EAGLE
User Manual

Brand of ACOEM

OneProd

EAGLE
USER MANUAL

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Chapter 1
SAFETY INSTRUCTIONS

Refer to the safety manual instruction before connecting and using.
Refer to the safety manual instruction each time you see a symbol of the list below.

List of symbols for sensors, expander and gateway

Table 1: symbols appearing on Eagle devices

	WARNING	Refer to the safety Instruction and the user manual
	WEEE symbol	Refer to dismantling / recycling chapter
	CE marking	Refer to the copy of the EC certificate for model EGL1101000, EGL1102000, EGL1103000 and EGL1104000
	Ex marking	Product intended for explosive atmospheres. Refer to the hazardous environments instructions in the user manual
	Polarity	Refer to battery installation recommendations
X	Mounting care	Refer to installation / disassembly for hazardous environments
	GATEWAY	Symbol representing the Eagle Gateway
	SENSORS	Symbol representing the Eagle Sensors
	EXPANDER	Symbol representing the Eagle Expander
48V ⎓ 0,3A	Power supply for Gateway	Refer to POE

The safety instructions delivered should be carefully followed and the devices should always be used within the limits specified here.

Chapter 1
PRESENTATION

1. INTRODUCTION

We want to congratulate you on your choice and hope that you will be fully satisfied with it. For this reason, we recommend that you read carefully the present user manual and the safety instructions.

Eagle is a smart wireless sensor that is easy to set up and allows you to continuously monitor the health status of rotating machinery. Any manufacturer can enhance the reliability of its production tools in the simplest way possible, freeing itself of the restrictions inherent in setting up standard wired solutions.

Eagle guarantees a drastic reduction of installation costs in severe environments or where preliminary engineering phases are necessary.

With its unique measurement capabilities, EAGLE is the first wireless solution without compromise on diagnosis capabilities. All types of industrial rotating machines can be monitored, thereby enabling you to increase the overall reliability of your industrial installed base.

In case of a problem, please contact OneProd Hotline
support@acoemgroup.com

1. GENERAL PRESENTATION

1.1. EAGLE DEVICES

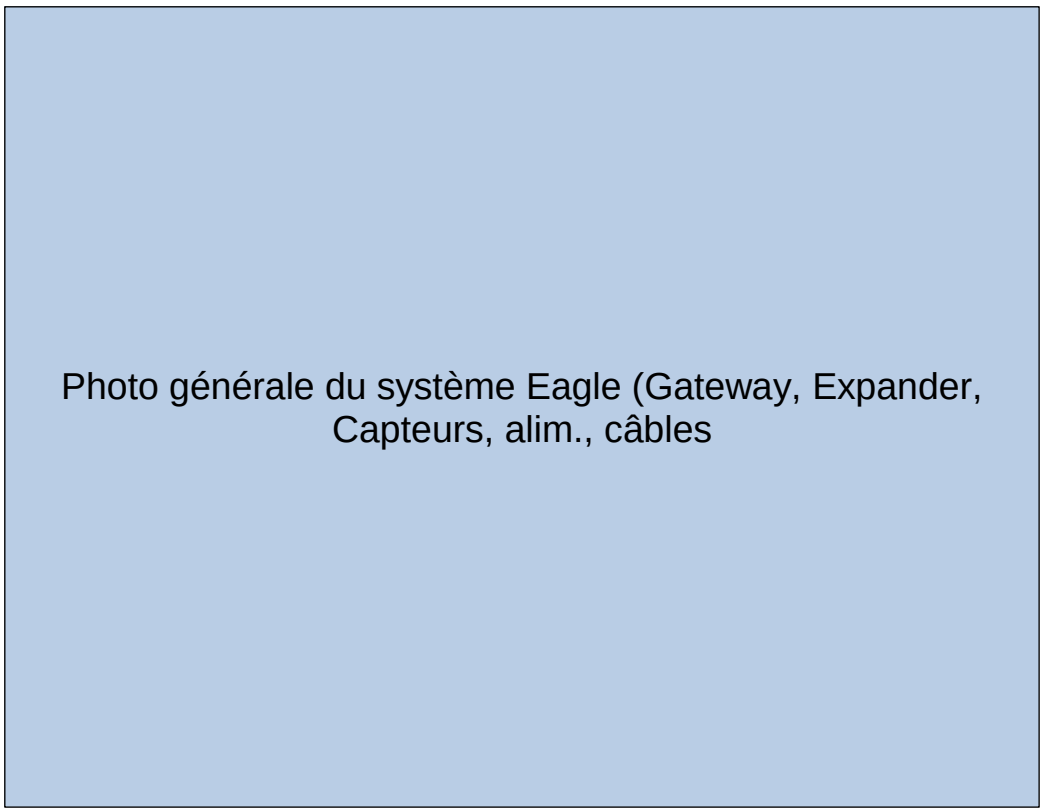


Figure 5 : Eagle system

1.2. EAGLE NETWORK

La communication entre le PC et la Gateway se fait via un câble Ethernet cat 5e, en réseau local uniquement. Ni le PC, ni la gateway ne peuvent se connecter à un réseau wifi ou bluetooth environnant, ces services sont complètement arrêtés sur le PC et inexistant sur la Gateway. Le réseau local de communication est physiquement séparé de tous réseaux environant.

1.2.1. Basics

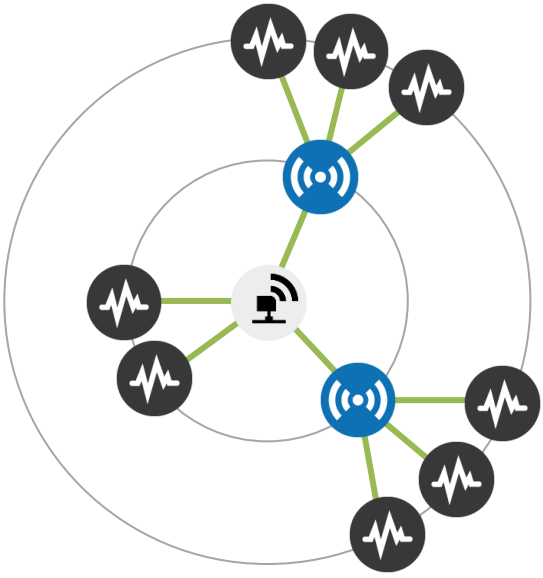


Figure 6 : basic Eagle network

1.2.2. Rules

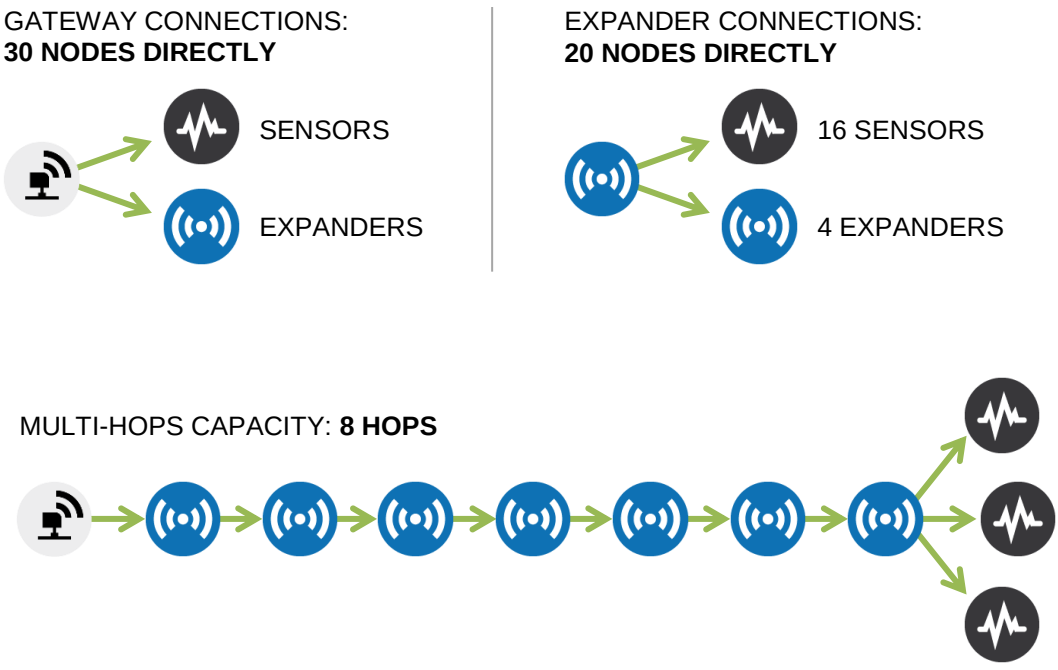


Figure 7 : Eagle network rules

1.3. RADIO COMMUNICATION

1.3.1. Characteristics

Parler de l'ISA100.11a

L'ensemble des produits utilise la bande de fréquence ISM 2.45GHz. Bande de fréquences regroupant entre autre le wifi, bluetooth, zigbee... Cependant, la modulation utilisée par la couche PHY (O-QPSK) ne permet pas de décoder physiquement les données wifi et bluetooth, seulement les données 802.15.4 PHY.

Les capteurs émettent à +3dBm, soit 2mW et les éléments du réseau (routeur et gateway) à +13dBm (20mW).

1.3.2. Radio standard

L'ensemble des produits utilise le protocole radio 802.15.4e. Cela permet d'avoir de base certaines sécurités quant aux échanges de données entre les différents éléments du réseau radio. En effet, chaque élément du réseau possède une adresse MAC unique codée sur

64bits. Cette adresse identifie un capteur unique sur un réseau unique. De plus, pour qu'un élément puisse rejoindre un réseau radio existant, il faut qu'il connaisse l'identifiant du réseau, codé sur 16bits. Pour encore plus de sécurité, lors d'installation sensible comme en milieu industriel, il est possible de rajouter une "liste blanche" sur la gateway, qui filtre sur adresse MAC et n'accepte sur le réseau que les éléments présents dans cette liste.

