ElecTRON
Subsea Instrumentation Feedthrough Connector Systems
Siemens Subsea Connectors (Tronic Products)

www.siemens.com/energy/subsea
Market-leading technology

Siemens Subsea has an established global reputation for the manufacture and delivery of market-leading subsea connector and measurement technology.

Siemens Subsea Connectors is recognised throughout the global subsea oil and gas industry as leading in the design, manufacture and installation of reliable subsea mateable electrical and optical connection systems.

Siemens Subsea Connectors, Tronic products are market-leading high integrity subsea power and data connection systems. These, combined with our subsea sensors, offer a convenient integrated scope of supply, with our customers benefiting from a single source of supply for complete systems including sensors. This gives the advantage of a simplified supply chain, coupled with a single warranty.

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**ElecTRON Instrumentation Feedthrough Subsea Connector Systems**

The ElecTRON range of instrumentation feedthrough subsea connectors are designed to convey electrical signals from pressure and temperature sensors down hole through the Tubing Hanger and Xmas Tree.

The ElecTRON range of connectors are used for both vertical and horizontal systems as well as landing strings and a wide range of test caps, dummy hangers etc.

ElecTRON connectors are currently qualified to maximum working pressure of 15,000 psi, temperatures up to 149°C and are rated for gas wells (currently developing a system capable of working at -18°C to 177°C at 15,000 psi and beyond).

ElecTRON products have proven reliability on a wide range of major developments worldwide (please see below.)

Siemens Subsea Connectors are also in the process of standardising interfaces for the range of vertical systems that will allow the customer to use only one set of interfaces irrelevant of individual project pressures and temperatures.

**Qualified to:** API6A-PR2 (Gas), API-17D, NACE MR0175, PSL3 & PSL3G

**ElecTRON Worldwide Systems Deployment**

![Map showing global deployment of ElecTRON systems]

- Tunisia
- Nigeria
- Malaysia
- Angola
- Brazil
- Gulf of Mexico
- India
- North Sea
- Australia
ElecTRON – Technology Overview

Controlled Environment (CE) Principle

ElecTRON wet-mateable connectors are based around the unique and patented Controlled Environment (CE) principle. This arrangement ensures the highest level of integrity for long life and repeated subsea mating capability.

- The CE plug features an oil-filled primary diaphragm to prevent water ingress. Each electrical socket is further protected within an individual secondary oil-filled diaphragm
- Both diaphragms have individual seals, failure of either seal would not compromise the connector’s integrity
- Shuttle pins prevent water ingress or loss of oil when the connector is not mated
- Insulated pins on the receptacle connector displace the shuttle pins during the mating process. The conductive tips of the pins are wiped twice before making contact with the electrical socket
- The whole assembly is pressure balanced to minimise stress within the sealing areas

CE Principle - Sequence of Operations

1. Receptacle & plug prior to mating
2. Receptacle pin engages with shuttle pin of plug assembly
3. Receptacle pin enters first oil chamber of the primary diaphragm and pushes back the shuttle pin
4. Receptacle pin enters secondary diaphragm and makes full contact with plug socket
ElecTRON 15,000 psi Standard Single Pin Horizontal Feedthrough System

The standard single pin horizontal feedthrough system is rated at 15,000 psi, 140°C (Gas), with systems also available rated at up to 149°C (Gas). These feedthrough systems use standard A70 dry mate plugs (1) which mate with the single pin dry mate receptacle (2) on the underside of the tubing hanger.

The signal wire is fed through the tubing hanger cavity to a single pin wet mate receptacle connector (3). A single pin wet mate plug connector (4) is compliantly mounted inside an actuator sleeve assembly (5) within a bonnet assembly which enables a connection between tubing hanger and tree.

An internal penetrator (6) and a DigiTRON Receptacle outlet (7) complete the feedthrough system.

A jumper harness, utilising AquaTRON hose and DigiTRON controls connectors, can then be used to maintain the signal continuity of the feedthrough system, on to the control pod or intervention monitoring equipment.

Once the tubing hanger has been run, an ROV operates a mechanism on the outside of the bonnet to move the carriage horizontally and mate the connectors. Retrieval is the reverse of the sequence. First the ROV de-mates the connectors and then the hanger can be pulled.

