MEMS IMU
3-axis Inertial Measurement Unit (6DoF sensors)

AU7684
PCB Type

TAG300
Waterproof Case Type

TAG204
MEMS Gyro

TAG206
MEMS Gyro

i-FOG
TA7774
High accuracy FOG

TAMAGAWA SEIKI CO., LTD.
MEMS IMU
i-FOG

Inertial Measurement Unit (IMU) is an electronic device that measures various kinds of motions in vehicle dynamics, attitude (roll & pitch) or heading (yaw) angle. In addition, it is an essential technology in autonomous driving for localization and dead-reckoning. Tamagawa Seiki Co., Ltd. offers wide range of product, such as MEMS Gyro, FOG or AHRS. We provide the best option for your application.

● Unmanned Construction Machine
IMU offers stable output under large vibration by utilizing gyroscope and accelerometer.

● Automated Guided Vehicle (AGV)
Gyroscope is used for AGV Magnetic Guidance to secure high running stability.

● Unmanned Agricultural Machine
IMU detects attitude (roll & pitch) and heading (yaw) angle of agricultural tractor. In addition, it is used for autonomous driving by combining GNSS.
High-accuracy MEMS IMU
P.03

MEMS Gyro
P.07

Interferometric Fiber Optic Gyro (i-FOG)
P.09

1. Security Robot
   IMU is used for attitude control in security robot.

2. Drone
   IMU is used for attitude control in drone.

3. Automobile
   IMU measures vehicle dynamics, attitude (roll & pitch) or heading (yaw) angle. In addition, it is used for autonomous driving by combining GNSS.
MEMS IMU
AU7684
TAG300

Inertial Measurement Unit (IMU) incorporates high-accuracy MEMS gyroscope. Both accuracy and cost are improved compared to conventional equipment. In addition to an external GNSS type, on-board Extended Kalman Filter based Dead Reckoning type is newly released.

FEATURES

01  Enhanced Accuracy (Roll & Pitch)
   Attitude Angle <0.1°
   - Power Protection Circuit
   - Vehicle Speed (VS) Input I/F

02  User-configurable Setting
   Definition of Axis, CAN ID Allocation, Offset Cancel, Alignment, etc.
   - Output Cycle: 1kHz
   - External GNSS Input I/F
   - Extended Kalman Filter + Dead reckoning

03  Waterproof Case (TAG300 Series)
   IP65, M6 Mounting Configuration, 0.5sq Wire Diameter

MEMS IMU functional block diagram

- Gyroscope
- Accelerometer
- Thermal Sensor
- Magnetometer
- Operation Sensor/ CPU etc.
- CPU
- DC/DC Convertor

External GNSS Module

Power source 8 ~ 28V DC

Note)
External GNSS Module including cable and antenna is not attached to the product. If required, GNSS module should be prepared by customer.

Connectable GNSS Module: KGM-810GRB1_P5_917/Position
Regarding the inquiries or purchases, please contact to our sales representative.
**Extended Kalman Filter + GNSS Dead reckoning type**

On-board Kalman Filter integrates measurements from 3-axis gyroscopes, accelerometers and GNSS to run a high-level estimation for dead-reckoning, localization and attitude detection.

### GNSS-denied Environment

**Multipath Propagation**

GNSS signal reaches its receiver by two or more paths due to buildings.

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**GNSS/INS/VS combined Navigation**

IMU performs Dead Reckoning which is the process of calculating one’s current position for a certain period time even in GNSS denied environment by using GNSS, Vehicle Speed and Kalman Filter that estimates gyro & acceleration error.

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**GNSS/INS/VS combined Navigation Algorithm**

- **MEMS IMU**
  - 3axis Gyroscopes
  - 3axis Accelerometers

- **GNSS**

- **Vehicle Speed**

Hybrid Navigation Data (Attitude/Heading/Velocity/Position)

- Position
- Velocity
- Position Error
- Velocity Error

Kalman Filter

Compensation
- Position/ Velocity
- Attitude/ Heading
- Angular rate
- Acceleration
PART NUMBER

**AU7684 (PCB Type)**

**AU7684N**

- Calculation
  1: Leveling
  2: GNSS/INS/VS combined Navigation

- Accelerometer/Magnetometer
  0: Accelerometer ±3G
  1: Accelerometer ±6G
  2: Accelerometer ±3G/Magnetometer (under development)
  3: Accelerometer ±6G/Magnetometer (under development)