1.3.3. Radio coverage

En champ libre, les capteurs peuvent avoir une portée radio d'envrion 100m. En environnement perturbé, et/ou industriel, la portée dépend énormément de l'environnement et des essais sur place sont nécessaires. Une portée d'environ 20m est plus réaliste dans ce type d'environnement. De même que pour les capteurs, la portée radio de la Gateway et des routeurs est fortement dépendante de l'environnement.

1.3.4. Security

1.4. EAGLE ACCESSORIES

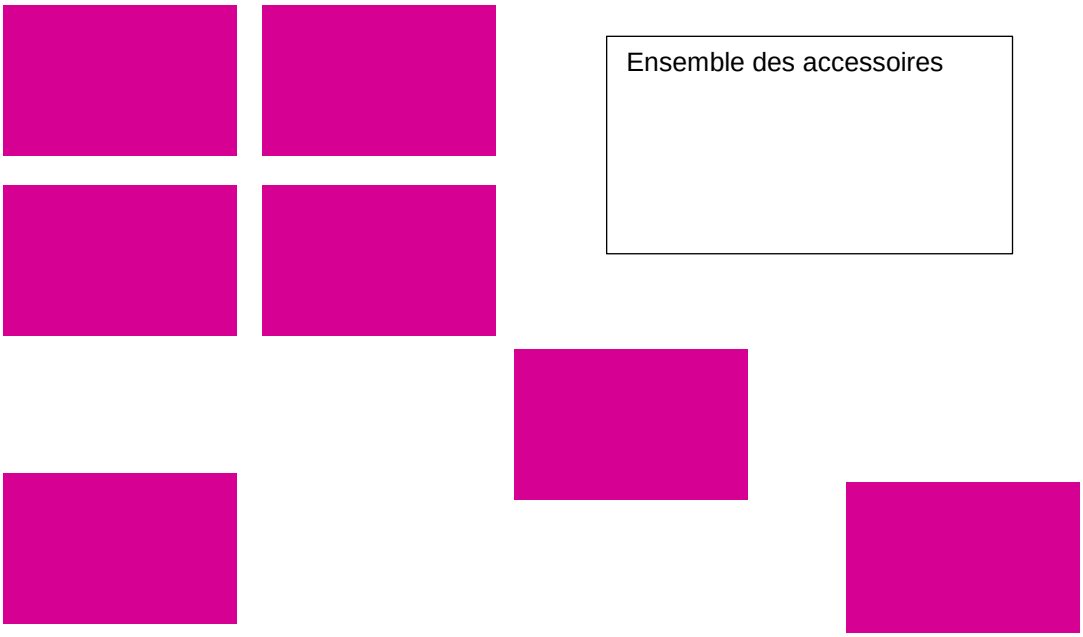


Figure 8: Eagle accessories

Model	Description
EGL 1201 000	Power over ethernet PoE IEEE 802.3af
EGL 1202 000	Primary cell SAFT LS33600 Li-SOCl2, 3.6V, 1.7Ah, D cell
EGL 1203 000	O-ring seal NBR 70 SH Ø int 37,82mm x Ø tore 1,78mm (UL)
EGL 1204 000	Suitcase
EGL 1205 000	Special wrench for Eagle sensor/expander tightening
EGL 1206 000	Special tool for Eagle triaxial sensor orientation (use with ACA1029000)
EGL 1207 000	Galvanic isolator for hazardous environments
EGL 1208 000	Tough Ball-joint mounting for Eagle gateway
EGL 1209 000	Tough Ball-joint mounting for Eagle expander
EGL 1210 000	Eagle protective shield
EGL 1211 000	(Option) Fall protection ring for operating at height (off-shore)

1.4.1. Mounting accessories for expander and gateway: RAM mounts

a. Fixed installation mounting accessories

The mounting accessories from RAM mounts supplied are limited to those mentioned below. It should be noted that there are other types of compatible mounts. These options are not available in the OneProd catalog.

Table 6: ball-joint mount references for expander mount (EGL1209000)

Description	Reference RAM
RAM 1" Tough-Ball™ with M6-1 x 6mm Male Threaded Post	RAP-B-379U-M616
RAM Double Socket Arm for 1" Ball Bases	RAM-B-201U
RAM 1.5" x 3" Rectangle Base with 1" Ball	RAM-B-202U-153

Table 7: ball-joint mount references for gateway mount (EGL1208000)

Description	Reference RAM
RAM Short Double Socket Arm for 1.5" Ball Bases	RAM-201U-B
RAM Topside Base with 1.5" Ball	RAP-395T-BCU
RAM 75mm x 75mm VESA 3.625" Plate with 1.5" Ball	RAM-2461U

Figure 9: EGL1208000 ball-joint mount for gateway

Figure 10: EGL1209000 ball-joint mount for expander

b. Starter kit mounting accessories

The starter kit comes with tough-claw instead of Vesa plate or rectangle base

The RAM Tough-Claw™ is the perfect mounting base for quick and easy tool-less installation and removal on round, square, odd shaped rails and bars. The Tough-Claw™ can be clamped on rails from 25.4 mm to 57.15 mm [1" to 2.25"] outer diameter.

Rubber pads provide stable, even gripping and protection of mounting surface. Clamp jaw is configured for round, flat and odd shapes.

- Clamping Range (Rail/Tube Surfaces): 25.4 mm to 57.15 mm [1" to 2.25"]
- Clamping Range (Flat Surfaces): 0 to 55 mm [0" to 2.2"]
- Physical Dimensions: Height: 167 mm [6.56"], Width: 57.15 mm [2.25"]
- Material: High strength glass filled nylon construction with corrosion resistant stainless steel hardware

Description	Reference RAM
RAM LARGE TOUGH-CLAW 1.5" DIAMETER BALL	RAP-401U
RAM LARGE TOUGH-CLAW 1" DIAMETER BALL	RAP-B-401U

Figure 11: RAM Tough-Claw™

1.4.2. Batteries and O-ring seals

1.4.3. Mounting tools

Les embases de fixations

Chapter 2
INSTALLATION GUIDE

1. SITE SURVEY

RF planning should be considered from the onset in order to determine the sensor locations and options for the expanders and gateway installation.

In the vast majority of cases, the RF requirements do not impede the installation of the sensors but by considering the RF implications from the start a very good first-time success rate is achieved.

The typical link budget calculations that are used in radio planning are not valid in the vast majority of industrial environments and accurate RF modelling is far too time consuming to be practical.

For this reason, the RF planning is simply guided by empirical data gathered from a vast array of previous installations. A set of best practices are presented which are effortless to follow and delivers reliable performance without the need for calculations or sophisticated survey equipment.

1.1. SITE PLANNING

The very first step is a site planning for RF (radio frequency).

On a site map:

- Determine and identify the machines that require monitoring with Eagle sensors,
- Determine potential locations for the gateway (allowing connection to the PoE <100m, power connection <100m).
- Estimate the distance from every Eagle sensor to the gateway after the initial survey and use the table below to determine whether special precautions need to be taken.

Table 8 : distances for coverage quality

Environment	Simply Works!	Special Precaution
Dense metal structures with no line-of-sight	20m	50m
Sparse metal structures with limited line-of-sight	30m	100m
Line-of-sight	100m	400m

- Identify obstacles that can interfere with radio coverage, sensors in complex areas (limited space, metal shields) and the most distant sensors.
-
    - des schémas avec plusieurs implantations possibles

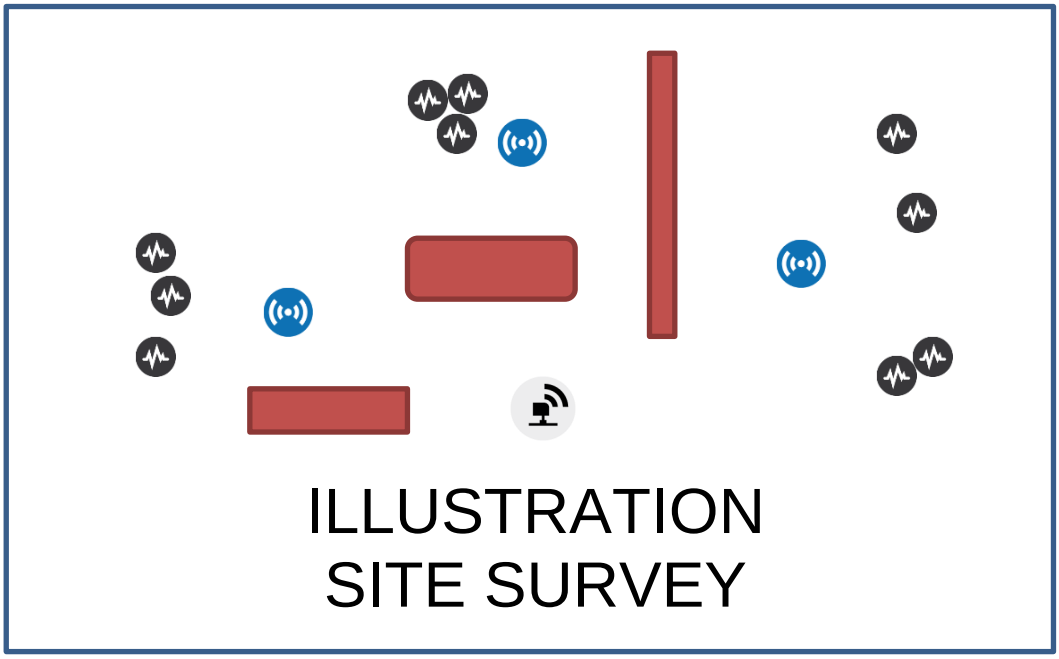


Figure 12: site survey example where all the information needed are identified

1.2. FIELD TEST

The second step is a field test to verify the reception of the farthest sensors or those with doubts about their reception because of their situation (metallic surroundings, casing, guards...) and

Perform a temporary installation in order to try out different gateway options and Eagle sensors locations.

