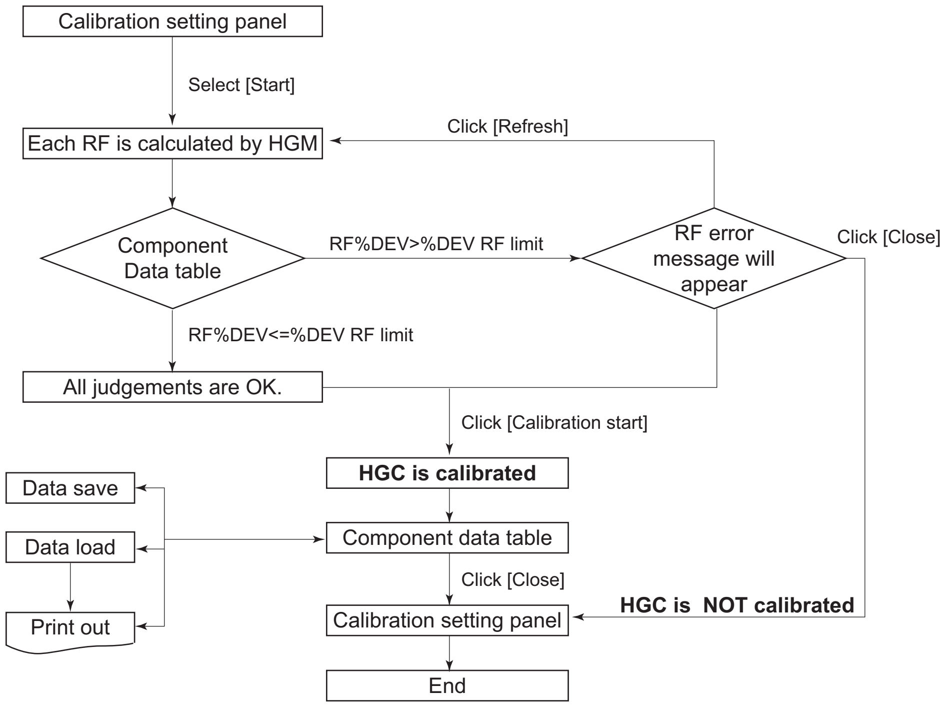
3-4-6 : Calibration methods

The model HGC303 has three-calibration methods, manual, automatic and semi automatic.

Manual calibration

Table 3-22 Manual calibration procedure

Step	Action
1	Select [Manual calibration].
2	Recall the saved calibration data or input concentration of each component manually.
3	Perform calibration by following the flow chart below.



Both the [Refresh] and the [Calibration Start] buttons are active when in manual calibration mode.

⚠ CAUTION

Perform calibration after verifying that the carrier pressure and oven temperature are both stable.
Do not input zero into any box.
Do not calibrate without calibration gas.

Auto calibration

Table 3-23 Operating auto calibration procedure

Step	Action
1	Set the model HGC303 Time Adjusting to the present time.
2	Select [Auto calibration].
3	Choose a [Time], [Interval], [Hold time] (Refer to “Table 3-20 Calibration factor setting” on page 3-50.)
4	Recall the saved calibration data or input concentration of each component manually, then check the small box.
5	Click [Start]. (When Auto calibration is “ON”, the [STOP] button will turn on. When Auto calibration is “OFF”, the [START] button will turn on.)

If you need to cancel auto calibration, click [Stop] from the Auto calibration setting panel.

Semi-auto calibration

Table 3-24 Operating semi auto calibration procedure

Step	Action
1	Set the model HGC303 Time Adjusting to the present time.
2	Select [Semi Auto calibration].
3	Choose a [Time], [Hold time]. (Refer to “Table 3-20 Calibration factor setting” on page 3-50.)
4	Recall the saved calibration data or input concentration of each component manually, then check the small box.
5	Click [Start] for immediate starting the Semi auto calibration.

3-5 : GPA mode

Perform the following procedures when the HGM is used in GPA mode.

3-5-1 : Setting the HGM to GPA

(1) Set the HGM online as described in "3-3-2 : Starting up the HGM with model HFA100" on page 3-8.

(2) Select [GPA] from calculation mode in the Setup HGM screen.

(Default: ISO mode)

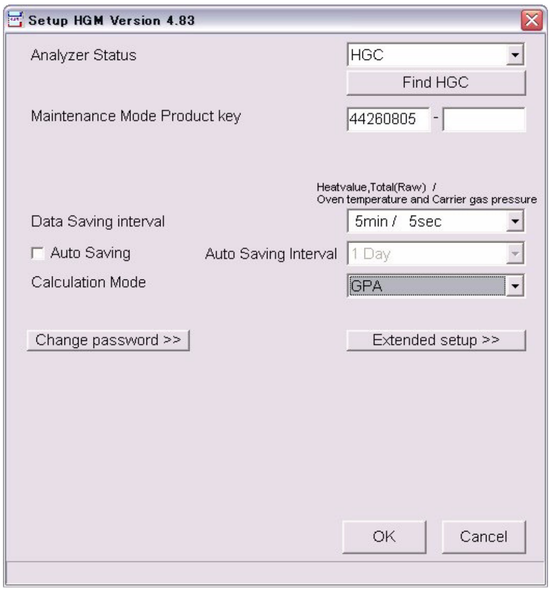


Figure 3-20 Setup HGM display (GPA)

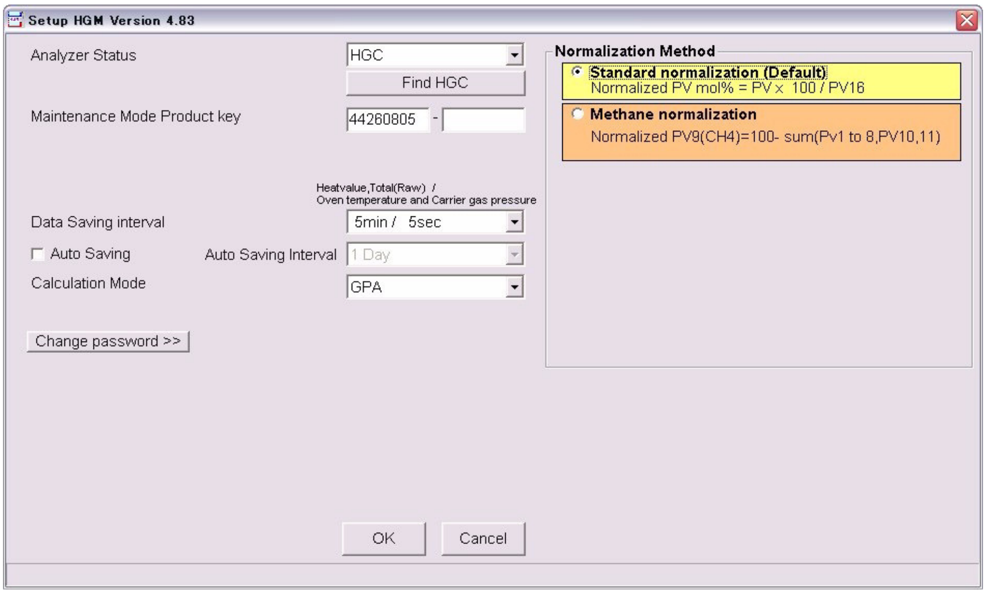


Figure 3-21 Normalization method setting (GPA)

(3) If necessary, click on [Extended setup >>], and select "Normalization method".

(4) Configure the other values such as “Data Saving interval”, and then click the [OK] button. The exchanging procedure is then completed.

3-5-2 : Data save

The mechanism is same as for ISO mode. (Refer to “3-3-4 : Set up HGM” on page 3-14)

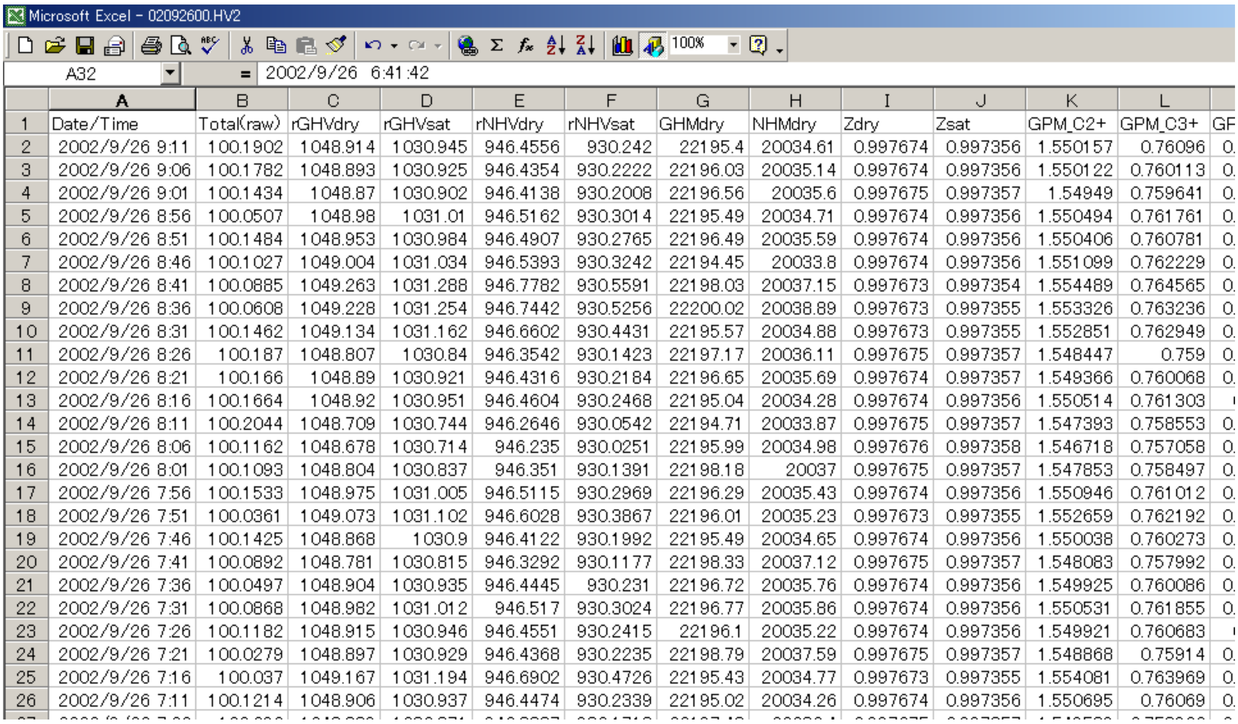
The data is saved as text files (.hv2 or.cv1 or.sv2) in C:\program files\hgm\data (Default).

In the case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data

~Note *The file (.sv2) includes date/time, oven temperature (unit: °F) and carrier gas pressure (unit: psi).*

3-5-3 : Data edit

The procedure to edit data is the same as for ISO mode.(Refer to “3-3-4 : Set up HGM” on page 3-14)


Microsoft Excel - 02092600.HV2

A32 = 2002/9/26 6:41:42

	A	B	C	D	E	F	G	H	I	J	K	L	
1	Date/Time	Total(raw)	rGHVdry	rGHVsat	rNHVdry	rNHVsat	GHMdry	NHMdry	Zdry	Zsat	GPM_C2+	GPM_C3+	GF
2	2002/9/26 9:11	100.1902	1048.914	1030.945	946.4556	930.242	22195.4	20034.61	0.997674	0.997356	1.550157	0.76096	0.
3	2002/9/26 9:06	100.1782	1048.893	1030.925	946.4354	930.2222	22196.03	20035.14	0.997674	0.997356	1.550122	0.760113	0.
4	2002/9/26 9:01	100.1434	1048.87	1030.902	946.4138	930.2008	22196.56	20035.6	0.997675	0.997357	1.54949	0.759641	0.
5	2002/9/26 8:56	100.0507	1048.98	1031.01	946.5162	930.3014	22195.49	20034.71	0.997674	0.997356	1.550494	0.761761	0.
6	2002/9/26 8:51	100.1484	1048.953	1030.984	946.4907	930.2765	22196.49	20035.59	0.997674	0.997356	1.550406	0.760781	0.
7	2002/9/26 8:46	100.1027	1049.004	1031.034	946.5393	930.3242	22194.45	20033.8	0.997674	0.997356	1.551099	0.762229	0.
8	2002/9/26 8:41	100.0885	1049.263	1031.288	946.7782	930.5591	22198.03	20037.15	0.997673	0.997354	1.554489	0.764565	0.
9	2002/9/26 8:36	100.0608	1049.228	1031.254	946.7442	930.5256	22200.02	20038.89	0.997673	0.997355	1.553326	0.763236	0.
10	2002/9/26 8:31	100.1462	1049.134	1031.162	946.6602	930.4431	22195.57	20034.88	0.997673	0.997355	1.552851	0.762949	0.
11	2002/9/26 8:26	100.187	1048.807	1030.84	946.3542	930.1423	22197.17	20036.11	0.997675	0.997357	1.548447	0.759	0.
12	2002/9/26 8:21	100.166	1048.89	1030.921	946.4316	930.2184	22196.65	20035.69	0.997674	0.997357	1.549366	0.760068	0.
13	2002/9/26 8:16	100.1664	1048.92	1030.951	946.4604	930.2468	22195.04	20034.28	0.997674	0.997356	1.550514	0.761303	
14	2002/9/26 8:11	100.2044	1048.709	1030.744	946.2646	930.0542	22194.71	20033.87	0.997675	0.997357	1.547393	0.758553	0.
15	2002/9/26 8:06	100.1162	1048.678	1030.714	946.235	930.0251	22195.99	20034.98	0.997676	0.997358	1.546718	0.757058	0.
16	2002/9/26 8:01	100.1093	1048.804	1030.837	946.351	930.1391	22198.18	20037	0.997675	0.997357	1.547853	0.758497	0.
17	2002/9/26 7:56	100.1533	1048.975	1031.005	946.5115	930.2969	22196.29	20035.43	0.997674	0.997356	1.550946	0.761012	0.
18	2002/9/26 7:51	100.0361	1049.073	1031.102	946.6028	930.3867	22196.01	20035.23	0.997673	0.997355	1.552659	0.762192	0.
19	2002/9/26 7:46	100.1425	1048.868	1030.9	946.4122	930.1992	22195.49	20034.65	0.997674	0.997356	1.550038	0.760273	0.
20	2002/9/26 7:41	100.0892	1048.781	1030.815	946.3292	930.1177	22198.33	20037.12	0.997675	0.997357	1.548083	0.757992	0.
21	2002/9/26 7:36	100.0497	1048.904	1030.935	946.4445	930.231	22196.72	20035.76	0.997674	0.997356	1.549925	0.760086	0.
22	2002/9/26 7:31	100.0868	1048.982	1031.012	946.517	930.3024	22196.77	20035.86	0.997674	0.997356	1.550531	0.761855	0.
23	2002/9/26 7:26	100.1182	1048.915	1030.946	946.4551	930.2415	22196.1	20035.22	0.997674	0.997356	1.549921	0.760683	
24	2002/9/26 7:21	100.0279	1048.897	1030.929	946.4368	930.2235	22198.79	20037.59	0.997675	0.997357	1.548868	0.75914	0.
25	2002/9/26 7:16	100.037	1049.167	1031.194	946.6902	930.4726	22195.43	20034.77	0.997673	0.997355	1.554081	0.763969	0.
26	2002/9/26 7:11	100.1214	1048.906	1030.937	946.4474	930.2339	22195.02	20034.26	0.997674	0.997356	1.550695	0.76069	0.

