

# MAVOWATT 45

## The High-End Energy Analyser

Author:  
GOSEN-METRAWATT / VMS / HG



# MAVOWATT 45

## 3 Analysers In 1 Housing

Author:  
GOSEN-METRAWATT / VMS / HG



### » Base Unit: complete Power and Energy Analysis for 1~ and 3~ systems (15 Hz...10 kHz or DC)

- alpha-numeric and graphic display of over 70 meas. quantities
- long-time recording on PCMCIA memory card (accessory)
- **optionally** integratable protocol printer for on-site print-outs

### » Option FFT: Harmonics Analysis for voltage and current up to 50<sup>th</sup> harmonic on signals with fundamental up to 400 Hz

- comparison of the mains voltage harmonics vs. EN 50160 limits
- and of current harmonics vs. limits of EN 61000-3-2

### » Option PDA: Power Disturbance Analysis with free programmable trigger criteria

- supervision of the mains quality to EN 50160 limits

### » Option TCM: Transient & Converter Measurements

- power / energy analysis at frequency converters
- logging of transients down to 20  $\mu$ s duration and up to 1500 V<sub>p</sub>

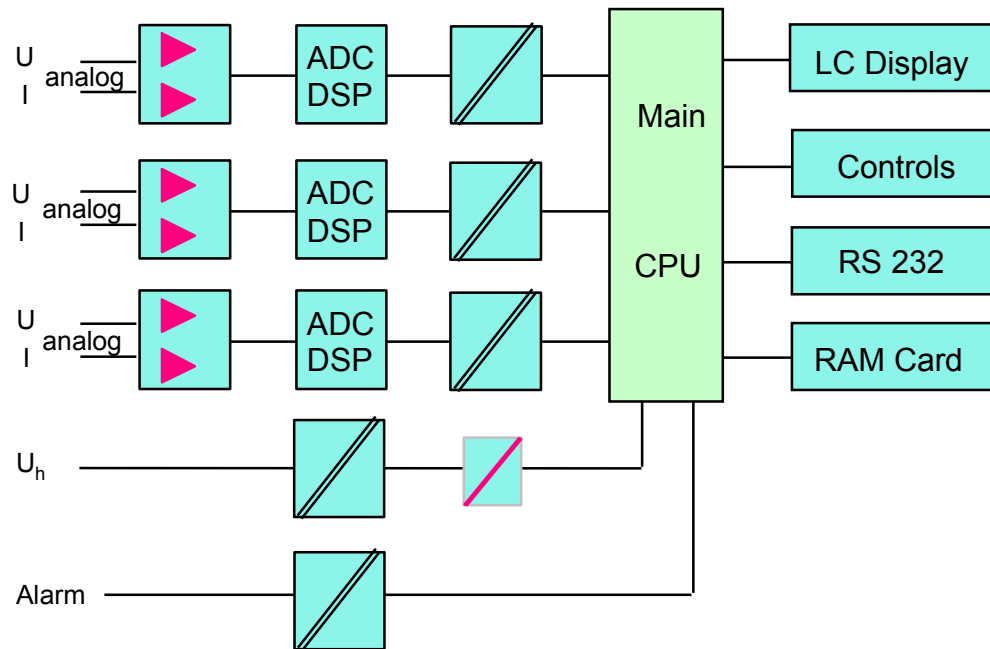
### » Option FSA: Flicker Distortions Analysis

- function of flickermeter according to IEC/EN 61000-4-15 (IEC 868)

### » METRAWin 45: Analysis software

for recording, presentation and extended interpretation of measurements (online / offline from memory card)





ADC = Analog/Digital Converter  
DSP = Digital Signal Processor

**three isolated measuring systems**

**16 bit resolution**

**50 kHz sampling rate for each input**

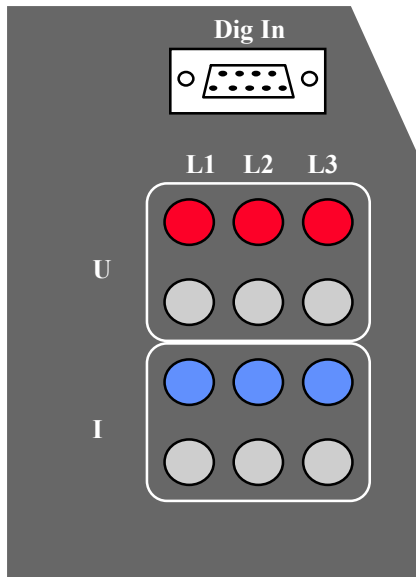
**highly protected inputs**

**U / I inputs: overvoltage CAT IV max. 600V**  
**supply input: overvoltage CAT III**

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## Meter Inputs

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### digital inputs for energy counter pulse trains

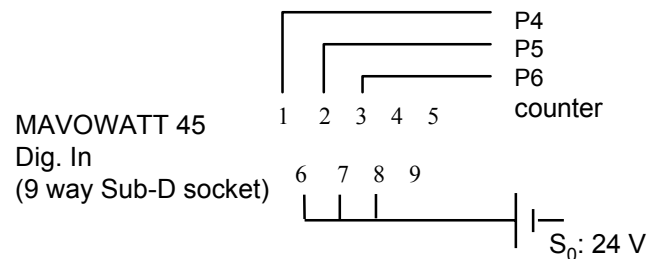
- S<sub>0</sub> compatible
- adjustable counter constants

### voltage measurement inputs

- for direct connection to up to 1000 V (Cat. III) or 600 V (Cat. IV)
- adjustable scaling factors for voltage dividers/transformers

### current measurement inputs (max. 1 V)

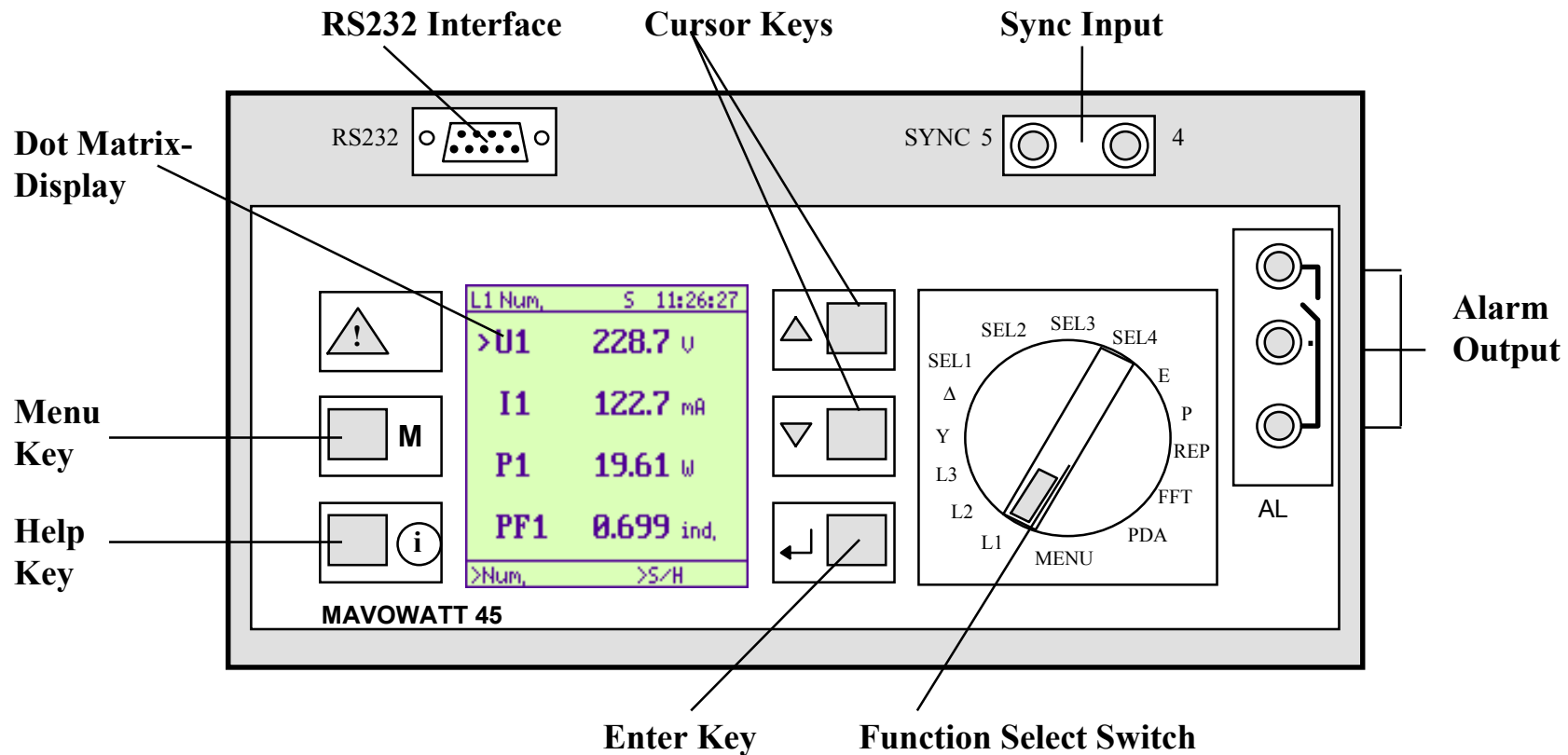
- for connection of (clamp-on) I to U transducers or shunts
- adjustable scaling factors



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# MAVOWATT 45 Front Panel

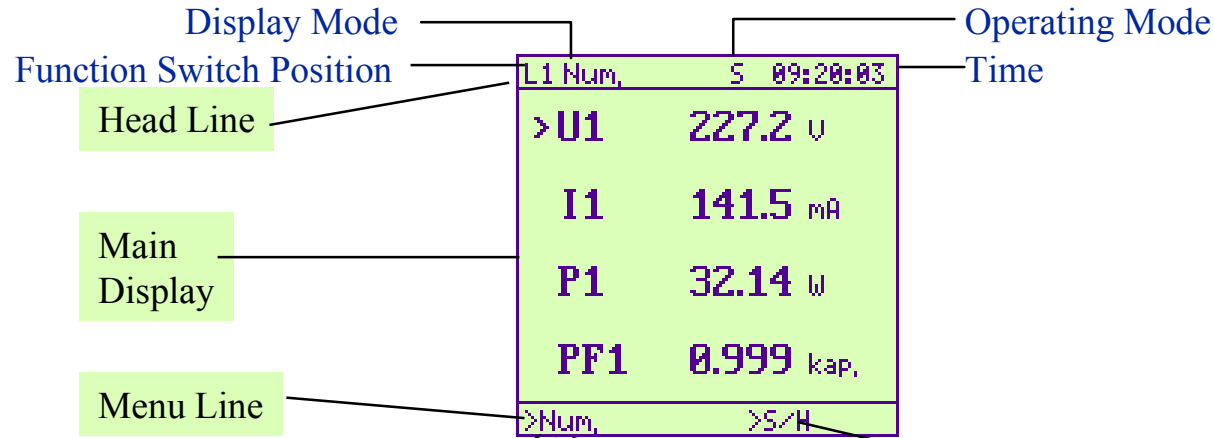
Author:  
GOSSEN-METRAWATT / VMS / HG



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## Easy Use Due To Menu Guidance

Author:  
GOSEN-METRAWATT / VMS / HG



Display Mode Menus				Device Setup Menu	SEL1 - 4 Setup Menu	Operating Mode Menu
BASIC FUNCTIONS	FFT OPTION	TCM / PDA OPTION	FSA OPTION			
numeric	numeric	stat. U	numeric	<b>general</b>	<b>meas.qty.</b>	<b>Sample/Hold</b>
bar	stat. THD	stat. I		<b>limits</b>	<b>meas.type</b>	<b>sync.</b>
statistic	stat. I	event		<b>zones</b>	<b>insert</b>	<b>PC-Card</b>
tabular	stat. U	graf		<b>printer</b>	<b>delete</b>	<b>hardcopy</b>
graphics	graf. L1/2/3				<b>default</b>	<b>setup</b>
wave	tab. L1/2/3					
	tab. L1/2/3 %					



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## Dual Language Setup Menus

Author:  
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```
menu general
> contrast 60
  language english
  Time 11:34:37
  date 05.10.1997
  mains 2/4-Wire

>general
```

### General Settings

**display contrast** (00 ... 99)  
**menu language** (GB / D / F / I)  
**actual time** (hh:mm:ss)  
**actual date** (DD:MM:YY)  
**type of mains system**  
- 2/4 wire: I1, I2, I3 measured  
- 3 wire: I1, I3 measured,  
I2 calculated

```
menu zones
> tarif 1 from 06:00
  tarif 1 from 06:00
  tarif 2 from 22:00
  tarif 2 from 22:00
  tarif 3 from 22:00
  tarif 3 from 22:00

