

Fisher™ FIELDVUE™ DLC3100 and DLC3100 SIS Digital Level Controllers

FIELDVUE DLC3100 and DLC3100 SIS digital level controllers are HART® communicating instruments that are used with level sensors to measure liquid level, level of the interface between two liquids, or liquid density (not applicable to DLC3100 SIS). The DLC3100 converts this measurement into 4-20 mA transmitter signal.

Unless otherwise noted, the information in this document applies to both DLC3100 and DLC3100 SIS. However, for simplicity, the DLC3100 model name will be used throughout.



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Features

Safety

- The DLC3100 SIS is certified to be SIL2 capable (HFT=0) in accordance to IEC61508 standard. It is designed and capable to be used in safety function to achieve a tolerable risk for a process hazard. It allows potential risk reduction for people, systems, devices and processes. The DLC3100 SIS is identified by a label affixed to the terminal box cover.

Ease of Use

- Intuitive Local User Interface with four push buttons and LCD allow you to setup and calibrate the device without external tool.
- Using Guided Device Setup digital level controller start-up is straightforward and fast. Level and temperature alarms, specific gravity tables, calibration trim and trending are readily configurable.

Dynamic Temperature Compensation

- Integration of process fluid temperature when needed, enables density compensation to maintain process variable accuracy.
- An Internal Temperature Sensor enables consistent performance of the digital level controller despite ambient temperature changes. With a temperature input signal, either via HART protocol or an RTD connected to the instrument, the digital level controller can also automatically compensate for specific gravity changes due to temperature. A user-supplied table of up to ten linear segments may be entered to implement this feature.

Maintenance Assistance

- HART registered DLC3100 provides device diagnostics and recommended actions to restore instrument functionality.

Alert History

- Alert Record saved in the instrument helps you to troubleshoot when there are abnormalities.

Rugged Construction

- Mechanical safeguards designed into the digital level controller help it to withstand physical abuse often incurred during installation or in transport, without compromising performance. The lever assembly is pinned at the neutral position when the coupling access door is open, providing shipping stabilization for a separate transmitter purchase.

Integration

- Modular design allows interchangeable of components. Part kits are available for spare parts replacement.
- The DLC3100 is designed to be mounted on a wide variety of 249 caged and cageless level sensors as well as on 3rd party non-Emerson displacers from Masoneilan, Foxboro-Eckardt, and Yamatake, through the use of mounting adaptors.

Reliability

- Accurate, high-gain analog-to-digital conversion enables measurement of small changes in the process variable. This allows the DLC3100 to be used in difficult liquid level, interface, or density applications. In addition, an adjustable input filter and output damping help to attenuate displacer-induced ripple in the output signal due to liquid turbulence.

Figure 1. View of Fisher 249 Displacer Sensor with FIELDVUE DLC3100 Digital Level Controller



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- The DLC3100 instrument has fully encapsulated electronics that resist the effects of vibration, temperature, and corrosive atmospheres. An IP66 wiring terminal box isolates field wiring connections from other areas of the instrument.

Specifications

Available Configurations

Mounts on caged and cageless 249 sensors

Function: Transmitter

Communications Protocol: HART

Input Signal

Level, Interface, or Density⁽¹⁾: Rotary motion of torque tube shaft proportional to changes in liquid level, interface level, or density that change the buoyancy of a displacer.

Process Temperature: Interface for 2- or 3-wire 100 ohm platinum RTD for sensing process temperature, or optional user-entered target temperature to permit compensating for changes in specific density.

Output Signal

Analog: 4 to 20 mA DC

■ Direct action—increasing level, interface, or density increases output; or

■ Reverse action—increasing level, interface, or density decreases output

High saturation: 20.5 mA

Low saturation: 3.8 mA

High alarm⁽²⁾: > 21.0 mA

Low Alarm⁽²⁾: < 3.6 mA

Digital: HART 1200 Baud Frequency Shift Keyed (FSK)

HART impedance requirements must be met to enable communication. Total shunt impedance across the master device connections (excluding the master and transmitter impedance) must be between 230 and 600 ohms.

Supply Requirements (see figure 3)

12 to 30 volts DC; 25 mA

Instrument has reverse polarity protection.

A minimum compliance voltage of 17.75 VDC (due to HART impedance requirement) is required to guarantee HART communication.

Transient Voltage Protection

Pulse Waveform		Max V _{CL} @ I _{pp} (Clamping Voltage) (V)	I _{pp} (Peak Pulse Current) (A)
Rise Time (μs)	Decay to 50% (μs)		
10	1000	48.4	12.4

Electrical Classification

Overvoltage Category II per IEC 61010 clause 5.4.2 d

Pollution Degree 4

Altitude Rating

Up to 2000 meters (6562 feet)

Ambient Temperature

The combined temperature effect on zero and span without the 249 sensor is less than 0.02% of full scale per degree Celsius over the operating range -40 to 80°C (-40 to 176°F)

LCD operating temperature limits

-20 to 70°C (-4 to 158°F)⁽³⁾

Process Temperature

The process density and torque rate are affected by the process temperature (see figure 5). Temperature compensation can be implemented to correct for process density changes.

Process Density

The sensitivity to error in knowledge of process density is proportional to the differential density of the calibration. If the differential specific gravity is 0.2, and error of 0.02 specific gravity units in knowledge of a process fluid density represents 10% of span.

Hazardous Area Approvals

CSA

Class/Division: Intrinsically Safe, Explosion-proof⁽⁴⁾, Division 2, Dust Ignition-proof

Zone: Intrinsically Safe, Flameproof, Type n, Dust by intrinsic safety and Enclosure

ATEX/IECEx—Flameproof, Intrinsic Safety, Dust by Intrinsic Safety

Electrical Housing

IP66, Type 4X

Electrical Connections

Two 1/2-14 NPT internal conduit connections. Both are at the bottom of terminal box.

