

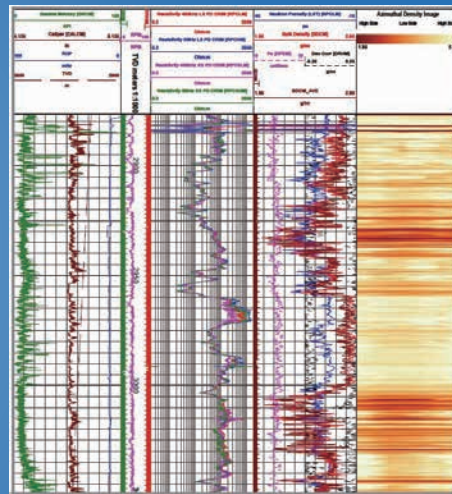


**Geo-Vista**

## Complete Logging While Drilling System (ComLWD)

Wireless Measurement While Drilling (MWD)  
Electromagnetic Propagation Resistivity (EPR)  
Inclination and Gamma Ray (IGR)  
Near-Bit Azimuth Gamma Ray (NB-AGR)  
Caliper Corrected Neutron Porosity (CCN)  
Rotary Azimuthal Density (RAD)  
Acoustic While Drilling (AWD)  
Pressure Unit While Drilling (PWD)

Pressure & Caliper Measurement While Drilling (PCD)  
Ultrasonic Caliper Measurement While Drilling (CWD)  
Generator Caliper Corrected Neutron Porosity (GCN)



[www.RenheSun.com](http://www.RenheSun.com)  
[www.geovista.cn](http://www.geovista.cn)

