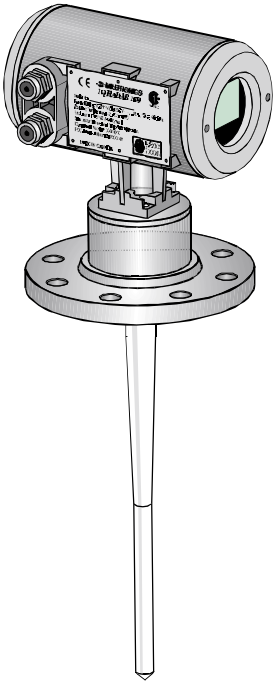
iQ RADAR 160



Instruction Manual

PL-550

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1954 Technology Dr., P.O. Box 4225, Peterborough, Ontario, **Canada** K9J 7B1
Tel.: +1 705-745-2431 Fax: +1 705-741-0466

August van de Wielelei 97, 2100 Deurne, Antwerp, **Belgium**
Tel.: +32(0)3326 45 54 Fax: +32(0)3326 05 25

Oak House, Bromyard Road, Worcester, **England** WR2 5XZ
Tel.: +44 1905-748404 Fax: +44 1905-748430

Parc de la Sainte Victoire, Bât. 5, 13590 Meyreuil, **France**
Tel.: +33 4 42 65 69 00 Fax: +33 4 42 58 63 95

Amores No. 1155, Col. Del Valle, 03100 Mexico D.F., **Mexico**
Tel.: +52 575-31-44 Fax: +52 575-26-86

Nikkelstraat 10, NL-4823 AB Breda, **The Netherlands**
Tel.: +31(0)76 542 7 542 Fax: +31(0)76 542 8 542

709 Stadium Drive, Arlington, Texas **U.S.A.** 76011
Tel.: +1 817-277-3543 Fax: +1 817-277-3894

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GENERAL INFORMATION

ABOUT THIS MANUAL

It is essential that this manual be referred to for proper installation and operation of your IQ Radar 160.

Installation gives you step-by-step direction for the installation and interconnection of your IQ Radar 160.

Start-up instructs you in how to operate the keypad, program the unit and read the display.

Operation describes the operation of the IQ Radar 160, detailing the interoperation of the salient features.

Applications looks at the IQ Radar 160 from a practical point of view, using a typical application example.

Parameters lists the parameters available to you, with a description of their function and use. You are urged to read this section to familiarize yourself with the parameters available to you and get your IQ Radar 160 working to its fullest.

Troubleshooting tabulates symptoms, causes and actions to common installation and application problems that you might encounter. Hopefully you will never have to read this section, but know it's there to help you.

Appendices what manual would be complete without one! Ours is an alphabetical cross-reference of the parameters and their numbers, and a record sheet for jotting down parameter values. Handy indeed!

ABOUT IQ RADAR 160

The IQ Radar 160 is to be used only in the manner outlined in this manual.

IQ Radar 160 is a versatile process material level monitoring instrument. Material level measurement is achieved using advanced pulse radar techniques. The unit consists of an electronic component coupled to the antenna.

IQ Radar 160 Features:

✓ ANSI, DIN flange or sanitary tri-clamp mounting

✓ corrosion-resistant construction, aluminum enclosure with stainless steel and Teflon® wetted parts

✓ local display

✓ infrared keypad and Dolphin-compatible

IQ Radar 160 Applications:

✓ liquids, slurries

✓ process temperatures up to 200°C

✓ vacuum and pressurized vessels

IQ Radar 160 Approvals and Certificates

✓ safety and radio

® Teflon is a registered trademark of Du Pont.

IQ RADAR 160

Power:	100/115/200/230 ±15% V ac*, 50/60 Hz, 15 VA *factory set – see device nameplate
Interface:	
analog output:	optically-isolated 0/4-20 mA into 750 Ω max, 0.02 mA resolution
Dolphin/RS-485 link:	refer to Dolphin product specification
programmer link:	infrared receiver (refer to Programmer specification below)
display (local):	backlight, alphanumeric and multi-graphic liquid crystal for readout and entry
Performance:	
frequency:	5.8 GHz
accuracy:	> ±0.3% of range (1 to 10 m)
range:	10 m
repeatability:	30 µW average
fail-safe:	mA programmable high, low or hold
Mechanical:	
enclosure (electronic):	
construction:	aluminum, epoxy coated
conduit:	2 x 1/2" NPT or PG 16 entry
ingress protection:	Type 6 / NEMA 6 / IP-67
resonator:	plated aluminum
flange:	316 stainless steel, 150 psi ANSI, DIN PN16, 3" sanitary tri-clamp
antenna:	
type:	dielectric rod
construction:	Teflon®
weight:	6.5 kg (14.3 lb) with 2"/150 psi ANSI flange, weight will vary with flange size and rating

Environmental:

location:	indoor/outdoor
altitude:	2000 m max
ambient temperature:	-20 to 60° C (-4 to 140° F)
relative humidity:	suitable for outdoor (Type 6/NEMA 6/IP 67 enclosure)
installation category:	II
pollution degree:	4

Process:

material dielectric:	$\varepsilon_r > 4$
temperature:	-40 to 200°C (-40 to 392°F)
pressure (vessel):	-100 kPa to 1000 kPa (-1 to 10 bar or -10 to 150 psi)

Programmer (remote keypad):

enclosure:	general purpose 67 mm w x 100 mm h x 25 mm 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:	150 g (0.3 lb)

