

sitrans

LR 200

SIEMENS

Safety Guidelines

Warning notices must be observed to ensure personal safety as well as that of others, and to protect the product and the connected equipment. These warning notices are accompanied by a clarification of the level of caution to be observed.

Qualified Personnel

This device/system may only be set up and operated in conjunction with this manual. Qualified personnel are only authorized to install and operate this equipment in accordance with established safety practices and standards.

Warning: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated, and maintained.

Note: Always use product in accordance with specifications.

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While we have verified the contents of this manual for agreement with the instrumentation described, variations remain possible. Thus we cannot guarantee full agreement. The contents of this manual are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

Technical data subject to change.

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Safety Notes

Special attention must be paid to warnings and notes highlighted from the rest of the text by grey boxes.



WARNING: relates to a caution symbol on the product, and means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.



WARNING: means that failure to observe the necessary precautions can result in death, serious injury, and/or considerable material damage.

CAUTION: means that failure to observe the necessary precautions can result in considerable material damage.

Note: means important information about the product or that part of the operating manual.

Safety marking symbols

In manual:	On product:	Description
		Earth (ground) Terminal
		Protective Conductor Terminal
		(Label on product: yellow background.) Caution: refer to accompanying documents (manual) for details.

The Manual

Notes:

- Please follow the installation and operating procedures for a quick, trouble-free installation and to ensure the maximum accuracy and reliability of your SITRANS LR 200.
- This manual applies to the SITRANS LR 200 only.

This manual will help you set up your SITRANS LR 200 for optimum performance. We always welcome suggestions and comments about manual content, design, and accessibility.

Please direct your comments to techpubs@siemens-milltronics.com. For the complete library of Siemens Milltronics manuals, go to www.siemens-milltronics.com.

- ! **WARNING: Changes or modifications not expressly approved by Siemens Milltronics could void the user's authority to operate the equipment.**

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Application Examples

The application examples used in this manual illustrate typical installations using SITRANS LR 200. Because there is often a range of ways to approach an application, other configurations may also apply.

In all examples, substitute your own application details. If the examples do not apply to your application, check the applicable parameter reference for the available options.

Standard applications are found in the main body of the manual: for more specialized applications, please see *Appendix F: Special Applications*, page 90.

If you require more information, please contact your Siemens Milltronics representative. For a complete list of Siemens Milltronics representatives, go to www.siemens-milltronics.com.

Abbreviations and Identifications

Short form	Long Form	Description	Units
A/D	Analog to digital		
CE / FM / CSA	Conformité Européene / Factory Mutual / Canadian Standards Association	safety approval	
C _i	Internal capacitance		
D/A	Digital to analog		
DAC	Digital Analog Converter		
DCS	Distributed Control System	control room apparatus	

Short form	Long Form	Description	Units
FV	Full Vacuum		
ESD	Electrostatic Discharge		
HART	Highway Addressable Remote Transducer		
I_i	Input current		mA
I_o	Output current		mA
IS	Intrinsically Safe	safety approval	
L_i	Internal inductance		mH
LRV	Lower Range Value	value for process empty level	4 mA ¹
LSL	Lower Sensor Limit	below which no PV is anticipated	
mH	milliHenry	10^{-3}	Henry
μ F	microFarad	10^{-6}	Farad
μ s	microsecond	10^{-6}	Second
PED	Pressure Equipment Directive	safety approval	
pF	pico Farads	10^{-12}	Farad
ppm	parts per million		
PV	Primary Variable	measured value	
SELV	Safety extra low voltage		
SV	Secondary Variable	equivalent value	
TV	Transmitter Variable		
TVT	Time Varying Threshold	sensitivity threshold	
U_i	Input voltage		V
U_o	Output voltage		V
URV	Upper Range Value	value for process full level	20 mA ¹
USL	Upper Sensor Limit	above which no PV is anticipated	

- ¹ 100% is most commonly set to 20 mA, and 0% to 4 mA: however, the settings can be reversed.

SITRANS LR 200

SITRANS LR 200 is a 2-wire loop-powered, continuous level measuring instrument that utilizes advanced pulse radar technology at 5.8 GHz (6.3 GHz in North America). The instrument consists of an electronic component coupled to the antenna and process connection. It is very easy to install and set up, using either the infrared hand-held programmer locally, or using SIMATIC¹ PDM from a remote location.

Communication is via HART². Signals are processed using Sonic Intelligence[®] which has been field-proven in over 500,000 applications worldwide (ultrasonic and radar).

SITRANS LR 200 is available in two versions

- General Purpose (non-hazardous)
- Intrinsically Safe (with suitable barrier)

A wide range of process connections and antenna options is available to suit virtually any vessel configuration.

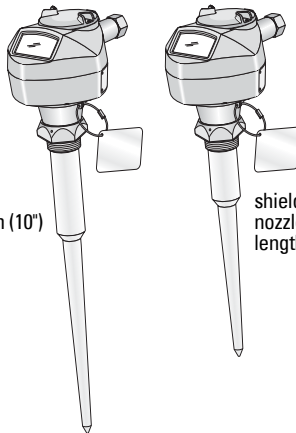
Applications

Notes:

- Please refer to product label for approval information.
- SITRANS LR 200 is to be used only in the manner outlined in this manual, otherwise protection provided by the equipment may be impaired.

SITRANS LR 200 is designed to measure liquid levels in a variety of applications:

- liquid bulk storage vessels
- simple process vessels with gentle agitation
- liquids
- slurries



shield length 250 mm (10");
use for long nozzles of 250 mm (10")
or less in length

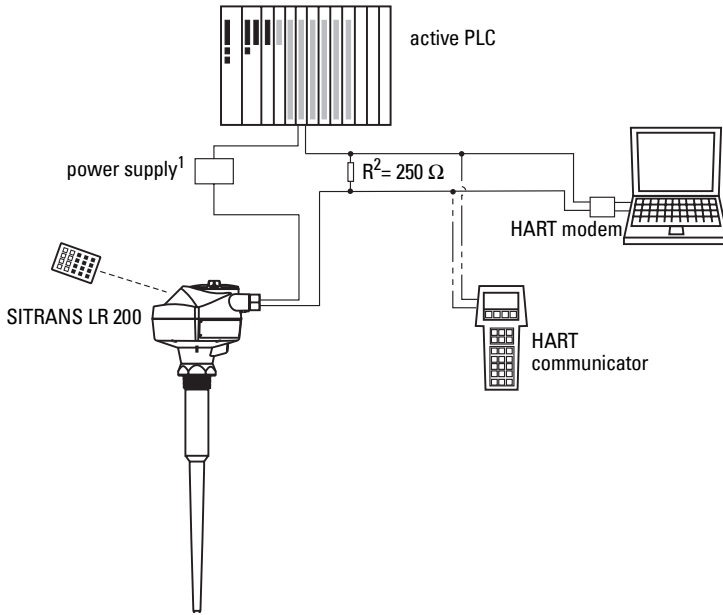
shield length: 100 mm (4"); use for
nozzles of 100 mm (4") or less in
length

1. SIMATIC[®] is a registered trademark of Siemens AG.
2. HART[®] is a registered trademark of the HART Communication Foundation.

SITRANS LR 200 System Implementation

SITRANS LR 200 supports HART communication protocol, and SIMATIC PDM software.

Typical PLC/mA configuration with HART



Programming

SITRANS LR 200 carries out its level measurement function according to the set of built-in parameters. You can make parameter changes via the hand programmer, via a PC using SIMATIC PDM, or via a HART Handheld Communicator.

SITRANS LR 200 Approvals and Certificates

Note: Please see *Approvals (verify against device nameplate)* on page 9 for an approvals listing.

1. Depending on the system design, the power supply may be separate from the PLC, or integral to it.
2. A 250 Ohm resistor may be required if the loop resistance is less than 250 Ohms.

Specifications

Notes:

- Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time.
- Please check the ambient and operating temperatures under *Enclosure* on page 8, and *Process* on page 8; also check *Approvals (verify against device nameplate)* on page 9, for the specific configuration you are about to use or install.

SITRANS LR 200

Power



Nominal 24 Vdc at
max. 550 Ohm.

For other configurations, see the chart *Loop Voltage versus Loop Resistance* on page 110.

- Maximum 30 Vdc
- 4 to 20 mA

Performance¹

- frequency: 5.8 GHz (6.3 GHz in N. America); refer to product nameplate for confirmation
- measurement range: 0.3 to 20 m (1 ft. to 65 ft.)
- blanking distance²: 0.3 m (1 ft.), plus the shield length (if any)
- accuracy: \pm the greater of: 0.1% of range, or 10 mm (0.4")
- influence of ambient temperature: 0.006% / K
- repeatability: \pm 5 mm
- dielectric constant: $\epsilon_r > 3$ (for < 3 use waveguide antenna or stillpipe)
- update time at 4 mA: \leq 5 seconds
- update time digital: \leq 1.5 seconds
- memory: non-volatile EEPROM, no battery required.

¹ Reference conditions.

² For the reference point for each configuration, see *SITRANS LR 200 Dimensions* on page 13 for the standard version, or *Appendix G: Flanged Antenna Options*, page 93 onwards.

Interface

- HART: standard, integral to analog output
- configuration: Siemens SIMATIC PDM (PC), or HART handheld communicator, or Siemens Milltronics infrared hand-held programmer
- analog output: 4–20 mA \pm 0.02 mA accuracy
- display (local): multi-segment alphanumeric liquid crystal with bar graph (representing level)

Programmer (infrared keypad)

Siemens Milltronics Infrared IS (Intrinsically Safe) Hand Programmer for hazardous and all other locations (battery is non-replaceable)

- approval: ATEX II 1 G, EEx ia IIC T4, certificate SIRA 01ATEX2147
- ambient temperature: –20 to 40° C (–5 to 104° F)
- interface: proprietary infrared pulse signal
- power: 3 V lithium battery
- weight: 150 g (0.3 lb)
- color: black

Mechanical

Process Connections:

- threaded connection 1.5" NPT, BSP, or G (polypropylene rod antenna)
- flange connection See *Appendix G: Flanged Antenna Options*, page 100.

Antenna:

- polypropylene rod hermetically sealed construction
standard 100 mm (4") shield for maximum 100 mm (4") nozzle,
or optional 250 mm (10") long shield
- PTFE rod see *Appendix G: Flanged Antenna Options*
- horns/waveguide see *Appendix G: Flanged Antenna Options*

Notes:

- Please check the ambient and operating temperatures under *Enclosure* on page 8, and *Process* on page 8; also check *Approvals (verify against device nameplate)* on page 9, for the specific configuration you are about to use or install.
- The use of approved watertight conduit hubs/glands is required for Type 4X / NEMA 4X, Type 6 / NEMA 6, IP67 (outdoor applications).

Enclosure

- construction: aluminum, polyester powder-coated
- conduit entry: 2 x M20, or 2 x 1/2" NPT with adaptor
- ingress protection: Type 4X / NEMA 4X, Type 6 / NEMA 6, IP 67 (see note below)

Weight:

- standard model: < 2 kg (4.4 lb.) polypropylene rod antenna

Environmental

- location: indoor/ outdoor
- altitude: 5000 m (16,404 ft.) max.
- ambient temperature: -40 to 80° C (-40 to 176° F)
- relative humidity: suitable for outdoor
Type 4X / NEMA 4X, Type 6 / NEMA 6, IP67 enclosure (see note below)
- installation category: I
- pollution degree: 4
- pressure rating: vented to atmosphere

Process

- temperature¹: -40 to 80 °C (-40 to 176 °F).
(at process connection)
- pressure (vessel)¹: 3 bar, gauge (43.5 psi, gauge)

Notes:

- Please check the ambient and operating temperatures under *Enclosure* on page 8, and *Process* on page 8; also check *Approvals (verify against device nameplate)* on page 9, for the specific configuration you are about to use or install.
- The use of approved watertight conduit hubs/glands is required for Type 4X / NEMA 4X, Type 6 / NEMA 6, IP67 (outdoor applications).

¹ The specifications apply to the polypropylene rod antenna only. The maximum temperature is dependent on the process connection, antenna materials, and vessel pressure. For more detail, or for other configurations, see *Maximum Process Temperature Chart* on page 84, and *Process Pressure/Temperature derating curves* beginning on page 86.

Approvals (verify against device nameplate)

- General: CSA_{US/C}, FM, CE
- Radio: Europe (R&TTE), FCC, Industry Canada
- Hazardous: Europe; EEx ia IIC T4
ATEX II 1 G

US; Class I, Div. 1, Groups A, B, C, D (barrier required)
Class II, Div. 1, Groups E, F, G
Class III

Canada; Class I, Div. 1, Groups A, B, C, D (barrier required)
Class II, Div. 1, Group G
Class IIII

Notes:

- Please check the ambient and operating temperatures under *Enclosure* on page 8, and *Process* on page 8.
- The use of approved watertight conduit hubs/glands is required for Type 4X / NEMA 4X, Type 6 / NEMA 6, IP67 (outdoor applications).

Installation

! WARNING: This product can only function properly and safely if it is correctly transported, stored, installed, set up, operated and maintained.

Notes:

- Installation shall only be performed by qualified personnel and in accordance with local governing regulations.
- This product is susceptible to electrostatic shock. Follow proper grounding procedures.

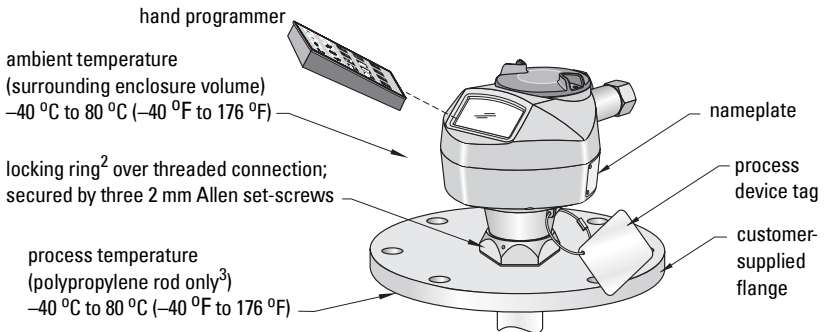
Mounting location

Recommendations:

- Ambient temperature within -40 to 80 °C (-40 to 176 °F)¹.
- Easy access for viewing the display and programming via the hand programmer.
- An environment suitable to the housing rating and materials of construction.
- Although the LCD has UV protection, we recommend using a sunshield if the instrument will be exposed to direct sunlight.

Precautions:

- Avoid proximity to high voltage or current wiring, high voltage or current contacts, and to variable frequency motor speed controllers.
- Avoid interference to the emission cone from obstructions or from the fill path.
- Avoid central locations on vessels.



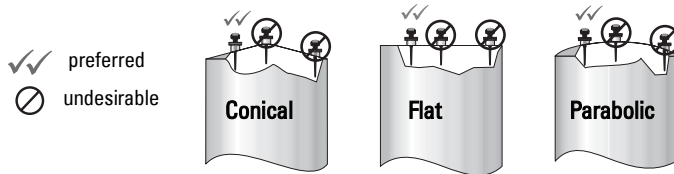
¹ For more detail on maximum interface and process temperatures, see *Maximum Process Temperature Chart*, page 84.

² When the locking ring is secured, it prevents the enclosure rotating on the threaded connection.

³ For other configurations, see *Maximum Process Temperature Chart*, page 84, and the process pressure derating curves beginning on page 86.

! **WARNING:** For vessels with conical or parabolic tops, avoid mounting the instrument at the centre. (The concavity of the top can focus echoes into the centre, giving false readings.)

Note: Under certain circumstances, it may be acceptable to mount SITRANS LR 200 at the centre of a flat-topped tank: please discuss this with your Siemens Milltronics Representative.

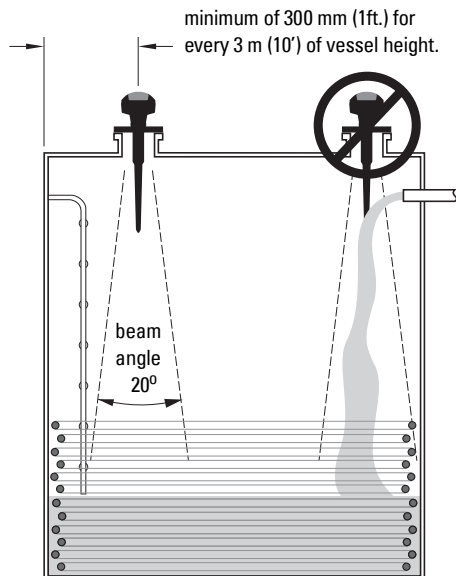


Keep the emission cone free of interference:

- make allowance for the emission cone spreading: allow a minimum of 300 mm (1 ft.) for every 3 m (10 ft.) of vessel height
- locate the antenna away from the side wall, to avoid interference from indirect echoes
- avoid interference from objects such as ladders or pipes, which can cause false reflections
- make sure the beam angle does not intersect the fill path

Notes:

- Beam angle defined at -3dB boundary.
- For more detail on false reflections, see *Appendix G: Flanged Antenna Options* on page 93.



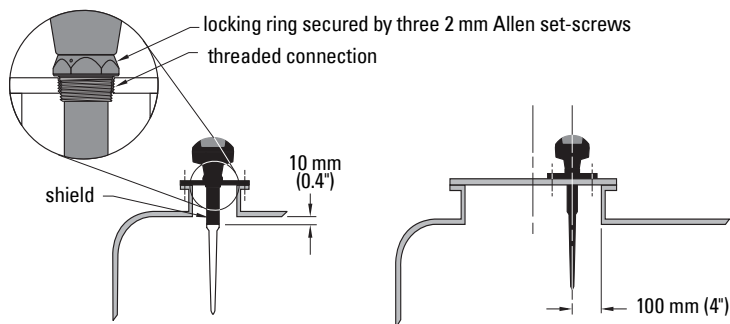
Location on a nozzle, or on a manhole cover

Notes:

- Use the 100 mm (4") shield on nozzles that are 100 mm (4") in length, or shorter.
- Use the 250 mm (10") shield on nozzles that are 250 mm (10") in length, or shorter.

On a nozzle, the end of the shield section should protrude a minimum of 10 mm (0.4") to avoid interference.

A manhole cover is typically a covered nozzle with a diameter 610 mm (24") or greater. To provide optimum signal conditions on a manhole cover, locate the antenna off-center, typically 100 mm (4") from the side.



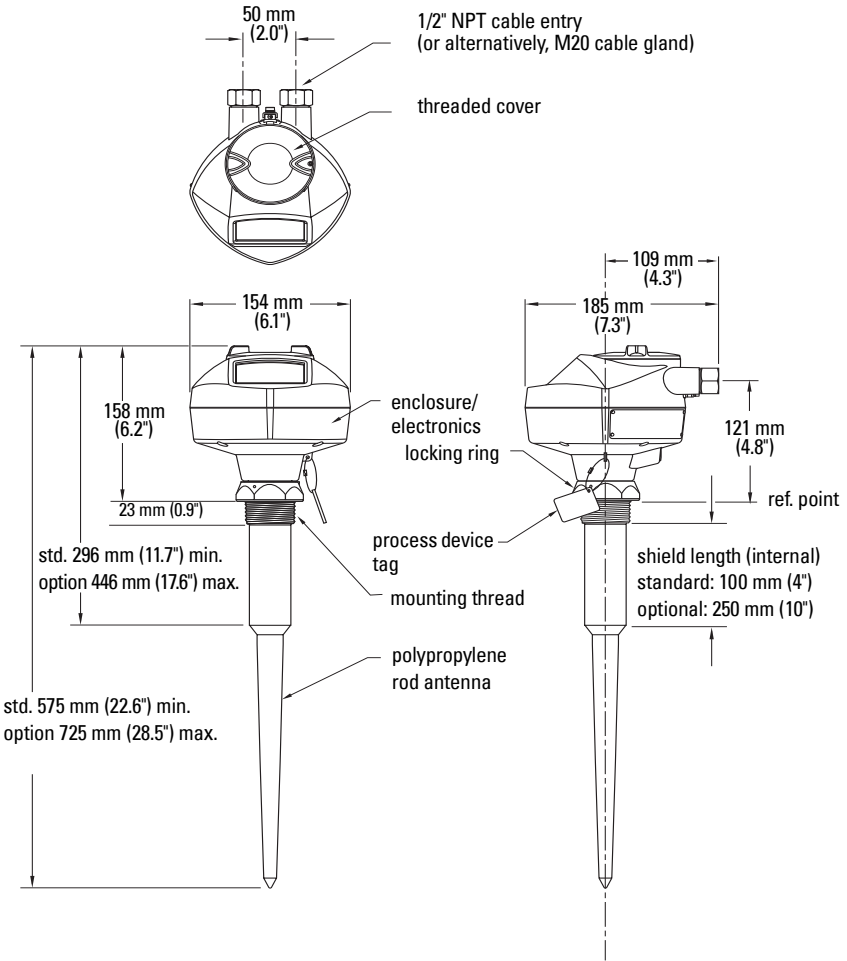
Note: For details on other applications, see *Appendix F: Special Applications* on page 90.

Mounting Instructions

1. Before inserting SITRANS LR 200 into its mounting connection, check to ensure the threads are matching, to avoid damaging them.
2. Simply screw SITRANS LR 200 into the process connection, and hand tighten. For pressure applications, it will be necessary to use PTFE tape (or other appropriate thread sealing compound) and tighten the process connection beyond hand tight. The maximum torque is 40 N-m (30 ft.lbs.).
3. If you want to rotate the enclosure, use a 2 mm Allen key to loosen the set-screws that secure the locking ring.
4. Once the enclosure is in a suitable position, tighten the set-screws.

Note: Do not rotate the enclosure after programming and vessel calibration, otherwise an error may occur, caused by a polarity shift of the transmit pulse.

SITRANS LR 200 Dimensions



Installation

Wiring

Power

WARNINGS:



dc terminals shall be supplied from an SELV source in accordance with IEC-1010-1 Annex H.

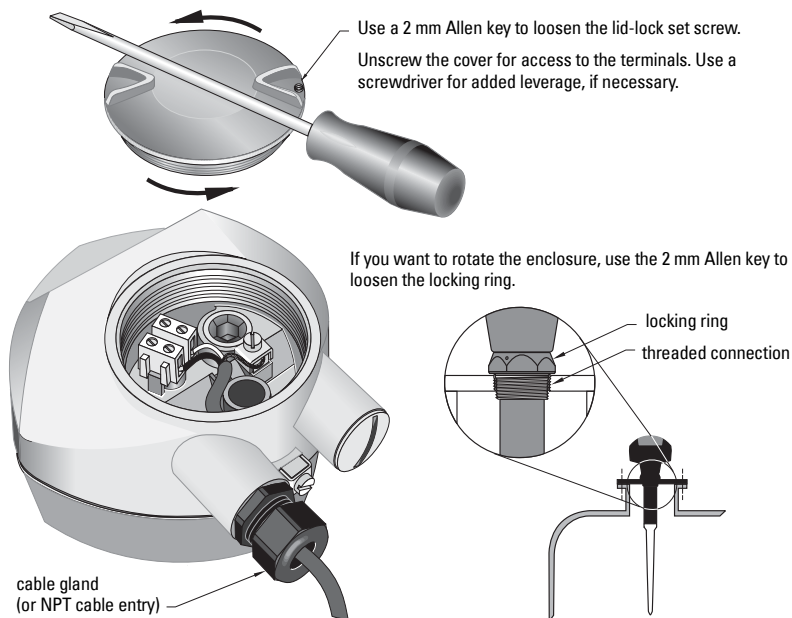


All field wiring must have insulation suitable for rated voltages.

