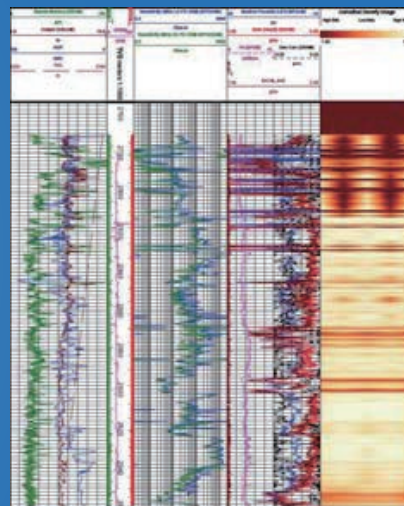




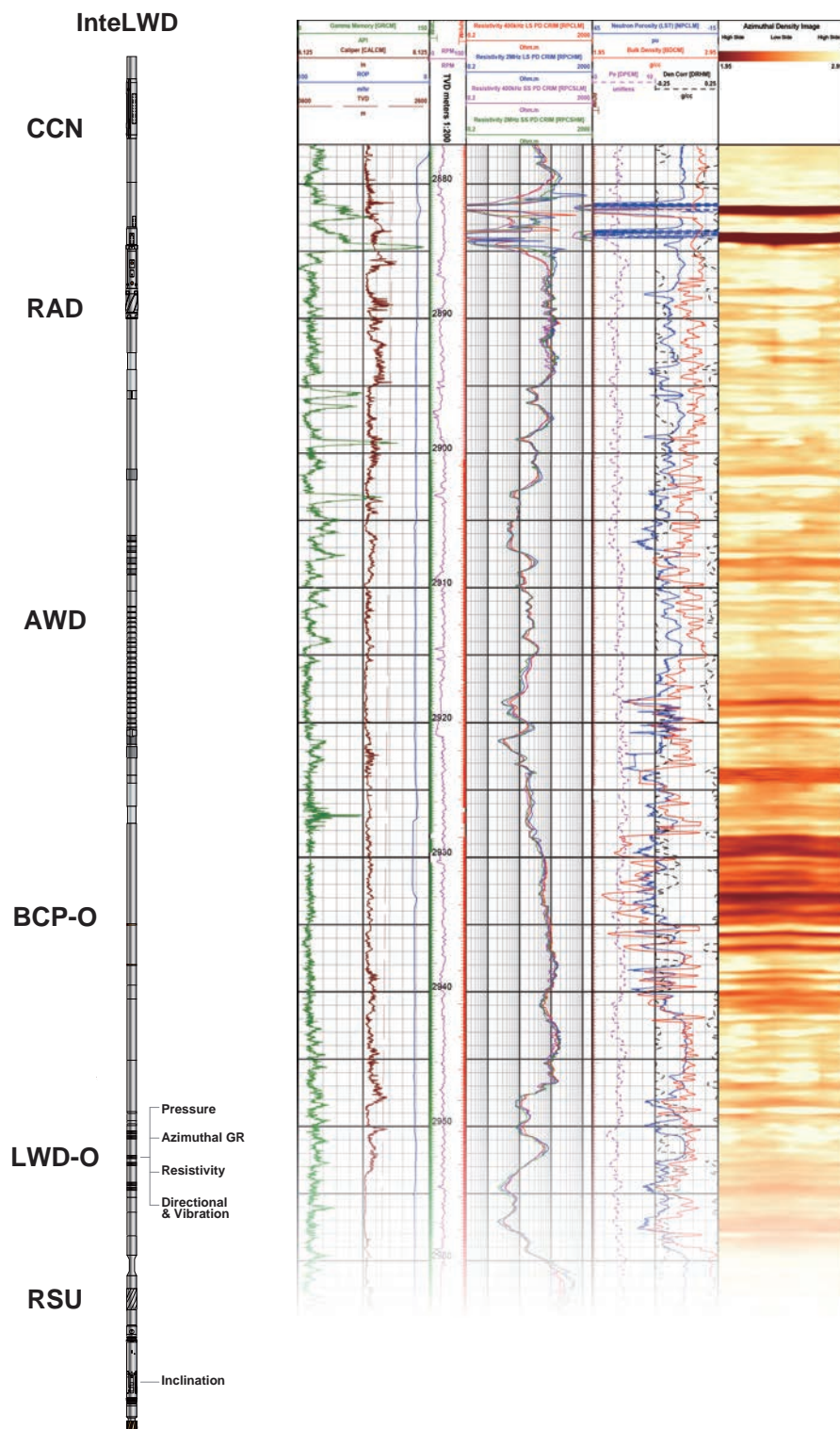
***Geo-Vista***

## **Integrated Logging While Drilling System (IntelLWD)**

Bi-directional Communication Power Module (BCP-O)      Drilling Dynamics Monitor (DDM)  
Integrated Logging While Drilling Tool (LWD-O)      Rotary Steerable Unit (RSU)  
Near-Bit Azimuth Gamma Ray (NB-AGR)      Caliper Corrected Neutron Porosity (CCN)  
Rotary Azimuthal Density (RAD)      Azimuthal Resistivity While Drilling (ARD)  
Nuclear Magnetic Resonance Imaging While Drilling (MRI)  
Acoustic While Drilling (AWD)      Ultrasonic Imaging While Drilling (UID)  
Pressure & Caliper Measurement While Drilling (PCD)  
Ultrasonic Caliper Measurement While Drilling (CWD)  
Generator Caliper Corrected Neutron Porosity (GCN)      Formation Tester While Drilling (FTD)



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### Rotary steering system BHA configuration with CCN-RAD

HWDP  
Centralizer Sub  
Crossover sub Box NC38/NC50 To GT6  
Caliper Corrected Neutron Porosity (CCN)  
Rotary Azimuthal Density (RAD)  
Bi-directional Communication Power Module (BCP-O)  
Drilling Dynamics Monitor (DDM)  
Upper Centralizer Sub (UCS)  
Battery Management Unit (BAT)  
Integrated Logging While Drilling Tool (LWD-O)  
Lower Centralizer Sub (LCS)  
Rotary Steerable Unit (RSU)

### Rotary steering system BHA configuration with GCN

HWDP  
Centralizer Sub  
Crossover sub Box NC38/NC50 To GT6  
Pressure&Caliper Measurement While Drilling (PCD)  
Generator Caliper Corrected Neutron Porosity (GCN)  
Bi-directional Communication Power Module (BCP-O)  
Drilling Dynamics Monitor (DDM)  
Upper Centralizer Sub (UCS)  
Battery Management Unit (BAT)  
Integrated Logging While Drilling Tool (LWD-O)  
Lower Centralizer Sub (LCS)  
Rotary Steerable Unit (RSU)

### Rotary steering system BHA configuration with MRI

HWDP  
Centralizer Sub  
Crossover sub Box NC38/NC50 To Pin GT6  
Pressure&Caliper Measurement While Drilling (PCD)  
Nuclear Magnetic Resonance Imaging While Drilling (MRI)  
Bi-directional Communication Power Module (BCP-O)  
Drilling Dynamics Monitor (DDM)  
Upper Centralizer Sub (UCS)  
Battery Management Unit (BAT)  
Integrated Logging While Drilling Tool (LWD-O)  
Lower Centralizer Sub (LCS)  
Rotary Steerable Unit (RSU)

