

The Next Generation  
XDrive Systems





# X20 Introduction

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## System Overview



# MAHLE Worldwide

MAHLE is a leading international development partner and supplier to the automotive industry as well as a pioneer and technology driver for the mobility of the future.

The MAHLE Group is committed to making transportation more efficient, more environmentally friendly, and more comfortable. MAHLE is continuously optimizing the combustion engine, driving forward the use of alternative fuels, and laying the foundation for the widespread acceptance and worldwide introduction of e-mobility. Thanks to its expertise in electric and electronic components and systems, MAHLE can thus also offer integrated system solutions for e-mobility.

MAHLE products are fitted in at least every second vehicle worldwide. For decades, MAHLE components and systems have also been used on the world's racetracks and off the road—in stationary applications, for mobile machinery, rail transport, as well as marine applications.



# MAHLE Worldwide Key Facts



EMPLOYEES

77,000+ (2019)



RESEARCH & DEVELOPMENT

16 R&D centers with more than 6,100 development engineers



100 YEARS OF HISTORY

Founded in 1920 as a light-alloy piston producer



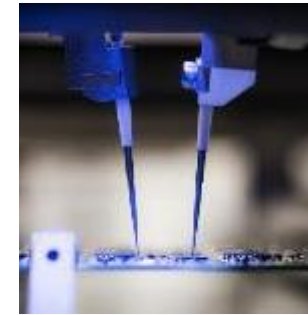
SALES

EUR 12.0 billion (2019)



PRODUCTION

160 locations (more than 30 countries)



5 BUSINESS UNITS

Engine Systems and Components, Filtration and Engine Peripherals, Thermal Management, Electronics and Mechatronics, Aftermarket

# MAHLE SmartBike Systems

MAHLE SmartBike Systems builds components and systems behind some of the most innovative eBikes in the world. Headquartered in Palencia (ES), SmartBike Systems designs hardware and software solutions for eBike manufacturers, dealers and riders. MAHLE SmartBike System's innovative solutions are guided by continuous dialog between the bicycle brands, dealers and riders.



## Employees

65+ employees in the HQ and RD Center in Spain

25+ additional RD engineers in other MAHLE RD locations.



## Main Regional Service

North America, UK, EU, China



## Country Managers

US, Spain, Italy, France, Germany,  
(Others coming in 2022)

# SmartBike Systems DNA

## LIGHT

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Thanks to the ultracompact design of our lightweight systems, our eBikes are nearly indistinguishable from traditional bikes.

For the first time ever, MAHLE SmartBike Systems make eBikes look and feel like riding a manual bike. Except a lot faster. This translates to unparalleled performance and agility in all kind of scenarios from long distance racing and off-road trail riding to everyday urban commuting.

## SPORT

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Finally, there is an alternative to big, heavy batteries and motors that unnecessarily burden most eBikes.

Our new generation of high-performance systems provide exactly the amount of power that you need eliminating unnecessary weight. Our ultracompact and powerful HUB and MID Drives have paved the way for the possibility of new eBike categories such as eRoad, eGravel, Urban and eMTB

## SMART

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By integrating our industry leading Artificial Intelligence technology directly into the bike, we can greatly enhance rider performance and experience

Precision sensors and environmental analysis combined with hundreds of rider data points come together to create a unique and unparalleled experience for each rider.

ANT+, Bluetooth®, GPS, IoT, Machine Learning, Artificial Intelligence, and cloud computing are fully integrated into the bike, creating an ecosystem of services and apps that push the eBike technology forward.

# Connectivity and Intelligence

The HEAD unit is the control center for all MAHLE SmartBike Systems. This almost invisible computer sits neatly in the top tube, continually processing inputs from the changing environment and adjusting the performance of each component in real time and creating a riding experience like none other.

## Active Sensors

- Gyroscope and Movement Sensor
- Motor and Battery temperature
- Cadence (pedaling)
- Speed
- User torque power meter
- Motor torque

## STANDARD version of the HEAD unit

CAN, BT, ANT+



## Machine Learning

Identification of terrain, incline, weather, as well as user activity, such as sprinting or braking.

