VPVision User Manual

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VP INSTRUMENTS

VPVision User Manual

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Managing Editor

Pascal van Putten

Table of Contents

1 Warnings

WARNING: 100...250 VAC MAINS CABLES ARE PRESENT IN THE HOUSING. DO NOT TOUCH THE CABLES AND THE POWER SUPPLY WHEN MAINS IS APPLIED. KEEP THE HOUSING CLOSED DURING NORMAL OPERATION. CHECK THE CABLE GLANDS ON WATER TIGHTNESS.

ALL ELECTRICAL INSTALLATIONS TO BE CARRIED OUT BY AUTHORIZED ELECTRICAL INSTALLATION ENGINEERS ONLY.

READ AND UNDERSTAND USER MANUALS OF ALL EQUIPMENT INVOLVED BEFORE COMMENCING INSTALLATION OR USE.

MAKE SURE THAT THE AMBIENT TEMPERATURE DOES NOT EXCEED THE LIMITS.

The default IP address of the VPVision M can be found on the configuration sheet, which comes with the product. When powered up and connected via your network, you can enter the address in any internet browser to view the VPVision dashboard. Initially, you will need a laptop or PC with static IP address assigned to it.

VPVision does support Chrome, Firefox, Safari, Opera,Internet Explorer > 8
Older versions of Internet Explorer are not supported.

2 Introduction

Thank you for choosing VPVision! Let the savings begin! VPVision is a web based energy monitoring system, primarily developed for compressed air systems. It monitors your entire compressed air system from supply to demand. Thanks to the standardized hardware and the modular software architecture, VPVision is scalable and adaptable.

About this manual

We have written this manual to help you to get the VPVision system up and running in no time. There are some steps that require basic knowledge about IT systems, networks and Linux. This is where you should get support of your IT department. In the entire manual, you will see small icons with a page number. These refer to background information or additional information on a certain subject.

Basic components:

- VPVision-M logger, with VPVision software
- 24 VDC 100 Watt power supply
- Web interface
- SQL database

Sensors:

VPVision support all VPInstruments sensors, and other modbus-RTU or 4..20 mA based sensor types. For some Modbus sensors, we offer pre-installed drivers for quick and easy installation.

Hardware extensions:

- Touch screen
- Modbus-Ethernet converters
- Analog IO modules
- Junction boxes for the RS485 network

Software options:

- P&ID visuals
- Report generator
- Report e-mail function (version 2.0 release Q1, 2013)
- Alarms module (version 2.0 release Q2, 2013)

Service subscriptions

We offer a service contract, which covers all software upgrades and support. Contact us for details.

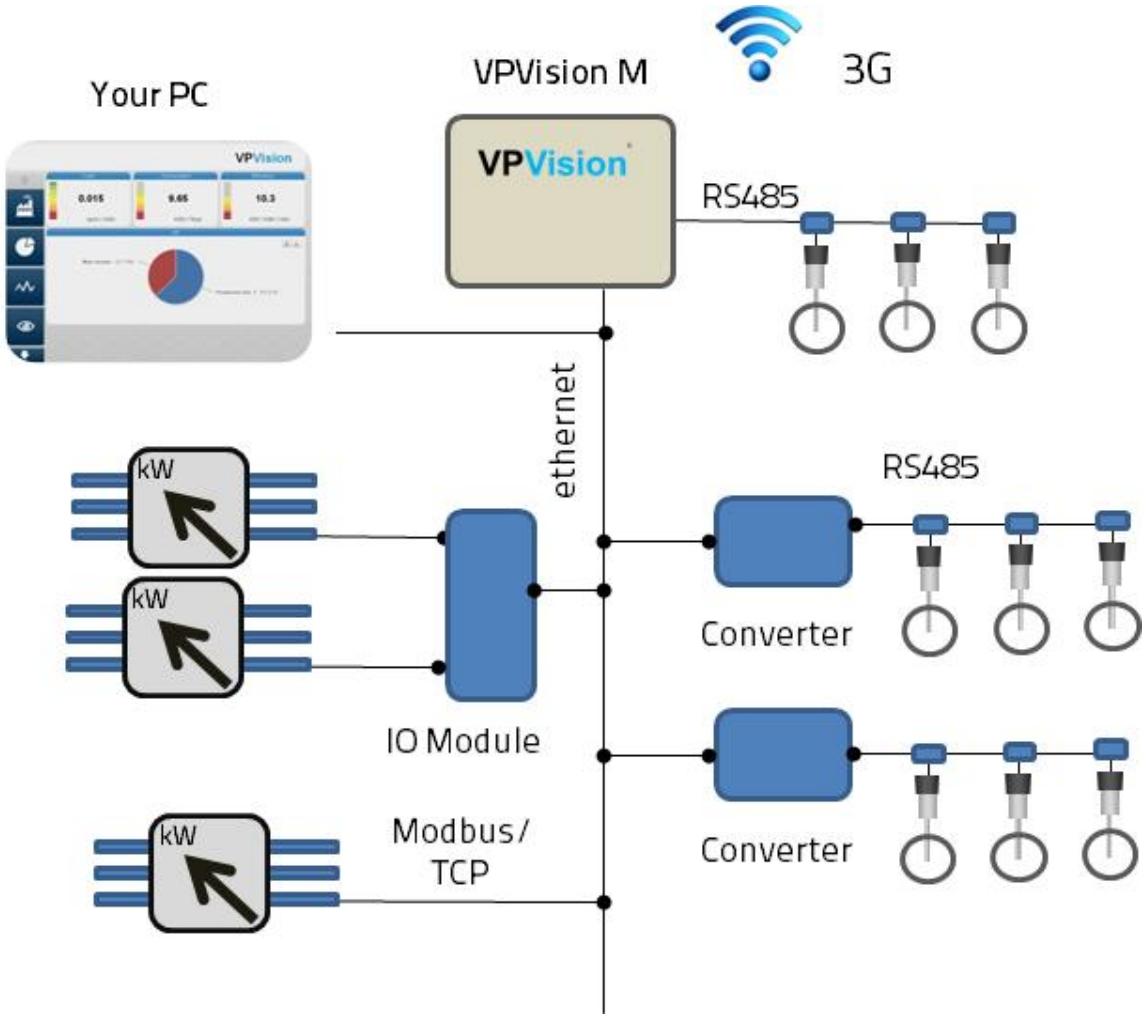
Language options:

At this moment, VPVision is available only in international English. More languages will be coming soon! But hey, it's web based, so you can access VPVision via real time translation, using Google Translate.

2.1 System overview

VPVision is an ethernet based monitoring system. The typical installation consists of the VPVision M data logger, a Modbus network with VPFlowScopes and additional (remote) IO modules for analog sensors. The VPFlowScope sensors can be read out via direct RS485 or an indirect modbus/TCP converter. The IO modules are read out via an ethernet interface. They can gather data from 4..20 mA based sensors, and the default number of channels is 8 per analog IO module.

VPVision is built around a powerful database structure with integrated web server. This makes the system flexible and scalable to meet the demands of virtually any compressed air installation.



3 Quick start in 10 steps

Step 1. Mount the VPVision cabinet

Unpack the box. Open the VPVision cabinet with the special key. Then remove all transport foam. Check if all DIN Rail mounted equipment is still in place. If not, please fix the modules on the DIN Rail. **Installation by certified professionals only.** Mount the VPVision M on a wall and establish the required Mains power connection. Read more about hardware installation here. 10

Step 2. Configure your VPFlowScope sensors

See VPFlowScope configuration. 11 Now it is time to assign the diameter and a Modbus address to each individual sensor, so they can be found within the modbus network.

Step 3. Assign IP addresses to all networking equipment

First, create a list of required IP adresses. See also Ethernet Networks. 12 Document this list on the configuration sheet. Get your laptop or PC, and connect it to the VPVision M. System Administrators: to change the IP address of the VPVision M, you need to establish a connection via NX Client. Now assign the IP addresses to the VPVision M. Depending on your system configuration, you also have to change the IP addresses of the modbus converters (see RS485-Ethernet module) 29 and any remote IO modules (see Moxa analog input module) 30 you have. Save time! Ask us to pre-configure your IP addresses.

Step 4. Install the sensors

Ask your certified (electrical) installation subcontractor to install the VPFlowScope 29 sensors in the pipe, and connect it to the modbus network. Install analog sensors and make a list of analog input channels on your configuration sheet. See also the Documentation example 42.

Step 5. Configure inputs

Now it is time to Configure the input channels 17 in VPVision. You can add the VPFlowScope and analog sensors via the web interface. Use your configuation sheet as a reference for the channel names, sensor locations, sensor ranges, diameter settings and so on.

Step 6. Configure widgets

Once the channels are in place, you can start to Configure the widgets 20. We have pre-defined a number of widgets. Now you can assign channels to the widgets.

Step 7. Configure pages

Once the channels and widgets are in place, you can start to Configure the pages 22. Assign the widgets to the pages, make combinations of widgets and so on.

Step 8. Create your first report

Now its time for the final step: (depending on your license). Creating your first Reports 24 using the reports module.

Step 9. Configure the optional touch screen

The touch screen PC is basically just a PC with a web browser. Startup the unit, run Firefox and type in the VPVision M IP address. That is all it takes.

Step 10. Use VPVision and save !

Now it is time to lean back, relax and monitor your entire system. See for example Page layout with widgets 26. Let us know how much you did save! We will reward every white paper or savings success story with a nice gift. And if it's really good, we'll send in the press for an exclusive interview

starring you!

3.1 Hardware installation

	**WARNING: INSTALLATION INVOLVES CONNECTION TO MAINS. INSTALLATION OF FIELD CABLES REQUIRES IN-DEPTH KNOWLEDGE AND SKILLS. THEREFORE ALL STEPS THAT INVOLVE ELECTRICAL INSTALLATION SHOULD BE CARRIED OUT BY CERTIFIED INSTALLATION PROFESSIONALS.**

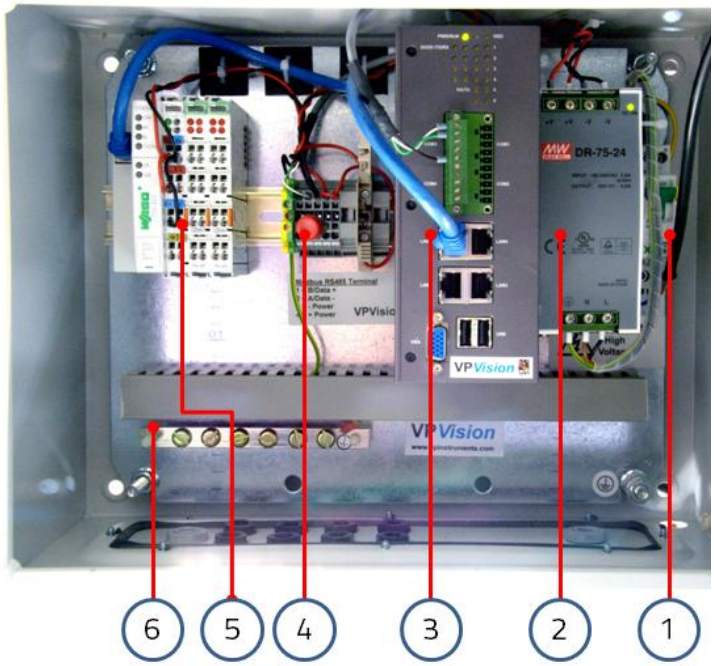
	**MAKE SURE THAT THE AMBIENT TEMPERATURE DOES NOT EXCEED THE LIMITS OF THE VPVISION M CABINET (MAX 40 deg C | 104 F). HIGHER AMBIENT TEMPERATURE REQUIRES CABINET COOLING.**

	**Check if the earth wire (field ground) is free of interference and potential dangerous high voltage. Make sure the circuit breaker is in off position. Then install the L, N and Earth wire. The L, N and Earth may have a different color, depending on your local legislation and directives for medium voltage systems.**

Each VPVision M consists of the following components:

1. Circuit breaker
2. Main power supply, 24 VDC, 100 Watt.
3. VPVision M
   - PostgreSQL database environment, pre-installed
   - VPVision application, pre-installed
   - Webserver, pre-installed
4. RS485 connection terminal (fused separately)
with front cable entry.
5. Optional analog input module.
6. Earth rail (for cable shielding)

The picture shows a typical configuration. Your actual system may vary from this picture.



