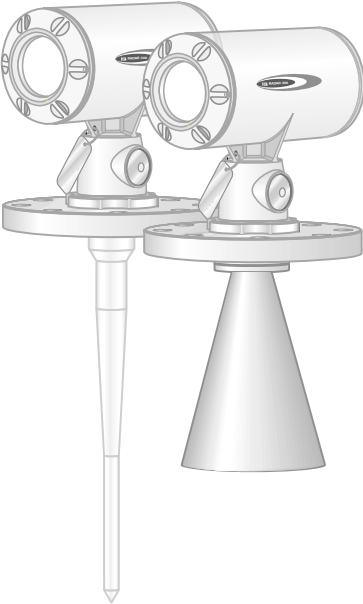


**MILLTRONICS**

# IQ RADAR 300

Instruction Manual

March 2001



IQ RADAR 300

## Safety Guidelines

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

## Qualified Personnel

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

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

**Note:** Always use product in accordance with specifications.

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

Technical data subject to change.

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# General Information

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## The Manual

Refer to this manual for proper installation and operation of your IQ Radar 300. The margin tabs denote the sections, and each section presents IQ 300 features.

**Note:** Please read all sections before operating your IQ 300.

<b>Installation:</b>	Installing the IQ 300.
<b>Interconnection:</b>	IQ 300 interconnection instructions.
<b>Start-up:</b>	Operating the keypad, programming the unit, and reading the display.
<b>Operation:</b>	IQ 300 operating instructions.
<b>Applications:</b>	Application examples and practical use.
<b>Parameters:</b>	Available parameters and a description of function and use. Please read this section and familiarize yourself with the parameters available to you, to fully optimize your instrument.
<b>Communications:</b>	Configure communication settings.
<b>Troubleshooting:</b>	Responses to common installation and application problems.
<b>Appendices:</b>	An alphabetical cross-reference of the parameters and their numbers, a record sheet for jotting down parameter values, Ambient/Operating Temperature Specifications, Process Pressure/Temperature de-Rating charts, Typical Power Consumption charts, and detailed information on HART Communications for the IQ Radar 300.

**IMPORTANT:** All specifications are subject to change without notice. Please ensure that any safety-related information is confirmed with a qualified Siemens Milltronics representative.

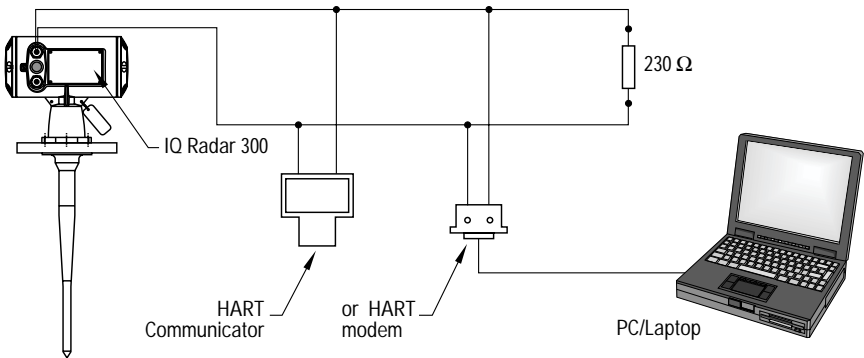
# IQ Radar 300

The IQ Radar 300 is to be used only in the manner outlined in this manual, otherwise protection provided by the equipment may be impaired.

IQ 300 is a versatile process level-monitoring instrument using advanced pulse radar techniques. The unit consists of an electronic component coupled to the antenna and process connection.

## IQ Radar 300 Communications

The standard IQ 300 supports Modbus<sup>®1</sup> or Dolphin protocol, and HART<sup>®2</sup> or Profibus PA.



## Dolphin Plus

Dolphin is a proprietary Milltronics protocol designed to be used with Dolphin Plus. For more information on Dolphin Plus or to obtain a copy of the software, please contact your Siemens Milltronics representative.

## IQ Radar 300 Applications

- liquids, slurries
- process temperatures up to 200°C
- vacuum and pressurized vessels

## IQ Radar 300 Approvals and Certificates

- general and radio
- hazardous

**Note:** See **Specifications** on page 11 for an approvals listing.

<sup>1</sup> Modbus is a registered trademark of Groupe Schneider.

<sup>2</sup> HART is a registered trademark of the HART Communications Foundation.

# Specifications

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**Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time. Please ensure these are the most recent specifications. Contact your representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.

## IQ Radar 300

### Power

- 24-230 Vac,  $\pm 15\%$ , 40-70Hz, 28 VA (11W)
- or
- 24-230 Vdc,  $\pm 15\%$ , (9W)

#### Note:

- Safety feature limits the inrush current during start up.
- This instrument features a universal power supply. AC or DC voltage may be applied to the same terminals.
- Power consumption will vary according to voltage. Please see Appendix V, Typical Power Consumption, page 94.

Normal start up takes about 2 seconds to power up the unit. If something (such as hesitation in plugging in the unit) causes a rapid power fluctuation, the unit will shut down for 10 seconds to ensure the inrush current will not exceed specified limits.

### Fuse

- FU1 & FU2, Fast Acting Ceramic Bussmann ABC fuse, 1 Amp. 250V.

### Interface

- analog output: optically-isolated 4-20 mA into 450  $\Omega$  max, 0.02 mA resolution
- serial interface<sup>3</sup>: isolated RS-485 (refer to RS-485 specifications)
- programmer link: infrared receiver (refer to Programmer specifications on page 11)
- display (local): backlit, alphanumeric, and multi-graphic liquid crystal for readout and entry
- HART: optional Profibus PA

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<sup>3</sup> This port is used to communicate through Modbus or Dolphin Plus.

## Performance<sup>4</sup>

- frequency: 5.8 GHz (U.S.A. 6.3 GHz)
- accuracy at 20° C:  $\pm 15\text{mm}$  from 0.4m to 10m  
 $\pm 0.15\%$  from 10m to 20m
- temperature drift:  $<\pm 0.25\%$  of range from  $-40$  to  $60^\circ\text{C}$  ( $-40$  to  $140^\circ\text{F}$ )
- measuring range: 0.4m to 20m<sup>5</sup>
- repeatability:  $\pm 2\text{mm}$  for range  $< 3\text{m}$   
 $\pm 3\text{mm}$  for range  $< 5\text{m}$   
 $\pm 5\text{mm}$  for range  $< 10\text{m}$   
 $\pm 10\text{mm}$  for range  $< 20\text{m}$
- Fail-Safe: mA and "reading" programmable high, low, or hold, upon Loss of Echo (LOE) condition

## Mechanical

Process Connections: **(Please refer to Appendix IV for pressure/temperature limitations.)**

- flat-faced flanges: 316 stainless steel  
ANSI #150/#300 2", 3", 4", 6", 8"  
DIN PN16/PN25/PN40 50mm, 80mm, 100mm,  
150mm, 200mm  
JIS 10K 50mm, 80mm, 100mm, 150mm, 200mm
- threaded connection: 316 stainless steel, 1-1/2" or 2"  
NPT, BSP, or G
- sanitary connection: 316 stainless steel, 2", 3", or 4" tri-clamp

Antennas:

- dielectric rod: Teflon<sup>® 6</sup> (PTFE)  
length 41cm (16.3"), including integral gasket
- horn: 316 stainless steel  
diameters 100mm (4"), 150mm (6"), 200mm (8")  
emitter cone PTFE  
waveguide extensions optional
- waveguide: 316 stainless steel  
emitter cone PTFE

### Note:

- Please ensure these are the most recent specifications. Contact your Siemens Milltronics representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.
- See Appendix III (Ambient/Operating Temperature Specification) on page 89 and Approvals on page 11, for the specific configuration you are about to use or install.

<sup>4</sup> Reference conditions.

<sup>5</sup> Minimum range may be extended or maximum range reduced, depending on the specific antenna system installed.

<sup>6</sup> Teflon is a registered trademark of Du Pont.

## Sanitary Antennas (FDA approved materials):

- dielectric rod: one piece UHMW-PE; optional PTFE  
2", 3", 4" tri-clamp connection
- horn: 304 stainless steel  
horn with integral 4" tri-clamp  
connection PTFE emitter

## Enclosure (electronic):

- construction: aluminum, epoxy-coated; or 316 stainless steel
- conduit: 2 x 1/2" NPT or M 20 x 1.5 entry
- ingress protection: Type 4X / NEMA 4X, Type 6 / NEMA 6, IP 67

## Weight:

- 7.5 kg (16.5 lb) with 2"/150 psi flange (aluminum); 13.6 kg (30 lb) stainless steel
- weight will vary with flange size and rating

## Environmental:

- location: indoor/outdoor
- altitude: 2000m max.
- ambient temperature: -40 to 60° C (-40 to 140° F)<sup>7</sup>
- relative humidity: suitable for outdoor
- installation category: II
- pollution degree: 4

## Process

- material dielectric:  $\epsilon_r > 1.8$   
for  $\epsilon_r < 3$ , you should use a waveguide antenna  
or stillpipe (see Mounting: on page 28 or  
Mounting: Stillpipe or Sidepipe on page 29)
- temperature: UHMW-PE -40 to 80°C (-40 to 176°F)  
PTFE -40 to 200°C (-40 to 392°F)<sup>7</sup>
- pressure (vessel): dependent on process connection type and  
temperature (refer to Appendix IV on page 89 for  
charts, or obtain the reference drawing listed on  
the device process tag)

### Note:

- Please ensure these are the most recent specifications. Contact your Siemens Milltronics representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.
- See Appendix III (Ambient/Operating Temperature Specification) on page 89, and Approvals on page 11 for the specific configuration you are about to use or install.

<sup>7</sup> See Appendix III (Ambient/Operating Temperature Specification) on page 89, and Approvals on page 11.

## Approvals (verify against device nameplate)

The following are possible approvals:

- General: CSA <sub>NRTL/C</sub>, FM, CE, 3A Sanitary
- Radio: Europe, Industry Canada, FCC
- Hazardous: Europe; EEx de IIC T6  
ATEX II 2G, EEx de IIC T6 or EEx d IIC T6  
U.S.; Class I, Div. 1, Gr. A,B,C,D (Class I, Zone 1, IIC T6)  
Class II, Div. 1, Gr. E,F,G  
Class III  
Canada; Class I, Div. 1, Gr. A,B,C,D (Class I, Zone 1, IIC T6)  
Class II, Div. 1, Gr. E,F,G  
Class III

## Programmer (remote keypad)

Standard Model for non-hazardous areas: (battery is replaceable)

- enclosure: general purpose  
67mm w x 100mm h x 25mm d  
(2.6" w x 4" h x 1" d)
- ambient temperature: -20 to 50° C (-5 to 122° F)
- interface: proprietary infrared pulse signal
- power: 9V battery (ANSI/NEDA 1604, PP3 or equivalent)
- weight: 150g (0.3 lb)
- colour: blue

Intrinsically Safe Programmer (I.S.) Model for hazardous locations: (battery is non-replaceable)

- approval: EEx ia IIC T4, SIRA certificate Ex002030
- ambient temperature: -20 to 40° C (-5 to 104° F)
- interface: proprietary infrared pulse signal
- power: 3V lithium battery
- weight: 150g (0.3 lb)
- colour: black

### Note:

- Please ensure these are the most recent specifications. Contact your Siemens Milltronics representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.
- See Appendix III (Ambient/Operating Temperature Specification) on page 89 and Approvals on page 11, for the specific configuration you are about to use or install.

# Installation

## Note:

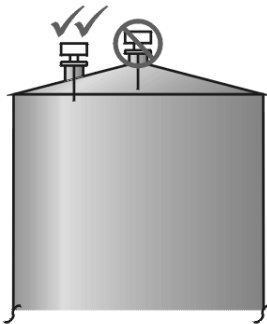
- Installation shall only be performed by qualified personnel and in accordance with local governing regulations.
- This product is susceptible to electrostatic shock. Follow proper grounding procedures.
- Do not use a Ground Fault Interrupt (G.F.I.) with the IQ 300. The ground path is used for filtering purposes in conjunction with the universal power supply.

## Mounting Location

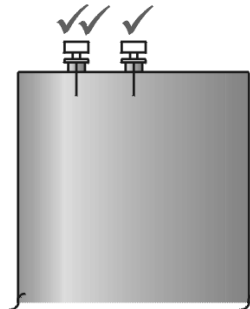
- Do not mount in direct sunlight without the use of a sun shield. Refer to Appendix III (Ambient/Operating Temperature Specification) on page 89

**Warning:** For vessels with conical or parabolic tops, avoid mounting the unit at the centre. The concavity of the top can focus echoes into the centre, giving false readings.

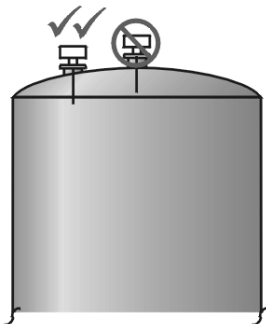
Conical



Flat



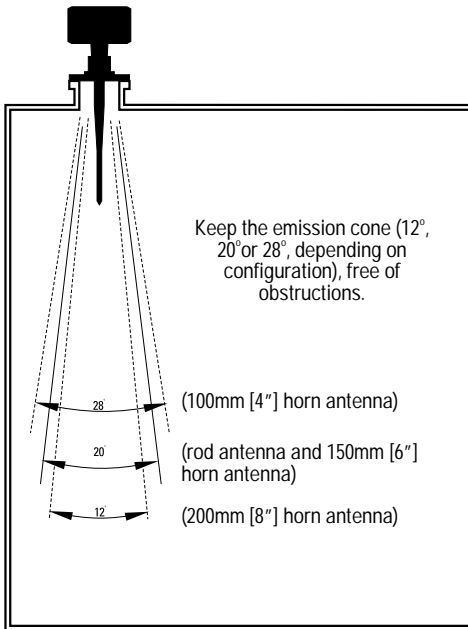
Parabolic



## Note:

- ✓✓ is preferred location.
- ✓ is acceptable location.

# Beam Spreading



Due to the polarization effect of the microwave signal related to the wall of the vessel, we recommend locating the IQ 300 a minimum of 30cm (1') away from the sidewall for every 3m (10') of vessel height.

## Polarization Effect

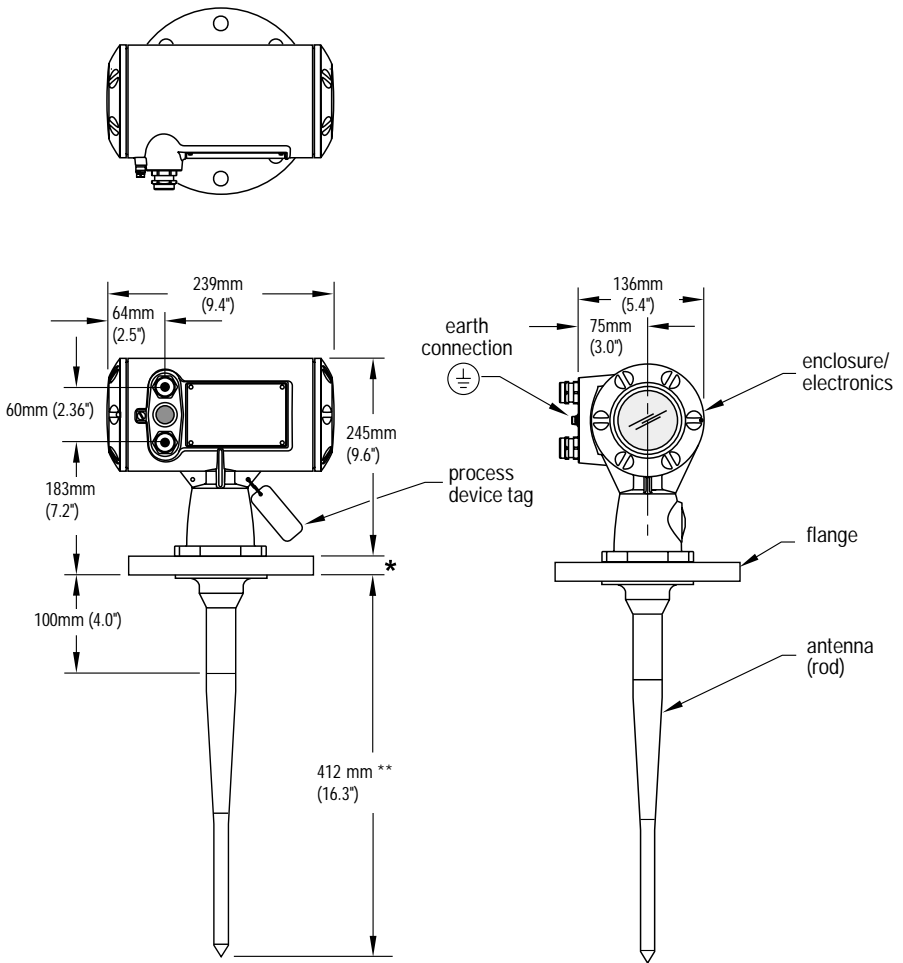
Mounting the unit too close to a wall may cause echoes to disappear at specific levels due to wave cancellation. A strong false reflection from an internal tank obstruction can be reduced or eliminated by rotating the unit to reduce this polarization effect.

## False Reflections

Flat obstructions and struts perpendicular to the emission cone cause large false reflections. They reflect the radar signal with high amplitude. Round profile interfering surfaces diffuse reflections of the radar signals and cause false reflections with low amplitude.

Minimize false reflections first by rotating the instrument for best signal (lowest false echo amplitude). Then use the TVT shaper parameters (P831, 832, 837 and 838) to prevent false echo detection.

# Dimensions: IQ Radar 300 with Rod Antenna



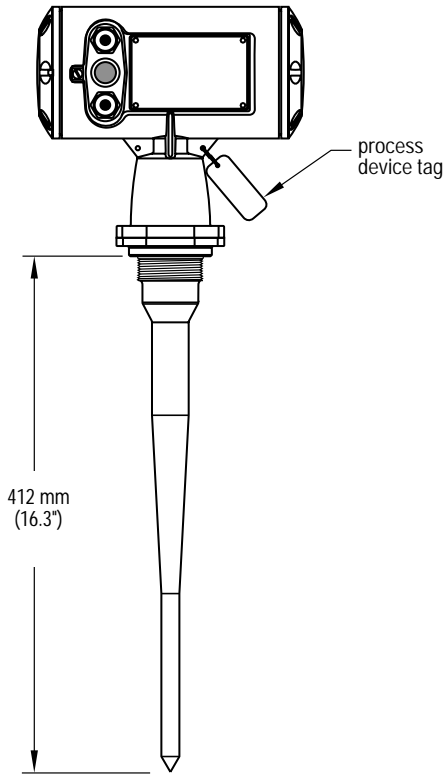
\* Flange thickness 25mm (1") nominal.

\*\* Standard length, 50mm and 100mm (2" and 4") extensions available.

For information on temperature and pressure ratings, see Appendix IV on page 90.

