

## ForeSite® Sense Quartz

Provides comprehensive multiparameter downhole sensing for well production, injection, and monitoring

### Applications

- Wide-ranging subsurface monitoring capacities throughout the expected well or field life
- Zonal isolation monitoring and pressure-transient analysis
- Pressure and temperature (P/T) applications and reservoir pressure monitoring
- P/T data monitoring for automation and analysis of artificial lift
- Intelligent completions and artificial lift optimization
- Subsea monitoring

### Features and Benefits

- Fully hybridized gauge is rated to 348°F (177°C) for exceptional accuracy and resolution in demanding environments.
- Fully welded gauge assemblies include 100% pressure testable sealing interfaces, with no elastomer seals.
- V0-rated cablehead with redundant metal-to-metal sealing is fully pressure-testable for enhanced versatility and reliability.
- P/T gauge eliminates wireline intervention and production downtime for pressure surveys in vertical or horizontal wells.
- Shear quartz resonator transducer provides stability and repeatability.
- Full digital signal transmission eliminates data corruption when installed with other wellbore electrical signal sources, such as electronic submersible pumps (ESPs).

### Tool Description

The Weatherford ForeSite Sense quartz solution is a value-adding production-optimization solution for superior real-time reservoir monitoring.

This electronic pressure and temperature gauge gauge is used in zonal-isolation, intelligent-completion, and artificial-lift applications to acquire P/T data for production optimization and reservoir management decisions.

Weatherford incorporates hybrid electronic technology into the gauge design to provide a rigorous operating envelope that covers extreme environmental, handling, and wellbore conditions. The implemented design specifications enable exceptional performance. Single-sensing gauges, dual gauges with splitter, and dual-sensing gauges with or without cable bypass configurations are all standard offerings.



The ForeSite Sense quartz solution provides permanent monitoring of pressures and temperatures.



# ForeSite<sup>®</sup> Sense Quartz

## Specifications

### Operational Performance

Maximum operating temperature	348°F (177°C)	
Calibrated temperature range	77 to 392°F (25 to 200°C)	
Available operational ranges	Pressure	Temperature
	10,000 psi (689.5 bar) (68.95 MPa)	77 to 302°F (25 to 150°C)
	16,000 psi (1,103.2 bar) (110.32 MPa)	77 to 302°F (25 to 150°C) 77 to 348°F (25 to 177°C)
	20,000 psi (1,379 bar) (137.90 MPa)	77 to 348°F (25 to 177°C)
	25,000 psi (1,723.7 bar) (172.37 MPa)*	77 to 348°F (25 to 177°C)
Maximum non-operating pressure at maximum temperature	10% over calibrated pressure	
Minimum storage temperature	-49°F (-45°C)	
Operating current	3.8 mA	

### Pressure Metrology

Accuracy at maximum temperature	0.015%
Resolution at maximum temperature	0.00008%
Long-term stability/year at maximum temperature	<0.5 psi/yr (<0.034 bar/yr) (<0.0034 MPa/yr)

### Temperature Metrology

Accuracy	+/-0.18°F (+/-0.10°C)
Resolution	<0.01°F (<0.005°C)
Long-term stability/year	<0.18°F/yr (<0.1°C/yr) @ 348°F (177°C)

### Mechanical

Weight	1.6 lb (0.73kg)
Outside diameter	0.875 in. (22.2 mm)
Length	16.0 in. (406 mm)

### Shock and Vibration Data

Vibration	40 Gmms NavMat, 0-5 kHz
Shock	500 g, 1 ms
Drop	1,000 g, 1 ms

\* Special Request

A TR-2385 qualified gauge is also available



# ForeSite<sup>®</sup> Sense Quartz

## Dry Mate Cablehead for Electronic Quartz Gauge

The ForeSite Sense dry mate cablehead is a highly reliable electromechanical connector for the Quartz PT electronic gauge. Redundant metal-to-metal seals and complete field pressure testability maximizes reliability of the downhole sensing system throughout the life of the well. The dry mate cablehead combined with the Quartz hybrid electronic-quartz permanent monitoring system is a value-added production optimization solution for superior permanent, real-time reservoir pressure and temperature monitoring.

The dry mate cablehead is tested to the same combined environmental stress standards as the Quartz gauge. The combined environmental stresses in a well can subject the cablehead termination to extreme temperatures, pressures, vibration and shock.

### Features and Benefits

- Field-proven design combines the highest industry standards with seal redundancy and pressure testability.
- Corrosion-resistant cablehead alloys comply with the NACE MR0175 standard to withstand corrosive and sour-gas environments.
- The cablehead is rated to 392°F (200 °C) and 20,000psi (1379 bar) to provide exceptional longevity and reliability under demanding environmental conditions.
- Cable armor stress relief against tensile loading prevents external stresses on the pressure seals.
- Redundant pressure testable, bi-directional metal-to-metal seals permit a secure and reliable pressure barrier from the cable to gauge termination.

