

Changing the detection range of waypoints in nRFready R/C racing

nAN24-16

Application Note v1.0

Keywords

- Detection range
- Output power
- Data rate

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1 Introduction

This application note describes why the detection range between the R/C (Radio Control) car and the waypoints may differ depending on your location, and how to change the system parameters to achieve a detection range that suits your environment.

The detection range between the car and the waypoints is set up to be approximately 1 meter when the race track is set up on solid ground. However, if you have the waypoints on non-solid ground (for example, in a house without reinforced concrete floors), the range where the car can detect the waypoints increases and the determining the location of the car becomes less accurate.

2 Detection range overview

The detection range between the car and the waypoints relies on the following four factors:

- Communication environment (especially the presence of large ground bodies)
- Antenna gain
- Waypoint output power
- System data rate

Even with antenna gain, waypoint output power, and the system data rate staying constant, the detection range of the RF link will change due to the communication environment. To control the detection range, you must modify the waypoint output power and/or system data rate to compensate for these changes.

To reduce the detection range of a waypoint you need to lower the waypoint output power and/or increase the system data rate and the opposite applies if you want to increase the detection range. Waypoint output power and system data rate are parameters that can be adjusted in the firmware.

[Table 1.](#) describes the theoretical effect these two parameters have on the detection range and refers to the default setting which is 250 kbps data rate and -18dBm waypoint output power.

	System data rate		
Waypoint output power (dBm)	250 kbps	1 mbps	2 mbps
-18	1x*	0.35x	0.25x
-12	2x	0.7x	0.5x
-6	4x	1.4x	1x
0	8x	2.8x	2x
*Default setting for nRFready R/C Racing			

Table 1. Detection range for waypoint transmitter output power and data rate settings

If you experience 1 meter detection radius with the default setup, you can reduce this radius to 0.5 meters by using 2 mbps data rate and -12 dBm waypoint output power. If you want to increase the radius to 1.4 meters you could, for example, use 1 mbps data rate and -6 dBm waypoint output power.

Changes to the system data rate influences the maximum range you achieve on all devices (cars, controllers, waypoints and dongles), while changing the waypoint output power only influences the range to a waypoint.

3 Implementation

In nRFready R/C racing the firmware functionality enabling you to change transmitter output power and the data rate settings 'on the go' have not been included, this means that changes to the firmware are necessary. However, these changes are relatively minor. If you are designing a toy that can be used in different environments (for example, both indoors and outdoors), it is worth considering the option of adding user selectable output power on the waypoints for more flexibility.

3.1 Changing the output power from a waypoint

1. Go to **C:\Nordic Semiconductor\nRFready RC Racing v1.0\Source code\firmware\projects\nRFready_RC_Racing\waypoint** and open the **main_waypoint.c** file.
2. Go to line 60.
3. Change **HAL_NRF_18DBM** to **HAL_NRF_12DBM**, **HAL_NRF_6DBM** or **HAL_NRF_0DBM** depending on the output power you want (-12dBm, -6dBm or 0dBm).
4. Recompile the waypoint project.
5. Upload the new hex file to the waypoint.

3.2 Changing the system data rate

1. Go to **C:\Nordic Semiconductor\nRFready RC Racing v1.0\Source code\firmware\projects\nRFready_RC_Racing\common** and open the **gzll_params.h** file.
2. Go to line 49 where you will find a define that controls the data rate: **#define GZLL_DATARATE GZLL_DR_250KBPS**.
3. Change **GZLL_DR_250KBPS** to **GZLL_DR_1MBPS** or **GZLL_DR_2MBPS**.
4. Compile all the projects.
5. Upload the new hex files to all the devices (cars, controllers, waypoints and dongles).

Note: When using the code base of nRFready R/C racing v1.0, the system data rate must be fixed at compile time for all the components.

4 Conclusion

The output power and 250 kbit default system data rate used in nRFready R/C racing was selected for its good range from controller to car and for giving a reasonable waypoint detection range (approximately 1 meter) given the scale of the cars and the size of the race track. However, by changing the output power and/or the system data rate you can customize nRFready R/C racing to suit the needs of different environments.

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