Manual

Version 29.07.2015

Ultrasonic Process Turbidimeter

Model AS3/AT3

Chemtronic Waltemode GmbH

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chemtronic Waltemode GmbH

Transportation Damages!

Please inspect the instrument immediately after receiving for potential shipping damages.
For any claims to the transportation insurance or warranty repair, it is absolutely required to notify transportation damages immediately after receiving the instrument. In case of obvious damages of the outer packaging, the carrier must give a receipt for this damage to make demands for the insurance. In case of a delayed announcement the insurance will not pay for damages and Chemtronic Waltemode GmbH will not assume liability for these damages.

Manufacturer and owner of rights model AS3/AT3:
Galvanic Applied Sciences Inc. 41 Wellman Street, Lowell, MA 01851, USA

Content

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Galvanic Applied Sciences Inc. 41 Wellman Street, Lowell, MA 01851, USA

Warranty Conditions

The warranty for this product takes place according to the legal provisions. As places of warranty we explicitly name Galvanic Applied Sciences Inc. or Chemtronic Waltemode GmbH, Monheim (Germany). In case of warranty service at the customer site, we will charge additional expenses e.g. travel expenses, overnight cost, etc. Consumable parts as well as wearing parts e.g. lamps, gaskets, etc. are not covered by warranty.
Improper use, gross negligence, use of the system outside of the technical specifications, missing or improper maintenance will cause a loss of the warranty claim.
Please pay attention to our general terms of contract.

Non-warranty

Chemtronic Waltemode GmbH takes no responsibility or warranty for technical or editorial mistakes or omissions in this document. The information in this publication will be provided without warranty for their correctness. Chemtronic reserves all rights to make changes to this document without announcement. Chemtronic Waltemode GmbH or Galvanic Applied Sciences Inc. is by no means liable for any consequential damages or miscellaneous damages, which occur during the use or storage of the system. Some countries do not allow the limitation of liability, so that this exclusion is possibly not valid for you.

Operational Note:

Problem at Calibration Procedure

CAUTION:

It has come to our attention that in some experiments with calibration plots containing high sample concentration values and plotted in 3rd and 4th order poly, a memory overflow condition may occur with the calculated coefficient data, causing a "CPU" reset in some menu operations.

Should this problem occur, it is important to write down all setup values and contact our customer service for unit reset instructions.

Safety Instructions

Pay attention to the following general safety instructions during use and operation of the system. Ignoring these instructions or special warnings inside of this manual can damage the sensor, cause inaccurate measurements, and possibly result in unsafe installations. Chemtronic Waltemode GmbH will not take any responsibility for consequences arising from ignoring the safety instructions and warnings.

For all chemical liquids

The water is may be toxic or otherwise harmful to human health. Observe appropriate precautions when handling and disposing the liquid. Review the appropriate published material safety data sheets regarding the safe handling and disposal of all reagents or standards.

Electrical installation

Qualified technical personnel must install the electrical installation of the system.

Hazardous area

DO NOT INSTALL the system in hazardous area without the optional Ex-proof equipment. Operation of non Ex- proof systems in hazardous area will cause a high risk.

Using the system in hazardous areas (Ex Zone I / Ex Zone II) will only be safe with the installation of the optional special Ex-proof designs including all required certifications

Maintenance

Always disconnect the instrument from power during maintenance, replacement of components, installation of additional components or any other operations at the open instrument.
Only qualified technical personnel must perform this work.

Operating the instrument with open enclosure

Only qualified technical personnel should operate the instrument when the enclosure is open.
Take care that no moisture enters the enclosure.

Some components inside the instrument are energized with voltages, which can cause lethal shocks in case of contact. Be careful during installation, handling and operation of the instrument.

Improper installation / operation of the system

Warranty is void if the system is installed improperly, handled improperly, used outside of the technical specifications (of the instrument), or damaged by gross negligence.

Before Installation and Start up

System Inspection

Check to ensure that all components of the instrument have arrived safely. Included should be: the AT3 Transmitter, the AS3 probe and the cable set. If there is any damage to the equipment or if anything is missing please contact us immediately. Save the packing material for future system storage or shipping.

General Installation guidelines

Please read the additional safety instructions before installation and start-up!

1. Transmitter and probe are sensitive components, do not drop and handle with care.
2. Please do not turn the probe in case of removing from the process (see figure 1).
3. Observe maximum process temperature 80°C (110°C with air purge)
4. Observe maximum pressure ratings.
5. The installation / insertion of the probe into the process pipe must be done easy and without feat of strength.
6. Do not short the coaxial cables of the probe. To avoid potential noise problems use original parts only.

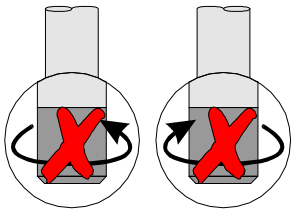


figure 1

7. Follow the connection plan during installation of the system.
8. Caution, for your own safety please do not install or remove the probe in case of high process temperature (more than 45°C) or pressure (more than 4 Bar).
9. The location of the sensor should be in a standpipe.
10. In case of installation of the probe in a horizontal pipe, please install the probe as well horizontal.
11. The process temperature and pressure cannot exceed the specification of the delivered Sensor.
12. Avoid air and gas bubbles inside the sensor, they cause disturbances. Noise and drift of the measurement would be the result (the air bubbles are not expected at a pressure upwards of 2 Bar in aqueous solutions).
13. The minimum distance between the tip of the probe and the pipe wall has to be at least 40 mm.
14. Minimum line size of the Process pipe has to be DN 50 (2").
15. Caution: Make sure that the probe is secured by using the chain during the running process.
16. Please make sure that probe and transmitter are set to the same measurement frequency!
17. Please do not use the system in case of any visible mechanical damages!

Please take notice:
The following items are important to avoid damages of the probe at temperature above 80°C:

- Please connect purge air (cooling) before probe insertion (dry, oil- & dust free instrument air only)
- Leave air output open
- Do not interrupt the air purge

An interrupt of air purge may damage the AS3 probe!

- Remove the probe immediately from the process in case air purge is not guarantied!

Please take notice: Mishandling of the system is not covered under warranty.

System Installation Site (Probe model AS3)

Location of the probe is very important! See Figure (next page). It should be placed well downstream (ideally greater than 10 pipe diameters) of any major flow disturbances, such as diaphragm or gate valves, elbows, flow meters, or pumps. Ultrasound demands a full pipe for best results; back pressure valves downstream of the sensor can be used to throttle the flow if necessary. When used in a sampling stream, isolation valves should be installed. The downstream valve should be capable of providing back pressure to minimize bubble formation.
In order to prevent gas bubbles from becoming trapped on the transducer's concave lens surface, it should never be placed on top of the pipe pointing down into the fluid. In case an installation on top is required, install the probe in an angle of at least 30°.

There is no special orientation for vertical pipe legs.
Mounting on vertical pipe legs is recommended for applications involving large amounts of suspended solids. Flow in vertical pipe sections should be upward to prevent pressure drop and cavitation caused by gravitational acceleration of the process liquid.

To mount the insertion adapter, you must first weld the supplied weldment adapter to the side of your pipe, make sure that no weldment remains can block or scratch the Probe. When this is done, the insertion adapter can be screwed to the weldment adapter and, after checking to make sure that the ball valve is closed, flow through the line can be resumed. There is no need to shut the line down to insert the probe to mild liquids at pressure ratings of less than 4Bar (50 PSI) and temperatures lower than 45°C (115°F).
Simply follow these steps:
(Do not twist the probe during this procedure!)

1. With valve closed, check that the Swagelok fitting is loose and the o-ring seals are not compressed.
2. Insert probe carefully into insertion adapter until the probe tip is shortly before the ball of the valve.
3. Tighten the Swagelok fitting tangible so that the o-rings start sealing (make sure that the probe is movable).
4. Open ball valve.
5. Fully insert probe through the ball valve into the process.
6. Adjust probe position so that the tip is about 2-15mm (0.1" to ½") in the process stream.
7. Tighten Swagelok fitting and use safety cable / chain to fix the probe in position.

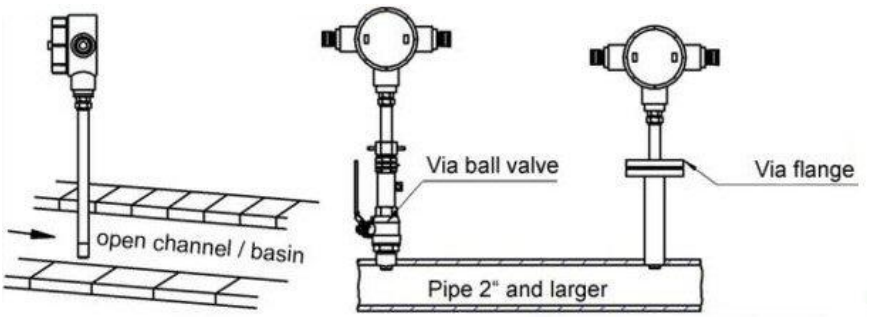
CAUTION DANGER!

Do not use this installation procedure at process pressures above 4 Bar (50 PSI) and / or at process temperatures higher than 45°C (115°F) and / or in case of aggressive / poison liquids!
For your own safety! Shut the line before you install or uninstall the Probe in case one of the above listed conditions will apply. (Contact or service for optional installation equipment)

It should be noted that when the probe is fully inserted the lens is extended into the flow stream. This will allow you to rotate the probe to align your conduit connections without damaging the lens. Remember, do not twist the probe while in the process of inserting or removing the sensor.

Alternative installations:

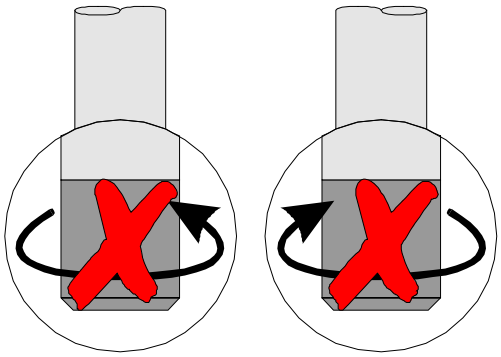
This Picture is for belief purposes only, a 30° angle is required in case you do an installation on top!



In order to prevent gas bubbles from becoming trapped on the transducer's concave lens surface, it should never be placed on top of the pipe pointing down into the fluid. In case an installation on top is required, install the probe in an angle of at least 30°, this is not shown in this picture.

Please take Notice:
Handle the sensor assembly with care.
The sensor tip is very sensitive to mechanical forces and shocks; please handle the probe extreme care fully a mechanical damage of the probe tip caused by rough handling is not covered by warranty.
Optional installation methods e.g. via flanges, or by using swivel clamps (open channel) are not described in this manual. In case of questions please contact Chemtronic or Galvanic.

!!! Do not twist the probe during insertion to process!!!
!!! Do not use extreme force during insertion to process!!!



Please take Notice!
Avoid air- or gas bubbles in the process pipe!
Bubbles will detected like particles and falsify your measurement results.

System Installation Site (Transmitter model AT3)

An appropriate installation site must be chosen for the AT3. The system should be mounted on a permanent, rigid surface (vertical or horizontal) using the mounting tabs or holes which extend from the system enclosure. The AT3 should be mounted to avoid direct sunlight, preferably indoors. The AT3 will operate properly between 0 °C to 50 °C (14 °F to 122 °F). Use dry and oil free instrument air to purge the transmitter in case of temperatures above 40°C. The workspace environment should be free of harmful chemical vapours to prevent damage to the system.

Connecting the Cables

Please follow the wiring diagram to connect transmitter and probe.

Transmitter Model AT3

The transmitter model AT3 is designed to display the measuring values in real time. An analog output 0/4 - 20mA can be used to forward the measuring results to a control room.
Fours et point triacs can be used to signalize upset conditions. Mechanical relays are available as an option.

A system fail relay (pulse missing is available as an option.

