a De Haardt Holding company

INSTALLATION INSTRUCTIONS XTRA.EXTERNAL ANTENNA KIT

External antenna for the Xtra.Range Extender
and the Xtra.Timing Host

200.516

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Preface

About the Xtra.External Antenna Kit

The Xtra.External Antenna Kit improves the range of the Xtra.Range Extender or the Xtra.Timing Host. Range improvement can be accomplished by installing the external antenna at a suitable location.
An example: The Xtra.Range Extender of Xtra.Timing Host are mounted on a wall, 1 meter high. A chosen location, near a power outlet and close to a PC for serial data transfer.
Despite this chosen location, the signal range of the Xtra.Range Extender or Xtra.Timing Host might be sub-optimal. In these situations, the Xtra.External Antenna Kit can provide an improvement.
The Xtra.External Antenna Kit can be mounted in a more favorable spot, where disruptions to the radio signal can be minimalized. For instance: 3 meters above the ground, free from metal objects like fences while the Xtra.Range Extender or the Xtra.Timing Host are positioned lower.
The Xtra.External Antenna also has a higher antenna gain, which improves the range and receiving sensitivity of the Xtra.Range Extender or Xtra.Timing Host.

De Haardt bv recommends the Xtra.External Antenna for use with the Xtra.Timing Host and Xtra.Range Extender.

For support, one can contact De Haard's support department by email: support@de-haardt.com.

About this manual

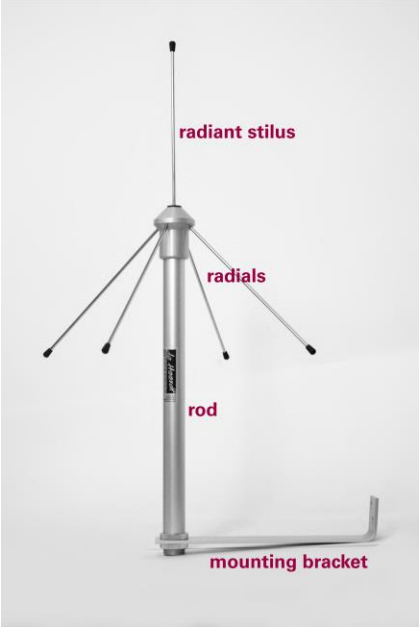
This manual helps with correctly installing the Xtra.External Antenna Kit. The instructions are divided into three steps:

- First step: Modifying the Xtra.Range Extender or Xtra.Timing Host.
  (connecting an antenna cable for use with the Xtra.External Antenna Kit.)
- Second step: determine an optimal location for the Xtra.External Antenna Kit and connecting it to the Xtra.Range Extender or Xtra.Timing Host.
- Third step: testing the new setup.

Contents of the Xtra.External Antenna Kit

Before proceeding, check the contents of the kit. The kit consists of the following parts:

Description	***Qty.***
Tie wraps	2
F connector	2
RG58 coax cable (antenna cable)	10 m
SMA to f adapter	1
Cable gland	1
Allen key (size 2)	1
Antenna-mounting-bracket	1
Antenna-rod	1
Antenna-stilus	1
Antenna-radials	4



Necessary tools

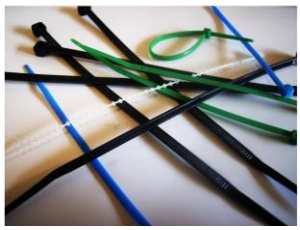
The following tools are required to install the Xtra.External Antenna Kit:

- Side cutter
- Stanley knife (or something similar like a cable stripper)
- Allen key (included)
- Phillips-head screwdriver (ph2)
- Slot-head screwdriver

cable gland

SMA to F adapter

tie-wraps



allen-key

Step 1: Modifications to the Xtra.Range Extender or Xtra.Timing Host

The first step to perform is modifying the Xtra.Range Extender or the Xtra.Timing Host.
From now on, this manual will refer to the Xtra.Range Extender. Read Xtra.Timing Host if you have a Xtra.Timing Host, the steps are the same.

Preparations

The first 5 points describe the preliminary actions, consisting of opening the Xtra.Range Extender and attaching the cable and cable gland.

> ⚠ Power off (unplug) the device, and remove the serial connection before you proceed

1. With a slot-head screwdriver, remove the sealing cap for the cable gland. (Figure 1)

Figure 1: bottom view of the Xtra.Range Extender

2. Attach the cable gland (Figure 2).

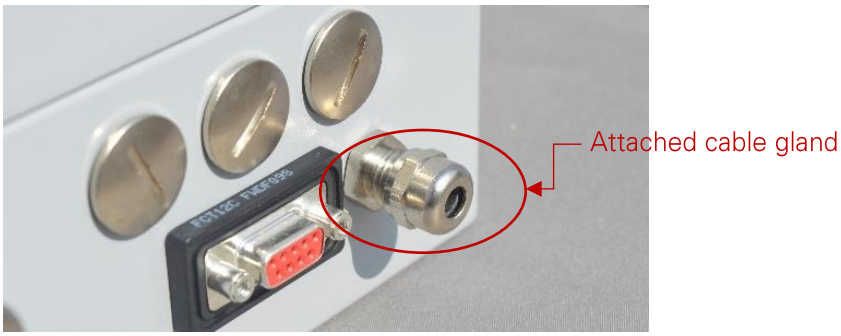


Figure 2: bottom view, with attached cable gland

3. Remove the screw covers (2x) and the screws (4x) by using the phillips-head (ph2) screwdriver (Figure 3).

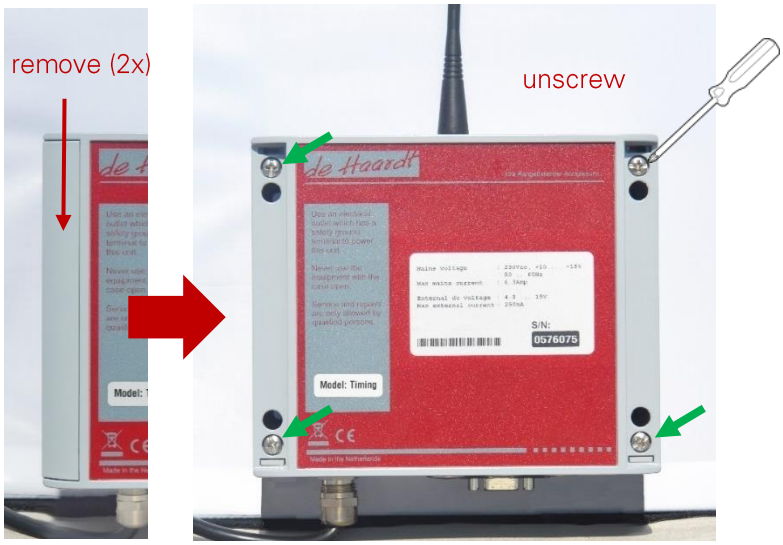


Figure 3: front view, remove the screw covers and the screws

4. Open the Xtra.Range Extender (Figure 4).

Figure 4: front view, opened Xtra.Range Extender

Beware of ESD! (electrostatic discharge). The printed circuit board inside the device can be damaged by touching it: ESD may occur via one's hand.
Prevent ESD by:

- Discharging yourself first. For instance, by touching a radiator pipe or another grounded metal object
- Attempting to touch the PCB as little as possible.

