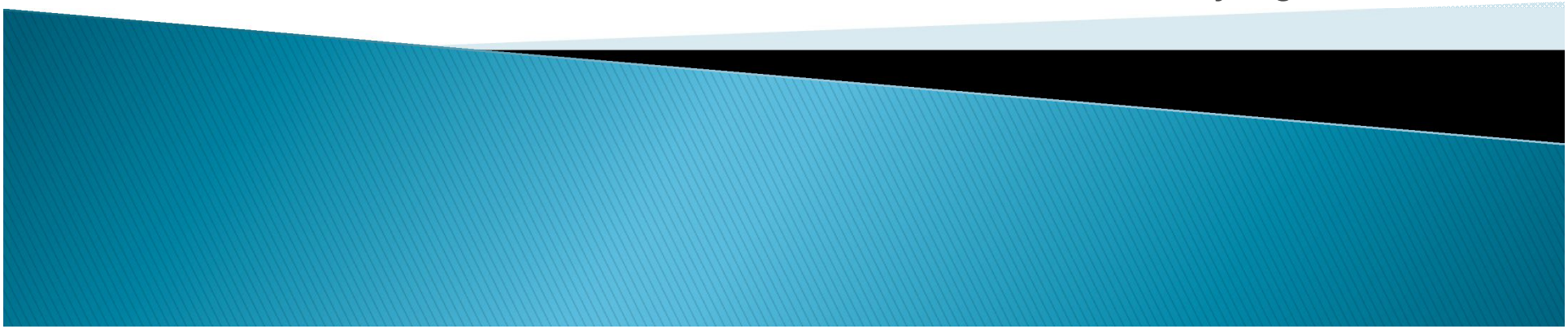
Power Quality Issues in UPS

by
A.D.Thirumoorthy
Member,APQI
Coimbatore
INDIA
adtmoorthy@gmail.com



1. HIGHLIGHTS OF POWER SECTOR

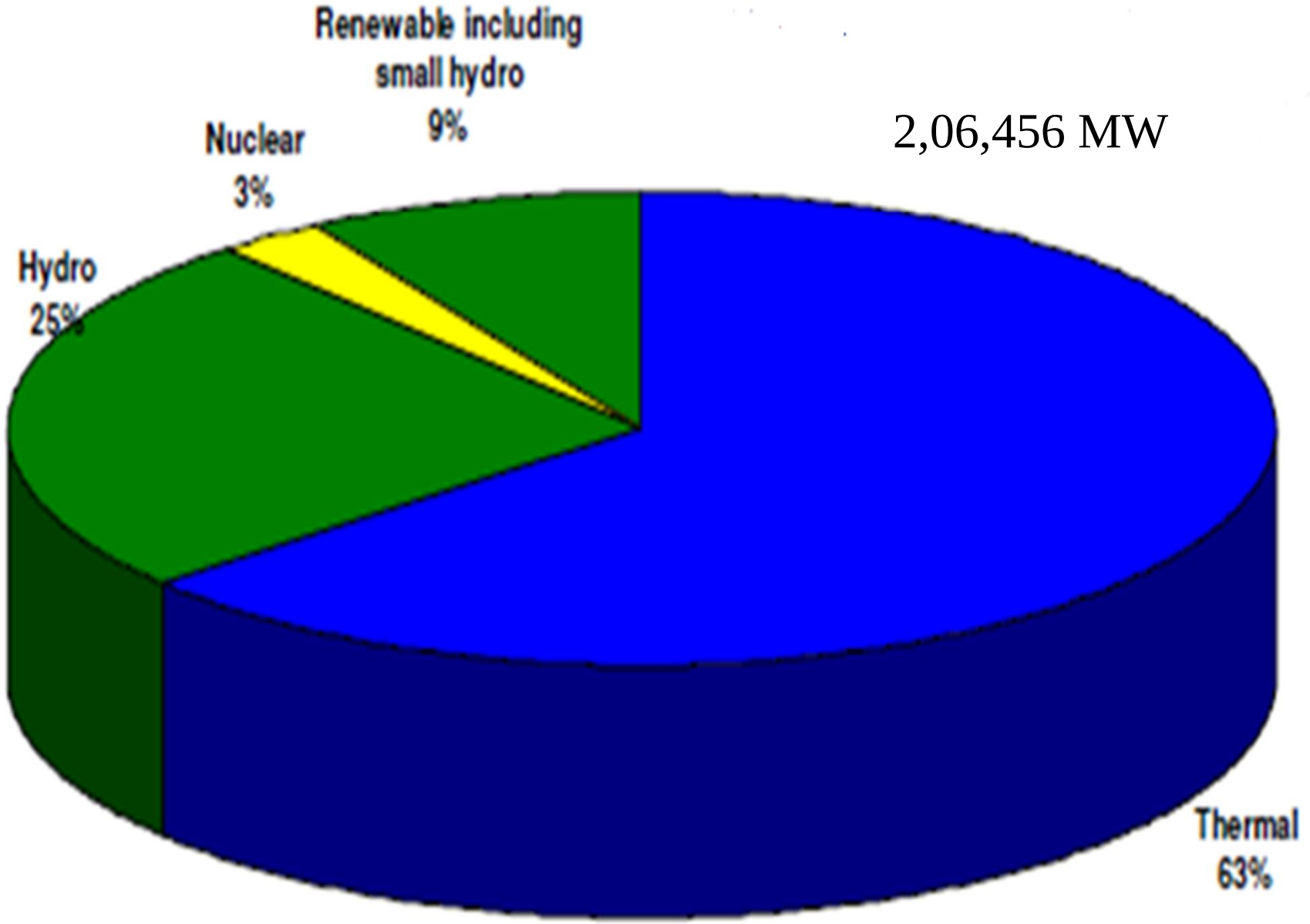
A Installed Generation Capacity (As on 31-07-12)

All India	Thermal				Nuclear	Hydro	RES@	Grand
	Coal	Gas	Diesel	Total		Renewable	(MNRE)	Total
MW	117283.38	18903.05	1199.75	137386.18	4780.00	39291.40	24998.46	206456.04
%age	56.8	9.2	0.6	66.5	2.3	19.0	12.1	100.0

@ Based on data as on 30-06-2012.

Indian Power Sector

2,06,456 MW



Power supply position 2012-13 July 2012*

Region	Energy (MU)	Deficit	Peak Demand	Deficit
	Requirement	%	(MW)	%
Northern	29,580	-11.3	41,659	-8.5
Western	22,285	-4.4	36,520	-3.6
Southern	23,000	-12.5	34,607	-13.2
Eastern	9,595	-5.3	15,248	-6.2
North Eastern	1,044	-6.9	1,946	-9.5
All India	85,504	-9.1	129,980	-8.1

Power Quality (PQ) problems-classic definitions

Impulses/Transient: High magnitude for extremely short duration.

Sag: A momentary voltage dip last for a few seconds.

Swell: A momentary voltage rise which last for a few seconds

Over Voltage: A steady state voltage rise last for SEVERAL seconds

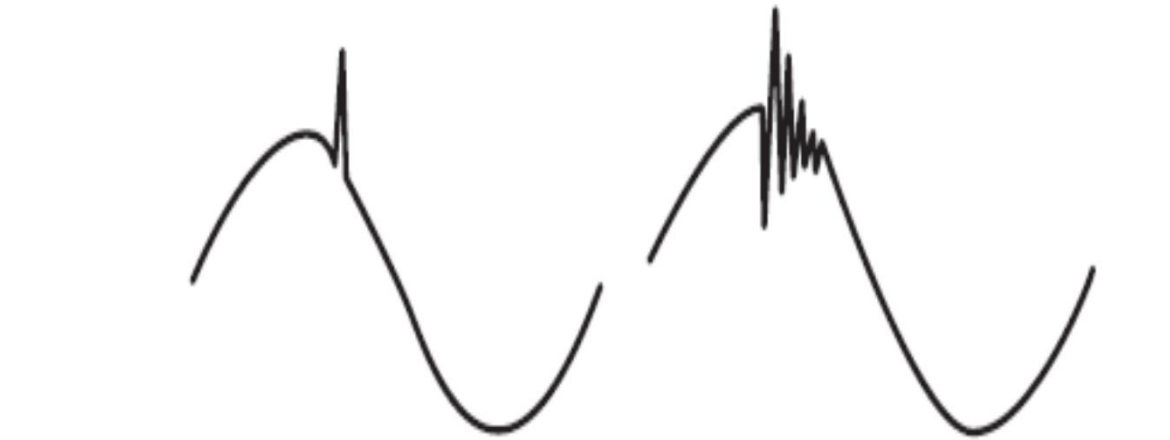
Under Voltage: A steady state voltage dip last for SEVERAL seconds

Interruption: A complete loss of voltage for a few seconds to several hours

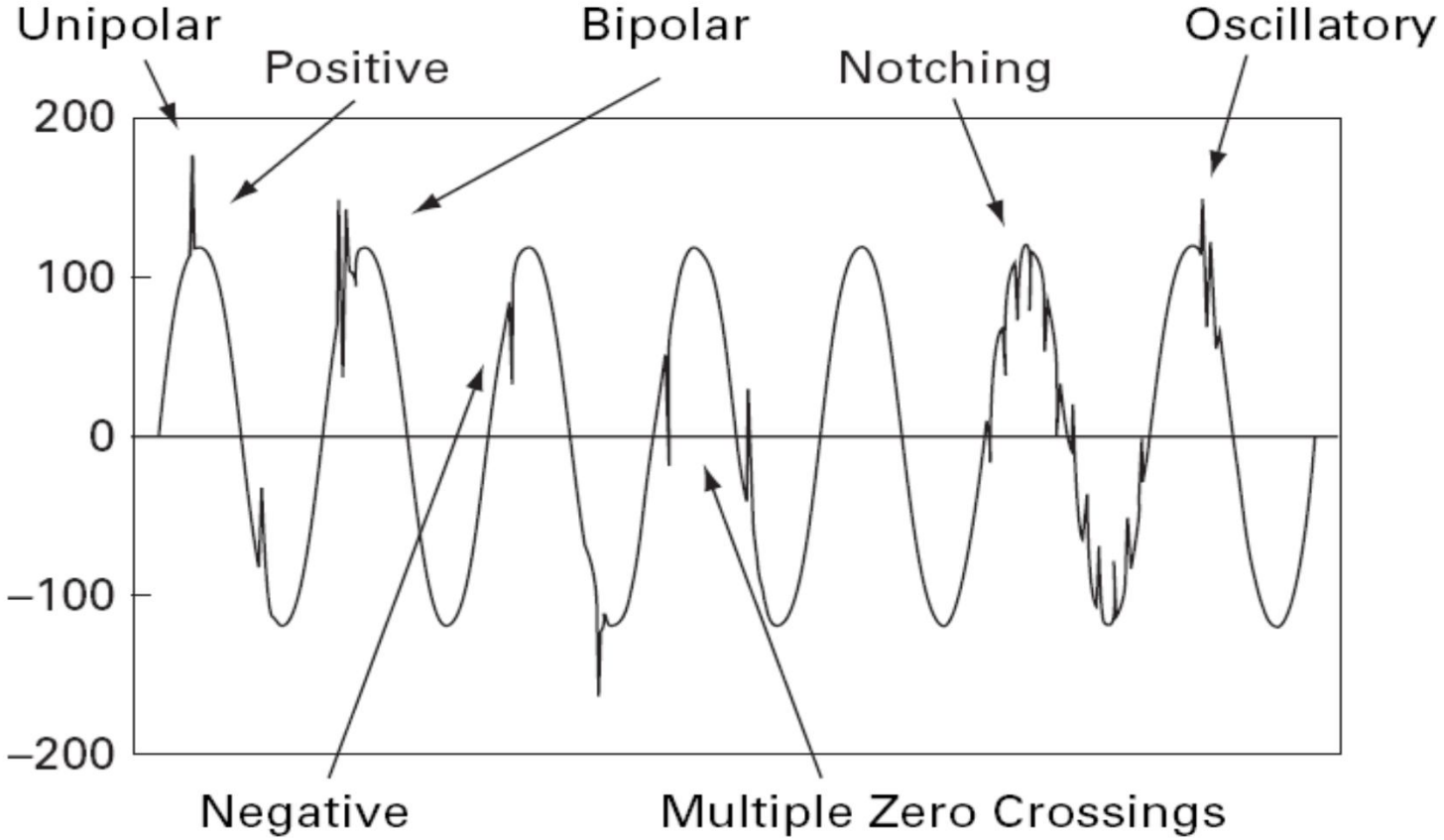
Flicker: A perceptible change in lamp output due to a sudden change in voltage

Harmonics: The non-fundamental frequency components of a distorted power frequency waveform.

