INTERREX - RINGS & TELEMETRY

BADGE

Debut BADGE series is designed to be highly adaptable, accommodating various transmission types, battery options, solar units, belt materials, drop-off, anti-bite spikes, and ground search beacons to meet the specific requirements of your projects and species.

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DECOUPLING BADGE

A BADGE device comprises three primary components: the main device (core functionality), energy source, and belt along with screws for securing the belt. Additionally, optional components such as drop-off modules (timed or remotely controlled), anti-bite spikes, and affiliated devices like cameras or beaconing devices for ground search can be integrated.

Below, we'll delve into the specifics of each part, along with potential candidates for constructing a terrestrial collar device.

MAIN DEVICE

The main device primarily comprises the PCBA and the housing.

The PCBA (Printed Circuit Board Assembly) serves as the core electronic component, functioning as the central nervous system that governs primary operations. For example, a BADGE device utilizing a LEGO 4G PCBA offers identical functionalities to the LEGO 4G model, yet provides flexibility in battery selection, solar options, and housing variations.

Below table lists the available PCBA & housing choices:

Component	Available Options
PCBA	• Cellular Type: LEGO 2G/4G, INTERREX 2G/4G • INTELINK Type: NANO, ULTRA, GEO • Satellite Type: Argos, Iridium, Global star
Housing	BADGE, LOCK, LEGO 3D-1, LEGO 3D-2, INTERREX+3D, IRIDIUM-1

Below photos show some of the main device housing.

BADGE

LOCK


BADGE C4 4G
LEGO 3D-2


BADGE C1 4G SP1
LEGO 3D-1


INTERREX B5 4G
PV2INTERREX+3D


BADGE C2 IRIDIUM
IRIDIUM-1

Choosing the main device begins with selecting the optimal data communication method for your tracking project:

Cellular Type

- Ideal for areas with reliable cellular network coverage.
- Enables automatic remote data updating, even in partially covered areas (data stored on board for later uploading).
- Suitable for species that periodically move within network-covered zones.

INTELINK Type

- Relies on receiver or manual data downloading at close range.
- Best for species with small home ranges or those returning to fixed locations.
- Compact size and compatibility with various battery options make it suitable for small-sized species like flying squirrels.

Satellite Type

- Chosen for automatic data update in areas without network service.
- Iridium transmission offers constant satellite coverage but results in larger device size, suitable for larger species like deer and mustang.
- Argos is compact but requires an external antenna, which can pose design challenges for some species and their environment.
- Note that all satellite transmission success rates are susceptible to environmental factors such as

electromagnetic interference, thick clouds, and forest canopy density. Therefore, antenna design is critical, especially when an external antenna cannot be used. Achieving the ideal device size and shape can be challenging under such circumstances.

ENERGY SOURCE

The energy source can be categorized as below:

Rechargeable Battery

Includes solar and manual-recharging types.

- Solar-charging is optimal if the animal spends time under direct sunlight and the solar unit is protected (e.g., covered by epoxy resin), allowing for long-term data collection without collar size constraints.
- Magnetic-touch recharging is an alternative but requires recapturing the animal to remove the collar.
- In some cases, researchers opt for a cable outside the collar for recharging, also requiring animal recapture.

Primary Cell

Considered when rechargeable options are not feasible.

Primary cells provide a fixed amount of energy, allowing for estimation of their lifespan based on specific operational schedules, such as GNSS interval and transmission frequency. Below are a few examples for your reference:

Main device	Primary Battery	Working Schedule	Environment*	Battery Life
IRIDIUM	19000 mAh	• GNSS: 1 hour • Transmission: 4 hours	Forest	500~600 days
LEGO 4G	19000 mAh	• GNSS: 30 min • Transmission: 24 hours	Forest	300~350 days
INTERREX 4G	9000 mAh	• GNSS: 1 hour • Transmission: 8 hours	Grass land	450~500 days
NANO	3600 mAh	• GNSS: 30 min • Transmission: 24 hours	Woods	80~120 days

In battery life time calculation, the major variable is the time consumption for GNSS fixing. Firstly, GNSS fixing time varies with the environment; for instance, a device may take 90 seconds or longer to acquire a fix under thick canopy, while only 20 seconds or less on open grassland. Secondly, GNSS accuracy settings influence time consumption; smaller error ranges typically result in longer search times for a qualified location. Thirdly, the device's attachment to the animal, especially the RF part, can affect signal search efficiency; for example, a device attached under the animal's body is less efficient than when facing the sky.

