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The impact of LHP position to remove waste heat from power components

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Loop Heat Pipe (LHP)

A loop heat pipe (LHP) is a two-phase device with extremely high effective thermal conductivity that utilizes pressure difference in wick to circulate working fluid.
The LHP consists of:

- an evaporator,
- a condenser,
- a compensation chamber (reservoir)
- vapor and liquid lines.

Only the evaporator and part of the compensation chamber are equipped with a wick structure. The use of the wick structure in the evaporator provides a stable physical interface between the liquid and the vapor phases in the LHP.

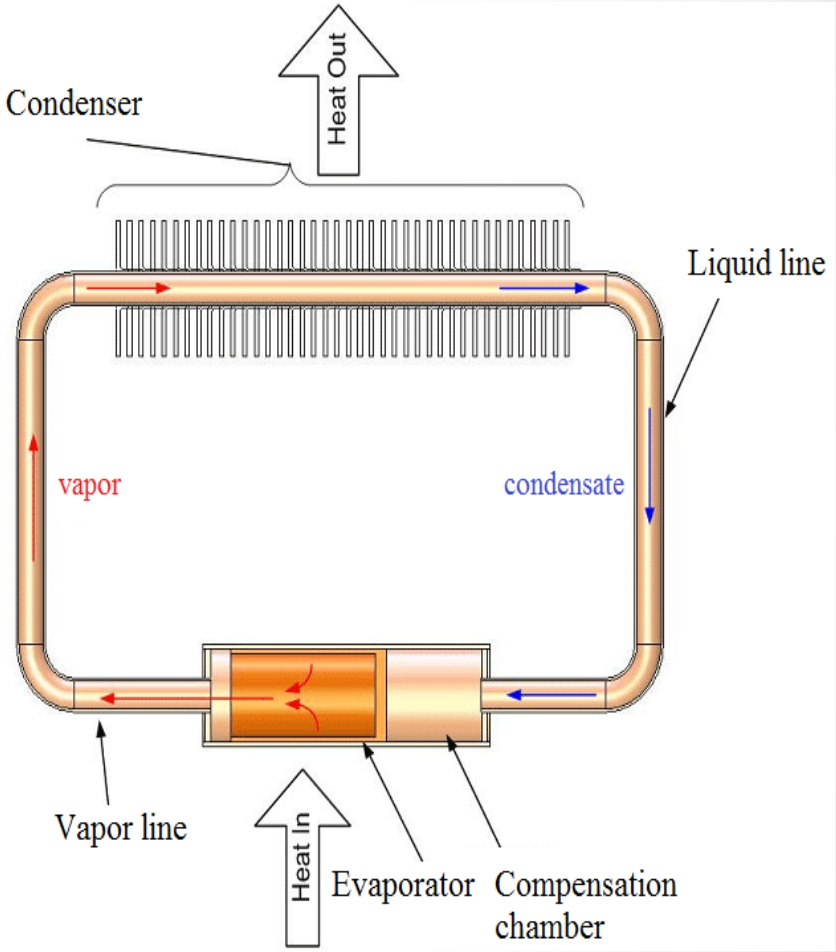


Fig.1
Schematic view of LHP.

