

UF 251

Signal Converter

Analogue => Frequency and Analogue => Serial



- Input range : -10...+10 V or 0/4...20 mA
- Very fast conversion times
- Frequency outputs HTL up to 100 kHz and RS422 up to 500 kHz
- Various user modes: , programmable V/f characteristics, motorized potentiometer function, cyclic frequency output curves etc.
- RS232 and RS485 interface for serial readout of the conversion result or internal registers
- Adjustable floating average filter as well as operator programmable linearization curves
- Printer mode for automatic data transfer via serial link

Operating Instructions



Safety Instructions

- This manual is an essential part of the unit and contains important hints about function, correct handling and commissioning. Non-observance can result in damage to the unit or the machine or even in injury to persons using the equipment!
- The unit must only be installed, connected and activated by a qualified electrician
- It is a must to observe all general and also all country-specific and application-specific safety standards
- When this unit is used with applications where failure or maloperation could cause damage to a machine or hazard to the operating staff, it is indispensable to meet effective precautions in order to avoid such consequences
- Regarding installation, wiring, environmental conditions, screening of cables and earthing, you must follow the general standards of industrial automation industry
- - Errors and omissions excepted –

Version:	Description:
UF25101a/ AF/HK/ July 2003	Original Version
UF25101b/ KK/HK/ Jan 2005	Hint page 7: DIL switch setting with PC set up

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1. Introduction

UF 251 represents a small and low-cost, but highly performing converter for industrial applications, where analogue signals need to be converted into a frequency or a serial data format. The unit has been designed as a compact module with 12 screw terminals and two 9-position SUB-D connectors (female and male). The housing is suitable for standard DIN rail mounting.

A voltage input signal of ± 10 V can be directly applied to screw terminals 1 and 4 (AGND). The input resistance is approximately $100\text{ k}\Omega$.

It is also possible to use a potentiometer to set input voltage by connecting the centre tap of the potentiometer to screw terminal 3 and the end taps to screw terminals 2 and 4. The resistance of the potentiometer should be about $1\text{ k}\Omega$.

For use of current input signals ± 20 mA, connect the current loop to screw terminals 3 and 4 (AGND) and bridge screw terminal 3 to screw terminal 7. The input resistance is approximately $150\text{ }\Omega$.

The output frequency range is programmable and extends from 0.01 Hz to 100 kHz (HTL output) and 500 kHz (TTL differential respectively RS422 output). HTL and RS422 output signals can be used independently. Additionally, the unit provides a programmable marker pulse. The output frequency direction can either be set by control input "UP-DOWN" or is determined by the polarity of the input signal.

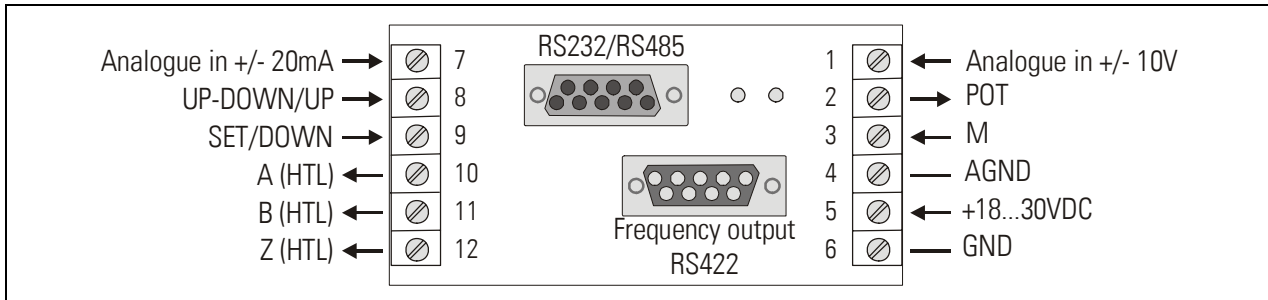
In "Motorized Potentiometer" Function Mode the UF251 can output a programmable frequency curve, under control of inputs "UP" and "DOWN".

In "Repeat Mode" the unit can output a cyclic frequency curve, controlled by the inputs "UP-DOWN" and "SET"

For applications with unstable input signals the unit provides a programmable digital filter to smoothen the output signal (floating average filter).

2. Terminal Assignment and Connections

Connect the power supply voltage to terminal 5 (+) and 6 (-). We recommend to tie the Minus wire of the power supply to earth potential. Terminals 4 (AGND) and 6 (GND) are connected internally. Depending on the power voltage level, the current consumption of the unit is approximately 120...180 mA.



2.1. Frequency Outputs

The unit provides two frequency outputs, one HTL level (A, B, Z) and one RS422 (A, /A, B, /B, Z, /Z). The marker pulse length is $\frac{1}{4}$ pulse period and is gated by A high and B high.

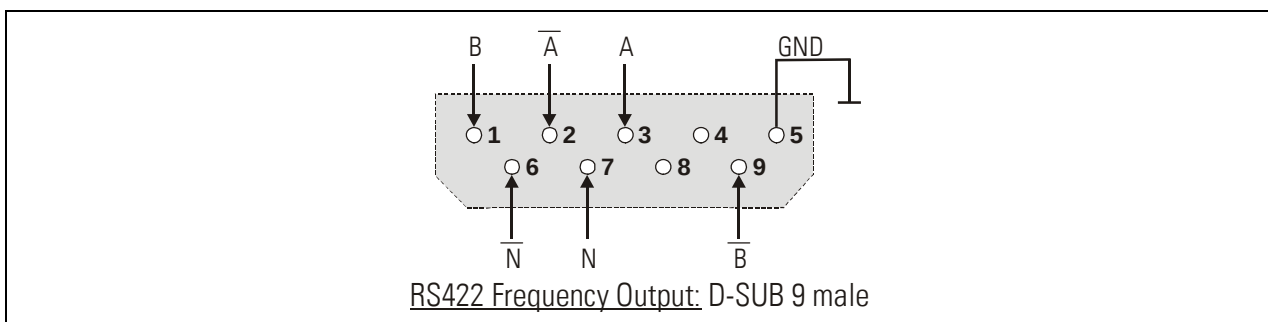
The HTL output, in High state, provides a no-load voltage of approximately the supply voltage minus 4 volts. The output is short-circuit proof up to 24 volts and has an internal resistance of approximately 600 Ω .

The maximum output frequency of the RS422 output is 500 kHz. The HTL output should however only be used up to approx. 100 kHz, since higher output frequencies could cause poor pulse edge quality.

