

EMC Technologies Report Number: M060937_Cert_MWS_ST_SR

APPENDIX G

USER MANUAL



MICROWAVE LEVEL SWITCH OPERATION MANUAL

MWS-ST/SR-2 DELUXE SERIES

DELUXE MODEL

MWS-ST-2 [TRANSMITTER]

MWS-SR-2 [TRANSCIEVER]

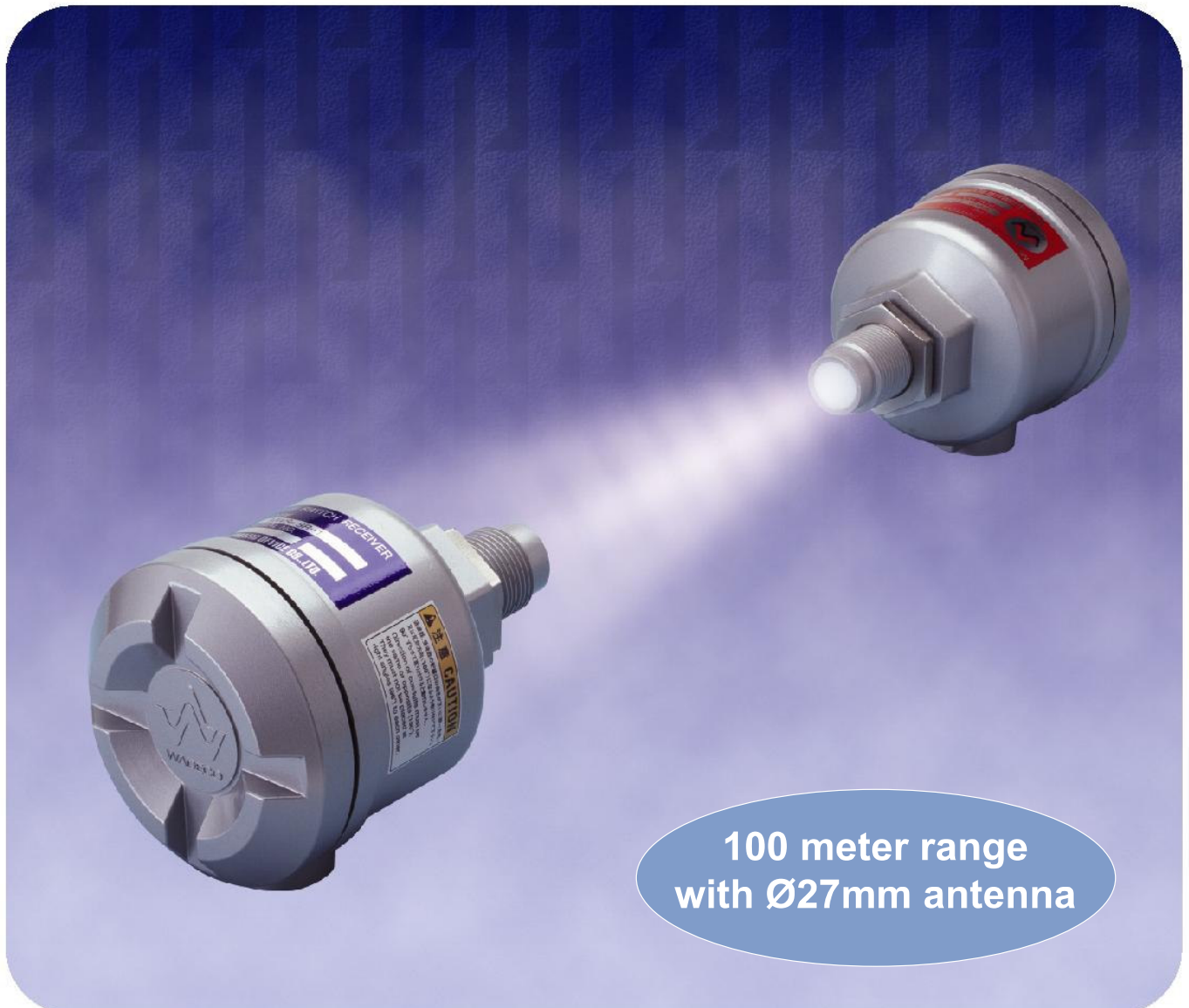


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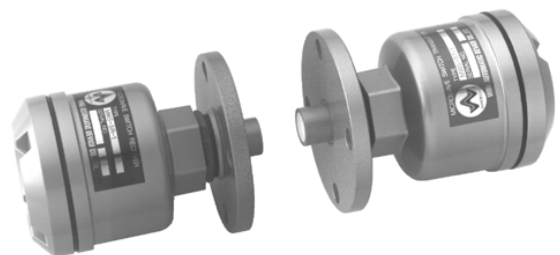
FCC Modification Warning

Any changes or modifications not expressively approved by WADECO LTD. could void the user's authority to operate this equipment.

NOTE:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna,
- Increase the separation between the equipment and receiver,
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected,
- Consult the dealer or an experienced radio/TV technician for help.



OPERATION PRINCIPAL

General

The MWS-ST/SR type microwave sensor is a level switch consisting of a transmitter (MWS-ST-2) and a transceiver (MWS-SR-2) installed face-to-face.

The transmitter emits a continuous, low power microwave beam towards the transceiver and an output relay is released when the beam is obstructed.

The sensor has wide application across all areas of industry where highly reliable, non-contact level detection is required. The sensor is generally used for process control by monitoring presence/absence of product, flow/no flow conditions and point level detection in bins and silos. The sensor may also be used as a proximity switch for detection of vehicles such as dump trucks and rail cars.

Penetrability of Microwaves

Harsh environments may result in a buildup of contaminants on the sensing head; however, the sensor is easily able to penetrate such buildup thanks to the high penetrability of microwaves.

When microwaves transmitted through air encounter an object, some will be reflected, some absorbed and the rest will pass through the object. The amount of microwaves passing through the object depends on its composition.

Generally speaking, microwaves cannot penetrate metals and are reflected; water absorbs the most microwaves.

Microwaves can easily pass through plastics, glass, ceramic, paper etc.

Safety of Microwaves

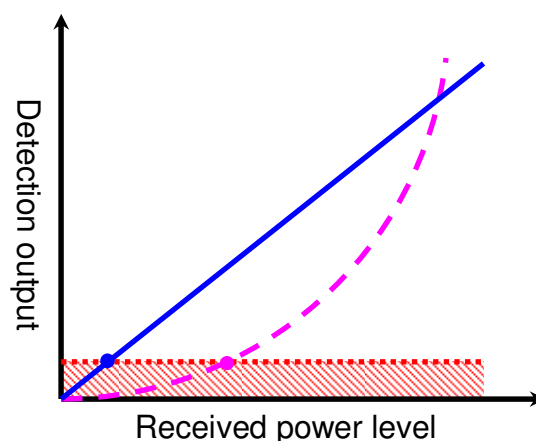
The sensor's output is regulated to assure compliance with FCC Rule 15, covering field disturbance devices.

With low output power, the sensor's power is well below the American OSHA exposure specifications as stated in Section 1910.97.

There are no health hazards to personnel operating WADECO sensors: no license, approval or caution sign posting is required.

Heterodyne vs. Diode Detection

The MWS-ST/SR level switch is the first of its kind to utilize the heterodyne detection method rather than the, now obsolete, diode detection method.



— **Heterodyne method (WADECO)**

- - - Diode method (commonly used)

..... Noise level

• Minimum received power: -70dBm

• Minimum received power: -50dBm

The heterodyne detection method gives detection output that is proportional to the received power level, whereas the diode detection method gives detection output that is proportional to the square of the received power level.

Therefore the heterodyne method allows detection with a minimum received power that is lower than that of the minimum level required by the diode detection method. This greatly increases the operating range/penetrability without any increase in the power of the transmitted microwave radiation.



