GAS MICRO

Electronic Volume Corrector
Electronic Pressure Recorder

Operator's Manual

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1 Introducing the GAS MICRO Features

The GAS MICRO is a microprocessor-controlled unit that can be configured for multiple purposes. The common platform allows a company to standardize on a single product for a range of applications.

The primary focus of the GAS MICRO is in the following uses:

- Electronic Volume Corrector (EVC) - As an EVC, the GAS MICRO measures the volume and flow rate of gas flowing through a meter and corrects these values for the effects of pressure, temperature, and the compressibility of the gas. The values can be corrected to any base values.

- Electronic Pressure Recorder (EPR) – As an EPR, the GAS MICRO measures and stores pressure and temperature values and is configurable for up to three (3) inputs including: pressure transducer, pressure transmitter, differential pressure transducer, differential pressure transmitter. PT100 temperature RTD, and temperature transmitter.

Both Electronic Volume Corrector (EVC) *and* Electronic Pressure Recorder (EPR) are in the same box, however, the flexibility of the platform allows it to also be configured for the following:

- 3 Channel Electronic Recorder (ER) or Stand-alone Electronic Readout (SER) – As an ER or as a SER, the unit can utilize most pressure and temperature transducers/transmitters. The GAS MICRO is capable of receiving a pulse input from a turbine, rotary, diaphragm or ultrasonic meter and displaying and storing associated corrected/uncorrected volume data.

The GAS MICRO is designed for mounting directly on the rotating instrument drive output of a turbine, rotary, diaphragm or positive displacement meter. The GAS MICRO can optionally be mounted remotely from the meter fitted with a GAS MICRO index with integral pulse generator or other commercial single pulse generators.

The GAS MICRO can be configured to measure live pressure, live temperature or to correct the displaced volume by applying fixed pressure/temperature factors.

The GAS MICRO is the ***most economical*** electronic volume corrector available, matching and often exceeding the accuracy of much more expensive units.

Features and benefits include:

- Low unit cost and low overall cost of ownership.
- Unsurpassed accuracy - ± 0.25% accuracy of reading across full operating pressure and temperature range (including calculation, live pressure and live temperature).
- Low power consumption - up to 2+ years of battery life.
- Versatile/scalable - one product for all AGA7, or AGA8 volume correction applications.
- Communications ready – Modbus protocol is standard. Optional integral dial-up modem and compatibility with most commercial modem/radio products. Internet access is optional.

- Extensive memory/audit trail - memory includes 64 days of hourly, 188 days of daily, and 3 years of monthly measurement records. Audit trail (Alarm/Event/Configuration data) includes 640 records maintained in non-volatile memory.
- Over 8000 additional Extended Log records are available for recording at more frequent intervals ranging from 1 hour down to every 15 seconds. Exception recording can be set up to check for exceptions every 2 seconds.
- Dependable – industrial components, rugged design and a 4-year comprehensive warranty.
- Ease of use - well-designed software interface with point-and-click operation and built-in context sensitive help.
- Intrinsic safety for hazardous locations - ETL – C – US certified to CAN/CSA C22.2 No. 157. Conforms to ANSI/UL 913-1988 for use in Class 1 Division1, Groups C & D Hazardous Locations.
- Removable mechanical base with integral pulse generator supports remote mounting.
- On-board energy measurement.
- Can be configured to handle two pressure transducers concurrently.
- Includes AGA8 supercompressibility calculations.
- 5 reed switch pulse generator and “smart” software eliminate the possibility of accumulating false uncorrected pulses.
- Pulse generator with 5 reed switches provides optional detection and measurement of reverse flow.
- Accepts Form A relay input up to a maximum of 2.3 hertz
- Accepts TTL level pulses directly into the GAS MICRO motherboard with a maximum input frequency of 175 hertz
- Accepts a TTL level pulse into optional pulse conditioning and divider board (part # PT2001CC), the input frequency for this configuration is 10 kilohertz
- Accepts a turbine signal connected to an optional pulse conditioning divider board (part # PT2001D), the maximum input for this configuration is 40 kilohertz
- Pixel-based LCD allows for plain language display.

2 Unpacking and Initial Inspection

2.1 Unpacking and Initial Inspection

1. Examine shipping container(s) for signs of damage and mishandling. If there is damage, file a claim with the shipper.

2. Carefully unpack GAS MICRO from its shipping container and verify the container contents with the shipping order and check them for damage. Report any discrepancies to Galvanic's customer service department and if anything has been damaged file a claim with the shipper.

3. Look at the label on the front of the GAS MICRO and check that the serial number, model, and pressure transducer range and type match the enclosed shipping documents and user configuration requirements. Contact your sales representative immediately if any discrepancies are detected.

4. Open the GAS MICRO and inspect the internal housing for any loose parts and check that all connectors, Printed Circuit Board (PCB), mounted coin cell battery and micro controller chip are properly seated.

5. Install the battery pack (see Installation, Section 3) and check the LCD (display) to see that characters are being displayed. The display items may include:

   i. One of the Display Parameters (See *Modems/Communication* Section 8 for details)
   ii. Display item **NO CONFIG**. This indicates that the unit has no default instrument configuration file stored in the system memory. See *Appendix II Troubleshooting* Section for procedure to load default configuration file.
   iii. No display item displayed – press piezo button located on front of GAS MICRO to activate display. If display still not active refer to *Troubleshooting* Section in this manual.

NOTE: It is recommended that the power supply be disconnected at battery pack male connector to preserve battery life if the instrument is not scheduled to be configured for a specific application immediately following the completion of the initial inspection procedure outlined above.

Report any problems or defects immediately to your sales representative or Galvanic Applied Sciences Inc. (GAS Inc.) Customer Service personnel.

2.2 Defining the General Parts of the GAS MICRO

Figure 2-1 shows the GAS MICRO and its general components.

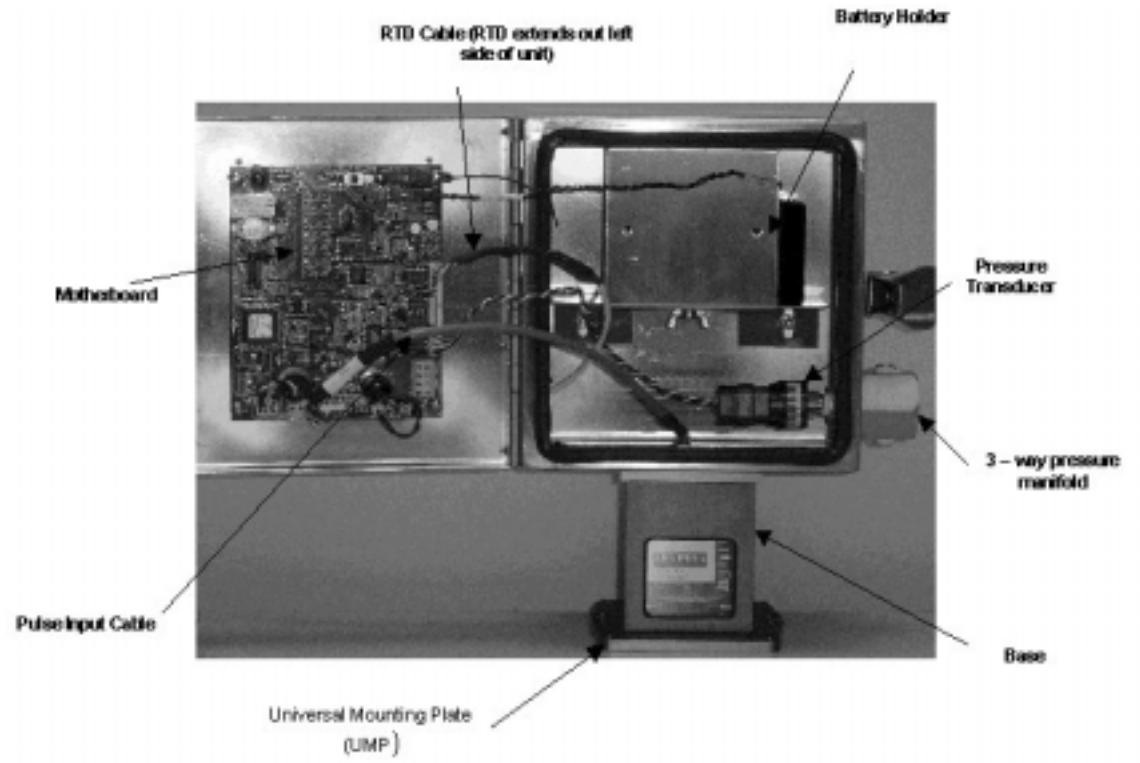


Figure 2-1 Electronic volume correction components

Figure 2-2 shows the connections on the GAS MICRO motherboard.

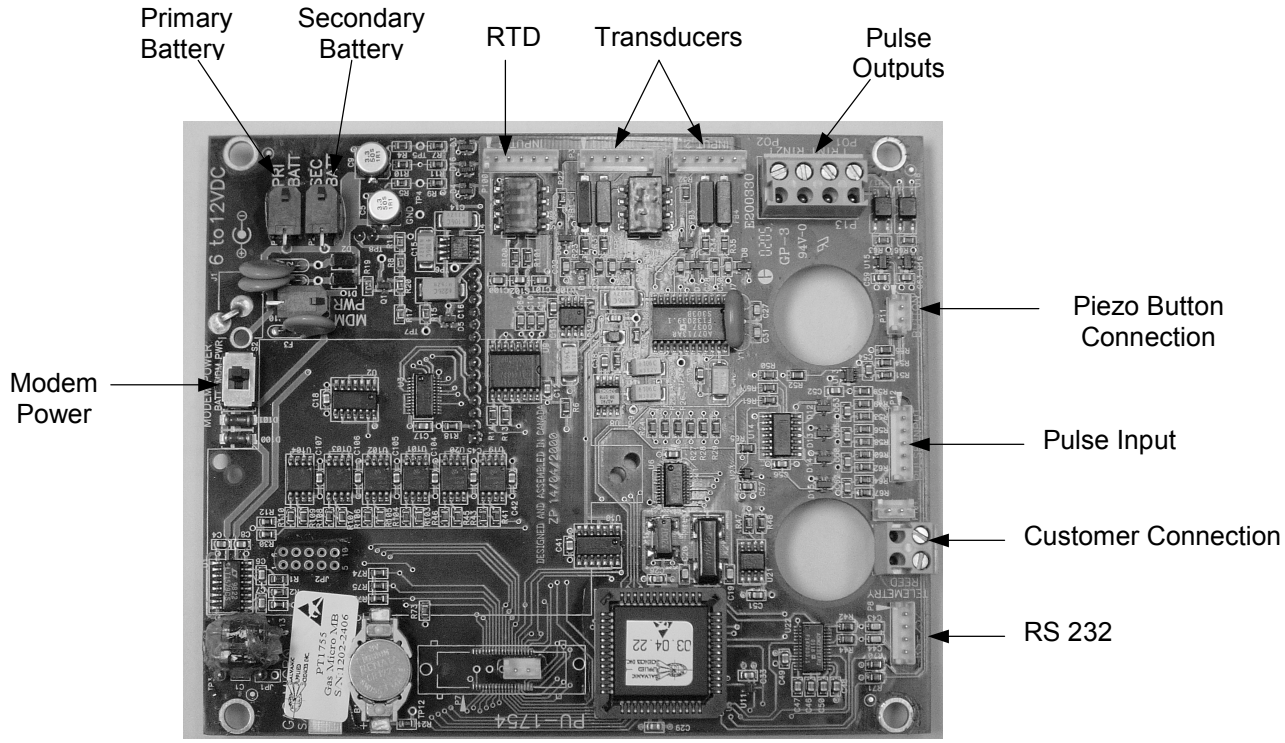


Figure 2-2 GAS MICRO motherboard

3 Installation

3.1 Pre-installation Set Up (Base and Power Supply)

3.1.1 Setting Base Gears for Clockwise (CW) or Counter Clockwise (CCW) Rotation

Usually this setting is preset as per customer configuration information. The default configuration is CW.

1. Check meter or installation work order to determine the meter drive rotation.

2. Inspect Mechanical Base Assembly to determine rotation setting (applicable If Mechanical Base Assembly includes a mechanical counter and counter has not been masked to cover any digits from the right)

3. Unplug pulse input cable from Base Assembly to PCB Pulse Input connector to avoid counting unnecessary pulses (see Figure3-1).

4. Tilt or lay the instrument backside down and use a finger to rotate the GAS MICRO wiggler one full revolution clockwise (viewed from top of instrument with perspective of the rotating Test wheel).

5. If the counter increments then the instrument is configured for CW rotation. If the counter decrements then the instrument is configured for CCW rotation.

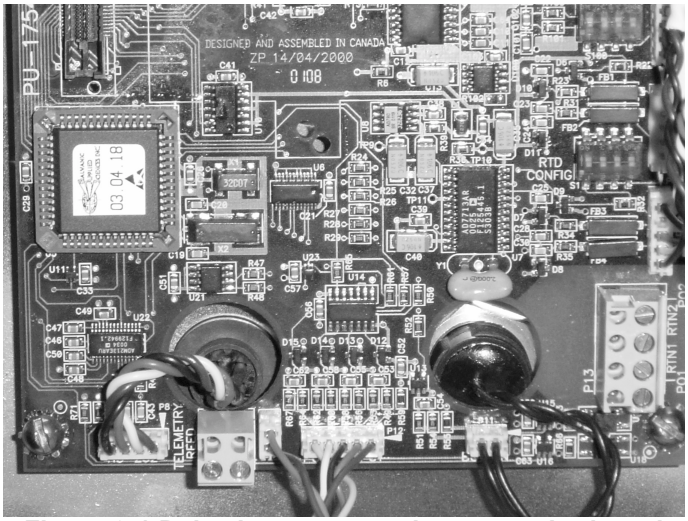


Figure 3-1 Pulse input connection on motherboard

3.1.2 Inspecting internal gearing or adjusting gears for non-rear door base housing

Use the following procedure to inspect the internal gearing or adjust the gears for non-rear door base housing.

1. Lay instrument backside down and remove the four A32 mounting screws to take off the universal mounting plate (UMP).

2. Without applying excessive force, pull the wiggler to lower the internal gearing assembly from the bottom of the mechanical base housing. You will be required to feed the index cables through the cable grommet in the bottom of the enclosure to provide sufficient slack to allow the internal housing to be lowered. You will require at least 1¾ " of cable slack to lower the internal gearing assembly to provide a suitable view of the gearing. Pulse board cables may have to be removed from the cable ties attached to the interior of the enclosure to provide adequate slack.

3. For rear door housing, remove screws on rear door for access to the gears. If the top bevel gear on the vertical shaft is lowered to engage the counter drive gear, the base assembly is configured for CCW rotation. The bottom gear should be lowered to rest on top of the watch hand. (Figure 3-2). If the bottom bevel gear on the main shaft is raised to engage the counter drive gear, the base assembly is configured for CW rotation. (Figure 3-3) The top gear should be raised to the bottom of the shaft collar at the top of the vertical shaft.

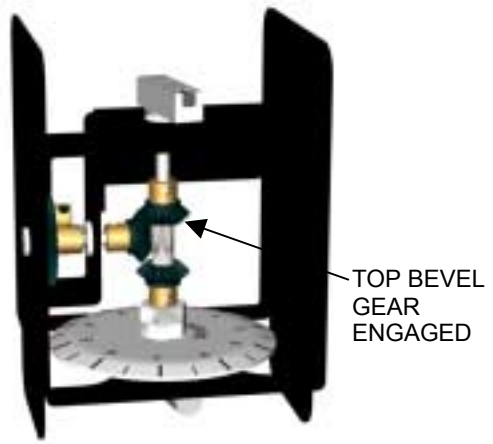


Figure 3-2 CCW base set up

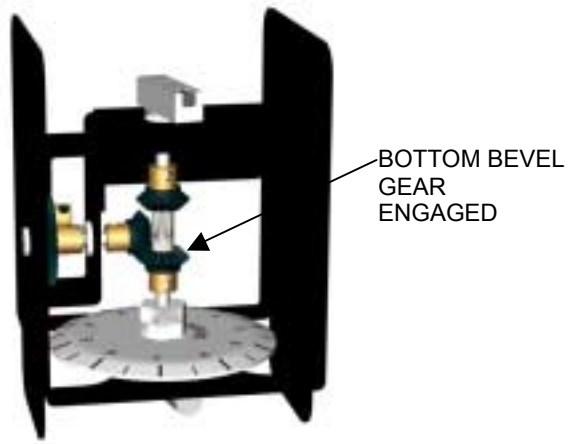


Figure 3-3 CW base set up

3.1.3 Confirming gear fastening and engagement of bevel gears

After gear adjustment for counter rotation has been completed, confirm that all gears are fastened and the corresponding bevel gears are engaged correctly.

1. While internal gearing assembly is lowered, check that all gears are firmly fastened. A very small flathead screwdriver is suitable to tighten down all fasteners.

> **Caution:** Do not over tighten. Over tightening may split the screw heads or strip the gear set screws.

2. Test wiggler rotation to ensure that there is no gear binding and that the mechanical index counts properly when the wiggler is turned. If gears are properly set, the motion of wiggler will be smooth and provide very little resistance.

Bevel gears on the main drive shaft must be adjusted so that the mechanical counter will increment correctly, when wiggler is rotated clockwise or counterclockwise.

3.1.4 Index Masking and Meter Foot Drive Labeling

1. Lower internal gearing housing as outlined above in 2.3.1.

2. Ensure instrument has the correct counter lens mounted. Instrument is shipped with a default counter lens labeled 1 REV = 10 x CF. Counter lenses are changed by removing the single flathead screw in the top center of the lens.

3. Set the index to the proper incremental factor. The appropriate 1 REV = x CF value must be displayed and the appropriate digits must be “blacked out”.

Uncorrected Counter Masking for Eight Digit Counter

Drive	Factor	Index Digits Masked
5 Cu. Ft./Rev.	1 REV = **10** X CF	■□□□□□□■
	1 REV = **100** X CF	□□□□□□■■
10 Cu. Ft./Rev.	1 REV = **10** X CF	■□□□□□□■
	1 REV = **100** X CF	□□□□□□■■
100 Cu. Ft./Rev.	1 REV = **100** X CF	■□□□□□□■
	1 REV = **1000** X CF	□□□□□□■■
1000 Cu. Ft./Rev.	1 REV = **100** X CF	■■□□□□□□
	1 REV = **1000** X CF	■□□□□□□■
	1 REV = **10000** X CF	□□□□□□■■

Figure 3-4 Uncorrected counter masking for eight digit counter

GAS MICRO standard configuration includes an 8-digit counter with only 7 digits exposed. The eighth digit (right-most digit) increments in tenths of a revolution.

3.1.5 Installing Battery

1. Open the GAS MICRO and locate the primary battery cable (red & black) and secondary battery cable (white & black) with male and female connectors.

2. Remove the battery holder by unscrewing the wing nut below it.

3. Place the battery packs on the shelf (if 2 packs are being installed, one must be placed on end so they will fit) and plug them into the battery cables. If only one battery is installed, a jumper will be plugged into the secondary power socket.

4. Check that the LCD comes on ensuring the batteries are connected properly.

5. Place the battery holder back in place and secure it with the wing nut. Ensure that the battery cables are tucked out of the way.

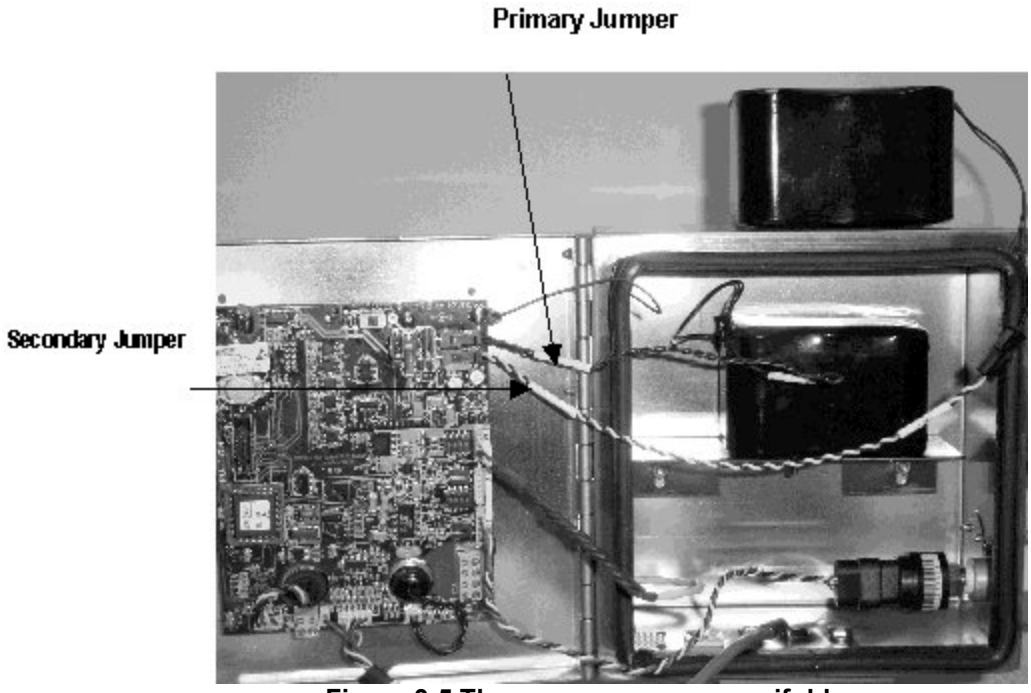


Figure 3-5 Three-way pressure manifold

3.1.6 Memory Backup Dime Cell

The GAS MICRO comes standard with a lithium dime cell battery that serves as a backup to protect non-volatile memory and system real time clock (RTC). The lithium cell can maintain non-volatile memory and RTC for up to 8 years without other power supply connected. We recommend replacing the dime cell battery after 5 years.

3.2 GAS MICRO Installation

Application notes for Class 1 Division 1 I.S. wiring.

- Certification of the GAS MICRO does not cover field installation and must be approved by an electrical authority having jurisdiction.
- Run separated ground return from the IS Barrier safety ground. (Earth bus bar)
- Intrinsically safe wiring shall be installed in accordance with ANSI/ISA RP12.6 and must be routed separately from other wiring.
- Barriers are not required for Class 1, Div. 2 when internal battery pack is used.
- GAS MICRO is approved for Class 1, Div. 1, Groups C&D without internal CDPD or telephone modem.
- For Class 1, Div. 2, no barriers are required. External power supply must be Class 2 power supply or fitted with Poly fuse (SRP 200) 2 amps @ 20°C.
- Modified to CSA Requirements (Barriers and Voltage).

