

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
Directional																												
APS Technology (Rental Division) • 7 Laser Lane Wallingford, CT 06492 (860) 613-4450 www.aps-tech.com																												
APS SureShot	3 1/8, 3 1/2, 4 3/4, 6 1/4, 6 3/4, 8, 9 1/2+	25*	Collar-limited	Collar-defined	150 and 175	20 and 25	(3 1/2) 27, (4 3/4 - 6 3/4) 6, (8) 3, (9 1/2) 2	(3 1/2) 150, (4 3/4 - 6 3/4) 35, (8) 20, (9 1/2) 10	(6 1/2 - 6 3/4) 114, (8) 61, (9 1/2) 32	(9 1/2) 220	(3 1/8, 3 1/2) 70-250 (4 3/4) 150-350 (6 1/4, 6 3/4) 150-750 (8) 300- 1,100 (9 1/2+) 650-1,200	Flow-on and timer	MPT positive pulse and EM	Y (4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 6.4	Incl: +/-0.1° Azi: +/-1.0° (Incl. >10°; Dip <70°) GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°)	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer	Azi., Incl., MTF, GTF, temp. Optional Pressure; Lateral Vib., Axial Vib.; Torsional Vib.; RPM; WOB/TOB/BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot with Gamma	3 1/8, 3 1/2, 4 3/4, 6 1/4, 6 3/4, 8, 9 1/2+	29*	Collar-limited	Collar-defined	150 and 175	20 and 25	(3 1/2) 29, (4 3/4 - 6 3/4) 6, (8) 3, (9 1/2) 2	(3 1/2) 165, (4 3/4 - 6 3/4) 40, (8) 20, (9 1/2) 10	(6 1/2 - 6 3/4) 114, (8) 61, (9 1/2) 32	(9 1/2) 225	(3 1/8, 3 1/2) 70-250 (4 3/4) 150-350 (6 1/4, 6 3/4) 150-750 (8) 300 -1,100 (9 1/2+) 650-1,200	Flow-on and timer	MPT positive pulse and EM	Y (4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 6.4 Gamma: 2.1	Incl: +/-0.1° Azi: +/-1.0° (Incl. >10°; Dip <70°) GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°) Gamma: 0 - 800 API +/-5%	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: NaI scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + WPR Propagation Resistivity	3 1/2, 4 3/4, 6 3/4, 8	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1° Azi: +/-1.0° (Incl. >10°; Dip <70°) GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°) Gamma: 0 - 800 API +/-5% Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: NaI scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureSteer 475-rss Rotary Steerable System (RSS)	4 3/4 (blades and stabilizers for 6 and 6 3/4 holes)	32.4	21, 15. Programmable build rates of 0.5 to 12.0. Also, vertical and tangent angle hold modes.		150	20	200 psi @ 350 gal/min				150 - 350 gal/min	Flow-on + rotation	May be connected directly to APS SureShot MWD system.	N	Y	N	Y (via MWD)	Y	Config. dependent	Config dependent	N/N	Dir: 14	Incl: +/-0.1° GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°)	Bi-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer	Rotation., Incl., MTF, GTF, temp, time, steering mode, blade activity. Integrated memory.	Turbine driving alternator + hydraulic pump	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureSteer 675-rsm Rotary Steerable Motor (RSM)	6 3/4 (blades and stabilizers for 8 3/8, 8 1/2 and 8 3/4 holes)	17*	15, 12. Programmable build rates of 0.5 to 8.0. Also, vertical and tangent angle hold modes.		150	20	250 psi @ 600 gal/min				300 - 600 gal/min	Flow-on + rotation	EM short-hop to MWD	N	Y	N	Y (via MWD)	Y	Config. dependent	Config dependent	N/N	Dir: 3.5	Incl: +/-0.1° GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°)	Bi-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer	Rotation., Incl., MTF, GTF, temp, time, steering mode, blade activity. Integrated memory.	Mud-motor driving alternator + hydraulic pump	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
Baker Hughes • www.bakerhughes.com																												
AutoTrak Curve high-build rotary steerable	6-3/4	37.8	30/15	BHA Dependent	150	20	N/A	N/A	Application Specific	N/A	300-750	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	55	Y/Y	5.9 (NBI) 21.5 (other)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AutoTrak eXact advanced high-build rotary steerable	4-3/4, 6-3/4	9.62, 10.5	12, 10	BHA Dependent	165, 150	30	N/A	N/A	N/A	N/A	125-350 Applicaton Dependent	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	55	Y/Y	4.86 NBI 5.9 NBI	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AutoTrak G3 advanced rotary steerable	4-3/4, 6-3/4, 8-1/4, 9-1/2	13.3 (4-3/4) 15.4 (6-3/4) 18.9 (8-1/4) 20.0 (9-1/2)	30/10 (4-3/4) 20/13 (6-3/4) 9/6.5 (8-1/4) 13/6.5 (9-1/2)	BHA Dependent	150, 175 (option)	20 25 (option) 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-350 (4-3/4) 0-900 (6-3/4) 0- 1,295 (8-1/4) 0-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	Op. Sel.	Op. Sel.	55	Y/Y	28.8, NBI = 3.8 (4-3/4) 27.5, NBI = 3.1 (6-3/4) 32.4, NBI = 3.1 (8-1/4) 33.1, NBI = 3.9 (9-1/2)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.1° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AutoTrak X-treme rotary steerable & mud motor	4-3/4, 6-3/4, 9-1/2	35.0 (4-3/4) 35.5 (6-3/4) 43.9 (9-1/2)	25/10 (4-3/4) 16/7 (6-3/4) 8/3.8 (9-1/2)	BHA Dependent	150, 175 (option 6-3/4 and 9-1/2)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-350 (4-3/4) 0-900 (6-3/4) 0-1,295 (8-1/4) 0-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	Op. Sel.	Op. Sel.	55	Y/Y	3.8 (4-3/4) 3.1 (6-3/4) 3.9 (9-1/2)	+/- 0.1° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AutoTrak eXpress rotary steerable	4-3/4, 6-3/4, 9-1/2	56.8 (4-3/4) 58.2 (6-3/4) 70 (6-3/4 high DLS) 64.6 (9-1/2)	30/10 (4-3/4) 23/8 (6-3/4) 23/12 (6-3/4 high DLS option) 13/6.5 (9-1/2)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,600 (9-1/2)	Stop/start pumps Stop rotary	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	62	Y/Y	3.8 (4-3/4 inclination) 32.9 (4-3/4 other) 3.1 (6-3/4 inclination) 34.7 (6-3/4 other) 3.9 (9-1/2 inclination) 40.8 (9-1/2 other)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AutoTrak V vertical rotary steerable	4-3/4, 6-3/4, 9-1/2	23.1 (4-3/4) 19.7 (6-3/4) 22.3 (9-1/2)	30/10 (4-3/4) 23/8 (6-3/4) 13/6.5 (9-1/2)	BHA Dependent	150, 175 (option 6-3/4 and 9-1/2)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	N/A	N/N	3.8 (4-3/4) 3.1 (6-3/4) 3.9 (9-1/2)	+/- 0.1° (inclination)	3-axis accelerometer	Near bit incl., Temp.	Turbine generator/ no limit	Y	N
UltraSlim directional & gamma ray	3-1/8	26.4	50 (sliding) BHA Dependent		150	20	Application Specific	N/A	N/A	N/A	79-180	Stop/start pumps Downlink	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	Continuous	Y/Y	5.4	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
CoilTrak (Directional & GR)	2-3/8, 3	49.5 (includes motor)	50 (2-3/8 sliding only) 45 (3 sliding only)		160	14.5	Application Specific	N/A	N/A	N/A	0-120 (2-3/8) 0- 210 (3)	Power on	Electric line	N	N	Y	N	Op. Sel.	Op. Sel.	56	Y/Y	5.2 (2-3/8) 5.4 (3)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Electric line/no limit (2-3/8 amd 3) Turbine generator/ no limit (3)	Y	Y
CoilTrak HT Directional & GR	3"	49.5 (includes motor)	45 (3 sliding only)		175	14.5	Application Specific	N/A	N/A	N/A	0- 210 (3)	Power on	Electric line	N	N	Y	N	Op. Sel.	Op. Sel.	56	Y/Y	5.4 (3)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Electric line/no limit (2-3/8 amd 3) Turbine generator/ no limit (3)	Y	Y
CoilTrak rib-steered motor	3"	19.6 (3)	10 (3 sliding only)		150	14.5	Application Specific	N/A	N/A	N/A	25-120 (3)	Power on	Electric line	N	N	Y	N	N/A	Op. Sel.	N/A	Y/Y	11.8	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, incl., TF reference Near bit incl. Temp.	N/A	Y	Y
GyroTrak gyroscopic MWD	6-3/4 (AutoTrak) 9-1/2 (AutoTrak) 6-3/4 (OnTrak) 8-1/4 (OnTrak) 9-1/2 (OnTrak)	30 (AutoTrak) 16.0 (OnTrak) 29.0 (NaviTrak)	BHA Dependent	BHA Dependent	150	22	Application Specific	Application Specific	Application Specific	Application Specific	See AutoTrak, OnTrak and NaviTrak	Pumps on	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	300	Y/Y	2	Survey accuracy is quantified by an ISCWSA format error model	3-axis acceleromet er 2/3-axis rate gyro	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Battery/100 (l)	Y	Y
NaviTrak HR directional & gamma ray	3-1/8, 4-3/4, 6-3/4, 8-1/4, 9-1/2	BHA Dependent	50/16 (3-1/8) 25/7 (4-3/4) 12.5/6.5 (6-3/4) 10.5/4.5 (8-1/4) 7/3.5 (9-1/2) 70/21 (3-1/8 flex) 82/21 (4-3/4 flex) 23/9.5 (6-3/4 flex)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	75-175 (3-1/8) 105-350 (4-3/4) 210-900 (6-3/4) 300-1,350 (8-1/4) 450-1,600 (9-1/2)	Stop/start pumps Stop rotary	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	62	Y/Y	16 (1-3/4 probe)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
NaviTrak EM directional & gamma ray	4-3/4, 6-1/2, 8	BHA Dependent	18/10 (4-3/4) 15/8 (6-1/2) 10/6 (8)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	max 375 (4-3/4) max 750 (6-1/2) max 1,200 (8)	Rotary, EM Downlink	EM	N	Y	N	Y	Op. Sel.	Op. Sel.	30	Y/Y	18.9	+/- 1.5° (toolface, roll) +/- 2° (azimuth, lat <55°) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl., Temp., AP, VSS	Battery, up to 160 hr	Y	N

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
NaviTrak UT directional & gamma ray	4-3/4, 6-1/2, 7, 8	BHA Dependent	18/7 (4-3/4) 15/6.5 (6-1/2) 10/4.5 (8)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	max 450 (4-3/4) max 800 (6-1/2) max 1,300 (8)	EM Downlink, Start/Stop Rotary, Stop/ Start pumps	Unified Telemetry (UT) Adaptive EM and Positive mud pulse	N	Y	N	Y	Op. Sel.	Op. Sel.	30 sec. after flow off. Survey capture is 1 sec. in duration. Both telemetries and downhole log files will reference the same survey capture.	Y/Y	9	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl., Temp., CP, VSS	Battery, up to 200 hr	Y	Y
OnTrak integrated formation evaluation	4-3/4, 6-3/4, 8-1/4, 9-1/2	31.3 (4-3/4) 27.7 (6-3/4) 30.7 (8-1/4) 30.2 (9-1/2)	BHA Dependent	BHA Dependent	150, 175, (optional 4-3/4, 6-3/4, and 9-1/2)	25 (4-3/4, 6-3/4, 8-1/4, 9-1/2) 30 (optional 4-3/4 and 6-3/4)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,295 (8-1/4) 300 -1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Programmable	Continuous	Y/Y	15.7 (4-3/4) 11.0 (6-3/4) 13.5 (8-1/4) 13.0 (9-1/2)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.1° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
AziTrak deep azimuthal resistivity	4-3/4, 6-3/4	23.5 (4-3/4) 22.1 (6-3/4)	BHA Dependant	BHA Dependent	150	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	N/A	125-350 (4-3/4) 200-900 (6-3/4)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Op. Sel	Continuous	Y/Y	17.7 (4-3/4) 17.6 (6-3/4)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.1° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
NaviTrak LCP LCM-tolerant directional & gamma ray	4-3/4, 6-1/2, 6-3/4	44.5 (4-3/4) 39.8 (6-1/2, 6-3/4)	BHA Dependent	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	N/A	120-350 (4-3/4) 240-750 (6-1/2, 6-3/4)	Stop/ startpumps Stop rotary	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	62	Y/Y	16 (1-3/4 probe)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.2° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
SureTrak steerable drilling liner	4-3/4 (7" liner) 6-3/4 (9 5/8" liner)	BHA Dependent	3 (rotating only)	BHA Dependent	150	20 25 (option) 30 (option)	Application Specific	Application Specific	Application Specific	N/A	125-350 (4-3/4) 200-900 (6-3/4)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	Op. Sel.	Op. Sel.	55	Y/Y	3.8 (4-3/4) 3.1 (6-3/4)	+/- 1.5° (toolface) +/- 1° (azimuth) +/- 0.1° (inclination)	3-axis accelerometer 3-axis fluxgate	GX, GY, GZ, HX, HY, HZ, Azi., incl., TF reference Near bit incl. Temp.	Turbine generator/ no limit	Y	Y
Bench Tree • Mitch Bancroft, 4681 CR Georgetown, TX 78626, 512-869-6900, mitch.bancrof@benchtree.net																												
Bench Tree MWD, Standard	1-7/8 Probe in Standard 3.5 - 9.5 NMDC	20.9 - 29.5	collar limited	collar defined	175	20	application dependent	application dependent	application dependent	application dependent	70-1250	Pumps, Rotary	mud pulse or optional 3rd party EM	Y	Y	N	3rd Party Option	Configurable Threshold	Config Dependent	Config Dependent	Real Time Inc (Rinc) & Azm (RAzm) Y/Y	14-15.3	Inc:±0.1° Az:±0.2° G:±6.0mG H:±0.035uT TF:±1.0° Temp:±1°C RPM:±12 Rinc@>20°: ±.35°	3 axis QFlex Accels, Proprietary Fluxgate Magetometer, Si Sensors	Inc, Az, TF, H(x,y,z), G(x,y,z), Temp, RPM, axial S&V, lateral S&V, Optional: Gamma, PWD	1 ea - 2 ea 8 cell Li Batt Packs, 800 hrs/pack	Y	Y
Bench Tree MWD, Short	1-7/8 Probe in Standard 3.5 - 9.5 NM Pony	16.5	collar limited	collar defined	175	20	application dependent	application dependent	application dependent	application dependent	70-1250	Pumps, Rotary	mud pulse or optional 3rd party EM	Y	Y	N	3rd Party Option	Configurable Threshold	Config Dependent	Config Dependent	Real Time Inc (Rinc) & Azm (RAzm) Y/Y	7.9	Inc:±0.1° Az:±0.2° G:±3.0mG H:±0.015uT TF:±1.0° Temp:±1°C RPM:±12 Rinc@>20°: ±.35°	3 axis QFlex Accels, Proprietary Fluxgate Magetometer, Si Sensors	Inc, Az, TF, H(x,y,z), G(x,y,z), Temp, RPM, axial S&V, lateral S&V, Optional: Gamma, PWD	8 cell Li Batt Pack, 800 hrs/pack	Y	Y
DriITech LLC • Brad Vincent, 248 Rousseau Road, Youngsville, LA 70592, (337) 837-1219, brad.vincent@drititech.net																												
Positive Pulse MWD Probe Based	2-7/8-8.0	18-25	60/30 (Approximate, Connection dependent)	As applicable to standard NMDC	150-175	20 (137 mpa)	50 (NMDC dependent)	100 (NMDC dependent)	150 (NMDC dependent)	N/A	2-7/8) 45-125, (3-1/2) 50-130, (4-3/4) 130-300, (6-3/4) 235-600, (8) 400-800	Pumps "On" or Rotational Logic	Positive pulse	Yes, (No if Lock Down option used)	Y	N	N	Op. Sel. 2 Deg. Min.	6 sec (5 bit); 12 sec (9.6 bit res.)	60 - 90	Y/N	10, 16, 22	Azm:+/- .5 (No interference) Inc: +/- .2	Tri-axial accelerometer, Tri-axial magnetometer	Incl., Azm, TF, battery voltage, tool temp, gravity, magnetic field strength, Dip angle, Shock and Vibration Log	Lithium battery, 400-800 Hours	Y	Y
Gyrodata • Chris Hartley, 23000 Northwest Lake Drive, Houston, TX 77095, (281) 213-1312, chris.hartley@gyrodata.com																												
Gyrodata Positive Pulse MWD	3-1/2, 4-3/4, 5-1/4, 6-1/2, 6-3/4, 8-1/4, 9-1/2	23	Collar limited	Collar-defined	150	25	400 (2.25"ID) 350 (2.69" ID) 300 (2.813"ID)	N/A 425 (2.69"ID) 400 (2.813"ID) 375 (3.25"ID) 340 (3.75"ID)	N/A, N/A, 525 (2.813"ID), 425 (3.25"ID), 400 (3.75"ID)	N/A, N/A, N/A, 600 (3.75"ID)	3 1/2 = 86-170, 4 3/4 = 106-358, 5 1/4 = 106-358, 6 1/2 = 179-475, 6 3/4 =179 -701, 8 1/4 = 419-800, 9 1/2 = 419-1,232	pumps off	Positive mud pulse	N	Y	N	N	Field selectable	9 sec.	120 seconds, pumps off to survey	N	5	Inc =+/- 0.15° Az = +/- 0.5° MagTF = +/- 0.5° GravTF = +/- 0.15°	3 axis accelerometer, 3 axis magnetometer	Inc, Az, TF, TMF, TGF, temp, vibe,batt volts	Battery 200+hr	Y	raw data
Gyrodata Positive Pulse Retrievable MWD	3-1/2, 4-3/4, 5-1/4, 6-1/2, 6-3/4, 8-1/4, 9-1/2	18	Collar limited	Collar-defined	150	20	400 (2.25"ID) 350 (2.69" ID) 300 (2.813"ID)	N/A 425 (2.69"ID) 400 (2.813"ID) 375 (3.25"ID) 340 (3.75"ID)	N/A N/A 525 (2.813"ID) 425 (3.25"ID) 400 (3.75"ID)	N/A, N/A, N/A, 600 (3.75"ID)	3 1/2 = 80-170, 4 3/4 = 100-400, 5 1/4 = 100-400, 6 1/2 = 120-475, 6 3/4 =120-701, 8 1/4 = 400-800, 9 1/2 = 400-1,300	pumps off	Positive mud pulse	Y	Y	N	N	Field selectable	9 sec.	120 seconds, pumps off to survey	N	12	Inc =+/- 0.15° Az = +/- 0.5° MagTF = +/- 0.5° GravTF = +/- 0.15°	3 axis accelerometer, 3 axis magnetometer	Inc, Az, TF, TMF, TGF, TG, Mag Dip, temp, vibe,batt volts, raw mag values	Battery 200+hr	Y	raw data
GWD90	3-3/4, 4-3/4, 5-1/4, 6-1/2, 6-3/4, 8-1/4, 9-1/2	48	Collar limited	Collar-defined	150	20	500 (2.25"ID) 400 (2.688" ID) 350 (2.8125"ID)	N/A 475 (2.69"ID) 45 (2.813" ID) 400 (3.25" ID)	N/A N/A 550 (2 813"ID) 450 (3.25"ID) 425 (3.75"ID)	N/A, N/A, N/A, 600 (3.75"ID)	3 3/4 = 80-150, 4 3/4 = 106-358, 5 1/4 =106-358, 6 1/2 =179-450, 6 3/4 =179-701, 8 1/4 =419-800, 9 1/2 = 419-1,232	pumps off	Positive mud pulse	N	Y	N	N	Field selectable	12 sec	200 Seconds, pumps off to survey	N	9	Inc =+/- 0.15° Az = +/- 0.25° GyroTF = +/- 0.25° GravTF = +/- 0.15°	3 axis accelerometer, 3 axis gyro	Inc, Az, TF, TMF, TGF, temp, vibe,batt volts	Battery 200+hr	Y	raw data
Directional EM MWD	3-1/2, 4-3/4, 5-1/4, 6-1/2, 6-3/4, 7-3/4	25.5' (adjusted to Monel length)	Collar limited	Collar-defined	150	20	25	100	100	100	50-1,200	flow on/off, EM downlink	EM	Y	N	N	Y	Field selectable	8 sec (TF and Gamma)	18 sec	N	+(adjusted to collar length)	Inc =+/- 0.15° Az = +/- 0.5° MagTF = +/- 0.5° GravTF = +/- 0.15°	3 axis accelerometer, 3 axis magnetometer	Inc, Az, TF, TMF, TGF, M Dip, temp, vibe,batt volts, gap impedance	Battery 200+hr	Y	raw data
Nabors Drilling Technologies USA, Inc. • Kirk Towns, 515 West Greens Road, Houston, Texas 77067, www.nabors.com/service																												
AccuMP (Mud Pulse)	4 3/4, 6 1/2, 8	(4 3/4) 10, (6 1/2, 8) 10	As applicable to standard NMDC	As applicable to standard NMDC	175	20K PSI (137 mpa)	N/A	60	125	350	225-1,250	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	10	Azi +/- .3, Inc +/- .1, TF +/- .1, Continuous Inclination ± 2° (0°-5°) ± 1° (5°-8°) ± .5° (8°-13°) ± .1° (greater than 13°)	Tri-axial accelerometer, Tri-axial magnetometer	GX, GY, GZ, HX, HY, HZ, Azi., Inc., TF reference, Temp.	Lithium battery, 500 hours	Y	Y
AccuWave (EM)	4 3/4, 6 1/2, 8	(4 3/4) 10, (6 1/2, 8) 10	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	N/A	225-1,250	Stop pumps, start pumps	Electromagnetic	N	N	N	N	Y	Variable	50	Y/Y	10	Azi +/- .3, Inc +/- .1, TF +/- .1, Continuous Inclination ± 2° (0°-5°) ± 1° (5°-8°) ± .5° (8°-13°) ± .1° (greater than 13°)	Tri-axial accelerometer, Tri-axial magnetometer	GX, GY, GZ, HX, HY, HZ, Azi., Inc., TF reference, Temp.	Lithium battery, 500 hours	Y	Y
AccuSteer (Mud Pulse)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	10	Azi +/- .3, Inc +/- .1, TF +/- .1, Continuous Inclination ± 2° (0°-5°) ± 1° (5°-8°) ± .5° (8°-13°) ± .1° (greater than 13°)	Tri-axial accelerometer, Tri-axial magnetometer & Z-Axis accelerometer for CINC	GX, GY, GZ, HX, HY, HZ, Azi., Inc., TF reference, Temp.	Lithium battery, 500 hours	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
AccuSteer (EM)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	10	Azi +/- .3, Inc +/- .1, TF +/- .1, Continuous Inclination ± 2° (0°-5°) ± 1° (5°-8°) ± .5° (8°-13°) ± .1° (greater than 13°	Tri-axial accelerometer, Tri-axial magnetometer & Z-Axis accelerometer for CINC	GX, GY, GZ, HX, HY, HZ, Azi, Inc., TF reference, Temp.	Lithium battery, 500 hours	Y	Y
National Oilwell Varco • Kirby Wedewer, 7909 Parkwood Circle Drive, Houston, Texas 77036, 713-689-0004, kirby.wedewer2@nov.com																												
iSeries Retrieivable	4.75	24.6	35/15	Collar Dependent	175	20	9	42			200 - 400	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 400hrs	Y	Y
iSeries Retrieivable	6.5	24.6	35/15	Collar Dependent	175	20	1	7	20		300 - 800	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 400hrs	Y	Y
iSeries Retrieivable	8	24.6	35/15	Collar Dependent	175	20	1	2	4	24	400 - 1,200	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 400hrs	Y	Y
iSeries Top Mount Pulser	4.75	24	35/15	Collar Dependent	175	20	9	42			200 - 400	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 350hrs	Y	Y
iSeries Top Mount Pulser	6.5	24	35/15	Collar Dependent	175	20	1	7	20		300 - 800	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 350hrs	Y	Y
iSeries Top Mount Pulser	8	24	35/15	Collar Dependent	175	20	1	2	4	24	600 - 1,200	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	15.9	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), clnc, cAzi, RPM	Lithium Batt, 350hrs	Y	Y
BlackStarII EM	3.75	28.9	33/14	Collar Dependent	150	20	60				30 - 160	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	8.66	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII EM	4.75	28.9	28/12	Collar Dependent	150	20	9	42			30 - 370	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	8.66	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII EM	6.5	28.9	20/10	Collar Dependent	150	20	1	7	20		30 - 700	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	8.66	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII EM	8	28.9	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	8.66	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII EM	9	28.9	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	8.66	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	3.75	33.4	33/14	Collar Dependent	150	20	60				30 - 160	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	11.05	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	4.75	33.4	28/12	Collar Dependent	150	20	9	42			30 - 370	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	11.05	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	6.5	33.4	20/10	Collar Dependent	150	20	1	7	20		30 - 700	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	11.05	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	8	33.4	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	11.05	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	9	33.4	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	11.05	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°	3-axis accelerometer, 3-axis Fluxgate	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat)	Lithium Batt, 260hrs	Y	Y
Oliden Technology, LLC • Jim Mather, 4025 Bluebonnet Drive, Stafford, TX 77477, (281) 265-0064, jim.mather@olidentech.com																												
TeleFusion	4.75, 6.75, 8.25, 9.5	26	Collar-Limited	Collar-defined	150 and 175	25	Collar-defined	Collar-defined	Collar-defined	Collar-defined	(4.75) 125-350 gpm, (6.75) 150-750 gpm, (8) 300-1100 gpm	flow-on and timer	MPT positive pulse	N	Y	N	N	Y	Config. Dependent	Config. Dependent	Y/Y	Directional: 6.4ft	Incl:+/-0.1 Azi:+/-0.75(Incl>5°) Toolface:+/-0.5 (Incl>5°)	3-axis accelerometer 3-axis fluxgate magnetometer	GX, GY, GZ, HX, HY, HZ, Azi, Inc, MTF, GTF, Temp, RPM, Shock&Vib	battery	Y	Y
Schlumberger																												
PowerDrive X6 Rotary Steerable Tool	4 3/4, 6 3/4, 8 1/4, 9, 11	(4 3/4) 13.65, (6 3/4) 13.47, (8 1/4) 13.84, (9) 13.84, (11) 15.22	(4 3/4) 30/10, (6 3/4) 16/8, (8 1/4) 12/6, (9) 10/5, (11) 8/2	(475) 11.5; (675) 14.7; (900) 15.0; (11) 18.0	150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	170-2,000	Continuous link to MWD	RT through MWD (WDP Option)	N	Y	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 6.76, (6 3/4) 7.13, (8 1/4) 7.7, (11) 9	Inclination: 0.11 Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray	Turbine / Infinite (hr)	Y	Y
PowerDrive Orbit Rotary Steerable Tool	4 3/4, 6 3/4, 8 1/4, 9, 11	(4 3/4) 13.50, (6 3/4) 13.53, (8.25) 13.84, (9) 14.05, (11) 15.22	(4 3/4) 30/10, (6 3/4) 16/8, (8 1/4) 12/6, (9) 10/5, (11) 8/2	(475) 11.5; (675) 14.7; (900) 15.0; (11) 18.0	150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	120-2,000	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	N	to compile	5°	Customizable	Continuous	Y/Y	(4 3/4) 6.93, (6 3/4) 6.76, (8 1/4) 7.14, (9) 8.24, (11) 8.99	Inclination: 0.11 Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y
PowerDrive ICE ultraHT Rotary Steerable Tool	6 3/4	(6 3/4) 34.26	(6 3/4) 16	(675) 14.7	200	30	N/A	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	N/A	275-800	Continuous link to MWD	RT through MWD (WDP Option)	N	Y	N	N	5°	Customizable	Continuous	Y/Y	(6 3/4) 13.30	Inclination: 0.11 Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth RT-status	Turbine / Infinite (hr)	Y	Y
PowerDrive Archer Rotary Steerable Tool	4 3/4, 6 3/4	(4 3/4) 14.98, (6 3/4) 16.15	Capability (°/100 ft) : (4 3/4, 6 3/4) 18 Pass Through (°/100 ft): (6 3/4), >15 Based on fatigue management		150	20	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	130-650	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 8.2, (6 3/4) 9.9	Incl.: 0.1 at 1 sigma, Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y
Power Drive Xceed Rotary Steerable Tool	6 3/4, 9	(6 3/4) 25.01, (9) 27.99	(6 3/4) 15/8, (9) 12/6.5	(675) 31.0; (900) 35.9	150	20	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	290-1,800	Continuous link to MWD	RT through MWD (WDP Option)	N	Y	Y	N	5°	Customizable	Continuous	Y/Y	(6 3/4) 12.8, (9) 16.7	Inclination: 0.20 Azimuth: 0.8 at 90deg (at 2 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth RT-status	Turbine / Infinite (hr)	Y	Y
PowerV Vertical drilling Rotary Steerable Tool	4 3/4 , 6 3/4 , 8 1/4 , 9, 11	13.5-34.26 Depends on the Configuration	(4 3/4) 30/10, (6 3/4) 16/8, (8 1/4) 12/6, (9) 12/6.5, (11) 8/4	(475) 11.5; (675) 14.7; (900) 15.0; (1100) 18.0	150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	100-2,000	Optional: Continuous link to MWD	Optional: RT through MWD (WDP Option)	N	NA	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 6.73, (6 3/4) 7.27, (8 1/4) 8.43, (11) 8.83	Inclination: 0.11 Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y
PowerDrive vortex	4 3/4, 6 3/4, 8 1/4, 9, 11	Depends on the Configuration (Power Section)	(4 3/4) 30/10, (6 3/4) 16/8, (8 1/4) 12/6, (9) 12/6.5, (11) 8/4		150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	100-2,000	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 6.73, (6 3/4) 7.27, (8 1/4 , 9) 8.43, (11) 8.83	Inclination: 0.11 Azimuth: 1.8 at 90deg (at 1 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y