### GeoLWD

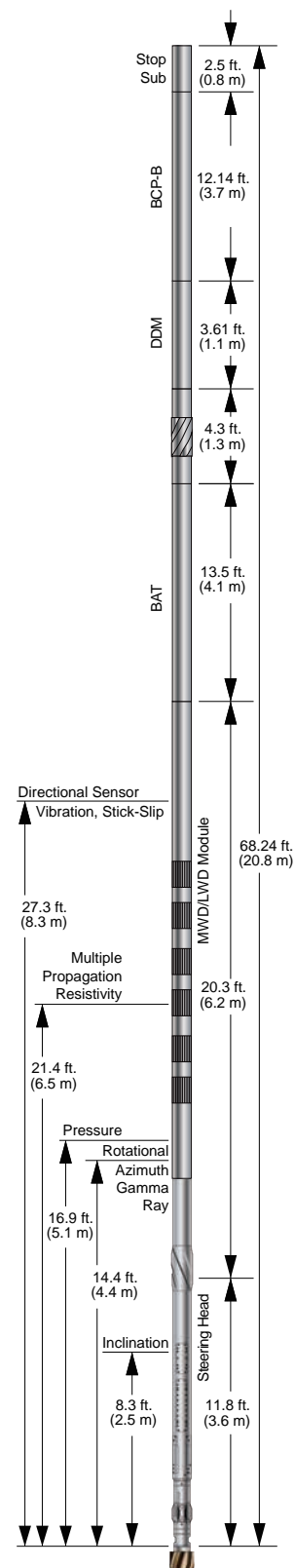
HWDP  
Centralizer Sub  
Crossover sub Box NC38/NC50 To Pin GT6  
Pressure&Caliper Measurement While Drilling (PCD)  
Acoustic While Drilling (AWD)  
Bi-directional Communication Power Module (BCP-O)  
Drilling Dynamics Monitor (DDM)  
Upper Centralizer Sub (UCS)  
Battery Management Unit (BAT)  
Integrated Logging While Drilling Tool (LWD-O)  
Lower Centralizer Sub (LCS)  
Rotary Steerable Unit (RSU)

## Introduction

IntelLWD is the new generation logging while drilling system, this system integrates the measurement of orientation, gamma, resistivity, borehole & annular pressure and drilling tool vibration, this system realize combined with CCN (Caliper Corrected Neutron Porosity), RAD (Rotary Azimuthal Density), MRI (Nuclear Magnetic Resonance Imaging While Drilling), AWD (Acoustic While Drilling), PCD (Pressure & Caliper Measurement While Drilling) and FTD (Formation Tester While Drilling). Improve the reliability of tools, reduced the connection point, and make the sensors distance from BHA to Bit optimized. This system also can realize the bi-directional communication with the surface system at the same time, can be combined with the rotation direction (RSU) realize geosteering.

## Specifications

Hole size		5-7/8 in. to 6-3/4 in.
OD		4-3/4 in.
Connection	Up	NC38 box
	Down	3-1/2 in. Reg box
Build Rate		0-10°/100 ft. (0-10°/30 m)
Max. Dogleg	Rotation	10°/100 ft. (10°/30 m)
	NO rotation	30°/100 ft. (30°/30 m)
Flow Range		125-350 GPM
Power		Drilling fluid driven Turbine
Max. RPM		400 rpm
Max. Temperature		302°F (150°C)
Max. Pressure		20000 psi (138 MPa)
Sand Content		≤1%
Max. LCM		40 ppb=114 kg/m <sup>3</sup>
Vibration		5 g RMS



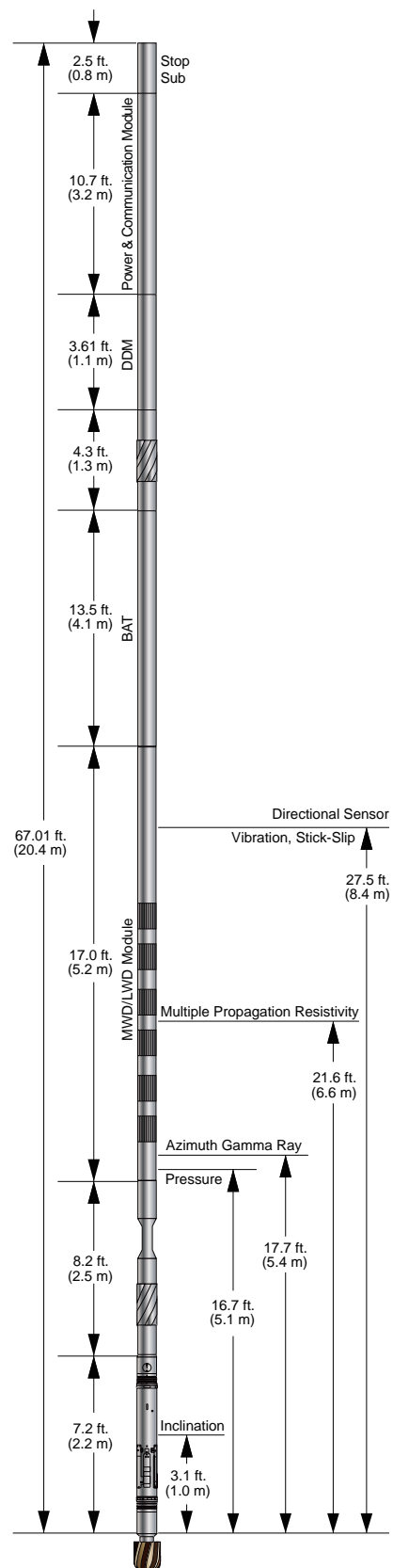


## Introduction

IntelLWD is the new generation logging while drilling system, this system integrates the measurement of orientation, gamma, resistivity, borehole & annular pressure and drilling tool vibration, this system realize combined with CCN (Caliper Corrected Neutron Porosity), RAD (Rotary Azimuthal Density), MRI (Nuclear Magnetic Resonance Imaging While Drilling), AWD (Acoustic While Drilling), PCD (Pressure & Caliper Measurement While Drilling) and FTD (Formation Tester While Drilling). Improve the reliability of tools, reduced the connection point, and make the sensors distance from BHA to Bit optimized. This system also can realize the bi-directional communication with the surface system at the same time, can be combined with the rotation direction (RSU) realize geosteering.

