

Jota Game board description

Introduction

This Jota Game board is partly based on the JUBI-GAME board that was developed in 2010, which is no longer available. For this board a different Microcontroller, a PIC, is used and different games have been developed. Next to that, the software is written in JAL (Just Another Language) and the software can later be used to develop your own game. In a separate manual you can read what you need for this.

But first you need to assemble the board before you can use the Jota Game board.

If you already want to know the features of this board, have a look at the following Youtube video: https://youtu.be/oen_fmnmz0

The hardware

Components

The complete Jota Game board consists of the following components:

- 1 printed circuit board (PCB)
- 2 switches, MENU (left) and START (right)
- 8 game LEDs (1..8), 4 red, 2 yellow and 2 green LEDs
- 1 red GO LED (at the MENU switch), 1 green OK LED 😊, 1 red NOK LED 😞
- 11 resistors of 82 Ohm, 2 resistors of 10 kOhm
- 1 programmed PIC Microcontroller 16F1829
- A 20 pin IC socket for the PIC Microcontroller
- 2 battery holders for AAA batteries
- Optional: 6-pin Connector for reprogramming the PIC Microcontroller
- Optional for the infra-red part:
 - Resistor of 8.2 Ohm, resistor of 330 Ohm, resistor of 10 kOhm
 - Transistor BC640
 - Infra-red LED
 - Infra-red receiver TSOP4838

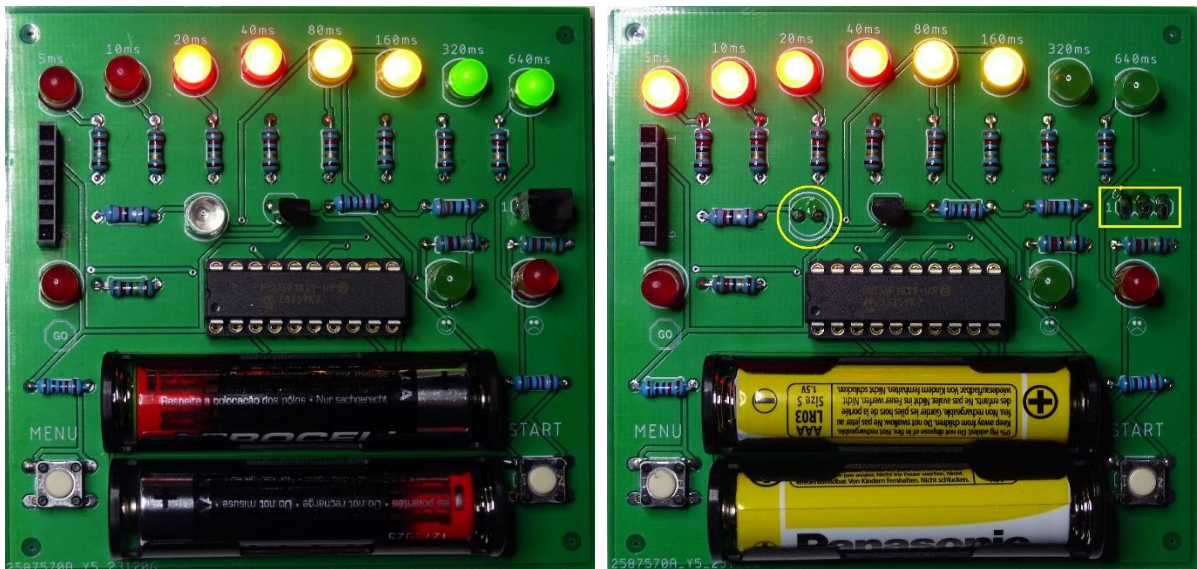
The preferred way of assembling the board is described later in this document. If you have assembled the board the assembled PCB will look like the pictures given below.

In the following pictures you will find two ways of assembling the infra-red components (the infra-red LED and the infra-red receiver).

