Controller wms-4/4i II

for the ultrasonic sensors of the wms series

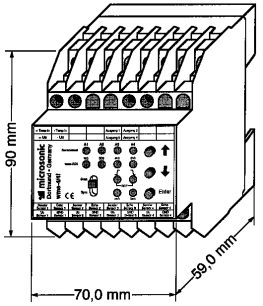

Fig. 1: Dimensions

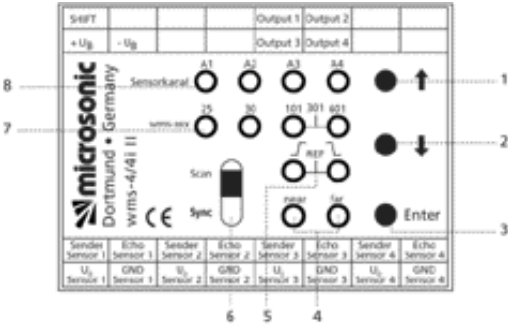

Fig. 2 Controls and LEDs showing sensors connected

Legend ○ LED »OFF« ◔ LED »ON«

1 »UP« button

2 »DOWN« button

3 »ENTER« button

4 Green LEDs »NEAR/FAR«

5 Green LEDs channel characteristic

6 Slider switch »SCAN/SYNC«

7 Green LEDs for type of sensor

8 Yellow LEDs for indicating channel

Contents

1 Description of unit

Please refer to the technical specification for details of the controller and the wms series data sheet for details of the sensors.

- The wms-4/4i II controller is designed for connecting up to four ultrasonic sensors of the wms series.

- The sensors are controlled and signals evaluated centrally in the controller. Therefore, only the robust sensors (all complying with class of protection IP 65) are subjected to the (sometimes) tough conditions of the working environment. The controller (class of protection IP 20), which controls the sensors and evaluates the signals, is accommodated safely in an electrical cabinet.

- The analogue signals are determined by ultrasonic measurement in the controller. The sensor emits a brief sound pulse (see Fig. 3). This pulse propagates in the air and is reflected back from an object as an echo. The wms-4/4i II measures the time taken between emitting the signal and receiving the echo. From this propagation time, the controller determines an analogue signal proportional to the distance (rising: 4...20 mA, or falling: 20...4 mA).

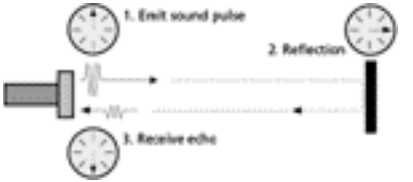

Fig. 3: Ultrasonic measurement

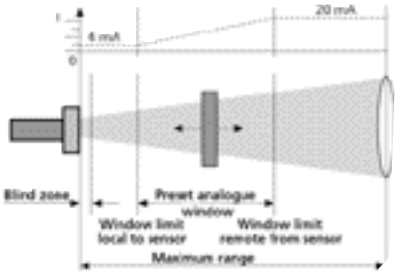

Fig. 4: Analogue signal proportional to distance

- Various wms sensors can be operated by one device.
- The controller can control the wms sensors either simultaneously (synchronous mode) or successively (scan mode or multiplexmode).
  The choice of operating mode (selected by way of a slider switch on the front, see Fig. 2) depends on the application.
- Very precise distances or thicknesses can be measured by combining the controller with the appropriate wms sensors (e.g. wms-25/RT/HV M18, see Fig. 5).
- The controller offers users the option of using one sensor channel for temperature compensation. The sensor connected to this channel measures the distance to a fixed target. The measured values of the other sensors are then compensated by the value of the »reference sensor« (see Fig. 6). Further, the average current value of the other, active channels is output at the reference channel output.
- The analogue windows set for all active sensors can be moved simultaneously and identically via the »SHIFT« input. This option requires the addition of an external circuit consisting of one special switch (see »Optional »SHIFT« mode«) and two resistors.

