Sensyflow VT 2 • VT 2-EX • VT-C2 Thermal Mass Flow Meter for Gases

Operating Instructions

TABLE OF CONTENTS

1 Application

The Sensyflow is a mass flow measuring system for gases and gas mixtures.

2 Important information

2.1 Symbols

Warning: warns of danger for the user

Warning: warns of danger for the mass-flowmeter or connected devices

2.2 Important security information

Attention, important!

To ensure the safety and precisely work of Sensyflow, there are some facts to heed:
- proper transport and storage
- professional use and installation by trained staff

Please follow as well:
- the content of this operating instruction
- the safety regulations for Sensyflow and other electrical installations
- the mentioned instruction dates of the calibration certificates
- the safety regulations for the industrial use of gas
- the ordinance of explosion protection

All safety rules and regulations in this operating instruction are german country regulations.
For the use of the Sensyflow in other countries, plesae follow the national regulations.

Sensyflow is constructed and checked in accordance with DIN VDE 0411Part1.
To keep the condition ……and insure the safe operation of Sensyflow, it is necessary to follow the safety regulations.
Otherwise persons may be injured or the Sensyflow or other units may be destroyed.

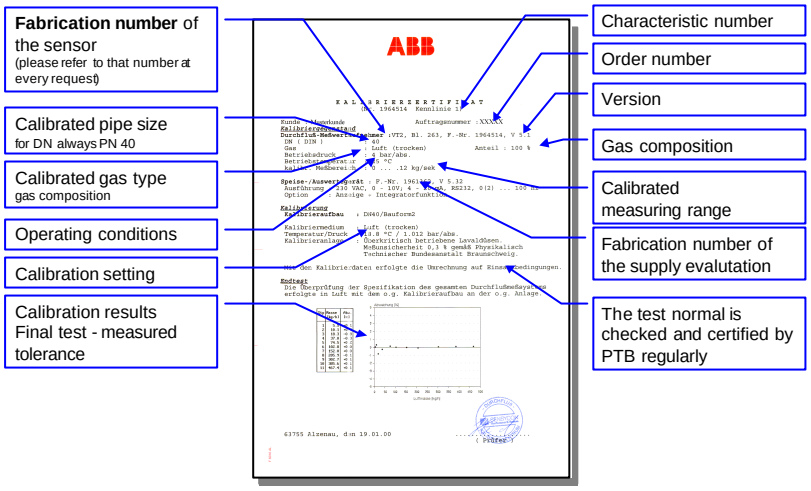
If you need more information regarding the Sensyflow which are not mentioned in this operating instruction, please do not hesitate to call our service team.

Please read this operating instruction carefully.

For easier initial start-up, please read the checklist in chap.9

2.3 Calibration certificate

Every measurement system that leaves our company has its own production process file. The most important document of this file is the calibration certificate.
It contains all necessary information of each system, for example gas composition, measuring range, nominal size, fabrication number and order number.



2.4 For questions

If you experience difficulties with the system or have technical questions which you are unable to resolve with these operating instructions, then please consult our service centre or telephone our customer service office directly under the following numbers.
To help us answer your queries as quickly as possible please state

- the serial numbers and
- our order number.

These are provided on the calibration certificate and the rating plate.

SENSYFLOW HOTLINE		
	Tel:	+49 [0] 6023 92-3597 oder -3267
	Fax:	+49 [0] 6023 92-3210
	E-mail:	sensyflow.deapr@de.abb.com

2.5 Documentation

With each delivery of a complete measuring system you get the **program** routine for configuration changes on a 3 ½“ disk.

Annex (depending on the type of the Sensyflow)

- Explosion-protected: copy of the **Ex-certificate of Confirmation**
- DVGW units: copy of the **DVGW-license**
- Units for O2 measurement: **Supplier certificate**
- Sensyflow VT-C2: copy of the **CIP/SIP license from TU Weihenstephan**

3 System description

A complete flow measuring system, based around the Sensyflow VT 2 or Sensyflow VT-C 2, comprises three components

- Pipe section
- Transmitter
- Supply/analysis unit

These are shown, by way of example, in Fig. 1 with a pipe component of type 1 and described in more detail below.

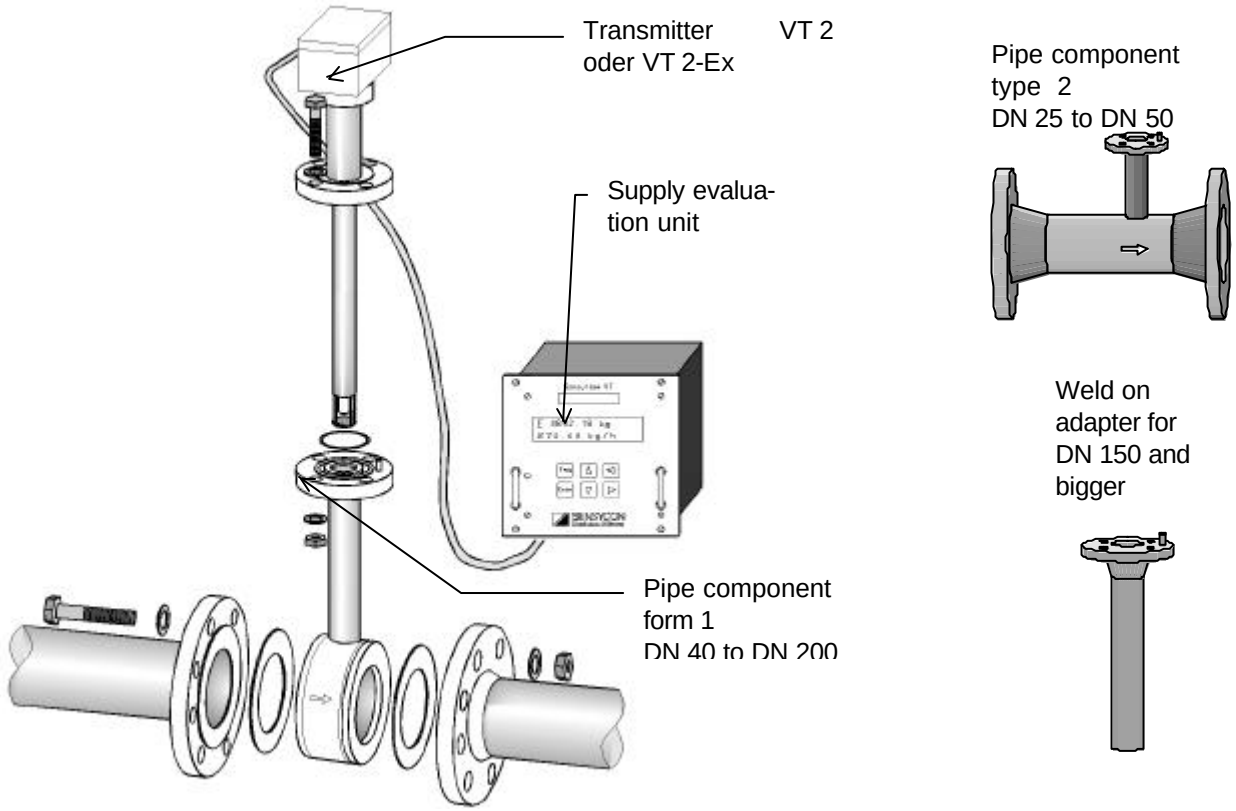


Figure 1: Schematic of a Sensyflow VT2 measuring system with a pipe component type 1

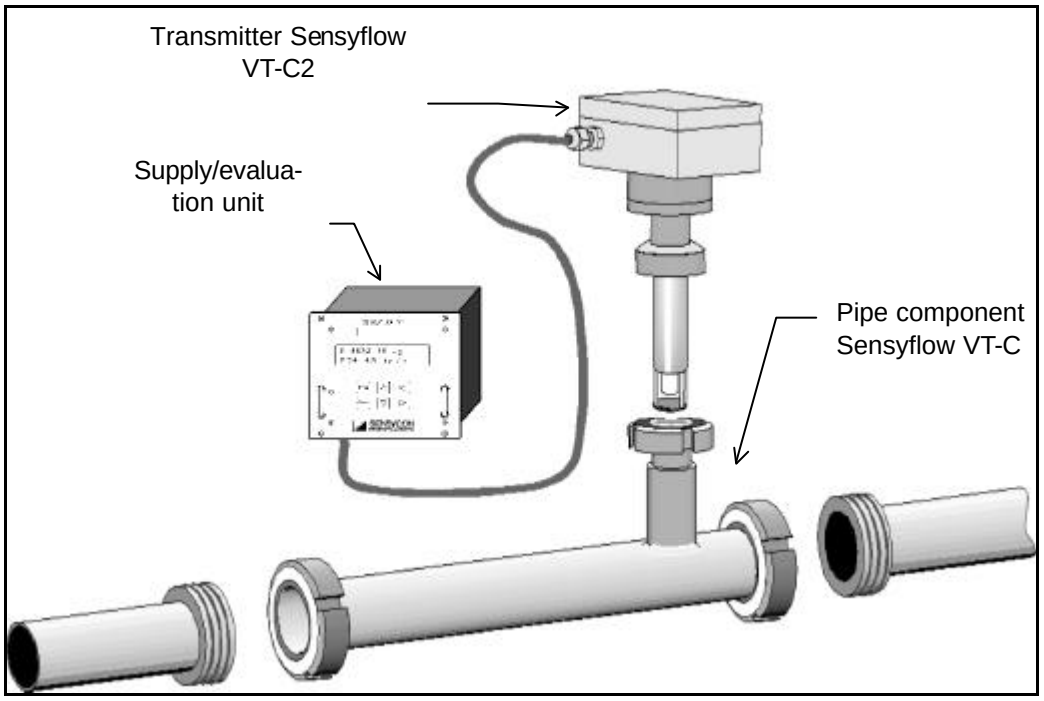


Figure 2: Overview: measuring system Sensyflow VT-C2 (hygienic version)

3.1 Pipe sections

The pipe sections and weld-on adapter ensure the precise installation of the transmitter in the pipe line. It further facilitates the installation and removal of the transmitter for inspection and/or cleaning. If the pipe is sealed with a blank flange (C 25 / PN 40 - DIN 2527) the measurement path can also be used without a transmitter.
At larger nominal sizes (= DN 150), or if the pipe cross-section is not circular, then the transmitter is precisely fitted in the pipe with a weld-on adapter.
The standard versions available - depending on the particular nominal size and the desired form of adaption - are given in Chap. 8.

3.2 Transmitters

The transmitter in the form of a penetration sensor - includes the transmitter circuit, completely encapsulated, within the connection head. This circuit mainlycomprises the passive component of differential temperature control for the sensor elements.
A memory for all measuring point specific parameters and computing capacity to create flow-dependent data records. All parameters and the current data records are sent in digital form to the supply/evaluation unit via a signal line. This arrangement .... a compatible transmitter which can be connected to different supply/evaluation units through 3-wire technology.
The dimensions and technical data of the various transmitters are given in Section 8.

3.3 Supply/evaluation units

The supply/evaluation unit supplies power for the transmitter and computing capacity for evaluation of the parameters and datas sent by the transmitter. This evaluation is then used for the control of mass flow-linear, standardized analogue outputs (0/4-20 mA and 0-10

V), mass flow-linear frequency ....outputs (0(10)-1000 Hz) and a serial interface. This serial interface further permits the configuration of the system. The following configurations are possible:

- Characteristics : Choice of max. 8 stored characteristics (optional)
- Frequency/pulse output : Select whether frequency or pulse output
- Maximum frequency : 100 or 1000 Hz (for frequency output)
- Pulse evaluation : Enter pulse value (e.g. 1 pulse per kg)
- Upper-range value : Select a new measuring range
- Display unit : Choice of 9 display units
- Damping : Choice of a dampingbetween 1 and 500 values
- Low flow cut off : Select between 0 to 200 ‰ of the upper-range limit
- Output characteristic : Choice between min. and max.; current/voltage or frequency output in the event of a fault
- Alarm values : Choice between 0 and 100% of upper-range value
- Transfer rate : Choice of 4 baud rates

The standard version is a 19" cassette which is designed for installation in a 19" rack.
Versions for wall mounting and panel instruments are also available.
The optional display version has a 2 x 16 character LC display and can display the cumulative flow value as well as the actual flow value at a given time (see Figure 2 and Figure 3).

