Heat Reduction of the MWD Telemetry System

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Abstract - **In this paper the simplified thermal model of conventional downhole MWD (Measurements While Drilling) telemetry system has been made. The heat reduction methods for the IC (integrated circuits) components of downhole drilling tools have been analyzed.**

Keywords – **MWD, telemetry system, heat dissipation.**

I. Introduction

The conventional drilling tool electronics in oil and gas industry are limited to 150°C. Electronics are based on standard commercial silicon semiconductors which operates stable at the temperatures below 125°C. When the well temperature increase to 120 deg, special procedures to cool down the MWD electronics are followed. With the increase depth of Oil reserves there is a need in a higher temperature tools. Table 1 shows temperature ranges of several markets and their expected life time [1]. Also the reliability of the conventional downhole tools is degraded with the temperature increase. All these drives are pushing the industry in searching the alternative ways of handling the high temperatures.

Table 1

High Temperature Electronic Markets

Market	Temp (°C)	Life(KHrs)
Down Hole Instruments:		
MWD & Gages	175-225	>2
Perm. Monitoring	150-225	40
Geothermal	250-300	Up to 8
Turbine Engine (Aircraft)	200-300	40-80
Int. Comb. Engine (ABS)	> 150	5
Heavy Engine	> 150	20

The electronics temperature is not only affected by the outside environmental temperature, but also by self-heating. The analysis shows that majority of electronics use only small amount of source energy to transform it into useful signals. The rest of the energy transforms into heat and self-heating the IC components. The overheating changes electrical properties of the components and cause its degradation, provoke changes in geometrical dimensions which leads to destructive thermo mechanical stresses, jamming the moving parts and cracking the fragile elements. The overheat reduction decrease destructive process and increases lifetime of the MWD tools.

II. Simplified Thermal Model of the Conventional MWD Tools

In the Fig. 1 the simplified thermal schematic of the downhole MWD system is shown. This model is needed to determine sources of heat and analyze heat transfers. The model consist of MWD electronics mounted in the non-magnetic frame, which is installed inside the drill collar. The drilling mud flows through the inner openings of the MWD frame.

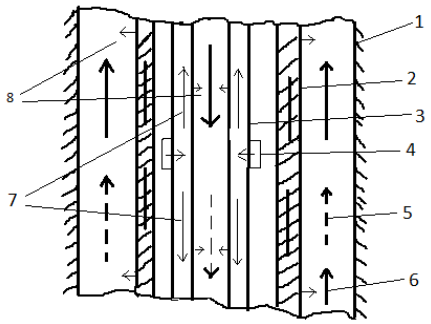

Fig.1 Downhole MWD simplified thermal schematics. 1-wellbore wall; 2-drill collar; 3-mwd frame; 4- electronic components; 5-convectional flow; 6-mud flow direction; 7-thermal heat transfer; 8-directions of thermal dissipation.

From the Fig 1. It is seen that MWD simplified thermal model includes: three main sources of heat (elements of IC, drill string, the wellbore); three main heat dissipaters (MWD frame, drill string, drilling fluid);

The electronics components generate self-heating, drillstring heat generates by friction of drill collar with the wellbore, and the earth has its natural temperature which increases in average 3°C / 100m.

III. Conclusion

By analyzing heat transfer inside and outside the MWD system the following methods were proposed:

- improve the heat dissipation use assemblies and functional cells fabricated on highly thermo-conductive boards;
- reduce electronics heating by using the CMOS fabrication technology and digital components;
- improve operating temperature by using SOI CMOS, Complementary GaAs, SiC technology [3].
- prospects of implementation heat pipe cooling system.

References

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