4. VERIFY THE PLAN WITH A TEMPORARY (OPTIONAL) INSTALLATION

When the planner is not confident due to inexperience or due to a particularly tricky installation, it is warranted to perform a temporary installation in order to try out different Gateway antenna options and Eagle Field Device locations. Typically the Eagles within the "Just Works!" range are installed permanently from the onset. The remaining Eagles are temporarily moved to the suspected troublesome locations and their signal strength monitored using the gateway web application. It is common practice to immediately install the Eagle permanently once the link quality is confirmed.

The signal strength of every device can be monitored from the web application of the gateway. It is advisable to improve the signal strength for devices lower than -80dBm.

Table 9 : signal strength qualification

Signal strength	Quality		Action
-30 to -50 dBm	Excellent		
-50 to -60 dBm	Good		
-60 to -80 dBm	Fair		Can be improved using an expander
< -80 dBm	Poor		Must be improved using an expander
< -90 dBm	Out of coverage		Must be improved using an expander

2. INSTALLATION PREREQUISITES

2.1. SAFETY

Refer to safety instructions, safety standards and procedures before installing any device.

2.2. SITE SURVEY

At this step the site survey is done.

The location of the gateway, sensors and expanders are identified in a site plan and ensure to each sensor the appropriate radio coverage.

2.3. FASTENING SUPPORT

The gateway must be placed on a wall or a pole at a height of about 5m [16 ft].

Adequate mounting support has to be installed on site (such as mast) if necessary and can therefore require the use of support facilities and operations of specific civil engineering if needed for the configuration of the area.

2.4. NETWORK AND POWER

The gateway has to be powered and connected to the customer IP network

Prior to installation, the site must be equipped with both power and ethernet connections.

A technical cabinet can be necessary. The link to the customer IP network can be fiber-optic, copper…

3. GATEWAY INSTALLATION

The gateway is fully assembled and ready to be deployed upon delivery.

Only one gateway is necessary to ensure the operation of the whole multi-hop wireless infrastructure. Additional gateway may be necessary depending on

The gateway is linking the wireless network of Eagle devices (ISA100.11a) to an IP network where the data are processed.

In hazardous environments, the operator has to arrange organizational safety measures which reliably prevent the occurrence of an ignitable atmosphere, by default reduce the probability that a flammable atmosphere can occur at all (employing the use of suitable gas detection systems).

3.1. LOCATION

The location of the gateway is very important.

- It must be placed at a height of about 5m [16 ft].
- It must comply with a maximum radius of 100m [328 ft] radio coverage.

The housing face with OneProd logo indicates the embedded antenna location. This face must be oriented in the direction of the sensors and expanders.

The radio link is sensible to physical obstacles, such as vehicles, tanks, or walls. If the distance between the gateway and sensors or expanders exceed 100m [328 ft], it may be necessary to add an additional expander to improve the signal strength.

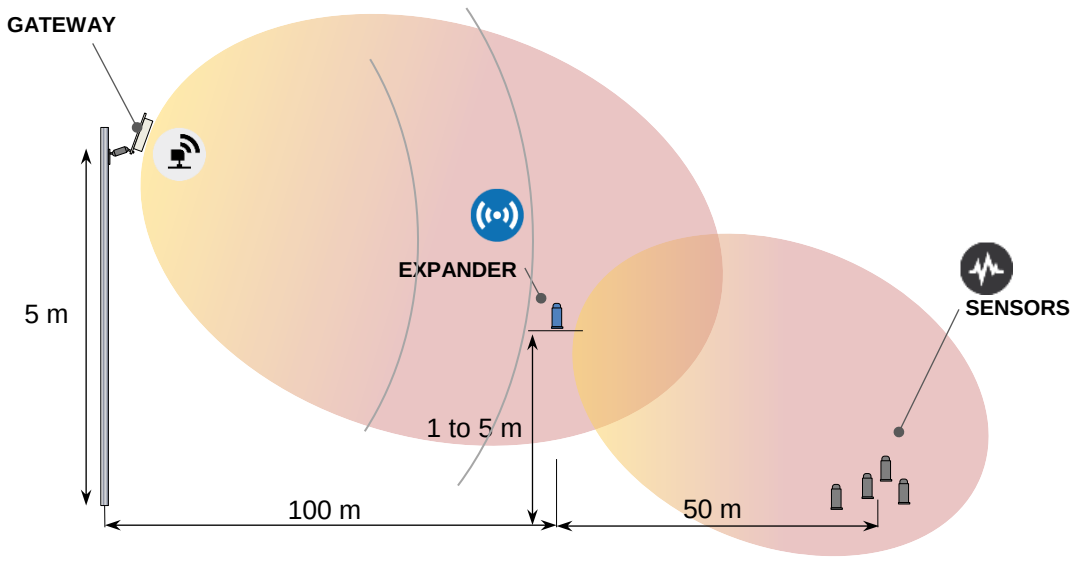


Figure 13 : Eagle system overview

3.2. MOUNT

A damp cloth should be used when installing or taking off the gateway in hazardous areas to eliminate static electricity resulting from this operation.

The gateway is fixed very quickly on a pole or on a wall using a ball-joint mount (EGL1208000).

The ball-joint mount is constituted of:

- **A ball-joint head**
  Fixed on the bottom of the gateway using M8 screw and bolt.
- **A ball-joint base**
  The base is to be pegged on a wall or on a pole.
  - The mounting on a pole requires a clamp, nuts and washers.
  - The mounting on a wall is done using four screws and anchors.
  - The mounting on a structure requires bolts nuts and washers.
- **An arm**
  The arm is joining the two ball-joints allowing precise orientation of the gateway.

Figure 14: ball-joint base, arm and ball-joint head from RAM mounts (EGL1208000)

Figure 15 : mounting on a wall

Figure 16 : mounting on a pole (clamp detail)

3.3. CONNECTION TO THE GATEWAY

The gateway is powered and connected to an IP network by a unique cable (ethernet category 5e) thanks to a PoE (Power over Ethernet) injector (compliant with 802.11.3af-2003).

Prior to installation, the site must be equipped with both power and ethernet connections where the PoE will be installed. A technical cabinet can be necessary. The link to the customer IP network can be fiber-optic, copper…

No hazardous on-field cabling!

- The ethernet cable must not be connected to the other end.
- The operator has to prevent the occurrence of an ignitable atmosphere (employing the use of suitable gas detection systems).

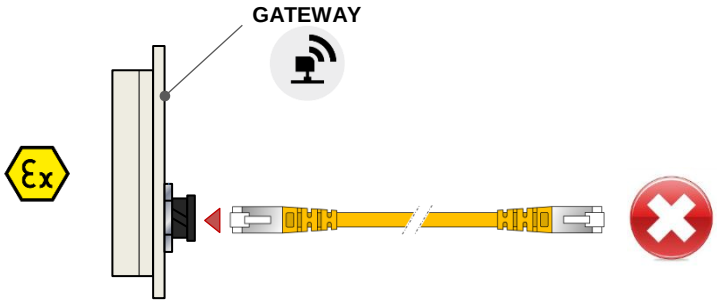


Figure 17 . gateway connection

The Ethernet connection to the gateway is tool free.

Step 1. Use a standard Ethernet Category 5e cable pulled from a technical cabinet (not connected).
Step 2. IP68 gland is delivered with the gateway housing and has to be mounted on the Ethernet cable before connecting the gateway. Figure 18 describes this procedure.
Step 3. Plug the assembly in the waterproof Ethernet receptacle located on the back of the gateway.
Step 4. Ensure that the assembly is fully tighten

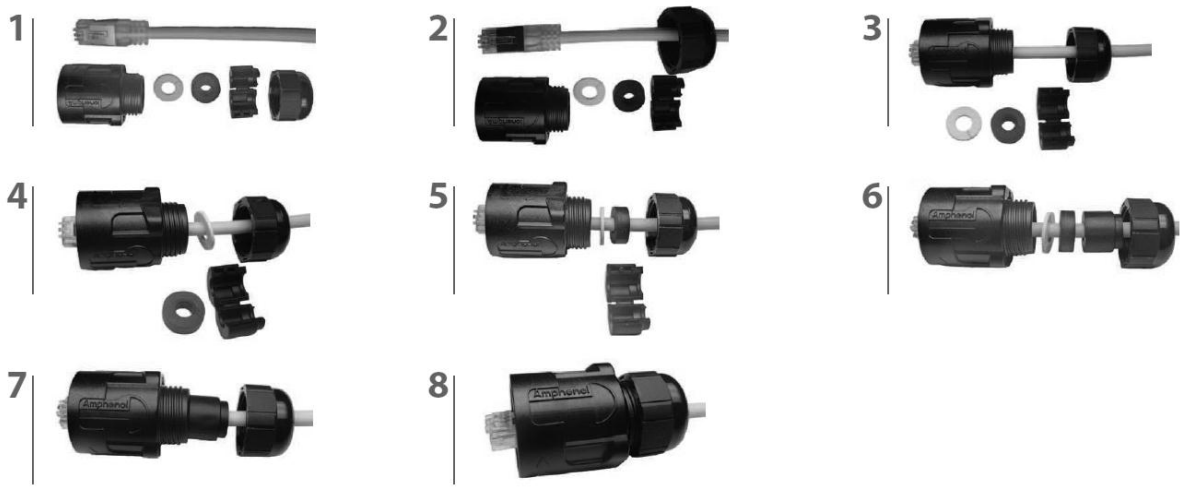


Figure 18 : Plug assembly instructions

Figure 19 : cable, gland and connector assembled

3.4. CONNECTION TO THE POE

Attention le POE doit être hors zone ATEX.

The PoE is preferably located close to the gateway (sauf en zone ATEX)but can be located at 100m max (Ethernet limitations).

Manage cables by using different colors to differentiate PoE from LAN.

Define a standard that is relevant to your requirements or the one in application in your company.

- Blue or Grey for Network (LAN)
- Yellow or Red for PoE

Be careful when connecting.

