<table>
<thead>
<tr>
<th>Component</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A Crown Block</strong></td>
<td>Measure weight on drill line via cable tension</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41, RM</td>
</tr>
<tr>
<td><strong>B Power Generation Unit</strong></td>
<td>Measure oil, water, and hydraulic fluid pressure</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: FP2000, MLH, IP IS, PX2, PK3, SPT</td>
</tr>
<tr>
<td><strong>C Drilling Cab</strong></td>
<td>Control/monitor operations actively</td>
</tr>
<tr>
<td></td>
<td>MICRO SWITCH basic switches: BZ, VT, V15W, 3X</td>
</tr>
<tr>
<td></td>
<td>MICRO SWITCH toggle switches: TL, NT, T5, TW, ET, AT</td>
</tr>
<tr>
<td></td>
<td>Key, rotary, and e-stop switches: custom</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41, RM</td>
</tr>
<tr>
<td><strong>D Accumulator Unit</strong></td>
<td>Measure inlet/outlet pressure with high accuracy</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: FP2000, STJ/E</td>
</tr>
<tr>
<td><strong>E Rig Hydraulics</strong></td>
<td>Measure hydraulic pressure, weight, force/strain or movement, monitor raising or lowering disk for directional drilling</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: FP2000, IP IS</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41</td>
</tr>
<tr>
<td><strong>F Drawworks</strong></td>
<td>Measure torque, load/weight/position while guiding pipe into position</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41, RM</td>
</tr>
<tr>
<td></td>
<td>MICRO SWITCH switches: BX, L5X</td>
</tr>
<tr>
<td><strong>G Iron Roughneck</strong></td>
<td>Measure torque while attaching pipe using hydraulic pressure or load measurements</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41</td>
</tr>
<tr>
<td><strong>H Water/Storage Tank</strong></td>
<td>Measure tank liquid levels</td>
</tr>
<tr>
<td></td>
<td>Switches: HSL, WLS, non-contact</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: MLH, LL-V, SPT, PK2</td>
</tr>
<tr>
<td><strong>J Top Drive</strong></td>
<td>Measure torque/rotating movement to ensure right amount of force is applied</td>
</tr>
<tr>
<td></td>
<td>Torque sensors: custom</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41</td>
</tr>
<tr>
<td><strong>K Traveling Block</strong></td>
<td>Measure weight on the drill line via cable tension</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41</td>
</tr>
<tr>
<td><strong>L Deadline Anchor</strong></td>
<td>Measure tension on deadline/drilling line cable</td>
</tr>
<tr>
<td></td>
<td>Load cells: 41, RM</td>
</tr>
<tr>
<td><strong>M Choke Manifold</strong></td>
<td>Measure valve position/choke valves</td>
</tr>
<tr>
<td></td>
<td>MICRO SWITCH hazardous area switch: CX, VPX</td>
</tr>
<tr>
<td><strong>N Mud Return Line</strong></td>
<td>Measure drilling mud pressure to monitor and control mud flow</td>
</tr>
<tr>
<td></td>
<td>Wing Union sensors: 434, 435, 437</td>
</tr>
<tr>
<td><strong>O Mud Shaker</strong></td>
<td>Position sensing or on/off applications</td>
</tr>
<tr>
<td></td>
<td>Switches: HSL, WLS, WOI</td>
</tr>
<tr>
<td><strong>P Mud Cleaner</strong></td>
<td>Measure pressure and flow of mud media</td>
</tr>
<tr>
<td></td>
<td>Wing Union sensors: 434, 435, 437</td>
</tr>
<tr>
<td></td>
<td>On/off or emergency start/stop applications</td>
</tr>
<tr>
<td></td>
<td>Limit switches: HSL, WLS, WOI</td>
</tr>
<tr>
<td><strong>Q Mud Pump</strong></td>
<td>Measure direct and indirect loads</td>
</tr>
<tr>
<td></td>
<td>Canister load cells: MP9, 3130, 3138, 3127</td>
</tr>
<tr>
<td><strong>R BlowOut Preventor</strong></td>
<td>Monitor FAD2 position via hydraulic volumetric or pressure behind the piston (“pinch offs”)</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: A-105, TJE</td>
</tr>
<tr>
<td><strong>S Drift Bit</strong></td>
<td>Measure pressure or differential pressure at high temperature and pressure ranges</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: 5</td>
</tr>
<tr>
<td><strong>T Fluid Manifold</strong></td>
<td>Measure drilling fluid pressure</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: FP2000</td>
</tr>
<tr>
<td></td>
<td>Wing Union sensors: 434, 435, 437</td>
</tr>
<tr>
<td><strong>U MudTank/Reservoir</strong></td>
<td>Measure tank liquid levels</td>
</tr>
<tr>
<td></td>
<td>Pressure sensors: FP2000, IP IS, SPT</td>
</tr>
<tr>
<td></td>
<td>Monitor tank valve position</td>
</tr>
<tr>
<td></td>
<td>Limit switches: BX, L5X, HDLS, WLS</td>
</tr>
</tbody>
</table>
Sensors and Switches in Oil Rig Applications

