# CCB – an electrically activated and software optimized brake

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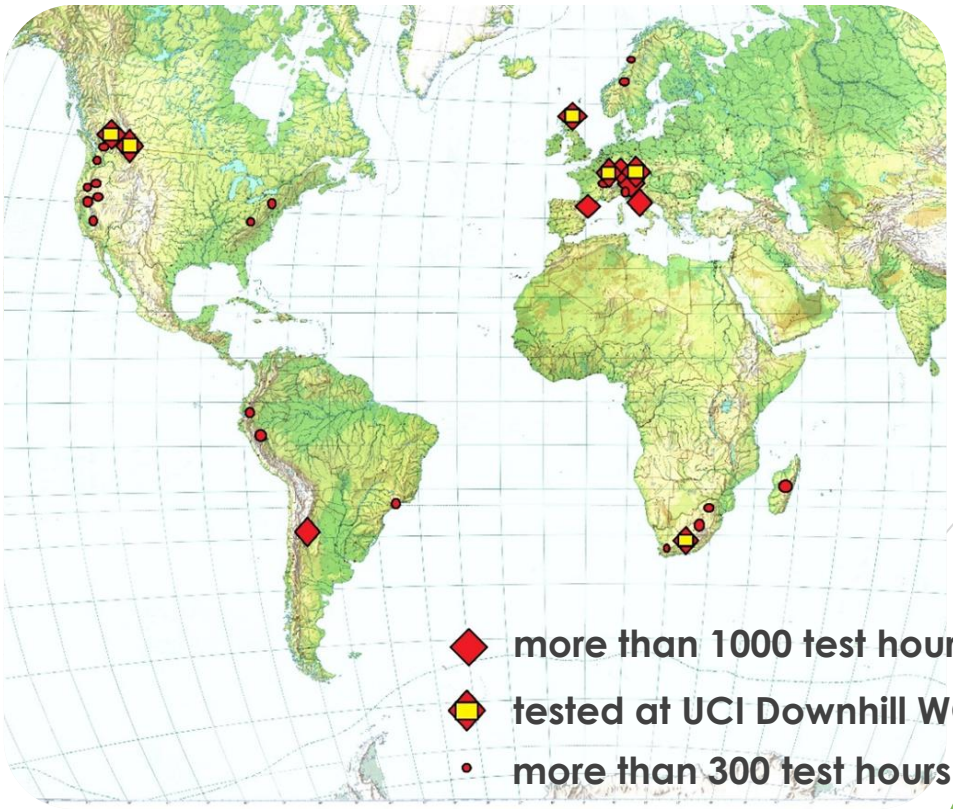
# Abstract

The *CCB "current control brake"* is the first electric disc brake in the world of bicycling. After electric suspension- and seat post adjustments and gear trains, the CCB was the last non-electric part so far. With the *CCB* we can offer the whole electric bike system as a turnkey package with a lot of new integrated features to increase your performance on your mountain bike. Especially in professional downhill racing this system sets completely new standards. For example a profibus system is implemented, which works like a small PC called *IntegralDrive Box (ID-Box),* which controls the brake. For more individuality in adjustments you can define your personal set up with the included software. If the brake lever is pulled, the integrated pressure sensor will send a signal to the *ID-Box*. The incoming data will be processed by the processor. Dependent on the chosen set up, the new modified signal goes through the electric wire to the brake caliper and moves the servo motors, which press the brake pad with the respective pressure onto the disc.

Tested arround the world. - For more safety.



# Do you really need it ?

During extreme descents a continuous and precise brake performance is necessary. Damaged or ruptured hydraulic tubes can endanger your performance or be a hazard for your health. So the combination of wireless data transmission and using electrical and signal wires provides a safe and steady performance, that gives you a race experience you have never had before.