Figure 3-22 An Example of saved data files (.hv2)

The contents of each line of.hv2 are described below.

Table 3-25 The contents of each line of.hv2

Displayed name	Full name
Date / Time	YYYY/MM/DD HH:MM:SS
Total (raw)	Total raw concentration
rGHVdry	real Gross Heating Value dry
rGHVsat	real Gross Heating Value sat
rNHVdry	real Net Heating Value dry
rNHVsat	real Net Heating Value sat
GHMdry	Gross Heating Value per unit mass
NHMdry	Net Heating Value per unit mass
Zdry	Compressibility Factor dry
Zsat	Compressibility Factor sat
GPM_C2+	Gallons per thousand cubic feet C2+
GPM_C3+	Gallons per thousand cubic feet C3+
GPM_C4+	Gallons per thousand cubic feet C4+
GPM_iC5+	Gallons per thousand cubic feet iC5+
rRdGas	real Relative density Gas
RdLiq	Relative density Liquid
Wobbe_dry	real Wobbe Index dry
Wobbe_sat	real Wobbe Index sat
GasDen	Gas Density
LiqDen	Liquid Density
RVP	Reid Vapor Pressure
PV(1)-(11)	raw data

3-5-4 : File auto saving

The mechanism is the same as for ISO mode. (Refer to “3-3-4 : Set up HGM” on page 3-14)

Data are saved using the extensions .hv2, .cv1 and.sv2 instead of.hv1,.cv1 and.sv1.

The configuration mode for the GPA mode is described next.

Make sure that configuration mode has been set properly.

3-5-5 : Configuration mode

Numerous configurations of the model HGC303 and the HGM can be done in this mode. Click on [Configuration mode] from the main menu. The following screen appears after entering the password.

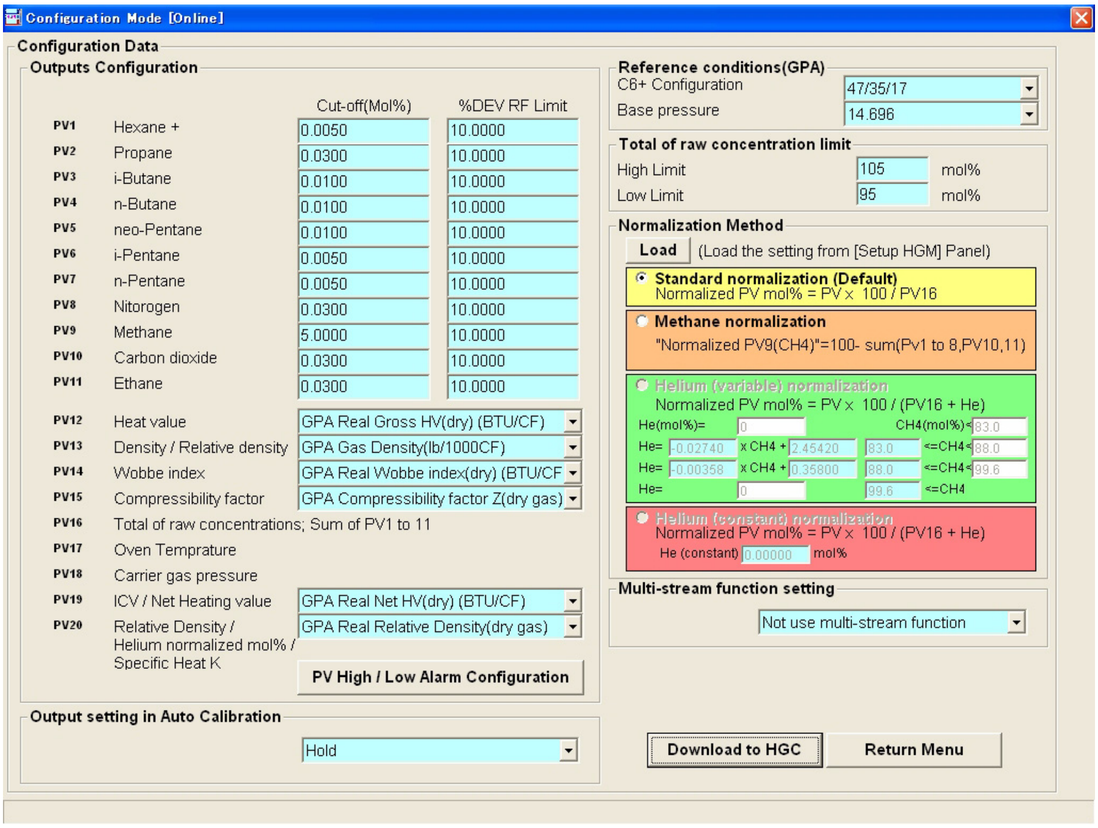


Figure 3-23 Configuration mode display (GPA)

Table 3-26 Description of configuration mode display (GPA)

Display	Description
Outputs configuration	Low cut off: Threshold of a peak or a noise When the detected value < low cut off value, the output is transmitted as 0 mol%. %DEV RF Limit: See “3-4-2 : Calibration procedure” on page 3-45 for details. Each RF %dev limit can be set independently. PV12 to 15, 19 and 20 can be configured to set which outputs will be transmitted to the host control system. PV High / Low Alarm Configuration: High / Low Alarm limit values can be entered for PV1-11, PV12-15, PV19-20. This setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination.

Table 3-26 Description of configuration mode display (GPA)

Display	Description
Output setting in Auto Calibration	Data update to the HDM during auto or semi-auto calibration can be selected after executing auto or semi-auto calibration. Hold [default] Calibration data (New RF) **~Note** *When Calibration data (New RF) is selected, Total (raw) error is also sent as the HGC status to the HDM with updated data. This setting is available for application of HGM (version is 4.83 or later) and HGC (version is 3.3 or later) combination.*
Reference conditions	Configuration data for heat value calculation can be selected or input manually.
Total of raw conc.	Usually, the total of raw concentration is within 95-105mol% during process gas analysis. If these values are required to be changed, input a user defined value for both high and low limit.
Normalization method	Normalization method can be selected. Default is “Standard normalization”.
Multi-stream function setting	use or Not use of multi-stream function can be selected. This setting is only available for application of HGC (version 3.0 or later) and HDM (version 2.30 or later) combination.
Download to HGC	All configured data are downloaded to the model HGC303 by clicking this button. When the message appears, download operation has been successfully completed.
Return Menu	Exit from Configuration mode. Return to Main Menu

A description of the data-setting panel is given next.

(1) PV1 - 11 configuration

~Note **These configuration methods are same as those for ISO mode. Refer to “ (1) PV1 - 11 configuration” on page 3-33.*

(2) PV12 - 20 configuration

PV12 to 15, 19 and 20 can be configured to set which outputs are to be transmitted to the host control system.

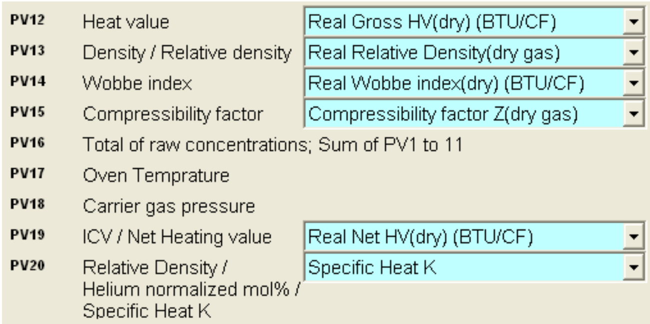


Figure 3-24 Output configuration panel (GPA)

Possible configurations for each PV are as follows:

Table 3-27 Possible configurations of PV12-20 (GPA)

PV12	Choose one from followings as a PV12 output value. GPA Real Gross HV(dry) (BTU/CF) [GPA default] GPA Real Gross HV(sat) (BTU/CF) GPA Ideal Gross HV(dry) (BTU/CF) GPA Ideal Gross HV(sat) (BTU/CF) GPA Gross HV(dry) (BTU/lbm) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO SCV(real) (MJ/m3) [ISO default] ISO SCV(ideal) (MJ/m3) ISO ICV(real) (MJ/m3) ISO ICV(ideal) (MJ/m3) ISO SCV(real) (kJ/m3) ISO SCV(ideal) (kJ/m3) ISO ICV(real) (kJ/m3) ISO ICV(ideal) (kJ/m3) ISO SCV(real) (kWh/m3) ISO SCV(ideal) (kWh/m3) ISO ICV(real) (kWh/m3) ISO ICV(ideal) (kWh/m3) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "GCV" means "Gross Calorific Value". GCV equals to SCV(Superior Calorific Value). "NCV" means "Net Calorific Value". NCV equals to ICV(Inferior Calorific Value). ISO GCV(real)(MJ/m3)[ISO default] ISO GCV(ideal)(MJ/m3) ISO NCV(real)(MJ/m3) ISO NCV(ideal)(MJ/m3) ISO GCV(real)(kJ/m3) ISO GCV(ideal)(kJ/m3) ISO NCV(real)(kJ/m3) ISO NCV(ideal)(kJ/m3) ISO GCV(real)(kWh/m3) ISO GCV(ideal)(kWh/m3) ISO NCV(real)(kWh/m3) ISO NCV(ideal)(kWh/m3)
PV13	Choose one from followings as a PV13 output value. GPA Gas Density(lb/1000CF) [GPA default] GPA Real Relative Density(dry gas) GPA Real Relative Density(sat gas) GPA Ideal Relative Density(dry gas) GPA Ideal Relative Density(sat gas) ISO Density(real) (kg/m3) [ISO default] ISO Density(ideal) (kg/m3) ISO Relative Density (real) ISO Relative Density (ideal)

Table 3-27 Possible configurations of PV12-20 (GPA)

PV14	Choose one from followings as a PV14 output value. GPA Real Wobbe Index (dry) [GPA default] GPA Real Wobbe Index (sat) GPA Ideal Wobbe Index (dry) GPA Ideal Wobbe Index (sat) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO Wobbe Index(real) (MJ/m3) [ISO default] ISO Wobbe Index(ideal) (MJ/m3) ISO Wobbe Index(real) (kJ/m3) ISO Wobbe Index(ideal) (kJ/m3) ISO Wobbe Index(real) (kWh/m3) ISO Wobbe Index(ideal) (kWh/m3) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "G" means "Gross". "G(Gross)" equals to "S(Superior)". "N" means "Net". "N(Net)" equals to "I(Inferior)". ISO G Wobbe index(real)(MJ/m3)[ISO default] ISO G Wobbe index(ideal)(MJ/m3) ISO G Wobbe index(real)(kJ/m3) ISO G Wobbe index(ideal)(kJ/m3) ISO G Wobbe index(real)(kWh/m3) ISO G Wobbe index(ideal)(kWh/m3) ISO N Wobbe index(real)(MJ/m3) ISO N Wobbe index(ideal)(MJ/m3) ISO N Wobbe index(real)(kJ/m3) ISO N Wobbe index(ideal)(kJ/m3) ISO N Wobbe index(real)(kWh/m3) ISO N Wobbe index(ideal)(kWh/m3)
PV15	Choose one from followings as a PV15 output value. GPA Compressibility factor Z(dry gas) [GPA default] ISO Compressibility factor Zmix [ISO default]
PV16	Total of raw concentrations
PV17	Oven temperature
PV18	Carrier gas pressure

Table 3-27 Possible configurations of PV12-20 (GPA)

PV19	Choose one from followings as a PV19 output value. GPA Real Net HV(dry) (BTU/CF) [GPA default] GPA Real Net HV(sat) (BTU/CF) GPA Ideal Net HV(dry) (BTU/CF) GPA Ideal Net HV(sat) (BTU/CF) GPA Net HV(dry) (BTU/CF) Following setting is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination. ISO ICV(real) (MJ/m3) [ISO default] ISO ICV(ideal) (MJ/m3) ISO ICV(real) (kJ/m3) ISO ICV(ideal) (kJ/m3) ISO ICV(real) (kWh/m3) ISO ICV(ideal) (kWh/m3) Following setting is available for application of HGC(version 3.6 or later) and HGM(version 6.10 or later) combination. Note: "NCV" means "Net Calorific Value". NCV equals to ICV(Inferior Calorific Value). ISO NCV(real)(MJ/m3)[ISO default] ISO NCV(ideal)(MJ/m3) ISO NCV(real)(kJ/m3) ISO NCV(ideal)(kJ/m3) ISO NCV(real)(kWh/m3) ISO NCV(ideal)(kWh/m3)
PV20	Choose one from followings as a PV20 output value. GPA Real Relative Density(dry gas) [GPA default] GPA Real Relative Density(sat gas) GPA Ideal Relative Density(dry gas) GPA Ideal Relative Density(sat gas) GPA Specific Heat K ISO Relative Density(real) [ISO default] ISO Relative Density(ideal) ISO Helium normalized mol%

(3) PV High/Low Alarm Configuration

~Note *These configuration methods are same as those for ISO mode. Refer to " (3) PV High/Low Alarm Configuration" on page 3-38.*

(4) Output setting in Auto Calibration

~Note *These configuration methods are same as those for ISO mode. Refer to " (4) Output setting in Auto Calibration" on page 3-39.*

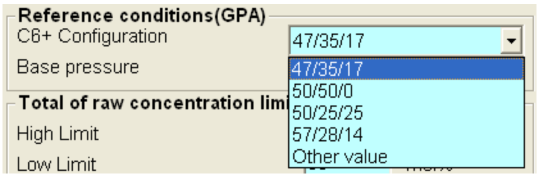
(5) Reference conditions

Configuration data for heat value calculation can be either selected from the menu or input manually.

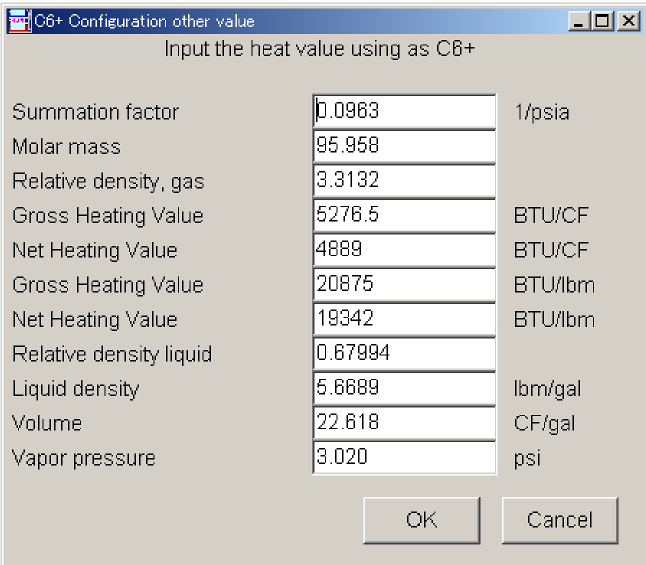
(5-1) C6+ configuration

Select a value to be used as C6+'s physical constant.

