

APPLICATION NOTE AN-001_EN

The Installation of autonomous Radon instrumentation sites

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This paper demonstrates the installation of autonomous Radon instrumentation sites linked to a control centre by remote control. Based on the usage of commercial available modems, complex sampling networks can be established. The several offered transmission standards allowing a perfect adoption to the various local infrastructures.

The installation steps are quite simple, even a non skilled person can do it. Only a low number of additional components is required

All solutions shown within this paper are available on the market or can be purchased directly from SARAD

During the planning period of an instrumentation site, two important aspects have to be considered beside the selection of the Radon monitor:

1. Which communication channels are available on site?
2. How can the system supplied with electricity?

The system concepts described in the following text offering a suitable solution for the most applications and local conditions.

Furthermore, an efficient shielding with respect to the climatic situation as well as protection against unauthorised access and vandalism have to be established. Those items depending strongly on the particular conditions on site, therefore no general concept can be offered.

Which Radon monitor is the best choice?

Remote control via modem is supported by the instrument types Radon-Scout, Radon-Scout PLUS, RTM1688-2, RTM1688 „Geo Station“ and RTM2200.

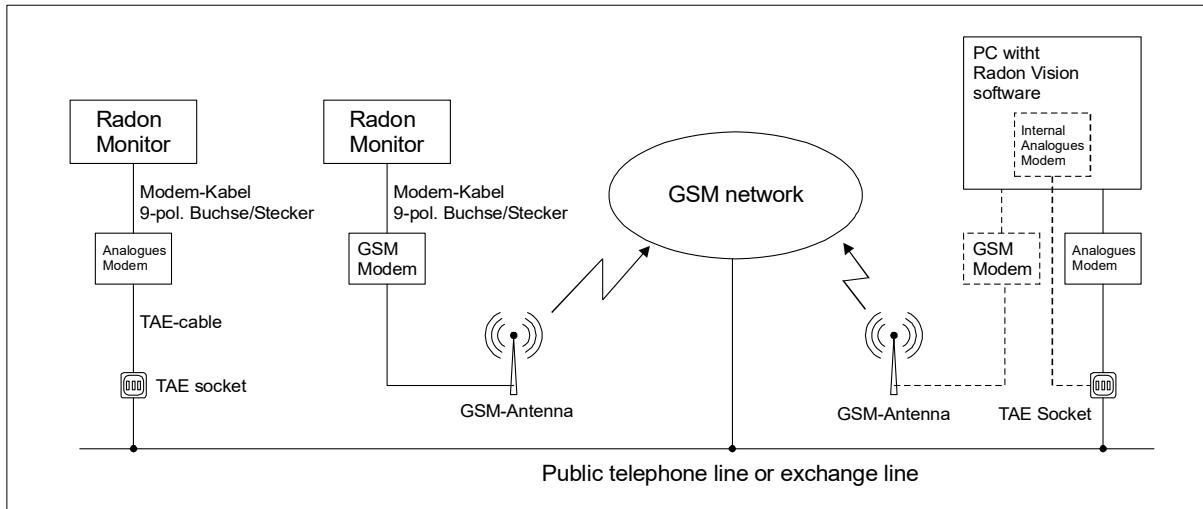
The basic model of the Radon Scout does not allow an external power connection. Therefore, the autonomous operation is limited to several weeks by the internal batteries.

A modem connection can still make sense if actual readings are always requested during the limited measurement period.

The Radon-Scout PLUS, the RTM1688-2 and the RTM2200 are the perfect choice for urban environments. The internal batteries serve as an energy buffer in case of temporary power interruptions.

The models RTM1688-2 or RTM1688 „Geo Station“ are recommended if no developed infrastructure is available at the place of installation. The internal 12V battery can be easily replaced by a commercial available solar or wind power system.

Which is the best communication concept?

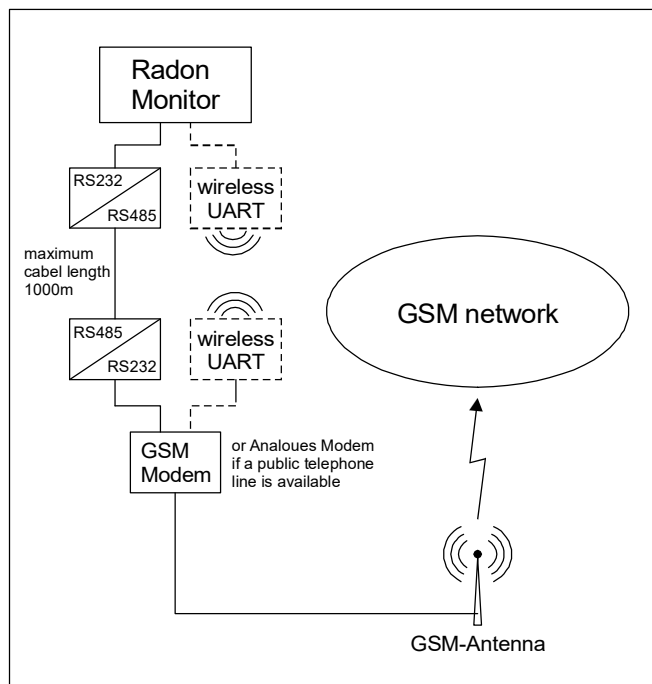


Installation on site

In the most urban regions a telephone line is available. The usage of an analogue modem is recommended in this case.

