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Ultrasonic Flowmeters

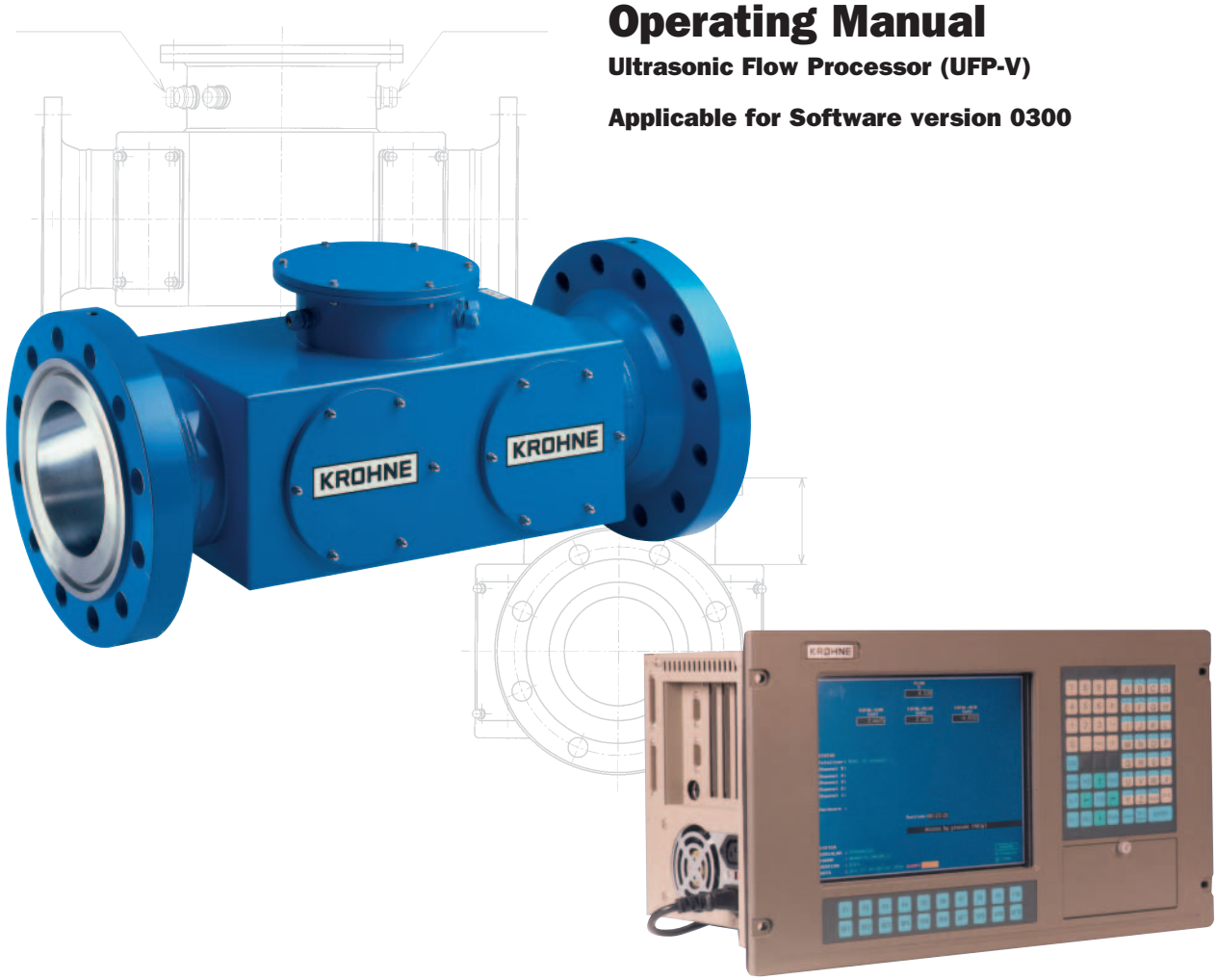
ALTOSONIC V

Reference Guide

Operating Manual

Ultrasonic Flow Processor (UFP-V)

Applicable for Software version 0300



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INTRODUCTION

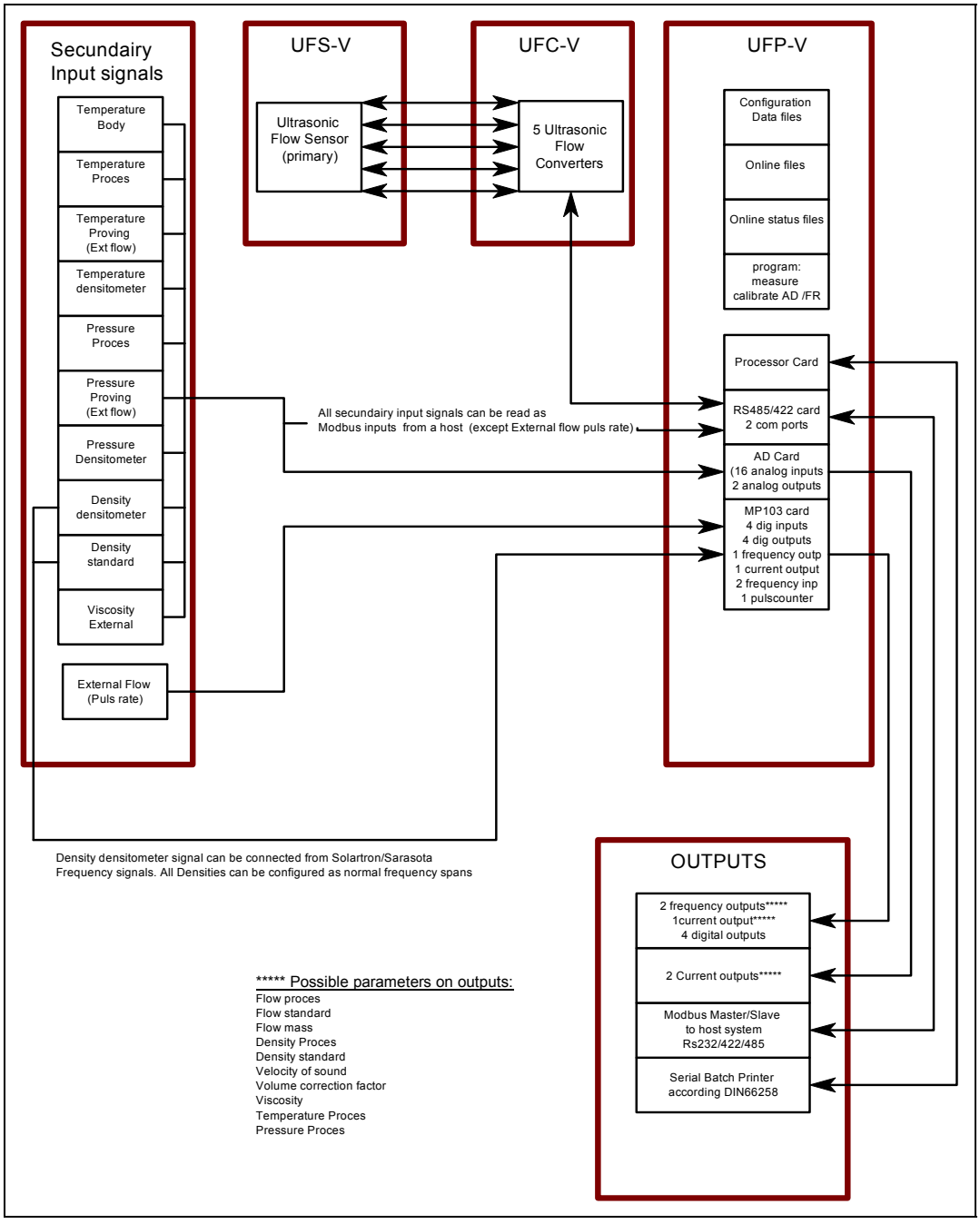
This manual describes the operation of the ALTOSONIC-V ultrasonic flow-meter system and the handling of the data-files.

Also, in this manual you will find a description of the computer that is used, its data-acquisition and control cards, the software, possible errors and recommendations.
Note that in this manual standard and optional specifications of the ALTOSONIC V are described.

1 SYSTEM CONFIGURATION

1.1 Hardware configuration

The flowchart below includes all hardware specifications of the ALTOSONIC V regarding the flow measurement.



From this point on, in this manual the following abbreviations will be used:

UFS-V	: Ultrasonic Flow Sensor (primary flowmeter body)
UFC-V	: Ultrasonic Flow Converter (5 converters)
UFP-V	: Ultrasonic Flow Processor
UFP-Program	: Software program running on the UFP for measuring the flow.

1.2 UFP-Program

The operating system is DOS 6.22 for its proven reliability using real time data Processing.
The UFP-Program is controlled by initialisation data files and on-line configurable data files.

1.2.1 Initialisation data files

These files can be accessed by a DOS-editor when the UFP-Program is not running.
The Initialisation data files are divided into 3 groups:

UFS files : Calibration data regarding the Ultrasonic Flow Sensor (primary)
UFP files : Calibration and configuration data on the hardware set up within the UFP (cards etc)
DAT files : Client configuration data regarding the set up of communication and signal IO.

1.2.2 On-line configurable data files

These files are binary and only accessible when the UFP-program is on-line.

API.bin : API settings on standard volume correction
DENSITOx.bin : 4 files for calibration data on densitometer cells Solartron 1 & 2, Sarasota 1 & 2
EXTERN.bin : External flow meter settings (if connected).
OVERRIDE.bin : Override value settings

1.2.3 Functionality

The functionality can be divided into primary and secondary functions

Primary functions:

- Monitor data- and system integrity
- Data acquisition: data of five converters and optional data such as temperatures, pressures, densities, control bits, etc.
- Check the measured data from the five converters and handle errors, if necessary.
- Calculate the Process volumetric flow in the primary head from the measured data.
- Calculate the standard volumetric flow (e.g. 15 °C, 1.01325 bar), if installed. Standard temperature can be set in the range 0-30°C.
- Totalise Process and standard flow as measured volumes
- Flow weighted averages on batching (temperature, pressure, density etc).
- Resetable and non resetable totalisers
- Prove external flow meter if installed.
- Output of calculated data and errors through: frequency output, analog outputs, digital outputs and Modbus communication.
- Possibility to override the input values (Temperatures, Pressures, Densities etc on line). Override is signalled as an alarm.
- Printing of tickets for batch functions such as Off Loading and Continuous Pipeline Measurement

Secondary functions:

- Statistics
- Back-up history such as totalisers, averages and alarms.
- Various screen functions for real-time monitoring.

1.3 Features

Data measured

RS485 UFC-V ↔ UFP-V (data communication connection between UFC-V and UFP-V):
- Flow velocity -five times (as a percentage)
- Transit time -five times
- Status UFC-V -out of range, path failure, communication failure

Analog in
- Temperature : body, Process, densitometer*, external flow meter*
- Pressure : Process*, densitometer*, external flow meter*
- Density : Process*, standard*, densitometer*
- Viscosity : external*
- External flow meter : Pulse counter*

Digital in data
- Start /Stop signals calibration (KROHNE used), or switch Densitometer calibration
- Reset volumes and errors
- Reset errors

Data Processed for output to user

Flow	: Process flow, standard flow*, mass flow*
Sound velocity	: five channel values, mean value
Resetable Totals	: Process volume, standard volume*, mass*. All forward, reverse, total.
Non resetable Totals	: Process volume, standard volume*, mass*. All forward, reverse, total.
API Density	: Process, standard*, densitometer*
Analog in Temperature	: body, Process*, densitometer*, external flow meter*
Analog in Pressure	: Process*, densitometer*, external flow meter*
Analog in Density	: densitometer*, standard*
Analog in Viscosity	: external*
Flow weight averages	: Temperature (body, Process*, Proving external*, standard*, densitometer*)
	Pressure (Process*, Proving external*, densitometer*)
	Density (Process*, standard*, Proving external*, densitometer*)
	Corrections (Ctl & Cpl values*)
	Viscosity (external dynamic*)
	[2 sets averages (= made in two time intervals*)]
Batch ticket print	: All output values can be printed by freely definable layout configuration

Data integrity

Alarms on flow data
Alarms on system
Alarms on Low/High Analog inputs*

Data corrections under normal conditions

Reynolds correction
Temperature expansion correction
Standard volume correction according to API 2540* standard

Data corrections under alarm conditions

Real time profile correction on channel failure
On-line override values on analog inputs*
Filtering of measured data*

Service values on Modbus (measured by UFP but not used for calculation directly)

All temperatures, pressures, densities and Viscosity

* = Optional

Secondary input	Function
Temperature body	For correction of the expansion of the UFS, resulting in a correction factor K_b on the measured flow
Temperature Process*	For standard volume correction Resulting in a correction factor $C_{tl\ 15\ to\ Process}$ on the measured flow
Temperature Process**	For correction on standard calibration volume (Factory use only). Function is only applicable when the calibration is not only monitored by the calibration facility but also, with a digital start/stop signal, by the UFP. The standard calibration volume is the volume measured at a standard temperature
Temperature densitometer*	For standard volume correction Resulting in a correction factor $C_{tl\ 15\ to\ densito}$ on the measured flow
Temperature external Flow meter*	For standard volume correction Resulting in a correction factor $C_{tl\ 15\ to\ proving}$ on the external flow
Pressure Process*	For standard volume correction Resulting in a correction factor $C_{pl\ Process}$ on the measured flow
Pressure densitometer*	For standard volume correction Resulting in a correction factor $C_{pl\ densito}$ on the measured flow
Pressure external Flow meter*	For standard volume correction Resulting in a correction factor $C_{pl\ proving}$ on the external flow
Densitometer density*	The density measured by the densito meter
Density standard*	The density standard with at predefined standard temperature
External viscosity*	External kinematic viscosity, for display and calibration use

* = Optional

**= KROHNE Altometer calibration use only

2 UFP-V START UP

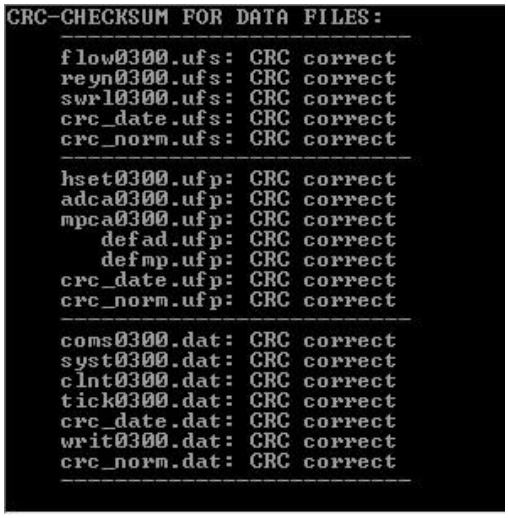
When the UFP is powered the UFP-Program starts automatically.
To prevent unattended changes to the initialisation files the data is protected at start-up by:

- **Calculation CRC checksum**
- **Check data from files on input range limits**
- **Password**

2.1 Calculation CRC checksum

Each file has a CRC checksum. When anything changes in the file, the CRC-checksum will also change.
At the start-up of the UFP-V the CRC checksums are calculated and checked:

Start-up:



CRC checksum:

All data files have a CRC checksum

CRC checksums are saved in file:
CRC_NORM.ufs
CRC_NORM.ufp
CRC_NORM.dat

Back-up of all data files in:
CRC_FILE.ufs
CRC_FILE.ufp
CRC_FILE.dat

CRC checksums and length of each file is saved in:
CRC_BACK.ufs
CRC_BACK.ufp
CRC_BACK.dat
(CRC checksums of these files are within the file)

If the checksum of a file is not identical to the one saved at the previous start-up in the CRC_NORM file, the program switches to fail mode.

Fail mode:

Possible cause:
Change of data in file

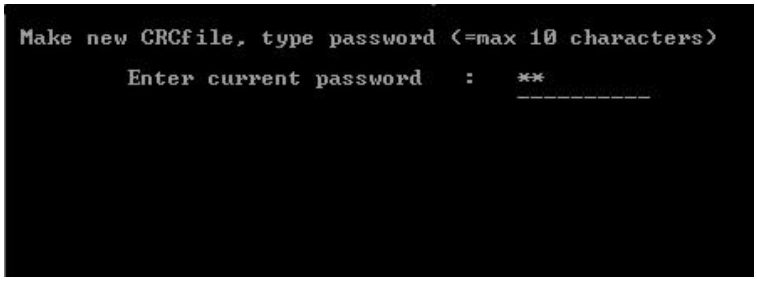
Only breakable by pin code:
1357

CRC checksum error
If the fail mode is caused by a CRC-checksum error, there are three options:
1. Calculate a new CRC-checksum. The calculation is protected by password.
2. Load the backup file
3. Escape

Causes:
1 Change made in data file
2 sudden checksum error (not likely to happen)

Possible actions:
1 new crc-checksum.
2 Load backup file:
If crc checksum of backup files also fail, backup file not loaded. Check parameter file
3. Escape

Make new CRC checksum



Making the new crc file:
1 Type the password
On delivery the password is 7531
2 Enter

When more than 30 characters are typed during input of the password the UFP-Program terminates and the UFP-Program must be restarted to make the new crc-file

To make a new CRC-checksum and to start the measure mode follow these steps:

1.	MEAS [enter]	(Batch file to start the measure mode)
2.	1357	(Pin code to stop the fail mode)
3.	1	(Choice to make a new CRC-checksum)
4.	“Your password”	(Pin code to make the new CRC checksum)
5.	MEAS [enter]	(Batch file to start the measure mode)

Note that the password can only be changed when the UFP-Program is running.
To change it:
- Go to the Main Window
- Type code : PSSWRD
- Follow the directions in the window
- After the password is changed, the program automatically shuts down and a new CRC-checksum must be created. Start the UFP-Program and make the new CRC-checksum by using your new password.

2.2 Reading initialisation files on input range

Each parameter is checked for its input range.

1. If a parameter is out of range, the software switches to fail-mode.
   (Only breakable by pincode 1357)

2. In fail mode a system set-up Error Code is given.
   The parameter and its input range are printed on screen. If the Modbus communication is active the set-up Error Code is also available on this output.

3. If there are no problems at start-up, the software checks whether the CRC-checked data files correspond with the backup files CRC_FILE.UFS, CRC_FILE.UFP and CRC_FILE.DAT.
   These backup file also have CRC-checksums. Only when a group (UFS, UFP or DAT) data files do not correspond or the backup checksum gives an error, a new backup file and checksums are made of that group.

2.3 Start up: system set-up errors

The system SET-UP ERRORS are caused by an improper initialisation such as data–change etc.

If the UFP-V identifies a system set-up error, it switches to fail-mode.
The fail-mode shows the found error and the elapsed Process error time. The mode can only be stopped by pin code 1357.

Identified set-up errors are:

Error No.	Function	Problem	How to solve
1	CRC	Error opening: file(filename) to check on CRC	Try to load backup (CRC-function)
2	CRC	Error closing: file(filename) to check on CRC	Try to load backup (CRC-function)
3	CRC	Error opening: CRC-code file(filename)	Try to load backup (CRC-function)
4	CRC	Error closing: CRC-code file(filename)	Try to load backup (CRC-function)
5	CRC	Error length: CRC-code file(filename)	Make new CRC checksum
6	Common, opening file	Error in path: file(filename) not found	Try to load back-up (CRC-function)
7	Not in use	Not in use in this version	
8	Common, read in table	File(filename), maximum rows exceeded	Put in less data points
9	Common, closing file	Error read in file(filename)	Try to load backup (CRC-function)
10	Common, closing file	Error write in file(filename)	Try to load backup (CRC-function)
11	Read in profiles	Error in file(filename): a parameter <|0.01|	Try to load backup (CRC-function)
12	Not in use	Not in use in this version	
13	Check on serial numbers	Serial numbers in parameter files do not correspond	Check the serial number in files
14	Initialising Graph driver	Graphics error	Is egavga.bgi file in directory ASV0300?
15	File location	Error in finding disk	Check the file locations in HSET0300.ufp
16	Frequency set-up	Error in set-up frequency output	Follow instructions on screen
17	Common, read in parameter	Error in a parameter file, bad up-dating, make sure that '#' is first	Check your last updated file or load backup (CRC function)
18	Common, read in parameter	Error in a parameter file, number too large (more then x characters)	Check your last updated file or load backup (CRC function)
19	Factory use only		
20	Factory use only		
21	Not in use		
22	Check location executable	Error in LOCATION_EXE, Process location is disk x	Change LOCATION_EXE in HSET0300.ufp
23	Not in use		
24	Check parameters on range	Out of range in file(filename), parameter(name)=x, Must be in range x1…x2	Follow the instructions on screen
25	CRC-checksum outcome	CRC checksum not correct!	Make a new checksum or if not certain about the data, load the backup (CRC-function)
26	Not in use		
27	CRC-checksum	CRC backup-files checksum not correct	Fill in the correct data in actual files Backup
28	Batch status files	When the batch mode is enabled and the batch status files are not found at start-up.	After breaking the fail mode follow the instruction on screen to insert your last ticket number
29	Initialisation Printer	When the batch mode is enabled, the printer software is initialised. On error of initialisation	Check the COMS0300.dat file for errors in Printer set-up
30	Password	If for any reason the password is lost	Try to load backup (CRC-function)

The errors, which may occur during the initialisation of the Modbus Driver and the initialisation of the driver for the communication with the ultrasonic converters, are listed below.
See for the communication system set-up errors also the **ALTOSONIC V ModBus Manual.**

Returned error numbers:

Error No.	Problem	How to solve
1001	Modbus driver: Requested interrupt not supported	Make sure MODBUS_UART_INTERRUPT is within the limits (3 or 4)
1002	Modbus driver: Requested baud rate is not supported	Make sure MODBUS_UART_BAUDRATE is within the limits (1200,2400,4800,9600,19200)
1003	Modbus driver: Parity setting error	Make sure MODBUS_UART_PARITY is within the limits (0,1,2)
1004	Modbus driver: Stop bit error	Make sure MODBUS_UART_N_STOPBITS is within the limits (1,2)
1005	Modbus driver: RTS_MODE not supported	Make sure MODBUS_UART_RTS_MODE is within the limits (0 or 1)
1006	Modbus driver: Number of bits not supported	Make sure MODBUS_UART_N_DATABITS is within the limits (7 or 8)
1007	UFC driver: UART_init parameters error	Make sure Setting for the UFC communication are correct
1008	Modbus driver: too many poll blocks installed	Make sure NUMBER_OF_POLLBLOCKS_TO_USE is not larger than 20
1009	Modbus driver: function 6 only supports integer types in modicon compatible mode	When using the Modbus master mode in modicon compatible mode, function 6 only support integer types. When Other types (float, double…) are necessary use function 16.
1010	Modbus driver: Slave ID not in range of 0…247	The Slave ID in a poll block request must be between 1 and 247 or in case of a broadcast 0.
1011	Modbus driver: Broadcast not allowed for this function (pollblock x)	Use a valid Slave ID to access only 1 slave.
1012	Modbus driver: Function 5 and 6 can only handle 1 point (poll block x)	When using function 5 or 6, make use the number of points is 1, these functions can handle only one point.
1013	Modbus driver: Minimum number of points to request is 1 (poll block x).	Make sure that at least 1 point is used for this action.
1014	Modbus driver: data type not allowed (poll block x)	The data type of the poll block is not the same as the data type in the Modbus mapping
1015	Modbus driver: unsupported data address, or request number of points out of range	The requested points must be in the available Modbus mapping.
1016	Modbus driver: Data type / function mismatch	Make sure the Modbus function and the allowed data type do match
1017	Modbus driver: Too many points requested	Make sure the Modbus message length is not exceeded, request fewer points.
1018	General: unable to open the communication set-up file	Make sure the coms0300.dat file exists in this directory
1019	General: unable to close the communication set-up file	Make sure the Drive is still powered.
1020	General: error reading communication set-up file in parameter x	A parameter was expected but could not be read, make sure all the variables start with a **#**
1021	General: error reading communication set-up file in parameter x, parameter out of range	A parameter was read, but not within the expected limits.
1022	General: PC timer initialisation failed.	Try to restart the flow computer (cold start) else contact KROHNE Altometer

2.4 System set-up warning

The system set-up warnings (SSW) are caused by:

- Insufficient statistical data during set-up (file REAL.BIN was not found)
  Default data is used until sufficient statistical information is recorded (under normal conditions within 3 minutes under normal flowing conditions). In this case the warning is self-resolving.
- Improper initialisation of the Modbus driver
  Modbus will not be accessible. In this case the warning remains active.

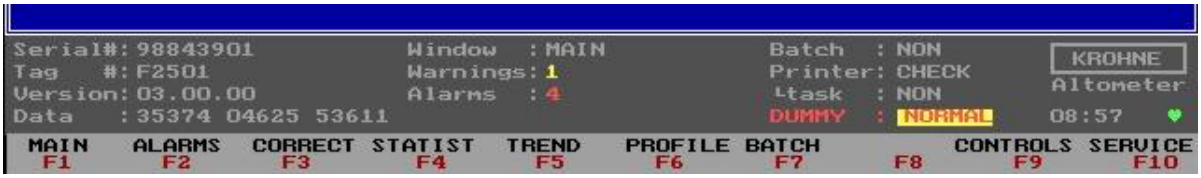
3 RUNTIME USER WINDOWS

In measure mode the screen is always divided into two parts.

- The Status Window at the bottom of the screen
- The Runtime User Window which is above the Status Window

Function keys control the Runtime User Windows. At the bottom of the Status Window the possible functions are showed for the particular Runtime User Window.

The status window:



It shows:

- Serial # : Serial number assigned by KROHNE Altometer
- Tag # : Tag number that can be defined by the user
- Version : Software version number
- Data : CRC-checksum of the 3 data sets (UFS, UFP, and DAT).
  This can be a first check for the data integrity (every change in a data set changes the checksum of that data set).
  Details can be found under F10 Service, F9 CRC-Data
- Window : The name of the Runtime window showing above
- Warnings : Number of actual warnings, details can be found in the Alarms window (F2)
- Alarms : Number of actual alarms, details can be found in the Alarms window (F2)

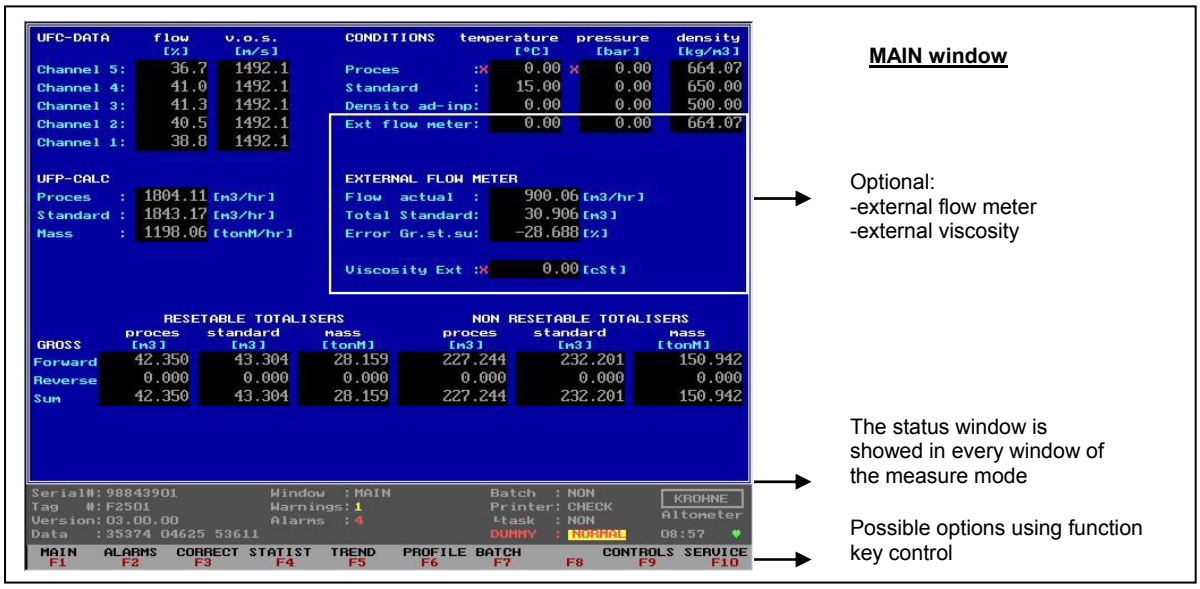
The following items are only shown if the batch mode is enabled in the initialisation file CLNT0300.dat

- Batch : Batch status
- Printer : Printer status
- Task : Print task

For more details on Batch mode see chapter 5.