### Specifications

#### Operational performance

Service temperature	-13 to 392°F (-25 to 200°C)
Service pressure	20ksi (1,379 bar)
Minimum storage temperature	-49°F (-45°C)
Electrical rating	1,000 volts

#### Material

Wetted	Nickel-base alloys (Inconel <sup>®</sup> 120Ksi)
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#### Seals\*

TEC (cable)	Dual compression set, metal-metal, pressure testable
Gauge	Metal C-ring compression, tapered metal-metal seal face, pressure testable

#### Mechanical

Weight	0.9 lb (0.408 kg)
Outside diameter	0.875 in. (22.2 mm)
Make-up length	8.376 in. (212.75 mm)

\*The xQuartzPT GT Cablehead version is VO rated and meets ISO 14998 VO standards.



# ForeSite® Sense Quartz

## Electronic Gauge Mandrel

The ForeSite Sense electronic gauge mandrels provide a means for mounting a pressure/temperature (P/T) gauge on the completion string. Each mandrel is machined from a single billet, with no welds, to provide mechanical protection along the full length of the gauge. A metal-to-metal interface between gauge and mandrel enhances sealing reliability.

Configurations of the gauge mandrel are available to support above-packer and interzonal monitoring requirements as well as single- or multi-gauge configurations for redundancy or tubing- and annulus-pressure measurement.

The gauge mandrel meets all completion sizes while maintaining full bore ID. It supports control-line bypass for applications requiring chemical-injection or intelligent-well configurations where control lines are required for flow-control valves.

### Features and Benefits

- Mandrel alloys are compatible with metals used in completion design.
- Premium threads and connections comply with completion design.
- Design accommodates single or multiple gauges with splitter block assembly.

### Specifications

- Designed to API 5CT specifications
- Burst and collapse pressure calculated per API 5C3



# ForeSite<sup>®</sup> Sense Quartz

## Splitter Block and Cable Splice Assemblies

The ForeSite Sense splitter block assemblies accommodate the connection of dual pressure/temperature (PT) gauges, a single PT gauge and cable bypass, or dual cable bypasses from a single conductor tubing-encapsulated cable (TEC). Complete cable and dual gauge terminations to the splitter block are accomplished with three connections. The simplified splitter design requires no field assembly, which increases overall system integrity. All connections are pressure testable.

Cable splice assemblies allow field splicing in the event that the cable becomes damaged during system conveyance. Splice assemblies use proven dual metal-to-metal seals that are fully pressure testable.

### Features and Benefits

- Splitter block assembly mandrel mount simplifies interconnectivity and reduces the number of mechanical and electrical connections.
- Simplified cable splitter is a one-in/two-out interconnection splice system.
- Internal connections within the splitter assembly are wire free.
- Design incorporates 100% metal-to-metal seals, with no elastomeric seals used for in-well seals.
- Internal bus bar system electrically interconnects dry mateable connectors for the cable and gauges to eliminate component failure resulting from vibration induced by production or well operations.
- Splitter blocks and cable splice assembly seals may be tested in the field to confirm mechanical, electrical, and pressure-bearing integrity.

### Specifications

Parameter	Splitter block	Cable splice
Seals	Welded and dual metal to metal	Dual metal to metal
Pressure testable	Fully pressure testable to system design specifications,	testing performed onsite after final makeup
Material	INCOLOY <sup>®</sup> 718	316L SS Alternate: INCOLOY 718 (high-yield alloys)
Interconnections	Single-pin dry connect	Metal-wire crimp
Pressure rating	INCOLOY: 20,000 psi (137.9 MPa)	INCOLOY: 20,000 psi (137.9 MPa) Stainless: 10,000 psi (68.9 MPa)
Collapse pressure**	INCOLOY: 22,000 psi (151.7 MPa)	INCOLOY: 22,000 psi (151.7 MPa) Stainless: 11,000 psi (75.8 MPa)

\* INCOLOY is a registered trademark of the Special Metals Company  
 \*\* Collapse pressure calculated in accordance with API 5C3.



# ForeSite® Sense Quartz

## Electrical Downhole Cable

The ForeSite Sense electrical downhole cable provides a reliable pathway to transmit data for in-well pressure and temperature sensing systems. It also provides power to the downhole gauge.

The tubular encapsulated conductor (TEC) uses a 0.25-in. (6.35 mm) diameter armor tube to encapsulate the electrical conductor. The cable is available in either 0.028-, 0.035-, or 0.049-in. (0.71-, 0.89-, or 1.24 mm) armor wall thickness. The electrical conductor is copper. Conductor 'tinning' or 'plating' is dependent upon the service temperature, to 302° or 392°F (150° or 200°C).