ComLWD



MWD

CCN /  
GCN + CWD

RAD

AWD

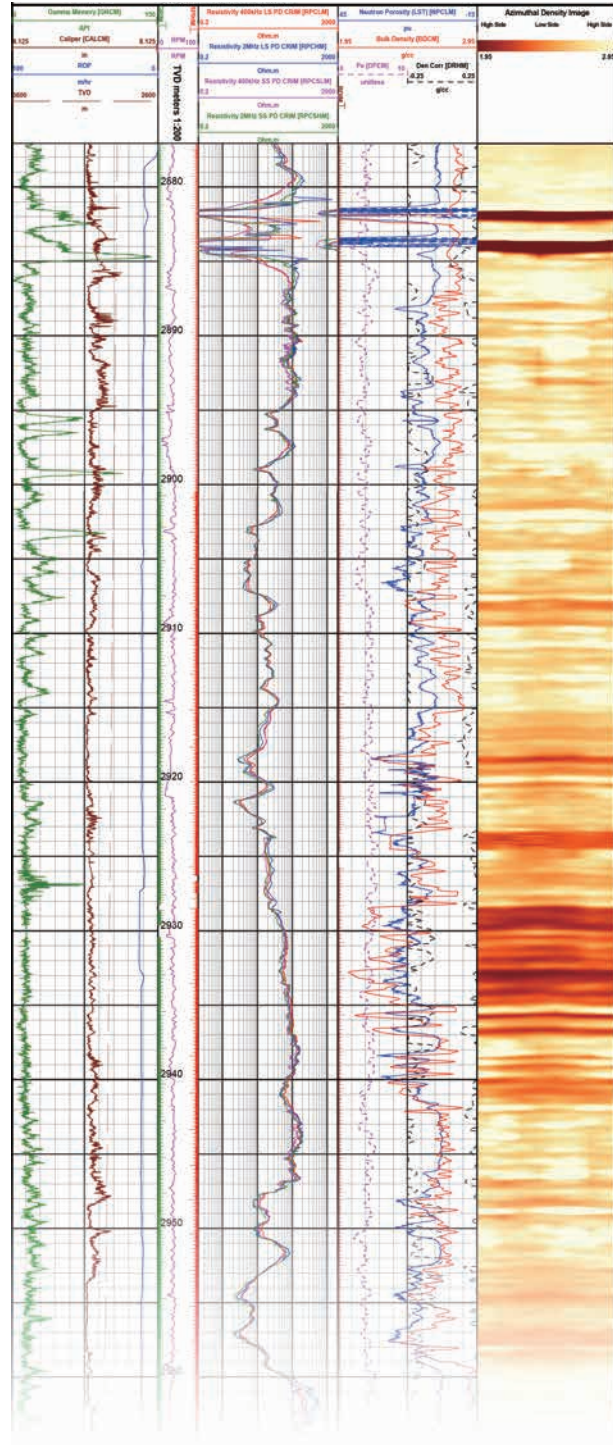
PWD/PCD

EPR

IGR

Downhole  
Motor

NB-AGR



## Applications

- Use generator model, in one run can drill long time without replacement battery, and security
- Insert mode, different sizes of instruments, electronic circuit are interchangeable, saving the cost
- Two kinds of pulser, have more choice to save cost
- Have 3.375 in. slim-hole instruments, can meet the requirements of slim-hole
- Can be connected to neutron density and acoustic instruments to logging more project
- Have Gamma inclination, it is easy to do direction drilling job

## Introduction

LWD has the advantage of measuring properties of a formation before drilling fluids invade deeply. Further, many wellbores prove to be difficult or even impossible to measure with conventional wireline tools, especially highly deviated wells. In these situations, the LWD measurement ensures that some measurement of the subsurface is captured in the event that wireline operations are not possible. Timely LWD data can also be used to guide well placement so that the wellbore remains within the zone of interest or in the most productive portion of a reservoir, such as in highly variable shale reservoirs.

## Specifications

### General Tool Specifications

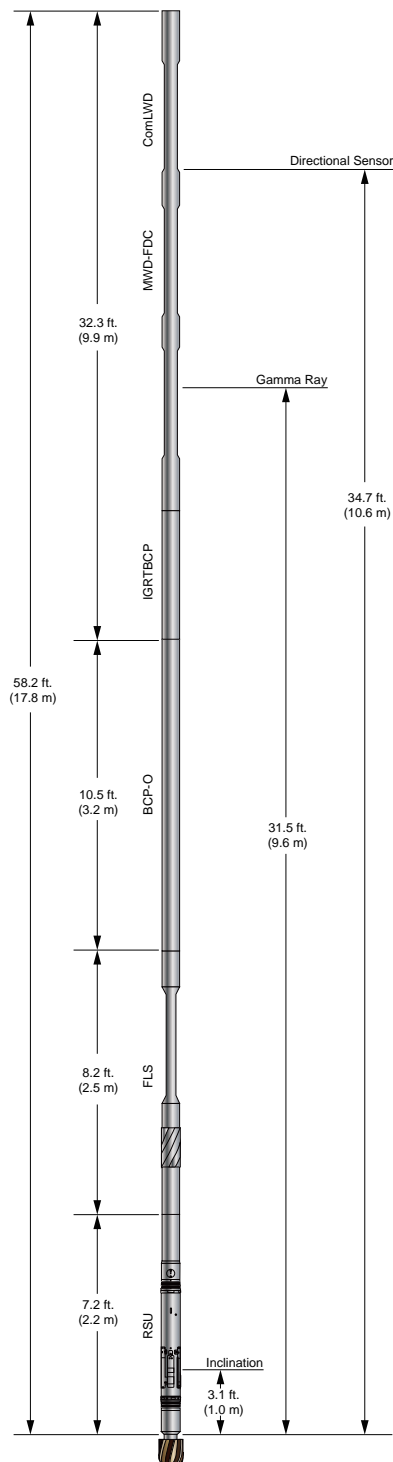
| Tool OD            | 3.375 in.                                     | 4.75 in.  | 6.75 in.  | 8.25 in.  | 9.5 in.   |
|--------------------|---|---|---|---|---|
| Well OD.           | 3-3/4 in. to 5-7/8 in.<br>(96-150 mm)         | 5-7/8 in. to 6-3/4 in.<br>(150-172 mm)                  | 8-1/2 in. to 9-7/8 in.<br>(216-251 mm)                  | 9-7/8 in. to 12-1/4 in.<br>(251 mm-311 mm)              | 12-1/4 in. to 26 in.<br>(311 mm-660 mm)                 |
| Connections        | 3 in. CDP box up<br>and 3 in. CDP<br>pin down | 3-1/2 in. I.F. box up<br>and 3-1/2 in. I.F.<br>pin down | 4-1/2 in. I.F. box up<br>and 4-1/2 in. I.F.<br>pin down | 6-5/8 in. Reg. box up<br>and 6-5/8 in. Reg.<br>pin down | 7-5/8 in. Reg. box up<br>and 7-5/8 in. Reg.<br>pin down |
| Dogleg<br>Severity | Max. Rotating<br>20°/100 ft.<br>(20°/30 m)    | Max. Rotating<br>12°/100 ft.<br>(12°/30 m)              | Max. Rotating<br>9°/100 ft.<br>(9°/30 m)                | Max. Rotating<br>8°/100 ft.<br>(8°/30 m)                | Max. Rotating<br>8°/100 ft.<br>(8°/30 m)                |
|                    | Max. Sliding<br>45°/100 ft.<br>(45°/30 m)     | Max. Sliding<br>30°/100 ft.<br>(30°/30 m)               | Max. Sliding<br>16°/100 ft.<br>(16°/30 m)               | Max. Sliding<br>8°/100 ft.<br>(8°/30 m)                 | Max. Sliding<br>8°/100 ft.<br>(8°/30 m)                 |
| Mud Flow<br>Range  | Battery<br>80-160 gpm                         | 160-320 gpm   | 300-675 gpm   | 400-900 gpm   | 600-1350 gpm  |

