RESEARCH ARTICLE OPEN ACCESS

Heat Sink for Cell Phones

K.Tharunkumar [1], J.Srinivasamahesh [2], S.Suman [3]
D.Subramanyam [4], A.V.L. Mrudula [5]
Under Graduate Student [1], [2], [3], [4], Associate professor [5]
Department of Mechanical Engineering
Narayana Engineering College, Gudur
Andhra Pradesh – India

ABSTRACT

Today we are facing problems frequently on smart phones overheating. Every electrical and electronic component circuit generates some amount of heat while the circuit is executed by providing power supply. These components are inadequate to dissipate heat, as their dissipation capability is significantly low. The accumulation of heat in an enclosure is potentially damaging to electrical and electronic devices. Overheating can shorten the life expectancy of costly electrical components or lead to catastrophic failure. Heat sink is designed to maximize its surface area in contact with the cooling medium surrounding it, such as the air. Protrusion design and surface treatment are factors that affect the performance of a heat sink. Heat sink attachment methods and thermal interface materials also affect the die temperature of the integrated circuit.

HSFCP - Heat Sink for Cell Phones can give solution to the phone overheating. This acts as a heat sink and the heat spreader on the device and avoids the further increase of temperature to higher values and protects from heating damages.

Keywords:- Heat Sink, Factors Causing Premature Failure Of Smart Phones, Hsfcp, Cpu Z.

I. INTRODUCTION

Heat sink is a device or substance for absorbing excessive or unwanted heat of the mechanical and electrical devices (machines) which are inadequate to dissipate the heat generated in them.

A heat sink is designed to maximize its surface area in contact with the cooling medium surrounding it, such as the air or a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium. Air velocity, choice of material, protrusion design and surface treatment are factors that affect the performance of a heat sink. Heat sink attachment methods and thermal interface materials also affect the die temperature of the integrated circuit. Thermal adhesive or thermal grease improve the heat sink's performance by filling air gaps between the heat sink and the heat spreader on the device. A heat sink is usually made out of copper or aluminium. Copper is used because it has many desirable properties for thermally efficient and durable heat exchangers.

A heat sink transfers thermal energy from a higher temperature device to a lower temperature fluid medium. The fluid medium is frequently air, but can also be water, refrigerants or oil. If the fluid medium is water, the heat sink is frequently called a cold plate. In thermodynamics a heat sink is a heat reservoir that can absorb an arbitrary amount of heat without significantly changing temperature. Practical heat sinks for electronic devices must have a temperature higher than the surroundings to transfer heat by convection, radiation, and conduction. The power supplies of electronics are not 100%efficient, so extra heat is produced that may be detrimental to the function of the device.

II. FACTORS EFFECTING CELL PHONES

Heating up and device getting burst is not uncommon now, as we see several related things happening around. But let's dig in to check what causes this. Lithium batteries have what we call it as "thermal runaway". It is a situation where an already heating up battery makes it worse by generating more heat. How much ever the companies try to make a device compact, maintaining all the safety for the battery, that isn't enough to keep the opposite sides far, and the battery too doesn't get space to properly dissipate

the heat out.

1 Processor heat up:

2 Workload:

3 Poor signals

4 Surrounding temperature:

5 Hardware defect

III. WORKING

HSFCP is passive type heat sink which does not possess any mechanical components and enables the cell phone to quick heat dissipation.
Generally the mode of heat transfer in cell phones is convection process which is between cell phone and surrounding medium air.
The basic relationship for heat transfer by convection is:

$Q_{CONVECTION} = h A (Ta - Tb)$

where Q is the heat transferred per unit time,
A is the area of the object,
h is the heat transfer coefficient,
Ta is the object's surface temperature
and *Tb* is the fluid temperature here surrounding environment air temperature.
The convective heat transfer coefficient is dependent upon the physical properties of the fluid and the physical situation. By considering the Ta value and A value of the source (cell phone) to constant value
so the factors which effects this process are :
The coefficient heat convection (h value) of air .
The temperature of the air and it's h value varies from time to time that means climatic conditions, and it's difficult to make this parameters feasible to quick heat transfer (heat transfer through convection) .

