

Quick Manual

to

Current sums - Antennas - Calculation

according to DL1VU principles

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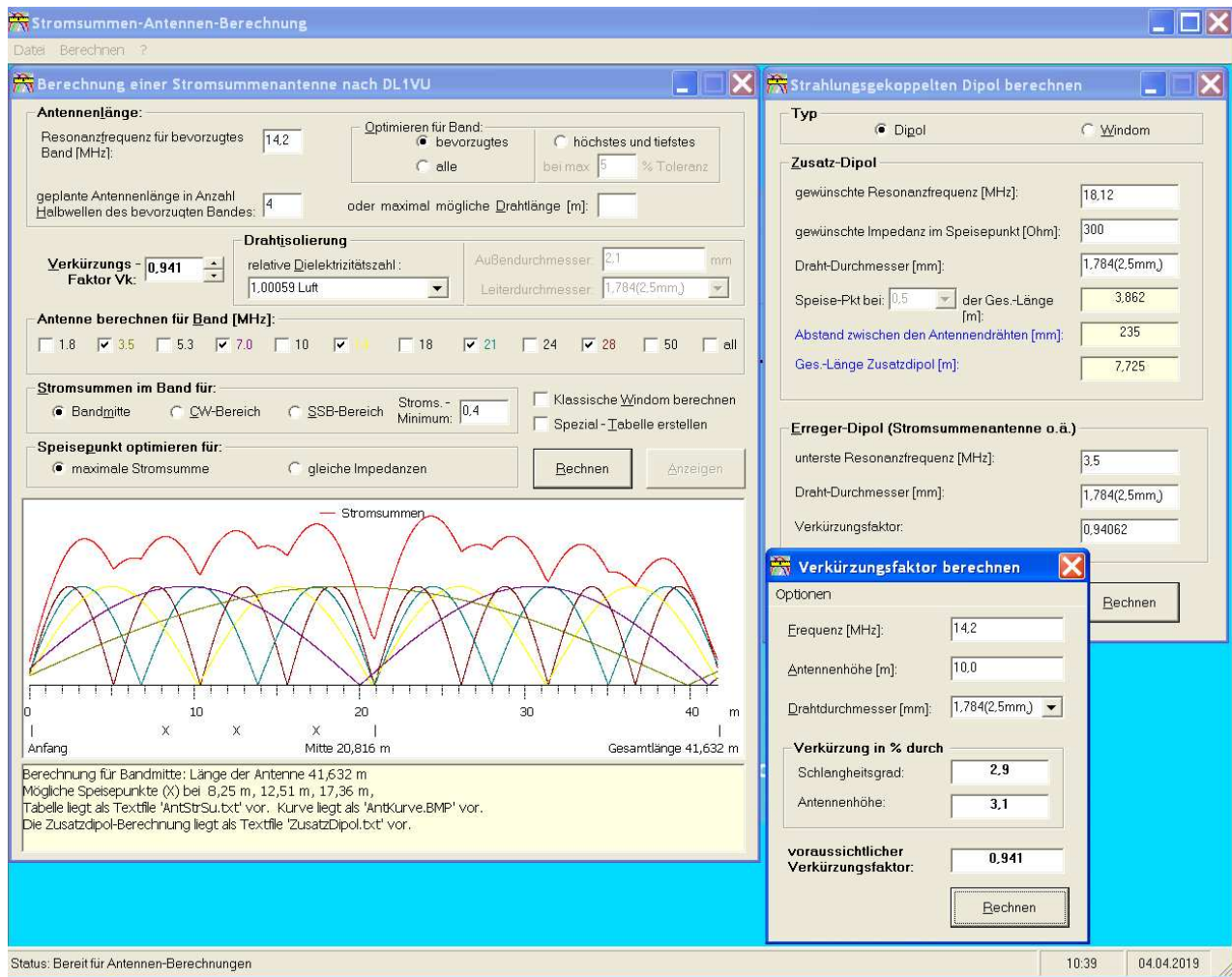


Fig.1 Program view

- in practice tried and tested
- logical and clear
- easy to operate
- in German and English language

