Gas Technology Services

VDS3000 Gas Corrector

Operator's Manual

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Work Instruction Title: **VDS 3000 Gas Corrector Operator Manual** Doc No: 342643-4	Authorised Louie Liu

VDS3000 Gas Corrector

Operator's Manual

IMPORTANT

Please read complete manual before configuring, interrogating, installing, operating and using the data retrieval methods that follow. The unit must be fully programmed and calibrated before putting into service.

All information that is contained in this manual is subject to change without prior notice and does not represent a commitment on the part of Gas Technology Services or Vipac Engineers & Scientists Ltd.

User is to understand that all software that is described herein and supplied is provided under an agreement of non-disclosure. Software may only be used or copied for the purchaser's use, and may not be altered, distributed or sold without the expressed written consent of Vipac Engineers & Scientists Ltd. All rights reserved.

WARNING

The VDS3000 electronic correcting devices are designed intrinsically safe for operation in hazardous areas and carry relevant approvals.

External power supply and communication systems cables that enter or leave the hazardous zone must be connected to the VDS3000 (or peripherals) through approved shunt-diode safety barriers. These barriers are usually located in a common enclosure along with power supply (if used). This enclosure must be mounted in a "safe area". A "safe area" is normally an area that is a minimum of 5 metres away from any possible gas leak point. However, please evaluate and conform to your local code requirements.

INTRODUCTION

The VDS3000 Gas Corrector is an internally or externally powered stand-alone microprocessor based system, which acts on inputs from a number of primary element sensors to provide an integrated display of gas volumes in various industry useable modes.

When gas is metered in a pipeline at pressures and temperatures different to those required in the billing process, it is necessary to apply various correction factors to the measured volume in order to obtain the correct "billing" volume.

The VDS3000 Gas Corrector responds to primary sensors for pressure, temperature, volume and time. It performs corrections according to the Gas Laws, and can be configured to indicate the volume data on an alpha/numeric liquid crystal display.

The VDS3000 Gas Corrector records and displays information on maximum demand volumes, in hourly and daily modes for the current month and also for the previous month. The hour/day/date of each maximum volume is also displayed.

Features of the VDS3000

- Multi-function data display (user selected) showing live pressure, temperature and correction factors.
- Internal 2G/3G modem for inbuilt Internet, SMS, email and dial-out features.
- Choice of gauge pressure or absolute pressure transducers.
- Selections on Operational Mode for automatic computation via live inputs, fixed factor correction, or automatic fixed factor correction on live input hardware failure detection.
- Internal battery power.
- External 7.5 VDC power option with full battery backup.
- Environmental secure enclosure.
- Self-test at each wake up.
- 4 digital relay outputs, each configurable to a variety of alarms, or uncorrected and corrected gas volume pulses.
- Maximum Demand Indicators daily and hourly for both current month and previous month.
- "Customer Accessible" push button for data display.
- Sealable for protection against unauthorized adjustment.
- Remote re-configuration of base data.

- RS232 port for direct communication – for maintenance in a safe area only.
- Low power ZigBee RF communication for meter reading while conforming to intrinsic safety requirements.
- 19 individually configurable alarm states. Operators can be notified of alarms via any combination of SMS, email, up to 4 digital relay outputs, and/or logging to internal flash memory.
- Scheduler for sending profiler, event log and alarm status via email.
- Flow Profiler with 8MB memory. Up to 10 years of hourly flow data stored in memory.
- Portable data retrieval system.
- Live super-compressibility computation to NX19.
- Retention of total corrected and uncorrected volumes in non-volatile memory.
- Local configuration/download via RS232 or ZigBee wireless.
- User-friendly software for programming/downloading.
- Intrinsically safe design.

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OVERVIEW OF MANUAL

This manual contains eight sections that are designed to help the user understand how to effectively utilize all of the powerful features of the VDS3000. Here is a listing and a brief description of each of the eight sections:

1. START-UP PROCEDURE

This section is designed to help you get started using Gas Explorer, the software required to communicate with the VDS3000. It is used to configure, interrogate, calibrate and acquire data from the VDS3000 instrument. This section also includes instructions on how to apply power to the VDS3000.

2. COMMUNICATION

This section contains information on the different methods of communication that may be used with the VDS3000, including email and SMS.

3. CONFIGURATION

This section covers all of the various configuration possibilities and requirements of the VDS3000, including the pre-setup of the pressure and temperature transducers.

4. INTERROGATION

This section discusses the VDS3000 status screen, which indicates the health and status of the device in real-time, or when last connected. The full calibration & reporting functionality of Gas Explorer will be introduced. The IOR (Instrument Operating Record) generated by VDS3000 will also be discussed.

5. INSTALLATION

This section gives instructions on how to install the VDS3000 in the field.

6. OPERATION

This section describes some of the operating features of the VDS3000. Methods of powering the instrument (internal and external) as well as the inputs to the VDS3000 (volume, pressure and temperature) are discussed.

7. ACQUISITION OF DATA & FILE SYSTEMS

This section discusses the different types of output data that is provided by the VDS3000: alarms via email, SMS, digital relay output. Profiler and event log reporting via email or manual download. Multiple report formats of VDS3000 are discussed.

8. WARRANTY

1. START-UP PROCEDURE

Please take the time to read this instruction manual completely before proceeding.

On receipt of your instrument please ensure that no damage has occurred during shipping. Report any problem to your representative or Vipac Engineers & Scientists Limited. To communicate with the VDS3000, the **Gas Explorer** software used on a PC running the Windows XP/Vista/7 operating system or equivalent is required. This software is supplied as standard when purchasing the VDS3000 instrument(s). A quick overview of how to use Gas Explorer follows:

Installing "Gas Explorer" software

Gas Explorer is written for personal computers operating with Windows XP, Windows Vista, or Windows 7. Gas Explorer allows the user the easiest means of configuring, calibrating, interrogating and downloading data files.

To use the software it will be necessary to install the program. To accomplish this please perform the following steps:

1) Insert the Gas Explorer CD into your computer.
2) Find “Installer.VIPAC.Gas.Explorer.XXX” and double click
3) Follow the on-screen prompts.

Battery installation / change out

The VDS3000 utilises a standard 3.6 volt Lithium Power Pack when used in "stand alone" operation (internal power only). Typical battery life is 5 years with hourly wake up. Exact life will depend on how the instrument is configured.

The power pack will be packed separately within the shipping box. Mount the pack into the VDS3000. To power up the VDS3000 simply plug the battery connector into the connector labelled BATT (P16) on the printed circuit board. The VDS3000 display will begin a scroll sequence, which indicates successful power application. You are now ready to utilise the VDS3000.

The battery pack in the VDS3000 is an intrinsically safe item and must be supplied by the manufacturer. The pack contains 3 “D” size Lithium-ion batteries, and should be disposed of in accordance with local government requirements.

2. COMMUNICATION

There are several methods that may be used to communicate with the VDS3000:

- Direct serial cable (for communication prior to intrinsically safe installation)
- On-site ZigBee short range RF communication.

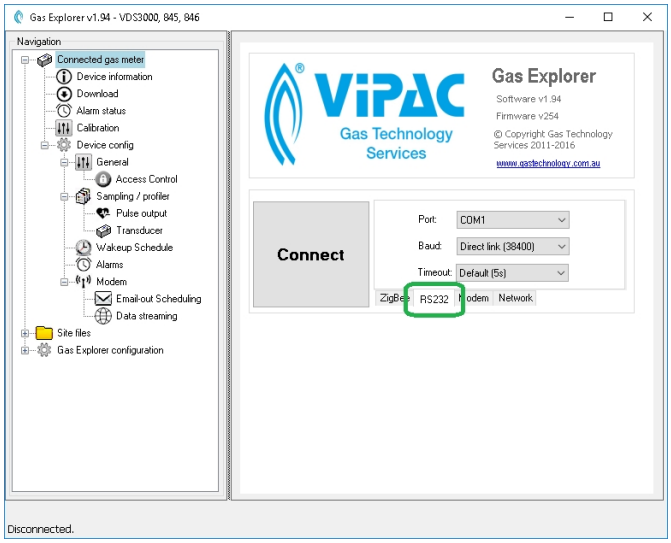
Direct serial cable

The user may communicate directly with the VDS3000 using Gas Explorer software developed for the Windows XP, Vista and Windows 7 platforms.

It is recommended that direct serial connection should be used for initial configuration so that ZigBee & modem settings may be configured.

Direct connection in-situ can affect the intrinsic safety of the site installation. Refer to appropriate rules and regulations before connecting a serial cable to the VDS3000.

The connection page is accessed by selecting 'Connected gas meter' in the navigation pane on the left.



Connect a serial cable between the laptop and serial connector on the VDS3000. A USB-serial converter may be used if your laptop does not have a 9-pin RS232 port.

From the Connection tabs, select "RS232" and choose the appropriate serial port, then press Connect.

You will be prompted to press the "Display" button on the VDS device when connecting via RS232 or ZigBee. It is not mandatory to press this button when connecting via ZigBee.

Once connected, an

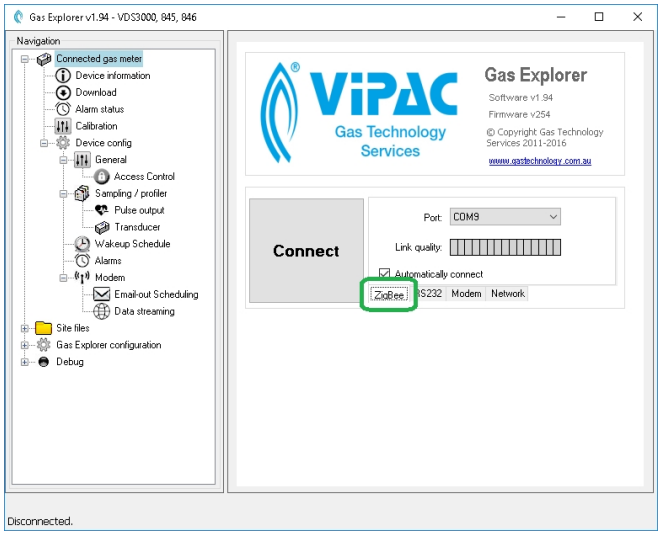
button will appear under the "Connect" button for password input.

Gas Explorer will indicate that you are connected to the VDS3000 by showing the word "**Connected**" in green, to the right of the RS232 selection tab.

ZigBee

The user may communicate with the VDS3000 via **ZigBee** using the Gas Explorer software, and a USB ZigBee dongle, within a 5m radius from the device. This method is designed for remote interrogation and/or programming in

locations where access to the device is restricted or difficult – this is ideal for meter readers. This also enables the unit to be integrated into building energy monitoring systems via Modbus / ZigBee (please refer to section 3).



From the "Connection" page select the "ZigBee" tab. The serial ports associated with the zigbee dongle will be automatically detected.

Once ready, press the "Connect" button to begin detecting ZigBee enabled devices.

Gas Explorer will automatically connect to the first detected device if 'Automatically connect' is checked.

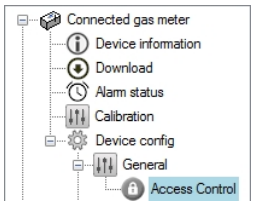
Otherwise, the user must select the device from a list and connect by pressing the "Select" button which will appear. This is useful in cases where two devices are within range.

NOTE: How quickly Gas Explorer detects a VDS3000 via ZigBee will depend on how often the device "wakes up" to listen for a ZigBee request. An immediate "wake up" can be forced by pressing the "Display" button on the device. Refer to Section 3 part e for more details.

Password control

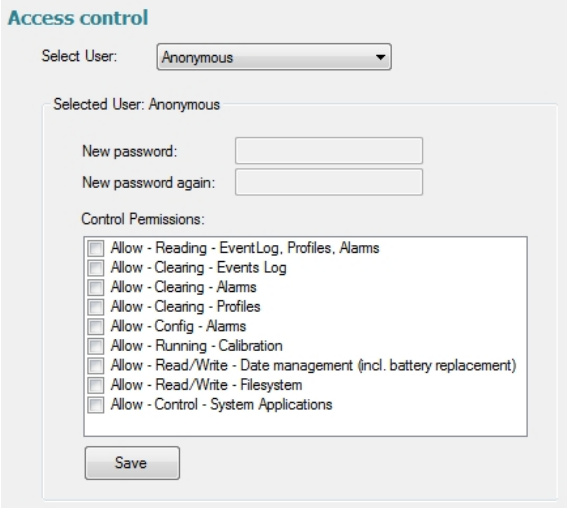
The VDS3000 has four levels of security which can be configured from the "Access Control" page.

- Anonymous access, no password required.
- Custom user level #1, requires password.
- Custom user level #2, requires password.
- Administrator access, requires password.



Each password may be up to 16 characters long. All characters are valid and are case sensitive. (i.e. if you set the password to "SECRET" the VDS3000 will not accept "Secret" or "secret")

Each security level can be configured to have access to any combination of the following functions:



- Read events, profiles, alarms
- Clear events log
- Clear alarms
- Clear profiles
- Configuring alarms
- Running calibration
- Date management – includes battery replacement, current date/time
- Read/write to filesystem - should be admin only
- Control of system applications

To set a password, choose the user level from the dropdown box and enter the new password into both input boxes. Then tick the boxes to enable access to certain features and press save to commit those assignments for the selected user level.