Hybrid Power Supply

In certain scenarios, where the animal's exposure to direct sunlight is intermittent or uncertain, or when extended periods of darkness are expected (e.g., during polar nights), a hybrid power supply can be utilized. This setup consists of a solar-charging battery as the primary power source, supplemented by a primary battery as a backup for times when solar charging is insufficient.

Below table lists the available energy supply components:

Component	Available Options
Primary Battery	• Cylindrical: 2700/3600/9000/13500/19000 mAh
Rechargeable Battery	• Cylindrical: 180/300/750/900 mAh • Pouch: 40/80/100/210/520/700 mAh • Supercapacitor: 550 mAh
Recharging Method	• Solar (GaAs) unit, one or multiple • Magnetic touch
Battery Pod	Aluminum case • BP-170: weight 170g, external dimensions at 76 x 66 x 66 mm • BP-50: weight 50g, external dimensions at 83 x 37 x 62 mm • BP-20: weight 20g, external dimensions at 70 x 30 x 40 mm • BP-10: weight 10g, external dimensions at 57 x 21 x 30 mm Other material (such as EVA or canvas wrapping, for minimum weight)

Note: All batteries can work at -20°C~60°C. Larger ones can work at -40°C.

It's important to note that not all battery components are compatible with every main device type. INTELINK type generally imposes the least demand on batteries, while Argos/Global Star/4G/5G fall into a moderate category. However, IRIDIUM and 2G types are the most demanding, significantly limiting available options, especially for small-sized animals.

Certain sub-models, such as BADGE 2G/4G and BADGE C3 Iridium, can be designed to enable battery change by yourself.

BELT & LOCKING

The belt materials can be categorized as below:

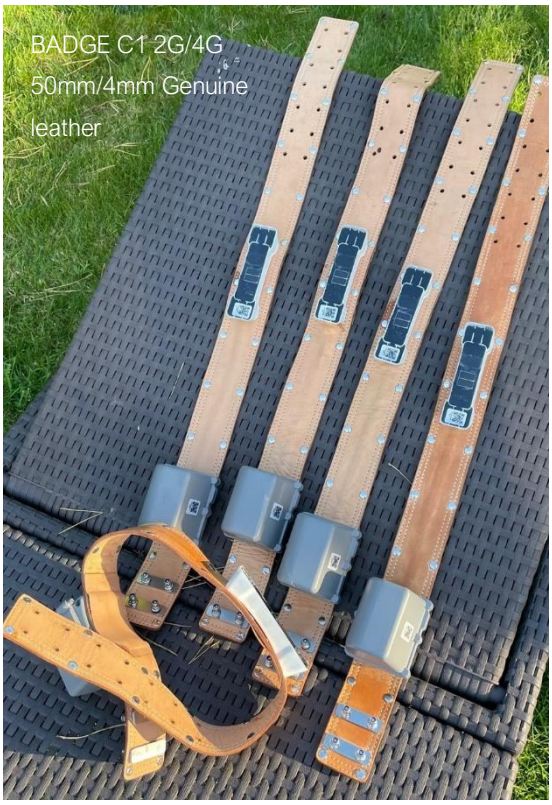
Material Type	Available color	Width/Thickness -- Weight/meter
Genuine leather	Beige /black	50mm/4mm – 160g 40mm/4mm – 130g 25mm/3mm – 60g 25mm/2mm – 40g
Synthetic leather	Beige	50mm/2mm – 110g
Thermoplastic Polyurethane (TPU)	Black	20mm/2mm – 55g

		38mm/2mm – 100g
Canvas cloth	White/Black	38mm/2mm -- 150g
Cable tie (with silicone tube wrapping)	Black	

Below photos show some of the belt material and locking components:

BADGE C2 IRIDIUM
50mm/2mm Synthetic leather

BADGE C2 IRIDIUM
50mm/2mm Synthetic leather



BADGE C1 2G/4G
50mm/4mm Genuine leather

BADGE C4 4G
25mm/3mm Genuine leather


20mm/2mm TPU


ULTRA B1
Cable tie


BADGE 2G
38mm/2mm TPU


BADGE 2G 38mm/2mm Canvas cloth

GENERAL RULES

The primary consideration when selecting or designing a collar for a terrestrial animal is typically the weight budget. A generous budget, such as 200 grams, opens up numerous possibilities, while a smaller budget, like 10 grams, largely eliminates options for cellular or satellite transmission unless solar-charging is assured or the device is intended for short-term use.