This display allows the following to be displayed:

- **Actual flow value** in the selected display unit (e.g. in kg/h) and the trend bargraph

- The **cumulative flow value** in the chosen display unit (eg. in kg) **and the actual flow value**

- The **cumulative flow value** in the chosen display unit (eg. in Nm3) and the **period** over which values are summated (in hours:minutes:seconds)

- The **cumulative flow value** in the chosen display unit (eg. in g) and the **trend display** by means of a 64-step bar-type diagram.

4 Installation

4.1 Pipe sections and transmitter

Straight let and outlet length should be provided to avoid negative effects on the accuracy.
These length ensure that turbulences in the flow are eliminated by the time the actual measuring point at the transmitter is reached. The inlet length should be straight, undisturbed pipe section an an adequate length.
The section "Recommended turbulence-reducing length for gas flow" in the Appendix (see chap. 9) shows the options.

- The inlet and outlet length are given as multiples of the pipe diameter D.

- The installation of components which affect the flow, such as valves or shut-off devices, should be confined to the outflow side (downstream of the measuring point)

- If the weld-on adapter is used (see chap. 3.1), the information contained in the information sheet "Fitting a weld-on adapter to a Sensyflow VT 2 transmitter" should be followed. This information sheet is supplied with each weld-on adapter and is reproduced in the Appendix (see chap. 9).

- The gaskets must not alter the cross-section of the aperture and must ensure complete freedom from leakages after installation of the transmitter and pipe sections.

- The direction of flow must correspond to the direction indicated by the arrow on the pipe section. The positioning pin on the pipe section or weld-on adapter must be located on the outflow side (downstream of the measuring point).

4.1.1 Recommended inlet sections

Steadying length are necessary to obtain the recommended accuracy. Shorter length will result in errors in the measurement

Recommended dampingzone respective DIN EN ISO 5167-1

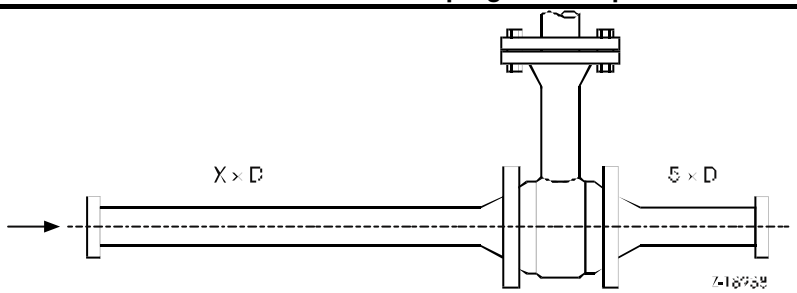
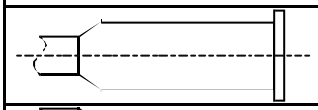
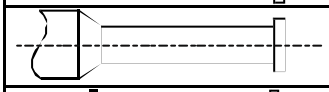
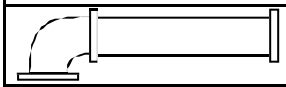
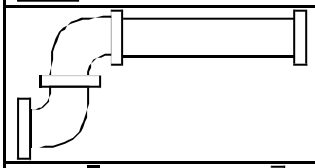
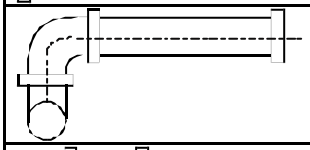
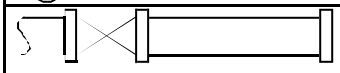
		X=
	Expansion	15 • D
	Reduction	15 • D
	90°-elbow	20 • D
	Two 90°-elbows in one level	25 • D
	Two 90°-elbows in two levels	40 • D
	Valve / Bolt	50 • D

Table 1: inlet zone

4.1.2 Fitting a weld-on adapter to a Sensyflow VT 2 transmitter

When installing the transmitter in pipes of greater nominal width or in pipes which have a non-circular cross-section, the weld-on adapter must be welded onto the pipe section, taking the following points into consideration:

1.) The weld-on adapter must be shortened to the length L given by the formula:

$L = L1 - \frac{1}{2} \times D$ where L1 = the transmitter length (263, 425 or 775 mm)

- Please take the thickness of the pipe wall and the degree of shrinkage into consideration when welding.
- The distance L1 from the upper flange edge of the adapter to the central axis of the pipe must be within a tolerance of ±2 mm.

2.) An angle of 90° to the axis of the pipe must be maintained without fail.

3.) The positioning pin of the adapter must be aligned with the pipe axis in the direction of flow (outflow side, downstream of the measuring point).

4.) An internal diameter of 28 mm must be allowed after welding to permit insertion of the transmitter (drill clear if necessary).

5.) Installation of the transmitter
5.1) Insert the supplied O-ring (55 x 3) supplied into the groove.
Never use a flat gasket
5.2) Push the transmitter into the adapter and thighten the screws.

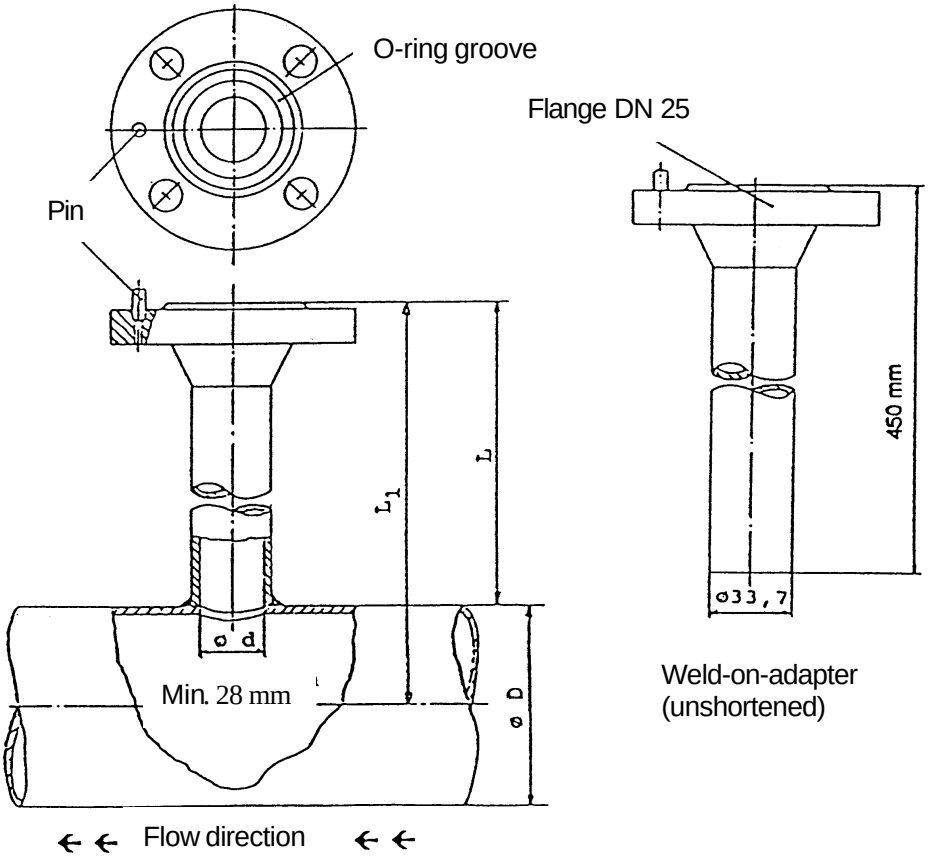


Figure 3: Adaption with weld on adapter

Deviations from the given dimensions and position tolerances will lead to increase measurement inaccuracies.

4.2 Connection

Please take care of the following installation points to fullfill the european safety regulation (see chap. 9.2)

4.2.1 Supply/evaluation unit in 19'' rack

The maximum ambient temperatures (see Section 7.1) must not be exceeded

A shielded three-wire cable has to be used between the transmitter and the supply/evaluation unit to fullfill EMC requirements.

- The shielding must be connected on **one side at the transmitter**.
- The total line resistance of the transmitter current supply (incoming and return lines) must not exceed 10 ohms.
- The following cutout dimensions must be observed for the panel-mounted version: W x H: 185 x 138 mm

4.2.2 Supply/evaluation unit in wall mounted version IP65

The maximum ambient temperatures (see chap.8) must not be exceeded

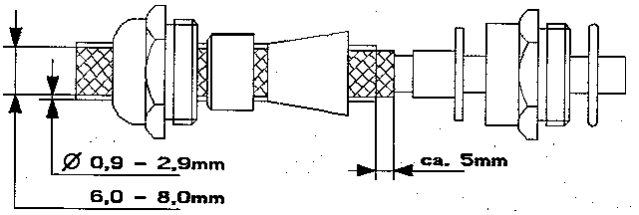
A shielded three-wire cable has to be used between the transmitter and the supply/evaluation unit to fullfill EMC requirements.

- The shielding must be connected on **one side at the transmitter**.
- The total line resistance of the transmitter current supply (incoming and return lines) must not exceed 10 ohms.
- The wall-mounting version of the supply/evaluation unit can be secured to the wall through 4 holes in the rear panel of the case. The drilling template diagram given in No. 8.6 of the Appendix can be used to assist mounting.
- The following cutout dimensions must be observed for the panel-mounted version: W x H: 185 x 138 mm

4.2.3. Connection

A shielded, three-wire cable is required to connect the transmitter to the supply/evaluation unit.

1.) Fit the EMC cable bushing (PG 13.5) shown in Fig. 4 to one end of the cable.



3 x 1, 5 mm², shielded, RL _ 10 ohms

Figure 4: EMC – cable bushing

2.) Open the 4 screws and remove the cover of the transmitter connection head.

3.) Connect the three wires to the terminals of the transmitter electronics (see Figure 5)

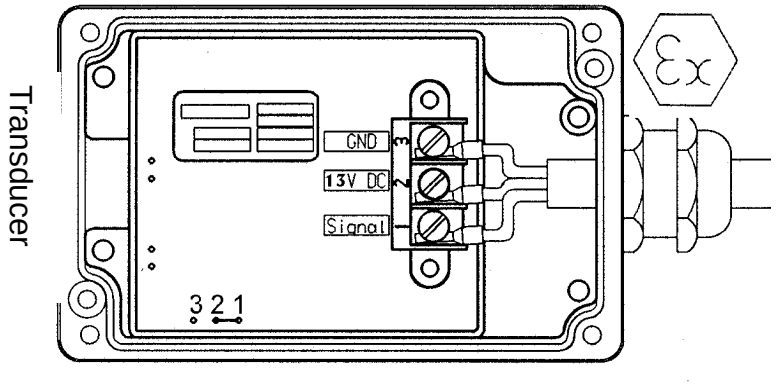


Figure 5: Terminals

4.) Secure the EMC cable bushing to the electronics housing of the transmitter.

5.) Replace the connection head cover and tighten it. Ensure that the seal is properly fitted.