By default, the administrator password is factory set to "**VDS3000**" and only has access to all of the above functions. The user should change it to prevent unauthorized access to the VDS3000. Please make sure you record the new password in a safe secure place. If this password is lost you will not be able to access the corrector to change any passwords and the corrector will have to be reset to factory defaults (see page 26 for details)*. This will result in loss of all stored data and calibration information.

*A service master password that will temporarily grant access to the device (during the hour for which it was generated) may be provided by the manufacturer.

3. CONFIGURATION

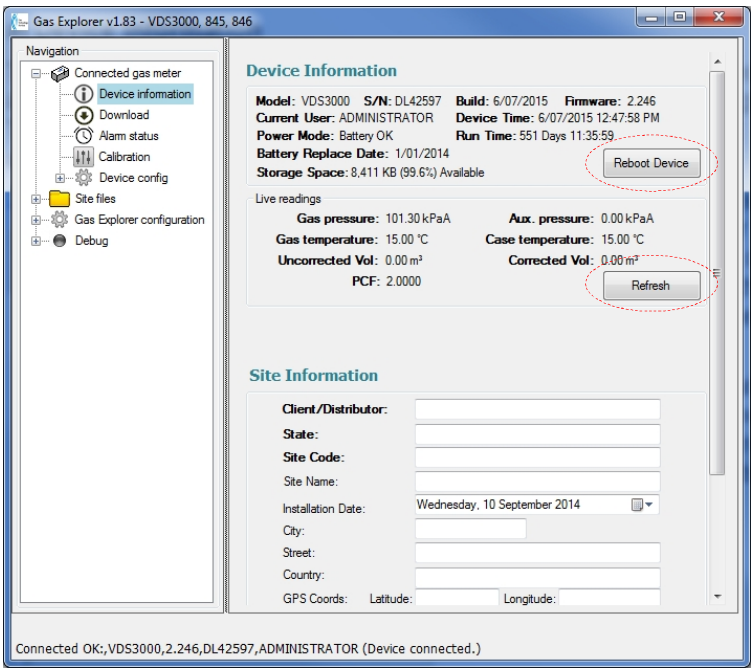
The VDS3000 requires configuration before installation in the field. Mechanical configuration (ensuring that meter rotation is proper), Gas Explorer (software) configuration and hardware configuration (configuring the hardware variables in the VDS3000) are covered.

Software Configuration – Gas explorer

In order for the VDS3000 to suit your application, it must be configured at a software level to enable all relevant hardware. The Gas Explorer default settings from the factory are usually set to allow immediate use of Gas Explorer. Basic configuration requirements were discussed in a previous section (see Communication). However, this section will discuss all possible configuration aspects of Gas Explorer.

Device information

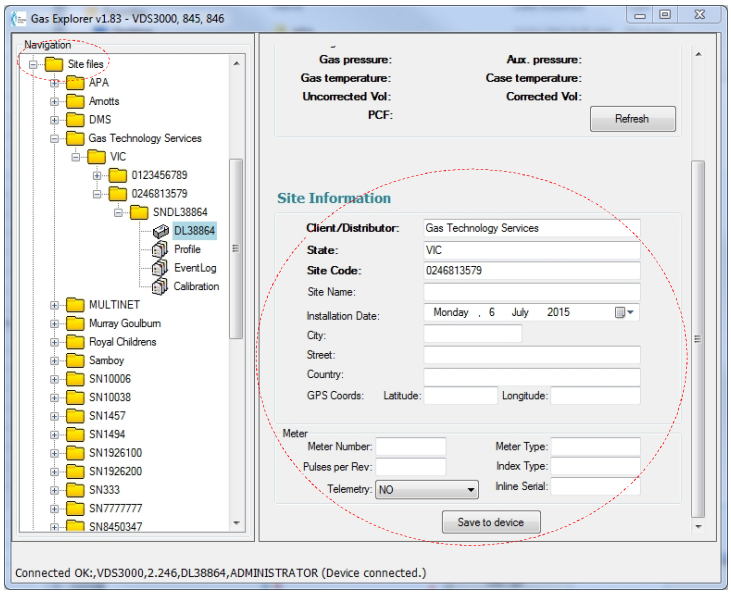
This page displays Device information and status of the connected VDS and is accessible by selecting 'Device Information' in the navigation panel. The information lists what is stored on the device and cannot be manually altered.



Live readings, such as gas pressure, temperature and corrected and uncorrected volumes will be updated when the "Refresh" button is pressed.

The "Reboot" button will cause the VDS300 to reboot. This may be required in the event that an unexpected error prevents the device from operating normally.

Site information

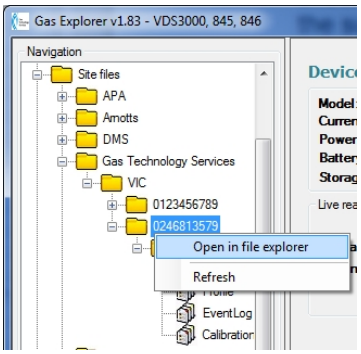


Site information is shown on the same page as device information, by scrolling down. This section enables the user to specify information relating to details of the site such as distributor name, site name, site location, and meter information. Files and reports associated with this site may be access through the navigation pane by expanding the node labelled ‘Site files’.

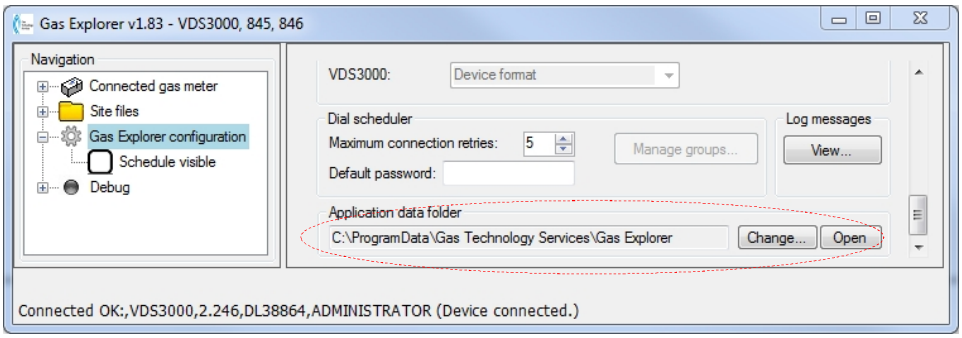
Fields shown in **BOLD** should be populated meaningfully as they correlate with the naming structure of the subfolders within the sites folder where all device data is saved.

Changes made to these fields are committed to the device and updated in the sites folder when the “Save to device” button is pressed, which is located at the bottom of the page.

Site files: The ‘site files’ node in the navigation pane displays all subfolders contained within the sites folder. To remove an unused site from the site-tree the user must manually delete the corresponding folders using windows file explorer and then refresh the site-tree. This is made easy by selecting the targeted folder, right-clicking to open the context menu and then selecting “Open in file explorer”. After the respective folders have been deleted (or moved outside the sites folder), right-click and select ‘Refresh’ to update the tree.



Site data is stored in the ‘Sites folder’ located within an application data folder. The default location of this folder may differ depending on the operating system. However this can be manually set via the ‘Gas Explorer configuration’ panel.



To avoid confusion and misplacement of files, it is recommended to have site details saved in the default path:

`%programdata%\Gas Technology Services\Gas Explorer`

Where **%programdata%** represents the folder used to store program data for all users. This differs between operating systems. Some examples follow:

- **Windows XP**

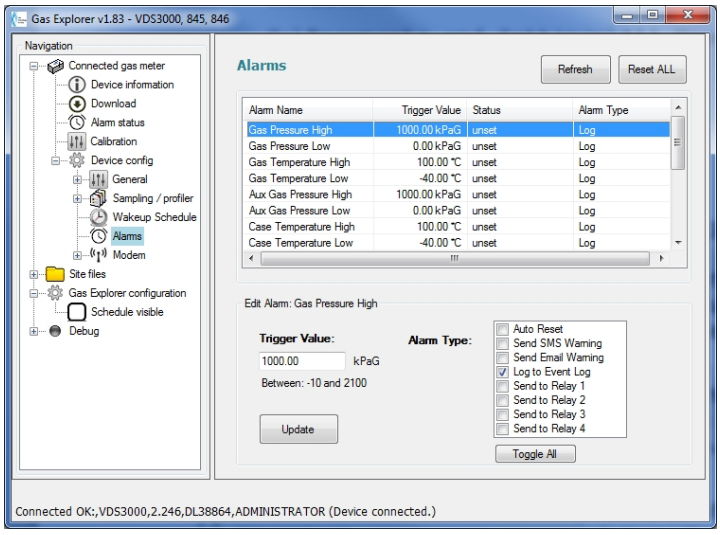
  `C:\Documents and Settings\All Users\Application Data`

- **Windows 7**

  `C:\ProgramData`

Alarms

The alarms panel allows the user to configure the trigger values and notification methods used for various alarms, as well as the current state of each alarm.



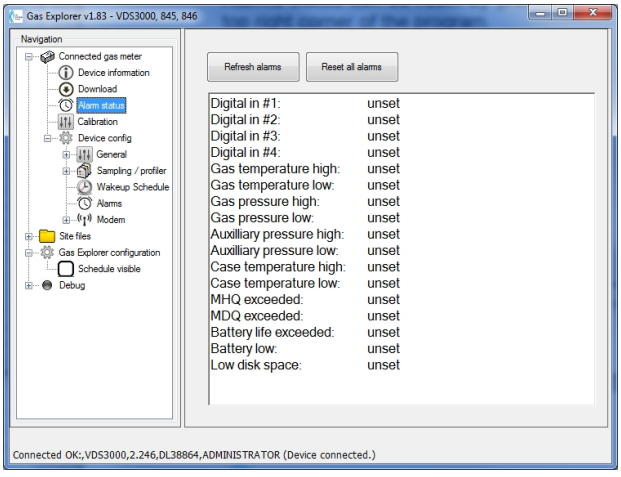
When configuring alarms, first select the type of alarm that needs to be configured and then enter the desired triggering value.

Select the notification method (for example, notify via email or SMS) by ticking the respective boxes listed on the bottom-right corner of the window.

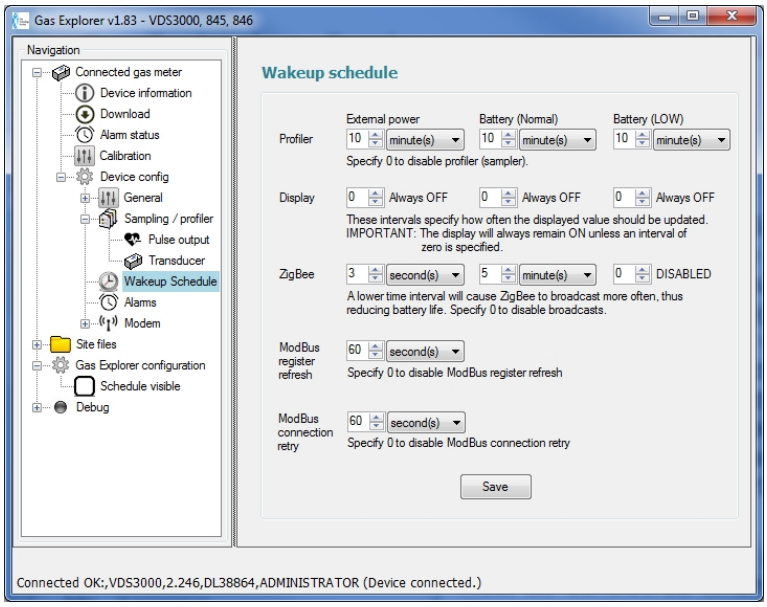
Once satisfied, press the “Update” button to commit the change.

Alarms states can be reset by pressing the “Reset ALL” button located on the top right corner of the program.

Alternatively, alarm states can be viewed via the ‘Alarm status’ panel. This provides a quick way to check alarm statuses without loading the configuration data associated with each alarm.



Sampler Wakeup Scheduler



The 'Wakeup Schedule' panel is used to configure how often the VDS3000 will wake-up to sample (write to profiler), search for a ZigBee signal, communicate with RTU via Modbus and update information displayed on the LCD screen. These settings can be configured for various power modes.

There are three power modes to consider when configuring "Profiler", "Display" and "ZigBee" wakeup intervals. They are "External power", "Battery (Normal)" and "Battery (LOW)".

Profiler Update Time – determines how often the VDS wakes up to take a reading of all sensors, recalculate the correction-factor and record all parameters to profiler memory. For example, if the profiler update time was set to 30 minutes, then the profiler data will be recorded every 30 minutes. When downloading profile data, this becomes the default interval. However, Gas Explorer can combine or split these intervals to generate a report of a different interval than 30 minutes (see "Acquisition of Data" section for more detail). To disable profiler update, set the numerical value to zero.

Display update Frequency – determines the duration for which a value should be displayed on the LCD before cycling to the next parameter. The displayed parameters can be chosen from the "LCD" tab under "Configuration".

Zigbee Wakeup Frequency – determines how often the ZigBee module wakes up to scan for a ZigBee enabled device in the area (laptop for instance). The ZigBee module can be woken manually by pressing the "Display" button on the VDS.

