

# Application GN04

## Natural Gas (AGA-8 Detailed) Flow Computer

for Stacked DP Meters  
(ISO 5167 & V-Cones)



### Features

- Tailored for differential pressure meters with single or stacked transmitters
- AGA-8 Natural Gas Detail Characterization Method calculations for gas compositions with up to 21 components
- Gross heating values calculated to ISO 6976:1995 and GPA Standard 2172-96
- ISO 5167 (2003) DP flow calculations, 9 meter types
- V-Cone DP flow calculations, 2 cone types
- Selection of second language and user tags
- RTC logging with over 1000 entries
- Programmable pulse width and scaling of pulse output
- 4-20mA retransmission
- RS-232 and RS-485 (optional) serial ports
- Modbus RTU, Printer and other serial port protocols
- Front panel adjustment of 8-24V DC output voltage
- Backlit display



### Overview

The 515 GN04 application measures the volume, mass and gross heat content of natural gas. The instrument uses single or stacked differential pressure meters such as orifice plates, nozzles, venturi tubes or V-Cones as well as temperature and pressure sensor inputs.

The instrument calculates the flow according to the differential pressure equations for the ISO 5167 or V-Cone meters. The flow calculations incorporate the conditions at which the flowmeter was calibrated and accurately account for thermal expansion effects.

The AGA-8 Detail Characterization Method is used to obtain accurate values of density and compressibility factors for the flow calculations. For other gas properties, such as viscosity and isentropic exponent, user entered values are used.

### Calculations

The gas density and compressibility factor calculations are based on the AGA-8 equations. The calculations are valid for the region:

$$\begin{aligned} -130^{\circ}\text{C} < t < 400^{\circ}\text{C} & \quad P < 280\text{MPa} \\ -200^{\circ}\text{F} < t < 760^{\circ}\text{F} & \quad P < 40000\text{psia} \end{aligned}$$

### Formulas

$$\text{Volume flow} = M_{\text{flow}} / \rho_{\text{flow}}$$

$$\text{Corrected flow} = M_{\text{flow}} / \rho_{\text{ref}}$$

$$\text{Heat flow} = M_{\text{flow}} \cdot H_m$$

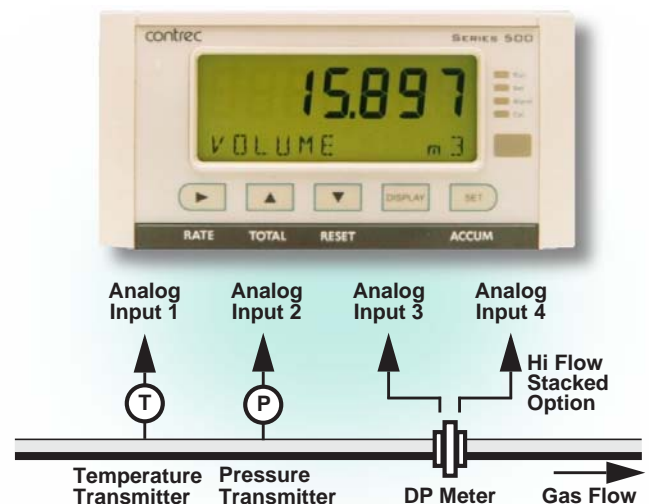
where:

$$M_{\text{flow}} = \text{mass flow}$$

$$\rho_{\text{flow}} = \text{density at flow conditions}$$

$$\rho_{\text{ref}} = \text{density at reference conditions}$$

$$H_m = \text{mass gross heating value}$$



## Displayed Information

The front panel display shows the current values of the input variables and the results of the calculations. A list of the variables for this application and their type (total or rate) is shown at the end of this document.

The instrument can be supplied with a real-time clock for data logging of over 1000 entries of the variables as displayed on the main menu.

## Communications

There are two communication ports available as follows:

- RS-232 port
- RS-485 port (optional)

The ports can be used for remote data reading, printouts and for initial application loading of the instrument.

## Isolated Outputs

The opto-isolated outputs can re-transmit any main menu variable. The type of output is determined by the nature of the assigned variable. Totals are output as pulses and rates are output as 4-20mA signals. One output is standard, a second output is available as an option.

## Relay Outputs

The relay alarms can be assigned to any of the main menu variables of a rate type. The alarms can be fully configured including hysteresis. Two relays are standard with additional two relays available as an option.

## Software Configuration

The instrument can be further tailored to suit specific application needs including units of measurement, custom tags, second language or access levels. A distributor can configure these requirements before delivery.

