Draft Manual
02/13/2006

million
in one

sitrans
LR 460

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.

Unit Repair and Excluded Liability:

- The user is responsible for all changes and repairs made to the device by the user or the user's agent.
- All new components are to be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not reuse faulty components.

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.

Contact SMPI Technical Publications at the following address:

Technical Publications
Siemens Milltronics Process Instruments Inc.
1954 Technology Drive, P.O. Box 4225
Peterborough, Ontario, Canada, K9J 7B1
Email: techpubs.smpi@siemens.com

- For a selection of Siemens Milltronics level measurement manuals, go to:
  www. siemens.com/processautomation. Under Process Instrumentation, select *Level Measurement* and then go to the manual archive listed under the product family.
- For a selection of Siemens Milltronics weighing manuals, go to:
  www. siemens.com/processautomation. Under Weighing Technology, select *Continuous Weighing Systems* and then go to the manual archive listed under the product family.

Table of Contents

DRAFT

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.**
>
> **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
∿		Alternating Current
⎓		Direct Current
⚠	⚠	(Label on product: yellow background.) WARNING: refer to accompanying documents (manual) for details.

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The Manual

This manual will help you set up your SITRANS LR 460 for optimum performance. SITRANS LR 460 is available in two versions (HART or PROFIBUS PA), and the manual is in three parts:

Part I: information common to both versions

- introduction to LR 460
- specifications
- installation
- wiring

Part II: SITRANS LR 460 4-20 mA version

- 4-20 mA Quick Setup
- local operation using handheld programmer
- LCD menu charts
- HART communications

Part III: SITRANS LR 460 PROFIBUS PA version:

- PROFIBUS PA Quick Setup
- remote operation
- PA profile
- PA Data Maps

Appendices provide further information common to both models:

- *Appendix A: Parameter Descriptions*
- *Appendix B: Technical Reference*
- *Appendix C: Troubleshooting*
- *Appendix D: Maintenance*
- *Appendix E: Software Revision History*

We always welcome suggestions and comments about manual content, design, and accessibility. Please direct your comments to techpubs.smpi@siemens.com.

For other Siemens Milltronics level measurement manuals, go to: www.siemens.com/level, and look under **Level Measurement.**

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.

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

Application Examples

The application example used in this manual illustrates a typical installation using SITRANS LR 460. Because there is often a range of ways to approach an application, other configurations may also apply. If the example does not apply to your application, check the applicable parameter reference for the available options.

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

Abbreviations and Identifications

Short form	Long Form	Description	Units
A/D	Analog to digital		
AIFB	Analog Input Function Block		
CE / FM / CSA	Conformitè Europèene / 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	
FV	Full Vacuum		
ESD	Electrostatic Discharge		
I_i	Input current		mA
I_o	Output current		mA
IS	Intrinsically Safe	safety approval	
L_i	Internal inductance		mH
LR	Level Radar		
LTB	Level Transducer Block		
mH	milliHenry	10^{-3}	Henry

Short form	Long Form	Description	Units (cont'd)
μF	microFarad	10^{-6}	Farad
μs	microsecond	10^{-6}	Second
PA	Process Automation (PROFIBUS)		
PDM	Process Device Manager (SIMATIC)		
PED	Pressure Equipment Directive	safety approval	
pF	pico Farads	10^{-12}	Farad
ppm	parts per million		
PSIA	pounds/square inch absolute		
PV	Primary Value[1]	measured value	
RH	relative humidity		
SCFM	standard cubic feet/minute		
SELV	Safety extra low voltage		
SV	Secondary Value[1]	equivalent value	
TB	Transducer Block		
TV	Transmitter Variable		
TVT	Time Varying Threshold	sensitivity threshold	
U_i	Input voltage		V
U_o	Output voltage		V

[1.] The output from the Level Transducer Block can be called the Primary Value (or Secondary Value). When it becomes the input to the AIFB, it is called the Process Variable.

Programming

SITRANS LR 460 carries out its level measurement function according to the set of built-in parameter tables. You can make parameter changes via the Siemens Milltronics handheld programmer, a PC running SIMATIC PDM or a HART handheld communicator.

Approvals and Certificates

Note: Please see *Approvals* on page 9.

DRAFT

Part I: SITRANS LR 460 (all versions)

SITRANS LR 460

SITRANS LR 460 is a long-range FMCW radar level transmitter for level measurement of solids. It can be used in high pressure applications or applications requiring gas safety approvals. The Easy Aimer design makes it easy to set up the device even in conditions of extreme dust. The narrow antenna beam creates a sharp emission cone, which makes the LR 460 quite insensitive to vessel interferences.
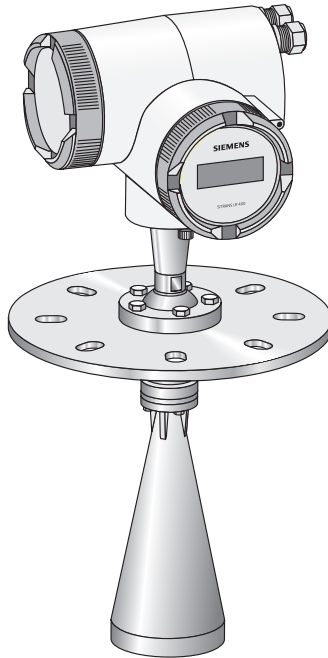
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System Implementation

SITRANS LR 460 supports HART communication protocol, and SIMATIC PDM software.

Typical PLC/mA configuration with HART

PLC with mA input card

HART

HART Communicator 275

PC/laptop with HART modem running PDM

SITRANS LR 460
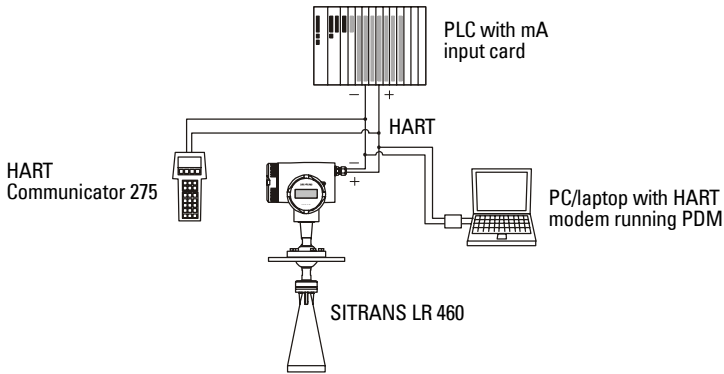
Note: A 250 ohm loop resistor may be required, depending on PLC input resistance.

Typical PLC/mA configuration with PROFIBUS PA

Class 1 Master

PLC

PDM

Class 2 Master

DP/PA Coupler

PROFIBUS PA

ET200

HART

SITRANS LR 460

SITRANS LR 460
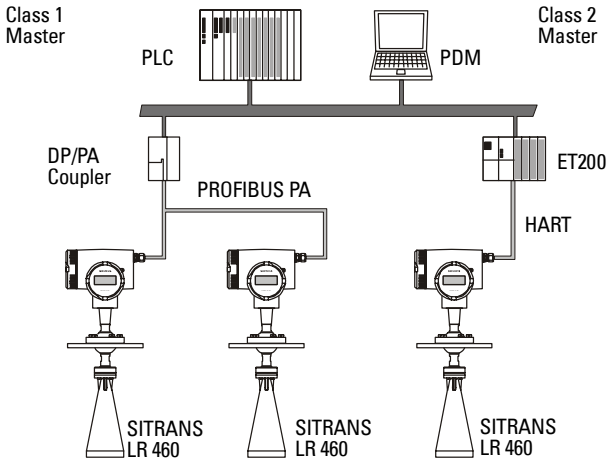
SITRANS LR 460

Specifications

> **Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications, but reserves the right to change them at any time.

SITRANS LR 460

Power

Power Supply (HART)
- 100 to 230 V AC, $\pm$15%, 50/60 Hz, 6 W (12VA)
- 24 V DC, +25/-20%, 6 W
- Power failure: bridge of at least 1 mains period (> 20 ms)

• Fuse (AC)	SI1	Fast acting ceramic, 4 x 20 mm, 1 A, 250 V AC
	SI2	Slow-Blow, 4 x 20 mm, 0.63 A, 250 V AC
• Fuse (DC)	SI1	Fast acting ceramic, 4 x 20 mm, 2 A, 250 V AC
	SI2	Slow-Blow, 4 x 20 mm, 0.63 A, 250 V AC

Power Supply (PROFIBUS PA)

Performance

Reference operating conditions according to IEC 60770-1
- ambient temperature   +15 to +25 °C
- humidity   45 to 75 % relative humidity
- ambient pressure   860 to 1060 mbar (12.47 to 15.37 psi)

Measurement Accuracy (measured in accordance with IEC 60770-1)
- non-linearity (accuracy)   greater of 25 mm (1") or 0.25% of span (including hysteresis and non-repeatability)
- non-repeatability   10 mm (0.4") [included in non-linearity specification]
- deadband (resolution)   10 mm (0.4") [included in non-linearity specification]
- hysteresis error   0 mm

Analog Output Accuracy (measured in accordance with IEC 60770-1)
- non-linearity (accuracy)   0.100% of span (including hysteresis and repeatability)
- non-repeatability   0.030% of span (included in non-linearity specification)
- deadband (resolution)   0.030% of span [included in non-linearity specification]
- hysteresis error   0%

Frequency   25 GHz nominal

Measurement range   0.35 to 70 m (1.15 to 229.66 ft)[1]

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1. Minimum range: 0.35 m (1.15 ft) from bottom of flange.

Long-term stability	$\leq \pm 1$ mm/year
Update time at 4mA	mA output and loop display is updated once per second
Beam angle	3" horn: 11° at –3 dB boundary
	4" horn: 8° at –3 dB boundary

Memory
- non-volatile EEPROM
- no battery required

Interface

Analog output (Not applicable to PROFIBUS PA option)
• signal range	4 to 20 mA
	upper limit 20 to 22.5 mA adjustable
• fail signal	3.6 mA; 22 mA; 24 mA or last value
• load	Max. 600 Ω; for HART[1] communication min. 230 Ω

Digital output
• function	Configurable as a device status or limit value (level, volume, mass)
• signal type	Relay, either NCC or NOC function, max. 50 V DC, max. 200 mA, rating max. 5 W.
	Self-resetting fuse, $R_i = 9 \ \Omega$

Electrical isolation	Outputs electrically isolated from the power supply and from each other

Display
• LCD	two lines of 16 characters each, configurable for the following displays:
	level, volume, mass, amplitude, digital output, temperature, validity, signal-to-noise ratio

Programmer (infrared keypad)

Siemens Milltronics infrared IS (Intrinsically Safe) handheld programmer for hazardous and all other locations (battery is non-replaceable)

• approval:	ATEX II 1 G EEx ia IIC T4, certificate SIRA 01ATEX2147
	CSA and FM Class I, Div. 1, Gr. A, B, C, D T6 @ max. ambient temperature of 40 °C (104 °F)

[1.] HART® is a registered trademark of HART Communication Foundation.

Specifications

- 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

Wetted parts (in contact
with the process) Stainless steel flange and horn; PTFE emitter

Process Connection
- universal flanges 2"/50 mm, 3"/80 mm, 4"/100 mm, 6"/150 mm (See page 11 for flange dimensions.)

Pressure (vessel) 0.5 bar (7.25 psi) maximum

Horn
- horn diameters 3" (80 mm); 4" (100 mm)
- optional extensions 4" or 8" (100 or 200 mm)
  500 and 1000 mm available for non-purged versions only

Weight
- Weight of instrument and flange

Process Connection	Weight
Universal, 3" / 80 mm flange with 3" horn	6.1 kg (13.4 lbs)
Universal, 4" / 100 mm flange with 4" horn	6.8 kg (15.0 lbs)
Universal, 6" / 160 mm flange with 4"horn	TBA

Enclosure
- construction Die-cast aluminum, painted (polyester powder-coated)
- conduit 2 x M20
  or 2 x ½" NPT (option)
- ingress protection Type 4X/NEMA 4X, Type 6/NEMA 6, IP67[1]

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1. Use only approved, suitable sized hubs for watertight applications.

Environmental[1]

- location   indoor/outdoor
- altitude   2000 m (6562 ft) max
- ambient temperature[2]   -40 to 65 °C (-40 to 149 °F)
- relative humidity   suitable for outdoor (Type / NEMA 4X, 6/ IP67)
- installation category   II
- pollution degree   4
- Perm. ambient   -40 to 65 °C (-40 to 149 °F) (non-hazardous version)
                                        temperature[3]LCD: -10 to 55 °C (14 to 131 °F)
                                        Observe the temperature classes in hazardous areas!

> **! WARNING:** 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.

Process

- Process temperature   -40 to 200 °C (-40 to 392 °F)
                                        [-40 to 250 °C (-40 to 418 °F) option]
- Pressure (vessel)   0.5 bar (7.25 psi) maximum

Communication

- Communication: HART
  Load   230 to 600 Ω, 230 to 500 Ω when connecting a coupling module
  Line   two-wire shielded: ≤ 3000 m
                                        multi-wire shielded: ≤ 1500 m
  Protocol   HART, Version 5.1
- Communication: PROFIBUS PA
  Protocol   Layer 1 and 2 PROFIBUS PA,
                                        technology: IEC 61158-2, slave-functionality
  Device Class   A
  Device Profile   3.0
- Software for PC/Laptop   Windows 95/98/2000/XP or NT 4.0
                                        SIMATIC® PDM

[1.] See Process/Ambient de-rating curves in Appendix III.

[2.] -20 °C (-4 °F) temperature rating available on SITRANS LR 460 with ATEX rating.