### General Tool Specifications

|                           |  |
|---------------------------|--|
| Max. Temperature          | 300°F (150°C)  |
| Max. Pressure             | 20000 psi (138 MPa)  |
| Sand Content              | Max. volume recommended < 1%   |
| Lost Circulation Material | Fine to medium nut plug  |
| Pulsation Dampener        | Recommended set to 1/3 stand pipe pressure   |
| Data Acquisition          | Mud pulse telemetry to surface and downhole memory   |
| Telemetry Type            | Positive pulse   |
| Mud Pumps                 | Either duplex or triplex   |
| Downhole RPM              | ± 80% max. deviation from the mean Operating rpm<br>(e.g., 100 rpm: Operation Range = 20-180 rpm)      |
| Pulser Pressure Drop      | Pressure drop dependent upon mud weight, flow rate,<br>MWD tool valve gap, and data transmission rate. |
| DP at Bit                 | No restrictions  |
| Mud Filter (Uphole)       | Most sizes supplied  |
| Full Survey Transmission  | 55 seconds from Pumps-On   |

## Upgrade ComLWD with Rotary Steering System

Realize rotary steering with minimum BHA using steering unit connecting with probe directional sensor and gamma. Reduce the drilling cost and improve economic benefit.



### ComLWD Crossover Sub (IGRTBCP)

Using the IGRTBCP to combine ComLWD with Rotary Steering System



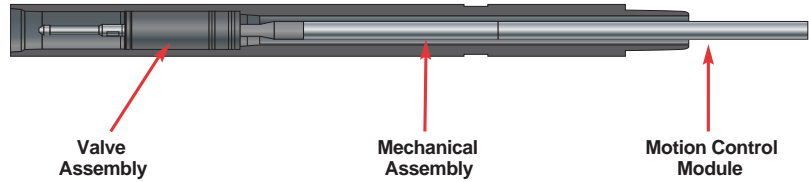
## Applications

- Steering drilling systems for re-entry and horizontal wells
- Directional control
- Relief well drilling
- Precision geosteering in high angle wells

## Introduction

MWD provides directional-drilling measurements. It helps for decision support for the smooth operation of the drilling by collected wellbore data in real-time like as deviation, azimuth, BHA tool face.

