

Power and Energy Meter with PC Interface (115 V, 50/60 Hz) Power and Energy Meter with PC Interface (230 V, 50/60 Hz)

1003131 (115 V, 50/60 Hz)
1003132 (230 V, 50/60 Hz)

Instruction sheet

10/12 ALF



1. Safety instructions

The power and energy meter conforms to safety regulations for electrical measuring instruments and control and laboratory equipment as per DIN EN 61010, part 1. It is intended for operation in a dry environment, suitable for the operation of electrical equipment and systems.

Safe operation of the device is guaranteed, provided it is used correctly. However, there is no guarantee of safety if it is used in an improper or careless manner.

If it may be assumed for any reason that non-hazardous operation will not be possible (e.g. visible damage), the power and energy meter should be switched off immediately and secured against any unintended use.

In schools and other educational institutions, the operation of the power supply unit must be supervised by qualified personnel.

- Before using the power and energy meter for the first time, confirm that the specifications printed on the rear side of the housing are compatible with the local mains voltage.
- The instrument may only be connected to the mains via a socket that has an earth connection.
- Replace a faulty fuse only with one matching the specifications stated at the rear of the housing.
- Disconnect the counter from the mains before replacing a fuse.
- Never short the fuse or the fuse holder.

2. Description

The power and energy meter is a microprocessor controlled instrument for measuring electrical active, apparent and reactive power as well as electrical work in the case of voltages and currents with any continuous curve shape.

Voltage, current, frequency, phase angle, power factor and time are measured simultaneously and can be displayed digitally via a pushbutton. It is also possible to simultaneously measure and display two temperatures as well as the difference between them. This device is particularly suitable for experiments involving heat pumps and Stirling engines.

The power and energy meter can be used alone or together with a PC. It has an internal data logger with a real-time clock. All 13 parameters and the time – a total of 3100 measured values - can be stored.

The storage of measured values can be commenced manually, or at a specified point in time, or if a power or temperature limit is exceeded or fallen short of. The stored data can be transferred subsequently to a PC via a RS232 interface. Included are Windows Software and an interface cable.

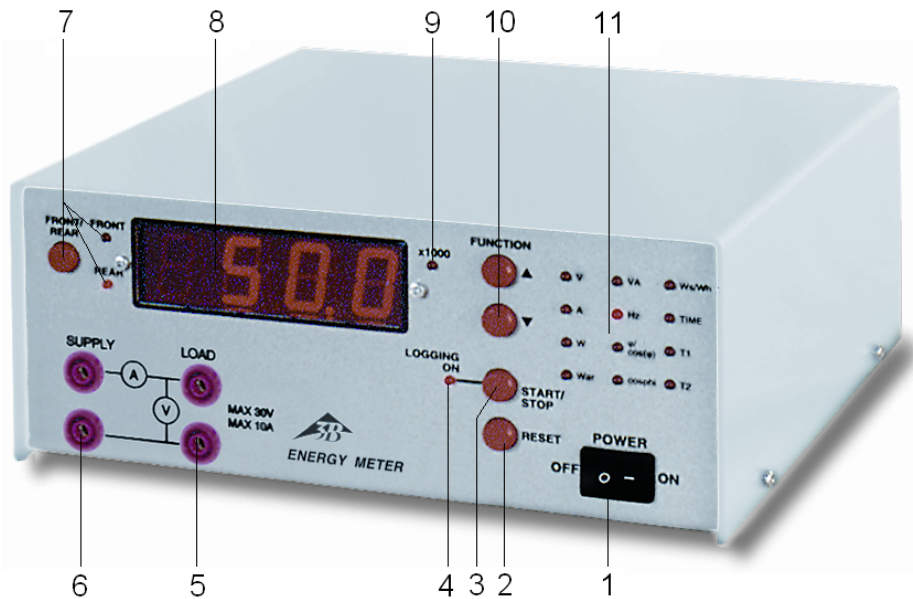
The software permits programming of the data logger, graphic displays of measured values and export of all measured data to a spreadsheet programme.

All measurements are displayed on the 4-digit LED display. Display reading from front or rear is selected with a push-button. Selection from the possible readings, is done with two push-buttons.

The power and energy meter with the order number 1003132 is for mains supplies of 230 V ($\pm 10\%$) while the one with order no. 1003131 is for 115 V ($\pm 10\%$) systems.