Approvals

(verify against device nameplate)

- Hazardous areas   FM/CSA Class II, Div. 1, Groups E,F and G, Class III
                     ATEX II 1/2 D T6
- General   CSAus/c, FM, CE
- Radio   FCC, Industry Canada, European Radio (R&TTE)

SITRANS LR 460 Dimensions

connection cover

electronics cover

204 mm (8.0")

278 mm (10.94")

Easy Aimer ball locking bolts

universal slotted flange (see page 11 for details)

reference point

horn extension (optional)

100 mm (3.94")

165.5 mm (6.5")

228.3 mm (9.0")

291.2 mm (11.5")

horn antenna

50 mm (1.97")

75 mm (2.95")

100 mm (3.94")

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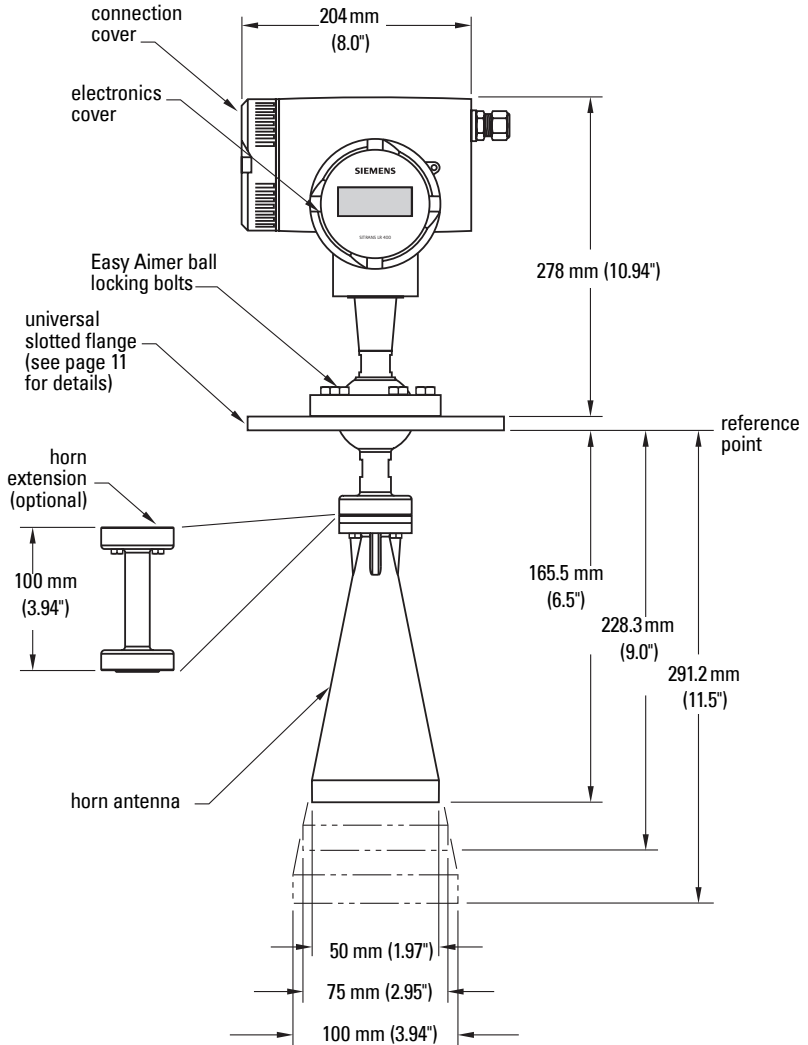
1. Consult factory when using horn extension in applications subject to shock and vibration.

2. Universal flange mates with DIN 2527 / ANSI B16.5 / JIS B2238 bolt hole pattern.

Flange Dimensions

Pipe Size	Flange O.D.	Thick-ness (s)	Bolt Hole Circle Max Ø	Bolt Hole Circle Min Ø	Bolt Hole radius	No. of Slotted Holes
2" or 50 mm	7.87" (200 mm)	0.38" (9.65 mm)	4.92" (125 mm)	4.72" (120 mm)	0.38" (9.5 mm)	4
3" or 80 mm	7.87" (200 mm)	0.38" (9.65 mm)	6.30" (160 mm)	5.91" (150 mm)	0.38" (9.5 mm)	8
4" or 100 mm	9.00" (229 mm)	0.38" (9.65 mm)	7.52" (191 mm)	6.89" (175 mm)	0.38" (9.5 mm)	8
6" or 150 mm	11.22" (285 mm)	0.38" (9.65 mm)	9.53" (242 mm)	9.45" (240 mm)	0.45" (11.5 mm)	8

Universal Slotted Flange Diagram

45°

number of slotted bolt holes
bolt hole circle max. diameter
bolt hole circle min. diameter

"A"   "A"

flange O.D.

thickness

section A-A
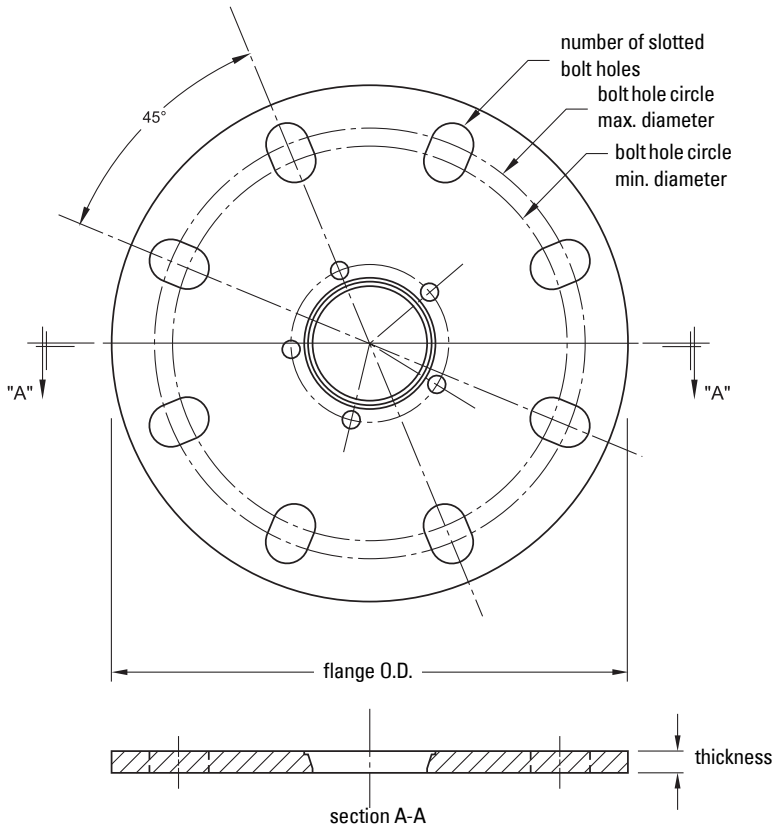
Specifications

Purged LR 460 version

Requirements for effective cleaning	
Recommended pressure	90 to 110 psi
Recommended inlet flow	10 SCFM [1]

Note: Short bursts of high pressure periodically are more effective for purging than continuous low pressure.

purged process connection with
factory-installed 1/2" NPT plug

alignment markings

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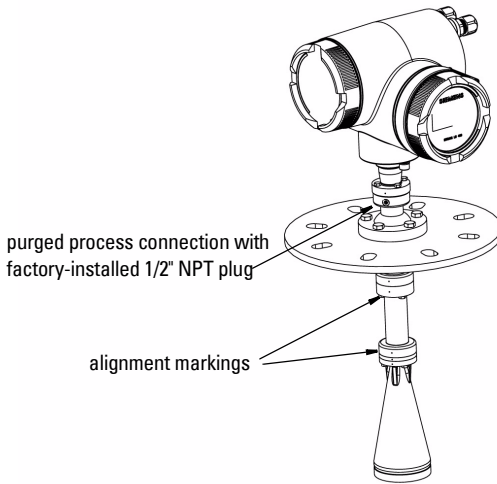
[1]. SCFM: standard cubic feet/minute referenced to 14.7 psia, 68°F and 36% relative humidity (RH)

Installation

! WARNINGS:

- **SITRANS LR 460 is to be used only in the manner outlined in this manual, otherwise protection provided by the equipment may be impaired.**
- **Installation shall only be performed by qualified personnel and in accordance with local governing regulations.**
- **Improper installation may result in loss of process pressure**

Notes:
- Installation must be according to ETSI EN 302372.
- Refer to device nameplate for approval information.
- For Type 4X/NEMA 4X, Type 6/NEMA 6, IP67 type of protection use only approved, suitable sized hubs for watertight applications.
- Observe all maximum permissible ambient and process temperatures. Refer to _Maximum Process Temperature Chart_ on page 86.
- Provide a warning sign and/or touch guard if the surface of the measuring instrument can become hotter than 70 °C (158 °F) in use.

Mounting Location

Recommendations

- Provide easy access for viewing display and programming via handheld programmer.
- Provide an environment suitable to the housing rating and materials of construction.
- Mount the unit more than 1 meter away from vessel walls, pipes and other assemblies as well as the filling stream, which could cause reflective interference.
- Align the antenna so that the radar cone intersects the surface of the measuring medium vertically if possible.

Precautions

- Do not mount in direct sunlight without the use of a sun shield.
- Avoid interference to emission cone from obstructions or from fill path.
- Avoid central locations on vessel.

Warning: Internal temperature must not exceed 85 °C (185 °F)!

ambient temperature 65 °C (149 °F) max.

internal enclosure temperature

flange temperature

handheld programmer

process temperature
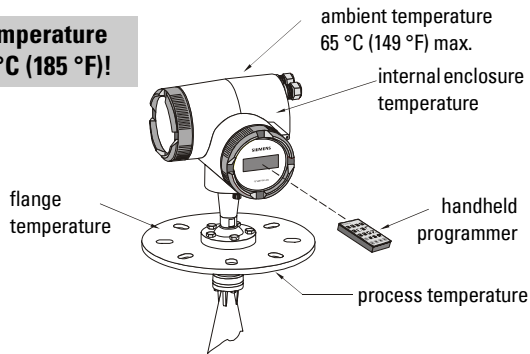
! WARNING: For vessels with conical or parabolic tops, avoid mounting the unit at the center. The concavity of the top can focus echoes into the centre, giving false readings.

Parabolic or Conical

Flat

✓✓ is preferred location

✓ is acceptable location

Beam Width

Keep the emission cone free of obstructions.

11° 3" horn

8° 4" horn
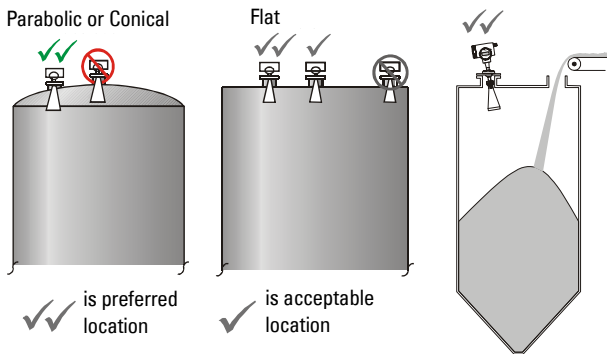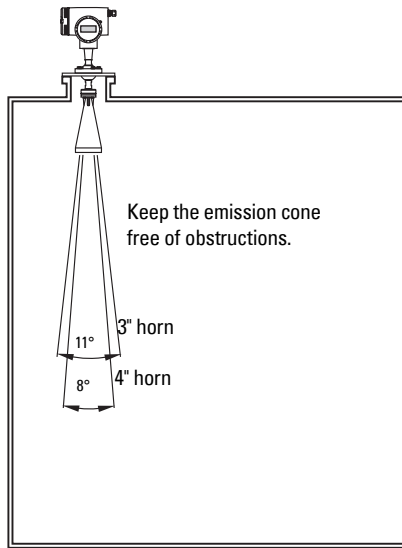
Installation in Mounting Nozzle

The bottom edge of the antenna must project into the vessel to avoid reflective interference at the wall of the nozzle. If the process nozzle diameter is greater than 6", the antenna does not need to project beyond the nozzle unless the emission cone touches the nozzle wall.

GRAPHIC TO BE UPDATED

10 mm
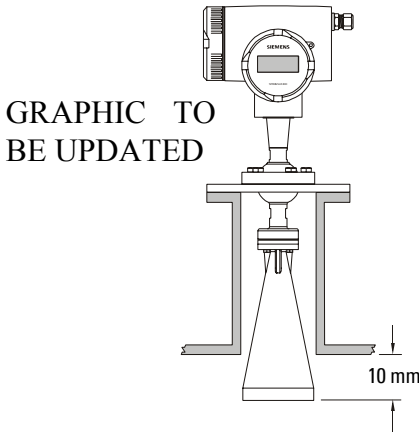
Installation

Easy Aimer Installation

Easy Aimer ball locking bolts

top clamping plate (upper socket)

bottom clamping plate (lower socket)

customer gasket as required [recommended thickness 1.5 to 1.8 mm (0.06 to 0.07")]

customer mounting plate, as required ø 4" (102 mm) min., central opening

0.38" (10 mm)

2" horn: 6.5" (165.5 mm)
3" horn: 9.0" (228.3 mm)
4" horn: 11.5" (291.2 mm)

30° max.
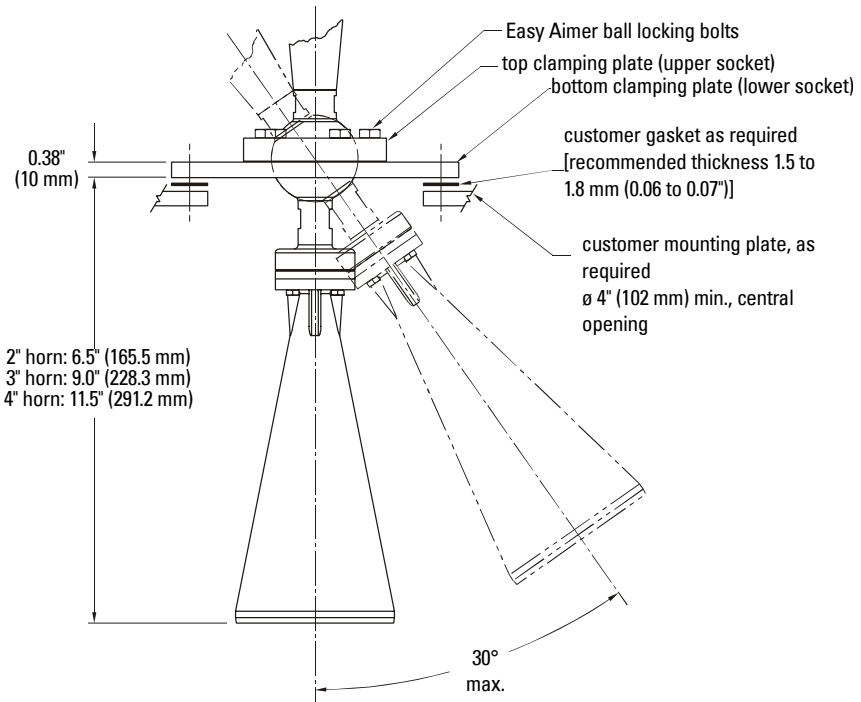
Easy Aimer Positioning

- Direct SITRANS LR 460 so the horn antenna is pointed at an angle to the filling level as shown.

- Loosen the Easy Aimer ball locking bolts and position the LR 460.

- Tighten bolts to secure the device.

Easy Aimer

SITRANS LR 460 – INSTRUCTION MANUAL

Installation

Notes
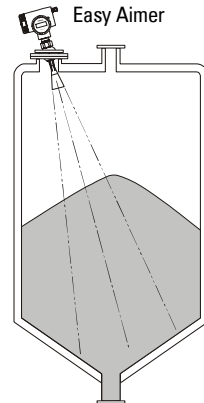
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Wiring

> ! **WARNINGS:**
>
> - **Turn off power to the device before unscrewing the housing cover in a hazardous area.**
> - **All field wiring must have insulation suitable for at least 250 V.**
> - **DC input terminals shall be supplied from an SELV source in accordance with IEC 1010-1 Annex H**
> - **The equipment must be protected by a 15A fuse or circuit breaker in the building installation.**
> - **A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.**
> - **To avoid short-circuits, do not connect a load resistance with bare wires in the connection box.**
>
> **Notes:**
> - AC and DC input circuits: min 14 AWG copper wire
> - Recommended torque on terminal clamping screws, 0.5 - 0.6 Nm

Connecting SITRANS LR 460

If the device is rotated, return the orientation of the housing to its previous position with reference to the enclosure, to ensure similar performance.

