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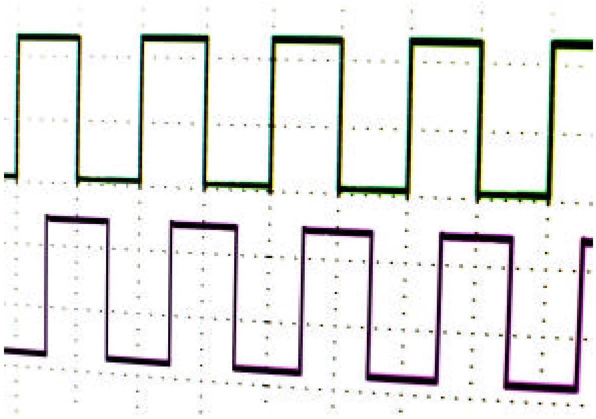
"pulse – generator TB2" Testbox
Operating instructions
Generator for generating A and B quadrature signals



- Simulates the output signals of incremental measuring systems (A,B with 90° phase shifting)
- Output frequency adjustable between 0 and 250 kHz
- Resolution of 0.1Hz
- Frequency accuracy of 100ppm
- Simulation of flow metering with VSE VS(I) series flow meters
- Sweep function which takes the direction of rotations of the most diverse frequency ranges into account
- Reversible direction of rotation (phase position A/B)
- Adjustable frequency/flow divisions during operation
- Output A, B with HTL level 10-28 V; optional additional differential outputs A,/A; B,/B with HTL level 10-28V or RS422 level
- Large distribution voltage range 10-28V DC
- Connection via a round M12 plug

Safety instructions

- This description includes important instructions concerning the installation, function and the operation. This information is therefore an important part of the device. A non-observance can result in damage being caused or the safety of personnel and plant being impaired!
- The device is only to be installed and commissioned by an electrical specialist.
- The general, country-related and usage-related safety regulations are to be observed and adhered to.
- If the device is to be used in processes by which a possible malfunction or incorrect operation can pose a risk to personnel and plant, corresponding safety precautions are to be taken in order to avoid this.
- The general standard for the construction of switch cabinets in the machine construction industry have validity for the installation
- - Amendments can be made to this document without further notification; errors excepted -

Contents:

1. General Information

It is not possible to imagine not using incremental measuring systems in almost all industrial areas. This technology is wide-spread for flow metering in fluid engineering and rotational speed counting in motion power engineering alone. Additional applications are path measuring, position measuring and speed measuring in industrial system solutions.
With the "pulse – generator TB2" testbox from VSE Volumentechnik GmbH, incremental sensor signals or two 90° phase-shifted pulse signals A and B are generated respectively. This pulse generator is able to generate frequencies of between 0.1Hz and 250,000.0Hz. The resolution is 0.1Hz. The incremental rotary encoder signals can either be adjusted by directly entering the frequency or by using a special menu to specify flow meter values from the VS(I) series of VSE flow meters. The construction size, interpolation factor and the corresponding flow unit are taken into account when generating the flows. An additional menu can be used to run through stipulated frequency ranges. Hereby, the direction of rotation is switched, depending on the set frequency range, i.e. the phase position of both of the quadrature signals A and B is shifted by 90° null.

It is a very useful and inexpensive means for the simulation of incremental encoder signals.

The following tasks can be fulfilled with the assistance of the incremental pulse encoder:

- Qualifying of the possibilities of use of a measuring system for the desired application
- Checking of the layout of an incremental measuring system
- Testing the functional testing of machine components and control units or evaluation units during the development phase
- Checking of the setting parameters of electronic evaluation units or converters without installing the mechanical components (e.g. flow sensors)
- Checking of the cabling between the sensory technology and the electronic measuring devices during commissioning
- Simulation of incremental sensor signals when servicing plants
- Simulation of the flow quantities of VSE flow meters (VS(I) series)
- Checking of incremental measurement data recordings and their dynamics
- Testing the frequency behavior of switchings
- Simple error analysis in case of plant disturbances

2. Description

The "pulse – generator TB2" testbox has three different types of operation or modes:

1. "manual" mode: setting of a frequency of between 0.1Hz and 250,000.0Hz
2. "VS(I)" mode: setting of a measured flow value, stipulating the VS(I) constructional size, the interpolation factor and the flow unit
3. "sweep" mode: setting of linear sweep ranges between two frequency values

The operation of the "pulse – generator TB2" testbox is quickly understood and utilizes the simple keypad.

3. The "manual" Operating Mode

3.1. Description of the "manual" operating mode

The "manual" operating mode enables a direct entering of the user-related frequency. The desired frequency can simply be entered using the numeric keypad. The entered frequency will be stored after it has been acknowledged. The output of the incremental pulses is started and stopped using the separate start/stop key . The direction of rotations can be changed, i.e. the phase position of both of the quadrature signals can be shifted by 90° (see Fig. 1) using the "direction" key. An additional function is provided by the % key, with which the entered frequency can be directly split. If only this key is activated, the frequency is output in the following percentages: 10%, 1%, 100%. In combination with a numeric key, it is possible to enter the frequency in percentages of 10, e.g. pressing the keys % and 6 simultaneously results in 60% of the entered frequency being output. The frequency display is updated accordingly.

