

MAXAM



ZEB

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ZEB Blaster OP Remote

User Manual V1

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Introduction

The ZEB Blaster OP is a high voltage Shock Tube Initiation System. The battery powered device charges a high voltage capacitor and discharges it by command into an electrode to generate a powerful spark to initiate shock tubes. The system communicates wireless via radio.



ZEB Blaster OP (Left: Slave Mode), Blaster OP Remote (Right: Master Mode)

The following document will give an overview on functions and operation of the ZEB Blaster OP system. For detailed information of the blasting machine ZEB Blaster OP please have a look at the Blaster OP user manual. There the different modes and accessories will be explained.



ZEB Blaster OP

Safety information and Overview

Explanation of symbols



Caution! Read this instruction manual carefully before using the device, even if you already have experience and pertinent training in blasting technology!



Warning for Blaster OP: High Voltage! Risk of electrical shock!

The device may only be used by trained and qualified personnel under observation of the applicable regulations and ordinances. It may only be transferred to third parties with the instruction manual. Access to the machine by unauthorized persons must be prevented.



It is not allowed to power the ZEB Blaster OP Remote with an external power source other than a USB C standard charger.



Attention for the ZEB Blaster OP: Only touch the electrode or the socket at the end of the flex-electrode cable when the device is fully discharged (OFF), since a very high DC voltage is present at the terminal while ignition. There is a risk of burns from the ignition spark. The device may only be triggered when the centering cap is installed!

Proper use:

The ZEB Blaster OP Remote features a double function power button. Keep in mind that a single push will switch the system on while a double push will switch it off. The remote will not switch off automatically to prevent a signal loss during waiting time. Switch the equipment off when it's not needed. Battery states are indicated by light signals.



CAUTION! Always switch equipment off after operation!

Always fold antenna down.

Improper use

Never use the ZEB Blaster OP system including the ZEB Blaster OP Remote in mines with a methane or coal dust explosion hazard or in other areas with explosion hazards. The device is not designed for use in explosive environments. (Not explosion-proof). It is strictly prohibited to do any physical changes to the device. This could lead to safety technology defects, possible material damage or personal injury during blasting work, and to the destruction of the equipment. Never attach any other adapters or Antennas to the antenna terminal than products provided by the manufacturer. Only use the provided antenna that comes with each equipment matched to the mounted radio module or ZEB approved antennas matching to the mounted radio module. The ZEB Blaster OP and remote must only be used in accordance with the specified guidelines.

Transportation and storage

Please inspect the packaging immediately upon receipt and the device during unpacking for any visible outer damage. Store all parts in the transport bag or the original packaging in case return shipment becomes necessary. Only the original packaging may be used for return shipment. Secure all parts and protect them from damage. Be sure that the equipment is switched OFF.

The ZEB Blaster OP Remote is powered by two rechargeable 18650 Lithium cells. It can be stored in any position without leakage.

Scope of delivery

- ZEB Blaster OP Remote
- USB-C Wide range charger
- USB-C Cable
- Antenna (matching the radio module frequency)
- This Instruction Manual



Technical data

Type	ZEB Blaster OP Remote
Operating principle	Wireless radio com
Power Supply	Dual 18650 Lithium cells
Weight	~0,5kg
Dimensions (LxWxH)	250 x 155 x 73 mm
Standard Antenna	$\lambda/2$
Range	Approx. 2000m
Transmitting power	<500mW
Frequency	868MHz (Region 1) 915MHz (Region 2)
Protection	IP67
Temperature Range	-20°C to +55°C
Optional antennas	Magnet unidirectional