1. Release the cover lock on the connection box with a 3 mm Allen key and unscrew the cover.(Use a screwdriver for extra leverage, if required.)
2. Push the power and signal cables through the cable glands until they reach the terminal strip.

cover lock

connection box

cable gland (2)

metal bracket

terminal strip

signal and power cables
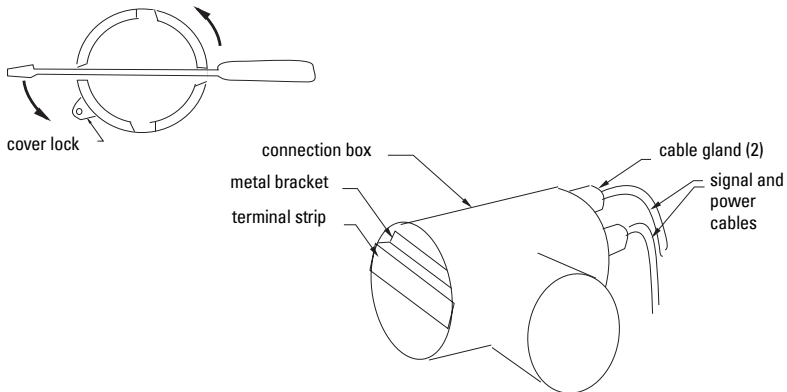
Wiring

AC version
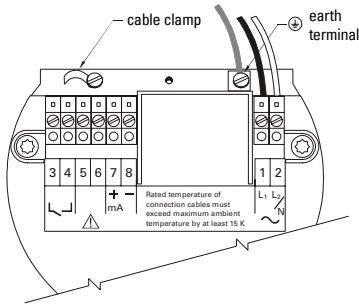
HART wiring[1]
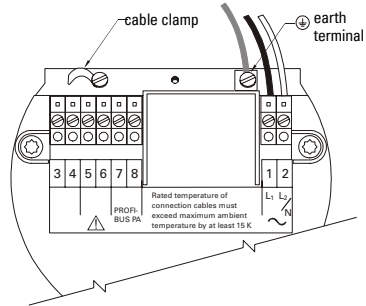
PROFIBUS wiring[2]

DC version

HART wiring[1]
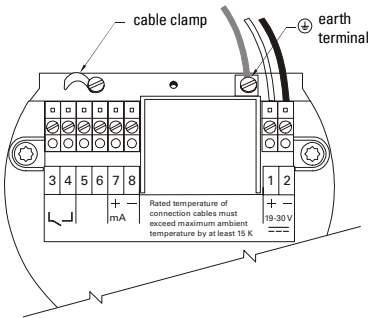
PROFIBUS wiring[2]
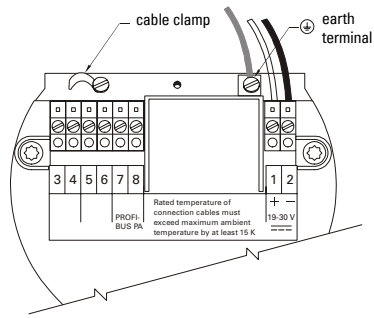
3. Connect the earth conductor of the power supply to the earth terminal ⏚ on the metal bracket inside the connection box. Adjust the cable length so that the earth conductor would be last to disconnect if cable is pulled.
4. Tighten the cable gland and check the strain relief (pull and turn).
5. Screw the cover onto the connection box and hand tighten it. The sealing ring must be clean and undamaged.
6. Reattach the cover lock on the connection cover.

Wirng

7. Connect the external earth terminal located between the cable glands to a ground connection at your vessel. Use a cable with a diameter of 2.5 mm^2.or greater.

For error-free communication via the HART protocol, a load of at least 230 Ω must be available in the signal circuit.

cable glands

SIEMENS

earth (ground) terminal

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Wiring
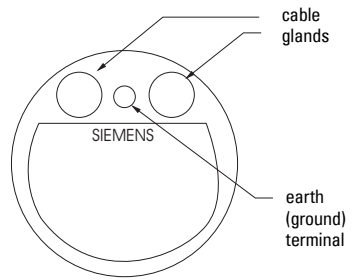
Hazardous area installations

Product Nameplate
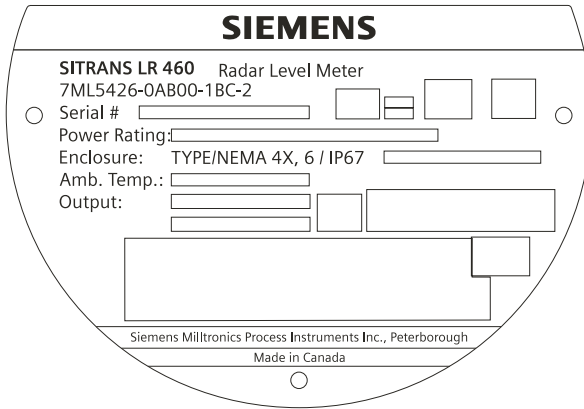
Instructions specific to hazardous area installations

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

The following instructions apply to equipment covered by certificate number DMT 01 ATEX E 038:

1. For use and assembly, refer to the main instructions.

2. The equipment is certified for use as Category 1/2 D equipment. The Essential Health and Safety Requirements are assured by compliance with EN 50281-1-1:1998; Dust Explosion Protection.

3. The equipment may be used with dust and fibers with apparatus temperature class T. See table below.

Wirng

- Permitted ambient temperature at the horn antenna (Category 1D):
  - 20 °C $\leq T_{amb} \leq$ +200 °C
- Permitted ambient temperature at the electronic enclosure (Category 2D):
  -20 °C $\leq T_{amb} \leq$ +65 °C

- Maximum permitted temperature within electronic enclosure (Category 1D): 85 °C

Ambient temperature at the horn antenna (Category 1D)	Maximum surface temperature at the horn antenna (Category 1D)	Maximum surface temperature Category 2D (electronic enclosure resp. flange)
- 20 °C $\leq T_{amb} \leq$ + 60 °C	72 °C	70 °C at $T_{amb} \leq$ 65 °C in Category 2
- 20 °C $\leq T_{amb} \leq$ + 100 °C	112 °C	100 °C independent from T_{amb} in Category 2
- 20 °C $\leq T_{amb} \leq$ + 200 °C	212 °C	200 °C independent from T_{amb} in Category 2

4. The equipment has not been assessed as a safety related device (as referred to by Directive 94/9/EC Annex II, clause 1.5).

5. 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).

6. 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).

7. 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.

8. 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.

9. Equipment Marking:
   The equipment marking contains at least the information on the product label, shown on page 22.

EU Equivalency

Any zener diode safety barrier, certified by an EU approved certification body to [EEx ia] IIC, its output voltage (Uo) not exceeding 24 V and its output current (Io) limited by load resistance (Ro); such that Io = Uo / Ro, does not exceed 250 mA.

Notes
- 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.

Wiring

Part II: SITRANS LR 460
4-20 mA version

DRAFT

4-20 mA Start Up

Only two steps are necessary for a Quick Setup (see page 29 for detailed instructions):

1. Use the handheld programmer to set the PROFIBUS address locally.
2. Use SIMATIC PDM to calibrate the four set points: High and Low Calibration Point, and High and Low Level Point.

SITRANS LR 460 automatically starts up in **RUN** mode and detects the material level. The LCD displays the material level referenced from the Low Level Point[1] (the output of Analog Input Function Block 1 or 2). System status is displayed on the LCD, or on a remote communications terminal.

> **Note:** Frequently switching the device off and on causes wear of the electronics (monitored using Parameter ???).

Startup Display (RUN mode)

Normal operation

Failsafe operation
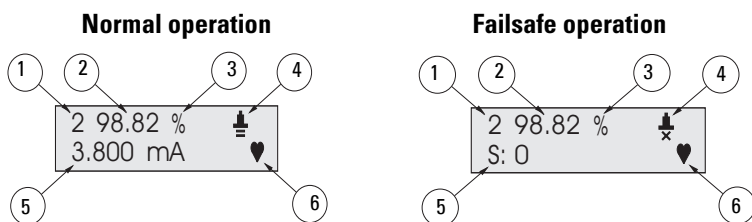
1 – Number of the active Analog Input Function Block (AIFB 1 or 2)

2 – Primary display: shows level, space, distance or volume (Output of the active AIFB)

3 – Units: the associated engineering units of the primary value (m, cm, mm, ft, in, or percent) if applicable

4 – Echo status indicator: Reliable Echo ⚓ or Unreliable Echo ⚓

  The Reliable Echo icon is visible during normal operation.

  If LOE is pending[2] the **x** flashes, alternating with the two horizontal bars.

  When LOE becomes active, the **x** becomes solid and the auxiliary display shows fault code **S: 0**.

5 – Auxiliary display: shows distance, mA value (HART only), confidence, or temperature, in response to request via Siemens Milltronics handheld programmer

6 – Heartbeat: a small heart-shaped icon flashes on and off once per second.

---

1. See *Calibration* on page 29 for an illustration.
2. See *LOE Timer* on page 84 for more details.

Programming SITRANS LR 460

The parameters that control the operation of the LR 460 are organized into function groups, and arranged in a 4-level menu structure that can be accessed either via the handheld programmer, or via PDM (see *LCD menu structure* on page 37).

The handheld programmer[1]

To activate PROGRAM mode, point the handheld programmer at the display (from a maximum distance of 600 mm [2 ft.]), and press the Mode key 🗐.
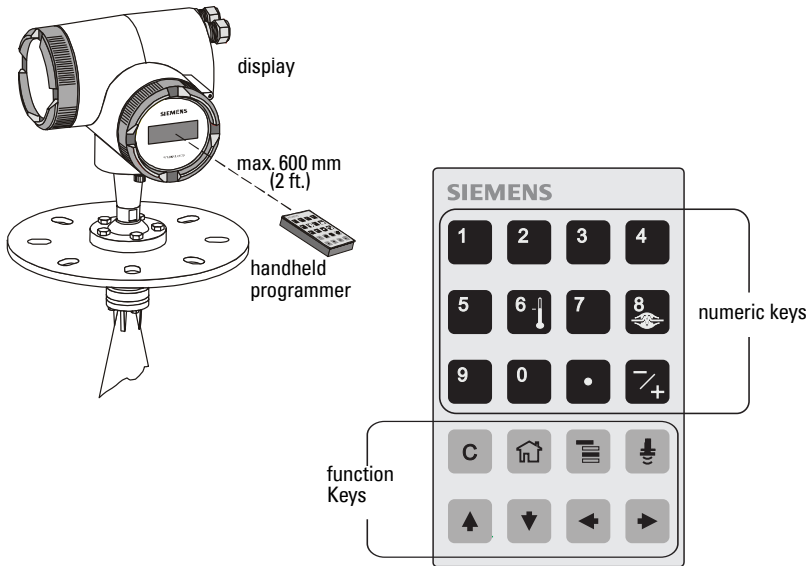
The handheld programmer has two modes of operation:

1. Navigation Mode
    *   In this mode, the rightmost digit of the menu number flashes (the Edit Mode icon ⠿ is not visible).
    *   Press Up or Down arrow to change the menu number.
    *   Press Right or Left arrow once to move to the next/previous menu level.
    *   Press Right arrow again to switch from Navigation to Edit Mode[2], or vice versa.

Note: For Quick Access to parameters via the handheld programmer, press Mode key 🗐 to activate PROGRAM mode, followed by Home key 🏠, then enter the menu number (see *LCD menu structure* on page 37 for details).

[1.] See *Programming via the handheld programmer* on page 33 for more detail.

[2.] When there is no further menu sub-level to access.

2. Edit Mode

Note: only parameter items can be in Edit mode.

- In this mode, the Edit Mode icon ▦ appears and flashes.
- Pressing a number key enters parameter data.
- In the case of read-only parameters, no change is permitted.

PROGRAM Mode Display

Note: SITRANS LR 460 continues to monitor In and Out values even when the device is in PROGRAM mode.

1 – Menu level
2 – Parameter name
3 – Edit Mode indicator
4 – Value of current parameter

```
1.3.1  SOFT REV   ▦
0.01.18
```
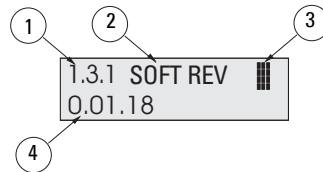
When you activate PROGRAM mode for the first time in any power cycle, the LCD displays the first menu. If, during the same power cycle, you switch to RUN mode, and then back to PROGRAM mode, then the LCD will display the menu or item that was last accessed in PROGRAM mode.

Security

Local operation enable

Local Operation can be enabled or disabled via PDM. Go to **Identification > Device > Local Operation Enable** and select the desired setting.

Remote operation enable

Remote Operation can be enabled or disabled via the handheld programmer. To change the setting:

- Open Menu level 1: **Identification.**
- Scroll down to REMLOCK.
           1. Identification
                1.2. Configuration
                     1.2.3. Remote Lock
- To enable programming, set REMLOCK to **0**. To disable programming, enter **1.**

Write locking

Write locking prevents any changes to parameters, either via PDM or the handheld programmer, but still allows access to the device.

Open the menu **Device – Write Locking**, and select On or Off.

How to do a Master Reset

Open the menu **Device– Master Reset** to access the reset options, including Factory Reset.

Fault Reset

This resets the Fault message after an active fault has occurred and been corrected. A manual reset is required only for certain faults, identified by an asterisk (*) in the table *General Fault Codes* on page 88.

To reset, key in the value of the fault code in question.

Quick Setup

Activating SITRANS LR 460

Note: Keep infrared devices such as laptops, cell phones, and PDAs, away from SITRANS LR 460 to prevent inadvertent operation.

Power up the instrument. SITRANS LR 460 starts in **RUN** mode, and the LCD displays the output of AIFB1 or AIFB2.

Performing calibration via PDM

Please consult the operating instructions or online help for details on using SIMATIC PDM. (An Application Guide Connecting *SMPI HART instruments toSIMATIC PDM using HART modem* is available on the product page of our website: https://pia.khe.siemens.com/index.asp?Nr=11813Changing parameter settings

- First launch SIMATIC PDM, connect to SITRANS LR 460, and upload data from the device.
- Adjust parameter values in the parameter view field (right side of screen).
- After adjusting the value, press Enter (the status fields read Changed).
- When you have completed the adjustments, open the Device menu, download data to the device, and save parameter settings offline (the status fields go blank).

Calibration

Only four settings are required for a Quick Setup:
- High Calibration Point and High Level Point
- Low Calibration Point and Low Level Point
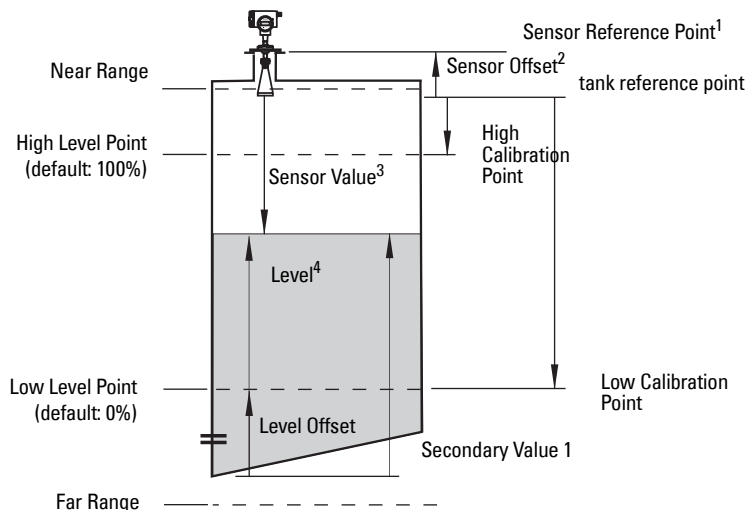
Calibration – steps 1 to 7

1. Open the menu **Device – Sensor Calibration** and select the button **Dry Calibration.** (Click on **Additional Information** to see the schematic showing the PROFIBUS parameters.)
2. Enter the new value for Low Calibration Point (default units are meters).
3. Enter the corresponding value for Low Level Point in percent (default is 0).
4. Enter the new value for High Calibration Point (default units are meters).
5. Enter the corresponding value for High Level Point in percent (default is 100).
6. Click on **Transfer**.
7. SITRANS LR 460 is now ready to operate.