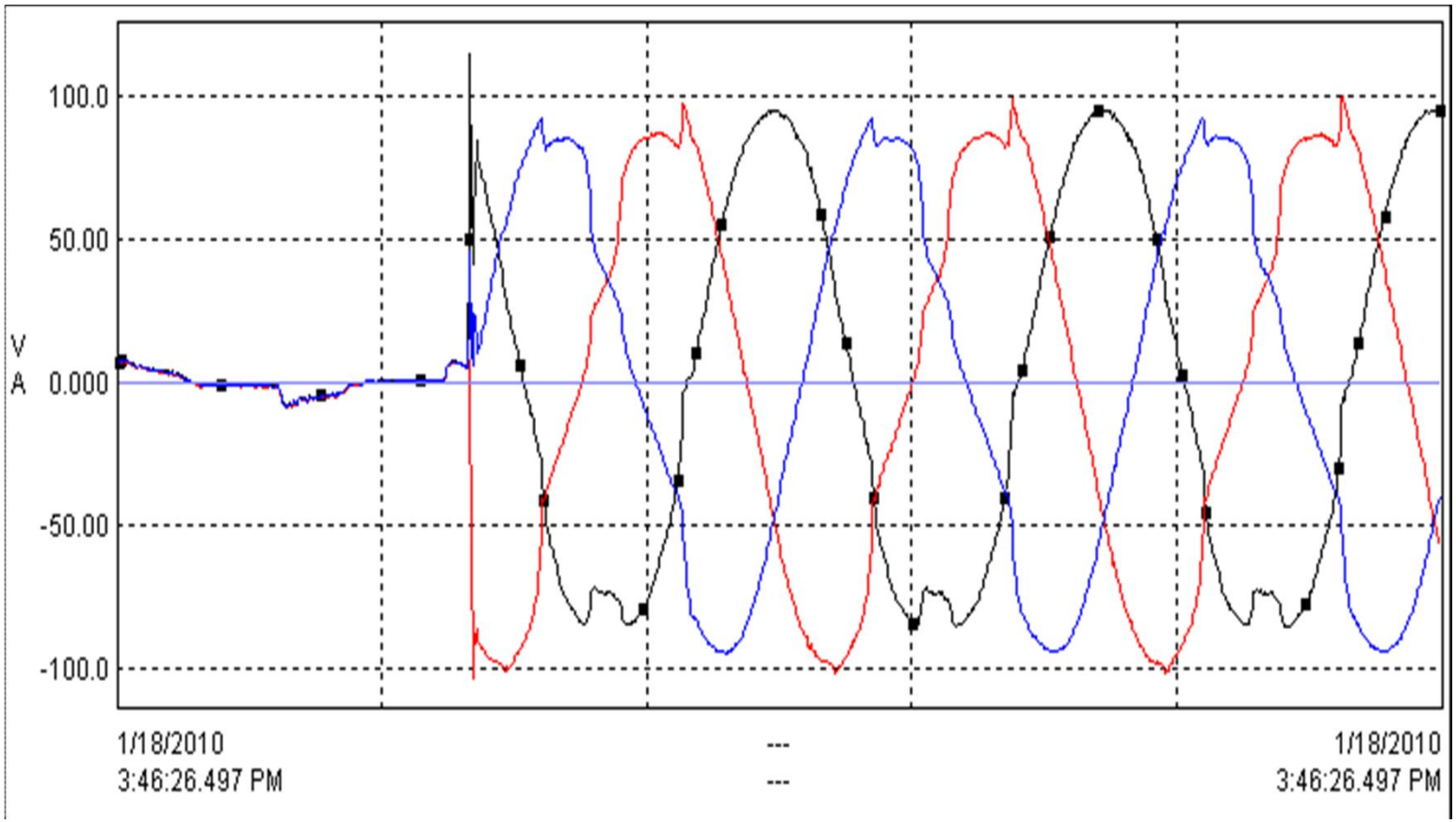
Transients classification



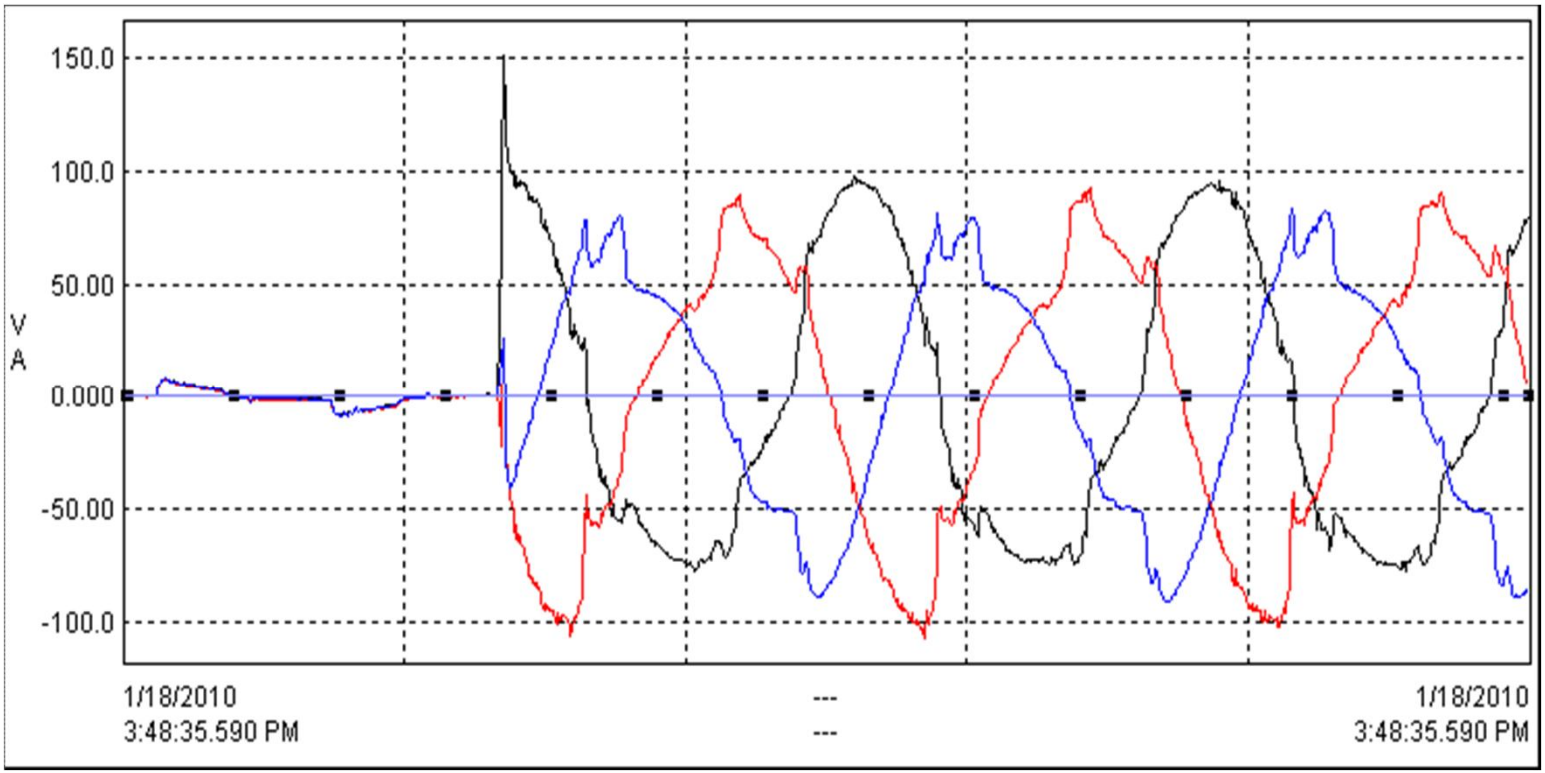
Transients classification



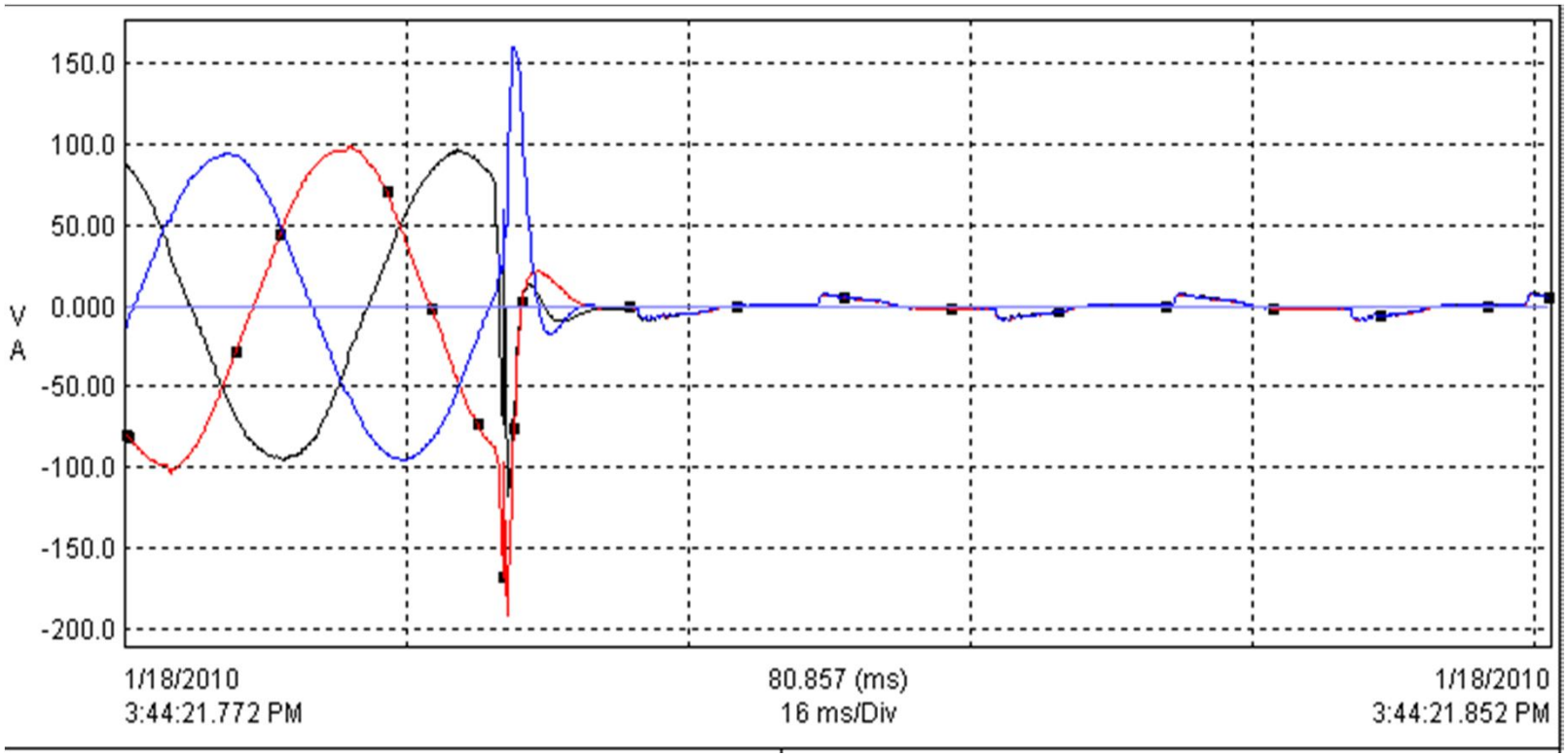
Transient During Charging a unloaded Transformer



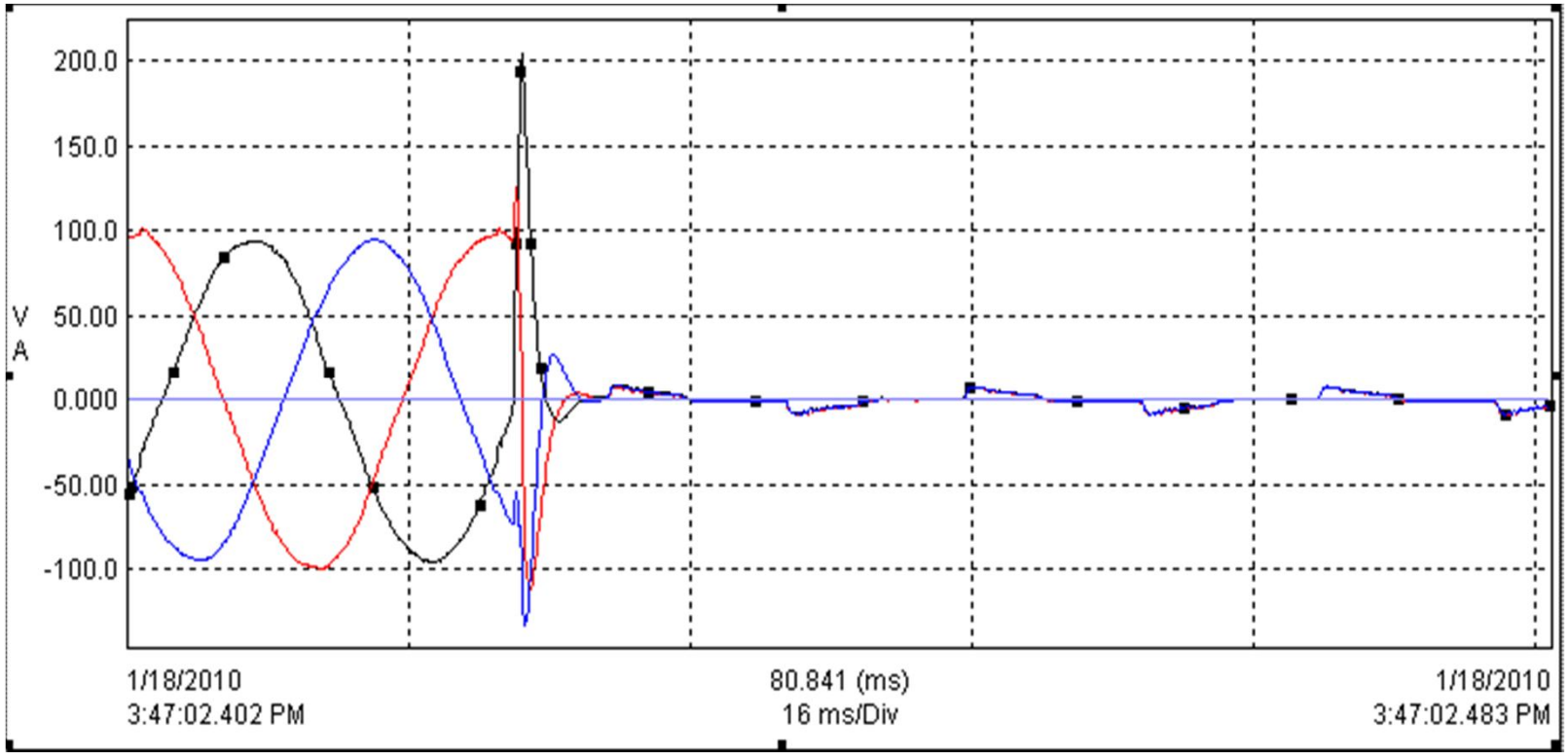
Transient During Charging a unloaded Transformer