GAS MICRO Class 1, Division 1 I.S. Wiring Diagram

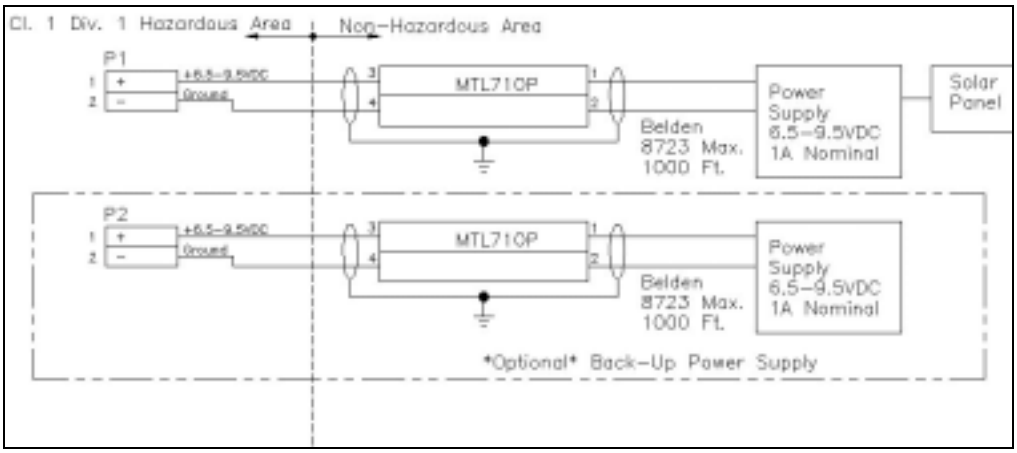


Figure 3-6 Power supply I.S. wiring diagram

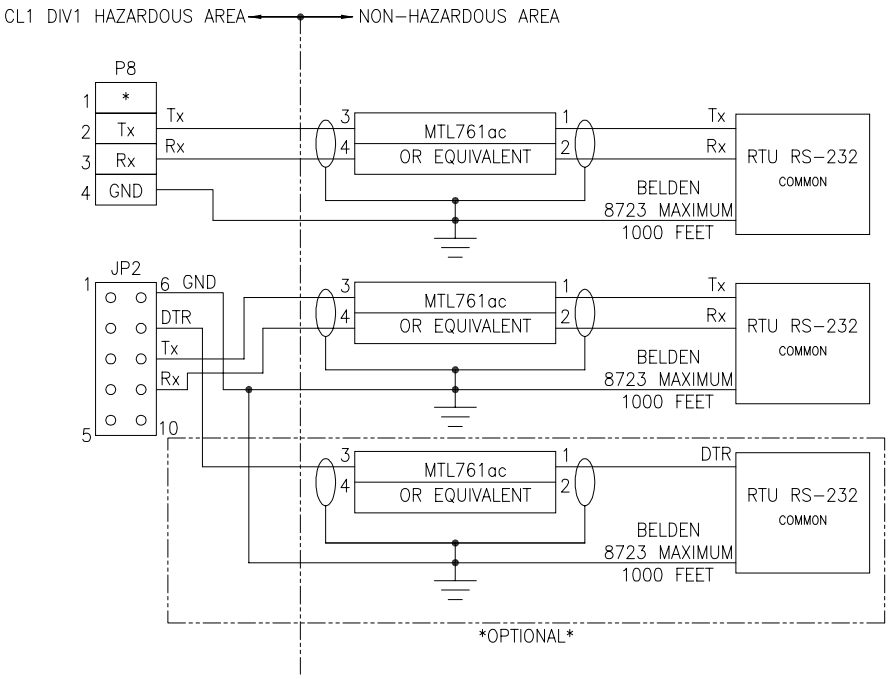


Figure 3-7 Communication wiring I.S. diagram

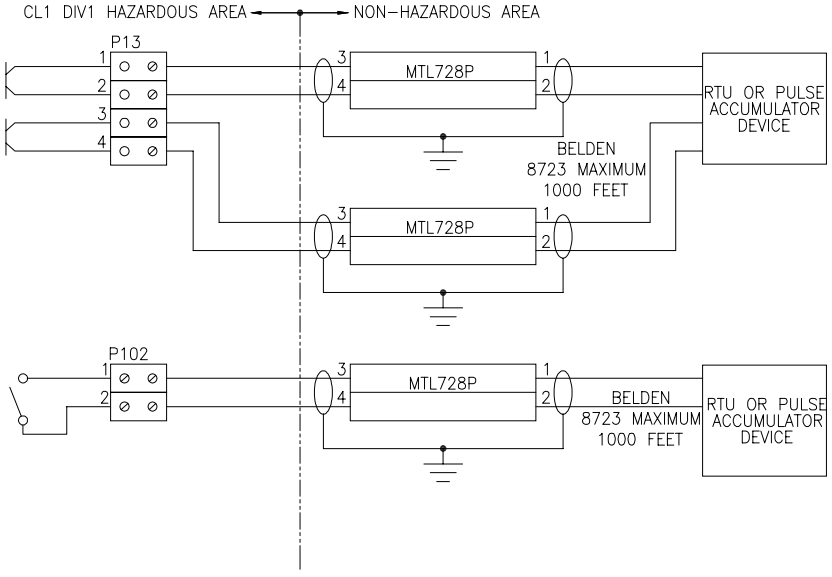


Figure 3-8 Pulse accumulation I.S. wiring diagram

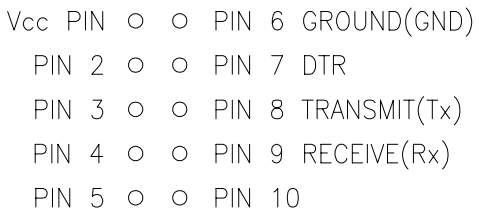


Figure 3-9 Gas Micro JP2 Pin Out (Located on Motherboard)

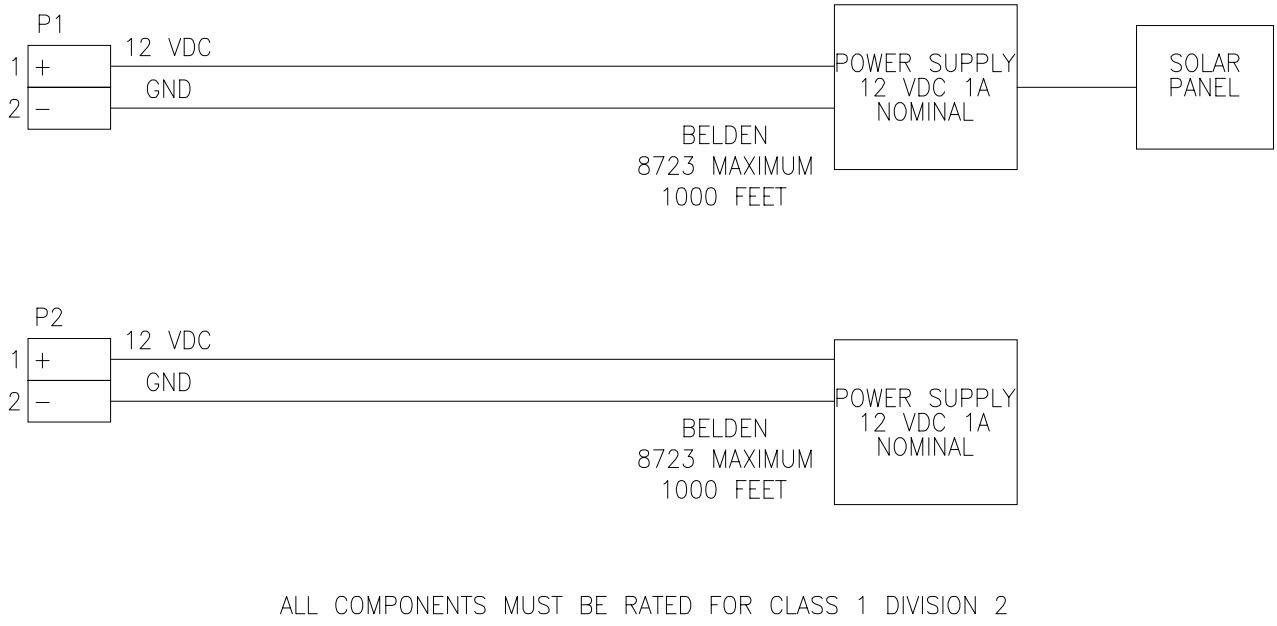


Figure 3-10 Gas Power Supply Wiring Diagram

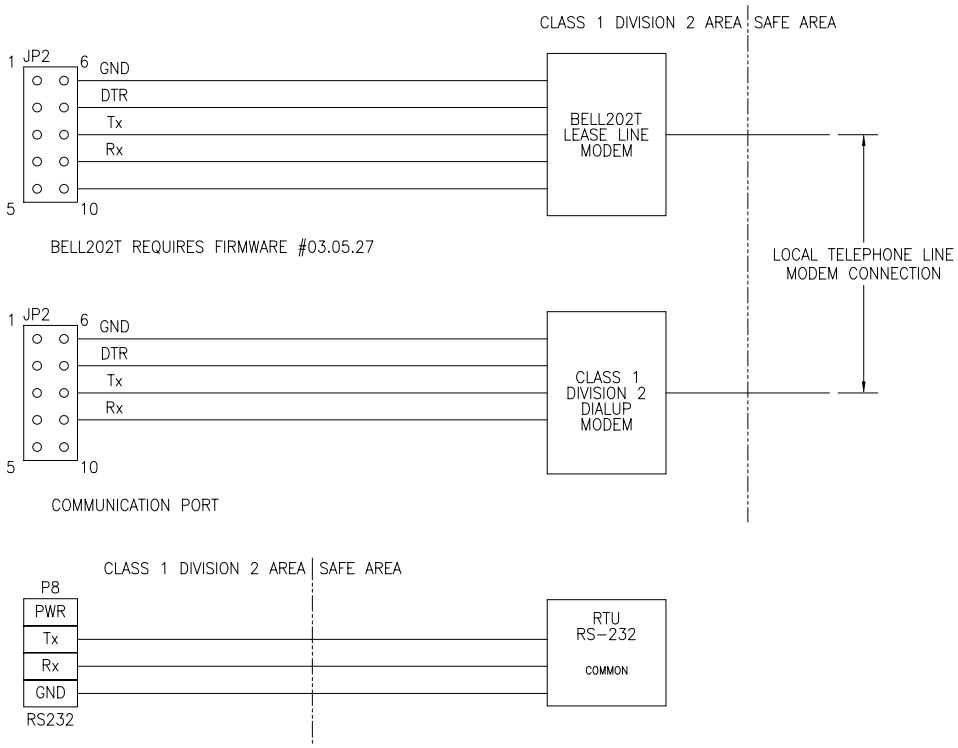


Figure 3-11 Communication Wiring Diagram

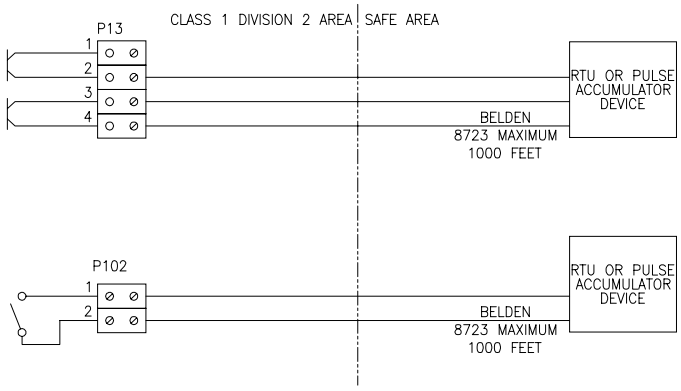


Figure 3-12 Pulse Accumulation Wiring Diagram

3.2.1 Mounting the GAS MICRO on the Meter

NOTE:
Make sure that the wiggler is aligned correctly with the drive dog. Do not force the GAS MICRO onto the meter.

3.2.3 Mounting the GAS MICRO on the Meter cont'd

1. Inspect meter to determine direction of rotation. Check GAS MICRO direction configuration and if required, configure instrument for meter rotation direction (see Section 3.1.1).

2. Ensure that the instrument drive mounting surface on the meter is clean and free of debris.

3. Place a meter-mounting gasket on instrument drive mounting surface. Line up gasket with bolt pattern of meter.

4. Place GAS MICRO over gasket and line up the wiggler with the instrument drive dog. The wiggler and drive dog are easily viewed through the Lexan lens on the mechanical base. Use this to help line up the wiggler and the drive dog. Insert appropriate meter mounting bolts through the GAS MICRO universal mounting plate. IMPORTANT – The anodized surface on the universal mounting plate is an electrical insulator. Use ¼" star washer provided on meter-mounting bolt to score the surface of the plate to ensure the integrity of the system ground path through to the meter.

5. Tighten fasteners until GAS MICRO is secure.

6. Inspect instrument to ensure that meter instrument drive dog has engaged the GAS MICRO wiggler and that the wiggler is moving without restriction.

3.2.2 Connecting the Pressure Line to GAS MICRO

Warning!

Care must be taken when working with gas. Practice the following safety measures. Failure to do so may result in **fire** and **explosion**, causing **damage to property** and **serious personal injury**.

- The meter and its associated piping **must be** depressurized.
- **Do not** attempt to connect any fittings or piping to a meter or pipe under pressure.
- **Do not** smoke while connecting equipment to the gas line or while test - pressurizing the meter.

3.2.4 Connecting the Pressure Line to GAS MICRO cont'd

1. Follow all safety precautions.

2. Connect the pressure tubing to the ¼" NPT three-way pressure manifold (see Figure 2-8). Appropriate thread sealant should be used on all fittings.



Figure 3-9 3-way pressure manifold

3. Ensure that unused ports in the pressure manifold are plugged with hole plugs and that the plugs are tightened and sealed correctly.

4. Ensure that pressure transducer is tightened and sealed into the pressure manifold inside the enclosure.

5. Ensure that the transducer pressure rating is higher than the line pressure.

6. Open valve to pressure system.

7. Use suitable leak detect methods to identify any pressure leaks.

8. If live pressure is configured as an LCD display item. Press the piezo switch to activate the scrolling function and scroll to PRESS (pressure). Verify that displayed value is correct.

3.2.3 Installing the Temperature RTD in the Thermowell

The standard 4 wire PT 100 RTD is a ¼" diameter, 6" long, or 9" long stainless steel probe with 60", or 72" armored leads.

1. Insert the RTD in the Thermowell and finger tighten the appropriate probe NPT fitting.

2. Add mineral oil or ethylene glycol, if desired, to improve heat transfer from the thermowell to the probe.

> **Warning!** It is possible to hydraulically crush the probe in the sealed thermowell if there is not enough air between the liquid and the top of the thermowell.

4 LCD Display

The LCD Display is located on the front face of the GAS MICRO, and is controlled by the piezo button. Every time the button is pushed, the next parameter in the cycle will be displayed. When a parameter is displayed, the following routine will occur:

- The parameter title will be displayed, followed by a brief pause
- The units for the particular parameter, if applicable, will be displayed, followed by another brief pause
- The value for the parameter will be displayed

Note: At low temperatures (below 0 °C), the display may take up to 15 seconds to refresh after pushing the piezo button. Also, the pause between items in the routine for each display parameter may be up to 15 seconds.

The LCD Display is fully configurable for up to 31 user-selectable items. Display items are selected from:

- 71 configurable values
- 51 instantaneous (calculated/measured) values
- 28 hourly trend values
- 32 daily trend values
- 32 monthly trend values
- 1344 hourly audit values (168 hours historical x 8 items)
- 1504 daily audit values
- 288 monthly audit values

Some parameters that can be shown on the LCD Display are:

- Time – Current time
- Date – Current date
- S.G. – Specific Gravity of sample
- Alarms – Alarm status
- Pressure – Pressure of sample
- Temp – Temperature of sample
- Corvol – Corrected volume of sample
- UnCorVo – Uncorrected volume of samplel
- BaseP – Base pressure
- BaseT – Base temperature
- PcorFact – Pressure correction factor
- TcorFactor – Temperature correction factor
- Super X2 – Super compressibility
- TolCFact – Total correction factor
- N2 – Nitrogen concentration
- C02 – Carbon dioxide concentration
- Battery (Volts) – Battery voltage

5 Software Installation

5.1 Introduction

The GAS MICRO incorporates sophisticated software that allows it to be configured quickly prior to installation, and once installed, the software uses a complex algorithm to achieve maximum accuracy for temperature and pressure readings. The software also allows the user to download the GAS MICRO's data logs on site using a serial connection to a laptop computer or remotely using an optional modem. In addition, the downloaded data can be processed into concise reports for management review.

5.2 Installation of GAS MICRO Software

To install the GAS MICRO software, follow these instructions:



1. Insert CD into your CD drive and run the setup program. Either double click on the setup icon or select the run command from the start menu and enter **D:\setup** in the command line (replace "D" with the drive letter for your CD drive).

2. Read the conditions of use and click on **Next** in the prompt window.



3. Set the desired destination folder for the program and ensure that there is enough free disk space for the program and click on **Next**.



4. Select a shortcut folder and click on **Next**.



5. Click on **Install** to install the GAS MICRO Program

6 Software Features

6.1 Linking with the GAS MICRO Unit

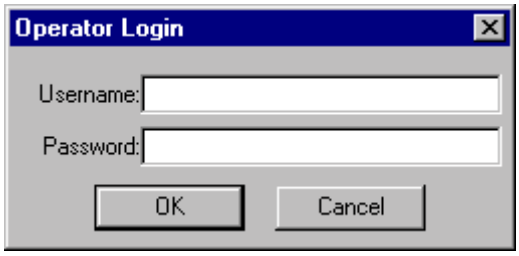
Once a unit has passed initial inspection, it can be linked to a computer. Be sure that a battery pack is correctly installed into the unit (see Section 3)

1. Install the GAS MICRO software on the computer you are using to test the unit. (see Section 5.2)
2. Connect GAS MICRO to a computer serial port using RS-232 cable.
3. Start GAS MICRO program by clicking on GAS MICRO icon.

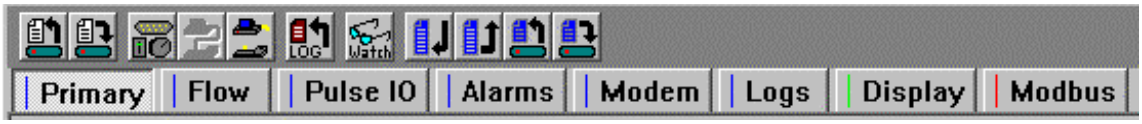


4. Link to GAS MICRO by clicking on the  button.

Enter username and password. Username will be logged in the system audit trail. There are two levels of password protection: Operator and Supervisor. Each level provides permission to different features in the system software.



6.2 Screen Tabs and Buttons



The main buttons are used to perform the tasks shown below:

 opens an existing complete configuration.

 saves complete configuration in current or new file.

 sets up the serial port and communications configuration.

 connect to GAS MICRO

 disconnect from GAS MICRO

 load and view logs from GAS MICRO. See Section 4.19.

 online monitor of GAS MICRO performance and calculations. See Section 4.20.

The screen tabs, used to navigate between the screens, are in three groups. The tabs are color coded to indicate that the information in each group is read from, and written to, the GAS MICRO as a group.

The ***blue*** group contains ID and runtime configuration items.



 reads all of the data on these screens from the GAS MICRO (downloads)

 writes all of the data from these screens to the GAS MICRO (uploads). This data is automatically read from the GAS MICRO when you log on to the unit.

 writes the data from this group to a file separate from the other groups.

 loads information that has been saved for this group only

---

The ***green*** group contains the items chosen to show on the LCD display.

 reads display information from the GAS MICRO

6.2 Screen Tabs and Buttons cont'd

 writes display information to the GAS MICRO. This data is automatically read from the GAS MICRO when you log on to the unit.

 writes the data from this group to a file separately from the other groups.

 loads information that has been saved for this group only.

The ***red*** group contains the Modbus configuration. 

 reads Modbus information from the GAS MICRO unit.

 writes Modbus information to the GAS MICRO. This data is automatically read from the GAS MICRO when you log on to the unit.

 writes the data from this group to a file separate from the other groups.

 loads information that has been saved for this group only.

6.3 Information Bar

The information bar is located just above the screen tabs.



6.3.1 Firmware Revision Number

The Firmware Revision Number is a 6-digit number in the format:
AA.BB.CC where

AA is the major revision number *
BB is the feature level
CC is the fix level

Have the Firmware Revision Number available for any support calls.

Note: This number must match the first 2 digits of the iMaCS Configuration Software revision number, which can be found on the main screen across from the Galvanic Applied Sciences logo. If these do not match, the software version is not compatible with the firmware version.

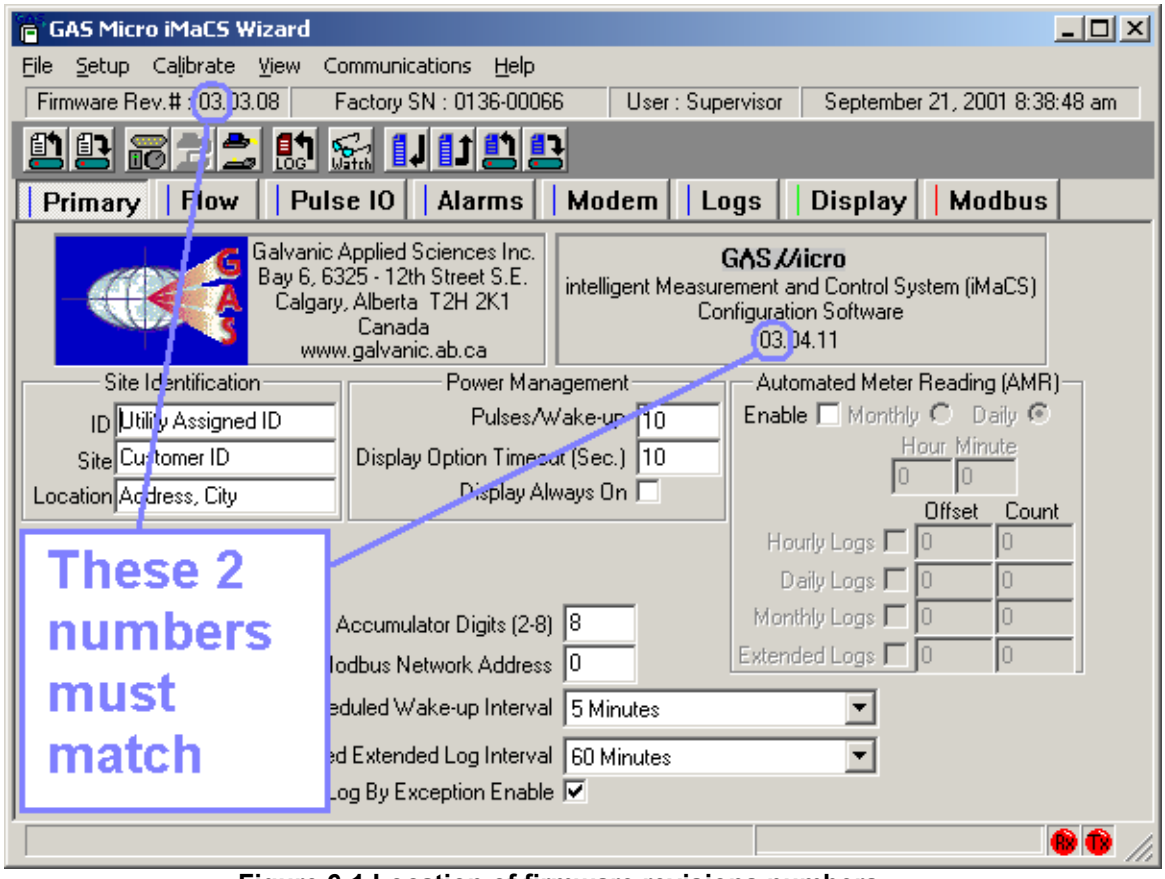


Figure 6-1 Location of firmware revisions numbers

6.3.2 Factory Serial Number

The Factory Serial Number is a 15-character code in the format:

YYWW–99999…..

YY Year of manufacture
WW Week within year of manufacture
99999 Unit Number
….. The last 5 characters are not currently used

Have the Factory Serial Number available for any support calls.

6.3.3 Current User

Displays “Offline” when not connected to a GAS MICRO unit. Displays the login ID when connected. This ID is written to the Configuration Event Log whenever changes are made to the unit’s configuration.

6.3.4 PC Time

Displays the current date and time according to the PC that the iMaCS software is running on. This is not the time according to the GAS MICRO unit’s internal clock. The time according to the GAS MICRO unit can be viewed from the **Watch Window** (see Section 6.25). The unit’s clock can be synchronized to the PC’s clock from the **Setup → Supervisor** menu (see Section 6.23).

6.4 Primary Setup Screen

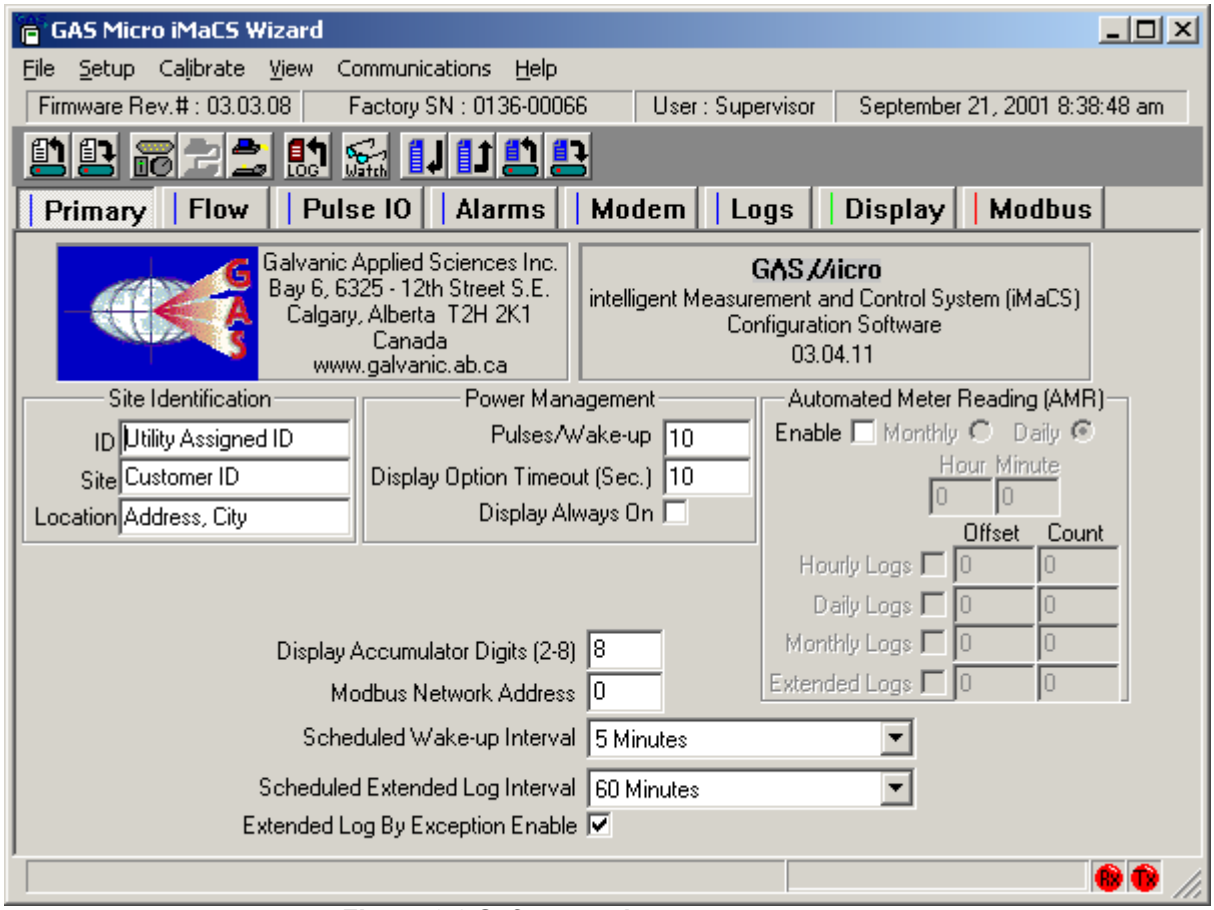


Figure 6-2 Software primary set up screen

6.4.1 Site Identification

ID
Site
Location

These three fields are provided to allow customers to supply their own Identification information for a unit. Each of these fields will accept up to 30 characters.

