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FELSENMEER

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[D.A.N.-Beacon Manual]

Contents

1	In-door localization with D.A.N.-Beacon.....	1
2	Commissioning.....	1
3	Setup.....	2
3.1	Initial planning.....	2
3.2	Setup and tuning of transmission power.....	2
3.3	Overlap of D.A.N.-Beacons.....	3
4	Maintenance	4
5	User interface.....	5
6	Storage, transport and disposal.....	6
7	Technical Data.....	6
8	Security advice.....	6

1 In-door localization with D.A.N.-Beacon

When a lone worker has an accident, helpers must be able to reach this person in time. They have to know where the accident happened, otherwise they waste precious time searching the whole building. The D.A.N.-Beacon provides precise location information.

To fulfill its purpose, the D.A.N.-Beacon is mounted at a fixed place and this place is connected with the identity of the D.A.N.-Beacon in an Alarm Management Software, such as the D.A.N.-Control Center. The D.A.N.-Beacon sends its ID every four seconds. A compatible device such as the gsm s plus or D.A.N.-Shalosh receives this ID. In case of an emergency, the D.A.N.-Shalosh sends this ID to the D.A.N.-Control center. This location information allows helpers to reach the person in time.

The D.A.N.-Beacon uses two primary Lithium (LiSOCl₂) batteries as energy source, they have to be exchanged on a regular basis.

The ID is transmitted on a frequency reserved for alarms. In a **CE** conform environment, only other alarm transmitting devices may interfere.

2 Commissioning

Only trained personal shall commission the D.A.N.-Beacon. Take ESD precautions.



Figure 1: Opening the housing

1. Open the housing using a flat screwdriver.
2. Remove the isolation band (see Figure 2) between battery and battery holder.
3. The red LED lights up. If it does not light up, check battery polarity and voltage.
4. Check whether the green LED flashes every 100ms. The device is now in interactive mode and the transmit power can be changed.
5. Check whether the D.A.N.-Beacon is received by a D.A.N.-Shalosh or D.A.N.-Controller and transmits the right location.
6. Mount the device on the wall.
7. Close the housing.



Figure 2: Opened housing, with isolation band

The D.A.N.-Beacon checks whether the transmission channel is idle or busy, preventing collisions with other alarm equipment. If the channel is busy, it will retry to send its ID at a later point in time. This may cause the green LED to blink in some random way, instead of every four seconds. After a few minutes, a stable four second rhythm should be reached. If not, there is an interfering transmission going on. Check whether the D.A.N.-Beacon can be received despite this interferer.

3 Setup

3.1 Initial planning

Finding a person who had an accident requires careful planning of the installation. Identify the places where workers are alone and are exposed dangers – this can be a simple blackout due to lack of something to drink as well as exposure to dangerous gases like hydrogen cyanide, which is deadly within minutes. The D.A.N.-Beacons have to be placed such that the helpers can find the person within a given time limit. This means that the real place of accident must be visible or audible (using the acoustic near localization feature of the D.A.N.-Shalosh) from where the D.A.N.-Beacon is mounted.

Plan installation places for D.A.N.-Beacons. Assume a 40m radio range for planning, while keeping a minimum distance between D.A.N.-Beacons of 3m. The exact transmission range depends on the environment: it can be very small in cellars with reinforced concrete walls, and larger in open halls. Place the D.A.N.-Beacons in a preliminary fashion. It is of utmost importance that helpers can find the person fast without making large detours. Ambiguous situations such as “before” or “behind” a wall must be resolved with more D.A.N.-Beacons such that the D.A.N.-Shalosh transmits the correct place.

3.2 Setup and tuning of transmission power

During the final setup phase and especially when resolving ambiguous situations, check the influence of the environment. This cannot be resolved during the planning phase, it requires some on site experiments placing the devices. In this phase,

you can also tune the transmission power of the D.A.N.-Beacons. The transmission power can be changed in eight steps with the capacitive touch button, see Figure 3.



Figure 3: User interface

By default, the capacitive touch button is checked every four seconds to conserve energy. Push the button until the green LED stays on for 250ms and the device changes to interactive mode. This mode is indicated by the green LED: It flashes every 100ms and the red LED counts the currently set transmission level.