>zones
```

### Tariff Zone Settings

**for evaluation of energy consumption in different zones under SEL1 ... SEL4:**  
e.g. WPT1 = active energy accumulated in tariff zone 1

```
L1 setup S 12:14:12
> cycle time 0001
  Iratio 1000.0
  Uratio 1.0000
  printer off
  interval 0060

>num, >setup
```

### Measurement Settings

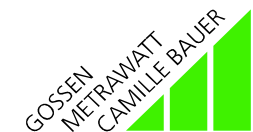
**refresh cycle** (1s ... 3600 s)  
**current scaling factor** (xxx A/V)  
**voltage scaling factor** (xxx V/V)  
**interval print** (on / off)  
**time interval** (1s ... 1800 s)  
- for MIN / MAX / AVR values  
- for interval print  
- for recording to memory

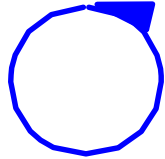
```
menu limits
> U1 ▼ 200,
  U1 ▲ 250,
  U2 ▼ 200,
  U2 ▲ 250,
  U3 ▼ 200,
  U3 ▲ 250,
  f ▼ 49,0
  f ▲ 51,0
  printer on

>limits
```

### Limit Settings

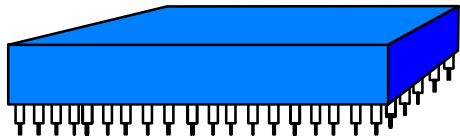
**for supervision of up to four selectable quantities under SEL4**  
alarm signal (relay contact) and print-out is triggered when any value leaves set tolerance band





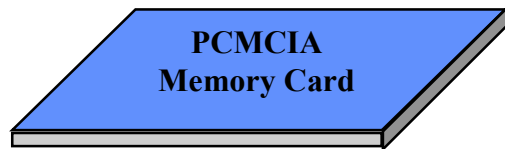
### **FIFO register for measured values (volatile)**

- capacity: approx. 900 values
- oldest values are overwritten by latest ones
- register is cleared when function is changed



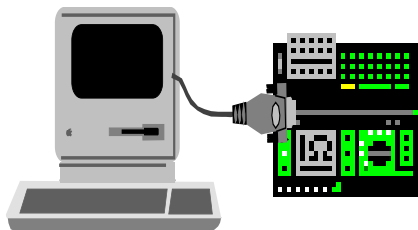
### **internal display memory (non-volatile)**

- capacity: 15 screen shots ("hardcopies")
- any displayed measurement can be stored



### **long-time recording by means of PC-Card**

- readback of measured values via display or
- via RS232 interface to a PC with METRAWin 45



### **online recording to a PC**

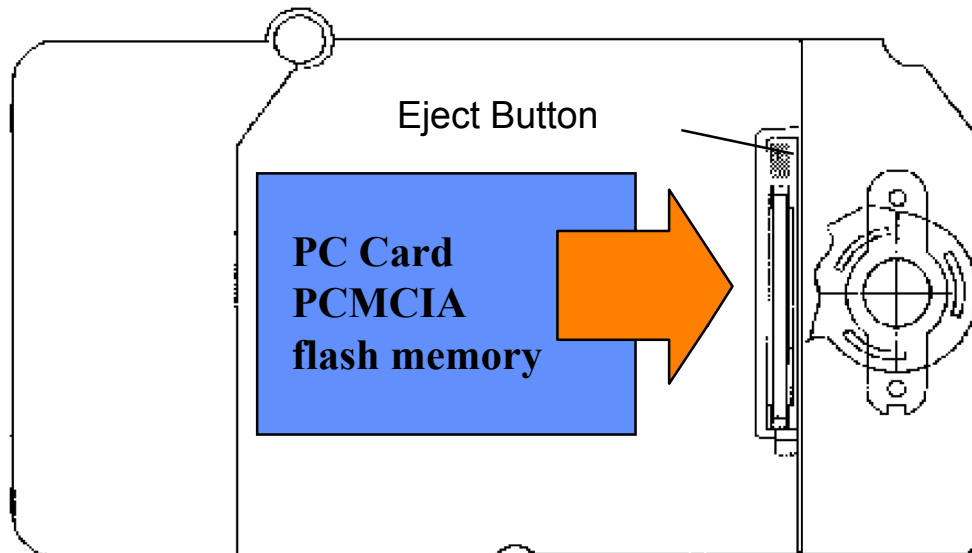
- with METRAWin 45 via RS232 interface  
(not available for FFT / PDA / FSA / Transient Measurement)



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## Memory Card For Long-term Recording

Author:  
GOSEN-METRAWATT / VMS / HG



**PCMCIA Flash RAM Memory Card**  
**JEIDA Standard 68 pin; AMD Series C**  
(accessory MAVO RC8 = 8 MByte Card)

**250 k measurements per Mbyte**

**Example:** with a 8 MByte Card the values of 12 quantities can be stored in 1 minute intervals over a period of 4 months

**storage and readback of up to 20 "runs" containing values of up to 20 quantities**

**comfortable evaluation of the stored data with software [METRAWin 45](#)**

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## Parameters For Recording To PC-Card

Author:  
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SEL4 num,	S	01:51:32
> store	no	
read	10	
interval	0001	
start time	01:51:15	
start date	25,11,1996	
end time	21:19:30	
end date	25,11,1996	
delete	yes	
#runs	10	
>num,	>PC-Card	

← start recording (yes/no)

← number of the run to be read (00 - 20)

← storage interval (1 - 3600 s)

← definition of starting time for delayed start of recording (time and date)

← calculated latest time for end of recording (time and date)

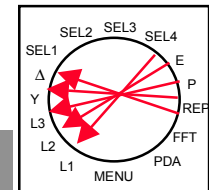
← start complete erase of PC Card (yes/no)

← number of runs being stored on PC Card (00 - 20)

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## Display Modes For Power Analysis (1)

Author:  
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### numerical mode

L1 Num,	S	22:15:24
>U1	230.7	V
I1	559.5	mA
P1	80.04	W
PF1	0.620	cap.
>Num,	>S/H	

- displays the measured and calculated values of up to 10 quantities as a 4-digit auto-ranging number with dimension
- values are refreshed according set *cycle time* (min. 1s)
- type size automatically adapts to number of quantities to be displayed
- cursor selects quantities for other display modes

### bargraph mode

L1 bar	S	16:22:31
>U1		
	0	230.3 1.000K
I1		
	0	559.9m 1.500
P1		
	0	81.46 1.500K
PF1		
	0	0.636CAP. 1.000
>bar	>S/H	

- displays the measured and calculated values of up to 4 quantities numerically and as horizontal bars with auto-ranging scale

### statistical mode

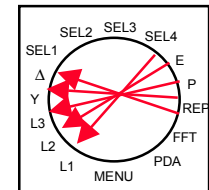
L1 stat,	S	16:23:34	
range U1		range I1	
< 229,8	4	< 294,9m	1
< 229,9	4	< 328,1m	0
< 229,9	0	< 361,3m	0
< 230,0	3	< 394,5m	0
< 230,0	1	< 427,6m	0
< 230,1	0	< 460,8m	0
< 230,2	0	< 494,0m	0
< 230,2	1	< 527,2m	0
< 230,3	2	< 560,4m	14
>stat,	>S/H		

- displays for two selectable quantities the statistical partition of their measured values being stored in the FIFO register  
= number of measurements within 9 ranges of equal width depending on MIN and MAX stored values

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## Display Modes For Power Analysis (2)

Author:  
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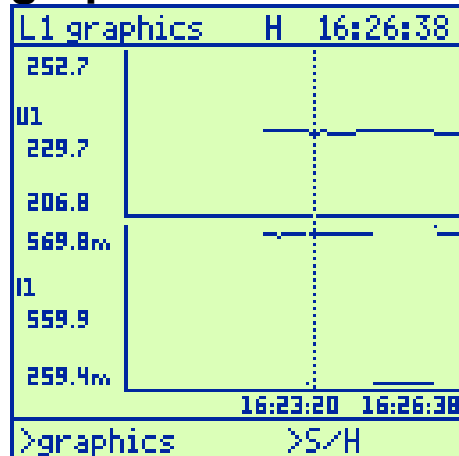
### tabular mode

L1 tab, S 16:24:16		
Time	U1	I1
16:23:40	229,6	558,6m
16:23:45	229,7	557,5m
16:23:50	229,7	556,6m
16:23:55	229,6	558,1m
16:24:01	229,6	558,3m
16:24:05	229,6	557,5m
16:24:10	229,6	557,3m
16:24:15	229,5	556,8m
16:24:16	229,6	557,2m

>tab, >S/H

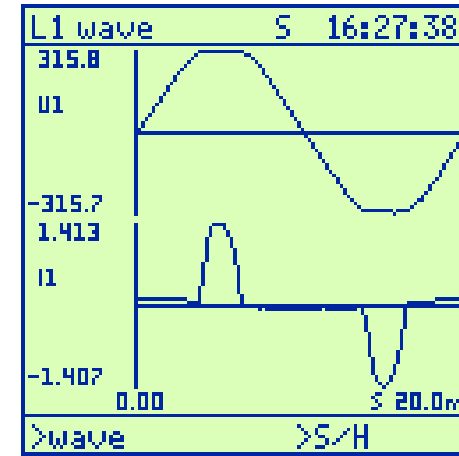
- displays for two selectable quantities a numerical listing of their measured values being stored in the FIFO register and the corresponding time of registration
- in HOLD mode table can be scrolled with cursor keys

### graphics mode



- displays for two selectable quantities their measured values being stored in the FIFO register as y-t graphs with scaled axis
- in HOLD mode graphs can be analyzed with a cursor being moved by cursor keys

### waveform mode

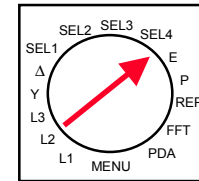


- displays one cycle of the sampled waveform of voltage and current like an oscilloscope
- axis are auto-scaled with the measured peak values and the detected periode

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## Display Modes For Energy Analysis

Author:  
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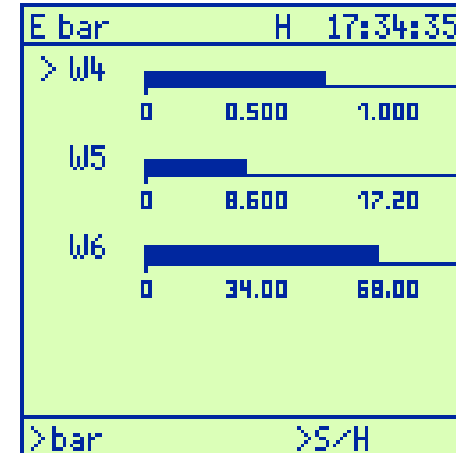
**Active Energy** of the three phases and in total  
- measured via the **analog inputs**

**(Apparent) Energy** of the three phases  
- measured via the **digital counter inputs**

### numerical

E Num,	S	09:08:05
>WP1	4.264	Wh
WP2	4.323	Wh
WP3	4.294	Wh
WPΣ	12.88	Wh
W4	16.00	VAh
W5	8.290	kVAh
W6	8.192	kVAh
>Num,	>S/H	

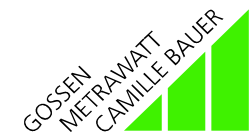
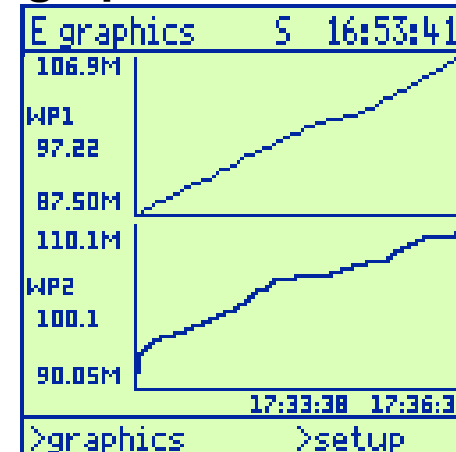
### bar



### tabular

E tab,	S	10:01:54
ime	WP1	WP2
10:00:30	34,89	35,25
10:01:30	36,69	37,03
10:01:53	37,37	37,71
tab.	>S/H	

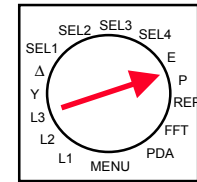
### graphics



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## Display Modes For Power Demand Analysis

Author:  
GOSEN-METRAWATT / VMS / HG



### numerical

**Power demand of the current period (trend power)**  
- measured via the **analog inputs**

**Power demand of the current period (trend power)**  
- measured via the **digital counter inputs**

P num.	S	09:11:09
>OP1	33.62	W
OP2	34.10	W
OP3	33.91	W
OPΣ	101.6	W
OP4	0.000	W
OP5	0.000	W
OP6	0.000	W
num,	>S/H	

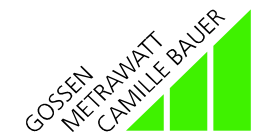
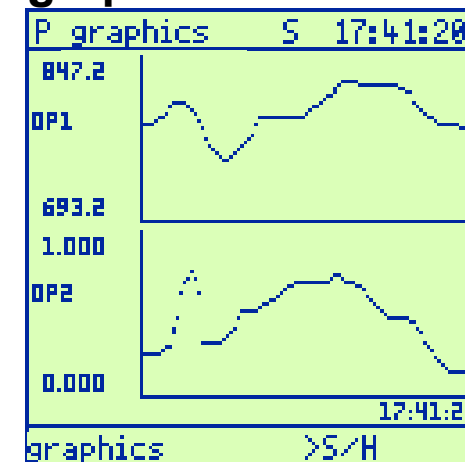
### statistic

P stat,	S	17:38:52
range U <sub>1</sub> OP1	range U <sub>1</sub> OP2	
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	0	< 0,000 0
< 770,0	1	< 0,000 1
stat,	>S/H	

### tabular

P tab,	S	17:40:24
ime	OP1	OP2
17:39:13	770,0	0,000
17:40:13	770,1	0,000
17:40:23	770,1	0,000
tab,	>S/H	

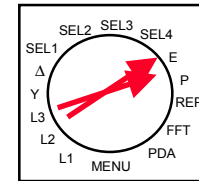
### graphics



# MAVOWATT 45

## Setup For Power Demand And Energy Analysis

Author:  
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```

E setup          5  16:48:03
> period        0900
  cconst-4      1,0000
  cconst-5      1,0000
  cconst-6      1,0000
  sync,         time
  PFnom         1,00
  printer        off
  interval      0005
  reset         no

>graphics      >setup
    
```

integration time for power demand calculation  
(60 - 3600 s)

counter input constants (0.1 - 99999 counts/kWh)