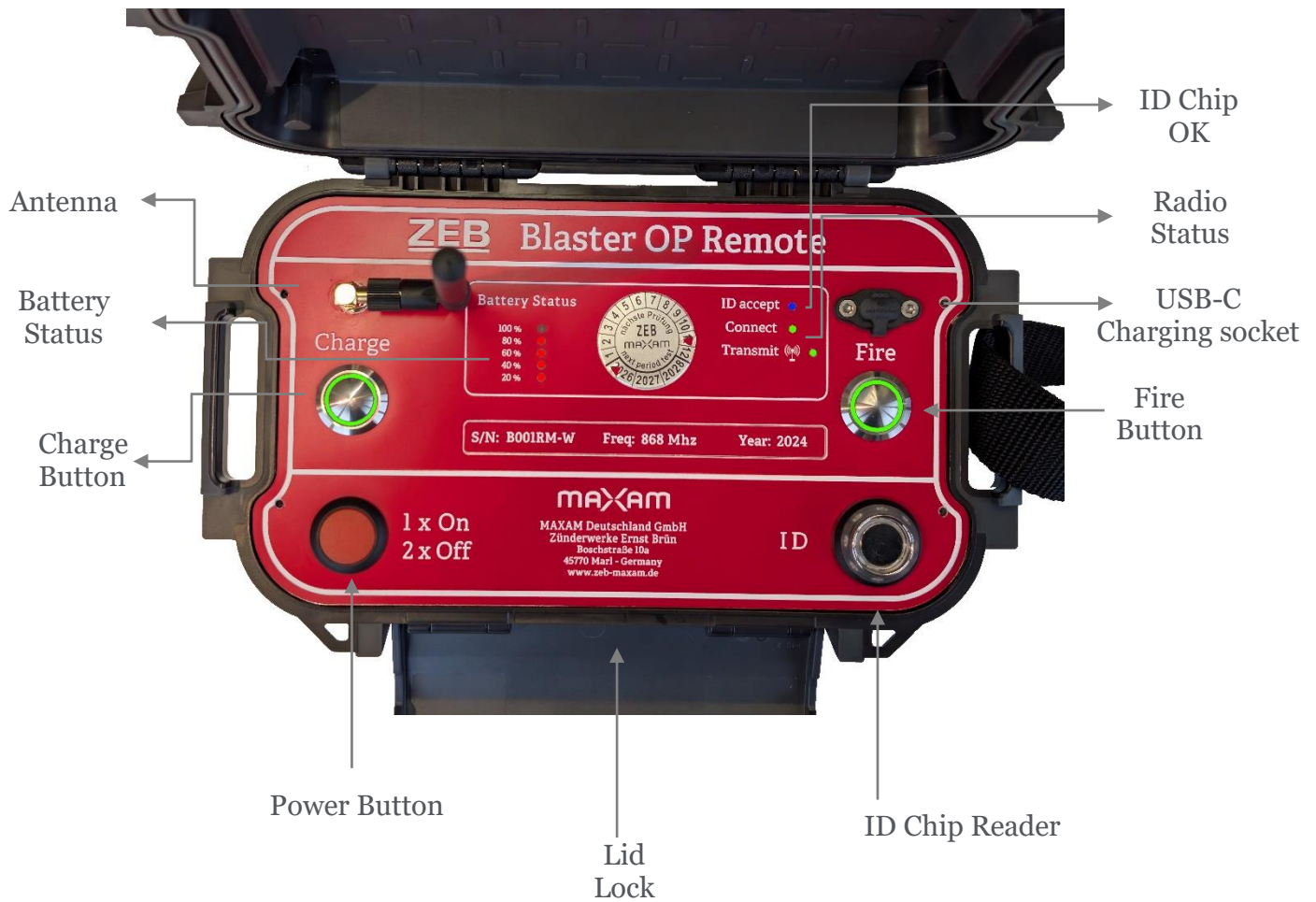
Region 1 (orange) & 2 (grey) Countries

Dimensions

LxWxH: 250 x 155 x 73 mm

Explanation of material

For a better understanding of this user manual the explosion chart shows the most important parts and positions of components.



LED color code

The ZEB Blaster OP Remote is equipped with several indication lights:

Battery Status: Shows charging level in %. Flashes while recharging.

Radio: **Connect** Led shows while a stable link is established. **Act** flashes while active communication is done. Idle telegrams at 3 seconds interval.

