

# Prode

Industrial Process Interface

User's Manual rel. 1.35

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Prode will provide the licensee with limited technical support by telephone, or by electronic media for a period of 60 days after delivery of the product

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**Prode, via Spalato 2 Milano 20124 Italia**

### How to obtain technical support

We welcome your comments or suggestions about our program. On request we will also provide information on the internal methods used. While the program has been tested carefully to ensure proper operation, it still may be possible for an unusual situation to result in an error. We will have a much greater chance of fixing or assisting with errors and problems if they are provided to us in a form that is repeatable.

In reporting a problem to us, the following information should be given:

- customer reference
- the version of the software
- a copy of the procedure you are running and if possible the input data
- a detailed description of what you were doing (sequence of operations) when the problem occurred
- any additional information you think may describe the problem

## Introduction

### OPC

OPC stands for OLE for Process Controls, it is a industry wide standard that allows connectivity between different devices, software applications, control systems. In OPC the servers provide methods which other software packages, the clients, can access to exchange data, each control device, such as a PLC or DCS and instruments can exchange data.

### MODBUS

MODBUS is an application-layer messaging protocol, it provides client-server communication between devices connected on different types of buses or networks, a industrial serial standard since 1979 MODBUS enables millions of automation devices to communicate.

### PRODE PROPERTIES

Prode Properties is the thermodynamic framework created by Prode, it solves problems such as physical properties data, process simulation, optimization and realtime control.

### PRODE INDUSTRIAL PROCESS INTERFACE

Available in different versions since 1995 Prode industrial interface works as a bridge between the world of industrial applications and the specialized software required for calculating thermodynamic properties. Many industrial applications need access to rigorous thermodynamic calculations and Prode interface in union with Prode Properties allows this at effective cost and in a very simple way.

Prode Interface includes a OPC server, a OPC client and a MODBUS device, it can receive data from inline devices or DCS systems and returns in realtime a series of calculated values, standard version has more than 30 predefined properties (see the list below), custom versions are available for expanding the list of properties (see below).

CricondenBar pressure  
CricondenBar temperaure  
CricondenTherm pressure  
CricondenTherm temperature  
Critical pressure  
Critical temperature  
Flash points  
Hydrate formation pressure  
Hydrate formation temperature  
Liquid Fraction  
Dew point temperature  
Bubble point temperature  
Gas heating value  
Gas Joule Thomson coefficient  
Gas Wobbe index  
Gas specific entropy  
Gas specific enthalpy  
Gas specific heat at constant pressure (cp)  
Gas specific heat at constant volume (cv)  
Gas speed of sound  
Gas compressibility  
Gas specific gravity  
Gas compressibility  
Gas specific gravity  
Gas density  
Gas viscosity  
Gas thermal conductivity  
Liquid specific entropy  
Liquid specific enthalpy  
Liquid specific heat at constant pressure (cp)  
Liquid specific heat at constant volume (cv)  
Liquid speed of sound  
Liquid viscosity  
Liquid thermal conductivity  
Liquid surface tension

### ADDITIONAL PROPERTIES

Custom versions can extend the features by including additional properties such as wax formation / cloud points / Reid vapor pressure etc.

in addition there are versions which allow real time simulation of equipments as distillation columns to optimize operating parameters

## How Prode Industrial Process Interface Works

### Introduction

A generic plant can include one or more equipments and each equipment can have one (or more) lines entering (influent) and lines exiting (effluent). For purposes of process simulation each line constitutes a stream, defined in terms of mixture composition and operating conditions (pressure, temperature). Different properties can require different specifications, for example the calculation of gas density requires as specifications composition plus operating temperature and pressure while gas heating value requires only composition. Prode interface permits to set each specification (composition, pressure, temperature) directly from external providers as in-line instruments, DCS systems or other devices and get immediately the calculated values, with Prode Interface it becomes very easy to add sophisticated process calculations to your applications.

### How it works

Once the data provider (OPC or MODBUS) is connected at regular intervals (set by time cycle) the software detects changes in inputs (specifications) and calls Prode Properties to calculate output values (or, in case of errors, generate reports), the outputs are then available as external connection.

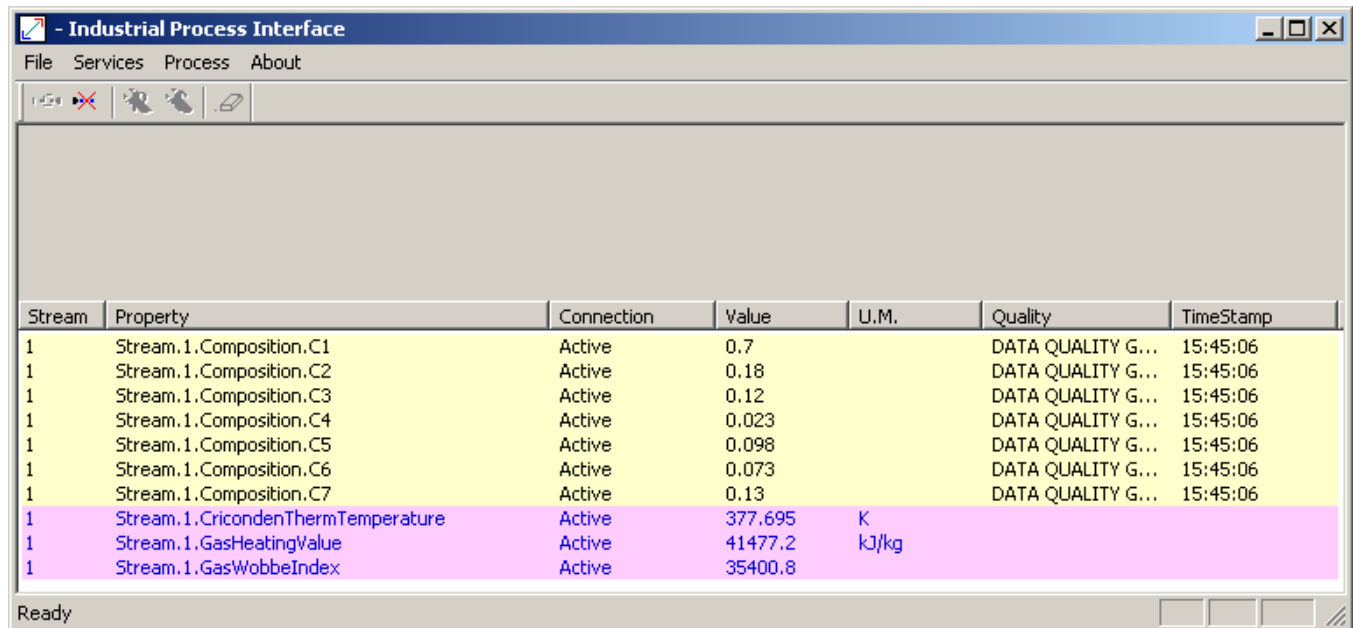
### Features

- Fully customizable list for inputs (specifications) and outputs (properties to be calculated)
- Support for up to 20 components per stream and up to 10 streams (up to 100 streams in custom versions) each stream supports a different list of components, pseudo components, thermodynamic models etc.
- Capability to relay each input to OPC and MODBUS ports
- Customizable parameters for OPC and MODBUS ports
- Automatic diagnostic and error reporting

### Operating

Once started the program shows two windows which have different purposes:

- on the first window the program shows errors and warnings which occurred during operations
- on the second window the program creates the list of ports, connections states, values etc.



The screenshot shows the 'Industrial Process Interface' window. It has a menu bar with 'File', 'Services', 'Process', and 'About'. Below the menu is a toolbar with icons for file operations. The main area contains a table with the following data:

Stream	Property	Connection	Value	U.M.	Quality	TimeStamp
1	Stream.1.Composition.C1	Active	0.7		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C2	Active	0.18		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C3	Active	0.12		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C4	Active	0.023		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C5	Active	0.098		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C6	Active	0.073		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C7	Active	0.13		DATA QUALITY G...	15:45:06
1	Stream.1.CricondenThermTemperature	Active	377.695	K		
1	Stream.1.GasHeatingValue	Active	41477.2	kJ/kg		
1	Stream.1.GasWobbeIndex	Active	35400.8			

At the bottom of the window, it says 'Ready'.

### Diagnostics

During the operations different events may occur and Prode interface includes procedures for validating data by utilizing filters and generating error / warning messages when the program detects a possible problem. When the problem is related to one (or more) ports the program can use different colors to emphasize the row (in the list of ports) which is related with the detected problem.

## Installing Prode Industrial Process Interface

32 and 64 bit versions of Prode Interface are included in Windows distribution file which installs automatically in your computer, install Prode Properties before Prode Interface, once installed both applications follow a few steps to manually configure the system.

### IMPORTANT

To register the OPC Server service you need to run proind.exe as administrator (you may use the “run as administrator” command)

To access OPC Server and Client services you may need to install separately the 32 or 64 bit version of OPC Core Components freely distributed by OPC Software Foundation (if these are not installed on your computer)

## Configuring the Interface

Configuring Prode Industrial Process Interface is easy, only a few steps are required

- defining the inputs
- define and set up connection devices (OPC Server, OPC Client, MODBUS)
- define and set up connecting ports

### IMPORTANT

Once you have completed each step you can save the configuration with the command File->Save config

The program automatically loads the configuration file at startup, if required it can autoconnect all OPC / MODBUS devices

## First step, define the Inputs

To execute the calculations the procedure needs for each property a suitable set of specifications, these inputs (usually provided by external devices via MODBUS or OPC protocols) can be the operating conditions (temperature, pressure) at which the process takes place and/or the composition of the mixture (the molar percentage of each component in the stream), the table below shows the list of required specifications per each property.

The user is allowed to force fixed values for compositions, temperatures and pressures (from Prode Properties Editor) as alternative to obtain these value at regular intervals from a data provider, in any case the procedure does require a consistent set of inputs (specifications) to solve the calculations.

Property	Main specifications	Additional specification
CricondenBar pressure	Composition	
CricondenBar temperaure	Composition	
CricondenTherm pressure	Composition	
CricondenTherm temperature	Composition	
Critical pressure	Composition	
Critical temperature	Composition	
Flash point	Composition	
Hydrate Formation pressure	Operating temperature	Composition
Hydrate Formation temperature	Operating pressure	Composition
Liquid Fraction	Operating temperature, pressure	Composition
Dew point temperature	Operating pressure	Composition
Bubble point temperature	Operating pressure	Composition
Gas heating value	Composition	
Gas Joule Thomson coefficient	Operating temperature, pressure	Composition
Gas Wobbe index	Composition	
Gas specific entropy	Operating temperature, pressure	Composition
Gas specific enthalpy	Operating temperature, pressure	Composition
Gas specific heat (cp)	Operating temperature, pressure	Composition
Gas specific heat (cv)	Operating temperature, pressure	Composition
Gas speed of sound	Operating temperature, pressure	Composition
Gas compressibility	Operating temperature, pressure	Composition
Gas specific gravity	Composition	
Gas compressibility	Operating temperature, pressure	Composition
Gas specific gravity	Composition	
Gas density	Operating temperature, pressure	Composition
Gas viscosity	Operating temperature, pressure	Composition
Gas thermal conductivity	Operating temperature, pressure	Composition
Liquid specific entropy	Operating temperature, pressure	Composition
Liquid specific enthalpy	Operating temperature, pressure	Composition
Liquid specific heat (cp)	Operating temperature, pressure	Composition
Liquid specific heat (cv)	Operating temperature, pressure	Composition
Liquid speed of sound	Operating temperature, pressure	Composition
Liquid viscosity	Operating temperature, pressure	Composition
Liquid thermal conductivity	Operating temperature, pressure	Composition
Liquid surface tension	Operating temperature, pressure	Composition

From Prode Interface application, menu Process->General to activate the dialog where to define the required properties and input specifications.