- 47/35/17 [Default]
- 50/50/0
- 50/25/25
- 57/28/14
- Other value



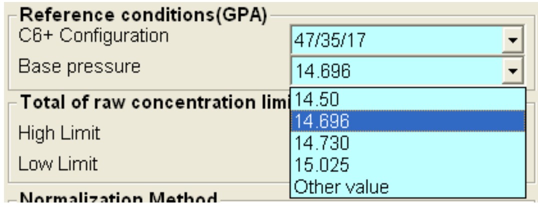
~Note *If [Other value] is selected, the following screen will appear.*



Input each value for C6+'s physical constant.

(5-2) Base pressure (psi)

- 14.50
- 14.696 [Default]
- 14.730
- 15.025
- Other value



(6) Total of raw concentration

~Note *These configuration methods are same as those for ISO mode. Refer to " (6) Total of raw concentration" on page 3-41.*

(7) Normalization method configuration

~Note *These configuration methods are same as those for ISO mode. Refer to " (7) Normalization method configuration" on page 3-41.*

(8) Multi-stream setting

~Note *These configuration methods are same as those for ISO mode. Refer to " (8) Multi-stream function setting" on page 3-42.*

3-5-6 : User's mode (GPA)

Click on [User's mode] in the main menu and a display as shown below will appear.

The size of the display is fixed (full screen).

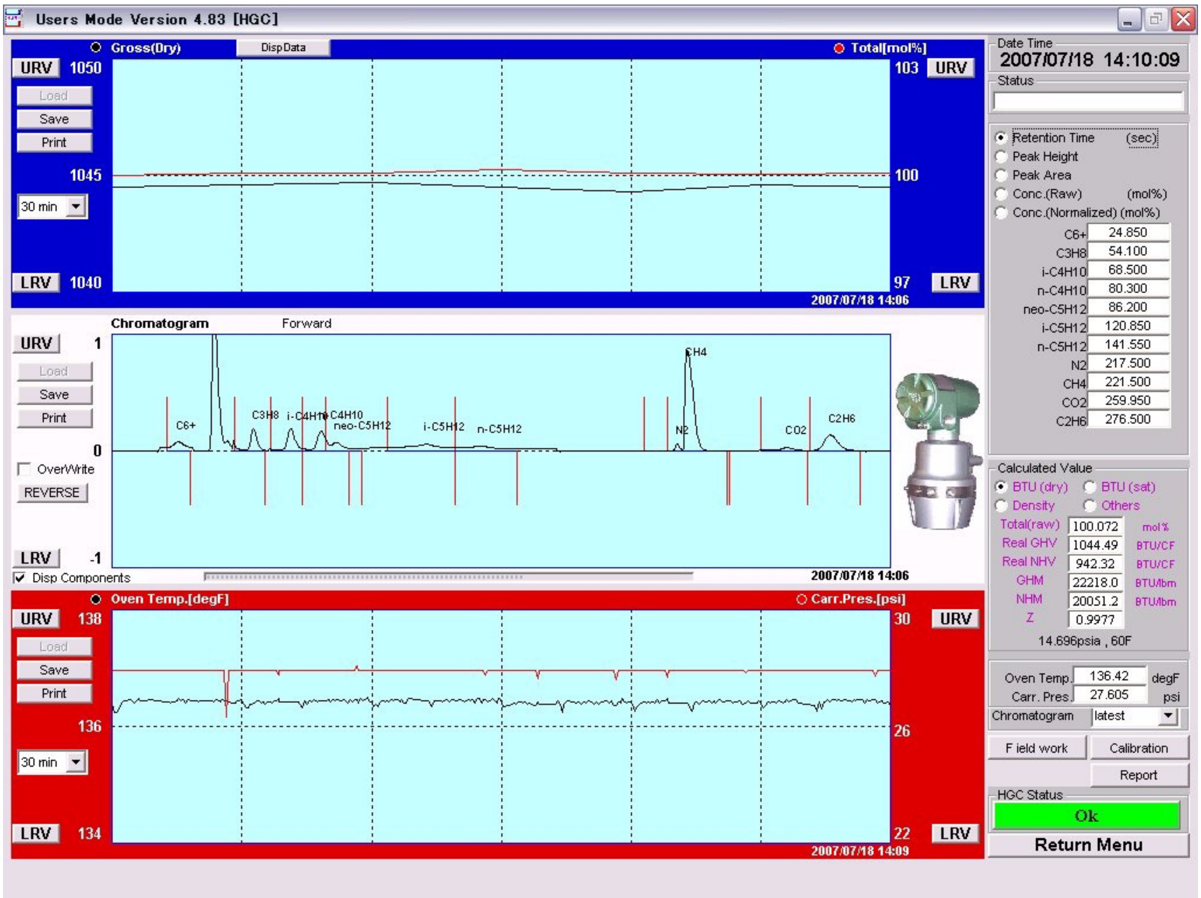


Figure 3-25 User's mode display (GPA)

This screen is divided into three graphs with measurement data on the right.

Table 3-28 Description of user's mode display (GPA)

Screen	Description
Top (blue)	Graph to monitor heat value and the total of raw concentration
Center (white)	Chromatogram
Bottom (red)	Graph to monitor carrier gas pressure and oven temperature
Right panel	Process gas analysis data

The differences between ISO and GPA mode in User's mode are given below.

Table 3-29 The difference between ISO and GPA mode in user's mode

Item		ISO	GPA
Top (Blue)	Left vertical axis	Unit: MJ/m3	Unit: BTU/CF or BTU/lbm
Center (white)	Chromatogram	ISO and GPA use the same display.	
Bottom (Red)	Left vertical axis	Unit: degree C	Unit: degree F
	Right vertical axis	Unit: kPa	Unit: psi
Right measure-ment data	Data Box (Rt, PH etc.)	ISO and GPA use the same display.	
	Calculated Value	Real or Ideal CV	Refer to the next page.
	Oven temperature Carrier gas pressure	Unit: degree C Unit: kPa	Unit: degree F Unit: psi
	Other function	ISO and GPA use the same function.	

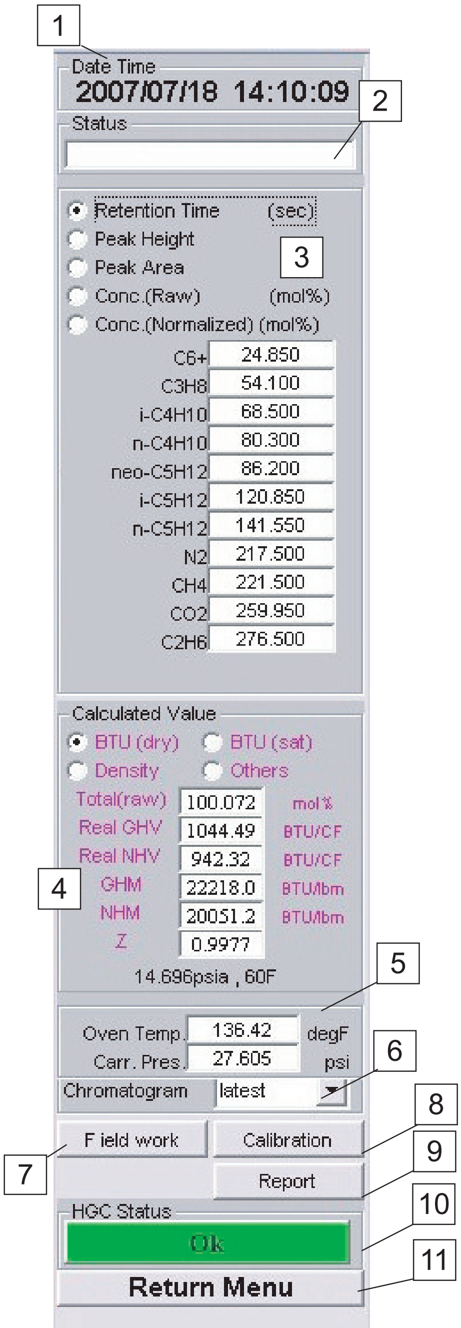
3-5-7 : Main display panels of HGM (GPA)

Indication panel

The data displayed in this panel is updated every 5 minutes.

Table 3-30 Indication panel description (GPA)

No.	Panel	Description
1	Date time	Current date and time
2	Status	Communication status appears when the HGM is communicating with model HGC303.
3	Data box	Click a button to select a data type. Default: Retention time (sec.)
4	Calculated Value	Select between for BTU (dry), BTU (sat), Density, or GPM Default: BTU (dry) Refer to description of calculated value on page 3-69.
5	Oven Temp. and Carr. Pres.	Oven temperature and carrier gas pressure
6	Chromatogram	The last 300 chromatograms are stored in RAM. Save data as required. Select [previous XX] or [latest] to view the chromatogram. If [previous XX] is selected, the auto reload function stops. XX: 01-299 **Return to [latest] to monitor the latest chromatogram.** **Auto reload function starts again.**
7	[Field work]	The model HGC303 holds outputs to the host control system during field maintenance. Click the [Field work] button then [ON], to set the holding time to [24hrs]. [Field work] button blinks while performing fieldwork.
8	[Calibration]	Click the [Calibration] button to perform calibration. The [Calibration] button blinks during auto calibration. Refer to “3-4 : Calibration” on page 3-44
9	[Report]	Click the [Report] button to make a report. Refer to “3-3-7 : Report” on page 3-28.
10	HGC Status	Green indicates that the model HGC303 is functioning normally. If the color changes to red, click this button to view the error message. Refer to “Chapter 5 : Troubleshooting” on page 5-1.
11	Return Menu	Exit from User's mode Return to Main Menu

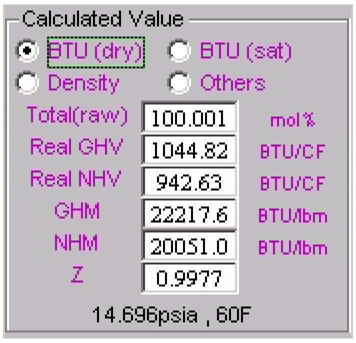


~Note ***Description of calculated value (GPA)***

Select one of the four items to view the calculated values (①BTU (dry), ②BTU (sat), ③Density, ④GPM)
All calculated values for that item are then displayed.

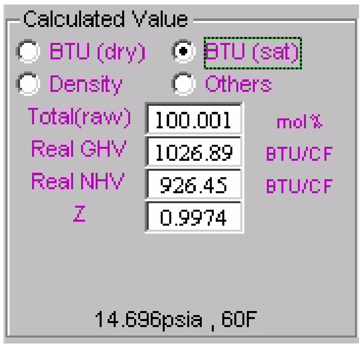
The contents of the calculated values are given below.

① BTU (dry)



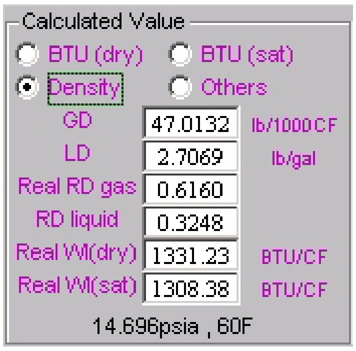
Total (raw)	Total raw concentration
Real GHV	Real Gross Heating Value (dry)
Real NHV	Real Net Heating Value (dry)
GHM	Gross Heating Value per unit mass (dry)
NHM	Net Heating Value per unit mass (dry)
Z	Compressibility factor (dry)

②BTU (sat)



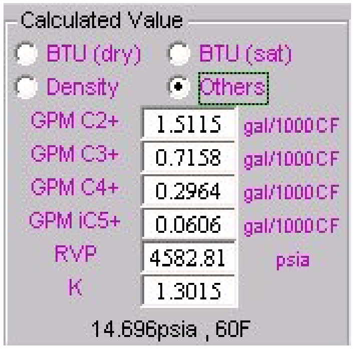
Total (raw)	Total raw concentration
Real GHV	Real Gross Heating Value (sat)
Real NHV	Real Net Heating Value (sat)
Z	Compressibility factor (sat)

③ Density



GD	Gas Density
LD	Liquid Density
Real RD gas	Real Relative Density, gas (dry)
RD liquid	Relative Density, liquid
Real WI (dry)	Real Wobbe Index (dry)
Real WI (sat)	Real Wobbe Index (sat)

④ Others



GPM C2+	Gallon per 1000CF C2+
GPM C3+	Gallon per 1000CF C3+
GPM C4+	Gallon per 1000CF C4+
GPM iC5+	Gallon per 1000CF iC5+
RVP	Reid Vapor Pressure
K	Specific Heat

Refer to the appendix for the calculation formula for each value.

