Gaps Series

Frequently Asked Questions

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1 QUESTIONS CONCERNING BOTH GAPS SYSTEMS

1.1 Why is a Gaps calibration free?

It is mandatory for USBL systems to be calibrated with an INS/AHRS on board of a vessel to give accurate position and attitude to the USBL system. Calibration is not necessary with Gaps M7 because it contains an INS inside of the USBL head. The calibration is done during the manufacture process, making Gaps M7 a precalibrated system. No calibration is necessary by the end user and Gaps M7 can be installed and be operational in less than an hour.

Gaps M5 does not need to be calibrated, even after a hydrophone replacement.

1.2 If Gaps systems are calibration free, why do I need to execute an alignment procedure?

Gaps systems mixes USBL, INS and GPS technologies to give the most accurate USBL data in its category, it operates in deep or very shallow water and difficult environments where other systems are deficient. As Gaps has an integrated INS, this allows its use without a calibration. Where it is necessary to carefully calibrate all other USBL systems with the INS on board, it is not necessary to carry out this calibration for Gaps, as it is precalibrated at our factory with Phins/Octans inside. This will save a lot of time for users and Gaps can be operational in less than an hour. The important point to know is that it is necessary to align Gaps to obtain the best accuracy. This means that it is necessary that the vessel stay with a constant heading during 5 minutes for the coarse alignment, then it is necessary that it move in different directions for 25 minutes for the fine alignment. In only 30 minutes, Gaps will be ready to deliver you the specified accuracy.

1.3 How can I retrieve the IP address of my Gaps system?

By default the IP address is indicated on the Gaps BOX sticker and is 192.168.36.1XX, with XX being the last two numbers of the serial number. If the IP address has been changed and is not known, the following steps can be taken. If you have changed the address and lost it, you can retrieve this IP address as follows: Connect a hyperterminal on the PC to one of the RS232 sockets. Configure the terminal to the following settings: baudrate 115200 bds, data bits 8, parity: none, stop bits: 1. Reboot the unit by switching it off and on, the IP address will be broadcasted by Gaps on the hyperterminal.

1.4 How should I set the blanking time on my Gaps for the best performance?

In order to get the best responses from your beacons, you must always set a blanking time based on the recurrence you have set in the Gaps. The blanking time must always be - 200ms from the recurrence of the interrogations from the system. For example, if the recurrence is set to 1s, then you must configure the blanking time to 0.8s. Refer to Gaps user manual for detailed tables for different examples.

1.5 What is the recommended procedure for Hydrophone and transducer maintenance?

For preventive maintenance:

In order to limit growth on the hydrophones, iXblue recommends the use of the following anti-fouling: International - TRILUX 33

1. Sigman Coatings : blue Sigma-glide
2. They should be cleaned with isopropylic alcohol (Steps mentioned below)
3. Light abrasions with 100/120 sand paper
4. Clean with isopropylic alcohol
5. Wet the surface with aliphatic hydrocarbon solvent
6. Wait for 2 minutes to dry
7. Apply anti fouling according to the manufacturer's recommendations (a thin coating)
8. Wait for 24 hours

For curative maintenance:

To clean the hydrophones; use synthetic soap and water

To remove gwth, use ro180 sandpaper and apply minimal pressure on the hydrophone

1.6 How do I check the battery status of my MT9?

In the configuration software, press F1. In this command menu, click "diagnostic button" to access the battery diagnosis. When the transponder is connected to the charger, the charger LED turns green when the battery is fully charged.

1.7 What should be the maximum voltage when my MT9 beacon is fully charged?

The level of the battery pack when fully charged should be around 8,5V (between 8,4V and 8,6V). The battery voltage level can be requested via the following steps:

1. Disconnect any external charger
2. Connect the transponder to the PC through the connection box
3. Launch the Transponder HMI interface
4. Press the F1 key

5.	In the command utility window that appears, click Diagnostic button to get the battery voltage.

## 1.8	What is the minimum voltage for an MT9 beacon to be operational?

The MT9 does not operate when the battery voltage is lower than 7V.

## 1.9	How should I configure my MT9 interrogation codes for responder mode?

You must apply the same interrogation code to both responder and transponder modes in the configuration software. If your responder signal is not sent to the beacon (in case of a cable cut), the beacon will automatically move to transponder mode.

In this case it is necessary to have the same interrogation code so that you can continue to follow your beacon. Keep in mind that it will be necessary to change the configuration of both Gaps when the responder signal is not sent anymore.