6.) The other end of the cable is connected

6.1) to the spring contact strip in the 19“ cassette version (seeFigure 6)
6.2) to the screw-clamp terminals in the wall-mounting version (see Figure 7

4.2.4 Connection Sensyflow VT 2-Ex in 19” rack or panel mounting

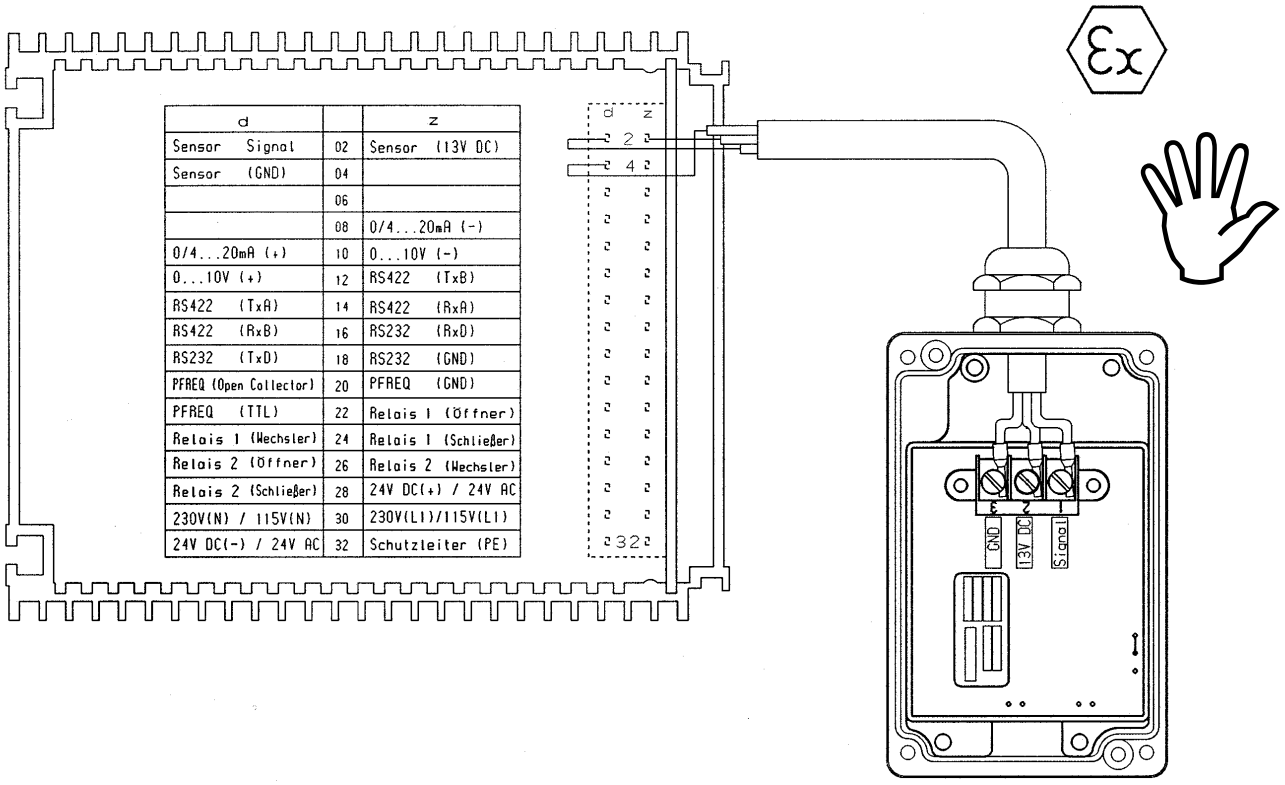


Figure 6: Connection Senyflow VT2 in 19” rack or panel mouting

4.2.5 Connection Sensyflow VT 2 / VT-C2 in 19“ rack or panel mounting

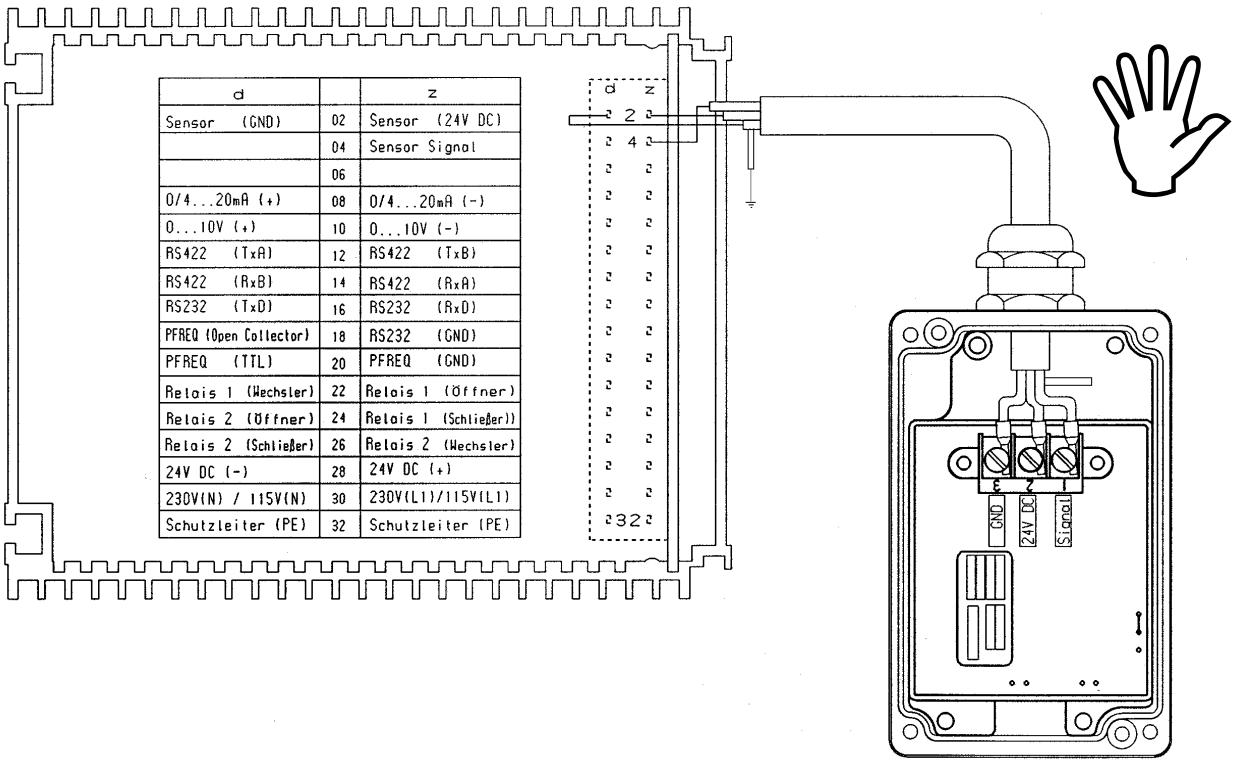
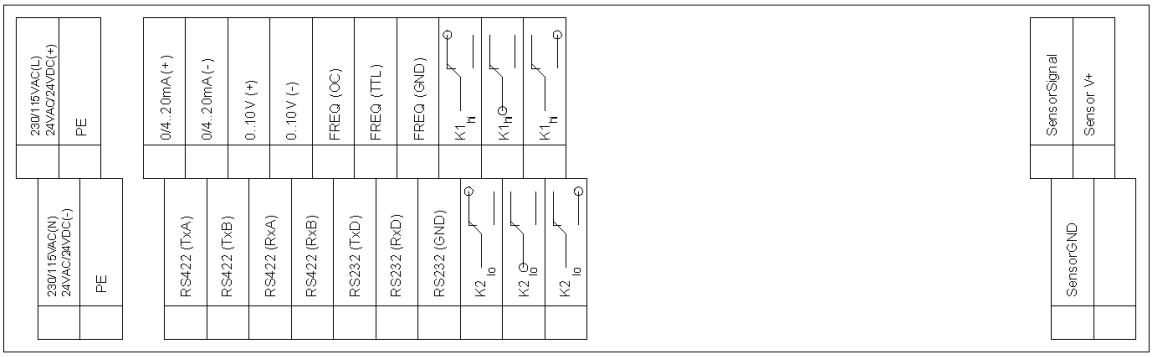


Figure 7: Connection Sensyflow VT2 / VT-C2 in 19” rack or panel mounting

4.2.6 Connection of supply/evaluation unit in wall-mounting



Sensor connection	Output signals		Power supply
01 Sensor Digital-Signal 02 Sensor supply voltage 03 Sensor ground	09 0/4...20 mA (+) 10 0/4...20 mA (-) 11 0...10 V (+) 12 0...10 V (-) 13 Pulse/ Frequency output (+) (Open-Collector) 14 Pulse/ Frequency output (+) (TTL) 15 Pulse/ Frequency output (-) (ground) 16 Relay 1 NC contact 17 Relay 1 two-way contact 18 Relay 1 NO contact	19 RS 422 (TxA) 20 RS 422 (TxB) 21 RS 422 (RxA) 22 RS 422 (RxB) 23 RS 232 (TxD) 24 RS 232 (RxD) 25 RS 232 (GND) 26 Relay 2 NC contact 27 Relay 2 two-way contact 28 Relay 2 NO contact	 05 230/115 VAC (L) 24V AC , 24V DC (+) 06 Earth (PE) 07 230/115 VAC (N) 24V AC , 24V DC (-) 08 Ground (PE)

Figure 8: Measure and connecting diagramm of Supply/evaluation unit in wall mounting case IP65

4.2.7 Connection of supply Open Collector (OC) output for survey frequency / impuls output

The pulse/frequency output can be configurated (Chap. 0) as frequency (0-100/1000 Hz) or as pulse output (integration of the flow with sending of a pulse per already flow amount e.g. 10 kg/pulse.
To provide a minimum of flexibility to the customer, the output is designed as open collector output. So there can be used different voltages to work with the ouptut.

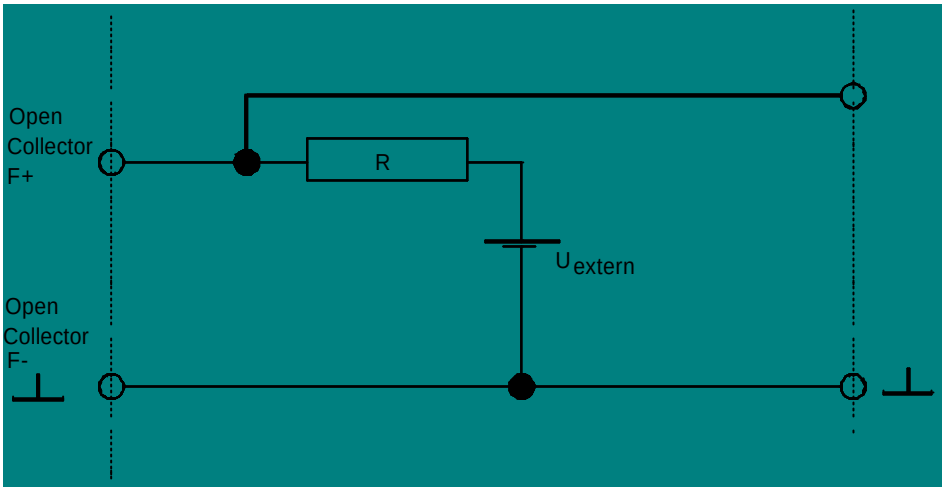


Figure 9: Connection of the Open-Collector output

The resistor defines the maximum current. The max. current should not be higher than 50 mA. The max. current depends on the external voltage and the resistor.

$U_{external}$ [V]	R [W]	P [Watt]
30	600	1,5
24	480	1,2
12	240	0,6
5	100	0,25

4.2.8 Circuit TTL output

The frequency or impulse output is also as 5 V TTL signal available. The current at the TTL output should not be higher than 5 mA.

Terminals:

Design	Frequency / Impuls OC- output	Frequency / Impuls TTL output	Frequency / Impuls Ground
IP65- clip nr.	13	14	15
19“plug connector Nr.	18 d	20 d	20 z
Ex - 19“plug connector Nr.	20 d	22 d	20 z

5 Commissioning

5.1 Switching the unit on

Caution: Compare the main voltage and frequency with that on the rating plate of the supply/evaluation unit.
The grounding conductor terminal (PE) must be connected to the ground before connecting the mains (L) and (N).
Please observe the technical requirements in Section 8 ?.

The system can be commissioned as follows:

1.) Connect the power supply to the evaluation unit

2.) The **initialization** of the system - lasting approx. 30 seconds - is indicated by the flashing green LED on the front panel of the supply/evaluation unit.

- With the display version, the initialization phase is additionally indicated by the message "Initializing ... Please wait..."

3.) Once the LED lights continuously, initialization is successfully completed and the **measuring system works** with the last good settings.

- Flashing of the green LED indicates a fault (see Section 5.2.8)

- A new or replacement unit is provided with factory settings which take into account the measuring point parameters specified by the user.

4.) Changing the configuration
The configuration of the Sensyflow VT 2 and Sensyflow VT-C 2 measuring systems can be changed via the supply/evaluation unit.

5.2 Reconfiguration via terminal communication

The options are as follows:

1.) Via the serial interface ...
1.1) … through a PC and menu-led configuration software (optional)
1.2) ... through a PC and monitor program*

*This monitor program is stored on a 3.5" disc which is supplied with every Operating Manual. This enables simple terminal communications.

5.2.1 Frequency-/Impulse output

The Sensyflow offers the possibility to use the digital output either as frequency or as impulse output.
Frequency output: The frequency output gives the mass lfow value as linear frequency. Either with a max of 100 or 1000 Hz.
Impulse output: The pulse length is always 250 ms. The pulse evaluation can be free configurated by the user (e.g. 1 kg/pulse).