This information will be included in messages sent when the report-by-exception (RBX) option is used.

6.4.2 Pulses per Wake-up

This option triggers the GAS MICRO unit to wake up and gather information after the requested number of pulses. The value can range from 1 to 255 pulses per wake-up. When wake-up occurs, the unit takes live measurements and updates calculated amounts. These are stored in memory until a logging event (monthly, daily, hourly, extended, or exception) writes them to a log. Battery power can be conserved on higher-frequency meter applications by setting the **Pulses per Wake-up** to a higher number.

This feature can be used together with the **Scheduled Wake-up Interval** option. In this case, readings and calculations will be performed when either condition is met.

6.4.3 Display Option Timeout (sec)

This option controls how long the LCD display shows before going blank. This value can range from 0 to 255 seconds. Note that the GAS MICRO unit is fully awake (i.e. reading live inputs and performing calculations continuously) during this time. Setting this value to "0" causes the GAS MICRO to read from inputs and calculate continuously.

Performing calculations and powering the LCD display draws additional power from the power source and can affect battery life.

6.4.4 Display Always On

When this option is selected, the LCD display is always on, even when the GAS MICRO is not performing calculations.

Powering the LCD display draws additional power from the power source and can affect battery life.

6.4.5 Automated Meter Reading (AMR)

The GAS MICRO can be configured to send in data logs on a scheduled basis. This data can be sent in by regular modem or by Cellular Data Packet Data (CDPD) modem. If a CDPD modem is used, the data is sent as an e-mail attachment. The modem can be set up using the Modem Screen.

- **Monthly / Daily**

  The reporting frequency can be set to either Monthly or Daily

- **(Day) / Hour / Minute**

  The reporting time is set by entering the hour using a 24-hour clock (0 to 23 with 0 being midnight) and the minute within the hour. For example, a reporting time of 10:30 PM would be set up by entering "22" in the hour field and "30" in the minute field. If a Monthly reporting frequency has been specified, the day of the month is also entered.

- **Offset & Count**

  The Offset specifies the number of log records between the ***next*** log record to be written after the reporting time, and the last log record to be included in the AMR report. Note that log records are written before the AMR routine is activated. This means that for a reporting time of 7 AM, the next hourly log record to be written will be at 8 AM. An Offset of "0" is invalid.

  The Count specifies the number of log records to be sent. Re-commissioning is ignored.

  If AMR is enabled, the destination phone number or e-mail address is specified on the Modem Screen. For more information on setting up a standard modem, see Section 6.16.1.
  For more information on setting up a CDPD modem, see Section 6.18.

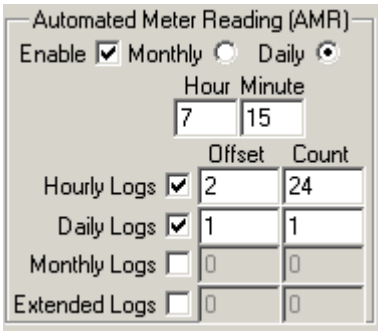
  Note that, for extended logs, the time interval represented by the Offset and Count depends on the Scheduled Extended Log Interval (see Section 6.4.9) and whether the Extended Log By Exception Enable option is turned on. (see Section 6.4.10)

  Also note that the Offset plus the Count should never exceed the number of records stored in the log. There are 1536 Hourly Log records (64 days worth), 188 Daily Log records (just over 6 months), 36 Monthly Log records (3 years worth), and 8192 Extended Log records.

— Examples —

Example A

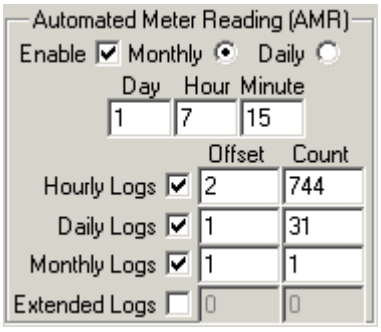
For the first example, assume that the "Start Hour" on the Flow Screen is 6 AM. (Also called the Billing Hour or Contract Hour. This specifies, based on a 24-hour clock, the start hour of a "contract day". It also determines when daily logs are written.) We want to use AMR to send in the hourly and daily log records for the preceding contract day. We wish to send this at 7:15 AM each day. We set up the AMR Section on the Primary Screen like this.



- The reporting frequency has been set for **Daily**.
- The reporting time has been set for **7:15 AM**.
- The **Hourly Log Offset** has been set at **2**. This reflects that, at 7:15 AM, the next hourly log record to be written will be at 8 AM and the last hourly log we wish to include in the report will have been written at 6 AM — an offset of 2 hourly log records.
- The **Hourly Log Count** has been set to **24** because there are 24 hours in the reporting period.
- The **Daily Log Offset** has been set to **1** because the next daily log record will be written at 6 AM on the following day, but the daily record we are interested in will have been written at 6 AM (the **Start Hour**) on the current day — an offset of 1 daily log record.
- The **Daily Log Count** has been set to **1** because there is only one day in the reporting period.

Example B

In this example, we wish to set up a monthly reporting schedule. The Start Hour is still 6 AM and we wish to report at 7:15 AM on the first day of each month.

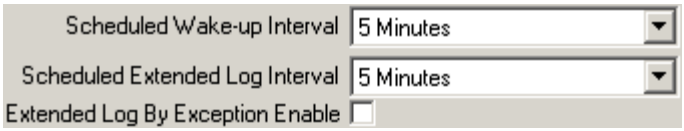


- The reporting frequency has been set to **Monthly**.
- The reporting time has been set for **7:15 AM** on the first day of the month (**1**).
- The **Hourly Log Offset** has been set at **2**. This reflects that, at 7:15 AM, the next hourly log record to be written will be at 8 AM and the last hourly log we wish to include in the report will have been written at 6 AM — an offset of 2 hourly log records.
- The **Hourly Log Count** has been set to **744** because there are a maximum of 744 (31 days X 24 hours per day) in the reporting period.
- The **Daily Log Offset** has been set to **1** because the next daily log record will be written at 6 AM on the following day, but the last daily record we are interested in will have been written at 6 AM (the **Start Hour**) on the current day — an offset of 1 daily log record.
- The **Daily Log Count** has been set to **31** because that is the maximum number of days in any given month. This ensures that the entire reporting period is included in the report.

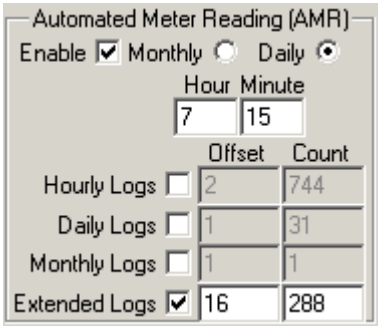
Examples cont'd

Example C

In this example, we are including Extended Logs in the AMR report. The Start Hour is still 6 AM and we are requesting a daily report. The extended logging is set up as follows.



The AMR Section is set up like this.



- The reporting frequency has been set to **Daily**.
- The reporting time has been set for 7:15 AM.
- The **Extended Log Offset** has been set to **16**. This reflects that, at 7:15 AM, the next extended log record to be written will be written at 7:20 AM and the last extended log we wish to include in the report will have been written at 6 AM — an offset of 16 extended log records.
- The **Extended Log Count** has been set to **288** because there are 288 records (24 hours X 12 records per hour) in the reporting period

6.4.6 Display Accumulator Digits

This sets the number of digits (2-8) to be displayed on the LCD for volume data. This can be useful when the readings will be entered into a system that assumes a specific number of digits.

6.4.7 Modbus Network Address

This is used to assign a separate address for each unit when several units are on the same network.

6.4.8 Scheduled Wake-up Interval

Calculations based on live data are performed every hour, on the hour, regardless of the number of pulses.

This option allows the GAS MICRO unit to wake up and perform these calculations at regular time intervals of less than an hour. Several time intervals are available ranging from 15 seconds to 30 minutes. It can also be set to scan *continuously*, which performs all necessary calculations approximately every 2 seconds. If this feature is disabled, calculations are performed hourly.

The only difference between the **Continuous Hi-Speed** option and the **Continuous Normal** option is that the **Continuous Hi-Speed** option can process pulses of up to 8 kilohertz, whereas the **Continuous Normal** option tops out at 4 kilohertz. Because the **Continuous Hi-Speed** option draws considerably more power from the battery, it should only be used for higher frequency meters or at powered sites where battery life is not an issue.

6.4.8 Scheduled Wake-up Interval cont'd

This feature can be used together with the **Pulses Per Wake-up** option. In this case, readings and calculations will be performed when either condition is met.

This feature can also be used along with the **Scheduled Extended Log Interval** option and the **Extended Log By Exception** option to provide extended logging by exception. In this context, the **Scheduled Wake-up Interval** controls how often the system checks for exceptions.

6.4.9 Scheduled Extended Log Interval

This controls how often information is written to the extended log. This interval cannot be less than the Scheduled Wakeup Interval or greater than 1 hour. This interval must also be an even multiple of the Scheduled Wakeup Interval. Both of these rules are enforced automatically.

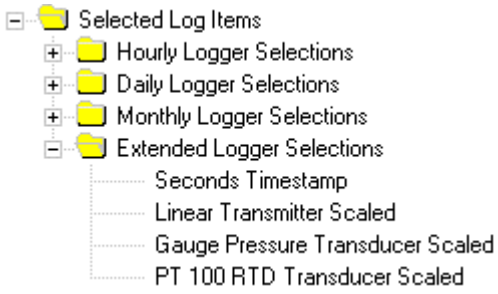
If the **Extended Log By Exception Enable** option is enabled, a record will be written to the extended log whenever an exception occurs as well as when the selected time interval occurs.

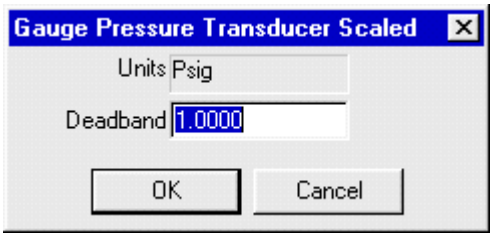
6.4.10 Extended Log By Exception Enable

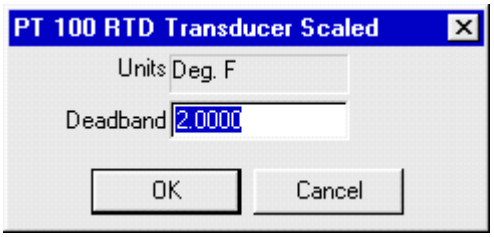
This option is only available when the **Scheduled Extended Log Interval** is being used.

When this option is selected, a record is written to the extended log whenever the items selected for extended logging vary beyond a certain amount. You can view the logging information by opening the **Logs** tab. **Extended Logger Selections** is located in the right panel. The first of the four extended log items is used for the timestamp. The other three items are available for user definable log items. The Logs tab is further explained in Section 6.18.

Double-clicking on an extended log item on the **Logs** screen displays pop-up windows where the deadband amount can be entered see Figure 6-11)







6.4.10 Extended Log By Exception Enable cont'd

The selected log items are checked for changes whenever the GAS MICRO unit wakes up to measure current conditions and perform calculations. This wake up cycle can be triggered by several events:

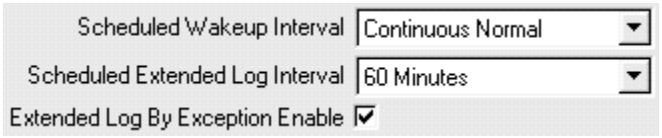
- a Scheduled Wakeup Interval has elapsed
- a specified number of pulses has been detected (Pulses Per Wakeup option)
- the piezo button has been pushed (awake until the LCD times out)
- the unit is being polled via the iMaCS software (Watch Window, battery calibration, I/O calibration)
- Modbus communication (awake for 5 seconds after last communication)

If any of the items selected for extended logging change by more than the specified deadband amount *from the last **logged** amount*, a record is written to the Extended Log recording all extended log items and a timestamp.

— Examples —

Example A

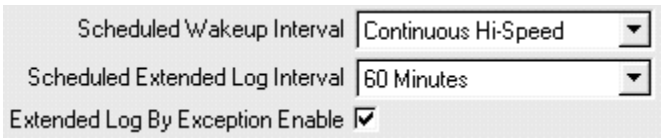
In the following example, the **Scheduled Wakeup Interval** has been set to **Continuous Normal**, the **Scheduled Extended Log Interval** has been set to **60 Minutes** and the **Extended Log By Exception** option has been enabled.



The GAS MICRO unit will scan the readings continuously, reporting any readings that vary from the previously logged amount by more than the deadband amount. In addition, an extended log record will be written once per hour, regardless of whether there are any significant changes or not.

Example B

Settings are the same as in the previous example except that **Continuous Hi-Speed** has been selected instead of the **Continuous Normal** option.

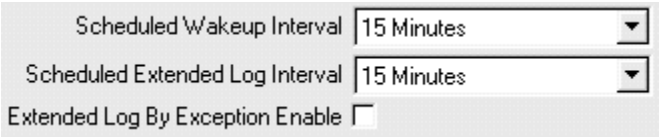


All processing and reporting happens in the same way. The difference is that the **Continuous Hi-Speed** option can process pulses of up to 8 kilohertz, whereas the **Continuous Normal** option tops out at 4 kilohertz. The **Continuous Hi-Speed** option should only be used for higher frequency meters, however, because it draws considerably more power from the battery.

6.4.10 Extended Log By Exception Enable cont'd

Example C

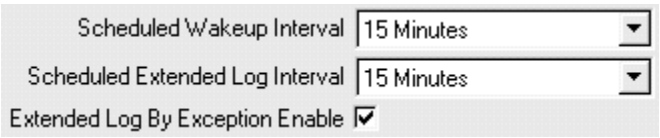
In this example, the **Scheduled Wakeup Interval** has been set to **15 Minutes**, the **Scheduled Extended Log Interval** has been set to **15 Minutes** and the **Extended Log By Exception** option is not enabled.



The GAS MICRO unit will wake up to take live readings and perform calculations every 15 minutes. It will write a record to the extended log at this time, regardless of whether the data has changed or not.

Example D

Here the **Scheduled Wakeup Interval** and the **Scheduled Extended Log Interval** have been set up as in the previous example, but the **Extended Log By Exception** option has also been enabled.



The GAS MICRO unit will check for changes every 15 minutes, plus whenever the unit wakes up to read live conditions and perform calculations due to any other trigger. Any of the following events will trigger the GAS MICRO to wake up and check for changes:

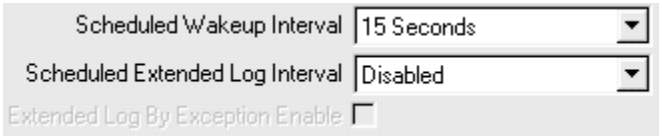
- a Scheduled Wakeup Interval has elapsed
- a specified number of pulses has been detected (Pulses Per Wakeup option)
- the piezo button has been pushed (awake until the LCD times out)
- the unit is being polled via the iMaCS software (Watch Window, battery calibration, I/O calibration)
- Modbus communication (awake for 5 seconds after last communication)

If any of the items selected for extended logging changed by more than the specified deadband amount from the last logged amount, a record is written to the extended log recording all extended log items and a timestamp.

6.4.10 Extended Log By Exception Enable cont'd

Example E

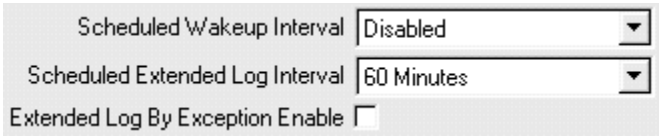
In the following example, the **Scheduled Wakeup Interval** has been set to **15 Seconds**, the **Scheduled Extended Log Interval** and the **Extended Log By Exception** option have both been disabled.



The GAS MICRO unit will wake up, take readings and perform calculations every 15 seconds. These items will be held in memory for use in the next Hourly, Daily, and Monthly log events, but no Extended Logs will be written.

Example F

In this example, the **Scheduled Wakeup Interval** has been disabled, the **Scheduled Extended Log Interval** has been set to **60 Minutes** and the **Extended Log By Exception** option is not enabled.



The GAS MICRO unit will write a record to the extended log based on live readings and calculations every hour, on the hour. (The unit wakes up every hour to collect hourly log data.)

Note: While hourly logs normally provide for 64 days worth of data for eight items, using extended logs in this way provides 341 days of hourly data for four items.

6.5 Flow Screen

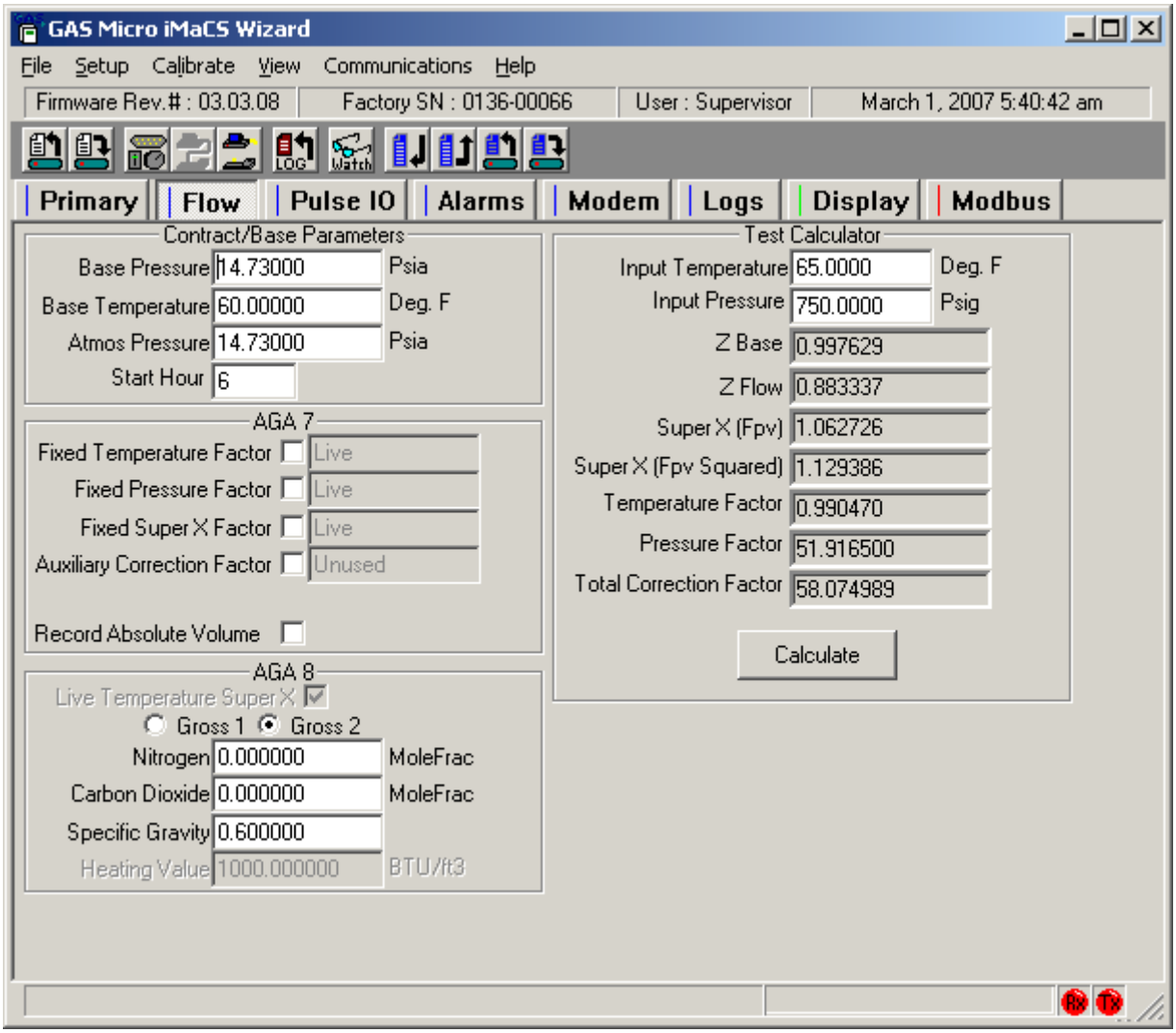


Figure 6-3 Flow screen

6.5.1 Base Pressure

The base pressure (absolute) is set as specified in the contract. The GAS MICRO's readings are corrected to this value.

6.5.2 Base Temperature

The base temperature is set as specified in the contract. The GAS MICRO's readings are corrected to this value.

6.5.3 Atmospheric Pressure

The atmospheric pressure (absolute) is set according to where the unit is located. The GAS MICRO's readings are corrected using this value.

6.5.4 Start Hour

The **Start Hour** is also referred to as the Billing Hour or Contract Hour. It specifies, based on a 24-hour clock, the start hour of a contract day. It also determines when daily logs are written.

6.6 AGA 7 — Corrected Volume Calculation

6.6.1 Fixed Temperature Factor

If this option is checked, the number entered is used for the Flowing Temperature Factor. This option would be used, for example, if the meter is temperature compensated.

Note: If this option is checked, the **Live Temperature Super X** option under AGA 8 becomes available. This allows a live temperature to be used for the **AGA 8** calculation even when a fixed factor is used for the **AGA7** calculation.

If this option is not checked, the Flowing Temperature Factor (F_{tm}) is calculated from the live temperature using the following equation:

$$F_{tm} = \frac{520}{T_f}$$

Where T_f is the actual flowing temperature of the gas in degrees Rankine.

6.6.2 Fixed Pressure Factor

If this option is checked, the number entered is used for the **Pressure Factor**. This option might be used if there is a regulator upstream.

If this option is not checked, the Pressure Factor (F_{pm}) is calculated from the live gauge pressure using the following equation:

$$F_{pm} = \frac{\frac{P_f}{+p_a}}{p_b}$$

Where: P_f is the gauge pressure
P_a is the atmospheric pressure
P_b is the contract base pressure (absolute)

6.6.3 Fixed Super X Factor

If this option is checked, the number entered is used for the Super Compressibility Factor.

If this option is not checked, the Super Compressibility Factor is calculated from the live temperature, pressure and gas composition.

If **Super X** is calculated in the Billing System software, then the Factor should be fixed with a value of 1.00000.

6.6.4 Auxiliary Correction Factor

This is an additional multiplier that is available if needed.

6.6.5 Record Absolute Volume

If this option is checked and **Direction Detection**, **Single Pulse**, or **Single Pulse w/ Direction** is selected on the *Pulse IO*"screen, the total AGA7 corrected volume passing in either direction is captured in the **Uncorrected Totalized Volume** and the **Corrected Totalized Volume**.

6.7 AGA 8 — Super Compressibility Calculation

6.7.1 Live Temperature Super X

This option becomes available when the **Fixed Temperature Factor** under the **AGA7** calculation is checked.

If this option is checked, it allows a live temperature to be used for the **AGA8** calculation even when a fixed factor is used for the AGA7 calculation.

6.7.2 Gross 1 / Gross 2

Gross 1 and Gross 2 are two methods for calculating the Super Compressibility. The appropriate fields for each calculation are enabled depending on which option is chosen.

- **Nitrogen**

  The Nitrogen component of the gas for the AGA 8 calculation.

- **Carbon Dioxide**

  The Carbon Dioxide component of the gas for the AGA 8 calculation.

- **Specific Gravity**

  The ratio of the density of the gas to the density of dry air.