The preset frequency ranges (selectable by DIL-switch) have an accuracy of 0.15% of full scale value and a dead band of 6.25 mV.

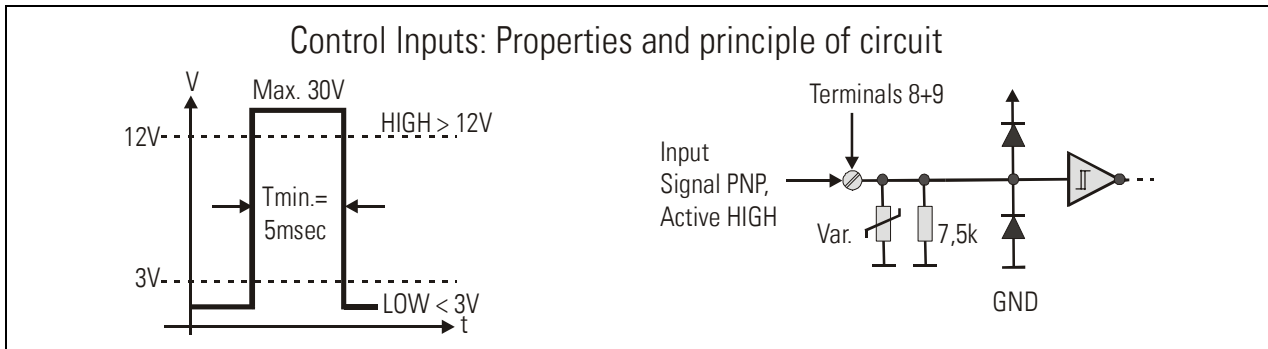
Accuracy and dead band can be increased by user specific limitation of the frequency ranges.

The overall frequency resolution is about 14 bits.

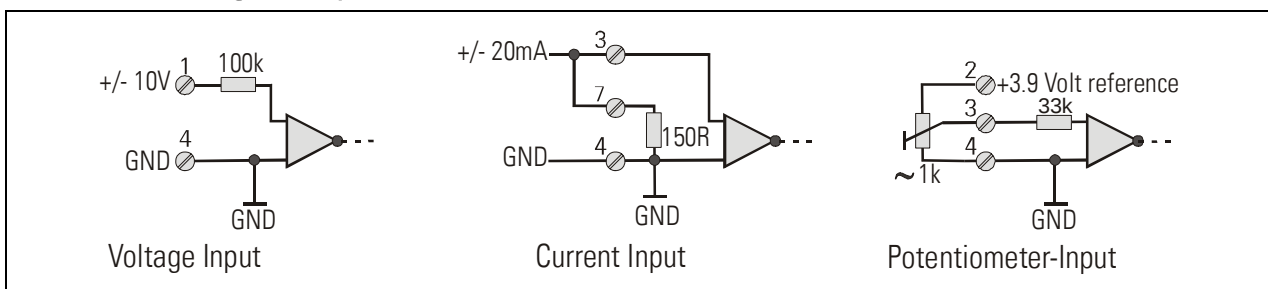


2.2. Control Inputs

The unit provides two digital HTL inputs for control of the output frequency. The function of these inputs depends on the mode of operation. For properties and electrical specifications see the diagram below.



2.3. Analogue Inputs



Voltage input requires position 5 of the DIL switch to be ON. The input voltage swing must not exceed the +/- 10 volts range. The resolution is 1 mV and the overall accuracy is 0.1%.