## Active Response

Activation or deactivation (Lights, Power)  
Adapted response to the situation  
Active Safety Response

## Cloud Sync, Cloud Computing, AI

Firmware Over the Air updates  
Adjustment of the motor response to user profile, terrain and environmental circumstances  
Dynamic adjustment of the electric motor support to archive and monitor the destination relative to the current battery level

# SmartBike Ecosystem

All the X20 components have been designed to seamlessly integrate into the ONE ecosystem. The components work flawlessly together creating the best ecosystem in the industry. Additionally, the rider experience is now customizable thanks to the new HEAD unit and the MAHLE ONE app, providing a phenomenal rider experience.







# X20 Introduction

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## System Overview

## Why X-Systems

For decades, the bike industry focused on creating the lightest product to maximize efficiency, maneuverability and adaptability. The desire to reduce unnecessary weight led to the adoption of some of the lightest materials on the planet such as carbon and hydroformed alloy tubes.

Despite this evolution in traditional bikes, eBikes remained behind - ultra heavy, bulky, inconvenient, and stiff. At MAHLE, we believe it doesn't have to be this way. The new X-Series finally provides a solution that combines the lightest materials of traditional bikes with the most advanced, natural feeling electric motor on the market.

For the first time, electric bikes exist that provide riders with a completely new experience unparalleled to any other on the market. An electric bike that is fully integrated, light and incredibly pleasant to ride.

## X35+

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This groundbreaking system paved the way to create eBikes that are affordable, slim, and a joy to ride. (old or new)

X35+ is the perfect choice for Urban Commuters, Road and Gravel bike enthusiasts. The hallmark feature of the X35+ system is the almost complete silence when riding, making the X35+ the most natural riding experience on the market.



## X20

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This cutting edge system is designed for high performance Gravel, Road and Cross-Country bikes. The latest innovations are used to create the right support at any cadence, whether racing at top speeds or climbing up a mountain. This eBike system is designed to push the rider and the whole industry forward.



# X20 Build for the Rider

## Industry leading weight to power ratio

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With only 3.2 Kg full system weight (DU, battery and components), X20 is the lightest system on the market. The X20 motor provides more than 23 Nm of torque at the rear wheel (comparable to a 55 Nm Mid Drive) while offering the look, feel and riding experience of a lightweight traditional bike.

## Smart sensors and intelligent support

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Cadence and a bottom bracket torque sensors ensure powerful motor assistance while climbing even the steepest hills. Head Unit processes incoming information from all sensors (torque, cadence, movement, gyroscope) adapting performance to the environment and unexpected changes.



## Smart battery

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Groundbreaking support depending on the ride data to ensure you never run out of power. Batteries iX250 & iX350 (177Wh extra with the Range Extender) can be fast charged thanks to the new Active Charger. e185Wh Range Extender can not only almost double the range but also can be used as direct power source or as a power bank.

## Intuitive Maintenance

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Compatibility with industry standards (142/148 Boost\*), standard freewheel integration and up to 12 speed cassettes, make X20 the most flexible and customizable system on the market today.

\*BOOST compatible from Summer 2022

# Main system key points

## Weight

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Ultra compact and lightweight premium rear hub drive system (total weight 3,2Kg) designed to provide the ideal user-oriented performance

## Invisible Integration

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Enables great design freedom making eBike frames almost indistinguishable from traditional bikes.

## Torque & Cadence

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Torque sensor in the bottom bracket compatible with all standard group sets (BB86, PF46 EVO, BB92)

## Motor

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Patent pending motor unit with thru-axle, O.L.D. 142mm (148 BOOST CY2023), Automatic connection and high Torque in any speed.



## Batteries

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Patented inner batteries (236/350Wh) and external Range Extender (173Wh, 1,1 Kg) allows the rider to tackle any distance with ease.

## HMI

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New industry leading innovative HMI with haptic feedback technology for unintrusive communication with the bike.

