In section [2, ds18b20], it is shown that a DS18B20 could operate in 2 modes: parasite and local power modes. Due to potential issues caused by software timing and/or electrical delays [sp report], in this thesis, the implemented DS18B20 temperature sensor shall be powered with an external supply.

[figure 1. General circuitry]

Given that the DS18B20 communicates via 1-wire protocol, [https://www.analog.com/en/technical-articles/how-to-power-the-extended-features-of-1wire-devices.html] provides the formula to calculate the available current on the bus as

I\_avail = (V\_pup – V\_pup\_min) / R\_pup

Thus the value for the pull-up resistor for the 1-wire bus

R\_pup = (V\_pup – V\_pup\_min) / I\_avail

Since the DS18B20 is externally powered, the active current I\_D is provided directly in the V\_dd pin, which leaves the “extra power demand” dependent on the input current of the data pin DQ [https://www.analog.com/en/technical-articles/how-to-power-the-extended-features-of-1wire-devices.html]. Maxim Integrated specifies the DQ input current I\_DQ to be typically 5uA, and the minimum pullup supply voltage to be 3V [ds18b20 datasheet]. The power supply for the DS18B20 is also the 3.3-V supply for the station, which yields the pull-up resistor to be

R\_pup = (V\_pup – V\_pup\_min) / I\_avail = (3.3V – 3V) / 5uA = 60kOhm

It is worth noticing that the given DQ input current is the necessary amount for data exchange to be successful, so it could go higher than 5uA but not lower. As a result, the calculated 60-kOhm pullup resistor is the maximum value to achieve 1-wire communication between the microcontroller and the DS18B20 temperature sensor. Since there shall be no other 1-wire devices included in this design, and the active current I\_D does not contributes in local power mode, the suggested value of 4.7 kOhms for the pullup resistor could be used freely, thus implemented in the design for the Autonomous Wireless Meteorology Station.

[figure 2. Final circuitry]