Ketterer DRIVES

Wheel hub motors

FOR AUTOMATED GUIDED VEHICLES

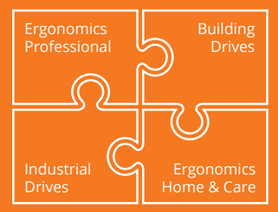
WE GET IDEAS MOVING

The spirit of innovation and a sense of ideas beyond the familiar has made us into a pioneering company over more than 185 years.

For a quarter of a century, we have been offering customized drive solutions for office and workplace workstations, as well as for shading systems and building technology.

Through our tradition of innovation, we have succeeded in establishing ourselves as a specialist and problem-solver in numerous areas.

Over 185 years' experience



More than 60 standard solutions for four different market segments

100%
Made in Black Forest

THE RIGHT PRODUCT FOR EACH APPLICATION

Liftung Units

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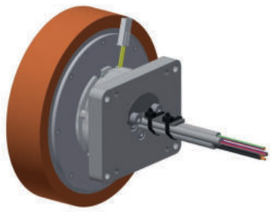
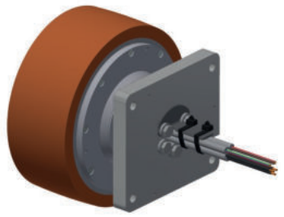
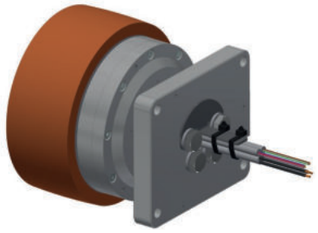
Wheel hub motors i-Wheel 3213



3213.00-1XXX



3213.00-2XXX

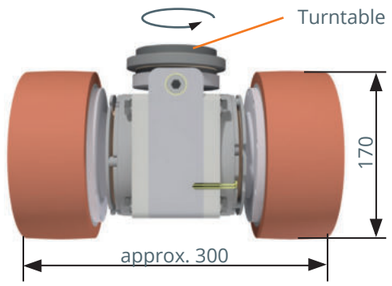


3213.00-3XXX

An optimal drive solution for every transport task

The Ketterer i-Wheel 3213 wheel hub drives have been specially developed for use in Automated Guided Vehicles (AGV). They are designed as direct drives that are completely integrated in the wheel and therefore need nei-ther an additional gearbox nor an extra motor.

An extremely flat design combined with a high power density allows an application with very tight installation spaces. The compact all-in-one solution not only impresses due to its benefits in terms of space requirements but also thanks to the fact it is maintenance-free and has a service life many times longer than systems equip-ped with a gearbox.
The i-Wheel 3213 series consists of three high-performance wheel hub drives, which can reach torques up to 34 Nm and speeds up to 27 km/h.

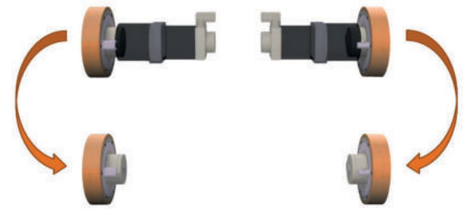


The ultra-compact design enables a simple arrange-ment of two drives on one rotary disk. This means that maneuvering the vehicle with a zero turning radius is no longer a challenge.

In terms of its efficiency and individual scalability, the family of drives offers an optimal modular solution for electric transportation vehicles.
We would be pleased to develop a solution for you that is specially tailored to your drive task!
Motor layout, flange geometry, the type of brake and the encoder can be implemented in line with your requirements.

Our technology - Your benefit

- Neither a gearbox nor an extra motor is needed
- Ultra-compact for tight installation spaces
- High power density in the smallest installation space
- Much longer service life compared to conventional drive technology with a gear stage
- No gear – no wear
- Easy to replace the wheel coating
- Very good running properties with minimal noise level



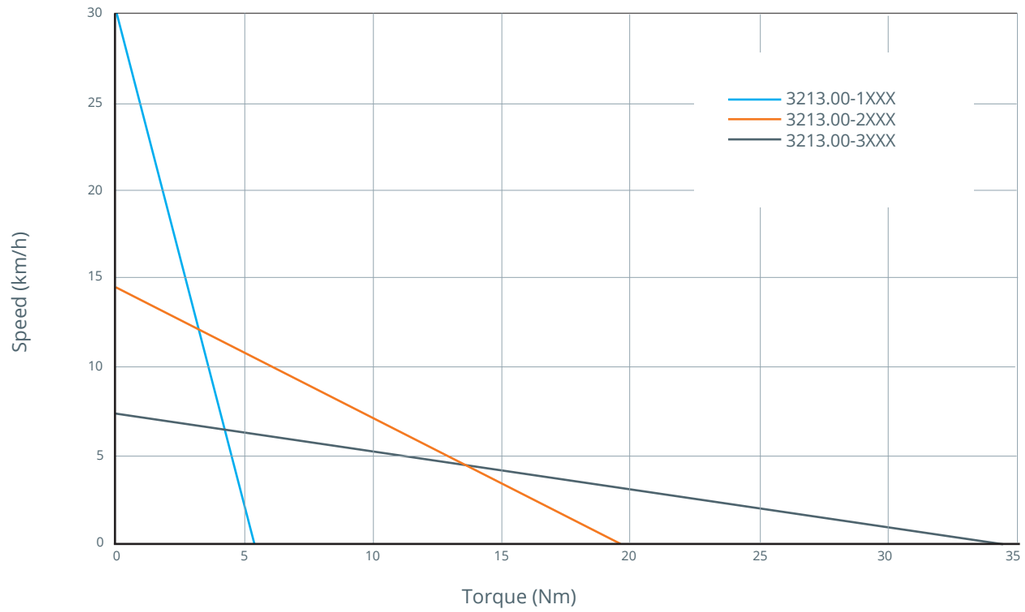
Safety first

- Safety architecture of the rotational control system using diverse redundancy, or two-channel design
- In combination with a suitable controller, a safety level of **PL-d** in accordance with EN ISO 13849-1 can be achieved
- Safe production processes, as there are no risks of contamination from gear oils and greases (no gearbox)

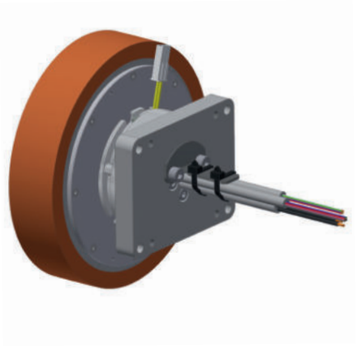
Flexibility and customer orientation are our strengths: The choice is yours - we implement it!