If there is an emergency and the tubing hanger has to be removed immediately, the wet mate plug is designed to shear. This prevents the tubing hanger from being ‘locked in’

<table>
<thead>
<tr>
<th>Single Pin Horizontal FT Systems Temperature &amp; Pressure Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C to 140°C @ 15,000PSI (Gas)</td>
</tr>
<tr>
<td>-18°C to 145°C @ 10,000PSI (Gas)</td>
</tr>
<tr>
<td>-18°C to 149°C @ 7,500PSI (Gas)</td>
</tr>
<tr>
<td>-18°C to 135°C @ 15,000PSI (Gas)</td>
</tr>
</tbody>
</table>
**Description**

1. A70 Downhole Dry Mate Plug
2. Downhole Dry Mate Receptacle
3. Wet Mate Receptacle
4. Wet Mate Plug
5. Actuator Sleeve Assembly
6. Internal Penetrator
7. DigiTRON Receptacle Outlet
ElecTRON Multi-Pin Horizontal Feedthrough Systems

The multi-pin horizontal feedthrough system is rated at 10,000 psi, -18°C to 145°C (Gas). This gives up to two downhole signals (plus earth) which are terminated to standard Siemens Subsea Connectors A70 downhole dry mate plugs (1). These mate with the 2 way splitter (2) which is fixed to the under-side of the tubing hanger.

The signal wires are fed through to a 4 pin wet mate receptacle connector (3). A 4 pin wet mate plug connector (4) is compliantly mounted inside an actuator sleeve assembly (5) within a bonnet assembly which enables a connection between tubing hanger and tree.

An internal penetrator (6) and a bonnet adaptor (7) leads to the subsea environment where AquaTRON™ hose (8) connects to DigiTRON™ stab plate receptacle connector (9), which is used to enable signals to be sent to the control pod or to intervention monitoring equipment.

Once the tubing hanger has been run, an ROV operates a mechanism on the outside of the bonnet to move the carriage and mate the connectors. Retrieval is the reverse of the sequence. First the ROV de-mates the connectors and then the hanger is pulled.

Siemens Subsea Connectors offer an alternative to the ‘two way splitter’ and dry mate plugs. This is in the form of a 2 pin dry mate connector pair (10 & 11). Each connector consists of one body with multi-pin internals.

We also offer a 3 way (plus earth) feedthrough system, which utilises a similar 3 way in-line dry mate receptacle splitter assembly and which connects up to 3 dry mate plug connectors.

<table>
<thead>
<tr>
<th>Multi-Pin Horizontal FT Systems</th>
<th>Temperature &amp; Pressure Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Splitter: -18°C to 145°C @ 10,000PSI (Gas)</td>
<td>18°C to 121 °C @ 10,000PSI</td>
</tr>
</tbody>
</table>

Optional Downhole Dry Mate Single Connector with multi-pin internals
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A70 Downhole Dry Mate Plug (2-off)</td>
</tr>
<tr>
<td>2</td>
<td>2 Way Splitter</td>
</tr>
<tr>
<td>3</td>
<td>4 Pin Wet Mate Receptacle</td>
</tr>
<tr>
<td>4</td>
<td>4 Pin Wet Mate Plug</td>
</tr>
<tr>
<td>5</td>
<td>Actuator Sleeve Assembly</td>
</tr>
<tr>
<td>6</td>
<td>Internal Penetrator</td>
</tr>
<tr>
<td>7</td>
<td>Bonnet Adaptor</td>
</tr>
<tr>
<td>8</td>
<td>AquaTRON Hose</td>
</tr>
<tr>
<td>9</td>
<td>4-Way DigiTRON Connector</td>
</tr>
<tr>
<td>10</td>
<td>Optional Downhole 2 Pin Dry Mate Plug</td>
</tr>
<tr>
<td>11</td>
<td>Optional Downhole 2 Pin Dry Mate Receptacle</td>
</tr>
</tbody>
</table>

**Bonnet Assembly**

![Diagram of Bonnet Assembly](image)
ElecTRON 15,000 psi Standard Single Pin Vertical Feedthrough System

Instrumentation Feedthrough Systems for Vertical Trees
Metal / metal and elastomeric sealing components are used for optimum performance and flexibility. All field assembled components are fitted with test ports to ensure integrity before deployment.
The single pin vertical feedthrough system is rated at 15,000 psi with working temperatures up to 135°C

Tubing Hanger Components
These systems use the standard A70 dry mate plugs (1) which mate to the dry mate receptacle end of the wet mate receptacle mandrel (2).
The wet mate receptacle mandrel is factory terminated / tested and simply screws into the tubing hanger sealing interface.
At the top of the of the wet mate receptacle mandrel (2) is the wet mate receptacle, which mates with the wet mate plug mandrel (3).

Valve Block Components
The wet mate plug mandrel (3) is factory terminated / tested and like the wet mate receptacle mandrel (2), screws into the valve block.
The mandrel uses a 1/8” diameter metal tube that is sealed to the body and fed through the valve block cavity. This tube provides protection for the wire as requested by customers.
The tube / wire is then terminated to the well head outlet (4) and DigiTRON wet mate receptacle. The DigiTRON wet mate receptacle is then mated to the DigiTRON diver mated plug (5).