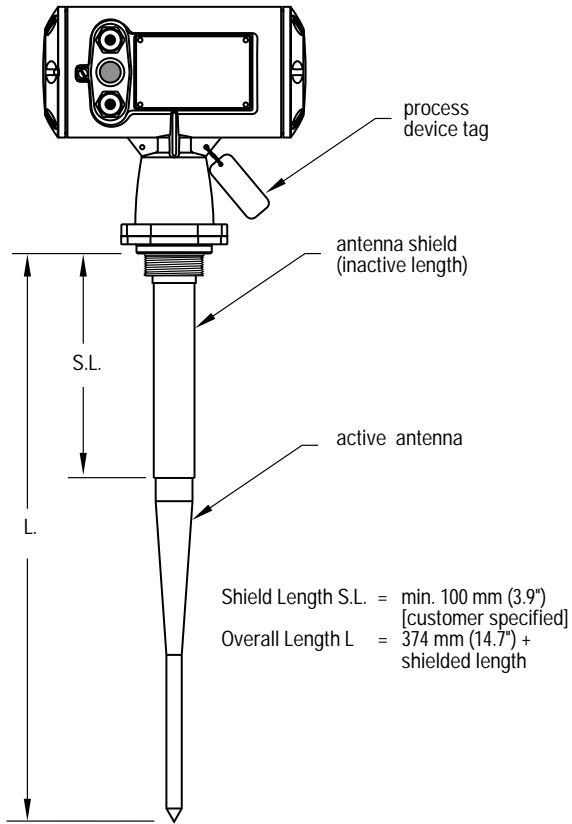
**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

## Dimensions: Threaded Rod



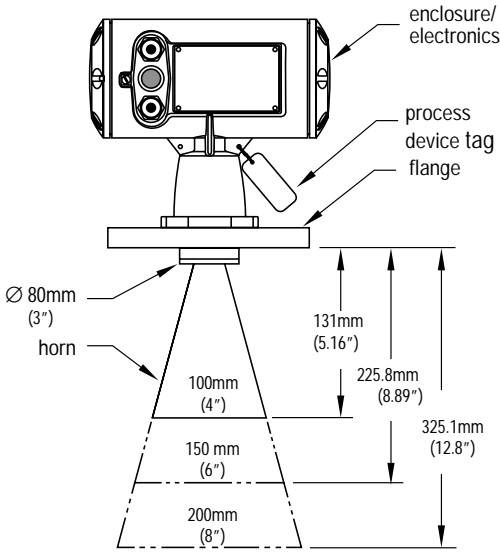
**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

# Dimensions: Shielded Rod



**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

# Dimensions: Horn



Nominal Horn Size	Horn O.D.	Horn Height	Beam Angle
100mm (4")	95.3mm (3.75")	131.0mm (5.16")	28 degrees
150mm (6")	146.0mm (5.75")	225.8mm (8.89")	20 degrees
200mm (8")	199.4mm (7.85")	325.1mm (12.8")	12 degrees

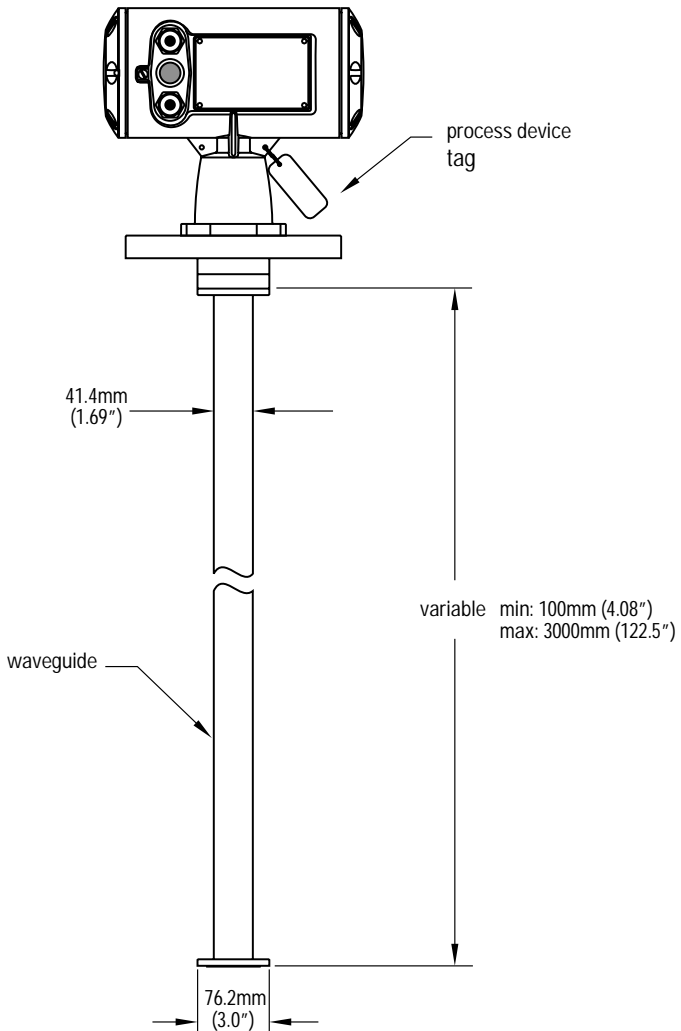
**Note:**

- Signal amplitude increases with horn diameter, so use the largest practical size.
- Optional waveguide extensions and/or purging system\* can be installed between the flange and the antenna.

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

**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

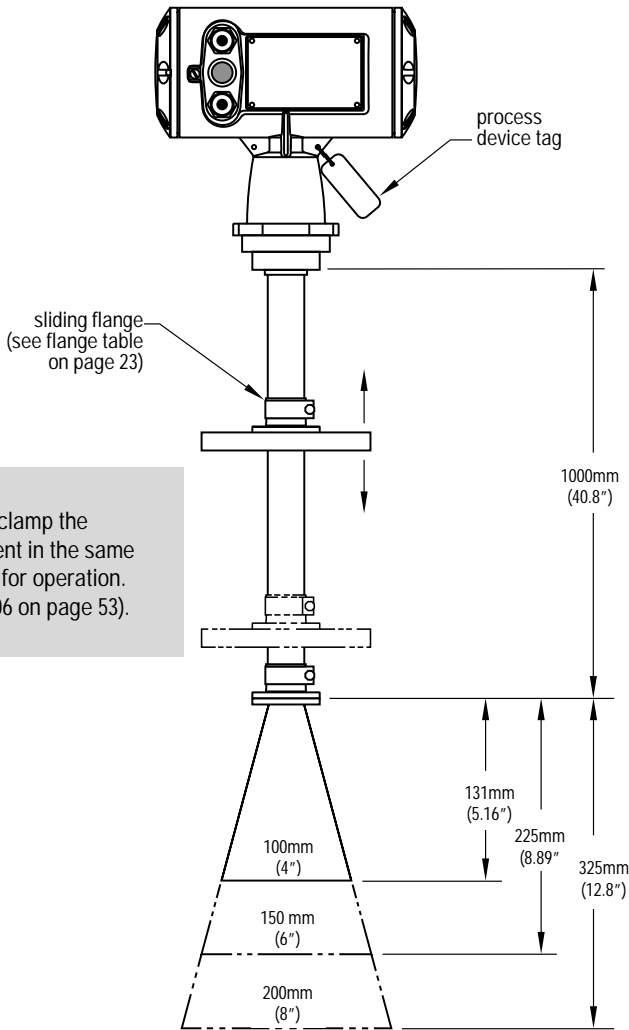
# Dimensions: Waveguide



## Note:

- You can connect a maximum of two waveguides together.
- This option is recommended only for clean liquids on vessels without agitators or turbulence.
- Horizontal stress on this antenna must be avoided, otherwise mechanical support may be required.
- Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

# Dimensions: Sliding Waveguide Configuration



**Note:**

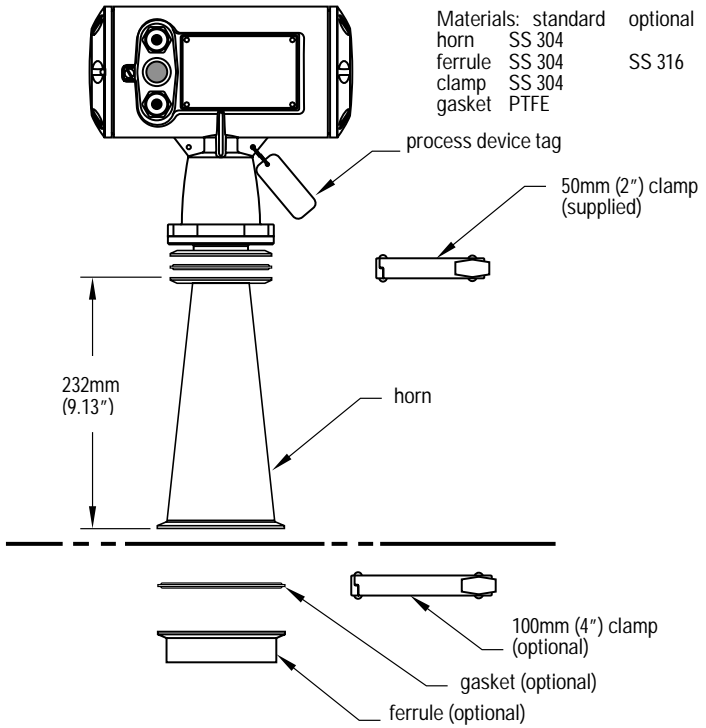
Always clamp the instrument in the same position for operation. (see P006 on page 53).

**Note:**

- Maximum pressure 0.5 bar at 60° C (140° F) for sliding flange option.
- Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

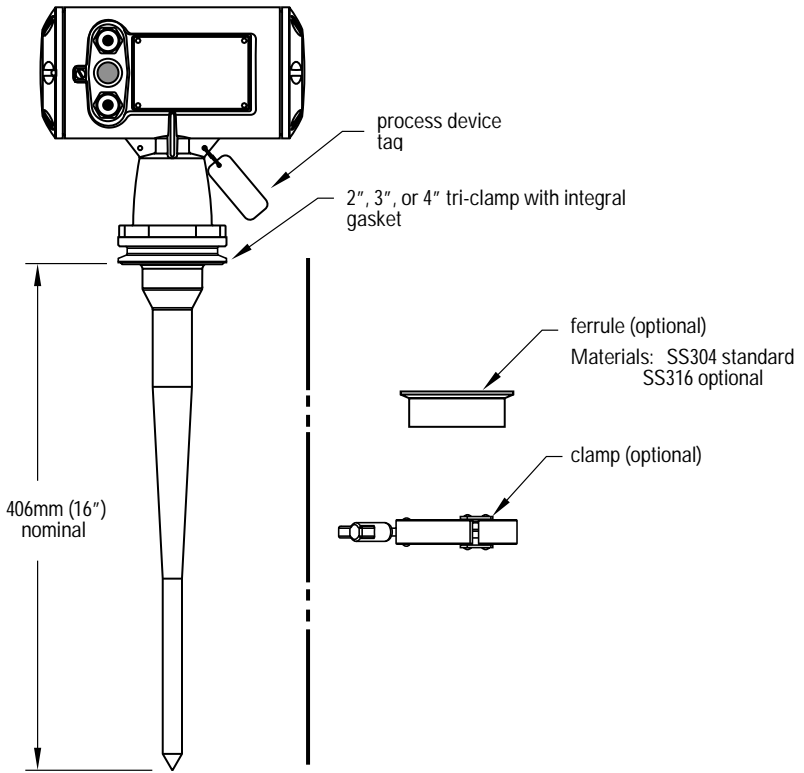
Installation

# Dimensions: Sanitary Horn



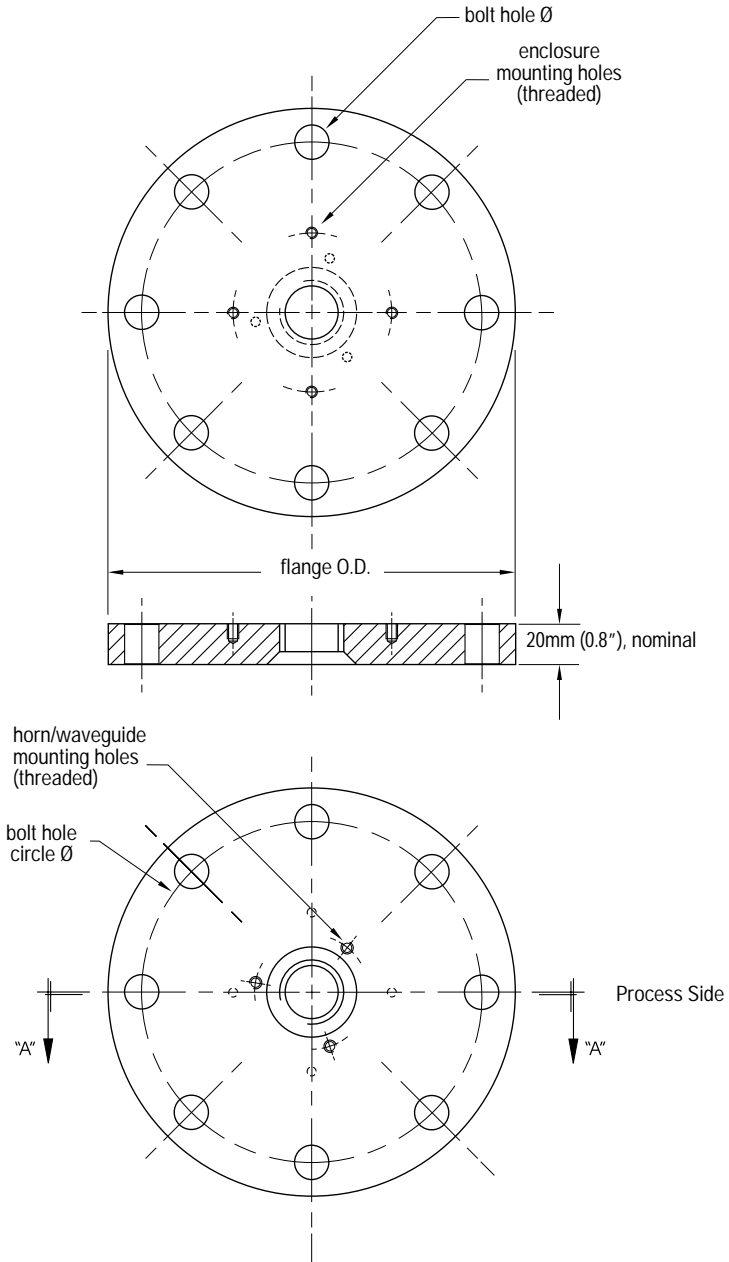
**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

# Dimensions: Sanitary Rod



**Note:** Process temperature and pressure capabilities are dependent upon information on the process device tag. Reference drawing listed on the tag is available upon request.

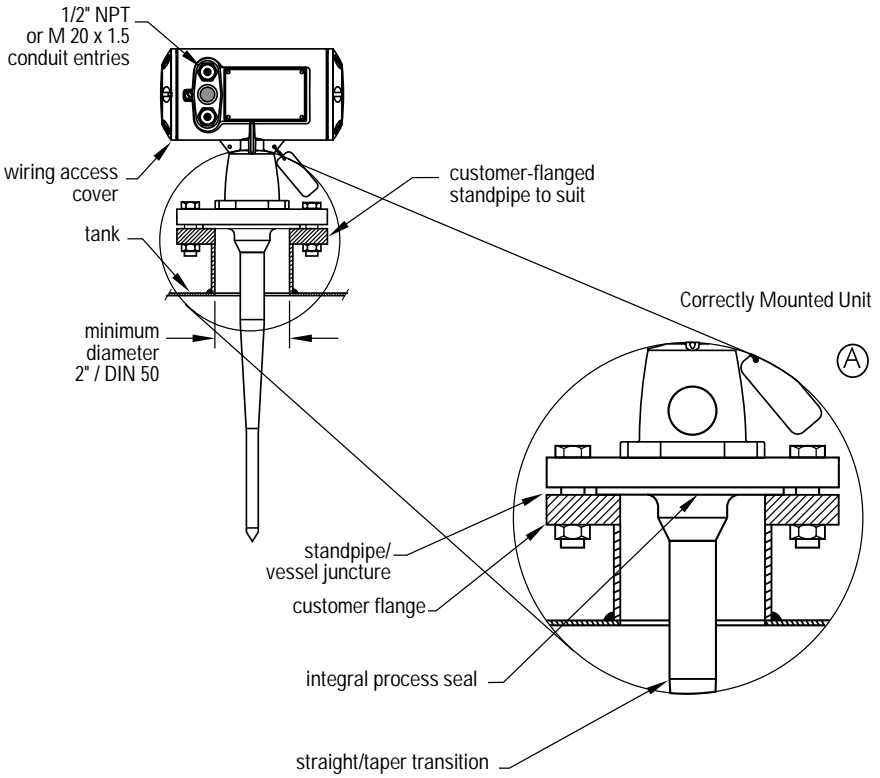
# Dimensions: Flanges



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

\*\* Due to the limited space on this flange the IQ 300 can only use 4 of the standard 8 bolt holes of the 2" ANSI #300 size

# Mounting

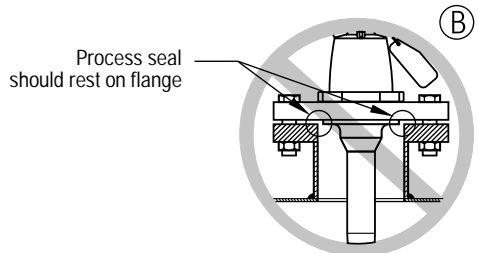


## Note:

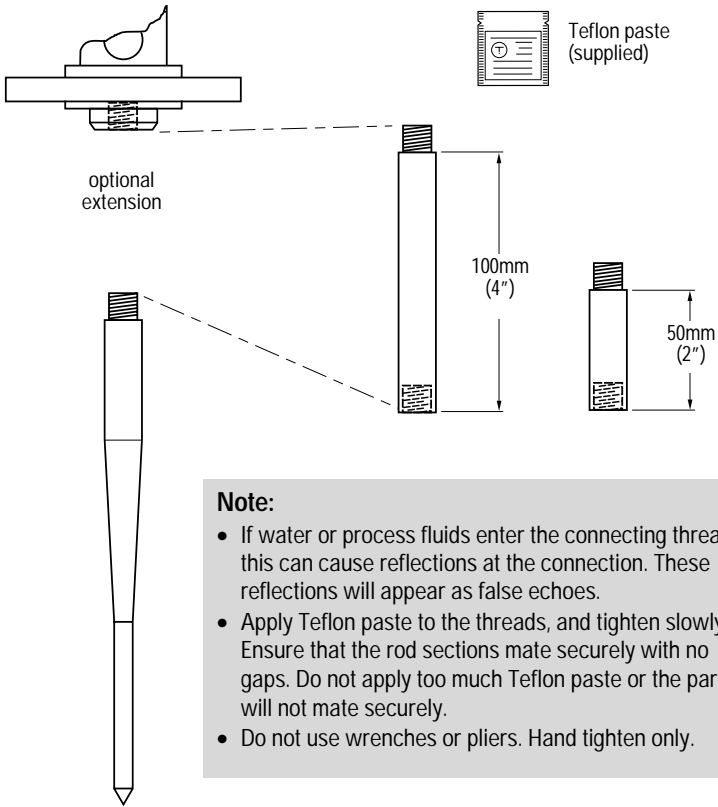
- The Integral process seal **MUST** rest on the customer flange. See detail (A) showing a correctly mounted unit.
- The straight/taper transition of the rod should extend past the standpipe/vessel opening. Add extensions as required\*.

\* Refer to the Rod Extension Requirements table on page 25.

## Improperly Mounted Unit (B)



# Rod Assembly



## Note:

- If water or process fluids enter the connecting threads, this can cause reflections at the connection. These reflections will appear as false echoes.
- Apply Teflon paste to the threads, and tighten slowly. Ensure that the rod sections mate securely with no gaps. Do not apply too much Teflon paste or the parts will not mate securely.
- Do not use wrenches or pliers. Hand tighten only.