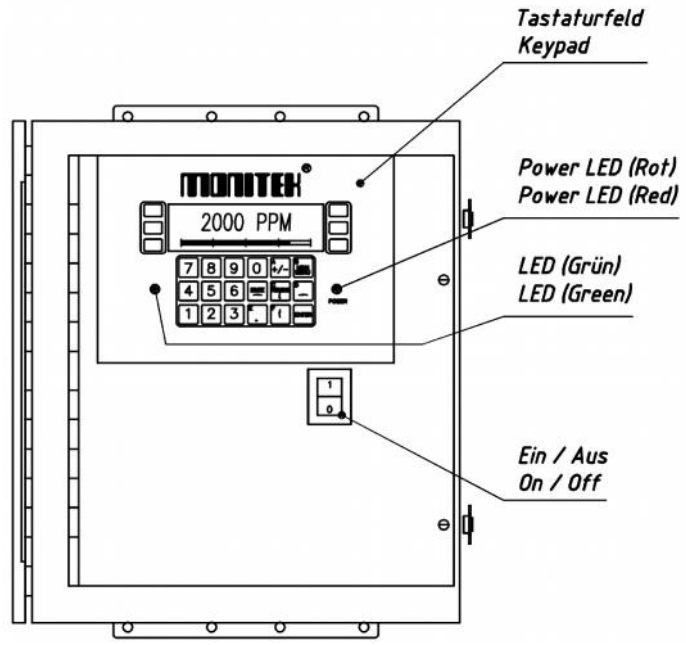


Abbildung 2: Messwertumformer AT3 (Elektronik) [MD094 - Abb-02.jpg]

Probe Model AS3

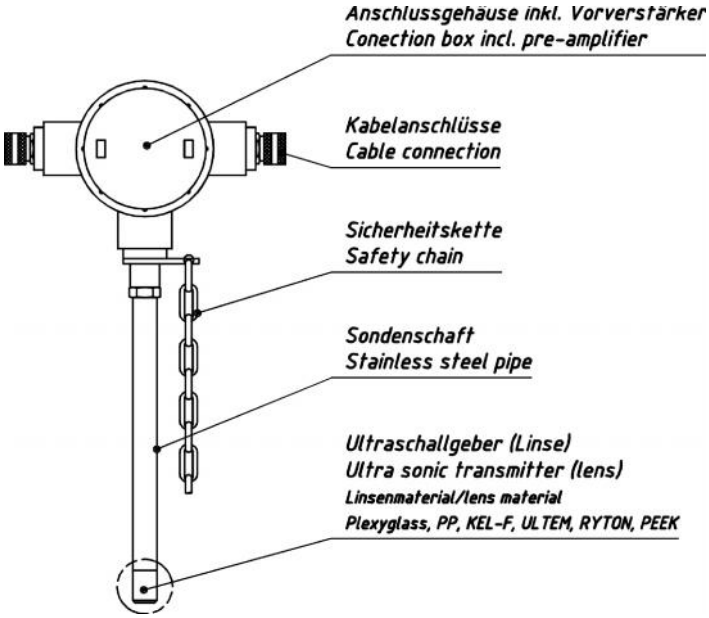


Abbildung 3:Messwertaufnehmer AS3 (Sensor) [MD094 - Abb-01.jpg]

The sensor model AS3 is designed as insertion probe. Installation can be done in open channel or via insertion adapter to any process pipe with inner diameter of 50mm (2”) or larger.

Optional installation feature like Flanges, swivel clamps, etc. are available.

Overview

Per definition is Turbidity an optical Impression.
Turbidity describes the characteristic of a transparent product, to scatter or absorb light. A focused light beam will be attenuated and scattered in hazy products, so that this product can become practically opaque in bigger layers. Turbidity is caused by particles in transparent products. A particle is defined as something with a different refractive index as the carrier liquid. Some examples of particles are minerals, yeast cells, metals, oil drops in water, milk in water, gas bubbles and aerosoles.

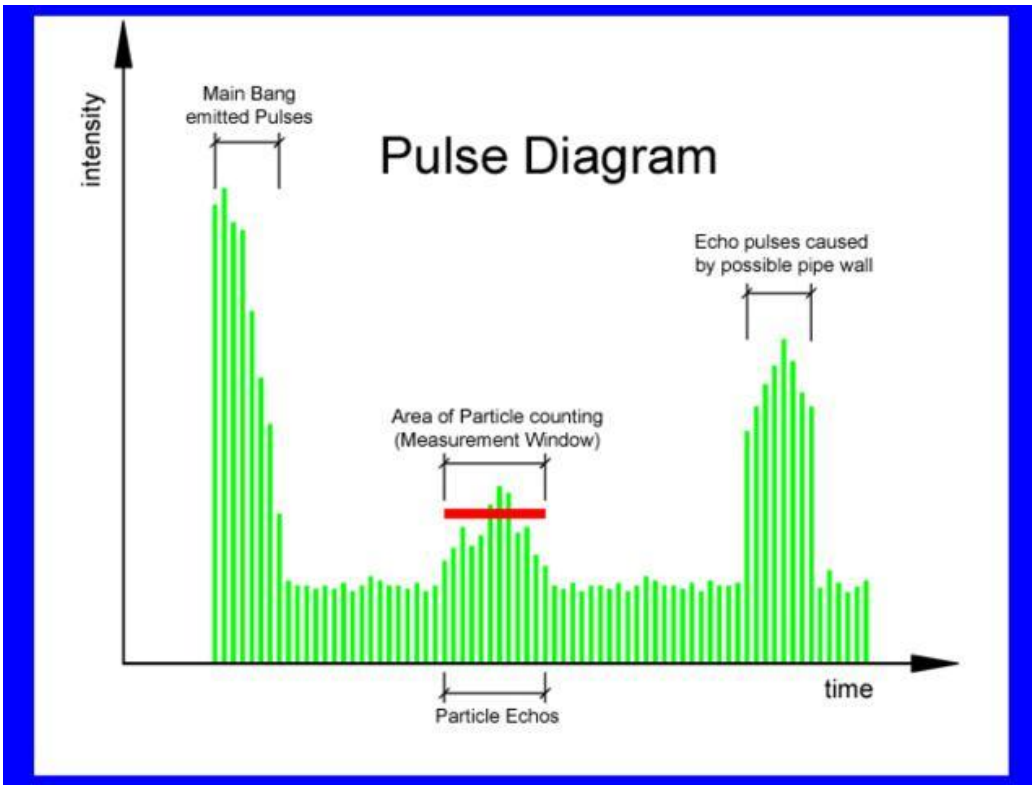
Ultrasonic Reflection:
The ultrasonic particle measurement is used to detect non-dissolved (suspended) particles in a liquid, similar to a turbidimeter. Turbidity is an optical effect. Therefore the acoustical method is typically named as particle or concentration measurement. Different as at the optical method here a particle is defined as something with a different speed of sound as the carrier liquid.

The AS3/AT3 particle monitor is a microprocessor based, real-time, in-line instrument used to monitor liquid-borne particle concentration and oil contaminants in various process liquids. Use of the microprocessor and graphics display provides a user friendly interface for setup and calibration. Because it is acoustically based, a transducer measures independent of the liquid's color, opacity, density, flow rate or photosensitivity. The sensor is relatively immune to the effects of coatings that would blind an optical sensor. Sensors mount directly into process piping, thus eliminating the handling error and dead time associated with grab sampling. The unit's dot matrix LCD display can present any user defined engineering unit (i.e., PPM, PCT, #/ml, etc.) along with the ability to plot calibration curves. The raw data is displayed as "counts".

Upset Monitor:
The most common use of the AT3 is to monitor equipment upsets (i.e., oil separators, filters, Dissolved Air Floatation devices, catalyst carryover). Here, the instrument can be set up to read in "counts" only. A reading in "counts" can be noted when a good or acceptable condition exists. Then an "upset" can be simulated and an alarm point established. This eliminates the need for taking samples to establish a calibration curve when all that is needed is for the AS3/AT3 to notify an upset condition.

Concentration Monitor:
The AT3 can also monitor suspended solids concentrations through the microprocessor establishing a correlation between "counts" and the known concentration (PPM, mg/L, %, etc.) can be determined, and the display will read out in engineering units. However, to establish an accurate correlation the particle size distribution must remain relatively constant at the point of sampling.

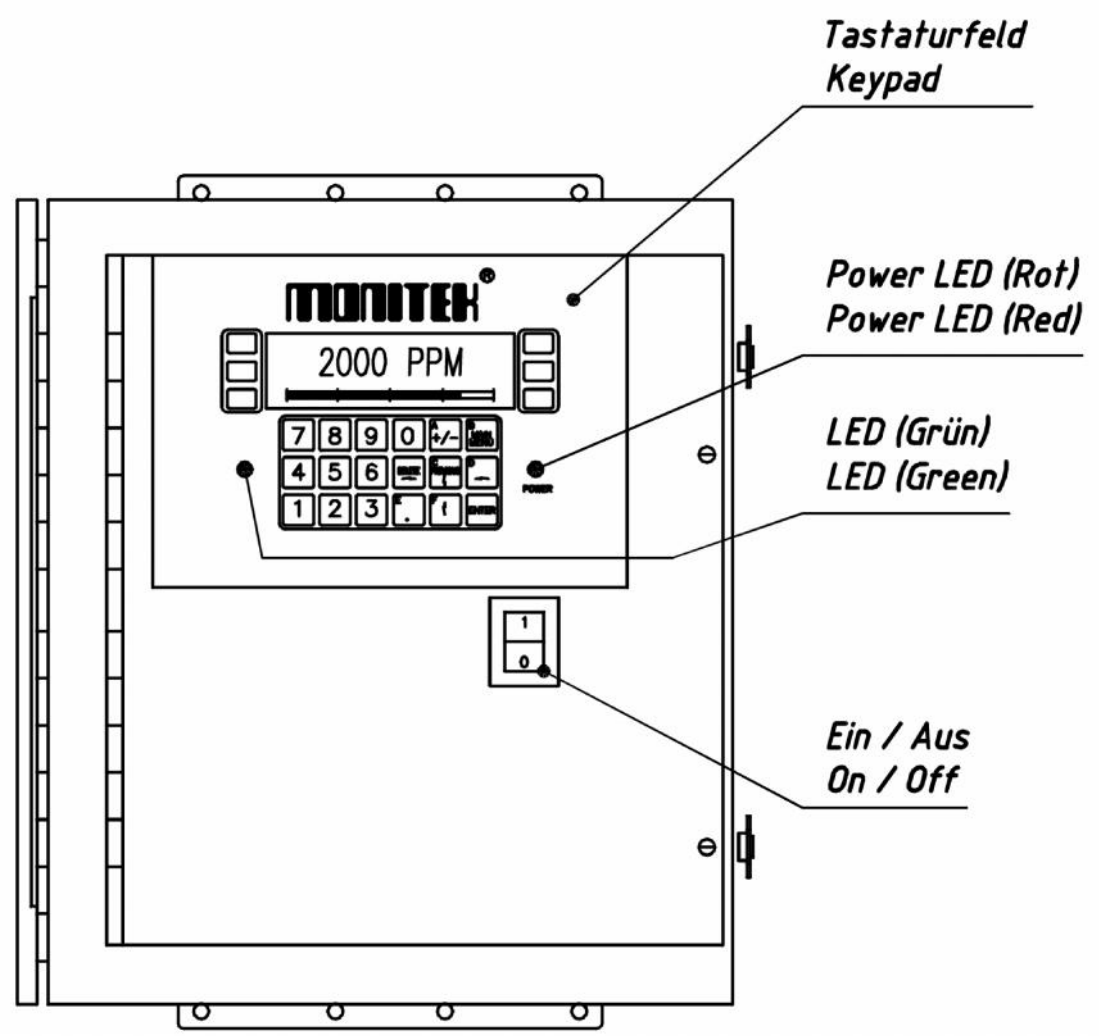
Theory:
The AS3/AT3 transmits acoustic pulses across the path of a liquid; these pulses are created by electrically exciting the transducer's piezoelectric crystal. Acoustic energy is reflected off any particles or bubbles encountered in the monitored liquid. Acoustic reflections received at the transducer are converted back into an electrical signal, which is amplified by a preamplifier and set to the receiver. Its amplitude is then compared to a reference voltage level known as the detection threshold. The signal is also time-gated to process only reflections from particles in the focal region. Signals that occur in the focal region and are greater than the detection threshold are analyzed by the software algorithm that accumulates counts. The total counts are processed by a mathematical curve fitting algorithm and a correspondent concentration value is displayed on the front panel of the system.
In addition to the return signals from contaminants in the monitored liquid, there are also reflections from the chamber wall opposite the transducer (far wall pulses) and from sound resonated in the transducer (main bang). Figure 1-1 illustrates these signals as well as how the receiver window is used to ensure that only reflections occurring in the focal region are processed.



The far wall pulses and the main bang, although not counted, provide an indication of the operating characteristics of the transducer. Changes in these signals may indicate a transducer problem. At 128 times a second the AT3 sends out a burst of energy into the process liquid, turns around and listens for echoes that return to the transducer, and then analyzes the data to determine a measurement.

The Front Panel

The AT3 uses a 240 x 64 dot liquid crystal graphics display in conjunction with a 24 key keypad as a user interface. See Figure 1-2. Three keys on the left and three on the right of the display are ³soft´, having different functions depending on what appears adjacent to them on the display.



INSTRUMENT OUTPUTS

The analog output option may be one of the following: 4 - 20mA or 0 - 20mA or 0 - 1mA, or the inverse of these (i.e., 20 - 4mA or 20 - 0mA or 1 - 0mA).

USER CARE

1. The following precautions will help ensure trouble-free operation and protect the instrument from possible damage.
2. Always turn power off before connecting or disconnecting the sensor or any of the circuit cards or the ribbon cable inside the instrument.
3. The door on the instrument enclosure must be kept tightly secured to reduce possible corrosion.
4. It is very important to make sure the printed circuit boards are plugged into the correct sockets on the motherboard.

