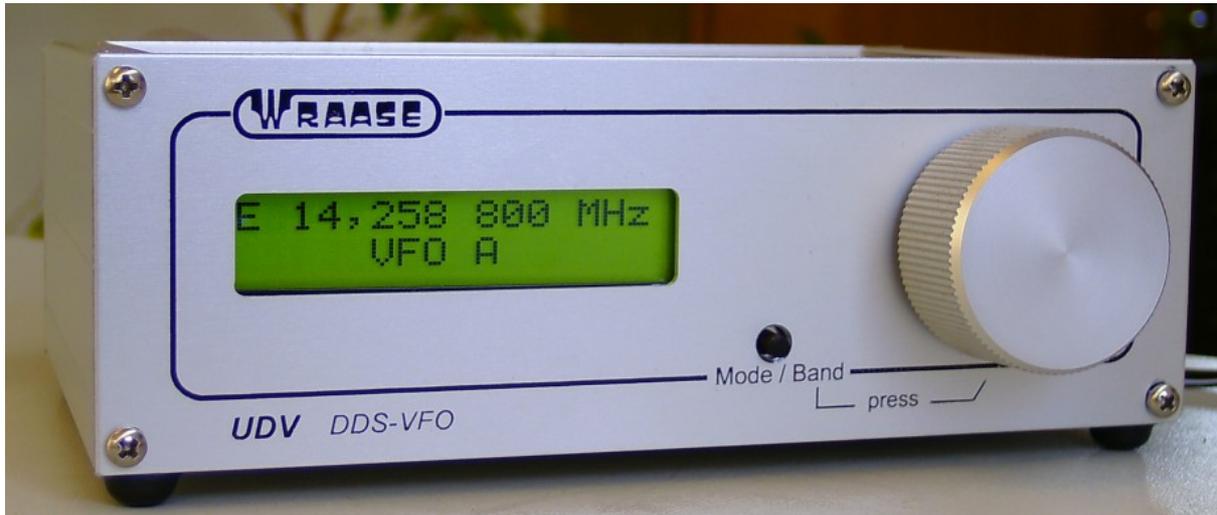


# UNIVERSAL-DDS-VFO „UDV“ ( 1 Hz to 10 MHz) Connection and operating instructions



## 1. Introduction

The UDV is the ideal device to adapt older, VFO-controlled transceivers to modern requirements regarding frequency stability and reading accuracy and to equip them with the additional comfort of a second VFO with VFO-A/B and split-capability.

Adaption of the UDV to different transceiver types is achieved by the following configuration options:

1. Hardware configuration by plug-in jumpers and the special-made connecting cable.
2. Software configuration via the PC software.

The connection to the transceiver is made via the "external VFO" socket. In the case of transceivers without such a socket, an appropriate connection can generally be retrofitted easily.

Each transceiver manufacturer uses its own concept for connection and control of a second VFO, whereby the transceivers can be divided into two groups: First, with a front-side VFO switch for internal/external/split and the other, where such switch is not provided on the transceiver itself, but on the original second VFO. The UDV can be configured for both groups of transceivers.

The UDV offers two modes of operation: First, it can be operated as a "normal" second VFO in alternating- and split-mode with the internal VFO. In addition, there is the "VFO A/B mode", in which two VFOs A and B are realized in the UDV for split and alternating operation. In this mode, the internal VFO of the transceiver is not used, however it will work normally again as soon as the DDS-VFO is switched off or the mode is changed.

## 2. Connection

Connection to the transceiver is made via the 5-pin DIN socket on the UDV. Depending on the transceiver type and the intended use, not all of the 5 connection pins are needed (see table below).

**Pin assignment of the DIN socket of the UDV (see also block diagram):**

<b>Pin 1</b>	Switching signal from the transceiver to enable/disable the DDS-VFO. There is an internal pull-up resistor and surge protector available.  For transceivers with front-side VFO switch, in which the UDV is to be operated as a normal secondary VFO in exchange with the internal VFO, the switching signal for the secondary VFO is required on this pin 1 (i.e. operating voltage on/off, as available on the Second VFO connector). A pull-down resistor of 1 kohm against ground may be required.
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	In case that the transceiver does not have a front-side VFO switch (or it has one, but it shall not be used, like in VFO A/B mode), the PTT signal of the transceiver is connected to this pin 1. Normally the PTT signal will go to ground level when in transmit. The UDV will, however, also accept a reversed signal, which goes to Earth when in receive mode. In this case, the checkbox "PTT => GND" must be disabled in the configuration software (in the box "VFO + Split Configuration").
<b>Pin 2</b>	Ground
<b>Pin 3</b>	UDV RF Output
<b>Pin 4 /5</b>	Relay contact, which is programmable as an opener or a closer via the bridge Plug J 4.  <b><u>These contacts are <u>not</u> needed for transceivers with front-side VFO switch.</u></b>  For transceivers without front-side VFO switches, these contacts are used to switch the <u>internal VFO</u> on and off (e.g. for Kenwood devices TS-510/515/520/820/830 and Drake TR-7). Even if alternate- or split-mode with the internal VFO of the transceiver is not desired, it is useful to use these contacts, so that the internal VFO can automatically resume its operation when switching off the DDS VFO.