3.1 Main menu: F1 Main window

The Main window is the default start-up window. This window shows an overview of the system and can always be accessed by function key F1.



Explanation of the Main window layout:

UFC-DATA shows:

- Raw data of the 5 channels regarding flow % and Velocity Of Sound (V.O.S.)
- A red marker (▪) per channel shows an active channel failure, a green marker (▪) shows a previously occurred channel failure

CONDITIONS show:

- Temperatures, pressures and densities measured or calculated for the conditions of Process, Standard, Densitometer and the optional external flow meter.
- A red marker (**X**) in front of a parameter shows an alarm for out of range or manual on-line override, a green marker (**X**) shows a previously occurred alarm

UFP-CALC shows:

- Flow rates at Process conditions, Standard conditions and Mass

EXTERNAL FLOW METER shows (if enabled)

- Flow rate at measurement conditions(external conditions)
- Standard Volume Totaliser (summation of forward and reverse)
- Difference between External and ALTOSONIC-V volume.

RESETABLE TOTALISERS shows:

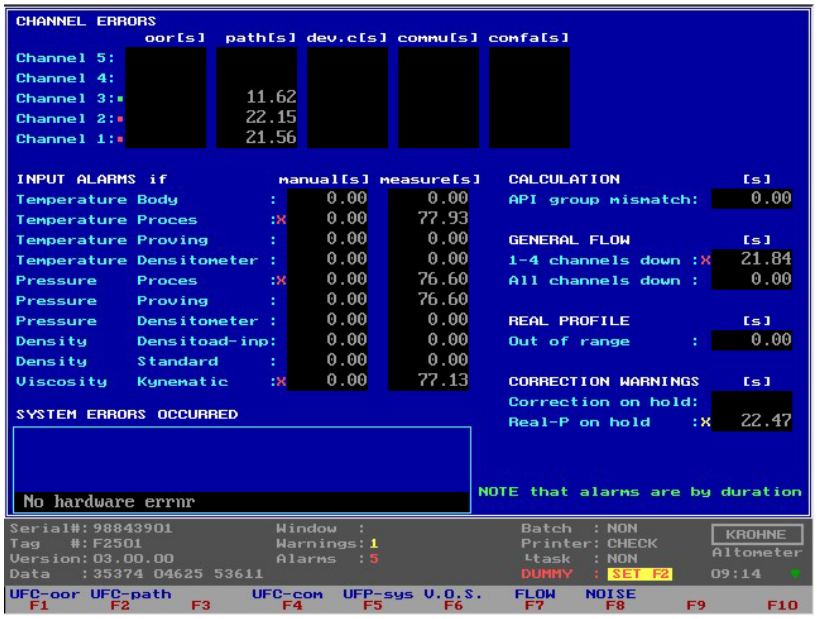
- The forward, reverse and summation of the Totaliser values at Process conditions, Standard conditions and Mass.
- The resetable totalisers can be reset in the Control menu: F8 RES-TOT. It is also possible to reset the totalisers by digital input signal or Modbus boolean.

NON RESETABLE TOTALISERS shows:

- The forward, reverse and summation of the Totaliser values at Process conditions, Standard conditions and Mass.

3.2 Main menu: F2 Alarms window

The Alarm window shows all alarms and warnings as occurred [seconds].



Explanation of the Alarms window layout:

CHANNEL ERROR shows:

There are 5 types of errors

1. **OOR,** Out Of Range, flow data from the UFC is out of the limits – 125...+125% flow rate.
   Possible causes are:
   - Flow out of range
   - Empty pipe
   - Problem with sensor
   - Problem with converter

   Common check is:
   - Value of the Process flowrate

2. **PATH**, Path failure. The transmitted signal from one sensor is not correctly received by the other sensor.
   Possible causes are:
   - Empty pipe
   - Particles or solids in the fluid
   - Cavitation due to low Process pressure resulting in gas bubbles
   - Problem with converter

   Common checks are:
   - Process pressure
   - Value of the Process flow rate

3. **DEV.C,** Deviation in sound velocity
   The UFP calculates the mean sound velocity out of the three most nearby channel values (5 times) and then checks all channels on their deviation to this mean value
   Deviation limit is set default to –0.5…+0.5 % of mean V.O.S.
   Possible causes are:
   - Local density variations due to sludge, mixtures or temperature variations
   - Empty pipe
   - Problem with converter
   - Problem with sensor

   Common checks are:
   - Flow and sound velocity per channel

4. **COMMU**, Communication failure between UFP and UFC (rs485).
   The communication is checked on communication errors. The incoming RS485 data is checked on validity. Single errors are skipped (COMFA's) but if there are more than 120 consecutive requests failing this alarm is raised.
   Possible causes are:
   - if all channels fail there is probably no power supply to the UFC
   - if all channels fail it is probably caused by a malfunction of the connection between UFP and UFC
   - if some channels fail the problem is in the specific converter of the UFC
   - The specific converter is in it's configuration menu
   - The specific converter is not configured properly

   Common checks are:
   - Power supply UFC
   - Converter displays
   - If a new converter is installed, check the configuration
   - Cable
   - Connections
   - Check the converter by exchanging the connections of a good converter for a probably bad converter. Note that the channel number is configured in the converter

5. **COMMFA,** single communication failures until COMMU is reached

Channel error types 1 to 4 are used to make the General Flow alarms. On General Flow alarm the REAL profile is used to correct the failing channels.
If COMFA's occur then the previous measurement on that channel is used for calculation.

Possible causes are:
- Multiple rapid window changes on slower CPU's
- EMC distortion through poorly connected wiring.

INPUT ALARMS shows:
Each parameter as stated below INPUT ALARMS has alarm settings in the CLNT0300.dat file.
If the alarm is enabled and the parameter is used in the calculation then on alarm the time of occurrence is counted.
When the parameter is in manual override, the time of occurred manual override is counted.

CALCULATION shows:
When using the calculation for the standard volume by API standards the alarm is on if the density is out of range for the API group that is used (see chapter 4).

GENERAL FLOW shows:
The combined channel errors give an alarm on "1-4 channels" down and "all channels down" in time of occurrence.
If the UPF has a power failure then the time between start up and program running is calculated and added at start up of the UFP-Program.

REAL PROFILE:
On GENERAL FLOW error "1-4 channels down" the REAL profile is used to correct the channels with errors. The real profile is sampled at a certain flow rate.
- The REAL-profile correction has a limited validity.
  When the actual profile changes too much, the previously sampled REAL-profile might not be reliable anymore. The check for profile changes is done through flow-rate difference.

- When the sampled REAL-profile flow rate differs too much from the actual flow-rate during REAL-profile correction this is shown as a warning.

CORRECTION WARNINGS shows:

- If there is too much flow variation for corrections, the corrections go on hold. When the corrections are on hold the real time profile is used as a standard for correcting the flow.
- If there are too much flow variations or channels failing, the sampling of the REAL profile goes on hold. On release the sampling is started at maximum time for sampling a profile.

SYSTEM ERRORS shows:

The status of the system is divided into:

- System Runtime Warnings. These are caused by system failures. These failures will not influence the flow measurement.
- System Runtime Alarms. These are caused by system failures. These failures might influence the flow measurement.
  Identified System Runtime Errors are numbered 1 to 60 are:

Identified System Runtime Errors are numbered 1 to 60, A = alarm, W = warning:

Error no.	In function	Problem	Consequence
A : 1	Get RS485 data from converters	Overrun, missed data	Missed data, message
A : 2	Self test	Error in memory self-test	Non-reliable memory
A : 3	Batch start / stop	Error during saving files of start or stop	File lost but ticket is made
A : 4	Profile correction (REAL)	Error in state_correction	Attempt divide to by zero
W: 5	Read Backup all files	Error in reading backup file	Possible loss of backup file
W: 6	Switching disk	Error in finding a drive	Message
W: 7	System time	A notice that the system time was adjusted manually or by Modbus.	No consequence for totalisers or Process time, only on ticket time
W: 8	End of a calibration	Error write in calibration report	File lost, message
A: 9	Batch status backup	Status file corrupt	Possible loss of batch status
W: 10	Override values files	Error in opening/closing override value file	Override values not stored but still in use
A: 11	Batch totaliser backup	Totaliser backup-file corrupt	File lost , message
A: 12	Batch average backup	Average backup-file corrupt	File lost, message
A: 13	Batch ticket create	Error in creating batch ticket file	Ticket itself is made for printing but lost during saving
W: 14	Opening file (for update)	Error in opening REAL file	File lost, message
W: 15	Closing file (for update)	Error in closing REAL file	File lost, message
W: 16	API settings	Error in file, defaults are loaded and saved	Old settings lost
W: 17	Batch 2	A alarm on batch 2 file (Batch 2 is only used through Modbus with a Scada system)	File lost, message
W: 18	Check free disk-space	Error dos_getdiskfree() call	Time-out function 30 s
W: 19	Check free disk-space	Low on disk-space	Time-out function 30 s
W: 20	Ad card overrun	The requested AD card is not noticed	Solve the problem
W: 21	Opening file (for update)	Error opening API table file	File lost, message
W: 22	Value check	1 or more API values defaulted	Check the installed parameters
W: 23	Opening file (for update)	Error opening external flow meter file	File lost, message
W: 24	Value check	Default external flow meter K-factor	Check the installed K-factor
W: 25	Counter input	Unable to read Counter value	Read on next entry
A : 26	Calibration MP103 card	MPCA File corrupt	Install backup
A : 27	Calibration AD card	File corrupt	Install backup
A : 28	Calibration data Densito Cells	File corrupt	Automatic install of default values Set the correct values on-line
A : 29	Batch ticket currently saved	A Requested batch ticket not available for printing	A ticket by that name was not saved or had a previous save error
A : 30	Batch ticket	CRC error in a Batch ticket	A ticket was not saved correctly or was changed manually
W: 31	Read batch ticket previously saved	A Requested batch ticket not available for printing	A ticket by that name was not saved or had a previous save error
W : 32	Batch ticket close file	Error in closing a ticket file	Ticket file not closed , probably because it could not be opened

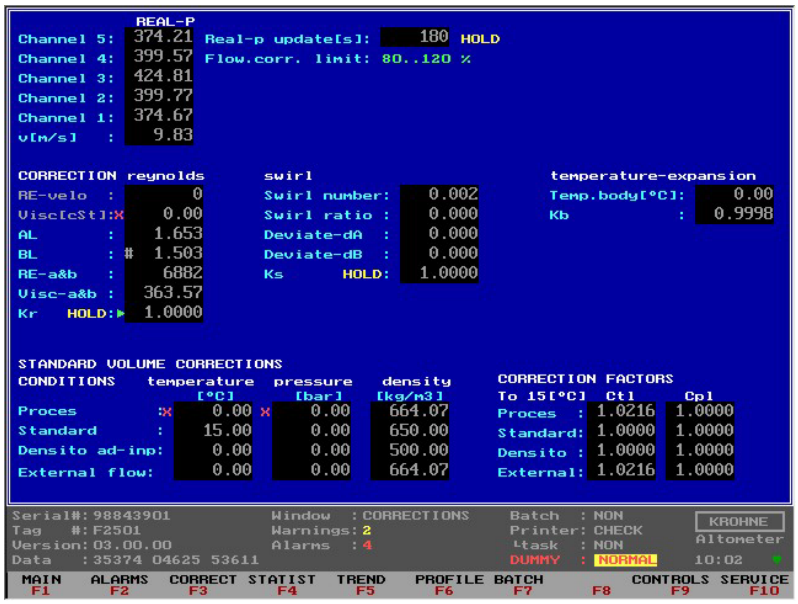
See for the communication runtime errors also the **ALTOSONIC V Modbus Manual.**

Err no.	In function	Problem	Consequence
W: 33	Modbus master	Poll block not send due to transmit error	
W: 34	Modbus master	Poll block response time-out occurred	
W: 35	Modbus master	Invalid Slave ID in response	
W: 36	Modbus master	Invalid function in response	
W: 37	Modbus master	Response not correct	
W: 38	Modbus master	Error handling function 1,2	
W: 39	Modbus master	Error handling function 3,4	
W: 40	Modbus master	Error handling function 5	
W: 41	Modbus master	Error handling function 6	
W: 42	Modbus master	Error handling function 15	
W: 43	Modbus master	Error handling function 16	
W: 44	Modbus master	Exception received	
W: 45	Modbus master	Error unpacking Boolean data	
W: 46	Modbus master	Error unpacking integer data	
W: 47	Modbus master	Error unpacking long integer data	
W: 48	Modbus master	Error unpacking float data	
W: 49	Modbus master	Error unpacking double data	
W: 50	Modbus master/slave	Error incorrect message length	
W: 51	Modbus master/slave	Invalid CRC or LRC received	
W: 52	Modbus master/slave	Error receive buffer saturated	
W: 53	Modbus master/slave	UART error (parity, framing, overrun)	
W: 54	Modbus master/slave	Transmit buffer not empty for new transmission	
W: 55	Modbus slave	Unsupported function requested	
W: 56	Modbus slave	Unsupported register(s) requested	
W: 57	Modbus slave	Requested data Level and function mismatch	
W: 58	Modbus slave	Too many data point (registers) requested	
W: 59	Modbus slave	Error unpacking received data	
W: 60	Modbus slave	Broadcast not allowed	

Note that: Occurred and disappeared alarms and warnings can be reset in the Control menu: F7 RES-ERR. It is also possible to reset by digital input signal or Modbus Boolean.

3.3 Main menu: F3 Corrections window

The Corrections window monitors the corrections.



Explanation of the Corrections window layout:

REAL-P shows:

- The previously sampled profile.
- The remaining update time to make the new REAL profile.
- The sampling goes on hold if:
  - Channel errors occur
  - Less than 5% flow rate
  This will show in yellow colour as HOLD.
- The validity range in flow rate percentage of the sampled REAL profile. Out of this range an alarm condition is activated

CORRECTION REYNOLDS:

There are two ways of making the Reynolds correction.

1. The cinematic viscosity is measured and the Reynolds number is calculated from F(Viscosity, Diameter, Velocity). By a calibrated Reynolds table the correction factor Kr is found
2. Through the calibrated Reynolds table the correction Kr is found

In the picture method 1 is in grey meaning this method is not used to make the Reynolds correction factor Kr.
In the picture method 2 is in light-blue meaning this method is used to make the Reynolds correction factor Kr.
The green arrow at the Kr location shows that this Kr factor is used in the flow calculation. No arrow means: Not used.
When the correction is on hold due to flow variations this is shown in yellow as HOLD at the Kr location. During the hold period the corrections are done with the REAL-profile as a reference.

SWIRL shows:

As a last help on build-in-site a swirl correction can be made in case of swirl, but strongly recommended is to avoid swirls by using flow-straighteners that are calibrated together with the ALTOSONIC-V flow meter.
The swirl number (Swnr.) is an indication for the found swirl. A normal value is 0…0.250. A value higher than this indicates a swirl that can influence the flow measurement.

Because the swirl also influences the profile this also influences the Reynolds correction. The deviation for the ratio number A and B are given. These are used to make the Swirl calibration table. By default the swirl correction factor is not used. Only if there is physically no way to correct a swirl it is used to make a more reasonable flow value but this value is not guaranteed to be within specs of the ALTOSONIC-V because of possible uncalibrated swirl intensities and viscosities.

- The green arrow at the Ks location shows that the factor is used in the flow calculation. No arrow means: Not used.
- If the correction is on hold due to flow variations, this is shown in yellow as HOLD at the Ks location. During the hold period the corrections are done with the REAL-profile as a reference.

TEMPERATURE EXPANSION shows:
The temperature expansion correction is done with the measured Body(Primary) temperature. The correction factor is Kb. The green arrow at the Kb location shows that the factor is used in the flow calculation. No arrow means: Not used.

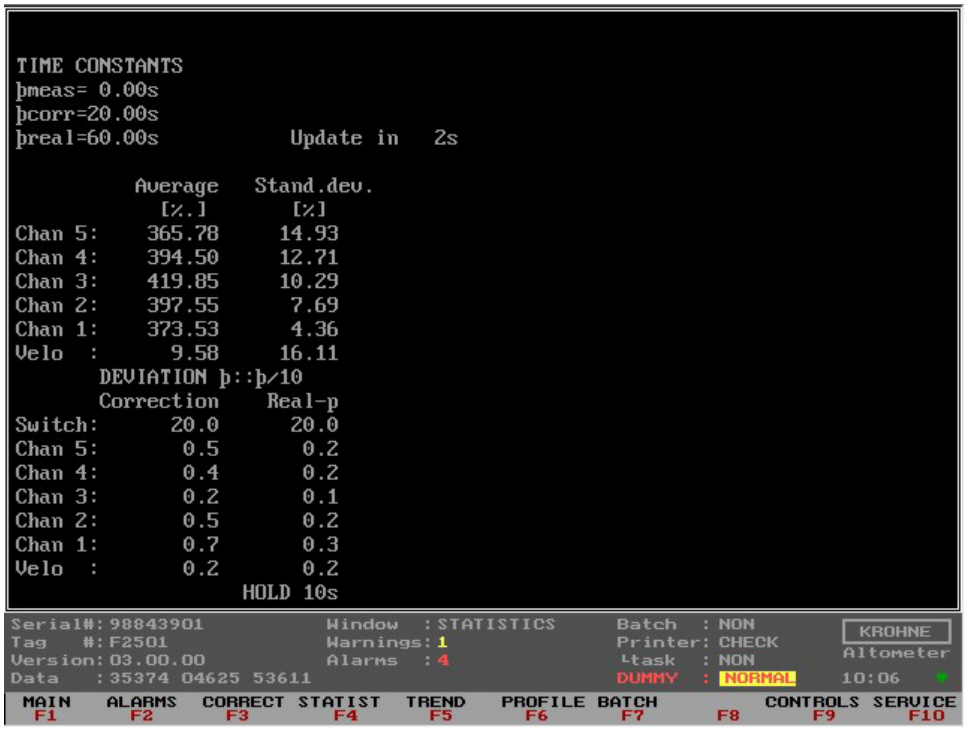
STANDARD VOLUME CORRECTIONS shows:

- The temperatures, pressures and densities at Process, standard, densitometer and optional external flow meter conditions in relation to the correction factors Ctl and Cpl
- The correction factors Ctl (temperature correction to 15°C) and Cpl (pressure correction to 1.01325 bar, or 0 barg)

See chapter 4 for more information on the Standard Volume correction

3.4 Main menu: F4 Statistics window

The Statistics window shows the statistics and monitors the flow variations for the corrections and REAL-profile sampling.



Explanation of the Statistics window layout:

TIME CONSTANTS:

- Tmeas gives the time-constant in seconds as used for the incoming 5 measuring paths flow percentages. Default the time-constant is 0 sec.
- Tcorr gives the time-constant in seconds as used for the Reynolds and Swirl corrections. Default the time-constant is 20 sec.
- Treal gives the time-constant that is used for sampling the REAL-profile. Default the time-constant is 60 sec. After 3 times Treal (180 seconds) the sampled REAL profile is used for possible correction.

STATISTICS:

- The average and relative standard deviation of the 5 channels and the calculated velocity is calculated over 200 measurements (about 7 seconds). So every 7 seconds there is an update on these values.
- The average for the channels is presented as flow-rate promillage (-1250…+1250), especially practical to measure the zero point deviation per channel at zero flow rate. Note that there will be temperature differences in the Process liquid causing local flows at zero flow.
- Normal is that channels 1 and 5 have a larger standard deviation then channels 2, 3 and 4. For ALTOSONIC-V ‘s without straightener the shown readings for the standard deviation are normal. With a flow straightener build-in these values can be reduced by approximately a factor 2.

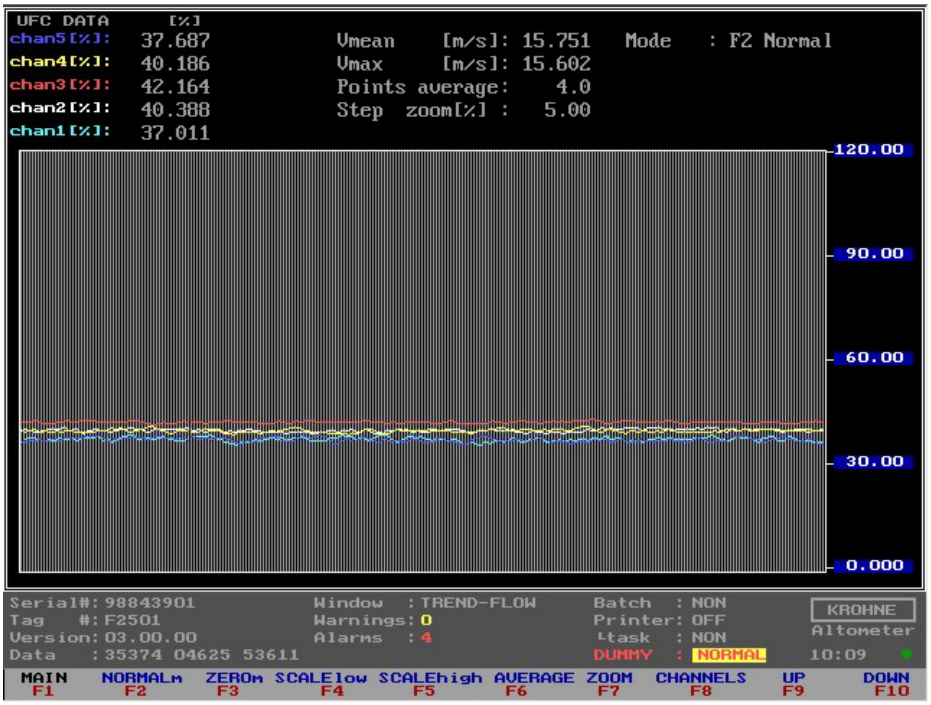
DEVIATION:

The flow variations for the corrections and REAL-profile are monitored as described below:

- All channels and calculated velocity are monitored with the normally used time-constant and with the normal time-constant divided by 10. If the difference between those two time-constants is more than the switch value (default 20%) for one of the channels or the velocity the corrections go on hold. When everything is normal again, they are released again and used in the normal way.

3.5 Main menu: F5 Trend-flow window

The Trend-flow window shows the Raw UFC flow percentage as a trend over 10 seconds.
This makes flow variations per channel visible in a graphic.



Each channel has is own colour.

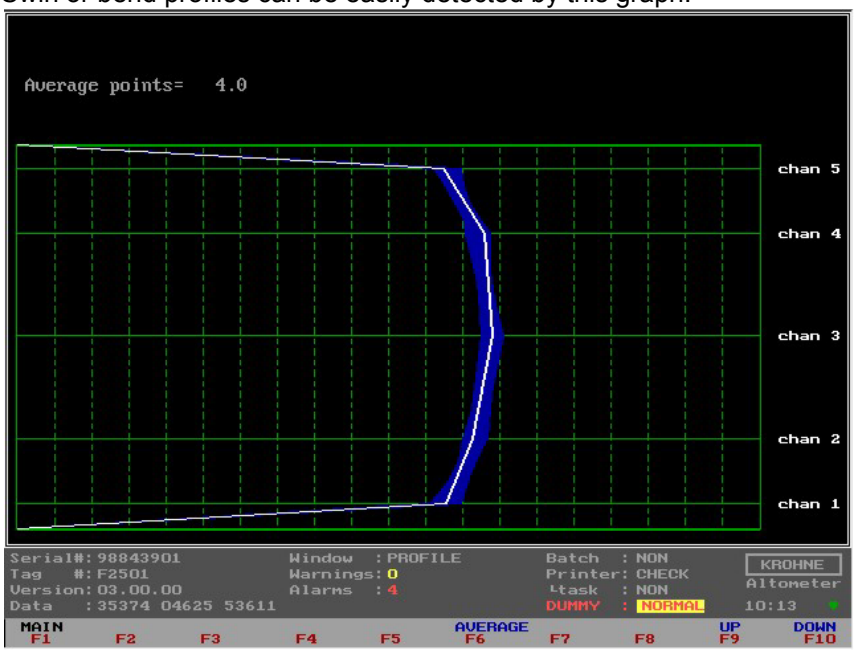
Function keys do the controls of this window, therefore it is only possible to go back to the Main window.

F1 : Back to Main window
F2 : To default normal Y scale (0…120%)
F3 : To zero flow Y scale (-0.5 … +0.5%)
F4 : To change low value Y scale, control by F9 and F10
F5 : To change high value Y scale, control by F9 and F10
F6 : To change points of average (default over 4 measurements), control by F9 and F10
F7 : To change step [%] for UP and DOWN scaling
F8 : To rule out channels, to get a better view over the remaining channels, type <C1>,<C2>,<C3>,<C4>,<C5> to enable and disable channels
F9 : Up scaling for function F4, F5, F6, F7
F10 : Down scaling for function F4, F5, F6, F7

Note that there is no influence on the normal flow measurements.

