MODERN POWER QUALITY MEASUREMENT TECHNIQUES

What has to be measured ?

POWER QUALITY PARAMETERS - TERMS AND DEFINITIONS ◣

- Electrical load character
- Phase values of voltage, current, power
- Phase toPhase values of voltage and power
- Voltage and current harmonics, Total Harmonic Distortion, Crest factor
- Voltage events (dips, sags, interruptions)
- Voltage and current transients
- Voltage symmetry
- Flickers
- Interharmonic and signalingvoltages
- Electrical energy

PARAMETERS RELATED TO EN50160AREMARKEDBLUE ▭

MEASUREMENT TECHNIQUES

ONLINEMEASURING ◣

(Fast snap-shoot measuring of all important power parameters)

Result o n instrument	Result onPC
• *METER*	• *"Direct Link" data table*
• *SCOPE*	• *"Direct Link"scope*
• *SPECTRUM*	• *"Direct Link" s pectrum*
• *ENERGY* ◣	• *"Direct Link" e nergy counter*

RECORDING

(Monitoring of power quality parameters in real time through predefined time period)

Measuringprocedure	Recordingtypes
• Set Up type of recording	• PERIODIC ◣
• Selectionof signals a n d parameters	• EN 50160 ◣
• … Recording …	• FAST LOGGING ◣
• Online checkingofrecorder	• WAVEFORMS ◣
• Download o f results	• TRANSIENTS ◣
• Analysis ofresults	

POWER QUALITY PARAMETERS 1/2

BASIC TERMS AND DEFINITIONS

U, I	Phase voltage, current	I_n	Calculated neutral current
P	Active power	P_{ft}	Total Power Factor
Q	Reactive power	3W, 4W	Wiring configuration
S	Apparent power	SEQ	Phase sequence
PF	Power Factor	THD	Total Harmonic Distortion
Φ	Phase angle	U_{CF}	Voltage Crest Factor
U_{UU}	Phase to phase voltage	I_{CF}	Current Crest Factor
P_t	Total Active power	hI_n	n-th Current harmonic
Q_t	Total Reactive power	hU_n	n-th Voltage harmonic
S_t	Total Apparent power	Plt	Longterm Flicker value
F_r	Frequency	Pst	Short term Flicker value

LOAD

Resistive   Capacitive   Inductive   Generator (negative)

PHASE VALUES

PF   1/Fr

PF=1 Φ=0°	PF=0.66c 0°>Φ>-90°	PF=0.66i 0°<Φ<90°	PF=0c Φ=-90°	PF=0i Φ=90°	PF=1 Φ=180°	PF=0.67c 90°<Φ<180°	PF=0.67i 180°<Φ<270°
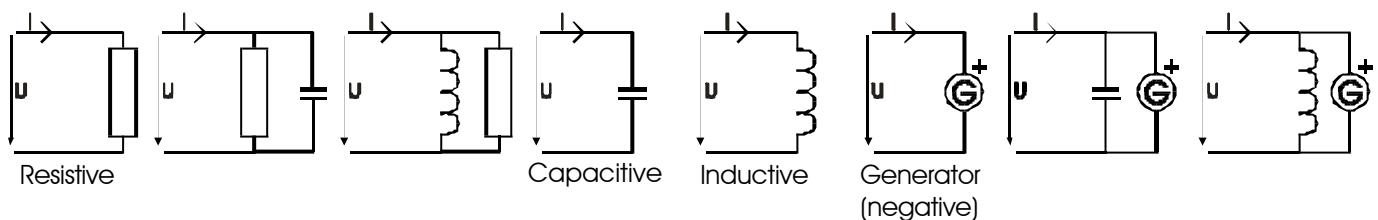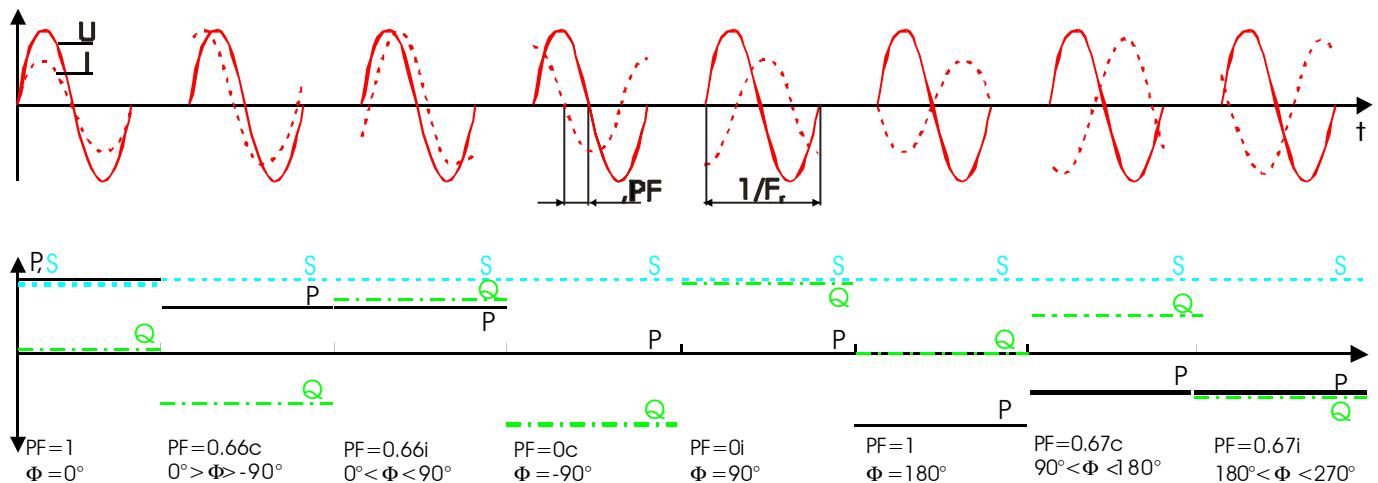
PHASE TO PHASE VALUES

4W (four wire system)

P_t, S_t, Q_t
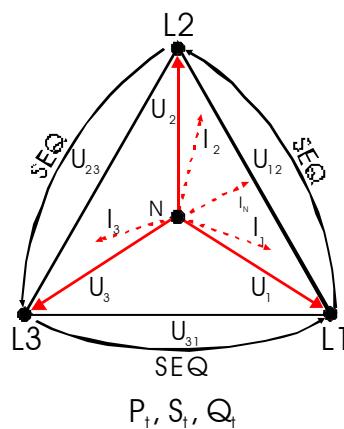
3W (three wire system)

P_t, S_t, Q_t

DISTORTION

U_{CF} THD_U

I_{CF} THD_I
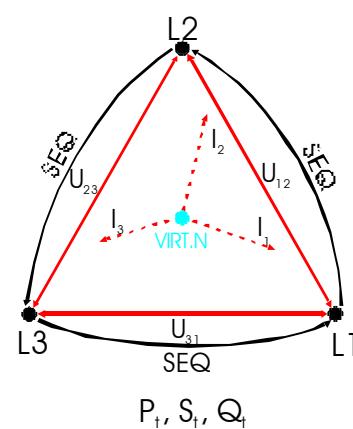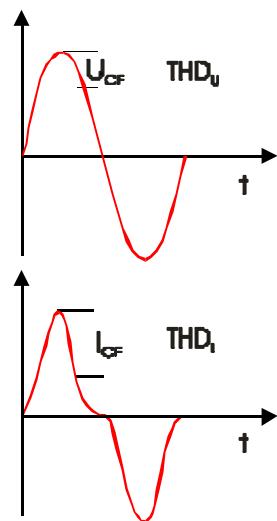
POWER QUALITY PARAMETERS 2/2

Voltage Harmonics and THD

U
FFT
hU_n
1 2 3 4 5 6 ... 25 n
200ms

Transients

U
t
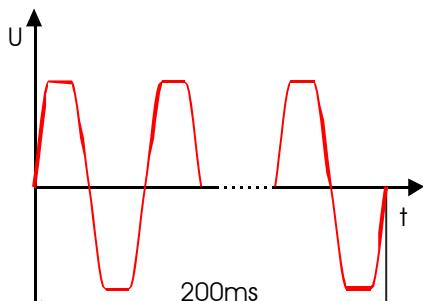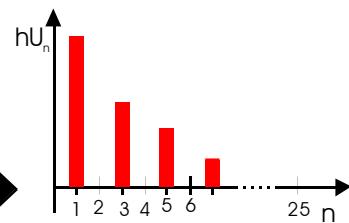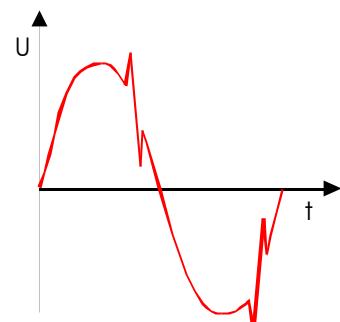
Current Harmonics and THD