## Accessories

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Ecosystem of tailored accessories such as external displays, eShifters, Range Extender, and more, GPS and Tracking (CY2023)

## Software Ecosystem

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New fully renovated mobile and web-based apps complement the hardware to provide a smart and holistic connectivity solution

# X20 Component Overview

## Main Components



## Accessories



## X20 system

- Ultracompact Sport Hub Drive Unit
- 55 Nm (compared to Mid Drive)
- 142 O.L.D. & 148 BOOST (coming)
- Thru axle (12mm, non included)
- Battery Capacity
  - iX250 (236Wh)
  - iX350 (350Wh)
- Max Range 535W (iX350 + e185)
- Automatic Motor Connection
- Standard freewheel integration (13s)
- Intelligent control (HEAD UNIT)
- Torque Sensor (Standard BB)
- Fast and Active Charge
- Range Extender Capacity (Optional)
  - e185 (173Wh)
- Optional Display and remotes
- Active & Fast Charging (4A)

# X20 open door to high end applications

X20 brings a unique combination of lightweight power, never seen in an eBike system before. This opens the door to a new segment of high-end road, gravel and urban eBikes. Additionally, X20 is a modern system finally applicable to the Mountain or XC eBike categories.



e-Road



e-Gravel



e-XC



e-Urban

A woman with blonde hair in a ponytail, wearing a white long-sleeved shirt, is sitting at a wooden table. She is looking down at a black smartphone in her hands. On the table in front of her is a blue bicycle helmet, a white coffee cup on a saucer, and a clear glass tumbler with a silver lid. In the background, a white and blue bicycle is parked. The scene is outdoors, possibly at a cafe or a break area.

## X20 Introduction

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## Component Highlights

# Drive Unit: Overview

X20 drive unit is the crown jewel of the new X20 system. We have spent months obsessing about each detail of the drive unit to make sure we deliver the flexibility and performance that will push the whole industry forward.

## Ultra compact size

1,399 gr without freewheel

## Thru-axle

O.L.D. 142mm, 148 Boost version in CY2022

## Straight-pull

28 spokes, compatible with any removable standard freewheel

## Internet of Things

CAN bus digital communication of status and diagnosis

## Automatic Motor Connection

No wire connection needed

## High Torque

Comparable to 55 Nm mid-drive

## Quality

6 bolts brake rotor and CNC Forged hub shell



*Flexible application – urban, gravel, road, XC*



# Drive Unit: Full Performance Customization

The X20 provides more performance customization options than ever before. Thanks to our flexible system, each bike manufacturer can define their own motor map as well as motor response to create a unique performance for each model. Additionally, the new MAHLE ONE app allows each rider to further customize their motor performance within the parameters set by the OEM.

## OEM Customization

The OEM motor map software empowers each manufacturer to define the top level responsiveness of the motor



## Rider Customization

Based on the parameters set by the OEM, each rider can further adjust the performance of the motor adjusting now in X20 response, acceleration, reactivity and other options.