Contents	Page
Program view	1
Contents	2
1. Prerequisites	3
1.1 License agreement	3
1.2 Warranty and liability exclusion	3
1.3 System requirements	4
1.4 Intended use	4
2. Installation	4
2.1 Update	4
3. Program basics	5
3.1 Program start	5
3.2 Structure of the program	5
3.2.1 The menu line	5
3.2.2 The menu 'File'	5
3.2.3 The menu 'Calculate'	5
3.2.4 The menu '?'	5
3.2.5 Key assignment	6
4. Guide to the <i>current sums- antennas- calculation</i>	6
4.1 What is a current sums antenna?	6
4.1.1 Differences between current sums- and Windom- antenna	7
4.1.2 Prejudice: Upper wave- slingshot	7
4.2 Inputs	8
4.2.1 Shortening factor calculation	8
4.2.2 Current sums antennas calculation	8
4.2.2.1 Set frequency bands of the antenna:	8
4.2.2.2 Shortening factor	8
4.2.2.3 Antenna length	8
4.2.2.4 Current sums in the band	9
4.2.2.5 Optimise feed point	9
4.3 Results of the calculations	9
4.3.1 Antenna pruning / optimization / additional dipole	10
4.4 Hints, tips and tricks	11
4.5 Examples	13
5. Postscript / Literature sources	14

1. Prerequisites

1.1 License agreement

The software product associated with this licence '*Stromsummem- Antennen- Berechnung*' is **freeware for amateur radio applications** and is protected by copyright and other international treaties on intellectual property. **Commercial use is only permitted with the consent of the author.**

By installing the software product, copy or otherwise use the software product, you agree to be bound by the terms of this licence agreement.

1.2 Warranty and liability exclusion

I do NOT guarantee the suitability of the programme for a specific application or a specific hardware or software - configuration.

Furthermore, under NO CIRCUMSTANCES shall I be liable for any damages resulting from the use or inability to use this product. This includes the loss of business profits, the interruption of business processes, the loss of data and all other material and non-material losses and their consequential damages and applies even if I have been expressly advised of the possibility of such damages in advance.

Should a error is discovered, I will endeavour endeavour to correct it as quickly as possible

BY USING THIS SOFTWARE, THE USER AGREES TO THE ABOVE DISCLAIMER OF WARRANTY AND LIABILITY.

1.3 System requirements

Hardware / Software - Requirements:

Any **PC** with an 80x86 processor from an 80486DX (and higher) is suitable,
 Processor - clock frequency as **higher 66 MHz**,
min. 16 MByte RAM (better ≥ 32 MByte and higher),
 a **hard drive** with at least 10MByte free storage capacity
VGA - graphics card and VGA – monitor with min 800 x 600 pixels,
WINDOWS 9x, Windows NT and successor, **WINDOWS XP, WIN 7** and higher,
 a program to view **PDF** files.

Trademarks:

WINDOWS is a registered trademark of Microsoft Corporation. All other trademarks are trademarks of their respective owners.

1.4 Intended use

The 'Current sum antenna calculation' programme is used to calculate current sum antennas according to DL1VU for the shortwave amateur radio bands and other bands. The antenna length and a selection of favourable feed points are calculated.

However, the programme can also be used to calculate a classic windome antenna, normal centre-fed dipoles and end-fed long-wire antennas. By the possible calculation of an additional dipole or an additional windom antenna, both radiation-coupled, the current sum antenna can be extended to an all-band antenna.

2. Installation

The ZIP file is copied to a new folder and unpacked there. The programme package is then installed by starting the Setup.exe.

If there are newer programme parts on your PC than those supplied with this programme, please click on 'Keep' or similar. The programme still runs without problems. As this programme is designed for use with WINDOWS 95 and higher, it naturally also contains the corresponding programme parts.

2.1 Update

After unpacking the corresponding file, the update is carried out by copying the 'Stromsummen.exe' and the other files into the folder created during the first installation of this programme. The old files are overwritten. For this simple procedure to work, the programme must have been completely installed once with an older version. From WINDOWS 7 and higher, the Stromsummen.exe may also work without a previous installation (try it).

However, if there are any problems with the function of the new version of the programme, please contact the author of this programme. You will then be sent an up-to-date installation programme.

3. Program basics

3.1 Program start

The 'Stromsummen-Antennen-Berechnung' - programme is started by clicking on the Stromsummen.exe in Explorer or via shortcut on the desktop. Under 64-bit operating systems, it may be necessary to activate the compatibility mode for WINDOWS 98 or XP for this programme.