Power Requirements

Ensure that the proper power is available at the installation site. The AT3 requires AC power voltage range of 85-265 VAC single phase, 50/60 Hz (other power supplies available on request). All power connections must be made to a properly grounded power source to protect both the operator and the system. Be sure that the system power is OFF before attempting to make any power Connections.

The power supply connection is made on the terminal strip at the lower right hand corner of the system enclosure box. The terminal strip is labeled ´L, G, and N´ (Line, Ground and Neutral). Connect the appropriate AC connections to L, G and N. The terminal strip is made to accept either fork or ring terminals for easy connection. All connections should be routed through the sealing fitting on the bottom of the system enclosure in order to maintain water tightness.

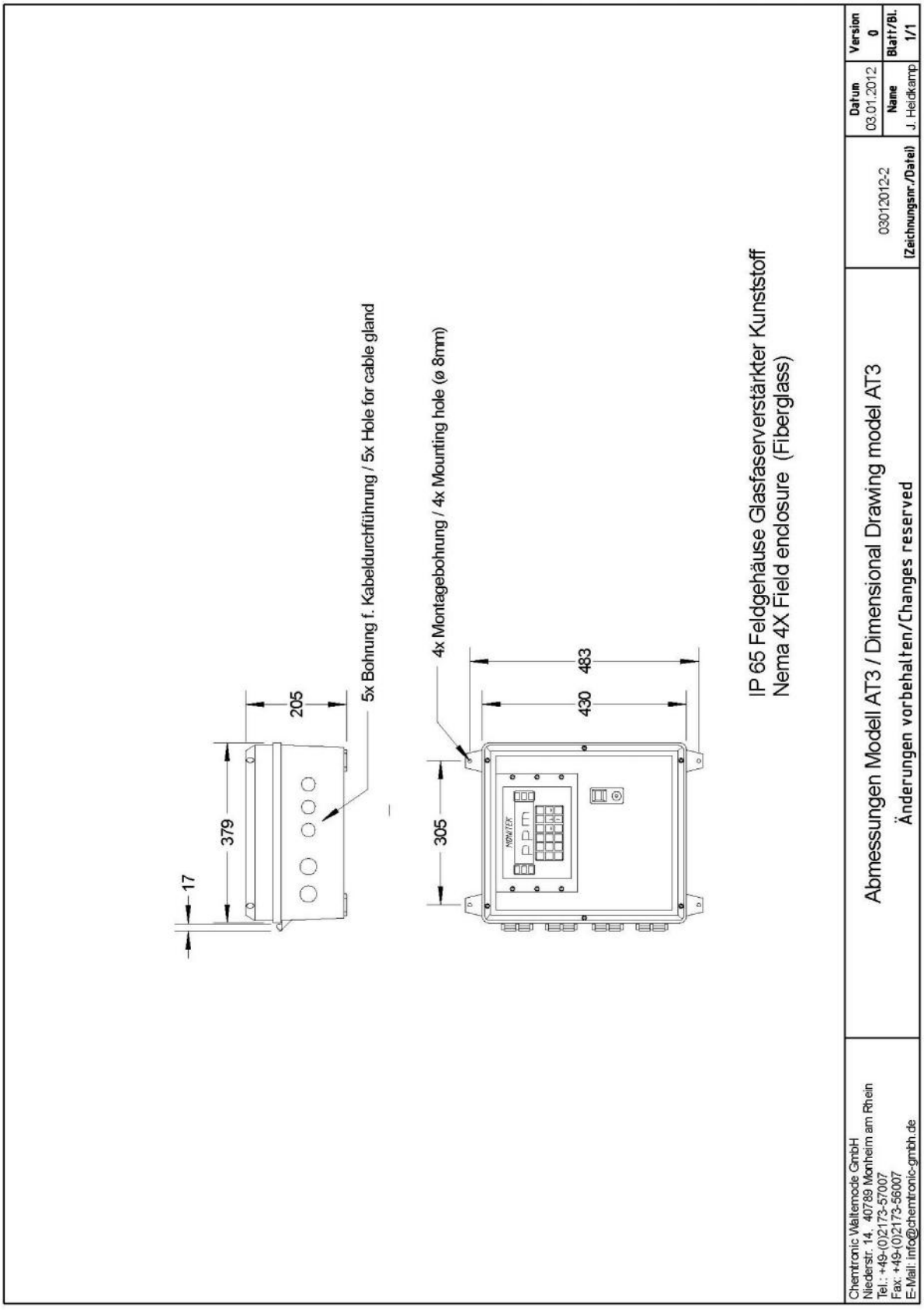
CIRCUIT BREAKER

The AT3 utilizes a 2amp slow blow thermal circuit breaker for added protection and convenience. If the circuit breaker releases reset it by pressing the reset button.

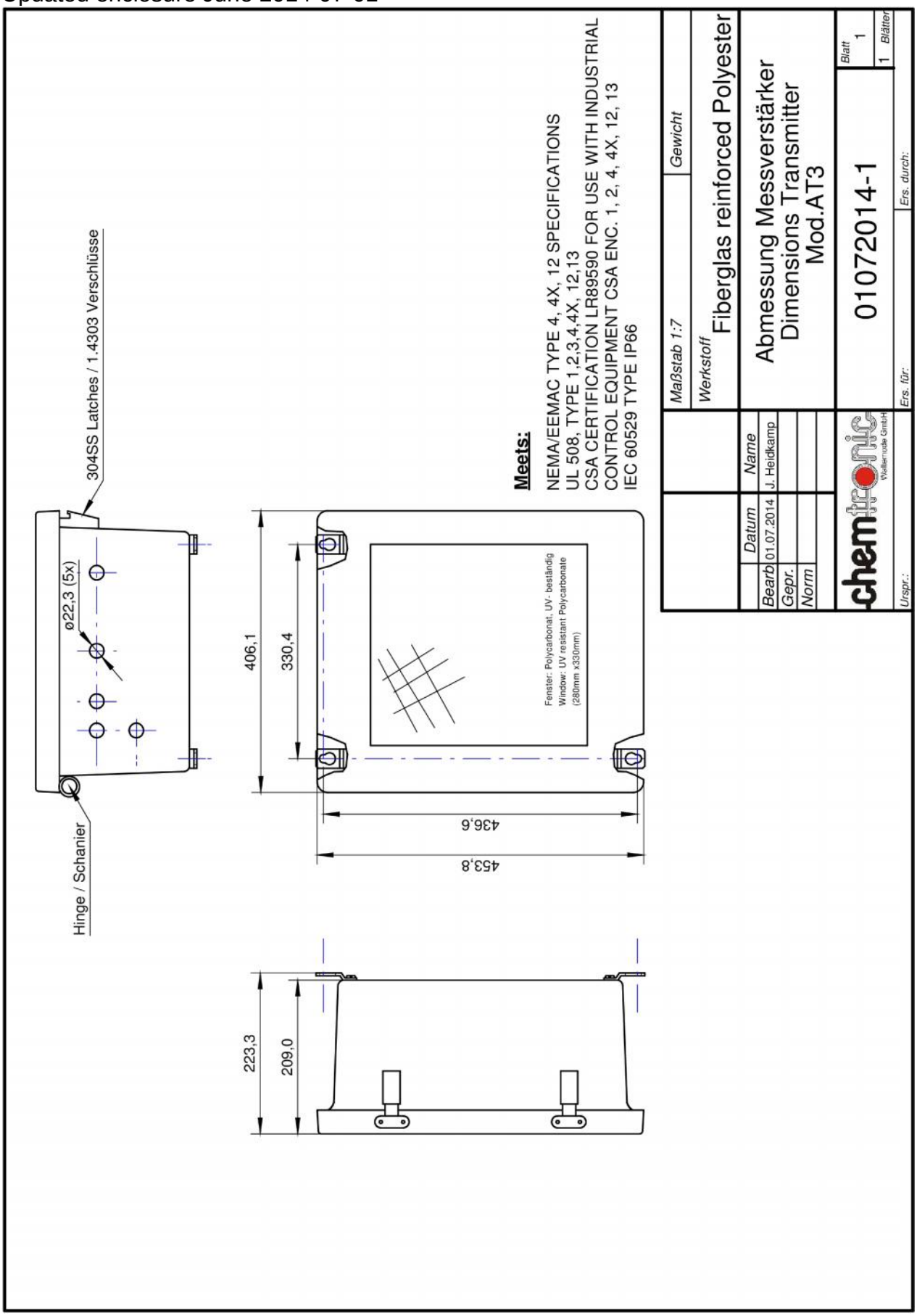
Please take notice:

A 24V AC/DC power supply is available as an option; please check your specification file or the instrument label to make sure that you connect the correct supply voltage!

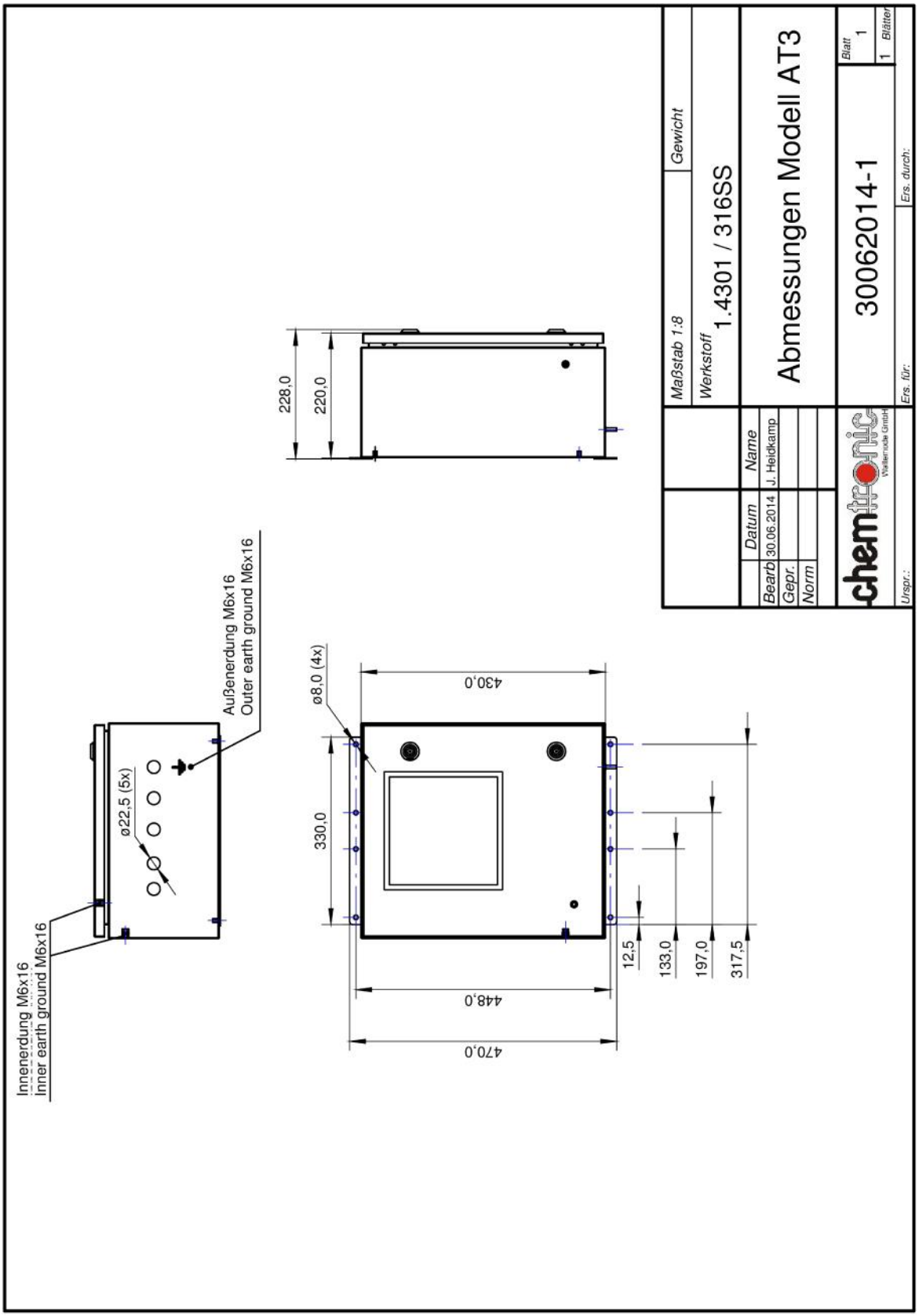
Dimensional Drawing (AT3 Field Enclosure Fiberglass)