5.2.2 Characteristics

The Sensyflow VT2 offers the possibility to store up to 8 characteristics.
These characteristics define all measurement data lipe pipe inner diameter, gas, temperature etc…
The number of calibrated characteristics and their settings depend on the customers purchase order.

5.2.3 Measuring range….

The thermal mass flow meter allows very huge measuring ranges. If the measuring range of the calibration will not be reached, the user has the possibility to reduce the range. The measuring range can never be set higher than the original calibration.

5.2.4 Flow units

The system has the possibility to work in 9 different flow units. The Standard-volume units like Nm³/h or SCFM always belong to a defined temperature and pressure. If no other conditions are ordered, it is always 0 Deg. C/ 1013,25 mbar.

5.2.5 Damping

The damping of the signal is based on a calculation which make the actual value dependant of the last measuring values. This kind of damping can be changed by a factor. This factor has to be a numeric value between 1 and 500.

5.2.6 No flow suppression

To suppress low flows which are caused by leackages or gas movement into the closed pipe, the Sensyflow has the possibility of a „ no flow suppression“. This suppression factor can be changed between 0 and 20 % of the maximum measuring range. The no flow suppression mainly depends on the real situation at the place of installation. Because of this fact, the no flow suppression should be adjusted into the real installation.

5.2.7 Alarm values

With 2 relais contacts,min. and max. value can be observed. The parametrization of these values has to be made in % of the max. range.

5.2.8 Error handling

Interrogation of the error status ...

... via the menu item no transmitter or transmitter ok / no calibration block or calibration block ok / no characteristics data or characteristics data ok / transmitter EEPROM not ok / or transmitter EEPROM ok / supply/sis unit EEPROM not ok / supply/analysis unit EEPROM ok / transmitter (MU) version not ok / transmitter (MU) version ok.

5.2.9 Basic settings manufactury settings

Activates the first delivered settings.

5.3 Reconfiguring via the keys on the front panel

With the display of the supply/analysis unit, the configurations described under No. 5.2.1 may be carried out via the six keys on the front panel (see information sheet "Menu mode in the display window of the supply/analysis unit" in No. 8.7 of the Appendix).

To effect configuration modifications, the following steps must be taken:

Basis of operation

Button	Display	Action
-	Normal display	Starts parametrization changes
Prog	Display instantaneous value	
↑	Back	

↑	Code-Number locked out	Read-only feature active
→	***0***000	Beginning of the entry
→	0***0***00	Next number
←	0***1***00 0***8***00	Increase the number up to 8
→	08***0***0	Next number
←	08***1***0	Increase the number up to 1
→	081***0***	Next number
←	081***1*** ... 081***7***	Increase the number up to 7
Enter	Code-Number enabled !	Read-only feature inactive
↑	Moving through the menue	Changing of the parameters
....	...	...
↑ or ↓	.... back	Quit the menue
Enter	... Normal display	End of the parametrization

Locate menue item SAVE to save modifications permanently.

6.) Quit the configuration menu via menu item <<<RETURN.
Note: The configuration program is automatically quit after 2 minutes, if no keys are pressed.

5.3.1 Display options

The following configurations can be effected in addition to the points described in Chapter 5.2.1:

- Display of the instantaneous flow rate value and of the trend (bargraph)...
  ... via the menu item INSTANTANEOUS VALUE

- Display of the cumulative flow value and ...
  a.) ... the tendency of the instantaneous flow value (bargraph), or
  b.) ... the instantaneous flow value, or
  c.) ... the time period of the summation ...
  ... via the menu item INTEGRATOR VALUE: and TREND / and INSTANTANEOUS VALUE / and TIME

5.3.2 Integrator options

■ Start or stop integration (summation)...
  ... via the menu item INTEGRATOR

- Resetting of the integrator value ...
  ... via the menu prompt RESET?> ... press ENTER !

5.3.2 Language

Select menu guidance language
... via the menu item LANGUAGE

5.3.3 Measuring options

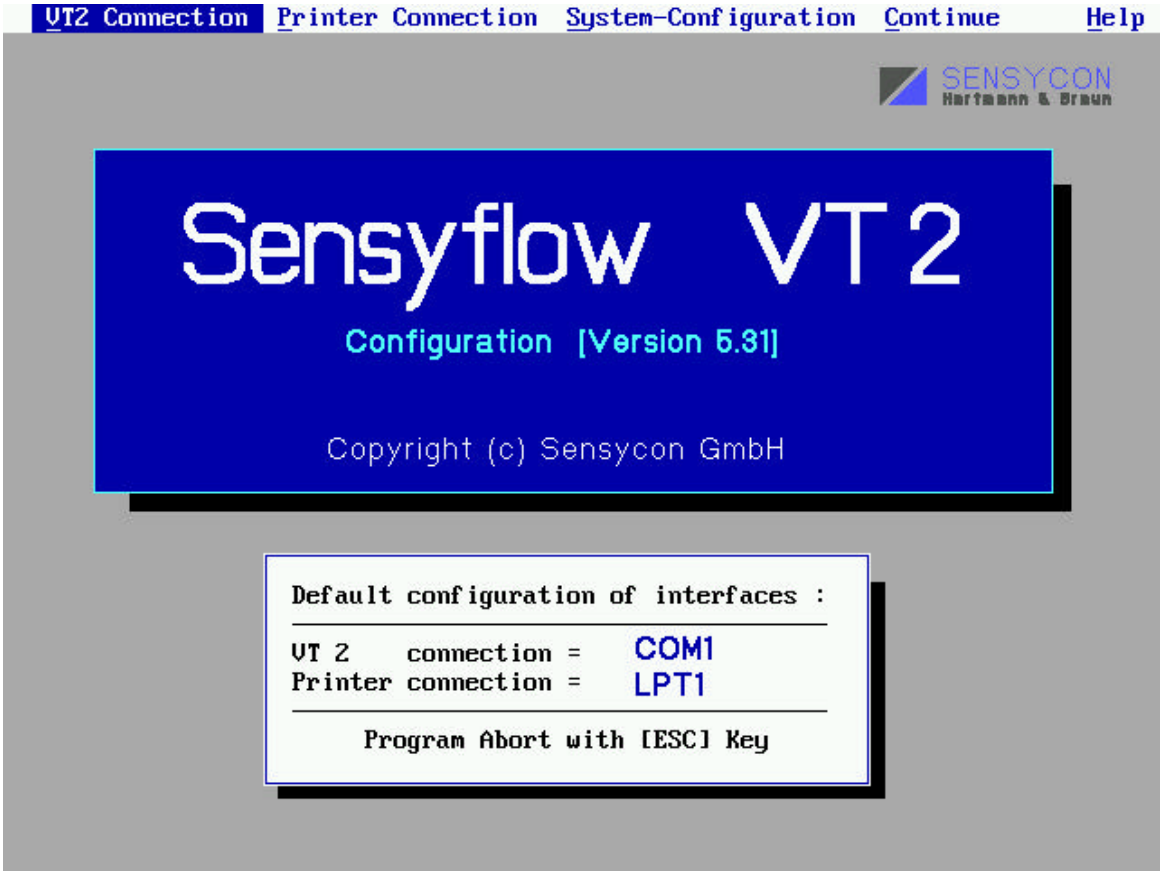
■**Frequency-/pulse output:**	Activates or desactivates the frequency- or impulse output
■**Maximum frequency:**	100 or 1000 Hz /if frequency output is activated)
■**Pulse evaluation:**	Pulse length is 250 ms, pulse input i.E. 1 pulse/kg (if pulse output activated)
■**Characteristic:**	VT2 saves up to 8 characteristic curves. You can choose between each characteristic in the menue “characteristic” (option). Please compare the charasteristic number with the data in the calibration certificate.
■**MEW (Measuring range endvalue):**	Measuring range full-scale value Input of a new measuring range. The value has to be within the calibration value shown in the calibration certificate.
■**Unit:**	Selection of 9 display units
■**Programm start:**	restarts the measuring system
■**Damping:**	selection of filter factor between 1 and 500
■**Low flow suppression:**	Selection within 0 and 20 % of the measuring range upper limit
■**Output characteristic:**	Selection within min. and max.; behavior of current-/voltage- and frequency output in malfunction
■**Limit value:**	Selection within 0 and 100 % of the measuring range upper limit for relais outputs.
■**Saving:**	Parameter saving in measuring system
■**Basis setting:**	Activation of supply settings
■**Baud rate:**	Selection of transmission speed between PC and Sensyflow
■**Error status:**	Survey of error status with the button ➔

5.4 Configuration Software for Sensyflow VT 2

You can change the configuration described in chap. 5.2 with the configuration software. This program is saved in DOS-Format on a 3 ½ “ disc and will be supplied with every order. The program is not copy protected.

5.4.1 Installation

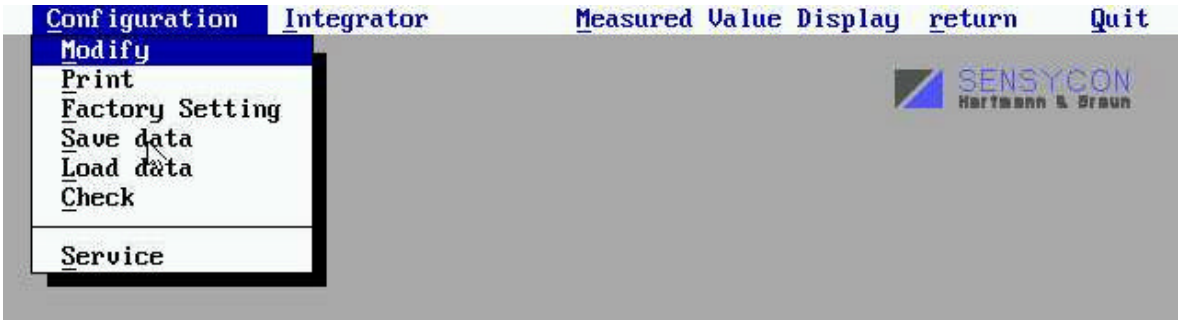
Please copy all 12 files in 1 file. If you want to start the program from disc please deactivate the writing protection of the disc.



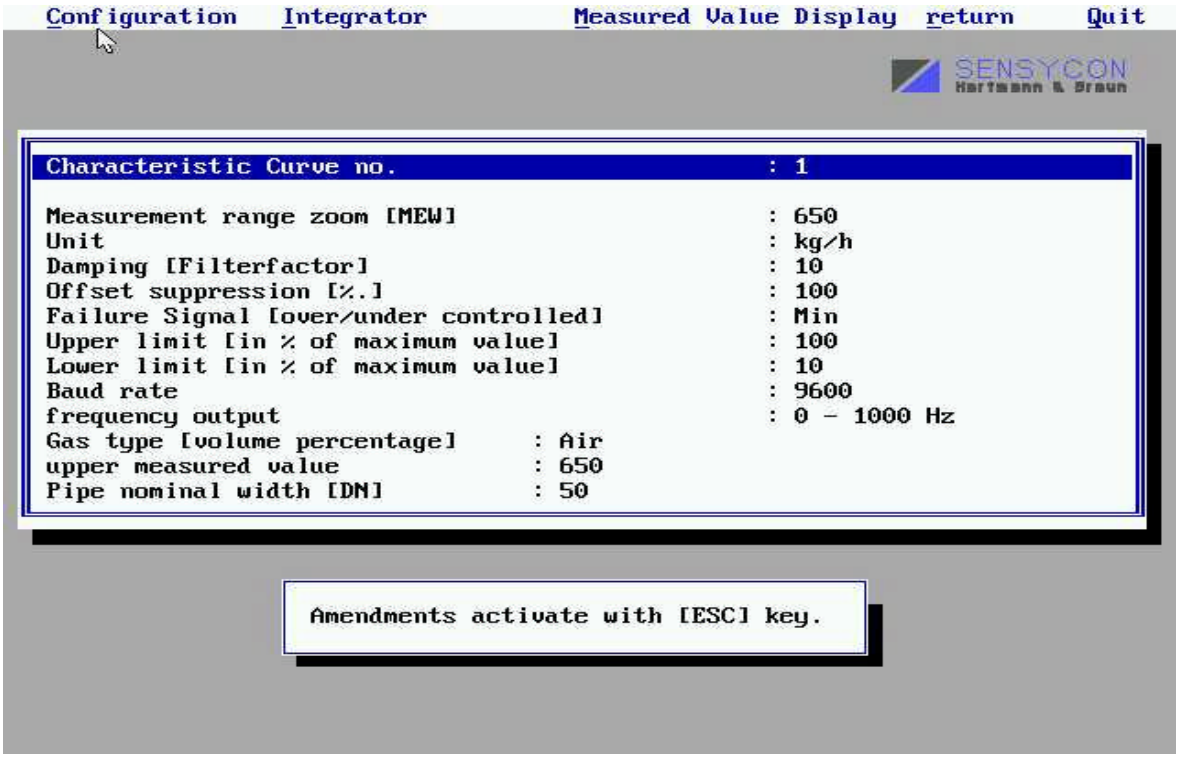
After starting the VT25.exe, you can choose your language in *German*, *English* or *French*.

