

Features

- High accuracy: $\pm 0.1^\circ$ for toolface (roll) and inclination, $\pm 0.3^\circ$ for azimuth
- Digital serial input/output
- Real-time vibration monitoring
- Accurate "Inclination-while-drilling" data
- Real-time rotation monitoring with accurate RPM reporting to 200 RPM
- Optional integrated axial shock mounts
- Temperature compensation to 150°

The Model 1150 Advanced Directional Sensor enables high-accuracy measurement of the toolface (roll), inclination, and azimuth orientation angles in borehole logging and drilling applications. The unit can be a direct replacement for Tensor MWD directional sensors; for example, sensor length is the same as Tensor units, and the Tensor 10 pin Q-Bus is implemented to carry signals through the sensor.

The Model 1150 Advanced sensor contains both a 3-axis flux-gate magnetometer and a 3-axis accelerometer. The combination of these two sensor systems enables determination of the toolface, inclination, and azimuth angles of the 1150 reference frame. The toolface and inclination angles are calculated from the accelerometer sensor outputs, while azimuth angle is calculated from the magnetometer sensor output.

To maintain high accuracy over the temperature range of the system, the sensors are temperature-compensated. This enables an accuracy of $\pm 0.1^\circ$ for toolface and inclination and an accuracy of $\pm 0.3^\circ$ for azimuth to be achieved over the full temperature range of the system.

The 1150 data interface is implemented with a Maxim Max186 analog to digital (A-to-D) converter; the user accesses this converter by the exposed SPI port. Calibration constants are



Applications

- Advanced drop-in replacement for GE Tensor Digital Orientation Module
- Orientation of borehole logging instruments
- Directional drilling

stored in a Microchip 24AA16 flash memory chip accessed with an exposed IIC interface. Both the A-to-D and flash memory design are Tensor compatible.

In addition to the Tensor A-to-D and flash memory interfaces, the Model 1150 Advanced has a digital serial interface. This interface is capable of transmitting either the magnetometer and accelerometer outputs or the system orientation angles. The data transmitted over the digital interface is temperature-calibrated and can be transmitted in either ASCII or binary format. The 1150 transmits digital data upon command or autosends data upon power up.

The Vibration Detection feature transmits a Vibration Severity variable as a 3-bit, 1 to 5 scale (1 = very low, 5 = extremely high), which allows the operator to mitigate downhole vibration in real time (1-2 normal, 3-4 = possible tool damage, 5 = imminent tool damage). The Vibration Severity algorithm reduces the timing impact of this additional data to the logging sequence. Peak G levels can be transmitted real time, or logged to memory for retrieval after the run.

The 1150 Advanced sensor also includes a Rotation Monitoring feature that displays the current downhole RPM, and an "Inc-While-Drilling" sensor with an accuracy of $\pm 3^\circ$. This gives the Directional Driller the measurement needed to monitor changes in inclination, without having to stop drilling for a survey.

Model 1150 Advanced

High Accuracy Directional Sensor



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PHYSICAL

Outside Diameter (O.D.)	1.360" (35 mm)
Length	29.2" (742 mm)
Weight	1.5 lbs (681g)
Top Connector	MDM21PH003F (ITT Cannon)
Bottom Connector	MDM15SH003B (ITT Cannon)

ELECTRICAL

Input Voltage Range	+12V to +30V
Current Draw	70 mA @ 15V
Logic Level	TTL / CMOS
Baud Rate	User programmable to 9600 Baud
Protocol	User Selectable, ASCII or Binary

ENVIRONMENTAL

Shock	1000 G 1ms half sine wave
Vibration	5G RMS random, 50-200Hz
Azimuth Accuracy	$\pm 0.3^\circ$
Roll (Toolface) Accuracy	$\pm 0.1^\circ$
Inclination Accuracy	$\pm 0.1^\circ$ ($\pm 0.5^\circ$ while drilling at 50RPM)
Operating Temperature Range	-20°C to +150°C
Storage Temperature Range	-30°C to +175° C

Specifications within this document are subject to change without notice.

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www.appliedphysics.com

281 East Java Drive, Sunnyvale, CA 94089 USA • 650.965.0500 • Fax: 650.965.0404 • email: service@appliedphysics.com