3.2 Structure of the program

The programme is operated using the keyboard and by mouse click. All programme functions can be accessed via the corresponding menus. The menus are opened by clicking on them with the mouse or by pressing the Alt key plus an underlined character. The most important programme functions can also be called up directly via shortcut keys (F keys or special key combinations). The data is entered in input masks.

3.2.1 The menu line

The menu line is the second line of the window and is labeled by **File** to ? (Help)

3.2.2 The menu 'File'

The files with the last calculation results of the antenna calculation, the feed point test and the additional dipole calculation can be **displayed** and **printed** here for subsequent evaluation. It is also possible to **print the inputs entries**. In the next menu item, the folder for saving the result files can be specified. The last item in this menu is used to **exit** the programme.

3.2.3 The menu 'Calculate'

This menu contains the most frequently used functions of the 'Current sum- antenna-calculation' programme:

Under '**1. shortening factor**' the V_k can be calculated.

The actual antenna calculation window can be accessed via '**2. current sum- antenna**'.

You can then use the '**3. point**' to check the selected **feed point for one frequency, for all frequencies** and **a distance for all frequencies**.

After the practical test of the antenna, you can perform calculations to improve the antenna via '**4. Pruning/Optimisation**'.

For control purposes, **an impedance can be calculated from a current sum** and, as the last menu item, it is possible to calculate an **additional dipole** or an **additional window (radiation-coupled)**.

3.2.4 The menu '?'

Here you can display this '**Help**' text and an '**Info**' for this programme can be displayed here. The **language** can be selected via '**Options**'.

3.2.5 Key assignment

F1	Show Help
Ctrl + F1	Show Info about the program
Ctrl + F	Checking feed point for a frequency
Ctrl + A	Checking feed point for multiple frequencies
Ctrl + L	Checking the fee point: one distance/all frequencies
Ctrl + O	Pruning / Optimizing the antenna
Ctrl + S	Calculate current sum- antenna
Ctrl + V	Calculate shortening factor
Ctrl + X	Program end

4. Guide to the *current sums- antennas- calculation*

4.1 What is a current sums antenna?

Internationally, this type of antenna is also known as an OCF antenna. This is a multiband-antenna. To explain this more precisely, one would have to write an entire book. I would therefore like to refer you to the book by Karl H. Hille, DL1VU, 'Windom- und Stromsummen-Antennen' [1]. This programme is based on the formulae and programme examples described in the book mentioned above. DG0KW has supplemented and further developed some of the information. Another article on this can be found in [4].

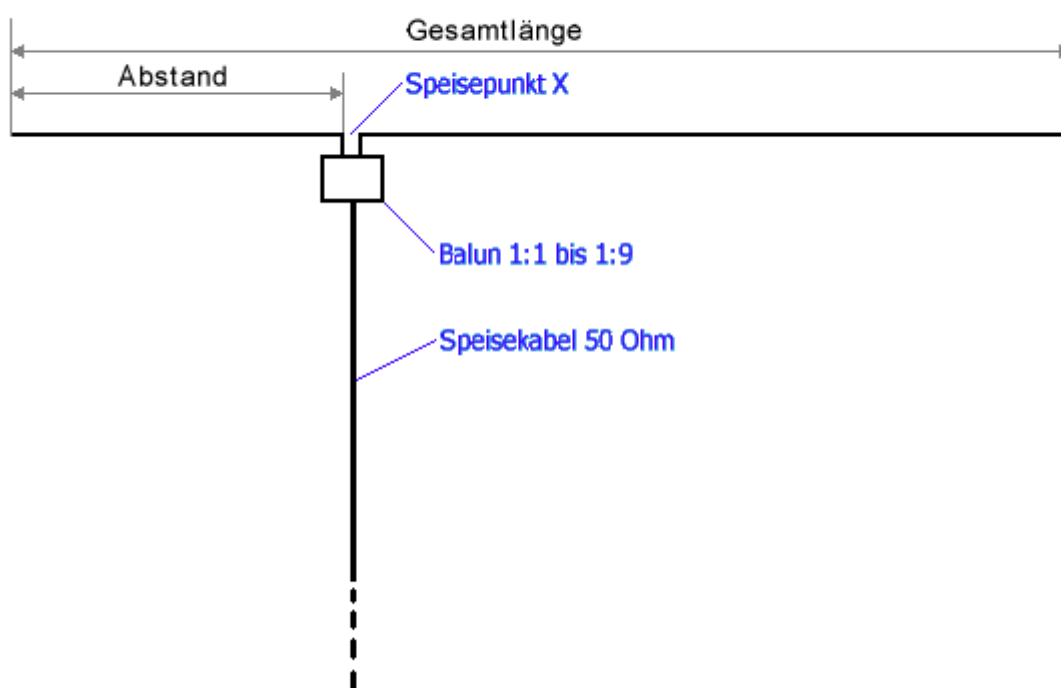


Fig.2 Schematic diagram of a current sum antenna antenna

(Gesamtlänge: total length, Abstand: distance, Speisepunkt: feed point, Speisekabel: feed cable)