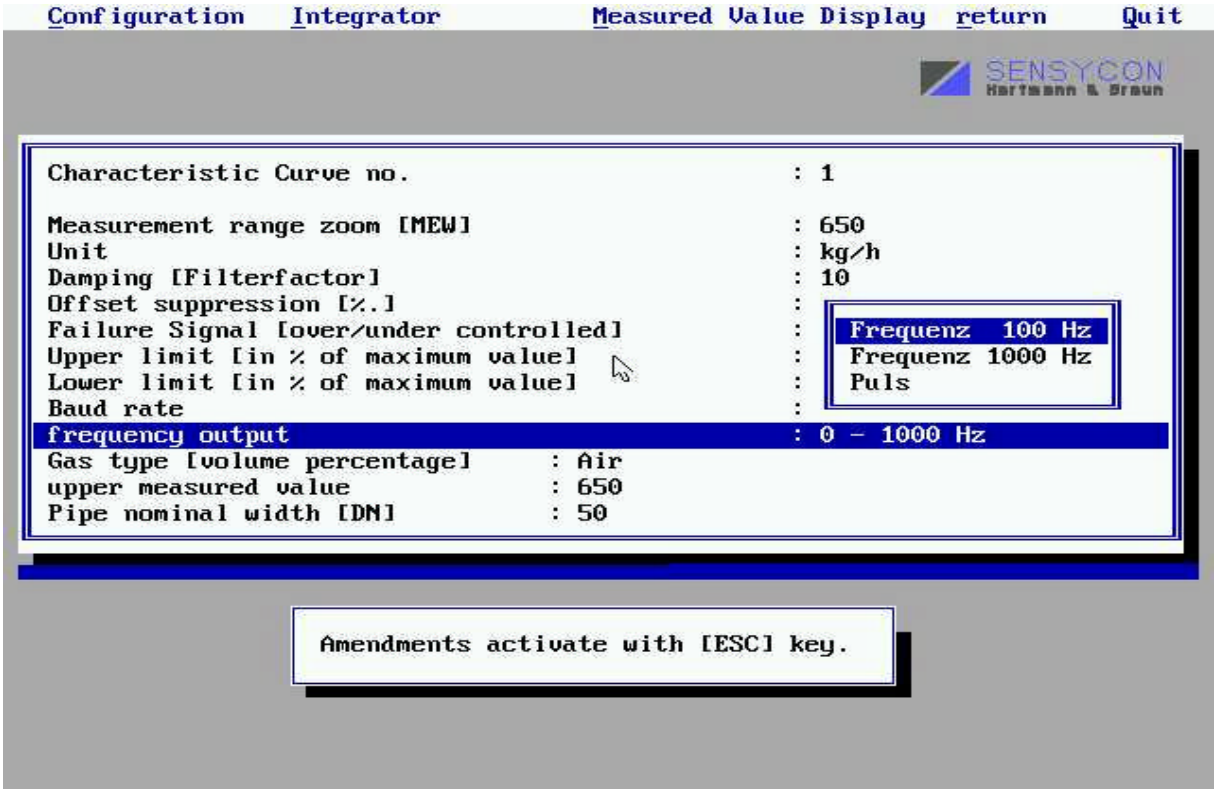
In the Start screen, you can choose the interfaces for the VT2 and printers. The program keeps these settings for the next start.

Menue: configuration



Configuration: Modify
The main function of this menue is to change the parametrization.
After choosing this point, the following screen will appear.





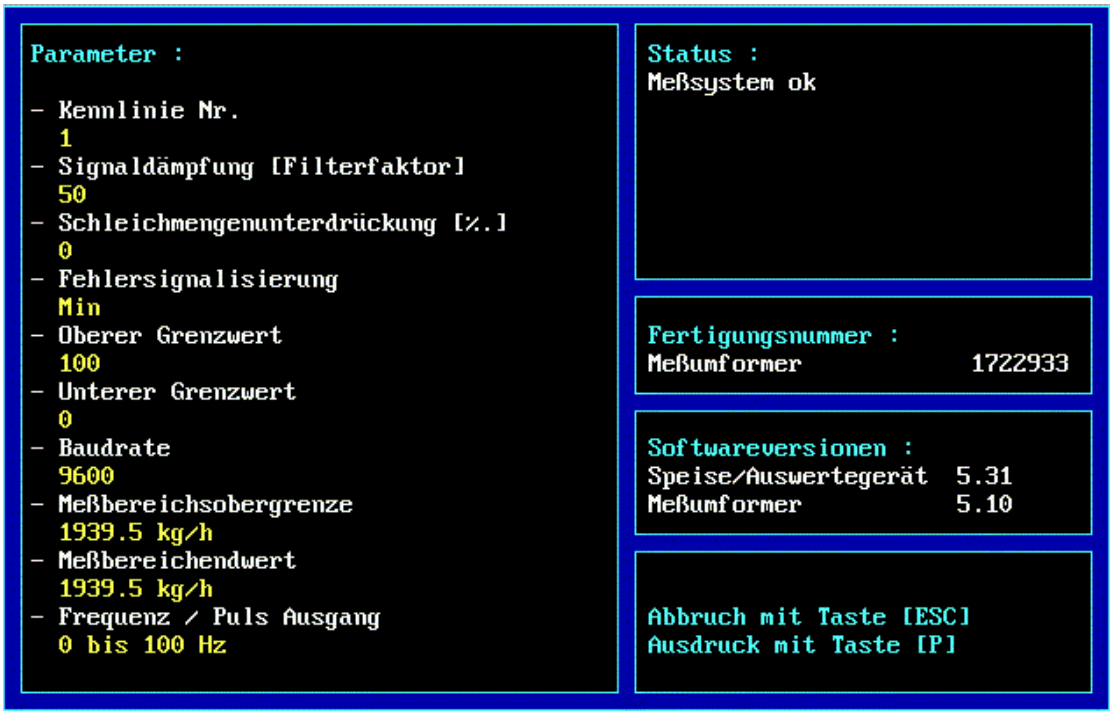
The 3 last menue items can not be changed by the customer

Configuration. Print
Print the actual configuration

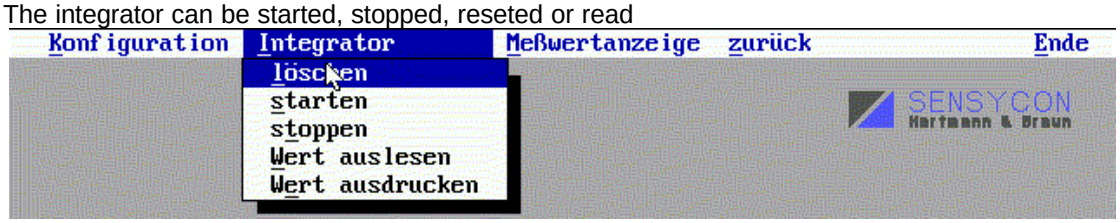
Configuration. Save data
The file formats text or configuration are possible. The format configuration is to transmit the data to another unit.

Configuration. Load data
Saved configurations can be reloaded and activated.

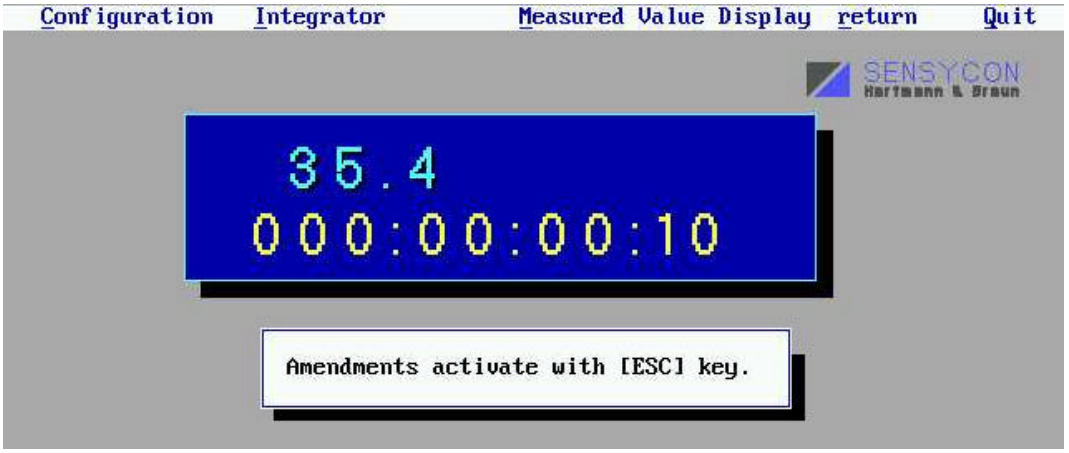
Configuration. Check
Displays the system status including the error status.



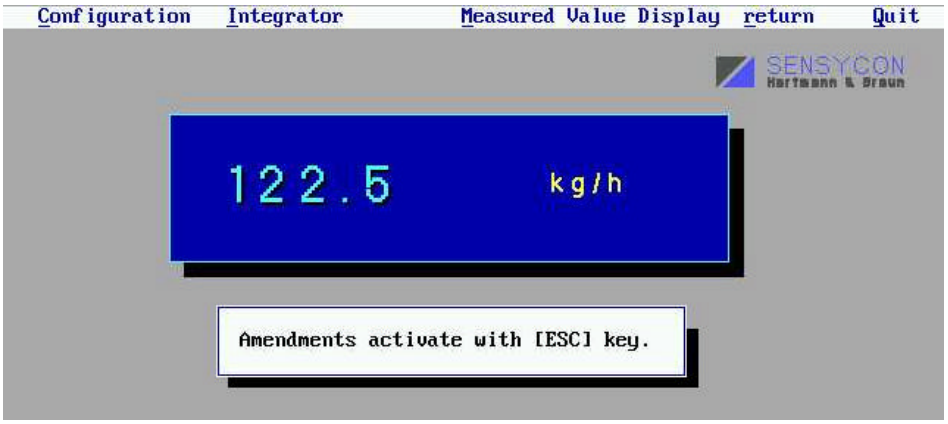
Integrator:
The integrator can be started, stopped, reseted or read



Integrator display



Measured value display



Help function

For the most cases, a help topic is available. This function gets activated by pressing the F1 button.

5.5 Changing the configuration via direct serial commands

Via RS 232 or RS422 interface a direct communication with the Sensyflow VT-2 supply evaluation unit is possible. The following commands can be used with this configuration.