If there is no telephone line, the digital cellular phone network (GSM) has to be used. GSM modems are offered by a large number of manufacturers. Similar to a mobile phone, a SIM card is required. The so-called “data” channel has to be activated for the SIM card by the provider. This is generally possible for each card but can involve additional costs for the clearing of the service. The “data” channel includes a separate call number beside the voice dial in. It is recommended to use special “data transfer only” cards resulting in lower initial and operational costs. Telephone charges have not to be paid for the modems on the instrument site because they are always listen to a call of the control centre.

If the installation site is out of the GSM footprint (e.g. in hollows), a satellite modem is the option. Because the charges for satellite communication are very high, an additional terrestrial line (cable or wireless) between modem and Radon monitor could be installed. This solution is also preferred if the place of installation is in underground mines, caves etc. where a telephone line is not available. A big number of converters for this purpose (e.g. RS485/RS232 or wireless UART) are commercially available.



Installation of the control centre

The communication between the control centre and the single Radon monitors is realised by the Radon Vision software running on a PC. A modem has to be connected to a free COM port of the computer. If is no COM port available, an USB/Serial adapter can be used.

Also for the control centre it could be the less expensive solution to choose a GSM modem instead of an analogous one. Especially the charges for GSM to GSM connections are not as high as for line to GSM connections. Use also a "data transfer only" SIM card and choose the best offer with respect to your transfer volume. Sometimes it is better to pay per data volume, sometimes per connection time.

Keep in mind that the modem at the PC in the control centre covers all the costs for the calls to the instrumentation sites.

Radon Vision will detect a connected modem automatically. Additional Windows drivers are not required.

Selection of the Modems

Generally, each modem which can be controlled by AT commands via a serial interface is suitable. External modems for the several transmission standards (analogue, ISDN, GSM, GPRS) are offered by SARAD. Also already existing modems or internal devices (e.g. the "Agere" soft modem in notebooks) can be used.

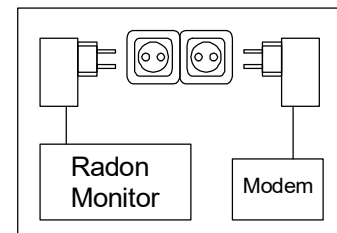
If possible, modems of the same type should be used for both, instrumentation site and control centre. This ensures a simple handling and optimised transfer rates.

If the modems has been purchased from SARAD, all necessary accessories like cables, antennas and AC/DC adapters are included in delivery. Otherwise those parts have to be ordered separately from the manufacturer or supplier of the equipment.

The only thing you have to buy from SARAD is the connection cable between the modem and the Radon monitor. This customised cable has additional solder bridges and a special connector.

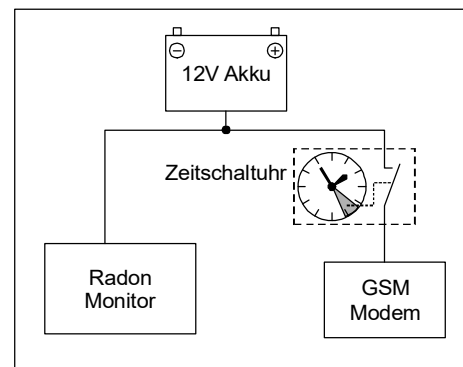
How to supply the system on site with electricity?

No problems are expected if the mains supply is available on site. Both, modem and radon monitor can be operated a infinite period using simple AC/DC wall adapters. The internal battery of the instruments ensures the continuous power supply during temporary power interruptions. If the interruption occur frequently, a buffer supply for the modem should be taken in account. If the mains power is not available, an autonomous power supply has to be designed. One can distinguish between a true autonomy and the autonomy for a given time span (limited autonomy).



Limited autonomy

The power is supplied by a battery which can not be recharged during the whole operation period. This requests an as low as possible continuous power consumption of the system. The wattage of a GSM modem is generally much higher than the one of the Radon monitor. Therefore it is a proper solution to switch on the modem periodically only for a short time. Within this time slot, the modem can be accessed by the control centre. The figure beside shows a typical configuration.