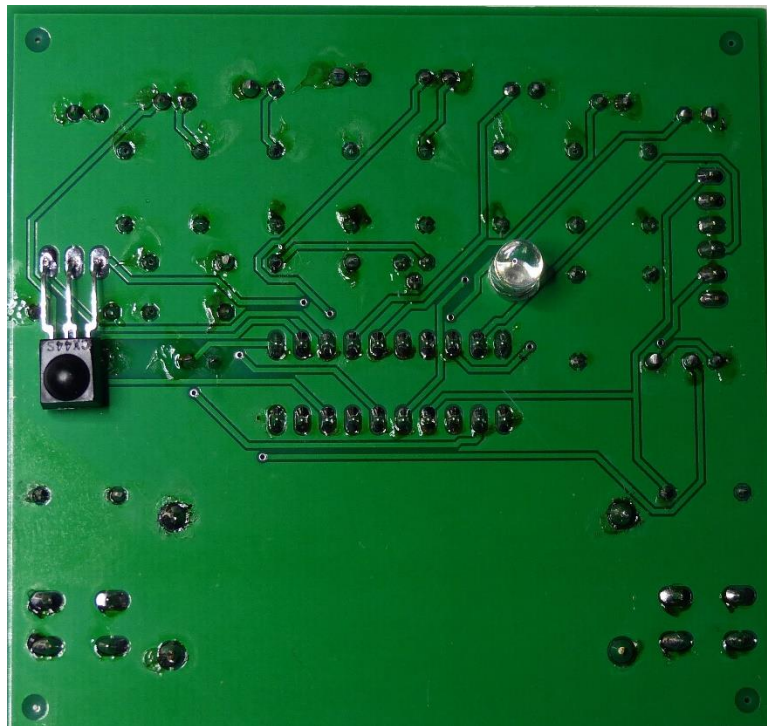
1. Both at the side where all components other are assembled.
2. On the other side of the PCB. Due to this way of assembling the range of the infra-red communication is extended because the infra-red signal is then directly sent to the other side and not indirect (assuming that you keep the board facing towards you).

Assembled board

The board on the left shows the infra-red components assembled at the component side. The board on the right show the infra-red components assembled at the back of the board (yellow markings).



Back of the board where you can see the infra-red LED and the infra-red receiver.



Power on

The Jota Game board operates on two alkaline AAA batteries. Together they supply the board with a supply voltage of 3 Volt. The infra-red receiver operates from a minimal supply voltage of 2.5 Volt. The PIC Microcontroller operates from a minimal supply voltage of 2 Volt. You could use two rechargeable batteries that will generate a supply voltage of 2.4 Volt but in that case the games that use the infra-red components will not work. You can still use the other LED games and LED patterns.

After installing the batteries, all game LEDs will turn on shortly and a random LED pattern is shown. After that a so called walking menu can be activated by pressing the MENU switch or the START switch.

Functions

You can select a function by using the walking menu. The game LEDs will light up one after another. As soon as you press the MENU switch or the START switch, the function that belongs to the selected LED will be activated. There are 8 possibilities from the most left game LED (red) to the most right game LED (green):

1. Light house (red LED)
2. Snake (red LED)
3. Knight Rider (red LED)
4. Simon Says (red LED)
5. Jota Game (yellow LED)
6. Pong (yellow LED)
7. Morse (green LED)
8. Battle ship (green LED)

Light house (LED pattern)

The GO LED will blink shortly. The power consumption is low, about 1.5 mA. The blinking stops as soon as one of the switches is pressed after which the walking menu will be shown.

If no switch is pressed for 3 minutes, the Microcontroller will go to sleep and the GO LED is turned off. In the sleep mode hardly any power is used which saves the batteries. It is not necessary to remove the batteries in the sleep mode.

After pressing one of the switches when in sleep mode, the light house will be activated again and the GO LED will blink shortly.

Snake (LED pattern)

This pattern starts with 1 LED that goes from left to right. As soon as the LED on the right is reached, the pattern starts again on the left but now with two LEDs. This continues until all LEDs are turned on after which the pattern starts again with 1 LED on the left. This pattern stops as soon as one of the switches is pressed, after which the walking menu is activated.

Knight Rider (LED pattern)

This pattern shows 4 LEDs that move from left to right and back again. The pattern comes from the series Knight Rider. This pattern stops as soon as one of the switches is pressed, after which the walking menu is activated.

Simon Says (Memory game)

This is a memory game. It starts with 1 LED that is turned on shortly. When the LED is off, the player has to select this LED using the two switches. A LED is turned on and with the MENU switch you can move the turned on LED to the left. The START switch will move the turned on LED to the right. As soon as the right LED is selected, the player has to keep one of the switches pressed for a longer time. This will confirm the selection after which the OK LED will be turned on for a short time. When the right LED was selected the game continues but now with two LEDs being turned on shortly. Note that it is possible that the same LED is turned on twice. When the player makes a mistake, the NOK LED will be turned on shortly. When a player makes a mistake the NOK LED will turn on shortly. The game can then be restarted by pressing the START switch. Pressing the MENU switch will then end the game.

