

# iNAV-FCAI-02

## Inertial Measurement System for Advanced Surveying Applications

iNAV-FCAI is an INS product family for inertial navigation and guidance, stabilization and dynamically motion analysis with fiber optical gyros that covers applications, which require high accuracy, reliability and an open interface to the user.

- accurate inertial navigation, guidance and surveying system for airborne, surface and underwater applications
- FOG technology with low angular random walk and high angular resolution
- high bandwidth, fast response
- integrated dual antenna GPS with RTK
- integrated 2 cm accurate RTK-GPS / GLONASS / GALILEO aiding
- Interfaces: Ethernet TCP/IP, UDP, CAN, RS232 / RS422 UART, ext. DGPS, RTK-GPS, MIL-STD1553B
- **No ITAR, no export restrictions within Europe, Canada, Australia, USA, Japan**

The iNAV-FCAI for airborne, naval, AUV, UAV, ROV, surface and railway applications consists of three high precision fiber optic gyroscopes, three servo accelerometers, a powerful strap-down processor and an open and flexible interface, which can be customized.

As an option, the modular designed system provides interfaces to (D/RTK)GNSS, external triggers and external I/Os for e.g. up to 3 odometers, laser altimeter, DVL or camera / antenna platform control. Possible outputs are Ethernet (TCP/IP, UDP), RS232/422 UART, CAN, MIL-STD-1553B or analog as well as internal data storage on solid-state flash-disk. Furthermore application specific interfaces can be realized on request (e.g. ARINC 429).

Data processing (strap-down algorithms, global or local navigation, GNSS aided north keeping or motion monitoring and control) inside of the iNAV-FCAI is as well available as data transmission of pure or corrected raw data.

A key feature is its high available data rate of up to 400 Hz and its high resolution (0.01 arcsec =  $2.8 \times 10^{-6}$  degree in roll/pitch/ yaw) as well as high accuracy e.g. for stabilisation tasks. As an option special designed algorithms allow to output most



stable angular and position information during definable time windows e.g. for SAR or LIDAR applications (HPST<sup>2</sup> = High Precision Short Time Tracking Mode) also under difficult motion conditions.

No internal shock mounts are used to guarantee high angular performance regarding to laser scanner integration.

The user software NavCommand allows the user a full control of the system as well as data storing and to perform maintenance activities (e.g. download of stored data). With the software iWP+ furthermore a powerful postprocessing tool is available for advanced surveying applications.

The system iNAV-FCAI has no autonomous north seeking capability and is only **export controlled with simplified EU001 procedure** (but no ITAR restrictions). With iNAV-RQH-1003 a form-fit-function (FFF) compatible system is provided on RLG technology. With iNAV-FJI-001-J a FFF compatible system with FOG technology is provided.



## Technical Data of iNAV-FCAI-02 (1 sigma values):

|                                   |  |
|-----------------------------------|--|
| Measurement parameters:           | Roll, pitch, yaw, acceleration, velocity, rate, position   |
| Measurement range:                | $\pm 500$ °/s angular rate (the INS shall be powered on at $< 250$ deg/s)  |
| Accuracy:                         | $\pm 10$ g acceleration (5g / 20 g as option)<br>$< 0.07$ ° true north (with GPS/GNSS under motion)<br>$0.1$ ° true north with dual-antenna GPS and 5 m antenna distance<br>$< 1$ °/hr heading drift (during outages of GPS);<br>$< 0.05$ °/hr short time stability at const. temperature<br>$< 0.1$ ° roll/pitch (initially after power-on)<br>$< 0.05$ ° roll/pitch (INS/GPS under dynamic flight conditions)<br>$< 0.03$ ° roll/pitch (INS/GPS under static flight conditions)<br>$< 0.01$ ° roll/pitch, $< 0.03$ ° heading with RTK post-proc under motion |
| Position error:                   | $< 10$ m with GPS (S/A off)<br>$< 1$ m with DGPS, Omnistar supported [ $< 10$ cm RTK mode option]  |
| Velocity error:                   | $< 0.1$ m/s (aided with GPS), $< 20$ mm/s with RTK in post-proc.   |
| Alignment duration:               | $< 1$ minute on land (for roll pitch inertially, heading by dual-antenna GPS)<br>$< 4$ minutes on the fly with GPS aiding  |
| Resolution:                       | 0.01 arcsec (roll/pitch/yaw) $< 10$ $\mu$ g (accel.) (averaged)  |
| Nonlinearity:                     | $< 100$ ppm (gyro) $< 20$ $\mu$ g/g <sup>2</sup> (accel.)  |
| Scale factor error:               | $< 300$ ppm (gyro) $< 500$ ppm (accel.)  |
| AngularRandomWalk / Accel. Noise: | 0.02 deg/sqrt(hr) $< 25$ $\mu$ g/sqrt(Hz)  |
| Bias repeatability:               | $< 1$ deg/hr (1 sigma) $< 500$ $\mu$ g (1 sigma)   |
| Dynamics capability:              | $> 1'500$ °/s <sup>2</sup>   |
| Axis misalignment                 | $< 200$ $\mu$ rad  |
| Sampling rate; Output rate:       | 400 Hz; 1...400 Hz (Ethernet, CAN, MIL-Bus)  |
| Latency:                          | $< 3$ ms (time stamp $\pm 10\mu$ s)  |
| Data output (options):            | Ethernet 10/100/1000BaseT, TCP/IP, UDP, RS232RS422 UART, CAN, MIL-STD1553B (all data with time stamp)  |
| Data input (options):             | internal/external (RTK)GNSS, marker event trigger, 3 x odometer, (RS422 level), [PPS / SYNC] integrated L1/L2 GPS/GLONASS/GALILEO receiver, dual antenna   |
| GNSS aiding:                      | approx. 10.5 kg  |
| Weight:                           | approx. 360 x 213 x 179 mm or 299 x 213 x 179 mm   |
| Size:                             | $> 20,000$ hrs (estimated for surveying applications)  |
| MTBF:                             | -40...+63 °C operating and -45...+85 °C storage (case temper.)   |
| Temperature:                      | 25 g, 11 ms; 60 g, 5 ms; 3 g rms 10...2'000 Hz endurance   |
| Shock, Vibration:                 | MIL-STD-810F, MIL-STD-461E, MIL-STD-704D, DO160E   |
| Qualification:                    | 11...34 V, $< 45$ W; 50 ms hold up time according to DO160E  |
| Power supply:                     | NavCommand realtime, open I/F XIO, iWP+ postproc   |
| Software:                         |  |

iMAR has extended longtime experience in the manufacturing and development of inertial navigation and guidance systems for all application areas. All systems manufactured by iMAR are maintained at iMAR in Eu-



rope / Germany.

In the iNAV-FCAI inertial navigation and guidance systems iMAR uses advanced FOG technology. The system requires only an European export license for the total system.

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**Option: Separate Measuring Head:**

Size, Weight of Measurement Head:

approx. 145 x 115 x 140 mm (plus connector), approx. 2'300 grams



**Measurements of Allan variance:**

At constant temperature the gyro bias is stable over > 2'000 s with < 0.02 deg/hr, which provides exceptional advantages for INS/GNSS coupled systems.