Dimensioning steps:

- Determination of the power consumption of the Radon monitor, the modem and the clock timer
- Definition of the time schedule (time and duration of desired modem access)
- Calculation of the total energy request
- Dimensioning of the battery with respect to the required period of autonomy

Example:

A RTM1688-2 set to continuous sampling mode shall be used in combination with a Falcom Tango-55 GSM modem and the clock timer model GEV 006102. The daily power up period of the modem shall be 1 hour. The autonomous operation has to be ensured for at least 3 month.

| | |
|-------------------------------|---------------------|
| power consumption RTM1688-2 | = 15 mA |
| power consumption modem | = 32 mA (logged in) |
| power consumption clock timer | = 1 mA |

Because the modem is switched on only 1 hour per day, the average current consumption is:

$$32 \text{ mA} * 1 \text{ hour} / 24 \text{ hours} = 1,33 \text{ mA}$$

The total continuous power consumption is calculated by the sum of the single currents (RTM1688-2, clock timer, modem average current):

$$\text{Total current} = 15 \text{ mA} + 1 \text{ mA} + 1,33 \text{ mA} = 17,33 \text{ mA}$$

Now it is possible to determine the required battery capacity:

$$3 \text{ (month)} * 30 \text{ (days)} * 24 \text{ hours} * 17,33 \text{ mA} = 37,43 \text{ mAh} = 37,43 \text{ Ah}$$

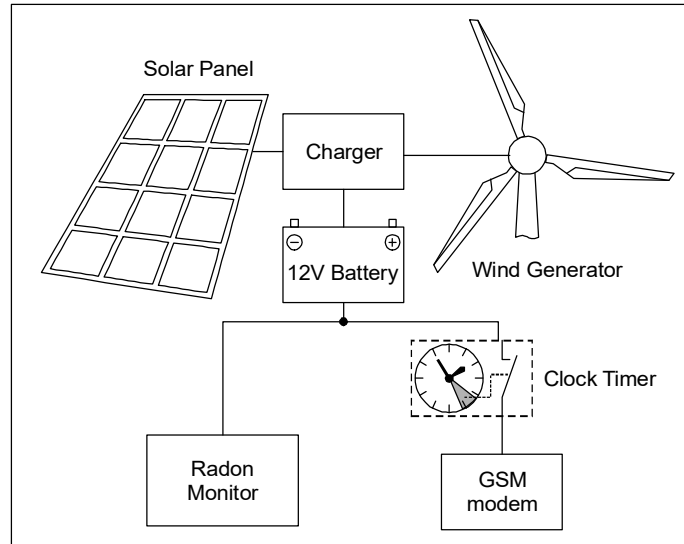
The self discharge process as well as capacity loss at low temperatures have to be taken in account for the battery selection. A safety factor of 2 is a good number. The usage of a battery with 12V/80Ah (e.g. Solar-Dryfit S12/85Ah manufactured by Sonnenschein) is recommended.

True autonomy

True autonomy is given if the used battery is recharged during system operation by renewable energy sources. The figure shows a typical system set-up. It makes also sense to insert a clock timer to reduce the required power output of the solar panel or wind generator.

The solar panel is the preferred solution because the expected problems during the operation even under extreme climatic conditions are much smaller.

Take in consideration that the average power generation of a solar panel is only in the order of 5% to 30% of the stated peak power depending on the place of installation. The battery capacity



has to be large enough to ensure the power supply over longer cloudy periods.

It is recommended to purchase a turn key system as used for yachts containing all necessary equipment. All components are well balanced and manufactured to withstand extreme environmental conditions.

The panel has to be installed at a place where it is exposed to the sun as long as possible over the daytime. The panel orientation shall be exactly southwards/northwards (in northern/southern hemisphere). The mounting angle has to be adjusted that the wave angle is 90° in case of the lowest altitude of the sun (winter time). This smoothes the seasonal variations of the radiation availability and avoids snow deposits on the surface of the panel.

Example:

A RTM1688 „Geo Station“ together with the GSM modem model Falcom Tango-55 are used. The modem shall be logged in permanently. To ensure a stable power supply, a solar power system is used. The average efficiency of the solar panel at the installation site is only 5% during the winter time. The 12V battery has to ensure the power supply for at least four weeks.

| | |
|---|---------------------|
| power consumption RTM1688 „Geo Station“ | = 5 mA |
| power consumption Modem | = 32 mA (logged in) |
| resulting total power consumption | = 37 mA |

Using a nominal battery voltage of 12V, an average wattage of approximately 450 mW (12 V * 37 mA) is necessary. The assumed panel efficiency of 5% leads to the required peak power of the solar panel:

$$450 \text{ mW} * 100\% / 5\% = 9000 \text{ mW} = 9 \text{ W}$$

To compensate the energy lost of the charge regulator etc. a safety factor of 2 should be applied additionally. A solar panel with 20 W peak power is a good selection.

Finally, the battery capacity has to be calculated by the current consumption and the period with no recharge:

$$4 \text{ (weeks)} * 7 \text{ (days)} * 24 \text{ hours} * 37 \text{ mA} = 24864 \text{ mAh} = \text{ca. } 25 \text{ Ah}$$

Because the battery is permanently recharged, the self discharging process is negligible. This results in a smaller safety factor. A solar battery 12V/35Ah (e.g. Solar-Dryfit S12/35Ah manufactured by Sonnenschein) is suggested.