MTi

Miniature Attitude and Heading Reference System

The MTi is a small size and low weight measurement unit, excellent for control and navigation of (un)manned systems and other objects. The MTi is a gyro–enhanced MEMS based Inertial Measurement Unit (IMU). Attitude and heading is referenced with gravity and the earth magnetic field (AHRS).

The MTi contains gyroscopes, accelerometers and magnetometers in 3D.
The internal low-power digital signal processor runs a real-time proprietary sensor fusion algorithm providing drift-free 3D orientation data. Additionally 3D dynamic data is outputted directly from the gyroscopes and accelerometers.

Highlights

- real-time computed attitude/heading and inertial dynamic data
- 360° orientation referenced by gravity and Earth Magnetic Field
- integrated 3D gyroscopes, accelerometers and magnetometers
- on board DSP, running sensor fusion algorithm
- gyroscopes enable high-frequency orientation tracking
- high update rate (120 Hz)
- individually calibrated for temperature, 3D misalignment and sensor cross-sensitivity
- accepts and generates synchronization pulses

Design

- compact and robust design
- easy integration in any system (OEM) application
- low weight, ultra-low power consumption

Sensor integration

The MTi uses inertial sensors in order to estimate the orientation. The gyroscopes are used to calculate orientation. Integration drift is inevitable whilst using gyroscopes. To compensate for drift completely, the MTi corrects its orientation every sample using the gravity and the earth magnetic field as reference vectors.

The sophisticated Xsens sensor fusion lgorithm can cope with short-term magnetic disturbances and lateral accelerations, resulting in a reliable orientation estimate. The MTi also incorporates a magnetic field mapping routine to correct for hard and soft iron effects.

User scenarios

The MTi is a sensor which can be used in a wide range of applications. Because of the specific requirements for these applications, the MTi uses different filter settings and constraints, implemented in scenarios.

Output

- 3D Orientation (360°)
- 3D acceleration
- 3D rate of turn
- 3D magnetic field

All sensor data is available in raw and calibrated format

xsens
motion technologies

MTi TECHNICAL SPECIFICATIONS

Attitude and Heading

Static accuracy (roll/pitch)	<0.5 deg
Static accuracy (heading)[1]	<1 deg
Dynamic accuracy[2]	2 deg RMS
Angular resolution[3]	0.05 deg
Dynamic range:	
- Pitch	± 90 deg
- Roll/Heading	± 180 deg
Maximum update rate:	
- Onboard processing	120 Hz
- External processing	512 Hz

Interfacing

Digital interface	RS-232, RS-485, RS 422 (max 921k6 bps) and USB (ext. converter)
Operating voltage	4,5 - 30V
Power consumption	350 mW
Interface options	SyncOut, AnalogIn, SyncIn (Depends on digital interface)

Maximum operational limits

Ambient temparature operating range[4]	-20...+60 °C

INDIVIDUAL SENSOR SPECIFICATIONS

Sensor performance

	rate of turn	acceleration	magnetic field
Dimensions	3 axes	3 axes	3 axes
Full Scale (standard)	± 300 deg/s	± 50 m/s²	± 750 mGauss
Linearity	0.1% of FS	0.2% of FS	0.2% of FS
Bias stability[5] (1σ)	1 deg/s	0.02 m/s²	0.1 mGauss
Scale Factor stability[5] (1σ)	-	0.03%	0.5%
Noise	0.05 deg/s/√Hz	0.002 m/s²/√Hz	0.5 mGauss (1σ)
Alignment error	0.1 deg	0.1 deg	0.1 deg
Bandwidth	40 Hz	30 Hz	10 Hz
Max update rate	512 Hz	512 Hz	512 Hz

HARDWARE DYNAMICS

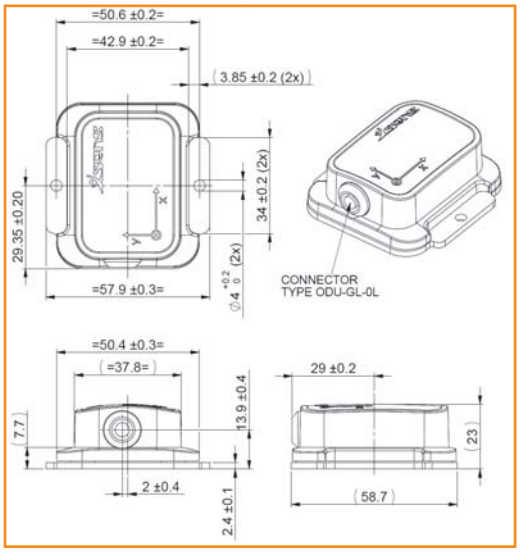
Housing

Dimensions (WxLxH)	58x58x22 mm
Weight	50 g

Options

Interface:		Full scale acceleration:		Full scale rate of turn:	
RS-232	28	1.7g (17 m/s²)	A33	150 deg/s	G15
RS-485	48	5g (50 m/s²)	A53	300 deg/s	G35
RS-422	68	18g (180 m/s²)	A83	1200 deg/s	G25

