Data Processing Sheet

Instrument:	HydroC CO2	Date of calibration:	26.05.2023 (pre 14.0°C)
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO:	RMA60419

Note! *For more information about the HydroC calibration, please check your individual sensor Calibration Sheet.*

Note! *For data processing, apply the application note Data Processing for CONTROS HydroC CO_2.*

Sensor Specific Values

T_0	273.15 K
p_0	1013.25 mbar
F	61470
T_{sensor}	47.9°C
$f(T_{sensor})$	9849.05 (only for T_{sensor} as given above)
$S'_{2beam,Z}$	14477.63 (found during calibration)
Polynomial degree	3 (with forced zero crossing)
Regression error:	<0.3 ppm (estimate error found during calibration)
Runtime:	96097435 s

Calibration coefficients

k_1	5.293108e-02
k_2	3.852329e-06
k_3	1.610175e-10

Data Processing Sheet

Instrument:	HydroC CO2	Date of calibration:	26.05.2023 (pre 14.0°C)
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO:	RMA60419

Calibration Data

S_{raw}	S_{ref}	T_{gas}	p_{NDIR}	S_{proc}	$x_{CO_2,reference}$*
[]	[]	[°C]	[mbar]	[]	[ppm]
19518.46	15223.15	40.52	1028.56	7853.22	827.11
20548.78	15212.11	40.49	1028.11	4981.97	428.74
21287.56	15201.99	40.49	1027.56	2912.14	216.19
20017.93	15218.75	40.49	1026.27	6465.27	620.22

Equations

Equation for $x_{CO_2,wet}$

$$x_{CO_2,wet} = \left(k_3 S_{proc}^3 + k_2 S_{proc}^2 + k_1 S_{proc}\right) \frac{p_0 T_{gas}}{T_0 p_{NDIR}}$$

Equation for p_{CO_2}

$$p_{CO_2} = x_{CO_2,wet} \frac{p_{in}}{1013.25}$$

Calibration Curve

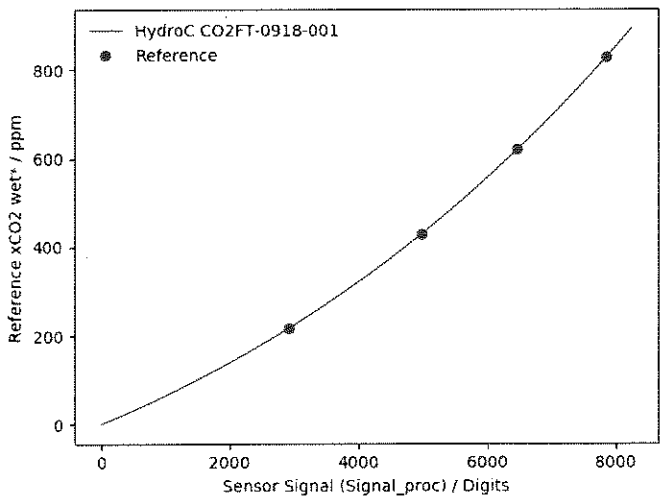

Figure 1: Calibration curve of the processed sensor signal (S_{proc}) against the x_{CO_2} of the Contros CO_2 reference system.

*Converted from the x_{CO_2} value in the reference system to the conditions in the gas stream of the sensor.

Data Processing Sheet

Instrument:	HydroC CO2	Date of calibration:	02.05.2023 (post 14.0°C)
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO:	RMA60419

Note! *For more information about the HydroC calibration, please check your individual sensor Calibration Sheet.*

Note! *For data processing, apply the application note Data Processing for CONTROS HydroC CO_2.*

Sensor Specific Values

T_0	273.15 K
p_0	1013.25 mbar
F	61470
T_{sensor}	47.7°C
$f(T_{sensor})$	9849.68 (only for T_{sensor} as given above)
$S'_{2beam,Z}$	14468.02 (found during calibration)
Polynomial degree	3 (with forced zero crossing)
Regression error:	<1.0 ppm (estimate error found during calibration)
Runtime:	95989972 s

Calibration coefficients

k_1	5.794972e-02
k_2	2.405865e-06
k_3	3.043968e-10

Data Processing Sheet

Instrument:	HydroC CO2	Date of calibration:	02.05.2023 (post 14.0°C)
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO:	RMA60419

Calibration Data

S_{raw}	S_{ref}	T_{gas}	p_{NDIR}	S_{proc}	$x_{CO_2,reference}$*
[]	[]	[°C]	[mbar]	[]	[ppm]
19670.94	15246.03	37.90	1007.48	7476.13	796.33
20656.56	15234.81	37.90	1007.69	4728.98	413.52
21388.92	15222.44	37.89	1007.71	2669.56	202.83
20086.23	15241.79	37.90	1008.39	6320.88	615.81

Equations

Equation for $x_{CO_2,wet}$

$$x_{CO_2,wet} = \left(k_3 S_{proc}^3 + k_2 S_{proc}^2 + k_1 S_{proc}\right) \frac{p_0 T_{gas}}{T_0 p_{NDIR}}$$

