

THE RADIO GUIDELINE

**Things worth knowing about radio
technology + practical tips**



Imprint

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For whom is this radio guideline intended?	5
Where can you use radio?	6
Which radio components are available?	8
What you should know about radio!	10
How do you check the function prior to the installation?	17
What should you pay attention to during planning?	21
When you want to use ARGUS smoke alarms	29
When you want to use ARGUS movement detectors	38
What legal requirements are fulfilled?	44
Why radio components are biologically compatible	46
Notes	48
Copy template for planning the transmission range	50

For whom is this radio guideline intended?

This radio guideline is aimed at experts in the field of electrical installation. It addresses both electrical planners and specialist dealers, as well as electricians who install Merten radio technology on site.

New areas of business are opened up by extending and retrofitting existing installations. With this guideline, our aim is to provide you with a tool that will help you make optimum use of the advantages of radio technology in sales and planning discussions.

At the same time, we want to support you in installing the radio components so that every-thing runs smoothly - from the planning stage to installation and right through to commissioning, so that we both have satisfied customers.

Where can you use radio?

The radio medium is always suitable for use in electrical installations when it is not possible to create a wire-bound connection or when such a connection is only possible with a high level of complexity.

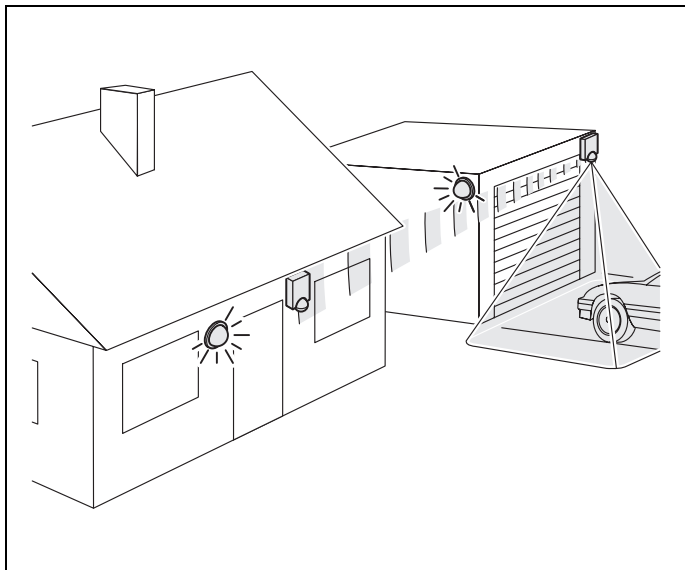


Fig. 1: Radio components in use

The movement detector at the garage entrance also switches on the light at the front

door without it being necessary to lay a connecting cable.

Light and shutter switches can be installed where the customer wishes – on glass surfaces, tiles or wooden panels. When extending unused attics too, it is also possible to reduce the amount of wiring required to a minimum by using radio components. The transmission ranges that can be realised are more than sufficient for normal buildings and living areas.

The retrofitting of functions, the modernisation of the building and the home or the demand for flexibility when selecting the installation location are ideal conditions for using radio systems. An already installed radio system can be adapted to changes in use and room conditions without too much effort.

Clean, fast and secure

With the Merten radio system, we provide you with a product range with which you can meet your customer's changing demands for lighting or shutter control cleanly, quickly and reliably.

All the components such as the radio buttons, adapters and sensor surfaces with radio receivers can be put into operation easily and quickly, are flexible in their application and, if you move, can also be removed easily, cleanly and quickly if you move.

What radio components are available?

At Merten, you will find radio components for many switching, dimming and shutter control applications. A distinction is made between transmitters and receivers – the radio modules of the ARGUS smoke alarms and movement detectors represent a special case, since they are both transmitters and receivers. The product range is being continually extended. The following overview therefore covers only some of the available radio components.

Transmitters

In the field of radio transmitters, single and double buttons are available, the latter also in a version that is optimally tailored to the possibilities offered by the ARGUS movement detector system.

The range is supplemented by a radio remote controller and a flush-mounted transmitter for incorporating any desired switching programs into the radio system.

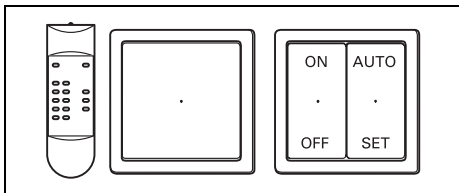


Fig. 2: Radio transmitter

Receivers

In the case of radio receivers, a distinction is made between applications for switching and dimming, shutter control applications and complete units for switching and dimming, in other words adapters as receivers. Flush-mounted receivers are also available.

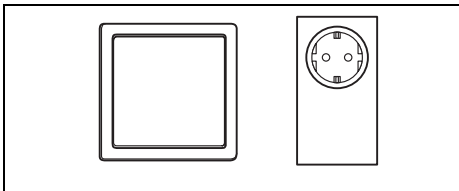


Fig. 3: Radio receiver

ARGUS

With ARGUS smoke alarms and movement detectors incorporating radio modules, the system offers components - particularly in the field of security - components that are outstanding in terms of both flexibility in selecting the installation site and functional reliability.

