Radio Society of Great Britain
Advancing amateur radio since 1913

EMF-2: RSGB Guidance on EMF Compliance Checking

In May 2021, Ofcom issued new Amateur Radio Licence conditions which now require an assessment of **EMF compliance** for each individual station **equipment configuration** that you are currently using. All bands down to 1.8MHz can now be checked using the RSGB EMF calculator app.

EMF assessments introduce many new concepts that can only be briefly outlined here. For further information, downloadable apps, calculators and practical advice, follow the RSGB EMF web pages at www.rsgb.org/emf

1. What is EMF compliance?

Our radio transmitting stations communicate by generating electromagnetic fields (**EMF**s for short) that propagate to other stations, often over considerable distances. This 'far field' becomes weaker with increasing distance, but very close to the antenna there are potential hazards due to interactions of strong EM fields with the human body.

Ofcom now requires us to comply with the recommendations of **ICNIRP**, the International Commission on Non-Ionizing Radiation Protection, and requires us to demonstrate compliance by making an EMF assessment for each **equipment configuration** that we currently use. You need to have these results available in case of any inspection.

2. What is an "equipment configuration"?

An **equipment configuration** is a list of the main parameters that affect the EMFs around your station. These include:

- **Frequency** (typically, the middle of the amateur band in use)
- **RF power** delivered to the antenna (PEP output of transmitter, minus losses in feedlines, ATU etc)
- **Mode of transmission and transmit/receive times** (to calculate the RF power averaged over any rolling 6-minute period)
- **Type of antenna** that is radiating the EM field, and properties (gain, directivity etc)
- **Where the antenna is installed**, relative to nearby dwellings and other places where the general public may have access.

Most amateur radio stations cover several bands and modes, and will therefore require several different assessments. A change in any of the above will create a new equipment configuration, which may then require a new assessment. Each assessment will then need to be recorded and archived.

The RSGB EMF calculator app is designed to make all of this as easy as possible.

Begin by making a careful list of all the assessments you will need, based on the amateur bands that you currently use. If you use more than one transmitting antenna, mode, etc on a given band, Ofcom will require a separate EMF assessment for each combination.

The rest of this document will help guide you through the assessment of a single equipment configuration. You can then repeat the process for each of your other equipment configurations, making appropriate variations where necessary.

If you can, make each EMF assessment at the highest power level that your transmitter can produce. No update will then be needed if you decrease the transmitter power below that (unless you change something else at the same time). Also, no update will be needed if you merely replace your current transmitter with another one of the same power.

3. What is an EMF assessment?

The core part of an EMF assessment consists of two steps – and you always need to do both.

Step 1: Calculate or measure the EM field strengths to determine the EMF **Exclusion Zone** where no member of the general public should remain while you are transmitting.

Step 2: Manage the Exclusion Zone. Following the licence regulations and guidance from Ofcom, find a practical way to ensure that no member of the general public can enter the Exclusion Zone while you are transmitting.

Be realistic in Step 2

Most real-life situations prove to be very straightforward. For example, simple solutions may include:

- "My antenna is on the chimney, inaccessible without a ladder."
- "Height of mast or tower makes the Exclusion Zone completely inaccessible."
- "My vertical antenna is ground-mounted, but I can easily verify that no-one is present in the Exclusion Zone while I am transmitting."
- "I have determined the size of the Exclusion Zone around my vehicle [Step 1 above]. I can then make informed decisions on whether or not to transmit."

RSGB's minimum separation guideline is 2.4m

Good practice in radio communication goes hand-in-hand with good practice for EMF compliance, and also with good practice in avoiding local interference. For all of these reasons, RSGB routinely recommends that antennas are installed as clear of obstructions as possible.

Good engineering practice for EMF compliance begins with avoiding anyone directly touching the antenna while you are transmitting. RSGB recommends that you **aim for a minimum separation of 2.4m (8 feet) between any person and any radiating part of the antenna**.