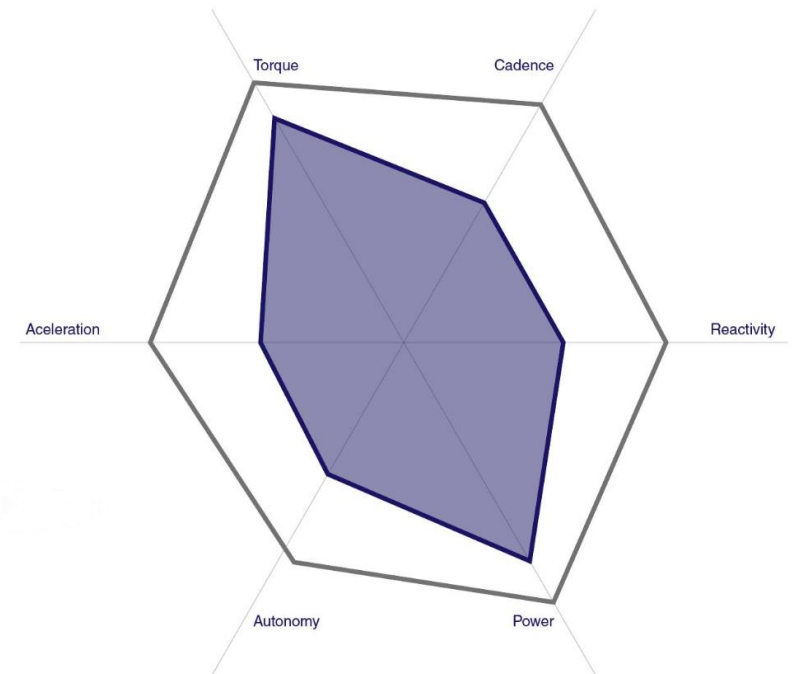
## Auto adjustment over the air

The full bike can be auto adjusted by itself using the information collected from the multiple sensors embed into the X20



## Customizable User Motor Response

Parameters set by **OEM**  
Parameters set by **USER**



# Drive Unit: The Summit Climber

The X20 Drive unit was designed to achieve the highest level of performance in the most compact size possible. Thanks to the innovative gearing system and custom design for thru axle integration, the X20 motor can sustain a torque of up to 6 km/h.

This makes X20 one of the most powerful motors on the market in its weight and size category. This performance makes X20 your best partner for climbing steep slopes at low speed. Once the rider reaches cruising speed, torque is decreased, and the motor support feels like a light, helpful wind on your back.

## Torque

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6 km/h torque

## New Applications

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Performance eRoad  
Gravel  
XC MTB  
Cross-country



# Drive Unit: Automatic Motor Connection

Assembling and disassembling the rear wheel should be simple and straightforward, just like on a regular bike. To achieve this goal, we created the “AMC”: Automatic Motor Connection. This system guides the motor through the dropout and connects to the motor automatically via fully sealed contra-connector in the dropout. The motor connection is so intuitive that the user can easily replace and maintain the motor if needed.

## Maintenance

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Connector and contraconnectors are designed to be fully replaceable, simplifying maintenance

## IP Protection

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IP64 waterproof protection

## AMC

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The guided installation system makes assembling and disassembling the wheel simple and easy



# Drive unit: Freewheel Freedom

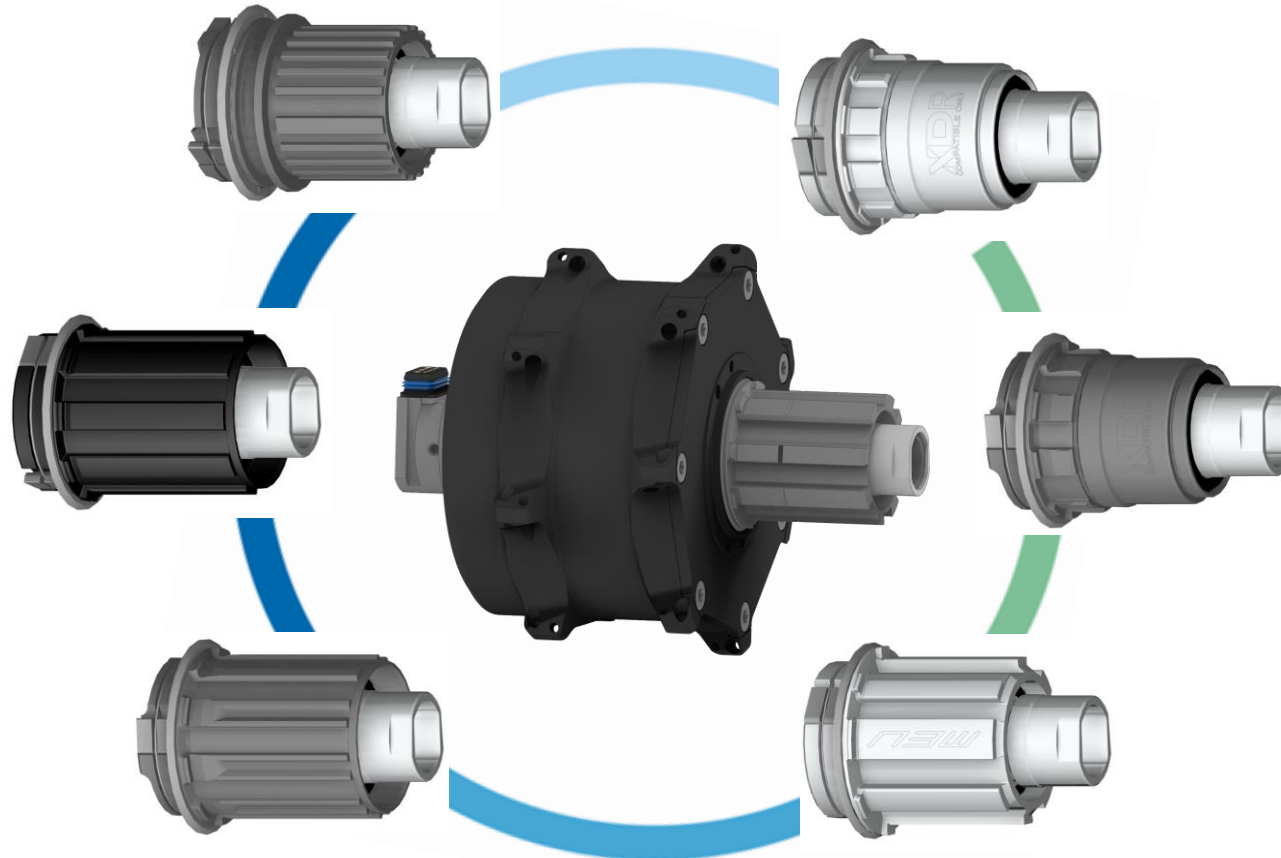
X20 is compatible with most popular standards for cassette integration. Possible to remove the freewheel with standard tooling and replace or change for another version like any other standard read hub.