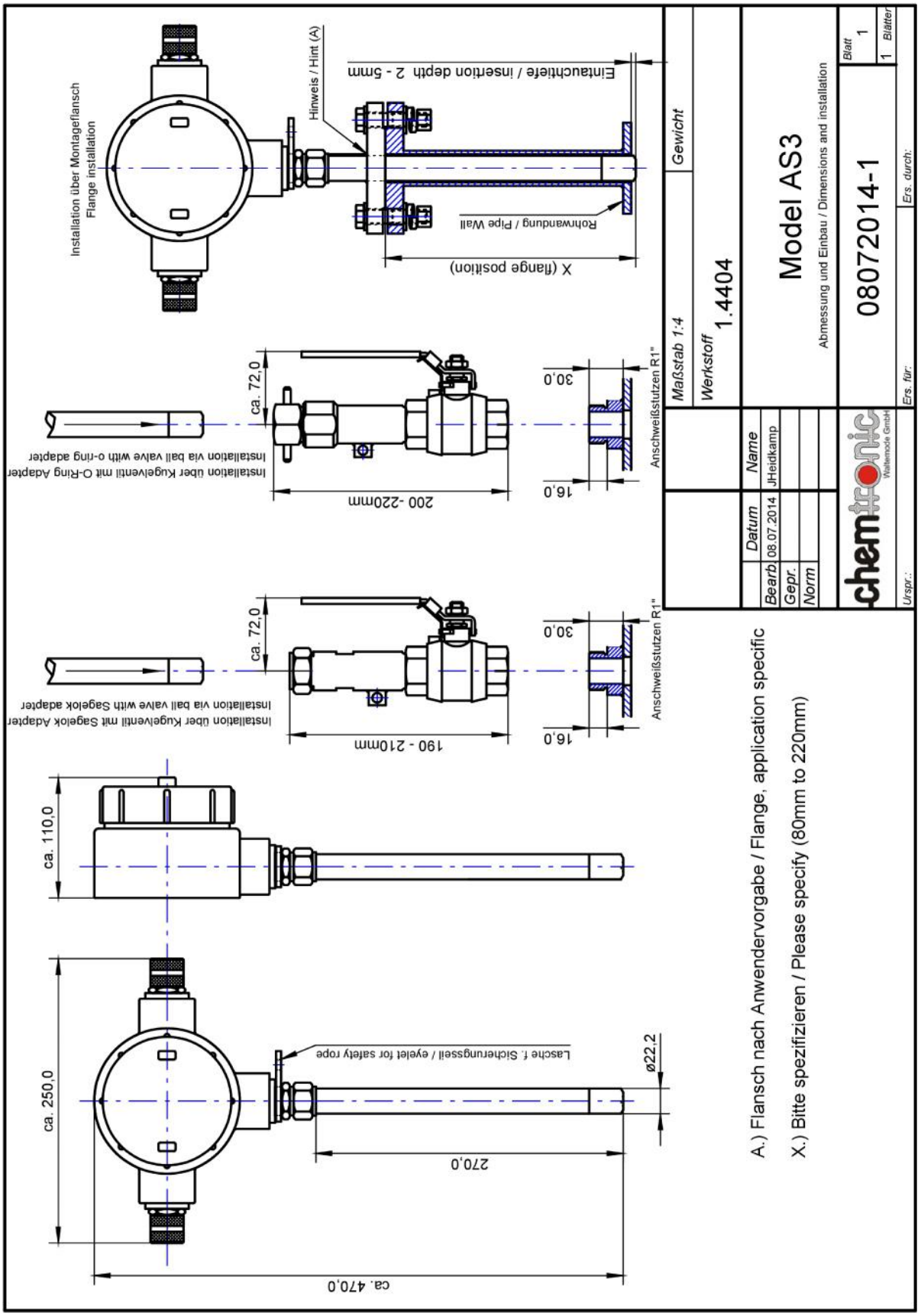
Updated enclosure June 2014-07-01



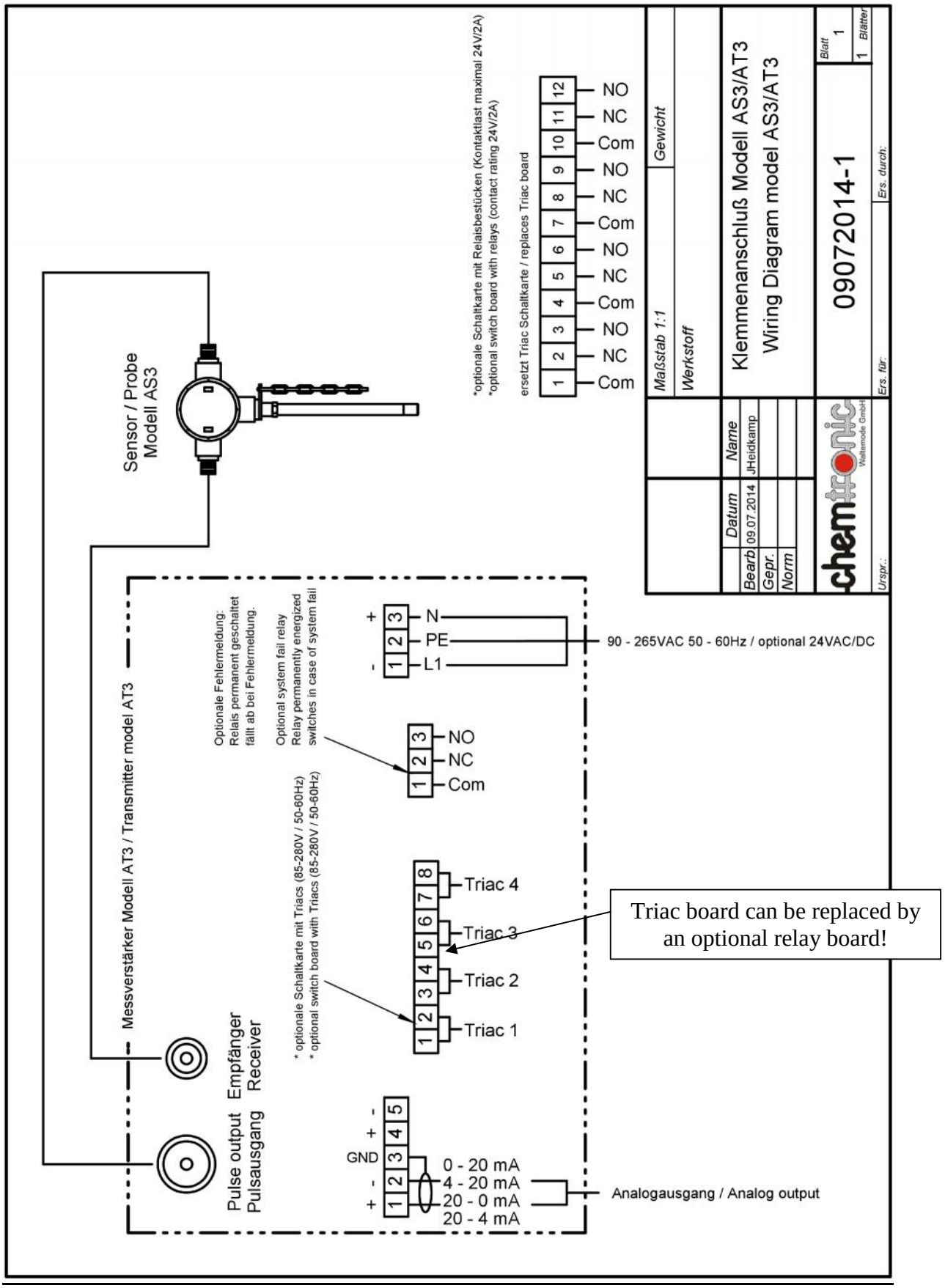
Dimensional Drawing (AT3 Field Enclosure Stainless Steel)



Dimensional Drawing (Probe model AS3)



Wiring Diagram



Note:

Each of the four alarm relays (Triacs) are solid state devices that control an output of 85 to 280VAC and 1A max. An example of the alarm control wiring is shown in Figure 3-21.

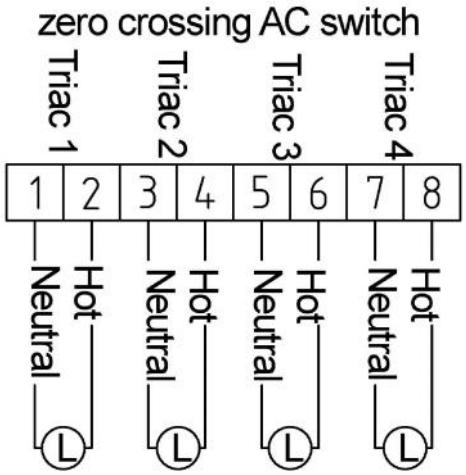


Figure 3-21: Example of Alarm Control Wiring

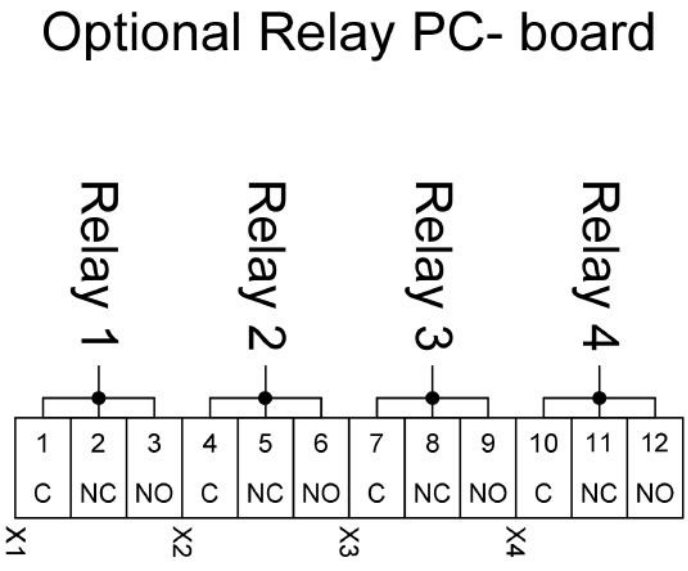
Optional Relay PC- board

Please take notice:

The PC-board with 4 Relays available as an option and replaces the Triac PC- board!

The PC-board with mechanical relays allows switching AC- and DC- Voltages.

Contact rating: 125VAC / 0.5A or 24VDC / 1A



Optional “System Fail” PC- Board

The system fail monitoring board is an optional PC board to monitor the function of the ultra sonic particle monitor model AS3/AT3.

Please take notice:

The board is already installed to the device or can be installed by our trained service personnel. Alternatively you can return the transmitter to our office in Monheim, to do the installation. An installation by the user is not permitted and may void the warranty coverage.
Monitored parameters are supply voltage, internal power supply, outgoing- / incoming Ultrasonic pulses and triggering. The status is displayed via 5 LEDs, an error message is passed on a relay. The relay is permanently energized, so that a failure of the entire supply voltage will be reported.

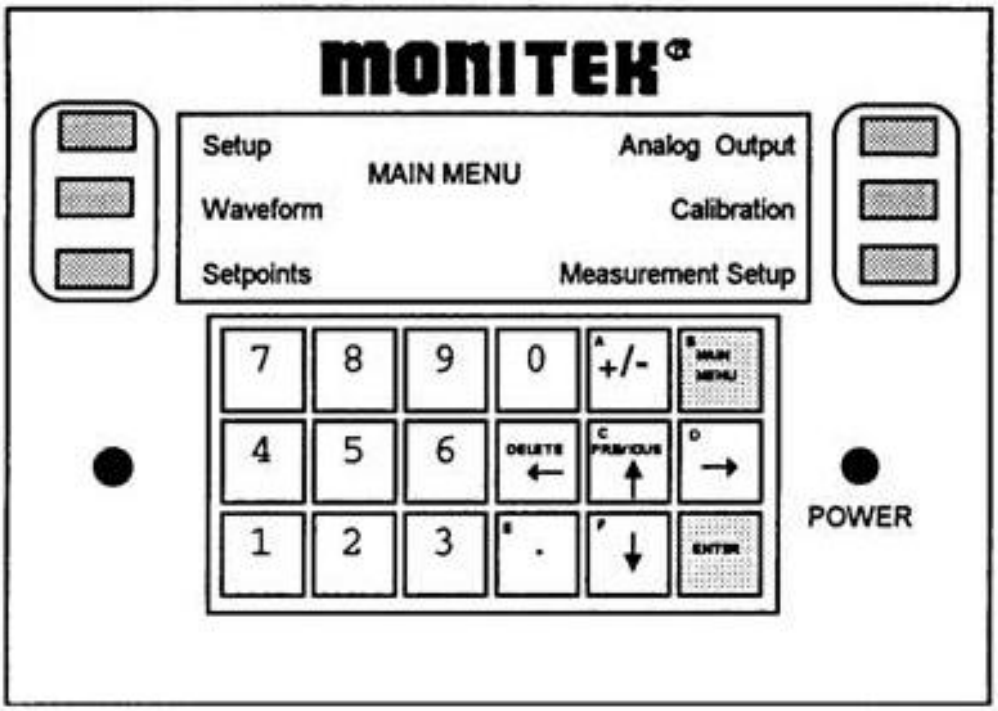
System status Led’s:

	System OK	**+5V of tolerance**	**-5,2V of tolerance**	**Pulse missing**
LED green (5V OK)	on	off	off	on
LED green (Relay On)	on	off	off	off
LED green (Trig A)	flashes	off	off	flashes / off
LED green (Trig B)	flashes	off	off	off
LED red (System Fail)	off	flashes (2 pulse interval)	flashes (slow)	on
Relay status	on	off	off	off

Introduction

Once the system has been installed, the hardware must be set up for your particular application, and checked to ensure that it is operating properly. The system operates by sending out a 5 or 15 MHz RF pulse (depending of sensor type) to the transducer, where it is converted to an acoustic pulse. This pulse travels through the monitored liquid. Reflections from contaminants and the chamber (pipe) wall radiate back to the transducer. These reflections are converted to electrical pulses, amplified by the preamplifier, and transmitted to the receiver. The signals are then time-gated by the receiver window and compared to a detection threshold. Signals that occur in the focal region and are greater than the detection threshold are detected by a software algorithm; the results are processed by a mathematical curve fitting algorithm which converts the raw counts into a corresponding concentration which is displayed on the LCD display on the front of the system.