Heat value and total raw concentration

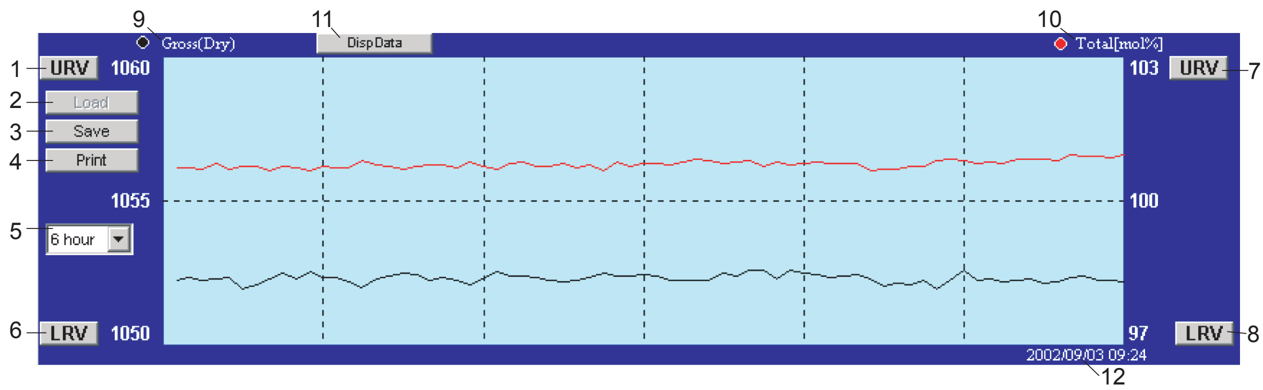


Figure 3-26 BTU trend graph and the total of raw concentration

Table 3-31 Trend graph of BTU and Total raw concentration description

No.	Display	Description
1	URV(BTU)	Upper Range Value for BTU, default value: 1150BTU/CF Click the [URV] button to change the URV value
2	Load (Offline)	Saved data is recalled. File name extension:.hv1
3	Save (Online)	The latest data is saved. Default directory is “C:\Program files\hgm\data”.*
4	Print	Verify that your printer is connected and working properly.
5	6 hours (time range)	Time range of the horizontal axis. Select a time range from pull-down menu: 30 min, 60 min, 3 hour, 6 hour, 12 hour, 1day, 2 days, 3 days, 6 days, 12 days. Default: 30 min.
6	LRV(BTU)	Lower Range Value for BTU, default value: 950BTU/CF Click the [LRV] button to change the LRV value
7	URV (Total raw conc.)	Upper Range Value for Total, default value: 103% Click the [URV] button to change the URV value.
8	LRV (Total raw conc.)	Lower Range Value for Total, Default value: 97% Click the [LRV] button to change the LRV value.
9	Black circle	Black indicates BTU graph. Click the [Disp data] button (No.11) to select a data type. Default: Gross/Dry
10	Red circle	Red indicates total raw conc. graph.
11	Disp. data	Select a data type for heat value. (Gross/Dry, Gross/Sat, Net/Dry, Net/Sat, GHM Dry, NHM Dry)
12	Time	Online: Date and time of the latest data (data is reloaded every 5 min.) Offline: Date and time of when the data was saved.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

Chromatogram

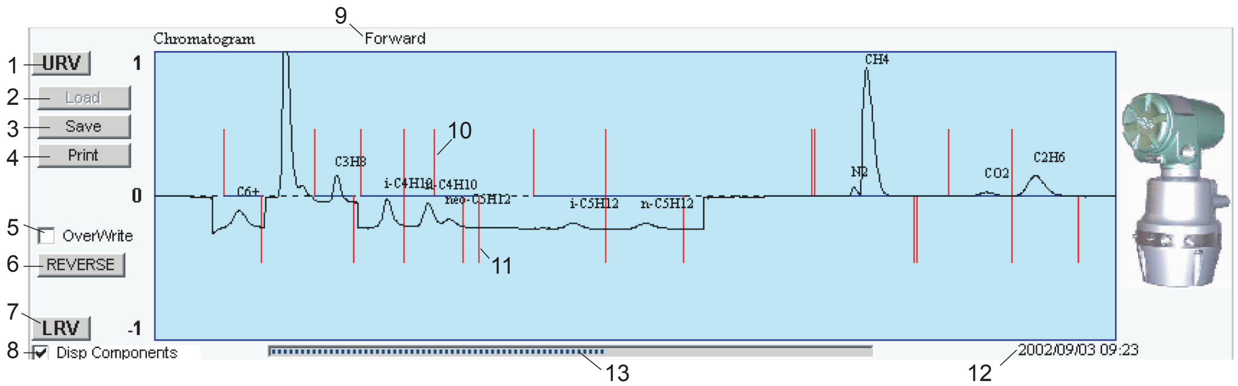


Figure 3-27 Trend Chromatogram (online)

Table 3-32 Chromatogram description

No.	Display	Description
1	URV	Upper Range Value for vertical axis Click the [URV] button to change the URV value Default value is 1
2	Load (Offline)	Saved data is recalled. File name extension:.cg1
3	Save (Online)	The latest data is saved. Default directory is “C:\Program files\hgm\data”.*
4	Print	Verify that your printer is connected and working properly.
5	Over write	Overlapped Chromatograms are displayed.
6	Reverse	Click the [reverse] button to invert the display and [No.9] [Forward] changes the display to [Reverse]. Default: [Forward]
7	LRV	Lower Range Value for vertical axis Click the [LRV] button to change the LRV value. Default value: -1
8	Disp Components	Check the box to display each component name.
9	Forward-Reverse	To invert / revert the display
10	Upper gate marker	Gate start marker of each component.
11	Lower gate marker	Gate end marker of each component.
12	Time	Online: Date and time when latest data is reloaded Offline: Saved date and time
13	Status bar (Online)	Online: Date and time of the latest data (data is reloaded every 5 min.) Offline: Date and time of when the data was saved.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

Trend graph of carrier gas pressure and oven temperature control

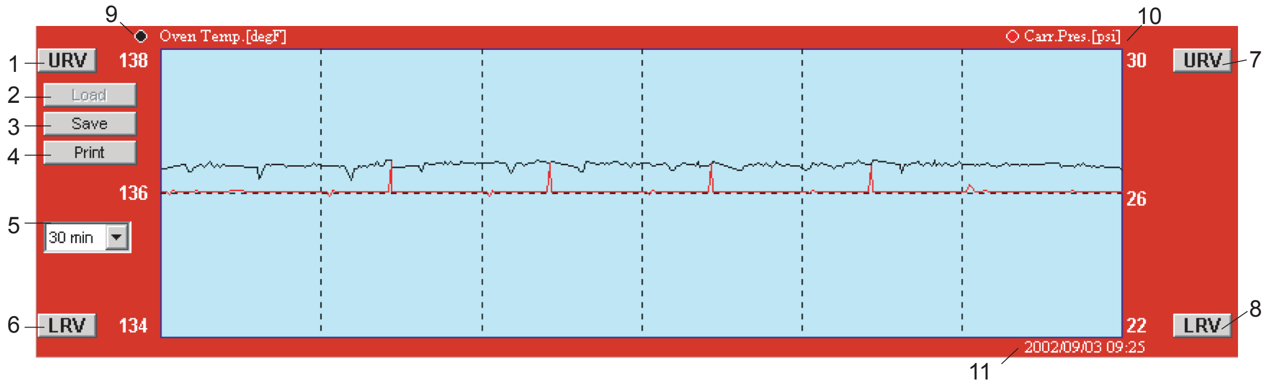


Figure 3-28 Trend graph of carrier pressure and oven temp. control

Table 3-33 Trend graph of Carrier gas pressure and Oven temperature control

No.	Display	Description
1	URV (Oven Temp.)	Upper Range Value for Oven temperature Click the [URV] button to change the URV value. Default value: 141°F
2	Load (Offline)	Saved data is recalled. File name extension: .sv2
3	Save (Online)	The latest data is saved. Default directory is "C:\Program files\hgm\data".*
4	Print	Verify that your printer is connected and working properly.
5	30 min (Time range)	The time range of the horizontal axis. Select a time range from the pull-down menu: 30 min., 60 min., 3 hours, 6 hours, 12 hours, 1 day, 2 days, 3 days, 6 days, 12 days.
6	LRV (Oven Temp.)	Lower Range Value for Oven temperature Default value: 131°F Click the [LRV] button to change the LRV value
7	URV (Carr Press.)	Upper Range Value for carrier gas pressure Default value: 51psi Click the [URV] button to change the URV value
8	LRV (Carr Press.)	Lower Range Value for carrier gas pressure Default value: 21 psi Click the [LRV] button to change the LRV value
9	Black circle	Black indicates oven temperature.
10	Red circle	Red indicates carrier gas pressure.
11	Time	Online: Date and time of the latest data. Offline: Date and time of when the data was saved.

* In case of 64bit type operation system, data are saved in c:\Program files (x86)\hgm\data.

3-5-8 : Report (GPA)

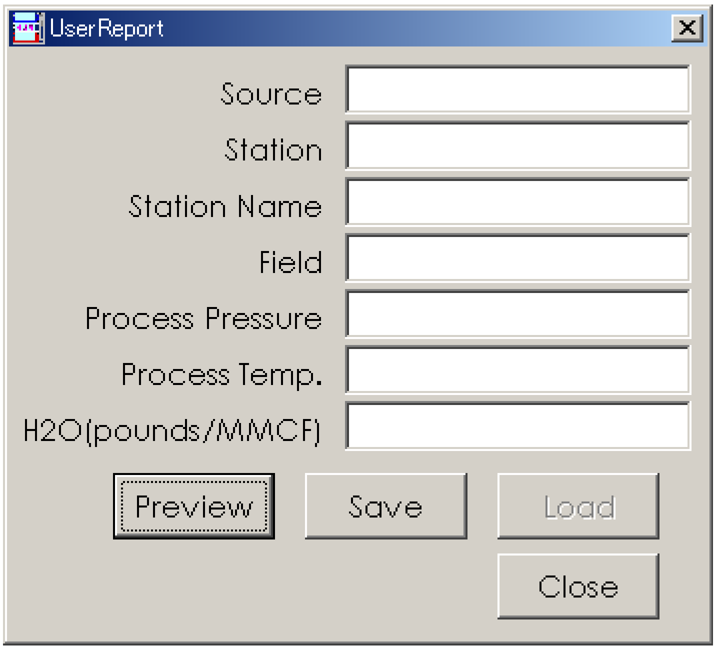


Figure 3-29 Report entry form (GPA)

HGC 303 Analysis Report

Source	:	Report Date - Time	:	Oct-19-2007 15:11:24
Station	:	Analysis Date - Time	:	Jul-18-2007 14:11:00
Station Name	:	Process Pressure	:	
Field	:	Process Temp.	:	
		H2O(pounds/MMCF)	:	0
File Name	**:**	**C:\ Program Files\ HGM_HFA\ DATA\ 07071800.CG1**		

PV	Component Name	Raw mol %	M ole Percent	Weight Percent	LiqVol Percent	Gallons/ 1000 SCF	Gross HV	Net HV	Relative Density
PV1	C6+	0.052	0.0516	0.2781	0.1328	0.0228	2.72	2.52	0.0017
PV2	C3H8	1.527	1.5267	3.7811	2.4196	0.4194	38.41	35.34	0.0232
PV3	iC4H10	0.305	0.3051	0.9959	0.5744	0.0996	9.92	9.15	0.0061
PV4	nC4H10	0.307	0.3073	1.0031	0.5576	0.0966	10.02	9.25	0.0062
PV5	neo-C5H12	0.103	0.1034	0.4192	0.2281	0.0396	4.13	3.82	0.0026
PV6	iC5H12	0.054	0.0536	0.2173	0.1130	0.0196	2.15	1.98	0.0013
PV7	nC5H12	0.050	0.0505	0.2045	0.1052	0.0182	2.02	1.87	0.0013
PV8	N2	3.000	3.0000	4.7201	1.8993	0.3292	0.00	0.00	0.0290
PV9	CH4	91.113	91.1124	82.0921	88.8861	15.4070	920.24	828.21	0.5047
PV10	CO2	0.505	0.5054	1.2492	0.4934	0.0855	0.00	0.00	0.0077
PV11	C2H6	2.984	2.9841	5.0396	4.5907	0.7957	52.81	48.31	0.0310
	Total	100.001	100.0000	100.0000	100.0000	17.3332	1042.43	940.47	0.6148

Base Pressure	14.696	
Real GrossHeating Value (dry)	1044.82	BTU / CF
Real Gross Heating Value (sat)	1026.89	BTU / CF
Actual Gross Heating Value	1044.82	BTU / CF
Real Net Heating Value (dry)	942.63	BTU / CF
Real Net Heating Value (sat)	926.45	BTU / CF
Actual Net Heating Value	942.63	BTU / CF
Gross Heating Value	22217.6	BTU / lbm
Net Heating Value	20051.0	BTU / lbm
Total GPM C2+	1.5115	gal / 1000CF
Total GPM C3+	0.7158	gal / 1000CF
Total GPM C4+	0.2964	gal / 1000CF
Total GPM iC5+	0.0606	gal / 1000CF
Real Relative Density Gas	0.6160	
Real Relative Density Liquid	0.3248	
Real Wobbe Index (dry)	1331.23	BTU / CF
Real Wobbe Index (sat)	1308.38	BTU / CF
Gas Density	47.0132	lb/1000 CF at 14.696 PSIA and 60 Deg.F
Liquid Density	2.7069	lb/gal
Reid Vapor Pressure	4582.81	PSIA

Figure 3-30 User report (GPA mode)

Chapter 4 : Maintenance

4-1 : Checking and changing the carrier gas

When checking the carrier gas, verify the following points:

1. Make sure the supply pressure of the carrier gas is stable at 400+/-50kPa.
2. During normal operation, the rate of carrier gas consumption will be approximately 25 ml/min. If the carrier gas is used as the valve operating gas at the same time, the carrier gas consumption rate will be doubled. Calculate the appropriate time for inspection intervals based on this figure and the quantity of the gas supply.
3. If the carrier gas is supplied from a pressurized cylinder, you should replace the cylinder if the primary pressure on the cylinder side drops to 1,000kPa.

4-2 : Checking and changing the filters in model HGC303

When checking the process line, verify the following points:

1. Make sure the process gas flow rate is stable between 30 ml/min and 70 ml/min.
2. The process input pressure should be over 50kPa to keep the flow rate at 30 ml/min. If an inspection reveals contamination in the flow meter or in the inline filter of the sample conditioning system, the sampling parts require maintenance. At the same time, the model HGC303 inlet line filter should also be replaced. It is recommended to change the filter every 6 months. (See the spare parts list at the back of this manual)

4-3 : Periodical check

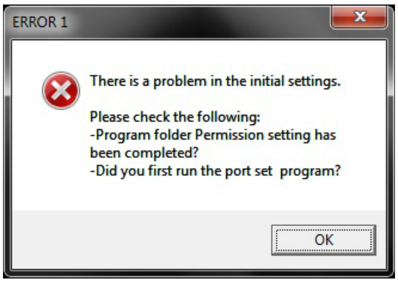
The model HGC303 analyzer part needs a periodical check at least every 3.5 years.

It is to be done at a Azbil Corporation technical center.

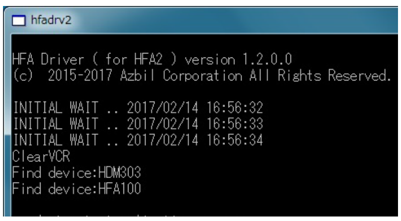
Chapter 5 : Troubleshooting

5-1 : Connection with PC

If you encounter a problem during starting up the connection with PC, please review the following table.

<table>
<tr><th>Problem</th><th>Possible cause</th><th>Correction</th></tr>
<tr><td rowspan="2">hfadrv2 detects initial setting error.

</td><td>Windows User Account Control (UAC) setting problem</td><td rowspan="2">Please do the following all in order from the top.
1. Please check the following folder:
C:\Users\(User ID)\AppData\Local
\VirtualStore\Program Files\
* “\AppData\” is a Hidden folder.
If the HDS folder exists, please remove the folder.
2. Confirm the program folder access rights.
Refer to “2-3-5 : Setting the folder access rights”
3. Do port configuration.
Refer to “3-3-2 : Starting up the HGM with model HFA100 (7)”.</td></tr>
<tr><td>Port setting</td></tr>
<tr><td rowspan="2">hfadrv2 couldn’t find HFA

</td><td>USB connection error between HFA and PC</td><td>Check the USB cable connection with HFA100.
Check the USB cable connection with PC.</td></tr>
<tr><td>Port setting</td><td>Do port configuration.
Refer to “3-3-2 : Starting up the HGM with model HFA100 (7)”.</td></tr>
<tr><td rowspan="2">hfadrv2 stoped at “ClearVCR”

</td><td>HFA fieldbus connection error</td><td>Check the FB cable connection with HFA100.</td></tr>
<tr><td>HDM connection error</td><td>Check the FB cable connection with HDM303.
Confirm HDM303 powered on.</td></tr>
<tr><td>hfadrv2 couldn’t find “HGC303”

</td><td>HGC Connection error</td><td>Check the FB cable connection with HGC303.
Confirm that power is supplied to HGC303.</td></tr>
</table>

5-2 : HGC status on HGM

You will need to troubleshoot if you observe a red error sign flashing on the HGM screen while the model HGC303 is running.