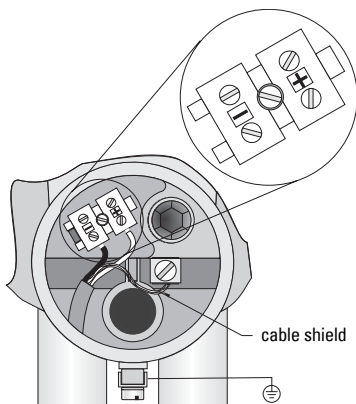
Connecting SITRANS LR 200

Notes:

- Use shielded, twisted pair cable (wire gauge 14-22).
- Separate cables and conduits may be required to conform to standard instrumentation wiring practices or electrical codes.
- For detailed information on Intrinsic Safety and Increased Safety setups, see *Wiring Details* on page 108.



1. Strip the cable jacket for approximately 70 mm from the end of the cable, and thread the wires through the gland¹.
2. Connect the wires to the terminals as shown below: the polarity is identified on the terminal block.
3. Ground the instrument according to local regulations.
4. Tighten the gland to form a good seal.



¹ If cable is routed through conduit, use only approved suitable-size hubs for waterproof applications.

Operating SITRANS LR 200

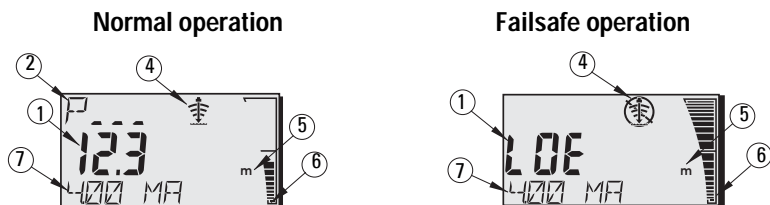
SITRANS LR 200 has two modes of operation: **RUN** and **PROGRAM**.



RUN Mode

SITRANS LR 200 automatically starts in **RUN** mode when power is applied, and detects the material level. The primary reading displays the material level (in meters) referenced from Empty (process empty level). This is the default start-up display mode.

System status is displayed on the LCD, or on a remote communications terminal.

Display










- 1 – Primary Reading (displays level, distance, or volume, in either units or percent)
- 2 – Parameter for Auxiliary Reading¹
- 4 – Echo status indicator: Reliable Echo  or Unreliable Echo 
- 5 – Units or Percent
- 6 – Active bar graph represents material level
- 7 – Auxiliary Reading (Depending on the parameter selected, it displays milliAmp value [HART only], distance, or confidence, with units where applicable.)


If the echo confidence drops below the echo confidence threshold, the failsafe timer starts running. When the timer expires, the letters **LOE** (Loss of Echo) alternate with the reading every two seconds, and the Reliable Echo indicator is replaced by the Unreliable Echo indicator. When a valid reading is received, the level reading display returns to normal operation.

¹ Press  to display the auxiliary reading field when in **RUN** mode.

Hand Programmer: function keys in RUN mode

Certain functions can be accessed directly from **RUN** mode by using specific keys.

Key	Run Mode
	mA output value displayed in auxiliary reading field.
	Internal enclosure temperature displayed in auxiliary reading field.
	Parameter for auxiliary readings ¹ .
	Displays the value representing Echo Confidence (P805).
	Toggle between Units and % on reading display.
	Initiate and complete PROGRAM mode access.
	Distance displayed in auxiliary reading field.

1. Press  plus three-digit parameter number to set parameter to show in the auxiliary display.

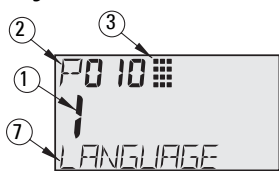
PROGRAM Mode

Programming

- Set parameters to suit your specific application.
- Activate **PROGRAM** mode at any time, to change parameter values and set operating conditions.
- For local programming, use the Siemens Milltronics hand programmer.
- For programming from a distance, use either a PC running SIMATIC PDM, or a HART handheld communicator.

Note: Do not use the handheld programmer at the same time as SIMATIC PDM, or erratic operation may result.

Display



- 1 – Primary Reading (displays parameter value)
- 2 – Secondary Reading (displays parameter number)
- 3 – Programming indicator
- 7 – Auxiliary Reading (displays parameter names for the Quick Start parameters, if a language is selected. It displays the index value for indexed parameters, such as P054.)

Hand Programmer: function keys in PROGRAM mode

Key	Programming Mode
0 to 9	Values
P...	Decimal point
Pxxx	Negative value
C	CLEAR value
▲%	TOGGLE between Units and % on parameter value
☰	End PROGRAM session and enable RUN mode
📶	Update echo quality parameters
▲	Parameter scroll-up
▼	Parameter scroll-down
🔄	DISPLAY opens parameter fields
➡	ENTER the displayed value

Security

The Lock parameter, P000, secures SITRANS LR 200 against changes via the hand programmer. To enable programming, set P000 to the Unlocked Value stored in P069. To disable programming, enter a different value.

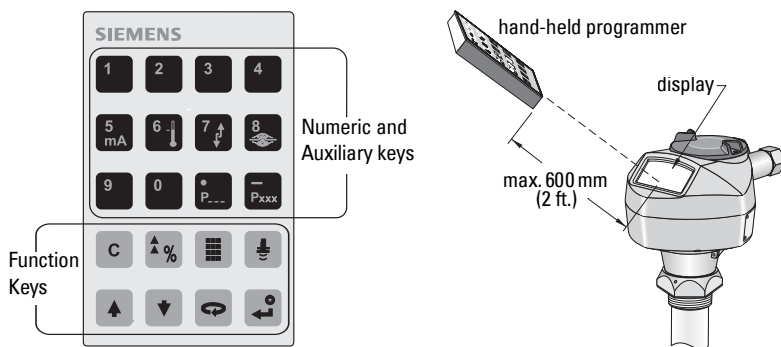
Note:

- A remote master can still change configuration, if P799 is set to allow this.

Hand programmer

Note: For detailed instructions on using the hand programmer, see the next page.

For direct access to SITRANS LR 200, point the hand programmer at the display (from a maximum distance of 600 mm [2 ft.]), and press the keys.






Activating SITRANS LR 200

Note: Keep infrared devices such as laptops, cell phones, and PDAs, away from SITRANS LR 200 to prevent inadvertent operation.

Power up the instrument. SITRANS LR 200 starts in **RUN** mode, and detects the material level. It displays the material level (in meters) referenced from Empty (process empty level). This is the default start-up mode.



Accessing a parameter

Notes:

- Press **PROGRAM**  then **DISPLAY**  to access **PROGRAM** mode, and press **PROGRAM**  to return to **RUN** mode.
- The following instructions apply when using the Hand Programmer.
- Do not use the Hand Programmer at the same time as SIMATIC PDM, or erratic operation may result.
- You do not need to key in initial zeros when entering a parameter number: for example, for P005, key in **5**.

1. Press **PROGRAM**  then **DISPLAY** , to activate **PROGRAM** mode.





2. Either use the **ARROW** keys   to scroll to a different parameter, or:



3. Press **DISPLAY**  to open the Parameter Number field.



4. Key in the desired parameter number followed by **ENTER** .


For example: press **5**  .






The LCD displays the new parameter number and value.





Changing a Parameter Value

Notes:

- Security must be disabled to enable programming: set P000 to the Unlocked Value stored in P069.
- Invalid entries will be rejected or limited.
- **CLEAR**  can be used to clear the field.

1. Use the **ARROW** keys   to scroll to the parameter number, or press **DISPLAY**  and key in the parameter number followed by **ENTER** .
2. Key in the new value.
3. Press **ENTER**  to set the value.

Parameter Reset to Factory Default

1. Scroll to the parameter or enter its address.
2. Press **CLEAR**  then **ENTER** . The value returns to the default setting.

P999 Master Reset

Note: Following a Master Reset, complete reprogramming is required.

Resets all parameters to their factory settings, with the following exceptions:

- *P000 and P069 are not reset.*
- *The learned TVT curve is not lost.*

1. Press **PROGRAM** , then **DISPLAY**  to activate **PROGRAM** mode.
2. Press **DISPLAY**  to open parameter fields.
3. Key in **999**.


Press **CLEAR**  then **ENTER** , to Clear All and initiate reset. The LCD displays **C.ALL**.



4. Reset complete. (Reset takes several seconds to complete.)



Using Units or Percent (%)

Many parameters can be viewed either as a percentage, or in measurement units (P005). View the parameter, then press **MODE**  to toggle between units and percentage.



Setup Steps (outline)

Set the Quick Start parameters between P001 and P010 (the main settings that apply to all applications and make the system operational). Then set P837 and 838 to ignore false echoes, and return to **RUN** mode.






1. Select a language option, or numeric, for the auxiliary reading¹ (P010).
2. Select the measurement mode: level, space, or distance (P001).
3. Set the response time to level changes (P003).
4. Select units of measurement: m, cm, mm, ft., or in. (P005).
5. Set process empty level (Empty: P006).
6. Set the range to be measured (Span: P007).
7. To ignore false echoes before the material echo: set Auto False-Echo Suppression Distance P838.
8. Enable Auto False-Echo Suppression P837.
9. Return to **RUN** mode.

Setup Instructions

Notes:

- In **PROGRAM** mode, you can use the **ARROW** keys   to scroll to a parameter number.
- The default parameter values are indicated by an asterisk (*) in the tables.

Using the hand programmer, set each parameter value to suit your application.

- a. Press **PROGRAM** , then **DISPLAY** , to activate **PROGRAM** Mode.
- b. Either scroll to the desired parameter number, or press **DISPLAY**  again and key in the parameter number followed by **ENTER** .
- c. Key in the appropriate value for each parameter.
- d. Press **ENTER**  to set the value.

¹ The language options are English, German, French, or Spanish. The parameter title appears in the language selected, for the first 10 parameters.

1. Select a language (P010: Language)

If a language is selected, parameter titles for the Quick Start parameters are displayed in the auxiliary reading field.

Parameter	Value	Description
P010	0 *	Numeric/None
	1	English
	2	German
	3	French
	4	Spanish

Parameter	Auxiliary reading
P000	LOCK
P001	OPERATION
P003	MEAS RESP
P004	ANTENNA
P005	UNITS
P006	EMPTY
P007	SPAN
P010	LANGUAGE

2. Select the measurement mode required for the application (P001: Operation)

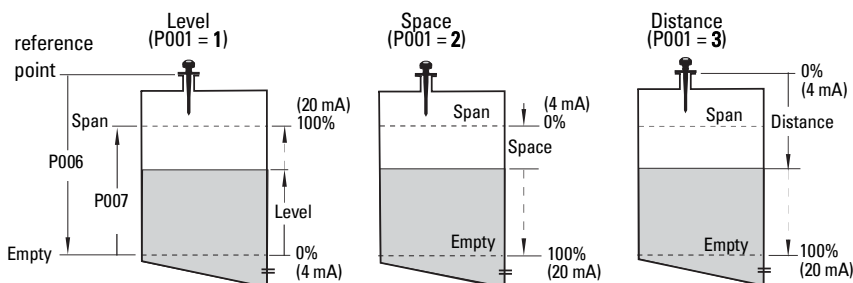
To measure how full the vessel is, select **Level**: the reading can be returned as level or as volume:

- for a level reading, ensure P050 is set to **0**: the reading returns the distance from process empty level (Empty) to the current level
- for a volume reading, select a vessel shape at P050, and set volume parameters 051 to 055 as required

To measure how much space remains in the vessel, select **Space**:

- **Space** returns a reading for the distance between current level and process full level (Span)

To measure the distance from the reference point¹ to the current level, select **Distance**.



¹ For the reference point for the standard model, see *SITRANS LR 200 Dimensions* on page 13. For other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

Notes:

- Setting P001 resets Span (P007), unless Span has previously been set to a different value. Span is set to Empty distance minus 110% of Blanking¹, unless Operation is set to distance measurement (P001 = 3). In this case, Span is set to the same value as Empty (P006).
- Changing P001 may reset Output Function (P201): this applies to HART only.

Parameter	Values	Description
P001	1	* Level returns material level referenced from Empty (process empty level). The reading is returned in volumetric units if parameters 050 to 055 are set to enable this.
	2	Space returns material level referenced from Span (process full level).
	3	Distance returns material level referenced from the reference point ¹ .

3. Set response time to filling/emptying rate (P003: Measurement Response)

Set P003 to a measurement response speed just faster than the maximum filling or emptying rate (whichever is greater).

Parameter	Values	Description	Parameters affected by P003
P003	1	* slow	0.1m/minute
	2	medium	1m/minute
	3	fast	10m/minute
P070, P700, P701, P709, P711			

Use a setting just faster than the maximum filling or emptying rate (whichever is greater). Slower settings provide higher accuracy: faster settings allow for more level fluctuation.

(For more detail on measurement response, see *Transceiver*, page 79.)

(P004 Antenna Type: view only)

Value	Description
240	antenna without PTFE extension
241	rod + 50 mm PTFE extension
242	rod + 100 mm PTFE extension

¹ See *Near Blanking* on page 81 for details.

² For the reference point for the standard configuration, see page 13. For other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

4. Select the measurement units required (P005: Units)

Parameter	Value	Description
P005	1	* meters
	2	centimeters
	3	millimeters
	4	feet
	5	inches

5. Set process empty level (P006: Empty)

Value	Range	0.0000 to 20.00
	Default	20.00 m (maximum range)

Enter the distance from the antenna reference point¹ to process empty level (Empty), using units set in P005. Empty can be set to any distance: not necessarily the bottom of the vessel

Note:

- P006 and P007 are interlinked: see notes attached to P007.

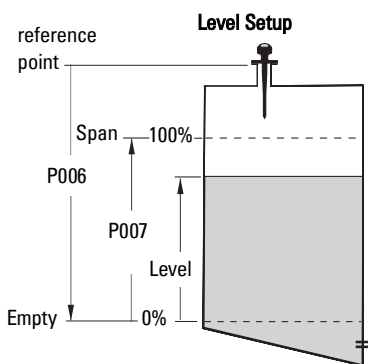
6. Set the range to be measured (P007: Span)

Value	Range	0.0000 to 20.00
	Default	19.56 (see note below)

Enter the distance between Empty (process empty level) and Span (process full level), in the units set in P005. Span can be set at any distance above Empty level.

Notes:

- Setting P006 resets Span, if it has not previously been set to a different value.
- The default setting for Span is based on Operation (P001) and Empty (P006). Span is set to Empty minus 110% of Blanking distance², unless Operation is set to **distance** (P001=3). In this case, Span is set to Empty distance.
- Always prevent the monitored surface from approaching within 0.3 m (1 ft) of the reference point, as this is the minimum distance detectable.



1. For the reference point for each configuration, see *SITRANS LR 200 Dimensions* on page 13 for the standard version, or *Appendix G: Flanged Antenna Options*, page 93 onwards.

2. 0.3 m (1 ft.), plus the shield length (if any).

7. Minimize false reflections (P838: Auto False-Echo Suppression Distance)

If SITRANS LR 200 displays an incorrect full level, or if the reading fluctuates between a false high level and a correct level, you can use the TVT (Time Varying Threshold)¹ shaper parameters P838 and P837 together to prevent false-echo detection. They elevate the TVT in this region and de-sensitize the receiver from any 'base noise' caused by internal antenna reflections, nozzle echoes, or other vessel false echoes.

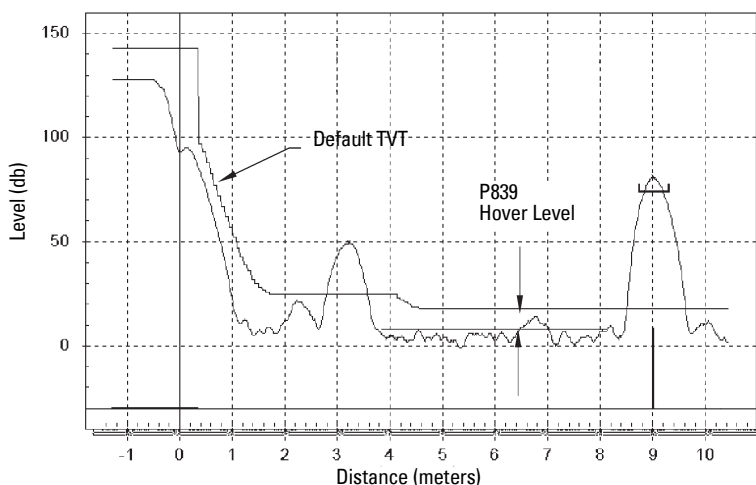
Notes:

- This function works best when tank is empty or nearly empty: use it only if there is a minimum distance of 2 meters from the radar instrument to the material.
- Set P837 and P838 during start up, if possible.
- If the vessel contains an agitator, the agitator should be running.

Parameter	Values	
P838	Range:	0.0000 to 20.00 (m)
	*	1.000

Determine the actual distance from the antenna reference point to the material surface. Subtract 0.5 m from this distance and enter the result. Do this in combination with P837: see the Setup Instructions following P837.

Display before Auto False-Echo Suppression (or when P837 = 0)






¹ For more detail on Auto TVT adjustments, see *P837 Auto False-Echo Suppression* on page 59. See also *Auto False-Echo Suppression* on page 81.

8. Enable False-Echo Suppression (P837: Auto False-Echo Suppression¹)

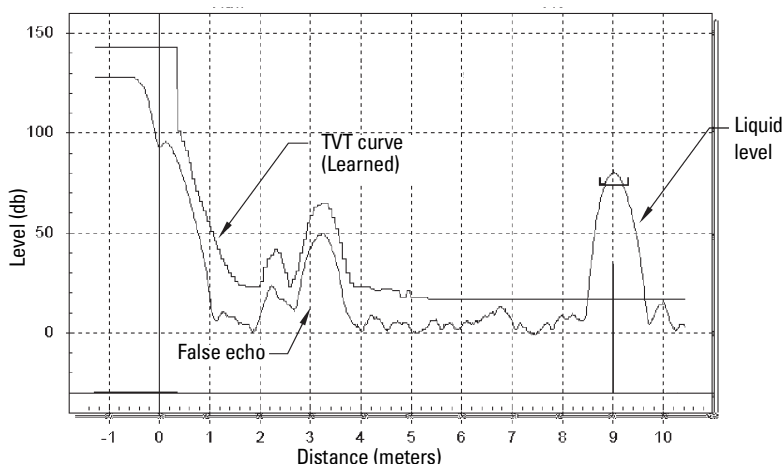
Use this feature to ignore false echoes before the material echo. Use P838 to set the Auto TVT distance first.

Parameter	Values	Description
P837	0	Off
	1	* Use "learned" TVT
	2	"Learn"

Setup Auto False-Echo Suppression:

- Perform this function when the vessel is empty or nearly empty.
- First rotate the instrument for best signal (lowest false-echo amplitude)
- Determine **distance** from radar instrument to material level.
- Press **PROGRAM** , then **DISPLAY** .
- Select P838 and key in [distance to liquid level minus 0.5m].
- Select P837.
- Press **2** and then press **ENTER** . P 837 will automatically revert to 1 (use Learned TVT) after a few seconds.

Example After Auto False-Echo Suppression



- Press **PROGRAM**  to return to RUN mode.

¹ For more detail on Auto TVT adjustments, see *P837 Auto False-Echo Suppression* on page 59.

Additional Settings

- Convert readings to volume (P050 to P055)
- Stored unlock value (P069)
- Set Failsafe timer conditions (P070 TO P073)
- Control Analog Output (P201 to P215, and P911)
- Check installation records (P341 to P346)
- Calibrate sensor for unusual conditions (P652 to P655)
- Limit rate of change of reading (P700 to P701)
- Verify measurements (P709 to P713)
- Configure communications (P799)
- Control echo processing (P800 to P820)
- TVT curve adjustments - Auto False-Echo Suppression (P837 to P839)
- Software diagnostic tests (P900 to P901)
- Adjust measurements (P911 to P924)

For a full list of available parameters, see *Parameter Reference*, starting on page 32.

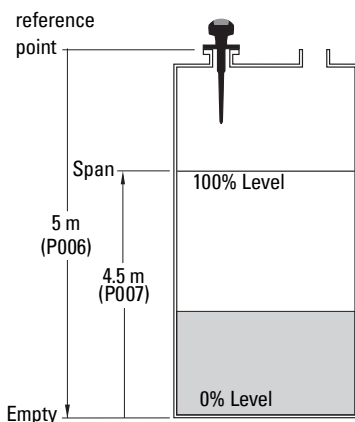
Application Examples

You can use these examples as setup references. Enter the values in the parameter tables to select the corresponding functions.

Example 1: Liquid resin in storage vessel, level measurement

Notes:

- The minimum distance from the flange face to the target is limited by near-blanking P800.
- Only set P837 if the product is at least 2 m (78") away from the flange face. If it is closer, leave P837 at **1** until the level drops and the distance increases beyond 2 m (78").



The application is to obtain a level measurement and corresponding 4 to 20 mA output proportional to resin levels in a storage vessel.

Process empty level (Empty) is the bottom of the tank, which is 5 m from the antenna flange face. Process full level (Span) is 4.5 m from the vessel bottom. The maximum rate of filling or emptying is about 0.2 m/min.

In the event of a loss of echo, SITRANS LR 200 is to go into Failsafe Hi after 2 minutes.

Parameter	Description	Value	Function
P001	mode of measurement	1	Level
P003	measurement response	2	1m/minute
P005	units	1	meters
P006	empty distance	5	5 m
P007	span	4.5	4.5 m
P070	Failsafe timer	2	2 minutes

P071	Failsafe mode	1	Hi
P838	Auto False-Echo Suppression Distance	[Distance ¹ minus 0.5 m]	Sets length of learned TVT curve ² to use
P837	Auto False-Echo Suppression	2 then 1	Enables the use of learned TVT curve ² .

- Distance to product from reference point.
- For more details on setting P837 and P838, see page 58 and page 59. For an explanation, see *Auto False-Echo Suppression* on page 81.