I
FFT
hI_n
1 2 3 4 5 6 ... 25 n
200ms

Unsymmetry

U2
U1
U3

Voltage, Frequency

U
1/Fr
200ms
t
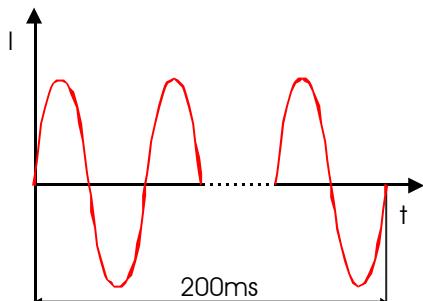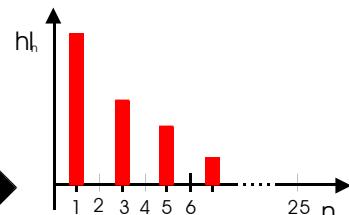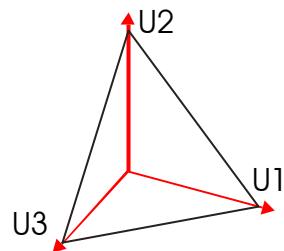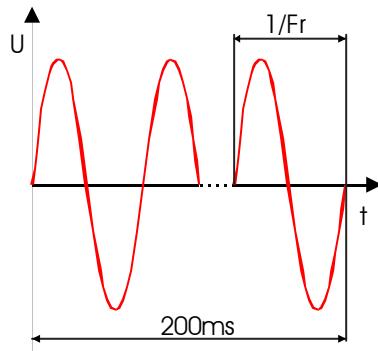
Voltage Events(Anomalies)

DIP
SAG
INTERRUPTION
<1%
>1sek
≥10ms   ≥10ms

Flicker (Plt, P st)

U
Plt 120' (Pst 10')
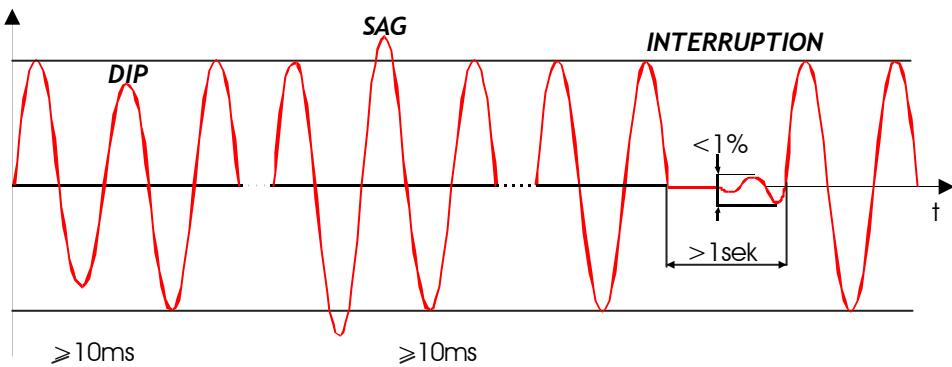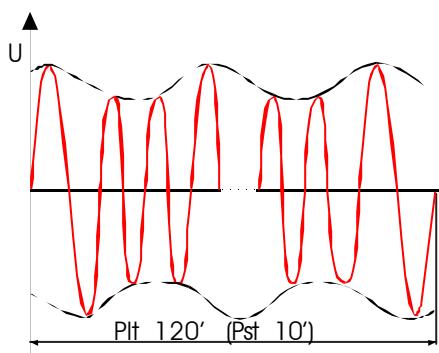
Interharmonics, Signalling Voltage *

U
FFT
314Hz
$F \neq n\frac{1}{T}$
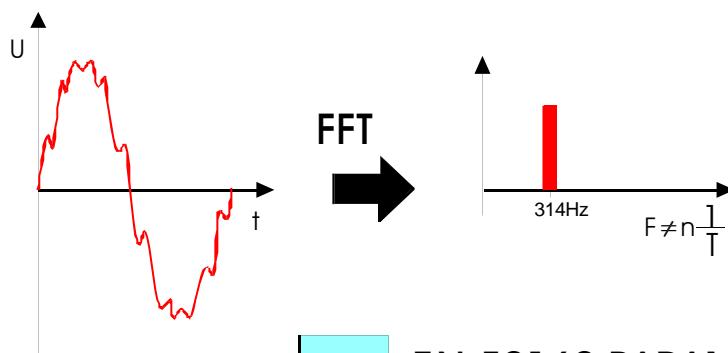
EN 50160 PARAMETERS
ARE LABELED BLUE

* not implemented in
Power Quality Analyser

Most of the important parameters can be viewed online on instrument's display or on a PC with software package Power Link ('Direct Link' mode).

1. SET UP INSTRUMENT'S CONFIGURATION

CONFIG.

```
SYSTEM

RECORDER
SIGNALS
HARMONICS

METER
```

```
METER Configuration


  Uinp. k.(*):      1
  Irange (1V):   1000A
  connection :     4 w
  sync.freq  :    50 Hz
  sync.inpt. :    auto
```

Manufacturer	METREL
Type of instrument	MI 2092
Serial number	00000000
Last calibr. date	18.06.2001 09:10:29
User note	DEMONSTRATION
Instrument load rate [%]	
U factor	1
I range (A)	1000
Connection	4 wire
Frequency (Hz)	50
Sync. input	auto
Type of recording	Periodics

Details

Send   Read   Clear   Help

Send

SET CONFIGURATION IS STORED INTO INSTRUMENT
THE ACTUAL SETTINGS STAY MEMORIZED TILL
A NEW SETUP IS PERFORMED.

MEASURING...

Snapshoots are taken of all six channels.
Further parameters are calculated and shown online.

U_1, U_2, U_3
I_1, I_2, I_3

t

Sampling $f_s = 6,4$ kHz

2. MEASURING AND RECORDING

U3

t

DATA X-3	6
DATA X-2	6
DATA X-1	6
I1	I2	I3	U1	U2	U3:DATA X	6

Selected quantities

| 20ms TRMS values of U1...U3, I1...I3 | P, S, Q, U_0, cos Φ … |
| FFT of U1...U3, I1...I3 | Voltage and Current Harmonics THD |

INSTRUMENT'S DISPLAY

PC (Direct Link)

3. CHECKS & ANALYSIS

Instrument´s DISPLAY ◄► PC (PowerLink,'DirectLink'mode)

NUMERICAL PRESENTATION -BASIC RESULTS

METER

```
4W    L1:       L2:       L3:  HOL
U :    234.5     234.5     234.5
I :    854.3     854.3     854.3
P : 132.22    132.22    132.22  k
S : 200.33    200.33    200.33kV
Q :-150.49-150.49-150.49kV
Pf:   0.66c     0.66c     0.33i
φ :   0.72      0.72      0.72
Uu:   407.6     407.6     407.6
      TOTALS:    SEQ:123   - Pow
Pt :   400.44  kW    Fr:50.02
St :   554.22  kVA   In: 7.3
Qt :   383.15  kVAr  Pft:0.72i
 20.05.1999.              18:44:00
```

Scope + go! + Execute,DataTable
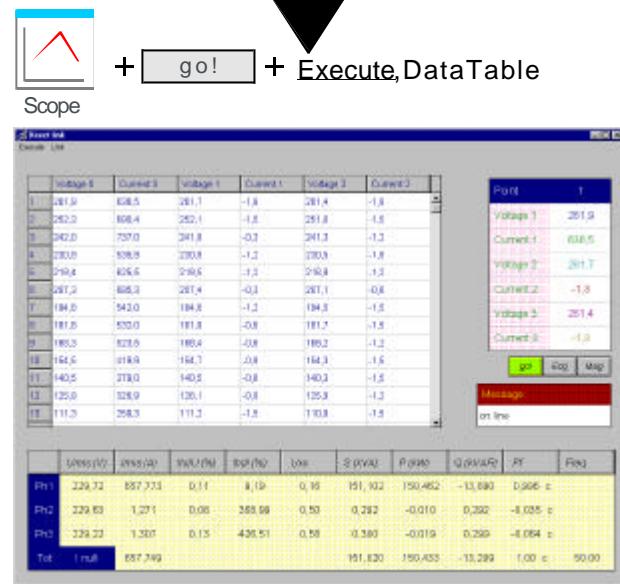
GRAPHICAL PRESENTATION -WAVEFORMS

SCOPE , SELECT —to select signal

ENTER —to view meter information

◄ , ► , ▲ , ▼ —to scale signals

```
L1   234.5V    854.3A    HOLD

              Fr=49.99Hz
              Um=321.5V
              Ua=130.2V
              Uthd= 2,7%
              Ucf=1.37
              Pf=0.66c
              Im=124.8A
              Ia=588.2A
              Ithd=3.5%
              Icf=1.45

                         12:44:00
```

Scope + go!
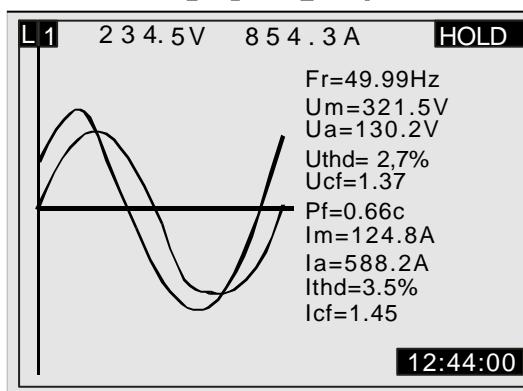
GRAPHICAL PRESENTATION -HARMONICS & THD

SPECTRUM + SELECT — to select signal

◄ , ► — to select harmonic's amplitude

```
L1    234.5V   50.02Hz   HOLD
- - - - - - - - - - - - - thd: 3.7%





h3:  0.8%     1.84V    12:44:00
```

