

The Harmonic Load of Various Technologies lamps vs Traditional Lamps

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Overview

- The objective of this experiment.
- Harmonics
- Sources of harmonics.
- The lamps under consideration.
- Testing for each type of lamp.
- Conclusion

The objective of this experiment.

- To investigate the characteristic of lamps.
- To compare the distortion of different technologies energy saving lamps with traditional lamps.

Harmonics

- **Harmonic:** A sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency.
- **Total Harmonic Distortion (THD):** The ratio of the root-mean-square of the harmonics content to the root-mean-square value of the fundamental quantity, express as a percent of the fundamental.

Sources of harmonics

- Adjustable speed drive.
- Electronic ballasts for fluorescent lighting.
- Switched-mode power supply in computer.
- Rectifiers.
- Electronic office machines.
- LED lighting.



The lamps under consideration

Five sample models of lamps available in the market obtained from four different manufacturer. The selected models are summarized in below table.

No.	Type of Lamp	Brand	Data Sheets		
			Current	Lumens	Watts
			(A)	(Lm)	(W)
1	Standard Incandescent	Philips	0.43	1380	100
2	Fluorescent	Toshiba	0.43	3250	36
3	Compact Fluorescent	Panasonic	0.06	520	8
4	LED Bulb	Toshiba	0.10	806	10.5
5	LED Bulb	GE	0.05	400	5

Remark :

- Item 1. Incandescent current from calculation.
- Item 2. FL spec. on the tube and excluded ballast.
- Items 3.-5. CF and LED bulbs spec. on the bulbs.

Measurement by

Standards Compliance

Power Quality

IEC 61000-4-30 Class A: Edition 2 (2008)

IEEE 1159: 2009

Power

IEEE 1459: 2000

Harmonics

IEC 61000-4-7 Class 1: Edition 2 (2008)

IEEE 519: 2014

Voltage Flicker

IEC 61000-4-15: Edition 2 (2010)

IEEE 1453: 2011

Compliance/Testing

EN 50160: 2010



Accuracy

Voltage :

+/-0.1% reading,
+/-0.05% FS.

Current :

+/-0.1% reading,
+/-0.05% FS.

+/- 0.2% of U_{din}

**DRANETZ HDPQ Visa
Monitor Mode: Standard Power Quality (IEC)**

AC Clamp On



PQ4LN2-01: 1A
600Vac, 50/60Hz, Class 85,
Output : 1500mV, +/-0.5% FS.

Testing for each type of lamp.

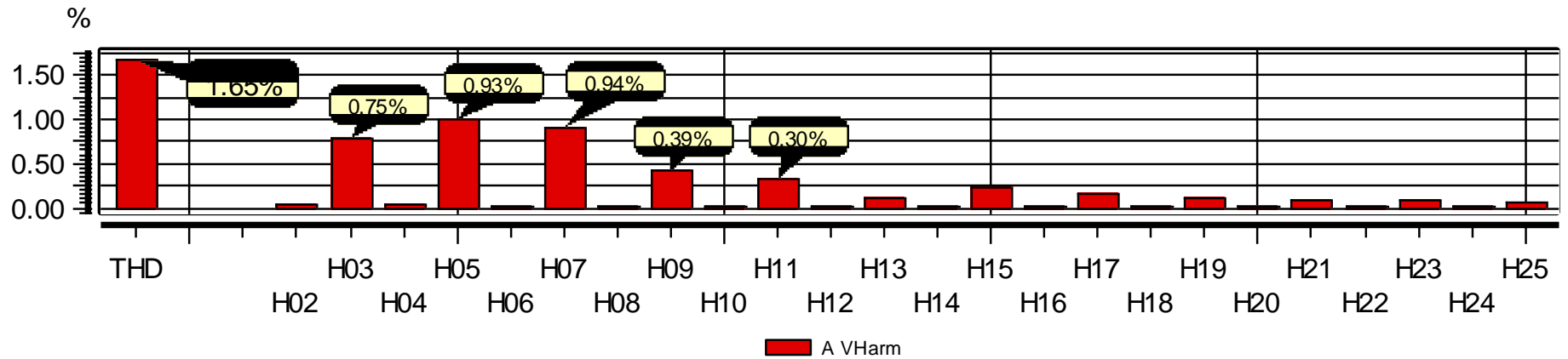
No.	Type of Lamp	Brand	Measured Values							
			Current	Voltage	Power Factor	Watt	Lumen	Efficacy	VTHD	ITHD
			(A)	(V)	(PF)	(W)	(Lm)	(Lm/W)	(%)	(%)
1	Incandescent	Philips	0.41	233	0.96	91.46	1,380	15.09	1.63	0.95
2	Fluorescent	Toshiba	0.82	229	0.70	131.76	3,250	24.67	1.50	8.39
3	Compact Fluorescent	Panasonic	0.05	231	0.61	7.35	520	70.75	1.65	79.45
4	LED 10.5W Bulb	Toshiba	0.07	231	0.61	9.78	806	82.41	1.61	91.34
5	LED 5W Bulb	GE	0.03	231	0.53	3.90	400	102.56	1.63	79.95

Remark :

- Items 3.-5. measured current by increased current 5 turns for more resolution.
- Item 2. Measured results of FL form 2 tubes including ballasts and different branch of circuit breaker.