## 2.1. Connecting cable for transceivers with front-side VFO switch

Wiring of the cable differs depending on whether the UDV is to be operated as a normal secondary VFO, alternating with the internal VFO (case 1) or in VFO A/B- mode when the internal VFO is switched off (case 2 ).

### 2.1.1 Case 1: The UDV is used as a normal secondary VFO in exchange with the internal:

Pin 1 of the DIN socket is connected to the VFO-switching signal of the transceiver, which is available on the EXT-VFO socket of the transceiver (normally: operating voltage on/off). A pull-down resistor of 1 kOhm may have to be installed against ground.

The UDV is configured via the PC software in the box "VFO + Split Configuration" as "TRX controlled split".

If the above VFO-switching signal of the transceiver is inverse, this can be compensated by activating the box "PTT => GND". The correct function can be checked in the display: With the transceiver-switch in position "internal VFO" the display (2<sup>nd</sup> line) must indicate "Trx-Ctr: DDS Off". When switching to ext. VFO it must change to " Trx-Ctr: DDS on ".

### 2.1.2 Case 2: The UDV is operated with the two VFOs A/B, the internal VFO of the TRX is switched off:

The transceivers VFO switch is always set to "ext". The UDV is configured for 2 VFOs A/B mode either via the PC software (in the box "VFO + Split Configuration") or by key-selection directly on the UDV after switching it on (only possible in the time slot as long as „Change mode?“ is displayed).

If the transceiver switches the PTT signal to ground potential during transmission, the "PTT=>GND" box must be active, otherwise it must be deactivated. "Transmitting B" must appear in the second display-line when transmitting in split-mode (A always acts as receive-VFO and B as transmit-VFO).

**Important: The front-side VFO switch on the transceiver must always be kept in the „ext. position, as long as the DDS-VFO is connected and switched on. Otherwise there is a risk that both VFOs work simultaneously and you may be transmitting on to 2 frequencies at the same time!**

Note: If you want to switch between the two above mentioned operating modes (see 2.1.1 and 2.1.2), you have to change the connection cable respectively, or a cable with a small switch must be prepared, so that both modes are covered with one cable.

## 2.2. Connecting cable for transceivers without front-side VFO switch

DIN socket PIN 1 will be connected to the PTT signal. If "PTT" is not available on the "ext VFO" socket, it is led out elsewhere ("aux" socket?). The UDV must know if the PTT-signal goes to ground potential (normal situation) or not. Check or uncheck the "PTT => GND" box in the configuration software accordingly.

The relay contact, which is carried out via the DIN socket pins 4 and 5, switches the internal VFO of the transceiver on and off. The corresponding connections should be available on the "ext.-VFO" socket of the transceiver. In order to meet all variants, the relay contact can be configured as a closer or opener via the bridge (jumper) plug J4 in the UDV. The cable can be used unchanged for the two modes "DDS + TRX-VFO" (see 2.2.1) and "VFO A/B-mode" (see 2.2.2).

### 2.2.1 The UDV is used as a normal second VFO (alternating with the internal):

The UDV is configured via the PC software in the box "VFO + Split Configuration" as "DDS + Trx VFO". Three modes can be selected with the front panel key on the UDV:

(1) on, (2) DDS VFO Off, (3) Split-> TX: DDS

**When transmitting in Split mode, the display will change to "transmitting DDS".**

**Should such text appear when the transceiver is in receive-mode, the polarity of the PTT signal is set incorrectly at PTT => Gnd.**

### 2.2.2 The UDV is operated with the two VFOs A/B, the internal VFO of the TRX is switched off:

The UDV is configured for 2 VFOs A/B mode (either via the PC software in the box "VFO + Split Configuration" or by the possible selection directly on the device after switching on.