Scope + go! + Mag
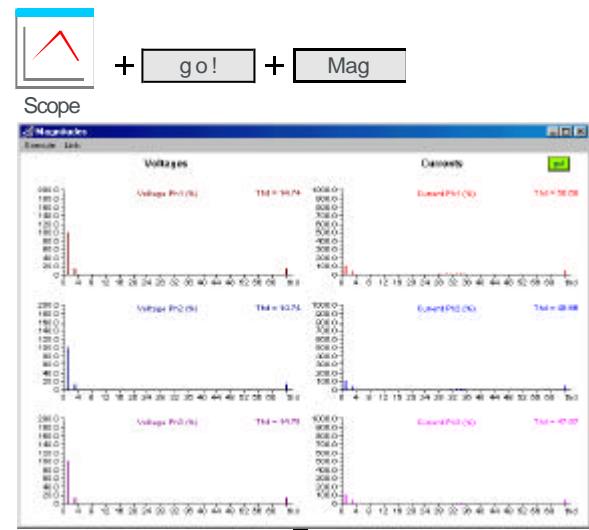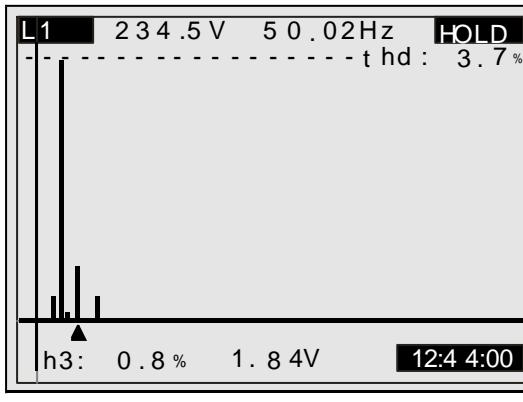
**DOCUMENTATION
(SAVE to FILE, PRINT, EXPORT)**

MEASURING ENERGY 1/2

DEFINITION

LOAD
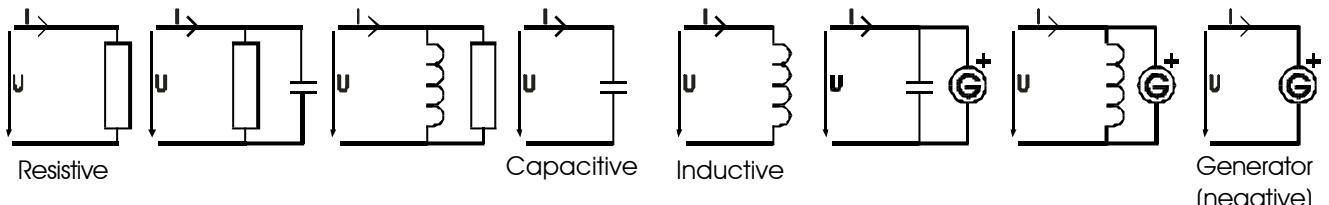
Resistive   Capacitive   Inductive   Generator (negative)

POWER

P
Q_I
Q_C
0
Resistive
t

TOTAL ENERGY COUNTER

E_P
E_{QI}
E_{QC}

RESET TOTAL
SELECT + ENTER
t

SUBTOTAL ENERGY COUNTER

E_P
E_{QI}
E_{QC}

RESET SUBTOTAL
SELECT + 2x ENTER
RESET SUBTOTAL
t

LAST IP ENERGY COUNTER

E_P+
E_P-
$E_{QI}+$
$E_{QI}-$
$E_{QC}+$
$E_{QC}-$

(Pt)
IP
t
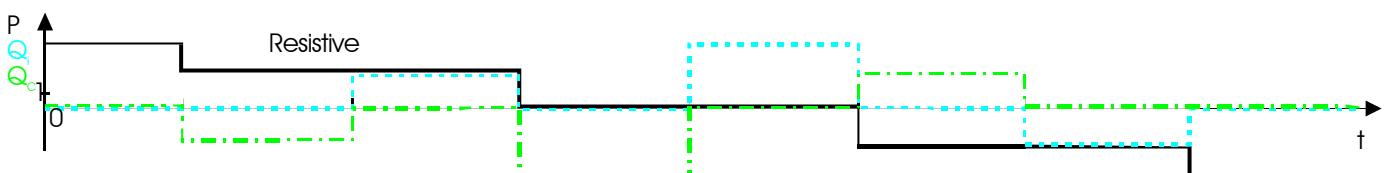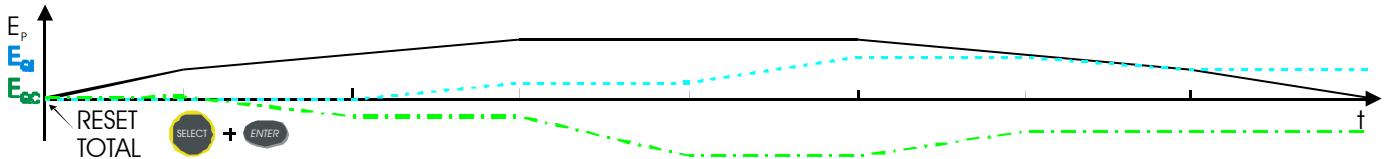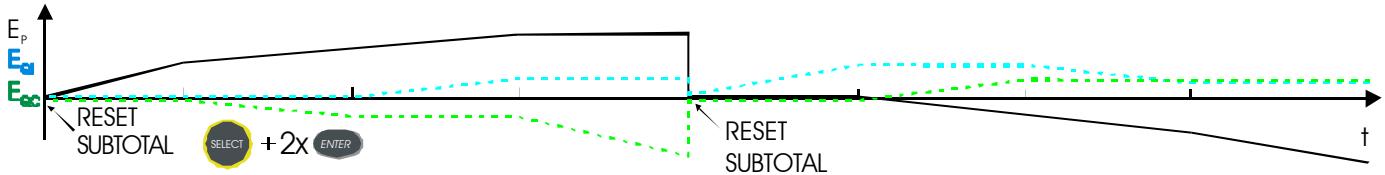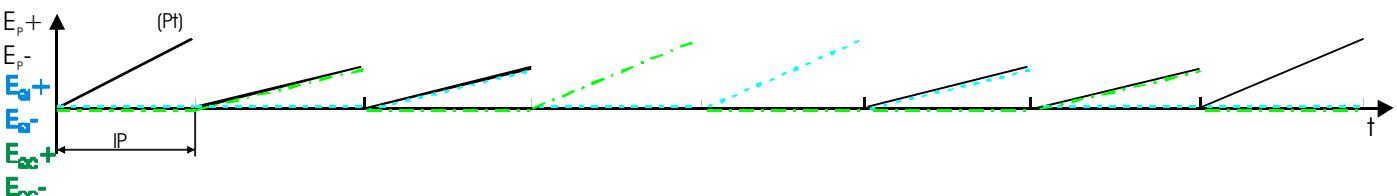
Note: Last IP energy counter is activated during active RECORDER active (PERIODICS mode)
IP (Integration Period - the period in which the realtime recorded signals are integrated)

TERMS

E_P	Complete active energy	E_{QC+}	Positive reactive energy, capacitive
E_{QC}	Complete reactive energy, capacitive	E_{QC-}	Negative reactive energy, capacitive
E_{QI}	Complete reactive energy, inductive	E_{Qi+}	Positive reactive energy, inductive
E_{P+}	Positive active energy	E_{Qi-}	Negative reactive energy, inductive
E_{P-}	Negative active energy	IP	Integration period

MEASURING ENERGY 2/2

1. SET UP CONFIGURATION AND PARAMETERS
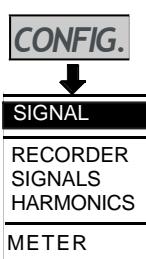
CONFIG.

SIGNAL

RECORDER
SIGNALS
HARMONICS

METER

```
METER  Configuration


 Uinp. k.(*):      1
 Irange (1V):   1000A
 connection :     4 w
 sync.freq  :    50Hz
 sync.inpt. :    auto
```

Send

Instrument settings — Execute

Manufacturer	METREL
Type of instrument	MI 2092
Serial number	00000000
Last calibr. date	18.06.2001. 09:10:29
User note	DEMONSTRATION
Instrument baud rate	57600
U factor	1
I range (A)	1000
Connection	4 wires
Frequency (Hz)	50
Sync. input	auto
Type of recording	Periodics

Details

Send   Read   Close   Help

Set configuration is stored into instrument. The actual settings remain memorized until a new setup is installed.

TOTAL & SUBTOTAL COUNTERS

LAST INTEGRATION PERIOD COUNTERS

- to start LAST I.P.

1. Select settings icon
2. Select PERIODS recording mode
3. Select at least one signal
4. Select IP
5. Select recorder's starting condition

2. MEASURING

- to start/reset SUBTOTAL

- to start/reset TOTAL

SELECT   ENTER

ENTER

... ● RECORDING...

...MEASURING ENERGY...
ON BASE OF 10ms TRMS U , I VALUES, NO GAPS

3. ANALYZING

ENERGY

```
 eP =   000001826.75   kWh
 eQC=   0000009 42.31   kVArh
 eQi =  000000029.66   kVArh
       SUBTOTAL
 eP =   000000213.58   kWh
 eQC=   000000152.49   kVArh
 eQi =  000000082.92   kVArh
       LASTI.P.
 eP+ =        18.26    kWh
 eQc+ =        2.38    kVArh
 eQi+ =        8.32    kVArh
 eP- =         1.48    kWh
 eQc- =        2.25    kVArh
 eQi- =        1.88    kVArh
```

Scope   +   go !   +   Eng

Energies

| Energy of P	0.00 kWh
Energy of Qc	-221.04 kVAr h
Energy of Qi	0.00 kVAr h

OK
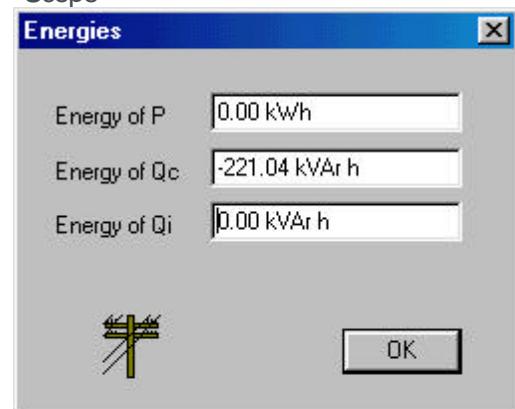
Note: LASTIP counters are not available

Recorder in PERIODICS mode: p eriodic values of o ver 300 signals (64 at t he same t ime) can be recorded and a nalysed.

