Model 515

# Application CS02

## Condensate & Steam Flow Computer

for Analog Volumetric Flowmeters

## Features

- **Tailored for closed 'Steam to Condensate' systems**
- **Accurately calculates Net Energy by accounting for energy in returning condensate**
- **Calculations based on 100% steam to condensate conversion**
- **Programmable condensate pressure value accessible via Modbus**
- **Tailored for volumetric analog flow input such as vortex flowmeters**
- **Uses IAPWS-IF97 steam calculation**
- **Suitable for Water, Saturated and Superheated steam applications**
- **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**

CE

## Overview

The 515 CS02 application accurately accounts for returning condensate energy when calculating the net energy in a closed 'steam to condensate' system. The volume, mass and energy content of steam and condensate lines are calculated by using an analog volume flow in conjunction with a temperature and/or pressure inputs.

A selection of various modes makes it suitable for many steam to condensate applications. The flowmeter, temperature and pressure inputs can be selected as a range of analog signal types.

The instrument calculates the mass flow and energy according to the IAPWS Industrial Formulation (1997) for the thermodynamic properties of steam. The equations use the pressure and temperature values to determine the specific volume and the specific enthalpy.

## Calculations

The steam energy calculations are based on the IAPWS Industrial Formulation (1997).

Superheated steam regions are:

| | |
|---|---|
| $0°C < t < 800°C$ | $P < 100\,MPa$ |
| $32°F < t < 1472°F$ | $P < 14500\,psia$ |
| | |
| $800°C < t < 2000°C$ | $P < 10\,MPa$ |
| $1472°F < t < 3632°F$ | $P < 1450\,psia$ |

Saturated steam regions are:

$0°C < t < 374°C$ (critical temperature)
$32°F < t < 705°F$

$P < 22\,MPa$ (critical pressure)
$P < 3190\,psia$

Water region is:

$0°C < t < t_{saturation}$ at system pressure
$32°F < t < t_{saturation}$ at system pressure

### Formulas

*Mass flow = Volume flow / Specific volume*
*Energy flow = Mass flow × Specific enthalpy*
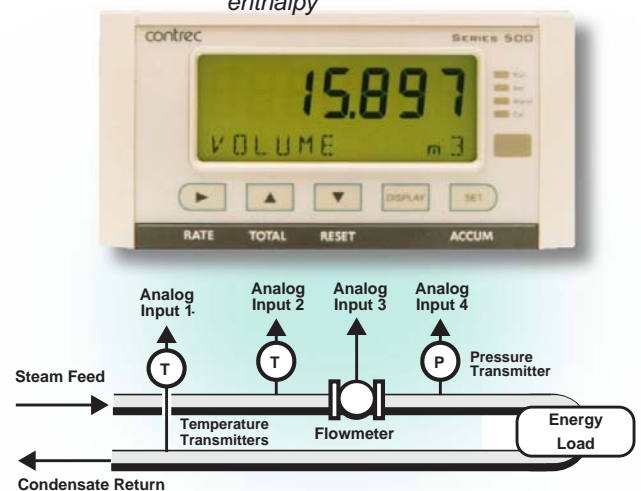
## Displayed Information