## Specifications

Hole size		8-1/2 in. to 10-5/8 in.	12 in. to 17-1/2 in.
OD		6-3/4 in.	9-1/2 in.
Connection	Up	NC50 box	7-5/8 in. Reg box
	Down	4-1/2 in. Reg box	7-5/8 in. Reg box 6-5/8 in. Reg. box
Build Rate		0-6.5°/100 ft.	0-6.5°/100 ft.
Max. Dogleg	Rotation	13°/100 ft. (13°/30 m)	6.5°/100 ft. (6.5°/30 m)
	NO rotation	20°/100 ft. (20°/30 m)	13°/100 ft. (13°/30 m)
Flow Range		200-900 GPM	300-1600 GPM
Power		Drilling fluid driven Turbine	
Max. RPM		400 rpm	
Max. Temperature		302°F (150°C)	
Max. Pressure		20000 psi (138 MPa)	
Sand Content		≤1%	
Max. LCM		40 ppb=114 kg/m³	
Vibration		5 g RMS	





## Specifications

Pressure	
Range	0 - 25000 psi
Resolution	5 psi
Accuracy	±0.25% of full scale
GR	
Tool Type	Scintillation Crystal
Range	0-500 API
Accuracy	± 2.5 API/100 API
Vertical Resolution	6 in. (153 mm)
Vibration	
Probe Type	Axial vibration z-Accelerometer Lateral vibration x-y Accelerometer
Acceleration Range	0 to 15 g
Frequency Range	0 to 82 Hz
Rotating & stick slip	
Probe Type	Two Axis Magnetometer
Range	0 to ±1000 rpm
Accuracy	±1%

Electronic Magnetic Resistivity		
2 MHz Resistivity		
Phase Difference	Range	0.1 - 3,000 ohm-m
	Accuracy	±1% (0.1-50 ohm-m) ±0.5 mmho/m (>50 ohm-m)
Attenuation	Range	0.1 - 500 ohm-m
	Accuracy	±2% (0.1-25 ohm-m) ±1 mmho/m (>25 ohm-m)
Vertical Resolution	8 in. (20 cm) for 90% response in conductive beds	
400 kHz Resistivity		
Phase Difference	Range	0.1 - 1,000 ohm-m
	Accuracy	±1% (0.1-25 ohm-m) ±1 mmho/m (>25 ohm-m)
Attenuation	Range	0.1 - 200 ohm-m
	Accuracy	±5% (0.1-10 ohm-m) ±5.0 mmho/m (>10 ohm-m)
Vertical Resolution	12 in. (30 cm) for 90% response in conductive beds	

### Azimuthal Module

Sensor Type	Tri-axial Accelerometer		
	Tri-axial Flux Gate		
MTF/GTF	Operator selectable (default: 3° )		
Measurement	Range	Resolution	Accuracy
Inclination	0°-180°	0.09°	± 0.15°
Azimuth	0°-360°	0.35°	± 1°
Toolface			
Magnetic TF	0°-360°	1.4°	± 1.5°
Gravity TF	0°-360°	1.4°	± 1.5°
Total Magnetic Field	0-100000 nT	35 nT	± 300 nT
Dip Angle	-90°~90°	0.04°	± 0.3°





### Applications

- Transmission of downhole data to surface.
- High density downhole sensor data storage.
- Transmission of surface commands to downhole.

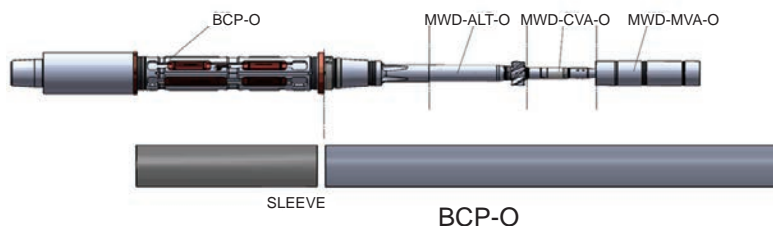
### Introduction

Bi-directional Communication Power Module (BCP-O) and downlink devices (BPC, NPG). The BCP-O (Bi-Directional Communication & Power Module-O) is capable of generating 300 Watt power output, providing 33 Vdc to the IntelLWD system, providing circuit breaker protection for upper and lower mounted instruments, detecting downlink data by monitoring turbine speed, transmitting data to the surface via a pulser. It can be installed in any position of the instrument string, which provides a lot of conveniences for the logging.

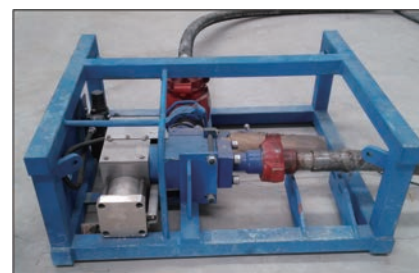
The BPC (Bypass Controller) sends commands from the surface to downhole instrument by controlling the NPG (Negative Pulse Generator) which controls the mud flow.

### Specifications

Tool O.D.	4.75 in.	6.75 in.	9.5 in.
Pulser Type	Rotary Pulser/Solenoid Pulser		
Max. Pressure	20,000 psi (137.9 MPa)/ 25000 psi (172 MPa) (option)		20,000 psi (137.9 MPa)
Max. Temperature	300°F (150°C)/350°F (175°C) (option)		300°F (150°C)
Make-up Length	12.10 ft. (3.7 m)	10.70 ft. (3.2 m)	14.11 ft. (4.3 m)
Weight	903 lbs. (410 kg)	1,006 lbs. (455 kg)	2392 lbs. (1082 kg)
Flow Range	125-350 gpm	200-900 gpm	300-1600 gpm
Transmission Rates	0.2 bit/s~3 bit/s Pulse Width Selectable: 3.0/2.0/1.5/ 1.0/0.8/0.5/0.36/0.32/0.24 sec		
Max. Turbine RPM	7000		
Output	33 Vdc $\pm$ 1		
Max. Power Output	300 Watts		



Safe Direction Drilling Panel (SDD)



Negative Pulse Generator (NPG)

## Applications

- Judge Bit working Condition

## Introduction

Drilling Dynamics Monitor (DDM) can measure Weight On Bit (WOB), BHA Torque, Hole Pressure and Annular Pressure, and transmit to surface via positive pulse. According the sensor data, drilling operator can modify the drilling parameter, mud equivalent circulation density, and drill safely and quickly.

## Specifications

Outside Diameter	4.75 in. (120 mm) / 6.75 in. (172 mm)	
Max Tempreature	300°F (150°C)	
Max Pressure	20,000 psi (137.9 MPa)	
Connector	Up	GVT2 Pin
	Down	GVT2 Box
Dogleg	16°/100 ft. (16°/30 m) @ Slidding	
	9°/100 ft. (9°/30 m) @ Rotation	
Tool Length	3.61 ft. (1.1 m)	
WOB Measure Range	±300 kN	
Accuracy	±5%	
Torque Measure Range	±30 kNm	
Accuracy	±5%	





## Applications

- Flow-off directional surveys
- Directional surveys connected downhole motor on BHA top

## Introduction

The Battery Management Unit provides directional sensor power during flow-off, acquire survey data, and store the data. Transmit the survey data to surface after flow-on.

## Specifications

Maximum Temperature	350°F (175°C)
Maximum Pressure	20,000 psi (137.9 MPa)
Outside Diameter	3.375 in. ( 85.7 mm)
	4.75 in. (120.7 mm)
	6.75 in. (171.5 mm)
	8.25 in. (209.5 mm)
Length	13.5 ft. (4.11 m)
Connections	GVT2 Box Up
	GVT2 PIN Down



## Applications

- Maximized drilling efficiency and wellbore placement with automated rotary drilling.
- Reduced risk of differential sticking via continuous rotation.
- Extended horizontal and lateral capabilities for maximum payzone contact—increasing production rates and extending the life of the well.
- Improved hole quality and hole cleaning to reduce completion risks.