As best, one can use an ESD wristband that one can connect electrically to the exterior of the Xtra.Range Extender. In that way, one's hand is always at the same potential with reference to the Xtra.Range Extender's exterior.

5. Feed the cable through the gland. (Figure 5). Make sure there is at least 60 cm of cable on the inside of the Xtra.Range Extender!

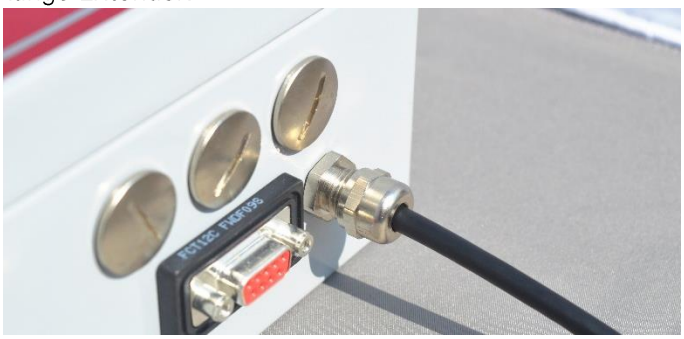


Figure 5: bottom view, cable gland with fed antenna cable

Sufficient cable length on the inside eases further steps attaching the connector.

Do not tighten the gland yet!

6. Loosen the SMA connector of the on board antenna (by turning counterclockwise). (Figure 6).

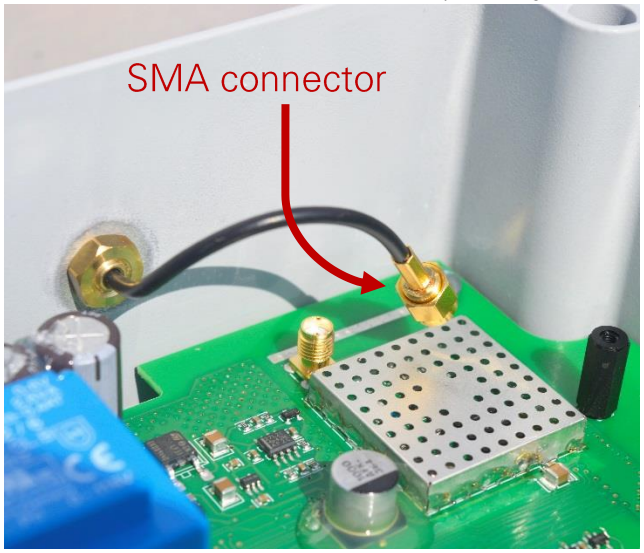


Figure 6: inside view, the SMA connector of the on board antenna is loosen

Fasten the connector to the cable

At this moment, the connector can be fastened on the antenna cable. Point 7 up to and including point 12 are describing the assembly instructions to do so. Those instructions are supported by Figure 8.

7. With a Stanley knife of cable stripper, cut in the outer sheath. Remove approx. 2 cm. Pry the outer sheath off the cable (Figure 8a).

8. Pull the inner sheath over the outer sheath. Remove the aluminum foil (Figure 8b).

9. Strip of the insulator, so that there remains 5 mm of insulation (Figure 8c).

10. Fasten the F-connector to the cable. Turn clockwise when the cable points toward you. (Figure 8d).
    The insulator fits into the middle opening but may not protrude (see Figure 7 for a bad example).
    Make sure that the f connector completely covers the inner sheath. If necessary, remove some inner sheath with a Stanly knife.

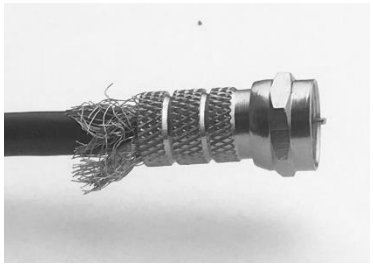


Figure 7: bad example

11. Cut the inner conductor with a side cutter. Make sure that the inner conductor protrudes 2 mm out of the f connector (Figure 8e).