Approvals (refer to device nameplate) :

safety:	$CSA_{NRTL/C}$, CE
radio:	BAPT, Transport Canada

INSTALLATION

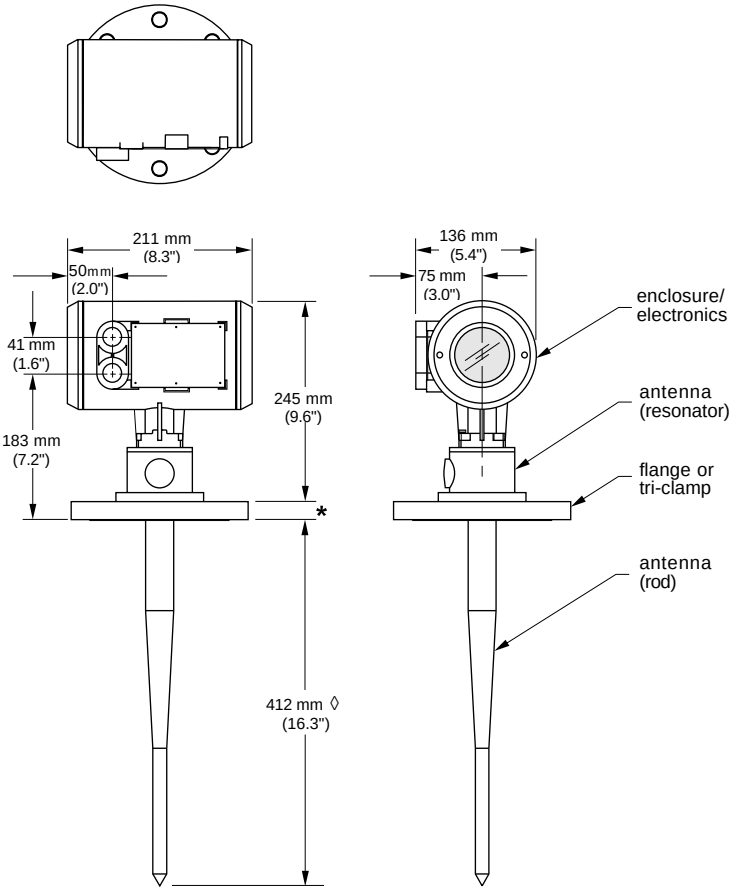
LOCATION

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 mount in direct sunlight without the use of a sun shield.

DIMENSIONS

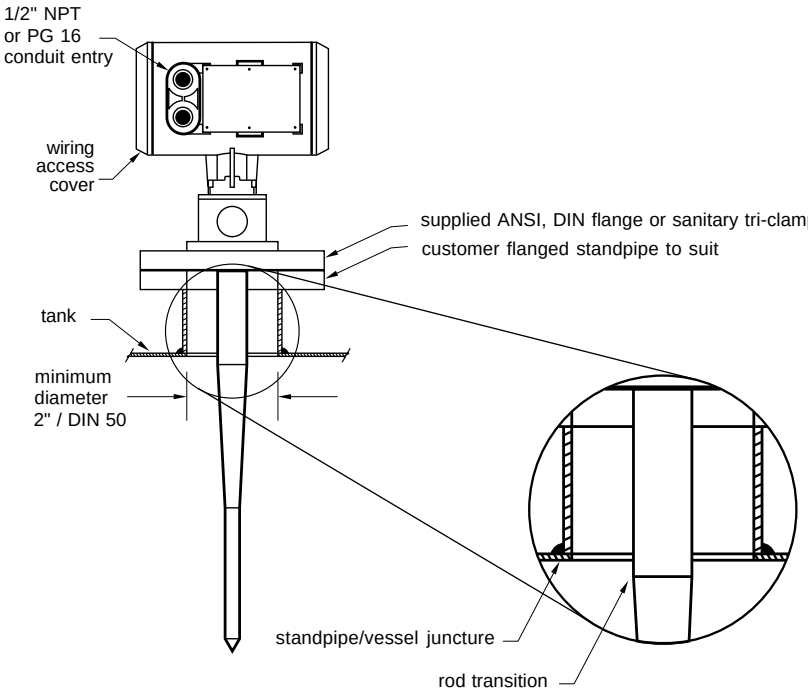


* Flange thickness varies with size and rating. 25mm (1") nominal. Check appropriate standard.

◊ Standard length, 50 and 100 mm (2” and 4") extensions available.