Between the conductor and armor tube ID, filler and insulator materials are used to centralize and enhance mechanical integrity to the cable system, as well as insulate the electrical conductor from the armor. All cables are pressure tested and undergo the standard 'Eddy Current Testing' process.

### Features and Benefits

- Encapsulation in a variety of polymeric materials is offered to suit a range of well conditions.
- Stranded core maximizes power and telemetry transmission characteristics.
- Process enhancements such as improved core concentricity, diameter tolerance and surface finish improve reliability.
- Installation technique isolates and protects the cable from stress, thus enhancing reliability throughout the life of the well.

### Specifications

#### Physical Properties

Tube wall thickness	0.028 in. (0.71 mm)	0.035 in. (0.89 mm)	0.049 in. (1.24 mm)
Tubing OD	0.25 in. (6.35 mm)		
Working pressure: 316L stainless steel	10,000 psi (689.48 bar)	15,000 psi (1,034.21 bar)	20,000 psi (1,378.95 bar)
Working pressure: INCOLOY® 825*	10,000 psi (689.48 bar)	15,000 psi (1,034.21 bar)	20,000 psi (1,378.95 bar)
Collapse pressure: 316L stainless steel	20,000 psi (1,378.95 bar)	30,000 psi (2,068.43 bar)	40,000 psi (2,757.90 bar)
Collapse pressure: INCOLOY 825	20,600 psi <sup>1</sup> (1,420.32 bar)	29,600 psi <sup>1</sup> (2,040.85 bar)	40,000 psi (2,757.90 bar)
Weight (bare): 316L stainless steel	87 lb/kft (130 kg/km)	100 lb/kft (149 kg/km)	100 lb/kft (149 kg/km)
Weight (bare): INCOLOY 825	88 lb/kft (131 kg/km)	101 lb/kft (150 kg/km)	124 lb/kft (185 kg/km)

<sup>1</sup> At 302°F (150°C)

\* INCOLOY is a trademark of the Special Metals Company



# ForeSite<sup>®</sup> Sense Quartz

## Electrical Downhole Cable (continued)

### Specifications (continued)

#### Electrical Properties

Capacitance at 68°F (20°C): 316L stainless steel	26 pF/ft (85.3 pF/m)	32 pF/ft (104.9 pF/m)	36 pF/ft (118.1 pF/m)
Capacitance at 68°F (20°C): INCOLOY 825	26 pF/ft (85.3 pF/m)	32 pF/ft (104.9 pF/m)	36 pF/ft (118.1 pF/m)
Conductor DC resistance at 68°F (20°C)	7 Ohms/kft (23 Ohms/km)		
Voltage rating	1,000 Vdc		
Insulation resistance (minimum)	6,500 Mohms/kft (21,325 Mohms/km)		

\*Manufacturer temperature rating in nominal test environment

#### Typical Encapsulation Options

Material	Material Temperature Rating*
Polypropylene	302°F (150°C)
Santoprene	302°F (150°C)
Nylon 11 (Rilsan)	275°F (135°C)
PVDF	302°F (150°C)
ETFE (Tefzel)	302°F (150°C)
ECTFE 350LC	302°F (150°C)
ECTFE 902 (Halar)	347°F (175°C)
FEP	392°F (200°C)
MFA/PFA	392°F (200°C)

\*Manufacturer temperature rating in nominal test environment

#### Material

Conductor	7-strand tin copper - 18 AWG
Insulator	Tefzel (ETFE): 302°F (150°C)* or Fluoropolymer: 392°F (200°C)
Filler Layer	Polypropylene: 302°F (150°C) or Fluoropolymer: 392°F (200°C)

\*Manufacturer temperature rating in nominal test environment



# ForeSite® Sense Quartz

## Mechanical Splice

The ForeSite Sense mechanical splice facilitates splicing of downhole instrumentation cables. This simple, cable-to-cable connection system features pressure testable seals and can be configured to work with either electrical or optical downhole cable designs. The TR2385-qualified design meets the industry's highest standards.

### Features and Benefits

- TR2385 qualified to 392°F (200°C) and 20 kpsi for reliable life-of-well applications.
- Cable compatibility facilitates use with electrical or optical cable.

### Specifications

#### Operational Performance

Service temperature	-13 to 392°F (-25 to 200°C)
Service pressure	20Kpsi (1379 bar)
Maximum tension	500 lb (2224 N)
Minimum storage temperature	-49°F (-45°C)
Electrical rating	1,000 volts

#### Material

Wetted	Nickel-base alloys (Incone® 120Ksi)
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#### Seals

Cable	Dual compression set, metal-metal, pressure testable
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#### Mechanical

Weight (single connector)	0.5 lb (0.227kg)
Outside diameter	0.875 in. (22.2 mm)
Make-up length (single connector)	8.376 in. (212.75 mm)





# ForeSite<sup>®</sup> Sense Quartz

## Cable Protector

The ForeSite Sense cable protector supports single or multiple cables and control lines outside the tubing to prevent damage or stretch where the cable or control line crosses pipe joints, safety valves, crossovers, and other associated downhole hardware.

