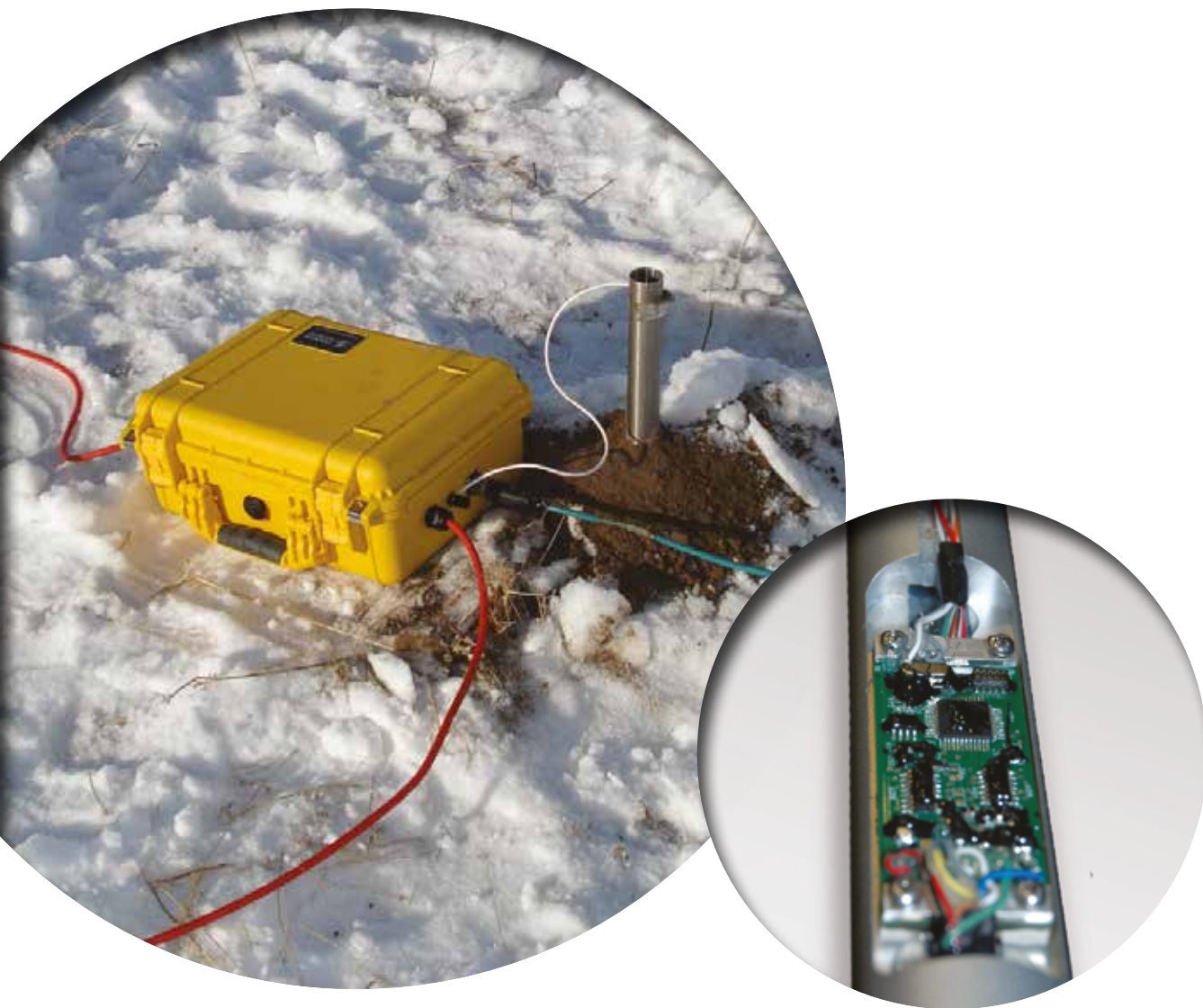


Enteq Twin EM System

Simultaneous Electromagnetic-Mud Pulse MWD Telemetry System



The Enteq Twin EM System is truly revolutionary. The system for the first time brings together simultaneous mud pulse and EM data transmission combined with step changes in bit rate, depth of operation and power consumption. This system is the one that will move previously niche EM telemetry into the mainstream MWD markets.

How the Enteq Twin EM System Works

- The EM Telemetry system is based on electromagnetic wave technology used to transmit drilling data uphole.
- It encodes downhole MWD/LWD data into low frequency electromagnetic waves.
- Signal is transmitted from the tool through the drill pipe and formation and detected on surface as low-voltage potential between the wellhead and remote electrode (antennae).
- Waves are decoded and processed by surface receiver and displayed on driller's display.
- It operates in environments where mud pulse may not be optimal or possible, under-balanced drilling for example:
 - Drilling with air and foam
 - Drilling with high concentrations of lost circulation material in mud
 - Fast horizontal drilling
 - Shallow gas/oil drilling.