Return to RUN: press PROGRAM  to start normal operation.

Example 2: Horizontal vessel with volume measurement

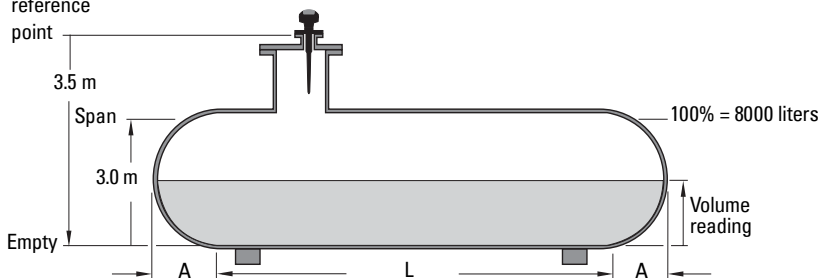
Notes:

- The minimum distance from the flange face to the target is limited by near-blanking P800.
- Only set P837 if the product is at least 2 m (78") away from the flange face. If it is closer, leave P837 at 1 until the level drops and the distance increases beyond 2m (78").

The application is to obtain a level measurement and corresponding 4 to 20 mA output proportional to vessel volume in a chemical vessel.

Process empty level (Empty) is the bottom of the tank, which is 3.5 m from the antenna flange face. Process full level (Span) is 3.0 m from the vessel bottom. The maximum rate of filling or emptying is about 0.2 m/min. Selecting tank shape 7 at P050, and entering values for A and L, will give a volume reading instead of level.

In the event of a loss of echo, SITRANS LR 200 is to go into Failsafe Hi after 2 minutes. reference point



Parameter	Description	Values	Function
P001	mode of measurement	1	Volume replaces Level when a tank shape is selected at P050
P003	measurement response	2	1m/minute
P005	units	1	meters
P006	empty distance	3.5	3.5 m
P007	span	3	3 m
P050	vessel shape	7	parabolic ends
P051	maximum volume	8000	8000 liters
P052	vessel dimension A	.8	0.8 meters
P053	vessel dimension L	6	6 meters
P070	Failsafe timer	2	2 minutes
P071	Failsafe	1	Hi
P838	Auto False-Echo Suppression Distance	[Distance ¹ minus 0.5 m]	Sets length of learned TVT curve ² to use
P837	Auto False-Echo Suppression	2 then 1	Enables the use of learned TVT curve ² .

1. Distance to product from reference point.
2. For more details on setting P837 and P838, see page 58 and page 59. For an explanation, see *Auto False-Echo Suppression* on page 81.

Return to **RUN**: press **PROGRAM**  to start normal operation.

Notes:

Parameter Reference

Notes:

- Keep infrared devices such as laptops, cell phones, and PDAs, away from SITRANS LR 200 to prevent inadvertent operation.
- Do not use the Hand Programmer at the same time as SIMATIC PDM, or erratic operation may result.








SITRANS LR 200 is configured through its parameters, and the application determines the parameter values which are entered into the instrument.

Please check your value entries carefully before operating SITRANS LR 200, to ensure optimum performance.

Helpful Hints





- **Default** values are indicated with an asterisk (*) in the parameter tables, unless explicitly described.
- **Primary index** is an address: for example, P054.
- **Secondary index** is a sub-address that allows for multiple values on an indexed point, and allows indexed values from more than one parameter to be linked, for example, the breakpoints in P054 and P055.

To access a parameter and change a value (primary index):

1. Press **PROGRAM**  then **DISPLAY**  to activate **PROGRAM** Mode.
2. Either use the **ARROW** keys   to scroll to each parameter number, or press **DISPLAY**  again to access the parameter number field and key in the parameter number followed by **ENTER** .
3. Key in the new value.
4. Press **ENTER** .

Note: Initial zeros in a parameter number do not have to be entered: for example, for P001, key in 1.

To access a secondary index and change a value:

1. Select the parameter number, for example P054: the secondary index is displayed in the auxiliary reading.
2. Press **DISPLAY**  twice¹ (the auxiliary reading field goes blank).
3. Key in the address of the desired index, or use the **ARROW** keys   to scroll to the desired secondary index number.
4. Key in the new index value.
5. Press **ENTER** .

P000 Lock

Secures SITRANS LR 200 from parameter changes via the hand programmer.

Value	Unlocked Value (P069)	*	Unlocked: programming permitted ¹
	other		Locked: programming not permitted

1. The factory setting for P069 is 1954: after a new Unlocked value is entered and accepted, the new value becomes the default setting.

Note:


- This lock only applies to the hand programmer: it does not lock access through communications.
- A remote master can change configuration if P799 is set to allow this.

To secure the programming lock:

1. Key in **0**, and press **ENTER** .
2. Key in any value other than the Unlocked Value (P069).
3. Press **ENTER** to set the value: **PROGRAM** mode is now active for viewing only.

To unlock the instrument and enable programming changes:

1. Key in **0**, and press **ENTER** .
2. Key in the Unlocked Value (P069).
3. Press **ENTER** to set the value: **PROGRAM** mode is now active for programming.

¹ At a parameter with a secondary index, pressing **DISPLAY**  twice focusses the control on the secondary index.

Quick Start (P001 to P010)

P001 Operation

Note: Default values are indicated with an asterisk (*) in the parameter tables, unless explicitly described.

Sets the type of measurement required for the application. (This affects the local LCD only: the primary variable for HART is controlled by P201.)

To measure how full the vessel is, select **Level**. The reading can be returned as level or as volume:

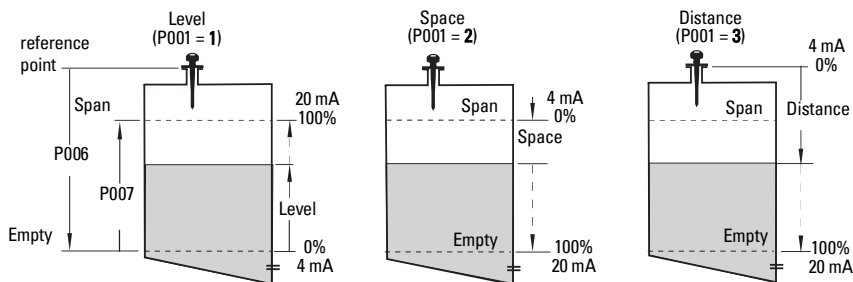
- for a level reading, ensure P050 is set to **0**: the reading returns the distance from process empty level (Empty) to the current level
- for a volume reading, select a vessel shape at P050, and set volume parameters 051 to 055 as required

To measure how much space remains in the vessel, select **Space**:

- **Space** returns a reading for the distance between current level and process full level (Span)

To measure the distance from the reference point¹ to the current level, select **Distance**.

Values	0	Instrument out of service.
	1 *	Level returns material level referenced from Empty (process empty level). The reading is returned in volumetric units if parameters 050 to 055 are set to enable this.
	2	Space returns material level referenced from Span (process full level).
	3	Distance returns material level reference from the reference point ¹ .



¹ For the reference point for the standard model, see *SITRANS LR 200 Dimensions* on page 13. For other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

Notes:

- Setting P001 resets Span (P007), unless Span has previously been set to a different value. Span is set to Empty distance minus 110% of Blanking¹ unless P001 is set to **3** (distance measurement). In this case it is set to the same value as Empty (P006).
- Changing P001 may reset Output Function (P201). This applies to HART only.

P003 Measurement Response

Sets the rate of response to level changes.

Related Parameters	P003			Failsafe Timer P070 (minutes)	Max. Measurement Response P700/P701	Damping Filter P709	Echo Verification P711
Values	1	*	slow	100	0.1 m/minute	10.0 s	2
	2		medium	10	1 m/minute	10.0 s	2
	3		fast	1	10 m/minute	1.0 s	2

Note: Changing P003 resets the following parameters: P070, P700, P701, P709, and P711.

Use a setting just faster than the maximum filling or emptying rate (whichever is greater). Slower settings provide higher accuracy: faster settings allow for more level fluctuation.

- **Echo Verification (P711):** discriminates between agitator blades in motion (spurious noise) and the target surface (true echo).
- **Failsafe timer (P070):** establishes the period from the time a loss of echo (LOE) starts until the Failsafe default (P071) is triggered. P070 takes precedence over P003.

P004 Antenna Type

Specifies the antenna type attached.

Values	240	*	antenna without PTFE extension
	241		rod + 50 mm PTFE extension
	242		rod + 100 mm PTFE extension

¹ See *Near Blanking* on page 81 for more details.

P005 Units

Specifies measurement units used for dimensional values.

Values	1	*	meters
	2		centimeters
	3		millimeters
	4		feet
	5		inches

P006 Empty (process empty level)

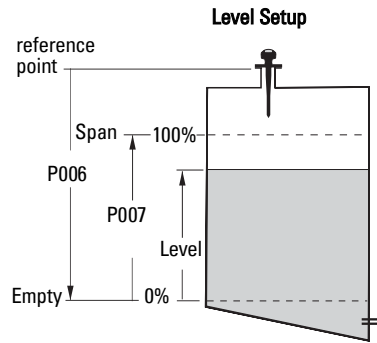
Sets the distance from the reference point¹ to the process empty level, in units selected at P005.

Values	Range	0.0000 to 20.00 (m)
	Default	20.00 m (max. range)

Enter the distance from the reference point to Empty (process empty level), using units set in P005. Empty can be set to any distance: not necessarily the bottom of the vessel

Notes:

- Default setting is maximum range.
- P006 and P007 are interlinked: see note attached to P007.



¹ For the reference point for the standard configuration, see *SITRANS LR 200 Dimensions* on page 13; for other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

P007 Span (process full level)

Sets the range to be measured (referenced from Empty) in units selected at P005.

Values	Range	0.0000 to 20.00 (m)
	Default	19.56 (see note below)

Enter the distance between Empty (process empty level) and Span (process full level), in units set in P005. Span can be set at any distance above Empty level.

Notes:

- Setting P006 will reset Span, if it has not previously been set to a different value.
- The default setting for Span is based on Operation (P001) and Empty (P006). Span is set to Empty minus 110% of Blanking¹ distance, unless Operation is set to **Distance** (P001 = 3). In this case, Span is set to Empty distance.
- Always prevent the monitored surface from approaching within 0.3 m (1 ft.) of the reference point, as this is the minimum distance detectable.

P010 Language

Selects the language used for the auxiliary reading on the display.

Values	0	*	Numeric / None
	1		English
	2		German
	3		French
	4		Spanish

If a language is selected, parameter titles for the Quick Start parameters are displayed. (See the table on page 22 for the titles displayed.)

¹ See *Near Blanking* on page 81 for details.

Volume (P050 to P055)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

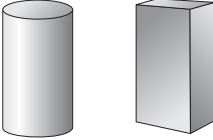
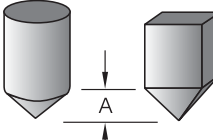
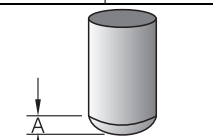
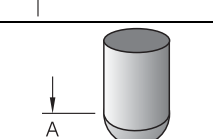
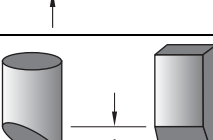
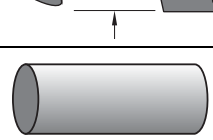
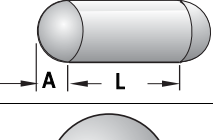
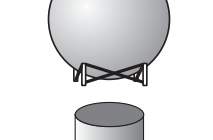
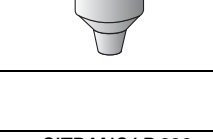
Set SITRANS LR 200 to calculate readings based on reservoir volume instead of level.

1. Operation must be set to Level (P001 = 1).
2. Select a vessel shape matching the monitored vessel (P050).
3. If required, add dimensions A or L (as shown in the chart on page 39), using P052 and P053,
or, if vessel shape 9 is selected, add level and volume breakpoints in P054 and P055.
4. Enter the value for the maximum vessel volume in P051.
5. Return to **RUN** mode: readings are now displayed in volumetric units. To select **PERCENT**, press $\left(\frac{\%}{\%}\right)$; the displayed volume reading will be a percentage of Maximum Volume.

P050 Vessel Shape

Defines the vessel shape (see chart on next page) and allows SITRANS LR 200 to calculate volume instead of level. The default setting for P050 is 0 (volume calculation not required).

Enter the value for the vessel shape matching the monitored vessel or reservoir (see chart on page 39).


P050 Value	Vessel Shape	Description	Also required	
0	*	----	no volume calculation required	N/A
1		flat bottom	P051	
2		conical or pyramidal bottom	P051, P052	
3		parabolic bottom	P051, P052	
4		spherical bottom	P051, P052	
5		angled bottom	P051, P052	
6		flat end cylinder	P051	
7		parabolic end cylinder	P051, P052, P053	
8		sphere	P051	
9		universal linear level/volume breakpoints	P051, P054, P055	

P051 Maximum Volume

For readings in volumetric units instead of percentage values, enter the vessel volume corresponding to Span (P007). Any volumetric units can be chosen, because the volume calculation is based on the maximum volume, and scaled according to the Vessel Shape (P050) value. If no value is entered, the default is 100, and the reading will be a percentage value.

Values	Range: 0.0000 to 99999
	Default: 100.0
Related Parameters	P006 Empty P007 Span

Enter the vessel volume corresponding to Span (P007).

1. Key in the value. (For example, if maximum volume = 3650 m³, key in 3650.)
2. Press **ENTER** .

If the value is too large for the LCD display, enter larger units.

Example:

If maximum volume = 267,500 gallons, key in **267.5** (thousands of gallons).

P052 Vessel Dimension A

Dimension A as used for P050 Vessel Shapes 2, 3, 4, 5, or 7, in the chart on page 39).

Values	Range: 0.0000 to 99999 in units (P005)
	Default: 0.0
Related Parameters	P050 Vessel Shape

Enter one of the following, using the units selected in P005:

- height of the vessel bottom if P050 = **2, 3, 4, or 5**
- length of one end-section of the vessel if P050 = **7**

P053 Vessel Dimension L

Dimension L as used in P050 Vessel Shape, in the chart on page 39).

Values	Range: 0.0000 to 99999 in units (P005)
	Default: 0.0
Related Parameters	P050 Vessel Shape





Enter the vessel length **L** (excluding both end sections) if P050 = **7**. Use the units selected in P005.

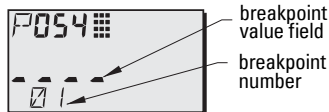
P054 Level Breakpoints

When the vessel shape is too complex for any of the preconfigured shapes, you can define the shape as a series of segments. In P054 you assign a level value to each breakpoint. In P055 you assign a corresponding volume value to each breakpoint.

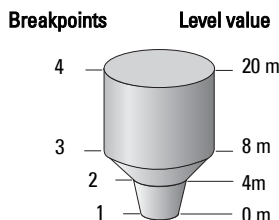
Primary Index	P054
Secondary Index	Breakpoint number
Values	Range: 0.0000 to 99999 in units (P005)
	Default: 0.0
Related Parameters	P055 Volume Breakpoints

Enter up to 11 level breakpoints, where the corresponding volume is known. The 100% and 0% levels must be entered. The breakpoints can be ordered from top to bottom, or the reverse.

1. First set P050 to **9**.
2. Select P054.
3. The empty breakpoint value field appears, with the breakpoint number 01 in the auxiliary reading.
4. Key in the level value for breakpoint 1, and press **ENTER** . (Use units defined in P005.)
5. Press **DISPLAY**  twice to focus control on the secondary index.
6. Press the **UP ARROW** key  to display 02 in the auxiliary reading.
7. Key in the level value for breakpoint 2, and press **ENTER** . (Use units defined in P005.)
8. Repeat steps 6 and 7 until level values have been entered for all the required breakpoints.



Example:



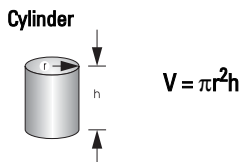
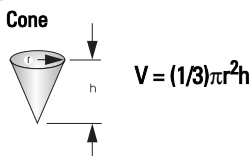
Breakpoint Number	Level breakpoint (P054)	Volume breakpoint (P055)
1	0	0
2	4	500
3	8	3000
4	20	8000

P055 Volume Breakpoints





Each segment defined by the level breakpoints (P054) requires a corresponding volume for SITRANS LR 200 to make the level-to-volume calculations.

Primary Index	P055
Secondary Index	Breakpoint number
Values	Range: 0.0000 to 99999 in units
	Default: 0.0000
Related Parameters	P054 Volume Breakpoints

Typical volume calculations:



Enter a volume for each breakpoint defined in P054. (See illustrated example for P054 on the previous page.)

1. First set P050 to **9**.
2. Select P055.
3. The empty breakpoint value field appears, with the breakpoint number 01 in the auxiliary reading.
4. Key in the volume for breakpoint 1, and press **ENTER** . (Any volumetric units can be used: see note to P051.)
5. Press **DISPLAY**  twice to focus control on the secondary index.
6. Press the **UP ARROW** key  to display 02 in the auxiliary reading.
7. Key in the volume for breakpoint 2, and press **ENTER** .
8. Repeat steps 5 and 6 until volume values have been entered for all the required breakpoints.

Lock (P069)

P069 Unlocked value

Stores the value to enter in Lock (P000) to unlock programming. If P000 is locked, P069 will not display the Unlocked value.

Values	Range	1 to 9999
	Factory setting	1954
	----	Display when P000 is locked

Notes:

- Default setting for P000 is unlocked.
- After a new value has been stored at P069, that value will be recalled after a master reset (P999).
- Consult your Siemens Milltronics representative, if you have forgotten the unlocked value.

Failsafe (P070 to P073)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P070 Failsafe Timer

Sets the time to elapse in minutes since the last valid reading, before Failsafe State activates.


Values	Range: 0.00 to 720 min.
	Default: 100.0 (based on P003)

Note: The last valid reading is maintained until the Failsafe timer expires. After the timer expires, the reading is set based on P071.

P071 Failsafe Material Level

The material level to be reported when the Failsafe Timer expires.

Values	1		HI	Use Maximum mA Limit (P213) as material level
	2		LO	Use Minimum mA Limit (P212) as material level
	3	*	HOLD	Level remains at last reading
	4		SEL	User-selected value (defined in P073)

1. Enter the value corresponding to the level you want reported when the Failsafe Timer expires.
2. Press **ENTER** .

P073 Failsafe level

Defines a user-defined level to report when the Failsafe timer expires.

Values	Range: 3.6 mA to 22.6 mA
	Default: 3.6 mA

Note: P071 must be set to **SEL** to use this value.

mA Output (P201 to P215)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P201 mA Output Function

Alters the mA output/measurement relationship, and allows the output to be set independently from P001. If a HART master is connected, only the master can change the value.

Values	0		manual
	1	*	level
	2		space
	3		distance
	4		volume (only available if a tank shape has been selected at P050)

Notes:

- P201 is set independently from P001: set P001 first, as changing P001 will reset P201 to the same setting.
- P201 controls the primary value and the loop current for the HART common module and should not be changed if using HART.
- Selection also affects the secondary, tertiary, and quaternary variables for HART.
- P201 must be set to **0** (manual) before you can modify P911. Remember to restore the previous setting after using P911.

Independent mA Setpoint Parameters (P210 and P211)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P210 and P211 allow you to explicitly define the normal operating range. Use these features to reference the minimum and/or maximum mA output to any point in the measurement range.

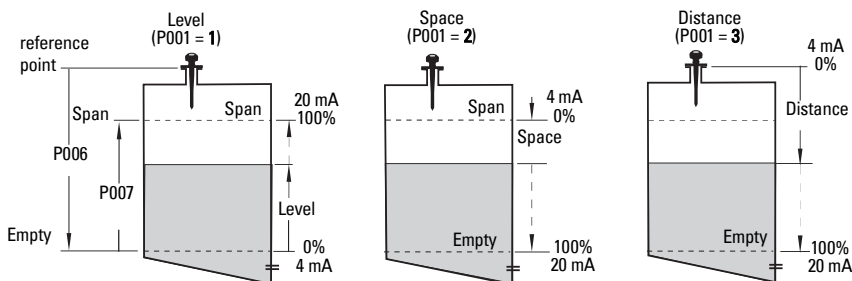
For HART, 4 mA and 20 mA represent the upper and lower range limits for the primary variable.

P201 (mA Function) Settings	Response for P210 and P211
Level, Space, or Distance	Key in the material level in Units (P005) or percent ¹ of Span (P007) as referenced from Empty (P006).
Volume	Key in the volume in Maximum Volume (P051) units or as a percent ¹ of Maximum Volume.

1. Ensure the % symbol is displayed before entering a % value.

P210 4 mA Setpoint (low output)

Sets the process level corresponding to the 4 mA value. 4 mA always defaults to 0, and P201 determines whether this is a Level, Space, Distance, or Volume measurement. Level and Space are measured as a percentage of Span; Distance is measured as a percentage of Empty.



Values	Range: -99999 to 99999 .
	Default: 0.000 m (set to 0% as defined by P201: mA Output Function)
Related Parameters	P201: mA Output Function

Enter the reading that is to correspond to a 4 mA output. Use percent or units, depending on the setting for P051.

Note: P210 is used to set the 4 mA loop current for the HART common module.

P211 20 mA Setpoint (high output)

Sets the process level corresponding to the 20 mA value. 20 mA always defaults to 100%, and P201 determines whether this is a Level, Space, or Distance measurement. Level and Space are measured as a percentage of Span; Distance is measured as a percentage of Empty.

Values	Range: -99999 to 99999 .
	Default: 19.56 m (set to 100% as defined by P201: mA Output Function)
Related Parameters	P201: mA Output Function

Enter the reading that is to correspond to a 20 mA output, Use percent or units, depending on the setting for P051.

Note: P211 is used to set the 20 mA loop current for the HART common module.

mA Output Limit Parameters (P212 and P213)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P212 and P213 allow you to explicitly set a failsafe current outside the normal operating range.

P212 Minimum mA limit

Prevents the mA output from dropping below this minimum level for a measurement value. This does not restrict the Failsafe or manual settings.

Values	Range: 3.8 to 20.5 (mA)
	Default: 3.8 (mA)

Note: P212 is available only for the HART common module.

P213 Maximum mA limit

Prevents the mA output from rising above this maximum level for a measurement value. This does not restrict the Failsafe or manual settings.

Values	Range: 3.8 to 20.5 (mA)
	Default: 20.5 (mA)

Note: P213 is available only for the HART common module.

P214 4 mA Output Trim

Note: P214 is available only for the HART common module.

Calibrates the 4 mA output. The mA output of the device is pre-calibrated; however, P214 can be used to trim remote displays or inputs.