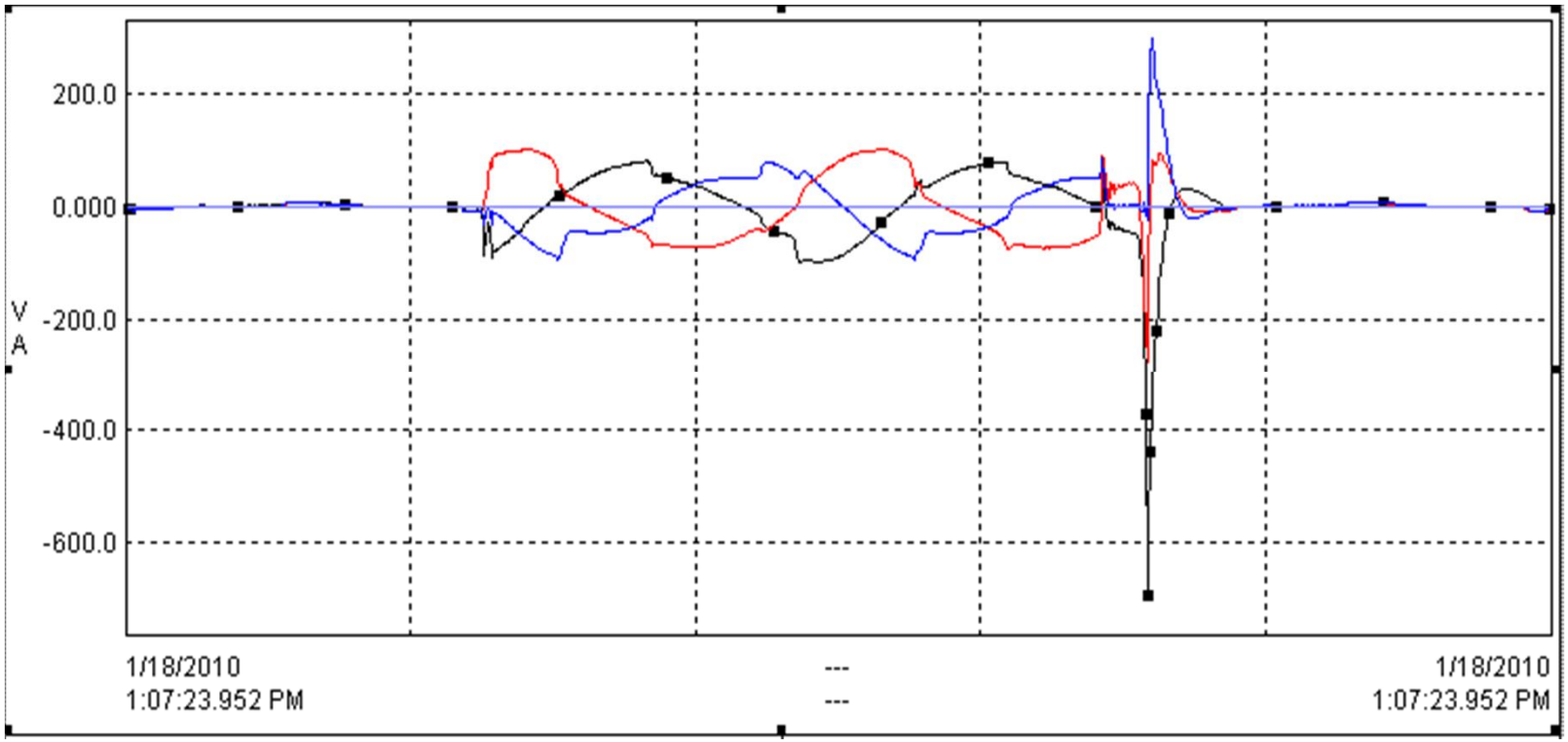
Transient when Transformer switched off



Transient when Transformer switched off



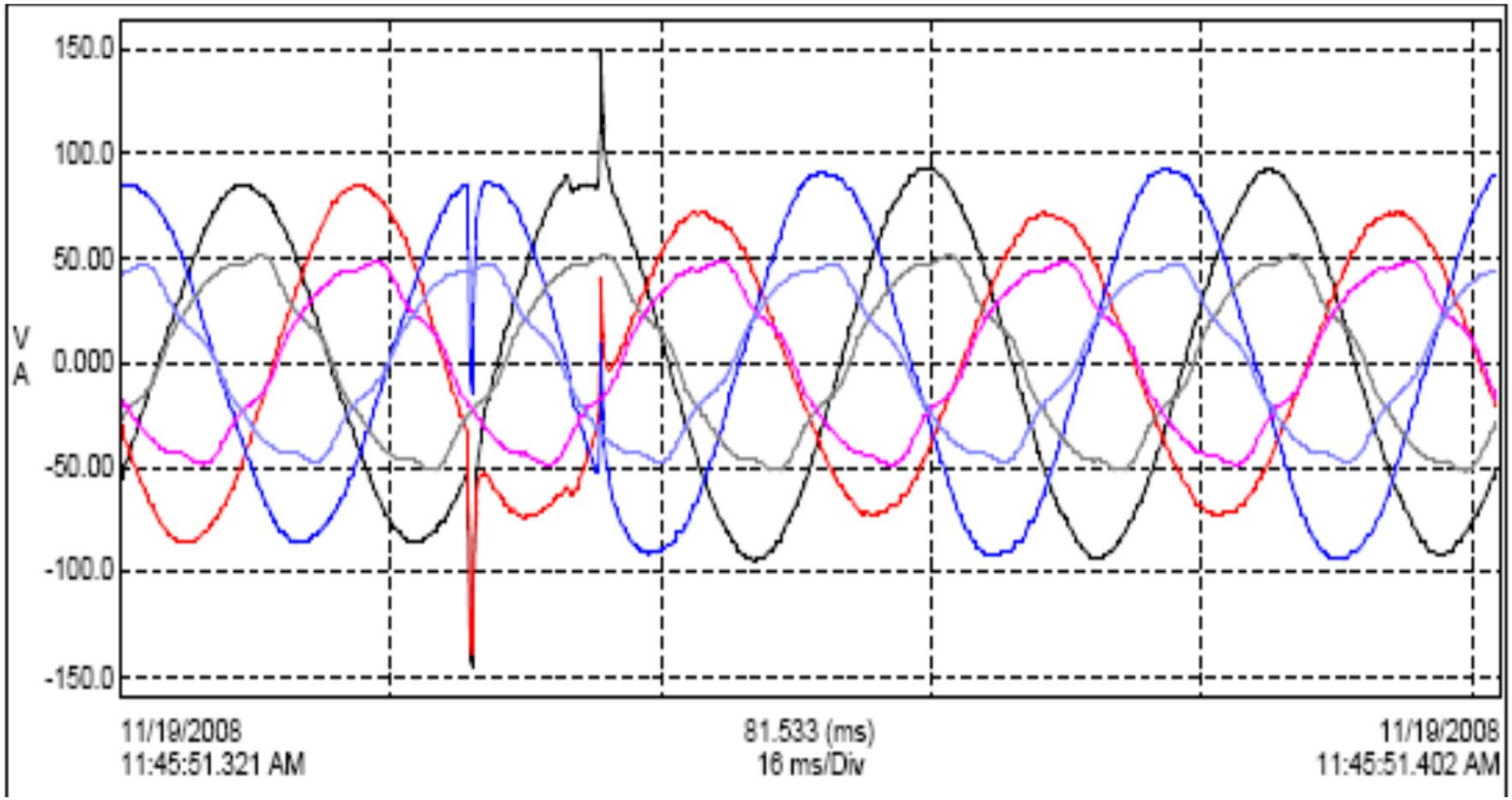
Transient due Tripping of Breaker due to inrush current



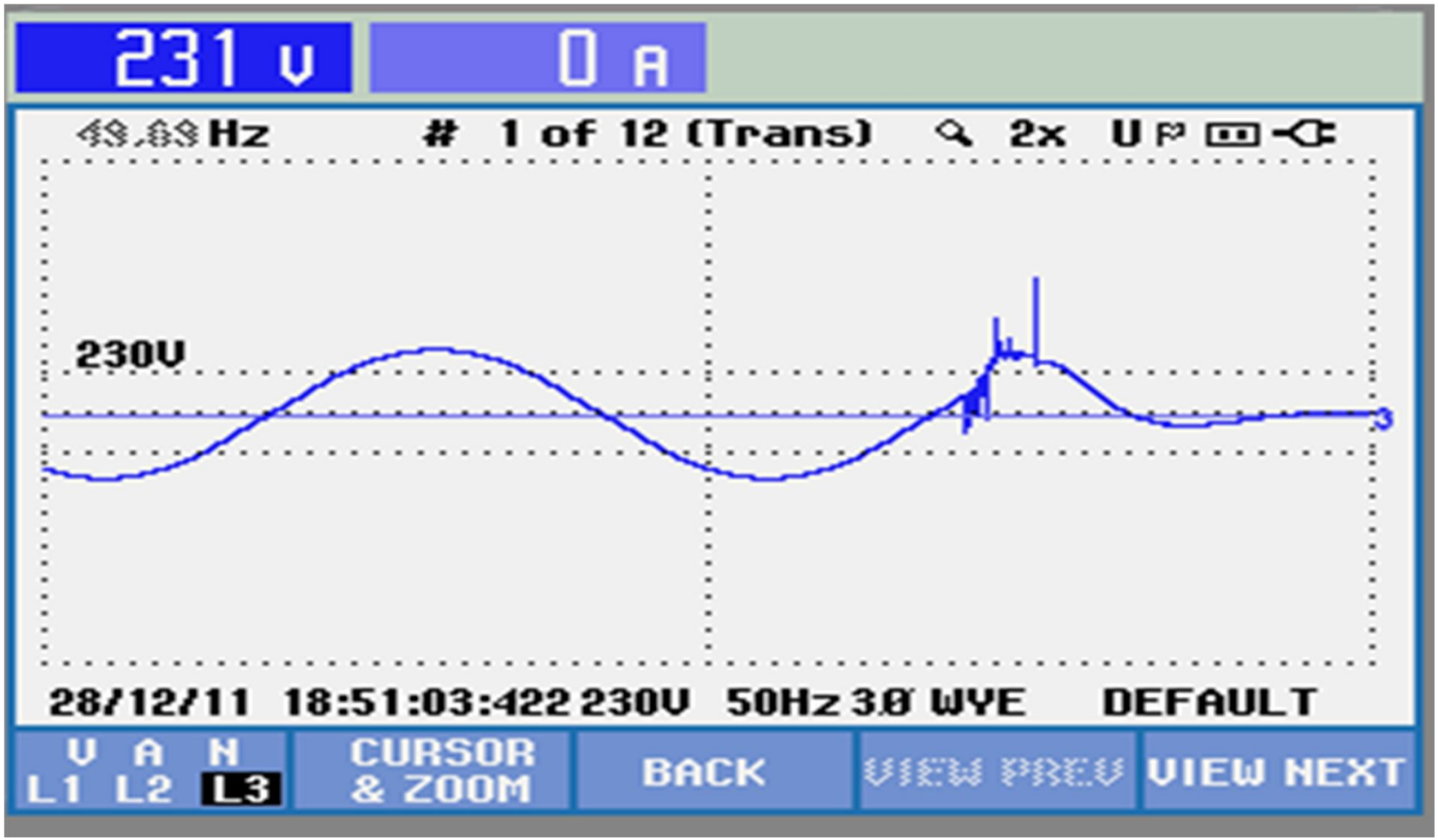
Transient due Tripping of Breaker due to inrush current

Name	Samples	Avg	Min	Max	Units
4Cycles V1	1024	-0.770	-695.400	79.600	V
4Cycles V2	1024	0.077	-276.800	101.600	V
4Cycles V3	1024	-0.142	-95.600	299.600	V
4Cycles I1	1024	0.000	0.000	0.000	p A
4Cycles I2	1024	0.000	0.000	0.000	p A
4Cycles I3	1024	0.000	0.000	0.000	p A
4Cycles V1	1024	0.193	-80.900	10.900	V
4Cycles V2	1024	-1.121	-150.000	19.200	V
4Cycles V3	1024	0.184	-12.500	65.000	V
4Cycles I1	1024	0.000	0.000	0.000	p A
4Cycles I2	1024	0.000	0.000	0.000	p A
4Cycles I3	1024	0.000	0.000	0.000	p A