Design of Loop Heat Pipe

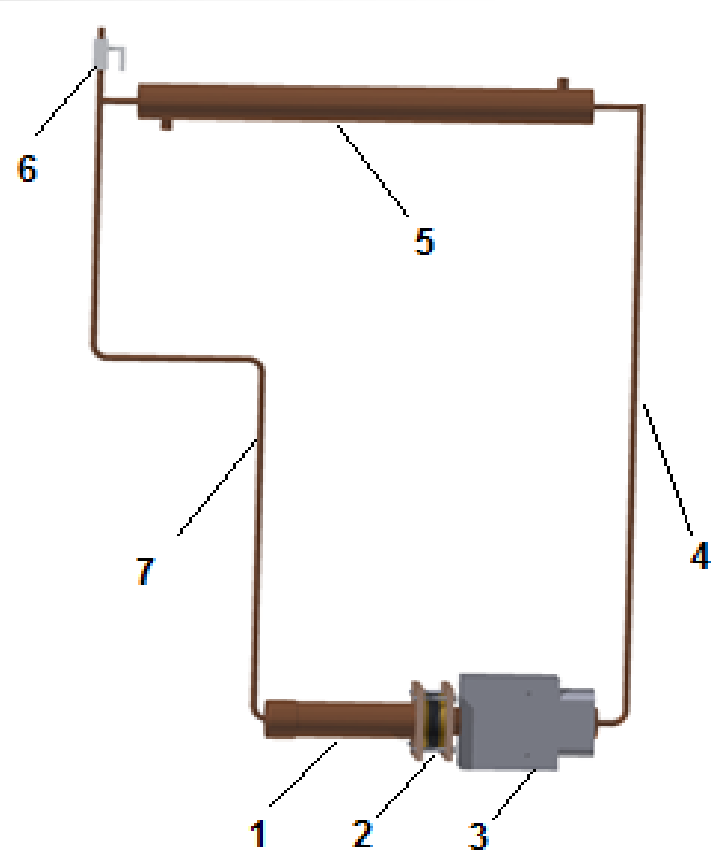


Fig.2
Model of LHP: 1. compensation chamber, 2. rubber seal, 3. aluminum block, 4. vapor line, 5. condenser 6. filling valve, 7. liquid line.

Sintered copper powder with grain size 50. Sintering temperature 950 °C, sintering time 30 min

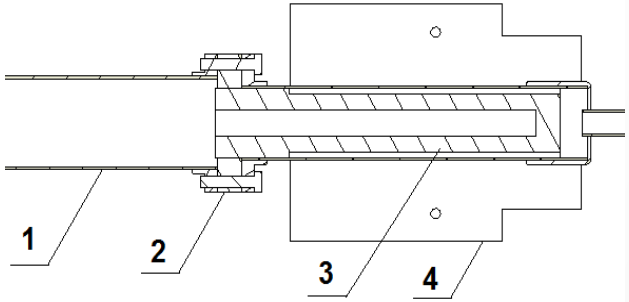


Fig.3
Section of evaporator: 1 compensation chamber, 2 rubber seal, 3 wick, 4 alumina block.

