



Instruction manual

AM-TBR

TURBIDITY SENSOR
With direct 4-20 mA output



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1 GENERAL WARNINGS AND INFORMATION FOR ALL USERS

1.1 WARRANTY

This product is guaranteed for 1 years from the date of purchase for all manufacturing defects.

Please take a look at the terms and conditions described on the warranty certificate at the end of the manual.

1.2 AFTER SALES SERVICE

B&C Electronics offers to all of its customers the following services:

- a free of charge technical assistance over the phone and email for problems regarding installation, calibration and regular maintenance;
- a repairing service for all types of damages, calibration or for a scheduled maintenance.

Please take a look at the technical support data sheet at the end of the manual for more details.

1.3 CE MARKING

This instrument is manufactured according to the following european community directives:

- 2011/65/EU "Restriction of the use of certain hazardous substances in electrical and electronic equipment"

Until 19/04/2016:

- 2004/108/EC "Electromagnetic compatibility" EMC

From 20/04/2016:

- 2014/30/EU "Electromagnetic compatibility" EMC
- EN 61326-1/2013 "Electromagnetic compatibility" EMC
 - Industrial electromagnetic environment
- EN 55011/2009 "Radio-frequency disturbance characteristics"
 - Class A (devices for usage in all establishment other than domestic)
 - Group 1 (Industrial equipment that do not exceed 9kHz)

The  marking is placed on the packaging and on the S/N label of the instrument.

1.4 SAFETY WARNINGS

It is important to underline the fact that electronic instruments are subject to accidental failure. For this, it is important to take all necessary precautions to avoid damages caused by malfunctions.

Any operation must be performed by authorized and trained staff.

The use of this transmitter must comply with the parameters described in chapter "Technical data (page 8)", in order to avoid potential damages and a reduction of its operating life.

1.5 SPECIAL WARNINGS

In order to ensure a reliable operation and to prevent irreversible damage, it is important to avoid all of the following:

- avoid exposure to direct sunlight;
- unscrewing or loosening the cable gland or the probe body.

1.6 MANUAL REVISIONS

This chapter shortly describes the differences between previously released versions of the same manual, so to help users that are already familiar with the product.

Rev. 0: initial release.

2 PRODUCT OVERVIEW

2.1 DEVICE OPTIONS

Standard Features

- NTU or FTU measurement option
- Loop powered (IR version)
- Optional constant pressure flow cell
- Automatic temperature compensation
- Direct 4-20mA output
- Compatible with AM-2300 controller

Light Source

White Light (USEPA180.1) (in-line NTU only)	W
Infrared (ISO 7027 - EN 27027)	R

Mounting Option

In-Line	L
Submersion with autoclean nozzle	S

Measuring Methode and Range

0 - 4 NTU	N4
0 - 40 NTU	N40
0 - 400 NTU	N400
0 - 100 FTU	F100
0 - 1000 FTU	F1000
0 - 10000 FTU	F10000

AM-TBR-R L N400

The submersion option is equipped with a device for automatic cleaning consisting of a conduit and an injector which directs a jet of compressed air on the sensitive part, keeping it clean from incrustation and deposit of organic substances.

2.2 ACCESSORIES

The items listed below are the ones most commonly used and are to be ordered separately.



- | | |
|---------------|--|
| AM-TBR-FC40 | flow cell for in-line mounting, low turbidity |
| AM-TBR-FC-400 | flow cell for in-line mounting, high turbidity |
| AM-ARM-TBR | pipe adapter for submersion installation |
| AM-TBR-TEE | 2" TEE adapter for in-line mounting |

3 INSTRUCTION MANUAL CONTENTS

This chapter describes the manual and gives suggestions to all users on how to read it and use it.

The manual is written according to the following norms:

- UNI 10893 "Instructions for use";
- UNI 10653 "Quality of product technical documentation".

3.1 SYMBOLS

Throughout the manual you may find the following symbols, which are both dictated by a norm or that are simply conventional.



WARNINGS: this symbol is used to warn users that if the instructions are ignored or not correctly followed, damage to the instrument can be caused.



