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A6_6 The AMD Heater

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Abstract

In the world of computer components, especially those designed for gamers, AMD components have always been synonymous with a long standing joke that in the past, these parts were capable of producing so much heat they could act as room heaters. In this paper, we establish whether this claim is valid, by using the power output of current generation components, and an average sized UK bedroom, among other assumptions. We determine that it would take approximately 37 minutes to heat an average sized room to 20^oC from 5^oC, the UK average in Winter. This means that, in this system, an AMD computer is a viable room heater, but in the real world, this is not the case due to heat loss from the room, and components not realistically being able to run at maximum power indefinitely.

Introduction

In the past, the gaming community has jokingly referred to AMD components as being able to produce enough heat to render central heating unnecessary. Although component efficiency has improved significantly since this joke started, we will attempt to answer the viability of using an AMD based computer to heat an average sized UK bedroom.

To do this, we will assume that the bedroom is perfectly insulated, and has a starting temperature of the average UK winter temperature of 5^oC [1]. We will attain how long it takes for the room to rise in temperature to 20^oC [2], which is the comfortable room temperature. Depending on the length of time, we will ascertain the viability of such a room heating method.

Components Considered

We will be using the latest generation of components in this analysis. We will also assume that as the heat generated from the other PC components is small compared to the CPU and GPU, their contribution can be ignored. The CPU and GPU used here will be the AMD Ryzen 9 5900x [3] and the AMD Radeon RX 6900 XT [4] respectively. These have Thermal Design Power (TDP) values of 105 W and 300 W respectively.

Calculations

First we will construct an approximation for the room. From [5], the average bedroom size in the UK is approximately $4 \times 4 \times 3$ metres, giving a volume of air of $V = 48\ m^3$. We will set the starting temperature, T_i, at 5^oC, and the ending temperature T_f at 20^oC. Due to the scope of the paper, we will assume the computer is acting as a point source in the centre of the room, and heats the room up uniformly. We will assume the volume of air is constant, and the room is perfectly insulated.

We will approximate the specific heat capacity of air, C, as being 1.01. By combining the TDP values of the CPU and GPU, we get a total power output of 405 W, assuming that all input power is released as heat. Now we determine the work required to heat the room to room temperature. This is done through the specific heat equation, Eq. (1):

$$Q = mC\Delta T \tag{1}$$

Where the mass m is the mass of air, given by Eq. (2):

$$m = V\rho \tag{2}$$

Where ρ is the density of air, $\rho = 1.225$ kgm^{-3}. Using the starting and ending temperatures, $\Delta T = 15$ degrees, hence giving a Q of $Q = 890.82$ kJ. By dividing through by the power output of the components, and converting to minutes, this configuration of components can heat this room to room temperature whilst under full load in approximately 37 minutes.

Conclusion

Under the assumptions of this system, a latest generation AMD based computer has sufficient power output under maximum load to heat an average sized UK bedroom in approximately 37 minutes. This suggests that a computer of such configuration would be enough to provide heating for a bedroom. However, there are certain problems with this calculation.

This system assumes that the room is perfectly insulated, effectively isolating it from the world. Of course in reality, depending on the room, there is a certain loss of heat to the outside, with open windows for ventilation also affecting the final result. This would skew the result to be a longer time, reducing the heating efficiency.

This system also assumes that the computer is running at 100% load, also running at maximum power. This is realistically unlikely, as the components will undergo so-called Thermal Throttling, meaning power output is actually lower than the maximum rates given by AMD [3][4]. Therefore, as the power output will be lower, the time to heat the room increases. For example, if the power output is lowered by 20%, then the time to heat increases to approximately 46 minutes, an increase of about 25% heating time.

Therefore, although in this system running such a computer configuration would be an effective heater, in the real world it would lack the consistency and reliability to heat a bedroom, and central heating would be a much more reasonable heating device. Therefore, in conclusion, current generation technology renders the long standing joke incorrect.

References

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[3] AMD Ryzen 9 5900x Specification, https://www.amd.com/en/products/cpu/amd-ryzen-9-5900x

[4] AMD Radeon RX 6900 XT Specification, https://www.amd.com/en/products/graphics/amd-radeon-rx-6900-xt#product-specs

[5] Average UK Bedroom Size, https://www.homebuilding.co.uk/advice/room-sizes-how-to-get-them-right