Equation for p_{CO_2}

$$p_{CO_2} = x_{CO_2,wet} \frac{p_{in}}{1013.25}$$

Calibration Curve

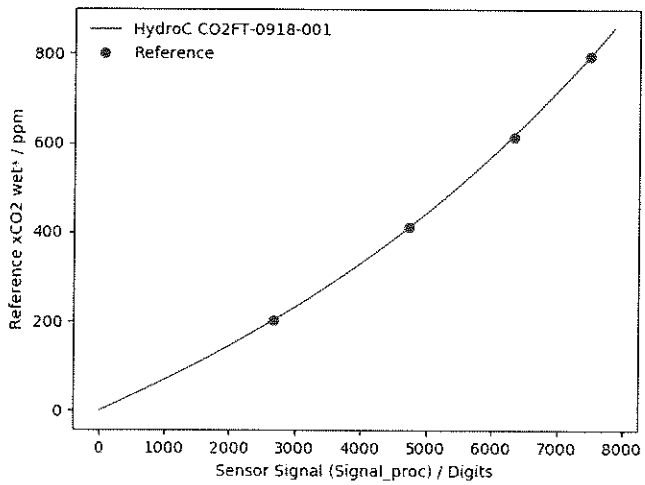

Figure 1: Calibration curve of the processed sensor signal (S_{proc}) against the x_{CO_2} of the Contros CO_2 reference system.

*Converted from the x_{CO_2} value in the reference system to the conditions in the gas stream of the sensor.

Calibration Sheet

4H JENA ENGINEERING

Instrument:	CONTROS HydroC CO_2 FT	Date of calibration:	26.05.2023
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO number:	RMA60419

Sensor characteristics

Note! *For proper handling please check our manual, esp. chapter "Important Notices"!*

Energy consumption

CONTROS HydroC™ FT standard, general values:

Current	20 °C	During warm-up**
@ 12 V	440 mA	710 mA
@ 24 V	280 mA	1060 mA

* measured during calibration
** warm-up time decreases with increasing voltage
[consumption during zeroing: +330 mA @ 12 V]

Warm-up time

(T_control, general values of standard CONTROS HydroC™ FT):

Warm-up time at 7 °C water temperature		Voltage	
		12 V	24 V
Ambient temperature	14 °C	31 min	
	20 °C	19 min	3 min
	25 °C	16 min	

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Wischhofstr. 1-3, Bld. 2
24148 Kiel
Germany

Calibration Sheet

Instrument:	CONTROS HydroC CO_2 FT	Date of calibration:	26.05.2023
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO number:	RMA60419

Sensor specifications

Operating depth:	Surface, flow through sensor
Gas tension (abs.):	800 mbar to 1100 mbar (defined through measuring range of the internal pressure sensors p_NDIR and p_in)
Measuring range:	200 µatm to 1000 µatm
Resolution – digital signal:	<1 µatm
Initial accuracy:	± 0.5 % reading (as total sum of all error)
Water temperature range:	1 °C to 30 °C
Calibration optimised for:	1 °C to 30 °C *(as requested by customer)*
Ambient temperature:	1 °C to 35 °C (The instrument should not be operated at ambient temperatures lower than 8 °C compared to the water to avoid condensation within the gas stream.)
Dimensions:	325 x 240 x 136 mm (L x W x H)
Weight:	5.3 kg
Output connector:	Hirschmann-plug CA6LD
Voltage:	11 to 24 V
RS232/ EIA-232 output signal:	See "CONTROS HydroC® On-line data"
RS485/ EIA-485 output signal:	See "CONTROS HydroC® On-line data"
Baud rate (preset):	115200 Bd
Interval settings (preset):	Warm-up: 0 min; Zero: 2 min; Flush: 0 min; Measure: 718 min
Data logger:	*2 GB*

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Calibration Sheet

Instrument:	CONTROS HydroC CO_2 FT	Date of calibration:	26.05.2023
Serial number:	CO2FT-0918-001	Date of delivery:	26.05.2023
Customer:	SMHI	PO number:	RMA60419

Calibration details

Setup and parameters

Calibration unit:	Contros CO_2 calibration tank #1
RS232 protocol unit:	DETECT-2 software package on CO-CALIB2
Voltage:	12.0 VDC
Temperature:	14.0 °C
Ambient temperature:	22.0 °C
Water:	Deionised water with carbonate additives
Salinity:	0 ‰
Reference gases:	102.18 ppm, 445.57 ppm 796.20 ppm CO_2 in natural air
Reference system:	SPRINK underway instrument with LiCOR LI7815
Calibration steps:	(200, 400, 600, 800) µatm
Pump Flow rate:	approx. 6.5 L/min
Pressure in water stream:	+100 mbar with respect to ambient pressure

Sensor

Membrane:	TOUGH membrane
Control temperature (NDIR detector):	50 °C

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