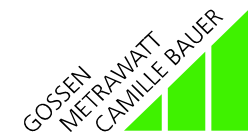
period/interval synchronisation (time / external)

power factor setpoint for calculation of correction  
power DQ (0.01 - 1.00)

enable printer for hardcopy (on/off)

time interval for printing and/or storage to PC Card;  
integration time for MIN/MAX/AVR values (1 - 1800 s)

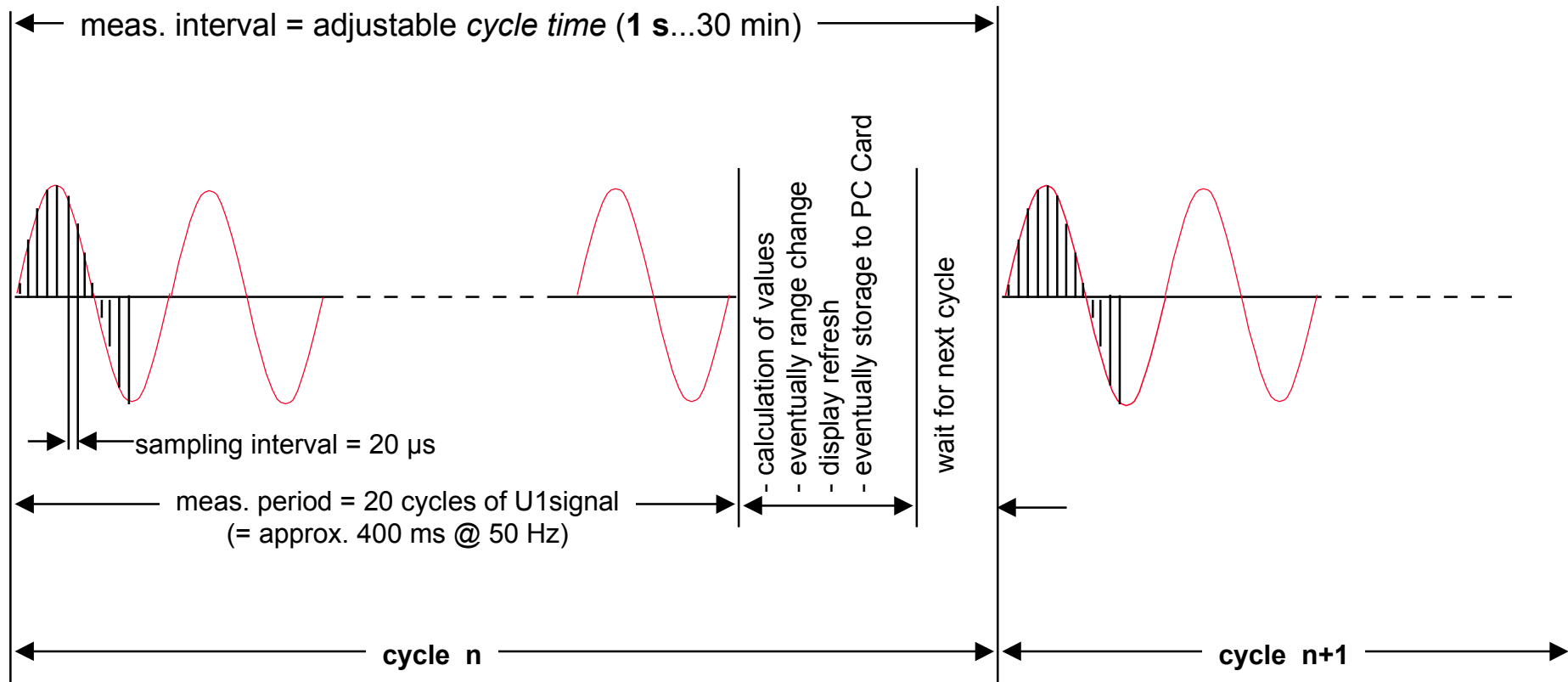
reset energy counter values to zero (yes/no)



# MAVOWATT 45

## Measuring Principal Of Power And Energy Analysis

Author:  
GOSEN-METRAWATT / VMS / HG

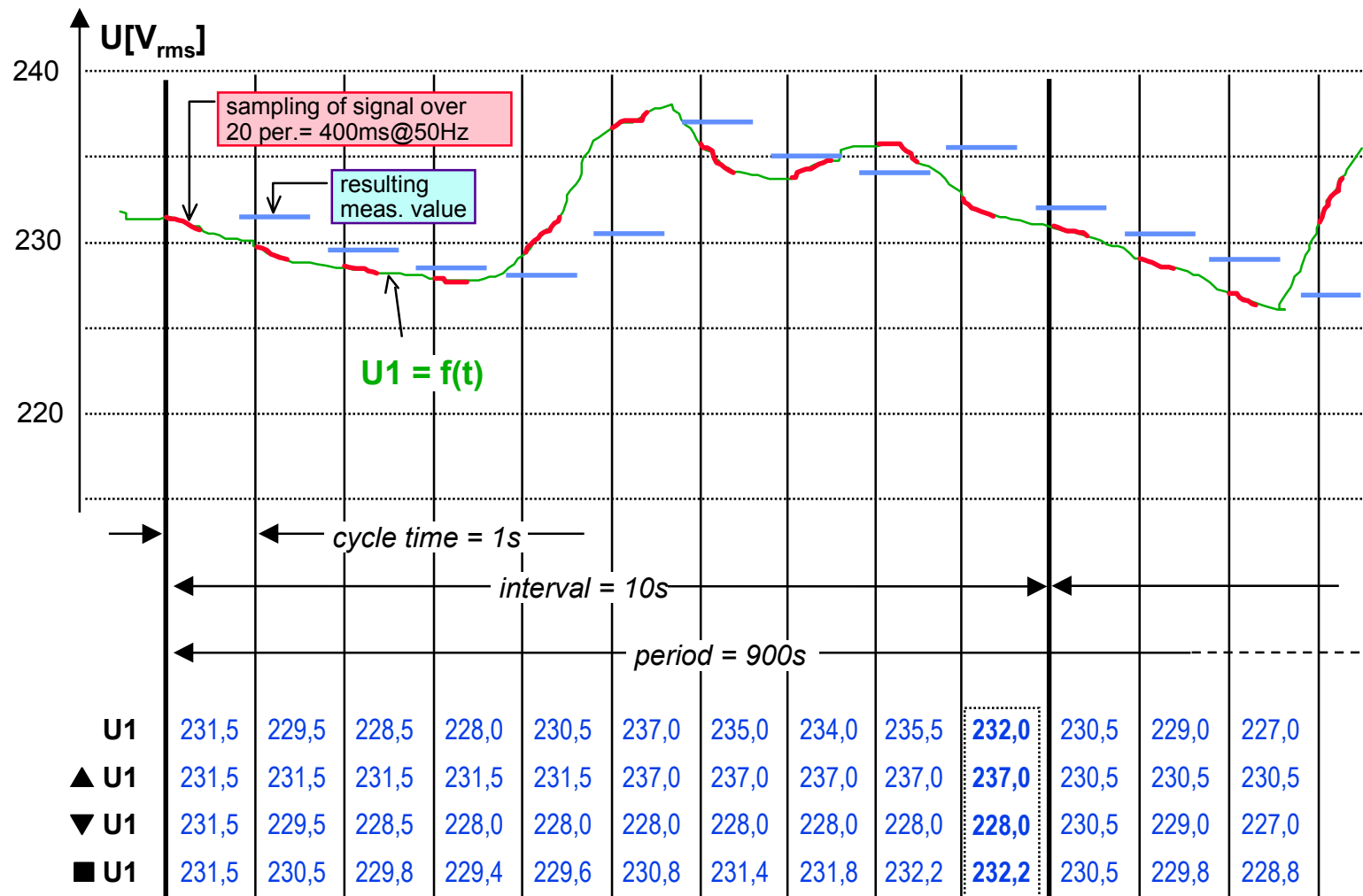




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## Registration of Mean and Extremum Values

Author:  
GOSEN-METRAWATT / VMS / HG

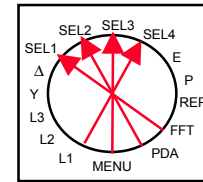


FIFO Register  
print-out if *printer on*  
PC-Card if *store yes*

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## SEL1 ... 4 = User Defined SElection Of Quantities



Four menus with up to 20 (2 x 10) free selectable quantities

### SEL4:

- The values of all quantities in this menu can be stored on PC Card
- The leading four quantities in this menu can be verified with adjustable MIN/MAX limits for ALARM signalisation and/or event print-out

SEL1 num,	S	16:33:43
>U1	230.0	V
U2	0.000	V
U3	0.000	V
I1	553.5	mA
I2	0.000	A
I3	0.000	A
f	49.92	Hz
>num,		>S/H

SEL3 num,	S	16:34:06
> U1	229,8	V
■I1	554,2	mA
▲I1	554,2	mA
▼I1	553,2	mA
I1	554,2	mA
S1	127,4	VA
P1	80,96	W
Q1	-98,31	var
WP1	1,063	kWh
0P1	81,12	W
>num,		>S/H

### Example for 10 selected quantities in SEL3:

- voltage at L1 (instantaneous RMS value)
- current in L1 (mean value within interval)
- current in L1 (MAX value within interval)
- current in L1 (MIN value within interval)
- current in L1 (instantaneous RMS value)
- apparent power in L1 (instantaneous value)
- active power in L1 (instantaneous value)
- reactive power in L1 (instantaneous value)
- active energy in L1 (since reset of counter)
- trend power of the current period in L1

# MAVOWATT 45

## Setup For SElected Measured Quantities

Author:  
GOSSEN-METRAWATT / VMS / HG

**1. Define number of measured quantities**  
by repeated "insert"

SEL2 setup	S	position
> U1		
U1		
U1		
U1		
U1		
U1		
>meas,qty		>end

**2. Define the measured quantity**  
by selecting the desired quantity in four different menus with 75 meas. quantities

SEL2 setup	S	meas,qty
> U1	U23	
U2	U31	
U3		
UΣ		
I1		
I2		
I3		
IΣ		
In		
U12		
>U/I		

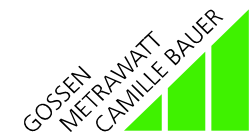
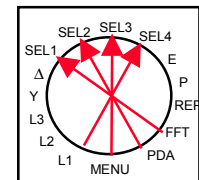
SEL2 setup	S	meas,qty
> P1	Q3	DQΣ
P2	QΣ	
P3	Qc	
PΣ	S1	
P4	S2	
P5	S3	
P6	SΣ	
PcΣ	DQ1	
Q1	DQ2	
Q2	DQ3	
>power		

**3. Define the meas. type**  
for each individual quantity

SEL2 setup	S	meas,type
>	effective	
	maximum	
	minimum	
	average	
	period0	
	period1	
>position		