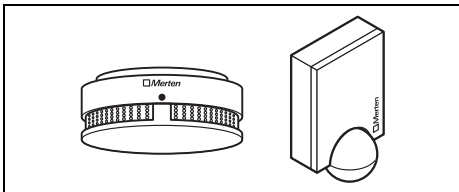


Fig. 4: ARGUS components

Various parts of the building can be monitored and jointly alarmed via radio networking of the smoke alarms - and without the need to lay any cables.

What you should know about radio

A little physics

Ideally, radio waves radiate evenly in all directions like light waves and at light speed ($c = 3 \times 10^8$ m/s) in free space, thereby forming a spherical field.

The wave length λ or the frequency f are significant for the respective technical applications.

They relate to light speed c as follows:

$$\lambda = c / f$$

In contrast to infrared waves or light waves, radio waves can penetrate ceilings, walls, furniture and other objects. However, such obstacles weaken the radio signal and reduce the range.

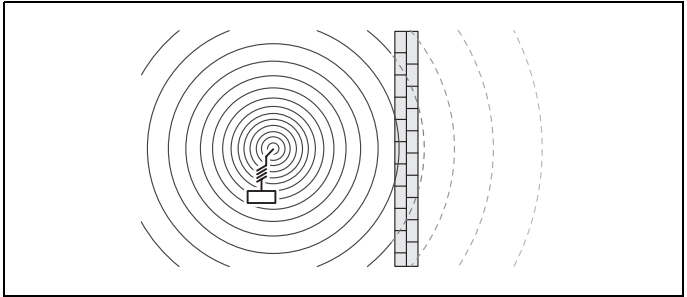


Fig. 5: The spread of radio waves

Significance for practical use

For practical use, it follows that radio components cannot be installed absolutely anywhere. It is necessary to take account of influences caused by structural features and other three-dimensional objects.

In the section **How do you check the function prior to the installation?** on page 17, we show you on the basis of an example how you can better assess the environment for installing radio components using an example.

Further information on this subject can be found in the section **What should you pay attention to in planning?** on page 21.

This knowledge will help you to achieve an installation with operational reliability and the best possible functionality.

Table, frequencies The following table indicates which radio frequencies and wave lengths are used for which type of applications.

Frequency (f)	Wave length (λ)	Designation	Application
50 Hz	6000 km	Alternating current	Power supply
0 - 10 kHz	~30 km	Low frequency	Telegraphy
16 Hz - 20 kHz	18750 - 15 km	Tone frequency	Music, voice transmissions
150 - 285 kHz	2 - 1 km	Long wave (LW)	Radio, weather service
526 - 1606 kHz	560 - 189 m	Medium wave (MW)	Radio, aeronautical radio
3.9 - 26.1 MHz	77 - 11 m	Short wave (SW)	Radio, amateur radio
2.9 - 2.2 MHz	11 m	ISM band	Radio remote controllers Power < 10 mW
40.6 - 40.7 MHz	7,4 m	ISM band	Radio remote controllers Power < 10 mW
88 - 108 MHz	3.4 - 2.8 m	Ultra-short wave (USW)	Radio, line-of-sight radio
174 - 223 MHz	1.7 - 1.3 m	Very high frequency (VHF)	Television
300 - 3000 MHz	10 - 1 dm	Decimeter wave	Television, line-of-sight
433.05 - 434.79 MHz	69.3 - 68.9 cm	ISM band	ISM radio systems, radio headsets < 10 mW

Frequency (f)	Wave length (λ)	Designation	Application
470 - 860 MHz	64 - 35 cm	Ultra-high frequency (UHF)	Television
868 MHz	34.6 cm	ISM band	ISM radio systems, limited transmission time
935 - 960 MHz	32.1 - 31.3 cm	D1 / D2 network	Mobile phone
1.805 - 1.880 GHz	16.6 - 16 cm	E network	Mobile phone
1.9 GHz	15.8 cm	DECT	Cordless phones
2.40 - 2.48 GHz	12.5 - 12 cm	ISM band	ISM radio systems, video transmission, wireless LAN, bluetooth
3 - 30 GHz	10 - 1 cm	Centimeter waves	Satellite radio, radar
30 - 300 GHz	10 - 1 mm	Millimeter waves	Satellite radio, radar
300 - 3000 GHz	1 - 0.1 mm	Microwaves	Electrical heat
$3 \cdot 10^{14}$ - $8.3 \cdot 10^{14}$ Hz	780 - 360 nm	Visible light	Lighting

ISM band

The frequency range of 868 MHz which has been selected for Merten components is part of the ISM band (**I**ndustrial-**S**cientific-**M**edical), which is specifically reserved for industrial, scientific and medical products. The frequency ranges for various applications within this band width are precisely defined. The products that operate in these bands do not require registration by the user. In these frequency ranges, the maximum permissible transmission power is in the milliwatt range.

Interference-free thanks to short transmission times

The radio transmission time at a frequency of 868 MHz is precisely defined. The transmission reliability is achieved via the specified short transmission periods and by repetition of the transmission signals.

Consequently, there is no continuous transmission at this frequency and the aforementioned stipulated transmission times apply to new developments. As a result, there are no continuous interference signals and these signals are also not expected in the future.