Modbus Register Refresh – determines how often the VDS samples and refreshes the Modbus Register.

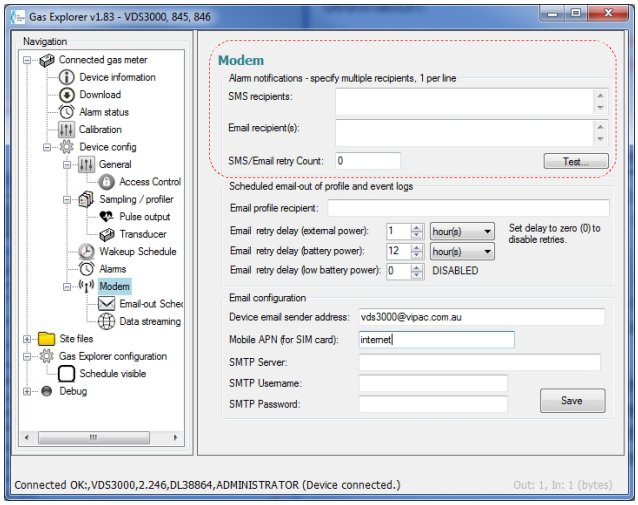
Modbus Connection Retry – determines how long the VDS3000 will delay between connection attempts to the ProBee serial dongle connected to the site's Modbus control hardware.

NOTE: The more often components wake-up, the more power will be consumed. It is therefore recommended that a VDS3000 to be connected to external power if it needs to wake-up on a regular basis.

Modem

The VDS3000 Internal Modem can be configured via the “Modem” panel. SMS, Email and server settings are configured through this page.

Alarm notification recipients



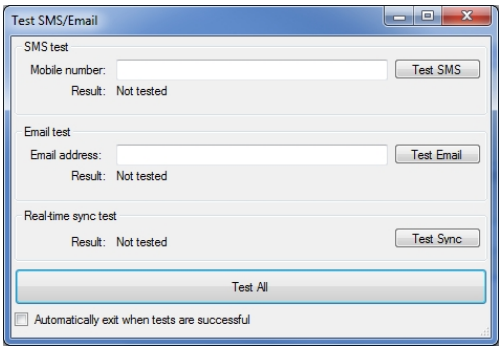
Enter the mobile numbers and/or email addresses in the indicated fields to determine the Alarm recipients. Multiple recipients must be specified on *separate* lines.

The number of times to retry should be set to a number suitable for all power modes.

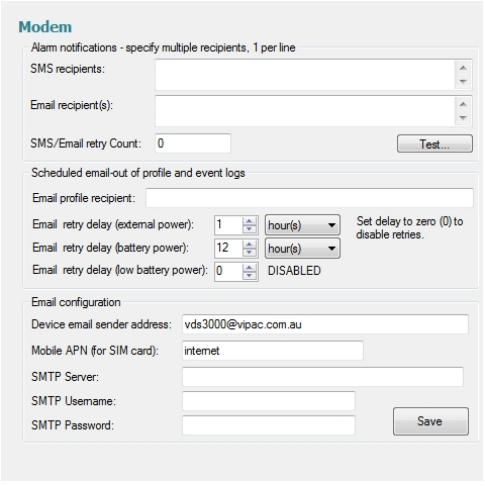
Sending of an SMS and/or email may be tested via the “Test SMS/Email” screen accessed via the “Test…” button.

Within the “Test SMS/Email” screen, enter the mobile number and email address of the recipient to test. The program will send a default test message/email to each appointed destination.

NOTE: Mobile numbers should be entered in the same format as if you were dialling from a land-line phone.



Scheduled email of profile and event logs

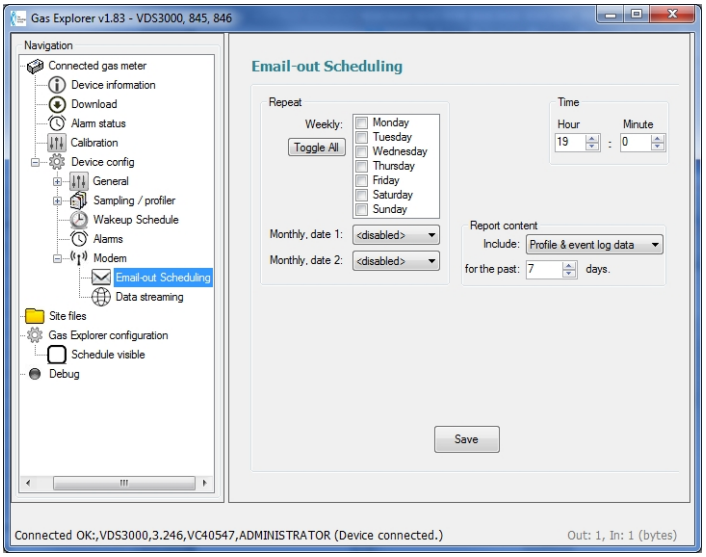


Enter a *single* email address into the “profile recipient” field to specify the sole recipient for receiving profile data.

If the device fails to send profile data then it will retry, for a specified interval of time, until it succeeds. A suitable time interval should be specified for each power mode.

To properly configure the modem, the user must obtain information from their SIM card provider regarding server information such as: APN, SMTP server, SMTP username and password. Press “Save” to commit.

Email-out Scheduling



Configure how often, and at what time, the profiler & event log data should be emailed to the sole recipient.

The user may select the time of day at which to send the data and the content of the report – profiler and/or event log data. The number of past days must be specified.

The device may be configured to send profile data on specific days of the week and/or up to two specific days of the month.

How to choose a SIM card and plan for your VDS3000

Older gas meters used a telemetry technology called circuit switched data. Telecommunication companies generally refer to this as **incoming data calls**. This service is becoming rarer by the year; there may be a time when this technology is no longer available. **The VDS3000 does not require this technology.**

The VDS3000 uses a telemetry technology called packet switched data. Telecommunication companies refer to this as **Internet**, **Mobile data**, or **Mobile WAP**. This is the way that all mobile phones, 3G USB dongles, and tablets talk to the Internet, and is more or less ubiquitous across mobile carriers. **This is the service required for VDS3000 email and data streaming.** If SMS alarms are desired, **outbound SMS** is also required on the SIM service.

When choosing an Internet data plan for your VDS3000 modem, keep the following data consumption requirements in mind:

- Each profile interval is ~110 bytes of data. For hourly intervals, this equates to ~2.5KB of data transmission per day. For 2-minute intervals, this equates to ~80KB per day.

- Each event log record is roughly the same as a profile interval: ~110 bytes of data. A unit without any alarms triggered or other errors will transmit a minimum of 220 bytes of data per day. A unit with several alarms triggered, or other warnings logged, throughout the day could result in several KB of data transmission just for event logs.

Examples:

- A VDS3000 configured with hourly intervals will use roughly 100KB of data per month.

- A VDS3000 configured with two-minute intervals will use roughly 2.3MB of data per month.

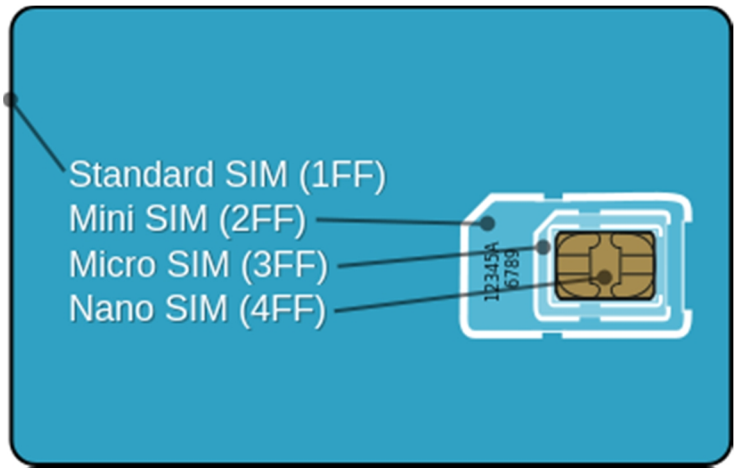
For scheduled emails: please note that these values are assuming there is no overlap of data sending; e.g. 7 days of data is transmitted once per week, or 1 day of data is transmitted daily. It is possible to configure an overlap, e.g. 3 days of data is transmitted daily. If an overlap of data is configured, the data allowance must be multiplied by the amount of overlap.

Please note that these values are rough indicators only. More or less data may be used, depending on the number of events recorded for the period, retries due to packet corruption from poor signal strength, and overheads introduced by the data network and protocols. In mobile telemetry, it is good practice to plan for 3 or 4 times the calculated data cost.

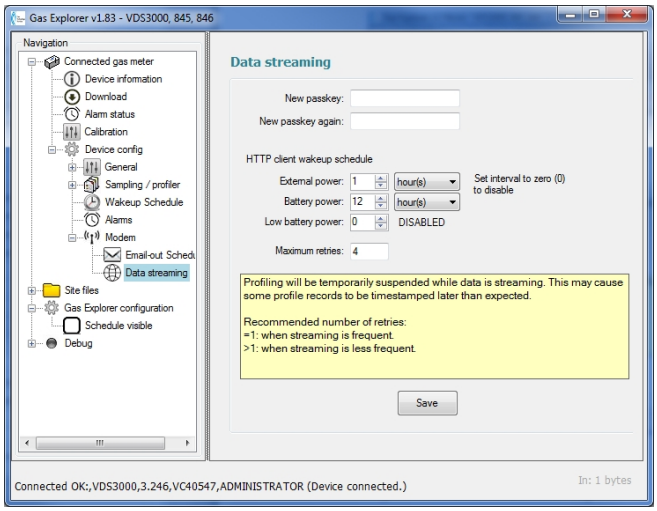
SIM CARD INFORMATION

The SIM card required for the VDS3000 is a Mini-SIM (2FF) – size: 15mm x 25mm. Some distributors will call it a standard-size SIM, which is misleading (there is a “standard SIM” which is the size of a credit card, though this is no longer the standard and never used anymore!), and liable to change again.

- Enable data for emailing profilers, alarms and real time tracking.
- Enable SMS for SMS alarms.



Data streaming



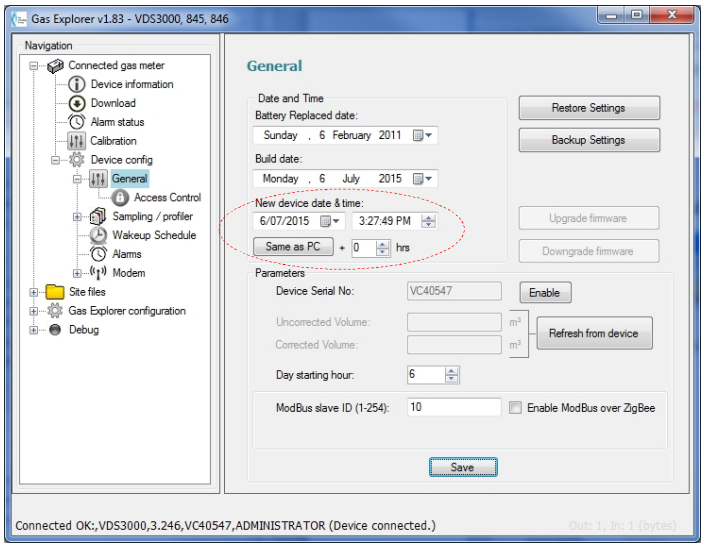
The VDS may be configured to periodically upload data to a dedicated server provided by Gas Technology Services. This way, event log and profile data history become available for viewing at any time without requiring a connection to the device.

The passkey fields are used to set the identity of the device to the server.

The HTTP client wakeup schedule fields set how often new data is submitted.

NOTE: Careful consideration should be given to the interval chosen for battery powered mode, to ensure adequate longevity.

Time and date setup



Having the correct time and date plays a very important part in gas flow monitoring and reporting. Time and date settings can be accessed via the “General” configuration panel.

To set the date for the VDS3000, choose the appropriate date from the drop down box.

Enter the date and time that you would like to set into the adjustable time box. To automatically fill it with the current date and time of the PC +/- displayed hours, press “Same as PC”.

NOTE: This requires the PC time to be accurate. When ready, press “Save” to commit changes to the device.

4. INTERROGATION

There are two main parts under this section of the manual, Calibration and Unit Debug.

Generally, Gas Technology Services recommends that VDS3000 units should be calibrated once a year at minimum to correct for possible pressure drifts and temperature variations. The details and steps involved with calibration will be introduced in the sections below.

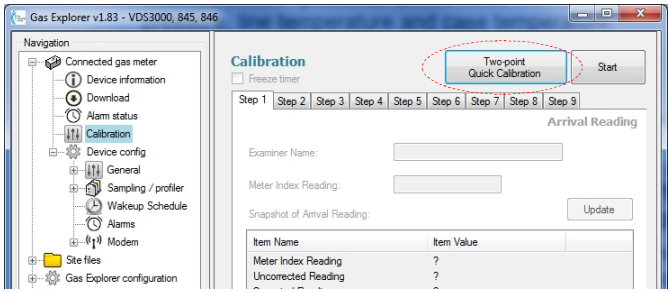
NOTE: All transducers need to be calibrated separately under Internal and External Power modes.