-continued-

Specifications (continued)

Electromagnetic Compatibility

DLC3100 meets EN61326-1:2013
Performance is shown in table 1
DLC3100 SIS meets EN61326-3-2:2008
Performance is shown in table 2

DLC3100 SIS

Safety Instrumented System Classification

SIL2 capable - certified by exida Consulting LLC

Performance

Performance Criteria	DLC3100 Digital Level Controller ⁽¹⁾	w/ NPS 3 249W, Using a 14-inch Displacer	w/ All Other 249 Sensors
Independent Linearity	± 0.25% of output span	± 0.8% of output span	± 0.5% of output span
Hysteresis	<0.2% of output span	---	---
Repeatability	± 0.1% of full scale output	± 0.5% of output span	± 0.3% of output span
Dead Band	<0.05% of input span	---	---
Hysteresis plus Deadband	---	<1.0% of output span	<1.0% of output span

NOTE: At full design span, reference conditions.

1. To lever assembly rotation inputs.

At effective proportional band (PB)<100%, linearity, dead band, and repeatability are derated by the factor (100%/PB)

Minimum Differential Specific Gravity

0.05 SGU

Construction Materials

Housing and Cover: Low-copper aluminum die casting alloy
Internal: Aluminum, and stainless steel; encapsulated printed circuit board
Lever assembly: Plated steel, neodymium iron boron magnets
Hall Guard: Thermoplastic elastomer

Weight

Less than 3.45 kg (7.57 lb)

Options

- Heat insulator⁽⁵⁾ (see figure 2 for use guidelines)
- Mountings for Masoneilan, Yamatake and Foxboro-Eckhardt sensors

1. Density application is not available in DLC3100 SIS.

2. Only one of the High/Low alarm definition is available in a given configuration. Both alarms are NAMUR NE43 compliance.

3. Outside of this limit, LCD will not be readable but it will not affect the functionality of DLC3100 if the temperature is still within the operating limits. Push buttons will be disabled when instrument temperature is below -20°C (-4°F) or above 70°C (158°F) where LCD display might be intermittent.

4. Not for use in Ester and Ketone atmospheres.

5. If the DLC3100 and a 249 sensor are ordered as an assembly, and a heat insulator is required for the application, order the heat insulator as a 249 sensor option.

If the DLC3100 is ordered separately, the heat insulator is available as a kit.

Table 1. DLC3100 EMC Summary Results—Immunity per EN61326-1

Port	Phenomenon	Basic Standard	Test Level	Test Results ⁽¹⁾⁽²⁾
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	4 kV contact 8 kV air	A
	Radiated EM field	IEC 61000-4-3	80 to 1000 MHz @ 10V/m with 1 kHz AM at 80% 1400 to 2000 MHz @ 3V/m with 1 kHz AM at 80% 2000 to 2700 MHz @ 1V/m with 1 kHz AM at 80%	A
	Radiated power frequency magnetic field	IEC 61000-4-8	30 A/m at 50 and 60 Hz	A
I/O signal/control	Burst	IEC 61000-4-4	1 kV	A
	Surge	IEC 61000-4-5	1kV (line to ground only, each)	B
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms	A
Protective earth	Burst	IEC 61000-4-4	2 kV	A
	Surge	IEC 61000-4-5	2 kV (line to ground only)	B
	Conducted RF	IEC 61000-4-6	150 kHz to 80 MHz at 3 Vrms	A

1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering. Specification limit = +/- 1% of span.

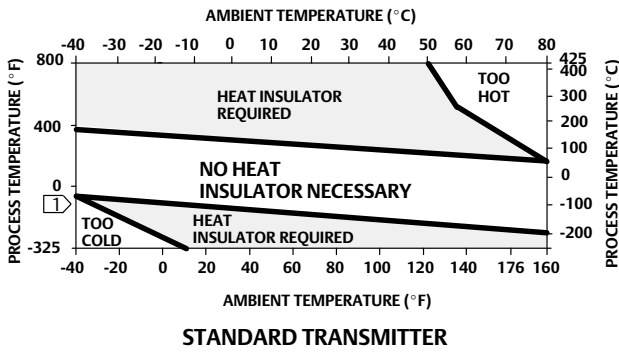
2. HART communication was considered as "not relevant to the process" and is used primarily for configuration, calibration, and diagnostic purposes.

Table 2. DLC3100 SIS EMC Summary Results—Immunity per EN61326-3-2

Port	Phenomenon	Basic Standard	Test Level	Test Results ⁽¹⁾⁽²⁾
Enclosure	Electrostatic discharge (ESD)	IEC 61000-4-2	6 kV contact 8 kV air	A
	Radiated EM field	IEC 61000-4-3	80 to 1000 MHz @ 10V/m with 1 kHz AM at 80% 1400 to 2000 MHz @ 10V/m with 1 kHz AM at 80% 2000 to 2700 MHz @ 3V/m with 1 kHz AM at 80%	A
	Radiated power frequency magnetic field	IEC 61000-4-8	100 A/m at 50 and 60 Hz	A
I/O signal/control	Burst	IEC 61000-4-4	1 kV	A
	Surge	IEC 61000-4-5	1 kV (line to ground only, each)	FS
	Conducted RF	IEC 61000-4-6	10 kHz to 80 MHz at 10 Vrms	A
Protective earth	Burst	IEC 61000-4-4	2 kV	A
	Surge	IEC 61000-4-5	1 kV (line to ground only)	A
	Conducted RF	IEC 61000-4-6	10 kHz to 80 MHz at 10 Vrms	A

1. A = No degradation during testing. B = Temporary degradation during testing, but is self-recovering. FS = Fail Safe. Specification limit = +/- 2% of span.
2. HART communication was considered as "not relevant to the process" and is used primarily for configuration, calibration, and diagnostic purposes.

Figure 2. Guidelines for Use of Optional Heat Insulator Assembly



Notes:

- ① For process temperature below -29° (C-20°F) and above 204°C (400°F) sensor materials must be appropriate for the process (refer to Fisher Bulletin 34.2:2500 [D200037X012] and table 4).
- 2. If ambient dew point is above process temperature, ice formation might cause instrument malfunction and reduce insulator effectiveness.