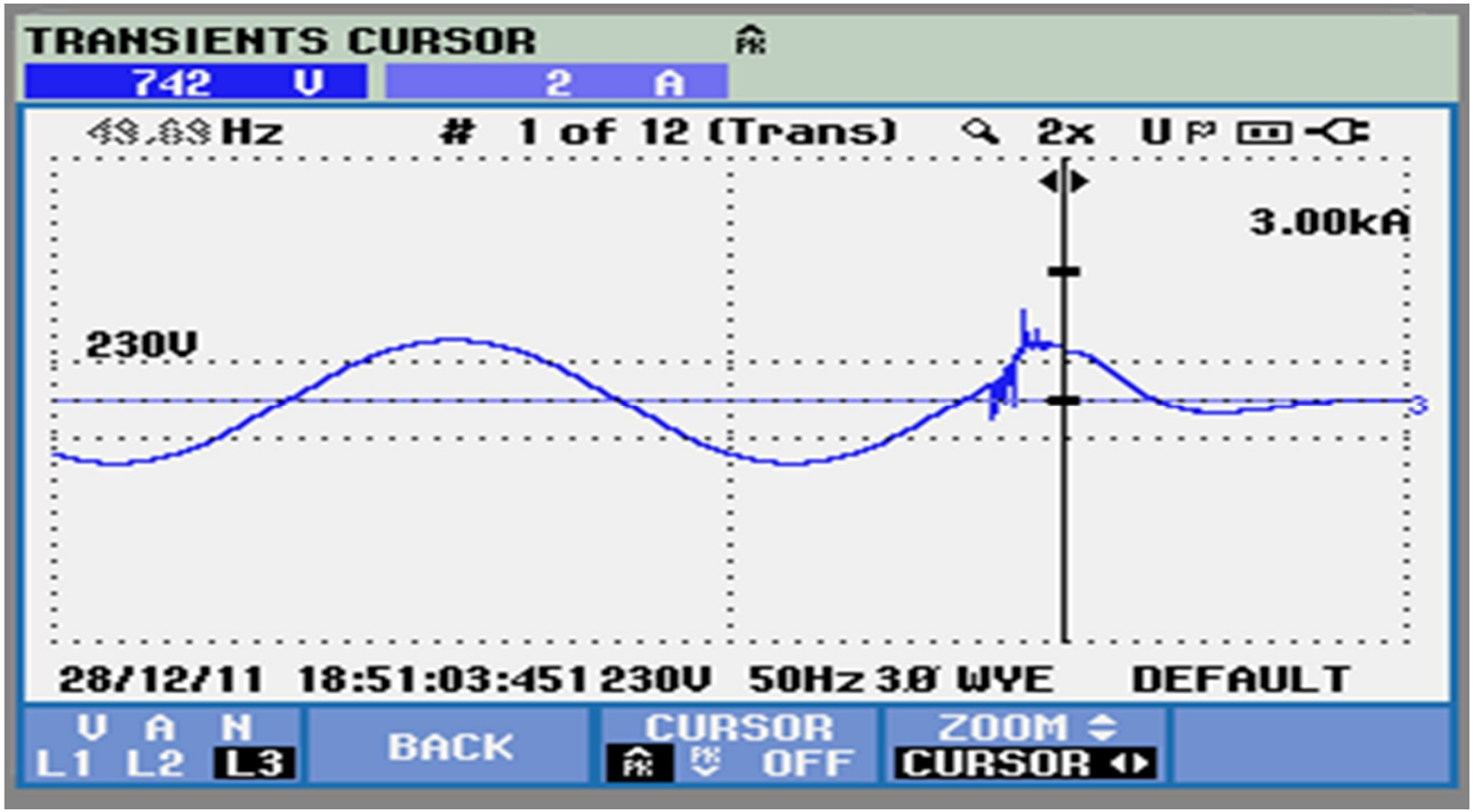
Transient due to Capacitor Switching



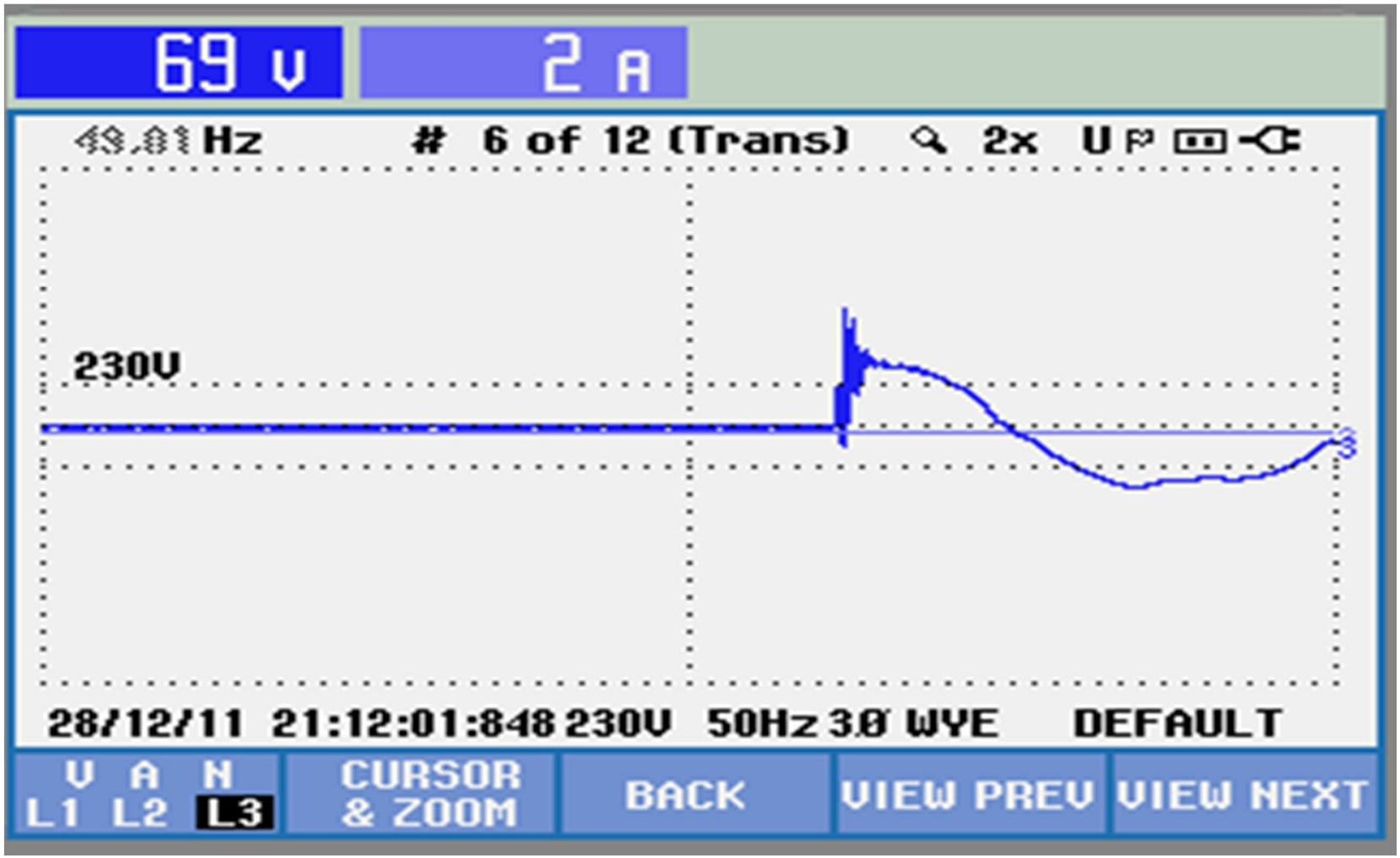
Transient Event



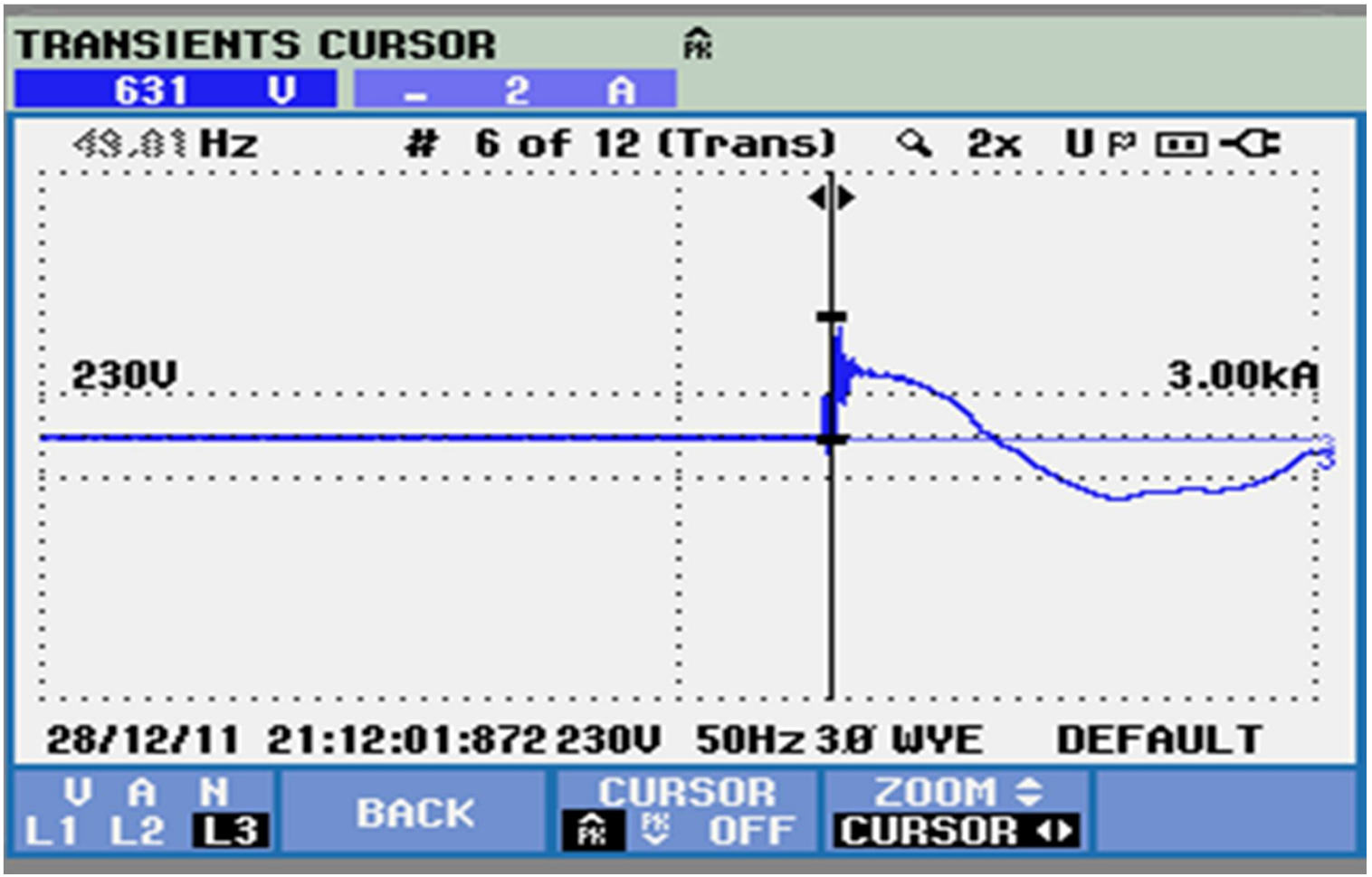
Magnitude of Transient



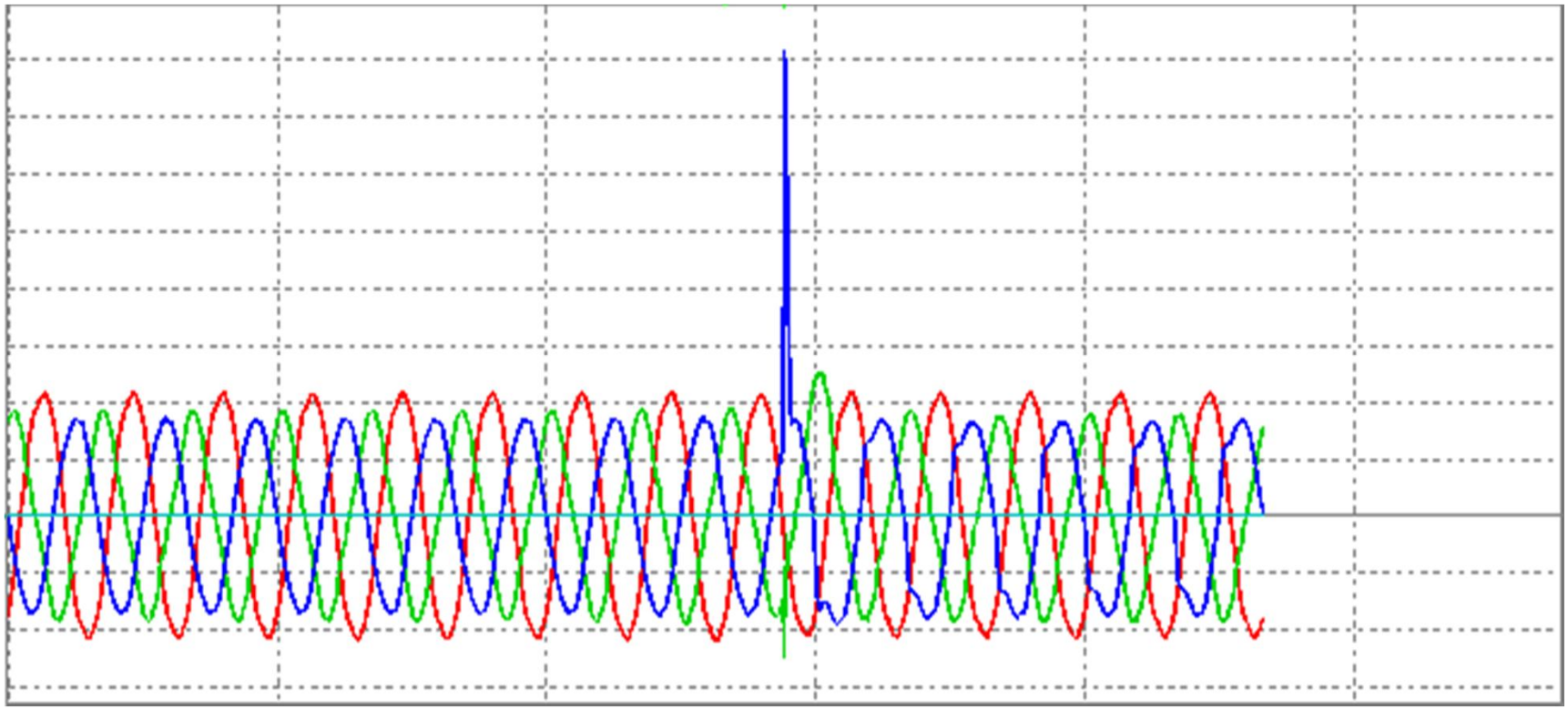
On Resumption of Supply



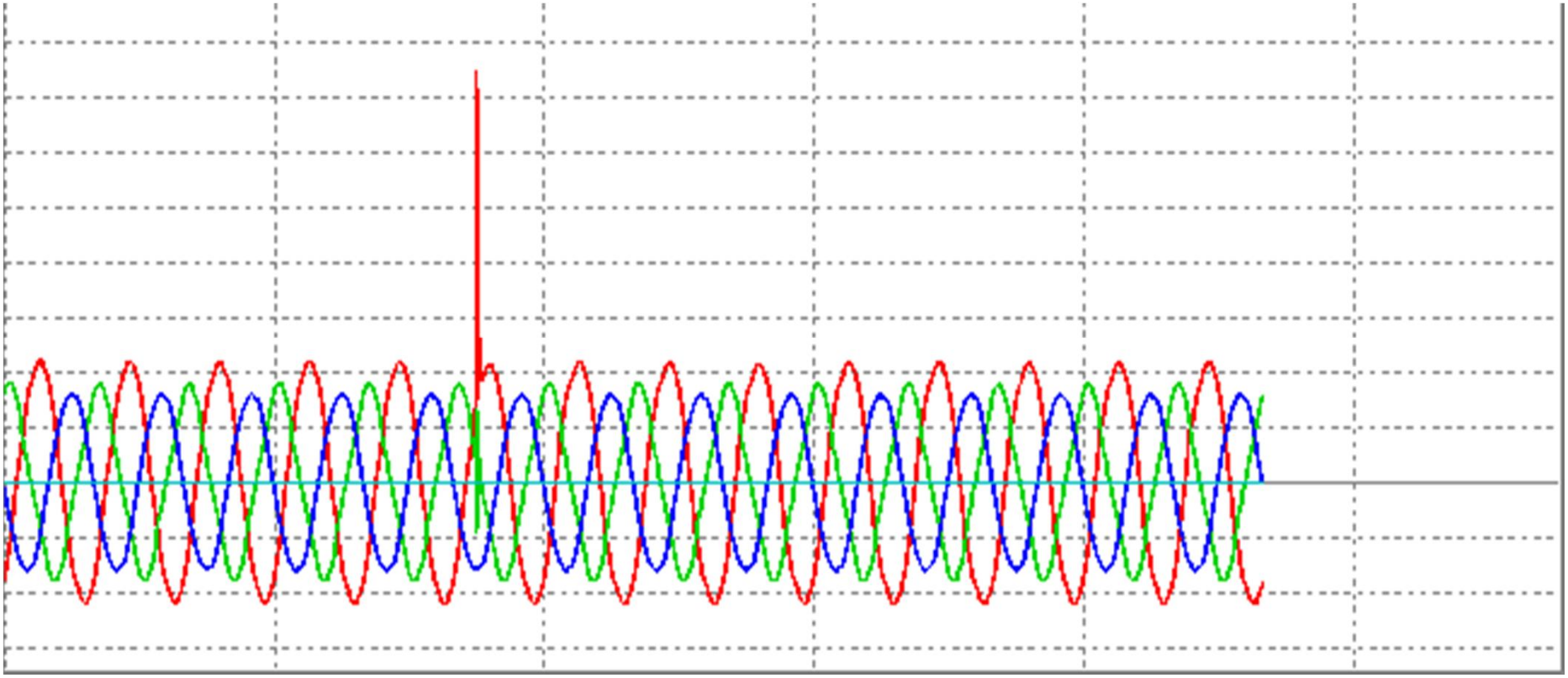
Magnitude


TRANSIENTS CURSOR
631 V
- 2 A
Hz
6 of 12 (Trans)
2x
230V
3.00kA
28/12/11 21:12:01:872 230V 50Hz 3Ø WYE DEFAULT
V A N
L1 L2 L3
BACK
CURSOR
OFF
ZOOM
CURSOR