12. Attach the F to SMA adapter onto the f connector (Figure 8f).

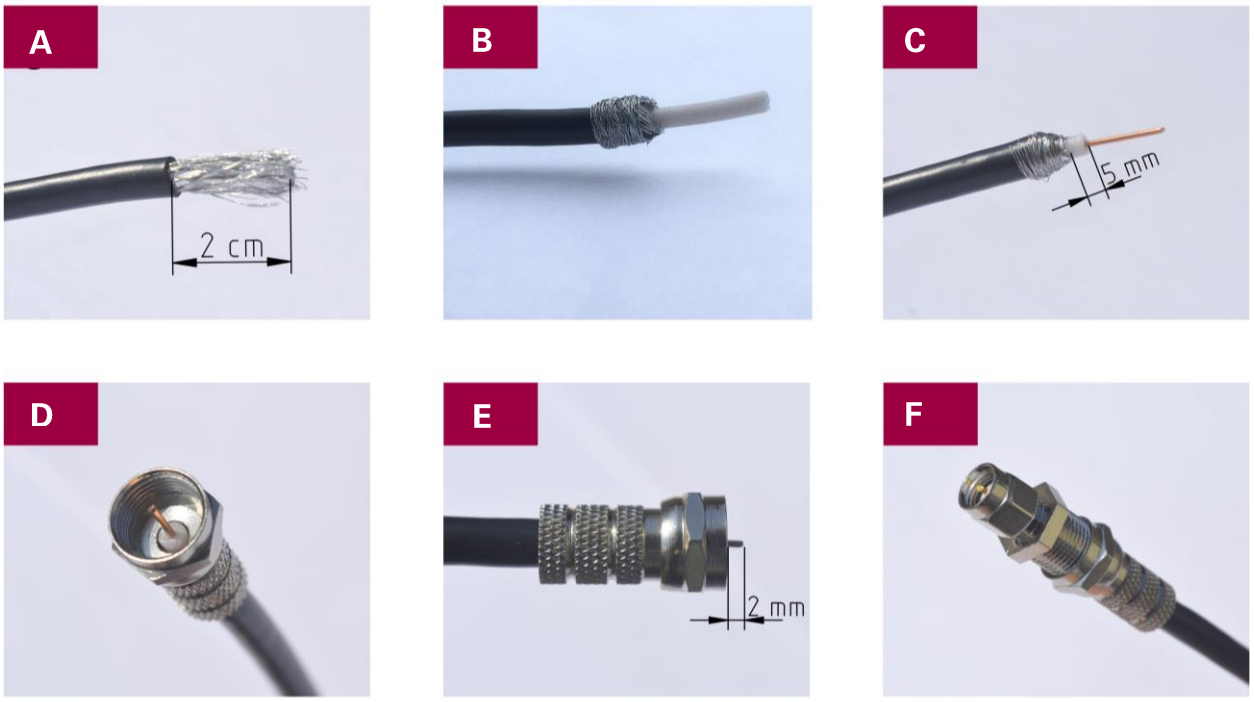


Figure 8: visual action plan: fasten the F connector on the cable

Warning: The inner conductor may not be electrically connected with the conducting inner sheath nor the F connector.

Connecting antenna cable and final assembly

Points 13 to 19 describe connecting the new antenna-cable to the Xtra.Range Extender and assembling the Xtra.Range Extender. Also, everything is being properly checked, before the cover is fastened.

13. Pull back some of the antenna cable (which is kept longer in point 5). Connect the antenna cable to the printed circuit board: fasten the SMA connector of the antenna cable onto the SMA connector of the circuit board (Figure 9).

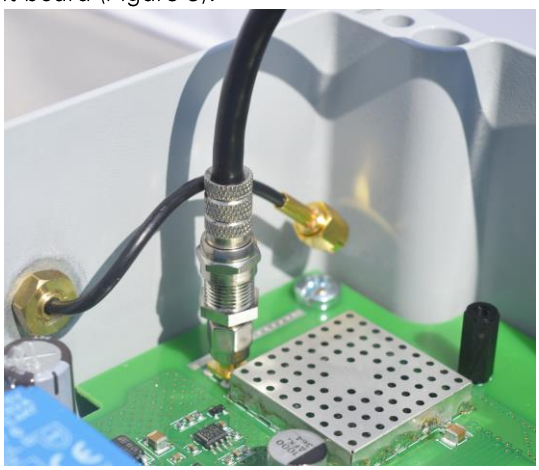


Figure 9: inside view, antenna cable connected to the printed circuit board

14. The cable of the on board antenna must be secured to the F connector in order to be assured it doesn't hang loose and consequently cannot shorten a circuit on the board (as illustrated in Figure 10). Use a tie-wrap to fasten the cable to the previously placed F connector. Cut off the remaining tie wrap.

Figure 10: inside view, former antenna cable secured

15. On the inside of the Xtra.Range Extender, the antenna cable is still too long. Carefully pull the cable out, until the cable on the inside is sufficiently pulled back, in order to place the cover without fixating the cable.

16. Clamp the cable by tighten the gland.

17. Fasten a tie-wrap around the antenna cable on the inside of the Xtra.Range Extender, near to the cable gland. Cut off the remaining tie wrap. (Figure 11).

Figure 11: inside view, a tie wrap is attached to the antenna cable as a cable strain relief

The tie-wrap takes care of some extra pull relief.

18. Verify if the cable is properly fastened, pull the cable carefully and verify if the gland and tie-wrap are holding the cable. (Figure 12).

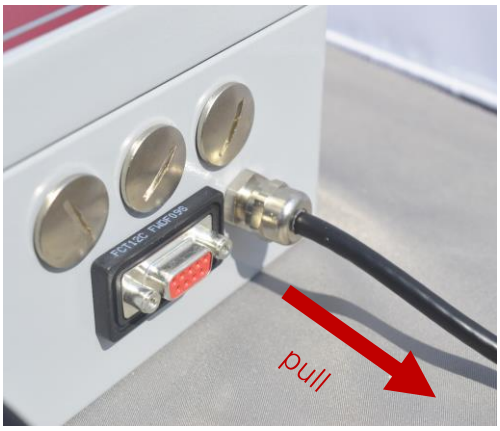


Figure 12: bottom view, antenna cable fed through the cable gland

A mistake made in the previous steps can irretrievable damage the Xtra.Range Extender.
Ask yourself these questions:

- Is the SMA to F adapter fastened properly?
- Is the antenna cable sufficiently pulled back, so that the cover can be placed without fixating the cable?
- Is the old antenna cable not hanging loose?
- Is the new antenna cable fastened properly: clamped by the gland and tie-wrap?

19. Assemble the Xtra.Range Extender by fastening the cover (tighten 4 screws) and placing the screw covers (2x) (Figure 13).