- Flexible voltage range from 24 V to 48 V
- Encoder: BiSS, SSI, TTL incremental in different resolutions
- Brake: Permanent magnetic brake or spring-operated brake with low energy consumption
- Can be combined with various controllers
- Adaptations for mechanical integration and system connection

i-Wheel 3213 family: Torque & achievable speeds & 48 V DC



i-Wheel 3213.00-1XXX



Direct drive - Benefits in a nutshell

- No gearbox – no wear
- Much longer service life compared to conventional drive technology with a gear stage
- Excellent running properties with barely perceptible noise level
- Safe operation due to permanent temperature monitoring
- Ultra-compact with extremely high power density
- Easy replacement of the the wheel coating on site possible thanks to the patented Ketterer solution

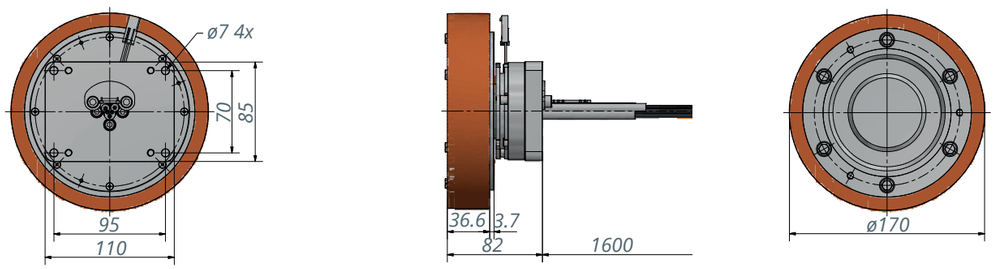
Safety first

- Rotational control system using diverse redundancy
- **PL-d** safety level achievable with suitable controller
- Safe production processes, as there are no risks of contamination from gear oils and greases (no gearbox)

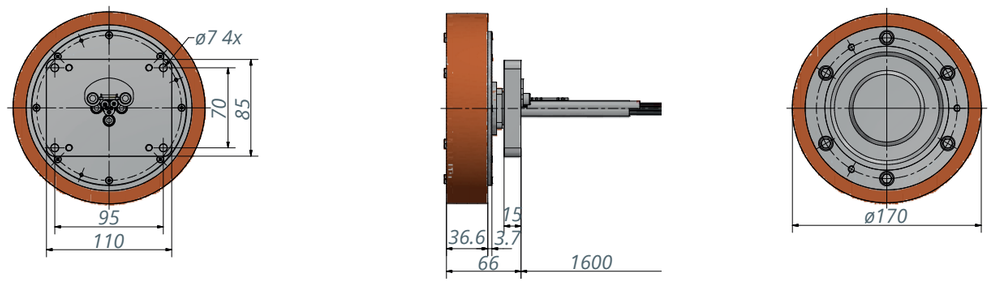
The choice is yours - we implement it

- Encoder optional: BiSS, SSI, TTL incremental (various resolutions)
- Brake optional: Permanent magnetic brake or spring-operated brake
- Can be combined with various controllers
- Customer-specific mechanical integration and system connection

3213.00-1XX1 with brake



3213.00-1XX2 without brake

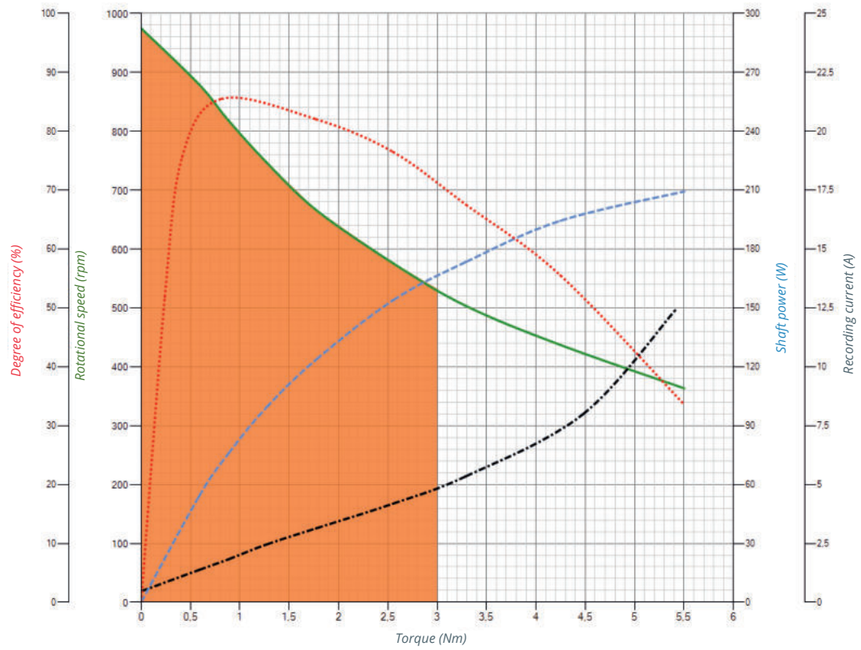


3213.00-1XXX i-Wheel-A-170	
Rated voltage	48 VDC
Rated current[1)]	5 A
Rated torque[1)]	3 Nm
Rated speed[1)]	530 rpm
Max. speed at rated torque[1)]	17 km/h
Shaft power (output)[1)]	165 W
Idle running speed[2)]	975 rpm
No-load current[2)]	0.5 A
Achievable max. speed[2)]	up to 31 km/h
Max. efficiency[2)]	86 %
Standstill torque[2)]	5.4 Nm
Starting current at idle speed[2)]	12,4 A
Torque constant[2)]	0.6 Nm/A
Speed constant[2)]	11 rpm/V
Terminal resistance (phase to phase)	0.65 Ohm
Terminal inductance	3.7 mH

1) Max. ambient temperature = 40 °C, controller-specific
2) At the nominal point (TU = 20°C), controller-specific
3) Radial and axial forces apply to the nominal service life L10h = 20,000h according to DIN ISO 281

3213.00-1XXX i-Wheel-A-170	
Rotor inertia	2,900 kg*mm²
Max. radial axle load F[3)]	800 N
Max. axial axle load F[3)]	200 N
Number of magnets poles	32
Interconnection of the motor	L63S4
Encoder type in standard	Digital Halls + TTL magnetic incremental ABZ
Encoder resolution	4.096 cpr
Material of the coating	Blickle Besthane 92 ±3 Shore A