Schematic diagram of measurement

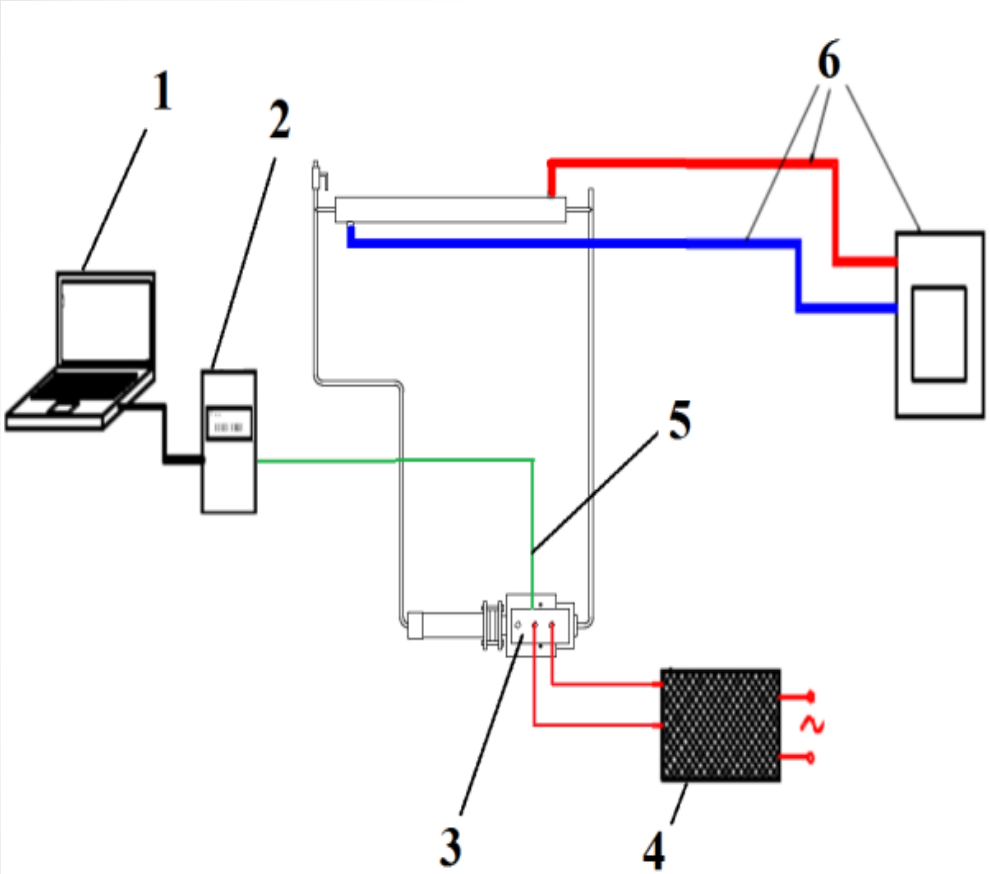


Fig.4
Schematic diagram of measuring device: 1-PC, 2- logger, 3-IGBT, 4- power supply voltage and current, 5- thermocouple, 6- thermostat.