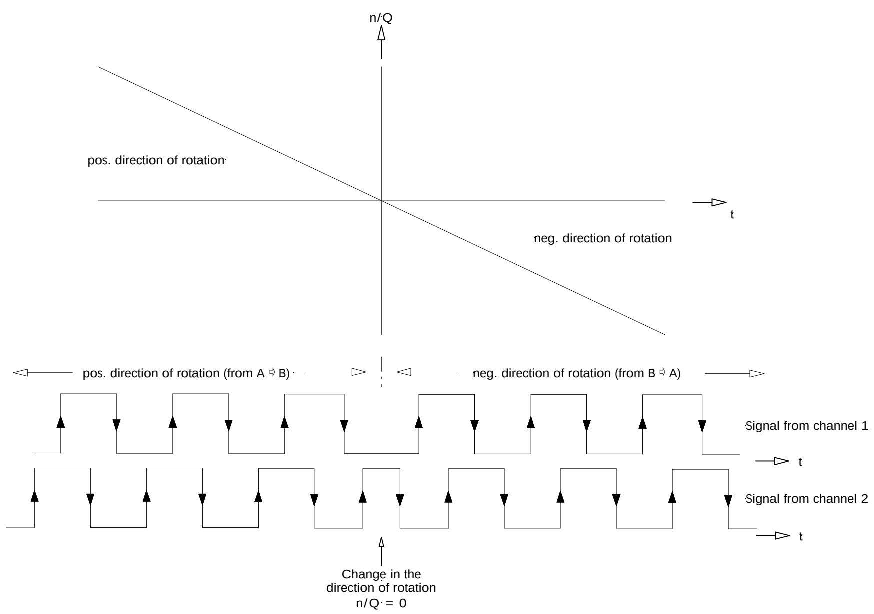


Fig. 1: Change of direction of the quadrature signals

3.2. Using the "manual" mode of operation

The "manual" mode of operation is used as follows:

General operation of the "manual" mode of operation

Display	Meaning
Mode MANUAL [Start]	Mode of operating display; Status of the frequency output
-100% Frequency	Displays the current frequency output split
>FRQ +000120.1 Hz	Frequency entry menu item
>change Mode VS(I)	Mode of operation selection menu item

Key	Function
▲ ▼	Change between each of the menu items
Enter	Entering the selected menu item
direction	Changing the direction of rotation
start / stop	Enable / Disable of frequency-output
% split	Splitting the frequency output 10%, 1%, 100%
% split + 7 8 9 4 5 6 1 2 3 0 (100%)	Splitting the frequency output 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%

Operation of the "frequency entry" menu item

```
Mode MANUAL   [Start]
-100% Frequency
xFRQ +000120.1 Hz
>change Mode VS(I)
```

Frequency entry menu item

	Changing the cursor position
+/- or direction	Changing the direction of rotation in the entry
	Increase the selected number (+1)
	Decrease the seceted number (-1)
7 8 9 / 4 5 6 / 1 2 3 / 0	Direct entry of the numbers
Enter	Confirmation of the entered frequency value Return to the menu item selection

Operation of the "mode of operation selection" menu item

```
Mode MANUAL   [Start]
-100% Frequency
>FRQ +000120.1 Hz
xchange Mode VS(I)
```

Mode of operation selection menu item

▲ ▼ Selection of the mode of operation

Enter Confirmation of the selected mode of operation
Entering the selected mode of operation
or return to the menu item selection

4. The "VS(I)" Mode of Operation

4.1. Description of the "VS(I)" mode of operation

The "VS(I)" (VS(I)flow meter series) mode of operation was especially developed for the "VS(I)" flow sensor system from VSE Volumentechnik.
Flow meters made by VSE Volumentechnik GmbH measure the volume flow of liquids according to the toothed wheel principle. A pair of very precisely adjusted toothed wheels in the housing constitutes the meter. A signal pick-up system registers the meter rotation free of contact and tooth by tooth. Each tooth is output as a digital pulse. The gaps in the teeth of the meter wheels form meter chambers in the areas in which they are completely enclosed by the housing walls; these chambers digitalize liquid flow depending on their chamber volume. The liquid flow quantity within one meter rotation of a tooth division forms the volume measurement per pulse (Vm) and is defined in cm³/pulse. It identifies the constructional size of a flow meter. The two-channel, incremental output of the digital signals provides a higher measured value resolution and a detection of the flow direction.

Fig. 2: VSE flow meters

An explicit simulation of the flow values of these flow meters is y possible in the "VS(I)" mode of operation.
The constructional sizes of the VS(I) are in a menu item in a selectable tabular form. The corresponding interpolation factor is also to be selected when using VSI flow meters. This is to be programmed with 1 when using the standard VS version. The desired flow is directly entered using the numeric keys. A corresponding flow unit is to be set prior to this. A choice can be made from seven different units:

Unit	Display
Liters per minute (l/min)	l/min
Liters per hour (l/h)	l/h
Liters per second (l/s)	l/s
US gallons per minute (USgal/min)	GPM
US gallons per hour (USgal/h)	GPH
US gallons per second (USgal/s)	GPS
Frequency display (Hz)	Hz

Table 1: programmable units

The flow entry field is adapted in accordance with the selected construction size and unit.