FEATURES

100m Range with heterodyne detection

Approx. 100m range with a Ø27mm antenna, thanks to the Heterodyne detection method.

High penetration

Easily penetrates process buildup on antenna, firebrick, refractory etc., thanks to the increased operating range.

Unaffected by adverse environments

The sensor is unaffected by surface contaminants, flames, steam, vapor or airborne particles.

Simple beam alignment

Easy initial beam alignment at installation, thanks to the wide beam angle.

Selectable detection mode

Either broken beam (BLOCK) or unbroken beam (UNBLOCK) detection method may be selected.

On delay time rheostat

On delay time, adjustable 0.1~10secs., prevents instantaneous detection of falling material whist filling.

15 LED indicator bank

A 15 LED indicator array displays the received power level and the sensitivity-set-point, allowing for visual sensitivity adjustment and maintenance.

No set-to-set interference

Four channels are available (CH1~4), selectable by rotary switch, eliminating set-to-set interference. The sensor can also operate in regular single channel mode by selecting CH0.

Analog output (optional)

The received power level may be output as a 4 ~ 20mA analog signal.

Inspection window (optional)

The received power level and the sensitivity-set-point are easily seen, without removing the controller cover.



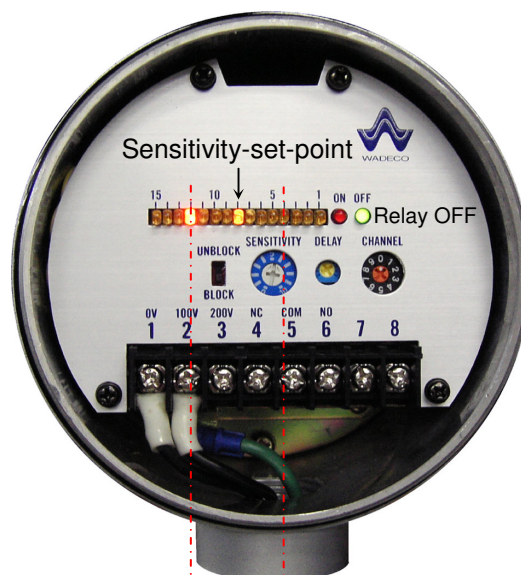
Transmitter

Transceiver



TRANSCIVER CONTROLS

Beam unobstructed



Received power levels

Beam obstructed



SPECIFICATIONS

Type

Transmitter : MWS-ST-2
Transceiver: MWS-SR-2

Power supply

AC100~120V $\pm 10\%$ 50/60Hz &
AC200~240V $\pm 10\%$ 50/60Hz
NOTE: Phase of power supply must be the same for both transmitter and transceiver.

Operating distance

<80 meters
Note: Operating distance may vary from sensor to sensor and according to installation.

Frequency & transmission power

Approx. 24GHz, less than 10mW
Note: Complies with FCC Title Rule 15 and OSHA exposure specification stated in Section 1910.97. Caution sign posting not required.

Number of channels

Single Channel Mode (CH0): 1
Multi Channel Mode (CH1~4): 4
Note: May operate in single channel mode by selecting CH0; doing so will disable the multi channel function.

Received power level

Indicated by 1 of 15 LED indicators
Note: Indicator is fully illuminated

Sensitivity-set-point

Indicated by 1 of 15 LED indicators
Note: Indicator is half illuminated

Radiation angle

Approx. $\pm 20^\circ$ (angle in half of receiving value)

Output contact (on receiver)

1C relay contacts AC250V, 3A (COS ϕ =1)

Response time

25msec (when in multi channel mode)
10msec (when in single channel mode)

On delay function

0.1 ~ 10sec

Condition of output function

Output occurs on change of state, but only after any delay period has past. Output relay is unexcited during output state.

Delay time from power on to function

Transmitter : Approx. 50msec.
Receiver : Approx. 5sec

Power consumption

Transmitter : 2VA
Receiver : 2VA

Noise tolerance

Square wave noise from noise simulator (Rising time: 1 nanosecond, Width: 1 microsecond), $\pm 1.5\text{KV}$ (normal and common modes), with the frequency of the power supply in the $0^\circ \sim 360^\circ$ phase.

Operating ambient temperature

$-10^\circ\text{C} \sim +55^\circ\text{C}$
Note: Optional hardware is available for high temperature applications up to 600°C .

Non-function ambient temperature

$-20^\circ\text{C} \sim +70^\circ\text{C}$

Continuous maximum pressure

0.5MPa
Note: Optional hardware is available for high pressure applications.