Command	Depiction or possible settings	Remarks
K	Characteristic selection kX: (X = 1 .. 9)	Configuration data of the respective characteristic can be ascertained via the CHECK command and calibration certificate
EIN	Transmit data continuously, stop with OFF command	Request for measured value series in the current unit
EW	Transmit single measured value	Request for single measured value in the current unit
MBEW	Enter upper-range value in the unit set	The upper-range value must be ? upper-range limit
HELP	Display this command list	
CHECK	View set parameters	Call current configuration and status message Specify the following data: characteristic, filter factor (damping), creep factor in ‰ of the upper-range limit, output characteristic in the event of fault, alarm value settings, baud rate, upper-range limit (MOG), upper-range value
EH	Unit EH(x): 1=kg/h, 2=Nm^3/h, 3=Nl/h, 4=kg/min, 5=Nm^3/min, 6=Nl/min, 7=kg/sec, 8=Nm^3/sec, 9=Nl/sec)	Standard settings for normal volume units are in relation to 0 Cel. And 1013,25 hPa
RES	Software reset	Restart and initialisation with the last data saved
TC	Set filter time constant tcX: (X = 1 .. 500)	Damping of the output signal
ZS	Creep factor suppression in per mill (of upper range value) zsX: (X = 0 .. 200)	Process-related zero elevation
EC	Output status in the event of fault ecX: (0=min, 1=max)	Output signal action in the event of fault

ULIM	Set upper alarm value in % (of upper range value) ulimX: (X = 0 .. 100)	Entry referred to the current upper-range value (c.f. command „MBEW“)
LLIM	Set lower alarm value in % (of upper range value) llimX: (X = 0 .. 100)	Entry referred to the current upper-range value (c.f. command „MBEW“)
S	Store parameter definition in the SAG-EEPROM of the supply/analysis unit	Permanent storage of the modifications effected
N	Fetch basic setting from the SAG-EEPROM of the supply/analysis unit	Activation of the default setting (default setting = application- related); (the configuration set can be ascertained via the CHECK command)
BR	Baud rate brX: (X = 1 .. 4) 1 = 1200 baud, 2 = 2400 baud, 3 = 4800 baud,	Transmission rate between supply/evaluation unit and PC
2 = 9600 baud		
LOCK	Inhibit parameter modification via front panal puchbutton (lock = on, lock = off)	Enable for configuration modifications (only in con-junction with the optionally available LC display !)

BALK	Bar-type display on/off (bar = on, bar = off)	Switch off trend display (bargraph) for combination with the instantaneous value display (only in conjunction with the optionally available LC display)
HELP2	Further commands …	Continuation of the command list …
=>		
INT	Transmit integrator value	Request the summation value in the current unit (only in conjunction with the optionally available LC display)
STARTI	Start integrator	Start summation (only in conjunction with the optionally available LC display)
STOPPI	Stop integrator	Stop summation (only in conjunction with the optionally available LC display)
CLI	Delete integrator and time	Delete summation value and summation time
RECLI	Retrieve deleted integrator	Delete summation value and cancel accumulated time
VOX	Language (1 = English, 2 = German, 3 = French)	Select menu guidance language (only in conjunction with the optionally available LC display)
POUT	Activate pulse output	Activate evaluable pulse output (instead of the flow-rate-linear frequency output)
PWERT	Compare value for pulse output	x = quantity per pulse (referred to the current unit); (e.g. 0.1 kg per pulse); (only relevant for activated pulse output (c.f. command „POUT“)
FOUT	Activate frequency	Activated flow-rate-linear frequency (instead of the pulse output)
FMAX	Frequency for MOG FMAX …	Maximum frequency for upper-range value (c.f. command „MBEW“); (only relevant for activated frequency output (c.f. command

Caution: To permanently save configuration modifications, they must be saved with the command

5.5.1 Example program

The following basic program reads integrator and value 10 times with a distance of 5 seconds.

```
REM  ------------------------------------------------------------------------
    ---
REM Demo-Programm zum zyklischen Auslesen des Integrators und des Messwer-
    tes
REM Funktion zum Auslesen des Datenbuffers
DECLARE FUNCTION lesesag$ (b$)

REM Variablen definieren
b$ = ""

PRINT "Oeffnen eines COM-Kanals"
OPEN "com1:9600,N,8,2,cs,ds,cd" FOR RANDOM AS #1 LEN = 1024

PRINT Echofunktion; ausschalten
PRINT "eoff"
PRINT #1, "eoff" + CHR$(13)

PRINT "Start Integrator"
PRINT #1, "starti" + CHR$(13)
b$ = lesesag$(b$)
```

```
SLEEP 1
i = 0
DO WHILE i < 10
        PRINT "--------------------Next loop----------------------"

        i = i + 1
        PRINT "Loop", i

        REM Sende Befehl zum Integrator auslesen
        PRINT #1, "INT" + CHR$(13)
        b$ = lesesag$(b$)
        PRINT b$
        REM
        REM Sende Befehl zum Messwert auslesen
        PRINT #1, "ew" + CHR$(13)
        b$ = lesesag$(b$)
        PRINT "Messwert", b$

        SLEEP 5

LOOP

REM COM Schliessen
CLOSE #1

FUNCTION lesesag$ (b$)
        b$ = ""
        a$ = ""
        DO
                a$ = INPUT$(1, 1)
                IF a$ <> CHR$(4) THEN
                        b$ = b$ + a$
                END IF
        LOOP WHILE a$ <> CHR$(4)
        lesesag$ = b$
END FUNCTION
```

5.6 Fault status messages

Three different types of faults of the measuring system can be indicated by the green LED on the front panel of the supply/analysis unit through the sequence of flashing. All of these faults lead to erroneous measured values or a complete failure of the measuring system.

LED	Fault	Assistance
Single flashing sequence X_____X_____	Error in the transmission of parameter data	- RESET command (via RS232, RS 422 interface or menu item)
		- Briefly interrupt the power supply
		- Inform the SENSYCON service centre
Double flashing sequence X_X_____X_X_____	Line break	- Check the electrical terminals/connections between the supply/analysis unit and the transmitter
		- Inform the SENSYCON service centre
Triple flashing sequence X_X_X___X_X_X__	XON/XOFF software handshake error in the communication via the RS232 or RS422 interface of the supply/analysis unit	- Briefly interrupt the power supply
		- Inform the SENSYCON sercice centre

Table 2: LED - fault messages

"X" = LED on; "_" = LED off

6 Maintenance and service

All measuring systems are accurately calibrated for the particular application in air using in-house calibration equipment which is also connected to the Federal German Calibration Service, and any conversions necessary are performed. These extensive calibration procedures, together with up-to-date manufacturing and testing procedures and ongoing product development all ensure that these measuring systems will work for a long period with very little need for maintenance. Only gases which contain humid impurities may necessitate that the transmitter has to be cleaned occasionally (depending on the degree of contamination).

6.1 Cleaning the transmitter

The following steps are necessary to clean the transmitter or its sensor unit:

1.) **Switch off** the supply/analysis unit so that the transmitter is de-energized and "unheated".

2.) **Remove the transmitter** from the pipe section or weld-on adapter (ensure that the pipe line is depressurized).

3.) **Carefully clean** the sensor unit with warm water or an alcohol solution. We recommend a soft brush or cotton wool for this.

- Under no circumstances should a hard object such as a screw driver, tweezers or the like be used, as this could lead to irreparable mechanical damage of the sensor unit.

4.) Allow the **sensor unit to dry** for a few minutes or blow dry it.

5.) Check the integrity of the **gasket** between the transformer and the pipe section or weld-on adapter and **make sure** that it is free of contamination. If necessary replace it with a new seal.

- For the Sensyflow VT 2 : O-ring (55 x 3)
- For the Sensyflow VT-C 2 : Sealing ring G according to DIN 11851

6.) **Replace the transmitter** in the pipe section or weld-on adapter.

7.) **Turn on** the supply/analysis unit.

The measuring system is now ready for use.

7 General points

The Sensyflow VT2 and Sensyflow VT-C2 are mass flow measuring systems for gases and gas mixtures. They have been developped to meet the many demands placed on such systems in the chemical industry, process technology and plant/equipment manufacture, as well as the food industry.

7.1 Mode of operation

These measuring systems offer technical measuring advantages such as
- direct mass flow measurement
- high accuracy of measured value
- rapid response time
- negligible pressure drop

and also additional safety through
- explosion protection („intrinsically safe“)
- licensed for use in zone 0
- construction and materials suitable for processes
- insensitive to contamination

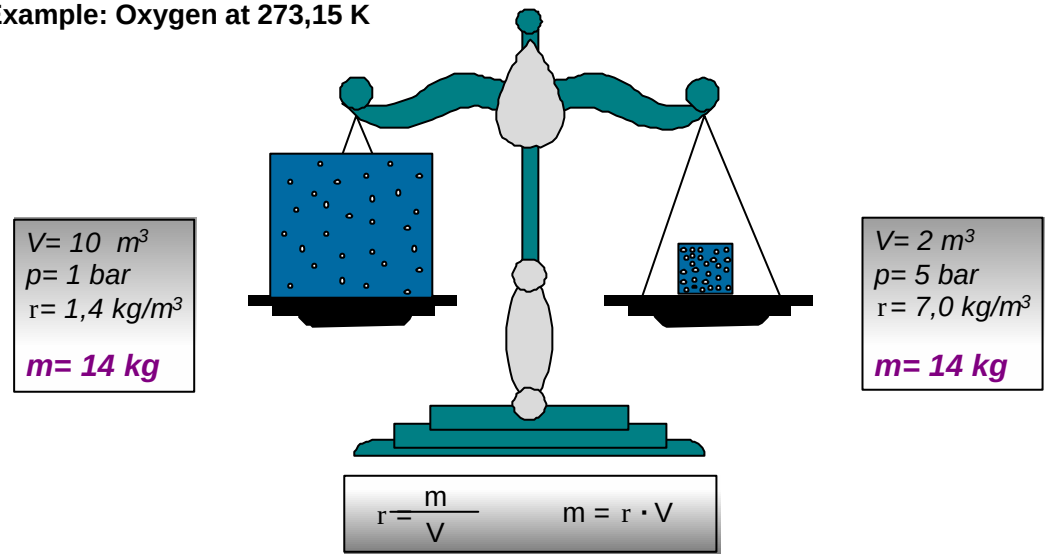
and simple instrumentation through
- easy installation
- optimal ergonimics
- compatible transmitter

7.2 Measuring principle

7.2.1 Mass flow

Most of the conventional flow meters determine volumetric flow rate. In this case, it is necessary to correct the density of the mass flow through additional measurement of pressure and temperature.

Example: Oxygen at 273,15 K



These corrective measures make measurements more ex-pensive and they reduce the ultimate accuracy of the measuring system. Sensyflow measuring systems provide the mass flow rate directly, i.e. without fur-ther measurement or correction. Flow based on units of mass is a requirement of almost all technical appli-cations. In view of the close relationship between mass and amount of substance, mass flow is used as an assessment factor in chemical reactions, e.g., to set the stoichiometric relationship between the reaction partners exactly.
Example:
If 10 m 3 of oxygen is to be compressed from 1 to 5 bar at a constant temperature, the volume or volume flow will change to 2 m³, although the amount of substance and the mass are still the same (14 kg). In this case, a volume flow meter will only indicate 20 % of the original volume flow.
As a result, a volume flow measurement for gases without a
correction of pressure and temperature is without any meaning. The mass flow meter directly determines the mass per unit of time of a flowing medium; a measured value in kg/h is displayed.

Parameters such as volumetric flow rate (referred to the standard state) can be calculated directly from the standard density of the medium: $q_n = q_m / \rho_n$ in e.g. m^3/h-q_n with

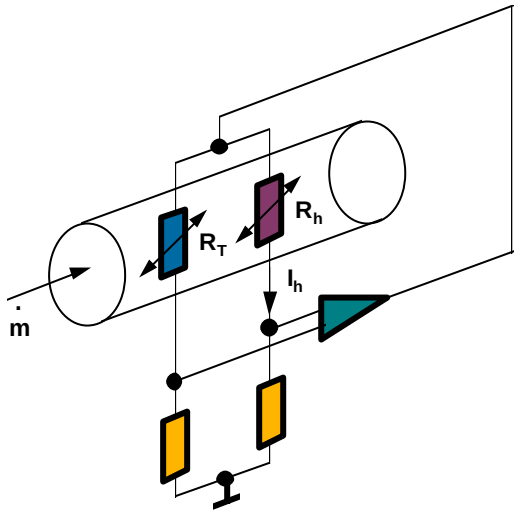
q_n = volume flow rate as a function of the normal flow rate (e.g. 0 ºC and 1013 hPa)

q_m = mass flow rate

ρ_n = density as a function of the normal status (e.g: 0 ºC and 1013 hPa)

Measuring principle

Sensyflow operates according to the principle of the hot-film anemometer. This method of measurement is based on the abstraction of heat from a heated body by an enveloping gas flow. The "flow-dependent" cooling impact is used as the measuring impact. The gas stream flows past two temperature-sensitive resistors Rh and RT which are part of an electrical bridge circuit. Due to the chosen resistance ratio Rh << RT, Rh is heated by the current Ih, and RT adopts the same temperature as the gas. The current Ih is preset by the electronic control circuit to produce a constant temperature difference between the heated resistor Rh and the temperature of the gas.