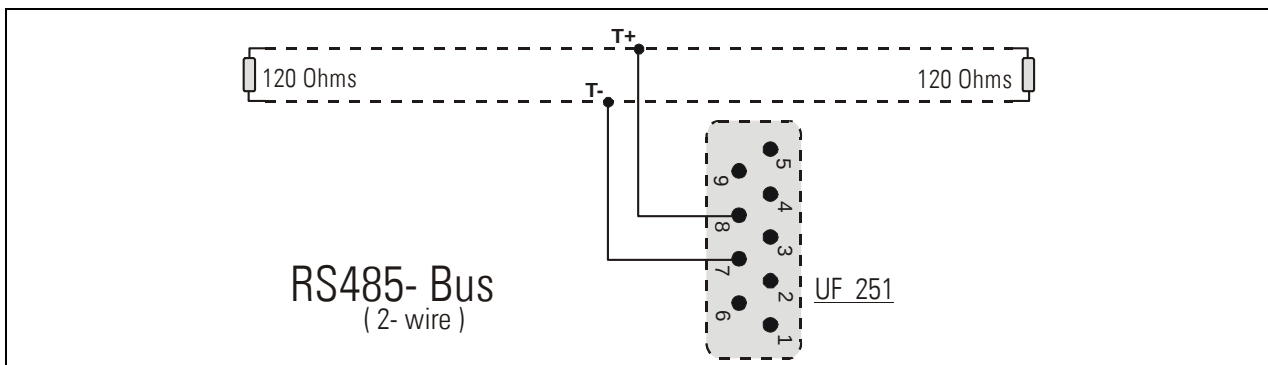
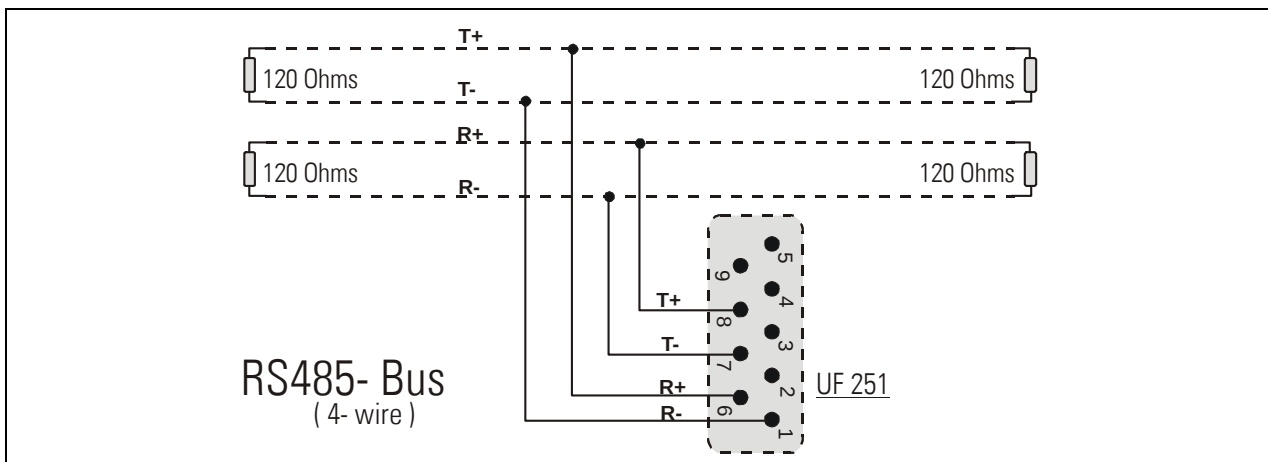
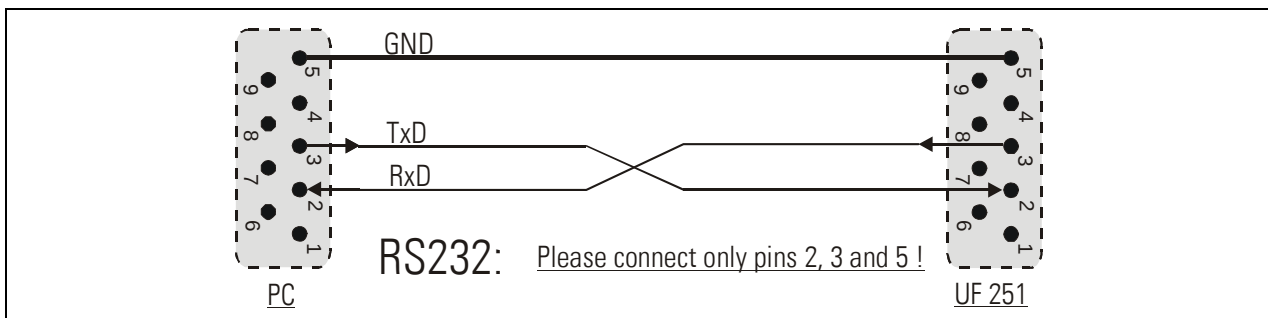
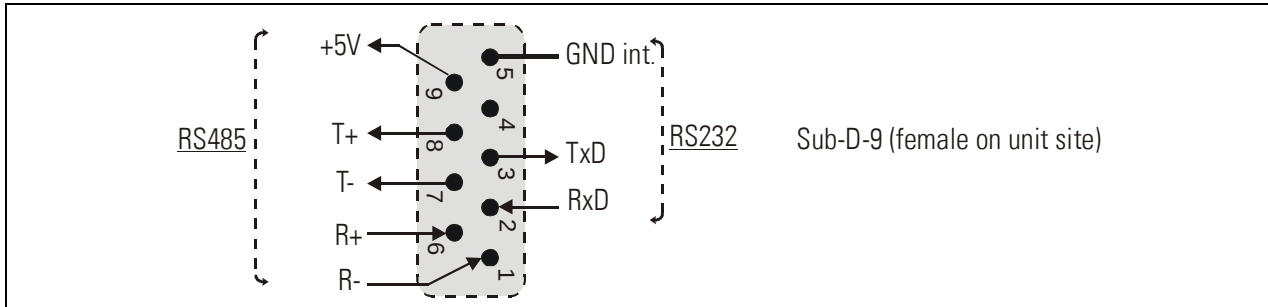
Current input requires position 5 of the DIL switch to be OFF. Terminals 3 and 7 must be bridged externally. The resolution is 2μA and the overall accuracy is again 0.1%.

For **potentiometer input** DIL switch position 5 must be OFF, too. With use of a 1k potentiometer, in the centre position of the tap an error of approx. 1% comes up due to the load by the internal resistance. However, this error can easily be eliminated with use of the linearization function. For potentiometer supply a highly stable reference voltage of about 3.9 volts is used.

2.4. Serial Interface

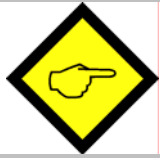
The unit provides a RS232 interface and a RS485 interface. However, only one of both can be used at a time. Serial communication allows to read out the conversion result and to set parameters and variables by PC, according to need.

The serial interface configuration is selected by DIL switch position 1. Position 6 of the switch selects the communication functions "PC-mode" or "printer-mode"