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A5494-1

Figure 3. Power Supply Requirements and Load Resistance

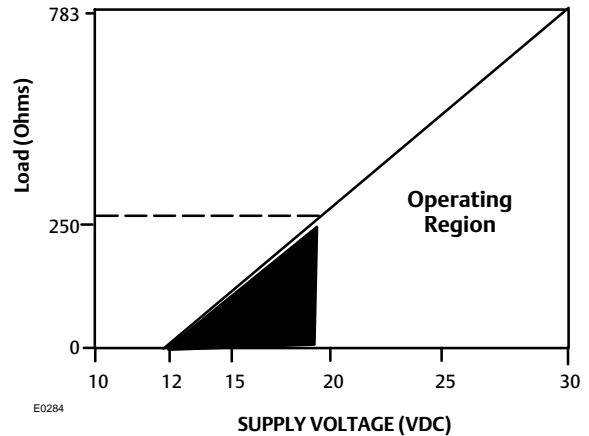


Figure 4. Fisher DLC3100 Overview

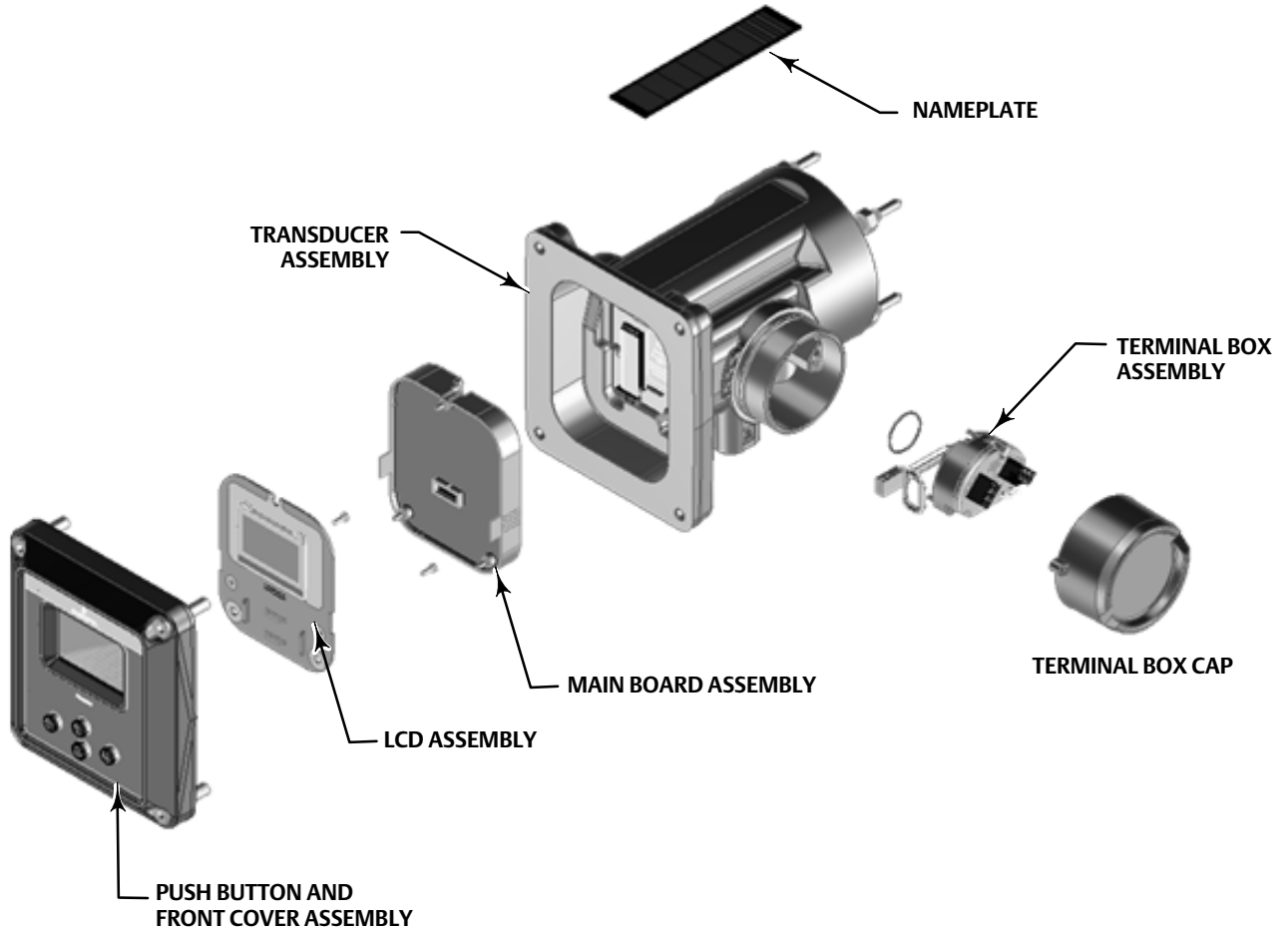
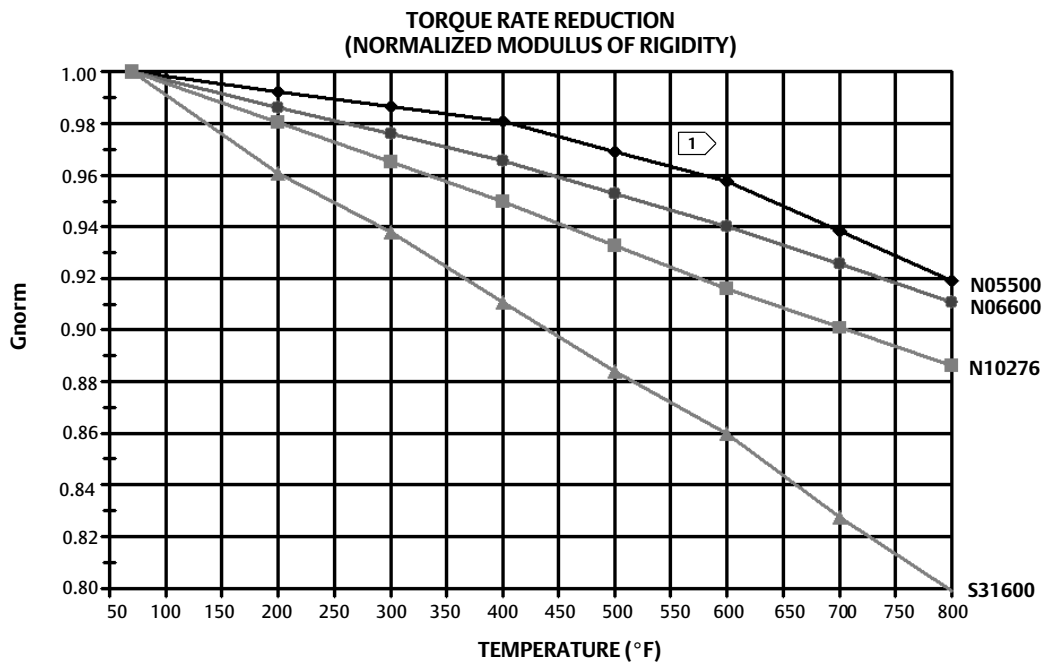
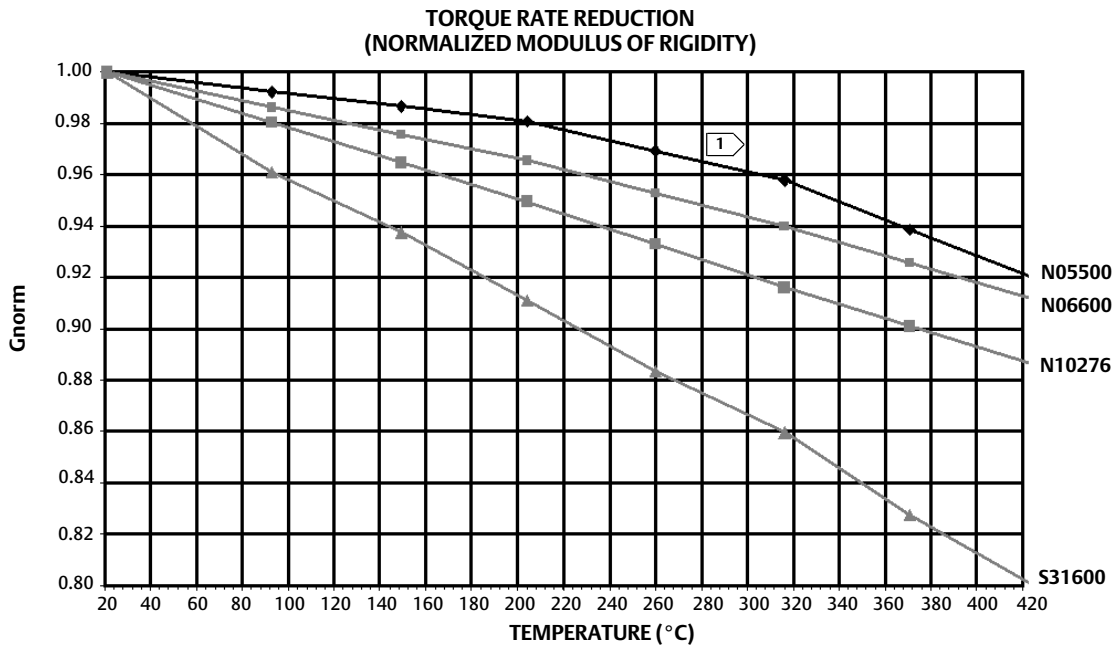