Menu



Setup

Used to set initial system parameters; to match the user's application. These include the measurement units, damping, the display resolution, and whether the instrument displays raw data (counts) or a curvefit reading (user-defined measurement units), or system summary, which consists of raw data, reading, analog output, relay outputs, and sensor frequency.

Waveform

Graphically displays the output of the sensor and whatever is reflected back, similar to an oscilloscope. The user has a choice of three views, depending on whether the farwall or the measurement window is the main Interest. To get the big picture select "0-154 µS", while "0-38 µS" gives more detail around the measurement window; "0-77 µS" is a

Calibration

Used to correlate raw data coming from the sensor to a corresponding concentration. Up to 16 different samples can be read by the instrument. From this information the instrument can construct a lookup table or perform a polynomial fit of degrees 1 to 4. The user can graphically plot the resulting curvefit to visually check how it corresponds to the samples. Samples can be edited or deactivated and curve fitting can be tried again quickly to improve the calibration. This menu is password protected.

Measurement Setup

Used to set up the parameters which affect the measurement. This includes the output power, detection threshold, window position and waveform adjust. This menu is pass word protected.

Analog Output

Adjusts parameters involving the instrument's control current output.
These include the"ZERO", "SPAN", and "RANGE"

Setpoints

Consists of all the parameters that can be set up to activate the four relays at certain conditions. Each setpoint value can have a Hysteresis, a time delay (the condition must be met for at least this time before the relay trips), and a mode ("HIGH" means make-on-rise, "LOW break-on-rise).

Menu Operation

All menu choices can be modified or activated merely by pressing the button corresponding to the menu item. If a screen contains more than six menu items the choice "<More>" will appear as the lower right menu choice, and pressing this will take the user to the next page of choices. See Figure 3<2. Some menu items act as gateways, and pressing them takes the user to another screen. Other menu items can cause a certain action to be performed when they are pressed. Most items, however, allow the user to change the parameters and operation of the instrument.

Setpt1: XXX.XXX PPM	Setpt Mode: High
SETPOINTS	
Hysteresis: XXX.XXX PPM	
Setpt1 Delay: XX Sec	<More>

Figure 3-2: <More> Example

Numerical items,

when pressed, display a flashing cursor to prompt for an input and expect the user to enter a number. The numerical keys, decimal point, and +/- key may all come into play depending on the type of number the instrument expects. See Figure 3-3. If a mistake is made, the left arrow can be used as a backspace. If the number entered is outside the expected range, the Instrument will flash in the center of the bottom line "NUMBER TOO HIGH" or "NUMBER TOO LOW' and the entered number will be rejected. In general, the bottom line is dedicated to messages to the user. See Figure 3-4. If an item is expressed in scientific notation, the UP arrow can be used to enter the exponent.

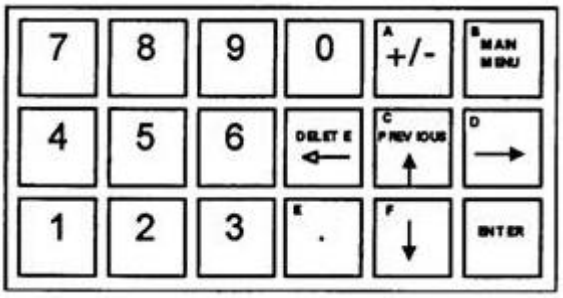


Figure 3-3: AT3 Front Panel Numerical Control Pad

	Low X value: X.XXX CNTS
PARTIAL PLOT	
	High X Value: X.XXX CNTS
NUMBER TO HIGH	
	PLOT

Figure 3-4: Example of Message Location

Option list items,

when pressed, allow the user to choose from a list of possible options. The user selects the desired option by pressing its corresponding button. The currently selected option is shown in inverse characters At any time "MAIN MENU" can be pressed to go back to the main menu screen. If "MAIN MENU" is pressed when already in the main menu screen, the instrument will return to the top screen (showing the instrument reading and the bar graph). "PREVIOUS" can be pressed to go back one screen previous to the current screen. On very few screens the previous key takes on its other identity as an UP arrow and will not return to the previous screen. On these screens pressing any key other than an arrow key will return the user to the previous screen.

Quick Start up

1. The "SETUP" menu. The parameters that can be chosen are: units (use the arrows), the resolution of the main display in digits to the right of the decimal point, and the instrument damping. See Figure 3-5. The "Display" menu allows the user to set the top screen to display "Raw Data" (which is given In COUNTS) or "Reading" that is the "Raw Data" mathematically transformed into the user-defined units and system summary. Press "PREVIOUS" or "MAIN MENU" to return to the main menu

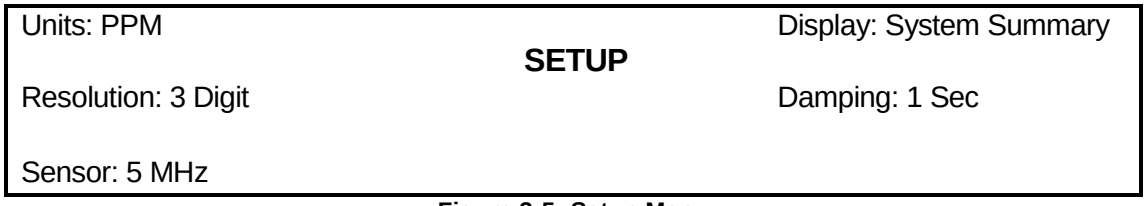


Figure 3-5: Setup Menu

1.a Press [3]Display in the setup menu to select Raw Data, System Summary or Reading (Figure 3-6).

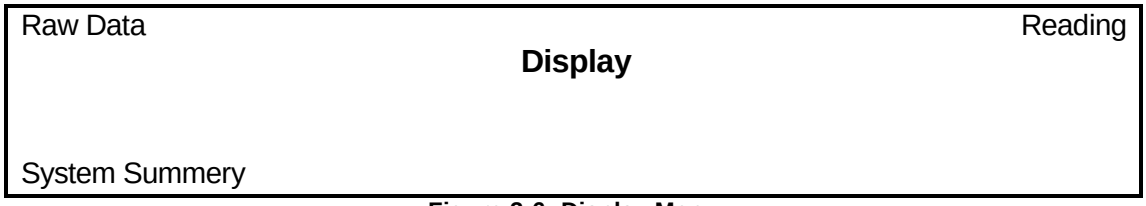


Figure 3-6: Display Menu

1.b First the sensor frequency must be set to match the sensor being used 5 MHz or 15 MHz (Figure 3-7).

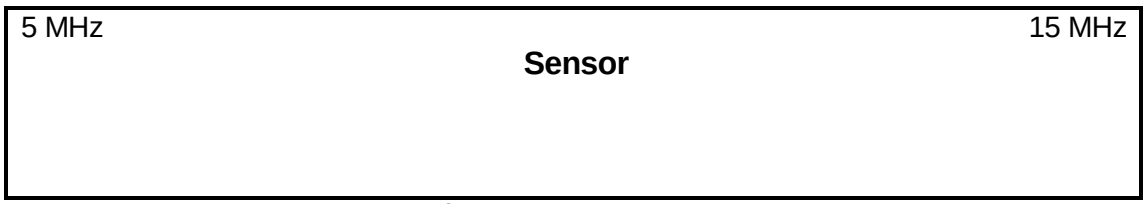


Figure 3-7: Sensor Menu

2. The "Measurement Setup" menu. These are parameters that intimately affect the measurement and must be set before samples are taken. See Figure 3-8. If any of these are changed after samples have been taken, the measurement environment is different enough that the previous samples are no longer valid. Most of the default values work just fine for most cases, but adjustments may have to be made for particular applications. The default password is 0000.

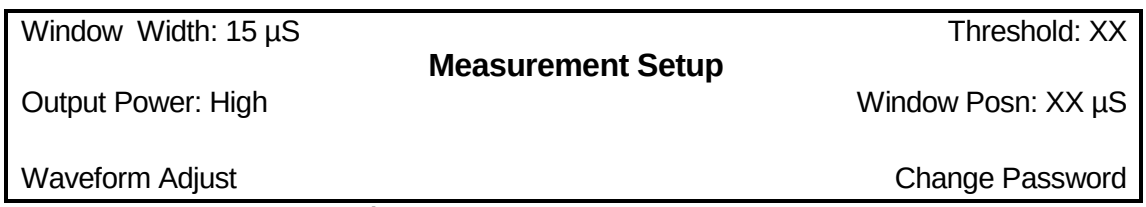


Figure 3-8: Measurement Setup Menu

2.a The "Window Width" menu. These parameters control the Window width as seen on the graphics display. See Figure 3-9 and Table 3-1.

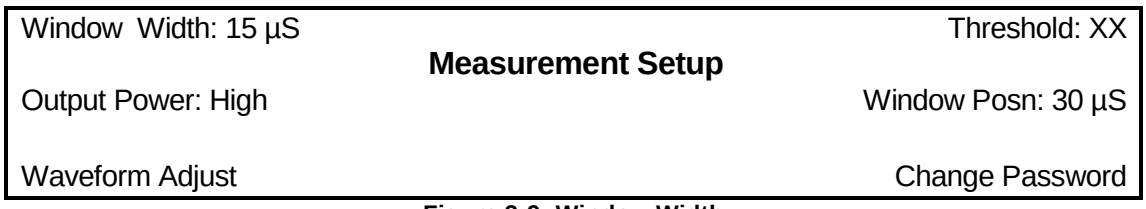


Figure 3-9: Window Width

Window Width in µSec	Counts
5	0–5000
10	0–10000
15	0–15000

Table 3-1: Window Width Guideline.

2.b The "Window Posn" and "Threshold" parameters affect where the measurement window is in relation to the main burst and how large an echo must be to affect the reading. These parameters can be adjusted either by entering numerical values or graphically In the "Waveform Adjust" menu. If the "Waveform Adjust" menu is used the arrow keys can be used to adjust the "Window Posn" and "Threshold" parameters and then the user must press the "ENTER" key to save the values

2.c The "Threshold" value needs to be set above the noise yet not so high that echoes are not seen at all.

NOTE: For concentration measurement, a good rule of thumb is to set the "Threshold" so that the typical process concentration gives a reading of 7000 to 8000 counts (the total range is 0 to 15000). This allows room for reading much higher concentrations during an upset condition.

NOTE: For ultra pure applications, the strategy is to set the "Threshold" just above the noise level so that everything is seen. Of course this means the instrument will saturate at a relatively low concentration

2.d The “Window Posn” is used to set the window in the focal point of the transducer, where the echoes should be at their highest levels. The default value usually works well, but occasionally it can be seen that the window does not quite match the position of the highest echoes, in which case it is appropriate to adjust the "Window Posn”.

2.e Finally, the "Password" menu allows the user to set a personal 4 digit password to protect the "Calibration” and "Measurement Setup" menus from unauthorized personnel. See Figure 3-10. The default password is 0000.

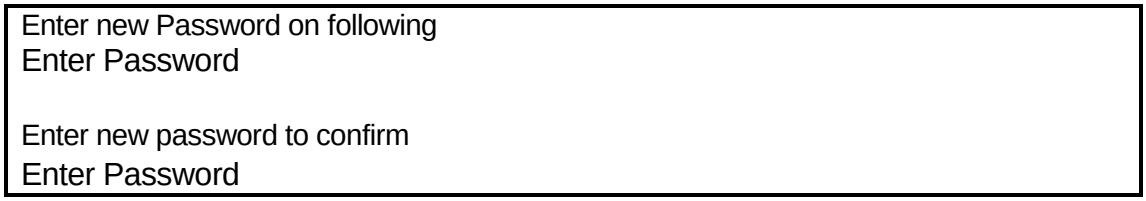


Figure 3-10: Change Password Menu

3. The "CALIBRATION" menu. Calibration is simply a matter of correlating the raw count level to reflect the concentration amount in the process. See Figure 3-11. The instrument allows the user to enter up to 16 different samples and their respective concentrations. These samples are stored in the "SAMPLE TABLE".