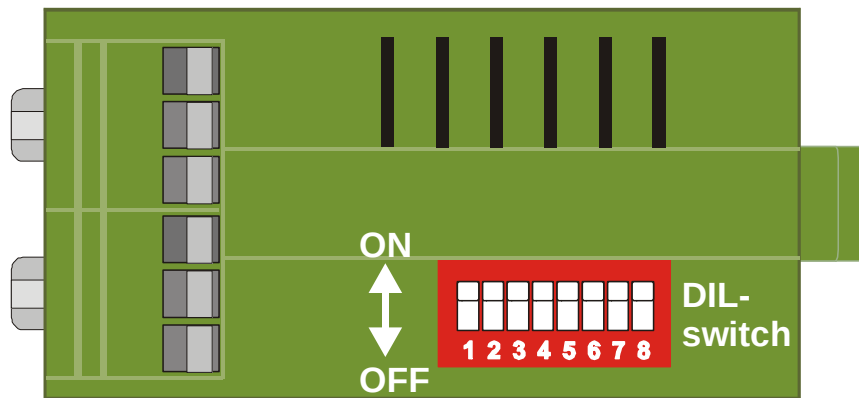


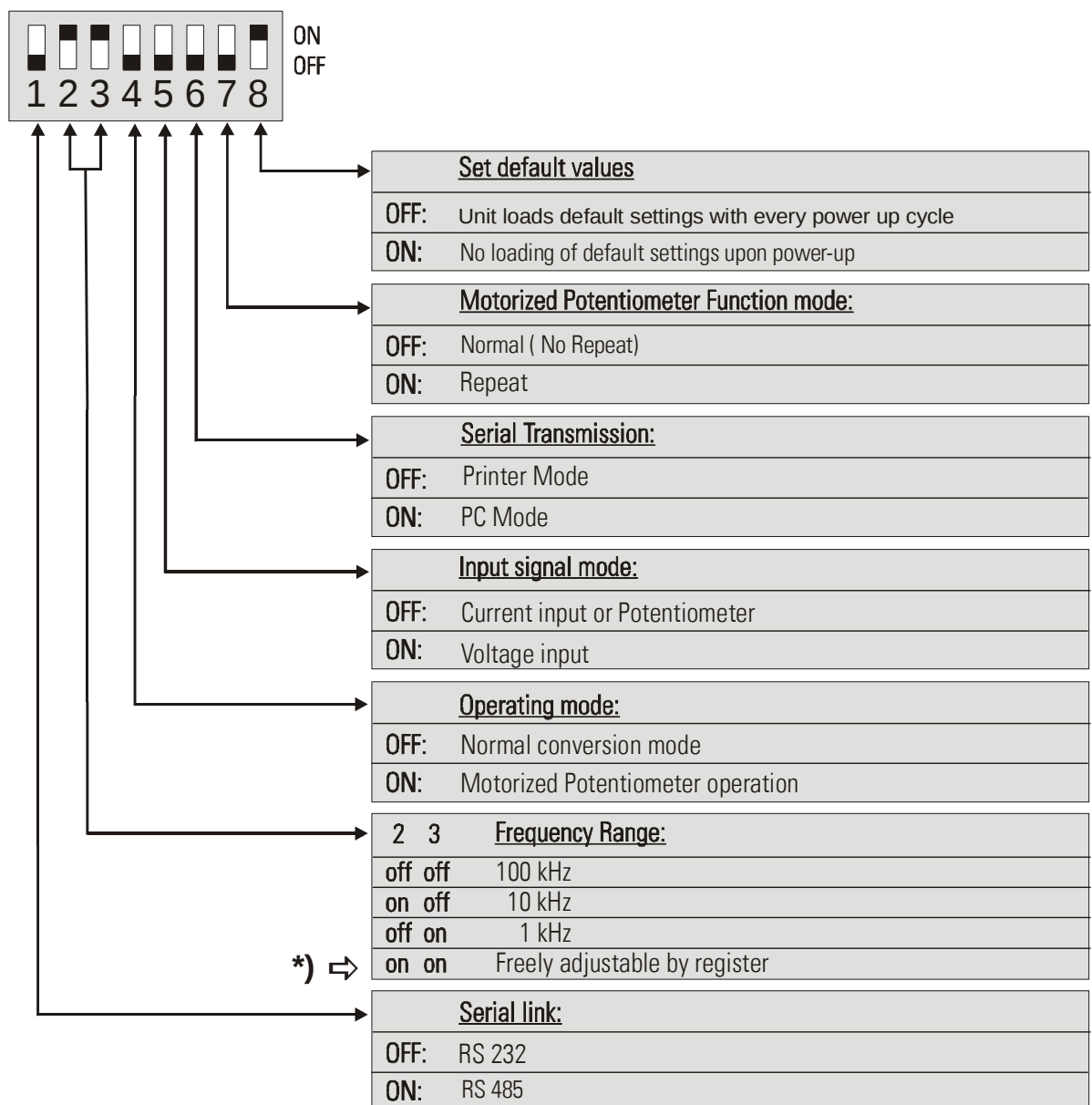
3. DIL Switch Settings

The DIL switch located on the top site of the unit provides customer-specific settings of desired operation modes.



Changes of switch settings will become active only after the next power-up cycle!





⇒ *) It is a "must" to apply this setting when you like to use free scaling of the unit by PC

The switch settings above show normal operating mode with current input and freely adjustable frequency range. No default values will be loaded, the serial link is set to RS232 format and to printer transmission mode.

4. Setup Procedure

All basic functions of the converter can easily be set up by the DIL switches, without use of a PC. For programming of advanced functions by PC see chapter 6.

Self test: Upon power up, both front LED's must be lit first, and the yellow status LED must switch off after the self test has been concluded successfully (approx. 1 sec.).

4.1. Conversion of voltage or current using a fixed frequency range

Settings: Set DIL-switch 2...5 according to chapter 3 and connect the input signal as described under chapter 2.3.

Depending on the selected frequency range, the unit will output a frequency of 100 kHz, 10 kHz or 1 kHz with a full-scale input signal of 10 volts or 20 mA.

4.2. Using a potentiometer for the input voltage and a fixed frequency range

Settings: Set the DIL-switch 2...5 according to chapter 3 and connect the potentiometer as described under chapter 2.3.

Depending on the selected frequency range, the unit will output a frequency of 100 kHz, 10 kHz or 1 kHz with maximum setting of the potentiometer. Fine tuning for maximum accuracy of the frequency must be performed by register setting via PC.

4.3. Conversion of a voltage or current using the freely adjustable frequency range

Settings: Set the DIL-switch 2...5 according to chapter 3 and connect the input signal as described in chapter 2.3.

The output frequency range is set via PC. Use registers "Low Voltage", "High Voltage", "Low Frequency" and "High Frequency" to define the frequency scaling.

The frequency set to register "Low Frequency" will be generated with an input signal as set to register "Low voltage".

The frequency set to register "High Frequency" will be generated with an input signal as set to register "High Voltage".

The value of "High Frequency" does also affect the accuracy of the output frequency. Basically there are two accuracy ranges which can be selected by register "High Resolution":

High resolution (Parameter "High Resolution" = 1) provides an accuracy of 0.1% at 250 kHz and a lowest possible frequency of 250 Hz

Standard resolution (Parameter "High Resolution" = 0) provides an accuracy of 0.1% at 67 kHz, and with a lowest possible frequency of 62.5 Hz.

With the standard resolution mode there is an auxiliary output frequency divider available (programmable by register "Output Divider").

By well-aimed selection of the settings of "High Frequency" and "Output Divider" it is possible to optimize the overall accuracy and the dead band around zero. For instance, to improve accuracy, we can decrease "High Frequency" and "Output Divider" but concurrently this entails an enlargement of the dead band. For better understanding of this coherence the following example shows two possibilities of settings:

Example: You like to get an output frequency of 0 Hz with 5 V input voltage and 20 kHz output frequency with 9 V input voltage.

Option (a):		
Low Voltage	:	5.000
High Voltage	:	9.000
Low Frequency	:	0
High Frequency	:	20.000
High Resolution	:	0 (standard resolution)
Output Divider	:	1 (no division)

This setting results in an accuracy of [20 kHz : 67kHz x 0.1%], therefore approx. 0.03%. But our lowest possible frequency is 62.5 Hz. This means we will need to accept a dead band window around zero which is

$$10V \times \frac{62,5 \text{ Hz}}{20.000 \text{ Hz}} = 0.031V$$

The unit will generate zero output frequency in a range of 5 Volts +/- 31 mV

Option (b):		
Low Voltage	:	5.000
High Voltage	:	9.000
Low Frequency	:	0
High Frequency	:	60.000 (= 3 x 20.000)
High Resolution	:	0 (standard resolution)
Output Divider	:	3 (60 kHz : 3 = 20 kHz as required)

This setting results in an overall accuracy of 0.1%. However the lowest possible frequency is now 1/3 of 62.5 Hz, this means 20.8 Hz. Therefore, our dead band around zero will only be

$$10V \times \frac{20,8 \text{ Hz}}{20.000 \text{ Hz}} = 0.010V$$

We will have zero output frequency in a range of 5 Volts +/- 10 mV.