Enclosure rating

IP65 Equivalent

Enclosure construction

Diecast aluminum

Color

Metallic silver grey

Weight

Transmitter : 1kg
Receiver : 1kg

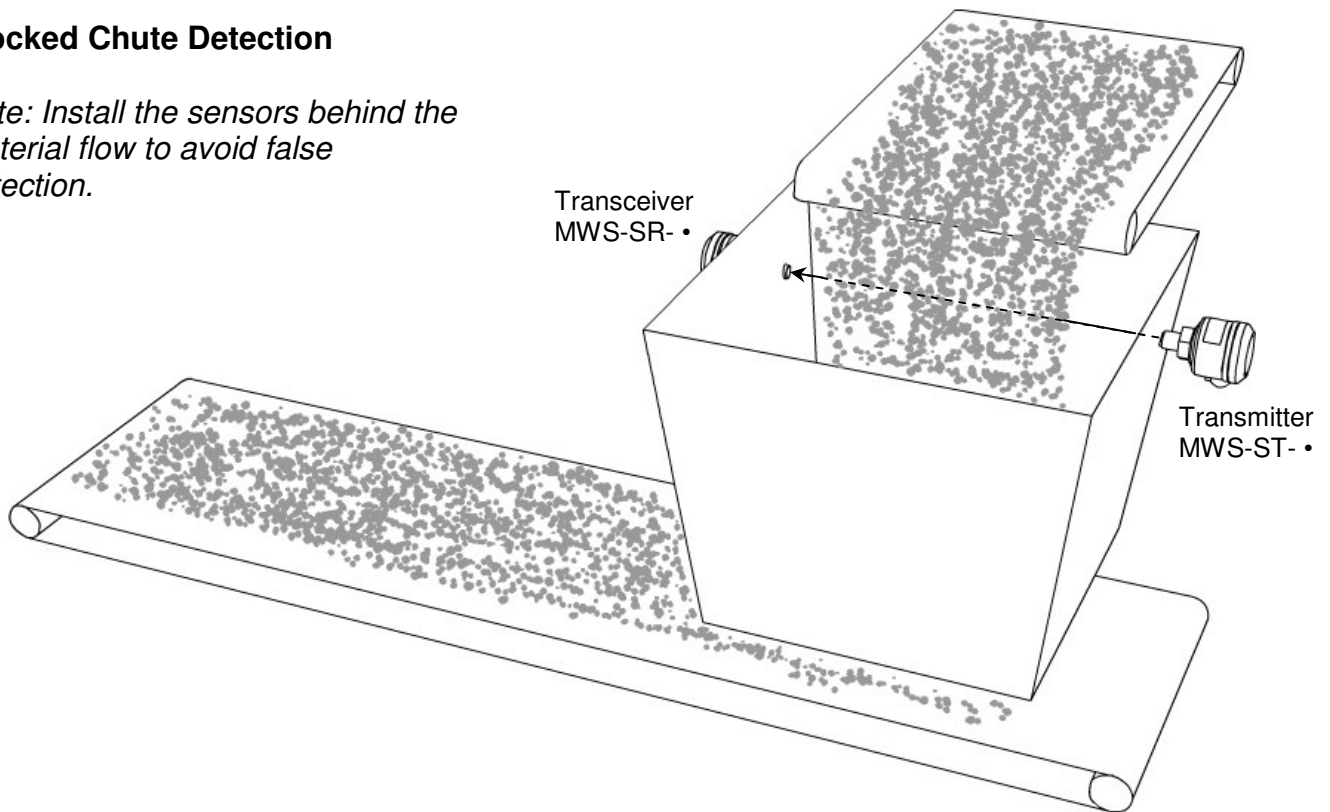


APPLICATIONS

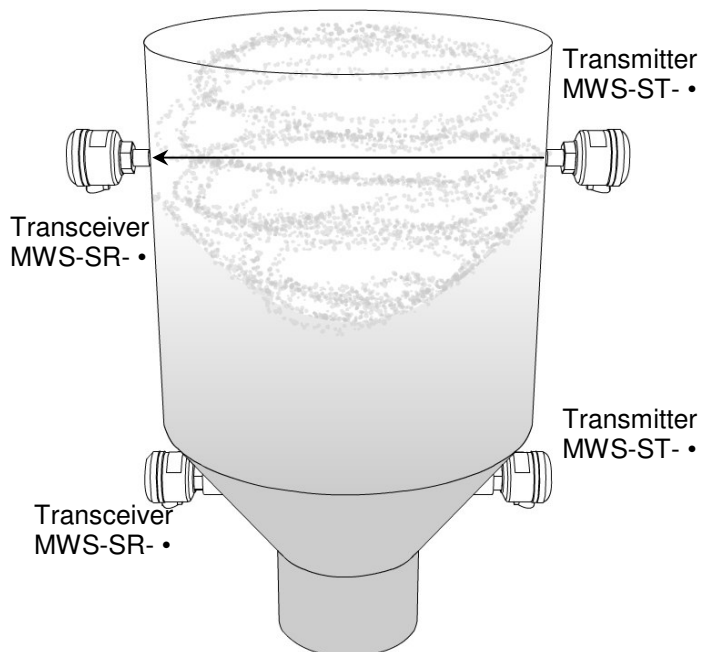
Standard Applications

Blocked Chute Detection

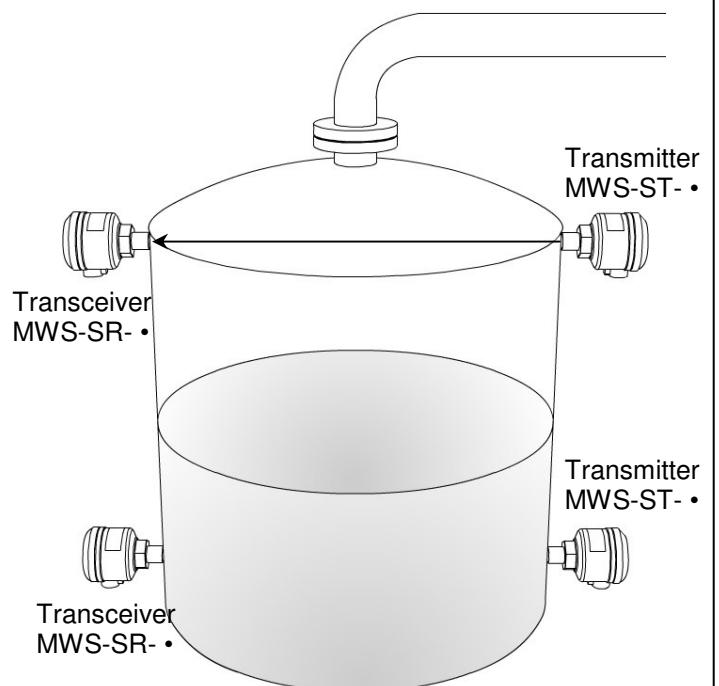
Note: Install the sensors behind the material flow to avoid false detection.



Hi/low level of solids in cyclone bins, hoppers, silos etc.



Hi/low level of liquids in tanks, and other storage vessels.

