



VOLTcraft®

Frequency Counter FC-2500

GB OPERATING INSTRUCTIONS

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Introduction

Dear customer,

with the acquisition of the Frequency Counter FC-2500 you have obtained a state-of-the-art measurement device. It features three inputs with channel A enabling measurements of up to 2.5 GHz (gigahertz) at 1Mohm. Measurements up to 500 MHz at 50 ohm can be performed at input B and up to 10 MHz at 50 ohm are possible at input C. The frequency is displayed on an 8-digit liquid crystal display (LCD).

The product is designed according to VDE 0411 = EN 61010. Furthermore, the FC-2500 is EMC-tested and therefore fulfils the requirements of the relevant European and national guidelines. Conformity has been proved; the relevant documents are in the possession of the manufacturer. To preserve this condition and to enable safe operation, you as the user must observe these operating instructions!

In case of technical questions please contact us:

**Germany: Tel. 0180/5 31 21 11,
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E-mail: Please use our contact form in the Internet:
www.conrad.de in the category "Contact"
Mon to Thurs 8.00am to 4.30pm Fri 8.00am to 2.00pm**

Proper use

- Measuring and displaying frequencies of 10 Hz min. up to 2500 MHz max. The maximum inputs of 88 Vrms at channel C and of 5 Vpp (peak-to-peak) at channel A and channel B must not be exceeded. The measurement voltages must be galvanically isolated from the mains (shock hazard).
- Performing measurements under unfavourable ambient conditions is not permissible. Unfavourable ambient conditions are:
 - Moisture or excessive air humidity
 - Dust and combustible gases, fumes or solvents
 - Thunderstorms or similar conditions such as strong electrostatic fields etc. A use other than the one described above is not permissible and causes damages to this product. Furthermore, it involves hazards such as short-circuit, fire, electric shock, etc.! The entire product must not be changed or modified! The safety instructions must be adhered to!

Controls

1. BNC-connector for the inputs 1a "A" 50 MHz to 2500 MHz at 1 Mohm, 1b "B" 10 MHz to 500 MHz at 50 ohm, 1c "C" 10 Hz to 10 MHz at 50 ohm
2. Selector switch for adjusting the sensitivity of channel "C" (High and Low)
3. "RANGE" – selector for range /input switching "CH A" (CH = channel), "CH B" and for "CH C" the positions "10Hz – 10 MHz" and period (period measurement)
4. Switch "GATE TIME" for adjusting the gate time "FAST" or "SLOW"

5. Push-button "RECORD" for recording (storing) a measured frequency
6. Push-button "CALL" for displaying a recorded frequency
7. Push-button for power "OFF" (device off) and "ON" (device on)
8. Push-button for the function "HOLD"
9. Push-button for the function "REL" (=relative = reference value)
10. Push-button for the function "RESO" (=resolution) in connection with the switch "SENSITIVITY"
11. 8-digit liquid crystal display (LCD)
12. Adjustable handle, supports the device at an easy-to-read angle
13. Connecting jack for an external power supply unit (not included in the delivery) with polarity "+" inside
14. Cover of the battery compartment

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Safety instructions

The guarantee claim becomes invalid for damages due to non-observance of these operating instructions! We do not assume liability for consequential damages!

We do not assume liability for property damages or personal injuries caused by improper use or non-observance of the safety instructions. In all such cases guarantee claims become invalid.

The Frequency Counter FC-2500 has left the factory in compliance with all relevant safety regulations. To preserve this state and to guarantee safe operation, the user must observe the safety instructions and warnings contained in this operating manual.

Measurement devices and their accessories must be kept out of reach of children!

In schools, training facilities, do-it-yourself and hobby workshops, test devices and accessories are to be used only under supervision of trained personnel.

Take the device into operation only when the housing is safely closed and screwed down.

Never apply mains voltage to the measurement inputs. This might destroy the device and represent a serious threat to your life. You must observe the maximum input ratings!

If there is reason to believe that safe operation has become impossible, the device must be put out of operation and must be secured against unintended operation. It can be assumed that safe operation is no longer possible,

- if the device shows visible damages
- if the device no longer works

- after prolonged storage under unfavourable conditions, or
- after it was exposed to extraordinary stress caused by transport.