Number of Streams	the procedure calculates the properties per each stream in the list
Timer Cycle	the procedure recalculates the properties at regular intervals of time
Sum of Mol.Fractions	acceptable range of values for the sum of molar fractions in compositions
Inputs (Specifications)	inputs from external devices
Outputs (Results)	required properties, outputs to external devices

### Setting the correct timer cycle

Once the data provider (OPC or MODBUS) is connected at regular intervals (set by timer cycle) the software detects changes in inputs (specifications) and calls Prode Properties to calculate output values (or, in case of errors, generate reports).

The different timing cycles don't affect the execution time of Prode Properties internal procedures but permits to reduce the number of calls when inputs are not updated frequently and, most important, setting the correct timer cycles reduces the risk to call the thermodynamic framework before the previous calc's have been completed.

A typical value for timer cycle would be 60 seconds but in some cases as with gas-chromatographs the timer cycle could be set at 10 minutes or more.

From Prode Interface application, menu Process->Process Data to activate the Prode Properties Editor

**Prode Properties Editor**

Stream: Operating

Select / edit stream: 1 Test Case 1 Test Case 1 Save

Operating Conditions: K Pa.a kg/s

Feed and Operation: 1 Test Case 1 T-P VL Compute

Specifications: 288.15 K 101327 Pa.a 1 kg/s

Specifications (OUT): Pa.a kW

Phase	Feed	Not present	Not present	Not present	Not present	Not present
Mol.fraction	0	0	0	0	0	0
C2H6	0.528701	0	0	0	0	0
C3H8	0.135952	0	0	0	0	0
C4H10	0.0906344	0	0	0	0	0
C4H10	0.0173716	0	0	0	0	0
C6H14	0.0740181	0	0	0	0	0
CH4	0.055136	0	0	0	0	0
CO2	0.0981873	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0

OK Cancel Apply

Use this editor to define

- List of components for all streams
- Thermodynamic models and options
- Units of measurement

To define the list of components, thermodynamic models and options for a stream select the stream in the list then in components page define the list of components

**Prode Properties Editor**

Stream: Operating

Components

ACETONE

Sort by first name

Molar fractions

Add Remove Clear

Component	Fraction (0-1)
ETHANE	0.528701
PROPANE	0.135952
ISOBUTANE	0.0906344
n-BUTANE	0.0173716
n-HEXANE	0.0740181
METHANE	0.055136
CARBON DIOXIDE	0.0981873
	0
	0
	0
	0
	0
	0
	0

OK Cancel Apply



### IMPORTANT

in stream's editor make sure to save your edited stream's data (button save) before to select a different stream, differently all changes will be discharged

In Models page define the models and options for this stream

in BIPS page enter the relevant binary interaction pairs, see Prode Properties manual for additional informations on these parameters , then back to page Operating, Select Save for saving this stream before selecting a different stream or leaving the dialog.

To define a set of Units of Measurement go to the page Units

Property	Unit
Pressure	Pa.a
Pressure (dp)	Pa
Temperature	Pa
Temperature (dt)	kPa
Calorific Value	mbar
Calorific Value (molar)	bar
Enthalpy (Streams)	kgf/cm²
Entropy (Streams)	psi
Heat Capacity	mmH2O
Heat Capacity (molar)	inH2O
Flow (mass)	mmHG
Flow (gas, mass)	atm
Density	kJ/(kmol*K)
Density (molar)	kg/s
Specific Volume	kg/s
Specific Volume (molar)	kg/m³
Thermal Conductivity	kmol/m³
Viscosity (dynamic)	m³/kg
Surface Tension	m³/kmol
Length	W/(m*K)
Area	Pa*s
Volume	N/m
Mass	m

Once all process parameters have been defined select Ok to leave the dialog

### Define calculated fractions (components not measured by analyzer)

Prode Interface allows to define fractions for heavy components not measured by in field analyzers, supposing we know (from laboratory analysis) the composition of a stream

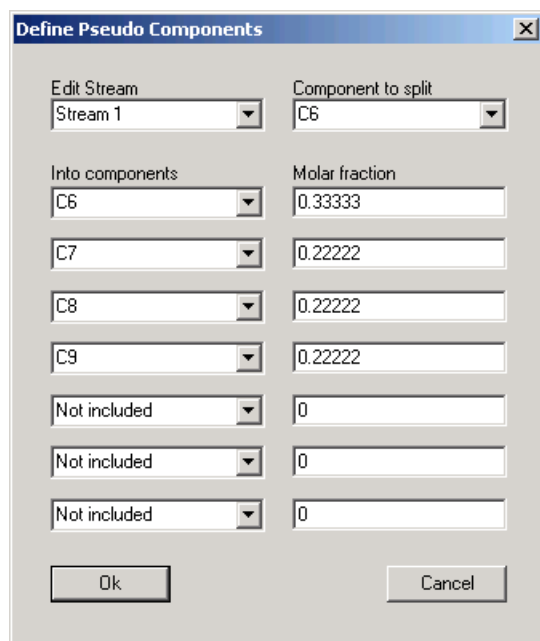
C1	CH4	0.7
C2	C2H6	0.11
C3	C3H8	0.05
C4	C4H10	0.03
C5	C5H12	0.02
C6	C6H14	0.03
C7	C8H14	0.02
C8	C9H20	0.02
C9	C10H22	0.02

when the in field analyzer is limited to C1-C5, we can configure the interface for calculating C6-C9 as fractions

total (C6+C7+C8+C9)	0.09
relative fractions C6	0.3333
C7	0.2222
C8	0.2222
C9	0.2222

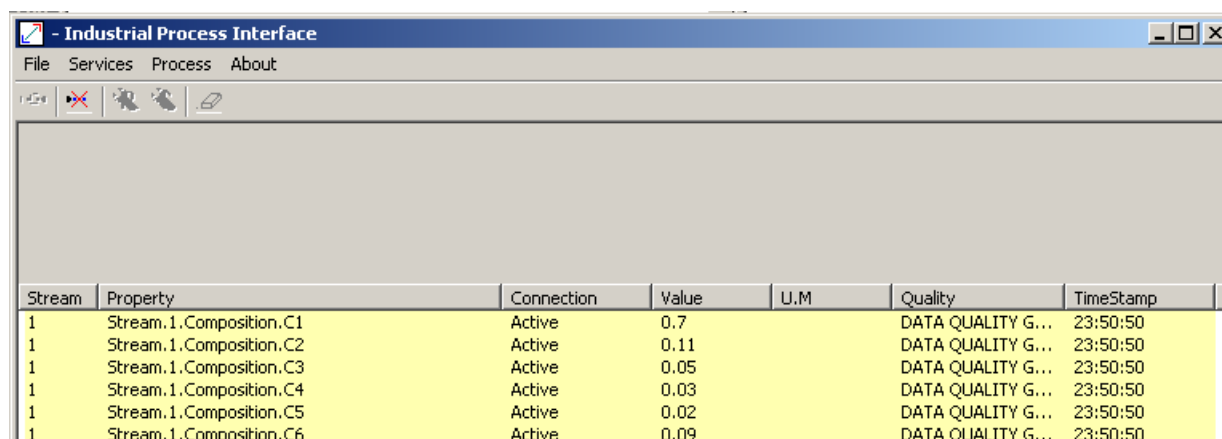
in that way we can obtain reasonable estimates from a limited set of values

From Prode Interface application, menu Process->Pseudo Components to activate the dialog.



The 'Define Pseudo Components' dialog box is shown. It has a title bar with a close button. Inside, there are two main sections. The first section has 'Edit Stream' with a dropdown menu set to 'Stream 1' and 'Component to split' with a dropdown menu set to 'C6'. The second section is titled 'Into components' and 'Molar fraction'. It contains six rows, each with a dropdown menu and a text input field. The first row has 'C6' in the dropdown and '0.33333' in the input field. The second row has 'C7' in the dropdown and '0.22222' in the input field. The third row has 'C8' in the dropdown and '0.22222' in the input field. The fourth row has 'C9' in the dropdown and '0.22222' in the input field. The fifth row has 'Not included' in the dropdown and '0' in the input field. The sixth row has 'Not included' in the dropdown and '0' in the input field. At the bottom, there are 'Ok' and 'Cancel' buttons.

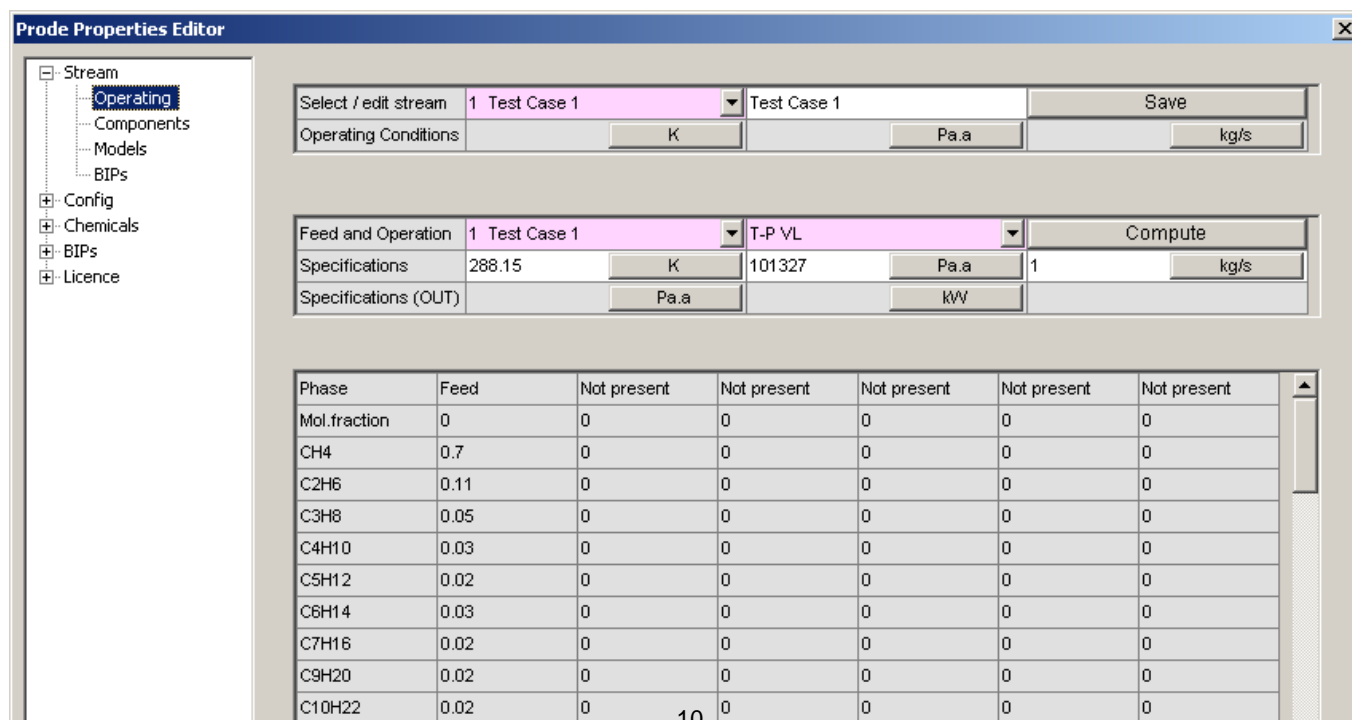
In the dialog select "Do not split" if you do not require calculated fractions, differently define in each stream the input component from which the software calculates the components not provided as inputs. Note that the interface will show only the input values (in this case C1-C6 from analyzer)



The 'Industrial Process Interface' window is shown. It has a menu bar with 'File', 'Services', 'Process', and 'About'. Below the menu bar is a toolbar with icons for file operations and process control. The main area is a table with the following columns: Stream, Property, Connection, Value, U.M, Quality, and TimeStamp. The table contains six rows of data for Stream 1, showing composition values for C1 through C6.