When the player remembers up to 8 LEDs correctly the winner pattern will be shown when the game ends. This is a kind of fire works pattern which starts with the 2 LEDs in the middle after which the LEDs on the left and the LEDs on the right will turn on. If the player does not remember the pattern up to 8 LEDs and the game is stopped, a bar graph pattern is shown as high score. After pressing one of the two switches the walking menu will be shown again.

Jota Game (Reaction Game)

When the game starts, a reaction time is shown for 2 seconds. Purpose of the game is to respond within the given reaction time by pressing the START switch as soon as the GO LED turns on. If the player succeeds, the OK LED will turn on and the reaction time will be shorter in the next round. If the player does not succeed then the NOK LED will turn on and the reaction time will be longer. When the player presses the START switch too soon the player is 'punished' because a LED bar will appear and the player has to wait until it slowly disappears by each LED going off once every second.

From left to right the LEDs represent the following reaction times: 5 ms, 10 ms, 20 ms, 40 ms, 80 ms, 160 ms, 320 ms and 640 ms. The final reaction time is the total of the LEDs that are turned on. When the player waits longer than 1275 ms then all LEDs are turned on and the NOK LED will light up.

The times within which the player has to respond are: 1 s, 600 ms, 400 ms, 300 ms, 280 ms and 240 ms. If the player succeeds to respond within all these reaction times, the game ends. Does the player not succeed, the game can be ended by pressing the MENU switch or the player can restart the game by pressing the START switch. When the game ends and the player has reacted within all these reaction times, the winner pattern is shown, if not the bar graph is shown. After pressing one of the two switches the walking menu will be shown again.

Pong (Reaction Game)

The game starts with the left most LED and continues to the right. As soon as the right most LED is turned on, the player has to press the START switch. If done in time the OK LED will turn on shortly and the pattern continues to the left but will go a little bit faster. When the left most LED is turned on again the player has to press the MENU switch. As long as the player reacts in time the pattern goes from left to right goes faster. When the player presses the switches too soon or too late the NOK LED will turn on and the pattern will slow down. In this situation the player can press the START switch to restart the game or the MENU switch to end the game.

There are 10 rounds. If the player wins all rounds the winner LED pattern is shown when the game ends, if not the bar graph is shown. After pressing one of the two switches the walking menu will be shown again.

Morse (Infra-Red game)

You can only play this game when the infra-red components are assembled on the board. You have to be sure that the players that are playing this game have the same infra-red address, otherwise the communication will not work. By default each Jota Game board has the same infra-red address but this address can be changed. Later in the manual you can read how the infra-red address can be changed.

The game is played with 1 player that sends the morse signals and 1 or more players that receive the morse signals. When the game is started an alternating dot pattern (2 LEDs) or dash pattern (8 LEDs) is shown. The player can then select what he wants to do. If the player presses the START switch, then the player becomes transmitter of the morse code. When pressing the MENU switch, the player becomes the receiver of the morse code.

Now the game can be played. The sender can send messages to 1 or more receivers using morse code. The game can be stopped – both for the sender and the receiver – by pressing both the MENU switch and the START switch at the same time after which the walking menu is shown again.

Sending morse code

As sender of the morse code, the player can select a dot (2 LEDs) using the MENU switch or a dash (8 LEDs) using the START switch. By pressing the MENU switch or START switch for a longer time, the dash or dot is transmitted via infra-red and the OK LED will light up shortly. The player can repeat this until the whole message was transmitted in morse code.

Receiving morse code

Multiple players can receive the transmitted morse code. The transmitted morse code is shown as dot (2 LEDs) or dash (8 LEDs). Each time a new message is received, the OK LED will light up shortly.

Because the sender of the morse code does not know if a receiver has received a message, it is important that there is a good infra-red connection. In general this means that sender and transmitter should not be too far apart and have a good line of sight.

Battle ship (Infra-Red game)

This game is played with 2 players. Make sure that both players have the same infra-red address otherwise communication is not possible. By default each Jota Game board has the same infra-red address but this address can be changed. Later in the manual you can read how the infra-red address can be changed.

The game starts by showing 5 random boats that your opponent has to destroy. This random pattern changes every 2 seconds until one of the switches is pressed. When a switch is pressed, the boats that were shown will be the ones that your opponent has to sink. The GO LED will light up. Each player takes turns. Before starting the game you have to decide which player starts in order to sink one of the ships of the opponent.