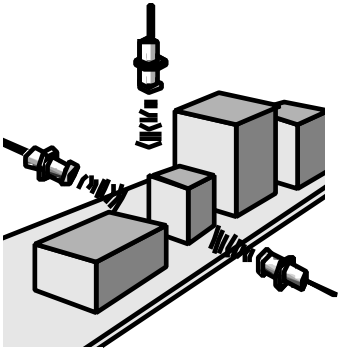

Fig. 5: Possible application: conveyor belt with measurement of width and height

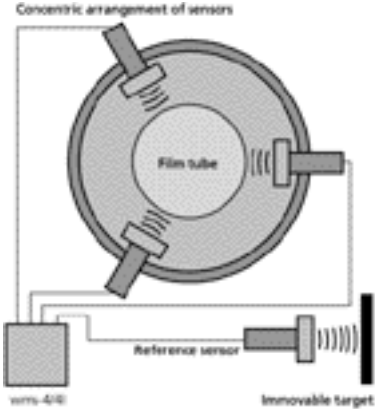

Fig. 6: Possible application: film extruder with reference channel

2 Important advice concerning installation and use

The wms-4/4i II is one component within a control system!
During installation, setting-up or maintenance work, all measures must be taken to ensure safety of personnel and plant (refer to operating instructions for complete plant and instructions of plant operator).

Hazards can arise from substances and materials being processed in the plant!
Take all necessary precautionary measures and wear suitable protective clothing (adhere to directives of employers' liability insurance association as well as instructions of plant operator or plant operating instructions).

The controller is <u>not</u> intended for use with systems serving the safety of persons or security of machines!

The operating instructions make use of the following keywords:

- **Danger** – health hazard or risk of injury
- **Caution** – important information regarding the safe operation of equipment
- **Warning** – risk of severe damage to equipment, machinery or the environment
- **Note** – advice concerning rational operation or special aspects which have to be taken into account

Before you attempt to intervene in the operation of the controller, carry out a risk analysis with regard to the repercussions of:

- failure of controller
- failure of sensors
- failure of temperature compensation set-up
- incorrect control commands (e.g. when programming the controller)

In doing so, take into account not only the immediate risks for personnel and plant but also the effects on the local environment!

Danger!

Ignoring the following instructions can result in a risk of injury to yourself or others or damage to property.

- Only operate the plant when you have sound knowledge of its operation and control. If necessary, ask the operator's specially trained personnel to assist you.
- Switch the plant to a safe condition (e.g. switched off, creep mode). For details, refer to the operating instructions for the complete plant.
- Take all precautions to ensure that this safe condition cannot be changed while work on the system is being carried out (e.g. actuate key-operated switch).

- Take all prescribed industrial safety measures (adhere to directives of employers' liability insurance association as well as instructions of plant operator or plant operating instructions).

3 Installation

The controller is intended to be

- mounted in a protective housing (e.g. distribution cupboard, electrical cabinet), and
- attached to a top-hat rail conforming to DIN EN 50022-35.

Warning!
All installation work must be carried out by a qualified, competent electrician.

Caution!

- The voltage supply for the sensors is provided by the wms-4/4i II controller. Never connect the sensors to any other external voltage supply.
- The connections for sensor voltage supply are protected against reversed polarity but not against short-circuits! A short-circuit can lead to considerable damage to the electronics.
- Ensure that the controller is installed in a well-ventilated position to keep it cool during operation (see »Technical Specification«).
- The operating environment for the controller must be dry and dust-free (class of protection IP 20).
- The sensor cables must not be more than 25 m long.
- All cables longer than 5 m should be shielded.

- Place the controller on the top-hat rail at the desired position and clip it onto the rail using light pressure.
- If required, install sensor and target for reference measurement (e.g. for temperature compensation).
- Attach the sensors to the screw terminals for inputs 1...4 (see Fig. 2). The wms-4/4i II can be operated with 1, 2, 3 or 4 sensors.

The following types of sensors can be operated simultaneously with the controller:

	wms-25/RT/HV/M18	wms-30/RT/HV/M30	wms-101/RT/HV/M30	wms-301/RT/HV/M30	wms-601/RT/HV/M30
wms-25/RT/HV/M18	•	•	•		
wms-30/RT/HV/M30	•	•	•		
wms-101/RT/HV/M30	•	•	•	•	•
wms-301/RT/HV/M30			•	•	•
wms-601/RT/HV/M30			•	•	•

Fig. 7 Sensor selection table

If you are using microsonic connecting cables, note the colour coding of the wires.