- Custom
  00: Standard
  Others: Exclusive

**TAG300 (Waterproof Case Type)**

**TAG300N**

- Calculation
  1: Leveling
  2: GNSS/INS/VS combined Navigation

- Accelerometer/Magnetometer
  0: Accelerometer ±3G
  1: Accelerometer ±6G
  2: Accelerometer ±3G/Magnetometer (under development)
  3: Accelerometer ±6G/Magnetometer (under development)

- Custom
  00: Standard
  Others: Exclusive

PERFORMANCE

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension (PCB Type)</td>
<td>35 × 35 × 16.1 mm</td>
<td>P/N: AU7684</td>
</tr>
<tr>
<td>Dimension (Waterproof Case Type)</td>
<td>100 × 59.8 × 49.5 mm (IP65)</td>
<td>P/N: TAG300</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>8V ~ 28V DC</td>
<td></td>
</tr>
<tr>
<td>Interface/ Baud rate</td>
<td>RS-232: 115.2kbps CAN: 500kbps (Initial setting)</td>
<td>User can change CAN baud rate</td>
</tr>
<tr>
<td>Output Cycle</td>
<td>RS232C: 200Hz, CAN: 1000Hz</td>
<td></td>
</tr>
<tr>
<td>Gyro Range</td>
<td>±200deg/sec</td>
<td></td>
</tr>
<tr>
<td>Gyro Bias</td>
<td>±0.2°/sec rms</td>
<td>Room temp.</td>
</tr>
<tr>
<td>±0.2°/sec</td>
<td>Ambient temp.</td>
<td></td>
</tr>
<tr>
<td>Gyro Scale Factor Error</td>
<td>0.2% Full Scale rms</td>
<td></td>
</tr>
<tr>
<td>Acceleration Range</td>
<td>±3G or ±6G</td>
<td>Factory setting</td>
</tr>
<tr>
<td>Acceleration Bias</td>
<td>±0.0156m/sec² rms (2mG)</td>
<td>Room temp.</td>
</tr>
<tr>
<td>±0.049m/sec² rms (5mG)</td>
<td>Ambient temp.</td>
<td></td>
</tr>
<tr>
<td>Acceleration Scale Factor Error</td>
<td>0.2% Full Scale rms</td>
<td></td>
</tr>
<tr>
<td>Static Accuracy (Roll &amp; Pitch)</td>
<td>0.1deg rms (Range 3G)</td>
<td>Room temp.</td>
</tr>
<tr>
<td>±0.2deg rms (Range 3G)</td>
<td>Ambient temp</td>
<td></td>
</tr>
<tr>
<td>In-run Drift (Yaw)</td>
<td>±0.01deg/s rms</td>
<td>Offset-cancel applied</td>
</tr>
<tr>
<td>Operation temp. range</td>
<td>-40°C ~ +85°C</td>
<td></td>
</tr>
<tr>
<td>Vibration</td>
<td>29.4m/s² rms (5Hz ~ 2kHz) (3G rms)</td>
<td>Random vibration</td>
</tr>
<tr>
<td>Shock</td>
<td>20G 10ms</td>
<td></td>
</tr>
</tbody>
</table>

FUNCTION

<table>
<thead>
<tr>
<th>Item</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterproof Case</td>
<td>IP65: TAG300</td>
</tr>
<tr>
<td>Magnetometer</td>
<td>Under development</td>
</tr>
<tr>
<td>Vehicle Speed (VS) Input (1/F)</td>
<td>RS232C/CAN/Pulse</td>
</tr>
<tr>
<td>Power Protection Circuit</td>
<td></td>
</tr>
<tr>
<td>GNSS Input (1/F)</td>
<td>Recommendation/Customization</td>
</tr>
<tr>
<td>CAN cable termination process</td>
<td></td>
</tr>
</tbody>
</table>

USER CONFIGURABLE COMMANDS

<table>
<thead>
<tr>
<th>Function</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment Compensation</td>
<td>If mounting surface is tilting, its attitude angle can be recognized as a zero (horizontal).</td>
</tr>
<tr>
<td>Definition of Axis</td>
<td>You can select not only Z axis but also X and Y axis as vertical axis</td>
</tr>
<tr>
<td>Update Cycle &amp; Output Cycle</td>
<td>The calculation update cycle &amp; output cycle can be changed.</td>
</tr>
<tr>
<td>CAN Format, CAN ID allocation</td>
<td>CAN format (standard/extended) and CAN ID allocation can be changed.</td>
</tr>
</tbody>
</table>