Sinking a ship

In order to sink a ship of your opponent you have to select one ship. Pressing the MENU switch selects moves your selection to the left, pressing the START switch moves your selection to the right. By pressing one of the switches for a long time you will fire the selected ship to your opponent. Since you do not know if you hit a ship of your opponent you have to remember which ship(s) you already used to fire. After firing, switch turns.

When firing, both the OK LED as well as the NOK LED will light up. When your action was received by your opponent the OK LED stays on. If the actions failed the NOK LED stays on. An action can fail when there is no infra-red link between the two Jota Game boards. This may mean that you did not sink a ship of your opponent. In order to prevent this makes sure that you are not too far away from your opponent but make sure that you cannot see which ships your opponent had selected.

When you fire, selected ship will blink at the side of your opponent. If there was indeed a ship present, it will sink.

End of the game

The game ends when all ships of one of the players sank. The end of the game is detected automatically and the GO LED will turn of for both players. The winner sees the winner pattern until one of the switches is pressed. At the opponent side, all LEDs (ships) are off and the NOK LED is on. After two seconds the Jota Game board returns to the walking menu.

Special functions

Changing the infra-red address

By default each Jota Gama board has 1 as infra-red address. You can change this by keeping both switches pressed while installing the batteries. You will see that the first LED will be on which means that the infra-red address is set to 1. By pressing the START switch you can increment the infra-red address and by pressing the MENU switch you can decrement the infra-red address. The infra-red address range is between 1 and 254. The LEDs 1 to 8 will show the infra-red address in binary notation. When pressing both switches at the same time, the infra-red is stored in non-volatile memory and stays at that value until the address is changed again.

A special infra-red address

There is one special infra-red address and that is address 0. This infra-red address is called a broadcast address and it can be used for the Morse game. All Jota Game boards respond to their own infra-red address but also on the broadcast address. It is not possible to select this address as described before but can only be set by programming the PIC Microcontroller. See the separate document about programming the PIC Microcontroller

The broadcast address makes it possible to address all other Jota Game board from one transmitter at once even if they would all have a different infra-red address.

Durability

The Jota Game board is equipped with some features that improve durability.

Batter saver

When the Jota Game board is activated, it starts with a random LED pattern. After 1 minute the board switches over to the walking menu. Again, after 2 minutes, the Jota Game board switches over to the light house. In this way power is saved. Again after 3 minutes the Jota Game board goes into sleep mode in which it hardly consumes any power. In this mode the power consumption is so low that the batteries can stay in the Jota Game board.

Next to that there is another power saving features and that is if the user stops playing a game but the game was not yet completed. If, in this situation, there is no activity for 5 minutes, the Jota Game board will reset itself which is the same behaviour as installing batteries. It then starts with the random LED pattern followed by the walking menu and the light house and finally goes into the sleep mode again.

(Re)Programming

The Jota Game board has a connector for reprogramming the PIC Microcontroller. Using this feature you can change the games on the Jota Game board and even create your own game. The software for the Jota Game board is written in the JAL programming language. A separate manual was made for (re-)programming the PIC Microcontroller and for changing the software.

Assembly Instructions

All components, but with the possible exception of the infra-red LED (LED 12) and the infra-red receiver (TSOP4838), are mounted on the printed side (component side) of the printed circuit board (PCB). The infra-red LED and infra-red receiver can be mounted on the opposite side of the PCB as can be seen in the schematic diagram and the PCB layout in the next section.

Alle componenten, met mogelijk als uitzondering de infra-rood LED (LED 12) en de infra-rood ontvanger (TSOP4838,) worden aan de bedrukte zijde (de componentzijde) van de print gemonteerd. De infra-rood LED en ontvanger kunnen dus ook aan de andere zijde van de print gemonteerd. Zie verderop voor het schema en print layout.

Recommended order of assembling the components

At the printed side of the PCB (component side)

1. The 20-pin IC socket. Make sure that the notch of the IC socket matches the notch on the PCB.
2. Both switches. They should easily fit on the PCB, if not the switch must most likely be rotated 45 degrees.
3. Resistors R1, R2 and R3 (10k). Make sure you have the correct resistor values (colors). See the table below about color codes of resistors
4. Resistors R1 t/m R14 (82).
5. Resistor R15 (330)
6. Resistor R16 (8E2)
7. Red LEDs. LED1, LED2, LED3, LED4, LED9 and LED11. Make sure that the flat side of the LED matched the print on the PCB so pointing to the left. This is also the shortest leg of the LED.
8. Yellow LEDs. LED5 and LED6.
9. Green LEDs. LED7, LED8 and LED 10.
10. Transistor Q1.
11. Connector SV1.
12. Mount the infra-red components at the component side or at the back side (see next section).
13. Two battery holders. Make sure they are mounted correctly. **Important. The print on the original PCB is not correct. See the print layout later in this instruction how to mount them. The spring of the battery holder is the ground connection (-).**
14. The PIC16F1829 (IC1) Microcontroller. Make sure that the notch is on the correct side and that the legs are not bended

At the back side:

Make sure that the components are mounted correctly at the back side. An the printed side of the PCB they are printed as they are mounted on the component side, not the back side.