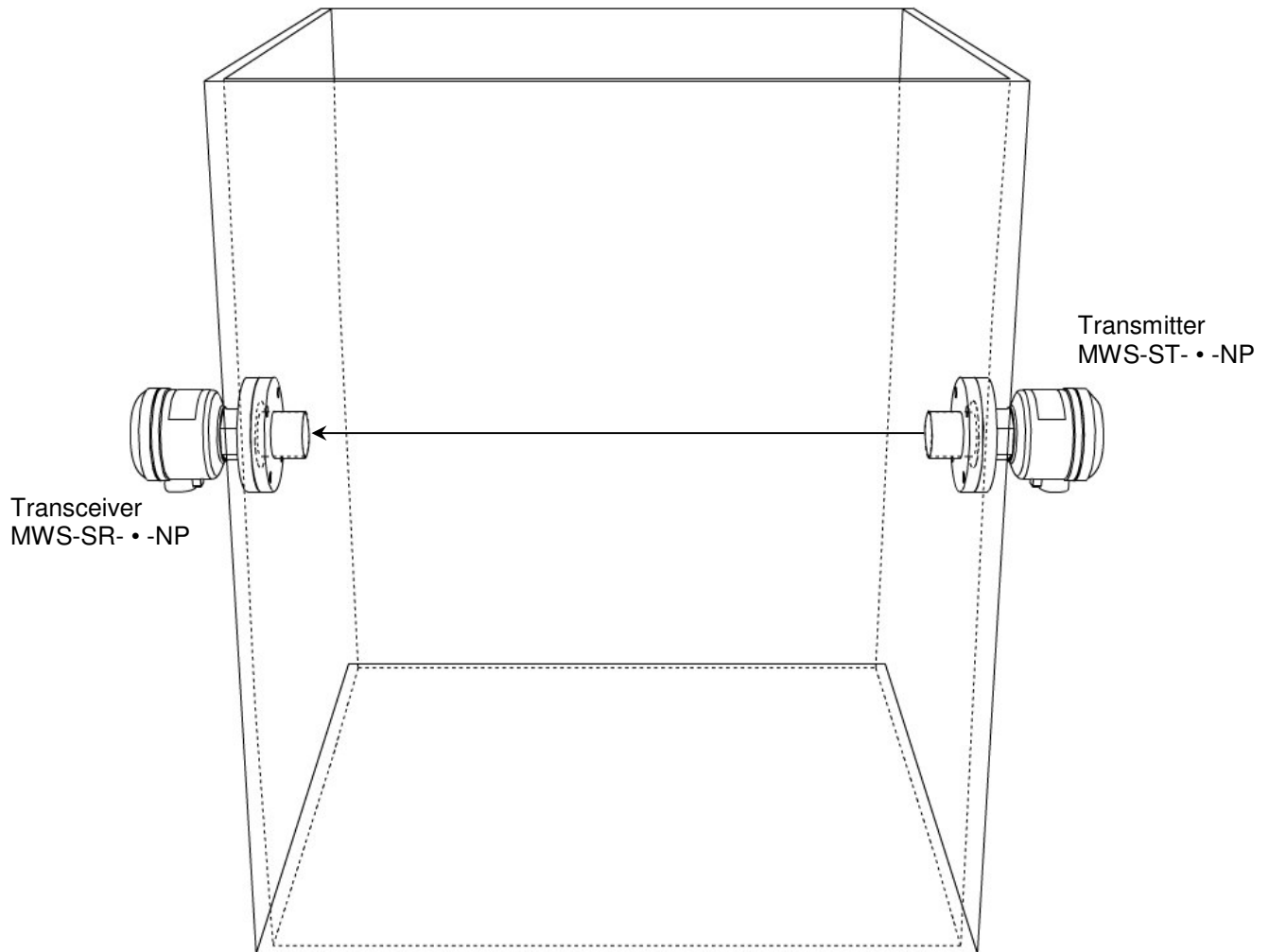


High Pressure Applications

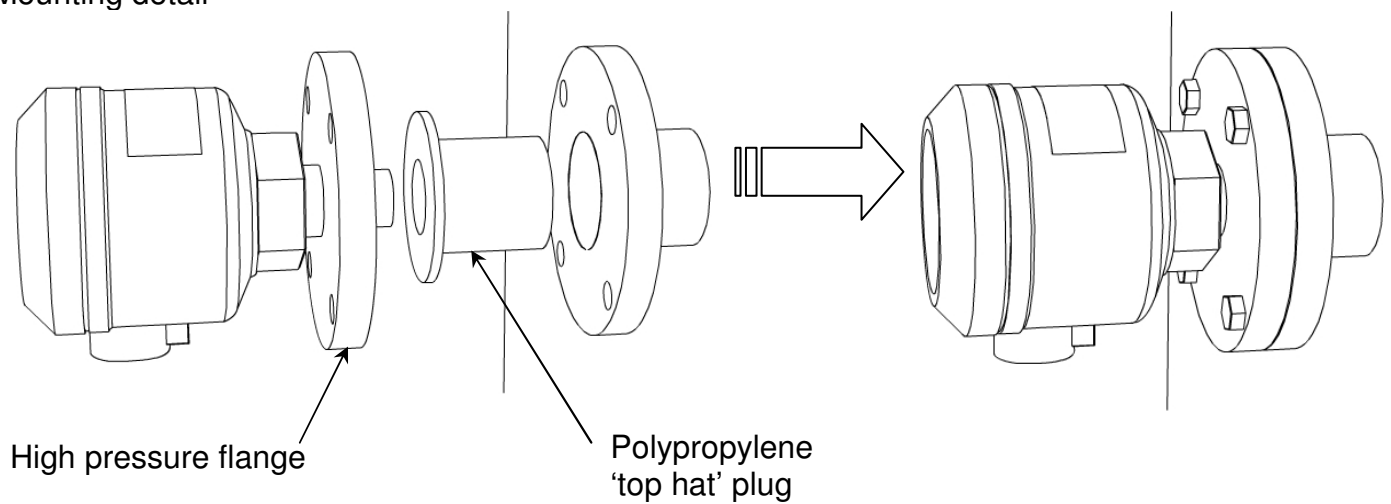
NP Type

Polypropylene plug with flange mounting.

Note: See HARDWARE OPTIONS for more details.



Mounting detail



High Vibration & Hazardous Applications

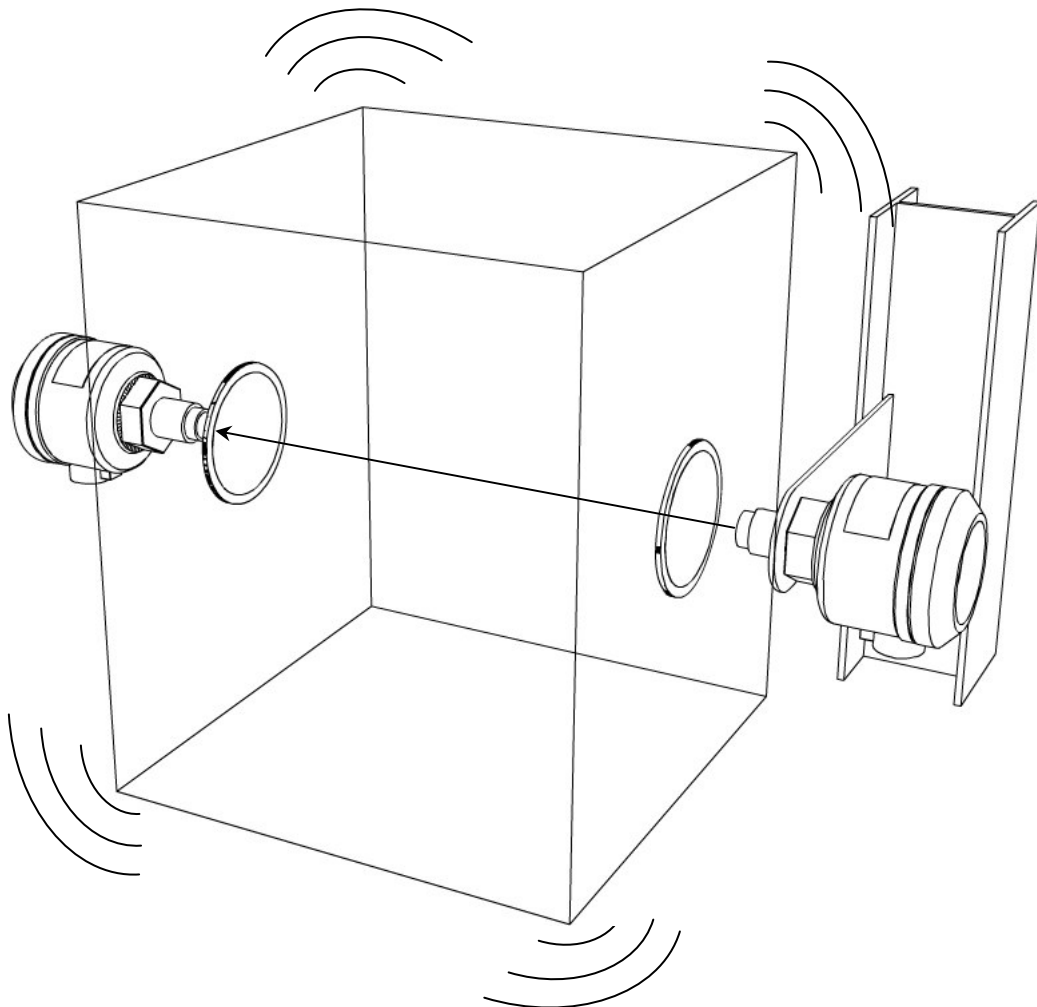
Isolated, Non-invasive Mounting

Sensors may be protected from high temperatures, hazardous materials, vibration and shock by providing detecting windows through which the microwaves can pass.

Detecting windows should be made of ceramic, glass, Teflon or polypropylene materials having no water content, through which there is minimal loss of microwave energy.

The detecting windows should be at least 60mm in diameter as microwaves pass more easily through larger apertures. The distance between the window and the antenna should be less than 200mm.

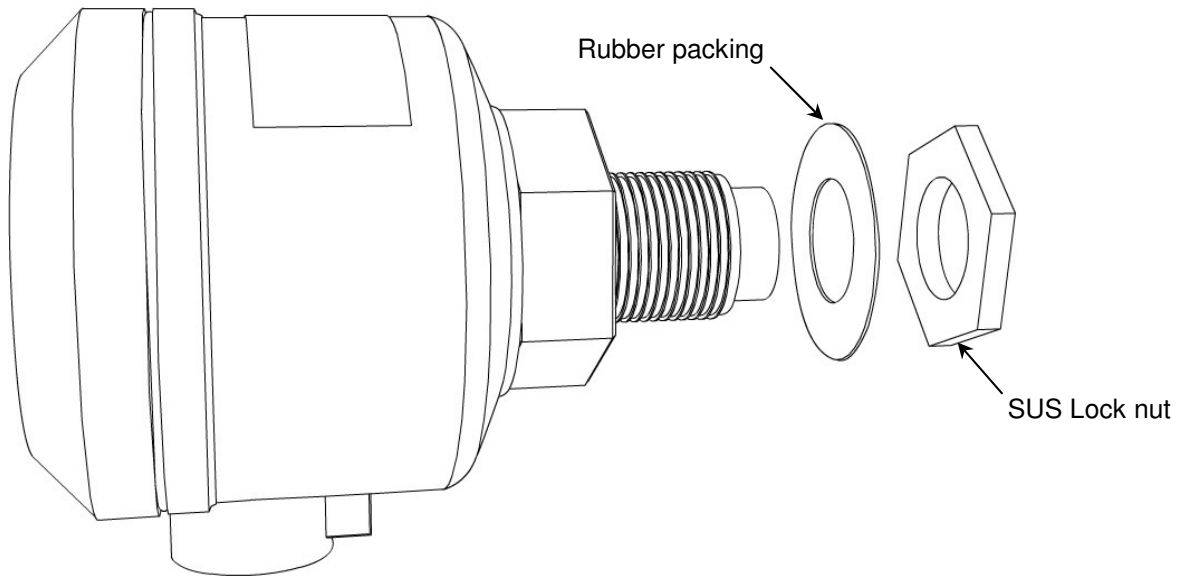
The sensors should be fixed to an isolated support structure to protect against high vibration.