With the button on the UDV three modes can be selected (at any time):

(1) VFO A, (2) VFO B, (3) Split-> TX: DDS

**When transmitting in Split mode, the display will change to "transmitting DDS".**

**Should such text appear when the transceiver is in receive-mode, the polarity of the PTT signal is set incorrectly at PTT => Gnd.**

Note on the PTT signal, if the same PTT port that operates the DDS-VFO is also used to switch a linear power amplifier:

There are tube power amplifiers, in which a negative blocking voltage of approx. 150V is switched to ground through the PTT contact. Such high voltage could damage the UDV. Since the PTT relays in the transceiver usually has a double pole contact, you can just use the opposite contact for safety, which then switches to ground at reception. The UDV can be configured by software for this: "PTT => GND" box unchecked. For many older Kenwood devices, this connection is on pin 3 of the "remote" jack.

Wiring examples for connection cables to specific transceiver types are in the appendix.

## 3. Hardware configuration using the jumpers

The following illustration of the rear panel and the table below shows the configuration possibilities of the three jumper arrangements that can be reached at the rear of the unit. The arrangement is from left to right: J1, J2, J3, pins each 1, 2, 3.

Configuration	J1	J2	J3
DDS-output without amplifier und without filter	1-2	-	2-3
DDS- output with amplifier, but without filter	2-3	2-3	2-3
DDS-output with amplifier und with filter	2-3	1-2	1-2



In the configuration "amplifier + Band pass Filter" You are always on the safe side, but should set the output level as low as possible. The best way to find the right value is to turn the transceiver on (tune) and carefully increase the level until the saturation (maximum transmitting power) is just being reached.

Operation without amplifier and without band pass filter offers the lowest output level variation over the full frequency range and low harmonics and is therefore optimal for the use of the device as a universal sine wave generator from 1 Hz to 10 MHz. If a higher output level is desired for this purpose, the 20dB amplifier can be switched on, but the harmonic content increases slightly.

Jumper bridge J4 can only be accessed with the cover of the unit being opened. It configures the relay contact available at pins 4 and 5 of the DIN socket, either as a closer or opener.

J4/1-2 Connected, 2-3 open: closing, i.e. relay contact closed when DDS-VFO is active,

J4/1-2 Open, 2-3 connected: opener, i.e. relay contact opened when DDS-VFO is active.

#### 4. Operation of the device

All operating functions are realized by the tuning knob and the button. Pressing down the tuning knob results in an additional switching function.

Turning the rotary knob: Frequency variation. There are fixed increments of 1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 KHz and an "automatic" mode, where the steps automatically adjust to the speed of knob rotation.

After switching on the UDV, the "automatic" mode is initially active.

Pressing down the rotary knob and turning it at the same time (left / right): Changing the frequency step.

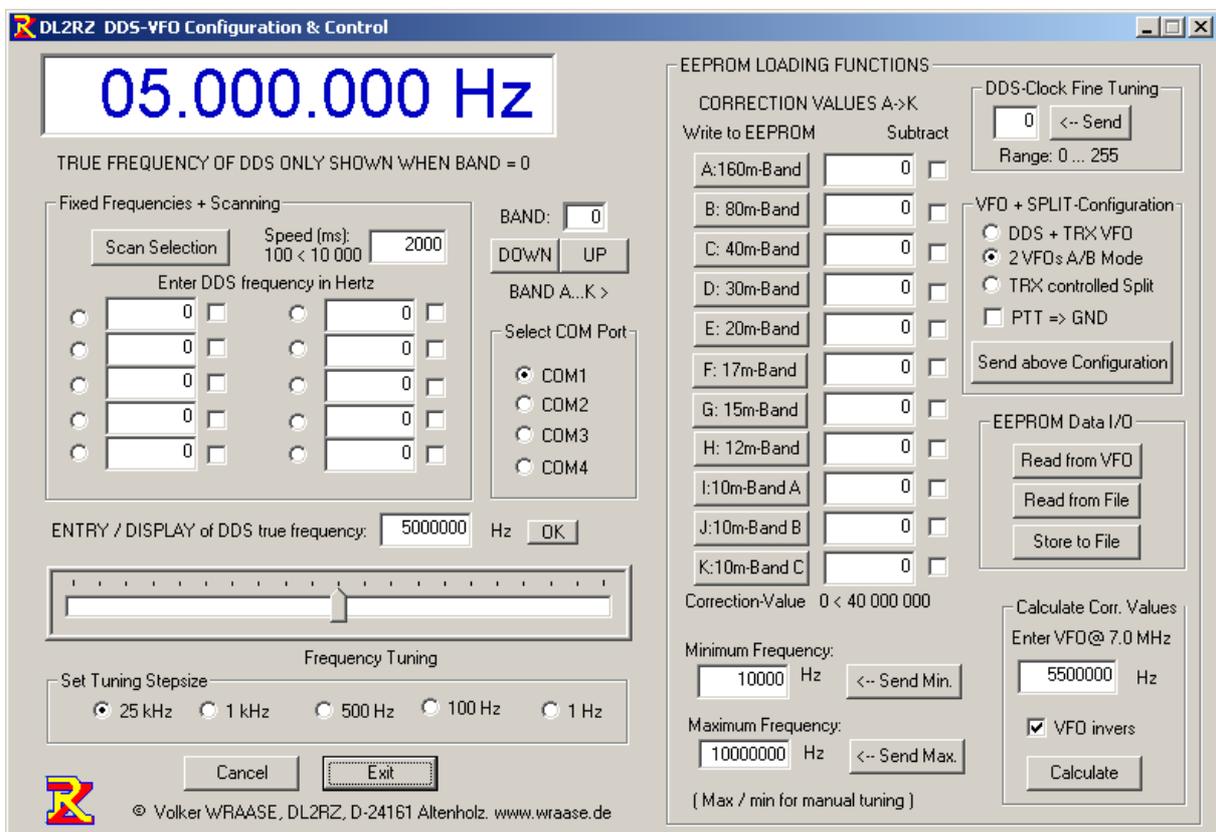
Pressing the button: Depending on the mode, you can switch between VFOs A and B and split mode or switch from transceiver VFO to UDV and split mode.