The unit can also be changed during operation by using the "unit" Unit key. The flow meter value display is changed automatically.
If the unit "Hz" should be selected, the corresponding output frequency is displayed, taking the set frequency split parameter and the IPF factor into account. Furthermore, in this mode it is also possible to have the flow meter value or frequency respectively, displayed as a percentage of the entry, by using the "split" % key or a corresponding key combination (e.g. % and 6).
With these options, one is explicitly able to simulate flows in order to set and optimize the evaluation and converter units correspondingly without taking the fluid circulation into operation or having to make an installation.
The construction size VS(I), interpolation factor IPF, flow meter value Q and the flow unit are stored after they have been entered in the device.

4.2. Operating the "VS(I)" mode of operation

You will find a detailed description of the usage of the "VS(I)" menu on the following pages.

General operation of the "VS(I)" mode of operation

Change between each of the menu items

Enter: Entering the selected menu item

Mode VS(I) [Stop]
>VS(I)0.02 >IPF10
- 90% Flow
>Q -00001.25 l/min
>change Mode SWEEP

Mode of operation display; Status of the flow output

VS(I) size menu / interpolation factor IPF menu

Current flow output split display

Flow entry menu item

Mode of operation selection menu item

direction: Changing the flow direction

start / stop: Enable / Disable the flow output

Unit – unit: Direct changing of the unit

% – split: Splitting the flow output 10%, 1%, 100%

% – split + 7 8 9 4 5 6 1 2 3 0 (100%): Splitting the flow output 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%

Operation of the "VS(I) size" menu item

```
Mode VS(I)    [Stop]
xVS(I)0.02  >IPF10
- 90% Flow
>Q -00001.25  l/min
- - - - - - - - -
>change Mode SWEEP
```

VS(I) size menu item

▲ ▼ Selection of the size (0,02; 0,04; 0,1; 0,2; 0,4; 1; 2; 4; 10)

Enter Confirmation of the selected VS(I) size
Return to the menu item selection

Operation of the "interpolation factor IPF" menu item

```
Mode VS(I)    [Stop]
>VS(I)0.02  xIPF10
- 90% Flow
>Q -00001.25  l/min
- - - - - - - - -
>change Mode SWEEP
```

Interpolation factor IPF menu item

▲ ▼ Selection of the IPF (1, 2, 3, 4, 5, 8, 10, 12, 16)

Enter Confirmation of the selected interpolation factor IPF
Return to the menu item selection

Operation of the "flow value entry" menu item

```
Mode VS(I)     [Stop]
>VS(I)0.02  >IPF10
- 90% Flow
xQ -00001.25  l/min
>change Mode SWEEP
```

Flow value entry menu item

◀ ▶ Changing the cursor position

+/- or direction: Changing the direction of rotation in the entry

▲ Increase the selected number (+1)

▼ Decrease the selected number (-1)

▲ ▼ Selecting the flow unit

7 8 9 / 4 5 6 / 1 2 3 / 0: Direct entering of the numbers

Enter: Confirmation of the entered frequency value
Return to the menu item selection

Operation of the "mode of operation selection" menu item

```
Mode VS(I)     [Stop]
>VS(I)0.02  >IPF10
- 90% Flow
>Q -00001.25  l/min
xchange Mode SWEEP
```

Mode of operation selection menu item

▲ ▼ Selection of the mode of operation

Enter Confirmation of the selected mode of operation
Entering the selected mode of operation menu
or return to the menu item selection

5. The "sweep" Mode of Operation

5.1. Description of the "sweep" mode of operation

The "sweep" operation enables the scan or sweep of a fixed range between two frequency values.
The start frequency, end frequency and the sweep time are programmed. Different frequency directions can also be selected. One function permits the starting of the sweep process with null or in a null scan respectively. This enables the simulation of the most diverse incremental frequency processes such as a flow characteristic for a servo valve.

The sweep characteristic is linear (ramp). It should, however, be taken into account that the frequency is actually changed incrementally and not linear. It should also be taken into account how the device actually reacts if extreme sweep time and sweep range combinations are used. In sweep mode, the software generates a table with 1200 intermediate frequencies, including the stipulated start and end frequencies. In the activated sweep mode, each of the used frequencies has to be extracted from the table and processed.
The frequency resolution of the steps depends on the programmed sweep range and the sweep time or sweep rate respectively.
A wide sweep range and a fast sweep rate result in a very rough frequency resolution of the steps.
Generally speaking, "sweeping" is normally used in connection with a measuring data recording or with an oscilloscope, in order to test the frequency behavior of evaluation devices or circuits.
A separate trigger outlet "TRIGOUT" is available for the triggering of oscilloscopes. This trigger outlet goes to low level at the start of the sweep and remains in this status during the first frequency step. The TRIGOUT status returns to high level after the first frequency step has been completed.