Terminal on unit	Colour	Pin-No.
Sender/Sensor	white	2
U_B/Sensor	brown	1
Echo/Sensor	black	4
GND/Sensor	blue	3

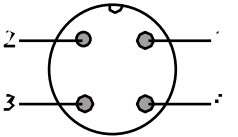

Fig. 8: Colour coding and view of pins on wms-type sensor

☛ If required, connect a »SHIFT« switch to the »SHIFT« screw terminal via the two external resistors according to the following diagram:

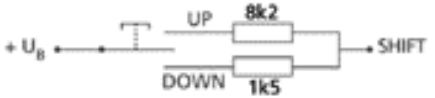

Fig. 9: Connection diagram for »SHIFT« switch

Danger!
The controller starts operating immediately once the voltage supply is switched on. This could result in undesirable control commands leading to hazards for persons and plan.

☛ Switch off the plant or only connect the cables to terminals »Output 1...4« after the controller has been properly programmed (see »Setting-up«).

☛ Lay the cables for controlling the plant as far as the controller.

☛ Connect the controller to the low-voltage supply (20...30 V d.c.) via screw terminals +UB and -UB.

4 Setting-up

All setting-up operations (e.g. initial set-up or after modifications/repairs) must be carried out by suitably trained, competent persons!
The settings of the controller must be checked or the controller fully programmed during every setting-up procedure. The wms-4/4i II is preprogrammed as follows before being dispatched:

- all sensor channels ON
- sensor type wms-101/RT/HV/M30
- sensor local window limit 190 mm
- sensor remote window limit 340 mm
- rising output characteristic
- synchronous mode

Danger!
The controller starts operating immediately once the voltage supply is switched on. This could result in undesirable control commands leading to hazards for persons and plant.

To carry out accurate programming of the device or to check the settings you will need a measuring instrument (e.g. ammeter) for the output currents of the controller's sensor channels.

Observe the foregoing warnings and safety instructions when attaching the measuring instrument!

Note
The connections for the voltage supply to the controller incorporate reverse polarity protection. If the controller or the sensors supplied via the controller do not function correctly, check the polarity of the connections for the controller's voltage supply and the connections of the sensors at the controller.

☞ Switch on the voltage supply to the controller.

The controller and its associated sensors are operating correctly when the green LEDs (Fig. 2, Pos. 7) of the active sensors light up in a cycle and hence indicate normal measuring mode (see »Normal mode«).

☞ Check the settings or reprogramme the controller. To do this, refer to »Programming«.

5 Operation

The wms-4/4i II controller can operate in the following modes:

- normal mode
- indicator mode
- »SHIFT« mode

5.1 Normal mode

- **Indication of measuring activity**
  All active sensor channels indicate measuring activity by way of a flashing green LED (Fig. 2, Pos. 7).

- **Function of channel LEDs**
  If there is an object within the detect range of a sensor, then the sensor's associated yellow LED (Fig. 2, Pos. 8) lights up.

■ **Selecting the operating mode**
The controller may be switched between two operating modes **at any time**. To do this, switch the »SCAN/SYNC« slider switch (Fig. 2, Pos. 6) accordingly.

☞ »SYNC«: switches the unit into the synchronous mode. All sensors are controlled and evaluated simultaneously.

☞ »SCAN«: all sensors are controlled and evaluated in succession. This mode allows, for example, opposing sensors to be operated. Please note that the measurement repeat rate of each individual sensor is lower than for sync mode.

5.2 Indicator mode

The unit's settings can be indicated at any time in normal mode. The normal operation of the controller does **not** have to be interrupted.

☞ Briefly press the »UP« or »DOWN« button (Fig. 2, Pos. 1 or 2).

This selects the indicator mode. The following information is provided for one channel (see Fig. 10):
- number of channel indicated
- channel characteristic
- type of sensor

Sensor channel (yellow LEDs, Fig. 2, Pos. 8)

○	●	○	○

Type of sensor (green LEDs, Fig. 2, Pos. 7)

●	○	○	○	wms-25/RT/HV/M18
○	●	○	○	wms-30/RT/HV/M30
○	○	●	○	wms-101/RT/HV/M30
○	○	●	●	wms-301/RT/HV/M30
○	○	○	●	wms-601/RT/HV/M30

Characteristic of sensor channel
(green LEDs, Fig. 2, Pos. 5)

●	○	rising 4...20 mA
○	●	falling 20...4 mA
●	●	reference channel

Fig. 10 LEDs on controller

- Briefly press the »DOWN« button to switch to the next sensor channel or the »UP« button to switch to the previous one.