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2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
PowerDrive Xcel	6 3/4, 9	(6 3/4) 24.93, (9) 27.89	(6 3/4) 15/8, (9) 12/6.5	(675) 31.0; (900) 35.9	150	20	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	260-1,800	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	Y	N	5°	Customizable	Continuous	Y/Y	(6 3/4) 14.5, (9) 16.2	Inclination: 0.20 Azimuth: 0.8 at 90deg (at 2 sigma)	3-AxisAccelerometer + 3-Axis magnetometer	Near bit inclination & azimuth RT-status Gamma Ray shocks & Vibration	Turbine / Infinite (hr)	Y	Y
PowerPak ERT high performance positive displacement motors	4 3/4, 6 3/4, 8, 9 5/8	17.3 (4 3/4), 16.3 (6 3/4), 30.2 (8), 30 (9 5/8)	As per motor specification for bend setting		175	30	Dependent on specific model	Dependent on specific model	Dependent on specific model	Dependent on specific model	125-325 (4 3/4), 300-650 (6 3/4), 300-900 (8), 600-1,200 (9 5/8)	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3 axis accelerometer	Near bit inclination & azimuth RT-status Azimuthal Gamma Ray image	Turbine / Infinite (hr)	N/A	N/A
PowerPak HR higher torque positive displacement motors	4 3/4, 6 3/4, 7, 8, 9 5/8, 11 1/4	Dependent on specific model	As per motor specification for bend setting		175	30	Dependent on specific model	Dependent on specific model	Dependent on specific model	Dependent on specific model	125-325 (4 3/4), 300-600 (6 3/4 and 7), 300-900 (8), 600-1,200 (9 5/8), 800-1,800 (11 1/4)	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DynaForce HR high performance motor highest torque at bit enhanced performance in motorized RSS configurations	5, 7, 9 5/8	Dependent on specific model	As per motor specification for bend setting		175	30	Dependent on specific model	Dependent on specific model	Dependent on specific model	Dependent on specific model	100-350 (5), 200-800 (7), 400-1200 (9 5/8)	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DynaForce DTX thin-wall power section	7, 9 5/8	Dependent on specific model	As per motor specification for bend setting		175	30	Dependent on specific model	Dependent on specific model	Dependent on specific model	Dependent on specific model	200-800 (7), 400-1200 (9 5/8)	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
DynaForce Flex Shale Drilling Motor	7	Depends on the Power sections to be used. Bit box to fix bend: 3.5ft	As per motor specification for bend setting		175	30	Dependent on specific model	Dependent on specific model	Dependent on specific model	Dependent on specific model	200 - 800	N/A	N/A	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ImPulse	4 3/4	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	N/A	125 (varies with Modulator gap)	N/A	N/A	130-360	Stop pumps, stop rotary, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	15	TF: 1, Azi.: 1, Incl.: 0.1 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Turbine	Y	Y
OmniSphere	4 3/4	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	N/A	125 (varies with Modulator gap)	N/A	N/A	130-360	Stop rotary, stop pumps, start pumps, OR Stop rotary (QuikSurvey)	Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	15	TF: 1, Azi.: 1, Incl.: 0.1 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Turbine	Y	Y
ShortPulse	4 3/4	27.3	30/15	4.75x2.25x34.8 -OR- 4.59x2.25x30.3	150 std., 175 opt.	20 std., 25 opt.	N/A	125 (varies with Modulator gap)	N/A	N/A	130-360	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	6.8	TF: 1, Azi.: 1, Incl.: 0.1 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Turbine	Y	Y
DigiScope	4 3/4	29.9	30/15	30.7 (9.4) of 4.75" OD x 2.25" ID API collar	150 std.	25 std., 30 opt.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	N/A	N/A	150-400	Stop rotary, stop pumps, start pumps, OR Stop rotary (QuikSurvey)	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 36bps physical & >140bps effective)	27-108	Y/Y	12.75	TF: 1, Azi.: 1, Incl.: 0.1 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Dual Stage Turbine	Y	Y
TeleScope	6 3/4, 8 1/4, 9, 9 1/2	24.7	(6 3/4) 16/8 (8 1/4) 12/7 (9, 9 1/2) 10/6	(6 3/4) 6.75x2.81x 1.5 (8 1/4) 8x2.81x26.2 (9 1/4) 9.25x3x28 (9 1/2) 9.5x3.5x26.2	150 std., 175 opt.	25 std., 30 opt.	N/A	(6 3/4) 56 (8 1/4) 32 (varies with modulator gap)	(6 3/4) 151 (8 1/4, 9 1/2) 84 (varies with modulator gap)	(8 1/4, 9 1/2) 595 (varies with modulator gap)	(6 3/4) 250-800 (8 1/4) 300-1,200 (8 1/4) opt. 800-1,400 (9 1/2) 400-2,000 (9 1/2) opt. 400-1,600	Stop rotary, stop pumps, start pumps, OR Stop rotary (QuikSurvey)	Positive Continuous wave / Wired drill pipe opt.	N	Y	Y	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.5bps to 20bps physical & >70bps effective)	27-80	Y/Y	11	TF: 1, Azi.: 1, Incl.: 0.1 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Turbine	Y	Y
TeleScope ICE	4 3/4	31.9	30/15	31.9 (9.7) of 4.75" OD x 2.25" ID API collar	200 std.	30 std.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	N/A	150-400	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	14.27	TF: 1, Azi.: 0.3, Incl.: 0.06 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Dual Stage Turbine	Y	Y
TeleScope ICE	6 3/4	31.4	15/8	32.5 (9.9) of 6.75" OD x 2.81" ID API collar	200 std.	30 std.	N/A	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	300 (varies with Mud weight and Modulator gap)	275-800	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	13.68	TF: 1, Azi.: 0.3, Incl.: 0.06 (at 1 sigma)	Accelerometer magnetometer	Local gravity and magnetic field	Turbine	Y	Y
SlimPulse	1 3/4 tool OD 3 1/8 to 9 1/2 collars	Collar based probe normally 30	(4 3/4 and smaller) 145/40 (6 3/4) 28/10 (8 1/4) 20/8 (9 1/2) 19/7	(4 3/4) 4.75x2.81x33 (6 3/4) 6.75x2.81x32	150 std., 175 opt.	22	(4 3/4) 68 (6 3/4) 16	(6 3/4) 100 (8 1/4) 18	(6 3/4) 324 (8 1/4, 9 1/2) 58	(8 1/4, 9 1/2) 411	Multiple configurations: 35-1,200	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	Y	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 6bps effective)	104sec to 150sec at 1bps	Y/Y	15 (variable)	TF: 3, Azi.: 1 at 1 sigma, Incl.: 0.1 at 1 sigma	Accelerometer magnetometer	Local gravity and magnetic field	Lithium battery	Y	Y
GyroSphere	6 3/4, 8 1/4, 9, 9 1/2	(6 3/4) 16/8 (8 1/4) 12/7 (9, 9 1/2) 10/6	(6 3/4) 8.25x3.5x26.2 (8 1/4) 8x2.81x26.2 (9 1/4) 9.25x3x28 (9 1/2) 9.5x3.5x26.2	(8 1/4) 8.25x3.5x26.2 (9 1/4) 9x3.5x28 (9 1/2) 9.5x3.5x26.2	150	25	N/A	N/A	4	26	(6 3/4) 250-800 (8 1/4) 300-1,200 (8 1/4) opt. 800-1,400 (9 1/2) 400-2,000 (9 1/2) opt. 400-1,600	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	30-88	Y/Y	3.4	TF: 3, Azi.: 1 at 1 sigma, Incl.: 0.1 at 1 sigma	North referencing rate gyro	Azimuth, inclination, tool face	Lithium battery and Turbine	Y	Y
GyroPulse	6 3/4, 8 1/4, 9, 9 1/2	(6 3/4) 16/8 (8 1/4) 12/7 (9, 9 1/2) 10/6	(6 3/4) 6.75x2.81x31.5 (8 1/4) 8x2.81x26.2 (9 1/4) 9.25x3x28 (9 1/2) 9.5x3.5x26.2	(8 1/4) 8.25x3.5x26.2 (9 1/4) 9x3.5x28 (9 1/2) 9.5x3.5x26.2	150	25	N/A	N/A	4	26	(6 3/4) 250-800 (8 1/4) 300-1,200 (8 1/4) opt. 800-1,400 (9 1/2) 400-2,000 (9 1/2) opt. 400-1,600	Stop rotary, stop pumps, start pumps	Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	30-88	Y/Y	3.4	TF: 3, Azi.: 1 at 1 sigma, Incl.: 0.1 at 1 sigma	North referencing rate gyro	Azimuth, inclination, tool face	Lithium battery and Turbine	Y	Y
xBolt	4 3/4, 6 3/4	(4 3/4 MP) 23.4 (6 3/4 MP) 23.8 (6 3/4 EM) 23.6 (6 3/4 DT) 26.4	(4 3/4) 34/17, (6 3/4 flex) 25/15, (6 3/4 slick) 15/7.5	(4 3/4) 4.68 x 2.69, (6 3/4 MP) 6.54 x 2.81, (6 3/4 EM) 6.61 x 2.81, (6 3/4 DT) 6.59 x 2.81	Mud Pulse 165 EM and Dual Telemetry 150	20	675 EM: 0 675 MP/DT: 3 475 MP: 32	675 EM: 2 675 MP/DT: 17 475 MP: 200	675 EM: 8 675 MP/DT: 54 475 MP: NA	675 EM: NA 675 MP/DT: NA 475 MP: NA	(4 3/4) max 375, (6 3/4) max 750	MP: Start pumps EM: Start pumps, stop pumps, EM downlink	positive continous wave, electromagnetic telemetry and downhole recording	N	Y	N	Y	Configurable	Configurable (max 4 bps Mud pulse, 16 bps EM)	60	Y/Y	Gamma: 4.5 Directional: 8	Azi: 1 deg Inc: 0.15 deg Tool Face: 1.5 deg GR: 5%	Accelerometer, magnetometer, GR NaI Scintillation	Azimuth, inclination, tool face, azimuthal and total GR, temperature, drilling dynamics	Lithium battery	Y	Y

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, 9/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
Scientific Drilling International • www.scientificdrilling.com																												
Falcon Mud Pulse MWD	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	17	Collar Limited	BHA Dependent	150C (177C available)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	50-200 GPM (3-1/8, 3-1/2) 100-400 GPM (4-3/4, 5-1/4) 200-600 GPM (6-1/4, 6-1/2, 6-3/4) 250-1000 GPM (6-3/4, 7, 8) 400-1500 GPM (9.5)	Pumps	Postvie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 3	ToolFace +/- 0.15 >3° Azimuth +/- 0.15 all	Tri-axial Accelerometer and Magnetometer	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics	Lithium Battery 300+ Hrs	Y	Y
Falcon EM ElectroMagnetic MWD	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	24	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-200 GPM (3-1/8, 3-1/2) 0-400 GPM (4-3/4, 5-1/4) 0-600 GPM (6-1/4, 6-1/2, 6-3/4) 0-1000 GPM (6-3/4, 7, 8) 0-1500 GPM (9.5)	Continuous Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 3	ToolFace +/- 0.15 >3° Azimuth +/- 0.15 all	Tri-axial Accelerometer and Magnetometer	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics	Lithium Battery 150+ Hrs	Y	Y
Weatherford DD/RSS • Jeff Whitney, Rasis Business Center, Al Barsha 1, Dubai, UAE 58014, jeffrey.whitney@weatherford.com																												
Weatherford M/LWD • Li Kai Kim, Rasis Business Center, Al Barsha 1, Dubai, UAE 58014, Likai.Lim@weatherford.com																												
Revolution 825 rotary steerable system (Core, Heat, V)	OD: 8.25 ID: 2.75	17.8	7.5		149 Core, V 175 Heat	25 Core, V 30 Heat	20	35	55	N/A	1,500	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Y	45	N/Y	14	TF: +/- 1, Azi.: +/- 0.5, Incl.: +/- 0.5	Tri-axial Accelerometer and Magnetometer	RPM, TF, Deflection, Stick-Slip, Whirl Severity, Sleeve Rotation	Lithium batteries, up to minimum 250 rotating-hrs.	Y	Y
Revolution 675 rotary steerable system (Core, Heat, V)	OD: 6.75 ID: 2.0	14.8	10		149 Core, V 175 Heat	25 Core, V 30 Heat	20	35	55	N/A	750	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Y	45	N/Y	11	TF: +/- 1, Azi.: +/- 0.5, Incl.: +/- 0.5	Tri-axial Accelerometer and Magnetometer	RPM, TF, Deflection, Stick-Slip, Whirl Severity, Sleeve Rotation	Lithium batteries, up to minimum 200 rotating-hrs.	Y	Y
Revolution 475 rotary steerable system (Core, Heat, V)	OD: 4.75 ID: 1.25	12.9	10		149 Core, V 175 Heat	25 Core, V 30 Heat	20	35	55	N/A	350	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Y	45	N/Y	9	TF: +/- 1, Azi.: +/- 0.5, Incl.: +/- 0.5	Tri-axial Accelerometer and Magnetometer	RPM, TF, Deflection, Stick-Slip, Whirl Severity, Sleeve Rotation	Lithium batteries, up to minimum 115 rotating-hrs.	Y	Y
Magnus 675	OD: 675 ID: 2.0	21.5	10		150	30	5	10	30	N/A	700	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Y	45	N/Y	6 Inc / 6.35 GR	TF: +/- 2, Incl: +/- 0.2, GR:+/- 5 API	Tri-axial Accelerometer & Magnetometer	Near-bit Inclination, Downhole RPM, Azimuthal GR	Turbine and/or Lithium Battery	Y	Y
Magnus 950	OD: 9.50 ID: 2.75	22.7	6		150	25	2	5	10	40	1200	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Y	45	N/Y	6.85 Inc, 7.2 GR	TF: +/- 2, Incl: +/- 0.2, GR:+/- 5 API	Tri-axial Accelerometer & Magnetometer	Near-bit Inclination, Downhole RPM, Azimuthal GR	Turbine and/or Lithium Battery	Y	Y
EMpulse (Electromagnetic MWD)	All sizes	(3 1/16) 28.4, (4 3/4) 33.1, (6 3/4) 34.8, (8) 35.4, (9 1/2) 36.4	(3 1/6) 116/38, (4 3/4) 25/16, (6 1/4) 20/14, (6 3/4) 18/13, (8) 15/10, (9 1/2) 14/7.5	(3-1/16) 3.06x2.16, (3-3/8) 3.38x2.16, (4-3/4) 4.53x2.25, (6-3/4) 6.59x2.81, (8) 7.78x2.81, (9-1/2) 9.69x3	150	15	(3 1/16, 3 3/8, 3 1/2) 50	(3 1/16, 3 3/8, 3 1/2) 100;	(4 3/4) 20; (6 1/4) 25, (6 3/4, 8) 7; (9.5) 4	(6 3/4, 8) 20; (9.5) 13	(3 1/16, 3 3/8, 3 1/2) 160; (4 3/4, 6 1/4) 350; (6 3/4) 800; (8, 9 1/2) 1,200	Two Way EM Comm.	Electromagnetic	Y	N	N/A	Y	Op. Sel.	15	45	Y/N	18	TF: +/- 1.5, Azi.: +/- 1, Incl.: +/- 0.1	Tri-axial Accelerometer and Magnetometer	Azi., Incl., TF, GR	Lithium battery	Y	Y
HEL (Hostile Environment Logging)	4-3/4, 6-3/4, 8, 8-1/4, 9-1/2	(4-3/4) 19.5, (6-3/4) 19.7, (8-1/4) 20.0, (9-1/2) 20.0	(4-3/4) 30/15, (6-3/4), 16/8, (8, 8-1/4) 14/7, (9-1/2) 12/6	(4-3/4) 4.75x3.22, (6-3/4) 6.75x4.20, (8-1/4) 8.25x5.17, (9-1/2) 9.50x5.16	150 std. 20 opt.	(4.75, 6.75, 8") 20 std., 30 opt. (8.25, 9.5) 20 std., 25 opt.	(4 3/4) 12, (6 3/4, 8) 2, (8 1/4, 9-1/2) 1	(4 3/4) 64, (6 3/4, 8) 9, (8 1/4, 9-1/2) 2	(6 3/4, 8) 26, (8 1/4, 9 1/2) 2	(8-1/4, 9-1/2) 33	(4 3/4) 80-350; (6 3/4, 8) 80-700; (8 1/4, 9 1/2) 80-1,600	Stop and start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	N	Op. Sel.	TF - 3	30	Y/Y	(4 3/4, 6 3/4, 8) 5.7	TF: +/- 1.5, Azi.: +/- 0.5, Incl.: +/- 0.1	Tri-axial Accelerometer and Magnetometer	Azi., Incl., TF, GR	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
EMpulse HEL (Electromagnetic Hostile Environment Logging)	4-3/4, 6-3/4	(4-3/4) 19.5, (6-3/4) 19.7	(4-3/4) 30/15, (6-3/4), 16/8	(4-3/4) 4.75x3.22, (6-3/4) 6.75x4.20	150 std.	(4.75, 6.75) 20 std.	(4 3/4) 12, (6 3/4, 8) 2	(4 3/4) 64, (6 3/4, 8) 9	(6 3/4, 8) 26		(4 3/4) 80-350; (6 3/4, 8) 80-700	Two Way EM Comm.	Electromagnetic	N	Y	N	N	Op. Sel.	TF - 3	30	Y/Y	(4 3/4, 6 3/4) 5.7	TF: +/- 1.5, Azi.: +/- 0.5, Incl.: +/- 0.1	Tri-axial Accelerometer and Magnetometer	Azi., Incl., TF, GR	Lithium battery, up to 1400 hrs.	Y	Y
HyperPulse MWD (Positive Pulse MWD)	All sizes	31	(3 1/6) 116/38, (4 3/4) 25/16, (6 1/4) 20/14, (6 3/4) 18/13, (8) 15/10, (9 1/2) 14/7.5	(4-3/4) 4.75x2.69, (6-1/4) 6.25x3.25, (6-3/4) 6.75x3.25	150	15	(3 1/16, 3 3/8, 3 1/2) 50	(3 1/16, 3 3/8, 3 1/2) 100;	(4 3/4) 8; (6 1/4) 9	(6 3/4, 8) 20; (9.5) 13	(3 1/16, 3 3/8, 3 1/2) 160; (4 3/4, 6 1/4) 350; (6 3/4) 800; (8, 9 1/2) 1,200	Stop pumps, stop rotary, start pumps	Positive Pulse, downhole recording	Y	N	N/A	N	Op. Sel.	12	180	Y/N	27	TF: +/- 2, Azi.: +/- 1, Incl.: +/- 0.2	Tri-axial Accelerometer and Magnetometer	Azi., Incl., TF, GR	Lithium battery	Y	Y
TrendLine	6-1/2, 6-3/4, 8-1/4, 9-1/2	Dependent on drill collar length - 26' minimum	(6-3/4) 8/16, (8-1/4) 7/14, (9-1/2) 6/12		150°C	20	100	140	200		(6-1/2, 6 3/4) 80-700; (8 1/4, 9 1/2) 80-1,600	Stop and start pumps	Positive mud pulse, Electromagnetic	N	N	N	N	Inertial TF / GT	TF - 3	180	N/N	4' with 26' collar	TF: +/- 1.0, Azi.: +/- 1.0, Incl.: +/- 0.1	Dual Axis Dry Tuned Rate Gyro and Tri-axial Accelerometer	Azi., Incl., TF	Battery / 70 hours constant use	Y	Y
Drilling Mechanics																												
APS Technology (Rental Division)																												
APS SureShot with Gamma + VMM + PWD	3 1/8, 3 1/2, 4 3/4, 6 1/4, 6 3/4, 8, 9 1/2+	29*	Collar-limited	Collar-defined	150 and 175	20 and 25	(3 1/2) 29, (4 3/4 - 6 3/4) 6, (8) 3, (9 1/2) 2	(3 1/2) 165, (4 3/4 - 6 3/4) 40, (8) 20, (9 1/2) 10	(6 1/2 - 6 3/4) 114, (8) 61, (9 1/2) 32	(9 1/2) 225	(3 1/8, 3 1/2) 70-250 (4 3/4) 150-350 (6 1/4, 6 3/4) 150-750 (8) 300-1,100 (9 1/2+) 650-1,200	Flow-on and timer	MPT positive pulse and EM	Y (4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 6.4 Gamma: 2.1	Incl: +/-0.1° Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + VMM + PWD + WPR Propagation Resistivity	3 1/2, 4 3/4, 6 3/4, 8	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi, Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
Drilling Dynamics Monitor (DDM)	4 3/4, 6 3/4, 8	6	24, 12 (4 3/4) 14,10 (6 3/4) 10, 8 (8)		150	20						Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via MWD)	Programmable threshold	Op. sel.	Op. sel.	Y/Y		+/-5% abs. WOB/TOB/BOB; 0.1% FSR press.	Strain gauge WOB/TOB/BOB; straing gauge press.; mag/accel.	WOB/TOB/BOB; pressure; temperature. Optional axial (bit bounce), lateral and torsional (stick-slip, chatter and whirl) vibrations and shocks.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
Vibration Memory Sub (VMS)	4 3/4, 6 3/4, 8	5.5			150	20						NA	NA	N	N	N	N	Y	Op. sel.	Op. sel.	Y/Y			Mag / accel	Collar axial (bit bounce), lateral and torsional (stick-slip, chatter and whirl) vibrations and shocks.		Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
Magnetorheological Active Vibration Damper (AVD) 6.75	6 3/4	32	10		150	20						Flow-on, timer, shock & vibration alarms.	NA	N	Y (via APS SureShot MWD)	N	N		Programmable threshold	Op. sel.	Op. sel.	Y/Y				Mandrel displacement --> Real time variable damping of axial, lateral & torsional vibration	Turbine alternator	N	Y
Magnetorheological Active Vibration Damper (AVD) 9.5	9 1/2	32	10		150	20						Flow-on, timer, shock & vibration alarms.	NA	N	Y (via APS SureShot MWD)	N	N		Programmable threshold	Op. sel.	Op. sel.	Y/Y				Mandrel displacement --> Real time variable damping of axial, lateral & torsional vibration	Turbine alternator	N	Y
Baker Hughes																													
LithoTrak bulk density & neutron porosity w/acoustic caliper	4-3/4, 6-3/4,8-1/4	14.4 (4-3/4) 17.6 (6-3/4) 18.2 (8-1/4)		BHA Dependent	BHA Dependent	150, 165 (option 6-3/4 ORD)	20, 25 and 30 option	Application Specific	Application Specific	Application Specific	N/A	4-3/4 160-329, 6-3/4 300-900, 8-1/4 310-1600	Stop/start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	N/A	Configuration	Continuous	N/A	Referenced to density measurement	10% (0 -2 inches)	Acoustic transducer	Hole diameter, azimuthal caliper	Turbine generator/ no limit	Y	Y
AutoTrak eXpress rotary steerable, AutoTrak V vertical rotary steerable	4-3/4, 6-3/4, 9-1/2	BHA Dependent		BHA Dependent	BHA Dependent	150, 175 (optional AutoTrak V 6-3/4 and 9-1/2)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,600 (9-1/2)	Stop/start pumps Stop rotary	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	62 / N/A	Y/Y	Vibration w/copilot 13.8 (4-3/4) 10.5 (6-3/4) 11.1 (9-1/2)	1% (0-82 Hz vibration) +/- 1,000 RPM 0.25% full scale (0 - 25kpsi)	3-axis accelerometer 3-axis fluxgate	Lateral and axial vibration (grms) stick-slip severity level	Turbine generator/ no limit	Y	Y
AziTrak deep azimuthal resistivity, OnTrak integrated formation evaluation	4-3/4, 6-3/4,8-1/4 (OnTrak only) 9-1/2 (OnTrak only)	34.3 (4-3/4 OnTrak) 27.7 (6-3/4 OnTrak) 30.7 (8-1/4 OnTrak) 30.2 (9-1/2 OnTrak) 23.5 (4-3/4) 22.1 (6-3/4) Azittrak		BHA Dependent	BHA Dependent	150, 175 (optional OnTrak 4-3/4, 6-3/4 and 9-1/2)	25 (4-3/4, 6-3/4, 8-1/4, 9-1/2) 30 (optional OnTrak 4-3/4 and 6-3/4)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,295 (8-1/4) 300- 1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	Op. Sel.	Programmable	55	Y/Y	As per directional tool specification	1% (0-82 Hz vibration) +/- 1,000 RPM 0.25% full scale (0 - 25kpsi)	3-axis accelerometer 3-axis fluxgate Strain gauge	Lateral & axial vibration (grms) stick-slip severity level flow on/ off annular & bore pressure **excludes AziTrak & 9.5 OnTrak for bore pressure	Turbine generator/ no limit	Y	Y
NaviTrak HR NaviTrak LCP	3-1/8 (NaviTrak only), 4-3/4, 6-1/2, 6-3/4, 8-1/4 (NaviTrak only) 9-1/2 (NaviTrak only)	BHA Dependent		BHA Dependent	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	As per directional tool specification	As per directional tool specification	Positive mud pulse (NaviTrak)	N	Y	N	Y	N/A	Op. Sel.	As per directional tool specification	Y/Y	As per directional tool specification	1% (0-120 Hz vibration)-200-1,000 RPM 0.25% full-scale (0 - 20kpsi)	3-axis accelerometer 3-axis fluxgate Strain gauge	Lateral and axial vibration (grms) stick-slip severity level, flow-on and flow-off annular and bore pressure.	Turbine generator/ no limit	Y	Y
CoPilot UHD drilling dynamics	4-3/4, 6-3/4, 8-1/4, 9-1/2	8.9 (4-3/4) 7.0 (6-3/4) 8.1 (8-1/4) 7.5 (9-1/2)		BHA Dependent	BHA Dependent	150	20, 25 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0 -350 (4-3/4) 0-800 (6-3/4) 0-1,600 (8-1/4, 9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	Pressure:(4-3/4) 3.1, (6-3/4) 1.9, (8-1/4) 2.2, (9-1/2) 1.9; others referenced to bit depth	1% (+/- 85 klb weight) 1% (+/- 28 klb torque) 0.4% (+/- 85 klb bending) 0.25% full scale (0 - 25kpsi) 1% (+/- 50g vibration) 1% (+/- 200g vibration) 0.1% (-500-1,000 RPM	3-axis accelerometer 3-axis fluxgate Strain gauges	16 channels sampled at either 40, 100, 200, 1,000, or 250	Turbine generator/ no limit	Y	Y
CoilTrak DP drilling performance	2- 3/8 (CoilTrak only) 3 (CoilTrak) 3-1/8	49.5 (includes motor)		50 (2-3/8) 45 (3) *sliding only	BHA Dependent	150, 160 (CoilTrak only)	14.5	Application Specific	N/A	N/A	N/A	0-120 (2-3/8) 0-210 (3)	Power on	Electric line, positive mud pulse	N	Y	Y	N	N/A	Op. Sel.	As per directional tool specification	Y/Y	1.2 (pressure) 0.8 (weight) 5.6 (vibration)	+/-0.25% (0 - 20 kpsi)+/-2% (V98+/- 9 (10.1) klbf) +/- 2% (0-2.2 klb in 3-1/8) 0-15g vibration	3-axis accelerometer 3-axis fluxgate	Lateral and axial vibration (grms) stick-slip severity level, flow-on and flow-off annular pressure, weight on bit.	Electric line/ no limit (2-3/8 amd 3) Turbine generator?/no limit (3)	Y	Y
CoilTrak HT DP drilling performance	3" CoilTrak	49.5 (includes motor)		45 *sliding only	BHA Dependent	175	14.5	Application Specific	N/A	N/A	N/A	0-210	Power on	Electric line	N	N	Y	N	N/A	Op. Sel.	As per directional tool specification	Y/Y	1.2 (pressure) 0.8 (weight) 5.6 (vibration)	+/-0.25% (0 - 20 kpsi)+/-2% (V98+/- 9 (10.1) klbf) +/- 2% (0-2.2 klb in 3-1/8) 0-15g vibration	3-axis accelerometer 3-axis fluxgate	Lateral and axial vibration (grms) stick-slip severity level, flow-on and flow-off annular pressure, weight on bit.	Electric line/ no limit Turbine generator?/no limit (3)	Y	Y
Directive Shock Measurement	3-1/2 to 9-1/2	As Tensor MWD		As Tensor MWD	As Tensor MWD	175	20	As Tensor MWD	As Tensor MWD	As Tensor MWD	As Tensor MWD	As Tensor MWD	Flow	Positive Pulse	Y	N	N	N	N/A	Op. Sel.	N/A	N/A	As Tensor MWD	+/-0.2% (+/-250 g)	2-axis MEMS accelerometers	Axial & lateral peak shock (30 sec period)	As Tensor MWD	Y	Y
Nabors Drilling Technologies USA, Inc.																													
AccuSteer (Mud Pulse)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12		As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	6	Weight on Bit: 1.6% max error; Torque on Bit: 0.9% max error; Bending Moment: 0.9% max error Annulus Pressure ± 0.2% (range 0-20,000 psi) Bore Pressure ± 0.2% (range 0-20,000 psi) Shock and Vibration (1000Hz) Axial and Lateral–Peak, RMS, Average	Strain Gages / Paine Pressure Transducers / Bd mounted accels	WOB , TOB , BOB & Annulus / Bore Pressure & Shock/ Vibration	Lithium battery, 500 hours	Y	Y
AccuSteer (EM)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12		As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	6	Weight on Bit: 1.6% max error; Torque on Bit: 0.9% max error; Bending Moment: 0.9% max error Annulus Pressure ± 0.2% (range 0-20,000 psi) Bore Pressure ± 0.2% (range 0-20,000 psi) Shock and Vibration (1000Hz) Axial and Lateral–Peak, RMS, Average	Strain Gages / Paine Pressure Transducers / Bd mounted accels	WOB , TOB , BOB & Annulus / Bore Pressure & Shock/ Vibration	Lithium battery, 500 hours	Y	Y
PetroMar Technologies, Inc. • Earle Drack, 440 Creamery Way, STE 100, Exton, PA 19340, +1 484-206-4182, edrack@petromartech.com																													
DrillView EX (DD + WOB/ TOB/BOB + Annular/Bore Pressure)	6.75	1.1		20, 10+	6.5x3.5	150	20	<1	1	3	N/A	0 - 750	Surface High-speed SWRO	Optional - contact PetroMar	N	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable, 50us min., (20kHz max.)	Both	0.7	DrillView BX + 0.1% FS Pressure	DrillView BX + Pressure Strain Gages	DrillView BX + Annular/ Bore Pressure	Batteries, > 200	Optional - contact PetroMar	Yes, >200h
DrillView BX (DD + WOB/ TOB/BOB)	6.75	1.1		20, 10+	6.5x3.5	150	20	<1	1	3	N/A	0 - 750	Surface High-speed SWRO	Optional - contact PetroMar	N	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable, 50us min., (20kHz max.)	Both	0.7	DrillView DX + 4% FS WOB/TOB/BOB	DrillView DX + Strain Gages	DrillView DX + WOB/ TOB/BOB Above + Annular/Bore Pressure	Batteries, > 200	Optional - contact PetroMar	Yes, >200h
DrillView DX (Wideband Drilling Dynamics)	6.75	1.1		20, 10+	6.5x3.5	150	20	<1	1	3	N/A	0 - 750	Surface High-speed SWRO	Optional - contact PetroMar	N	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable, 50us min., (20kHz max.)	Both	0.7	0.25g rms, +/-1rpm	Precision 10kHz 4-axis accels, multi-axis mags	Drilling Dynamics (shock, vibration, motion, RPM), Orientation (gravity and magnetic)	Batteries, > 200	Optional - contact PetroMar	Yes, >200h