MOUNTING

FLANGED



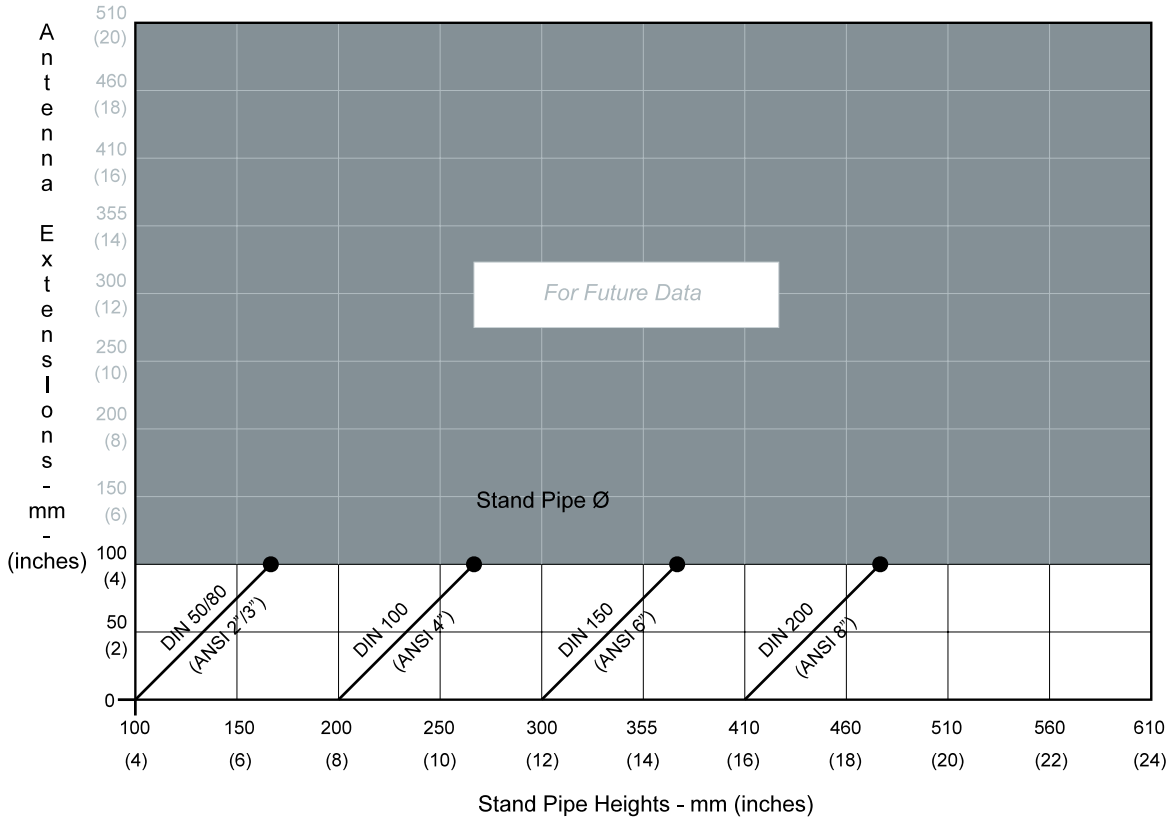
INSTALLATION

For 2" or 3" / DIN 50 or DIN 80, the straight/taper transition of the rod should extend past the standpipe/vessel opening. Add extensions as required.

For larger diameter standpipes, refer to Extension Requirements.

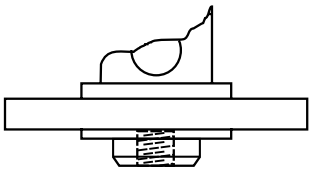
MOUNTING (continued)

EXTENSION REQUIREMENTS

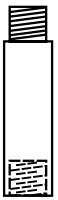


MOUNTING (continued)

ROD ASSEMBLY



standard
rod



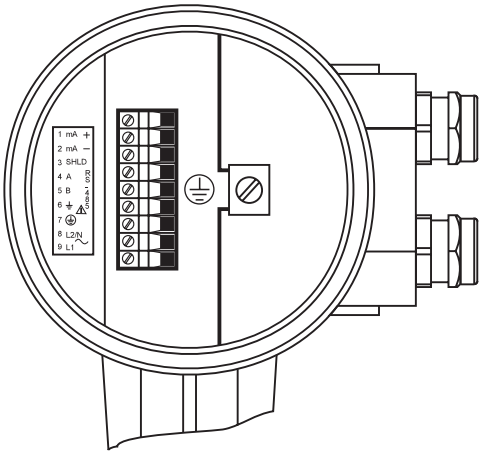
50 mm

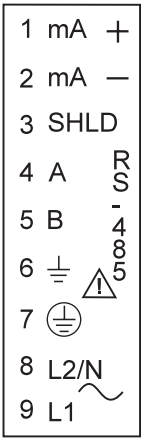
100 mm

extensions

INTERCONNECTION

TERMINAL BLOCK LAYOUT





⚠ All field wiring must have insulation suitable for at least 250 V.

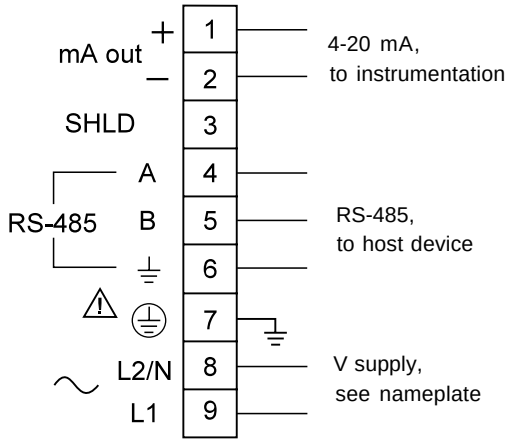
– mA wiring, 14 – 20 AWG, copper wire, shielded

– RS-485, 14 – 20 AWG, copper wire, shielded

– Line, 12 – 14 AWG, copper wire

– Recommended torque on clamping screws, 0.5 – 0.6 Nm

WIRING



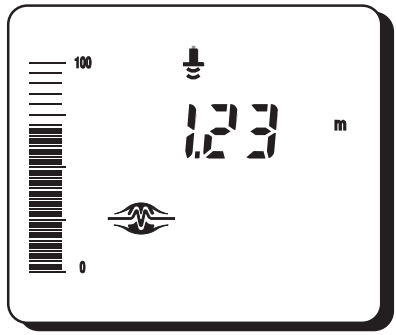
Ground shields at one end only.

The equipment must be protected by a 15 A fuse or circuit breaker in the building installation.