HARDWARE OPTIONS

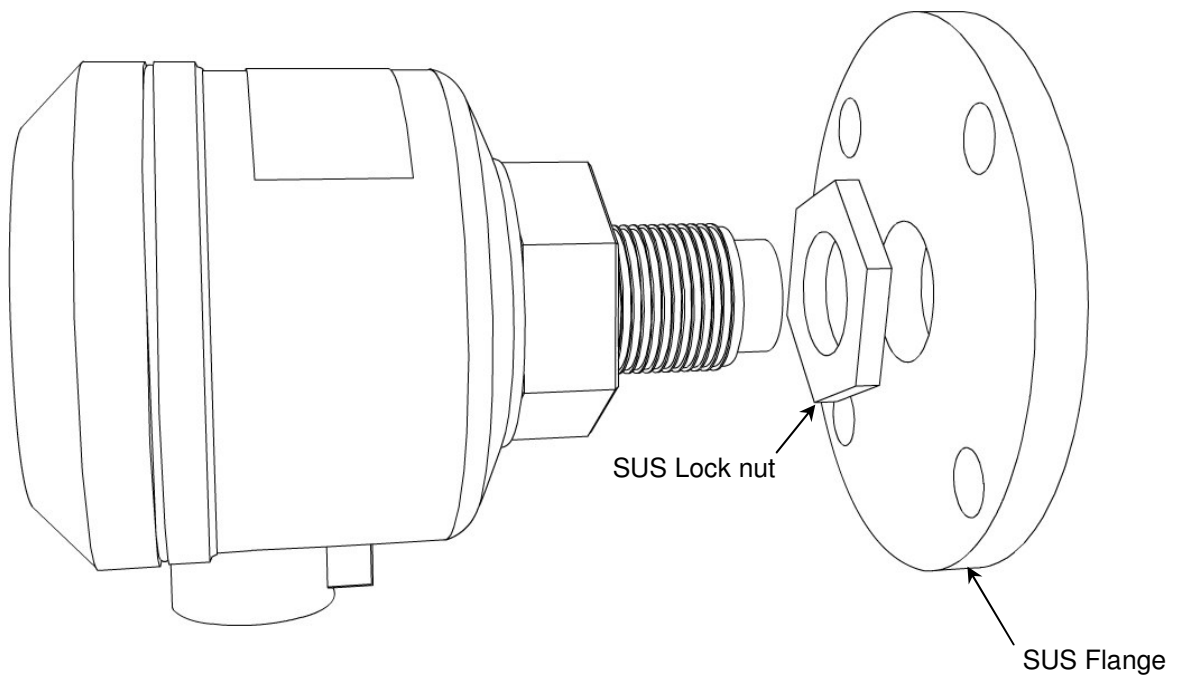
Standard: Diecast Aluminum Antenna Head with Teflon Antenna cover

The standard enclosure is suitable for most applications that do not exceed the general specifications (temperature, pressure, vibration etc).



Standard (as above) with Optional Flange Mounting

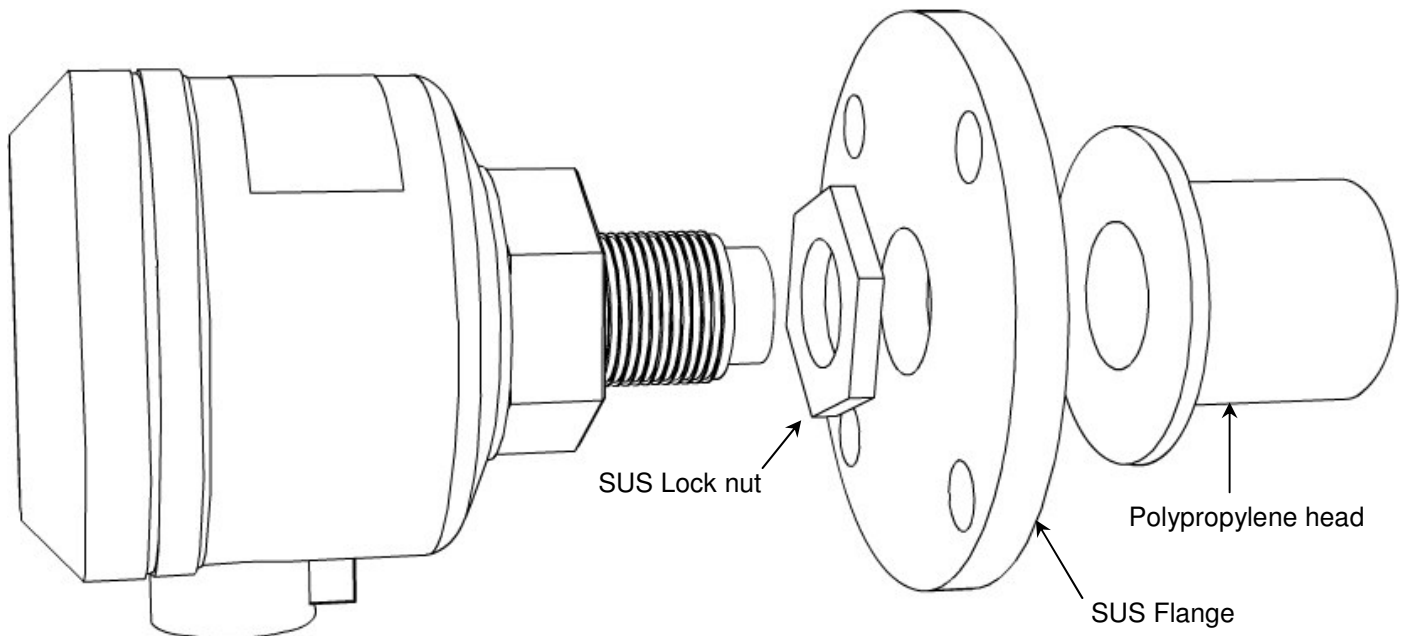
Threaded flanges are available in most standards (JIS, DIN, ANSI etc).



Optional NP Type: Polypropylene Head and Flange

The NP type is useful for applications where the process material is conductive and tends to buildup, impairing the microwaves; the polypropylene plug should be placed into the standoff portion preventing material from entering the standoff.

The NP type, when combined with a high pressure flange/seal, is also suitable for high pressure applications. Threaded flanges are available in most standards (JIS, DIN, ANSI etc).