Weatherford provides a wide range of cable protectors to suit different types of well-monitoring applications. The type of cable protector required depends upon completion configuration, wellbore geometry, and well type. The cable protector is customized for specific tubing sizes, thread types, materials, coupling dimensions, number of cable or control lines, encapsulation size of cable or control lines, and overall dimension requirements inside the casing.

The one-piece assembly has no loose parts, with the bolting inbuilt to the protector. Using a pre-engaged swing bolt enables easy fitting and torquing during installation, which saves rig time and reduces the risk of cable damage. If needed, cable protector refurbishment is offered where practical.

The protectors, which are ductile yet hard-wearing and reliable, are highly resistant to steady-state shock and shock loads. The standard protectors withstand high axial loads up to 30 tons (67,200 lbf) and high lateral loads up to 20 tons (44,800 lbf).

Protector material is all-cast carbon steel or stainless steel, which conforms to NACEMR0175 for sour wells. For optical or electronic cables, Weatherford provides predominantly cast-cross-coupling protectors as a safe means of deploying cable in the well. Other alloys suited for harsh environments are also available. Advanced polymers are offered for low friction and superior impact resistance.

### Features and Benefits

- Bolting system locks the protector in place with a close fit over the coupling.
- Bolting or tightening torque resists axial and rotational lateral movement.
- Contoured profile mitigates the potential for impact while running or pulling the completion string by deflecting the cable away from damaged casing or production string.
- Angled or chambered profile protects the bolting mechanism against running hang-ups.



# ForeSite<sup>®</sup> Sense Quartz

## Cable Protector (continued)

### Specifications

General	Wiper Blade	I-Wire	Cast/Strapped X-Coupling	Stamped X-Coupling	Polymer X-Coupling
Well geometry	Vertical, no deviation, no dogleg	Vertical, no deviation, no dogleg	Any well deviation through horizontal	Any well deviation through horizontal	Any well deviation through horizontal
Applications	Single, 1/4-in., bare line only	Up to 2 1/4-in. lines	For any cable and line combination and encapsulation	Up to five bare lines or three encapsulated cables	For any cable and line combination and encapsulation
Outer diameter*	2-7/8 to 3-1/2 in. (50.8 to 76.2 mm)	All tubing sizes	All tubing sizes	All tubing sizes	All tubing sizes
Length	15 in. (381 mm)	18 in. (457.2 mm)	Varies upon design criteria	Varies upon design criteria	Varies upon design criteria
Make-up	Pneumatic or manual with 3/4-in. banding	Pneumatic or manual with 3/4-in. banding	30-ft/lb (40.7-N•m) captive bolts	Pneumatic or manual with hinged tapered pin	30-ft/lb (40.7-N•m) captive bolts
Casing size	5 to 6-5/8 in. (127 to 168.3 mm)	4-1/2 to 6-5/8 in. (114.3 to 168.3 mm)	5-1/2 to 9-5/8 in. (139.7 to 244.5 mm)	5-1/2 to 9-5/8 in. (139.7 to 244.5 mm)	5-1/2 to 9-5/8 in. (139.7 to 244.5 mm)
Casing weight	20.3 to 50.4 lb (9.2 to 22.9 kg)	18.8 to 20 lb (8.5 to 9.1 kg)	User specified	User specified	User specified
Special protector**	N/A	N/A	Available	Available	Available

\* Protector clearance with tubing and casing combinations are verified for each completion

\*\* SSSV, SSAV, GLM, injection valve, ICD/ICV, and Xovers

Note: Selection criteria and final cable protector programmed are project specific. Torque and drag, and tubing-stress-analysis tools, will support the final choice.



# ForeSite<sup>®</sup> Sense Quartz

## Tubing Hanger Termination Kit: Bend Restrictor for Tubing Encapsulating Cable (TEC)

The ForeSite Sense bend restrictor for 1/4-in. downhole instrument cables prevents cable damage at high stress points at the top of the tubing hanger. The tubing bend restrictor is placed at the fitting on top of the hanger to prevent the cable from breaking at the fitting and to prevent the minimum bending radius of the cable from being exceeded.

The 1/4-in. TEC is typically fed through the tubing hanger on dry trees. The TEC is normally sealed off with one or two metal-to-metal seal fittings, with one on top and one on the bottom of the tubing hanger. Further, the cables are normally wrapped once or twice around the neck of the tubing hanger before landing the hanger. During the landing process, pinching or breaking of the Instrument TEC cable can occur. The bend restrictor reduces the probability of cable damage.

