Overview of Permanent Monitoring Systems

PPS27 permanent downhole monitoring systems have multiple levels of gauges and surface data acquisition units (SDAU) to choose from. This equipment can be used for diverse applications from low pressure CBM wells to extremely corrosive wells with high concentration carbon dioxide \([\text{CO}_2]\) and/or hydrogen sulphide \([\text{H}_2\text{S}]\).

PPS can also provide all the accessories necessary for intelligent well completions. This includes gauge carriers, downhole cable, cable protectors, cable head and wellhead outlets.

**Premium, Elite & LPLT Series**

Customers can choose from single to multi-drop permanent gauge completions with an option of gauge reading tubing pressure or annulus pressure. All of PPS’s state-of-the-art downhole tools incorporate industry leading sensors, innovative electronic components, and an electron beam welded housing design.

There are different SDAU configurations to choose from, including **SmartWatcher Touch** which provides instant data trending and charting or **SmartWatcher II** which makes it possible to connect up to four wells—with a maximum of four gauges per well—and therefore a total of 16 gauges communicating to the surface unit.

**Analog Series**

The PPS27 Analog Series is specifically designed for permanent low pressure, low temperature monitoring and remediation monitoring. Using 4-20mA output and integrated cable head, this option can provide high quality data at low cost, with easy installation and no need for additional surface monitoring equipment. Overall the design is based on the Premium Series of peizo gauges, but modified to provide a reliable and effective alternative for applications below 3,000 psi and 110°C.

**ESPLink Monitoring & Control**

The PPS electric submersible pump monitoring system can measure pressure, temperature, pump motor operating parameters, and vibration on the x, y and z axes. One of the key advantages of the PPS equipment is the high level of accuracy and resolution provided for all measurements.

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**System Applications**

- Production optimization
- Injection monitoring
- \(\text{CO}_2\) injection monitoring
- Observation well monitoring
- Pump system monitoring
- Well testing without additional equipment
- Intelligent completions
- Pressure build-up surveys without additional equipment
- High pressure and high temperature monitoring
Having the ability to control the pump is essential to maintaining optimum pump lifting efficiency. Using ESPLink operators can monitor intake and discharge pressure, as well as set parameters for the minimum and normal dynamic fluid level, and the critical and normal motor temperature. When these values are entered into the monitoring system, commands will be sent to the Variable Frequency Drive (VFD) to either stop or restart the pump when these specific levels are reached.

**PCPLink Monitoring & Control**

The PCPLink system provides real time downhole pressure measurements and the full vibration spectrum of three axes simultaneously creating a snapshot of whether machinery is operating within optimum parameters. The *SmartWatcher Touch* surface unit was specifically designed to provide a convenient interface for viewing real time numeric data or graphical representations of the data.

By using vibration as a leading indicator of equipment health, operators can recognize issues and plan preventative maintenance thereby protecting and increasing pump longevity. As well pressure data can prompt operators to vary the pump speed, maximizing pump efficiency and production, all while maintaining bottom-hole pressure.
Diagram of PPS27 Permanent Downhole Monitoring

System Components:
1. Surface Data Acquisition Unit
2. Wellhead Outlet
3. Cable Protectors
4. Electric Downhole Cable
5. Gauge Carrier
6. Downhole Gauges

Encapsulation (11mm x 11mm)
1/4" OD Tube
Insulation and Support Filler
Inner Insulating Jacket
Stranded Copper or Tin Plated Copper Wire
SmartWatcher

PPS SmartWatcher is available in multiple configurations for downhole data interfacing, processing and logging. This system has a modular structure that connects to multiple gauges with a single cable (maximum four downhole gauges) and supports Modbus/RTU communication. The modular structure allows for maximum flexibility with unit expansion for different applications, enhanced reliability in harsh environments, independent mobility for unit improvement, upgrades and certification, and convenience for production and unit maintenance.