### Rotary Pulsar

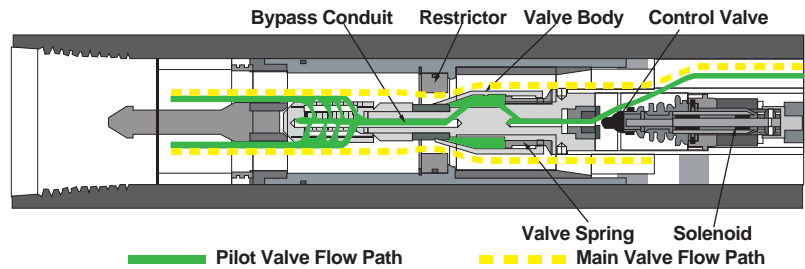


### Features

Rotary Pulsar:

- Increased reliability pulser.
- An ultra-reliable, high-efficiency DC brushless motor and controller.
- More durable shafts and seals, and better serviceability.

### Solenoid Pulsar



### Features

Solenoid Pulsar:

- Easy for maintenance
- Anti-corrosion
- Wide range flowrate



## Applications

- Steering drilling systems for re-entry and horizontal wells
- Directional control
- Relief well drilling
- Precision geosteering in high angle wells

## Introduction

|                        |                 |  |
|------------------------|-----------------|--|
| Max. Pressure          |                 | 20000 psi (137.9 MPa) /<br>25000 psi (172 MPa) (option)                                    |
| Max. Temperature       |                 | 300°F (150°C)/350°F (175°C) (option)   |
| Tool O.D.              | Battery         | 3.375 in.  |
|                        | Generator       | 4.75 in./6.75 in./8.25 in./9.5 in.   |
| Pulser Type            |                 | Rotary Pulser/Solenoid Pulser  |
| Transmission Rates     | Solenoid Pulser | 0.2 bit/s~3 bit/s<br>Pulse Width Selectable:<br>3.0/2.0/1.5/1.0/0.8/0.5/0.36/0.32/0.24 sec |
|                        | Rotary Pulser   | 0.2 bit/s~2 bits/s<br>Pulse Width Selectable:<br>3.0/2.0/1.5/1.0/0.8/0.5/0.36 sec          |
| Pulse Width Selectable |                 | 3.0/2.0/1.5/1.0/0.8/0.5/0.36/0.32/0.24 sec   |
| Vibration Measurement  |                 | Shock and vibration measurements using a Triaxial Accelerometer arrangement                |
| Sensors                |                 | Min., Max., and Ave. RPM measurements using dual Magnetometers                             |

| Measurement  | Range                  | Resolution | Accuracy |
|--|------------------------|------------|----------|
| Inclination  | 0° - 180°              | 0.1°       | ± 0.15°  |
| Azimuth <sup>1,2</sup>   | 0° - 360°              | 0.35°      | ± 1.0°   |
| Toolface   |                        |            |          |
| Magnetic <sup>1</sup>  | 0° - 360°              | 1.4°       | ± 1.5°   |
| Gravity <sup>2</sup>   | 0° - 360°              | 1.4°       | ± 1.5°   |
| Temperature  | 150°C / 175°C (option) | 2°C        | ±3.0°C   |
| Dip Angle <sup>1</sup>   | -90° - 90°             | 0.044°     | ± 0.3°   |
| MTF/GTF Switching Inclination Degrees: Operator Selectable (default set at 5°) |                        |            |          |

1 Assumes typical magnetic field values at 30° latitude.

2 Accuracy applies to inclinations greater than 5.0°.

| Tool Size | Restrictor ID    | Flow Range (gpm) | Flow Range (lpm) |
|-----------|------------------|------------------|------------------|
| 3-3/8 in. | 40mm             | 80-160 gpm       | 302-605 lpm      |
| 4-3/4 in. | 49 mm (standard) | 160-320 gpm      | 606-1,211 lpm    |
|           | 47 mm (low Flow) | 160-220 gpm      | 606-833 lpm      |
| 6-3/4 in. | 52 mm (standard) | 300-675 gpm      | 1,136-2,555 lpm  |
|           | 50 mm (low flow) | 300-450 gpm      | 1,136-1,703 lpm  |
| 8-1/4 in. | 54 mm (standard) | 400-900 gpm      | 1,514-3,407 lpm  |
|           | 53 mm (low flow) | 400-600 gpm      | 1,514-2,271 lpm  |
| 9-1/2 in. | 57 mm (standard) | 600-1,350 gpm    | 2,271-5,100 lpm  |
|           | 55 mm (low flow) | 600-900 gpm      | 2,271-3,407 lpm  |