Enteq Twin EM System Offers

- The latest and most technologically advanced EM technology.
- The only system to use mud pulse and EM telemetry concurrently with fall-over contingency for full downhole redundancy.
- Advanced signal processing for optimum performance at greater depths and over a wider range of formations.
- Compatibility with existing direction sensor packages meaning significant cost savings.
- A high voltage system which covers a wide range of formation resistivity (0.1–2000 ohm.m) including coal and anhydrite.
- A system that works where other systems would simply saturate.
- Quicker data transmission resulting in significant cost savings.

Delivering
revolutionary
EM technology for
mainstream application



Partners in technology support



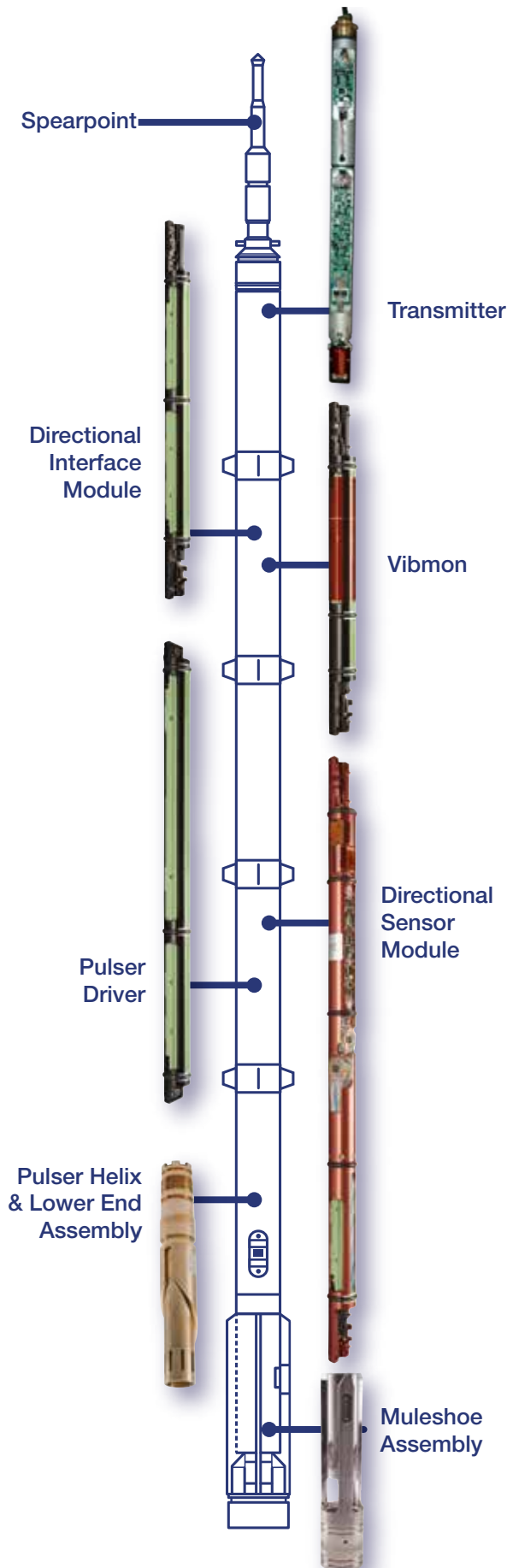
Based in the UK,
Leading Magnetic
Design has been at

the cutting edge of electromagnetic research for decades, with a wide experience of EM applications including geophysical prospecting and satellite sensing. The Twin system has been in development for over a decade and truly is a next generation system. The LMD team continues to develop the Twin system to ensure it will remain at the cutting edge of EM technology for the foreseeable future.



Based in Canada, Drill-Tek has an enviable reputation for great engineering and world class support. Drill-Tek designs and manufactures a wide range of products including pulsers, test systems and surface software. Drill-Tek has been instrumental in helping package the Twin system to meet the needs of the field making it robust and ensuring the interface to the XXT MWD system is seamless. Drill-Tek's support team have field trialed the Twin system extensively to ensure reliability in any environment.

Enteq Twin EM MWD System



EM Transmitter & Gap Sub

The EM transmitter is the only one to simultaneously transmit data alongside our standard DC motor driven pulser for added data security. The transmitter also works faster and deeper than any comparable system. The highly efficient electronics do this by generating almost zero noise which translates into very low power consumption. The Gap Sub provides electrical isolation between the transmitter and the drillstring using extremely robust ceramic insulators.