Instead of the balun and the coaxial cable, the antenna can of course also be fed with a flat ribbon cable ('chicken ladder') with the appropriate impedance. A balun or a balanced antenna matching device is required to match the transceiver or receiver at the end of the ribbon cable.

4.1.1 Differences between current sums- and Windom- antenna

A windome antenna is also a current sum antenna and vice versa. In the classic Windom, a feed point was found through experiments starting in 1925 at which all usable bands have the same impedance. But at least two bands are fed at the current minimum and are therefore hardly usable (e.g.: 21 and 10 MHz).

In contrast to the classic Windom antenna, the best known representatives of this antenna type in Europe are the FD4 and the FD3 from 'Fritzel', a current sum antenna calculated with this programme can be adapted to almost all bands. The maximum that remains is a band with poor adjustment remains. An additional radiation-coupled dipole can then be calculated for this band using this programme. This creates a real allband antenna.

However, the impedances are divided into two groups (see 4.5 examples), one group with impedances around 200 Ω and the other group around 400 Ω . The impedance of the balun or the ribbon cable is placed between these two groups on the average sum (\emptyset sum) of the impedances of the usable bands, whereby the standing wave ratio usually remains below 1:2. The remaining ripple (SWR) can then be eliminated with a simple hand-tuned unbalanced antenna matching device. At its lowest resonance frequency, the antenna behaves like a dipole, at the higher bands like a long-wire antenna, also recognisable in the directional diagram of the antenna.

4.1.2 Prejudice: Upper wave- slingshot

Of course, with a genuine all-band antenna there is a risk of harmonics being emitted by the transmitter if it is not operated correctly. However, modern transceivers have been equipped with low-pass or band-pass filters at the antenna output for decades, which suppress the first harmonic by at least 40 - 60 dB. As a result, this problem only exists in people's minds as a prejudice from times gone by.

It should also be mentioned that a normal 80m band dipole also has a low impedance in the 30m, 17m and 12m bands and would therefore also radiate these harmonics unhindered.

4.2 Inputs

all entries are made in metres [m] or millimetres [mm] and in MHz

4.2.1 Shortening factor calculation

The menu '[Calculate / 1. shortening factor](#)' menu to open the calculation window. The resonant frequency of the antenna, the antenna height above the ground and the thickness of the antenna wire are entered here and then the shortening factor (V_k) is calculated. The calculated V_k is automatically forwarded to the next calculation window. The V_k is calculated from two factors: the shortening factor of the slenderness ratio of the antenna wire and the shortening factor resulting from the antenna height above ground. The total V_k is on average at 0.95. However, the V_k is also influenced by the surroundings (distance to the house, trees, etc.) and the nature of the ground. Since this is difficult to calculate, deviations from the calculated V_k may still occur after hanging the antenna. The resonances of the antenna should then be measured. This allows the true shortening factor to be determined or the shortening factor will change the program until calculation and practice match. This time determined shortening factor can then usually be used again for antennas at the same location at the same frequency.

4.2.2 Current sums antennas calculation

For this purpose, the menu '[Calculate / 2. current sums-antenna](#)' the actual window for calculating the antenna opened.

4.2.2.1 Set frequency bands of the antenna:

For this purpose, the corresponding frequency is provided with a check mark under '**Antenna Calculate for Band [MHz]**'. If the results of this frequency are to be displayed only, but not used for the calculation, a 0 (zero) can be entered via the keyboard. The frequency band is then displayed dimmed. By entering a 1, it can be undone.

4.2.2.2 Shortening factor

The determined shortening factor is used here. If an isolated antenna wire is used, the material of the insulation can be selected to the right of it. To the right of it is to enter the diameter of the conductor and the outside diameter of the antenna wire. From this, the program calculates an additional shortening factor that acts on the entire wire length. The example given there is a vein of a standard 1.5 mm² speaker cable (insulation: 2.3 PE).