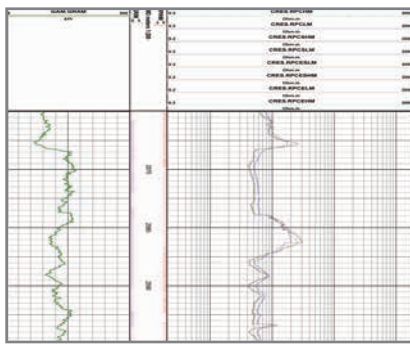


## Applications

- Provides formation resistivities
- Provide realtime formation evaluation services
- Provide wellbore placement
- Improve geosteering capabilities

## Features

- Operates at frequency of 2 MHz and 400 kHz Compensated antenna design with dual spacing transmitter pairs
- 8 quantitative resistivities with separate depths of investigation (3.375 in. provides 4 quantitative resistivities) Works in all mud types



## Introduction

Transmits electromagnetic waves into formation and measures the change in physical character of the wave on its return. The change in physical character of wave gives an indication of the Resistivity of the drilled formation.

## Specifications

|                           |  |  |  |  |                             |
|---------------------------|--|--|--|--|-----------------------------|
| Tool O.D.                 | 3.375 in.  | 4.75 in.   | 6.75 in.   | 8.25 in.   |                             |
| Hole Sizes                | 3.75 in. to 5.875 in.<br>(96-150 mm)                 | 5.875 in. to 6.75 in.<br>(150-172 mm)                      | 8.5 in. to 9.875 in.<br>(216-251 mm)                       | 10 in. to 12.25 in.<br>(254-311 mm)                      |                             |
| Max. Pressure             | 20,000 psi (137.9 MPa)                               |  |  |  |                             |
| Max. Temperature          | 300°F (150°C)  |  |  |  |                             |
| Length                    | 7.4 ft. (2.3 m)                                      | 12 ft. (3.7 m)   | 12 ft. (3.7 m)   | 12 ft. (3.7 m)   |                             |
| Weight                    | 175 lbs.<br>(79 kg)                                  | 600 lbs.<br>(272 kg)                                       | 1,280 lbs.<br>(581 kg)                                     | 1,595 lbs.<br>(725 kg)                                   |                             |
| Connections               | 3 in. CDP<br>Box Uphole<br>3 in. CDP<br>Pin Downhole | 3-1/2 in. I.F.<br>box up and<br>3-1/2 in. I.F.<br>box down | 4-1/2 in. I.F.<br>box up and<br>4-1/2 in. I.F.<br>box down | 6-5/8 in. Reg<br>box up and<br>6-5/8 in. Reg<br>box down |                             |
| Dogleg                    | Max. Rotating  | 20°/100 ft.<br>(20°/30 m)                                  | 12°/100 ft.<br>(12°/30 m)                                  | 9°/100 ft.<br>(9°/30 m)                                  | 8.2°/100 ft.<br>(8.2°/30 m) |
| Severity                  | Max. Sliding   | 45°/100 ft.<br>(45°/30 m)                                  | 30°/100 ft.<br>(30°/30 m)                                  | 16°/100 ft.<br>(16°/30 m)                                | 8.2°/100 ft.<br>(8.2°/30 m) |
| Lost Circulation Material | Fine to medium nut plug                              |  |  |  |                             |
| Pulsation Damper          | Recommended, 1/3 Standpipe Pressure                  |  |  |  |                             |
| Data Acquisition          | Mud pulse telemetry to surface and downhole memory   |  |  |  |                             |
| Telemetry Type            | Positive Pulse                                       |  |  |  |                             |