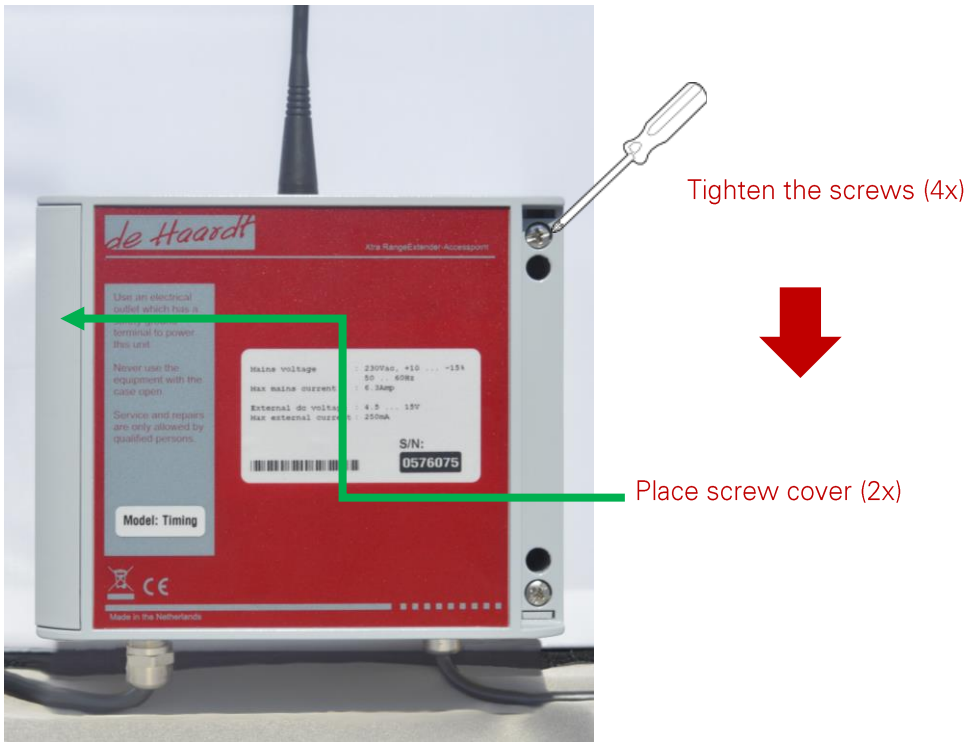


Figure 13: front view, attaching the sealing cap and the screw covers on the Xtra.Range Extender

Step 2: Placing the antenna

The goal of this step is to:

- Determine the right location; and after that
- Mounting the antenna and connecting the antenna cable

Determine the right location and position

- The antenna must be mounted straight up (Figure 14)

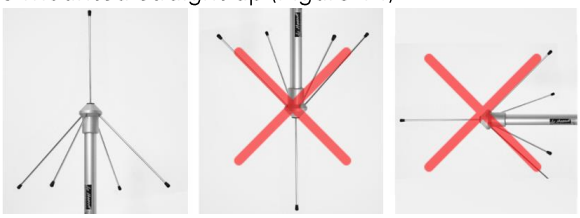


Figure 14: good/bad example: direction of the antenna

- The antenna must be mounted at a height between 2,5 m and 3,5 m.

- The surrounding must be free of metal objects. Thus, don't place the antenna against metal substructures or flat against fences (Figure 15). If the antenna is being mounted against a metal construction (for example: a substructure of a building or a metal fence), make sure that the antenna mounting bracket is electrically conductive connected to the construction (so, the antenna is earthed via the construction). The connection can be accomplished, by fastening the antenna with metal screws.

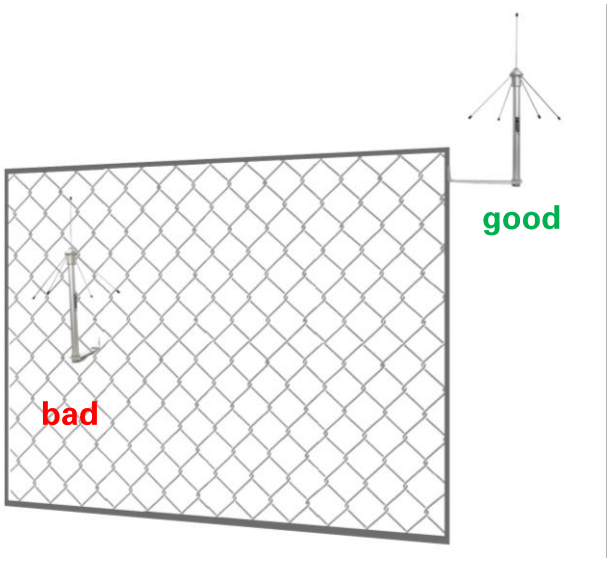


Figure 15: good/bad example: place the antenna against a fence

Place the antenna at the right position relative to the track, according to the explanation that follows now. The explanation is supported by Figure 16.

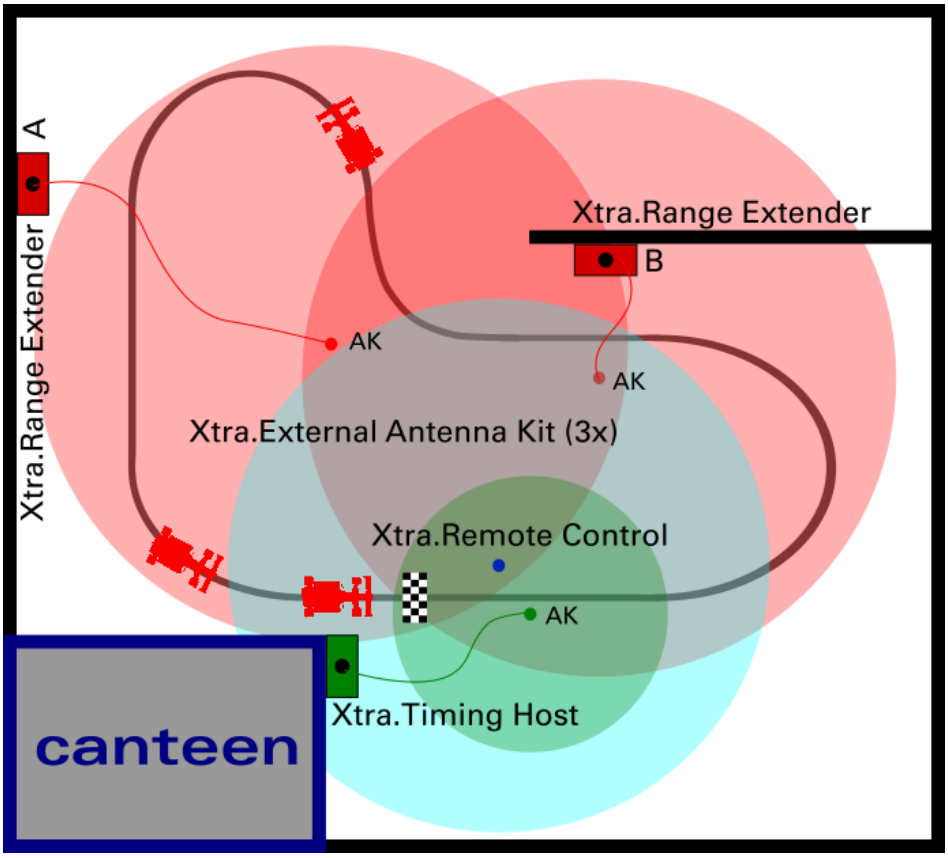


Figure 16: determine the position of the Xtra.Timing Host and the Xtra.Range Extender

The following De Haardt products are present this figure:

- An Xtra.Range Extender (designated as A, color: red)
- A second Xtra.Range Extender (designated as B, color: red)
- An Xtra.Remote Control (color: blue)
- An Xtra.Timing Beacon (is located besides the finish line)
- An Xtra.Timing Host (color: green)
- Three Xtra.Timing Sensors (are located on the karts)
- Three Xtra.Shutdown Transponders (are located on the karts)
- Three Xtra.External Antenna Kits (designated as AK)

There is also present:

- A kart track
- Three karts
- One finish line
- One canteen (blue/gray) and the walls that are surrounding the hall (black).