## 1. SETUP CONFIGURATION, PARAMETERS AND DATA

1. Step: enter configuration menu

```
SYSTEM

CONFIG. ➤   RECORDER
            SIGNALS
            HARMONICS
            METER
```

2. Step: select RECORDER conditions

```
RECORDER :  conditions
rec.mode:PERIODICS
start   22.05.2001.    14:25
stop    MANUAL
stat.   ON
per.    ON
anom.windowFIXED
main.integ.per.:  1min
powersub.i.p. :  1per
nominal voltage  :  230.0 V
upper limit:  10%  253.0 V
lower limit:  10%  207.0 V
buffermode:  circular
 20.05.2001.         12:44:00
```

3. Step: select signals of interest

```
RECORDER:  signals      +51
L1  U     S+    Pfc+   Pfc -   Qi +
    I     S-    Pfi +  Pfi -   Qi -
    P+    P-    Qc+    Qc -    dPf
L2  U     S+    Pfc+   Pfc -   Qi +
    I     S-    Pfi +  Pfi -   Qi -
    P+    P-    Qc+    Qc -    dPf
L3  U     S+    Pfc+   Pfc -   Qi +
    I     S-    Pfi +  Pfi -   Qi -
    P+    P-    Qc+    Qc -    dPf
T  Pt +  Pft c+  Pfti+  Freq  S+
   Pt -  Pft c-  Pfti-  Inu   S -
  ►Qt c+ Qt c-  Qt i+  Qt i-  Uu
```

4. Step: select harmonics of interest

```
RECORDER :  harmonics      +47
enabled on :   L1  L2  L3
thd:            thdU  thd I
harmonics :
U 02  03  04  05  06  07  08  09
  10  11  12  13  14  15  16  17
 ►18  19  20  21  22  23  24  25
  26  27  28  29  30  31  32  33
  34  35  36  37  38  39  40  41
I 02  03  04  05  06  07  08  09
  10  11  12  13  14  15  16  17
  18  19  20  21  22  23  24  25
  26  27  28  29  30  31  32  33
  34  35  36  37  38  39  40  41
```

5. Step: check or adjust instrument's configuration

```
METER  Configuration


   Uinp. k.(*):      1
   Irange (1V):   1000A
   connection :     4 w
   sync.freq  :    50Hz
   sync.inpt. :    auto
```
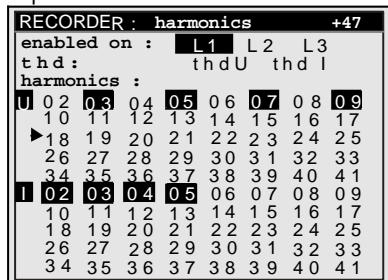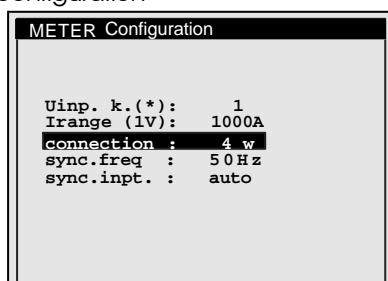
1. Step: check instrument's settings and select PERIODICS MODE
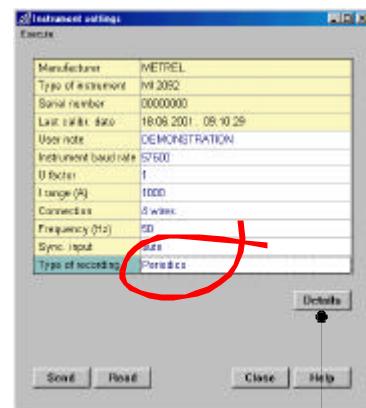
2. Step: select RECORDER conditions
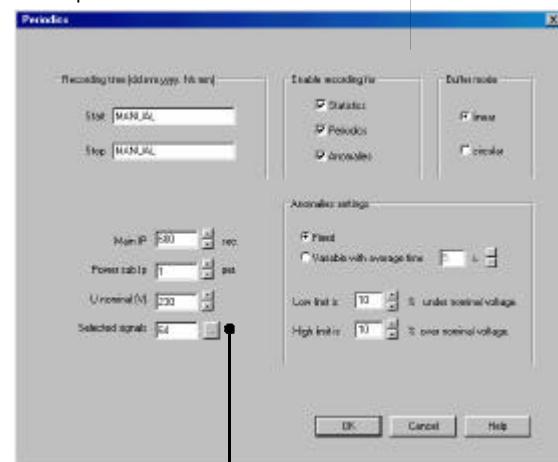
3. Step: select signals of interest
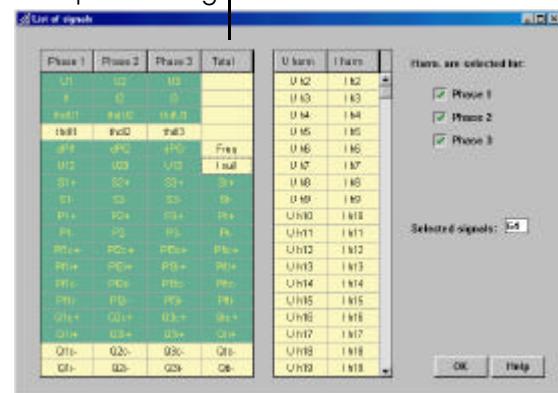
4. Step: send settings to the instrument

Send

- to activate RECORDER   **SELECT** ; *ENTER*   ❗

RECORDER = READY

- waiting for START condition

... ● RECORDING…
START on TIMER or MANUAL (HOLD/MANUAL)

Real time recording of selected quantities is performed.
Averaged data and anomalies (if selected) are stored into memory.

Sampling $f_s = 6,4$ kHz

U3

t

DATA X-3 /6
DATA X-2 /6
DATA X-1 /6
I1 I2 I3 U1 U2 U3 : DATA X /6

Selected quantities (up to 64)	10ms TRMS values of U1...U3, I1...I3	Voltage anomalies Power breaks (RealTime)	store 64 samples before event
		P, S, Q, U_u, cos Φ … (RealTime)	Averaging: $\overline{\Sigma}$ over integration (subinteg) period
	FFT of U1...U3, I1...I3	Harmonics THD (1/160ms)	

2. MEASURING AND RECORDING
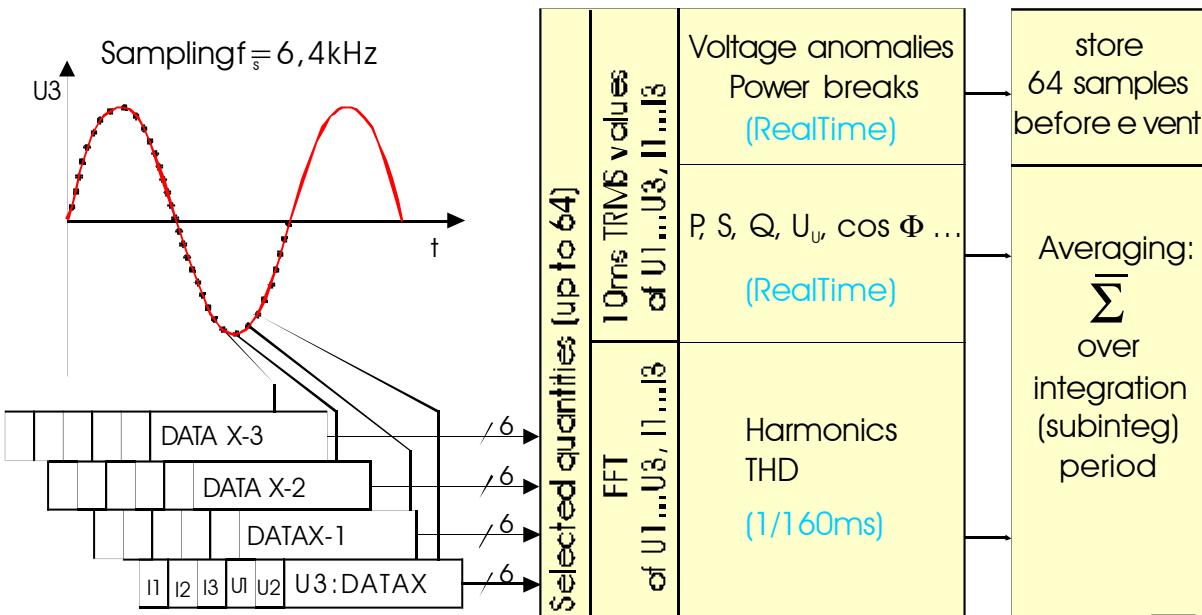
Two memory modes are available:

CIRCULAR BUFFER
(oldest data is erased when memory is full)

LINEAR BUFFER
(recording stops when memory is full)