Buttons and switches

The ZEB Blaster OP Remote is equipped with several buttons:

Element	Action	Result
Power Button	Push 1X	Power ON
Power Button	Push 2X	Power OFF
Charge Button	Push down & Hold	Charge Generator Command
Charge Button	Release	Discharge Generator Command
Fire Button	Push down	Fire (only if Charge Button is still pressed)

Housing overview



Housing upwards and on the ground

ID Chip reader



ID Chip reader with LED indication and ID Chip

To ensure a very high safety level during trainings and operation the ZEB Blaster OP is equipped with unique ID-Chips. Each equipment is programmed with a unique ID Chip. Only with the matching ID Chip a blaster can be remote controlled or initiated.

Operation



Remote shows a connected state and ready to fire – (ID-Chip missing) for light symbolization

To establish the connection to a ZEB Blaster OP or ZEB Blaster OP Mini their ID Chip must be attached to the ZEB Blaster OP Remote. The antenna needs to be raised upwards. When an ID-Chip is attached to the reader and is recognized by the remote, the **Accept** LED lights blue. Once the Connect Led lights green a connection is established. The **Act** LED will show a flashing green LED while there is communication. The Charge and Fire buttons of the ZEB Blaster OP Remote now control the ID Chip's matching equipment functions and generator. The equipment can only operate one Slave at a time. As soon as the ID Chip is removed the blaster will revert to idle Slave Mode.

How to operate:

Always keep in mind to switch all Blasters OFF after operation! The ID Chips are unique. A loss will cause the resend the blaster to ZEB for reprogramming a new ID Chip!



WARNING!! Keep a minimum distance of >5m between each Blaster. If used with a shorter distance the radio modules will be damaged!!

Remote operation

1. Prepare a ZEB Blaster OP as slave.
2. Take the slave ID Chip with you.
3. Clear the blasting site from staff, check for a safe blasting site.
4. Switch on ZEB Blaster Op Remote by pressing the Power Button once. All LEDs will light up for initialization. Fold the antenna into a vertical position.
5. If the Battery LED is at 20% the battery needs to be recharged!
6. Place the slave's ID Chip on reader. The Remote will show ID accept blue.



If the slave is in range the master unit has now total control about the slave.

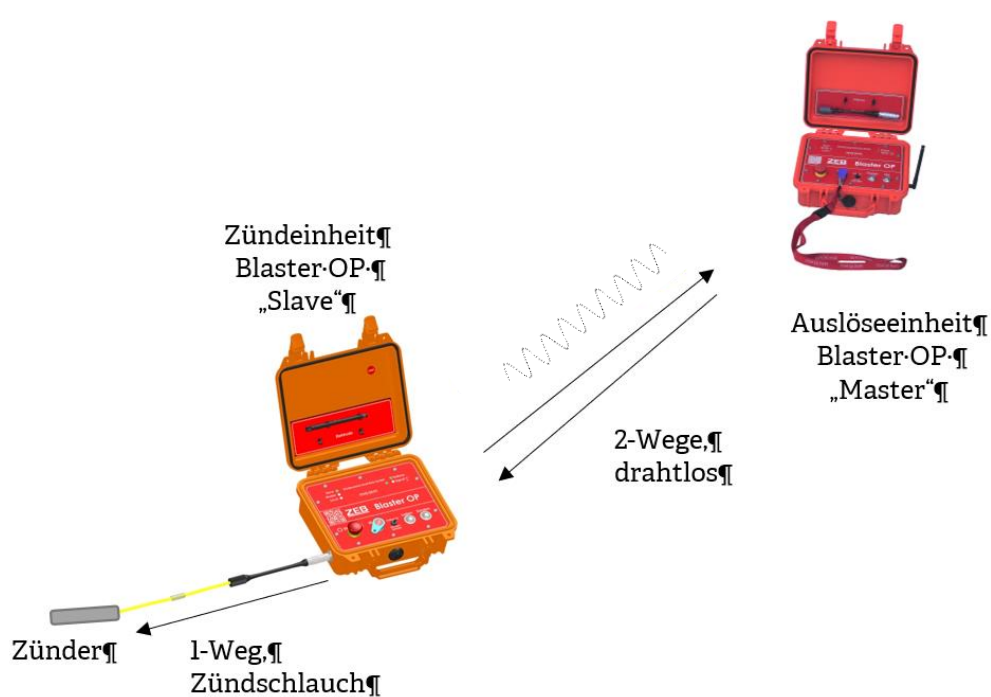
7. The **connect** LED will light as long as the controlled slave is in range and communication is stable. The **act** LED will flash during command transmission about every second.
8. To start charging process of the slave press and **hold** the remote **Charge** button.
9. When the slave is ready to fire the **Charge** button and **Fire** button illumination will light green.
10. To initiate the blast additionally press the **Fire** button. Then release all buttons.
11. After the blast fold antenna in horizontal position.
12. Pick up slave blaster and switch it off. Stow slaves flex-electrode cable and antenna in the slave's top. Recharge all blasters if needed.