### Features and Benefits

- Sizes available for 1/8-, 1/4-, 3/8-, and 1/2-in. tubing fittings; adapters for other sizes or configurations are available upon request.

## Tubing Hanger Termination Kit: Tubing Hanger Feed-Through Fitting

The ForeSite Sense tubing hanger feed-through fitting provides a pressure barrier at the point of entry between the tubing hanger and the cable. TEC downhole Instrument cables are typically fed through the tubing hanger on dry trees and are sealed off with one or two metal-to-metal seal fittings.

### Features and Benefits

- Metal fitting alloys are available in either Inconel or stainless steel.
- Fitting configuration uses common rear and front ferrule metal seals.



# ForeSite® Sense Quartz

## Electrical Wellhead Outlet

The ForeSite Sense electrical wellhead outlet (eWHO) accommodates cable feed-through and exit of TEC electric downhole cable from a wellhead. A metal-to-metal primary pressure seal on the TEC armor and the bore of the wellhead penetrator provides the primary pressure barrier. The chamber within the eWHO enables interface of the downhole cable with the surface cabling. A bulkhead feed-through provides a secondary pressure barrier.

The eWHO is quick and easy to install and can operate in harsh environments throughout the life of the well. This outlet is designed to API 6A standards, and has been certified as complying with the Essential Health and Safety Requirements of Annex II of ATEX Directive 94/9/EC. It also complies with European Community standards EN 60079-0: 2012 and EN 60079-1: 2007.

### Features and Benefits

- Wellhead-flange adaptors comply with specific wellhead designs
- Metal-to-metal seals provide system integrity for low and high-pressure applications.
- Customizable design conforms to client requirements regarding port size, materials, pressure/ temperature ratings, and well conditions.

### Specifications

Working pressure	10,000 psi (689.5 bar)	15,000 psi (1,034 bar)
Wellhead connection thread	1/2 in. NPT male	
Intermediate body connection thread	1 in. AE	
Electrical exit connecting thread	1/2 in. NPT male	9/16 in. NPT male
Component material (standard)	400 series stainless steel (13 Cr)	
Component material (options)	HP yield alloys	
Overall length, in. (cm)	11.5 in. (29.21cm)	18.83 in. (47.82 cm)
Certifications	CML 15 ATEX 1181 Ex d IIB T4 Gb IP66 ATEX/QPS, Zone 1	



# ForeSite<sup>®</sup> Sense Quartz

## Electrical Surface Instrument Cable

The ForeSite Sense electrical surface instrumentation cable provides electrical power connection and signal communication from the wellhead outlet to the surface instrument system. This Gardex<sup>®</sup> FieldBus cable consists of a 600 volt, 18 AWG shielded twisted pair instrumentation cable with XLPE insulation. It is approved for Class I, Zone 1 locations.

Gardex FieldBus cable is flexible, with impervious armor that prevents the entrance of water, gas and corrosive elements into the electrical core. It may be installed in tray, duct, conduit, self-supported or direct burial applications.

### Features and Benefits

- Completely self-contained fieldbus communication cable is suitable for use in harsh environments.

### Specifications

#### General

Wire size (AWG)	18 AWG
Number of pairs	1 (multi-pair available)
Inner jacket thickness	0.04 in. (1.02 mm)
Armor thickness	0.025 in. (0.64 mm)
Armor diameter	0.54 in. (13.7 mm)
Outer jacket thickness	0.05 in. (1.27 mm)
Nominal overall diameter	0.65 in. (16.51 mm)
Approximate net weight	182 lb per 1,000 ft (597 kg per 1,000 m)
Temperature rating	-94 to 194°F (-70 to 90°C)
Insulation	Passes ASTM D 746-04 brittleness temperature impact test at -103°F (-75°C) Passes MIL-C-13777 cold bend test at -85°F (-65°C)
UL listed	NEC Type MC, UL 1569 NEC Type MC-HL, UL 2225
UL approved and marked	FT-4 designation (flame test) -40°F (-40°C) meeting cold impact requirement of CSAC22.2 No. 0.3

#### Construction

Conductor	18 AWG, 7 strand annealed tin copper, Class B strand per ASTM B-8 and B-33
Insulation	Cross-linked polyethylene (XLPE)
Shielded pair	Twisted with tin copper drain wire and aluminum foil shield
Shielded pair jacket	Flame-retardant black ARCTIC Grade PVC
PVC armor	Continuously welded and corrugated aluminum

#### Electrical

Impedance	100 ohms
Mutual capacitance,	17 pf per ft (55.8 pf per m)
Inductance	0.17 μH/ft (.56 μH/m)
Conductor resistance at 68°F (20°C)	7.34 ohms per 1,000 ft (24.1 ohms per 1,000 m)

Gardex is a registered trademark of Rockbestos-Suprenant Cable Corporation.



