



REFRESHING MWD TECHNOLOGY

Noralis Directional Module NDM

Transforming MWD technology by integrating solid-state sensors, processor and power supply into a fully-featured and reliable cost-effective solution.



Noralis Directional Module NDM

Solving the technical barriers that have prevented MWD tools from evolving into an Integrated Solid State product.

- Multiple arrays of sensors, proprietary calibration routines and patented bias correction algorithms provide the accuracy and temperature requirements for downhole use.
- Integrated Sensors, MPU, and TPS creates a rugged and powerful single chassis solution.
- Shock, vibration, and RPM added for a complete directional and environmental sensing product.
- A single powerful processor gathering sensor data also manages the bus, pulser and gamma lines.
- Eliminate tool interface boxes with a simple USB cable & PC.
- Integrated with cloud based data management (tool tracking, firmware, running history, calibration history & lifetime logging).

Legacy Compatibility

- Designed to replace the existing ODT style directional module, strongback, MPU, and TPS.
- Standard Wiring
- Standard Connections
- Programmable by competitor's surface systems.
- Compatible with Pulsers, Gamma or other MWD components over the standard 10 wire bus.
- Compatible with M-ARY based decoding and ODT (Q-Bus) compatible surface kits.
- Noralis has a powerful and cost-effective surface decoding and MWD software management solutions for more advanced users who want to fully utilize all the powerful features of NDS.



KEY FEATURES

Short Length

Full Functional Electronics in DM footprint

Equivalent Accuracy

Same accuracy as standard tool at 50% the cost

Solid Reliability Gains

Reduction in # of total boards

Reduction in total connections

Reduction in voltage rails

Centralized circuitry and single micro processor reduces processor-to-processor and PCB-to-PCB errors.

Redundancy

Individual sensor failure is not cause to trip

Dual temperature sensors

Dual lines for non-traditional wiring set-ups

Ruggedness

Solid-State Sensors, many times stronger than quartz accelerometers

Ultra-ridged chassis (Cross Sectional area no less than 50%)

Live Inclination

Internal Logging

NDM has unprecedented logging capabilities with a large memory fast dump.

- 20+ days logging
- Keeps most recent data
- 60+ data points every 20 seconds
- All telemetered variables
- All surveys (Raw Format)
- Gamma every 5 seconds

Fully featured shock and vibration logs:

- Counts
- Max
- Average
- RMS

Environmental Logging

NDM records and accumulates downhole environmental data into segmented temperature ranges. In this way the exact temperature exposure for the tools are can be fully understood and documented.

Shock and vibration exposure are also segmented into increasing severity buckets. This allows users to know how much stress the tool has experienced laterally, axially, and torsionally.

As NDM is all of your MWD Electronics - life time maintenance management becomes easy.

This invaluable data is internally logged by the NDM for both sensor lifetime and the last downhole run.

When connected to the Internet, downloaded data is automatically added to your company's private "HUB" account. Full historical tool records saved in the cloud available from any web browser.

Tool Lifetime Data

Peak	0 g	5 g	10 g	15 g	20 g	25 g	30 g	35 g	40 g	45 g
Gx	70.1 day	15.9 day	2.2 day	1.3 day	18.3 hr	7.1 hr	3.1 hr	2.1 hr	51.7 min	11.2 min
Gz	76.3 day	11.2 day	1.7 day	23.3 hr	9.0 hr	3.9 hr	2.1 hr	50.4 min	1.3 min	0.2 min
Avg	0 g	2 g	4 g	6 g	8 g	10 g	12 g	14 g	16 g	18 g
Gx	60.3 day	14.6 day	10.4 day	3.8 day	1.2 day	6.2 hr	4.9 hr	1.2 hr	41.7 min	10.2 min
Gz	65.1 day	20.5 day	3.7 day	12.93 hr	17.5 hr	2.1 hr	2.7 hr	23.4 min	17.3 min	1.3 min
Temp	0 deg C	20 deg C	40 deg C	60 deg C	80 deg C	100 deg C	125 deg C	150 deg C	160 deg C	180 deg C
	39.8 min	7.4 day	8.8 day	13.5 day	19.4 day	12.2 day	8.3 day	2.7 day	41.7 min	0.0 min