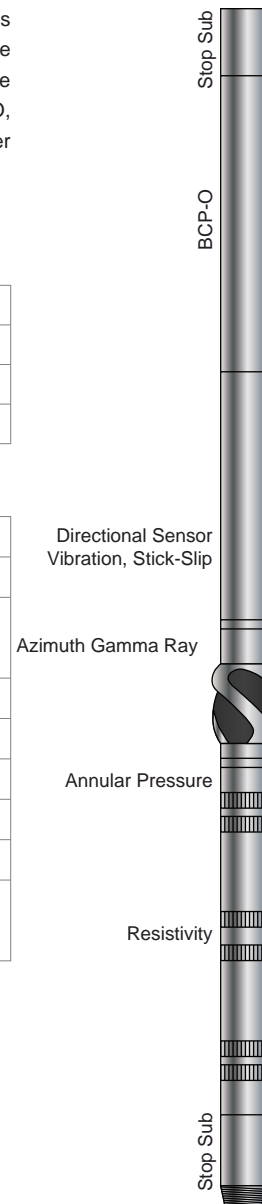
## Introduction

LWD-O combines real-time azimuth, gamma ray, resistivity, annulus pressure and vibration measurement together. This reduces the number of connection joints, improve reliability, and optimize the distance from BHA sensors to drilling bit. InteLWD consists BCP-O, directional sensor, resistivity, pressure sensor, gamma ray, master controller memory.

## Specifications

Max. Temperature	300°F (150°C)
Max. Pressure	20,000 psi (137.9 MPa)
Max. Rotation Rate	400 rpm
Max. Lost Circulation Material	40 ppb=114 kg/m <sup>3</sup>

Tool O.D.		4.75 in.	6.75 in.	9.5 in
Make-up Length		20.34 ft. (6.2 m)	17.06 ft. (5.2 m)	18.1 ft. (5.5 m)
Hole Diameter		5-3/4 in. to 6-3/4 in. (146-172 mm)	8-3/8 in. to 10-5/8 in. (212-270 mm)	12 in. to 17-1/2 in. (305-445 mm)
Dogleg Severity	With Rotation	10°/100 ft. (10°/30 m)	13°/100 ft. (13°/30 m)	6.5°/100 ft. (6.5°/30 m)
	Without Rotation	30°/100 ft. (30°/30 m)	20°/100 ft. (20°/30 m)	13°/100 ft. (13°/30 m)
Max. Temperature		300°F (150°C) Upon Request 350°F (175°C)		
Max. Pressure		20,000 psi (137.9 MPa)		
Max. Rotation Rate		400 rpm		
Max. Lost Circulation Material		40 ppb=114 kg/m <sup>3</sup>		



## Applications

- Precise reservoir navigation
- Exact wellbore placement
- Early detection of bed boundaries
- Geo-confirmation of sedimentary structures
- Offers a smooth wellpath and excellent hole quality for faster completions and enhanced production.
- Identifies hole cleaning problems and fluid influx into the wellbore.
- Optimizes drilling performance and reliability
- Increased Rate Of Penetration (ROP)

## Introduction

RSU is based on closed-loop systems with new designed MWD technique. It allows steering to target by advanced directional control methods in most challenging wellbore trajectories. Adds any LWD tools or borehole optimization systems into integrated BHA follow application needs.

## Specifications

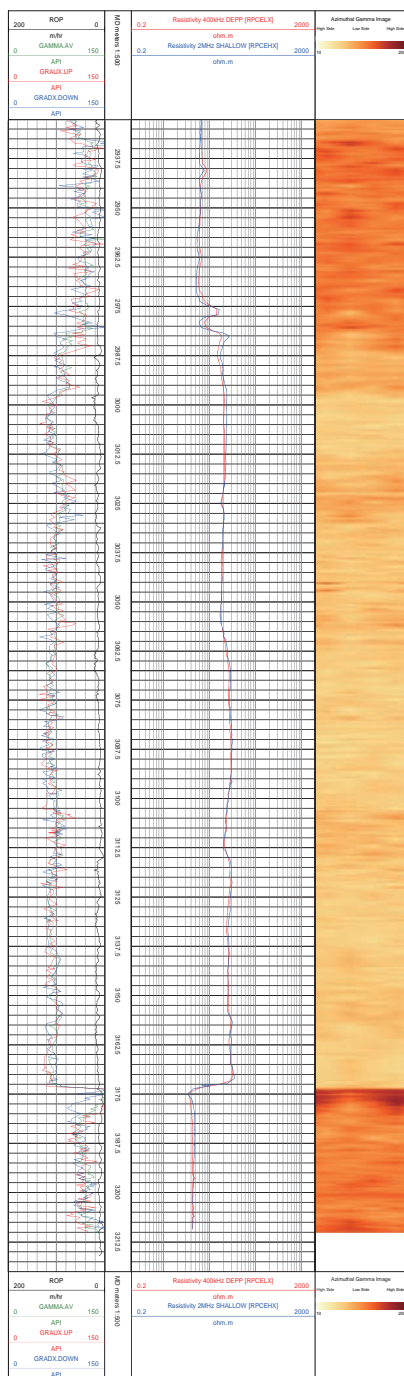
Tool O.D.		4.75 in.	6.75 in.	9.5 in.
Max. Pressure		20,000 psi (137.9 MPa)		
Max. Temperature		300°F (150°C)		
Make-up Length		14.55 ft. (4.4 m)	7.22 ft. (2.2 m)	8.2 ft. (2.5 m)
Weight		881 lbs. (400 kg)	905 lbs. (410 kg)	3,638 lbs. (1650 kg)
Hole Diameter		6 in. to 6-3/4 in. (152-172 mm)	8-3/8 in. to 10-5/8 in. (212-270 mm)	12 in. to 17-1/2 in. (305 mm-445 mm)
Build Rate		0-10°/100 ft. (30 m)	0-6.5°/100 ft. (30 m) 0-15°/100 ft. (30 m)	0-6.5°/100 ft. (30 m)
Dogleg Severity	With Rotation	10°/100 ft. (10°/30 m)	13°/100 ft. (13°/30 m)	6.5°/100 ft. (6.5°/30 m)
	Without Rotation	30°/100 ft. (30°/30 m)	20°/100 ft. (20°/30 m)	13°/100 ft. (13°/30 m)
	Rotation			





## Applications

- Horizontal well geosteering and formation evaluation
- Achieve precise window-in target
- Accurately identify the change direction of the geological structure of the drilled reservoir and increase the rate of drilled encounters
- Reduce cycle and waiting time
- Improve drilling efficiency



## Introduction

Near-bit azimuth gamma can accurately measure near-bit inclination and gamma, and provide early formation recognition during drilling.