Pressure Sensors

FP2000 Series
- All-inclusive stainless steel construction
- Gage, absolute, barometric, vacuum, differential pressure
- Range: 0.5 psi to 10,000 psi
- Accuracy: 0.1% or 0.25% FS
- Intrinsically safe options available

MLH Series
- All-metal wetted parts for use in invariable fluid applications
- No internal elastomeric seals mean no o-ring compatibility issues
- Range: 50 psi to 80,000 psi
- Accuracy: ±0.25% FS/BSFL
- Rated IP65 or better for protection from harsh environments

IP IS Series
- Rugged, all-welded stainless steel and Hastelloy® wetted parts for durability
- Compatible with a wide variety of media
- Range: 7 bar to 350 bar, 1.0 psi to 5,000 psi
- Accuracy: ±0.15% or ±0.25% FSFL
- Fully configurable

PX2 and PX3 Series
- Cost effective, highly configurable and highly durable
- Compatible with a wide variety of harsh media
- Broad compensated temperature range with industry-leading Total Error Band
- Range: 1 bar to 4 bar, 1.5 psi to 667 psi (PX3)
- Accuracy: ±0.25% FS/BSFL, ±0.4% FS (±0.25°C to 1.25°C (±0.9°F to 257°F))

6PT Series
- Rugged, stainless steel in a small size package
- Absolute, gage, sealed gage, vacuum gage
- Range: 0 to 100,000 psi
- Accuracy: ±0.25% FSFL
- Reliable semiconductor technology, NEMA 4x design
- Calibrated and temperature compensated

Model TJE
- Rugged, all-welded, stainless steel construction
- Built for applications requiring high accuracy and temperature stability
- Unique “true gage” design hermetically sealed against atmospheric contamination
- Range: ±1 psi to ±6000 psig/gauge, accuracy: ±0.1% FSFL
- Intrinsically safe available

Super TJE Series
- Ultra precision pressure sensors with up to ±0.2% accuracy
- Range: 2 psi to 10,000 psi
- Accuracy: ±0.25% FSFL
- Dual rape thread air pressure fitting for easy build-up/break-down
- Explosion proof

Model 5
- Rugged, high-frequency stainless steel
- Extremely small size (5’s) in tight spaces
- Range: 0 to 15,000 psi
- Operating temperature range: -54°C to 149°C (-65°F to 300°F)
- Accuracy: ±0.1% FSFL

Model A-10S
- Rugged, utilized stainless steel design with heavy sidewalls
- Thin diaphragm design able to measure low pressures
- Push mount design with minimum dead pressure
- Can be used in corrosive fluid environments
- Range: 100 psi to 15,000 psi, accuracy: ±0.5%

Model 434A, 435, 437 Wing Union Pressure Sensors
- Rugged design with “A”-X750 or NACE-compliant Inconel®; 788 wattage parts
- Build to provide durability with abrasive or corrosive media
- Accuracy: ±0.1% FS/BSFL, Model 435 (±0.25% FSFL)
- Reliable semiconductor technology, NEMA 4x design
- IP66; NEMA 13 sealing

LL-V Series
- Designed for vertical entry into a tank
- Compact fluid submersion, corrosion resistant to most fluids
- True gage design with all welded stainless steel construction
- Range: 0 to 10 mHg, 0 to 500 psi, 0 to 60 psi
- Accuracy: ±0.1% FSFL

Load Cells

Model 434
- Rugged, low profile pancake style
- All-welded stainless steel with double diaphragm load range of 5 lbs to 500 lbs; Accuracy ±0.1%
- Low sensitivity to extraneous loads
- Intrinsically safe option available

Model 41
- Rugged, rod-in-line tension load cell
- Rugged design with stainless steel, all-welded construction
- Load ranges from 2000 lbs to 2000,000 lbs
- Accuracy: ±0.2% full scale

Model 3130
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges of 150,000 lbs to 1,000,000 lbs
- Accuracy: ±0.3% full scale

Model 3156
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges of 25,000 lbs to 150,000 lbs
- Accuracy: ±0.30% full scale