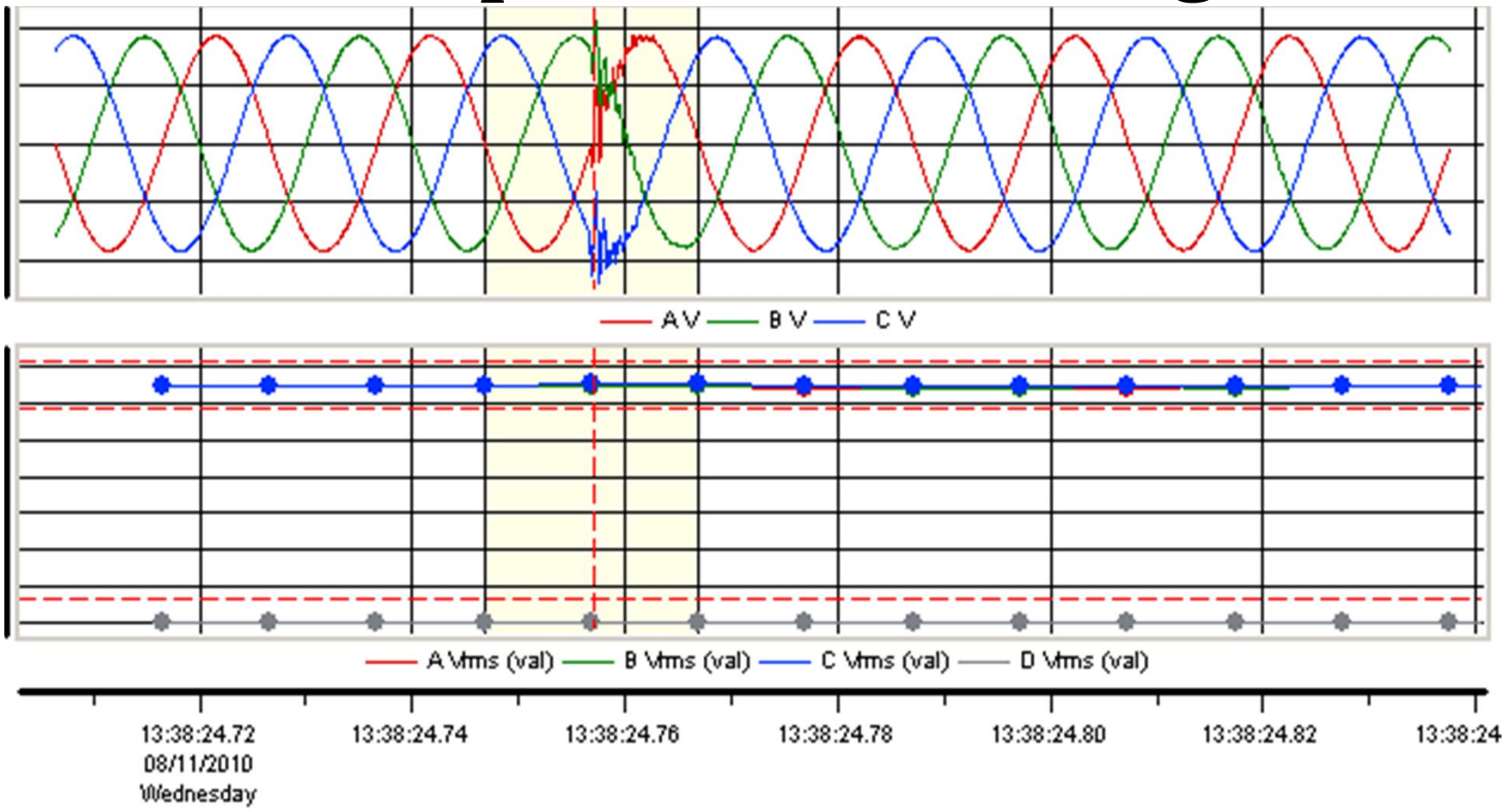
Severe Transient



Severe Transient

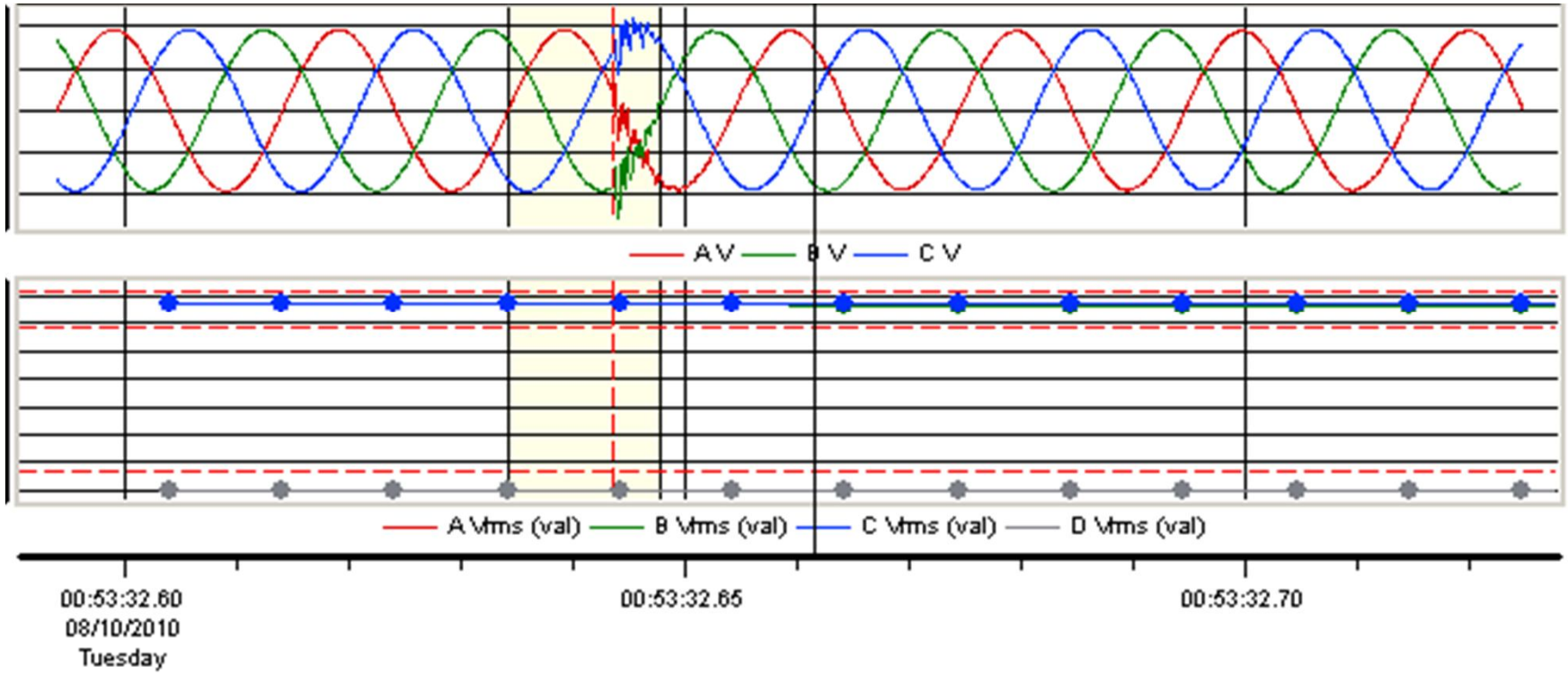


Multiple Zero Crossing



Event #19096 at 08/11/2010 13:38:24.746
AV Mult Z Cr

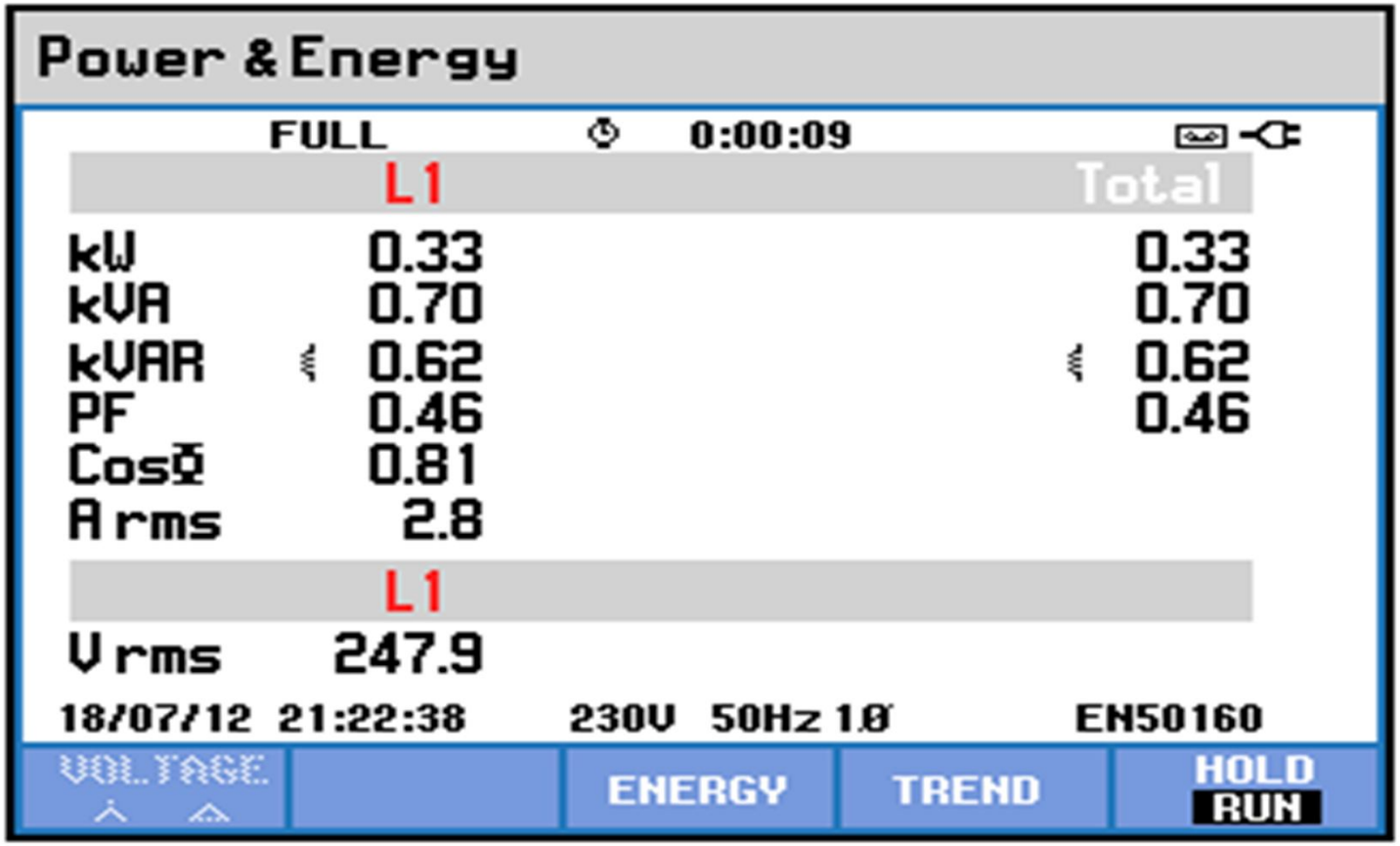
Phase Shift Event



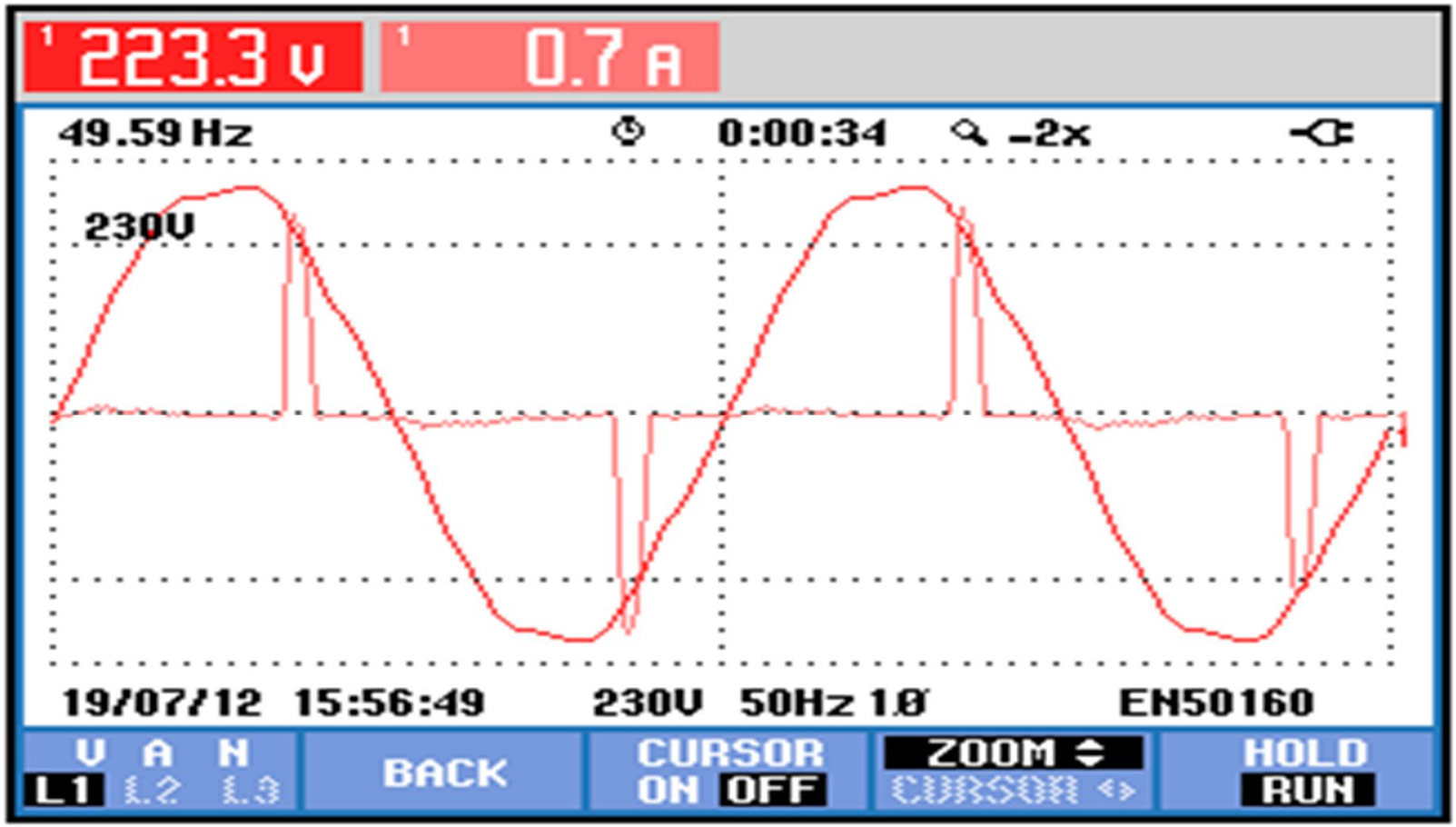
Event #9241 at 08/10/2010 00:53:32.634
BV Mild Phase Shift Neg 1/8 Cyc

	A	B	C	D	A-B	B-C	C-A
Vrms	67363	67398	67360	21.07	116145	116785	116633
VPeak	95629	127450	106794	30.73			
Irms	97.00	102.5	89.45	0.09468			
IPeak	251.8	195.6	167.6	0.1865			