Using Auto False Echo Suppression

If SITRANS LR 460 displays a false high level, or the reading is fluctuating between the correct level and a false high level, you can use the Auto False Echo Suppression parameters to prevent false echo detection. See *TVT (Auto False Echo Suppression) setup* on page 68 for instructions.

[1.] The point to which all of the above parameters are referenced. For the standard rod antenna, see *SITRANS LR 460 Dimensions* on page 10.

[2.] Sensor Offset is a negative value (see *Sensor Offset (default 0)* on page 64 for more detail).

[3.] The value produced by the echo processing, representing the distance from the Sensor Reference Point to the target.

[4.] Level Value: the level measured in level units.

Level application example

If volume conversion is not selected, Primary Value (PV) will be level (SV1). SV1 is the sum of level plus level offset (if any).

Level Units: **Sensor Units:**

Sensor Reference Point[1]

Sensor Offset

Near Range

High Level Point = 100%

Sensor Value SV2

High Calibration Point = 3 m

Level

Low Level Point = 0%

Low Calibration Point = 5 m

Level Offset (if any)

Secondary Value 1

Far Range

---
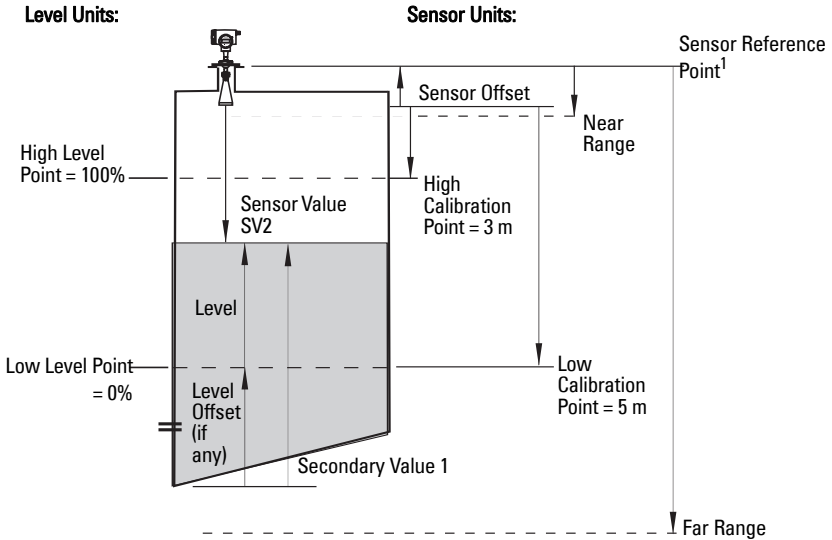
1. For standard configuration reference point, see *SITRANS LR 460 Dimensions* on page 10.

DRAFT

Local Operation

Programming via the handheld programmer

Although the complete range of parameters is only accessible via PDM[1], you can access and adjust many of the parameters via the Siemens Milltronics infrared handheld programmer.

- For the complete list of parameters, see *Appendix A: Parameter Descriptions* on page 58.
- *LCD menu structure* on page 37 gives a list of all parameters accessible via the handheld programmer, preceded by the menu number.

Parameter Menu Structure

The parameters are organized into function groups, and arranged in a 4-level menu structure. For example:

1. Identification
1.2. Configuration
1.2.2. Remote Lock.

The LCD Display

Details on the LCD display are given in *Start Up*, page 24 onwards.

r

> **Note: The ARROW buttons shown below are required for programming this product. The additional buttons on the hand programmer do not apply to SITRANS LR 400.**

SITRANS LR 400 buttons
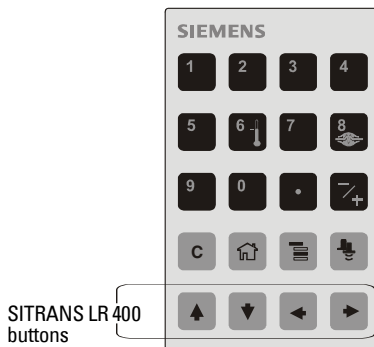
Key	Programming Mode
▲	Parameter scroll UP
▼	Parameter scroll DOWN
◄	LEFT Arrow (or CANCEL)
►	RIGHT Arrow (or ENTER)

---

1. Please see page 46 for *Remote operation via PROFIBUS PA*

Using the handheld programmer

Note: For Quick Access to parameters via the handheld programmer, press the mode key to activate PROGRAM mode, then key in the menu number.

Detailed instructions on using the handheld programmer start on page 25, and on doing a Quick Setup start on page 27.

The following pages give details on how to programme some of the more complex SITRANS LR 460 parameters via the handheld programmer.

Security

Local operation enable

Local Operation can be enabled or disabled via PDM. Go to **Identification > Device > Local Operation Enable** and select the desired setting.

Write locking

Write locking prevents any changes to parameters, either via PDM or the handheld programmer, but still allows access to the device.

Values	**2547 (unlock value)**	**Off**	Enables parameter changes
	any other value	**On**	Disables parameter changes

1. Go to **Write Locking:**
   - **1. Identification Menu**
     - **1. 3. Configuration**
       - 1.3.5. Lock
2. Press **Right ARROW** to open Edit mode.
3. Key in **2547** (unlock value) to enable parameter changes.
4. Press **Right ARROW** again, to accept the change and return to Navigation mode.

Remote operation enable

Remote Operation can be enabled or disabled via the handheld programmer.

Values	**0**	Remote operation enabled
	1	Remote operation disabled

To change the setting:

- Open **Identification** Menu, then scroll down to CONFIG.
- Press **Right ARROW** to open the Config Menu, then scroll down to REMLOCK.
  - **1. Identification**
    - 1.2. Configuration
      - 1.2.2. Remote Lock
- To enable programming, set REMLOCK to **0**. To disable programming, enter **1.**

How to do a Master Reset

Master Reset

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

	1	Reset all parameters (except PROFIBUS address) to PROFIBUS PA profile default values
Values	**2506**	Warm Start: restart the device (this option is rarely used)
	2712	Reset PROFIBUS address to 126
	32768	Reset to manufacturer's default values (factory settings)[1]

Example: do a Profile reset

1. Go to **Reset**:
   - **1. Identification Menu**
     - **1. 2. Configuration**
       - 1.2.3. Reset
2. Press the **Right ARROW** key ▶ to open Edit mode.
3. Key in **1 (Profile Reset)** to reset all parameters except PROFIBUS address.
4. Press the **Right ARROW** key ▶ again, to accept the changes and return to
   Navigation mode.

Individual Parameter Reset

1. Press **Right ARROW** ▶ , then **CLEAR** c , then **Right ARROW** ▶ .
2. The value returns to the default factory setting.

Fault Reset

Used to reset a fault message after an active fault has occurred and been corrected. A manual reset is required only for certain faults, identified by an asterisk (*) in the General Fault Code list on page 51.

To reset, key in the value of the fault code in question.

1. Go to **Reset Fault**:
   - **1. Identification Menu**
     - **1. 2. Configuration**
       - 1.2.4. Reset Fault
2. Press the **Right ARROW** key ▶ to open Edit mode.
3. Key in the number of the Fault Code to reset the status to normal operation.

[1.] Manufacturer's settings:
   AIFB Filter Time Constant = 10 s
   LTB values set for 0 - 20 m (Low and High Calibration points; Near Range and Far Range)

4. Press the **Right ARROW** key ▸ again, to accept the change and return to Navigation mode.

Device calibration

Only four settings are required for a Quick Setup: High Calibration Point, Low Calibration Point, High Level Point, and Low Level Point. (For an illustration, see *Calibration* on page 28.)

2.3. Sensor Calibration:

2.3.1. Sensor Units (default meters)

2.3.2. Calibration Type.

Values	**0**	*****	"Dry" calibration
	1		"Wet" calibration (not recommended for SITRANS LR 460)

2.3.3. Low Calibration Pt.

2.3.4. High Calibration Pt.

2.3.5. Unit [Level] (default percent)

2.3.6. Low Level Point

2.3.7. High Level Point

1. Go to **Calibration Type** and verify that "Dry" Calibration is selected.
2. Go to **Low Calibration Point** and enter the new value (default units are meters).
3. Go to **High Calibration Point** and enter the new value (default units are meters).
4. Go to **Low Level Point** and enter the corresponding value in percent (default is 0).
5. Go to **High Level Point** and enter the corresponding value in percent (default is 100).
6. SITRANS LR 460 is now ready to operate.

LCD menu structure

FOR PLACEMENT ONLY - TO BE REPLACED WITH FLIPOUT PAGE

1. Identification

Identification
2. Configuration
3. Device
4. Statistics

Configuration
1. Address
2. Remote Lockout
3. Factory Reset
4. Reset Fault
5. Menu Timeout

Device
1. Software Revision
2. Loader Revision
3. Hardware Revision
4. PROFIBUS Ident Number
5. Lock
6. Language

Statistics
1. Powered Hours
2. Powered Resets

2. Input

Input
1. Reset Filter
2. Standard Setup
3. Sensor Calibration'
4. Measuring Limits
5. Linearization
6. Detailed Setup

Standard Setup
1. Response Rate
2. Echo Lock

Sensor Calibration
1. Sensor Unit
2. Calibration Type
3. Low Calibration Pt.
4. High Calibration Pt.
5. Unit (Level)
6. Low Level Point
7. High Level Point
8. Level Offset
9. Sensor Offset
A. Temperature Unit

Operation
1. Temperature Unit
2. PV Unit
3. Sensor Units

Measuring Limits
1. Min. Measurement Value
2. Max. measurement Value
3. Lower Value Min
4. Upper Value Max.
5. Process Temperature Min
6. Process Temperature Max

Linearization
1. PV (volume/level) Unit
2. Linearization/Tank Shape
3. Linearization Volume
4. Dimension A
5. Dimension L

3. Output

Output
See Output: page 39

FOR PLACEMENT ONLY - TO BE REPLACED WITH FLIPOUT PAGE

Input

8. Detailed Setup

Detailed Setup

1. Failsafe
2. Volume
3. Echo select
4. Echo sampling
5. Range
6. TVT setup
7. TVT shaper
8. Rate

Failsafe

1. LOE Timer

Volume

Table A 1. Level 1
2. Volume 1
3. Level 2
4. Volume 2
5. Level 3
6. Volume 3
7. Level 4
8. Volume 4
Table B 1. Level 5
2. Volume 5
3. Level 6
4. Volume 6
5. Level 7
6. Volume 7
7. Level 8
8. Volume 8
Table C 1. Level 9
2. Volume9
3. Level 10
4. Volume 10
5. Level 11
6. Volume 11

Echo select

1. Algorithm
2. Threshold Long
3. Marker
4. Shots
5. Velocity
6. Propagation Factor

Echo Sampling

1. Sampling up
2. Sampling down
3. Window

Range

1. Near Range
2. Far Range

TVT setup

1. TVT Hover Level
2. Auto TVT
3. Range
4. Shaper Mode

TVT Shaper

1. Shaper A (1-9)
2. Shaper B (10-18)
3. Shaper C (19-27)
4. Shaper D (28-36)

Rate

1. Fill rate
2. Empty rate

```
3. Output  →  Output                    AIFB1                           Batch Information
              1. AIFB1              →    1. Target Mode            →     1. Batch ID
              2. AIFB2                   2. Unit                         2. Batch Unit
              3. mA Output              3. Filter Time Constant          3. Batch operation
              4. Relay Config          4. Channel                       4. Batch Phase
                                       5. Batch Information
                                       6. Process Value Scale     →     Process Value Scale
                                       7. Output Scale                  1. Lower Value
                                       8. Output Limits                 2. Upper Value
                                       9. Failsafe Mode
                                       A. Interface                     Output Scale
                                                                  →     1. Lower Value
                                                                        2. Upper Value

                                                                        Output Limits
                                                                  →     1. Lower Limit Alarm
                                                                        2. Lower Limit Warning
                                                                        3. Upper Limit Warning
                                                                        4. Upper Limit Alarm
                                                                        5. Limit Hysteresis
                                                                        6. Min. Out
                                                                        7. Max Out

                                                                        Failsafe Mode
                                                                  →     1. Failsafe Mode
                                                                        2. Failsafe Value

                                                                        Interface
                                                                  →     A. Decimal Point

                                       AIFB2                            Batch Information
                                  →    1. Target Mode            →     1. Batch ID
                                       2. Unit                          2. Batch Unit
                                       3. Filter Time Constant          3. Batch operation
                                       4. Function                      4. Batch Phase
                                       5. Batch Information
                                       6. Process Value Scale     →     Process Value Scale
                                       7. Output Scale                  1. Lower Value
                                       8. Output Limits                 2. Upper Value
                                       9. Failsafe Mode
                                       A. Interface                     Output Scale
                                                                  →     1. Lower Value
                                                                        2. Upper Value

                                                                        Output Limits
                                                                  →     1. Lower Limit Alarm
                                                                        2. Lower Limit Warning
                                                                        3. Upper Limit Warning
                                                                        4. Upper Limit Alarm
                                                                        5. Limit Hysteresis
                                                                        6. Min. Out
                                                                        7. Max Out

                                                                        Failsafe Mode
                                                                  →     1. Failsafe Mode
                                                                        2. Failsafe Value

                                                                        Interface
                                                                  →     A. Decimal Point

                                                                        mA Output
                                                                  →     1. Function
                                                                        2. Output value
                                                                        3. Manual value
                                                                        4. Min limit
                                                                        5. Max limit
                                                                        6. FS mode
                                                                        7. FS value
                                                                        8. 4 mA Trim
                                                                        9. 20 mA Trim

                                                                        Relay config
                                                                  →     1. AIFB
                                                                        2. Function
                                                                        3. NC/NO
                                                                        4. State
```

Maintenance settings

5. Maintenance settings

→

Maintenance settings

1. Remaining Device Lifetime
2. Remaining Sensor Lifetime
3. Service Interval
4. Calibration Interval

→

Remaining Device Lifetime

1. Total Device Operating Time
2. Remaining Device Lifetime
3. Maintenance Required Limit
4. Maintenance Demanded Limit
5. Maintenance Alert Activation
6. Total Expected Device Life
7. Maintenance Status
8. Acknowledge Status
9. Acknowledge

Remaining Sensor Lifetime

1. Total Sensor Operating Time
2. Remaining Sensor Lifetime
3. Maintenance Required Limit
4. Maintenance Demanded Limit
5. Maintenance Alert Activation
6. Total Expected Sensor Life
7. Maintenance Status
8. Acknowledge Status
9. Acknowledge

Service Interval

1. Time Elapsed Since Last Service
2. Maintenance Required Limit
3. Maintenance Demanded Limit
4. Maintenance Alert Activation
5. Total Service Interval
6. Units
7. Maintenance Status
8. Acknowledge Status
9. Acknowledge

Calibration Interval

1. Time Elapsed Since Last Calibration
2. Maintenance Required Limit
3. Maintenance Demanded Limit
4. Maintenance Alert Activation
5. Total Calibration Interval
6. Units
7. Maintenance Status
8. Acknowledge Status
9. Acknowledge

HART Communications

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 460 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 Description (DD)

In order to configure a HART device, the configurator must have the HART Device Description 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 460. Older versions of the library will have to be updated in order to use all the features of SITRANS LR 460.