Stream	Property	Connection	Value	U.M	Quality	TimeStamp
1	Stream.1.Composition.C1	Active	0.7		DATA QUALITY G...	23:50:50
1	Stream.1.Composition.C2	Active	0.11		DATA QUALITY G...	23:50:50
1	Stream.1.Composition.C3	Active	0.05		DATA QUALITY G...	23:50:50
1	Stream.1.Composition.C4	Active	0.03		DATA QUALITY G...	23:50:50
1	Stream.1.Composition.C5	Active	0.02		DATA QUALITY G...	23:50:50
1	Stream.1.Composition.C6	Active	0.09		DATA QUALITY G...	23:50:50

To see the different fractions stop connection and access the Process Editor which shows the full composition (including estimated fractions for heavy components C6-C9 not measured by analyzer) .



The 'Prode Properties Editor' window is shown. It has a title bar with a close button. On the left is a tree view with 'Stream' selected, showing sub-items: 'Operating' (selected), 'Components', 'Models', and 'BIPs'. Below the tree view are buttons for 'Config', 'Chemicals', 'BIPs', and 'Licence'. The main area is divided into several sections. The top section is 'Select / edit stream' with a dropdown menu set to '1 Test Case 1' and a 'Save' button. Below this is 'Operating Conditions' with input fields for 'K', 'Pa.a', and 'kg/s'. The next section is 'Feed and Operation' with a dropdown menu set to '1 Test Case 1' and a 'Compute' button. Below this are 'Specifications' and 'Specifications (OUT)' with input fields for 'K', 'Pa.a', 'kg/s', and 'kW'. At the bottom is a table with the following columns: Phase, Feed, Not present, Not present, Not present, Not present, Not present. The table contains ten rows of data for various chemical species, showing their feed values and estimated fractions for heavy components C6-C9.

Phase	Feed	Not present	Not present	Not present	Not present	Not present
Mol.fraction	0	0	0	0	0	0
CH4	0.7	0	0	0	0	0
C2H6	0.11	0	0	0	0	0
C3H8	0.05	0	0	0	0	0
C4H10	0.03	0	0	0	0	0
C5H12	0.02	0	0	0	0	0
C6H14	0.03	0	0	0	0	0
C7H16	0.02	0	0	0	0	0
C9H20	0.02	0	0	0	0	0
C10H22	0.02	0	0	0	0	0

## Second step, setting up connection devices

Prode interface can act as OPC client, OPC server and MODBUS device, each connection can get data from external providers (input port) or working as output port, in addition connections can relay data (expose a copy) from a different connection. From Prode Interface application, menu Services->Settings to activate the Connection Settings dialog.

**Connection Settings**

**General**

☐ OPC Client Active    ☐ OPC Server Active    ☒ MODBUS Active

Get Data with  
MODBUS

☐ Automatic Connection

**OPC**

Remote Machine Name:

Update the List of OPC Servers:

Extern OPC Server:

OPC out data type: VT\_R4

OPC in data transfer: SYNC

Delimiter for hierarchical namespace: .

**MODBUS**

Connector: TCP

Baud Rate: 9600 bps

Protocol: RTU

Unit ID: 1

Stop Bits: 1

Parity: ODD

☐ DSR/DTR    ☐ CTS/RTS

### General

In this section define  
the required connections (OPC client, OPC server, MODBUS)  
the service which provides the input data  
automatic connection at application's startup, required when OPC server is activated

### OPC Connection

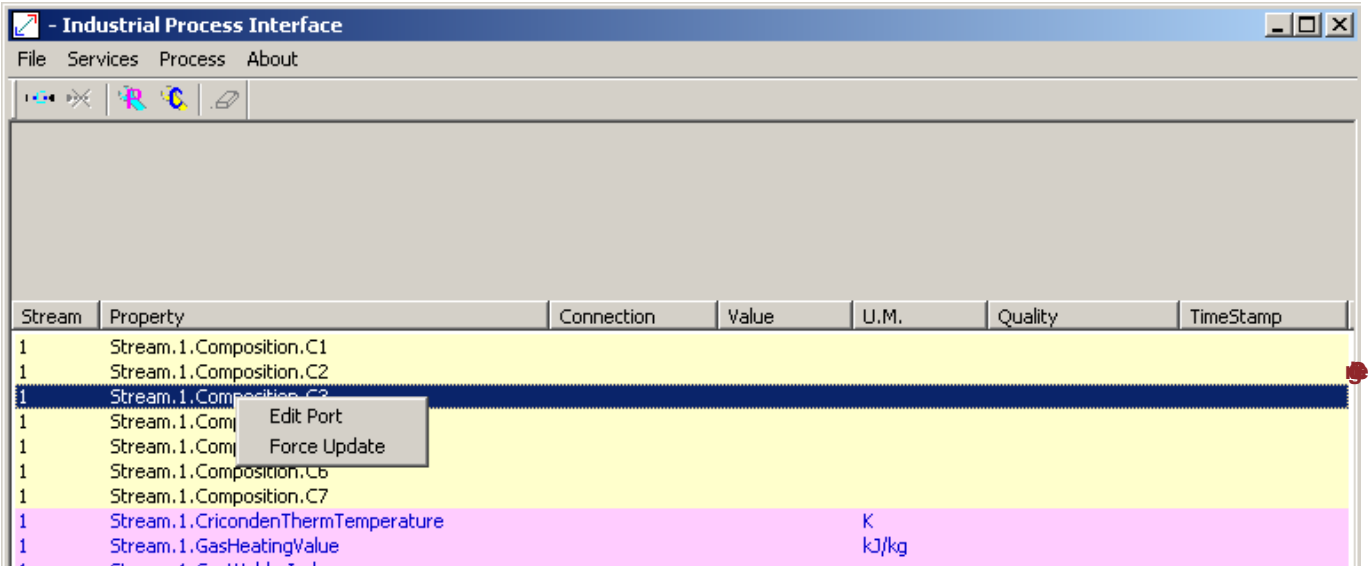
In this section define  
the extern OPC server in case of OPC client active, with OPC Client active select the button "Update" to see the list of OPC Servers available, then select one  
OPC out data type, calculated values are of real types, COM provides two compatible types  
OPC in data transfer, SYNC forces reading at each cycle  
OPC delimiter, must be compatible with external OPC devices

### MODBUS Connection

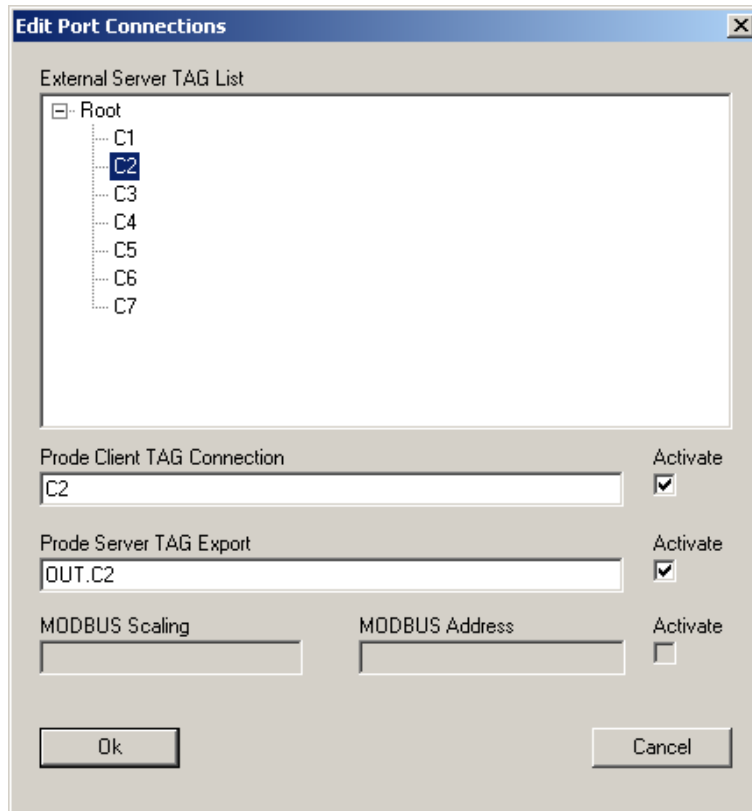
In this section define  
Connector, TCP or computer's COM port  
Device ID, the address to access this MODBUS device  
Baud Rate, port speed  
Protocol, MODBUS protocol  
Stop Bits, Parity, MODBUS connection settings

### Third step, setting up connection ports

Each position in the list represents a port, select the connection to edit



Then for activating the Connection Settings dialog use the right button in the mouse or the application menu Services->Edit Port



the different sections of the dialog are editable when the related service (OPC client, OPC server, MODBUS) has been activated in Connection Settings dialog.