- **Heating Value**

  The amount of heat provided by the complete combustion of a unit of fuel.

6.8 Test Calculator (AGA 8)

This is a reference tool that calculates several values based on a temperature and pressure. The numbers are calculated using the options and numbers currently in the Contract/Base Parameters setup and the AGA8 setup. This can be used to verify meter calculations. To use this tool, simply enter a temperature and pressure, then click on the “Calculate” button.

- **Input Temperature**

  Enter a temperature into the Test Calculator.

- **Input Pressure**

  Enter a pressure into the Test Calculator.

- **Z Base**

  The Base Compressibility Factor as calculated by the Test Calculator.

- **Z Flow**

  The Flowing Compressibility Factor as calculated by the Test Calculator.

- **Super X (F_{pv})**

  The Supercompressibility Factor as calculated by the Test Calculator.

- **Super X (F_{pv}) Squared**

  The Compressibility Ratio Factor as calculated by the Test Calculator. Also known as the “s” factor, it is equal to Z Base divided by Z flow.

- **Temperature Factor**

  The Temperature Factor (F_t) as calculated by the Test Calculator.

- **Pressure Factor**

  The Pressure Factor (F_p) calculated by the Test Calculator.

- **Total Correction Factor**

  The Total Correction Factor as calculated by the Test Calculator. This number, multiplied by the uncorrected volume or rate, should give the corrected volume or rate.

6.9 Pulse I/O Screen

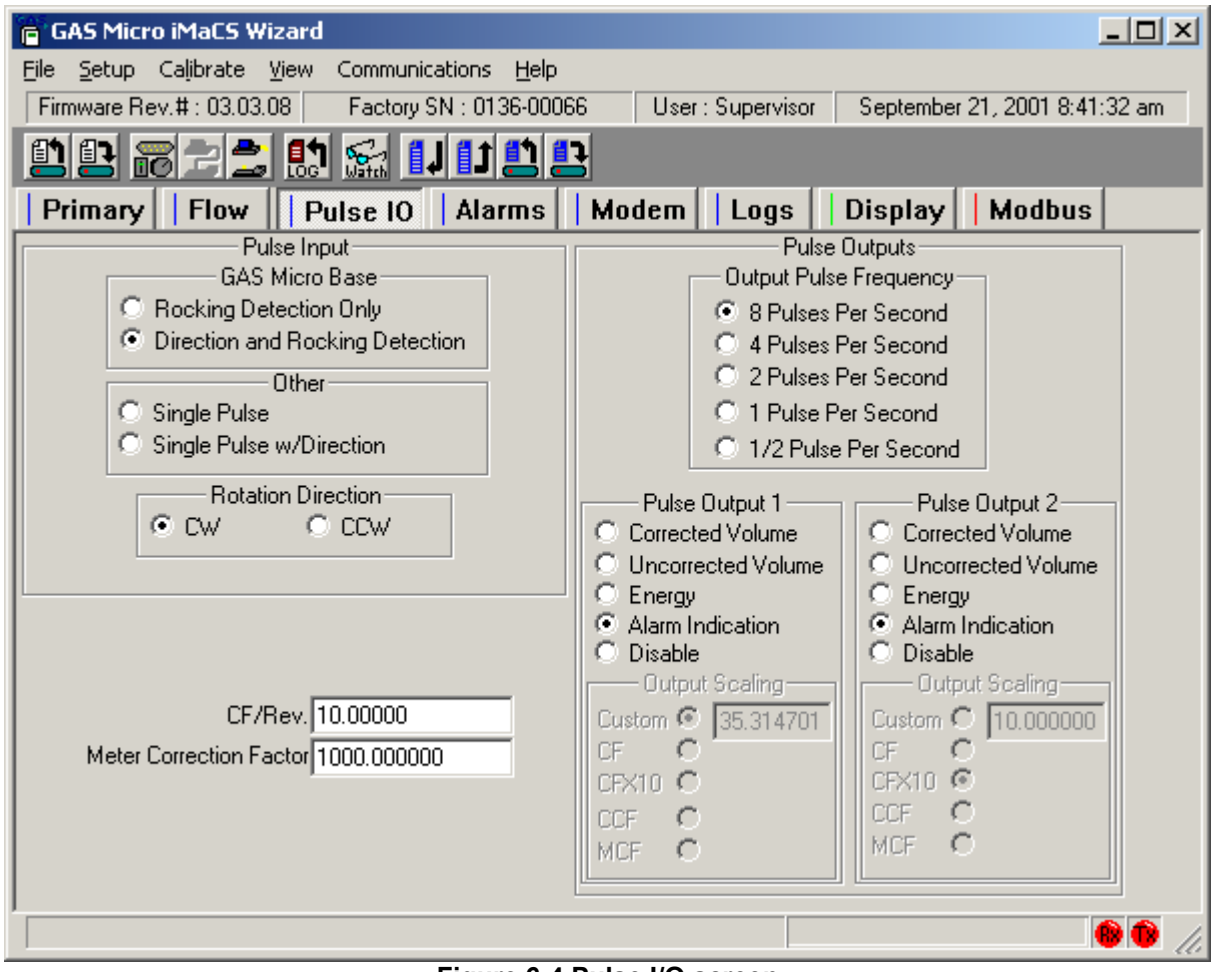


Figure 6-4 Pulse I/O screen

6.10 Pulse Input Options

6.10.1 Rocking Detection Only

When this option is selected, rocking and reverse flow are ignored.

Rocking detection eliminates the collection of false pulses due to rocking (a back and forth movement of the wiggler that could cause erroneous readings.) or dithering (magnet vibration causing a rapid activation/deactivation of a reed switch.). A fail-safe, rocking-detection routine incorporating four independent reed switches requires a complete revolution to register a valid pulse. This corrects for the effect of meter bumping and rocking.

Reverse flow is ignored unless **Direction Detection** is enabled.

6.10.2 Direction Detection

Direction detection detects reverse flow and accumulates it separately from forward flow. Rocking detection is automatically included when **Direction Detection** is enabled.

6.10.3 Rotation Direction

This option is used to set which direction will be considered a forward flow. Choose **CW** for clockwise rotation or **CCW** for counter-clockwise rotation. The direction refers to the direction of the meter's mechanical index.

6.10.4 Forward Signal Level

This option only applies to the **Single Pulse with Direction** option. It is used to set whether TTL Low (0 volts) or TTL High (5 volts) signals a flow in the forward direction.

6.10.5 Single Pulse (Also see Section 9.3)

This feature is used if the GAS MICRO is being configured to accept single pulse inputs from any pulse output device. This setting does not apply if the GAS MICRO is being remotely mounted with a GAS MICRO base using the 5-reed switch pulse input cable.

There are two ways to supply single pulse input to the GAS MICRO.

1. The first method is for the device providing the pulse to provide an open collector output. This is the preferred method. In this case, the sending device provides an electrical relay only (form A). A +5 volt voltage is provided at Pin 1 of connector P12. Pin 1 and Pin 3 are connected to P101 using a single pulse input jumper. P101 and P102 are connected with on-board traces. The customer connects pulse input to P102.

> **Note:** No voltage is supplied by the customer in this case. Maximum length = 100 ft. See Figure 6-10.

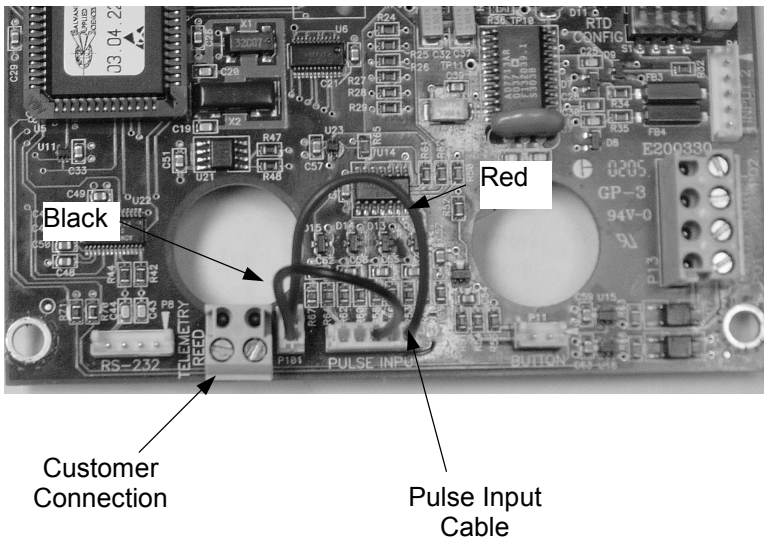


Figure 6-5 Single pulse

6.10.5 Single Pulse cont'd

2. The second method is to provide TTL-level voltage pulses. The input pulses must be at TTL levels (0 volts for the low signal and 5 volts for the high signal). Sending a voltage that is too high can damage the GAS MICRO unit. If the device providing the signal does not supply the signal at these levels, the signal must be converted to these levels. Signal input is connected to the left terminal of P102 and the 'common' from the signal device is connected to 'ground' on the GAS MICRO. This is accomplished by connecting to one of the motherboard mounting screws on the bottom corners of the motherboard.

Note: The P12 connector has no ground pin. A ground wire can be connected to one of the four motherboard mounting posts or the device can be grounded externally.

If the **Single Pulse with Direction** option is used, pin 5 (yellow wire) of connector P12 can be used to signal forward or reverse flow. The **Forward Signal Level** option is used to set whether TTL Low (0 volts) or TTL High (5 volts) signals a flow in the forward direction. (See Figure 6-6)

6.10.6 Single Pulse with Direction

This option is used when another device supplies an input pulse *and* a separate signal identifying the direction. The second signal is input through pin 5 (yellow wire) on connector P12. The *Forward Signal Level* setting (See Section 6.10.4) determines whether TTL Low (0 volts) or TTL High (5 volts) will be considered forward flow. (See Figure 6-6)

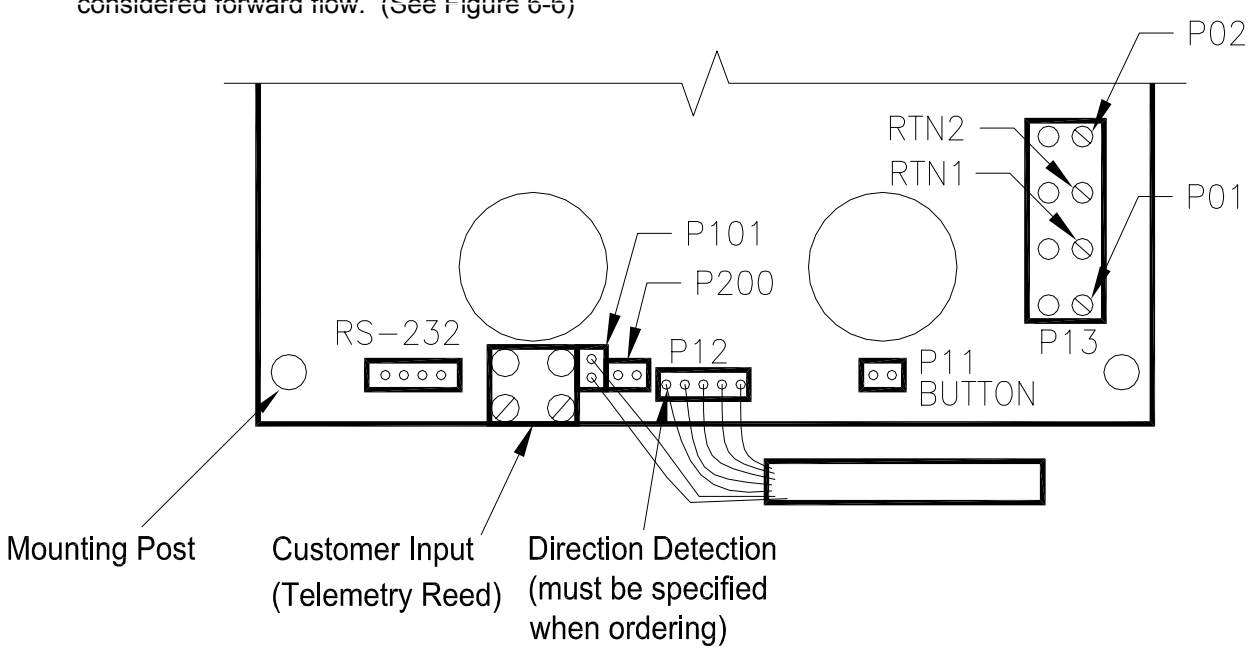


Figure 6-6 Single pulse with direction pin out

6.11 Meter Scaling & Calibration

6.11.1 CF / Rev

Cubic feet per revolution of the meter's mechanical index should be entered here. This is the "K" factor of the meter.

6.11.2 Meter Correction Factor

This is the multiplier required to correct the meter's scaling should be entered here.

6.12 Pulse Output Options

The pulse output options allow the GAS MICRO to send pulses to another device for various reasons. Pulses can represent uncorrected volume, corrected volume, or alarm conditions. The options for configuring pulse output are found on the *Pulse I/O* screen.

6.12.1 Output Pulse Frequency

Output pulses are sent out at the rate that is selected ranging from 8 pulses per second down to 1 pulse every two seconds. Each pulse has a duty cycle of 62.5 miliseconds. These options come into play when the pulses are being used to represent uncorrected or corrected volumes. Each pulse that is sent out represents the volume amount that is set up in the **Output Scaling** options under **Pulse Output 1**or **Pulse Output 2**. The output pulse frequency sets the upper limit to how fast these pulses will be sent out.

6.12.2 Pulse Output 1 / Pulse Output 2

Two channels are available for sending output pulses. Each channel can be configured separately. A channel can be set to send pulses according to the corrected volume, the uncorrected volume, or the energy volume. Pulses can also be sent for alarm conditions. If the option is disabled, the pulse output signals can be controlled remotely by way of the Modbus.

If the **Corrected Volume**, **Uncorrected Volume**, or **Energy** option is selected, the scaling can be configured by specifying a custom scaling factor or by selecting one of the provided choices ranging from one pulse per unit to one pulse every 1000 units. (Units are BTUs for the Energy setting.)

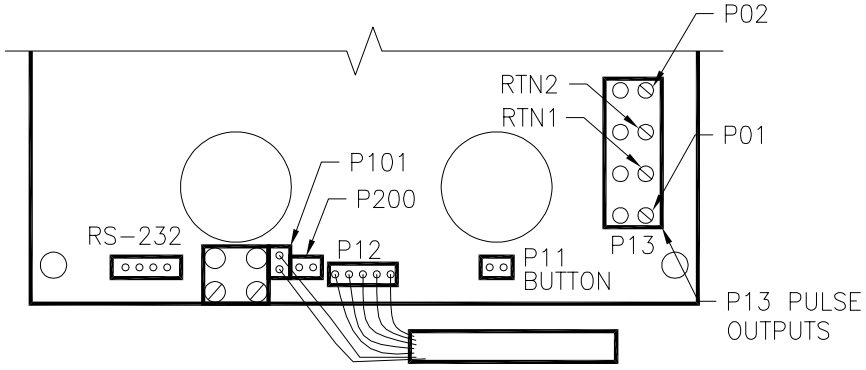
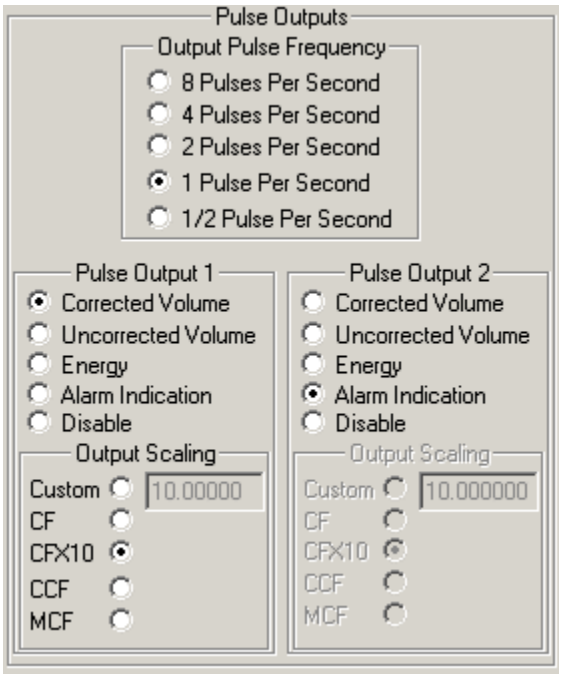


Figure 6-7 Pulse output terminals

Hint: Entering a custom factor of "35.3147" will generate one pulse per cubic meter. This conversion factor is accurate to within 0.0001%. The pulse output connectors (P13) are electrically isolated from the rest of the GAS MICRO circuitry.

-Example-

In the following example, **Output Pulse 1** is set up for **Corrected Volume** and the scaling is set to **CF x 10**. **Output Pulse 2** is set to **Alarm Indication**. The **Output Pulse Frequency** is set to **1 pulse per second**.



The GAS MICRO will send out a pulse each time it measures 10 corrected cubic feet of volume. If there is a temporary surge registering 1000 cubic feet in a short time period, the GM will continue to send out pulses on pulse output channel 1, one per second, until the volume has been accounted for (100 pulses in this example). It may take several minutes to catch up from such a surge. Remember, the pulses represent volume, not flow rate. Typically, the pulse rate is limited by what the receiving device can handle. This is normally used for applications like odorizers where a squirt of odorant is injected into the gas stream each time a specific volume of gas has passed through the meter.

If an alarm condition occurs, a single pulse will be sent out on pulse output 2.

6.12.3 Raw Pulse Output

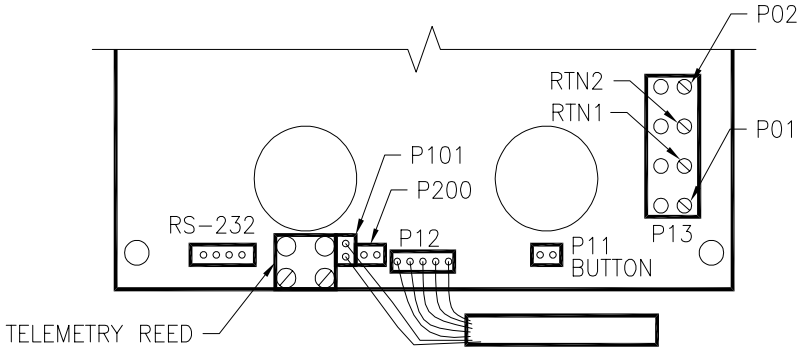


Figure 6-8 Connectors P12 and P101

There are two sets of wires coming from the GAS MICRO base. The first is a 5-wire connector that provides pulses to the GAS MICRO and connects to connector P12 on the GAS MICRO motherboard. The second is a two-wire cable that connects to the connector labelled **P101**. This is just to the left of connector P12. These wires come from the pulse board in the GAS MICRO base. They provide raw (uncorrected) pulses to any device that needs them. (They open and close a relay while the device receiving the pulses must supply the voltage. This also means that even if the GM loses all power, the other device can still receive pulses – assuming that the other device still has power.) To receive these pulses the wires from the GAS MICRO base should be connected to **P101** and the wires from the other unit are then connected to the connection block labelled **Telemetry Reed** that is just to the left of connector **P101**. This is connected straight through and is not processed in any way by the GAS MICRO.

6.13 Alarms Screen

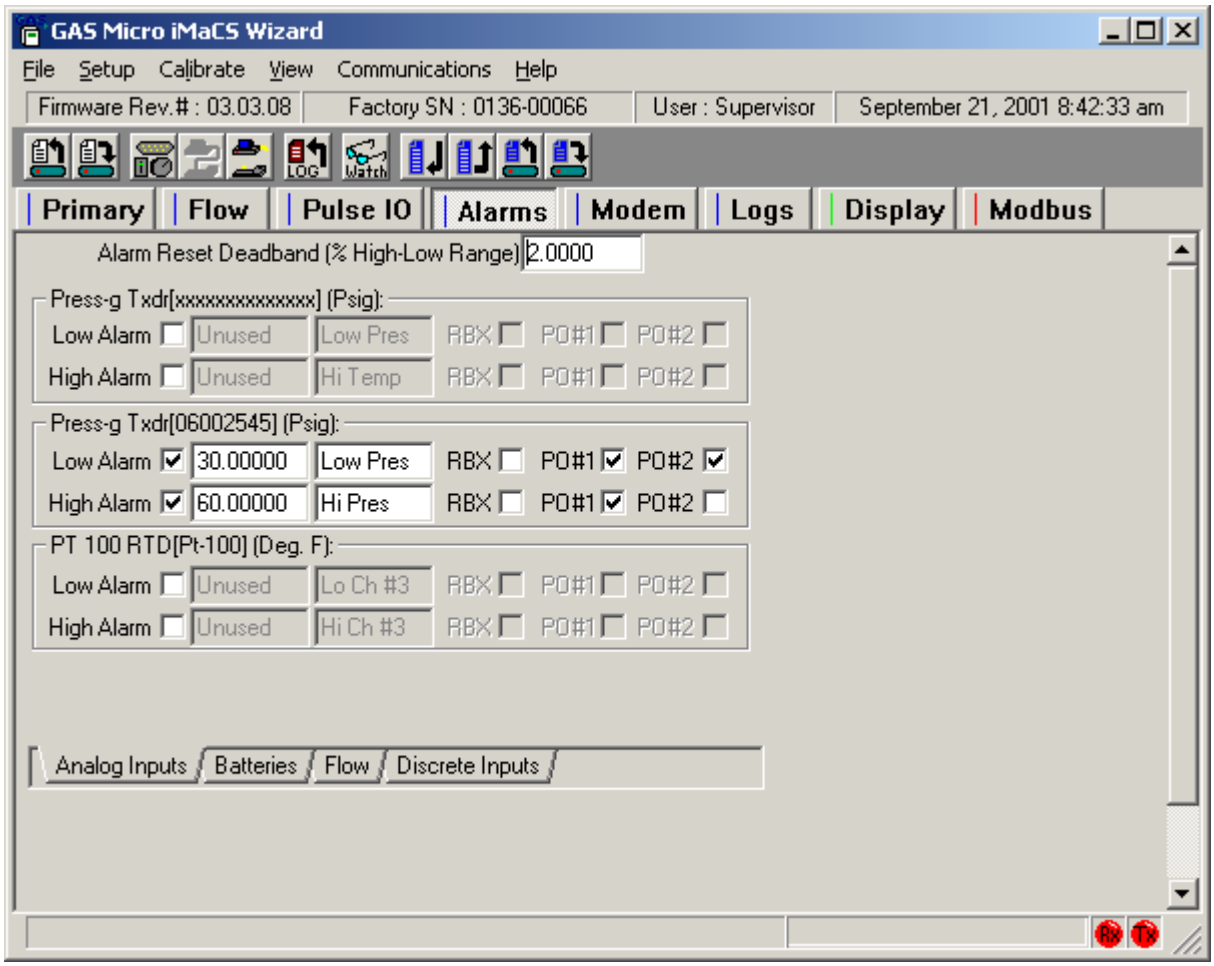


Figure 6-9 Alarms screen

6.13.1 Alarm Reset Deadband (% High-Low Range)

This number is a percentage of the range between the High Alarm Value and the Low Alarm Value.

When an alarm condition has been detected, the alarm is not reset until the measurement that caused the alarm falls within the valid range by the Deadband percentage.

Alarm Reset Deadband Examples

High Alarm example

Given the following settings:

Guage Pressure Low Alarm:	5 psig
Guage Pressure High Alarm:	100 psig
Alarm Reset Deadband:	10%

The deadband amount is calculated as:
10% of (100 psig – 5 psig) = 9.5 psig
If a high alarm condition is detected, the pressure must drop to 90.5 psig (100 - 9.5 psig) for the alarm condition to be reset.

6.13.1 Alarm Reset Deadband cont'd

Low Alarm example

Given the following settings:

Flow Rate Low Alarm:	100 cubic feet / hour	The deadband amount is calculated as: 5% of (10,000 – 100 psig) = 495 If a high alarm condition is detected, the flow rate must increase to 595 cubic feet / hour (100 + 495) for the alarm condition to be reset
Flow Rate High Alarm:	10,000 cubic feet / hour	
Alarm Reset Deadband:	5%	

The Alarm Reset Deadband value applies to all alarms except the nomination-exceeded alarm and the alarms on the "Discretes" tab.

6.14 Alarm Details

6.14.1 Low Alarm / High Alarm

To set a low alarm or high alarm threshold, select the check box next to the appropriate item and enter the low or high value. If this value is exceeded, an alarm condition will be set and appropriate action will be taken depending on the other options chosen. The alarm details will be logged.

6.14.2 RBX

If the **RBX** (Report By eXception) option is chosen, an alarm condition will initiate a call using the phone number(s) set up in the modem setup section. The text in the box to the right will be included in the message along with the Site Identification information from the *Primary setup* screen.

