Technical Information & Data Reference

POSITIVE MUD PULSE - MWD

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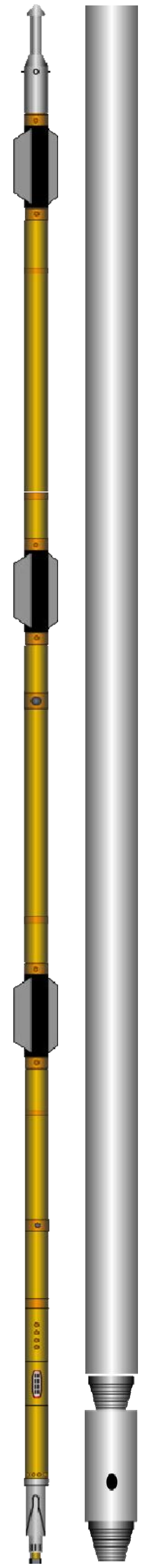
The positive pulse measurement while drilling system (PP-MWD) principle is based on the temporary restriction of drill string mud flow to create a series of pressure spikes that form a communicative pulse waveform that is decoded using surface equipment. Downhole configurations are fully modular adding the flexibility of adjustments specific to BHA. KAMBI's PP-MWD new design reduces survey time and increases reliability for deeper drilling applications. Our system has minimal moving parts, which allows for extended downhole life and simple maintenance.

Reliable surface decoding is further enhanced with the added option of wireless systems for long-range communication between rig and command center. Quality sensor measurement is made possible through industry standard magnetometer and accelerometer packages, including API standardized gamma ray modules.

KAMBI's PP-MWD is fully retrievable and reinsertable which reduces potential downtime and lost in hole equipment.



Applications

- Directional, vertical, horizontal and re-entry wells.
- Short radius slim hole applications (3.50in tools).
- Logging While Drilling, Gamma, Annular Pressure, Vibration.

Feature & Benefits

- High operating temperature (175°C) and pressure (20,000psi).
- Wireline retrievable and reinsertable design (minimum 2.25in I.D.).
- Available real-time LWD measurements - Rotational Inclination, Azimuthal Gamma , Focused Gamma.
- Downlink capability for selectable operating modes.
- Proven software and firmware for efficient decoding.
- Adaptable tool configurations and programming flexibility.
- Long battery life.
- Reliable, proven rugged design.
- Mud telemetry not affected by formation or drilling fluid resistivity.

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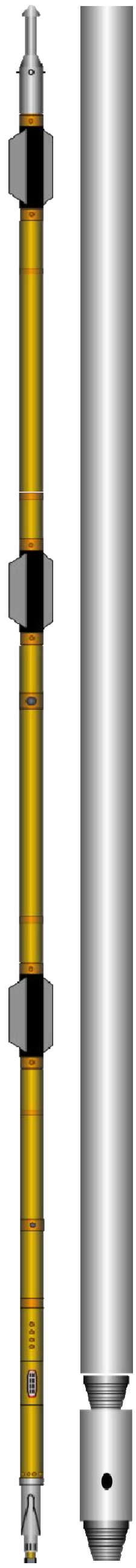
PP-MWD	Positive Pulse Measurement While Drilling
Data Transmission Type	Positive Mud Pulse
Collar Sizes	89mm-203mm (3.50in-8.00in) Additional sizes available
Operating Flow Rate	0.28-4.54m3/min (75-1200gpm)
Wireline Retrievability	Retrievable and Reinsertable
Minimum ID for Retrievability	57mm (2.25in)
Flow Switch	Vibration
Nominal Length	9.75m (32ft), 11.88m (39ft) w/gamma
Housing O.D.	47.625mm (1.875in)
Power Supply	Lithium 28VDC/3amp (21VDC/5amp available)
Shock Limit	1000g, 0.5msec, ½ sine all axes
Vibration Limit	5-30 Hz at 1in double amplitude, 30-500Hz 20g all axes
Operating Temperature (max)	150°C (302°F), 175°C (347°F) avalable
Hydrostatic Pressure (max)	137,895kPa (20,000psi)
Pressure Drop (6.50in w/Water)	689 kPa at 1.51m3/min (100 Psi at 400 GPM)
6Velocity Rate (max)	10m/sec (32ft/sec)
Bend Radius (max)	20deg/10m
LCM Tolerance (max)	40-50ppb concentration, any size, premixed
Operating Pulse Width	0.600-2.00sec
Data Update Rate	10-28sec
Survey Transmission Rate	<120sec (resolution and pulse width dependent)
Toolface Accuracy	0-360° +/- 0.50°
Inclination Accuracy	0-180° +/- 0.10°
Azimuth Accuracy	0-360° +/- 0.25°
Survey Procedure	Rotary OFF → Pumps OFF→ Hold 60sec → Pumps ON → Survey Sequence Received → Steering Sequence Received
Operational Modes	Operator-selectable survey and steering sequences, resolution and pulse width settings
Downlink Capability	Pumps ON/OFF sequences for mode-selection, steering and survey sequences, and pulse width settings
BHA Configuration	UBHO – NMDC – NMDC
BHA Landing	Bottom Landing
Tool Configuration (Standard)	Pulser – Battery(1) – Directional Module – Battery(2)
Tool Configuration (Gamma)	Pulser – Gamma – Directional Module – Battery(2) – Battery(1)
Rotary Power Save Mode	Yes (RFS available)
Battery Consumption	20-320hrs (medium-rate dual battery), 180-260hrs (medium-rate dual battery w/gamma). Consumption factors include resolution and pulse width settings



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