The electrical power generated with resistor Rh exactly compensates its loss of heat to the gas flow. As this loss of heat is dependent on the number of particles which collide with the surface of resistor Rh, Ih represents a measure of mass flow rate.

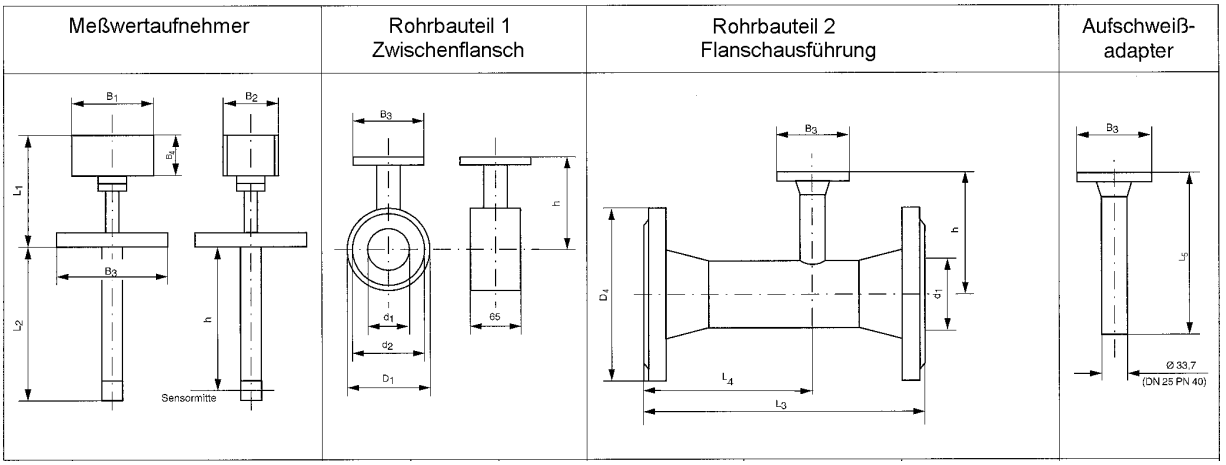
8 Technical Data

Type	**Sensyflow VT 2**	**Sensyflow VT 2-Ex**	**Sensyflow VT-C2 Hygiene version**
Application	Process engineering		Beverage and food industry
Explosion protection	-	Transducer EEx ib [ia] IIC T5 Zone 0 PTB-NR. Ex-94.C.2077	-
Modules	• VT 2Transducer • VT-pipe component design 1 or 2 or weld-on-adapter • VT 2-supply-/evaluation unit		• VT-C2 transducer VT-C • VT 2-Supply-/evaluation unit
Standard-Nominal sizes	• Pipe component form 1: intermediate flange DN 40, 50, 80, 100, 150, 200 • Pipe component form 2: measuring section DN 25, 40, 50 • Weld-on-adapter: 150 to 3000 mm		Pipe component form 2: measuring section DN 25, 40, 50, 80
Standard-Materials	1.4571, Hastelloy		Stainlesss steel (e.g. 1.4301)
Standard-process connection	Flange according to DIN 2635, Form C, PN 40		Fitting S Accord. To DIN 11851
Measured gases	Gases and gas mixtures with known composition		Air, N_2, O_2, CO_2
Nominal sizes DN 25 DN 40 DN 50 DN 80 DN 100 DN 150 DN 200 Up to 3000 mm	Standard measuring ranges in kg/h 0(1,6)..... 160 0(4) ..... 430 0(7) ..... 700 0(17).....1700 0(30).....3000 0(70).....7000 0(120).....12000 up to 0(2700) 2.700.000		Standard measuring ranges in kg/h 0(1,6) .....160 0(4).....430 0(7).....700 0(16) 1700
	The above values are guide values for applications involving air under atmospheric conditions. The value in brackets states the lower range value of the standard measuring range.		
Measuring deviation	under calibration conditionsin the stated measuring range for air < ± 0.9 % of measured value ± 0.05 of possible end value in this nominal size (see measuring ranges) for other gases < ± 1.8 % of measured value ± 0.1 of possible end value in this nominal size (see measuring ranges)		
Repeatability	< 0,25 % of measured value		
Temperature effect	< 0,05 %/K of measured value (dependent on type of gas)		
Pressure effect	< 0,2 %/100 kPa (/1 bar) of measured value (dependent on type of gas)		

Technical data

Type	Sensyflow VT 2	Sensyflow VT 2-Ex	Sensyflow VT-C2
max. operating pressure	$4 \bullet 10^6$ Pa (40 bar)		$16 \bullet 10^5$ Pa (16 bar)
Operating temperature Medium (Transmitter)	Standard range: -25 ... 150 °C With DVGW certification 0 …..150°C Extended range: -25 ... 300 °C	Temperature class T3: -25 ... 80 °C	-25...150 °C
Ambient temperature Connection head area	-25 ... 80 °C		
Ambient temp. Supply/ analysis unit with LC-Display	-25 ... 60 °C -25.....50 °C		
Storage temperature	-25.....85 °C		
Response time	T_{63} = 0,5 s (Metall sensor 2 s)		T_{63} = 2 s
Degree of protection Transducer	IP 65		
Supply/ evaluation unit	IP 65 (or 19“ plug-in unit)		
Recommended steadying length	According to DIN EN ISO 5167-1 minimum entry 15 x pipe Diameter , exit 5 x D pipe diameter D (s. page 5)		
Pressure drop (logarithmic diagram)		< 1,0 kPa (10 mbar) **typical value** 1 kPa (1 mbar)	
Electrical terminal values			
Supply unit	230 V AC	230 V AC	230 V AC
Power supply	115 V AC 24 V DC 24 V AC	115 V AC 24 V DC 24 V AC	115 V AC 24 V DC 24 V AC
Power consumption Transducer:	< 50W	< 15 W	< 50 W
Power consumption	15 W	1,8 W	15 W
Current drain	< 600 mA	<130 mA	< 600 mA
Connecting cable Transmitter – supply/ evaluation unit	Maximum permitted inductances and capacities are specified in the certificate of conformity		
Line resistance (feed & return cable)	< 10 ohms (ie., for a line cross section of 1.5 mm^2, _ 400 m distance)		
Output			
Analog	0...20 mA, Load < 1kΩ 4...20 mA, Load < 1kΩ 0...10 V (Max. 4 mA)		
Frequency	0....100 or 0...1000 Hz, 16 Bit resolution (open-collector, TTL)		
Pulse length	Pulse length 250 ms, maximum 2 pulses / s		
Relay outputs	Max. 60 V, 0.5 A		
Digital interface	RS 232, RS 422		

8.1 Dimensions Transducer and pipe component Sensyflow VT 2



PN40

Nominal size		L_2	h	D_1	d_1	d_2	D_4	L_3	L_4	L_5
DN 25				-	-	-	115	600	486	-
DN 40	L1 = 198			94	43,1	88	150	860	731	-
DN 50				109	54,5	102	165	1000	837	-
DN 80	B1 = 125	269	263	144	82,5	138	-	-	-	-
DN 100	B2 = 80			170	107,1	162	-	-	-	-
DN 150	B3 = ∅115			226	159,3	218	-	-	-	
DN 200	B4 = 58			293	206,5	285	-	-	-	
> 350		431	425							450
> 700		781	775							

ANSI 150 lb, Sch 40 S

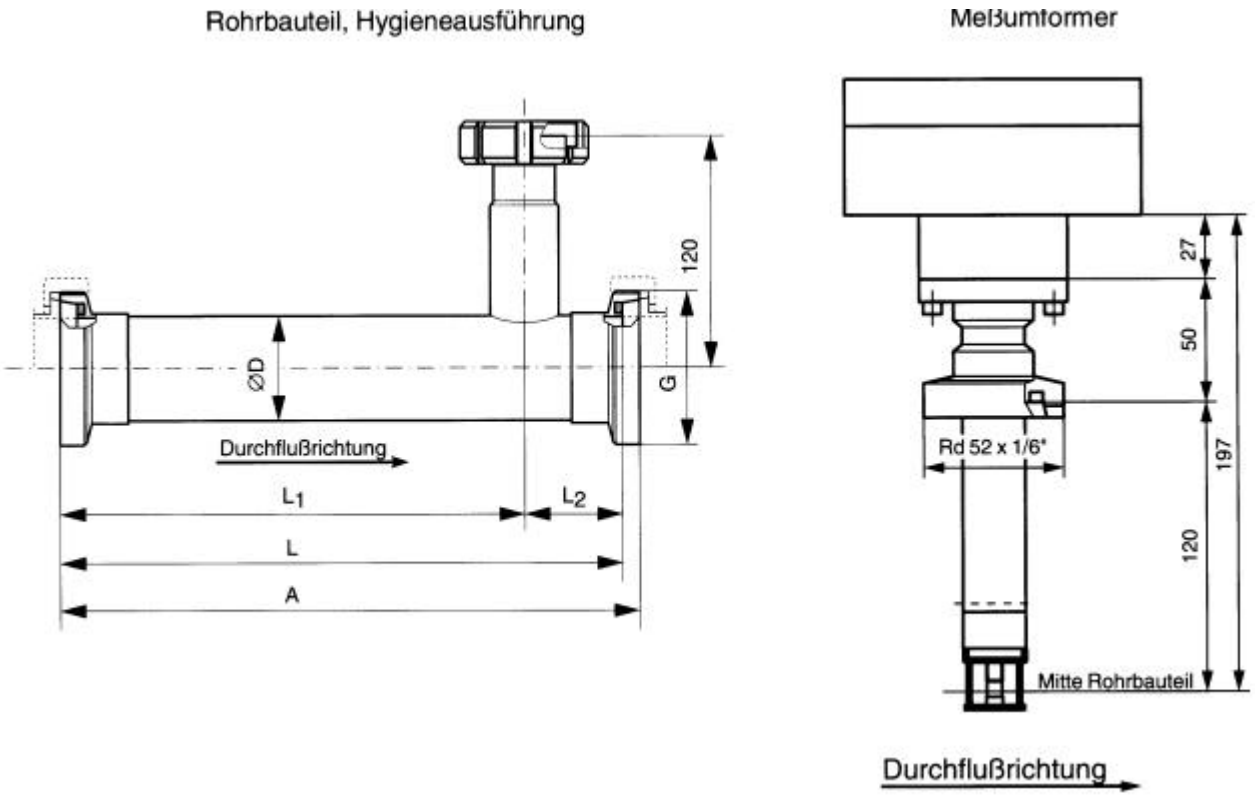
Nominal size		L_2	h	D_1	d_1	d_2	D_4	L_3	L_4	L_5
ANSI 1“				-	-	-	108	560	454	
ANSI 1,5 “	L1 = 198			85	40,9	73	127	864	741	-
ANSI 2“				103	52,6	92	154	1003	846	-
ANSI 3“	B1 = 125	269	263	135	78,0	127	-	-	-	-
ANSI 4“	B2 = 80			173	102,4	157	-	-	-	-
ANSI 6“	B3 = ∅115			221	154,2	216	-	-	-	
ANSI 8“	B4 = 58			278	202,7	270	-	-	-	
> ANSI 14“		431	425							450
> ANSI 28“		781	775							

ANSI 300 lb, Sch 40 S

Nominal size		L_2	h	D_1	d_1	d_2	D_4	L_3	L_4	L_5
ANSI 1“				-	-	-	123,9	560	454	
ANSI 1,5 “	L1 = 198			94	40,9	73	155,4	864	741	-
ANSI 2“				110	52,6	92	165,1	1003	846	-
ANSI 3“	B1 = 125	269	263	148	78,0	127	-	-	-	-
ANSI 4“	B2 = 80			180	102,4	157	-	-	-	-
ANSI 6“	B3 = ∅115			249	154,2	216	-	-	-	
ANSI 8“	B4 = 58			307	202,7	270	-	-	-	
> ANSI 14“		431	425							450
> ANSI 28“		781	775							

8.2 Dimensions Transducer and pipe component Sensyflow VT-C2

(all measures in mm)