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 4-20 mA 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, 4-20 mA, 0-5 V or 1-5 V signals. Pressure sensor input(s) can be either 4-20 mA, 0-5 V or 1-5 V signals.
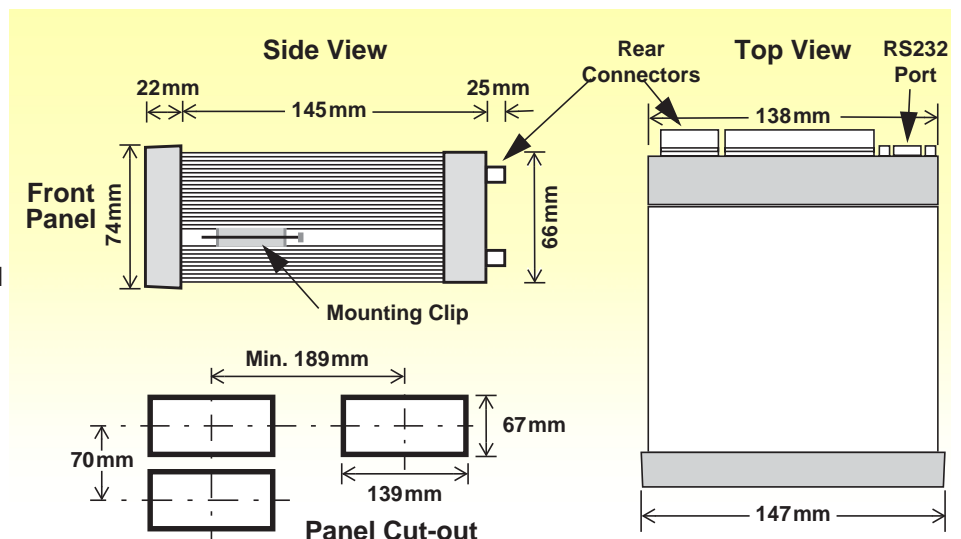
## Terminal Designations

| | Terminal Label | | Designation | Comment |
|---|---|---|---|---|
| 3 | SG | - | Signal ground | |
| 5 | EXC V | 2+ | Excitation Term 2+ | For AINP1 RTD Input |
| 6 | EXC V | 3+ | Excitation Term 3+ | For AINP2 RTD Input |
| 7 | AINP1 | + | Analog Input ch 1 (+) | Condensate Temperature Input |
| 8 | | - | Analog Input ch 1 (-) | |
| 9 | AINP2 | + | Analog Input ch 2 (+) | Steam Temperature Input |
| 10 | | - | Analog Input ch 2 (-) | |
| 11 | AINP3 | + | Analog Input ch 3 (+) | Steam Volumetric Flow Input |
| 12 | | - | Analog Input ch 3 (-) | |
| 13 | AINP4 | + | Analog Input ch 4 (+) | Steam Pressure Input |
| 14 | | - | Analog Input ch 4 (-) | |
| 15 | Vo | + | 8-24 volts DC output | Overload protected |
| 16 | G | - | DC Ground | |
| 17 | Vi | + | DC power input | DC power in 12-28V |
| 18 | SH | E | Shield terminal | |
| 19 | RS485 | + | RS485 (+) | |
| 20 | | - | RS485 (-) | Optional RS485 port |
| 21 | | G | RS485 ground | |
| 22 | LOGIC INPUTS | 1+ | Switch 1 | |
| 23 | | 2+ | Switch 2 | |
| 24 | | 3+ | Switch 3 | |
| 25 | | 4+ | Switch 4 | |
| 26 | | C- | Signal ground | |
| 27 | OUT1 | + | Output ch 1 (+) | |
| 28 | | - | Output ch 1 (-) | |
| 29 | OUT2 | + | Output ch 2 (+) | Optional output |
| 30 | | - | Output ch 2 (-) | |
| 31 | RELAYS | RC | Relay common | |
| 32 | | R1 | Relay 1 | |
| 33 | | R2 | Relay 2 | |
| 34 | | R3 | Relay 3 | Optional relays |
| 35 | | R4 | Relay 4 | |
| E | AC MAINS | E | Mains ground | AC power in 95-135V or 190-260V |
| N | | N | Mains neutral | |
| A | | A | Mains active | |
| RS232 port | | | 9-pin serial port | |