The products are approved for most European countries within the framework of the CEPT treaty. For example the 868 MHz range is approved in D, NL, B, LUX, A, CH, P, E, GR and I, since these countries have already implemented the CEPT treaty in their respective national laws.

Division of the frequency band

The frequency band 868 MHz is divided up into several ranges. For example, Merten uses the range 868.7 to 869.2 MHz for the radio transmitters in smoke alarms, and the range 869.4 to 869.65 MHz for transmitting switching signals.

Frequency band:	Transmission power:	Band width:	Signal transmission duration (duty cycle):	used by
868.7 - 869.2 MHz	25 mW	25 kHz, 50 kHz	< 0.1 %	Smoke alarm
869.4 - 869.65 MHz	500 mW	25 kHz	< 10 %	Radio transmitter

Within the two ranges, the components operate with different transmission power levels and a different duty cycle.

Duty cycle

A duty cycle of 10 % means that a transmitter may transmit for six minutes in a one-hour period – a value that, thanks to their short transmission times, our radio

Transmission reliability in smoke alarms

transmitters do not reach even when continuously actuated.

One of the main requirements for Merten smoke alarms is the transmission reliability of the radio signal. The frequency band used is almost always free due to the short duty cycle of 0.1 %. The size of the transmission cell was also designed exactly so that the transmission power is fully sufficient for communication inside a house, with there being only a few consumers that could interfere with transmission.

Wide range for switching elements

With the switching elements (radio push buttons, flush-mounted transmitters), great importance was attached to the transmission range to allow perfect functioning on large sites or under difficult installation conditions. At 10%, the duty cycle in the frequency band in use is still sufficiently low to ensure that signal interference occurs very rarely. Merten radio transmitters also fall well below the maximum permitted transmission power levels.

How do you check the function prior to the installation?

Below we will use an example to show you how to optimally plan the installation of radio components.

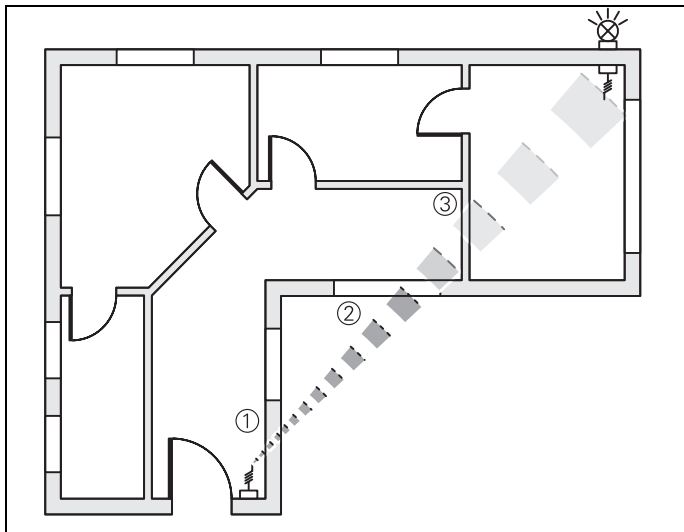


Fig. 6: Example sketch diagram

In a sketch diagram, draw the positions of the transmitters and receivers and connect these with a line.

With the aid of the table **Attenuation caused by building materials** and the **flow table** at the end of the radio guideline, you can determine the radio signal attenuation.

Flow table example

First check whether the distance between the transmitter and receiver is less than 30 m.

Then check, as shown in the table, how strong the attenuation is through walls, windows etc. You can find the attenuation values on page 50.

Obstacle	Start range	Type	Attenuation	Resulting range
①	30 m	Concrete	30 %	21 m
②	21 m	Glass	10 %	18,9 m
③	18,9 m	Plasterboard	10 %	17 m
....	17 m

If the final resulting range is greater than the measured distance between the transmitter and receiver, the components should function without any problems.

You should however, if applicable note the additional attenuation caused by:

- Furniture
- The installation of radio components in a flush-mounted socket
- Metal coatings
- Plants
- High humidity

Since it is difficult to give guideline values for these attenuations, we recommend that, despite the usefulness of the calculation using the flow table, that the components are temporarily secured before the final installation and that their function is tested.

This example could also just as easily have led to completely different results. If the window had e. g. a metal coating, there would have been very strong additional attenuation. Plants in the radio line outside the building could also have influenced the result.

You can see that your evaluation of the property is largely responsible for correct project planning and functioning of the radio system.

Our possibilities for providing you with sufficient concrete planning aids remotely are limited. However, in our joint interests we aim to have satisfied customers. This can only be carried out via a thorough analysis of the structural features, **particularly before systems are installed**. We wish to provide you with as much help and advice as we can.

To simplify planning for you, we have printed a blank flow table as a copy template on page 51. Copy this for each project and enter in it the values you have determined.

Merten test set

The Merten test set provides you with an additional aid with which you can check your calculations and at the same time determine any interference sources. The test set consists of a transmitter and a receiver and offers the possibility of directly reading off the function of a radio connection.

What should you pay attention to during planning?

The installation of Merten radio components is basically simple and can be done without any additional training. Despite this, you should follow a few instructions so that any avoidable problems do not arise later.