Braking torque	5 Nm
Power supply brake	24 VDC / 17,6 W
Power consumption brake	7 W through PWM Power reduction
Weight incl. brake	4,5 kg



Brake:

1	+24 V	PIN 1
2	GND	PIN 2

Motor phases:
Alpahwire 6716 AWG16

U = red
V = black
W = yellow

Hall sensors:
igus CF240.PUR.01.08 (8x0,14)C

1	+5 V	red
2	GND	blue
3	H1	white
4	H2	brown
5	H3	green
6	PT1000	gray
7	PT1000	pink

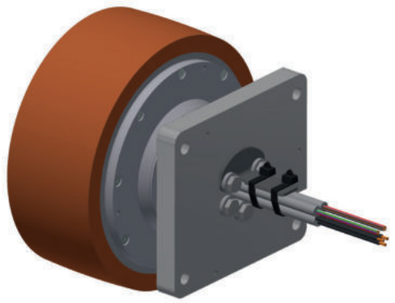
Hall output signal: 3 square-wave signals
The hall signals have a phase shift of 120° to each other.
Power supply: 5V ± 5%
Input current: typ. 40 mA

Encoder:
igus CF240.PUR.01.08 (8x0,14)C

1	+5 V	red
2	GND	blue
3	A	gray
4	A-	pink
5	B	green
6	B-	yellow
7	Z	white
8	Z-	brown

Differential encoder output signal:
3 square-wave signals (RS422)
Channel A, B (90° phase shift) and Index Z
Accuracy: ± 0.5°
Power supply: 5V ± 5%
Input current: typ. 35 mA

i-Wheel 3213.00-2XXX



Direct drive - Benefits in a nutshell

- No gearbox – no wear
- Much longer service life compared to conventional drive technology with a gear stage
- Excellent running properties with barely perceptible noise level
- Safe operation due to permanent temperature monitoring
- Ultra-compact with extremely high power density
- Easy replacement of the the wheel coating on site possible thanks to the patented Ketterer solution

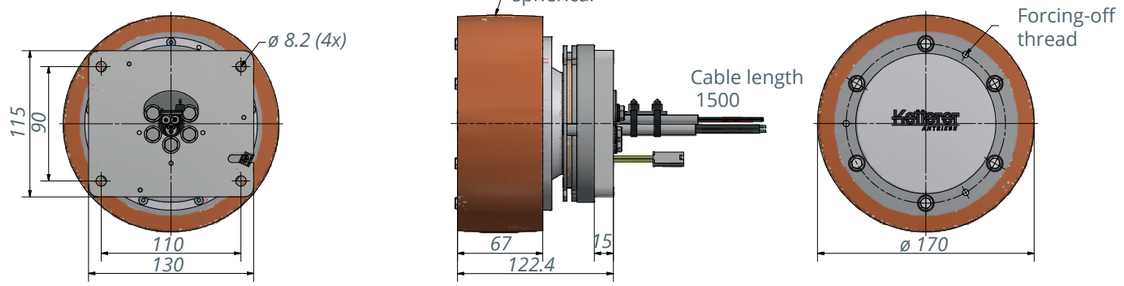
Safety first

- Rotational control system using diverse redundancy
- **PL-d** safety level achievable with suitable controller
- Safe production processes, as there are no risks of contamination from gear oils and greases (no gearbox)

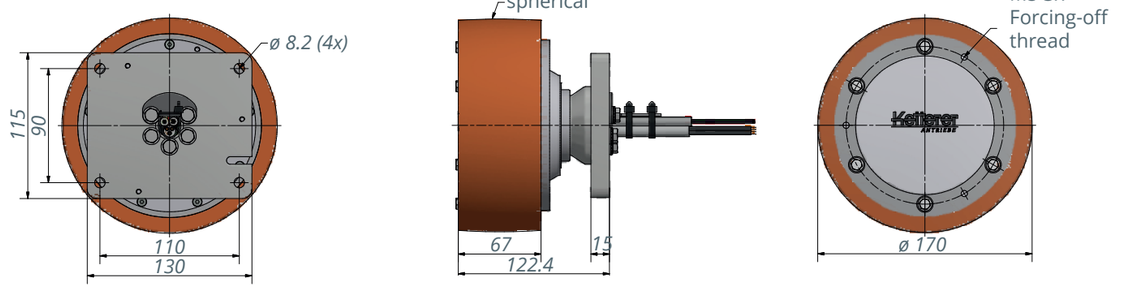
The choice is yours - we implement it

- Encoder optional: BiSS, SSI, TTL incremental (various resolutions)
- Brake optional: Spring-operated brake
- Can be combined with various controllers
- Customer-specific mechanical integration and system connection

3213.00-2XX1 with brake



3213.00-2XX2 without brake

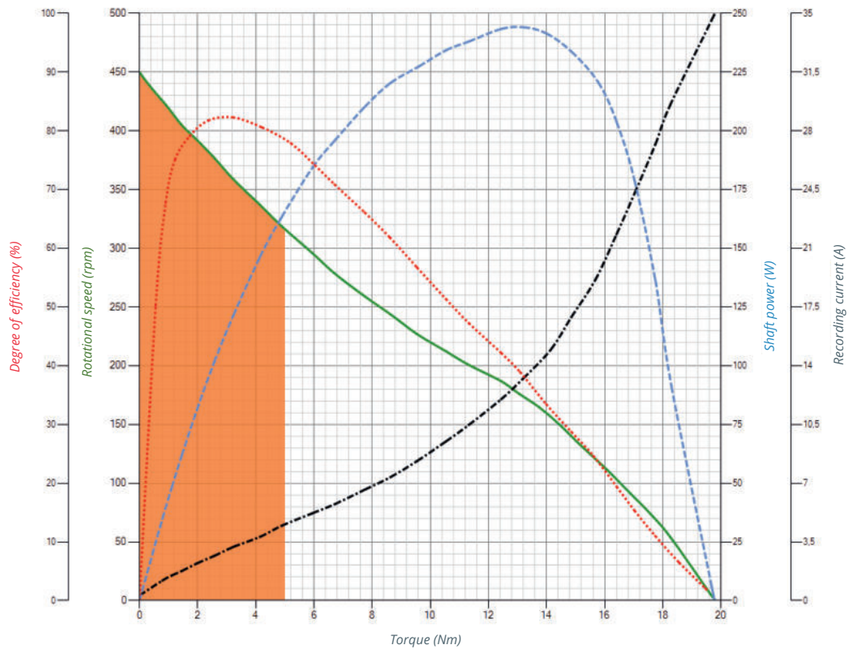


3213.00-2XXX i-Wheel-A-170-123	
Rated voltage	48 VDC
Rated current[1)]	4.5 A
Rated torque[1)]	5 Nm
Rated speed[1)]	316 rpm
Max. speed at rated torque[1)]	10 km/h
Shaft power (output)[1)]	165 W
Idle running speed[2)]	450 rpm
No-load current[2)]	0.3 A
Achievable max. speed[2)]	up to 14 km/h
Max. efficiency[2)]	82 %
Standstill torque[2)]	20 Nm
Starting current at idle speed[2)]	32 A
Torque constant[2)]	1.25 Nm/A
Speed constant[2)]	9.4 rpm/V
Terminal resistance (phase to phase)	1.05 Ohm
Terminal inductance	7 mH