Figure 5. Theoretical Reversible Temperature Effect on Common Torque Tube Materials



Note:

1 Due to the permanent drift that occurs near and above 260°C (500°F), N05500 is not recommended for temperatures above 232°C (450°F).

Principle of Operation

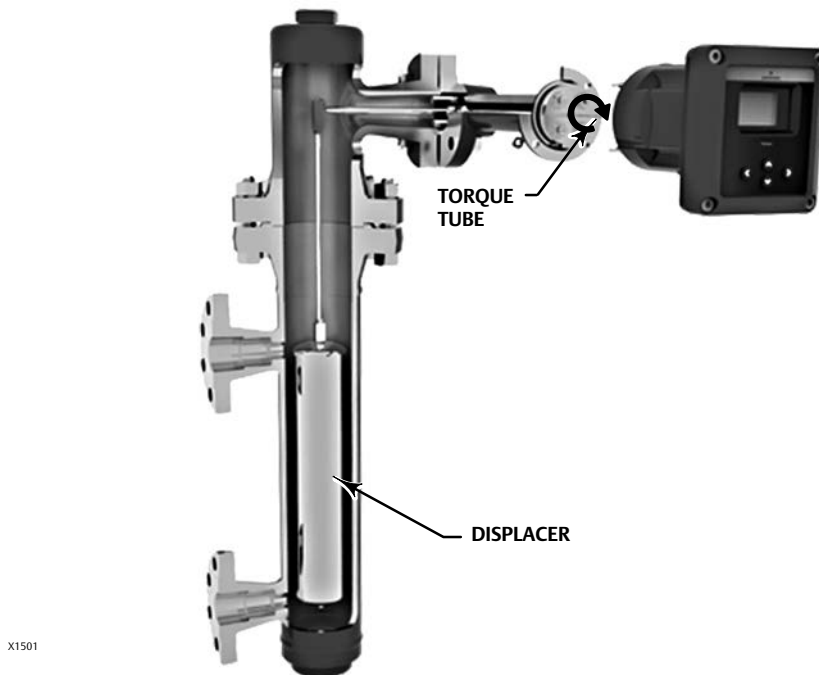
The DLC3100 digital level controller is a loop-powered instrument that measure changes in liquid level, level of an interface between two liquids, or density of a liquid. A level, density, or interface level change in the measured fluid causes a change in the displacer buoyancy (figure 6). This change is transferred to the torque tube assembly. As the measured fluid changes, the torque tube assembly rotates.

The rotary motion of the torque tube is transferred to the digital level controller lever assembly (figure 6). The rotary motion moves a magnet attached to the lever assembly, changing the magnetic field that is sensed by the Hall-effect sensor. The sensor converts the magnetic field signal to a varying electronic signal, which is processed digitally to provide linearity corrections, sensitivity adjustment, and temperature compensation.

The signal is interpreted as a buoyancy change by reference to the stored torque rate, coupling point, and moment arm data. The buoyancy change in turn is interpreted as a level, interface, or density change by reference to stored displacer volume, specific gravity, and displacer length data. In level or interface modes, the correction for displacer motion is then added, as well as user-supplied offset to change the PV reference from the bottom of the displacer or correct for a coupling point error.