Installation, commissioning

A basic adjustment, general

- a1 Do not operate the device in extremely cold or hot places, in vehicles during summer, near fan heaters.
- a2 Do not expose the device to direct insolation. The display becomes black at temperatures over approx. 60°C (no longer readable). Only after corresponding cooling (in the shadow) the display becomes visible again.
- a3 Never turn on the device immediately after it has been brought from a cold into a warm room. Condensation water that forms might destroy your device. Leave the device switched off and wait until it has reached room temperature.
- a4 Do not operate the device in the direct vicinity of hot soldering irons.
- a5 Do not place the device with the control panel side down as this may cause misadjustments.
- a6 If signal sources with BNC outputs are to be connected to the corresponding counter input (A, B or C), a coaxial cable is usually used for this connection. These cables are screened, i.e. the inner signal-conducting wire is shielded against external disturbance signals through a network of copper wires or tin-coated copper wires. This protective screen is generally connected to the earth of the signal source or of the counter. If you want to measure signals to devices or modules of electronic circuits, use a coaxial cable for this purpose that has a male BNC connector at one end and is open at the other end. The open ends are fitted with alligator clips.

- a7 The use of a telescopic antenna for increasing the input sensitivity is recommended from approx. 50 MHz on (fully extended) up to more than 1GHz (pushed together).

Caution !

Make sure that the circuits in/at which you perform your measurements are separated from the mains galvanically via an isolation transformer. Never connect the inputs/outputs (BNC) directly to the mains, to chassis to which voltage may be applied and to circuits operated without transformers (galvanic isolation). Caution danger to your life!

Observe the maximum input ratings. Never connect voltages of more than 88 Vrms to channel C and 5 Vpp to the channels A and B. Before each measurement check all BNC jacks for damage or short-circuit.

If the source resistance or the line capacitance of a direct connection between the measurement object and the frequency counter are unknown, especially at high frequencies, use a 1:10 probe with a low capacitance for the inputs A and B. Do not use a probe for channel C as its relatively high impedance might produce incorrect measurement results.

A strategy for coaxial cables to keep measurement errors low when measuring low frequencies is the use of a terminator. The impedance of this terminator, which is connected directly to the frequency counter, should correspond to the impedance of the signal source and of the cable.

Example: Output resistance of a frequency generator = 50 ohm,
Resistance of the coaxial cable used = 50 ohm
==> Resistance value of the terminator = 50 ohm

B Working with the frequency counter/commissioning

Three inputs are available for measuring frequencies: channel (CH) A, channel (CH) B and channel (CH) C. By using the push-button

"RANGE" you can switch between the inputs and in the case of channel C you can switch to period measurement. According to the following formula:

$$T = 1/f \quad (f = \text{frequency}, T = \text{period})$$

Attention!

Never exceed the maximum input rating(s). Only measure signal voltages that are separated galvanically from the mains. The voltage value must not exceed 5 Vpp max. at the channels A and B and 88 Vrms at channel C.

B1 Adjusting the input channel

Depending on the frequency range you intend to measure, select either channel A, channel B or channel C by setting the switch "RANGE" correspondingly. In the position CH A frequencies between 50 Mhz and max. 2500 MHz are measured. In the position CH B measurements between 10 MHz and 500 MHz (= 0.5 GHz) can be performed. The position CH C enables the frequency or period of a measurement signal to be detected in the range of 10 Hz and 10 MHz and 0.1 s to 0.1 μ s (microsecond), respectively.

B2 Adjusting the "GATE TIME"

The setting of the gate time depends on the measurement signal. If you are measuring a relatively constant frequency and if you desire a high accuracy, set the switch "GATE TIME" to the position "SLOW". If the measurement signal changes constantly, set the switch "GATE TIME" to "FAST". The current sampling time is indicated by a flashing decimal point on the lower right corner of the display. The resolution and the display accuracy indirectly connected to it can be adjusted via the push-button "RESO" (see also B4).

B3 Adjusting the input sensitivity "SENSITIVITY" (channel C)

For detecting weaker signals in the range up to 10 MHz the input sensitivity can be increased via the switch "SENSITIVITY" for chan-

nel C. For this purpose, set the switch to "HIGH". If the measured signals have a high amplitude ($88 \text{ V}_{\text{rms}} = 250 \text{ V}_{\text{pp}}$ max.) set the switch to "LOW". In doing so, the measurement input is not overrun (= overdriven).