Place the slave antenna on an elevated position for example on a tripod to lift it from the ground. To increase the range of the system.

Technical realization wireless communication

The ZEB Blaster OP is used as an example to describe the realization of detonations triggered by radio signals. This is a blast ignition machine, which operates at 868MHz/915MHz in the ISM band. This frequency range can be used for industrial, scientific and medical applications in Europe and beyond (International Region 1). The devices at the blasting site and the blaster communicate via a bi-directional radio link.



This means that the units mutually exchange their status queries and releases. This ensures that an ignition is only triggered by the ignition unit when all the required releases of the triggering unit have been made.

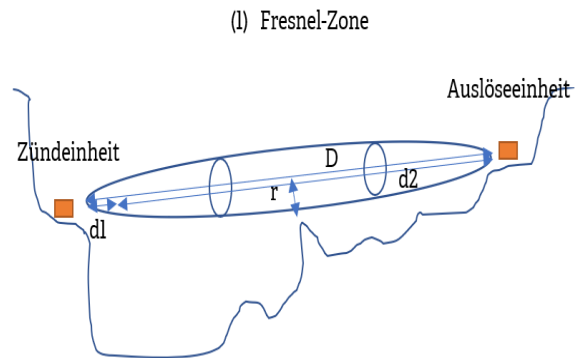
In addition, the individual enable levels of the release unit can only be reached if the ignition unit has confirmed defined states (e.g. ignition readiness with sufficient ignition voltage).

Radio Transmission physics

Generally applicable requirements apply to the radio link. A direct line-of-sight connection is advantageous, but not necessary. Non-penetrable surfaces cause interfering reflections (metal), penetrable materials cause absorption of the signal (concrete).

This also applies to small areas if they are in the Fresnel zone. With soft materials such as trees, a slight absorption per object occurs, which reduces the signal strength.

For an optimal radio connection, the 1st Fresnel zone must be kept free from interference. There should be no sources of interference within this ellipsoidal zone between the transmitter and receiver.



Various online calculators can be found on the Internet. The calculations take place according to the simplified basic formular (A. J. Fresnel):

$$r = \frac{\sqrt{\lambda * D}}{2}$$

Here, the largest extension between transmitter and receiver is calculated as radius r. λ corresponds to the wavelength of the radio signal and D to the distance between transmitter and receiver. If one wants to determine the extension at a certain point, D can be divided into d1 (distance from the transmitter) and d2 (remaining distance to the receiver). The formula for the first zone expands to:

$$r = \sqrt{\frac{\lambda * d1 * d2}{D}}$$

Using the ZEB Blaster OP as an example, the calculation is performed for a radio ignition at a distance of 300m. For this, the wavelength λ is calculated from the radio frequency and the speed of light c.

$$\lambda = \frac{c}{f} = \frac{299\,792\,458 * m * s}{868000000 * s} = 0,3454m$$

The maximum extension of the rotational ellipsoid is calculated.

$$r = \frac{\sqrt{\lambda * D}}{2} = \frac{\sqrt{0,3454m * 300m}}{2} = 5,1m$$

For example, if the ignition unit is located at the blast site with the antenna on the ground, the Fresnel zone can be determined at a distance of 10cm from the transmitter.

$$r = \sqrt{\frac{\lambda * d1 * d2}{D}} = \sqrt{\frac{0,3454m * 0,1m * 299,9m}{300m}} = 0,19m$$

The Fresnel zone is disturbed by the ground directly at the device. There is a strong absorption of the radio signal, which limits the range.