Values	Range: 2.0 to 6.0 (mA)
Related parameters	P215: 20 mA Output Trim

Steps:

1. Set Output Function (P201) to **0** (manual).
2. Set Output Value (P911) to **4 mA**.
3. Attach a calibrated meter and check the output at the terminals; record the remote reading in mA.
4. Enter this value in P214.
5. Restore P201 to previous setting.
6. Confirm that the mA output is as expected.

P215 20 mA Output Trim

Note: P215 is available only for the HART common module.

Calibrates the 20 mA output. The mA output of the device is pre-calibrated; however, P215 can be used to trim remote displays or inputs.

Values	Range: 18.0 to 24.0 (mA)
Related parameters	P214: mA Output Trim

Steps:

1. Set Output Function (P201) to **0** (manual).
2. Set Output Value (P911) to **20 mA**.
3. Attach a calibrated meter and check the output at the terminals; record the remote reading in mA.
4. Enter this value in P215.
5. Restore P201 to previous setting.
6. Confirm that the mA output is as expected.

Installation Records (P341 to P346)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P341 RUN Time

Displays the number of uninterrupted 24 hour periods that the device has been operating.

Values (view only)	Range: 0 to 99999 (days)
	Default: 0
Related	P342: Power-on Resets

P341 is updated once a day.

- If power is cycled before 24 hours have passed, the run time will not be updated.
- If an instrument is powered down on a regular basis, P341 will not have an accurate value.

P342 Power-On Resets

The number of times power has been applied since the date of manufacture.

Values (view only)	Display: 0.0 to 99999
	Default: 0
Related	P341 RUN Time

This parameter is updated every time the instrument is reset or is powered up.

P343 Internal Temperature

Displays (in degrees C) either the current temperature on the circuit board, or the maximum or minimum temperature recorded by the internal sensor. The high and low values are maintained over a power cycle.

Values (view only)	Range	-50 °C to 150 °C
	1	Current temperature
	2	Maximum temperature
	3	Minimum temperature

! **WARNING:** Internal temperature must not exceed 80 °C (176 °F).

P346 Serial Number

Displays the serial number of the instrument. The numbers stored in Index 2, followed by the numbers stored in Index 1, give you the complete serial number.

	Index 2	Index 1	
Values (view only)	Range: 00000 to 99999	Range: 00000 to 99999	
Example: 1503010	15	03	010

Range Calibration (P652 to P655)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P652 Offset Correction

A fixed offset value that is added to the reading as a correction to the measurement.

Values	Range: -99999 to 99999
	Default: 0.000

P655 Propagation Factor

The value used to compensate for changes in microwave velocity due to propagation within a metal stillpipe, instead of in free space.

Values	Range: 0.3000 to 1.5000
	Default: 1.000

Pipe Size (I.D.)	Propagation Factor
50 mm (2")	0.827
80 mm (3")	0.915
100 mm (4")	0.955
150 mm (6")	0.980
200 mm (8")	0.990

Contact your Siemens Milltronics representative for other sizes and propagation factor numbers.

Note: For waveguide antennas used as stillpipes, the propagation factor value is shown on the process device tag.

The propagation factor is constant for a given pipe diameter, or can be determined by comparing the radar distance reading to the actual process material distance (measured from the reference point¹).

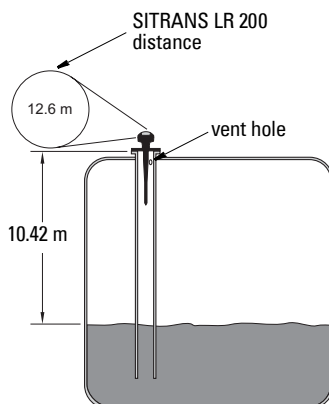
Example:

$$\frac{\text{actual distance}}{\text{SITRANS LR 200 distance}} = \text{p.f. (propagation factor)}$$

Using the readings shown:

$$\frac{10.42\text{m}}{12.6\text{m}} = 0.827$$

Enter the propagation factor: **0.827**



Rate (P700 and P701)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

These parameters determine how material level changes are reported.

P700 Maximum Fill Rate

Allows you to further adjust the SITRANS LR 200 response to increases in the actual material level (or an advance to a higher Failsafe Material Level, P071). P700 is automatically updated whenever Measurement Response (P003) is altered.

Values	Range: 0.0000 to 99999 m / min.
	Factory setting: 0.1
Altered by	P003 Maximum Process Speed
Related	P005 Units P007 Span P071 Failsafe Material Level

Enter a value slightly greater than the maximum vessel-filling rate, in Units (P005) or percent of Span (P007) per minute.

P003 Value	Meters/Minute
1	0.1
2	1
3	10

¹ For the reference point for the standard model, see *SITRANS LR 200 Dimensions* on page 13. For other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

P701 Maximum Empty Rate

Adjusts the SITRANS LR 200 response to decreases in the actual material level (or an advance to a lower Failsafe Material Level, P071). P701 is automatically updated whenever Measurement Response (P003) is altered.

Values	Range: 0.0000 to 99999 m / min.
	Factory setting: 0.1
Altered by	P003 Maximum Process Speed
Related	P005 Units P007 Span P071 Failsafe Material Level

Enter a value slightly greater than the vessel's maximum emptying rate, in Units (P005) or percent of Span (P007) per minute.

P003 Value	Meters/Minute
1	0.1
2	1
3	10

Measurement Verification (P709 to P713)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P709 Damping Filter

Stabilizes the reported level within the Echo Lock Window (P713) in the event of level fluctuations (for example, a rippling or splashing liquid surface). The value is in seconds, and depends on the number of seconds it takes the device to reach 63% of a step value change in reading.

Values	Range: 0 to 100 seconds (0 = off)
	Default: 10.0 seconds
Altered by	P003 Maximum Process Speed
Related	P007 Span P713 Echo Lock Window

The value is automatically altered when Measurement Response Speed (P003) changes. The higher the value entered, the greater the range of stabilized fluctuation.

P711 Echo Lock

Use this feature to select the measurement verification process.

Values	0		Off
	1		Maximum Verification
	2	*	Material Agitator
	3		Total Lock
Related	P700 Maximum Fill Rate P701 Maximum Empty Rate P712 Echo Lock Sampling P713 Echo Lock Window P820 Algorithm		

If a material agitator or mixer is used in the monitored vessel, set Echo Lock for Maximum Verification or Material Agitator, to avoid agitator blade detection.

Note: Ensure the agitator is always running while SITRANS LR 200 is monitoring the vessel, to avoid stationary blade detection.

- When Maximum Verification or Material Agitator is selected, a new measurement outside the Echo Lock Window (P713) must meet the sampling criterion (P712).
- When Total Lock is selected, Echo Lock Window (P713) is pre-set to **0**.

SITRANS LR 200 continuously searches for the best echo according to the algorithm chosen (P820). If the selected echo is within the window, the window is then centered about the echo. If not, the window widens with each successive shot until the selected echo is within the window. The window then returns to its normal width.

When Echo Lock is Off, SITRANS LR 200 responds immediately to a new measurement, as restricted by the Maximum Fill / Empty Rate (P700 / P701). However, measurement reliability is affected.

P712 Echo Lock Sampling

The sampling criterion sets the number of consecutive echoes that must appear above or below the echo currently locked onto, before the measurements are validated as the new reading. (Echo Lock P711 must be set to **1** or **2**.)

Values	Range: 1:1 to 50:50
	Format: xy x = the number of above echoes y = the number of below echoes
Related	P711 Echo Lock

P711 default value		Description	P712 pre-set value
1		maximum verification	5:5
2	*	material agitator	5:2

Example:

- Set P711 to **2** (material agitator)
- The preset values for P712 in this case are **5:2**
- Result: a new reading will not be validated unless 5 consecutive measurements higher or 2 consecutive measurements lower than the current reading occur.

Note: Resetting P711 returns P712 to the respective pre-set values.

P713 Echo Lock Window

Adjusts the size of the Echo Lock Window. This value is automatically altered when Measurement Response (P003), Maximum Fill Rate (P700), or Maximum Empty Rate (P701), are altered.

Values	Range: 0.000 to 9999
	Default: 0.000
Altered by	P003 Maximum Process Speed
Related Parameters	P005 Units P711 Echo Lock

The Echo Lock Window is a 'distance window'¹, centered on the echo used to derive the reading. When a new measurement falls within the window, the window is re-centered and the new reading calculated. Otherwise, the new measurement is verified by Echo Lock (P711) before the reading is updated.

¹. Units are those set in P005.

When the value is **0**, the window is automatically calculated after each measurement. The value is fixed at **0** if Echo Lock (P711) is set to **3**.

- For slower Measurement Response values (P003), the window is narrow.
- For faster P003 values the window becomes progressively wider.

Note: The echo lock window is stored as standard samples, but displayed in units based on P005. Any value entered for P713 will be rounded to the nearest sample.

Communications (P799)

P799 Communications Control

Enables the read/write access to parameters via remote communications.

Values	0		Read only
	1	*	Read/write
	2		Restricted access – read only except for P799 which is read/write

Notes:

- P799 controls the access if you are using a HART master.
- P000 controls the lock access if you are using the Siemens Milltronics hand programmer.

Echo Processing (P800 to P807)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

The following parameters are for authorized Siemens Milltronics Service personnel or technicians familiar with Siemens Milltronics echo processing techniques. View the echo profile first, before attempting to modify these parameters.

P800 Near Blanking ¹

Defines the distance from the reference point to be ignored by the transmitter/receiver.

Values	Range: 0.00 to 20 (m: selected in P005)
	Default: 0.400 m
Related	P006 Empty P007 Span P838 Auto False-Echo Suppression Distance

To extend the blanking beyond the minimum default, enter a value in units.

P801 Range Extension

Allows the material level to drop below Empty (process empty level), without generating an LOE state.

Values	Range: 0 to 99 (% or units)
	Default: 5.000 (% of Span)
Related	P006 Empty P007 Span P838 Auto False-Echo Suppression Distance

Use this feature if the surface monitored can drop below Empty level (P006) in normal operation. The value for P801 is added to Empty, and the sum can be greater than the range of the antenna. Range Extension can be increased (in Units or percent of Span) to a point where Empty plus Range Extension is greater than the distance from the flange face to the furthest surface to be monitored. The distance below empty is not blanked.

- Enter the value as a percentage of P006.
- For vessels with conical or parabolic bottoms, increase the value for P801 to ensure that an empty vessel reads Empty.

¹ For more details, see *Near Blanking* on page 81.

P804 Confidence Threshold

Determines which echoes are evaluated by software.

Values	Range: 0 to 99
	Default: 5
Related Parameters	P070 Failsafe Timer


P804 sets the minimum echo confidence that the echo must meet in order to prevent a Loss of Echo condition and the expiration of the Failsafe timer (P070). When Echo Confidence (P805) exceeds the Confidence Threshold, the echo is evaluated.

This feature is used when an incorrect material level is reported.

P805 Echo Confidence

Measures echo reliability. It displays the echo confidence of the measurement echo from the last shot. P804 defines the minimum criterion for echo confidence.


Values (view only)	Display: 0 to 99	
	Default: 0	
	----	Shot not used
Related Parameters	P804 Confidence Threshold	

Press the measurement key  to get a new reading that will update confidence values.

P806 Echo Strength

Displays the absolute strength (in dB above 1 μV rms) of the echo selected as the measurement echo.

Values (view only)	Display: -20 to 99
	Default: -15


Press the measurement key  to get a new reading that will update echo strength.

P807 Noise

Displays the average and peak ambient noise (in dB above 1 μ V rms) of a noise profile, as x.y. Noise level is a combination of transient noise and receiving circuitry.

Values (view only)	x = average (range: -20 to 99)
	y = peak (range: -20 to 99)
	Start up display ¹ : -15 . - 15 (x.y)

1. The start up display, before a noise shot has been taken.

After a measurement, the values from the previous noise shot will be displayed. Press the measurement key  to get a new reading that will update the noise profile.

Algorithm (P820)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P820 Algorithm

Selects the algorithm to be applied to the echo profile to extract the true echo.

Values	3		Largest echo
	4		Reserved
	8		best of Largest or First echo
	12	*	First echo

TVT (Time Varying Threshold) Adjustment Parameters (P837 to P839)

Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

First SITRANS LR 200 learns the echo profile. Then the learned profile, or part of the learned profile, is used to screen out false echoes.

The following parameters are for authorized Siemens Milltronics Service personnel or technicians familiar with Siemens Milltronics echo processing techniques. View the echo profile first, before attempting to modify these parameters.

P837 Auto False-Echo Suppression

Use P837 and P838 together, to set SITRANS LR 200 to ignore false echoes. Use P838 to set the Auto TVT distance first.

Notes:

- This function works best when the vessel is empty or nearly empty: use it only if there is a minimum distance of 2 meters from the radar instrument to the material.
- Set P837 and P838 during start up, if possible.
- If the vessel contains an agitator, the agitator should be running.

If SITRANS LR 200 displays a full level, or if the reading fluctuates between a false high level and a correct level, set P837 to elevate the TVT in this region and to de-sensitize the receiver from any 'base noise' caused by internal antenna reflections, nozzle echoes, or other vessel false echoes. (For examples of echo profiles before and after using this feature, see page 60.)

1. Rotate the instrument for best signal (lowest false-echo amplitude).
2. Set P 838 and then P837.

Values	0		Off
	1	*	Use 'learned' TVT. (See 'learned TVT curve' in <i>Example After Auto False-Echo Suppression</i> on page 60.)
	2		Learn





P838 Auto False-Echo Suppression Distance

Defines the range of Auto False-Echo Suppression (P837) to use for ignoring false echoes. (Units are defined in P005.)

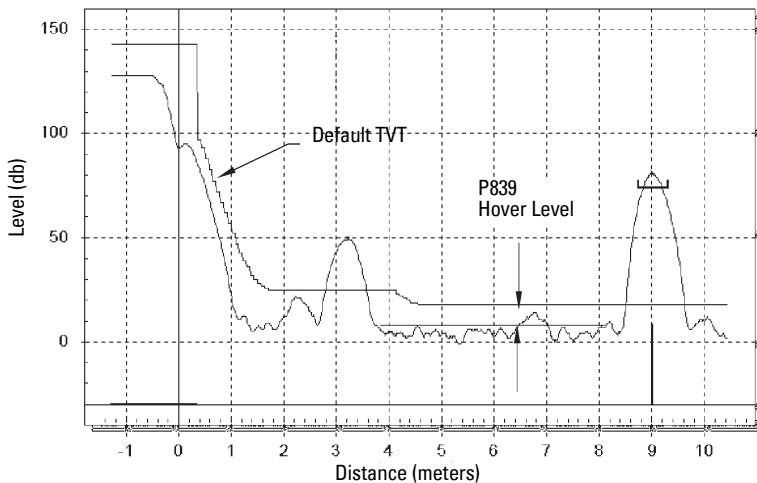
Values	Range: 0.000 to 20.00 m (maximum range)
	Default: 1.000 m

Determine the actual distance from the antenna reference point to the material surface. Subtract 0.5 m from this distance, and enter the result.

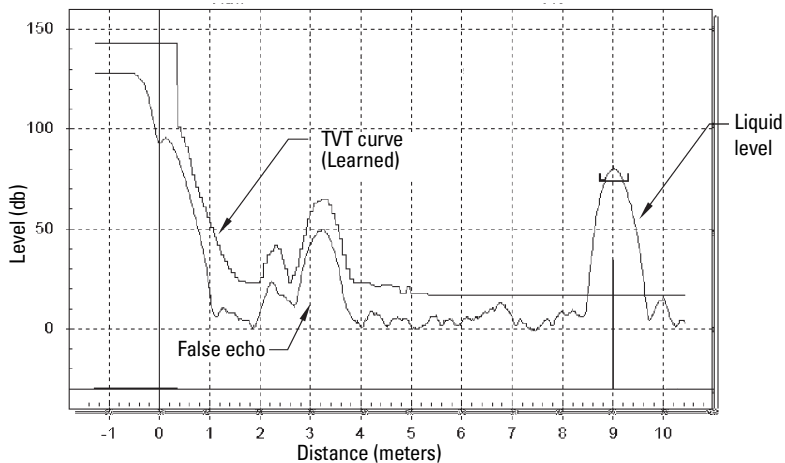
Set Up:

1. Perform this function when the vessel is empty or nearly empty.
2. Determine **distance** from radar instrument to liquid level.
3. Press **PROGRAM**  then **DISPLAY** .
4. Select P838 and set [distance to liquid level minus 0.5m].
5. Select P837.
6. Press **2** and then press **ENTER** . P837 will revert to **1** (use Learned TVT) automatically after a few seconds.
7. Press **PROGRAM**  to return to **RUN** mode.

Display before Auto False-Echo Suppression (or when P837 = 0)



Example After Auto False-Echo Suppression



P839 TVT Hover Level

Defines (in percent) how high the TVT curve is placed above the profile, relative to the largest echo. When SITRANS LR 200 is located in the center of the vessel, lower this parameter to prevent multiple echo detections.

Values	Range: 0 to 100%
	Default: 40 %

Test (P900 to P924)


Note: Factory settings are indicated by an asterisk (*) in the parameter tables, unless explicitly described.

P900 Software Revision Number

Displays the software revision level.

Values (view only)	Range: 0.00 to 99.99	
	1	Main code revision
	2	Primary boot revision
	3	Alternative boot revision
	3	Hardware stack revision
	Default	Determined by the software revisions installed

P901 Memory Test

Press **ENTER**  to activate the test.

Values (view only)	PASS	Memory test successful
	F1	Fail RAM
	F2	Fail EEPROM
	F3	Fail FLASH

Measurement

P911 mA Output Value (HART/mA only)

Access this parameter to display the current value of the mA output.

Values (HART)	Range: 3.6 to 22.6 (mA)	
	*	4 mA in HART fixed current mode

1. Set P201 to 0 (manual).
2. Enter a test value.

Note: P201 must be set to 0 to enable the test value to be entered at P911; be sure to restore P201 to the previous setting after the test!

P920 Reading Measurement

P920 corresponds to the final reading after all programming is applied. It is a copy of one of P921 to P924, depending on the setting for Operation (P001).

	Operation P001		Source Parameter for P920
	0	Off	-----
	1	Level	P921 if P050 = 0, otherwise P924
	2	Space	P922
	3	Distance	P923
P920 Values (read only)	Range: -99999 to 99999 (dimensional units, if volume has not been selected)		

P921 Material Measurement

Displays the distance between Empty /process empty level (P006) and the monitored surface, in Units (P005) or percent of Span (P007).

Values (view only)	Range: -99999 to 99999
--------------------	-------------------------------

P922 Space Measurement

Displays the distance between the monitored surface and Span / process full level (P007).

Values (view only)	Range: -99999 to 99999
--------------------	------------------------

P923 Distance Measurement

Displays the distance between the monitored surface and the reference point¹.

Values (view only)	Range: -99999 to 99999
--------------------	------------------------

P924 Volume Measurement

The calculated vessel capacity in Maximum Volume (P051) or percent of Maximum Volume (volume calculation must be enabled at P050).

Values (view only)	Range: -99999 to 99999
Related Parameters	P051 Maximum Volume P050 Vessel Shape

Note: The display for P924 reads - - - -, when volume calculation is not enabled at P050 (P050 = 0).



P999 Master Reset

Note: Following a Master Reset, complete reprogramming is required.

Resets all parameters to their factory settings, with the following exceptions:

- P000 and P069 are not reset.
- The learned TVT curve is not lost.

Use this feature after upgrading software:

1. Select P999.
2. Press **CLEAR**  then **ENTER**  to Clear All and initiate reset.
3. Reset complete.
(**Note:** Reset takes several seconds to complete.)



¹ For the reference point for the standard model, see *SITRANS LR 200 Dimensions* on page 13. For other configurations, see *Appendix G: Flanged Antenna Options*, page 93 onwards.

Appendix A

Alphabetical Parameter List

Parameter Name	Parameter Number	Page Number
20 mA Setpoint (high output)	211	46
20 mA Output Trim	215	48
4 mA Output Trim	214	48
4 mA Setpoint (low output)	210	46
Algorithm (Echo)	820	58
Antenna Type	004	35
Auto False-Echo Suppression	837	59
Auto False-Echo Suppression Distance	838	59
Level Breakpoints	054	41
Communications Control	799	55
Confidence Threshold	804	57
Damping Filter	709	52
Distance Measurement	923	63
Echo Confidence	805	57
Echo Lock	711	53
Echo Lock Sampling	712	54
Echo Lock Window	713	54
Echo Strength	806	57
Empty (process empty level)	006	36
Failsafe Level	073	44
Failsafe Material Level	071	44
Failsafe Timer	070	43
Internal Temperature	343	49
Language	010	37
Lock	000	33
mA Output Function	201	44
mA Output Value (HART / mA only (911	62
Master Reset	999	63
Material Measurement	921	62
Maximum Empty Rate	701	52

Parameter Name	Parameter Number	Page Number
Maximum Fill Rate	700	51
Maximum mA limit	213	47
Maximum Volume	051	40
Measurement Response	003	35
Memory Test	901	61
Minimum mA limit	212	47
Near Blanking	800	56
Noise	807	58
Offset Correction	652	50
Operation	001	34
Power-on Resets	342	49
Propagation Factor	655	50
Range Extension	801	56
Reading Measurement	920	62
Serial Number	346	50
RUN Time	341	49
Software Revision Number	900	61
Space Measurement	922	63
Span (process full level)	007	37
Vessel Dimension A	052	40
Vessel Dimension L	053	40
Vessel Shape	050	38
TVT Hover Level	839	61
Units	005	36
Unlocked Value	069	43
Volume Breakpoints	055	42
Volume Measurement	924	63

Appendix B

Programming Chart

Parameter Number and Name	Value
P000 Lock	
P001 Operation	
P003 Measurement Response	
P004 Antenna Type	
P005 Units	
P006 Empty (process empty level)	
P007 Span (process full level)	
P010 Language	
P050 Vessel Shape	
P051 Maximum Volume	
P051 Maximum Volume	
P053 Vessel Dimension L	
P054 Level Breakpoints	
P055 Volume Breakpoints	
P069 Unlocked value	
P070 Failsafe Timer	
P071 Failsafe Material Level	
P073 Failsafe level	
P201 mA Output Function	
P210 4 mA Setpoint (low output)	
P211 20 mA Setpoint (high output)	
P214 4 mA Output Trim	
P215 20 mA Output Trim	
mA Output Limit Parameters (P212 and P213)	
P213 Maximum mA limit	
P341 RUN Time	
P342 Power-On Resets	
P343 Internal Temperature	

Parameter Number and Name	Value
P346 Serial Number	
P652 Offset Correction	
P655 Propagation Factor	Propagation Factor
P700 Maximum Fill Rate	
P701 Maximum Empty Rate	
P709 Damping Filter	
P711 Echo Lock	
P712 Echo Lock Sampling	
P713 Echo Lock Window	
P799 Communications Control	
P800 Near Blanking	
P801 Range Extension	
P804 Confidence Threshold	
P805 Echo Confidence	
P806 Echo Strength	
P807 Noise	
P820 Algorithm	
P837 Auto False-Echo Suppression	
P838 Auto False-Echo Suppression Distance	
P839 TVT Hover Level	
P900 Software Revision Number	
P901 Memory Test	
P911 mA Output Value (HART/mA only)	
P920 Reading Measurement	
P920 Reading Measurement	
P921 Material Measurement	
P922 Space Measurement	
P923 Distance Measurement	
P924 Volume Measurement	
P999 Master Reset	

HART Communications for SITRANS LR 200

Highway Addressable Remote Transducer, HART, is an industrial protocol that is superimposed on the 4-20 mA signal. It is an open standard, and full details about HART can be obtained from the HART Communication Foundation at www.hartcomm.org

SITRANS LR 200 can be configured over the HART network using either the HART Communicator 275 by Fisher-Rosemount, or a software package. There are a number of different software packages available. The recommended software package is the SIMATIC Process Device Manager (PDM) by Siemens.