- Briefly pressing both buttons simultaneously switches the controller back to normal mode.

The unit automatically returns to the normal mode 20 s after the last button is pressed.

5.3 Optional »SHIFT« mode

This operating mode allows the window limits for the output of analogue values to be modified.

Consequently, »SHIFT« mode is suitable for the fine calibration of sensors and control, e.g. during a plant test run.

This operating mode is an optional feature. To enable this function, a special switch must be installed (see »Installation«). This switch has three positions:

- »UP«
- »OFF«
- »DOWN«

All window limits for the output of analogue values are moved in the same direction (»UP« or »DOWN«).

- You can make small changes by briefly moving the switch to »UP« or »DOWN« or larger changes by holding the switch in one of these positions.
- The preset window size remains constant.
- The windows can be moved until they reach the preset limits of the sensors.
- The speed at which the windows are moved depends on which mode – »SCAN« or »SYNC« – has been set (»SCAN« = slower shift than »SYNC«).

Danger!
The operation of the controller is **not** interrupted during »SHIFT« mode! All changes take effect immediately. This could result in undesirable control commands leading to hazards for persons and plant.

☞ Move the »SHIFT« switch into the »UP« or »DOWN« position (briefly and then releasing it or by holding it in position).

The preprogrammed windows for the output of analogue values are changed for all active sensors.
- »UP« = moving away from sensor
- »DOWN« = moving towards sensor

The direction of the movement is indicated by the flashing green LEDs »NEAR« (= down) or »FAR« (= up) on the front of the controller.

At the same time, the channel indicator LED flashes for the channel which is being adjusted.

☞ Release the »SHIFT« switch.

The new values for the window limits local to and remote from the sensor are stored in the EEPROM. The controller returns to the normal mode.

6 Programming

The programming feature enables settings to be made so that the controller's program can be adjusted to the actual measuring and control requirements of the application.

The following settings are possible:
- (complete) programming
- changes to programmed settings
- copying of settings
- activation/deactivation of channels

Programming (e.g. initial set-up or after modifications/repairs) must be carried out by suitably trained, competent persons!

Danger!
The operation of the controller is **not** interrupted during programming! All changes take effect immediately. This could result in undesirable control commands leading to hazards for persons and plant.

Warning!
If the plant cannot be shut down completely, then the connection between plant control and wms controller may only be interrupted when no undesirable control commands would result from such an interruption.

☞ Take all necessary measures to ensure safety of persons and plant (see »Important advice concerning installation and use«).

The exact settings of the analogue windows (position and size) can be made and checked with an ammeter.
Observe the foregoing warning and safety instructions when attaching the measuring instrument!

The following points apply to the procedure:

- Individual programming steps may be skipped. Briefly press the »ENTER« button. This switches to the next step and existing settings are not altered.
- An incorrect entry can be corrected by waiting 20 s. Provided no button is pressed during the 20 s, no changes are stored and the unit automatically returns to normal mode.
- Settings and changes are only accepted when
  – the programming procedure has been completed or
  – the copying of settings has been completed.

Note the various functions of the »ENTER« button:

- In normal mode, press »ENTER« for approx. 3 s in order to initiate the channel selection (one yellow channel LED flashes).
- Briefly press »ENTER« in order to confirm a selection/setting and to switch to the next programming step.
- Press »ENTER« for approx. 5 s in order to copy settings to the other active channels (see »Copying settings«).

Note

If you wish to use one sensor channel for temperature compensation, you must first set up this channel as a reference channel before programming the other sensor channels.

6.1 Setting up the reference channel (option)

■ Initiating the programming

☛ Press the »ENTER« button until one of the yellow channel LEDs (Fig. 2, Pos. 8) flashes (after approx. 3 s).

☛ Release the »ENTER« button.

■ Selecting the reference channel

☛ Select the reference channel using the »UP« or »DOWN« button.

The yellow channel LEDs (Fig. 2, Pos. 8) indicate the channel selected.

☛ Briefly press the »ENTER« button.

■ Entering the type of sensor

☛ Select the type of sensor connected to the reference channel by pressing the »UP« or »DOWN« button.