## Rod Extension Requirements

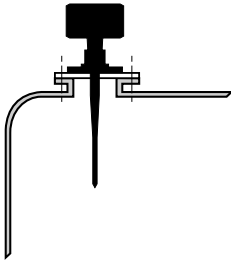
standpipe I.D.	standpipe height mm (inches)*		
	<100 (4)	100 to 150 (4 to 6)	150 to 200 (6 to 8)
50mm (2")	n/r	**	**
80mm (3")	n/r	50mm	100mm
100mm (4")	n/r	50mm	100mm
150mm (6")	n/r	50mm	100mm
>150mm (6")	n/r	n/r	n/r

n/r extension not required

\* Consult Siemens Milltronics for assistance with standpipe sizes not listed.

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

## Mounting: Rod Assembly



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

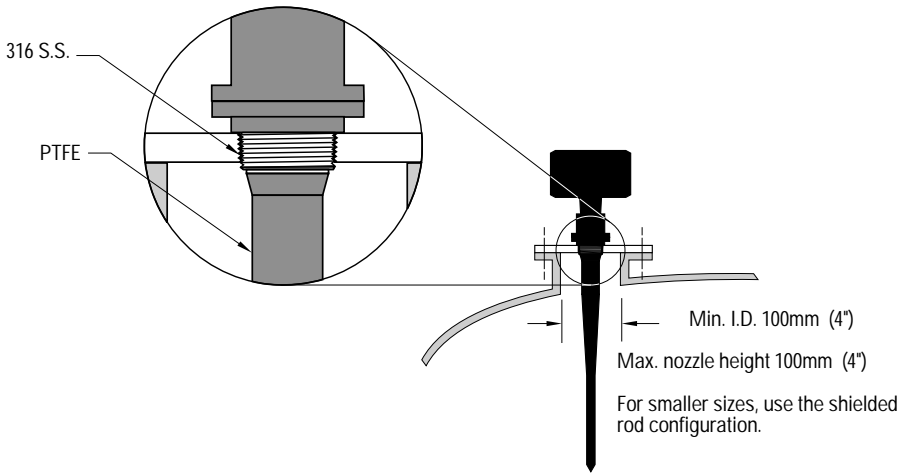
If you create a new standpipe for the radar unit, the weld seams must be on the outside of the standpipe. Ensure that there are no seams or lips on the inside of the standpipe or you may get erratic readings.

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

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

## Mounting Threaded Rod Antenna

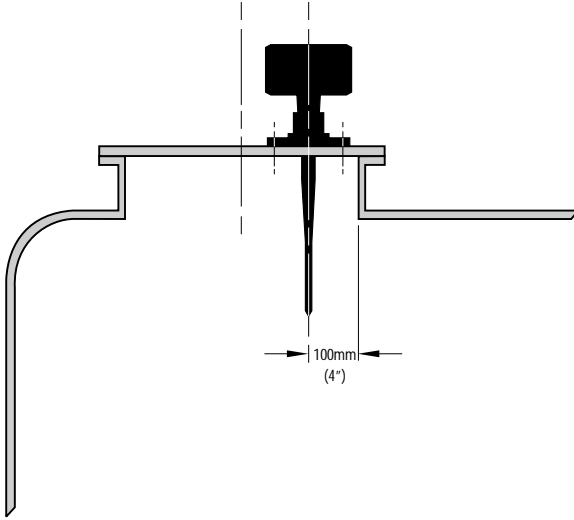
You can use 1.5" or 2" threaded process connections. There are three thread types: NPT, BSP, and G.



# Mounting: Manhole Covers

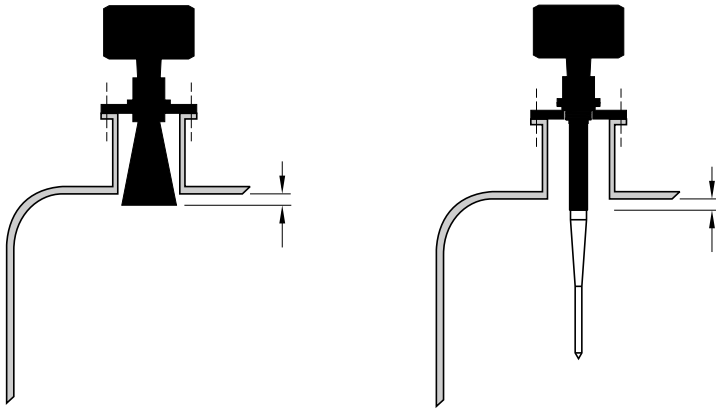
A manhole cover is typically a standpipe that is 610mm (24") or greater in diameter, with a cover.

To provide the optimum signal conditions, locate the antenna off-center with respect to the cover, typically 100mm (4") from the side of the manhole.



# Mounting: Horn Antennas or Shielded Rod

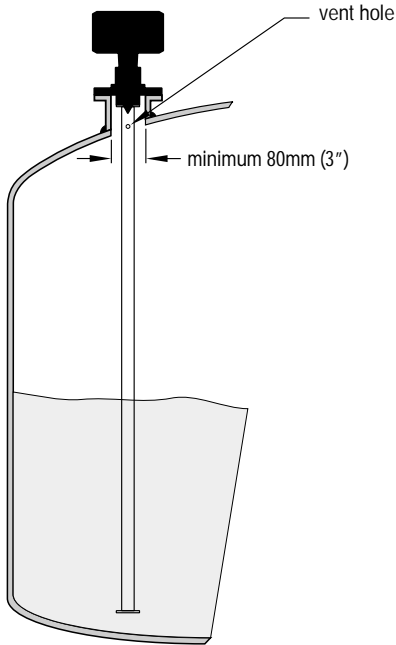
The end of the horn, or the end of the shield section, should protrude a minimum of 10mm (0.5") to avoid interference with the standpipe.



Installation

# Mounting: Waveguide Antenna

This option is recommended for products with  $\epsilon_r$  lower than 3. See P655 on page 62 for the related propagation factor.



## Note:

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

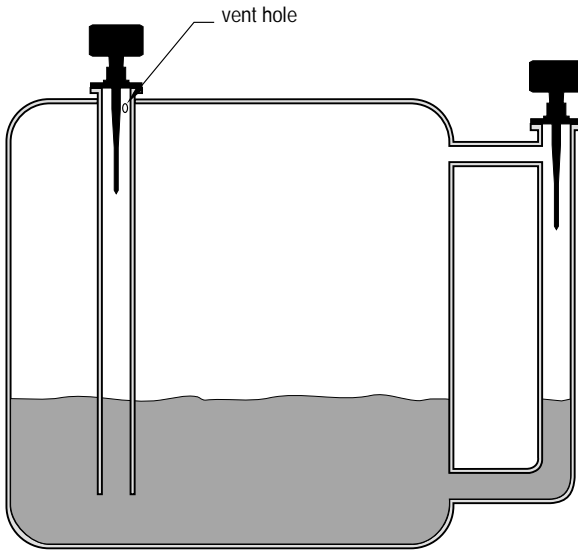
# Mounting: Stillpipe or Sidepipe

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

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

## Smoothness

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



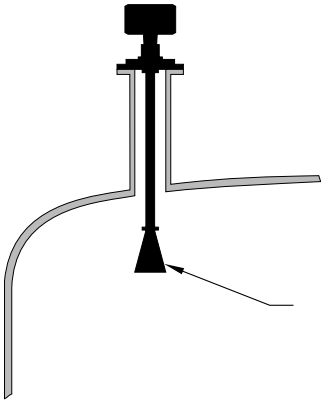
Suitable pipe diameters are:  
2" (50mm) to  
10" (250mm).

You can use either  
a rod or horn  
antenna.

See P655 on page 62 for the related propagation factor.

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

# Mounting: Horn with Waveguide Extensions



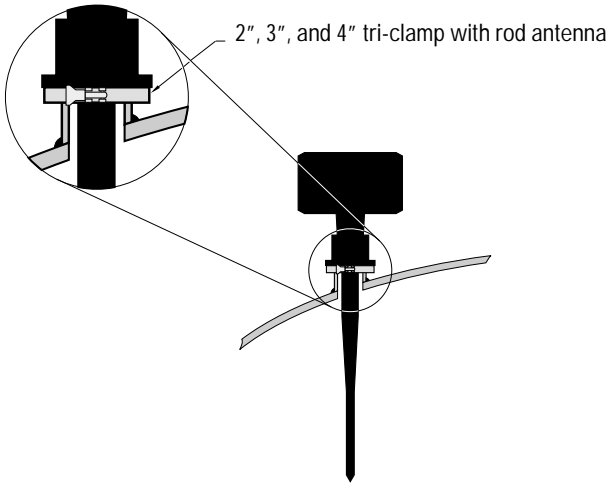
Use this combination if the standpipe is long and the diameter is small.

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

Waveguide extensions are available in custom lengths.

If the horn diameter is too large for the standpipe opening, you need to insert it from inside the vessel. The horn must be connected to the IQ 300 process flange.

# Mounting: Sanitary Rod Antenna

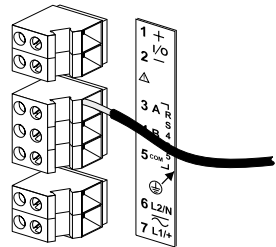
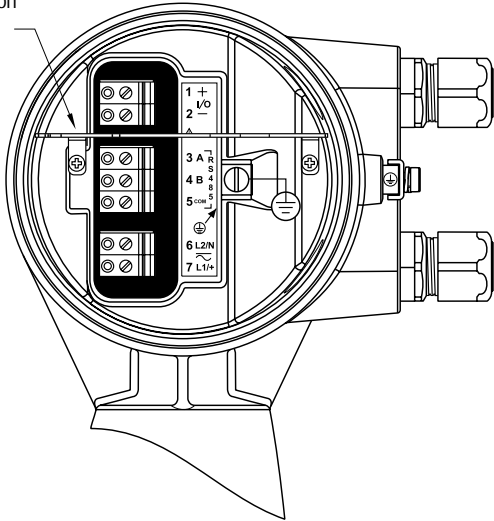


# Interconnection

## IQ Radar 300 Terminal Block

Two options are available. The Intrinsically Safe mAmp Output Version has a shield installed: the standard version does not.

Shield installed on Intrinsically Safe version only



Wiring access is from the side of the terminal block

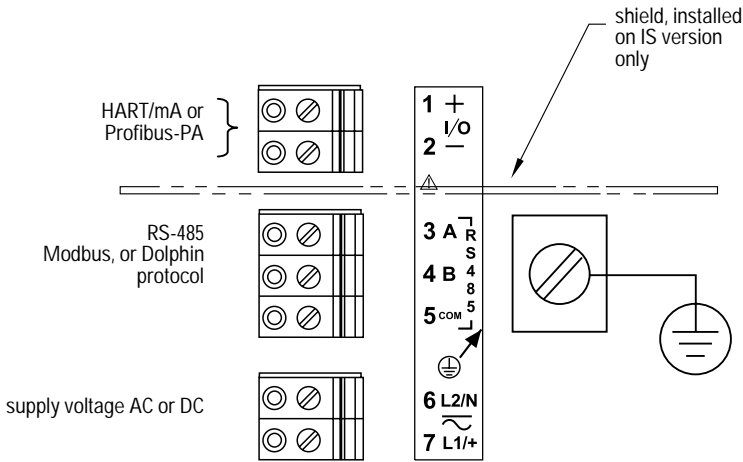
### Wiring requirements:

- Increased safety, EEx e version: solid 4  
flexible stranded 2.5
- General safety or hazardous EEx d version: rigid 0.2 to 4  
flexible stranded 0.2 to 2.5  
AWG 24 to 12

### Note:

- The recommended torque on the terminal clamping screws is 0.5 – 0.6 Nm.
- Connect the shielding of instrument cables to ground at one end only.

# IQ Radar 300 Wiring



## Notes

- Installation shall only be performed by qualified personnel and in accordance with local governing regulations.
- The equipment must be protected by a 15 A fuse or circuit breaker in the building installation.
- The 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.
- Do not use a Ground Fault Interrupt (G.F.I.) with the IQ 300. The ground path is used for filtering purposes in conjunction with the universal power supply.
- All Input/Output wiring must be shielded for CE compliance, except for supply voltage.



All field wiring must have insulation suitable for the applied input voltage.

# Communications Installation

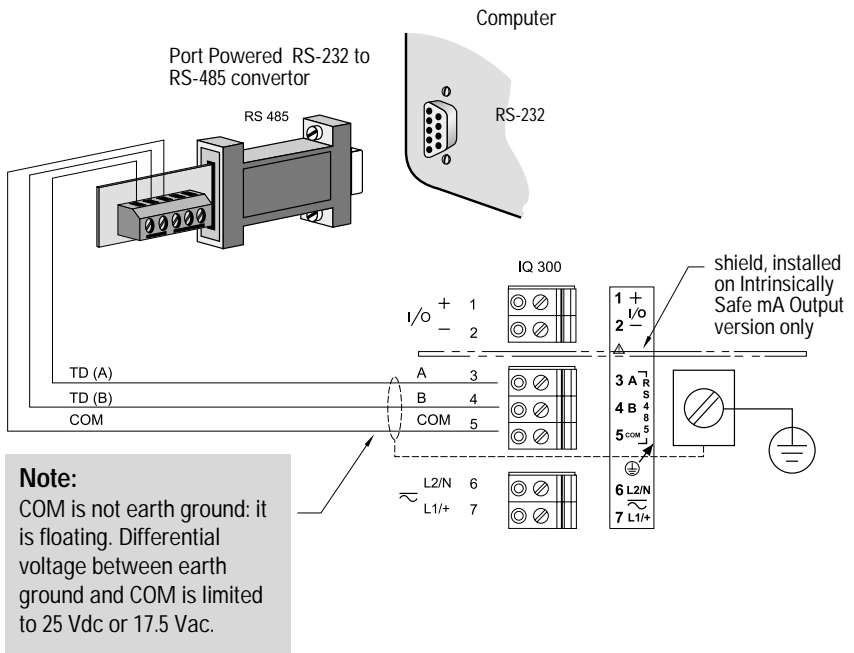
## Wiring Guidelines

- RS-485 maximum length is 1,200 meters (4,000 feet).
- Use good quality communication grade (shielded twisted pairs) cable for port 1, as recommended for RS-485.
- Connect the shielding of instrument cables to ground at one end only.
- Run the communication cable separately from the power and control cables. (Do not tie-wrap your RS-485 cable to the power cable or have them in the same conduit.)
- Follow proper grounding guidelines for all devices on the bus.

### Note:

- Improper wiring and incorrect cable choices are the two most common causes of communication problems.
- Increased safety, EEx de version: use solid 4, flexible stranded 2.5
- General safety or hazardous EEx d version: use rigid 0.2 to 4 flexible stranded 0.2 to 2.5 AWG 24 to 12

## Port 1: RS-485



## PC Connection

To connect the device to a computer requires the use of a RS-485 to RS-232 converter. Siemens Milltronics offers a converter that is powered by the RS-232 port on the computer (part number 7ML1830-1HA).

## Port Configuration

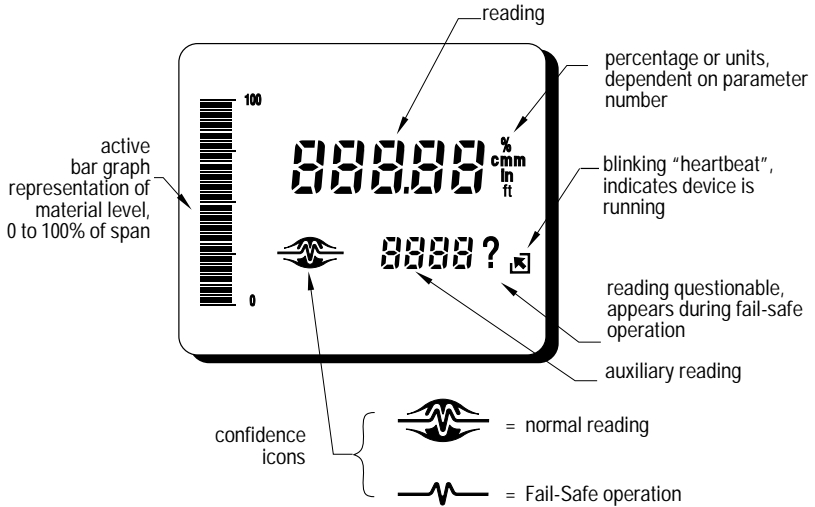
See Communication Parameters on page 65.

# Start Up

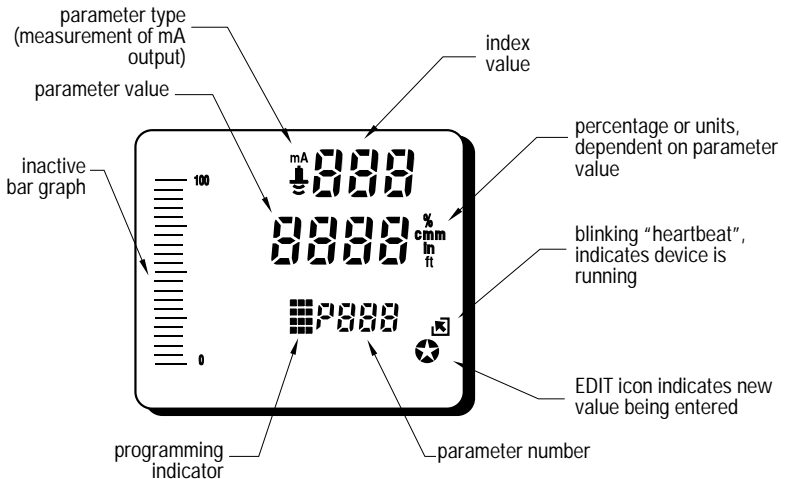
## Overview

The IQ Radar 300 has two modes of operation: **RUN** and **PROGRAM**. After powering up and installation procedures are completed, the unit starts in the **RUN** mode and detects the distance from the antenna flange to the target in meters. This is the default display measurement before any programming is initiated, or following a factory reset.

## RUN Mode Display



## PROGRAM Mode Display



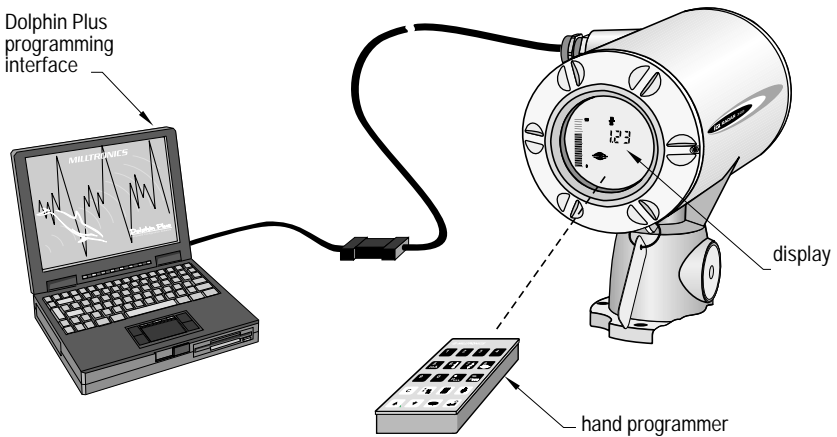
Start Up

# Programming

**PROGRAM** mode has two states: **EDIT** and **DISPLAY**. In **DISPLAY** state, the parameter number, parameter type, and parameter value are being displayed. In **EDIT** state, the **EDIT** icon is also visible, indicating that the device is accepting input into the current field.