A circuit breaker or switch in the building installation, marked as the disconnect switch, shall be in close proximity to the equipment and within easy reach of the operator.

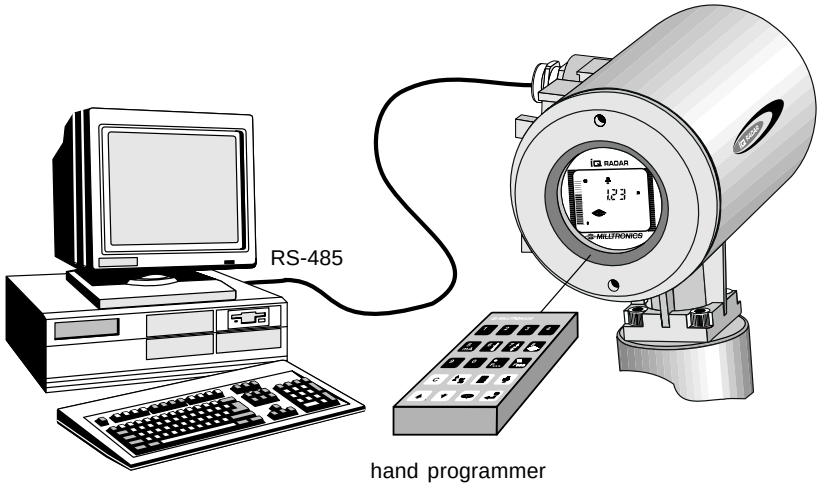
OVERVIEW

The IQ Radar 160 has two modes of operation: *run* and *program*. When the unit is powered, after installation procedures have been completed, it is programmed to start up in the *run* mode, to detect the distance from the antenna flange to the target in meters.



typical display

The unit can be placed into the *program* mode at any time; to alter a number of program parameters in order to better suit the application or user's preferences. Programming can be carried out locally via the hand programmer or remotely via the optional Dolphin/RS-485 interface.



hand programmer

The first step in programming is to ensure that all parameters are at their factory setting. The quickest way is to perform a master reset, P999.

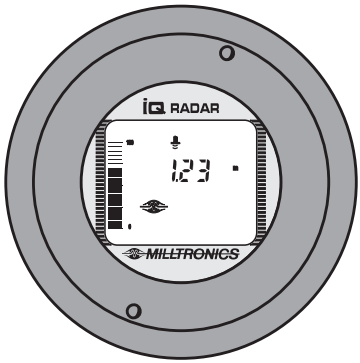
For a Quick Start, P001 to P007 are the key parameters requiring entry.

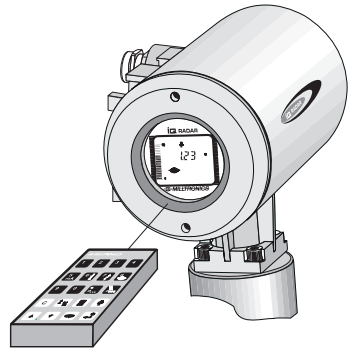
They set:
- mode of measurement
- process material
- antenna configuration
- measurement response
- units
- empty distance
- span

There are a number of other program parameters that can be changed subsequently or during another programming session. Refer to Parameter Description for a list of the parameters available.

When programming has been completed, the IQ Radar 160 can be put into *run* by pressing or exiting Dolphin.

DISPLAY AND KEYPAD

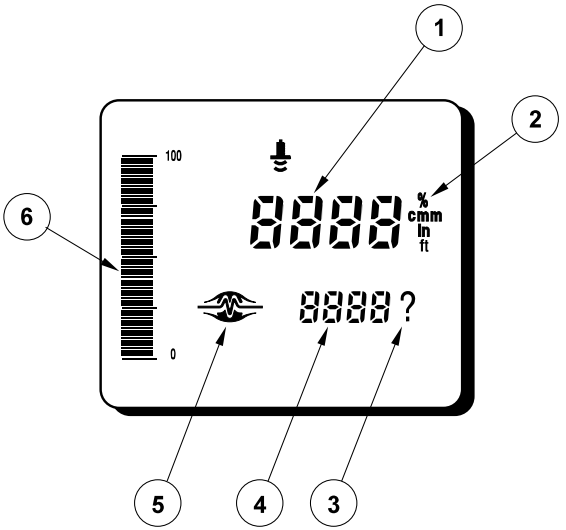




START UP

LOCAL OPERATION

RUN DISPLAY



① reading

② units

③ reading questionable, appears during fail-safe operation

④ auxiliary reading

⑤ = normal operation = fail-safe operation

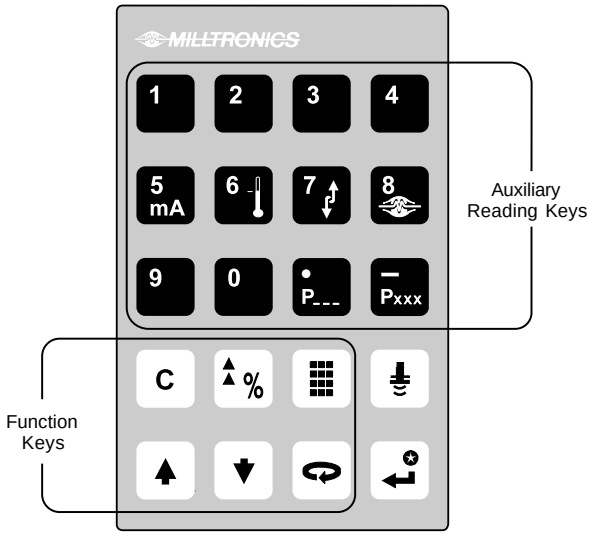
⑥ bar graph representation of material level, 0 to 100% of span

START UP

LOCAL OPERATION (continued)

RUN KEYPAD

In the *run* mode, the following programmer keys perform the identified functions.