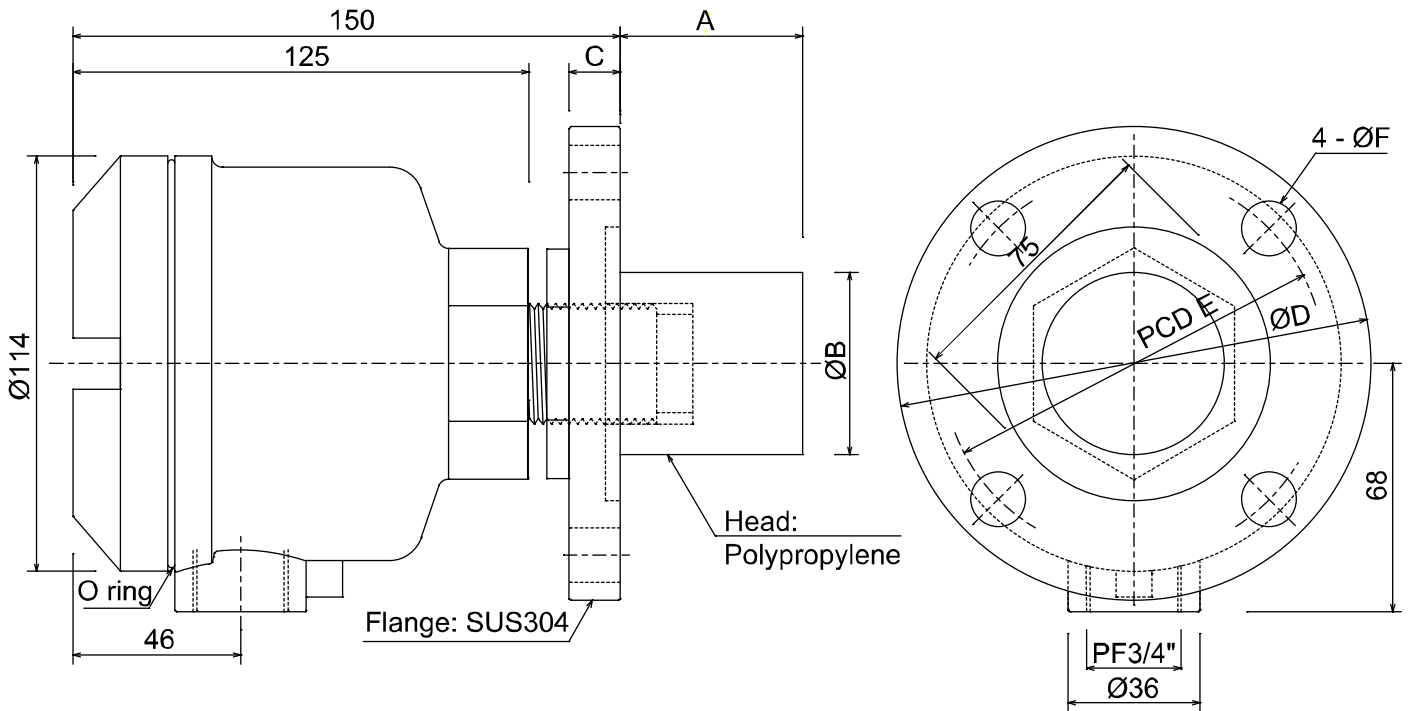
Standard

F- -10

1: 10K

NOTE: Other flange sizes are available upon request.

NP Type



NP-□□-□□□

- Head length (A)
 - 050: 50mm
 - 075: 75mm
 - 100: 100mm
- Flange size
 - 5: 50A
 - 6: 65A
- Pressure
 - 5: 5K
 - 1: 10K

Dimensions (mm)

FLANGE	B	C	D	E	F
JIS5K50A	50	14	130	105	15
JIS5K65A	65	14	155	130	15
JIS10K50A	50	16	155	120	19
JIS10K65A	65	18	175	140	19

Part Number Example: NP-56-075 = 5K65A Flange with 75mm long polypropylene head.

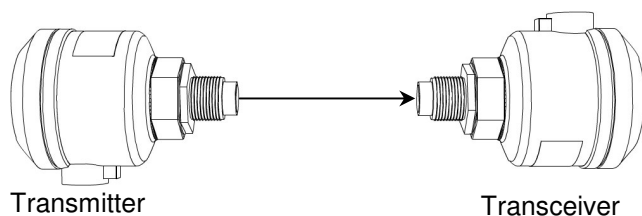
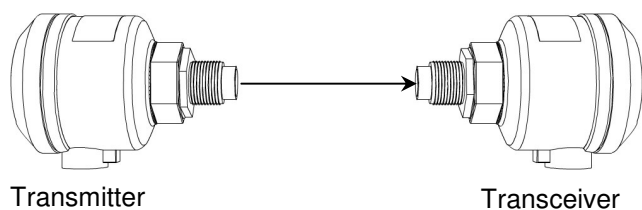
NOTE: Other flanges and polypropylene head lengths are available upon request.

INSTALLATION & MOUNTING

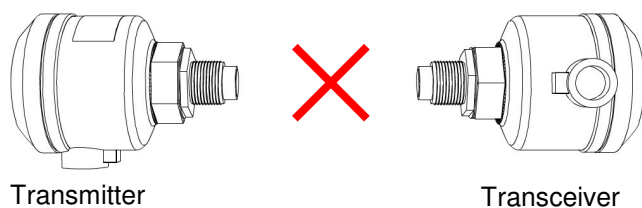
General Guidelines

Mounting angle

The transmitter emits liner polarized microwaves; as such it is necessary to align the transmitter and its corresponding transceiver in the same plane. The cable entry of both the transmitter and transceiver should be facing in the same direction, or be 180° opposite each other.

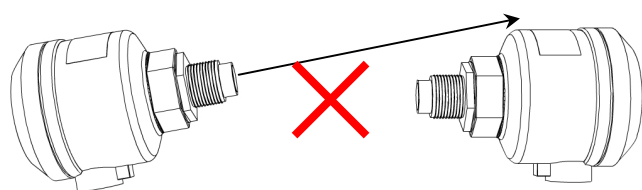


If the units are installed with the cable entries at 90° to each other they will not function.



Elevation angle

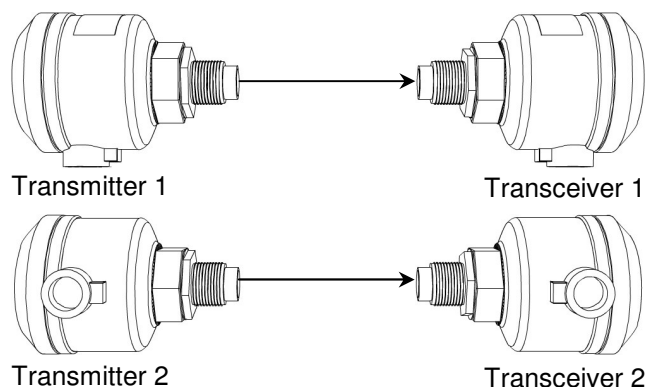
The sensors should be mounted with the antennas facing each other on the same horizontal axis.



Note that the sensors do not have to be perfectly aligned, thanks to the wide beam angle, however suitable care should be taken.

Set-to-set interference

If two transmitter transceiver sets are installed in close proximity to each other, one set should be mounted at 90° to the other to eliminate set-to-set interference.



Note that the Deluxe Level Switch MWS-ST/SR-2 comes with 4 channels, selectable by rotary switch, to eliminate set-to-set interference. As such, installation of multiple sets as shown above may not be necessary.

Mounting flush

It is desirable to mount the units flush so as to minimize material buildup on the antenna. This is especially important if the process material contains moisture. Microwaves are able to penetrate most surface containments; however it is recommended that you optimize the installation to gain maximum reliability.

