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Abstract

In recent days the development of electromagnetic energy harvesting near the power line leads by the demand of low power device and energy conservation. But most of the time the output voltage of energy harvester is very less- in the range of μV to mV near the low voltage power line. In this paper current transformer-based energy harvester is proposed. Generally, the output voltage generated at secondary coil terminal wounded on core is affected by the dimensions and value of flux density in the core changes with the value of primary current. In this research paper the variation in magnitude of flux density and output voltage was examined using analytical model and an experiment set up for four different dimensional same magnetic permeability cores. Analyzed result shows the generated ac voltage across 500 secondary turns is 3.72 Volt and experimentally it was 4.1 Volt at 8.3 Amp primary current with the energy harvesting core having area of cross-section 1.26 cm^2. Therefore, the selection of proper size energy harvester is very significant for efficient output near low voltage power line.

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Keywords

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Evaluation of dimensional effect on electromagnetic energy harvesting

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Abstract

In recent days the development of electromagnetic energy harvesting near the power line leads by the demand of low power device and energy conservation. But most of the time the output voltage of energy harvester is very less- in the range of μV to mV near the low voltage power line. In this paper current transformer-based energy harvester is proposed. Generally, the output voltage generated at secondary coil terminal wounded on core is affected by the dimensions and value of flux density in the core changes with the value of primary current. In this research paper the variation in magnitude of flux density and output voltage was examined using analytical model and an experiment set up for four different dimensional same magnetic permeability cores. Analyzed result shows the generated ac voltage across 500 secondary turns is 3.72 Volt and experimentally it was 4.1 Volt at 8.3 Amp primary current with the energy harvesting core having area of cross-section 1.26 cm^2. Therefore, the selection of proper size energy harvester is very significant for efficient output near low voltage power line.

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10.1016/j.procs.2018.10.351

References

1 Bolt R., Magno M., Burger T., Romani A., Benini L.
Kinetic AC/DC Converter for Electromagnetic Energy Harvesting in Autonomous Wearable Devices
IEEE Transactions on Circuits and Systems II: Express Briefs, 64 (12) (2017), pp. 1422-1426
View in Scopus ↗ Google Scholar ↗

2 Leicht J., Manoli Y.
A2.6 μW–1.2 mW Autonomous Electromagnetic Vibration Energy Harvester Interface IC with Conduction-AngleControlled MPPT and up to 95% Efficiency
IEEE Journal of Solid-State Circuits, 52 (9) (2017), pp. 2448-2462
View in Scopus ↗ Google Scholar ↗

3 Leicht, J., Hehn, T., Maurath, D., Moranz, C. and Manoli, Y., Physical insight into electromagnetic kinetic energy transducers and appropriate energy conditioning for enhanced micro energy harvesting. In Journal of Physics: Conference Series012023). IOP Publishing. 2013; 476(1):1-5.
Google Scholar ↗

4 Roscoe N.M., Judd M.D.
Harvesting energy from magnetic fields to power condition monitoring sensors
IEEE Sensors Journal, 13 (6) (2013), pp. 2263-2270
View in Scopus ↗ Google Scholar ↗

5 Ouyang Y., He J., Hu J., Wang S.X.
A current sensor based on the giant magnetoresistance effect: Design and potential smart grid applications
Sensors, 12 (11) (2012), pp. 15520-15541
CrossRef ↗ View in Scopus ↗ Google Scholar ↗

6 Pathak M.J.M., Sanders P.G., Pearce J.M.
Optimizing limited solar roof access by exergy analysis of solar thermal
photovoltaic, and hybrid photovoltaic thermal systems. Applied Energy., 120 (2014), pp. 115-124
View PDF View article View in Scopus ↗ Google Scholar ↗

7 Raghunathan V, Kansal A, Hsu J, Friedman J, Srivastava M. IEEE design considerations for solar energy harvesting wireless embedded systems. 2005; 457–462.
Google Scholar ↗