Quarry example

Elevated approx. 1m above the ground, the radius of the Fresnel zone is approx. 60cm. Since in a quarry it can be assumed that the person authorized to blast is on a higher position, a significant improvement of the radio signal can be achieved by increasing the distance of the receiving trigger unit from the ground by approx. 100cm.



With the ZEB Blaster OP it is possible to connect a wired antenna to prevent interference and to protect the unit from possible flying rocks.

Good practice

- Never place a unit, that should communicate via radio link, on the ground, except that the operator is at a much higher position
- Set the antennas up vertical, except that the operator is at a much higher position, then tilt the antenna to avoid loss due to the 1st Fresnel zone.
- Don't set the equipment directly in front of a rock face. The reflections of the vertical wall reduce the transmission signal quality.
- Use external cable extended antennas to protect the Blaster OP from flying rocks.
- To get more transmission power by raising the antenna to an elevated position of the ground. 2m above ground would be perfect.
- Always keep a distance of >5m between each ZEB Blaster OP

Recharging the battery

Every equipment is delivered with a wide range USB-C charger.



ZEB Blaster OP Remote USB-C charger

The Charger can be powered with 110-230V from 50-60Hz for worldwide usage. The Charger will automatically regulate the current to optimize the loading procedure and protect the battery.

Faults table

The equipment can help the operator to make a diagnosis in case something is not working properly.

Fault Explanation Table

Charge button lights red	Generator cannot reach target voltage. A hardware damage to the generator might have occurred.
Fire button doesn't light while pressing Charge button	Generator reached target voltage, but can't fire. A hardware damage to the initiation circuit might have occurred.
Connect LED switches off	No or only broken commands are received within the allowed communication window. Reduce distance to target, avoid metal structures, lift the antennas higher over the ground or change the position relative to the target. Keep in mind to always setup the antenna upwards.

Accessories & Spare Parts

ZEB offers some accessories for the ZEB Blaster OP like other Antennas or transport cases.

Magnetic Universal Antenna



In case the slave blaster is hidden behind a rock or the operator needs protection in a bunker it is possible to use the unidirectional magnetic universal antenna. It features a 3m connection cable.



Flex-Electrode Cable, Centering Cap & Ignition Electrode



If the flex-electrode cable is damaged or missing a replacement is available. This also counts for the centering cap and the ignition electrodes. The ignition electrodes are wear parts and need to be replaced once their energy spark couldn't ignite a shock tube anymore.

Transport Bag for up to two blasters



For an easy transportation of two units as a classic setup we designed a transport bag. The bag holds two blasters and is equipped with an additional compartment for accessories like spare electrodes, antennas, charging units, etc...

Charging Unit & Regional Plugs



The Charger can handle 120-230V for worldwide usage. It is equipped with a waterproof automatic plug that connects to the power socket of the equipment. Different power plugs are available for regional power networks.

Maintenance

Regular inspections

The functional and safety technology features of the ZEB Blaster OP Remote must be inspected at regular intervals within the framework of quality assurance. The responsible operating company must define a suitable interval and the type and scope of this inspection. The respective applicable legal or agency regulations and ordinances for blasting technology accessories must be observed. Subject to other requirements, we recommend a maximum testing interval of 2 years for the energy output analysis at the manufacturer.

Cleaning, Service, Maintenance, and Disposal

Do not use any aggressive cleaning agents (solvents or the like), only a cloth moistened with a mild soap solution. Ensure that no liquid gets into the device and dry it with a soft, dry cloth. Large amounts of dirt must be removed immediately. Take care to ensure that the sockets for electrode, charging unit and antenna are kept clean. Also take care of the ID Chip reader. The device might be subject to type testing by BAM and LOM. This prerequisite requires that the service personnel have years of experience and a thorough knowledge of the design and function of the ignition system. Necessary inspections, maintenance, and repairs may only be performed by ZEB or by local partners authorized by ZEB. Only original spare parts may be used.



The old device may not be disposed of in household waste.

Warranty

The regular one-year warranty and conformity expires in case of

- non-observance of the manufacturer guidelines in the instruction manual
- use not conforming to the described application
- modification of the device
- mechanical damage and damage due to substances or liquids

The warranty expires with natural wear and tear.