Check twice that "PoE" port is connected with the gateway.

Wrong connections may cause damages

Step 1. Connect the ethernet cable from the gateway to the PoE injector on the "PoE" Port.
Step 2. Connect "LAN" port of the PoE to the IP network.
Step 3. Check your connections
Step 4. Power the PoE using the appropriate power plug for your country.

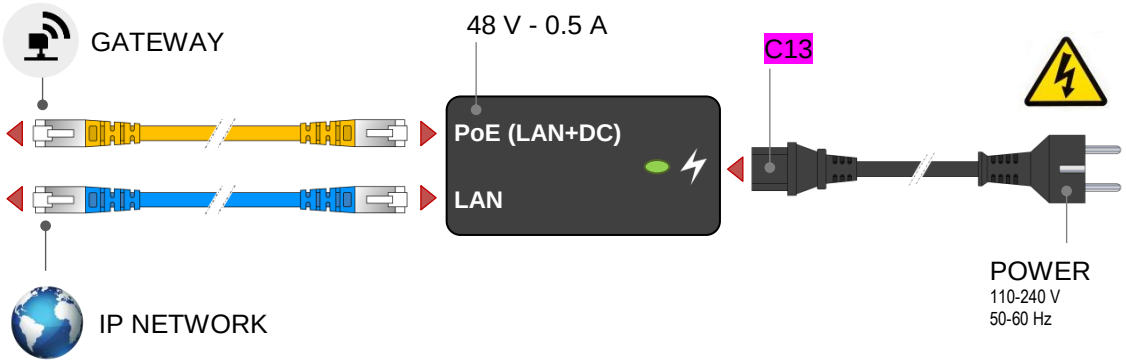


Figure 20 : PoE connection instructions

3.5. SIZES

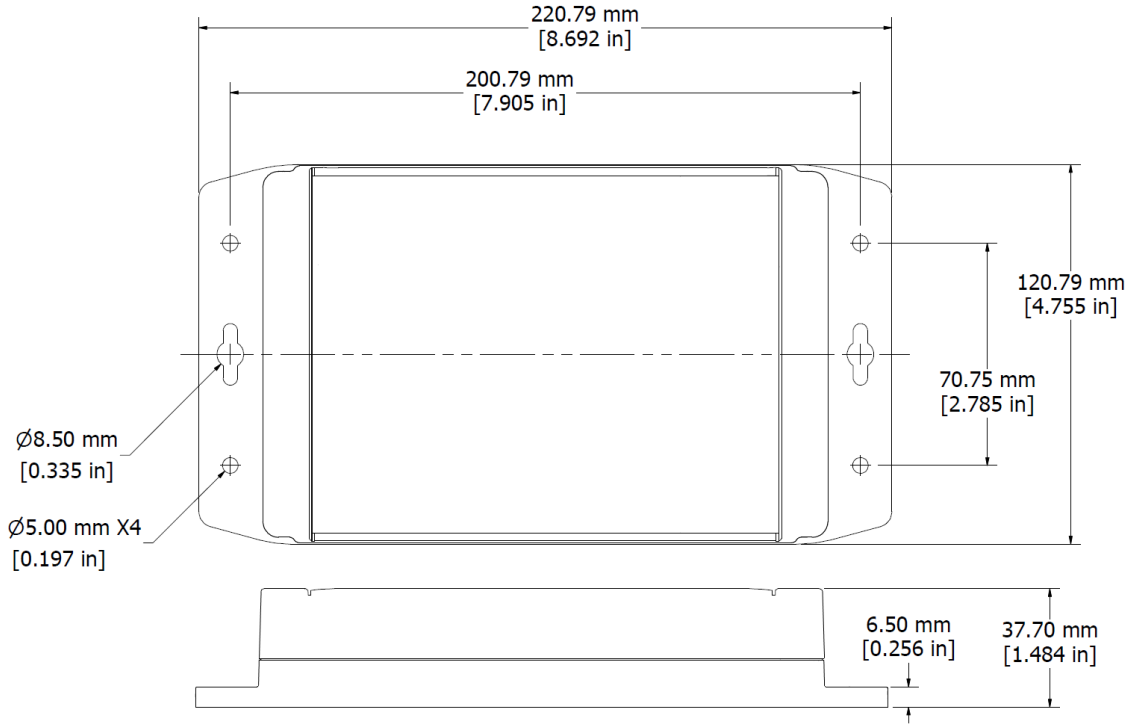


Figure 21 : dimensions of the gateway

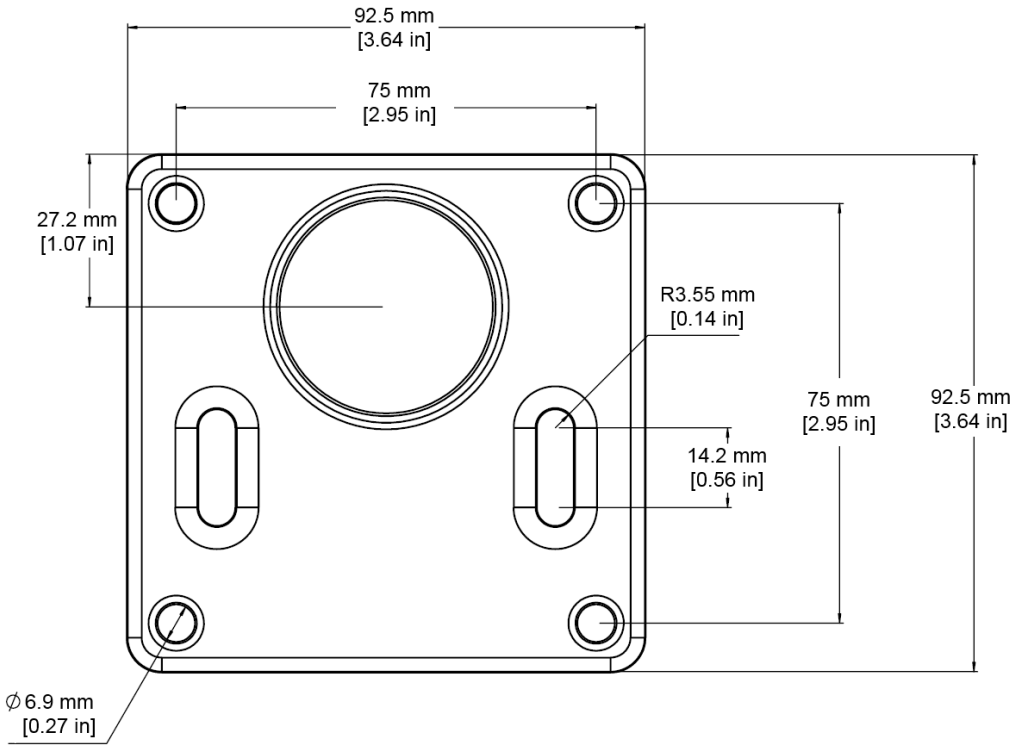


Figure 22 : dimensions of the ball-joint base RAM-2461U

4. SENSORS INSTALLATION

4.1. SENSOR LOCATION

The sensors are mounted on the equipment to monitor following the rules for vibration sensor installation.

Leave enough space around the sensor to ensure the best transmission/reception possible of radio signals. At least 100 mm around the device antenna (plastic cap). If the sensor has to be installed in tiny spaces, the use of an expander might be a solution to improve the radio coverage (if necessary).

Figure 23 : clear space around the sensor/expander

4.2. MOUNTING INFORMATION FOR SENSORS

A damp cloth should be used when installing or taking off the gateway in hazardous areas to eliminate static electricity resulting from this operation.

Table 10 : mounting characteristics for sensors

Thread	M6-1, max depth 6mm [0.23 in]
Flat mounting surface	Ø32.5 mm x 1mm height [Ø1.28 in x 0.039 in]
Hex head	44 mm [1.73 in]
Fastening torque	5 – 7 Nm [44 – 62 inch-lb]

CAUTION:

- Do not grasp the sensor by the plastic cap.
- Do not hit the plastic cap.
- Do not tighten the sensor by the plastic cap

5 mounting modes:

- Direct mounting: M6 stud on a flat surface
- Spotface mounting : for convex surface
- Cementing pad: the easiest way to install
- Triaxial mount: to position the triaxial sensor accurately.
- Temporary mount: only for testing wireless coverage before final assembly.

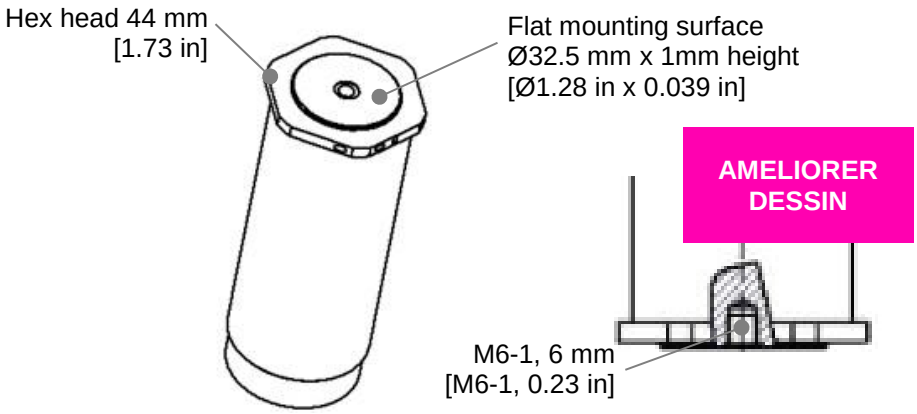


Figure 24: sensor and expander mounting interface (threads, hex head)