## Specifications

Tool Size	4.75 in.	6.75 in.
Max Pressure	20000 psi (137.9 Mpa)	
Max Temperature	300°F (150°C)	
Gamma Specification		
Crystal Type	Scintillation	
Measurement	API GR	
Measuring Range	0 - 250 API	
Measuring Accuracy	±3% API of full scale	
Vertical Resolution	6 in. (153 mm)	
Inclination Specification		
Sensor Type	X-Y axis accelerometer Z axis accelerometer	
Measuring Range	0 - 180°	
Measuring Accuracy	±1°@INC>30°	
Electromagnetic Wave Type		
Tool Length	914 mm	
Tool OD	5.4 in. (138 mm)	7.25 in. (184 mm)
Modulation Type	ASK	
Baud Rate	20 Baud	
Supply Voltage	7.3 V	
Current and Power	470 mA @ 7.3 V (3.43 W)	
Connection	4-1/2 REG	
Transmission Distance	20 m	
Battery working time	150 hours	
Inclination and gamma measurement points	450 mm (Behind the drill bit)	
Electric Current		
Tool Length	914mm	
Tool OD	5.4 in. (138 mm)	7.25 in. (184 mm)
Modulation Type	GMSK	
Baud Rate	20 Baud	
Supply Voltage	+12 V to +24 V	
Current and Power	120 mA @ 22 V (2.64 W)	
Connection	4-1/2 REG	
Transmission Distance	20 m	
Battery working time	240 hours	
Inclination and gamma measurement points	450 mm (Behind the drill bit)	



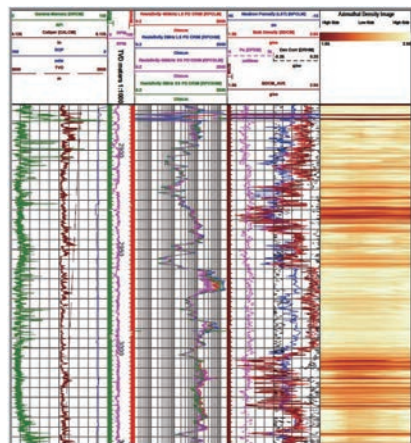
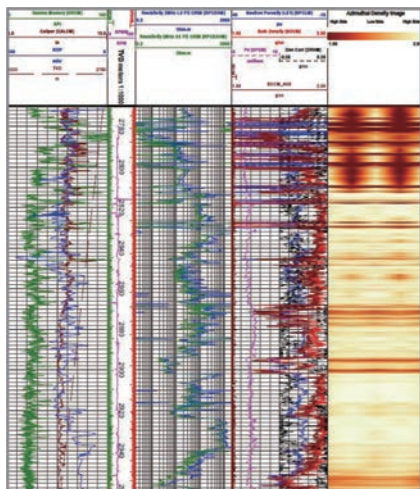


# Caliper Corrected Neutron Porosity- Rotary Azimuthal Density-4.75 (CCN-RAD-4.75)

**Geo-Vista**

## Applications

- Accurate, real-time quantification of porosity and gas identification for saturation calculations.
- Reservoir Navigation using high-resolution imaging and gas-oil/water identification in real-time.
- Wellbore stability analysis using azimuthal caliper and density imaging in real-time.
- Structural formation dip analysis and updating reservoir models from density imaging.



## Introduction

CCN-RAD offers measurement of formation density, neutron porosity, borehole caliper, and formation imaging. That provides geosteering for maximum reservoir exposure. Neutron porosity and bulk density are critical for the quantification of hydrocarbons in the reservoir.

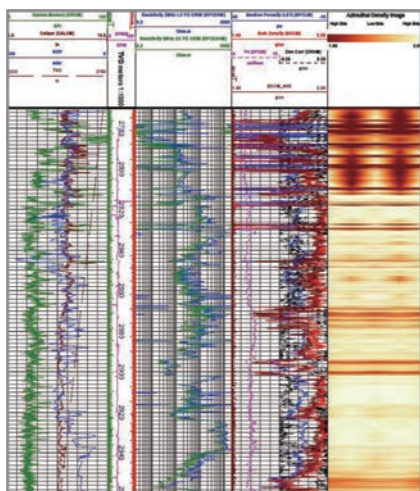
## Specifications

Diameter	4.75 in. With 5.59 in. upset
Max. Pressure	20000 psi (137.9 MPa)
Max. Temperature	300°F (150°C)
Weight	1100 lbs. (498 kg) (CCN-RAD 4)
Max. Dogleg Severity	15°/100 ft. (15°/30 m) Rotating 30°/100 ft. (30°/30 m) Sliding
<b>CCN</b>	
Service	Formation Porosity
Tool Type	Caliper Corrected Neutron
Detectors	Lithium-6 Iodide Crystal with Photomultiplier tube for both Near and Far detectors
Porosity Accuracy	0.5 pu below 10 pu, 5% of reading for 10-50 pu
Vertical Resolution	24 in. (61 cm)
Statistical Repeatability	± 0.6 pu@20 pu @ 200 ft./hr.
Max. Logging Speed	180 ft./hr (@2 points/ft.)
Depth Of Investigation	10 in. estimated for 8.5 in. 10 pu borehole
Radioactive Source	Am 241-Be Strength: 5 Curies (185 GBq)
Measure Point	4.6 ft. (1.4 m) (From downhole tool end)
Voltage	30 Vdc
Current Draw	160-170 mA
<b>RAD</b>	
Service	Formation Bulk Density Service with Hole Caliper
Tool Type	Rotational Azimuthal Density
Detectors	Nal Scintillation Crystal with photomultiplier tube for both Long and Short Spaced detectors
<b>Density Specifications</b>	
Range	1.6-3.1 g/cc
Accuracy	± 0.025 g/cc@200 ft./hr (60 m/hr) and 2.5 g/cc
Statistical Repeatability	18 in. (45 cm) (full resolution)
Downhole End Measure Point	5.1 ft. (1.5 m)
<b>Photoelectric Factor Specifications</b>	
Range	1-10 Barnes/electron (B/e)
Accuracy	± 0.25 B/e from 2-5 B/e
Statistical Repeatability	± 0.25 B/e@200 ft./hr (60 m/hr)
Vertical Resolution	6 in. (150 mm) (full resolution)
Downhole End to Pe Measure Point	5.1 ft. (1.5 m)
<b>Acoustic Standoff Caliper Specifications</b>	
Range	0-2 in. (Out of housing)
Accuracy	±0.075 in. (0 to 0.5 in.) ±0.125 in. (0.5 to 1.0 in.) ±0.25 in. (1.0 to 2.0 in.) Out of housing
Max. Logging Speed	180 ft./hr (@2 points/ft.)
Radioactive Source	Cs137 Strength: 2 Curies (74 GBq)
Voltage	30 V
Current Draw	350 mA~390 mA



## Applications

- Accurate, real-time quantification of porosity and gas identification for saturation calculations.
- Reservoir Navigation using high-resolution imaging and gas-oil/water identification in real-time.
- Wellbore stability analysis using azimuthal caliper and density imaging in real-time.
- Structural formation dip analysis and updating reservoir models from density imaging.

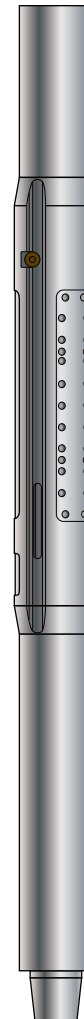


## Introduction

CCN-RAD offers measurement of formation density, neutron porosity, borehole caliper, and formation imaging. That provides geosteering for maximum reservoir exposure. Neutron porosity and bulk density are critical for the quantification of hydrocarbons in the reservoir.