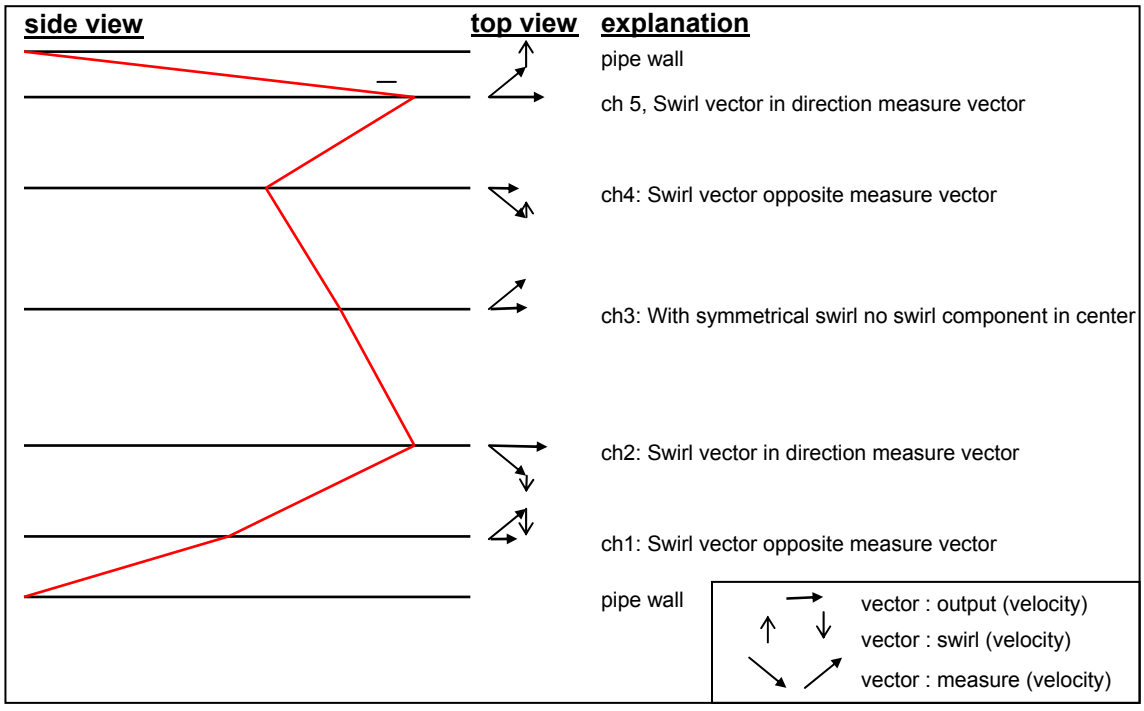
3.6 Main Menu: F6 Profile window

The Profile window shows the profile of the flow that in the measuring section of the flowmeter and is therefore a good graphical display of the measured profile.
Swirl or bend profiles can be easily detected by this graph.



F6 : To change points of average (default over 4 measurements), control by F9 and F10
F9 : Up scaling for function F6
F10 : Down scaling for function F6, F7
Note that anything that is done in this window by using function keys causes no interference with the normal flow measurements.

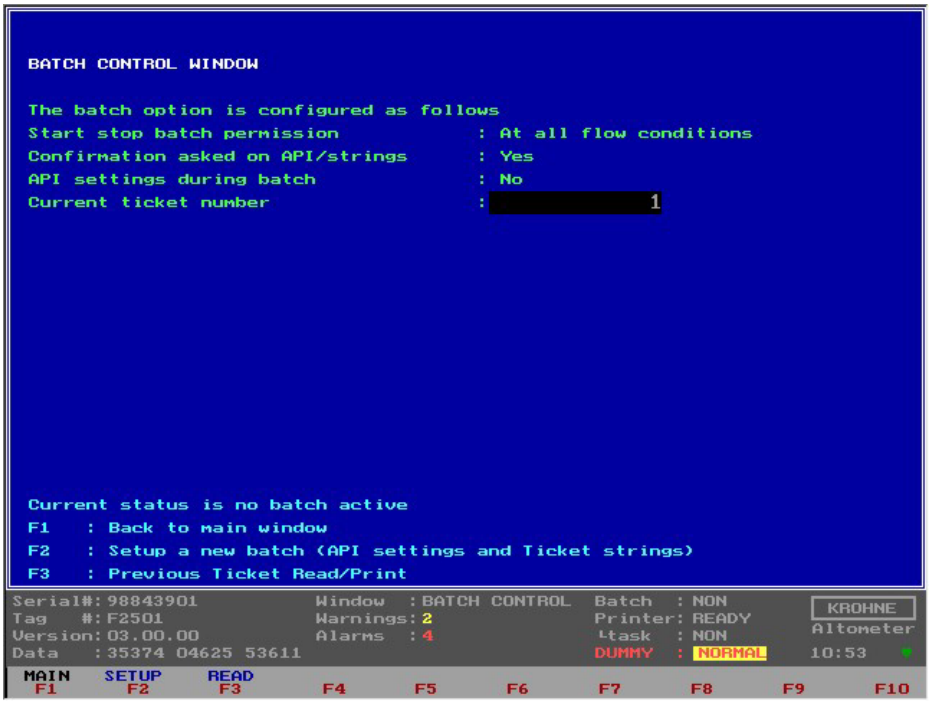
For example a symmetrical swirl profile would look like this:



For this example in relation to normal: ch5 larger, ch1 smaller, ch4 smaller, ch2 larger, and ch3 close to normal.

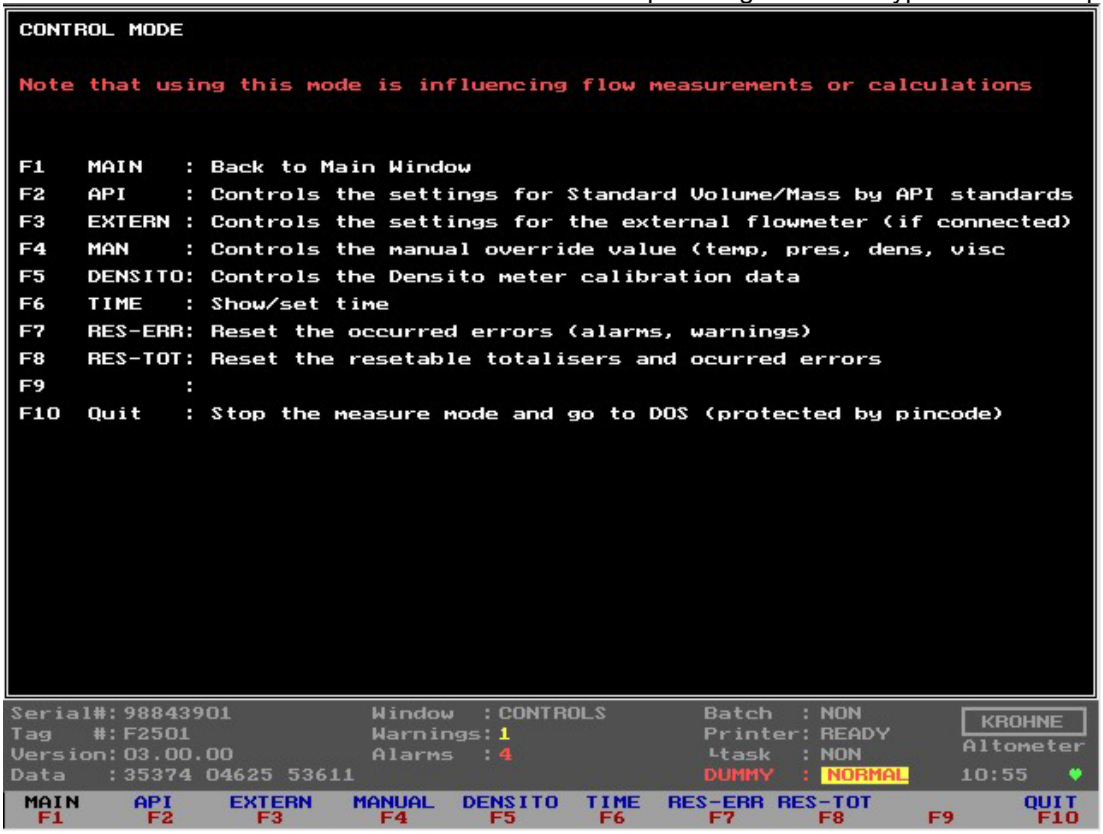
3.7 Main Menu: F7 Batch window

This window is only visible when batch mode is enabled in de initialisation file CLNT0300.dat.
Below is only the window as showed when no batch is running.
For more details on batch mode see chapter BATCH MODE.



3.8 Main menu: F9 Controls window

This is the start window for the controls where a description is given of the types of controls possible.

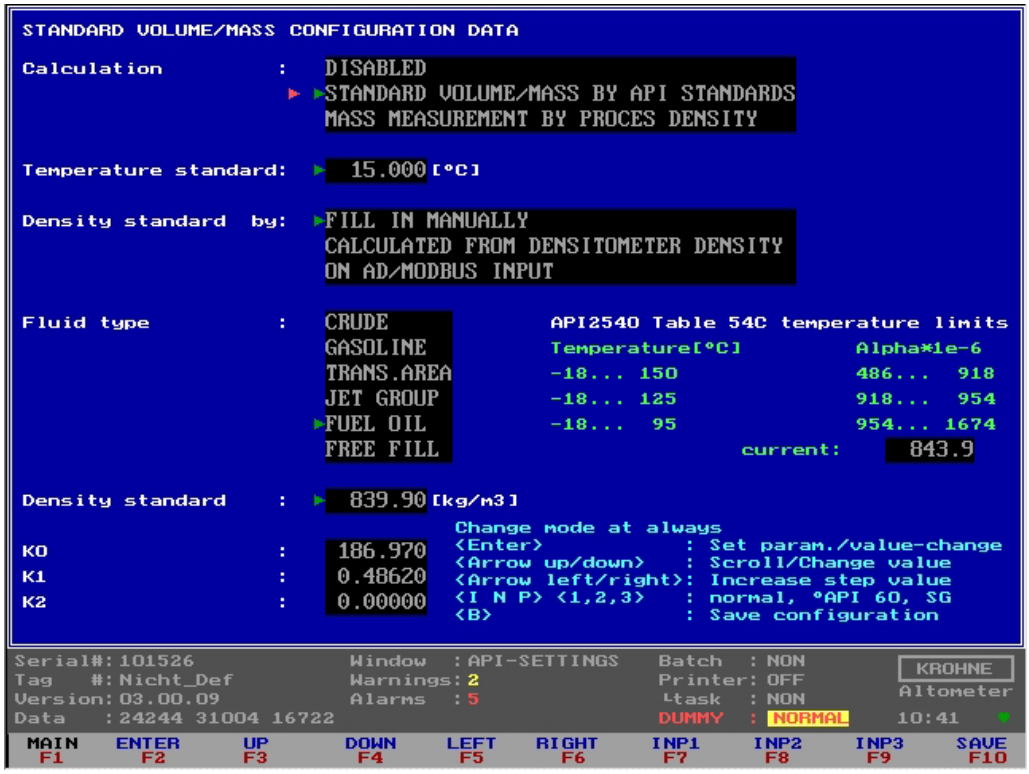


IMPORTANT:

- Using this mode (CONTROLS) is influencing flow measurements or calculations (except for function F6).
- When Batch mode is enabled it is possible that certain controls are not accessible due to the batch mode configuration. See chapter 5 BATCH MODE for more details.

3.8.1 Controls menu: F2 API settings window

In this window the configuration can be made for calculating the standard volume / mass.
The green arrows represent the current settings per option. The red arrow is the option cursor.



CALCULATION option is configurable:

1. *Disable*, no standard volume or mass is calculated
2. *Standard volume/mass by API standards*
3. *Mass measurement by input of Process density.*

TEMPERATURE STANDARD:

When the CALCULATION option is 2, the used temperature standard is selectable between 0-30°C or equivalent in °F. If the temperature standard is changed, the input limits for the density standard per fluid type also change to default and have to be configured as desired.

DENSITY STANDARD BY:

When the CALCULATION option is 2 then the method to establish the density standard is configurable:

1. *Fill in manually* value for the density standard manually in this window. Additional only Process temperature and pressure must be measured.
2. *Calculated from Process density.* The density standard is calculated by iteration of the measured Process density (on frequency or AD input). Additional Process and densitometer temperatures and pressures must be measured.
3. *On AD input.* Density standard on an AD input. Additional only Process temperature and pressure must be measured and the temperature standard must be set according to input density standard.

FLUID TYPE:

When the CALCULATION option is 2 then the used fluid type is configurable. Each fluid type has its own density standard limits.

DENSITY STANDARD:
When the CALCULATION option is 2 and the DENSITY STANDARD BY is fill in manually, the density standard value is selectable within the limits of the chosen FLUID TYPE.

K0, K1, K2:
When the CALCULATION option is 2 and the FLUID TYPE is Freefill then the correction factors K0, K1 and K2 can be configured.

API2540 Table 54C temperature limits
The used table is limited by temperatures (such as temperature Process, Densitometer) used in the calculation and the calculated Alpha. The Alpha is a function of the installed fluid type (i.e. K0, K1, K2) and the density at 15º C.
When limitation is reached, API GROUP MISMATCH alarm is raised.

Description of the controls in this window:
Function keys do the controls of this window, therefore it is only possible to go back to the Main window. For practical use also normal keys have the same functionality.

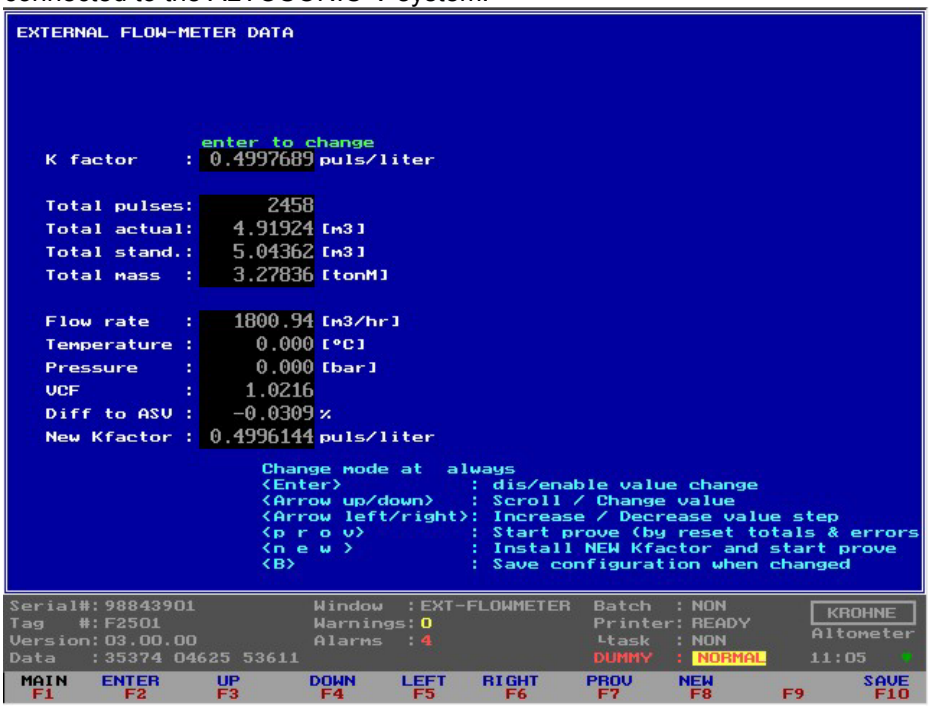
F1	: Go back to Main window
F2 (or <ENTER>)	: Set a parameter or disable/enable value change
F3 (or <arrow up>)	: Scroll up with red cursor. Or if value change is enabled(F2) increase value
F4 (or <arrow down>)	: Scroll down with red cursor. Or if value change is enabled (F2), decrease value
F5 (or <arrow left>)	: If value change is enabled(F2) increase step value of change(F3,F4)
F6 (or <arrow right>)	: If value change is enabled(F2) decrease step value of change(F3,F4)
F7 (or <INP1>)	: Normal density standard manually input
F8 (or <INP2>)	: Density standard manually input as °API 60
F9 (or <INP3>)	: Density standard manually input as SG
F10(or <B>)	: Save configuration

Note:
Make sure you save the data after the changes are made as desired.
It is also possible to make the configuration by Modbus communication

Additional information about the used API standards etc can be found in: chapter 4 CALCULATION OF STANDARD VOLUME AND MASS

3.8.2 Controls menu: F3 External-flow meter window

The UFP-V has the possibility to act as a Master meter to calibrate an external flow meter.
In this window the K factor for the external flow meter can be configured if the necessary inputs are connected to the ALTOSONIC-V system.



The necessary inputs are:

- The flow signal from the external flow meter must be a pulse input for the UFP-V. An optional pulse counter on the MP103 card reads in the number of pulses. The K factor (pulse/liter) converts the counted pulses to the measured Process volumetric total
- Recommend is to use the temperature and pressure at external flow meter conditions for calculation of the standard volume. If the meter is close enough to the ALTOSONIC-V system the Process temperature and pressure can be copied to the external temperature and pressure but note that 1°C difference causes about 0.1% error, and 1 bar difference causes about 0.01% error.

Practice shows that both repeatability and linearity improve when comparing calculated standard values.
It is possible to compare the Process volumetric total of the external flow meter with the Process volumetric total of the UFP-V but then the ALTOSONIC-V must also be set as only calculating Process volume.

Description of the controls in this window:

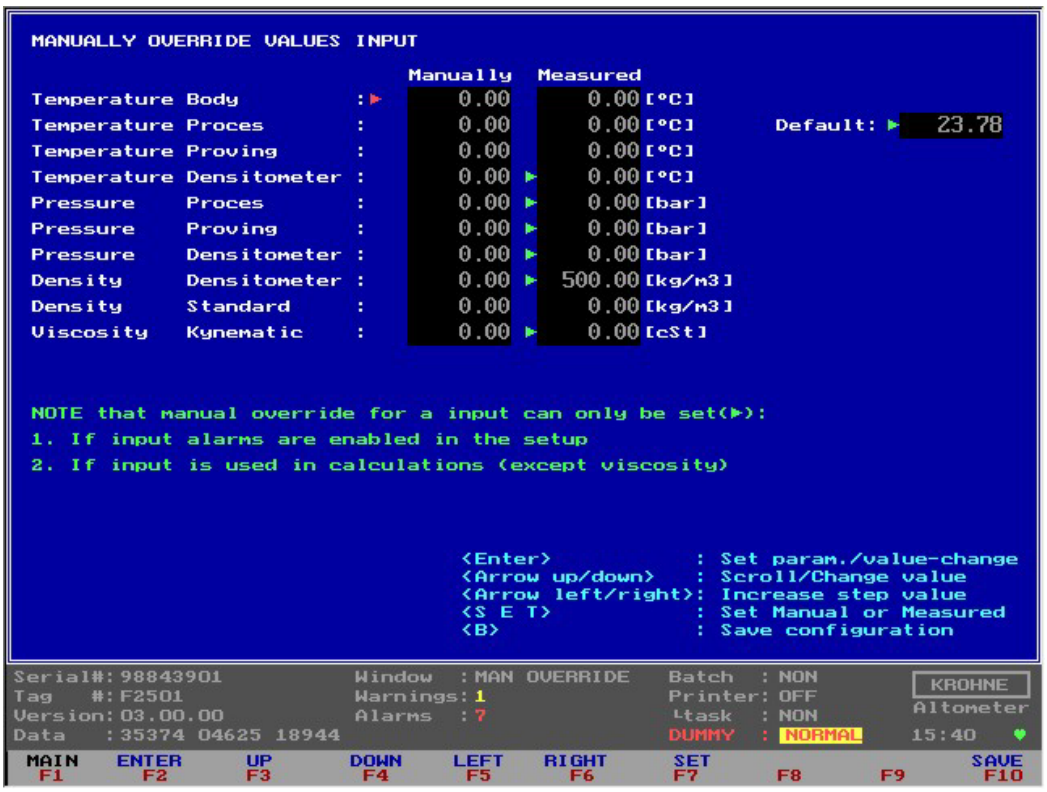
Function keys do the controls of this window, therefore it is only possible to go back to the Main window.

F1	: Go back to Main window
F2 (or ENTER)	: Disable/enable value change of the K factor manually
F3 (or arrow up)	: If value change is enabled (F2) increase value
F4 (or arrow down)	: If value change is enabled (F2) decrease value
F5 (or <arrow left>)	: If value change is enabled F2) increase step value of change (F3,F4)
F6 (or <arrow right>)	: If value change is enabled (F2) decrease step value of change (F3,F4)
F7 (or <PROV>)	: Start proving, reset of totals and errors on both UFP-V and External
F8 (or <NEW>)	: Install found NEW K factor and start prove as described in F7
F10 (or < B>)	: Save configuration if K factor is manually installed

Note: Starting a prove involves resetting of resetable totalisers and occurred alarms.
It is also possible to start a proving or install a new K factor by Modbus communication.

3.8.3 Controls menu: F4 Manual override window

In this window a manual override can be made on several input parameters.



Note that manual override for an input:

- Can only be set if the input alarms are enabled in the initialisation
- Can only be set if the input is used in calculations (except for the viscosity)
- Sets the alarm for the parameter that is in manual override, but the alarm time is counted separately. See Alarms window

The green arrows represent the current settings per parameter. No arrow means that it is not possible to set that parameter because of the above restrictions.

- Manually : The override value is set manually, this always causes an alarm condition
- Measured : Value as measured on AD/Modbus/Frequency input
- Default : The default override value on first occurrence of active alarm.

The default override value on first occurrence active can be configured in the initialisation file CLNT0300.dat section 9.

Example Temperature Process parameter:

```
TEMPERATURE PROCESS
9.8  MODE                =#1     //Use input:0=disable, 1=AD-input, 2=Modbus
9.9  MODBUS_SERVICE      =#0     //Service input:0=disable, 1=AD-input
9.10 Alarm_out           =#1     //disable=0, enable=1  alarm to output
9.11 alarmLow            =#0     //Low alarm  below this value [øC]
9.12 alarmHigh           =#100   //High alarm above this value [øC]
9.13 Override            =#20    //Default static override value [øC] on alarm
9.14 Override_code       =#0     //0=disable override value, 1=use default override
                                 //2=use default batch average as override
```

The OVERRIDE_CODE (9.14) makes it possible on first occurrence of active alarm to have:

- (0) No override value, measurement value is used for calculations
- (1) Use the default static override value OVERRIDE (9.13) .

- (2) Use the batch average value of the parameter as calculated up to first occurrence of active alarm

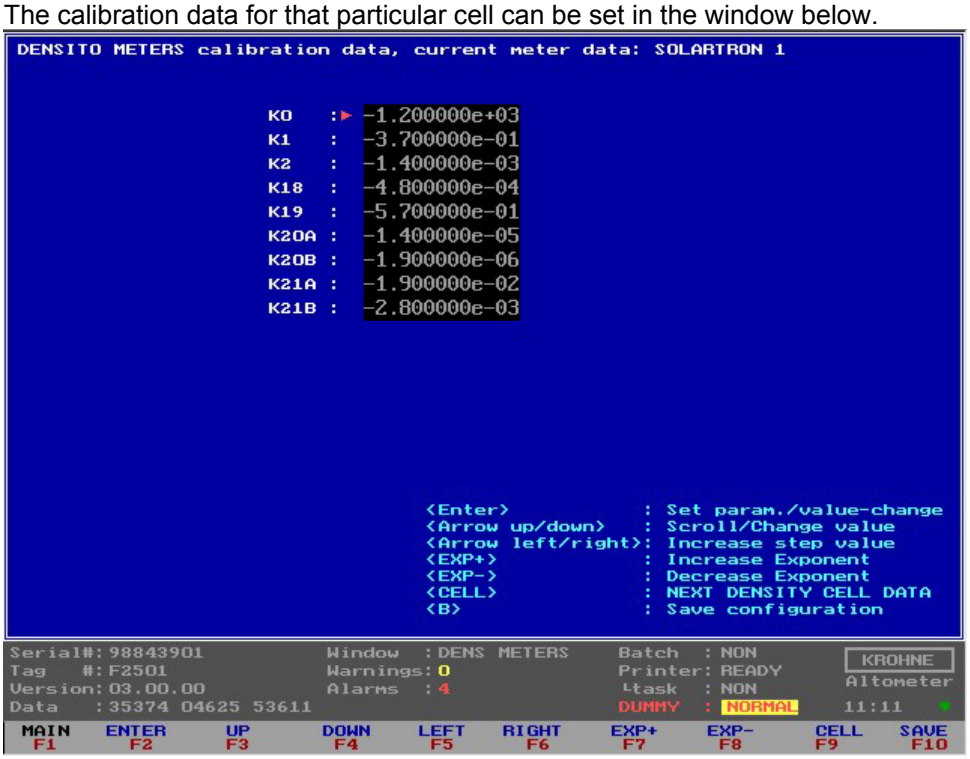
Description of the controls in this window:

Function keys do the controls of this window, therefore it is only possible to go back to the Main window.

F1 : Go back to Main window
F2 (or <ENTER>) : Set a parameter or disable/enable value change
F3 (or <arrow up>) : Scroll up with red cursor. Or if value change is enabled (F2) increase value
F4 (or <arrow down>) : Scroll down with red cursor. Or if value change is enabled (F2), decrease value
F5 (or <arrow left>) : If value change is enabled (F2) increase step value of change (F3, F4)
F6 (or <arrow right>) : If value change is enabled (F2) decrease step value of change (F3,F4)
F7 (or <SET>) : Set as manual override or measured input
F10 (or <B>) : Save configuration

3.8.4 Controls menu: F5 Density cell window

When a density cell is used to measure the density for Standard Volume calculation then the hardware configuration must be made in the initialisation files HSET0300.ufp and CLNT0300.dat. The calibration data for that particular cell can be set in the window below.



Description of the controls in this window:

Function keys do the controls of this window, therefore it is only possible to go back to the Main window.

F1 : Go back to Main window
F2 (or <ENTER>) : Set a parameter or disable/enable value change
F3 (or <arrow up>) : Scroll up with red cursor. Or if value change is enabled (F2) increase value
F4 (or <arrow down>) : Scroll down with red cursor. Or if value change is enabled (F2), decrease value
F5 (or <arrow left>) : If value change is enabled (F2) increase step value of change (F3, F4)
F6 (or <arrow right>) : If value change is enabled (F2) decrease step value of change(F3, F4)
F7 (or <EXP+>) : Increase the exponential value, when value change is enabled (F2)
F8 (or <EXP->) : Decrease the exponential value, when value change is enabled (F2)
F9 (or <CELL>) : Scroll the data set, possible to scroll between:
SOLARTRON 1
SOLARTRON 2
SARASOTA 1
SARASOTA 2
F10(or <B>) : Save configuration

3.8.5 Controls menu: F6 Time window

The system time can be set in this window.

Note:

- The system time is not the time used for making the totalisers. The time used by the totalisers is the Process time. This time is calibrated together with the frequency output because the frequency output uses the same Processor timer in the UFP.
- The Set Time can have a maximum deviation to System Time of ± 2 hours in one saving.
- For very large deviation settings it is better to do the setting under DOS by commands TIME and DATE.
- It is also possible to set the time through Modbus controls.

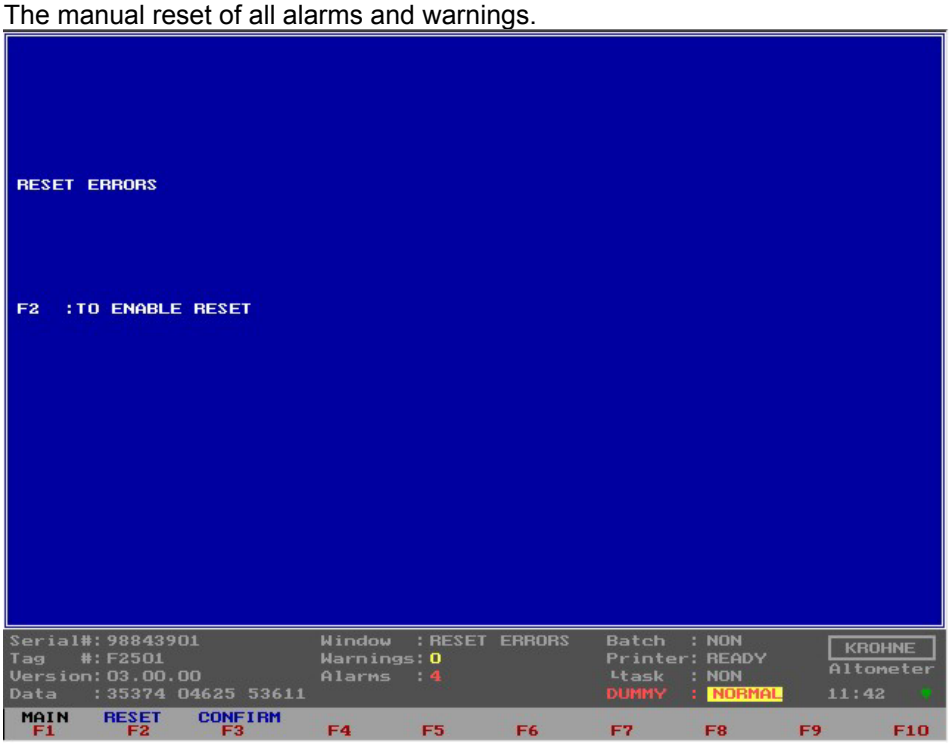
Description of the controls in this window:

Function keys do the controls of this window, therefore it is only possible to go back to the Main window.