You can activate the **PROGRAM** mode at any time and set parameters to suit the application and/or user preferences. Programming can be carried out locally using the hand programmer or remotely through one of the communication channels: Dolphin Plus, Simatic PDM, HART Master, or Profibus Master.

The instruction examples in this manual use icons from the hand programmer.



## Dolphin Plus, Simatic PDM, HART Master, or Profibus Master

Dolphin Plus is a user interface program designed to configure the IQ Radar 300 from a laptop or a desktop PC. With Dolphin Plus you can modify parameter values in real time, view process values in graphic form on screen, save profiles, and generate instrument configuration reports. To use the Dolphin protocol, ensure the serial protocol parameter P770 is set to Dolphin protocol (1).

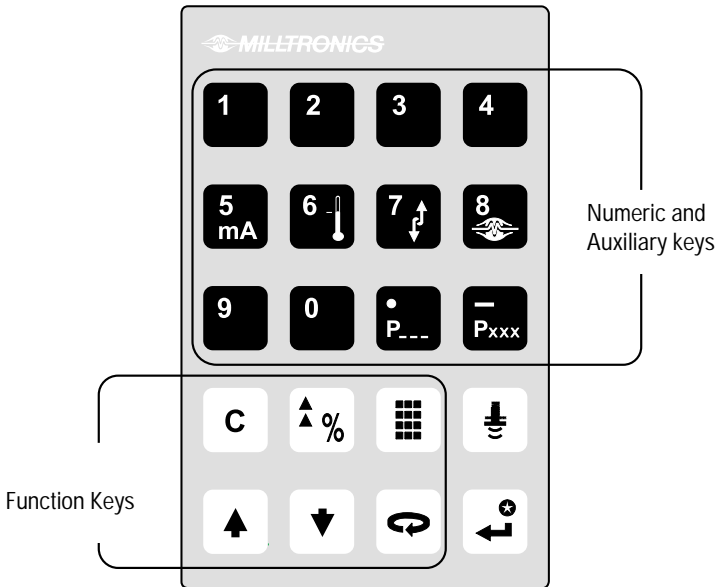
Dolphin Plus software is purchased separately. Please contact your Siemens Milltronics representative.

## Hand Programmer

The programmer is a sturdy, hand-held, programming unit offering immediate access to the configuration parameters. Point the programmer at the lower portion of the IQ Radar 300 display window (from a maximum distance of 15cm [6"]) and press the buttons in the required sequence.

# Local Programming

The hand programmer is used for local programming sequences. Please make sure you hold the programmer close to the unit (within 15cm [6"]), and point it directly at the bottom of the display to activate the programming options.




Start UP



Key	Programming Mode	Run Mode
0 to 9	Values	
5 mA		mA output value displayed in auxiliary reading field
6 (thermometer icon)		Internal enclosure temperature displayed in auxiliary reading field (P343).
P...	Decimal point	Parameter for auxiliary readings*
- Pxxx	Negative value	
C	Clear value	
up arrow %	Toggle between Units and % on parameter value	Toggle between Units and % on reading display
grid icon	End <b>PROGRAM</b> session and enable <b>RUN</b> mode	Initiate and complete <b>PROGRAM</b> mode access
ground symbol	Update echo quality parameters	Distance displayed in auxiliary reading field.
up arrow	Parameter scroll-up	
down arrow	Parameter scroll-down	
refresh icon	Toggle fields	
left arrow +	Enter the displayed value	

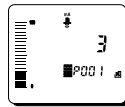
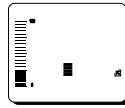
\* Pressing **P...** plus three-digit parameter number, sets parameter to show in the auxiliary display.

# Accessing PROGRAM Mode

**PROGRAM** mode has two states: **EDIT** and **DISPLAY**. In **DISPLAY** state, the parameter number, parameter type, and parameter value are being displayed. In **EDIT** state, the **EDIT** icon  indicates that the unit is accepting input into the current field. The icon remains visible until the **ENTER** key has been pressed, and the new value is accepted.

**Note:** Values shown are for demonstration purposes only.

1. The unit starts in **RUN** mode and readings correspond to existing settings.
2. Press the **PROGRAM** key  once to activate the **PROGRAM** mode. (The number fields go blank.)
3. Press the **TOGGLE** key  to display parameter fields. Initial program starts at P000.





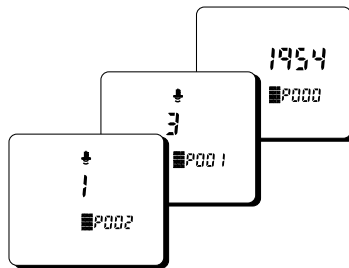
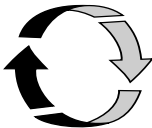
## Accessing a Parameter

The parameter settings configure the units to a specific use. Press the **PROGRAM** key followed by the **TOGGLE** key: then choose **Scroll Access** or **Direct Address** to access a parameter.

### Scroll Access



In **PROGRAM** mode, you can scroll through the parameters sequentially and in either direction until you reach the required parameter. [P000 to P999]

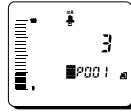
1. Press **ARROW** keys   to scroll up or down.





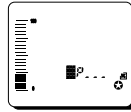
## Direct Address




In **PROGRAM** mode, you can access a parameter directly by entering its number.

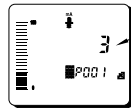
1. Press the **PROGRAM** key  followed by the **TOGGLE** key  to display the Parameter Number field.





2. Press the **TOGGLE** key  to open the Parameter Number field. The Parameter Number field goes blank and the **EDIT** icon  appears.



3. Enter the parameter number. Example:   . The new parameter number and value appear.



value

**Note:** You can enter parameter numbers below 100 without leading zeros. Enter the number followed by the **ENTER** key. Example: To access P005, press  .




## Modifying a Parameter Value

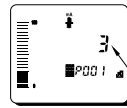
Once a parameter is accessed, you can set or modify its values.

### Note:

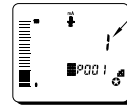
- Security must be disabled. To disable security, set P000 to 1954.
- Values shown are for demonstration purposes only.
- Invalid entries will be rejected or limited.

## Changing Parameter Values

1. Select the parameter to modify.
2. Enter the new value. Example: press . The new value and the **EDIT** icon  appear.
3. Press the **ENTER** key  to set the value. The **EDIT** icon disappears.






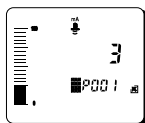
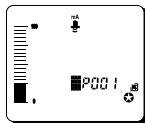
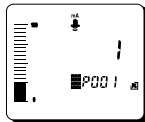
value entry field




**Note:** The **CANCEL** key  can be used to clear the field.

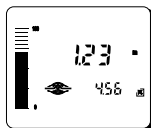
## Resetting a Parameter to Factory Setting

1. Scroll to the parameter or enter its address.
2. Press the **CANCEL** key . The value field goes blank and the **EDIT** icon  appears.
3. Press the **ENTER** key . The value returns to factory default and the **EDIT** icon disappears.



## Accessing RUN Mode

1. In **PROGRAM** mode, press the **PROGRAM** key . The screen may go blank for a moment. The IQ 300 returns to **RUN** mode.




## Quick Start Programming

The first step in programming is to configure all parameters to their factory settings by performing a master reset via Parameter 999 (see page 73).

Then set these key parameters (P001 to P007) for a Quick Start: (see page 51).

- (P001) mode of measurement
- (P002) process material
- (P003) measurement response
- (P004) antenna configuration
- (P005) units
- (P006) empty distance
- (P007) span
- (P837) Auto False Echo Suppression

Numerous other program parameters can be changed subsequently, or during another programming session. Refer to the Parameter Descriptions section that starts on page 51 for a list of available parameters.

When programming has been completed, press the **PROGRAM** key  to return to **RUN** mode.

# Operation

## Overview

The IQ Radar 300 is an advanced level-measuring device for liquids and slurries. Using advanced pulse radar technology, the device calculates material level by emitting a series of radar pulses and then analyzing their reflections.

The device consists of an enclosed electronic component mounted to a flanged antenna component. The electronic component generates a 5.8 GHz (U.S.A. 6.3 GHz) radar signal that is directed to the antenna, waveguide, or horn.

The radar signal is emitted axially from the antenna and propagates along this axis in a defined conical beam decreasing in strength at a rate proportional to the square of the change in distance.

The radar pulse detects the interface between the dielectric constant of the atmosphere and that of the material being measured. Electro-magnetic wave propagation is not sensitive to the temperature and atmospheric conditions, or to variations in the vessel.

Pulses are transmitted from the antenna at a fixed repetition rate. The reflected echoes are received and digitally converted to an echo profile. The profile is analyzed to determine the distance from the material surface to the flange face. This distance is used as a basis for the display of material level and mA output.

## Transceiver

The IQ Radar 300 transceiver operates under 1 of 5 sets of pre-set conditions (P003).

Measurement Response parameter P003	Max. fill/empty rate P700/P701		Echo verification P711	Fail-Safe timer P070
1	0.1 m/min	slow	2	100
2	1 m/min	↑	2	10
3	10 m/min	↓	2	1
4	100 m/min	↓	0	0.1
5	1000 m/min	fast	0	0

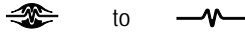
When the echoes are received, the relevant echo algorithm (P820) is applied to determine the true material echo.

The measurement response limits the maximum rate at which the display and analog output respond to changes in measurement. Select this carefully, especially where liquid surfaces are in agitation or fall into the radar path during filling. Determine the actual vessel filling and emptying rates, and set P003 to a measurement response just faster than the maximum filling or emptying rate (whichever is greater).

# Loss of Echo (LOE)

A loss of echo (LOE) occurs when the calculated measurement is judged to be unreliable because the confidence (P805) is less than the threshold (P804). Refer to Operation Troubleshooting on page 83.

If the condition persists beyond the time limit set by the Fail-Safe timer (P070), the Confidence icon changes from full to partial:



The response to LOE is set by P072 and P219. They determine whether the reading and mA output will be immediately forced to the Fail-Safe default (P071 and P219). Upon receiving a reliable echo, the loss of echo condition is aborted, the Confidence icon returns to full, and the reading and mA output return to the current level at the rate set by P072.

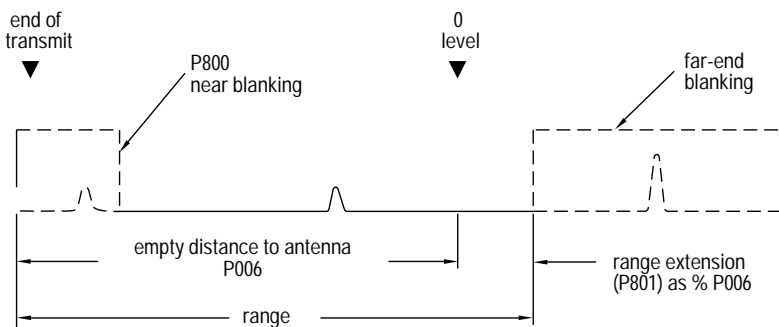
## Blanking

Near-blanking (P800) is set to ignore the zone in front of the antenna where 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. False echoes can be overcome by increasing the near-blanking value from its factory setting.

Auto False Echo Suppression (P837) is recommended in preference to extending the blanking distance from factory values.

Far-end blanking is a feature that ignores the zone below the zero or empty level, where false echoes can appear at levels that interfere with the processing of the true echo.

## Typical Receiver Signal



In applications where the zero level is above the bottom of the vessel and you need to monitor the zone below the normal zero, range extension (P801) can extend the range into far-end blanking. Range extension is entered as a percentage of P006.

# Analog Output

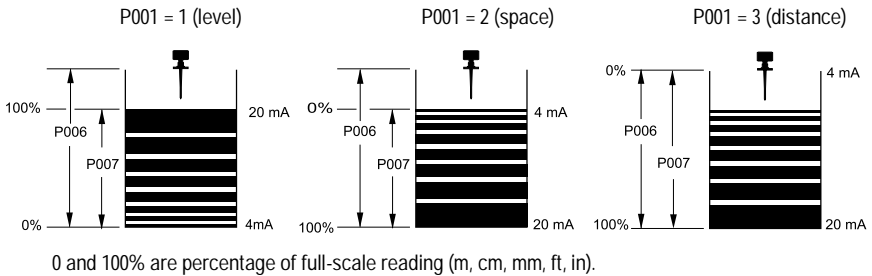
The IQ Radar 300 can be programmed to provide an analog output (P200) of 4 to 20 mA, and for proportional or inverse span.

## Programming

When the unit is put into **PROGRAM** mode, the analog output level holds its prior value unless the mA output function is the common output or HART is the communication protocol.

## Run

The analog output responds in the following manner:



## Volume

To program the unit for volume, set:

- operation (P001) to level 1 (see page 51)
- tank shape (P050) to a value other than 0 (see page 53)
- other volume parameters (P051 to P053) as required

To program the unit for ullage, set:

- operation (P001) to space 2 (see page 51)
- tank shape (P050) to a value other than 0 (see page 53)
- other volume parameters (P051 to P053) as required

## Fail-Safe

When the Fail-Safe timer (P070) expires, the mA output responds as follows:

Fail-Safe Mode (071)	Status (4 - 20)	Status (20 - 4)
1 = high	22	2
2 = low	2	22
3 = hold	hold	hold

## RUN/PROGRAM

When the IQ Radar 300 changes from **RUN** to **PROGRAM**, the unit no longer responds to the process. The last measurement is stored and the associated readings and mA signal output are held.

The unit reverts to the parameter last addressed during the previous program session.

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

If the IQ 300 is left in **PROGRAM** mode for 10 minutes without input, it automatically reverts to **RUN** mode.

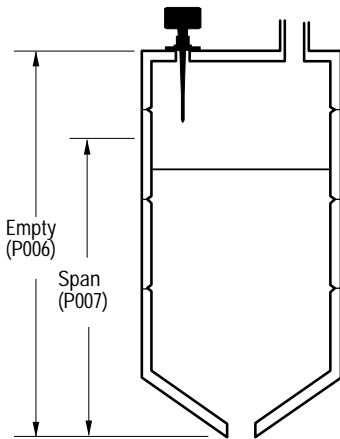
# Application Examples

These IQ Radar 300 application examples can be used as set-up references. The parameter value tables relate the values to the functions.

## Application Example: Asphalt in Storage Tank

### Note:

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




The application is to obtain a level measurement and corresponding 4-20 mA output proportional to asphalt levels in a storage tank.

The bottom of the antenna flange is 5m from the tank bottom. The empty level is 0m (bottom) and the full level (span) is 4.5m from the bottom. The maximum rate of filling or emptying is about 0.1m/min. In the event of a loss of echo, the IQ 300 is to go into Fail-Save Hi after 2 minutes.

Asphalt build-up on the rod antenna does not affect performance.

Parameter	Enter		
P999	----	master reset	
P001	1	mode of measurement	= level
P002	1	material	= liquid
P003	2	measurement response	= 1m/minute
P004	240	antenna	= factory
P005	1	units	= meters
P006	5	empty distance	= 5m
P007	4.5	span	= 4.5m
P070	2	Fail-Safe timer	= 2 minutes
P071	1	Fail-Safe	= Hi
P820	8	algorithm	= Blf (best of Largest or First)
P830	7	TVT type	= factory
P837/838 (Note above)	2 & 1	Auto False Echo Suppression	

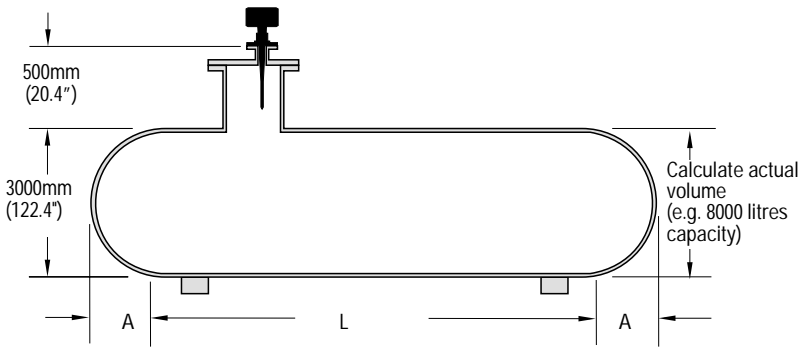
**Run:** To start normal operation, press the **PROGRAM** key .

# Application Example: Horizontal Tank with Volume


**Note:**

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

The application is to obtain a level measurement and corresponding 4-20 mA output proportional to vessel volume in a chemical tank. The bottom of the antenna flange is 3.5m from the tank bottom. The empty level is 0m (bottom) and the full level (span) is 3.0m from the bottom. The maximum rate of filling or emptying is about 0.1 m/min. In the event of a loss of echo, the IQ 300 is to go into Fail-Safe Hi after 2 minutes.



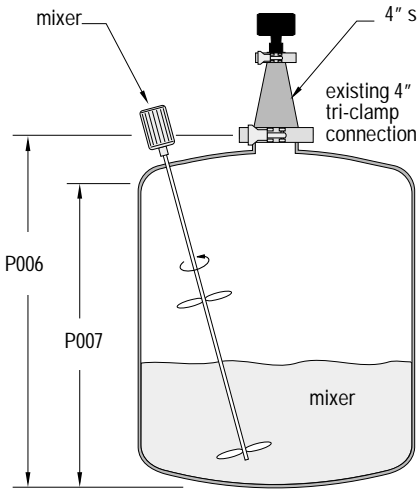
Parameter	Enter		
P999	----	master reset	
P001	1	mode of measurement	= level
P002	1	material	= liquid
P003	2	measurement response	= 1m/minute
P004	240	antenna	= factory
P005	1	units	= meters
P006	3.5	empty distance	= 3.5m
P007	3	span	= 3m
P050	7	tank shape	= parabolic ends
P051	8000	maximum volume	= litres
P052	.8	tank dimension A	= 0.8 meters
P053	6	tank dimension L	= 6 meters
P070	2	Fail-Safe timer	= 2 minutes
P071	1	Fail-Safe	= Hi
P820	12	algorithm	= First echo
P837/838 (Note above)	2 & 1	Auto False Echo Suppression	

**Run:** To start normal operation, press the **PROGRAM** key .

# Application Example: Juice Batch Tank with Sanitary Horn Antenna

**Note:**

- The minimum distance from the antenna face to the target is limited by the near-blanking, P800.
- Only set P837 if the product is at least 2m (78") away from the flange face. If it is closer, leave P837 at **1** until the level drops and the distance increases beyond 2m (78").
- Choose **First only** (P820 = **12**) if the IQ 300 is in the center. Otherwise, keep it at **8 (bLF)**.
- Sanitary Antenna Options: The one-piece antenna/process seal provides an excellent mounting method, even on non-sanitary installations.




This application is to obtain a level measurement and corresponding 4-20 mA output proportional to the juice level on a batch process tank.

The bottom of the horn is 5m from the tank bottom. The empty level is 0m (bottom) and the full level (span) is 4.5m from the bottom. The maximum rate of filling or emptying is about 0.5m/min.

In the event of a loss of echo, the IQ 300 is to go into fail-safe Hi after 2 minutes.