# What are the advantages of an electric brake system?

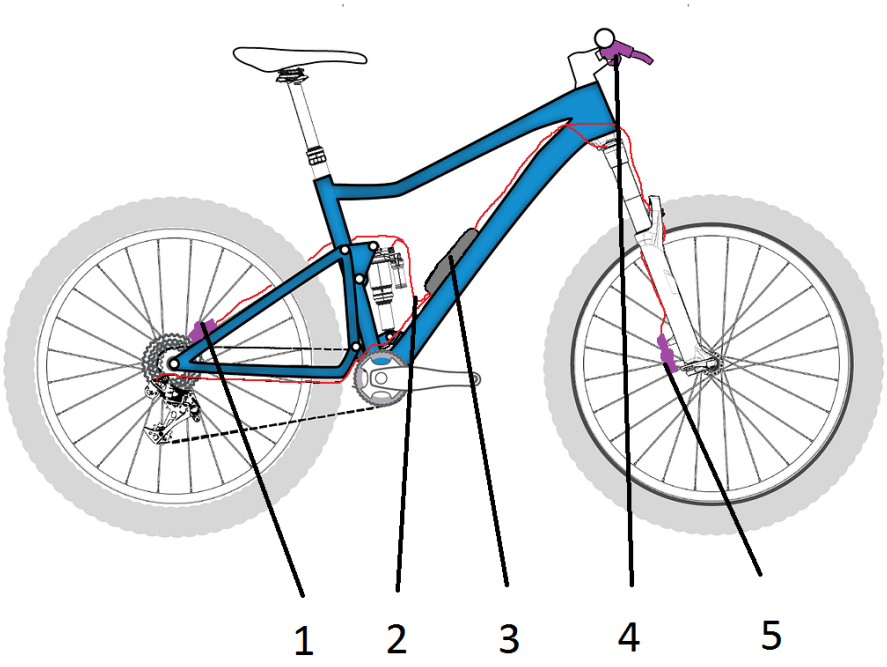
With our technology it will be possible to install different software packages for an individual set-up of your bike parts, for instance the electronic brake "CCB". The *ID-Box*, a central component of our invention, enables an individual control to all connected components. You define your configuration on your Smart Phone or Laptop and send the information via Bluetooth to the receiver in the *ID-Box* on your bike.

Another feature is the memory unit, which collects all data during your trip from connected components and prepares it for an analysis. To optimize your set up, the software supports you in modifying it more efficiently and comfortably.

In the end you have a smart brake system: smart in dimension, smart in handling and smart in maintenance for its whole lifespan.

# What you get!

The package includes the bus system in combination with a powerful lithium ion battery pack, electrically controlled brake calipers, brake levers that give their signals through a pressure sensor to the *ID-Box* and a software with a lot of possibilities to personalize your set-up. This package can be up-graded with other different electrically controlled components that can be implemented into the optimized control flow by our software.




1. rear brake caliper
2. electrical wire
3. ID - Box
4. brake lever
5. front brake caliper

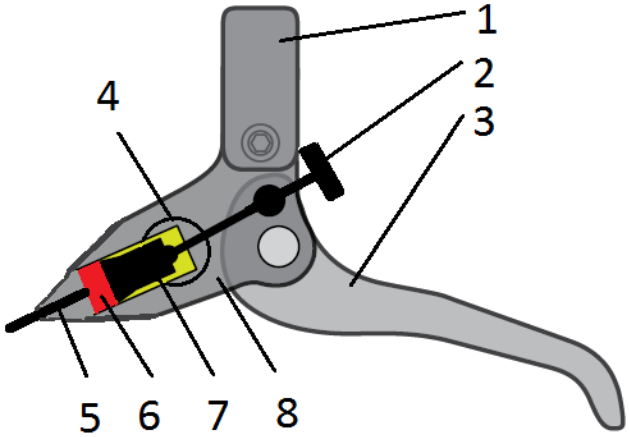
# Parts in Detail

## *Brake Levers*

The brake levers are the joint between the human and the bicycle. Therefore ergonomics and simple handling are important features of this part.

It consists of the housing, clamp, lever, lever adjustment, master cylinder, coin cell, pressure sensor and the transmitter. The brake which is presented in this text is especially for racing and content of the mountain bike edition. Due to this, the housing is made of magnesium. With this, it loses weight and is as stiff as an aluminum version. Also the body is designed much smaller than a conventional hydraulic brake because of the missing brake fluid reservoir, which is not used on electric systems. Therefore the total weight of a brake lever pair can be reduced to 102 g. The clamp is important to mount the brake lever at the handle bar. It is designed for any common handle bar with a standard diameter of 22.2 mm. The lever itself consists of carbon, which is very stiff and light weight. It is designed for one or two finger braking and hence very comfortable. To set up the lever position for the individual cyclist, the lever adjustment is very useful. The lever width can be adjusted with a small screw. The lever is connected with the master cylinder. This cylinder touches the subsequent sensor. It converts the manual signal into a digital one. This digital signal will be sent to the ID-B by the transmitter, which is powered by a coin cell.

Because of the wireless handle bar, we save a lot of weight and avoid technical failure - no cable cracks after crashing and no more pressure drop because of long or leaky hydraulic cables.



