Integrated Sensor Platform (ISP) with ANAVS Software Framework

Integrated Sensors and Electronics:
- Multi-GNSS, Multi-Antenna Setup
- IMU
- Cameras
- 3D-LiDAR
- Vehicle Data
- Powerful processors
- LTE module

Hardware-platform and software-framework for the combination of classical sensor fusion with artificial intelligence algorithms for autonomous driving, mapping and object detection and classification.

Accurate Position and Attitude
High Precision Maps (2D/3D)
Artificial Intelligence

Complete Sensor-Setup for Autonomous Driving
Easy System Integration
**SENSOR FUSION PERFORMANCE**

Accurate RTK Positioning * (1σ):
- Horizontal accuracy: 0.006 m + 1 ppm
- Vertical accuracy: 0.010 m + 1 ppm

Accurate PPP Positioning * (1σ):
- Horizontal accuracy: 0.15 m + 1 ppm
- Vertical accuracy: 0.20 m + 1 ppm

Accurate Attitude * (1σ):
- Accuracy: 0.25° (1m antenna spacing)

Velocity Accuracy: 0.03 m/s RMS
Time-Stamp Accuracy: 1 μs RMS
Solution Output-Rate: up to 120 Hz

RTK Initialization *:
- Initialization Time: < 7 sec

PPP Initialization *:
- Initialization Time: < 15 min

* Depends on Environment and used GNSS-Antenna

**GNSS FEATURES**

**GNSS Constellations:**
- Galileo, GPS, Gionass,
- Beidou, SBAS (Egnos, WAAS, GAGAN)

**GNSS Const. concurrent:**
- All

**GNSS-Bands:**
- GPS: L1C/A, L1C, L1PY, L2C, L2P, L5
- GLO: L1CA, L2CA, L2P, L3
- GAL: E1, E5a, E5b, E5 AltBoc, E6
- BDS: B1I, B1C, B2a, B2i, B3
- QZSS: L1C/A, L1C, L2C, L5, L6

Channels: 448
GNSS data rate: max 100 Hz
Jamming detection: Yes
Timepulse-Output: Yes

**CAMERA 1 FEATURES**

Type: FLIR Grasshopper3 USB3
Model: GS3-U3-23S6C-C
Description: High-quality color-camera with high frame-rate and global shutter
Frame rate: 163 FPS
Resolution: 1920 x 1200 (2.3 MP)
Image sensor: Sony IMX174

**CAMERA 2 FEATURES**

Type: Intel Real Sense Camera
Model: Tracking Camera T 265 or Depth Camera D435i
Description: Global shutter fisheye stereo-camera with integrated IMU and visual-inertial odometry, or depth camera (global shutter infrared stereo-camera) and RGB camera with integrated IMU

**LIDAR FEATURES**

Type: Velodyne LiDAR
Model: Puck (VLP-16)
Channels: 16
Measurement Range: 100m
Range accuracy: up to +/- 3 cm (typical)
Field of View (Vertical): +15° to -15° (30°)
Angular res. (Vertical): 2.0°
Field of View (Horizontal): 360°
Angular res. (Horizontal): 0.1° to 0.4°
Rotation rate: 5 Hz to 20 Hz

**STANDARD* IMU FEATURES**

Linear acceleration meas. range: +/- 16 g (configurable)
Angular rate meas. range: +/- 4000 dps (configurable)
Linear acceleration sensitivity: 0.061 mg/LSB with +/- 2 g range
Angular rate sensitivity: 4.37 mdps/LSB bei +/- 125 dps range
Angular random walk (T=25°C): 0.21 deg/h
Bias stability: 3 degree/hour (typical)

* more powerful IMUs can be chosen.

**ODOMETRY FEATURES**

Performance: Depends on resolution and quality of user-based wheel/steering measurements
Input/Output: Configurable with DBC-files or according to customer specification
Communication Interfaces: CAN, Ethernet, USB
### ELECTRICAL & INTERFACES

<table>
<thead>
<tr>
<th>Power Connector:</th>
<th>12V (optional 230 V) via waterproofed screwable connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Consumption:</td>
<td></td>
</tr>
<tr>
<td>Peak:</td>
<td>30 W (5A)</td>
</tr>
<tr>
<td>Average:</td>
<td>20 W (3 A)</td>
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<tr>
<td>Communication Interfaces:</td>
<td>Gigabit-Ethernet, Wi-Fi, CAN, USB 2.0, LTE</td>
</tr>
<tr>
<td>Output format:</td>
<td>Standardized: NMEA format, ROS</td>
</tr>
<tr>
<td></td>
<td>Proprietary: ANavS binary format</td>
</tr>
</tbody>
</table>

### INDUSTRIAL CASING

| Dimension: | 800 x 800 x 300 mm |
| Weight: | 7000 g |
| Operating Temp.: | -25°C to +65°C |
| Display: | Yes |
| Mounting: | Screwable or use of suction cups |

### PROCESSOR 1 PERFORMANCE

| CPU: | ARM 64Bit Quad-Core with 1.4 GHz |
| RAM: | 1 Gbyte LPDDR2 RAM |
| Flash: | 16 Gbyte |
| OS: | Linux |
| Description: | Used for classical ANavS sensor fusion with GNSS, IMU and Odometry sensors |

### PROCESSOR 2 PERFORMANCE

| CPU: | 6-core NVIDIA Carmel ARM®v8.2 64-bit CPU, 6 MB L2 + 4 MB L3 |
| GPU: | NVIDIA Volta™ architecture with 384 NVIDIA® CUDA® cores and 48 Tensor cores |
| Memory: | 8 GB 128-bit LPDDR4x 51.2GB/s |
| Storage: | microSD |
| OS: | Linux |
| Description: | Used for deep learning algorithms, object-detection/classification, semantic maps (LiDAR-based), HD-maps (Camera-based) and SLAM. |