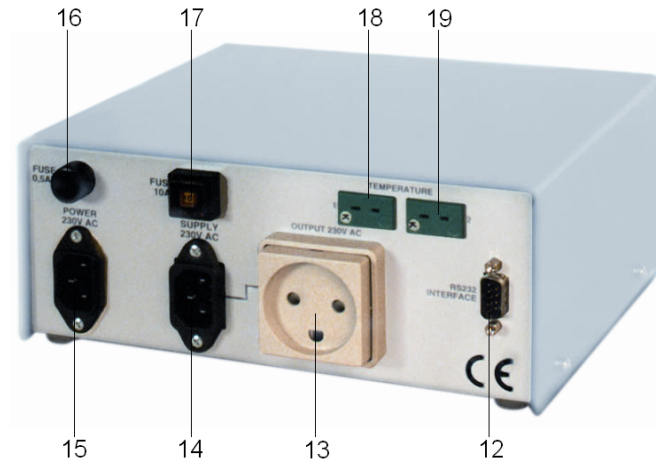
3. Operating controls and connections

Front panel



- | | |
|---------------------|---|
| 1 POWER | On / Off button |
| 2 RESET | Push-button for deleting the log and reset of Ws/Wh and Time. At the first push CLR? is displayed and at the second push, the log is reset. |
| 3 START/STOP | Push-button for start and stop of logging. (Starting the log also resets Ws/Wh and Time). |
| 4 LOGGING ON | Light Emitting Diode (LED) is turned on when the logging has been started. LED is flashing when log-memory is full (logging is stopped). |
| 5 LOAD | Connection for load on the front panel (0 - 10 A) |
| 6 SUPPLY | Connection for supply on the front panel (0-30 V AC / 0-42 V DC) |
| 7 FRONT/REAR | Push-button for selection of measurements on the front panel or the rear panel and LED indicating that measurement on the front or rear panel is selected |
| 8 Display | 4-digit LED-display |
| 9 X1000 | LED indicates that the display reading is to be multiplied by 1000. |
| 10 FUNCTION | Push-buttons to step forward or backward in list of functions |
| 11 Kontrollleuchten | LEDs (12 pcs.) for indication of the selected function |

Rear panel



12 RS232 INTERFACE	RS232 interface for PC
13 OUTPUT 230V AC	Connection of load on the rear panel (0 - 10 A)
14 SUPPLY 230V AC	Connection of the supply on the rear panel (10 – 240 V _{RMS} AC)
15 POWER 230V AC	230V AC mains connector
16 FUSE 0,5AT	Mains fuse. (0,2 AT(preferred) or 0,5 AT(max)).
17 FUSE 10 A	Fuse for 230 VAC output on the rear panel (10 A).
18 TEMPERATURE 1	Connection of Thermocouple type K, input no. 1
18 TEMPERATURE 2	Connection of Thermocouple type K, input no. 2
115 V version not shown	

4. Technical data

Measurements on front panel

Voltage:	AC: 0 – 30 V _{RMS} DC: 0 – 42 V
Resolution:	0.01 / 0.1 V _{RMS}
Accuracy:	±1% of measured value ± 1 digit
Current:	0 – 10 A _{RMS}
Resolution:	0.01 A _{RMS}
Accuracy:	±1% of measured value ± 1 digit
Frequency:	DC... 1000 Hz

Measurements on rear panel

Voltage:	10 – 240 V _{RMS}
Resolution:	0.01 / 0.1 V _{RMS}
Accuracy:	±1% of measured value ± 1 digit
Current:	0 – 10 A _{RMS}
Resolution:	0.01 A _{RMS}
Accuracy:	±1% of measured value ± 1 digit
Frequency range:	45 Hz bis 65 Hz

Functions

Power

Active power:	0 – 2400 W
Reactive power:	0 – 2400 VAR (only sinusoidal)
Apparent power:	0 – 2400 VA (only sinusoidal)
Resolution:	0.01 / 0.1 / 1 W

Accuracy: ±2% of measured value
± 1 digit

Frequency

Measuring range:	DC 16 – 999 Hz
Resolution:	0.1 Hz
Accuracy:	±1% of measured value ± 1 digit

Phase angle

φ:	0° – ±90°
Resolution:	0.1°
cos φ:	0.999 – 0.000
Resolution:	0.001
Accuracy:	±1% of measured value ± 1 digit

Work

Measuring range:	0.0 – 9999 x 1000 Ws/Wh
Resolution:	0.1 Ws / 0.001 Wh
Accuracy:	±2% of measured value ± 1 digit

Time

Measuring range:	0 – 9999 x 1000 s
Resolution:	1 s
Accuracy:	±0.1%

Temperature 1 and 2

Measuring range:	-100°C – 450°C
Resolution:	0.1° C
Accuracy:	±1% of measured value ± 1 digit

General data

Dimensions:	215x310x210 mm approx.
Weight:	5.7 kg approx.