The debug section gives details of obtaining and understanding the event log as well as performing a manufacture-reset and backup/restore of the unit settings.

Calibration

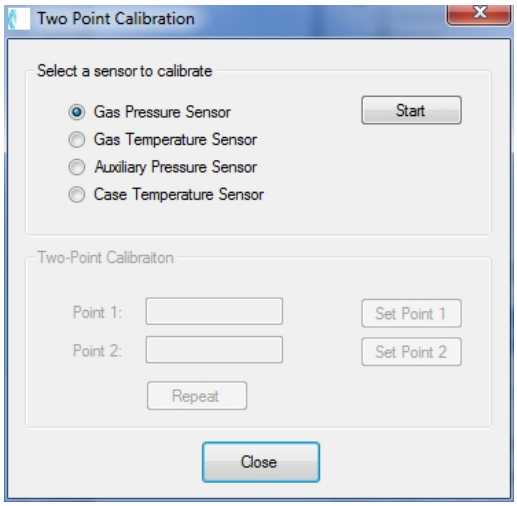
The VDS3000 provides 2 methods for calibrating line pressure, auxiliary pressure, line temperature and case temperature.

Method 1: Two-point quick calibration.



To run the two-point quick calibration, the user must ensure that the relevant sensors are set to 'sampled' factor (rather than 'fix' factor – please see installation page for more information).

Once the sensor has been set, click "Two-point Quick Calibration" to open the calibration screen.



Select the sensor that needs to be calibrated and press "Start".

The pressure transducer requires a two-point calibration due to the offset and gain errors which must be compensated for. One calibration is required at near 70 percent of the full scale of the transducer and one near zero.

To calibrate the pressure transducer (both line and auxiliary), it is recommended that it be connected to either a dead weight tester or other accurately known source of pressure. The transducer should be allowed to stabilise if it has been subjected to temperature changes (see Section 6e for initial setup of pressure transducer).

For the pressure nearest to Zero, enter the value indicated by the reference equipment into the field labelled “Point 1”. Once the transducer has stabilised, press the button labelled “Set Point 1” to commit the first set-point into the VDS3000. Then, for a pressure near 70% of full transducer range, enter the value indicated by the reference equipment into the field labelled “Point 2”. Once the transducer has stabilised press the button labelled “Set Point 2” to complete the calibration.

NOTE: The new calibration will only take effect after the second set-point is committed.

To calibrate the temperature (PT100 Sensor), you need to select the gas temperature sensor option and press “Start”.

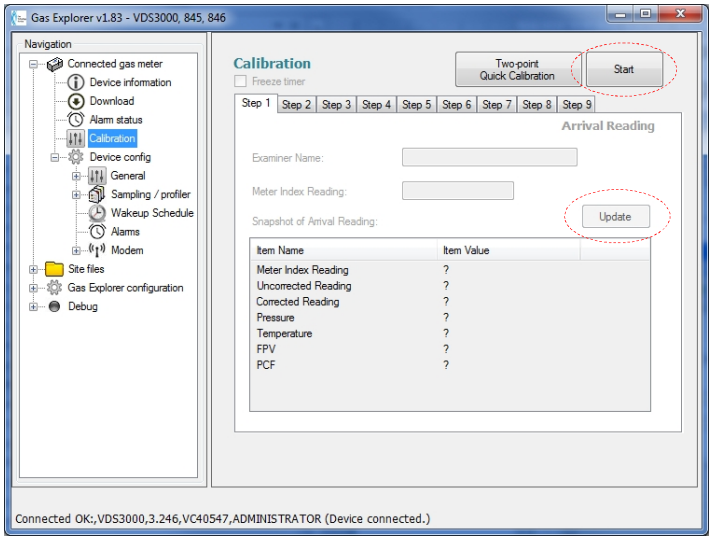
You will then need to do a two-point temperature calibration. This will involve placing the PT100 in a temperature bath/reference at a cold temperature (between 0-5˚C) and setting the first calibration point. Then you will need to use a higher temperature reference (between 45-50˚C) to calibrate the second point. Note that you can take as long as you like between point one and two.

To calibrate the temperature probe, it is recommended that it be immersed in a liquid of known temperature (i.e. ice bath reference) and allowed to stabilise for 10 minutes.

A calibration error will be indicated if the required calibration factor is out of limits (indicating a faulty temperature transducer or connection).

Method 2: Two-point calibration via the “Calibration” tab.

The Calibration pages are accessed via the “Calibration” tab.



Step 1

To start the calibration process, press the “Start” button.

Enter the name of the examiner (calibrator) and enter the meter index reading in the relevant fields, then press “Update”. A snapshot of the current status of the VDS will be displayed in the window below. If the meter index is ±2 counts from the uncorrected reading then it will be highlighted. This indicates that the VDS should be realigned using the controls found in the “General” configuration panel (see Installation & Setup Section). The information listed in the window will be recorded in the calibration report as the “arrival reading”.

Step 2

Choose the reference equipment used for calibration. Also, the ambient temperature, ambient pressure and maximum value of the pressure transducer should be entered.

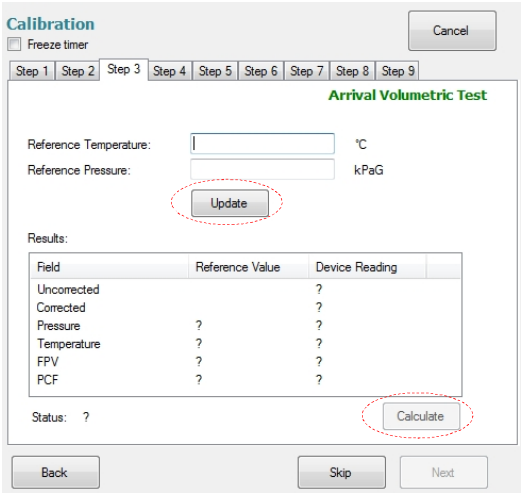
For a Data Logger scenario where pressure and temperature sensors are not employed, it is possible to skip to the “Departure” readings (see step 10).

Once all data has been entered, press “Next” to continue. Press “Back” to return to the previous page.

Freeze Timer

The freeze timer is used to override the live temperature and pressure readings with the readings that were sensed when the timer was activated. The purpose of this is to prevent the profiler from logging spikes in temperature and pressure that are generated during calibration, when the sensors are exposed to a regulated source. The corrected volume will be calculated using the overriding values for as long as the timer is counting down.

Step 3



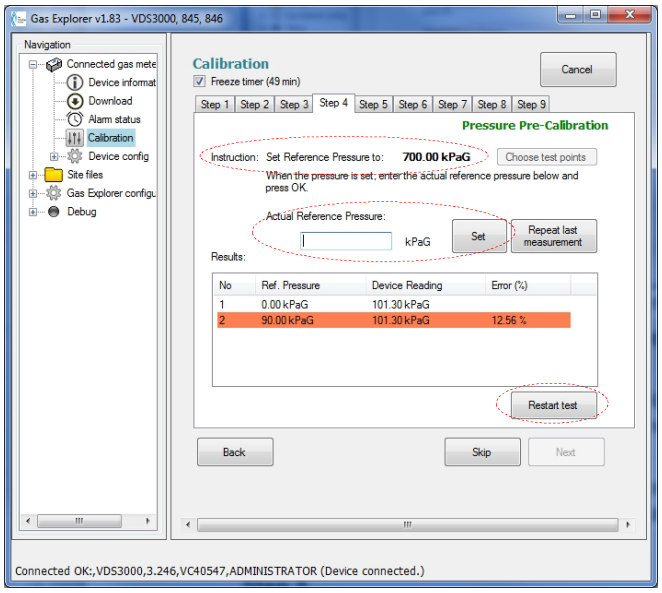
Arrival Volumetric Test calculates the “as found” percentage error between the values & volumes reported by the device and the values & volumes theoretically expected.

To perform this test, the pressure and temperature sensors connected to the VDS will need to be removed / isolated from the unregulated source and exposed to a regulated source that is generated by referencing equipment.

Once the references have been set and the VDS sensors have stabilised, press “Update”. This will initialise a list of values that compare what has been entered with what the sensors are reading.

When ready, press the “Calculate” button to initiate the volumetric test. The VDS is now waiting for sufficient pulses to pass through, depending on the “Volume Counter Multiplier” and the type of meter index. It is essential to keep the reference pressure and temperature as stable as possible during this time. Once the pulses have come through, the VDS automatically calculates the percentage error between the theoretical volume and actual volume. If the calibration technician made no operational errors and the error value still falls outside an acceptable range, this could mean the pressure or temperature transducers have drifted and may need to be recalibrated or replaced. If an Arrival Volumetric Test is not needed, press the “Skip” button to enter step 4.

Step 4



This step is for checking the accuracy of the pressure transducers.

Set the reference equipment to the pressure as instructed by the program. Once the pressure is stabilised, enter the pressure shown on the reference equipment into the field and press “Set”.

The program will compare the value entered to the value detected by the VDS. If the error is more than 2%, Gas explorer will highlight the test in red to indicate that the pressure transducer may need to be recalibrated.

Gas explorer will allow 4 test points before prompting the user whether a pressure calibration is necessary.

Once all testing processes have been completed, the “Next” button located at the bottom of the program will become enabled.

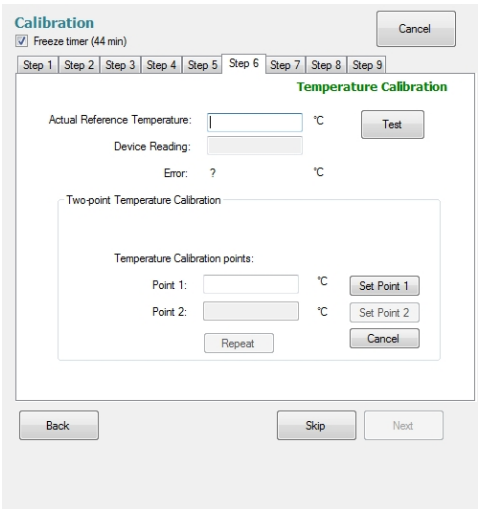
Step 5

If Gas Explorer has prompted the user to perform a pressure calibration during the previous step, it will be necessary to complete a two-point calibration to ensure that the VDS is sensing accurately. If the previous step returned satisfactory results, then the user may still choose to perform the two-point pressure calibration.

Refer to the pressure transducer calibration procedure described in **Method 1** to complete this step.

Step 6

A temperature transducer test will be conducted during this step, which compares a reference reading with a device reading to generate an error (in ºC). Enter the reading from the reference equipment into the corresponding field and press “Test”. If the result was ±0.2 degrees or more, Gas explorer will prompt the user to conduct a two-point temperature test. Refer to the temperature transducer calibration procedure described in **Method 1** to complete this step.



Step 7

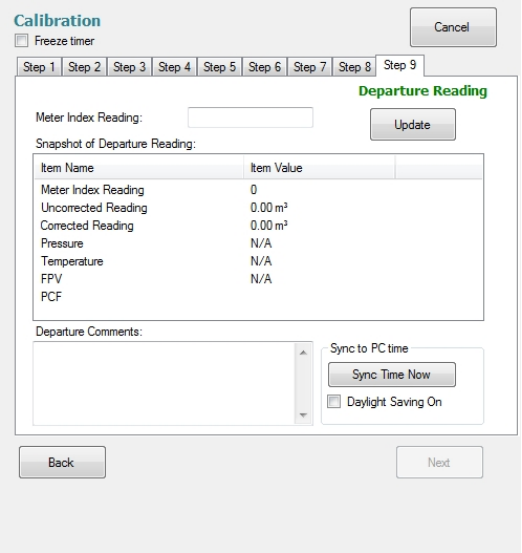
Calibration of Auxiliary pressure is identical to the calibration of the Gas Pressure transducer (step 5).

Step 8

Departure Volumetric Test calculates the “final” percentage error between the detected values/volume and theoretical values/volume. This value is to be used as a comparison between accuracies before and after the calibration. Please refer to step 3 “Arrival Volumetric Test” for details.

Step 9

The departure reading allows the user to record the status of the VDS at the end of the calibration process.



As in Step 1, enter the meter index into the relevant field and press “Update”. A snapshot of the current device status will be listed and the uncorrected reading will be highlighted if it still isn’t aligned.

Departure comments may be entered in the relevant field that relate to the calibration process.

Press the “Sync Time Now” button to set the VDS onboard clock to the same time as the PC. Tick “Daylight Saving On” to compensate for Daylight savings mode.

To complete the calibration process, press “Next”. Gas Explorer will generate and display a report which can be printed or copied. The calibration files can be found in the Calibration folder located in the device folder, accessible from the site-tree window. (Refer to part 7 – Acquisition of data & File systems for more information).

Error interrogation & Event log

One major part of the error interrogation process apart from checking the accuracy and the functionality of transducers is to download the Event Log stored in the VDS (refer to part 7 – “Data Acquisition & File Systems” for more information)

The Event Log consists of records of events that affects, changes, activates and resets certain parameters or functions in the VDS3000. Also, daily summaries of the accumulative uncorrected and corrected volumes are also recorded.