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
Schlumberger																												
ImPulse *Downhole shocks *Downhole flow/washout *APWD (with VisionPWD sub)	4 3/4	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 27.5 opt.	20	125 (varies with Modulator gap)	N/A	N/A	130-360	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout *Stick Slip *Collar RPM *Tool temperature *Continuous D&I *APWD	Turbine	Y	Y
OmniSphere *Downhole shocks *Downhole flow/washout *APWD (with VisionPWD sub)	4 3/4	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	20	125 (varies with Modulator gap)	N/A	N/A	130-360	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout *Stick Slip *Collar RPM *Tool temperature *Continuous D&I *APWD	Turbine	Y	Y
ShortPulse *Downhole shocks *Downhole flow/washout *APWD (with VisionPWD sub)	4 3/4	27.3	30/15	4.75x2.25x34.8 -OR- 4.59x2.25x30.3	150 std., 175 opt.	20 std., 25 opt.	20	125 (varies with Modulator gap)	N/A	N/A	130-360	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical & >70bps effective)	30-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout *Stick Slip *Collar RPM *Tool temperature *Continuous D&I *APWD	Turbine	Y	Y
VisionPWD *APWD *IPWD	4.75	13.6	30/15	4.75x2.25x38.5	150 std., 175 opt.	25	5	29	N/A	N/A	0-400	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	N	N	N	N	N/A	Variable	N/A	N/A	Various	Various	Pressure	*APWD *IPWD *Internal Temperature *External Temperature	Lithium battery	Y	Y
DigiScope *Internal & Annular Pressure While Drilling (built in)*3 axis Shocks & Vibrations *Downhole flow/washout	4 3/4	29.9	30/15	30.7 (9.4) of 4.75" OD x 2.25" ID API collar	150 std.	25 std., 30 opt.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	N/A	N/A	150-400	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 36bps physical & > 140bps effective)	27-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout detection *Stick Slip *Collar RPM *Tool temperature *Continuous D&I *Internal and Annular PWD	Dual Stage Turbine	Y	Y
TeleScope ICE *Internal & Annular Pressure While Drilling (built in) *3 axis Shocks & Vibrations *Downhole flow/washout	4 3/4	31.9	30/15	31.9 (9.7) of 4.75" OD x 2.25" ID API collar	200 std.	30 std.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	N/A	150-400	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout detection *Stick Slip *Collar RPM * APWD Dynamic and Static *Tool temperature *Continuous D&I *Internal and Annular PWD	Dual Stage Turbine	Y	Y
TeleScope ICE *Internal & Annular Pressure While Drilling (built in) *3 axis Shocks & Vibrations *Downhole flow/washout	6 3/4	31.4	15/8	32.5 (9.9) of 6.75" OD x 2.81" ID API collar	200 std.	30 std.	N/A	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	300 (varies with Mud weight and Modulator gap)	275-800	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	Various	Various	Various	*Shocks *Downhole flow/washout detection *Stick Slip *Collar RPM * APWD Dynamic and Static *Tool temperature *Continuous D&I *Internal and Annular PWD	Turbine	Y	Y
TeleScope *APWD *3 axis vibrations (MVC) *Downhole WOB *Downhole TORQ *Downhole flow/washout	6 3/4, 8 1/4, 9, 9 1/2	24.7	(6 3/4) 16/8 (8 1/4) 12/7 (9, 9 1/2) 10/6	(6 3/4) 6.75x2.81x 1.5 (8 1/4) 8x2.81x26.2 (9 1/4) 9.25x3x28 (9 1/2) 9.5x3.5x26.2	150 std., 175 opt.	25 std., 30 opt.	N/A	(6 3/4) 56 (8 1/4) 32 (varies with modulator gap)	(6 3/4) 151 (8 1/4, 9 1/2) 84 (varies with modulator gap)	(8 1/4, 9 1/2) 595 (varies with modulator gap)	(6 3/4) 250-800 (8 1/4) 300-1,200 (8 1/4) opt. 800-1,400 (9 1/2) 400-2,000 (9 1/2) opt. 400-1,600	Real-time, pumps on dowhole recording	Positive Continuous wave / Wired drill pipe opt.	N	Y	Y	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.5bps to 20bps physical & >70bps effective)	27-80	Y/Y	Various	Various	Various	*3 axis vibrations/ shocks *Downhole WOB *Downhole TORQ *Downhole flow/wash-out *Annular Pressure *Stick slip *Collar RPM *Tool temperature *Annular temperature *Continuous D&I *Gamma Ray *Torsional vibration	Turbine	Y	Y
SlimPulse *Shocks *Stick Slip	1 3/4 tool OD 3 1/8 to 9 1/2 collars	Collar based probe normally 30	(4 3/4 and smaller) 145/40 (6 3/4) 28/10 (8 1/4) 20/8 (9 1/2) 19/7	(4 3/4) 4.75x2.81x33 (6 3/4) 6.75x2.81x32	150 std., 175 opt.	22	(4 3/4) 68, (6 3/4) 16	(6 3/4) 100, (8 3/4) 18	(6 3/4) 324, (8 3/4, 9 3/4) 58	(8 3/4, 9 3/4) 411	Multiple configurations: 35-1,200	Real-time, pumps on dowhole recording	Positive Continuous wave and downhole recording	Y	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 6bps effective)	104sec to 150sec at 1bps	Y/Y	Various	Various	Various	*Shocks *Tool temperature *Continuous D&I *Gamma Ray * Stick Slip	Lithium battery	Y	Y
EcoScope *APWD dynamic and static *Multi-axis shock & vibration (MVC) *Ultrasonic caliper (UCAL) *Density caliper (DCAL)	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on dowhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	9	APWD: 25 psi accuracy from 0. to 25kPI, MVC: 4 accelerometers 2kHz bandwidth, UCAL: 2 sensors 0.1-in resolution, Inc: 0.1deg from 1 to 90 deg, DCAL: 1-in max standoff.	Accelerometer, ultrasonic, scintillation	APWD dynamic and static, multi-axis shock & vibrations, ultrasonic and density caliper	TeleScope turbine	Y	Y
NeoScope *APWD dynamic and static *Multi-axis shock & vibration (MVC) *Ultrasonic caliper (UCAL)	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on dowhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	9	APWD: 25 psi accuracy from 0. to 25kPI, MVC: 4 accelerometers 2kHz bandwidth, UCAL: 2 sensors 0.1-in resolution, Inc: 0.1deg from 1 to 90 deg	Accelerometer, ultrasonic, multi-detectors	APWD dynamic and static, multi-axis shock & vibrations, ultrasonic caliper	TeleScope Turbine	Y	Y
PeriScope APWD	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	(4 3/4) 30/15, (6 1/2) 16/8	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17.4 (4 3/4) 13.5 (6 3/4)	APWD: 25 psi accuracy from 0. to 25kPI	Pressure	APWD dynamic and static	MWD turbine	Y	Y
PeriScope HD APWD	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	(4 3/4) 30/15, (6 1/2) 16/8	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17.4 (4 3/4) 13.5 (6 3/4)	APWD: 25 psi accuracy from 0. to 25kPI	Pressure	APWD dynamic and static	MWD turbine	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
proVISION Plus (Magnetic Resonance while Drilling) *3 axis motion detection *Shocks *Stick Slip *Downhole flow/washout	6 3/4 with Slick, 7 3/4, 8 1/4, or 9 5/8 Stabilizer Options	37.3	16/8	6.5x2.81x36.5	150	20	2.7	17.4	56	N/A	300-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.8	Incl.: 0.1 at 1 sigma	3 axis accelerometer	Collar RPM, collar stick&slip, shocks and vibrations	Tool Turbine	Y	Y
proVISION Plus (Magnetic Resonance while Drilling) *3 axis motion detection *Shocks *Stick Slip *Downhole flow/washout	8 1/4 slick, 10 1/4, 10 3/8, 12 1/8 Stabilizer Options	38.47	14/7		150	20 std, 22 opt.	1	6.35	20.6	146	300-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.8	Incl.: 0.1 at 1 sigma	3 axis accelerometer	Collar RPM, collar stick&slip, shocks and vibrations	Tool Turbine	Y	Y
Scientific Drilling International																												
Falcon Mud Pulse MWD	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	17	Collar Limited	BHA Dependent	150C (177C available)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	50-200 GPM (3-1/8, 3-1/2) 100-400 GPM (4-3/4, 5-1/4) 200-600 GPM (6-1/4, 6-1/2, 6-3/4) 250-1000 GPM (6-3/4, 7, 8) 400-1500 GPM (9.5)	Pumps	Postivie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 3	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all	Tri-axial Accelerometer and Magnetometer	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics	Lithium Battery 300+ Hrs	Y	Y
Falcon EM ElectroMagnetic MWD	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	24	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-200 GPM (3-1/8, 3-1/2) 0-400 GPM (4-3/4, 5-1/4) 0-600 GPM (6-1/4, 6-1/2, 6-3/4) 0-1000 GPM (6-3/4, 7, 8 0-1500 GPM (9.5)	Continuous EM Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 3	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all	Tri-axial Accelerometer and Magnetometer	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics	Lithium Battery 150+ Hrs	Y	Y
Weatherford																												
BAP (Borehole/Annular Pressure)	4-3/4, 6-3/4, 8-1/4, 9-1/2	Added to HEL length - (4-3/4) 2.71, (6-3/4) 2.67, (8-1/4, 9-1/2) 2.67	(4-3/4) 30/15, (6-3/4), 16/8, (8-1/4) 14/7, (9-1/2) 12/6	(4-3/4) 4.75x3.22, (6-3/4) 6.75x4.24, (8-1/4) 8x4.28, (9-1/2) 9.5x5.16	150 std. 200 opt.	(4.75, 6.75) 20 std., 30 opt. (8.25, 9.5) 20 std., 25 opt.	(4 3/4) 12, (6 3/4) 2, (8 1/4, 9-1/2) 1	(4 3/4) 64, (6 3/4) 9, (8 1/4, 9-1/2) 2	(6 3/4) 26, (8 1/4, 9 1/2) 2	(8-1/4, 9-1/2) 33	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4, 9 1/2) 80-1,600	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Variable	N/A	N/A	(4 3/4, 6 3/4) 10.6	+/- 7.5 psi	Quartz gauges	Annular and drillpipe pressure, temperature	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
TVM (True Vibration Monitor)	4-3/4, 6-3/4, 8-1/4, 9-1/2	No additional Length	N/A, Electronic Boards	N/A, Electronic Boards	150 std. 180 opt.	N/A, Electronic Boards	N/A, Electronic Boards	N/A, Electronic Boards	N/A, Electronic Boards	N/A, Electronic Boards	N/A, Electronic Boards	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Variable Trigger	N/A	N/A	(4 3/4, 6 3/4) 17.3	0 - 200 g's	Accelerometer.	Three axis acceleration, shock and RPM	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
RAT (Rapid Annular Temperature)	4-3/4, 6-3/4, 8-1/4, 9-1/2	No additional Length	N/A, External Sensor	N/A, External Sensor	150 std. 180 opt.	(4-3/4, 6-3/4), 20 std., 30 opt. (8.25, 9.5) 20 std., 25 opt.	N/A, External Sensor	N/A, External Sensor	N/A, External Sensor	N/A, External Sensor	N/A, External Sensor	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Variable	N/A	N/A	(4 3/4, 6 3/4) 10.6	+/- .5 deg C @ 20 C +/- 2 deg C @ 200 C	IC Semiconductor	Annular fluid temperature	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
EMPulse MWD Annulus Pressure	All Sizes	31	(3 1/6) 116/38, (4 3/4) 25/16, (6 1/4) 20/14, (6 3/4) 18/13, (8) 15/10, (9 1/2) 14/7.5	(4 3/4) 4.53 x 2.25, (6 1/4) 6.09 x 2.25), (6 3/4) 6.59 x 2.81, (8) 7.78 x 2.81	150°C	15	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	(3 1/16, 3 3/8, 3 1/2) 160; (4 3/4, 6 1/4) 350; (6 3/4) 800; (8, 9 1/2) 1,200	Two way EM Communication	Electromagnetic	Y	N	N	Y	Op. Sel.	Variable			10-3 of FSR	Strain Gauge	Annular Pressure and Temperature	Lithium battery	Y	Y	
MWD TVMS (Total Vibration Monitoring Sonde)	All sizes	31	(3 1/6) 116/38, (4 3/4) 25/16, (6 1/4) 20/14, (6 3/4) 18/13, (8) 15/10, (9 1/2) 14/7.5	(4 3/4) 4.75x2.69, (6 1/4) 6.25x3.25, (6 3/4) 6.75x3.25	150	15	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	(3 1/16, 3 3/8, 3 1/2) 160; (4 3/4, 6 1/4) 350; (6 3/4) 800; (8, 9 1/2) 1,200	Stop pumps, Start pumps, Two way EM Communication	Positive mud pulse, Electromagnetic	Y	N	N	N	Op. Sel.	Variable			0 - 200 g's	Accelerometer.	Three axis acceleration and shock	Lithium battery	Y	Y	
Gamma Ray																												
APS Technology (Rental Division)																												
APS SureShot	3 1/8, 3 1/2, 4 3/4, 6 1/4, 6 3/4, 8, 9 1/2+	25*	Collar-limited	Collar-defined	150 and 175	20 and 25	(3 1/2) 27, (4 3/4 - 6 3/4) 6, (8) 3, (9 1/2) 2	(3 1/2) 150, (4 3/4 - 6 3/4) 35, (8) 20, (9 1/2) 10	(6 1/2 - 6 3/4) 114, (8) 61, (9 1/2) 32	(9 1/2) 220	(3 1/8, 3 1/2) 70-250 (4 3/4) 150-350 (6 1/4, 6 3/4) 150-750 (8) 300-1,100 (9 1/2+)- 650 - 1,200	Flow-on and timer	MPT positive pulse and EM	Y (4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 6.4	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer	Azi., Incl., MTF, GTF, temp. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot with Gamma	3 1/8, 3 1/2, 4 3/4, 6 1/4, 6 3/4, 8, 9 1/2+	29*	Collar-limited	Collar-defined	150 and 175	20 and 25	(3 1/2) 29, (4 3/4 - 6 3/4) 6, (8) 3, (9 1/2) 2	(3 1/2) 165, (4 3/4 - 6 3/4) 40, (8) 20,(9 1/2) 10	(6 1/2 - 6 3/4) 114, (8) 61, (9 1/2) 32	(9 1/2) 225	(3 1/8, 3 1/2) 70-250 (4 3/4) 150-350 (6 1/4, 6 3/4) 150-750 (8) 300-1,100 (9 1/2+)- 650 - 1,200	Flow-on and timer	MPT positive pulse and EM	Y (4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 6.4 Gamma: 2.1	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + WPR Propagation Resistivity	3 1/2, 4 3/4, 6 3/4, 8	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1° Azi: +/-1.0° (Incl. >10°; Dip <70°) GTF: +/-1.0° (Incl. >10°) MTF: +/-2.25° (Dip <70°) Gamma: 0 - 800 API +/-5% Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + PWD + WPR Propagation Resistivity	3 1/2, 4 3/4, 6 3/4, 8	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureLog-AGZ (Azimuthal Gamma) 4.75	4.75	7.3	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	500 max.	Flow-on and timer	MPT positive pulse and EM	N	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	2.5	API-calibrated 0 - 800 API +/- 3 API @ 100 API;0.8 cps API per detector	Nal Crystal w/PMT	Up to 24-bin azimuthal natural gamma; inclination, rotation & vibration; direction	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
APS SureLog-AGZ (Azimuthal Gamma) 6.75	6.75	7.3	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	1,000 max.	Flow-on and timer	MPT positive pulse and EM	N	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	2.5	API-calibrated 0 - 800 API +/- 3 API @ 100 API;0.8 cps API per detector	Nal Crystal w/PMT	Up to 24-bin azimuthal natural gamma; inclination, rotation & vibration; direction	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y	
Baker Hughes																													
AutoTrak Curve high-build rotary steerable w/gamma ray	6-3/4	37.8	30/15 (6-3/4)	BHA Dependent	150	20	N/A	N/A	Application Specific	N/A	300-750	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Op. Sel.	55	Y/Y	11.5 (6-3/4)	+/- 5 API @ 100 API and 60ft/hr	Scintillator	4-sector gamma ray	Turbine generator/ no limit	Y	Y	
AutoTrak eXact advanced high-build rotary steerable w/near-bit gamma ray	4-3/4	9.62	12	BHA Dependent	150	30	N/A	N/A	N/A	N/A	125-350 Applicaton Dependent	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	55	Y/Y	10.3 (GR)	+/- 5 API @ 100 API	2 scintillators	16-sector gamma ray	Turbine generator/ no limit	Y	Y	
AutoTrak G3 advanced rotary steerable w/near-bit gamma ray	4-3/4	12.3 34.0 (X-treme)	30/10 (3.0) 25/10 (X-treme)	BHA Dependent	150	20, 25 (option), 30 (option)	Application Specific	Application Specific	N/A	N/A	125-350	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	Y	N	Op. Sel.	Op. Sel.	55	Y/Y	5.74	+/- 5 API @ 100 API	2 scintillators	16-sector gamma ray	Turbine generator/ no limit	Y	Y	
AutoTrak eXpress rotary steerable w/gamma ray	4-3/4, 6-3/4, 9-1/2	56.8 (4-3/4) 58.2 (6-3/4) 70 (6-3/4 high DLS option) 64.6 (9-1/2)	30/10 (4-3/4) 23/8 (6-3/4) 23/12 (6-3/4 high DLS option) 13/6.5 (9-1/2)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 300-1,600 (9-1/2)	Stop/start pumps Stop rotary	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	62	Y/Y	29.5 (4-3/4) 31.3 (6-3/4) 37.5 (9-1/2)	+/- 3 API @ 100 API and 60 ft/hr	Scintillator	Gamma ray	Turbine generator/ no limit	Y	Y	
AutoTrak V vertical rotary steerable w/gamma ray	4-3/4	22.1 33.0 (X-treme)		BHA Dependent	150	20, 25 (option), 30 (option)	Application Specific	Application Specific	N/A	N/A	125-350	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	N/A	N/N	5.74	+/- 5 API @ 100 API	2 scintillators	8-sector gamma ray	Turbine generator/ no limit	Y	Y	
CoilTrak directional & gamma ray UltraSlim directional & gamma ray	2-3/8 (CoilTrak only) 3-1/8	49.5 (includes motor)	50 (2-3/8) 45 (3) *sliding only	BHA Dependent	150, 160 (CoilTrak only)	14.5	2-3/8 (CoilTrak only) 3-1/8	N/A	N/A	N/A	0-120 (2-3/8) 0-210 (3)	Power on	Electric line, positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel	Continuous	Y/N	5.2 (2-3/8) 5.3 (3)	+/- 3 cps at 100 API	Scintillator	Gamma ray	Electric line, no limit (2-3/8) Electric line, no limit (3-1/8) Lithium battery, 140 hr (3-1.8 option)	Y	Y	
OnTrak integrated formation evaluation	4-3/4, 6-3/4, 8-1/4, 9-1/2	34.3 (4-3/4) 27.7 (6-3/4) 30.7 (8-1/4) 30.2 (9-1/2)	BHA Dependent	BHA Dependent	150, 175 (optional 4-3/4, 6-3/4 and 9-1/2)	25 (4-3/4, 6-3/4, 8-1/4, 9-1/2) 30 (optional 4-3/4 and 6-3/4)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 395-1,290 (8-1/4) 430-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Programmable	Continuous	Y/Y	2.5 (4-3/4) 2.2 (6-3/4) 1.3 (8-1/4) 4.2 (9-1/2)	+/- 2.5 API @ 100 API and 60 ft/hr	2 scintillators	8-sector gamma ray	Turbine generator/ no limit	Y	Y	
AziTrak deep azimuthal resistivity	4-3/4, 6-3/4	23.5 (4-3/4) 22.1 (6-3/4)	BHA Dependent	BHA Dependent	150	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	N/A	125-350 (4-3/4) 200-900 (6-3/4)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Op. Sel	Continuous	Y/Y	13.2 (4-3/4) 11.6 (6-3/4)	+/- 2.5 API @ 100 API and 60 ft/hr	2 scintillators	8-sector gamma ray	Turbine generator/ no limit	Y	Y	
NaviTrak HR directional & gamma ray	3-1/8, 4-3/4, 6-3/4, 8-1/4, 9-1/2	BHA Dependent	50/16 (3-1/8) 25/7 (4-3/4) 12.5/6.5 (6-3/4) 10.5/4.5 (8-1/4) 7/3.5 (9-1/2) 70/21 (3-1/8 flex) 82/21 (4-3/4 flex) 23/9.5 (6-3/4 flex)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	75-175 (3-1/8) 105-350 (4-3/4) 210-900 (6-3/4) 300-1,350 (8-1/4) 450-1,600 (9-1/2)	Stop/start pumps Stop rotary	Positive mud pulse	N	Y	N	N	Op. Sel.	Op. Sel.	62	Y/Y	1.07 (1-3/4)	+/- 3 API @ 100 API and 60 ft/hr	Scintillator	Gamma ray	Turbine generator, no limit, lithium batteries >200 hr	Y	Y	
NaviTrak EM directional & gamma ray	4-3/4, 6-1/2 8 (no NB GR)	BHA Dependent	18/10 (4-3/4) 15/8 (6-1/2) 10/6 (8)	BHA Dependent	150	20	Application Specific	Application Specific	Application Specific	Application Specific	max 375 (4-3/4) max 750 (6-1/2) max 1,200 (8)	Rotary, EM Downlink	EM	N	Y	N	Y	Op. Sel.	Op. Sel.	Continuous	Y/Y	18.9 2 (NB GR, Inc.)	+/- 5%	Scintillator	Gamma ray, Near-bit Azi (up/down) Gamma and Inc.	Battery, up to 160 hr (Gamma), 80-240 (NB GR)	Y	N	
ZoneTrak G near-bit gamma ray	4-3/4, 6-3/4, 9-1/2	Only RSS option available for 4-3/4 , 5.35 or 4.79 for 9-1/2, 4.52 or 4.06 for 6-3/4	BHA Dependent	BHA Dependent	150	20, 25 (option) 20, 25 (option), 25	Application Specific	Application Specific	Application Specific	Application Specific	300-1600 9-1/2, 200-900 for 6-3/4, 125-350 4-3/4	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	2.1 or 2.66 9 for -1/2, 2.16 or 1.73 for 6-3/4, 4.87 for 4-3/4	+/- 5 API @ 100 API	2 scintillators	Gamma ray w/ up to 16 sectors (size dependent)	Turbine generator/ no limit	Y	Y	
Scinturion Gamma	3-1/2, 4-3/4, 6-1/2, 8, 9-1/2	30.4	100/50, 30/15, 21/10, 14/8, 7/4	2.96 x 2.25 4.75 x 2.81 6.71 x 3.25 7.93 x 4.00 9.42 x 4.00	175	20	(4-3/4 - 6-1/2) 6	(4-3/4 - 6-1/2) 39	(4-3/4 - 6-1/2) 127	(9-1/2) 373	75-1,200	Flow	Positive mud pulse	Y	Y	Y	Y	Op. Sel.	Variable	From 90 (data dependent)	Y/Y	Variable	+/- 1.5% range	Scintillation Nal crystal PMT	Gamma Ray	Battery/ upto 400 hr	Y	Y	
Electro-Trac MWD with Gamma	4, 4-3/4, 6-1/2, 6-3/4, 7-3/4, 8, 9-1/2	26.9 (adjusted to Monel Length)	37/25 25/15 18/10 18/10 8/5 7/5 6/4	Collar-defined	150	20	25	100	100	100	50-1,200	Flow	EM	Y	N	N	Y	Op. Sel.	8 (TF & Gamma)	18	N	Variable (adjusted to collar length)	+/- 5% range	Scintillation Nal crystal PMT	Gamma Ray	Battery/ 200+hr	Y	N	
Bench Tree																													
Bench Tree M/LWD, Standard	1-7/8 Probe in Standard 3.5 - 9.5 NMDC	21.7 - 30.7	collar limited	collar defined	175	20	application dependent	application dependent	application dependent	application dependent	70-1250	Pumps, Rotary	mud pulse or optional 3rd party EM	Y	Y	N	3rd Party Option	Configurable Threshold	Config Dependent	Config Dependent	Real Time Inc (Rinc) & Azm (RAzm) Y/Y	Dir: 15.2-16.5 Gam: 5	Inc:±0.1° Az:±0.2° G:±6.0mG H:±0.035uT TF:±1.0° Temp:±1°C RPM:±12 Rinc@>20°: ±.35° Gamma:±5%	3 axis QFlex Accels, Proprietary Fluxgate Magetometer, Si Sensors, Nal Scintillator	Inc, Az, TF, H(x,y,z), G(x,y,z), Temp, RPM, axial S&V, lateral S&V, Gamma Optional: PWD	1 ea - 2 ea 8 cell Li Batt Packs, 700 hrs/pack	Y	Y	
Bench Tree M/LWD, Short	1-7/8 Probe in Standard 3.5 - 9.5 NM Pony	16.5	collar limited	collar defined	175	20	application dependent	application dependent	application dependent	application dependent	70-1250	Pumps, Rotary	mud pulse or optional 3rd party EM	Y	Y	N	3rd Party Option	Configurable Threshold	Config Dependent	Config Dependent	Real Time Inc (Rinc) & Azm (RAzm) Y/Y	Dir: 7.9 Gam:5	Inc:±0.1° Az:±0.2° G:±3.0mG H:±0.015uT TF:±1.0° Temp:±1°C RPM:±12 Rinc@>20°: ±.35° Gamma:±5%	3 axis QFlex Accels, Proprietary Fluxgate Magetometer, Si Sensors, Nal Scintillator	Inc, Az, TF, H(x,y,z), G(x,y,z), Temp, RPM, axial S&V, lateral S&V, Gamma Optional: PWD	8 cell Li Batt Pack, 700 hrs/pack	Y	Y	
CBG Corp. • Mike Pochkowski 4616 West Howard Ln, Suite 900, Austin, Texas 78728, (512) 491-7541, mpochkowski@cbgcorp.com																													
NGT-T	1.36"	1.13'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
MGT-T	1.36"	1.13'			175	18							Mud Pulse						4 sec avg				+/-2%	Nal(Tl)	CPS		Y	Y	
NGT-TX	1.36"	0.97'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
NGT-CSX	1.05"	1.05'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
NGT-CN	1.36"	1.13'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
NGT-075	0.75"	1.15'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
DGA - Focused Gamma	1.30"	1.13'			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
NGT-Custom	Custom	Custom			175	18							Mud Pulse						1				+/-2%	Nal(Tl)	CPS		Y		
DrilTech LLC																													
Positive Pulse MWD and Gamma Ray Probe Based (8 Bin RT (16 Bin Memory) Azimuthal GR Available)	2-7/8-8	23-28	60/30 (Approximate, Connection dependent)	As applicable to standard NMDC	150-175	20 (137 mpa)	50 (NMDC dependent)	100 (NMDC dependent)	150 (NMDC dependent)	N/A	2-7/8) 45-125, (3-1/2) 50-130, (4-3/4) 130-300, (6-3/4) 235-600, (8) 400-800	Pumps "On" or Rotational Logic	Positive pulse	Yes, (No if Lock Down option used)	Y	N	N		Op. Sel. 2 Deg. Min.	6 sec (5 bit); 12 sec (9.6 bit res.)	60 - 90	Y/N	5, 9 , 15, 21	Azm: +/- .5 (No interference) Inc: +/- .2	Tri-axial accels, Tri-axial mags, Scintillation Gamma	MWD Plus..... 0 - 800 API Gamma	Lithium battery, 400-800 Hours	Y	Y
Gyrodاتا																													
Gyrodاتا Positive Pulse MWD with gamma	3 1/2, 4 3/4, 5 1/4, 6 1/2, 6 3/4, 8 1/4, 9 1/2	23	Collar limited	Collar-defined	150	25	400 (2.25"ID) 350 (2.69" ID) 300 (2.813"ID)	N/A 425 (2.69"ID) 400 (2.813"ID) 375 (3.25"ID) 340 (3.75"ID)	N/A, N/A, 525 (2.813"ID) 425 (3.25"ID) 400(3.75"ID)	N/A, N/A, N/A, N/A, N/A, N/A, 600 (3.75"ID)	3 1/2= 86-170 , 4 3/4 = 106-358, 5 1/4 = 106-358, 6 1/2 = 179-475, 6 3/4 =179 -701, 8 1/4, = 419-8,00, 9 1/2 = 419-1,232	pumps off	mud pulse	N	Y	N	N		Field selectable	9 sec.	120 secpnds, pumps off to survey	N	4	Inc =+/- 0.1o Az = +/- 1.0o TF=+/- 1.0°	Scintillation	Inc, Az, TF, TMF, TGF, TG, Mag Dip, temp, vibe,batt volts, raw gamma, raw mag values	Battery 200+hr	Y	raw data
Gyrodاتا Positive Pulse Retrievable MWD with gamma	3 1/2, 4 3/4, 5 1/4, 6 1/2, 6 3/4, 8 1/4, 9 1/2	18	Collar limited	Collar-defined	150	20	400 (2.25"ID) 350 (2.69" ID) 300 (2.813"ID)	N/A 425 (2.69"ID) 400 (2.813"ID) 375 (3.25"ID) 340 (3.75"ID)	N/A, N/A, 525 (2.813"ID) 425 (3.25"ID) 400(3.75"ID)	N/A, N/A, N/A, N/A, N/A, N/A, 600 (3.75"ID)	3 1/2= 80-170, 4 3/4 = 100-400, 5 1/4 = 100-400, 6 1/2 = 120-475, 6 3/4 =120-701, 8 1/4 = 400-800, 9 1/2 = 400-1,300	pumps off	mud pulse	Y	Y	N	N		Field selectable	9 sec.	120 secpnds, pumps off to survey	N	4	Inc =+/- 0.25o Az = +/- 2o TF=+/- 1°	Scintillation	Inc, Az, TF, TMF, TGF, TG, Mag Dip, temp, vibe,batt volts, raw gamma counts, raw mag values	Battery 200+hr	Y	raw data
GWD90 W/ Gamma	4 3/4, 5 1/4, 6 1/2, 6 3/4, 8 1/4, 9 1/2	54	Collar limited	Collar-defined	150	20	500 (2.25"ID) 400 (2.688" ID) 350 (2.8125"ID)	N/A 475 (2.69"ID) 45 (2.813" ID) 400 (3.25" ID)	N/A, N/A, 550(2 813"ID) 450 (3.25"ID) 425(3.75"ID)	N/A, N/A, N/A, N/A, N/A, N/A, 600 (3.75"ID)	3 3/4= 80-150 , 4 3/4" = 106-358, 5 1/4 =106-358, 6 1/2 =179-450, 6 3/4 =179-701, 8 1/4 =419-800, 9 1/2 = 419-1,232	pumps off	Inverted valve mud pulse	N	Y	N	N		Field selectable	12 sec	200	N	9	Inc =+/- 0.1o Az = +/- 1o TF=+/- 0.1°	3-axis accelerometer 3-axis fluxgate	Inc, Az, TF, TMF, TGF, temp, vibe,batt volts	Battery 200+hr	Y	raw data
EM MWD with Gamma	3 3/4, 4 3/4, 6 1/2, 6 3/4, 7 3/4	26.9	Collar limited	Collar-defined	150	20	25	100	100	100	50-1,200	flow on/off, EM downlink	EM	Y	N	N	Y		Field selectable	8 sec (TF and Gamma)	18 sec	N	3'+(adjusted to collar length)	Inc =+/- 0.1° Az = +/-0.25° TF=+/- .5° TMF=.003 µT gamma+/- 5%	Scintillation	Inc, Az, TF, TMF, TGF, M Dip, temp, vibe,batt volts, gap impedance + AAPi Gamma cps	Battery 200+hr	Y	raw data
Nabors Drilling Technologies USA, Inc.																													
AccuMP (Mud Pulse)	4 3/4, 6 1/2 & 8	(4 3/4) 10, (6 1/2 & 8) 10	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	N/A	225-1,000	Stop pumps, start pumps	Positive pulse	N	N	N	N	Y	Variable	50	Y/Y	10	Gamma ray ± 2% (Range: 0°C-150°C); ± 5% (150°C-175°C) ±0.1°	Scintillation	API Units	Lithium battery, 500 hours	Y	Y	
AccuWave (EM)	4 3/4, 6 1/2 & 8	(4 3/4) 10, (6 1/2 & 8) 10	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	N/A	225-1,000	Stop pumps, start pumps	Electromagnetic	N	N	N	N	Y	Variable	50	Y/N	10	Gamma ray ± 2% (Range: 0°C-150°C); ± 5% (150°C-175°C) ±0.1°	Scintillation	API Units	Lithium battery, 500 hours	Y	Y	
AccuSteer (Mud Pulse)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	10	Gamma ray ± 2% (Range: 0°C-150°C); ± 5% (150°C-175°C) ±0.1°	Dual Azimuthal Focused Scintillation Detectors 16 Bin Processed Image 9:1 Front/Back Shield Ratio	API Units	Lithium battery, 500 hours	Y	Y	
AccuSteer (EM)	4 3/4, 6 1/2	(4 3/4) 12, (6 1/2) 12	As applicable to standard NMDC	As applicable to standard NMDC	175	20	N/A	60	125	350	4 3/4: 150-325 6 1/2: 300-850	Stop pumps, start pumps	Positive	N	N	N	N	Y	Variable	50	Y/Y	10	Gamma ray ± 2% (Range: 0°C-150°C); ± 5% (150°C-175°C) ±0.1°	Dual Azimuthal Focused Scintillation Detectors 16 Bin Processed Image 9:1 Front/Back Shield Ratio	API Units	Lithium battery, 500 hours	Y	Y	
National Oilwell Varco																													
iSeries Top Mount Pulser	4.75	26.4	35/15	Collar Dependent	175	20	9	42			200 - 400	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 300hrs	Y	Y	
iSeries Top Mount Pulser	6.5	26.4	35/15	Collar Dependent	175	20	1	7	20		300 - 800	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 300hrs	Y	Y	
iSeries Top Mount Pulser	8	26.4	35/15	Collar Dependent	175	20	1	2	4	24	600 - 1,200	Pump cycle	Mud Pulse	N	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 300hrs	Y	Y	
iSeries Retrievable	4.75	27	35/15	Collar Dependent	175	20	9	42			200 - 400	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 350hrs	Y	Y	
iSeries Retrievable	6.5	27	35/15	Collar Dependent	175	20	1	7	20		300 - 800	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 350hrs	Y	Y	
iSeries Retrievable	8	27	35/15	Collar Dependent	175	20	1	2	4	24	400 - 1200	Pump cycle	Mud Pulse	Y	Y	N	N	Y	4.0 bps	Configurable	Y/Y	14.7	Inc: +/- 0.1°, Azi: +/- 0.2° @ 90° Inc, GTF: +/- 1.0° @ Inc > 5°, MTF: +/- 1.0° @ Inc < 7°, Gamma +/- 0.5cps	Hamamatsu PMT, Azimuthal Gamma Available	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), cInc, cAzi, RPM, Gamma	Lithium Batt, 350hrs	Y	Y	
BlackStarII EM	3.75	30.75	33/14	Collar Dependent	150	20	60				30 - 160	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	4.31	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y	
BlackStarII EM	4.75	30.75	28/12	Collar Dependent	150	20	9	42			30 - 370	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	4.31	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y	
BlackStarII EM	6.5	30.75	20/10	Collar Dependent	150	20	1	7	20		30 - 700	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	4.31	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y	
BlackStarII EM	8	30.75	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	4.31	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y	