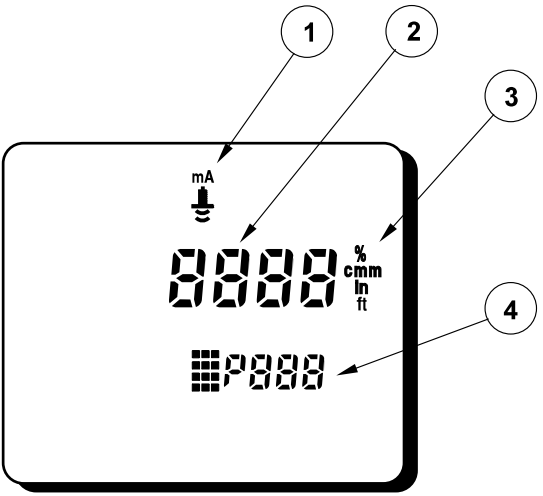


Key	*Auxiliary readings*
5 mA	"mA Output Value"
7	"Rate of Change" (in Units/minute)
8	"Fail-safe Time Left" (in percent)
Pxxx	"Material Level"
	"Distance"
	initiate and complete program mode access
%	toggle between Units and %

START UP

LOCAL OPERATION (continued)

PROGRAM DISPLAY



① parameter type (measurement or mA output)

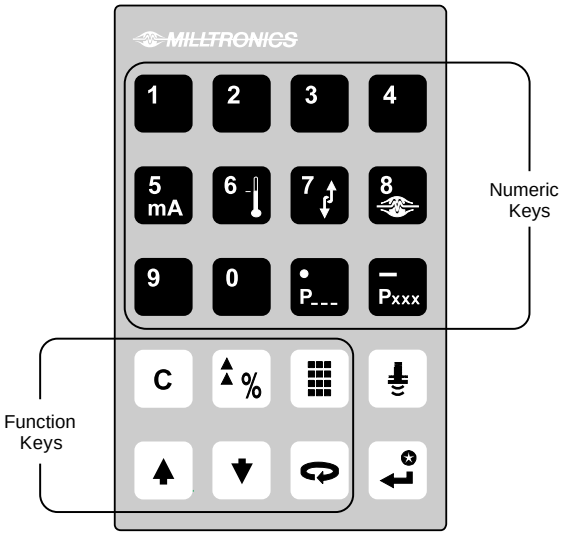
② parameter value

③ units

④ parameter number

START UP

PROGRAM KEYPAD



Key

0 to 9	values
P___	decimal point
Pxxx	negative value
C	clear value
	enter the displayed value
	parameter scroll-up
	parameter scroll-down
	end program session and enable *run* mode

START UP

LOCAL OPERATION (continued)

Legend

Press the associated key on programmer:

Programmer key:

Display shown on IQ Radar 160:

LOCAL PROGRAMMING

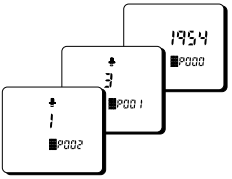
To Access Program

run mode

Initial program starts at P000

To Access a Parameter

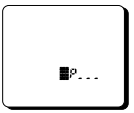
scroll



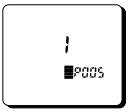
Scroll up or down

direct

e.g. P000 accessed



index parameter field



e.g. P005 accessed

START UP

LOCAL OPERATION (continued)

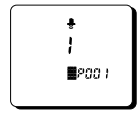
Local Programming (continued)

To Change a Parameter Value:

Security must be disabled!

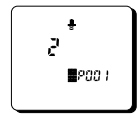
change

Select parameter
e.g. P001 = 3

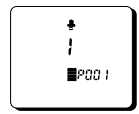


e.g. P001 = 1

clear



e.g. field entry = 2

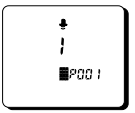


e.g. P001 = 1

START UP

Local Programming (continued)

reset

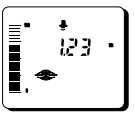


e.g. P001 = 1

Reset to factory value
P001 = 3

To Access Run:

from *program*



exit and return to *run*

OPERATION

OVERVIEW

IQ Radar 160 is a process material level measuring device using advanced pulse radar technology. The device emits a series of radar pulses and analyses the reflection to calculate the material level.

The device consists of an enclosed electronic component, mounted to a flanged antenna component. The electronic component generates a 5.8 GHz radar signal which is directed to the antenna, a Teflon® dielectric rod coupled to the core of the device's mounting flange.

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 inversely proportional to the square of the distance.

Radar reflection is based on the dielectric constant and planar property of the materials encountered and thus radar is very suitable for still (non-agitated) liquids and slurries. Radar is immune to temperature and atmospheric conditions and variations in the vessel. In an ideal application, echoes from stratified vapours are either non-existent, or minimal compared to major echoes from the process material. Where atmospheric conditions are such that dielectric constants and stratifications are of significance, their echoes can compete with the desired reflection from the process material, making the application troublesome.

The series of echoes from the pulses transmitted are sensed by the antenna during the receive period of the electronics. The echoes are stored as a profile of the activity in the vessel. The profile is analysed and the distance of the material surface to the radar antenna is determined. This distance is used as a basis for display of material level and mA output.