## Specifications

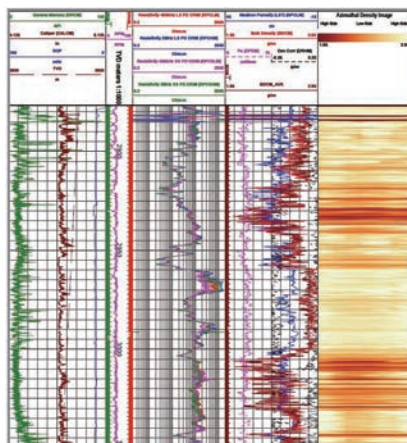
Diameter	6.75 in. with 7.50 in. upset	8.25 in. With 10.125 in. upset
Max. Pressure	20000 psi (137.9 MPa)	
Max. Temperature	300°F (150°C)	
Weight	893 lbs. (405 kg)	1325 lbs. (600 kg)
Service	Formation Porosity	
Tool Type	Caliper Corrected Neutron	
Dogleg Severity	9°/100 ft. (9°/30 m)	6.5°/100 ft. (6.5°/30 m)
	Rotating	Rotating
	16°/100 ft. (16°/30 m)	12°/100 ft. (12°/30 m)
	Sliding	Sliding
Detectors	Lithium-6 Iodide Crystal with Photomultiplier tube for both Near and Far detectors	
Porosity Accuracy	0.5 pu below 10 pu, 5% of reading for 10-50 pu	
Vertical Resolution	24 in. (61 cm)	
Statistical Repeatability	± 0.6 pu@20 pu @ 200 ft./hr.	
Max. Logging Speed	180 ft./hr (@2 points/ft.)	
Depth Of Investigation	10 in. estimated for 8.5 in. 10 pu borehole	
Radioactive Source	Am 241-Be Strength: 5 Curies (185 GBq)	
Measure Point	4.6 ft. (1.4 m) (From downhole tool end)	
Voltage	30 Vdc	
Current Draw	160-170 mA	





## Applications

- Accurate, real-time quantification of porosity and gas identification for saturation calculations.
- Reservoir Navigation using high-resolution imaging and gas-oil/water identification in real-time.
- Wellbore stability analysis using azimuthal caliper and density imaging in real-time.
- Structural formation dip analysis and updating reservoir models from density imaging.
- 8 or 16 sector azimuthal density, Pe and borehole caliper measurements.



## Introduction

CCN-RAD offers measurement of formation density, neutron porosity, borehole caliper, and formation imaging. That provides geosteering for maximum reservoir exposure. Neutron porosity and bulk density are critical for the quantification of hydrocarbons in the reservoir.

## Specifications

Diameter		6.75 in.	8.25 in.
Max. Pressure		20000 psi (137.9 MPa)	
Max. Temperature		300°F (150°C)	
Weight		1092 lbs. (495 kg)	1945 lbs. (881 kg)
Service		Formation Bulk Density Service with Hole Caliper	
Tool Type		Rotational Azimuthal Density	
Max. Dogleg	Rotating	9°/100 ft. (9°/30 m)	6.5°/100 ft. (6.5°/30 m)
Severity	Sliding	16°/100 ft. (16°/30 m)	12°/100 ft. (12°/30 m)
Detectors		NaI Scintillation Crystal with photomultiplier tube for both Long and Short Spaced detectors	
Density Specifications			
Range		1.6-3.1 g/cc	
Accuracy		± 0.015 g/cc	
Statistical Repeatability		± 0.025 g/cc@200 ft./hr (60 m/hr) and 2.5 g/cc	
Vertical Resolution		18 in. (45 cm) (full resolution)	
Downhole End Measure Point		5.1 ft. (1.5 m)	
Photoelectric Factor Specifications			
Range		1-10 Barnes/electron (B/e)	
Accuracy		± 0.25 B/e from 2-5 B/e	
Statistical Repeatability		± 0.25 B/e@200 ft./hr (60 m/hr)	
Vertical Resolution		6 in. (150 mm) (full resolution)	
Downhole End to Pe Measure Point		5.1 ft. (1.5 m)	
Acoustic Standoff Caliper Specifications			
Range		0-2 in. (Out of housing)	
Accuracy		±0.075 in. (0 to 0.5 in.)	
		±0.125 in. (0.5 to 1.0 in.)	
		±0.25 in. (1.0 to 2.0 in.)	
		Out of housing	
Max. Logging Speed		180 ft./hr (@2 points/ft)	
Radioactive Source		Cs137 Strength: 2 Curies (74 GBq)	
Voltage		30 V	
Current Draw		350 mA~390 mA	



## Applications

- For geosteering, the distance to the layer interface can be inferred to enhance the reliability and accuracy of geosteering.
- The azimuth resolution of 16 sectors close to the ground can be obtained. Its dynamic compensation can eliminate environmental interference.
- The 4 3/4" ARD and 6 3/4" ARD are compatible with HbuildLWD tools. This combination of drilling tools can accurately control the steering during drilling in complex formations.

## Benefits

- Deeper detection radius, the approaching stratum can be warned in advance to make timely decisions.
- The 16-sector azimuth resolution can determine the azimuth angle close to the formation and avoid entering shale or other hard formations.
- Improve the rate of oil reservoir drilling.
- The oil-water interface can be clearly distinguished from the inclined top layer of shale.
- Suitable for all types of mud.

## Features

- ARD eliminates environmental influences to a great extent, such as wellbore size, tool eccentricity, tool bending degree and temperature.
- The multiple coil system makes the tool more sensitive to detection near the ground.
- The rectangular coil receiver enhances the detection depth of ring waves.

## Introduction

ARD determines the azimuth angle close to the formation interface in real-time, such as the azimuth angle of the shale lens, cap layer or oil-water interface. The detection radius from the borehole axis is up to 17 feet (5.2 m). ARD is used for water-based mud, synthetic-based mud or oil-based mud.

## Specifications

Tool O.D.	4 3/4 in. (121 mm) / 6 3/4 in. (172 mm)
Applicable borehole size	5 7/8 in.-6 3/4 in. / 8 3/8 in.-10 5/8 in.
Common borehole size	6 1/8 in. (156 mm) / 8 1/2 in. (216 mm)
Tool length	11.03 ft. (3.36 m)
Tool weight	672 lbs (305 kg) / 1274 lbs (578 kg)
Equivalent stiffness OD×ID	4.755 in.×2.165 in. / 6.755 in.×2.165 in.
Type of cut-off sub upper connector	NC38 / NC50 Female thread
Type of connector	GT4 / GT6
Operating specifications and restrictions	
Displacement limited by LWD	125-350 gpm / 200-900 gpm
Maximum pull	534 klbs (2376kN) / 704 klbs (3132 kN)
Maximum bending torque	
Rotating	7 kft-lbs (10 kNm) / 20 kft-lbs (27 kNm)
Sliding	16 kft-lbs (22 kNm) / 61 kft-lbs (82 kNm)
Maximum temperature	300°F (150°C)
Maximum pressure	20000 psi (1378 bar)
Sensor Specifications	
Distance between measuring point and tool bottom	5.46 ft. (1.66 m)
Detection boundary	17 ft. (5.2 m)
Statistical repetition rate	±2%
Vertical resolution	24 in. (61 cm) (High resolution)
Azimuth quadrant	16

2 MHz	Phase Difference	Range	0.1-3000 ohm-m
		Accuracy	± 1% (0.1-50 ohm-m) ±0.5 mmho/m (> 50 ohm-m)
	Attenuation	Range	0.1-500 ohm-m
		Accuracy	± 2% (0.1-25 ohm-m) ±1.0 mmho/m (> 25 ohm-m)
		Vertical Resolution	8 in. (203 mm)
400 kHz	Phase Difference	Range	0.1-1000 ohm-m
		Accuracy	± 1.0% (0.1-25 ohm-m) ±1.0 mmho/m (>25 ohm-m)
	Attenuation	Range	0.1-200 ohm-m
		Accuracy	± 5.0% (0.1-10 ohm-m) ±5.0 mmho/m (>10 ohm-m)
		Vertical Resolution	12 in. (304 mm)



## Applications

- Continuous, real-time, lithology-independent porosity without chemical sources.
- Resistivity-independent pay identification.
- Continuous, real-time permeability evaluation.
- Thin-bed characterization.
- Carbonate facies characterization.
- Irreducible water saturation.
- Gas-bearing reservoir evaluation.
- Heavy oil and tar identification.
- Hole size distribution

## Introduction

By providing lithology-independent porosity, pore-size distribution, continuous permeability and direct hydrocarbon detection, the MRI delivers a step change in real-time producibility assessment for complex reservoirs.