8 Azizi S, Ghodsi A, Jafari H, Ghazavi MR
A conceptual study on the dynamics of a piezoelectric MEMS (Micro Electro Mechanical System) energy harvester

Energy, 96 (2016), pp. 495-506

View PDF View article View in Scopus Google Scholar

9 Siddique ARM, Mahmud S, Van Heyst B

A comprehensive review on vibration based micro power generators using electromagnetic and piezoelectric transducer mechanisms

Energy Convers Manag, 106 (2015), pp. 728-747

View PDF View article View in Scopus Google Scholar

10 Toprak A, Tigli O

Piezoelectric energy harvesting: state-of-the-art and challenges

Appl Phys Rev, 1 (3) (2014), p. 031104

CrossRef View in Scopus Google Scholar

11 Xin Y, Li X, Tian H, Guo C, Qian C, Wang S, *et al.*

Shoes-equipped piezoelectric transducer for energy harvesting: a brief review

Ferroelectrics, 493 (1) (2016), pp. 12-24

CrossRef View in Scopus Google Scholar

12 Sunghyun Y, Jai Kyoung S, Young-Ho C

A flexible piezoelectric pulsewave energy harvester for application to high-efficiency multi-functional skin patches

J Microelectromech Syst, 25 (2) (2016), pp. 388-393

Google Scholar

13 Sheng Y, Yi H, Jiafeng Z, Qian X, Chaoyun S, Thompson P

Magnetic field energy harvesting under overhead ower lines

IEEE Trans Power Electron, 30 (11) (2015), pp. 6191-6202

Google Scholar

14 Soyata T, Copeland L, Heinzelman W

RF energy harvesting for embedded systems: a survey of tradeoffs and methodology

Ieee Circuits Syst Mag, 16 (1) (2016), pp. 22-57

View in Scopus Google Scholar

15 Gupta, V., Kandhalu, A. and Rajkumar, R.R., Energy harvesting from electromagnetic energy radiating from AC power lines. In Proceedings of the 6th Workshop on Hot Topics in Embedded Networked Sensors 2010; (17). ACM.

Google Scholar

16 Moghe R., Iyer A.R., Lambert F.C., Divan D.M.
A low-cost wireless voltage sensor for monitoring MV/HV utility assets
IEEE Transactions on Smart Grid., 5 (4) (2014), pp. 2002-2009
View in Scopus ↗ Google Scholar ↗

17 Liu Y, Xie X, Hu Y, Qian Y, Sheng G, Jiang X, Liu Y
A novel high-density power energy harvesting methodology for transmission line online monitoring devices
Review of Scientific Instruments., 87 (7) (2016), p. 075119
View in Scopus ↗ Google Scholar ↗

18 Yuan S, Huang Y, Zhou J, Xu Q, Song C, Thompson P
Magnetic field energy harvesting under overhead power lines
IEEE Transactions on Power Electronics, 30 (11) (2015), pp. 6191-6202
View in Scopus ↗ Google Scholar ↗

19 Wang W, Huang X, Tan L, Guo J, Liu H
Optimization Design of an Inductive Energy Harvesting Device for Wireless Power Supply System Overhead High-Voltage Power Lines
Energies., 9 (4) (2016), p. 242
doi:10.3390/en9040242
Google Scholar ↗

20 CW McLyman
Transformer and inductor design handbook
CRC press; (2016)
Apr 19.
Google Scholar ↗

21 Derebasi N
Effect of Geometrical Factors on Magnetic Induction Distribution of Toroidal Cores Using Numerical Methods
Journal of Superconductivity and Novel Magnetism., 28 (3) (2015), pp. 761-765
CrossRef ↗ View in Scopus ↗ Google Scholar ↗

Cited by (6)

A Study on the Prediction of B-H Curve of Magnetic Core for Energy Harvesting ↗
2024, Transactions of the Korean Society of Mechanical Engineers, A