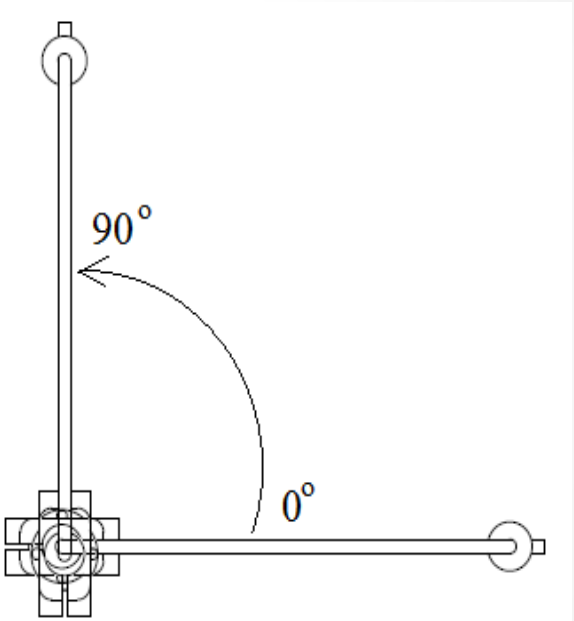
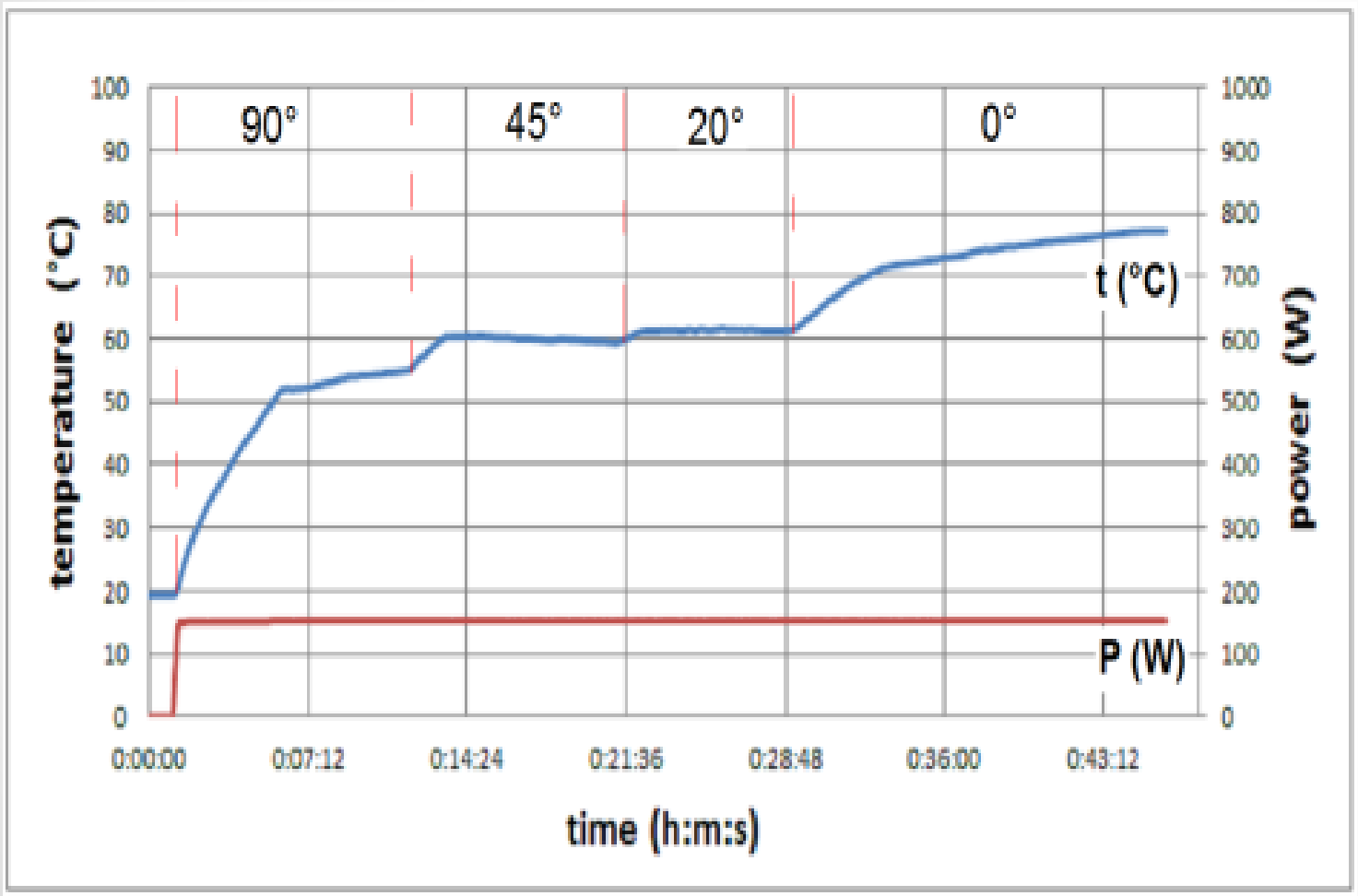


Fig.5
Section of evaporator: 1 compensation chamber, 2 rubber seal, 3 wick, 4 alumina block.

Main design parameters of LHP

LHP evaporator	
Total length (mm)	130
Active length (mm)	89
Outer/inner diameter (mm)	28/26
Material	copper
Saddle	
Size (length/ high/ wide)	118/89/40
Material	alumina
Sintered copper powder	
Number of vapor grooves	6
Porosity (%)	51
Outer/inner diameter (mm)	26/8
Compensation chamber	
Outer/inner diameter (mm)	35/33
Length (mm)	110
Charge mass	
Distilled water	70%
Vapor line	
Length (mm)	670
Outer/inner diameter (mm)	6/4
Liquid line	
Length (mm)	820
Outer/inner diameter (mm)	6/4
Condenser	
Length (mm)	420
Outer/ inner diameter (mm)	6/4

Cooling IGBT with LHP (150W)