Penetrability of walls

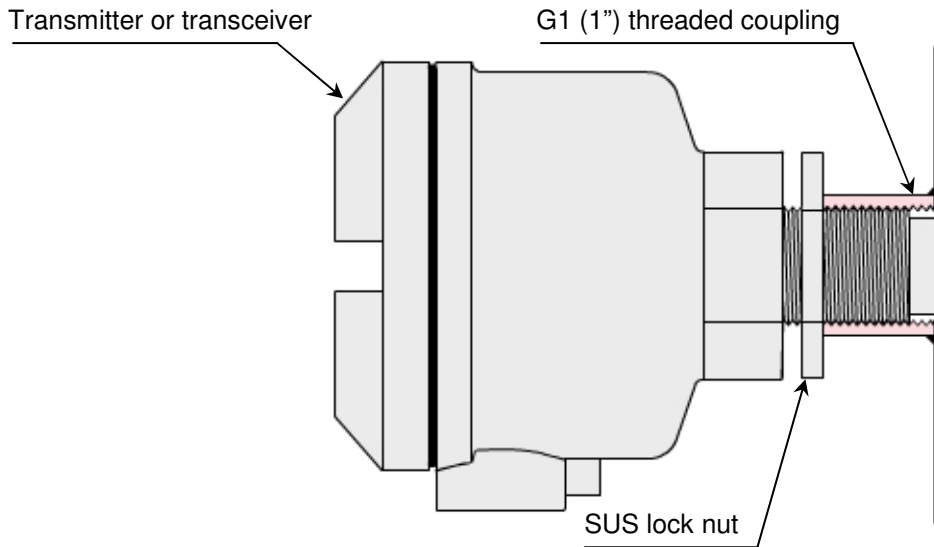
Microwaves are able to penetrate walls made from non-conductive materials such as refractory/firebrick, ceramic, plastic, glass etc. Microwaves can not penetrate metallic or conductive wall linings: a hole must be made and a suitable process connection welded to the vessel.

Temperature Variation

The ambient temperature between the transmitter and transceiver should not vary by more than 10°C.

Mounting

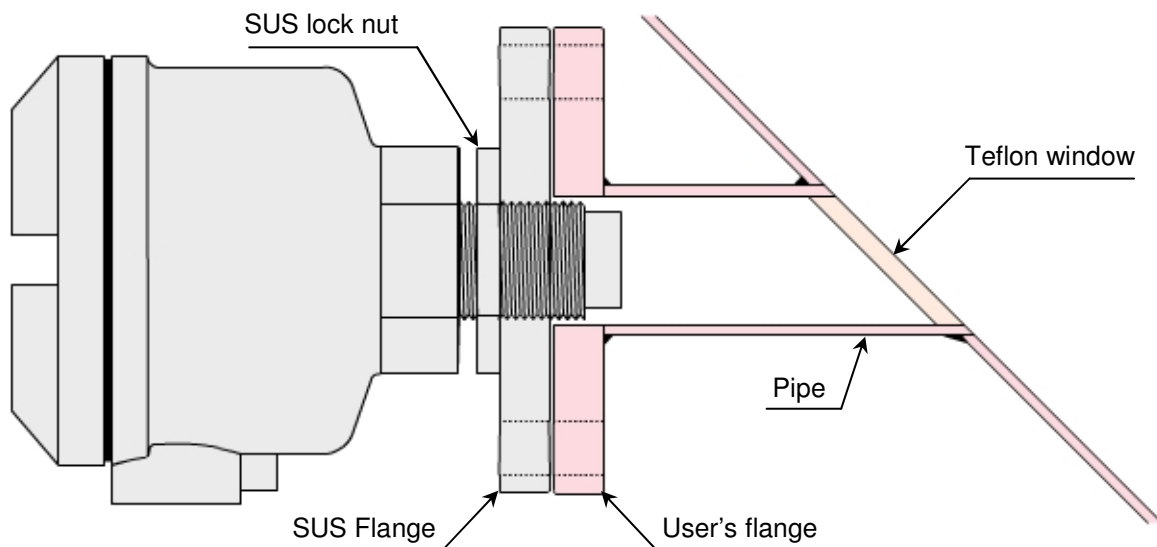
Standard Mounting



The sensor is threaded into an internal half connector welded to the wall. The sensor should be mounted flush with the inside of the vessel and the SUS lock nut used to fix the sensor in position.

Apply liquid sealant into screw hole and/or any gaps.

Optional Flange Type Mounting

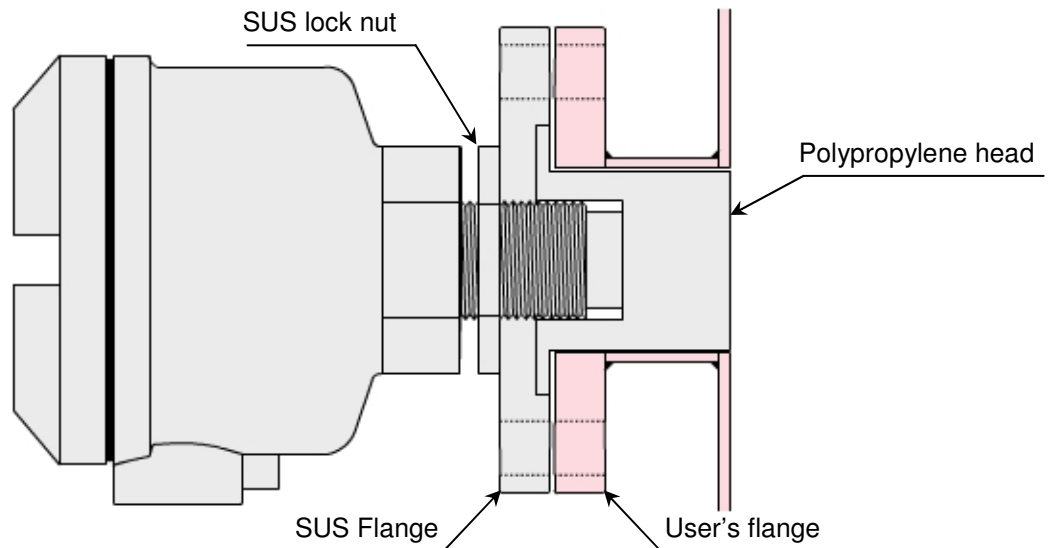


Flanges are optionally available in most standard sizes. The sensor's flange is bolted to the process connection flange supplied by the user.

Installation on sloped walls may be accomplished with a pipe and Teflon window as shown above.

*Note: The length and diameter of the pipe are critical to ensure optimal performance; **consult your representative or the factory before deciding on these dimensions**, we will advise you on the most appropriate dimensions for your application.*

Optional NP Type Mounting



The polypropylene head is placed in the stand-off portion of the pipe and mounted flush with the inside of the vessel.

The polypropylene head is not fixed to the sensor; rather it is sandwiched between the two flanges.

Use suitable gaskets for high pressure applications.

WIRING

Warning

Do not disconnect the wires connected to ground, either inside or outside the sensor. If they are disconnected it may cause electrocution or damage the circuits.



Do not touch live terminals of the sensor as high voltages may be present.



Do not disassemble any part of the sensor's electronics.



Turn off the power before connecting to any terminals. If this is not done electrocution or damaged circuits may result.



To prevent electrocution, ensure that the ground terminal of the sensor is connected to ground before turning on the power.



If there are problems with grounded wires, or if other protective functions are absent, do not turn on the power.

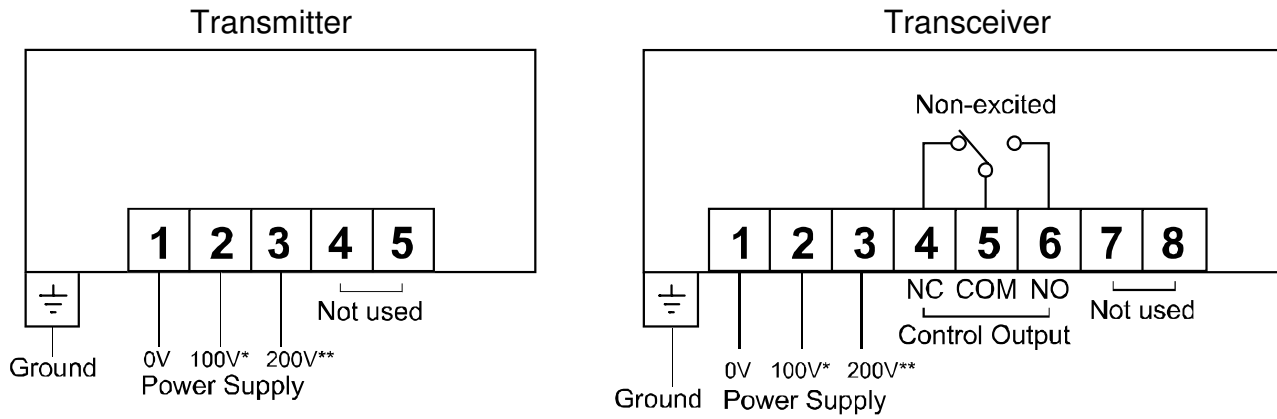


Before turning on the power, confirm that the rated voltage of the controller is compatible with the voltage of the power supply.



