Navigation Sensors

Product Guide

130-7523-001

Version 5.0

For Use with DC-4, GEDC-6 and AHRS-8 Sparton Navigation Sensors

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Revision History

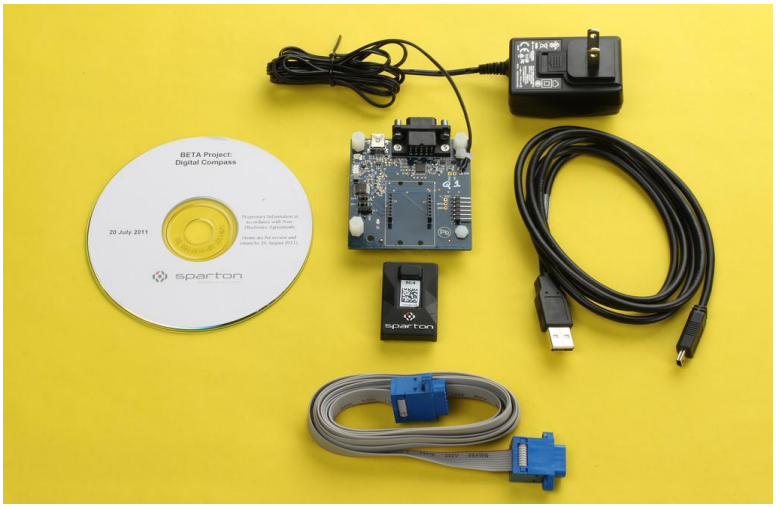
REV	CHANGE NO.	DATE OF CHANGE	DESCRIPTION OF CHANGE	INITIALS AND DATE
1.0	n/a	9/30/11	ORIGINAL RELEASE FOR DC-4 AND GEDC-6	JT 9/30/11
2.0	n/a	11/30/11	UPDATES TO SPECIFICATIONS, ADDS NDS-1 MECHANICALS AND NORTHTEK™ FEATURE	JT 11/30/2011
3.0	n/a	1/27/2012	ADDITION OF RM-1 RUGGEDIZED MOUNTING ADAPTER KIT, UPDATED INPUT POWER OF DC-4	JT 2/14/2012
4.0	n/a	7/3/2012	ADDITION OF AHRS-8 PRODUCT INFORMATION, ADAPTNAVII AND RECCOMENDED CIRCUIT FOR FIRMWARE AND WORLD MAGNETIC MODEL UPDATES	JT 7/3/2012
5.0	n/a	8/2/2012	CHANGES TO AHRS-8 SPECIFICATIONS	JT 8/2/2012

DC-4 Navigation Sensor

GEDC-6 Gyro-Enhanced Navigation Sensor

AHRS-8 Attitude Heading Reference System

RM-1 Ruggedized Mounting Kit



NDS-1 Navigation System Development Kit

INTRODUCTION

The Sparton Navigation and Exploration line of navigation sensors provides superior performance and flexibility. Using advanced hardware and software, the Sparton navigation sensor offers an impressive list of features at an affordable price. It is the world's only low-cost navigation sensor that provides adaptive in-field calibration via the best-in-class AdaptNav™ sensor fusion adaptive algorithm, and full user programmability via the NorthTek™ Development System. The DC-4, GEDC-6 and AHRS-8 navigation sensors are designed to easily integrate into any system using a logic-level Universal Asynchronous Receiver/Transmitter (UART) interface.

FEATURES

FEATURES	DC-4	GEDC-6	AHRS-8
Tilt Compensated Heading	X	X	X
Adaptive 2D and 3D In-Field Magnetic Calibration	X	X	X
Full 360° Rollover Capability	X	X	X
True North Heading via Built in World Magnetic Model	X	X	X
Pitch and Roll	X	X	X
3D Magnetic Field (milligauss)	X	X	X
3D Acceleration (milli-g)	X	X	X
Horizontal, Vertical, Right Edge, Left Edge and Inverted Mounting	X	X	X
Selectable Baud Rate	X	X	X
Quaternion/Rotation Matrix Output	X	X	X
UART Communications	X	X	X
Power Management (Sleep Mode)	X	X	X
RoHS Compliant	X	X	X
AdaptNav™ Adaptive Algorithm		X	
AdaptNavII™ Adaptive Algorithm			X
Motion Stabilization: Gyroscopes		X	X
NorthTek™ User Programmable	X	X	X
Update Rate	10Hz	100Hz	100Hz
Power Consumption @ 4 V	132 mW	320 mW	330 mW
Fully Temperature Compensated, Individually Calibrated Over -40° to +70° C Temperature Range			X
Selectable Accelerometer Dynamic Ranges for Highly Dynamic Application Environments			X

- Small Size (42 x 28 x 11 mm)
  - The small size of the Sparton navigation sensor allows for use in space sensitive applications. The mass is a miniscule 16 grams.

- Accurate Tilt Compensated Magnetic Heading
  - Magnetic heading is based on a level condition relative to the surface of the Earth. When the sensor platform is tilted, an incorrect heading would result if left uncompensated. The Sparton navigation sensor measures the 3-dimensional magnetic and acceleration field conditions and mathematically corrects the magnetic readings based on the sensor orientation.

- 2D and 3D In-Field Magnetic Calibration
  - The Sparton navigation sensor uses a unique adaptive algorithm that monitors the magnetic field conditions during movement (roll, pitch, and yaw) of the sensor platform. The adaptive algorithm minimizes both hard and soft magnetic distortion errors of the mounting platform (i.e. distortions that move with the sensor). This revolutionary calibration algorithm is capable of full 3D magnetic calibration as well as accurate 2D calibration for applications with limited pitch and roll capability.

- Full 360° Rollover Capability
  - The Sparton navigation sensor processing is able to tilt compensate the magnetic readings in any orientation. This gives the sensor the ability to provide an accurate magnetic heading for full 360° roll angles.

- AdaptNav™ and AdaptNav II™ Sensor Fusion Adaptive Algorithms
  - Best in class AdaptNav™ adaptive algorithm outperform traditional Kalman filter based approaches by providing real-time optimizations when used in varying magnetic and dynamic operating environments, assuring an industry leading sensor performance (applicable to GEDC-6).
  - The AdaptNavII™ adaptive algorithm builds upon AdaptNav™ feature functionality and provides revolutionary real-time noise characterizations used for drift compensation of heading, pitch and roll when in electrically and mechanically noisy environments (applicable to AHRS-8).