To conserve energy, this key is checked when the green LED is lit. Push the button until the green LED changes from the slow 4s blinking to a fast 100ms blinking. Now the key is checked much faster and can be used to change the transmit power. The red LED blinks slowly and counts the current transmission power level. By default, the transmit power level is set to 6: The red LED shines six times followed by a three seconds long break. This level is equivalent to a gso-v at full transmit power or a transmission range of 70m. The level can be increase by two levels to about 200m range in free field. The next push of the button switches to transmit level one, which has a range of about 1m. After pushing the button, wait until the change takes effect before pushing the button again. When a pushed button is detected, the green LED stays on for a quarter of a second. The new transmit power level is automatically stored in the D.A.N.-Beacon and will be used even after the batteries have been changed. When no user interaction is detected, the D.A.N.-Beacon will resume normal operation after thirty seconds.

Adjust the transmit power such that the right place is transmitted during an alarm. Keep in mind that a closed lid reduces the transmission range a little.

3.3 Overlap of D.A.N.-Beacons

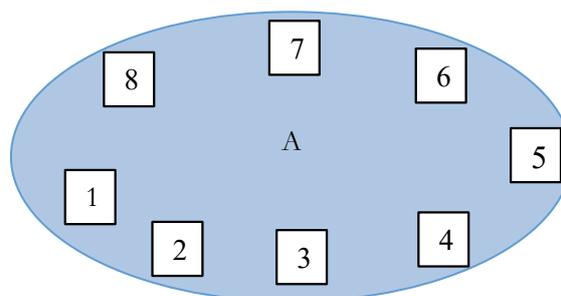


Figure 4: Recommended maximum overlap

To ensure a reliable operation of the system, the transmission range of a single D.A.N.-Beacon should not cover more than eight other D.A.N.-Beacons, as shown in Figure 4. Here, eight D.A.N.-Beacons are within the transmission range of D.A.N.-Beacon with the ID “A”, this is a permissible installation. In extreme situations, up to 17 D.A.N.-Beacons may be within the range of another D.A.N.-Beacon, this number must never be exceeded.

For an optimal transmission of the ID to the emergency mobile phone the antennas should have the same direction. Since the mobile phones are carried in an upright position, the D.A.N.-Beacon should also be mounted upright. In this position, the Felsenmeer Logo on the PCB can be read without any problems. It should be mounted in the same height as the mobile phone, that is, at chest height or at belt level of a grown up person. The distance to steel girders, metal surfaces and ceilings should be more than 30cm if possible.

The D.A.N.-Beacon must be accessible, allowing a fast exchange of the battery, but care must be taken that the D.A.N.-Beacon is not damaged during normal plant operation.

The ID of the D.A.N.-Beacon is printed on the label as “RadioID”. The four numbers at the end of the radio ID are the same as in the serial number. You can find the serial number on the housing label as well as on the PCB.

To mount the D.A.N.-Beacon draw the drill holes, the distances are 50 mm x 79 mm. Open the housing and fix the D.A.N.-Beacon in place.

Once all D.A.N.-Beacons are mounted, the pilot phase starts. During this phase, check whether the system works according to the requirements. Especially in the lone worker areas the D.A.N.-Shalosh must be able to determine its locations, i.e. its status LED must never blink blue. Once the system is up and running, check all devices and instruct your staff members and users.

4 Maintenance

To ensure a reliable operation, check every months whether the D.A.N.-Beacons transmit their ID. If it is not transmitted, replace the battery. The battery life time is about two years typical with a three years maximum. The real life time is influenced by the installation environment as well as series strays in capacity of the batteries.

About one month before the battery is empty, the D.A.N.-Beacons sends an additional “battery empty” warning with its ID. This warning is relayed by the D.A.N.-Shalosh to the D.A.N.-Control center, if configured. In addition, the D.A.N.-Controller can be used to check this. Change the battery as soon as possible:

1. Take ESD precautions.
2. Open the housing, take the empty batteries out of the battery holder.
3. Place two Saft LS14500EX batteries in the battery holder.
4. The red LED lights up. If it does not light up, check the polarity and the voltage of the batteries.
5. Check whether the LED blinks every 100ms and signals the right transmit power.