<table>
<thead>
<tr>
<th>Single Pin Vertical FT Systems</th>
<th>Temperature &amp; Pressure Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C to 135 °C @ 15,000PSI (Gas)</td>
<td></td>
</tr>
<tr>
<td>-18°C to 121°C @ 10,000PSI (Gas)</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td></td>
</tr>
<tr>
<td>1 A70 Dry Mate Downhole Plug</td>
<td></td>
</tr>
<tr>
<td>2 Wet Mate Receptacle Mandrel</td>
<td></td>
</tr>
<tr>
<td>3 Wet Mate Plug Mandrel</td>
<td></td>
</tr>
<tr>
<td>4 Well Head Outlet with DigiTRON</td>
<td></td>
</tr>
<tr>
<td>5 DigiTRON Diver Mate Receptacle</td>
<td></td>
</tr>
<tr>
<td>6 DigiTRON Diver Mate Plug</td>
<td></td>
</tr>
</tbody>
</table>
ElecTRON
10,000 psi Single Pin Vertical Feedthrough System (Increased Vertical Compliance)

This system has been developed by Siemens Subsea Connectors to meet the demands of projects which require a greater level of vertical compliance. It is the preferred choice for certain regional applications.

The system is rated at 10,000 psi and up to 135°C, it is suitable for use with gas wells when used with tubing hanger connector (1).

Tubing Hanger Components
The downhole gauge cable enters the tubing hanger connector (1) and feeds through and is terminated to the wet mate receptacle (2). This negates the need for a dry mate plug.

Valve Block Components
The wet mate plug (3) which is mounted to the valve block, has greater vertical compliance than the ‘standard’ vertical system. This is achieved by utilising a spring energised design with an internal flexible curled signal wire tube.

A metal tube with an electrical wire is terminated to the back of the plug. This tube then feeds up through the valve block cavity and is terminated to the well head outlet (4) and DigiTRON receptacle which mates with a DigiTRON diver mate plug (5).

Design Improvement
The design of the wet mate plug connector has recently been improved to allow in-country replacement of the metal tube to re-terminate to the well head outlet. This is a significant step forward in assisting Customers in reducing tree re-work lead times.

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**Single Pin Vertical FT Systems Temperature & Pressure Ratings**

<table>
<thead>
<tr>
<th>Temperature &amp; Pressure Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>-18°C to 121 °C @ 10,000 psi</td>
</tr>
<tr>
<td>-18°C to 135°C @ 10,000 psi (Gas)</td>
</tr>
</tbody>
</table>

**Description**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Tubing Hanger Connector</td>
</tr>
<tr>
<td>2 Wet Mate Receptacle Connector</td>
</tr>
<tr>
<td>3 Wet Mate Plug Connector</td>
</tr>
<tr>
<td>4 Well Head Outlet with DigiTRON Diver Mate Receptacle</td>
</tr>
<tr>
<td>5 DigiTRON Diver Mate Plug</td>
</tr>
</tbody>
</table>
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177°C at 15,000 psi and beyond, for use in both oil and gas wells. With this in mind, we are currently developing the next generation of XHPHT vertical feedthrough systems, capable of working at -18°C to 177°C at 15,000 psi and beyond, for use in both oil and gas wells.

Siemens Subsea connectors are proven high quality, high reliability products. To enable the products to evolve and keep pace with client requirements, designs are continually reviewed for any possible improvements in terms of ease of operability, maintenance and extended temperature and pressure capability.

With this in mind, we are currently developing the next generation of XHPHT vertical feedthrough systems, capable of working at -18°C to 177°C at 15,000 psi and beyond, for use in both oil and gas wells.

General Specification

<table>
<thead>
<tr>
<th></th>
<th>VERTICAL SYSTEMS</th>
<th>HORIZONTAL SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Improved</td>
</tr>
<tr>
<td>Maximum number of electrical conductors</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Maximum Working Pressure PSI (Bar)</td>
<td>15,000 (1034)</td>
<td>10,000 (689)</td>
</tr>
<tr>
<td>Maximum Test Pressure PSI (Bar)</td>
<td>22,500 (1551)</td>
<td>15,000 (1034)</td>
</tr>
<tr>
<td>Maximum Water Depth (metres)</td>
<td>3,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Operating Temperature °C</td>
<td>-18 to 135</td>
<td>-18 to 135</td>
</tr>
<tr>
<td>Test Medium</td>
<td>Gas</td>
<td>Gas</td>
</tr>
<tr>
<td>Number of Matings (Wet Mate pair)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Number of Matings (Dry Mate pair)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Minimum Storage Temperature °C</td>
<td>-18</td>
<td>-18</td>
</tr>
</tbody>
</table>