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
BlackStarII EM	9	30.75	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM	Y	N	N	Y	Y	6.0 bps	Configurable	Y/Y	4.31	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	3.75	35.25	33/14	Collar Dependent	150	20	60				30 - 160	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	6.69	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	4.75	35.25	28/12	Collar Dependent	150	20	9	42			30 - 370	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	6.69	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	6.5	35.25	20/10	Collar Dependent	150	20	1	7	20		30 - 700	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	6.69	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	8	35.25	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	6.69	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
BlackStarII Dual Telemetry	9	35.25	12/7	Collar Dependent	150	20	1	2	4	24	30 - 1,200	Pumps or Rotary	EM/MPT	Y	N	N	Y	Y	7.5 bps	Configurable	Y/Y	6.69	Inc: +/- 0.1°, Azi: +/- 1.0°, GTF: +/- 1.5°, MTF: +/- 1.5°, Gamma +/- 1 cps @ 120RPM	Scintillation	Inc, Azi, GTF, MTF, Shk, Vib (Ax, lat), Gamma (360° & Azimuthal)	Lithium Batt, 260hrs	Y	Y
Oilden Technology, LLC																												
Gamma Ray TeleFusion	4.75, 6.75, 8.25, 9.5	Depends on Hang-Off collar	Collar-Limited	Collar-Limited	175	25	Collar-defined	Collar-defined	Collar-defined	Collar-defined	(4.75) 125-350 gpm, (6.75) 150-750 gpm, (8) 300-1,100 gpm	flow-on and timer	MPT positive pulse and EM	N	Y	N	N	Y	Config. Dependent	Config. Dependent	Y	Directional: 6.4ft Gamma: 2ft	Gamma Ray: +/-7%	Gamma Ray: Nal Scintillation with PMT	Gamma Ray: Averaged Gamma Ray	battery	Y	Y
Azimuthal Gamma Ray ArtFusion	4.75 / 6.75 / 8.25	16 / 16 / 16	30, 15 / 16, 8 / 14, 7	4.75x2.25x16.1, 6.50x2.81x15.4, 8.00x2.81x15.8	150	20	<30	<30	<30	N/A	400 / 800 / 1,200	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	0ft / 4ft / 4ft	Gamma Ray: +/-7%	Gamma Ray: Nal Scintillation with PMT	Gamma Ray: Azimuthal Gamma Ray GR Images (8 sector)	lithium battery, optional turbine-alternator	Y	Y
Azimuthal Gamma Ray DartFusion	4.75 / 6.75	16 / 16	30, 15 / 16, 8	4.75x2.25x16.1, 6.50x2.81x15.4,	150	20	<30	<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	0ft / 4ft	Gamma Ray: +/-7%	Gamma Ray: Nal Scintillation with PMT	Gamma Ray: Azimuthal Gamma Ray GR Images (8 sector)	lithium battery, optional turbine-alternator	Y	Y
Azimuthal Gamma Ray GeoFusion	4.75/ 6.75	19.3/15	30, 15 16, 8	4.75x2.25x19.8, 6.50x2.81x15.9	175	20	<30	<30	<30	N/A	400	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Gamma Ray: 14.3ft	Gamma Ray: +/-7%	Gamma Ray: Nal Scintillation with PMT	Gamma Ray: Azimuthal Gamma Ray GR Images (8 sector)	lithium battery, optional turbine-alternator	Y	Y
Ultrasonic Imager GPUFusion	4.75/ 6.75	6.4 /7.7	30, 15 16, 8	4.75x2.25x5.0/ 6.5x2.81x7.57	150	20/ 25	<10/ <30	<10/ <30	<10/ <30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	675: USS: 2.36 ft Gamma Ray: 4.23 ft APWD: 3.07 ft	Ultrasonic Image: 0.04" / 0.04"	Multiple acoustic transceivers	Ultrasonic: Reflected amplitude and travel time images at 64 sectors.	lithium battery, optional turbine-alternator	Y	Y
PetroMar Technologies, Inc.																												
SpectraView LWD Spectral/ Azimuthal Gamma Ray	6.75 nom., 7.25 max.	5	20, 10+	6.5x2	150 (175 HPHT version)	20 (25 HPHT version)	<1	2	6	N/A	0 - 750	Surface High-speed SWRO	Optional - contact PetroMar	N	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable	Azimuthal Gamma Counts rotating only, Total API, Energy Spectrum, K/U/TH, and Dynamics/ Orientation both	2.5	Gamma: > of +/- 5% or 2 API	Scintillation, Source-free Gain Stabilization, Multi-axis Accelerometer & Magnetometer	Total API Gamma Count, Azimuthally Binned Gamma Count, Gamma Energy Spectrum, K/U/Th Components, Drilling Dynamics (shock, vibration, motion, RPM), Orientation (gravity and magnetic)	Batteries, > 200	Optional - contact PetroMar	Yes, >200h
Schlumberger																												
PowerDrive X6 Rotary Steerable Tool	4 3/4, 6 3/4, 8 1/4, 9, 11	(4 3/4) 13.65, (6 3/4) 13.47, (8 1/4) 13.84, (9) 14.07, (11) 15.22	(4 3/4) 30/10, (6 3/4) 16/8, (8 1/4) 12/6, (9) 10/5, (11) 8/4	(475) 11.5; (675) 14.7; (900) 15.0; (1100) 18.0	150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	100-2,000	Continuous link to MWD	RT through MWD (WDP Option)	N	Y	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 5.86, (6 3/4) 6.40, (8 1/4, 9) 7.56, (11) 7.97	+/- 5%	Azimuthal Gamma Ray (4 Quadrant)	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray	Turbine / Infinite (hr)	Y	Y
PowerDrive Xcel	6 3/4, 9	(6 3/4) 24.93, (9) 27.89	(6 3/4) 15/8, (9) 12/6.5	(675) 31.0; (900) 35.9	150	20	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	160-1,800	Continuous link to MWD	RT through MWD (WDP Option)	N	Y	Y	N	5°	Customizable	Continuous	Y/Y	(6 3/4) 15.83, (9) 10.89		Scintillation	Near bit inclination & azimuth RT-status Gamma Ray shocks & Vibration	Turbine / Infinite (hr)	Y	Y
PowerDrive Orbit Rotary Steerable Tool	4 3/4, 6 3/4, 9	(4 3/4) 13.50, (6 3/4) 13.53, (9) 14.00	(4 3/4) 30/10, (6 3/4) 16/8, (9) 10/5	(475) 11.5; (675) 14.7; (900) 15.0	150 std., 175 opt.	20 std, 35 opt	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	100-2,000	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 5.9, (6 3/4) 6.4, (9) 7.5	+/- 5%	Azimuthal Gamma Ray Image (8 Sector)	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y
PowerDrive Archer Rotary Steerable Tool	4 3/4, 6 3/4	(4 3/4) 14.98, (6 3/4) 16.64	Capability (°/100 ft) : (4 3/4, 6 3/4) 18 Pass Through (°/100 ft): (6 3/4) , >15 Based on fatigue management		150	20	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	Depends Mud Design and Tool Sizes	220-650	Continuous link to MWD	RT through MWD (WDP Option)	N	Y (Flow and RPM)	N	N	5°	Customizable	Continuous	Y/Y	(4 3/4) 5.9, (6 3/4) 6.4	+/- 5%	Azimuthal Gamma Ray Image (8 Sector)	Near bit inclination & azimuth, Shocks & Vibrations, RT-status Azimuthal Gamma Ray Image	Turbine / Infinite (hr)	Y	Y
ShortPulse	4.75	27.3	30/15	4.75x2.25x34.8 -OR- 4.59x2.25x30.3	150 std., 175 opt.	20 std., 25 opt.	20	515 - medium flow (varies with modulator gap)	N/A	N/A	130-360	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 70bps effective)	30-108	Y/Y	8.8	+/-3%	Scintillation	API Average GR	Turbine	Y	Y
ImPulse	4.75	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	20	515 - medium flow (varies with modulator gap)	N/A	N/A	130-360	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 70bps effective)	30-108	Y/Y	13.5	+/-3%	Scintillation	Azimuthal GR	Turbine	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
Omnisphere	4.75	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	20	515 - medium flow (varies with modulator gap)	N/A	N/A	130-360	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 70bps effective)	30-108	Y/Y	13.5	+/-3%	Scintillation	Azimuthal GR	Turbine	Y	Y
DigiScope	4 3/4	29.9	30/15	30.7 (9.4) of 4.75" OD x 2.25" ID API collar	150 std.	25 std., 30 opt.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	N/A	N/A	150-400	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	(0.25bps to 36bps physical & > 140bps effective)	85 sec at 6bps	Y/Y	8.2	+/-5%	Scintillation	Azimuthal GR	Dual Stage Turbine	Y	Y
TeleScope ICE	4 3/4	31.9	30/15	31.9 (9.7) of 4.75" OD x 2.25" ID API collar	200 std.	30 std.	75 (varies with Mud weight and Modulator gap)	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	N/A	150-400	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	9.65	+/-5%	Scintillation	Azimuthal GR	Dual Stage Turbine	Y	Y
TeleScope ICE	6 3/4	31.4	15/8	32.5 (9.9) of 6.75" OD x 2.81" ID API collar	200 std.	30 std.	N/A	115 (varies with Mud weight and Modulator gap)	200 (varies with Mud weight and Modulator gap)	300 (varies with Mud weight and Modulator gap)	275-800	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (0.25bps to 6bps physical)	27-108	Y/Y	9.05	+/-5%	Scintillation	Azimuthal GR	Turbine	Y	Y
TeleScope	6 3/4, 8 1/4, 9, 9 1/2	24.7	(6 3/4) 16/8 (8 1/4) 12/7 (9, 9 1/2) 10/6	(6 3/4) 6.75x2.81x31.5 (8 1/4) 8x2.81x26.2 (9 1/4) 9.25x3x28 (9 1/2) 9.5x3.5x26.2	150 std., 175 opt.	25 std., 30 opt.	N/A	(6 3/4) 56 (8 1/4) 32 (varies with modulator gap)	(6 3/4) 151 (8 1/4, 9 1/2) 84 (varies with modulator gap)	(8 1/4, 9 1/2) 595 (varies with modulator gap)	(6 3/4) 250-800 (8 1/4) 300-1,200 (8 1/4) opt. 800-1,400 (9 1/2) 400-2,000 (9 1/2) opt. 400-1,600	Real-time, pumps on downhole recording	Positive Continuous wave / Wired drill pipe opt.	N	Y	Y	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 120bps effective)	27-80	Y/Y	9.9	2.5 cps	Scintillation	API Average GR	Turbine	Y	Y
SlimPulse	1 3/4 tool OD 3 1/8 to 9 1/2 collars	Collar based probe normally 30	(4 3/4 and smaller) 145/40 (6 3/4) 28/10 (8 1/4) 20/8 (9 1/2) 19/7	(4 3/4) 4.75x2.81x33 (6 3/4) 6.75x2.81x32	150 std., 175 opt.	22	(4 3/4) 68, (6 3/4) 16	(6 3/4) 100, (8 3/4) 18	(6 3/4) 324, (8 3/4, 9 3/4) 58	(8 3/4, 9 3/4) 411	Multiple configurations: 35-1,200	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	Y	Y	N	N	Reg 5 dwn - 8 up Low 2.5 dwn - 3.5 up	Variable (1bps physical to 6bps effective)	104sec to 150sec at 1bps	Y/Y	Variable	+/-6%	Scintillation	API Average GR	Lithium battery	Y	Y
xBolt	4 3/4, 6 3/4	(4 3/4 MP) 23.4 (6 3/4 MP) 23.8 (6 3/4 EM) 23.6 (6 3/4 DT) 26.4	(4 3/4) 34/17, (6 3/4 flex) 25/15, (6 3/4 slick) 15/7.5	(4 3/4) 4.68 x 2.69, (6 3/4 MP) 6.54 x 2.81, (6 3/4 EM) 6.61 x 2.81, (6 3/4 DT) 6.59 x 2.81	Mud Pulse 165 EM and Dual Telemetry 150	20	675 EM: 0 675 MP/DT: 3 475 MP: 32	675 EM: 2 675 MP/DT: 17 475 MP: 200	675 EM: 8 675 MP/DT: 54 475 MP: NA	675 EM: NA 675 MP/DT: NA 475 MP: NA	(4 3/4) max 375, (6 3/4) max 750	MP: Start pumps EM: Start pumps, stop pumps, EM downlink	positive continous wave, electromagnetic telemetry and downhole recording	N	Y	N	Y	Configurable	Configurable (max 4 bps Mud pulse, 16 bps EM)	60	Y/Y	Gamma: 4.5 Directional: 8	Azi: 1 deg Inc: 0.15 deg Tool Face: 1.5 deg GR: 5%	Accelerometer, magnetometer, GR Nal Scintillation	Azimuth, inclination, tool face, azimuthal and total GR, temperature, drilling dynamics	Lithium battery	Y	Y
geoVISION675	6 3/4	10.12	16/8	6.5x2.81x10	150	18	0.9	5.5	18	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	2.5	+/- 7%	Scintillation	API Azimuthal GR GR images	MWD turbine or lithium battery	Y	Y
geoVISION825	8 1/4	12.72	13/7	8x2.81x13.5	150	15	0.15	0.95	3	21.8	0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	2.7	+/- 7%	Scintillation	API Azimuthal GR GR images	MWD turbine or lithium battery	Y	Y
arcVISION312	3.125	23.5	100/30	3x1.75x33	150	20	112	N/A	N/A	N/A	0-160	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	16	+/- 3%	Scintillation	API Average GR	Lithium battery	Y	Y
arcVISION475	4.75	21	30/15	4.75x2.81x22	150	25	3	30	N/A	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	10.1	+/- 3%	Scintillation	API Average GR	MWD turbine or lithium battery	Y	Y
arcVISION675	6 3/4	18	16/8	6.5x2.81x19	150 std. 175 opt.	20 std., 25 and 30 opt.	1	9	20	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.2	+/- 3%	Scintillation	API Average GR	MWD turbine or lithium battery	Y	Y
arcVISION825	8 1/4	18	14/7	8.25x2.81x19.8	150 std. 175 opt.	25 std., 30 opt.	0.12	1.5	2.5	17.8	0-1,950	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.2	+/- 3%	Scintillation	API Average GR	MWD turbine or lithium battery	Y	Y
arcVISION900	9	18	12/4	9x3x20.7	150	25	0.12	1.5	2.5	17.8	0-1,950	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.2	+/- 3%	Scintillation	API Average GR	MWD turbine or lithium battery	Y	Y
EcoScope	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	5	+/- 2%	Scintillation	API Average GR and azi. 16-sector real-time image	TeleScope turbine	Y	Y
NeoScope	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	5	+/- 2%	Scintillation	API Average GR and azi. 16-sector real-time image	TeleScope Turbine	Y	Y
MicroScope	4 3/4 with 5 3/8 slick sleeve	18	30/15	4.75x2.25x18	150	20	9.8	61	198	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	11.1	+/- 5%	Scintillation	API Azimuthal GR image	MWD Turbine	Y	Y
MicroScope HD	4 3/4 with option for 5-3/4", 5-7/8", 6" and 6-3/8" sleeves 6 3/4" with 8 3/8" sleeve	18 (4 3/4), 15.6 (6 3/4)	(4 3/4) 30/15, (6 3/4) 16/8	4.75x2.25x18 (4 3/4), 6.5x2.81x15.6 (6 3/4)	150	(4 3/4) 20, (6 3/4) 20 std. 25 opt.	(4 3/4) 9.8, (6 3/4) 2	(4 3/4) 61, (6 3/4) 11	(4 3/4) 198, (6 3/4) 36	N/A	0-400 (4 3/4) 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	11.1 (4 3/4), 10 (6 3/4)	+/- 5%	Scintillation	API Azimuthal GR image	MWD Turbine	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
PeriScope	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	(4 3/4) 30/15, (6 1/2) 16/8	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17.4 (4 3/4) 3.5 (6 3/4)	+/- 3%	Scintillation	API Azimuthal GR image	MWD turbine	Y	Y	
PeriScope HD Multiple Bed Boundary Detection Service	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	(4 3/4) 30/15, (6 1/2) 16/8	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17.4 (4 3/4) 3.5 (6 3/4)	+/- 3%	Scintillation	API Azimuthal GR image	MWD turbine	Y	Y	
Scientific Drilling International																													
Falcon Mud Pulse MWD w/ Sci-Gamma (Radial)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	20	Collar Limited	BHA Dependent	150C (177C available)	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	50-200 GPM (3-1/8, 3-1/2) 100-400 GPM (4-3/4, 5-1/4) 200-600 GPM (6-1/4, 6-1/2, 6-3/4) 250-1000 GPM (6-3/4, 7, 8) 400-1500 GPM (9.5)	Pumps	Postivie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 2.1API (4.75") and +/- 2.7API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Radial Gamma	Lithium Battery 300+ Hrs	Y	Y	
Falcon EM ElectroMagnetic MWD w/ Sci-Gamma (Radial)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	27	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-200 GPM (3-1/8, 3-1/2) 0-400 GPM (4-3/4, 5-1/4) 0-600 GPM (6-1/4, 6-1/2, 6-3/4) 0-1000 GPM (6-3/4, 7, 8) 0-1500 GPM (9.5)	Continuous EM Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 2.1API (4.75") and +/- 2.7API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Radial Gamma	Lithium Battery 150+ Hrs	Y	Y	
Falcon Mud Pulse MWD w/ Sci-GAIN (Radial Gamma & Inclination Module)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	21	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	50-200 GPM (3-1/8, 3-1/2) 100-400 GPM (4-3/4, 5-1/4) 200-600 GPM (6-1/4, 6-1/2, 6-3/4) 250-1000 GPM (6-3/4, 7, 8) 400-1500 GPM (9.5)	Pumps	Postivie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 3.2API (4.75") and +/- 4.2API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Radial Gamma, Closer to Bit Inclination	Lithium Battery 300+ Hrs	Y	Y	
Falcon EM ElectroMagnetic MWD w/ Sci-GAIN (Radial Gamma & Inclination Module)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	28	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-200 GPM (3-1/8, 3-1/2) 0-400 GPM (4-3/4, 5-1/4) 0-600 GPM (6-1/4, 6-1/2, 6-3/4) 0-1000 GPM (6-3/4, 7, 8) 0-1500 GPM (9.5)	Continuous EM Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 3.2API (4.75") and +/- 4.2API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Radial Gamma, Closer to Bit Inclination	Lithium Battery 150+ Hrs	Y	Y	
Falcon Mud Pulse MWD w/ Sci-Guide (Azimuthal Gamma & Inclination Module)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	21	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	50-200 GPM (3-1/8, 3-1/2) 100-400 GPM (4-3/4, 5-1/4) 00-600 GPM (6-1/4, 6-1/2, 6-3/4) 250-1000 GPM (6-3/4, 7, 8) 400-1500 GPM (9.5)	Pumps	Postivie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000	Tri-axial Accelerometer and Magnetometer, Scintillator, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Hemispherical Gamma, Closer to Bit Inclination	Lithium Battery 300+ Hrs	Y	Y	
Falcon EM ElectroMagnetic MWD w/ Sci-Guide (Azimuthal Gamma & Inclination Module)	3-1/8, 3-1/2, 4-3/4, 5-1/4, 6-1/4, 6-1/2, 6-3/4, 7 , 8, 9-1/2	28	Collar Limited	BHA Dependent	150C	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	0-200 GPM (3-1/8, 3-1/2) 0-400 GPM (4-3/4, 5-1/4) 0-600 GPM (6-1/4, 6-1/2, 6-3/4) 0-1000 GPM (6-3/4, 7, 8) 0-1500 GPM (9.5)	Continuous EM Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 5.1 API (4.75") and +/- 6.6 API (6.75") @60ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics, Hemispherical Gamma, Closer to Bit Inclination	Lithium Battery 150+ Hrs	Y	Y	
Falcon Mud Pulse MWD w/ BitSub (At Bit Azi Gamma & Inclination)	4-3/4, 6-3/4	2.4	Collar Limited	BHA Dependent	150C	15	Application Specific	Application Specific	Application Specific	Application Specific	100-400 GPM (4-3/4) 250-1000 GPM (6-3/4)	Pumps	Postivie Mud Pulse	N	Y	N	N	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1 At Bit - 1.3	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 2.1API (4.75") and +/- 2.4API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator Nal, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics; At Bit Total, 2, 4 Bin Realtime (16 bin Memory) Gamma, At Bit Inclination	Lithium Battery 300+ Hrs	Y	Y	
Falcon EM ElectroMagnetic MWD w/ BitSub (At Bit Azi Gamma & Inclination)	4-3/4, 6-3/4	2.4	Collar Limited	BHA Dependent	150C	15	Application Specific	Application Specific	Application Specific	Application Specific	100-400 GPM (4-3/4) 250-1000 GPM (6-3/4)	Continuous EM Pulse	Electromagnetic	Y	N	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	Directional - 6 Gamma - 1 At Bit - 1.3	ToolFace +/- 0.15 >3° Azimuth +/- 0.25 >3° Inclination +/- 0.15 all Gamma API 0-1000 +/- 2.1API (4.75") and +/- 2.4API (6.75") at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator Nal, additional Tri-axial accelerometer near motor	Azi, Inc, MTF, GTF, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous D&I, Continuous Magnetics; At Bit Total, 2, 4, 8 Bin Realtime (16 bin Memory) Gamma, At Bit Inclination	Lithium Battery 150+ Hrs	Y	Y	
Weatherford																													
MWD UGR (Universal Gamma Ray)	All Sizes	31	(3 1/6) 116/38, (4 3/4) 25/16, (6 1/4) 20/14, (6 3/4) 18/13, (8) 15/10, (9 1/2) 14/7.5	(4 3/4) 4.53 x 2.25, (6 1/4) 6.09 x 2.25), (6 3/4) 6.59 x 2.81, (8) 7.78 x 2.81	150	15	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	N/A, Additional Sonde	(3 1/16, 3 3/8, 3 1/2) 160; (4 3/4, 6 1/4) 350; (6 3/4) 800; (8, 9 1/2) 1,200	Stop pumps, Start pumps, Two way EM Communication	Positive mud pulse, Electromagnetic	Y	N	N	Y	Op. Sel.	Variable				Gamma +/- 5 API	Scintillation	Total AAPI	Lithium battery	Y	Y	