The external Server TAG List shows the connections exposed by the external OPCserver (which connects with the OPC client in Prode interface)

The TAG names are those exposed by OPC ports

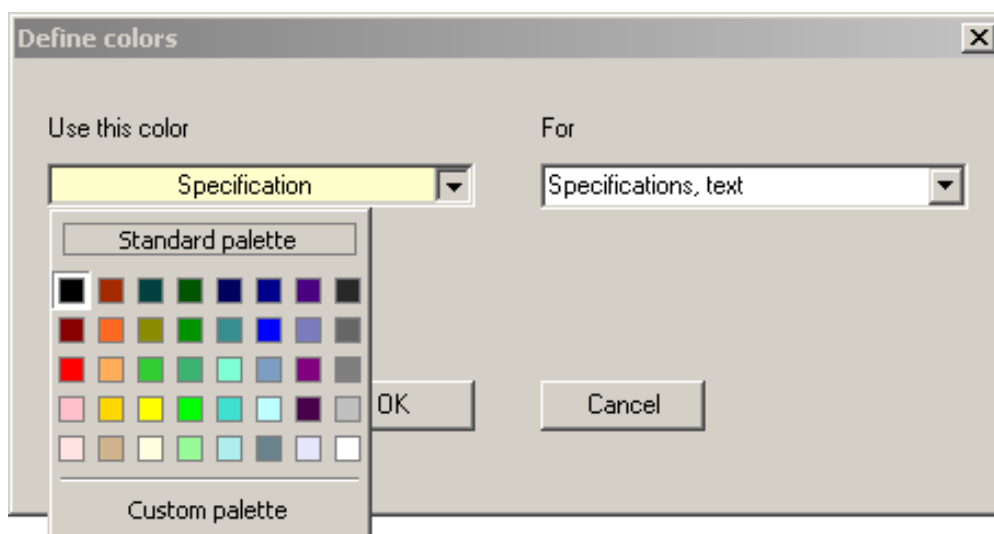
MODBUS Scaling defines a multiplier (a real which defines the full scale) for extending the MODBUS range.

MODBUS address defines the address.

To activate a service set the related box

## Define Colors

Select Process->File in menu, then Set colors.

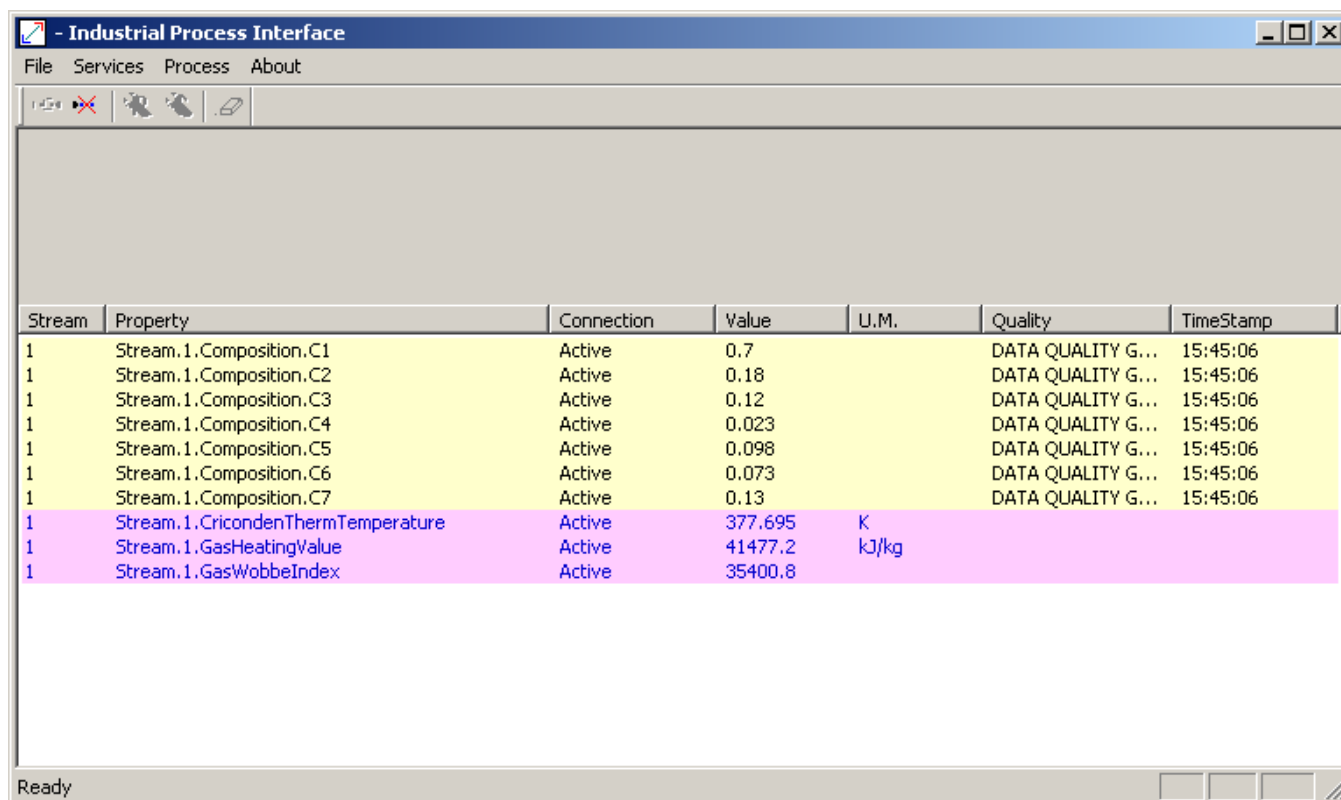


From this dialog you can set the different colors (text and background) associated to each operating condition :

- Normal condition, the connection is working as expected
- Warning condition, the connection doesn't receive data
- Error condition, the port isn't connected

## Connect the Services

To connect the external services select Services->Connect



Stream	Property	Connection	Value	U.M.	Quality	TimeStamp
1	Stream.1.Composition.C1	Active	0.7		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C2	Active	0.18		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C3	Active	0.12		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C4	Active	0.023		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C5	Active	0.098		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C6	Active	0.073		DATA QUALITY G...	15:45:06
1	Stream.1.Composition.C7	Active	0.13		DATA QUALITY G...	15:45:06
1	Stream.1.CricondenThermTemperature	Active	377.695	K		
1	Stream.1.GasHeatingValue	Active	41477.2	kJ/kg		
1	Stream.1.GasWobbeIndex	Active	35400.8			

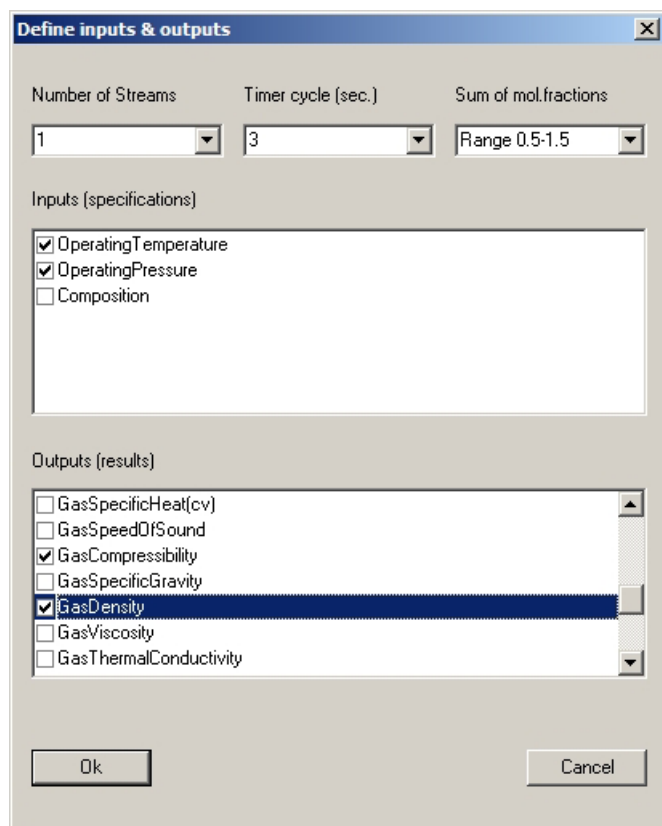
For disconnecting Services->Disconnect

Once connected at regular intervals the procedure reads the inputs (specifications), calls Prode Properties to calculate output values and show the results (or, in case of errors, generate reports) , outputs are then available to external connections.

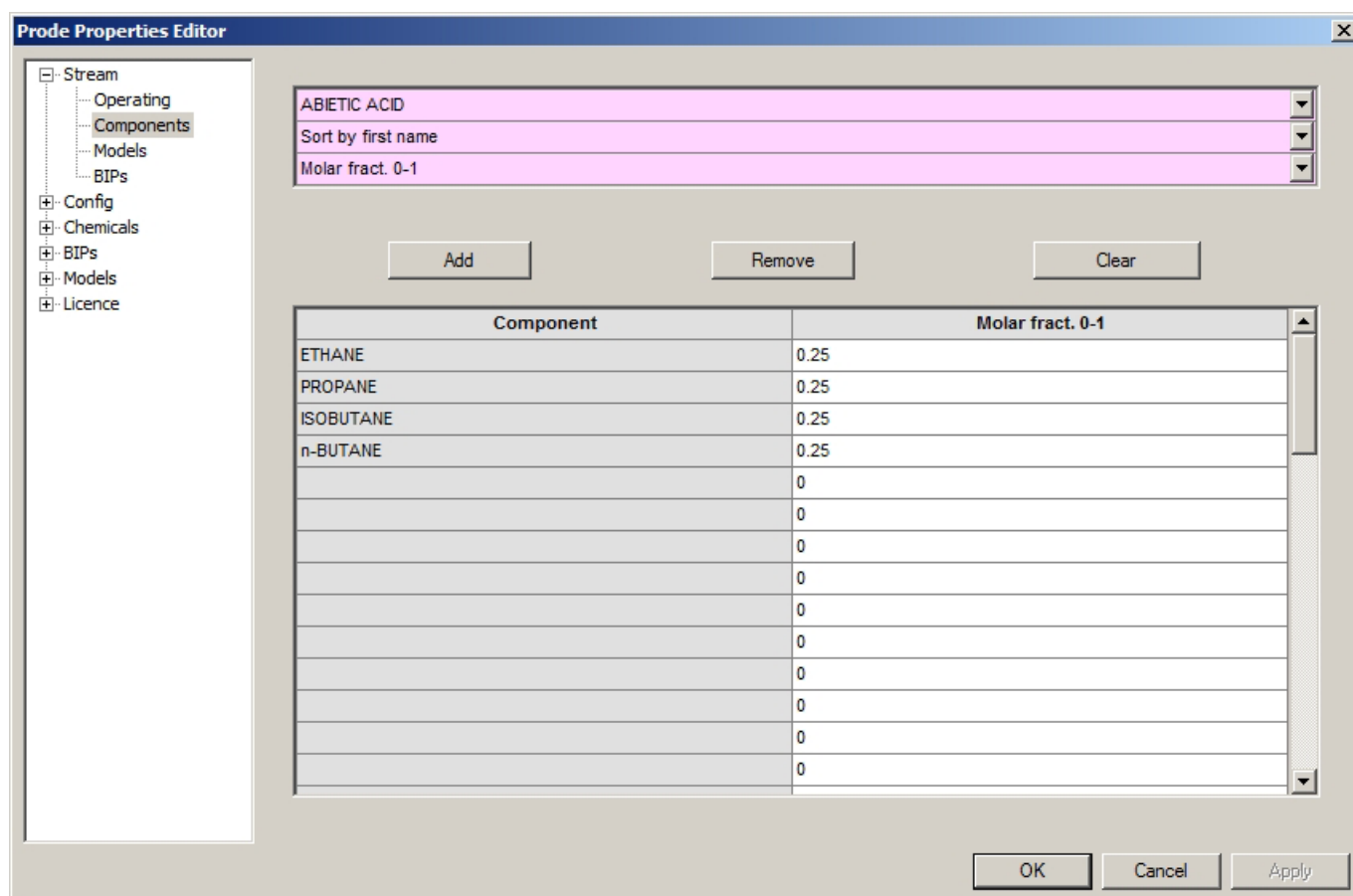
## MODBUS configuration example

this example shows how to configure and connect via MODBUS TCP a MODBUS slave (Prode Interface) installed on computer with IP 10.0.0.1 with a MODBUS server installed on computer with IP 10.0.0.2

this is a minimal example with just two inputs (temperature and pressure) and two outputs (compressibility and density) but one can easily add all inputs and outputs required by complex applications, we start to define inputs, outputs and process data



Define inputs & outputs dialog box. It contains three dropdown menus at the top: 'Number of Streams' (set to 1), 'Timer cycle (sec.)' (set to 3), and 'Sum of mol.fractions' (set to 'Range 0.5-1.5'). Below these are two sections: 'Inputs (specifications)' and 'Outputs (results)'. The 'Inputs' section has three checkboxes: 'OperatingTemperature' (checked), 'OperatingPressure' (checked), and 'Composition' (unchecked). The 'Outputs' section has seven checkboxes: 'GasSpecificHeat(cv)' (unchecked), 'GasSpeedOfSound' (unchecked), 'GasCompressibility' (checked), 'GasSpecificGravity' (unchecked), 'GasDensity' (checked and highlighted), 'GasViscosity' (unchecked), and 'GasThermalConductivity' (unchecked). At the bottom are 'Ok' and 'Cancel' buttons.