5. Operation

The instrument is turned on with the mains-switch marked **POWER**.

When the instrument is turned on, first the version no. i.e. 'r 1.00' is displayed.

If one or more of the calibration values of the device is outside the limit, the message **L d d F** (Load default) is displayed and the default values are automatically loaded. The instrument starts with the same selections as when it was shut off, and is immediately ready for use.

Voltage supply and load may be connected on the front or rear panel.

With the button **FRONT/REAR** the front or rear measurement is selected.

All parameters are measured and calculated every second. With the buttons **FUNCTION ^** and **FUNCTION v** the parameter to be shown on the display, is selected.

5.1 Display parameters possible

V	True RMS-Voltage
A	True RMS-Current
W	True Power
VA _r	Reactive Power (Only at sinus! Calculated as: $(VA^2 - W^2)^{1/2}$)
VA	Apparent Power (Only at sinus! Calculated as: $U_{RMS} * I_{RMS}$)
Hz	Frequency
φ	Phase Angle (measured)
COS(φ)	cos(phase angle) (φ-LED is flashing)
Cosphi	Calculated cosphi (Calculated as: W/VA)
Ws	Energy in Ws
Wh	Energy in Wh (Ws-LED is flashing))
Time	Time for Ws/Wh in seconds
T1	Temperature 1 (From thermocouple type K sensor no. 1)
T2	Temperature 2 (From thermocouple type K sensor no. 2)

5.2 Use of the Log Function

If the instrument displayed **L d d F** when started, the log is set to default, i.e. all values are logged with 60 seconds interval. Change of the log-setup is done with the PC-programme.

Logging is started and stopped again with the button **START/STOP**. When logging is started, the LED **LOGGING ON** is lit. If the log is full, the LED **LOGGING ON** is flashing.

At every start of the log function, the value of Ws/Wh and Time is reset to zero.

At logging means values of the measurements since last logging, are saved.

The content of the log is cleared by pressing the button **RESET** twice. The display shows **C l r ?** before the second push of the button. If the button is not pushed the second time within 5 seconds, the log will not be cleared.

5.3 Display messages

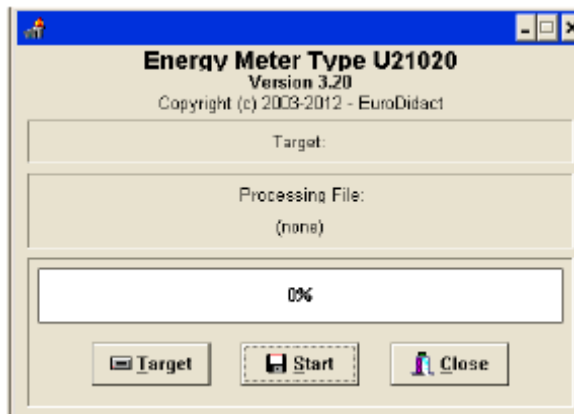
In some cases the display is "text" rather than values of measurement. The following list explains the "text":

Display	At	Description
r x. x x	Startup	Instrument, software version no. (i.e. r 2. 01)
L d d F	Startup	Warning. Default values for voltage, current and temperature measurements, and setup of log, are read.
----	Always	IData is not available, or data is not ready.
C l r ?	Reset of Log	Warning before second push at RESET .
F u l l	Start of Log	Warning by attempt to start the log, when this is full..
L o U	Hz	Voltage is too low for measurements (under 1.0 V). The frequency can not be measured.
H i U	V	Too high voltage (outside range).
H i A	A	Too high current (outside range).
L o F	Hz	Too low frequency (below 16 Hz).
H i F	Hz	Too high frequency (above 999 Hz).
d c	Hz	Bei DC

6. PC-Programme

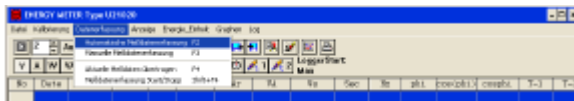
Installation

- Insert the CD ROM in the drive.
- From Windows, run the programme <SETUP.EXE>.
- Click the **Target**-button to select where you want to install the programme (e.g.: C:\U21020\).
- Start the installation with the **Start**-button. The programme is then installed on your hard disk and the folder "3B Scientific Instruments" containing the icon "U21020" is added.

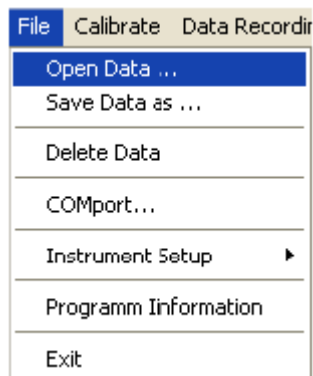


- Start the programme by clicking the icon "U21020"

When the device has been correctly connected with the supplied cable, the programme automatically fetches the instruments actual selections. See the example below.