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 460 was written with SIMATIC PDM in mind and has been extensively tested with this software.

The Device Description for SIMATIC PDM may be downloaded from the product page of our website at: https://pia.khe.siemens.com/index.asp?Nr=7427, under **Downloads**.

All parameters accessible via the HART Communicator are also accessible via PDM. In addition, the Maintenance parameters listed below are accessible via PDM only.

Maintenance settings (accessible via PDM only)

Device Lifetime
Total Device Operating Time
Remaining Device Lifetime
Maintenance Required Limit
Maintenance Demanded Limit
Maintenance Alert Activation
Total Expected Device Life
Units
Maintenance Status
Acknowledge Status
Acknowledge

Sensor Lifetime
　Total Sensor Operating Time
　Remaining Sensor Lifetime
　Maintenance Required Limit
　Maintenance Demanded Limit
　Maintenance Alert Activation
　Total Expected Sensor Life
　Units
　Maintenance Status
　Acknowledge Status
　Acknowledge
Service Interval
　Time Elapsed Since Last Service
　Maintenance Required Limit
　Maintenance Demanded Limit
　Maintenance Alert Activation
　Total Service Interval
　Units
　Maintenance Status
　Acknowledge Status
　Acknowledge
Calibration Interval
　Time Elapsed Since Last Calibration
　Maintenance Required Limit
　Maintenance Demanded Limit
　Maintenance Alert Activation
　Total Calibration Interval
　Units
　Maintenance Status
　Acknowledge Status
　Acknowledge

Supported HART Commands:

SITRANS LR 460 conforms to HART rev. 5 and supports the following:

Universal Commands
0, 1, 2, 3, 6, 11, 12, 13, 14, 15, 16, 17, 18, 19

Common Practice Commands
34, 38, 40,41, 42, 44, 45, 46, 48, 59

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.smpi@siemens.com.

Notes

Part III: SITRANS LR 460 PROFIBUS PA version

DRAFT

Remote operation via PROFIBUS PA

SITRANS LR 460 is a Class B, Profile Version 3.0, PA device. It supports Class 1 Master for cyclic and acyclic data exchange, and Class 2 for acyclic services. The full range of SITRANS LR 460 functions is available only over a PROFIBUS PA network.

PROFIBUS PA is an open industrial protocol. Full details about PROFIBUS PA can be obtained from PROFIBUS International at www.profibus.com.

To use PROFIBUS PA, you will need a PC configuration tool: we recommend SIMATIC PDM. Please consult the operating instructions or online help for details on using SIMATIC PDM. (You can find more information at www.fielddevices.com: go to Products and Solutions > Products and Systems > Process Device Manager.)

SIMATIC PDM

SIMATIC PDM is a software package for designing, parameterizing, commissioning, diagnosing and maintaining SITRANS LR 460 and other process devices.

SIMATIC PDM contains a simple process monitor of the process values, alarms and status signals of the device. Using SIMATIC PDM you can

- display
- set
- change
- compare
- check the plausibility of
- manage
- simulate

process device data.

Device Description

In order to use **Process Device Manager (PDM)** with PROFIBUS PA, you will need the Device Description for SITRANS LR 200, which will be included with new versions of PDM. You can locate the Device Description in **Device Catalog**, under **Sensors/Level/ Echo/Siemens Milltronics**. If you do not see **SITRANS LR 460** under Siemens Milltronics, you can download it from our web site. Go to the SITRANS LR 460 product page at https:/ /pia.khe.siemens.com/index.asp?Nr=7427 and click **Downloads**. After downloading the DD file, you need to execute DeviceInstall.

Configuration

To configure a PROFIBUS PA Class 1 Master (for example, a PLC), you will need a **GSD** file.

The GSD file

The GSD file **SIEM810F.gsd** is available from the SITRANS LR 460 product page on our web site. Go to https://pia.khe.siemens.com/index.asp?Nr=7427 and click **Downloads**. Download the DeviceInstall, and run it from your computer. This will install the GSD file into your system (as long as you are using SIMATIC software).

Note: If you are not using SIMATIC software, you can download the GSD file separately, and import it with the software you are using.

Setting the PROFIBUS address

When your instrument is shipped, the PROFIBUS address is set to 126. You can set it locally (see *Setting the PROFIBUS address via the handheld programmer* on page 27) or remotely via the bus, using a parameterization tool such as SIMATIC PDM (see *Address (default 126)* on page 58).

PROFIBUS address

Values	Range: 0 to 126
	Pre-set: 126

Bus Termination

Note: PROFIBUS PA MUST be terminated at both extreme ends of the cable for it to work properly. Please refer to the PROFIBUS PA User and Installation Guidelines (order number 2.092), available from www.profibus.com.

Power Demands

To determine how many devices can be connected to a bus line, calculate the combined maximum current consumption of all the connected devices: 10.5 mA for SITRANS LR 200. Allow a current reserve for safety.

Cyclic versus Acyclic Data

When you request data from a device via PROFIBUS PA, you have two choices. Cyclic data is provided at every bus scan: acyclic data is requested and provided as needed.

Input information is always requested at every bus scan and is set up as cyclic data. Configuration information is only needed periodically and is set up as acyclic data.
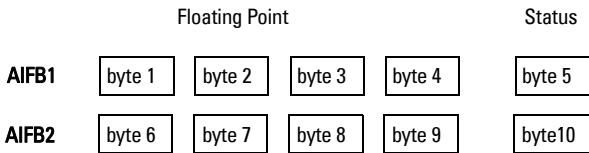
Cyclic Data

When you configure SITRANS LR 460 on the PROFIBUS PA bus, there are two slots available for modules.

> **Note:** Each of the slots has to have a module defined in it.

Slot 0 always transmits **AIFB1** information[1]; slot 1 defaults to Free Place, but can be changed to **AIFB2** information. If you do not wish to have data transmitted, then you must use a **Free Place** module in that slot.

Each of the two Analog Input Function Blocks can be set up to return **Level**, **Distance**, or **Volume**. Within the function blocks, the values are scaled according to the user requirements (see *Analog Input Function Blocks 1 and 2* on page 55 for details).

AIFB1 and **AIFB2** return 5 bytes of data each:

	Floating Point				Status
AIFB1	byte 1	byte 2	byte 3	byte 4	byte 5
AIFB2	byte 6	byte 7	byte 8	byte 9	byte10

The first 4 bytes are the floating point representation (IEEE) of the variable. The variables are the outputs of the function block. The 5th byte is the status word and the list of possible values is given in the chart below.

The 5 bytes must be read consistently, in a contiguous chunk: they cannot be read byte by byte, and cannot suffer an interrupt. If you are using an S7-300 / 400, you will need to use SFC14 DPRD_DAT: Read Consistent Data of a Standard PD Slave.

Status Byte

Status Codes for Good Quality	
Values in hex notation	**Description**
0x80	Data is GOOD.
0x84	A parameter in the function block has been changed: status active for 10 s
0x89	Active low warning.
0x8A	Active high warning.
0x8D	Active low alarm.
0x8E	Active high alarm.

---

1. See *Analog Input Function Blocks 1 and 2* on page 55 for more information.

Status Codes for Bad Quality	
Values in hex notation	**Description**
0x10	The LOE timer has expired: this could be caused by LOE or by a sensor malfunction: value is BAD.
0x01	There is an error in the configuration of the function blocks in PROFIBUS PA[a].
0X1F	The function block has been placed out of service. (You will see this only if you read status word via acyclic services, after placing the function block out of service.)
0xC4	Bad configuration: value is BAD.
0XDE	AI block out of service: value is BAD.

> [a.] This could happen when a firmware download has been done, but a system reset has not been done. This could also happen if the function blocks are not configured properly using PDM or acyclic services.

Status Codes for Uncertain Quality	
Values in hex notation	**Description**
0x4B	Value is a substituted value (normally used in Failsafe).
0x4C/0x4F	Initial value.
0x47	Last usable value.

Diagnostics

All diagnostic information shown below is viewable via PDM.

Diagnosis reply (applies only to cyclic masters)

This is a response to a GET-DIAG message.

During DPV0 data exchange, the PROFIBUS PA slave will notify the Master when a serious error occurs. The Master will then send a Diagnosis request. The reply to this request is normally logged in the PLC and is referred to as the "Hex values."

The reply may contain two parts. The first part is 6 bytes long and is defined by the PROFIBUS standard. If there is a second part, it is called the 'extended diagnostic' and it is eight bytes long. The last four bytes of the extended diagnostic message give the error code shown below. (The same information is also available acyclically via the Diagnosis Object.

Acyclic Diagnostics

This consists of four bytes.

Hex values	Byte	Bit	Description	Indication class[a]
0x01000000	0	0	Electronics failure	R
0x02000000		1	Mechanical failure	R
0x04000000		2	Motor Temperature too high	R
0x08000000		3	Electronics temperature too high	R
0x10000000		4	Memory error	R
0X20000000		5	Measurement failure	R
0X40000000		6	Device not initialized (no calibration)	R
0x80000000		7	Self calibration failed	R
0x00010000	1	0	Zero point error (limit position)	R
0x00020000		1	Power supply failure (electrical, pneumatic)	R
0x00040000		2	Configuration invalid	R
0x00080000		3	New startup carried out (Warm Start)	A
0x00100000		4	Restart carried out (Cold Start)	A
0X00200000		5	Maintenance required	R
0X00400000		6	Characterization invalid	R
0X00800000		7	Set to 1 (one), if the Ident_Number of the running cyclic data transfer and the value of Physical Block IDENT__NUMBER_SELECTOR parameter are different.	R
	2	0 to 7	Reserved for use within the PNO	
	3	0 to 6	Reserved for use within the PNO	
0X00000080		7	More diagnosis information is available	

a. **R** indicates the message remains active as long as the reason for the message exists.
   A indicates the message will automatically reset after 10 seconds

Values of the DIAGNOSIS bit:
   0 = not set
   1 = set

Acyclic Extended Diagnostics (General Fault Codes)

In addition to the extended diagnostics available by cyclic data exchange (shown above), further extended diagnostics are available via acyclic communications. This consists of six bytes. See *Appendix B: Asynchronous Communications Data Map* on page 58 , for the location of **Extended Diagnostics**

For a table listing the fault codes, meanings, and suggested corrective action to take, see *General Fault Codes* on page 88.

Acyclic Data

SITRANS LR 460 supports up to four simultaneous connections by a Class 2 Master (C2 connection). It supports one connection by a Class 1 Master (C1 connection). A list of all acyclic data, including address (slot and index), format, range of values, start value, and attributes, can be found at *Appendix B: Asynchronous Communications Data Map* on page 58.

Configuration Example

To configure and use PROFIBUS PA with an S7-300/ 400 PLC

1. If SITRANS LR 460 is not listed in the STEP 7 device catalog, you can download the DeviceInstall file from the Siemens Milltronics Web site and run it from your computer. Go to https://pia.khe.siemens.com/index.asp?Nr=7427 and click **Downloads**.

2. Add the SITRANS LR 460 "rack": click and drag the SITRANS LR 460 folder from the hardware catalog.

3. Fill the rack with desired modules, by dragging and dropping them from the hardware catalog.

4. After configuring PROFIBUS PA in steps 2 and 3, download it to the PLC.

5. Add code to the PLC program to read data consistently using the SFC14.

PROFIBUS PA Profile Structure

PROFIBUS Level Device Design

The device follows the profile block model and is implemented as a Profile 3.0, Class B, PA device. Standard profile parameters are used to program the level transducer block.

Block Model for recording and processing measured values

The functions of the device are divided into blocks for different areas of responsibility. They can be parameterized by acyclic data transfer via PDM.
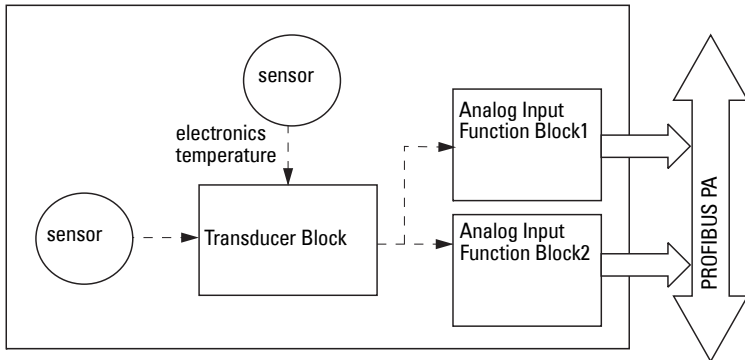
The device is implemented with one Physical Block (PB1), one Level Transducer Block (LTB1), and two Analog Input Function Blocks (AIFB1 and AIFB2).

All data is viewed from the perspective of the DCS or PLC, so information from the sensor is an input.

Transducer Block (TB)

The Level Transducer Block (LTB) carries out adjustments to the sensor, such as level calibration and volume calibration. It supplies the outputs utilized by either or both of the AIFBs.

Analog Input Function Blocks AIFB1 and AIFB2

The two AIFBs are completely independent of each other. They utilize the output from the Level TB, and apply any required quality checks, scaling, and Failsafe operation selections.

The output of an Analog Input Function Block supplies the measured value and associated status information to PROFIBUS PA, via cyclic data transfer.

Description of the blocks

Transducer block function groups

The figure below shows the signal flow of measured values from the sensor through the Transducer block into the output value (Primary Value/ Level or Volume; Secondary Value 1 / Level; Secondary Value 2 /Distance 1; or Secondary Value 3 / Distance 2). The Level TB implements all of the basic parameters (see parameter diagram on page 54), including level to volume calculation, if that option has been selected.

Level Transducer Block
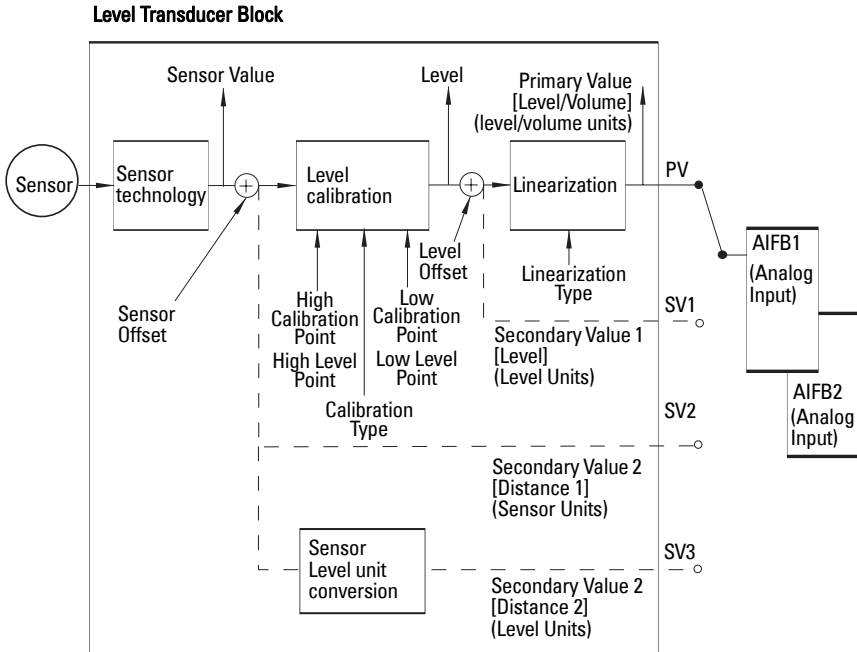
How the LTB works:

1. The sensor technology block selects the proper echo. For an explanation of sensor technology, please refer to *Appendix B: Technical Reference*, page 82 onwards.