1) Max. ambient temperature = 40 °C, controller-specific
2) At the nominal point (TU = 20°C), controller-specific
3) Radial and axial forces apply to the nominal service life L10h = 20,000h according to DIN ISO 281

3213.00-2XXX i-Wheel-A-170-123	
Rotor inertia	14,500 kg*mm^2
Max. radial axle load F[3)]	2,500 N
Max. axial axle load F[3)]	1,250 N
Number of magnets poles	32
Interconnection of the motor	L63S4
Encoder type in standard	Digital Halls + TTL magnetic incremental ABZ
Encoder resolution	4,096 cpr
Material of the coating	Blickle Besthane 92 ±3 Shore A

Braking torque	16 Nm
Power supply brake	24 VDC / 19.4 W
Power consumption brake	7 W through PWM Power reduction
Weight incl. brake	10,3 kg



Brake:
1 +24 V PIN1
2 GND PIN2

Motor phases:
igus CF77.UL.25.04.D (4G2.5)

U = 1
V = 2
W = 3

The PE conductor is not connected

Hall sensors:
igus CF240.PUR.01.08 (8x0.14)C

1	+5 V	red
2	GND	blue
3	H1	white
4	H2	brown
5	H3	green

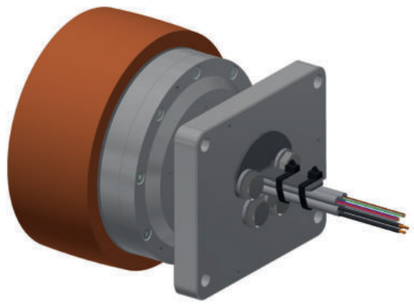
Output signal: 3 square-wave signals
The hall signals have a phase shift of 120° to each other.
Power supply: 5V ± 5%
Input current: typ. 40 mA

Encoder:
igus CF240.PUR.01.08 (8x0.14)C

1	+5 V	red
2	GND	blue
3	A	gray
4	A-	pink
5	B	green
6	B-	yellow
7	Z	white
8	Z-	brown

Differential output signal:
3 square-wave signals (RS422)
Channel A, B (90° phase shift) and Index Z
Accuracy: ± 0.5°
Power supply: 5V ± 5%
Input current: typ. 35 mA

i-Wheel 3213.00-3XXX



Direct drive - Benefits in a nutshell

- No gearbox – no wear
- Much longer service life compared to conventional drive technology with a gear stage
- Excellent running properties with barely perceptible noise level
- Safe operation due to permanent temperature monitoring
- Ultra-compact with extremely high power density
- Easy replacement of the the wheel coating on site possible thanks to the patented Ketterer solution

PATENTED

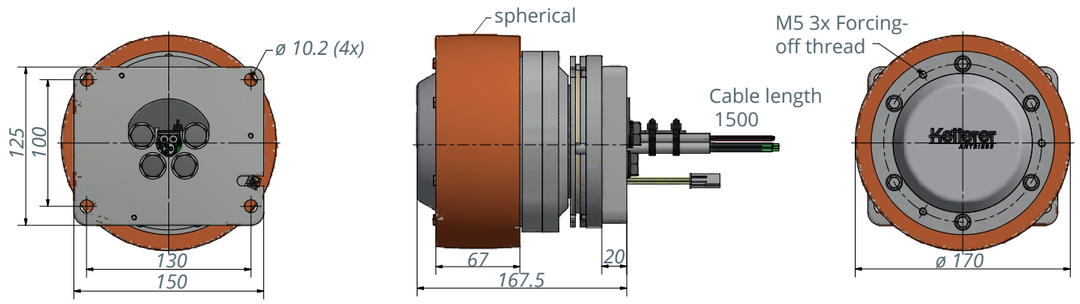
Safety first

- Rotational control system using diverse redundancy
- **PL-d** safety level achievable with suitable controller
- Safe production processes, as there are no risks of contamination from gear oils and greases (no gearbox)

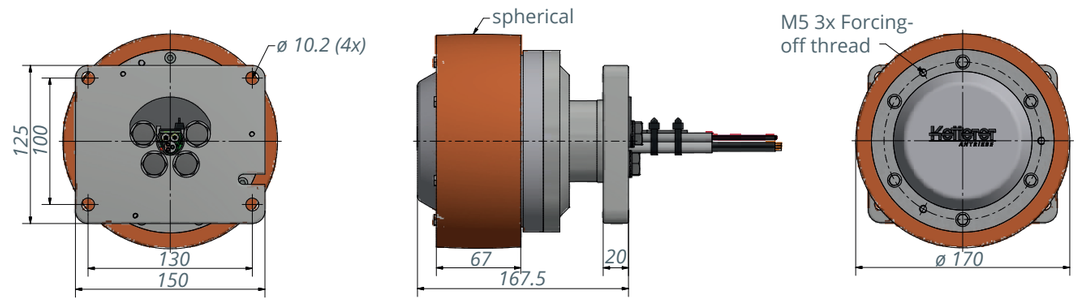
The choice is yours - we implement it

- Encoder optional: BiSS, SSI, TTL incremental (various resolutions)
- Brake optional: Spring-operated brake
- Can be combined with various controllers
- Customer-specific mechanical integration and system connection