SEL2 setup	S	meas,qty
> WP1	WS3	W4T3
WP2	WSΣ	W5T1
WP3	W4	W5T2
WPΣ	W5	W5T3
WQ1	W6	W6T1
WQ2	WPT1	W6T2
WQ3	WPT2	W6T3
WQΣ	WPT3	
WS1	W4T1	
WS2	W4T2	
>energy		

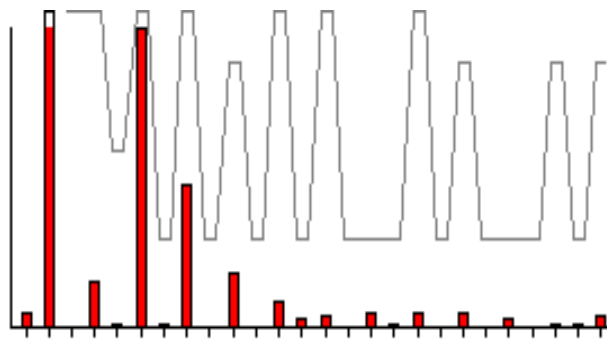
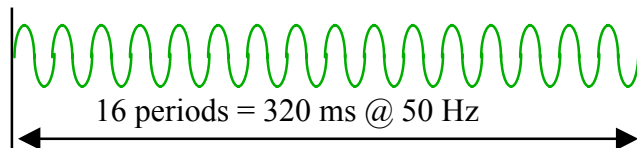
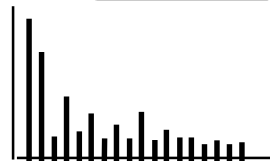
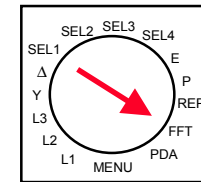
SEL2 setup	S	meas,qty
> PF1	ci1	
PF2	ci2	
PF3	ci3	
PFΣ	ciΣ	
PFc	Rot	
cu1		
cu2		
cu3		
cuΣ		
f		
>factor		



# MAVOWATT 45

## Harmonics Analysis With Option MAVO-FFT

Author:  
GOSEN-METRAWATT / VMS / HG



### MAVOWATT is functionally upgraded by software

- key code number must be requested by mail or fax

### analysis up to 50th harmonic

- in power systems with line frequency up to 400 Hz

### evaluation of harmonics by Fast Fourier Transformation

- over a rectangular time window of 16 periods

### compliance test to the limits for harmonic distortions

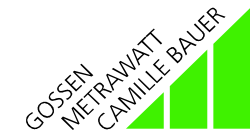
- of the voltage : **stat. U**

according to EN 50160 (IEC / EN 61000-2-2)

- of the current : **stat. I**

according to IEC / EN 61000-3-2

class A, B, C, D (former DIN VDE 0555-2)



# MAVOWATT 45

## Important Standards For Mains Quality

---

Author:  
GOSSEN-METRAWATT / VMS / HG

### International

### National (Germany)

#### Supplier:

EN 50160

DIN EN 50160  
VDE 0839 T160

Voltage characteristics of electricity  
supplied by public distribution systems

#### Consumer:

IEC 61000-3-2  
EN 61000-3-2  
(former IEC 555-2)

DIN EN 61000-3-2  
VDE 0838T2

Limits for harmonic current emissions  
(equipment input current  $\leq 16A$ )  
Classes A, B, C, D

IEC 61000-3-3  
EN 61000-3-3

DIN EN 61000-3-3

Limitations of voltage fluctuations and flicker  
in low-voltage supply systems for equipment  
with rated current  $\leq 16A$

#### Basis:

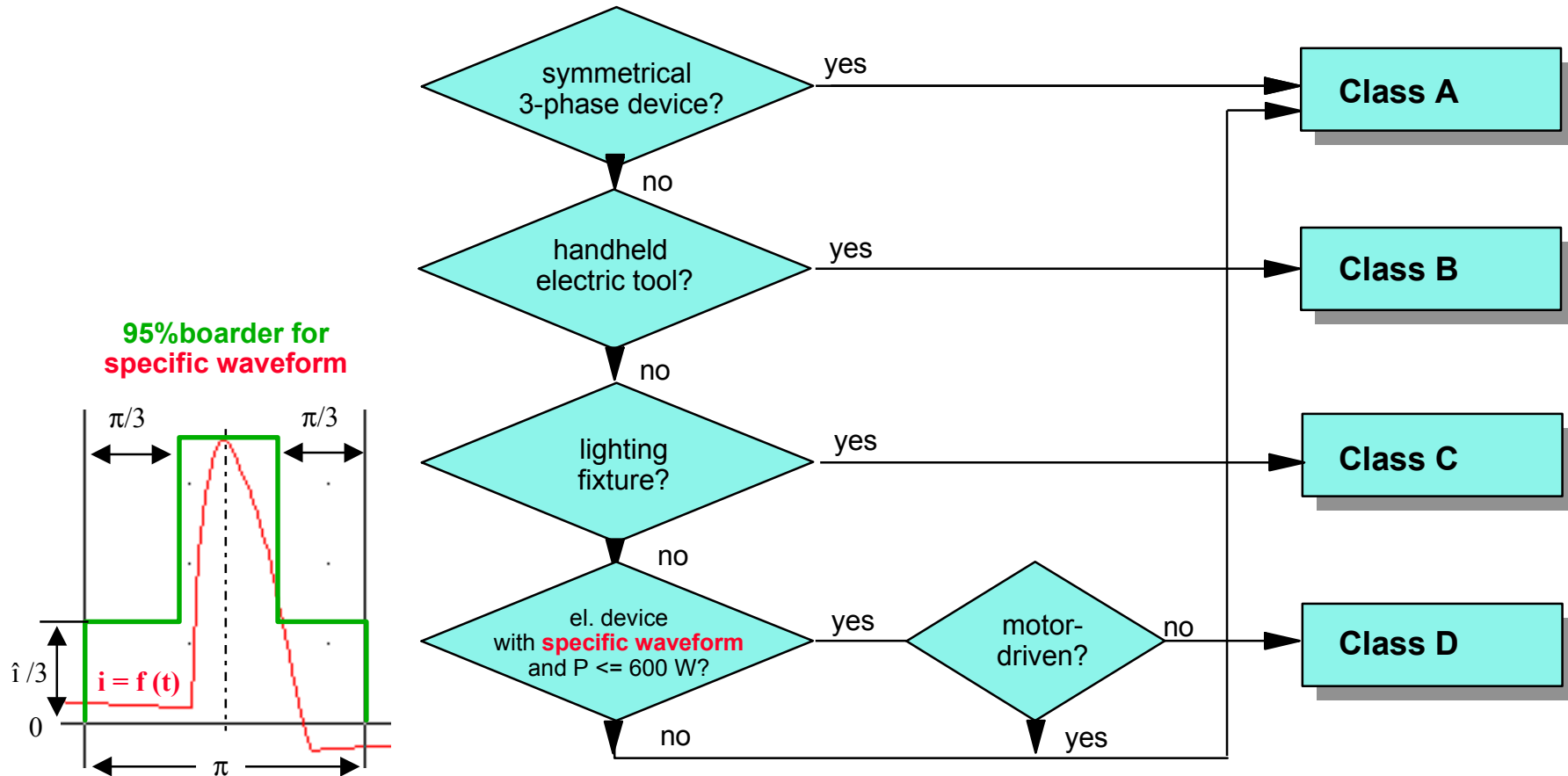
EC regulations  
EMC law  
CE mark



# MAVOWATT 45

## Classification Of Consumers As Per EN 61000-3-2

Author:  
GOSEN-METRAWATT / VMS / HG

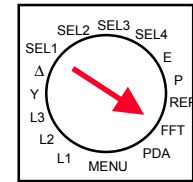


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# MAVOWATT 45

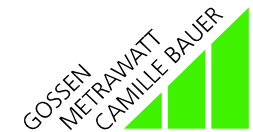
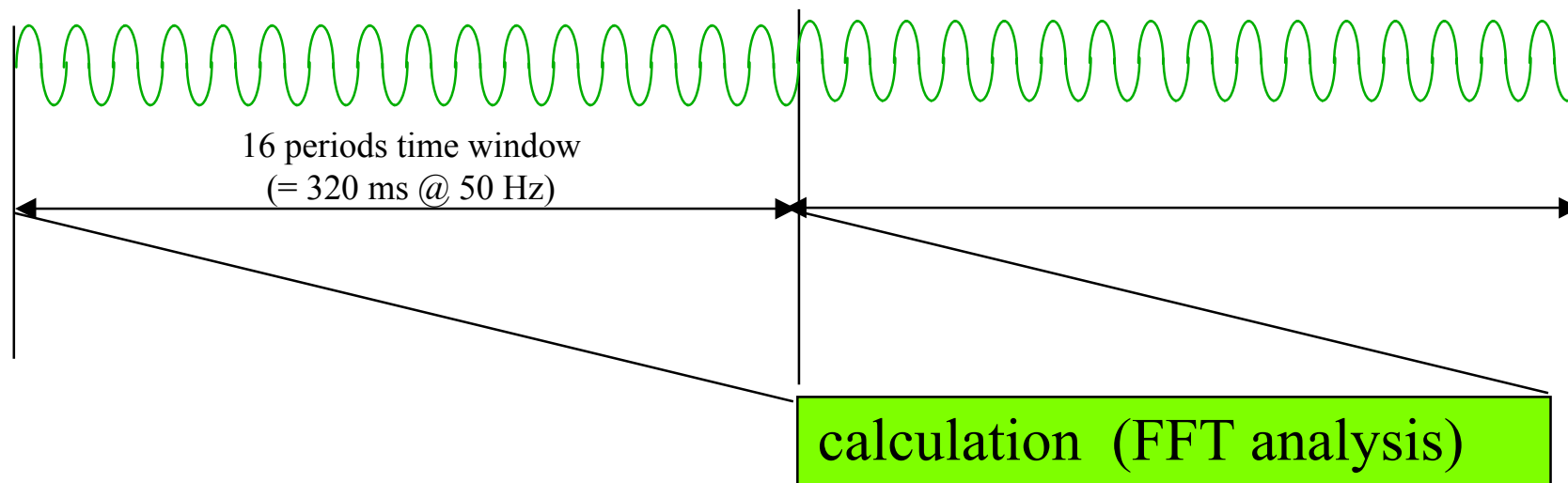
## Measuring Principal Of Harmonics Analysis (1)

Author:  
GOSEN-METRAWATT / VMS / HG



For modes FFT num / FFT stat THD / FFT stat U / FFT stat I

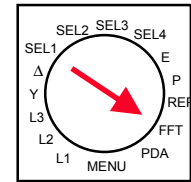
- non-intermittend evaluation of the signals
- real-time operation



# MAVOWATT 45

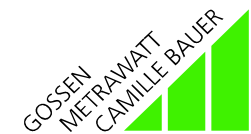
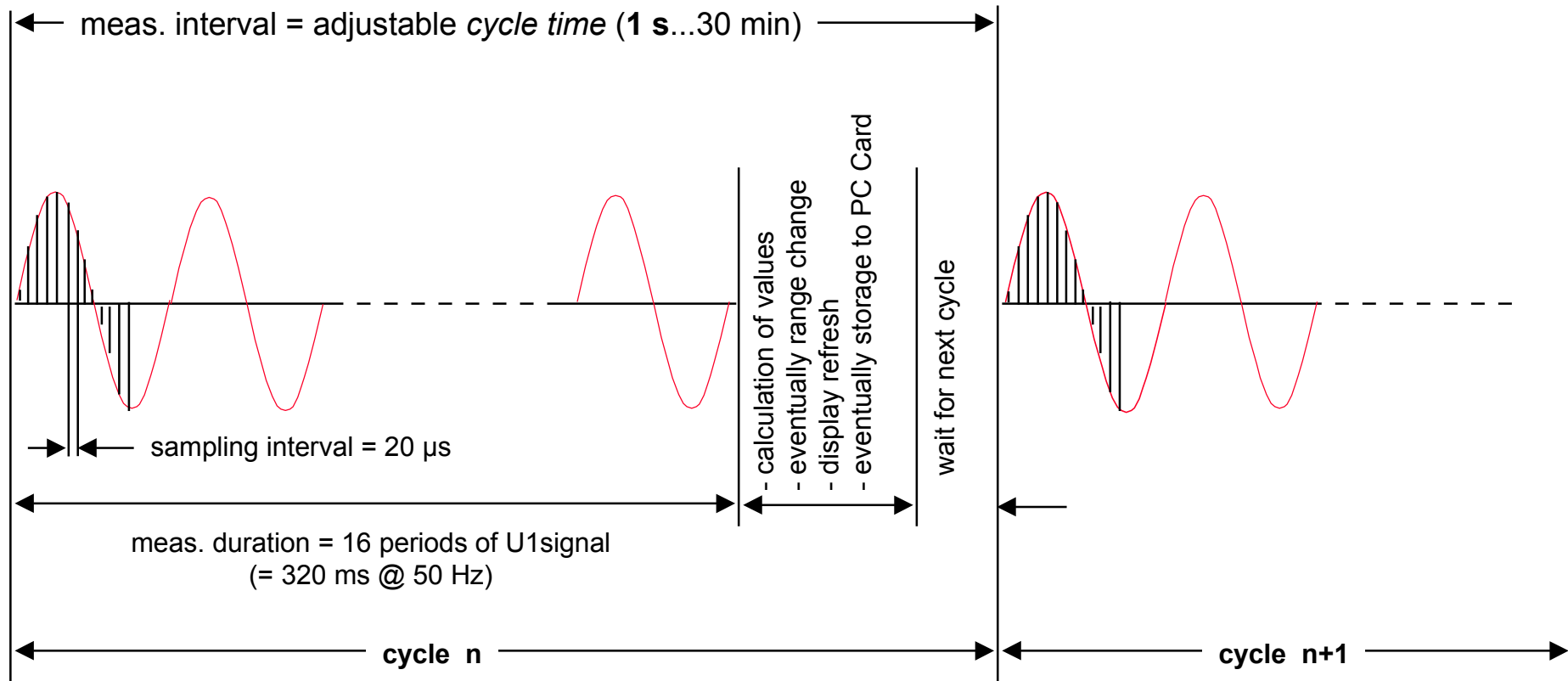
## Measuring Principal Of Harmonics Analysis (2)