HART Device Descriptor (DD)

In order to configure a HART device, the configurator must have the HART Device Descriptor for the instrument in question. HART DDs are controlled by the HART Communication Foundation. Please check with the HART Communication Foundation for the availability of the HART DD for SITRANS LR 200. Older versions of the library will have to be updated in order to use all the features of SITRANS LR 200.

SIMATIC Process Device Manager (PDM)

This software package is designed to permit easy configuration, monitoring, and troubleshooting of HART devices. The HART DD for SITRANS LR 200 was written with SIMATIC PDM in mind and has been extensively tested with this software.

The Device Descriptor for SIMATIC PDM may be downloaded from our website: www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Downloads.

HART Communicator 275:

Chart 1

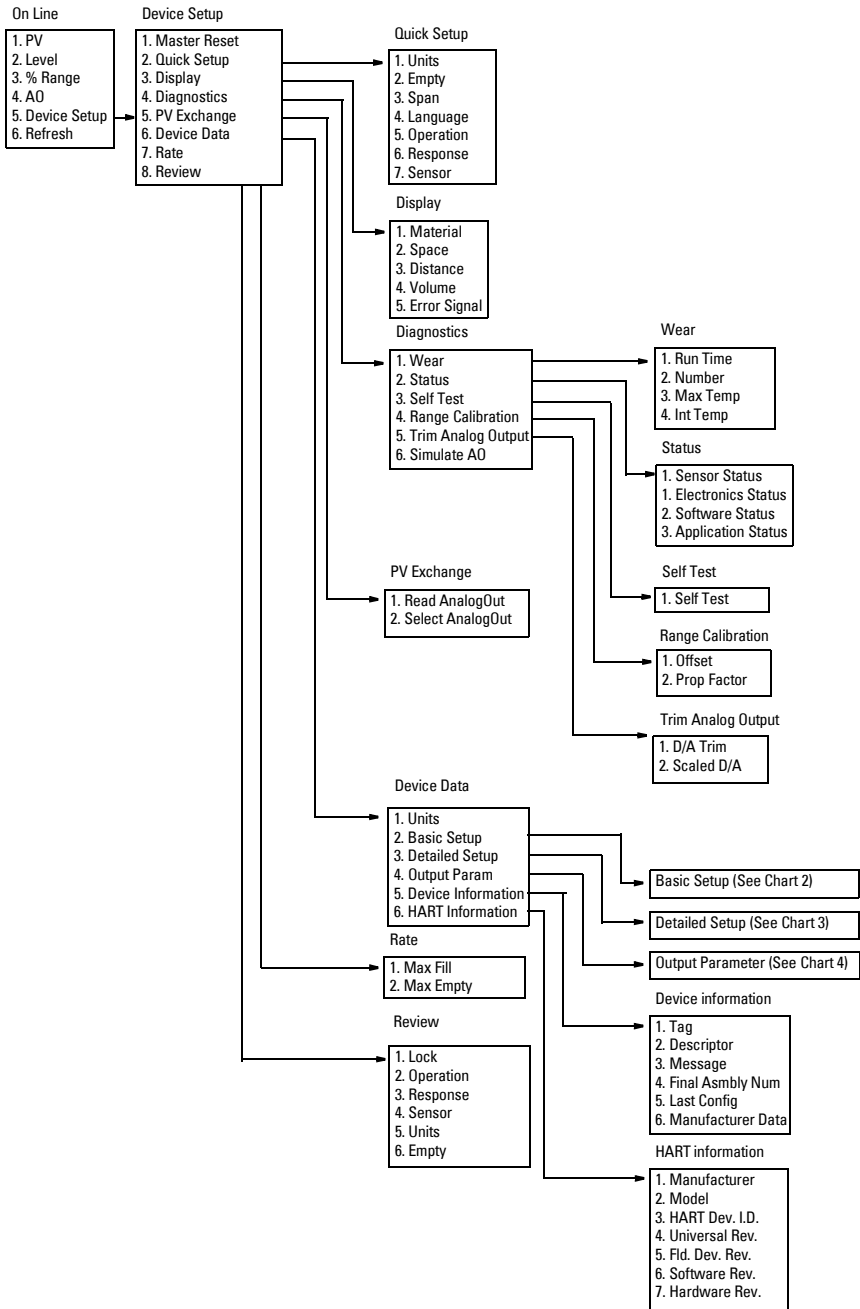


Chart 2

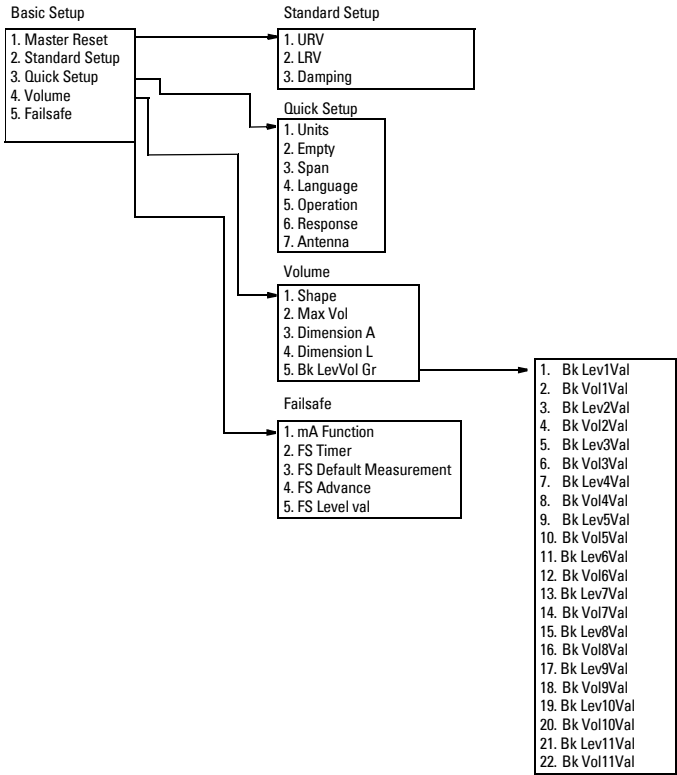


Chart 3

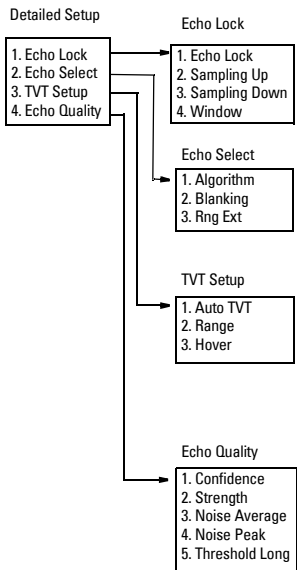


Chart 4

Output parameter

1. Analog Output
2. Apply Values
3. Local Display.
4. HART Output

Analog Output

1. Read AnalogOut
2. mA Function
3. FS Default Measurement
4. Min mA
5. Max mA
6. Low Setpoint
7. High Setpoint

Local Display

1. Write Protect
2. Lock
3. Write Protect
4. Unlock Value

HART Output

1. Poll Addr
2. Num Req Preams
3. Num Resp Preams

Supported HART Commands:

SITRANS LR 200 conforms to HART rev. 5 and supports the following:

Universal Commands

0, 1, 2, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

Common Practice Commands

33, 34, 35, 36, 37, 38, 40, 41, 42, 44, 45, 46, 48, 50, 51, 53, 54, 59, 110

Device Specific Commands

Command 138	Read the user specific characteristics
Command 139	Write the user specific characteristics
Command 140	Perform Device Specific Configuration
Command 160	Read Quick Setup
Command 161	Write Quick Setup
Command 162	Read Volume
Command 163	Write Volume
Command 164	Read Volume Breakpoint
Command 165	Write Volume Breakpoint
Command 166	Read Failsafe
Command 167	Write Failsafe
Command 168	Read Echo Data
Command 169	Write Echo Data
Command 170	Read Echo Lock
Command 171	Write Echo Lock
Command 172	Read TVT
Command 173	Write TVT
Command 174	Read TVT Shaper
Command 175	Write TVT Shaper
Command 176	Read Confidence
Command 178	Read Analog Special
Command 179	Write Analog Special
Command 180	Read Local Display Commands
Command 181	Write Local Display Commands
Command 182	Read Range Calibration
Command 183	Write Range Calibration
Command 184	Read Serial Port Settings
Command 185	Write Serial Port Setting
Command 186	Read Wear

Universal and Common Practice Commands

For details on the Universal and Common Practice Commands, please contact the HART Communication Foundation.

Device Specific Commands

For a document containing the Device Specific Commands, please contact Siemens Milltronics at techpubs@siemens-milltronics.com.

Appendix D: Troubleshooting

Communication Troubleshooting

Generally:

1. Check the following:
 - There is power at the instrument
 - The LCD shows the relevant data
 - The device can be programmed using the hand programmer
2. Verify that the wiring connections are correct.
3. If you continue to experience problems, go to our website at www.siemens-milltronics.com, and check the FAQs for SITRANS LR 200, or contact your local Siemens Milltronics representative.

Specifically:

1. If you try to set a SITRANS LR 200 parameter via remote communications, but the parameter remains unchanged:
 - Some parameters can only be changed when the device is not scanning. Try putting the device in PROGRAM mode using the operating mode function.
 - Try setting the parameter from the keypad. (First make sure that the lock parameter [P000] is set to the value stored in P069.)
 - The communications control parameter P799 must be set to 1 to allow you to write parameters to SITRANS LR 200.
2. If you see unanticipated displays, for example:
 - PROGRAM mode displayed instead of RUN mode
 - the wrong parameter displayed in response to a command
 - a parameter displayed in response to no command

make sure no infrared-capable device is close to SITRANS LR 200. Any device with infrared capabilities (laptops, cell phones, PDAs) can cause interference which simulates a command to the SITRANS LR 200, potentially causing it to switch modes or to change a parameter.





3. If the operation is erratic, make sure the Hand Programmer is not being used at the same time as SIMATIC PDM.

Error Messages (HART)

Description	Code
DIAG_STATE_ZERO_ERR	17
DIAG_STATE_POWER_SUPPLY_FAILURE	18
DIAG_STATE_CONFIGURATION_INVALID	19
DIAG_STATE_MAINTENANCE_REQUIRED	22
DIAG_STATE_CHARACTERIZATION	23
DIAG_STATE_HW_ELECTRONICS_FAILURE	25
DIAG_STATE_HW_MECHANICAL_FAILURE	26
DIAG_STATE_TEMP_MOTOR	27
DIAG_STATE_ELECTRONICS_TEMP_TO_HI	28
DIAG_STATE_MEM_CHECKSUM_ERR	29
DIAG_STATE_MEASUREMENT_FAILURE	30
DIAG_STATE_NOT_INITIALIZE_PROPERLY	31
DIAG_STATE_INIT_CALIBRATION_ERR	32
DIAG_STATE_FAILSAFE	34
DIAG_STATE_STACK_OVERFLOW	35
DIAG_STATE_EEPROM_NOT_INITED	38
DIAG_STATE_EEPROM_CALIBRATE_INDEX_CORRUPT	39
DIAG_STATE_EEPROM_CALIBRATE_DATA_CORRUPT	40
DIAG_STATE_EEPROM_CANNOT_COMMUNICATE	41
DIAG_STATE_LOW_PAUX_SUPPLY	42

Operation Troubleshooting

Operating symptoms, probable causes, and resolutions.

Symptom	Cause	Action
Display flashes LOE and status symbol shows 	level or target is out of range	<ul style="list-style-type: none"> • check specifications • check P006 • increase range extension P805
Display flashes LOE and status symbol shows 	material build-up on antenna	<ul style="list-style-type: none"> • clean the antenna • upgrade to purged antenna • re-locate SITRANS LR 200
Display flashes LOE and status symbol shows 	location or aiming: <ul style="list-style-type: none"> • poor installation • flange not level 	<ul style="list-style-type: none"> • check to ensure nozzle is vertical • use P837/P838 • check to ensure nozzle is clean and free of internal seams/welds
Display flashes LOE and status symbol shows 	antenna malfunction: <ul style="list-style-type: none"> • temperature too high • physical damage • excessive foam • multiple echoes 	<ul style="list-style-type: none"> • check P343 • use foam deflector or stilling well • relocate • use a defoamer • set P820 to 12 (First echo)

Symptom	Cause	Action
Reading does not change, but the level does	SITRANS LR 200 processing wrong echo, i.e. vessel wall, or structural member	<ul style="list-style-type: none"> re-locate SITRANS LR 200 check nozzle for internal burrs or welds rotate instrument 90° use P837/P838
Measurement is consistently off by a constant amount	P006 not correct P652 not correct	<ul style="list-style-type: none"> check distance from flange face to zero level (P006) check offset value (P652) or device tag
Screen blank	power error	<ul style="list-style-type: none"> check nameplate rating against voltage supply check power wiring or source
	too much load resistance	<ul style="list-style-type: none"> change barrier type, or remove something from the loop, or increase supply voltage
Reading erratic	echo confidence weak	<ul style="list-style-type: none"> refer to P805 use P837/P838 use foam deflector or stilling well
	liquid surface vortexed	<ul style="list-style-type: none"> decrease measurement response P003 relocate instrument to side pipe increase confidence threshold P804
	material filling	<ul style="list-style-type: none"> re-locate SITRANS LR 200
Reading response slow	P003 setting	<ul style="list-style-type: none"> increase measurement response if possible

Symptom	Cause	Action
Reads correctly but occasionally reads high when vessel is not full	<ul style="list-style-type: none"> • detecting close range echo • build up near top of vessel or nozzle • wrong antenna choice for application • nozzle problem 	<ul style="list-style-type: none"> • clean the antenna • shielded antenna required • see <i>Application Example: Stillpipe</i> on page 91 • use P837/P838
Level reading lower than material level	<ul style="list-style-type: none"> • material is within near blanking zone • vessel near empty and low ϵ_r material • multiple echoes processed 	<ul style="list-style-type: none"> • decrease blanking P800: min. 0.4 m (1.3 ft) • raise SITRANS LR 200 • decrease range extension • ensure P820 is set to 12 (First echo)
	<ul style="list-style-type: none"> • nozzle too narrow for length 	<ul style="list-style-type: none"> • see <i>Rod Extension Requirements</i> on page 103 • shielded antenna required
	<ul style="list-style-type: none"> • internal seam in nozzle 	<ul style="list-style-type: none"> • inspect and remove seam • use P837/P838 • upgrade to shielded rod antenna

Maintenance

SITRANS LR 200 requires no maintenance or cleaning under normal operating conditions.

Under severe operating conditions, the antenna may require periodic cleaning. If cleaning becomes necessary:

- Note the antenna material and the process medium, and select a cleaning solution that will not react adversely with either.
- Remove the instrument from service and wipe the antenna clean using a cloth and suitable cleaning solution.

Appendix E: Technical Reference

Principles of Operation

SITRANS LR 200 is a sophisticated radar instrument that uses advanced microwave pulse technology¹ to provide non-contacting continuous level measurement in liquids or slurries. Radar level measurement uses the time of flight principle to determine distance to a material surface. The device transmits a signal and waits for the return echo. The transmit time is directly proportional to the distance from the material.

Pulse radar uses polarized electromagnetic waves. Microwave pulses are emitted from the antenna at a fixed repetition rate, and reflect off the interface between two materials with different dielectric constants (the atmosphere and the material being monitored). The echo is detected by a receiver, and the transmit time is used to calculate level.

Electromagnetic wave propagation is virtually unaffected by temperature or pressure changes, or by changes in the vapor levels inside a vessel. Electromagnetic waves are not attenuated by dust.

SITRANS LR 200 consists of an enclosed electronic component coupled to an antenna and process connection. The electronic component generates a radar signal (6.3 GHz in North America, 5.8 GHz elsewhere) that is directed to the antenna.

The signal is emitted from the antenna, and the reflected echoes are digitally converted to an echo profile. The profile is analyzed to determine the distance from the material surface to the reference point on the instrument. This distance is used as a basis for the display of material level and mA output.

Transceiver

The SITRANS LR 200 transceiver operates under one of three sets of pre-set conditions which affect the speed of the measurement response (P003).

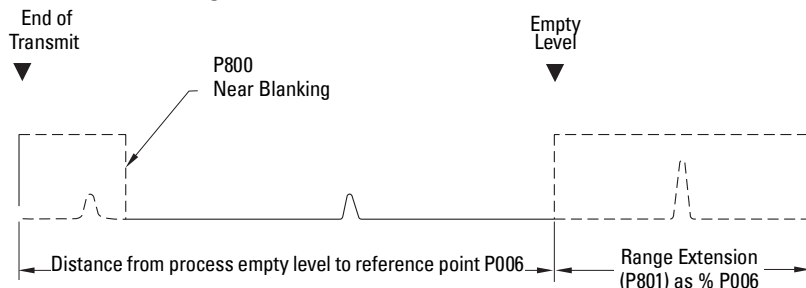
Measurement Response P003		Max. fill/empty rate P700/P701		Echo verification P711	Failsafe timer P070 (time in minutes)
1	*	0.1 m/min	slow	2	100
2		1 m/min	medium	2	10
3		10 m/min	fast	2	1

¹ The microwave output level is significantly less than that emitted from cellular phones.

The measurement response limits the maximum rate at which the display and analog output respond to changes in measurement. P003 should be set to a measurement response just faster than the maximum filling or emptying rate (whichever is greater).

When the echoes are received, the relevant echo algorithm (P820) is applied to determine the true material echo.

Typical Receiver Signal



Loss of Echo (LOE)

A loss of echo (LOE) occurs when the calculated measurement is judged to be unreliable because the confidence value (P805) is less than the threshold value (P804).

If the LOE condition persists beyond the time limit set by the Failsafe timer (P070), the Reliable Echo indicator will be replaced by the Unreliable Echo indicator. The reading will alternate at two second intervals with the letters LOE.

Reliable Echo indicator  Unreliable Echo indicator 

P070 determines the time to elapse after the last valid reading before a Failsafe state is activated. P071 determines the level to be reported when the Failsafe timer expires. Upon receiving a reliable echo, the loss of echo condition is aborted, the Reliable Echo indicator replaces the Unreliable Echo indicator, and the reading and mA output return to the current level.

Range Extension

In applications where the base of the vessel is conical or parabolic, a reliable echo may be available **below** the vessel empty distance, due to an indirect reflection path. Increasing the range extension to 30% or 40% can provide stable empty vessel readings.

Range extension is entered as a percentage of P006 (process empty level).

False-Echo Suppression

False echoes can appear during the receive cycle. They are often created by internal impediments like a ladder rung, and are usually indicated by an incorrect high level reading.

Near Blanking

Near Blanking programs SITRANS LR 200 to ignore the zone in front of the antenna. The default blanking distance is 0.3 m (1 ft.), plus any shield length, from the reference point¹.

P800 allows you to increase the near blanking value from its factory setting. But Auto False-Echo Suppression (P837) is generally recommended in preference to extending the blanking distance from factory values.

Auto False-Echo Suppression

The TVT adjustment parameters allow you to set a TVT (Time Varying Threshold) curve, so that SITRANS LR 200 will ignore false echoes.

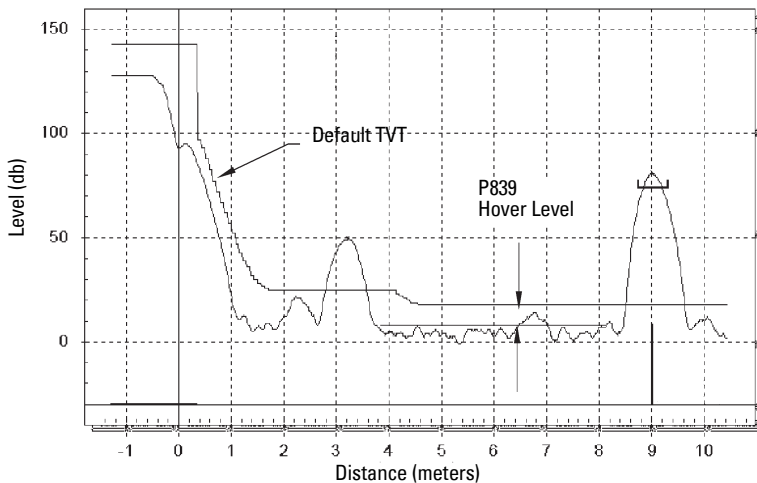
The default TVT curve hovers above the echo profile, and effectively screens out small false echoes. But if an obstruction is causing a large echo before the material level echo, that echo will rise above the default TVT curve. You can use Auto False-Echo Suppression to filter it out. If possible, rotate the instrument before using Auto False-Echo Suppression, to lower the amplitude of false echoes.

When you set P837 to 'Learn', the instrument learns the echo profile at that moment². Then it uses the learned profile instead of the default TVT curve, for the distance set in P838. The learned profile (learned TVT curve) follows the echo profile, so that no large false echoes rise above the learned TVT curve. From the end of the Auto False-Echo Suppression Distance, the default TVT curve is used. The material level echo rises above this, and is selected as the true echo.