4.2.1. Direct mounting

See Figure 25

Step 1. Ensure a flat surface: remove paint layers.
NOTE: if you use a spot facing tool be sure to not exceed 0.8mm depth [0.031 in].
Step 2. Drill a hole (Ø5 mm and XXmm depth [Ø 0.19 in -)
Step 3. Thread the hole with M6 tap
Step 4. Screw M6 stud with a length of XXmm
CAUTION: The part of the stud inserted into the sensor can be up to **6 mm** [0.23 in]. A bottoming stud may cause base-strain and also potentially damage electronics.
Step 5. Screw the sensor on the stud and tighten at **5 - 7 Nm** [44 - 62 inch-lb] using the dedicated tube wrench and your handgrip.
NOTE: for a better contact a film of grease/oil can be applied between sensor and mounting surface (note the oil/grease must be compatible with the temperature of the measurement point).
CAUTION: If you use a 44mm wrench [1.73 in] or an adjustable wrench be careful to observe the indicated torque range.
Step 6. Fill in the installation report with sensor information (S/N, type, location, orientation…)

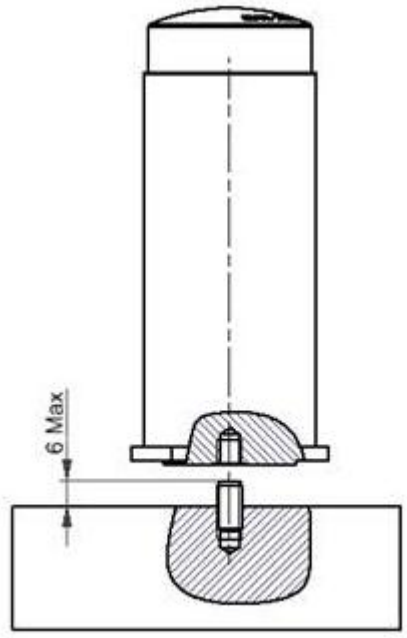


Figure 25: direct mounting with M6 stud

Figure 26: spotface mounting

4.2.2. Spotface mounting

See Figure 26

This mounting mode is mainly dedicated to convex surfaces or to remove paint layers on a machine.

Picture	Reference	Description
	ACA1030000	Washer adapter for 1"1/4 spotface + M6 stud

Step 1. Create a flat surface on the machine using a 1.25” [31.75 mm] spot facing tool with a drill bit for an M6 tap
Do not exceed 2 mm depth.
Step 2. Thread the hole with M6 tap
Step 3. Screw M6 stud with a length of XXmm
CAUTION: The part of the stud inserted into the sensor can be up to 6 mm. A bottoming stud may cause base-strain and also potentially damage electronics.
Step 4. Thread the washer adapter on the stud. This washer is necessary to adapt the 1.25” spotface depth and diameter to the sensor design.
Step 5. Screw the sensor on the stud and tighten at 5 - 7 Nm [44 - 62 inch-lb] using the dedicated tube wrench and your handgrip.
NOTE: for a better contact a film of grease/oil can be applied between sensor and mounting surface (note the oil/grease must be compatible with the temperature of the measurement point).
CAUTION: If you use a 44 wrench or an adjustable wrench be careful to observe the indicated torque range.
Step 6. Fill in the installation report with sensor information (S/N, type, location, orientation…)

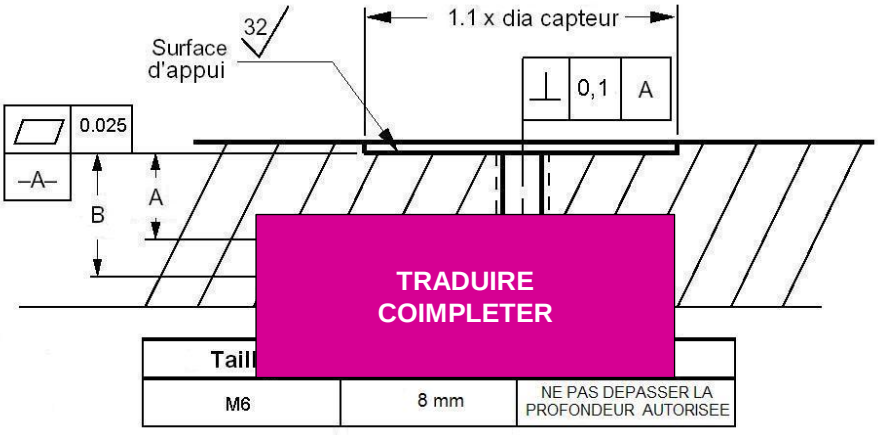


Figure 27: spotfacing tool with drill bit

4.2.3. Cementing pad mounting

This mounting mode is fast and easy.

Picture	Reference	Description
	ACA1023000	M6 cementing pad - Ø35 mm [1.38 in]

Recommended adhesives:

- HBM® X60: is a 2-component fast curing adhesive, consisting of a liquid component and a powder.
- LOCTITE® F246™: is a one component, toughened and high strength acrylic adhesive system for structural bonding.

Step 1. Remove coats of paint to get a clean metallic surface on the machine
Step 2. Remove grease from the surface
Step 3. Glue the cementing pad using HBM® X60 or LOCTITE® F246™ adhesive. Pin the pad to the surface.
WARNING: Refer to gluing safety datasheet and procedures before gluing and always wear the prescribed protections.
Step 4. Wait for the glue to dry
Step 5. Screw the sensor on the cementing pad and tighten at 5 - 7 Nm [44 - 62 inch-lb] using the dedicated tube wrench and your handgrip.
NOTE: for a better contact a film of grease/oil can be applied between sensor and cementing pad (note the oil/grease must be compatible with the temperature of the measurement point).
CAUTION: If you use a 44 wrench or an adjustable wrench be careful to observe the indicated torque range.
Step 6. Fill in the installation report with sensor information (S/N, type, location, orientation…)

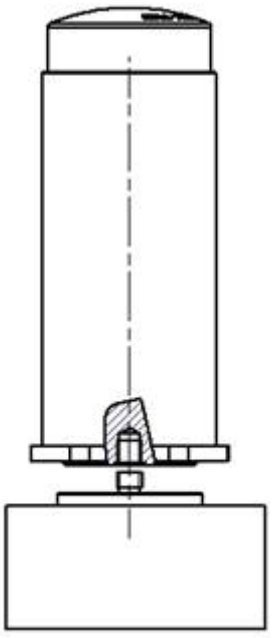


Figure 28 : cementing pad mounting

4.2.4. Triaxial mount

This mounting mode is dedicated to triaxial sensors. It helps to

Picture	Reference	Description
	ACA1029000	Specific fastening for triaxial sensors (washer and stud)

Step 1. Ensure a flat surface: remove paint layers.
Step 2. NOTE: if you use a spot facing tool be sure to not exceed 2 mm depth [0.078 inch].
Create a flat surface on the machine using a 1.25" spot facing tool with a drill bit for an M8 tap
Do not exceed XX mm depth.
Step 3. Drill a hole (Ø6.8 mm and XXmm depth [Ø 0.28 in – XX in)
Step 4. Thread the hole with M8 tap
Step 5. Screw special M8 stud in the machine
Step 6. Thread the washer on the stud. This washer is necessary to adapt the 1.25'' spotface depth and diameter to the sensor design.
Step 7. Screw the sensor on the M6 side of the stud until contact without tightening it.
Step 8. Identify orientation of the triaxial sensor axis.
Step 9. Turn the washer to adjust the axis orientation in the chosen direction Use the dedicated tool for orientation if the dedicated tube wrench is also used.
Step 10. Screw the sensor on the stud and tighten at 5 - 7 Nm [44 - 62 inch-lb] using the dedicated tube wrench and your handgrip.
NOTE: for a better contact a film of grease/oil can be applied between mounting surfaces (note the oil/grease must be compatible with the temperature of the measurement point).
CAUTION: If you use a 44 wrench or an adjustable wrench be careful to observe the indicated torque range.
Step 11. Fill in the installation report with sensor information (S/N, type, location, orientation…)

Figure 29 : specific fastening for triaxial sensors

4.2.5. Temporary mount

Performing field test during a site survey may require a temporary mount. This allows testing locations and orientations of the farthest sensors or those with doubts about their reception because of their situation (metallic surroundings, casing, guards…) to get the best coverage possible.

A magnetic mount is the best solution in that specific case.

Step 1. Screw the sensor on the magnetic base using appropriated stud or bolt (M6).
Step 2. Place the system on the location to test

NOTE: An adapter stud may be required depending on the design of the magnetic base to allow M6 mount.

Table 11: magnetic mounts references

	Brand	Reference	Adapter stud	Pull strength	Max temp.
	CTC	MH114-3A + MH108-5B	1/4-28 to M6-1	23kg [50lbs]	80°C [176°F]
	OneProd	ACA To be defined	N/A	23kg [50lbs]	80°C [176°F]

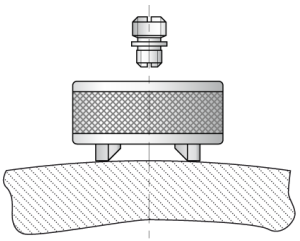


Figure 30 : multi-purpose magnetic base

5. EXPANDER INSTALLATION

5.1. EXPANDER LOCATION

The location of the expanders is very important. It must comply with a maximum radius of 50m radio coverage. It must be located in the coverage of the gateway or of another expander.

It is best practice to install the expanders at high to improve the coverage. This way the expander has a clear view of the sensors close to it.

The blue plastic cap is where the embedded antenna is located. It must be oriented in the direction of the sensors or at least vertically.

The radio link is sensible to physical obstacles, such as vehicles, tanks, or walls. If the distance between an expander and sensors exceed 50m or an obstacle is present, it may be necessary to add an additional expander to improve the signal strength.

5.2. EXPANDER MOUNTING

A damp cloth should be used when installing or taking off the gateway in hazardous areas to eliminate static electricity resulting from this operation.

Expander shares the same design as sensors. See “Figure 24: sensor and expander mounting interface (threads, hex head)” on page 31.