Author:  
GOSEN-METRAWATT / VMS / HG



For modes FFT graf L1/L2/L3 / FFT tab L1/L2/L3/ FFT tab L1%/L2%/L3%

- **intermittend evaluation of the signals**

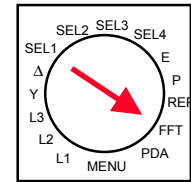




# MAVOWATT 45

## Display Modes For Harmonics Analysis (1)

Author:  
GOSEN-METRAWATT / VMS / HG



### FFT numerical

FFT Num	S	13:35:15
	THD-I %	THD-U %
L1	35,7	3,7
L2	35,6	3,7
L3	32,3	3,7
	P W	f Hz
L1	1,697k	49,99
L2	1,721k	49,99
L3	1,784k	49,99
>Num,	>S/H	

simultaneous analysis of all three phases by numeric values for

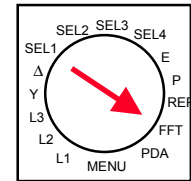
- Total Harmonic Distortion of voltage and current
- Active Power
- frequency

data can be stored to PC Card in intervals of 1 s min.

# MAVOWATT 45

## Display Modes For Harmonics Analysis (2)

Author:  
GOSSEN-METRAWATT / VMS / HG



### FFT stat. THD

statistical partition (classification)  
of the Total Harmonic Distortion  
of voltage and current in all three phases

FFT stat, THD S 16:58:09					
	<2%	>2%	>5%	>10%	>20%
I1	0	0	0	0	22
U1	0	22	0	0	0
I2	22	0	0	0	0
U2	22	0	0	0	0
I3	22	0	0	0	0
U3	22	0	0	0	0

>stat, THD      >setup

THD classes

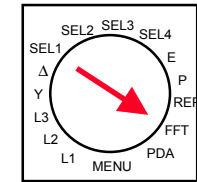
number of counts within the specified class  
(counters are reset after end of set interval)

- non-intermittend evaluation of the signals
- samples integration time  
= 16 periods of fundamental frequency  
approx. 3 counts per second @ 50 Hz

# MAVOWATT 45

## Display Modes For Harmonics Analysis (3)

Author:  
GOSEN-METRAWATT / VMS / HG



### FFT statistic U

FFT stat,U	S	16:59:06
limits: EN 50160		
U11	0	
U21	0	
U31	0	
>stat,U	>setup	

### compliance test to the limits for harmonic distortions of the voltage

according to EN 50160 (IEC/EN 61000-2-2)

number of counts exceeding the limits  
(counters are reset after end of set interval)

### FFT statistic I

FFT stat,I	S	16:58:42
limits: D		
I11	10	
I21	0	
I31	0	
>stat,I	>setup	

### compliance test to the limits for harmonic distortions of the current

according to IEC/EN 61000-3-2 class A, B, C, D (former DIN VDE 0555-2)

**Example:** Compliance test of a PC's mains current harmonics vs. EN 61000-3-2 limits

SETUP: limits = D (classification of consumers)  
interval = 600 s (as per EN 61000-3-2)  
remaining parameters are not relevant

→ No. of measurements within interval =  $600 \text{ s} / 320 \text{ ms} = 1875$

according to standard 5 % of the measurements (= 94) may exceed the limits

→ displayed counts < 94 : unit meets standard limits  
displayed counts > 94 : unit does not comply

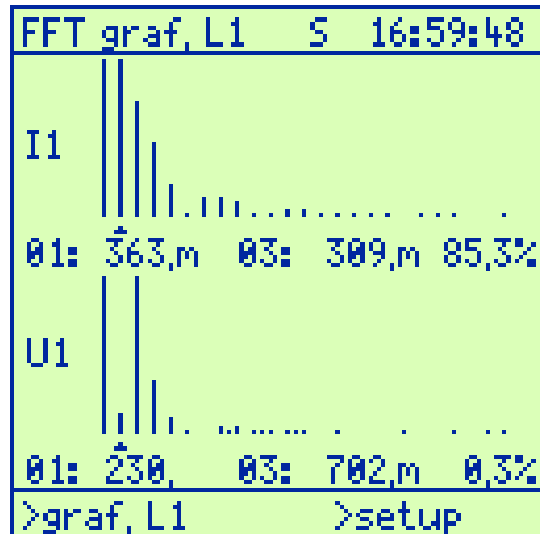


# MAVOWATT 45

## Display Modes For Harmonics Analysis (4)

Author:  
GOSEN-METRAWATT / VMS / HG

### FFT grafic L1/L2/L3

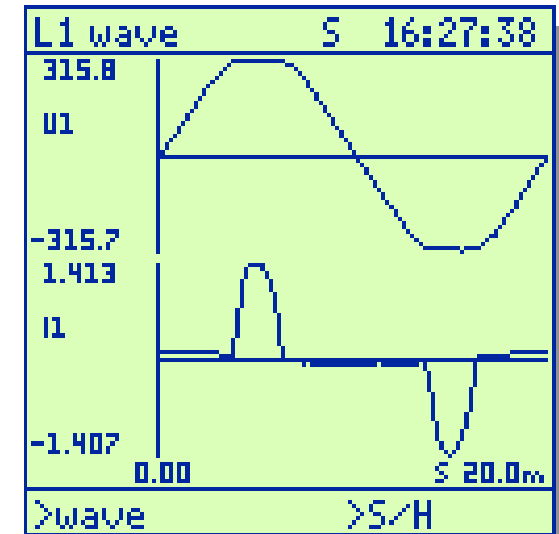


- up to 50th harmonic
- odd and even harmonics
- automatically optimized scaling
- absolute values for fundamental wave and selected harmonic
- % value of selected harmonic
- odd/even selection for tabular display mode

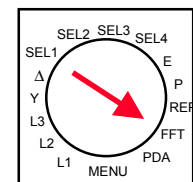
### FFT tabular L1/L2/L3 (dto. %) L1/L2/L3 wave

FFT tab, L1 S 17:01:18					
L1	I	%	U	%	
FFT tab, L1 S 17:00:41					
L1	I	phiI	U	phiU	
01	364,m	-080,3	230,	-090,5	100,0
03	310,m	094,2	853,m	-009,5	1,96
05	230,m	-084,4	5,67	085,0	0,02
07	142,m	099,8	2,01	-078,0	0,01
09	59,9m	-072,8	502,m	164,0	0,02
11	7,53m	-143,5	251,m	-033,7	0,01
13	37,5m	094,7	100,m	-090,0	0,01
15	43,7m	-080,6	351,m	168,6	
17	28,7m	101,5	201,m	-090,0	

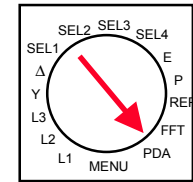
- table for amplitude (rms) and phase angle of all odd or even harmonics of voltage and current of one phase
- table for amplitude (rms) and % value of all odd or even harmonics of voltage and current of one phase
- values for all three phases will be stored to PC Card in tab L3 mode



- display of the waveforms of voltage and current of the selected phase



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```
PDA setup      S  01:29:09
> oU / U      253,00
  uU / U      207,00
  dU / U      10,000
  THDU / %     8,00
  syU / %     ,000
  ofU / Hz     ,000
  ufU / Hz     ,000
  printer      off
  interval     0001

>statU        >setup
```

### Voltage trigger criteria in accordance to EN 50160

- ← upper voltage limit (RMS value)
- ← lower voltage limit (RMS value)
- ← delta voltage limit (between two consecutive measured values)
- ← limit for Total Harmonic Distortion of the voltage (% value)
- ← limit for voltage unsymmetry in the 3-phase system (% value)
- ← upper limit for mains frequency (absolute Hz value)
- ← lower limit for mains frequency (absolute Hz value)

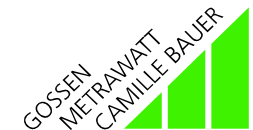
```
PDA setup      S  01:29:44
> oI / A      ,10000
  uI / A      ,00000
  dI / A      ,00000
  THDI / %    ,000
  syI / %    ,000
  printer      off
  interval     0001

>statI        >setup
```

### Current trigger criteria

- ← upper current limit (RMS value)
- ← lower current limit (RMS value)
- ← delta current limit (between two consecutive measured values)
- ← limit for Total Harmonic Distortion of the current (% value)
- ← limit for current unsymmetry in the 3-phase system (% value)

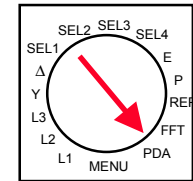
OR function for all set trigger criterias  $\neq$  .000  
i. e. any appearing event will cause a trigger



# MAVOWATT 45

## General Setup For Power Disturbance Analysis

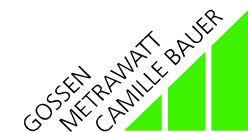
Author:  
GOSEN-METRAWATT / VMS / HG



```

PDA setup      5  17:08:18
  display      singlemode
>#peribds     02
  rangeU       600U·Uratio
  rangeI       1A·Iratio
  phases       1
  >event
  >setup
    