Prode Properties Editor dialog box. On the left is a tree view with 'Stream' expanded, showing 'Operating', 'Components', 'Models', and 'BIPs'. Below this are 'Config', 'Chemicals', 'BIPs', 'Models', and 'Licence'. The main area has three dropdown menus: 'ABIETIC ACID', 'Sort by first name', and 'Molar fract. 0-1'. Below these are 'Add', 'Remove', and 'Clear' buttons. A table follows with two columns: 'Component' and 'Molar fract. 0-1'. The table contains five rows with data: ETHANE (0.25), PROPANE (0.25), ISOBUTANE (0.25), n-BUTANE (0.25), and four empty rows with 0. At the bottom are 'OK', 'Cancel', and 'Apply' buttons.

Component	Molar fract. 0-1
ETHANE	0.25
PROPANE	0.25
ISOBUTANE	0.25
n-BUTANE	0.25
	0
	0
	0
	0
	0
	0
	0
	0
	0

**Probe Properties Editor**

Stream

- Operating
- Components
- Models**
- BIPs

Config

- Chemicals
- BIPs
- Models
- Licence

Predefined packages: **2 NAT.GAS VLE PR-VDW** NAT.GAS VLE PR-VDW **Save**

	Vapor	Liquid	Solid
Hydrate	PR VDW	PR VDW	SSM
Not included	PR VDW	PR VDW	REGULAR
Enthalpy	PR VDW	PR VDW	REGULAR
Entropy	PR VDW	PR VDW	REGULAR

Multiphase vapor-liquid-solid	Volume
Reduced tests (quick)	Multiphase equilibria
From Isothermal Compressibility and Liq.Dens.	From Gibbs or Isothermal Compr. and Liq.Dens.
Accept all solutions	Discard unstable solutions
Do not end when crossing phase boundary lines	End when crossing phase boundary lines
Select and validate EOS roots according state	Select EOS roots for minimum Gibbs energy

**OK Cancel Apply**

**Prode Properties Editor**

- Stream
  - Operating
  - Components
  - Models
  - BIPs
- + Config
- + Chemicals
- + BIPs
- + Models
- + Licence

Edit BIPs	Use edited BIPs
Get BIPs	Get BIPs from database
Select the model	PR VDW

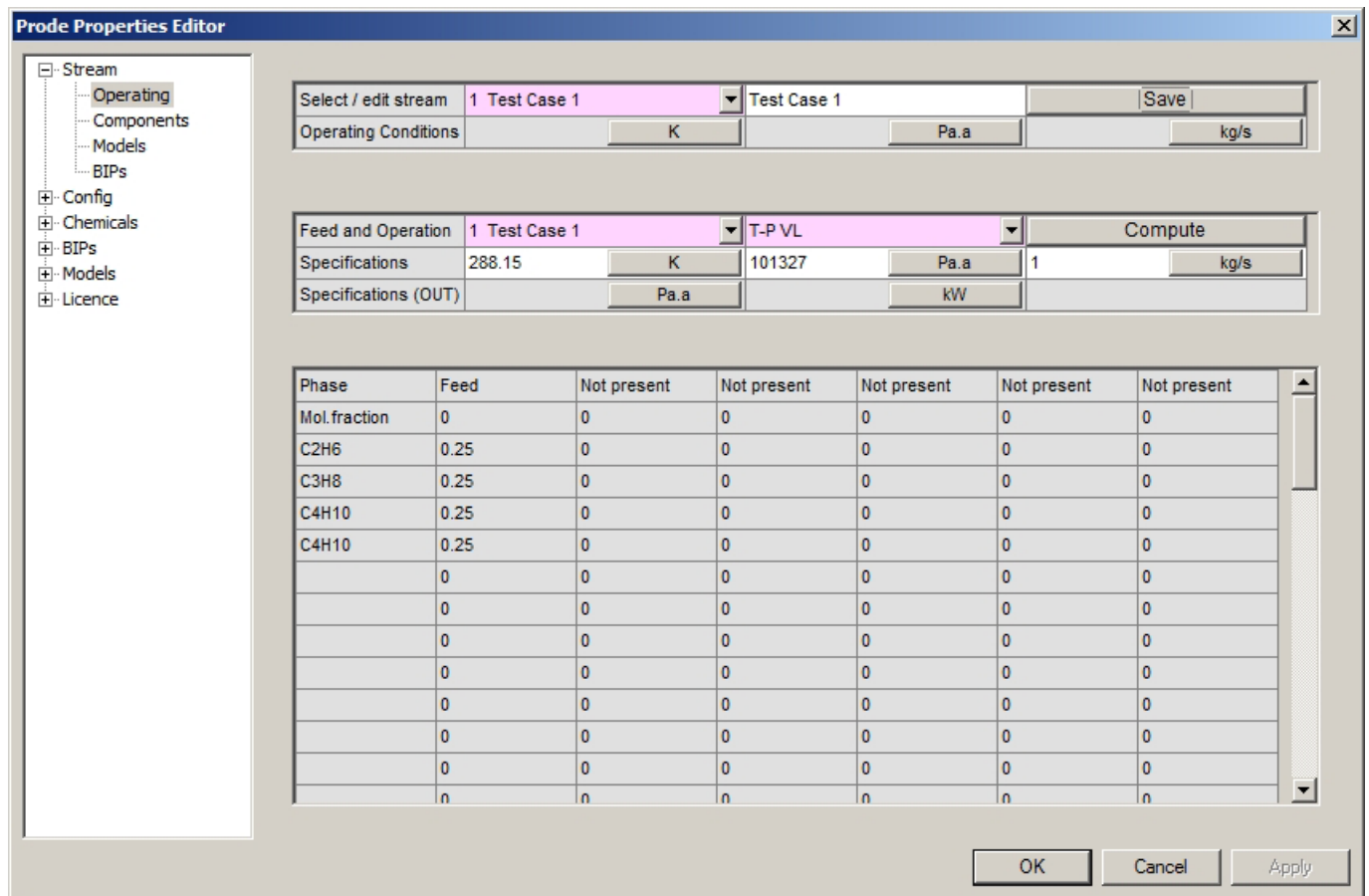
  

C1	C2	BIP-1	BIP-2	BIP-3	BIP-4	BIP-5
1	2	0.001	0	0	0	
1	3	-0.007	0	0	0	
1	4	0.001	0	0	0	
2	3	-0.007	0	0	0	
2	4	0.003	0	0	0	
3	4	0.209207	-0.343105	0.164551	0.0507658	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	
0	0	0	0	0	0	

OK Cancel Apply

### IMPORTANT !

Do not forget to save the stream (button save on first tab) before to leave the dialog, this (saving stream) is a important step otherwise data will be lost closing the dialog.



The Prode Properties Editor dialog box is shown with the 'Stream' tab selected. The left sidebar contains a tree view with 'Stream' expanded, showing sub-items: Operating, Components, Models, BIPs, Config, Chemicals, BIPs, Models, and Licence. The main area contains the following sections:

**Select / edit stream:** 1 Test Case 1 (dropdown), Test Case 1 (text), Save (button)

**Operating Conditions:** K (dropdown), Pa.a (dropdown), kg/s (dropdown)

**Feed and Operation:** 1 Test Case 1 (dropdown), T-P VL (dropdown), Compute (button)

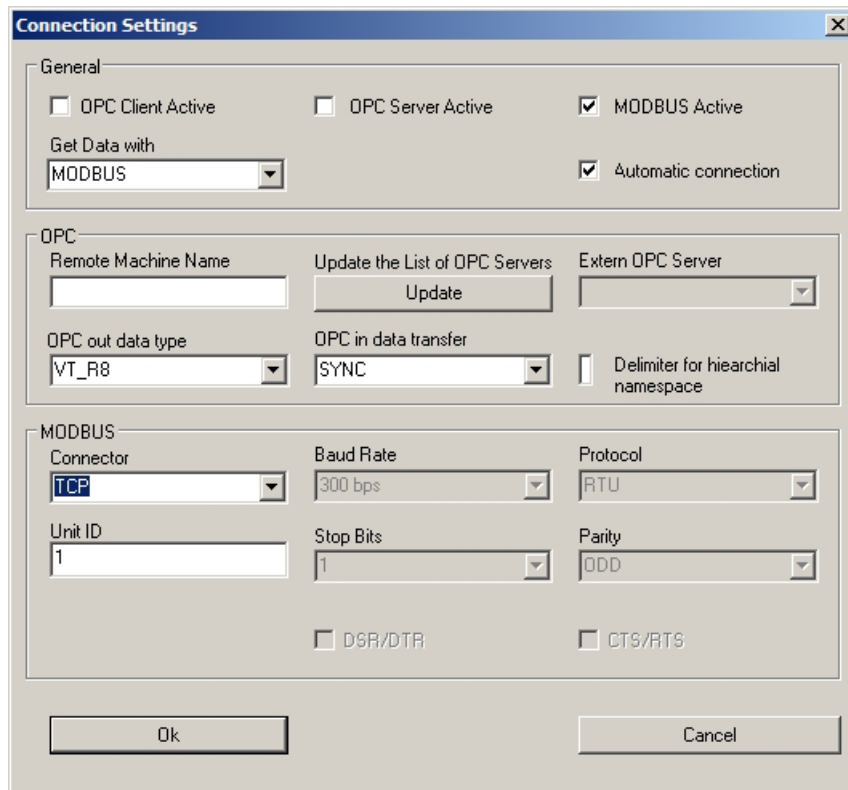
**Specifications:** 288.15 (text), K (dropdown), 101327 (text), Pa.a (dropdown), 1 (text), kg/s (dropdown)