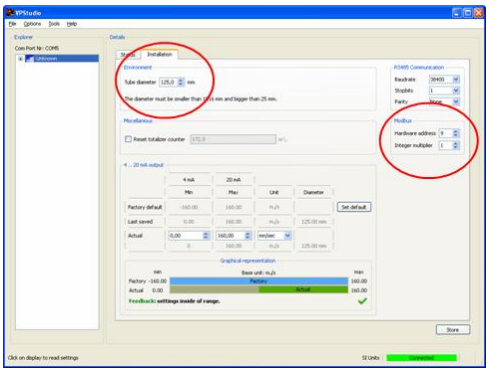
3.1.1 VPFlowScope configuration

Set the modbus addresses per VPFlowScope 29. Each VPFlowScope needs an individual address, in order to be found in the modbus network.

	**Always start with VPFlowScope modbus assignment before putting them into the network. Label / Tag the VPFlowScopes for convenience.**

Use VPStudio to set:
- Diameter
- Modbus address
- Other settings (Analog)

On the screen shot you can see the settings that are key: diameter and modbus address. Please refer to the VPStudio manual for details.



3.1.2 Network preparations

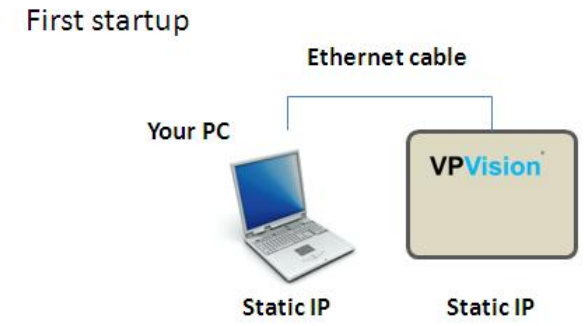
You need to set your IP address to a STATIC IP address when connecting your laptop or PC to the VPVision M. The address should be within the same IP range. See the configuration sheet which comes with your VPVision M.

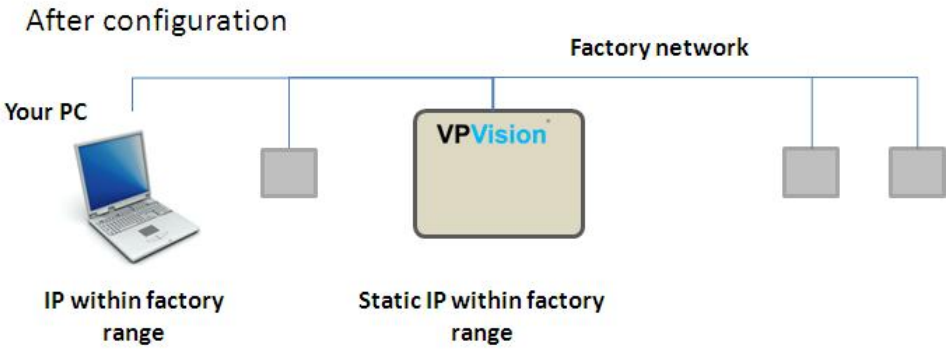
Make sure that your IT department provides VPN access to the network for remote support. If not possible, we strongly advice to install the 3/ 4G gateway module.

Define your network

- IP addresses must be unique
- Gateway must be defined
- Subnet mask must be defined
- When using existing network structure: Get your Address range: Check with client IT dept

General convention on IP numbers
To make it more easy to find a device, we will use the following guideline to assign IP addresses to devices in the network. In existing networks, this might be not possible due to limitation on the number of IP addresses. In any case, always document the final IP configuration.





Ethernet address example

The default address for LAN port 1: See the configuration leaflet, which comes with your VPVision system

As an example, the configuration may look as follows:

192.168.1.XXX VPVision M

192.168.1.XXX RS485 to Ethernet converter for remote VPFlowScope
192.165.2.XXX Remote analog IO module

In most networks, the first three groups of digits will be 192.168.X. In specific situations, the network might be AAA.BBB.C.XXX

Where XXX (last three digits) may be assigned as follows:

0	Reserverd as network address, do not use
254	Reserverd as broadcast address, do not use
1	VPVision-M default address (can be changed when required)
2...20	VPFlowScope flow meters (Modbus - TCP/IP converters)
21..40	Analog input modules(See also Moxa analog input module 30 and Wago analog input module) 31
41...60	Other devices, for example Ethernet enabled kW meters.

Example network configuration:

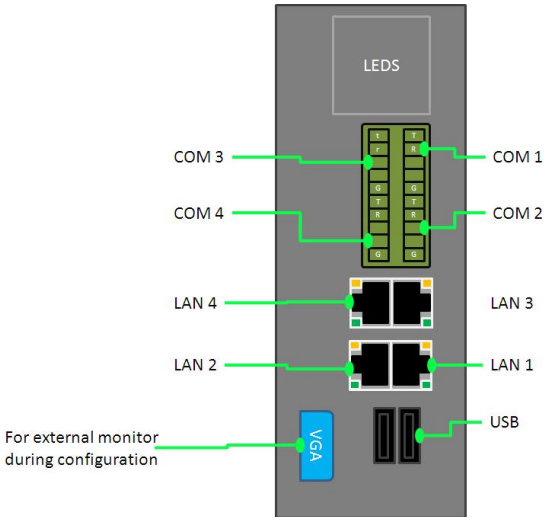
192.168.1.1	VPVision M 33
192.168.1.2	VPFlowScope RS485 network, compressor house building 1
192.168.1.3	VPFlowScope RS485 network, compressor house building 2
192.168.1.21	Analog inputs, building 1
192.168.1.22	Analog inputs, building 2
192.168.1.41	Power meters, building 2
192.168.1.254	Gateway

3.1.3 PC connection

To connect your PC or Laptop, open the electrical cabinet. You will see the VPVision M unit. On the VPVision M you will find multiple Ethernet Ports. By Default, **LAN 1 is used for configuration.**

Connect an Ethernet cable between Laptop (PC) and the VPVision M LAN 1. The Laptop should have a static IP address within the same range as the VPVision M. Make sure the IP address is not the same as the VPVision M!

Open your webbrowser, type in the IP address of the VPVision M and you should see the startup screen. Now you can configure the system (see Configuration backend) 14.



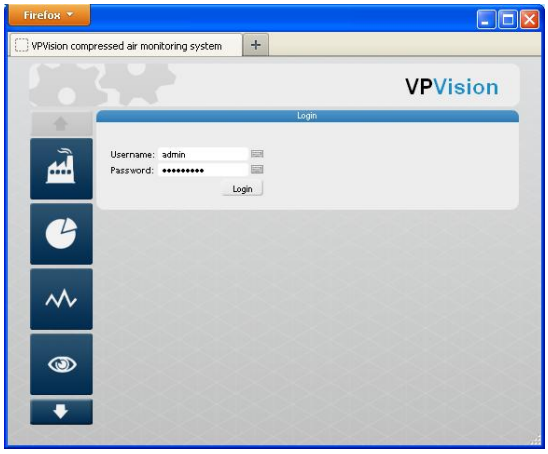
3.2 Software configuration

3.2.1 Configuration backend

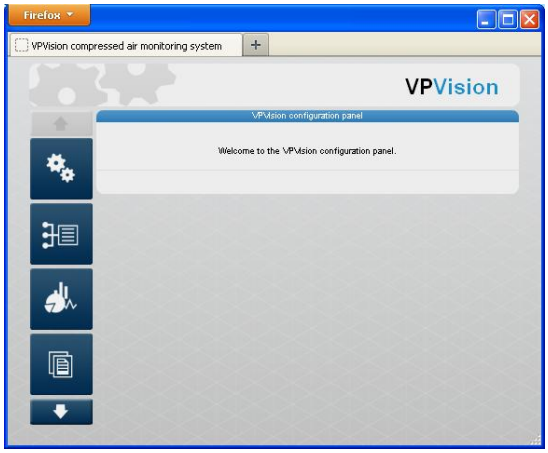
By clicking on the green puzzle icon, you enter the back-end of VPVision. In the backend, the entire configuration can be made. The interface is designed to be extremely intuitive and easy to use.

Login to the configuration backend first.Click on  to log in.

Use the default admin password to log in. You can find the password on your system configuration sheet.



You are now logged in. New icons appear on the left.



Configuration - description of functions

	System settings	User settings General settings	Set users and permissions Set language settings, preferred units and so on.
	Channels	Configure channels	Enter this section to configure VPFlowScope channels, analog sensor channels, set zero and span, change channel names.
	Widgets	Configure widgets	Enter this section to configure widgets, for example pie charts, dashboard overviews, real time graphs, Key Perfomance Indicators
	Pages	Configure pages	Here you can configure a page. A page can contain multiple widgets. You can assign icons to a page, drag and drop widgets and so on.
	Reports	Configure reports	Create reports, add data channels to the report. Once the report is set up, it can be generated automatically with jut one mouse click.

3.2.2 User Configuration

In this menu, you can change/ add/ remove users and depending on your privileges, you can also set up a device driver.

Click on to configure a user. You will see a list of existing users. To add a user click on the icon. The add user window will appear. Enter a name, an e-mail address and assign rights.

User types

Super User	Can do everything except for system settings
Administrator	Can add SuperUsers and Administrators. Can change date and time format, thousands and decimal separator, currency units.

User Configuration Window

In the user configuration window, you can activate and deactivate users, you can check their last active date and you will see their rights.

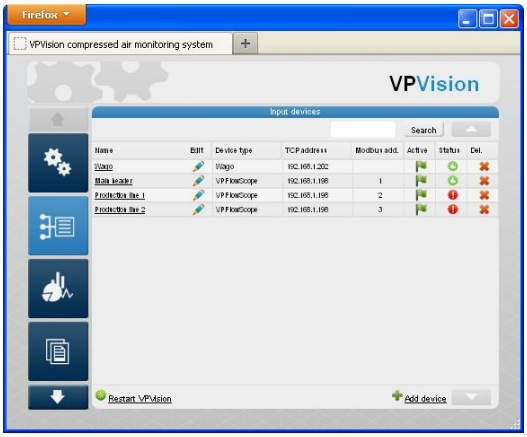
- Press Add user to add another user.
- Press the icon to edit an existing user.
- Press the flag to deactivate/ activate a user.
- Press the red cross to delete a user.

Sander : SVP screendump met fake users maken

3.2.3 Inputs

In this step you will configure the inputs. This is where the software connects to the physical devices in the network. It is the most important step, as this forms the basis for all VPVision data.

Device overview



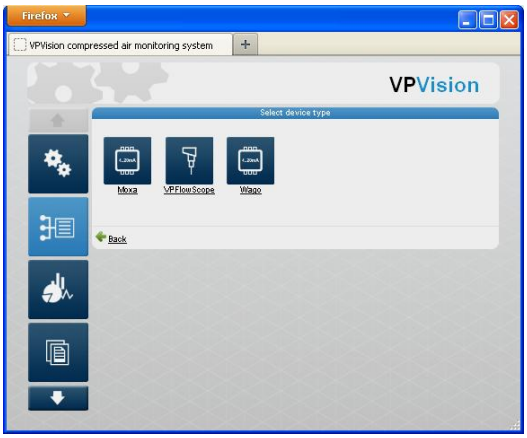
Click on the icon. you will get an empty list or an overview of configured inputs.

Click on an existing device via ✎ or click on "add device" to add a new device.

In the device overview list, you will also see some status columns.

Active	Flag green: device is active Red is inactive.
Status	Thumbs up: Device is responding properly
Del	Delete the device from the list. Are you sure? window will pop up. Data will be lost.

Select device type



In the second step, choose the device you want to add. It can be VPFlowScope, an IO module, a power meter with modbus intereface.

VPFlowScope: The one and only three in one compressed air meter. Needs no further introduction.

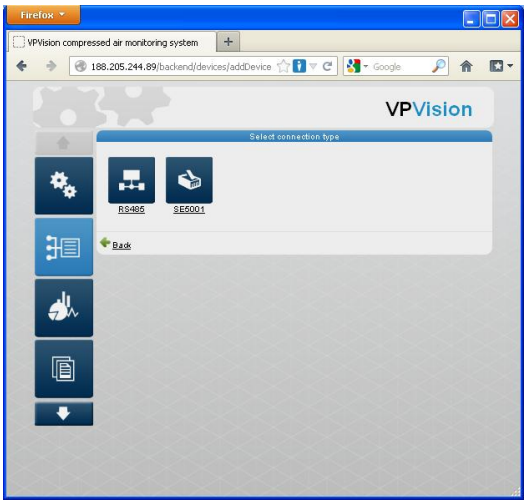
Moxa: A remote analog IO module with 8 channels. Driver is pre-configured.See also Moxa analog input module 30.