In Figure 16, the following rules for positioning are being applied:

- The sum of the individual coverage of the two Xtra.Range Extenders covers the entire track.
- Both of the Xtra.Range Extenders can 'see' each other. That means, that one Xtra.Range Extender is located within the coverage of the other Xtra.Range Extender.
- One or both Xtra.Range Extenders can 'see' the Xtra.Remote Control, if the Xtra.Remote Control is in the vicinity of the track.
- The Xtra.Timing Host is placed nearby the finish, in the driving direction of the karts.
- The minimal distance between the Xtra.Range Extender and the Xtra.Timing Host is 10 m.
- The line of sight between the antenna and the kart track is kept free. Place definitely no metal objects like fences within the line of sight. Try to avoid the placement of non-metal objects like wooden buildings.

Now, the rules are explained in detail. The explanation is divided into two parts: part one covers the placement of the Xtra.External Antenna Kit for use with the Xtra.Timing Host, part two covers the placement of the Xtra. External Antenna Kit for use with the Xtra.Range Extender.

Determining the location of the Xtra.External Antenna Kit for use with the Xtra.Timing Host

The Xtra.Timing Host has the following function: receiving of lap-time messages transmitted by Xtra.Shutdown Transponders which are placed in the karts. The Xtra.Shutdown Transponder transmits a number of messages containing the lap time. Those messages are being send, when the Xtra.Timing Sensor detects an Xtra.Timing Beacon (a loop under the asphalt).
In order to assure that messages will be received, they are transmitted 5 times. The time interval between the transmitted messages depends on the Xtra.Range Extender's serial number. Because every serial number is unique, which means that every Xtra.Shutdown Transponder transmits messages with a different time interval, the chance that individual messages of different Xtra.Shutdown Transponders are disrupting each other, is minimal.
This will be illustrated based on Figure 17.
That figure shows us the following: one kart equipped with an Xtra.Shutdown Transponder and an Xtra.Timing Sensor, which drives over a finish line that is equipped with an Xtra.Timing Beacon.

The kart is shown in different places in time, which are:

- 00:45:01:00 – kart drives over the finish, Xtra.Timing Sensor detects Xtra.Timing Beacon
- 00:45:01:21 – kart transmits fist broadcast (lap time 00:45:01:00)
- 00:45:02:03 – kart transmits second broadcast (lap time 00:45:01:00)
- 00:45:02:50 – kart transmits third broadcast (lap time 00:45:01:00)
- 00:45:04:15 – kart transmits fourth broadcast (lap time 00:45:01:00)
- 00:45:05:30 – kart transmits fifth broadcast (lap time 00:45:01:00)

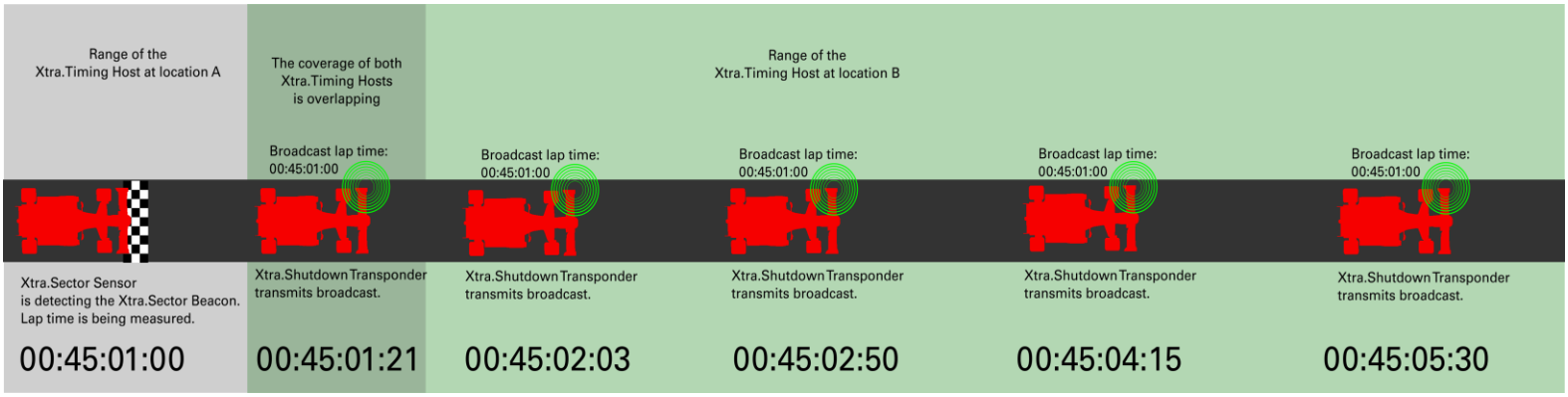


Figure 17: transmit example of the lap time to the Xtra.Timing Host

The example given in Figure 17 consists of the coverage of an Xtra.Range Extender if it is placed at location A (left-sided of the finish line) and if that one is placed at location B (right-sided of the finish line).

At this moment, it is the right time to examine the messages received by the Xtra.Range Extender if it is placed location A and if that one is placed at location B.
The Xtra.Timing Host at location A receives: broadcast#1
The Xtra.Timing Host at location B receives: broadcast#1 up to and including broadcast#5.
If broadcast#1 gets interrupted due to external factors, the Xtra.Timing Host at location A will not receive any lap time information.
Examples of interruptions due to external factors:

- Other equipment that communicates over the same channel.
- Wide-spectrum RF energy which is produces by spark plugs, fluorescent tube starters, sparking switches.
- In some random circumstances, due to two Xtra.Shutdown Transponders which are transmitting their timing message at the same time.