F1	: Go back to Main window
F3	: Scroll up in value at the red cursor position value
F4	: Scroll down in value at the read cursor position
F5	: Change cursor position to the left
F6	: Change cursor position to the right
F10	: Save configuration (set the desired time)

3.8.6 Controls menu: F7 Reset Errors window

The manual reset of all alarms and warnings.



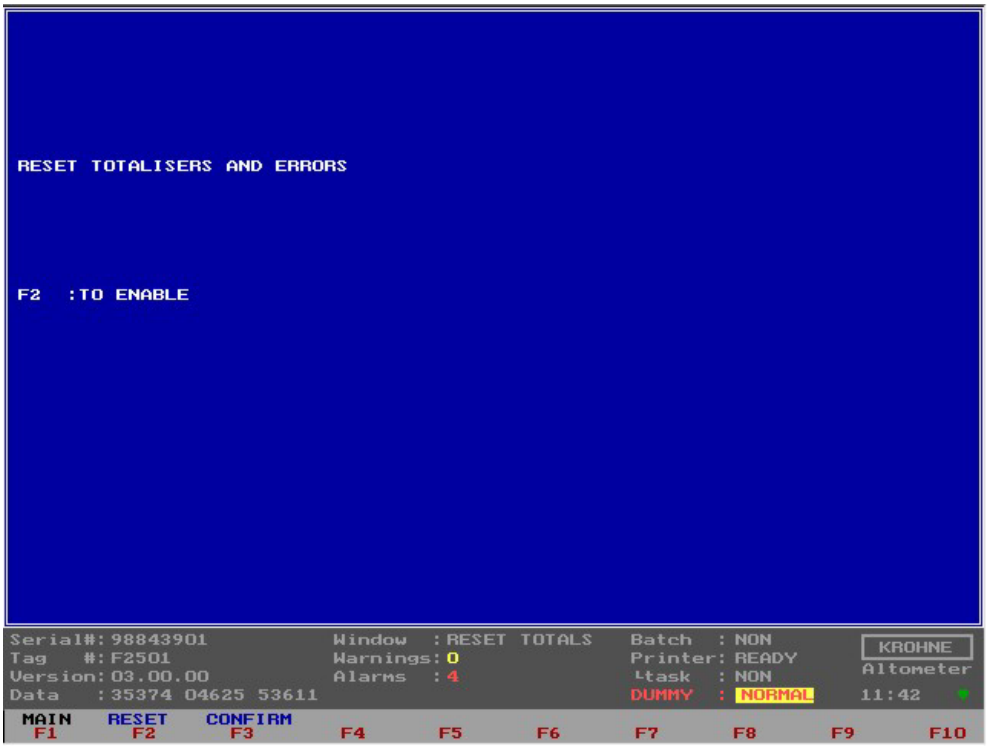
Reset sequence:

- Enable the reset by function key F2
- Confirm to reset by function key F3

It is also possible to reset by digital input signal or Modbus Boolean.

3.8.7 Controls menu: F8 Reset Totalisers window

The manual reset of the resetable totalisers and all alarms and warnings.



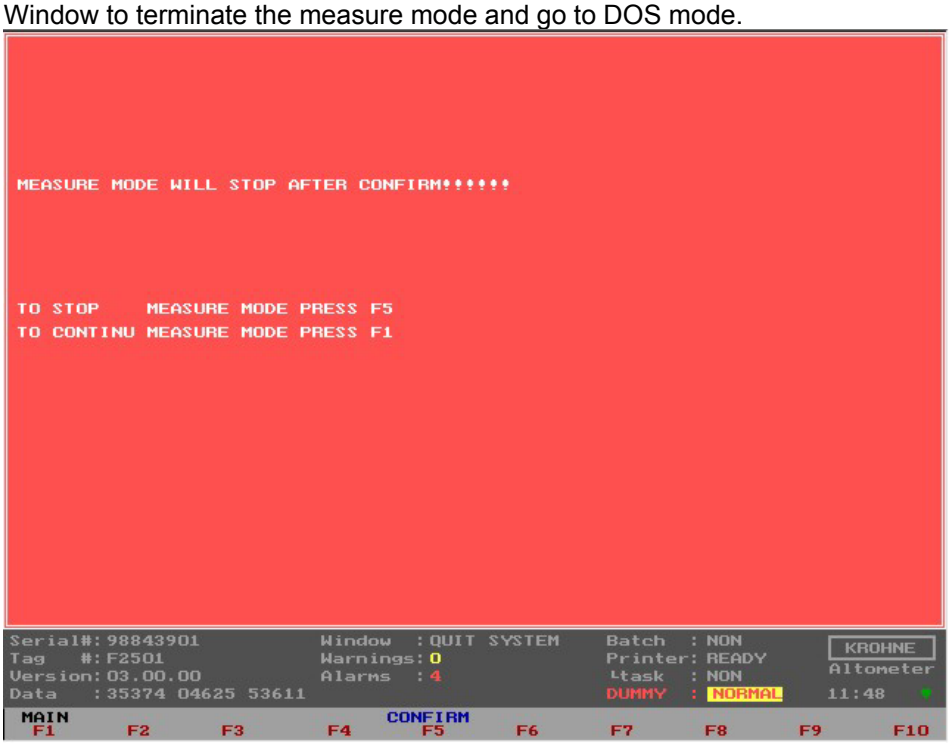
Reset sequence:

- Enable the reset by function key F2
- Confirm to reset by function key F3

It is also possible to reset by digital input signal or Modbus Boolean.

3.8.8 Controls menu: F10 Quit measure mode window

Window to terminate the measure mode and go to DOS mode.



Quit sequence:

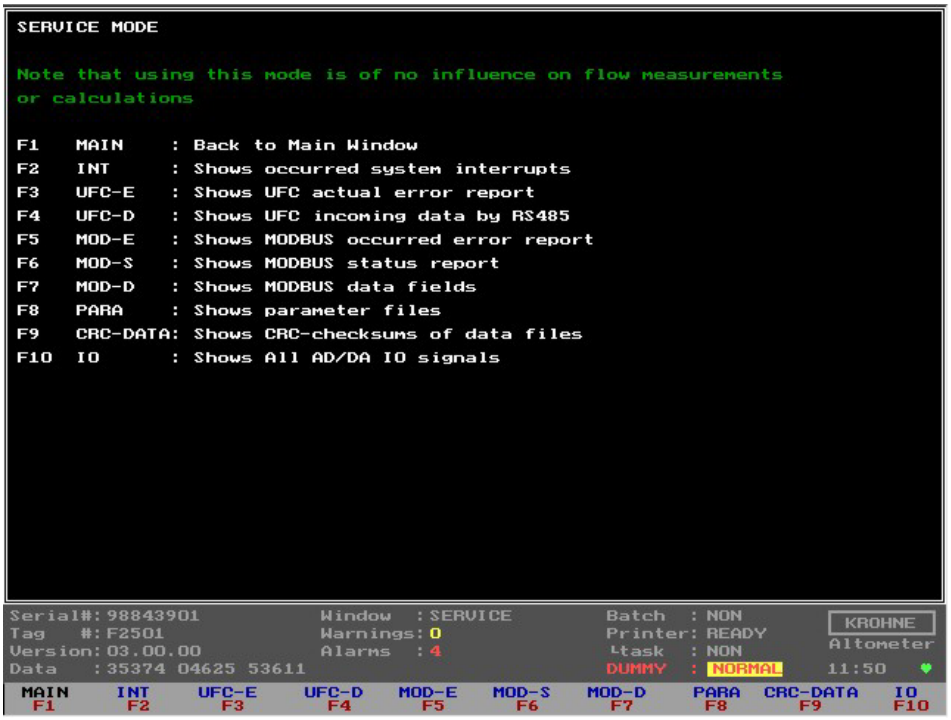
- Confirm to quit function key F5

To proceed use function key F1

IMPORTANT: If the UFP-Program is stopped than there are no more flow measurements/calculations performed.

3.9 Main menu: F10 Service window

This is the start window for the Service windows where a description is given of the types of Service windows there are.

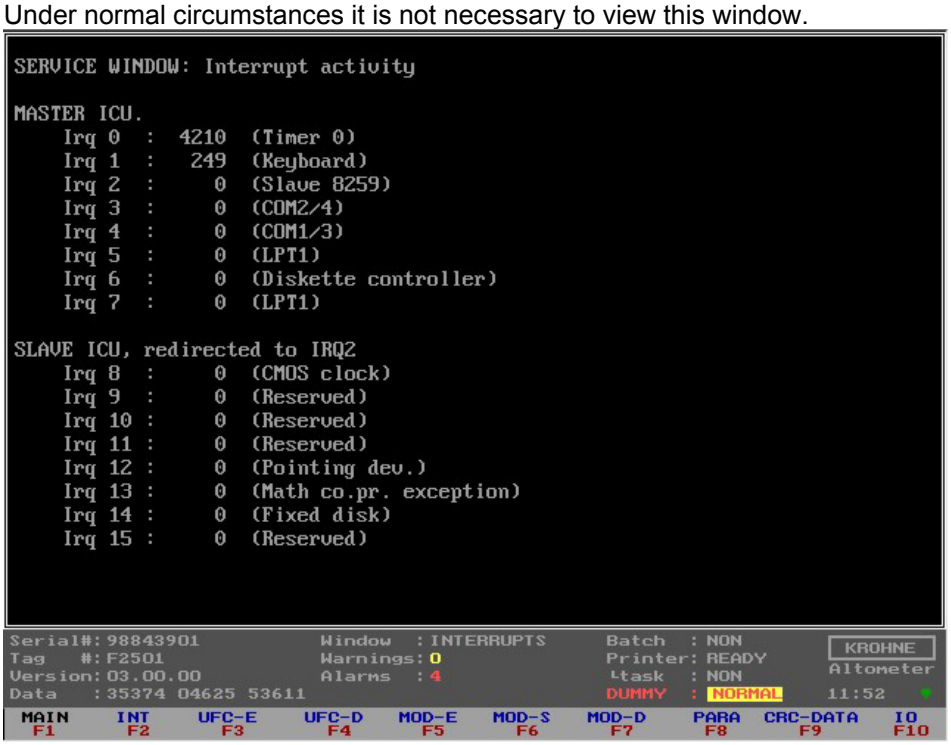


Note that using this mode (SERVICE) is of no influence on flow measurements or calculations

These Service windows are especially practical for debugging errors when an ALTOSONIC V system is set-up for Modbus and I/O signals (AD/DA).

3.9.1 Service menu: F2 Interrupts window

Under normal circumstances it is not necessary to view this window.



The Interrupt window is the lowest level PC activity monitor.

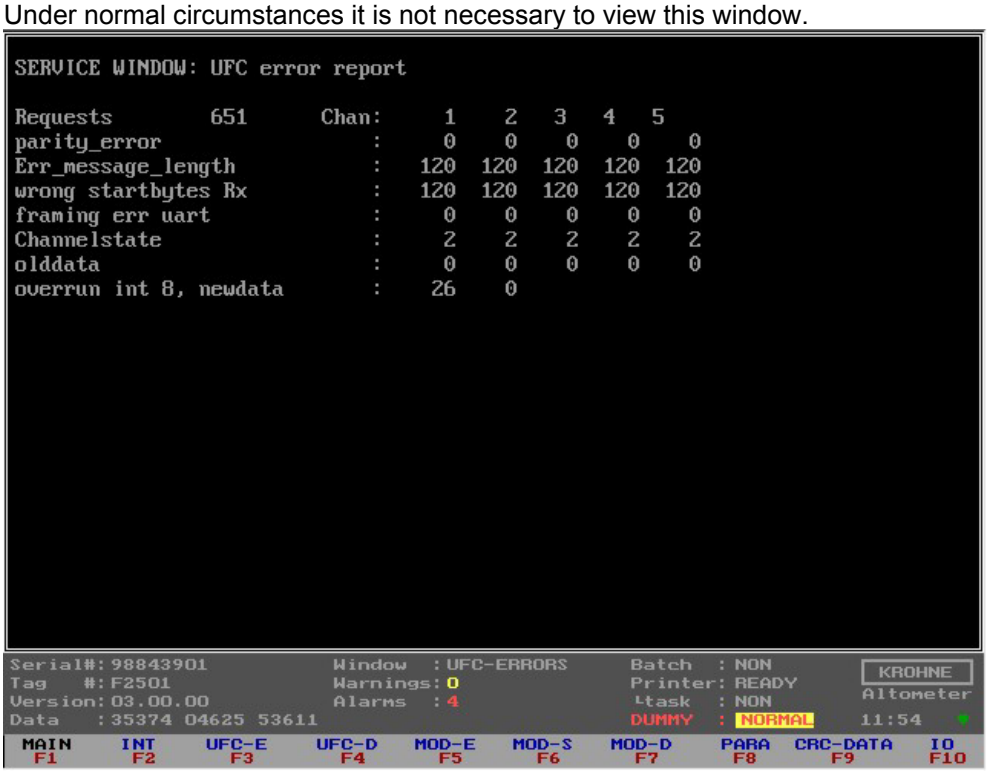
The serviced interrupts are counted per source. Therefore the activity on for example a COM port for Modbus can easily be monitored for any signals coming in.

The settings for the communication can be found in parameter file COMS0300.dat
Default settings for the COM ports are:
Irq 3: COM 4, Modbus for RS422/RS485.
Irq 4: COM 3, RS 485 UFC DATA communication.

If the Modbus communication is set up there must be activity on COM 4. If there is no activity then check the configuration in the COMS0300.dat and check the connections.

3.9.2 Service menu: F3 UFC errors window

Under normal circumstances it is not necessary to view this window.



All data shown here is also available in more common used windows in perhaps other formats or sublimated into less variables.
The status is shown as counters per channel.
There is no history in the counters so **previous occurred errors will turn to zero.**

Communication *errors* per communication message (=per channel request):

- Parity errors
- Error in message length
- Wrong start bytes
- Framing error UART

Communication *status* sublimated from communication errors per channel:

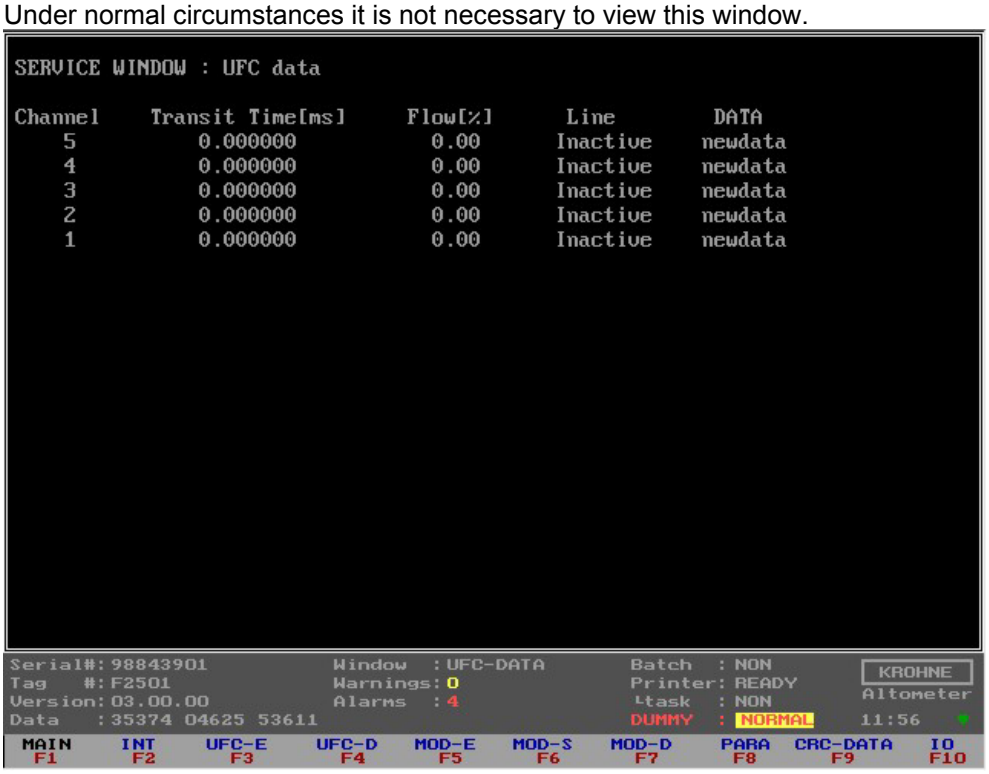
- Channel state = 0: no errors (status normally)
- Channel state = 1: error resulting in a single communication failure (COMFA)
- Channel state = 2: comm. failures in succession resulting in a communication alarm (COMMU)

Communication *status* regarding data skipped or already handled:

- Old data : Counter for data, already handled(Note: normally toggles between 0 and 1).
- Overrun : Counter for data, skipped because of system time shortage (note: cumulative!).

3.9.3 Service menu: F4 UFC data

Under normal circumstances it is not necessary to view this window.



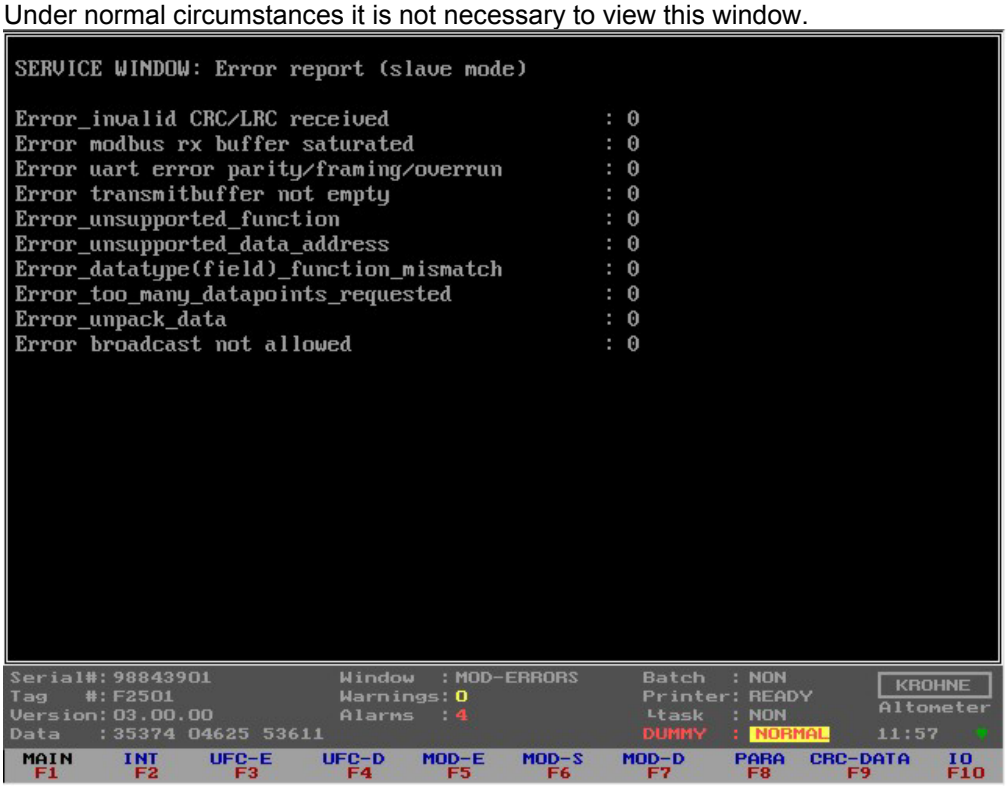
All data shown here is also available in more common used windows in perhaps other formats.
This window shows the raw basic flow data from the UFC-V with no history capacity.

Data of all channels:

- Transit time as [ms]
- Flow rate as percentage [-125...+125%]
- Line status (normally *active*, on communication failure *Inactive*)
- Data status (*New data*, *old data* (previously handled), *old data time out* (on communication alarm))

3.9.4 Service menu: F5 Modbus errors window

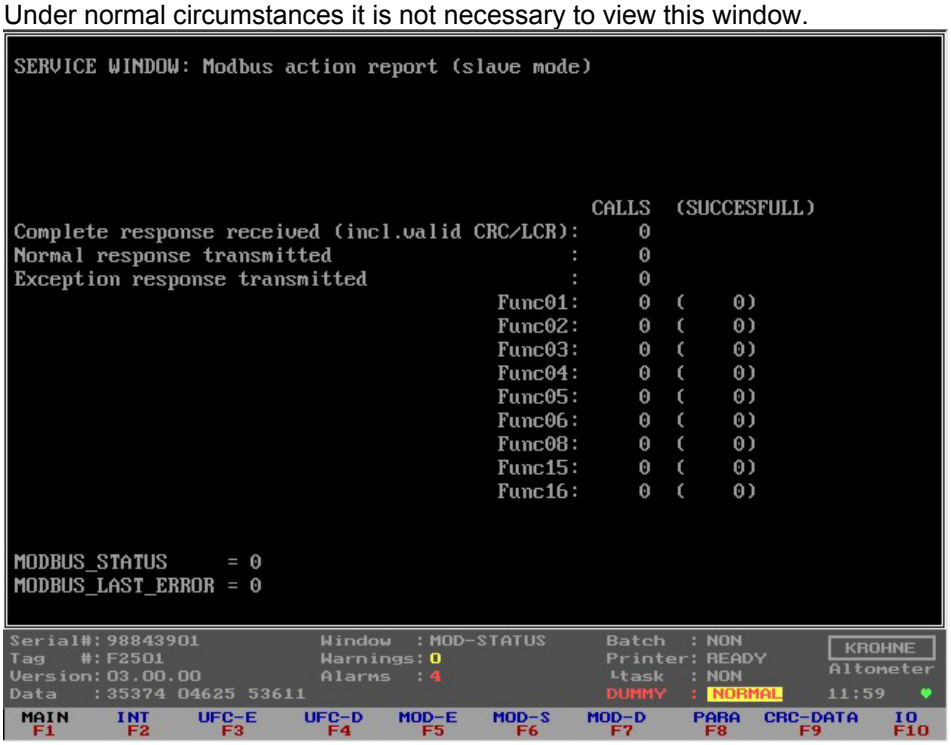
When setting up the UFP-V Modbus driver for communication this window is very useful for showing the occurred Modbus communication errors. The various errors are shown as historical counters per communication error.
Under normal circumstances it is not necessary to view this window.



When every counter is zero but the Modbus communication seems to fail first monitor the Interrupt window for any activity on the Comport.
All data shown here is also available in more common used windows in perhaps other formats or sublimated into less variables.

3.9.5 Service menu: F6 Modbus STATUS

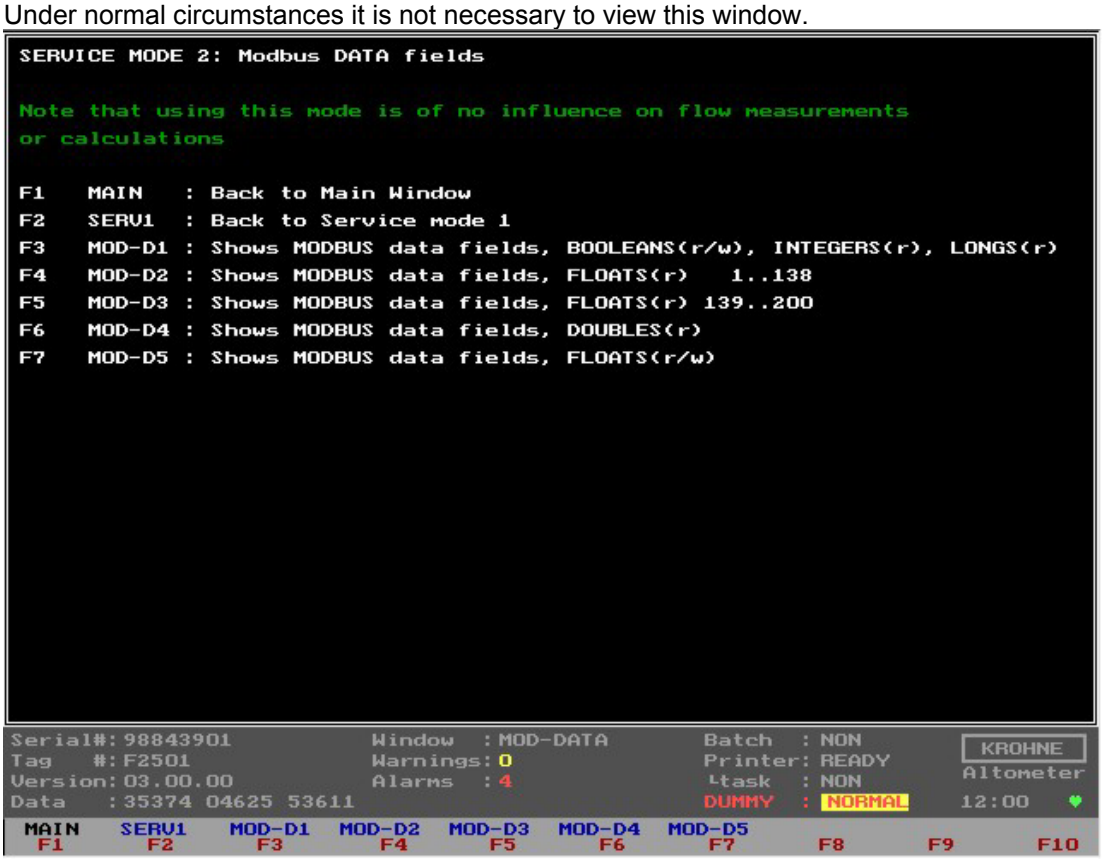
When setting up the UFP-V Modbus driver for communication this window is very useful for showing addressed functions and responses.
Under normal circumstances it is not necessary to view this window.