Pressing the button while keeping the knob pressed down at the same time: Range changeover A ... K.

After switching power on, it is possible to change the general mode on the button (as long as "Change Mode?" is displayed). The possible modes are: (1) transceiver internal VFO alternating with the UDV VFO. (2) Operation of the two UDV VFOs without that of the transceiver. In addition, the mode can be switched at any time using the PC software.

When the UDV is switched off, the currently set values (frequency, range, mode) are automatically saved and loaded again the next time the device is switched on.

#### 4. The Windows PC program "DDS.EXE", structure and operation



DDS.EXE does not need a special installation, it is immediately available. It's best to copy it to your hard drive and create a link to the desktop.

In the "Select COM Port" area, select the COM port which the UDV is connected to.

##### 5.1 Entering the parameters in the box "EEPROM LOADING FUNCTIONS"

The firmware allows to display actual DDS output frequency from 0 to 10 MHz, so that the VFO can be used as a universal sine signal generator with +/- 1 Hz resolution.

When being used as transceiver-vfo, however, it should show the real operating frequency of the transceiver.

For this, the value of the actual DDS frequency is mathematically converted using correction values which are stored in the VFOs EEPROM. Eleven such correction values are provided for a maximum of 11 bands, marked A, B, C, ..., K, which can be selected on the push-button of the UDV when simultaneously pressed the rotary knob. The respective band code letter appears at the far left of the first display-line. Since the displayed final operating frequency is calculated in the DDS-VFO itself with no feedback from the transceiver, care must be taken - to avoid irritation - that both units are always set to the same band. The HF-bands specified in the program window are not compulsory, the areas A to K may also be assigned differently.

Frequency stability and accuracy of the VFO depend exclusively on the corresponding values of the internal reference oscillator. In order to compensate for deviations in the range of approx. +/- 200 Hz, a fine adjustment of the global DDS computational constant has been provided in the upper right corner of the program window. The adjustment is best done on a precisely calibrated frequency counter, which is connected to the RF-OUT cinch socket of the UDV. For this adjustment, the original frequency must be displayed on the UDV display, i.e. A band must be set in which the correction value in the EEPROM is zero. This (global) adjustment should be made before proceeding to a fine correction of the individual band values A ... K. The numerical value in the "DDS-CLOCK fine tuning" box is varied until the display on the UDV matches that on the frequency counter.

In the "EEPROM LOADING FUNCTIONS" box, all the parameters that are important for the respective application of the VFO can be entered and transferred to the non-volatile EEPROM memory of the device. It is also possible to read these values out of the VFO ("Read from VFO" key). In addition, it is possible to create a file with the extension ".VFO" ("Store to File") and read it back into the program ("Read from File"). If you want to use the UDV with different transceivers, you can create the corresponding .VFO file for each transceiver.

To determine the correction values, the frequency plan of the transceiver need not be known in detail. It is sufficient to determine the transceiver VFO frequency associated with a certain reception frequency and to check whether the final operating frequency increases or decreases as the VFO frequency increases. In the event that the final frequency and VFO move in the same direction, the end frequency is formed by **adding** the correction value to the VFO frequency, in the case of inverting the final frequency it is obtained by **subtracting** the VFO frequency from the correction value; the respective box "Subtract" must then be activated. In the case that the VFO and the end frequency move in the same direction, a problem with above rule occurs in the 160m and 80m bands such that, on the one hand, addition must be used, but on the other, the frequency value to be displayed is lower than the VFO value. The correction value therefore is calculated such that a final frequency value results which is higher by 10 Mhz. This 10 MHz value is then made invisible in the display by suppressing the first digit. This trick automatically applies to the "A" and "B" bands, intended for the 160m and 80m bands. Since the correction values for each band are entered and stored separately, any deviations of the band- and sideband crystals can be taken into account, so that the actual frequency is always displayed correctly.