While drilling a well with a challenging trajectory to target a complex carbonate reservoir the MRI (The high-quality, real-time magnetic resonance) to evaluate rock and fluid properties and obtain accurate lithology independent porosity and continuous permeability to optimize placement of the wellbore, the advanced petrophysical evaluation improved testing and completion design and calculated reservoir producibility for focus on well.

## Specifications

Max. Tool O.D. (Single-sleeve Stabilizer)	6.9 in. (175 mm) (single-sleeve stabilizer)	
Max. Pressure	20,000 psi (137.9 MPa)	
Max. Temperature	300°F (150°C)	
Make-up Length	32.38 ft. (9.87 m)	
Weight	3385.4 lbm. (1535.6 kg)	
Borehole Size Range	8.25 to 10.375 in. (20.96-26.36 cm)	
Normal Collar O.D.	6-3/4 in. (171.5 mm) API tolerance	
Thread Connections	GT6 box up/ GT6 box down	
Vertical Resolution Static	1.5 in./min.-4 in./min. (3.81 cm/min.-10.16 cm/min.)	
Vertical Resolution Dynamic	10 in. @50 ft./h (25.4 cm@15 m/h)-0.25 m/min. 20 in. @100 ft./h (50.8 cm@30 m/h)-0.5 m/min.	
Measurement of Porosity	0-100 pu	
Min. mud Resistivity	0.02 ohm.m	
Shell Diameter	15 in. (381 mm)	
Shell Thickness	0.24 in. (6 mm)	
Max. Number of Echoes	2000	
Min. Echo, Spacing	0.6 ms	
T <sub>2</sub> Distribution	0.5 to 5,000 ms	
Precision	< 10 pu/PAP	
Depth of Investigation	14 in. (356 mm)	
Static Field Gradient	58 gauss	
Freq of Sensitive Volume	245 kHz	
Operating Position	Centralized	
Hole Deviation	Vertical to Horizontal	
Power Supply	Turbine alternator	
Dogleg	Sliding	16°/100 ft. (16°/30 m)
	Rotating	8°/100 ft. (8°/30 m)
Max. System Shock Level	30 min. at shock level 5 (50-gn threshold or accumulatd 200,000 shocks above 50 gn)	
Torque	23,500 ft. lbf (31,800 N.m)	
Max. PH	< 9	



## Applications

- Optimize mud-weight selection
- Predict pore pressure independent of temperature and salinity effect.
- Identify top-of-cement
- Understand rock mechanical properties
- Measure porosity sourceless
- Position bit-on-seismic using synthetics
- Identify gas influx or formation gas.
- Perform many other standard sonic applications.

## Introduction

Acoustic While Drilling (AWD) provides real-time compressional and shear wave travel-time measurements in slow and fast formations. Shear and compressional slowness with computed semblance values are acquired using a state-of-the-art acoustic source combined with multiple arrays of receivers. Advanced downhole processing and waveform stacking techniques ensure reliable and fully compensated measurements.

## Specifications

Diameter		4.75 in.	6.75 in.
Tool O.D.		4.82 in. (122.43 mm)	6.9 in. (175.26 mm)
Hole Size		5.625 in. to 8 in. (143 to 203 mm)	8.5 in. to 10.625 in. (216 mm to 270 mm)
Max. Operating Temperature		300°F (150°C)	
Max. Operating Pressure		20,000 psi (137.9 MPa)	
Length		30 ft. (9 m)	23.8 ft. (7.254 m)
Weight		1,760 lbm (798 kg)	2,500 lbm (1,134 kg)
Thread Connections	HbuildLWD	GT4 box up/ GT4 pin down	GT6 box up/ GT6 pin down
	ComLWD	NC38 box up/ NC38 pin down	NC46 box up/ NC46 pin down
Makeup Torque		8845 ft.-lbf (11,984 N.m)	25,000 ft.-lbf (33,895 N.m)
Max. Dogleg Severity	Rotating	15°/100 ft. (15°/30 m)	8°/100 ft. (8°/30 m)
	Sliding	30°/100 ft. (30°/30 m)	16°/100 ft. (16°/30 m)
Max. Flow Rate		400 gal US/min. (1,514 L/min.)	800 gal US/min. (3,028 L/min.)
Max. Sand Content		3%	
Max. LCM Size		0.63 in. (16 mm)	
Average Inertia		62 in.	
Transmitters Number		1	
Receivers Number		4	
Measurement Type		Compression Wave & Shear Wave	
Accuracy, us/ft. (us/0.305 m)		± 1	
Measurement Range		All tools 40-230 us/ft. dependent on mud type	
Max. Shock		250 g for 100,000 cycles	
Measure Point From Tool Bottom		14 ft. (4.267 m)	



## Applications

- Fracture characterization
- Borehole breakouts and geomechanics
- Borehole geometry evaluation
- Thin-bed identification
- Structural dip determination
- Lithology and porosity variations
- Secondary porosity identification
- Sedimentary features identification

## Features

- Measures both Amplitude and Travel Time to obtain fully sampled images of the borehole surface.
- Enables client to evaluate borehole quality
- Enables a 256 sector circumferential resolution (1.4°) which is sufficient to fully sample the borehole wall in the typical ROP and RPM ranges experienced while drilling

## Benefits

- High quality ultrasonic acoustic transducer
- 3D Borehole image visualization
- High sampling rate

## Introduction

Ultrasonic Imaging While Drilling (UID) provides high-resolution borehole images while drilling in OBM/WBM.

Borehole imaging has been used to calculate borehole caliper, stress, breakout orientation, stratigraphic and geologic structure imaging in conventional wells. Borehole wall images are commonly used for fracture characterization during well planning to optimize hydraulic stimulation and maximize the possible return from a reservoir.

The image service is only available in memory mode while drilling, caliper is in real-time.