The green LEDs (Fig. 2, Pos. 7) indicate the type of sensor. (If all LEDs flash, then this shows that the sensor channel has been deactivated.)

☛ Briefly press the »ENTER« button.

■ Selecting the channel characteristic »REF«

☛ Select the channel characteristic »REF« by pressing the »UP« or »DOWN« button.

Both channel characteristic LEDs = »REF« (Fig. 2, Pos. 5) must flash.

■ Setting up the reference channel

☛ Briefly press the »ENTER« button.

The wms-4/4i II **now** stores the current distance to the reference target. The arithmetic mean current value of all the other active channels is output at the analogue output of the reference channel. (In the case of thickness gauging with two sensors plus one reference sensor, the value of the current at the

reference channel now corresponds directly to the measured thickness.) The settings for the reference channel are copied into the EEPROM of the controller and stored permanently.

The controller immediately returns to normal mode. You should now set the other sensor channels.

Note

If there is no valid echo time present in the analogue window set for the reference channel, the programming procedure stops at this point

- until a valid measurement is available;
- until no button is pressed within 20 s.

If another channel was previously the reference channel, then this now becomes a »normal» channel. Its settings – type of sensor, channel output characteristic, position and size of analogue window – remain unchanged.

6.2 Programming a channel of the controller

The programming is carried out separately for each channel of the controller. The window sizes can be set manually or copied at the press of a button (»teach-in«).

Note

- The minimum width of window is 50 mm. If this width is reached, then the other window limit is moved 50 mm ahead of the limit to be adjusted until the maximum range or the blind zone of the sensor is encountered (see Fig. 4).
- If there is no target within the beam spread during teach-in, then the local sensor limit is set 50 mm short of the maximum range or the remote sensor limit is set to the maximum range.

	Largest window limit remote from sensor	Smallest window limit close to sensor
wms-25/RT/HV/M18	35 mm	350 mm
wms-30/RT/HV/M30	65 mm	600 mm
wms-101/RT/HV/M30	200 mm	1.300 mm
wms-301/RT/HV/M30	350 mm	3.500 mm
wms-601/RT/HV/M30	800 mm	7.000 mm

Abb. 11: Variable window limits

■ **Initiating the programming**

☛ Press the »ENTER« button until one of the yellow channel LEDs (Fig. 2, Pos. 8) flashes (after approx. 3 s).

☛ Release the »ENTER« button.

■ **Selecting a channel**

☛ Select the channel to be programmed by pressing the »UP« or »DOWN« button.

The yellow channel LEDs (Fig. 2, Pos. 8) indicate the channel selected.

☛ Briefly press the »ENTER« button.

■ **Entering the type of sensor**

☛ Select the type of sensor connected to the channel input by pressing the »UP« or »DOWN« button.

The green LEDs (Fig. 2, Pos. 7) indicate the type of sensor selected. (If all LEDs flash, then this shows that the sensor channel has been deactivated.)

☛ Briefly press the »ENTER« button.

■ **Selecting the channel characteristic**

☛ Select the channel characteristic by pressing the »UP or »DOWN« button.

The green channel characteristic LEDs (Fig. 2, Pos. 5) indicate the chosen characteristic:

- »rising« (4...20 mA) or
- »falling« (20...4 mA)

☛ Briefly press the »ENTER« button.

■ Setting the local window limit

The green LED »NEAR« flashes (Fig. 2, Pos. 4).

☛ Move the object to be scanned or a temporary target to the position at which the local limit of the analogue window is to be set.

☛ Press the »UP« and »DOWN« buttons simultaneously.

The controller accepts the current distance to the target as the local window limit (»teach-in«).

Or adjust it manually:

☛ Press the »UP« or »DOWN« button.

The local limit is moved away from the sensor with the »UP« button, towards it with the »DOWN« button. Check the setting with an ammeter if necessary.

Note
You can adjust the limit step by step (press briefly) or continuously (hold down).

☛ Briefly press the »ENTER« button.

■ **Setting the remote window limit**

The green LED »FAR» flashes (Fig. 2, Pos. 4).

☛ Move the object to be scanned or a temporary target to the position at which the remote limit of the analogue window is to be set.

☛ Press the »UP« and »DOWN« buttons simultaneously.