    The sensor value (in sensor units) is checked to see if it is within its measuring limits. If the limit is exceeded, this results in a **Bad** status and the error message **Failure in measurement**. The sensor value is stored in Sensor Value.

    The analog signal from the sensor is transformed into a digital signal.

    A Sensor Offset (default 0) provides compensation if necessary for changes in the sensor.

2. Level Calibration is a linear transfer function that converts a sensor value to a level value. The level value is used for volume calculation, if that function is enabled.
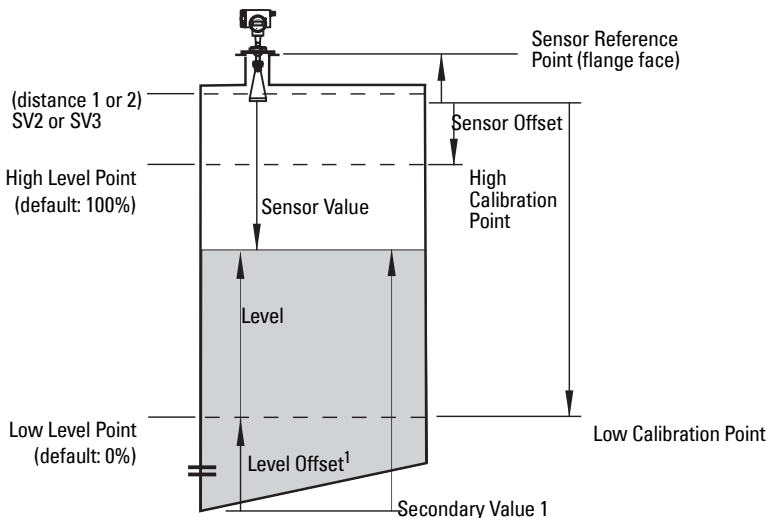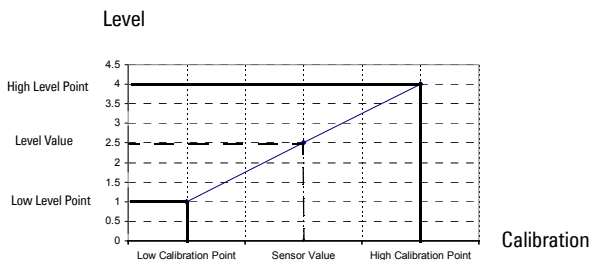
3. Then linearization can be carried out to accommodate complex tank shapes, or to provide level to volume conversion.

4. The LTB provides four possible outputs

- Primary Value (PV) / Level or Volume
- Secondary Value 1 (SV1) / Level
- Secondary Value 2 (SV2) / Distance1 (sensor units)
  or
- Secondary Value 3 (SV3) / Distance 2 (any level units, except %)

---

1. Level Offset (default 0) can compensate for specific tank configurations.

Electronics temperature

The transducer block also monitors the internal temperature of the device electronics. If the temperature exceeds permitted limits, it does not change the sensor value, but it does change the status.The permitted limits correspond to those of the permitted ambient temperature.

If a temperature limit is exceeded, the status changes. Peak indicators[1] allow you to check the maximum and minimum temperatures that have occurred.

Analog Input Function Blocks 1 and 2

The figure below shows how measured values are processed within the two Analog Input Function Blocks (**AIFB1** and **AIFB2**) to produce the device outputs, which are communicated via cyclic transfer to PROFIBUS PA, and displayed on the LCD.

Analog Input Function Block function groups (simulation, mode and status)

---
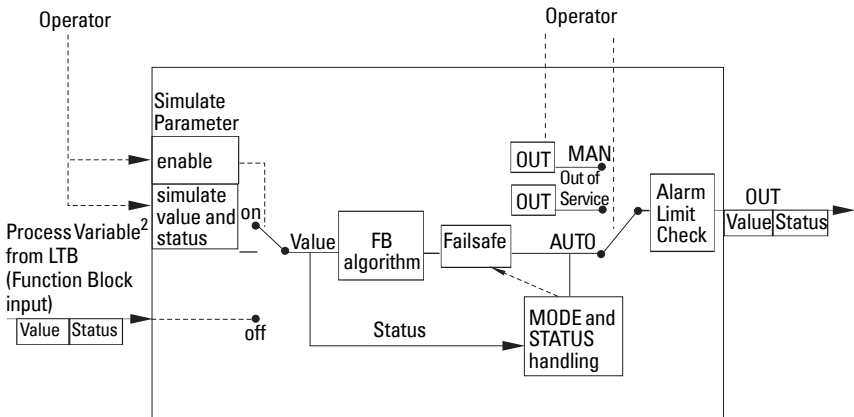
1. Open View menu, scroll down to Peak Values, and click on Temperature tab in the Peak Values window.
2. The output from the Level Transducer Block can be called the Primary Value (or Secondary Value). When it becomes the input to the AIFB, it is called the Process Variable.

How the AIFBs work

The Analog Input Function Blocks allow you to control modifications to the output value (PROFIBUS cyclic data).

Output Conversion

Values transmitted by the Level TB have a status attached. The decision on what to do with each value is made by the Analog Input Function Block.

Device/ Input Simulation

The input can be a simulated value instead of a TB OUT value. This allows the AI block to be tested independently of the characteristics of the environment.

Failsafe

- If the status of the Primary Value or Simulation Value is **bad**, the fault logic can output either the last usable measured value, or a given substitute value.

Device / Output Simulation

One of three settings can be selected:

Setting	description	Output value
AUTO	automatic	the automatically-recorded measured value
MAN	manual	a manually-set fixed simulation value
O/S	function block disabled	the preset safety value.

- The result is the output parameter (OUT).

AIFB execution steps:

The AIFBs can provide a linear conversion to any desired units.

1. The input value is normalized (Scaling Input)

   Process Variable range applies to any of the four LTB values. (Units of the Process Variable scale are the same as the units used for the LTB output.) Output units together with Process Variable range determine how the LTB output is converted to whatever units the customer wants.

2. The scaling output is applied.

For example:
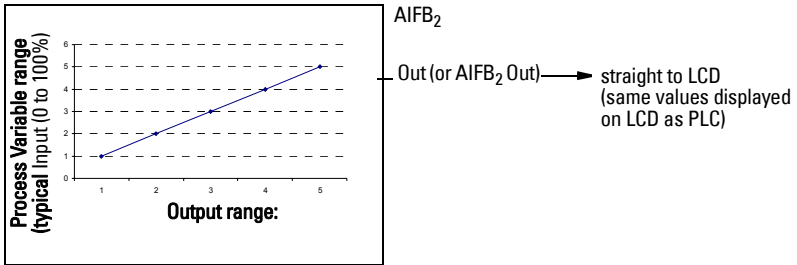
3. This value is filtered using a first order filter based on a time constant provided by the user.

4. The status of the Process Variable (input value) is checked. If the status is Bad, a Failsafe condition occurs. The output is determined by the Failsafe Mode of the block.

5. The target mode parameter allows the entire AI block to be overridden by a Manual Out value.

6. The value is checked against the user parameterized warning and alarm limits. (There is an upper and lower warning limit and an upper and lower alarm limit. The unit of the limits corresponds to the unit of the output range. A hysteresis parameter prevents toggling in the Status field of the OUT value.)

7. The OUT VALUE parameter is the value for the cyclic data transfer.

Profile structure

Appendix A: Parameter Descriptions

SITRANS LR 460: parameter menus

The parameters are grouped in menus according to function. Submenus, arranged on four levels, give access to associated features and options.

Some menus are accessible in PDM only via pull-down menus: in those cases, directions are given beside the individual parameter.

Not all menus are accessible via the handheld programmer. Menus that are accessible via the handheld programmer are preceded by a number applicable only to the handheld programmer.

Notes:
- For Quick Access to parameters via the handheld programmer, press the mode key to activate PROGRAM mode, then key in the menu number. (For more details, see *The handheld programmer* on page 25.)
- Values shown in the tables below can be entered via the handheld programmer.

1. Identification

Operation Unit

Tag

Text that can be used in any way, for example as a unique label for a field device in the plant.

Description

Text that is associated with the Field Device. This text can be used by the user in any way. There is no specific recommended use.

Message

Text that is associated with the Field Device. This text can be used by the user in any way. There is no specific recommended use.

1.2. Configuration

1.2.2. Address (default 126)

The unique address of the device on the network (called PROFIBUS address in PROFIBUS devices).

Values	0 - 126

Open the menu **Device – Set Address** (only in PROFIBUS PA).

1.2.3. Remote operation enable

Enables or disables programming via the network and PDM.

Values	0	Remote operation enabled
	1	Remote operation disabled

Parameters

1.2.4. Master Reset

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

Values	1	Reset all parameters (except PROFIBUS address) to PROFIBUS PA profile default values
	2506	Warm Start: restart the device (this option is rarely used)
	2712	Reset PROFIBUS address to 126
	32768	Reset to manufacturer's default values (factory settings)

1.2.5. Reset Fault

Resets the Fault message after an active fault has occurred and been corrected. This is required only for faults listed as requiring a manual reset in the General Fault Code list (see page 51).

To reset, key in the value of the fault code in question.

1.2.6. Menu Timer

Determines the length of time (in seconds) the device will stay in PROGRAM mode without any key presses occurring.

1.2.7. Backlight

Allows you to increase the contrast of the LCD.

| Values | 0 to 2 | Adjusts contrast. |

1.3. Device

Manufacturer

References a specific manufacturer, usually the name of the company responsible for the manufacture of this Field Device.

Product designation

Uniquely identifies the Field Device when combined with the Manufacturer Identification and Device Type. This variable cannot be modified by the Host user.

Device Serial Num

Uniquely identifies the Field Device. This variable cannot be modified by the Host.

Order No.

The order number for this device.

Date of birth

Date of manufacture.

1.3.1. Software Revision

Corresponds to the software or firmware that is embedded in the Field Device.

1.3.2. Loader Revision

Corresponds to the software used to update the Field Device.

Parameters

1.3.3. Hardware Revision

Corresponds to the electronics hardware of the Field Device.

Profile Revision

PROFIBUS PA Profile standard that this device conforms to.

Static Revision No.

The revision level of the static data associated with the Physical Block. The Static Revision No. is updated whenever a standard profile configuration parameter is changed.

1.3.4. PROFIBUS Ident Number

Identifies the device on the network. The Ident Number must match that in the GSD file (the GSD file provides information on the device to the master).

Values	0	Profile-specific (uses generic device DD and profile GSD for class B device)
	1	Manufacturer-specific (uses SMPI DD and GSD file, which identifies the LR 460.

Installation Date

Date on which the device was installed. The user must enter the date.

Local Operation Enable

Enables/disables programming the device via the handheld programmer.When disabled, the user still has access to the mode control of the two Analog Input Function Blocks.

1.3.5. Write Locking

Prevents any changes to parameters via PDM or the handheld programmer.

Values	**2547 (unlock value)**	Off (enables programming)
	any other value	On (disables programming)

Open the menu **Device – Write Locking**, and select On or Off.

1.3.6. Language

Selects the language to be used on the LCD.

Values	0	English
	1	German
	2	French
	3	Spanish
	4	Italian

Parameters

1.4. Statistics[1]

1.4.1. Powered Hours

Number of hours the unit has been powered up since manufacture.

1.4.2. Poweron Resets

The number of power cycles that have occurred since manufacture.

2. Input

Static Revision Number

The revision level of the static data associated with the Transducer Block, updated whenever a standard profile configuration parameter is changed.

Class

Indicates the Level Transducer Block as per PROFIBUS PA PRofile specifications.

2.1. Reset Filter

Resets the rate filter.

Value	1	the sensor value immediately goes to the target distance

2.2. Standard Setup

2.2.1. Antenna

Identifies antenna configuration.

Values	300	No horn
	302	3" horn
	303	4" horn

Parameters

---

[1]. To find Statistics in PDM, open **View** menu and scroll down to **Wear**.

Page 61   SITRANS LR 460 – INSTRUCTION MANUAL   7ML19985JM01

2.2.2. Response Rate

Sets the reaction speed of the device to measurement changes in the target range.

Related para- meters	Response Rate			LOE Timer[1] (minutes)	Fill Rate	Empty Rate	Echo Lock[2]	
Values	1	*	slow	100	**0.1** m/minute	**0.1** m/minute	2	material agitator
	2		medium	10	**1** m/minute	**1** m/minute		
	3		fast	1	**10** m/minute	**10** m/minute		

Note: Changing Response Rate resets the following parameters: LOE Timer, Fill Rate, Empty Rate, and Echo Lock.

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.

2.2.3. Echo Lock

Note: Ensure the agitator is always running while SITRANS LR 460 is monitoring the vessel, to avoid stationary blade detection.

Selects the measurement verification process.

Values	0		Off
	1		Maximum Verification
	2	*	Material Agitator
	3		Total Lock
Related parameters	Maximum Fill Rate Maximum Empty Rate Echo Lock Sampling Echo Lock Window Algorithm		

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

---

1. For more detail, see *LOE Timer* on page 84.

2. For more detail, see *Echo Lock* on page 83.

2.3. Sensor Calibration
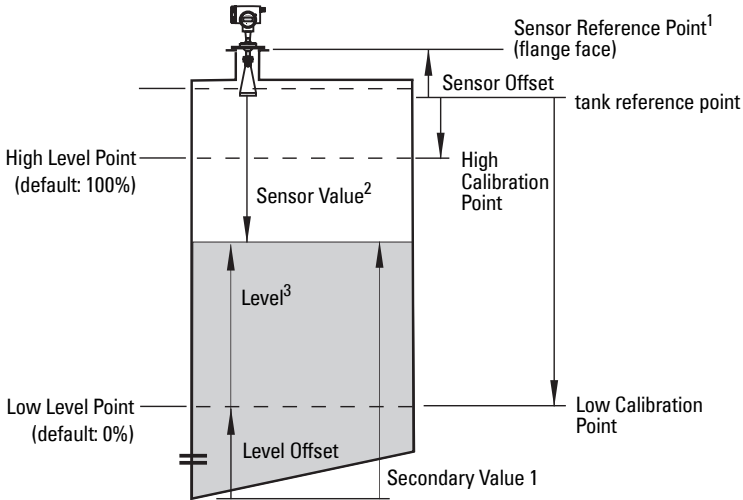
2.3.1. Sensor Units

Whatever units the sensor is measuring in.