## Groupset Integration

Shimano HG  
MicroSpline  
SRAM XD  
SRAM XDR  
N3W

## Compatibility

Compatible with most standard freewheels  
Up to 13s  
Easy replacement (interface to drive unit shell compatible with Campagnolo freewheel interface).



# Battery: iX250

The iX250 battery is light, compact, and supplies just the right amount of power. This battery provides a perfect solution for urban commuters who want the extra boost from an eBike combined with the ultralight weight of modern traditional bikes.

## Power

236 Wh / 36V

## Full Charge

3.5 hours. 75% in less than 2 hours

## Top Connectors

2x HMI, Accessories  
Lights: 2A | 6V (12W) / 12V (24W)  
USB: 2A | 5V

## Dimensions

49,6 x 41,8 x 469,5 mm in the downtube

## Bottom Connectors

Motor, Charge Port, Torque & Cadence Sensor

## Weight

1.5 kg



# Battery: iX350

With an impressive 21700 cells, the iX350 increases the rider's battery life by 45% when compared to the iX250. This additional power is possible by adding less than 1cm of extra width inside the downtube making the iX350's combined weight, size, and power-ratio one of the best in the world.

## Power

350 Wh / 36V

## Full Charge

3.5 hours. 80% in less than 2 hours

## Top Connectors

2x HMI, Accessories  
Lights: 2A | 6V (12W) / 12V (24W)  
USB: 2A | 5V

## Dimensions

51 x 52 x 469,5 mm in the  
downtube

## Bottom Connectors

Motor, Charge Port, Torque &  
Cadence Sensor

## Weight

2.25 kg



# Active Charger

The new Active Charger includes CAN BUS for real time communication with the battery. This direct communication combined with a more powerful converter allows the battery to be charged at different intensities from 0 to 4.5A making the charging process faster and better. The micro-USB port on the charger provides an additional connecting point option to make updates to the full eBike system directly.

## Fast Charging

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iX250 - 75% charge in < 2 hours  
iX350 – 82% charge in <2 hours

## Status LED

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Information about charging mode and status

## Interchangeable wires

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For any X20 compatible region

## Direct Communication

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CAN communication between battery and charger

## Micro USB

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Update the charger with latest firmware or charge your small accessories in parallel

## Compatibility

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Compatible with all MAHLE batteries iX and Range Extender (New Generation)



# Active Charger Wall Mount

The Wall Mount is a special accessory that MAHLE includes with the charger in order to place the Active Charger in the wall of your garage keeping the wires shorted at any time.