- Motion Stabilization: Gyroscopes
  - Most navigation sensors measure the direction of acceleration due to Earth's gravity to determine a level orientation for tilt compensation. Acceleration due to platform movement can cause errors in heading determination. The gyroscopes and their unique algorithms developed for the Sparton GEDC-6 and AHRS-8 navigation sensors help to stabilize heading, pitch and roll information in the presence of motion, and compensate for transient magnetic disturbances (not applicable to DC-4).

- Variation Correction/World Magnetic Model
  - The Sparton navigation sensor directly determines the magnetic heading. The sensor can provide True North heading when given the current magnetic variation. The sensor can calculate the magnetic variation when given positional information (latitude, longitude, altitude, date) or can be entered directly if the variation angle is known.

- True 3D Magnetic Measurements (in milligauss)
  - The on-board magnetometers are calibrated in-factory to provide true X, Y, and Z magnetic field strengths in milligauss. This magnetic vector is relative to the sensor platform. Stray magnetic fields within the sensor application are compensated for by using the in-field adaptive calibration to maintain accuracy.

- Quaternion/Rotation Matrix Output
  - The Sparton navigation sensors provide a Quaternion/Rotation Matrix output.

- Temperature Compensation and Calibration Over Temperature
  - The AHRS-8 is fully temperature compensated over the entire operating range and individually calibrated from -40° to +70° C for performance in the most challenging of application environments

- True 3D Acceleration Measurements (in milli-g)
  - The on-board accelerometers are calibrated in-factory to provide true X, Y, and Z acceleration strengths in milli-g (where 1000milli-g = Earth's Gravity).

- Pitch and Roll (in degrees)
  - Pitch and Roll angles describe the orientation of the Sparton navigation sensor in degrees from a level condition.

- Temperature (in degrees C)
  - The temperature of the Sparton navigation sensor in degrees-C is available as output on the DC-4, GEDC-6 and AHRS-8.

- Customizable Mounting Options
  - Mounting configuration is user-selectable between horizontal, vertical, left edge, right edge and inverted orientations. Custom orientations are possible by modifying the Boresight matrix via NorthTek™ TARE software scripts.

- Bi-Directional 3.3V Logic-Level UART Communication
  - A 3.3V Logic Level UART interface is provided. The specifics are detailed in the digital interface section of this guide (see page 19).
  - Selectable baud rates in the range of 300 baud to 115.2k baud.

- High Dynamic Range Options
  - The AHRS-8 offers selectable 4g or 8g accelerometer dynamic ranges suitable for highly dynamic application environments

- Power Management Capability (Low Power or 'Sleep' Mode)
  - The Sparton navigation sensors may be commanded into an ultra low power ('Sleep') Mode and brought back to normal power via the UART interface. The sensor becomes fully functional within 1.5 seconds after receiving the command.

- Robust Design
  - The Sparton navigation sensor is a RoHS compliant potted module ready to meet the requirements of your design application and environment.

- User Configurable Messages
  - The Sparton navigation sensors provide many user configurable output messages (single values or predefined set of values), and three user configurable output messages.

- User Programmable Sensor Customizations via NorthTek™ Development System
  - The DC-4, GEDC-6 and AHRS-8 are the world's only programmable navigation sensors, providing programming capability for powerful in-sensor customizations via a built in Forth interpreter. For more information, please reference the NorthTek™ Development System Programming Guide.

SPECIFICATIONS

DC-4 Navigation Sensor

Performance data applies to 25°C, 0g Acceleration for Pitch/Roll unless otherwise specified:

Static Heading Accuracy	0.3° RMS
Heading Repeatability	0.1° RMS
Static Pitch/Roll Accuracy	0.2° RMS
Pitch/Roll Repeatability	0.1° RMS
Pitch/Roll Range	± 90°, ± 180°
Accelerometer Range	+/- 4g (+/- 1g)[1]
Accelerometer Noise Density	126 µg/√Hz
Accelerometer Bias Stability	0.023 mg
Accelerometer Velocity Random Walk	0.063 m/s
Magnetic Range	±1.2 Gauss (±900 MGauss)[1]
Maximum Magnetic Inclination (Dip)	± 80°
Update Rate (Samples/Sec)	10
Baud Rate	0.3, 1.2, 2.4, 4.8, 9.6; 19.2; 38.4; 57.6; 115.2 kbaud
Dimensions L x W x H	42 x 28 x 11 mm (1.66 x 1.11 x 0.43 inches)
Mass	16g
Encapsulated or Enclosure	Yes
Operating Temp	-40° to +85° C
Storage Temp	-40° to +85° C
Humidity Resistance	95%, 70° C, 240 hrs Meets MIL-STD-202G – Method 103A, Test Condition A
Shock Resistance	1500g, 1ms Pulse, Half-Sine Wave Meets MIL-STD-202G – Method 213B, Test Condition F
Vibration Resistance	.06 dB Power Spectral Density, 9.26 G RMS Meets MIL-STD-202G – Method 214A, Test Condition I/C
Power Supply Input (Unregulated Voltage)	+4 to +10V DC
Input Power, Operating Mode (Typical @ 4V)	132 mW
Input Power, Sleep Mode (Typical @ 4V)	14 mW
3.3V Logic UART Interface	Yes
3D In-Field Calibration	Yes
2D In-Field Calibration	Yes
Temperature Compensated	Yes
Able To Maintain Function When Inverted	Yes
Quaternion/Rotation Matrix Output	Yes
True North Heading Output	Yes
NorthTek™ User Programmable Customizations	Yes
Includes World Magnetic Model	Yes

[1] ***Specifications in parentheses represent current limits of calibration methodology***

GEDC-6 Gyro-Enhanced Navigation Sensor

Performance data applies to 25°C, 0g Acceleration for Pitch/Roll unless otherwise specified:

Dynamic Heading Accuracy	1.0° RMS[2]
Static Heading Accuracy	0.3° RMS
Heading Repeatability	0.1° RMS
Dynamic Pitch/Roll Accuracy	1.0° RMS[2]
Static Pitch/Roll Accuracy	0.2° RMS
Pitch/Roll Repeatability	0.1° RMS
Pitch/Roll Range	± 90°, ± 180°
Accelerometer Range	+/- 4g (+/- 1g)[3]
Accelerometer Noise Density	126 µg/√Hz
Accelerometer Bias Stability	0.023 mg
Accelerometer Velocity Random Walk (VRW)	0.063 m/s
Gyro Dynamic Range	± 480°/s (± 300°/s)[3]
Gyro Noise Density	0.03 dps/√Hz
Gyro Bias Stability	10.8°/Hr
Gyro Angular Random Walk (ARW)	1.5 deg/Sqrt[Hr]
Magnetic Range	±1.2 Gauss (±900 MGauss)[3]
Maximum Magnetic Inclination (Dip)	± 80°
Update Rate (Samples/Sec)	100
Baud Rate	0.3, 1.2, 2.4, 4.8, 9.6; 19.2; 38.4; 57.6; 115.2 kbaud
Dimensions L x W x H	42 x 28 x 11 mm (1.66 x 1.11 x 0.43 inches)
Mass	16g
Encapsulated or Enclosure	Yes
Operating Temp	-40° to +85° C
Storage Temp	-40° to +85° C
Humidity Resistance	95%, 70° C, 240 hrs Meets MIL-STD-202G – Method 103A, Test Condition A
Shock Resistance	1500g, 1ms Pulse, Half-Sine Wave Meets MIL-STD-202G – Method 213B, Test Condition F
Vibration Resistance	.06 dB Power Spectral Density, 9.26 G RMS Meets MIL-STD-202G – Method 214A, Test Condition I/C
Power Supply Input (Unregulated Voltage)	+4 to +10V DC
Input Power, Operating Mode (Typical @ 4V)	320 mW
Input Power, Sleep Mode (Typical @ 4V)	12 mW
3.3V Logic UART Interface	Yes
2D and 3D In-Field Calibration	Yes
Temperature Compensated	Yes
Able To Maintain Function When Inverted	Yes
Quaternion/Rotation Matrix Output	Yes
True North Heading Output	Yes
NorthTek™ User Programmable Customizations	Yes
Includes World Magnetic Model	Yes

[2] ***Dynamic heading accuracy derived from Scorsby table set for 7 RPM, 30 degrees of inclination***

[3] ***Specifications in parentheses represent current limits of calibration methodology***

AHRS-8 Attitude Heading Reference System

Product specifications are preliminary and are subject to change

Performance data applies to 20° C, 0g Acceleration for Pitch/Roll unless otherwise specified.

Dynamic Heading Accuracy	1.0° RMS[4]
Static Heading Accuracy	0.2° RMS (<1.0° RMS from -40° to +70° C)
Heading Repeatability	0.1° RMS
Dynamic Pitch/Roll Accuracy	1.0° RMS[1]
Static Pitch/Roll Accuracy	0.2° RMS
Pitch/Roll Repeatability	0.1° RMS
Pitch/Roll Range	± 90°, ± 180°
Accelerometer Range (Selectable)[5]	+/- 4g or +/- 8g (+/- 1g)[6]
Accelerometer Noise Density	126 µg/√Hz
Accelerometer Bias Stability	0.023 mg
Accelerometer Velocity Random Walk (VRW)	0.063 m/s
Gyro Dynamic Range (Selectable)	± 480°/sec (± 300°/sec)[6]
Gyro Noise Density	0.03 dps/√Hz
Gyro Bias Stability	10.8°/Hr
Gyro Angular Random Walk (ARW)	1.5 deg/Sqrt[Hr]
Magnetic Range	±1.2 Gauss (±900 MGauss)[6]
Maximum Magnetic Inclination (Dip)	± 80°
Update Rate (Samples/Sec)	100
Baud Rate	0.3, 1.2, 2.4, 4.8, 9.6; 19.2; 38.4; 57.6; 115.2 kbaud
Dimensions L x W x H	42 x 28 x 11 mm (1.66 x 1.11 x 0.43 inches)
Mass	16g
Encapsulated or Enclosure	Yes
Operating and Storage Temperature	-40° to +85° C
Humidity Resistance	95%, 70° C, 240 hrs Meets MIL-STD-202G – Method 103A, Test Condition A
Shock Resistance	1500g, 1ms Pulse, Half-Sine Wave Meets MIL-STD-202G – Method 213B, Test Condition F
Vibration Resistance	.06 dB Power Spectral Density, 9.26 G RMS Meets MIL-STD-202G – Method 214A, Test Condition I/C
Power Supply Input (Unregulated Voltage)	+4 to +10V DC
Input Power, Operating Mode (Typical @ 4V)	330 mW
3.3V Logic UART Interface	Yes
2D and 3D In-Field Calibration	Yes
Able To Maintain Function When Inverted	Yes
Quaternion/Rotation Matrix Output	Yes
True North Heading Output	Yes
NorthTek™ User Programmable Customizations	Yes
Includes World Magnetic Model	Yes
Fully Temperature Compensated	Yes
Individually Calibrated Over Temperature Range (-40° to +70° C)	Yes

[4] ***Dynamic heading accuracy derived from Scorsby table set for 7 RPM, 30 degrees of inclination***

[5] ***Note selection of the high range mode for the accelerometers results in decreased sensitivity, but also offers increased dynamic range. Consequently, optimal mode selection is dependent upon the intended application and associated linear accelerations present.***

[6] ***Specifications in parentheses represent current limits of calibration methodology***

Digital Interface

Parameter	Conditions	Typical	Units
UART	8 Data Bits, 1 Stop Bit No Parity	115.2K Factory Default 300 – 115.2K	Baud
UART: USER_RXD, DEBUG_RXD	Input	Logic 0: 0 Logic 1: 3.3	V
UART: USER_TXD, DEBUG_TXD	Output	Logic 0: 0 Logic 1: 3.3	V

Connections

Connector – Pin Number	Pin Name	I/O	Function
P1-1	V_TEST	O	3.3V regulator output for test purposes (factory use only)
P1-2	DEBUG_RXD	I	3.3V logic RXD Input to Debug Port (factory use only)
P1-3	DEBUG_TXD	O	3.3V logic TXD Output from Debug Port (factory use only)
P1-4		N/A	pin removed for keying
P1-5	#WP_EEPROM	I	3.3V logic, active-low EEPROM write protect (the pin has 10kΩ pull-down)
P1-6	Factory Use	I	Do not connect (factory use only)
P1-7	GND	N/A	System Ground
P2-1	V+	I	+4 to +10V DC power supply input. Max load = 80mA
P2-2	USER_RXD	I	3.3V logic RXD input to User Com Port
P2-3	USER_TXD	O	3.3V logic TXD output from User Com Port
P2-4	#RESET	I	3.3V logic, active-low reset input (the pin has a weak pull-up)
P2-5	#EINT0	I	3.3V logic, active-low interrupt input (the pin has a weak pull-up). Used for programming purposes
P2-6	GND	N/A	System Ground
P2-7	GND	N/A	System Ground

Sensor female mating connectors manufacturer's part numbers are:

- J1: Samtec, Part Number: TMM-107-03-G-S-004
- J2: Samtec, Part Number: TMM-107-03-G-S

Note: The DC-4, GEDC-6 and AHRS-8 navigation sensors are all pin-for-pin compatible

Mechanical Interface

The navigation sensor is shipped as a potted module as shown below. The potting is an electrically insulating, thermally conductive epoxy. The potting provides a robust, rugged design suited for a variety of applications. The potting (encapsulant) properties are shown on page 19 of this document.