Parameter	Enter		
P999	----	master reset	
P001	<b>1</b>	mode of measurement	= level
P002	<b>1</b>	material	= liquid
P003	<b>2</b>	measurement response	= 1m/min.
P004	<b>240</b>	antenna	= factory
P005	<b>1</b>	units	= meters
P006	<b>5</b>	empty distance	= 5m
P007	<b>4.5</b>	span	= 4.5m
P070	<b>2</b>	Fail-Safe timer	= 2 minutes
P071	<b>1</b>	Fail-Safe	= Hi
P820	<b>12</b>	algorithm	= First echo
P830	<b>7</b>	TVT type	= factory
P837/838 (Note above)	<b>2 &amp; 1</b>	Auto False Echo Suppression	

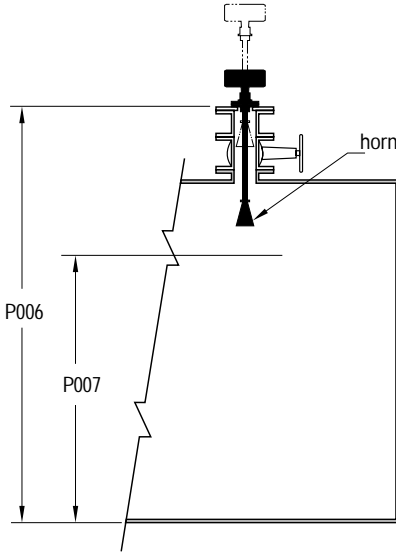
**Run:** To start normal operation, press the **PROGRAM** key .

Applications

# Application Example: Sliding Waveguide on Anaerobic Digesters

**Note:**

- Only set P837 if the product is at least 2m (78") away from the flange face. If it is closer, leave P837 at 1 until the level drops and the distance increases beyond 2m (78").
- Blanking and P800 will be set at the factory. Check the process device tag for specific values.




Maximum level should be maintained at least .46m (18") from the end of the horn.

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

This application is to obtain a level measurement and corresponding 4-20 mA output proportional to the sludge level on a digester. The bottom of the IQ 300 mounting flange is 10m from the bottom of the digester when the IQ 300 is lowered to its normal operating position.

The empty level is 0m (bottom) and the full level (span) is 8m from the bottom. The maximum rate of filling or emptying is about 0.1m/min.

Parameter	Enter		
P999	----	master reset	
P001	1	mode of measurement	= level
P002	1	material	= liquid
P003	2	measurement response	= 1m/minute
P004	240	antenna	= factory
P005	1	units	= meters
P006	10	empty distance	= 10m
P007	8	span	= 8m
P800	tag value	blanking	= factory
P820	8	algorithm	= bLF (best of Largest or First)
P830	7	TVT type	= factory
P837/838 (Note above)	2 & 1	Auto False Echo Suppression	

**Run:** To start normal operation, press the **PROGRAM** key .

# Application Example: Stillpipe

This is an alternative to the waveguide antenna option, used for products with an  $\epsilon_r$  of less than 3, or if extremely turbulent or vortex conditions exist.

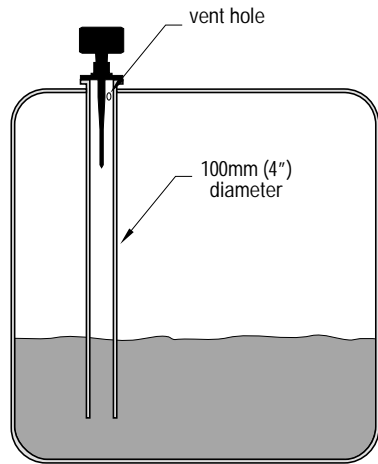
## Note:

- For  $\epsilon_r < 3$ , the lower 40cm of vessel level may not be measurable.
- Only set P837 if the product is at least 2m (78") away from the flange face. If it is closer, leave P837 at 1 until the level drops and the distance increases beyond 2m (78").

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

The bottom of the IQ 300 flange is 5m from the tank bottom. The empty level is 0m (bottom) and the full level (span) is 4.5m from the bottom. The stillpipe inside diameter is precisely 4.00 inches. The maximum rate of filling or emptying is about 0.1m/min.


In the event of a loss of echo, the IQ 300 is to go into fail-safe Hi after 2 minutes.



This mounting arrangement can also be used to provide optimum signal conditions on foaming materials.

Suitable pipe diameters are 50mm (2") to 250mm (10")\*.

Parameter	Enter		
P999	----	master reset	
P001	1	mode of measurement	= level
P002	1	material	= liquid
P003	2	measurement response	= 1m/minute
P004	240	antenna	= factory
P005	1	units	= meters
P006	5	empty distance	= 5m
P007	4.5	span	= 4.5m
P655 (see chart below)	0.955	propagation factor	= 10mm (4") pipe I.D.
P820	12	algorithm	= First echo
P830	7	TVT type	= factory
P837/838 (Note above)	2 & 1	Auto False Echo Suppression	

**Run:** To start normal operation, press the **PROGRAM** key .

\* See Chart on next page for typical P655 values.

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

\* These values are provided as a guideline.

# Parameter Descriptions

The parameters are the programmable features of the IQ Radar 300. Adjust the value settings on the parameters to configure the unit.

The parameter tables show the values you need to enter in **bold type**, followed by additional information when necessary. The pre-set values are the factory settings, which may need alteration for specific applications.

Press the **PROGRAM** key followed by the **TOGGLE** key twice to open the parameter fields.

## P000 Lock

*Secures the IQ 300 from changes.*

Value	<b>1954</b>	Lock off: programming permitted
	<b>other</b>	Lock activated: programming secured

Enter **000** to access the parameter, then enter any value other than **1954** to secure the programming lock. Press **ENTER** to set the value. The **PROGRAM** mode is now active for viewing only. To unlock, access this parameter and enter **1954**.

### Note:

- This lock only applies to LCD/ hand programmer and Dolphin.
- A remote master can change configuration if P799 is set to allow this.

**WARNING: Use this lock as backup security only. It uses a fixed value which can be discovered by unauthorized personnel.**

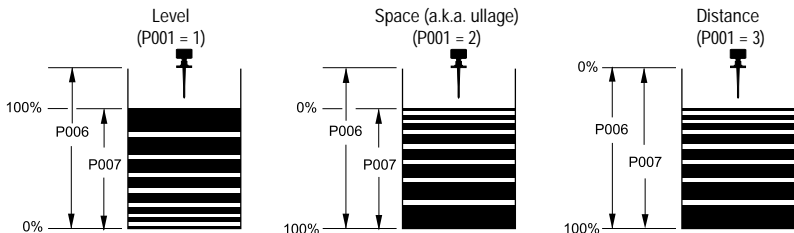
## Quick Start Parameters (P001 to P007)

*Parameters P001 to P007 are the main settings that apply to all applications and make the system operational.*

### P001 Operation (F = 3)

*Sets the display variable for the local LCD only. (The primary variable for the HART/Profibus Master is controlled by P201.)*

Values	<b>1</b>	Level: material level referenced to empty distance (P006)
	<b>2</b>	Space: space to material level referenced from span (P007)
	<b>3</b>	Distance: distance to target referenced from the flange face



**Note:** P050 sets the IQ 300 to calculate readings based on reservoir volume.

**P002**

*Identifies the material being monitored.*

<b>Values</b>	<b>1</b>	liquids or slurries
---------------	----------	---------------------

**P003 Measurement Response (F = 2)**

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

<b>Values</b>	<b>measurement response P700/P701</b>		<b>echo verification P711</b>	<b>Fail-Safe timer P070</b>
	1	0.1m/minute	slow	2
2	1m/minute	▲	2	10
3	10m/minute	↕	2	1
4	100m/minute	▼	0	0.1
5	1000m/minute	fast	0	0

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

If the IQ 300 does not keep step with the rate of level change, select a faster rate. If the reading bounces around an average value, select a slower rate. In general, slower response time is associated with greater reliability. Noisy applications or those with agitators tend to be more manageable at slower response rates, as these make use of filtering, echo verification, and longer Fail-Safe delay.

- **echo verification:** discriminates between agitator blades in motion (spurious noise) and the target surface (true echo).
- **Fail-Safe timer:** establishes the period from the time a loss of echo (LOE) starts until the Fail-Safe default (P071) is triggered. The P003 pre-set timer value can be overridden by P070.

**P004 Antenna (F = 240)**

*Identifies antenna configuration.*

<b>Values</b>	<b>240</b>	factory setting for all antenna types
	<b>241</b>	rod + 50mm PTFE (Teflon) extension
	<b>242</b>	rod + 100mm PTFE (Teflon) extension

**P005 Units (F = 1)**

*Specifies units for programming and measurement.*

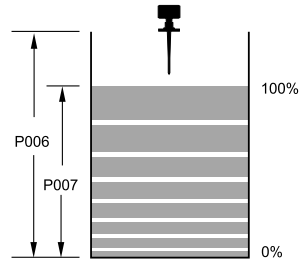
<b>Values</b>	<b>1</b>	meters
	<b>2</b>	centimeters
	<b>3</b>	millimeters
	<b>4</b>	feet
	<b>5</b>	inches

## P006 Empty (F = 10m)

*Sets the distance in units (see P005) from flange face to empty level.*

Values	-----	# units set in P005
--------	-------	---------------------

Empty level can be set at any distance desired, not just actual empty.



## P007 Span (F = 10m)

*Sets the distance from empty (P006) to full/100% level.*

Values	-----	# units set in P005
--------	-------	---------------------

Full level can be set at any measurement above the empty level.

**Note:** After these start-up parameters are configured, set Parameter P837.

## Volume Parameters (P050 to P055)

*Set the IQ 300 to calculate readings based on reservoir volume rather than level.*

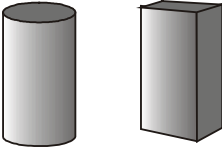
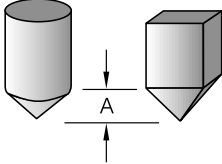
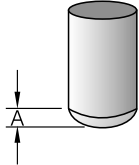
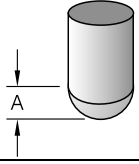
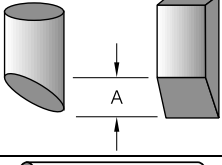

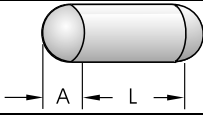
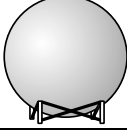
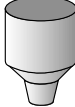
### P050 Tank Shape (F = 0)

Enter the Tank Shape value that matches the monitored vessel or reservoir. (See chart on next page.)

When Operation is **LEVEL** (P001 = 1), liquid (material) volume is calculated. When Operation is **SPACE**, remaining vessel capacity is calculated.

In the **RUN** mode, readings are displayed in volumetric units. (See Maximum Volume [P051] on page 55.) When percent is selected, the displayed volume reading is a percentage of Maximum Volume.

**Note:** Parameters P052 and P053 set tank dimensions A and L.

P050 Value	Tank Shape	Description	Additional Volume Parameters required
0	----	volume calculation not required (factory disabled)	N/A
1		flat bottom	P051
2		conical or pyramidal bottom	P051, P052
3		parabolic bottom	P051, P052
4		spherical bottom	P051, P052
5		angled bottom	P051, P052
6		flat ends	P051
7		parabolic ends	P051, P052, P053
8		sphere	P051
9		universal linear level/volume breakpoints	P051, P054, P055

## P051 Maximum Volume (F = 100 i.e. 100%)

For readings in volumetric units (rather than percent), enter the vessel volume between Empty (P006) and Span (P007).

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

The units of measurement for this reading are non-dimensional. The volume is calculated from the empty position to the maximum position and is scaled according to the Tank Shape (P050) value. This allows the use of any volume units required.

### Example

1. If maximum volume = 3650m<sup>3</sup>, enter **3650**.  
**or**
2. If maximum volume = 267500 gallons, enter **26750** (gallons x 10).
3. Enter the volume of the tank at full (Factory Setting = 100).

## P052 Tank Dimension A (F = - - - -)

Dimension A is used in the tank shape parameter (P050) on page 53.

Values	Range: 0.0000 to 99999 in units (P005)
Related Parameters	P050 Tank Shape

If P050 = 2,3,4, or 5, enter the height of the tank bottom.

If P050 = 7, enter the length **A** of one end-section of the tank. (See chart on previous page.)

**Note:** Enter the dimension in units chosen in P005.

## P053 Tank Dimension L (F = - - - -)

Dimension L is used in the tank shape parameter (P050) on page 53.

Values	Range: 0.0000 to 99999 in units (P005)
Related Parameters	P050 Tank Shape

If P050 = 7, enter the tank length L (excluding both end sections). (See chart on previous page.)

**Note:** Enter the dimension in units chosen in P005.

## P054 Breakpoint Levels (F = - - - -)

When the tank shape is too complex for any of the pre-configured shapes, you can specify the volume based on segment.

Secondary Index	Breakpoint
Values	Range: 0.0000 to 99999 in units
Related Parameters	P055 Volume Breakpoints (Universal Volume Calculation)

Enter up to 32 level breakpoints (where volume is known) if P050 = 9.

### Entering a Level Breakpoint

1. Open parameter P054.
2. Enter a breakpoint in measurement units.
3. Match each breakpoint to the same index value for P055.

## P055 Volume Breakpoints (Universal Volume Calculation)

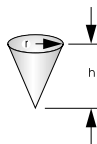
(F = - - - -)

Each segment defined by the level breakpoints (P055) requires a volume to allow the IQ 300 to make the level-to-volume calculations.

Secondary Index	Breakpoint
Values	Range: 0.0000 to 99999 in units
	Pre-set: 0.0000
Related Parameters	P054 Volume Breakpoints (Universal Volume Calculation)

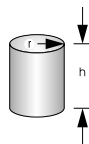
### Typical volume calculations:

#### Cone



$$V = (1/3)\pi r^2 h$$

#### Cylinder



$$V = \pi r^2 h$$

### Entering a Volume Breakpoint

1. Open parameter P055.
2. For each index enter a volume.
3. Match each volume to the same index value for P054.

# Display and Reading Parameters (P060 to P063)

## P060 Decimal Position (F = 2)

*Defines the maximum number of decimal places used on the LCD.*

Values (Level measurement only)	0	no digits after the decimal point
	1	1 digit after the decimal point
	2	2 digits after the decimal point
	3	3 digits after the decimal point

In **RUN** mode, the decimal position is adjusted to prevent the number of digits from exceeding the display capabilities. To keep the decimal place from shifting, reduce the number of decimal places to that shown at 100%.

For example, if 100% = 15m, use two decimal places for readings of 15.00 or parts thereof (e.g. 12.25).

## P062 Offset Reading (F = 0.0000)

*Adds the specified value to the level reading, usually to reference the reading to sea level or to another datum level.*

Values (Level measurement only)	Range: -999 to 99999
	Pre-set: 0.0000

The operation of the device is not affected by the Offset Reading. This value is used for display only. All control measurements are still referenced to empty.

## P063 Minimum Reading (F = 0.0000)

*Adjusts the minimum reading the product will show. This is useful on conical or parabolic tanks to prevent negative values on the display.*

Values (Level measurement only)	Range: -999 to 99999
	Pre-set: 0.0000

P063 is only applied after P062 Offset Reading and then only if reading displays level/volume (P001=1).

The milliAmp output is not affected.

## Fail-Safe Parameters (P070 to P072)

### P070 Fail-Safe Timer

*Sets the time delay, in minutes, before going into Fail-Safe mode.*

Values	Range: <b>0.0000 to 99999</b>
	Pre-set: Refer to Table for P003 on page 52.

### P071 Fail-Safe Material Level (F = 3)

*Selects the default measurement in the event that the Fail-Safe timer expires. (See also P219.)*

Values	1	High: maximum span value
	2	Low: minimum span value
	3	Hold: hold current value

### P072 Fail-Safe Level Advance (F = 1)

*Sets the speed at which the IQ 300 advances and returns to the Fail-Safe Material Level.*

Values	1	Restricted (pre-set): unit advances to/from the Fail-Safe Material level as set by P003, P700, or P701.
	2	Immediate: Fail-Safe Material Level is assumed at once.
	3	Fast Back: Fail-Safe Level Advance is restricted. Returns to new measured material level at once.
Related parameter	P219 mA Output Fail-Safe	

## mA Output Parameters (P201 to P219)

### P201 mA Output Function (F = 1)

*Alters the mA output/measurement relationship. Set independently from P001. This determines the primary variable for HART/Profibus PA, and should not be changed if using HART.*

Values	0	manual
	1	level
	2	space
	3	distance
	4	volume
	9	controlled by HART or Modbus

Selection can be done locally, or from the Master, using the Primary Variable exchange.

**Note:**

- Ensure the master is off-line with the device when changing this value locally. Changes will affect the mA Output directly, and can cause serious problems if under automatic control.
- Selection also affects the secondary, tertiary, and quaternary variables.
- 0 (manual) setting is required to utilize P911. Remember to change back to previous setting after P911 usage.

## Independent mA Setpoint Parameters (P210 and P211)

*Use these features as a reference for calculating the minimum and/or maximum mA output to any point in the measurement range.*

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

**Note: Ensure the % symbol is displayed before entering a % value.**

P201 (mA Function) Settings	Response
level, space, or distance	Enter the material level in Units (P005) or percent of Span (P007) as referenced to Empty (P006).
volume	Enter the volume in Maximum Volume (P051) units, or as a percent of Maximum Volume.

### P210 mA Setpoint Parameter

*Used to set the process level that corresponds to the 4 mA value. 4 mA always defaults to 0, and P201 determines whether this is a level, space, or distance measurement.*

### P211 mA Setpoint Parameter

*Used to set the process level that corresponds to the 20 mA value. 20 mA always defaults to 100%, and P201 determines whether this is a level, space, or distance measurement.*

### P212 mA Output Minimum Limit

*Values 2 to 22.00*

### P213 mA Output Maximum Limit

*Values 2 to 22.00*

## P214 4 mA Output Trim

Used to calibrate the mA output for 4 mA. The device mA output is pre-calibrated; however, this parameter can be used to trim remote displays or inputs.

Values	Range: <b>0 to 22.00. Display P911</b>
Related Parameters	P215 20 mA Output Trim

Steps:

1. Set P201 to **0** (manual).
2. Set P911 to **4 mA**.
3. Record remote reading in mA.
4. Enter this value in P214.
5. Set P201 to previous setting.

## P215 20 mA Output Trim

Used to calibrate the output for 20 mA. The device mA output is pre-calibrated; however, this parameter can be used to trim remote displays or inputs.

Values	Range: <b>0 to 22.00. Display P911.</b>
Related Parameters	P214 4 mA Output Trim

Steps:

1. Set P201 to **0** (manual).
2. Set P911 to **20 mA**.
3. Record remote reading in mA. Attach calibrated meter.
4. Enter this value in P215.
5. Set P201 to previous setting.

## P219 mA Output Fail-Safe

Used to set the mA Fail-Safe operation, independent of the Fail-Safe Material Level (P071).

Values	<b>0</b>	Off (pre-set)	mA output responds to Fail-Safe Material Level
	<b>1</b>	HI	produces P213 (mA Output Maximum Limit)
	<b>2</b>	LO	produces P212 (mA Output Minimum Limit)
	<b>3</b>	HOLD	last known value is held until normal operation resumes

## Installation Records Parameters (P340 to P346)

### P340 Manufacture and Calibration Dates

Displays the year and month (yy-mm) for the following indexes:

Index	Data
01	manufacture date
02	calibration date
03	user date 1

**Note:** User date can only be set remotely by a HART/Profibus master.

### P341 Run Time

Shows the accumulated number of days the IQ Radar 300 has been operating.

Values (view only)	Display: 0.0 to 99999 (days)
--------------------	------------------------------

### P342 Power-On Resets

A counter that increments every time power is applied to the unit following an interruption.

### P343 Internal Temperature

See Appendix III (Ambient/Operating Temperature Specification) on page 89 for more details.