When an error occurs, the events are most likely recorded in the event log for bug fixing/problem diagnosis.

Possible events from the Event Log are shown in the table below. Most indicate the occurrence of an event, while others indicate possible errors. Possible solutions are also provided in the table.

Some events or codes may not be listed in the table. These are response codes from software or hardware.

Event description	Parameter meaning	Solution
--------BOOT-------	0 = reboot requested 1 = boot failed during init 2 = failure initialising counter 3 = failure initialising modem 4 = failure initialising power management 5 = failure initialising data flash file storage 6 = failure initialising ADC 7 = failure initialising AD7709 ADC 8 = failure initialising DIO 9 = failure initialising app management 10 = failure initialising firmware updater 11 = failure initialising button control 12 = too many failures; remedial format 13 = too many failures; remedial settings delete 14 = system narcolepsy; 15 = failure initialising sampler 16 = failure initialising RS-232 17 = failure initialising ZigBee 18 = failure initialising alarms control 19 = failure initialising profiler 21 = failure initialising modem control 22 = failure initialising LCD	This error means that the VDS has rebooted or crashed due to errors or hardware failure. Under general circumstances, the VDS will automatically recover and continue to operate normally. Should unit fail to recover, user could perform a manufacture reset. If still unable to recover, Please contact distributor or manufacturer. Manufacture reset: 1. Disconnect power to VDS3000 2. Hold on to “Display” button in front of the unit. 3. Reconnect power to VDS and wait for countdown. 4. Once the unit has finished counting, reboot will automatically initiate.

Firmware updated	90 = firmware update success 91 = no update occurred 92 = firmware loader missing 1 = firmware loader failed unexpectedly; 2 = invalid firmware file 93 = verify failed 94 = update failed 95 = erase failed	For error 91,92,93,94 and 95. Reload Gas explorer to update firmware. If error still occurs, please contact distributor or manufacturer.
Missing setting	Parameter # will be displayed.	Check all settings have been set correctly
Corrupt setting	Parameter # will be displayed.	Set corrupted setting to the correct value/option
SMS failure	Displays the number of retries before giving up	Check modem settings and connection signal.
Email failure	Displays the number of retries before giving up	Check modem settings and connection signal.
SMS rec missing	No recipients have been set	Check modem settings from Gas Explorer
Email rec missing	No recipients have been set	Check modem settings from Gas Explorer
Write parameter	When values are set	
Format data flash	Factory reset	
Mark new firmware	Just before flashing firmware	
Xmodem started	Transmission of new firmware file	
Xmodem aborted	Aborting firmware file transmission	
Xmodem completed	Completion of firmware file transmission	
Elevate privileges	Logging in, User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Session started	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 =	

	administrator)	
Session timeout	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Session completed	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Event log cleared	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Profiler cleared	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Alarms cleared	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Date set	User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Delete parameter	When parameters are changed, Parameter #	
SMTP error	SMTP setting error, Parameter #	Refer to SMTP protocol standard for full list of error codes.
VDS3000 rebooting	Been asked to reboot from software User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Reboot recovery mode	Current sample period been preserved before reboot	
SMS notification	0 = success 1 = no modem power 2 = failed CMGF 3 = failed CMGS 4 = failed GPRS enable 5 = no socket connection	

	6 = failed HELO 7 = failed MAIL FROM 8 = failed RCPT TO 9 = failed DATA 10 = message could not send 11 = feature disabled 12 = set SMTP error 13 = set user error 14 = set password error 15 = set sender error 16 = init email error 17 = send email error 18 = send email power event	
Email notification	Same us SMS notification	
Pulses sent on ch1	Relay Pulse out	
Pulses sent on ch2	Relay pulse out	
Pulses sent on ch3	Relay pulse out	
Pulses sent on ch4	Relay pulse out	
Set total uncorr vol	New uncorrected volume (as integer, modulus 65536)	
Set total corr vol	New corrected volume (as integer, modulus 65536)	
Read profile	Profiler has been read by User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
Read event log	Event log has been read by User # (0 = anonymous; 1 = USER1; 2 = USER2; 3 = administrator)	
All other	Manufacturer internal use only	

Alarm events		
Digital in 1of4	n/a	
Digital in 2of4	n/a	
Digital in 3of4	n/a	
Digital in 4of4	n/a	
Gas temp high	Gas temperature (as integer, modulus 65535)	
Gas temp low	Gas temperature (as integer, modulus 65535)	
Gas pressure high	Gas pressure (as integer, modulus 65535)	
Gas pressure low	Gas pressure (as integer, modulus 65535)	
Case temp high	Case temperature (as integer, modulus 65535)	
Case temp low	Case temperature (as integer, modulus 65535)	
Aux pressure high	Aux pressure (as integer, modulus 65535)	
Aux pressure low	Aux pressure (as integer, modulus 65535)	
Battery life exceed	Hours exceeded (as integer, modulus 65535)	
Battery low	Battery running low	
Power mode changed	New power mode (0 = EXT SUP, 1 = BATTERY; 2 = LOW BAT)	
Low drive space	Free drive space % (as integer)	

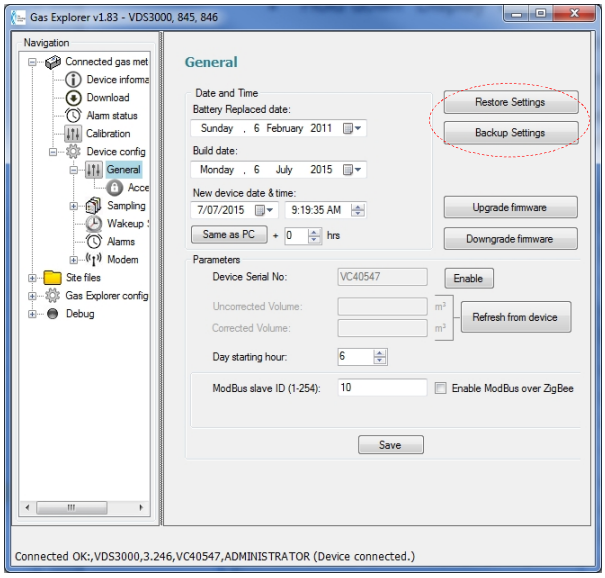
Manufacture reset & setting backup/restore

On the rare occasion that the user experiences a hardware “freeze” or crash due to incorrect operations or software bug, the VDS may not resume functions after a restart. This will require a Manufacture reset.

The steps for performing a manufacture reset are as follows:

- Disconnect power from VDS3000
- Hold down “Display” button on front of unit.
- Wait for countdown to start, then continue holding button down.
- Once the unit has finished counting, reboot will automatically initiate.

NOTE: All settings in the unit will be reset to defaults. Therefore, it is good practice to back up all device settings and profilers before attempting manufacturer restart.



Backup & Restore settings facilities are accessible via the “General” configuration panel.

When backing up settings, a pop-up window will appear requesting where the backup file will be saved.

Choose an appropriate location and file name (recommend unit serial number) and press “Save”.

To restore, press “Restore Settings”, choose the backup file and press “Open”. A progress bar will appear until the process is completed.

NOTE: Do not disconnect power or computer during restoration to avoid data corruption.

5. INSTALLATION

It is recommended that experienced field personnel carry out installation of the VDS3000. It is also recommended that all configurations of programmable variables be completed before putting the VDS3000 into service (see CONFIGURATION). The exception to this recommendation is to wait until after installation to enter the starting uncorrected and corrected volume totals and to initialise the profiler. This will ensure that all subsequent data collected will be true and accurate. Check all clearances around the corrector and ensure the front cover can be opened to facilitate connection of inputs and outputs.

Mounting

A pulsar that is mounted on the meter will be required. Connect the two wires from the pulsar to the VDS3000 Main PC Board at the top to the terminals labeled P3. The bottom two pins from the jumper (LINK 1) located just above these connections must also be connected to enable single reed operation.

Pressure/Aux Pressure Connection

Connect the pressure (or gas) supply to the 1/4 inch NPT female connector located on the lower back section of the VDS3000 using an AGA approved thread sealant. After piping is complete check all connections to ensure that no leaks are present. Make sure the maximum pressure applied to the pressure connection does not exceed the transducer's upper pressure limit. Please chose an appropriate pressure transducer where the meter operating pressure is around 70% of the full transducer range.

Temperature Connection

The temperature probe should be installed in the appropriately sized thermo well filled with a thermo-conductive medium such as glycol or alcohol. Insert the temperature probe into the thermo well through the 1/4-inch NPT male gland (provided) until the tip of the probe reaches the bottom of the well.

Safe Area Connection

The hazardous area classification needs to be determined. Please refer to AS/NZS 2430.3.4:2004, Classification of Hazardous Areas, or equivalent standard.

There are a number of connections available for outputs to the safe area. These are:

- P13/14 UNCOR VOL user configurable as pulse output for uncorrected or uncorrected volume

Enclosure entry and exit points for the above ports are either via standard cable gland or optional connector.

For installation refer to AS/NZS 2381.1:2005, Electrical equipment for explosive atmospheres – Selection, installation and maintenance, Part 7: Intrinsic Safety.

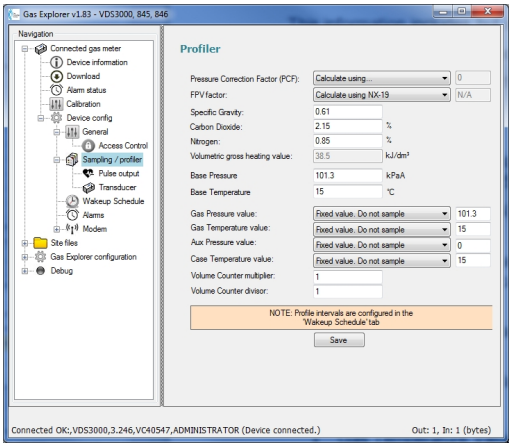
Recommended Safety Barrier Type:

- MTL Instruments Safety Barrier Model No. MTL7758+/-, or equivalent for external power connection, relay output, and communications.

NOTE: A Safety barrier must be used if digital inputs P3/P5/P12 were connected to instruments outside of hazardous areas.

See Appendix F for Schematic for installing external equipment to INLINE VDS3000 Gas Volume Corrector.

Offline / configuration



The “Profiler” tab under “Configuration” enables the user to set vital parameters used for calculating the gas correction factor. These are normally configured during initial installation.

This information includes but is not limited to:

- Pressure Correction factor (PCF)
- FPV factor (fixed; NX-19; AGA 8)
- Specific gravity of the gas (default: 0.6113)
- Molar % of Carbon dioxide (CO_2) in the gas (default: 2.15%)
- Molar % of Nitrogen (N) in the gas (default: 0.85%)
- Volumetric gross heating value (for A.G.A. 8 calculations) (default: 38.5)
- Base pressure (default: 101.3 kPaA)
- Base temperature (default: 15°C)
- Gas Pressure Value
- Gas Temperature Value
- Volume Counter Multiplier
- Volume Counter Divisor

Pressure Correction Factor – the factor applied to the raw (uncorrected) gas volume to obtain the actual (corrected) volume. This factor could be applied as a fixed factor or calculated from temperature and pressure. To switch between the two modes, choose the appropriate option from the drop down box. Enter a value for the fixed factor when applying a fixed factor.

Gas Pressure Value – the gas pressure (in kPa) to be used for corrected volume calculations. The user could choose from the following three options:

1) Sampled value – pressure obtained from sensors (pressure transducers).

2) Fixed factor – a user specified pressure value

3) Fixed value only if hardware fail – a user specified value that will be automatically applied when sensor fail to respond. This option works as a dual mode between sampled & fixed value.

Gas Temperature Value – is the gas temperature (in °C) to be used for the corrected volume calculations. The user could choose from the following three options:

1) Sampled value – temperature obtained from sensors (temperature transducers).

2) Fixed factor – a user specified temperature value.

3) Fixed value only if hardware fail – a user specified value that will be automatically applied when sensor fail to respond. This option works as a dual mode between sampled & fixed value.

The VDS3000 is compatible with PT100 RTD; Please speak with distributor / manufacture for more information.

Auxiliary Pressure Value – gas pressure (in kPa) measured from the auxiliary pressure transducer. This will NOT affect corrected volume calculations. There are also three setup options similar to the Gas Pressure Value.

Case Temperature Value –ambient temperature (in ˚C) to be used for the corrected volume calculation. There are also three setup options similar to the Gas Temperature Value.

Volume Counter Multiplier (ICM) / Volume Counter Divisor (ICD)

These factors are used to set the number of input pulses per volume unit. The uncorrected volume received by the VDS3000 is calculated as follow:

Uncorrected input volume = Input Pulses x ICM / ICD

NOTE: Volume Counter Multiplier and Volume Counter Divisor should only be setup one at a time to avoid confusion. Most index manufacturers specify the pulses per revolution/volume on the meter index. However, number of pulses should always be tested with a multi-meter.

Output Pulses – See section 7c for detail.

6. OPERATION

Once it is fully configured and mounted, the VDS3000 will operate in the field converting the uncorrected volume usage to a corrected volume value. This section will cover some of the important operating parameters of the VDS3000.

The items that will be covered are:

- Power supply (internal and external)
- Data System Inputs (volume, pressure and temperature)
- Alarms

Please see appendix G for more information on installation conditions and parameters.