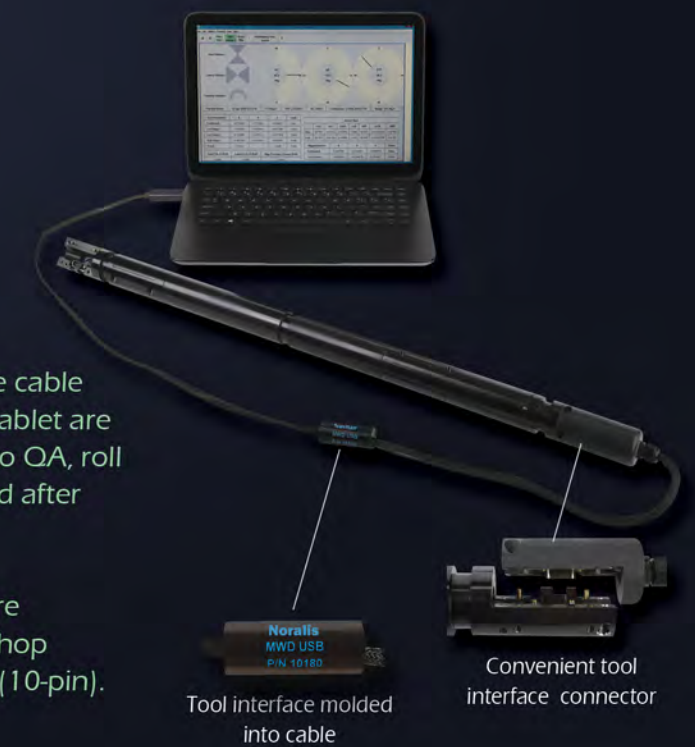
Bit Run Data

Peak	0 g	5 g	10 g	15 g	20 g	25 g	30 g	35 g	40 g	45 g
Gx	8.7 day	1.9 day	6.6 hr	3.9 hr	2.3 hr	58.9 min	40.2 min	32.7 min	6.4 min	2.1 min
Gz	7.8 day	2.7 day	3.7 hr	2.4 hr	1.9 hr	44.4 min	21.5 min	19.4 min	2.7 min	0.4 min
Avg	0 g	2 g	4 g	6 g	8 g	10 g	12 g	14 g	16 g	18 g
Gx	7.5 day	1.8 day	1.3 day	11.4 hr	1.2 hr	40.1 min	29 min	9.3 min	5.8 min	1.2 min
Gz	8.1 day	2.6 day	11.1 hr	1.6 hr	2.2 hr	15.7 min	20.3 min	3.9 min	2.0 min	0.4 min
Temp	0 deg C	20 deg C	40 deg C	60 deg C	80 deg C	100 deg C	125 deg C	150 deg C	160 deg C	180 deg C
	5.1 min	23.8 day	1.1 day	1.7 day	2.4 day	1.5 day	1.0 day	23 day	5.6 min	0.0 min

Easy to Use!

USB Tool Interface cable and a computer/tablet are all that's needed to QA, roll test and download after the run.

Interface cables are available for the shop (21-pin) and field (10-pin).



Tool interface molded into cable

Convenient tool interface connector

NDM Specifications



Physical

- Length 29.2" (74.17 cm)
- Diameter 1.38" (3.5 cm)
- Weight 3.1 lbs (1.4 kg)
- Rigidity 50% of total X-sectional area
- Isolation >10 M ohms electrical barrier

Environmental

- Operating Temperature 0 - 175° C *
- Survival Temperature -40 - 175° C
- Vibration Qualification 20g RMS 15-500 Hz
- Shock Qualification 1000G, 1ms, half-sine
- Sensors Vib. Qualification 250g RMS 10-500 Hz
- Sensors Shock Qualification 3500G, 1ms, half-sine

Interface & Internal Memory

- Memory 32 Mb (20 days)
- Logic Level TL/CMOS
- RS-485 57,600 baud
- R&D Logging Memory (opt) 8 Gigabyte
- USB interface for Tool Comms

Instrumentation Accuracy

- Sensor Accuracy 16 bit
- A/D Conversion 16 bit
- Inclination $\pm 0.1^\circ$
- Azimuth @ 90° Inc. (Dip < 70°) $\pm 0.25^\circ$
- Azimuth @ 45° Inc. (Dip < 70°) $\pm 0.375^\circ$
- Dip Angle $\pm 0.4^\circ$
- Total Gravity Field ± 2.5 mG
- Total Magnetic Field ± 300 nT

* 167-175 °C : Inclination $\pm 0.3^\circ$, Azimuth $\pm 1.0^\circ$

Patents pending

Electronics

- Efficient, clean 5V Power Supply Circuitry
- Ultra low noise signal conditioning
- 32-bit Processor
- 24 x 16-bit A/D Converters
- Oversample all 27 sensors at 1000 samples/sec
- Standard USB Interface or Q-bus Interface

27 Solid-State Sensors

- 18 Accelerometers
(6 high-range, 12 low-range solid-state devices)
- 3 Magnetometers
- 3 Shock Sensors (x,y,z)
- 2 Temperature Sensors
- 1 Gyro Sensor (RPM Measurement)

Memory

- 32 Megabytes (20 days drilling)
- Gamma Ray every 5 seconds (20-sec Average)
- Full 27 sensor array every 20 seconds
- All Pulsed Data & Static Surveys
- Lifetime & Bit-Run Logs
- RS-485 Interface for downloading logs

Compatibility

- Standard End Connectors (21-pin / 15-pin)
- Standard Pulser/Gamma Interfaces
- Standard M-ARY encoding/decoding
- Q-bus compatible
- Provide raw 6-axis outputs & calculated values

Power Requirements

- Works with standard MWD batteries
- Input Voltage Range 9V - 40V
- Power Usage @ 28V 1.15 W