FIGURE 1 -- NAVIGATION SENSOR -- TOP

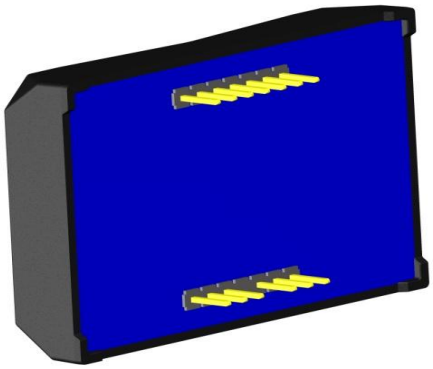


FIGURE 2 -- NAVIGATION SENSOR -- BOTTOM

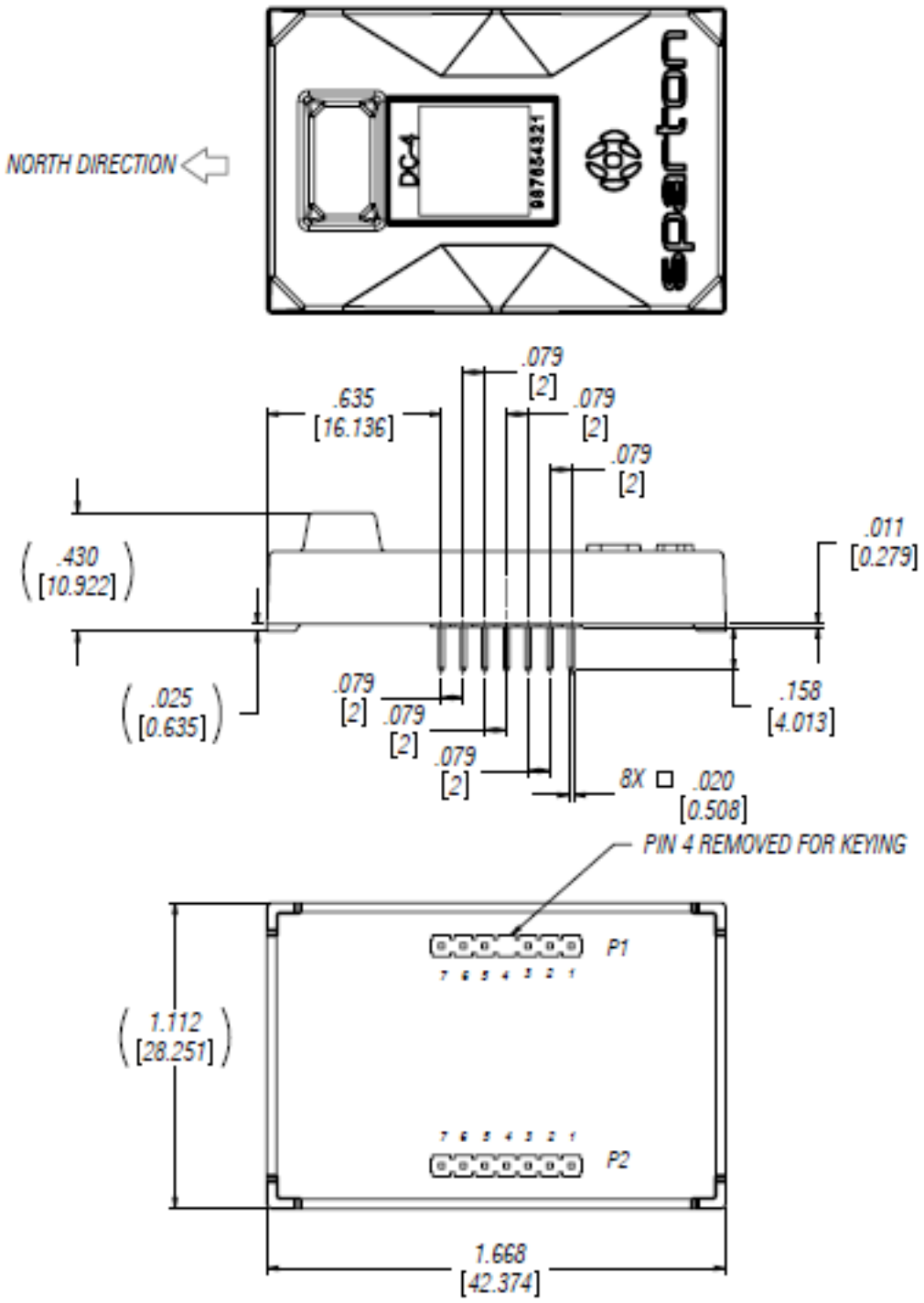

NORTH DIRECTION
sparton
DC4
.079
[2]
.635
[16.136]
.079
[2]
.079
[2]
.430
[10.922]
.011
[0.279]
.025
[0.635]
.079
[2]
.079
[2]
.079
[2]
.158
[4.013]
8X .020
[0.508]
PIN 4 REMOVED FOR KEYING
P1
7 6 5 4 3 2 1
1.112
[28.251]
7 6 5 4 3 2 1
P2
1.668
[42.374]

FIGURE 3 – MECHANICAL LAYOUT

Applicable solid model STEP drawings are available at www.spartonnavex.com/technical-support/downloads

CAUTION: The Sparton Navigation Sensor is an electrostatic sensitive device. Observe proper ESD precautions to avoid permanent damage caused by static discharge.