B4 Adjusting the sampling time and resolution (last digit)

By applying the switch "GATE TIME" and the push-button "RESO" you can change the sampling rate and the resolution for the three channels "A", "B" and "C". This is done as follows:

Set the switch "GATE TIME" from "FAST" to "SLOW". Immediately afterwards, press the push-button "RESO" (= resolution). Subsequently, "—SEL.1—" appears on the display. If you apply the push-button "RESO" again, "—SEL.2—" is displayed. In this context, observe the following table:

Range	Switch position GATE TIME	Resolution	Sampling time
2500 MHz (CH A)	FAST	1000 Hz	0,50 s
	SLOW	100 Hz	2,75 s
	SLOW (SEL.1)	200 Hz	1,50 s
	SLOW (SEL.2)	500 Hz	0,75 s
FAST (CH B)	100 Hz	0,75 s	500 MHz
	SLOW	10 Hz	6,00 s
	SLOW (SEL.1)	20 Hz	5,00 s
	SLOW (SEL.2)	50 Hz	1,50 s
10 MHz (CH C)	FAST	10 Hz	0,50 s
	SLOW	1 Hz	1,25 s
	SLOW (SEL.1)	0,2 Hz	6,00 s
	SLOW (SEL.2)	0,1 Hz	11,00 s

B5 Hold function

If the push-button "HOLD" is pressed, the last frequency reading is "frozen", i.e. it is held. Even when the BNC cable is disconnected from the measurement object. The held value and "—HOLD—" appear alternately on the display. To return to the current measurement, again press the push-button "HOLD" once.

B6 Measuring the period

When performing frequency measurements at channel "C", the reciprocal value of the frequency, the so-called period, can be displayed by setting the switch "RANGE" to "PERIOD". If a measurement signal of e.g. 74 kHz is applied, the period of the measurement signal is $1/74 \text{ kHz}$ that is 13,513 μs . At a measured frequency of 50 Hz the period is 20 ms. On the display "20.000 -S." is displayed (due to technical reasons the measuring unit "ms" cannot be displayed).

B7 Reference value measurement "REL" (=relative)

If the push-button "REL" is applied during the measurement, the display is set to "0" and the symbol "REL" appears on the lower right corner of the display. The reference measurement "REL" indicates the difference between the held value and the currently measured value. This special feature is especially helpful when determining slowly changing frequencies or in the case of superposed frequencies.

If you want to exit the reference value measurement, again press the "REL" push-button. The symbol disappears and you return to the current measurement.

B8 Measurement value recording (minimum, maximum and average value)

If measurement value recording is activated, the lowest measured frequency, the highest measured frequency and the average value can be displayed after approx. 10 measurements. For this purpose, press the push-button "RECORD" once. The symbol "R.C" appears on the upper right corner of the display. The recording was started.

After at least 10 measurements (depends on the gate time and the frequency change) press the push-button "CALL" once. "---HI—" then appears on the display, shortly afterwards the highest measured frequency value is displayed. "R.C." flashes.

Press the push-button "CALL" again (second time). "---Lo---" then appears on the display, shortly afterwards the lowest measured frequency value is displayed.

Apply the push-button "CALL" again (third time). Subsequently, "---A---" is displayed, followed immediately afterwards by the average value. The averaging is updated every 10 measurements.

Press the push-button "CALL" again (fourth time). The symbol "R.C." no longer flashes. The measurement value recording can be terminated by applying the push-button "RECORD". The symbol "R.C." then disappears from the display.

B9 Auto-Power-Off

The measurement device features an Auto-Power-Off. After approx. 30 minutes the measurement device is switched off, if no push-button or switch is applied and the last digit of the measured value does not change by more than 10.

B10 Overload display

The display "---oL---" appears and an acoustic warning signal sounds,

- if the value measured at channel C exceeds 10 MHz,
- if the value measured at channel B exceeds 500 MHz, or
- if, during period measurement, no signal is applied to channel C.

Disposal

At the end of its useful life dispose of the (irreparable) Frequency Counter FC-2500 according to the relevant statutory regulations!

Troubleshooting

The Frequency Counter FC-2500 is a state-of-the-art measurement device of the latest generation. However, trouble may occur. Therefore, we present strategies in the following how to eliminate some of the problems relatively easily:

Problem	Possible solution
No display	Is the device turned on? Are the batteries working? Did you observe the correct polarity ("+" and "-") when replacing the batteries?
Frequency display "0..."	Is the correct channel adjusted (CH A or CH B or CH C)? Is the signal line connected to the correct input (A, B or C)?