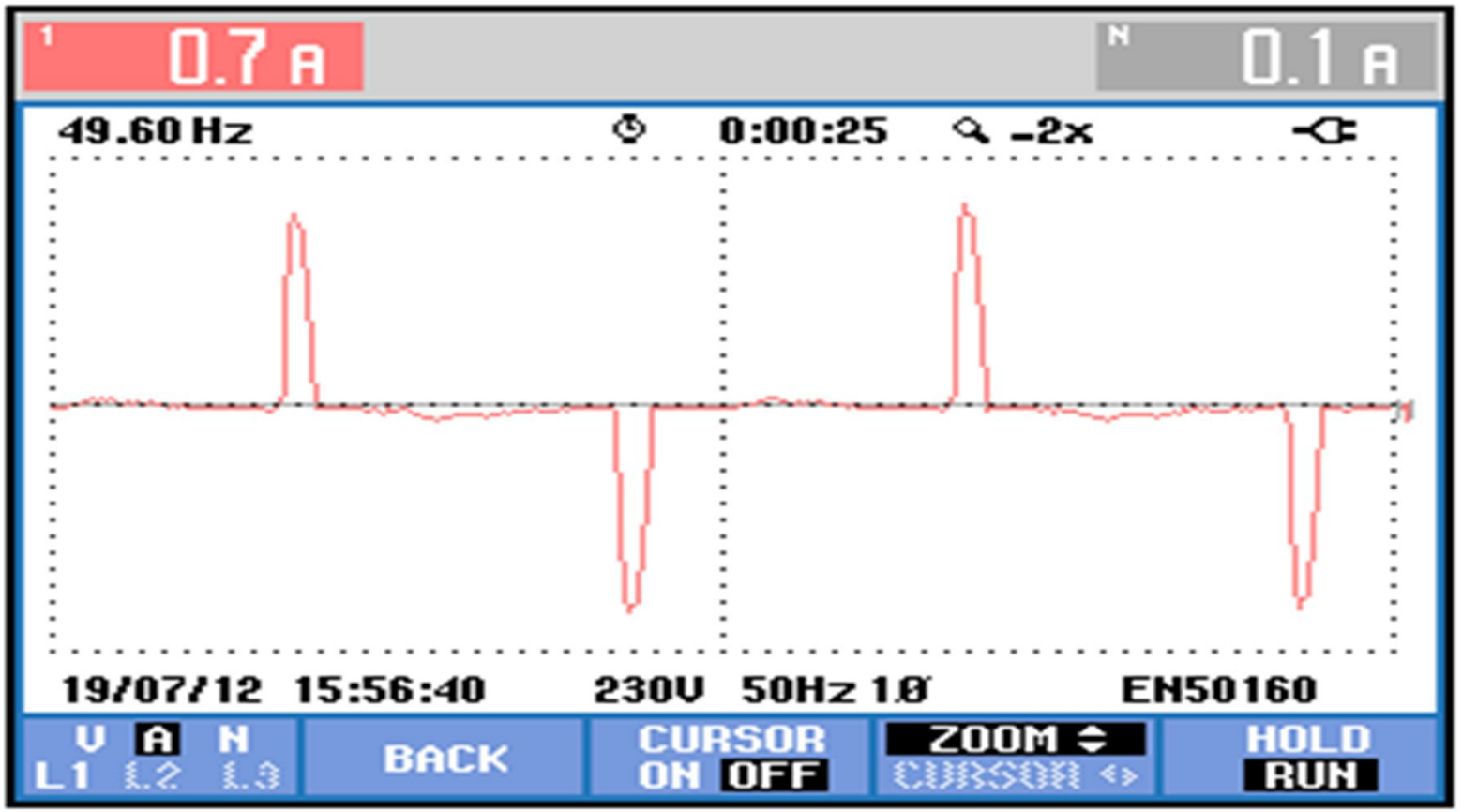
Case Study on UPS



Case Study on UPS

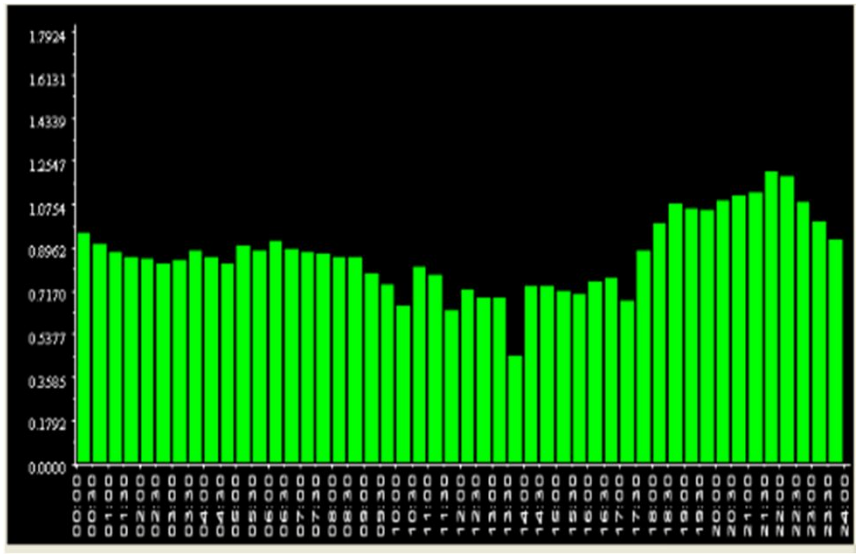


Case Study on UPS

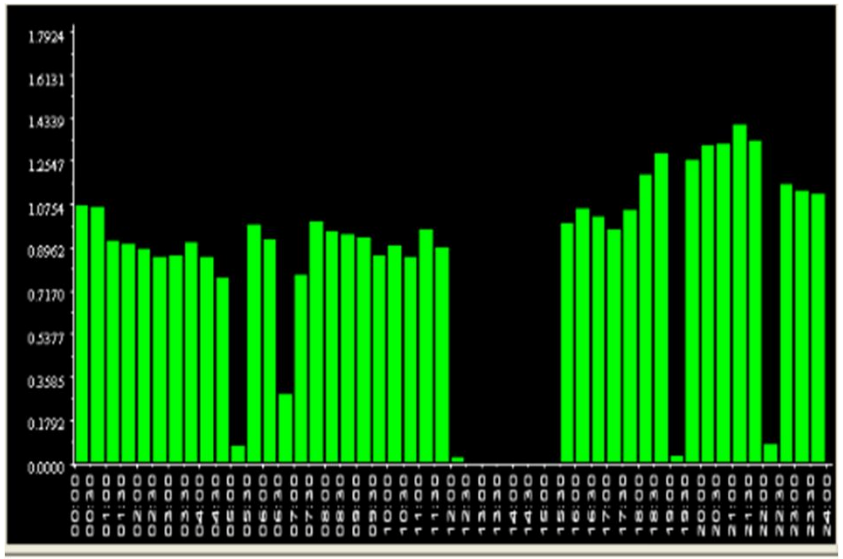


Comparison of LS Graph

Without Interruption

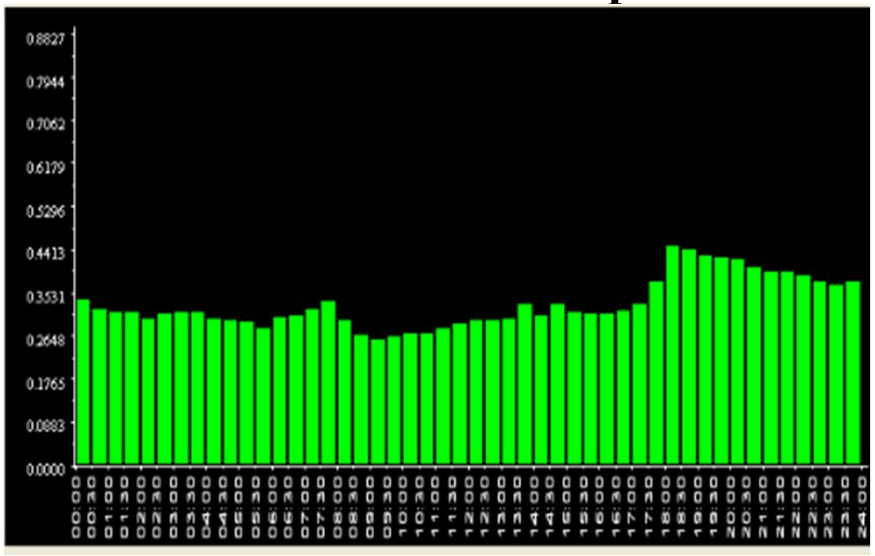


With Interruption

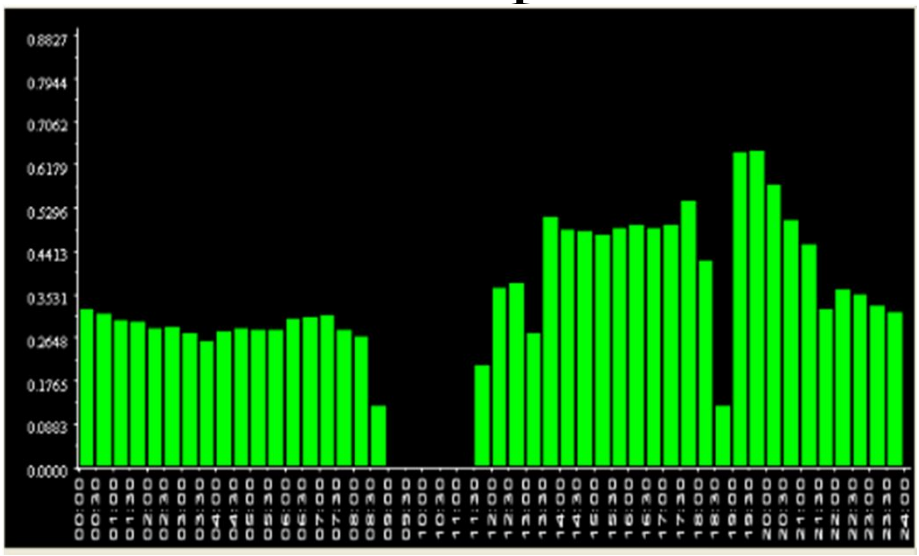


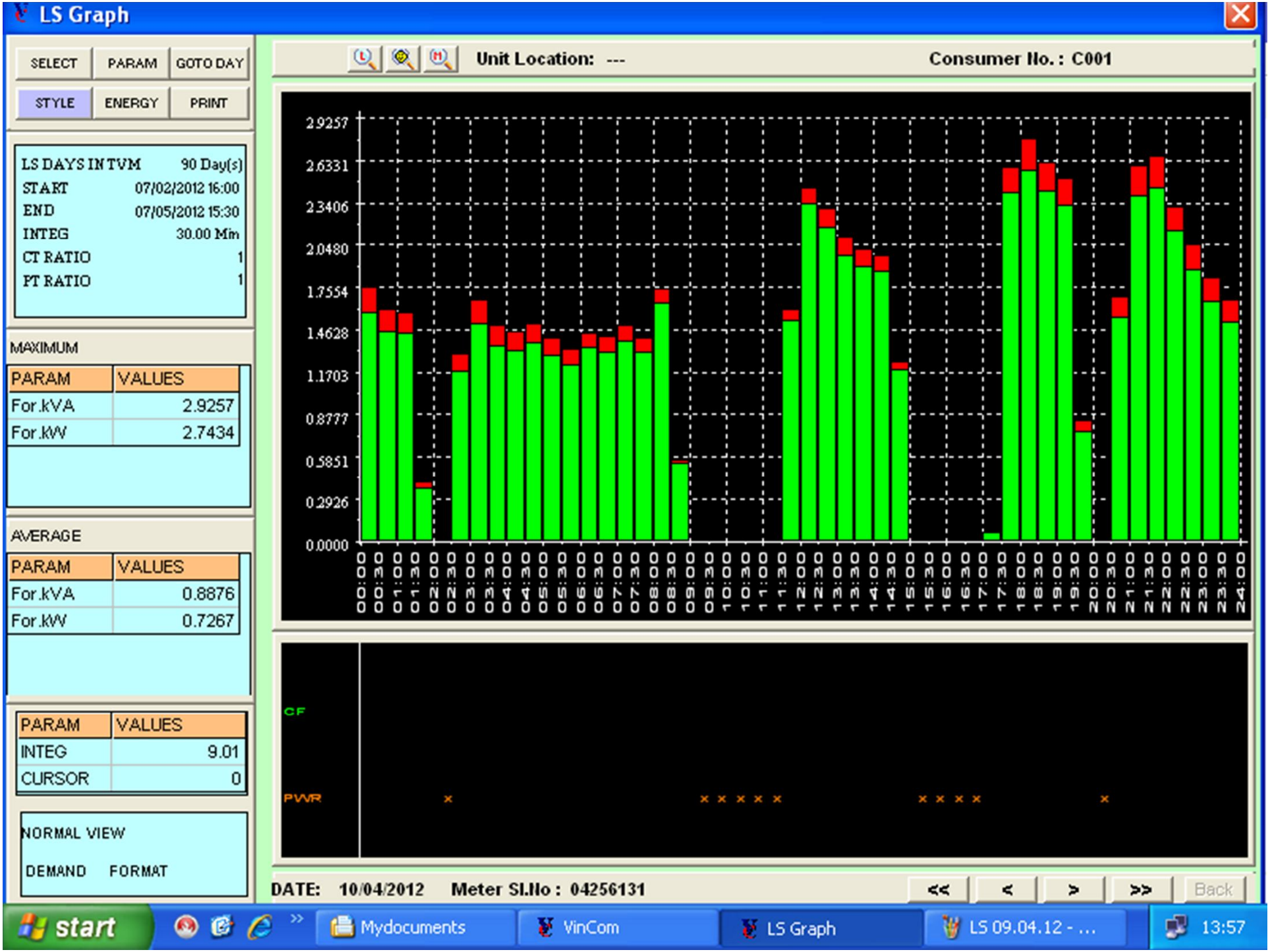
Comparison of LS Graph

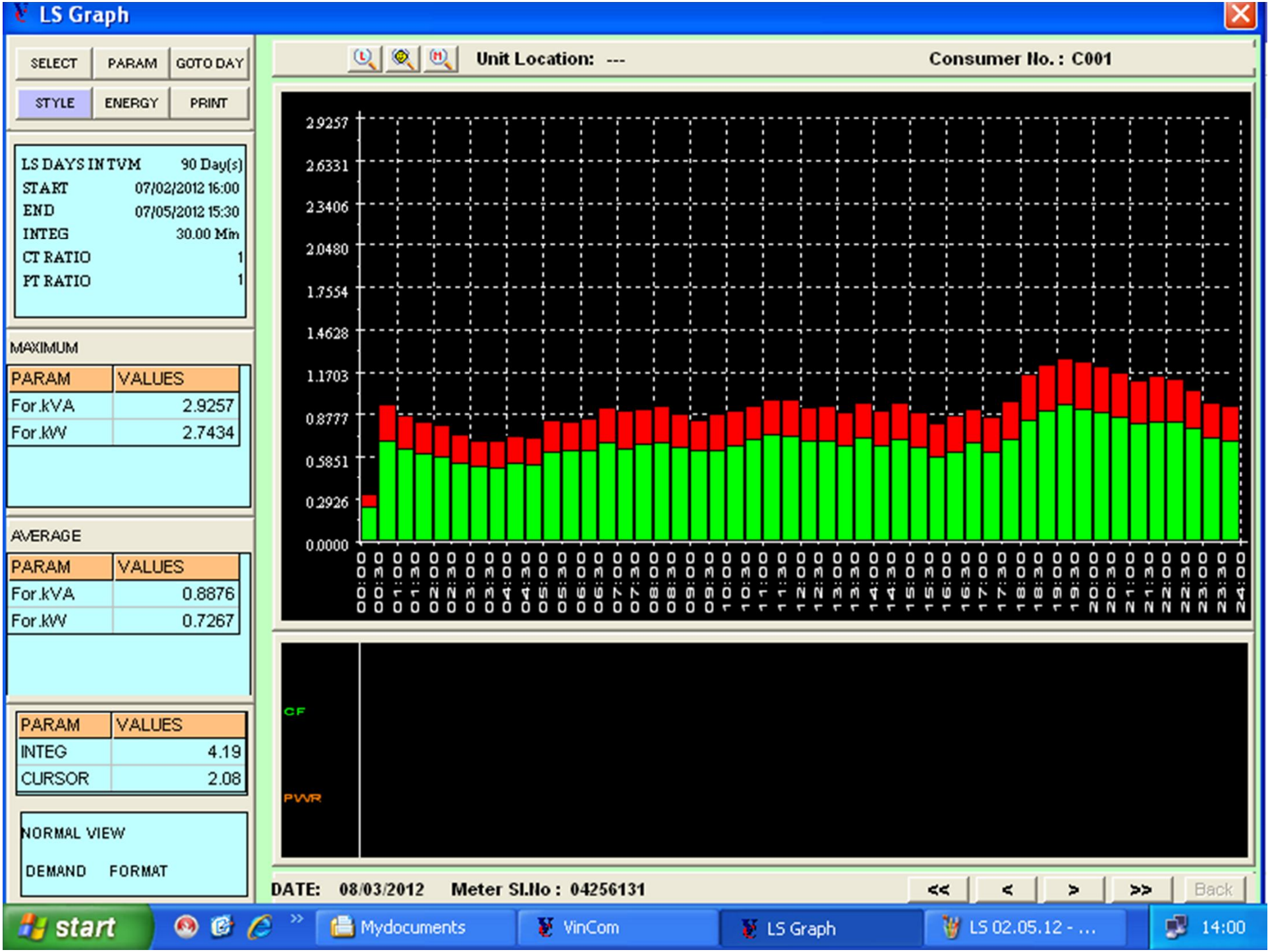
Without Interruption



With Interruption




LS Graph
SELECT
PARAM
GOTO DAY
STYLE
ENERGY
PRINT
LS DAYS IN TVM 90 Day(s)
START 07/02/2012 16:00
END 07/05/2012 15:30
INTEG 30.00 Min
CT RATIO 1
PT RATIO 1
MAXIMUM
PARAM VALUES
For.kVA 2.9257
For.kW 2.7434
AVERAGE
PARAM VALUES
For.kVA 0.8876
For.kW 0.7267
PARAM VALUES
INTEG 9.01
CURSOR 0
NORMAL VIEW
DEMAND FORMAT
Unit Location: ---
Consumer No. : C001
2.9257
2.6331
2.3406
2.0480
1.7554
1.4628
1.1703
0.8777
0.5851
0.2926
0.0000
CF
PWR
DATE: 10/04/2012
Meter Sl.No : 04256131
<<
<
>
>>
Back
start
Mydocuments
VinCom
LS Graph
LS 09.04.12 - ...
13:57


