



Applied Physics
Systems

Model 1150

High Accuracy Directional Sensor

Features

- High accuracy:
 - ±0.1° for toolface (roll) and inclination
 - ±0.3° for azimuth
- Digital serial input/output
- Small size: 1.36" OD by 29.2" long
- Temperature compensated up to 150°C

Applications

- Tensor digital drop in replacement
- Orientation of borehole logging instruments
- Directional drilling



The Applied Physics Systems Model 1150 Directional Sensor enables high accuracy measurement of the toolface (roll), inclination, and azimuth orientation angles in borehole logging and drilling applications. The unit is a direct replacement for Tensor directional sensors. For example, the length of the sensor is 29.2", which is the same length as Tensor units.

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 stored in a Microchip 24AA16 flash memory chip accessed by an exposed IIC interface. Both the A-to-D and flash memory design are Tensor compatible. The Tensor 10-pin bus is also implemented to carry signals through the sensor.

The Model 1150 sensor contains both a 3-axis fluxgate 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. The magnetometer sensor outputs are used to calculate the system azimuth angle.

To maintain high accuracy over the temperature range of the system, the sensors are temperature compensated. This enables an accuracy of ±0.1° for toolface and inclination and an accuracy of ±0.3° for azimuth to be achieved over the full temperature range of the system.

In addition to the Tensor A-to-D and flash memory interfaces, the Model 1150 has a digital serial interface. This interface transmits 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 ASCII protocol sends ASCII characters to the Model 1150 to obtain data. The data returned by the 1150 is transmitted as an ASCII data stream, complete with returns and line feeds, so that it can be easily displayed on a video terminal (provided a TTL to RS-232 conversion is made by the user).
- The binary protocol is used for high speed computer to computer interchange. In this case, one byte is sent to request data. The Model 1150 then responds with a multibyte data packet containing the desired data plus header and checksum.

The 1150 can be configured to transmit digital data upon command or can be configured to autosend data upon power-up. The serial in and serial out lines of the digital interface operate at TTL/CMOS levels and are normally set to operate at 9600 baud with one stop bit and no parity. Other baud rates can be user programmed.

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PHYSICAL

Outside Diameter (OD)	1.36" (35 mm)
Length	29.2" (742 mm)
Weight	1.5 lb (681 grams)
Top Connector	MDM21PH003F (ITT Cannon)
Bottom Connector	MDM15SH003B (ITT Cannon)

ELECTRICAL

Input Voltage Range	+12 V to +30 V
Current Draw	40 mA @ +15 V, 40 mA @ -15 V
Logic Level	TTL/CMOS
Baud Rate	User programmable to 9600 Baud
Protocol	User selectable: ASCII or binary

ENVIRONMENTAL

Shock	1000 G 1 ms half sine wave
Vibration	20 G RMS 5 Hz to 1000 Hz
Operating Temperature Range	-20°C to +150°C
Storage Temperature Range	-55°C to +175°C

PERFORMANCE

Toolface (Roll) Accuracy	$\pm 0.1^\circ$
Azimuth Accuracy	$\pm 0.3^\circ$
Inclination Accuracy	$\pm 0.1^\circ$