Wago: A remote analog IO system with flexible channel configuration. Driver might need custom configuration by VPInstruments.See also Wago analog input module 31.

VPFlowScope

Select connection type; RS485 or Ethernet

Now choose the connection type. Is the VPFlowScope connected directly via RS485 or is it connected via an ethernet converter? We will show you both possibilities.

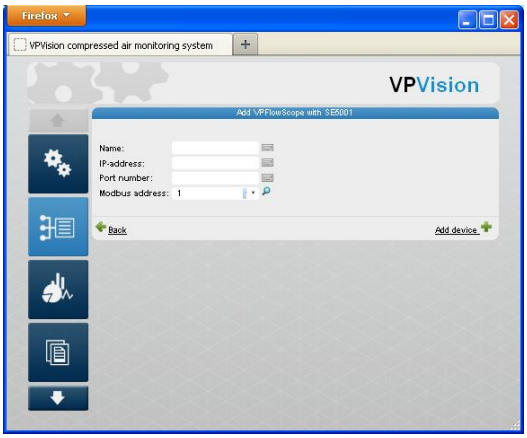


VPFlowScope via RS485- ethernet converter

1. Assign a name, The IP of the converter and a port number of the converter. **Remember: the converter needs to be pre-configured before you can use it!**

2. Second, you select the Modbus address.

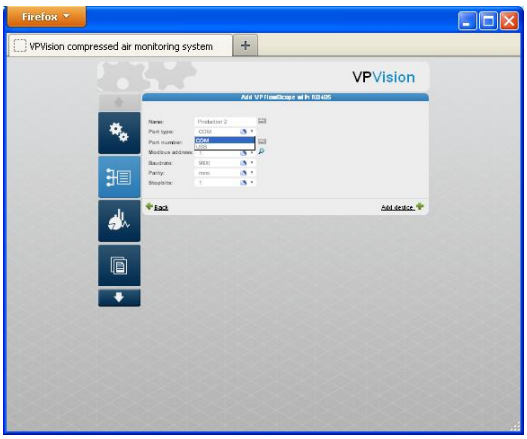
3. Press add device to finalize this step.



VPFlowScope direct serial

Add an RS485 based VPFlowScope connection:

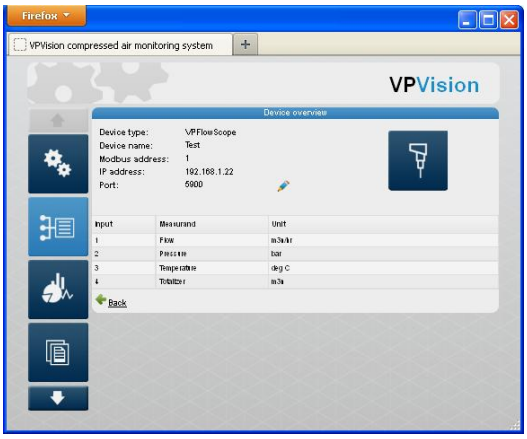
1. Assign a name to the channel.
2. Select the Port type (COM or USB)
3. Set the port number
4. Set the VPFlowScope modbus address
5. Set communication parameters Baudrate, parity and stop bits.
6. Press Add Device to finalize.



Device added!

The VPFlowScope with device name "test" in this example has been added.

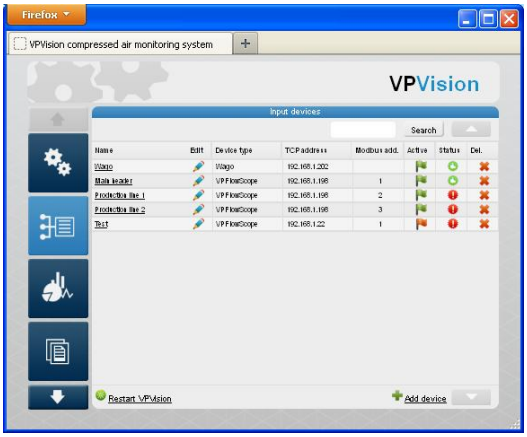
Press back arrow to go to the main device list. You will see the device added and the status is disabled.



Restart VPVision

After all devices have been added, you have to restart the VPVision system. Click on Restart VPVision: This re-starts the Data Acquisition process with the new input device configuration.

This is the moment of truth! Your data is now being logged, while you can continue with configuration of the visualization. You don't have to worry about any data loss, and you can take your time to change visualizations independent of data acquisition!



3.2.4 Widgets

In this step you will configure the widgets. This is where the fun part starts!.

Widget overview

In the overview, you will see all the widgets that have been configured. You can edit them and delete them.

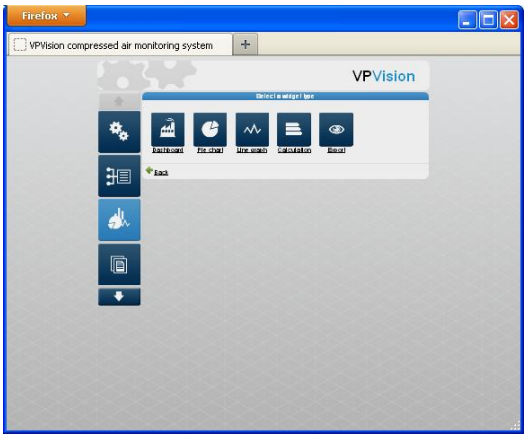
You cannot delete a widget when it is in use on a page.

Add widget

Click on add widget in the right bottom corner. Now you can choose a widget type.

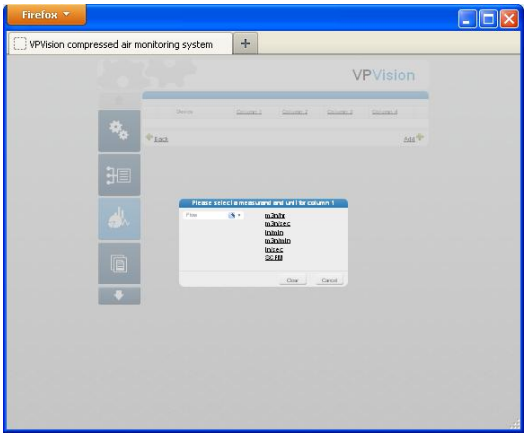
Once the type has been chosen, you will be guided through a number of intuitive steps to finalize your widget configuration.

The number of required steps varies per widget type.



Dashboard

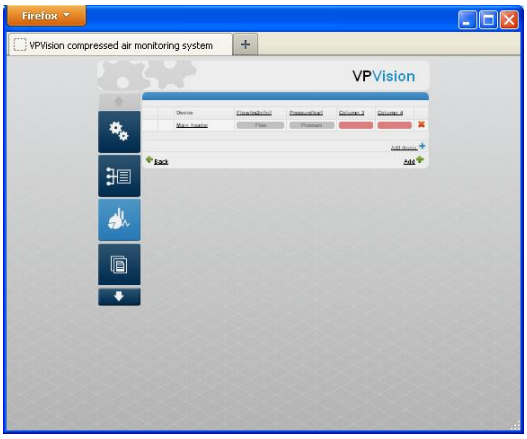
1. First you have to define the columns to show in the dashboard.
2. Click on each column header to assign a measurand.
3. Select the measurand from the pull down menu.
4. If you do not assign a measurand, the column will remain red. This is not a problem, you do not have to assign all columns.



You can only assign measurands which are defined in the column headers. Other measurands will be ignored.

Add a device

Now you can start to add devices to the dashboard. in this example we added the main header flow meter. Depending on the device type, VPVision automatically assigns the measurands to the columns. Cant go wrong!



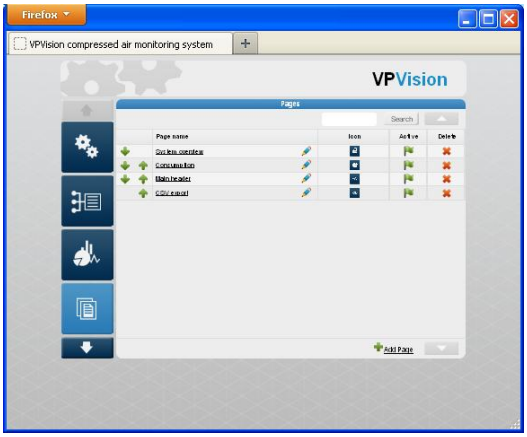
Standard Widgets

	Dashboard	A table overview of measurement data, with sum and averaging options
	Pie Chart	A pie chart, showing consumption per area or generation of air per compressor. Can be freely configured. It also offers a print option, export option.
	Line Graph	Real time and historical visualization of data, with intuitive zoom option, print option, export option.
	Calculation (KPI)	Calculation widget for Key Performance Indicators. Examples are cost, efficiency, average consumption.
	Export	Export widget, with pre-configured data format, number of channels and averaging functions.

3.2.5 Pages

After the widgets have been configured, you are ready to configure your pages. Without widgets, you cannot proceed with this step.

Page overview

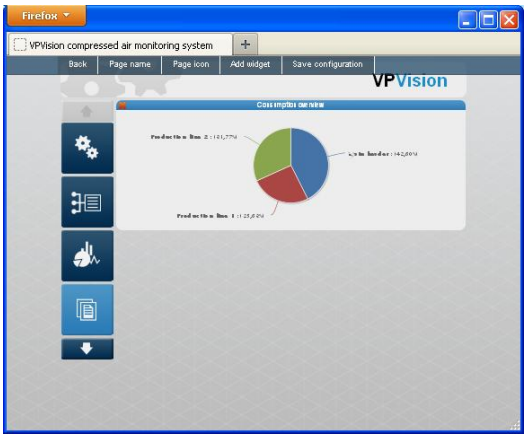


In the page overview you see all the pages that have been configured for your VPVision system. The order of pages (how they appear in the navigation) can be changed by pressing the green arrows. The page icons are shown, and the page active/ inactive status is shown as well.

The page icon can be changed at any time, by clicking on the icon you get an overview of available icons.

All Icons are designed for VPVision. It is not possible to add your own icons.

Page configuration



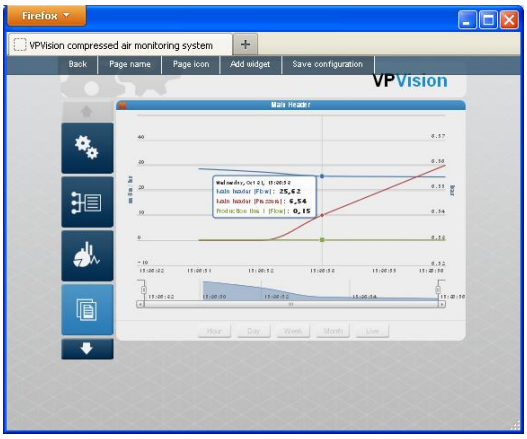
By clicking on  you will enter the page configuration window. Here you can do the following:

- Change page name
- Change page icon
- Add a widget
- Drag and drop widgets at your convenience

Remember: Widgets can be used on multiple pages! You can create, for example, a pie chart widget about air consumption and let it appear on different pages.

Example page setup

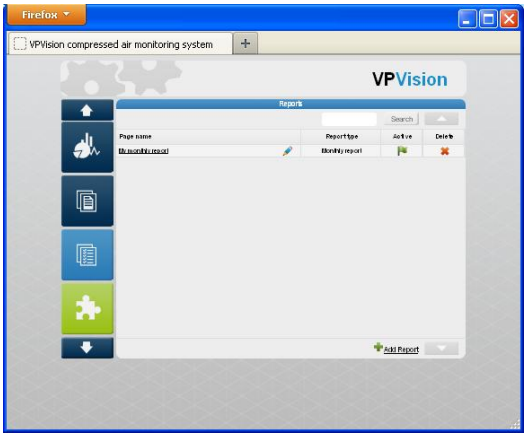
A cookie manufacturer has two business units. Each business unit will be charged for it's own compressed air consumption. Two pages will be made, one for each business unit. Each page will have a dedicated real time graph, shown the air consumption and pressure of their area.
The page will look as shown on the right.



3.2.6 Reports

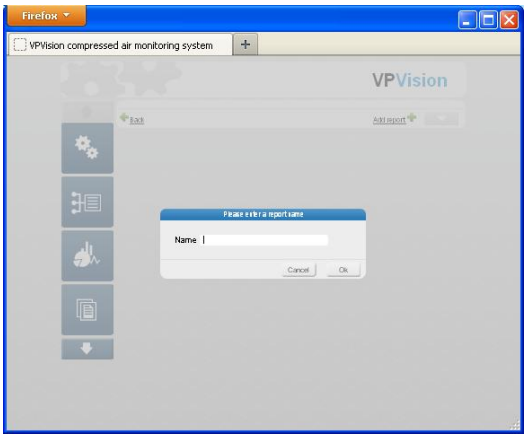
Its time for the final step, create your first report!