3 Values	Index	Temperature
	1	Current Internal Enclosure Temperature
	2	Maximum Recorded Internal Enclosure Temperature
	3	Minimum Internal Enclosure Temperature

**Warning:** Internal temperature must not exceed 81° C! Warranty may be void.

**Note:** Internal Enclosure Temperature will always be higher than ambient.

### P346 Serial Number

Displays the serial number of the unit.

## Range Calibration Parameters (P652 and P655)

### P652 Offset Correction (F = 0)

Shows the offset value applied to the reading as a correction to the measurement.

Values	Range: -999 to 99999
	Pre-set: 0

## P655 Propagation Factor (F = 1)

Compensates for the change in the microwave velocity as compared with propagation in free space, when propagation is within a stillpipe (metal).

Values	Range: <b>0.0000 to 1.0000</b>
	Pre-set: 1

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

Consult Technical Assistance at the factory for other sizes and propagation factor numbers.

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

The propagation factor is constant for a given pipe diameter, or can be determined by comparing the radar distance reading to the actual process material distance (measured from the face of the IQ 300 flange).

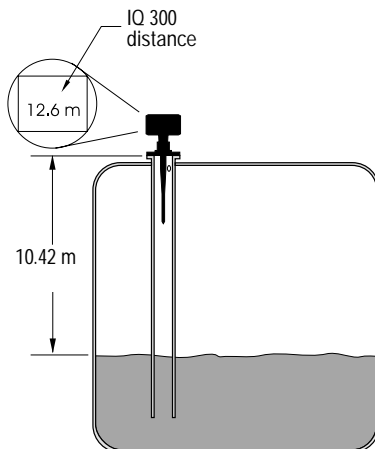
Example:

$$\frac{\text{actual distance}}{\text{IQ 300 distance}} = \text{p.f. (propagation factor)}$$

Using the readings shown:

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

Enter the propagation factor: **0.827**



## Rate Parameters (P700 and P701)

These parameters determine how material level changes are reported.

### P700 Maximum Fill Rate

Adjusts the IQ 300 response to increases in the actual material level (or an advance to a higher Fail-Safe Material Level, P071).

Values	Range: <b>0.0000 to 99999</b> (stored in meters)
Altered by	P003 Measurement Response
Related Parameters	P005 Units
	P007 Span
	P071 Fail-Safe Material Level

Enter a value slightly greater than the maximum vessel-filling rate. This value, in Units (P005) or % of Span (P007) per minute, is automatically altered when Maximum Process Speed (P003) is altered.

P003 Value	Meters/Minute
1	0.1
2	1
3	10
4	100
5	1000

## P701 Maximum Empty Rate

*Adjusts the IQ 300 response to decreases in the actual material level (or an advance to a lower Fail-Safe Material Level, P071).*

<b>Values</b>	Range: <b>0.0000 to 99999</b> (stored in meters)
<b>Altered by</b>	P003 Measurement Response
<b>Related Parameters</b>	P005 Units P007 Span P071 Fail-Safe Material Level

Enter a value slightly greater than the vessel's maximum emptying rate. This value, in Units (P005) or % of Span (P007) per minute, is automatically altered when Measurement Response Speed (P003) is altered.

P003 Value	Meters/Minute
1	0.1
2	1
3	10
4	100
5	1000

## Measurement Verification Parameters (P709 to P713)

### P709 Damping Filter

*Stabilizes the reported level due to level fluctuations (such as a rippling or splashing liquid surface) within the Echo Lock Window (P713). The value is in seconds, and depends on the number of seconds it takes the device to reach 66% of a step value change in reading.*

<b>Values</b>	Range: <b>0 to 100</b> (0= off)
<b>Altered by</b>	P003 Measurement Response
<b>Related Parameters</b>	P007 Span P713 Echo Lock Window

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

## P711 Echo Lock (F = 2)

*Selects the measurement verification process.*

Values	0	off
	1	maximum verification
	2	material agitator
	3	total lock
(P711) Related Parameters	P700 Maximum Fill Rate P701 Maximum Empty Rate P712 Echo Lock Sampling P713 Echo Lock Window P820 Algorithm	

If a material agitator (mixer) is used in the vessel monitored, set Echo Lock to **1** (maximum verification) or **2** (material agitator) to avoid agitator blade detection. To avoid stationary blade detection, ensure the agitator is always running while the IQ 300 is monitoring the vessel.

When set for **1** (maximum verification) or **2** (material agitator), a new measurement outside of the Echo Lock Window (P713) must meet the sampling criterion (P712).

For **3** (total lock), Echo Lock Window (P713) is pre-set to **0** (zero). The IQ 300 continuously searches for the best echo according to the algorithm chosen (P820). If the selected echo is within the window, the window is then centered about the echo. If not, the window widens with each successive shot until the selected echo is within the window. The window then returns to its normal width.

When Echo Lock is **0** (off), the IQ 300 responds immediately to a new measurement, within the constraints set by the Max Fill/Empty Rate (P700/P701). However, measurement reliability is affected.

## P712 Echo Lock Sampling

*Sets the number of consecutive echoes appearing above or below the echo currently locked onto. Sampling ratio must occur before the measurements are validated as the new reading (for Echo Lock P711 values: 1 or 2).*

Values	Range: <b>1:1 to 99:99</b>
	Format: xx:yy <ul style="list-style-type: none"> <li>• xx = the number of <b>above</b> echoes</li> <li>• yy = the number of <b>below</b> echoes</li> </ul>
Related Parameter	P711 Echo Lock

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

**Example Settings:**

- P711 = 2: material agitator
- P712 = 5:2

**Example Results:**

- A new reading will not be validated unless 5 consecutive measurements higher or 2 consecutive measurements lower than the current reading occur.

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

## P713 Echo Lock Window (F = 0.0000)

*Adjusts the new measurement changes permitted before the Echo Lock is applied.*

<b>Values</b>	Range: <b>0.0000 to 99999</b>
	Pre-set: 0.0000
<b>Altered by</b>	P003 Maximum Process Speed
<b>Related Parameters</b>	P005 Units P711 Echo Lock

The Echo Lock Window is a “distance window” (Units, P005) centered on the echo and used to derive the reading. When a new measurement is in the window, the window is re-centered and the new reading calculated. Otherwise, the new measurement is verified by Echo Lock (P711) before the reading is updated.

When **0** is entered, the window is automatically calculated after each measurement. For slower Measurement Response (P003) values, the window is narrow; for faster P003 values, the window is wider.

## Serial Communication Parameters (P770 to P799)

*These parameters control the RS-485 port. If you are using the Modbus protocol, use P799 to set the IQ 300 to read-only or read-write. The Modbus Register Map is on page 74.*

### P770 Serial Protocol (F = 1)

*Sets the communications protocol used on the RS-485 port.*

<b>Values</b>	<b>0</b>	Communications disabled
	<b>1</b>	Dolphin Protocol
	<b>2</b>	Modbus ASCII slave serial protocol
	<b>3</b>	Modbus RTU slave serial protocol

## P771 Protocol Address (F = 1)

*Allocates the unique identifier of the IQ 300 on the network for the RS-485 port.*

Values	Range: <b>0 to 99999</b>
	Pre-set: 1

For devices connected with a serial Modbus slave protocol, this parameter is a number from 1-247. The network administrator must ensure that all devices on the network have unique addresses. Do not use the value **0** (zero) for Modbus communications because this is the broadcast address and is inappropriate for a slave device.

## P772 Baud Rate (F = 9.6)

*Sets the communication rate with the master device.*

Values	<b>4.8</b>	4800 baud
	<b>9.6</b>	9600 baud
	<b>19.2</b>	19,200 baud
	<b>38.4</b>	38,400 baud

This specifies the rate of communication in Kbaud. Any value may be entered, but only the values shown are supported. The baud rate should reflect the speed of the connected hardware and protocol used. For updating software, you must use 9600 baud.

## P773 Parity (F = 0)

*Sets the serial port parity for the RS-485 port.*

Values	<b>0</b>	No Parity (default)
	<b>1</b>	Odd Parity
	<b>2</b>	Even Parity

## P774 Data Bits (F = 8)

*Sets the number of data bits.*

Values	<b>8</b>	8 data bits (Modbus ASCII or RTU)
	<b>7</b>	7 data bits (Modbus ASCII only)

### Note:

- If 7 data bits are chosen for Modbus ASCII, then parity must be set to either **1** (odd) or **2** (even), and not to **0** (no parity).

## Stop Bits

*There is always 1 stop bit.*

### Note:

- Ensure that the communications parameters are identical between the IQ 300 and all connected devices.

## P799 Communications Control (F = 1)

This parameter determines the read/write access to parameters via remote communications. If it has a value of **0**, then the master can only read parameters. If it has a value of **1**, then the master can read and write parameters. If it has a value of **2**, then the master can read/write P799, but can only read other parameters.

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

### Note:

- Even if P000 is locked, a communications master can write to any parameter if P799=1, or can write to P799 if P799=2.
- P000 controls the lock access if you are using the Milltronics keypad hand programmer and Dolphin, but it has no effect on Modbus.
- P799 controls the access if you are using a Modbus, HART, or Profibus master.

## Echo Processing Parameters (P800 to P807)

### P800 Near Blanking (F = 0.4m)

*Sets the amount of blanking as measured from the flange face and extending into the measurement range. See Blanking on page 42.*

Values	Range: <b>0 to 99999</b>
	Pre-set: 0.4m
Related parameter	P837 Auto False Echo Suppression

Enter the value in units as set in P005.

**Note:** This parameter may be set at the factory. If so, the appropriate value appears on the product tag.

### P801 Range Extension (F = 5%)

*Sets the amount of range extension as measured from the empty distance (P006) and extending into the far-end blanking. See Blanking on page 42.*

Values	Range: <b>0 to 99%</b>
	Pre-set: 5%

Enter the value as a percentage of P006. The distance below empty is not blanked.

For tanks with conical or parabolic bottoms, increase this parameter to ensure that an empty tank reads empty.


### P804 Confidence Threshold (F = 5)

*Sets the minimum echo confidence that the echo must meet in order to prevent a loss of echo condition and the expiration of the fail-safe timer (P070).*

Values	Range: <b>0 to 99</b>
	Pre-set: 5
Related Parameters	P070 Fail-Safe Timer

## P805 Echo Confidence

*Measures echo reliability.*

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

Values (view only)	Display: <b>0 to 99</b>
Related Parameters	P804 Confidence Threshold

## P806 Echo Strength


*Displays the strength of the selected echo, in dB above 1  $\mu$ V rms.*

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

Values (view only)	Display: <b>-20 to 99</b>
--------------------	---------------------------

## P807 Noise

*Displays the average and peak ambient noise (in dB above 1  $\mu$ V RMS) being processed.*

Press the measurement key  get a noise reading. The noise level is a combination of transient noise and electrical noise (receiving circuitry).

Values (view only)	x = average (-20 to 99)
	y = peak (-20 to 99)

## Algorithm Parameter (P820)

### P820 Algorithm (F = 8)

*Selects the algorithm to be applied to the echo profile in order to extract the true echo.*

Values	3	L = Largest only
	8	bLF = best of Largest or First
	12	F = First only

Select **8 (bLF)** for most applications and all mounting locations except the center of the vessel. Select **12 (F)** for the center of the vessel mounting location and for still pipes and waveguide antennas used as stillpipes. Select **3 (L)** only when the vessel level will remain at low levels.

## TVT (Time Varying Threshold) Adjustment Parameters (P830 to P841)

The following parameters are for authorized Siemens Milltronics Service personnel or technicians familiar with Milltronics echo processing techniques. Dolphin Plus should be used to view the echo profile before attempting to modify these parameters.

### P830 TVT Type

Value	7	Smooth TVT
-------	---	------------

### P831 TVT Shaper

Turns the TVT Shaper **ON** or **OFF**.

Values	0	off
	1	on
Related Parameters	P832 TVT Shaper Adjust	

Turn the TVT Shaper **ON** before using P832, and afterwards turn the TVT Shaper **ON** and **OFF** while monitoring the effect to pick up the true echo.

### P832 TVT Shaper Adjust





Allows manual adjustment of the TVT curve.

Values	Range: -50 to 50	
	Pre-set: 0	
Related Parameters	P831 TVT Shaper	

Use this feature to bias the shape of the TVT curve to avoid crossing false echoes from fixed objects.

Adjust this parameter while viewing the echo profile with Dolphin Plus. Refer to the Dolphin Plus online help for details. The TVT curve is divided into 40 breakpoints, which you can access via the index field. Each breakpoint is normalized to a value of 0, as displayed in the parameter value field. By changing the breakpoint value up or down, the intensity of the bias applied to that breakpoint of the curve is changed accordingly. By changing the value of adjacent breakpoints, the effective bias to the shaper can be broadened to suit the desired correction. If you are experiencing more than one false echo, you can apply additional shaping can along different points of the curve. Apply shaping sparingly in order to avoid missing the true echo.

#### To change a breakpoint:

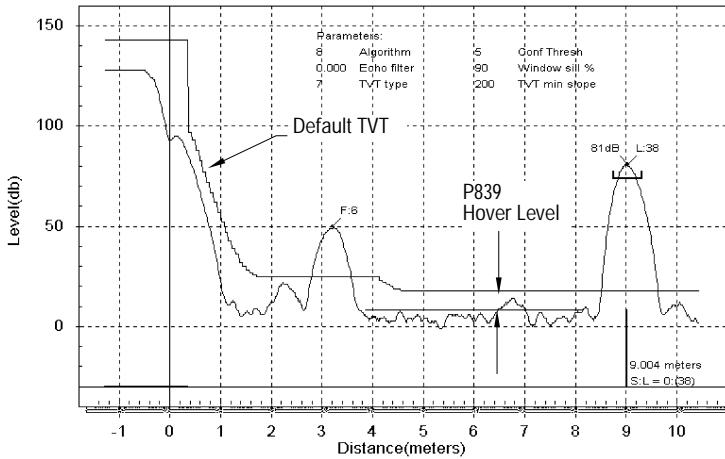
1. Confirm that P831, TVT shaper, is **ON**.
2. Go to P832.
3. Press  twice to highlight the secondary index value.
4. Press  or  to scroll through the 40 points (or type in the desired point).
5. Enter the value from -50 to 50.
6. Press .

## P837 Auto False Echo Suppression (F = 1)\*

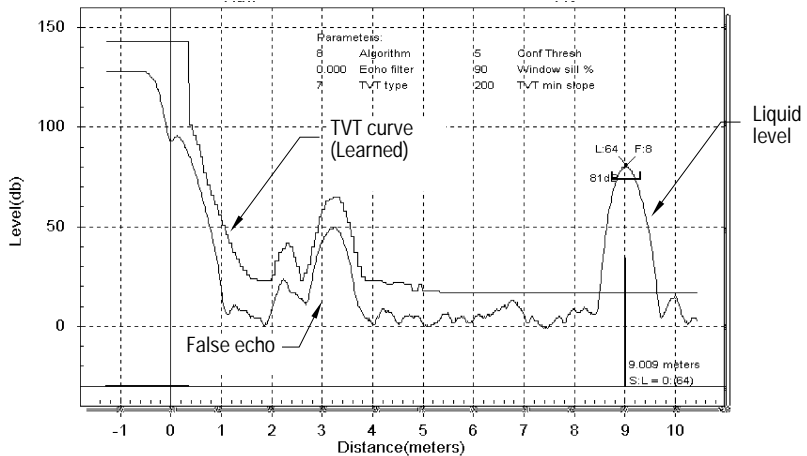
Use P837 and P838 during start up, if possible. It works ideally if the tank is empty or at low levels. Only use this function if there is a minimum 2m distance from the radar unit to the material. The agitator should be running, if the vessel contains an agitator.

Use this feature to adjust the TVT Curve height to ignore false echoes on the Echo Profile by placing the TVT above the current signal. Use P838 to set the Auto TVT length.

### Dolphin Plus Display before Auto False Echo Suppression (or when P837 = 0)



### Example After Auto False Echo Suppression



If the IQ 300 displays a full level, or if the reading fluctuates between a high level and a correct level, set this parameter to elevate the TVT in this region and to de-sensitize the receiver from any 'base noise' caused by internal antenna reflections and/or standpipe echoes.

\* P837 will be preset to 1 by the factory. This is done to accommodate internal antenna reflections.





**Entry:**

0 = Off (not used).

1 = Use Learned TVT. (See Learned TVT Curve, Example: After Auto False Echo Suppression Chart, page 70.)

2 = Learn.

**Set Up:**

1. Perform this function at low tank levels.
2. Determine *distance* from radar unit to liquid level.
3. Press the **PROGRAM** key , then the **TOGGLE** key .
4. Select P838 and set [distance to liquid level – 0.5m].
5. Select P837.
6. Press **2** and then press the **ENTER** key . P 837 will revert to **1** (use Learned TVT) automatically after a few seconds.
7. Press the **PROGRAM** key  to return to **RUN** mode.

**P838 Auto False Echo Suppression Distance (F = 1.0m)**

*Defines the endpoint of the Learned TVT distance. Set this parameter with P837, as above.*

**P839 TVT Hover Level (F = 40)**

*Defines (in %) how high the TVT is placed above the profile, with respect to the largest echo. When the IQ Radar 300 is located in the center of the vessel, this parameter may be reduced to prevent multiple echo detections.*

**P841 Number of Shots (F = 5)**

*Defines the number of profiles used for averaging before the processing and output are determined. Increasing this value provides slower response times*


**Test Parameters (P900 to P999)****P900 Software Revision**

*Displays the software revision level.*

Values (view only)	<b>Index</b>	
	<b>1</b>	Software
	<b>2</b>	Boot revision
	<b>3</b>	Downloader revision
	<b>4</b>	Hardware release

**P901 Memory**

*Tests the memory.*

Test is initiated by scrolling to the parameter or repeated by pressing the **ENTER** key .

Values (view only)	<b>PASS</b>	normal
	<b>1</b>	consult Siemens Milltronics

## P911 mA Output Value

*Displays the current value of the mA output in MilliAmps.*

Values	Range: 4.00 to 20.00
--------	----------------------

When P201 is set to 0 (manual), a test value can be entered and the displayed value transmitted to the output. Be sure to switch P201 back to the desired function after the test!

## P920 Reading Measurement

*Displays the reading measurement that the unit is programmed for in **RUN** mode (P001, operation).*

Values (view only)	units showing Level/Space/Distance
--------------------	------------------------------------

## P921 Material Measurement

*Displays the reading measurement as though the unit were programmed to read Level (P001 = 1).*

## P922 Space Measurement

*Displays the reading measurement as though the unit were programmed to read Space (P001 = 2).*

## P923 Distance Measurement

*Displays the reading measurement as though the unit were programmed to read Distance (P001 = 3).*


## P924 Volume Measurement

*The calculated vessel capacity in Maximum Volume (P051) or % of Maximum Volume.*


Values	Range: 0.0000 to 99999
Related Parameters	P051 Maximum Volume

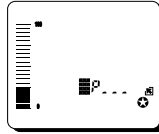
## P999 Master Reset

*Resets parameters to their factory setting.*

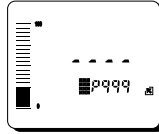
1. Press the **PROGRAM** key  to activate the **PROGRAM** mode.





2. Press the **TOGGLE** key  twice to access parameter fields.



3. Enter **999**.



4. Press the **CANCEL** key  followed by the **ENTER** key  to Clear All and initiate reset.



5. Reset complete.  
**Note:** Reset takes several seconds to complete.



**Note:** Ensure that any parameter values on the process device tag are re-entered following a master reset.

# Communications: Modbus Register Map

The memory map of the IQ-300 occupies the Modbus holding registers (R40,001 and up). This map is used when the protocol is Modbus RTU slave or Modbus ASCII slave.