Function 1 : Read coil
Function 2 : Read input status
Function 3 : Read multiple holding registers
Function 4 : Read input registers
Function 5 : Write single coil
Function 6 : Write single holding register
Function 8 : Diagnostics
Function 15 : Write multiple coil
Function 16 : Write multiple holding register

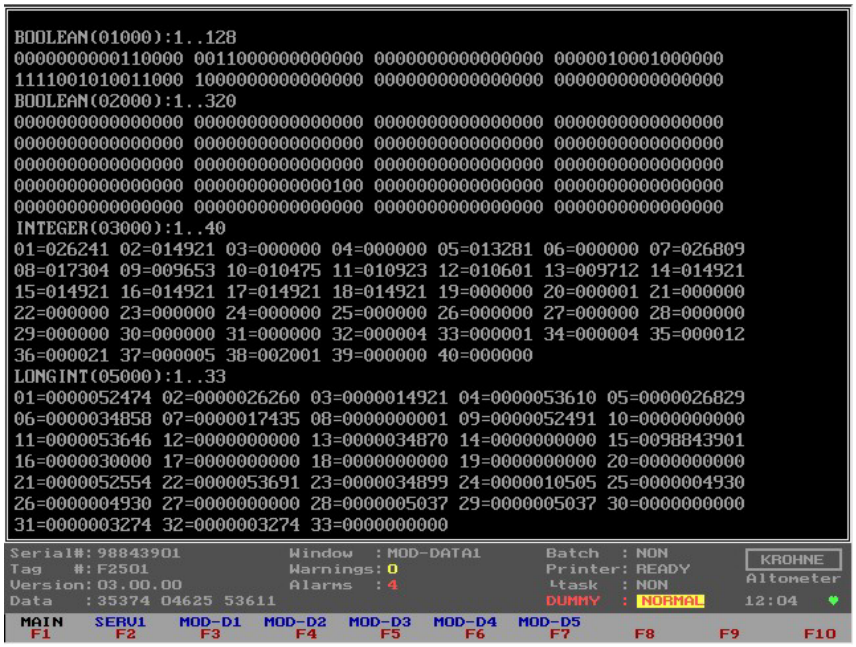
3.9.6 Service menu: F7 Modbus data window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window.



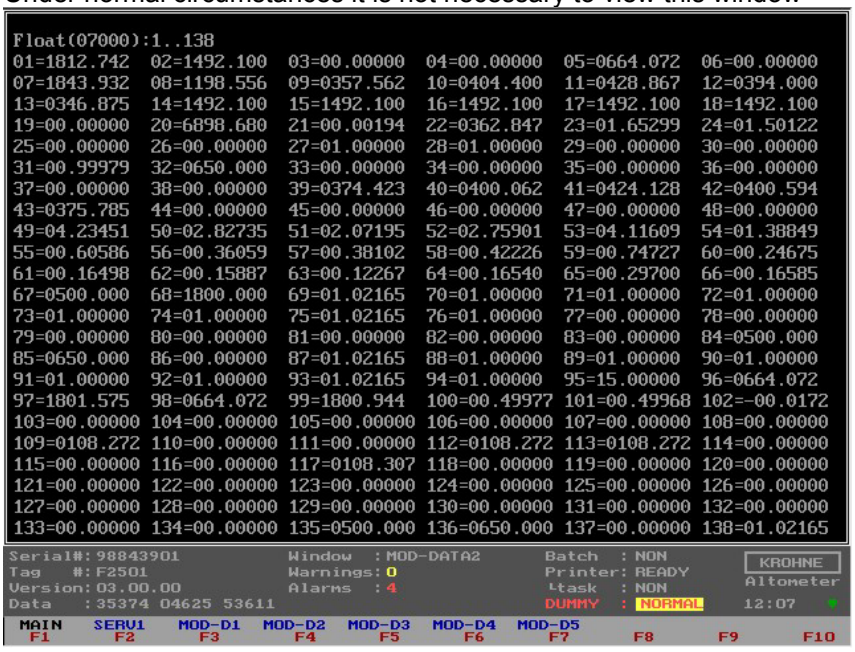
3.9.6.1 Service menu 2: F3 Modbus data1 window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window



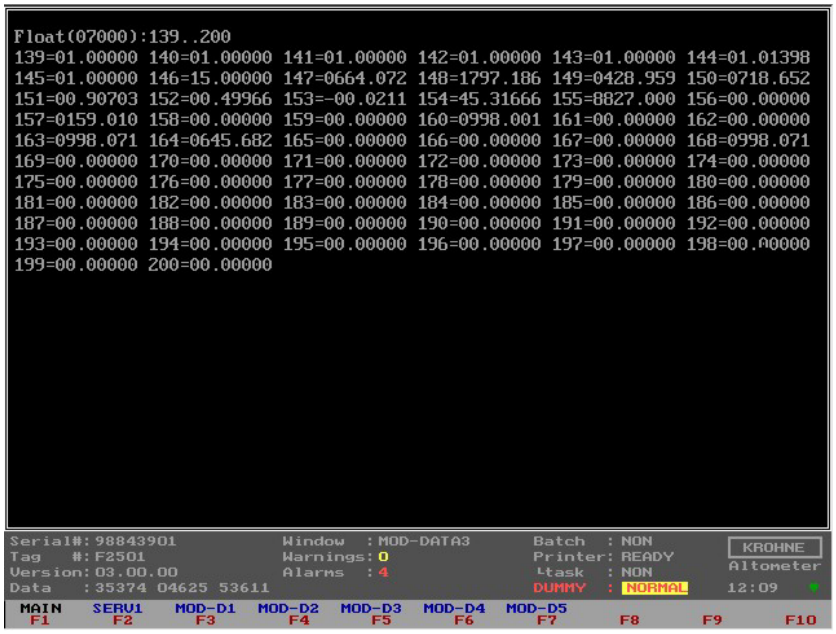
3.9.6.2 Service menu 2: F4 Modbus data2 window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window



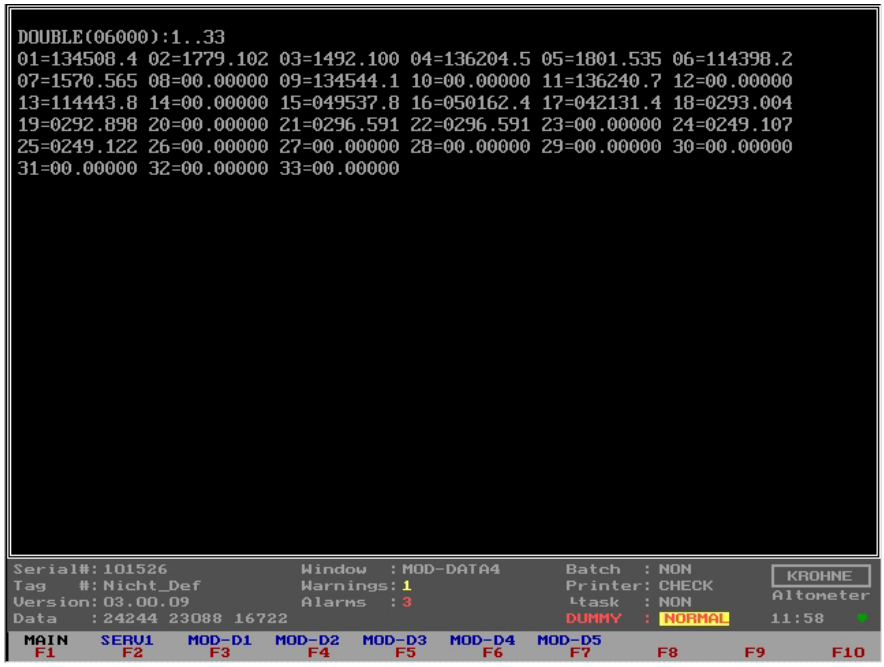
3.9.6.3 Service menu 2: F5 Modbus data3 window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window



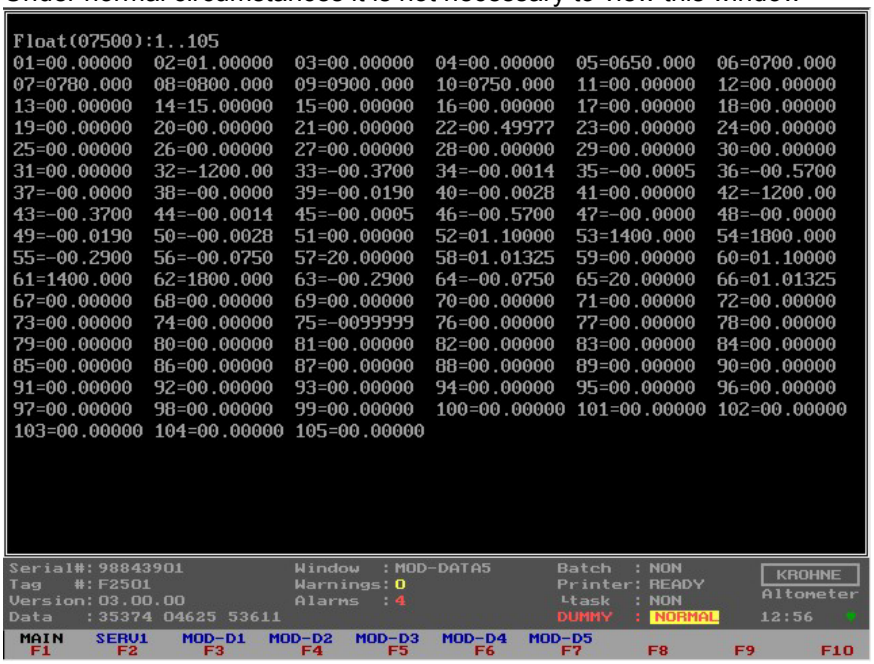
3.9.6.4 Service menu 2: F6 Modbus data4 window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window



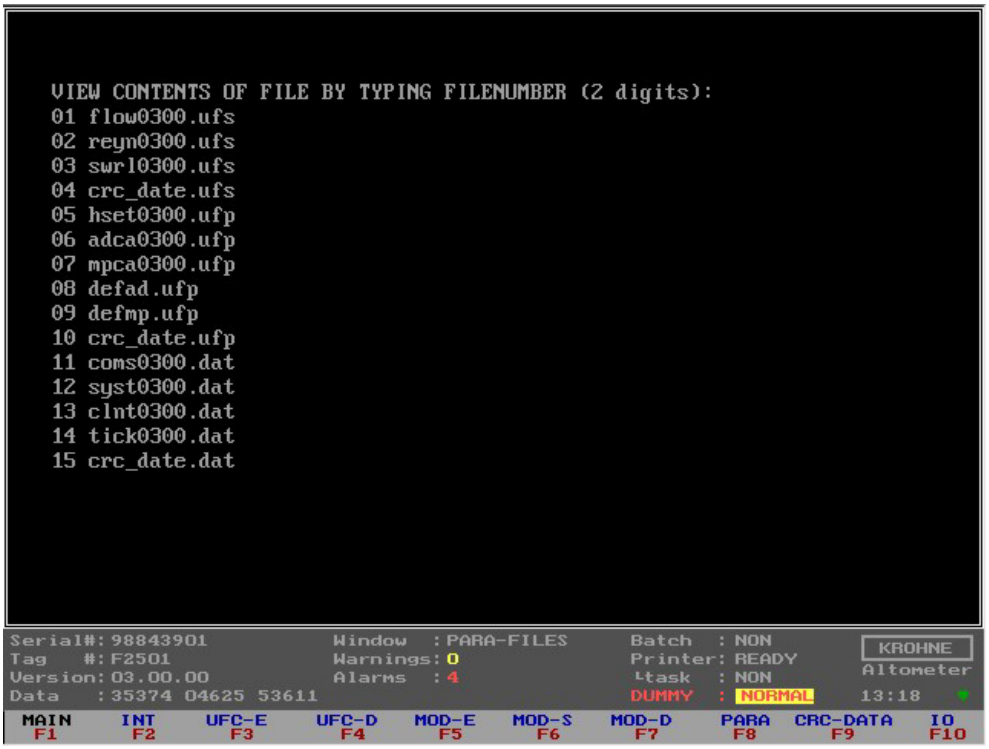
3.9.6.5 Service menu 2: F7 Modbus data5 window

When setting up the UFP-V Modbus driver for communication this window is very useful for showing the available Modbus data fields in address and value for verifying data on both host side and UFP side per data register.
Under normal circumstances it is not necessary to view this window



3.9.7 Service menu: F8 Parameter window

It is possible to view the Initialisation files on line while measuring.
For safety not the actual files are viewed but the backup file, so parameter files themselves are safe.

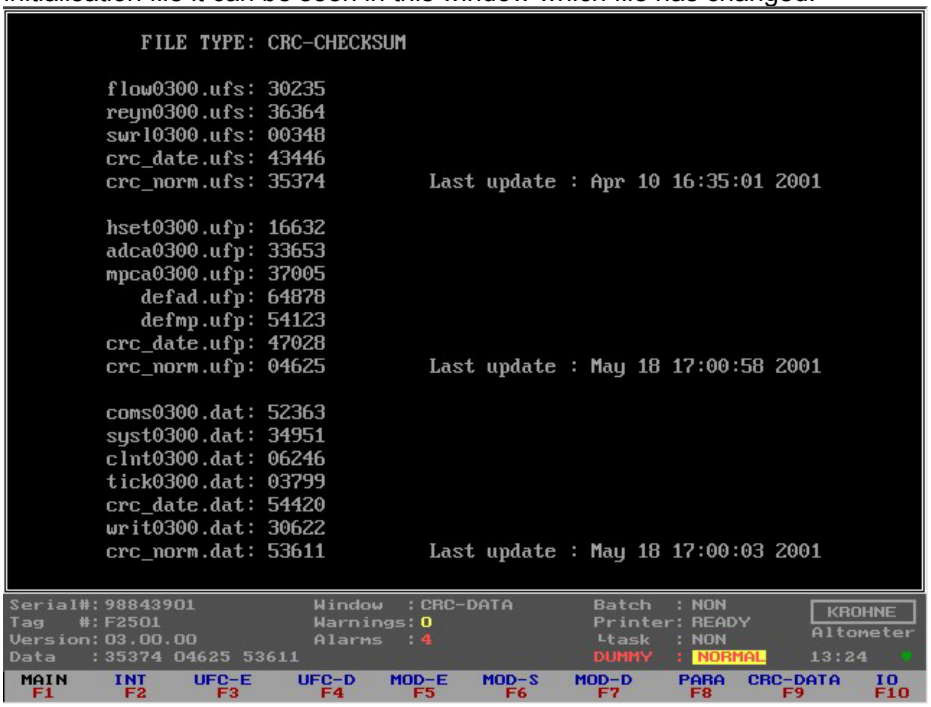


Type the two numerical digits that are in front of the filename and the content of the file can be viewed.
Page down is activated by SPACE key.

It is save to use the function keys at any time during viewing the file to switch to other windows.

3.9.8 Service menu: F9 CRC-data window

As an extra service the CRC-checksums per file can be viewed, so in case of a change in a initialisation file it can be seen in this window which file has changed.

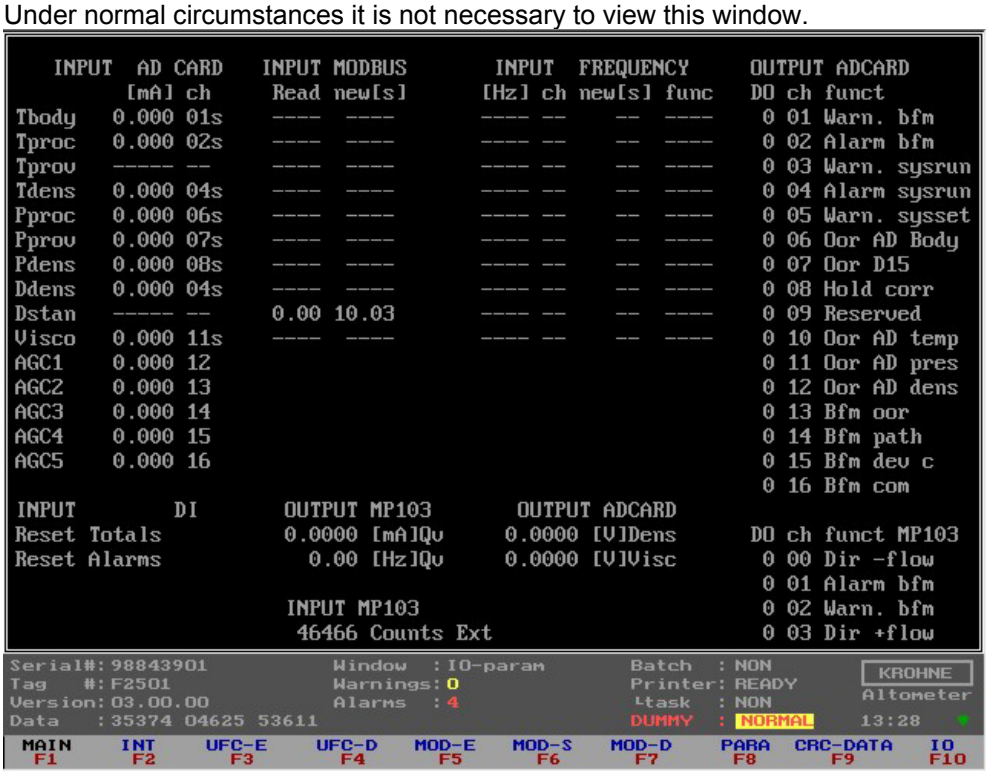


Note that the CRC_NORM file CRC checksums are also at the bottom of the Status window
This file holds the CRC checksums of the other files in the data set.
So when anything changes in a file in the data set this also changes the CRC_NORM CRC-checksum.

3.9.9 Service menu: F10 IO window

All secondary inputs and all outputs other then Modbus can be seen in this window

Under normal circumstances it is not necessary to view this window.



Input secondary signals

The signals for temperatures pressures densities and viscosity can be input by AD Card, Modbus or Frequency Input.
The configuration of these signals is in the CLNT0300.dat file.

When setting up analog and digital I/O signals this window shows the signals for the AD card and MP103 card of the UFP-V. Per card functions can be enabled / disabled card through off-line software settings.

AD card configuration : see chapters DATA ACQUISITION and OUTPUT
MP103 card configuration : see chapters DATA ACQUISITION and OUTPUT

4 CALCULATION OF STANDARD VOLUME AND MASS

The principle of the UFP-V is measuring the volumetric Process flow rate. Integrating this value in time results in the volumetric Process total.
Often measured quantities are compared. Because of temperature and pressure dependency of the volumetric Process it can be preferable to convert to more standard conditions:

- Volumetric standard (1.01325 bar and for example 15°C).
- Mass

4.1 Volumetric standard

The correction of the volumetric Process to volumetric standard is done according to API/ASTM-IP standards.
The volume correction factor VCF can be divided into:

- Correction for the temperature dependency, using API 11.1 standard 2540 equation and constants, resulting in a correction factor C_{tl}
- Correction for the pressure dependency, using API 11.2.1M equation and constants, resulting in a correction factor C_{pl}.

$$VCF = C_{tl} \cdot C_{pl}$$

$$Vol_{s\tan d} = Vol_{proces} \cdot VCF$$

VCF : Volume correction factor
C_{tl} : Temperature correction factor
C_{pl} : Pressure correction factor
Vol_{stand} : Volumetric standard [m3]
$Vol_{Process}$: Volumetric Process [m3]
Also available after calculation is the density at Process conditions. This means that mass is also calculated.

4.1.1 Calculation of correction temperature dependency C_{tl}

The correction for the temperature dependency to the 15°C reference base:

$$C_{tl} = EXP[-\alpha_T \cdot (T_{proces} - 15) \cdot (1 + 0.8 \cdot \alpha_T \cdot (T_{proces} - 15))]$$

C_{tl} : Temperature correction factor
α_T : Thermal expansion coefficient [1/°C]
$T_{Process}$: Temperature Process [°C]
In this, the equation is independent of the group or substance. It can be used with any valid method of obtaining the thermal expansion coefficient for a given fluid, as long as a statistically significant number of points is obtained. A minimum of ten such points is recommend. In addition, the values of the constants K_0, K_1 and K_2 are given for each major group.
These constants relate the thermal expansion coefficient to base density by :

$$\alpha_T = \frac{K_0}{\rho_{15}^{\,2}} + \frac{K_1}{\rho_{15}} + K_2$$

α_T : Thermal expansion coefficient [1/°C]
ρ_{15} : Density at reference 15 °C [kg/m^3]
K_0, K_1, K_2: Constants, depending on the type of the product

The API table for the 15°C reference base as installed in the UFP-V is:

Type of product	Low limit ρ_{15} [kg/m3]	High limit ρ_{15} [kg/m3]	K_0	K_1	K_2
Crude	610.5	1075.0	613.9723	0	0
Gasoline	653.0	770.0	346.4228	0.4388	0
Trans.area	770.5	787.5	2680.3206	0	-0.00336312
Jet group	788.0	838.5	594.5418	0	0
Fuel oil	839.0	1075.0	186.9696	0.4862	0
Free fill in	500.0	2000.0	0	0	0

Practical rule: The correction per °C is approximately 0.05% - 0.15% depending on conditions and type of product.

Standard temperature different from 15°C:
The method is based on a reference standard of 15°C. For example if the Process temperature is 65°C.

$$C_{tl} = C_{tl\,65\rightarrow 15}$$

If the required standard temperature is different from 15°C the correction for the difference is introduced. For example if the standard temperature is 20°C,

$$C_{tl} = \frac{C_{tl\,65\rightarrow 15}}{C_{tl\,20\rightarrow 15}}$$

Note: If the standard temperature is different from 15°C the density limits per product type also change. The UFP-V calculates the limitations for the installed standard temperature. A density can not be filled in beyond limitations. The Free Fill product type is for uncommon products, K0, K1 K2 are adjustable.

4.1.2 Calculation of correction pressure dependency C_{pl}

The basic mathematical model, used to develop this standard, relates the compressibility factor exponentially to temperature and the square of the molecular volume. That is:

$$F = EXP[-1.62080 + 0.00021592 \cdot T_{proces} + \frac{0.87096}{\rho_{15}{}^2 \cdot 10^{-6}} + \frac{0.0042092 \cdot T_{proces}}{\rho_{15}{}^2 \cdot 10^{-6}}]$$

F : Compressibility factor, [1/kPa]
$T_{Process}$: Temperature Process [°C]
ρ_{15} : Density at 15 °C [kg/m^3]

The compressibility factor F is used in the normal manner of volume correction to make the correction for the pressure effect:

$$C_{pl} = \frac{1}{1 - F \cdot P_{proces} \cdot 10^{-4}}$$

C_{pl} : Pressure correction factor
F : Compressibility factor
$P_{Process}$: Pressure Process [bar]
Practical rule: The correction per bar is approximately 0.005% - 0.015% depending on conditions and product.

4.1.3 Operating with the standard density

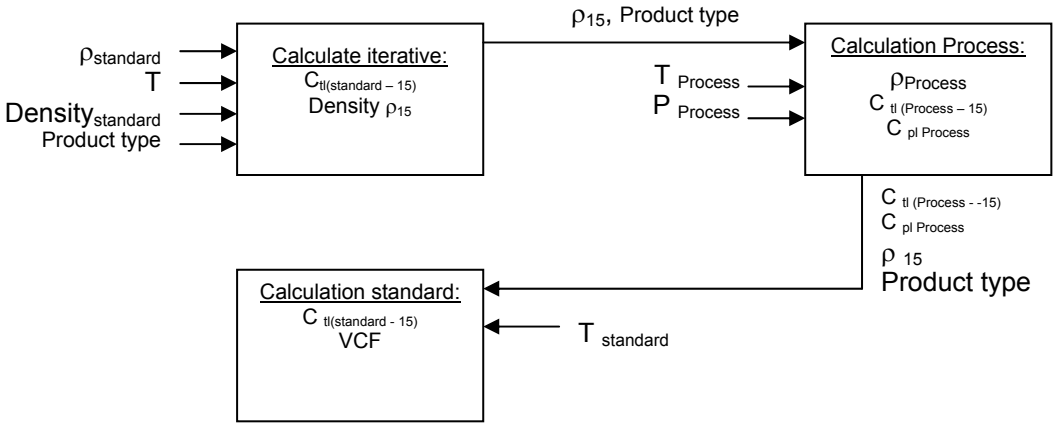
Products with a known constant homogeneous standard density do not need to be monitored by a densito meter.
Input of the standard density can be

- Manually in the running UFP-Program
- Through Modbus
- Analog input

It is named standard density and not density 15 because of the possibility to have a standard temperature different from 15°C.

The density at 15°C is calculated through iteration by the input of the standard density in a maximum of 40 steps or a remainder REM less then 10^{-5}:

Diagram for calculation VCF from standard density input:



Input for calculating density at 15°C:

- $T_{standard}$:[°C] Temperature standard
- $\rho_{standard}$:[kg/m^3] Density standard
- Product type
- Start value for density at 15°C is the mean value of the high and low limits of the required product type.

In a maximum of 40 loops:

- Calculate the thermal expansion coefficient α_T with the new found density 15
- Calculate the C_{tl} factor ($C_{tl\ standard\ -->15)}$)
- Calculate the new reference density at 15°C by:

$$\rho_{15} = \frac{\rho_{s\tan dard}}{C_{tl(s\tan dard-15)}}$$

- Calculate the difference between the new found density 15 and the last found density 15. If the difference is smaller then 0.001% then the new found density 15 is correct, otherwise use the new found density 15 as new input.
- If the density 15 after 40 loops is not found then an alarm is shown on screen and through Modbus communication.

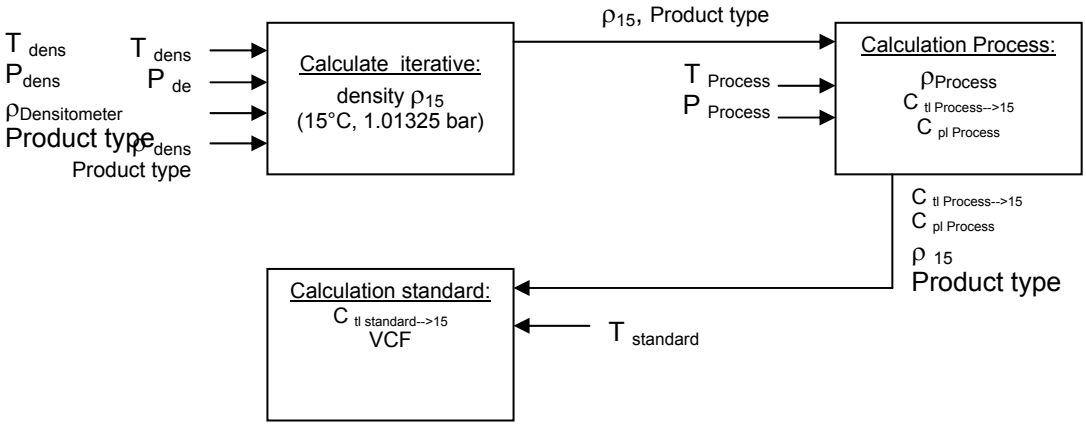
So now the density at 15°C is found.

If an external flow meter is connected and in function, the comparison is normally done by standard volume or mass. Therefore the temperature and pressure at external flow meter conditions is measured and treated like the UFS Process conditions to calculate the standard volume/mass.

4.1.4 Operating with the measured density

For less homogenous products like Crudes it is more practical to measure the density.
The density at 15°C is calculated through iteration by the input of the measured density in a maximum of 40 steps or a remainder REM less then 10^{-5}.

Diagram for calculation VCF from measured density input:



Input for calculating density at 15°C:

- T_{dens} :[°C] Temperature densito meter
- P_{dens} :[bar] Pressure densito meter
- ρ_{dens} :[kg/m3]Density densito meter (measured density)
- Product type
- Start value for density at 15°C is the mean value of the high and low limits of the required product type.