Table 12: mounting characteristics for expander (identical to sensor)

Thread	M6-1, max depth 6mm [0.236 in]
Flat mounting surface	Ø32.5 mm x 1mm height [Ø1.28 in x 0.039 in]
Hex head	44 mm [1.73 in]
Fastening torque	5 - 7 Nm [44 - 62 inch-lb]

CAUTION:

- Do not grasp the expander by the plastic cap.
- Do not hit the plastic cap.
- Do not tighten the expander by the plastic cap

4 mounting modes:

- Ball-joint mount : the most appropriate mounting allowing precise orientation
- Direct mounting: M6 stud on a flat surface
- Cementing pad: the easiest way to install
- Temporary mount: only for testing wireless coverage before final assembly.

5.2.1. Ball-joint mount

The expander is fixed very quickly on a pole or on a wall using a ball-joint mount.

The ball-joint mount is constituted of:

- **A ball-joint head**
  Screw the expander on M6-1 x 6MM male threaded post of the ball-joint head.
- **A ball-joint base**
  The base is to be pegged on a wall or on a pole.
  - The mounting on a pole requires a clamp, nuts and washers.
  - The mounting on a wall is done using four screws and anchors.
  - The mounting on a structure requires bolts nuts and washers.
- **An arm**
  The arm is joining the two ball-joints allowing precise orientation of the expander.

Figure 31: ball-joint base, arm, and ball-joint head for expander mount

ILLUSTRATIONS montage BALL-JOINT RAM MOUNT POUR EXPANDER

Figure 32 : ball-joint mount installation

5.2.2. Direct mounting

See « Figure 25: direct mounting with M6 stud » on page 32

Step 3. No need of flat surface
Step 4. Drill a hole (Ø5mm and XXmm depth [Ø 13/64 in -)
Step 5. Thread the hole with M6 tap
Step 6. Screw M6 stud with a length of XXmm
CAUTION: The part of the stud inserted into the expander can be up to **6 mm**. A bottoming stud may cause base-strain and also potentially damage electronics.
Step 7. Screw the sensor on the stud and tighten at **5 - 7 Nm** using the dedicated tube wrench and your handgrip.
CAUTION: If you use a 44 wrench or an adjustable wrench be careful to observe the indicated torque range.
Step 8. Fill in the installation report with expander information (S/N, location,…)

5.2.3. Cementing pad mounting

See Chapter 3 § 0 «

Cementing pad mounting » on page 34

5.2.4. Temporary mount

- A Tough-Claw™ is the perfect mounting base for quick and easy tool-less installation and removal on round, square, odd shaped rails and bars. The Tough-Claw™ can be clamped on rails from 25.4 mm to 57.15 mm [1" to 2.25"] outer diameter. See Chapter 2 § 1.4.1 b “Starter kit mounting accessories” on page 19.
- A magnetic base can also be used: See Chapter 3 § 4.2.5 « Temporary mount » on page 31

6. BATTERY REPLACEMENT (SENSORS / EXPANDER)

Refer to Safety Instruction § 0

Standards applied:

EN60079-0 **edition 2012**

Atmosphères explosives Partie 0 : Matériel - Exigences générales

EN60079-11 **edition 2012**

Atmosphères explosives Partie 11: Protection de l'équipement par sécurité intrinsèque «i»

IEC 60079-0 : 2011 Edition: 6.0

Explosive atmospheres - Part 0: General requirements

IEC 60079-11 : 2011 Edition: 6.0

Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

Special condition for a safe use:

- -20°C ≤ Tamb ≤+85°C
- WARNING – USE ONLY SAFT LS33600 BATTERY. Only replace the primary cell in a safe area
- The equipment must be installed so that it is protected against mechanical shocks.
- A damp cloth should be used when installing or taking off the sensors and expanders in all hazardous areas to eliminate static electricity resulting from this operation.

Primary cell on page 9 before any battery replacement.

Only use SAFT LS33600 3.6 V primary lithium-thionyl chloride (Li-$SOCl_2$)

D-size bobbin cell

Use of any other battery causes risk of explosion

Respect the orientation of the battery. A Mistake may result in short circuit of the cell.

Step 1. Open the sensor by unscrewing the protection tube. If the tube is hard to unscrew, use a rubber strap wrench. Remove the old battery from the bottom side. Pull out the seals (pinch up it to grab it).

Step 2. Prepare a new battery and 2 new seals. Use only primary cell SAFT LS33600 3.6 V lithium-thionyl chloride (Li-SOCl2) and O-ring seal NBR 70 SH Øint. 37.82mm [1 31/64 in] x Øtorus 1.78mm [1/16 in], UL MH25709 certified.

Step 3. Use a cardboard (business card) to help the battery to slip in place and avoid short circuit.

Step 4. Start to insert the battery from the bottom. The battery must be installed in the direction indicated by the polarity symbol.

Step 5. Push the top part to fully insert the battery in its housing.

Step 6. Place the new seals in the appropriate groove. Check that the battery is well inserted and manually close the sensor with the protection tube.

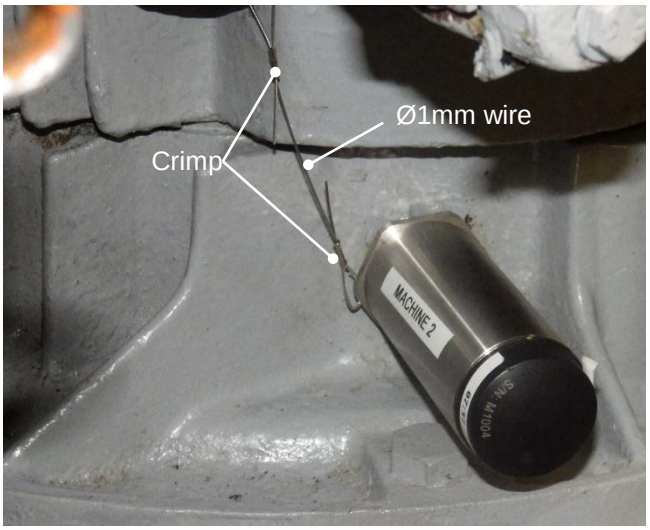
CAUTION: Only use your hands or a rubber strap wrench to remove the protection tube from the sensor/expander. The use of tongue-and-groove pliers (also known as water pump pliers, adjustable pliers, groove-joint pliers, arc-joint pliers, Multi-Grips, and Channellocks) are forbidden and will cause damages and lose of sealing IP67.

7. PROTECTIONS

7.1. FALL PROTECTION

Make a sensor/expander tether with a stainless steel lanyard to provide more safety and avoid to the sensor/expander to fall.

Step 1. Thread a thin cable through the Ø 2 mm hole [Ø 0.078 in] drilled into the sensor/expander.
Step 2. Thread the other side of the wire through a fixed object
Step 3. Crimp the loop ends



7.2. PROTECTIVE SHIELD

You can use a footstep protection to protect the sensor

Need of drawing for dimensions and steps for installation

Figure 33: protective shield accessory

STOP – STOP - STOP – STOP - STOP – STOP - STOP – STOP -

DOCUMENT EN COURS D'ELABORATION

LES PARAGRAPHES CI-DESSOUS NE SONT PAS A JOUR

Chapter 3
OPERATING MANUAL

1. USAGE

1.1. POWER UP THE SENSOR AND EXPANDER

To power the Eagle Field Device for the first time, unscrew the battery and **remove the protective tape** on the battery's connectors. Then screw the battery fully

1.1.1. Sleep mode

After power-up the Eagle field device will attempt to join the ISA100.11a network every 5 minutes while entering in an ultra-low power state between the join attempts. After 30 minutes the join attempt period will increase to 15 minutes for the subsequent 24 hours followed by one join attempt per hour.

To exit sleep mode unscrew and screw the battery fully (off/on).

2. EAGLE EMBEDDED PROCESSING

2.1. PARAMETERS

2.1.1. Overall velocity

Table 13: overall velocity parameter settings for Eagle sensor

Paramètre mesuré	Vitesse vibratoire
Unité résultat	**mm/s** **inch/s**
Référence dB	Not used
Type entrée	Accéléromètre
Unité entrée	g
Sensibilité (mV/unité entrée)	Not used
Pleine échelle (unité param)	Not used
Autorange	YES (fixed)
Intégration	1 intégration
Surveillance temps réel	Not used
Constante de temps	Not used
Filtre passe haut	**2 Hz** **10 Hz**
Filtre passe bas	**sans** **1 kHz**
Détection	RMS
Durée	5s (fixed)
Moyennage	Average (fixed)

2.1.2. Overall acceleration

Table 14: overall acceleration parameter settings for Eagle sensor

Paramètre mesuré	Accélération
Unité résultat	g
Référence dB	Not used
Type entrée	Accéléromètre
Unité entrée	g
Sensibilité (mV/unité entrée)	Not used
Pleine échelle (unité param)	Not used
Autorange	Oui
Intégration	0 intégration
Surveillance temps réel	Not used
Constante de temps	Not used

Filtre passe haut	**sans** **2 Hz**
Filtre passe bas	**sans** **20 kHz**
Détection	RMS
Durée	**0.1 to 5s max**
Moyennage	Average

2.1.3. Temperature

Table 15: temperature parameter settings for Eagle sensor

Paramètre mesuré	Température
Unité résultat	**°C** **°F**
Référence dB	Not used
Type entrée	Continue
Unité entrée	Not used
Sensibilité (mV/unité entrée)	Not used
Pleine échelle (unité param)	Not used
Not used	Not used
Intégration	0 intégration
Surveillance temps réel	Not used
Constante de temps	Not used
Filtre passe haut	Sans
Filtre passe bas	Sans
Détection	Pas de détection
Durée	To be defined
Moyennage	Moyenne