At initial mobile temperature is equals to room temperature i.e. 32˚C to 38˚CAfter it's usage temperature will reaches up to 49˚C .It is causing due to weak heat transfer and it heat transfer mode is convection .Enhancing the heat transfer by HSFCP

HSFCP phone case consists of thermal conducting tape and thermal grease by wearing this case to cell phone we make transfer of heat via direct contact and convert the mode of heat transfer of cell phones to conduction from convection.

so, now the mode of heat transfer in the cell phone becomes heat conduction. The rate at which energy is conducted as heat between two bodies is a function of the temperature difference (temperature gradient) between the two bodies and the properties of the conductive medium through which the heat is transferred.

$Q_{CONDUCTION} = -k (T_a - T_b)$

Q is the local heat flux density, $W \cdot m^{-2}$
K is the material's conductivity, $W \cdot m^{-1} \cdot K^{-1}$,
(TA-TB) is the temperature gradient, $K \cdot m^{-1}$

IV. COMPONENTS

It consists of three components namely thermal grease, thermal conducting tapes, phone case.
THERMAL GREASE :

eq(6.1)

Fig: Thermal grease

Thermal grease is a kind of thermally conductive (but usually electrically insulating) compound, which is commonly used as an interface between heat sinks and heat sources (e.g., high-power semiconductor devices).The main role of thermal grease is to eliminate air gaps or spaces (which act as thermal insulator) from the interface area in order to maximize heat transfer. Thermal grease is an example of a thermal interface material.
As opposed to thermal adhesive, thermal grease does not add mechanical strength to the bond between heat source and heat sink. It will have to be coupled with a mechanical fixation mechanism such as screws,

applying pressure between the two, spreading the thermal grease onto the heat source.

V. THERMAL CONDUCTIVE TAPES

Thermally conductive tapes are designed to provide preferential heat-transfer between heat-generating electronic components and cooling devices such as fans, heat sinks, heat spreaders or thermal greases. They are also used for thermal management of high powered LED's which can run at high temperature, thus increasing the efficiency and reliability of the system. They come in various sizes and various versions we offer also a double-sided thermally conductive tape. very effective and reliable used by all the top professionals in the industry. Intacting thermal conducting tape to cell phone is also to make no air gaps in between cell phone and thermal grease and to make heat transfer to conduction rather than convection.

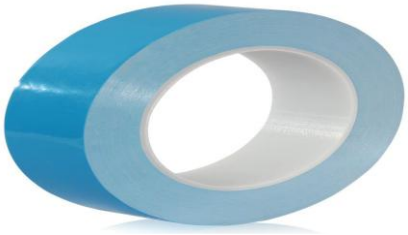


Fig : Thermal conductive tapes

PHONE CASE :

Cases, which are designed to attach to, support, or otherwise hold a Smartphone, are popular accessories. Case measures are based on the display inches .Holsters are commonly used alone for devices that include rubberized padding, and/or are made of plastic and without exposed rigid corners. Heavy duty cases are designed to protect from drops and scratches.

Fig: Phone case

A Standing case keeps the device standing upright. Folio cases are a combination of a case and stand, and may include a keyboard.

Skins and design covers can serve for protection and personalization. These are the result of the relatively "naked" designs produced by manufacturers such as Apple, where the metal and glass components of the device are exposed and vulnerable to damage.

VI. METHODOLOGY

According to Fourier's law of heat conduction the rate of heat transfer is

$Q = -k A (dT/dx)$

According to the Newton's law of convection the rate of heat transfer is $Q = h A(TS - T\infty)$

As considering the HSFCP phone case's heat transfer as heat transfer through the composite wall of different K values the rate of heat transfer is

$Qc = (t1-t4)/((Lp/Kp*Ap)+(Lt /Kt * At) +(LG /KG * AG)$

Where

"Lp" is the length of the phone

"Kp" is the thermal conductivity of the phone

"Ap" is the area of the phone where we calculate the heat

"Lt" is the length of the thermal conducting tape

"Kt" is the thermal conductivity of the thermal conducting tape

"At" is the area of the thermal conducting tape

"LG" is the length of the thermal grease

"KG" is the thermal conductivity of the thermal grease

"AG" is the area of the thermal grease

S.NO	TS	TF	Q_c=h A(TS–TF)W/m k.
1	40	38	0.003812

THEORETICAL CALCULATION OF HEAT CONVECTION

Where TS=40°C

TF=38°C

H=0.019 W/Mk
A=0.005776 m2
Q_C=0.019*0.005776*(40-38)
$Q_{Convection}$=0.003812W/m k.