Power supply (Internal)

When powered internally, with the 3.6-volt battery pack (standard), the unit "wakes up" and calculates at pre-programmed time intervals. The internal power supply has been designed to allow for a system wake up time of every 30 minutes, one profile emailing per day and a 5 minute Zigbee wakeup schedule. The expected estimated life of the battery is in excess of 12 Months. A shorter wake up time (more frequent wake up), more frequent emailing and Zigbee wakeup time will greatly reduce battery life. When the battery voltage reaches a point where it is considered LOW by the VDS3000 the battery alarm will be triggered and logged. Battery status on screen will indicate "Battery LOW". The VDS3000 will also revert to “Low battery” mode. (See section 3e for details on power mode setups).

Power supply (External)

It is possible to power the VDS3000 from an external mains supply through the use of a regulated 7.5 volt DC power supply (that is mains powered). This effectively puts the internal battery pack into a "backup" role. When externally powered the flow calculation process is continuous and can be set to sample and calculate more frequently (see section 3e for detail). Should external power fail, the sample period and calculations will return to the programmed schedule

for internal battery mode. Suitable zener barriers are required when external power is bought in to the hazardous area. External power is connected to the VDS3000 by connecting directly to the terminals labeled "Ext PWR" on the main PC Board. Connect positive to (+) and negative to (-) (see Appendix E for detail)

Single reed switch (Standard)

The pulsar will normally provide a single switch closure (2 wires) that should be connected to the bottom left connector on the main PC Board of the VDS3000 (see “On board connector layout diagram” in Appendix E). The two wires should connect to the terminals labelled P3. **NOTE:** When the VDS3000 is used with a pulsar, the "anti-dither" feature is disabled. Therefore, the integrity of the pulse from the pulsar cannot be guaranteed. Errors that occur due to unreliable pulse inputs to the VDS3000 are not the responsibility of Gas Technology Service.

NOTE: For the single reed switch option, a jumper must be placed on Pin 2 and 3 of connector JP3. See Appendix E for detail.

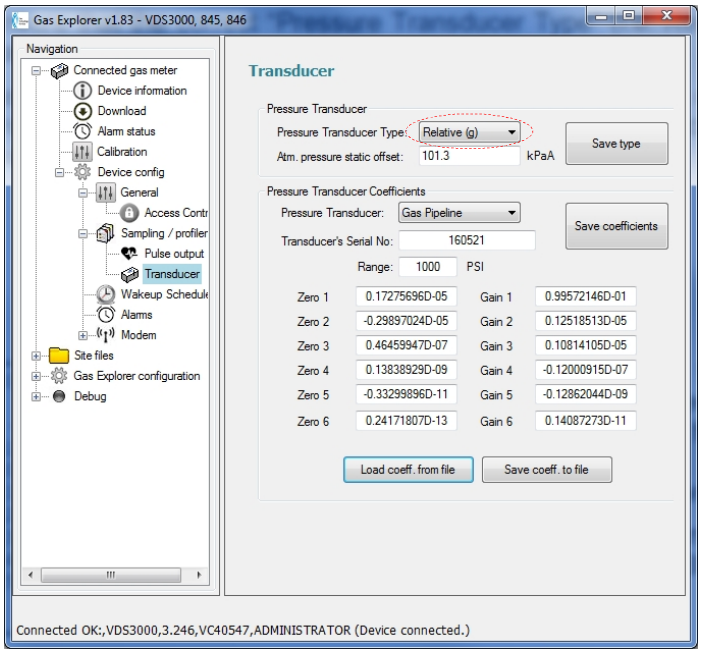
Dual reed switch (Optional)

The VDS3000 utilizes an "anti-dither" dual reed switch input for determining the uncorrected volume that the meter has passed. Some mechanical index assembly attaches directly to the meter incorporates a dual reed switches. These switches are located approximately 180 deg. apart, and therefore dither problems will not occur. After both switches are activated, the VDS3000 treats this as 1 complete pulse that corresponds to a known volume of gas, depending on the meter the VDS3000 is connected to and the input scale factor that was configured to.

NOTE: The input scale factor (volume per one revolution) must be configured properly in the VDS3000 and the jumper switch labeled JP3 **must** be set accordingly.

Data system inputs – pressure transducer

The VDS3000 is programmed to accept a pressure transducer with a 10 VDC excitation and a full-scale output of 100mV. Since pressure transducers inherently produce errors due to low and high temperature extremes, the VDS3000 utilizes a method to compensate for these errors. When the transducer is manufactured the errors are determined at that time. Since the transducer used by the VDS3000 is very repeatable, these same errors are likely to occur for the life of the transducer. From the error data, temperature characterization factors are created. These temperature characterization factors are then programmed into the VDS3000 prior to shipment and are to remain in the VDS3000 until that particular pressure transducer (installed at factory) is removed from the unit in the future due to pressure range change or transducer failure. Any replacement transducer that the user may obtain from Gas Technology Service will include a document that shows the new characterization factors that must be entered into the VDS3000 that transducer is installed into.



Configuration of the pressure transducer connected to the VDS is specified in the "Transducer" page under the "Configuration" tab.

Ensure that the correct "Pressure Transducer Type" (i.e. Relative or Absolute) has been selected.

Temperature characterization factors are listed at the bottom of each data sheet provided by Gas Technology Services. Each transducer coefficient may be manually entered into the corresponding field.

```
160521        1000PSI

   ----- Temperature Coefficients -----
Null Coefficients       Span Coefficients
X(0) = 0.17275696D-05  X(0) = 0.99572146D-01
X(1) =-0.29897024D-05  X(1) = 0.12518513D-05
X(2) = 0.46459947D-07  X(2) = 0.10814105D-05
X(3) = 0.13838929D-09  X(3) =-0.12000915D-07
X(4) =-0.33299896D-11  X(4) =-0.12862044D-09
X(5) = 0.24171807D-13  X(5) = 0.14087273D-11
```

Alternatively, these coefficients may be loaded directly from an .apt file. The format of the data should look similar to the example shown left.

NOTE: 'D' denotes the exponent (e.g. 0.27275696D-05).

Press "Save" when all coefficients have been entered.

The maximum pressure that can be accommodated by the VDS3000 is 1000 PSIG (7000 kPa). The battery life expectancy is based on the use of this low power transducer supplied with the VDS3000.

The following chart shows the available transducer ranges:

0 - 100 kPa A&G	0 - 200 kPa G
0 - 420 kPa A&G	0 - 690 kPa A&G
0 - 1380 kPa G	0 - 2060 kPa G
0 - 3450 kPa G	0 - 7000 kPa G

G = Gauge A = Absolute

Data system inputs – Temperature transducers

The VDS3000 will only accept the I.C. temperature transducer (probe) that has been supplied with the instrument. The probe will operate over the temperature range of -40 to +80 degrees C.

Data system input - Alarms

Internal alarms are activated when monitored parameters fail or go over range. Battery Status indication will be "Battery OK" when battery is normal and "Battery LOW" when battery is low and requires change. For digital input monitoring valves or other devices, an alarm will be triggered when device state has changed (e.g. when a valve state changes from open to closed). A corresponding event log entry will be created and an alarm will be sent via email or SMS for all alarming events (modem functions need to be preset for email and SMS capability).

7. ACQUISITION OF DATA

The ability to acquire useable data from the VDS3000 is one of its most important assets. This section describes the different types of data available from the VDS3000 and discusses some data transfer methods. Also covered is information describing how to set up the user's computer for data retrieval. The concepts and usage of both the event log and profiler functions are also discussed.

VDS3000 display

Data is retrievable directly from the VDS3000 display (see Interrogation - Display of VDS3000 for functions available). This data is accessible via the scrolling “Display” button located on the front of the VDS panel.

Modbus connection

Modbus can be connected between VDS3000 and an RTU (Remote Terminal Unit) via Modbus/ZigBee converter. The converter is a preprogrammed piece of equipment attached to the RTU serial port to transfer information from the VDS. This equipment can be separately purchased from Gas Technology Services. The Modbus addresses are as follows:

Register	Format	Description
40001	Modbus Int32 HL	Uncorrected volume total – actual cubic metres (ACM)
40003	Modbus Int32 HL	Corrected volume total – standard cubic metres (SCM)
40005	Modbus Int32 HL	Always reads 0 – unused
40007	Modbus Int32 HL	Always reads 0 – unused
40009	Modbus Int32 HL	Always reads 0 – unused
40011	Modbus Fl 32 LH	Corrected volume rate - SCM/hr
40013	Modbus Fl 32 LH	Gas temperature - degrees C
40015	Modbus Fl 32 LH	Gas pressure – kPa (absolute)
40017	Modbus Fl 32 LH	Pressure correction factor (PCF)
40019	Modbus Fl 32 LH	Base density - kg/m^3
40021	Modbus Fl 32 LH	Specific gravity
40023	Modbus Fl 32 LH	Always reads 0 – unused
40025	Modbus Fl 32 LH	Nitrogen – percentage
40027	Modbus Fl 32 LH	Carbon dioxide - percentage
40029	Modbus Fl 32 LH	Fpv (NX19 supercompressibility)
40031	Modbus Int32 HL	Always reads 0 – unused
40033	Modbus Int32 HL	Serial number
40035	Modbus Int32 HL	Meter current date – DDMMYY
40037	Modbus Int32 HL	Meter current time – HHNNSS
40039	Modbus Int32 HL	Always reads 0 – unused
40041	Modbus Int32 HL	Always reads 0 – unused

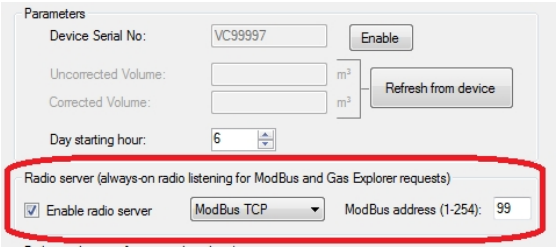
40043	Modbus Int32 HL	Logged in user level – 0 = ANON, 1 = USER1, 2 = USER2, 3 = ADMIN
40045	Modbus Fl 32 LH	Volumetric input multiplier
40047	Modbus Fl 32 LH	Volumetric input divider
40049	Modbus Fl 32 LH	Case temperature – degrees C
40051	Modbus Fl 32 LH	Auxilliary pressure – kPa (absolute)
40053	Modbus Fl 32 LH	Battery voltage
40055	Modbus Fl 32 LH	External supply voltage
40057	Modbus Fl 32 LH	Always reads 0 – unused
40059	Modbus Fl 32 LH	Always reads 0 – unused
40061	16-bit unsigned	ZigBee radio power as a percentage: 0-100
40062	16-bit unsigned	ZigBee radio link quality as a percentage: 0-100

Binary input	**Format**	**Description**
101500	Binary flag	Digital (relay) input #1
101501	Binary flag	Digital (relay) input #2
101502	Binary flag	Digital (relay) input #3
101503	Binary flag	Digital (relay) input #4
101504	Binary flag	Always reads 0 – unused
101505	Binary flag	Always reads 0 – unused
101506	Binary flag	Alarm – gas temperature exceeds limits
101507	Binary flag	Alarm – gas pressure exceeds limits
101508	Binary flag	Alarm – case temperature exceeds limits
101509	Binary flag	Alarm – auxiliary pressure exceeds limits
101510	Binary flag	Always reads 0 – unused
101511	Binary flag	Alarm – device recently rebooted or recent power failure
101512	Binary flag	Remote access currently active
101513	Binary flag	Alarm - low battery or max battery hours exceeded
101514	Binary flag	Alarm - Drive space low
101515	Binary flag	Alarm - MHQ exceedance
101516	Binary flag	Alarm – HDQ exceedance
101517	Binary flag	Alarm – sum of alarms (will be active if any other alarm is active)

Each 32-bit value is transmitted as two 16 bit registers. 32-bit integers are most significant byte first. Floating-point numbers are least significant byte first.

Modbus Int32 HL – 32-bit integer values are packed into 2 contiguous 16-bit register addresses, high word first. For example, to decode the uncorrected volume: UNCORRVOL = REGVALUE[40001] * 0xFFFF + REGVALUE[40002]

Modbus FI32 LH – 32-bit floating point values are packed into 2 contiguous 16-bit register addresses, low word first. Refer to the IEEE 754 standard for floating point computation for details on decoding these registers.



To enable this feature the user needs to configure the ModBus address (slave ID) located at the bottom of the "General" tab under "Configuration". Also, check the "Enable radio server" box when using ZigBee to communicate between the RTU and VDS. The VDS3000 supports ModBus RTU (nominally used when connected to the RTU via RS-232), and ModBus TCP (used preferentially for modern SCADA systems; requires the ZigBee dongle to be connected to the SCADA network via a serial Ethernet interface).

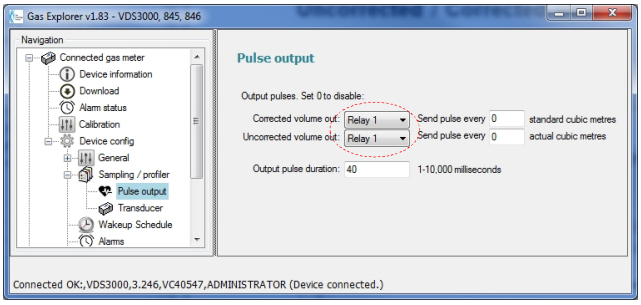
NOTE: If using Modbus to determine current alarm status in real-time on ancillary equipment, set all the alarms to auto-reset. This will ensure that the alarms will automatically clear once the appropriate value drops below the configured threshold, and no user intervention is required.