For fine tuning of the input signal scaling it is possible to use the monitor function of the PC software. If you like to do this, set register "Average" to 6 to activate average mode and smooth the input signal. The monitor now will show very stable values of the analogue input (register code :5), which you can use to set your "High Voltage" and "Low Voltage" registers. The voltage measurement with the monitor function provides an accuracy of 0.1%.

4.4. Motorized Potentiometer Mode

With the Motorized Potentiometer Mode you can program a voltage curve as desired to be converted to output frequency. The output frequency can be ramped up and down by control inputs "UP" and "DOWN" respectively. If no input is activated, the output frequency remains at its actual value. The output frequency is limited by the minimum and maximum frequency settings, regardless of whether the inputs are still active or not.

Settings: Set DIL-switch 4 and 7 according to chapter 4. It is not necessary to apply any voltage or current input signal to the unit, because the voltage curve is generated internally.

Set register "Low Voltage" to 0 and register "High Voltage" to 10000 (the range of the internally generated voltage will be 0...10 V).

The output frequency range can be set by registers "Low Frequency" and "High Frequency".

The output frequency curve can be defined by linearization function:

If you desire a linear output frequency curve, set registers P1(x) and P1(y) to 0 and registers P2(x) and P2(y) to 100%. Non-linear characteristic can be programmed by using the linearization function, as described in chapter 9. To activate linearization function set register "Linearization Mode" to unequal 0.

A change of the output frequency direction (phase A/B) can also be obtained by using the linearization function.

The ramp-up time (input "UP" activated) is set to register "Time Up" and the ramp-down time (input "DOWN" activated) is set to register "Time Down".

4.5. Repeat Mode

The repeat mode differs from normal motorized potentiometer mode only in one item:

The frequency curve is generated cyclically.

Control input "UP-DOWN" changes the direction of the frequency sequence and control input "SET" stops the output cycle and freezes the actual frequency.

Settings: Set DIL-switch 4 and 7 according to chapter 4. It is not necessary to apply any voltage or current input signal to the unit, as the voltage curve will be generated internally.

All parameter setting is equal to normal motorized potentiometer mode (as described above)

5. Readout of Register Values via Serial Interface

Independent on your settings you can read out the actual voltage and the actual frequency at any time via serial link. For setting of serial communication parameters etc., you must however apply PC set-up anyway, like shown later.

UF251 uses the DRIVECOM communication protocol according to the ISO 1745 standard.

Details about the protocol can be found in our file named **SERPRO.pdf**, available at any time on request. You are also free to download these instructions from our homepage

www.motrona.com

The following register codes are available for readout:

Register Code:		Description:
C1	C2	
:	3	Actual frequency, format xxxxxx.xx Hz
:	5	Actual input value, scaling 0...10000 mV (which also corresponds to input current 0...20 mA)

6. PC Setup with Use of the Operator Software OS3.x

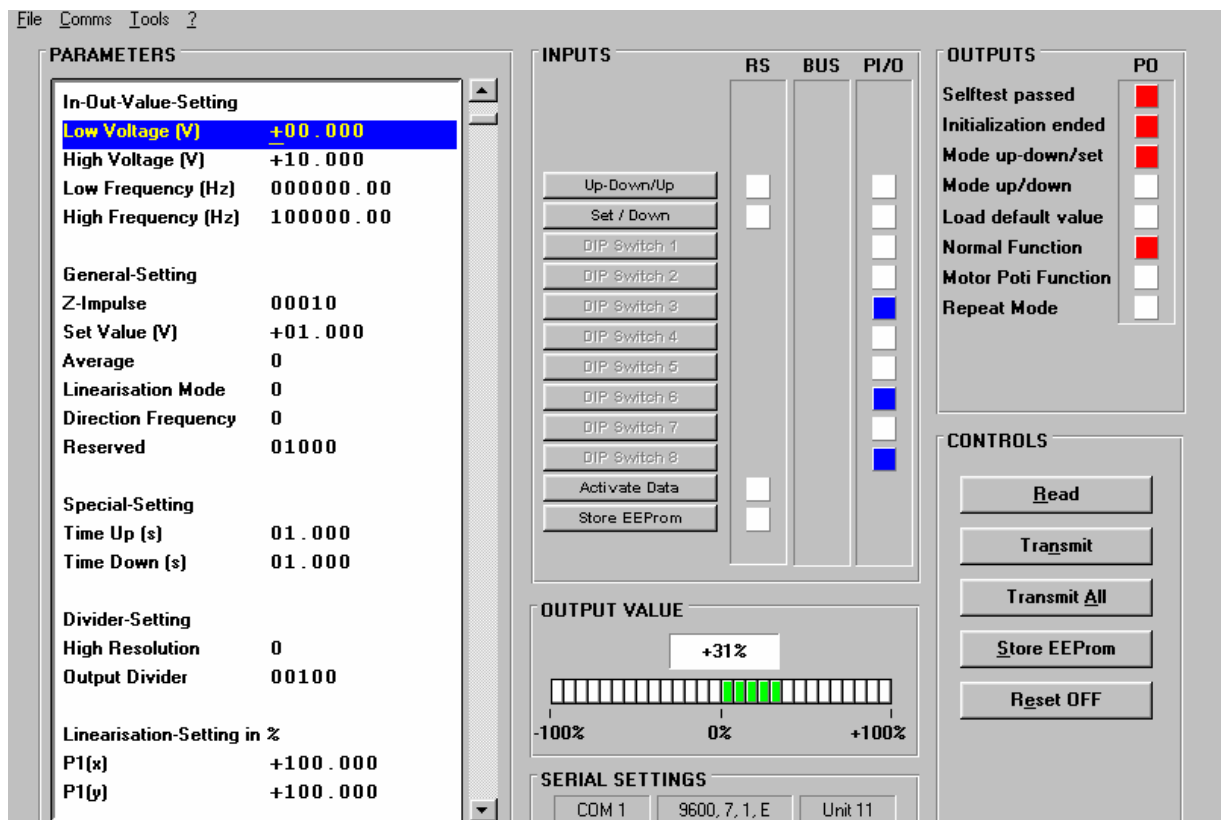
You can apply the full set of functions of the UF251 converter when using a PC and our operator software OS3.x for setup of the unit. The software is available for free download under

www.motrona.com

- Connect your PC to the converter using a serial RS232 cable like shown in section 2.4 of this manual. Make sure the cable only uses pins 2, 3 and 5. Pins 2 and 3 must be crossed.
- Run the OS3.x software and you will see the screen shown below.
- In case your text and colour fields should remain empty and the headline says „OFFLINE“, you must verify the setting of DIL switch positions 1 and 6 and check your serial settings. Select „Comms“ from the menu bar to check for serial settings.
Ex factory, all motrona units use the following serial default settings:

RS232, Unit No. 11, Baud Rate 9600, 1 start bit, 7 data bit, parity even, 1 stop bit

- If the serial settings of your unit should be unknown, you can run the „Scan“ function from the „Tools“ menu to find out.