Once the weight budget is established, and the expected data collection and transmission schedule are taken into account, we can then determine the appropriate transmission type, power supply, and belt specifications, including material, diameter, and width.

OTHER SPECIFICATIONS

Item	Description
Solar Type	GaAs solar unit (30% efficiency) with good performance under weak light
Battery	All with under-and-over-charging protection
Working Temperature	All can work at -20°C~60°C, Larger batteries can work at -40°C. (enough for very cold winter if close to warm-blood animal body)
Waterproof	IP 68 (tested as being sub-merged 20cm underwater for 7 days) (For deep diving species, we can inject epoxy into the housing for further strengthening.)
GPS Module	Precision: CEP（50%）5m Maximum update rate: 10 Hz
Data Types	For cellular and INTELINK(Bluetooth) type: - GNSS: longitude, latitude, altitude, altitude (ellipsoid), course, satellite quantity - ENV: voltage, light intensity, temperature - ODBA (overall dynamic body acceleration) - ACC: x/y/z acceleration data (upon request) - Beacon: with Debut series gateway devices For Iridium type: - GNSS: longitude, latitude - Summary: voltage, temperature, ODBA (overall dynamic body acceleration)
Data Storage	Collected data will be stored in memory before transmission. - Flash memory: 16 MB - Regular data storage: 460 days at default setting (1h GNSS+1h ENV+10 min ODBA) - BOOST data storage: 280,000 pieces - ACC data storage: 28,700 pieces
Transmission Bands	For cellular and INTELINK(Bluetooth) type: Refer to the main device. For Iridium type: - Frequency Bands: 1616MHz~1626.5Hz, - Maximum Data Rate: 2400bps
Working Schedule	For cellular and INTELINK(Bluetooth) type: - Programmable from 1 min, changeable via 2G/4G/5G network, or instantly via INTELINK (Bluetooth) For Iridium type:

	- Includes three packages: SBD12: 1h GPS+4h Transmission SBD17: 1h GPS+3h Transmission or 2h GPS+2h Transmission SBD30: 1h GPS+1h Transmission
Firmware Upgrade	Remotely via 2G/4G/5G network, or instantly via INTELINK (Bluetooth)
User Interface	Ecotopia web portal + mobile App (both Android / iOS) SaaS platform for device configuration, data browsing, and account management.

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EXISTING SUB-MODELS

Below lists the existing sub-models grouped by the data transmission method.

CELLULAR TYPE

Name	Energy Supply	Belt Material Width/Thickness/Neck Circumstance	Approx. Weight
BADGE 2G/4G [1]	Primary cell 13500 [10]/19000 mAh	TPU 38mm/2mm/68cm	600g
BADGE C1 2G/4G [2]	Hybrid (550+13500/19000 mAh)	Genuine leather 50mm/4mm/40cm	570g
BADGE C1 4G Lite [3]	Hybrid power (550+13500/19000 mAh)	Genuine leather 40mm/4mm/35cm	310g
BADGE C1 4G SP1 [4]	Hybrid power (550+13500/19000 mAh)	Genuine leather 50mm/4mm/57cm	705g
BADGE C4 4G [5]	Hybrid power (520+9000 mAh)	Genuine leather 25mm/3mm/27mm	150g
BADGE C4 4G PV2 [6]	Hybrid power (520+9000 mAh)	Genuine leather 25mm/3mm/27mm	153g
BADGE C4 4G SP2 [7]	Hybrid power (520+9000 mAh)	Genuine leather 25mm/3mm/27mm	158g
LEGO BG4 4G [8]	Hybrid power (550+13500/19000 mAh)	Genuine leather 50mm/4mm/50cm	750g
INTERREX B5 4G PV2 [9]	Solar recharging 900 mAh	Genuine leather 25mm/2mm/30cm	82g

[1] BADGE is the basic type, using a tough orange-colored ASA injection molding housing. Originally designed for livestock, it supports belt and battery change by users themselves.

[2] [3] [4] BADGE C1 is originally designed for deer of different sizes, featuring genuine leather and hybrid power. The “lite” version is with slightly smaller main device housing, narrower belt, shorter neck circumstance, and lighter battery pod. The “SP1” version is originally designed for shepherd dog so that anti-bite spikes are embedded around the belt.

[5] [6] [7] BADGE C4 is a new series designed for small animals. “PV2” indicates that two extra solar units are added to harvest more solar energy and generate more data. “SP2” version is added with spikes (smaller size).