NOTE: *this symbol is to invite the user to pay particular attention to a specific section of the manual.*

3.2 HOW TO READ THE INSTRUCTION MANUAL

The manual contains all the information needed to acquire full knowledge of the product, to ensure a proper installation, proper use and maintenance in order to achieve the desired result at the time of its choice.

The manual is aimed at staff with appropriate knowledge and experience in the field of measurement and control through the use of sensors and transmitters in the context of industrial plants.

The index of the manual refers the reader to the chapters on aspects that want to learn and develop.

In particular, the first chapters show general topics and allow the user to become familiar with the product, with its functional purpose and with the necessary accessories or options for its use.

The user can then check whether he knows all the elements necessary for the use of the instrument and of the measuring/control.

4 SPECIFICATIONS AND TECHNICAL DATA

4.1 FUNCTIONAL SPECIFICATION

Inputs

The probe is able to perform the measurement of turbidity and temperature.

Scale

The instrument allows the selection of three different scales:

4 / 40 / 400 NTU

100 / 1,000 / 10,000 FTU

Check signal

The probe is designed to detect problems that alter the measure (dirt on the optical windows, lack of contact with liquid, too high external light, the measurement uncertainty for the internal converter saturation).

The fault condition is signaled by an alarm on the analog output.

Analog output

The probe operates in current loop 4-20 mA proportional to the value of the principal measure.

The output is galvanically isolated, so to be interfaced directly to a PLC or data acquisition cards.

Power supply

The probe must be powered with a 9 ÷ 15 Vdc (80 mA OUT not connected; 110 mA OUT connected).

4.2 TECHNICAL DATA

4.2.1 GENERAL SPECIFICATIONS

Common specification

Cable	5 x 0.25 mmq, L= 10 m included
Cable sheath	flame retardant PVC CEI 20-22/II
Room temperature	-5 °C ÷ +50 °C
Relative humidity	up to 95 % without condensation
Storage temperature	-5 °C ÷ +50 °C
Protection of the probe	IP68
Material	PVC
Conformity EMC/RFI	EN61326

In-line version

Diameter	39.5 mm
Length	143 mm
Weight	body 160 g, cable 640 g
Pressure	6 bar max

Submersible version

Diameter	60 mm
Length	165 mm
Weight	body 420 g, cable 640 g
Pressure	1 bar max
Thread	2" NPT
Autoclean	Built-in nozzle
Air inlet fitting	1/4" internal, 3/8" external
Air pressure	3 bar MAX

4.2.2 TECHNICAL SPECIFICATIONS

MAIN MEASURING				Default
Measure	Turbidity			
Measuring method	nephelometric USEPA 180.1			
Turbidity scales	4.000 / 40.00 / 400.0 NTU 100.0 / 1,000 / 10,000 FTU			
Scale	Resolution	Under range	Over range	
4.000 NTU	0.001 NTU	- 0.400	4.400	
40.00 NTU	0.01 NTU	- 4.00	44.00	
400.0 NTU	0.1 NTU	- 40.0	440.0	
Measuring cycle	2 s			
<u>Filtrer software</u>				
Response time at 90 % small signal (<3 % fs) 5 ÷ 220 seconds				120 s
Response time at 90 % large signal (>3 % fs) 5 ÷ 220 seconds				40 s
Zero	± on all scales			0 NTU / FTU
Sensitivity	70 ÷ 130 %			100 %
Zero standard solutions	0.000 ÷ 4.000 NTU 0.000 ÷ 100.0 FTU			0.020 NTU 0.0 FTU
Sensitivity standard solutions	0.000 ÷ 400.0 NTU 0.000 ÷ 1000 FTU			400.0 NTU 1000 FTU

SENSOR TYPE	Default
Turbidity sensor composed by:	
• LED	
• Photodiode for turbidity measuring	
• Photodiode for check signal	

ANALOG OUTPUT		Default
Current loop proportional to the measuring	4-20 mA	
Output scale factor	10 ÷ 100 %	100 %
Under / Over range	3.80 mA / 20.80 mA	
Under alarm condition (if activated) of the check signal of:		
• dry cell;		
• fouling;		
• external light too high;		
the analog output will show the following sequence:		
• loop at 3.80 mA for 15 seconds;		
• loop at 21.00 mA for 15 seconds.		
The above sequence is repeated during the alarm conditions.		
The analog output will restore automatically at the end of alarm conditions.		