APPLICATIONS

- Weather, data, and ocean surveillance
- Electro-optical target designation sensors
- Accurate vehicle attitude position and orientation sensing
- Precision autonomous vehicle guidance
- Ground, sea surface and sub sea surface survey and monitoring
- Challenging application environments requiring high accuracy over a full range of temperature (AHRS-8)
- Communications antenna pointing and tracking systems

Mounting and Heading Identification Options

All navigation sensors (DC-4, GEDC-6 and AHRS-8) are capable of being mounted in a variety of orientations or heading identifications. By selecting the corresponding option code in the NDS-1 graphical user interface, the user can select the desired heading identification (see NDS-1 Development System Users Guide). Heading is defined to be the angle between magnetic North and the X- axis as shown below. Pitch is the angle of rotation from level about the Y-axis with the positive direction indicated by an arrow about the axis. Roll is the angle of rotation from level about the X-axis with the positive direction also indicated by an arrow. Additionally, it is also possible to mount the Sparton DC-4, GEDC-6 and AHRS-8 navigation sensor in any arbitrary orientation by utilizing available NorthTek™ TARE Command program scripts to modify the boresight matrix. These scripts and applicable application notes are available at www.spartonnavex.com/northtek

The following table lists all five available mounting options selectable by serial command:

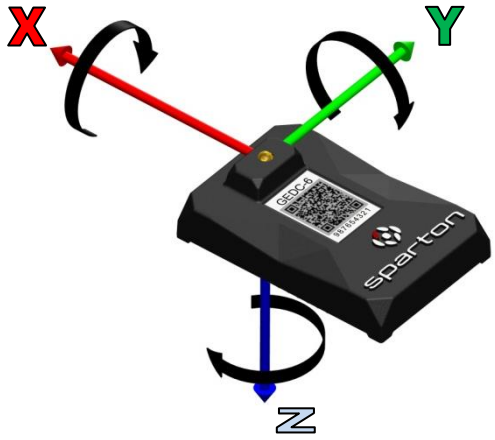
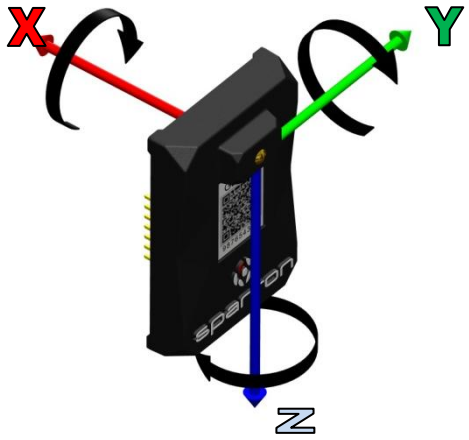
Option #	Heading Identification	Picture
0	Horizontal (Default)	
1	Vertical Mounting	

FIGURE 4- NAVIGATION SENSOR MOUNTING OPTIONS

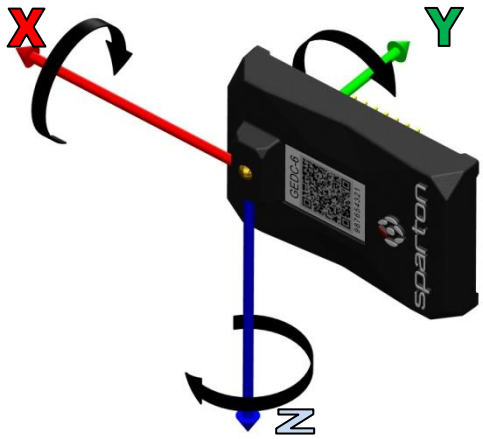
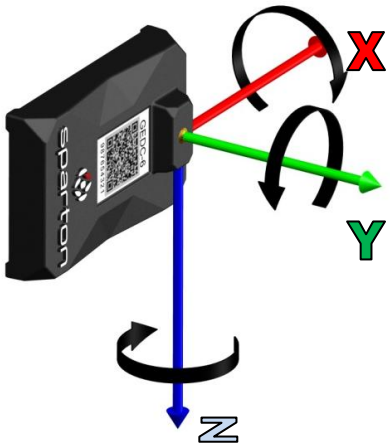
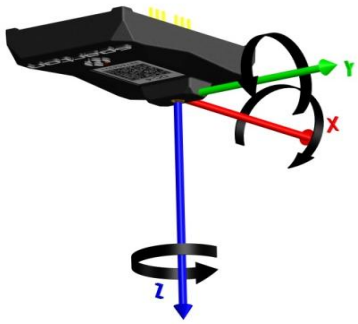
Option #	Heading Identification	Picture
2	Left Edge Mounting	
3	Right Edge Mounting	
4	Inverted	

FIGURE 4- NAVIGATION SENSOR MOUNTING OPTIONS

Navigation Sensor Integration Design Considerations

The Sparton DC-4, GEDC-6 and AHRS-8 navigation sensor modules can be mounted to a customer interface board through the use of mating connectors or direct soldering to plated thru-holes. The plated thru-hole pattern required for direct soldering is shown in Figure 5. A pin is missing from the appropriate connector to enable orientation keying when the navigation sensor is soldered to an interface board.

Note: The navigation sensor is calibrated relative to the planes defined by the four feet on the bottom of the housing.

If a removable connection method is desired, the navigation sensor can be mated to an interface board which includes keyed female connectors (Samtec part numbers TMM-107-03-G-S-004 and TMM-107-03-G-S).

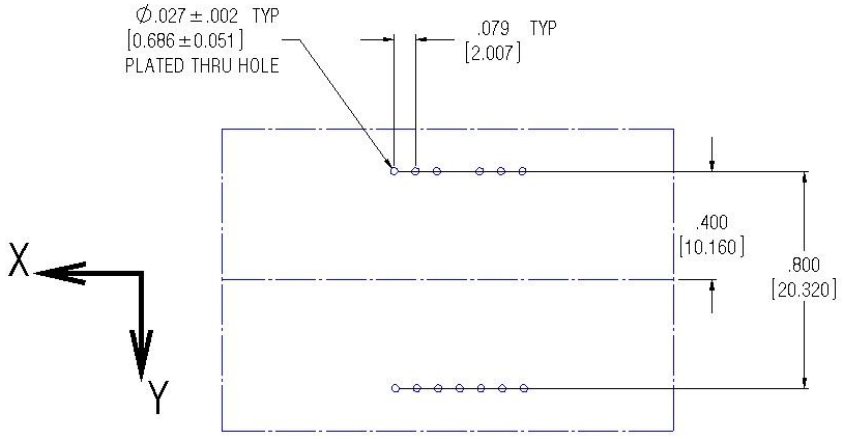


FIGURE 5 - HOLE PATTERN FOR SOLDERING TO INTERFACE BOARD

Recommended Circuit for Firmware Upgrades and World Magnetic Model Updates

The recommended circuit for field update of firmware and World Magnetic Model with the Sparton DC-4/GEDC-6/AHRS-8 navigation sensors is outlined in Application Note AN-1004. The subject Application Note is available at www.spartonnavex.com/technical-support/downloads

The AN-1004 Application Note describes a sample circuit, connector and connector layout to allow the DC-4, GEDC-6 and AHRS-8 to be able to accept a field firmware upgrade. This circuit also allows these sensors to accept an update of the World Magnetic Model used to compute True North heading. It is recommended that the end user design this circuit into the product if the DC-4, GEDC-6 and AHRS-8 will be soldered in to the user's end application.