Here we have compiled some general information that is intended to help you to avoid possible planning and installation errors.

Radio signals are weakened by many influences on their route from the transmitter to the receiver. A prerequisite for obtaining a perfect reading is that a signal of sufficient strength arrives at the receiver to enable the receiver to evaluate it correctly.

Free field range

Only in very rare cases is it possible to make reliable forecasts about the achievable range, because the signal attenuation is influenced by too many parameters. One generally useful detail is the free field range, which can be measured outdoors without interference variables. This free field range is, of course, significantly greater than the achievable distance inside a building.

Range in buildings

In the case of Merten components, the free field range is approximately 100 m, and in the case of smoke alarms the maximum range is approximately 30 m. In a building, there are favourable and unfavourable locations for installing the individual radio components. In limited cases, the selection of the installation location is the crucial factor in ensuring that the system functions perfectly.

Distance from interference sources

Receivers of the radio system should be fitted at a minimum distance of **50 cm** from interference sources. Examples of interference sources are:

- Computers,
- Microwaves,
- Electronic transformers,
- Audio and video systems,
- Ballast units for fluorescent lamps.

The distance between transmitter antennae and other radio services such as cordless phones or audio transmission via radio (headset), should be at least **3 m**.

Also, the following radio interference sources should not be ignored:

- Interference from switching operations or electric motors,
- Radio interference from defective electrical devices,
- Interference from HF welding units,

- Heat treatment equipment in medical practices.

Effective wall thickness

If possible, the locations of transmitters and receivers should be selected so that the direct connecting line only runs across distances that are as straight as possible and not at an angle through attenuating masonry or other materials.

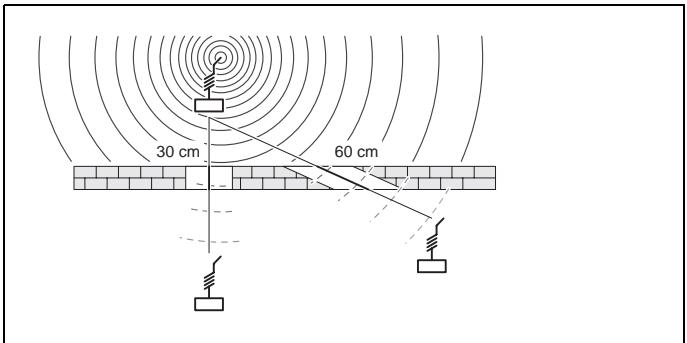


Fig. 7: Effective wall thickness

In this way, the physically unavoidable attenuation can be kept as low as possible. For example, locating a transmitter in a wall niche is particularly unfavourable.

Radio shadows

Metallic objects or furniture screen the electromagnetic waves thereby creating what are referred to as radio shadows in which no direct reception is possible.

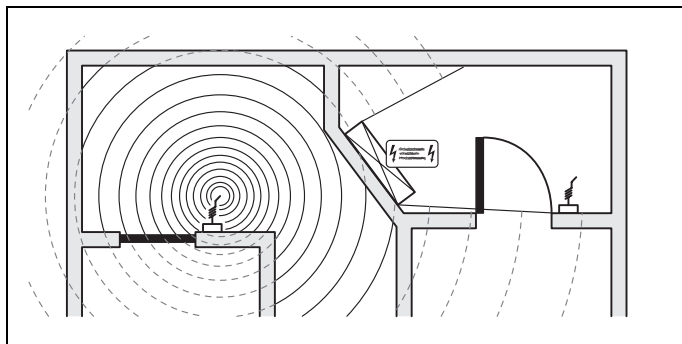


Fig. 8: Radio shadows, e.g. caused by a switch cabinet

Receivers can then no longer receive the transmitter’s signals directly. However, the radio medium also permits the reflection of waves. Reflection means that the radio waves can still reach their destination via deflection from particular objects. However, this method should be tested on a case-by-case basis to determine whether it functions properly.

Reflections are used in a targeted way in amateur radio in order to bridge great distances in the short-wave range (several thousand kilometers with a comparatively

low power). To do this, we make use of the reflecting properties of the ionosphere in this frequency range.

In the case of the Merten radio system, the reflection of the radio signals on the interfaces of different materials is used (e.g. surfaces of walls against air).

Interference effects

In buildings however, reflections can also cause interference because the reflected and the direct wave can meet on the reception antenna.

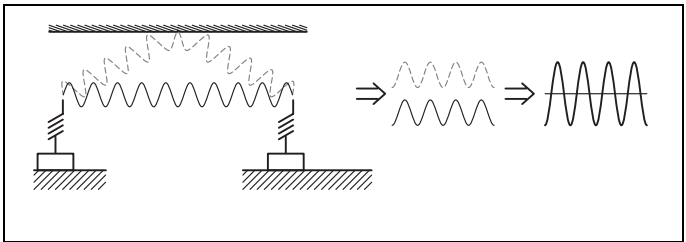


Fig. 9: Signal boosting through superimposing

Signals can become stronger or weaker due to different phase layers caused by different run times and paths of the radio waves.