Click on the error box on the HGM screen to get more detailed information regarding the error.

Table 5-1 shows the self-diagnostic functions of the model HGC303.

Table 5-1 Model HGC303 self-diagnostics

Error message	Error description	Action
Oven temperature extremely high	Temperature sensor failure	This is a critical problem. Turn off the power of HGC. Contact a closer Azbil Corporation office or distributor.
Carrier Gas pressure error	Carrier gas pressure PV PV<50kPa or 300kPa<PV	1. Check the carrier gas supply pressure setting (400+/-50kPa) 2. If the carrier gas PV is equal with carrier gas supply pressure, this is a critical problem. Turn off the power and stop the carrier gas supply. Contact the azbil Group or distributor.
Response Factor error	Auto calibration fail. RF percent deviation limit< RF% DEV	Check the standard gas connection, composition and supply. This error continues until the correct calibration take place.
Chromatogram baseline error	TCD baseline out of range	1. Check whether the carrier gas type and purity is correct. 2. If the problem is not caused by the carrier gas, a critical problem may have occurred.
Oven temperature error	Oven temperature not stable SP+/-2°C<PV	Verify whether a sudden change has occurred in the ambient temperature. Shield the HGC to resume normal operation. **
Carrier gas pressure out of control	Carrier gas pressure SP+/-30kPa<PV	1. Check the carrier gas supply pressure setting (400+/-50kPa) 2. Check the remaining gas cylinder pressure. 3. If the problem is not caused by the carrier gas, a critical problem may have occurred.

Table 5-1 Model HGC303 self-diagnostics

Error message	Error description	Action
Chromatogram peak height over the measurement range	32500 counts <peak height in measuring gate	1. Verify whether the vent lines are open to the atmospheric pressure respectively. 2. Gas concentration is over specification. **
HGC overhaul time	Analyzing times exceed recommended periodical check times (315000 times)	Recommended the HGC unit periodical check.Contact the azbil Group or distributor.
Total raw error	Total raw is out of limit Limit is configurable Default is 95% to 105%	1. Check the flow meter and flow rate. 2. Check the air supply pressure. **
Retention time lock error	Ethane (C2) Retention Time is out of range C2 Rt < SP-2sec. or SP+2sec. < C2 Rt	Check the HGC analysis used Standard Gas which contains Ethane. **
PV High / Low Alarm	PV value is out of limit (high or low)	Check the HGC analysis using standard gas.Check the setting of high / low limit value.**This self-diagnostics is available for application of HGC (version 3.1 or later), HGM (version 4.70 or later) and HDM (version 2.40 or later) combination.

** This error will occur during HGC start up.

Appendix

GPA calculation

Description of normalization method

The model HGC303 has two kinds of normalization methods. One is the Standard normalization method, and the other is the Methane normalization method. Normalization method is used to derive each component's normalized concentration from un-normalized components' concentration. And each component's normalized concentration is used to calculate the heating value and other physical properties which are important values for you. Thus, we describe how the HGC calculates each component's normalized concentration on each normalization method first. Next, we explain how to calculate the heating value and other physical properties.

1. Standard normalization method

The model HGC303 calculates the normalized concentration by the following formula.

$$x_i = \frac{yi}{\sum_{i=1}^{n} yi} \times 100$$

Where: x_i = Normalized concentration for component i

yi = Un-normalized concentration for component i

2. Methane (CH4, PV9) normalization method

The model HGC303 calculates the normalized concentration for methane by the following formula.

$$x_9 = 100 - \left(\left(\sum_{i=1}^{8} y_i\right) + y_{10} + y_{11}\right)$$

Where: x_9 = Normalized concentration for methane (CH4, PV9)

x_i = Normalized concentration for component i except methane

y_i = Un-normalized concentration for component i except methane

Table A-1 shows the result of each component's normalized concentration and the difference of heating value between normalization methods.

Table A-1 An example of the calculated normalized concentration and heating value

PV	Component name	Un- normalized conc. (yi mol%)	Normalized conc. (mol%)	
			Standard	Methane
1	C6+	0.05	0.05	0.05
2	C3H8	1.5	1.47	1.5
3	i-C4H10	0.3	0.29	0.3
4	n-C4H10	0.3	0.29	0.3
5	neo-C5H12	0.1	0.1	0.1
6	i-C5H12	0.05	0.05	0.05
7	n-C5H12	0.05	0.05	0.05
8	N2	3	2.95	3
9	CH4	93	91.31	91.15
10	CO2	0.5	0.49	0.5
11	C2H6	3	2.95	3
Sum		101.85	100	100
GHV (BTU/CF)*			1045.86	1046.44

* GHV: Gross Heating Value (British Thermal Unit / Cubic Foot)

Decide which normalization method should be selected, and configure it to the model HGC303 at the configuration mode. In addition, don't forget to setup it at the [Setup HGM] screen for HGM.

Next describes how to calculate heating value and other properties.

Formulas

This section shows formulas for heat value calculations.

1) Real dry heating value per unit volume

2) Real saturated (sat) heating value per unit volume

3) Dry heating value per unit mass

4) Compressibility factor (dry)

5) Compressibility factor (sat)

6) Real Relative density, gas (dry)

7) Relative density, liquid

8) Gas density

9) Liquid density

10) Wobbe index (dry)

11) Wobbe index (sat)

12) Gallons per thousand cubic feet (GPM)

13) Reid vapor pressure

14) Weight fraction

15) Liquid volume fraction

16) Specific Heat K

~Note *Base temperature: 60°F.*

1) Real dry heating value per unit volume: HV (dry) [BTU/CF]

Real GHV (dry) and Real NHV (dry) are calculated using the following formula.

ex.

$$RealGHV(dry) = \frac{GHV^{id}}{Z(dry)} = \frac{\sum_{i=1}^{n} xi \times (GHV^{id})_i}{Z(dry)}$$

where, GHV^{id} = ideal gross heating value per unit volume

$(GHV^{id})_i$ = ideal gross heating value per unit volume for component *i*

xi = mole fraction for component *i*

2) Real saturated (sat) heating value per unit volume: HV (sat) [BTU/CF]

Real GHV (sat), Real NHV (sat) are calculated using the following formula.

ex.

$$Real\ GHV\ (sat) = \frac{(1 - xw) \times GHV^{id}}{Z(sat)}$$

where, xw = mole fraction of water

3) Dry heating value per unit mass: HM (dry) [BTU/lbm]

GHM (dry), NHM (dry) are calculated using the following formula.

ex.

$$GHM\ (dry) = \sum_{i=1}^{n} ti \times (GHM^{id})_i$$

where, ti = weight fraction for component *i*

$(GHM^{id})_i$ = ideal gross heating value per unit mass for component *i*

4) Compressibility factor Z (dry)

Compressibility factor (dry) is calculated using the following formula.

$$Z\ (dry) = 1 - PB \times \left(\sum_{i=1}^{n} xi \times bi \right)^2$$

where, PB = Base pressure

bi = summation factor at 60°F

5) Compressibility factor Z (sat)

Compressibility factor (sat) is calculated using the following formula.

$$Z\,(sat) = 1 - \left\{ (1 - xw) \times \sum_{i=1}^{n} (xi \times bi) + xw \times bw \right\}^2 \times PB$$

where, *bw* = summation factor of water

6) Real relative density, gas (dry): G

$$G = G^{id} \times \frac{Z(dry\ air)}{Z(dry)},\ G^{id} = \sum_{i=1}^{n} xi \times (G^{id})_i$$

where, G^{id} = ideal relative density

$(G^{id})_i$ = ideal relative density for component *i*

Z (dry air) = compressibility factor for dry air

7) Relative density, liquid: RD liquid

$$RDliquid = \sum_{i=1}^{n} li \times Li$$

where, *li* = liquid volume fraction for component *i*

Li = liquid density for component *i*

8) Gas density: GD [lb/1000CF]

$$GD = \frac{G \times Density(air)}{Z(dry\ air)} \times \frac{PB}{14.696}$$

9) Liquid density: LD [lb/gal]

$$LD = \sum_{i=1}^{n} li \times (LD)_i \times \frac{PB}{14.696}$$

where, *(LD)i* = liquid density for component *i*

10) Wobbe index (dry) [BTU/CF]

$$Real\ Wobbe\ Index\ (dry) = \frac{RealGHV(dry)}{\sqrt{G}}$$

$$Ideal\ Wobbe\ Index\ (dry) = \frac{GHV^{id}}{\sqrt{G^{id}}}$$

11) Wobbe index (sat) [BTU/CF]

$$Real\ Wobbe\ Index\ (sat) = \frac{RealGHV(sat)}{\sqrt{G}}$$

$$Ideal\ Wobbe\ Index\ (sat) = \frac{(1 - xw) \times GHV^{id}}{\sqrt{G^{id}}}$$

12) Gallons per thousand cubic feet (GPM) [gal /1000CF]

$$GPM = \sum_{i=1}^{n} \left(xi \times \frac{1000}{V_i} \times \frac{PB}{14,696} \right)$$

where, *Vi* = volume for component *i*

13) Reid vapor pressure: RVP [psia]

$$RVP = \sum_{i=1}^{n} xi \times VPi$$

where, *VPi* = Vapor pressure at 100°F for component *i*

14) Weight fraction

$$ti = \frac{xi \times Mi}{\sum_{i=1}^{n} xi \times Mi}$$

where, *Mi* = Molar mass for component *i*

15) Liquid volume fraction

$$li = \frac{(ti)/(LD)_i}{\sum_{i=1}^{n} ti/(LD)_i}$$

16) Specific Heat K

$$K = \sum_{i=1}^{n} x_i \times k_i$$

Where, K_i = specific heat for component i

Components	GHV^id (BTU/ CF)	NHV^id (BTU/ CF)	GHM^id(BTU/ lbm)	NHM^id (BTU/ lbm)	Sum. Factor (1/psi)	Molar mass	Rel. den. gas	Rel. den. liquid	Liq. den. (lbm/gal)	Volume (CF/gal)	Vapor press. (psi)	K= Cp/Cv
C6+ *	5276.5	4889	20875	19342	0.0898	95.96	3.31309	0.67991	5.6685	22.616	3.019	1.0576
C3H8	2516.1	2315	21654	19922	0.0347	44.0956	1.5225	0.50719	4.2285	36.391	188.62	1.1316
i-C4H10	3251.9	3000	21232	19590	0.0441	58.1222	2.0068	0.56283	4.6925	30.637	72.644	1.0969
n-C4H10	3262.3	3011	21300	19658	0.047	58.1222	2.0068	0.5842	4.8706	31.801	51.567	1.0947
neo-C5H12	3993.9	3691.4	20958	19371	0.05774	72.15	2.4911	0.5967	4.975	26.11	35.9	1.0775
i-C5H12	4000.9	3699	21044	19456	0.0576	72.1488	2.4911	0.62514	5.212	27.414	20.474	1.0775
n-C5H12	4008.7	3707	21085	19481	0.0606	72.1488	2.4911	0.63071	5.2584	27.658	15.576	1.0764
N2	0	0	0	0	0.00442	28.0134	0.9672	0.80687	6.7271	91.128	0	1.3996
CH4	1010	909.4	23892	21511	0.0116	16.0425	0.5539	0.3	2.5	59.138	5000	1.3073
CO2	0	0	0	0	0.0195	44.0095	1.5195	0.81716	6.8129	58.746	0	1.2929
C2H6	1769.7	1619	22334	20429	0.0238	30.069	1.0382	0.35628	2.9704	37.488	800	1.1932
n-C6H14	4755.9	4404	20943	19393	0.0776	86.1754	2.9754	0.66406	5.5364	24.38	4.961	1.0635
n-C7H16	5502.6	5100	20839	19315	0.0951	100.2019	3.4597	0.68823	5.7379	21.73	1.619	1.0544
n-C8H18	6249	5796	20760	19256	0.1128	114.2285	3.944	0.70655	5.8907	19.57	0.5349	1.0476
Water	50.31	0	1059.8	0	0.0651	18.0153	0.62202	1	8.3372	175.62	0.9505	1.3295
Air	0	0	0	0	0.00537	28.9625	1	0.87586	7.3022	95.678	0	1.4002

**C6/C7/C8 = 47/35/17*

Constants are based on GPA2145-09, at base pressure 14.696psia, temperature 60°F

GPA2145-09 constants are used for HGC (version 3.4 or later) and HGM (version 4.85 or later).

GPA2145-03 constants are used for HGC (version 3.0 or later) and HGM (version 4.60 or later).

GPA2145-00 constants are used for HGC (version earlier than 3.0) and HGM (version earlier than 4.60).

ISO calculation

Description of normalization method

Model HGC303 has four kinds of normalization methods for ISO calculation.

These are Standard normalization, Methane normalization, Helium (variable) normalization and Helium (constant) normalization. You can select one type of normalization.

1 Standard normalization method

This method is same as for GPA calculation. Refer to GPA calculation.

2 Methane (CH4, PV9) normalization method

This method is same as for GPA calculation. Refer to GPA calculation.

3 Helium (variable) normalization method

Model HGC303 calculates the normalized concentration using total raw and Helium concentration by following formula.

Helium calculation

Calculate Helium value using CH4 formula.

Condition	Helium calculation
CH4 < A	He = 0
A <= CH4 < B	He = D × CH4 + E
B <= CH4 < C	He = F × CH4 + G
C <= CH4	He = 0

Parameters (A, B, C, D, E, F, G) for He calculation can be entered.

Default value is following.
A = 83
B = 88
C = 99.6
D = -0.0274
E = 2.4542
F = -0.00358
G = 0.358

then,

Condition	Helium calculation
CH4 < 83	He = 0
83 <= CH4 <88	He = -0.0274 × CH4 + 2.4542
88 <= CH4 <99.6	He = -0.00358 × CH4 + 0.358
99.6 <= CH4	He = 0

Total raw calculation

Total raw = sum of raw concentrations (PV1-PV11)

Helium is not included in Total raw.

Normalization with (Total raw + Helium)

PV1(normalized) = PV1(raw) × 100 / [Total raw + Helium]

…

PV11(normalized) = PV11(raw) × 100 / [Total raw + Helium]

Helium (normalized) = Helium × 100 / [Total raw + Helium]

ISO calculation of Calorific value, density, relative density, Wobbe index and compression factor will be calculated using PV1-PV11(normalized) and Helium (normalized).

4 Helium (constant) normalization method

Model HGC303 calculates the normalized concentration using total raw and Helium concentration by following formula.