Pulse output

Data from the VDS3000 can be retrieved via pulse output O/P1 and O/P2. For detailed information on connection of all pulse outputs, see VDS3000 "On board connector layout diagram" and "37 Pin connector wiring diagram" in Appendix E & F. Also, see Appendix F for physical connection/wiring to 37 pin connector.

When using the relays to send pulses to a data acquisition system it is recommended that the VDS3000 be externally powered. Excess battery consumption may result when using the relays. However, this will depend on how the output relays are configured.

Uncorrected / Corrected volume output



For information re-transmission, an output pulse of programmable duration may be configured to trigger every time a specified number of corrected and uncorrected cubic metres of gas passes through the meter.

These parameters are set in the "Pulse output" page under the "Configuration" tab.

To enable pulse outputs, a relay needs to be selected via the drop down box and the corresponding volume step-count must be set to a non-zero value.

Pulse duration is to be set between 1-10,000ms. When completed, press “Save” to apply changes.

NOTE: If output pulses are not required then disabling pulse outputs (setting the step-count to 0) will save considerable battery life. Larger step-counts will also contribute to better battery life if output pulses are enabled.

Example: If a step-count for the corrected volume is set to 1000, then a pulse will be output every time 1000 *standard* cubic meters passes through the meter. Similarly, if a step-count of 1000 is specified for uncorrected volume, then a pulse will be output every time 1000 *actual* cubic meters passes through the meter.

Alarm relay output

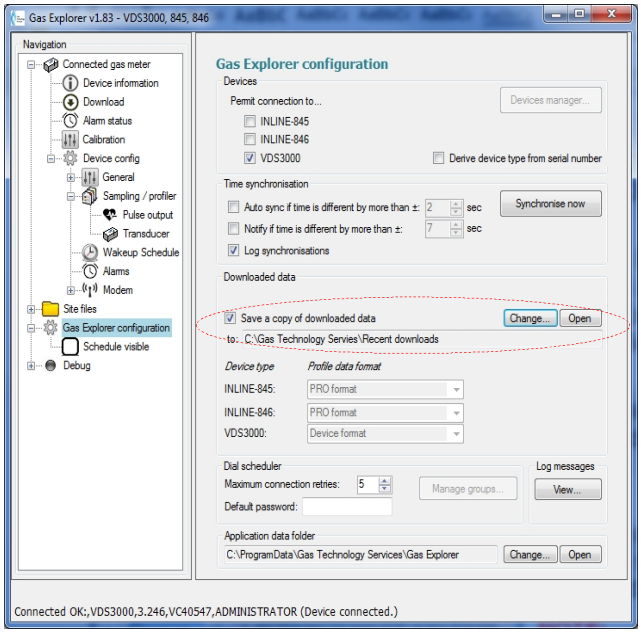
When an alarm such as low battery power has been activated, the VDS3000 will switch to the low battery mode and activate any alarm notifications that have been configured under “Configuration” – “Alarms”. This alarm will be sent to the appropriate relay output as configured in the alarm settings page.

NOTE: When low battery alarm has been triggered, the estimated running time is approximately 2 months under normal operating conditions.

Data transfer and download

When a PC is connected to the VDS3000 via RS232 or ZigBee, data is transmitted serially between the laptop and the VDS3000. The user has the option of dumping event log and profiler data.

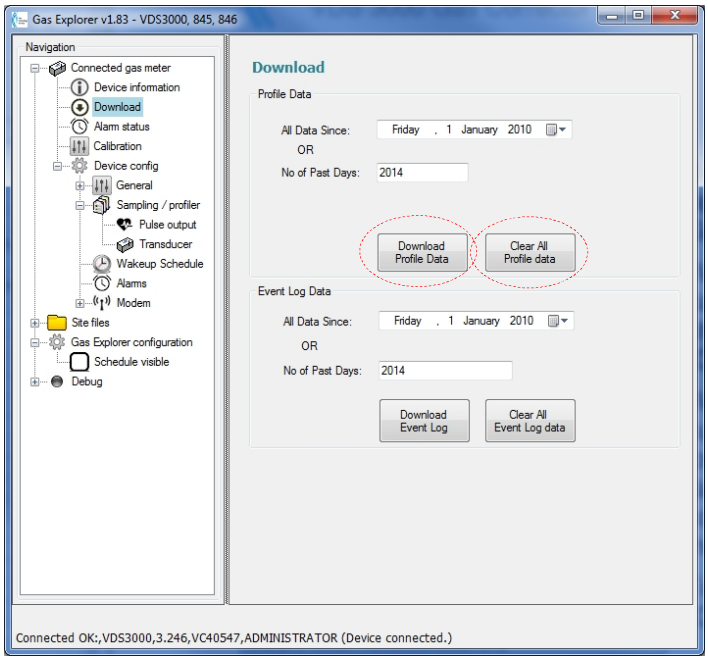
When downloading profile data from a site, Gas Explorer will save the downloaded data into a folder named “Profiles” located in the device folder (see site tree in navigation pane for exact location).



Gas Explorer can also save a *copy* of this data into a separate ‘shared’ folder specified in the “Gas Explorer Configuration” panel.

To activate this feature, simply specify a destination path and tick “Save a copy of downloaded data”.

NOTE: Profile files saved into the common folder are named according to the serial number of the device from which it came. Thus, each file will be overwritten when new data is downloaded from the same device.



Both Profiler and Event log data can be downloaded via the “Download” panel.

When downloading data, specify the date or number of days from which data should be downloaded, then press the “Download” button.

To clear *all* existing data, press the “Clear All data” button.

8. WARRANTY

The Gas Technology Services Volume Data System is warranted against faulty construction, materials or design for a period of 5 Years from the date of purchase.

The obligation assumed under this warranty is limited to the replacement of parts which, by our examination are proved to be defective and have not been misused, carelessly handled, defaced, damaged due to excessive voltage or current, heat, moisture, vibration or incorrect installation. This guarantee is VOID where the unit has been tampered with or if repairs have been made or attempted by anyone except an authorised representative of Vipac Engineers & Scientists Limited.

Instruments for attention under guarantee (unless otherwise authorised) are to be sent freight paid and, if accepted for warranty repair, will be returned to the customers address free of charge.

Prior to returning the instrument for service or repair you must contact Gas Technology Services who will issue a job number. This number must be quoted on the documentation returned with the instrument along with a full description of the fault

The information in this manual is believed to be correct at the time of printing. The manufacturer reserves the right to implement design, material and/or software changes without prior notice and accepts no responsibility to upgrade or modify equipment previously manufactured.

All statements, technical information, and recommendations related to this product are based on information believed to be reliable, but the accuracy or completeness is not guaranteed. Before installing the equipment, the user should determine the suitability of the product for the intended use, and the purchaser assumes all risks and liability in connection with that use.

The manufacturer or representative shall not be liable for any injury or for indirect, incidental, or consequential damages sustained or expenses incurred by the buyer resulting from use of this equipment.

Appendix A:

SPECIFICATIONS

CORRECTIONS

Pressure Temperature Live Supercompressibility via NX19

DISPLAY UNITS

Alpha Numeric Programmable: Imperial

VOLUME INPUT

Programmable value 0.001 to 10,000 units/pulse clockwise or counterclockwise rotation.

VOLUME OUTPUT SCALE

Fully programmable: volume units x1, x10, x100, x1000, x10 000.

UNCORRECTED INDEX

Mechanical

DISPLAY DATA

Scrolls with pause function.
Scroll sequences programmable.

FLOW TEMPERATURE RANGE

-40 degrees C to 80 degrees C.

AMBIENT TEMPERATURE RANGES

-40 degrees C to 80 degrees C.

AVAILABLE PRESSURE RANGES

15, 30, 60, 100, 200, 300, 500, PSIG 15, 60, 100 PSIA

BASE CONDITIONS ADJUSTABLE IN FIELD

Yes

TRANSDUCER LOCATION

Pressure -internal STD characterised for ambient temp effects

Aux pressure – external from Main unit (Aux pressure transducer case)

Temperature -external in probe Temperature

SYSTEM ACCURACY

± 0.5% from -40 degrees F to 170 degrees F and within 20% and 100% of transducer range. Total system accuracy better than

± 0.25% of full scale at 25C.

System Linearity included in system accuracy.

System Hysteresis included in system accuracy.

System Repeatability included in system accuracy.

SYSTEM AMBIENT TEMPERATURE EFFECTS

Included in system accuracy.

LONG TERM DRIFT

Less than 0.2% per year.

SAMPLE INTERVAL

Internal battery power -programmable 1 min - 60 min. It is recommended to use external power for more frequent intervals.

MAX INPUT DRIVE RATE

Meter mounted low frequency: 180 pulses/minute.

TYPE OF INPUT SWITCHES

Dual Hermetically sealed reed switches

INPUT SWITCHES RATED LIFE

In excess of 10 million operations.

POWER

Internal 3.6 V Lithium-ion Battery
External 7.5V supply (Ex: solar, mains)

MOUNTING

Remote mounting

WEIGHT

2.5 kg

INTRINSIC SAFETY

Designed for Exi ib Group IIA Class T4 IECEx Approved: IECEx TSA 11.0022X

METHOD OF PROGRAMMING

Windows based PC.
Can be programmed via Zigbee

DATE FOR PRODUCTION

March 2012

EQUIPMENT ADD-ONS

Modem for interrogation and Data collection.

Various software packages for dedicated applications and Data Management.

VOLUME OUTPUT CONTACTS

Pulse Outputs is standard on board. Volume Uncorrected Volume Corrected

Appendix B:

VDS3000 CALCULATIONS

SUPERCOMPRESSIBILITY

The VDS can calculate supercompressibility according to either of the following standards:

- NX-19
- A.G.A. 8 Gross Characterisation - Methods 1 and 2.

NX-19

The VDS computes the supercompressibility function F_{PV} as described in A.G.A. project NX-19 1962. The range over which the current version calculates F_{PV} is for Zone E1 and E2 of NX-19 as follows:

Pressure range: 0-1000 PSI (0-7000 kPa); Temperature range: -40°C - 100°C (-40°F – 212°F); Specific gravity (SG): 0.554 - 1.000; Carbon dioxide: 0.0 - 15.0 Mol %; Nitrogen: 0.0 - 15.0 Mol %

Note in particular that the temperature and pressure range specified by NX-19 is the corrected temperature and pressure of the gas. These corrected values depend on the concentrations of carbon dioxide, nitrogen and specific gravity of the Gas.

CORRECTION FACTOR

In addition to the supercompressibility functions, the following parameters must also be factored in to calculate the corrected gas volume: Base temperature; Base pressure; and Zone pressure.

Using the live compressibility function, the correction formula applied is as follows:

$$V = q \times {F_{PV}}^2 \times \frac{P_f + P_g}{P_b} \times \frac{273.15 + T_b}{273.15 + T_f}$$

Where: V is the corrected volume
q is the uncorrected volume registered by meter
F_{PV} is the supercompressibility factor
P_f is the flow pressure of gas
P_g is the zone pressure
P_b is the base pressure (Absolute)
T_b is the base temperature
T_f is the flow temperature of gas

The factor required for converting to absolute temperature is:
273.15 if converting °C, or 460 if converting to °F.

A correction factor is developed (calculated) and is one of the "displays" that may be viewed by user.

A.G.A. 8 – GROSS CHARACTERISATION METHODS 1 & 2

The VDS computes the supercompressibility function F_{PV} according to the Gross Characterisation methods described in the A.G.A. document titled: Compressibility Factors of Natural Gas and Other Related Hydrocarbon Gases (Catalog No. XQ9212).

For more detailed information on the calculations used, the reader should consult the aforementioned document.

Appendix C:

TEMPERATURE COMPENSATION OF PRESSURE TRANSDUCER

INTRODUCTION

This document describes the theory of operation behind the temperature compensation of the pressure transducers used on the VDS3000.

The VDS3000 is designed to operate over a temperature range of -40ºC to +60ºC (-40ºF to +140ºF). In order to achieve the desired accuracy of measurement from the pressure transducer over this wide temperature range, compensation of zero and gain changes in the pressure transducer is performed by the microprocessor on the Gas Flow Meter.

As the temperature shift of the pressure transducer is a repeatable function of temperature, the temperature shift curve may be stored in EEPROM on the microprocessor and used to compensate temperature changes.

POLYNOMIAL TEMPERATURE COMPENSATION CURVE

The temperature characteristics of the pressure transducer are expressed by a polynomial curve up to the fifth order. One polynomial is used to characterise the zero shift, and a second is used to characterise the gain shift.

The fifth order polynomial takes the forms as follows:

$Pz(T) = CZ_o + CZ_1T + CZ_2T2 + CZ_3T^3 + CZ_4T1 + CZ_5T1$. (Note in this formula 1 means to the power of 4 & 1 means to the power of 5)

Where CZ are the coefficients of the polynomial.