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
HAGR (High-temperature Azimuthal GR)	4-3/4, 6-3/4, 8-1/4, 9-1/2	(4-3/4) 22.47, (6-3/4) 22.63, (8-1/4) 22.96, (9-1/2) 22.93	(4-3/4) 30/15, (6-3/4), 16/8, (8-1/4) 14/7, (9-1/2) 12/6	(4-3/4) 4.75x3.22, (6-3/4) 6.75x4.24, (8-1/4) 8x4.28, (9-1/2) 9.5x5.16	150 std. 180 opt.	(4-3/4, 6-3/4, 8-1/4, 9-1/2) 20 std. 30 opt.	(4-3/4) 12, (6-3/4) 2, (8-1/4, 9-1/2) 1	(4-3/4) 64, (6-3/4) 9, (8-1/4, 9-1/2) 2	(6 3/4) 26, (8 1/4, 9 1/2) 2	(8-1/4, 9-1/2) 33	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4, 9 1/2) 80-1,600	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Variable			(4-3/4) 8.69, (6-3/4) 8.43, (8-1/4) 8.39, (9-1/2) 8.36	Gamma +/- 5 2 API	Geiger Mueller	API GR: Total, up/ down, quadrant, and 8-bin azimuthal image	Lithium battery, up to 1,400 hrs.; and or generator	Y	Y
HeatWave GR	4-3/4, 6-3/4	(4-3/4) 22.47, (6-3/4) 22.63	(4-3/4) 30/15, (6-3/4), 16/8	(4-3/4) 4.75x3.22, (6-3/4) 6.75x4.24	200°C	(4-3/4, 6-3/4, 20 std. 30 opt	(4-3/4) 12, (6-3/4) 2	(4-3/4) 64, (6-3/4) 9	(6 3/4) 26		(4 3/4) 80-350; (6 3/4) 80-700	Pumps on	Positive mud pulse	N	N	N	N	Op. Sel.	Variable			(4-3/4) 8.69, (6-3/4) 8.43	Gamma +/- 5 2 API	Geiger Mueller	API GR: Total	Lithium battery, up to 940 hrs.	Y	Y
SpectralWave (Spectral Azimuthal GR)	4-3/4, 6-3/4	(4-3/4) 12.83, (6 3/4) 13.08	(4 3/4) 30/15, (6 3/4) 16/8	(4-3/4) 4.75x3.125 (6-3/4) 6.75x4.44	150 Std. 165 opt.	20	(4-3/4) 19 (6-3/4) 8	(4-3/4) 19 (6-3/4) 2	(6-3/4) 2		(4 3/4) 80-350; (6 3/4) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	Op. Sel.	Variable			(4-3/4) 3.5, (6 3/4) 3.1	Gamma +/- 5 2 API	Scintillation	Spectral GR (K,U,Th); API GR: Total, up/ down, quadrant, and 16-bin image	Lithium battery, up to 1,400 hrs.; and or generator	Y	Y
At-Bit Measurement System	4-3/4, 6-3/4	(4 3/4) 2.83 ft., (6 3/4) 3.01 ft.	(4 3/4) 30/15 (6 3/4) 16/8		(4 3/4, 6 3/4) 150	(4 3/4) 10 (6 3/4) 10	(4 3/4) 12, (6 3/4) 2	(4 3/4) 64, (6 3/4) 9	(6 3/4) 26		(4 3/4) 80-350; (6 3/4) 80-700	N/A	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	N	N/A	Variable	inc 16	sliding/rotating - inc only	Inc .7 Gamma 1.5	Inc >20°, +/- .25° Gamma 5%@100 API	Accelerometer Scintillation	1- axis inc API GR: Realtime - Total, up/ down API GR Recorded - Total, Recorded up/ down/left/right	Lithium battery - 240 std 800 opt	Y	Y
Resistivity																												
APS Technology (Rental Division)																												
APS SureShot Gamma + WPR 3.5	3 1/2	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + WPR 3.75	3 3/4	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + WPR 4.75	4 3/4	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
APS SureShot Gamma + WPR 6.75	6 3/4	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill™ drilling optimization system.	Y
APS SureShot Gamma + WPR 8.0	8	59 (2 pcs.)*	Collar-limited	Collar-defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	(3 1/2) 150 max. (3 3/4) 200 max. (4 3/4) 350 max. (6 3/4) 700 max. (8) 1,200 max.	Flow-on and timer	MPT positive pulse and EM	Y (Sondes; 4 3/4+)	Y	N	Y	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Dir: 16.0 Gamma: 11.6 Prop. Resistivity: 5.3	Incl: +/-0.1°Azi: +/-1.0° (Incl. >10°; Dip <70°)GTF: +/-1.0° (Incl. >10°)MTF: +/-2.25° (Dip <70°)Gamma: 0 - 800 API +/-5%Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	Tri-axial fluxgate magnetometer with USGS-/NIST-traceable calibration; tri-axial quartz accelerometer Gamma: Nal scintillation with PMT	Azi., Incl., MTF, GTF, temp, Gamma. Optional Pressure; Lateral Vib., Axial Vib., Torsional Vib.; RPM; WOB/TOB/ BOB.	Lithium battery Optional turbine-alternator	Y Real time shock and vibration data can also be fed to SureDrill drilling optimization system.	Y
Baker Hughes																												
UltraSlim MPR resistivity	2-3/8, 3-1/8	9.6 (2-3/8) 17.0 (3-1/8)	BHA Dependent	BHA Dependent	150	20	Application Specific	Application Specific	N/A	N/A	System dependent	Stop/start pumps Stop rotary Downlink	Positive mud pulse	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	3.9 (2-3/8) 9.3 (3-1/8)	2 MHz phase diff. +/-0.5 mmho/m 400 kHz phase diff. +/-1 mmho/m 2 MHz Atten. +/- 1 mmho/m 400 kHz Atten. +/- 5 mmho/m	Transmitter/receiver antennas	2 MHz resistivity 400 kHz resistivity	Electric line, no limit (2-2/8, 3-1/8) Lithium battery, 140 hr (3-1/8 option)	Y	Y
OnTrak integrated formation evaluation	4-3/4, 6-3/4, 8-1/4, 9-1/2	34.3 (4-3/4) 27.7 (6-3/4) 30.7 (8-1/4) 30.2 (9-1/2)	BHA Dependent	BHA Dependent	150, 175 (optional 4-3/4, 6-3/4, and 9-1/2)	25 (4-3/4, 6-3/4, 8-1/4, 9-1/2) 30 (optional 4-3/4 and 6-3/4)	Application Specific	Application Specific	Application Specific	Application Specific	125-350 (4-3/4) 200-900 (6-3/4) 395-1,290 (8-1/4) 430-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Programmable	Continuous	Y/Y	9.7 (4-3/4) 6.2 (6-3/4) 6.7 (8-1/4) 5.5 (9-1/2)	2 MHz phase diff. +/-0.4 mmho/m 400 kHz phase diff. +/-0.8 mmho/m 2 MHz atten. +/- 0.85 mho/m 400kHz atten. +/- 4 mmho/m	Transmitter/receiver antennas	2 MHz resistivity 400 kHz resistivity	Turbine generator/ no limit	Y	Y
AziTrak deep azimuthal resistivity	4-3/4, 6-3/4	23.5 (4-3/4) 22.1 (6-3/4)	BHA Dependent	BHA Dependent	150	20, 25 (option), 30 (option)	Application Specific	Application Specific	Application Specific	N/A	125-350 (4-3/4) 200-900 (6-3/4)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Op. Sel.	Continuous	Y/Y	4.6 (4-3/4) 5.1 (6-3/4)	2 MHz phase diff. +/-0.4 mmho/m 400 kHz phase diff. +/-0.8 mmho/m 2 MHz Atten. +/- 0.85 mmho/m 400kHz Atten. +/- 4 mmho/m	Transmitter/receiver antennas	2 MHz azimuthal resistivity 400 kHz azimuthal resistivity	Turbine generator/ no limit	Y	Y
StarTrak high-definition electrical imaging	4-3/4, 6-3/4	9.8 (4-3/4), 8.3 (6-3/4)	BHA Dependent	BHA Dependent	150	25	Application Specific	Application Specific	Application Specific	N/A	Function of Ontak system	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	5.6 (4-3/4) 3.7 (6-3/4)		Button electrode	High resolution azimuthal resistivity	Turbine generator/ no limit	Y	Y
ZoneTrak R at-bit resistivity	6-3/4, 9-1/2	6.3 or 6.8 (6-3/4) 5.7 or 6.2 (9-1/2)	BHA Dependent	BHA Dependent	150	25, 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	200-900 (6-3/4) 420-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	Application specific and a function of mud resistivity, formation resistivity contrast and hardware configuration	+/- 5%	Transmitter/receiver antennas	Apparent Resistivity	Turbine generator/ no limit	Y	Y
Centerfire Propagation Resistivity	4-3/4, 6.91, 8-1/4	14.5 (4-3/4) 14.5 (6.91) 15.17 (8-1/4)	25/ 12 (4-3/4) 17/ 8 (6.91) 14/ 7 (8-1/4)	5.0 x 2.81 (4-3/4) 6.58 x 2.81 (6.91) 8.25 x 2.81 (8-1/4)	175	20	As Tensor MWD	As Tensor MWD	As Tensor MWD	As Tensor MWD	100-350 (4-3/4) 300-750 (6.91) 450-1,200 (8-1/4)	Flow	Positive Pulse	MWD Only	Y	N	N	N/A	Op. Sel.	Op. Sel.	Y/Y	6.1 (4-3/4) 6.1 (6.91) 6.7 (8-1/4)	2 MHz phase diff. +/-1.0 mmho/m 400 kHz phase diff. +/-6.0 mmho/m 2 MHz Atten. +/-6 mmho/m 400kHz Atten. +/- 15 mmho/m	Transmitter/receiver antennas	2 MHz resistivity 400 kHz resistivity	Battery, upto 250 hrs	Y	Y