3213.00-3XX1 with brake



3213.00-3XX2 without brake

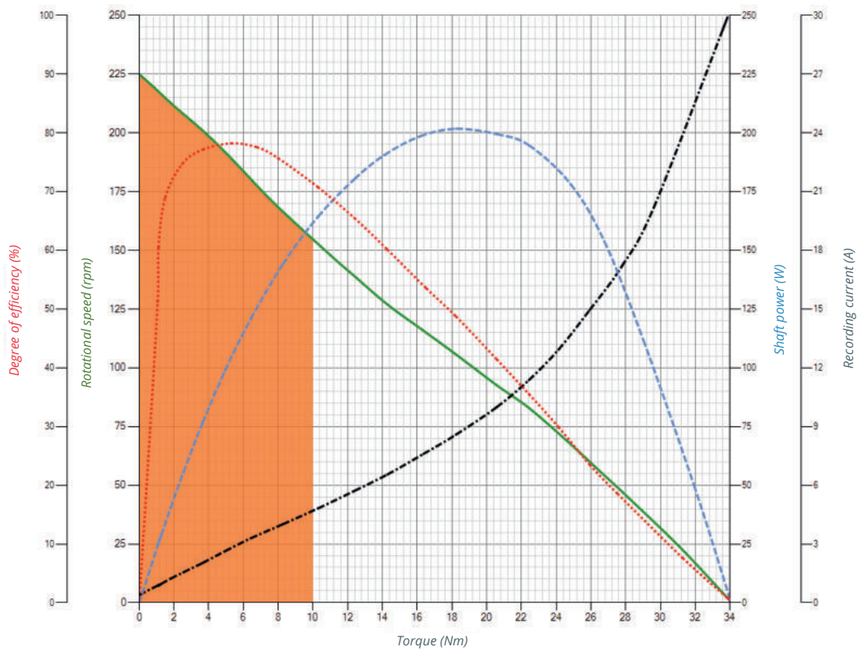


3213.00-3XXX i-Wheel-A-170-168	
Rated voltage	48 VDC
Rated current[1)]	4.7 A
Rated torque[1)]	10 Nm
Rated speed[1)]	154 rpm
Max. speed at rated torque[1)]	5 km/h
Shaft power (output)[1)]	161 W
Idle running speed[2)]	225 rpm
No-load current[2)]	0.4 A
Achievable max. speed[2)]	up to 7 km/h
Max. efficiency[2)]	78 %
Standstill torque[2)]	34 Nm
Starting current at idle speed[2)]	29 A
Torque constant[2)]	2.1 Nm/A
Speed constant[2)]	4.7 rpm/V
Terminal resistance (phase to phase)	1.75 Ohm
Terminal inductance	15 mH

1) Max. ambient temperature = 40 °C, controller-specific
2) At the nominal point (TU = 20°C), controller-specific
3) Radial and axial forces apply to the nominal service life L10h = 20,000h according to DIN ISO 281

3213.00-3XXX i-Wheel-A-170-168	
Rotor inertia	26,850 kg*mm^2
Max. radial axle load F[3)]	7,500 N
Max. axial axle load F[3)]	2,500 N
Number of magnets poles	32
Interconnection of the motor	L62S4
Encoder type in standard	Digital Halls + TTL magnetic incremental ABZ
Encoder resolution	4,096 crp
Material of the coating	Blickle Bestha-ne 92 ±3 Shore A

Braking torque	30 Nm
Power supply brake	24 VDC / 21.5 W
Power consumption brake	7 W through PWM Power reduction
Weight incl. brake	17.6 kg



Brake:

1	+24 V	PIN1
2	GND	PIN2

Motor phases:
igus CF77.UL.25.04.D (4G2.5)

U = 1
V = 2
W = 3

The PE conductor is not connected

Hall sensors:
igus CF240.PUR.01.08 (8x0.14)C

1	+5 V	red
2	GND	blue
3	H1	white
4	H2	brown
5	H3	green

Output signal: 3 square-wave signals
The hall signals have a phase shift of 120° to each other.
Power supply: 5V ± 5%
Input current: typ. 40 mA

Encoder:
igus CF240.PUR.01.08 (8x0.14)C

1	+5 V	red
2	GND	blue
3	A	gray
4	A-	pink
5	B	green
6	B-	yellow
7	Z	white
8	Z-	brown

Differential output signal:
3 square-wave signals (RS422)
Channel A, B (90° phase shift) and Index Z
Accuracy: ± 0.5°
Power supply: 5V ± 5%
Input current: typ. 35 mA

i-Wheel Clever 3213.00-21XX

SIL2 PL-d FUNCTIONAL SAFETY

synapticon INTEGRATED MOTION

Wheel hub drive with fully integrated Circulo 9 Motion Controller from Synapticon - a compact, intelligent drive system with minimal integration expenses.

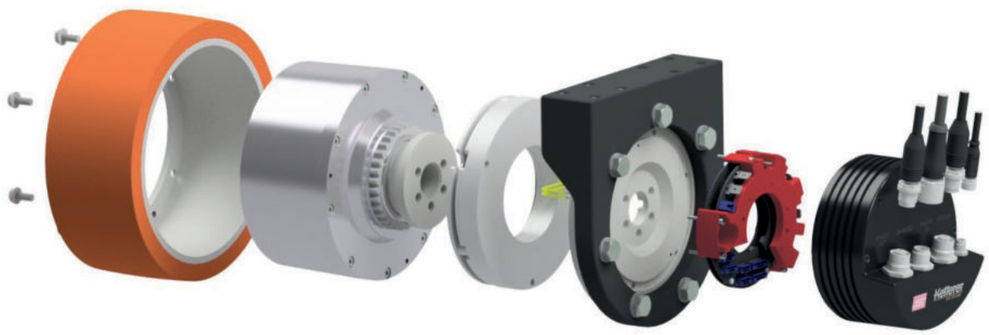
Direct drive: Advantages in a nutshell

- No gearbox – no wear
- Much longer service life compared to conventional drive technology with a gear stage
- Excellent running properties with barely perceptible noise level
- Safer operation through permanent temperature monitoring
- Ultra-compact with extremely high power density
- Easy replacement of wheel coating on site possible thanks to patented Ketterer solution

PATENTED

Overall System: Intelligent - Safe - Ultracompact

- Optimum Performance Scaling: Available in all three Ketterer standard performance classes of the i-Wheel family on request
- Highest performance in drive control in the smallest installation space
- Easy to Use: Seamless Integration in a few easy steps
- Plug & Play: Standard plug & standard cable can be used
- High speed EtherCAT interface, low latency, negligible Jitter
- Over 10 certified safety functions (SIL2, Pl-d)
  SIL 3, PL-e on request
- High Resolution Absolute Encoder
- User-friendly Synapticon parameterization and tuning software
- Model predictive field-oriented control for high efficiency, maximum bandwidth
- Optional emergency holding brake with energy saving mode
- Available in the near future: Circulo 9 with Safe Motion Module