|                  |            | 2 MHz Resistivity                                   | 400 kHz Resistivity                                |
|------------------|------------|---|--|
| Phase Difference | Range      | 0.1 to 3,000 ohm-m                                  | 0.1 to 1,000 ohm-m                                 |
|                  | Accuracy   | ±1% (0.1 to 50 ohm-m)<br>± 0.5 mmho/m (> 50 ohm-m)  | ± 1% (0.1 to 25 ohm-m)<br>± 1.0 mmho/m (>25 ohm-m) |
| Attenuation      | Range      | 0.1 to 500 ohm-m                                    | 0.1 to 200 ohm-m                                   |
|                  | Accuracy   | ± 2% (0.1 to 50 ohm-m)<br>± 1.0 mmho/m (> 50 ohm-m) | ± 5% (0.1 to 10 ohm-m)<br>± 5.0 mmho/m (>10 ohm-m) |
|                  | Vertical   | 8 in. (20 cm) for 90%                               | 12 in. (30 cm) for 90%                             |
|                  | Resolution | response in conductive beds                         | response in conductive beds                        |

## Applications

- Shale content evaluation
- Stratigraphic Correlation
- Lithology determination
- Bed boundaries estimation

## Introduction

The Gamma instruments measures the natural radioactivity emanating from the formation.

## Specifications

|                                  |   |
|----------------------------------|---|
| Tool OD                          | 3.375 in./4.75 in./6.75 in./8.25 in./9.5 in.      |
| Max. Pressure                    | 20000 psi (137.9MPa)/25000 psi (172 MPa) (option) |
| Max. Temperature                 | 300°F (150°C)/350°F (175°C) (option)              |
| <b>Gamma Specification</b>       |   |
| Type                             | Scintillation                                     |
| Measurement                      | API GR  |
| Range                            | 0 - 250 API                                       |
| Accuracy                         | ±3% API of full scale                             |
| Vertical resolution              | 6 in. (153 mm)                                    |
| <b>Inclination Specification</b> |   |
| Max. Temperature                 | 150°C/175°C (option)                              |
| Sensor Type                      | Z axis accelerometer                              |
| Range                            | 0 - 180° degrees                                  |
| Accuracy                         | ±1°@INC>30°                                       |