TRANSCEIVER

The IQ Radar 160 transceiver operates under 1 of 5 sets of preset conditions (P003), summarized as follows:

parameter value	measurement response		echo verification	filter	fail-safe timer
1	0.1 m/min	slow	on	on	100
2	1 m/min	•	on	on	10
3	10 m/min	•	on	on	1
4	100 m/min	•	off	on	0.1
5	1000 m/min	fast	off	off	0

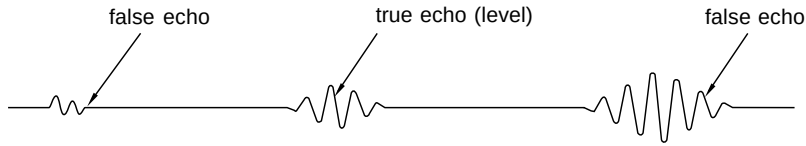
When the echoes are received, the relevant echo extraction technique (P820) is applied to determine the true material echo.

The measurement response limits the maximum rate at which the display and analog output respond to changes in measurement. It is of concern especially where liquid surfaces are in agitation or falls into the radar path during filling.

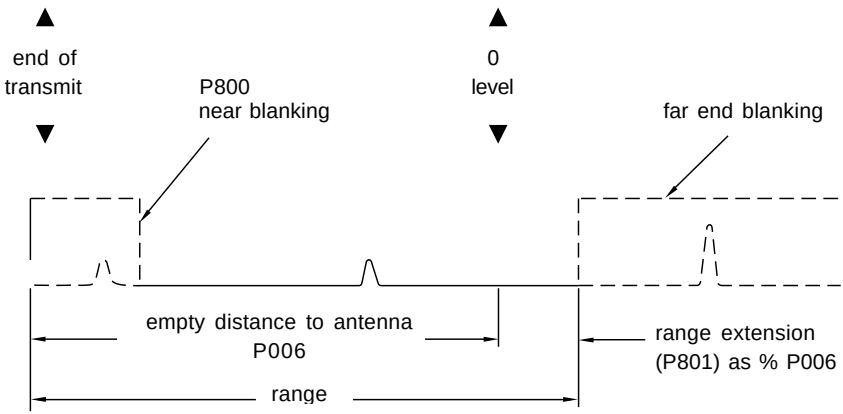
BLANKING

Near blanking (P800) is used to ignore the zone in front of the antenna where false echoes (e.g. ladder rung) appear as an echo during the receive cycle. This is usually indicated by an incorrect high level reading and can be overcome by increasing the near blanking from its factory set value.

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



Typical receiver signal

In applications where the zero level is above the bottom of the vessel and it is desired to monitor the zone below the normal zero, range extension (P801) can be used to extend the range into the far end blanking. Range extension is entered as a percentage of P006. As range extension reduces the protection afforded by the far end blanking, it should be used judiciously. Avoid excessive range extension as this can reduce the measurement's reliability and accuracy. Range extension is factory set for 20% of P006. If it is found that false echoes are appearing ahead of the blanking zone, P006 should be reduced accordingly.

LOSS OF ECHO

A loss of echo occurs when the IQ Radar 160 deems that the calculated measurement is unreliable, i.e. the confidence (P805) is less than the threshold (P804). This can be due to such circumstances as high level of electrical noise or poor grounding. Refer to Troubleshooting. If the condition persists for a time beyond the limit as set by the fail-safe timer (P070), the confidence icon changes from full to partial and the reading and mA output are immediately forced to the fail-safe default (P071).

Upon receiving a reliable echo, the loss of echo condition is aborted (icon returns to full) and the reading and mA output return to the present level immediately.

ANALOG OUTPUT

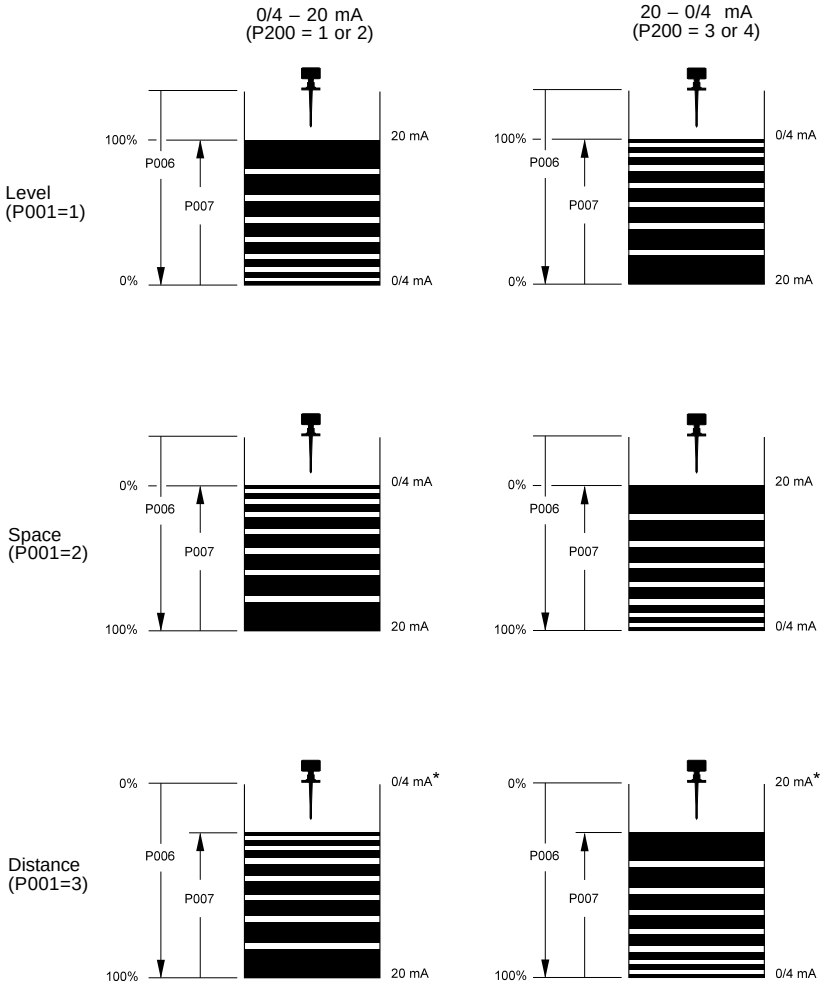
The IQ Radar 160 can be programmed to provide an analog output (P200) of 0 to 20 or 4 to 20 mA, and for proportional or inverse span.