Report overview



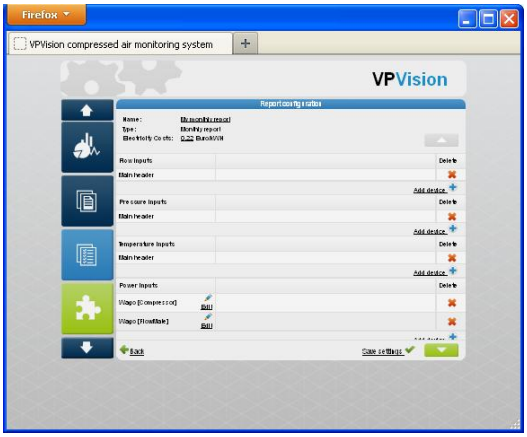
In the overview page, you see the reports that have been defined.
Press add report or click on the icon to change an existing report.

Add Report



First, give the report a name. For example: "Weekly |Report"

Configure report content



Now you can edit the content. First, set the electricity costs.
Second, add the desired inputs for the report.

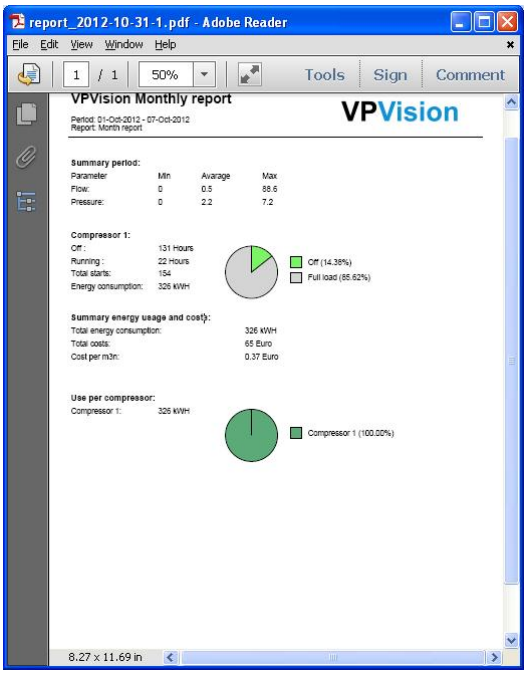
1. Add flow meters
2. Add pressure sensors or VPFlowScope pressure signals
3. Add temperature inputs
5. Add power inputs from the compressors.
Configure multistage compressors.

Generate report

Go to the front end, and scroll down in the menu to the report icon.

Now click on the generate report button to see your first report! Obviously, you should have data in your system, so during the first hours of operation, the report might look empty or might show incomplete results.

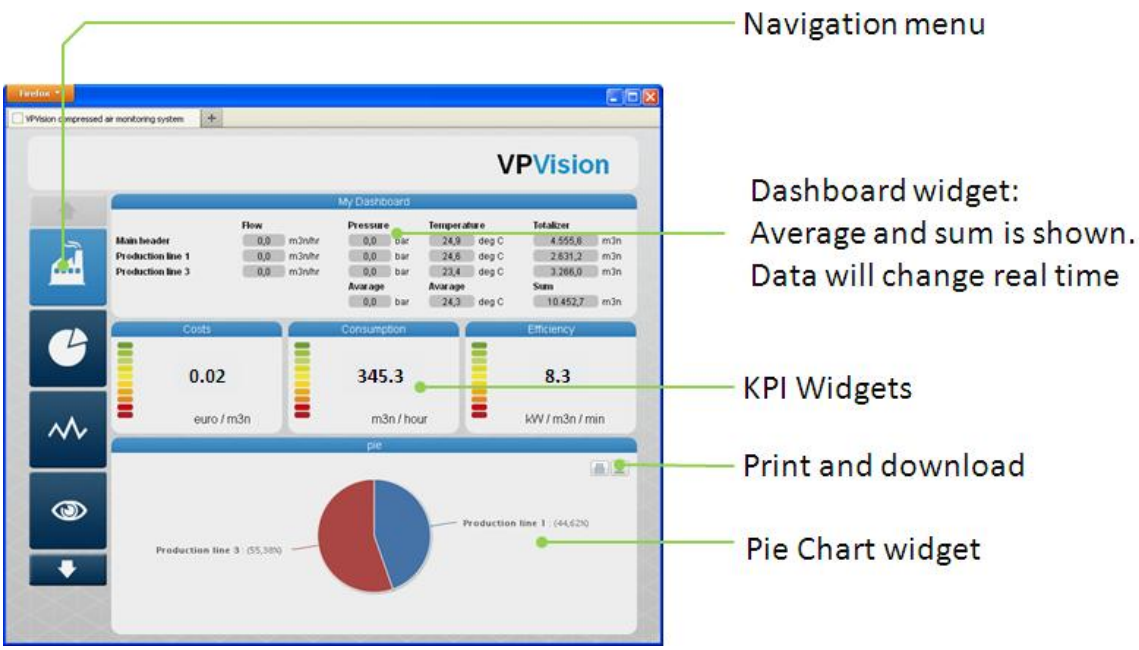
Basic report: Compressors vs main header.



4 Daily use

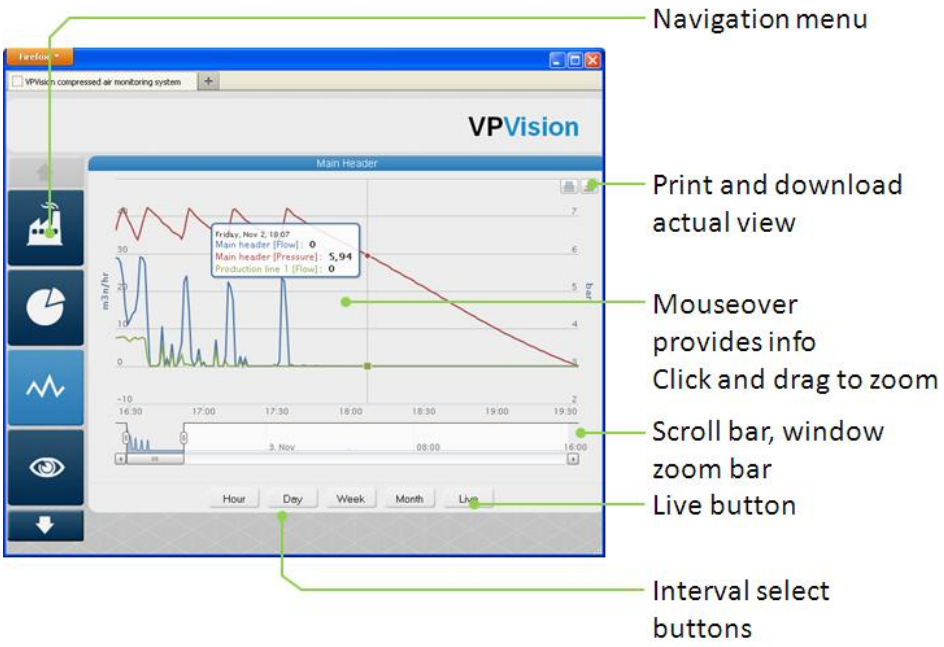
4.1 Page layout with widgets

A page can contain various widgets. The most common widgets are shown below. In this example page, a dashboard widget, three KPI widgets and a pie chart are displayed. The widgets are updated real-time.



4.2 Real time graphs

In the graph view, you can see real time data or historical data. The controls are very intuitive. A brief explanation is given below.

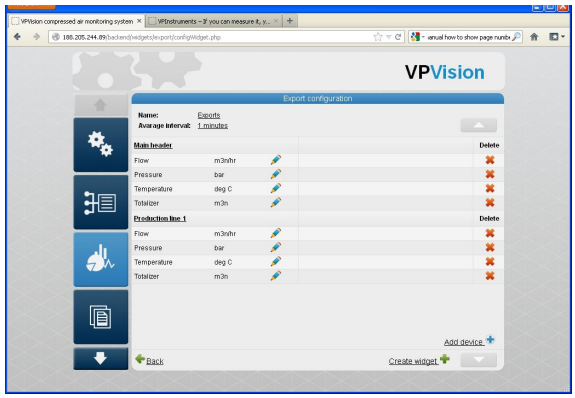

Navigation menu
VPVision
Main Header
Print and download actual view
Mouseover provides info
Click and drag to zoom
Scroll bar, window zoom bar
Live button
Hour
Day
Week
Month
Live
Interval select buttons

4.3 Data export

To export data, click on the export icon (default is an eye, but you can change icons in the backend). You will then enter your export page with a pre-defined export widget.

Create an export widget

To create an export widget, see also the chapter Widgets 20.



The export page is basically identica an export widget.

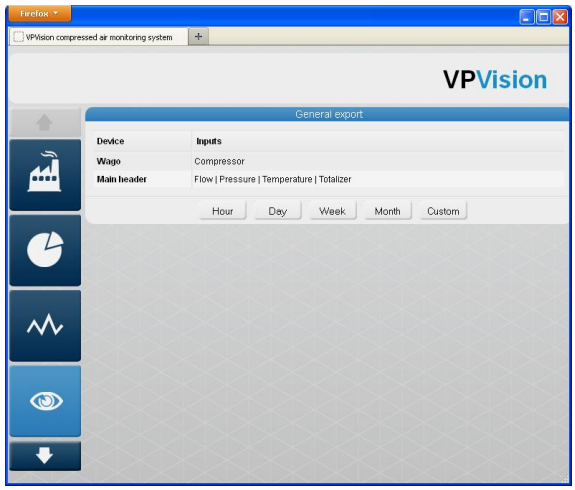
In the export widget, you can add channels, similar to adding devices. Once defined, you can place the export widget on the export page.

Depending on the channel type, you are able to set the unit to a different value, or to delete a certain unit. For example, for the VPFlowScope, you can decide to export only flow and pressure, and ignore temperature and totalizer.

You can also pre-set the export averaging interval in minutes. The minimum value is one minute. For energy management applications, we recommend 5 minute or 15 minute intervals.

When done, press the create widget button to finalize.

On the export page, you simply click the button corresponding to the time period you want to export.



Export button functions

Hour	Last hour
Day	Last 24 hours
Week	Last week
Month	Last month
Custom	Select period

5 Sensors and IO

5.1 VPFlowScope

The VPFlowScope is based upon unique and proprietary sensor technology, enabling bi-directional consumption measurement over a large dynamic range. The all-in one design reduces installation costs. Thanks to the combination of mass flow, pressure and temperature measurement, the VPFlowScope provides the complete picture of the energy consumption in a compressed air network, which is key to sustainable savings.

Features:

- 3-in-one device: Measures: mass flow, pressure, temperature
- Optional measurement of flow direction
- Built-in data logger
- Display with keypad
- Flow range: 0..150 mn/sec | 1,6..500 sfps (open 525 sfps)
- Output: RS485, 4..20mA

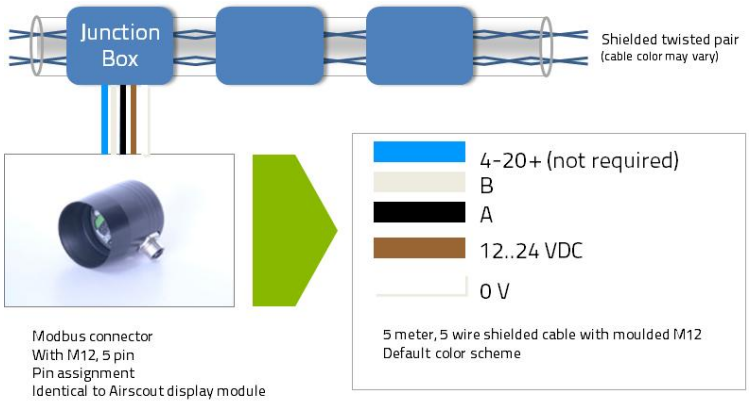
Usage:

- The perfect device for mobile audits
- Field performance measurement
- Efficiency monitoring

Configuration parameters

For VPVision, the following parameters must be configured. See VPFlowScope configuration 11.

- Tube diameter (in mm or inch)
- Modbus address
- RS485 communication parameters



Wiring

The basic wiring schematic is shown on the right. For detailed information on the VPFlowScope, please refer to the user manual.