3213.00-21XX i-WheelC-A-170-185	
Rated voltage	48 VDC
Rated current[1)]	4.5 A
Rated torque[1)]	5 Nm
Rated speed[1)]	316 rpm
Max. speed at rated torque[1)]	10 km/h
Shaft power (output)[1)]	165 W
Idle running speed[2)]	450 rpm
No-load current[2)]	0.3 A
Max. efficiency[2)]	82 %
Standstill torque[2)]	19.7 Nm
Starting current at idle speed[2)]	35 A
Max. radial axle load F[3)]	2,500 N
Max. axial axle load F[3)]	1,250 N
Encoder resolution	262,144 cpr
Material of the coating	PU-Rad: 92° ±3° Shore A
Braking torque of the emergency holding brake	16 Nm

1) Max. ambient temperature = 40 °C, controller-specific
2) At the nominal point (TU = 20°C), controller-specific
3) Radial and axial forces apply to the nominal service life L10h = 20,000h according to DIN ISO 281

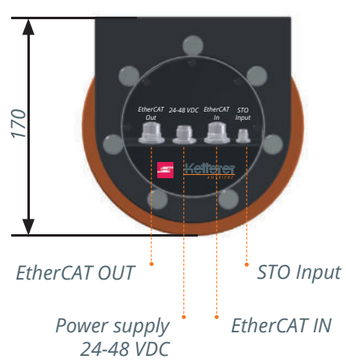
Circulo 9 Motion Controller by Synapticon	
Communications interface	EtherCAT, FSoE (FailSafe over EtherCAT)
Rated voltage range	24 - 48 V DC
Max. voltage	60 V DC
Continuous phase current RMS	20 A
Max. efficiency	99 %
Hardware Protection	Overcurrent, overvoltage, undervoltage, PW deadtime, overtemperature, PWM shoot through
Standard Safety Functions	STO/SBC
Safe Motion Modul	FSoE, STO, SBC, SS1/2, SOS, SMS, 4xSLS, Safe Process Data (position, velocity)

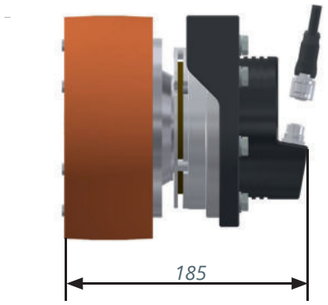
Certified Safety Functions

STO – SAFE TORQUE OFF
SBC – SAFE BRAKE CONTROL
SBT – SAFE BRAKE TEST*
SS1 – SAFE STOP 1
SS2 – SAFE STOP 2
SLS – SAFELY LIMITED SPEED
SLP – SAFELY LIMITED POSITION*
SLT – SAFELY LIMITED TORQUE*
SAFE VELOCITY PROCESS DATA
SAFE POSITION PROCESS DATA
SAFE TORQUE PROCESS DATA
SAFE DIGITAL GPIO AND ANALOG INPUTS

*The functions must be implemented in the safety controller using secure process data

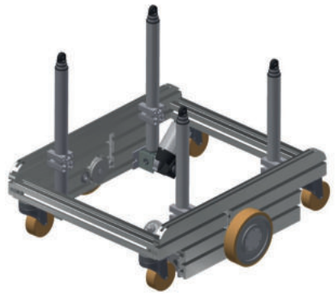
i-Wheel Clever 3213 with integrated Circulo 9 Motion Controller by Synapticon





BLDC-Wheel hub motors

Ket-Rob - Drive platform for AGV/AGC



Description

Tailored to the requirements of autonomous robot technology, Ketterer offers a modular drive platform for **A**utomated **G**uided **V**ehicle systems or - **C**arts (**AGV/AGC**).
All components are designed for simple integration.

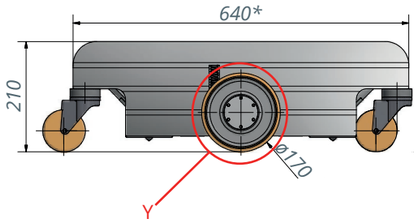
Your benefits

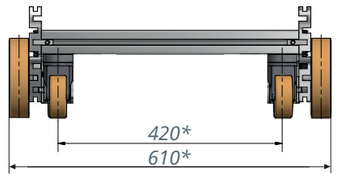
- Complete basic drive module for **A**utomated **G**uided **V**ehicle systems or - **C**arts (**AGV/AGC**)
- Dimensioning of the drive platform according to individual requirements
- Gearless BLDC wheel hub drives with a durable Vulkollan or solid rubber wheel
- Noise-reduced direct drive with spring suspension (spring travel 20 mm). Therefore driving on uneven surfaces is not a problem
- Large design scope of the vehicle structure due to very low installation depth of the wheel hub drives
- Very quiet in operation
- Maintenance-free, therefore no maintenance and service needed
- Load platform height adjustment and load platform in accordance with customer-specific requirements optionally possible
- Customer-specific adaptions of the drives or systems are possible

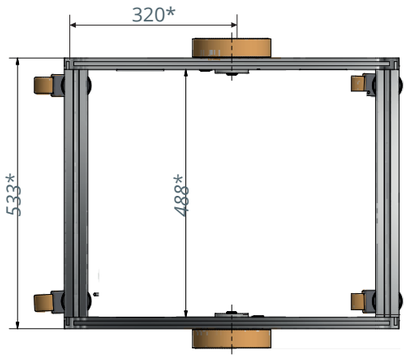
Technical data

	Ket -Rob
Power supply	24 V- 48 V
Utilize speed	7 km/ h
Acceleration	0.5 m/s²
Max. Engine power (per drive unit)	210 W
Load capacity	100 kg
Starting torque (per drive unit)	6 Nm
Braking torque (per brake)	9 Nm
Power supply brake (per drive unit)	24 V/ 18 W
Driving direction	forward and backward
Ground clearance	30 mm
Max. incline	4 %
Protection class	IP 20
Operating temperature	5 to 40 °C (Humidity 10-90 % non-condensing)

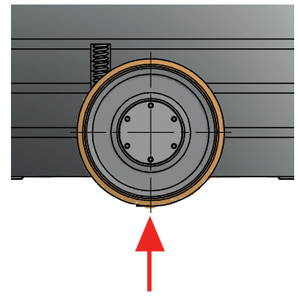
Basis: Without height adjustment for transport platform