**Specifications (OUT):** Pa.a (dropdown), kW (dropdown)

Phase	Feed	Not present	Not present	Not present	Not present	Not present
Mol.fraction	0	0	0	0	0	0
C2H6	0.25	0	0	0	0	0
C3H8	0.25	0	0	0	0	0
C4H10	0.25	0	0	0	0	0
C4H10	0.25	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0
	0	0	0	0	0	0

Buttons: OK, Cancel, Apply

now we proceed to configure connection's settings for MODBUS TCP



The Connection Settings dialog box is shown with the 'General' tab selected. The left sidebar contains a tree view with 'Connection Settings' expanded, showing sub-items: General, OPC, and MODBUS. The main area contains the following sections:

**General:**

- ☐ OPC Client Active
- ☐ OPC Server Active
- ☒ MODBUS Active
- Get Data with: MODBUS (dropdown)
- ☒ Automatic connection

**OPC:**

- Remote Machine Name: (text field)
- Update the List of OPC Servers: Update (button)
- Extern OPC Server: (dropdown)
- OPC out data type: VT\_R8 (dropdown)
- OPC in data transfer: SYNC (dropdown)
- ☐ Delimiter for hierarchical namespace

**MODBUS:**

- Connector: TCP (dropdown)
- Baud Rate: 300 bps (dropdown)
- Protocol: RTU (dropdown)
- Unit ID: 1 (text field)
- Stop Bits: 1 (dropdown)
- Parity: ODD (dropdown)
- ☐ DSR/DTR
- ☐ CTS/RTS

Buttons: Ok, Cancel



then we configure the four ports (two inputs and two outputs) , the information about how to define the values for MODBUS address and scaling factors is available in paragraph "MODBUS Interface",

Note : you should select Scaling Factors as the maximum possible values for that input or output taking in account the selected units (for temperatures, pressures, densities etc.)  
in this example we assume that selected units are K for temperature Pa for pressure and Kg/M3 for density (see previous paragraph about how to define a set of Units of Measurement) .

Now we configure the inputs , for the first port we set 400 (K) as scaling factor (or full range) and position1 notice that MODBUS address for all input ports is in MODBUS Holding Registers range

The screenshot shows the 'Edit Port Connections' dialog box. The title bar is 'Edit Port Connections' with a close button. The main area has a label 'Label for Stream1OperatingTemperature' with a text box containing 'Stream1OperatingTemperature'. Below it is an 'External Server TAG List' which is empty. Further down are three sections: 'Prode Client TAG Connection' with an empty text box and an 'Activate' checkbox (unchecked); 'Prode Server TAG Export' with an empty text box and an 'Activate' checkbox (unchecked); and 'MODBUS Scaling' with a text box containing '400', 'Holding Register Number' with a text box containing '1', and an 'Activate' checkbox (checked). At the bottom are 'Ok' and 'Cancel' buttons.

for the second port we set 10000000 (Pa) as scaling factor and position2 (in MODBUS Holding Register range)

The screenshot shows the 'Edit Port Connections' dialog box. The title bar is 'Edit Port Connections' with a close button. The main area has a label 'Label for Stream1OperatingPressure' with a text box containing 'Stream1OperatingPressure'. Below it is an 'External Server TAG List' which is empty. Further down are three sections: 'Prode Client TAG Connection' with an empty text box and an 'Activate' checkbox (unchecked); 'Prode Server TAG Export' with an empty text box and an 'Activate' checkbox (unchecked); and 'MODBUS Scaling' with a text box containing '10000000', 'Holding Register Number' with a text box containing '2', and an 'Activate' checkbox (checked). At the bottom are 'Ok' and 'Cancel' buttons.

we have two outputs,  
on first (compressibility) we set 2 as scaling factor and position 3 (in MODBUS Input Register)  
notice that MODBUS address for all output ports is in MODBUS Input Register range

The screenshot shows the 'Edit Port Connections' dialog box. The title bar is 'Edit Port Connections' with a close button. The main area has a label 'Label for Stream1GasCompressibility' with a text box containing 'Stream1GasCompressibility'. Below it is an 'External Server TAG List' which is empty. Further down are three sections: 'Prode Client TAG Connection' with an empty text box and an 'Activate' checkbox (unchecked); 'Prode Server TAG Export' with an empty text box and an 'Activate' checkbox (unchecked); and 'MODBUS Scaling' with a text box containing '2', 'Input Register Number' with a text box containing '3', and an 'Activate' checkbox (checked). At the bottom are 'Ok' and 'Cancel' buttons.

on second (density) we set 1000 (kg/m3) as scaling factor and position 4 (in MODBUS Input Register)

The screenshot shows the 'Edit Port Connections' dialog box. The title bar is 'Edit Port Connections' with a close button. The main area has a label 'Label for Stream1GasDensity' with a text box containing 'Stream1GasDensity'. Below it is an 'External Server TAG List' which is empty. Further down are three sections: 'Prode Client TAG Connection' with an empty text box and an 'Activate' checkbox (unchecked); 'Prode Server TAG Export' with an empty text box and an 'Activate' checkbox (unchecked); and 'MODBUS Scaling' with a text box containing '1000', 'Input Register Number' with a text box containing '4', and an 'Activate' checkbox (checked). At the bottom are 'Ok' and 'Cancel' buttons.

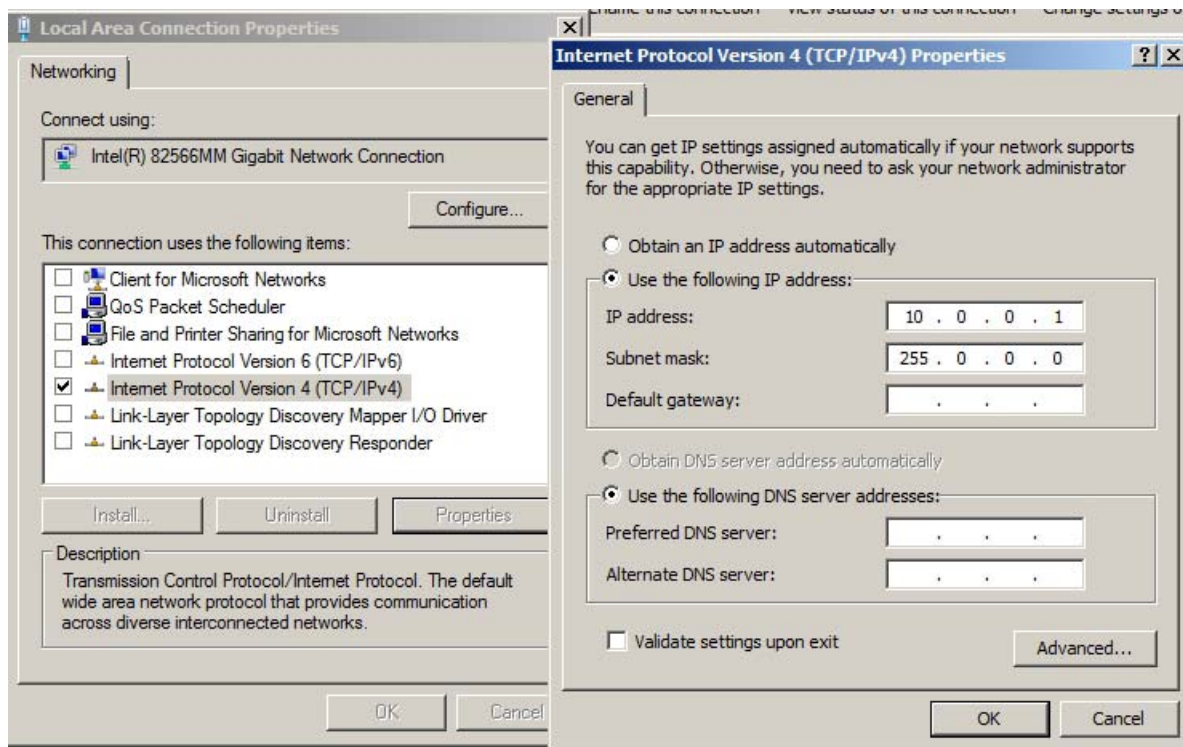
now we save the configuration, from menu' (File->Save Config) (do not forget this step !)  
and connect the client, from menu' (Services->Connect)  
this operation makes the client visible from MODBUS Server and ready to start communication.

For purposes of testing any MODBUS server can be utilized, in this example we utilize ModScan32

Before to test MODBUS communication it is important to verify settings on both computers, specifically you must verify :

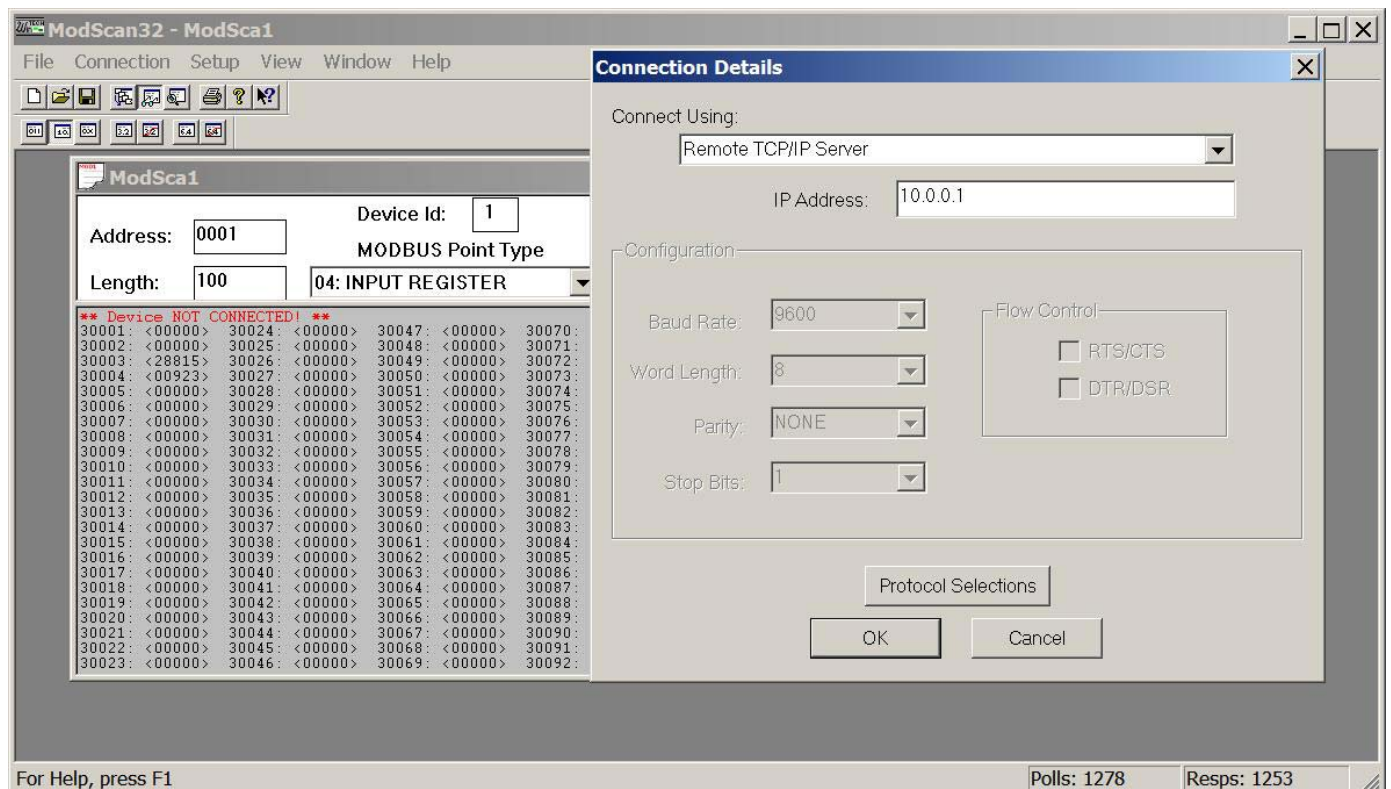
- machine IP
- TCP settings
- firewalls settings etc.

and make sure that TCP services on both computers are active and exchanging data.