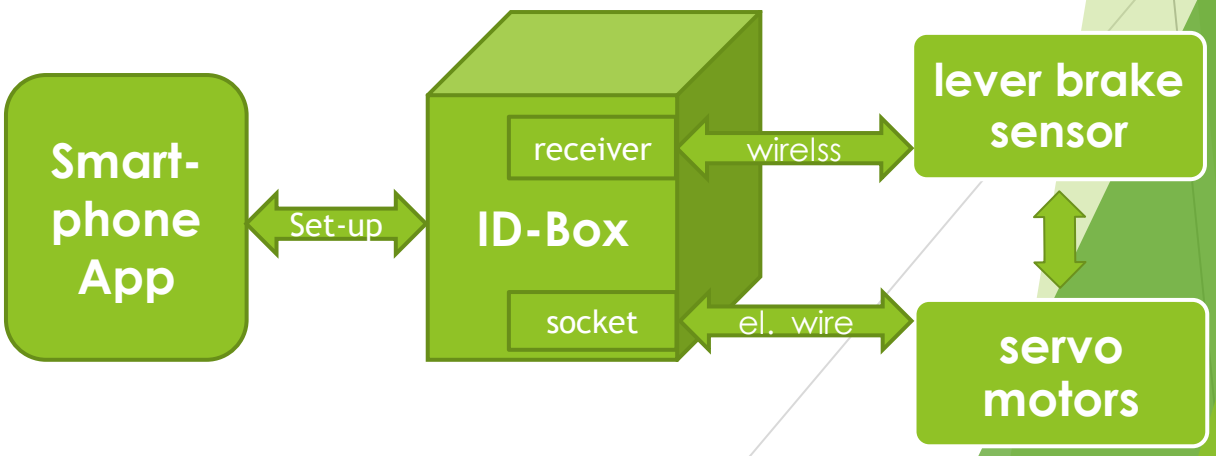

1 - clamp
2 - lever adjustment
3 - brake lever
4 - coin cell
5 - transmitter
6 - pressure sensor
7 - master cylinder
8 - housing

# The“IntegralDrive-Box”

The *ID-Box* is the brain of the whole system. It is the processor for all signals from the components. Also it supplies the current for the servo motors and processes all incoming and outgoing data.

The *ID-Box* includes a 1.0 GHz micro processor, a 16GB removable memory card, a receiver, a lithium-ion rechargeable battery pack with 36 volt direct current , 11 Ah and 400 Wh. All this is contained in a reinforced black polypropylene plastic box with the dimensions of 8cm L by 3cm W by 3cm H. The *ID-Box* is extremely shock-proof, water resistant and perfectly suited to the demands of downhill racing.

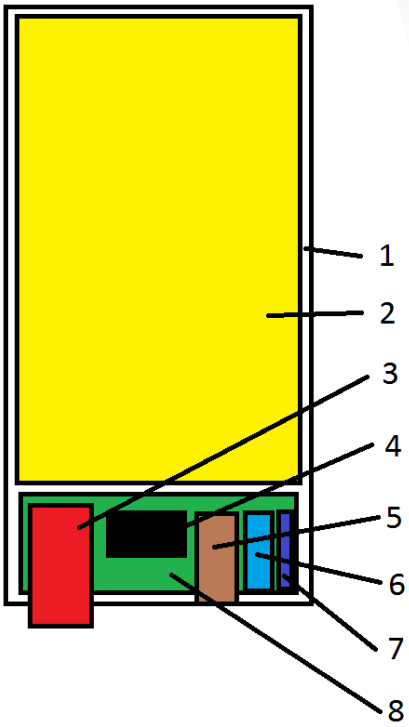
The communication on the bike between the transmitter of the brake lever and the ID-Box receiver works via a coded radio signal and replaces the connection via electrical cables. The signal between the ID-Box and the brake caliper is transmitted through electric wires. On the customer side you can transmit the data via Bluetooth to your laptop or a smart phone that has the *ID-Box* App installed. For a safe data streaming on the customer side you can code it with a dynamic safety-key, which can be defined while installing the app.



To provide safety, the system is equipped with a safety feature, consisting of a visual warning light scale and a capacitor safety brake. For a safe use of the electric brake the battery charge level is absolutely important. A four stage capacity display is integrated on the surface of the ID-Box. It consist of four green LEDs and a red one. In the case of four illuminated LED's, the charge condition is at 100%. With only one LED illuminated, the capacity is 20% or more. If the red one is illuminated, the battery has reached a critical level of 19% and the capacitor of the brake calipers will be activated.