Vibmon

The Vibmon monitors downhole shock and vibration in three axes. Real-time telemetry and display of downhole shock and vibration enables drillers to avoid costly downhole equipment failure and optimize ROP. Data is also recorded downhole for plotting and analysis on surface.

Directional Interface Module

The XXT DIM provides a flexible, intelligent solution for the acquisition, formatting, and telemetry of downhole data to surface. It is a drop-in downhole Directional Interface Module providing mud pulse telemetry compatible with industry standard Tensor systems.

Directional Sensor Module

The XXT-DS Directional Sensor, designed to XXT standards and specifications, incorporates the industry renowned JAE accelerometers and magnetometers. Incorporating XXT's Digital Head Module, the complete Directional Sensor assembly provides a temperature corrected plug-and-play solution using the most reliable aviation specification components.

Pulser Driver and DC Drive Pulser

The XXT-PDEM Pulser Driver and DC Drive Pulser is a rugged field proven unit with a highly efficient and reliable brushless DC motor. The intelligent PDEM electronics optimizes telemetry rates and manages power consumption using an accelerometer flow switch. The DC motor drive gives huge battery savings and higher MTBF than comparable solenoid-based units while being easy to service.

Accessories

Enteq manufactures a complete range of MWD and DD accessories including everything needed to run an MWD survey. Our South Houston product centre makes everything from spearpoints to muleshoes and all of the barrels and interconnects in between. We also supply larger accessories including the kit boxes, tools racks and pipe screens.

Options

Gamma Ray Sensor

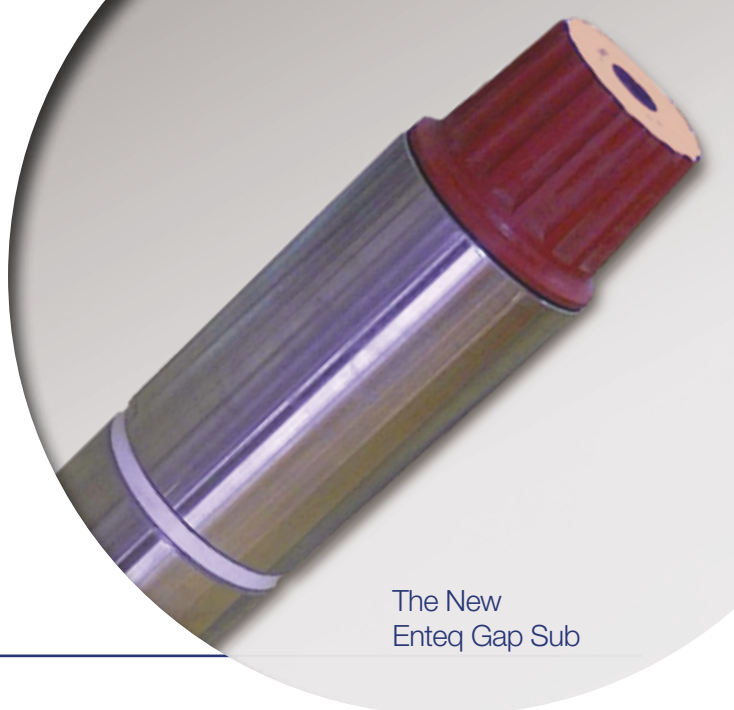
An industry standard, natural Gamma Ray tool based around a highly ruggedized scintillation counter and photomultiplier tube. The GR data can be used in depth correlation and geosteering applications where radioactive uranium is associated with gas rich shales.

Resistivity Tool

Single and Multifrequency LWD tools available in a complete range of sizes including slim hole. These field proven tools deliver true reservoir saturation data from multiple depths of investigation. The wireline log quality output has been used by oil companies all over the world. The data can also be used for geosteering applications.

Advantages of Enteq Twin EM System

- Improved overall reliability with a combined mud pulse and EM telemetry system.
- Ability to slide out of casing shoe.
- Drill in discontinuous borehole fluid column.
- Drill in highly resistive formations.
- Faster MWD/LWD data-point update rates.
- No switch over needed between systems if one system encounters problems.
- Can be run as stand-alone EM system if the operating environment dictates.



The New
Enteq Gap Sub

Benefits of Enteq Twin EM System

- Twice as fast as older EM systems at same carrier frequency delivering faster updates.
- 20W output equivalent to 60W competitor output optimising battery length without compromising operational efficiency.
- Data rate up to 10 BPS. 10 x standard MWD mud pulse.
- Fully retrievable.
- 2-10 Hz adjustable carrier frequency.
- Transmit 4 global parameters: Gamma (including focused), Toolface, three generic variables including shock, vibration and resistivity.
- Updates at 15 second intervals compared to 120 seconds for mud pulse.
- Constant current mode enables automatic lithology compensation.
- Power efficient mode for signal transmission through formation (Example: 10 ohm.m formation).
- Standard power mode (120 hours/battery).
- Power saving mode (240 hours/battery).
- 75% less power than other systems.
- Ultra low-noise receiver technology.
- Capable of detecting low/weak signal under 20nV amplitude meaning deeper operations (TVD in excess of 2500m and MD in excess of 4000m).
- Continuous wave (AC) transmission model.