Once verified that the two computers are communicating,

on second computer start the MODBUS server and connect to IP 10.0.0.1 (the IP of first computer, where Prode MODBUS client is running)



Once MODBUS server is connected with the client you may update the values of pressure and temperature and read the calculated values,  
to set the temperature use the address 1 in Holding Register, the value which Prode Industrial Interface reads is  $400 \times 50000 / 65535$   
where 400 K is the scaling factor or full range for temperature (see the previous port's configuration) and 65535 is the maximum integer value for MODBUS

ModSca1

Address: 0001      Device Id: 1      Number of Polls: 743  
Length: 100      MODBUS Point Type      Valid Slave Responses: 718

03: HOLDING REGISTER

**Write Register**

Address: 1  
Value: 50000

Update      Cancel

40001:	<45000>	40024:	<00000>	40047:	<00000>	40070:	<00000>
40002:	<04500>	40025:	<00000>	40048:	<00000>	40071:	<00000>
40003:	<00000>	40026:	<00000>	40049:	<00000>	40072:	<00000>
40004:	<00000>	40027:	<00000>	40050:	<00000>	40073:	<00000>
40005:	<00000>	40028:	<00000>	40051:	<00000>	40074:	<00000>
40006:	<00000>	40029:	<00000>	40052:	<00000>	40075:	<00000>
40007:	<00000>	40030:	<00000>	40053:	<00000>	40076:	<00000>
40008:	<00000>	40031:	<00000>	40054:	<00000>	40077:	<00000>
40009:	<00000>	40032:	<00000>	40055:	<00000>	40078:	<00000>
40010:	<00000>	40033:	<00000>	40056:	<00000>	40079:	<00000>
40011:	<00000>	40034:	<00000>	40057:	<00000>	40080:	<00000>
40012:	<00000>	40035:	<00000>	40058:	<00000>	40081:	<00000>
40013:	<00000>	40036:	<00000>	40059:	<00000>	40082:	<00000>
40014:	<00000>	40037:	<00000>	40060:	<00000>	40083:	<00000>
40015:	<00000>	40038:	<00000>	40061:	<00000>	40084:	<00000>
40016:	<00000>	40039:	<00000>	40062:	<00000>	40085:	<00000>
40017:	<00000>	40040:	<00000>	40063:	<00000>	40086:	<00000>
40018:	<00000>	40041:	<00000>	40064:	<00000>	40087:	<00000>
40019:	<00000>	40042:	<00000>	40065:	<00000>	40088:	<00000>
40020:	<00000>	40043:	<00000>	40066:	<00000>	40089:	<00000>
40021:	<00000>	40044:	<00000>	40067:	<00000>	40090:	<00000>
40022:	<00000>	40045:	<00000>	40068:	<00000>	40091:	<00000>
40023:	<00000>	40046:	<00000>	40069:	<00000>	40092:	<00000>

in the same way you can set a pressure

ModSca1

Address: 0001      Device Id: 1      Number of Polls: 785  
Length: 100      MODBUS Point Type      Valid Slave Responses: 760

03: HOLDING REGISTER

**Write Register**

Address: 2  
Value: 4500

Update      Cancel

40001:	<50000>	40024:	<00000>	40047:	<00000>	40070:	<00000>
40002:	<04500>	40025:	<00000>	40048:	<00000>	40071:	<00000>
40003:	<00000>	40026:	<00000>	40049:	<00000>	40072:	<00000>
40004:	<00000>	40027:	<00000>	40050:	<00000>	40073:	<00000>
40005:	<00000>	40028:	<00000>	40051:	<00000>	40074:	<00000>
40006:	<00000>	40029:	<00000>	40052:	<00000>	40075:	<00000>
40007:	<00000>	40030:	<00000>	40053:	<00000>	40076:	<00000>
40008:	<00000>	40031:	<00000>	40054:	<00000>	40077:	<00000>
40009:	<00000>	40032:	<00000>	40055:	<00000>	40078:	<00000>
40010:	<00000>	40033:	<00000>	40056:	<00000>	40079:	<00000>
40011:	<00000>	40034:	<00000>	40057:	<00000>	40080:	<00000>
40012:	<00000>	40035:	<00000>	40058:	<00000>	40081:	<00000>
40013:	<00000>	40036:	<00000>	40059:	<00000>	40082:	<00000>
40014:	<00000>	40037:	<00000>	40060:	<00000>	40083:	<00000>
40015:	<00000>	40038:	<00000>	40061:	<00000>	40084:	<00000>
40016:	<00000>	40039:	<00000>	40062:	<00000>	40085:	<00000>
40017:	<00000>	40040:	<00000>	40063:	<00000>	40086:	<00000>
40018:	<00000>	40041:	<00000>	40064:	<00000>	40087:	<00000>
40019:	<00000>	40042:	<00000>	40065:	<00000>	40088:	<00000>
40020:	<00000>	40043:	<00000>	40066:	<00000>	40089:	<00000>
40021:	<00000>	40044:	<00000>	40067:	<00000>	40090:	<00000>
40022:	<00000>	40045:	<00000>	40068:	<00000>	40091:	<00000>
40023:	<00000>	40046:	<00000>	40069:	<00000>	40092:	<00000>

after a few seconds the values calculated by Prode Properties will be visible in Input Register 3 and 4

ModSca1

Address: 0001      Device Id: 1      Number of Polls: 785  
Length: 100      MODBUS Point Type      Valid Slave Responses: 760

04: INPUT REGISTER

30001:	<00000>	30024:	<00000>	30047:	<00000>	30070:	<00000>
30002:	<00000>	30025:	<00000>	30048:	<00000>	30071:	<00000>
30003:	<28815>	30026:	<00000>	30049:	<00000>	30072:	<00000>
30004:	<00923>	30027:	<00000>	30050:	<00000>	30073:	<00000>
30005:	<00000>	30028:	<00000>	30051:	<00000>	30074:	<00000>
30006:	<00000>	30029:	<00000>	30052:	<00000>	30075:	<00000>
30007:	<00000>	30030:	<00000>	30053:	<00000>	30076:	<00000>
30008:	<00000>	30031:	<00000>	30054:	<00000>	30077:	<00000>
30009:	<00000>	30032:	<00000>	30055:	<00000>	30078:	<00000>
30010:	<00000>	30033:	<00000>	30056:	<00000>	30079:	<00000>
30011:	<00000>	30034:	<00000>	30057:	<00000>	30080:	<00000>

this confirms that communication is active and both client and server are working as expected

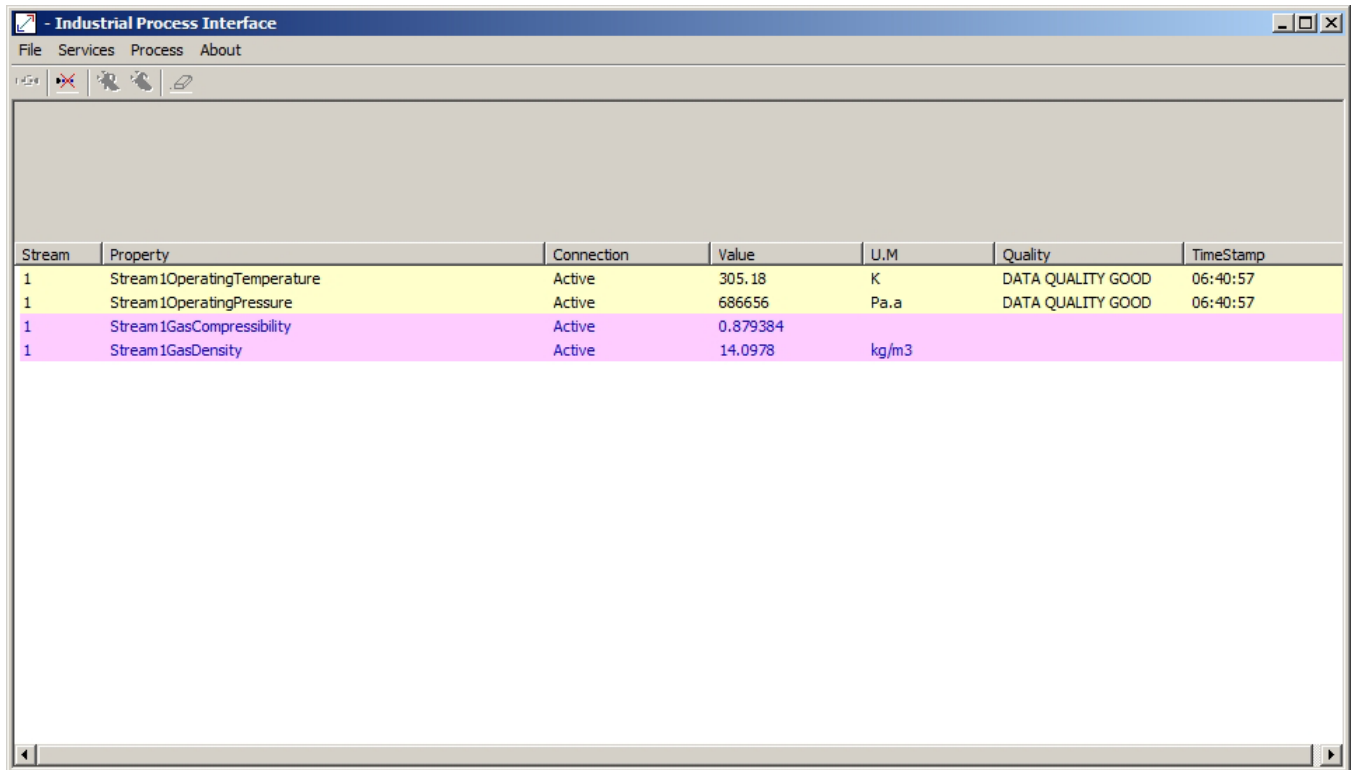
To convert the value returned by MODBUS to the value calculated by Prode Properties we use the same procedure discussed before

value = Scaling Factor \* MODBUS Value / 65535

for the compressibility (port 3) Scaling Factor is 2 and the value calculated by Prode Properties is

$2 * 28815 / 65535 = 0.8793$

as shown in Prode Industrial Interface



The screenshot shows the 'Industrial Process Interface' window. It contains a table with the following data:

Stream	Property	Connection	Value	U.M	Quality	TimeStamp
1	Stream1OperatingTemperature	Active	305.18	K	DATA QUALITY GOOD	06:40:57
1	Stream1OperatingPressure	Active	686656	Pa.a	DATA QUALITY GOOD	06:40:57
1	Stream1GasCompressibility	Active	0.879384			
1	Stream1GasDensity	Active	14.0978	kg/m3		

In the same way we can convert the value of density

$1000 * 923 / 65535 = 14.084$

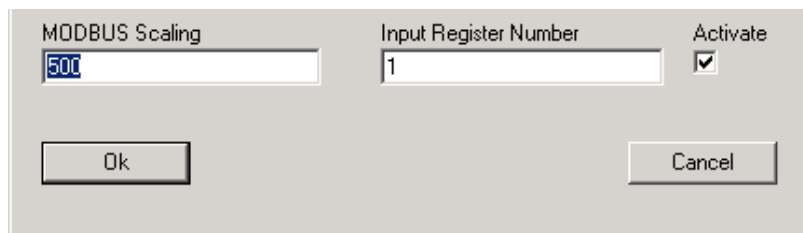
which shows a little difference due to improper Scaling Factor, a value of 100 as Scaling Factor for density (full range of 100 Kg/M3) should have reduced the error by a factor of about 10

this is a important point to consider when setting Scaling Factors !