## Register Map for Most Common Data

Legend	
Type	The type of data held in the group of registers.
Start	The first register to hold the referenced data.
Data Type	The possible values of the data in the register. See Data Types on page 78 for more information.
Description	The type of data held in the individual registers.
#R	The number of registers used for the referenced data.
Read/Write	Indicates whether the register is readable, writeable, or both.

The IQ Radar 300 was designed to make it easy for master devices to get useful information via Modbus. The chart below gives an overview of the different sections. A more detailed explanation of each section follows.

Type	Description	Start	#R <sup>a</sup>	Data Type	Read/Write
ID	Milltronics Product Code	40,064	1	3	R
Point Data	Reading (1)	41,010	1	-20,000 to 20,000	R
	Volume (1)	41,020	1	-20,000 to 20,000	R
I/O Data	mA Output	41,110	1	400 to 2,000	R/W
Parameter Values	Parameter Access	43,997 to 44,999		Depends on Parameter	R/W

## Product ID (R40,064)

This value identifies the Milltronics device type. For the IQ Radar 300, the value is 3.

## Point Data (R41,010 – R41,031)

Measurement point data contain the current instrument readings. These are the values shown for the reading measurement: level, distance, or volume, according to the setting for P001 (see page 51 for details); and volume for the volume measurement.

<sup>a</sup> Maximum registers shown, fewer may be used depending on options installed.

The available registers are:

Data	Registers	Parameter
Reading	41,010	P920
Volume	41,020	P924

The reading is expressed as a percentage of full scale, multiplied by 100:

Reading	Value
0	0.00%
5000	50.00%
7564	75.64%
20,000	200.00%

## Input/Output

The IQ 300 has one mA output.

### mA Output (R41,110)

The mA output is scaled from 400 to 2,000 (4 to 20 mA multiplied by 100). Displayed in P911.

## Parameter Access (R43,997 – R46,999)

Parameter values are given as integers in the range of registers from R44,000 to R44,999. The last three numbers of the register correspond to the parameter number.

Parameter Register #	Parameter #
44,000	P000
44,001	P001
44,002	P002
...	...
44,999	P999

The parameters are usually all read/write. However, before a parameter can be read or written to, the format (where decimal place is) and the indexes must be defined.

#### Note:

- Parameter P999 is read only.
- Parameter P999 (Master Reset) cannot be used via Modbus.
- See Data Types on page 78 for a description of the different types of data associated with different parameters.

# Format Word (R43,997)

Format Word is an unsigned integer that contains a value that represents a certain decimal offset.

The decimal offset indicates how the remote system must interpret the integer value that is stored in the parameter access register. The following table shows how different parameter values can be shown based on a register value (integer) of 1234.

Decimal	Offset	Example
0	0	1,234
1	-1	12,340
2	-2	123,400
3	-3	1,234,000
4	-4	12,340,000
5	-5	123,400,000
6	+1	123.4
7	+2	12.34
8	+3	1.234
9	Percent	12.34%

Examples of using the Format Word for both the index values and the decimal offset value are shown below:

Format	Decimal
0	0
3	3 right
8	3 left
9	percent

## Primary Index (R43,999) and Secondary Index (R43,998)

Many parameters are indexed. There are two possible indexes, a primary index and a secondary index. A secondary index is a sub-address of the primary index.

If there is not an index, enter a value of 1.

## Reading Parameters

1. Write the primary index value into R43,999.

This is a value between 1 and 40 that specifies the primary index on the parameter. This value is normally 1.

2. Write the secondary index value into R43,998.

This is a value between 1 and 40 that specifies the secondary index on the parameter. This value is normally 1.

3. Write the desired format value into R43,997.
4. Read the value from the appropriate parameter register.

### Types of values are:

- Numeric Values on page 78.
- Split Values on page 78.
- Text Messages on page 79.

A value of 22,222 indicates that an error has occurred. Specify a different format type and try again.

## Writing Parameters

The method of writing parameters is similar to the method of reading them. Become familiar with Reading Parameters, (above), before attempting to write any parameters.

Writing parameter values to the IQ 300:

1. Write the primary index value into R43,999.
2. Write the secondary index value into R43,998.
3. Write the desired format value into R43,997.
4. Write the value to the appropriate parameter register.

# Communications: Data Types

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The IQ Radar 300 parameters do not always use integers to hold values. For the convenience of the programmer, those values are converted to and from a 16-bit integer number. This section describes the conversion process.

## Numeric Values

Numeric parameter values are the most common. For example, parameter P920 (Reading) returns a number that represents the current reading (either level or volume, depending on the IQ-300 configuration).

Numeric values are requested or set in units or percent of span, and may be specified using a number of decimal places.

Numeric values must be in the range -20,000 to +20,000 to be valid. If a parameter is requested and its value is more than +20,000, the number 32,767 is returned; if it is less than -20,000, the number -32,768 is returned. If this overflow happens, decrease the number of decimal places.

If a parameter cannot be expressed in terms of percent of span, or has no meaningful value, the number 22,222 is returned. Try requesting the parameter in units, or refer to the Parameter Description section on page 51 for an explanation of the format and use of the requested parameter.

## Split Values

Certain parameters are actually a pair of numbers separated by a colon, using this format: **xx:yy**.

**One example is P712 (Echo Lock Sampling) where:**

xx = the number of above echoes  
yy = the number of below echoes

The number which corresponds to xx:yy, for either reading or setting a parameter, is determined by the following formula:

For storing to the device:

$$\text{value} = (\text{xx} + 128) \times 256 + (\text{yy} + 128)$$

For reading from the device:

$$\text{xx} = (\text{value} / 256) - 128$$

$$\text{yy} = (\text{value} \% 256) - 128$$

where % is the modulus operator.

The modulus can be computed by following these steps:

$$\text{value}_1 = \text{value} / 256$$

$$\text{value}_2 = \text{remainder of value}_1$$

$$\text{value}_3 = \text{value}_2 \times 256$$

$$\text{yy} = \text{value}_3 - 128$$

It may simplify the calculation to note:

$$\text{xx} = (\text{most significant byte of value}) - 128$$

$$\text{yy} = (\text{least significant byte of value}) - 128$$

# Text Messages

If a device parameter returns a text message, that message is converted to an integer and is then provided in the register. The numbers are shown in the following table:

Number	Text Message as displayed on LCD
22222	Invalid value
30000	Off
30001	On
30002	≡ ≡ ≡ ≡
30003	£ : : : (parameter does not exist)
30004	Err
30005	Err1
30006	Open
30007	Short
30008	Pass
30009	Fail
30010	Hold
30011	Lo
30012	Hi
30013	De
30014	En
30015	- - - - (parameter has not been set)
-32768	Value is less than -20,000
32767	Value is greater than 20,000

# Error Handling

## Modbus Responses

When polled by a Modbus Master, a slave device will do one of the following:

1. Not reply. This means that something went wrong with the transmission of the message.
2. Echo back the command with the correct response (see the Modbus specification for more details). This is the normal response.
3. Return an Exception Code. This reflects an error in the message.

IQ Radar 300 uses the following exception codes:

Code	Name	Meaning
01	Illegal Function	The function code received in the query is not an allowable action for the slave.
02	Illegal Data Address	The data address received in the query is not an allowable address for the slave.
03	Illegal Data Value	A value contained in the query data field is not an allowable value for the slave.

## Error Handling

Errors can be traced to two general sources:

1. There is an error in transmission.  
**or**
2. The host tries to do something that is not a valid action.

In the first case, the IQ 300 does not respond and the master waits for a **Response Time Out** error, which causes the master to re-send the message.

In the second case, it depends on what the host tries to do. In general, IQ 300 will not give an error to the host request. Various actions and the expected outcome are as follows:

- If the host reads an invalid register, the host will get an undetermined value back.
- If the host writes an invalid register (a non-existing parameter or a read only parameter), the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.

- If the host writes a read only register, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.
- If P799 is read-only, then the value will be ignored and no error response will be made. However, the current value will not reflect the desired new value.
- If the host attempts to write one or more registers that are out of range, an exception response code 2 or 3 is generated depending on whether the start address is valid.
- If the host attempts to read one or more registers that are out of range, an exception response code of 2 or 3 is generated.
- If the host used an unsupported function code, an exception response code of 01 should be generated. However, this is not guaranteed and there may be no response.

# Troubleshooting

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## Communication Troubleshooting

### Generally:

1. Check the following:
  - There is power at the unit
  - The LCD shows the relevant data
  - The device can be programmed using the hand programmer
2. Check the wiring pin-outs and verify that the connection is correct.
3. Verify that values in set-up parameters P770 to P773 match the settings in the computer communicating with the unit.
4. Check that the port you are using on the computer is correct. Sometimes trying a different Modbus driver will solve the problem. An easy stand-alone driver called ModScan32 is available from Win-Tech at [www.win-tech.com](http://www.win-tech.com). We have found that this driver is useful to test communications.





### Specifically:

If you try to set an IQ 300 parameter via remote communications, but the parameter remains unchanged:

- Some parameters can only be changed when the device is not scanning. Try putting the device in program mode using the operating mode function.
- Try setting the parameter from the keypad. (First make sure that the lock parameter [P000] is set to **1954**.)
- The communications control parameter P799 must be set to **1** to be able to write parameters to the IQ 300.

# Operation Troubleshooting

Operating symptoms, probable causes, and resolutions.

Symptom	Cause	Action
display reads 	level or target is out of range	<ul style="list-style-type: none"> <li>• check specifications</li> <li>• check P006</li> <li>• increase range extension P805</li> </ul>
display reads 	material build-up on antenna	<ul style="list-style-type: none"> <li>• clean</li> <li>• upgrade to purged antenna</li> <li>• re-locate IQ 300</li> </ul>
display reads 	location or aiming: <ul style="list-style-type: none"> <li>• poor installation</li> <li>• flange not level</li> </ul>	<ul style="list-style-type: none"> <li>• check to ensure standpipe is vertical</li> <li>• use P837</li> <li>• check to ensure standpipe is clean and free of internal seams/welds</li> </ul>
display reads 	antenna malfunction: <ul style="list-style-type: none"> <li>• temperature too high</li> <li>• physical damage</li> <li>• excessive foam</li> <li>• multiple echoes</li> </ul>	<ul style="list-style-type: none"> <li>• check P343</li> <li>• use foam deflector or stilling well</li> <li>• relocate</li> <li>• use a defoamer</li> <li>• set P820 to 12 (First echo)</li> </ul>
Reading does not change, but the level does	IQ 300 processing wrong echo, i.e. vessel wall, or structural member	<ul style="list-style-type: none"> <li>• re-locate IQ 300</li> <li>• check standpipe for internal burrs or welds</li> <li>• rotate unit 90°</li> <li>• use P837</li> </ul>
Measurement is consistently off by a constant amount	P006 not correct P652 not correct	<ul style="list-style-type: none"> <li>• Check distance from Flange face to zero level (P006)</li> <li>• Check offset value (P652) or device tag</li> </ul>
Screen blank	power error	<ul style="list-style-type: none"> <li>• check nameplate rating against voltage supply</li> <li>• check power wiring or source</li> </ul>
Reading erratic	echo confidence weak	<ul style="list-style-type: none"> <li>• refer to P805</li> <li>• use P837</li> <li>• use foam deflector or stilling well</li> </ul>
	liquid surface vortexed	<ul style="list-style-type: none"> <li>• decrease measurement response P003</li> <li>• relocate unit to side pipe</li> <li>• increase confidence threshold P804</li> </ul>
	material filling	<ul style="list-style-type: none"> <li>• re-locate IQ 300</li> </ul>

Symptom	Cause	Action
Reading response slow	P003 setting	<ul style="list-style-type: none"> <li>increase response if possible</li> </ul>
Reads correctly but occasionally reads high when vessel is not full	<ul style="list-style-type: none"> <li>detecting close range echo</li> <li>build up near top of tank or nozzle</li> <li>water or other high <math>\epsilon_r</math> material in antenna threads</li> <li>wrong antenna choice for application</li> <li>stand pipe problem</li> </ul>	<ul style="list-style-type: none"> <li>clean</li> <li>rod extensions may be required</li> <li>See Application Example: Stillpipe on page 49</li> <li>use P837/P838</li> <li>upgrade to shielded rod antenna</li> </ul>
Level reading lower than material level	<ul style="list-style-type: none"> <li>material is within near blanking zone</li> <li>tank near empty and low <math>\epsilon_r</math> material</li> <li>multiple echoes processed</li> </ul>	<ul style="list-style-type: none"> <li>decrease blanking P800 (min. 0.4 m)</li> <li>raise IQ 300</li> <li>decrease range extension</li> <li>set P820 to 12 (First echo)</li> </ul>
	<ul style="list-style-type: none"> <li>Standpipe too narrow for length</li> </ul>	<ul style="list-style-type: none"> <li>See Rod Extension Requirements on page 25</li> <li>Upgrade to Shielded Rod Antenna</li> </ul>
	<ul style="list-style-type: none"> <li>Internal seam in standpipe</li> </ul>	<ul style="list-style-type: none"> <li>Inspect and remove seam</li> <li>Use P837</li> <li>upgrade to shielded rod antenna</li> </ul>

## Maintenance

The IQ Radar 300 requires no maintenance or cleaning under normal operating conditions.

**Note:** Under severe operating conditions, the antenna may require periodic cleaning.

# Appendix I

## Alphabetical Parameter List

Parameter Name	Parameter Number	Page Number
20 mA Output Trim	215	60
4 mA Output Trim	214	60
Algorithm	820	68
Antenna	004	52
Auto False Echo Suppression	837	70
Auto False Echo Suppression Distance	838	71
Baud Rate	772	66
Breakpoint Levels	054	56
Communications Control	779	67
Confidence Threshold	804	67
Damping Filter	709	63
Data Bits and Stop Bits	774	66
Decimal Position	060	57
Distance Measurement	923	72
Echo Confidence	805	68
Echo Lock	711	64
Echo Lock Sampling	712	64
Echo Lock Window	713	65
Echo Strength	806	68
Empty	006	53
Fail-Safe Level Advance	072	58
Fail-Safe Material Level	070	58
Fail-Safe Timer	070	58
Internal Temperature	343	61
Lock	000	51
mA Output Fail-Safe	219	60
mA Output Function	201	58
mA Output Maximum Limit	213	59
mA Output Minimum Limit	212	59
mA Output Value	911	72
mA Trim	214/215	60
Manufacture and Calibration Dates	340	61
Master Reset	999	73
Material	002	52
Material Measurement	921	72
Maximum Empty Rate	701	63

Parameter Name	Parameter Number	Page Number
Maximum Fill Rate	700	62
Maximum Volume	051	55
Measurement Response	003	52
Memory	901	71
Minimum Reading	063	57
Near Blanking	800	67
Noise	807	68
Number of Shots	841	71
Offset Correction	652	61
Offset Reading	062	57
Operation	001	51
Parity	773	66
Power On Resets	342	61
Propagation Factor	655	62
Protocol Address	771	66
Range Extension	801	67
Range Extension	801	62
Reading Measurement	920	72
Run Time	341	61
Serial Number	346	61
Serial Protocol	770	65
Software Revision	900	71
Space Measurement	922	72
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Tank Dimension 'A'	052	55
Tank Dimension 'L'	053	55
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TVT Hover Level	839	71
TVT Shaper	831	69
TVT Shaper Adjust	832	69
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Volume Breakpoints	055	56
Volume Measurement	924	72

# Appendix II

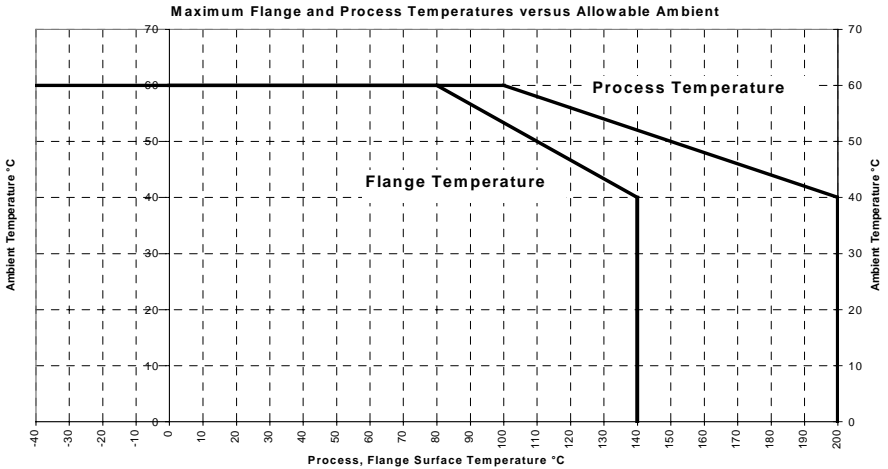
## Programming Chart

Number	Parameter Name	Value
001	Operation	
002	Material	
003	Measurement Response	
004	Antenna	
005	Units	
006	Empty	
007	Span	
050	Tank Shape	
051	Max Volume	
052	Tank Dimension 'A'	
053	Tank Dimension 'L'	
054	Breakpoint Level	
055	Volume Breakpoints	
060	Decimal Position	
062	Offset Reading	
063	Minimum Reading	
070	Fail-Safe Timer	
071	Fail-Safe Material Level	
072	Fail-Safe Level Advance	
201	mA Output Function	
212	mA Output Minimum Limit	
213	mA Output Maximum Limit	
214	4 mA Output Trim	
215	20 mA Output Trim	
219	mA Output Fail-Safe	
340	Manufacture and Calibration Dates	
341	Run Time	
342	Power On Resets	
343	Internal Temperature	
346	Serial Number	
652	Offset Correction	
655	Propagation Factor	
700	Maximum Fill Rate	
701	Maximum Empty Rate	
709	Damping Filter	
711	Echo Lock	
712	Echo Lock Sampling	
713	Echo Lock Window	
770	Serial Protocol	
771	Protocol Address	
772	Baud Rate	
773	Parity	

Number	Parameter Name	Value
774	Data Bits and Stop Bits	
799	Communications Control	
800	Near Blanking	
801	Range Extension	
804	Confidence Threshold	
805	Echo Confidence	
806	Echo Strength	
807	Noise	
820	Algorithm	
830	TVT Type	
831	TVT Shaper	
832	TVT Shaper Adjust	
837	Auto False Echo Suppression	
838	Auto False Echo Suppression Distance	
839	TVT Hover Level	
841	Number of Shots	
900	Software Revision	
901	Memory	
911	mA Output Value	
920	Reading Measurement	
921	Material Measurement	
922	Space Measurement	
923	Distance Measurement	
924	Volume Measurement	

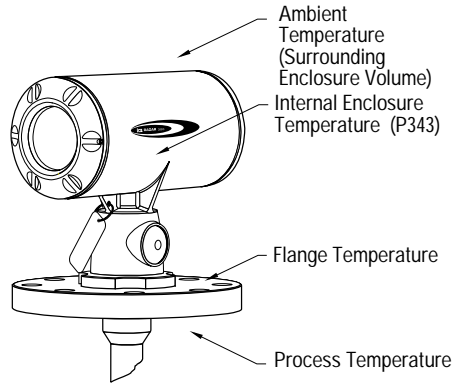
# Appendix III

## Ambient/Operating Temperature Specification



The chart above is provided for guidance only.