2.3.2. Calibration Type

In "Dry" calibration, the user enters all four calibration values: High and Low Level Points, and High and Low Calibration Points.

Values	0	*	"Dry" calibration
	1		"Wet" calibration (not recommended for SITRANS LR 460)

2.3.3. Low Calibration Pt.

Distance from Sensor Reference to Low Calibration Point (corresponding to Low Level Point). Unit is defined in Sensor units. (In PDM, go to Device menu > Sensor Calibration, then click on More Information, to see an illustration.)

2.3.4. High Calibration Pt.

Distance from Sensor Reference to HIgh Calibration Point (corresponding to High Level Point). Unit is defined in Sensor units. (In PDM, go to Device menu > Sensor Calibration, then click on More Information, to see an illustration.)

[1.] Sensor Reference Point: the point to which all of the above parameters are referenced, which is the flange face.

[2.] Sensor Value: the value produced by the echo processing, which represents the distance from the Sensor Reference Point to the target.

[3.] Level Value: the level measured in level units.

2.3.5. Unit (Level)

Selected engineering units for Level (PV).

- Referenced from Low Level Point (plus level offset, if any)
- Default %
- Can be any linear measurement

2.3.6. Low Level Point

*The level when the material is at Low Calibration Point. The unit is defined in Level units. (In PDM, go to **Device menu > Sensor Calibration**, then click on **More Information** to see an illustration.)*

2.3.7. High Level Point

*The level when the material is at High Calibration Point. The unit is defined in Level units. (In PDM, go to **Device menu > Sensor Calibration**, then click on **More Information** to see an illustration.)*

2.3.8. Level Offset

A constant offset that is added to Level to form either PV (Level or Volume) output. The unit is defined in Level units.

2.3.9. Sensor Offset (default 0)

The offset from the Sensor's reference point to the tank's reference point. This is a constant offset that is subtracted from the Sensor value. The unit is defined in Sensor Units.

Compensates, for example if the sensor head is changed.

2.3.A. Temperature Units

Selects the engineering unit to be displayed with the value representing temperature.

2.4. Measuring Limits

2.4.1. Min. Measured Value[1]

The minimum recorded Sensor value, defined in Sensor units.

2.4.2. Max. Measured Value[1]

The maximum recorded Sensor value, defined in Sensor units.

2.4.3. Min. Sensor Value

Defines the minimum usable value for the measuring range (physical limit of the sensor) in Sensor units.

2.4.4. Max. Sensor Value

Defines the maximum usable value for the measuring range (physical limit of the sensor) in Sensor units.

[1.] In PDM, open View menu, scroll down to Peak Values, and click Sensor tab.

2.4.5. Process Temperature Min.

The minimum recorded temperature of the internal electronics.

Open the menu **View – Peak Values** and select the tab **Temperature.** If necessary, click on the reset button, and download to the device.

2.4.6. Process Temperature Max.

The maximum recorded temperature of the internal electronics.

Open the menu **View – Peak Values** and select the tab **Temperature.** If necessary, click on the **Reset** button, and download to the device.

2.5. Detailed Setup

2.5.1. Failsafe

2.5.1.1. LOE (Loss of Echo) Timer

Amount of time, in minutes, that a Loss of Echo must persist, before the device goes into Failsafe mode. See page 84 for more details.

Values	Range**: 0.00 to 720** (minutes)
	Default:10

2.5.2. Echo select

2.5.2.1. Algorithm

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

Values	12	*	F	First echo
	3		L	Largest echo (reserved for SMPI service personnel)
	8		bLF	best of Largest or First echo (reserved for SMPI service personnel)

2.5.2.2. Confidence Threshold

Sets the minimum echo confidence that the echo must meet in order to prevent a Loss of Echo condition and the expiration of the LOE timer. When Echo Confidence exceeds the Confidence Threshold, the echo is evaluated.

Values	Range: **0 to 99**
	Default: **5**
Related Parameters	LOE Timer

Use this feature when an incorrect material level is reported.

2.5.2.3. Echo Marker

The point on the selected echo from which the measured value is taken.

2.5.2.4. Shots

The number of echo profile samples averaged to produce a measurement.

2.5.2.5. Velocity

Effective propagation velocity in m/s.

Parameters

2.5.3. Echo Sampling

2.5.3.1. Sampling up[1]

Once echo is outside the window, a specified number of consecutive echoes must appear above the echo locked onto, before measurement is accepted as valid.

2.5.3.2. Sampling down[1]

Once echo is outside the window, a specified number of consecutive echoes must appear below the echo locked onto, before measurement is accepted as valid.

2.5.3.3. Window[1]

*A "distance window" centered on the echo, used to derive the reading. When a new measurement is in the window, the window is re-centered and the reading is calculated (see **Display before Auto False Echo Suppression,** page 69 for an illustration).*

When the value is 0, the window is automatically calculated after each measurement.

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

Note: The echo lock window is stored as standard sample, but displayed in the engineering units selected to display level. Any value entered for the echo lock window will be rounded to the nearest sample.

2.5.3.4. Window Used[1]

2.5.4. Range

2.5.4.1. Near Range (LOW RANGE)

The range in front of the device (measured from the reference point[2]) within which any echoes will be ignored. (This is sometimes referred to as "Blanking" or "Dead Zone".)

Values	Range: **0** to **20 m**
	Default: **0.4 m**

---

1. This parameter is for use only by Siemens Milltronics service technicians.
2. For the standard configuration reference point, see *SITRANS LR 460 Dimensions* on page 10.

Parameters

2.5.4.2. Far Range (HI RANGE)

Maximum distance from the reference point[2], within which an echo should be considered valid.

Values	Range: **0** to **20 m**
	Default: **Low Calibration Point**

Echo Profile

Echo Confidence

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

Values (view only)	**0 to 99**	
	----	Shot not used
Related Parameters	Confidence Threshold	

Open the menu **View – Profile.**

Echo Strength

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

Values (view only)	**–20 to 99**

Open the menu **View – Profile.**

Noise Average

Displays the average ambient noise (in dB above 1 µV rms) of a noise profile, as x.y. Noise level is a combination of transient noise and receiving circuitry. After a measurement, the values from the previous noise shot will be displayed.

Open the menu **View – Noise**.

Noise Peak

Displays the peak ambient noise (in dB above 1 µV rms).

Open the menu **View – Noise**.

Noise Minimum

Displays the minimum ambient noise (in dB above 1 µV rms).

Open the menu **View – Noise**.

2.5.5. TVT (Auto False Echo Suppression) setup

> **Note:** The Auto False Echo Suppression 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.

First SITRANS LR 460 learns the echo profile. Then the learned profile, or part of the learned profile, is used to screen out false echoes.

2.5.5.1. TVT Hover Level[1]

Defines in percent how high the TVT (Time Varying Threshold) curve is placed above the echo profile, with respect to largest echo. When SITRANS LR 460 is located in the center of the vessel, lower this parameter to prevent multiple echo detections.

Values	Range: **0** to **100%**
	Default: **40**%

2.5.5.6. Auto False Echo Suppression[1]

Enables a 'learned' TVT curve to be used in place of the default TVT curve. Use this feature to ignore false echoes before the material echo. Set Range (Auto False Echo Suppression Distance) first.

Values	**0**	Off
	1	Enable Auto False Echo Suppression
	2	"Learn" the TVT curve

   a.   Rotate the instrument for best signal (lower false-echo amplitude).
   b.   Go to **Range**, and set the value (see details below).
   c.   Open the menu **Device – Auto False Echo Suppression** and select the option to change it.
   d.   Select **Learn.** The device will automatically revert to On (Use Learned TVT) after a few seconds.

2.5.5.7. Range (Auto False Echo Suppression Distance)

Defines the endpoint of the Learned TVT distance.

   a.   Go to **Input > Detailed Setup > TVT Setup > Range.**
   b.   Determine the actual distance from the antenna reference point to the material surface.
   c.   Subtract 0.5 m (20") from this distance, and enter the result.

[1.] For an illustration, see *Display before Auto False Echo Suppression* and *Example after Auto False Echo Suppression*, page 69.

Parameters

Display before Auto False Echo Suppression
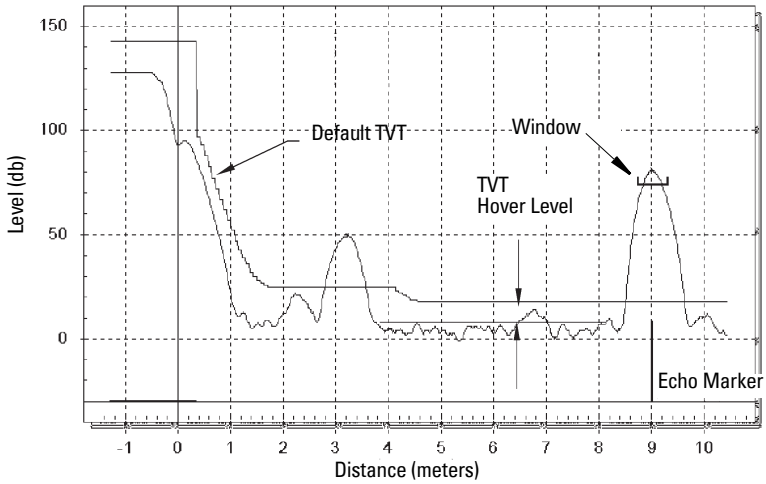
Example after Auto False Echo Suppression
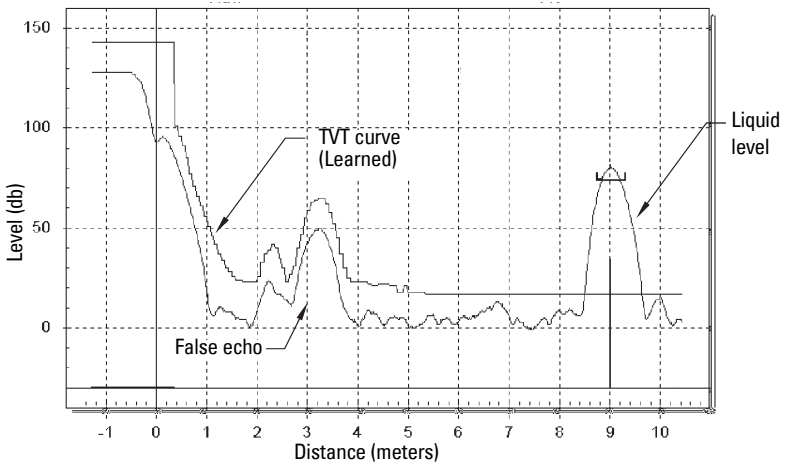
Curves to be updated to SITRANS LR 460 curves.

2.5.5.8. Shaper Mode

Adjusts the TVT curve at a specified range.

2.5.6. TVT shaper

A breakpoint on the TVT curve, normalized to 0.

2.5.6.1. Shaper A (1-9)
2.5.6.2. Shaper B (10-18)
2.5.6.3. Shaper C (19-27)
2.5.6.4. Shaper D (28-36)
2.5.6.5. Shaper E (37 - 40)

2.5.7. Rate

2.5.7.1. Fill Rate

Defines the maximum rate at which the reported sensor value is allowed to increase.Allows you to further adjust the LR 460 response to increases in the actual material level (or an advance to a higher Failsafe Material Level, P071). Fill Rate is automatically updated whenever Response Rate is altered.

Values	Range: **0.0000 to 99999** m / min.
	Factory setting: **0.1**
Altered by	Response Rate
Related	Unit (Level) High Level Point

Enter a value slightly greater than the maximum vessel-filling rate, in Sensor Units per minute.

Handheld programmer Value	Meters/Minute
1	0.1
2	1
3	10

DRAFT

Parameters

2.5.7.2. Empty rate

Defines the maximum rate at which the reported sensor value is allowed to decrease.Adjusts the LR 460 response to decreases in the actual material level. Empty Rate is automatically updated whenever Response Rate is altered.

Values	Range: **0.0000 to 99999** m / min.
	Factory setting: **0.1**
Altered by	Response Rate
Related	Units (Level) High Level Point

Enter a value slightly greater than the vessel's maximum emptying rate, in Sensor Units per minute.

Handheld programmer Value	Meters/Minute
1	0.1
2	1
3	10

2.5.8. Transducer Block (TB) Values (for diagnostic purposes)

2.5.8.1. PV

The value for level, or volume (if volume conversion is selected).

Open the menu **View – Display,** and select the tab **Measure Valued (Secondary Values)**.

2.5.8.2. SV1

The value for level.

Open the menu **View – Display,** and select the tab **Measure Valued (Secondary Values)**.

2.5.8.3. SV2

The value for distance.

Open the menu **View – Display,** and select the tab **Measure Valued (Secondary Values)**.

Parameters

3. Output

3.1. AIFB1

Static Revision No.

The revision level of the static data associated with Analog Input Function Block 1. The Static Revision No. is updated whenever a standard profile configuration parameter is changed.

3.1.1. Target Mode

Used to request an operating mode from the Function Block.

Values	**128**	Out of Service (O/S)
	16	Manual Mode (MAN)
	8	Automatic Mode (AUTO)

Open the menu **Device – Simulation,** go to **Function Block – AIFB1** or **2,** click on the tab **Simulation Output,** and select a target mode. Then click on the tab **Simulation (Measured Value)**, and enable or disable **Simulation**.

3.1.2. Unit

Engineering unit to be displayed with the output value.

3.1.3. Filter Time Constant

The time constant for the damping filter. The engineering unit is always in seconds. (This is an exponential filter: when a change occurs at the input, the output will be at 63.2% of the change in one time constant, and will be at full change after 5 time constants.)

3.1.4. Function

Used to select between the different level block outputs (Volume/Level, Level, Distance in Sensor units, Distance in Level units).

3.1.5. Batch Information

These 4 parameters are intended to be used in Batch Applications conforming to IEC 61512 Part 1 (ISA S88). Other applications do not require these values, which are only stored in the Function Block.

3.1.5.1. Batch ID

Identifies a certain batch to allow assignment of equipment-related information (for example faults, alarms) to the batch.

3.1.5.2. Batch Unit

Identifies the active Control Recipe Unit Procedure or the related Unit (for example, reactor, centrifuge, drier).

3.1.5.3. Batch operation

Identifies the active Control Recipe Operation.

3.1.5.4. Batch Phase

Identifies the active Control Recipe Phase.

Parameters

3.1.6. Process Value Scale

3.1.6.1. Lower Value

Defines the operational lower range value of the input value (Process Value Scale) in engineering units. Process Value Scale normalizes the input value to a customer-defined range.

3.1.6.2. Upper Value

Defines the operational upper range value of the input value (Process Value Scale) in engineering units. Process Value Scale normalizes the input value to a customer-defined range.
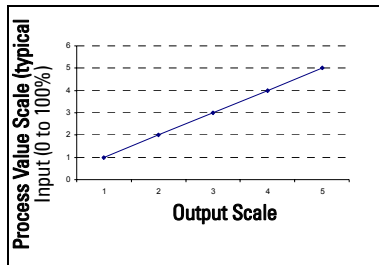
3.1.7. Output Scale

Scales the Process Variable. The function block parameter OUT SCALE contains the values of the lower limit and upper limit effective range.

3.1.7.1. Lower Value

Defines the operational lower range value of the output value in engineering units.