View Y



Spring mounted/
Spring deflection 20 mm

* Dimensions can be customized

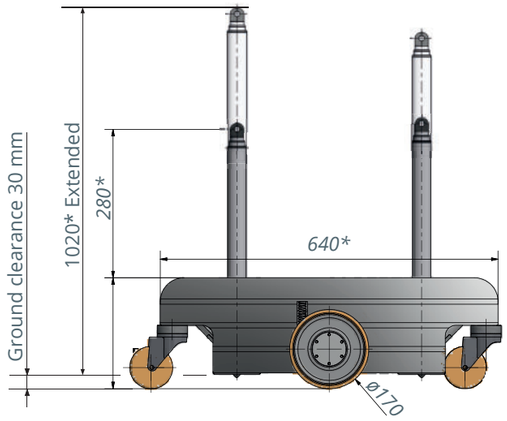
Ket Rob consists in the standard version of:

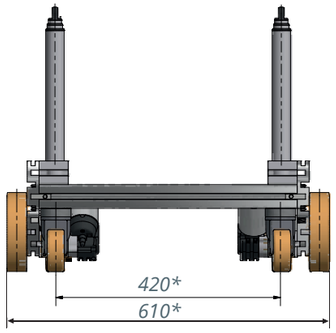
- 2 x BLDC wheel hub drives with encoder and brake (without regulation/control)
- 4 x load bearing steering wheels
- Frame

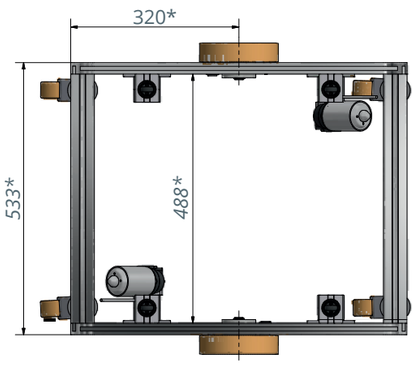
Additional options:

- Height adjustment for transport platform
- Transport platform

Additional option: Height adjustment for transport platform

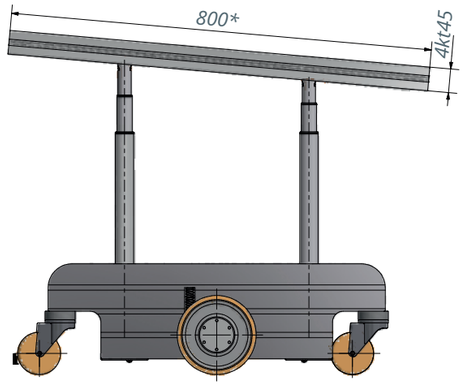


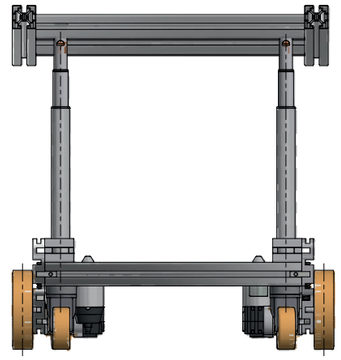


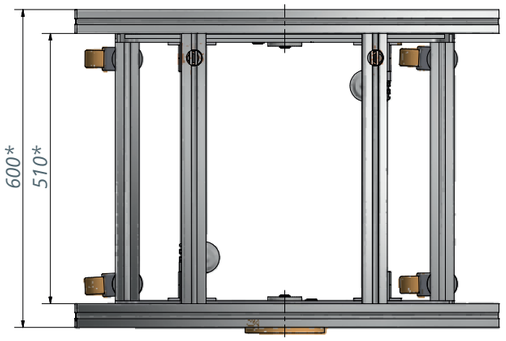


* Dimensions can be customized

Additional option: Transport platform







* Dimensions can be customized

Technical notes

- For the linear height adjustment many Ketterer standard solutions conceivable: e.g. 3120, 4643, 4114, ... Information about these products can be found at www.ketterer-drives.com/products
- Customer-specific adaptations are possible

Orientation aid

In the era of Industry 4.0 and Big Data, it is unimaginable to do without Automated Guided Vehicle Systems (AGVS) and Automated Guided Vehicles (AGV).
They have become a component of modern intralogistics solutions.

Automated Guided Vehicle Systems (AGVS)

Automated Guided Vehicle Systems are floor-bound systems that are used in-plant, inside and/or outside of buildings. They essentially consist of one or more automatically controlled vehicles, guided without contact, with their own travel drive and, if necessary, of

- *a master controller,*
- *a device for location determination and position detection*
- *a device for data transmission and*
- *infrastructural and peripheral devices*

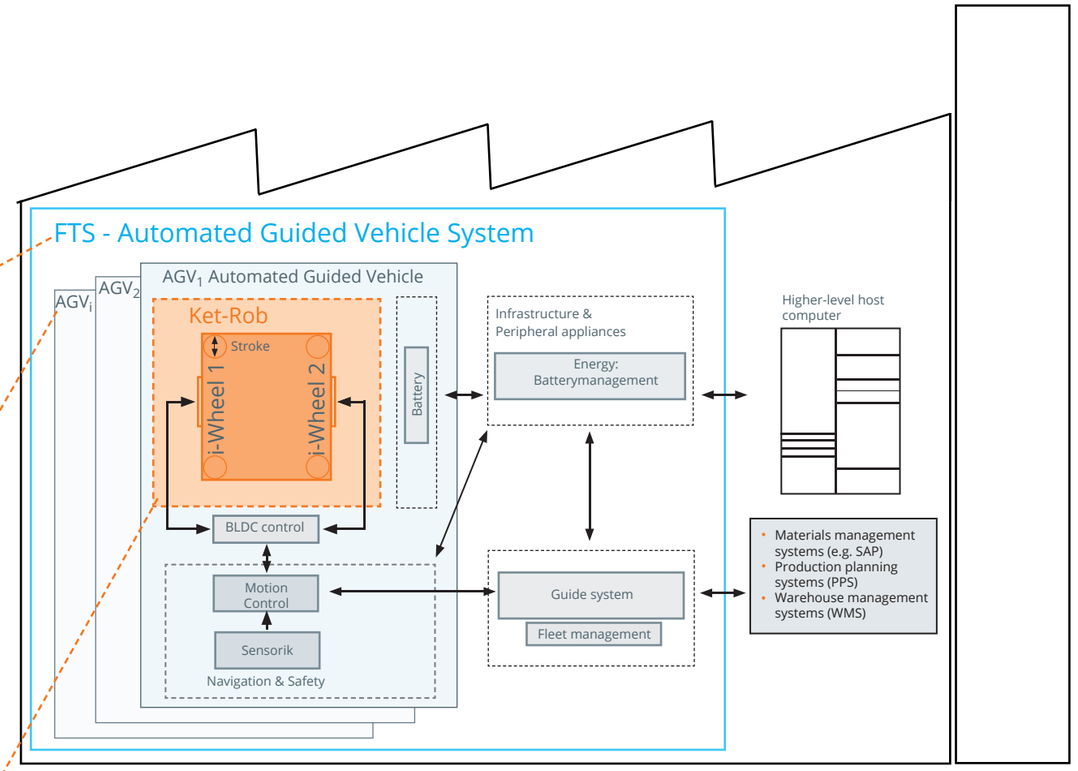
The main task of an AGVS is the automatic transport of materials. In the broader sense, AGVSs also include systems that are used for service tasks such as handling, monitoring, cleaning, mobile information and guidance – including in areas accessible to the general public.