In this example, the Xtra.Timing Host at location B receives broadcast#2 up to and including broadcast#5 uninterrupted. Thus, the lap time information will arrive 4 times at the Xtra.Timing Host, location B. For that reason, the Xtra.Timing Host is located near the finish line, towards the kart's direction of travel.
The installation instructions are as follows.
Place the Xtra.External Antenna Kit:

- 7 till 10 m away from the Xtra.Timing Beacon
- As near as possible to the track, but at least within 5 m
- At a height of approximately 3 m
- With regards to all instructions relating to the placement of the Xtra.External Antenna Kit discussed before.
- Hold at least 10 m distance between the Xtra.Timing Host's antenna and the antenna of the Xtra.Range Extender.

The above is graphical explained in Figure 18.

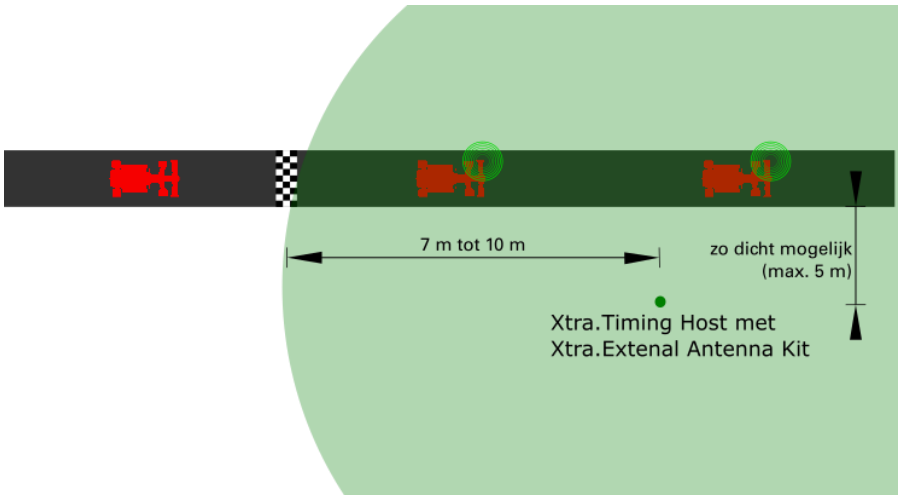


Figure 18: placement of the Xtra.Timing Host relative to the Xtra.Timing Beacon (marked as finish)

These installation instructions should only be noticed as a guideline. The range of the Xtra.Timing Host and the Xtra.Range Extender will, in practice, be influenced by many factors.
For example: influence by the building (a building which consists of metal substructures with sheet metal has much more RF reflection and damping compared to a building constructed with stone walls), influence by the interference of high voltage power lines or other radio equipment which operates at or near the same channel). Test the intended location first, before the Xtra.External Antenna Kit is being mounted.

Determining the location of the Xtra.External Antenna Kit for use with the Xtra.Range Extender

The Xtra.Range Extender works as a repeater. Every message that is received by the Xtra.Range Extender, is being retransmitted once.
The Xtra.Range Extender increases the range of other De Haardt products. For example: The Xtra.Range Extender can increase the range of the Xtra.Remote Control (see Figure 16 again).
The Xtra.External Antenna Kit can increase the range (the receiver sensitivity and the transmission range) of the Xtra.Range Extender. Thus, the Xtra.External Antenna Kit can solve problems with insufficient range of the Xtra.Range Extender. The now following explanation is supported by Figure 19.

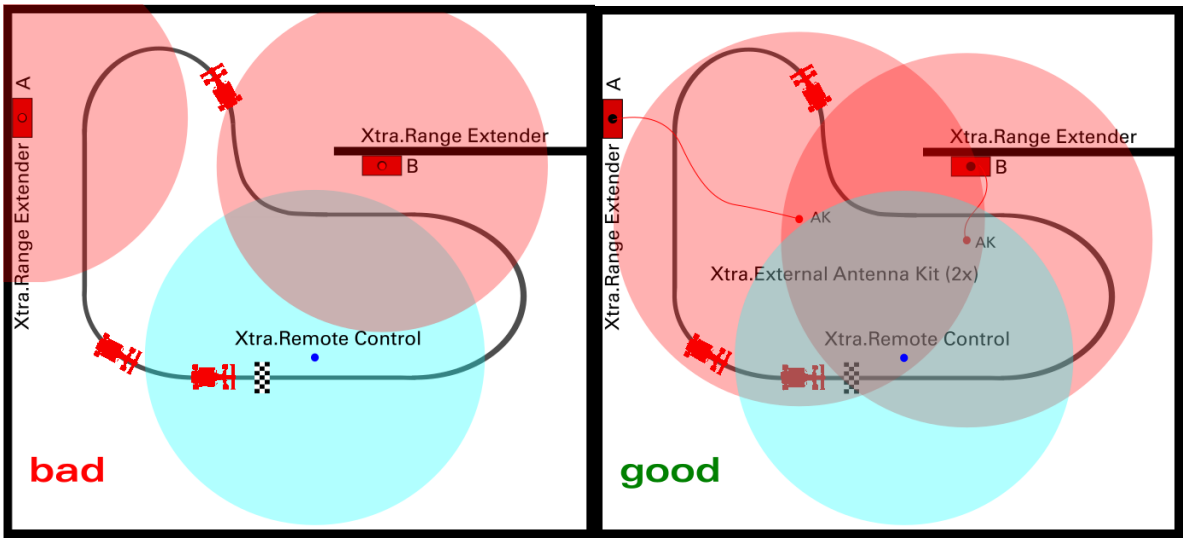


Figure 19: good/bad example: placing the Xtra.Range Extenders

In the bad example, the Xtra.Range Extenders are secured against the walls of the building. Because of that:

- The location of the Xtra.Range Extender relative to the track is not optimal.
- The Xtra.Range Extenders have a limited range.

In the good example, the Xtra.Range Extenders have an improved range due to the placement of Xtra.External Antenna Kits. The range is improved, because:

- The antennas hang freely, at sufficient height.
- The location of the antennas relative to the track is determined strategically, allowing:
    - The Xtra.Range Extenders to see each other, while the overlap is as minimal as possible. Thus, the Xtra.Range Extender at location A is just within the range of the other Xtra.Range Extender at location B.
    - That both Xtra.Range Extenders are covering the entire track.
    - The Xtra.(mini) Remote Control to communicate with the Xtra.Range Extender, on every place in the vicinity of the track. This allows commands, send by the Xtra.(mini) Remote Control, to be resend by the Xtra.Range Extender as long as the Xtra.(mini) Remote Control stays close to the track.