## 1.10	What is Gaps systems positioning accuracy?

Gaps M7 positioning accuracy depends mainly on Signal to Noise Ratio. This Signal to Noise Ratio depends on the beacon transmit level, the range to the beacon, the noise level and the vertical angle. In best case (SNR_in > 20 dB and in vertical conditions), the positioning accuracy is 0.1% of the slant range (CEP-50). i.e. 100 cm accuracy at 1000 m of distance. If SNR_in is 10 dB, the positioning accuracy is 0.17% of the slant range (CEP-50). For low SNR (around 0 dB), the positioning accuracy is 0.5% of the slant range (CEP-50). When tracking horizontally, the positioning accuracy is 3 times less.

Gaps M5 positioning accuracy depends on the same criterias and is 0.5% of the slant range.

## 1.11	What are Gaps M7 and Gaps M5 maximum range?

Gaps M7

The maximum range depends on the noise level and beacon transmit level. For a TL = 191 dB ref µPa :

- if noise level is 60 dB ref µPa: max range is 5 000 m (example of buoy installation - SEA STATE 6 + 10 dB)
- if noise level is 70 dB ref µPa: max range is 3 600 m (example of quiet vessel)

- if noise level is 80 dB ref μPa: max range is 2 300 m (example of a vessel manoeuvring, Gaps at a reasonable distance from the thrusters)
- if noise level is 90 dB ref μPa: max range is 1 300 m (example of a vessel manoeuvring, Gaps very closed from the thrusters)

Gaps M5

Gaps M5 maximum range is 995 m, making it free-of-export restrictions.

1.12 How accurate must my GPS lever arm be?

Try to use lever arms 10x as accurate as your measurement. For example, within 10cm for a 1 m accurate GPS. This will make sure your lever arms will not affect the performance of your system.

1.13 What is the longest available cable for Gaps systems?

The Gaps systems cable can be 95m maximum long because of the limitation of Cat 5 Ethernet maximum length. If longer distances are required between Gaps head and Gaps box, it is possible to connect 2 x 95 m cables through a repeater box (total length is then 190 m).

1.14 Where is the reference point of the Gaps systems?

The reference point of the USBL is the SUBCON connector, on top of Gaps M7 and M5 heads.

1.15 Why are Gaps systems the most adapted for shallow water?

Because of its specific antenna composed of 4 hydrophones, that form a tetrahedron. This is a 3D antenna than enables to position a beacon with good accuracy on 3 axis (X, Y and Z). Gaps M7 and M5 have an aperture of 200° which means we can track a beacon less deep than the antenna.

1.16 Which Navigation Softwares are compatible with Gaps M7 and M5?

Almost all navigation softwares have Gaps driver (QINSY, NAVIPAC, HYPACK, STARFIX, WINFROG, GECDIS). If your navigation software is not in this list, Gaps M7 and M5 can emulate third party protocols (GPGGA, SONARDYNE, KONGSBERG) Most of the time,

Gaps M7 must not be declared as a standard USBL system because this is a pre-calibrated system. In QINSY for example, Gaps M7 and M5 must be declared as a positioning system.

1.17 Do I need to measure the sound velocity profile?

To get Gaps M7 and M5 nominal accuracy, the measurement of the sound velocity in the water column is mendatory. If the sound velocity profile is not measured and not configured into Gaps M7 and M5, this can lead to unaccuracy and even to non positioning. If no sound velocity probe is available on the vessel, statistical sound velocity profiles can be used. Contact iXblue to get a tatistical sound velocity depending on your location and season.

1.18 How to optimize Gaps M7 and M5 performances?

The different possibilities are :

- increase beacon transmit level
- reduce noise received by the Gaps (increase the horizontal distance between Gaps and source of noise, increase Gaps depth)

1.19 What to do if positioning accuracy is not as good as expected?

If positions are jumpy, this probably comes from a multipath (reflective surface which is too close from the Gaps M7 or M5 or the beacon) and/or difficult conditions for acoustic propagation (shallow water or horizontal tracking). Increase Gaps M7 or M5 depth or place differently the beacon transducer. If a bias is observed in the positioning:

- check beacon turn around time (in the beacon and in the Gaps web MMI)
- check that a correct sound velocity profile has been configured into the Gaps
- check the GPS lever arm and potential mounting misalignments.

1.20 What comes in a standard Gaps M7/M5 delivery?

Gaps M7 standard package comprises the Gaps M7 head, a 50 m cable and the Gaps M7 box. Beacons, other cable lengths, GPS antenna can be ordered separately.