Serial Interface Information

Users can communicate with Sparton's navigation sensors via a Universal Asynchronous Receiver/Transmitter (UART) interface. This interface can be accessed on the navigation sensor directly via the pins labeled USER_RXD and USER_TXD

(3.3V logic-level) or, if using the NDS-1 Adaptor board, via the DB9 connector (at which point it has been converted to RS232).

The serial interface settings are 8 data bits, 1 stop bit, no parity with the factory default baud rate set to 115.2K (user selectable and selection is preserved through power-cycles).

The serial interface provides full duplex communication. See the Software Interface Users Manual for a description of the interface commands.

Navigation Sensor Installation Considerations

Magnetic sensors measure the Earth's local magnetic field and acceleration due to gravity to determine an accurate heading. Any magnetic material that would change the intensity or direction of the Earth's magnetic field will affect sensor performance. The following guidelines should be considered when installing the navigation sensor:

- Install sensor away from magnetic materials such as iron or steel. If the sensor is to be enclosed, use aluminum, copper, or other non-magnetic material. Please note such an enclosure does not shield the sensor from magnetic interference.
- Batteries are magnetic and should be kept as far away as possible.
- Permanent magnets and electric motors generate both static and time-varying magnetic disturbances and should be kept away from the sensor
- High-current carrying wires can also generate static and time-varying magnetic fields and should be routed away from the sensor
- The Sparton navigation sensor can be mounted horizontally, vertically or as shown in figure 4 depending on your application and space requirements. The sensor orientation can be selected using the NDS-1 Development System GUI 'Orientation' menu option, or via software using the Software Users Manual instructions. Custom orientations are possible utilizing available NorthTek™ TARE Command program scripts to modify the Boresight matrix.

WARNING: It is important to note that operating environments can adversely affect magnetic navigation sensors. Any device operating in the vicinity of a magnetic sensor that produces a time-varying magnetic field may degrade sensor performance. In addition, any magnetic material that causes severe magnetic distortions in the vicinity of the sensor may also degrade sensor performance. It is recommended that Sparton be included at the front-end of your product design to assist with navigation sensor application platform integration.

Navigation Sensor Operational Considerations

- The Sparton navigation sensor is an electrostatic sensitive device. Observe proper ESD precautions to avoid permanent damage caused by static discharge.
- The DC-4, GEDC-6 and AHRS-8 sensors operate on an unregulated voltage in the range of 4 to 10V on pin 1 of connector P2.
- The sensor reset, pin 4 of connector P2, can be used to force a hardware reset of the sensor. This pin has an internal 100k pull-up resistance to the internal 3.3V. Reset is accomplished by pulling this pin to GND.
- In applications with strong EMI or ESD, it is recommended that inputs #RESET (P2 pin 4) and #EINT0 (P2 pin 5) be connected to sensor 3.3V supply (P1 pin 1) when not used.

- The in-field magnetic calibration in the application of end use must be performed after installation to achieve specified accuracy. Follow the calibration steps listed in the NDS-1 Development Systems Users Guide or the Software Interface Users Manual. Pitch and roll are factory calibrated and require no additional field calibration.

ENCAPSULANT PROPERTIES

Description

The potting compound is a proprietary two component, thermally conductive epoxy encapsulant. It features a low coefficient of thermal expansion and excellent electrical insulative properties.

Key Features

- Provides structural integrity to the product during handling and a robust design for applications exposed to environmental shock and vibration conditions
- Provides a top-level corrosion/moisture barrier
- Exhibits excellent thermal conductivity which readily dissipates heat from embedded components
- Has a low coefficient of thermal expansion which provides low stress on embedded components

Material Properties

Property	Test Method	Unit	Value
Hardness	ASTM-D-2240	Shore D	92
Flexural Strength	ASTM-D-790	mPa psi	106 15,300
Compressive Strength	ASTM-D-695	mPa psi	120 17,400
Linear Shrinkage	ASTM-D-2566	cm/cm	0.003
Water Absorption (24 hours)	ASTM-D-570	%	0.02
Coefficient of Thermal Expansion α1 α2	ASTM-D-3386	 10^{-6}/°C 10^{-6}/°C	 39.4 111.5
Glass Transition Temperature	ASTM-D-3418	°C	68
Thermal Conductivity	ASTM-D-2214	W/m.K Btu-in/hr-ft^2-°F	1.02 7.1
Temperature Range of Use	n/a	°C	-65 to +105
Dielectric Strength	ASTM-D-149	kV/mm V/mil	14.8 375
Dielectric Constant @ 1 mHz	ASTM-D-150	-	5.36
Dissipation Factor @ 1 mHz	ASTM-D-150	-	0.051
Volume Resistivity @ 25°C	ASTM-D-257	Ohm-cm	>10^{15}

WORLD MAGNETIC MODEL SOFTWARE UPDATES

The navigation sensor uses a spherical harmonic model to calculate the magnetic variance. This variance is then used to adjust the magnetic heading to provide for a true north heading. In order to retain accuracy, the magnetic model must be updated periodically. An NDS-1 application is available on the supplied CD that will assist in downloading new coefficients into the navigation sensor. This only affects the calculation of True North heading and does not affect the magnetic heading accuracy.

The current World Magnetic Model expires on 12/31/2014. The next updates must be downloaded and installed in January of 2015. The World Magnetic Model is typically updated every five years thereafter.