The Xtra.External Antenna Kit allows one to increase the coverage of one or more Xtra.Range Extenders, so they can: 1) see each other and 2) together cover the entire track. To obtain the example explained in

Figure 19 in practice, the range from and to the individual De Haardt products must be specified in numbers.

Distance between Xtra.Range Extender -> Xtra.Range Extender = 150 m max., 75 m min.
Distance between Xtra.Range Extender -> Xtra.Shutdown Transponder-> = 150 m
Distance between Xtra.Remote Control -> Xtra.Range Extender = 100 m
Distance between Xtra.Remote Control -> Xtra.Shutdown Transponder = 100 m
Distance between Xtra.Mini Remote Control-> Xtra.Range Extender = 50 m
Distance between Xtra.Mini Remote Control-> Xtra.Shutdown Transponder = 50 m

Mounting and connecting the antenna

If a suitable location is found, the antenna can be placed.

1. Mount the antenna-rod onto the antenna-mounting-bracket.

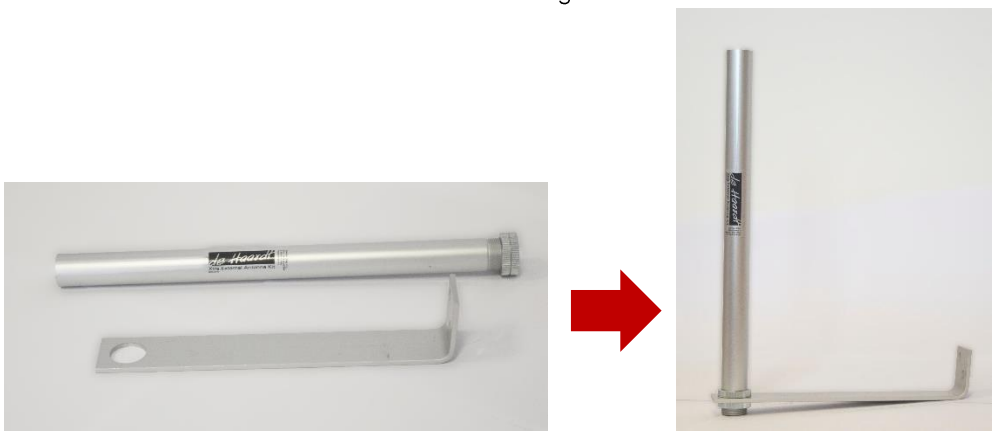


Figure 20: mounting the antenna rod onto the antenna mounting-bracket.