Product code:	MTi-## A## G##
Standard version:	MTi-28 A53 G35



1 in homogeneous magnetic environment
2 under condition of a stabilized Xsens sensor fusion algorithm
3 1σ standard deviation of zero-mean angular random walk
4 non-condensing environment
5 deviation over operating temperature range (1σ)

TYPICAL USAGE APPLICATIONS

Subsurface marine

- Control and stabilization of AUV/ROV/UUV
- Orientation correction for USBL-systems

The MTi will fit even in the smallest AUV/ROV/UUV, because of its small footprint. Still it offers a remarkable accuracy in terms of orientation and dynamic data and has proven to be an excellent choice for small to medium sized submersibles. The on-board digital processor outputs orientation for instantaneous attitude control. The MTi can be used as a stable compass as well, using various hard- and software features. Another good example of the application of the MTi is the orientation correction for USBL systems. The direct low-level communication allows full and easy control.

Surface Marine

- State estimation of all kinds of ships and platforms
- Orientation correction for echo sounders and sonar
- Sensor input for Dynamic Positioning (DP) systems
- Correction of sensor systems on buoys

The MTi is used for state estimation on ships, ranging from small survey vessels to large container ships. The information can be stored or displayed real-time. The MTi easily fits in small systems, such as echo sounders, sonar heads and harbor protection systems. Because of small data-packages the MTi is extremely suitable for installation in buoys to monitor orientation for long-term measurements, where storage capacity may be an issue. The MTi is also used in research concerning sea and weather dynamics.

Unmanned ground vehicles and robotics

- Autonomous attitude control of driving and walking robots
- Control and stabilization of Unmanned Ground Vehicles (UGV)

Using the MTi in robotics is a logical choice when accurate attitude and a direct communication is mandatory. The MTi is praised for its low size and weight and is easily configured in accordance with the user's requirements. In walking, humanoid and biped robots, the low response time of the MTi proves to be essential to provide reliable balance control. For unmanned ground vehicles, the MTi is just as useful, providing orientation and dynamic information at a very low cost. The MTi has been used by teams in all DARPA Challenges.

Other

- Vehicle dynamics
- Bore technology
- Camera/antenna stabilization

The MTi's internal sensors provide full 3D dynamics data (acceleration and rate of turn) of any vehicle. The small size makes that the MTi can be used in small-diameter pipes (under 40 mm). Together with odometry, the MTi can serve as an input to provide a full map of underground piping.

The MTi can be used in many other miscellaneous applications, such as camera stabilization and antenna aiming.

MTi DEVELOPMENT KIT

MTi Development Kit (MTi DK)

The MTi DK contains the following:

- MTi (any configuration)
- USB cabling
- MT Software Development Kit (see below)
- Hardcopy documentation
- Optional: serial cabling
- Suitcase

MT Software Development Kit (MT SDK)

The MT SDK is an extensive set of tools for every level of interfacing, which allows configuring the MTi to the user needs, reading out and storing data and (re-)processing MTi data previously recorded. It also allows the user to extend own source code using commands and code examples provided.

The MT SDK contains:

MT Manager
An easy-to-use graphical user interface with possibilities to configure Xsens' sensors, read out, store and show data in real-time charts and visualizations.

MT COM-object API and DLL API for Windows
Integrating the MTi in Windows programs, such as Matlab, C++ and Excel is made easy with the MT COM-object API and the DLL API. User-modifiable example code for programs Matlab, C++ and Excel (VBA) is included.

C++ Class and binary communication for any (RT)OS
A C++ class is available for users who want to use the MTi on a binary level. Direct communication without using the C++ class is possible, following the fully documented communication protocol.

Magnetic Field Mapper plug-in
The Magnetic Field Mapper plug-in enables compensation for hard and soft iron effects.

ACCESSORIES

Cable options

CA-USB2

USB cable

CA-SERi

Serial cable
RS232 + pigtail

CA-DB9i

RS232, DB9
power

PA-MP

Power adapter
(for CA-DB9i only)

Xsens Technologies is a leading supplier of products for measurement of motion, orientation and position, based upon miniature MEMS inertial sensor technology. Xsens' products are small, low-cost and highly accurate 3D motion measurement units. These specific qualities enable applications such as control, stabilization and navigation of small (unmanned) vehicles and totally new applications such as inertial full-body human motion capturing.

Xsens was founded in 2000 and has grown to a leading company in its field. Xsens has won several awards for excellent entrepreneurship, innovative products and rapid growth. All employees in R&D and sales have a technical higher education or extensive experience in their field of technical sales. Xsens has customers in more than 50 countries.

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