In a maximum of 40 loops:

- Calculate the thermal expansion coefficient α_T with the new found density15
- Calculate the C_{tl} factor ($C_{tl\ Tdens\ -->15)}$)
- Calculate the C_{pl} factor.($C_{pl\ Pdens}$)
- Calculate the new density at 15°C by:

$$\rho_{15} = \frac{\rho_{dens}}{C_{tldens} \cdot C_{pldens}}$$

- Calculate the difference between the new found density15 and the last found density15. If the difference is smaller then 0.001% then the new found density15 is correct, otherwise use the new found density15 as new input.
- If the density15 after 40 loops is not found then an alarm is shown on screen and through Modbus communication.

So the density at 15°C is found.
Practically the conditions (T, P) for the densito meter can differ from the conditions of the measured flow rate in the UFS-V.
Therefore, the VCF that is eventually used, is calculated using the found density at 15°C as its base and the conditions of the measured flow rate as its goal.

If an external flow meter is connected and in function, the comparison is normally done by standard volume or mass. Therefore the temperature and pressure at external flow meter conditions are measured and treated like the UFS Process conditions to calculate the standard volume/mass.

4.2 Mass calculation

For mass calculation without using API standard volume calculations for the Process density it is of great importance that its measurement conditions are approximately similar to the measurement conditions of the flow rate in the UFS.

$$\phi_m = \phi_v \cdot \rho$$

Φm : Mass flow rate [kg/hr], the unit used in UFP is [ton/hr], 1 [ton] is 1000 [kg]
Φv : Volume flow rate at Process conditions
ρ : Density at Process conditions [kg/m^3]

Any deviation in measured density as function of the measurement conditions is directly proportional in the calculation of the mass flow rate.

For example: Crude oil with flow measurement at 25 °C and density measurement at 24°C.
Density 25°C: 845.00 kg/m3
Density 24°C: 845.71 kg/m3

This gives a deviation in mass flow rate of:

$$\frac{845.71 - 845}{845} \cdot 100 = 0.08\%$$

So variations of the measurement conditions for densitometer position to flow rate position will effect linearity and repeatability of the mass measurement.

When this problem occurs it is better to use the API standard volume calculation for its mass calculation. Its a little more complicated but then there is a correction for the measurement conditions.

4.3 Solartron meter density is calculated as follows:

Density calibration at 20 °C, 1 barA.
Density temperature and pressure corrected:

$$D = K0 + K1 \cdot T + K2 \cdot T^2$$

$$D_t = D(1 + K18(t - 20)) + K19(t - 20)$$

$$D_p = D_t(1 + K20(p - 1)) + K21(P - 1)$$

Where K20 and K21 are:

$$K20 = K20A + K20B(p - 1)$$
$$K21 = K21A + K21B(p - 1)$$

D : Density, uncorrected [kg/m^3]
Dt : Density, temperature corrected [kg/m^3]
Dp : Density, pressure corrected [kg/m^3]
T : Periodic time [µs]
t : Temperature [°C]
p : Pressure [barA]
K0, K1, K2 : Calibration factors, Density calibration at 20 °C, 1 barA.
K18, K19 : Calibration factors, Density calibration at 20 °C, 1 barA.
K20A,K20B : Calibration factors, Density calibration at 20 °C, 1 barA.
K21A,K21B : Calibration factors, Density calibration at 20 °C, 1 barA.
The calibration factors can be altered on-line while the system is operating, by keyboard (CONTROLS F9, DENSITO F5) or by Modbus control.

4.4 Sarasota meter density is calculated as follows:

$$T_0' = T_0 + N_t(t - t_{cal}) + N_p(p - p_{cal})$$

$$\rho_m = D_0 \cdot \frac{T - T_0'}{T_0'} \cdot (2 + K \cdot \frac{T - T_0'}{T_0'})$$

ρ_m : Calculated measured mass density of fluid [kg/m^3]
T : Measured periodic time [µs]
T_0‘ : Corrected value of T_0 [µs]
T_0 : Calibration factor, reference periodic time [µs] of spool at 15°C and zero density
t : Absolute temperature [K]
t_{cal} : Calibration factor, calibration temperature used in density calculations [15°C]
p : Absolute pressure [bar]
p_{cal} : Calibration factor, calibration pressure used in density calculations [1.01325 bar]
N_t : Calibration factor, temperature coefficient of spool [µs/K]
N_p : Calibration factor, pressure coefficient of density transducer [µs/bar]
D_0 : Calibration factor, calibration constant of spool [kg/m^3]
K : Calibration factor, spool calibration constant [ ]

The calibration factors can be altered on-line while the system is operating, by keyboard (CONTROLS F9, DENSITO F5) or by Modbus control.

5 BATCH MODE

In batch mode the UFP-Program generates batch tickets by manual demand, Modbus controlled demand or time controlled demand.
These batch tickets are printed by a serial printer, according to DIN66258 standard.

5.1 Hardware set-up

The hardware set-up concerning Baud rate, stop bits etc. of the serial printer port is defined in an initialisation file used for all communication settings: COMS0300.DAT
Under section 2:

```
2<PRINTER COMMUNICATION SETUP>
2.1 PRINTER_COMPORT                 =#1     //1,2,3,4
2.2 PRINTER_WORD_LENGTH             =#8     //7 or 8
2.3 PRINTER_PARITY                  =#2     //0=disabled,1=odd,2=even
2.4 PRINTER_STOP_BITS               =#1     //1 or 2
2.5 PRINTER_BAUDRATE                =#9600  //38400, 19200, 9600, 4800, 2400, 1800
                                            //1200, 600, 300, 200, 150, 134.5, 110, 75
2.6 PRINTER_DTR_POLARITY            =#1     //0=pos,1=neg
2.7 PRINTER_RTS_POLARITY            =#1     //0=pos,1=neg
2.8 PRINTER_TIMEOUT                 =#5000  //Timeout[ms] on acknowledges etc.
2.9 PRINTER_TIMEOUT_MANAGE          =#10    //Timeout[ s] for print management switch
```

These settings must also be done at the printer side.

5.2 Layout of the ticket

The layout of the ticket is fixed in a file named TICK0300.DAT (see next page)
This file can be configured as required.
The file is protected by a CRC-checksum as all initialisation files are.
The CRC-checksums from the 3 data sets used (UFS, UFP and DAT) are printed on the ticket for additional security. Any change in the ticket layout is identified by a change in CRC-checksum.
The layout of the ticket consists of free to fill in text and data.

The data is framed as follows:

~	1 or 3	1 to 999	L or R	@
Frame Start character	1=batch start value 2=batch stop value 3=special character input	Parameter Mapping address	Optional alignment Left or right Default is R	Frame End Character

If the data needs to be printed in a specific format (by default the values are printed in format %10.3)

~	1 or 2	1 to 999	L or R	%	1 to 15	.	0 to (Width-1)	@
Frame Start character	1=start value 2=stop value	Parameter Mapping address	Optional alignment Left or right Default is R	Indicator For specific format	Width, number of characters to print	Period as decimal point	Number of characters in decimal	Frame End Character

Example of ticket layout in file TICK0300.dat:

```
~3027@~3087@~3049@          KROHNE Altometer
~3027@~3087@~3048@
IDENTIFICATION
  Ticket number      : ~1001L@
  Start time         : ~1101L@
  Stop  time         : ~2101L@
  Serial number      : ~1201L@
  Software version   : ~1202L@
  Tag number ID      : ~1203L@
  Batch ID           : ~1204L@
  Batch name         : ~1205L@

TOTALISERS
                        Process[m3]        Standard[m3]     Mass[tonM]
Start Cum.          :~1401R%10.2@    ~1404R%10.2@    ~1407R%10.2@
Stop  Cum.          :~2401R%10.2@    ~2404R%10.2@    ~2407R%10.2@
Batch               :~2301R%10.2@    ~2304R%10.2@    ~2307R%10.2@


BATCH FLOW WEIGHTED AVERAGES
                     Temperature[°C]     Pressure[bar]     Density [kg/m3]
Process            :  ~2502R%8.2@     ~2505R%8.2@     ~2520R%9.3@
Densito meter      :  ~2504R%8.2@     ~2507R%8.2@     ~2508R%9.3@
Standard           :  ~2519R%8.2@                     ~2509R%9.3@


CONFIGURATION ON STANDARD VOLUME CALCULATION
Calculation Method              : ~2701L@
Temperature standard [°C]       : ~2702L%5.2@
Density standard by             : ~2703L@
Api group fluid type            : ~2704L@
API correction factor K0        : ~2705L%11.4@
API correction factor K1        : ~2706L%11.4@
API correction factor K2         : ~2707L%11.8@


ALARMS                        Measured[s]     Override[s]
Temperature Body                : ~2606R%10.1@    ~2616R%10.1@
Temperature Process             : ~2607R%10.1@    ~2617R%10.1@
Temperature Densitometer        : ~2609R%10.1@    ~2619R%10.1@
Pressure    Process             : ~2610R%10.1@    ~2620R%10.1@
Pressure    Densitometer        : ~2612R%10.1@    ~2622R%10.1@
Density     Process             : ~2613R%10.1@    ~2623R%10.1@
Density     Standard            : ~2614R%10.1@    ~2624R%10.1@


General Flow 1-4 channels down          : ~2601R%10.1@
General Flow all channels down          : ~2602R%10.1@
Calculation API group mismatch          : ~2603R%10.1@
System runtime alarms occurred          : ~2604R%10.1@
Realtime Profile out of range           : ~2605R%10.1@
```

For the specific parameter mapping addresses see next paragraph.

5.3 Parameter mapping addresses

5.3.1 Ticket number

1 Non resetable sequence number for the batch
2 … 99 reserved

5.3.2 Times

101 Time and date of start and stop
102 ... 199 reserved

5.3.3 Operate names (optional at batch set-up)

201 Serial number (internal)
202 Software version (internal)
203 Tag number ID (internal)
204 Batch ID (fill in optional)
205 Batch name/source (fill in optional)
206 Batch reference number (only accessible by Modbus input)
207 ... 299 reserved

5.3.4 Resetable Totalisers (at start and stop time)

301 Resetable Actual Totaliser
302 Resetable Actual forward Totaliser
303 Resetable Actual reverse Totaliser
304 Resetable Standard Totaliser
305 Resetable Standard forward Totaliser
306 Resetable Standard reverse Totaliser
307 Resetable Mass Totaliser
308 Resetable Mass forward Totaliser
309 Resetable Mass reverse Totaliser
310 Resetable External Flow meter Standard Totaliser
311 Resetable External Flow meter Standard Forward Totaliser
312 Resetable External Flow meter Standard Reverse Totaliser
313.. 399 reserved

5.3.5 Non Resetable Totalisers (at start and stop time)

401 Non resetable Actual Totaliser
402 Non resetable Actual Forward Totaliser
403 Non resetable Actual Reverse Totaliser
404 Non resetable Standard Totaliser
405 Non resetable Standard Forward Total
406 Non resetable Standard Reverse Total
407 Non resetable Mass Totaliser
408 Non resetable Mass Forward Totaliser
409 Non resetable Mass Reverse Totaliser
410..499 reserved

5.3.6 Batch Flow weighted averages

501 Batch 1 average temperature body
502 Batch 1 average temperature Process
503 Batch 1 average temperature proving external flow meter
504 Batch 1 average temperature densito meter
505 Batch 1 average pressure Process
506 Batch 1 average pressure proving external flow meter
507 Batch 1 average pressure densito meter
508 Batch 1 average density densito meter
509 Batch 1 average density standard
510 Batch 1 average External Viscosity dynamic
511 Batch 1 average Ctl (15°C to Process)
512 Batch 1 average Cpl (0 Bar to Process)
513 Batch 1 average Ctl (15°C to standard)
514 Batch 1 average Cpl (0 Bar to standard, always 1)
515 Batch 1 average Ctl (15°C to densito meter)
516 Batch 1 average Cpl (0 Bar to densito meter)

517 Batch 1 average Ctl (15°C to proving external flow meter)
518 Batch 1 average Cpl. (0 Bar to proving external flow meter)
519 Batch 1 average temperature standard
520 Batch 1 average density Process
521 Batch 1 average flow actual
522 Batch 1 average density proving external flow meter
523 Batch 1 average flow proving external flow meter
524 Batch 1 average Installed K factor proving external flow meter
525 Batch 1 found New K factor proving external flow meter
526 Batch 1 difference installed vs new found K factor external
527…599 reserved

5.3.7 Batch alarms in seconds:

601 Batch 1 alarm: General Flow 1-4 channels down
602 Batch 1 alarm: General Flow all channels down
603 Batch 1 alarm: calculation API group mismatch
604 Batch 1 alarm: system runtime alarm occurred
605 Batch 1 alarm: real time profile out of range when used
606 Batch 1 alarm: measured Body temperature out of range
607 Batch 1 alarm: measured Process temperature out of range
608 Batch 1 alarm: measured External Prove temperature out of range
609 Batch 1 alarm: measured Densito temperature out of range
610 Batch 1 alarm: measured Process pressure out of range
611 Batch 1 alarm: measured External Prove pressure out of range
612 Batch 1 alarm: measured Densito pressure out of range
613 Batch 1 alarm: measured Densito Density out of range
614 Batch 1 alarm: measured Standard Density out of range
615 Batch 1 alarm: measured External viscosity out of range
616 Batch 1 alarm: override Body temperature applied
617 Batch 1 alarm: override Process temperature applied
618 Batch 1 alarm: override External Prove temperature applied
619 Batch 1 alarm: override Densito temperature applied
620 Batch 1 alarm: override Process pressure applied
621 Batch 1 alarm: override External Prove pressure applied
622 Batch 1 alarm: override Densito pressure applied
623 Batch 1 alarm: override Densito Density applied
624 Batch 1 alarm: override Standard Density applied
625 Batch 1 alarm: override External viscosity applied
626…699 reserved

5.3.8 Configuration API etc

701 Calculation method: Only Process flow, Standard volume/mass by API standards, mass measurement by Process density
702 Temperature standard in value
703 Density standard by: fill in manually, calculated from densito meter density, on AD / Modbus input
704 Fluid type: crude, gasoline, trans. area, jet group, fuel oil, free fill
705 API correction factor K0
706 API correction factor K1
707 API correction factor K2
708..799 reserved

5.3.9 Security

801 CRC checksum on data set UFS
802 CRC checksum on data set UFP
803 CRC checksum on data set DAT
804..999 reserved

5.3.10 Special characters for printer control

Special characters for printer control start with a 3.
The so called escape codes for printer control can be inserted into the Ticket Layout
Examples:

~3007@	Printer sounds a bel
~3012@	Formfeed
~3027@~3067@~3000@~30xx@	Set page length in inch in ~30xx@: xx=1…22
~3027@~3067@~3000@~3xxx@	Set page length in lines in ~3xxx@: xx=1…127
~3027@~3087@~3049@	Select double sized characters
~3027@~3087@~3048@	Cancel double sized characters

~3027@~3071@	Select double strike printing
~3027@~3072@	Cancel double strike printing
~3027@~3052@	Select italic characters
~3027@~3053@	Cancel italic characters
~3027@~3054@	Cancel italic characters
~3027@~3057@	Enable paper out sensor
~3027@~3056@	Disable paper out sensor

5.4 Initial batch set-up

The initial batch set-up is by initialisation file CLNT0300.dat file under section 12:

```
12 <BATCHING CONTROL>
Only in use when a Epson Serial Printer according DIN66258 standard
is connected.
Note that in the HSET0300.UFP file (for hardware setup) the following data
must be set:
-1.4 Location_stat must be enabled (saving of status)
-1.8 Location_tic  must be a disk with enough storage capacity

12.1 BATCHING_ON        =#2     //0=Internal batching disabled
                                //1=Enable Batching (start stop at zero flow)
                                //2=Enable Batching (start stop at all flows)
                                //3=Enable Batching (continuous pipe line) auto reset
                                //4=Enable Batching (continiuous pipe line) no reset at end
                                //If enabled then automatic initialize printer
12.2 Max_tickets        =#100   //Maximum number of last tickets saved 10..100000
                                //depending on disk space (see Location_tic above)
12.3 Hour_start         =#10    //Start hour    0..23 for continous pipe line ticket
12.4 Hour_interval      =#1     //Interval hour 1..24 for continous pipe line ticket
                                //0=No tickets automatic, only on demand
12.5 Modbus_control     =#1     //Control batching through modbus
```

- There are 3 modes for Batch configuration:

BATCHING ON	Start stop batch permission	Confirmation asked on batch settings	API settings during batch possible
0	Batch mode disabled	-------	------
1	Only at zero flow conditions	Yes	No
2	At all flowing conditions	Yes	No
3	At all flowing conditions	No	Yes (continuous pipe line measurement)

  BATCHING_ON 1 and 2 have the following restrictions during a batch:
  -No reset possible of resetable totalisers
  -No reset of error times but the possibility to reset occurred error messages

- The previous number of tickets saved is set with MAX_TICKETS. Default is 100 tickets.
  Be careful with increasing the number of tickets. Not enough disk space means losing tickets

- For Continuous Pipe Line Measurement the ticket automatically is printed starting from HOUR_START

- For Continuous Pipe Line Measurement the ticket automatically is printed every HOUR_INTERVAL, but if interval 0 is installed than tickets are only printed on demand

- By MOD_BUS_CONTROL it is possible to enable the controls through Modbus for batching:
  -Start batch
  -Stop batch
  -Reset printing
  -Confirm printing

Or in case of using continuous Pipe Line measurement
-Ticket on demand with reset of values
-Ticket on demand without reset of values
- Reset printing

5.5 Batch status

Batch status (status window text)	As a value on Modbus	Explanation
NON	0	No batch active, ready to set-up
SETUP	1	In set-up mode. After set-up is done, it is possible to start a batch
RUNNING	2	Batch is started
END-BATCH	3	Batch is stopped and ticket is made, then attempt to END_PRINT
END-PRINT	5	Status during successful printing
END-FAIL	6	If printing fails or printer is busy too long
CONFIRM	7	After successful print job waiting for manual confirmation
RESET	10	Waiting for reset command after END_FAIL

5.6 Printer status

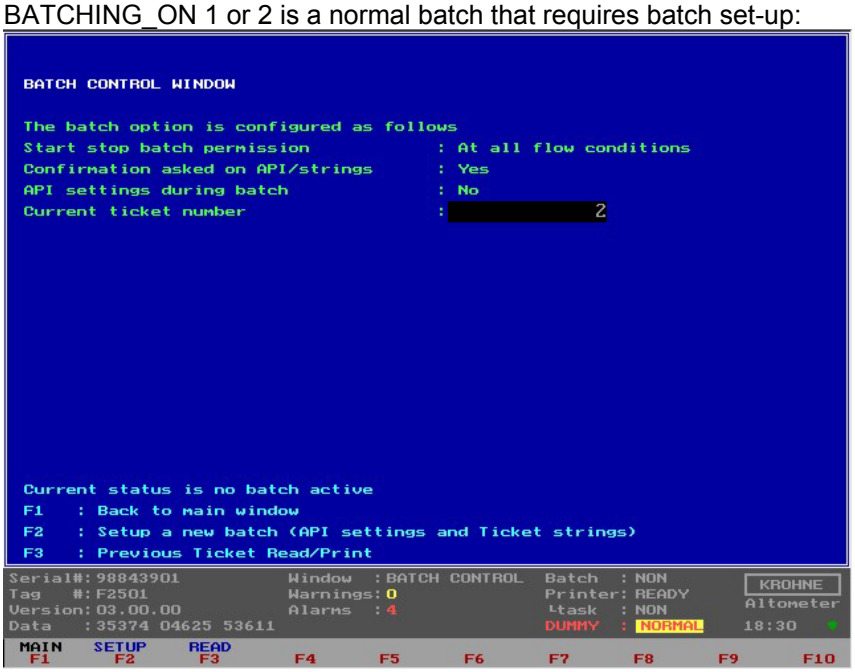
Printer status (status window text)	As a value on Modbus	Explanation
Ready	0	Ready for printing
Fail	1	If printer failed during print job
Busy Check	2 2	During print job If no print job, check if printer is connected and ready
Off	3	If printer is not found after Check

5.7 Printer task status

Printer status (status window text)	As a value on Modbus	Explanation
NON	0	No print job
BUSY	1..2	Attempt first character
Xxxs …0s Timeout print management Value in seconds counting down, if 0 then status to RESET	3	Getting acknowledge if printer is taking print job. For multiple UFP's connected by a printer switch to 1 serial printer. Timeout print management can be set in COMS0300.dat under section 2.9
BUSY	4..98	Printing headers
Progress counter as percentage 0…100	99	Successful printing ticket
CONFIRM	100	Ready to confirm print job, see batch status CONFIRM
RESET	101	Ready for reset command on batch status RESET

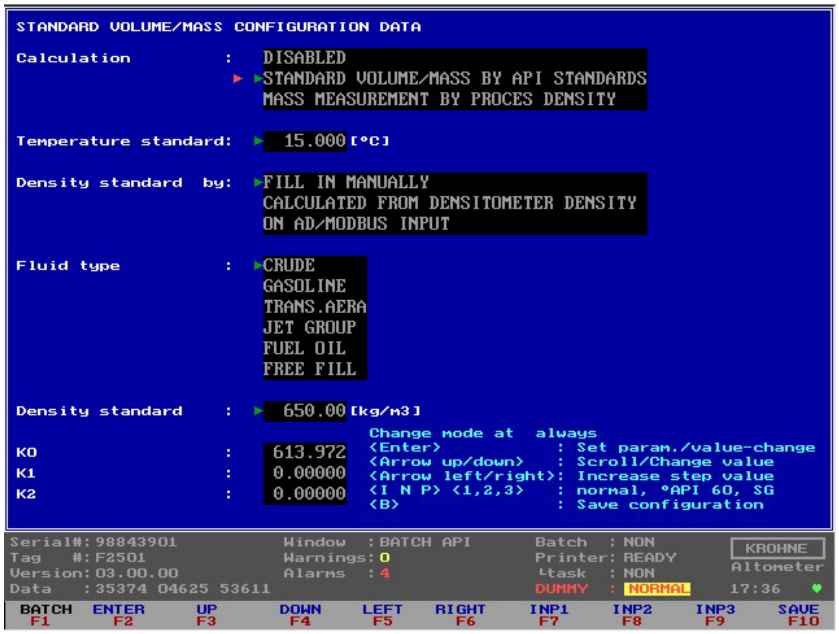
5.8 Batch set-up

BATCHING_ON 1 or 2 is a normal batch that requires batch set-up:



A new batch can only be set if the last batch is stopped and the ticket is printed correctly and confirmed
Start the set-up by pressing function key F2 for confirmation on the API settings

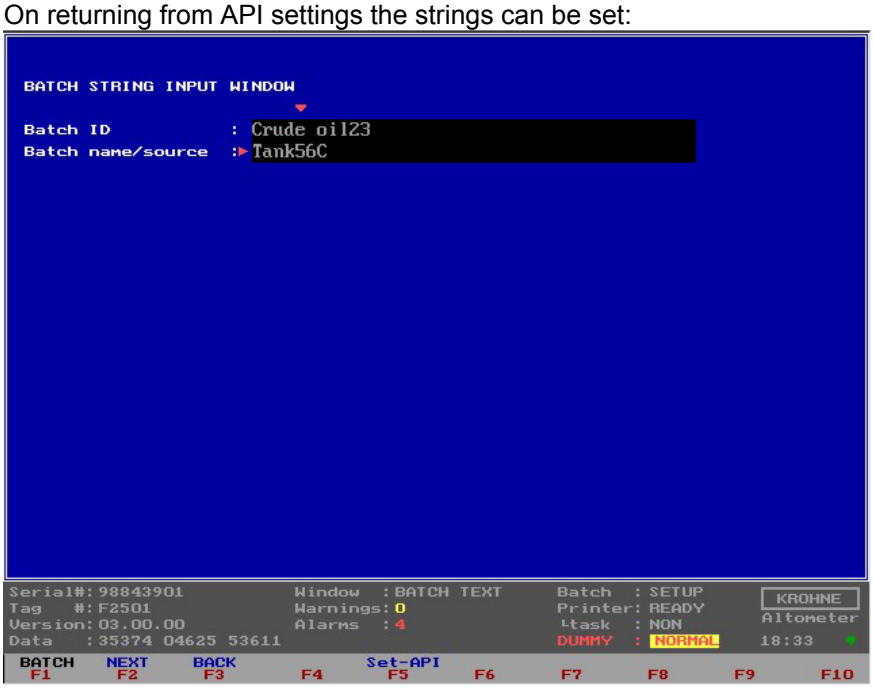
5.8.1 API set-up



The operator is forced to look at the API setting. He can change the settings and SAVE by F10 or return back to BATCH by F1.
If the batch is controlled by Modbus this step must be handled by the Host system.

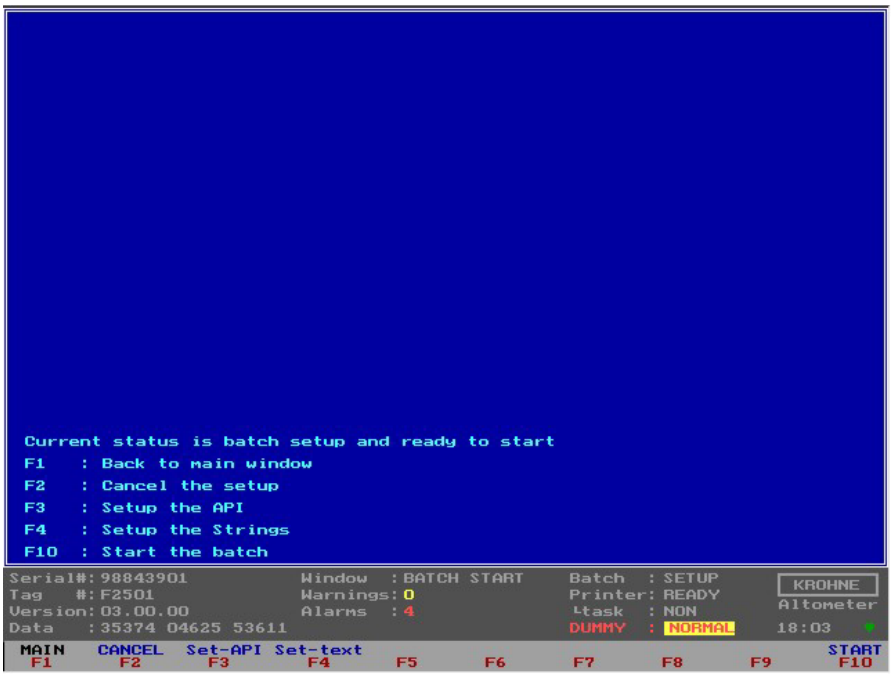
5.8.2 Batch text set-up

On returning from API settings the strings can be set:



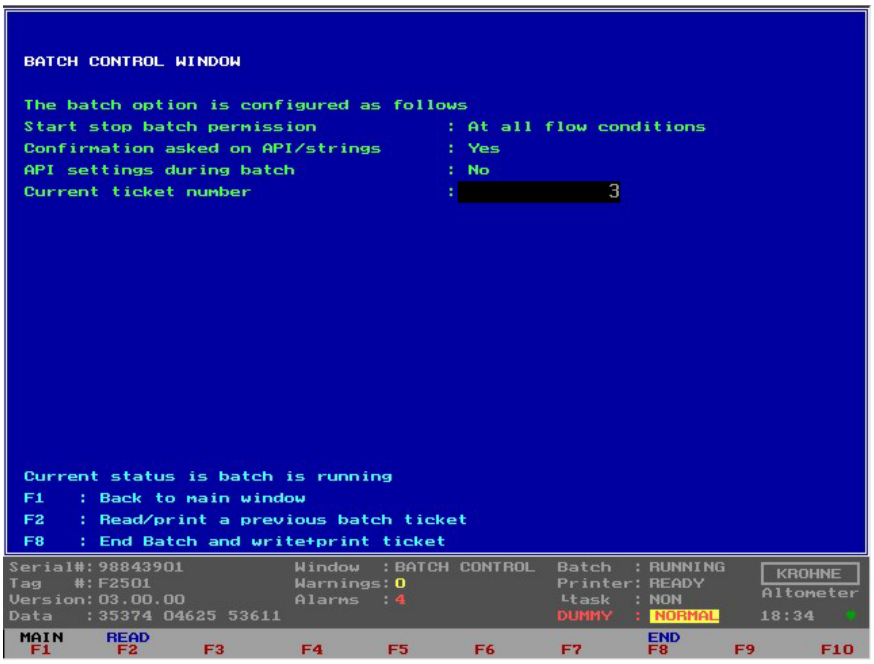
Returning to batch means confirmation on texts
Confirmation on Batch ID and Batch name/source is only possible with manual set-up
Note that the Modbus data is only numerical, so Modbus can not set Batch ID and Batch Name.