3.1.7.2. Upper Value

Defines the operational upper range value of the output value in engineering units.

3.1.8. Output Limits

3.1.8.1. Lower Limit Alarm

The setting for the lower alarm limit in engineering units.

3.1.8.2. Lower Limit Warning

The setting for the lower warning limit in engineering units.

3.1.8.3. Upper Limit Warning

The setting for the upper warning limit in engineering units.

3.1.8.4. Upper Limit Alarm

The setting for the upper alarm limit in engineering units

3.1.8.5. Limit Hysteresis

Hysteresis is used to adjust the sensitivity of the trigger for alarm messages. It is used to compensate when a process variable fluctuates around the same value as a limit. A high level alarm occurs when a value exceeds an upper limit. The alarm's status remains true until the value drops below the limit minus the alarm hysteresis. The directions are reversed for low limit detection.

Enter a value for the hysteresis here, to be used for all warnings and alarms. The units are the same as the output value scale.

3.1.8.6. Min Out

Min Out is a minimum peak indicator for the AIFB output values.

3.1.8.7. Max Out

Max Out is a maximum peak indicator for the AIFB output values.

3.1.9. Failsafe Mode
3.1.9.1. Failsafe Mode

Failsafe Mode occurs if the status of the input value is bad, or if the device has been put into Failsafe mode using Simulation. One of three options can be selected for the material level to be reported when the LOE timer expires.

Handheld programmer Values		Material level to be reported
0		Default value used as output value.
1	*	Store last valid output value.
2		Calculated output value is incorrect.

3.1.9.2. Failsafe Value

*(Accessible in PDM only after **0** is selected in Failsafe Mode).*

User-defined default value for the OUT parameter, if sensor or sensor electronic fault is detected. Units are the same as the OUT value.

3.1.A. Human Interface
3.1.A.1. Decimal Point

The number of digits to display after the decimal point. (The LCD is limited to displaying three decimal places.)

Out unit text

If the code list does not contain a desired unit for the OUT parameter, (see General Requirement) you can write the specific text in this parameter.

3.2. AIFB2

(See AIFB1: the parameters for AIFB2 are identical.)

Parameters

Certificates and Approvals
Device Certification

5. Maintenance settings

Parameters

Parameters

Parameters

...

Appendix B: Technical Reference

Principles of Operation

SITRANS LR 460 is a long range FMCW (Frequency Modulated Continuous Wave) radar transmitter. Radar level measurement uses the time of flight principle to determine distance to a material surface. The transmit time is directly proportional to the distance to the material.

FMCW radar transmits a continuous wave. The frequency of the wave is constantly increasing: this is known as the sweep. By the time the first part of the wave has been reflected off the target and returned to the device, the part of the wave that is just being emitted is at a higher frequency. The difference in frequency between the transmitted and received signals is proportional to time of flight.

Electromagnetic wave propagation is virtually unaffected by temperature or pressure changes, or by changes in the vapor or dust levels inside a vessel.

SITRANS LR 460 consists of an enclosed electronic component coupled to an antenna and process connection. The electronic component generates an electromagnetic signal from 24.2 GHz to 25.2 GHz 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 output.

Measurement Response

The measurement response (response rate) limits the maximum rate at which the display and output respond to changes in the measurement. Once the real process fill/empty rate (m/s) is established, a response rate can be selected that is slightly higher than the application rate. The response rate automatically adjusts the filters that affect the output response rate.

There are three preset options: slow, medium, and fast.

Related Parameters	Response Rate			LOE Timer (minutes)	Fill Rate	Empty Rate	Echo Lock	
Values	1	*	slow	100	0.1 m/minute	0.1 m/minute	2	material agitator
	2		medium	10	1 m/minute	1 m/minute		
	3		fast	1	10 m/minute	10 m/minute		

If none of the preset options is satisfactory, the filters can be adjusted individually.

Echo Lock

When the echoes are received, the relevant echo algorithm is applied to determine the true material echo. If the selected echo is within the window, the window is then centered about the echo. Otherwise the window widens with each successive shot until the selected echo is within the window, which then returns to its normal width.

Echo Lock selects the measurement verification process:

Values	0		Off
	1		Maximum Verification
	2	*	Material Agitator
	3		Total Lock

- When Echo Lock is Off, SITRANS LR 460 responds immediately to a new measurement (within the restrictions set by the Maximum Fill / Empty Rate). However, measurement reliability is affected.
- When Maximum Verification or Material Agitator is selected, a new measurement outside the Echo Lock Window must meet the sampling criteria.
- When Total Lock is selected, Echo Lock Window is pre-set to **0,** and the window is automatically calculated after each measurement.

Loss of Echo (LOE)

A loss of echo (LOE) occurs when the calculated measurement is judged to be unreliable because the echo confidence value has dropped below the echo confidence threshold. The LOE timer starts running, and if the LOE condition persists beyond ten minutes (the time limit set by the LOE timer) the Unreliable Echo indicator replaces the Reliable Echo indicator.

Reliable Echo indicator   Unreliable Echo indicator   .

While LOE is pending the **x** flashes, alternating with the two horizontal bars. When LOE becomes active, the **x** becomes solid and the auxiliary display shows fault code **S: 0**.

Upon receiving a reliable echo, the loss of echo condition is aborted, the Reliable Echo indicator reappears, and the reading returns to the current level.

LOE Timer

The LOE timer determines the time (in minutes) to elapse after the last valid reading before Failsafe mode is activated. When the LOE timer expires, the material level to be reported is determined by Failsafe Mode.

Failsafe Mode

Failsafe mode may be triggered by a loss of echo, a bad configuration, or certain device faults. You can select can select one of three possible values to be reported when a Failsafe mode occurs:

•   Default value (Failsafe value) used as output value.
•   Store last valid output value.
•   Calculated output value is incorrect.

Failsafe value

Failsafe value is a user-defined value. This allows you to enter the safest output value for your application.

For example, you may want to select a user-defined high value, to prevent an overfill (Failsafe Hi). Or you may want to select a low value, to protect a pump from operating dry (Failsafe Lo).

False Echoes

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 Range (Blanking)

Near Range allows you to set a distance in front of the antenna, within which any echoes will be ignored. But Auto False-Echo Suppression is generally recommended in preference to using Near Range.

Auto False-Echo Suppression

The TVT adjustment parameters allow you to set a TVT (Time Varying Threshold) curve, so that SITRANS LR 460 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 Auto False-Echo Suppression to **Learn**, the instrument learns the echo profile at that moment[1]. Then it uses the learned profile instead of the default TVT curve, for the distance set in Auto False Echo Suppression Distance. 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 69 for examples of the echo profile before and after using Auto False-Echo Suppression.

---

1. Set **Auto False-Echo Suppression** to **Learn** when the material level is substantially lower than process full level (ideally when the tank is empty or almost empty).

Maximum Process Temperature Chart

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

Note: The chart below is for guidance only. Information to be updated to SITRANS LR 460 information.

Maximum Flange and Process Temperatures versus Allowable Ambient for Polypropylene Rod or Flange Adaptor versions of SITRANS LR 200
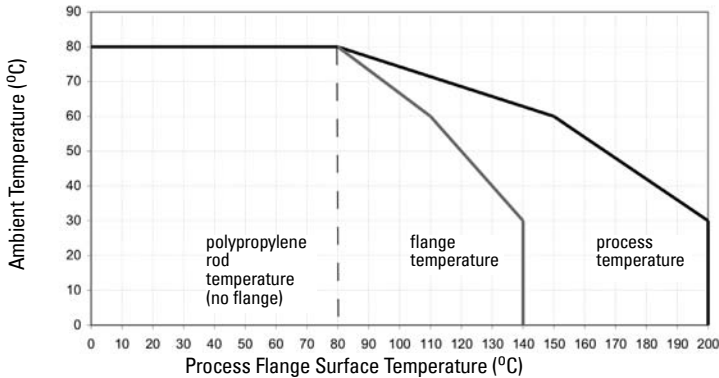
- The chart does not represent every possible process connection arrangement. For example, it will NOT apply if you are mounting the LR 200 on a nozzle greater than 8" nominal, or directly on a metallic vessel surface.
- The chart does not take into consideration heating from direct sunshine exposure.
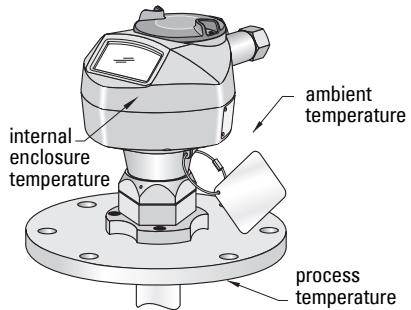
Where the chart does not apply, please use your own judgement regarding the use of SITRANS LR 200. Open the menu **View – Peak Values**, and click on the temperature tab to see the maximum and minimum temperatures recorded. These can be used to determine whether the installation needs to be redesigned.

For example, if the internal temperature exceeds the maximum allowable limit, a sun shield or a longer nozzle may be required. The peak temperatures indicate the extent of change required to the installation in order to provide a reliable thermal-operating zone for SITRANS LR 200.

Appendix C: Troubleshooting

1.   Check the following:

     •   There is power at the instrument.
     •   The LCD shows the relevant data.
     •   Check whether any fault codes are being displayed (see *Acyclic Extended Diagnostics (General Fault Codes)* on page 51 for a detailed list).
     •   The device can be programmed using the handheld programmer.

2.   Verify that the wiring connections are correct.

3.   Check the PROFIBUS address and make sure all devices are at unique PROFIBUS addresses.

4.   If the device cannot be programmed via the handheld programmer, make sure local operation is enabled. See *Local operation enable* on page 26. Also make sure that Write Locking is Off. See *Write locking* on page 34.

5.   If you try to set a SITRANS LR 460 parameter via remote communications, but the parameter remains unchanged, make sure remote operation is enabled. See *Remote operation enable* on page 26. Also make sure that Write Locking is Off. See *Write locking* on page 27.

6.   If you continue to experience problems, go to our website at www.siemens.com/processautomation, and check the FAQs for SITRANS LR 200, or contact your Siemens Milltronics representative.

7.   If the PLC value equals the display value, but does not correspond to actual material level, either:
     •   scaling in AIFB1 is incorrect, or
     •   High Calibration Point is incorrectly entered, or
     •   the wrong echo is being selected.

8.   If the PLC value is not equal to the displayed value (regardless of actual material level), either:
     •   you may not be looking at the right spot in the PLC, or
     •   you may have programmed scaling into the PLC, instead of leaving all scaling to be performed in the LR 200, or
     •   the PLC may not be communicating with the LR 460. Check the network to verify that you are communicating.

General Fault Codes

Note: Some faults cause the device to go to Failsafe mode (Fault 52). These are indicated with an asterisk (*).

LCD display		Meaning	Corrective Action	Byte	Bit
S:0		The device was unable to get a measurement within the Failsafe timer period. Possible causes: faulty installation, material buildup,and/or presence of foam.	Ensure installation details are correct. Ensure no material buildup. Adjust process conditions to minimize foaming. If problem persists, contact your local Siemens representative.	0	0
S:2		Internal electronics failure.	Reset power. If fault persists,contact your local Siemens representative: repair required.		2
S:3		Device is nearing its lifetime limit according to the value set in Maintenance Required Limit.	Replacement is recommended.		3
S:4		Device is nearing its lifetime limit according to the value set in Maintenance Demanded Limit.	Replacement is recommended.		4
S:6		Sensor is nearing its lifetime limit according to the value set in Maintenance Required Limit.	Replacement is recommended.		6
S:7		Sensor is nearing its lifetime limit according to the value set in Maintenance Demanded Limit.	Replacement is recommended.		7

LCD display		Meaning (cont'd)	Corrective Action	Byte (cont'd)	Bit
S:8		Service interval as defined in Maintenance Required Limit has expired.	Perform service.		0
S:9		Service interval as defined in Maintenance Demanded Limit has expired.	Perform service.		1
S:10		Input parameters High Calibration Point and Low Calibration Point are the same.	Check calibration settings of device. Ensure settings for High Calibration Point and Low Calibration Point are different.		3
S:11		Internal temperature sensor failure.	Return the device to the factory.		4
S:12	*	Internal temperature of the device has exceeded specifications: it is operating outside its temperature range.	Lower the ambient temperature enough to cool the device. Fault code will persist until a manual reset is performed using PDM or the LCD interface.	1	5
S:14		Upper and lower input values (Process Value Scale) for AIFB1 are the same.	Check configuration for AIFB1. Ensure that Upper Value and Lower Value (Process Value Scale) are not the same.		6
S:15		Upper and lower input values (Process Value Scale) for AIFB2 are the same.	Check configuration for AIFB2. Ensure that Upper Value and Lower Value (Process Value Scale) are not the same.		7

LCD display		Meaning (cont'd)	Corrective Action	Byte (cont'd)	Bit
S: 17		Calibration interval as defined in Maintenance Required Limit has expired.	Perform calibration.	2	1
S: 18		Calibration interval as defined in Maintenance Demanded Limit has expired.	Perform calibration.		2
S:28		Internal device failure caused by a memory error.	Repair required: contact your local Siemens representative.	3	4
S:29		EEPROM damaged.	Repair required: contact your local Siemens representative.		5
S:30		EEPROM corrupt.	Reset power. If error persists, contact your local Siemens representative.		6
S:31		Flash error.	Repair required: contact your local Siemens representative.		7
S: 32		The IDENT number used in communications, and number selected by the Ident Number Selector do not correspond.	Ensure value of the Ident number selector is correct for the network configuration. If it is correct, the device needs to be re-parameterized by the PLC.	4	0
S:33		Factory calibration for the internal temperature sensor has been lost.	Repair required: contact your local Siemens representative.		1

LCD display		Meaning (cont'd)	Corrective Action	Byte (cont'd)	Bit
S:34		Factory calibration for the device has been lost.	Repair required: contact your local Siemens representative.		2
S:35		Factory calibration for the device has been lost.	Repair required: contact your local Siemens representative.		3
S:36		Unable to start microwave module.	Reset power. If error persists, contact your local Siemens representative.	4	4
S:37		Unable to collect profile.	Repair required: contact your local Siemens representative.		5
S:38		Microwave module hardware failure: unable to calculate distance measurement.	Repair required: contact your local Siemens representative.		6

G: Troubleshooting

Appendix D: Maintenance

SITRANS LR 460 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.

Unit Repair and Excluded Liability

All changes and repairs must be done by qualified personnel, and applicable safety regulations must be followed. Please note the following:

- The user is responsible for all changes and repairs made to the device.
- All new components must be provided by Siemens Milltronics Process Instruments Inc.
- Restrict repair to faulty components only.
- Do not re-use faulty components.

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Appendix E: Software Revision History

Soft-ware Rev.	DD Rev.	Date	Changes
			•
			•
			•
			•
			•
			•

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.

Glossary

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 Permitivity. 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 1[1].

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 μV rms.

Echo Profile: a graphical display of a processed echo.

emission cone: the extension of the antenna's angle

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.

Glossary

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.

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.

PROFIBUS PA: one of the PROFIBUS family of protocols, specifically tailored for the needs of process industries (PA = Process Automation).

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 parallel 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, 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.

Index

DRAFT

Index

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7 M L 1 9 9 8 5 J M 0 1

Rev. 1.0