2016 International Symposium on Nonlinear Theory and Its Applications,
NOLTA2016, Yugawara, Japan, November 27th-30th, 2016

Circuit Characteristics of DC/DC Converter for Waste Heat Recovery Power System

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Abstract– In this report, the multi input flyback converter for waste heat generation systems is proposed. This research is aiming for maximizing the output power and high efficiency of converter circuit design, high efficiency of power converting circuit and the waste heat power generation system.

When the switching frequency is changed, the efficiency of the converter is measured. The experimental results show that the efficiency depends on the switching frequency.

1. Introduction

Thermoelectric devices can convert some of this waste heat into useful electrical energy. Thermoelectric generation is a process where power is obtained by giving a temperature difference to the thermoelectric module in accordance to the Seebeck effect theory. Waste heat power generation system is a generator for recovering electrical energy by giving a temperature difference in the thermoelectric module (TEM), but the energy conversion efficiency and durability problems are often in the spread. Therefore, this research is considering the application of a thermoelectric device in extent to a variety of waste heat and study about the multi-input flyback converter for waste heat power generation system.

This research is aiming for high efficiency of converter circuit design, high efficiency of power converting circuit for waste heat power generation system.

2. Multi Input Flyback Converter

Power converter as a means of power conversion from source to load need to be properly controlled and regulated in order to achieve stability at all operating conditions and environments. Experiment is been carried out based on the basic configuration of flyback converter. Figure 1 shows conventional converter. The voltage across each TEM is very low (0.3V). To obtain the higher voltage for the system, the modules must be series-connected. To implement the system, it requires a DC/DC converter. TEMs are series-connected. The current is fixed by the module which is located on low temperature.

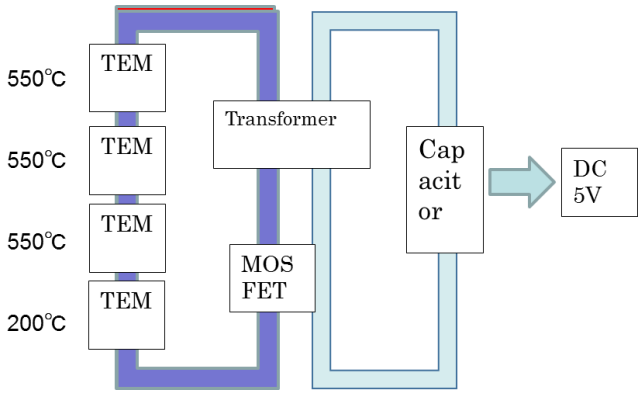

Figure 1 : Conventional flyback converter

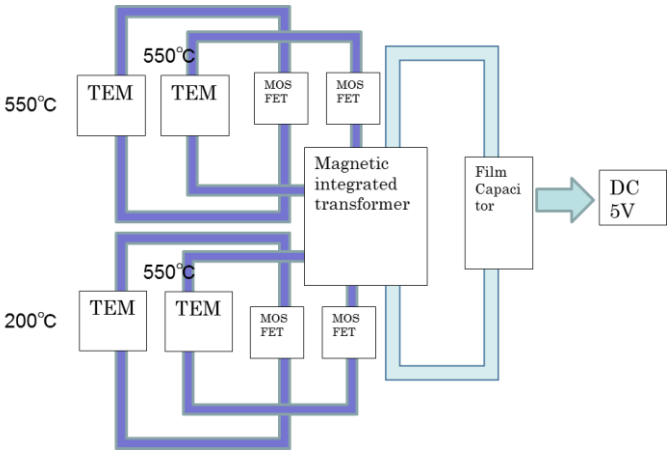

Figure 2 : Multi input flyback transformer

Figure 2 shows our proposed multi input flyback converter used for this research. The modules are parallel-connected. The current is not fixed by the module which is located on low temperature.

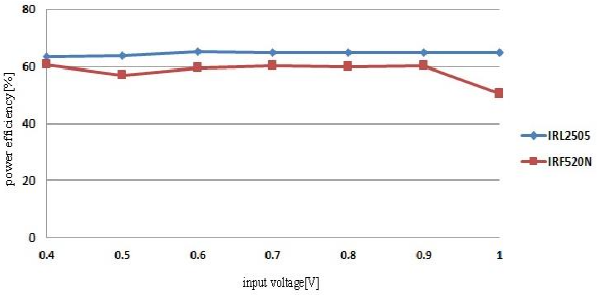

Figure 3: Efficiency of dc/dc converters.

Figure 3 shows the comparison efficiency graph of when the input voltage of the dc voltage power supply is changing from 0.4V to 1.0V. When the switching devices are changed from IRF520N to IRL2505 whose on-resistance is very low, the efficiency is improved at 3 point.

3. Experimental System

An experimental system was assembled in the laboratory as shown in Figure 4. The converter consists of the main switches (MOSFETs) and the flyback transformer. The system is implemented by a micro controller.

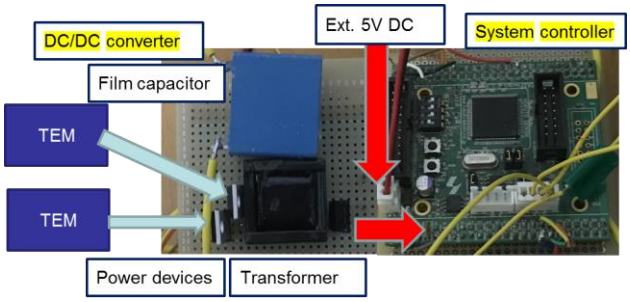

Figure 4 : Experimental system.

TEM	#1	TEM	#2
Voltage	0.20V	Voltage	0.20V
Current	0.26A	Current	0.34A
Power	0.05W	Power	0.07W

Electric load	
Voltage	4.73V
Current	0.017A
Output Power	0.08W

Figure 5 : 2 input flyback converter

Figure 5 shows the experimental results of the system at 300 degrees centigrade. The efficiency is 66%.

Figure 6 shows the relationship between the temperature of the hot side of the thermoelectric module and the power which is supplied by 12V power supply.

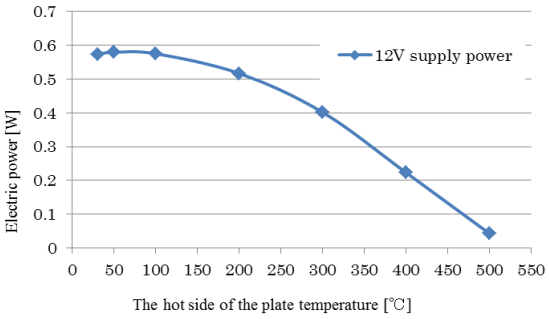

Figure 6 : Power by 12V power supply.

4. Conclusions

The prototype of waste heat recovery power generation system based on multi-input flyback converter has been proposed.

5.References

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