6.14.3 PO#1

The **PO#1** (Discrete Pulse Output 1) option is available if **Pulse Output 1** on the *Pulse IO* screen is set to **Alarm Indication**. If this option is selected, a pulse will be sent on channel one whenever there is an alarm condition for this item.

6.14.4 PO#2

The **PO#2** (Discrete Pulse Output 2) option is available if **Pulse Output 2** on the *Pulse IO* screen is set to **Alarm Indication**. If this option is selected, a pulse will be sent on channel two whenever there is an alarm condition for this item.

6.14.5 Description

This text is used when viewing alarm logs. It is also sent along with the Site Identification information from the *Primary setup* screen whenever the **RBX** option is chosen and the modem setup information is provided.

6.15 Available Alarms

6.15.1 Low Alarm — Battery

Select the check box to enable this alarm and enter the minimum value. If the voltage falls below the value specified, an alarm condition will be set and appropriate action will be taken depending on the other options chosen. The alarm details will be logged.

> **Note:**
> The GAS MICRO will not function at voltages lower than 6.0 volts DC. It is recommended that the low battery alarm be set to 6.5 volts.

6.15.2 Secondary Battery

This alarm applies to the secondary battery pack.

6.15.3 Modem Battery

This alarm applies to the battery connected to the modem power jack.

> **Note:** A CDPD modem requires considerably more voltage (and current) than the GAS MICRO unit. Ensure an appropriate value is entered for the modem being used.

6.15.4 Single Power Supply

Enabling this option makes the **Second Battery** alarm option unavailable. The single power supply will display in the system as the **Primary Battery**, even if it is connected to the **Secondary Battery input** on the GAS MICRO motherboard.

6.15.5 Reed Switch Fail

If this is enabled, a reed switch failure will cause an alarm condition. The event will be logged and appropriate action taken depending on the other options chosen.

6.15.6 Alarms — Discrete Inputs #1 and #2

If this is enabled, a pulse received on the corresponding **Input Pulse** channel will initiate an alarm condition. The alarm event will be logged and appropriate action will be taken depending on the other options chosen.

These options are available when one of the single input pulse options is selected on the *Pulse IO* screen. If **Single Pulse** is selected, both **Discrete Inputs** are available. If **Single Pulse w/ Direction** is selected, only **Discrete Input #2** is available.

Discrete Input #1 is input through Pin 5 (Yellow wire) on connector P12 of the GAS MICRO motherboard.

Discrete Input #2 is input through Pin 2 (Green wire) on connector P12 of the GAS MICRO motherboard.

> **Note:** The P12 connector has no ground pin. A ground wire can be connected to one of the four motherboard mounting posts or the device can be grounded externally.

6.14 Alarms cont'd

6.15.7 Input Channel #1

The alarms in this group apply to the Analog Input device on channel 1.

6.15.8 Input Channel #2

The alarms in this group apply to the Analog Input device on channel 2.

6.15.9 Input Channel #3

The alarms in this group apply to the Analog Input device on channel 3.

6.15.10 Modem Battery

This alarm applies to the Modem Battery. The integral standard modem requires a minimum of 6 volts to function properly. It is recommended that the alarm value be set to 6.5 volts.

6.15.11 Flow Rate

The alarms in this group apply to the corrected flow rate.

6.15.12 Nomination

This alarm applies to nominated gas volume amounts. The nomination-exceeded alarm can be set up for hourly, daily, or monthly nominations.

6.16 Modem Screen

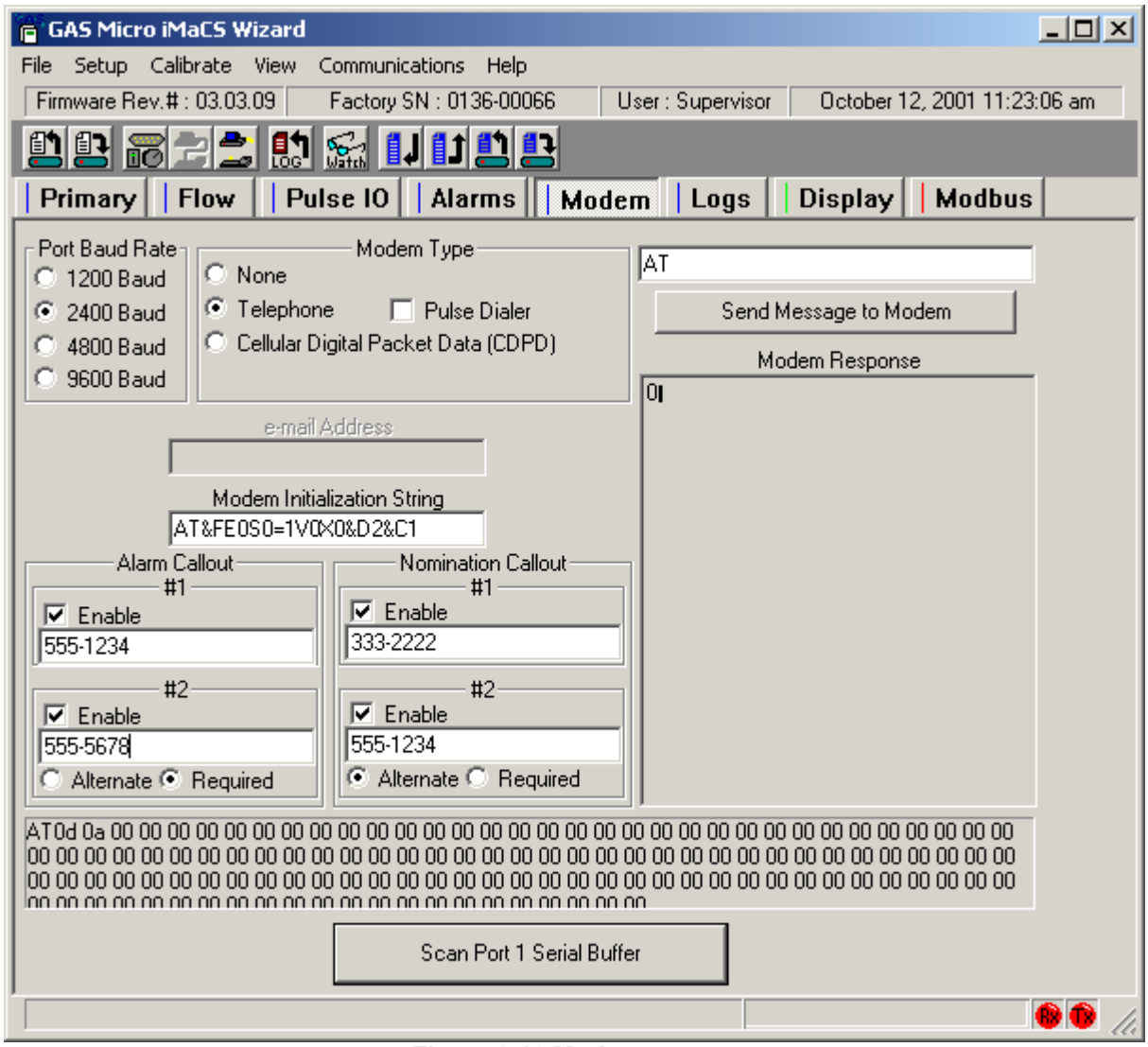


Figure 6-10 Modem screen

6.16.1 Scan Port 1 Serial Buffer

Clicking on the **Scan Port 1 Serial Buffer** button displays the contents of the buffer for the internal serial port. This is a diagnostic tool only.

6.16.2 Send Message to Modem

Standard Hayes™-compatible AT commands can be sent to a modem attached to the internal serial port by entering the command in the box above the **Send Message to Modem** button. The modem's response displays in the **Modem Response** box. The keyboard arrow keys can be used in the **Modem Response** box to scroll through longer responses.

6.17 GAS MICRO Modem Setup (Standard Modem)

(For CDPD Modem Setup, see Section 6.18.)

6.17.1 Port Baud Rate

The standard modem attaches to the internal serial port on the GAS MICRO motherboard. The baud rate for the serial port can be set to 1200, 2400, 4800, or 9600 baud. The default for the low-power modems which we can provide is 2400 baud. The serial port should be set to match the modem speed.

6.17.2 Pulse Dialer

Use this option to dial by pulse when tone dialing is not available.

6.17.3 Modem Initialization String

This accepts standard Hayes™ -compatible modem commands. We have found that the following command string works best under most conditions:

AT&FE0S0=1V0X0&D2&C1

6.17.4 Alarm Dial Out Numbers

If the GAS MICRO will be set up to send notification of alarm conditions (other than a nomination exceeded alarm), specify the dial out number(s) here. The dial out number field becomes available when the matching **Enable** box is selected. Either one or two numbers may be specified.

The GAS MICRO will attempt to call a number three times. If all three attempts fail and a second number has been supplied as an alternate, it will try the second number three times. If the calls to the alternate phone number fail, the GAS MICRO will attempt to call the number(s) again at the top of the hour, every hour, until the alarm condition is successfully reported.

If the **Required** option is selected, both numbers are always dialled for an alarm condition. If either call is unsuccessful, the GAS MICRO will try again at the top of the hour, every hour, until the alarm condition is successfully reported to both numbers.

6.17.5 Nomination Dial Out Numbers

If the GAS MICRO will be set up to send notification when the nomination amount is exceeded, specify the dial out number(s) here. The **dial out number** field becomes available when the matching **Enable** box is selected. Either one or two numbers may be specified.

The GAS MICRO will attempt to call a number three times. If all three attempts fail and a second number has been supplied as an alternate, it will try the second number three times. If the calls to the alternate phone number fail, the GAS MICRO will attempt to call the number(s) again at the top of the hour, every hour, until the alarm condition is successfully reported.

If the **Required** option is selected, both numbers are always dialed for an alarm condition. If either call is unsuccessful, the GAS MICRO will try again at the top of the hour, every hour, until the alarm condition is successfully reported to *both* numbers.

> **Note:** If **Automated Meter Reading** (AMR) is enabled on the *Primary* screen, only one nomination callout number is available; the other is used as the callout number for AMR reporting.

6.18 GAS MICRO Modem Setup (CDPD Modem)

(For Standard Modem Setup, see Section 6.17)

6.18.1 General Information

The GAS MICRO can be set up to communicate over a TCP/IP network (such as the Internet) via a CDPD modem. We recommend the AirLink Raven™ from AirLink Communications, Inc. (www.airlink.com) for this purpose. When using a CDPD modem, alarms are sent as e-mail messages.

6.18.2 Port Baud Rate

The CDPD modem attaches to the internal serial port on the GAS MICRO motherboard. The baud rate for the serial port can be set to 1200, 2400, 4800, or 9600 baud. The default for the AirLink Raven™ CDPD modem is 9600. The port baud rate should be set to match. To change the baud rate of the CDPD modem, see the AT Commands Section of the User's Manual for the CDPD modem.

6.18.3 Modem Type

For a CDPD modem, the "Cellular Digital Packet Data (CDPD)" option should be selected.

6.18.4 Pulse Dialer

This option is ignored for CDPD modems.

6.18.5 e-mail Address

When using the GAS MICRO unit with a CDPD modem, this field sets the unit's 'mail-from' address for sending out alarms by e-mail. The domain name portion of this e-mail address (the part to the right of the '@' symbol) also specifies the mail server to which the unit will connect.

The 'mail-to' address is set up in the *Alarm Callout* Section.

6.18.6 Modem Initialization String

Standard Hayes™-compatible style AT commands can be used to communicate with, and program, the AirLink Raven™ modem or other CDPD modem. We recommend the following settings as starting point:

AT&FE0S0=1V0X0&D2&C1

Note: The "0"s above are the number zero, *not* the letter O. The "1"s are the number one, *not* the letter L.

This accomplishes the following:

AT	Tells the modem that commands are to follow
E0	Turns echo off
V0	Sets command response mode to terse (numeric). The GAS MICRO cannot interpret verbose responses.
X0	Turns off "call progress" extended result codes
&D0	Ignore DTR. (Same as register S211=1)

6.18.7 Alarm Callout Numbers

If the GAS MICRO will be set up to send notification of alarm conditions (other than a nomination exceeded alarm), specify the 'mail-to' e-mail address here. The field becomes available when the matching "Enable" box is selected. Either one or two e-mail addresses may be specified. The 'mail-from' address is set up in the **e-mail Address** field.

The GAS MICRO will attempt to send an e-mail to the server. If the attempt fails and a second e-mail address has been supplied as an alternate, it will try the second e-mail address. If the unit is unable to successfully send an e-mail to either address, the GAS MICRO will attempt to send to the e-mail address(es) again at the top of the hour, every hour, until the Alarm condition is successfully reported.

If the **Required** option is selected, e-mails are sent to both addresses for an alarm condition. If either transmission is unsuccessful, the GAS MICRO will try again at the top of the hour, every hour, until the alarm condition is successfully reported to both e-mail addresses.

6.18.8 Nomination Callout Numbers

If the GAS MICRO will be set up to send notification when the nomination amount is exceeded, specify the dial out address(es) here. The **Dial out number** field becomes available when the matching **Enable** box is selected. Either one or two numbers may be specified.

The GAS MICRO will attempt to send an e-mail to the server. If the attempt fails and a second e-mail address has been supplied as an alternate, it will try the second e-mail address. If the unit is unable to successfully send an e-mail to either address, the GAS MICRO will attempt to send to the e-mail addresss(es) again at the top of the hour, every hour, until the Alarm condition is successfully reported.

If the **Required** option is selected, e-mails are sent to both addresses for an alarm condition. If either transmission is unsuccessful, the GAS MICRO will try again at the top of the hour, every hour, until the alarm condition is successfully reported to both e-mail addresses.

> **NOTE:** If **Automated Meter Reading** (AMR) is enabled on the *Primary* screen, only one nomination callout address is available; the other is used as the destination address for **AMR** reporting.

6.18.9 Additional Information

The GAS MICRO iMaCS software provides a **Modem Pass-thru** option that allows standard Hayes™-compatible AT commands to be sent to the modem. This feature can be used to configure any modem that is attached to the GAS MICRO unit via the internal serial port. For the AirLink Raven™ modem or the Novatel Expedite™ modem, the following modem register settings should be used.

Register	Content	Description
S0	1	Auto Answer = On
S23	9600,8N1	Line parameter settings
S53	T999.999.999.999/99999	Where the first letter is "T" for TCP or "P" for UDP.
		The remainder of the string is the IP address and port for the SMTP host.
S110	999.999.999.999/99999	IP address and port for the CDPD modem.
S211	1	Ignore DTR.

6.19 Logs Screen

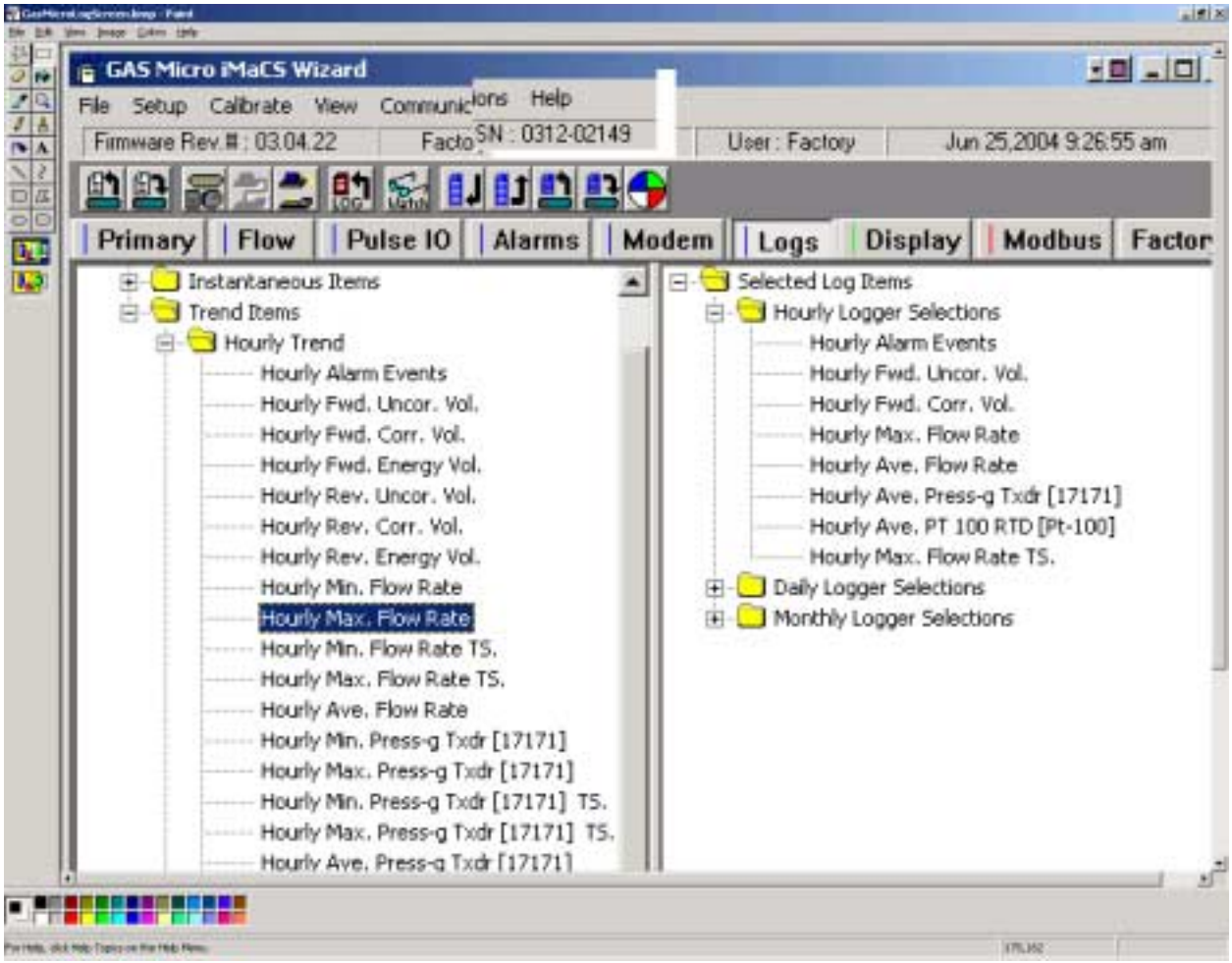


Figure 6-11 Logs screen

6.19.1 GAS MICRO Database Item List — Logs Screen

The left panel contains a list of items that can be selected for logging. The items are contained in three major groups. Each group can be expanded or collapsed by either double-clicking on the group's folder icon or clicking on the plus sign to the left of the folder icon.

To choose any item for logging, drag it to the appropriate folder in the right panel. The folders on the right panel represent reporting frequency options. For example, to report on the maximum flow rate each hour, drag the item labeled **Current Hour Max. Flow Rate** from the left panel and drop it into the folder called **Hourly Logger Selections** in the panel on the right. All items in the **GAS MICRO Database Item List** are calculated, but only the selected items are logged.

6.19.2 Configuration Items

Configuration Items are options having to do with the unit's configuration. These items are not based on the GAS MICRO's measurements or calculations.

6.19.3 Instantaneous Items

Instantaneous Items are calculated each time the GAS MICRO takes a measurement.

6.19.4 Trend Items

Trend items show the characteristics of the measurements over a specific period of time. They are calculated according to measurements driven by time events or pulse events. All minimums, maximums, averages and totals for a given time period are included. Trend items are accumulated up to the indicated time period and reset for the next time period.

> **NOTE:** These numbers will be time-weighted averages, flow-weighted averages, or a combination of the two, depending on the options selected on the **Power Management** panel of the *Primary setup* screen.

6.19.5 Selected Log Items

The right panel contains the items that have been selected for logging. Each group represents a different reporting frequency. A group can be expanded or collapsed by either double-clicking on the group's folder icon or clicking on the plus sign to the left of the folder icon.

A maximum of eight items each can be selected for the Hourly, Daily and Monthly Logs. A maximum of four items can be selected for the Extended Logs.

The Logger provides 64 days of hourly data, 188 days (just over six months) of daily data, and three years of monthly data. Extended logs provide an additional 8192 records that can be set up for various time intervals ranging from 1 minute to 1 hour. The extended logs can also be set up for exception reporting, writing records only when the measured value changes beyond a deadband range. If exception reporting is used, the first of the four selectable logging items is set aside for a timestamp.

> **Note:** All items in the **GAS MICRO Database Item List** are calculated, but only the selected items are logged.

6.19.6 Adding an item

To include an item for logging, simply drag the item from the choices provided in the left panel and drop it in the appropriate folder in the right panel. For example, to report on the maximum flow rate each hour, drag the item labeled "Current Hour Max. Flow Rate" from the left panel and drop it into the folder called "Hourly Logger Selections" in the panel on the right.

6.19.7 Removing an item

To remove an item from the **Selected Log Items**, click on the item to select it, and press the <Delete> key.

6.19.8 Moving an item

An item can be moved up or down in the list within the same reporting frequency by clicking once on the item to select it, then holding down the <Alt> key while using the ↑ and ↓ keys to move the item.

6.19.9 Changing an item (applies only to items selected for the Extended Logs)

Double-click on the item to set the deadband amount for Extended Log exception reporting.

6.19.10 Downloading the current Log Item List from the GAS MICRO Unit

To download the current **Log Item List** from the GAS MICRO unit, connect to the unit and press the  button on the toolbar.

6.19.11 Uploading the new Log Item List to the GAS MICRO Unit

After making the necessary changes, upload the new selections to the GAS MICRO unit by pressing the  button on the toolbar.

6.20 Display Screen

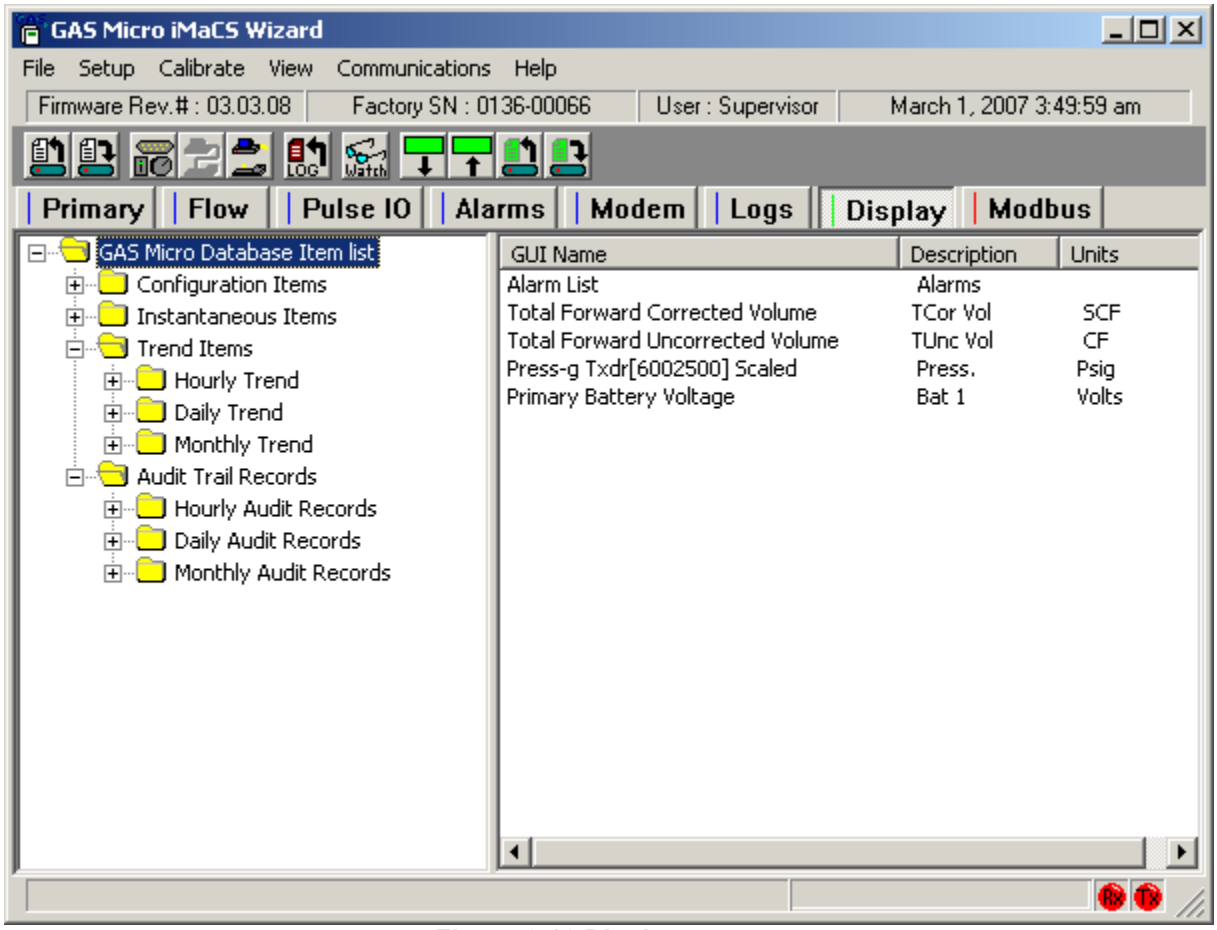


Figure 6-12 Display screen

6.20.1 GAS MICRO Database Item List — Display Screen

The left panel contains a list of items that can be selected for display. The items are broken down into four major groups that are described below. Each group can be expanded or collapsed by either double-clicking on the group's folder icon or clicking on the plus sign to the left of the folder icon.

