SureShot™ MWD System

APS’s SureShot family of directional and directional plus gamma systems provides reliable and flexible measurement-while-drilling performance in combination with our second-generation Rotary Pulser. The system can be powered by our battery modules, our turbine alternator, or a combination of the two. This MWD system provides highly accurate azimuth and inclination data for all applications from straight-hole through horizontal drilling. Rapid and accurate toolface transmission enables the most complex well paths to be drilled with confidence.

SureShot’s downhole portion includes a rugged directional sensor package with NIST-traceable magnetometer calibration; a reliable, field-proven, Rotary Pulser*; and battery and/or turbine alternator for power. SureShot’s modular design allows the addition of other functions like high-quality gamma and/or vibration logging. Each package is protected by a state-of-the-art vibration isolation system and is mounted in beryllium copper or high-strength steel pressure barrels. A small, robust surface decoder interfaces with a computer running APS’s SureShot Control Center software. The SureShot MWD can store up to 32 MB of MWD/LWD and diagnostic data for retrieval during trips.

SureShot’s patented second-generation Rotary Pulser* is the toughest, most advanced, most LCM-tolerant mud pulse transmitter in the industry. Our pulser’s ultra-reliable, high-efficiency DC brushless motor and controller, single open-flow path, positive pulse output and anti-jamming control virtually eliminates jamming or blockage, and the on-board memory allows post-run analysis of pulser performance. The Rotary Pulser is easily converted between fixed-mount and retrievable configurations.

The SureShot system is easy to learn, assemble and operate. In fact, APS’s customers frequently train their personnel themselves to operate our system.

> The highly reliable APS second-generation Rotary Pulser converts easily from fixed-mount to retrievable, providing fixed-mount reliability or retrievable lost-in-hole security.

> Additional sensors including gamma, vibration monitoring and resistivity can be quickly incorporated into our “LWD-Ready” system.

> The surface system presents data in a simple, user-friendly control and display module. The data is transferred to a central control PC from which it can be directed back to a dedicated wireless rig-floor display and/or rig monitoring system.

> Multiple encoding schemes and advanced decoding enable rapid customization of the data stream for maximum speed or maximum data integrity.

> The unique APS power management module enables the system to be powered through dual battery packs or a combination of battery power and APS turbine alternator †.

* U.S. Patents #6,714,138 and #7,327,634 † U.S. Patent #7,201,239
SureShot™ MWD System

Operating Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>0° - 180°</th>
<th>± 0.1°</th>
<th>0° - 360°</th>
<th>± 1.0° (Inc &gt; 10°, Dip &lt; 70°)</th>
<th>± 1.0° (Inc &gt; 10°)</th>
<th>± 2.25° (Dip &lt; 70°)</th>
<th>API-calibrated 0 - 800 API ±5% to 300°F (150°C) ±10% to 350°F (175°C) (based on typical API scale factor of 1.35 API counts/sec)</th>
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<td>Inclination Range</td>
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<td>Azimuth Range</td>
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<td>Tool Face (Gravity)</td>
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<td>Tool Face (Magnetic)</td>
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<td>Gamma (Optional)</td>
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Sensors

- **Directional**: Tri-axial fluxgate magnetometer with NIST-traceable calibration; quartz accelerometer
- **Gamma (Optional)**: Scintillator/PMT unit

Product Specifications

- **Signal Transmission**: Positive mud pulse
- **Pulse Height**: Adjustable
- **Retrievable/Reseatable**: Available
- **Fixed-mount**: Available
- **Activation**: Electromechanical
- **Operating Voltage**: 28 - 40 VDC
- **Pulser sub O.D.**: 9.5\(^{\text{§}}\), 8, 6.25 to 6.75, 4.75, 3.5 & 3.125 in.**
  - 241\(^{\text{§}}\), 203, 159 to 171, 121, 89 & 79 mm**
- **Flow Ranges**:
  - 9.5 in. or larger – 650 to 1200 gpm
  - 8 in. – 300 to 1100 gpm
  - 6.25 to 6.75 in. – 150 to 750 gpm
  - 4.75 in. – 125 to 350 gpm
  - 3.125 & 3.5 in. – 70 to 250 gpm
  - 7.25 in. (h) x 22 in. (w) x 20 in. (d)
  - Weight – 37 lb
  - 184 mm (h) x 559 mm (w) x 508 mm (d)
  - Weight – 16.8 kg
- **Sand Content**: < 1% by volume recommended, 3% by volume max
- **LCM Tolerance**: 50 lb/bbl medium nut plug
- **Operating Temperature**: -13˚ to 302˚F; -25˚ to 150˚C
- **Maximum Pressure**: 20,000 psi; 137.9 MPa
- **Differential Pressure**: No requirement
- **Dogleg Capability**: API connection limited

Surface System

- **SIU 2 & Plotter General Specifications**
  - **Electrical Requirements**: 100 - 240 VAC, 47 - 63 Hz, 13 W
  - **Operating Temperatures**: 32˚ to 158˚F (0˚ to 70˚C)
  - **Storage Temperatures**: 14˚ to 185˚F (-10˚ to 85˚C)
- **“Ruggedized” System**
  - **Directional**: Case – 19 in. EIA Standard
  - Weight – 119 lb
  - Case – 483 mm EIA Standard
  - Weight – 54.0 kg
  - **Directional & Depth Tracking**: Case – 19 in. EIA Standard
  - Weight – 119 lb
  - Case – 483 mm EIA Standard
  - Weight – 54.0 kg
- **“Lite” System**
  - **Directional**: 5.5 in. (h) x 22 in. (w) x 20 in. (d)
  - Weight – 12 lb plus laptop
  - 140 mm (h) x 559 mm (w) x 508 mm (d)
  - Weight – 5.4 kg plus laptop
  - **Directional & Depth Tracking**: 5.5 in. (h) x 22 in. (w) x 20 in. (d)
  - Weight – 12 lb plus laptop
  - 140 mm (h) x 559 mm (w) x 508 mm (d)
  - Weight – 5.4 kg plus laptop
- **Printrex Plotter**: 7.25 in. (h) x 22 in. (w) x 20 in. (d)
  - Weight – 37 lb
  - 184 mm (h) x 559 mm (w) x 508 mm (d)
  - Weight – 16.8 kg

Surface Sensors

- **Pressure Transducer**: 4 - 20 mA current loop; certified intrinsically safe Class 1 Division 1, Class 1 Zone 0
  - -4 to 140˚F (-20 to 60˚C) operating; -40 to 180˚F (-40 to 75˚C) storage
- **Hook Load Sensor**: 4 - 20 mA current loop; certified intrinsically safe Class 1 Division 1, Class 1 Zone 0
  - -40 to 180˚F (-40 to 80˚C) operating; -40 to 257˚F (-40 to 125˚C) storage
- **Depth Encoder**: Standard NAMUR Type; certified intrinsically safe Class 1 Zone 1
  - -40 to 180˚F (-40 to 80˚C) operating; -40 to 257˚F (-40 to 125˚C) storage

Specifications subject to change without notice.
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