Helium

Fixed value is used for Helium.

Fixed value can be entered.

Total raw calculation

Total raw = sum of raw concentrations (PV1-PV11)

Helium is not included in Total raw.

Normalization with (Total raw + Helium)

PV1(normalized) = PV1(raw) × 100 / [Total raw + Helium]

…

PV11(normalized) = PV11(raw) × 100 / [Total raw + Helium]

Helium (normalized) = Helium × 100 / [Total raw + Helium]

ISO calculation of Calorific value, density, relative density, Wobbe index and compression factor will be calculated using PV1 - PV11 (normalized) and Helium (normalized).

Formulas(ISO6976:1995)

This section shows formulas for heat value calculations of ISO6976:1995.

1) Compression factor

2) Superior calorific value

3) Inferior calorific value

4) Density

5) Relative density

6) Wobbe Index

1) Compression factor Zmix

Compression factor Zmix = 1 - [sum (xj × sqrt (1 - Zj)) + xhelium × sqrt(b)helium] ^ 2

where, xj = mole fraction for component j
xhelium = mol fraction for Helium
Zj = compression factor for component j at (t2, p2) (ISO6976 Table2)

sqrt(b)helium = square root of summation factor for Helium at (t2, p2) (ISO6976 Table 2)

2) Superior calorific value SCV(MJ/m^3)

Ideal gas superior calorific value, SCV (ideal) = sum (xj × Hs0j)

Real gas superior calorific value, SCV (real) = SCV (ideal) / Zmix

where, xj = mole fraction for component j
Hsoj = ideal superior calorific value for component j, at (t1/t2) (ISO6976 Table 5)

3) Inferior calorific value ICV(MJ/m^3)

Ideal gas inferior calorific value, ICV (ideal) = sum (xj × Hl0j)

Real gas inferior calorific value, ICV (real) = ICV (ideal) / Zmix

where, xj = mole fraction for component j

Hloj = ideal inferior calorific value for component j, at (t1/t2) (ISO6976 Table 5)

4) Density (kg/m^3)

Ideal gas density, Density (ideal)

= [sum (xj × Mj) + xhelium × Mhelium] × p2 / (R × (t2 + 273.15))

Real gas density, Density (real) = Density (ideal) / Zmix

where,
xj = mole fraction for component j
xhelium = mol fraction for Helium
Mj = molar mass for component j (ISO6976 Table 1)
Mhelium = molar mass for Helium (ISO6976 Table 1)
p2 = metering reference pressure = 101.325 (kPa)
R = molar gas constant = 8.31451(J / (mol × K))
t2 = metering reference temperature (°C)

5) Relative density

Ideal gas relative density, Relative density (ideal)

= [sum (xj × Mj) + xhelium × Mhelium] / Mair

Real gas relative density, Relative density (real)

= Relative density (ideal) × Zair / Zmix

where,
xj = mole fraction for component j
xhelium = mol fraction for Helium
Mj = molar mass for component j (ISO6976 Table 1)
Mhelium = molar mass for Helium (ISO6976 Table 1)
Mair = molar mass for Air (ISO6976 Table 1)
Zair = compression factor for Air at (t2, p2) (ISO6976 Table 1)

6) Wobbe Index (MJ/m^3)

Ideal gas Wobbe index, Wobbe index (ideal)

= SCV (ideal) / sqrt (Relative density (ideal))

Real gas Wobbe index, Wobbe index (real)

= SCV (real) / sqrt (Relative density (real))

Formulas(ISO6976:2016)

This section shows formulas for heat value calculations of ISO6976:2016.

1) Compression factor

2) Calorific value on a molar basis

    Gross calorific value

    Net calorific value

3) Calorific value on a volume basis

    Ideal gas gross calorific value

    Ideal gas net calorific value

    Real gas gross calorific value

    Real gas net calorific value

4) Associated properties

    Ideal gas relative density

    Ideal gas density

    Ideal gas gross Wobbe index

    Ideal gas net Wobbe index

    Real gas relative density

    Real gas density

    Real gas gross Wobbe index

    Real gas net Wobbe index

1) Compression factor Z

Compression factor Z = 1 - (p2/p0) * [sum(xj * sj) + (xhelium * sjhelium)]^2

where	p2	metering reference pressure(kPa), $90 < p2 < 110$
	p0	reference pressure, 101.325(kPa)
	xj	mole fraction of component j
	xhelium	mole fraction of Helium
	sj	summation factor of component j (Table2)
	sjhelium	summation factor of Helium (Table2)

2) Calorific value on a molar basis

Gross calorific value HcG0 = sum(xj * HcG0j)

where	HcG0j	ideal gas gross molar basis calorific value of component j (Table 3)

Net calorific value $HcN0 = HcG0 - sum[xj * (bj/2) * L0]$

where	bj	hydrogen atomic index, number of hydrogen atoms present in each molecule of component j (Table 1)
	L0	standard enthalpy of vaporization of water (Table A.5)

3) Calorific value on a volume basis

Ideal gas gross calorific value $HvG0 = HcG0 / V0$

where	V0	ideal molar volume of the mixture, $V0 = R * (t2 + 273.15) / p2$
	R	gas constant (Table A.1)

Ideal gas net calorific value $HvN0 = HcN0 / V0$

Real gas gross calorific value $HvG = HcG0 / V$

where	V	real gas molar volume of the mixture, $V = Z * R * (t2 + 273.15) / p2 = Z * V0$

Real gas net calorific value $HvN = HcN0 / V$

4) Associated properties

Ideal gas relative density $G0 = M / Mair$

where	M	molar mass of the mixture, $M = sum(xj * Mj) + (xjhelium * Mjhelium)$
	Mj	molar mass of component j (Table 1)
	Mjhelium	molar mass of Helium (Table 1)
	Mair	molar mass of dry air of reference composition (Table A.3)

Ideal gas density $D0 = M / V0$

Ideal gas gross Wobbe index $WG0 = HvG0 / sqrt(G0)$

Ideal gas net Wobbe index $WN0 = HvN0 / sqrt(G0)$

Real gas relative density G = G0 * Zairp2 / Z

where	Zairp2	compression factor of dry air at reference composition, Zairp2 = 1 - (p2/p0) * (1 - Zairp0)
	Zairp0	compression factor of dry air at reference condition (Table A.4)

Real gas density D = D0 / Z

Real gas gross Wobbe index WG = HvG / sqrt(G)

Real gas net Wobbe index WN = HvN / sqrt(G)

ISO6976 edition and software relationship

ISO6976

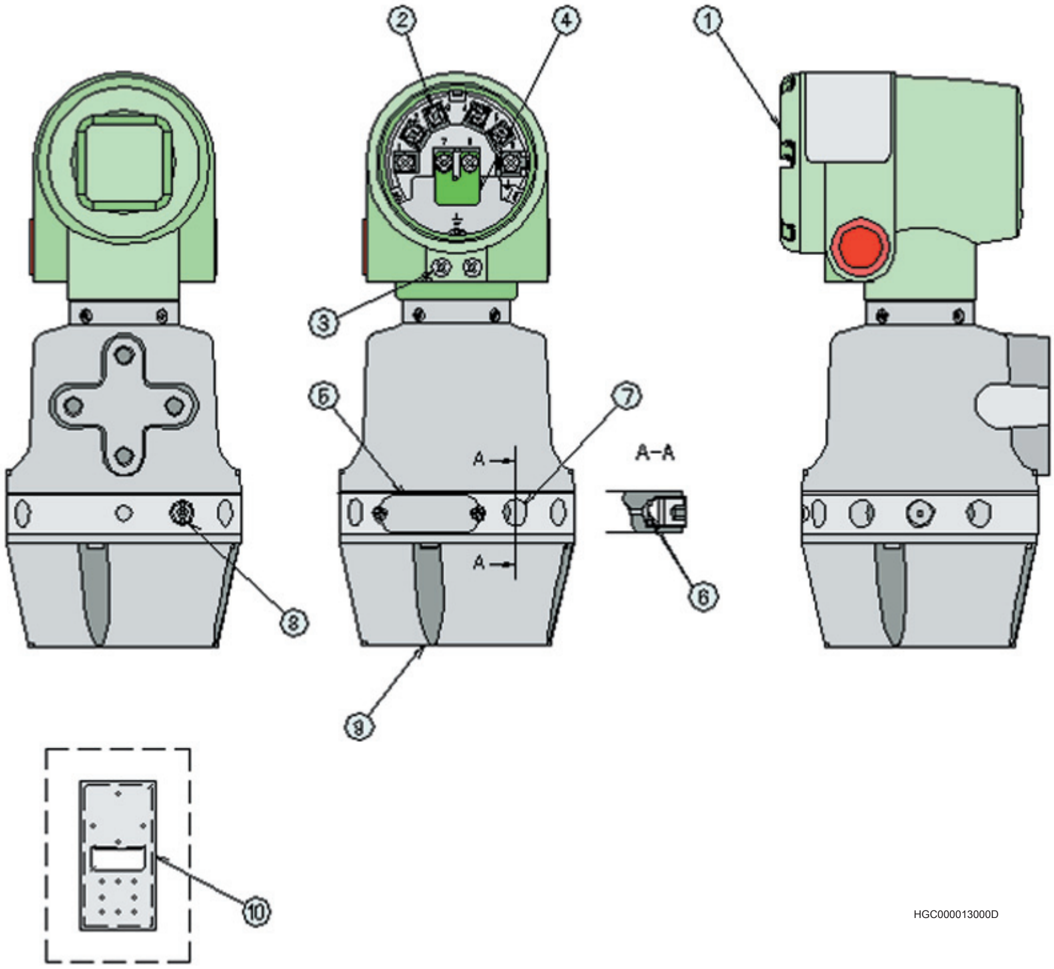
title: Natural gas - Calculation of calorific values, density, relative density and Wobbe indices from composition

ISO6976 specifies calculation formulas and physical properties.

Following table shows ISO6976 edition and our product software relationship.

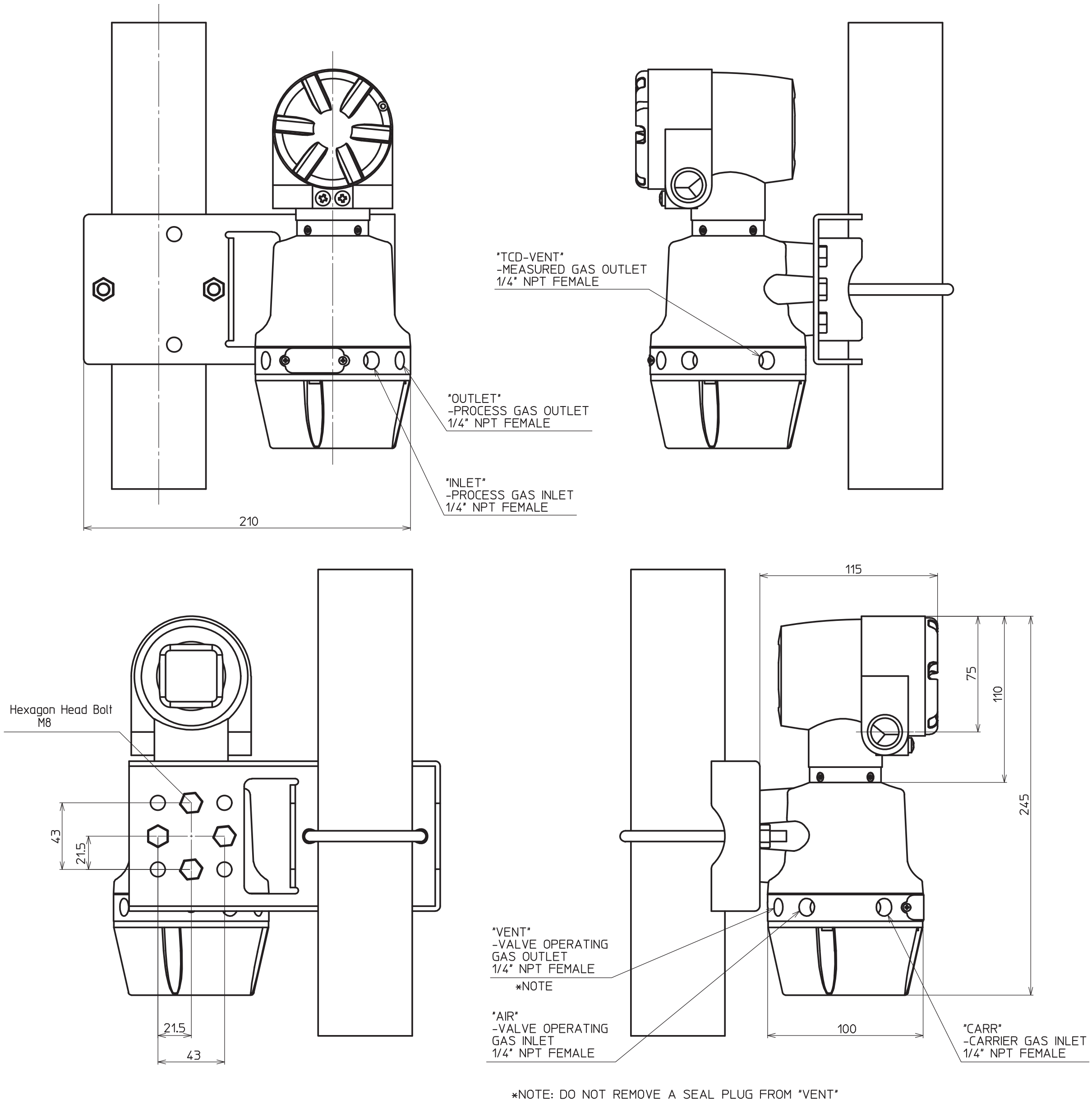
ISO6976 edition	HGC software	HGM software
ISO6976:1995	V3.5 or former	V5.20 V6.00
ISO6976:2016	V3.6 or later	V6.10

List of replacement parts



No	Part	Quantity	Diagram number
1	Terminal Case Cover with O-Ring	1	80344446-00100
2	Terminal Screws	10	80277581-00100
3	Gland Screw (2pcs.)	1	80344452-00100
4	Terminator	1	80344482-00100
5	Tag Number Plate with Screws	1	80344295-00100
6	Gas Connection Membrane Filters with O-Rings (6pcs.)	1	80344296-00100
7	Seal Plugs (1/4 NPT, 6pcs.)	1	80344452-00200
8	Vent Plug (NPT1/4)	1	80344292-00100
9	Oven Cover Assembly	1	80344297-00100
10	Mounting Bracket	1	80279919-00800

Drawings


"TCD-VENT"
-MEASURED GAS OUTLET
1/4" NPT FEMALE
"OUTLET"
-PROCESS GAS OUTLET
1/4" NPT FEMALE
"INLET"
-PROCESS GAS INLET
1/4" NPT FEMALE
210
Hexagon Head Bolt
M8
43
21.5
21.5
43
115
75
110
245
100
"VENT"
-VALVE OPERATING
GAS OUTLET
1/4" NPT FEMALE
*NOTE
"AIR"
-VALVE OPERATING
GAS INLET
1/4" NPT FEMALE
"CARR"
-CARRIER GAS INLET
1/4" NPT FEMALE
*NOTE: DO NOT REMOVE A SEAL PLUG FROM "VENT"

Software Compatibility

		PC S/W Version	
		HGM	HDS
HFA100 Version	V3.1 V3.0	6.10 6.00	4.10 4.00
	V1.0	5.20 5.10 4.84 4.83	3.10 2.12

HFA100 Version

Heat Value Gas Chromatograph ISO standard version

Model HGC303

OVERVIEW

The model HGC303 is the world smallest gas chromatograph, which is capable of analyzing 11 different components of natural gas and digitally publishing the derived parameters, such as calorific value, Wobbe-index, or density. By using our leading sensing & control technology, we designed the model HGC303 specifically for custody transfer, quality control, and other natural gas applications to meet the demands of the expanding natural gas market.
The model HGC303's size, weight, cost and other great features gives the user the benefits of functionality, flexibility and economy from the production site to the pipe line station to the gas distributor and onto the end user's station.