## Features

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Quick lock/unlock charger to the wall

System to keep the wire shorted when is not connected to the eBike or used

Visual information of the status of the charger and the eBike in the Wall





# Head Unit

The new Head Unit becomes the heart of intelligence and connectivity in MAHLE SmartBike systems. Now it includes the capability to update the system firmware via APP (FOTA), dual information and advanced sensors with real-time information processing to adapt the bike response to conditions and terrain.

## HEAD Unit STANDARD version

X20 included from the factory with the new HEAD Unit Control Bluetooth® for app connectivity & Ant+ for MAHLE or third-party wireless components. In combination with the MAHLE ONE APP the ebike will include firmware over the AIR (CY2022)

## HEAD unit HIGH version

The High version of the HEAD Unit Control introduces IoT capabilities that removes the need to use your smartphone to keep your eBike connected to MAHLE Cloud Service Platform.



### Control Button

System On / Off  
Assist Level Control  
Lights On / Off

### Ambient light sensor

Brightness automatically adjusted to light conditions for perfect visualization

### RGB dynamic line

Battery Level (by area filled)  
Assist Level (by color)  
System info (by animations of the line)



# Bottom Bracket: Torque & Cadence Sensor

A new torque and cadence sensor helps riders conserve battery by measuring the power input from the rider and adjusting the support from the motor accordingly.

## Full Compatibility with Standard Cranksets

- BB86 standard to 24mm spindle (124g).
- BB92 standard to 24mm spindle (130g).
- PF46-24 compatible with 24mm spindle (161g).
- PF46-30 compatible with 30mm and DUB cranks (142g).

## Sensor Performance

- Torque accuracy of approx. 95% (+-5% of tolerance)
- Torque signal refreshing each 5ms
- Cadence signal of 40 pulses per revolution

## User Friendly

- Waterproof
- Silent adjustment





X20

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Accessories Highlights

# The New Range Extender

The new Range Extender e185 is the best in class in terms of size, weight and capacity, adding 173Wh to extend your ride. Thanks to the new technology used you can get full power of it or even use as single on battery in the X20-S version.

## Range

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50 - 70 km of additional range (full power, economy mode) with smart range optimization

## Weight-capacity Ratio

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Best in class weight-capacity 1,1 kg – 173 Watt hour

## Direct power source

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Even if your main battery is empty, just plug and ride

## Charging

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Blazing fast charging - 80% in under 1 hour

## Freedom

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Free yourself from unnecessary weight. Add extra weight and range to your bike only when you needed.

## Universal Holder Design

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Enables you to put the Range Extender or standard water bottle



# The New Range Extender as a Power bank

Meet our new docking station that brings a whole new level of functionality to our Range Extender. For the first time ever, a smart bike range extender is not only limited to charging bikes. The Docking Station's\* USB-C and USB-A ports now allows ultimate flexibility for all your charging needs from your bike to your laptop and smartphone.

## Smartphone

Up to x12 smartphone charges

## Laptop

Up to x2 laptop charges

## Compatibility

USB-C Docking Station  
Charge 2 devices at the same time



*\*patent pending*

# E-Shifters

E-Shifter is the perfect solution for curved handlebars. The e-Shifter allows riders to better seamlessly control their bike including two small control buttons, vibration technology, and flexible placement of the included silicon bands.

Also suitable for straight handlebars.

## Convenience

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Operate your bike without removing your hands from the handlebar

## User Friendly

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Patented vibration technology to communicate between you and the bike. IP67 Waterproof.

## Compatibility

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Designed to fit all common handlebar tube dimensions from 24,2 to 31,8 mm.