- The chart does not represent every possible process connection arrangement. For example, it will NOT apply if you are mounting the IQ 300 on a standpipe greater than 8" nominal, or directly on a metallic tank 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 the IQ 300. Parameter P343 is required to monitor the Internal Temperature. It gives you an excellent indication of how reliably the product will perform thermally when installed on your process vessel. The maximum allowable internal temperature (P343) is 81° C.

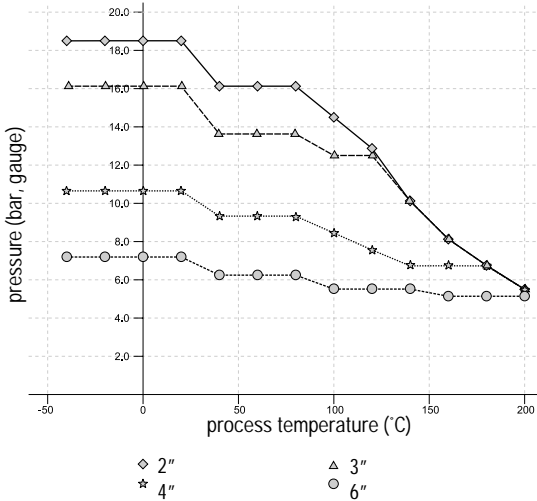
P343 also allows you to decide whether or not attention should be focussed on redesigning the installation. For example, if the internal temperature exceeds the maximum allowable limit, a sun shield or a longer standpipe may be required. Engineering will use this temperature reading (P343) to gauge the extent of change required to the installation in order to provide a reliable thermal-operating zone for the IQ 300.

**Warning: Internal temperature must not exceed 81° C! Warranty may be void.**

# Appendix IV

## Process Pressure/Temperature de-Rating

### Rod Antenna ANSI Hole Pattern, 150#<sup>9, 10</sup>



Process Configuration:

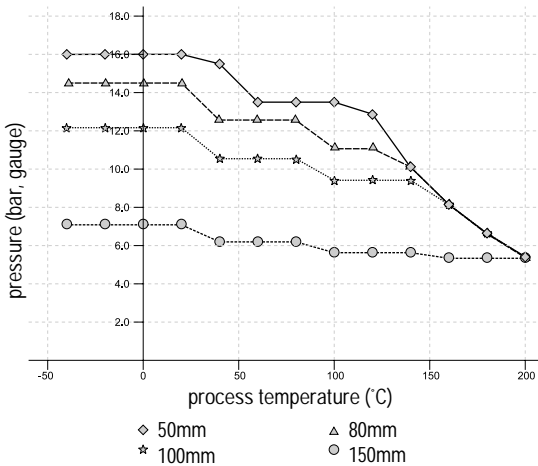
- 51003 with flange series 22452.
- Flange will be stamped 22452. Process connection tag will have the series identified as 51003.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

**Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time. Please ensure these are the most recent specifications. Contact your representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.

<sup>9</sup> UHMW-PE antennas are rated to a maximum of 80°C (176°F) of continuous duty.

<sup>10</sup> Customer to provide adequate bolting to retain vessel pressure and provide sufficient sealing.

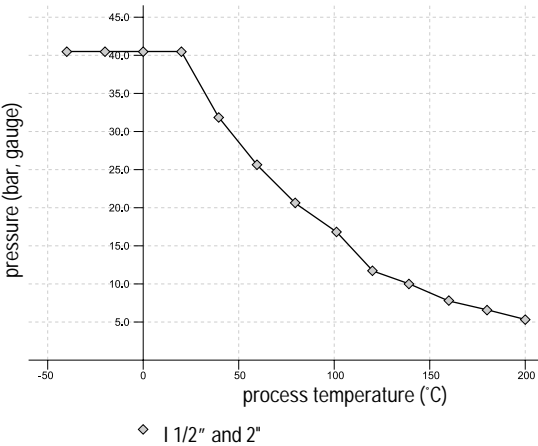
# Rod Antenna DN Hole Pattern, PN16<sup>11, 12</sup>



### Process Configuration:

- 51003 with flange series 22452.
- Flange will be stamped 22452. Process connection tag will have the series identified as 51003.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

# Rod Antenna Threaded Connection



### Process Connection Series:

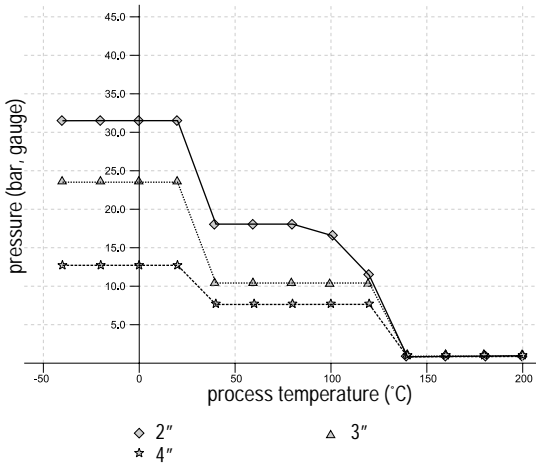
- 51002, 51004, 51005
- Ensure the unit has a process connection identification tag showing one of this series.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

**Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time. Please ensure these are the most recent specifications. Contact your representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.

<sup>11</sup> UHMW-PE antennas are rated to a maximum of 80°C (176°F) of continuous duty.

<sup>12</sup> Customer to provide adequate bolting to retain vessel pressure and provide sufficient sealing.

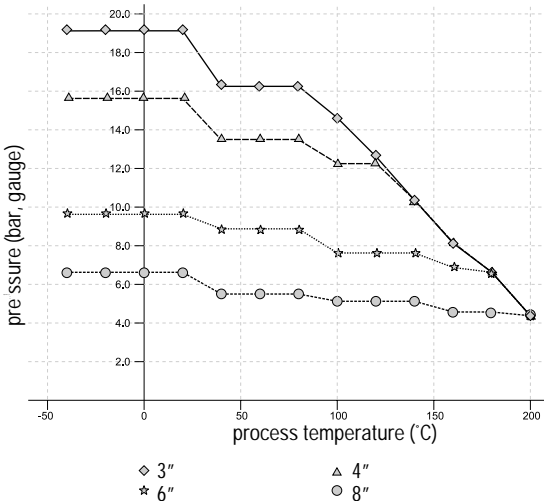
# Rod Antenna Sanitary Connection<sup>13</sup>



Process Connection Series:

- 51010
- Ensure unit has the process identification tag showing this series number.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

# Horn Antenna or Wave Guide – ANSI Hole Pattern, 150#<sup>14</sup>



Process Connection Series:

- 51006 to 51012 with 22452 series flange.
- Ensure your unit has the process identification tag showing one of this series, and 22452 stamped on flange.

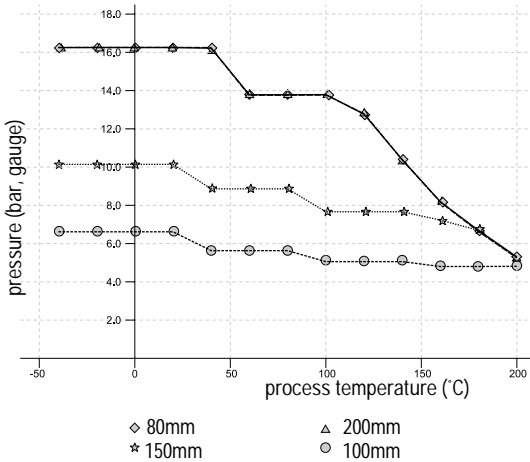
Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

**Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time. Please ensure these are the most recent specifications. Contact your representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.

<sup>13</sup> UHMW-PE antennas are rated to a maximum of 80°C (176°F) of continuous duty; however, they can be used for periods of up to 3 hours at temperatures up to 120°C (248°F) at 1 bar pressure.

<sup>14</sup> Customer to provide adequate bolting and flat-faced gasket to retain vessel pressure and provide sufficient sealing.

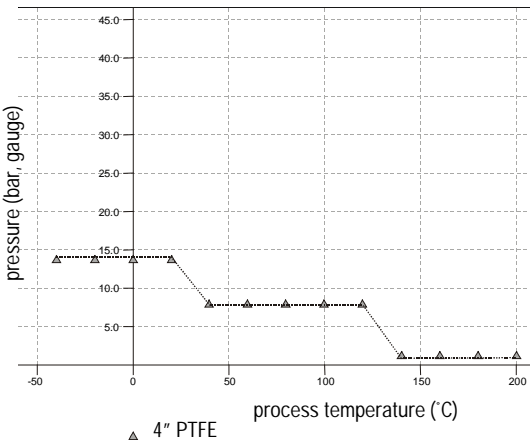
# Horn Antenna or Wave Guide DN Hole Pattern, PN16<sup>15</sup>



## Process Connection Series:

- 51006 to 51012 with 22452 series flange.
- Ensure your unit has the process identification tag showing one of this series, and 22452 stamped on flange.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

# Horn Antenna Sanitary Connection



## Process Configuration:

- 51009
- Ensure unit has the process identification tag showing this series.
- Reference drawing number is shown on the process device tag. This drawing can be obtained on request.

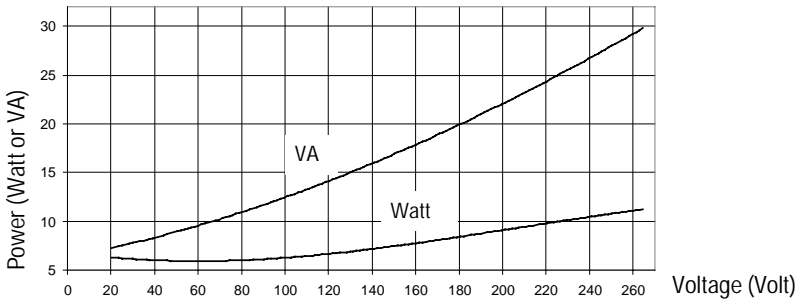
**Note:** Siemens Milltronics makes every attempt to ensure the accuracy of these specifications but reserves the right to change them at any time. Please ensure these are the most recent specifications. Contact your representative, or check our website at [www.milltronics.com](http://www.milltronics.com) for the most up-to-date information.

<sup>15</sup> Customer to provide adequate bolting and flat-faced gasket to retain vessel pressure and provide sufficient sealing.

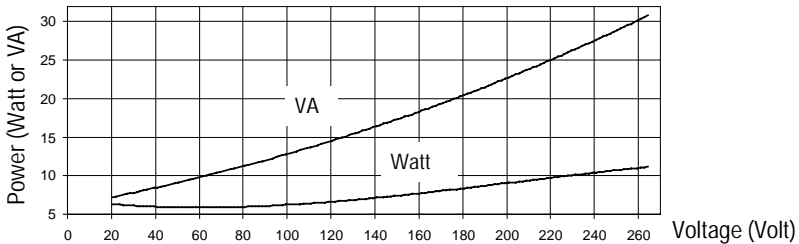
# Appendix V

## Typical Power Consumption

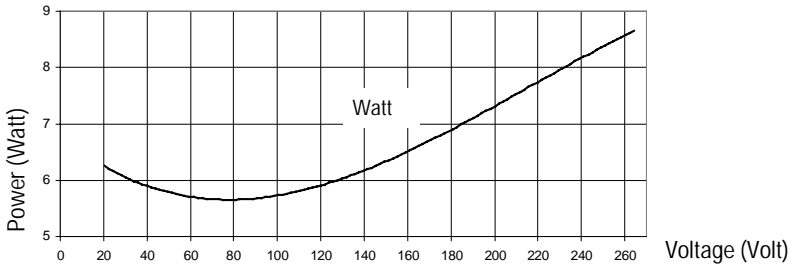
**IQ Radar 300 Typical Consumption  
with 50Hz AC Input Supply**



**IQ Radar 300 Typical Consumption  
with 60Hz AC Input Supply**



**IQ Radar 300 Typical Consumption  
with DC Input Supply**



# Appendix VI

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## HART Communications for the IQ Radar 300

Highway Addressable Remote Transducer, HART, is an industrial protocol that rides on top of a 4-20 mA signal. It is an open standard, and full details about HART can be obtained from the HART Communication Foundation ([www.hartcomm.org](http://www.hartcomm.org)).

The IQ-300 can be configured over the HART network using either the HART Communicator 275 by Fisher-Rosemount, or a software package. There are number of different software packages available, and the IQ Radar 300 should work well with any of them. The recommended software package is the Simatic Process Device Manager (PDM) by Siemens.

### HART Device Descriptor (DD)

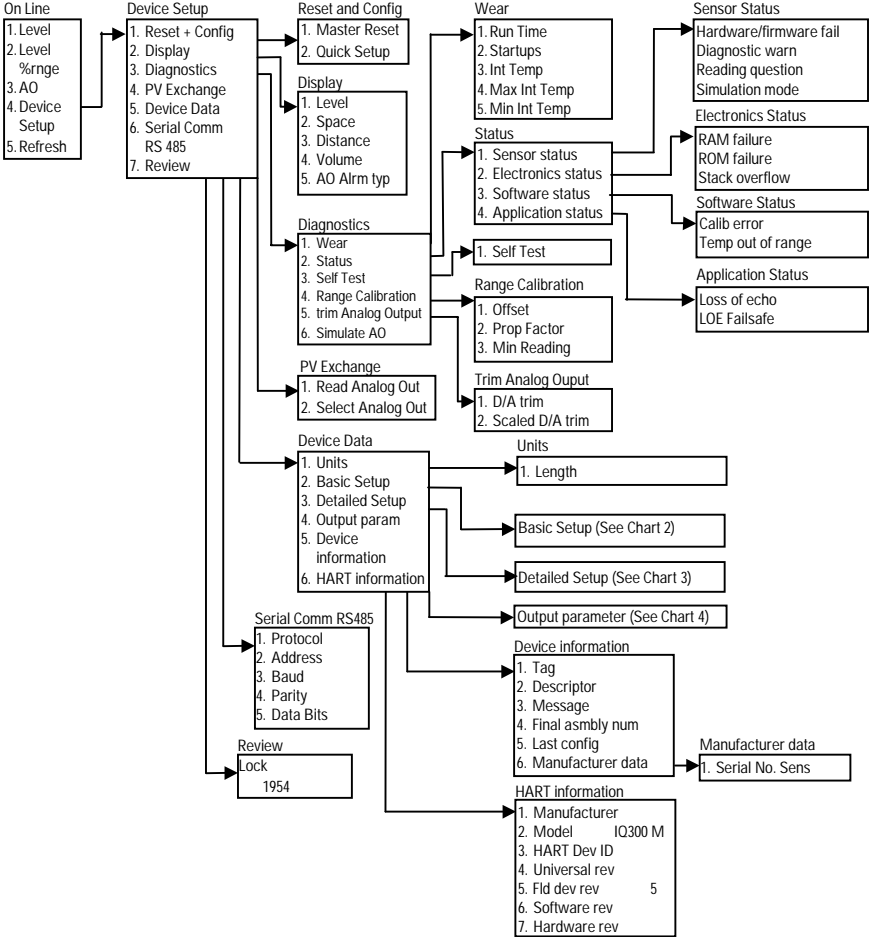
In order to configure a HART device, the configurator must have the HART Device Descriptor for the unit in question. HART DD's are controlled by the HART Communications Foundation. The HART DD for the IQ RADAR 300 is being released in 2001. Please check availability with the HART Communications Foundation. Older versions of the library will have to be updated in order to use all the features in the IQ Radar 300.

### Simatic Process Device Manager (PDM):

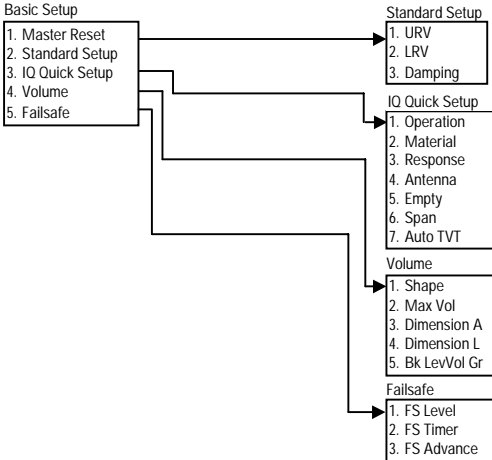
This software package is designed to permit easy configuration, monitoring and troubleshooting of HART and Profibus PA devices. The HART DD for the IQ RADAR 300 was written with Simatic PDM in mind and has been extensively tested with this software.

# HART Communicator 275:

**Chart 1**

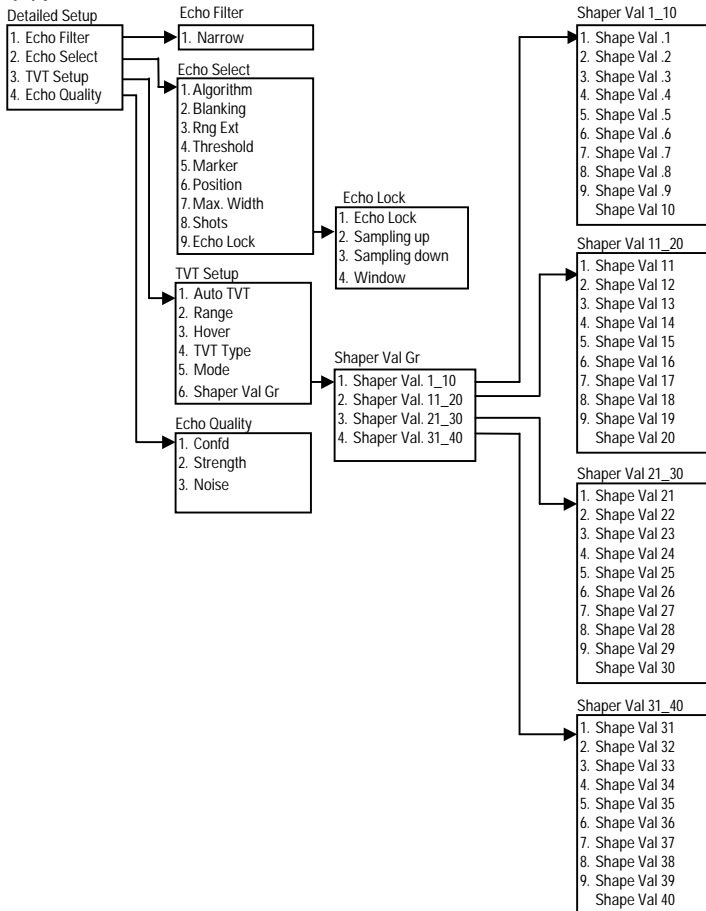


**Chart 2**

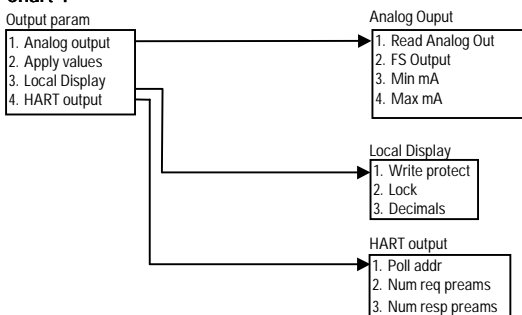


Appendix VI

**Chart 3**



**Chart 4**



## Supported HART Commands:

The IQ RADAR 300 conforms to HART rev. 5 and supports the following:

### Universal Commands

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

### Common Practice Commands

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

### Device Specific Commands

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

The HART commands are rarely if ever used by end users. For details on the Universal and Common Practice Commands, please contact the HART Communication Foundation. For details on the Device Specific Commands, please contact Siemens Milltronics.

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