Power Challenges

The logistical challenges of EM previously associated with lithium cells and lack of power no longer apply. The Enteq Twin EM System is more power efficient than any previous EM system with running costs similar to standard mud pulse, meaning the system can be used economically anywhere in the world.

Competitor 1

EM systems from a large independent MWD supplier

Competitor 2

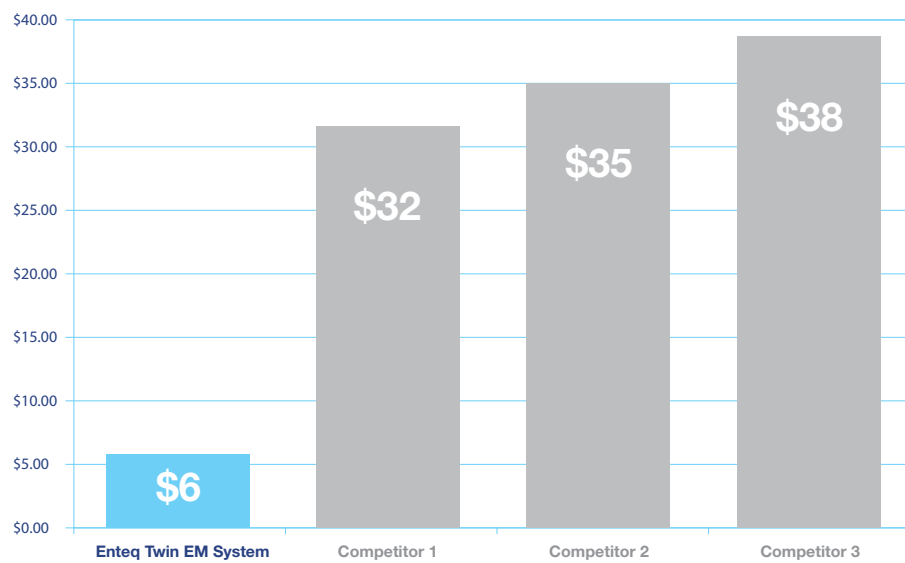
EM systems from a multinational oilfield products supplier

Competitor 3

EM system from a multinational oilfield products and services supplier

Price based upon cost of \$1400 per battery.

Battery cost per hour



System Specifications

Operating

Operating	
Transmission Mode	Continuous Wave
Wireline Retrievality	Fully retrievable
Typical Operating Depth (no repeater)	10,000 ft (3,000 m) Maximum depth down to over 12,000 ft
Data Rate	10 bps
Operating Pulse Width	0.4-0.8 seconds
Battery	2 x standard Lithium batteries
Typical Battery Life	Over 200 hours per battery
Maximum Power Draw	20W (60W equivalent)
Gap Sub OD available	8", 6½", 4¾", 3½"
Tool Programming	Fully surface programmable
Downlink	Pump-control: EM power and frequency downhole-programmable

Downhole

Downhole	
Operating Temperature	165 C (329F)
Maximum Pressure	20,000 psi (137.9 MPa)
Shock	1,000g
Vibration	30-500Hz 20g all axes

Surface

Surface	
Operating Temperature	-23 to 52C (-9 to 126F)
Storage Temperature	-40 to 52C (-40 to 126F)

Directional Sensor Specifications*

Parameters	Accuracy	Repeatability	Resolution
Azimuth (Degrees)	+/- 0,5	+/- 0,5	0.1
Inclination (Degrees)	+/- 0,05	+/- 0,05	0.1
Operating Temperature (°C)	+/- 2,0	+/- 1,0	0.1
Local Magnetic Field (Total Magnetic Field, microTeslas)	+/- 0,1 mT	+/- 0,1 mT	0,05mT
Gravitational Position - front of the unit (Highside Toolface, Degrees)	+/- 0,5	+/- 0,5	0.1
Magnetic Position - front of the unit (Magnetic Toolface, Degrees)	+/- 1,0	+/- 1,0	0.1
Azimuth Position - front of the unit (Magnetic Toolface referenced to Grid or True North, Degrees)	+/- 1,0	+/- 1,0	0.1
Transmission Resolution: Selectable			
Speed (Data Rate): 0.625 bits/sec nominal			

*calculated data only





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