5.2 RS485-Ethernet module

The VPFlowScope can be connected via an RS485-Ethernet converter. The great advantage of this method is that you can create modbus networks anywhere around your factory, as long as you can connect them to the factory ethernet. This saves a lot of cable installation work.

In most systems, we use the SE5001 RS485-Ethernet converter, manufactured by B&B. You may use different brands and types, but try before you roll out a system with those. Some converters cannot deal with the encapsulated modbus RTU commands and this may result in communication

faillures.

For the SE5001 configuration, please refer to the user manual.

Basis things to set:

- IP address
- TCP/IP Listening Port
- RS485 Baud rate, data bits and stop bits.

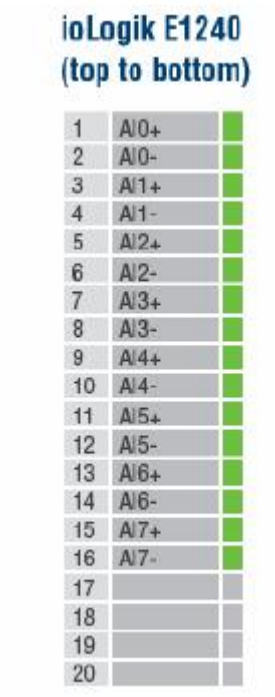
See also Network preparations 12.

5.3 Moxa analog input module

Analog sensors can be connected to the analog IO module. We have chosen for 4..20 mA as default interface. If needed, you can change the IO module to 0..10 Volt. The default module is the ioLogik E1240 manufactured by Moxa. It contains an internal Ethernet Switch and it features two Ethernet connectors. This enables you to interconnect the modules without an external switch.

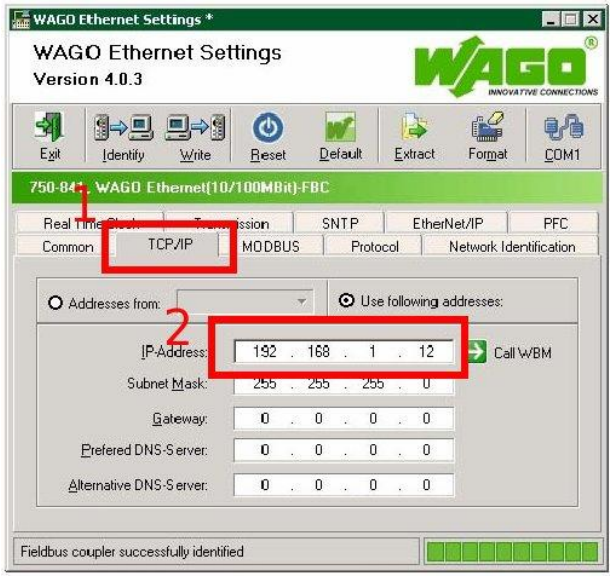
IO module description

The pinout of the IO module is shown on the right. Internally, you can find dip switches which affect the analog input configuration. It can be set to 4..20 mA (default) or 0...10 Volt. Details can be found in the Moxa E1240 user manual.



5.4 Wago analog input module

Wago IO modules are configured through their own software, or their internal website. Use the wago ethernet settings software to pre-program the IP address. After this, you can use the internal website of the Wago module to check and change parameters. See the wago user manual for further details.



IO module internal port assignment

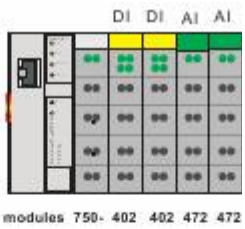
Modbus: Automatic number assignment

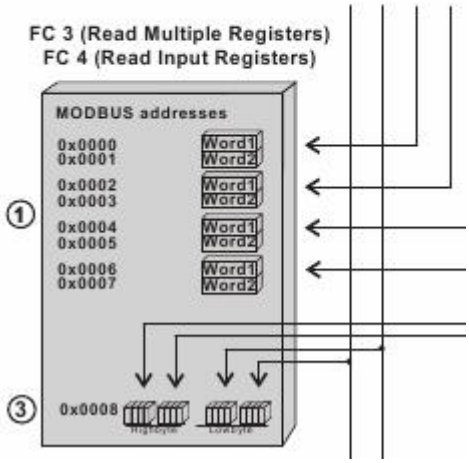
- Analog and digital inputs can be mixed
- Analog inputs will be assigned first
- Digital inputs will be assigned second

Example: 4 x Analog, 8 x digital:

Input
1. Analog 1
2. Analog 2
3. Analog 3
4. Analog 4
5. Digital 1
6. Digital 2
7. Digital 3

And so on…





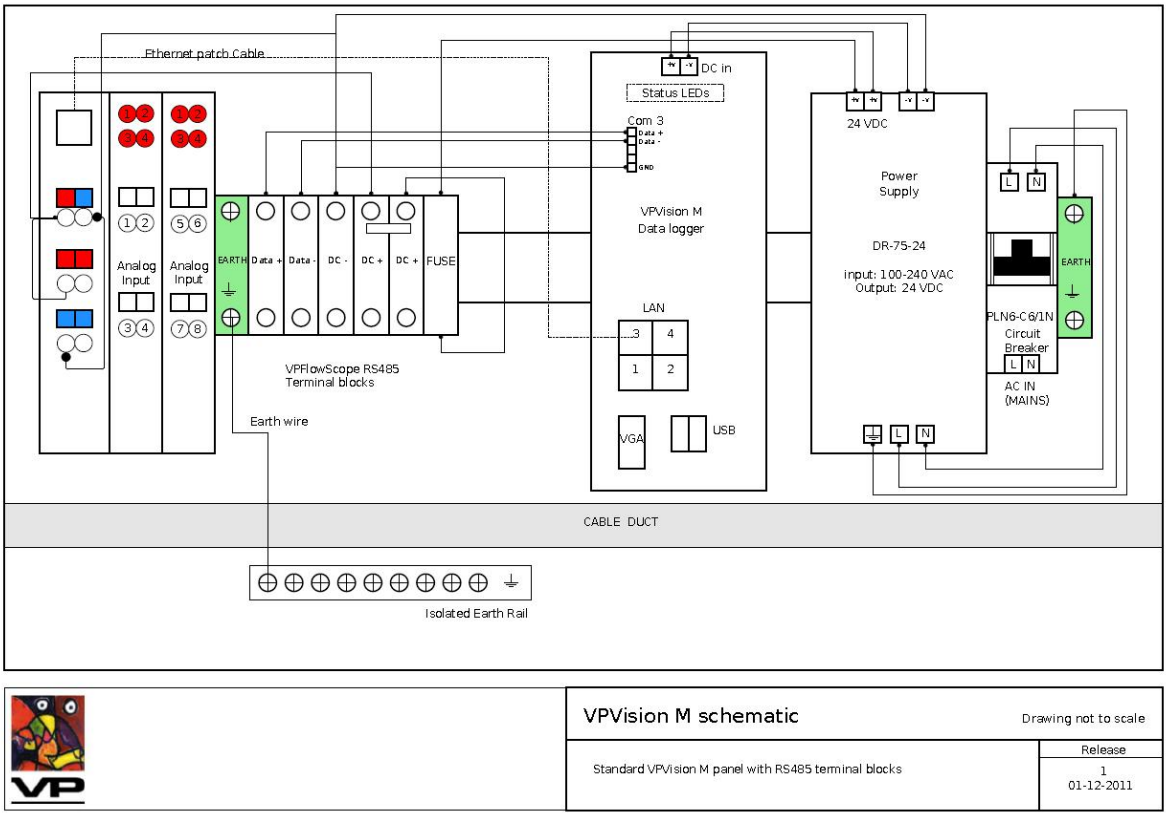
5.5 Analog sensor types

Name	Description/ application
VPLog-i:	The VPLog-i is a 4..20 mA based Rogowski coil transmitter. The output is linear with the current. For example 4..20 mA can correspond with 0...250 A. You need to program the VPVision system 4..20 mA range with power instead of current.
Dew point transmitter	The dew point transmitter can be placed downstream of a drier. It will monitor the drier function and performance.
Differential pressure sensor	A differential pressure sensor can be used to detect pressure loss, for example the pressure loss over air treatment equipment.
Temperature sensor	Can be used to monitor the coolant temperature of a compressor, the oil temperature and so on.

6 Hardware

6.1 VPVision M

The VPVision M is mounted in a sturdy powder coated field enclosure. The basic schematic is shown below. Versions with optional IO may have different schedules. For customized and special versions, the VPVision-M will be supplied with a hardcopy of it's schedule "As Built".



Legend:

LAN: Ethernet ports for connection to your network. Address can be pre-configured.
AC IN: Two Phase Mains input 100..240 VAC. Mains is connected to a circuit breaker.

Terminal Blocks: These are the RS485 and power supply terminals for connecting the VPFlowScope
Data logger: The VPVision M Data logger is an Embedded Linux System, pre configured with a web server.

6.2 Power supplies

The base unit features a 4 Amp (100 Watt) power supply, which delivers power to the VPVision-M, up to 8 VPFlowScopes and 8 analog 4..20 mA loop powered sensors. The remote IO units feature a 2 Amp (50 Watt) power supply. Type/ model number: see type plate on power supply.

! Warning. Use UL approved power supplies. For compliance with UL508, consider to fuse all individual sub-systems @ 2 Amps per sub-circuit. Check also individual sensors on UL-requirements for power supplies.

Power consumption rules of thumb:

The following is a guideline on power consumption of the individual components. Add 10% to be sure. Check with supplier's user manuals, as product specifications are subject to change.

VPFlowScope : 2 Watt each, at full load (100% flow)
Remote IO unit : 12 Watt+ 0.5 Watt per 4..20 mA sensor
Analog sensor : 0,5 Watt per 4..20 mA sensor

RS485-Ethernet converter: 15 Watt
Ethernet switch: 5 Watt

VPVision M logger: 60 Watt

Example configuration: Remote IO cabinet with Wago (8 IO), RS485 and ethernet switch. 4 x VPS + 8 x 4..20 mA

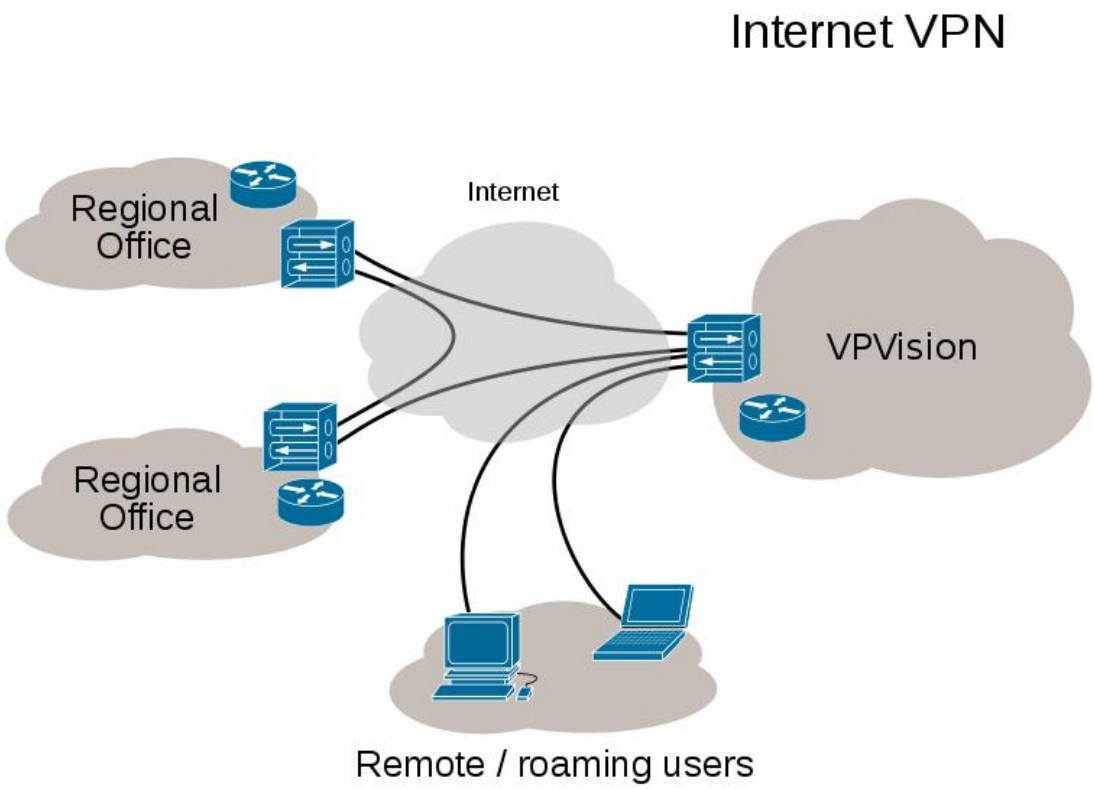
20 Watt + 15 Watt + 5 Watt + 8 Watt + 4 Watt = 52 Watt + 10% = 57 Watt. With 24 VDC, a 2,5 Amp power supply is safe.