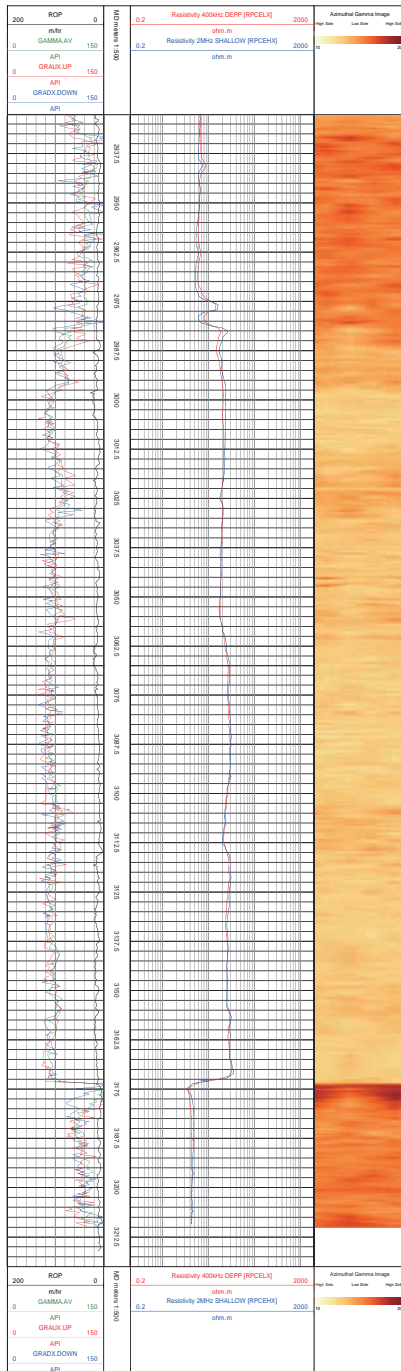






## Applications

- 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

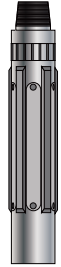


## Introduction

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)                                  |                   |
| <b>Gamma Specification</b>               |  |                   |
| Crystal Type                             | Scintillation                                  |                   |
| Measurement                              | API GR   |                   |
| Measuring Range                          | 0 - 250 API                                    |                   |
| Measuring Accuracy                       | ±3% API of full scale                          |                   |
| Vertical Resolution                      | 6 in. (153 mm)                                 |                   |
| <b>Inclination Specification</b>         |  |                   |
| Sensor Type                              | X-Y axis accelerometer<br>Z axis accelerometer |                   |
| Measuring Range                          | 0 - 180°                                       |                   |
| Measuring Accuracy                       | ±1°@INC>30°                                    |                   |
| <b>Electromagnetic Wave Type</b>         |  |                   |
| 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)                  |                   |
| <b>Electric Current</b>                  |  |                   |
| 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)                  |                   |



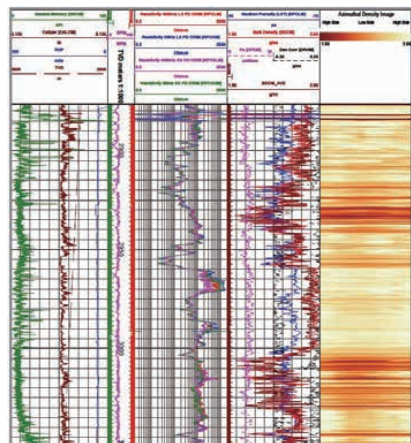
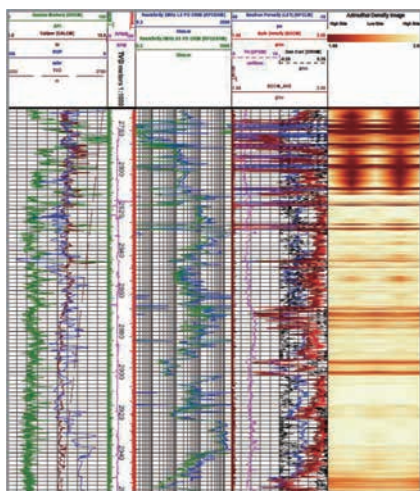


# Caliper Corrected Neutron Porosity- Rotary Azimuthal Density-4.75 (CCN-RAD-4.75)

**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.

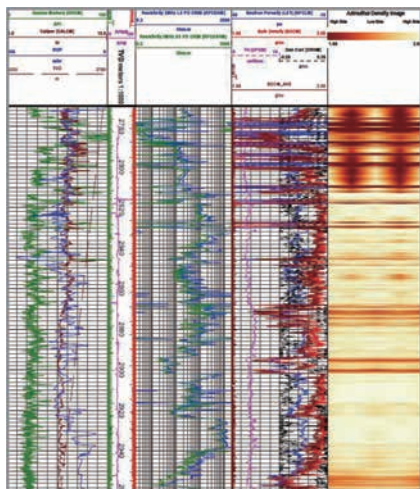
## Specifications

|  |   |
|--|---|
| 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<br>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          |
| Density Specifications                   |   |
| 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)   |
| 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.)<br>±0.125 in. (0.5 to 1.0 in.)<br>±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.

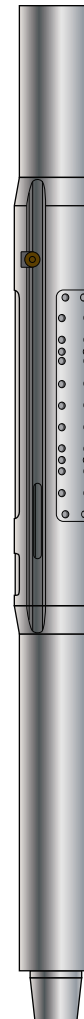


## Introduction

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.

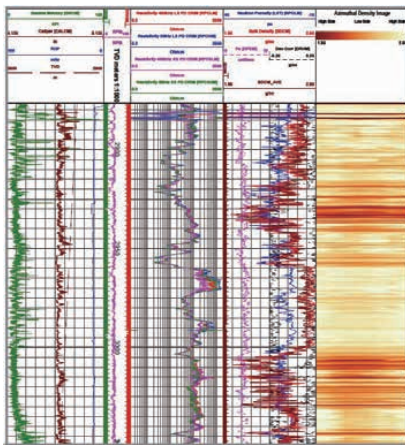
## Specifications

|                           |  |                                      |
|---------------------------|--|--------------------------------------|
| Diameter                  | 6.75 in. with<br>7.50 in. upset  | 8.25 in. With<br>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)<br>Rotating   | 6.5°/100 ft. (6.5°/30 m)<br>Rotating |
|                           | 16°/100 ft. (16°/30 m)<br>Sliding  | 12°/100 ft. (12°/30 m)<br>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.