Programming

Upon entering the Program mode, the analog output level holds its prior value.

Run

The analog output responds in the following manner:



*reference value only. mA level limited by near blanking.
0 and 100% are percentage of full scale reading (m, cm, mm, ft, in)

Fail-safe

When the fail-safe timer (P070) expires, the mA output responds as follows:

Fail-safe Mode (071)	Status	
	0/4 - 20	20 - 0/4
high	22	0/2
low	0/2	22
hold	hold	hold

RUN / PROGRAM

When the IQ Radar 160 changes from *run* to *program*, the transceiver stops operating and the unit no longer responds to the process. The last measurement is stored and the associated reading and mA output are held.

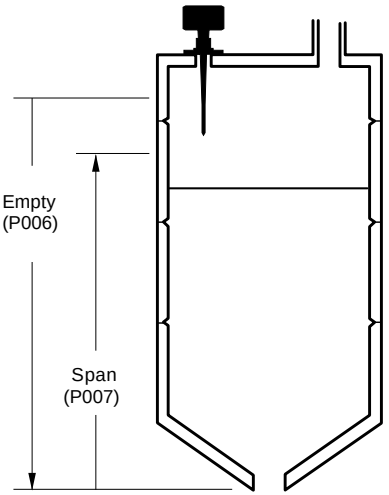
As a courtesy, the unit reverts to the parameter last addressed during the previous program session.

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).

APPLICATION EXAMPLE

The minimum distance from the antenna face to the target is limited by the near blanking, P800.

The application is to obtain a level measurement and corresponding 4-20 mA output proportional to material levels in a chemical tank. The antenna flange is 5 m from the tank bottom. The empty level is 0 m (bottom) and the full level (span) is 4.5 m from the bottom. The maximum rate of filling or emptying is about 1 m/min. In the event of a loss of echo, the IQ Radar 160 is to go into fail-safe low after 2 minutes.



reset:

P999	master reset	

program:

P001	enter ‘1’	mode of measurement = level
P002	enter ‘1’	material = liquid
P003	enter ‘2’	measurement response = 1m/min.
P004	enter ‘240’	antenna = dielectric rod, standard length
P005	enter ‘1’	units = metres
P006	enter ‘5’	empty distance = 5 m
P007	enter ‘4.5’	span = 4.5 m
P070	enter ‘2’	fail-safe timer = 2 min.
P071	enter ‘2’	fail-safe = low

run: press run to start normal operation

OPERATION

PARAMETER DESCRIPTION

P000 lock

Locks out the ability to change parameter values P001 through P999. The program mode is still active, but restricted to viewing only. The lock is enabled if P000 value is other than 1954.

entry: 1954 = unlocked
~~1954~~ = locked

P001 operation

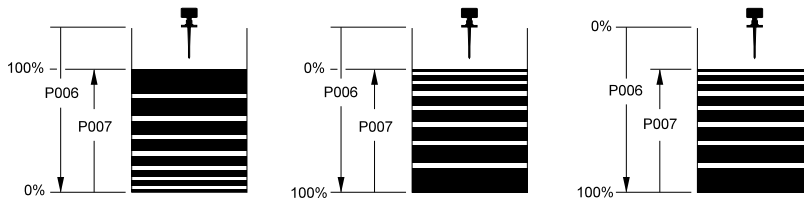
Determines the mode of measurement.

entry:

1 = level; material level referenced to empty distance (P006)

2 = space; space to material level referenced from zero span

3 = distance; distance to target referenced from the flange face



Level (P001 = 1) Space (P001 = 2) Distance (P001 = 3)

P002 material

Optimizes measurement reliability for target type.

entry: 1 = liquids, fluids or flat surfaces

P003 measurement response

Collectively sets a number of operating parameters that determine the maximum rate of change in target range that the reading and mA output can keep up to.

If IQ Radar 160 cannot keep up with the rate of level change, select a faster rate. If the reading bounces around an average value, select a slower rate. In general, reliability is traded for speed. 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.

Select P003 for a measurement response just faster than the greater of the maximum filling or emptying rate.

echo verification: discriminates between agitator blades in motion or spurious noise, and the target surface (true echo).

filter: discriminates between false echoes from constant acoustical or electrical noise and the target surface.

fail-safe timer: establishes the period from the time a loss of echo starts until the fail-safe default (P071) is effected. The P003 preset timer value can be overridden by P070.

entry:

measurement response		echo verification	filter	f-s timer (P070)
1 = 0.1 m/min	slow	on	on	100
2 = 1 m/min	•	on	on	10
3 = 10 m/min	•	on	on	1
4 = 102 m/min	•	off	on	0.1
5 = 1020 m/min	fast	off	off	0

P004 antenna

Identifies antenna configuration.

entry: 240 = dielectric rod
241 = rod + 50 mm extension
242 = rod + 100 mm extension
243 = rod + 150 mm extension (50 + 100mm)

P005 units

Determines the units for programming and measurement.