Ensure that the ground wire is connected to earth before connecting any other wires to the controller.



Terminal Connection for AC Power Supply Type MWS-ST/SR-2

* AC 100V~120V $\pm 10\%$, 50/60Hz

**AC 200V~240V $\pm 10\%$, 50/60Hz

Note:

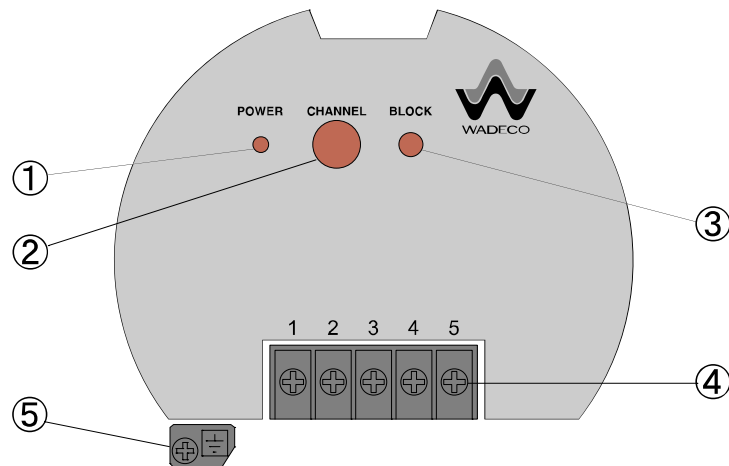
- The MWS-ST/SR-2 is not available with DC24V power supply.
- The phase of the power supply must be the same for both transmitter and transceiver.

Selection of Detection Mode and Relay Configuration

Detection Mode		Beam broken BLOCK		Beam unbroken UNBLOCK	
Terminal Number		4 & 5	5 & 6	4 & 5	5 & 6
Unpowered state		Closed	Open	Closed	Open
Powered state	Non-detecting state	Open	Closed	Open	Closed
	Detecting state	Closed	Open	Closed	Open

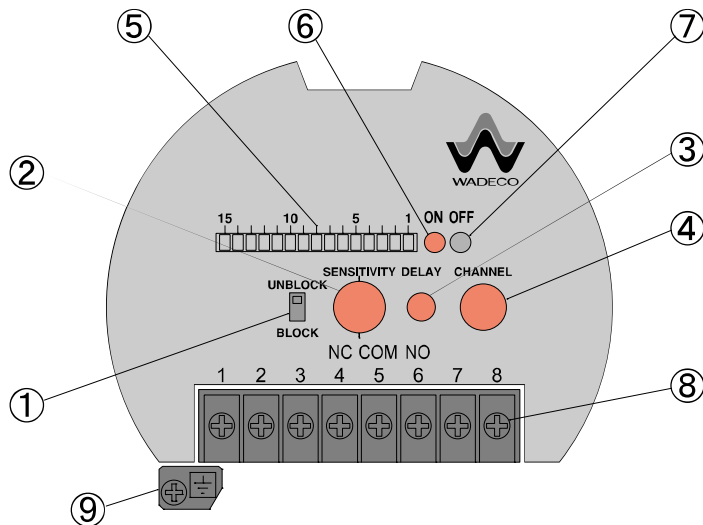
FUNCTION OF SWITCHES, INDICATORS AND RHEOSTATS

Transmitter MWS-ST-2



	Part name	Description
①	Power indicator	Green when power is on
②	Channel selector	Multi channel mode: CH 1 ~ 4 Single channel mode: CH 0
③	Block button	Blocks transmission
④	Terminals	Power supply (1~3)
⑤	Ground	Connected to chassis

Transceiver MWS-SR-2



	Part name	Description
①	Mode selection switch	BLOCK: Outputs on broken beam UNBLOCK: Outputs on unbroken beam
②	Sensitivity rheostat	For sensitivity adjustment
③	Delay time rheostat	0.1 ~ 10sec. delay period after state changes
④	Channel selector	Multi channel mode: CH 1 ~ 4, Single channel mode: CH 0
⑤	Received power level indicators	Received power level: indicated by one of 15 LEDs Sensitivity-set-point: indicated by one of 15 LEDs
⑥	Output indicator	ON (red): Illuminates on output
⑦	Output indicator	OFF (green): Illuminates on no output
⑧	Terminals	Power supply (terminals 1 ~ 3) and relay contacts (4~6)
⑨	Ground	Connected to chassis

SENSITIVITY ADJUSTMENT

Before adjusting the sensitivity:

- Ensure that there is a clear line of sight between the transmitter and transceiver,
- Set the CHANNEL selector on both the transmitter and transceiver to 0 (single channel mode) if you are installing one transmitter/transceiver set only: if you are installing more than one transmitter/transceiver set, in close proximity, then select channel 1, 2, 3 or 4 (multi channel mode) to prevent set-to-set interference.
- The phase of the power supply to must be the same for both the transmitter(s) and the transceiver(s).

Transmitter MWS-ST-2

- Apply power to the unit. The green POWER indicator will illuminate.

Transceiver MWS-SR-2

- Apply power to the unit. Either the red ON or the green OFF indicator will illuminate.
- Set the mode selection switch to BLOCK. Turn sensitivity rheostat fully counter clockwise (minimum).
- Turn the delay time rheostat fully counter clockwise (minimum).
- The red output indicator ON will illuminate.
- The sensitivity is adjusted visually using the 15LED indicator array. The received power level and sensitivity-set-point are indicated on the receiver by a bank of 15 LEDs. Turn the sensitivity rheostat clockwise until the sensitivity-set-point is located halfway between the received power level in the BEAM UNOBSTRUCTED and the BEAM OBSTRUCTED states.

BEAM UNOBSTRUCTED



BEAM OBSTRUCTED



Sensitivity-set-point

- For an application where material is introduced from above, a suitable delay time must be provided to avoid instantaneous detection of falling material.
- To use UNBLOCK output mode, switch the mode selection switch to UNBLOCK.
- When adjusting the delay time, use the TEST button on the transmitter to simulate the beam being blocked.

GUARANTEE

Guarantee Period

The guarantee period is for 1 year from the date of delivery.

Conditions

Any sensor that malfunctions during the guarantee period, as a result of a manufacturing fault, will be repaired free of charge once it has been returned to the factory.

The cost of freight will be borne by the buyer. This guarantee does not cover any malfunction resulting from conditions listed below:

- 1) When used under conditions or in environments not stated in the manufacturer's specifications or brochures.
- 2) When the cause of the malfunction is not the result of the operation of the unit itself.
- 3) When repairs or adjustments have been performed by anyone other than the manufacturer.
- 4) When used for purposes other than for what it was intended.
- 5) When the cause of the malfunction was not predictable at the time of delivery or within the scientific know-how of that time.
- 6) When the cause of the malfunction is due to a natural disaster.

The guarantee is not transferable to any second party.

Service

On site service and/or experimentation by WADECO personnel/technicians is not included in the unit's price. If requested WADECO will provide an estimate of the cost for such services.

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