Instrument parameters including units of measurement can be programmed in the field, according to the user access levels assigned to parameters by the distributor.

All set-up parameters, totals and logged data are stored in non-volatile memory with at least 30 years retention.

## Temperature and Pressure Input Types

Temperature sensor input(s) can be either PT100, PT500, 4-20mA, 0-5V or 1-5V signals. Pressure sensor input(s) can be either 4-20mA, 0-5V or 1-5V signals.

## Terminal Designations

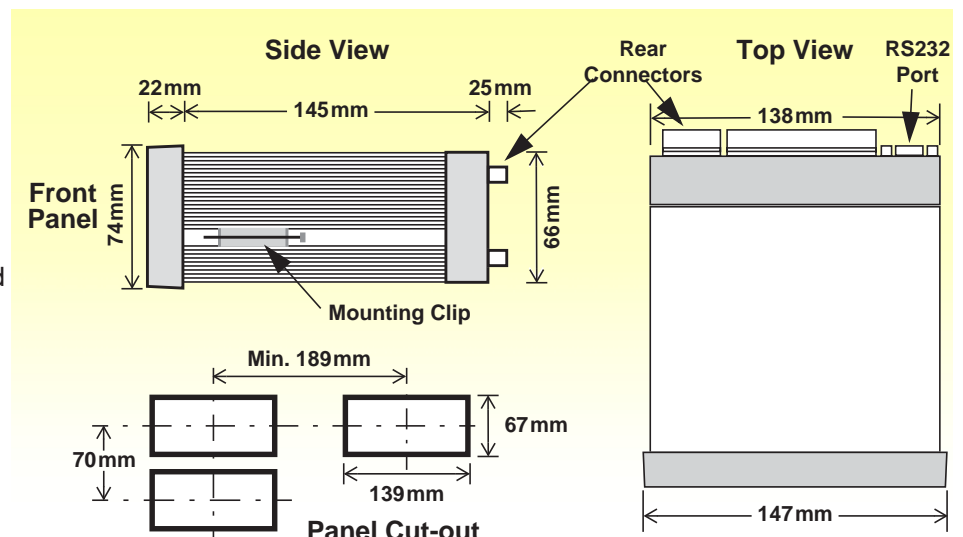
| Terminal Label | Designation     | Comment               |
|----------------|-----------------|-----------------------|
| 3              | SG -            | Signal ground         |
| 5              | EXC V 2+        | Excitation Term 2+    |
| 7              | AINP1 +         | Analog Input ch 1 (+) |
| 8              | -               | Analog Input ch 1 (-) |
| 9              | AINP2 +         | Analog Input ch 2 (+) |
| 10             | -               | Analog Input ch 2 (-) |
| 11             | AINP3 +         | Analog Input ch 3 (+) |
| 12             | -               | Analog Input ch 3 (-) |
| 13             | AINP4 +         | Analog Input ch 4 (+) |
| 14             | -               | Analog Input ch 4 (-) |
| 15             | Vo +            | 8-24 volts DC output  |
| 16             | G -             | DC Ground             |
| 17             | Vi +            | DC power input        |
| 18             | SH E            | Shield terminal       |
| 19             |                 |                       |
| 20             | RS485 +         | RS485 (+)             |
| 21             | -               | RS485 (-)             |
| 22             | G               | RS485 ground          |
| 23             | LOGIC INPUTS 1+ | Switch 1              |
| 24             | 2+              | Switch 2              |
| 25             | 3+              | Switch 3              |
| 26             | 4+              | Switch 4              |
| 27             | C-              | Signal ground         |
| 28             | OUT1 +          | Output ch 1 (+)       |
| 29             | -               | Output ch 1 (-)       |
| 30             | OUT2 +          | Output ch 2 (+)       |
| 31             | -               | Output ch 2 (-)       |
| 32             | RELAYS RC       | Relay common          |
| 33             | R1              | Relay 1               |
| 34             | R2              | Relay 2               |
| 35             | R3              | Relay 3               |
|                | R4              | Relay 4               |
| E              | AC MAINS E      | Mains ground          |
| N              | N               | Mains neutral         |
| A              | A               | Mains active          |
| RS232 port     |                 | 9-pin serial port     |