To choose any item for display, simply drag it and drop it into the right panel.

6.20.2 Configuration Items

Configuration Items are options having to do with the unit's configuration. These items are not based on the GAS MICRO's measurements or calculations.

6.20.3 Instantaneous Items

Instantaneous Items are calculated each time the GAS MICRO takes a measurement.

6.20.4 Trend Items

Trend items show the characteristics of the measurements over a specific period of time. They are calculated according to measurements driven by time events or pulse events. It includes all minimums, maximums, averages and totals for a given time period. Trend items are accumulated up to the indicated time period and reset for the next time period.

> **Note:**
> These numbers will be time-weighted averages, flow-weighted averages, or a combination of the two, depending on the options selected on the **Power Management** panel of the *Primary setup* screen.

6.20.5 Audit Trail Records

Audit Trail Records are only available for items that have been chosen for logging on the *Log* screen.

6.20.6 Selected Display Items

The right panel contains the items that have been selected for display when the button on the front of the GAS MICRO is pressed. The LCD display will cycle through the selected items in the order listed on this panel. A maximum of 31 options can be selected for display.

6.20.7 Adding an item

To include an item for display, simply drag the item from the choices provided in the left panel and drop it into the right panel.

6.20.8 Changing an item

To modify an item on the display list, double-click on it. A pop-up screen will appear allowing you to change the item description, units description and number of decimal places. When applicable, unit conversion and scaling options are also available.

6.20.9 Removing an item

To remove an item from the **Selected Log Items**, click on the item to select it, and press the <Delete> key.

6.20.10 Moving an item

An item can be moved up or down in the list by clicking once on the item to select it, then holding down the <Alt> key while using the ↑ and ↓ keys to move the item.

6.20.11 Downloading the Current Display List from the GAS MICRO Unit

To download the current **Display List** setup from the GAS MICRO unit, connect to the unit and press the  button on the toolbar. This button is only available from the Display screen.

6.20.12 Uploading the New Display List to the GAS MICRO Unit

After making the necessary changes, upload the new selections to the GAS MICRO unit by pressing the  button on the toolbar. This button is only available from the *Display* screen.

6.21 Modbus Screen

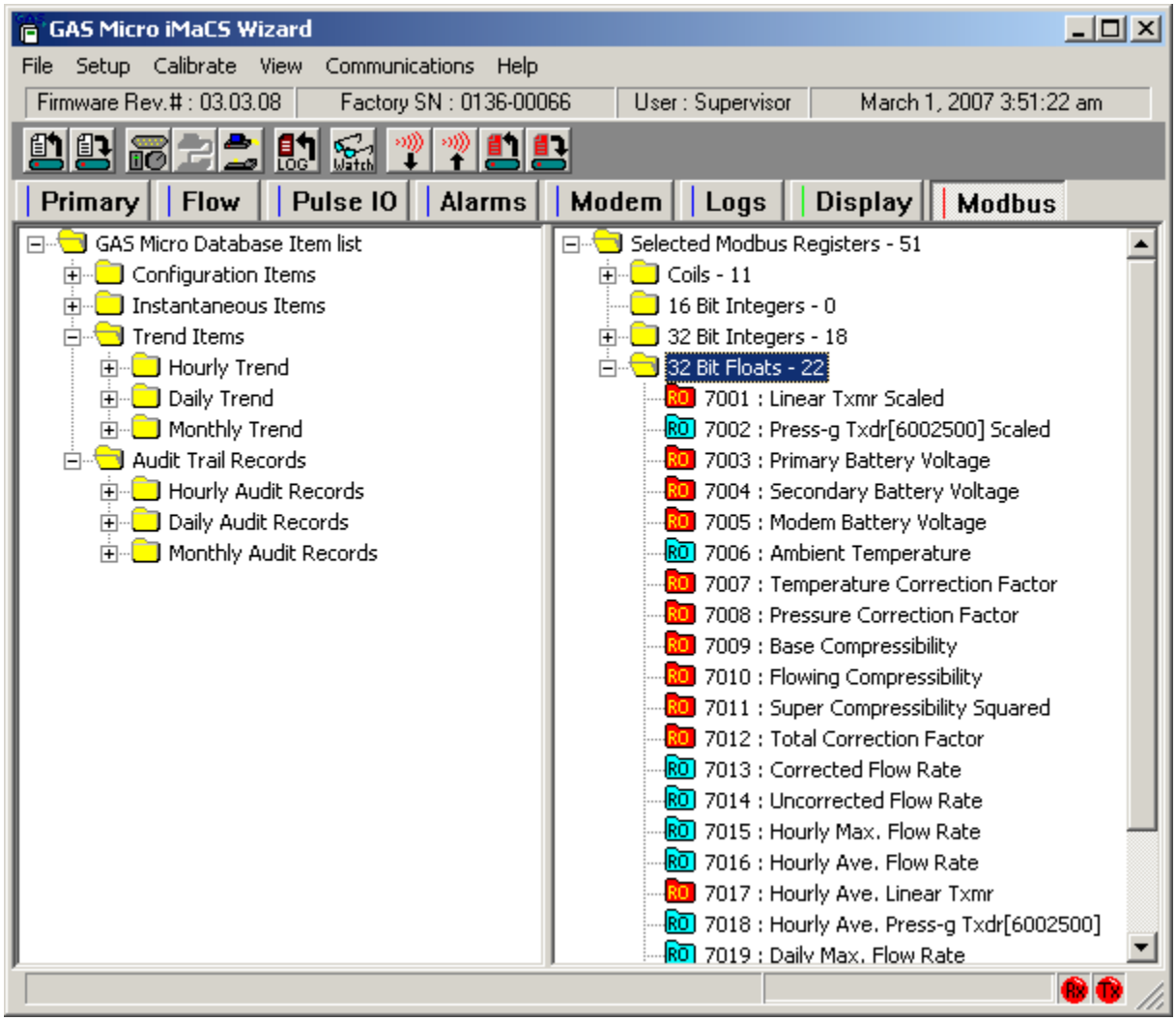


Figure 6-13 Modbus screen

6.21.1 GAS MICRO Database Item List — Modbus Screen

This panel contains a list of items that can be selected for Modbus communication. The items are broken down into four major groups that are described below. Each group can be expanded or collapsed by either double-clicking on the group's folder icon or clicking on the plus sign to the left of the folder icon.

To choose any item for display, simply drag it and drop it into the appropriate folder in the right panel. The folders on the right represent the structure of the data that will be transferred.

6.21.2 Configuration Items

Configuration Items are options having to do with the unit's softwareconfiguration. These items are not based on the GAS MICRO's measurements or calculations.

6.21.3 Instantaneous Items

Instantaneous Items are calculated each time the GAS MICRO takes a measurement.

6.21.4 Trend Items

Trend items show the characteristics of the measurements over a specific period of time. They are calculated according to measurements driven by time events or pulse events. It includes all minimums, maximums, averages and totals for a given time period. Trend items are accumulated up to the indicated time period and reset for the next time period.

> **Note:** These numbers will be time-weighted averages, flow-weighted averages, or a combination of the two, depending on the options selected on the **Power Management** panel of the *Primary setup* screen.

6.21.5 Audit Trail Records

Audit Trail Records are only available for items which have been chosen for logging on the *Log* screen.

6.21.6 Selected Modbus Registers

This panel contains the items that have been selected for communication with SCADA systems via the Modbus protocol. A maximum of 119 options can be selected for Modbus communication.

6.21.7 Adding an item

To include an item for display, simply drag the item from the choices provided in the left panel and drop it into one of the folders in the right panel. The folders in the right panel control the data format that will be used for sending and receiving this information.

When an item is added to this panel, the Modbus register number displays along with one of three icons. The icons indicate whether the item is modifiable or not.

- A green icon indicates that the register may be written to or read.
- A blue icon indicates that the register may only be read, but the data can be scaled.
- A red icon indicates that the register may only be read and there are no scaling options.

6.21.8 Changing an item

To modify an item with a blue or green icon, double-click on the item. A pop-up screen will appear allowing you to change the scaling or read/write permissions.

6.21.9 Removing an item

To remove an item from the **Selected Log Items**, click on the item to select it, and press the <Delete> key.

6.21.10 Moving an item

An item can be moved up or down in the list within the same data type by clicking once on the item to select it, then holding down the <Alt> key while using the ↑ and ↓ keys to move the item.

6.21.11 Downloading the current Selected Modbus Registers from the GAS MICRO Unit

To download the current Modbus Registers setup from the GAS MICRO unit, connect to the unit and press the  button on the toolbar. This button is only available from the Modbus screen.

6.21.12 Uploading the new Selected Modbus Registers to the GAS MICRO Unit

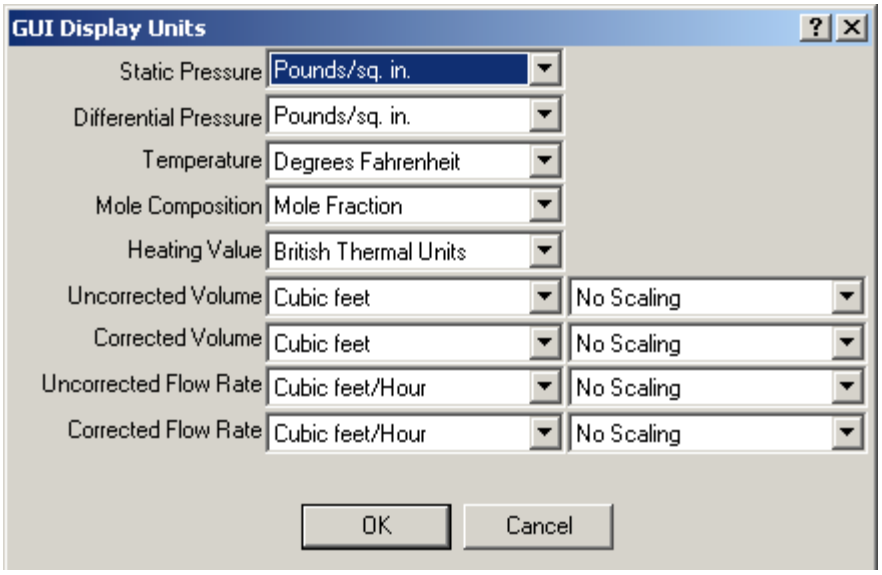
After making the necessary changes, upload the new selections to the GAS MICRO unit by pressing the  button on the toolbar. This button is only available from the Modbus screen.

6.22 Setup — Display Units

For each type of measurement, choose the units in which you want the values displayed. For each category, a list of appropriate options from which to choose has been provided. Scaling factors may be selected for several of the options. Available scaling factors include:

- No Scaling
- x10 (x10)
- x100 (C)
- x1000 (M)
- x10000 (Mx10)
- x100000 (MM)

The display units and scaling factors chosen here are reflected throughout the iMaCS screens.

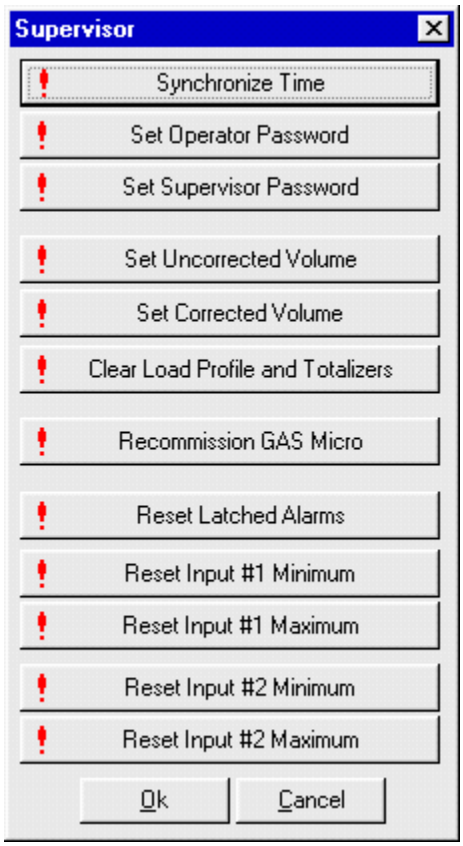


Note: The unit and scaling choices made here only impact the screens in the iMaCS program. The LCD display on the GAS MICRO unit and the values in the Modbus registers are not affected by changes made on this screen. For information on configuring the LCD display units on the GAS MICRO unit, see Section 6.20.8. For information on configuring the Modbus register units see Section 6.21.8.

6.23 Setup — Supervisor

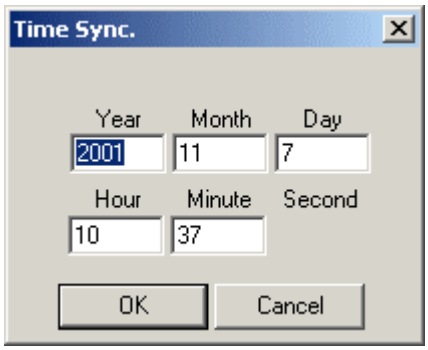
This list of options available from the **Setup menu** option requires Supervisor level access. Some of these options may not be available depending on your country's regulations.

When the selected operation completes successfully, the ! symbol changes to ✓.



6.23.1 Synchronize Time

This function resets the time and date in the GAS MICRO unit. The following screen is displayed when the **Synchronize Time** button on the menu is selected.



The default time that appears on this screen is the local time on the PC or laptop computer running the GAS MICRO iMaCS Wizard. This can be changed to any other date and time as needed.

6.22.1 Synchronize Time cont'd

The time must be synchronized whenever the CPU of the GAS MICRO unit has been removed and replaced. This should also be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

> **Note:** Synchronizing the time creates a record in the **Configuration Event Log**. In addition, synchronizing the time or date to a different hour, day, or month will cause an hourly, daily or monthly log record to be written at the moment that the time is synchronized. In this case, the timestamp on the hourly, daily or monthly log record will reflect the hour, day, or month that was in progress before the time synchronization.

6.23.2 Set Operator Password

Allows a person logged on with Supervisor-level access to change the password used to validate Operator level access. The password must be numeric and can be up to 10 digits.

6.23.3 Set Supervisor Password

Allows a person logged on with Supervisor-level access to change the password used to validate access at the Supervisor level. The password must be numeric and can be up to 10 digits.

6.23.4 Set Uncorrected Volume

Allows the **Totalized Forward Uncorrected Volume** to be set to a specific value. This allows a new or re-commissioned unit to easily replace another.

> **Note:** This feature is not available in Canada due to Canadian regulations.

6.23.5 Set Corrected Volume

Allows the Totalized Forward Corrected Volume to be set to a specific value. This allows a new or recommissioned unit to easily replace another.

> **Note:** This feature is not available in Canada due to Canadian regulations.

6.23.6 Clear Load Profile and Totalizers

Clears all hourly, daily and monthly load profile information (maximums, minimums, totals, and averages) as well as the forward, reverse, and absolute totals for both corrected and uncorrected volumes. All corrected and uncorrected volumes accumulated in memory are cleared. This should be done whenever setting up a GAS MICRO unit for the first time or re-commissioning a unit (see Section 6.23.7).

Historical measurement records stored in the audit trail are not affected.

6.23.7 Recommission GAS MICRO

Marks the current date so that any future log dumps ignore previously logged information. This feature is useful when a unit is redeployed at a different location, making the previously logged information invalid for the new site. This should also be done whenever setting up a unit for the first time.

6.23.8 Reset Latched Alarms

Resets **Latched Alarms**. When an alarm condition has been set, the latched alarm marks this event. The latched alarm does not get reset until this button is clicked. This should be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

6.23.9 Reset Input #1 Minimum

Resets the overall minimum value for the device on **Analog Input Channel One**. This should be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

6.23.10 Reset Input #1 Maximum

Resets the overall maximum value for the device on **Analog Input Channel One**. This should be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

6.23.11 Reset Input #2 Minimum

Resets the overall minimum value for the device on **Analog Input Channel Two**. This should be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

6.23.12 Reset Input #2 Maximum

Resets the overall maximum value for the device on **Analog Input Channel Two**. This should be done whenever setting up a unit for the first time or re-commissioning a unit (see Section 6.23.7).

6.24 Log Viewer

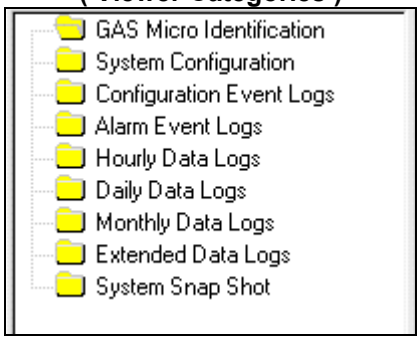
To view the Log, click on the  button. Open the data you would like to view, and then click the **View Log** button.

6.24.1 Log Viewer Categories

The left panel of the *Log Viewer* screen displays several folder icons representing categories of logged data as well as ID and system snapshot information.

Clicking on any of these folders displays the data for the selected category in the right panel. Clicking on one of the **Data Log** or **Event Log** categories also displays the Date Range tool that can be used to view log data within a specific period of time.

Log Viewer — Left Panel
(Viewer Categories)



Log Viewer — Right Panel
(Viewer Data)

Item#	Timestamp	Fwd. UVol.(CF)	Fwd. CVol....	Max. CRate...	Ave. CRate...	Ave. Press.
1	Apr 30, 2001 10	13.000	7.886	3.203	1.602	0.300
2	Apr 30, 2001 09	0.000	0.000	3.203	3.203	0.300
3	Apr 30, 2001 08	3.000	1.820	2670.566	1337.941	0.300
4	Apr 30, 2001 07	16.000	9.706	945.382	237.675	0.300
5	Apr 30, 2001 06	0.000	0.000	0.000	0.000	0.300
6	Apr 30, 2001 05	0.000	0.000	0.000	0.000	0.301
7	Apr 30, 2001 04	0.000	0.000	0.000	0.000	0.301
8	Apr 30, 2001 03	0.000	0.000	0.000	0.000	0.301
9	Apr 30, 2001 02	8.000	4.853	2394.512	802.123	0.301

Figure 6-14 Log viewer – left and right panel (categories and data)

6.24.2 Log Viewer Data

The right panel of the *Log Viewer* screen displays data within a category selected from the left panel. If Data Logs or Event Logs are being displayed, the Date Range tool is available to limit the information displayed to data within a specific date/time period. The labels across the top of this panel change depending on the category selected in the left panel.

For the **Configuration Event Logs** and **Alarm Event Logs**, a sequence number is given in addition to the item number. The item number represents the record number within the records that were read to create this log. The sequence number is increased by one each time a new record is written and is written as part of the log record. This allows data from several logs to be combined by sequence number. The sequence numbers range from 1 to 65000+.

Item #	Timestamp	GUI Name	Sequence	Old Value	New Value	User
1	Oct 3, 2001 16:29:24	Time Sync.	404	Oct 3, 2001 16:29:24	Oct 3, 2001 16...	System
2	Oct 3, 2001 16:29:11	Input #2 Clear Max.	403	0.00585	-0.00064	Factory
3	Oct 3, 2001 16:29:10	Input #2 Clear Min.	402	-0.00064	-0.00064	Factory
4	Oct 3, 2001 16:29:09	Input #1 Clear Max.	401	0.06656	0.04381	Factory
5	Oct 3, 2001 16:29:07	Input #1 Clear Min.	400	0.03236	0.04381	Factory
6	Oct 3, 2001 16:29:06	Alarm Latch Clear	399			Factory
7	Oct 3, 2001 16:29:05	Clear Load Profile	398			Factory
8	Oct 3, 2001 16:28:37	Factory Logon	397		Q-login	Factory
9	Oct 3, 2001 15:32:36	Factory Logoff	396	Q-login		Factory
10	Oct 3, 2001 15:31:27	Config. Log Download	395			Factory
11	Oct 3, 2001 15:30:41	Recommission Unit	394			Factory

Figure 6-15 Configuration Event Logs and Alarm Event Logs

6.24.3 Working with the data

Data analysis capabilities are built into the Log Viewer.

Selecting one or more log items in the right panel will cause summary and trend data for the selected item(s) to be displayed in the column headers.

***Example — Log Viewer* — Data Analysis**

Item#	Timestamp	571.669 [SCF]Fwd. Corr. Vol.	114333.805 [SCF/H]Max. Flow Rate	31600.146 [SCF/H]Ave. Flow Rate
1	Apr 6, 2001 14	251.536	61222.832	19940.873
2	Apr 6, 2001 13	178.647	114333.805	37518.969
3	Apr 6, 2001 12	17.865	68887.312	22991.449
4	Apr 6, 2001 11	71.459	531.099	300.137
5	Apr 6, 2001 10	375.158	98587.234	34290.020
6	Apr 6, 2001 09	0.000	0.000	0.000
7	Apr 6, 2001 08	0.000	0.000	0.000
8	Apr 6, 2001 07	0.000	0.000	0.000
9	Apr 6, 2001 06	0.000	0.000	0.000

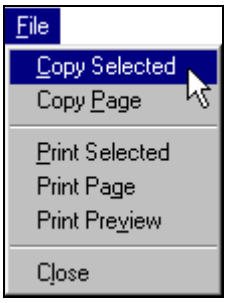
Figure 6-16 Log Viewer data analysis

When you select specific log records by their Item Number (highlighted in blue), the data for these records (circled in yellow) is summarized on the label at the top of each column (circled in red).

Notice that the **Forward Corrected Volume** data is totaled. The maximum is shown for the column labeled **Max. Flow Rate**.The average is calculated for the **Average Flow Rate** column.

6.23.3 Working with the data cont'd

A range of data can also be selected and copied to the clipboard for pasting into another program such as Excel or Word. Simply select the item number range for the data you are interested in. Then select the *File → Copy Selected* menu option.



Other options from the menu include the ability to copy all logged data or to print selected data or all data.

6.24.4 Date Range Setup

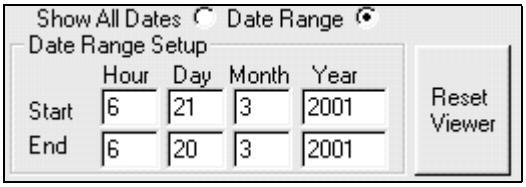


Figure 6-17 Date range tool for the log viewer

Enter the date range (including the hour) to be used for displaying data. This setup only applies to Event Logs and Data Logs.

> **Note:** Since the logs start at the present and go back in time, the start date entered here is the most recent date in the range to be considered. The end date will be the earlier date of the range.

Click on the 

button for the date range changes to take effect.

6.24.5 Show All Dates option

Display all data that has been collected. This only applies to **Event Logs** and **Data Logs**.

6.24.6 Date Range option

Only display data that falls within the date range specified below. This only applies to **Event Logs** and **Data Logs**.

6.25 Watch Window

The *Watch Window* is available whenever you are logged onto a GAS MICRO unit. This allows the live data to be viewed in real time. To access this function, click on the Watch button. Click on the Start Polling button to view live data.

The following information is available from the *Watch Window* when it is polling a GAS MICRO unit.