Harmonic V Thd from electrical system

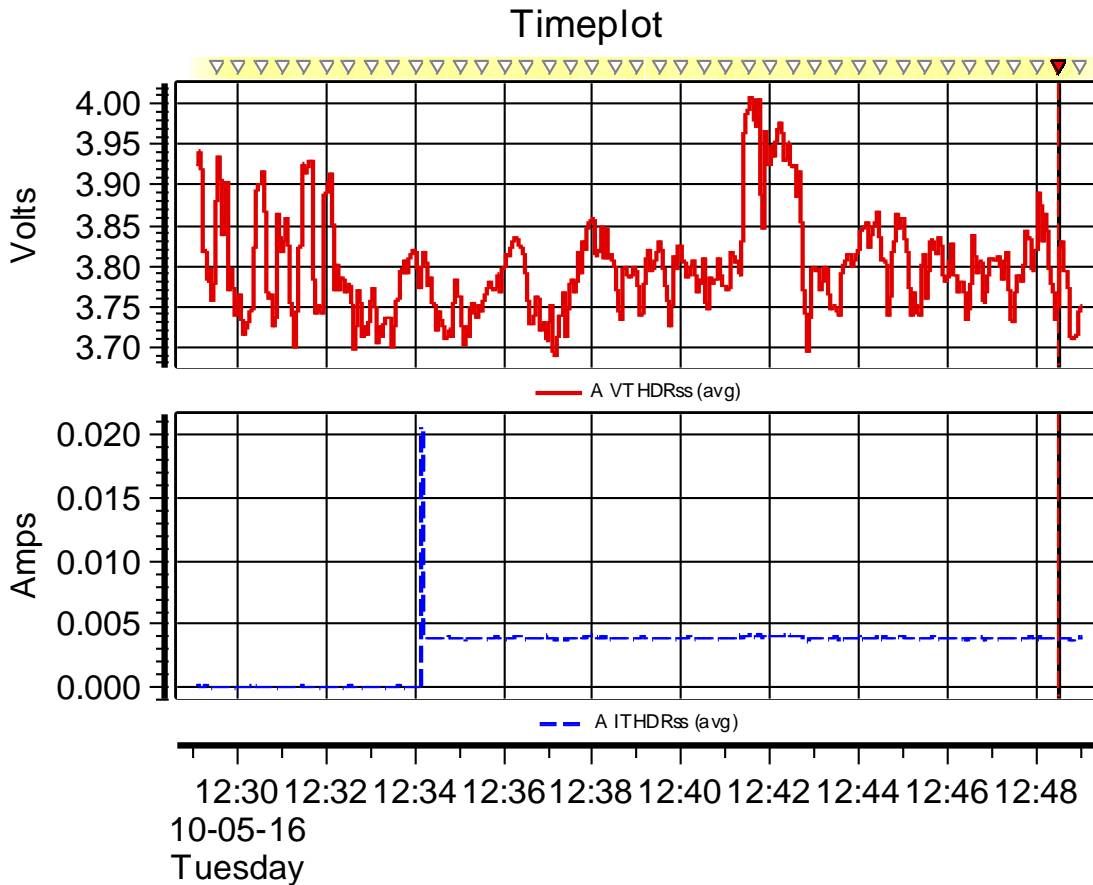
Waveform harmonics



1. Incandescent 100W (Philips) (Continue)



Harmonics trend of voltage and current



Voltage distortion does not change. VTHD has value about 1.63 % of FND because harmonic from electrical system. ITHD is 0.95 % of FND.

Event #39 at 10-05-16 12:48:29.801
Timed

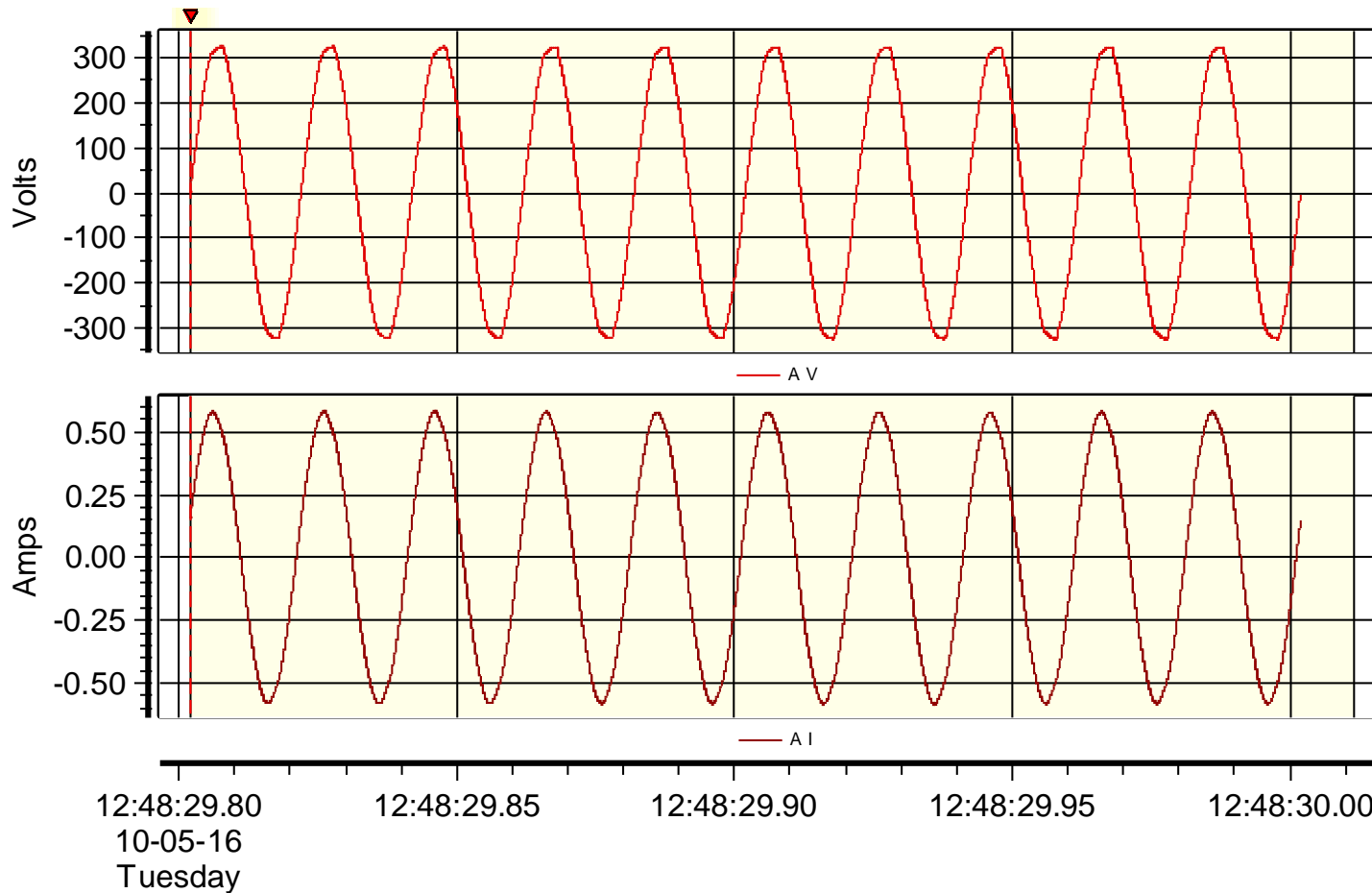
	Min	Max	Avg
AVTHDRss	3.689	4.008	3.800
AITHDRss	0.0000366	0.02056	0.002979