CIRCULAR 1 2 3 LINEAR

MEMORY
PERIODICS
STATISTICS
ANOMALIES

STOP **!** CONSIDER AVAILABLE MEMORY SIZE

(Avoid recording unimportant parameters, take care of length of integration period)

$$\text{Number of stored data} = \frac{(2032 - N_{STAT}) \times 1024 - N_{ANOM} \times 164}{R_{LEN}}$$
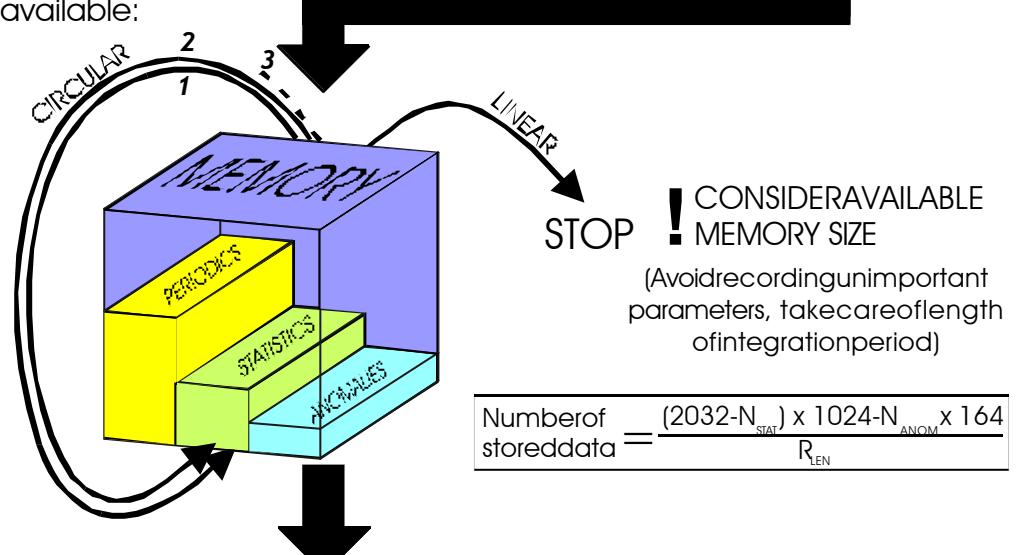
■ RECORDING
STOP on TIMER, REMOTE(⊠) or MANUAL (SELECT , ENTER)

Basic information of current recorder status are shown on instrument's display during recording
Note: Online measurements are available during recording!

3. CHECKING RECORDING STATUS

RECORDER ,

```
rec.stat: STOP
buf.mode: READY  (circ.)

start: AUTO
       18.05.1999  14:25:00
stop:  MANUAL
       20.05.1999  10:38:10

statist: OFF    anomal:  3
periods: 14     int.pr: 60s
   max: 2384    remain: 17s
power off/on: 0
20.05.1999            12:44:39
```
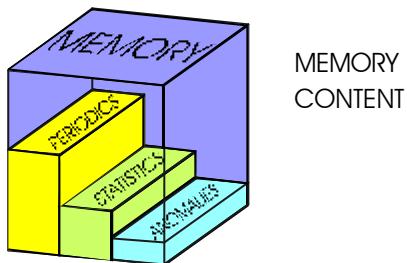
Current RECORDER status
Memory (buffer) configuration

START / STOP time
START / STOP settings

remaining memory
info. about set parameters
number of detected events
(anomalies, breaks)

5. DOWNLOAD

MEMORY CONTENT

1.Step: Save the selected results to a PowerLink file

Select Recording , Download

Xy.pmd

6. ANALYZING

1.Step: Open a PowerLink file and select data record to analyse

Analyse

2.Step: Select signals of interests

Short report of recorded Data

Stored signals are red coloured

Selected signals for analysis are blue coloured

3.Step: Select type of analysis

Execute

PERIODICS: to analyse periodical values of signals

STATISTICS: to perform statistical analysis
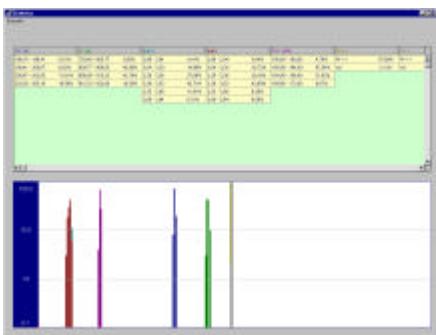
ANOMALIES: detailed analysis of captured voltage events
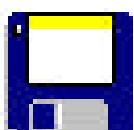
7. DOCUMENTATION

SAVE

PRINT

EXPORT

POWERLINK FILE

PRINTOUTS

EXCELFILE
(For making custom test report or further analysis with other tools)

In this recorder mode the EN 50150 parametersare preselected to simplify the instrument's set-up. Preselected and other signals can be switched on/off.

1. SET UP PARAMETERS

CONFIG.

METER Configuration
```
Uinp.k.(*):    1
Irange (1V):   1000A
connection:    4 w
```

SYSTEM
- RECORDER
- SIGNALS
- HARMONICS
- METER

RECORDER: signals   +51
```
L1 U   S+   Pfc+  Pfc -  Qi +
   I   S-   Pfi +  Pfi -  Qi -
      P+   Qc+   Qc+   dPf
L2 U   S+   Pfc+  Pfc +  Qi +
   I   S-   Pfi +  Pfi -  Qi -
      P-   Qc+   Qc-  dPf
                      Qi +
                      Qi -
                      dPf
                      S +
                      S-
                      Uu
```

RECORDER: harmonics   +47
```
            L1    L2  L3
enabledon:
thd:       thdU  thdI
harmonics:
U 02 03 04 05 06 07 08 09
  10 11 12 13 14 15 16 17
▶18 19 20 21 22 23 24 25
  26 27 28 29 30 31 32 33
              39 40 41
              07 08 09
              15 16 17
              23 24 25
              31 32 33
              39 40 41
```

RECORDER: conditions
```
rec.mode:EN50160
start  MANUAL
stop   MANUAL
flick:  ON
per:    ON
anom.windowFIXED
main.integ.per.: 1 min
powersub.i.p. : 1 per
nominalvoltage : 230.0V
upperlimit: 10%  253.0V
lowerlimit: 10%  207.0V
buffermode:  circular
20.05.2001.        12:44:00
```

Send

Instrument settings
Manufacturer	METREL
Type of instrument	MI 2892
Serial number	80008008
Last calibr. date	10.08.2001 08:13:29
User note	DEMONSTRATION
Instrument load rate	EN38
U factor	1
I range (A)	100B
Connection	4 wires
Frequency (Hz)	50
Sync. input	
Type of recording	EN50160

1.Step:enterconfigurationmenu
2.Step:selectEN 50160and RECORDER conditions
3.Step:select/deselectsignals(optional)
4.Step:checkoradjustinstrument'sconfiguration

1. Step: checkinstrument settingsandselectEN50160mode
2. Step: selectRECORDERconditions
3. Step: select/deselectsignals(optional)
4. Step: Sendsettingstotheinstrument

- toactivate RECORDER   SELECT + ENTER   !

RECORDER = READY

- waitingforSTARTcondition

**... ● RECORDING...
START on TIMER**

DEFAULT SETTINGS

nogap:
VOLTAGE
FREQUENCY
DIPSandSAGS
INTERUPTIONS
FLICKERS
UNSIMETRY

1/200ms:
THD(1...40)
HARMONICS (1...25)