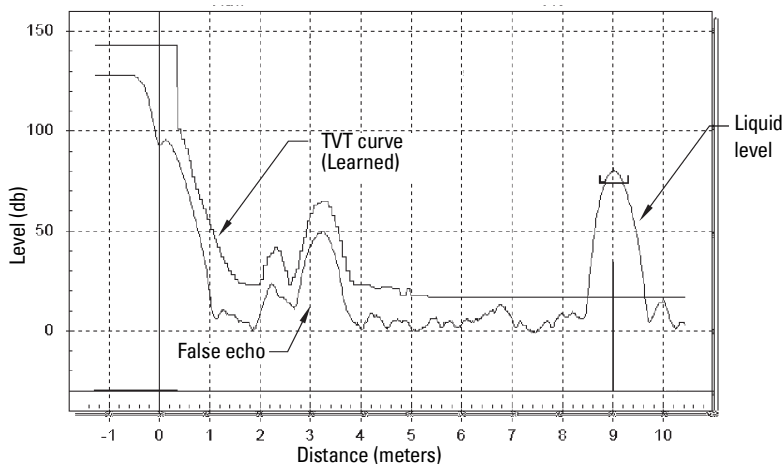
See page 82 for examples of the echo profile before and after using Auto False-Echo Suppression.

-
1. For the reference point for each configuration, see *SITRANS LR 200 Dimensions* on page 13 for the standard version, or *Appendix G: Flanged Antenna Options*, page 93 onwards.
 2. Set P837 to 'Learn' when the material level is substantially lower than process full level (ideally when the tank is empty or almost empty).

Display before Auto False-Echo Suppression (or when P837 = 0)



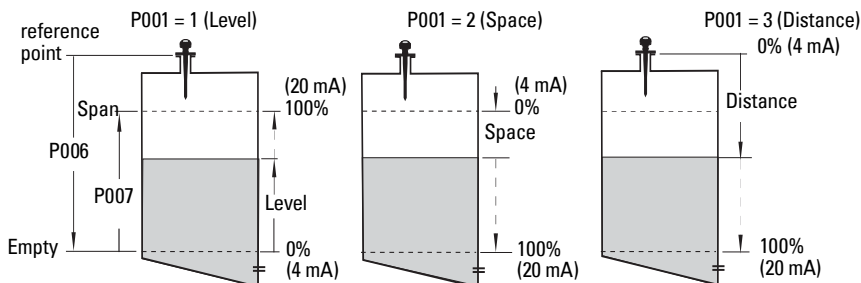
Example After Auto False-Echo Suppression



RUN/PROGRAM

Output

The mA output is proportional to the level, in the range 4 to 20 mA. Generally, the output is set so that the output for 0% is 4 mA, and the output for 100% is 20 mA. 0 and 100% are percentages of the full-scale reading (m, cm, mm, ft, in).



When SITRANS LR 200 is put into **PROGRAM** mode it stops responding to the process. It stores the most recent measurement, and holds the associated readings and mA signal output. The instrument reverts to the parameter last addressed during the previous program session.

When the instrument is returned to **RUN** mode, the transceiver resumes operation. The reading and mA output default to the last measurement taken. The reading and associated outputs migrate to the current process level at a rate controlled by the measurement response (P003).

If SITRANS LR 200 is left in **PROGRAM** mode for 10 minutes without input, it automatically reverts to **RUN** mode.

Failsafe

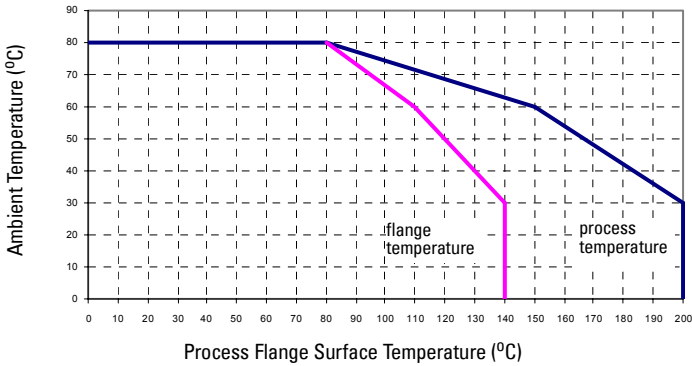
When the Failsafe timer (P070) expires, the material level to be reported is determined by P071 (Failsafe Material Level).

Failsafe Mode P071	
1 = HI	Use Maximum mA Limit (P213) as material level
2 = LO	Use Minimum mA Limit (P212) as material level
3 = HOLd	Level remains at last reading
4 = SEL	User-selected value (defined in P073)

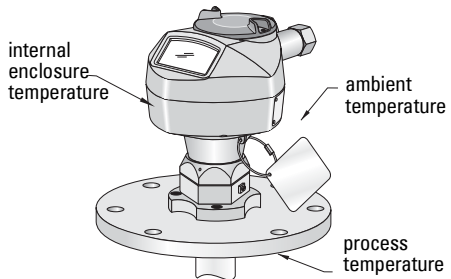
Maximum Process Temperature Chart

Note: The chart below is for guidance only:

Maximum Flange and Process Temperatures versus Allowable Ambient for Flange Adaptor version of SITRANS LR 200



- The chart does not represent every possible process connection arrangement. For example, it will NOT apply if you are mounting SITRANS LR 200 on a nozzle greater than 8" nominal, or directly on a metallic vessel surface.
- The chart does not take into consideration heating from direct sunshine exposure.



Where the chart does not apply, please use your own judgement regarding the use of SITRANS LR 200. Parameter P343 is required to monitor the Internal Temperature. It gives you an excellent indication of how reliably the product will perform thermally when installed on your process vessel.

P343 also allows you to decide whether or not attention should be focussed on redesigning the installation. For example, if the internal temperature exceeds the maximum allowable limit, a sun shield or a longer nozzle may be required. Engineering will use this temperature reading (P343) to gauge the extent of change required to the installation in order to provide a reliable thermal-operating zone for the SITRANS LR 200.

- ! **WARNING: Internal temperature must not exceed 80 °C (176 °F).**

Process Pressure/Temperature derating curves

Notes:

- These configurations are subject to revision: other options may be added.
- Process configuration numbers are not final.
- The Process Device Tag shall remain with the process pressure boundary assembly¹. In the event the instrument package is replaced, the Process Device Tag shall be transferred to the replacement unit.
- SITRANS LR 200 units are hydrostatically tested, meeting or exceeding the requirements of the ASME Boiler and Pressure Vessel Code and the European Pressure Equipment Directive.
- The serial numbers stamped in each process connection body, (flange, threaded, or sanitary), provide a unique identification number indicating date of manufacture. Example: MMDDYY – XXX (where MM = month, DD = day, YY = year, and XXX= sequential unit produced)
Further markings (space permitting) indicate flange configuration, size, pressure class, material, and material heat code.

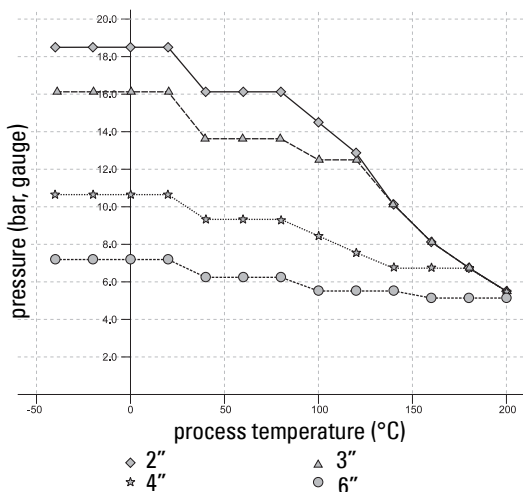


WARNINGS:

- **Never attempt to loosen, remove or disassemble process connection or instrument housing while vessel contents are under pressure.**
- **This product is designated as a Pressure Accessory per Directive 97/ 23 / EC and is not intended for use as a safety device.**
- **Materials of construction are chosen based on their chemical compatibility (or inertness) for general purposes. For exposure to specific environments, check with chemical compatibility charts before installing.**
- **The user is responsible for the selection of bolting and gasket materials which will fall within the limits of the flange and its intended use and which are suitable for the service conditions.**
- **Improper installation may result in loss of process pressure.**

¹ The process pressure boundary assembly comprises the components that act as a barrier against pressure loss from the process vessel: that is, the combination of process connection body and emitter, but normally excluding the electrical enclosure.

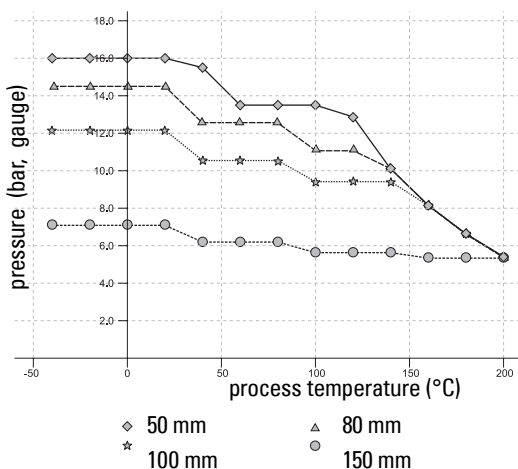
Rod Antenna ANSI Hole Pattern, 150#^{1, 2}



Process Configuration:

- 51003 with flange series 22452.
- Flange will be stamped 22452. Process connection tag will have the series identified as 51003.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

Rod Antenna DN Hole Pattern, PN16^{1, 2}



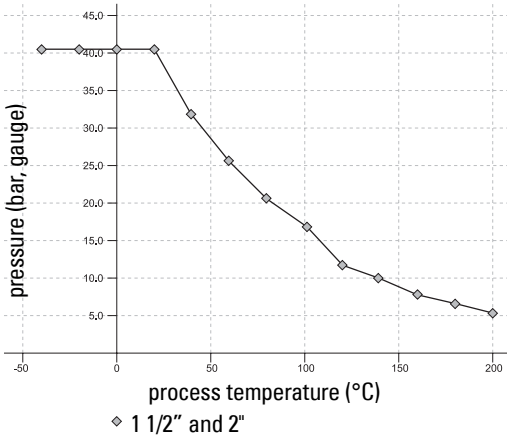
Process Configuration:

- 51003 with flange series 22452.
- Flange will be stamped 22452. Process connection tag will have the series identified as 51003.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

! WARNING: Never attempt to loosen, remove or disassemble process connection or instrument housing while vessel contents are under pressure.

1. UHMW-PE antennas are rated to a maximum of 80°C (176°F) of continuous duty.
2. Customer to provide adequate bolting to retain vessel pressure and provide sufficient sealing.

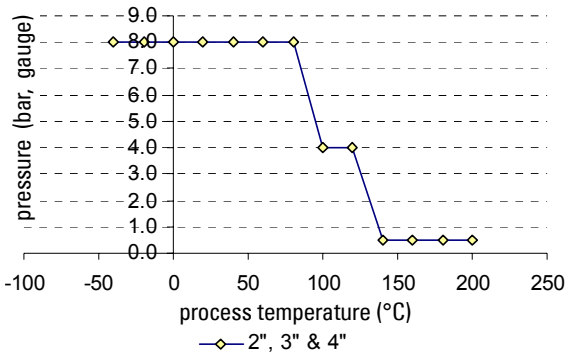
Rod Antenna Threaded Connection



Process Connection Series:

- 51002, 51004, 51005
- Ensure the instrument has a process connection identification tag showing one of this series.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

Rod Antenna Sanitary Connection¹



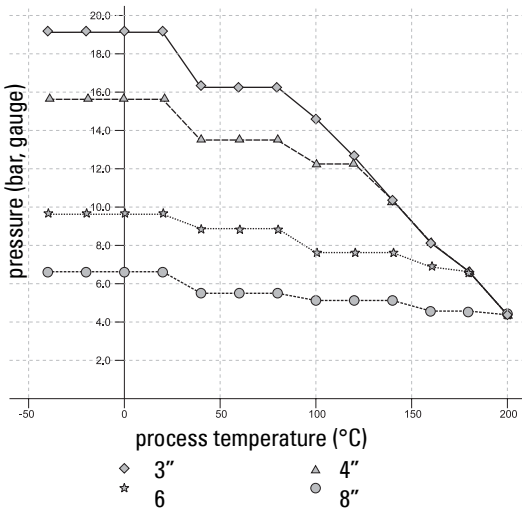
Process Connection Series:

- 51010
- Ensure instrument has the process identification tag showing this series number.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

! WARNING: Never attempt to loosen, remove or disassemble process connection or instrument housing while vessel contents are under pressure.

¹ UHMW-PE antennas are rated to a maximum of 80°C (176°F) of continuous duty; however, they can be used for periods of up to 3 hours at temperatures up to 120°C (248°F) at 1 bar pressure.

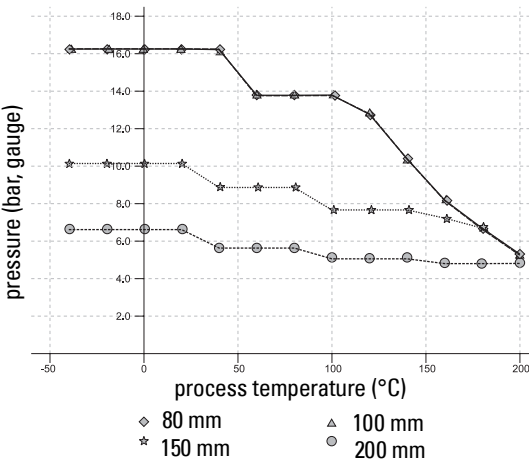
Horn Antenna or Wave Guide – ANSI Hole Pattern, 150#¹



Process Connection Series:

- 51006 to 51008, and 51010 to 51012, with 22452 series flange.
- Ensure your instrument has the process identification tag showing one of this series, and 22452 stamped on flange.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

Horn Antenna or Wave Guide DN Hole Pattern, PN16²



Process Connection Series:

- 51006 to 51008, and 51010 to 51012 with 22452 series flange.
- Ensure your instrument has the process identification tag showing one of this series, and 22452 stamped on flange.
- Reference drawing number is shown on the process device tag. You can find this drawing on our website: www.siemens-milltronics.com, on the LR 200 product page, under Process Connection Specifications.

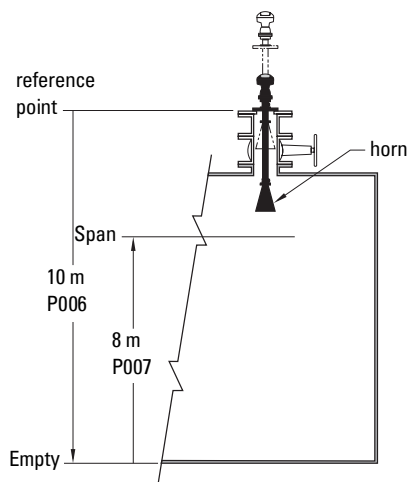
! WARNING: Never attempt to loosen, remove or disassemble process connection or instrument housing while vessel contents are under pressure.

1. Customer to provide adequate bolting and flat-faced gasket to retain vessel pressure and provide sufficient sealing.
2. Customer to provide adequate bolting and flat-faced gasket to retain vessel pressure and provide sufficient sealing.

Appendix F: Special Applications

These more complex SITRANS LR 200 application examples can be used as setup references. The parameter value tables relate the values to the functions.

Example: Sliding Waveguide on Anaerobic Digesters




The raised position is for installation and maintenance. The lowered position is for operation. Program the instrument for operation in the lowered position.

This application is to obtain a level measurement and corresponding 4-20 mA output proportional to the sludge level on a digester. Process empty level (Empty) is the bottom of the digester, which is 10 m (33 ft.) from the antenna flange face when the instrument is lowered to its normal operating position.

Process full level (Span) is 8 m (26.25 ft.) from the bottom. The maximum rate of filling or emptying is about 0.1 m (4")/min.

Parameter	Enter		
P001	1	mode of measurement	= level
P003	2	measurement response	= 1 m/minute
P005	1	units	= meters
P006	10	empty distance	= 10 m
P007	8	span	= 8 m
P838 ¹	distance to material – 0.5 m	auto false-echo suppression distance	
P837 ²	2	auto false-echo suppression	enable false-echo suppression

- For more details on P837 and P838, see page 59.
- Only set P837 if the product is at least 2 m (78") away from the flange face. If it is closer, leave P837 at 1 until the level drops and the distance increases beyond 2 m (78").

Return to **RUN**: to start normal operation, press **PROGRAM** .

Application Example: Stillpipe

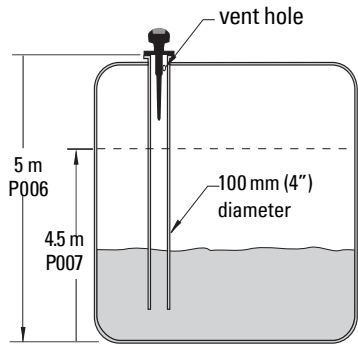
This is an alternative to the waveguide antenna option, used for products with an ϵ_r of less than 3, or if extremely turbulent or vortex conditions exist. This mounting arrangement can also be used to provide optimum signal conditions on foaming materials.

Notes:

- For $\epsilon_r < 3$, the lower 400 mm of vessel level may not be measurable.
- Blanking and P800 will be set at the factory. Check the process device tag for specific values.
- Suitable pipe diameters are 50 mm (2") to 250 mm (10"): See the chart on page 92 for typical P655 values.

This application is to obtain a level measurement and corresponding 4-20 mA output proportional to the oil level in a fuel storage vessel.


- The reference point of SITRANS LR 200 is 5 m (16.5 ft.) from the vessel bottom.
- Empty level is 0 m/ft. (bottom of tank).
- Full level (span) is 4.5 m (14.74 ft.) from the bottom.
- The stillpipe inside diameter is 100 mm (4").
- The maximum rate of filling or emptying is about 0.1 m (4")/min.
- In the event of a loss of echo, SITRANS LR 200 is to go into Failsafe Hi after 2 minutes.



Parameter	Enter		
P001	1	mode of measurement	= level
P003	2	measurement response	= 1 m/minute
P005	1	units	= meters
P006	5	empty distance	= 5 m
P007	4.5	span	= 4.5 m
P655*	0.955	propagation factor	= 10 mm pipe I.D.

Parameter	Enter		
P838 ¹	distance to material – 0.5 m	auto false-echo suppression distance	
P837 ^{1, 2}	2	auto false-echo suppression	enable false-echo suppression

1. For more details on P837 and P838, see page 59.
2. Only set P837 if the product is at least 2 m (78") away from the flange face. If it is closer, leave P837 at **1** until the level drops and the distance increases beyond 2 m (78").

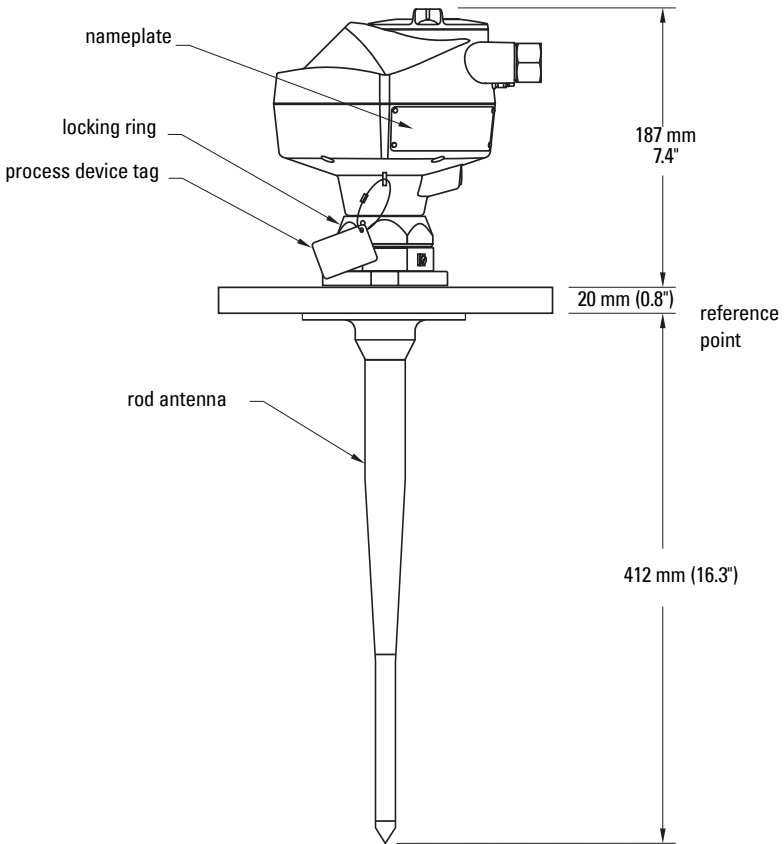
Return to **RUN**: to start normal operation, press **PROGRAM** .

Pipe Inside Diameter	P655 Value (Typical)*
50 mm (2")	0.827
80 mm (3")	0.915
100 mm (4")	0.955
150 mm (6")	0.980
200 mm (8")	0.990

* These values are provided as a guideline only.