1. Incandescent 100W (Philips)



Voltage and current waveform

Event Details/Waveforms



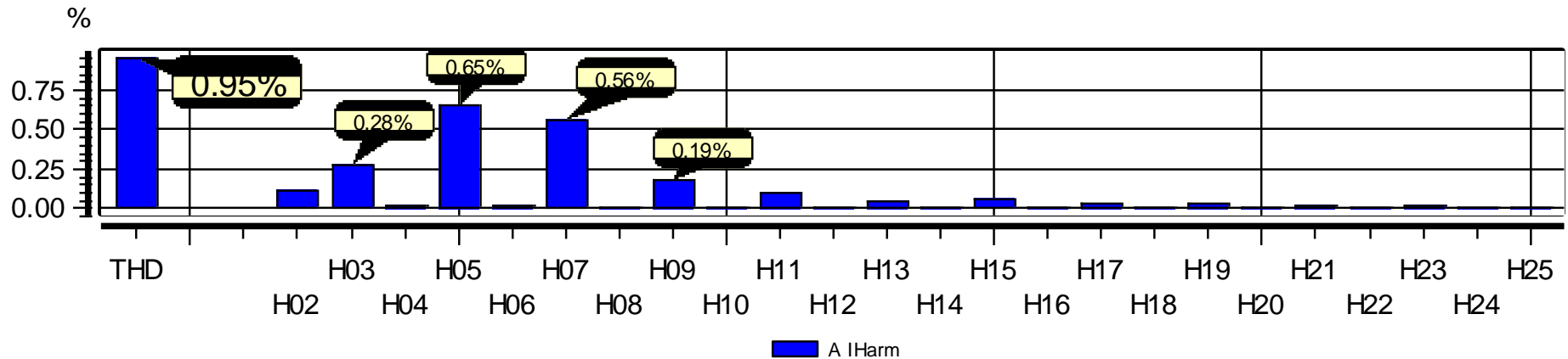
Event #39 at 10-05-16 12:48:29.801
Timed

1. Incandescent 100W (Philips) (Continue)

Harmonics distortion of current



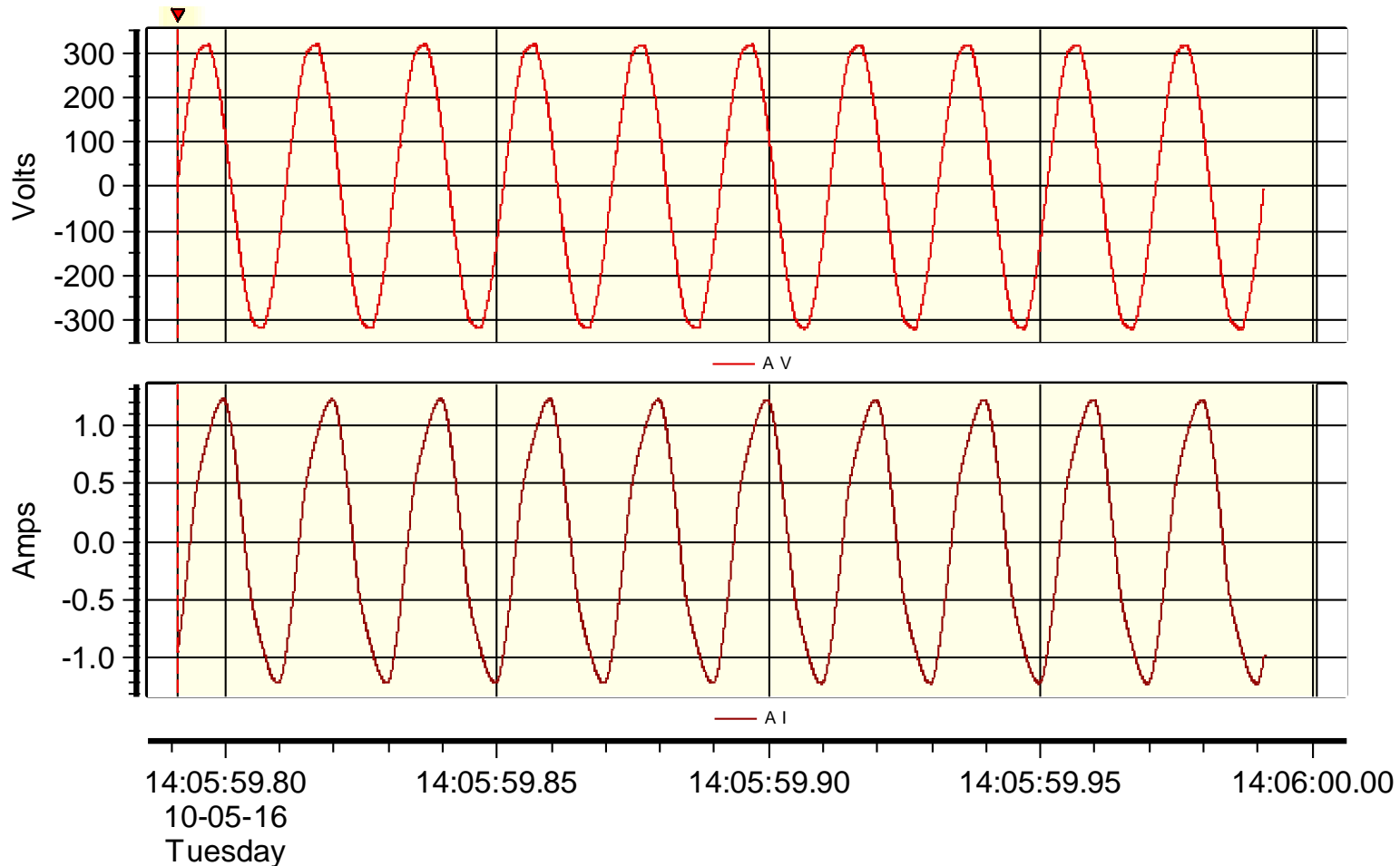
Waveform harmonics



2. Fluorescent 36W (Toshiba) Voltage and current waveforms



Event Details/Waveforms



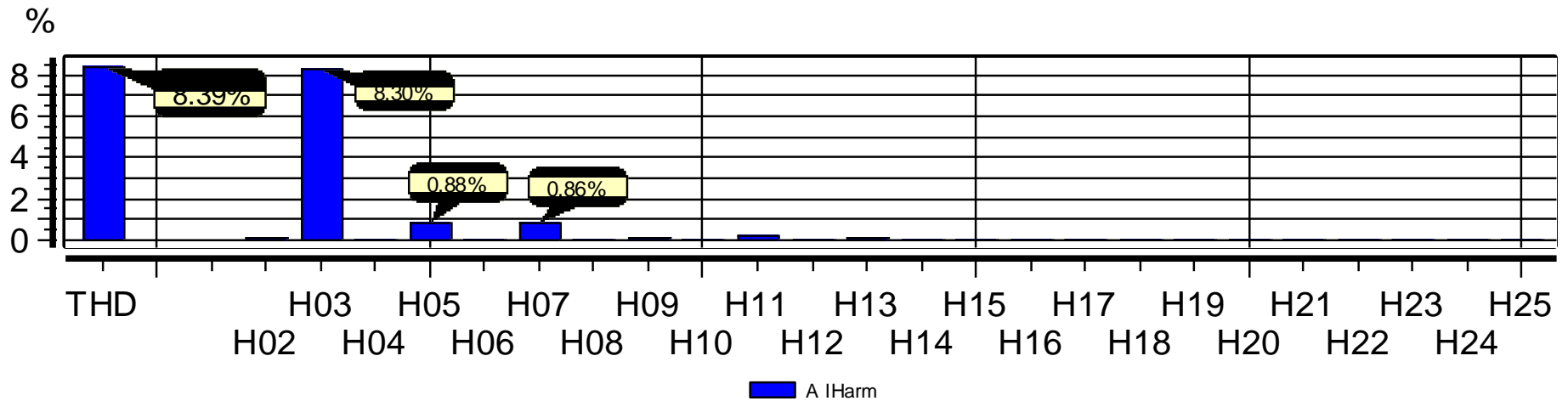
Event #39 at 10-05-16 14:05:59.791
Timed