LS Graph
SELECT
PARAM
GOTO DAY
STYLE
ENERGY
PRINT
Unit Location: ---
Consumer No. : C001
LS DAYS IN TVM 90 Day(s)
START 07/02/2012 16:00
END 07/05/2012 15:30
INTEG 30.00 Min
CT RATIO 1
PT RATIO 1
MAXIMUM
PARAM VALUES
For.kVA 2.9257
For.kW 2.7434
AVERAGE
PARAM VALUES
For.kVA 0.8876
For.kW 0.7267
PARAM VALUES
INTEG 4.19
CURSOR 2.08
NORMAL VIEW
DEMAND FORMAT
2.9257
2.6331
2.3406
2.0480
1.7554
1.4628
1.1703
0.8777
0.5851
0.2926
0.0000
CF
PWR
DATE: 08/03/2012 Meter Sl.No : 04256131
<<
<
>
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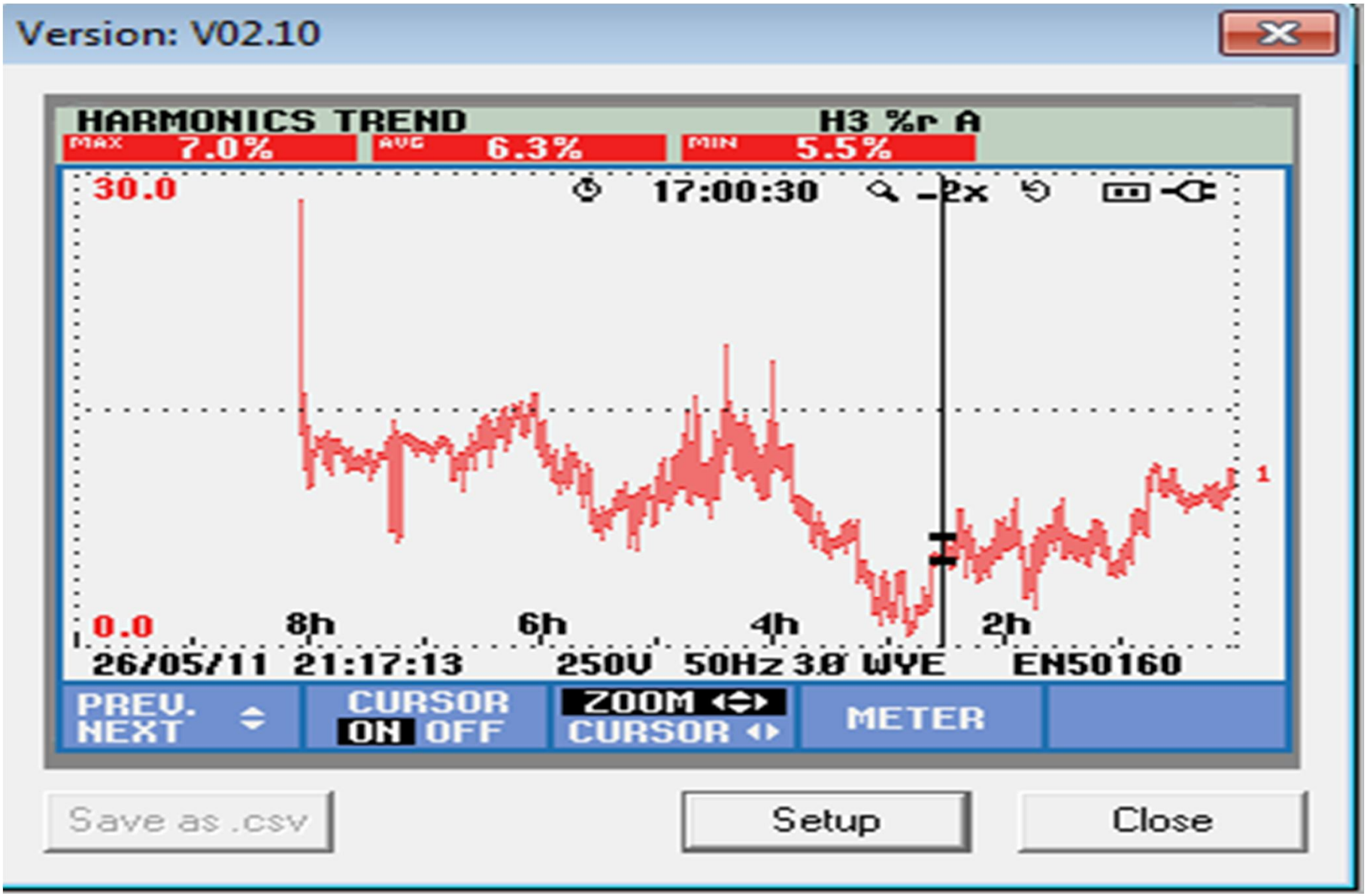
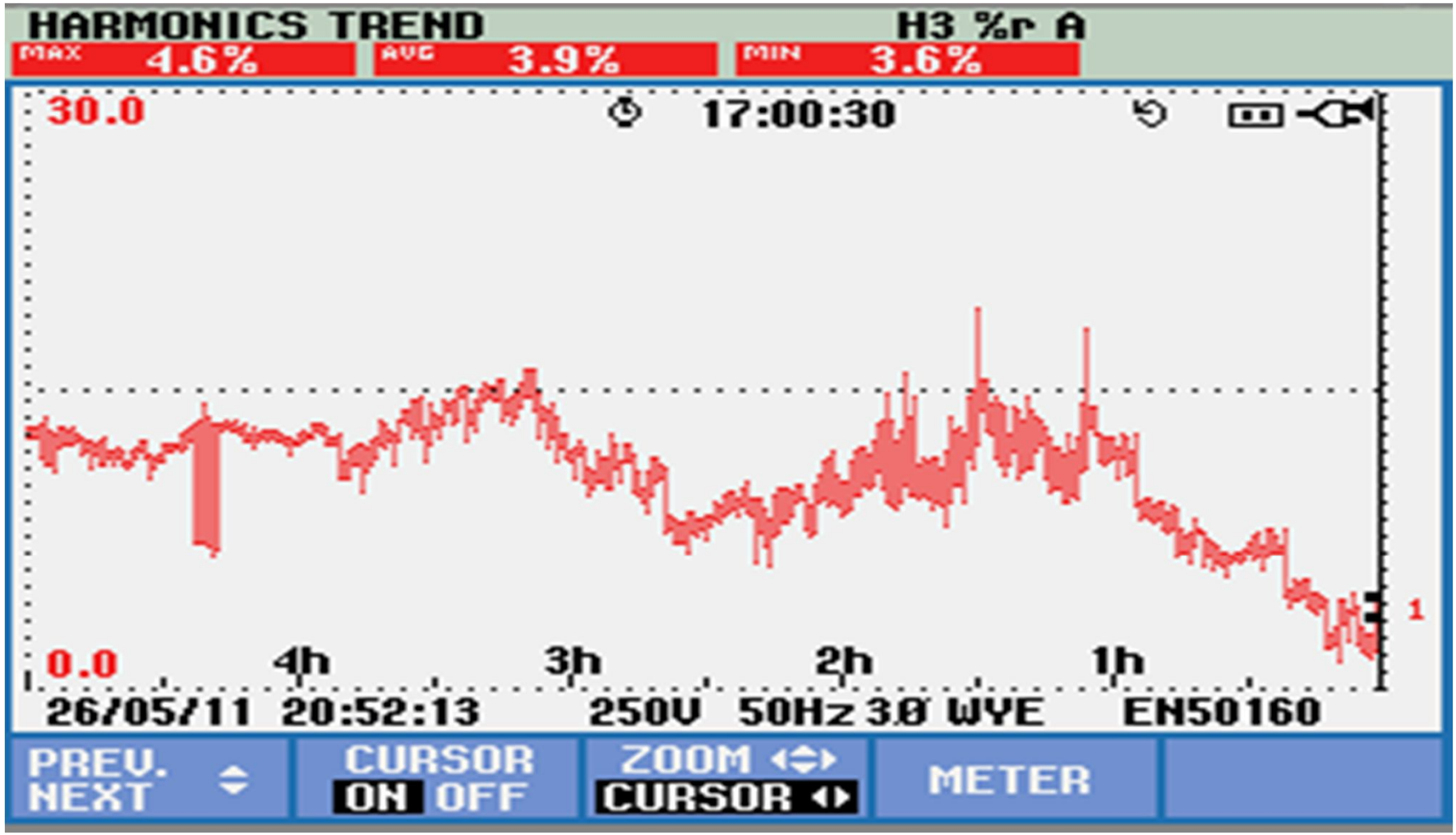
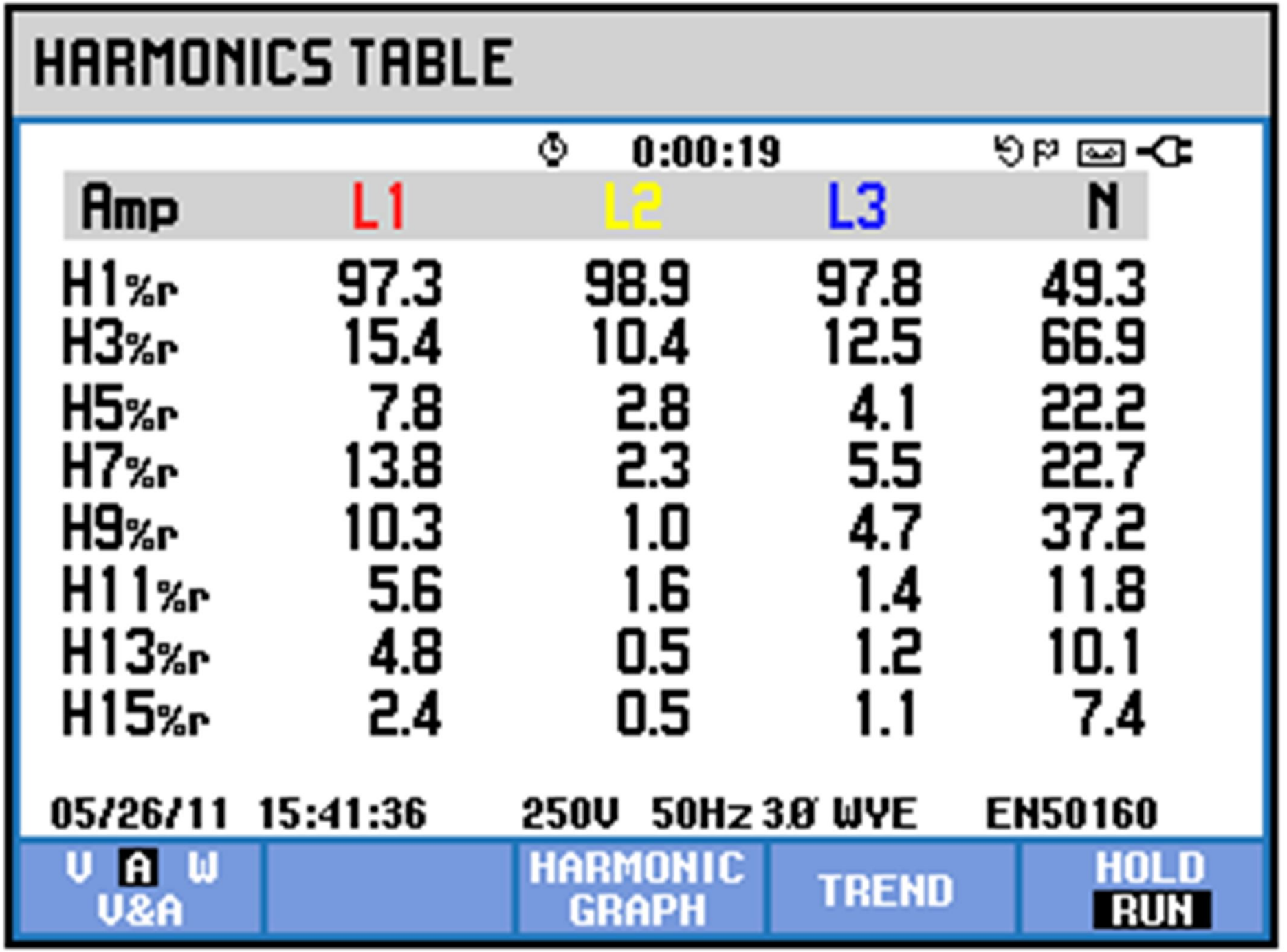
Back
start
Mydocuments
VinCom
LS Graph
LS 02.05.12 - ...
14:00