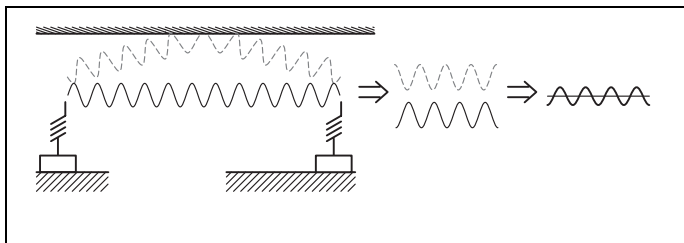


Fig. 10: Signal attenuation caused by superimposing

In such cases, changing the position of the transmitter or receiver in three-dimensional space almost always provides a remedy, even if only by a few centimetres.

Attenuation by building materials

Between the transmitter and receiver, the radio waves must penetrate various obstacles. This weakens the radio waves, a phenomenon referred to as attenuation.

The table with the most common attenuation values can be found at the back of the Radio Guideline on Page 50.

It must always be noted that moisture in the materials or in the ambient air can result in greater attenuation.

Normal window glass attenuates electromagnetic waves only slightly. However, caution is required in the case of specially coated glass, for example of the types used for thermal insulation. These additional layers are frequently extremely thin, metallised layers, which although they allow visible light through well, also greatly attenuate radio waves or reflect them completely.

When partition walls are insulated with aluminium-coated mineral wool, the metal has a shielding effect on radio waves. The same effect also occurs with materials such as wallpaper or similar things containing metal elements.

When transmitters and receivers are installed, a minimum distance of 10 cm should be maintained from metal door frames or walls.

Attenuation by furniture

Just as building materials can influence the range of radio signals, the arrangement of a home can also have an influence. Metal furniture or cabinet panels with vapourised glass also cause attenuation in exactly the same way as the TV cabinet causes it on the TV inside.

Rules

The following **basic rules** should therefore be followed as early as in the planning stage:

- Maintain a distance from interference sources.
- Pay attention to effective wall thicknesses.
- Pay attention to materials that have a shielding effect.
- Include attenuation by building materials and furniture in the planning.
- In the event of a negative calculation result, if necessary use a test set-up to check whether the radio transmission still functions thanks to reflection.

If you want to use ARGUS smoke alarms!

ARGUS smoke alarms can be connected to each other both by wire via the integrated networking terminal and by radio via the optionally retrofittable radio module.

Radio module for ARGUS smoke alarms

With the radio module for ARGUS smoke alarms, it is possible to issue different transmitter ID numbers (IDs). These are set with four dip switches on the board of the radio module. This means that there are 16 different IDs available. By issuing different IDs, you can for example ensure that your smoke alarms or other nearby smoke alarms are not triggered accidentally.

When a smoke alarm is triggered, the radio module transmits its signal. All other smoke alarms with radio modules that have the same ID and that are within the transmitter's radius receive the signal and issue the warning tone. These radio modules can no longer forward the signal because they can only be a receiver **or** a transmitter at any one time.

Network up to 40 smoke alarms

Normally, several smoke alarms are combined to form a system of smoke alarms. However, no more than 40 smoke alarms may be networked. It does not matter whether the interconnections are made by radio or by wire. If more smoke alarms are networked with each other, the time until the last alarm reacts becomes too long to guarantee a safe fire alarm.

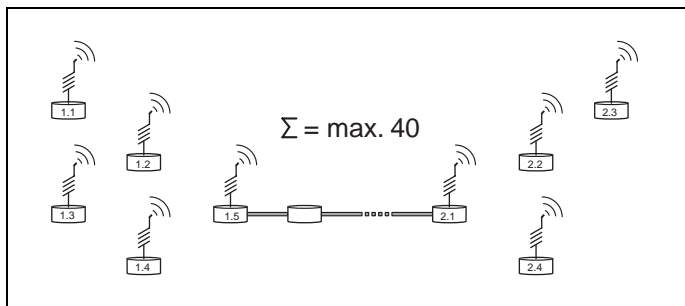


Fig. 11: Network up to 40 smoke alarms

Operate up to 10 radio smoke alarms in a radio cell

Due to the maximum range of 30 m that radio modules for smoke alarms have, the result is a radio cell around the devices with a diameter of 30 m. A maximum of 10 radio smoke alarms may be connected to each other within a radio cell of this type.

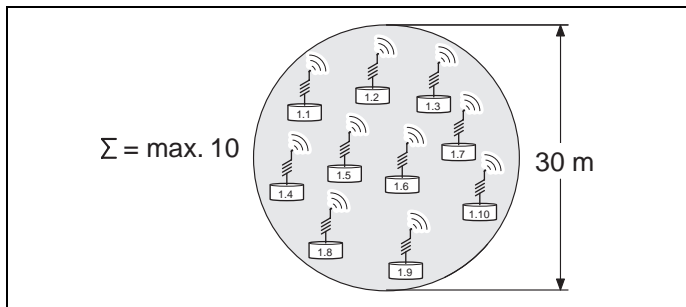


Fig. 12: Up to 10 radio smoke alarms in a radio cell

Pay attention to the reduced size of a radio cell

In practice, the size of a radio cell is reduced by many variables. Of course, structural factors have just as much an effect as on all other radio components. As described further on in this radio guideline, walls, furniture and similar things cause attenuation for which allowance must be made in the calculations. A function test before final installation is therefore compulsory!