4.2.2.3 Antenna length

Under antenna length you can enter a preferred band and how many **half-waves** should be in this band on the antenna length. From this, the program then calculates the antenna length. If you can't do anything with it, it is enough to enter the **maximum wire length** for which the place is available. To optimise the antenna calculation, it is also possible to set the optimum to a **preferred band**, to an **average value of all bands** or to an **average value of the highest and lowest bands** within a defined tolerance limit. (see also **additional band** under 4.4).

4.2.2.4 Current sums in the band

Furthermore, the position of the current sums in the band can be set to the **centre of the band**, the **CW range** or the **SSB range**, as well as the **current minimum** of the current sum to be taken into account in the calculation.

4.2.2.5 Optimise feed point

Here it is possible to specify whether a feed point is calculated that results in the maximum antenna current or the same impedance for all bands. In the latter case, points are sought where as many many curves of the bands intersect. If '**Calculate classic WIDOM**' is ticked, only one point is calculated to which this applies. **Then please click on 'Calculate' button.**

4.3 Results of the calculations

The results of the calculations are displayed graphically and in text format. The currents of the individual frequencies and the sum of the currents (in red) are displayed graphically. Below this are the lengths in metres and the possible feed points (tapping points) are marked as **X**. The length specifications to the feed point represent the distance from the beginning of the antenna to the feed point (see Fig.2). Via '**Display**' you get more accurate results in a separate text window, the quick view. The 'AntStrSu.txt' file created during the calculation is displayed for this purpose. The current sums of the calculated supply feed points for the individual frequencies and the trend within a band are shown separately. The resonance frequencies of the calculated antenna are also listed here. In order to be able to estimate the transformation ratio that the balun must have in order to adapt a coaxial cable, I have developed a formula with which current sums can be converted into an impedance.

With the average sum (\emptyset sum) of the impedances the transformation ratio 1:x for the balun can then be calculated.

$$\text{Translation ratio } x = \frac{\emptyset\text{Sum } [\Omega]}{\text{Cable impedance } [\Omega]} \quad * \text{ mostly } 50 \Omega$$

With a \emptyset sum of 200 Ω , a transmission ratio of 1:4 results when supplied via a 50 Ω cable. Baluns with a transmission ratio of 1:1, 1:4, 1:6 and 1:9 are commercially available. If the antenna is to be fed via a ribbon cable, the \emptyset sum corresponds to the impedance of the ribbon cable.

The most favourable feed point is the one at which the impedances of all required bands remain below 600 Ω or (and) all impedances oscillate as close as possible to the \emptyset sum.

If '**Special - Create table**' is ticked before the calculation, a result text (AntSpezi.txt) with all calculations is generated. This text can be opened in the quick view via '**File / Display / Print**'. All texts can still be edited, formatted and then printed. For each calculation, the graphical representation of the current sums is also saved as 'AntKurve.BMP' and can be viewed and printed out later using a graphics programme. With each new calculation, the generated files, including 'SpeisePkt.txt' and 'Dipol.txt', are overwritten by the results of the new calculations. If these files are to be preserved, they must be renamed before a new calculation.

4.3.1 Antenna - pruning / optimization / additional dipole

Once the antenna has been completed, it is tested at its location and the resonance frequencies or the frequencies with the best standing wave ratio (SWR) are determined. If these do not match the calculation due to the antenna's surroundings, the length of the antenna must be adjusted. To shorten this process, open a calculation window via the [menu 'Calculate / 4. Pruning / Optimise'](#). The antenna length and of the measured resonance frequency as well as the desired resonance frequency are entered there. The length by which the antenna length must be changed is then calculated. The result of the calculation shows the size and direction of the required change in length.

However, this change in antenna length should be made in smaller steps if possible. There is nothing worse than the antenna being too short after the wire has been cut.

It is usually possible to tell from the antenna calculations whether one of the bands cannot be optimally adjusted. This is usually the 17m band for a current sum antenna and the 15m and 30m bands for a classic WINDOM antenna. An additional antenna element can be calculated for this band via the [menu 'Calculate / Additional dipole / Windom \(radiation-coupled\)'](#). The wire length of the antenna element and its distance to the current summation antenna as excitation dipole are calculated. This wire is attached to the antenna at the calculated distance using insulating spacers and is not electrically connected to the antenna. The 'virtual' feed point of the additional element must be located exactly below the feed point of the current sum antenna. Examples of mechanical realisation can be found under [\[3\]](#) [\[4\]](#).