2. Fluorescent 36W (Toshiba) (Continue)

Harmonics distortion of current



Waveform harmonics

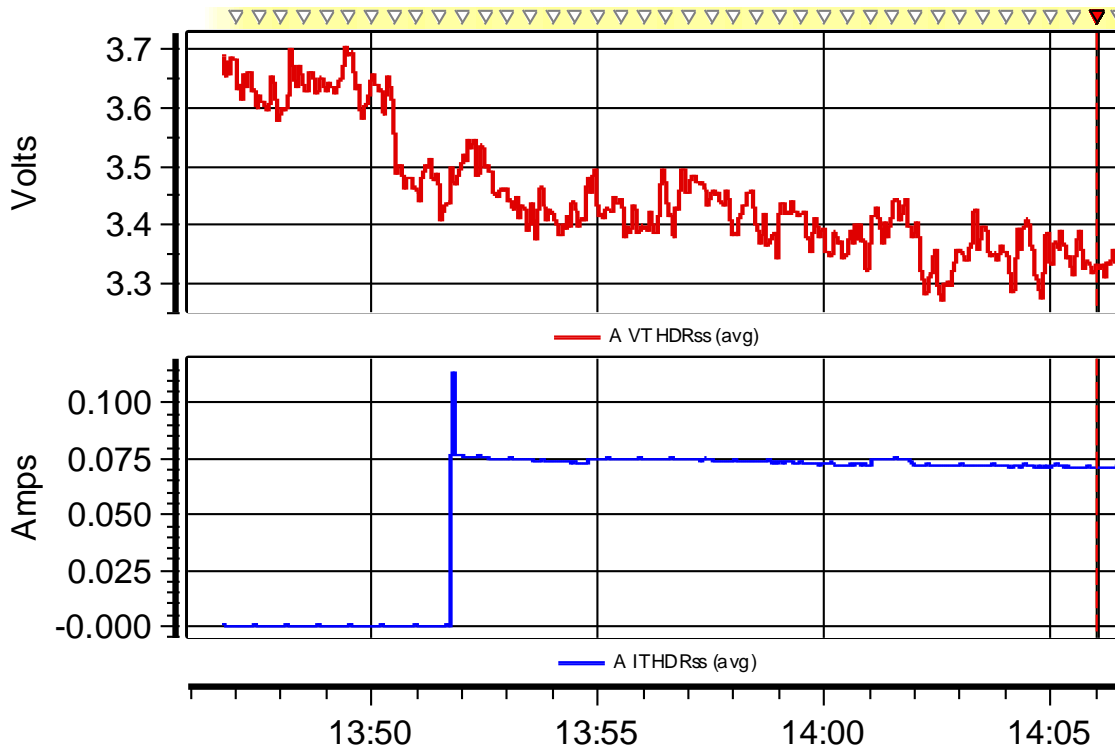


2. Fluorescent 36W (Toshiba) (Continue)

Harmonics trend of voltage and current



Timeplot



Event #39 at 10-05-16 14:05:59.791
Timed

	<i>Min</i>	<i>Max</i>	<i>Avg</i>
AVTHDRss	3.273	3.703	3.451
AITHDRss	0.0000462	0.1137	0.05477

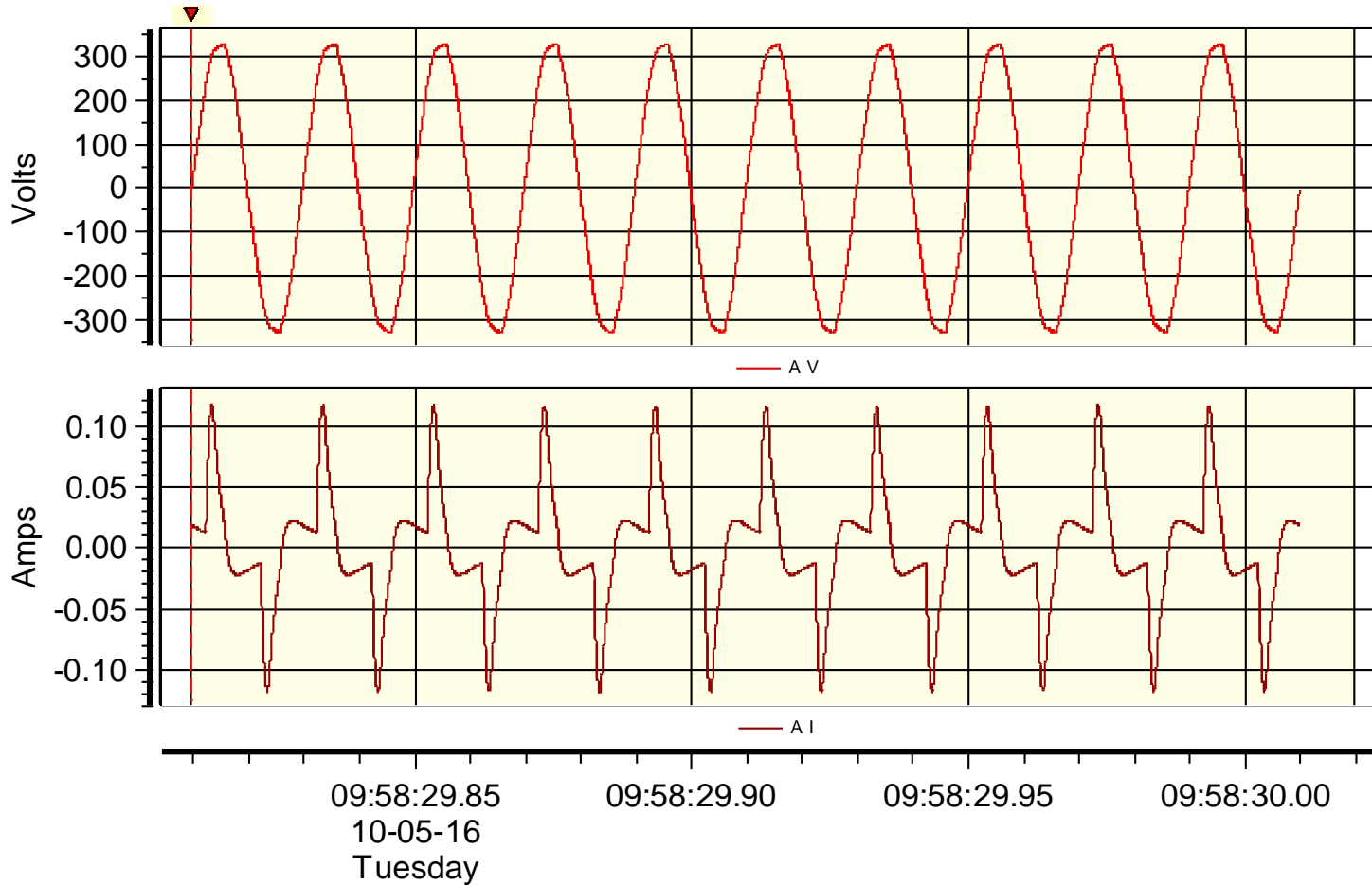
- Voltage distortion does not change. VTHD has value about 1.50 % of FND because harmonic from electrical system.
- ITHD is 8.39 % of FND.