EQUATIONS USED TO CALCULATE PRESSURE IN 831PT, 841, VDS3000 AND 881R.

The 831PT, 841, VDS3000 and 881R use software calibration for the pressure input. This means that when calibrating the unit, the calibration constant is calculated and stored in EEPROM. The raw ADC value is converted to a pressure reading by the following equation: Press = ADC × P_{GAIN} + P_{ZERO} where P_{GAIN} is the Pressure Gain Factor and P_{ZERO} is the Pressure Zero Factor .

These factors are calculated when the unit is calibrated and saved in the non-volatile EEPROM.

In order to apply the temperature correction polynomials to the above equation the following modification is made to the above formula:

Press = (ADC) x P_{GAIN} + P_{ZERO} + $P_z(T)$ x $P_g(T)$

Where: P_{GAIN} is the Pressure Gain Factor.
P_{ZERO} is the Pressure Zero Factor.
$P_z(T)$ is the Pressure Transducer zero correction polynomial.
$P_g(T)$ is the Pressure Transducer gain correction polynomial.

In order for the polynomials to work, they must be in the correct units. The Zero Correction Polynomial must be in pressure units, while the Gain Correction Polynomial is a dimensionless scale factor.

Note that internally all calculations of pressure are done in kPa. Thus the zero correction polynomial must give the zero shift in kPa as a function of temperature. The gain polynomial must give the gain correction as a function of temperature.

NOTE: The correction polynomials must be entered into the unit before the unit is calibrated. This is because the zero and gain changes must be taken into account by the instrument's software when it calculated the P_{ZERO} and P_{GAIN}.

COEFFICIENT CALCULATIONS FROM PRESSURE TRANSDUCER DATA

In order to calculate the polynomial coefficients, tests must be done on the transducer at various temperatures. The zero offset and span must be measured. The actual pressure and millivolt readings must be normalised to zero and full-scale reading of the transducer. The zero error is derived from span reading. This data is then used to calculate the coefficients. This is best done by using a least squares approximation. This allows as many data points as measured to be entered, and will result in a polynomial curve which passes close to each measured data point. The more data points entered into the least squares approximation, the better the curve fit will be **NOTE:** An absolute minimum of 6 data points is required to calculate a fifth order polynomial.

ABSOLUTE PRESSURE TRANSDUCERS

In order for the zero and gain to work correctly, the zero offset of absolute transducers must be calculated. As the low pressure test is normally conducted at atmospheric pressure, the result must be linearly extrapolated back to absolute zero. This requires that atmospheric pressure be measured during the testing of absolute transducers. The following is an example of a printout of factors that have been put into a VDS3000 Flow Computer. These factors are used for transducer serial number 30036 and are unique to it only. Every transducer will have their own factors that must be entered and stay "in" the VDS3000 as long as that particular transducer is resident in the VDS3000.

Appendix D:

ENHANCEMENTS (SOFTWARE/ACCESSORIES)

AUTODIAL

Enhanced version of Gas Explorer can be ordered for remote dialing of Inline 909, 845, 846 for profile data retrieval.

ABSOLUTE TRANSDUCERS

VDS3000 may be ordered with an absolute pressure transducer instead of gauge (standard).

DC TO DC CONVERTER

A 12V DC to 7.5V DC can be ordered as part of external power system for VDS3000

SOLAR POWER SYSTEMS

Solar Panel Systems (SPS) can be ordered as external power for VDS3000.

COMMUNICATION DEVICES

Zigbee/Modbus converters and Zigbee dongles can be ordered for VDS remote communication to RTU and laptops.

INTRINSIC SAFETY BARRIERS

Intrinsic safety barriers or isolators for connection of VDS3000 signals from hazardous area to safe area are available from several manufacturers. Any locally approved devices may be used. Inline instrument parameters are:

External power +7.5V DC max at 750 mA.

Input/output pulses, voltage free relay contacts.

COMMUNICATION CABLES

Spare communication cables as well as custom length local communication cables are available (see Appendix G for input parameters).

FACTORY CALIBRATION AND CONFIGURATION

Instruments can be factory calibrated/configured to customer specified parameters.

FIRMWARE UPGRADE

Automatic Firmware upgrades available with Gas explorer software.

SPECIAL TEMPERATURE PROBE LENGTHS

Custom length temperature probes (Up to 2.5m) are available.

PLEASE CONTACT GAS TECHNOLOGY SERVICES IF THERE ARE ANY MODIFICATIONS OR ASSOCIATED PRODUCTS YOU REQUIRE.

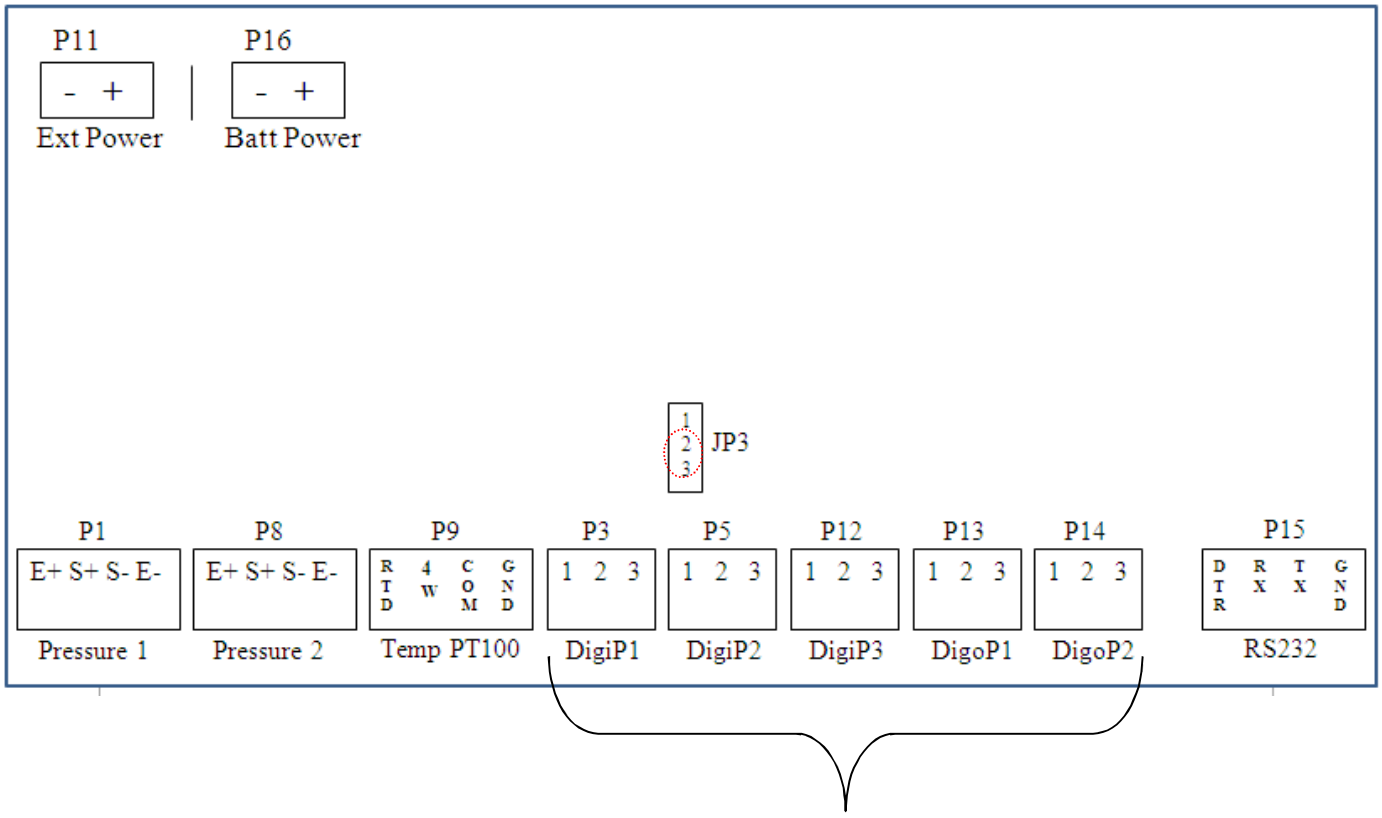
Appendix E:

ON BOARD CONNECTOR LAYOUT DIAGRAM

For Single reed switch connection (2 wire system - pulse and ground wire only), Connect input pulse signal to Pin 2 and 3 of P3 (DigiP1)

For Single reed switch connection (2 wire system - pulse and ground wire only), Jumper must be placed on Pin 2 and 3 of JP3 (See diagram below)

For all connector parameters please refer to Appendix G for detail.



Please see Appendix G for 37 pin connector detail.

Appendix F:

37PIN CONNECTOR WIRING DIAGRAM

Circuit name	Pin on circuit	37 connector	Colour	Length	Description
Dig O/P1 (p13)	1	4	Orange		Relay 1 Comm
	2	3	Brown		Relay 1 N/O
	3	15	White		Relay 2 Comm
	4	14	Grey		Relay 2 N/O
Dig O/P2 (p14)	1	28	Violet		Relay 3 Comm
	2	27	Brown		Relay 3 N/O
	3	37	Grey		Relay 4 Comm
	4	36	Blue		Relay 3 N/O
Dig I/P1 (p3)	1	1	Grey		Input 1 +ve
	2	5	Blue		Input 2 +ve
	3	6	White		Input Gnd
Dig I/P2 (p5)	1	10	Grey		Input 3 +ve
	2	16	Blue		Input 4 +ve
	3	17	White		Input Gnd
Dig I/P3 (p12)	1	23	Orange		Input 5 +ve
	2	29	Violet		Input 6 +ve
	3	30	White		Input Gnd
Ex Power (p11)	1	19	Black		7.5Vdc +ext power
	2	25	Red		7.5Vdc –ext power
Extra Gnd(s)		11	White		Gnd
		12	White		Gnd
		24	White		Gnd

Appendix G:

VDS3000 INPUT/OUTPUT PARAMETERS

(Also see page 6-8 of VDS IECex Certification Report No 33704 for detail)

Electrical Parameters	**External Power Input 19 and 25 of 37 pin connector (Internal P11)**
Maximum Input Voltage Ui	7.5V
Maximum Input Current Ii	0.75A
Maximum Power Pi	1.4W
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
	Relay Contact inputs/outputs Pin 3, 4 of 37 pin connector (Internal P13 Pins 1,2)
Maximum Input Voltage Ui	15V
Maximum Input Current Ii	0.15A
Maximum Power Pi	2W
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
	Relay Contact inputs/outputs Pin 14, 15 of 37 pin connector (Internal P13 Pins 3,4)
Maximum Input Voltage Ui	15V
Maximum Input Current Ii	0.15A
Maximum Power Pi	2W
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
	Relay Contact inputs/outputs Pin 27, 28 of 37 pin connector (Internal P14 Pins 1,2)

Maximum Input Voltage Ui	15V
Maximum Input Current Ii	0.15A
Maximum Power Pi	2W
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
	Relay Contact inputs/outputs **Pin 36, 37 of 37 pin connector** **(Internal P14 Pins 3,4)**
Maximum Input Voltage Ui	15V
Maximum Input Current Ii	0.15A
Maximum Power Pi	2W
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
	Input 1 +ve input, Input 2 +ve input (meter) **Pin 1, 5, 6 of 37 pin connector** **(Internal P3)**
Maximum Input Voltage Ui	5.6V
Maximum Input Current Ii	Not critical
Maximum Power Pi	Not critical
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
Maximum Output Voltage Uo	5.88V
Maximum Output Current Io	0.012A
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH

	Input 3 +ve input, Input 4 +ve input (meter) **Pin 10, 16, 11 of 37 pin connector** **(Internal P5)**
Maximum Input Voltage Ui	5.6V
Maximum Input Current Ii	Not critical

Maximum Power Pi	Not critical
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
Maximum Output Voltage Uo	5.88V
Maximum Output Current Io	0.012A
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH
	Input 5 +ve input, Input 6 +ve input (meter) **Pin 23, 29, 24 of 37 pin connector** **(Internal P12)**
Maximum Input Voltage Ui	5.6V
Maximum Input Current Ii	Not critical
Maximum Power Pi	Not critical
Maximum Internal Capacitance Ci	0µF
Maximum Internal Inductance Li	0µH
Maximum Output Voltage Uo	5.88V
Maximum Output Current Io	0.012A
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH
	Pressure Transducer inputs **(Internal P10)**
Maximum Input Voltage Ui	0V
Maximum Output Voltage Uo	5.88V
Maximum Output Current Io	2.85A
Maximum Power output Po	1.25W
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH
	Aux Pressure Transducer inputs **(Internal P8)**
Maximum Input Voltage Ui	0V
Maximum Output Voltage Uo	5.88V

Maximum Output Current Io	2.85A
Maximum Power output Po	1.25W
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH
	Temperature Transducer inputs (Internal P9)
Maximum Input Voltage Ui	0V
Maximum Output Voltage Uo	5.88V
Maximum Output Current Io	2.85A
Maximum Power output Po	1.25W
Maximum Output Capacitance Co	1µF
Maximum Output Inductance Lo	10µH
	RS232 port (Internal P15)
	This is a maintenance calibration port not to be used in the hazardous area