Maintenance and care, battery replacement

For maintenance and battery replacement, please observe the safety instructions. The guarantee claim becomes invalid in case unauthorised alterations/modifications are performed to circuits. If repairs or adjustments become necessary to internal components of the device, please take it to your local service shop. Use a clean, dry, antistatic and lintfree cloth to wipe the device clean.

Attention!

Do not use carbon-containing cleaning agents, benzines, alcohols or the likes as they attack the surface of the measurement device. Furthermore, the fumes are detrimental to the health and

explosive. Do not use sharp tools, screwdrivers, metal brushes, etc. for cleaning.

Battery replacement

If the frequency display flashes, the supply voltage is in the range between approx. 4.5 and 4.7 VDC. In this case, a correct measurement is no longer possible. The batteries must be replaced as follows:

- Switch the frequency counter to the position "OFF",
- remove all connected cables,
- use a small screwdriver for recessed-head screws to
- loosen the two screws of the battery compartment on the bottom side of the device.
- Carefully lift the cover,
- remove the empty batteries and
- replace them by new batteries of the same type.
- Observe the correct polarity ("+" and "-") and
- carefully close the battery compartment after the battery replacement.

Caution!

Do not operate the frequency counter when it is open. Do not leave empty batteries in the measurement device. Even leak-proof batteries may corrode and set free chemicals that are hazardous to your health or destroy the battery compartment.

Empty batteries are to be considered as special waste and, therefore, must be disposed of in an ecologically sound manner. For this purpose, special collecting boxes are provided at specialist retail shops and also in several supermarkets or recycling collection centers.

Technical data, sensitivity

Input "A"

Frequency range	: 50 MHz to 2500 MHz
Resolution	: 0.1 kHz (= 100 Hz, Gate Time set to "SLOW") to 1kHz (Gate Time set to "FAST") : 50 MHz to 75 MHz max. ==> < 100 mV > 75 MHz to 2500 MHz ==> < 50 mV
Input sensitivity	
Impedance	: 1 Mohm parallel to < 40pF
Max. input voltage	: 5 Vpp, sinusoidal

Input B

Frequency range	: 10 MHz to 500 MHz
Resolution	: 10 Hz (Gate Time set to "SLOW") to 100 Hz (Gate Time set to "FAST")
Input sensitivity	: 10 MHz to 35 MHz ==> < 120 mV > 35 MHz to < 350 MHz ==> < 50 mV > 350 MHz to 500 MHz ==> < 120 mV
Impedance	: 50 Mohm
Max. input voltage	: 5 Vpp, sinusoidal

Input C

Frequency range	: 10 Hz to 10 MHz
Resolution	: 1 Hz (Gate Time set to "SLOW") to 10 Hz (Gate Time set to "FAST")
Input sensitivity	: 10 Hz to 10 MHz fi < 50 mV (frequency measurement) < 50 mV (measurement of the period)
Impedance	: 50 Mohm

Max. input voltage	: 88 Vrms = 88 Veff, sinusoidal
Accuracy of the frequency	: $\pm(4\text{ppm} + 1\text{d})$ for CH A, B and C; at 23°C $\pm 5\text{K}$, after the calibration (K = Kelvin; d = digit)
Time base	
Type	: crystal oscillator
Frequency	: 4.194 MHz
Temperature coefficient	: 0.1 ppm per °C (typically 23°C $\pm 5\text{K}$)
Digital display	
Display	: 8-digit LC-display, 13mm high, with the symbols "REL" for reference value and "R.C." for record, "--HOLD—" and "---oL---" (overload)
General technical data	
Voltage supply	: 4 x 1,5 V alkaline batteries, type AA or an AC adapter with 9 VDC / > 300 mA, "+" inside (not included in the delivery)
Current consumption	: approx. 105 mA for measurements at channel A or channel B approx. 5 mA for measurements at channel C
Ambient conditions	
Operating temperature range	: 0°C to +50°C (32°F to 122°F)
Relative air humidity	: max. 90% (0°C to 35°C), non-condensing
Dimensions (L x W x H)	: approx. 173 x 80 x 35 mm (without leads)
Weight	: approx. 340 g (without connections, batteries incl.)