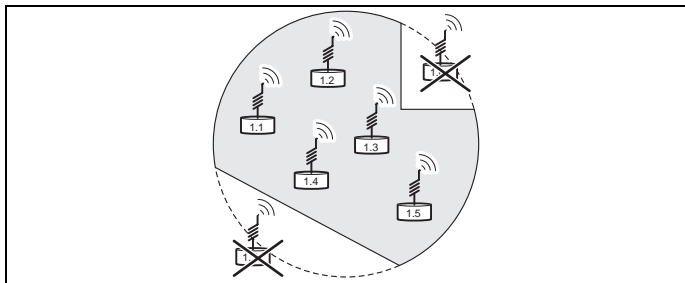


Fig. 13: Reduced size of a radio cell (radio shadow)

Operate only 2 radio modules in a wired line

If radio modules are connected to each other by wire, they form a wired line. A maximum of 2 radio modules are permitted within such a line. These two radio modules must always be assigned different IDs. Such a set-up can be envisaged in a multi-family residential building in which two stories are connected to each other.

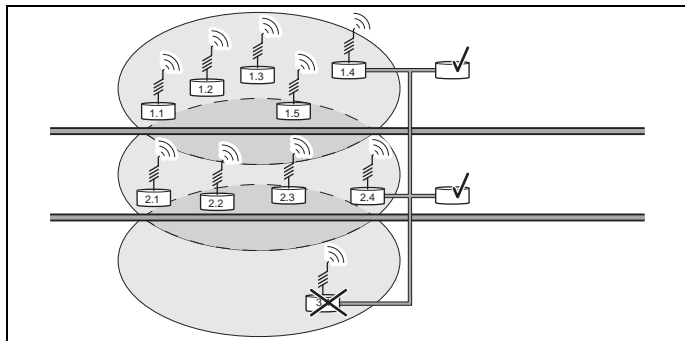


Fig. 14: Up to 2 radio modules in a wired line

**With 2 radio modules in a wired line:
Do not connect any other wired lines by radio**

If there are already 2 radio modules in the wired line, no more wired lines may be connected via radio to this system.

The reason for this is also the excessively long signalling time that would occur in a system of this type. The time between triggering of the first alarm and the reaction of the last alarm would be too long to guarantee a safe fire alarm.

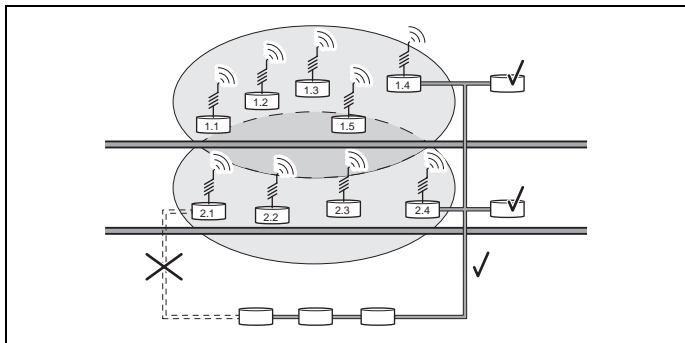


Fig. 15: Up to 2 radio cells per wired line

With 1 radio module per wired line: Connect up to 10 other wired lines via radio

If there is only one radio module in each of the wired lines, up to 10 wired lines may be networked with each other via radio. The radio modules of these wired lines must all be in a common radio cell.

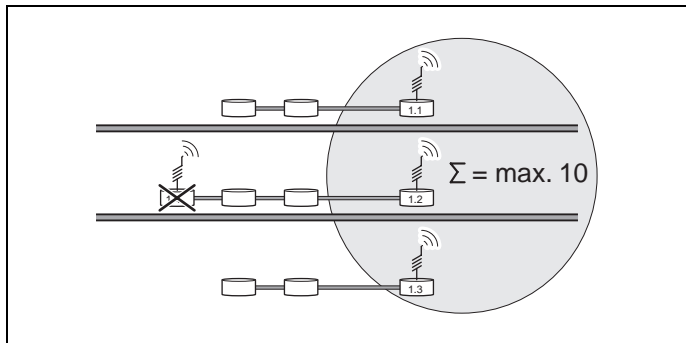


Fig. 16: Network up to 10 wired lines by radio

Avoid locations that produce lots of vapours, dust and smoke

There are some locations in a house or apartment where smoke alarms should generally not be installed. The reason for this is the visual process by which a smoke alarm detects the presence of smoke. This restriction applies to all smoke alarms that work on this method.

Heavy cooking steam in the kitchen, dust produced during sawing or sanding in a hobby cellar or damp vapours coming from the sauna door can cause unwanted triggering of a smoke alarm.