# ForeSite® Sense Quartz

## Surface Data Acquisition Unit

The ForeSite Sense surface data acquisition unit collects data collection from the quartz pressure and temperature gauge. This stand-alone system monitors up to 64 quartz PT gauges in up to 16 wells. The surface data acquisition system is capable of high-speed data transfer, connectivity, and data storage. It provides continuous service in harsh environments including desert, swamp, platform, and low- temperature environments. Power requirements are suitable for use with solar arrays or thermoelectric generators.

The surface data acquisition unit is fully compatible with Weatherford reservoir monitoring system software including Admin Client, SCADA, Launcher, Data Viewer, Web Data Viewer, Database Reporting Tool, DCE Triggering Tool, and PanQL™ software (auto-transient quick look). A Windows®-based operating system requires no custom programming. The unit provides remote access to real-time and historical data through a web browser.

The surface data acquisition unit has been assessed and certified to the requirements of the European Union's ATEX Directive 94/9/EC as Ex nA IIB T4 Gc IP66 (-20°C ≤ Ta ≤ 65°C) for installation and operation in flammable gas atmospheres it is marked as Group II Category 3 G (Class I, Zone 2).

### Features and Benefits

- Modular design enables phased implementation for multi-well and multi-gauge projects to ease the integration of future installations.
- Easy setup and field termination offer fast and trouble-free installations with all output options and configurations performed at the wellsite.
- Fast data rates enable data recording at the highest density irrespective of transfer rate to the client SCADA or server, for detailed analysis of any production anomalies.

### Specifications

#### General

CPU	Arbor Ares-530WT with Intel® Atom™ E3845, 1.91 GHz processor
Memory	DDR3L RAM 4 GB, 1,333 MHz
Operating system	Windows
Software	Web-viewer reservoir monitoring software controlling data collection, storage, display, and I/O output
Display	4-line by 20-characters, vacuum florescent
Power (approximate - application specific)	18 to 36 VDC or 85 to 264 VAC input, 55W maximum power consumption
Bandwidth capability	Up to 64 gauges
Update rate selectable range	1 second to no limit
Data storage	Up to 2 years
Units	Configurable (metric, imperial, oilfield)

#### Communications

Serial port	One RS232, one RS422 or RS485 selectable
Ethernet	Two ports, 10/100/1,000 BaseT
Protocol	Modbus ASCII, Modbus RTU, Modbus TCP/IP, OPC version 1.0 and 2.0, CSV ASCII, formatted ASCII



# ForeSite<sup>®</sup> Sense Quartz

## Surface Data Acquisition Unit

### Specifications (continued)

#### Physical

Overall dimensions	32.5 H x 26 W x 10.35 D in. (826 H x 661 W x 263 D mm)
Mounting dimensions	Four 3/8 in. (10 mm) bolts
Horizontal mounting spacing	18 in. (457 mm) centers
Vertical mounting spacing	31.25 in. (794 mm) square pattern
Weight	95 lb (43.1 kg)
Enclosure material	316 stainless steel

#### Environment

Operating temperature	-40° to 140°F (-40° to 65°C)
Relative humidity	95% non-condensing
Certification markings	ATEX, CE
Transportation vibration	NAVMAT P9294 section 3

#### ATEX Certifications

Standard	Group II, Category 3 G (Class 1, Zone 2)
Optional	ATEX Directive Category II GP 11B for use in Zone 1 hazardous locations

Windows, MODBUS, Intel and Core are registered trademarks of their respective companies.



# ForeSite<sup>®</sup> Sense Quartz

## Interrogation Unit

The ForeSite Sense interrogation unit queries Quartz PT permanent downhole gauges to provide pressure and temperature monitoring. The primary function of the interrogation unit is to send raw Quartz PT gauge data to the surface acquisition unit so that the software can convert the data to processed pressure and temperature information based upon calibration values for each specific sensor.

The secondary function is to monitor and control the downhole Quartz PT gauges through commands sent to the downhole interface (DHI) card to enable or disable power. It also receives diagnostic and state-of-health information from the downhole quartz PT gauges.

All the sensor connections and the data interface connections are accessed through the interrogation unit front panel. The front panel is accessible by pulling the handles on the front cover and allowing the cover to rotate in a downward direction. Only AC main power is connected to the back. The interrogation unit is 3U high (5.25 inches of rack height) and has a perforated cover on the top and bottom for cooling. 1U of space is required above and below the unit and other rack items to allow cool, dry air to move through the chassis. The 1U cable management tray included on the bottom of the unit will satisfy cooling-space requirements for the bottom of the unit. A total of 5U (8.75 inches of rack space) is required for ideal installation. The unit dissipates less than 100 W (128 x Quartz PT gauges connected), when operating.