The instrument arrives Factory Calibrated according users specification and is ready to measure! There is typically no new calibration required in the first 3 years of operation!

Sample Table		Fit Sample Data
	CALIBRATION	
Cal Type: Best Fit Line		Full Plot
Partial Plot		Coefficients

Figure 3-11: Calibration Menu

3.a Press "SAMPLE TABLE" and you will see a summary of the 16 samples. See Figure 3-12. If a sample has not been entered yet, it will read "INACTIVE". Otherwise it will display the raw data and corresponding concentration for the sample. The instrument prompts the user for a sample number (1 to 16), which is entered by the keypad.

ENTER SAMPLE NUMBER->

(1) 500CNTS = 10.000 PPM	(9) 6000 CNTS = 5000.000 PPM
(2) 1000CNTS 250.000 PPM	(10) INACTIVE
(3) 1500CNTS 600.000 PPM	(11) INACTIVE
(4) 3000CNTS 900.000 PPM	(12) INACTIVE
(5) 4000CNTS 1500.000 PPM	(13) INACTIVE
(6) 4500CNTS 2500.000 PPM	(14) INACTIVE
(7) 5000CNTS 3500.000 PPM	(15) INACTIVE
(8) 5500CNTS 4500.000 PPM	(16) INACTIVE

Figure 3-12: Sample Table Menu Example.

Once in the sample menu, the user can read a sample, enter a sample value by hand, activate an inactive sample, or deactivate an active sample. Only "active" samples are used in the calibration procedure. See Figure 3-13. By deactivating a sample the data is not lost but is simply ignored by the calibration procedure. See Figure 3-14. By activating it again it can once again have an effect on the calibration. When a sample is read, it reads the sensor for 1 minute and stores the result. The user must enter the concentration of the sample, although this can be at a later time.

Read Sample		Activate Sample
	SAMPLE n	
Sample Data: XXXX CNTS	(INACTIVE)	↑
Concentration: XXXX PPM	(INACTIVE)	↓

Figure 3-13: Inactivate Sample Number "n" Menu.

Read Sample		Deactivate Sample
	SAMPLE n	
Sample Data: XXXX CNTS		↑
Concentration: XXXX PPM		↓

Figure 3-14: Activate Sample Number "n" Menu.

3.b The user must decide what type of curve fitting to perform on the data, this is done in the "Cal Type" menu (Figure 3-15).

Read Sample	Deactivate Sample
SAMPLE n	
Sample Data: XXXX CNTS	↑
Concentration: XXXX PPM	↓

Figure 3-15: Cal Type Menu.

3.c Once the "Cal Type" is chosen, the user presses the "Fit Sample Data" menu to perform the curvefitting calibration routine using the active samples.

NOTE:

If "Lookup Table" is chosen, the instrument will do a "connect the dots" type of calibration on all the active samples. This can be viewed by pressing the "Plot" menu, which graphs all the samples and the resultant curvefit.

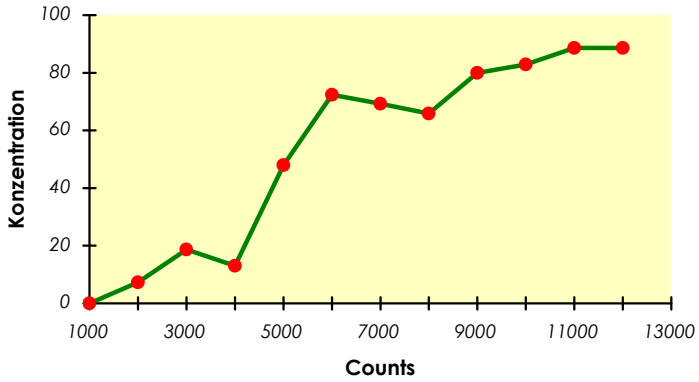
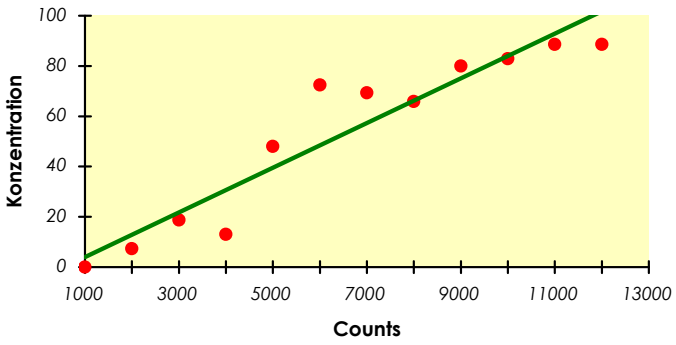
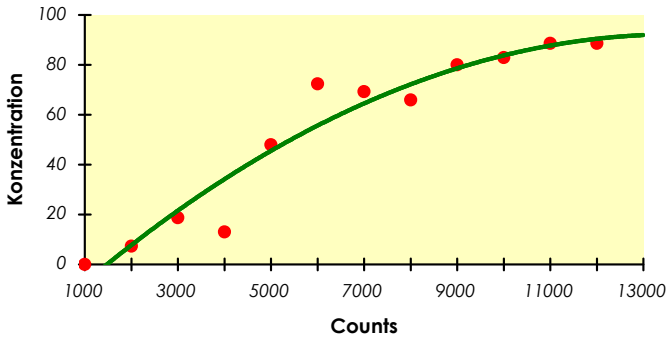
If "Best Line Fit" is chosen, upon pressing the "Fit Sample Data" menu the instrument will calculate the 2 coefficients that define the line that best matches the active samples. "Best Fit Parabola" is similar except it will require 3 coefficients, and "3rd Order Poly" and "4th Order Poly" require 4 and 5 coefficients respectively. In the "Coefficients" menu are the parameters calculated from polynomial curve fitting to define the curve. There is always one more coefficient than the degree of the polynomial. See Table 3-2. If a lookup table is used the "COEFFICIENT" menu is disabled.

NOTE:

The user can try all different types of "Cal Types"; However, a "Fit Sample Data" **must be done** after any change to perform an update of the calibration (Figure 3-17)

If only a portion of the curve is of interest, the user can go into the ³Partial Plot´ menu and choose the desired range to plot (by specifying the Low and High X values). See Figures 3-16 and 3-18. By viewing the graphs produced by the various methods the user can get a feel as to the best match for the process being monitored, and can experiment with activating and deactivating particular samples to see their effect on the calibration curve. Once a suitable curve is found, the coefficients that define it should be recorded.

Table 3.2: Calibration Type and Number of Active Samples Required.

Lookup Table  *Abbildung 4 [MD094 - Diagramme.xls]*	Lookup Table If "Lookup Table" is chosen, the instrument will do a "connect the dots" type of calibration on all the active samples.
Best Line Fit  *Abbildung 5 [MD094 - Diagramme.xls]*	Best Line Fit If "Best Line Fit" is chosen, upon pressing the "Fit Sample Data" menu the instrument will calculate the 2 coefficients that define the line that best matches the active samples.
Parabola  *Abbildung 6 [MD094 - Diagramme.xls]*	Parabel This type of curve fitting generates compensation parabola, determined by the measured data points. A minimum of 3 calibration samples are required to use this function..

Poly. 3. Ord.

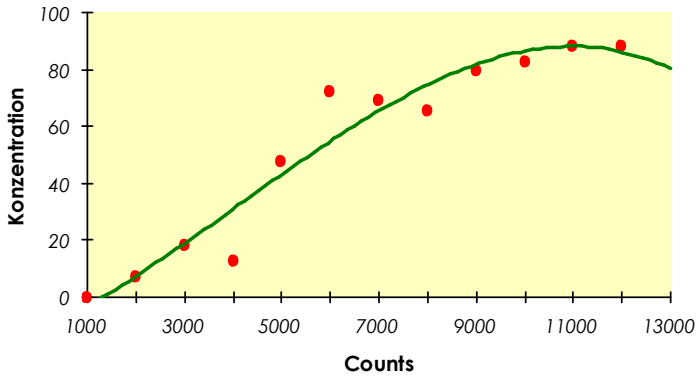


Abbildung 7 [MD094 - Diagramme.xls]

3rd Order Poly

This type of curve fitting creates a smooth curve with a good approach to the data points.

A minimum of 4 calibration samples are required to use this function.

Poly. 4. Ord.

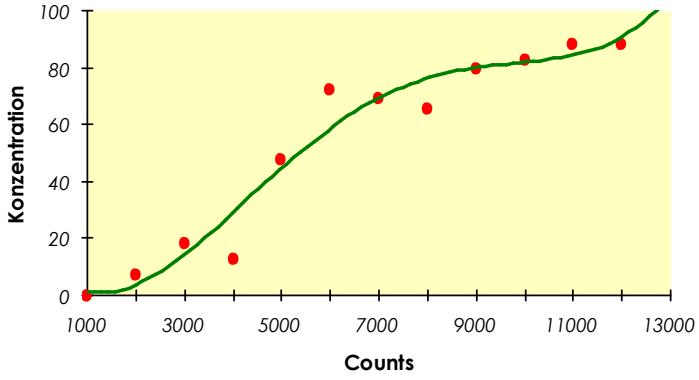


Abbildung 8 [MD094 - Diagramme.xls]

4rd Order Poly

This type of curve fitting creates a smooth curve with a high approach to the data points.

A minimum of 5 calibration samples are required to use this function.

! Take Notice!

The third order Poly and the fourth order Poly 4 allow the possibility of multiple zero crossings.

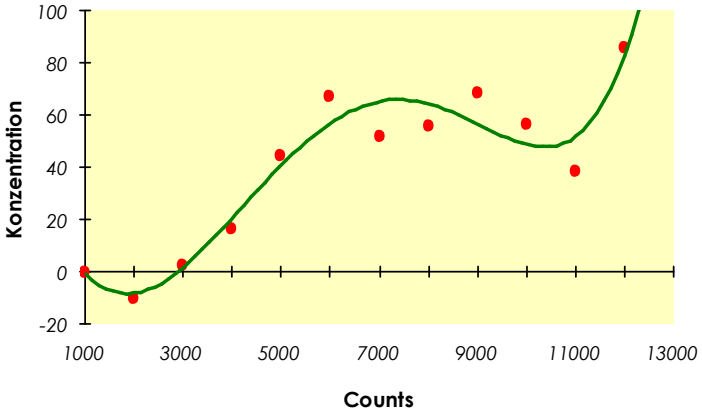


Abbildung 9 [MD094 - Diagramme.xls]

Polynomial with multiple zero crossings

This effect can be caused e. g. by measurement errors (outliers).
A correction is easily made by selectively disabling individual samples.

4. The „ANALOG OUTPUT“ menu consists of the parameters to perform a test procedure (Figure 3-19)

Zero: X.XXX PPM	Range: 4 to 20mA
ANALOG OUTPUT	
Span: XXX.X PPM	

Figure 3-19: Analog Output Menu..

4.a Press RANGE´ to select the output analog current range (i.e., 4 to 20mA).

4.b Press ³ZERO´ to enter the output low value (i.e., 0 PPM = 4mA)

4.c Press ³SPAN´ to enter the output high value (i.e., 100 PPM = 20mA

4.d Analog Output Test: Allows entering of any value within selected range to check scaling or response.

5. The ¨SET POINT" menu. Allows entering value of operation for 1-4 output alarm relays. The parameters that can be entered are Hysteresis, a time delay (an alarm condition must be met for this time before the relay actuates) and mode (make or break on activity count rise). See Figure 3-20.

Setpt1: XXX.XX PPM	Setpt Mode: High
SET POINTS	
Setpt1 Hysteresis: XXX.XX PPM	
Setpt1 Delay: XX Sec	<More>

Figure 3-20: Setpoint Menu.

Note:

Each of the four alarm relays (Triacs) are solid state devices that control an output of 20 to 280VAC and 1A max. An example of the alarm control wiring is shown in Figure 3-21.

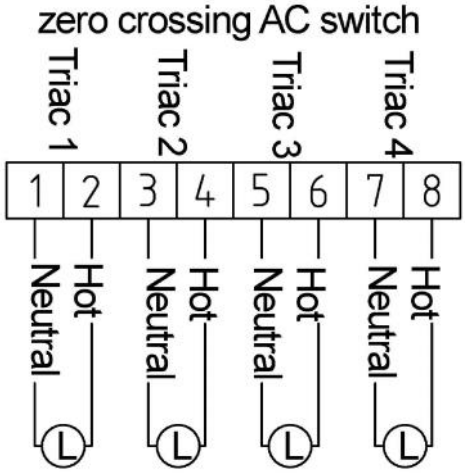


Figure 3-21: Example of Alarm Control Wiring

Note:

A PC-board with mechanical relays to allow switching DC Voltages is available as an option.

AT3/ AS3 Calibration Procedure (Example 0-100ppm)

The instrument arrives Factory Calibrated according users specification and is ready to measure!
There is typically no new user calibration required in the first 3 years of operation!
If possible we recommend that our service personnel performs the calibration of the system.