## Specifications

Maximum Temperature	300°F (150°C)
Maximum Pressure	20.000 psi (137.9 MPa)
Tool Size	6-3/4 in. (172 mm)
Hole Size	8-3/8 to 10 in. (213 mm to 254 mm)
Tool Weight	825 lbs. (375 kg)
Tool Length	8.8 ft. (2.68 m)
Logging Speed	Up to 400 ft./hr
Mud Type	OBM/WBM
Maximum Mud Weight	16 ppg
Azimuthal Sectors	256





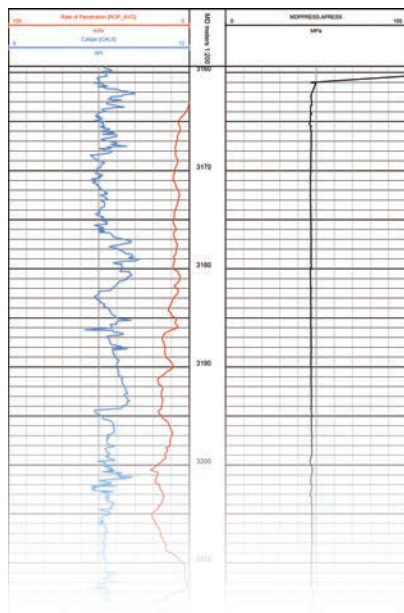
# Pressure & Caliper Measurement While Drilling (PCD)

## Ultrasonic Caliper Measurement While Drilling (CWD)

**Geo-Vista**

### Features

- Accurate downhole measurement of equivalent circulating density.
- Swab/surge pressure monitoring while tripping and reaming.
- Accurate downhole measurement of hydrostatic pressure and effective mud weight.
- Accurate measurement of caliper



### Introduction

PCD can accurately detect the annular pressure, the caliper, the borehole pressure and temperature. If PCD has no pressure measurement function, it is CWD (Ultrasonic Caliper Measurement While Drilling). It is used to judge the underground complex situation, such as well leakage, blowout, well inflow and monitoring well, and conducive to the control of well safety.

### Specifications

Tool Diameter	4.75 in. (120mm)/6.75 in. (171 mm)/ 8.25 in. (210 mm)
Max. Pressure	20,000 psi (137.9 MPa)
Max. Temperature	300°F (150°C)
Make-up Length	6 ft.-2.8 in. (1.9 m)
Operating Time Real-Time	No Limited
Flow Range	100-300 gpm
Data Acquisition Type	Real-time & Downhole Record
Data Transmit Type	Positive pulse
Pressure Measurement Range	0-25000 psi
Caliper Measurement Range	0-2 in. (Out of housing)
Caliper Accuracy	±0.075 in. (0 to 0.5 in.)
	±0.125 in. (0.5 to 1.0 in.)
	±0.250 in. (1.0 to 2.0 in.)
	Out of housing







# Generator Caliper Corrected Neutron Porosity (GCN)

**Geo-Vista**

## Features

- Safety, environmental protection, non-radioactive to operator
- High pulse neutron energy, high count rate, it can be extended for full spectrum measurement
- With open bus structure, it can be combined with other LWD tools

## Introduction

The GCN is a logging-while-drilling tool that uses a pulsed neutron generator instead of a chemical source. The instrument only use one drill collar, it uses an open bus structure can be combined with other LWD tools. It is used to monitor formation porosity during drilling to achieve “chemical source free logging”.

It consists of pulsed neutron generator, neutron detector, processing circuit It needs to be combined with PCD (Pressure & Caliper measurement while drilling) for neutron porosity corrected.

## Specifications

Tool Diameter	4.75 in. (120 mm)/6.75 in. (171 mm)/8.25 in. (210 mm)
Max. Pressure	20,000 psi (137.9 MPa)
Max. Temperature	300°F (150°C)
Make-up Length	15 ft.-8.98 in. (4.8 m)
Vibration	20 G, random frequency range 20~100,100 ~200 Hz
Shock	500 G, 11 ms semi-sine wave
Neutron Energy	2.5 MeV
Neutron Yield	$> 1 \times 10^8$ n/s
Measurement Range	0 to 100 p.u.
Measurement Accuracy	0.5 p.u. below 10 p.u.; 5% of measurement otherwise
Repeatability	$\pm 0.6$ p.u. @ 20 p.u. @ 200 ft./hr.



## Applications

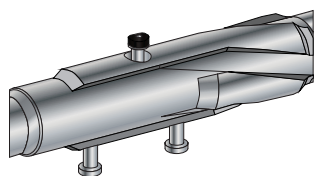
- Optimization of mud weight
- Selection of optimal case
- Estimation of reserves
- Identification of fluids and their contacts.
- Reservoir model refinement
- Well placement

## Benefits

- Mitigates risk through reservoir pressure management.
- Improves prediction of reserves using fluid typing.
- Enhances drilling performance through optimal mud weight.
- Saves time and cost by eliminating need for tool orientation.

## Features

- Provides formation pressure in drilling environment
- Provides direct pore pressure and mobility data for fluid typing and mud-weight optimization
- Used in any hole orientation—vertical or deviated
- Optimizes pretest volume and drawdown to formation characteristics
- Real-time measurements with quality control indicators

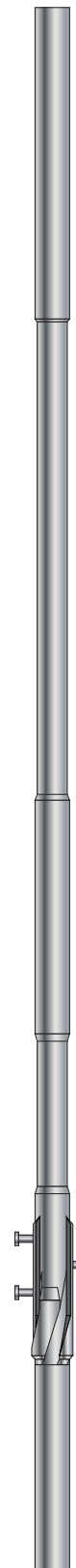


## Introduction

Formation Tester While Drilling (FTD) service makes accurate measurements that provide direct pore pressure and mobility data for fluid typing, reservoir pressure management, and mud-weight control and optimization. It achieves time savings through a focus on operational efficiency and measurement versatility, accuracy, and quality.

## Specifications

		4.75 in.	6.75 in.
Tool Design			
Measurement Type		Probe pretest	
Pressure Gauges		High-precision quartz and strain	
Power Supplies		Battery, MWD turbine power	
Measurement Specifications			
Probe Dimensions		1.75 in. (44.45 mm) OD 0.44 in. (11.18 mm) ID	2.25 in. (57.15 mm) OD 0.56 in. (14.22 mm) ID
Pretest	Volume	0 to 25 cm³, fully adjustable	
	Drawdown Rate	0.1 to 2.0 cm³/s	
	Delta Pressure	6,000 psi (41 MPa)	>6,000 psi (>41 MPa)
Setting Piston Diameter Reach		1.38 in. (35.05 mm) more than tool OD	2.00 in. (50.00 mm) more than tool OD
Memory Capacity		Up to 120 pretests depending on time downhole	80 pretests of 5 min. duration
Battery Capacity		150 pretests 1 cm³/s at 3,200 psi (22 MPa) drawdown at 275 °F (125 °C)	
General Specifications			
Tool Max. O.D.		4.82 in. (122.43 mm) 5.75 in. (146.05 mm) 5.5 in. (139.7 mm) optional	8.25 in. (209.6 mm) 9.25 in. (234.95 mm) with optional collar
Tool Length		40.2 ft. (12.3 m)	31 ft. (9.45 m)
Weight		2,000 lbm (907 kg)	2,866 lbm (1,300 kg)
Thread Connections		GT4 box up/ GT4 box down	GT6 box up/ GT6 box down
Operating Temperature		300 °F (150 °C)	
Mechanical Specifications			
Max. Dogleg Severity	Rotary Mode	15°/100 ft. (15°/30 m)	8°/100 ft. (8°/30 m)
	Sliding Mode	30°/100 ft. (30°/30 m)	16°/100 ft. (16°/30 m)
Axial And Lateral Shocks		10g rms	
Hydraulics			
Max. External Pressure		20,000 psi (138 MPa)	
Flow Range		0 to 400 galUS/min. (0 to 1,514 L/min.)	0 to 800 galUS/min. (3,028 L/min) (standard)
Note: Specifications are subject to change.			





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