## Dimension Drawings

## Part Number

515.XXXXXX-CS02
see **Product Codes** to select required features

Default Application software:
515-CS02-000000



**Side View** — 22mm, 145mm, 25mm, Front Panel, 74mm, 66mm, Mounting Clip

**Rear Connectors**, **Top View**, **RS232 Port**, 138mm

**Panel Cut-out** — Min. 189mm, 70mm, 67mm, 139mm, 147mm

# Specifications

## Operating Environment

| | |
|---|---|
| Temperature | -20°C to +60°C (conformal coating) +5°C to +40°C (no coating) |
| Humidity | 0 to 95% non condensing (conformal coating) 5% to 85% non condensing (no coating) |
| Power Supply | 95...135 V AC or 190...260 V AC or 12...28 V DC |
| Consumption | 6W (typical) |
| Protection | Sealed to IP65 (Nema 4X) when panel mounted |
| Dimensions | 147mm (5.8") width 74mm (2.9") height 167mm (6.6") depth |

## Display

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

## Non-volatile Memory

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

## Approvals

| | |
|---|---|
| Interference | $C\epsilon$ compliance |
| Enclosure | ATEX, FM, CSA and SAA approved enclosures available for hazardous areas |

## Real Time Clock (Optional)

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

## Analog Input (General)

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

### RTD Input

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

### 4-20mA Input

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

### 0-5 or 1-5 Volts Input

| | |
|---|---|
| Impedance | 10MOhms (to common signal ground) |
| Accuracy | 0.05% full scale (20°C) 0.1% (full temperature range, typical) |

## Logic Inputs

| | |
|---|---|
| Signal Type | CMOS, TTL, open collector, reed switch |
| Overvoltage | 30V maximum |

## Relay Output

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

## Communication Ports

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

## Transducer Supply

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

## Isolated Output

| | |
|---|---|
| No. of Outputs | configurable output |
| Configuration | Pulse/Digital or 4-20mA output |

### Pulse/Digital Output

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

### 4-20mA Output

| | |
|---|---|
| Supply | 9 to 30 volts DC external |
| Resolution | 0.05% full scale |
| Accuracy | 0.05% full scale (20°C) 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** . | | | | | | - CS02 | |
| **Enclosure** | 1 | | | | | | Panel mount enclosure |
| | 2 | | | | | | Field mount enclosure (not yet available) |
| | 3/5 | | | | | | Explosion proof Ex410 with metric glands (5 specifies heater version) |
| | 4/6 | | | | | | Explosion proof Ex410 with NPT glands (6 specifies heater version) |
| **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 | | | | |
| | | | 2 | | | | 2 electromechanical and 2 solid state relays |
| | | | 3 | | | | Solid state relays only (not yet available) |
| **Power Supply** | | | | E | | | For 220/240 VAC |
| | | | | A | | | For 110/120 VAC |
| | | | | D | | | For DC power only 12-28 VDC |
| **Display Panel Option** | | | | | F | | Fully optioned (with backlight & LCD backup) |
| **PCB Protection** | | | | | | C | **Conformal coating** - required for maximum environmental operating range. Recommended to avoid damage from moisture and corrosion. |
| | | | | | | N | **None** - suitable for IEC standard 654-1 Climatic Conditions up to Class B2 (Heated and/or cooled enclosed locations) |
| **Application Pack Number** | | | | | | CS02 | Defines the application software to be loaded into the instrument |

Example full product part number is 515.112EFC-CS02 (this is the number used for placing orders).

## Main Menu Variables

| Main Menu Variables | Default Units | Preferred Units | Variable Type |
|---|---|---|---|
| Net Energy | MWh | | Total |
| Net Power | MW | | Rate |
| Mass | kg | | Total |
| Mass Flowrate | kg/min | | Rate |
| Steam Energy | MWh | | Total |
| Steam Power | MW | | Rate |
| Condensate Energy | MWh | | Total |
| Condensate Power | MW | | Rate |
| Steam Temperature | Deg C | | Rate |
| Steam Pressure | MPa | | Rate |
| Steam Specific Enthalpy | kJ/kg | | Rate |
| Steam Volume Flowrate | $m^3$/min | | Rate |
| Condensate Temp | Deg C | | Rate |
| Condensate Pressure | MPa | | Rate |
| Condensate S-Enthalpy | kJ/kg | | Rate |



500 Series in Ex410 Enclosure