Electrical Specification

<table>
<thead>
<tr>
<th></th>
<th>VERTICAL SYSTEMS</th>
<th>HORIZONTAL SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Improved</td>
</tr>
<tr>
<td>Maximum Working Voltage</td>
<td>1000V DC</td>
<td>1000V DC</td>
</tr>
<tr>
<td>Maximum Working Current</td>
<td>5 Amps</td>
<td>5 Amps</td>
</tr>
<tr>
<td>Insulation Resistance (System @ Ambient)</td>
<td>&gt;1 G</td>
<td>&gt;1 G</td>
</tr>
<tr>
<td>Insulation Resistance (Connector @ Ambient)</td>
<td>&gt;10 G</td>
<td>&gt;10 G</td>
</tr>
<tr>
<td>Insulation Resistance (Connector @ Max Temp)</td>
<td>&gt;100 M</td>
<td>&gt;100 M</td>
</tr>
<tr>
<td>Contact Resistance (per connector pair - excludes cables)</td>
<td>&lt;4 milli</td>
<td>&lt;4 milli</td>
</tr>
<tr>
<td>Line Resistance (gently installed equipment - excluding leads)</td>
<td>&lt;100 milli</td>
<td>&lt;100 milli</td>
</tr>
</tbody>
</table>

Misalignment Capability

<table>
<thead>
<tr>
<th></th>
<th>VERTICAL SYSTEMS</th>
<th>HORIZONTAL SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>Improved</td>
</tr>
<tr>
<td>Radial mm (inch)</td>
<td>up to ±2.5 (±0.1)</td>
<td>up to ±2.5 (±0.1)</td>
</tr>
<tr>
<td>Axial mm (inch)</td>
<td>up to ±0.2 (±0.5)</td>
<td>up to ±12.7 (±0.09)</td>
</tr>
<tr>
<td>Maximum Tubing Hanger Rotation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Angular Misalignment</td>
<td>1°</td>
<td>1°</td>
</tr>
</tbody>
</table>

Future Developments

Siemens Subsea connectors are proven high quality, high reliability products. To enable the products to evolve and keep pace with client requirements, designs are continually reviewed for any possible improvements in terms of ease of operability, maintenance and extended temperature and pressure capability.

With this in mind, we are currently developing the next generation of XHPHT vertical feedthrough systems, capable of working at -18°C to 177°C at 15,000 psi and beyond, for use in both oil and gas wells.
Life Cycle Management
Installation, Commissioning, Refurbishment, Field Service and After Care for the entire design life of all our products and systems
Siemens Subsea Services - Life Cycle Management

www.siemens.com/energy/subsea
Subsea Services - Life Cycle Management

Siemens Subsea Services - Life Cycle Management group provides a range of post-sales support. We have an extensive field service team of qualified and fully trained UK installation engineers along with teams based in Brazil, USA, Norway and Malaysia, whose expertise is utilised around the world, supporting our customers at both onshore and offshore locations.

Our Life Cycle Management Services
- Connector installation and test
- Offshore deployment support
- Spares and inventory management
- Investigation support
- Condition reports / inspections
- Umbilical test
- Test connector hire

Global Capabilities
Our UK based service team has extensive experience of installing the full range of connectors at onshore and offshore locations around the world. Additionally, we provide growing and dedicated in-country support utilising locally based personnel. This not only provides focused in-country resource but also offers indigenous workforces where 'local content' is required. In-country support is available in the UK, Europe, USA, Brazil, West Africa and Malaysia.

Capabilities
- Termination, installation and test of the complete connector range
- 24 hour access to inventory for spares and emergency scenarios
- Priority Service Response mobilisation within 24 - 48 hours
- Fully equipped vehicles and installation containers for large 'on site' project requirements
- On-site system interrogation and applications advice
- 24 hour 7 days a week telephone emergency response service
- Installations assured by warranty
- Paperless documentation system available to complement hard copy project records

Service Team Profile
Today, our installation engineers boast a combined experience of over 200 man-years and we continue to grow in order to meet market demand. Only our Engineers are certified for the installation and test of the Siemens Subsea connector range, ensuring the highest possible electrical performance throughout the connector life time.
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Siemens Subsea Services - LIFE CYCLE MANAGEMENT are based on all sites worldwide, plus other sites including Macaé, Rio de Janeiro (Brazil) and Angola.

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