Gaps M5 standard package comprises the Gaps M5 head, a 20 m cable and the Gaps M5 box. Beacons, other cable lengths, GPS antenna can be ordered separately.

1.21 What operating system do Gaps M7/M5 support ?

Gaps M7/M5 are operated through an Internet browser (Firefox, Chrome, Internet Explorer, Safari…) and operated from any device that runs an Internet browser (laptop, workstation, computer, mobile, tablet...). It means that there is no restrictions regarding the Operating System. iXblue recommends the use of Firefox because this is our qualification environment.

1.22 What is the best location to mount the Gaps M7/M5 head?

As far as possible from any source of noise (thrusters, propellers, engines...) and below the wash created by the thrusters.

1.23 What is the best location to mount the beacon on ROV?

As far as possible from any source of noise (thrusters, propellers, engines...) and on top of the ROV in order there is direct acoustic line of sight between the Gaps M7/M5 head and the beacon transducer.

1.24 What is the impact of Gaps M7/M5 mounting misalignments (heading, roll, pitch)?

If the Gaps M7/M5 to GPS lever arm is small (< 5 m), Gaps mounting misalignment has low impact. If the Gaps M7/M5 to GPS lever is bigger, it may have an impact and it is recommended to enter these misalignments into Gaps M7/M5 web MMI (mechanical installation parameters).

These misalignments can be estimated at sea (when INS correctly aligned) by comparing Gaps M7/M5 heading roll and pitch to vessel heading roll and pitch. If the Gaps M7/M5 to GPS lever arm are really large (20 m or more), it is recommended to compensate this lever arm into a navigation software (QINSY, NAVIPAC, WINFROG...) and to input into Gaps M7/M5 this compensated position.

1.25 Do third-party beacons have the same positioning performances compared to iXblue beacons?

Each type of beacon has its own characteristics (transmit level, directivity, type of signal), the positioning performances are then different from one type of beacon to the other.

2 QUESTIONS CONCERNING GAPS M5

2.1 Performance, operation and applications

A.1.1 HOW MANY TARGETS CAN I TRACK WITH GAPS M5

Gaps M5 can track up to 40 targets and 10 with a common interrogation code.

A.1.2 IN RESPONDER MODE, HOW MANY BEACONS CAN BE TRIGGED SIMULTANEOUSLY WITH THE SURFACE UNIT SYNCH OUTPUT?

Up to 10 beacons in responder mode.

A.1.3 DOES GAPS M5 SUPPORT DATA TELEMETRY?

Yes, it does. Gaps M5 offers robust binary data transfer capability with simultaneous positioning. So, it can be use for INS realignment and coupling but also for any type of use in the range of AUV control or status recovering for example.

A.1.4 WHAT IS THE MAXIMUM DATA RATE OBTAINED IN COMMUNICATION MODE?

The maximum data rate obtained is 20 bytes sent and 20 bytes received in a 6 seconds window. Position cycle is default 1 seconds and increased by 5 seconds to allow the beacon to process the data and receive the reply.

A.1.5 CAN WE USE THE SYSTEM FOR POSITIONING AND COMMUNICATION IN PARALLEL?

Yes, Gaps M5 acoustic communication is telemetry, which is a low rate and robust communication mode design to be interlaced with the positioning.

A.1.6 IN CASE OF UNAVAILABILITY OF GPS SIGNAL, IS THERE A WORKAROUND TO BYPASS THE INPUT OF GPS SIGNAL WHEN TESTING WITHOUT INDUCING A SYSTEM ERROR MESSAGE?

The origins of error/warning message triggers are not configurable, then if no GPS signal is inputed into Gaps M5, an error message will occur. This can be avoided during workshop testing using a GPS simulator.

A.1.7 IS GAPS M5 BETTER THAN GAPS M7 FOR SOME APPLICATIONS?

Gaps M5 will be never better than Gaps M7. Gaps M7 is the ultimate precalibrated system whereas Gaps M5 is a cost-effective version.

A.1.8   WHAT IS THE TELEMETRY RATE?

Instant telemetry rate is 500bits/sec. Effective rate is 160 bits/positioning cycle. Positioning cycle is majored by 5sec to let the transponder time to process the request (sensor measurement, fix INS...). For example, if you are positioning an AUV with a positioning cycle of 2 seconds, when telemetry is transmitted to the AUV, the positioning cycle will be 7 seconds.

A.1.9   WHAT IS THE RECOMMENDED SHORT RANGE OF OPERATION?