NDS-1 NAVIGATION DEVELOPMENT SYSTEM KIT

Features

The NDS-1 Development System Kit is designed as a development tool for Sparton's navigation sensors, including DC-4, GEDC-6 and AHRS-8. This tool gives the user a pre-designed platform to interface and communicate with the navigation sensor via an industry leading graphical users interface (GUI). Included in the development kit are:

- NDS-1 Adapter board with power adapter (DC-4/GEDC-6/AHRS-8 purchased separately)
- Non-magnetic serial cable
- USB Cable
- NDS-1 Host Application Software
- CD containing application software and documentation

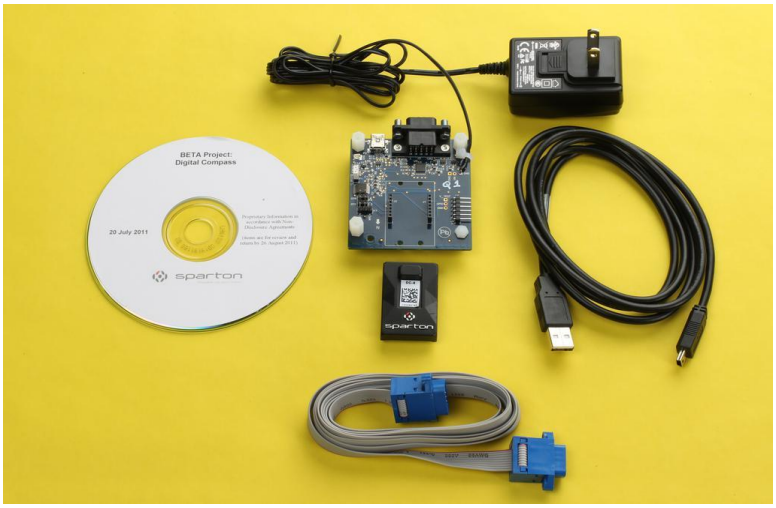


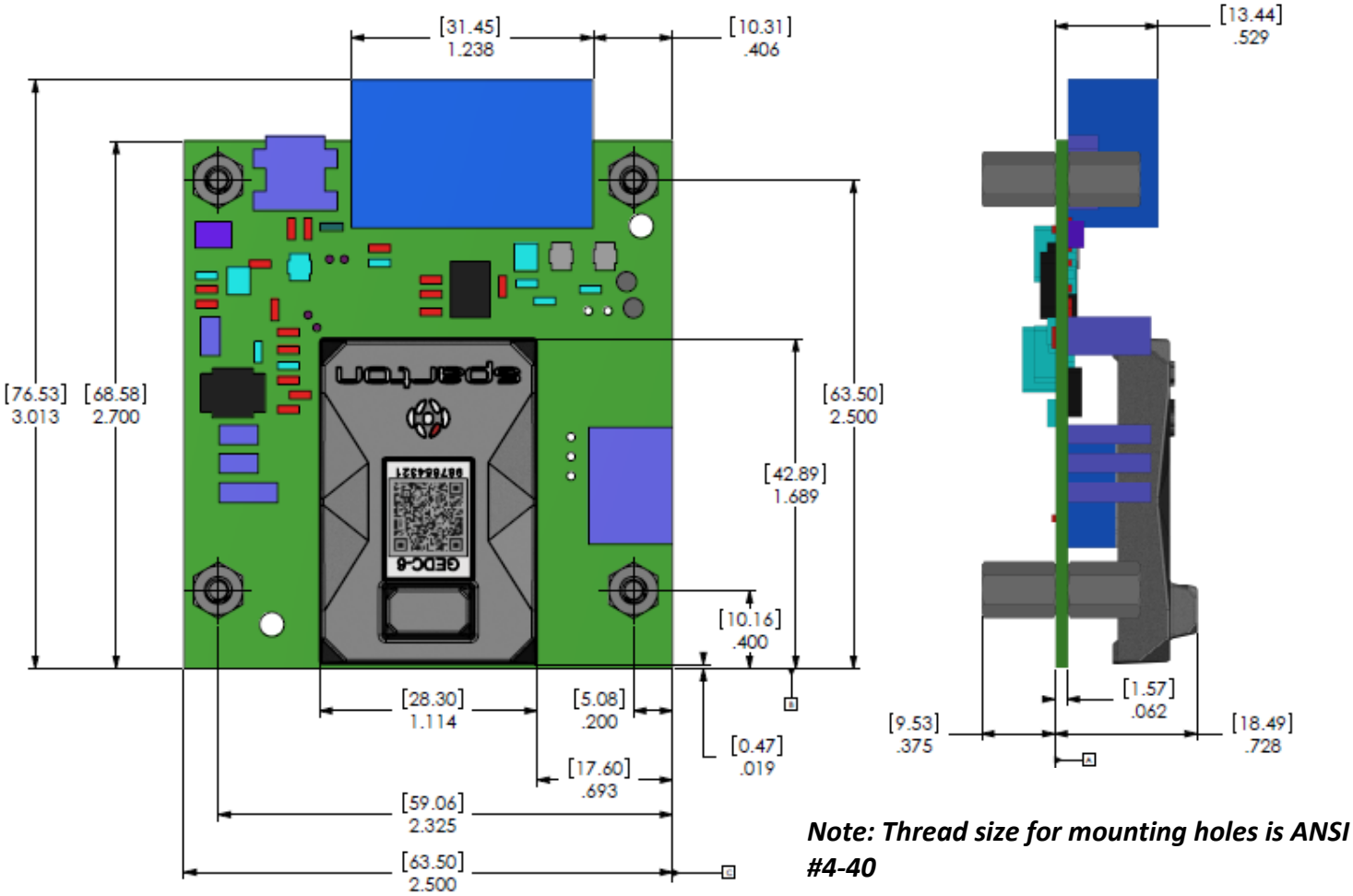
FIGURE 6 - NDS-1 HARDWARE

The NDS-1 Adapter Board allows the navigation sensor to be connected directly to the 9 pin serial port or USB port of a PC. It also provides convenient access to all sensor signals for development and testing.

Hardware and Software Setup

Please reference the NDS-1 Navigation Development Systems Users Manual and the Software Interface Users Manual for navigation sensor hardware and software setup, as well as calibration instructions.

NDS-1 Mechanicals



Note: Thread size for mounting holes is ANSI #4-40

FIGURE 7- NDS-1 ADAPTER BOARD MECHANICALS

RM-1 RUGGEDIZED MOUNTING ADAPTER KIT

The Ruggedized Mounting Adapter Kit (RM-1) for Sparton's DC-4, GEDC-6 and AHRS-8 navigation sensors provides a convenient connection of the sensor to a user's application. It provides the hardware interface required and supports connection to the application via a standard size USB connector.

The six foot cable provides a FTDI USB to serial interface to the DC-4, GEDC-6 and AHRS-8 navigation sensor. Alternatively, the user can eliminate the USB connector and wire directly to the application platform if desired (the cable provides power, ground, and a UART interface).

