iPRENA-II / -III / -IV
iPRENA-M-II / -III / -IV

Family of precise Inertial/GNSS based Navigation Systems

iPRENA-M-II…IV and iPRENA-II…IV are product families of highly precise Inertial Navigation and Timing systems (iNAT), applicable in defence.

It is used for north finding, navigation, surveying and dynamic motion measurements and contains ring laser gyros (RLG). The iPRENA covers applications, which require highest accuracy and reliability, like mining, surveying or gun alignment.

- High performance inertial navigation, artillery pointing, target gelocationing and surveying system for for miliary ground, airborne, naval and underwater platforms
- True North Reference, fast and accurate gyro compassing in static and dynamic environment
- Small size, low weight, low power, highest reliability also in GNSS denied environment
- Integrated multi-constellation / multi-frequency GNSS receiver (up to RTK / PPP)
- Option: Interface for external mil. grade P/Y code GNSS receivers (M-Code, SAASM)
- Various interfaces: Ethernet TCP/IP, UDP, CAN, RS422/RS232 UART, ARINC825 /429. NTP time server capability
- Military environment qualified (MIL-STD-810G, MIL-STD-461G, MIL-STD-704F)
- Several versions available:
  - standard MOTS version iPRENA-xx [0] with standard shock isolators and miniature encl.
  - gun-fire hardened version iPRENA-**M**-xx [B] within MAPS / DRU compatible enclosure and with integrated highly shock & vibration resistant isolators (gunfire resistant, preferred shock direction along enclosure length direction);
  - same as before (iPRENA-M-xx [A]), but with standard shock isolators

iPRENA-(M)-II…IV consists of three high precision ring laser gyroscopes (RLG), three accelerometers, a powerful strapdown processor and an open and configurable interface.

The system contains a GNSS receiver for GPS, GLONASS, GALILEO, BEIDOU etc.; it can also be operated with external GNSS receivers. Available COM I/Os are Ethernet (TCP/IP, UDP), RS422/232 UART, CAN, ARINC429, ARINC825, CAN-aero, NMEA 0183 as well as a large internal data storage on solid-state non-volatile memory.

Data processing (strapdown navigation, gyro compassing / north seeking, north keeping or motion monitoring) is performed inside of the iPRENA as well as data transmission and data storage.

A key feature is its high data rate of up to 400 Hz and its long-term supreme accuracy stability, which is a key factor of RLG technology compared to other gyro technologies. **The MTBF of the core inertial sensors is > 100'000 hrs field experience.**

iMAR's HMI software iXCOM-CMD allows the user full control of the system, data storage and visualization as well as configuration and maintenance activities (e.g. download of stored data).

iPRENA-xx

iPRENA-M-xx

The iPRENA systems come with the major advantages of ring laser gyros (e.g. no significant aging, i.e. long term performance of gyro bias and scale factor as well as high reliability), and they do not suffer from the typical strong disadvantages of higher performance FOG or CVG based systems (like aging or degraded bias accuracy under vibration or temperature gradients etc.).

Due to the modular system architecture, the iPRENA systems can be delivered with customized data interfaces and connectors, e.g. to replace obsolete navigation systems of any other provider in a form, fit & function manner.

The iPRENA-(M)-II/II/IV systems are only covered by European dual-use export control (no ITAR restrictions).




Technical Data of iPRENA-M-II/-III/-IV and iPRENA-II/-III/-IV (rms values)

