

# iPST-FMS-6

## Inertial Measurement System for Surveying Pipelines (Pipeline Surveying Tool)

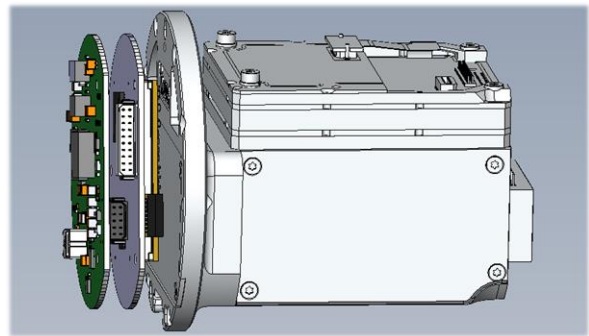
For maintenance purposes pipelines have to be checked on a regular basis with the help of inspection tools searching for damage such as deformation, corrosion or leaks. During this inspection it is especially important to determine the exact location of the inspection tools (“pig”) in the pipeline, as this can significantly reduce the scope of necessary repairs. Imprecise location of the damage can make it necessary to clear a large area of the pipeline, resulting in much greater repair costs.

With the help of Inertial Navigation Technology the position of a pipeline inspection tool in a pipeline can be exactly determined. To achieve this, the inspection tool is coupled with a inertial Pipeline Surveying Tool (iPST) consisting of three gyroscopes, three accelerometers, odometers and further optional devices as well as an electronic device for signal recording. The gyroscopes are used to determine attitude and heading of the iPST. The accelerometers and the odometers are used to determine the translational motions.

iPST-CFM-6 is a member of iMAR’s **iPST Pipeline Surveying Tools** targeting small pipelines with diameters down to 6 inch. The system provides acceleration and angular rates as well as odometer counts with high data rate for precise post processing with localization precision down to 1m/km. The post-proc software iPosCAL-PST provides the capability to include various aiding points (external GNSS markers, magnetic markers, known pipeline segments, etc.). iPST hardware can be adapted to different pipeline diameters and housings.

- High performance inertial measuring system with fiber optical gyroscopes (FOG).
- Designed for industrial environments
- Supports up to 3 odometer units
- High turn rate capabilities for quick cornering
- Time synchronization via iMAR iPST-GPS-Box.
- Internal 64+ GByte data storage for black-box operation capability (option 128 GByte or more tbd.)
- High data rate, open interfaces: Ethernet TCP/IP - UDP, CAN, UART RS422/RS232 or customized
- Small size, low weight, low power

After mission, all data being acquired during the mission are then processed using iMARs iPosCal-PST post processing toolbox, a software developed to gain high precision position data for pipeline inspection tools, allowing to include various aiding information. Using sufficient known aiding or marker information, a position deviation of 1m per km inspection can be achieved.



**Figure: iPST-FMS-6 Sensor + Electronics**

The iPST-FMS-6 contains fiber optical gyros of class 1 deg/hr. The accelerometers used have 5 g range, 1.5 mg bias and 50 µg resolution. The sensor and electronics require for a minimum

diameter of 120 mm and 160 mm in length.



Because of their modular construction, the systems can be adapted to the

specific requirements of each customer without restrictions on the system alignment. Post processing capabilities allowing for one combined inspection unit or the iPST in a separate housing behind the pig.

## Technical Data of iPST-FMS-6

Measurement parameters:	Angular Rates, Acceleration, Magnetic field, Encoder/Odometer Tics
	Gyroscopes                      Accelerometers      Magnetometer
Measurement Range:	± 860°/s                      ± 5 g                      ± 800.000 nT
Noise:	< 0.15 °/√h                      < 0.05 mg/√Hz      15 nT
Linearity / Scale Factor:	0.03 % / 0.05 %                      0.2 % / 0.2 %                      0.5 % / n/a (mag)
Drift (unaided):	< 1°/h                      < 1.5 mg
Bias Stability (AV):	< 0.1 °/h                      < 50 µg
Position Accuracy:	1m / km (sufficient marker spacing required) [post-processing]
GNSS Receiver:	none; iPST-GPS-Box required for GNSS Time
Input Interfaces:	Ethernet (100BASE-TX, IEEE 802.3), event trigger (PPS / SYNC, RS422 level), odometer (opto-coupler input up to 36V, A/B quadrature or counts & direction, RS422 level compliant)
Output Interfaces:	Ethernet (100Base-TX, IEEE 802.3) TCP/IP / UDP
Data Output Rate:	1...1'000 Hz
Data storage:	64 GByte on internal non-volatile memory (128 Gbyte as option)
Temperature:	-10...+50 °C operating (case), -40...+70 °C storage (case)
Shock, Vibration:	30 g / 18 ms, 90 g / 6 ms; 10...500 Hz, 15 g
EMC/EMI Qualification:	Environment Industry, light Industry, Residential according-DIN EN 61326-1:2013 §3.1
Power; Start-up-Time:	10...34 V, < 15 W (after initial heating); < 10 sec
Weight / Size:	Sensor Core: 1.8 kg / cylindric shape, 160 mm x 120 mm (LxD), on request customized enclosure
Software:	iXCOM communication protocol; iXCOM-CMD GUI / HMI and iPosCal-PST post processing software under MS Windows and under Linux available

iMAR Navigation manufactures and designs inertial navigation, surveying, guidance, control and stabilization systems for defence, airborne, industrial, gravimetry, automotive, agriculture, mining, drilling, surveying and many other applications. All systems are manufactured and maintained by iMAR Navigation in Europe / Germany.

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<sup>1</sup> initial heading accuracy obtained from dual-antenna setup only; will be automatically improved as soon as sufficient motion is observed; accuracy rule of thumb: 0.2 °/[m baseline]