optional
PERIODICS
ANOMALIES

MEMORY

VOLTAGE | FREQ. | DIPS, SAGS | INTERUPTIONS | FLICKERS | THD&HARMONICS | OTHER

! CONSIDERAVAILABLE MEMORYSIZE

2. MEASURING

**■ RECORDING
STOP o n T IMER, REMOTE (⊠)or MANUAL (SELECT + ENTER)**
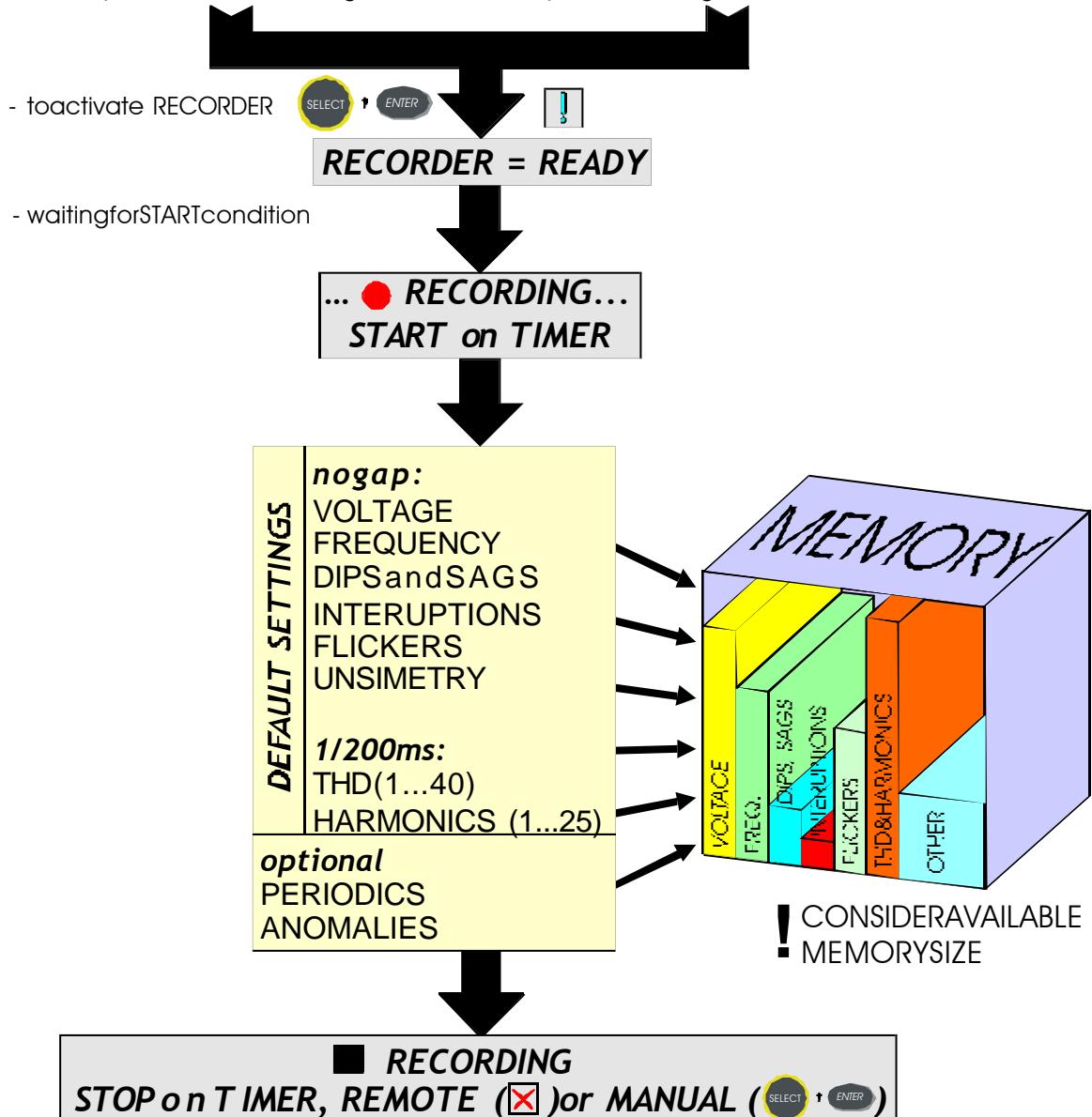
EN 50160 ANALYSIS 2/2

3. DOWNLOAD

MEMORY CONTENT

1.Step:Savetheselected resultsto a Power Linkfile:

Select Recording , Download

Xy.pmd

1.Step:OpenaPowerLinkfile andselectdata recordto analyse:

, Analyse , Execute , EN50160

2.Step:Checkstandardized EN50160 report

ThestandardizedEN50160 reportquicklydisplayswhether themeasuredvaluesarewithin thelimitsdefinedbythestandard.

3.Step:Selectfurther EN50160 analysingtools

Note :Periodicandanomalies analysisare alsoavailable inthismode

OPTIONAL:
Periodics
Voltage Anomalies

4. ANALYZING

Execute

Dataintabelaricform

FlickersGraph

CumulativeFrequencyGraphs

5. DOCUMENTATION

SAVE

PRINT

EXPORT

Xy.pmd

POWERLINKFILE

PRINTOUTS

EXCEL FILE
(Formakingcustom test
reportsorfurtheranalysis
withothertools)

FAST LOGGING 1/2
MEASURING STARTUPS, INRUSHES, FLUCTUATIONS…

DEFINITION

Measuredsignal

U or I

Inrush, fluctuationorotherevent

Recordingofwaveformwith high
resolution128samples/period
(6.4kHz@50Hz)

U or I

half period
TRMSvalues
(10msat50Hz)

t

## SETTINGS

TRIGGERS

Definesstartingconditions
(different combinationsare possible):
LEVEL-predefined signal10msTRMSvalue
SLOPE-predefined slopeof10msTRMSvalues
TIMER-startonelapsedtime
MANUAL-manualstart
INPUT: U_1, U_2, U_3, U, I, I_2, I_3, I_X - t riggerchannel

1a LEVEL SLOPE: RISE
1b LEVEL SLOPE: FALL
2 TIMER
3 MANUAL

4 LEVELandTIMER
5 LEVELorMANUAL
6 TIMERorMANUAL
7 (LEVELandTIMER)orMANUAL
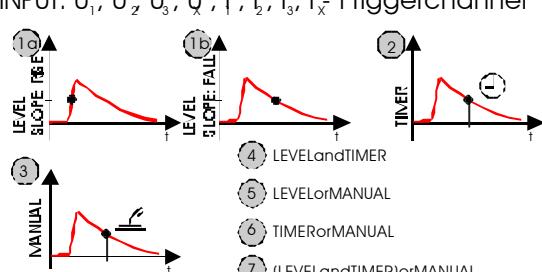
LOGGING OF1 TO6 SIGNALS

Fastloggingon 1 to6channels canbe recorded
simultaneously.Considermaximalrecordingbuffer
size **(max.rec.buff)**.

PREandPOSTBUFFER

Pretriggerbufferisusedtoobservewaveforms
beforetriggerconditionhas occured

TOTALBUFFER
PRE
POST
START
F.LOGGING
TRIGGER POINT
STOP
F.LOGGING

STORE MODE

SINGLE MODE: recordingisstoppedafterbuffer isfull

SINGLE
START

REPEAT MODE: recordingisperformedn-times
a new startisallowedafterpreviousrecordisfinished.

REPEAT
START   START   START

FAST LOGGING 2/2

1. SET UP RECORD CONDITIONS

SetParameters& Date Send

```
RECORDER : conditions
rec.mode:FASTLOGG.
trigg:  LEVEL  MANUAL  TIMER
timer:  17.07.2001  11:01
signals: U1 U2 U3 I1 I2 I3
storebuffer:    2 sec
pretrig.buff:   1 sec
lev.trg.input:  Ux
lev.trg.level:  244.0 V
lev.trg.slope:  RISE
storemode:      SINGLE

max.rec.buff:  10321sec
 20.05.2001.          12:44:00
```

CONFIG.

```
SYSTEM

RECORDER
SIGNALS
HARMONICS

METER
```

```
METER  Configuration


  Uinp. k.(*):      1
  Irange (1V):   1000A
  connection :      4 w
  sync.freq  :    50 Hz
  sync.inpt. :     auto
```

- to activateRECORDER SELECT , ENTER   [!]
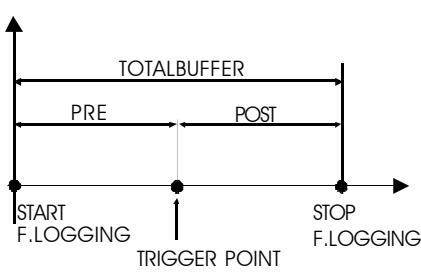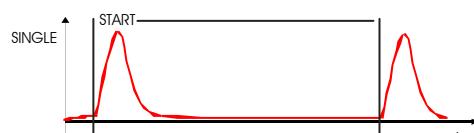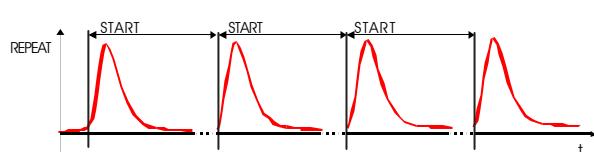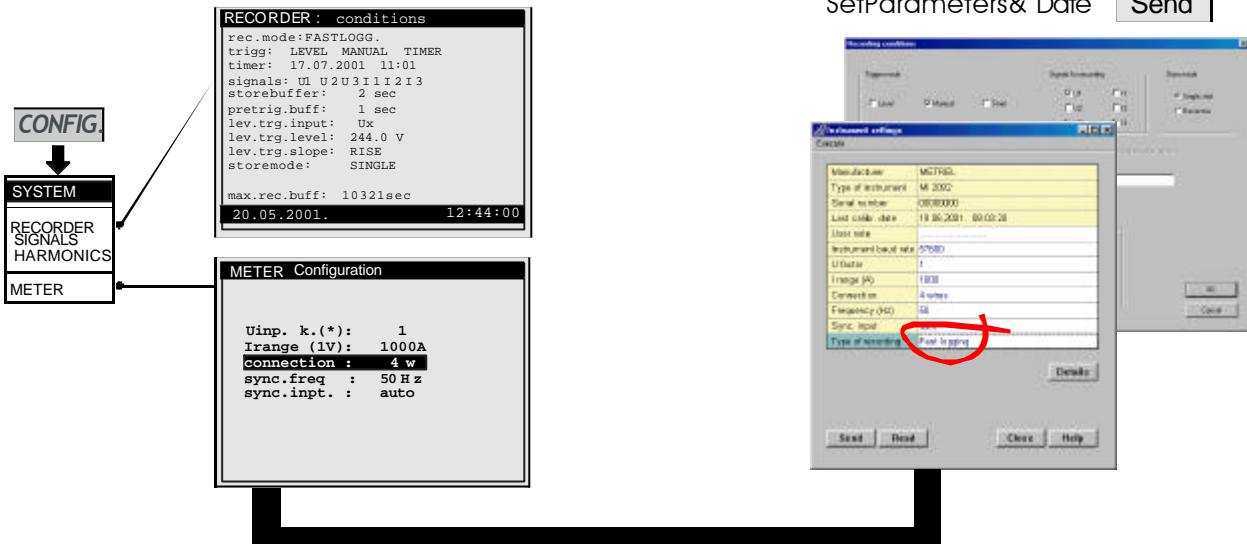
RECORDER=READY

- waitingforcorrectstarting condition

2. MEASURING

... ● RECORDING...
START on TRIGGER, TIMER or MANUAL (HOLD MANUAL)