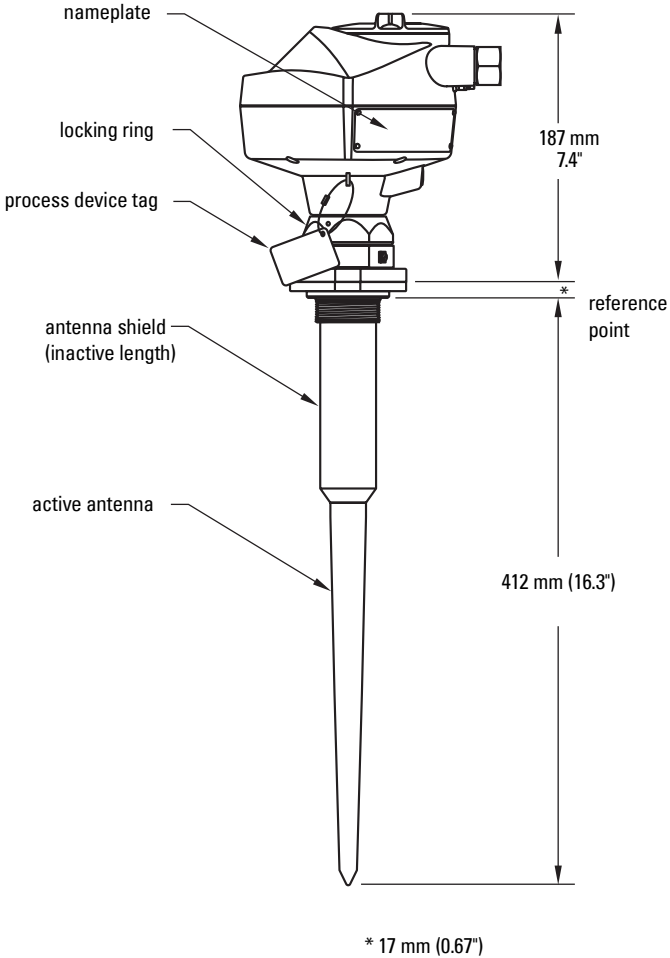
Appendix G: Flanged Antenna Options

Dimensions: Rod Antenna



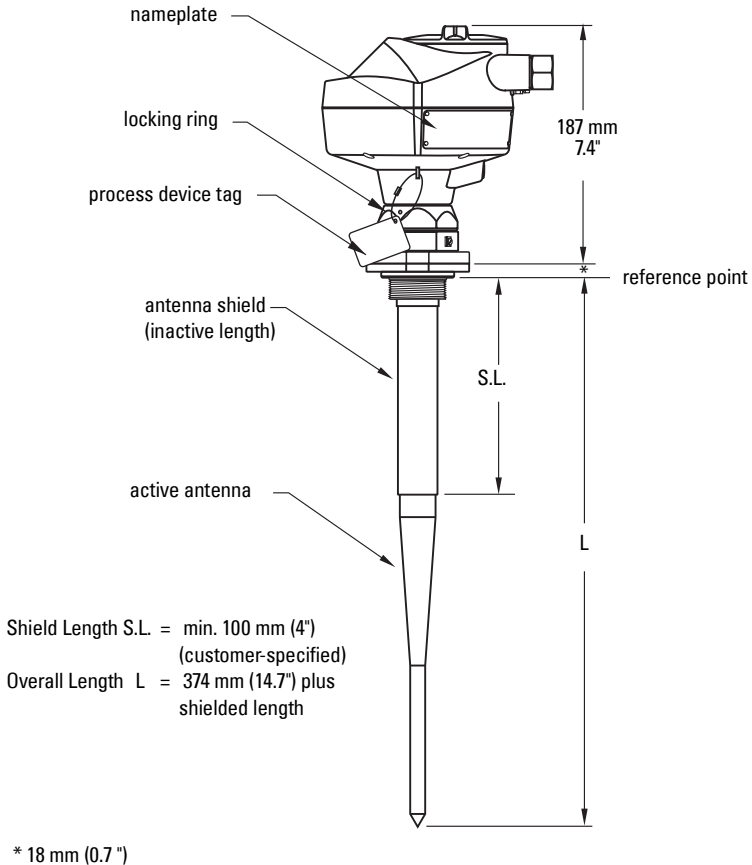
Note: Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

Dimensions: Threaded Rod



Note: Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

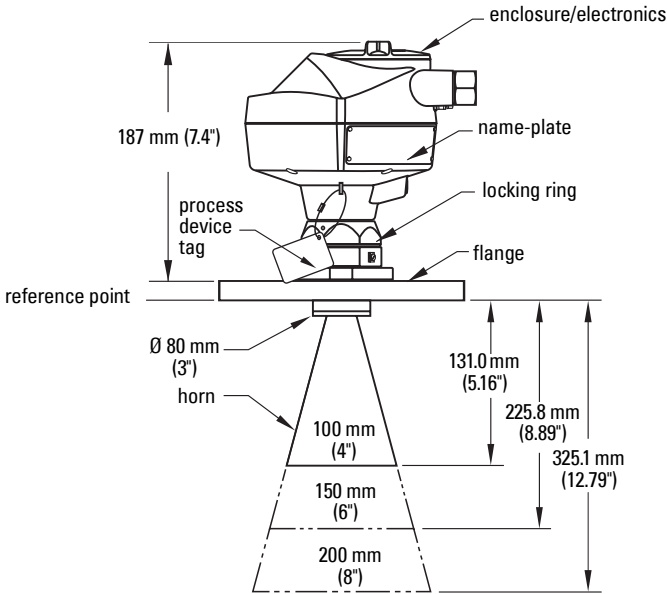
Dimensions: Shielded Rod



G: Antenna Options

Note: Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

Dimensions: Horn .



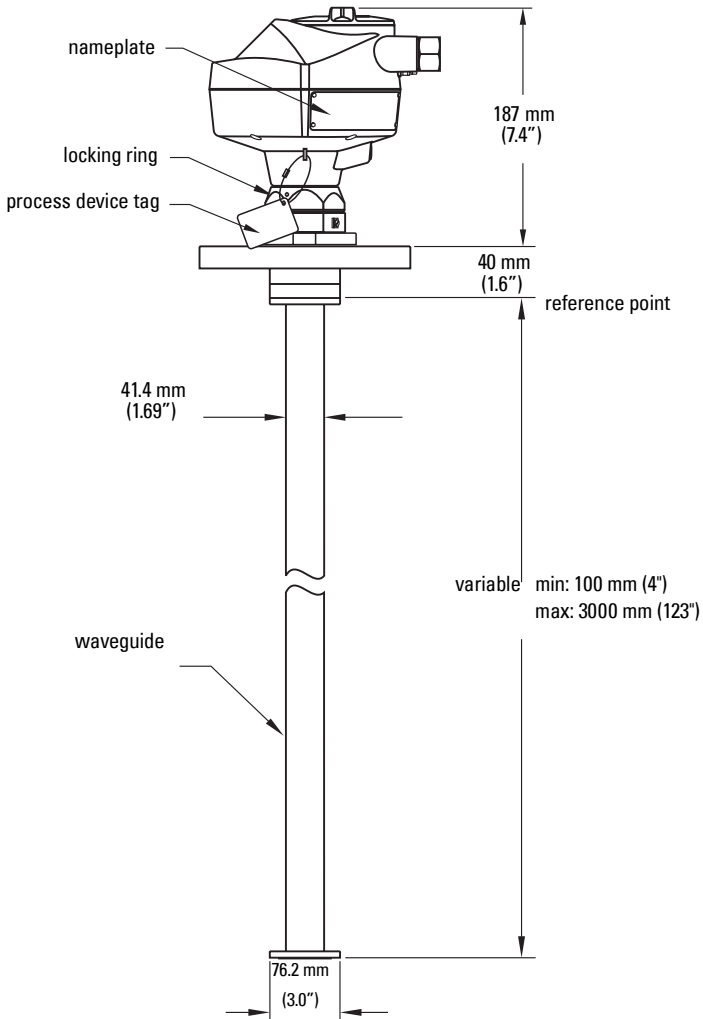
Nominal Horn Size	Horn O.D.	Horn Height	Beam Angle
100 mm (4")	95.3 mm (3.75")	131.0 mm (5.16")	29 degrees
150 mm (6")	146.0 mm (5.75")	225.8 mm (8.89")	20 degrees
200 mm (8")	199.4 mm (7.85")	325.1 mm (12.79")	17 degrees

Notes:

- Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.
- Signal amplitude increases with horn diameter, so use the largest practical size.
- Optional waveguide extensions and/or purging¹ system can be installed between the flange and the antenna.

¹ A purging system is an option available for this antenna type. This provides an inlet on the flange where cooling air or cleaning fluid may be supplied. The air or liquid passes through the flange and exits the inside of the horn to clean the antenna system.

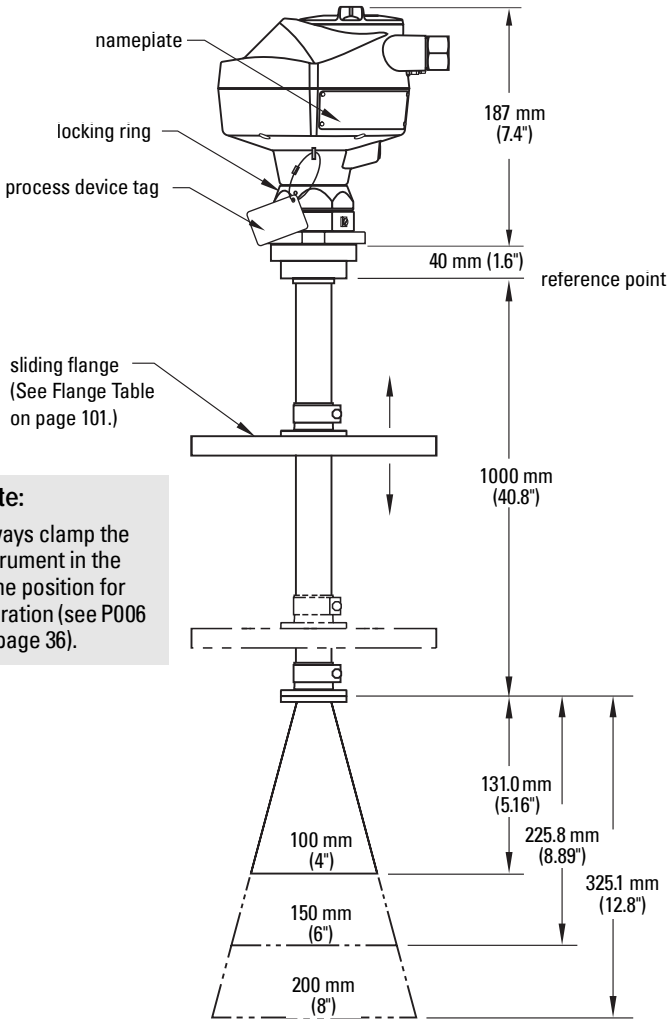
Dimensions: Waveguide



Notes:

- You can connect a maximum of two waveguides together.
- This option is recommended only for clean liquids on vessels without agitators or turbulence.
- Horizontal stress on this antenna must be avoided, otherwise mechanical support may be required.
- Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

Dimensions: Sliding Waveguide Configuration



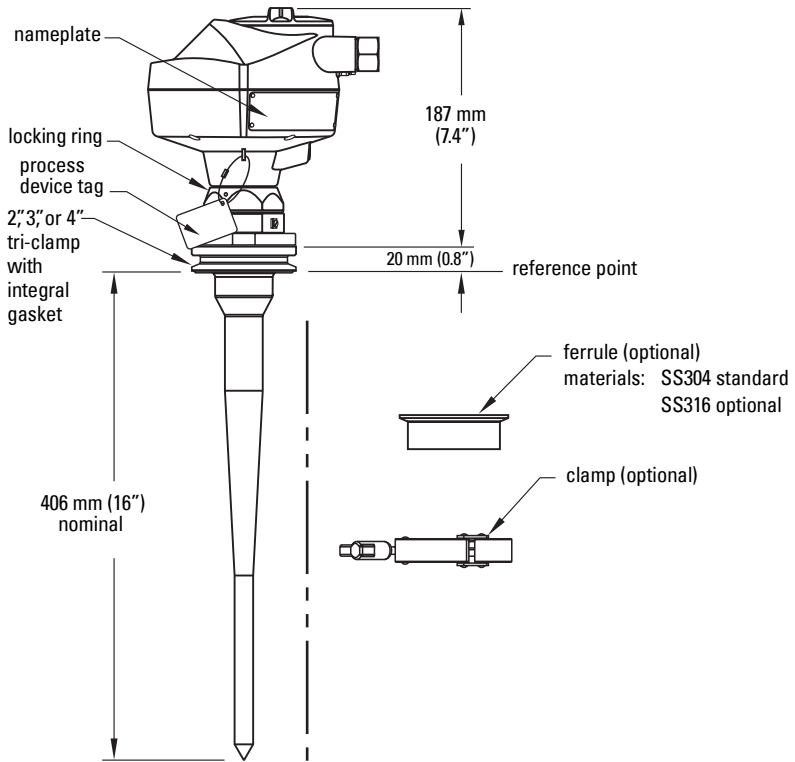
Note:

Always clamp the instrument in the same position for operation (see P006 on page 36).

Notes:

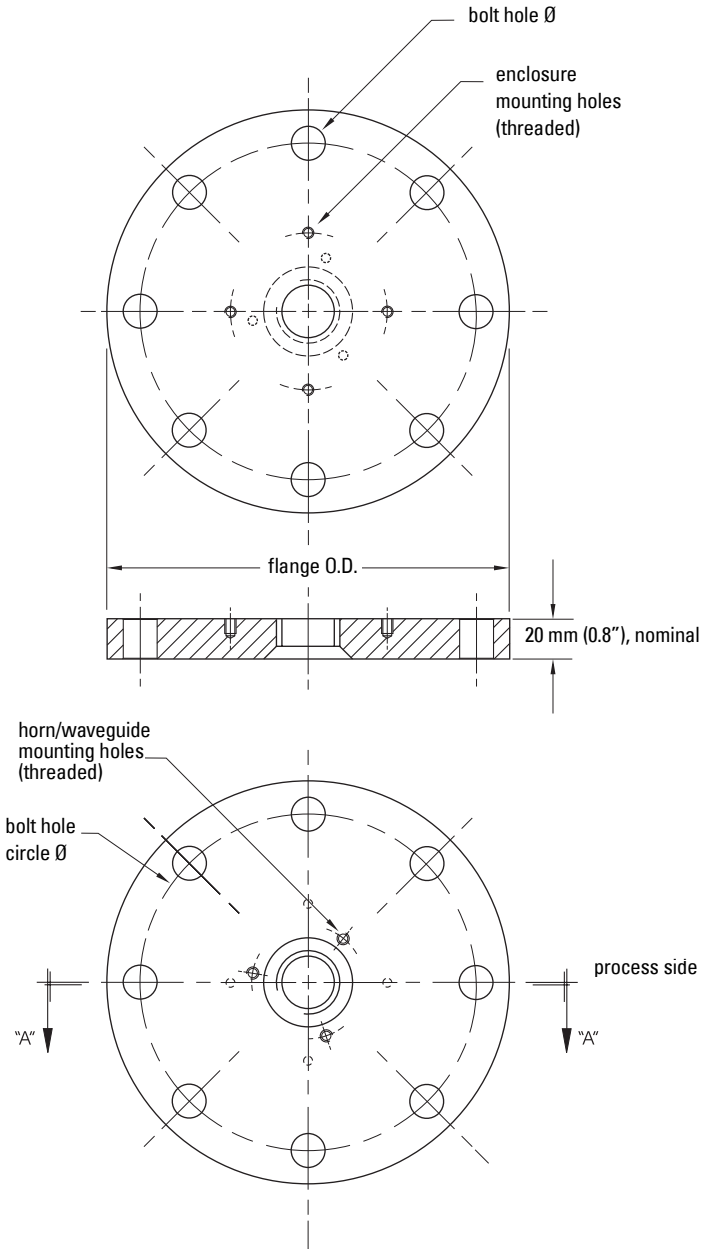
- Maximum pressure 0.5 bar at 60° C (140° F) for sliding flange option.
- Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

Dimensions: Sanitary Rod



Note: Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available on our website at www.siemens-milltronics.com, on the product page for SITRANS LR 200, under Process Connection Specifications.

Dimensions: Flanges



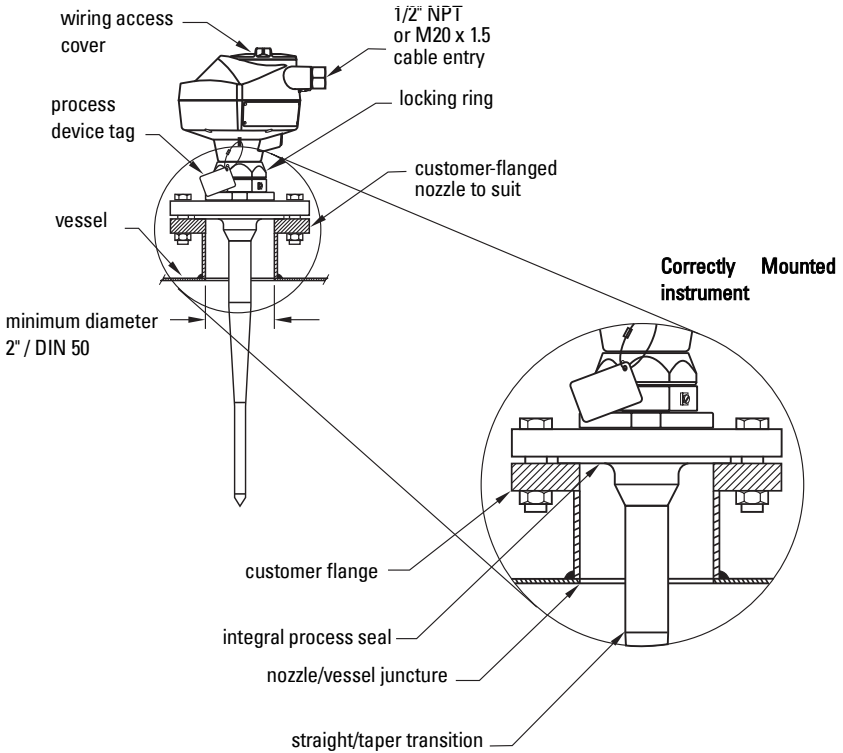
See chart on page 101 for further details on flange sizes.

Pipe size	Flange Size	Flange O.D.	Bolt Hole Circle Ø	Bolt Hole Ø	Number of Bolts
2"	ANSI 150#	6.0"	4.75"	.7"	4
3"	ANSI 150#	7.5"	6.0"	.75"	4
4"	ANSI 150#	9.0"	7.50"	.75"	8
6"	ANSI 150#	11.0"	9.50"	.88"	8
8"	ANSI 150#	13.5"	11.75"	.88"	8
2"	ANSI 300#**	6.50"	5.00"	.75"	4**
3"	ANSI 300#	8.25"	6.62"	.88"	8
4"	ANSI 300#	10.00"	7.88"	.88"	8
6"	ANSI 300#	12.50"	10.62"	.88"	12
8"	ANSI 300#	15.00"	13.00"	1.00"	12
50 mm	DIN PN 16	165 mm	125 mm	18 mm	4
80 mm	DIN PN 16	200 mm	160 mm	18 mm	8
100 mm	DIN PN 16	220 mm	180 mm	18 mm	8
150 mm	DIN PN 16	285 mm	240 mm	22 mm	8
200 mm	DIN PN 16	340 mm	295 mm	22 mm	12
200 mm	DIN PN 25	360 mm	310 mm	26 mm	12
50 mm	DIN PN 40	165 mm	125 mm	18 mm	4
80 mm	DIN PN 40	200 mm	160 mm	18 mm	8
100 mm	DIN PN 40	235 mm	190 mm	22 mm	8
150 mm	DIN PN 40	300 mm	250 mm	26 mm	8
200 mm	DIN PN 40	375 mm	320 mm	30 mm	12
50 mm	JIS 10K	155 mm	120 mm	19 mm	4
80 mm	JIS 10K	185 mm	150 mm	19 mm	8
100 mm	JIS 10K	210 mm	175 mm	19 mm	8
150 mm	JIS 10K	280 mm	240 mm	23 mm	8
200 mm	JIS 10K	330 mm	290 mm	23 mm	12

** Due to the limited space on this flange, SITRANS LR 200 can only use 4 of the standard 8 bolt holes of the 2" ANSI #300 size.

Mounting Instructions

Mounting

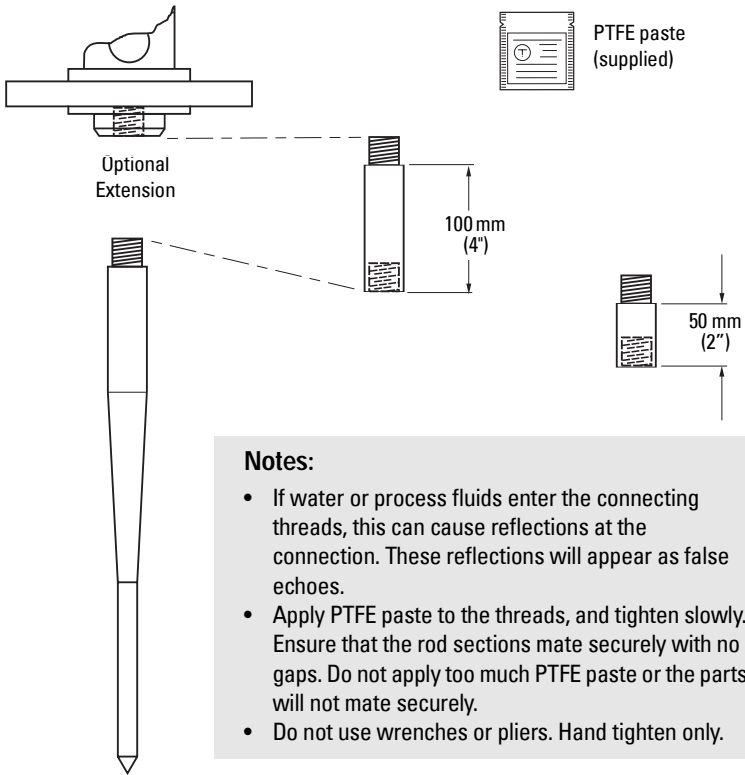


Notes:

- The integral process seal **MUST** rest on the customer flange. See the detail above, showing a correctly mounted instrument.
- The straight/taper transition of the rod should extend past the nozzle/vessel opening. Add extensions as required*.

* Refer to the Rod Extension Requirements table on page 103.

Rod Assembly



Rod Extension Requirements

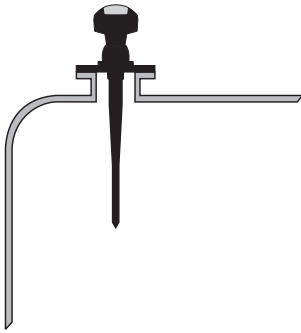
Nozzle I.D.	Nozzle Height mm (inches)*		
	<100 (4)	100 to 150 (4 to 6)	150 to 200 (6 to 8)
50 mm (2")	n/r	**	**
80 mm (3")	n/r	50 mm	100 mm
100 mm (4")	n/r	50 mm	100 mm
150 mm (6")	n/r	50 mm	100 mm
>150 mm (6")	n/r	n/r	n/r

n/r: extension not required

* Consult Siemens Milltronics for assistance with nozzle sizes not listed.

** Application not recommended for 50 mm (2") I.D. nozzles longer than 100 mm (4"). Shielded rod antennas are available for these applications.

Mounting: Rod Assembly



Ideally, the nozzle should be as short as possible. If your application requires a nozzle that exceeds our recommended maximum length, consider using a shielded rod configuration.

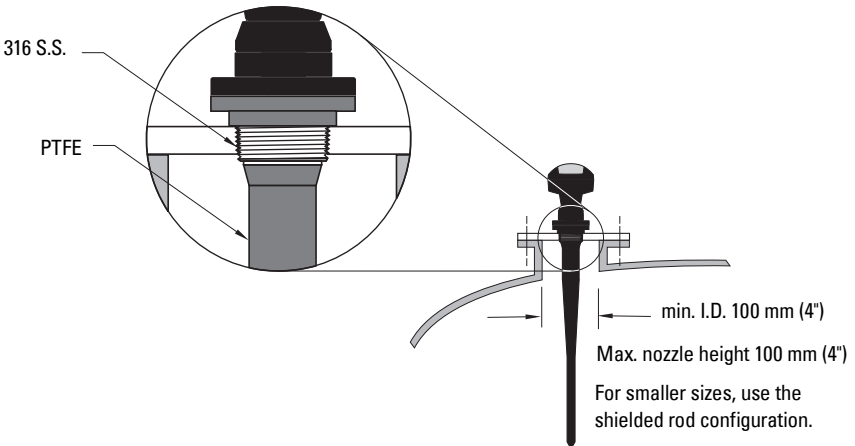
If you create a new nozzle for the radar instrument, the weld seams must be on the outside of the nozzle. Ensure that there are no seams or lips on the inside of the nozzle or you may get erratic readings.