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
Bench Tree																													
Bench Tree HPR-M/LWD	4-3/4, 6-1/2, 8	475: 38.3 650:39.5 800:39.8	475:14, 28 650:12, 24 800:10, 20	475: 4.82" X 2.81" 650: 6.46" X 2.81" 800: 8.02" X 2.81"	175	15 or 20	application dependent	application dependent	application dependent	application dependent	70-750	Pumps, Rotary, Timer	mud pulse or optional 3rd party EM	N	Y	N	3rd Party Option	Configurable Threshold	Config Dependent	Config Dependent	Real Time Inc (Rinc) & Azm (RAzm) Y/Y	Gam:8.4 Res:18.5 Dir:30	RPhase: ±0.25mmhos RAttenuation: ±0.50 mmhos Inc:±0.1° Az:±0.2° G:±3.0mG H:±0.015uT TF:±1.0° Temp:±1°C RPM:±12 RInc@>20°: ±.35° Gamma:±5%	Compensated 2MHz & 400kHz Propagation @ 28in & 48in, 3-axis QFlex Accels, Proprietary Fluxgate Magnetometer, Si Sensors, NaI Scintillator	Resistivity, Inc, Az, TF, H(x,y,z), G(x,y,z), Temp, RPM, axial S&V, lateral S&V, Gamma Optional: PWD	1 ea - 2 ea 8 cell Li Batt Packs, 300 hrs/pack	Y	Y	
Bench Tree HPR-650 HPR-800	6-1/2, 8	27	650:12, 24 800:10, 20	650: 6.46" X 2.81" 800: 8.02" X 2.81"	175	15 or 20	5	25	85	-	0-750	Timer or via client MWD	N/A or via client MWD	N	N/A or via client MWD	N	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	12 or 17	RPhase: ±0.25mmhos RAttenuation: ±0.50 mmhos	Compensated 2MHz & 400kHz Propagation @ 28in & 48in	Resistivity (Phase & Attenuation), Temp Optional: Integration w/ client MWD	8 cell Li Batt Pack, 640 hrs/pack, memory mode	Optional: via client MWD	Y	
Bench Tree HPR-475	4-3/4	26	14, 28	4.82" X 2.81"	175	15 or 20	22	135	-	-	0-300	Timer or via client MWD	N/A or via client MWD	N	N/A or via client MWD	N	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	N/A or via client MWD	11 or 16.5	RPhase: ±0.25mmhos RAttenuation: ±0.50 mmhos	Compensated 2MHz & 400kHz Propagation @ 28in & 48in	Resistivity (Phase & Attenuation), Temp Optional: Integration w/ client MWD	8 cell Li Batt Pack, 640 hrs/pack, memory mode	Optional: via client MWD	Y	
CBG Corp.																													
GRT 4.75	4.75	11.34	20 sliding / 15 rotate		160	20					330		Mud Pulse						4			2.3	+/-10%	Lateralog	Ohm-Meter		Y	Y	
GRT 6.50	6.50	11.54	15 sliding / 10 rotate		160	20					870		Mud Pulse						4			2.3	+/-10%	Lateralog	Ohm-Meter		Y	Y	
DrilTech LLC																													
DrilTech WPR (Wave Propogation Resistivity)	4.75, 6.5, 8	18 - 21	(4.75) 28 /14; (6.5) 24 / 12; (8) 20 / 10	4.75: 4.82" X2.81" 6.5: 6.46" X 2.81" 8: 8.02" X 2.81"	165	20	(4.75) 5, (6.5 / 8.0) 22	(4.75) 15, (6.5 / 8.0) 85	(4.75), N/A (6.5 / 8.0) 135	Not Specified	150-800	Pumps "On" or Rotational Logic	Positive pulse	No	Y	N	N	Op. Sel. 2 Deg. Min.	15-30	60 - 90	Y/N	12/16	Phase: ±0.25 m-mhos Attenuation: ±0.5 m-mhos	28" AND 48" Spacing	2 MHz, 400 KHz phase shift (0.1 -4,000 ohm-m), attenuation (0.1 - 700 ohm-m);	Battery, 200-400	Y	Y	
National Oilwell Varco																													
SPR	4.75	14.7	30/15	Collar Dependent	150	20	8	40			150 - 400	Pump cycle	Mud Pulse	N	Y	N	N	N	4.0 bps	Configurable	Y/Y	5.8	Attenuation 400KHz +/- 2% @ 22in TX-RX Spacing & +/- 8 mS/m @ 40in TX-RX Spacing, Attenuation 2 MHz +/- 2% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing. Phase Shift 400KHz +/- 1% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing, Phase shift 2 MHz +/- 1% @ 22in TX-RX spacing & +/- 0.2 mS/m @ 40in TX-RX spacing.	Compensated 400KHz and 2 MHz propagation at 22in and 40in TX-RX spacing	Resistivity Attenuation and Phase shift	Lithium Batteries, 160 hours	Y	Y	
SPR	6.75	13.7	16/8	Collar Dependent	150	20	8	38	105		300 - 750	Pump cycle	Mud Pulse	N	Y	N	N	N	4.0 bps	Configurable	Y/Y	6	Attenuation 400KHz +/- 2% @ 22in TX-RX Spacing & +/- 8 mS/m @ 40in TX-RX Spacing, Attenuation 2 MHz +/- 2% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing. Phase Shift 400KHz +/- 1% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing, Phase shift 2 MHz +/- 1% @ 22in TX-RX spacing & +/- 0.2 mS/m @ 40in TX-RX spacing.	Compensated 400KHz and 2 MHz propagation at 22in and 40in TX-RX spacing	Resistivity Attenuation and Phase shift	Lithium Batteries, 160 hours	Y	Y	
SPR	8.25	13.9	15/8	Collar Dependent	150	20	1	5	14	80	400 - 1,200	Pump cycle	Mud Pulse	N	Y	N	N	N	4.0 bps	Configurable	Y/Y	6	Attenuation 400KHz +/- 2% @ 22in TX-RX Spacing & +/- 8 mS/m @ 40in TX-RX Spacing, Attenuation 2 MHz +/- 2% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing. Phase Shift 400KHz +/- 1% @ 22in TX-RX spacing & +/- 1 mS/m @ 40in TX-RX spacing, Phase shift 2 MHz +/- 1% @ 22in TX-RX spacing & +/- 0.2 mS/m @ 40in TX-RX spacing.	Compensated 400KHz and 2 MHz propagation at 22in and 40in TX-RX spacing	Resistivity Attenuation and Phase shift	Lithium Batteries, 160 hours	Y	Y	
Oliden Technology, LLC																													
DartFusion	4.75 / 6.75	16 / 16	30, 15 / 16, 8	4.75x2.25x16.1, 6.50x2.81x15.4,	150	20	<30	<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	7.6ft / 7.6ft	2 MHz PS (0.1-60 Ohm.m) +/- 2% accuracy. 2 MHz PS (60-3000 Ohm.m) +/- 0.3mS/m accuracy. 500 KHz PS (0.1-10 Ohm.m) +/- 2% accuracy. 500 KHz PS (10-100 Ohm.m) +/- 2mS/m accuracy.	Antenna Spacings @ 20in, 28in, 36in, 44in, 52in spacings.	Compensated 2MHz and 500KHz Propagation Phase Shift and Attenuation Resistivities.	lithium battery, optional turbine-alternator	Y	Y	
GeoFusion	4.75 / 6.75	19.3/15	30, 15 / 16, 8	4.75x2.25x19.8, 6.50x2.81x15.9	150 / 150 std (175 opt)	20 / 20	<30	<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Bit Resistivity: At Bit Azimuthal Resistivity: 7.2ft / 6ft	Azimuthal Resistivity: (0.1-1,000 Ohm.m) +/- 5% accuracy. (1,000-2,000 Ohm.m) +/- 10% accuracy. (2000-20,000 Ohm.m) +/- 20% accuracy. Bit Resistivity: Apparent Resistivity (0.1 to 2,000 Ohm.m)	Laterolog Resistivity: Quadrant Electrodes Bit Resistivity: Transmitter / Receiver Toroids	Laterolog Resistivity Array: Azimuthal Laterolog Resistivity with 3 depths of investigation. (up to 20,000 ohm.m range). Provides Azimuthal resistivity even while sliding. Bit Resistivity: Laterolog Bit Resistivity measurement up to 2,000 Ohm.m range.	lithium battery, optional turbine-alternator	Y	Y	
Schlumberger																													
ImPulse	4 3/4	32	30/15	4.75x2.25x38.5	150 std., 175 opt.	20 std., 25 opt.	N/A	125	N/A	N/A	130-360	Real-time, pumps on downhole recording	Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	6.1	+/- 2% for PS res< 60 ohm-m, +/- 3% for ATT res<25 ohm-m	10, 16, 22, 28, 34 in. spacing	2 MHz phase shift, attenuation resistivity	Turbine	Y	Y	
geoVISION675	6 3/4	10.12	16/8	6.5x2.81x10	150	18	0.9	5.5	18	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Ring 3.5, Button D - 4.2, Button M - 4.8, Button S - 5.2	+/- 5% 0.1<=res< 250 ohm-m, +/- 10% 250<=res< 500 ohm-m, +/- 20% 500<=res< 5,000 ohm-m	Ring, bit, and 3 buttons	Azi. laterolog resistivity 56 sector real-time images	MWD turbine or lithium battery	Y	Y	

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
geoVISION825	8 1/4	12.72	13/7	8x2.81x13.5	150	15	0.15	0.95	3	21.8	0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Ring 3.7, Button D - 4.2, Button M - 4.8, Button S - 5.2	+/-5% 0.1<=res< 250 ohm-m, +/-10% 250<=res< 500 ohm-m, +/- 20% 500<=res< 5,000 ohm-m	Ring, bit, and 3 buttons	Azl. laterolog resistivity 56 sector real-time images	MWD turbine or lithium battery	Y	Y
arcVISION312	3 1/8	23.5	100/30	3x1.75x33	150	20	112	N/A	N/A	N/A	0-160	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	4.4	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	10, 16, 22, 28, 24 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	Lithium battery	Y	Y
arcVISION475	4 3/4	21	30/15	4.75x2.81x22	150	25	3	30	N/A	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	5.1	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	10, 16, 22, 28, 34 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	Lithium battery	Y	Y
arcVISION675	6 3/4	18	16/8	6.5x2.81x19	150 std. 175 opt.	20 std., 25 and 30 opt.	1	9	20	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	6.9	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	MWD turbine or lithium battery	Y	Y
arcVISION825	8 1/4	18	14/7	8.25x2.81x19.8	150 std. 175 opt.	25 std, 30 opt.	0.12	1.5	2.5	17.8	0-1,950	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	6.9	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	MWD turbine or lithium battery	Y	Y
arcVISION900	9	18	12/4	9x3x20.7	150	25	0.12	1.5	2.5	17.8	0-1,950	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	6.9	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	MWD turbine or lithium battery	Y	Y
PeriScope	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	30/15 (4 3/4), 16/8 (6 3/4)	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	7.7 (4 3/4) 9.1 (6 3/4)	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	MWD turbine	Y	Y
PeriScope HD Multiple Bed Boundary Detection Service	4 3/4, 6 3/4	18.3 (6 3/4), 23.5 (4 3/4)	30/15 (4 3/4), 16/8 (6 3/4)	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	7.7 (4 3/4) 9.1 (6 3/4)	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	MWD turbine	Y	Y
EcoScope	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	15	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS res < 3,000 ohm-m, +/-3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	TeleScope Turbine	Y	Y
NeoScope	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	15	+/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS res < 3,000 ohm-m, +/-3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT res < 50 ohm-m	16, 22, 28, 34, 40 in. spacing	2 MHz and 400 kHz phase shift, attenuation resistivity	TeleScope Turbine	Y	Y
MicroScope	4 3/4 with 5 3/8 slick sleeve	18	30/15	4.75x2.25x18	150	20	9.8	61	198	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	6.1	+/- 5%	Toroidal, Button and bit	Azimuthal Laterolog Reistivity, 56 sector standard resolution images	MWD Turbine	Y	Y
MicroScope HD	4 3/4 with option for 5-3/4", 5-7/8", 6" and 6-3/8"sleeves 6 3/4" with 8 3/8" sleeve	18 (4 3/4), 15.6 (6 3/4)	(4 3/4) 30/15, (6 3/4) 16/8	4.75x2.25x18 (4 3/4), 6.5x2.81x15.6 (6 3/4)	150	(4 3/4) 20, (6 3/4) 20 std. 25 opt.	(4 3/4) 9.8, (6 3/4) 2	(4 3/4) 61, (6 3/4) 11	(4 3/4) 198, (6 3/4) 36	N/A	0-400 (4 3/4) 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	6.1 (4 3/4), 5.5 (6 3/4)	+/- 5%	Toroidal, Button and bit	Azimuthal Laterolog Resistivity, 56 sector standard resolution images and 160 sector high resolution image	MWD Turbine	Y	Y
Weatherford																												
Multi-Frequency Resistivity (MFR)	4-3/4, 6-3/4, 8-1/4, 9-1/2	(4 3/4) 28.0, (6-3/4) 28.1', (8-1/4, 9-1/2) 28.3	(4-3/4) 30/15, (6-3/4), 16/8, (8-1/4) 14/7, (9-1/2) 12/6	(4-3/4) 4.75x2.29; (6-3/4) 6.75x3.06; (8-1/4) 8.25x5.28, (9-1/2) 9.5x6.08	150°C	(4.75, 6.75) 20 std. 30 opt. (8.25, 9.5) 20 std, 25 opt.	(4-3/4) 19 (6-3/4) 2 (8-1/4, 9-1/2) 2	(4-3/4) 105 (6-3/4) 11 (8-1/4, 9-1/2) 2	(6-3/4) 32 (8-1/4, 9-1/2) 6	(8-1/4, 9-1/2) 45	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4, 9 1/2) 80-1,600	Stop pumps, start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	(4-3/4) 13.15 (6-3/4) 13.19 (8-1/4, 9-1/2) 13.17	Phase +/- .25 mmho Attenuation +/- .5 mmho	Compensated 2 MHz & 400 kHz; 20", 30", & 46" xmr. spacing	2 MHz and 400 kHz phase and atten. resistivity	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
HeatWave Resistivity	4-3/4, 6-3/4	(4 3/4) 28.0, (6-3/4) 28.1'	(4-3/4) 30/15, (6-3/4), 16/8	(4-3/4) 4.75x2.29; (6-3/4) 6.75x3.06	200°C	(4.75, 6.75) 20 std. 30 opt.	(4-3/4) 19 (6-3/4) 2	(4-3/4) 105 (6-3/4) 11	(6-3/4) 32		(4 3/4) 80-350; (6 3/4) 80-700	Stop pumps, start pumps	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	(4-3/4) 13.15 (6-3/4) 13.19	Phase +/- .25 mmho Attenuation +/- .5 mmho	Compensated 2 MHz & 400 kHz; 20", 30", & 46" xmr. spacing	2 MHz and 400 kHz phase and atten. resistivity	Lithium battery, up to 330 hrs.;	Y	Y
(GuideWave Azimuthal Resistivity Tool)	4-3/4, 6-3/4	(4-3/4) 34.7, (6-3/4) 35.3	(4-3/4) 30/15, (6-3/4), 16/8	(4-3/4) 4.75x2.54, (6-3/4) 6.75x3.40	150°C	20 Std., 30 opt.	(4-3/4) 19, (6-3/4) 2	(4-3/4) 105, (6-3/4) 11	(6-3/4) 32	n/a	(4 3/4) 80-350; (6 3/4) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	(4-3/4) 17.2, (6-3/4) 17.7	Phase +/- .25 mmho Attenuation +/- .5 mmho	Compensated 2 MHz, 400 & 100 kHz radial, axial, and tilted antennas	Compensated 2 MHz, 400 & 100 kHz phase and atten. Resistivity of up, down, total, and image; bed azimuth	Lithium battery, up to 264 hrs.; and or generator	Y	Y
Porosity																												
APS Technology (Rental Division)																												
SureLog FWS (Full Wave Sonic) 4.75	4 3/4	18	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	350 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Sonic: 10.6	+/- 1 microsecond/ft	Piezoelectric; double-redundant transmitters; receivers at 6.0, 6.5, 7.0, 7.5, 8.0 & 8.5 ft	DTC Slowness, DTS Slowness	Turbine Alternator + Battery	Y	Y
SureLog FWS (Full Wave Sonic) 6.75	6 3/4	18	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	700 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Sonic: 10.6	+/- 1 microsecond/ft	Piezoelectric; double-redundant transmitters; receivers at 6.0, 6.5, 7.0, 7.5, 8.0 & 8.5 ft	DTC Slowness, DTS Slowness	Turbine Alternator + Battery	Y	Y
SureLog FWS (Full Wave Sonic) 8.0	8	18	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent				1,000 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Sonic: 10.6	+/- 1 microsecond/ft	Piezoelectric; double-redundant transmitters; receivers at 6.0, 6.5, 7.0, 7.5, 8.0 & 8.5 ft	DTC Slowness, DTS Slowness	Turbine Alternator + Battery	Y	Y

Offshore

2020 MWD/LWD Services Directory

Service line (s)	Tool OD, in.	Length, ft	Max. DLS, %/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. o temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
SureLog iPCD (Integrated Porosity, Caliper & Density) 4.75	4 3/4	17.5	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent				350 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Porosity: 15	+/- 0.5 p.u. < 10 p.u.; +/-5% 10 - 50 p.u.	Li6l Crystal w/PMT	Neutron porosity	Turbine Alternator + Battery	Y	Y
SureLog iPCD (Integrated Porosity, Caliper & Density) 6.75	6 3/4	19	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent				650 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Porosity: 15.3	+/- 0.5 p.u. < 10 p.u.; +/-5% 10 - 50 p.u. +/- 0.2 in. caliper +/- 0.1 in. standoff	Li6l Crystal w/PMT; piezoelectric transceiver	Neutron porosity; acoustic caliper & standoff	Turbine Alternator + Battery	Y	Y
SureLog (Integrated Porosity, Caliper & Density) iPCD 8	8	19	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent				1,500 max.	Flow-on and timer	MPT positive pulse and EM (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Porosity: 15.5	+/- 0.5 p.u. < 10 p.u.; +/-5% 10 - 50 p.u. +/- 0.2 in. caliper +/- 0.1 in. standoff	Li6l Crystal w/PMT; piezoelectric transceiver	Neutron porosity; acoustic caliper & standoff	Turbine Alternator + Battery	Y	Y
Baker Hughes																												
LithoTrak bulk density & neutron porosity	4-3/4, 6-3/4, 8-1/4	14.4 (4-3/4) 17.6 (6-3/4) 18.2 (8-1/4)	BHA Dependent	BHA Dependent	150 up to 165 (6-3/4)	20, 25 (4-3/4 option) 30 (6-3/4 and 8-1/4 option)	Application Specific				0-320 (4-3/4) 0-900 (6-3/4) 0-1,300 (8-1/4)	Stop/start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Configuration	Continuous	Y/Y	Neutron: 11.25 (4-3/4) 13.5 (6-3/4) 13.54 (6-1/4) 13.4 (8-1/4S) ; Density: 2.46 ft (4 3/4), 4.60ft (6 3/4), 5.10ft (8 1/4) ; Caliper: 5.95ft (8 1/4), 6.70ft (6 3/4), 4.85ft (4 3/4).	0.5 pu below 10 pu 5% of reading for 10-50 pu	Li6 scintillator	Neutron porosity, 0-100 pu, near and far counts	Turbine generator, no limit; battery option.	Y	Y
SoundTrak acoustic porosity	6-3/4, 8-1/4, 9-1/2	32.8 (6-3/4) 32.8 (8-1/4) 32.8 (9-1/2)	BHA Dependent	BHA Dependent	150	25, 30 (option)	Application Specific				200-900 (6-3/4) 100-1,300 (8-1/4) 420-1,600 (9-1/2)	Stop/start pumps Downlink	Positive mud pulse, positive continuous wave	N	N	N	N	N/A	Op. Sel.	Continuous	N/A	(6-3/4, 8 1/4 9-1/2) 9.3	+/- 2 % DeltaT compressional, +/- 5% DeltaT shear	Piezoelectric	Compressional and shear acoustic slowness	Turbine generator, no limit; battery option.	Y	Y
MagTrak magnetic resonance porosity	4-3/4, 6-3/4, 8-1/4	27.7 (4-3/4) 29.9 (6-3/4) 24.3 (8-1/4)	BHA Dependent	BHA Dependent	150	25, 30 (option 8-1/4)	Application Specific	Application Specific	Application Specific	N/A	145-410 (4-3/4) 264-753 (6-3/4) 423-1162 (8-1/4)	Stop/start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	4.28 (4-3/4) 4.28 (6-3/4) 5.22 (8-1/4)	+/- 1 p.u.	Antenna	Total porosity, CBW, BW, BVI, BVM, PHE, SHC index, Permeability index, T2 distribution	Turbine generator/ no limit	Y	Y
Oliden Technology, LLC																												
LithoFusion Density and Porosity LWD Tool	4.75 /6.75 with screw on stabilizer options of: 5 3/4", 5 7/8", 6", 6 1/8", 6 3/8" for 475 and 8 1/4", 8 3/8" for 675	16 /16	30, 15 16, 8		150 operating (175 survival)	25					400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Neutron Porosity: 11.3 ft Acoustic Standoff: 10.25 ft	Neutron Porosity: +/- 0.5 p.u. (<10 p.u.), +/- 5% (10 - 40 p.u.) Acoustic Standoff: +/- 0.1 in. from 0.375 in. to 2 in.	Helim 3	Neutron Porosity, Averaged 4 and 16 sector Acoustic Caliper Acoustic Caliper Image	lithium battery, optional turbine-alternator	Y	Y
Schlumberger																												
SonicScope475	4 3/4	30	30/15	33.7	150 std. 175 opt.	25	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 7,500				0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	15.76	+/- 2us/ft in range 40 to DeltaT mud for compressional. +/-1% in range from 60 to 300 us/ft. +/-2% in range from 300 to 600 us/ft	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Quadropole Shear 3) Stoneley acquisition 4) Real Time and memory Top of Cement	MWD turbine or lithium battery	Y	Y
SonicScope675	6 3/4	32	16/8	29.4	150 std.	30	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 42,500				0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	18.04	+/- 2us/ft in range 40 to DeltaT mud for compressional. +/-1% in range from 60 to 300 us/ft. +/-2% in range from 300 to 600 us/ft	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Quadropole Shear 3) Stoneley acquisition 4) Real Time and memory Top of Cement	MWD turbine or lithium battery	Y	Y
SonicScope825	8 1/4	32	14/7	38	150 std.	30	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 130,500				0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	18.65	+/- 2us/ft in range 40 to DeltaT mud for compressional. +/-1% in range from 60 to 300 us/ft. +/-2% in range from 300 to 600 us/ft	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Quadropole Shear 3) Stoneley acquisition 4) Real Time and memory Top of Cement	MWD turbine or lithium battery	Y	Y
SonicScope900	9	32	12/6	35	150 std.	25	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 130,500				0-1,600	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	18.65	+/- 2us/ft in range 40 to DeltaT mud for compressional. +/-1% in range from 60 to 300 us/ft. +/-2% in range from 300 to 600 us/ft	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Quadropole Shear 3) Stoneley acquisition 4) Real Time and memory Top of Cement	MWD turbine or lithium battery	Y	Y
sonicVISION675	6 3/4	23.8	16/8	35	150 std. 175 opt.	25 std. 30 opt.	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 256,000				0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	13.5	+/- 2us/ft in range 40 to DeltaT mud	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Top of Cement	MWD turbine or lithium battery	Y	Y
sonicVISION825	8 1/4	22.6	14/6	32	150 std. 175 opt.	25 std. 30 opt.	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 750,000				0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	13.5	+/- 2us/ft in range 40 to DeltaT mud	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Top of Cement	MWD turbine or lithium battery	Y	Y
sonicVISION900	9	22.6	12/4	37	150	25	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 750,000				0-1,400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	13.5	+/- 2us/ft in range 40 to DeltaT mud	Sonic	1) Real Time and Memory Monopole Compressional and Shear 2) Memory Top of Cement	MWD turbine or lithium battery	Y	Y

