



# navX<sup>mxp</sup>

## OVERVIEW



**navX-MXP** is a 9-axis sensor (3-axis accelerometers, gyroscopes and magnetometers) with sophisticated data fusion, motion processing and sensor calibration algorithms. Key specifications include:

- High-accuracy pose (yaw/pitch/roll), with *minimal yaw drift of ~1 degree per minute*
- Tilt-corrected compass heading with magnetic disturbance detection
- 9-axis heading combining pose and magnetically-valid compass heading

Even in electro-magnetically challenging environments, the 9-axis heading's combination of "pose" and magnetically-valid compass heading data (e.g., before motors are energized, or when the robot is at rest) enable tracking of a robot's absolute heading.

## FEATURES



- **Plug-n-play install on a National Instruments RoboRio™ and an Android-based FTC Robot**
- **High-Quality Sensor Calibration**
- **Multiple Communication Interfaces**
- **Open source software and hardware**
- **LabView™, Java and C++ libraries and sample code enable rapid integration on FIRST FRC robot. Android library and sample code enabled rapid integration on a FIRST FTC robot.**
- **navX MXP Aero: adds a barometric pressure sensor for altitude measures**



# navX-MXP Robotics Navigation Sensor

## BENEFITS



**Supercharge your robot with:**

- **Field-oriented drive**
- **Auto-balancing**
- **Auto-rotate-to-angle**
- **Motion/no-motion detection**
- **Collision Detection**
- **and more...**

**Expand your National Instruments RoboRIO™ with:**

- **10 Digital I/O ports**
- **4 Analog Input**
- **2 Analog Output**
- **I2C, SPI and TTL UART ports**

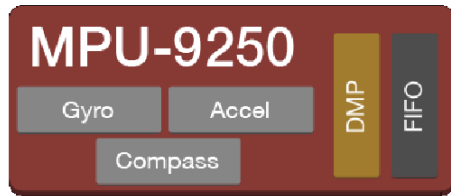


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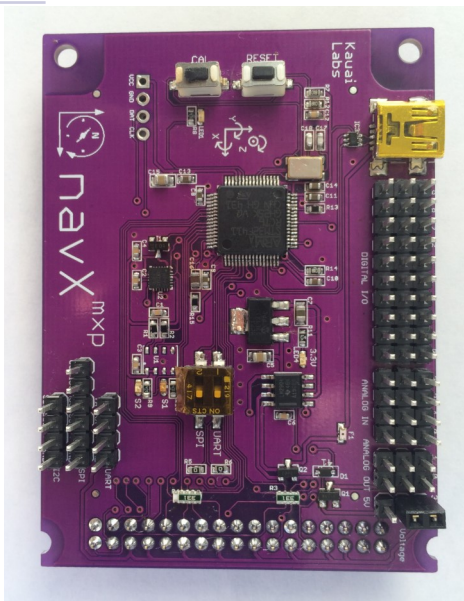


CUTTING-EDGE SENSORS



9-Axis Invensense MPU-9250 MEMS Motion Tracking Sensor

EASY-TO-USE DESIGN



MXP-compliant circuit board



Multiple Interface Options

\*NOTE: navX-MXP firmware includes the Invensense Motion Driver™ library, which is free, but is *not* open source. If you wish to compile the navX-MXP firmware you must first register with Invensense and download this free library.

# Technical Specifications

## Key Components

COMPONENT	DESCRIPTION	MODEL	CAPABILITIES
<b>Microcontroller</b>	100Mhz 32-bit ARM Cortex-M4 w/FPU	ST Microelectronics STM32F411RCTx	Data acquisition, calibration and 9-axis fusion
<b>Inertial / Magnetic Sensors &amp; Motion Processor</b>	9-Axis sensor-system-on-chip w/Digital Motion Processor	Invensense MPU-9250	High-quality acceleration, rotation rate and heading measures
<b>Altimeter (navX-MXP Aero only)</b>	High-resolution barometric pressure w/24-bit Delta-Sigma ADC	Measurement Specialties MS5611	High-quality relative altitude measures with 10cm resolution

## Communication Interfaces

TYPE	MAXIMUM SPEED	CAPABILITIES
<b>SPI</b>	2Mb/s	3.3V and 5V Tolerant
<b>I2C</b>	400Khz	3.3V and 5V Tolerant
<b>TTL UART</b>	57.6 KHz	3.3V and 5V Tolerant
<b>USB</b>	12 Mb/s	Provides power to the navX MXP when MXP Connector not used

## RoboRio™ MXP I/O Expansion (w/selectable 5V or 3.3V Source Power)

INTERFACE	COUNT	USAGE
<b>Digital I/O</b>	10	RoboRio PWM, Quad Encoders, GPIO
<b>Analog Inputs</b>	4	Input to RoboRio ADC
<b>Analog Outputs</b>	2	Output from RoboRio DAC
<b>I2C</b>	1	RoboRio External Device Control
<b>SPI</b>	1	RoboRio External Device Control
<b>UART</b>	1	RoboRio External Device Control

## Key Features

FEATURE	DESCRIPTION	BENEFIT
<b>Automatic Accelerometer and Gyro Calibration</b>	Self-calibration algorithms; storage of calibration coefficients in flash memory; continuous gyro recalibration during operation	High-accuracy yaw, pitch and roll measures with no calibration effort required.
<b>Magnetometer Calibration Tools and Anomaly Detection</b>	Support and tools for in-situ hard and soft-iron magnetometer calibration, and auto-detection of magnetic anomalies	High-accuracy compass heading measures with a simple calibration process.
<b>Configurable Update Rate</b>	From 4-60 Hz	Allows tradeoff between application load and latency
<b>Tilt-compensated Compass Heading</b>	Compass heading correction based upon tip/tilt measures	Heading accuracy independent of sensor "pose"
<b>Open-source Software</b>	Eclipse & G++ compatible C, C++ Source Code	Customizable firmware using free development tools*
<b>Open-source Hardware</b>	Schematics and Board-layout Files in Eagle PCB Format	Customizable hardware using free development tools

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