For example, if all radiating parts are more than 2.4m above ground, there is very little risk of anyone accidentally touching the antenna overhead. This will then be a good start in ensuring compliance with the radiated EM fields. Obviously this simple rule cannot guarantee compliance in every case, but a wide range of assessments and measurements have shown 2.4m to be a useful guideline for time-averaged transmitter powers up to 100W.

Low-power compliance

The 2.4m separation guideline obviously cannot apply to hand-held or body-worn radios. For these and many other low power situations, Ofcom allows compliance to be demonstrated a different way, by showing that the time-averaged EIRP is less than 10W (and also that the peak EIRP is less than 100W). If you can show that, then no further assessment is required – but you still have to calculate the EIRP and record that fact.

This low power compliance route applies to almost all VHF/UHF "5 watt" handheld radios. When operating, you should still try to keep the antenna away from your head or body.

The same low power compliance route can often be used for other kinds of low power operation, on any band, using simple low-gain antennas. But even at low power, operation with a beam antenna will very often exceed the 10W EIRP level, so more detailed assessment will be needed. This is where EMF calculators come in.

4. EMF calculators

Ofcom and RSGB have both produced online EMF calculators to help you complete your assessments – but the RSGB EMF calculator app offers more help in several important areas:

- Guidance with entering the basic data about your equipment configuration
- A quick route to claim the low power exemption for typical VHF/UHF hand-held radios and some other kinds of low power operation (the RSGB calculator opens with typical values already entered for this situation – see the screenshot on page 5)
- Help with navigating the ICNIRP guidelines, which vary considerably across the amateur bands from 1.8MHz to the high microwaves
- Formatted, downloadable copies of the completed calculations.

If the low power exemption does not apply, the RSGB app continues the calculation, and will then help you to choose the most appropriate method to check compliance:

- The RSGB app implements two simple calculators for 'first look' assessments. One of these replicates the Ofcom calculator. The other uses the same methodology but applies the more recent ICNIRP 2020 guidelines.

- RSGB is developing a range of advanced assessment options that can provide more realistic results in cases where the simpler calculators may be over-cautious (see below). The EMF calculator app will offer these further options as they become available.

Remember that Ofcom allows you to use whichever assessment method meets your needs; see below.

Why do there have to be options?

Short answer: "because simplified calculators don't work for all situations."

The RSGB and Ofcom calculators both use a simplified, standardised method from the International Telecommunications Union publication ITU-T K.52. For many cases, that simplified 'first look' calculation will be all you need to demonstrate compliance.

But in other cases – notably on the lower HF bands, or involving the use of beam antennas on any band – the ITU-T K.52 methodology can over-estimate the size of the Exclusion Zone. Many UK amateurs operate in heavily built-up areas where an overestimate of even a few metres could cause practical difficulties – which is why RSGB volunteers are developing advanced methods that take more account of the actual antenna and installation details, if needed.

You are free to use any valid assessment method that demonstrates compliance – so by all means use a simplified method if you can. Ofcom will accept either the ITU-T K.52 method, or a range of more advanced methods developed by RSGB or other recognised organisations.

The RSGB EMF calculator app always uses the ITU-T K.52 method first[1]. If the calculated size of the Exclusion Zone is workable for you, then that's fine – save the results and you're done.

Advanced calculation methods (Pre-Assessed Equipment Configurations)

The advanced methods being developed by RSGB are based on **Pre-Assessed Equipment Configurations (PAECs)** which are one of the alternative assessment methods acceptable to Ofcom. Unlike the simple K.52 calculators discussed above, the PAEC methodology builds up a database of EMF assessments from detailed computer modelling of literally thousands of different equipment configurations, or from detailed measurements. Combining this with your own site-specific data, you can then make a much more realistic description of your own site-specific Exclusion Zone.