- (A) Current readings of all inputs
- (B) The time according to the GAS MICRO unit's internal clock
- (C) Current battery voltages
- (D) Ambient temperature
- (E) The device for which each of the Analog input channels is configured
- (F) Overall minimum and maximum values for Analog inputs 1 and 2 (since the last time these were reset).
- (G) Current Uncorrected and Corrected Flow Rates
- (H) Current Uncorrected and Corrected Forward, Reverse, and Absolute volumes
- (I) Current Hourly, Daily, and Monthly load profile information (maximums, minimums, totals, and averages for all measured items)
- (J) AGA calculated values based on live inputs and current settings
- (K) Current alarm states
- (L) Currently latched alarms
- (M) Timestamps for all minimums and maximums, showing when they occurred
- (N) Number of downloads
- (O) Start time for current hour, day, and month information

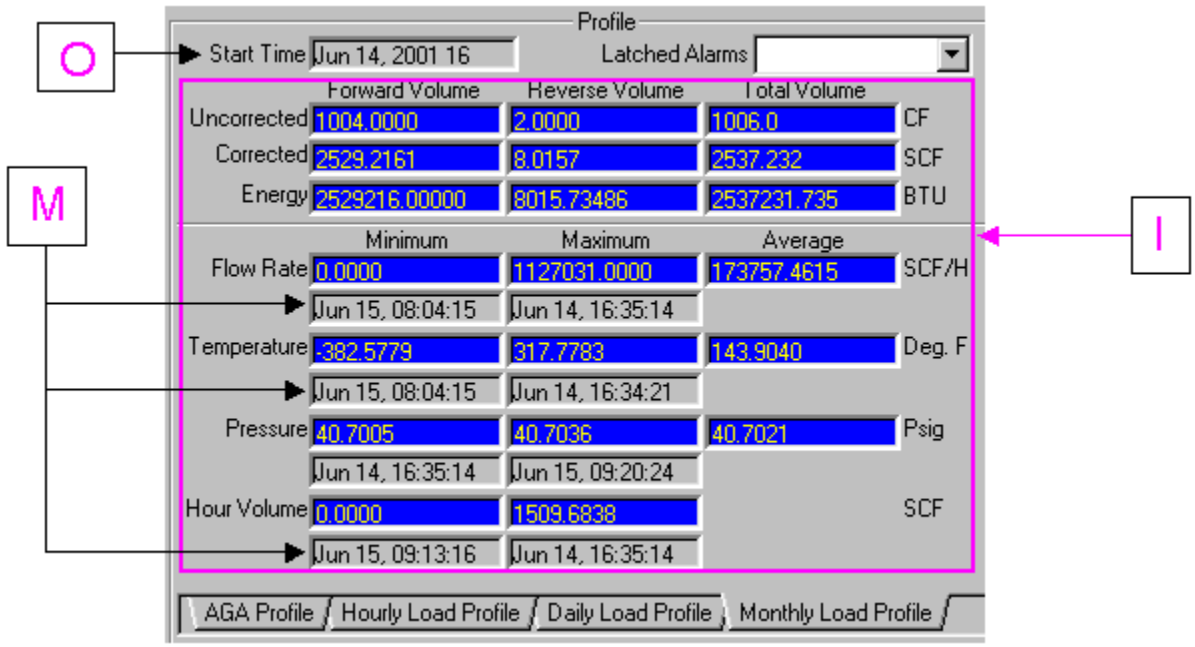


Figure 6-18 Watch Window features

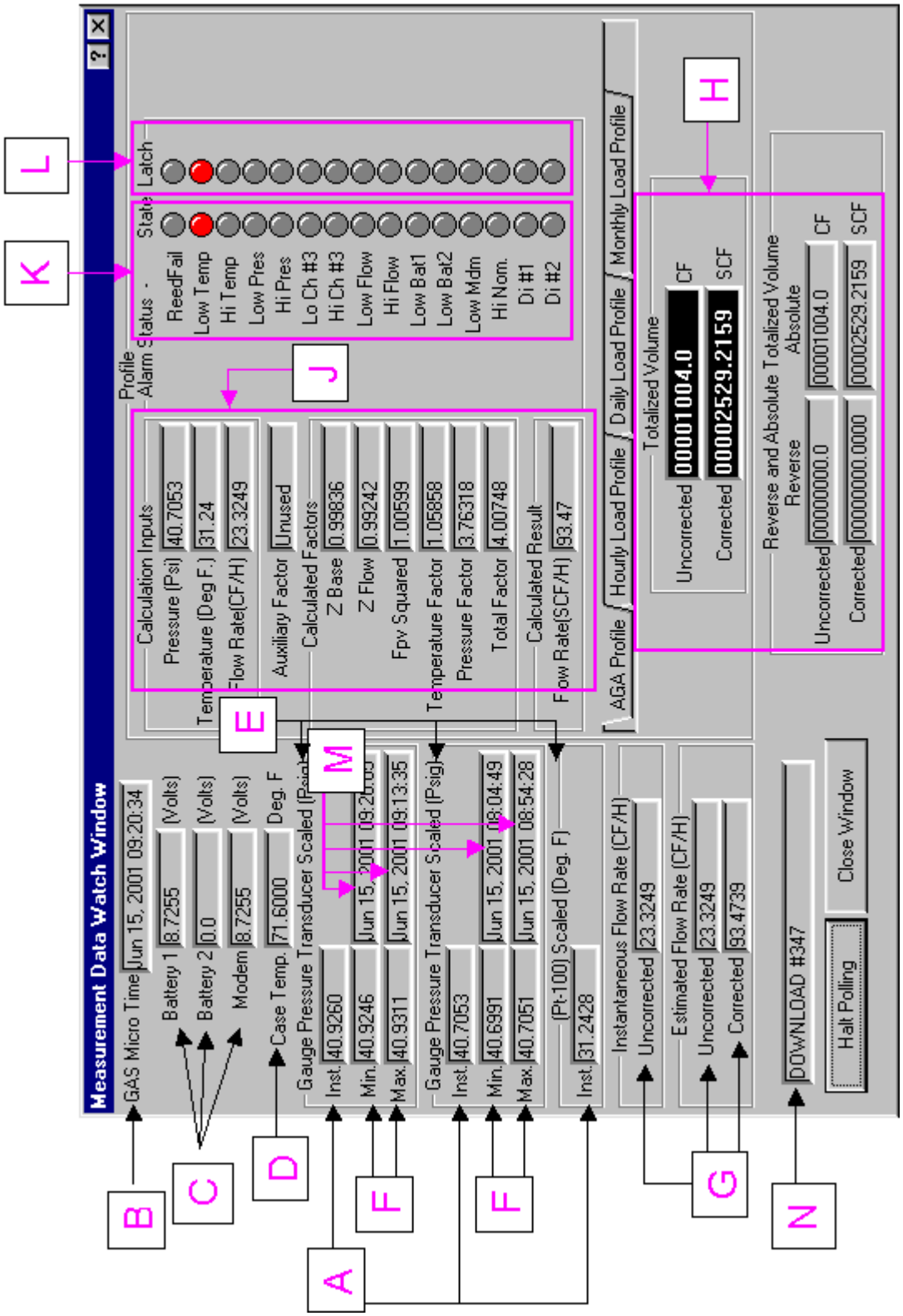


Figure 6-19 More Watch Window features

6.26 Calibrate I/O

The following screen is available from the **Calibrate** menu. It is used to verify or set the calibration for each Analog to Digital Converters (ADC). The entry fields are not available until the Start Polling button has been selected.

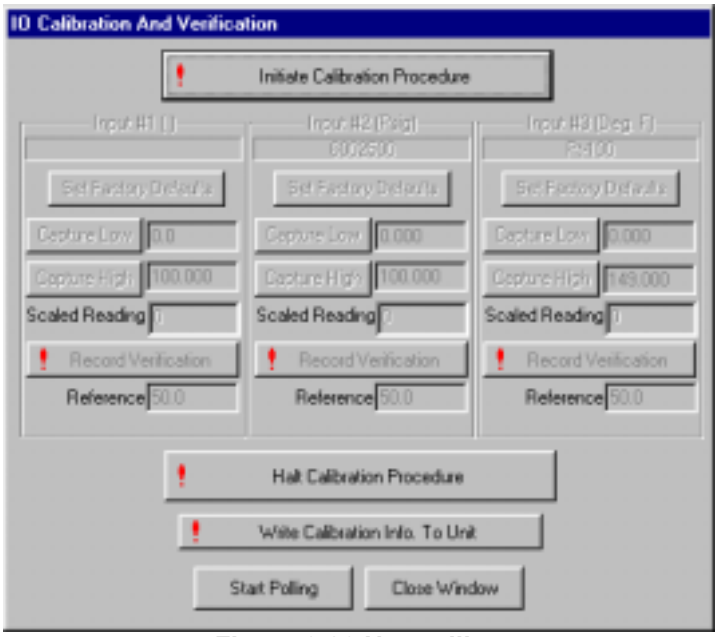


Figure 6-20 Not polling

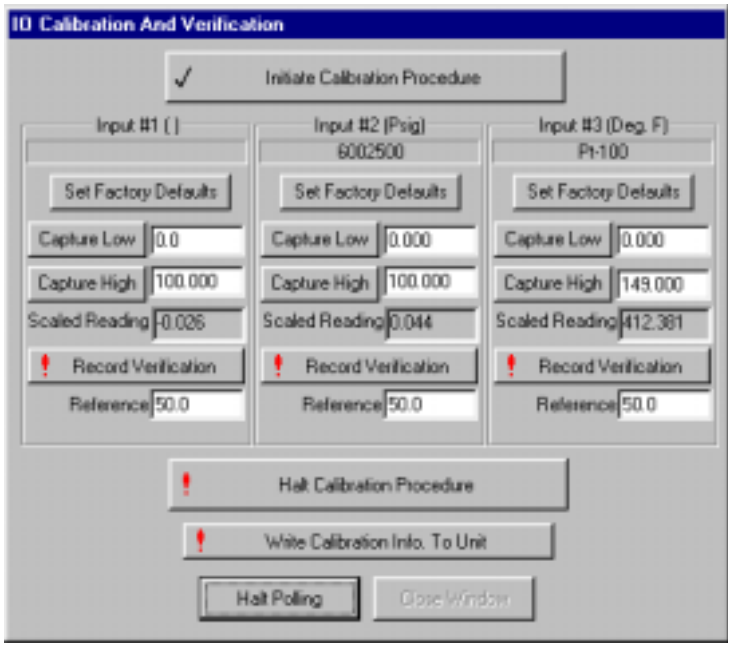


Figure 6-21 Polling

6.26.1 ADC Calibration

If the factory calibration for any of the ADC's does not match the reading from your calibration device, you may perform a two-point calibration on the GAS MICRO.

To perform a two-point calibration

1. Click on the Start Polling button.
2. If calibrating while the unit is online, click the ! Initiate Calibration Procedure button.
3. Use the calibration device to set a known value in the lower portion of the measurement range. Wait several seconds for the reading to settle. Enter this value in the box next to the "Capture Low" button.
4. Click on the Capture Low button for the device being calibrated.
5. Use the calibration device to set a known value in the upper portion of the measurement range. Wait several seconds for the reading to settle. Enter this value in the box next to the "Capture High" button.
6. Click on the Capture High button for the device being calibrated.
7. The "Scaled Reading" field should now display the same reading as the calibrating device.
8. Repeat the procedure for any other ADC channels requiring calibration.
9. If calibrating while the unit is online, click the ! Halt Calibration Procedure button.
10. When you are finished calibrating, click on the Halt Polling button.
11. Click on the ! Write Calibration Info. To Unit button to write the new calibration information to the GAS MICRO unit.

Note: The low and high calibration set points should be entered in the same units as are specified just above the device serial number.

6.26.2 Special Note for Calibrating online

Although it is preferable to take the unit offline for calibration, it is possible to calibrate the GAS MICRO while it is online by using the following two buttons.

! Initiate Calibration Procedure ! Halt Calibration Procedure

The **! Initiate Calibration Procedure** button suspends alarms, updates to trend information, and flow rate calculations so that these features will not pick up invalid information from the calibration procedure. These will remain suspended until the **! Halt Calibration Procedures** button is clicked. In the meantime, the GAS MICRO unit continues to collect pulses so that meter flow during the calibration procedure is not

6.25.2 Special note for calibrating online cont'd

lost. The unit is able to store up to 65,000 pulses during the calibration procedure. Any pulses over and above this number will be lost. If the hour, day or month rolls over during the calibration procedure, the log entry will be written based on information collected prior to clicking the **Initiate Calibration Procedure**. Note that the system will not allow the calibration procedure to be exited until the **Halt Calibration Procedure** button is clicked and normal calculations are resumed. If the unit is offline during calibration it is not necessary to use these two buttons.

Online calibration may be performed without using the **Initiate Calibration Procedure** and **Halt Calibration Procedure** buttons, but the procedure may set off any enabled alarms and/or cause incorrect information to be captured in the trend data.

6.26.3 Returning to Factory Defaults

To ignore the new calibration and return to the factory set calibration for an ADC, click on the corresponding 

button.

6.26.4 Logging a Calibration Event

Although the calibration procedure creates a log record of the calibration event when the new calibration information is written to the GAS MICRO unit, it is also possible to merely verify the calibration and write a log confirming that the calibration has been checked. To do this, enter the reference value used in the verification and click on the 

button for the corresponding ADC channel. A record is written to the Configuration Event Log with the Scaled Reading value, the Reference value, the operator's ID, and the date and time of the verification. After a successful calibration, the Scaled Reading value and the Reference value should be the same. The button changes to 

to indicate that a log record has been written.

6.27 Calibrate Batteries

The following screen is available from the **Calibrate** menu. It is used to set the calibration for the batteries or battery packs.

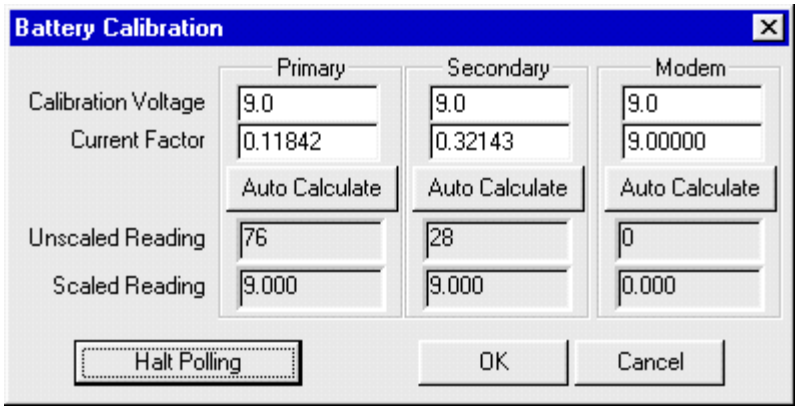


Figure 6-22 Battery calibration

To calibrate the battery voltage readout:

1. Click on the Start Polling button.
2. Read the voltage from the calibration device and enter that value in the **Calibration Voltage** field. Click on the Auto Calculate button.
3. The correction factor will be calculated and the new corrected voltage will be displayed in the **Scaled Reading** field. This number should now match the number entered in the **Calibration Voltage** field.
4. Repeat the procedure for any other batteries or battery packs that need to be calibrated.
5. When you are finished calibrating, click on the Halt Polling button.

6.28 Communication Indicator Lights

The two indicator lights at the bottom right corner of the GAS MICRO software window indicate when communication is taking place between the program and the GAS MICRO unit.



(Red, Red) Idle

(Red, Green) Transmitting to unit

(Green, Red) Receiving from unit

(Yellow, Yellow) Unable to communicate with unit

6.29 Power Management

Every attempt has been made to keep the power usage of the GAS MICRO as low as possible while maintaining flexibility and providing an easy to use design.

The battery life may vary from several months to over four years depending on the set up options chosen. The battery power is used at a faster rate when any of the following is taking place:

- The unit is doing heavy calculations
- The unit is communicating via serial port or modem
- The LCD display is on

As a result, the following options on the *Primary Setup* screen affect the battery life of the unit.

Scheduled Wakeup Interval – If this option is disabled, the unit performs calculations and writes logs once per hour. Setting this to a shorter period of time, while providing additional information, decreases the life of the battery due to the additional calculations.

Pulses Per Wakeup – If it is not necessary for the unit to calculate trend data (such as averages, minimums and maximums) for every pulse, this option can be used to increase the life of the battery by allowing the unit to wait for a specified number of pulses before calculating these values.

Display Option Timeout – When the piezo button on the front of the GAS MICRO unit is pressed, the unit takes live measurements and performs calculations continuously until the display times out.

Display Always On – The battery life is decreased when this option is used because the LCD is on even when the unit is not calculating. The last measured/calculated value for the first display item is displayed.

7 Maintenance Procedures for GAS MICRO Hardware Components

The following components may be replaced should a failure occur or when an update is required

7.1 Replacing Battery

1. Unscrew the wing nut holding the battery holder in place and remove it.

2. Connect replacement battery pack to secondary battery jumper (white & black) and temporarily set it on top of GAS MICRO enclosure (See Figure 7-1)

3. Remove old battery pack and disconnect from primary jumper (red & black)

4. Place new battery pack onto shelf and secure with battery holder.

NOTE: It is not required that the replacement battery pack be connected prior to removing the old battery pack. However, any pulses realized during the time off battery supply will be lost. If the instrument is configured for multiple pulses per wakeup and there are pulses in the memory buffer, the volume will be lost if the power supply is disconnected before the pulses have been reconciled. To ensure no pulses are lost, you must first push the piezo switch to cause a system wakeup so that the pulses are reconciled before disconnecting the power supply.

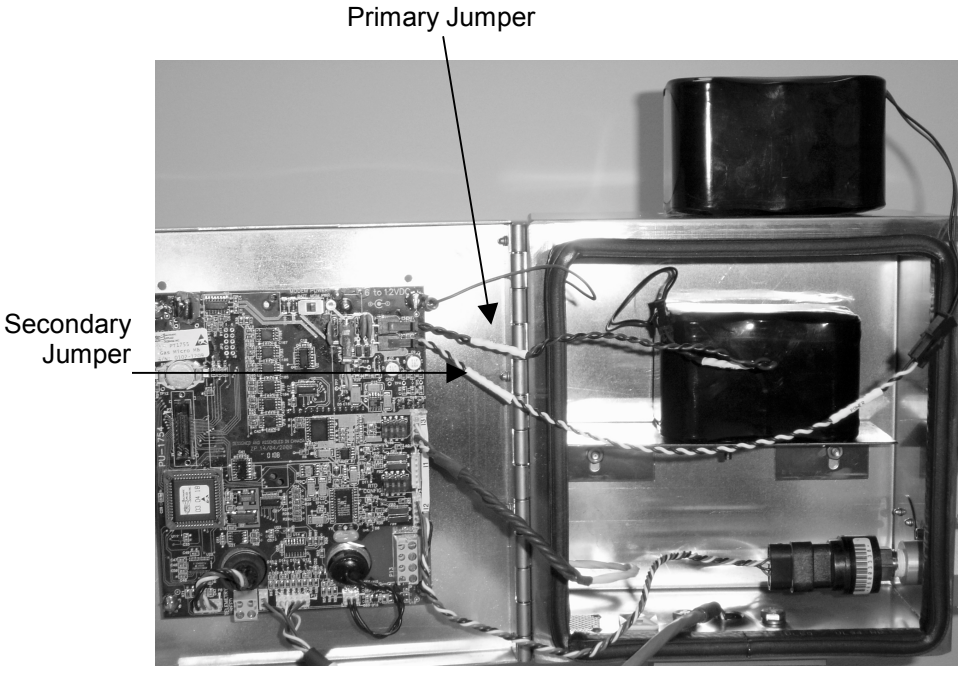


Figure 7-1 Battery connection

7.2 Replacing Transducer

1. Disconnect transducer cable from the motherboard.
2. Use a 5/8” wrench CCW to remove any PSIG transducer from the transducer adaptor.
3. Use a 7/8” or 1 1/8” wrench CCW to remove any PSIA transducer from the transducer adaptor.
4. Remove any Teflon tape remnants or thread sealant from inside the transducer adaptor.
5. Before installing new transducer, check that transducer is of correct range and type, record serial number, and wrap threads with appropriate thread sealant.
6. Insert transducer into transducer adaptor and tighten with a wrench.
7. Reconnect transducer cable to the motherboard and tie transducer cable to the cable support bracket.

Note: Replacing a transducer requires that new temperature characterization and pressure normalization data is required for the software. **Galvanic Applied Sciences, Inc.** supplies a self-extracting program that updates this information along with the replacement transducer.

7.3 Replacing a Piezo Button

1. Remove motherboard to gain access to piezo button. (Steps 1-3 from Section 7.7)
2. Remove piezo button nut and remove piezo button.
3. Install new piezo button and tighten piezo button nut.
4. Install motherboard.

7.4 Replacing an RS-232 Plug

1. Disconnect RS-232 plug from motherboard.
2. Remove RS-232 nut from front of unit.
3. Install new RS-232 plug and tighten nut.
4. Plug RS-232 connector into motherboard.

7.5 Replacing an RTD.

1. Remove RTD from gas line.
2. Disconnect RTD connector from motherboard.
3. Remove RTD from cable grip.
4. Install new RTD in cable grip and connect to motherboard.

7.6 Replacing the CPU

Note: Canadian customers must return the unit to Galvanic Applied Sciences, Inc. for factory replacement of the CPU.

1. Open the main compartment of the GAS MICRO so that the motherboard and battery pack can be seen.
2. Disconnect the battery pack from the motherboard.
3. Note the orientation of the old CPU chip in the socket. Use a chip puller to carefully remove the CPU chip from the motherboard. The fingers of the chip puller fit into the slots at the top-left and bottom-right corners of the chip socket (figure 7-2).
4. Insert the fingers of the chip puller into the slots of the chip socket and squeeze to remove the chip. (Figure 7.3)

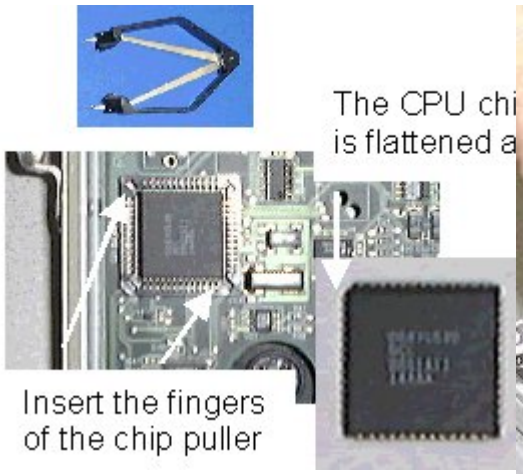


Figure 7-2 CPU chip location



Figure 7-3 CPU chip removal

7.6 Replacing the CPU cont'd

5. After removing the old CPU chip, place the new CPU chip on the socket and verify that it is straight and in the same position as the old chip. One corner of the CPU chip is flattened. The socket is shaped to match this so that the CPU chip can only be inserted in one way. Make sure that the writing on the CPU chip is visible.

6. Gently press the new CPU chip into the socket. The chip should go in easily. If it does not, check that the CPU chip is positioned properly and try again.

7. Reconnect the battery cable that was disconnected in step 2.

8. Close the main compartment of the GAS MICRO. Be careful not to pinch any wires in the door of the compartment.

9. Connect to the GAS MICRO unit using the PC-based iMaCS software. Click on the **Setup → Supervisor** menu option. (This must be done whenever the CPU is removed from the motherboard and replaced.) On the **Supervisor** menu, click on the following buttons in the order shown below.

   a. Click on the **Synchronize Time** button. (This must be first.)

   b. Click on the **Recommission GAS MICRO** button.

   c. Click on the **Clear Load Profile and Totalizers** button. (Not available in Canadian version so the unit must be sent back to Galvanic Applied Sciences, Inc. for servicing.)

   d. Click on the **Reset Latched Alarms** button.

   e. Click on the **Reset Input #1 Minimum** button.

   f. Click on the **Reset Input #1 Maximum** button.

   g. Click on the **Reset Input #2 Minimum** button.

   h. Click on the **Reset Input #2 Maximum** button.

7.7 Replacing a motherboard

1. Disconnect power supply, RS-232 connector, transducer cables, piezo button, RTD connection, and pulse board cable from motherboard.
2. Remove the four mounting screws and replace the motherboard.
3. Hold motherboard by edges while removing it from GAS MICRO.
4. Place new motherboard in the GAS MICRO and attach with four screws. Make sure the ground wire is attached correctly.
5. Reconnect RS-232 plug, transducer cable, piezo button, RTD connection, and pulse board cable.
6. Install new microprocessor if required.
7. Reconnect power supply.
8. Push piezo button to see if LCD functions correctly

Note: When a new motherboard is installed, voltage A/D and temperature A/D require calibration and a new configuration needs to be created.

8 Modems/Communications Options

The GAS MICRO can be configured with one of several different modem options. They are listed below, along with some brief specifications:

2400 Baud Modem (Also see Section 6.16)

- Dialup modem
- 2400 bps

14400 Modem

- Leased line
- 9600 bps

Bell 202

- Leased line
- 1200 bps
- Requires special firmware

Airlink Raven II CDPD (Also see Section 6.17)

- 9600 bps
- Solar panel required due to power consumption
- 2 way communication
- Requires IP address
- Transfers packets of data
- Alarming capabilities
- Output in email form

Bullhorn

- Information is published to web
- Requires auxiliary mounting bracket
- Outbound only
- Transfers registers in packets
- One way communication
- Solar panel required due to power consumption
- Alarming capabilities

8.1 Installation Procedure for 2400 Baud Modem, 14400 Modem, and Bell 202

Note:
Care should be taken when handling electronic components to avoid damage by static discharge.

1. Remove motherboard (see Section 7.7)
2. Plug modem into motherboard.
3. Secure modem to motherboard using nylon 4/40 screws, nuts and ¼'' spacers.
4. Install motherboard (see Section 3.6)
5. Install GAS MICRO on meter site.
6. Remove blank PG-9 plug from side of unit.
7. Insert phone cord through opening and secure with strain relief fitting.
8. Connect phone line to modem.