## Dimension Drawings

### Part Number

515.XXXXXX-GN04  
see **Product Codes** to select required features

Default Application software:  
515-GN04-000000



# Specifications

## Operating Environment

|                                      |  |
|--------------------------------------|--|
| <b>Temperature</b>                   | -20°C to +60°C (conformal coating)<br>+5°C to +40°C (no coating)                     |
| <b>Humidity</b>                      | 0 to 95% non condensing (conformal coating)<br>5% to 85% non condensing (no coating) |
| <b>Power Supply</b>                  | 100-240 V AC (+/-10%) 50-60 Hz (+/-10%) or<br>12-28 V DC                             |
| <b>Consumption</b>                   | 6W (typical)   |
| <b>Protection</b>                    | Sealed to IP65 (Nema 4X) when panel mounted  |
| <b>Dimensions<br/>(panel option)</b> | 147mm (5.8") width<br>74mm (2.9") height<br>167mm (6.6") depth                       |

## Display

|                    |   |
|--------------------|---|
| <b>Type</b>        | Backlit LCD with 7-digit numeric display and<br>11-character alphanumeric display |
| <b>Digits</b>      | 15.5mm (0.6") high  |
| <b>Characters</b>  | 6mm (0.24") high  |
| <b>LCD Backup</b>  | Last data visible for 15min after power down                                      |
| <b>Update Rate</b> | 0.3 second  |

## Non-volatile Memory

|                    |                        |
|--------------------|------------------------|
| <b>Retention</b>   | > 30 years             |
| <b>Data Stored</b> | Setup, Totals and Logs |

## Approvals

|                     |  |
|---------------------|--|
| <b>Interference</b> | CE compliance  |
| <b>Enclosure</b>    | IECEX, ATEX and CSA approved enclosures<br>available for hazardous areas |

## Real Time Clock (Optional)

|                     |                                      |
|---------------------|--------------------------------------|
| <b>Battery Type</b> | 3 volts Lithium button cell (CR2032) |
| <b>Battery Life</b> | 5 years (typical)                    |

## Gas Properties Calculations (AGA- 8)

|                    |   |
|--------------------|---|
| <b>Update Rate</b> | 1 sec - gas composition unchanged<br>2 sec - when changed, 10 components<br>4 sec - when changed, 21 components |
|--------------------|---|

## Analog Input (General)

|                      |  |
|----------------------|--|
| <b>Overcurrent</b>   | 100mA absolute maximum rating            |
| <b>Update Time</b>   | < 1.0 sec                                |
| <b>Configuration</b> | RTD, 4-20mA, 0-5V and 1-5V input         |
| <b>Non-linearity</b> | Up to 20 correction points (some inputs) |

## RTD Input

|                    |                                 |
|--------------------|---------------------------------|
| <b>Sensor Type</b> | PT100 & PT500 to IEC 751        |
| <b>Connection</b>  | Four Wire                       |
| <b>Range</b>       | -200°C to 350°C                 |
| <b>Accuracy</b>    | 0.1°C typical (-100°C to 300°C) |

## 4-20mA Input

|                  |   |
|------------------|---|
| <b>Impedance</b> | 100 Ohms (to common signal ground)                                |
| <b>Accuracy</b>  | 0.05% full scale (20°C)<br>0.1% (full temperature range, typical) |

## 0-5 or 1-5 Volts Input

|                  |   |
|------------------|---|
| <b>Impedance</b> | 10M Ohms (to common signal ground)                                |
| <b>Accuracy</b>  | 0.05% full scale (20°C)<br>0.1% (full temperature range, typical) |

## Logic Inputs

|                    |  |
|--------------------|--|
| <b>Signal Type</b> | CMOS, TTL, open collector, reed switch |
| <b>Overvoltage</b> | 30V maximum                            |

## Relay Output

|                       |   |
|-----------------------|---|
| <b>No. of Outputs</b> | 2 relays plus 2 optional relays                                       |
| <b>Voltage</b>        | 250 volts AC, 30 volts DC maximum<br>(solid state relays use AC only) |
| <b>Current</b>        | 3A maximum  |

## Communication Ports

|                  |                                       |
|------------------|---------------------------------------|
| <b>Ports</b>     | RS-232 port<br>RS-485 port (optional) |
| <b>Baud Rate</b> | 2400 to 19200 baud                    |
| <b>Parity</b>    | Odd, even or none                     |
| <b>Stop Bits</b> | 1 or 2                                |
| <b>Data Bits</b> | 8                                     |
| <b>Protocols</b> | ASCII, Modbus RTU, Printer*           |