```

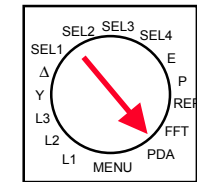
- ← display trigger mode (*singlemode* / *rollmode*)
- ← number of signal periods (cycles) for meas. duration (2 / 4 / 8 / 16)
- ← fixed voltage measuring range (12 / 120 / 600 V rms)
- ← fixed current measuring range (0.12 / 1 A rms)
- ← phase selection for PDA (1 / 2 / 3 / 1+2 / 1+3 / 2+3 / 1+2+3)



# MAVOWATT 45

## Display Modes For PDA Function (1)

Author:  
GOSEN-METRAWATT / VMS / HG



### PDA statistic U

PDA statU				S	02:19:14
	U1	U2	U3		
o	0	0	0		
w	0	0	0		
d	0	0	0		
THD	0	0	0		
sy	0	0	0		
of	0	0	0		
uf	0	0	0		
>statU				>treset	

Individually for each phase and trigger criteria the number of measured values exceeding the corresponding trigger level are listed (counters are reset after end of set interval)

- non-intermittend evaluation of the signals

### Example:

Assumed Setup:

oU	264 V
uU	216 V
syU	5 %
#periods	4
phases	123
interval	10 s
store	yes

Assumed Event: continuous undervoltage (e.g. 200 V) in L1 of a 240V-50 Hz-3phase-system

Result: the counter values being stored in intervals of 10 s will show

-for uU1:	125 (= 10s / (4 x 0.02s))
-for syU1:	125
else:	0



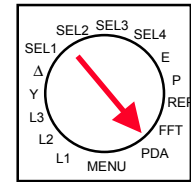
### PDA statistic I

PDA statI				S	17:06:59
	I1	I2	I3		
o	0	0	0		
w	0	0	0		
d	0	0	0		
THD	228	0	0		
sy	0	0	0		
>statI				>setup	

# MAVOWATT 45

## Display Modes For PDA Function (2)

Author:  
GOSSEN-METRAWATT / VMS / HG



### PDA event

PDA event	S	17:09:32
17:09:00	uU1	229,0
17:09:00	THDI1	100,0
17:09:00	uU1	229,0
17:09:00	THDI1	100,0
17:09:00	uU1	229,0
17:09:00	THDI1	100,0
17:09:00	uU1	229,0
17:09:00	THDI1	100,0
17:09:00	uU1	229,0
17:09:00	THDI1	100,0
>event	>setup	

In the sequence of appearance all events are listed with

- the time of event
- the criterion which has caused the trigger
- the measured value of the corresponding criterion

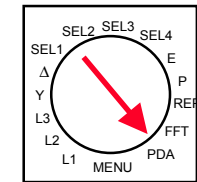
- non-intermittend evaluation of the signals if #periods = 16



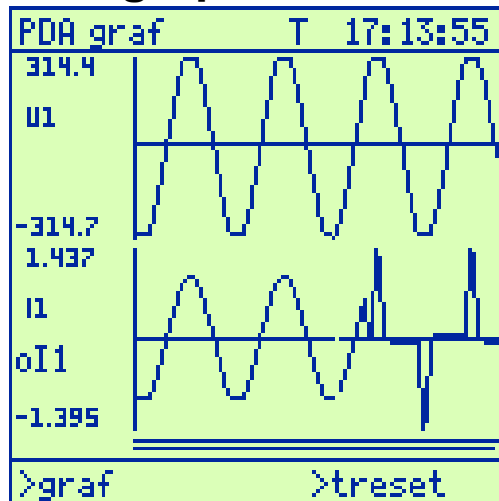
# MAVOWATT 45

## Display Modes For PDA Function (3)

Author:  
GOSEN-METRAWATT / VMS / HG



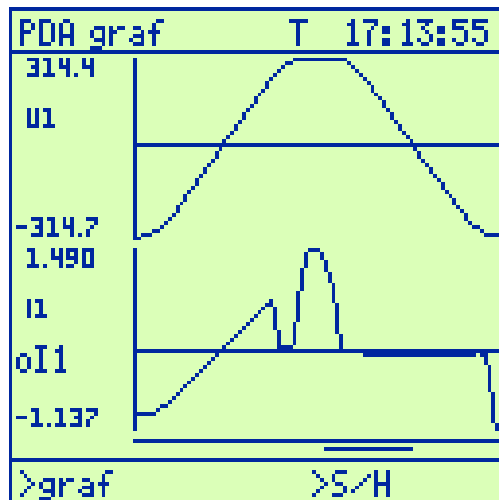
### PDA graphic



When an event appears, then the time, the causing trigger criterion and the waveform of voltage and current of the affected phase will be stored and/or displayed

Recorded time window = 3850 samples x 20  $\mu$ s = **77 ms**  
(= 4 periods approx. @ 50 Hz)

- intermittend evaluation of the signals  
(no signal analysis for approx. 1.5 s or 7 s if storing to PC Card)



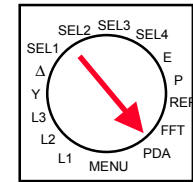
The displayed graph can be zoomed and scrolled in several steps to make short transients visible (for display setup singlemode only)

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# MAVOWATT 45

## Setup For Measurement Of Transients With Option TCM

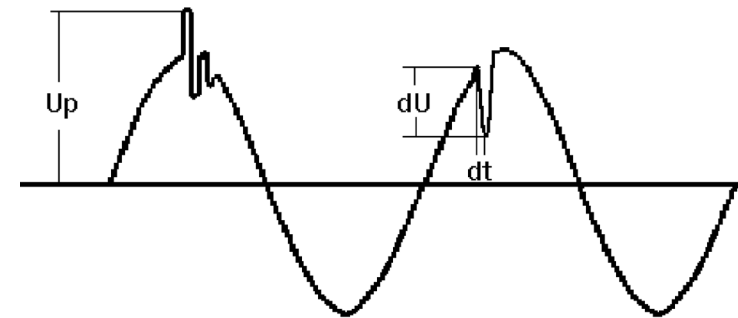
Author:  
GOSEN-METRAWATT / VMS / HG