The resultant primary variable (PV) is then compared to PV alarm thresholds (if enabled) and used to set status bits and/or trigger the analog alarm current. If the alarm is not triggered, the PV is used to generate 4-20 mA analog and 0-100% range digital signals by reference to the stored upper and lower range values. The resultant analog command is limited at the saturation values to allow discrimination between saturated and alarm signals.

Figure 6. Cutaway View of Fisher 249 Displacer Sensor with FIELDVUE DLC3100 Digital Level Controller



249 Level Sensors Specifications

Input Signal

Liquid Level or Liquid-to-Liquid Interface Level: From 0 to 100 percent of displacer length
Liquid Density: From 0 to 100 percent of displacement force change obtained with given displacer volume—standard volumes are ■ 980 cm³ (60 inches³) for 249C and 249CP sensors or ■ 1640 cm³ (100 inches³) for most other sensors; other volumes available depending upon sensor construction

Sensor Displacer Lengths

See tables 5 and 6 footnotes

Sensor Working Pressures

Consistent with applicable ASME pressure/temperature ratings for the specific sensor constructions shown in tables 5 and 6

Caged Sensor Connection Styles

Cages can be furnished in a variety of end connection styles to facilitate mounting on vessels; the equalizing connection styles are numbered and are shown in figure 8.

Mounting Positions

Most level sensors with cage displacers have a rotatable head. The head may be rotated through 360 degrees to any of eight different positions, as shown in figure 9.

Construction Materials

See tables 3, 5, and 6

Operative Ambient Temperature

See table 4.
For ambient temperature ranges, guidelines, and use of optional heat insulator, see figure 2.

Options

■ Heat insulator ■ Gauge glass for pressures to 29 bar at 232°C (420 psig at 450°F), and ■ Reflex gauges for high temperature and pressure applications

249 Level Sensors

249 level sensors used with the DLC3100 digital level controller are available in both caged and cageless configurations. Figure 7 shows a DLC3100 mounted on a caged 249 sensor. Caged sensors provide more stable operation than do cageless sensors for vessels with internal obstructions or considerable internal turbulence. Cageless sensors are generally used on specific gravity and interface control applications requiring large displacers that are more easily accommodated by flange connections up to 8 inches. The availability of many different displacer stem lengths permits lowering the displacer down to the most advantageous depth in the vessel.

Figure 7. FIELDVUE DLC3100 Digital Level Controller and Fisher 249 Level Sensor



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Table 3. Displacer and Torque Tube Materials

Part	Standard Material	Other Materials
Displacer	304 Stainless Steel	316 Stainless Steel, N10276, N04400, Plastic, and Special Alloys
Displacer Stem, Driver Bearing, Displacer Rod and Driver	316 Stainless Steel	N10276, N04400, other Austenitic Stainless Steels, and Special Alloys
Torque Tube	N05500 ⁽¹⁾	316 Stainless Steel, N06600, N10276

1. N05500 is not recommended for spring applications above 232°C (450°F). Contact your [Emerson sales office](#) or application engineer if temperatures exceeding this limit are required.

Table 4. Allowable Process Temperatures for Common Fisher 249 Sensor Pressure Boundary Materials

MATERIAL	PROCESS TEMPERATURE	
	Min.	Max.
Cast Iron	-29°C (-20°F)	232°C (450°F)
Steel	-29°C (-20°F)	427°C (800°F)
Stainless Steel	-198°C (-325°F)	427°C (800°F)
N04400	-198°C (-325°F)	427°C (800°F)
Graphite Laminate/SST Gaskets	-198°C (-325°F)	427°C (800°F)
N04400/PTFE Gaskets	-73°C (-100°F)	204°C (400°F)

Table 5. Caged Displacer Sensors⁽¹⁾

TORQUE TUBE ORIENTATION	SENSOR	STANDARD CAGE, HEAD, AND TORQUE TUBE ARM MATERIAL	EQUALIZING CONNECTION		PRESSURE RATING ⁽²⁾
			Style	Size (NPS)	
Torque tube arm rotatable with respect to equalizing connections	249 ⁽³⁾	Cast Iron	Screwed	1-1/2 or 2	CL125 or 250
			Flanged	2	
	249B, 249BF ⁽⁴⁾	Steel	Screwed or optional socket weld	1-1/2 or 2	CL600
			Raised face or optional ring type joint flanged	1-1/2	CL150, 300, or 600
				2	CL150, 300, or 600
			249C ⁽³⁾	316 Stainless Steel	Screwed
	Raised face flanged	1-1/2			CL150, 300, or 600
				2	CL150, 300, or 600
	249K	Steel	Raised face or optional ring type joint flanged	1-1/2 or 2	CL900 or 1500
	249L	Steel	Ring type joint flanged	2 ⁽⁵⁾	CL2500

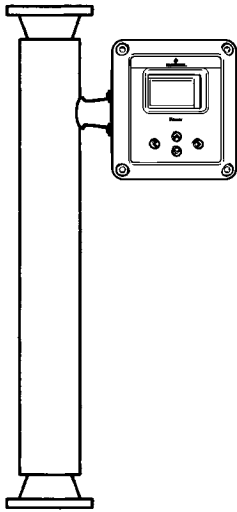
1. Standard displacer lengths for all styles (except 249) are 14, 32, 48, 60, 72, 84, 96, 108 and 120 inches. The 249 uses a displacer with a length of either 14 or 32 inches.
 2. DIN flange connections available in EMA (Europe, Middle East and Africa).
 3. Not available in EMA.
 4. 249BF available in EMA only. Also available in DIN size DN40 with PN10 to PN100 flanges and size DN50 with PN10 to PN63 flanges.
 5. Top connection is 1-inch ring-type joint flanged for connection styles F1 and F2.