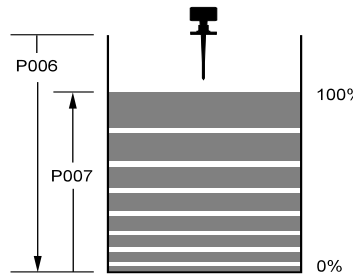
entry: 1 = metres
2 = centimetres
3 = millimetres
4 = feet
5 = inches

P006 empty

Distance from flange face to empty level or maximum target range.

P007 span

Distance from empty (P006) to full/100% level or minimum target range.



P070 fail-safe timer

The amount of time delay, in minutes, before going into fail-safe mode.

P071 fail-safe material level

Selects the default measurement in the event that the fail-safe timer expires.

entry: 1 = high; maximum span value
2 = low; minimum span value
3 = hold; hold current value

P200 mA range

Enables the mA output function by selecting the range and relationship to span.

Refer to Functional / mA output.

entry: 1 = 0 to 20 mA
2 = 4 to 20 mA
3 = 20 to 0 mA
4 = 20 to 4 mA

P341 run time

View the accumulated number of days the IQ Radar 160 has been operating.

P652 offset correction

An offset value can be applied to the reading as a correction to the measurement.

values: -999 to 9999

P800 near blanking

Sets the amount of blanking as measured from the flange face and extending into the measurement range. Refer to Operation / Blanking.

enter value in units of P005.

P801 range extension

Sets the amount of range extension as measured from the empty distance (P006) and extending into the far end blanking. Refer to Operation / Blanking.

enter as a % of P006, the distance below empty not blanked.

P804 confidence threshold

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

enter value in the range of 0 to 99.

P805 echo confidence

A measure of echo reliability.

P806 echo strength

The absolute strength of the selected echo, in dB above 1 μV rms.

P820 algorithm

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

entry: 1 = best of first and largest
2 = first echo
3 = largest echo

P830 TVT type

Selects the TVT profile applied to the echo profile.

entry: 1 = standard
2 = flat

P900 software revision

Displays the EPROM software revision level.

P901 memory

Tests the memory. Test is initiated by scrolling to the parameter or repeated by

display: PASS = normal
FAIL = consult Milltronics

P911 mA output value

Displays the value from the previous measurement. A test value can be entered and the displayed value is transmitted to the output. Upon returning to the run mode, the parameter assumes the actual mA output level.

P920 reading measurement

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

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)

P999 master reset

Resets parameters to their factory setting

initiate reset

reset complete

TROUBLESHOOTING

The following is a list of operating symptoms, their probable causes and the actions needed to resolve them.

SYMPTOM	CAUSE	ACTION
display reads	level or target is out of range	check specifications check parameters
	application too steamy, under these conditions range can be adversely affected.	re-locate IQ Radar 160 increase fail-safe timer, P070
	material build-up on antenna	clean re-locate IQ Radar 160
	location or aiming: -poor installation -moved by material or vibration -flanging not level -standpipe not vertical	relocate or re-aim IQ Radar 160 for maximum echo confidence, P805
	antenna malfunction: -temperature too high -physical damage -excessive foam or skin	inspect use foam deflector or stilling well or relocate
Reading does not change, but the level does	IQ Radar 160 processing wrong echo, i.e. vessel wall, or structural member	re-locate IQ Radar 160 check standpipe for internal burrs or welds increase blanking, P800 raise short measurement confidence threshold, P804

*refer to associated manual

... continued

SYMPTOM	CAUSE	ACTION
Measurement is consistently off by a constant amount	measurement offset	correct using P652
Screen blank	power error	check nameplate rating against voltage supply check power wiring or source
Reading erratic	echo confidence weak, liquid surface agitated, material filling	refer to P805 decrease measurement response P003 enable filter, echo verification re-locate IQ Radar 160
Reading 'EEEE'	reading too large	re-program ie. empty distance P006 or span P007
Reading response slow	P003 setting	increase response if possible
Reads correctly but occasionally reads high when vessel is not full	detecting close range echo	increase blanking
High level reading lower than material level	material is within near blanking zone	decrease blanking P800

MAINTENANCE

The IQ Radar 160 requires no maintenance or cleaning; however, a program of periodic checks is advised.

ALPHABETICAL PARAMETER LIST

algorithm P820
antenna P004
confidence threshold P804
echo confidence P805
echo strength P806
empty P006
fail-safe material level P071
lock P000
long shot number* P841
mA output value P911
mA range P200
master reset P999
material P002
measurement response P003
memory P901
near blanking P800
offset correction P652
operation P001
range extension P801
run time P341
software revision P900
span P007
TVT type P830
units P005

* accessible in Dolphin only.

PROGRAMMING CHART

PARAMETER		
#	NAME	VALUE
P001	Operation	
P002	Material	
P003	Measurement Response	
P004	Antenna	
P005	Units	
P006	Empty	
P007	Span	
P070	Fail-Safe Timer	
P071	Fail-Safe Material Level	
P200	mA Range	
P652	Offset Correction	
P800	Near Blanking	
P801	Range Extension	
P804	Confidence Threshold	
P820	Algorithm	
P830	TVT Type	
P841	Long-Shot Number	