## Smart Control

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Discrete buttons connected to the HEAD Unit that can control 1 or 2 operations - assist level, lights and more (4 operations in total)

## Placement

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E-Shifters can be placed on any handlebar (curved or flat) in different positions with or without the rubber holder



# Front Wheel Hub

For those seeking complete control and balance, MAHLE X20 also added the option to order the front hub with the same smart design of the rear wheel. This optional addition is produced in Europe by one of the most prestigious wheel manufacturers and provides an elevated look and feel to the rear and front wheel

## Compatibility

Straight-pull front hub  
28 holes – 14 Left | 14 Right  
Thru axle 12x100 mm  
6 bolts brake rotor

## Weight

139 grams

## Design

Forged & 5 Axis CNC aluminum hub  
Black anodized  
Radial bearing  
Double sealing

## Dimensions

51x100 (12 mm thru axle)



# New MAHLE ONE: X20 In-App Customization

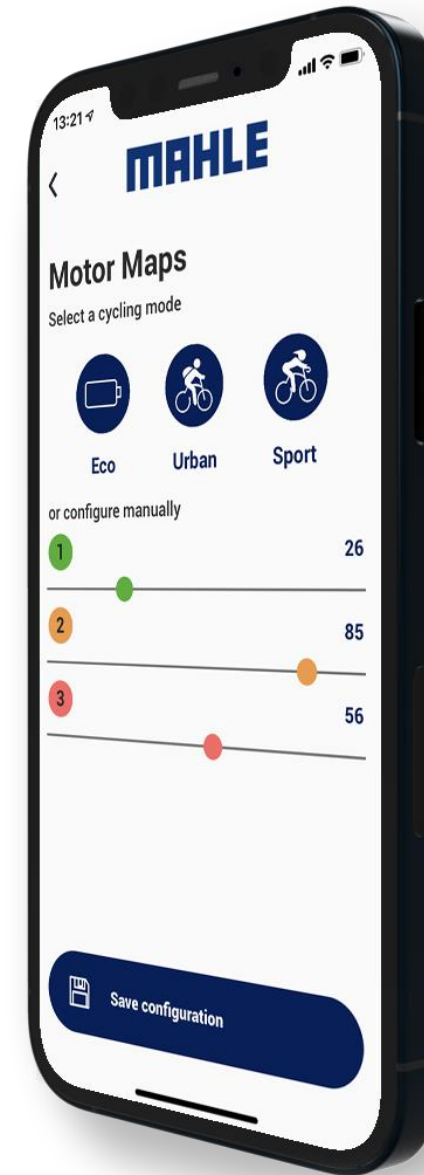
With the launch of X20, the new MAHLE ONE app increases the level of customization available to the user. Riders can now personally configure each level of power, adjusting the response and reactivity of the system.

## APP & HEAD Unit STANDARD version

From factory the user will be able to adjust the response of the ebike adapting the reactivity, acceleration, torque, etc. In combination with the HEAD unit STANDARD and thanks to the FOTA, it will be able to update the full ebike (CY2022). Now the APP is more oriented to improve your pure electric bike experience.

## APP and HEAD Unit HIGH version

The High version of the HEAD Unit Control introduces IoT capabilities that removes the need to use your smartphone to keep your eBike connected to MAHLE Cloud Service Platform. The new MAHLE ONE APP will include options to control the new functionalities once they will be ready like antitheft system, where is my ebike, dynamic adjustments, etc.



MAHLE ONE app



# PulsarONE Display

For the lovers of details, the wireless PulsarONE display provides detailed information about your ride – from battery status, to available range and your custom level of assist.



## eBike Information

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- Main battery level
- Range Extender battery level\*\*
- Assist level / Walk mode
- Lights status
- Range (rideable distance based on current battery level and assist level)
- % of adjustment per assist level
- Odometer
- Active error\*

## eBike Functions

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- Increase & decrease assist level
- Head lights control

## Ride Information

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- Bike speed
- Average speed
- Ride distance
- Odometer
- Ride & current time
- Cadence, power meter and heart rate (using ANT+ sensors)

## Connectivity

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- ANT+ LEV, HR, CAD, PWR, CTF
- Wireless Installation
- Compatible with Garmin mount standard
- Used as Remote Control