3. Compact fluorescent 8W (Panasonic)



Voltage and current waveforms

Event Details/Waveforms



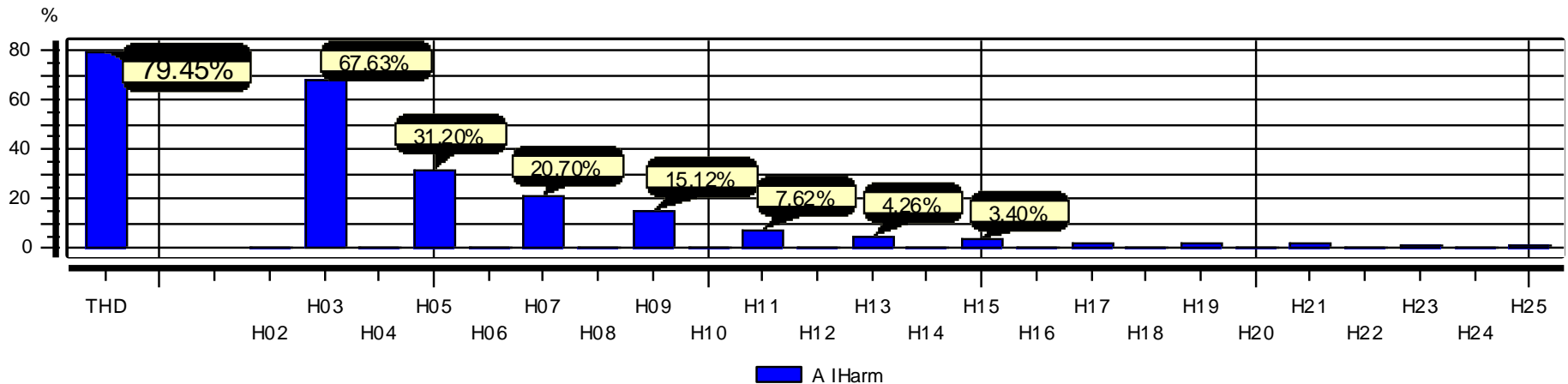
Event #39 at 10-05-16 09:58:29.809
Timed