The interrogation unit accommodates up to eight third-generation DHI cards that can each communicate to a downhole telemetry line (downhole tubing encapsulated cable—TEC). Each single conductor TEC cable can have up to 16 individual addressable Quartz PT gauges. Thus, a single nForm-mqx rack mount instrument can receive data from up to 128 Quartz PT pressure-temperature gauges.

### Features and Benefits

- Multiple port Ethernet switch facilitates interconnection with all DHI cards; a serial port bus accommodates legacy connections.
- Moderate operating range withstands temperatures from 41 to 104°F (5 to 40°C).

### Specifications

#### General

Design life	25 years
Maximum number of Quartz PT gauges interfaced per rack	128

#### Outputs

Communications	Ethernet RS422/RS485
DHI to wellhead	Type: One twisted-pair plus shield ground Connector: Spring release terminal Output signal: Up to 50 VDC at 200 mA





# ForeSite<sup>®</sup> Sense Quartz

## Interrogation Unit

### Specifications (continued)

#### Input Power

Frequency	50 to 60 Hz nominal AC single phase, operating range 47 to 63 Hz
Operating voltage	Universal 85 to 265 VAC
Current	2.5 Amps maximum

#### Physical

Dimensions (W x D x H)	Standard 19-in. EIA rack-mount 3U high 19 in. x 14.5 in. x 5.25 in. (483 mm x 369 mm x 133.4 mm)
Weight	Approximately 18 lb (8.2 kg), depending upon exact DHI count configuration

#### Environmental

Operating temperature	+5 to +40°C (41 to 104°F)
Storage temperature	-40 to +85°C (-40 to 185°F)
Humidity	0 to 85% non-condensing
Maximum operating elevation	3,050 meters (10,000 feet)
Shock and vibration	Transportation vibration Navmat P9294 profile random vibration 10 minutes per axis six Grms, non-operating. Operational vibration 0.1 g sweep 0.1 octave/minute 5 to 100 Hz, 90 minutes per axis (TelecordiaGR-63-CORE for network equipment operation) Shock 10 g, peak 2-ms half sine in each of three axes
Enclosure	IP Rating: IP 20 – Closed to ingress of objects larger than 12.5 mm and not water protected. For indoor use only. Suitable for use in Pollution Degree 2: (where) normally only nonconductive pollution occurs. Temporary conductivity caused by condensation is to be expected.
EC directive(s)	Directive 2006/95/EC, Low Voltage Directive
Applicable standards	EN 61010-1:2010, Safety requirements for electrical equipment for measurement, control and laboratory use Part 1 General requirements



# ForeSite<sup>®</sup> Sense Quartz

## Data Acquisition System

The ForeSite Sense data acquisition system collects and distributes real-time pressure and temperature data from Weatherford Quartz PT gauges. This standalone system can monitor up to 32 quartz PT pressure and temperature gauges in harsh environments, including desert, swamp, and arctic settings. It can withstand extreme weather conditions ranging from -22° to 149°F (-30° to +65°C).

The data acquisition system uses a 24 VDC input with a low current draw. This Class I Zone 2 ATEX-certified system is capable of high-speed data transfer and storing more than 6 years of data at a sample rate of once per second. The ability to initiate 'smart' trigger logging to record transients is standard in all systems. It can be configured to log at any user-defined rate and comes standard with digital and analog inputs and outputs to meet a wide range of field applications.

### Features and Benefits

- Compact, powder-coated enclosure with an external visor facilitates on-site data viewing and configuration using the enhanced graphic display (EGD) and keypad or human machine interface (HMI) graphical touchscreen.
- HMI touchscreen display enables visualization of data charts, historical data or point-to-point data in real time with a single touch of the screen.
- Built-in web page interface enables on-site or remote configuration of output and setup options, for enhanced programming flexibility.
- Automatic control logic (ACL) offers flexibility and structured text programming for ease of system configuration.
- High-density data via secure digital (SD) card or universal serial bus (USB) download enables detailed analysis of production anomalies.