Circuit breakers

When powered from Mains, VPVision equipment is equipped with a 2-pole circuit breaker.

6.3 VPN router

For safe remote access to the VPVision M without interfering with the client's network, a VPN router is mandatory. Nowadays, most industrial sites provide a VPN for their employees. The only thing they need to configure is the remote access to the IP address of the VPVision M. This VPN connection enables us to provide remote support. The VPVision does not send out or retrieve any data to the internet. As long as port 80 is blocked, the VPVision is not visible from outside the premises. For remote viewing, port 80 or another (mapped) port can be added to access the web server from remote. We strongly advice to add a strong Apache password (not 1234 or password), to prevent unwanted exposure of data.



More reading about VPN:
http://www.starlancs.com/EducateMe/educate_vpn.html
http://ezinearticles.com/?VPN-Explained---The-Basics-of-VPN-Simplified&id=624480
http://en.wikipedia.org/wiki/Virtual_private_network

VPN hardware devices

Various hardware can be used for the VPN service. VPInstruments does not recommend or promote any special brand. It is best to consult a local IT supplier for advice. They can offer the right solution with the appropriate safety level. For example, there are password and hardware key based VPN authorizations.

Known brands are Cisco, Korenix, Juniper.

6.4 Cables for VPVision

	**ALL ELECTRICAL INSTALLATIONS TO BE CARRIED OUT BY AUTHORIZED ELECTRICAL INSTALLATION ENGINEERS ONLY.**

RS485 and Ethernet

For RS485, and Ethernet, Cat5e cable with 4 twisted pairs must be used. For some applications, a higher quality cable might be needed. In case of any doubt, It is best to consult the site on their existing cables to make sure that the VPVision cables match the prescribed standards. The cable should match the power budget of all connected sensors. Long cables will result in increased cable resistance, which might cause issues when not properly addressed.

Cable example: Belden 7939A

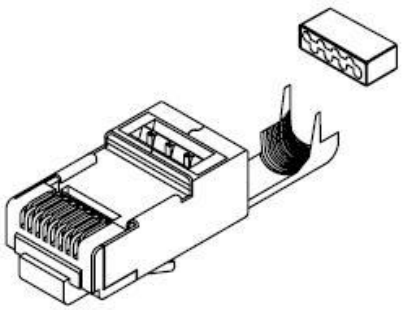
SHIELDED MULTIPAIR CABLE 4PR 1500FT 300V BLK

- Reel Length (Imperial):2000ft
- Reel Length (Metric):609.6m
- LAN Category:Cat5e
- Cable Type:Shielded
- No. of Pairs:4
- Conductor Size AWG:24AWG
- Resistance : check with manufacturer
- Jacket Color:Black
- RoHS Compliant: Yes

Recommended plug:

*Special RJ45 plug required. See WWW. BELDEN.COM - Tools - Connector Cross Reference.

SENTINEL 111S08080090H34



Analog sensors

For 4..20 mA based sensors, a single or double twisted pair cable can be used.

Cable example: Belden 8723 - 060100

- SHLD MULTIPR CABLE 2PR 100FT 300V CHR
- Reel Length (Imperial):100ft
- Reel Length (Metric):30.48m
- Cable Type:Shielded
- No. of Pairs:2
- Conductor Size AWG:22AWG
- Jacket Color:Chrome
- No. of Strands x Strand Size:7 x 30AWG
- RoHS Compliant: Yes

Suppliers: Newark Electronics, Various Belden distributors

7 Appendix

7.1 Modbus networks

Introduction to modbus

Modbus is a messaging structure developed by Modicon in 1979. It purpose is master-slave/client-server communication between intelligent devices.
It is a de facto standard, truly open and the most widely used network protocol in the industrial manufacturing environment. The MODBUS protocol provides an industry standard method that MODBUS devices use for parsing messages.For more information see modbus.org.

How does it work?

Modbus communication is called "Master-slave" communication: The master can initiate transactions (called queries). The slaves respond to the master, take the action requested in the query. A slave is any peripheral device (I/O transducer, valve, network drive, or other measuring device) which processes information and sends its output to the master. Masters can address individual slaves, or can initiate a broadcast message to all slaves. Slaves return a response to all queries addressed to them individually, but do not respond to broadcast queries.

Register map
MODBUS devices usually include a Register Map (Point Map). You should refer to the register map for your device to gain a better understanding of its operation. The available options and registers of the point map are device-dependent. A simple sensor might have only one register, while a multi-parameter sensor might have ten or more registers.

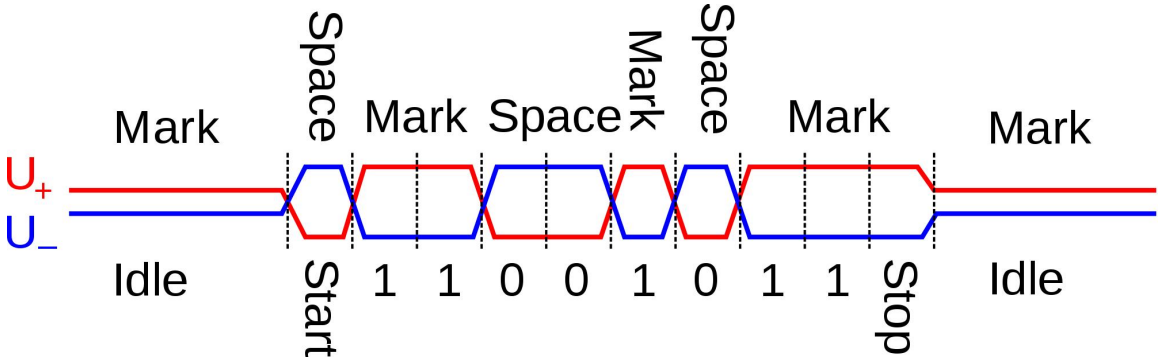
Communication modes
Standard MODBUS networks employ one of two types of transmission modes: ASCII Mode and RTU Mode. The mode of transmission is usually selected along with other serial port communication parameters (baud rate, parity, etc.) as part of the device configuration. Just remember:
VPFlowScope: RTU mode

Pin layout:

- A aka '- ' aka TxD-/RxD- aka inverting pin
- B aka '+' aka TxD+/RxD+ aka non-inverting pin
- SC aka G aka reference pin

ALWAYS use the SC/ Ground reference! Without reference, modbus networks might work for a while but eventually, you could run into communication issues due to capacitive effects or electromagnetic interference.

Waveform example:
Below you see a typical waveform. While debugging a system, you could check with an oscilloscope to see the actual messages. They will look similar to the waveform below.



More information
http://www.bb-europe.com/guide/RS485_Trouble_Shooting.pdf
http://www.bb-europe.com/cheatsheet/RS485_Cheat_Sheet.pdf

7.2 Troubleshooting

7.2.1 Problems and solutions

This section will address common problems and their resolution.

Issue	Symptom	Cause	Resolution
Cannot find VPVision in my network		IP conflict, IP address out of range	Re-connect to LAN 1 with a direct Ethernet connection. See also PC connection 13.
VPVision page is not updating	All widgets are static	Connection problems with remote IO, network off line, switch off line	Restart DAQ process via the configuration backend. Inputs 17
VPFlowScope communication problem	No data on screen	Modbus address not properly assigned, modbus conflict	
	No LED blinking	Wrong Com port assignment	Check Com port in Device Configuration
	TX LED blinking, but no RX LED.	Wrong wiring	Swap RX and TX (A and B) wire and see if this resolves. Disconnect all but one VPFlowScope to isolate the problem.
		Wrong wiring	Connect the VPFlowScope via the RS485 network to VPStudio using the JB5. See if you can read in the configuration.
	TCP/IP converter TX	IP conflict, or not	Refer to converter user

Issue	Symptom	Cause	Resolution
	and RX not blinking	properly configured converter	manual. Configure IP address. Use Modpoll to debug the connection.
Wrong kW measurement	Wrong kW in display	The VPlog i is just an Ampere meter... make sure that the voltage and power factor is as correct as possible	If not good enough--> invest in a real kW meter with modbus (Shark, Wattnode).

7.2.2 Communication issues

Debugging communication issues

RS485 Modbus related issues

Check LED indicators on the RS485 converter. Both TX (Transmit) and RX (Receive) should blink intermittent.
Blinking led, once per second: VPVision Data Acquisition is active

In terminal: re-start service and check messages

In database: Check historical values

Testing modbus with Modpoll

Example for Wago (RTU TCP protocol).
./modpoll -m tcp 192.168.1.197 -r 0x2003 -t 3:hex

Example for Flowscope (RTU USB protocol).
Find the USB connection in /dev. It should be ttyUsBX where X is a
subsequent number, depending on the number of USB converters you have connected.

./modpoll /dev/ttyUSB0 -a 9 -r 73 -t4:float -b 38400 -p none

Example for Flowscope (TCP/RTU protocol).
./modpoll -m enc 192.168.1.198 -p4660 -a 1 -r 73 -t4:float

Ethernet issues

Ethernet issues can be localized by pinging the individual components of the system. Each Ethernet device has a unique IP address. The addresses can be pinged and when they respond, you know that the device is reachable. An unreachable device will result in a request time out. See below for an example.

7.3 Documentation example

Proper documentation is key to long term success. Therefore we added an example (empty) documentation sheet here. You can use it as a guideline for documentation of your VPVision configuration.

IP Address list

No	Name	IP Address
1	VPVision M	192.168.1.223
2		
3		
4		
5		

Device list - VPFlowScopes

Use the list below to write down your configuration. Store this list for future reference

No	Name	Diameter	Modbus address	Comment/ Tag number
1	Packaging dept.	80 mm	10	
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Analog Channel configuration - Remote analog IO module

Use the list below to write down your configuration. Store this list for future reference

No	Name	Min (4 mA)	Max (20mA)	Comment/ Tag number
1	Dew Point	-40	+10	
2				
3				
4				
5				
6				
7				
8				

`

7.4 Terms And Conditions of Sale

This chapter addresses our Terms and Conditions of Sale, which can be downloaded from www.vpinstruments.com, which apply on all sales transactions. By using the equipment, you agree upon these terms.

1. EXCLUSION ON WARRANTIES: NO REPRESENTATION OR WARRANTY, EXPRESSED OR IMPLIED, MADE BY ANY DISTRIBUTOR, SALES REPRESENTATIVE, OR FIELD AGENT OF VPI, SHALL BE BINDING ON VPI UNLESS SPECIFICALLY SET FORTH HEREIN.

2. LIMITED WARRANTY: VPI makes the following limited warranty in respect of "Hardware Products", "Cable Products" and "Software Products":

a. Hardware Products are warranted against defects in materials and workmanship for two (2) years from the date of shipment from the factory. Cable Products are warranted against defects in materials and workmanship for ninety (90) days from the date of shipment from the factory. VPI's obligation is limited to repair, or at its sole option, replacement of products and components which, upon verification by VPI at the VPI manufacturing headquarters in prove to be defective. VPI shall not be liable for installation charges, for expenses of Customer for repairs or replacement, for damages from delay or loss of use, or other direct or indirect or consequential damages of any kind.
b. Software Products that are licensed to Customer under the terms of the appropriate VPI license and will, for a period of ninety (90) days following shipment by VPI (a) perform substantially in accordance with the accompanying written materials, and (b) the medium on which the software product is recorded will be free from defects in materials and workmanship under normal use and service. Any replacement of a licensed Software Product will be warranted for the remainder of the original warranty period or thirty (30) days, whichever is longer.

This warranty is extended only to Products properly used and properly installed for the specific application for which intended and quoted. This warranty is void if failure of the Products has resulted from accident, abuse, misapplication, improper calibration, third party software not intended for use with the applicable VPI software, utilization of an improper hardware or software key or unauthorized maintenance or repair.