The following table shows an example of the values required for the DRAKE TR-7.

(VFO range: 5,050 MHz to 5,550 MHz, addition in all bands)

A: 160m Band	6 450 000	G: 15m-Band	15 950 000
B: 80m-Band	8 450 000	H: 12m-Band	19 450 000
C: 40m-Band	1 950 000	I: 10m Band A	22 950 000
D: 30m-Band	4 950 000	J: 10m-Band B	23 450 000
E: 20m-Band	8 950 000	K: 10m-Band C	23 950 000
F: 17m-Band	12 950 000	K: Original frequency	0

**Table :** Display-correction values for the DRAKE TR-7

It is recommended to set one of the ranges to zero in order to be able to display the original VFO frequency, preferably "K", which is intended for the barely used upper part of the 10m band.

The program also includes a routine for automatically calculating the correction values for all HF bands, with only the actual VFO frequency having to be known when setting the transceiver to 7.0 MHz (in the program window at the bottom right). However, it is always advisable to fine-tune the automatically calculated values for each band. If the transceiver has a digital display, simply change the correction values until the DDS LCD-indicator and the display in the transceiver match. For older devices without digital display, use the 100 kHz calibration generator or alternatively an external calibrated signal generator. The transceiver calibrator should first be tested, e.g. with the WWV signal, because calibration crystals can deviate considerably due to aging. For transceivers where the sideband is changed by switching the carrier crystals, it should be noted that the DDS VFO will only display the frequency correctly for the sideband normally used on the particular band.

Notes on entering:

- 1.) When starting the program, the input fields are empty or set to zero, regardless of the actual contents of the EEPROM. Click "Read from VFO" to fill the fields with the actual values being stored in the UDV.
- 2.) Enter the correction values in the respective input fields as Hertz value and, if the subtraction procedure is required, activate the box to the right.
- 3.) By clicking on the button to the left of the respective input field, the value is transmitted via the serial connection to the processor and stored there in the EEPROM. Any old value is deleted at the same time. The function can be checked immediately on the LCD display.
- 4.) If the original output frequency of the DDS VFO is to be displayed, the correction value "0" must be transmitted.

Below the correction value fields, there are edit-boxes to limit the tuning range: A minimum and maximum value can be set and transmitted to the processor EEPROM.

The correct storage of all values can be checked by reading from the EEPROM (click on the "Read from VFO" button).

## **5.2 Control of the UDV via PC software "DDS.EXE"**

The left part of the program window offers a comfortable interface for the operation of the VFO from the PC. The frequency can either be numerically entered in Hertz or continuously adjusted on a slider so that transceiver tuning can be operated by turning the mouse wheel from the PC. In addition, up to 10 fixed frequencies can be programmed and recalled in scan mode with adjustable scanning speed.

If the display at the top of the program window should show the actual VFO frequency, set "BAND" to "0" with the "UP" / "DOWN" buttons. Otherwise, the final frequency being calculated using the correction values is displayed. These correction values stored in the EEPROM of the UDV must first be transferred to the program by clicking on the "Read from VFO" button. To adjust the frequency, place the cursor on the slider, click once with the left mouse button and then vary the frequency by turning the mouse wheel or by pressing the cursor keys on the keyboard. Alternatively, you can move the slider with the mouse while holding down the left mouse button. The adjustment grid can be changed with "Set Tuning Stepsize". When switching, the slider automatically locks in the middle position without changing the frequency, so that you always get the maximum variation range.

In the box "Fixed Frequencies + Scanning" there are 10 frequency input fields whose values are automatically saved when leaving the program and are immediately available again when restarting. The uncorrected original frequency of the VFO must be entered. This is always displayed in the window above the frequency slider and can be copied from there. By clicking on the round button to the left of the input field, the respective frequency is set in the VFO. On the right, by activating (checking) the square boxes, you can put together any selection of these fixed frequencies for the scan mode. Clicking on the field again deactivates it. To start the scan mode, click on "Scan Selection". Clicking on this field again stops scanning. The scan speed can be entered numerically in milliseconds in the field "Speed (ms)". A changed scanning speed is not effective until the scanning process is restarted (click „Scan Selection“ again).