Gaps M5 can be use from a few meters to 995m range. Even in reflective environement and very short range less than 10m, the performance will be nominal.

A.1.10   CAN THE RANGE BE EXTENDED BEYOND 995?

No, Gaps M5 is an export free system. Gaps M7 is the solution for longer range tracking.

A.1.11   IS THERE ANY DECREASE IN POSITION AROUND THE HORIZONTAL BEAMS (180-200 DEGREES)? CAN THE GAPS BE TILTED IN SHALLOW WATER TO HAVE BETTER POSITION PERFORMANCE OR IS THIS NOT NEEDED AT ALL?

There is a little accuracy decrease with the elevation angle, especially in the target depth estimation. Tilting the Gaps M5 is possible up to 45° but the accuracy gain is not huge.

A.1.12   WHAT IS THE POSITION UPDATE RATE?

Maximum positioning update rate is 1.25Hz (0.8sec cycle)

A.1.13   YOU SAY THERE IS NO CALIBRATION NEEDED AT ALL? NOT EVEN A SPINCHECK? YOUR COMPETITOR STATES THAT WITH AN INTEGRATED INS, A SPINCHECK IS STILL NEEDED.

Gaps M5 does not need calibration at all. The mechanical design alone allows for 0.5% of the distance.

A.1.14   CAN ONE LOAD NEW CALIBRATION PARAMETERS?

Gaps M5 is calibration free and do s not require any calibration at sea. However, it is possible to change each hydrophone vertical offset (value in mm), this value is preset in factory. Each spare hydrophone is deliverd with a vertical correction offset to be entered in the Gaps MMI.

A.1.15 How about the calibration interval for the Octans Nano gyro? Do we need to calibrate the gyro?

The internal AHRS is pre-calibrated.

A.1.16 Since Gaps M5 is pre-calibrated at factory and no calibration is needed, what can we do if we find out that the underwater position is not good or far away from the actual position?

Deploying a transponder on the seabed and record Gaps M5 data during a circle and an "8-shape" trajectory is a good way to check the system operational accuracy. Considering the median transponder position is the reality, you will check the position dispersion and accuracy.

A.1.17 If position is unstable in very shallow waters – what will be the difference performance-wise between Gaps M5 and M7?

In shallow water, the Gaps M7 will be at least two time better than Gaps M5 in X/Y estimation, and 5 times better on depth estimation due to its antenna geometry and higher-grade hydrophones.

A.1.18 Can Gaps M5 be utilized as DP System Reference Systems?

Gaps M5 can be interfaced to DP systems by delivering, through a serial or ethernet link, transponder relative position (USBL) from one transponder deployed on the seabed and vessel absolute position (LBL) when at least 3 transponders are deployed. Gaps M5 is an effective acoustic part for dynamic positioning DP2 and DP3 in shallow water.

A.1.19 Is Gaps M5 stable on vessel move?

Gaps M5 embeds an AHRS Octans Nano. It automatically compensates the vessel move for attitude and heading.

A.1.20 What is the maximum sea state that we can use Gaps M5?

There is no established limitation of the sea state, the internal AHRS compensates the vessel use. In case of strong wave condition, we adise to mount the Gaps a bit deeper to avoid air buble issue.

A.1.21 HOW DOES THE GAPS INTERFACE WITH YOUR INS ON AN AUV?

Gaps can transmit the USBL position of the AUV using the telemetry link. The AUV-embedded transponder on the AUV will automatically output the USBL position to the INS. This is really easy to configure, and it is fully explained in the Gaps user manual.

A.1.22 HOW FAST CAN AUV BE TRACKED RELIABLY?

Gaps MFSK modulation offers doppler resistant codes that can be used to track above 30 knots.

A.1.23 HOW CAN I USE THE M5 TO COMMUNICATE WITH AN AUV IN MODEM MODE ON A COMPATIBLE BEACON WITHOUT USING THE TOWFISH MODEM FOR AUV POSITIONING?

Gaps M5 can communicate with an AUV that embeds a MTBx2 OEM beacon. You will use the telemetry link to transmit command to the AUV and receive status, the message length in 20 bytes and the input/output data format is given in the user manual. This communication is interlaced with the positioning cycle.

A.1.24 HOW IS SVP DATA LOADED INTO GAPS M5?

SVP data is loaded into Gaps M5 manual from the MMI or by loading a SVP file.

A.1.25 HOW DO WE KNOW WHEN THE INS HAS FAILED IN THE GAPS? ERROR CODES?