Table 6. Cageless Displacer Sensors⁽¹⁾

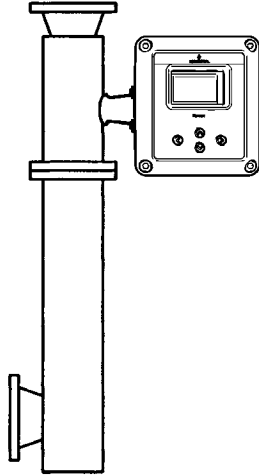
Mounting	Sensor	Standard Head ⁽²⁾ , Wafer Body ⁽⁶⁾ , and Torque Tube Arm Material	Flange Connection	Pressure Rating ⁽³⁾
Mounts on top of vessel	249BP ⁽⁴⁾	Steel	NPS 4 raised face or optional ring type joint	CL150, 300, or 600
			NPS 6 or 8 raised face	CL150 or 300
	249CP	316 Stainless Steel	NPS 3 raised face	CL150, 300, or 600
	249P ⁽⁵⁾	Steel or Stainless Steel	NPS 4 raised face or optional ring type joint	CL900 or 1500 (EN PN 10 to DIN PN 250)
NPS 6 or 8 raised face			CL150, 300, 600, 900, 1500, or 2500	
Mounts on side of vessel	249VS	Cast Iron, Cast Steel or CF8M (316 Stainless Steel)	For NPS 4 raised face or flat face	CL125, 150, 250, 300, 900, or 1500 (EN PN 10 to DIN PN 160)
			For NPS 4 butt weld end, XXS	CL2500
Mounts on top of vessel or on customer supplied cage	249W	WCC (steel) or CF8M	For NPS 3 raised face	CL150, 300, or 600
		LCC (steel) or CF8M	For NPS 4 raised face	CL150, 300, or 600

1. Standard displacer lengths are 14, 32, 48, 60, 72, 84, 96, 108, and 120 inches.
 2. Not used with side-mounted sensors.
 3. DIN flange connections available in EMA (Europe, Middle East and Africa).
 4. Not available in EMA.
 5. 249P available in EMA only.
 6. Wafer Body only applicable to 249W.

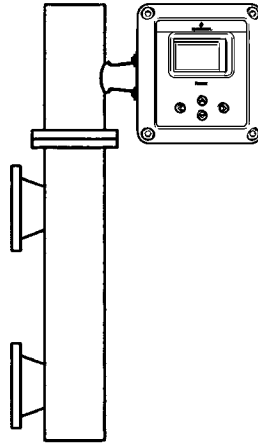
Figure 8. Style Number of Equalizing Connections



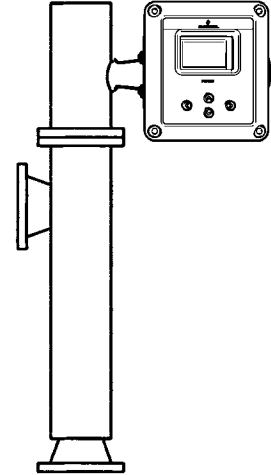
TOP & BOTTOM
CONNECTIONS
SCREWED (S-1) OR
FLANGED (F-1)



TOP & LOWER SIDE
CONNECTIONS
SCREWED (S-2) OR
FLANGED (F-2)



UPPER & LOWER SIDE
CONNECTIONS
SCREWED (S-3) OR
FLANGED (F-3)



UPPER SIDE & BOTTOM
CONNECTIONS
SCREWED (S-4) OR
FLANGED (F-4)

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Installation

A 249 sensor may be shipped with the DLC3100 digital level controller installed or they may be shipped separately.

When shipping a skid mounted system, where the displacer cannot be restrained, it is recommended that the transmitter be uncoupled and the lever assembly locked to prevent damage. The transmitter must be re-coupled at commissioning, and a zero-trim will be required.

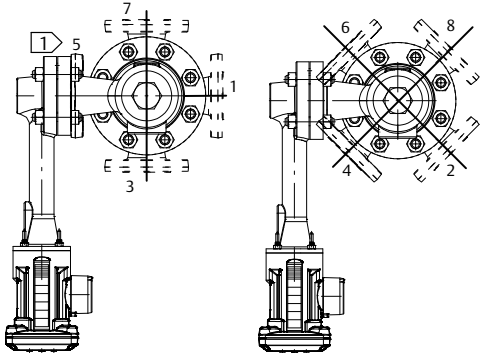
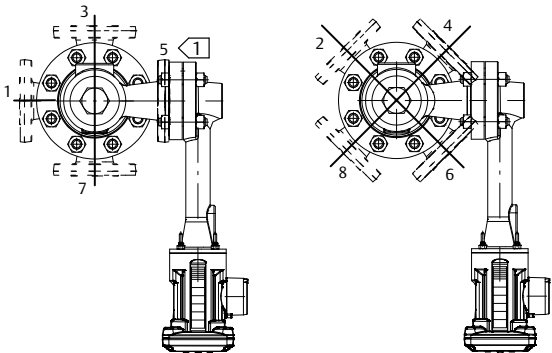
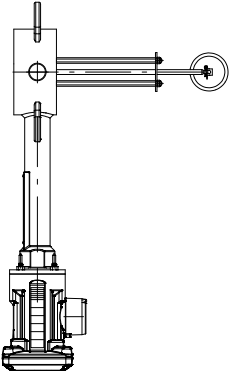
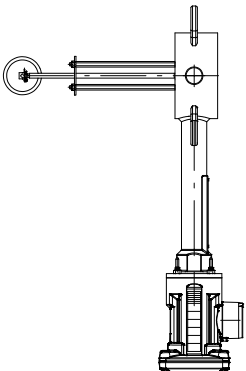
Dimensions for the DLC3100 are shown in figure 10.

Ordering Information

When ordering, specify:

- Process temperature and pressure and ambient air temperature
- Application
- Liquid level service (specific gravity)
- Interface level service (specific gravity of both liquids and minimum differential gap or span required)
- Density service (minimum and maximum specific gravity required)
- Liquid(s) Category (Water/Steam, Hydrocarbon, H₂SO₄, Custom Fluid)
- Liquid(s) Type (Water, Saline, Saturated Water, Saturated Steam, Crude Oil, Refined Product, Gas Well Condensate, H₂SO₄ %)

Figure 9. Typical Mounting Positions for FIELDVUE DLC3100 Digital Level Controller on Fisher 249 Sensors

SENSOR	LEFT-OF-DISPLACER	RIGHT-OF-DISPLACER
CAGED		
CAGELESS		

1 Not available for 249C and 249K.

E1700

Construction

Refer to the specifications tables. Review the descriptions below each specification and in the referenced tables and figures; specify the desired choice whenever there is a selection to be made.