6. Check whether the ID is received by a D.A.N.-Shalosh or a D.A.N.-Controller and close the housing.

5 User interface

The user interface consists of two LEDs and a capacitive touch button. The two LEDs signal various states using different flash patterns.

LED	Pattern	Interpretation and action
Green	On for 250ms.	Button touched.
Red	Toggles every 100ms.	The D.A.N.-Beacon consumes too much energy. Take battery out and put it back in.
Red	Toggles every 300ms then 3s off, repeated.	Interactive mode: The short toggles indicate the power level. Count them to figure out the current transmission power level. The green LED signals that the power level can be changed.
Green	On for 5ms, off for 100ms, repeated.	Interactive mode: the power level can now be changed by touching the button. The red LED shows the current transmit power level.
Green	On for 2ms, off for 4s.	Packet transmitted. Touch button and discharge state were checked by the device.
Red	Flashes twice (10ms on, 100ms off, 10ms on), off for 2s, repeated.	Battery empty. Replace it within a month after first battery empty signal. It may also occur when a new battery is placed into the device. It disappears after 30 to 60min.

In general, these signals are easy to interpret once you see them in real life. When you first connect the batteries, the red LED is on, indicating that the D.A.N.-Beacon is booting. Once booted, the green LED flashes fast and the red LED flashes slowly: the D.A.N.-Beacon is in interactive mode and you can change the transmit power level. The level is counted with the red LED. Once you are satisfied and stop changing the level, the D.A.N.-Beacon leaves interactive mode after 30s. The green LED now flashes every four seconds. In this mode, the device measures the battery discharge level. When the battery is empty, the red LED starts to flash twice short every 2s. Once you replace the batteries, the D.A.N.-Beacon signals the configured power level.

Under rare circumstances the D.A.N.-Beacon does not start into low power mode, as indicated by a toggling red LED. Just re-connect the batteries to force it into low power mode.

When a new battery is placed into the device, the device may signal an empty battery. This happens especially when the battery has been stored for a long time (“Passivation”) or when it is cold ($< 10^{\circ}\text{C}$) and the device has room temperature. Just wait for 30 to 60min in this case, and the “battery empty” signal stops:

- Passivation of battery dissolved
- Device now measures the correct temperature and the
- “Battery empty” algorithm is calibrated

Passivation is a normal phenomenon for this battery type and the reason why this type can be stored and used for very long times, it is a wanted feature. Unfortunately, it fools the “Battery empty” algorithm for a short time.

The capacitive touch button works when it is dry. Touch it with a bare finger and cover as much as you can. The first touch places the device in interactive mode. Any subsequent touches will change the transmit power level.

If your touches are not recognized, dry your fingers and the button, restart the device and wait for one minute: The touch button is now initialized and adjusted to the current environment.

6 Storage, transport and disposal

Remove the battery during storage and transport, or break the contact between the battery and the battery holder.

The D.A.N.-Beacon contains a Lithium battery. Dispose empty batteries according to the applicable regulations.

Give the device to a center for electronic waste or return it to the manufacturer for environmentally compatible disposal.

7 Technical Data

Device	D.A.N.-Beacon
Operating temperature	-40°C to +80°C, 60°C for 24h
Operating time	2 years typical, up to 3 years
Storage	0°C to 30°C with battery, -30°C to 60°C without battery
Housing classification	IP66, IK08, UL94-V2
Dimensions	94 x 65 x 57 mm
Weight	180g with batteries
Battery	2x Saft LS14500EX (LiSOCl ₂ , 3.6V, 2.6Ah)
Transmission frequency	ISM band for alarms, 869.6875 MHz 25 kHz channel bandwidth
Transmission range	Typical 40m, adjustable from 1m to 200m. Depends on environment.

8 Security advice

Only trained personal or our service may open the D.A.N.-Beacon. Do not damage the housing and the sealing gasket. Take ESD precautions.

All installations and maintenance works must be performed by trained personal according to the requirements and regulations.

Observe the warnings in the Lithium battery.

Check once per month whether the D.A.N.-Beacons transmit their IDs, otherwise the place of accident cannot be reliably determined by a D.A.N.-Shalosh.

The battery discharge algorithm is tested with Saft LS14500EX batteries. It may give wrong results with batteries of another manufacturer or different types.