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Advantages of Comparing Radio Frequency Communication Modules

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Summary

Since we are currently surrounded by IoT systems that communicate wirelessly with each other, it is extremely important to know how they work, how to communicate, and how to manage them so that we can use these systems to their full potential. In this paper we will analyze communication in 433 MHz and 2.4 GHz radio frequencies. 433 MHz frequency communication modules will be compared with 2.4 GHz frequency communication modules both in terms of technical performance and in terms of the electromagnetic radiation they produce.

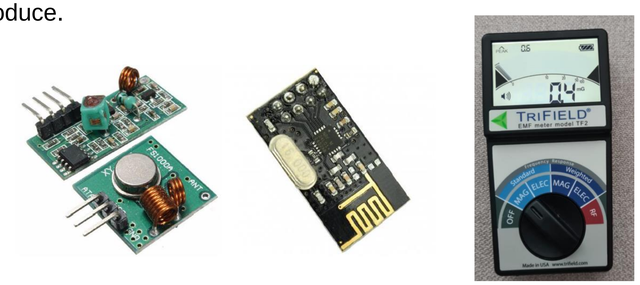

Fig.1 433 MHz communication module and 2.4GHz communication module (nrf24l01) [1],[2] and EMF meter model TF2 TRIFIELD

Technical measurements of electrical and magnetic emissions for nRF24L01 module

Transmitter 2.4GHz		Receiver 2.4GHz		Distance between equipment and emission source [m]
electric field emissions [V/m]	magnetic field emissions [mG]	electric field emissions [V/m]	magnetic field emissions [mG]	
1.8	5.2	1.9	4.6	0
1.7	4.8	1.8	4.3	20
1.8	4.5	1.9	3.9	40
1.9	4.5	1.8	3.8	60
1.8	4.4	1.7	3.7	70

Technical measurements of electrical and magnetic emissions for the module operating on the 433MHz frequency

Transmitter 433MHz		Receiver 433MHz		Distance between equipment and emission source [m]
electric field emissions [V/m]	magnetic field emissions [mG]	electric field emissions [V/m]	magnetic field emissions [mG]	
1.9	5.1	1.8	4.7	0
1.9	5.1	1.9	4.6	10
1.8	4.2	1.9	3.9	50
1.8	3.9	1.8	3.5	70
1.8	3.4	1.9	2.9	100

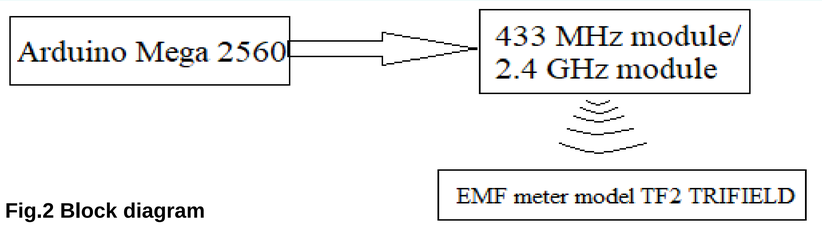

Fig.2 Block diagram

Conclusions:

Also, if we take into account instead the programming module of the two modules and the efficiency, for this category I consider that the nRF24L01 module that uses the 2.4GHz frequency is superior to the module that uses the 433 MHz frequency.

From the point of view of electromagnetic radiation, both modules are equivalent. The level of radiation is normal, which does not affect the health of people around. It is also observed that in the case of both modules the magnetic radiation decreases if the distance between the measuring equipment and the emission source increases. Also, the electric radiation remains approximately constant throughout the measurement period.

The main conclusion is that each type of project involves certain functionalities and depending on them the optimal communication module is chosen because each module has its advantages and disadvantages.

Results

The maximum distance each module can transmit has been determined by increasing the distance between the transmitter and receiver until the connection is lost. In this measurement it was found that the module that operates on the 433MHz frequency emits at a much greater distance than the module that operates on the 2.4 GHz frequency. For the 433 MHz working frequency module, the maximum distance it emitted is about 120 meters in the open field, while the 2.4GHz operating frequency module emitted at a maximum distance of about 40 meters.

References:

[1] https://www.electronics-lab.com/using-433mhz-rf-transmitter-receiver-arduino/
[2] https://www.optimusdigital.ro/ro/ism-24-ghz/48-modul-tranceiver-nrf24l01-24-ghz.html
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