However, this option is not only available for current-sums antennas; any other dipole can be extended in this way for other bands.

However, the following points must be noted:

- The (lowest) resonance frequency of the exciter's antenna (main antenna) must be smaller than that of the additional dipole.
- The main antenna must have a higher impedance at the frequency of the additional dipole.
- The additional dipole must be centered and symmetrical to the feed point.
- The "virtual" feed point of an additional windom must be located exactly below the feeding point of the antenna.
- The additional dipole must always be shorter than the main antenna and must not protrude beyond the end of the antenna.
- The entries for wire insulation are included in the calculation.
- Only one additional dipole can be calculated with sufficient accuracy. If two or more radiation-coupled dipoles are to be added (not necessary for a current-summation antenna), the distance calculations are only sufficient as a rough guide. Own experiments are then necessary.

The result of the calculation is saved in the file 'ZusatzDipol.txt' file and can therefore also be printed out. A normal centre-fed half-wave dipole for the 80m band has a low impedance in the 80m, 30m, 17m and 12m bands and can be extended by an additional dipole for the 40m, 20m, 15m or 6m band.

4.4 Hints, tips and tricks:

- The calculations are only correct if all frequencies are in the amateur radio bands and the shortening factors do not fall below values that occur in practice! If a frequency outside the bands is entered, this can be included in the calculations as an **additional-band** after confirmation. However, an additional band usually only produces useful results if all activated frequencies harmonise with each other.
- When calculating a **multiband-antenna**, it may be advisable not to include the WARC bands (5.3, 10, 18 and 24 MHz) in the calculation. The 10 MHz band in particular is so far off in frequency that the calculations do not produce an optimum for the other bands.
- With the **current-sum-minimum-specification** (0.4) of the current-sums, less good supply points can be excluded immediately. If the calculation results in a large number of feed points, the default value can be increased until only one feed point remains. If the antenna is calculated for many bands simultaneously, it can happen that no feed point is calculated. The minimum must then be set lower and the calculation repeated. The specification can be in the range of **0.01 - 0.85**.
- Impedances above 3000 ohms have only theoretical value at altitude and hardly ever occur in practice due to the attenuation of the antenna by the ground and the environment. They simply mean that the antenna impedance is very high and the antenna is therefore difficult to adjust to the frequency.
- In practice, the **impedance of the antenna in the lowest frequency band** is lower than calculated. This is caused by the ground and the surroundings of the antenna. If the antenna is suspended high and free, this influence is lower.
- If the antenna centre is entered as the distance for '*Check feed point/one distance at all frequencies*', a **normal dipole** is calculated. When entering almost 0 (0.000001) as the distance results in an **end-fed long-wire antenna**. The antenna length is taken from the previous calculation. The result of the calculation is saved in the 'SpeisePkt.txt' file and can therefore also be printed out.
- With all shortwave antennas, the impedance of the antenna is only real at the resonant frequencies and then usually does not equal 50 Ω . If the antenna cable has an unfavourable length, it acts as a quarter-wave transformer and converts this impedance into completely different ranges. The **antenna cable** should therefore have a **certain length** if possible (see [2]). You can easily determine whether this effect applies to your antenna system. Measure the standing wave ratio (SWR) of your antenna without antenna tuner on all bands (make a note of the values) and then insert a 2 to 5 metre extension cable. The measurements will now be repeated. If larger deviations can be detected in one or more bands, this effect is present. Therefore, measurements of the impedance or resonance of an antenna should always be carried out directly at the antenna connection (balun).