7. Displays and Soft Keys

The edit window for all unit parameters can be found on left hand side of the screen.

The "INPUTS" field shows the soft keys to switch the control commands on or off.
Display boxes in the RS column indicate when the corresponding command is set to ON by PC.
Display boxes in the PI/O column indicate that the corresponding command is activated by external hardware.

The boxes in the "OUTPUTS" field provide information about the state of the unit.

The colour bar graph displays the actual and undivided output frequency in a range of +/-100% of full scale.

The soft keys in the "CONTROL" field are available for readout, transmission and storage of parameters.

8. Parameter Settings

Parameter	Description														
<u>In-Out Value Setting</u> Low Voltage: High Voltage: Low Frequency: High Frequency :	These registers select the input and output signal range and define the voltage-frequency curve of the converter. With an input voltage of "Low Voltage" the frequency value entered to "Low Frequency" will be generated and with an input voltage of "High Voltage" the frequency value "High Frequency" will be generated.														
<u>General Setting</u> Z-Impulse: 	This register selects the generated marker pulse distance. E. g. a setting of 2000 will generate a marker pulse every 2000 pulses of the output frequency. The minimum setting of this register is 10. The marker pulse generation is not affected by the setting of register "Output Divider", i.e. the marker pulse distance is calculated by the originally generated frequency with no respect to the division. The marker pulse is gated by channel A high and channel B high. Thus the marker pulse length is ¼ of one pulse period. The marker pulse does <u>not</u> recognize any direction and will always appear after the number of preset pulses, even when the A/B direction should have changed meanwhile!														
Set Value:	With normal operating mode, when control input „SET" is activated (terminal 9), a fixed frequency value will be generated as defined by the voltage entered to register "Set Value". This means, when control input "SET" is active, the unit operates as if a fixed input voltage of "Set Value" would be applied to the input. With other operating modes this register has no function.														
Average:	This register activates and adjusts the floating average filter to smooth unstable input signals. When register "Average" is set to 0, the floating average filter is switched off. The higher the register setting, the stronger the input signal is smoothed (see table below).														
Setting of register "Average":	<table><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>---</td><td>2</td><td>4</td><td>8</td><td>16</td><td>32</td><td>64</td></tr></table>	0	1	2	3	4	5	6	---	2	4	8	16	32	64
0	1	2	3	4	5	6									
---	2	4	8	16	32	64									
Number of averaging cycles:															
	The floating average filter affects the response time of the frequency output. With a setting of 6, a step change of the input signal will result in a step response of the frequency output of approx. 120 ms delay. Decrementing „Average" by 1 approximately halves the response time. The floating average filter is only active in normal operation mode.														

Parameter	Description
Linearization Mode:	Sets the mode of linearization. 0: Linearization off, registers P1 to P16 do not affect the output characteristics. 1: Linearization in a range of 0 – 100% 2: Linearization over full range –100% to +100% <u>For full details about Linearization please refer to chapter 9.</u>
Direction Frequency:	This register controls the direction of the output frequency. 0: the direction of the frequency output signal depends on the polarity of the input signal or on the linearization curve settings respectively. 1: the frequency is output in one direction only with no respect to the polarity of the input signal. 2: equals setting 0 but additionally provides inversion of the output frequency direction by control input "UP-DOWN" 3: equals setting 1 but additionally provides inversion of the output frequency direction by control input "UP-DOWN" In operating modes Motorized Potentiometer and Repeat Mode the function of this register is disabled.
<u>Special Setting</u> Time Up: Time Down:	For use with operating modes Motorized Potentiometer and Repeat Mode only. Sets the ramp time (up or down) of the frequency output from 0.001 to 999.999 seconds for a transition over the full range
<u>Divider Setting</u> High Resolution:	0: <u>Standard resolution</u> Accuracy 0.1% at 67 kHz, minimum output frequency 62.5 Hz. Register "Output Divider" divides the output frequency. By this means you can achieve minimum frequencies lower than 62.5 Hz. 1: <u>High Resolution</u> Accuracy 0.1% at 250 kHz, minimum output frequency 250 Hz. The output divider is disabled.
	You should set register "High Resolution" to 1 only when you want to generate <u>very high output frequencies</u> (e.g. >>100kHz) at high accuracy.

Parameter	Description
Output Divider: 	This register is only active with standard resolution (Parameter „High Resolution“ = 0). The frequency generated by the converter is divided by the value set to this register, before it appears at the output. Setting 1 results in no division (Frequency output 1:1). Setting 2 results in output frequency divided by 2 etc. The maximum possible setting is 10.000 for a 1:10 000 division It is a “must” to use the divider whenever you like to generate frequencies lower than 62.5 Hz.
Linearization Setting P1(x), P1(y), ..., P16(x), P16(y):	See description of the linearization function in chapter 9.
Protocol Setting	The following register settings control the automatic cyclic transmission of internal register values by serial interface to peripherals like printers or displays. Please note: For cyclic transmission of a register value DIL-switch 6 must be set to “Printer Mode” (see chapter 3).
Serial Protocol:	Selects the serial protocol for the cyclic transmission. 0: the string starts with the serial address of the unit (Unit Number), followed by a space and the value of the register to be read out. The string ends with a “Line Feed” character and a “Carriage Return” character. 1: the unit number is omitted, the string starts with the register value, to allow faster transmission at shorter transmission cycles

	Unit No.											
Serial Protocol = 0 :	1	1		+/-	X	X	X	X	X	X	LF	CR
Serial Protocol = 1 :				+/-	X	X	X	X	X	X	LF	CR

Serial Timer:	Determines the cycle time in seconds for the cyclic transmission. With a setting of e.g. 0.100 the selected register value will be transmitted every 100 ms. The accuracy of the timer is +/-500 µsec.
Register Code:	Selects the register to be transmitted cyclically. Setting of 00 selects register code :0, setting of 01 selects register code :1 etc.