SmartWatcher II

This is the most advanced SDAU that PPS offers, because it is able to have up to four wells communicating to it. Each well can have a maximum of four gauges connected for a total of 16 gauges communicating with SmartWatcher II unit. Other features include internal memory, an SD card, Modbus/Push data port via RS485 or RS232, AC & DC power entries, and solar station availability. The electronics are enclosed in a NEMA-4 box with a large viewing window so that data reading and system status can be monitored without opening the door. The unit is compatible with PPS’s online remote monitoring.

SmartWatcher Touch

SmartWatcher Touch can display two channels of pressure, one channel of temperature and three axes of vibration. The data channels are displayed on a touch screen which provides a convenient interface for viewing real time numeric data or graphical representations of the data. The samples that are displayed are simultaneously saved to text files which can later be extracted to a standard USB memory drive.
**Specifications**

### Elite Series
**Quartz Gauges**

- Sensor: Quartz
- Pressure Ranges*: psi 10K | 16K | 25K
- Temperature Range*: °C 150 | 177 | 200
- Service: H₂S / CO₂ Services

* Additional pressure and temperature ranges available upon request

### Premium Series
**SOI Gauges**

- Sensor: SOI
- Pressure Ranges*: psi 10K | 20K
- Temperature Range*: °C 20 to 125
- Vibration Sensor**: MEMS Accelerometer
- Service: H₂S / CO₂ Services upon request

* Additional pressure and temperature ranges available upon request

** Premium Series
**Piezo Gauges**

- Sensor: Piezo
- Pressure Ranges*: psi 6K | 10K
- Temperature Range*: °C 20 to 125
- Vibration Sensor**: MEMS Accelerometer
- Service: H₂S / CO₂ Services upon request

* Additional pressure and temperature ranges available upon request

** Vibration sensor is optional for 6K gauges only

### LPLT Series
**Quartz Gauges**

- Sensor: Quartz
- Pressure Ranges: psi 5K | 10K
- Temperature Range: °C 20 to 130
- Service: H₂S / CO₂ Services upon request

### Analog Series
**Silicon Sapphire Gauges**

- Sensor Type: Silicon-Sapphire
- Pressure Range: psi 0 to 3K psi
- Temperature Range: °C 20 to 110

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- Analyze drawdown and build-up pressure transients to enhance production
- Increase asset management by enabling a deeper understanding of reservoir performance and optimization
- Acquire pressure and temperature information without requiring well intervention
- Optimize artificial lift and extend the run life of Electric Submersible and Progressive Cavity pumps by using vibration measurements to monitor pump integrity

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## Specifications

### SmartWatcher

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downhole Gauge Support</td>
<td>Maximum 4 gauges</td>
</tr>
<tr>
<td>Communication</td>
<td>Modbus/RTU protocol</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>1200, 2400, 4800, 9600 (default), 19200, 38400 bps</td>
</tr>
<tr>
<td>Interface</td>
<td>RS485/RS232 (15kV ESD Protection)</td>
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<tr>
<td>Power Supply</td>
<td>+12VDC(40mA), +24VDC(25mA) or 9-28VDC or Solar Power Station Optional</td>
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<tr>
<td>Operating temperature</td>
<td>-40°C to +70°C</td>
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<tr>
<td>Safety</td>
<td>Class I Division 2</td>
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</table>

### SmartWatcher II

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Downhole Gauge Support</td>
<td>Maximum 16 gauges</td>
</tr>
<tr>
<td>Communication</td>
<td>Modbus/RTU protocol</td>
</tr>
<tr>
<td>Baud Rate</td>
<td>1200, 2400, 4800, 9600 (default), 19200, 38400, 57600 or 115200 bps</td>
</tr>
<tr>
<td>Interface</td>
<td>RS485/RS232 (15kV ESD Protection)</td>
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<tr>
<td>Power Supply</td>
<td>85-264VAC, 50-60Hz (±10%), 40W 9-32VDC or Solar Power Station Optional</td>
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<tr>
<td>Operating temperature</td>
<td>-40°C to 85°C (continuous use)</td>
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<td>Safety</td>
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</table>

### SmartWatcher Touch

<table>
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<td>Communication</td>
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<td>Operating temperature</td>
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Smart Gauges and Simple Software