

# Application CS02

## Condensate & Steam Flow Computer

for Analog Volumetric Flowmeters  
(in Steam line)



### Features

- Tailored for closed 'Steam to Condensate' systems
- Accurately calculates Net Energy by accounting for energy in returning condensate
- Caters for flowmeter in the Steam line
- 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
- 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 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 flowmeter installed in the steam line, in conjunction with a temperature and/or pressure inputs.

The energy calculations are based on the measurements, taken at the same point in time, from the sensors in the steam and condensate lines. A selection of modes makes it suitable for a range of steam to condensate applications.

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:

$$0^{\circ}\text{C} < t < 800^{\circ}\text{C} \quad P < 100\text{MPa}$$

$$32^{\circ}\text{F} < t < 1472^{\circ}\text{F} \quad P < 14500\text{psia}$$

$$800^{\circ}\text{C} < t < 2000^{\circ}\text{C} \quad P < 10\text{MPa}$$

$$1472^{\circ}\text{F} < t < 3632^{\circ}\text{F} \quad P < 1450\text{psia}$$

Saturated steam regions are:

$$0^{\circ}\text{C} < t < 374^{\circ}\text{C} \text{ (critical temperature)}$$

$$32^{\circ}\text{F} < t < 705^{\circ}\text{F}$$

$$P < 22\text{MPa} \text{ (critical pressure)}$$

$$P < 3190\text{psia}$$

Water region is:

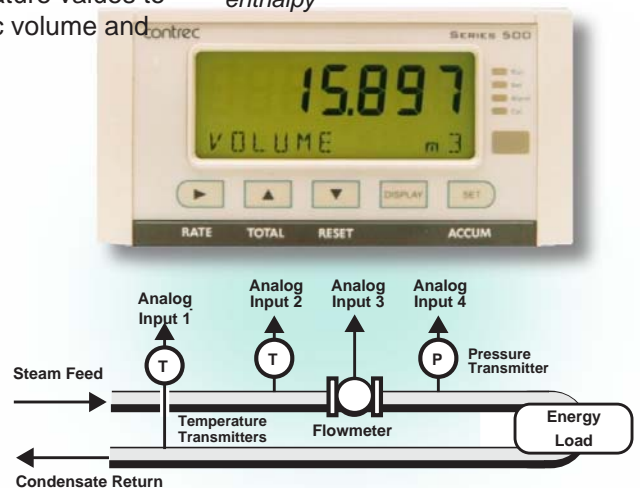
$$0^{\circ}\text{C} < t < t_{\text{saturation}} \text{ at system pressure}$$

$$32^{\circ}\text{F} < t < t_{\text{saturation}} \text{ at system pressure}$$

### Formulas

$$\text{Mass flow} = \text{Volume flow} / \text{Specific volume}$$

$$\text{Energy flow} = \text{Mass flow} \times \text{Specific enthalpy}$$



## 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 4-20mA 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

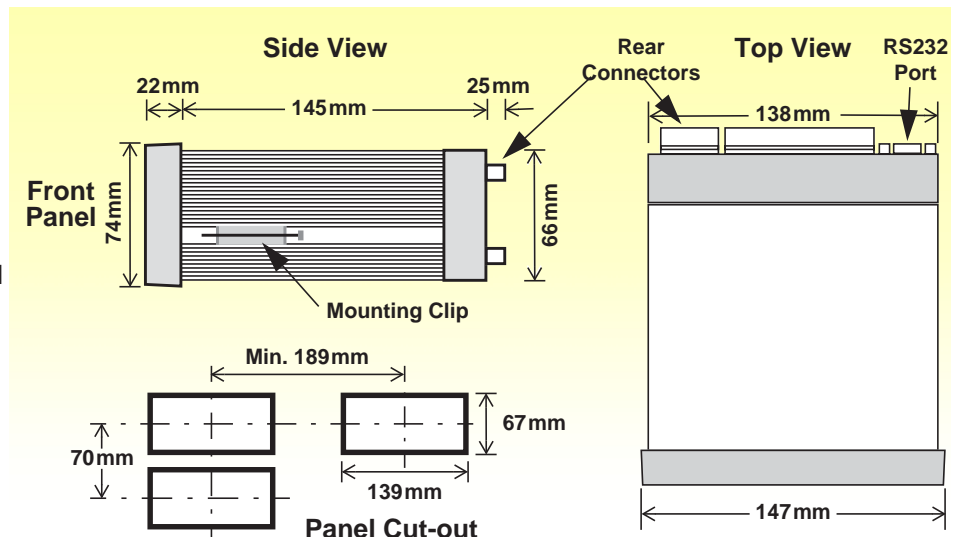
Terminal Label	Designation	Comment
3	SG -	Signal ground
5	EXC V 2+	Excitation Term 2+
6	EXC V 3+	Excitation Term 3+
7	AINP1 +	Analog Input ch 1 (+)
8	-	Analog Input ch 1 (-)
9	AINP2 +	Analog Input ch 2 (+)
10	-	Analog Input ch 2 (-)
11	AINP3 +	Analog Input ch 3 (+)
12	-	Analog Input ch 3 (-)
13	AINP4 +	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	+	RS485 (+)
20	-	RS485 (-)
21	G	RS485 ground
22	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 (+)
30	-	Output ch 2 (-)
31	RC	Relay common
32	R1	Relay 1
33	R2	Relay 2
34	R3	Relay 3
35	R4	Relay 4
E	E	Mains ground
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



# Specifications

## Operating Environment

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

## Display

<b>Type</b>	Backlit LCD with 7-digit numeric display and 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 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)

## 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) 0.1% (full temperature range, typical)

## 0-5 or 1-5 Volts Input

<b>Impedance</b>	10MOhms (to common signal ground)
<b>Accuracy</b>	0.05% full scale (20°C) 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 (solid state relays use AC only)
<b>Current</b>	3A maximum

## Communication Ports

<b>Ports</b>	RS-232 port 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) 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 (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 (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) (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	CS02	Defines the application software to be loaded into the instrument

Example full product part number is 515.111USC-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 <sup>3</sup> /min		Rate
Condensate Temp	Deg C		Rate
Condensate Pressure	MPa		Rate
Condensate S-Enthalpy	kJ/kg		Rate



500 Series in Ex410 Enclosure

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



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