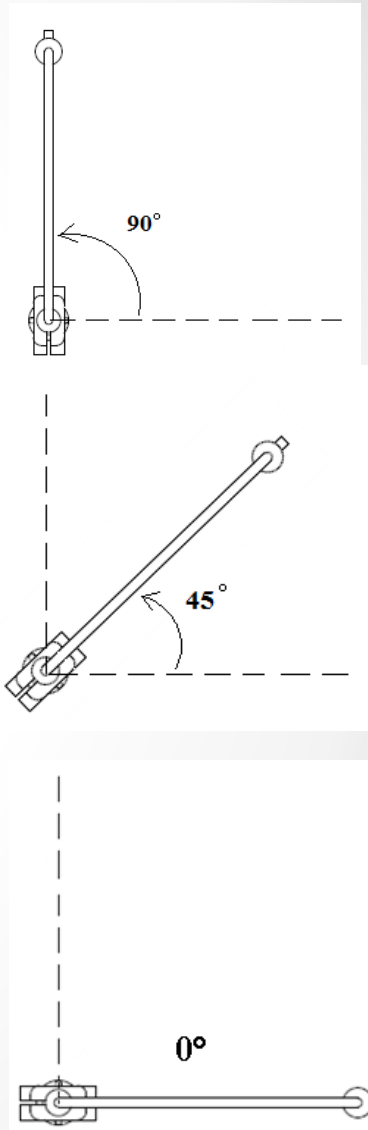
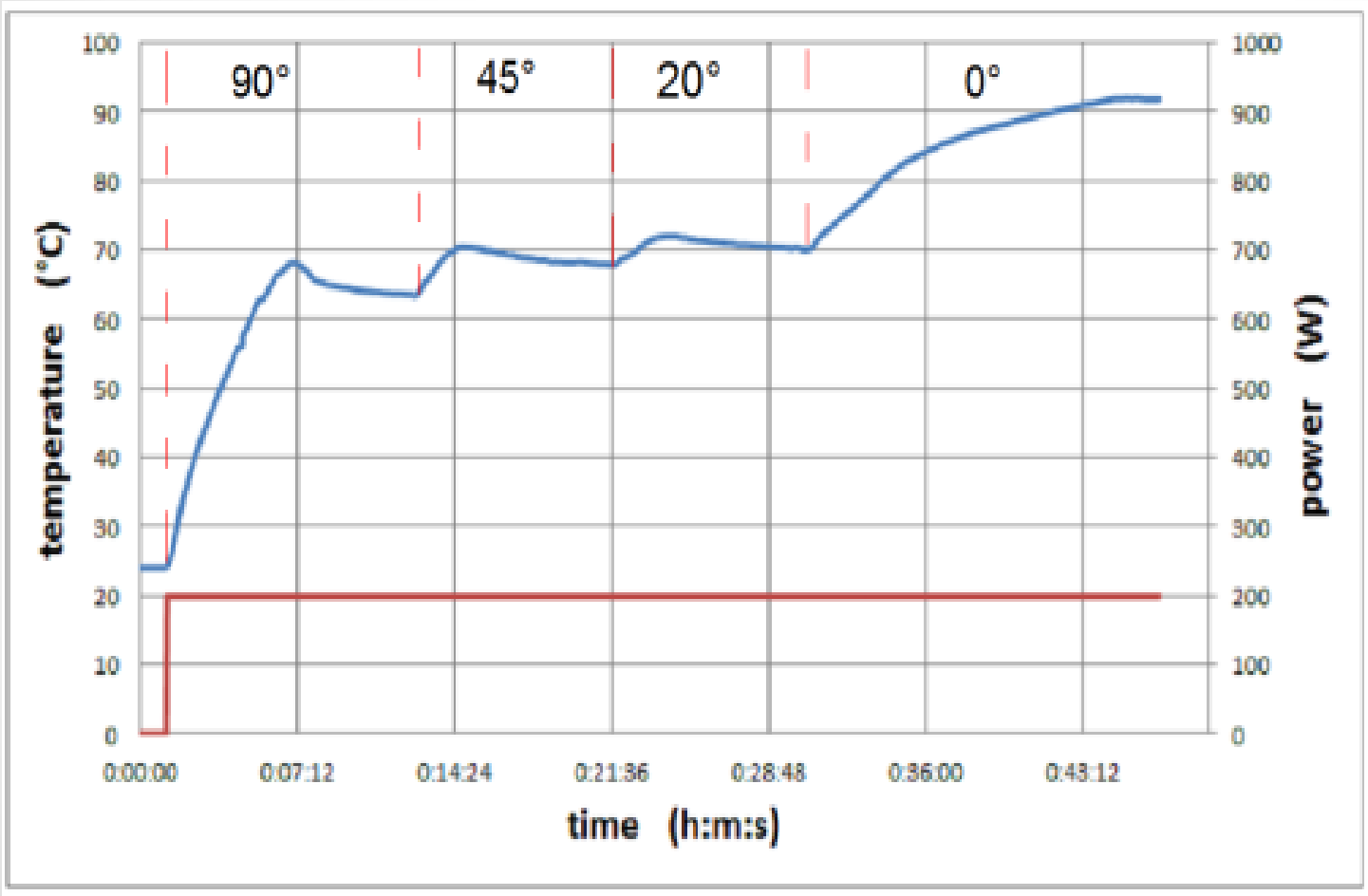