VDI guideline 2510

Automated Guided Vehicles (AGVs)

Automated Guided Vehicles (AGVs) are floor-bound conveyances with their own travel drive, which are automatically controlled and guided without contact. They are used for the transport of materials, i.e. for pulling and/or carrying conveyed goods with active or passive load handling devices. This guideline deals with vehicles with wheel drives. Rail-guided vehicles, air-cushion vehicles and walking machines are excluded.

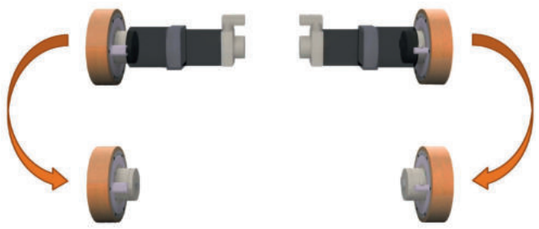
VDI guideline 2510



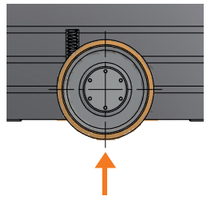
Ket-Rob – more time for essentials

Ketterer's drive platform „Ket-Rob" enables the project manager, in the development of an AGV / AGVS, to concentrate on the complex part of the work, i.e. the proprietary application and idea, including the programming and coordination of the necessary control systems.
If the controller is to be evaluated, the Ketterer platform enables a prototype for an AGV / AGVS to be created and tested very quickly. The time saved can be used in the development of system variants in order to find the optimum solution for the in-house AGV / AGVS.

★ More space due to gearless configuration

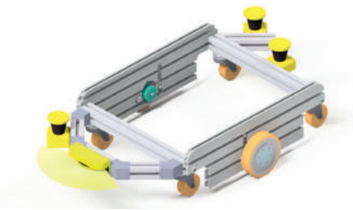


★ Drives with spring suspension – uneven surfaces are not a problem



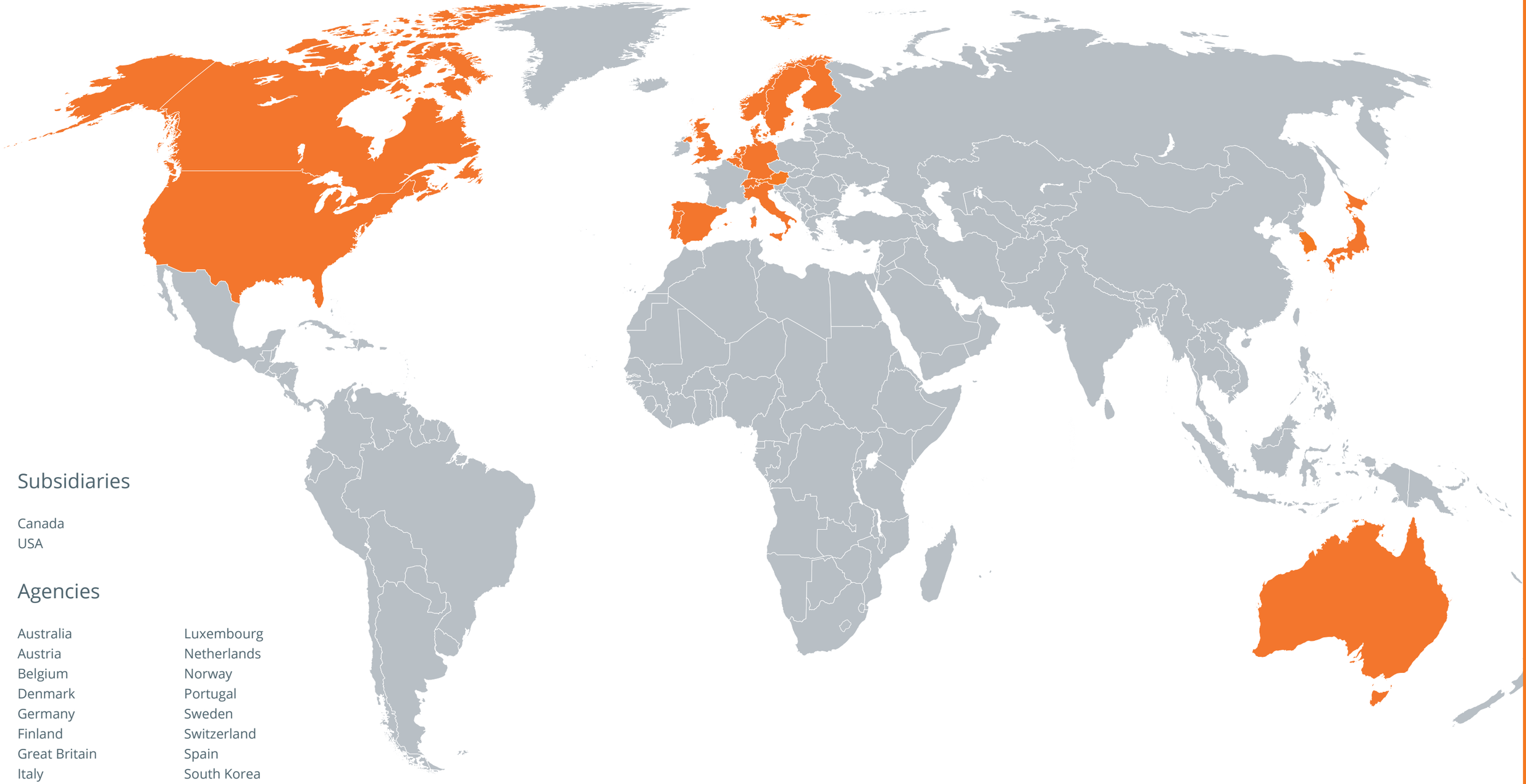
★ Variable dimensioning

★ Frame prepared for the mounting of sensors



★ Optionally with lifting and/or tilting unit

USED AROUND THE WORLD



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