...FAST LOGGING RECORD... ➡ MEMORY
REPEAT   SINGLE

- to abort recording: SELECT , ENTER   [X]

■ RECORDING

3. ANALYZING

Scope

Part (around trigger point) oflast recorded fastlogging is displayed
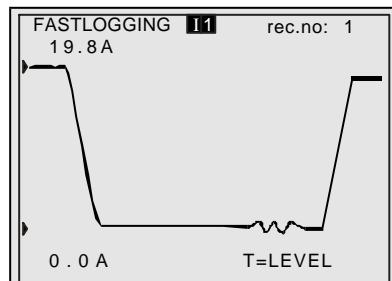
```
FASTLOGGING  I1      rec.no: 1
 19.8A




 0.0 A              T=LEVEL
```

1.Step:Savetheselected resultstoaPowerLinkfile: , Select Recording , Download

2.Step:OpenaPowerLinkfile andselectdatarecordtoanalyse: , Analyse
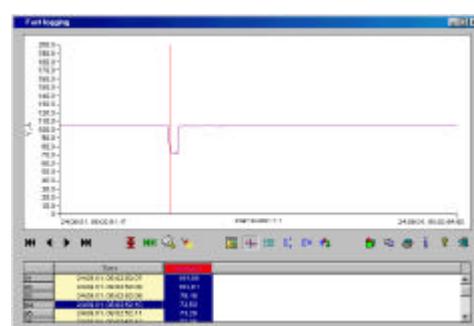
DOCUMENTATION
### (SAVE to FILE, PRINT, EXPORT)

TOOL FORANALYSING VOLTAGE AND CURRENT WAVEFORMS

DEFINITION

Measuredwaveform

Voltageevent, fluctuationorotheranomaly

U or I

t

Recordingofhalf periodTRMSvalues (10ms@50Hz)

U or I

U or I

Recording ofwaveformwithhigh resolution 128samples/period (6.4kHz@50Hz)

t
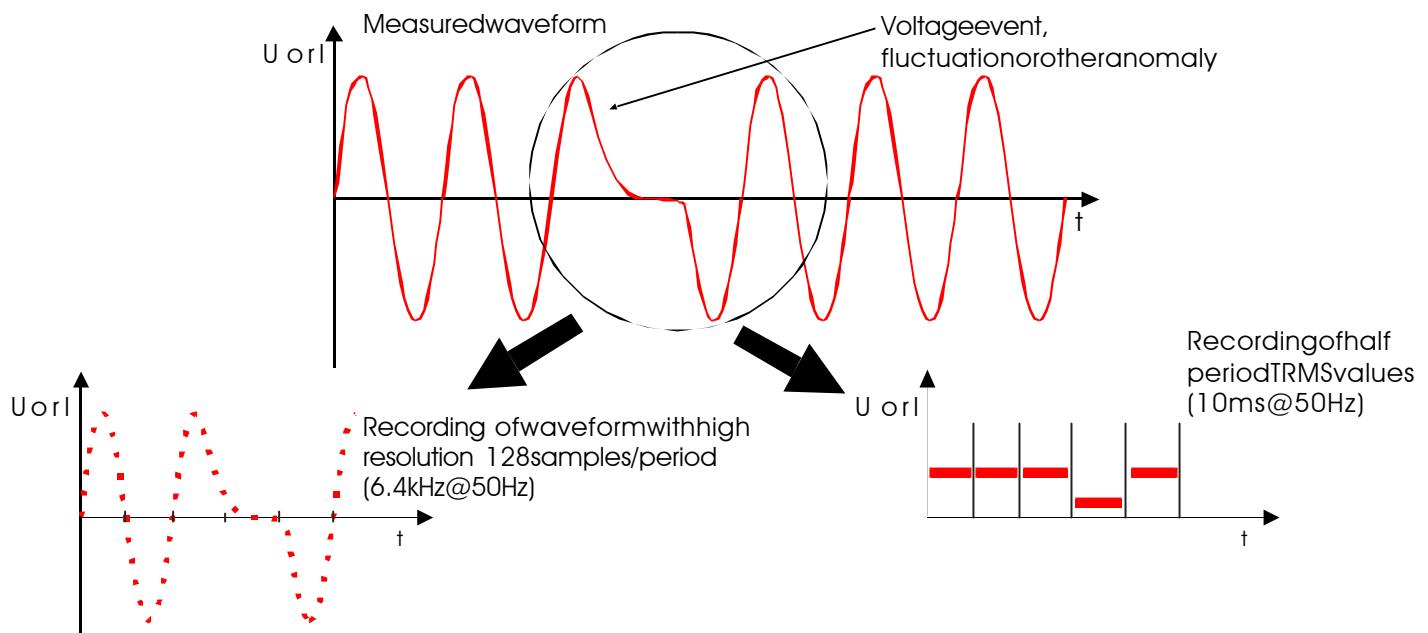
WAVEFORM PARAMETERS

TRIGGERS

Definesstarting conditions
(different combinations arepossible):
LEVEL-predefinedsignal10msTRMSvalue
SLOPE-predefinedslopeof10ms TRMS values
TIMER - start on elapsed time
MANUAL-manualstart
INPUT: U_1, U_2, U_3, U_X, I_1, I_2, I_3, I_X- t riggerchannel
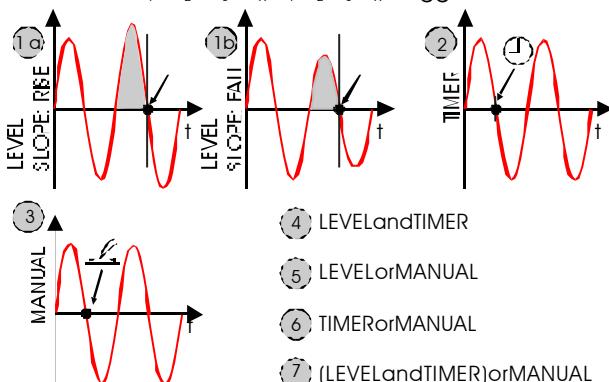
1a) LEVEL SLOPE: RISE

1b) LEVEL SLOPE: FALL

2) TIMER

3) MANUAL

4) LEVELandTIMER

5) LEVELorMANUAL

6) TIMERorMANUAL

7) (LEVELandTIMER)orMANUAL

PRE and P OST BUFFER

Pretriggerbufferisused toobservewaveforms
beforetrigger condition hasoccured

TOTALBUFFER

PRE   POST

START
RECORDING

TRIGGERPOINT
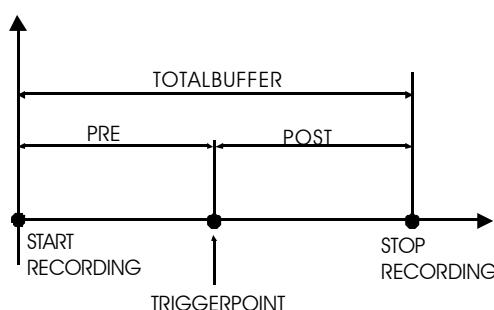
STOP
RECORDING

### RECORDING OF 1 TO 6 WAVEFORMS

Waveformson1to6channelscanberecorded
simultaneously. Considermaximalrecording buffer
size **(max. rec.buff)**.

U,I

U1   U2   U3

I1   I2   I3

STORE MODE

SINGLEMODE:recordingisstoppedafter buffer isfull

START

REPEAT MODE: recordingisperformedn-times
anewstartis allowedafterpreviousrecordisfinished.

START   START   START
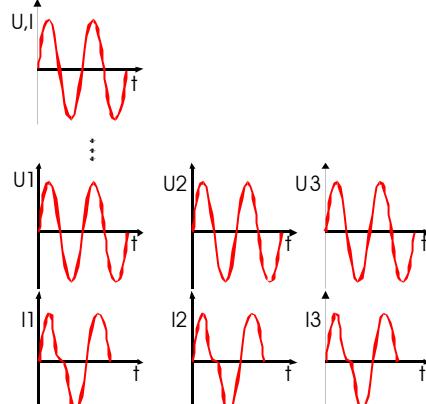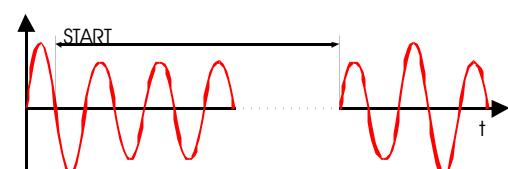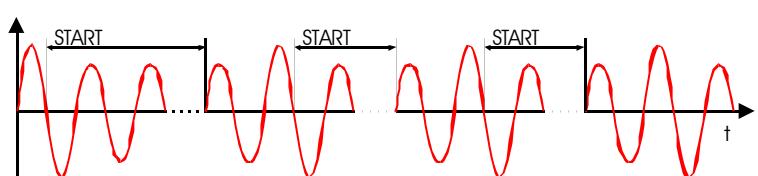
WAVEFORMS 2/2

1. SET UP RECORD CONDITIONS

CONFIG.