5.8.3 Ready to start batch after set-up is complete



- Now batch is ready to start by Function key F10 or by Modbus command if enabled. Note that depending on security level it is only possible to start a batch if flow is at zero flow conditions
- Possible to cancel the set-up (F2)
- Or return to the API settings (F3) or the Text settings (F4)

5.9 Batch start



Starting a batch holds the following automatic actions:

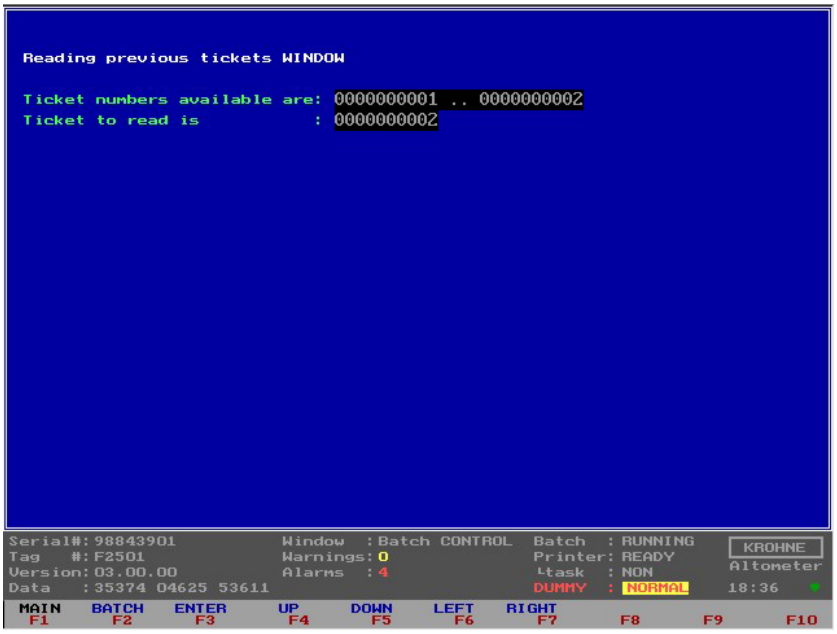
- Reset of : errors, resetable totalisers and batch flow-weighted averages (temp, press, densities etc.)
- Increase ticket number by one (is saved in the “batch status” file.
- Saving of all batch parameters (for later use when batch is stopped and certain batch start values are requested on ticket) in a “batch start” file that is secured by a CRC-checksum

5.10 During batch

During a batch the restrictions are handled as the installed BATCHING_ON level prescribes.
Files with all alarm times, totalisers, and batch averages are saved every 20 seconds to a SRAM disk in dual files. Sequentially saving it each time in a different file.
So when the power is turned of during a file-save causing the file to be corrupted, the previously saved dual file is used at start-up to load previously saved alarm times, totalisers, and batch averages.

5.10.1 Reading / Printing previous batch ticket

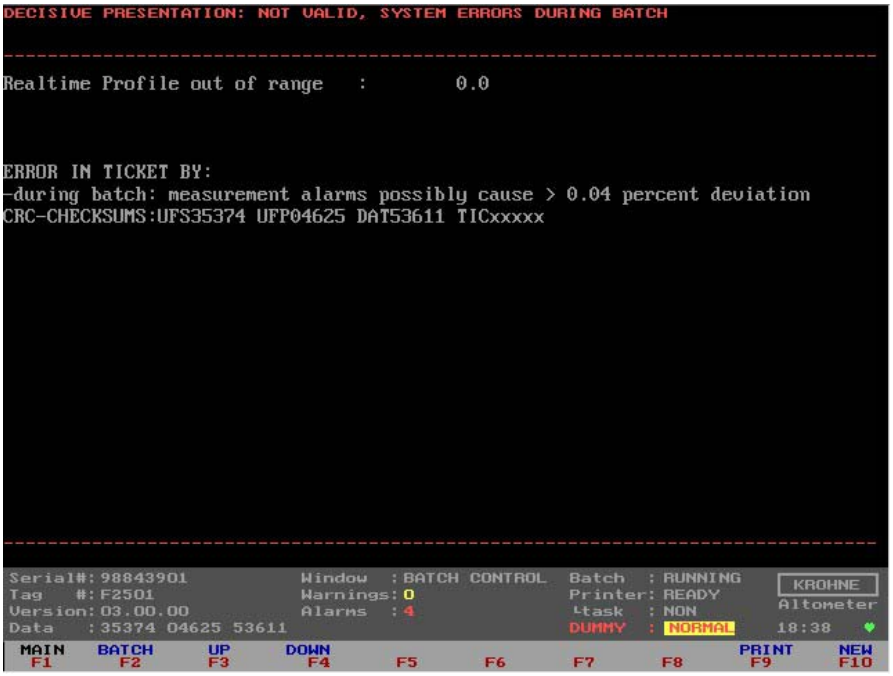
During a batch it is possible to read and print a previous batch ticket
From Main window to Batch Control window by F7 and then Function Key F2 for reading previous batch ticket



Explanation Function keys:

F1	: Back to Main Window
F2	: Return to Batch Control window
F3	: Upload “Ticket to read “
F4…F7	: Change “Ticket to read” number within the limits of “Tickets available”

5.10.1.1 Read ticket

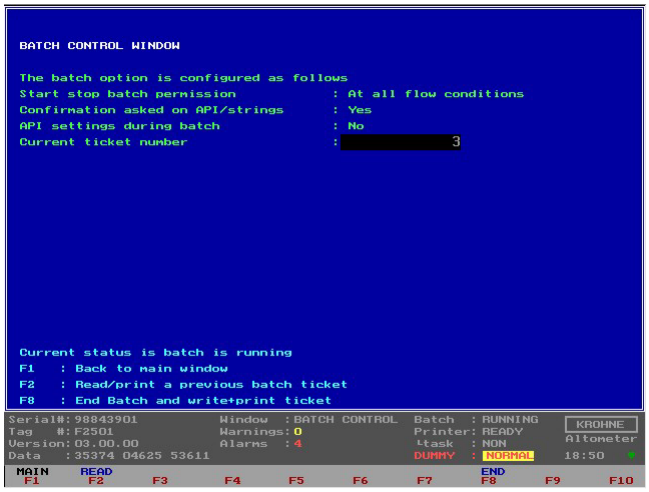


Notice that the ticket that is read is not valid:
The header explains that there were system errors.
The System errors are mentioned at the bottom of the ticket therefore in this example the reading of the ticket is scrolled down to the bottom.

Function keys:
F1 : back to Main window
F2 : back to Batch control
F3 : Scroll up in ticket
F4 : Scroll down in ticket
F9 : Print the ticket
F10 : Read another ticket

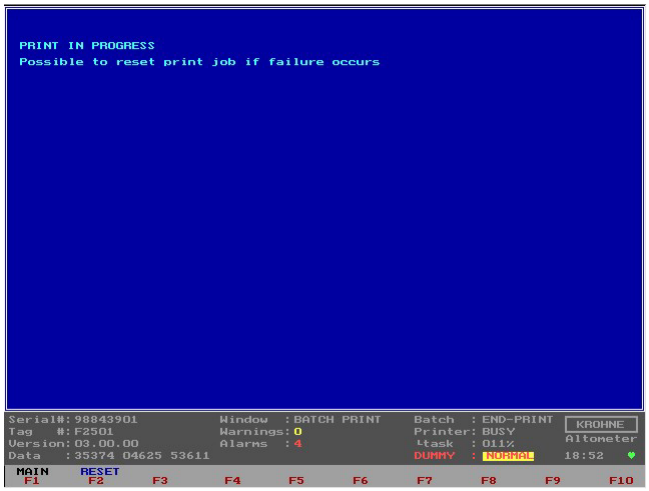
5.11 Batch stop

After starting a batch, this batch can be stopped manually in the Batch Control window by F8, or by Modbus command if enabled
Note that depending on security level it is only possible to stop a batch if flow is at zero conditions



Stopping a batch holds the following automatic actions:

- Saving of all parameters possible (in values) on ticket in a “batch stop” file that is secured by a CRC-checksum.
- Make and save ticket according to the “layout ticket” file that is secured by a CRC-checksum
- If saving of the ticket failed a message will appear on screen and on the ticket.
- The ticket will be send to the printer after saving the ticket



In the picture above the batch is ended and is just started to print.
Batch status : END PRINT
Printer status : BUSY
Printer task at : 011%
It is always possible to reset the printer buffer in the UFP, this will cause the print task to start at the beginning of the ticket again.
Note that it can be necessary to reboot the printer itself on a real print failure.

Stopping a batch holds the following “manual actions” / “ModBus commands”:

- After ticket is printed, confirm the printed ticket is printed successful and is the same as shown on screen.

- If the printing has failed the software generates an alarm and no confirmation can be given only a reset of the printer. Check and reset the printer. After reset, the complete ticket is printed again. If the ticket is printed correct a confirmation can be given.

Note that a next batch can only be started when the previous batch is confirmed.

If any CRC is corrupted this will be indicated on the ticket Printout
- In the header of the ticket, that the ticket is invalid due to system errors
- At the end of the ticket, the explanation of the system errors and so that there was a crc checksum failure

If status batch files are all corrupt at initialisation of the UFP-Program, a new status file is made. The ticket number can then be set to desired value (for logistical reasons) and the DAT data set will have CRC checksum update.

5.11.1 Possible errors that cause an Invalid Batch ticket

In the header of the ticket one of the 3 following messages will be printed
- Decisive presentation: Valid
- Decisive presentation: Not valid, crc-checksum error (ticket)
- Decisive presentation: Not valid, system errors during batch

At the end of the ticket, there will be an explanation of the system errors if they have occurred:
Error in batch by:
- During read/write of start/stop value files
- During making ticket file (write errors)
- During batch: batch status files
- During batch: batch totaliser files
- During batch: batch average files
- During batch: system stopped during batch
- During batch: measurement alarms possibly cause > 0.04 percent deviation
- During batch: batch status file saving

5.11.2 Measurement alarms batch validation

To validate a batch when a measurement alarm has occurred over a period of time (Alarm in [s]) the following calculation is used to validate the batch within a 0.04% error.

$$Volume\_error[m3] = \frac{MaxFlow[m3/h]}{3600} \cdot Alarm[s] \cdot \frac{Error[\%]}{100}$$

$$Deviation[\%] = \frac{Volume\_error[m3]}{Batch\_Volume\_proces[m3]} \cdot 100[\%]$$

Secondary inputs measurement Error% on occurred alarm:

Secondary inputs	Error%	Explanation
Temperature body	2	10°C is 0.036% deviation: 2% caused by >500°C
Temperature Process	50	1°C is 0.1% deviation: 50% caused by 500°C deviation
Temperature proving external flow meter	50	1°C is 0.1% deviation: 50% caused by 500°C deviation
Temperature densito meter	50	1°C is 0.1% deviation: 50% caused by 500°C deviation
Pressure Process	5	1 bar is 0.01% deviation: 5% caused by 500 bar deviation
Pressure proving external flow meter	5	1 bar is 0.01% deviation: 5% caused by 500 bar deviation
Pressure densito meter	5	1 bar is 0.01% deviation: 5% caused by 500 bar deviation
Density densito meter	100	Standard volume correction uncertain therefore 100% errror
Density standard	100	Standard volume correction uncertain therefore 100% errror

UFP measurement Error% on occurred alarm:

Secondary inputs	Error%	Explanation
1-4 channels down	10	Correction curve over viscosity never > 5%. To secure validity value=10%
All channels down	100	System is not measuring flow therefore 100% error
API group mismatch	100	Standard volume correction uncertain therefore 100% errror
System alarms	10	Over estimated value on alarms as file not found, overrun etc
Real time profile out of range	10	Correction curve over viscosity never > 5%. To secure validity value=10%

Each alarm is measured in seconds, and the Volume_Error it causes, is calculated.
All Volume_error values are summated and the total deviation is calculated.

Example: How long may a certain error be active during a batch before the batch is Not Valid:

- Only alarm 1-4 channels down: alarm time is x
- Maximum flow rate is 1200m3/h
- Batch time is 24 hours at 80% of the maximum flow rate

The batch volume in 24 hours at 80% flow rate:

$$Batch\_Volume\_\mathrm{Pr}oces[m3] = 24[h] \cdot \frac{80[\%]}{100} \cdot 1200[m3/h] = 23040[m3]$$

For the alarm “1-4 channels down” to be within 0.04% :

$$Volume\_error\_\max = \frac{0.04[\%]}{100} \cdot 23040[m3] = 9.216[m3]$$

$$Alarm[s] = 9.216[m3] \cdot \frac{3600}{1200[m3/h]} \cdot \frac{100}{10[\%]} = 276[s]$$

5.12 Continuous Pipeline Measurement tickets

When the BATCHING_ON mode is on Continuous Pipeline Measurement no confirmations are asked after printing the ticket.
If a new ticket has failed in printing it is asked to reset. But if no reset is made then the next ticket will just make the reset and start printing the next ticket.
The previous ticket can then be printed as described in paragraph: Reading / Printing previous batch ticket

There are two options for continuous Pipeline measurement:
3 Auto reset of totalisers, errors, averages etc between tickets
4 No auto reset of totalisers, errors, averages etc between tickets, but possible on demand.
(clnt0300.dat file section 12.1 option 3 or 4)

For Continuous Pipe Line Measurement the ticket automatically is printed starting from HOUR_START (clnt0300.dat file section 12.3)

For Continuous Pipe Line Measurement the ticket automatically is printed every HOUR_INTERVAL, but if interval 0 is installed than tickets are only printed on demand (clnt0300.dat file section 12.4)

5.13 Example of ticket to output

DECISIVE PRESENTATION: NOT VALID, SYSTEM ERRORS DURING BATCH

KROHNE Altometer

IDENTIFICATION

Ticket number	: 3
Start time	: May 21 18:34:46 2001
Stop time	: May 21 18:51:46 2001
Serial number	: 98843901
Software version	: 03.00.00
Tag number ID	: F2501
Batch ID	: Crude oil23
Batch name	: Tank56C

TOTALISERS

		Process[m3]	standard[m3]	Mass[tonM]
Start Cum.	:	731.60	747.43	485.83
Stop Cum.	:	757.43	773.82	502.99
Batch	:	25.83	26.39	17.15

BATCH FLOW WEIGHTED AVERAGES

		Temperature[°C]	Pressure[bar]	Density [kg/m3]
Process	:	0.00	0.00	664.072
Densito meter	:	0.00	0.00	500.000
Standard	:	15.00		650.000

CONFIGURATION ON STANDARD VOLUME CALCULATION

Calculation Method	: API2540
Temperature standard [°C]	: 15.00
Density standard by	: Manually
Api group fluid type	: Crude
API correction factor K0	: 613.9723
API correction factor K1	: 0.0000
API correction factor K2	: 0.00000000

ALARMS		Measured[s]	Override[s]
Temperature Body	:	0.0	0.0
Temperature Process	:	51.7	0.0
Temperature Densitometer	:	0.0	0.0
Pressure Process	:	51.7	0.0
Pressure Densitometer	:	0.0	0.0
Density Process	:	0.0	0.0
Density Standard	:	0.0	0.0

General Flow 1-4 channels down	:	0.0
General Flow all channels down	:	0.0
Calculation API group mismatch	:	0.0
System runtime alarms occurred	:	0.0
Realtime Profile out of range	:	0.0

ERROR IN BATCH BY:
-during batch: measurement alarms possibly cause > 0.04 percent deviation
CRC-CHECKSUMS:UFS35374 UFP04625 DAT53611 TICxxxxx

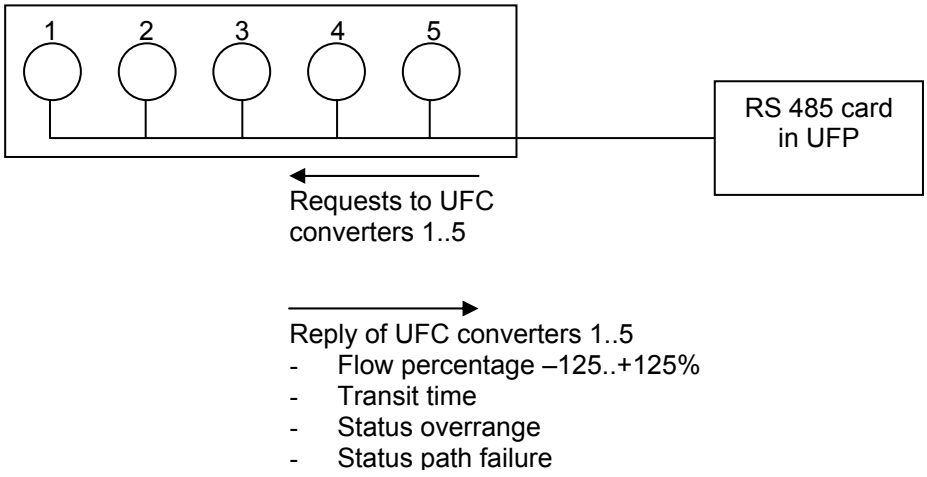
The alarms on Temperature Process and Pressure Process caused a deviation on the Standard Volumes that will be larger then 0.04% therefore the batch was declared not valid.

6 DATA ACQUISITION

Input data can be divided into:
- Data input RS485 card
- Digital inputs MP103 card
- Frequency inputs MP103 card
- Analog inputs AD card

6.1 Data input RS485 card

The data measured by the five converters UFC-V is transferred to the UFP-V by using a half-duplex protocol based on balanced data transmission (RS485).
The communication protocol requests the five converters for new measured data. The incoming data is first checked on parity-errors, framing-errors, and overruns. The data essentially contains the measured flow from 5 ultrasonic measuring paths, transit time, and error codes. The converter sends data every 35 ms.



6.2 Digital inputs MP103 card

The MP103 card has 4 digital inputs.
The digital inputs are normally open (is 0)
The logic level is TTL compatible, maximum 12 VDC.

Channel no.	Function	Action
0	Reset measured volume, Process-time and error messages	Make input '1' to reset
1	Reset error messages	Make input '1' to reset
2	Calibration start-signal (KROHNE Altometer use only)	Make input '1' to arm, make '0' to enable
3	Calibration stop-signal (KROHNE Altometer use only)	Make input '1' to arm, make '0' to enable

- The digital input function can be disabled/enabled in the Initialisation files: HSET0300.UFP section 3
- The individual channels can be disabled/enabled in the Initialisation files: CLNT0300.dat section 8
- The signals can be checked on value in the service window IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)

HSET0300.UFP section 3

```
3.3 MP_Dig_in              =#0      //Digital   Inputs  0=disable, 1=NO, 2=NC
```

CLNT0300.dat section 8

```
8 <DIGITAL INPUT CHOICES>
8.1  DI_ZERO_VOL           =#1      //0=disable, 1=MP103 CARD 2=ADCARD812/816
8.2  DI_ZERO_ERR           =#1      //0=disable, 1=MP103 CARD 2=ADCARD812/816
8.3  DI_START_STOP         =#0      //0=disable, 1=MP103 CARD 2=ADCARD812/816
                                    //if disabled then possible to choose Solartron1 or 2
                                    //see frequency input parameters for further details,
```

6.3 Frequency inputs MP103 card

There are 2 frequency-input channels.
The MP103 card itself can only handle TTL signals. With optional signal converters/barriers a non-TTL input signal can be converted into a TTL signal.
The used crystal oscillator properties are:
Stability 100 ppm over an operating temperature range of 0 –70°C.

Frequency measurement (option on channel 1 and 2):
The frequency-input range is 1-5000 Hz.
The frequency measurement is 24 bit. Multiple pulses are counted over a period of time.
Each frequency measurement takes approximately 8 seconds.
The function is to measure the density input from a Solartron/Sarasota densitometer.

Pulse counter (option on channel 1 only):
The input range is 0-5000 pulse/sec.
The pulse counter is 32 bit. Every 35 ms the counter is read. The counter can reset on demand.
It is used for the pulse input from an external flow meter.

Note that the two options are also embedded in the hardware, so depending on the used chipset for channel 1 the option is available.

- The Frequency input function can be disabled/enabled in the Initialisation file: HSET0300.ufp section 3
- The Secondary input parameter can be set in Initialisation file CLNT0300.dat section 9 and 11.
- The signals can be checked on value in the service window IO
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)

HSET0300.ufp section 3

```
3.5 MP_freq_inp1        =#1     //Frequency input1  0=disable, 1=Frequency
3.6 MP_freq_inp2        =#0     //Frequency input2  0=disable, 1=Frequency
```

CLNT0300.dat section 9 example density densitometer

```
DENSITY DENSITOMETER
9.50 MODE               =#1     //Use input:0=disable, 1=AD-input, 2=Modbus, 3=Freq-in
9.51 MODBUS_SERVICE     =#2     //Service input:0=disable, 1=AD-input, 2=Freq-in
9.52 Alarm_out          =#1     //disable=0, enable=1  alarm to output
9.53 alarmLow           =#500   //Low alarm  below this value [kg/m3]
9.54 alarmHigh          =#1200  //High alarm above this value [kg/m3]
9.55 Override           =#750   //Default static override value [kg/m3] on alarm
9.56 Override_code      =#0     //0=disable override value, 1=use default override
                                //2=use default batch average as override
```

CLNT0300.dat section 11 example Frequency input 1

```
11.1 FREQ1_APPLIANCE    =#6     //0 =SOLARTRON1, 1=SARASOTA1,
                                //2 =SOLARTON 1/2 CHOICE by digital input,
                                //3 =SARASOTA 1/2 CHOICE  by digital input
                                //4 =Density Densitometer with span
                                //5 =Density Standaard with span
                                //6 =Counter for external flowmeter
                                //99=disabled
11.2 FREQ1_val_low      =#0     //Lowerlimit Value, for FREQ1_APPLIANCE 4-5
11.3 FREQ1_val_high     =#1000  //Upperlimit Value, for FREQ1_APPLIANCE 4-5
11.4 FREQ1_low          =#0     //Lowerlimit Freq[Hz],(min=0 Hz   ) FREQ1_APPL 4-5
11.5 FREQ1_high         =#1000  //Upperlimit Freq[Hz],(max=5000 Hz) FREQ1_APPL 4-5
```

6.4 Analog inputs AD card

The AD card has 16 analog inputs.

The input range is bipolar 12bit and only the positive range is used, so the resolution is 11 bit for 0 - 20mA (11 bits =2048 positions) .
The linearity is ± 1 bit.
Accuracy 0.015% of reading ± 1bit
The resolution for 4-20 mA is 1638 positions.

This is sufficient for the standard volume correction:

- The deviation approximately is 0.1% per 1°C for the temperature correction on the standard volume.
- For a span of 0 - 100°C and 4-20 mA this gives: 100°C / 1638 = 0.061 °C/position

The deviation in standard volume per bit then is 0.1%/°C * 0.061 °C/position = 0.0061% / position

- The AD input function can be disabled/enabled in the Initialisation file: HSET0300.ufp section
- The specific secondary input can be set in Initialisation file CLNT0300.dat section 9 and 10.
- The signals can be checked on value in the service window: IO
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)
- All inputs can have high/low alarm limitations. In case of an alarm a pre-defined override value can be used (see CLNT0300.dat section 9)
- Adjustable input range 0-20 mA

HSET0300.ufp section 4

```
4.1 AD_Card_Type        =#0     //0=disable, 1=AD12 card, 2=AD16 card
4.2 AD_curr_in          =#0     //Current inputs  disable=0, enable=1
```

CLNT0300.dat section 9: example Temperature Process parameter

```
TEMPERATURE PROCESS
9.8  MODE               =#1     //Use input:0=disable, 1=AD-input, 2=Modbus
9.9  MODBUS_SERVICE     =#0     //Service input:0=disable, 1=AD-input
9.10 Alarm_out          =#1     //disable=0, enable=1  alarm to output
9.11 alarmLow           =#0     //Low alarm  below this value [øC]
9.12 alarmHigh          =#100   //High alarm above this value [øC]
9.13 Override           =#20    //Default static override value [øC] on alarm
9.14 Override_code      =#0     //0=disable override value, 1=use default override
                                //2=use default batch average as override
```

CLNT0300.dat section 10: example Temperature Process on AD input

```
AD TEMPERATURE PROCESS
10.7  val_low           =#0     //Lowerlimit Process temperature as [Celsius]
10.8  val_high          =#100   //Upperlimit Process temperature as [Celsius]
10.9  curr_low          =#4     //Lowerlimit current as [mA] (min.  0mA)
10.10 curr_high         =#20    //Upperlimit current as [mA] (max. 20mA)
10.11 tau               =#1     //Timeconstant (average) [sec]
10.12 channel           =#2     //Channelnr on ad812/816 card ch2/5, 99=disable
```

7 OUTPUT

The output consists of:

- Frequency output MP103 card
- Analog output MP103 card
- Relay outputs MP103 card
- Analog outputs AD card
- Digital outputs AD card
- Modbus communication

7.1 Frequency output MP103 card

Frequency output:
- Maximum output range is software adjustable 1 – 2000 Hz
- 12V/24V / open-collector selectable by card jumpers
- There is one output value but there are two physical outputs, these can be phase-shifted 90°/180° selectable by card jumper to simulate a turbine output for pulse fidelity and integrity check.

The resolution of the frequency output is max 0.016% of the output value. The resolution mentioned is for a static output value. In practice the resolution will be averaged because of the variations in signal. Over a period of time of flow measurement and output the resolution will not be an issue.