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adnVISION475	4 3/4 with Slick, 5 7/8, or 6 1/4 Stabilizer options	23.6	30/15	4.75x2.25x24.7	150 std., 175 opt.	20	35	220	N/A	N/A	0-400	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	8.7	+/- 0.5 pu < 10 pu +/- 5% 10-50 pu	Helium 3	Neutron porosity	MWD turbine or lithium battery	Y	Y
adnVISION675	6 3/4 with Slick, 8 3/8, or 9 3/8 Stabilizer Options	20.5	16/8	6.5x2.25x27.4	150 std. 175 opt.	20 std., 30 opt.	1	4	10	N/A	0-800	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	13.7	+/- 0.5 pu < 10 pu +/- 5% 10-50 pu	Helium 3	Neutron porosity, ultrasonic caliper	MWD turbine or lithium battery	Y	Y
adnVISION825	8 1/4 with Slick or 10 3/8 Stabilizer Options	22.3	14/7	8.25x2.81x26.1	150	20 std., 30 opt.	1	2	6	41	0-1,600	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	13.7	+/- 0.5 pu < 10 pu X296 +/- 5% 10-50 pu	Helium 3	Neutron porosity, ultrasonic caliper	MWD turbine or lithium battery	Y	Y
adnVISION825s	8 1/4 with 12 stabilizer	31	12/4	8.0x2.81x21.0	150	20 std., 25 opt.	1	7	22	90	0-1,000	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	17.7	+/- 0.5 pu < 10 pu +/- 5% 10-50 pu	Helium 3	Neutron porosity, ultrasonic caliper	MWD turbine or lithium battery	Y	Y
proVISION Plus (Magnetic Resonance while Drilling) *3 axis motion detection *Shocks *Stick Slip *Downhole flow/washout	6 3/4 with Slick, 7 3/4, 8 1/4, or 9 5/8 Stabilizer Options	37.3	16/8	6.5x2.81x36.5	150	20 std, 22 opt.	4	25	81	N/A	300-800	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	3	+/- 1 pu or +/- 5% whichever is greater	Gradient field antenna	Total porosity, BFV, FFV, RT T2 distribution	Tool Turbine	Y	Y
proVISION Plus (Magnetic Resonance while Drilling) *3 axis motion detection *Shocks *Stick Slip *Downhole flow/washout	8 1/4 slick, 10 1/4, 10 3/8, 12 1/8" Stabilizer Options	38.47	14/7		150	20 std, 22 opt.	1	6.35	20.6	146	300-1,200	Real-time, pumps on dowhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	3	+/- 1 pu or +/- 5% whichever is greater	Gradient field antenna	Total porosity, BFV, FFV, RT T2 distribution	Tool Turbine	Y	Y
EcoScope	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on dowhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	+/- 0.5 pu < 10 pu +/- 5% 10-50 pu	Helium 3 (Source is non-chemical)	Neutron porosity (BPHI & TNPH), Capture Spectroscopy, Sigma (Source is non-chemical; i.e. Pulsed-Neutron-Generator)	TeleScope Turbine	Y	Y
NeoScope	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on dowhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	+/- 0.5 pu < 10 pu +/- 5% 10-50 pu	Helium 3 (Source is non-chemical)	Neutron porosity (BPHI & TNPH), Neutron-Gamma-Density, Capture Spectroscopy, Sigma (Source is non-chemical; i.e. Pulsed-Neutron-Generator)	TeleScope Turbine	Y	Y
Weatherford																												
AZD (Azimuthal Density Sensor)	4-3/4, 6-3/4, 8-1/4	(4-3/4) 23.2, (6-3/4) 26.8, (8-1/4) 27.25 (includes TNP)	(4-3/4) 30/15 (6-3/4) 16/8, (8-1/4) 14/7	(4-3/4) 4.75x 3.18 (6-3/4) 6.75x4.39 (8-1/4) 8.25x4.28	150 Std. 165 Opt.	(4-3/4 & 6-3/4) 20 std., 30 opt., (8-1/4) 20 std., 25 opt.	(4 3/4) 16, (6 3/4) 2, (8 1/4) 2	(4 3/4) 87, (6 3/4) 10, (8 1/4) 2	(6 3/4) 27, (8 1/4) 11	(8 1/4) 43	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4) 80-1,600	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable			6.8	Density +/- .025 g/cc ; Pe +/- 5%	Gain-stabilized Scintillation	self-binned, quadrant, and 16-bin azimuthal RHOB, DRHO, Pe, and Caliper	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
TNP (Thermal Neutron Porosity)	4-3/4, 6-3/4, 8-1/4	(4-3/4) 23.2, (6-3/4) 26.8, (8-1/4) 27.25 (includes AZD)	(4-3/4) 30/15, (6-3/4) 16/8, (8-1/4) 14/7	(4-3/4) 4.75x 3.18 (6-3/4) 6.75x4.39 (8-1/4) 8.25x4.28	150 Std. 165 Opt.	(4-3/4 & 6-3/4) 20 std., 30 opt., (8-1/4) 20 std., 25 opt.	(4 3/4) 16 (6 3/4) 2 (8 1/4) 2	(4 3/4) 87 (6 3/4) 10 (8 1/4) 2	(6 3/4) 27 (8 1/4) 11	(8 1/4) 43	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4) 80-1,600	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable			14.25	Neutron 0-10 pu: +/- .5 pu; 10-40 pu: +/- 5%	He-3	Compensated neutron porosity	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
HeatWave TNP	4-3/4	14.86	30/15	4.75 x 3.04	200°C	20 std., 30 opt.	(4-3/4) 19	(4-3/4) 19			80-350	Pumps-on	Positive mud pulse, Electromagnetic, Wired Pipe	N	N	N	N		Variable			10.48	Neutron 0-10 pu: +/- .5 pu; 10-40 pu: +/- 5%	He-3	Compensated neutron porosity	Lithium battery, up to 380 hrs.	Y	Y
CrossWave Azimuthal Sonic	4-3/4, 6-3/4, 8-1/4, 9-1/2	(4-3/4) 29.7, (6-3/4) 26.0, (8-1/4) 26.5, (9-1/2) 26.75	(4-3/4) 20/12, (6-3/4) 11/5, (8-1/4) 10/4, (9-1/2) 8/4	(4-3/4) 4.75 x 4.12, (6-3/4) 6.75 x 3.06, (8-1/4) 8.25 x 6.89, (9-1/2) 9.5 x 8.8	150 Std. 165 Opt.	(4-3/4 & 6-3/4) 20 std., 30 opt., (8-1/4 & 9-1/2) 20 std., 25 opt.	(4-3/4) 19, (6-3/4) 2, (8-1/4, 9-1/2) 2	(4-3/4) 105, (6-3/4) 11, (8-1/4, 9-1/2) 2	(6-3/4) 32, (8-1/4, 9-1/2) 6	(8-1/4 , 9-1/2) 45	(4-3/4) 80-350; (6-3/4) 80-700; (8-1/4, 9-1/2) 80-1,600	Pumps-on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable			(4-3/4) 15.77, (6-3/4) 14, (8-1/4, 9-1/2) 12.75	+/- 1 µs/ft	piezo-electric, 6-rcvr array	360 degrees Azimuthal Compressional and Shear slowness	Lithium battery, up to 1400 hrs.; and or generator	Y	Y
Density																												
APS Technology (Rental Division)																												
SureLog iPCD (Integrated Porosity, Caliper & Density) 4.75	4 3/4	17.5	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	350 max.	Flow-on and timer	MPT positive pulse and EM	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Density: 3.2	+/- 0.015 g/cc @ 2.2 g/cc; ±0.25 B/e- (1 - 5 B/e-)	Nal Crystal w/PMT	24-bin azimuthal bulk density (delta rho) & Pe	Turbine Alternator + Battery	Y	Y
SureLog iPCD (Integrated Porosity, Caliper & Density) 6.75	6 3/4	19	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	650 max.	Flow-on and timer	MPT positive pulse and EM	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Density: 3.2	Density +/- 0.015 g/cc @ 2.2 g/cc; ±0.25 B/e- (1 - 5 B/e-). +/- 0.2 in. caliper +/- 0.1 in. standoff	Nal Crystal w/PMT; piezoelectric transceiver	24-bin azimuthal bulk density (delta rho) & Pe; acoustic caliper & standoff	Turbine Alternator + Battery	Y	Y
SureLog (Integrated Porosity, Caliper & Density) iPCD 8	8	19	Collar-limited	Collar-defined	150 and 175	20	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	1,500 max.	Flow-on and timer	MPT positive pulse and EM	N	Y (via APS SureShot MWD)	N	Y (via APS SureShot MWD)	Programmable threshold	Config. dependent	Config. dependent	Y/Y	Density: 3.2	Density +/- 0.015 g/cc @ 2.2 g/cc; ±0.25 B/e- (1 - 5 B/e-). +/- 0.2 in. caliper +/- 0.1 in. standoff	Li6I Crystal w/PMT; piezoelectric transceiver	24-bin azimuthal bulk density (delta rho) & Pe; acoustic caliper & standoff	Turbine Alternator + Battery	Y	Y
Baker Hughes																												
LithoTrak bulk density & neutron porosity	4-3/4, 6-3/4, 8-1/4	14.4 (4-3/4) 17.6 (6-3/4) 18.2 (8-1/4)	BHA Dependent	BHA Dependent	150 up to 165 (6-3/4)	20, 25 (4-3/4 option) 30 (6-3/4 and 8-1/4 option)	Application Specific	Application Specific	Application Specific	Application Specific	0-320 (4-3/4) 0-900 (6-3/4) 0-1,290 (8-1/4)	Stop/start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Configuration	Continuous	Y/Y	Neutron: 11.25 (4-3/4) 13.5 (6-3/4) 13.54 (8-1/4) 13.4 (8-1/4S) ; Density: 2.46 ft (4 3/4), 4.60ft (6 3/4), 5.10ft (8 1/4) ; Caliper: 5.95ft (8 1/4), 6.70ft (6 3/4), 4.85ft (4 3/4).	Density: +/- 0.015 g/cc PEF: 0.25 B/e from 2-5 B/e acoustic standoff: +/- 0.075 up to 0.5 in., +/- 0.25 at 2 in.	Nal scintillator	Bulk density (1.6 - 3.1 g/cc) 16-sector density Delta Rho Pe index Standoff & caliper	Turbine generator, no limit; battery option.	Y	Y

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Oliden Technology, LLC																													
LithoFusion Density and Porosity LWD Tool	4.75 /6.75 with 5 3/4" / 8 1/4" integral blade stabilizers	16 /16	30, 15 16, 8		150 operating (175 survival)	25					400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Density: 2.9 ft Acoustic Standoff: 10.25 ft	Density: +/- 0.015 g/cc from 1.70 to 3.05 g/cc PEF: +/- 0.25 B/e from 1 to 10 B/e Acoustic Standoff: +/- 0.1 in. from 0.375 in. to 2 in.	Nal scintillator	Averaged 4 and 16 sector azimuthal density, PEF and Standoff. Density Images PEF Images Acoustic Caliper Images.	lithium battery, optional turbine-alternator	Y	Y	
Schlumberger																													
adnVISION475	4 3/4 with Slick, 5 7/8, or 6 1/4 Stabilizer options	23.6	30/15	4.75x2.25x24.7	150 std., 175 opt.	20	35	220	N/A	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Average density 4 and 16 sector azimuthal density Image derived density Real time and recorded images PEF Density caliper	MWD turbine or lithium battery	Y	Y	
adnVISION675	6 3/4 with Slick, 8 3/8, or 9 3/8 Stabilizer Options	20.5	16/8	6.5x2.25x27.4	150 std. 175 opt.	20 std., 30 opt.	1	4	10	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Average density 4 and 16 sector azimuthal density Image derived density Real time and recorded images PEF Density caliper	MWD turbine or lithium battery	Y	Y	
adnVISION825	8 1/4 with Slick or 10 3/8 Stabilizer Options	22.3	14/7	8.25x2.81x26.1	150	20 std, 30 opt.	1	2	6	41	0-1,600	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.1	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Average density 4 and 16 sector azimuthal density Image derived density Real time and recorded images PEF Density caliper	MWD turbine or lithium battery	Y	Y	
adnVISION825s	8 1/4 with 12 stabilizer	31	12/4	8x2.81x21	150	20 std, 25 opt.	1	7	22	90	0-1,000	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Average density 4 and 16 sector azimuthal density Image derived density Real time and recorded images PEF Density caliper	MWD turbine or lithium battery	Y	Y	
EcoScope	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Neutron porosity: BPHI / TNPH Ultrasonic caliper Capture Spectroscopy Sigma	TeleScope Turbine	Y	Y	
NeoScope	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	+/- 0.025 g/cc from 1.7 - 2.90 g/cc in clean formations	Multi-Detectors (Source is non-chemical)	Neutron porosity (BPHI & TNPH), Neutron-Gamma-Density, Capture Spectroscopy, Sigma (Source is non-chemical; i.e. Pulsed-Neutron-Generator)	TeleScope Turbine	Y	Y	
Weatherford																													
AZD (Azimuthal Density Sensor)	4-3/4, 6-3/4, 8-1/4	(4-3/4) 23.2, (6-3/4) 26.8, (8-1/4) 27.25 (includes TNP)	(4-3/4) 30/15 (6-3/4) 16/8, (8-1/4) 14/7	(4-3/4) 4.75x 3.18 (6-3/4) 6.75x4.39 (8-1/4) 8.25x 4.28	150 Std. 165 Opt.	(4-3/4 & 6-3/4) 20 std., 30 opt., (8-1/4) 20 std., 25 opt.	(4 3/4) 16, (6 3/4) 2, (8 1/4) 2	(4 3/4) 87, (6 3/4) 10, (8 1/4) 2	(6 3/4) 27, (8 1/4) 11	(8 1/2) 43	(4 3/4) 80-350; (6 3/4) 80-700; (8 1/4) 80-1,600	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable			6.8	Density +/- .025 g/cc ; Pe +/- 5%	Gain-stabilized Scintillation	self-binned, quadrant, and 16-bin azimuthal RHOB, DRHO, Pe, and Caliper	Lithium battery, up to 1400 hrs.; and or generator	Y	Y	
HeatWave Density	4-3/4, 6-3/4	(4-3/4) 23.2, (6-3/4) 26.8	(4-3/4) 30/15 (6-3/4) 16/8	(4-3/4) 4.75x 3.18 (6-3/4) 6.75x4.39	200°C	(4-3/4 & 6-3/4) 20 std., 30 opt.	(4 3/4) 16, (6 3/4) 2	(4 3/4) 87, (6 3/4) 10	(6 3/4) 27		(4 3/4) 80-350; (6 3/4) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	N	N	N		Variable			6.8	Density +/- .025 g/cc ; Pe +/- 5%	Gain-stabilized Scintillation	RHOB, DRHO, Pe, and Caliper	Lithium battery, up to 380 hrs.	Y	Y	
Formation Pressure Testing																													
Baker Hughes																													
TesTrak formation pressure testing	4-3/4, 6-3/4, 8-1/4	23.0 (4-3/4) 24.3 (6-3/4) 24.4 (8-1/4)	BHA Dependent	BHA Dependent	150	30	Application Specific	Application Specific	Application Specific	Application Specific	0-350 (4-3/4) 0-900 (6-3/4) 0-1,295 (8-1/4)	Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.		N/A	(4-3/4) 1.7, (6-3/4) 20.7, (8-1/4) 20.8	0.02% FS	Quartz gauge	Formation pressure, annular pressure	Turbine generator, no limit; battery option.	Y	Y	
Schlumberger																													
StethoScope 675	6 3/4 w/ 8 1/4 stab 6 3/4 w/ 9 1/4 stab (Optional)	31	16/8	31	150 std. 165 opt.	20 std. 25 opt. 30 opt.	MW x Q²/C MW = mud weight in ppg Q = Flowrate in gpm C = 58,620				0-800	Downlink from surface	TeleScope positive continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	5.29	± [2.2 + 0.01% of reading]	Advanced CQG - High Precision Crystal (primary) Strain gauge (secondary)	Formation pressure, annular pressure	MWD turbine and lithium battery	Y	Y	
StethoScope 825	8 1/4 w/ 12.0 stab 8 1/4 w/ 10 3/8 stab 8 1/4 w/ 10 1/8 stab (Optional)	31.5	13/7	35	150	20 std. 25 opt. 30 opt.	MW x Q²/C MW = mud weight in ppg Q = Flowrate in gpm C = 79,439				0-1,600	Downlink from surface	TeleScope positive continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	5.62	± [2.2 + 0.01% of reading]	Advanced CQG - High Precision Crystal (primary) Strain gauge (secondary)	Formation pressure, annular pressure	MWD turbine and lithium battery	Y	Y	
StethoScope 475	4 3/4 w/ 5 3/4 stab 4 3/4 w/ 5 1/2 stab (Optional)	26	30/15	43.5	150	20 std. 25 opt. 30 opt.	MW x Q²/C MW = mud weight in ppg Q = Flowrate in gpm C = 6,000				0-400	Downlink from surface	IMPulse positive continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Variable	N/A	N/A	5	± [2.2 + 0.01% of reading]	Advanced CQG - High Precision Crystal (primary) SOI (secondary)	Formation pressure, annular pressure	MWD turbine or lithium battery	Y	Y	

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
SpectraSphere	Pretest module: 6.906 drill collar nominal OD,8.25 max diameter at stabilizer. Fluid mapping module: 6.906 drill collar nominal OD, 7.5 at wear band Sample Carrier Module: 6.891 drill collar nominal OD, 7.35 at bottle section, 7.5 at wear band	39 (Pretest module) + 42.5 (Fluid mapping module) + 17.7 (each Sample Carrier Module)	16/8	Pretest module: 6.5x2.81x54.6 Fluid mapping module: 6.5x2.81x46.2 Sample Carrier Module (no ILS): 6.5x2.81x18.5	150	25 std 30 opt	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm Pretest module C = 53,000 Fluid mapping module C = 18,000 Sample Carrier Module C = 140,000				275-800	Downlink from surface	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.7	0-10,000 psi: Axton ± 1.5, SOI ± 3 10,000-20,000 psi: Axton ± 2.2, SOI ± 6.0. 20,000-30,000 psi: Axton ± 5.0, SOI ± 7.5	Axton gauge (primary), SOI (secondary)	Formation pressure, annular pressure, fluid composition (C1, C2, C3, C4, C5, C6+, CO2), GOR, FVF, Asphaltene content, mud filtrate contamination estimation and monitoring	MWD Turbine and Internal Turbine	Y	Y	
Weatherford																													
PressureWave Formation Tester	4-3/4, 6-3/4, 8-1/4	(4.75) 26.2, (6.75) 24.3, (8.25) 24.6	(4.75) 30/15, (6.75) 16/8, (8.25) 14/7	(4.75) 4.75x3.28, (6.75) 6.75x4.24, (8.25) 8.25x5.17	150 Std. 165 Opt.	(4-3/4 & 6-3/4) 20 std., 30 opt., (8-1/4) 20 std., 25 opt.	(6 3/4) 2	(6 3/4) 10	(6 3/4) 27		(4.75) 80-350, (6.75) 80-700, (8.25) 80-1,600	Downlink	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y	N/A	As low as 4 sec depending on bandwidth available	N/A	N/A	(4.75) 11.8, (6.75) 9.44, (8.25) 9.82	0.02% of Full scale	Quartz Pressure Gauge	Formation Pressure, Mobility, Annular Pressure, Temperature	Lithium battery, up to 600 hrs.	Y	Y	
Seismic																													
Baker Hughes																													
SeismicTrak seismic-while-drilling	6-3/4, 9-1/2	10.7 (6-3/4) 11.4 (9-1/2)	BHA Dependent	BHA Dependent	125	25	N/A	N/A	Application Specific	Application Specific	265-900 (6-3/4) 530-1,270 (9-1/2)	Start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	1-5 minutes	N/A	(6-3/4) 1.94 and 4.10, (9-1/2) 2.43 and 4.40	1ms	Geophone Hydrophone	Seismic	Battery/200	Y	Y	
Schlumberger																													
seismicVISION675	6 3/4	14	16/8	13.8	150	25, 30 opt	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 217,000				0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Downhole logic configuration	Typical 150	N/A	36.05 hydrophone & geophones	+/- 2 ms check-shot recorded mode, 3s recording for each components	Hydrophone and 3 component geophones	1) RT Check shot 2) 4-component waveforms 3) RT waveforms capability	MWD turbine or lithium battery	Y	Y	
seismicVISION825	8 1/4	13.84	14/7	14.4	150	25, 30 opt	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 769,000				0-2,000	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Downhole logic configuration	Typical 150	N/A	30.41 hydrophone & geophones	+/- 2 ms check-shot recorded mode, 3s recording for each components	Hydrophone and 3 component geophones	1) RT Check shot 2) 4-component waveforms 3) RT waveforms capability	MWD turbine or lithium battery	Y	Y	
seismicVISION900	9	13.84	12/4	14.8	150	23	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm C = 769,000				0-2,000	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording, Wired Drill Pipe option	N	Y	N	N	N/A	Downhole logic configuration	Typical 150	N/A	30.41 hydrophone & geophones	+/- 2 ms check-shot recorded mode, 3s recording for each components	Hydrophone and 3 component geophones	1) RT Check shot 2) 4-component waveforms 3) RT waveforms capability	MWD turbine or lithium battery	Y	Y	
Well Placement Technology																													
Baker Hughes																													
AziTrak deep azimuthal resistivity	4-3/4, 6-3/4	23.5 (4-3/4) 22.1 (6-3/4)	BHA Dependent	BHA Dependent	150	20, 25 (4-3/4 option) 30 (6-3/4 option)	Application Specific	Application Specific	Application Specific	N/A	125-350 (4-3/4) 200-900 (6-3/4)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	Op. Sel.	Op. Sel.	Continuous	Y/Y	Pressure: (4-3/4) 9.1, (6-3/4) 8.5, others referenced to bit depth	1%, 0-82 Hz - vibration, 0 - +/- 1,000 rpm - stick-slip, 0.25% full-scale (0-30k) - pressure	3-axis accelerometer 3-axis fluxgate Strain gauge	Lateral and axial vibration (grms) stick-slip severity level, flow-on and flow-off annular pressure.	Turbine generator/ no limit	Y	Y	
ZoneTrak G near-bit gamma ray	4-3/4, 6-3/4, 9-1/2	Only RSS option available for 4-3/4 , 5.35 or 4.79 for 9-1/2, 4.52 or 4.06 for 6-3/4	BHA Dependent	BHA Dependent	150	20, 25 (option), 20, 25 (option), 25	Application Specific	Application Specific	Application Specific	Application Specific	300-1600 9-1/2, 200-900 for 6-3/4, 125-350 4-3/4	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	2.1	+/- 5 API @ 100 API	2 scintillators	Gamma ray	Turbine generator/ no limit	Y	Y	
ZoneTrak R at-bit resistivity	6-3/4, 9-1/2	6.3 or 6.8 (6-3/4) 5.7 or 6.2 (9-1/2)	BHA Dependent	BHA Dependent	150	25, 30 (option)	Application Specific	Application Specific	Application Specific	Application Specific	200-900 (6-3/4) 420-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	Application specific and a function of mud resistivity, formation resistivity contrast and hardware configuration	+/- 5%	Transmitter/receiver antennas	Apparent Resistivity	Turbine generator/ no limit	Y	Y	
VisiTrak reservoir navigation and analysis	4-3/4, 6-3/4, 9-1/2	Transmitter - 8.9 Receiver - 28.9 (6-3/4) Receiver - 29.2 (9-1/2), Transmitter -7.9 receiver 28.6 4*3/4	BHA Dependent	BHA Dependent	150	30	Application Specific	Application Specific	Application Specific	N/A	200-900 (6-3/4) 290-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	N/Y	Prop. resist: 10.9, extra deep azim resist: 2.7, 6-3/4 Prop. resist: 13.5 extra deep azim resist: 5.4 9-1/2 Prop. resist: 13.2 extra deep azim resist: 4.9 4-3/4	Phase diff.: 0.3° for signal 20 dBµV; Attenuation: 0.06dB for signal 20 dBµV	Transmitter/receiver antennas	20 kHz / 50 kHz extra deep azimuthal resistivity	Turbine generator/ no limit	Y	Y	
StarTrak high-definition electrical imaging	4-3/4, 6-3/4	9.8 (4-3/4)8.3 (6-3/4)	BHA Dependent	BHA Dependent	150	25	Application Specific	Application Specific	Application Specific	N/A	Function of Ontak system	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	5.6 (4-3/4) 3.7 (6-3/4)		Button electrode	High resolution azimuthal resistivity	Turbine generator/ no limit	Y	Y	
SeismicTrak seismic-while-drilling	6-3/4, 9-1/2	10.73 (6-3/4) 11.35 (9-1/2)	BHA Dependent	BHA Dependent	125	25	N/A	N/A	Application Specific	Application Specific	265-660 (6-3/4) 530-1,270 (9-1/2)	Start pumps Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	1-5 minutes	N/A	(6-3/4) 1.94 and 4.10, (9-1/2) 2.43 and 4.40	1 ms	Geophone Hydrophone	Seismic wavetrain	Battery/200	Y	Y	
National Oilwell Varco																													
iSeries Near-Bit Sub (NBS)	4.75	2.86	30/15	Collar Dependent	175	20	0	1			150-300	Surface activation or inclination trigger	EM	N	N	N	N	N	4.0 bps	Configurable	Y/Y	1.5	clnc: +/- 0.2°, Azi Gamma: 5%	CBG	clnc, Azimuthal Gamma, RPM	Lithium Battery, 200hrs	Y	Y	
iSeries Near-Bit Sub (NBS)	6.75	2.86	16/8	Collar Dependent	175	20	0	1	2		300-600	Surface activation or inclination trigger	EM	N	N	N	N	N	4.0 bps	Configurable	Y/Y	1.5	clnc: +/- 0.2°, Azi Gamma: 5%	CBG	clnc, Azimuthal Gamma, RPM	Lithium Battery, 200hrs	Y	Y	
Oriden Technology, LLC																													
DartFusion Resistivity and bed boundary Mapper	4.75 / 6.75	16 / 16	30, 15 / 16, 8	4.75x2.25x16.1, 6.50x2.81x15.4,	150	20	<30	<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	7.6ft / 7.6ft	2 MHz PS (0.1-60 Ohm.m) +/- 2% accuracy. 2 MHz PS (60-3000 Ohm.m) +/- 0.3mS/m accuracy. 500 KHz PS (0.1-10 Ohm.m) +/- 2% accuracy. 500 KHz PS (10-100 Ohm.m) +/- 2mS/m accuracy.	Antenna Spacings @ 20in, 28in, 36in, 44in, 52in spacings.	Compensated 2MHz and 500KHz Propagation Phase Shift and Attenuation Resistivities.	lithium battery, optional turbine-alternator	Y	Y	