CHECK SIGNAL		Default
Check signal scale	0.0 ÷ 200.0 %	
Over range	200.0 %	
Sensitivity	50.0 ÷ 200.0 %	100.0 %
Alarm from check signal and external light too high	On / Off	Off
Min alarm (fouling or lamp damaged)	0.0 ÷ 100.0 %	10.0 %
Max alarm (dry cell)	100.0 ÷ 200.0 %	200.0 %

POWER SUPPLY		Default
Voltage	9/15 Vdc	
Current	80 mA (analog output not connected) 110 mA (analog output connected)	

5 INSTALLATION

5.1 PACKING LIST

The instrument package contains:

- N° 1 turbidity probe;
- N° 1 instruction manual.

5.2 UNPACKING AND REPACKING OF THE UNIT

- 1 Remove from the carton box the instruction manual and keep it.
- 2 Remove the probe wrapped in clear plastic guard.
- 3 Remove the plastic cap.

 Handle the probe with care.

If repackaging do the reverse.

5.3 STORAGE AND TRANSPORT

For prolonged storage, keep the product in dry places.

In the case of transportation, pack the product in the carton box.


5.4 INSTALLATION OF AM-TBR

In-line installation:

This probe is designed for use online or in the flow cell AM-FC-TBR40 or AM-FC-TBR400 (refer to the latter's instructions for proper installation).

- Is advisable to use the probe in the flow cell, especially in the case of measurements of turbidity up to 40 NTU.
- - Insert the adapter with the O-ring on the probe;
- - insert the probe into the flow cell.

In applications with high turbidity, the probe can also be installed directly in the flow, preferably in a bypass with stopcocks in order to allow the removal of the probe for maintenance.

 Do not unscrew/remove the cable gland fitting. You can damage the internal circuits.

Warranty will not be applied if sensors are tampered with.

Submersible installation with autoclean:

The probe should be submersed preferably with an inclination that favors cleaning air escaping upwards.

The submersion arm AM-ARM-TBR allows this type of installation.

Before the immersion of the probe it is necessary to make the following:

- find appropriate installation place with mounting brackets
- provide the PVC tubing with suitable length
- insert the flexible tubing in the air connector
- insert the cable and the tubing in the AM-ARM-TBR and screw it on the probe

The pressure air provided by the customer must be a clean air at 3 bar MAX.

The typical cleaning time is 15 seconds and the typical cleaning frequency is 2 times/day, but it is depending on the application and the actual efficiency of the cleaning action.

Higher cleaning frequency could reduce the lifetime of optical lens, especially in the presence of abrasive suspended solids in the sample.

Submersible installation without autoclean:

Before the immersion of the probe it is necessary to make the following:

- install a stopper on the air line connector to avoid the water entering into the room between the adaptor and the probe when the probe is submersed.

Without the stopper the water will damage the cable and it may leak inside the probe.

The probe cable can be submerged but must check the compatibility of its PVC jacket with the same liquid. in any case it is necessary to periodically check that the cable is in good condition.

5.5 ELECTRICAL INSTALLATION

Connect the probe to the meter by following the color of the wires of the cable. The shield of the cable is not connected inside the probe but must be connected to the system ground.