```
TCM setup      S  10:23:48
> display      rollmode
rangeU         600U-Uratio
rangeI         1A-Iratio
phases         1
pr,trigger     30 %
>graf          >setup
```

### Setup menu 1: measurement parameters

- display mode (*singlemode / rollmode*)
- fixed voltage measuring range ( $12 / 120 / 600 V_{rms}$ )
- fixed current measuring range ( $0.12 / 1 A_{rms}$ )
- phase selection ( $1 / 2 / 3 / 1+2 / 1+3 / 2+3 / 1+2+3$ )
- pre-trigger ( $10 / 30 / 50 / 70 / 90$  % of recording window)



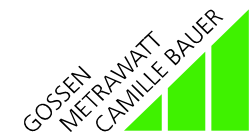
```
TCM setup      E  16:41:39
> Up / V       400,00
dU / V/ms     150,00
Ip / A        ,00000
dI / A/ms     ,00000
sample / us   40
printer       off
interval      0001
>event        >setup
```

### Setup menu 2: trigger parameters

- absolute voltage trigger level (*sampled value in Volts*)
- voltage slew-rate trigger ( $dU/dt$  in  $V/ms$ )
- absolute current trigger level (*sampled value in Amps*)
- current slew-rate trigger ( $dI/dt$  in  $A/ms$ )
- sampling interval ( $20 / 40 / 81 / 162 / 324 / 648 \mu s$ )
- activation of event-controlled printout (*on/off*)
- printer/storage interval (*not relevant for this function*)

OR function for all set trigger criterias  $\neq .000$

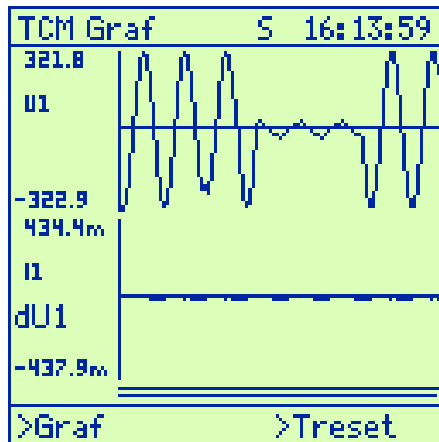
**!! TCM is also applicable for DC signals !!**



# MAVOWATT 45

## Display Modes of Transient Events with Option TCM

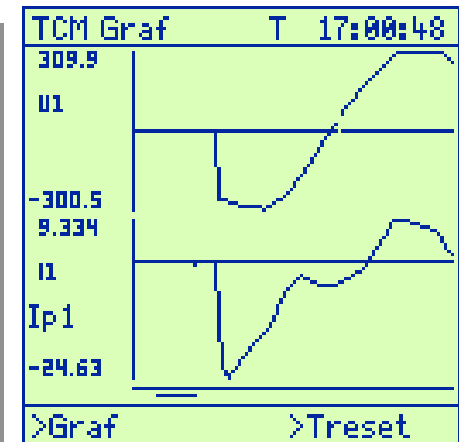
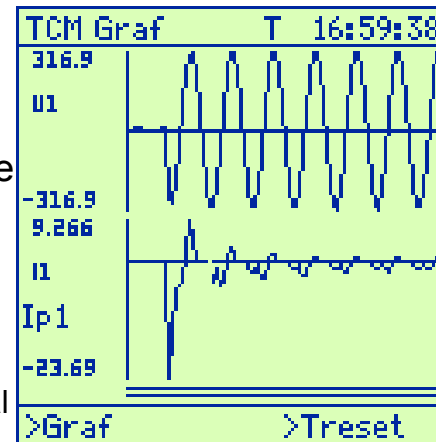
Author:  
GOSEN-METRAWATT / VMS / HG



### TCM Graf

When an event appears, then the time, the causing trigger criterion and the wave form of voltage and current of the affected phase will be stored and/or displayed.

**recorded time window**  
= 3850 samples x sample interval  
= 77 ms to 2,5 s



The displayed graph can be zoomed and scrolled in several steps to make short transients visible.

TCM Event E 16:41:14		
16:38:39	Up1	404,7
16:38:39	Up1	416,3
16:38:39	Up1	449,5
16:38:39	dU1	153,5
16:40:05	Up1	409,6
16:40:05	Up1	417,4
16:40:05	Up1	449,3
16:40:06	dU1	154,3
16:40:38	dU1	420,3

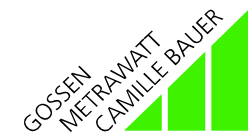
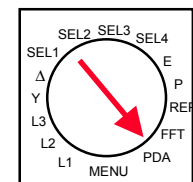
>Event      >Treset

### TCM Event

Events are stored and listed in the events table in the order in which they are recognized.

- The table includes
- time of occurrence,
  - cause of triggering and
  - the relevant measured value

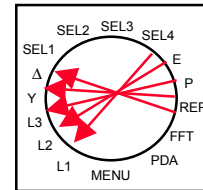
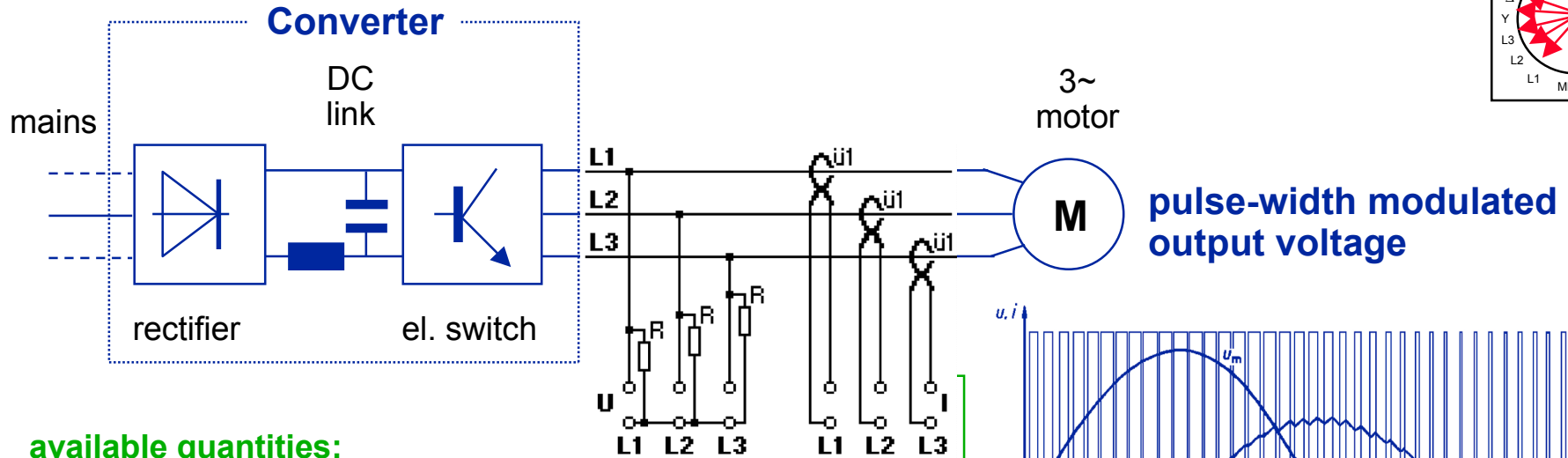
**No non-intermittend evaluation of the signals:**  
TCM Graf: trigger deactivated during event  
processing time for 2 s  
(6 s if PC Card storage is active)  
TCM Event: max. 40 events/s



# MAVOWATT 45

## Measurements on Frequency Converters with Option TCM

Author: GOSSEN-METRAWATT / VMS / HG

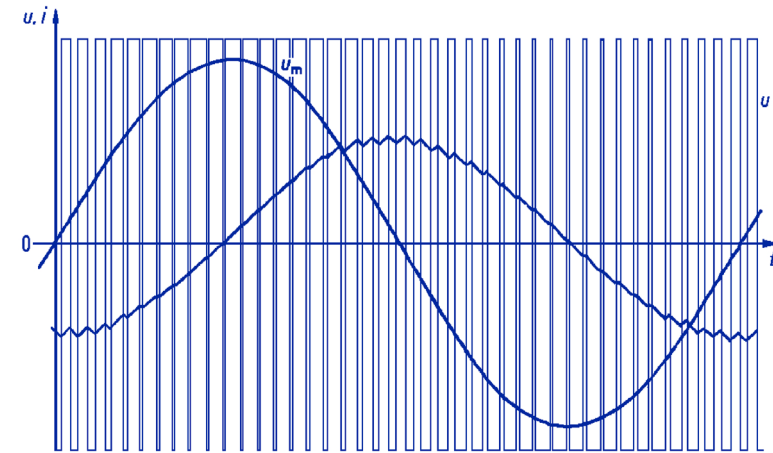


### available quantities:

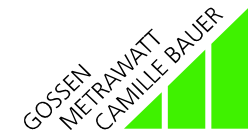
- neutral referenced voltages  
also waveform (filtered signal)
- phase-to-phase voltages
- phase currents  
also waveform (unfiltered signal)
- rotation frequency / ~ sense
- active / apparent / reactive power
- active / apparent / reactive energy
- power factors

**MAVOWATT 45**

SEL1 Num,	S	16:34:15
>U1	230.1	V
U2	229.8	V
U3	230.0	V
I1	1.000	A
I2	999.8	mA
I3	998.9	mA
f	50.00	Hz
>Num,	>S/H	



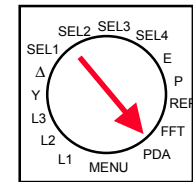
**Prerequisite:**  
 chopper frequency >1000 Hz  
 motor frequency 10...100 Hz



# MAVOWATT 45

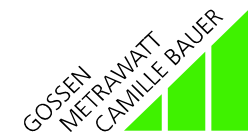
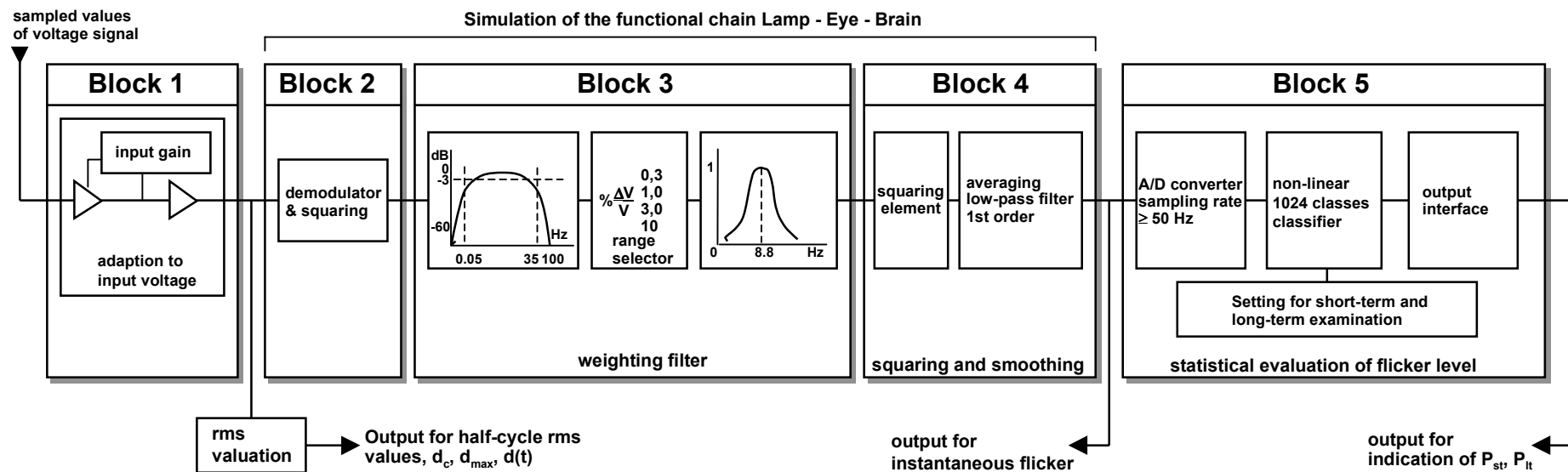
## Flicker Measurements with Option FSA

Author:  
GOSEN-METRAWATT / VMS / HG



**Flicker:** Physiological perception of light intensity variations of electrical lighting fixtures due to mains voltage fluctuations

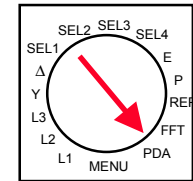
### Functional schematic of a flickermeter according to IEC/EN 61000-4-15 (IEC60868)



# MAVOWATT 45

## Flicker Measurements with Option FSA

Author:  
GOSEN-METRAWATT / VMS / HG



Flicker Num, 5 13:17:27			
396	L1	L2	L3
Pst	0,639	0,613	0,327
dmax / %	3,32	2,6	3,37
dc / %	1,65	2,13	1,69
dt > 3% / s	3,47	4,32	4,63
12			
P1t	0,429	0,326	0,566
> Num,	> 5 / H		

### Evaluated Quantities

(simultaneously for each individual phase)

#### Pst – Short-term flicker

Flicker level within a short-term interval (selectable *fli. int.*: 1 or 10 minutes)

#### dmax – Maximum relative voltage change

Within the short-term interval: the maximum difference between the highest and lowest level (10ms rms values) of a voltage variation event

#### dc – Relative constant voltage deviation

Within the short-term interval: the maximum difference which occurred between two constant voltage levels, within them at least one voltage variation occurred

#### dt > 3% – Maximum duration of relative voltage change > 3%

Within the short-term interval: the longest duration within a voltage variation event during which the relative voltage change was > 3%

#### P1t – Long-term flicker

Flicker level within a long-term interval; results from 12 consecutive Pst values

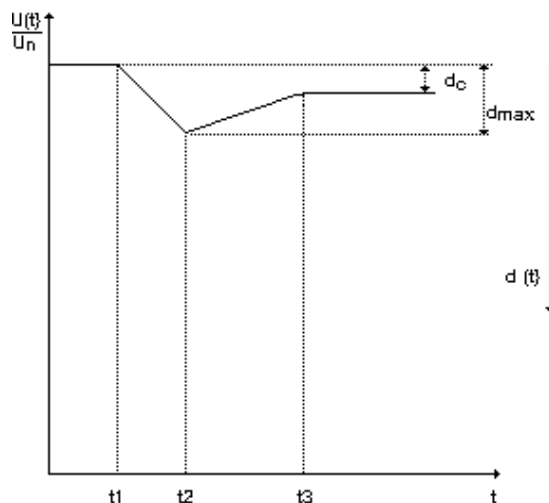
### Additionally displayed informations

#### 396 (example) – Remaining time of interval

Remaining number of seconds till end of currently running interval, i. e. till refresh and storage of evaluated quantities

#### 12 (example) – Elapsed intervals

Number of intervals elapsed since begin of measurement

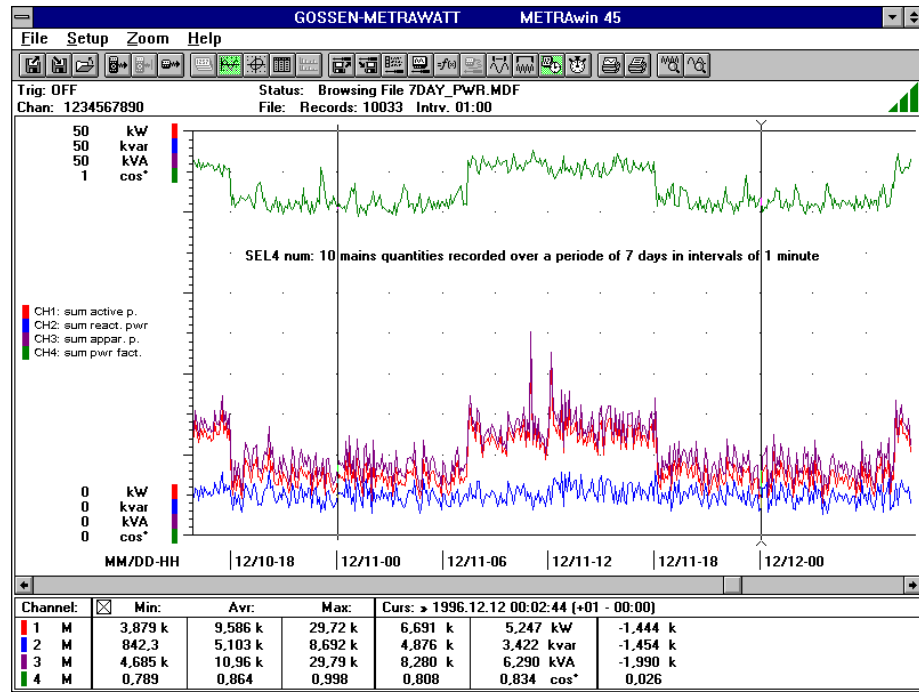


# METRAwin 45

## Display Modes of Recorded Data

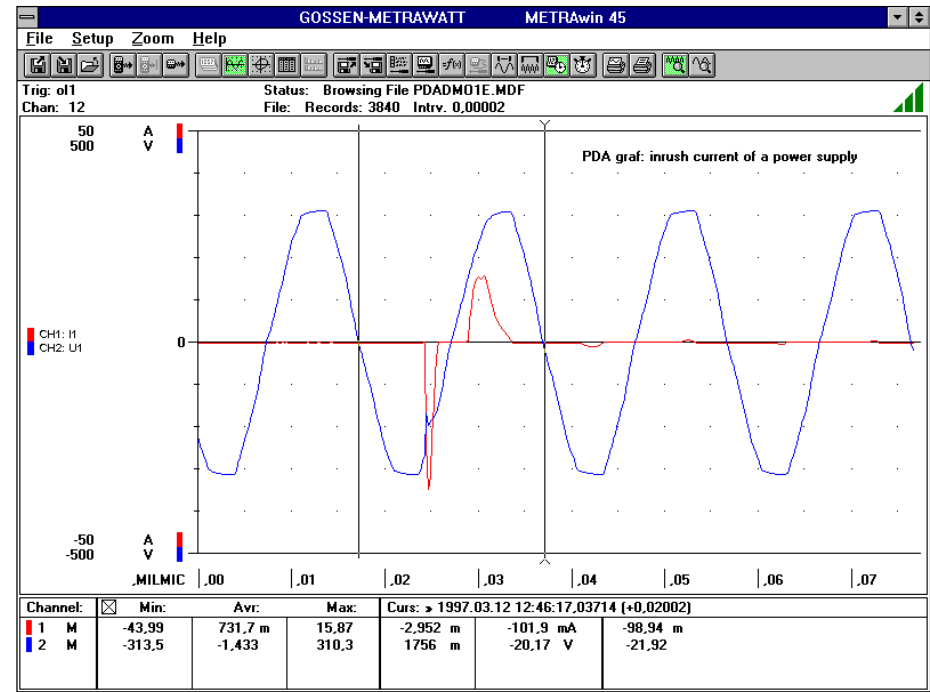
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### Y-t Recorder (Continuous-line Recorder)



- Up to four channels are displayed online / offline
- Y and t axes can be zoomed in/out
- Data can be analysed by means of two cursors e.g. Min./Max./Avr./Delta inbetween cursor positions

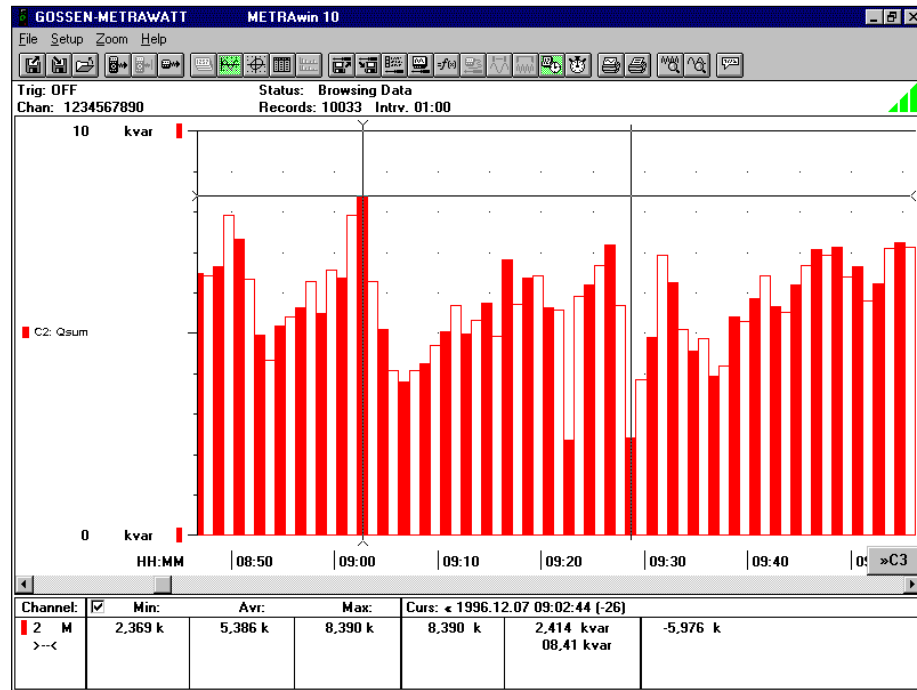
### Y-t Recorder (Transient Recorder)



- Voltage and current signals being recorded with MAVOWATT functions PDA/TCM Graf to PC Card can be analysed with time resolution up to 20 µs

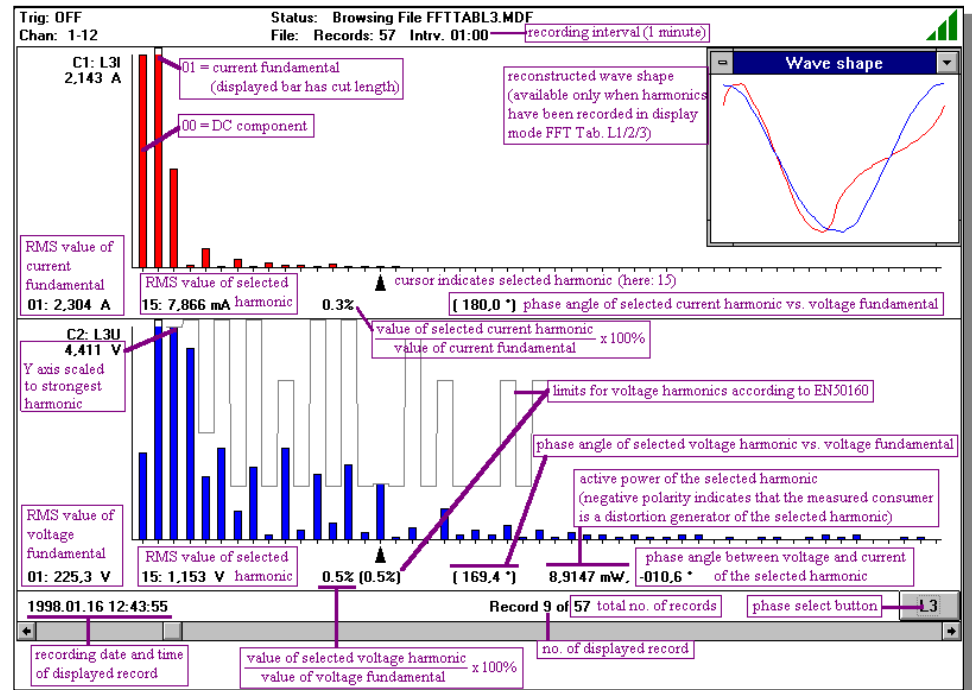
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### Y-t Bar Graph



- Instead of continuous-line display mode the values of selectable individual channels can be displayed as vertical bars
- For data analysis three cursors are available