There are a lot of other commands except for the above-mentioned. The customer can change various settings. Please refer to the specification for the details.
OUTLINE DRAWING

AU7684 (PCB Type)

TAG300 (Waterproof Case Type)

AU7684 Interface Cable EU8937N1000 (sold separately)

AU7684 Interface Cable with GNSS connector EU8937N1001 (sold separately)

TAG300 Interface Cable EU8940N1000 (sold separately)

TAG300 Interface Cable with GNSS connector EU8940N1001 (sold separately)
MEMS Gyro Sensor
TAG206N5000
TAG204N5000

When an oscillating object is rotated, Coriolis Force works in the direction perpendicular to the vibration, and the other vibration occurs. This induced vibration is detected and converted into voltage proportional to the amplitude of the vibration.

Widespread MEMS Gyro
TAG206N5000

▲ ELECTRICAL SPECIFICATION

<table>
<thead>
<tr>
<th>Items</th>
<th>Digital Output</th>
<th>Analog Output</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>TYP</td>
<td>MAX</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>5V</td>
<td>±5%</td>
<td>V</td>
</tr>
<tr>
<td>Consumption Current</td>
<td>9mA</td>
<td>Max.</td>
<td>mA</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±60deg/sec</td>
<td>deg/sec</td>
<td>±60deg/sec</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1000Hz</td>
<td>Hz</td>
<td>-</td>
</tr>
<tr>
<td>Maximum Output</td>
<td>16383d</td>
<td>-</td>
<td>3.9</td>
</tr>
<tr>
<td>Minimum Output</td>
<td>0d</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Zero Rate Output</td>
<td>-12</td>
<td>+12</td>
<td>deg/sec</td>
</tr>
<tr>
<td>Zero Rate Output with</td>
<td>-3</td>
<td>+3</td>
<td>deg/sec</td>
</tr>
<tr>
<td>temperature variance</td>
<td>-3</td>
<td>+3</td>
<td>deg/sec</td>
</tr>
<tr>
<td>Scale Factor</td>
<td>74</td>
<td>82</td>
<td>90</td>
</tr>
<tr>
<td>Linearity</td>
<td>-0.5</td>
<td>+0.5</td>
<td>%FS</td>
</tr>
<tr>
<td>Scale Factor Variation with</td>
<td>-2</td>
<td>+2</td>
<td>%</td>
</tr>
<tr>
<td>Temperature</td>
<td>8102d</td>
<td>8192d</td>
<td>8282d</td>
</tr>
<tr>
<td>Temperature Sensor</td>
<td>-16</td>
<td>-18</td>
<td>-20</td>
</tr>
</tbody>
</table>

Coriolis Force: \( F = 2mv \Omega \)
Mass: \( m \)
Velocity: \( v \)

Rotation Axis
Regular Rate: \( \theta = 0° \sim 20° \)
Inclined to the direction of Pin 1

Tilt angle
\( \theta = 0° \sim 20° \)
High Accuracy MEMS Gyro
TAG204N5000

► ELECTRICAL SPECIFICATION

<table>
<thead>
<tr>
<th>Items</th>
<th>Digital Output</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MIN</td>
<td>TYP</td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>5V</td>
<td>± 5%</td>
</tr>
<tr>
<td>Consumption Current</td>
<td>9mA</td>
<td>Max.</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 60deg/sec</td>
<td>deg/sec</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>1000Hz</td>
<td>Hz</td>
</tr>
<tr>
<td>Maximum Output</td>
<td>16383d</td>
<td>-</td>
</tr>
<tr>
<td>Minimum Output</td>
<td>0d</td>
<td>-</td>
</tr>
<tr>
<td>Zero Rate Output</td>
<td>-6</td>
<td>+6</td>
</tr>
<tr>
<td>Zero Rate Output with temperature variance</td>
<td>-2</td>
<td>+2</td>
</tr>
<tr>
<td>Scale Factor</td>
<td>74</td>
<td>82</td>
</tr>
<tr>
<td>Linearity</td>
<td>-0.5</td>
<td>+0.5</td>
</tr>
<tr>
<td>Temperature Output</td>
<td>8102d</td>
<td>8192d</td>
</tr>
<tr>
<td>Scale Factor of Temperature Sensor</td>
<td>-16</td>
<td>-18</td>
</tr>
</tbody>
</table>

IMU Simulator software

In dedicated software is able to graph monitor and data outputs of the IMU’s output.
※There are two types of software with GNSS or without GNSS. Please check at the time of your order.
Software can be downloaded free from our HP.