3. Compact fluorescent 8W (Panasonic) (Continue)

Harmonics distortion of current



Waveform harmonics

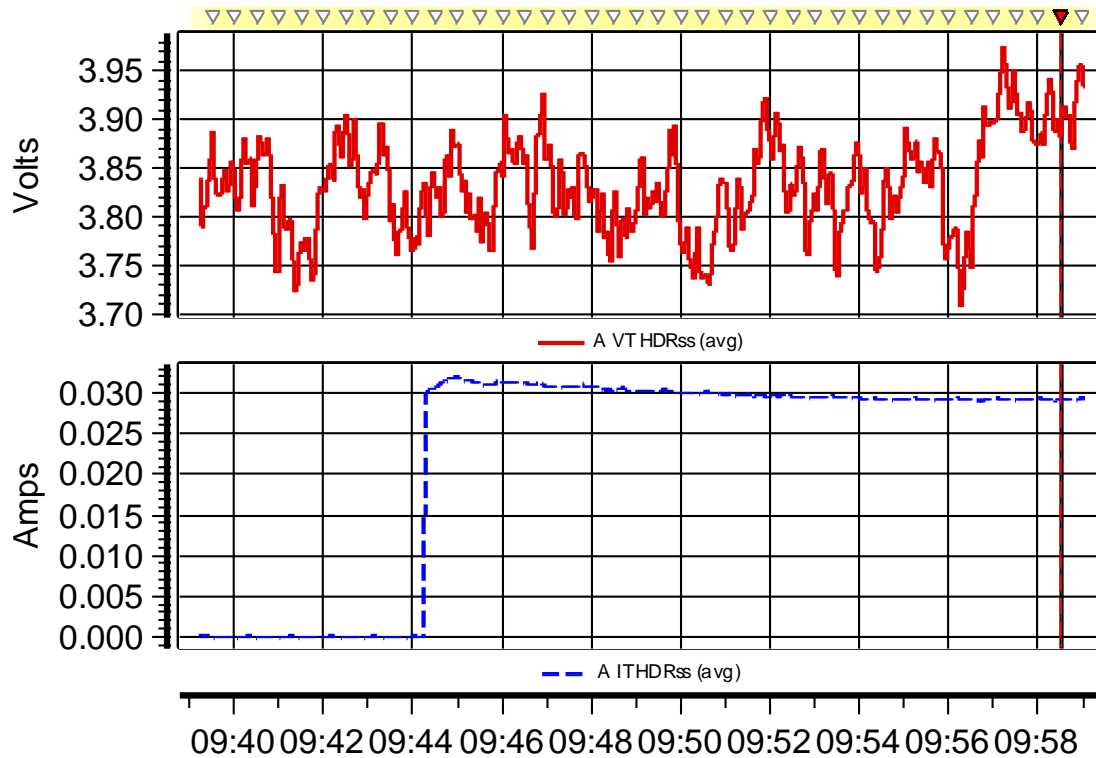


3. Compact fluorescent 8W (Panasonic) (Continue)



Harmonics trend of voltage and current

Timeplot



10-05-16
Tuesday

Event #39 at 10-05-16 09:58:29.809
Timed

	Min	Max	Avg
AVTHDRss	3.708	3.974	3.832
AITHDRss	0.00000696	0.03183	0.02236

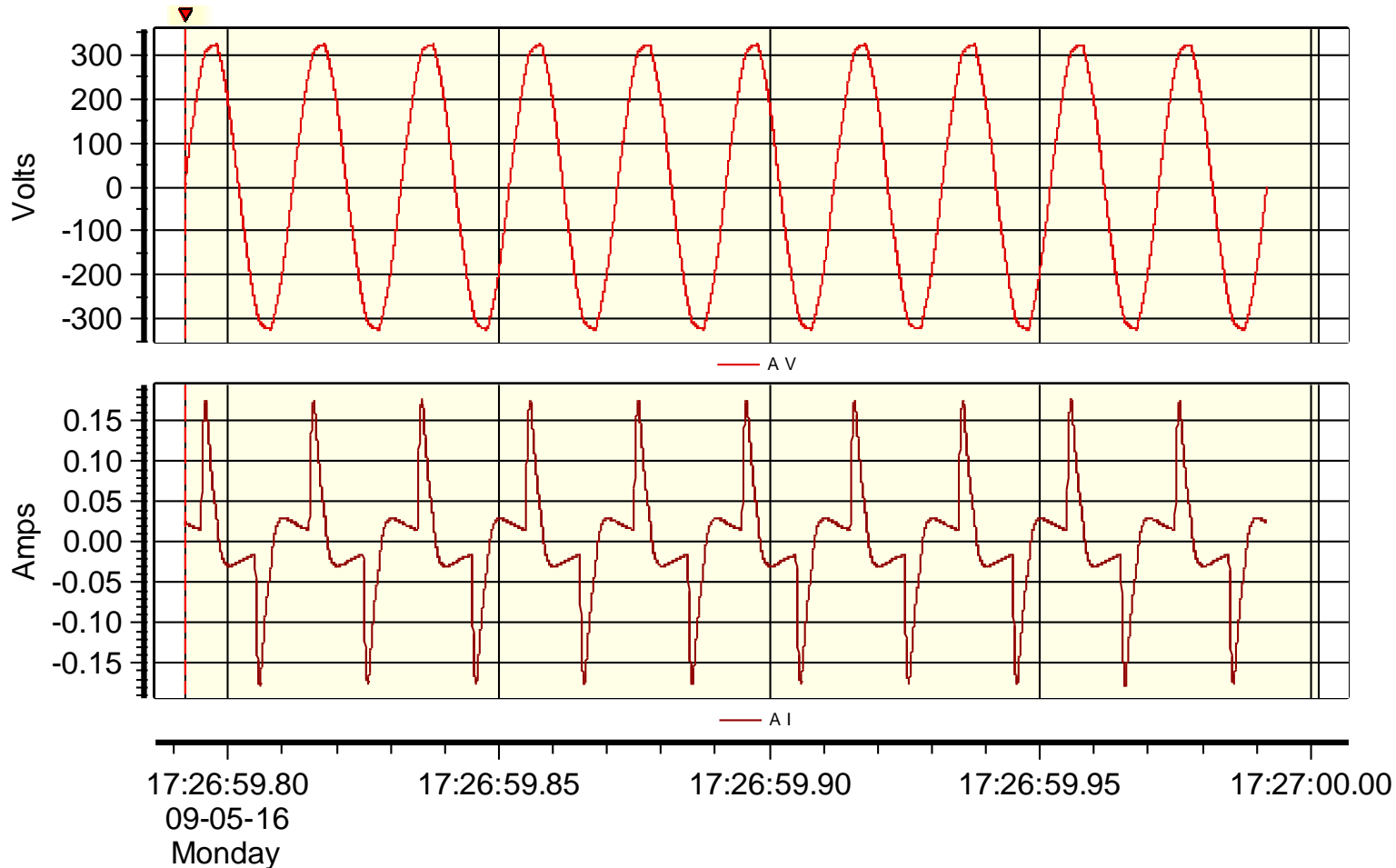
Voltage distortion does not change. VTHD has value about 1.65 % of FND because harmonic from electrical system.
ITHD is 79.45 % of FND.

4. LED Bulb 10.5W (Toshiba)



Voltage and current waveforms

Event Details/Waveforms



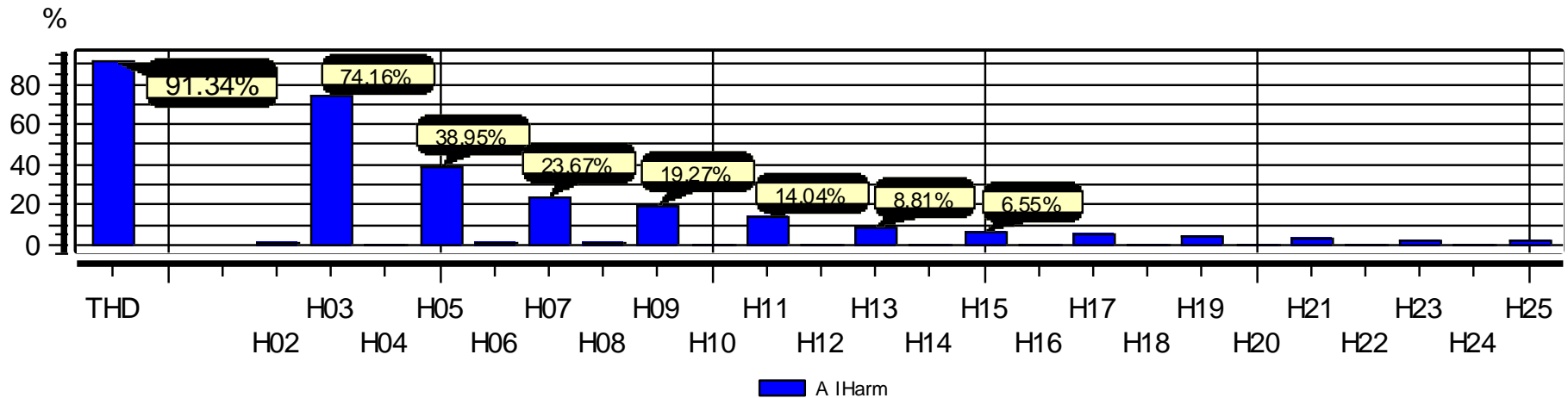
Event #39 at 09-05-16 17:26:59.791
Timed