3. RMA #: No items will be returned for warranty repair without prior authorization from VPI, and Customer must obtain a Return Material Authorization ("**RMA**") number from VPI before returning any Products under warranty to VPI for any reason. RMA # numbers may be obtained by calling VPI between 8:00 AM and 5:00 PM EST Monday through Friday. You may also request an RMA, by fax (+31-15-2130669), e-mail **sales@vpinstruments.com**, or at VPI's website **www.vpinstruments.com**. Customer shall pay expenses for shipment of repaired or replacement Products to and from VPI. After examining and testing a returned product, if VPI concludes that a returned product is not defective, Customer will be notified, the product returned at Customer's expense, and a charge made for examination and testing. Customer shall exercise due caution in returning VPI instrumentation, including (*inter alia*) taking special care when packaging a meter for return to the factory (e.g. Insertion Style meters), since sensors in particular may easily be damaged if (a) not prevented from shifting around within the package and (b) not covered (with PVC or other protective method) in order to keep it from contacting other package contents. Any damage resulting from improper packaging is the responsibility of the Customer, and costs incurred to repair the damage will be charged to the Customer.

4. TRANSPORTATION. Transportation charges for materials shipped to the factory for warranty repair are to be paid by the Customer. VPI will return items repaired or replaced under warranty to a location indicated by the Customer, provided (and to the extent) shipping costs have been prepaid by the Customer. For international returns, any special payment arrangements for the shipment must be approved in writing by the VPI International Manager prior to shipping the materials. In accordance with the "Emergency Planning and Community Right to Know Act" and applicable US Department of Transportation (DOT) regulations, VPI will not accept delivery of equipment that has been contaminated (see "Warranties and Service Work" in any VPI Instruction Manual for further details on cleaning and decontamination) without written evidence of decontamination, and has instituted the following Return/Repair conditions. Strict adherence to these conditions is required. Returned equipment that does not conform to the requirements listed below will not be processed. If VPI finds evidence of contamination, we may, at our option, have the unit returned at your expense. For your reference, the requirements for packaging and labeling hazardous substances are listed in DOT regulations 49 CFR 172, 178, and 179.

5. LIMITATIONS ON WARRANTY. If after inspection of the returned equipment VPI determines that the defect is a result of damage, misuse, mishandling, installation, abnormal conditions of storage or operation, unauthorized repair or modification, or due to the Customer's failure to install, maintain or operate the equipment in compliance with the written instructions, all expenses incurred by VPI in connection with the replacement or repair of the equipment shall be for the

account of the Customer. There will be a minimum service charge for inspecting the product and determining the defect of $250.00. Any additional charges necessary to repair the product will be quoted to Customer, and must be authorized by Customer before VPI will proceed with repair. Once an evaluation is completed and a quote has been issued, Customer can choose to proceed with the work or have the unit returned with only the evaluation and freight fee billed to the Customer.

6. NO OTHER WARRANTIES. EXCEPT AS EXPRESSLY SET FORTH ABOVE, THE PRODUCTS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, AND NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED ARE MADE WITH RESPECT TO THE PRODUCTS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE OR NONINFRINGEMENT OR ANY OTHER WARRANTIES THAT MAY ARISE FROM USAGE OF TRADE OR COURSE OF DEALING. VPI DOES NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS REGARDING THE USE OF OR THE RESULTS OF THE USE OF THE PRODUCTS IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY, OR OTHERWISE AND DOES NOT WARRANT THAT THE OPERATION OF THE PRODUCTS WILL BE UNINTERRUPTED OR ERROR FREE. VPI EXPRESSLY DISCLAIMS ANY WARRANTIES NOT STATED HEREIN.

7. WARNING: (1) VPI PRODUCTS ARE NOT DESIGNED WITH COMPONENTS AND TESTING FOR A LEVEL OF RELIABILITY SUITABLE FOR USE IN OR IN CONNECTION WITH SURGICAL IMPLANTS OR AS CRITICAL COMPONENTS IN ANY LIFE SUPPORT SYSTEMS WHOSE FAILURE TO PERFORM CAN REASONABLY BE EXPECTED TO CAUSE SIGNIFICANT INJURY TO A HUMAN. (2) IN ANY APPLICATION, INCLUDING THE ABOVE, RELIABILITY OF OPERATION OF THE SOFTWARE PRODUCTS CAN BE IMPAIRED BY ADVERSE FACTORS, INCLUDING BUT NOT LIMITED TO FLUCTUATIONS IN ELECTRICAL POWER SUPPLY, COMPUTER HARDWARE MALFUNCTIONS, COMPUTER OPERATING SYSTEM SOFTWARE FITNESS, FITNESS OF COMPILERS AND DEVELOPMENT SOFTWARE USED TO DEVELOP AN APPLICATION, INSTALLATION ERRORS, SOFTWARE AND HARDWARE COMPATIBILITY PROBLEMS, MALFUNCTIONS OR FAILURES OF ELECTRONIC MONITORING OR CONTROL DEVICES, TRANSIENT FAILURES OF ELECTRONIC SYSTEMS (HARDWARE AND/OR SOFTWARE), UNANTICIPATED USES OR MISUSES, OR ERRORS ON THE PART OF

THE USER OR APPLICATIONS DESIGNER (ADVERSE FACTORS SUCH AS THESE ARE HEREAFTER COLLECTIVELY TERMED "SYSTEM FAILURES"). ANY APPLICATION WHERE A SYSTEM FAILURE WOULD CREATE A RISK OF HARM TO PROPERTY OR PERSONS (INCLUDING THE RISK OF BODILY INJURY AND DEATH) SHOULD NOT BE RELIANT SOLELY UPON ONE FORM OF ELECTRONIC SYSTEM DUE TO THE RISK OF SYSTEM FAILURE. TO AVOID DAMAGE, INJURY, OR DEATH, THE USER OR APPLICATION DESIGNER MUST TAKE REASONABLY PRUDENT STEPS TO PROTECT AGAINST SYSTEM FAILURES, INCLUDING BUT NOT LIMITED TO BACK-UP OR SHUT DOWN MECHANISMS. BECAUSE EACH END-USER SYSTEM DIFFERS FROM VPI TESTING PLATFORMS AND BECAUSE A USER OR APPLICATION DESIGNER MAY USE VPI PRODUCTS IN COMBINATION WITH OTHER PRODUCTS IN A MANNER NOT EVALUATED OR CONTEMPLATED BY VPI, THE USER OR APPLICATION DESIGNER IS ULTIMATELY RESPONSIBLE FOR VERIFYING AND VALIDATING THE SUITABILITY OF VPI PRODUCTS WHENEVER VPI PRODUCTS ARE INCORPORATED IN A SYSTEM OR APPLICATION, INCLUDING, WITHOUT LIMITATION, THE APPROPRIATE DESIGN, PROCESS AND SAFETY LEVEL OF SUCH SYSTEM OR APPLICATION.

8. NO LIABILITY FOR CONSEQUENTIAL DAMAGES. VPI and its licensors, distributors, and suppliers (including their respective directors, officers, employees, and agents) shall not be liable for any damages, including, but not limited to, any special, direct, indirect, incidental, exemplary, punitive, or consequential damages, expenses, lost profits, lost savings, business interruption, lost business information, or any other damages arising out of the use or inability to use the Products, except to the extent such damage arises from wilful misconduct (*opzet*) or gross negligence (*grove schuld*). If the foregoing limitation of liability is not enforceable because an VPI product sold or licensed to Customer is determined by a court of competent jurisdiction in a final, non-appealable judgment to be defective and to have directly caused bodily injury, death, or property damage, VPI's liability will not exceed the amount (if any) paid out under VPI's applicable product liability insurance policy. If, for whatever reason, VPI's insurance policy provides no coverage, then VPI shall be liable for the lesser of $50,000 or fees paid for the specific product that caused such damage

9. ACCEPTANCE STATES THE ENTIRE CONTRACT. Subject to these Terms and Conditions, the acknowledgment by VPI of the Customer's order to purchase is an acceptance of the Customer's order and intended to embody the complete and exclusive contract of sale in relation to the subject matter hereof, and no understandings or agreements, verbal or otherwise, in relation thereto except as herein expressly set forth or incorporated herein by reference shall be binding on either party. The acknowledgment by VPI of the Customer's order(s) is accepted on the condition that the terms and conditions set forth herein shall apply and shall constitute complete agreement between the parties. Any provisions or conditions of the Customer's order forms or any verbal or other understandings or agreements, which are in any way in conflict with or in addition to these terms and conditions shall not be binding on VPI and shall not be applicable, unless expressly agreed to in writing by VPI. Customer shall be deemed to have consented to the exclusive terms and conditions hereof unless objection by the Customer hereto in writing has been received by VPI at its headquarters in Delft, the Netherlands (by regular mail, or by e-mail to sales@vpinstruments.com) within five (5) working days after receipt of the acknowledgment by the Customer, and in the event of such objection and at VPI's option, the acknowledgment shall thereupon be revoked and the sale contract terminated.

10. ACCEPTANCE OF ORDERS. Orders and offers to purchase received by or on behalf of VPI are subject to acceptance only at its headquarters. No VPI distributor, sales representative, or field agent has authority to accept orders or make contracts of sale on behalf of VPI.

11. PRICES, TAXES AND TRANSPORTATION CHARGES. The sales price stipulated in this contract is exclusive of all customs duties, charges or surcharges, consular fees, sale, use, excise, turnover, occupational or transportation taxes, or any other taxes imposed by any country or political subdivision thereof. If any such tax or charge is imposed by law on the Customer on account of this sale and VPI is obligated to pay such tax or charge, the amount of such disbursement shall be reimbursed to VPI by the Customer forthwith in addition to the purchase price. Freight and insurance quotations are merely estimates based upon currently prevailing rates and, because VPI has no control over such quotations, any variations in the actual rates at the time of shipment shall be for the Customer's account. VPI may add a charge for export packing to the price, and VPI reserves the right to impose an additional reasonable charge for packing and/or packaging to comply with Customer's specifications or instructions.

12. TERMS AND PAYMENT; INSTALLATION CHARGES AND FINANCE CHARGES. Absent contrary provision on the face hereof and subject to approval and continuance of approval of credit by VPI, terms of payment are thirty days (30) net from the date of invoice. In the case of equipment for destination outside the United States, terms of payment are by Wire Transfer or Credit Card prior to shipment, unless otherwise noted, or other arrangements are approved in writing by VPI's International Manager. All payments shall be in legal currency of the United States. Acceptance and endorsement by VPI of an instrument for less than the full amount which claims to be due shall not be deemed to be an admission of payment in full and any conditions to the contrary which are noted on such an instrument shall not be binding on VPI. VPI's prices prevailing at time of each shipment shall apply. Prices are subject to correction for error. All costs of installation shall be borne by Customer. It is contemplated that any installation or supervision labor and services agreed on the face hereof to be performed by VPI or VPI agents, are to be performed during regular working hours on regular business days. If for any reason the Customer requests VPI to furnish any such labor or services outside of such regular working hours, any overtime or other additional expense thereby shall be billed to and paid by the Customer. In the event of any order for several units, each unit(s) will be invoiced when shipped. A finance charge will be assessed on past due amounts at one and one half percent (1-1/2%) per month or the highest rate permitted by law whichever is lower.

13. RETENTION OF OWNERSHIP. VPI retains fulls ownership (*eigendomsvoorbehoud*) of the Products until Customer has paid all amounts due under these Terms and Conditions in full.

14. SERVICES. Limited Warranty. VPI warrants that all its services in relation to this Agreement (the "**Services**") will be performed in a good and workmanlike manner as set forth in Article 7:402 Dutch Civil Code (*goed opdrachtnemer*). However, VPI makes no express or implied warranties with respect to the Services, including but not limited to (a) any warranty relating to third-party products or (b) any warranty concerning the results to be obtained from the Services or the results of any recommendation VPI may make, including without limitation any implied warranties concerning the performance, merchantability, suitability, non-infringement or fitness for a particular purpose of any of the deliverables or of any system that may result from the implementation of any recommendation VPI may provide. In order to receive warranty remedies, deficiencies in the Services must be reported to VPI in writing within 90 days of completion of the Services. *Limitation of Liability:* VPI is not liable for any incidental, indirect, special, punitive, or consequential damages arising out of or in connection with the Services provided by VPI, including without limitation loss of use of the Products or any other software or data, including inability to achieve a particular result, even if VPI has been advised of the possibility of such damages or even if the damage is the direct result of an instruction or suggestion made by VPI. Except for claims that the Services caused bodily injury (including death), VPI's total liability arising out of or in connection with any event or series of connected events occurring in connection with the Services shall not exceed the amount of fees paid under the separate written agreement between Customer and VPI. *High Risk Activities*: Customer understands and agrees that VPI has not tested or certified its Services for use in high risk applications including medical life support, nuclear power, mass and air transportation control, or any other potentially life critical uses. VPI makes no assurances that the Services are suitable for any high risk uses. *Indemnification:* Customer accepts responsibility for, and agrees to indemnify and hold VPI harmless from, any and all liability, damages, claims, or proceedings arising out of (a) the failure of Customer to obtain the appropriate license, intellectual property rights, or any other permissions required to support any Products or Services, including but not limited to, the right to make any copies or reproductions of any Customer-provided software or (b) any inaccurate representations regarding the existence of an export license or the eligibility for export of software or other materials without a license.