FEATURES

Small size for easy field installation

The model HGC303 has a compact design thus facilitating field installation. In addition, the device can be mounted with a sampling system in the field.

- Small compact packaging
- No analyzer house is required
- Flameproof certified

Pre-engineered analysis and calculations for Natural Gas Metering

The model HGC303 has pre-engineered analysis and calculations for Natural Gas Metering so that no additional programming or application work is required.

- Easy to set up straight out of the box
- Analysis of 11 components and pre-configured value calculations
- Analysis and calculations based on international standards

Digital communication for system integration

The model HGC303 is capable of supporting MODBUS protocols with optional analog output capabilities and has been tested with leading flow computers.

PC monitoring and online diagnostics

The Heat Value Gas Chromatograph Monitor (HGM) is a PC-based software that allows the user to view all data and diagnostic information from a laptop computer.

ADVANTAGES

Simple to start-up and easy to maintain

A huge amount of time and cost in the analyzer system start up phase can be saved with the model HGC303's unique packaging and pre-engineered functions.
The unit's easy-to-maintain design contributes to time and cost savings and it can be repaired without the need for analyzer expertise.

FUNCTIONAL SPECIFICATIONS

Principle of measurement

Gas chromatography

Measured gas streams

1

Analyzed components

11

Analysis time

300 sec.

Detector

Micro TCD (Thermal Conductivity Detector)

Chromatographic method

ISO 6974, part 4

Heat value calculation method

ISO 6976

Gas to be analyzed

Natural gas

Component measuring ranges and minimum detection

Components	Ranges (mol%)	Minimum detection (mol%)
Sum of C6+	0-0.3	0.01
C3H8 (propane)	0-3	0.05
i-C4H10 (i-butane)	0-1	0.01
n-C4H10 (n-butane)	0-1	0.01
neo-C5H12 (neo-pentane)	0-0.5	0.01
i-C5H12 (i-pentane)	0-0.5	0.01
n-C5H12 (n-pentane)	0-0.5	0.01
N2 (nitrogen)	0-20	0.1
CH4 (methane)	50-100	-
CO2 (carbon dioxide)	0-10	0.05
C2H6 (ethane)	0-15	0.05

Analyzer outputs

PV1	C6+ (sum of C6+)(mol%)
PV2	C3H8 (propane)(mol%)
PV3	i-C4H10 (i-butane)(mol%)
PV4	n-C4H10 (n-butane)(mol%)
PV5	neo-C5H12 (neo-pentane)(mol%)
PV6	i-C5H12 (i-pentane)(mol%)
PV7	n-C5H12 (n-pentane)(mol%)
PV8	N2 (nitrogen)(mol%)
PV9	CH4 (methane)(mol%)
PV10	CO2 (carbon dioxide)(mol%)
PV11	C2H6 (ethane)(mol%)
PV12	SCV (real) (MJ/m^3) [default], (kJ/m^3), (kWh/m^3) or SCV (ideal) (MJ/m^3), (kJ/m^3), (kWh/m^3) or ICV (real) (MJ/m^3), (kJ/m^3), (kWh/m^3) or ICV (ideal) (MJ/m^3), (kJ/m^3), (kWh/m^3)
PV13	Density (real) (kg/m^3) [default] or Density (ideal) (kg/m^3) or Relative density (real) or Relative density (ideal)
PV14	Wobbe index (real) (MJ/m^3) [default], (kJ/m^3), (kWh/m^3) or Wobbe index (ideal) (MJ/m^3), (kJ/m^3), (kWh/m^3)
PV15	Compressibility factor Zmix
PV16	Total of raw concentrations(mol%)
PV17	Oven temperature(degree C)
PV18	Carrier gas pressure(kPa)
PV19	ICV (real) (MJ/m^3) [default], (kJ/m^3), (kWh/m^3) or ICV (ideal) (MJ/m^3), (kJ/m^3), (kWh/m^3)
PV20	Relative density (real) [default], Relative density (ideal) or Helium normalized conc. (mol%)

Auto-calibration

External solenoid valve and HDM contact are required.

Normalization of concentrations

On-line diagnostics

Hazardous area certification

ISSeP/ATEX certifications: II 2 GD EEx d IIC T6
IP65

Process Gas

Temperature
-10°C to +50°C

Flow rate
50 ± 20ml/min

Dust and mist
None

Moisture
Less than 2000 ppm

Coexisting components limit
H_2 < 0.1 mol%
He < 0.1 mol%
Oxygen < 0.1 mol%
H_2S (dry) < 0.1 mol%

Ambient temperature limits
-10°C to +50°C
-40°C to +70°C for storage and transportation

Ambient humidity Range
0-95%RH

CE marking
Electromagnetic compatibility (EMC):2014/30/EU
Equipment explosive atmospheres (ATEX): 94/9/EC

PERFORMANCE SPECIFICATIONS

Repeatability of analysis
± 0.05% CV

PHYSICAL SPECIFICATIONS

Color
Metallic light green, silver

Material

Body
Cast aluminum

Oven
Cast aluminum

Wet-parts
304 Stainless steel, polyimide

Sensor
Pt, glass, gold

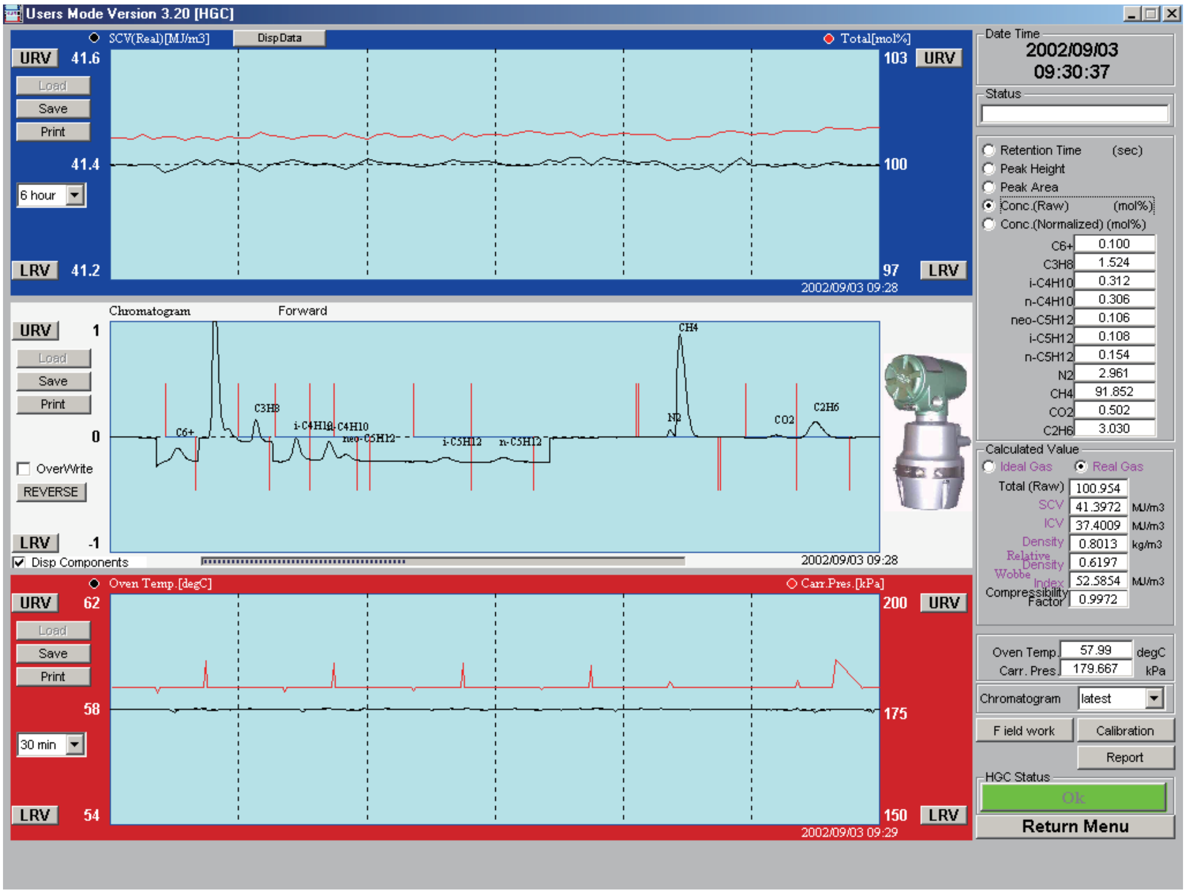
Dimensions
W: 100 mm × D: 115 mm × H: 244 mm

Weight
3.5kg

COMMUNICATIONS

The model HGC303 communicates to a PC for configuration, maintenance and data transmission. PC and HGC bus connections are provided as standard equipment.

A specific Windows-based model HGC303 software, the HGC Monitor HGM, enables convenient model HGC303 instrument control in a user-friendly environment. Retransmission of data to the central system can be performed via the Internet. Modbus communication is also available for networking with, for example, a flow computer or SCADA system.



INSTALLATION

Mounting

Vertical 2 in. pipe mount

Power supply

24V DC ± 15% 4A min

Power consumption

5~50VA at -10°C to +50°C

Utilities

Carrier gas: Helium

Purity

99.99% or higher

Pressure

400 kPa ± 50 kPa

Consumption

25ml/min (approximately)

Instrument air (for actuating the valve)

Pressure

400 kPa ± 50 kPa

Environmental classification

Sheltered location (protected from sunlight or precipitation)

MODEL SELECTION

Heat Value Gas Chromatograph

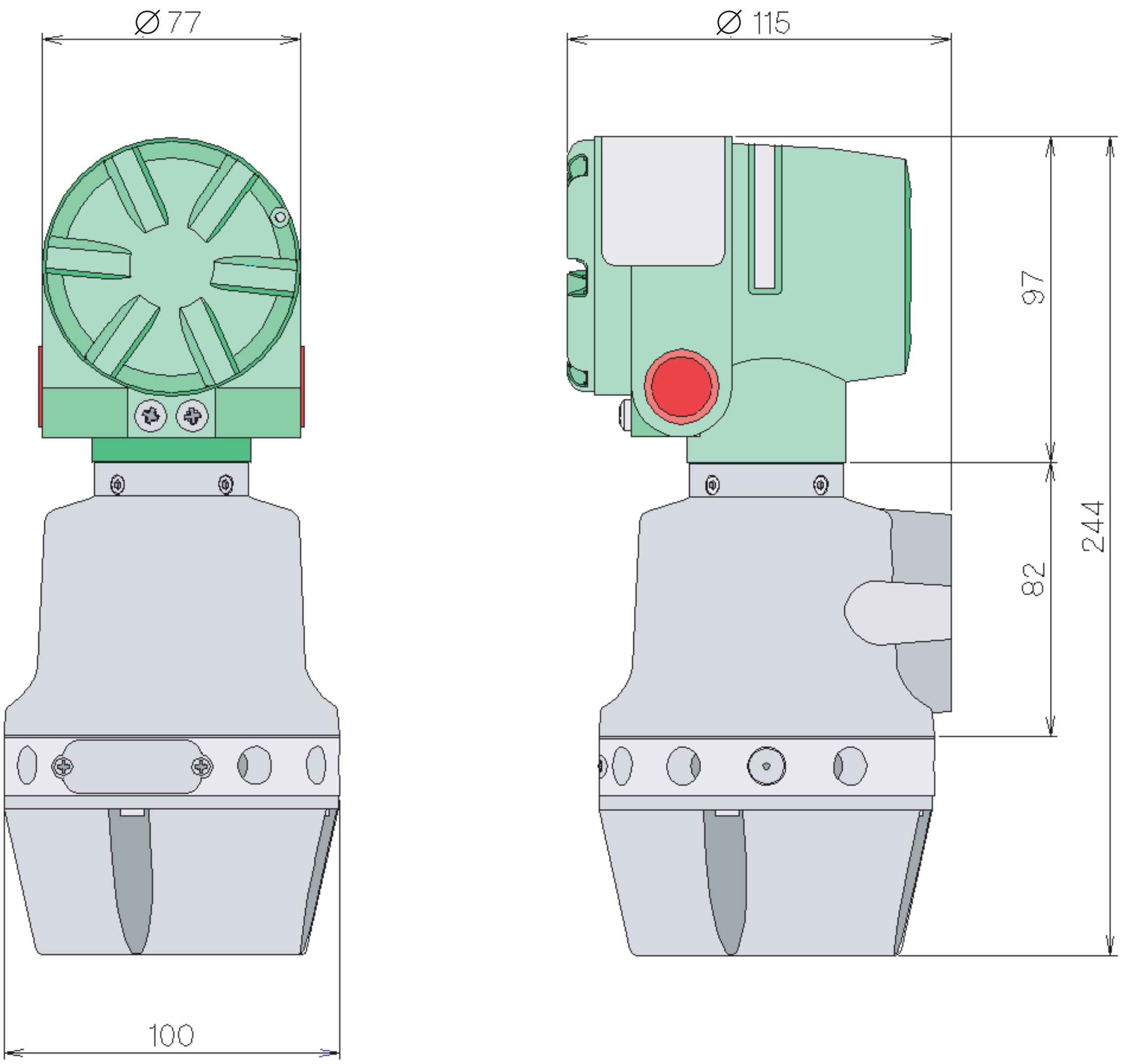
HGC303 - I II

Basic Model No.	HGC303-

I	Conduit entry	1/2 NPT	1	
	Gas connection	1/4 NPT		
II	Explosion-protection	ISSeP/ATEX Flameproof		E

DIMENSIONS

[Unit: mm]



Heat Value Gas Chromatograph GPA standard version

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The Heat Value Gas Chromatograph Monitor (HGM) is a PC-based software that allows the user to view all data and diagnostic information from a laptop computer.