4. LED Bulb 10.5W (Toshiba) (Continue)



Harmonics distortion of current

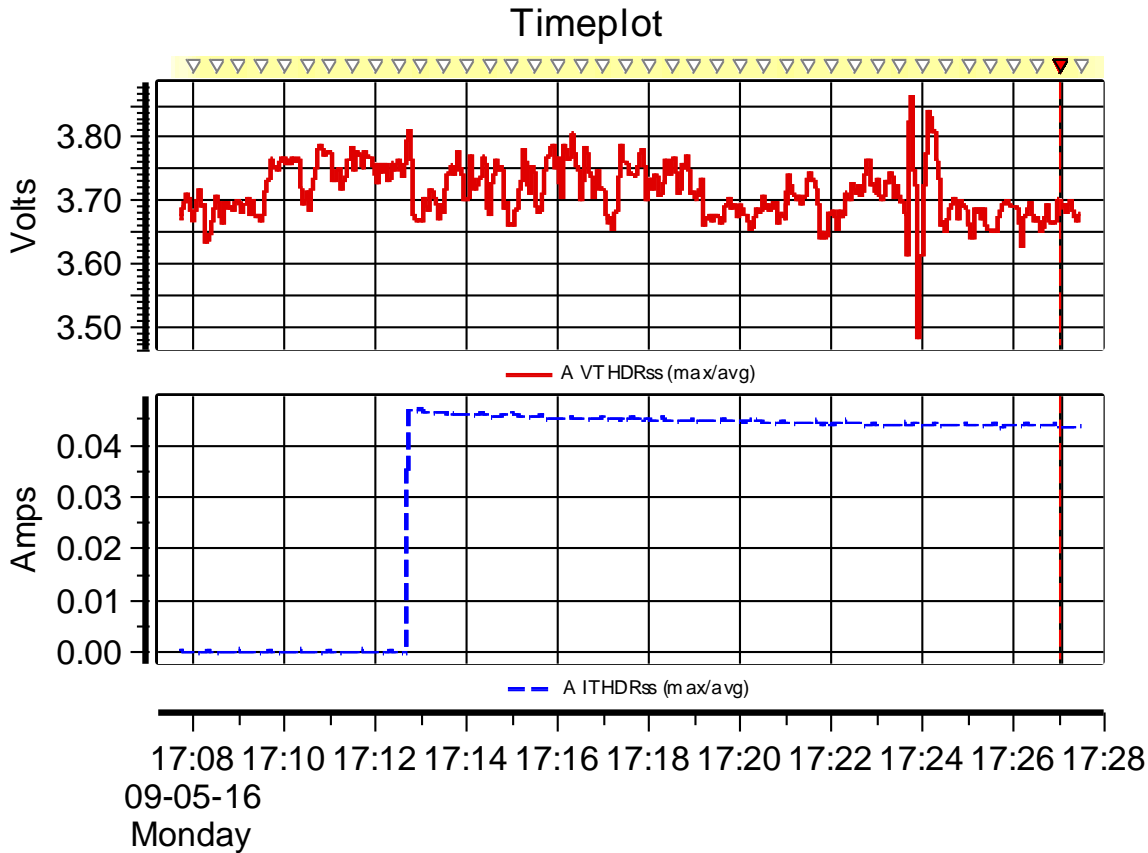
Waveform harmonics



4. LED Bulb 10.5W (Toshiba) (Continue)



Harmonics trend of voltage and current



Event #39 at 09-05-16 17:26:59.791
Timed

	<i>Min</i>	<i>Max</i>	<i>Avg</i>
AVTHDRss	3.481	3.866	3.713
AITHDRss	0.00000733	0.04693	0.03339

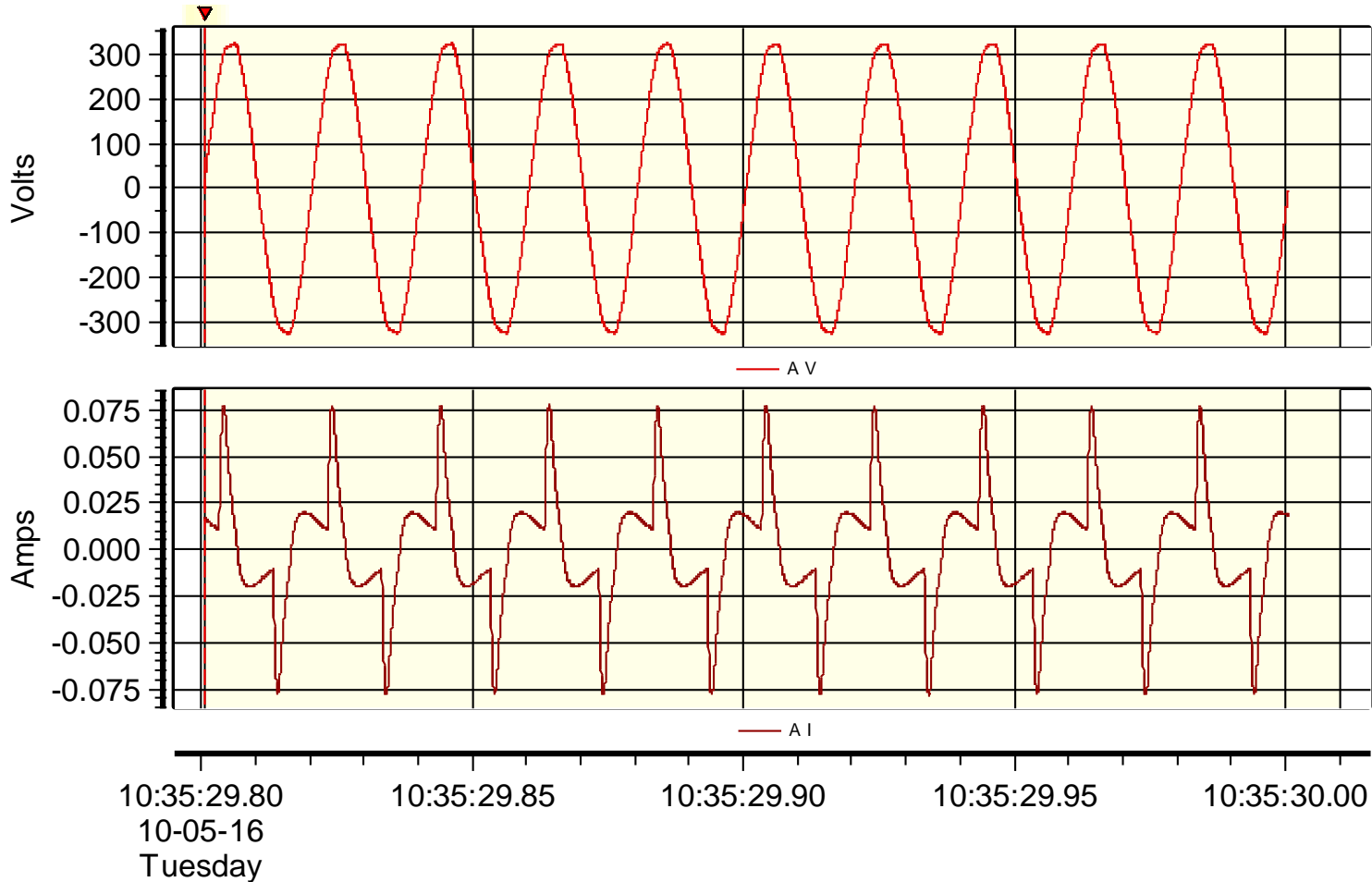
Voltage distortion does not change. VTHD has value about 1.61 % of FND because harmonic from electrical system. ITHD is 91.34 % of FND.