Several different PAEC calculators are needed to cover the different kinds of antennas used on amateur bands from HF through to microwaves. (For example, PAEC-2 covers Yagi antennas from 50MHz to 2.4GHz.) PAEC calculators and guidance are continually under development, and the RSGB app will direct you to the relevant options that are currently available. Open the app from the RSGB EMF web pages at http://www.rsgb.org/emfcalculator and then follow the instructions.

5. Practical EMF Measurements

Sad to say, **accurate and validated EMF measurements are beyond the reach of ordinary radio amateurs.** Such measurements require specialised techniques and expensive calibrated test equipment. That is why RSGB and Ofcom emphasise calculator methods as the preferred way for amateurs to demonstrate EMF compliance.

If anyone's compliance calculations ever do require formal validation, Ofcom engineers will then take measurements of actual field strengths. On behalf of radio amateurs, RSGB has purchased the same professional instruments as Ofcom, so that any measurements can be directly comparable. RSGB's test equipment will also be used to help develop future advice to amateurs.

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1. The RSGB EMF calculator actually produces **two** sets results using the ITU-T K.52 method https://www.itu.int/rec/T-REC-K.52/en. One set assesses compliance against the ICNIRP 1998 recommendations, which are still used by Ofcom for administrative reasons. The other set of results is based on the more recent ICNIRP 2020 recommendations, which Ofcom will eventually adopt. The differences are technical and mostly minor, and for the present you are free to choose either set.

For future compatibility, all of the advanced methods developed by RSGB are based on ICNIRP 2020.