The ID-Box will be installed on the water bottle holding holes and fixed with screws that are included in the package.

To charge your battery you can buy a power pack that can be connected with a plug to a socket in your household or via transmitter plug in the 12V socket in your car.




Scheme ID-Box
1 - housing (Box)
2 - battery
3 - memory card
4 - processor
5 - wire socket
6 - signal receiver
7 - bluetooth receiver
8 - mainboard

# *The Controlled System*

As a result of the electrically controlled brakes their special characteristics in normal road or hard downhill mode is much more controllable and adjustable than a hydraulic brake system you can currently buy on the market.

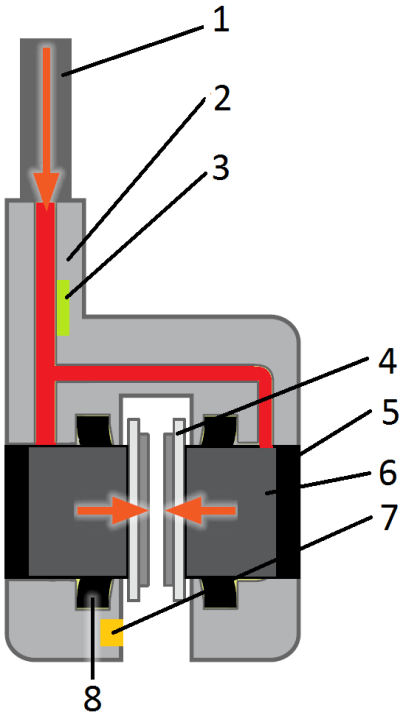
The electrically controlled brake system consists of the lever brake sensor on the handling bar, the Bluetooth sender which is also a part of the sensor, a receiver in the box, cables which transmit the electricity between the box and the servomotors on the brakes. The software processes and controls the incoming wireless signals from the brake lever sensor, converts them into electrical signals and sends them through the electric wires to the servo motors in the brake caliper. The intensity of incoming signals steers the power of the brake force.

# Brake Caliper

The brake caliper has the most important task on the bicycle. A failure of that part has grave ramifications for the cyclist. That is why reliability and easy maintenance service are absolutely important for satisfied customers. To ensure this, the brake caliper is built of the body, two servo motors with their brake pads, capacitor, wire package, receiver and a speed sensor. The housing is made of aluminum because of higher forces during the braking procedure. It is forged in one piece to make it more light weight and sturdy. The external metal rips, which are integrated in the design of the caliper housing, ensure the cooling of the brake. The seating of the body is normalized for a post mount standard of 74.2 mm width between fastening screws. An adapter is included to take into account various  brake disc diameters. In this way the brake discs can be mounted with a diameter of 160 mm, 180 mm or 203 mm

- The servo motors have a diameter of 24 mm and a depth of 10 mm. They are pressed into the body and are stabilized by locking screws. Close to the left servo motor is where the speed sensor is attached. It detects the speed of the brake disc. The brake pads consist of wear-resistant titanium-aluminum plates. The external cooling ribs serve to guide brake heat release. Because of heavier servo motors, the weight of the brake caliper is a tad higher than conventional hydraulic disc brakes. It is around 298 g for both the front and rear caliper.

  Because of the electric control, the braking procedure is more individual. According to weather conditions or subsurface, the brake requirement can be changed. If the disc brake is blocked, the sensor will send a signal and the servo motors reduce their brake forces. That is why the CCB can operate like an anti-blocking system of a car.




1. wire
2. housing
3. capacitor
4. brake pads
5. locking screw
6. servo motor
7. speed sensor
8. seal

# Ride It!

# The whole working cycle

When the brake lever is pushed by the cyclist, the force will be passed onto the master cylinder. The pressure sensor will be pressed down by the cylinder and converts the pressure into a digital signal. This signal will be sent to the *ID-Box* via a transmitter. The brake lever is powered by the integrated, removable coin cell.

The modified signal will be broadcast to the servo motors. Both will be activated and moved towards to the disc. The enclosed brake pads press the brake disc and generate significant friction. If the main battery is empty, the servo motors can't be used anymore. This could cause dangerous crashes. The capacitor is integrated to prohibit this worst case scenario. If the electric power fails, for example through a low battery capacity level, the servo motors move out of position to braking power of 50% using the last energy reserves of the capacitor. Now the bicycle will stop quickly and the rider can charge or change the battery.

# Sources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