2.2. SIGNALS

2.2.1. Spectrum

Table 16: spectrum setting parameters for Eagle sensor

Paramètre mesuré	**Accélération** **Vitesse**
Unité résultat	**g** (Accélération) **mm/s** (Vitesse) **in/s** (Vitesse)
Référence dB	Not used
Type entrée	Accéléromètre
Unité entrée	g
Sensibilité (mV/unité entrée)	Not used
Pleine échelle (unité param)	Not used
Autorange	**Oui** **Non**
Filtre passe haut	**Sans** **2 Hz**
Intégration	**0** (Accélération) **1** (Vitesse)
Fréquence. Maximale (Hz)	**100** **200** **500** **1,000** **2,000** **5,000** **10,000** **20,000**
Nombre de points de FFT	**800** **1,600** **3,200**
Fenêtre	Hanning
Mode de moyennage	Linéaire
Nombre de moyennes	**5** (changeable)
Recouvrement	**0 %** **50 %** **75 %**
Déclenchement	Libre
Niveau déclenchement (unité entrée)	Not used
Délai de déclenchement (ms)	Not used
Pente	Not used
Hystérésis (unité entrée)	Not used

2.2.2. Time signal

Table 17: time signal setting parameters for Eagle sensor

Paramètre mesuré	Acceleration
Unité résultat	g
Type entrée	Accelerometer
Unité entrée	g
Sensibilité (mV/unité entrée)	Not used
Pleine échelle (unité param)	Not used
Autorange	YES (Fixed)
Filtre passe haut	Sans 2 Hz
Intégration	0 intégration
Fréq. Echantillonnage (Hz)	**256** **512** **1,280** **2,560** **5,120** **12,800** **25,600** **51,200**
Nombre de point du signal	**512** **1,024** **2,048** **4,096** **8,192** **16,384**
Mode de moyennage	Linéaire
Nombre de moyennes	1
Recouvrement	Not used
Déclenchement	Libre
Niveau déclenchement (unité entrée)	Not used
Délai de déclenchement (ms)	Not used
Pente	Not used
Hystérésis (unité entrée)	Not used
Analyse synchrone	Not used
Détection enveloppe	Not used
Facteur Zoom/Env	Not used
Fréquence centrale Zoom/Env	Not used

Chapter 4
OLD EAGLE

Chapitre à supprimer => pas de confusion dans les produits ATEX. Mettre cet article dans un autre document (note d'application par exemple)

1.1. PROTECTIONS

1.1.1. Lightning protection

Protection of RF connections

It is recommended to protect the connections to prevent a long-term oxidation, oxidation for which RF connections are more sensitive than others. Adhesive tape used is self-amalgamating types (Scotch® Super 33+ 3M™).

1.2. NETWORK CONNECTION

The gateway is powered and connected to the network with a unique ethernet cable through a PoE injector (power over ethernet).

PoE injector characteristics:

- Input: 110-240V ~ 50-60Hz
- Output: 24V DC – 1A

- Connect the LAN port on the injector directly to a computer or Ethernet switch through an Ethernet cable.
- Unscrew the gland from the Gateway and connect the POE port (POE OUT) on the injector directly to the gateway through an ethernet cable.
- Power the PoE injector.
- The gateway initialize (1-2 minutes)
- The max ethernet cable length is 100 m for each cable.

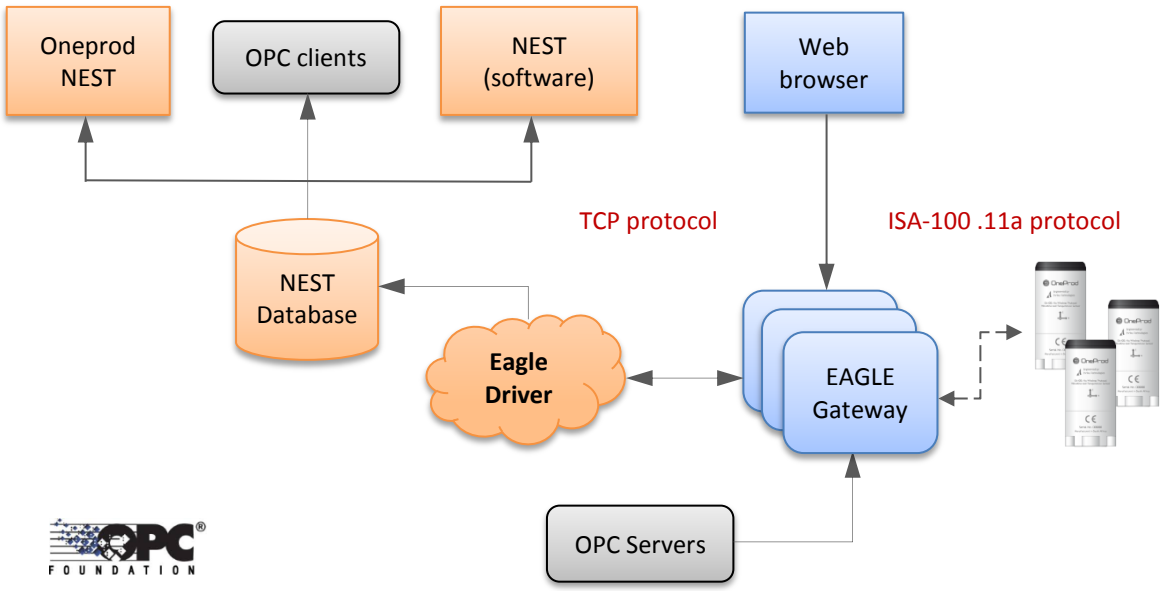
RJ45

Ethernet category 5 cable

Max length = 100 meter / cable

50 sensors / gateway max.

2. NETWORK ARCHITECTURE



IP address	Port	
192.168.0.yyy	80	Gateway web interface
192.168.0.yyy	23	Telnet
192.168.0.yyy	4900	Gateway API

The computer IP address has to be in the same subnet as the Gateway

Example:

- Gateway: 192.168.0.110
- Computer: 192.168.0.100

Chapter 5
COMMON USAGE OF EAGLE

Eagle is designed to make measurements daily while using the battery for several years without the need of dismantling.

ENERGY SAVING IS A KEY INPUT

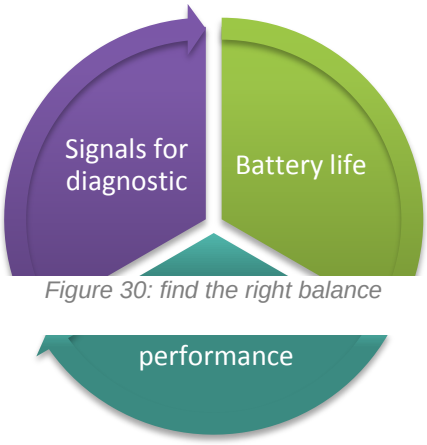


Figure 30: find the right balance

1. CONFIGURATION

Eagle is ready for embedded processing, but for the moment Eagle's firmware is capable of measuring time signals which can be post processed in XPR.

1.1. TIME SIGNAL

To perform a diagnostic we recommend the following signals

Signal	Sampling frequency (Hz)	Nbr. of points	Type
T-512Hz-4k	512	4096	WAV LF
T-5.12kHz-16k	5120	16384	WAV MF
T-51.2kHz-16k	51200	16384	WAV HF

1.2. FFT

FFT can be processed in XPR based on the signal above. A new FFT post-processing was developed in XPR. Its name is "Spectrum". It needs only to define the signal to process and the number of lines of the FFT. Spectrum is a FFT with Hanning window / 75% overlap / Unilateral amplitude.

Name	Signal to process	Nbr. of lines	FFT range (Hz)	Corresponding # of average
FFT LF	T-512Hz-4k	800	0-200	5
FFT MF	T-5.12kHz-16k	1600	0-2000	10
FFT HF	T-51.2kHz-16k	800	0-20000	20

1.3. PARAMETERS

You can use all the parameters that XPR can post-process to configure your defect detection grid.

XPR gives you the possibility to set thresholds for your parameters.

Refer to XPR user manual.

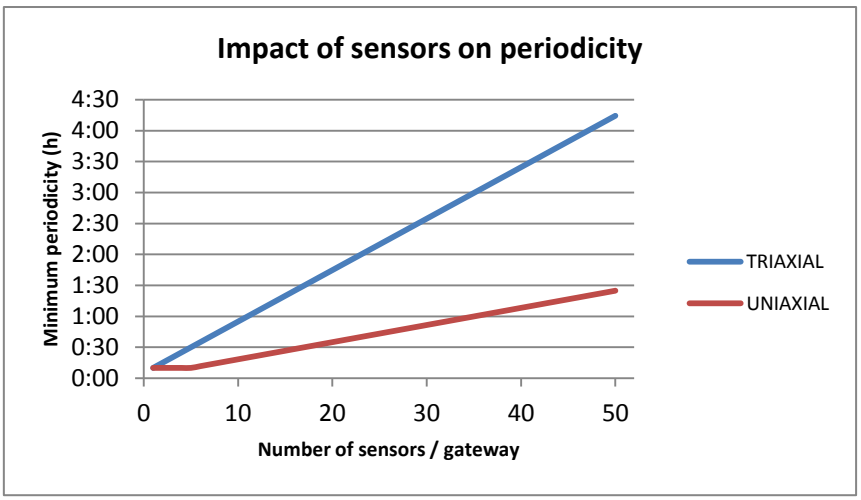
2. PERIODICITY

Normal use of the product corresponds to a daily measurement and no more than 6 measurements per day.

Below 4h of periodicity (minimum theoretical periodicity is 10 minutes) many parameters can affect periodicity and battery life.

The numbers of sensors of one network (paired with the same gateway) is a parameter. The more they are, the larger is the minimum periodicity. This is due to the sum of time needed for each sensor to send its data.

The signal strength is another parameter. The weakest the signal, the longer the upload.



3. AUTONOMY

The expected autonomy when measuring the recommended configuration is:

Periodicity	Uniaxial	Triaxial
8-24 hrs	> 5 years	~ 5 years
6 hrs	> 5 years	~ 3 years
4 hrs	~ 4 years	~ 1 year

Things that will make this Autonomy worse:

- **RF link:** poor RF link will cause large transfer duration or the signal to fail to transmit and retry, which uses up power.
- **Temperature:** Extreme temperatures makes the electronics use more power and the battery to have less potential capacity.
- **Signals**: aggressive waveforms configurations or high quantity of signals make data bigger and increase the transfer duration.
- **Periodicity**: too short periodicity increases the number of measurement requests and transfers.