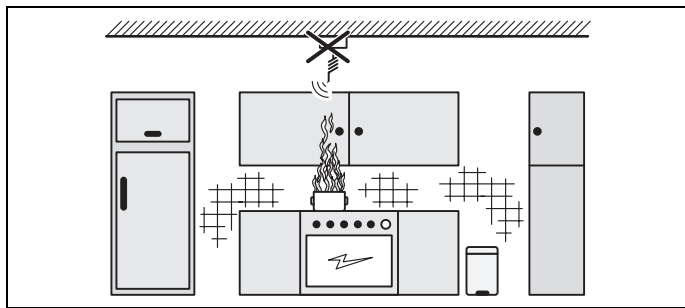


Fig. 17: Vapour, dust and smoke production

Install smoke alarms only where they will function safely and reliably. A smoke alarm fitted skilfully from an aesthetic point of view in the corner of a room or in a niche cannot respond in the right way because in the event of a fire, the corners of rooms

and niches are the last places to be filled with smoke. For example, do not install smoke alarms in the gable of a top-floor apartment. By the time a smoke alarm fitted there is triggered, it may already be too late!

Rules

The rules that you must observe in conjunction with ARGUS smoke alarms are again summarised here:

- Network no more than 40 smoke alarms with each other in a system (radio and cable).
- Operate no more than 10 smoke alarms networked via radio in a radio cell (diameter 30 m).
- Pay attention to the reduced size of a radio cell as a result of structural features.
- Operate only two radio modules within a wired line; different IDs are required.
- When there are 2 radio modules in a wired line: Do not connect any more wired lines by radio.
- When there is 1 radio module per wired line: Connect max. 10 other wired lines by radio.
- Avoid installation locations where a lot of vapour, dust or smoke is produced.

If you want to use ARGUS movement detectors!

Radio module for ARGUS movement detectors

The movement detectors ARGUS 220 Connect or Timer can be supplemented by radio modules for incorporation into the Merten radio system.

So that the movement detector switches on particular loads when it detects movements, it must be harmonized with e.g. a sensor surface. The period for which the consumer remains switched on can be adjusted. For example, if you return home during the night, not only the light by the house door is switched on but also the one in the hallway.

If several movement detectors are connected to each other without wires, the detector that has recognised a movement sends a signal to all connected detectors. Depending on its settings, each of these detectors then switches on the connected consumer and then switches it off again after a certain period.

For example, if a detector registers movement in front of the garage, it transmits a signal to all other movement detectors on the building and all lights are switched on automatically in response to the first movement. Or for example when a garden party is being held, the press of a button provides lighting.

With the pre-programmed ARGUS radio button, the functions Continuous ON, Continuous OFF, Automatic and SET can be assigned with a teaching operation (SET only in the case of ARGUS 220 Timer). This simplifies handling and makes work easier for you.

**Reduced range
due to attenuation**

The range of the radio modules is approximately 30 m in the building, and outside building it is approximately 100 m. However, bear in mind that the radio waves spread out along the shortest route to the receiver, thereby directly penetrating outside walls, inside walls and furniture. How you find out whether the resulting attenuation is still acceptable is explained in the section **How do you check the function in advance at the place of use?**, Page 17.

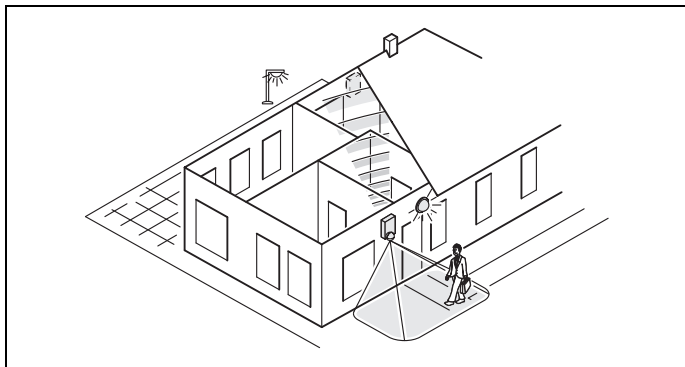


Fig. 18: *Reduced range*

Pay attention to the installation height of movement detectors

If you install movement detectors on the outside of the building, it is essential to pay attention to the installation height.

If you install movement detectors at ceiling level, the radio signal must also penetrate this ceiling at a very narrow angle. The signal may then be attenuated, see the section

Effective wall thickness, Page 23.

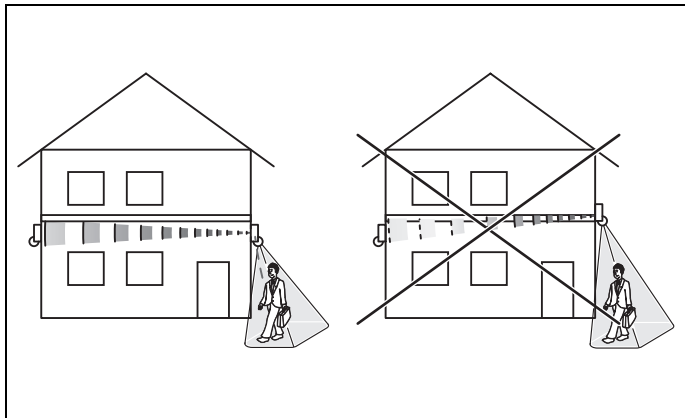


Fig. 19: Installation height

A maximum of four movement detectors per radio module

From a technical point of view, up to 16 radio transmitters can be connected to the radio module ARGUS 220. In practice however, as few as four connected movement detectors are sufficient for reliable monitoring. Additional movement detectors often result in unnecessary switching operations.