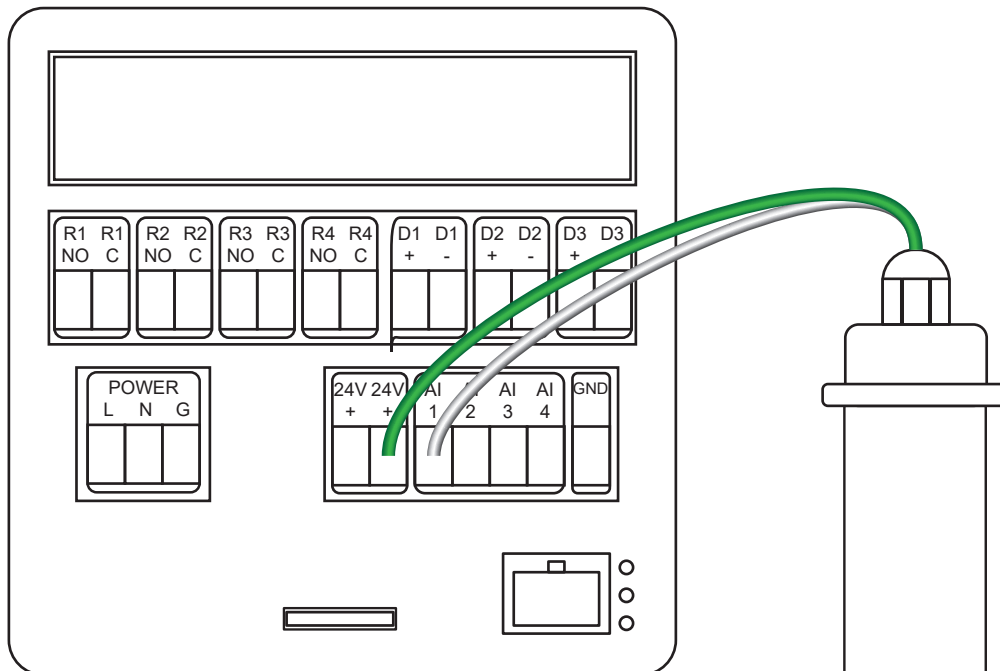
Wire color	White light	IR light
Shield	not connected	not connected
Yellow	RS485 A (+)	RS485 A (+)
Gray	RS485 B (-)	RS485 A (+)
Brown	+ analog output	not connected
Green	+ power supply (min 110 mA)	+ current loop
White	- power supply / - analog output	- current loop

Avoid interruptions of the cable. If needed, use junction boxes with high insulation and the extension cable p/n 2423405 (5x0.25 - D 5.70 mm).

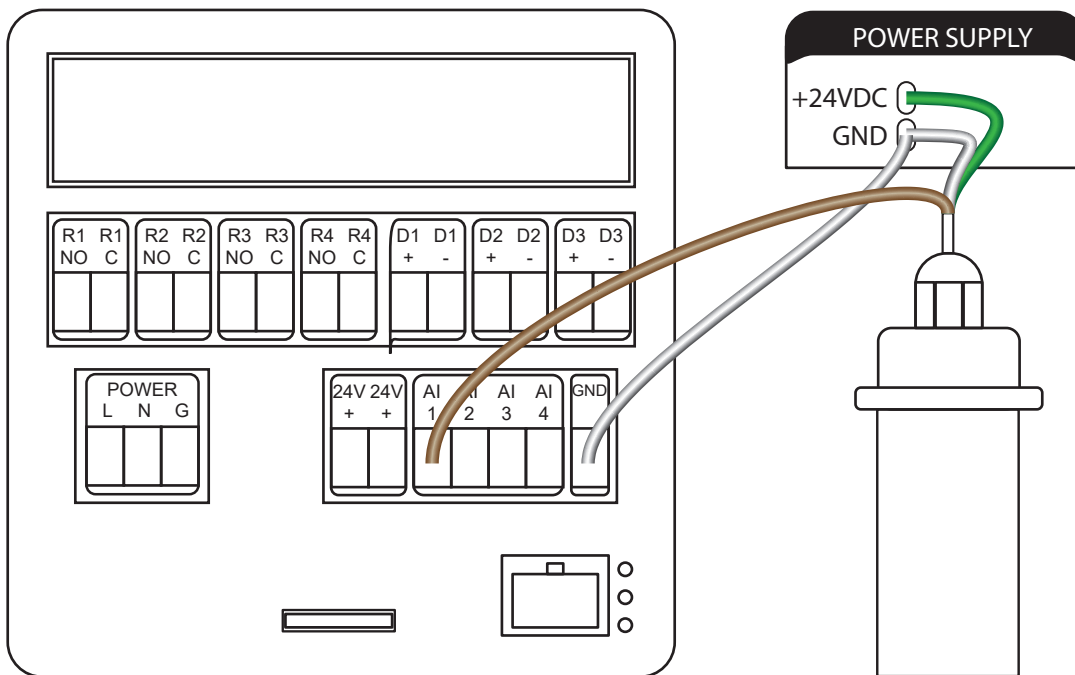
Keep the cable away from the power cables also inside the electrical panel.