Model 3127
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges up to 2,000,000 lbs
- Accuracy: ±0.30% full scale

MICRO SWITCH Basic Switches

MICRO SWITCH Premium Large Basic Switches, BZ Series
- Designed for the world’s largest oil rig explosion switch
- Best suited for high cost-of-failure applications
- Current ratings from 10 A to 25 A
- UL/CSA, CE, ENEC approvals

MICRO SWITCH Premium V-Basic Switches, V7 Series
- Designed for better cost and differential (set/act)
- Design for 100k operations at full load or 10M for mechanical life
- Current ratings from 0.1 A to 25 A
- UL/CSA, ENEC approvals

MICRO SWITCH Watertight Miniature Switches, VLSJ Series
- Miniature-sized basic switch designed for harsh-duty, wash down areas
- Rugged, highly accurate machine control for turning circuits on and off
- Compact, lightweight and weather resistant
- UL cUL, ENEC, CQC approvals

MICRO SWITCH Hazardous Area Switches, BX and LSX Series
- Excellent suitability for applications (including explosion switch)
- Superior reliability and repeatability
- Explosion-proof design with flame path to contain and cool escaping hot gases
- O-ring seals render switches weather-proof, water-tight, dust-tight
- UL, CSA (BX, LSX Series); ATEX, IECEx, NEMEP; European approvals (BX Series)

MICRO SWITCH Hazardous Area Switches, CX Series
- Heavy-duty atmosphere suitable design to suit any application
- Superior reliability and repeatability
- Compact, lightweight, and long-lasting
- UL cUL; IECEx, ATEX (CX Series)

MICRO SWITCH Hazardous Area Valve Position Indicator, VFX Series
- Certified for ATEX, IECEx, and CE and suitable specifications for global applications
- Di-cast aluminum housing and various sealing (NEMA 4/4X, 6, and 13)
- Models available in both snap-action switches and intrinsically safe inductive proximity switches
- Versions of the VFX with proximity switches carry an Intrinsically Safe (IS) rating

MICRO SWITCH Hazardous Area Switches, EX Series
- Designed for hazardous indoor or outdoor locations
- Superior reliability and repeatability
- Smallest UL-listed housings available for use in hazardous locations
- O-ring seals render switches weather-proof, water-tight, dust-tight
- UL, CSA, ATEX, IECX Ex approvals

MICRO SWITCH Heavy-Duty Limit Switches, HDLS Series
- Three series offer rugged, die-cast body and epoxy coating
- Compact, rounded-head design for less load-to-body penetration
- Multiple mounting and actuator options
- UL, CSA, CE, CCC approvals

MICRO SWITCH Wireless™ Wireless Solutions

“Wireless” Wireless Operator Interface, WOI Devices
- Enables operator indication from locations where wiring is too costly or not possible
- Flexible operator type options (push button, rotary or key switch, etc.)
- Reduces installation/maintenance costs with no wires, conduit, connectors, etc.
- Eliminates issues with wire connection integrity on moving equipment

“Wireless” Wireless Non-Contact Switches, WLS Series
- MICRO SWITCH HDLS heritage combined with the latest wireless technology
- Provides positive position feedback reading where wiring is an issue or not feasible
- Reduces installation/maintenance costs due to no wires, conduit, connectors, etc.
- Eliminates wire connection integrity issues on moving equipment

Torque Shafts

Custom Torque Shaft
- Modify/adjust the calibration rig flanges to the custom flanges on a top drive shaft
- Calibrate to torque levels required on a top drive
- Strain-gauge the complex large shafts found in top drives
- Range: 0 to 100,000 psi
- Accuracy: ±0.1% FSFL

Operator Controls

Rotary Switches
- 3- and 4-position options
- May be engineered with lever or knob actuator
- Integral connectors (Mignight 280 and Sumitomo)
- Environmentally sealed design

e-Stop Switches
- Provides positive contact closure and opening when the switch is operated
- Environmentally sealed design (IP67 sealing)
- UV-resistant knob for outdoor use
- Knob available in a variety of colors

MICRO SWITCH Toggle Switches (Sealed and Unsealed), TL, TL T, TL SW, ET, AT Series
- Broad product range meets a variety of electrical and load requirements
- Sealed models built to withstand harsh, wet, dusty, or dirty environments
- 2 or 3 position, momentary and/or maintained action; 1-2, 0- or 4-pole circuits
- NIMS (integrated wire termination system) for ease of assembly & maintainability

Note: All models can be custom-engineered to fit specific needs.