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
GeoFusion Laterolog Resistivity and Imager	4.75 / 6.75	19.3/15	30, 15 16, 8	4.75x2.25x19.8, 6.50x2.81x15.9	150 / 150 std (175 opt)	20 / 20	<30	<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Resistivity Image: 7.6ft / 3.7ft	Resistivity Image: 0.4in. (128 sectors) / 0.5in. (128 sectors)	Resistivity Imaging: 2 Button electrodes. 0.4" dia. (4.75 tool) / 0.5" dia. (6.75 tool)	Laterolog Resistivity Images at 128 sector.	lithium battery, optional turbine-alternator	Y	Y
Ultrasonic Imager GPUFusion	4.75 /6.75	6.4 /7.7	30, 15 16, 8	4.75x2.25x5.0/ 6.5x2.81x7.57	150	20/ 25	<10/ <30	<10/ <30	<10/ <30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	675: USS: 2.36 ft Gamma Ray: 4.23 ft APWD: 3.07 ft	Ultrasonic Image: 0.04" / 0.04"	Multiple acoustic transceivers	Ultrasonic: Reflected amplitude and travel time images at 64 sectors.	lithium battery, optional turbine-alternator	Y	Y
Schlumberger																												
PeriScopeHD	4 3/4, 6 3/4	23.5 (4 3/4), 18.3 (6 3/4)	30/15 (4 3/4) , 16/8 (6 3/4)	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	7.7 (4 3/4) 9.1 (6 3/4)	Azimuthal Resolution - 2°	22, 34, 44, 74, 84 & 96 in spacing	API Azimuthal GR, 360° directional, deep reading, bed boundary identification and mapping for optimal well placement	MWD turbine	Y	Y
PeriScope	4 3/4, 6 3/4	23.5 (4 3/4), 18.3 (6 3/4)	30/15 (4 3/4) , 16/8 (6 3/4)	4.75x2.25x27 (4 3/4), 6.5x2.81x19.3 (6 3/4)	150	25	(4 3/4) 10, (6 3/4) 0.7	(4 3/4) 65, (6 3/4) 4	(6 3/4) 14	N/A	0-400 (4 3/4), 0-800 (6 3/4)	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	7.7 (4 3/4) 9.1 (6 3/4)	Azimuthal Resolution - 2°	22, 34, 44, 74, 84 & 96 in spacing	API Azimuthal GR, 360° directional, deep reading, bed boundary identification and mapping for optimal well placement	MWD turbine	Y	Y
geoVISION675	6 3/4	10.12	16/8	6.5x2.81x10	150	18	0.9	5.5	18	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Ring 3.5, Button D - 4.2, Button M - 4.8, Button S - 5.2	5% 0.1<=res< 250 ohm-m, 10% 250<=res< 500 ohm-m, 20% 500<=res< 5,000 ohm-m	Ring, bit, and 3 buttons	Azi. laterolog resistivity 56 sector real-time images	MWD turbine or lithium battery	Y	Y
geoVISION825	8 1/4	12.72	13/7	8x2.81x13.5	150	15	0.15	0.95	3	21.8	0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Ring 3.7, Button D - 4.2, Button M - 4.8, Button S - 5.2	5% 0.1<=res< 250 ohm-m, 10% 250<=res< 500 ohm-m, 20% 500<=res< 5,000 ohm-m	Ring, bit, and 3 buttons	Azi. laterolog resistivity 56 sector real-time images	MWD turbine or lithium battery	Y	Y
arcVISION312	3 1/8	23.5	100/30	3x1.75x33	150	20	112	N/A	N/A	N/A	0-160	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	4.4	Inclination: 0.2° at 90° incl. ; Resistivity : +/- 2% for PS res< 60 ohm-m, +/-0.3mS/m for PS 60 < res < 3,000 ohm-m, +/- 3% for ATT res<25 ohm-m, +/-1.5mS/m for ATT 25 < res < 50 ohm-m	Accelerometer, 10, 16, 22, 28, 24 in. spacing	Near bit Inclination, 2 MHz and 400 KHz phase shift, attenuation resistivity	Lithium battery	Y	Y
adnVISION475	4 3/4 with Slick, 5 7/8, or 6 1/4 Stabilizer options	23.6	30/15	4.75x2.25x24.7	150 std., 175 opt.	20	35	220	N/A	N/A	0-400	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Azi. density & PEF 16-sectors real-time images	MWD turbine or lithium battery	Y	Y
adnVISION675	6 3/4 with Slick, 8 3/8, or 9 3/8 Stabilizer Options	20.5	16/8	6.5x2.25x27.4	150 std. 175 opt.	20 std., 30 opt.	1	4	10	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Azi. density & PEF 16-sectors real-time images	MWD turbine or lithium battery	Y	Y
adnVISION825	8 1/4 with Slick or 10 3/8 Stabilizer Options	22.3	14/7	8.25x2.81x26.1	150	20 std., 30 opt.	1	2	6	41	0-1,600	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.1	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Azi. density & PEF 16-sectors real-time images	MWD turbine or lithium battery	Y	Y
adnVISION825s	8 1/4 with 12 stabilizer	31	12/4	8x2.81x21	150	20 std, 25 opt.	1	7	22	90	0-1,000	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	Source: Y	Y	N	N	N/A	Variable	N/A	N/A	10.5	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units	Scintillation	Azi. density & PEF 16-sectors real-time images	MWD turbine or lithium battery	Y	Y
EcoScope	6 3/4 with 7 7/8, 8 1/4, or 9 3/8 Stabilizer Options	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	+/- 0.015 g/cc from 1.7 - 3.05 g/cc, PEF: +/- 5% from 1-10 units, Inclination: 0.2° at 90° incl.	Scintillation	Azi. NGR, Density, PEF, Ultraonic image 16-sectors real-time image. Inclination at the bit.	TeleScope Turbine	Y	Y
NeoScope	6 3/4 with 8 1/4 stabilizer	25.2	16/8	6.5x2.81x24.5	150 std. 175 opt.	20 std., 25 opt.	2	10	32	N/A	250-800	Real-time, pumps on downhole recording	MWD Positive Continuous Wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	17	Inclination: 0.2° at 90° incl.	Scintillation	Azi. NGR, Ultraonic image 16-sectors real-time image. Inclination at the bit.	TeleScope Turbine	Y	Y
MicroScope	4 3/4 with 5 3/8 slick sleeve	18	30/15	4.75x2.25x18	150	20	9.8	61	198	N/A	0-500	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	6.5	+/- 5% 0.1 <=res< 250 ohm-m, +/- 10% 250 <=res< 500 ohm-m, +/- 20% 500 <=res< 1,000 ohm-m	2 Collocated button electrodes (180 deg apart)	Azimuthal laterolog resistivities at 4 depths of investigation. 56 sectors real-time image. Azimuthal gamma ray.	MWD Turbine	Y	Y
MicroScope HD	4 3/4 with 5 3/4, 5 7/8, 6, 6 3/8 OD sleeve	18	30/15	4.75x2.25x18	150	20	9.8	61	198	N/A	0-500	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording / Wired drill pipe opt.	N	Y	N	N	N/A	Variable	N/A	N/A	4.5	0.4in vertical resolution, 0.2 in x 0.125 in pixel resolution	8 button electrodes	Laterolog images in 160 Azimuthal bins. Azimuthal laterolog resistivities at 4 depths of investigation. Azimuthal gamma ray.	MWD Turbine	Y	Y
SpectraSphere	Pretest module: 6.906 drill collar nominal OD,8.25 max diameter at stabilizer. Fluid mapping module: 6.906 drill collar nominal OD, 7.5 at wear band Sample Carrier Module: 6.891 drill collar nominal OD, 7.35 at bottle section, 7.5 at wear band	39 (Pretest module) + 42.5 (FFluid mapping module) + 17.7 (each Sample Carrier Module)	16/8	Pretest module: 6.5x2.81x54.6 Fluid mapping module: 6.5x2.81x46.2 Sample Carrier Module (no ILS): 6.5x2.81x18.5	150	25 std 30 opt	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm Pretest module C = 53,000 Fluid mapping module C = 18,000 Sample Carrier Module C = 140,000				275-800	Downlink from surface	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.7	0-10,000 psi: Axton ± 1.5, SOI ± 3 10,000-20,000 psi: Axton ± 2.2, SOI ± 6.0. 20,000-30,000 psi: Axton ± 5.0, SOI ± 7.5	Axton gauge (primary), SOI (secondary)	Formation pressure, annular pressure, fluid composition (C1, C2, C3, C4, C5, C6+, CO2), GOR, FVF, Asphaltene content, mud filtrate contamination estimation and monitoring	MWD Turbine and Internal Turbine	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op. press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded	
Scientific Drilling International																													
BitSub 4.75 (At Bit Azi Gamma & Inclination)	4-3/4"	2.4	Collar Limited	BHA Dependent	150C	15	Application Specific	Application Specific	Application Specific	Application Specific	100-400 GPM (4-3/4) 250-1000 GPM (6-3/4)	via telemetry system	Electromagnetic or Mud Pulse	N	Y	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	1.3	Static Inclination +/-0.15° Drilling Inc +/-0.3° Sliding +/-0.5° Rotating Gamma API 0-1000 +/- 2.1API at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator Nal	At Bit Inclination, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous Inc, At Bit Total, 2, 4, 8 Bin Realtime (16 bin Memory) Gamma	Lithium Battery 300+ Hrs	Y	Y	
BitSub 6.75 (At Bit Azi Gamma & Inclination)	6-3/4"	2.4	Collar Limited	BHA Dependent	150C	15	Application Specific	Application Specific	Application Specific	Application Specific	100-400 GPM (4-3/4) 250-1000 GPM (6-3/4)	via telemetry system	Electromagnetic or Mud Pulse	N	Y	N	Y	Y	Frequency Dependent	Frequency Dependent	Y/Y	1.3	Static Inclination +/-0.15° Drilling Inc +/-0.3° Sliding +/-0.5° Rotating Gamma API 0-1000 +/- 2.4API at 60 ft/hr at 100 API	Tri-axial Accelerometer and Magnetometer, Scintillator Nal	At Bit Inclination, Shock & Vibe (Axial & Lateral), Stick Slip, RPM, Temp, Continuous Inc, At Bit Total, 2, 4, 8 Bin Realtime (16 bin Memory) Gamma	Lithium Battery 300+ Hrs	Y	Y	
Sci-Quest Propagation Resistivity	4-3/4	15	26,10	BHA Dependent	150C	18	Application Specific	Application Specific	Application Specific	Application Specific	up to 330 GPM	via telemetry system	Electromagnetic or Mud Pulse	N	Y	N	Y	N/A	Frequency Dependent	N/A	N/A	0.9	2 MHz 23in spacing PS 0.2-20 Ohm.m +/- 0.3% accuracy. 20-80 Ohm.m +/- 1.0% accuracy. 80-1000 Ohm.m +/- 0.1 mS/m accuracy. 2 MHz 33in spacing PS 0.2-20 Ohm.m +/- 0.2% accuracy. 20-80 Ohm.m +/- 0.5% accuracy. 80-1000 Ohm.m +/- 0.1 mS/m accuracy. 2 MHz 23in spacing Att 0.2-20 Ohm.m +/- 0.6% accuracy. 20-80 Ohm.m +/- 3.0% accuracy. 80-1000 Ohm.m +/- 0.6 mS/m accuracy. 2 MHz 33in spacing Att 0.2-20 Ohm.m +/- 0.5% accuracy. 20-80 Ohm.m +/- 2.0% accuracy. 80-1000 Ohm.m +/- 0.25 mS/m accuracy.	2MHz Propagation at 23 in. and 33 in. TX-RX spacing	2MHz Propagation Phase Shift and Attenuation Resistivities.	Lithium Battery	Y	Y	
	6-1/2		19.8								up to 600 GPM																		
	6-3/4		16.8								up to 750 GPM																		
	8		12.6								up to 1000 GPM																		
WPR Wave Propagation Resistivity	3.5	14.45	40,16	Collar - defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	150 max	via telemetry system	Electromagnetic or Mud Pulse	N	Y	N	Y	N/A	Frequency Dependent	N/A	N/A	5.3	Propagation Resistivity: ± 2% [0.1 – 25 ohm-m @ 2 MHz]; ± 1% [0.1 – 25 ohm-m] @ 400 kHz	2MHz & 400kHz Propagation	2MHz & 400 kHz Propagation Phase Shift and Attenuation Resistivities.	Lithium Battery	Y	Y	
	3.75	15.13	38,15	Collar - defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	200 max			N	Y	N	Y												
	4.75	14.95	25,13	Collar - defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	350 max			Y (Sonde)	Y	N	Y												
	6.75	14.95	24,10	Collar - defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	700 max			Y (Sonde)	Y	N	Y												
	8	14.95	15,8	Collar - defined	150 and 175	20 and 25	Configuration-dependent	Configuration-dependent	Configuration-dependent	Configuration-dependent	1200 max			Y (Sonde)	Y	N	Y												
Weatherford																													
GuideWave Azimuthal Resistivity Tool	4-3/4, 6-3/4	(4-3/4) 34.7, (6-3/4) 35.3	(4-3/4) 30/15, (6-3/4), 16/8	(4-3/4) 4.75x2.54, (6-3/4) 6.75x3.40	150	20 std., 30 opt.	(4-3/4) 19, (6-3/4) 2	(4-3/4) 105, (6-3/4) 11	(6-3/4) 32	n/a	(4 3/4) 80-350; (6 3/4, 8) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	(4-3/4) 17.2, (6-3/4) 17.7	Phase +/- .25 mmho Attenuation +/- .5 mmho	Compensated 2 MHz, 400 & 100 kHz radial, axial, and tilted antennas	Compensated 2 MHz, 400 & 100 kHz phase and atten. Resistivity of up, down, total, and image; bed azimuth	Lithium battery, up to 264 hrs.; and or generator	Y	Y	
At-Bit Measurement System	4-3/4, 6-3/4	(4 3/4) 2.83 ft., (6 3/4) 3.01 ft.	(4 3/4) 30/15, (6 3/4) 16/8		(4 3/4, 6 3/4) 150	(4 3/4) 10 (6 3/4) 10	(4 3/4) 12, (6 3/4) 2	(4 3/4) 64, (6 3/4) 9	(6 3/4) 26		(4 3/4) 80-350; (6 3/4)	N/A	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	N	N/A	Variable	inc 16	sliding/rotating - inc only	Inc .7 Gamma 1.5	Inc >20°, +/- .25° Gamma 5%@100 API	Accelerometer Scintillation	1- axis inc API GR: Realtime - Total, up/down API GR Recorded - Total, Recorded up/down/left/right	Lithium battery - 240 std 800 opt	Y	Y	
Formation Fluid Identification and Sampling																													
Baker Hughes																													
FASTrak Prism fluid analysis and sampling while drilling service	6-3/4	1X Tank Carrier = 42.7 ft 4X Tank Carriers = 101.7 ft	BHA Dependent	BHA Dependent	150	30	Application Specific	Application Specific	Application Specific	Application Specific	351–446 gpm 412–538 gpm 471–660 gpm 541–747 gpm 632–900 gpm	Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	30	N/A	N/A	18 ft	Temperature - ±0.2°C SoundSpeed - >5 m/s Refractometer - .005 Density - ±0.005/cm³ for non-conductive fluids less than 20 cP Viscosity - ±20% of measured viscosity or ±0.1 cP, whichever is greater	N/A	Fluid Color, Fluorescence,NIR Absorbance, Compressibility, Temp, Soundspeed, Refractive Index, Density, Viscosity, Pressure, Bubble Point	Turbine generator/ no limit	Y	Y	
CBG Corp.																													
FIT-A	12.69	2			175	15							Wireline										+/- 2 D.U. Dielectric; +/- 0.02 gm/cc Density	Dielectric / Density	D.U.; gm/cc		Y		
Microimager																													
Baker Hughes																													
StarTrak high-definition electrical imaging	4-3/4, 6-3/4	9.8 (4-3/4) 8.3 (6-3/4)	BHA Dependent	BHA Dependent	150	25	Application Specific	Application Specific	Application Specific	N/A	Function of Ontak system	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	5.6 (4-3/4) 3.7 (6-3/4)		Button electrode	High resolution azimuthal resistivity	Turbine generator/ no limit	Y	Y	

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, °/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/ min	Press. drop, psi at 250 gal/ min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
ImageTrak high-definition acoustic imaging	6¾	8.8	BHA Dependent	BHA Dependent	150	25	Application Specific	Application Specific	Application Specific	N/A	See Ontral limitation	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	6.7	256 sectors	Transmit/Receive Transducer	High resolution azimuthal ultrasound, Amplitude and Travel Time	Turbine generator/ no limit	N	Y
Weatherford																												
SineWave Microimager	4-3/4, 6-3/4	(4-3/4) 12.77, (6-3/4) 12.85	(4-3/4) 30/15, (6-3/4) 16/8	(4-3/4) 4.75x2.29, (6-3/4) 6.75x3.06	150 Std. 165 Opt.	20 std., 30 opt.	(4-3/4) 19, (6-3/4) 2	(4-3/4) 19, (6-3/4) 2	(6-3/4) 2		(4-3/4) 80-350, (6-3/4) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	To small probe 3.375	NA	2 Button Electrodes (0.5" and 0.2"), 1.25" apart	High Resolution images with optional Up/Down, Quadrant 16 bins , 32 bins , 64 bins images in RT and 128 bins image in RM	Lithium battery, up to 600 hrs.; and or generator	Y	Y
MicroResistivity Imager																												
OIden Technology, LLC																												
GeoFusion Laterolog Resistivity and Imager	4.75 / 6.75	19.3/15	30, 15 16, 8	4.75x2.25x19.8, 6.50x2.81x15.9	150 / 150 std (175 opt)	20 / 20		<30	<30	N/A	400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	Resistivity Image: 7.6ft / 3.7ft	Resistivity Image: 0.4in. (128 sectors) / 0.5in. (128 sectors)	Resistivity Imaging: 2 Button electrodes. 0.4" dia. (4.75 tool) / 0.5" dia. (6.75 tool)	Laterolog Resistivity Images at 128 sector.	lithium battery, optional turbine-alternator	Y	Y
Reservoir Mapping While Drilling																												
Baker Hughes																												
VisiTrak reservoir navigation and analysis	4-3/4, 6-3/4, 9-1/2	Transmitter - 8.9 Receiver - 28.9 (6-3/4) Receiver - 29.2 (9-1/2), Transmitter -7.9 receiver 28.6 4*3/4	BHA Dependent	BHA Dependent	150	30	Application Specific	Application Specific	Application Specific	N/A	200-900 (6-3/4-4-3/4) 290-1,600 (9-1/2)	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	N/Y	Prop. resist: 10.9, extra deep azim resist: 2.7, 6-3/4 Prop. resist: 13.5 extra deep azim resist: 5.4 9-1/2 Prop. resist: 13.2 extra deep azim resist: 4.9 4-3/4	Phase diff.: 0.3° for signal 20 dBµV; Attenuation: 0.06dB for signal 20 dBµV	Transmitter/receiver antennas	20 kHz / 50 kHz extra deep azimuthal resistivity	Turbine generator/ no limit	Y	Y
Schlumberger																												
GeoSphere 675 (6 3/4" Transmitter and Receiver)	6 3/4	12.83 (Transmitter), 13.16 (Receiver)	16/8	6.5x2.81x12.83 (UD1T6), 6.5x2.81x13.16 (UD3R6)	150	25	MW x Q²/C MW = mud weight in ppg Q = Flowrate in gpm C = 124,000			N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	3.8 (Transmitter), 5.51 (Receiver)	Not defined	Tilted Directional Antennas	360° Tri-axial Att. And Phase measurements in degrees and dB; deep reading, bed boundary identification and reservoir mapping for optimal well placement	MWD Turbine	Y	Y
GeoSphere 825 (8" Transmitter and Receiver)	8 1/4	13.42 (Transmitter), 13.58 (Receiver)	14/7	8x2.81x13.42 (UD1T8), 8x2.81x13.58 (UD3R8)	150	25	MW x Q²/C MW = mud weight in ppg Q = Flowrate in gpm C = 500,000				0-1,200	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	4.02 (Transmitter), 5.82 (Receiver)	Not defined	Tilted Directional Antennas	360° Tri-axial Att. And Phase measurements in degrees and dB; deep reading, bed boundary identification for landing and well placement	MWD Turbine	Y	Y
SpectraSphere	Pretest module: 6.906 drill collar nominal OD,8.25 max diameter at stabilizer. Fluid mapping module 6.906 drill collar nominal OD, 7.5 at wear band Sample Carrier Module: 6.891 drill collar nominal OD, 7.35 at bottle section, 7.5 at wear band	39 (Pretest module) + 42.5 (Fluid mapping module) + 17.7 (each Sample Carrier Module)	16/8	Pretest module: 6.5x2.81x54.6 FLuid mapping module: 6.5x2.81x46.2 Sample Carrier Module (no ILS): 6.5x2.81x18.5	150	25 std 30 opt	(MW x Q²/C) MW = mud weight in ppg Q = Flowrate in gpm Pretest module C = 53,000 Fluid mapping module C = 18,000 Sample Carrier Module C = 140,000				275-800	Downlink from surface	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	7.7	0-10,000 psi: Axton ± 1.5, SOI ± 3 10,000-20,000 psi: Axton ± 2.2, SOI ± 6.0. 20,000-30,000 psi: Axton ± 5.0, SOI ± 7.5	Axton gauge (primary), SOI (secondary)	Formation pressure, annular pressure, fluid composition (C1, C2, C3, C4, C5, C6+, CO2) GOR, FVF, Asphaltene content, mud filtrate contamination estimation and monitoring	MWD Turbine and Internal Turbine	Y	Y
OptiDrill675	6 3/4"	11.05	16/8		150	30	1	4	14	N/A	0-800	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Variable	WOB +/-3000lbf, Torque +/-1000ftlbs, Bending +/-3000ftlbs, Vibrations +/-0.25 grms, RPM +/-5rpm, Pressure +/-30psi, Temp +/-1degC	Strain gauge,accelerometer, magnetometer, gyroscope, pressure gauge, PT1000	DWOB, DTOR, Bending Moment, Axial vib, Lateral vib, RPM, Annular & Internal Pressure, Annular & Internal Temp	MWD turbine and lithium battery	Y	Y
OptiDrill900	9"	12.71	12/6		150	30	.1	.4	1	10	0-1600	Real-time, pumps on downhole recording	MWD Positive Continuous wave and downhole recording	N	Y	N	N	N/A	Variable	N/A	N/A	Variable	WOB +/-4000lbf, Torque +/-2000ftlbs, Bending +/-6000ftlbs, Vibrations +/-0.25 grms, RPM +/-5rpm, Pressure +/-30psi, Temp +/-1degC	Strain gauge,accelerometer, magnetometer, gyroscope, pressure gauge, PT1000	DWOB, DTOR, Bending Moment, Axial vib, Lateral vib, RPM, Annular & Internal Pressure, Annular & Internal Temp	MWD turbine and lithium battery	Y	Y
Acoustic Imager																												
Baker Hughes																												
ImageTrak high-definition acoustic imaging	6¾	8.8	BHA Dependent	BHA Dependent	150	25	Application Specific	Application Specific	Application Specific	N/A	see OnTrak limitation	Stop/start pumps Stop rotary Downlink	Positive mud pulse, positive continuous wave, wired pipe	N	Y	N	N	N/A	Op. Sel.	Continuous	Y/Y	6.7	256 sectors	Transmit/Receive Transducer	High resolution azimuthal ultrasound, Amplitude and Travel Time	Turbine generator/ no limit	N	Y
OIden Technology, LLC																												
Ultrasonic Imager GPUFusion	4.75 /6.75	6.4 /7.7	30, 15 16, 8	4.75x2.25x5.0/ 6.5x2.81x7.57	150	20/ 25	<10/ <30	<10/ <30	N/A		400 / 800	Via MWD system	Via MWD system	N	Y	N	Via MWD system	N / A	Fully programmable	Via MWD system	Via MWD system	675: USS: 2.36 ft Gamma Ray: 4.23 ft APWD: 3.07 ft	Ultrasonic Image: 0.04" / 0.04"	Multiple acoustic transceivers	Ultrasonic: Reflected amplitude and travel time images at 64 sectors.	lithium battery, optional turbine-alternator	Y	Y

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Service line (s)	Tool OD, in.	Length, ft	Max. DLS, 9/100 ft (sliding, rotation)	Equivalent bending stiffness (u)	Max. op. temp (C)	Max. op press, kpsi	Pressure drop, psi at 100 gal/min	Press. drop, psi at 250 gal/min	Press. drop, psi @ 450 gal/min	Press. drop, psi @ 1,200 gal/min	Flow range, gal/min (v)	Transmission trigger	Telemetry type	Wireline retrievable	Downlink mud	Downlink e-line	Downlink e-mag	MTF/GTF switch	Real time update period, sec.	Survey time period, sec.	Survey (sliding/ rotating)	Measure point(s) from tool bottom, ft	Measurement accuracy	Detector type	Measurement	Power source/ life, hr	Realtime	Recorded
PetroMar Technologies, Inc.																												
FracView LWD Borehole Imager/Caliper/Drilling-Dynamics-Monitor	6.5/6.75 nom., 7 max	5.2	20, 10+	6.5x2.25	150 (165 HPHT version)	20 (25 HPHT version)	<1	1	4	N/A	0 - 750	Surface High-speed SWRO	Optional - contact PetroMar	No	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable,1ms min.	Images rotating only, Dynamics both	4.0	<0.2" Image Resolution, <0.05" Feature Detection	Dynamically-focusable Ultrasonic Piezo Transducers (X2), Multi-axis Accelerometers & Magnetometers	High-resolution Borehole Images (amplitude and transit-time), Borehole Diameter and Shape, Drilling Dynamics (shock, vibration, motion, RPM), Orientation (gravity and magnetic)	Batteries, >200	Optional - contact PetroMar	Yes, >200h
FracView LWD Borehole Imager/Caliper/Drilling-Dynamics-Monitor (Slim Hole)	5.0 nom., 5.25 max.	6	30, 15	5x1.25	150 (165 HPHT version)	20 (25 HPHT version)	5	26	N/A	N/A	0-400	Surface High-speed SWRO	Optional - contact PetroMar	No	Optional - contact PetroMar	Optional - contact PetroMar	Optional - contact PetroMar	Configurable	Optional - contact PetroMar	Configurable,1ms min.	Images rotating only, Dynamics both	4.8	<0.2" Image Resolution, <0.05" Feature Detection	Dynamically-focusable Ultrasonic Piezo Transducers (X2), Multi-axis Accelerometers & Magnetometers	High-resolution Borehole Images (amplitude and transit-time), Borehole Diameter and Shape, Drilling Dynamics (shock, vibration, motion, RPM), Orientation (gravity and magnetic)	Batteries, >200	Optional - contact PetroMar	Yes, >200h
Weatherford																												
Ultrawave Ultrasonic Imager	4-3/4, 6-3/4	(4-3/4) 11.96, (6-3/4) 12.15	(4-3/4) 30/15, (6-3/4) 16/11	(4-3/4) 4.75x2.29, (6-3/4) 6.75x3.06	165 Std.	30 Std.	(4-3/4) 13, (6-3/4) 1	(4-3/4) 73, (6-3/4) 5	(6-3/4) 16		(4-3/4) 80-350, (6-3/4) 80-700	Pumps on	Positive mud pulse, Electromagnetic, Wired Pipe	N	Y	N	Y		Variable	N/A	N/A	(4-3/4) 3.79, (6-3/4) 3.90	0.20"	1.5" OD Acoustic Transciever	128-bin ultrasonic amplitude and travel time images	Lithium battery, up to 600 hrs.; and or generator	Y	Y