The controller accepts the current distance to the target as the remote window limit (»teach-in«).
Or adjust it manually:

☛ Press the »UP« or »DOWN« button.

The remote limit is moved away from the sensor with the »UP« button, towards it with the »DOWN« button. Check the setting with an ammeter if necessary.

Note
You can adjust the limit step by step (press briefly) or continuously (hold down).

☛ Briefly press the »ENTER« button.

Only now are all the settings copied into the EEPROM of the controller and stored permanently. The controller returns to normal mode.

If necessary, set further sensor channels. To do this, return to »Initiating the programming«.

6.3 Copying settings

This program function of the controller eases the task of programming several channels of the controller.

All the settings are copied to the other channels of the controller.

A number of points must be taken into account:

- The copying of settings is **only possible when** the active sensors are all of the same type.
- No settings can be copied **from** a (temperature) reference sensor **to** other sensors.
- Only the setting »Output characteristic rising/falling« can be copied to a reference sensor.

Warning!
The changed settings are copied into the EEPROM without any further acknowledgement!

☛ Press the »ENTER« button until one of the yellow channel LEDs (Fig. 2, Pos. 8) flashes (after approx. 3 s).

☛ Release the »ENTER« button.

☛ Briefly press the »UP« or »DOWN« button until the channel is shown from which you wish to copy settings.

☛ Press the »ENTER« button for approx. 5 s.
The controller copies all settings from this sensor channel to all other active sensor channels and then returns immediately to normal mode.

☛ Release the »ENTER« button.

6.4 Activating/Deactivating a channel

The activation and deactivation of channels are among the programming functions of the controller.

☛ Press the »ENTER« button until one of the yellow channel LEDs (Fig. 2, Pos. 8) flashes (after approx. 3 s).

☛ Release the »ENTER« button.

☛ Briefly press the »UP« or »DOWN« button until the channel you wish to activate or deactivate is shown.

☛ Briefly press the »ENTER« button.

The green LEDs (Fig. 2, Pos. 7) indicate the type of sensor.

☛ Briefly press the »UP« or »DOWN« button until the type of sensor connected is shown (activation)
or
all sensor type LEDs flash (deactivation).

☛ Briefly press the »ENTER« button four times.

The change is copied to the EEPROM. The controller automatically returns to normal mode.

7 Technische Daten

Operating voltage U_B	20 bis 30 V d.c., reverse polarity protection, 10% voltage ribble
No-load current consumption	50 mA (without sensors)
Type of connection	23 srew terminals (wire cross-section max. 1,5 mm²)
Outputs	4 x current outputs 4...20 mA
Controls	3 button & 1 slider
Indicators	4 yellow LED´s (sensor chanel)
	8 green LED´s (programming)
Sensors wich may be	wms-25/RT/HV/M18, wms-30/RT/HV/M30
connected	wms-101/RT/HV/M30, wms-301/RT/HV/M30
	wms-601/RT/HV/M30
Sensor connections	up to 4 sensors with 4 wires (U_0,GND, 2 x signal lines)
Method of measurement	Echo propagation time
Resolution	0,36 mm
Reproducibility	± 1 mm in scan mode, ± 3 mm in synchronous mode

Temperature drift	0,17 %/°C without temperature compensation	
Temparature compensation	by way of ultrasonic reference measurement	
Measurement recording	Synchronous of scan (multiplex) oparation selected via	
	slider swith	
Responce time	85 to 220 ms, depends on sensortype	
Housing	Plastic housing, suitable for top-hat rail mounting	
	(DIN EN 50022-35)	
Operating temperature	– 20 °C ... + 70 °C, non-condensing	
Storage temperature	– 40 °C ... + 85 °C	
Class of protection	IP 20	
Weight	210g	
EMC-resistance	IEC 61000-4-2	Electrostatic dischage 4 kV/8 kV
	IEC 61000-4-3	HF interference 10V/m
	IEC 61000-4-4	Fast transient 2 kV
	IEC 61000-4-2	HF interference 10 V (3 V)
	EN 55011	irradiated interference

microsonic GmbH
Hauert 16
D-44227 Dortmund

Telefon: +49 (0) 231/975151-0
Telefax: +49 (0) 231/975151-51
E-Mail: info@microsonic.de
Internet: www.microsonic.de

MV-DO-817 Rev.0