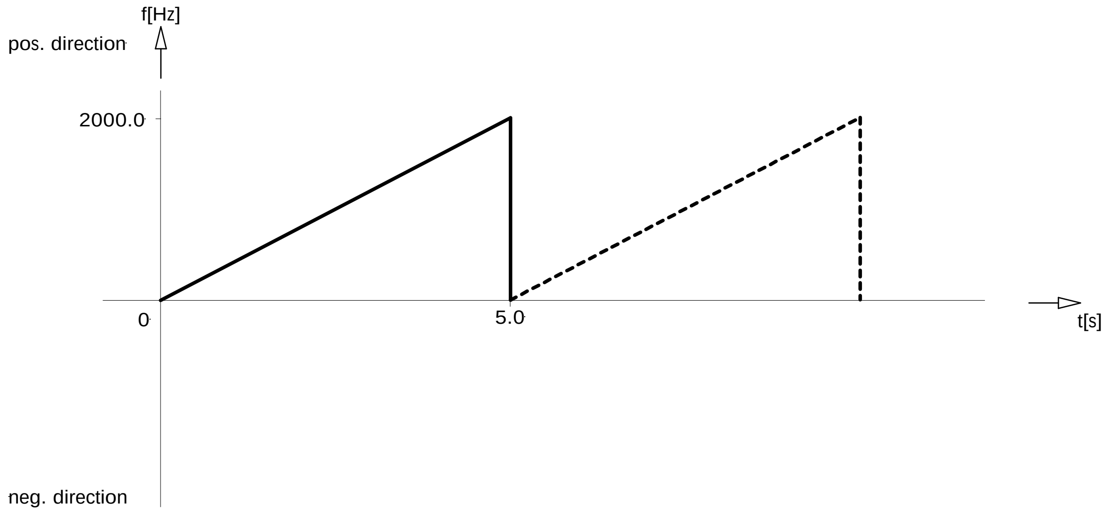
The "sweep" mode of operation has the following technical data:

- Sweep simulations of incremental frequency responses with and without changes of direction
- Sweep modes of operation: single sweep and continuous sweep operation due to adjustable loops
- Sweep characteristic: linear
- 4 different incremental sweep modes with two cutoff frequencies can be programmed
- The start and end frequencies can be adjusted infinitely (0.1…250,000.0Hz) within a range
- Triggering of an oscilloscope or x-y recorder possible due to an additional trigger outlet TRIGOUT
- Sweep direction exchangeable via a mode change-over
- "Sweep-Start" can be adjusted at zero or at "start on zero"
- Sweep time can be infinitely variably adjusted between 0.1s ... 20.0s
- A programmable number of loops can be adjusted between 1 and 1000

5.2. Functions of the "sweep" mode of operation

The following "sweep" functions of incremental signals are possible with the "pulse – generator TB2":

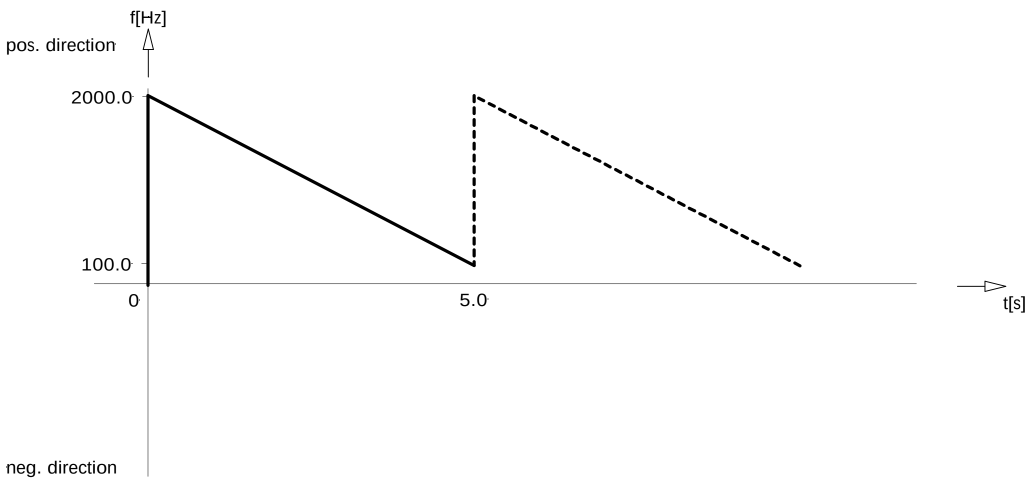
Example 1:



Settings:

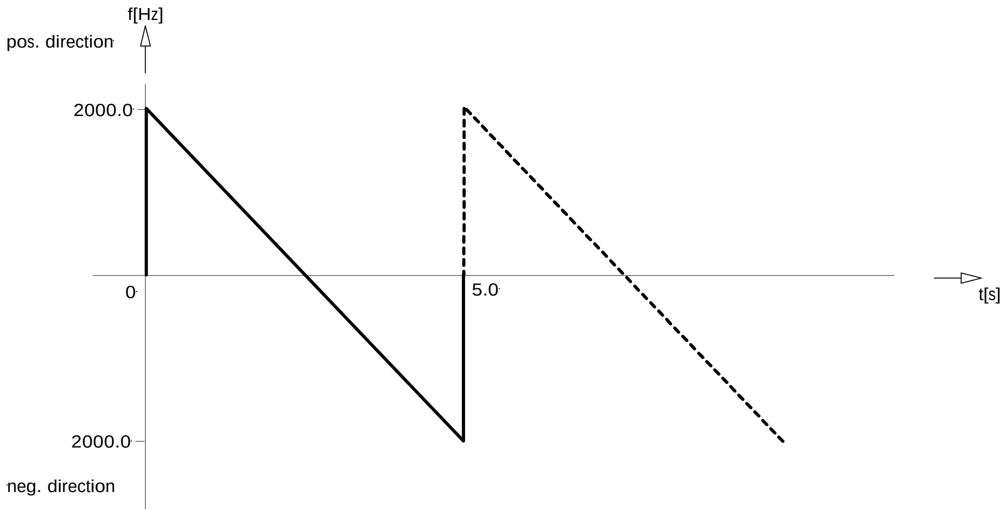
- Sweep **UP** (FRQ_1 ⇒ FRQ_2)
- FRQ_1 **+000000.0Hz**
- FRQ_2 **+002000.0Hz**
- Start on zero **off**
- Sweep time **005.0**s
- No. of loops **0002**

Example 2:



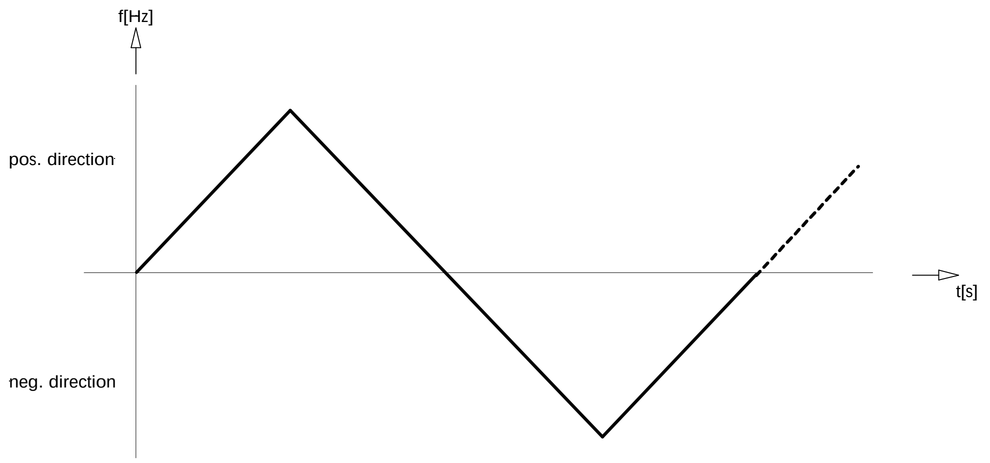
Settings:
- Sweep **DOWN** (FRQ_2 ⇒ FRQ_1)
- FRQ_1 **+000100.0Hz**
- FRQ_2 **+002000.0Hz**
- Start on zero **off**
- Sweep time **005.0**s
- No. of loops **0002**

Example 3:



Settings:
- Sweep **UP** (FRQ_1 ⇒ FRQ_2)
- FRQ_1 **+002000.0Hz**
- FRQ_2 **- 002000.0Hz**
- Start on zero **off**
- Sweep time **005.0**s
- No. of loops **0002**

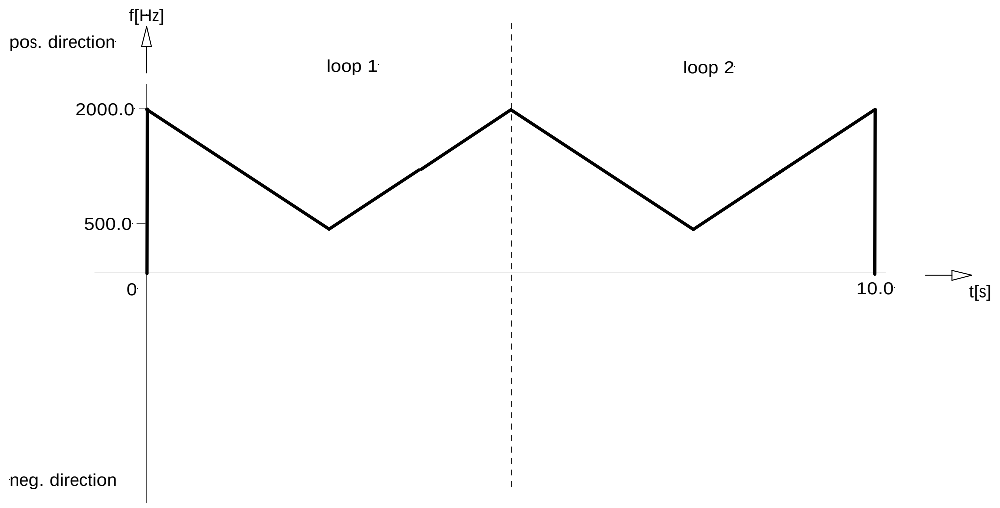
Example 4:



Settings:

- Sweep **UP / DOWN** (FRQ_1 ⇒ FRQ_2 ⇒ FRQ_1)
- FRQ_1 **+02000.0Hz**
- FRQ_2 **- 02000.0Hz**
- Start on zero **on**
- Sweep time **005.0**s
- No. of loops **0002**

Example 5:



Settings:

- Sweep **DOWN / UP** (FRQ_2 ⇒ FRQ_1 ⇒ FRQ_2)
- FRQ_1 **+0500.0Hz**
- FRQ_2 **+02000.0Hz**
- Start on zero **off**
- Sweep time **005.0**s
- No. of loops **0002**

5.3. Operating the "sweep" mode of operation

Adjusting the sweep parameters:

General operation of the "sweep" mode of operation

▲ ▼ Change between each of the menu items

Enter — Entering the selected menu item (only possible if sweep is disabled!)

Display	Description
Mode SWEEP [Start]	Mode of operation display; Status of the sweep output
>Sweep UP/DOWN	Sweep functions selection menu item
>FRQ_1 -000250.0Hz	Frequency entry FRQ_1 menu item
>FRQ_2 +000250.0Hz	Frequency entry FRQ_2 menu item
>Start on zero off	Start on zero menu item
>SweepTime 000.5s	Time entry menu item
>No. of loops 1000	Number of loops menu item
>change Mode MANUAL	Mode of operation selection menu item

start / stop — Enable / Disable the sweep output (Activiation only possible outside of the menu items possible!)

Operation of the "sweep mode" menu item

Mode SWEEP [Start]
xSweep UP/DOWN
>FRQ_1 -000250.0Hz
>FRQ_2 +000250.0Hz
>Start on zero off
>SweepTime 000.5s
>No. of loops 1000
>change Mode MANUAL

Sweep functions selection menu item

▲ ▼ Selecting the sweep mode (UP; DOWN; UP/DOWN; DOWN/UP)

Enter Confirmation of the selected sweep mode
Return to the menu item selection

UP: FRQ_1 >> FRQ_2
DOWN: FRQ_2 >> FRQ_1
UP/DOWN: FRQ_1 >> FRQ_2 FRQ_1
DOWN/UP: FRQ_2 >> FRQ_1 FRQ_2

Operation of the "frequency entry FRQ_1; FRQ_2" menu item

Mode SWEEP [Start]
>Sweep UP/DOWN
xFRQ_1 -000250.0Hz
xFRQ_2 +000250.0Hz
>Start on zero off
>SweepTime 000.5s
>No. of loops 1000
>change Mode MANUAL

Frequency entry menu item FRQ_1

Frequency entry menu item FRQ_2

Key	Function
◀ ▶	Changing the cursor position
+/- or direction	Changing the direction of rotation in the entry
▲	Increase the selected number (+1)
▼	Decrease the selected number (-1)
7 8 9 4 5 6 1 2 3 0	Direct Entering of the numbers
Enter	Confirmation of the entered frequency value Return to the menu item selection

Operation of the "start on zero" menu item

```
Mode SWEEP    [Start]
>Sweep UP/DOWN
>FRQ_1  -000250.0Hz
>FRQ_2  +000250.0Hz
- - - - - - - - - - -
xStart on zero  off
>SweepTime 000.5s
>No. of loops 1000
>change Mode MANUAL
```

Start on zero menu item

▲ ▼ Selection (on; off)

Enter Confirmation of the selection
Return to the menu item selection

Operation of the "sweep time" menu item

```
Mode SWEEP    [Start]
>Sweep UP/DOWN
>FRQ_1  -000250.0Hz
>FRQ_2  +000250.0Hz
- - - - - - - - - - -
>Start on zero  off
xSweepTime 010.5s
>No. of loops 1000
>change Mode MANUAL
```

Sweep time menu item

◀ ▶ Changing the cursor position

▲ Increase the selected number (+1)

▼ Decrease the selected number (-1)

7 8 9 / 4 5 6 / 1 2 3 / 0 Direct Entering of the numbers

Enter Confirmation of the entered frequency value
Return to the menu item selection

Operation of the "no. of loops" menu item

```
Mode SWEEP    [Start]
>Sweep UP/DOWN
>FRQ_1  -000250.0Hz
>FRQ_2  +000250.0Hz
- - - - - - - - - - -
>Start on zero  off
>SweepTime 010.5s
xNo. of loops 0100
>change Mode MANUAL
```

Number of loops menu item

◀ ▶ Changing the cursor position

▲ Increase the selected number (+1)

▼ Decrease the selected number (-1)

7 8 9
4 5 6 Direct Entering of the numbers
1 2 3
0

Enter Confirmation of the entered frequency value
Return to the menu item selection