5. LED Bulb 5W (GE)



Voltage and current waveforms

Event Details/Waveforms



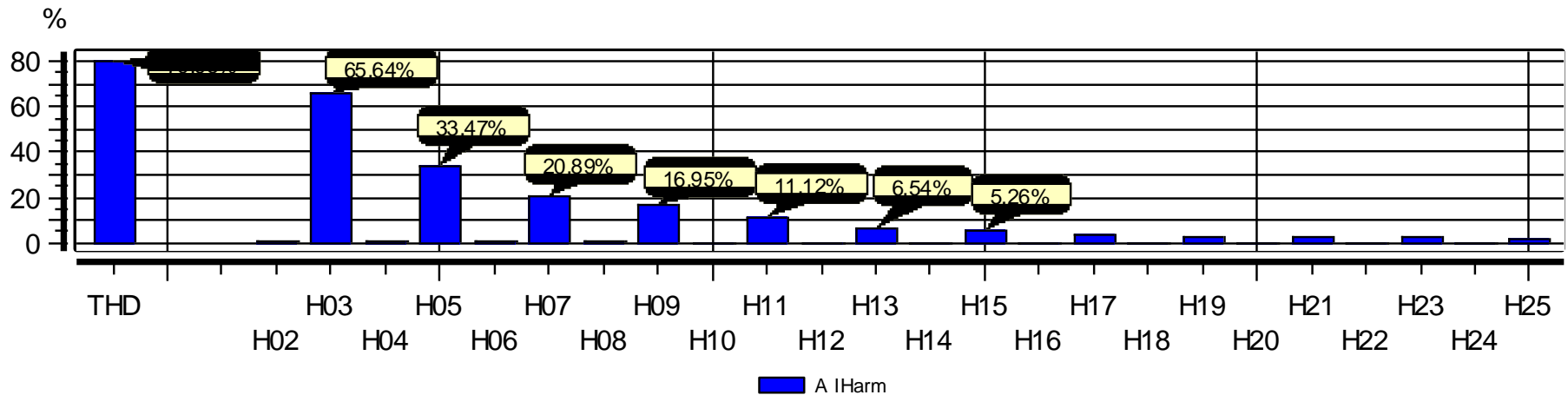
Event #39 at 10-05-16 10:35:29.800
Timed

5. LED Bulb 5W (GE) (Continue)

Harmonics distortion of current



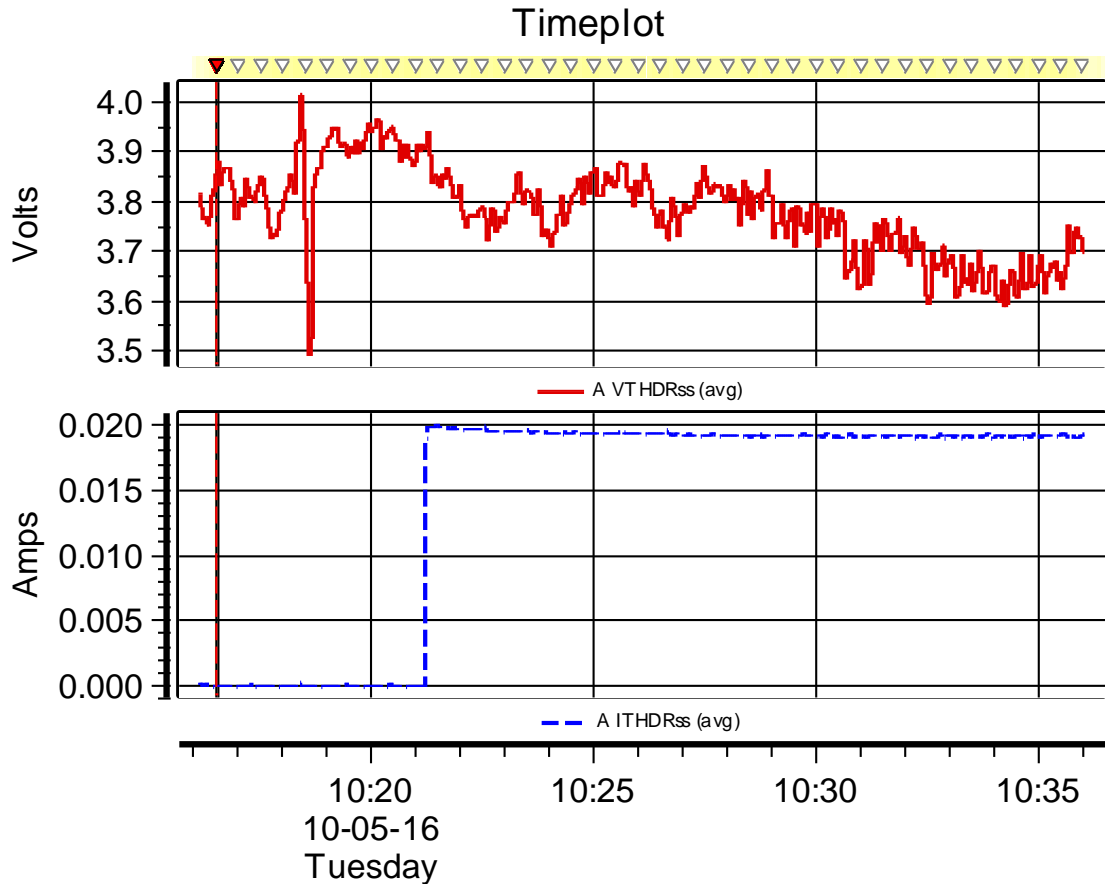
Waveform harmonics



5. LED Bulb 5W (GE) (Continue)



Harmonics trend of voltage and current



Event #1 at 10-05-16 10:16:29.795
Timed

	Min	Max	Avg
AVTHDRss	3.493	4.012	3.780
AITHDRss	0.00000744	0.01985	0.01435

- Voltage distortion does not change. VTHD has value about 1.63 % of FND because harmonic from electrical system.
- ITHD is 79.95 % of FND.

Conclusion

- VTHD from electrical system is 1.65 % of FND.
- When connected incandescent lamp, compact fluorescent lamp, fluorescent tubes, and LED lamps the VTHD does not change about 1.6 % of FND because harmonic from electrical system.
- The highest value of ITHD are LED 10.5W, LED 5W and CF about 91.34%, 79.95% and 79.45% respectively.
- Incandescent and fluorescent lamps are very low values of ITHD about 0.95% and 8.39% respectively.

Conclusion (Continue)

- From the results all the lamps have low power factor excepted incandescent lamps.
- Today, using energy saving lamps produce higher harmonic distortion and low power factors.
- The modern building will be designed to using a lot of LED lamps which has higher harmonic and low power factor may effect to electrical system.