8.2 GAS MICRO CDPD Modem Change-Out Procedure

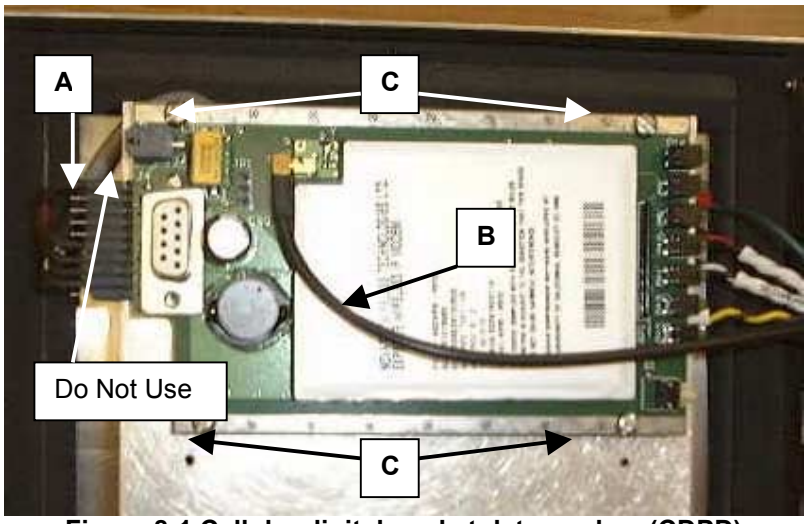


Figure 8-1 Cellular digital pocket data modem (CDPD)

The picture above shows the GAS MICRO with a CDPD modem installed.

1. Disconnect connector (**A**) in Figure 8-1.
2. Disconnect the cable (**B**) from the antenna.
3. Remove the screws, (**C**).

Note: The board is raised from the shielding plate by four plastic spacers, (one spacer per screw) which are required to mount the new modem into place.

4. Once the modem has been removed, you will need to remove the metal shielding plate which covers the GAS MICRO motherboard. Remove the auxiliary mounting plate by removing the screws, (Figure 8-2). Retain both the screws and the washers in order to replace the shield once the modem has been swapped out.

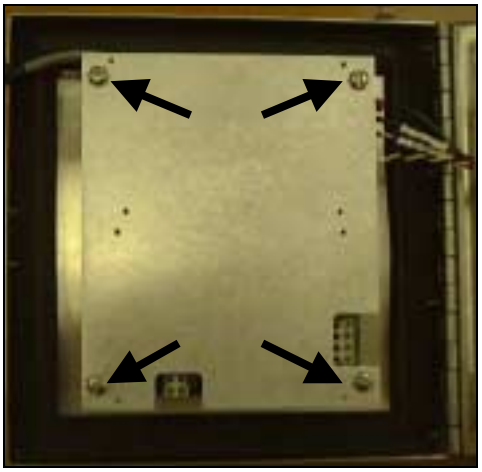


Figure 8-2 Auxiliary mounting plate

8.1.2 GAS MICRO CDPD Modem Change-Out Procedure cont'd

5. After removing the plate, unplug the modem cable from the JP2 connector on the motherboard and replace it with the new cable supplied.



Figure 8-3 JP2 Connection

6. Remount the plate over the motherboard and install the new modem by reversing the procedure for removing the old modem.

WARNING!
Do ***not*** connect power to the modem using the external 9V connector. This connector is ***not*** wired the same as the other, similar connectors on the GAS MICRO motherboard. Power is supplied to the modem through the connector to the motherboard (**A**).

8.3 Communications

GAS MICRO incorporates Modbus (ENRON RTU) protocol:

- Modbus register list is fully mapable and fully configurable.
- Modbus items are configurable for Read/Write where applicable.
- Modifications to Modbus register items via Modbus host are logged in the GAS MICRO configuration event logs.
- Register list is configured using drag-and-drop method from the following user selectable items:
    - 123 configuration items
    - 78 Instantaneous items
    - 28 Hourly
    - 32 Daily and 32 Monthly measurement values
    - 3136 hourly, monthly and audit items

See Section 6.20 for more information on Modbus communication
.

9 Available Options

Some of the options that are available for GAS MICRO are described in this Section.

9.1 Area Classification

- Class 1 Division 1 (No internal mounted communications or solar assembly)
- Class 1 Division 2

9.2 Software

- IMACS: configurable data logs, mappable and configurable Modbus, configurable extended logs
- Configurable extended logs (For EPR)

9.3 Pulse Input

- Single pulse input (Also see Section 6.10.5) – With this option, the pulse input is provided from a remote unit that supplies the pulse output, so there is no need for the GAS MICRO IM Index. The single pulse input cable is provided.

- Input conditioning board (high frequency input/pulse divider) - This optional board is designed to take low level voltage pulse signals from the coil of a gas turbine meter and produce a clean square wave 0-5 volt pulse. The user, via a jumper position, selects an "accumulate and divide function" so that a conditioned output signal is produced on 1:1, 1:2,1:4,1:8,1:16,1:32,1:64, or 1:128 ratio. This would allow in the case of a GasMicro, accumulate up to 128x400hz = 51,200 hertz pulse. The jumper positions are shown in Figure 9-1. In short the jumper position 1&2 produces a ratio of 1:1, doubling the division each time with each position pair up to position 15&16, which provides a ratio of 1:128.

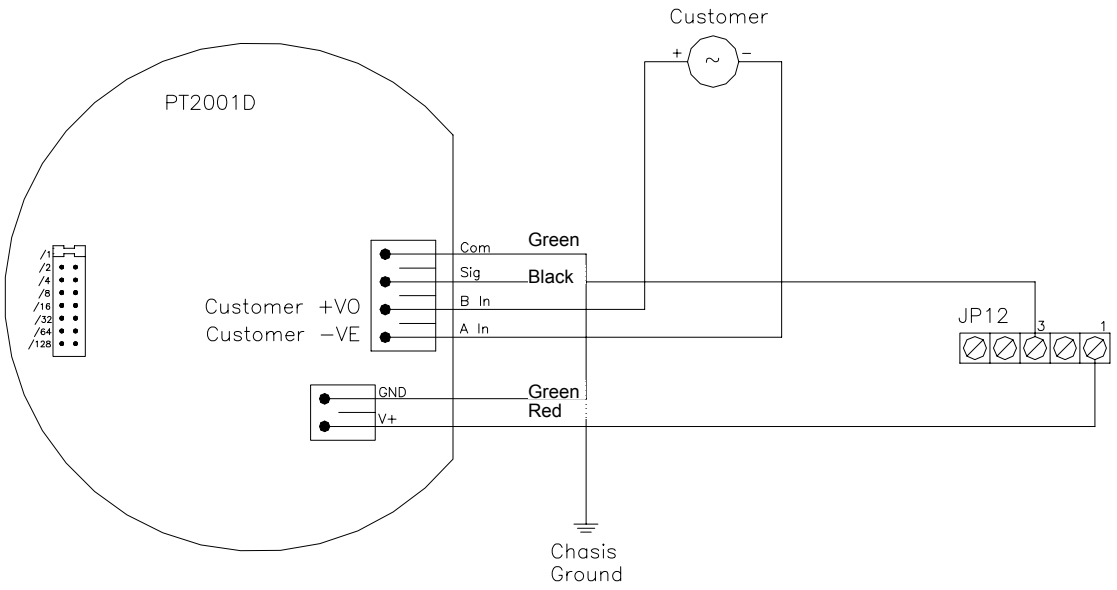


Figure 9-1 High Frequency input/pulse divider

9.4 Pressure Range

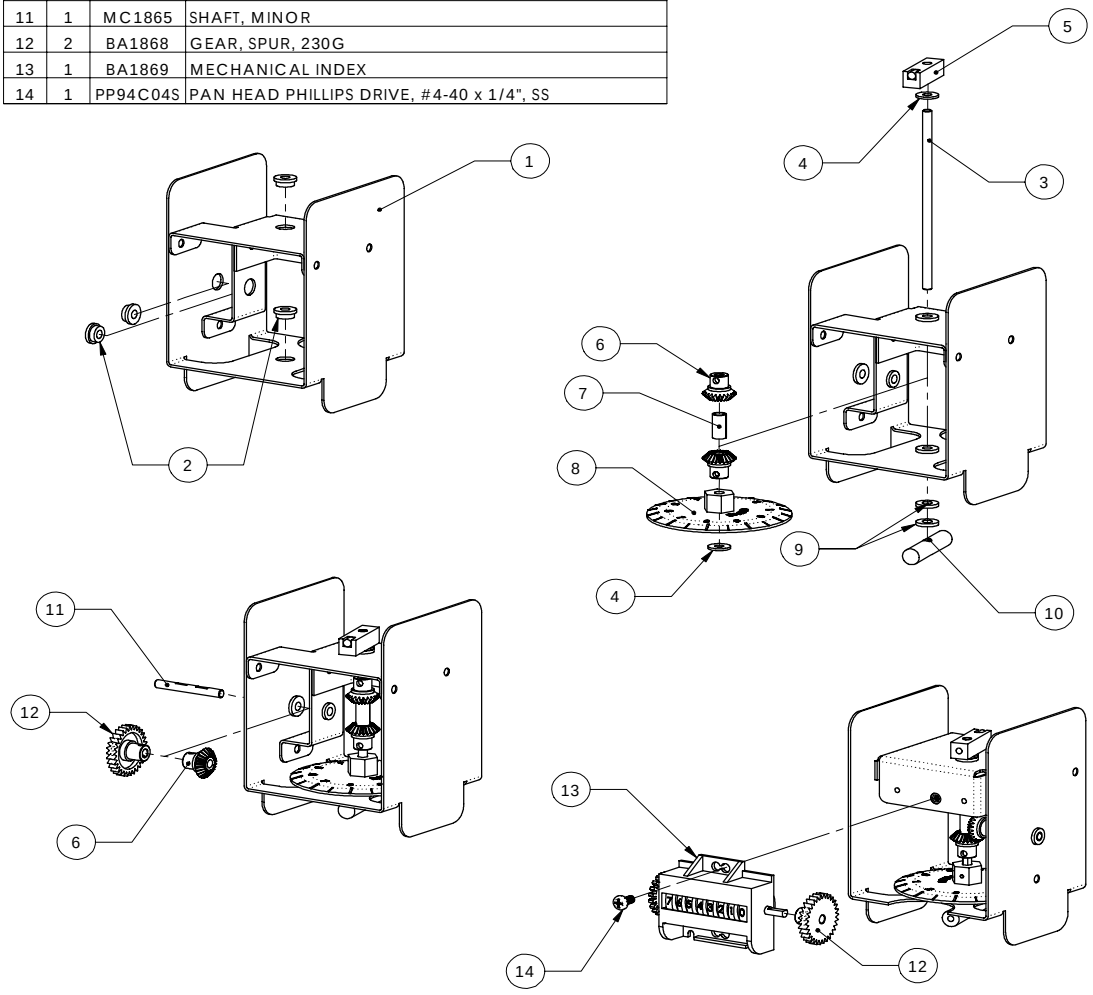
- 100, 500,1000, psia
- 100, 500, 1000 psig
- Channel 1 or 2

9.5 Power Supply

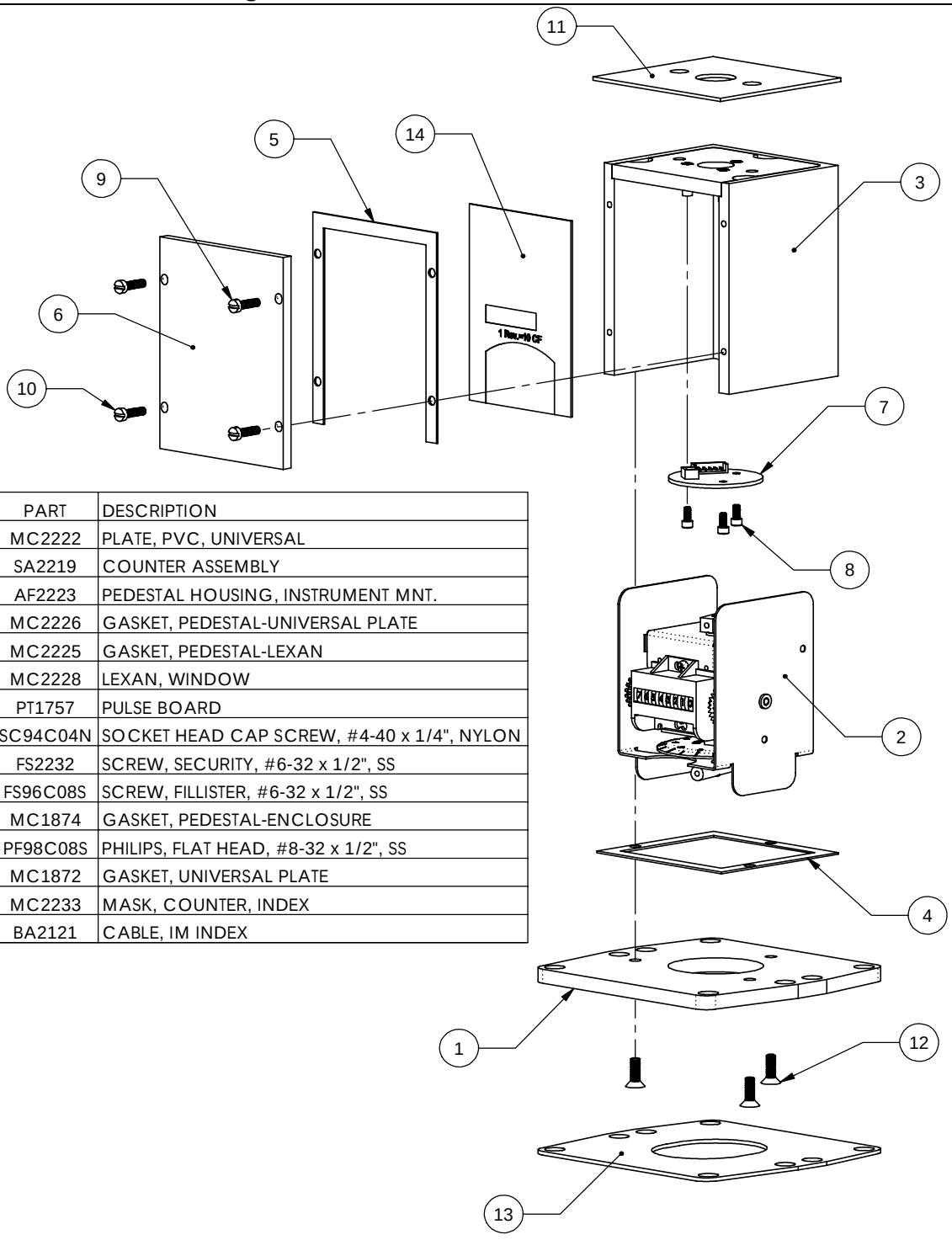
- Alkaline battery pack (six D cells)
- Alkaline battery receptacle (six D cells, no batteries supplied), Class1 Div 1 and 2
- Lithium battery pack
- Solar power subassembly – 10 W solar panel, charge controller, 12 VDC – 8.5 AH battery
- 110 VAC – 12VDC switching power supply, Class 1 Div 2

Appendix I — Technical Drawings

ITEM	QTY.	PART	DESCRIPTION
1	1	MC2155	FRAME, WELDMENT, COUNTER ASSEMBLY
2	4	BA1866	BUSHING, TEFLON
3	1	MC1861	SHAFT, MAJOR
4	2	WF94S	0.125" ID X 0.3125" OD X 0.032" TH WASHER, STEEL
5	1	SA2229	FLYWHEEL, MAGNET, SUB-ASSEMBLY
6	3	BA1867	GEAR, BEVEL
7	1	607-043	SPACER, BUTTITE, SPAENAUR
8	1	BA1870	WATCH HAND
9	2	WF94N	0.140" ID X 0.3125" OD X 0.046" TH WASHER, NYLON
10	1	MC1862P	WIGGLER BLOCK
11	1	MC1865	SHAFT, MINOR
12	2	BA1868	GEAR, SPUR, 230G
13	1	BA1869	MECHANICAL INDEX
14	1	PP94C04S	PAN HEAD PHILLIPS DRIVE, #4-40 x 1/4", SS



GAS MICRO Base Drawing and Parts List



ITEM	QTY.	PART	DESCRIPTION
1	1	MC2222	PLATE, PVC, UNIVERSAL
2	1	SA2219	COUNTER ASSEMBLY
3	1	AF2223	PEDESTAL HOUSING, INSTRUMENT MNT.
4	1	MC2226	GASKET, PEDESTAL-UNIVERSAL PLATE
5	1	MC2225	GASKET, PEDESTAL-LEXAN
6	1	MC2228	LEXAN, WINDOW
7	1	PT1757	PULSE BOARD
8	3	SC94C04N	SOCKET HEAD CAP SCREW, #4-40 x 1/4", NYLON
9	2	FS2232	SCREW, SECURITY, #6-32 x 1/2", SS
10	2	FS96C08S	SCREW, FILLISTER, #6-32 x 1/2", SS
11	1	MC1874	GASKET, PEDESTAL-ENCLOSURE
12	3	PF98C08S	PHILIPS, FLAT HEAD, #8-32 x 1/2", SS
13	1	MC1872	GASKET, UNIVERSAL PLATE
14	1	MC2233	MASK, COUNTER, INDEX
15	1	BA2121	CABLE, IM INDEX

10 Appendix II — Troubleshooting

Problem	Cause / Solution
LCD does not display.	*Temperature is below LCD tolerance*. *Piezo button has not been pushed*. Push Piezo button. *Piezo button disconnected*. Check piezo button connection and reconnect. *Battery disconnected*. Check battery connection and reconnect. *Battery voltage low*. Check battery voltage and replace if too low. *Faulty piezo button*. Unplug button from board and use jumper wire across connectors. If LCD displays, replace piezo button. *Motherboard is faulty*. Establish a serial link with the GAS MICRO. If unable to establish link, replace motherboard.
No serial communication with GAS MICRO.	*GAS MICRO did not wake up*. Push piezo button to establish link again. *Wrong communication port selected.* Change ports. *Bad RS-232 cable*. Check RS-232 cable for continuity or use another cable. *Low voltage or dead battery*. Check batteries and replace if necessary. *Faulty RS-232 plug*. Check RS-232 plug and connection to motherboard. *Faulty motherboard*. Replace motherboard.
No live pressure transducer readings.	Apply gas pressure to the pressure transducer and observe the pressure readings on the LCD display or on the computer in the watch window. CAUTION – Stay within the transducer's rated pressure range. *Low voltage or dead batteries*. Check batteries and replace if necessary. *Bad connection to transducer*. Check transducer cable connection to transducer and motherboard. *Faulty transducer*. Replace transducer and recalibrate / reconfigure.

Problem	Cause / Solution
No live RTD temperature readings.	Apply heat to the RTD by holding it by the tip. Observe any live reading temperature change. *Low voltage or dead batteries.* Check batteries and replace if necessary. *Bad connection to RTD*. Check RTD connection to motherboard. *Faulty RTD*. Replace RTD. *Faulty motherboard.* Replace motherboard.
Unit produces wrong pressure readings.	*Transducer out of calibration*. Compare live pressure readings of the GAS MICRO to reference pressure source. If readings agree, perform a two point pressure transducer calibration. *Wrong configuration file loaded*. Check configuration file and verify that transducer coefficients and calibration factors are correct. If wrong configuration has been loaded, load correct configuration. *Voltage A/D out of calibration.* Recalibrate voltage A/D and perform a two point transducer calibration.
RTD does not read correct temperature.	*Ambient temperature sensor not reading correct temperature*. Attach reference temperature device to the ambient sensor and compare readings. If readings disagree, adjust live ambient temperature reading to match reference. If reference pressure matches live pressure reading, ambient sensor is faulty. Replace motherboard. If adjusting the ambient sensor to match the reference temperature does not cause the live pressure reading to match the reference pressure, replace the transducer. RTD can be checked for accuracy with a stable temperature bath or an RTD calibrator. *RTD out of calibration*. Perform a two point calibration. *Wrong configuration is loaded*. Check configuration file and see if correct temperature coefficients and calibration factors have been loaded. If configuration is wrong, load correct configuration.

Problem	Cause / Solution
Total corrected volume does not increase.	*Faulty pulse board.* Disconnect pulse board cable from motherboard and use a meter to verify that pulses are being generated when wiggler is turned. If three pulses per revolution are detected, pulse board is OK, replace motherboard. If two or fewer pulses are detected there may be a problem with the pulse board cable or reed switch. *Bad pulse board cable*. Check pulse board for continuity. *Magnet wheel is loose*. Dismantle base and check that magnet wheel is secure. *Gears are loose / damaged / not meshing*. Dismantle base and check that gears are secured to shafts that they are meshing correctly and not damaged. *Broken / faulty reed switch*. Remove pulse board from base and examine for damage and replace if necessary.
Server does not load.	*Tcomgasserver7 installed incorrectly***.** Rerun setup program.
***Communications Failure* message appears or communication indicator lights are both yellow.**	*Computer is not communicating with GAS MICRO*. More detailed troubleshooting instructions are shown below. *No modem installed*. Install modem (see windows help files for assistance)
Computer will not dial out to a GAS MICRO.	*Modem not connected to phone line*. Connect computer to phone line. *No modem selected or connection set to serial.* Select modem option from modem / serial setup window. *Modem configured incorrectly*. Reconfigure modem (see windows help files for assistance). *No phone number entered*. Use Add number feature to add GAS MICRO phone number.
Computer dials out but does not connect with GAS MICRO	*Wrong Phone number.* Check that phone number is correct. *Modem timeout too long*. Change timeout to a lower value. *GAS MICRO is disconnected or phone line is damaged.* Check phone line. *GAS MICRO battery is dead.* Check battery and change if necessary.
***Line Reply – Call Unavailable* message appears**	*Modem is busy*. Close gmaccess and restart.

Problem	Cause / Solution
Cannot disconnect and reconnect GAS MICRO	*Previous call terminated incorrectly.* Close gmaccess and restart.
Collection sequence does not function. Logs are blank	*No Information categories selected*. Select information category. *Incorrect date range selected*. Check date range and correct.
Logs will not print	*Printer not connected or not installed correctly*. Check printer connection, drivers, and correct installation.
Logs print but are cut off	*Printer set on portrait print.* Set printer to landscape.
Cannot save log files	*Log file saved incorrectly*. Log files must be saved as .log files and name must follow format “name.log”.

Appendix III — Theory of Operation

When a gas is shipped to a consumer, the customer's meter records the volume of gas shipped via a watch hand that is turned by gas pressure and the rate of flow. As the watch hand turns it is incremented on a mechanical index. This is called uncorrected volume since the volume is calibrated to a single temperature and pressure. There are however always variations in the temperature and pressure of the gas.

According to ideal gas law

PV = nRT

Where:

P = Pressure
V = Volume
n = moles of gas – remains constant
R = Gas constant – remains constant
T = Temperature

When the constants are removed the relation becomes

PV ∝ T

Or **V ∝ T / P**

The volume of gas varies with temperature over pressure.

When gas flows through the meter and turns the GAS MICRO wiggler, one pulse is generated for each revolution. Each revolution represents a measure of uncorrected volume and is incremented on the mechanical index. When a pulse is generated, the GAS MICRO "wakes up" and measures temperature and pressure, which the microprocessor uses to calculate the corrected volume of the gas flowing through the meter. The corrected volume is used for other calculations and data is then logged and stored in memory.

Appendix IV — Manufacturer's Warranty Statement

This product is warranted against defects in materials and workmanship for four years from date of shipment. During the warranty period the manufacturer will, as its option, either repair or replace products, which prove to be defective.

The manufacturer or its representative can provide warranty service at the buyer's facility only upon prior agreement. In all cases the buyer has the option of returning the product for Warranty service to a facility designated by the manufacturer or its representatives. The buyer shall prepay shipping charges for products returned to a service facility, and the manufacturer or its representatives shall pay for return of the products to the buyer. The buyer may also be required to pay round-trip travel expenses and labor charges at prevailing labor rates if warranty is disqualified for reasons listed below.

Galvanic Applied Sciences Ltd. spare parts and products for the operation of their instruments are manufactured under a stringently controlled quality environment. If a substitute is used, instrument performance may not be satisfactory. Accordingly, Galvanic Applied Sciences Ltd. will not be responsible for the performance of instruments manufactured by it if product substitutes are used.

Limitation of Warranty

The foregoing warranty shall not apply to defects arising from:

- Improper or inadequate maintenance by the user,
- Improper or inadequate site preparation.
- Unauthorized modification or misuse.
- Operation of the product in unfavorable environments, especially high temperature, high humidity.
- Corrosive or other damaging atmospheres or otherwise outside published specifications of analyzer.

Disclaimer

No other warranty is expressed or implied. The manufacturer specially disclaims the implied warranties of merchantability and fitness for a particular purpose.

Caution

The manufacturer shall not be liable for personal injury or property damage suffered in servicing the product. The product should not be modified or repaired in a manner at variance with procedures established by the manufacturer

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