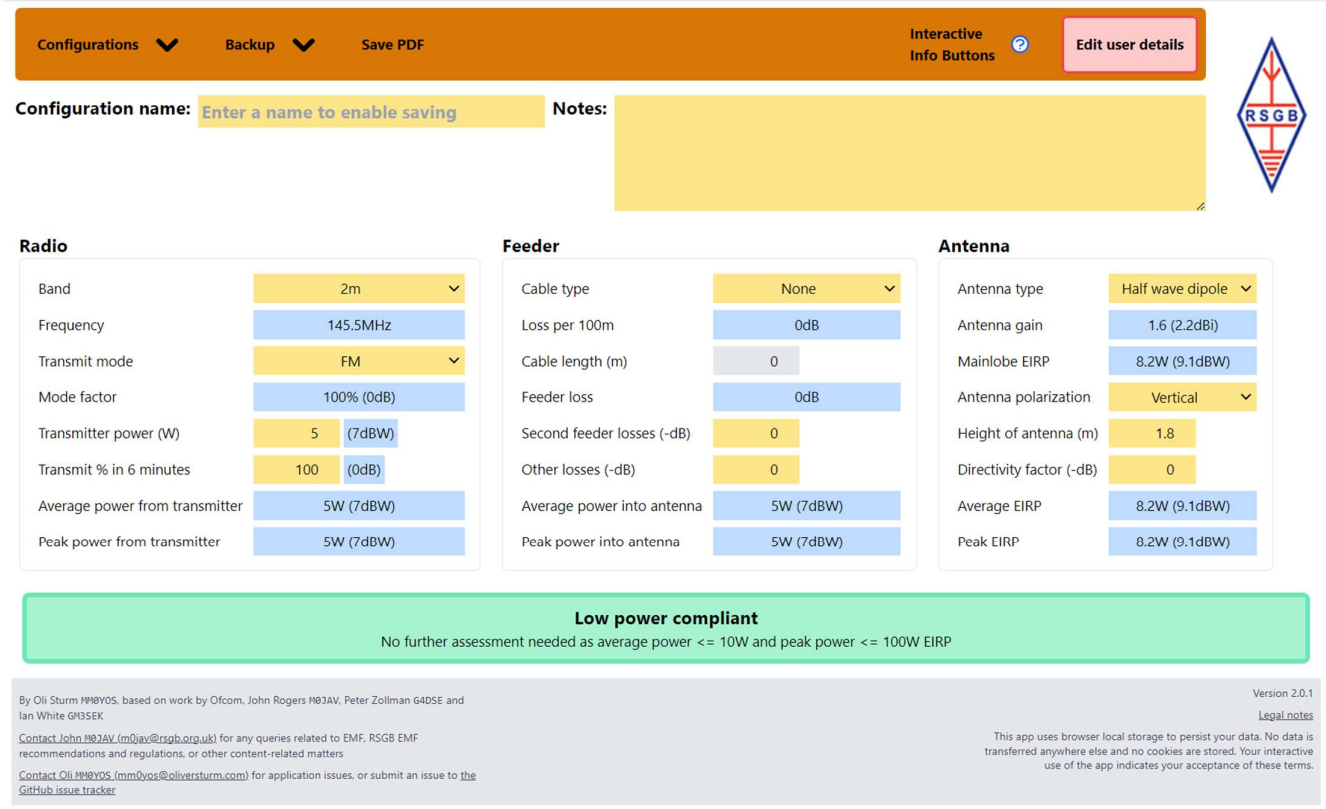
6. The RSGB EMF calculator app

The RSGB EMF calculator is now hosted as a web app at https://rsgb.org/emfcalculator (see next page). This multi-platform app downloads an interactive web page into your browser each time you need it, which ensures that you always have the latest version.

NB: Currently, you do not need to repeat any successful assessments based on older versions of either the RSGB or the Ofcom calculator.

Low power compliant configurations

The first time you use the RSGB EMF calculator, it opens with the default configuration for a typical 2m 5W FM handheld with its small antenna directly attached.



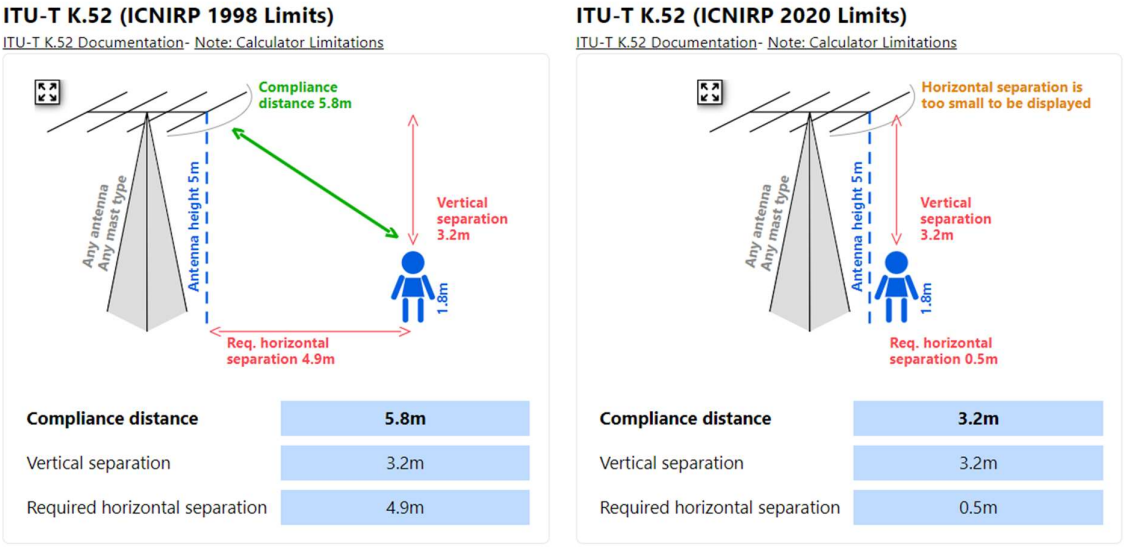
The green bar saying **Low power compliant** means this equipment configuration meets the criteria for the low EIRP exemption, as mentioned on page 2. If this is an accurate description of your radio, no further EMF assessment is needed. You only need to fill in your **User details** (top right) and a configuration name. You can then save the results (see **Saving results and backups** at the end of this section).

