



## RUGGED, HIGH SPEED, HIGHER TEMPERATURE, RETRIEVABLE DUAL TELEMETRY MWD SYSTEM.

**Altitude's RapidFire EM** system combines our legendary transmission capabilities with advanced Shock Isolation techniques and optional downhole generator to produce the industry's most robust and powerful EM tool. The system can be configured as either retrievable or rigid mount depending on application, and if desired, coupled with the RapidFire pulser to function as a dual telemetry system.

EM telemetry is well-suited for underbalanced drilling and time sensitive projects where survey times associated with mud pulse telemetry are eliminated.

### WHAT MAKES IT RUGGED?

**Robust design & construction:** Threaded barrel sections connected with robust latch connectors improve reliability in high vibration environments.

**Battery, gamma & directional shock suspension:** Each component section has internal torsional and axial shock suspension systems that improve vibration dampening over other designs. In addition, a shorter tool length, coupled with lightweight titanium alloys, reduces vibration due to tool harmonics. The risk of Gamma, Accelerometer, and even catastrophic battery failure is reduced.

### WHAT MAKES IT HIGH SPEED?

**EM transmission speed:** RapidFire transmits data at approximately 4X the speed of conventional pulse systems.

**Elimination of survey NPT:** Since EM transmits during pipe connections, survey time NPT associated with pulse systems waiting for "pumps up" is eliminated.

### WHAT MAKES IT HIGH TEMP?

**Latest sensors, soldering techniques, and select components:** Specialized soldering materials and techniques are utilized to maintain electrical integrity at temperatures well above the quoted operating limits. High temperature proprietary electronics has also improved the survivability and performance of the tool over 300°F (150°C) -- an industry challenge for EM systems due to the heat generated during transmission.

### WHAT MAKES IT RETRIEVABLE?

The standard RapidFire EM system uses a proprietary mounting system (patent pending) that enables the tool to be wireline retrievable.

### WHAT ELSE MAKES IT UNIQUE?

**Well-suited for deeper programs:** Our advanced digital surface system coupled with proprietary decoder software enables the surface detection of extremely small signals resulting in greater depth capabilities. We continue to set depth records for EM in basins where conventional EM systems typically fail to detect signals.

**Well-suited for programs with various hole sizes:** RapidFire EM can be readily configured on the rig floor for various string diameters.

**Well-suited for non-conventional drilling fluids:** RapidFire EM functions in compressible drilling fluids including foam, mist, air, nitrogen, and aerated muds.

Tool Specifications	
Max. Operating Temp	350°F (175°C)
Max. Operating Pressure	20,000 psi (137 MPa)
Downlink - Adjustable Parameters	Frequency, Power level, Data sequence
Wireline Retrievability	Yes. Minimum bore diameter of 2.25" (57mm)
OD-Housing	1.875" (4.75mm)
Total Length (3 Battery)	35.75ft (11.0m)
Total Weight (w/o collar)	132lb (60kg)

Gap Sub Operating Limits					
Drill Collar OD		Gap Sub Tensile Rating (Static Pull)		Dogleg (Flex Collars) $\varphi$ /30m	
in	mm	lbf	daN	Sliding	Rotating
4.75	121	125,000	55,600	19.3	15.3
6.50	165	150,000	66,700	15.6	12.2
8.00	208	200,000	89,000	11.3	8.7
9.63	250	50,000	111,200	8.1	6.2

Sensor Specifications		
Sensor Parameter	Range	Absolute Accuracy
Inclination - Static	0-180 Deg	+/- 0.1 Deg
Inclination - Rotating	0-180 Deg	+/- 0.2 Deg
Azimuth	0-360 Deg	+/- 1.0 Deg
Azimuth - Rotating	0-360 Deg	+/- 1.0 Deg
Azimuth at Toolface	0-360 Deg	+/- 1.0 Deg
Magnetic Toolface	0-360 Deg	+/- 1.0 Deg
Gravity Toolface	0-360 Deg	+/- 0.5 Deg
Gamma	0-511 cps	+/- 1 AAPI

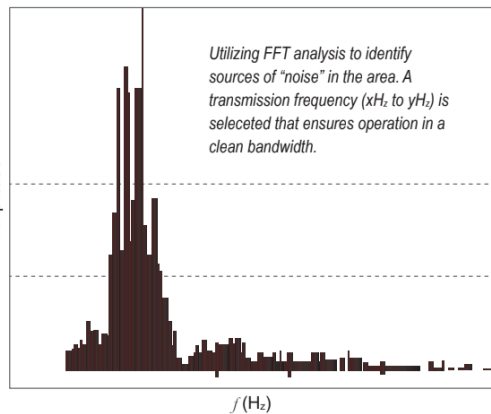
Environmental Specifications	
Sand Content	<1% by volume recommended
LCM Size	All types
LCM Weight	100lbs/bbl (285 Kg/m <sup>3</sup> )

Collar Dimensions		Flow Ranges	Pressure Drop H <sub>2</sub> O @ Max Flow
OD	ID		
4.75" (121mm)	2.68" (68mm)	0-340gpm (1.30m <sup>3</sup> /min)	50 psi (344 kPa)
6.50" (165mm)	3.25" (82mm)	0-685gpm (2.60m <sup>3</sup> /min)	75 psi (516 kPa)
8.00" (208mm)	4.25" (95mm)	0-1050gpm (4.00m <sup>3</sup> /min)	125 psi (861 kPa)
9.63" (250mm)	4.25" (108mm)	0-1465gpm (5.55m <sup>3</sup> /min)	125 psi (861 kPa)

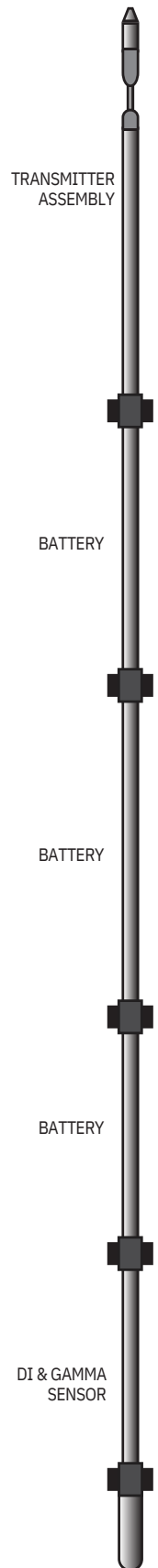
EM Transmission Time					
Frequency (hertz)	Data Rate (bps)	Survey Transmission Times		Update Frequency	
		Calculated	Vector	TF + Gamma	TF + Gamma + Rinc
9	4.5	0:16	0:27	0:05	0:08
8	4.0	0:18	0:31	0:05	0:09
7	3.5	0:21	0:35	0:06	0:10
6	3.0	0:25	0:41	0:07	0:12
5	2.5	0:30	0:49	0:09	0:14
4	2.0	0:37	1:02	0:11	0:18
3	1.5	0:50	1:22	0:15	0:24
2	1.0	1:15	2:04	0:23	0:37

## RAPIDFIRE EM FEATURES

- ✓ Bi-directional communication (Downlink)
- ✓ Change frequencies, power levels and data packets while drilling
- ✓ Rotating inclination
- ✓ Real-time shock/vibration
- ✓ No lost circulation material (LCM) or mud weight restrictions
- ✓ No rig floor handling - assemble on catwalk and drop into BHA



**DELIVERS CONSISTENT DATA TRANSMISSION IN A GREATER RANGE OF IMPEDANCE FORMATIONS**



Contact Altitude Today

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RapidFire EM