If the mounting illustrated above is not suitable due to the minimum blanking requirements, consider the shielded rod or horn antenna options.

Nozzles that are 200 mm (8") or larger in diameter provide excellent signal conditions. Under these conditions you can use the standard rod without extensions for nozzle lengths of up to 610 mm (24").

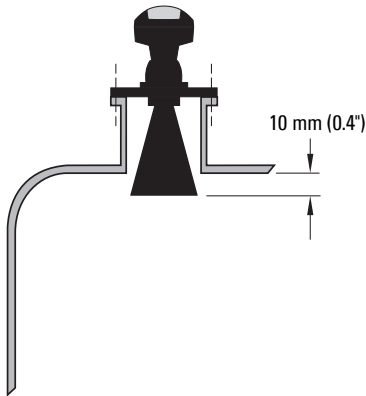
Mounting: Threaded Rod Antenna

You can use 1.5" or 2" threaded process connections. There are three thread types: NPT, BSP, and G.



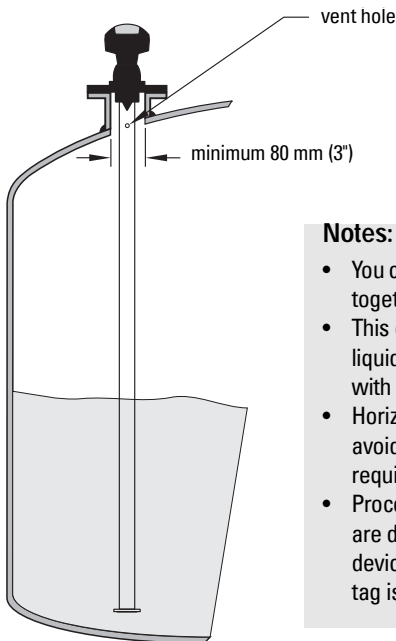
Mounting: Horn Antennas

The end of the horn should protrude a minimum of 10 mm (0.4") to avoid interference with the nozzle.



Mounting: Waveguide Antenna

This option is recommended for products with ϵ_r lower than 3. See P655 on page 50 for the related propagation factor.



Notes:

- You can connect a maximum of two waveguides together.
- This option is recommended only for clean liquids, and only on vessels without an agitator, with no turbulence.
- Horizontal stress on this antenna must be avoided, otherwise mechanical support may be required.
- Process temperature and pressure capabilities are dependent upon information on the process device tag. The reference drawing listed on the tag is available upon request.

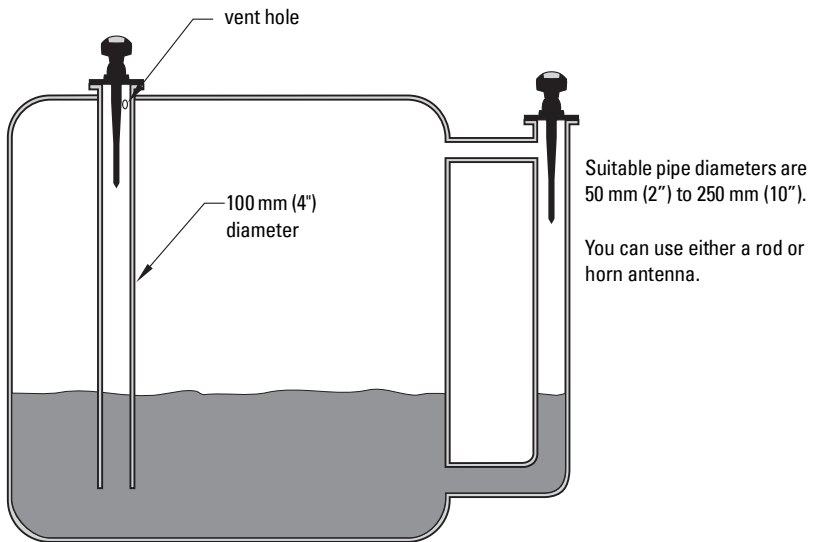
Mounting: Stillpipe or Sidepipe

This is an alternative to the waveguide antenna option, used for products with an ϵ_r less than 3 or for extremely turbulent or vortex conditions. This mounting arrangement can also be used to provide optimum signal conditions on foaming materials.

Suitable pipe diameters are 50 mm (2") to 250 mm (10"). A rod antenna or a horn antenna may be used.

Smoothness

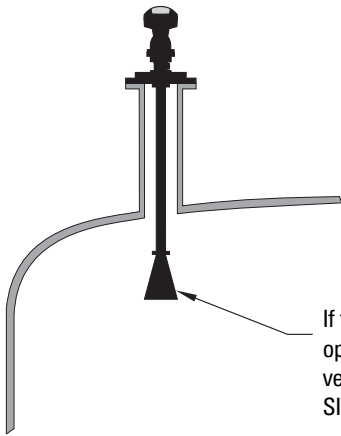
One continuous length of metallic pipe is preferred, without joints. If joints are unavoidable, you must machine them to close tolerances (± 0.25 mm [± 0.010 "]) and weld a connecting sleeve on the outside.



See P655 on page 50 for the related propagation factor.

Ensure there is a vent at the upper end of the side pipe to equalize pressure and keep the liquid-level in the pipe constant with the liquid-level in the vessel.

Mounting: Horn with Waveguide Extensions



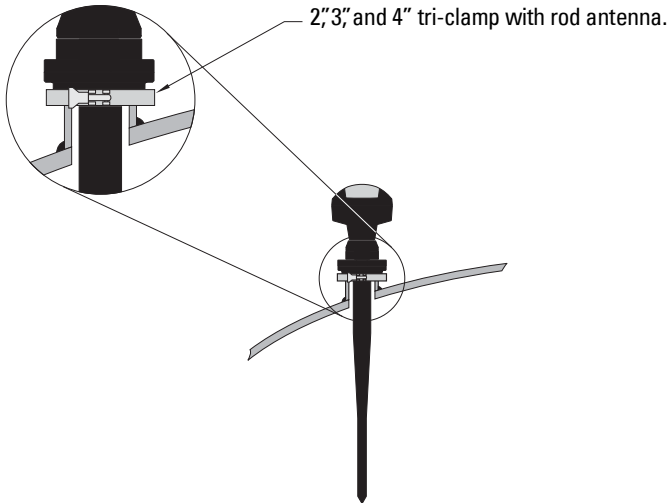
Use this combination if the nozzle is long and the diameter is small.

For example, if the nozzle is 100 mm (4") in diameter and 460 mm (18") in length, the rod antenna is not suitable due to nozzle interference.

Waveguide extensions are available in custom lengths.

If the horn diameter is too large for the nozzle opening, you need to insert it from inside the vessel. The horn must be connected to the SITRANS LR 200 process flange.

Mounting: Sanitary Rod Antenna



Appendix H: hazardous area installations

- Wiring details
- Instructions specific to hazardous area installations

Wiring Details

Intrinsically Safe Model

FM (reference drawing 23651611)

CSA (reference drawing 23651621)

Under the entity evaluation concept, SITRANS LR 200 has the following characteristics:

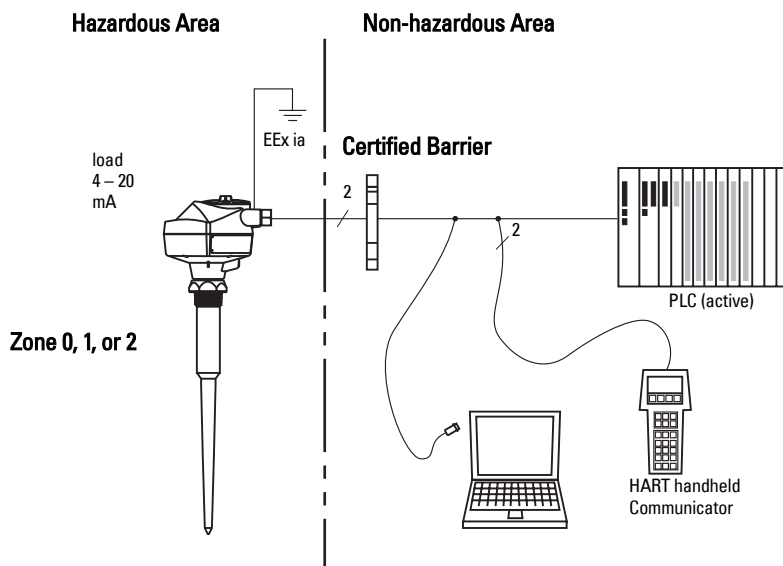
(input voltage) U_i	= 30 V dc (max.)
(input current) I_i	= 120 mA dc (max.)
(internal capacitance) C_i	= 3.6 nF
(internal inductance) L_i	= 0.1 mH

Definition:

The Entity Concept allows interconnection of intrinsically safe apparatus to associated apparatus not specifically examined in such combination. The criteria for interconnection is that the voltage and current which intrinsically safe apparatus can receive and remain intrinsically safe, considering faults, must be equal to or greater than the output voltage (U_o) and output current (I_o) levels which can be delivered by the associated apparatus, considering faults and applicable factors. In addition, the maximum unprotected capacitance (C_i) and Inductance (L_i) of the intrinsically safe apparatus, including interconnecting wiring, must be equal to or less than the capacitance and inductance which can be safely connected to associated apparatus.

FM/CSA

- Approved dust-tight and water-tight conduit seals are required for outdoor NEMA 4X / type 4X / NEMA 6, IP67 locations.
- The maximum voltage of the non-intrinsically safe apparatus must not exceed 250 V rms.
- Recommended intrinsically safe barriers are listed on page 110.



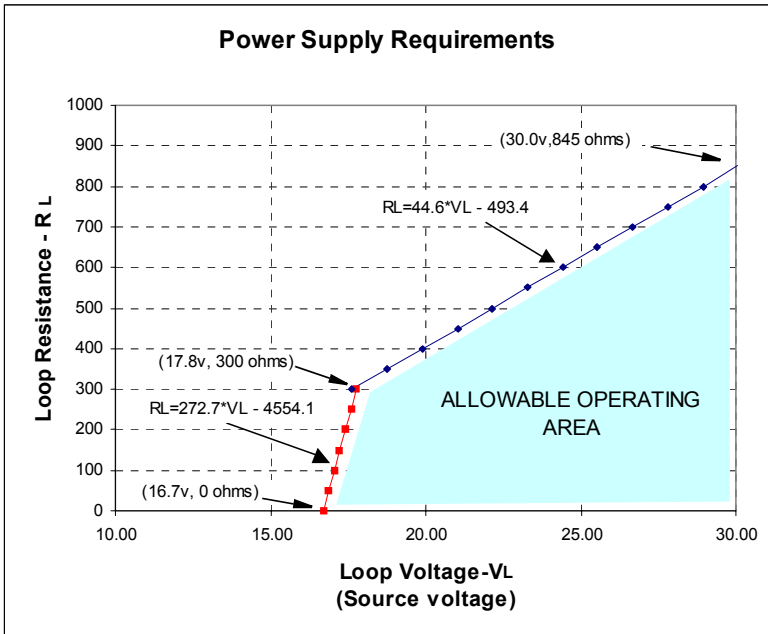
EU Equivalency

Any zener diode safety barrier, certified by an EU approved certification body to [EEx ia] IIC, its output voltage (U_o) not exceeding 30 V and its output current (I_o) limited by load resistance (R_o); such that $I_o = U_o / R_o$, does not exceed 120 mA.

Notes

- The electrical circuit in the hazardous area must be capable of withstanding an ac test voltage of 500 V rms to earth or frame of the apparatus for one minute.
- The installation must comply with national requirements.
- The safe area is unspecified except that it must not be supplied from nor contain, under normal or abnormal conditions, a source of potential with respect to earth in excess of 250 V rms or 250 V dc.

Loop Voltage versus Loop Resistance



IS Safety Barrier Selection

Selecting a suitable barrier or power supply requires knowledge about Intrinsic Safety and the application. It is the responsibility of the installer to ensure that the intrinsically safe installation complies with both the apparatus approval requirements and the relevant national code of practice.

How to select a passive barrier for SITRANS LR 200

1. Make sure that the barrier safety description is suitable for the LR 200 Intrinsically Safe (IS) input parameters.
2. Determine the maximum end-to-end resistance of the barrier (R_{e-e}) from the data sheet.
3. Determine other loop resistance (R_{loop}): for example, sense resistance, displays, and/or PLC inputs.
4. Calculate $R_{working} = R_{e-e} + R_{loop}$.

5. Determine any non-linear voltage drops due to the barrier (V_{barrier}) from the barrier data sheet (for example, voltage drops due to diodes).
6. Calculate $V_{\text{working}} = V_{\text{supply}} - V_{\text{barrier}}$.
7. Using V_{working} and R_{working} , confirm that operation is within the shaded area of the graph *Loop Voltage versus Loop Resistance* on page 110.

Notes:

- The following list is not complete: there are many safety barriers on the market, which will work with the LR 200.
- The barriers listed below have all been tested and are functionally compatible with the LR 200.
- The barriers listed below are all HART compatible.

PLC Input Modules

Manufacturer	Part Number
Siemens	SM331 PCS7 HART Input Module

Passive Shunt Diode Barriers

Note: A well regulated supply voltage is required.

Manufacturer	Part Number
MTL	787SP+ (Dual channel)
MTL	7787P+ (Dual channel)
Stahl	9001/01-280-100-10 (Single channel)
Stahl	9002/01-280-110-10 (Dual channel)

Active barriers (repeating barriers)

Manufacturer	Part Number
MTL	706
MTL	7206
Stahl	9001/51-280-110-14

Instructions specific to hazardous area installations

(Reference European ATEX Directive 94/9/EC, Annex II, 1/0/6)

The following instructions apply to equipment covered by certificate number SIRA 03ATEX2142X:

1. For use and assembly, refer to the main instructions.
2. The equipment is certified for use as Category 1G equipment.
3. The equipment may be used with flammable gases and vapors with apparatus group IIC and temperature class T4.
4. The equipment is certified for use in an ambient temperature range of $-40\text{ }^{\circ}\text{C}$ to $80\text{ }^{\circ}\text{C}$.
5. The equipment has not been assessed as a safety related device (as referred to by Directive 94/9/EC Annex II, clause 1.5).
6. Installation and inspection of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (EN 60079-14 and EN 60079-17 in Europe).
7. Repair of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice (e.g. EN 60079-19 within Europe).
8. Components to be incorporated into or used as replacements in the equipment shall be fitted by suitably trained personnel in accordance with the manufacturer's documentation.
9. It is the responsibility of the user to ensure that manual override is possible in order to shut down the equipment and protective systems incorporated within automatic processes which deviate from the intended operating conditions, provided that this does not compromise safety.

10. The 'X' suffix to the certificate number relates to the following special conditions for safe use:
- Parts of the enclosure may be non-conducting and may generate an ignition-capable level of electrostatic charge under certain extreme conditions. The user should ensure that the equipment is not installed in a location where it may be subjected to external conditions (such as high-pressure steam) which might cause a build-up of electrostatic charge on non-conducting surfaces.
 - As either Aluminum, Magnesium, Titanium or Zirconium may be used at the accessible surface of the equipment. In the event of rare incidents, ignition sources due to impact and friction sparks could occur. This shall be considered when the SITRANS LR 200 is being installed in locations that specifically require group II, category 1G equipment.
11. The certification of this equipment relies upon the following materials used in its construction:

Aluminum alloy ANSI ref. A380.0 (aluminum enclosure option)
Valox 365 (injection moulded plastic enclosure option)
Ultem 1010 (window on plastic enclosure option)
Stycast 2651-40FR encapsulant, catalyst II

The detailed composition of Aluminum A380.0 as used in the metal enclosure (threaded lid option only) is as follows:

Si – 8.5%, Fe – 1.3%, Cu – 3.5%, Mn – 0.5%, Mg – 0.1%, Ni – 0.1%, Zn – 3%,
Sn – 0.35%, others – 0.5%, Al - balance

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

Aggressive substances: e.g. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials.





Suitable precautions: e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals.

12. Equipment Marking

The equipment marking contains at least the information on the product nameplate, shown on page 114.

Product Nameplate

SIEMENS	
SITRANS LR 200	
SERIAL No: 2003/12345678	
ENCL.: NEMA/TYPE4X, 6, IP67	
AMB.TEMP.: -40°C to 80°C	
POWER RATING: 24V $\overline{=}$ Nom., 30V $\overline{=}$ Max., 4-20mA	
Siemens Milltronics Process Instruments Inc. Peterborough	
Made in Canada	

Ex ia per drawing: 23651611	U _i = 30V, I _i = 120 mA
Temp. Code: T4	P _i = 0.8W, C _i = 3.6nF
Class I, Div 1. Group A, B, C, D	L _i = 0.1mH
Class II, Div 1, Group E, F, G	
Class III	II 1G
HART 5.8 GHz	EEEx ia IIC T4
  	 II 1G SIRA 03ATEX2142X
WARNING: POSSIBLE STATIC HAZARD, DO NOT RUB OR CLEAN ON SITE.	

CANADA: 267P – LR200	FCC ID: NJA-LR200
Ex ia per drawing: 23651621	Temp. Code : T4
Class I, Div 1. Group A, B, C, D	I _{max} = 120mA
Class II, Div 1, Group G	P _{max} = 0.8 W
Class III	V _{max} = 30V
6.3 GHz	C _i = 3.6 nF
HART	L _i = 0.1 mH 159134
WARNING: POSSIBLE STATIC HAZARD, DO NOT RUB OR CLEAN ON SITE.	

H: Hazardous installation

Glossary

accuracy: degree of conformity of a measure to a standard or a true value.

agitator: mechanical apparatus for mixing or aerating. A device for creating turbulence.

algorithm: a prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps.

ambient temperature: the temperature of the surrounding air that comes in contact with the enclosure of the device.

antenna: an aerial which sends out and receives a signal in a specific direction. There are four basic types of antenna in radar level measurement, horn, parabolic, rod, and waveguide.

attenuation: a term used to denote a decrease in signal magnitude in transmission from one point to another. Attenuation may be expressed as a scalar ratio of the input magnitude to the output magnitude or in decibels.

Auto False-Echo Suppression: a technique used to adjust the level of a TVT curve to avoid the reading of false echoes. (See TVT.)

Auto False-Echo Suppression Distance: defines the endpoint of the TVT distance. (See TVT.) This is used in conjunction with auto false echo suppression.

beam angle: the angle diametrically subtended by the one-half power limits (-3 dB) of the sound beam.

beam spreading: the divergence of a beam as it travels through a medium.

blanking: a blind zone extending away from the reference point plus any additional shield length. The instrument is programmed to ignore this zone.

capacitance: the property of a system of conductors and dielectrics that permits the storage of electricity when potential differences exist between the conductors. Its value is expressed as the ratio of a quantity of electricity to a potential difference, and the unit is a Farad.

confidence: describes the quality of an echo. Higher values represent higher quality. Confidence threshold defines the minimum value.

damping: term applied to the performance of an instrument to denote the manner in which the measurement settles to its steady indication after a change in the value of the level.

dB (decibel): a unit used to measure the amplitude of signals.

derating: to decrease a rating suitable for normal conditions according to guidelines specified for different conditions.

dielectric: a nonconductor of direct electric current.¹

dielectric constant (DK): the ability of a dielectric to store electrical potential energy under the influence of an electric field. Also known as Relative Permittivity. An increase in the dielectric constant is directly proportional to an increase in signal amplitude. The value is usually given relative to a vacuum/dry air: the dielectric constant of air is 1¹.

echo: a signal that has been reflected with sufficient magnitude and delay to be perceived in some manner as a signal distinct from that directly transmitted. Echoes are frequently measured in decibels relative to the directly transmitted signal.

echo confidence: the recognition of the validity of the echo. A measure of echo reliability.

Echo Lock Window: a window centered on an echo in order to locate and display the echo's position and true reading. Echoes outside the window are not immediately processed.

Echo Marker: a marker that points to the processed echo.

Echo Processing: the process by which the radar unit determines echoes.

Echo Strength: describes the strength of the selected echo in dB above 1 μ V rms.

Echo Profile: a graphical display of a processed echo.

false echo: any echo which is not the echo from the desired target. Generally, false echoes are created by vessel obstructions.

1. Many conductive liquids/electrolytes exhibit dielectric properties; the relative dielectric constant of water is 80.

frequency: the number of periods occurring per unit time. Frequency may be stated in cycles per second.

hertz (Hz): unit of frequency, one cycle per second. 1 Gigahertz (GHz) is equal to 10^9 Hz.

HART: Highway Addressable Remote Transducer. An open communication protocol used to address field instruments.

horn antenna: a conical, horn-shaped antenna which focuses microwave signals. The larger the horn diameter, the more focused the radar beam.

inductance: the property of an electric circuit by virtue of which a varying current induces an electromotive force in that circuit or in a neighboring circuit. The unit is a Henry.

microwaves: the term for the electromagnetic frequencies occupying the portion of the radio frequency spectrum from 1 GHz to 300 GHz.

multiple echoes: secondary echoes that appear as double, triple, or quadruple echoes in the distance from the target echo.

Near Blanking: see Blanking

nozzle: a length of pipe mounted onto a vessel that supports the flange.

parameters: in programming, variables that are given constant values for specific purposes or processes.

polarization: the property of a radiated electromagnetic wave describing the time-varying direction and amplitude of the electric field vector.

polarization error: the error arising from the transmission or reception of an electromagnetic wave having a polarization other than that intended for the system.

propagation factor (pf): where the maximum velocity is 1.0, pf is a value that represents a reduction in propagation velocity as a result of the wave travelling through a pipe or medium.

pulse radar: a radar type that directly measures distance using short microwave pulses. Distance is determined by the return transmit time.

radar: radar is an acronym for **RA**dio **D**etection **A**nd **R**anging. A device that radiates electromagnetic waves and utilizes the reflection of such waves from distant objects to determine their existence or position.

range: distance between a transmitter and a target.

range extension: the distance below the zero percent or empty point in a vessel.

relative permittivity: see dielectric constant

repeatability: the closeness of agreement among repeated measurements of the same variable under the same conditions.

shot: one transmit pulse or measurement.

speed of light: the speed of electromagnetic waves (including microwave and light in free space. Light speed is a constant 299, 792, 458 meters per second.

stillpipe: a pipe that is mounted inside a vessel perpendicular to the vessel wall, and is open to the vessel at the bottom.

stilling-well: see **stillpipe**.

two wire radar: a low-energy radar. Can be loop powered, analog, intrinsically safe 4 to 20 mA, or a digital (BUS) transmitter.

TVT (time varying threshold): a time-varying curve that determines the threshold level above which echoes are determined to be valid.

waveguide antenna: a hollow, metallic tube that transmits a microwave signal to the product target.

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