[8] “BG” means “Badge as a Gateway”, indicating that the main device can function as a gateway to download data from other devices nearby, or send commands to other devices, e.g., setting changes, automatic drop-off.

[9] INTERREX B5 4G PV2 is an even smaller collar originally designed for small pandas.

[10] The 13500 mAh has supreme low-temperature performance, meaning that it can support 2G/Iridium transmission at – 40°C, not to mention the other transmission types, GNSS collecting and other sensors working.

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BADGE C4 4G PV2

INTERREX B5 4G PV2

BADGE C1 4G SP1

SATELLITE TYPE

Name	Energy Supply	Belt Material Width/Thickness/Neck Circumstance	Approx. Weight
BADGE C2 Iridium	Hybrid power (550+13500/19000 mAh)	Synthetic leather 50mm/4mm/65cm	690g
BADGE C3 Iridium	Primary cell 13500/19000 mAh	Synthetic leather 50mm/4mm/100cm	800g

INTELINK TYPE

Name	Energy Supply	Belt Material Width/Thickness/Neck Circumstance	Approx. Weight
NANO B1	Primary cell 3600 mAh	Genuine leather 25mm/2mm/23cm	60g
ULTRA B1	Magnetic Touch Recharging 750mAh	Cable tie	27g
ULTRA B2	Magnetic Touch Recharging 300mAh	Cable tie	17g

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PRICING

Sub-Model Name	Device (Feed Subscription)		Ecotopia Data Services [1]	Debut Renewal
	Retail Price	Promotion Price	(per unit per year)	Plan [2]
BADGE 2G	699	699	131.88	99
BADGE 4G	999	799	131.88	249
BADGE C1 2G	899	899	131.88	249
BADGE C1 4G	1199	999	131.88	349
BADGE C1 4G Lite	1199	999	131.88	349
BADGE C1 4G SP1	1199	999	131.88	349
BADGE C4 4G	1199	999	131.88	349
BADGE C4 4G PV2	1299	1099	131.88	399
BADGE C4 4G SP2	1199	999	131.88	349
LEGO BG4 4G	1349	1149	131.88	449
INTERREX B5 4G PV2	1299	1199	131.88	449
BADGE C2/ C3 Iridium	1299	1299	245.88 (SBD12) 269.88 (SBD17) 389.88 (SBD30)	N/A
NANO B1	349	349	59.88	N/A
ULTRA B1	1099	599	59.88	N/A
ULTRA B2	1099	599	59.88	N/A

Note: The prices are in EUR.

[1] To know more about Ecotopia Data Service, please click:
https://www.ecotopiago.com/help/en/#/essential/data_service/overview

[2] To know more about Debut Renewal Plan, please click:
https://www.youtube.com/watch?v=IM75JLGhsHU&t=6s

CUSTOMIZATION SERVICE

We welcome customization requests for BADGE sub-models. If the assembly can be achieved using existing components, no additional customization fee is required. However, if new components such as batteries, housing, or belts are necessary, a one-time customization service fee of EUR 499 will apply.

DROP-OFF MODULE

We currently offer two types of automatic drop-off modules as independent accessories that can be added to the collar belt, weighing 150g and 20g, respectively. They have different requirements for the collar's neck circumference and belt width.

Following methods can be used for unlocking:

- Use Ecotopia App to connect to the lock device via Bluetooth, and send immediate unlock commands.
- Associate the main device and the lock device on the same collar as a pair. Then, schedule an unlock command in the main device. When the scheduled time arrives, the main device will send an unlock command to the lock device.
- If the main device is cellular type, you can also send immediate unlock command to it at any time. Upon receiving the command, the main device will promptly send an unlock command to the lock device.

ANTI-BITE SPIKES

For collars requiring anti-bite protection, such as those worn by shepherd dogs to prevent neck injuries from wolves, we offer the option to embed anti-bite spikes over the collar. Our copper anti-bite spikes come in various sizes, lengths, and colors. We can decide together based on the overall appearance of the collar and specific needs or preference for the tracking project.

BEACON FOR GROUND SEARCH

We offer three types of radio signal transmitters to facilitate ground searches:

- Long-distance Bluetooth: Capable of reaching distances up to 1000m in open field. (Requires Debut series receiver)
- LoRa: Achieves a range of 5km in open field, extendable to 8-10km with an extended antenna. (Requires Debut series receiver)
- VHF: Provides coverage of up to 2km in open areas, compatible with VHF receivers from other brands.