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Simple to start-up and easy to maintain

A huge amount of time and cost in the analyzer system start up phase can be saved with the model HGC303's unique packaging and pre-engineered functions.
The unit's easy-to-maintain design contributes to time and cost savings and it can be repaired without the need for analyzer expertise.

FUNCTIONAL SPECIFICATIONS

Principle of measurement

Gas chromatography

Measured gas streams

1

Analyzed components

11

Analysis time

300 sec.

Detector

Micro TCD (Thermal Conductivity Detector)

Chromatographic method

ISO 6974, part 4

Heat value calculation method

GPA2172

Gas to be analyzed

Natural gas

Component measuring ranges and minimum detection

Components	Ranges (mol%)	Minimum detection (mol%)
Sum of C6+	0-0.3	0.01
C3H8 (propane)	0-3	0.05
i-C4H10 (i-butane)	0-1	0.01
n-C4H10 (n-butane)	0-1	0.01
neo-C5H12 (neo-pentane)	0-0.5	0.01
i-C5H12 (i-pentane)	0-0.5	0.01
n-C5H12 (n-pentane)	0-0.5	0.01
N2 (nitrogen)	0-20	0.1
CH4 (methane)	50-100	-
CO2 (carbon dioxide)	0-10	0.05
C2H6 (ethane)	0-15	0.05

Analyzer outputs

PV1	C6+ (sum of C6+) (mol%)
PV2	C3H8 (propane) (mol%)
PV3	i-C4H10 (i-butane) (mol%)
PV4	n-C4H10 (n-butane) (mol%)
PV5	neo-C5H12 (neo-pentane) (mol%)
PV6	i-C5H12 (i-pentane) (mol%)
PV7	n-C5H12 (n-pentane) (mol%)
PV8	N2 (nitrogen) (mol%)
PV9	CH4 (methane) (mol%)
PV10	CO2 (carbon dioxide) (mol%)
PV11	C2H6 (ethane) (mol%)
PV12	Real Gross HV (dry) (BTU/CF) [default] or Real Gross HV (sat) (BTU/CF) or Ideal Gross HV (dry) (BTU/CF) or Ideal Gross HV (sat) (BTU/CF) or Gross HV (dry) (BTU/lbm)
PV13	Gas Density (lb/1000CF) [default] or Real Relative Density (dry gas) or Real Relative Density (sat gas) or Ideal Relative Density (dry gas) or Ideal Relative Density (sat gas)
PV14	Real Wobbe index (dry) (BTU/CF) [default] or Real Wobbe index (sat) (BTU/CF) or Ideal Wobbe index (dry) (BTU/CF) or Ideal Wobbe index (sat) (BTU/CF)
PV15	Compressibility factor Z (dry gas)
PV16	Total of raw concentrations (mol%)
PV17	Oven temperature (degree C)
PV18	Carrier gas pressure (kPa)
PV19	Real Net HV (dry) (BTU/CF) [default] or Real Net HV (sat) (BTU/CF) or Ideal Net HV (dry) (BTU/CF) or Ideal Net HV (sat) (BTU/CF) or Net HV (dry) (BTU/lbm)
PV20	Real Relative Density (dry gas) [default] or Real Relative Density (sat gas) or Ideal Relative Density (dry gas) or Ideal Relative Density (sat gas) or Specific Heat K

Auto-calibration

External solenoid valve and HDM contact are required.

Normalization of concentrations

On-line diagnostics

Hazardous area certification

FM Approvals

- Explosionproof for C1 I, Div 1, Gps C & D
- Flameproof for Cl I, Zone 1, AEx d IIB
- Dust-ignitionproof for Cl II &III, Div 1, Gps E, F&G hazardous (classified) locations
- Seal All Conduits Within 18 in.

NEMA Type 4X

IP 65

Process Gas

Temperature
14°F to 122°F (-10°C to +50°C)

Flow rate
50 ± 20ml/min

Dust and mist
None

Moisture
2000 ppm or less

Coexisting components limit
H_2 < 0.1 mol%
He < 0.1 mol%
Oxygen < 0.1 mol%
H_2S (dry) < 0.1 mol%

Ambient temperature limits
14°F to 122°F (-10°C to +50°C)
-40°F to 158°F (-40°C to +70°C) for storage and transportation

Ambient humidity Range
0-95%RH

CE marking
Electromagnetic compatibility (EMC): 2014/30/EU

PERFORMANCE SPECIFICATIONS

Repeatability of analysis
± 0.05% CV

PHYSICAL SPECIFICATIONS

Color
Metallic light green, silver

Material

Body
Cast aluminum

Oven
Cast aluminum

Wet-parts
304 Stainless steel, polyimide

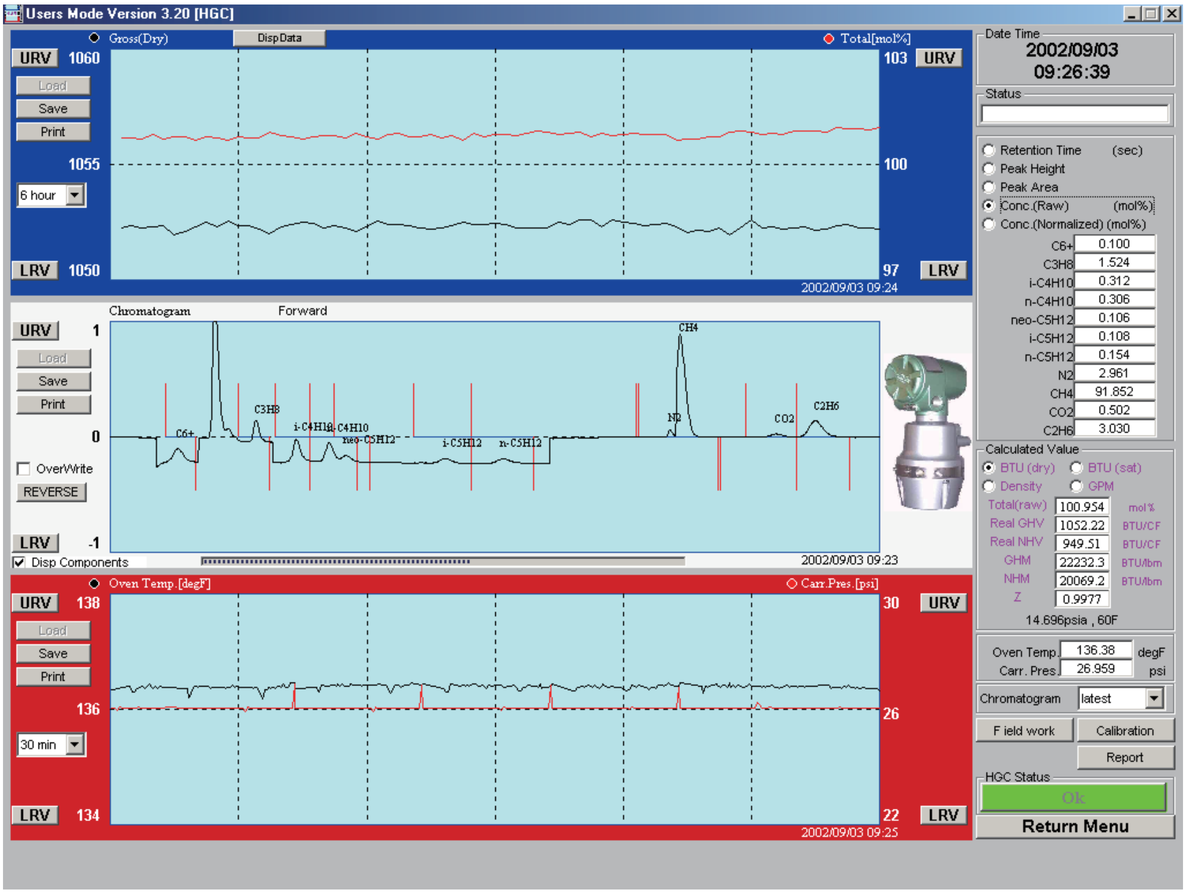
Sensor
Pt, glass, gold

Dimensions
W: 3.9 in. × D: 4.5 in. × H: 9.6 in.
(W: 100 mm × D: 115 mm × H: 244 mm)

Weight
7.7lbs (3.5kg)

COMMUNICATIONS

The model HGC303 communicates to a PC for configuration, maintenance and data transmission. PC and Fieldbus connections are provided as standard equipment.
A specific Windows-based model HGC303 software, the HGC Monitor HGM, enables convenient model HGC303 instrument control in a user-friendly environment. Retransmission of data to the central system can be performed via the Internet. Modbus communication is also available for networking with, for example, a flow computer or SCADA system.



INSTALLATION

Mounting

Vertical 2 in. pipe mount

Power supply

24V DC ± 15% 4A min

Power consumption

5~50VA at 14°F to 122°F (-10°C to +50°C)

Utilities

Carrier gas: Helium

Purity

99.99% or higher

Pressure

58 psi ± 7 psi (400 kPa ± 50 kPa)

Consumption

25ml/min (approximately)

Instrument air (for actuating the valve)

Pressure

58 psi ± 7 psi (400 kPa ± 50 kPa)

Environmental classification

Sheltered location (protected from sunlight or precipitation)

MODEL SELECTION

Heat Value Gas Chromatograph

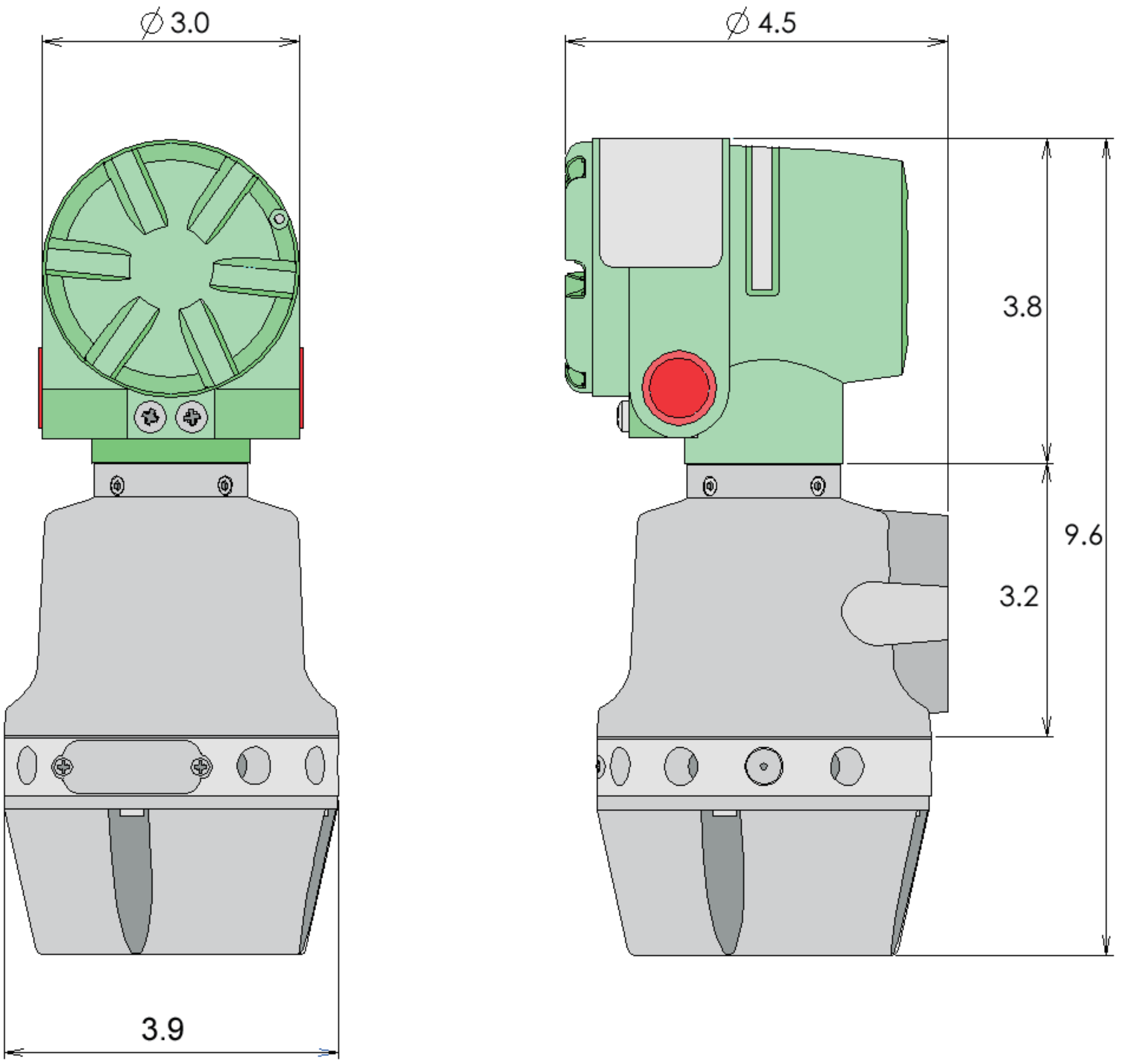
HGC303 - I II

Basic Model No.	HGC303-

I	Conduit entry	1/2 NPT	1	
	Gas connection	1/4 NPT		
II	Explosion-protection	FM Explosionproof / Flameproof		F

DIMENSIONS

[Unit: inch]



Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products. You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

(1) Failure caused by your improper use of azbil product
(noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);

(2) Failure caused for other reasons than Azbil Corporation's product;

(3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;

(4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;

(5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or

(6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

(1) Regulations and standards or laws that your Equipment is to comply with.

(2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.

(3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use
Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down.
You are required to provide your Equipment with safety design such as fool-proof design, *1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance, *3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.
*2. A design that is safe even if the device fails.
*3. Avoidance of device failure by using highly reliable components, etc.
*4. The use of redundancy.

3. Precautions and restrictions on application

Azbil Corporation's products other than those explicitly specified as applicable (e.g. azbil Limit Switch For Nuclear Energy) shall not be used in a nuclear energy controlled area (radiation controlled area).
Any Azbil Corporation's products shall not be used for/with medical equipment.
The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.
In addition,
you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below.
Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

(1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals

(2) For use of specific purposes, such as:
   * Nuclear energy/radiation related facilities
     [For use outside nuclear energy controlled areas] [For use of Azbil Corporation's Limit Switch For Nuclear Energy]
   * Machinery or equipment for space/sea bottom
   * Transportation equipment
     [Railway, aircraft, vessels, vehicle equipment, etc.]
   * Antidisaster/crime-prevention equipment
   * Burning appliances
   * Electrothermal equipment
   * Amusement facilities
   * Facilities/applications associated directly with billing
(3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
(4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
(5) Machinery or equipment that may affect human lives, human bodies or properties
(6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification.
Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.
In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used.
Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc.
as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals.
System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts.
For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason.
For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice.
For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts.
For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service.
Accordingly, a separate fee will be charged in any of the following cases:
(1) Installation, adjustment, guidance, and attendance at a test run
(2) Maintenance, inspection, adjustment, and repair
(3) Technical guidance and technical education
(4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

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