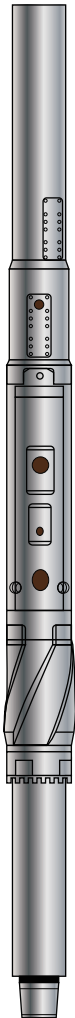


## Introduction

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)   |
| 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 |                        |
| <b>Density Specifications</b>                   |  |                        |
| 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)  |                        |
| <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.)<br>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

- 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.<br>(143 to 203 mm)         | 8.5 in. to 10.625 in.<br>(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                            | HbuildLWD | GT4 box up/<br>GT4 pin down                   | GT6 box up/<br>GT6 pin down                 |
|                                   | ComLWD    | NC38 box up/<br>NC38 pin down                 | NC46 box up/<br>NC46 pin down               |
| Connections                       |           |   |   |
| 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.<br>(1,514 L/min.)             | 800 gal US/min.<br>(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.<br>(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<br>Tool Bottom |           | 14 ft. (4.267 m)                              |   |



## Applications

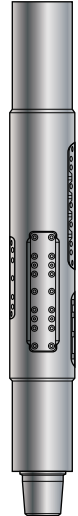
- Conductive to the control of well safety
- Optimizing the acquisition period
- Minimizing the total time required to accurately measure annular pressure

## Introduction

PWD can accurately detect the annular pressure, the borehole pressure and temperature. 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 O.D.                  | 4.75 in. / 120 mm                                 | 6.75 in. / 172 mm      | 8.25 in./210 mm       |
| Max. Pressure              | 20000 psi (137.9MPa)/25000 psi (172 MPa) (option) |                        |                       |
| Max. Temperature           | 300°F (150°C)/350°F (175°C) (option)              |                        |                       |
| Length                     | 5 ft.-6.93 in. (1.7 m)                            | 4 ft.-3.18 in. (1.3 m) | 4 ft.-8 in. (1.424 m) |
| Flow range                 | 160-320 gpm                                       | 300-675 gpm            | 400-900 gpm           |
| Data Acquisition Type      | Real-time & Downhole Record                       |                        |                       |
| Data Transmit Type         | Data Transmit Type Positive pulse                 |                        |                       |
| Pressure Measurement Range | 0 - 25000 psi                                     |                        |                       |
| Accuracy                   | Accuracy ± 0.25% full scale                       |                        |                       |



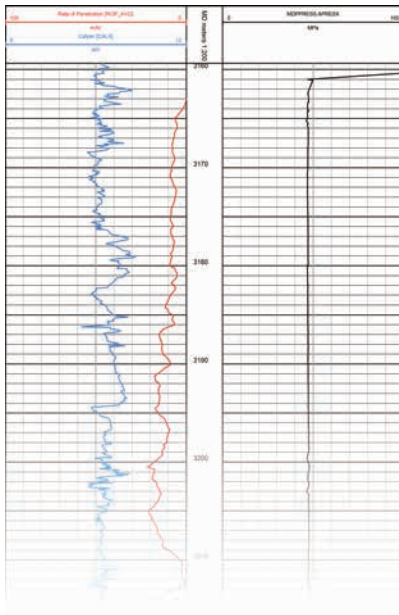


# Pressure & Caliper Measurement While Drilling (PCD) Ultrasonic Caliper Measurement While Drilling (CWD)

**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)/<br>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   |





### 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*10 <sup>8</sup> n/s                               |
| Measurement Range    | 0 to 100 p.u.   |
| Measurement Accuracy | 0.5 p.u. below 10 p.u.; 5% of measurement otherwise   |
| Repeatability        | ± 0.6 p.u. @ 20 p.u. @ 200 ft./hr.                    |







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