Parameter	Description			
<u>RS232/RS485 Setting</u> Unit Number:	With RS485 applications it is necessary to attach a specific address to each unit, since up to 32 units can be connected to the same bus. You can choose any address number between 11 and 99. Factory setting: 11 Unit addresses must not contain a “0” because these numbers are reserved for collective addressing.			
<u>Serial Baud Rate:</u>	Setting		Baud	
	0*		9600	
	1		4800	
	2		2800	
	3		1200	
	4		600	
	5		19 200	
	6		38 00	
	* = Factory setting			
<u>Serial Format:</u>	Setting	Data bits	Parity	Stop bits
	0*	7	even	1
	1	7	even	2
	2	7	odd	1
	3	7	odd	2
	4	7	none	1
	5	7	none	2
	6	8	even	1
	7	8	odd	1
	8	8	none	1
	9	8	none	2
	* = Factory setting			

9. Programmable Linearization

This programmable feature allows the user to convert a linear input signal to a non-linear output signal. There are 16 programmable x/y interpolation points available, which can be set in any desired distance over the full conversion range. Between two points, the unit uses linear interpolation. Therefore it is advisable to use more coordinates in a range with strong curves and only a few coordinates where the curvature is less.

To specify your desired linearization curve, you must first set „Linearization Mode“ to either 1 or 2.

Use registers **P1(x)** to **P16(x)** to specify the coordinates on the x-axis.

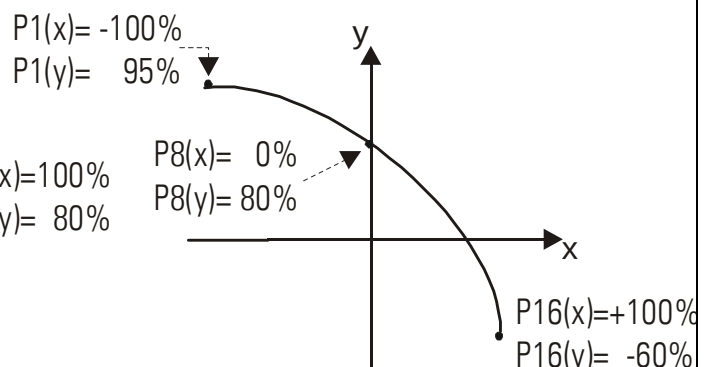
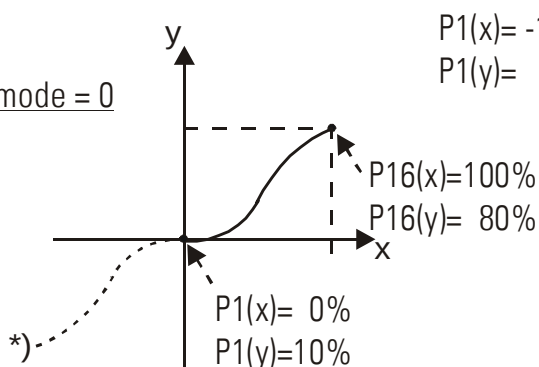
These settings must be in % of full scale.

Now enter the attached values to registers **P1(y)** to **P16(y)**. These are the values that the output will generate instead of the x-values, i.e. P2(y) will substitute P2(x) etc.