		used for:
Data Output:	Azimuth (True Heading) and elevation, position and velocity (including standard deviations), roll, pitch, angular rates, acceleration, system status (BIT) etc.	
Azimuth / True Heading:	[all values: sec Lat, free inertial / gyro compassing]:	
iPRENA-II and iPRENA-M-II:	< 0.3 mil gyro compassing within 10 min.; 0.2 mil with GNSS on the move[1]	
	< 0.8 mil gyro compassing within 5 min.; 0.2 mil with GNSS on the move[1]	
iPRENA-IIIA and iPRENA-M-IIIA:	< 0.6 mil gyro compassing within 10 min.; 0.2 mil with GNSS on the move[1]	
	< 1.0 mil gyro compassing within 5 min.; 0.2 mil with GNSS on the move[1]	
iPRENA-III and iPRENA-M-III:	< 1.0 mil gyro compassing within 6 min.; 0.2 mil with GNSS on the move[1]	
	< 3.0 mil gyro compassing within 3 min.; 0.2 mil with GNSS on the move[1]	
iPRENA-IV andiPRENA-M-IV:	< 1.5 mil gyro compassing within 7 min.; 0.2 mil with GNSS on the move[1]	
	< 3.0 mil gyro compassing within 4 min.; 0.2 mil with GNSS on the move[1]	
Elevation (Pitch), Roll:	< 0.18 mil (< 0.1 mil dynamically[1] with GNSS aiding)	
Position and Velocity Accuracy:		
INS/GNSS:	< 0.5 … 2 m [CEP50] and < 0.01…0.05 m/s with GNSS aiding[1] (GNSS receiver dep.)	all vehicles)
	< 2 … 5 m [PE] vertical[1]	
INS/GNSS-RTK:	< 0.05 m [CEP50] , < 0.005 m/s with RTK-GNSS aiding (sufficient visibility and motion)	all vehicles)
	< 0.1 m [PE] vertical	
free inertial[2]:	< 0.5 nm/hr [CEP50] and < 1 m/s free inertial drift (iPRENA-(M)-II)[3]	surface, air, sub
	< 1.0 nm/hr [CEP50] and < 1.3 m/s free inertial drift (iPRENA-(M)-III)[3]	surface, air, sub
	< 1.5 nm/hr [CEP50] and < 1.5 m/s free inertial drift (iPRENA-(M)-IV)[3]	surface, air, sub
pure inertial (w/o VMS, w/o GNSS)[4]:	< 0.01…0.08 % dist. travelled LON/LAT [CEP50], < 0.04 % dist. travelled ALT [PE50]	ground vehicles
VMS aided (w/o GNSS)[5]:	< 0.01…0.1 % dist. travelled LON/LAT [CEP50] , < 0.05 % dist. travelled ALT [PE50]	ground vehicles
ZUPT aided:	< 18 m horizontal [CEP50] / 10 m vertical [PE50] without GNSS and each 10 minutes ZUPT (given accuracy for up to 10 ZUPTs or 20 km distance)	ground vehicles
Alignment Methods:	Automatic, Static and Dynamic Alignment, Stored Heading/ Stored Position Alignment, Transfer Alignment	
Aiding Methods:	GNSS and/or VMS and/or ZUPT (zero velocity update) and/or PUPT (position aiding)	
Data storage:	up to 128 GByte on internal non-volatile memory; processed data and sensor raw data	
Software:	internal embedded software: under OS QNX. iXCOM communication protocol; iXCOM-CMD HMI software under MS Windows and Linux available; integrated real-time Kalman filter (42+ states); RTC	
Inertial Sensor Ranges:	± 395 °/s and ± 40 g; GNSS altitude unlimited	
Data Output Rate, Latency:	integer divisor of 400 Hz; internal data rate > 3 kHz; data latency < 6.5 ms, jitter < 1 ms	
GNSS Receiver (integrated):	up to all-frequencies / all constellations GPS+GLONASS+GALILEO+BEIDOU, RTK/PPP; option: independent heading determination with GNSS dual-antenna support, providing 4 mil / L [m] with L = antenna baseline (according to SIL demands)	
GNSS external receiver support:	ERGR™ with SAASM / PPS (Precision Positioning Service) capability, other on request	
Output Interfaces (options):	RS232/422 UART, Ethernet TCP/IP / UDP, PPT (Pulse Per Time), PPS, CAN, ARINC429, ARINC825, CANaero, NMEA 0183, USB; NTP Time Server (PTP on request)	
Input Interfaces:	internal/external GNSS (standard: integrated GNSS engine), marker event, PPS, trigger, odometer / vehicle motion sensor (VMS) / wheel sensor (opto-coupler input up to 32 V, RS422 level compliant)	
Qualification:	MIL-STD-810G, MIL-STD-461G, MIL-STD-704F; designed partially to meet DO160G	
Temperature (case); rel humid.; alt.:	-40...+71 °C operating, -55...+85 °C storage; 8...100 %, IP67; 60'000 ft	
Shock, Vibration, Altitude: (MIL-STD-810G)	iPRENA-II/III/IV [0]: 6 g / 20 ms (operating); 5…2'000 Hz, 4.3 g rms (operating); 50 g / 11ms endurance	
	iPRENA-**M**-II/III/IV [A]: 6 g / 20 ms sawtooth; 5…2'000 Hz, 4.3 g rms (operating)	
	iPRENA-**M**-II/III/IV [B]: Gunfire shock resistant 60 g / 8 ms half sinus 10.5 g rms with 5…2000 Hz random vibration (operating)	
MTBF / MTTR:	> 50,000 hrs (estimated for surveying applications), 120'000 hrs ISA core (field data) / < 30 minutes	
Power Supply & Consumption:	11...35 V DC, < 28 W (incl. internal GNSS receiver); 50 ms hold up time according to DO160G	
Weight / Size:	iPRENA-II/III/IV: approx. 6.9 kg / approx. 187 x 128 x 296 mm³ (without connectors)	
	iPRENA-M-II/III/IV: approx. 16 kg / 383 x 276 x 221 mm³ (LxWxH; without connectors)	
Connectors:	MIL-C-38999 Series III (opt. Series I, if compatibility to MAPS/DRU cabling required), TNC	
Export license:	Standard Dual-Use equipment, not covered by ITAR	
Part-Number:	00190-0420x-05yz with x = accuracy class (1 = -II, 2 = -III, 3 = -IIIA, 0 = -IV), y = shock protect. (0, A, B), z = 6 (single ant.) or 7 (dual-antenna)	

iMAR is manufacturing and developing inertial navigation and guidance systems for all application areas. All systems manufactured by iMAR are maintained at iMAR in Europe / Germany.

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[1] with sufficient GNSS aiding and sufficient moton dynamics
[2] free inertial: no aiding (no GNSS, no VMS, no ZUPT, …), arbitrary motion
[3] can be improved if sufficient GNSS aiding and motion is available before switching to free inertial mode
[4] pure inertial: no external aiding (no GNSS, no VMS), valid for ground vehicles (truck, car, tank, …), using iMAR proprietray motion constraint algorithms [data valid for iPRENA-II and iPRENA-M-II version]
[5] VMS aided: no other aiding than VMS / odometer / wheel sensor (no GNSS…) [data valid for iPRENA-II, iPRENA-M-II version]