## Transducer Supply

|                   |                                 |
|-------------------|---------------------------------|
| <b>Voltage</b>    | 8 to 24 volts DC, programmable  |
| <b>Current</b>    | 70mA @ 24V, 120mA @ 12V maximum |
| <b>Protection</b> | Power limited output            |

## Isolated Output

|                       |   |
|-----------------------|---|
| <b>No. of Outputs</b> | 1 configurable output (plus 1 optional) |
| <b>Configuration</b>  | Pulse/Digital or 4-20mA output          |

## Pulse/Digital Output

|                    |   |
|--------------------|---|
| <b>Signal Type</b> | Open collector                              |
| <b>Switching</b>   | 200mA, 30 volts DC maximum                  |
| <b>Saturation</b>  | 0.8 volts maximum                           |
| <b>Pulse Width</b> | Programmable: 10, 20, 50, 100, 200 or 500ms |

## 4-20mA Output

|                   |   |
|-------------------|---|
| <b>Supply</b>     | 9 to 30 volts DC external   |
| <b>Resolution</b> | 0.05% full scale  |
| <b>Accuracy</b>   | 0.05% full scale (20°C)<br>0.1% (full temperature range, typical) |

*Important: Specifications are subject to change without notice.  
Printer protocol is available only if RTC option is installed.*

# Ordering Information

## Product Codes

| Model                   | Supplementary Code | Description   |
|-------------------------|--------------------|---|
| 515                     | - GN04             |   |
| Enclosure               | 1                  | Panel mount enclosure   |
|                         | 2                  | Field mount enclosure (NEMA 4X / IP66)  |
|                         | 3/5                | Explosion proof Ex d (IECEX/ATEX), metric glands (5 specifies heater)   |
|                         | 4/6                | Explosion proof Ex d (CSA), NPT glands (6 specifies heater)   |
| Output Options          | 0                  | 4 logic inputs, 1 isolated output, 2 relays (only relay type 1 is available), RS232 (DB9) communication port                                    |
|                         | 1                  | 4 logic inputs, 2 isolated outputs, 4 relays, real-time clock data logging, RS232 (DB9) and RS485 communication ports                           |
|                         | 2/3                | 4 logic inputs, 2 isolated outputs, 4 relays, real-time clock data logging, RS232 (DB9) and Ethernet/RF communication ports (not yet available) |
| Relay Type              | 1                  | Electromechanical relays only   |
|                         | 2                  | 2 electromechanical and 2 solid state relays  |
|                         | 3                  | Solid state relays only (not yet available)   |
| Power Supply            | U                  | Inputs for 12-28VDC and 100-240 VAC, 50-60Hz<br>(Previous Models: A = 110/120 VAC, E = 220/240 VAC)   |
|                         | D                  | Input for 12-28VDC power only   |
| Display Panel Option    | S                  | Standard option (now with backlight & LCD backup)<br>(original Full option: F, with Infra-Red comms, no longer available)                       |
| PCB Protection          | C                  | <b>Conformal coating</b> - required for maximum environmental operating range. Recommended to avoid damage from moisture and corrosion.         |
|                         | N                  | <b>None</b> - suitable for IEC standard 654-1 Climatic Conditions up to Class B2 (Heated and/or cooled enclosed locations)                      |
| Application Pack Number | GN04               | Defines the application software to be loaded into the instrument   |

Example full product part number is 515.111USC-GN04 (this is the number used for placing orders).

## Main Menu Variables

| Main Menu Variables    | Default Units       | Preferred Units | Variable Type |
|------------------------|---------------------|-----------------|---------------|
| Volume                 | m <sup>3</sup>      |                 | Total         |
| Volume Flowrate        | m <sup>3</sup> /min |                 | Rate          |
| Corrected Volume       | m <sup>3</sup>      |                 | Total         |
| Corrected Flowrate     | m <sup>3</sup> /min |                 | Rate          |
| Heat                   | GJ                  |                 | Total         |
| Heat Flowrate          | GJ/h                |                 | Rate          |
| Mass                   | kg                  |                 | Total         |
| Mass Flowrate          | kg/min              |                 | Rate          |
| Temperature            | Deg C               |                 | Rate          |
| Pressure               | MPa                 |                 | Rate          |
| Differential Pressure  | kPa                 |                 | Rate          |
| Reynolds Number        | E+3                 |                 | Rate          |
| Compressibility Factor | - - -               |                 | Rate          |



500 Series in Ex410 Enclosure

[www.contrec.co.uk](http://www.contrec.co.uk)



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