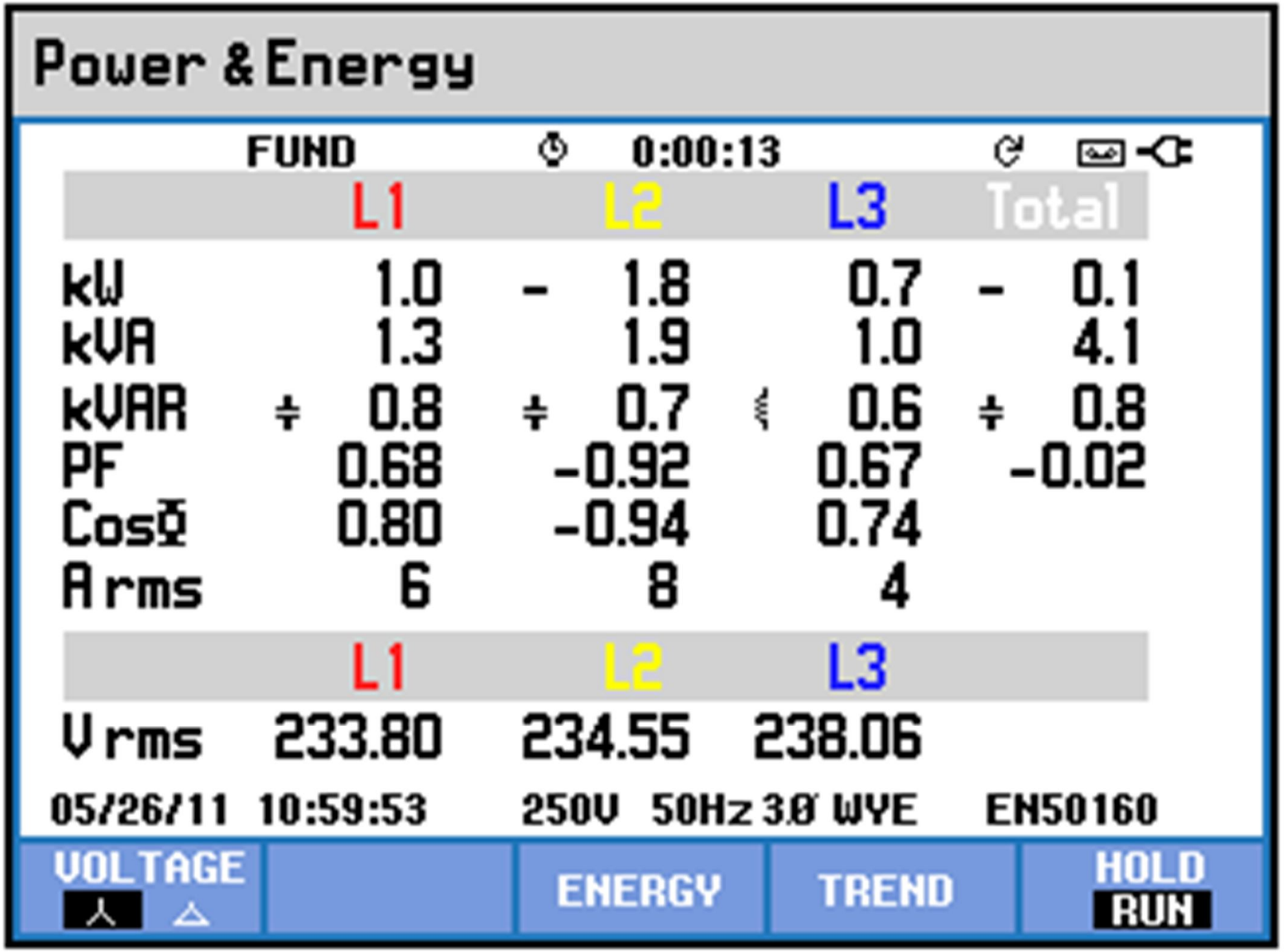
Harmonic Trend

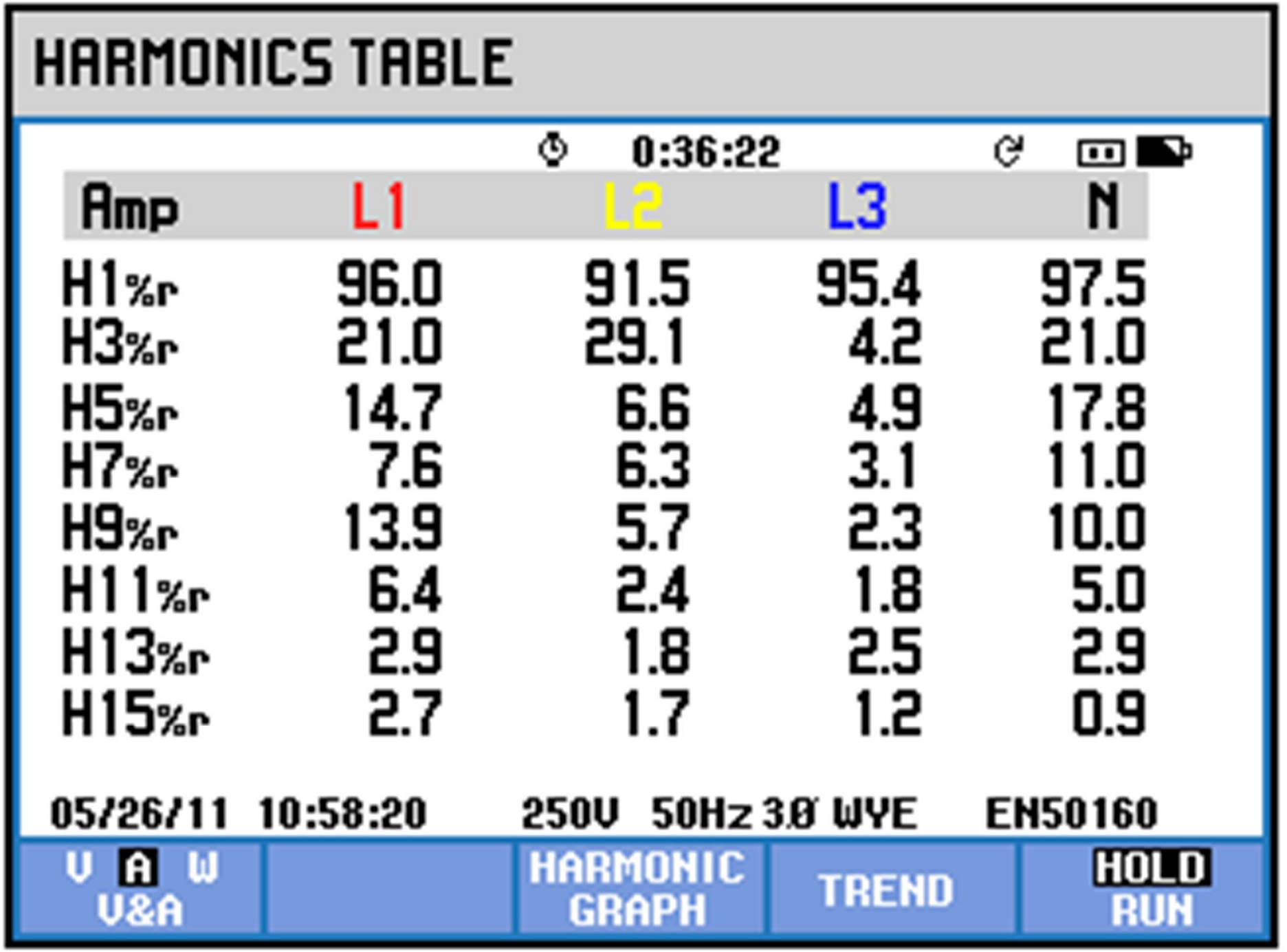


Harmonic Trend in Domestic Complex




HARMONICS TABLE
0:00:19
Amp L1 L2 L3 N
H1%r 97.3 98.9 97.8 49.3
H3%r 15.4 10.4 12.5 66.9
H5%r 7.8 2.8 4.1 22.2
H7%r 13.8 2.3 5.5 22.7
H9%r 10.3 1.0 4.7 37.2
H11%r 5.6 1.6 1.4 11.8
H13%r 4.8 0.5 1.2 10.1
H15%r 2.4 0.5 1.1 7.4
05/26/11 15:41:36
250V 50Hz 3Ø WYE
EN50160
V A W
V&A
HARMONIC GRAPH
TREND
HOLD
RUN


Power & Energy
FUND
0:00:13
L1
L2
L3
Total
kW
1.0
-
1.8
0.7
-
0.1
kVA
1.3
1.9
1.0
4.1
kVAR
0.8
0.7
0.6
0.8
PF
0.68
-0.92
0.67
-0.02
Cosφ
0.80
-0.94
0.74
A rms
6
8
4
L1
L2
L3
V rms
233.80
234.55
238.06
05/26/11 10:59:53
250V 50Hz 3Ø WYE
EN50160
VOLTAGE
ENERGY
TREND
HOLD
RUN

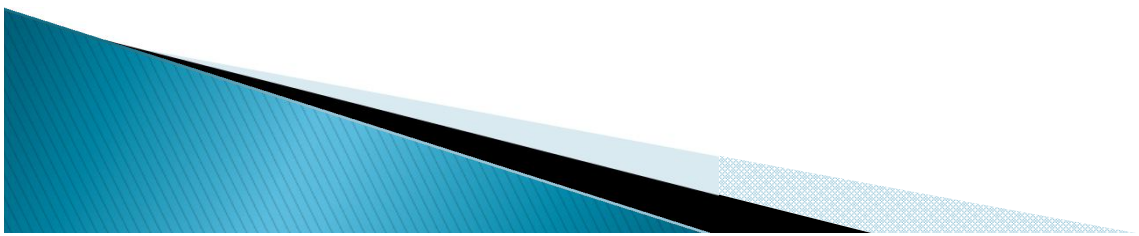

HARMONICS TABLE
0:36:22
Amp L1 L2 L3 N
H1%r 96.0 91.5 95.4 97.5
H3%r 21.0 29.1 4.2 21.0
H5%r 14.7 6.6 4.9 17.8
H7%r 7.6 6.3 3.1 11.0
H9%r 13.9 5.7 2.3 10.0
H11%r 6.4 2.4 1.8 5.0
H13%r 2.9 1.8 2.5 2.9
H15%r 2.7 1.7 1.2 0.9
05/26/11 10:58:20 250V 50Hz 3Ø WYE EN50160
V A W
V&A
HARMONIC GRAPH
TREND
HOLD
RUN

EFFECTS OF HARMONICS ON TRANSFORMERS

- Harmonics can affect transformers primarily in two ways CORE LOSSES OF TRANSFORMER: voltage harmonics produce additional losses in the transformer core as the higher frequency harmonic voltages setup hysteresis loops, which superimpose on the fundamental loop.
- Each loop represents higher magnetization power requirements and higher core losses. Increasing the voltage distortion may increase the eddy currents in the core laminations.
- These losses depend on the core lamination and the quality of the core steel. A second and a more serious effect of harmonics is due to harmonic frequency currents in the transformer windings

EFFECTS OF HARMONICS ON TRANSFORMERS

- The harmonic currents increase the net RMS current flowing in the transformer windings which results in additional I^2R losses (conductor losses).
- Winding eddy current losses are also increased. Eddy-current losses are induced currents in a transformer caused by the magnetic fluxes.
- These induced currents flow in the windings in the core, and in other conducting bodies subjected to the magnetic field of transformers and cause additional heating.

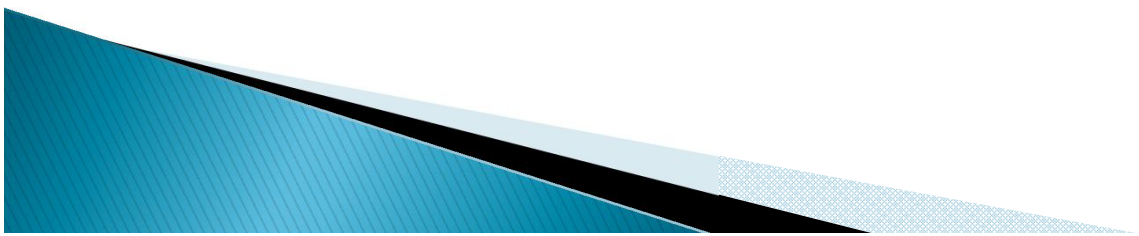


DERATING OF TRANSFORMERS AND “K” FACTOR:

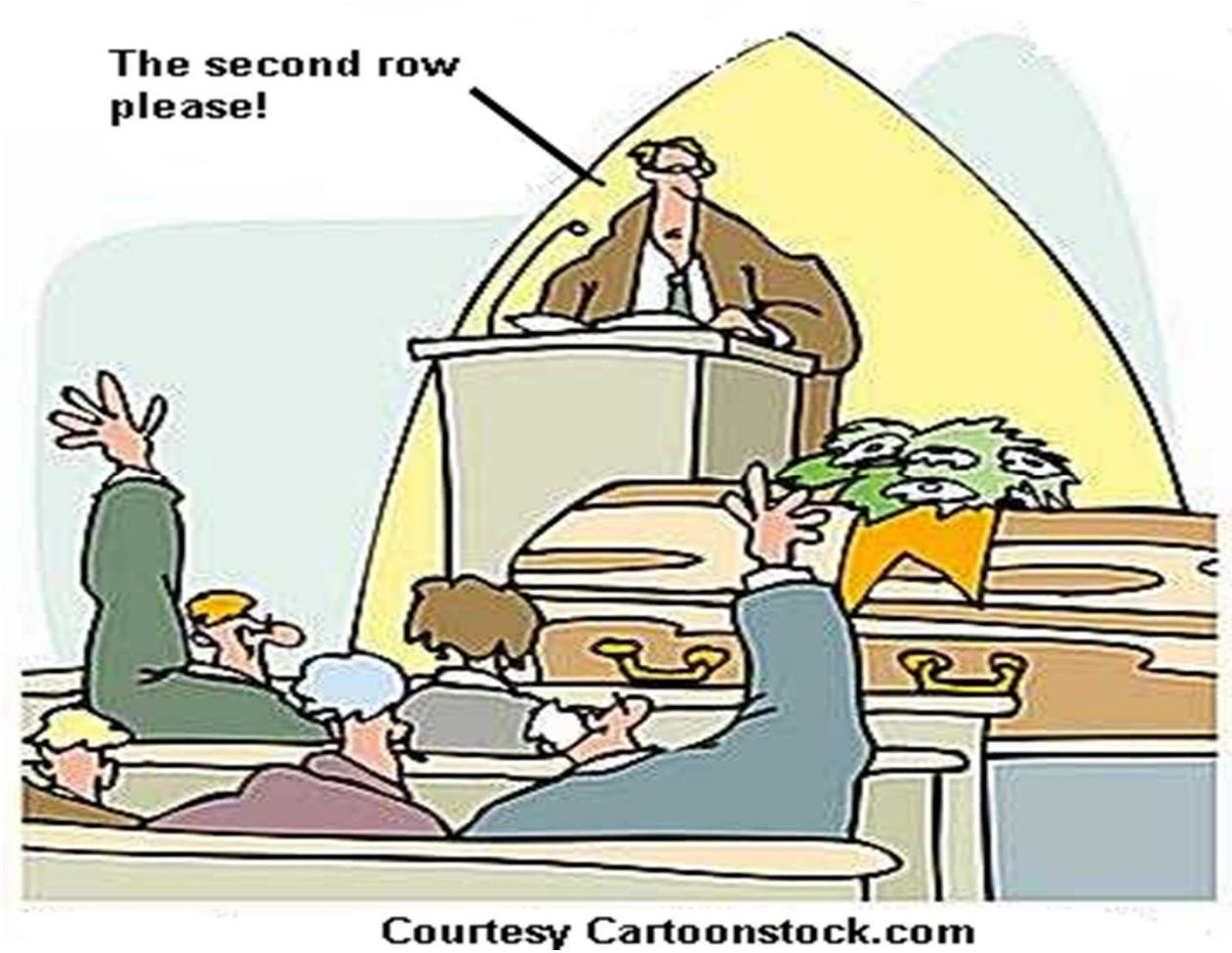
- Transformers that are required to supply large non-linear loads must be derated to handle the harmonics. This derating factor is based on the percentage of the harmonic currents in the load and the rated winding eddy current losses.
- Two recommended methods have been proposed for derating transformer Kilovolt ampere ratings to accommodate harmonic loading.
- One is the COMPUTER AND BUSINESS EQUIPMENT “MANUFACTURER METHOD” [CBEMA-METHOD] also called CREST FACTOR METHOD; and another is the IEEE. Method by which transformers may be rated for suitability to handle harmonic loads is by “K” factor rating

NEUTRAL BUS SIZE AND TRIPLEN HORMONICS:

- THE TRANSFORMER THAT SUPPLY LARGE TRIPLEN HARMONICS GENERATING LOADS SHOULD HAVE TO THE NEUTRALS OVER SIZED.
- THIS IS BECAUSE, THE THIRD HARMONIC CURRENTS OF THE THREE PHASES ARE IN PHASE AND THERFORE TEND TO ADD IN THE NEUTRAL CIRCUIT.
- IN THEORY, THE NEUTRAL CURRENT CAN BE AS HIGH AS 173% OF THE PHASE CURRENTS.
- TRANSFORMERS FOR SUCH APPLICATIONS SHOULD HAVE A NEUTRAL BUS THAT IS TWICE AS LARGE AS THE PHASE BUS.



Questions Please



Thanks for the opportunity