Other configurations

To assess a different configuration, you can edit all relevant the details in the default '5W FM' configuration, or else click **Configurations** (top left) and look for a more suitable pre-defined example in the drop-down list of **Standard configurations**. Note that a 'standard configuration' is still only a starting point for further editing; you can change any of the user input fields highlighted in yellow.

If you have specified any configuration that does not qualify for the low EIRP exemption, the green bar will turn red and say **Further assessment required.** The calculator will then take you further into the app, to calculate an EMF Exclusion Zone and find a practical way to implement that.

If you see the red bar, the RSGB calculator will also display two sets of results using the ITU-T K.52 method. When more advanced calculations based on Pre-Assessed Equipment Configurations are also available, these too will be displayed close by.



Interpreting ITU-T K.52 results

In the K.52 calculation method, the EMF Exclusion Zone is expressed as a simple "compliance distance" measured between the head of the exposed person and the nearest part of the antenna. The dimensions in the graphics above will scale according to the input data (except for the generic picture of the antenna itself) and you can click to view an enlarged version.

The left-hand graphic shows the compliance distance based on ICNIRP 1998 (see footnote to page 4). For this particular example, compliance requires a downward-slanting separation of 5.8m (green arrow). Given the height of the antenna above ground (5.0m) and the height of the exposed person (taken to be 1.8m), the available vertical separation is only 3.2m. To increase the overall distance to 5.8m, the person needs to move away horizontally by a further 4.9m.

The right-hand graphic shows a significantly smaller compliance distance based on ICNIRP 2020. In this case the same 3.2m vertical separation almost exactly meets the compliance criteria (the small discrepancy has no practical significance). Since you have a choice, you would almost always choose the less restrictive ICNIRP 2020 option for this assessment.

Notes about the Exclusion Zone

If the RSGB calculator has helped you to find a compliance solution, you still need to use the **Notes** section of the app to state why the general public will not be present in the Exclusion Zone while you are transmitting.

Saving results and backups

To make a backup of your configuration, give it a name and then click **Save** under the **Configurations** dropdown. This will save the configuration details as a .JSON file (a text format, but primarily intended to be machine readable)[2].

To make a PDF backup that you can keep along with your downloaded amateur licence, click **Save PDF**[2].

Where applicable, both forms of backup will include your **Notes** section on managing the Exclusion Zone.

7. How to use the results

This section condenses together all the points from earlier section into a few simple rules.

Recall what you have read in previous sections. Section 3 outlined the steps needed to complete an EMF assessment.

Then sections 4, 5 and 6 have been all about **determining the Exclusion Zone**.

This section is about **managing the Exclusion Zone** where no member of the general public should remain while you are transmitting. This is the practical part – the part that will depend on your own local circumstances.

If the Exclusion Zone boundaries include areas that are accessible to the general public, RSGB recommends that you take one or more of the following actions:

1. **Increase antenna height and/or relocate the antenna** to move the Exclusion Zone away from those accessible areas.
2. **Reduce RF power**, to shrink the size of the Exclusion Zone.
3. **Take other practical steps to manage and/or monitor access to the Exclusion Zone.** Use the results from the RSGB calculator app to judge what would be most appropriate in your particular situation.

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2. In a Windows PC, the saved files will normally appear in your (Username)\Downloads folder.

If no-one is actually present in the Exclusion Zone, you are always free to transmit.
Radio amateurs have a special advantage, that operation almost always takes place "in the presence of and under the direct supervision of the Licensee" – in other words, yourself. As the person on the spot, no-one is better able to judge the situation.

Always keep a record of how you decide to manage the situation in the Exclusion Zone.

That completes your first assessment. Then repeat the entire process until all your station configurations have been assessed.

8. The last word

These detailed requirements for EMF compliance are all new to UK radio amateurs, but:

- **Don't give up.**
- **You aren't the first person in this situation.**
- **Many people have already done their EMF assessments and found practical solutions.**
- **If in doubt, ask for help.**