Typical Default Settings

1. Sensor: 15 or 5MHz depending by your hardware (Setup Menu)
2. Display: System Summery (Setup Menu)
3. Damping: 5s (Setup Menu)
4. Power level: high (Measurement Setup Menu)
5. Window width: 15µs (Measurement Setup Menu)
6. Window position: 30µs (Measurement Setup Menu)
7. CAL TYPE: Lookup Table (Calibration Menu)

These settings cover about 90% of possible applications and calibrations.

Required Material to perform a Calibration

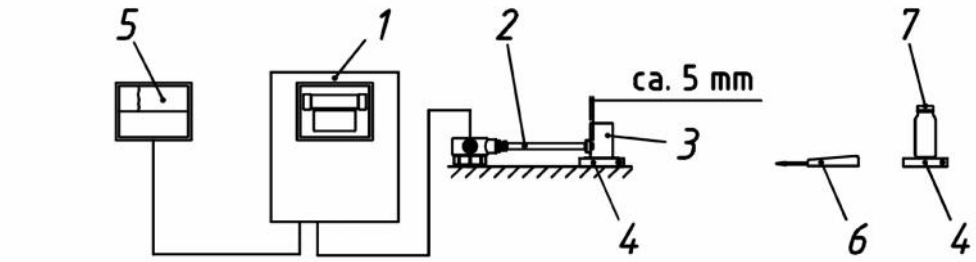


Figure 3-22: Calibration equipment

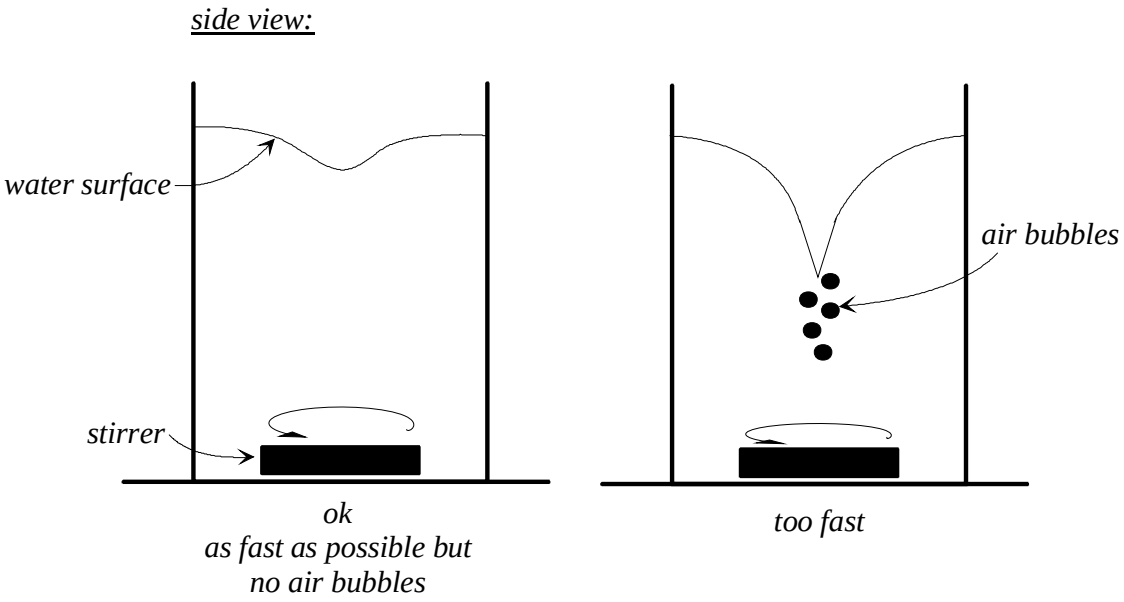
① Converter AT3 ② Sensor AS3 ③ Calibration vessel [1]
④ Magnet stirring ⑤ Recorder ⑥ Pipette ⑦ Calibration Liquid 10000ppm [2]

[1] The Calibration Vessel is available as an option
[2] Please contact us for information how to prepare calibration liquids

The example uses six laboratory samples to perform calibration.
The concentration of the samples should be about 0%, 20%, 40%, 60%, 80% and 100% of your maximum range. The samples will be prepared, by adding a calibration liquid with high concentration, into the zero sample (water).

The Calibration Procedure

1. Prepare system like shown in drawing.
2. Make sure that the " typical default settings" are programmed to the transmitter
3. Make sure that all equipment (calibration vessel, pipettes, etc.) is properly cleaned
4. Fill up vessel with 600ml DE or distilled water (DE or distilled water has approx. 0.3ppm turbidity).
5. Switch on magnetic stirrer and set stirrer speed so, that no air can go into the calibration vessel.
6. Switch on second stirrer and set stirrer speed so, that no air can go into the calibration liquid.



7. Wait 30 Minutes for complete deairation of water and homogeneous mixing of the calibration liquid.
8. By using a pipette, put 6ml of 10000ppm of calibration liquid into the water in the calibration vessel, to get a turbidity of about 100ppm (maximum range for this example calibration).
9. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
10. Set threshold (MEASUREMENT SETUP MENU) until you get 8000 to 10000 cts instrument reading.
11. Remove sample, clean up measuring chamber, refill with 600ml hot water and wait for deairation.
12. Call up calibration menu - sample table - sample no. 1.
13. Read water as low concentration value and assign a concentration of 0,3ppm.
14. Select sample no. 2.
15. By using a pipette, put 1,2ml calibration liquid into the water in the calibration vessel, to get a turbidity of 20,3ppm.
16. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
17. Read sample no. 2 and assign the concentration of 20,3ppm.
18. Select sample no. 3.

19. By using a pipette, put 1,2ml calibration liquid into the water in the calibration vessel, to get a turbidity of 40,3ppm.
20. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
21. Read sample no. 3 and assign the concentration of 40,3ppm.
22. Select sample no. 4.
23. By using a pipette, put 1,2ml calibration liquid into the water in the calibration vessel, to get a turbidity of 60,1ppm.
24. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
25. Read sample no. 4 and assign the concentration of 60,1ppm.
26. Select sample no. 5.
27. By using a pipette, put 1,2ml calibration liquid into the water in the calibration vessel, to get a turbidity of 79,9ppm
28. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
29. Read sample no. 5 and assign the concentration of 79,9ppm.
30. Select sample no. 6.
31. By using a pipette, put 1,2ml calibration liquid into the water in the calibration vessel, to get a turbidity of 99,5ppm
32. Wait 3 minutes, to guaranty, the sample has homogeneous turbidity.
33. Read sample no. 6 and assign the concentration of 99,5ppm (please check: 99,5ppm should have 8000 to 10000 counts again).
34. Push two times the previous key to return to the calibration menu.
35. Select perform “Fit Sample Data” to complete calibration procedure.

Note

Double check your calibration curve with “Full Plot”, you can choose other calibration type if you like. In case you choose other calibration types like “Best FIT LINE”, “3rd Degree Poly”, etc. you must perform “Fit Sample Data” again and check with “Full Plot”.

Maintenance

System Cleaning

Disengage the A T3 from its power source before any cleaning. The unit can be cleaned with a soft cloth dampened with water. A mild detergent may be used if necessary. Do not allow water inside the unit. Also be sure that no water remains near the power connections to eliminate the possibility of electrical shock.

Troubleshooting

Below is a preliminary list of the steps to take in diagnosing a system problem.

If there are no system outputs or display:

Make sure that there is power to the A T3.
Ensure that the system power switch is in the ON position.
Check that the circuit breaker is not tripped. Press it to reset.

If there is erratic data or off-scale values in the absence of an upset condition:

Ensure that the cables to the preamplifier are connected; check to see if they are shorted.
Make sure that the pipeline is full.
Ensure that the preamplifier is firmly attached to the transducer.

If none of these items correct the problem, go to the "Waveform" menu and verify that the system output is normal. Follow the system setup procedure; readjusting the receiver window, detection threshold, or power level may correct the problem. Contact your Customer Service Representative if the problem cannot be found.

Service and Repair

If you have determined that your A T3 is in need of service or repair, do the following before calling Monitek for service information:

Leave the system in its malfunctioning configuration.

Have a description of the malfunction readily available.

Have a list of the equipment's serial numbers.

Shipping Instructions

If it becomes necessary to ship all or part of the AS3/AT3 system back to the factory for repair, be sure that it is cleaned and packaged with care.. Damage incurred during shipment is not covered under warranty; therefore, it is suggested that all shipments be properly insured.

Glossary of Terms

Chamber: The short piece of piping in which the AT3 transducer is positioned (see sensor).

Detection threshold: The level that the signal from an acoustic reflection must exceed before it Is counted by the receiver. A number from 1 to 255, it is usually shortened to DT.

Far wall pulse: Acoustic reflections from the inside diameter of the pipe opposite the transducer. There will usually be two or three such pulses.

Focal region: The area about the focal point where particle measurements are made.

Lens: The material (usually plastic) onto which the transducer crystal is bonded. The lens focuses acoustic energy to increase system sensitivity, just as a magnifying glass focuses light energy. The lens is that part of the transducer that comes into contact with the process fluid.

Main bang: The signal returned from sound resonating in the transducer.

Main bang duration: A characteristic of the transducer related to the length of *time* it reverberates as a result of the main bang. The transducer must "ringdown" quickly to allow detection of the return echoes.

Piezoelectric: The property possessed by some substances to deform when a voltage is applied across them. Many common substances, like quartz, are piezoelectric.

Piezoelectric crystal: The small disk of material in the transducer that converts the electrical energy from the pulser into acoustic (sound) energy. Crystals in the AT3 transducers are generally made of lithium niobate (LiNb03).

Preamplifier: The circuit that amplifies the signals from particle echoes before they are transmitted to the receiver. This minimizes interference from cable noise.

Pulse-echo: A configuration in which the same transducer transmits pulses and receives acoustic reflections. The AT3 operates in the pulse-echo configuration.

Pulser: The circuitry that creates the electrical pulses sent to the transducer. The pulser transmits pulses at either 5 or 15 MHz

RF: Short for radio frequency, which is any frequency in the range that radio waves may be transmitted (10KHz to 300 GHz).

Receiver: The receiver circuitry processes the signals from acoustic reflections from contaminants in the monitored liquid.

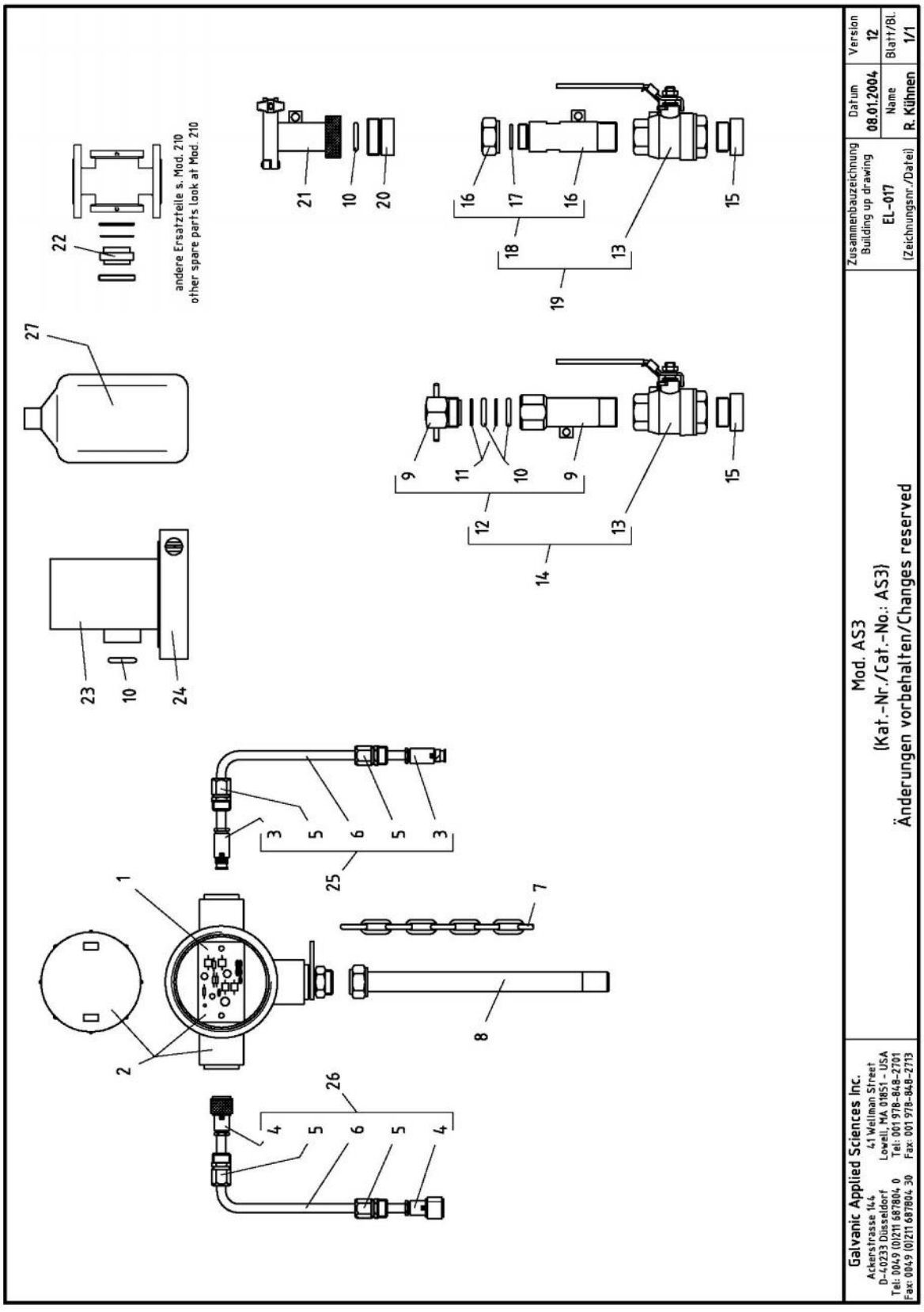
Receiver window: The time gate used to define the region in the monitored liquid in which acoustic reflections must occur in order to be counted. This prevents echoes from anywhere outside the focal region from being counted. The window width is factory set to 5µs and is adjustable.