## MODBUS Interface

MODBUS standard offers two types of analog registers, the Holding Register which permits read/write operations and the Input Register for read only operations. Each register has a size of 16 bits and can store unsigned integers with values between 0 and 65535, each register has a address, Input Registers in range 30000-30999 and Holding Registers in range 40000-49999.

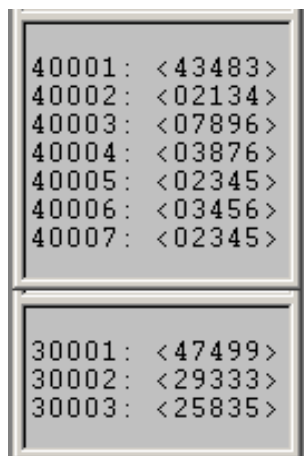
Prode interface maps the inputs (compositions, temperature, pressure) in Holding Registers and the outputs (calculated values) in Input Registers, the interface accepts values for address in range 1-9999



The dialog box titled 'MODBUS Scaling' contains three fields: 'MODBUS Scaling' with the value '500', 'Input Register Number' with the value '1', and an 'Activate' checkbox which is checked. At the bottom are 'Ok' and 'Cancel' buttons.

In this example the address 1 for calculated Cricondenthern will be translated by MODBUS to 30001 which is the first position in Input Registers area.

Standard MODBUS registers have 65536 possible values and a proper scaling is important, the MODBUS Scaling factor is the full range value, in the example for Cricondenthern the range is 0 to 500 Kelvins, a MODBUS register value of 0 means 0 K and a value of 65535 the value 500 K



Two panels showing MODBUS register values. The top panel shows registers 40001 to 40007 with values in angle brackets. The bottom panel shows registers 30001 to 30003 with values in angle brackets.

40001:	<43483>
40002:	<02134>
40003:	<07896>
40004:	<03876>
40005:	<02345>
40006:	<03456>
40007:	<02345>
30001:	<47499>
30002:	<29333>
30003:	<25835>

In the example there are 7 input values (the molar fractions of each component in mixture) and 3 output values (Cricondenthern, Gas Heating Value and Gas Wobbe Index)

Stream	Property	Connection	Value	U.M.	Quality	TimeStamp
1	Stream.1.Composition.C1	Active	0.663508		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C2	Active	0.0325628		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C3	Active	0.120485		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C4	Active	0.059144		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C5	Active	0.0357824		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C6	Active	0.0527352		DATA QUALITY G...	08:49:02
1	Stream.1.Composition.C7	Active	0.0357824		DATA QUALITY G...	08:49:02
1	Stream.1.CricondenThermTemperature	Active	362.398	K		
1	Stream.1.GasHeatingValue	Active	44760.6	kJ/kg		
1	Stream.1.GasWobbeIndex	Active	39423.2			

To obtain the value in Kelvins for Cricondenthern from MODBUS internal value of 47499 (address 30001) use the formulation

Value = Scaling factor \* MODBUS value / 65535

or  $500 * 47499 / 65535$



## OPC Interface

The standard OPC interface, based on Microsoft Variant objects, support several data types including

VT\_R432-bit floating-point value

VT\_R864-bit floating-point value

Prode interface recognizes automatically the different types and the user can define the format for outputs.

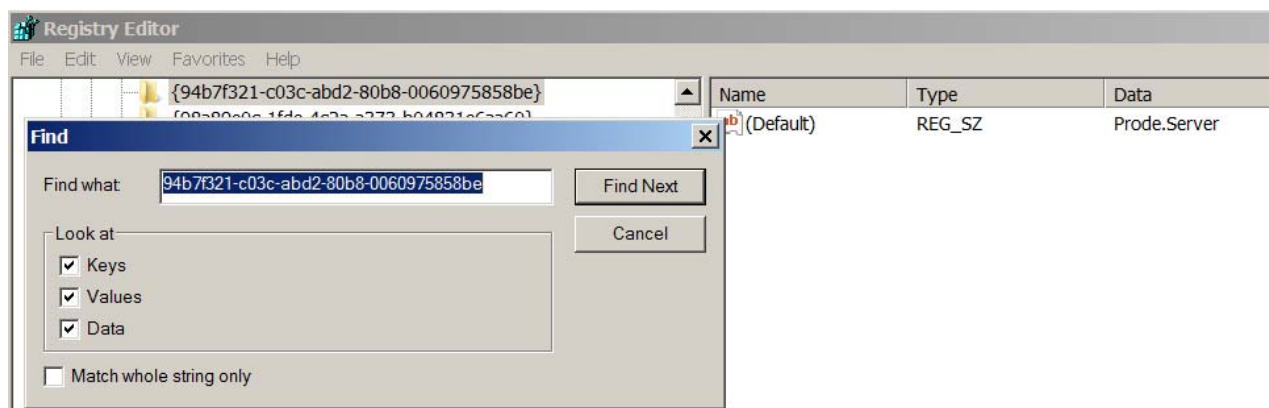
## Unregister OPC Server, delete registration keys in Windows Registry

When deinstalling (removing) the application or installing different versions or moving the application to different folders you need to delete all the information stored in Windows Registry (to register the OPC Server.), this information include registration keys, the name of the application, the installation folder etc.

To clear Windows Registry, you can simply select the command in menu Services->Unregister Server Service or you may delete manually all the keys, to delete manually :

1) run regedit.exe

2) find and delete all the strings 94b7f321-c03c-abd2-80b8-0060975858be



## Data files folder

When running Prode Interface requires to access several files, these are placed in a directory \Prode\ in user space to avoid possible conflicts with code reserved areas, the exact path depends from Windows version and settings, for example in Windows XP they could be placed in C:\Documents and Settings\All Users\Application Data, the list of files includes

proind.lan

proind.ppp

proind.cfg

do not remove or rename these files

## Translate resources to different languages

A large part of the resources are stored in the file proind.lan, this is a text file, easily editable by the user.

Example

in English language

PID\_LABEL\_14 = "Automatic connection";

in French language

PID\_LABEL\_14 = "Connecter automatiquement";

in Italian language

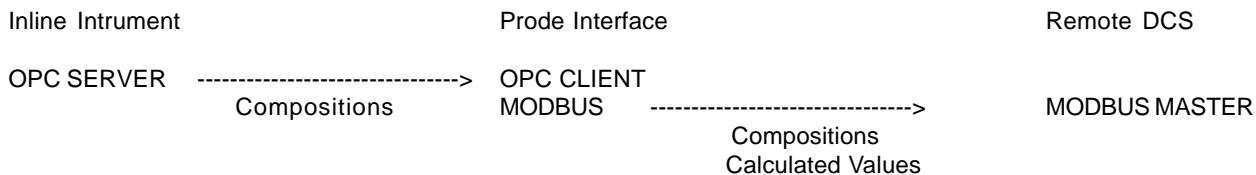
PID\_LABEL\_14 = "Connessione automatica";

### IMPORTANT

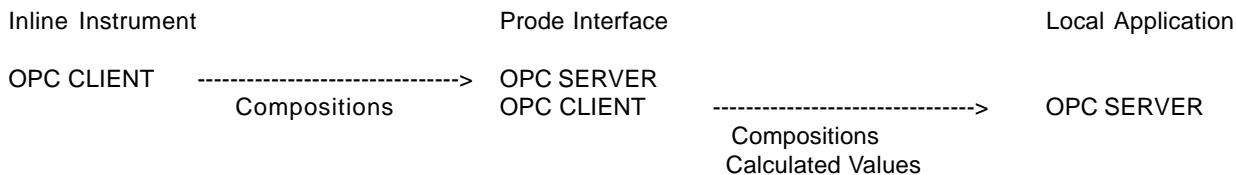
When editing a string take care to modify only the parts enclosed within the braces "" and do not alter/modify the data structures composed by special characters

## Application Examples

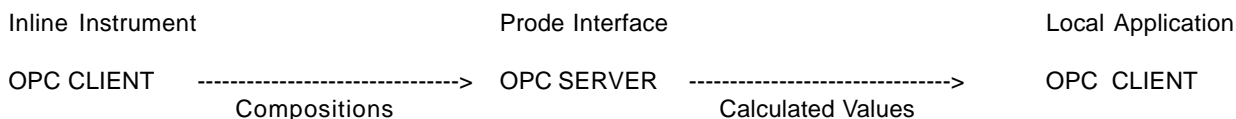
A inline Instrument includes a OPC Server to export compositions, the OPC Client in Prode Interface reads data, the package calculates properties and exports compositions and calculated properties via MODBUS



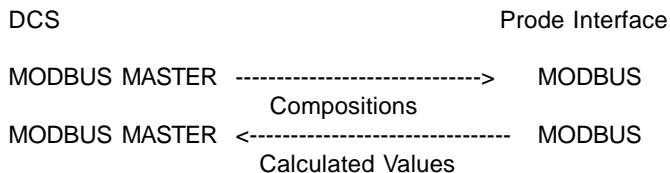
A inline instrument includes a OPC Client to export compositions, the OPC Server in Prode Interface reads data, the package calculates properties and exports compositions and calculated properties via OPC Client



A inline instrument includes a OPC Client to export values such as pressure or temperature, the OPC Server in Prode Interface reads data and exports calculated values to another OPC client



A DCS provides via MODBUS compositions plus operating conditions to Prode Interface, calculated values are then exported via MODBUS interface



## Custom solutions

On request Prode software is available preinstalled and tested in different types of industrial grade computers, these can be very small with rugged metal case, splash/dust resistant.