Heat Insulator

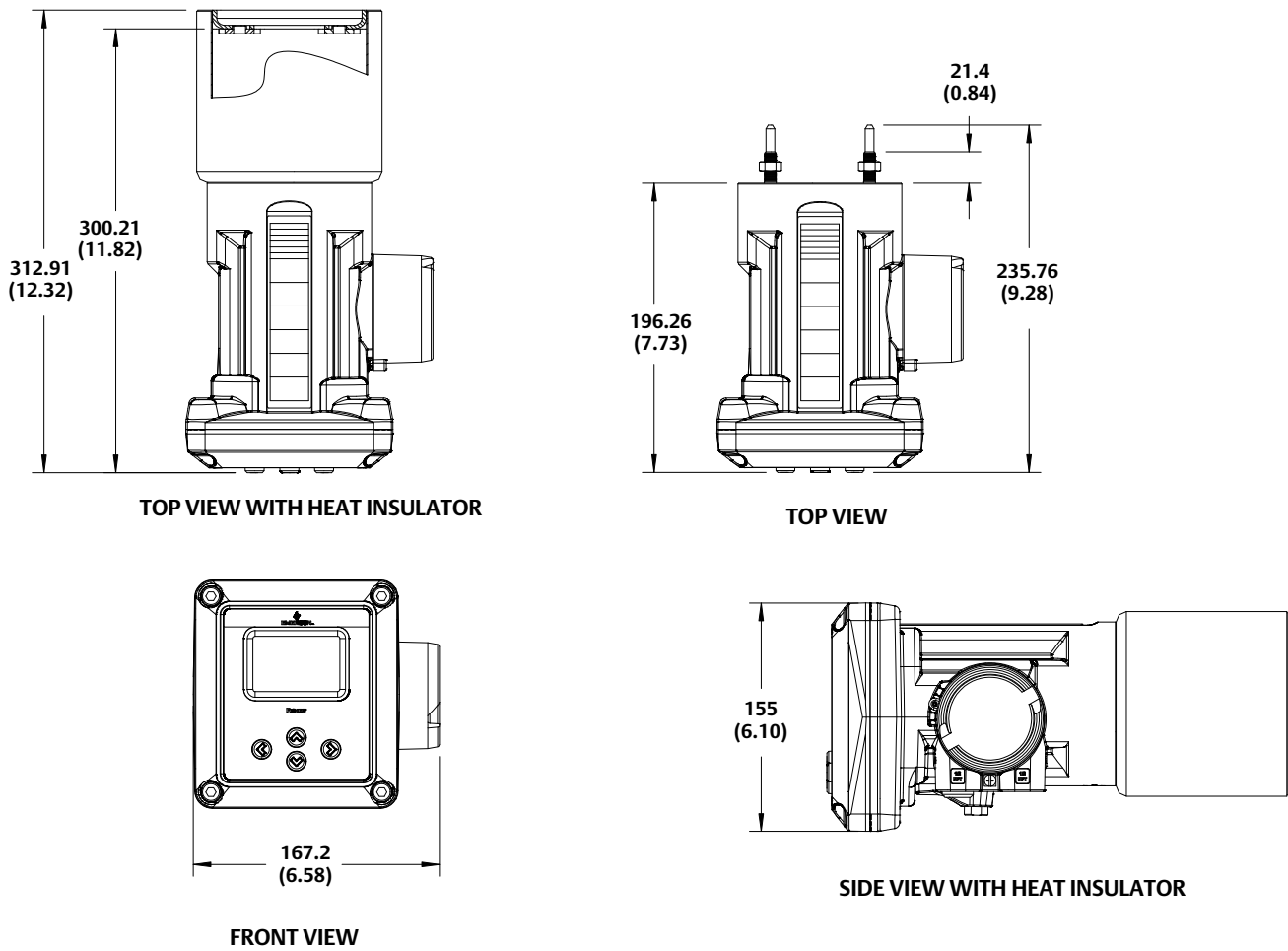
DLC3100 Digital Level Controller

If the DLC3100 and the 249 sensor are ordered as an assembly, and a heat insulator is required for the application, order the heat insulator as a 249 sensor option. If the DLC3100 is ordered separately, the heat insulator is available as a kit.

Sunshade

Although the DLC3100 is not affected by sunlight, a sunshade kit is available, to be mounted on a 249 torque tube arm, if there is concern about direct sunlight shining on the instrument. See figure 11 and 12.

Figure 10. Dimensions for FIELDVUE DLC3100 Digital Level Controller



GC42807

mm
(INCH)