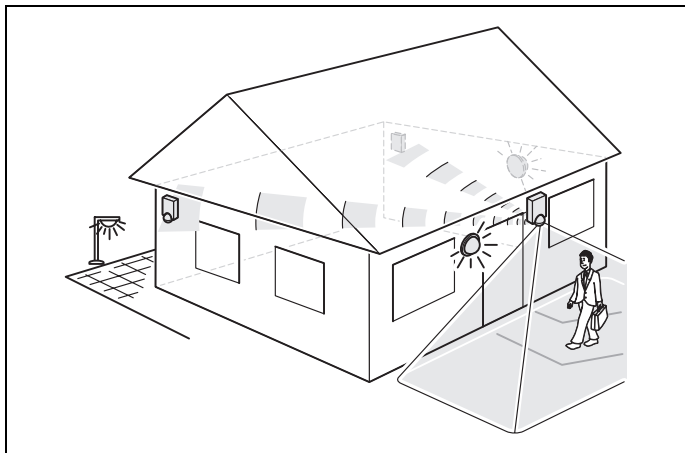


Fig. 20: A maximum of four movement detectors

How the transmitters are taught and connected is explained in detail in the instructions for the corresponding products.

Rules

The following is another summary of the rules that you must follow in conjunction with ARGUS movement detectors with radio modules:

- Make allowance for the reduced range caused by attenuation.
- Do not install the movement detectors at ceiling height.
- Network a maximum of four movement detectors with each other by radio module.

What legal requirements are fulfilled?

Like all Merten products, it goes without saying that the components of the Merten radio system also conform to German and European standards and directives that are intended to ensure consumer and environmental safety.

Tested and certified

The Low Voltage Directive (73/23/EC and 93/68/EC) and the EMC Directive (89/336/EC and 92/31/EC) as well as the associated standards of the manufacturers of electrical products are applied in particular here.

The Low Voltage Directive regulates the electrical safety of products and the EMC Directive regulates electromagnetic compatibility, in other words the emission of electromagnetic interference by the product itself, but also resistance against external interference.

Radio products that emit radio waves must also have the appropriate official approval in line with the currently valid telecommunications ordinances.

The CE symbol confirms that a product has passed the approval inspections and that it fulfils the specified statutory limit values.



Fig. 21: Inspection symbol

All products of the Merten radio system are accordingly approved for operation in D, NL, B, LUX, A, CH, P, E and I.

That's why radio components are biologically compatible!

Here, we would like to provide you with a few facts that will enable you to assess the Merten radio system in this respect and that may also be helpful to you in discussions with your customers.

The emission power of radio transmitters that act on the organism are important in this context. A comparison with the everyday object the mobile phone should therefore be made here.



Fig. 22: The effects of radiation from a mobile phone

Millions of mobile phones that, depending on the type, are permanently transmitting, operate with peak outputs of 2000 mW. Used without further protection and mostly directly against the head, it can be assumed that about 100 mW is absorbed by the head during the entire call.

In contrast, the Merten radio system operates with peak powers of max. 10 mW,

corresponding to an average radiation output of just 1 mW. Since neither a radio remote control, a radio switch nor a radio transmitter of a movement detector is normally operated directly up against the body, the signal attenuation that is already produced by a distance from the body of just 1 m further reduces the radiation power by a factor of 40.

This means that a radiation power of only 0.025 mW reaches the head. It is **less by a factor of 4000** than is the case with a mobile phone and acts mainly only while the transmitter is actuated, in other words for a **very short time**.

This means that the Merten radio system contributes hardly anything to electromagnetic fields that act on the human organism.

Notes

Copy template for your range planning

Use these tables to check your planning as described on Page 17. If you copy this double page, you will have the most important figures to hand and can enter your values in the flow table.

Attenuation by building materials

The table shown here contains **guideline values** for determining the attenuation by the building materials penetrated by the radio waves.

No.	Material	Material thickness	Attenuation
1	Wood	< 30 cm	10 %
2	Plaster, plasterboard panels	< 10 cm	10 %
3	Glass (without metal coatings or wire inlays)	< 5 cm	10 %
4	Stone, pressboard panels	< 30 cm	30 %
4.1	Pumice stone	< 30 cm	10 %
4.2	Gas concrete block	< 30 cm	20 %
4.3	Brick	< 30 cm	35 %
5	Iron-reinforced concrete	< 30 cm	30 - 90 %
5.1	Ceiling	< 30 cm	70 %
5.2	Outside wall	< 30 cm	60 %
5.3	Inside wall	< 30 cm	40 %
6	Metal grille (e.g. wire netting for plaster)	< 1 mm	90 %
7	Metals, Aluminium lamination	< 1 mm	100 %

Flow table

Obstacle	Start range	Type	Attenuation	Resulting range
①	30 m			
②				
③				
④				
⑤				
⑥				

If the resulting range is greater than the measured distance between the transmitter and receiver, the transmission should function. If applicable, also take into account additional attenuation caused by furniture etc. (see Page 19).

 **Merten**
Schalten Sie auf Zukunft



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