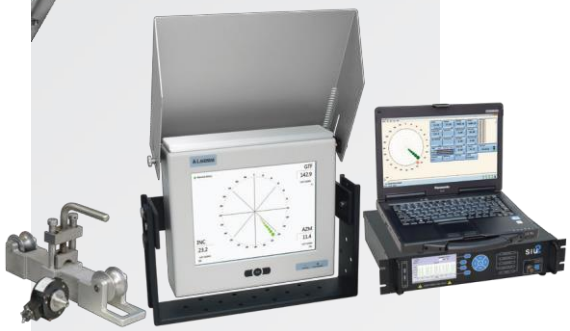
APS TECHNOLOGY

Global perspective. Independent thinking.

SureShot™ MWD System

SureShot-MP

Fixed-mount Pulser



Standard APS Surface System

Printrex Plotter

APS's SureShot family of directional and directional plus gamma systems provides reliable and flexible measurement-while-drilling performance in combination with our fourth & Fifth 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 ToughMet alloy or NT50 alloy or INC718 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 fourth & fifth-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 fourth & fifth-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, resistivity, iPZIG and rotatory steerable tool can be quickly incorporated into our SureShot MWD platform 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.

> APS enables multiple data output format, including ASCII, LAS, WITS and WITSML.

> 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

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SureShot-MP

Retrievable Pulser with Stinger

Low-temperature Rig Floor Display

Advanced Decoding Software

Surface System	
System Components	SIU2, Laptop, Plotter, Rig Floor Display, Transducer, Electric cable etc.
SIU2 & Plotter Voltage	100-240VAC, 47-63 Hz, 13W
SIU2 & Plotter Temps	0～70℃ (32 to 158°F) Operating; -10～85℃ (14 to 185 °F) Storage
Printrex Plotter	Real time printing survey data with APS Plot™
Standard Rig Floor Display	Certified Zone 1 Division 2, 9 in, wireless -20˚ to 60˚C (-4 to 140 °F) operating; -40˚ to 75˚C (-40 to 167 °F) storage
Low temperature Rig Floor Display	Certified Zone 1 Division 2, 15 in, wired/wireless -40˚ to 50˚C (-40 to 122 °F) operating; -40˚ to 85˚C (-40 to 167 °F) storage
Pressure Transducer	4 - 20 mA current loop, certified intrinsically safe Class 1 Division 1, Class 1 Zone 0 -40˚ to 121˚C (-40 to 250 °F) operating; -55˚ to 150˚C (-67 to 302 °F) storage
Hook Load Sensor	4 - 20 mA current loop, certified intrinsically safe Class 1 Division 1, Class 1 Zone 0 -40˚ to 80˚C (-40 to 180 °F) operating; -40˚ to 125˚C (-40 to 257 °F) storage
Depth Encoder	Standard NAMUR Type, certified intrinsically safe Class 1 Zone 0 -40˚ to 80˚C (-40 to 180 °F) operating; -40˚ to 125˚C (-40 to 257 °F) storage
Downhole Tools	
Downhole String	Pulser, Battery (or TA), Directional Sensor, plus Gamma and other sensors
Data Rate	MPT≥1bps; EM ≥12bps (Option)
Pulser Mounting	Fixed mount, Retrievable or Floating (string anchored at bottom)
Pulser Operation	Reciprocating oscillating (shear valve style)
Pulser Height	Adjustable
Activation	Electromechanical
Operating Voltage	28-40V DC
Sonde OD & Materials	47.63mm (1.875in); ToughMet Alloy, NT50 Alloy (option) or INC718 Alloy (option)
Power Supply	Battery（1 or more pack） or Turbine Alternator
Sand Content	Sand ≥3% by volume recommended
Mud type	Oil-base mud, Water-base mud; (EM for air, N2, foam UBO)
Flow Sub O.D. & Flow Flow Ranges	9.5" or larger：650～1200 gpm　241mm or larger：41～76 L/Sec 8"：300～1200 gpm　203mm：18.9～76 L/Sec 6.25"～6.75"： 150～750 gpm　159mm～171mm： 9～47 L/Sec 4.75"： 125～350 gpm　121mm： 7.9 ～22 L/Sec 3.125" & 3.5"： 70～250 gpm　79mm & 89mm： 4 ～16 L/Sec
LCM Tolerance	50 lb/bbl medium nut plug　143 kg/m3 medium nut plug
Operating Temperature	-25° to 150℃ (-4 to 302°F); 175℃ (350°F) (option)
Max Operating Pressure	Standard: 20,000 Psi (140MPa); High pressure: 25,000 Psi (175MPa) or Ultrahigh pressure: 30,000 Psi (210Mpa) (Option)
Data Exported Formats	ASCII, LAS, WTIS, WITSML
Dogleg Capability	API connection limited
Pulser	G4 & G5 (with Flow MC, more power efficiency and higher data rate)
Sensor	Tri-axial fluxgate magnetometer with NIST-traceable calibration; quartz accelerometer with rotating INC and rotating AZI feature
Inclination Range/Accuracy	0° to 180° / ± 0.1°
Azimuth Range/Accuracy	0° to 360° / ± 0.75° (Inc > 10°, Dip < 70°)
Tool Face Accuracy	Gravity: ± 1° (Inc > 10°); Magnetic: ± 0.5° (Dip < 70°)
System Expansion	
LWD Option	PWD、Gamma、AziGM、WPR、iPZIG、iPCD、FWSonic、iDNSC
Drilling Optimization	VMS、DDM、AVD、RSM、RSS

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