5.5.1 CONNECTION TO AM-2300

Connect the IR sensor to the controller as follows:



Connect the white light sensor to the AM-2300 controller:



Calibration

The probe comes calibrated from the factor: 4 mA = zero, 20 mA = max range.

5.6 DISPOSAL

In the case of disposal of the instrument, apply the terms of the law provided for the disposal of electronic devices.

6 OPERATING PROCEDURE

6.1 OPERATING PRINCIPLES

The turbidity measurement is based on light's diffusion made by the suspended particles in the sample. A light beam from a tungsten or IR lamp is sent to the sample through an optical lens.

The 90° (NTU) or back (FTU) scattered light by suspended particle is collected by the probe through a second lens and it is converted in an electric signal proportional to the turbidity of the sample.

The white light probe version uses a lightsource emitted from a tungsten lamp as determined by EPA method.

External light effect

The exposure of the probes to high external light can influence the turbidity measurement.

The circuits of the probe detect the external light that may effect the accuracy of the measuring.

If the effect cannot be automatically compensated, the probe sends an error message and an alarm if the analog operating mode has been selected.

The user must modify the installation in order to protect the lens from the sun or the stray light.

This effect is not present in the in-line model because it is normally installed into the flow cell AM-FC-TBR or in pipe.

6.2 OPERATING MODE

The probe works in analog and digital mode at the same time.

6.3 ANALOG MODE

In analog mode, the probe can be connected to AM-2300 controller or to a PLC.

In both cases it is necessary to power to the probe properly.

After 2 seconds from the switching on, the current loop will provide for 8 seconds a fixed current value depending of the selected scale:

- 8 mA for 4.000 NTU or 100.0 FTU scale;
- 12 mA for 40.00 NTU or 1,000 FTU scale;
- 20 mA for 400.0 NTU or 10,000 FTU scale.

This feature allows the operator to identify the scale of measurement configured.

After this period the output current will be proportional to the turbidity value of the sample.

7 MAINTENANCE

The two optical windows on the lower part of the probe must be inspected and cleaned periodically.

Cleaning is recommended before zero and sensitivity calibration.

Remove any deposits on the optical windows using a soft, damp cloth or a tissue, avoiding pressing on the surface to not to score.

If necessary, use a soft detergent or a very diluted acid if the deposits are of limestone.

The frequency of cleaning depends on the type of use, the nature and concentration of the sample measurement.



During these operations avoid removing the cable gland.

This removal is reserved to the manufacturer and if carried out by the operator it will damage the internal circuits voiding the warranty.

7.1 CALIBRATION

The probe is supplied with a factory calibration of the zero and sensitivity done with known standard solutions.

Checking and periodic calibration of the probe is always necessary to ensure the accuracy of the measure.

The optical components like tungsten lamp and photodiodes can have small drifts during the life.

The cleanliness of the optical lens is an important element to check before making a new calibration. If necessary, clean them with a soft cloth.

Is suggested to run the zero calibration before the sensitivity calibration.

The check signal calibration must be performed with the probe immersed in the liquid without the presence of air bubbles on the surfaces of the optical lens.

Zero calibration

The zero calibration must be performed in the zero standard solution or in water with known turbidity value next to zero.

Sensitivity calibration

It is done in formazine solution or in a known turbidity value solution.