### Specifications

#### Environmental

Temperature rating	EGD display models: -22° to 149°F (-30° to 65°C)
	HMI models – graphical touchscreen -22° to 140°C (-30° to 60°C)

#### Power Requirements

Electrical rating	85 to 230 VAC, 50/60 Hz (AC model)
	18 to 32 VDC (DC model)
Power	Single-gauge system: 23.2 W
	Fully loaded system: 33.5 W

#### Physical Properties

Physical size (W×D×H)	15.8 in. × 10.5 in. × 17.12 in. (401.3 × 266.7 × 434.85 mm)
Mounting type	Wall or pole (pole with standard mounting kit)
Weight	44 lb (19.95 kg) – standard powder coated enclosure
	55 lb (24.9 kg) – marine stainless-steel enclosure



# ForeSite<sup>®</sup> Sense Quartz

## Data Acquisition System

### Specifications (continued)

#### Communications

Optional Wi-Fi	Plug-on
Serial	RS232, RS485
Ethernet	10BaseT

#### Inputs/Outputs (Standard Configuration)

Digital inputs (DI)	Two each
Analog output (AO)	One, isolated, configurable for content selection
Analog inputs (AI)	Two, configurable 1 to 5 V, 4 to 20 mA

#### Gauge Properties for Gauge Interface Card (DHI)

Maximum number of DHI	2
Maximum number of gauges	32

#### Logging Capabilities

Maximum update range	1 second
Data storage (SD card)	> 6 years at maximum update rate (for 8GB SD Card and single gauge)

#### Firmware Upgrades

Available via preprogrammed SD card or via Weatherford Configuration Manager (WCM)
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#### Standard Certifications

ATEX	II 3 G Ex nA IIB T4 Gc, $-30^{\circ}\text{C} \leq T_a \leq +65^{\circ}\text{C}$ for EGD (Enhanced Graphic Display Models)
	II 3 G Ex nA IIB T4 Gc, $-30^{\circ}\text{C} \leq T_a \leq +60^{\circ}\text{C}$ for HMI (Human Machine Interface – color touchscreen)



# ForeSite® Sense Quartz

## Quartz PT Subsea Interface Card

The ForeSite Sense quartz PT subsea interface card is used for monitoring downhole pressure and temperature in subsea wells. This card provides a reliable and robust interface between the quartz PT downhole gauge and subsea electronics module (SEM) or subsea control module (SCM). This subsea interface permits communication with multiple gauges per well.

Interface connectors depend on tree vendor selection regarding the SEM. The standard interface is IWIS compliant, and can be interfaced via the SEM or directly to a PC. The Ethernet interface and the IWIS interface each enable operation of:

- Web server
- Modbus/TCP
- Telnet
- Weatherford maintenance tools

The Ethernet interface supports IEEE 802.3/802.3u - 100BASE-TX/ 10BASE-T physical layers, providing speeds of 10/100Mbps. Auto negotiation is supported, and the IP address can be set by the dynamic host configuration protocol (DHCP) server or with a fixed configured address. The Weatherford nForm-ssq subsea interface card has proprietary state-of-the-art technology, and uses the latest field-programmable gate array (FPGA) architectures.

This interface card surpasses all environmental requirements with regard to testing standards. The interface operating envelope is designed to withstand extreme environmental, handling, and sea-bed conditions.

Weatherford interface card manufacturing processes adhere to stringent industry specifications for functionality, testing and reliability

### Specifications

#### General

Mechanical dimensions	Standard Eurocard (100 X 160 mm)
Interface	Eurocard 96 pin DIN 41612 Male (other Interfaces available, depending on SEM requirements)
Input supply voltage (Vdc)	18-32Vdc
Electrical inspection standards	FCC Part 15, EN61000, EN55022, ISO 13628-6
Electrical specifications	IPC A-620A, IPC A-620D, IPC-600G
Configurable engineering units	Pressure: barA, barG, psiA, psiG, kPaA and kPaG Temperature: °C or °F
Redundancy	Hot switchable, depending upon SEM/Tree vendor
Number of Quartz PT gauges per card	Up to 16
Operating range	-4°F to 158°F (-20°C to +70°C)



# ForeSite<sup>®</sup> Sense Quartz

## Quartz PT Subsea Interface Card

### Specifications (continued)

#### Communication

Ports	RS-422, RS-485, Ethernet
Interfaces	IWIS, Modbus RTU, Modbus TCP/IP
Configurable interface protocols	IWIS (Bitrates from 9.6 kbps up to 230.4 kbps – Auto Detect)
	Modbus RTU (configurable parity and bitrate) or TCP/IP (10 or 100 Mbps)

#### Diagnostics

Complete internal card and gauge diagnostics	Protocol IP address Status Transmitted bytes Total throughput bytes Errors – characters and packets Modbus RTU (configurable parity and bitrate) or TCP/IP (10 or 100 Mbps)
Gauge diagnostics	Complete gauge diagnostics, including communications measurements and errors
Communications diagnostics	Ethernet diagnostics TCP/IP diagnostics IWIS diagnostics Internal subsea interface diagnostics

#### Vibration and Shock

Vibration (each x, y, z)	Severity 5Hz - 25Hz: +/- 2mm displacement Severity 25Hz - 1kHz: 5g Resonance amp. factor: ≤10 from 5 - 150Hz
Shock GPEAK	30g 11ms half-sine: all axis