2. Tighten the antenna-radials (4x) onto the antenna-stilus. Use the supplied Allen key.

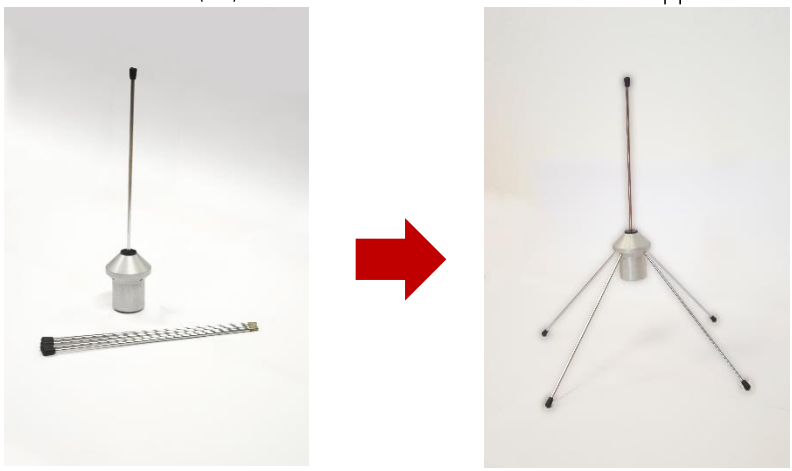


Figure 21: mounting the antenna radials onto the antenna mounting bracket

3. Lay out the antenna-cable to the location where the antenna will be placed.

4. Fasten the other F-connector in the same way as steps 7 through 12 from the previous chapter.

5. Feed the cable through the rod.

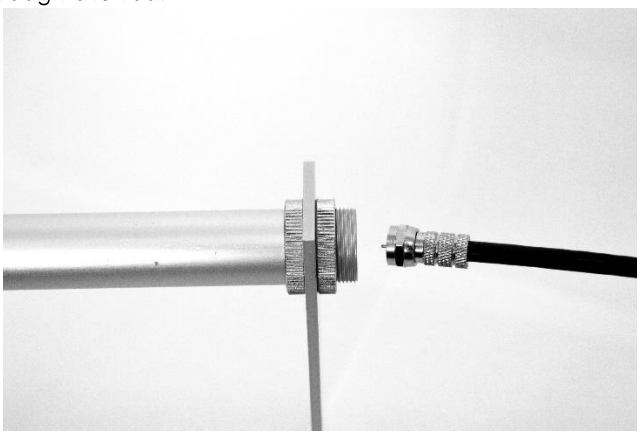


Figure 22: cable is fed through the rod

6. Connect the F connector to the antenna-stilus

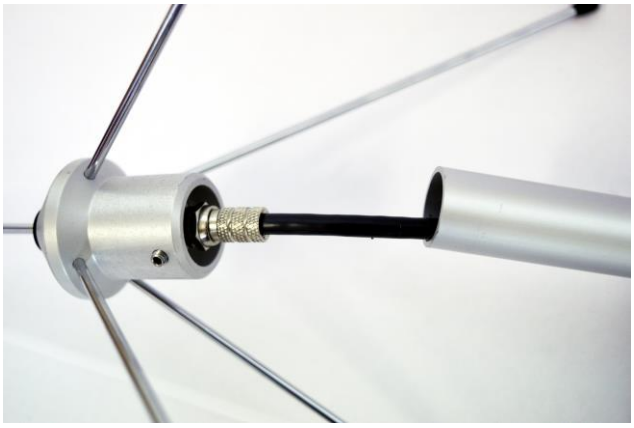


Figure 23: antenna stilus connected

7. Fasten the antenna-stilus to the rod and tighten the Allen screw with the supplied Allen key.

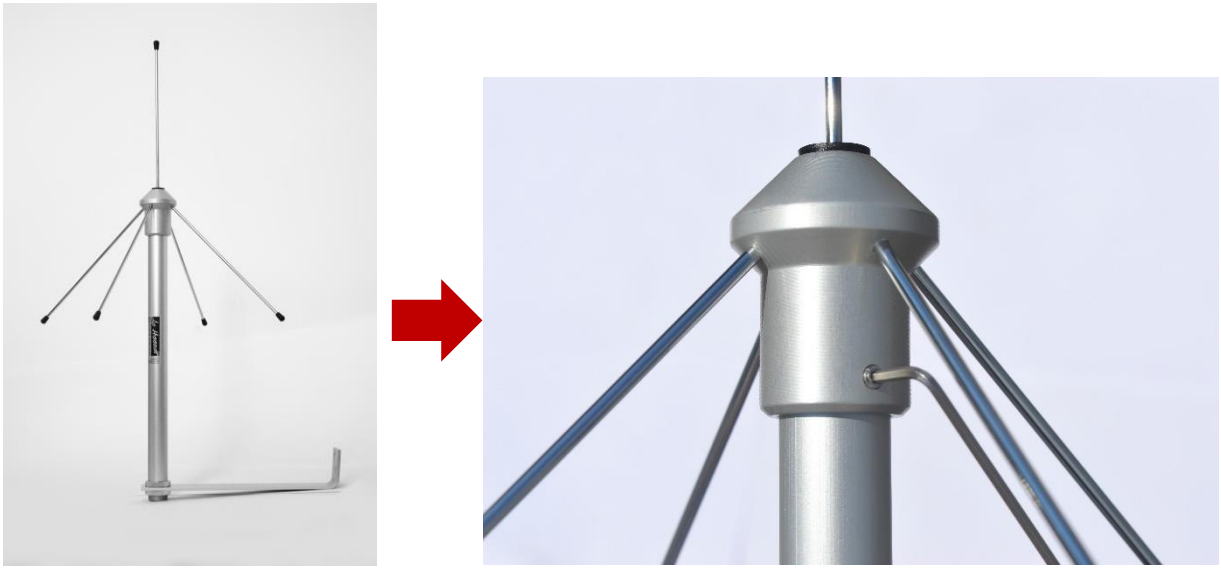


Figure 24: mounting the antenna radials onto the antenna rod

8. Secure the antenna mounting bracket to the wall.

Step 3: Testing the setup

At this point:

- The Xtra.Range Extender is modified (step 1).
- The right location is chosen and pre-tested (step 2).
- And the Xtra.External Antenna Kit is situated at the right place (step 2).

Now, the complete modified setup can be tested. This chapter describes the test procedure, that's being supported by Figure 25.

The test can be done at best with two persons:

- Person A is making laps continuously
- Person B operates the Xtra.(mini) Remote Control.

An optimal radio coverage is present if the kart at every side can 'see' the Xtra.Range Extender or the Xtra.(mini) Remote Control (the last mentioned fact counts only if the Xtra.(mini) Remote Control is used on a fixed location).

Person A is making laps, while person B operates the Xtra.(mini) Remote Control at every location where the remote could be used. Thus, also at places where one normally does not come, but where one, for example during calamities, could be.

- Person B switches within one lap, driven by person A, between speed 1, speed 2, speed 3 and speed 4 sequentially. Verify if every transmitted command is being executed by the kart.
- Also, person B verifies that the kart's voltage and RPM (measured by the Xtra.Shutdown Transponder on the kart) is received properly by the Xtra.Remote Control. By doing that, one can assure that data transmitted by the Xtra.Shutdown Transponder is received correctly by the Xtra.Range Extender and/or the Xtra.Remote Control. This test can only be executed with an Xtra.Remote Control (not the Xtra.Mini Remote Control).

These are the steps to perform above mentioned tasks with the Xtra.Remote Control (mk2).
At first, power on the Xtra.Remote Control:

- ➢ Press the on/off button.

Make sure that one Xtra.Shutdown Transponder is powered up. More than one Xtra.Shutdown Transponder powered up can perturb the readout of the voltage and RPM.
To change the speed level sequentially:

- ➢ Press SPD1, SPD2, SPD3 and SPD4 sequentially.

To read the voltage and RPM value measured by the transponder:

- ➢ Enter the Configuration menu by pressing the right pointing arrow that is located at the right side of the red stop button.
- ➢ Enter the kart (transponder) menu by pressing the leftmost function button (located just under the display) whereby a figure representing a kart is displayed.
- ➢ Command the Xtra.Remote Control to search nearby Xtra.Shutdown Transponders by pressing the leftmost function button whereby a figure representing a magnifying glass is displayed.

Wait until the Xtra.Shutdown Transponder is found, then:

- ➢ Scroll down through the displayed menu by pressing the second left function button until the 'read battery voltage and RPM' menu item is selected.
- ➢ Press the second left function button (whereby the ✓ sign is displayed) to display the measured voltage and RPM.

Verify if all lap-times are being registered by the Xtra.Timing Host; one can see the measured lap times in the timing section of one's track management system.

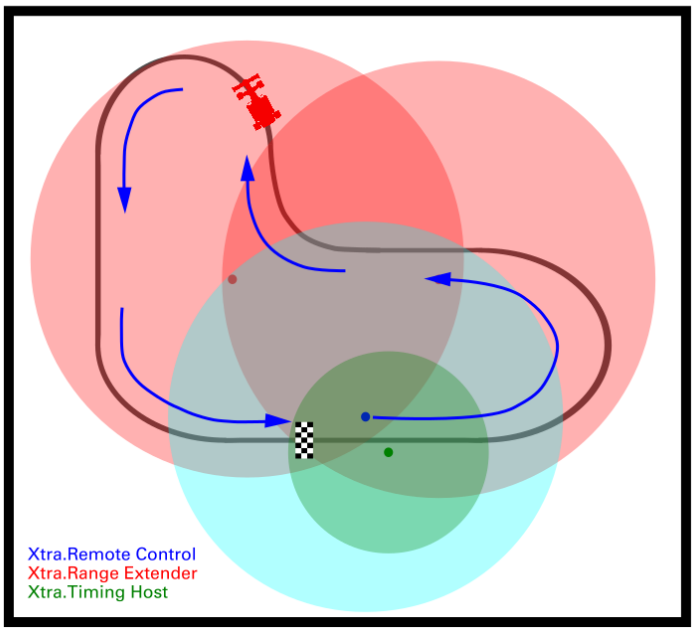


Figure 25: testing timing and safety from De Haardt

If the above steps are performed and have had a positive outcome, the setup is positively validated. Now, the modified setup shall be taken in use.