THEORETICAL CALCULATION OF HEAT CONDUCTION

S.NO	T_1	T_2	T_3	T_4	Qconduction
1	40	38	38	38	0.113

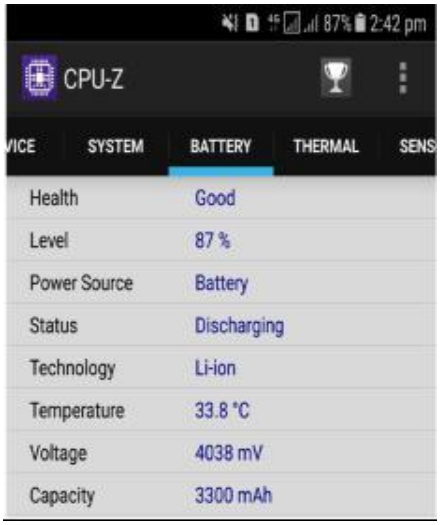
IT IS CALCULATED BY TAKING THE READINGS OF HEAT CONDUCTION
Where
L phone=0.002m,
L tape=0.002m,
L grease=0.001m.
K phone=0.019W/m k
K tape=1.5W/m k
K grease=1.2W/m k
A=0.005776 m2.
Qc = (t1-t4)/((Lp/Kp*Ap)+(Lt /Kt * At) +(LG /KG * AG)
=(40-38)/(0.002/0.019*0.005776)+(0.002/1.5*0.005776) +(0.001/1.2*0.005776)
Q conduction=0.113 W/m k

By comparing this values of both heat conduction and heat convection Heat transfer through convection is greater than heat transfer through conduction.

PRACTICAL RESULTS RECORDED BY APP SENSOR CPU Z

Before using phone temperature recorded

VII. CONCLUSION



HSFCP is a new phone case having a additional feature of protecting cell phones from overheating to ordinary phone cases which gives protection from physical damages i.e.,
HSFCP =TEMPERATURE PROCECTION
+ PHYSICAL DAMAGE PROTECTION
HSFCP a heat sink for our smart phones which can be used as a phone case prevents the phone overheating and avoids the premature damage of the phones. Finally in this report we explain about the factors causing overheating of cell phone , components used in making of HSFCP phone case, working of the HSFCP as a heat sink and showed theoretical calculation and practical result of HSFCP phone case in preventing higher temperatures.

REFERENCE

[1] https://en.wikipedia.org/wiki/Heat_sink

[2] https://me-mechanicalengineering.com/fouriers-law/

[3] https://en.wikipedia.org/wiki/Thermal_conduction

[4] https://en.wikipedia.org/wiki/Convective_heat_transfer

[5] http://web.mit.edu/lienhard/www/ahttv211.pdf

[6] http://web.mit.edu/lienhard/www/ahtt.html

[7] http://nptel.ac.in/courses/112108149/pdf/M1/Student_Slides_M1.pdf

[8] https://www.forbesmarshall.com/fm_micro/news_room.aspx?Id=boilers&nid= 160

[9] https://me-mechanicalengineering.com/modes-of-heat-transfer/

[10] https://en.wikipedia.org/wiki/Thermal_grease

[11] https://whatis.techtarget.com/definition/thermal-grease-thermal-paste-or-thermal-compound

[12] https://www.mgchemicals.com/products/greases-and-lubricants/thermal-greases/

[13] http://www.cosmostapes.in/heat-sink-tape.html

[14] http://www.tapeindia.in/thermal-conductivity-tape.html

[15] http://www.tapeindia.in/thermal-conductivity-tape.html

[16] https://www.youtube.com/watch?v=29XJ1ujMlak

[17] https://www.youtube.com/watch?v=JQMdjZYAvss