### FFT Bar Graph (Spectrum Analysis)



- Voltage and current harmonics being recorded to PC Card with MAVOWATT function FFT Tab. are displayed as frequency spectrum with vertical bars
- Border lines of several standard limit values and a reconstructed waveform can be shown additionally



# METRAwin 45

## Display Modes of Recorded Data

Author:  
GOSSSEN-METRAWATT / VMS / HG

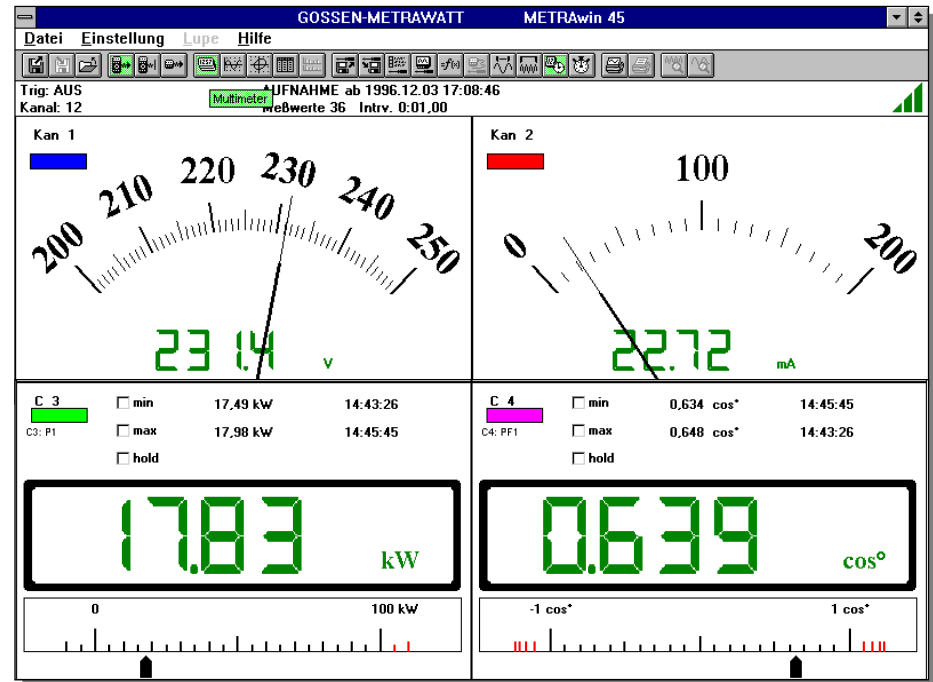
### Data Logger (Numerical Table)

The screenshot shows the 'Data Logger' interface with a menu bar (File, Setup, Zoom, Help) and a toolbar. The status bar indicates 'Status: Browsing File UEBUNG4A.MDF' and 'File: Records: 30 Intrv. 10.0'. The main display is a table with columns for time and 10 channels (CH1-CH10) with various units (VA, Vh, Wh). The data is recorded from 1997.05.16 12:21:32 to 12:24:02.

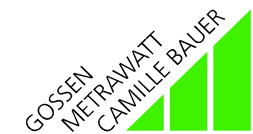
Time	CH1: S1 VA	CH2: S2 VA	CH3: S3 VA	CH4: S1 VA	CH5: S2 VA	CH6: S3 VA	CH7: WP1 Vh	CH8: WP2 Vh	CH9: WP3 Vh	CH10: WP4 Vh
1997.05.16 12:21:32	318.0	325.7	249.1	320.3	328.0	250.9	2.770	2.865	2.088	7.723
12:19:12	273.9	282.1	211.0	310.7	327.7	250.9	3.386	3.501	2.538	9.425
12:19:32	229.2	259.3	172.1	231.1	262.0	196.5	3.893	4.083	2.903	10.88
12:19:42	237.0	300.8	261.3	303.2	354.1	263.7	4.413	4.756	3.453	12.62
12:19:52	307.0	366.1	282.7	323.1	357.4	263.8	5.093	5.557	4.015	14.67
12:20:02	316.9	362.8	263.1	317.5	368.1	268.0	6.795	6.370	4.577	16.74
12:20:12	317.5	345.2	171.5	318.9	365.0	269.1	6.501	7.153	4.956	18.81
12:20:22	316.9	421.3	147.3	318.2	472.9	147.9	7.204	8.087	5.268	20.56
12:20:32	347.4	448.5	148.4	374.4	467.1	158.8	7.964	9.103	5.582	22.85
12:20:42	372.3	442.0	188.8	374.2	444.1	249.2	8.795	10.10	5.983	24.86
12:20:52	370.6	442.7	247.4	371.7	453.7	248.0	9.622	11.10	6.492	27.21
12:21:02	372.6	448.8	241.2	373.4	449.8	248.2	10.45	12.11	7.009	29.57
12:21:12	374.1	434.0	250.2	374.9	450.9	251.2	11.28	13.09	7.542	31.92
12:21:22	126.4	348.4	301.7	374.2	350.7	415.2	11.86	13.87	9.199	33.72
12:21:32	188.9	347.7	460.1	263.1	350.6	464.1	12.08	14.72	9.254	38.06
12:21:42	260.7	349.9	463.4	263.2	350.4	464.2	12.64	15.51	10.26	38.41
12:21:52	233.7	336.3	463.0	243.0	349.7	463.3	13.16	16.26	11.26	40.67
12:22:02	262.9	300.2	435.2	263.3	301.0	462.8	13.74	16.93	12.20	42.87
12:22:12	262.5	299.7	411.9	262.9	300.3	427.8	14.32	17.60	13.09	45.01
12:22:22	263.1	300.5	415.8	263.7	301.3	428.3	14.90	18.28	13.98	47.16
12:22:32	263.1	296.3	398.0	263.4	301.3	471.8	15.49	18.94	14.84	49.27
12:22:42	270.0	237.5	389.4	376.5	237.9	369.7	16.11	19.47	15.63	51.21
12:22:52	461.3	257.2	372.3	492.1	293.0	389.6	17.09	20.04	16.43	53.56
12:23:02	441.1	394.9	392.1	441.6	457.7	392.6	18.08	20.91	17.27	56.26
12:23:12	484.1	456.1	458.9	507.6	457.4	467.4	19.11	21.94	18.25	59.30
12:23:22	505.8	480.4	456.3	507.2	483.3	467.3	20.24	23.02	19.24	62.51
12:23:32	492.6	442.3	441.2	494.5	483.9	452.4	21.35	24.04	20.20	65.59
12:23:42	208.2	291.2	245.8	494.5	344.5	288.1	21.87	24.70	20.73	67.29
12:23:52	208.0	266.4	181.3	208.3	278.4	225.0	22.33	25.30	21.13	68.75
12:24:02	208.2	222.6	183.3	208.4	222.8	163.5	22.79	25.79	21.47	70.05

- Time and numerical values of up to 10 channels are displayed in tabular format
- A selectable range of data can simply be copied to clipboard and exported (pasted) to other programs

### Multimeter (Online Meter)



- Currently measured values of up to four channels being received online are displayed as analog or digital meter



# MAVOWATT 45

## Product Sets, Options and Accessories

Author:  
GOSSSEN-METRAWATT / VMS / HG

Indication	Description	Order No.
<b>MAVOWATT 45 L</b>	MAVOWATT 45 Energy Analyser with basic functions (power and energy analysis), incl. power cord, RS232 cable, 3 pairs of measuring leads, 2 jumper leads, diskette with software for changing the info text language (D/GB/F/I/E), carrying bag, operating manual	M815C
<b>MAVOWATT 45 S</b>	MAVOWATT 45 Energy Analyser with basic and optional functions (power and energy analysis, FFT, PDA, TCM, FSA), incl. power cord, RS232 cable, 3 pairs of measuring leads, 2 jumper leads, diskette with software for changing the info text language (D/GB/F/I/E), transport case, 3 passive current clamps Z823B, operating manual	M815E
<b>MAVO-FFT</b>	Option for Harmonics Analysis (diskette for firmware installation)	Z850B
<b>MAVO-PDA</b>	Option for Power Disturbance Analysis (diskette for firmware installation)	Z851B
<b>MAVO-TCM</b>	Option for Transients and Converter Measurements (diskette for firmw. install.)	Z851C
<b>MAVO-FSA</b>	Option for Flicker Analysis (diskette for firmware installation)	Z851D
<b>SECUTEST PSI</b>	Printer module incl. color ribbon and 2 paper rolls	GTM5016000R0001
<b>METRAWin 45</b>	PC software for data readout and recording, analysis and documentation	Z852B
<b>MAVO-RC8</b>	8 MB Flash memory PC Card (PCMCIA, AMD Series C, 5 V)	Z845D
<b>USV Pulsar EL2</b>	Uninterruptable Power Supply (4 minutes @ 200VA; 30 minutes @ 30VA)	Z864B

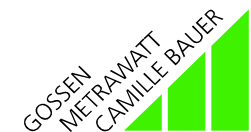
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# MAVOWATT 45

## Accessory for Current Measurement

Author:  
GOSEN-METRAWATT / VMS / HG

Indication	Description	Order No.
Z860A	Plug-in shunt resistor 50Ω, 0.2%, 1.5W (1V/20mA)	Z860A
Z861A	Plug-in shunt resistor 1Ω, 0.2%, 1.5W (1V/1A)	Z861A
Z862A	Plug-in shunt resistor 0.05Ω, 0.2%, 1.5W (250mV/5A)	Z862A
Z863A	Plug-in shunt resistor 0.01Ω, 0.2%, 1.5W (160mV/16A)	Z863A
Z201A	Clip-on current-voltage transformer, active, 17Aac, 24Adc, w. battery	Z201A
Z202A	Clip-on current-voltage transformer, active, 20/200Aac, 30/300Adc, w. battery	Z202A
Z203A	Clip-on current-voltage transformer, active, 200/1000Aac, 300/1000Adc, w. batt.	Z203A
WZ12F	Clip-on current-voltage transformer, passive, 15Aac/1.5V, 45Hz...500Hz	Z823E
WZ12E	Clip-on current-voltage transformer, passive, 150Aac/1.5V, 45Hz...500Hz	Z823D
Z823B	Clip-on current-voltage transformer, passive, 1000Aac/1V, 45Hz...10kHz	Z823B
Z821B	Clip-on current-voltage transformer, passive, 3000Aac/1V, 30Hz...5kHz	Z821B
AF11A	Ampflex flexible current sensor, 5...1000Aac	Z207D
AF033A	Ampflex flexible current sensor, 5...17/170Aac	Z207A
AF33A	Ampflex flexible current sensor, 5... 170/1700Aac	Z207B
AF101A	Ampflex flexible current sensor, 5...1000/10000Aac	Z207C



# **THANK YOU!**

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## **for your interest**