Modern LED sources and harmonic pollution, which they caused

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In recent years, LED light sources are increasingly used. Along with their undisputed advantages (good energy efficiency, long service life, etc.) some disadvantages are also reported. The main disadvantage, in terms of energy supply systems, is that they are semiconductor devices powered with DC voltage. To ensure adequate supply conditions of LED sources, electronic drivers are mainly used for the power supply, which essentially are pulse power supplying devices. The use of these devices usually results in the generation of harmonic distortion components that return to the power supply network and cause a harmonic "pollution"

The **purpose of this paper** is to investigate the harmonic "pollution" in the electrical power nets for lighting caused by the use of LED light sources.

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Figure 1. Retrofit LED lamp

Figure 2. LED lamp, Downlight

Figure 3. LED lamp with G9 socket

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- Measurement of electrical technical qualities is performed by using a LEM ANALYST 3Q analyzer. The analyzer give the possiblity to measure all electrical quantities relating to the electrical energy quality in the power supply network.
- The measurement of the harmonic components of the current and voltage becomes up to 41 harmonics.
- During the study, the requirements of the electrical energy quality standard were followed.
- Every light source was subject to an independent study.
- Table 1 shows only the more significant results of LED lamps that are of interest from the point of view of "polluting" the grid with higher harmonics.

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Table № 1

Study Results from the different types of LED light sources.

Type of LED source	P, W	S, VA	cos φ	PF	Q_B, VAR	THD U, %	THD I, %
LED A60 BULB SKU-4378 VT-2007 Cool White 6000K	5	10	0,545	0,470	-6	1,7	61,0
LED A60 BULB SKU-4376 VT-2007 Warm White 2700K	5	11	0,520	0,448	-7	1,7	61,6
LED SPOTLIGHT VT-1878 Nature White 4500K	4	9	0,839	0,456	-2	1,6	99,9
LED SPOTLIGHT VT-1878 Warm White 3000K	4	8	0,834	0,505	-2	1,6	99,9
LED G9 LAMP VT-1849 Warm White 3000K	3	7	0,933	0,429	1	1,7	99,9
GLASS TUBE VT-6272 SMD Cool White 6000K	9	17	0,907	0,504	-3	1,9	99,9
LED LAMP PREMIUM Warm White 2700K	7	15	0,942	0,462	-2	1,7	99,8
LED LAMP PREMIUM Neutral White 4200K	7	15	0,940	0,450	-2	2,6	99,8

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Table № 1 (continued)

Study Results from the different types of LED light sources.

Denomination, type of LED source	P, W	S, VA	cos φ	PF	Q_B, VAR	THD U, %	THD I, %
LED SPOTLIGHT SMD2835 Warm White 2700K	5	12	0,924	0,453	-2	1,6	99,9
LED SPOTLIGHT SMD2835 Neutral White 4200K	5	12	0,928	0,444	-1	1,5	99,9
LED G9 Warm White 2700K	2	5	0,333	0,307	-4	2,6	55,1
LED T8 TUBE SMD2835 Cool White 6000K	8	9	0,952	0,930	-2	1,8	19,6
LED bulb Warm White 2700K	6	8	0,870	0,730	-2	2,5	57,1
Core Pro LED bulb Warm White 2700K	8	17	0,954	0,495	-2	1,9	99,8
LED SPOTLIGHT Warm White 2700K	3	7	0,500	0,407	-4	2,4	65,7
LED G9 Warm White 2700K	1	5	0,301	0,280	-3	1,8	55,1
Core Pro LED T8 TUBE Cool White 6000K	8	8	0,969	0,917	-1	1,9	22,6

CONCLUSION

Based on the Study of harmonic pollution in electrical net for lighting caused by the modern LED sources, the following conclusions can be drawn:

- Study of harmonic pollution in the power nets caused by LED lighting sources is carried out by means of the Electrical Energy Quality Analyzer;
- Most parameters of low-cost LED sources are deteriorated – PF, cos ϕ, THD I, etc.;
- Degraded operating parameters lead in turn to an increase in energy consumed by the LED source and serious harmonic contamination of the electric power net, especially when are using large number of lamps.
- In low budget LEDs, very high values of the total current indicator are observed
- In the higher class LED products, the THDi has a fairly good value