Operation of the "mode of operation selection" menu item

```
Mode SWEEP    [Start]
>Sweep UP/DOWN
>FRQ_1  -000250.0Hz
>FRQ_2  +000250.0Hz
>Start on zero  off
>SweepTime 010.5s
>No. of loops 0100
xchange Mode MANUAL
```

Mode of operation selection menu item

▲ ▼ Selection of the mode of operation

Enter Confirmation of the selected mode of operation
Entering the selected mode of operation menu
or return to the menu item selection

6. Resetting to the Works Setting

The Testbox can be reset by pressing the keys ▼ Unit ◄ ► simultaneously. This key combination initiates the reset process. The power failure-safe memory is hereby reloaded with "default" values before being reset.
After the reset, the "pulse – generator TB2" is in the "manual" mode of operation.

7. "pulse – generator TB2" Testbox Connections

The "pulse – generator TB2" testbox has a M12 plug and a BMC socket as standard.
The device is provided with power and outputs the incremental pulse signals via the M12 plug. A connection diagram is shown in Fig. 4.
The "TRIGOUT" trigger outlet for the sweep operation is at the BNC socket.
Special versions are equipped with an additional M12 plug on the device.
This is situated between the standard M12 plug and the BNC socket (see Fig. 3).
At this plug, the digital signals can be differentially output at this plug with the supply voltage (HTL level: 10-28V) or in a RS422 format (level 2-3V, f_{max} = 150kHZ) as requested. Each signal is hereby transmitted to 2 lines with complementary levels. The logic level is determined at the receiver on the basis of the difference between the two lines A, B and /A, /B. This makes long transmission links possible in addition to increasing the interference immunity.

The connection cable should only be a well-screened cable with a wire cross-section of =4 x 0.25mm². Please note that the round M12 plug has a metallic housing, a connection for the shielding and that the potential of the grounding conductor PE or the ground is connected to the cable screen.