The most likely frequency output is the Process volumetric flow (default).
- The frequency output function can be disabled/enabled in the Initialisation file: HSET0300.ufp section 3
- The frequency output can be configured in the Initialisation file: CLNT0300.dat section 5
- The signals can be checked on value in the service window: IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)

HSET0300.ufp section 3

```
3.1 MP_freq_out              =#0      //Frequency output  0=disable, 1=enable
```

CLNT0300.dat section 5

```
5 <FREQUENCY OUTPUT, mp103 card>
5.1  Freq_max                =#1000   //Max.scale [Hz], range= 1 - 2000 [Hz]
5.2  Freq_mode               =#1      //0=DIS 1=flow[m3/h] 2=flow15 3=mass[ton/hr]
                                      //4=dens[kg/m3] 5=c_s[m/s] 6=VCF   7=viscosity[10e-6 m2/s]
                                      //8=dens15[kg/m3] 9=Temp[øC] 10=Pres[bar]
5.3  Freq_min_unit           =#0      //Min outputvalue in [unity]
5.4  Freq_max_unit           =#1800   //Max outputvalue in [unity]
5.5  Freq_tau                =#0      //Averaging time tau[s]
5.6  Freq_dir_flow           =#1      //Directionflow for output frequency: 0=+, 1=+-
```

7.2 Analog output MP103 card

The analog output is a pulse width modulated current output, resolution 14 bit.

- The AD output function can be disabled/enabled in the Initialisation file: HSET0300.ufp section 3
- The AD output can be configured in the Initialisation file CLNT0300.dat section 6
- The signals can be checked on value in the service window: IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)

HSET0300.ufp section 3

```
3.2 MP_curr_out              =#0    //Current   output  0=disable, 1=enable
```

CLNT0300.dat section 6:

```
6 <ONE D/A OUTPUT 0-22mA (adjustable), mp103 card>
6.1  Out1_mode               =#1        //0=DIS 1=flow[m3/h] 2=flow15 3=mass[ton/hr]
                                        //4=dens[kg/m3] 5=c_s[m/s] 6=VCF 7=viscosity[10e-6 m2/s]
                                        //8=dens15[kg/m3] 9=Temp[øC] 10=Pres[bar]
6.2  Out1_min_curr           =#4        //Minscale I [mA], range= 0 - max_currout [mA]
6.3  Out1_max_curr           =#20       //Maxscale I [mA], range= min_currout - 22 [mA]
6.4  Out1_min_unit           =#0        //Min outputvalue in [unity] choice
6.5  Out1_max_unit           =#1000     //Max outputvalue in [unity] choice
6.6  Out1_tau                =#0        //Averaging time tau[s]
```

7.3 Relay output MP103 card

There are four relay outputs, normally (no power) open.
Open is 0, closed is 1.

Relay No.	Open/Close	Function
0	0	Negative flow, a flow smaller than minus low-flow cut-off
	1	Flow larger than minus low-flow cut-off
1	0	Alarm (system is not reliable): - More than 2 channels failure - One or more channels failure and flow is out of range for correction - System alarm
	1	No alarms(system is reliable)
2	0	Warning (system is still reliable): - 1 or 2 channels failure - System warning
	1	No warnings
3	0	Positive flow, flow larger than positive low-flow cut-off
	1	No flow (flow rate within limit low-flow cut-off)

- The digital output function can be disabled/enabled in the Initialisation files: HSET0300.UFP section 3
- The signals can be checked on value in the service window: IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)
- More information on warnings and alarms can be found in chapter RUNTIME Windows (alarm window)

HSET0300.ufp section 3

```
3.4 MP_Dig_out          =#0     //Digital   Outputs 0=disable, 1=NO, 2=NC
```

7.4 Analog outputs AD card

The AD card has two 0-10V analog outputs.
Resolution is 12 bits, linearity ±½ bit, settling time 30 microseconds. With additional converters the 0-10V range can be converted into 4-20 mA signals

- The AD output function can be disabled/enabled in the Initialisation file: HSET0300.ufp section 4
- The AD output can be configured in the Initialisation file CLNT0300.dat section 7
- The signals can be checked on value in the service window: IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP Calibration and Verification I/O)

HSET0300.ufp section 4

```
4.3 AD_curr_out         =#0     //Current outputs disable=0, enable=1
```

CLNT0300.dat

```
7 <TWO D/A OUTPUTS 0-10 volt, ad812/ad816 card>
7.1  Out2_mode          =#4     //0=DIS 1=flow[m3/h] 2=flow15 3=mass[ton/hr] 4=dens[kg/m3]
                                //5=c_s[m/s] 6=VCF 7=viscosity[10e-6 m2/s]
                                //8=dens15[kg/m3] 9=Temp[øC] 10=Pres[bar]
7.2  Out2_min_volt      =#0     //Minscale U [V], range= 0 - max_volt [V]
7.3  Out2_max_volt      =#10    //Maxscale U [V], range= min_volt - 10 [V]
7.4  Out2_min_unit      =#610   //Min outputvalue in [unity] choice
7.5  Out2_max_unit      =#1075  //Max outputvalue in [unity] choice
7.6  Out2_tau           =#10    //Averaging time tau [s]
7.7  Out3_mode          =#7     //0=DIS 1=flow[m3/h] 2=flow15 3=mass[ton/hr] 4=dens[kg/m3]
                                //5=c_s[m/s] 6=VCF 7=viscosity[10e-6 m2/s] 8=dens15[kg/m3]
                                //9=Temp[øC] 10=Pres[bar]
7.8  Out3_min_volt      =#0     //Minscale U [V], range= 0 - max_volt [V]
7.9  Out3_max_volt      =#10    //Maxscale U [V], range= min_volt - 10 [V]
7.10 Out3_min_unit      =#0     //Min. outputvalue in [unity] choice
7.11 Out3_max_unit      =#150   //Max. outputvalue in [unity] choice
7.12 Out3_tau           =#60    //Averaging time tau [s]
```

7.5 Digital outputs AD card

The Ad card has 16 digital outputs, these outputs are connected to the output board PCLD-885 (optional).
The relays on this board are normally open (no power), single-pole-single-throw(SPST).
Open is 0, closed is 1.
When the message is valid the relay is opened

Relay No.	Message
0	Basic flow measurement WARNING
1	Basic flow measurement ALARM
2	System runtime WARNING
3	System runtime ALARM
4	System set-up WARNING
5	Body temp. on AD input not within set limits for low and high ALARM
6	Density 15°C OUT OF RANGE
7	Corrections on hold due to flow deviations WARNING
8	Percentage data filtered OUT OF RANGE
9	Temperature on AD input not within set limits for low and high ALARM
10	Pressure on AD input not within set limits for low and high ALARM
11	Density on input not within set limits for low and high ALARM
12	Basic flow measurement, status channel(s): out of range
13	Basic flow measurement, status channel(s): path failure (mostly due to gas or particles)
14	Basic flow measurement, status channel(s): deviation in measured sound velocities
15	Basic flow measurement, status channel(s): communication failure

- The digital output can be disabled/enabled in the Initialisation file: HSET0300.ufp section 4
- The signals can be checked on value in the service window: IO.
- Monitoring is also possible by its calibration program (see Manual: ALTOSONIC-V UFP I/O Calibration and Verification)
- Further information on warnings and alarms can be found in chapter of the Alarm window

HSET0300.ufp section 4

```
4.5 AD_Dig_out                =#0        //Digital inputs  disable=0, 1=NC, 2=NO
```

7.6 Modbus communication

The Modbus protocol defines a message structure that controllers, using a master-slave principle, will recognise and use, regardless of the type of networks over which they communicate.
In the communication initialisation file COMS0300.DAT the configuration can be changed to make the program compatible with the host system.
The program can act as master and as slave.
Both transmission modes ASCII and RTU are supported.
The data types supported are Boolean, Integer (16 bit), Long Integer (32 bit), Float (32 bit) and double (64 bit).
With these data types all relevant data from the ALTOSONIC V can be retrieved.

The available data is grouped at four levels:
1. Primary data
2. Data for analysis
3. Data for error analysis
4. Control data

These data are grouped by data type in data fields.

- The data available in these fields can be shown real-time on the ALTOSONIC V flow Processor screen. See chapter RUNTIME USER WINDOWS.
- For more details on the Modbus protocol and on the available data by Modbus communication see the **ALTOSONIC V ModBus Manual**.

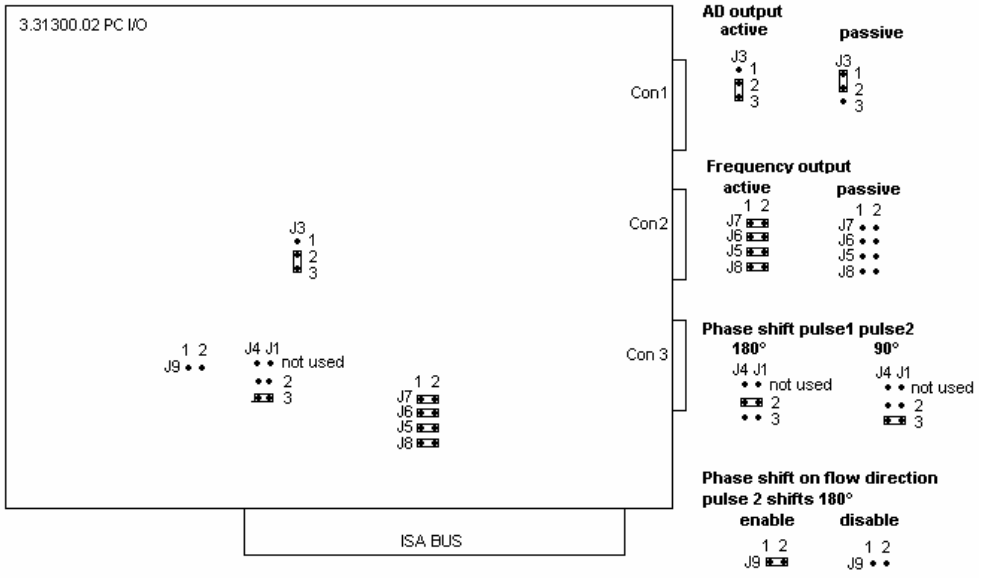
8 Hardware configuration

8.1 MP103 card

There are two possible generations of MP103 cards:

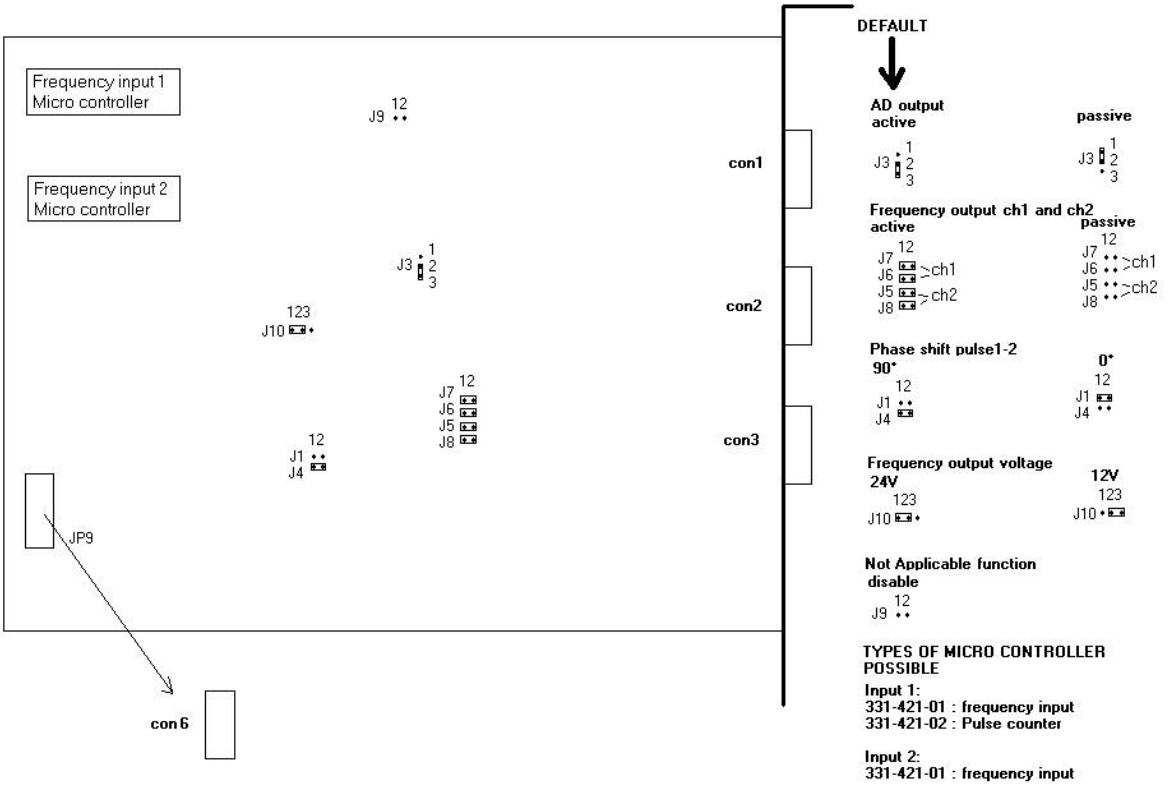
8.1.1 MP103 revision: 3.31300.02

The first generation of MP103 cards, note that this card does not work correct together with the current P233 Processor card, only with the previous 486 DX4 100.

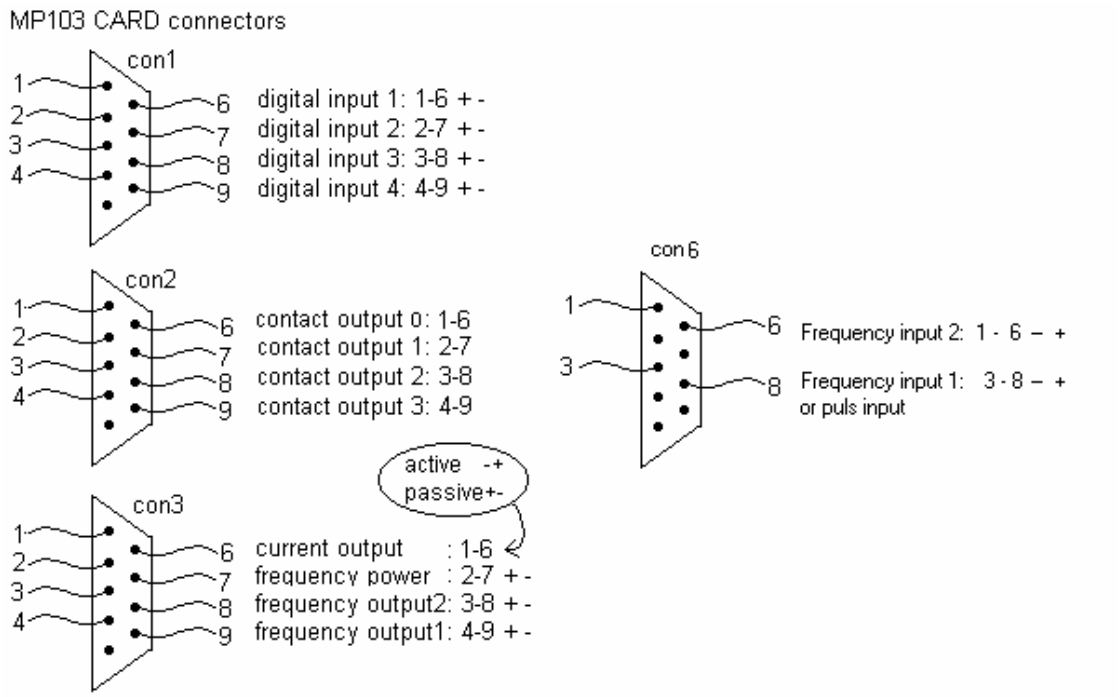


8.1.2 MP103 revision: 3.39993.01

The current generation MP103 card



8.1.3 The signals on the D connectors of the MP103 cards

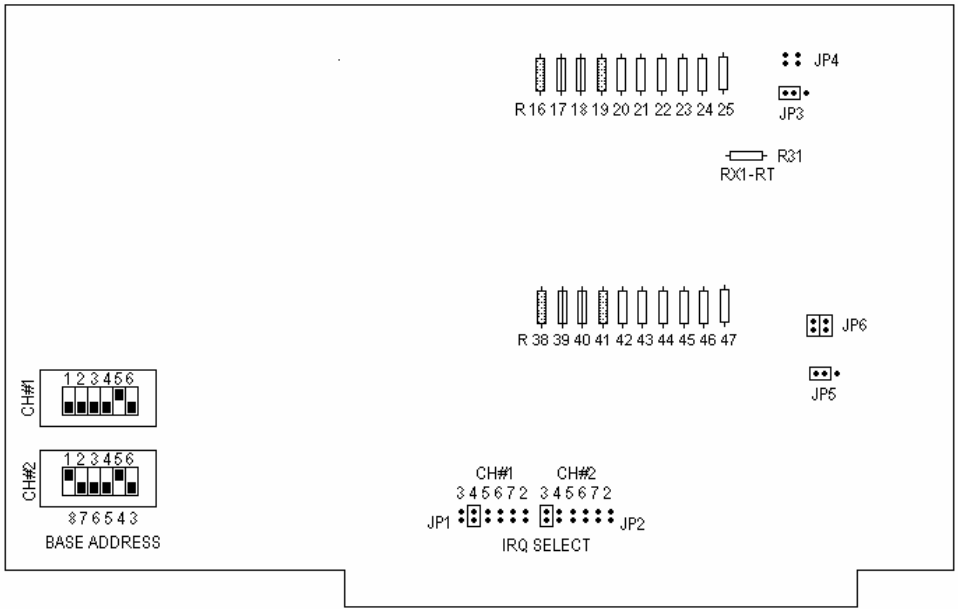


8.2 RS485/422 card

There are two possible generations of RS485 cards

8.2.1 RS485/422 card: AX4285A

The first generation of RS 485 cards used



DIP SWITCH CH1***	: COM 3 Baseaddress ch#1: 3E8
DIP SWITCH CH2***	: COM 4 Baseaddress ch#2: 2E8
JP1***	: COM3 Interrupt IRQ4
JP2***	: COM4 Interrupt IRQ3
JP3***	: COM3 RS 485 mode
JP4***	: COM3 Serial resistors enabled, No jumpers installed
JP5	: COM4 RS 485 mode as a default
JP6	: COM4 Serial resistors not enabled, jumpers installed

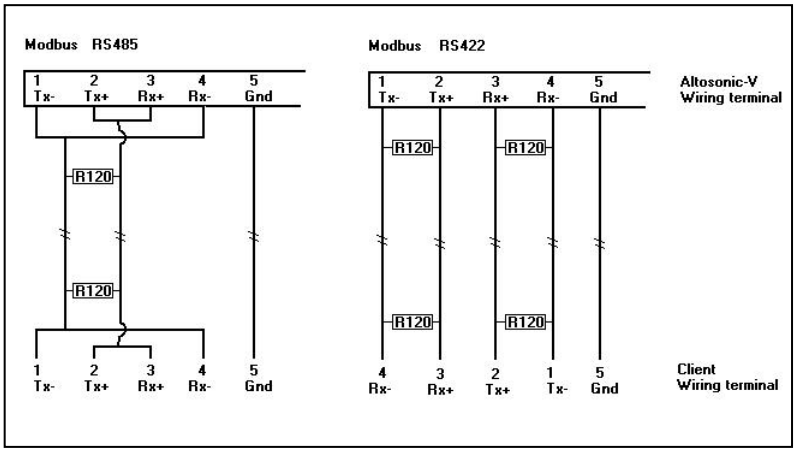
***(=KROHNE Altometer setting)

NOTE:

RS485 mode and RS422 mode for COM4 (Modbus) differs in set-up by:

- Jumper JP5 RS485 or RS422
- The external wiring for RS422 and RS485

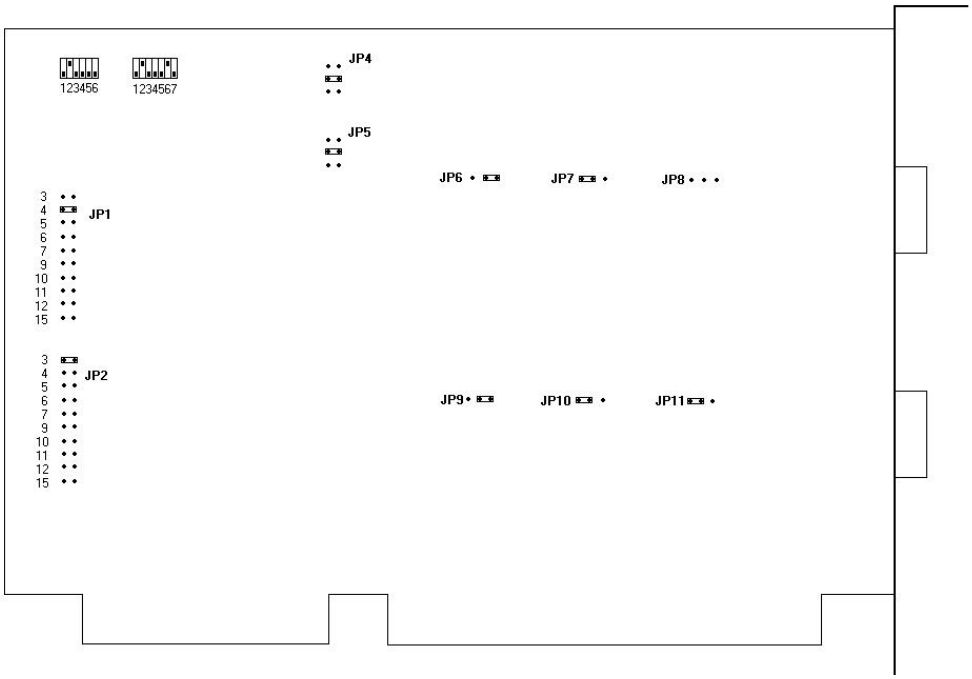
External wiring AX5285A for Modbus:



The resistors of 120 Ohm must be placed At the ALTOSONIC-V wiring terminal.

8.2.2 RS485/422 card: PCL-745 S

The current generation RS485/422 card.



Dip switch ch1***	: COM 3 Address 3E8 (KROHNE Altometer setting)
Dip switch ch2***	: COM4 Address 2E8
JP1***	: Interrupt COM3 IRQ4
JP2***	: Interrupt COM4 IRQ3
JP4***	: Transmit driver enable COM3 always RTS
JP5	: Transmit driver enable COM4 default RTS
JP6***	: Receive COM3 (422 is always on)
JP7***	: Terminator jumper COM3 120
JP8***	: Terminator jumper COM3 always not installed
JP9***	: Receive COM4 (422 is always on)
JP10***	: Terminator jumper COM4 120
JP11	: Terminator jumper COM4 (120 for RS422 mode, not installed for RS485 mode)

***(=KROHNE Altometer setting)

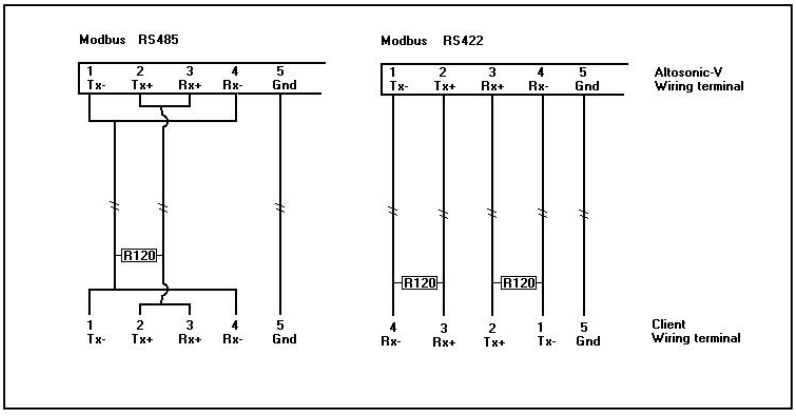
NOTE:

JP6 and JP9 are always 422 because the receiver is for both RS485 mode and RS422 mode expected to be enabled for the UFP-Program.

RS485 mode and RS422 mode for COM4 (Modbus) therefore only differs in set up by:

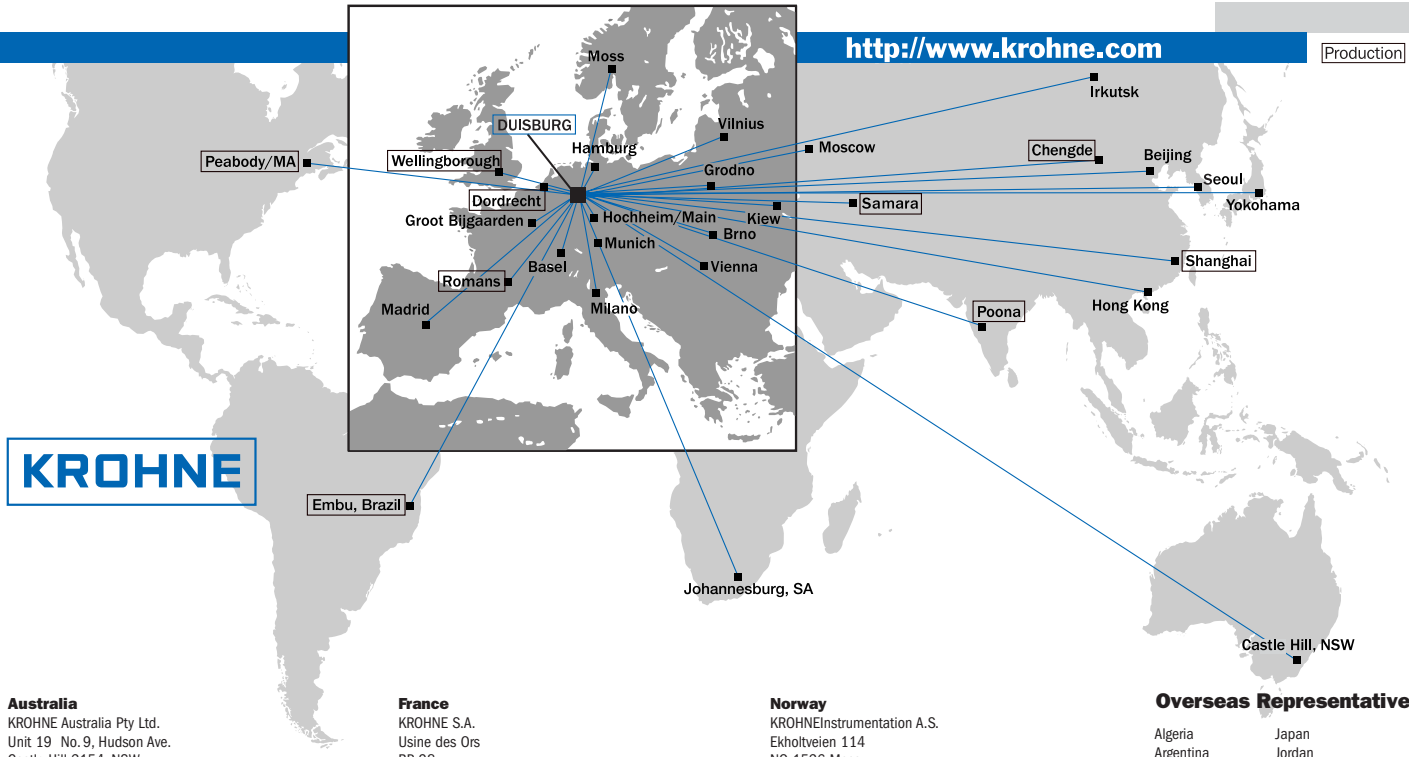
- Jumper JP11 not installed (RS485) or installed on 120 (RS422)
- The external wiring for RS422 and RS485

External wiring PCL745 for Modbus:



http://www.krohne.com

Production



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