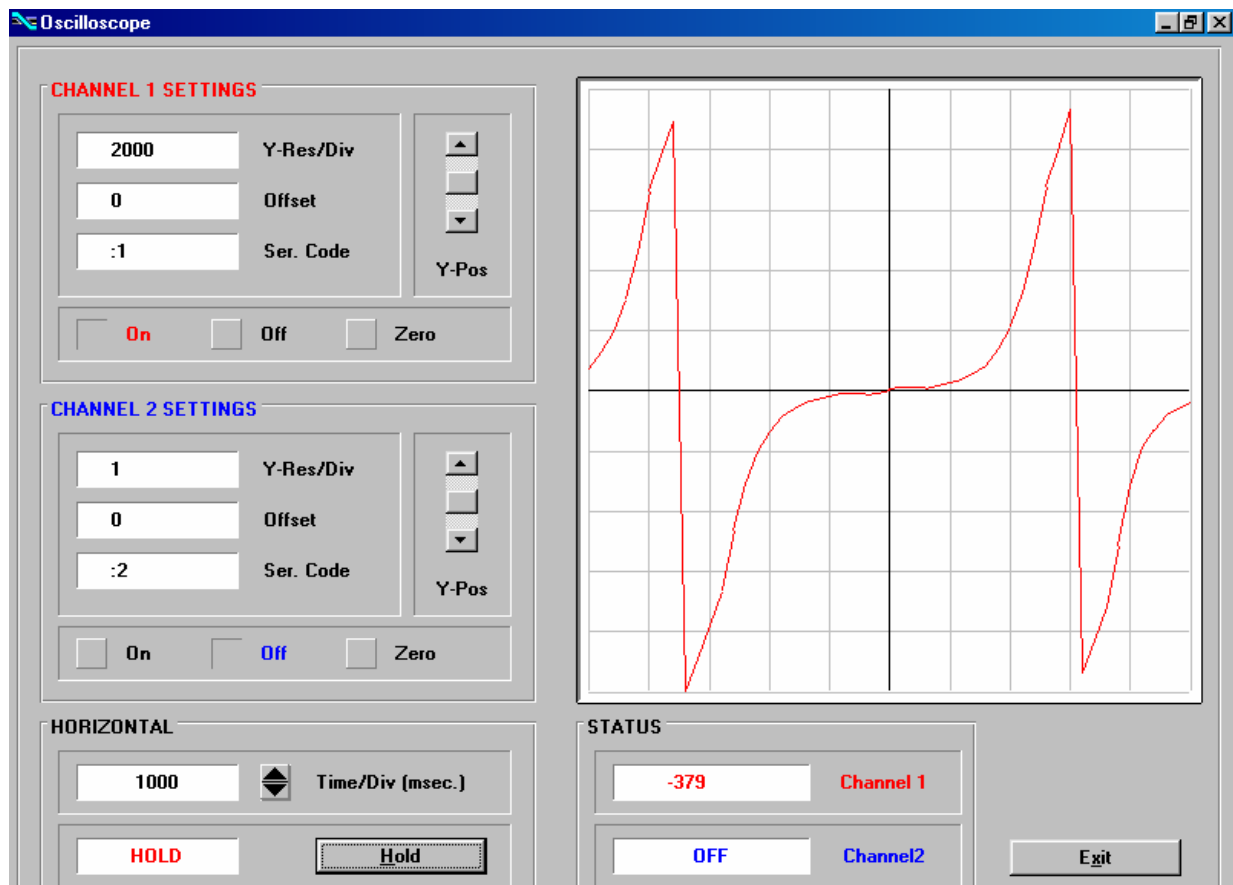


- x-registers must use continuously increasing settings, i.e. P1(x) must have the lowest and P16(x) must have the highest setting.
- All entries use a percent format of xx.xxx% full scale. Setting 0.000% means zero output and setting 100.000% means full scale output.
- With Linearization Mode set to 1, it is a must to set P1(x) to 0% and P16(x) to 100%. Linearization then is defined in the positive range only and the negative range will be a mirror image of the positive range with reference to zero.
- With Linearization Mode set to 2, it is a must to set P1(x) to -100% and P16(x) to +100%. This enables the user to set curves which are not symmetric to the zero position.

*) Output mode = 0



You can visualize your curve on the PC screen or by means of an external oscilloscope. When you like to do this, please select **TOOLS / TEST / „Linear Function Test“**. The unit will now simulate a repeating course over the full range and generate the output accordingly.



10. Test Functions

When you select TEST from the TOOLS menu, you are able to verify the following data, by clicking to the corresponding field:

- Actual frequency
- DIL switch settings
- Internal supply voltages
- Frequency output state

Test Menu UF251

AUXILIARY VOLTAGE

[mV/°C]	Actual
Input	+3806
Difference	+35
Reference	+1237
+5 V	+5040
Temp	+37

Linear Function Test

Start Stop

EEPROM

Checksum:

I²C-Bus

Written Value

Readback Value (1 Byte)

Dip-Switches/Inputs

☐ Switch 1 ☐ Switch 5 ☐ Down
☐ Switch 2 ☐ Switch 6 ☐ Up
☐ Switch 3 ☐ Switch 7
☐ Switch 4 ☐ Switch 8

Frequency

Offset

Return

Temperatur

Temperatur

Return

Channel 1

☒ Voltage Test ☐ Current Test

Range

Offset

Return

Channel 2

☒ Zero Voltage ☐ Range Voltage
☐ Zero Currer ☐ Range Current

Offset

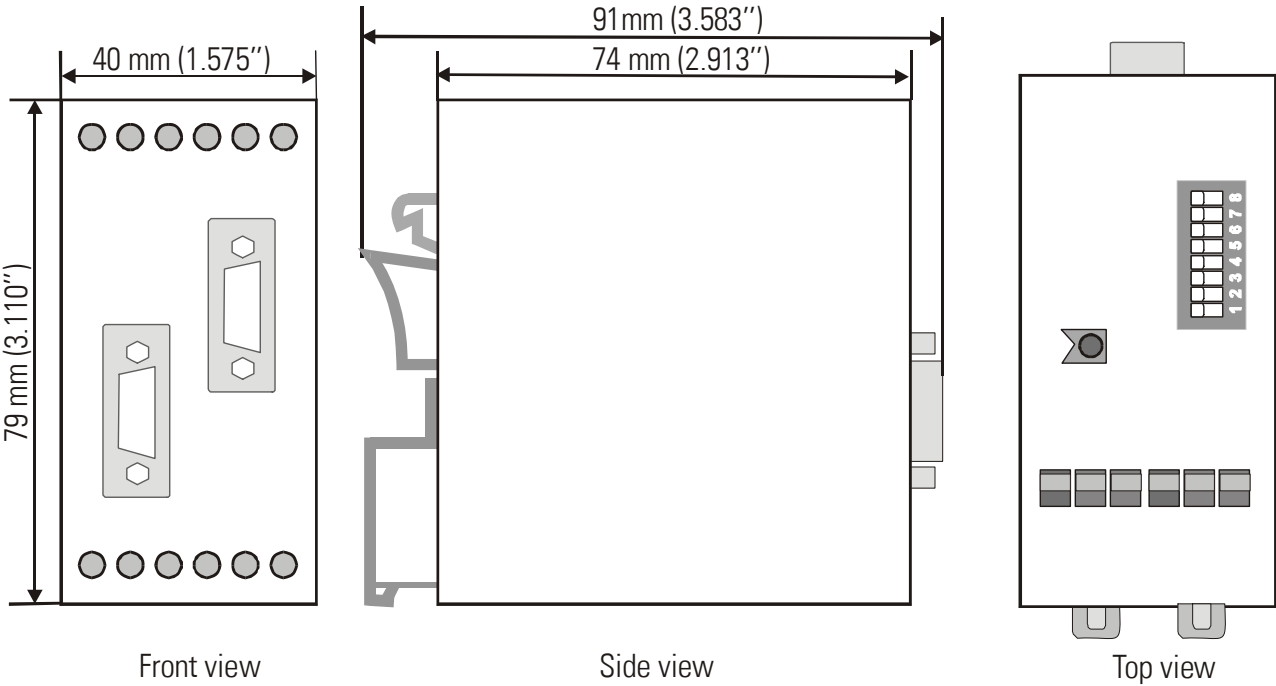
Return

Frequency Test

Frequency:

Exit

11. Dimensions



12. Specifications

Power Supply	: 18...30 V DC
Power consumption	: approx. 120 mA (30 volts) ... 180 mA (18 volts)
Analogue Input Voltage	: +/-10 V / 100 k Ω
Analogue Input Current	: +/-20 mA / 150 Ω
Resolution Analogue Input	: 1 mV / 2 μ A
Accuracy of analogue input	: 0.1%
Control Inputs HTL (8, 9)	: High > 12 V, Low < 3 V, Minimum pulse width 5 ms
Frequency outputs HTL	: High Level = Power Supply Voltage minus 4 volts, output resistance 600 Ω , max. frequency 100kHz
Frequency Output TTL / RS422	: Max. Frequency 500 kHz
Accuracy of output frequency	: High Resolution = 1: 250 kHz => 0.1% High Resolution = 0: 67 kHz => 0.1%
Response time frequency output	: approx. 3 msec
Operating Temperature Range	: 0...45°C / 32...113°F
Weight	: approx. 190 g
Conformity and Standards	: EMC 89/336/EEC: EN 61000-6-2 EN 61000-6-3 LV73/23/EEC: EN 61010-1