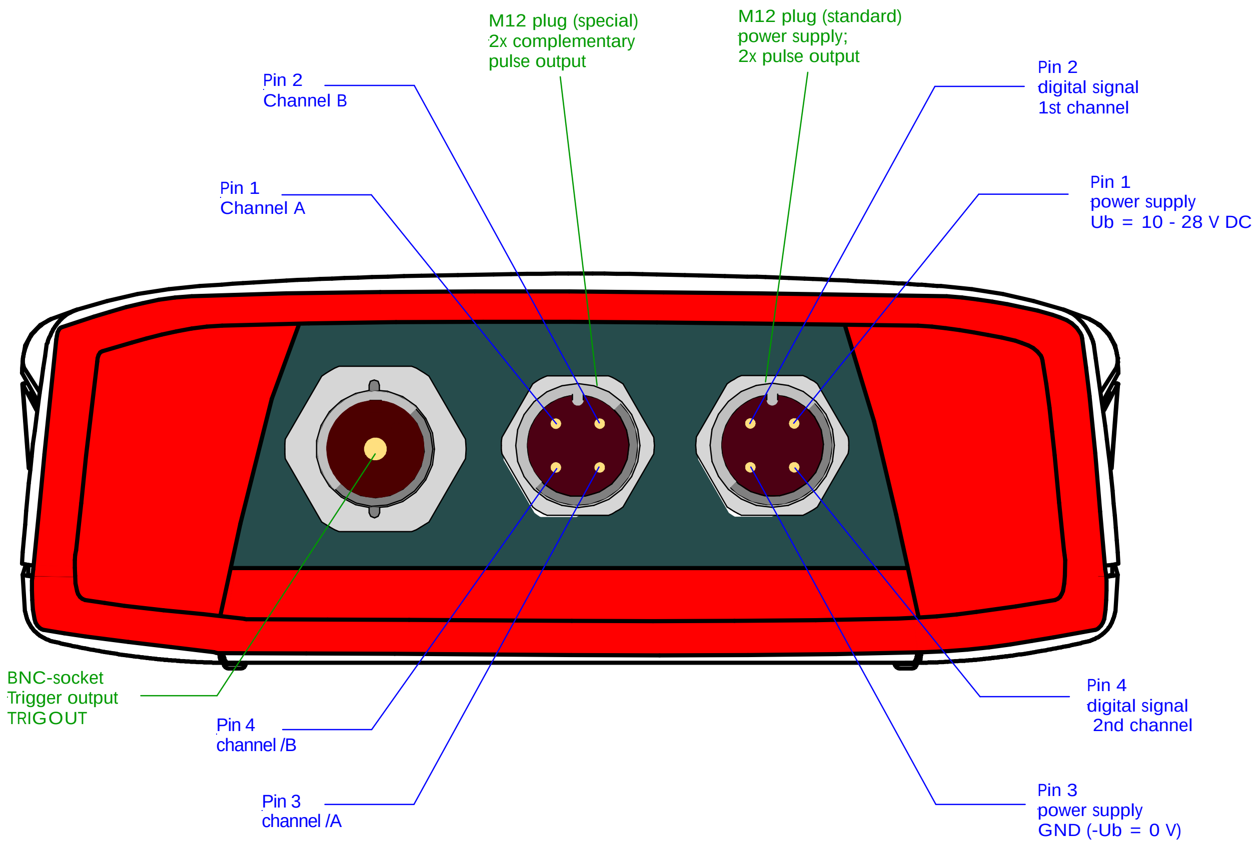


Fig. 3: The "pulse – generator TB2" testbox connections

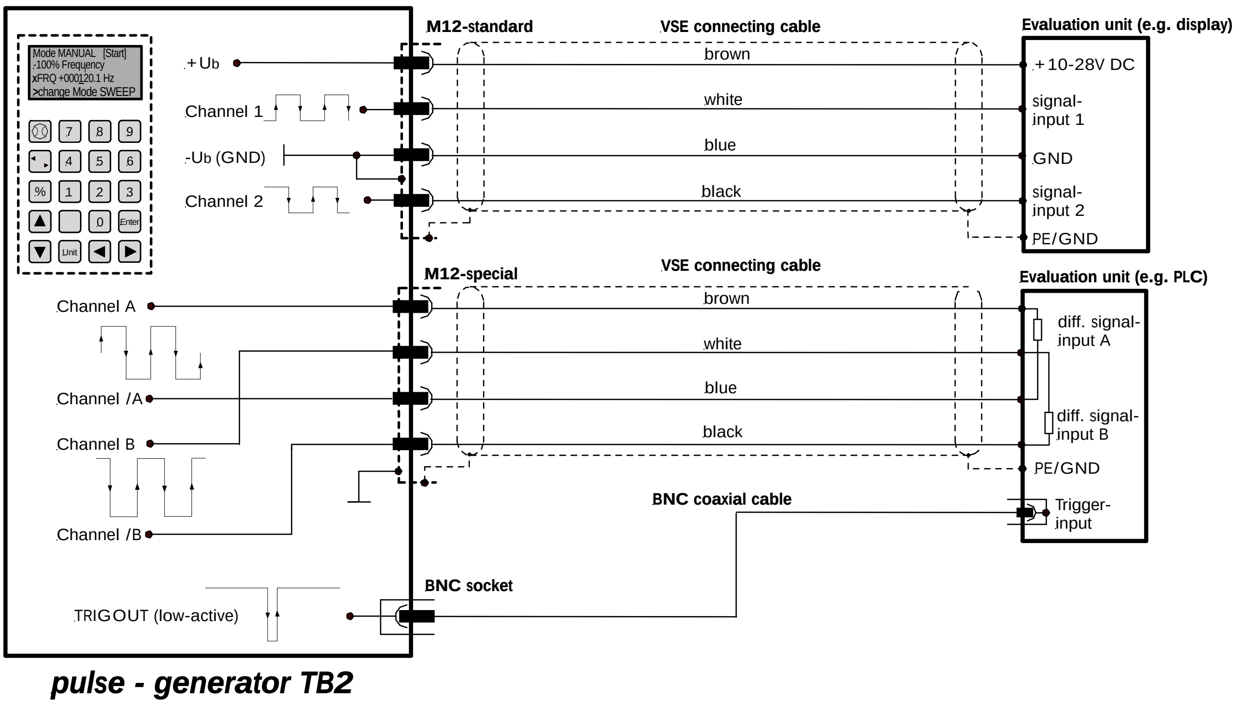


Fig. 4: Connecting diagram for the power supply and the signal outputs

8. Technical Data

Power supply:

Supply voltage:	U = 10…28V DC; voltage reversal-safe
Current consumption:	I_0 = 42mA (at 24VDC); unloaded

Signal outputs (standard):

Signal form:	Quadrature signals (A,B with 90° phase shifting)
Frequency range:	0.1 – 250,000.0 Hz
Resolution:	0.1Hz
Signal voltage output: (channel 1; channel 2)	U_{SS} = 9…27VDC
Signal output current: (channel 1; channel 2)	I_{OUT} = 300mA max at 24V DC
Output preamps:	Push-Pull preamps; current limited; short-circuit proof; internal cable adaptation; low saturation voltage; temperature protection circuit with hysteresis; high-impedance outlets in case of failures

Additional signal outputs (special):

Signal output:	Channel A, /A (with inversion), Channel B, /B (with inversion)
Signal output level:	HTL level 10 – 30 V or RS422 level
Signal voltage output:	U_{SS} = 8…27VDC differential (with HTL) U_{SS} = 0.4…3.2VDC differential (with RS422)
Signal output current:	I_{OUT} = 200mA (with HTL), I_{OUT} = 20mA (with RS422)
Output preamps:	Push-Pull preamps; current limited; short-circuit proof; internal cable adaptation (with HTL) or RS422-driver AM26C31 (f_{max} = 150kHz)

<u>Housing:</u>

Dimensions:	LxWxH 209.3 x 98 x 34.8mm
Material:	Material: ABS (acrylonitrile-butadiene-styrene)
Color:	graphite gray
System of protection:	IP64