Figure 11. FIELDVUE DLC3100 with GRP Sunshade

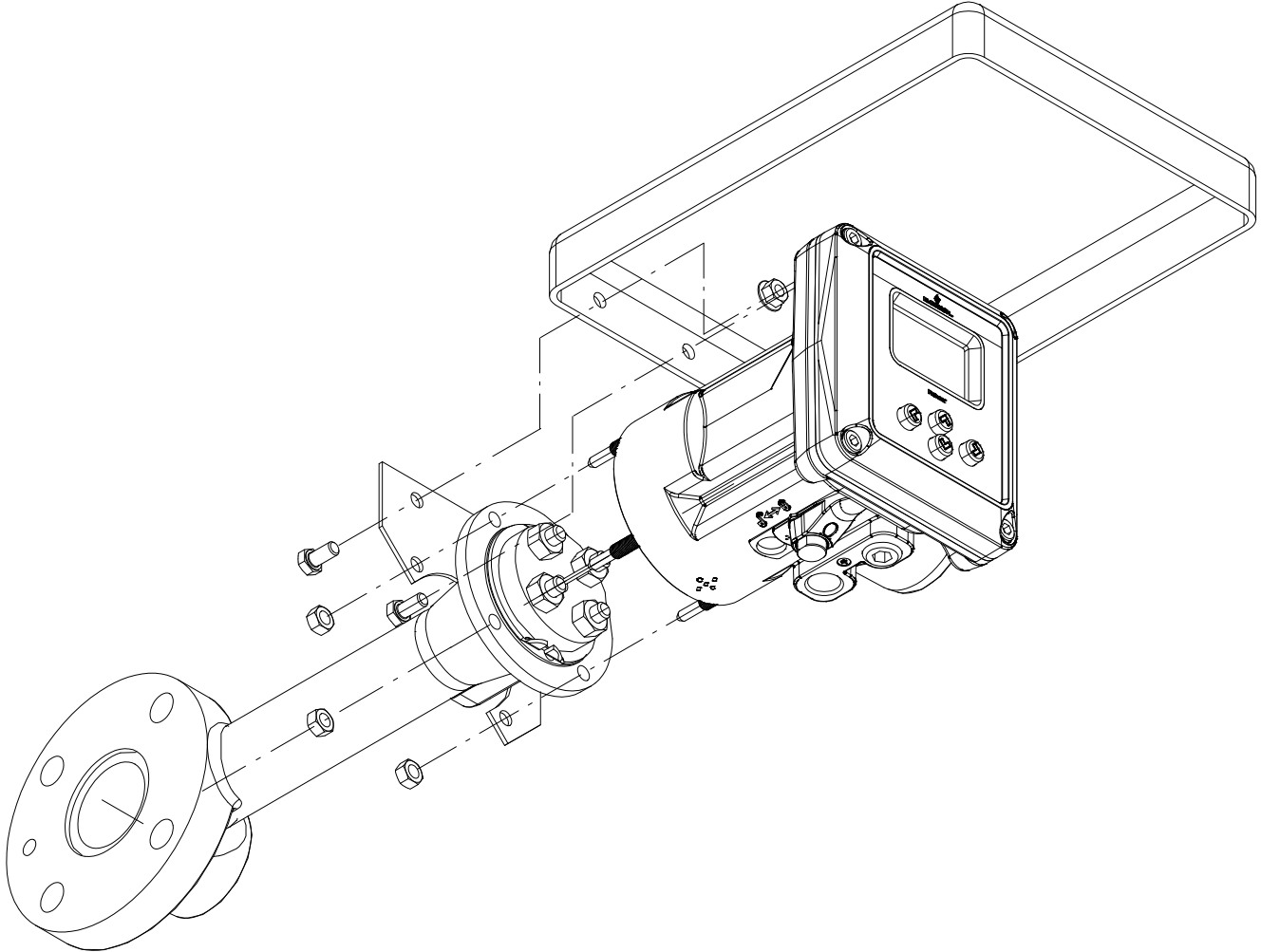
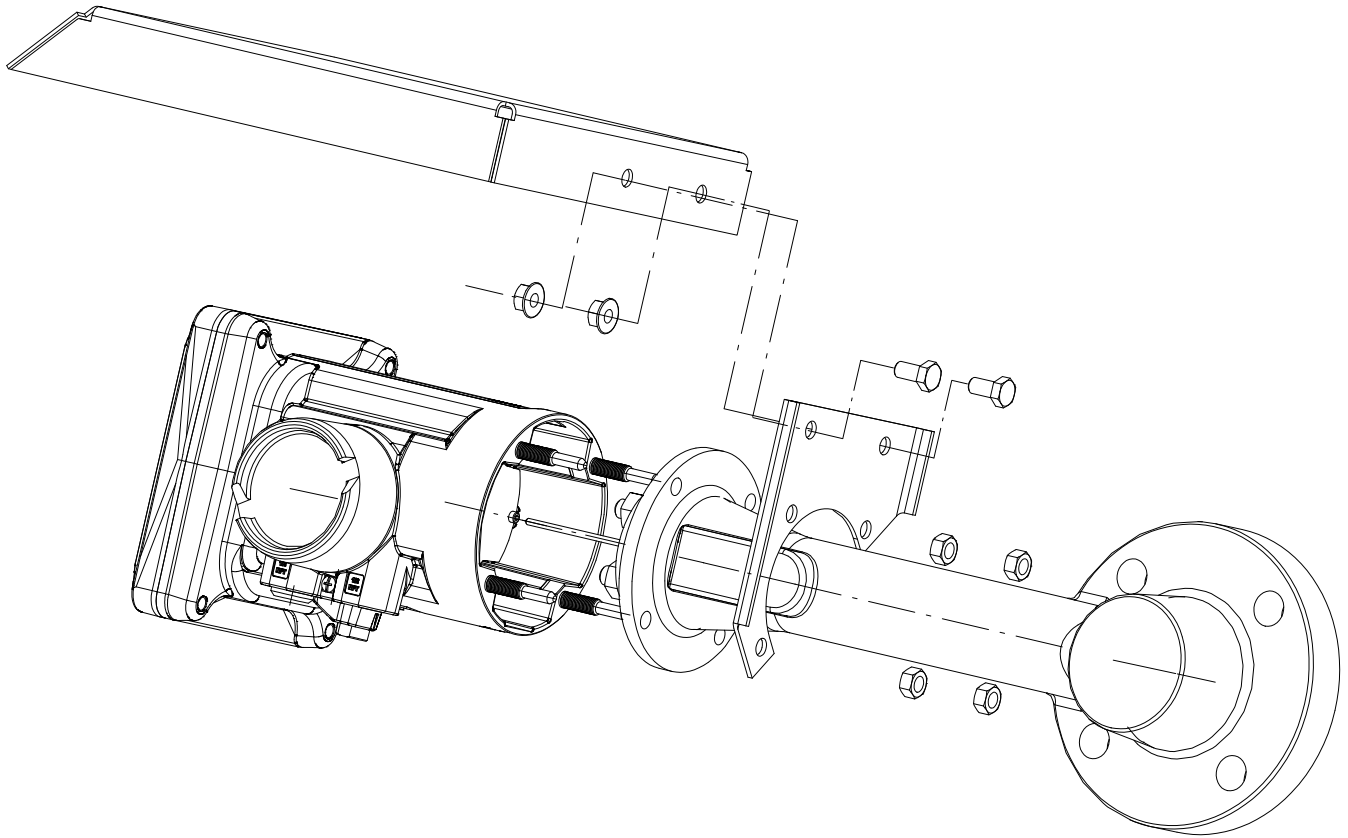


Figure 12. FIELDVUE DLC3100 with 316SST Sunshade



Product Bulletin

11.2:DLC3100
July 2019

DLC3100 Digital Level Controller
D104216X012

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