Resonant frequency: The "natural" frequency of oscillation of a circuit or crystal, or that frequency at which the most power is produced or transmitted. Crystals used in the AT3 transducers have resonant frequencies of either 5 or 15 MHz.

Sensor assembly: The unit comprised of a transducer and preamplifier.

Transducer: A device that converts one form of energy to another. Specifically the AT3 transducers convert electrical pulses to acoustic pulses and acoustic energy back to electrical energy.

Spare part List (Probe MODEL AS3)



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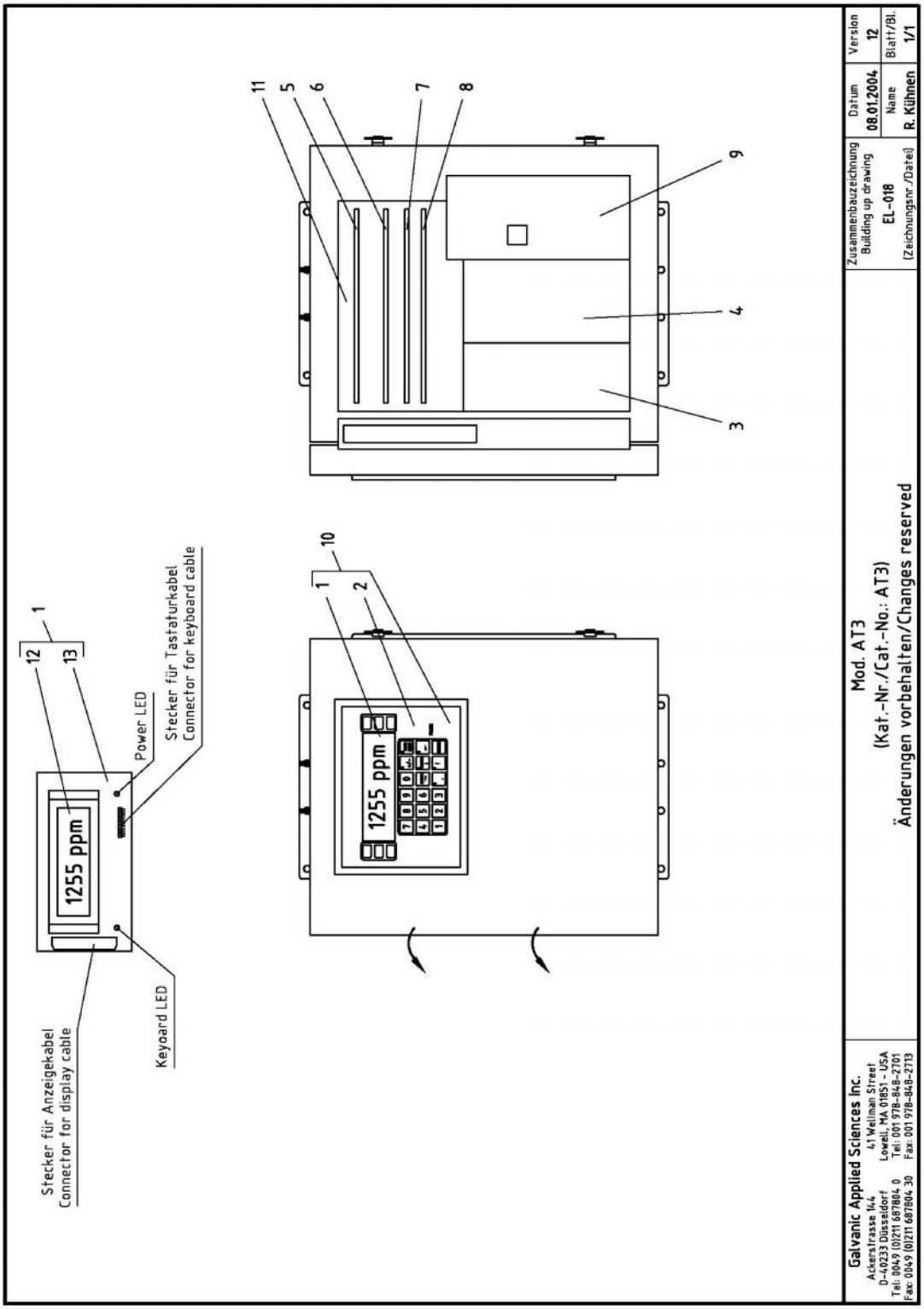
Ersatzteilliste / Spare-parts-list

Pos.	Qty required	Article-No.	Article-Description
001	1	S-0000-0009-00	Stückliste AS3
002	1	4800-0085-10	Vorverstärker 15MHz AS3 / Pre amp assy. 15MHz AS3
003	1	4800-0085-12	Vorverstärker 5MHz AS3/ Pre amp assy. 5MHz AS3
004	1	4800-0231-05	Linse Peek AS3 15MHz / Lense PEEK AS3 15MHz
005	1	4800-0231-06	Linse Peek AS3 5MHz/ Lense Peek AS3 5MHz
006	1	4800-0220-06	Sondenrohr AS3 m. 15MHz Peek / Probe pipe AS3 w. Peek 15MHz
007	1	4800-0220-05	Sondenrohr AS3 m. 5MHz Peek / Probe pipe AS3 w. Peek 5MHz
008	1	4800-1000-00	Kalibrierset AS3 / Calibration set AS3 (230/115 VAC)
009	1	4800-1000-50	Kalibrierbeh. o. Rührer / calibration vessel w.o. Stirrer (AS3)
010	1	4800-0214-RE	Koaxialkabel Epfänger AS3/ Coaxial cable Receiver AS3
011	1	4800-0214-TR	Koaxialkabel Sender AS3/ Coaxial cable transmitter AS3

Spare part List (TANSMITTER MODEL AT3)



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Ersatzteilliste / Spare-parts-list

Pos.	Qty required	Article-No.	Article-Description
001	1	S-0000-0008-00	Stückliste AT3
002	1	4805-0051-10	LCD Grafikplatine komplett / Display board complete (AT3)
003	1	C400-0135-00	Tastatur (AT3) / Keypad (AT3)
004	1	4805-0024-10	Analogausgangsplatine AT3 / AO-board AT3
005	1	4805-0026-10	Relaiskarte AT3 / Relay board AT3
006	1	4805-0021-10	Pulserplatine AT3 / Pulser board AT3
007	1	3000-1050-10	Prozessorplatine AT3 / CPU board AT3
008	1	4805-0023-10	Ein- / Ausgangskarte AT3 - I/O-board AT3
009	1	4805-0022-10	Empfängerplatine AT3 / Receiver board AT3
010	1	C609-0020-00	Netzteil AT3 / power supply AT3 (90-265VAC)
011	1	4805-0020-00	Hauptleiterplatine AT3 / Motherboard AT3
012	1	C402-0327-00	Display Modul AT3
013	1	4810-0034-10	Steuerplatine Display AT3 / Display controller AT3

Technical Data Probe Model AS3

Model AS3

- **Free of maintenance**
- **Extended calibration interval: Typical 24 month**
- **Process insertion through pipe adapter with ball valve**
- **Insertion/removal without process interruption (max. 5 bar)**
- **Optional available with DIN- or ANSI flanges**
- **Wide span of ranges**
- **Insensitive to colour**
- **Insensitive to coatings**
- **Self cleaning effect due to ultra sonic pulses**
- **No wearing parts**

Description:

The ultrasonic probe model AS3, together with transmitter model AT3, has been specially designed to measure particle concentration in a variety of liquids. According to the application, calibration can be done in multiple ranges and measurement units like EBC, ppm, %, etc.. The measurement system has been designed for continuous operation with long life time. The probe design allows an installation into process pipes, tanks or open channels. Up to a process pressure of 5bar and non critical product, process insertion and removal of the probe can be easily done via a 1"ball valve. Calibration and maintenance ensues without process interruption. Other process connections like flanges, swagelok fittings, etc. are available on request.

Applications:

- Product concentration
- Filtration control
- Oil in condensate
- Oil in water / Water in oil

Operational areas:

- Chemical industry
- Petrochemical industry
- Pulp & Paper
- Power plants

Technical Data:

Line size:	< DN 50 / 2"	Measurement range:	0–10ppm, 0–30000ppm
Process pressure:	maximum PN 40 / ANSI class 300	Reproducibility:	± 1 %
Process temperature:	maximum 80°C / 110°C with air purge	Length of probe pipe:	approx. 300mm
Probe material:	1.4471 / 316SS (other material on request)	Weight:	approx. 3kg
Lens material:	Peek (other material on request)	Protection:	IP65 / NEMA 4X
Gasket material:	typical Kalrez	optional hazardous area:	ATEX Zone I / Zone II

Technical Data Transmitter Model AT3

Model AT3

Principle of measurement: Ultrasonic reflection

- **Intuitive user interface**
- **High reproducibility**
- **Programmable range**
- **Linearization of measurement values**
- **Programmable measurement units (ppm, m/l, %, etc.)**
- **Analogue output: 0/4 – 20mA (isolated)**
- **Four programmable set point relays**
- **Backlit graphic display**

Description:

The transmitter model AT3, together with a probe model AS3, has been specially designed to measure particle concentration in a variety of liquids. The large span of measurement ranges of 0 – 1ppm to 0 – 30000ppm allows a wide range of applications. A user friendly interface provides great assistance in setting up of the instrument. Between two and sixteen samples are required to define a calibration curve for a specific customer application. Calibration can be done in multiple ranges and measurement units like mg/l, %, g/l, ppm, ppb, etc. according to customer specification. The 0/4-20mA output allows transferring the measurement results to an external PLC system.

Applications:

- Product concentration
- Filtration control
- Oil in condensate
- Oil in water / Water in oil

Operational areas:

- Chemical industry
- Petrochemical industry
- Pulp & Paper
- Power plants

Technical Data:

Supply voltage:	90 - 260 VAC, 50 - 60 Hz
Power consumption:	maximum 50 VA
Relay capacity:	(48V / 2A) programmable
Analogue output:	0/4 - 20mA isolated / 800Ohm
Display:	Backlit graphic display

Measurement range:	0–10ppm, 0–30000ppm
Reproducibility:	± 1 %
Ambient temperature:	-10°C to 50°C
Enclosure:	1.4301 / IP65 (NEMA 4X)
Dimensions:	440 x 360 x 205 mm / 10 Kg
optional hazardous area:	ATEX Zone I / Zone II

Declaration of Conformity (CE)

EG DECLARATION OF CONFORMITY
EG-KONFORMITÄTSBESCHEINIGUNG

Für das folgend bezeichnete Erzeugnis
For the following named product

Mod. AS3 / AT3

wird hiermit bestätigt, daß es den Schutzanforderungen entspricht, die in der Richtlinie des Rates zur Angleichung der Rechtsvorschriften der Mitgliedsstaaten über die elektromagnetische Verträglichkeit (2004/108/EC & 2006/95/EC) festgelegt sind.

Herewith it is certified, that it corresponds to the protection requirements laid down in the guidelines of the board for equivalence of legal regulations of the member states about the electromagnetic compatibiliy (2004/108/EC & 2006/95/EC).

Zur Beurteilung des Erzeugnisses hinsichtlich elektromagnetischer Verträglichkeit wurden folgende Normen herangezogen:

For the judgement of the product regarding electromagnetic compatibility following standard were consulted:

EN 61010-0
EN 61000-6-2 / 2005
EN 61000-6-4 / 2007

Diese Erklärung wird, verantwortlich für den Hersteller / Importeur
This declaration is given, in reponsibility for the producer / importer

Galvanic Applied Sciences Inc.
41 Wellman Street,
Lowell, MA 01851, USA

abgegeben durch: Herrn E. Sayier
by Mr. E. Sayier
Lowell, Feb. 2007

Word:daten/zeugnisse/ce-certs/as3at3.doc