Gaps M5 web MMI shows the AHRS Octans Nano status. Then if an error occurs, the user will be informed by the overall systus status.

A.1.26 IS GAPS ABLE TO CHOOSE THE BETTER FREQUENCY ITSELF (IN NOISY ENVIRONMENT FOR EXAMPLE)?

No, the acoustic interrogation and reply code must be selected by the user.

2.2 Integration and mechanical aspects

A.1.27 HOW DELICATE IS THE HYDROPHONE ARRAY WHEN USING IT FROM A SMALL VESSEL?

Gaps M5 has to be handle with care and never be let standing on its hydrophones. We advise to place protective caps (delivered with Gaps) to protect the 4 hydrophones.

A.1.28 CAN GAPS M5 BE TESTED IN AIR?

Gaps M5 does not have a full self test. Hydrophones can be tested in air by a noise measurement and a comparison each other. Basic functional test of the emitting transducer is also possible.

A.1.29 HOW LONG WE CAN USE THE GAPS M5 IN AIR FOR TESTING?

It is advised NOT to use Gaps in air. A few pings for testing is acceptable.

A.1.30 CAN THE IP RANGE BE CHANGED TO A USER OWN NETWORK IP RANGE?

Gaps M5 IP Range has the same restriction as Gaps M7. We are working on resolving this in a later firware release.

A.1.31 IS THERE ANY DIFFERENCE BETWEEN GAPS M7 & GAPS M5 MOUNTING FLANGE DIMENSIONS?

Gaps M5 and M7 (ex-G4) have the same mounting flange dimension, thus it is possible to mount a Gaps M5 or a M7 on a same deployment mechanism.

A.1.32 WHAT IS THE IDEAL DISTANCE BETWEEN LEVEL ARMS TO GAPS?

GNSS lever arms measurement is very important to ensure good performances. The less the lever arms are, the less the error will be. We advise to mount the GNSS antenna right above the Gaps head when possible.

A.1.33 CAN I USE MY EXISTING GAPS CABLES?

Yes, Gaps M5 and Gaps M7 use the same cable, available in 20, 50 and 95meters versions and extendable to 190m using a repeater box.

2.3 Compatibility

A.1.34 WHICH BEACON CAN WE USE WITH GAPS M5? MT8? MT9?

Gaps M5 is compatible with all iXblue Medium Frequency range, Applied acoustics 1000 series and WB1 modulation (optional).

A.1.35 GAPS M5 HAS THE SAME ARCHITECTURE AS GAPS M7, SO CAN I TRACK 3RD PARTY BEACONS LIKE I USED TO WITH GAPS M7?

Yes, Gaps M5 have the same 3rd party beacon compatibility as the Gaps M7.

A.1.36 CAN I CONNECT IT TO MY MBES, DOES IT INCLUDE HEAVE?

Octans Nano provides reliable heading and attitude, but we recommend using Gaps M7 for MBES applications.

A.1.37 DOES IT SUPPORT THIRD PARTY SYSTEMS LIKE CNODE, HPR OR SONARDYNE WB?

In addition to the iXblue MF band including tonal, MFSK1 MFSK2 and CHORUS code, it is compatible with WB1 modulation. It is not compatible with cNode and HPR.

A.1.38 DO WE NEED AN UPGRADE FOR WB1 OR IS IT A STANDARD FUNCTION?

Yes, the activation of WB1 can be done remotely by entering an activation code into the Gaps.

A.1.39 IF NO SCOPE FOR WB 2, IS THERE GOING TO BE ANY SCOPE FOR WB 3 OR USING 6G+ COMPATTS?

Not in short term development

A.1.40 ANY PLANS FOR CYMBAL FREQUENCIES – KONGSBERG CNODE COMPATIBILITY?

Compatibily in positioning with Cymbal is not in the product development roadmap.

2.4 Miscalleneous

A.1.41 WHEN WILL THE M5 COME ON THE MARKET AND WHEN WILL IT BE AVAILABLE IN RENTAL COMPANIES?

Gaps M5 first units will be delivered at the beginning of July 2020. You can contact your rental company for futher information.

A.1.42 DO YOU PLAN TO LAUNCH A GAPS M5 WITH A FLUSH ARRAY?

Using a flush or a 3D antenna is a trade off between robustness and performances, we have decided to keep this shape in order to offer the best performances in shallow water. We propose spare hydrophone pre-mounted on arms for on-filed replacement. Gaps M5 is a calibration free system even when the acoustic is replaced.