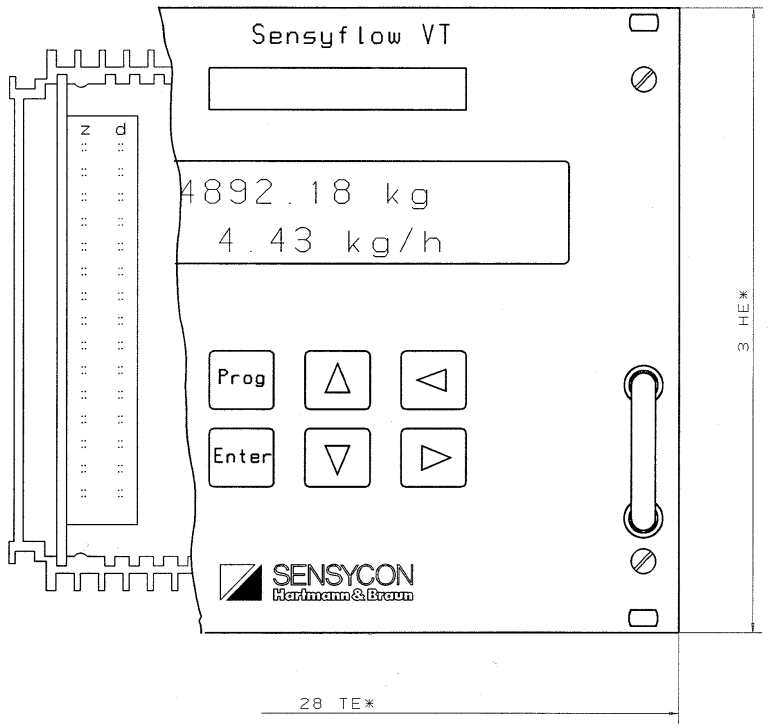


DN	A	L	L1	L2	ÆD	G
25	196	182	140	42	28 x 1	Rd52 x 1/6“
40	284	270	205	65	40 x 1	Rd62 x 1/6“
50	344	330	265	65	52 x 1	Rd78 x 1/6“
80	526	510	425	85	85 x 2	Rd110 x 1/4“

8.3 Dimensions Supply/evaluation unit Sensyflow VT 2

(all measures in mm)

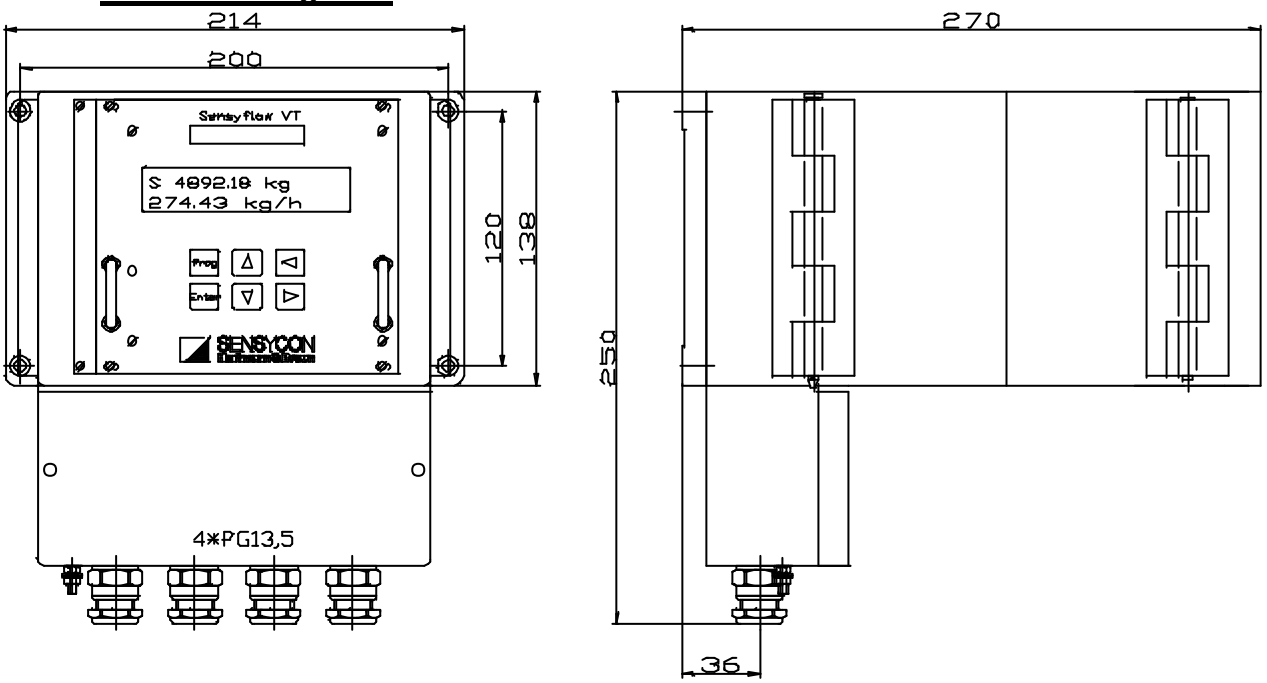
8.3.1 19“ rack



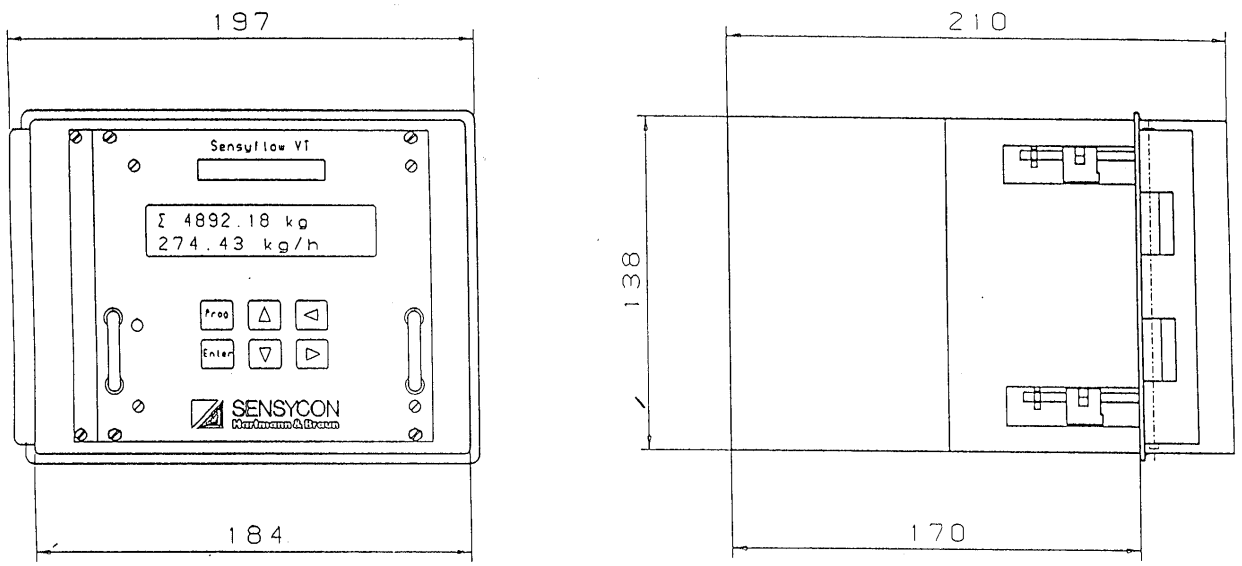
* TE= Teilungseinheit (=5,08 mm)

* HE = Höheneinheit (44,45 mm)

8.3.2 Wall mounting IP65



8.3.3 Panel mounting



9 Appendix

9.1 Checklist

The following points must be observed before commissioning the system:

1.) Do the „ measuring point“ data (medium to be measured, operating temperature, operating pressure, measuring range,….) correspond to the date on the calibration certificate?
2.) Are the permitted ambient temperatures being adhered to?
3.) Is the pipe section or weld-on adapter correctly fitted (observe the direction of flow)?
4.) Have the recommended inflow and outflow paths been adhered to?
5.) Has the connection between the transmitter and pipe section been properly established?
6.) Are the gaskets correctly fitted and in a good condition?
7.) It the electrical connection between the transmitter and the supply/evaluation unit satisfactory (e.g. sizing, shielding)?
8.) Have the connections between the output signals (current, voltage and frequency outputs) and the apparatus downstream been properly made (polarity, load)?
9.) If the system is being used in hazardous areas, have the relevant regulations been adhered to (acceptance by specialist personnel)?

9.2 Extract of the declaration of conformity

ABB Automation Products GmbH - 63755 Alzenau

declares that the product

Device: Sensyflow – mass flow measurement for gas

Type: VT 2-Ex, VT 2, VT-C 2

Productnumber: 14221-0-xxxxxxx, 14226-0-xxxxxxx

Complies with the requirements of the european emc-directive 89/336/EEC and the changes

Generic standard /product standard

Emission: EN 55011 Klasse A
EN 55022 Klasse A

Immunity: EN 50 082-2:1995

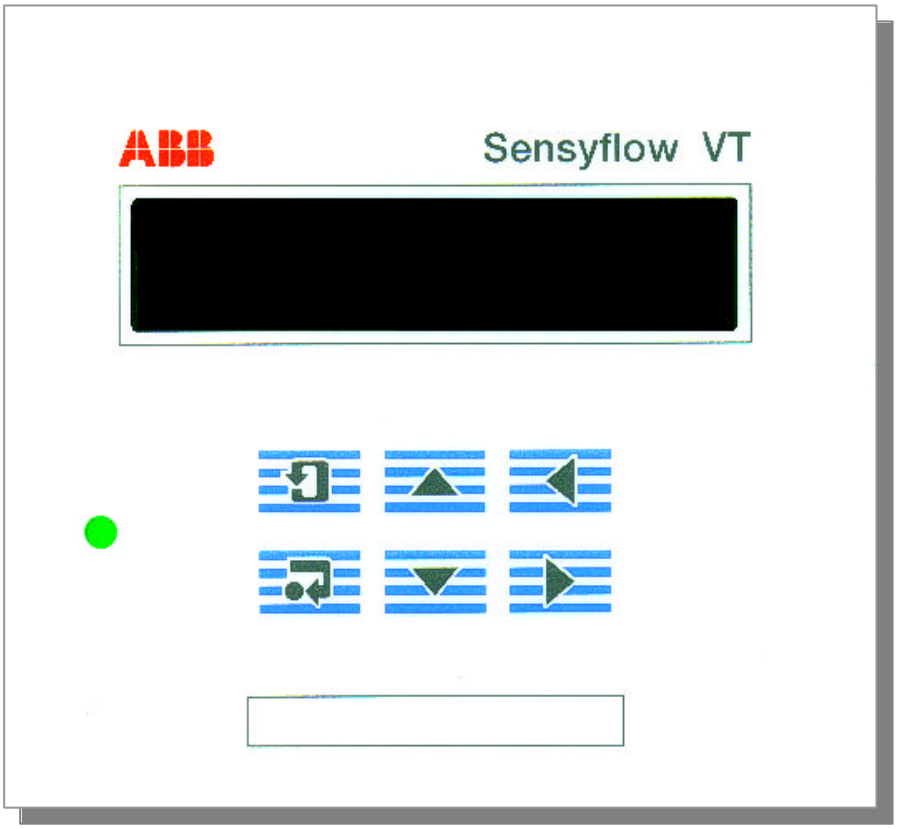
Basic standards: IEC 801-2 1991, IEC 801-3 1984, IEC 801-4 1988

Remark:
Measurments were partly made at ABB´s central EMC-Test center (formally Hartmann&Braun). Measuring results can be requested on demand.

Sensyflow VT 2, VT2-Ex, VT-C2

Ergänzung zur Bedienungsanleitung
Supplement to Operation Manual

Beschreibung der Frontplatte ab April 2000
Description of front plate since April 2000



	**Programm Taste** wechselt vom Anzeigemodus in die Betriebsart Parametrierung	**Programm Key** changes from Display to Parameter setup mode
	**Enter Taste** Abschluss einer Eingabe	**Enter Key** to finish a parameter input
 	**Bewegung durch das Menü** Mit den Pfeiltasten **auf** und **ab** können die verschiedenen Menüpunkte angewählt werden **Pfeil rechts** Bewegung innerhalb einer Eingabe	**Move through the menu** The different menu items can be selected by pushing the arrow keys **up** and **down**. **Right Arrow** Movement within an Input field
	**Pfeil links** Ziffer-Eingabe	**Left Arrow** Number-Input