Simulator software

2D monitor
Graph monitor
Graph monitor → Data output
Interferometric Fiber Optic Gyro (i-FOG)

TA7774N4

High accuracy [0.1°/h] Gyro, which is a key technology to realize fully autonomous driving.

▲ FEATURES

01 High-accuracy
Achieved [0.1°/h] which is required for fully autonomous driving.

02 Low-price
Our unique technology for winding and Fiber Optical IC realizes cost reduction.

03 Closed-loop Type

▲ CENTIMETER CLASS LOCALIZATION

The accuracy of localization of vehicles is increased to centimeter class by using i-FOG. It is necessary to maintain the accuracy of localization at a centimeter class under GNSS-denied environment.

Red line is the track of localization by i-FOG

▲ POSITION ACCURACY BY FYRO ERROR & VEHICLE SPEED

The accuracy of FOG (TA7774) is 0.1°/h which is possible to keep the accuracy of localization for a certain period of time. The accuracy of MEMS IMU (AU7684/TAG300) is better than standard class MEMS gyro. Therefore, customers can select the best type according to the requirement of accuracy.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>AU7684/TAG300</th>
<th>TA7774</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-in Gyroscope</td>
<td>MEMS Gyro × 3</td>
<td>FOG × 1</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Good</td>
<td>Very Good</td>
</tr>
<tr>
<td>Cost</td>
<td>Very Good</td>
<td>Good</td>
</tr>
<tr>
<td>Size (3-axis of sensor)</td>
<td>Very Good</td>
<td>Good</td>
</tr>
</tbody>
</table>
| Features | • Accuracy [5°/h]  
• Suitable for short-term measurement for fast-moving machine  
• Waterproof Case (TAG300 Series) | • High Accuracy [0.1°/h]  
• Suitable for long-term measurement for slow-moving machine |

Target Application

Construction machine, Agricultural machine

Automobile, Drone
**SPECIFICATION**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>TA7774N4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>±200°/sec</td>
</tr>
<tr>
<td>Bias Repeatability</td>
<td>&lt;0.1°/h (σ) (at 25°C static)</td>
</tr>
<tr>
<td>Bias Instability</td>
<td>&lt;0.1°/h</td>
</tr>
<tr>
<td>Random Walk</td>
<td>&lt;0.01°/h</td>
</tr>
<tr>
<td>Scale Factor Accuracy</td>
<td>±100ppm</td>
</tr>
<tr>
<td>Scale Factor Linearity</td>
<td>± 100ppm FS</td>
</tr>
<tr>
<td>Mass</td>
<td>&lt;400g</td>
</tr>
<tr>
<td>Power-supply voltage</td>
<td>±5V, ±15V</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>±5V: &lt;1.5A at startup</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-20°~+60°C</td>
</tr>
<tr>
<td>Non-operating Temperature</td>
<td>-30°~+70°C</td>
</tr>
</tbody>
</table>

**CONFIGURATION**

- **LIGHT SOURCE MODULE**
- **COUPLER**
- **OPTICAL IC**
- **OPTICAL DETECTOR MODULE**
- **OSCILLATION CIRCUIT**
- **FEEDBACK SIGNAL GENERATING CIRCUIT**
- OUTPUT

**ALLAN VARIANCE**

Random walk : 0.01°/√h

**SCALE FACTOR & LINEARITY**

- INPUT RATE[°/s]
- OUTPUT[°/s]
- LINEARITY[%(FS)]

- For more details, contact to our technical support written in the last page.

**OUTLINE DRAWING**

Unit : mm

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i-FOG + MEMS IMU

Combination of i-FOG (Yaw) & MEMS GYRO×2 (Roll & Pitch) is now under development. Please contact us for the details.
WARRANTY

When ordering, please contact our Sales Department as the contents of this catalog are subject to change without notice.

The outline of operation and the examples of an application circuit indicated in this catalog are only showing standard operation and usage of electronic components and do not guarantee the operation by actually used equipment. Therefore, please design equipment at your own risk in case you use our products. We cannot take responsibility for damages resulting from the use of our products.

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Failure of electronic components occurs in a certain probability. So we request you to establish safety designs, such as a redundant design of equipment, a design to prevent spread of a fire, an over-current prevention design, and a malfunction prevention design, even if the electronic components should break down so that an accident resulting in injury or death, a fire accident, and social damage may not take place.

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