Fig.6 Temperature of IGBT depends on tilt angle of LHP when power of source was 150 W

Cooling IGBT with LHP (200W)



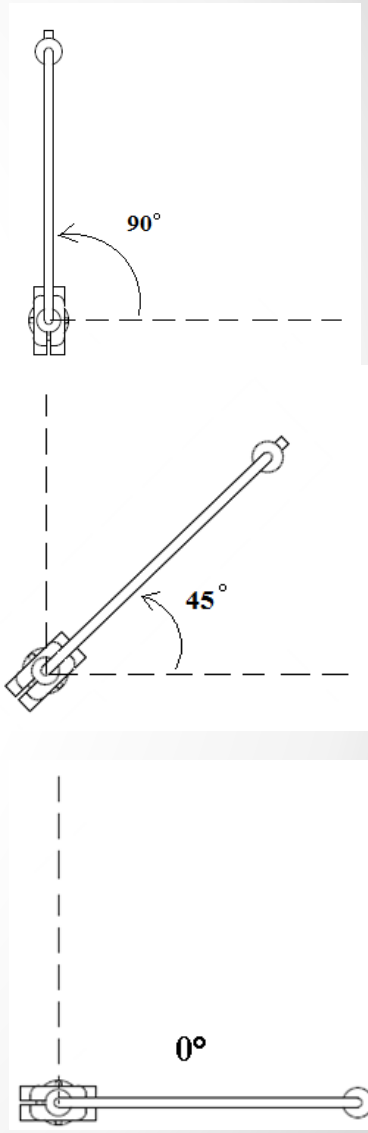
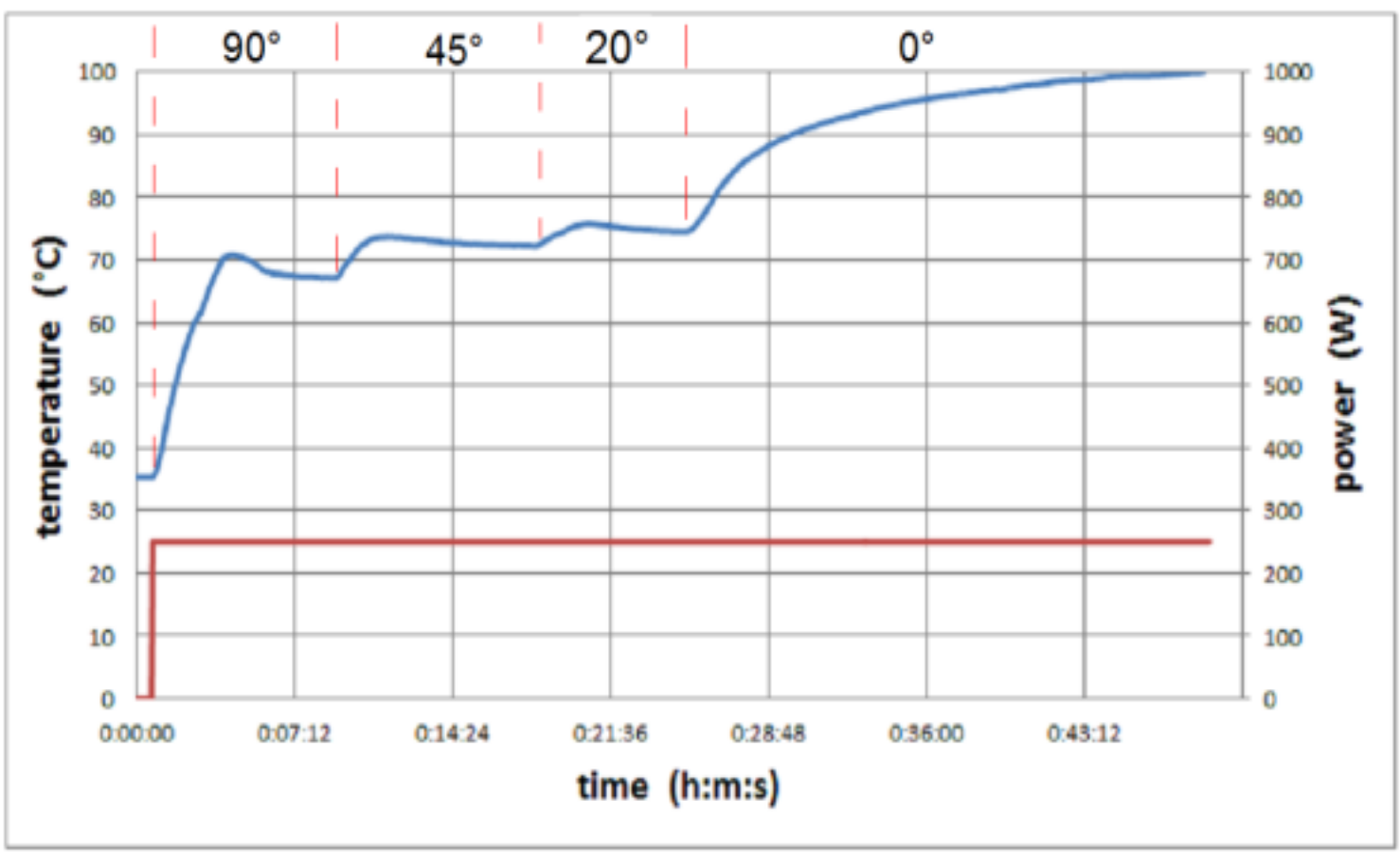
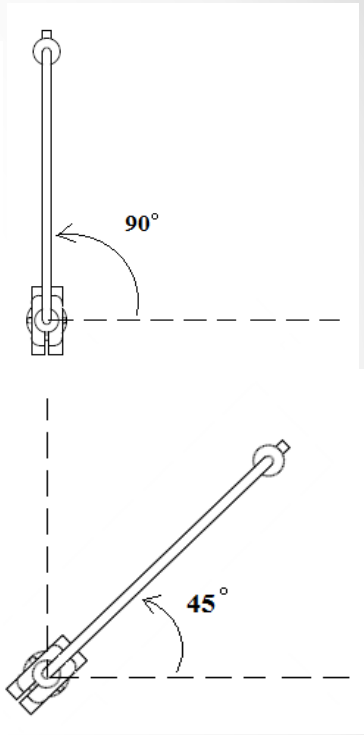