FIGURE 8 - RM-1 RUGGEDIZED MOUNTING ADAPTER KIT

Features

- Low insertion force sensor mating sockets for easy plug-in installation
- Six foot cable provides FTDI USB to serial interface with standard USB connector
- Easily convertible from USB to a UART interface by removal of the USB connector (connector includes FTDI chip)
- Rugged ABS plastic housing
- Retainer clip to restrain the Sparton navigation sensor in the event of platform dynamics, shock or vibration
- Encapsulated cable interface cavity provides strain relief and water resistant cable connection to housing
- Mounting holes facilitate convenient assembly to the application platform
- Compact size, measures only 2.6" x 1.2"
- RoHS Compliant Product

RM-1 Kit Contents

- Ruggedized Mounting Adapter Board Housing with attached FTDI USB cable (navigation sensor sold separately)
- Retainer clip

Applications

- Sensor evaluation and testing
- Provides turn-key hardware interface to Sparton DC-4, GEDC-6 and AHRS-8 navigation sensors
- Facilitates ease of sensor platform integration

RM-1 Mechanicals

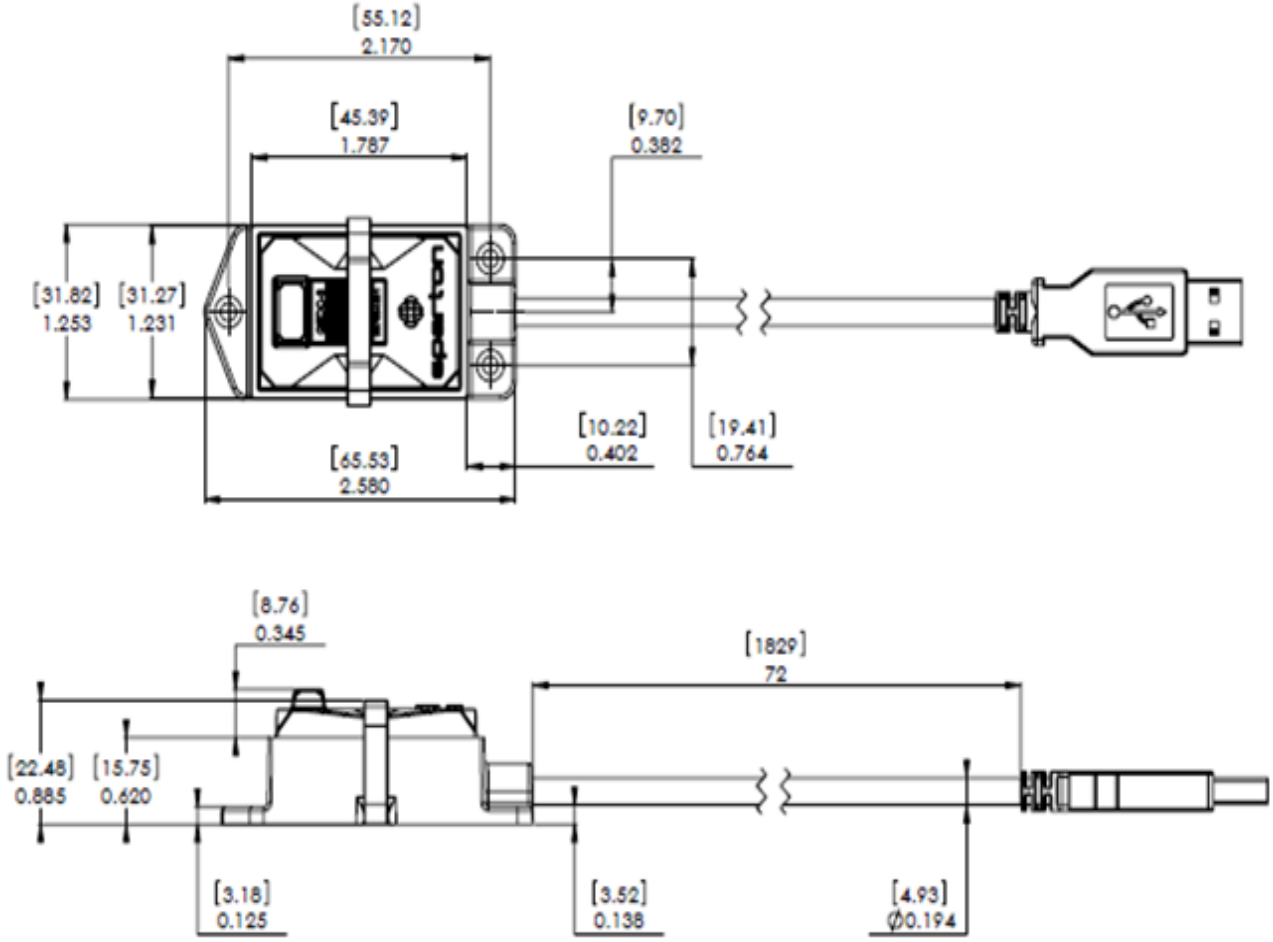


FIGURE 9 - RM-1 RUGGEDIZED MOUNTING ADAPTER MECHANICALS

SUPPORTING DOCUMENTATION

A full suite of supporting documentation and Sparton coded NorthTek™ application downloads are available at www.spartonnavex.com/technical-support including:

- Software Interface Users Manual
- RFS Protocol Suite
- NorthTek™ Programming Manual
- NDS-1 Users Manual
- Sparton coded NorthTek™ apps
- Product Application Notes
- Solid model STEP drawings

ORDERING INFORMATION

DESCRIPTION	ORDERING PART NUMBER	UNIT OF MEASURE
DC-4 Navigation Sensor	DC-4	EACH
GEDC-6 Gyro-Enhanced Navigation Sensor	GEDC-6	EACH
AHRS-8 Attitude Heading Reference System	AHRS-8	EACH
NDS-1 Development Kit w/ Software	NDS-1	EACH
RM-1 Ruggedized Mounting Adapter Kit	RM-1	EACH

The Sparton Navigation Sensor is delivered as a potted module ready to meet the requirements of your design application and environment. The Sparton Navigation sensor can be integrated into any system using a serial interface. Sparton also offers product integration, Design for Manufacturing (DFM), Design for Assembly (DFA) and contract manufacturing services.

For more information, please visit www.spartonnavex.com or contact the Business Development professionals at Sparton Navigation and Exploration in De Leon Springs, FL, at (800) 824-0682. For Technical Support, please email your questions to productsupport@sparton.com

To place an order or obtain pricing information, please call (800) 824-0682, or order online at www.spartonnavex.com

Warranty information and applicable terms and conditions (T&Cs) are available at https://thedigitalcompass.com/about/shipping-returns/

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