In the menu **File** the following selections are available:



Open Data: Opens a file containing measurement data

Save Data as: Saves the measurement data to a file

Delete Data: Deletes measurement data from the memory

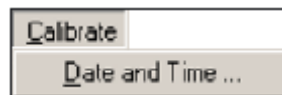
Comport: Select the PC serial comport (COM-1 or COM-2)

Instrument setup: Temperature reading in °C or °F, and selection of language

Programme Information: Programme info. If an U21020 is connected, this instrument version is also displayed

Exit: Ends the programme

In the menu **Calibrate** the date and time may be set:



In the upper part of the menu date and real-time clock from the power and energy meter is displayed.

In the lower part the date and time can be entered.

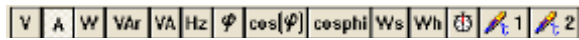
In the **Datalogging** menu automatic or manual datalogging can be started and stopped automatically or manually. In the automatic modus data are collected at an adjustable intervall (from 1 to 60 seconds).

Data Recording	Display	Energy Reading	Graphs	Log
Automatic Data Recording from Instrument	F2			
Manual Data Recording from Instrument	F3			
Read Data from Instrument	F4			
Start / Stop of Automatic Data Recording	Shift+F4			

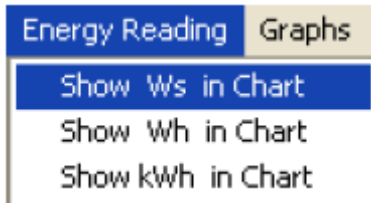
In the menu **Display** the following is available:

Display	Energy Reading	Graphs	Log
Voltage [V]	Ctrl+V		
Current [A]	Ctrl+A		
True Power [W]	Ctrl+S		
Reactive Power [VAr]	Ctrl+B		
Apparent Power [VA]	Ctrl+T		
Frequency [Hz]	Ctrl+Z		
phi	Ctrl+P		
cos(phi)	Ctrl+C		
cosphi	Ctrl+O		
Energy [Ws]	Ctrl+E		
Energy [Wh]	Ctrl+H		
Time [Sec]	Ctrl+I		
Temperature 1	Ctrl+1		
Temperature 2	Ctrl+2		
Reading from Frontpanel	Ctrl+F		
Reading from Rearpanel	Ctrl+G		

This is where to select what is displayed on the digital LED-display, and if measurements are made on the front panel or on the rear panel. Alternatively the buttons can be used.

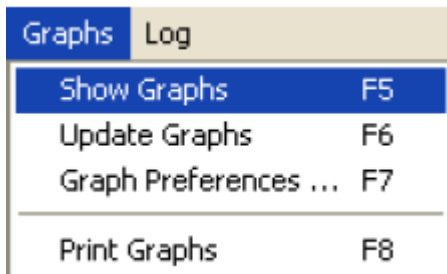



In the menu **Energy Reading** the following options are available:

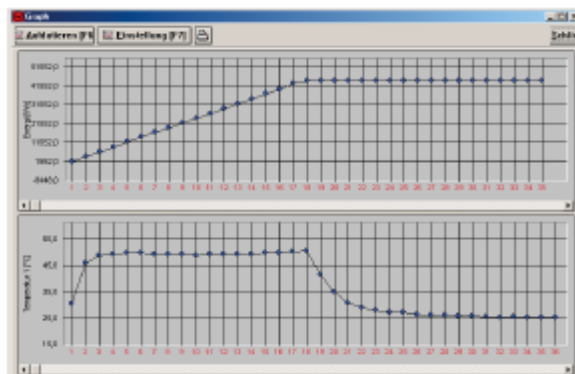


Menu **Graphs**

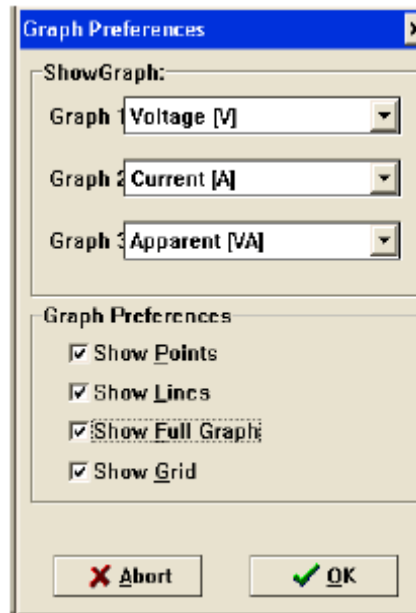
The following options are available:



The **Graph** window can be opened from the menu, by using **F5** or with the button . It only opens when data is available. See example below:

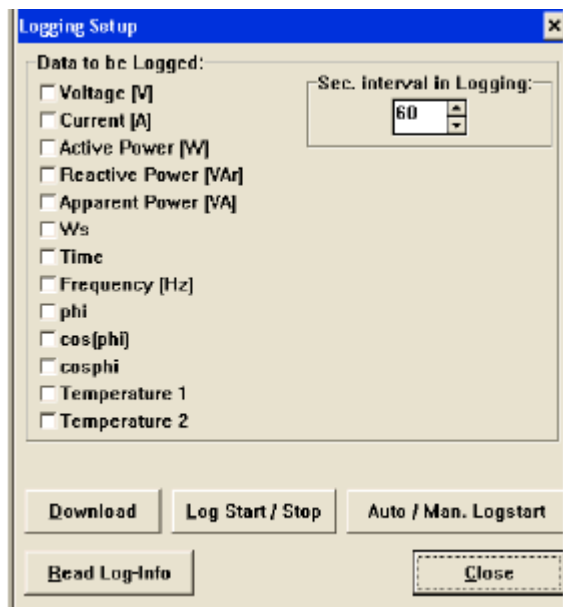


Using **Graph Preferences** or **F7**, it is possible to select display of 1, 2 or 3 graphs, how to display them (Show points, Show lines between data, Show all graph, Show grid and select the data to be shown on each graph.



Menu **Log**

In the menu **Log** the following data are selectable:



Here it is possible to mark each data that is to be logged, and at what interval. The more data to log at each interval, - the fewer „log-lines“ are possible. For maximum number of intervals („log-lines“), select only the data that is necessary. The maximum number of log-lines and the maximum logging-time is calculated and displayed.

Automatic or manual logging is also set here.

The instrument always starts in **Manual data-logging**.

Clicking on **Download** transfers the new settings to the power and energy meter and deletes the old setup.

The meter can now be switched off and brought to the place where the measurement should be conducted.

After logging is finished, the power and energy meter has to be connected to a PC again and data are transferred from the meter using this window by clicking of **Read data from instrument**-button in the menu **Datalogging** or **F4**.

7. Instructions for Calibrating

(only by skilled technician)

Note: The instrument is calibrated from the factory!

7.1 Calibration of date and time

Calibration of date and time is done with the PC-programme (menu **Calibrate - Date and time**). In the top part of the window, the actual date and time from the power and energy meter is shown. In the lower part, the new date and time may be entered, and transferred to the meter by selecting **Download**.

7.2 Calibration of the temperature measurements

This is only possible, if **ALLOW_CALIBRATION (TILLAD_KALIBRERING)** is set to **I**, in the **U21020.ini** file.

If the temperature is to be calibrated, the line **TILLAD_KALIBRERING** in the **U21020.ini** file is changed from **0** to **I**, before the PC-programme is started. For editing, use a text editor like Notepad. The **U21020.ini** file is located in the same directory as **U21020.exe**.

The calibration is done with the PC-programme (menu **Calibrate - Temperature**). The temperature error is adjusted for each input, until the display is correct.

The displayed **Temperature Correction** is transferred to the meter when the indication **Downloaded** on the screen is green.

7.3 Calibration of voltage and current

This is only possible, if **ALLOW_CALIBRATION (TILLAD_KALIBRERING)** is set to **I**, in the **U21020.ini** file.

If the voltage and current are to be calibrated, the line **TILLAD_KALIBRERING** in the **U21020.ini** file is changed from **0** to **I**, before the PC-programme is started. For editing, use a text editor like Notepad. The **U21020.ini** file is located in the same directory as **U21020.exe**.

Calibration of the voltage and current is done from the PC-programme (menu **Calibrate - Voltage and current**). The shown values are

transferred from the power and energy meter. Offset for voltage and current measurements are adjusted by selecting **Measurement on front panel**, short-circuit the input bushings (**SUPPLY**) and selecting **Adjust offset**. A value for the offset is displayed on the screen.

Full-scale values are adjusted separately for voltage and current on the front panel and the rear panel.

The new values are transferred to the meter by selecting **Download**.

8. Care and maintenance

- Before cleaning the counter, disconnect it from the mains.
- Use a soft, damp cloth to clean it.

9. Disposal

- The packaging should be disposed of at local recycling points.
- Should you need to dispose of the counter itself, never throw it away in normal domestic waste. Local regulations for the disposal of electrical equipment will apply.