15. DELIVERY. Unless agreed otherwise, delivery of equipment with final destination within the USA shall be F.O.B. at VPI warehouse in Ohio, USA (Incoterms 2010). Delivery to all other countries shall be EX Works. at VPI warehouse in Delft, The Netherlands (Incoterms 2010).

Title and risk in relation to the Products will pass to the Customer as set out in Clause 18. Title and risk in relation to the Products will pass to the Customer as set out in Clause 18. Shipping dates are approximate and are based upon current and anticipated manufacturing capabilities and upon receipt of all necessary information from the Customer. VPI reserves the right to make delivery in installments and the contract shall be severable as to each such installment. Delay

in delivery or other default in any installment shall not relieve the Customer of its obligation to accept and pay for remaining deliveries. If delivery of goods is delayed due to default in payment of the purchase price or to delay in receipt of shipping instructions, documents for payment, required inspection, export license or authorization or other cause for which VPI is not responsible, charges for demurrage and storage shall be paid by the Customer. All claims for a delay in delivery shall be deemed waived unless presented to VPI in writing thirty (30) days after the delivery of each shipment. Unless otherwise indicated on the front side of the order confirmation and invoice, all shipping and insurance charges, any duty and all taxes related to the Customer's order shall be paid by the Customer. Claims for damages in transit must be asserted against the Carrier. Within (7) days after receipt of shipment, the Customer must report to VPI any shortage or damage not due to the carrier, otherwise claims for such shortage or damage will be deemed waived.

16. ULTIMATE DESTINATION. United States and International Law prohibits disposition of the equipment to certain countries. It is the responsibility of Customer to inform VPI if the ultimate destination is other than the United States, the European Union or their possessions.

17. FORCE MAJEURE. Fulfillment of this order is contingent upon the availability of materials. VPI shall not be liable for any delays in delivery, or for non-delivery or nonperformance, in whole or in part, caused by the occurrence of any contingency beyond the control of either VPI or suppliers of VPI, including but not limited to one or more of the following causes: fires, destruction of plant; strike; lockout; dispute with workmen; epidemic; flood; accident; delay in transportation; war (whether declared or undeclared); insurrection; riot; blockage; embargo; acts, demands or requirements of the United States, or the country in which or through which delivery is to be made or any state or territory thereof, or of any governmental subdivision of any thereof; restraining orders for decrees of any court or judge; or any other cause whatsoever, whether similar or dissimilar to those herein before enumerated. The existence of any such cause or causes of delay shall extend the time of performance by the time or times measured by any such cause or causes of delay. If delivery is not completed within sixty (60) days after the date stipulated in the acceptance of the order due to any said causes, either VPI or the Customer may cancel this contract on ten (10) working days' notice to the other. If any contingency occurs, VPI reserves the right to allocate production and deliveries among its customers.

18. TITLE AND RISK OF LOSS. Title and Risk of Loss shall pass to the Customer upon delivery to the carrier, Customer or Customer's agent as set out in Clause 15 unless specified otherwise. If, however, payment of the purchase price is not contemporaneous with, or does not precede delivery of the merchandise to the carrier or the Customer, the Customer agrees at VPI's request, and hereby appoints VPI as its attorney-in-fact, to execute, acknowledge and record appropriate financing statements so as to perfect a security interest in the products in favor of VPI. Customer also agrees to execute a contract of conditional sale containing the provisions as VPI shall deem proper Loss or damage that occurs during shipping is the Customer's responsibility, unless an Incoterm was agreed to prior to the Sale that has contrary provisions.

19. CANCELLATIONS AND RETURN POLICY. Orders accepted by VPI cannot be cancelled or countermanded, or shipments deferred or equipment returned except with the prior written consent from VPI's headquarters, and upon terms that will indemnify VPI against any losses that may result, including the profit on any part of the order that is cancelled. When VPI authorizes the return of equipment, the Customer shall prepay the shipping charges on such returned equipment unless otherwise expressly stated by VPI in its written return authorization. Note: In-Line or Insertion Flow Meters that have Flanges are not cancellable, if the Flange fabrication has begun, or is already completed. After issuance of a purchase order (by phone, mail, e-mail or fax) or a credit card order (by phone, mail, e-mail or fax), there will be a cancellation fee for any cancelled order. Cancellations must be in writing (by mail, e-mail or fax):

a) If credit card order or non-credit card order is cancelled within seven (7) days of issuance of purchase order or date order was placed (whichever is earlier), there will be a 10% cancellation fee (in addition to any "Expedite" fee);
b) If credit card order or non-credit card order is cancelled after seven (7) days, but prior to shipment, there will be a 20% cancellation fee (in addition to any "Expedite" fee). (If order is cancelled due to late delivery, the cancellation fee will be waived. Late delivery is defined as shipping a meter seven (7) days or later than the delivery date acknowledged by VPI at time of placing order);
c) "Expedite" fees are defined as pre-negotiated fees agreed to by customer in order to guarantee delivery at or before a specific date that is sooner than normal delivery time. These arrangements are part of the Purchase Order, and are shown as a line item "EXPED" described as Expedite Service Fee;
d) If a credit card customer (Customer) decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged or if equipment is returned after four (4) months of shipment. If equipment is not damaged, then equipment can be returned after issuance of a Return Material Authorization (RMA) by VPI.
e) Returned package must be insured by Customer and must reference proper RMA# on outside of package, or package may be rejected (i.e., package will be returned unopened). Credit Card customers (Customer) will be charged a 30% re-stocking fee (70% balance will be credited back). Customer is responsible for return shipping charges and any damage if improperly packaged;
f) If a non-credit card customer (Customer) decides to return the equipment after shipment for credit, credit will not be issued if equipment is damaged, or if equipment is returned after one (1) month of shipment, unless authorized by a representative at VPI in writing.

The VPI representative will issue a Return Material Authorization (RMA #) at that time and will advise of the restocking fee, and confirm in writing. Minimum restocking fee is 30%. Returned package must be insured by Customer and must reference proper RMA # on outside of package, or package may be rejected (i.e., package will be returned unopened). Customer is responsible for return shipping charges and any damage if improperly packaged. VPI may terminate any order if any representations made by Customer to VPI are false or misleading. Changes to orders shall not be binding upon nor be put into effect by VPI unless confirmed in writing by VPI's appropriate representative

20. PATENTS. Customer shall indemnify and hold VPI harmless from any claim of patent infringement if such patent infringement or claim involves a product produced by VPI at Customer's direction or is based upon the use of the product in combination with other items where such infringement or claim thereof would not have occurred from the normal use for which the product was designed.

21. GENERAL PROVISIONS. VPI reserves the right to correct any stenographical or clerical errors in any of the writings issued by it. Except as otherwise set forth herein, the terms and conditions of sale and any description on the face of this acknowledgement constitute a complete and exclusive statement of the terms and conditions of the sale of the products by VPI to the Customer. There are no other promises, conditions, understandings, representations or warranties. This Agreement may be modified only in a writing signed by VPI. No waiver of any right will be effective against VPI unless supported by consideration and expressly stated in the writing signed by VPI, and the failure of VPI to enforce any right will not be construed as a waiver of VPI's right to performance in the future. The Customer may not assign any rights to, or delegate any performance owed under this Agreement without the written consent of VPI. VPI shall have the right to credit toward the payment of any monies that may become due VPI hereunder and any sums, which may now or hereafter be owed to the Customer by VPI. The validity and performance in all matters relating to the interpretation and effect of this Agreement and any amendment hereto shall be governed by and construed in accordance with the laws of the Netherlands, and the Vienna Convention on the International Sale of Goods is excluded. The Customer shall pay VPI all fees, costs and expenses of VPI reasonably incurred in the enforcement of VPI's rights under or with respect to this Agreement, including, without limitation, reasonable attorneys' fees.

22. LICENSES AND PERMITS. Where Customer is located in the United States, or has provided a duly executed power of attorney to its agent, Customer shall be solely responsible for obtaining all export licenses or governmental permits necessary to export the products from the United States. At Customer's request, VPI will endeavor to assist Customer in obtaining such licenses and permits. Customer shall be solely responsible for obtaining all import permits or other documents necessary for the importation of the products into another country or political subdivision thereof.

23. NON-DISCLOSURE OF CONFIDENTIAL AND/OR PROPRIETARY TECHNICAL INFORMATION. The Customer shall not disclose any technical/proprietary information furnished by VPI or acquired by Customer or by virtue of or as a result of the implementation of this order to any person, firm or body or corporate authority and shall make all endeavors to ensure such technical/proprietary information is kept Confidential. Title to such technical/proprietary information imparted/ supplied by VPI to Customer shall at all times remain the absolute property of VPI.

24. SOFTWARE LICENSE. All software programs which are embodied in a human readable media or machine readable media and which include, but are not limited to, programs having a series of instructions, statements and data, and are related materials furnished by VPI, are trade secrets and proprietary to VPI. VPI provides such programs under a non-transferable and non- exclusive license to use them on the system for which VPI provided it; the Customer may not assign, sublicense or otherwise transfer said license and programs or materials without the prior written consent of VPI. In the event information/data is exchanged between VPI and the Customer, both parties mutually agree not to expose said programs to any claim, lien, conversion or any other encumbrance. VPI and the Customer further agree to exercise due care and employ reasonable efforts to prevent disclosure of said technical information/data program(s) unless it was or is:

a. Known to the receiving party without restriction when received or thereafter developed independently by the receiving party, or
b. Obtained from a source other than the originating party, or
c. In the public domain when received or thereafter enters the public domain through no fault of the receiving party, or
d. Disclosed by the originating party to a third (3rd) party without restriction.

25. LIMITED INDEMNITY AGAINST INFRINGEMENT. VPI shall, at its own expense, defend any litigation resulting from sales of the Products to the extent that such litigation alleges that the Products or any part thereof infringes any United States patent, copyright, or trademark, provided that such claim does not arise from the use of the Products in combination with equipment or devices not made by VPI or from modification of the Products, and further provided that Customer notifies VPI immediately upon its obtaining notice of such impending claim and cooperates fully with VPI in preparing a defense. If Customer provides to VPI the authority, assistance, and information VPI needs to defend or settle such claim, VPI shall pay any final award of damages in such suit and any expense Customer incurs at VPI's written request, but VPI shall not be liable for a settlement made without its prior written consent. If the Products are held to be infringing and the use thereof is enjoined, VPI shall, at its option, either (i) procure for the Customer the right to use the Products, (ii) replace the Products with others which do not constitute infringement, or (iii) remove the infringing

Products and refund the payment(s) made therefor by Customer. The foregoing states the Customer's sole remedy for, and VPI's entire liability and responsibility for, infringement of any patent, trademark, or copyright relating to the Products provided hereunder. THIS LIMITED INDEMNITY IS IN LIEU OF ANY OTHER STATUTORY OR IMPLIED WARRANTY AGAINST INFRINGEMENT.

26. CHANGES. The Customer may make changes, additions or deletions to specifications, drawings and other descriptions and conditions recited in the related document(s) upon written notice to VPI. If any such change(s), addition (s) or deletion(s) initiated by the Customer affects the cost of manufacture or time of delivery, VPI shall give the Customer written notice thereof within two (2) weeks from the date of Customer's notice, and the Customer shall give the instruction within a period of two (2) weeks from the date of Customer's receipt of whether to accept VPI's proposed cost or delivery changes or to withdraw such change(s). In case of withdrawal of change(s), addition(s), deletion(s) during the above period(s), the original contract price and/or delivery shall remain unchanged.

27. ACKNOWLEDGMENT/GOVERNING LAW.
These Terms and Conditions are governed by the laws of the Netherlands. The competent court in Rotterdam, the Netherlands, shall have exclusive jurisdiction in relation to all disputes arising out of ore in connection with these Terms and Conditions. Applicability of the Vienna Convention on the International Sale of Goods is excluded

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Notes

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Measure


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