All this points are interconnected; the goal is to find the appropriate balance.

Chapter 6
GATEWAY WEB INTERFACE

The gateway web interface allows to change multiple settings and to monitor signal strength.

1. CONNECT TO THE GATEWAY INTERFACE

- Force your computer IP address to the same subnet as the Gateway (ex.: 192.168.0.100) and test whether it responds to pings.
  The Gateway has two IP addresses. The configurable and failsafe address 172.17.17.17.
- Connect to the web-interface at http://< IP address> (ex. : 192.168.0.112) and log into its Monitoring and Control Portal with the username and the password provided on the Factory Settings Report received with the delivery.
-
- The Network / Devices page will display the connected hardware.
  The Gateway incorporates 3 ISA100.11a components namely the System Manager, Backbone Router and Gateway. All three should be present in the Devices list.
- The paired and powered field devices should appear in that list.

2. MONITOR SIGNAL STRENGTH

After the Eagle has joined, the Gateway Backbone will start recording the received signal strength from every device.

- Click on the Backbone's EUI-64 address on the Network / Devices page and then on the Neighbours Health tab. Click Refresh.

A list of Eagle Field Devices together with their signal strengths and packet transmission statistics will be displayed. Note that the information will not be available immediately for a newly joined device because the Eagle Field Device is designed not to transmit unnecessarily in order to conserve maximal battery life. Therefore the Backbone requires some time in order to build up an accurate record of the received signal strength.

A typical installation should aim to have the signal strength of all Field Devices larger than **-80dBm** in order to maintain a reasonable fade margin and ensure robust communication. The following sections provide details of how to plan an installation how to maximize performance.

Note that the update of this information is not instantaneous and can take up to 5 minutes. The gateway must test the connection with all the sensors.

The aim is to achieve a signal strength:
above -80 dBm and definitely not below -85 dBm.

Chapter 7
RADIO INSTALLATION GUIDELINE

RF planning should be considered from the onset in order to determine the sensor locations and options for the Gateway installation. In the vast majority of cases, the RF requirements do not impede a sound mechanical installation of the Eagle Field Devices but by considering the RF implications from the start a very good first-time success rate is achieved.

The typical link budget calculations that are used in radio planning are not valid in the vast majority of industrial environments and accurate RF modelling is far too time consuming to be practical. For this reason, the RF planning is simply guided by empirical data gathered from a vast array of previous installations. A set of best practices are presented which are effortless to follow yet delivers reliable performance without the need for calculations or sophisticated survey equipment.

1. INITIAL SITE SURVEY

Conduct the first site survey in order to determine the points that require monitoring and identify potential Gateway and antenna locations.

Choose the location that offers the smallest distance to the farthest group of Eagle Field Devices.

Be aware of the RF cable loss if the antenna will be placed far from the Gateway and bear in mind that every 3dB loss will roughly reduce the range by 30%.

Test the reception of the farthest sensors or those with doubts about their reception because of their situation (metallic surroundings, casing, guards...).

2. CHOOSE A SUITABLE ANTENNA

In order to select the correct antenna for the Gateway and ensure a successful installation, a basic understanding of antenna specifications and how they operate is presented.

2.1. RADIATION PATTERN

An antenna receives a finite amount of power at its port from the Gateway and focuses this power when transmitting it according to its “radiation pattern” which is simply describes how the antenna focuses the transmitted power. The antenna will focus the power more in one direction than another an important concept to grasp is that when it focused more power in one direction it has to take that power away from other directions. That is why a higher gain antenna has a narrower beam width.

In the same narrative, when an antenna is listening more intently in a direction it will have a diminished “listening” ability in other directions. Antennas also behave according the physical law of reciprocity, meaning that the focus of an antenna’s “listening” ability is exactly the same as its transmitting focus. In other words, the “radiation pattern” is identical to its “reception pattern”.

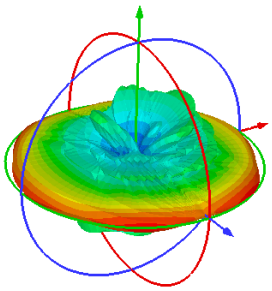
It is best practice to choose an antenna with a radiation pattern that will focus as much power in the direction of the Eagle Field Device installation and not waist energy in directions where there are none. For example, use a sector or panel antenna and not an omnidirectional antenna if it is located at the one end of all the Eagles.

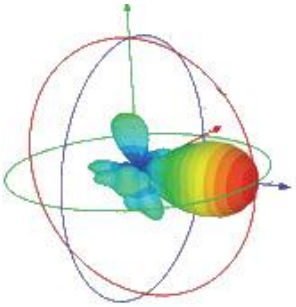
Some common antenna types are shown below together with an illustration of their radiation patterns.

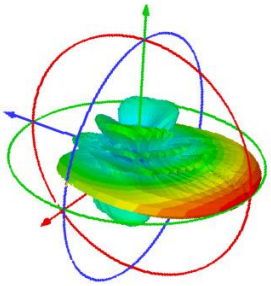
Omnidirectional

Panel antenna

Sector antenna







2.1.1. Polarization

Antenna polarization is another property which the installer must bear in mind especially in an environment with few obstacles.

A radio wave travelling in free space contains an electric field pointing in a perpendicular direction to that of the propagation. The orientation of this electric field in the antenna's main beam is referred to as the antenna polarization. The electric field is described as either linear or circular which means that the field is either orientated along a single axis or rotating as the radio wave passes a point in space.

The Eagle is linearly polarized in the direction of its height and in order to achieve the maximum range it must be orientated in the same direction as the polarization of the incident radio wave. It is important to note that due to the prevalence of conductive surfaces in a typical industrial environment, the incident radio wave polarization is likely not to be as the purely polarized as the wave emitted in the Gateway antenna. This randomizing of the polarization due to the interaction with conductive structures is why a good signal strength is practically always achieved within 30m regardless of the Eagle orientation.

Never-the-less, being cognizant of the effect of polarization is very important and changing either the Eagle or Gateway's antenna polarization is one of the tricks discussed later in order to improve the signal for hard to reach Eagle. The table below lists the signal loss due to a mismatch in polarization.

Incident Wave Polarization	Eagle Orientation Offset	Polarization Mismatch Loss
Linear	0°	0dB
Linear	180°	0dB
Linear	45°	3dB
Linear	90°	∞
Circular Left-Hand	Any Direction	3dB
Circular Right-Hand	Any Direction	3dB

Chapter 8
APPENDIX 1: RADIO

Marque / *Brand* : OneProd

Le système EAGLE se compose d'une gateway, d'une antenne et de plusieurs capteurs sans-fil (+accessoires) / *Eagle system includes a gateway, an antenna, wireless sensors (+ accessories)*

Type	Gateway	Capteurs
Modèle(s) / *Model*	NG1110	2010, 2030, 2010Ex, 2030Ex
Constructeur / *Manufacturer*	Divigraph (pty) LTD	Divigraph (pty) LTD
Bandes de fréquence émission/réception / *Radiation/reception frequency band*		**UHF ISM 2,400-2,4835 GHz**
Largeur de bande des canaux / *Channel Bandwidth*		5MHz
Nombre de canaux / *Nbr. of channels*		16
Possibilité de choix des canaux / *		OUI
Protocole radio / *RF standard*		IEEE 802.15.4
Protocole de communication / *Communication protocol*		ISA100.11a
Antenne intégrée / *Internal antenna*		Capteurs / *Sensors* 2010, 2030, 2010Ex, 2030Ex
Antenne externe / *External antenna*		Gateway NG1110
Puissance de l'émetteur / Output power of transmitter		<10mW
PIRE (puissance isotropique rayonnée équivalente) / *EIRP (Equivalent isotropically radiated power)*		<10mW (10dBm)
PAR (Puissance apparente rayonnée), *ERP (equivalent radiated power)*		Conforme CE / *EC compliant*
DAS (Débit d'absorption spécifique) / *SAR (Specific absorption rate)*		Conforme CE / *EC compliant*

Les produits sont conformes aux exigences des directives suivantes / *Products are compliants with following directives*

Directives	Gateway NG1110	Capteurs 2010, 2030, 2010Ex, 2030Ex
CEM / *EMC*	2004/108/EC	2004/108/EC
Directive courant faibles / *Low voltage directive*	2006/95/EC	2006/95/EC
R&TTE	1995/5/EC	1995/5/EC

Normes applicables à la conformité / *Applicable standards*

Normes / *Standards*	Gateway NG1110	Capteurs 2010, 2030, 2010Ex, 2030Ex
CEM / *EMC*	ETSI EN 55024 (1998 incluant A1 :2001 et A2 :2003)	IEC 61326-1 (2005) ETSI EN 301 489-1 V1.9.2 (2011-09) CISPR22 (2008)
Radio fréquence / *Radio spectrum*	ETSI EN 300 328 V1.7.1 (2006-10)	ETSI EN 300 328 V1.7.1 (2006-10)
Sécurité / *Safety*	IEC 60950 (2004)	ETSI EN 61010-1 (2010) IEC 62479 (2010)

ACOEM
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ACOEM offers comprehensive products and services comprising smart monitoring, diagnosis and solutions, drawing upon its unique expertise in the field of vibrations and acoustics.

ACOEM contributes to the improvement of:

- **quality of life and risk prevention in urban and industrial environments**
- **productivity and the reliability of industrial processes**
- **the design of robust and high-performance products with low noise levels**
- **protection of sites, vehicles and people in hostile environments**

With its 01dB, METRAVIB and ONEPROD brands, ACOEM works with decision-makers in industry, defence and the environment throughout the world.

For more information, visit our website at www.acoemgroup.com

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