- If **calculation results are displayed in red**, they are outside the limits documented by measurements. However, this does not necessarily mean that the values are incorrect. This can occur especially with the shortening factor (V_k). In practice, for example, at antenna heights below one tenth of the wavelength, the minimum ends here, contrary to theory, and a steep increase in V_k can be measured again. If the **ground correction** is activated in the V_k calculation window in [Options](#), this effect is taken into account in the calculations.
- If the **window for V_k calculation** is not closed, the antenna height and the wire diameter are also used to calculate the antenna. An aerial is then calculated specifically for the values entered. The V_k is recalculated on each band as it changes with the frequency. This can be noticeable in the antenna length, the feed points, the resonance frequencies and in the calculation of an additional dipole.
- The length and distance of a **radiation-coupled additional dipole** to the current sum antenna must also be adapted to the ambient conditions. However, this should be done last. If there is a standing wave minimum above and below the resonant frequency of the additional dipole, the distance between the current summation antenna and the additional dipole is too small. If there is only a minimum, but the standing wave ratio is not yet good enough, the distance is too large. However, if this one minimum is at the wrong frequency, the length of the additional dipole must be changed accordingly. An additional dipole also has another positive effect. The resonance frequencies of the upper bands are pulled down by a few KHz and are therefore more favourable in the respective bands (cannot be displayed in the programme).
- If the [shortening factor](#) and the [relative dielectric constant](#) are **set to 1**, the output curves also correspond approximately to the **half-waves of the individual frequencies on the antenna** (without shortening factor).

4.5 Examples

A classic WINDOM-antenna (4 bands) is to be replaced by a current sum-antenna. The antenna is calculated for 14.2 MHz and 4 half-waves, for band centre: 28, 21, 14, 7, 3.5 MHz. The shortening factor of the wire is 0.95 (without insulation). The calculation yields an entire antenna length of 41.725 m with the following results:

Impedances [Ω]:

m	ØSum	50 MHz	28 MHz	24,9 MHz	21 MHz	18 MHz	14 MHz	10 MHz	7 MHz	3,5 MHz	
8,29	317	391	165	146	389	1599	456	215	154	473	*3
12,55	290	463	136	770	505	115	414	4068	163	271	*2
13,8	336	176	201	240	4696	202	232	1398	218	232	*1

*1 the classic 4 band windom for comparison, bad on 21 and 10 MHz (in the original with 1:6 balun)

*2 Current sum antenna, poor at 10 MHz, perhaps still usable at 24 MHz (1:4 or 1:6 balun)

*3 Current sum antenna, poor at 18 MHz (balun: 1:4 (28, 24, 10, 7 MHz) or 1:9 (50, 21, 14, 3.5 MHz))

My favourite is the antenna with the feed point at 8.29 m and a 1:6 balun. This antenna can be used on 8 bands. The residual ripple is compensated for with an antenna matching device.

Resonance frequencies [MHz]

50 MHz-Band:	50,149
28 MHz-Band:	28,580
24 MHz-Band:	24,985
21 MHz-Band:	21,390
18 MHz-Band:	17,795
14 MHz-Band:	14,200
10 MHz-Band:	10,605
7 MHz-Band:	7,010
3,5 MHz-Band:	3,415
1,8 MHz-Band:	-

The resonant frequencies of the antenna with or without wire insulation are the same. Only the antenna lengths (and thus the feed points) vary from 41.725 m with bare antenna wire to 40,851 m with the example insulation with 2.3 PE. However, there is also a solution for the 18 MHz band, which is only of limited use, a radiation-coupled additional dipole. The additional dipole is calculated for an impedance of 300 Ω (6 x 50 Ω) at 18.12 MHz. It is around 7.7 m long and is attached to the antenna wire of the current-summing antenna at a distance of 233 mm (wire diameter: 2 mm / 1.4 mm) along its entire length (insulated, symmetrical to the feed point). This means that the antenna can be used on all 9 bands.

5. Postscript

I would like to thank Karl H. Hille †, DL1VU, for his kind consent to this programme.

Relevant information, suggestions and your own practical examples as well as measurement results are welcome and will contribute to the further optimisation of this programme.
(email: dg0kw@darc.de)

Literature sources (in German language):

- [1] Karl H. Hille, DL1VU „Windom– und Stromsummen– Antennen“
Funkamateure – Bibliothek Band 15
Theubeger Verlag GmbH
- [2] K. Warsow, DG0KW „Kabellängen – Berechnung“
www.dl0hst.de (see under Software)
- [3] K. Warsow, DG0KW „Multiband – Dipol DO – Antenne“
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- [4] K. Warsow, DG0KW „Allbänderweiterung von Windom- und Stromsummen-Antennen“,
Funkamateure 59 (2010) Heft 7, S.737-739 u. Heft 8, S.846-847

**Much success with the calculation of the current sum – antennas
wish you the author K. Warsow , DG0KW**

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