SYSTEM
RECORDER
SIGNALS
HARMONICS
METER

```
RECORDER: conditions
rec.mode: WAVEFORMS
trigg: LEVEL MANUAL TIMER
timer: 17.07.2001 11:01
signals: U1 U2 U3 I 1 I 2 I3
storebuffer:    2 sec
pretrig.buff:   1 sec
lev.trg.input:    Ux
lev.trg.level:  2 4 4 . 0 V
lev.trg.slope:  RISE
storemode:      SINGLE

max.rec.buff:   161sec
20.05.2001.          12:44:00
```

```
METER  Configuration


  Uinp. k.(*):      1
  Irange (1V):   1000A
  connection :     4 w
  sync.freq  :    50 H z
  sync.inpt. :    auto
```

- to activate RECORDER   (SELECT), (ENTER) | (REMOTE)

RECORDER=READY

- waiting for proper starting condition

... ● RECORDING...
START on TRIGGER, TIMER or MANUAL (HOLD MANUAL)

2. MEASURING

...WAVEFORMS... ➡ MEMORY
REPEAT   or   SINGLE mode

- to abort recording: (SELECT), (ENTER)   ✗

■ RECORDING

3. ANALYZING

Scope
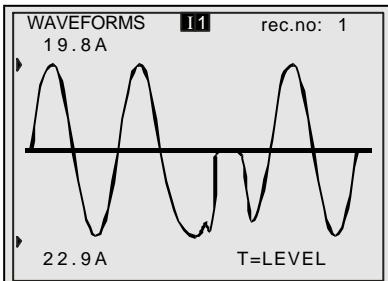
Part (around trigger point of last recorded waveform is displayed

```
WAVEFORMS   I1      rec.no: 1
 19.8A




 22.9A         T=LEVEL
```

1. Step: Save the selected results to a PowerLink file: , Select Recording , Download
2. Step: Open a Power Link file and select data record to analyse: , Analyse
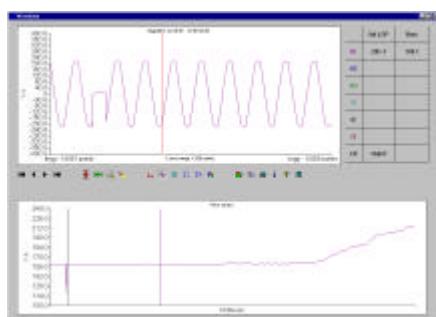
DOCUMENTATION
### (SAVE to FILE, PRINT, EXPORT)

TRANSIENTS 1/2

TOOL FORANALYSING FAST VOLTAGE AND CURRENT TRANSIENTS
(observing waveforms in full detail, with very high resolution)
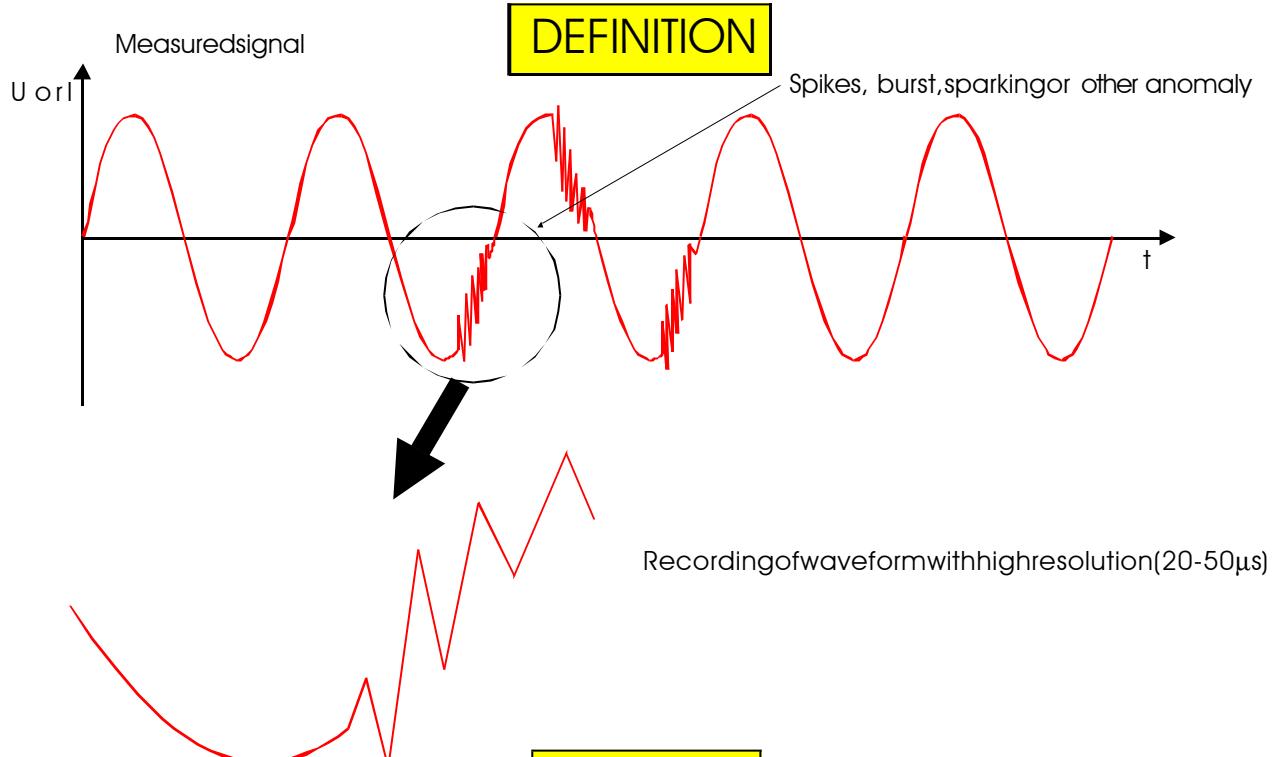
Measuredsignal

U or I

DEFINITION

Spikes, burst,sparkingor other anomaly

Recordingofwaveformwithhighresolution(20-50μs)

SETTINGS

**TRIGGERS**

Definesstartingconditions
(different combinationsarepossible):
LEVEL-predefinedsignal'smomentary level
dL/scan-signalsslope
MANUAL-manualstart
INPUT-triggerchannel(U$_x$I)

① ②

dL/scan

dL/scan

LE/EL

1scan(20-50μs)

③ LEVELanddL/scan

④ LEVELorMANUAL

⑤ (LEVELanddL/scan)orMANUAL
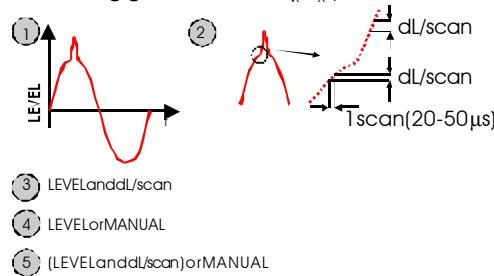
LOGGING OF 1 TO 6 SIGNALS

Transientson1to 6 channelscanberecorded
simultaneously. Considermaximalrecordingbuffer
size **(max. rec. buff)**.

U,I

U$_x$ U$_x$ U$_x$

I$_x$ I$_x$ I$_x$

PREandPOST BUFFER

Pretriggerbufferisused toobservewaveforms
beforetriggerconditionhasoccured

TOTAL BUFFER

PRE   POST

START   STOP
RECORDING   RECORDING

TRIGGERPOINT

STORE MODE

SINGLE MODE:recording isstopped after bufferisfull

SINGLE   START

REPEAT MODE: recording isperformedn-times
a new startisallowedafterpreviousrecordisfinished.

REPEAT   START   START   START   START   START

1. SET UP RECORD CONDITIONS

```
RECORDER : conditions
rec.mode:TRANSIENTS
trigg:  LEVEL  MANUAL  TIMER
timer:  17.07.2001  11:01
signals:U1U2U3I1I2I3
storebuffer:    10per
pretrig.buff:    5 per
lev.trg.input:  Ux
lev.trg.level:  230.0V
lev.trg.slope:  RISE
storemode:     REPEAT      15x

max.rec.buff:  50per
 20.05.2001.                12:44:00
```

CONFIG.

```
SYSTEM
  RECORDER
  SIGNALS
  HARMONICS
  METER
```

```
METER  Configuration


  Uinp.k.(*):      1
  Irange (1V):   1000A
  connection :     4 w
  sync.freq  :   50Hz
  sync.inpt. :   auto
```

SetParameters&Date Send

```
Recording conditions
Instrument settings
  Manufacturer        METREL
  Type of instrument  MI 2800
  Serial number       00000000
  Last callibr. date  03.08.2001  09:45:07
  User note
  Instrument baud rate  57600
  U factor            1
  I range (A)         1000
  Connection          4 wires
  Frequency (Hz)      50
  Sync. input
  Type of recording   Transients
                                Details
  Send  Read          Close  Help
```
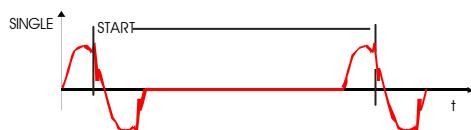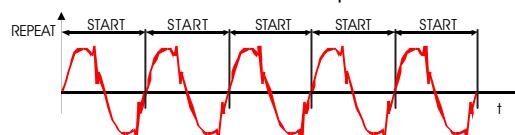
- to activateRECORDER SELECT ' ENTER

RECORDER=READY

-waitingforproperstartingcondition

... ● RECORDING…
START on TRIGGER or M ANUAL (HOLD MANUAL)

2. MEASURING

…TRANSIENTS… → MEMORY
REPEAT   SINGLE

- to abort recording: SELECT ' ENTER ✕

■ RECORDING

3. ANALYZING

Scope

Part (around triggerpoint) oflast recorded transient is displayed

```
TRANSIENTS   U1      rec.no: 1
 325.2V




 318.2V          T=LEVEL
```

1.Step: Savethe selected results to a PowerLink file: Select Recording ' Download
2.Step: OpenaPowerLinkfile andselectdatarecordtoanalyse: Analyse

DOCUMENTATION
(SAVE to FILE , PRINT , EXPORT)