Fig.7 Temperature of IGBT depends on tilt angle of LHP when power of source was 2000 W

Cooling IGBT with LHP (250W)





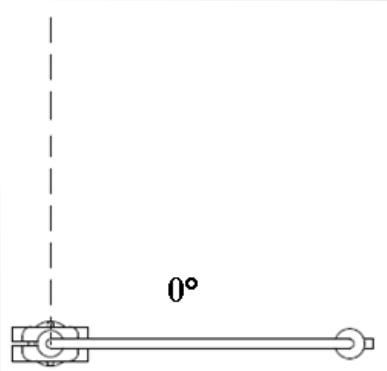
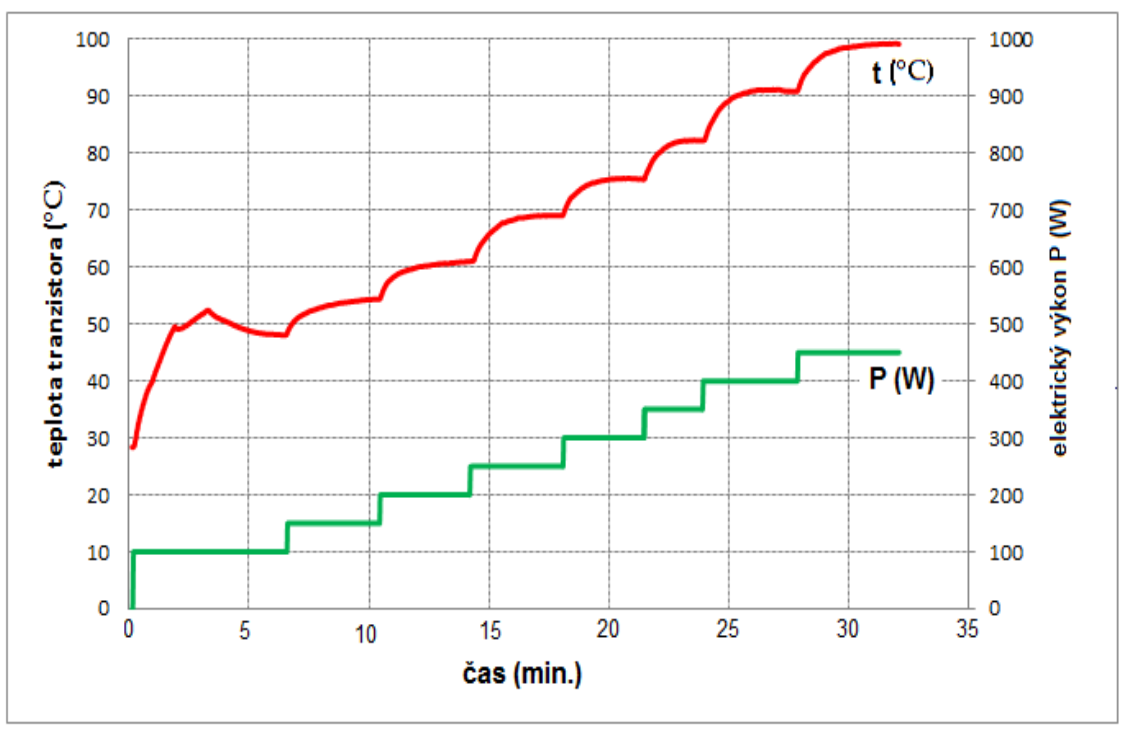


Fig.8 Temperature of IGBT depends on tilt angle of LHP when power of source was 250 W

Conclusion

- **High heat capability.**
- **Capability to transport energy over long distance.**
- **THP don’t need mechanical devices for circulation of fluid.**
- **Long life of device.**



Thank you for your attention

Acknowledgments
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