1. Infra-red LED (LED12).
2. Infra-red receiver (IR1). Bend the legs of the infra-red receiver so that it can be mounted in a laying position. Make sure the connection is correct. See the example of the assembled board at the begining of this document.

Pin 1 of the infra-read receiver is the most left pin if you put the infra-red receiver on a flat surface on its back.

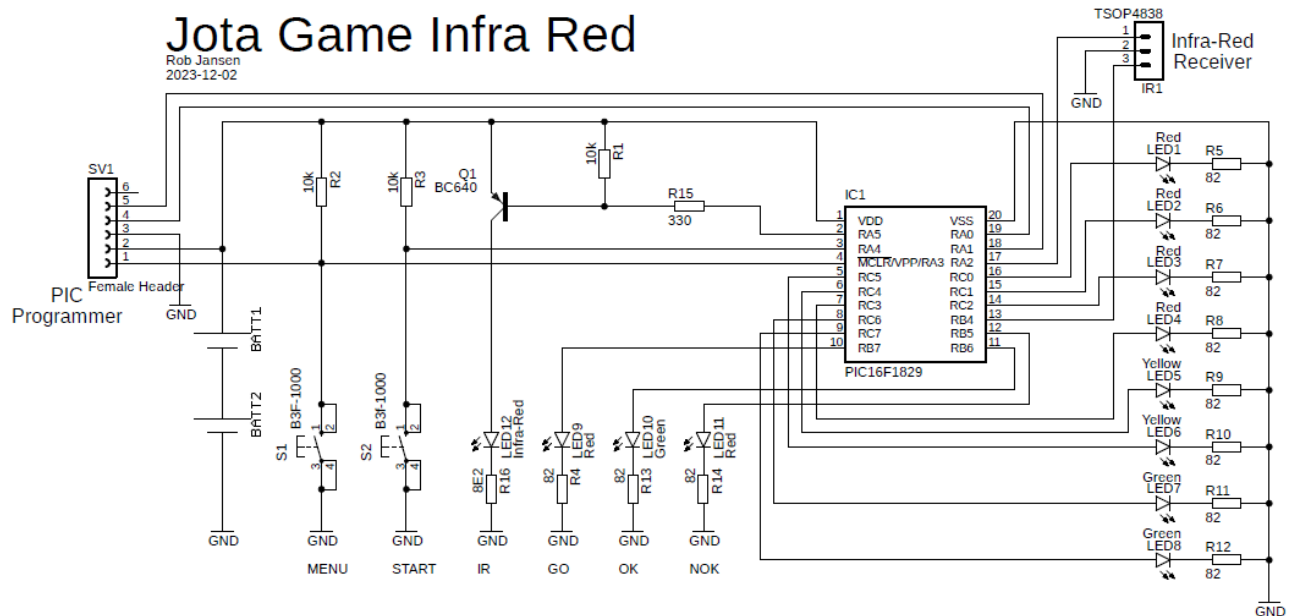
Resistor values

There are various types of resistors, each with a different color scheme. The most commonly used resistors are carbon resistors and metal film resistors. The latter have a lower tolerance. Carbon resistors have 4 color rings where the last ring is often gold or silver. Metal film resistors have 5 color rings where the last ring is often brown or red. The next table gives an overview of the resistors used for the Jota Game board and their colors.

Resistor value	Kleuren koolweerstand	Kleuren metaalfilmweerstand
8,2 Ohm (8E2)	Grey-red-gold-gold	Grey-red-black-silver-brown
82 Ohm (82E)	Grey-red-black-gold	Grey-red-black-gold-brown
330 Ohm (330E)	Orange-orange-brown-gold	Orange-orange-black-black-brown
10 kOhm (10K)	Brown-back-orange-gold	Brown-black-back-red-brown

Let op dat je de 8,2 Ohm en 82 Ohm weerstanden niet door elkaar haalt!

Schematic diagram of the Jota Game board



Print layout of the Jota Game board (component side)

Important. In this layout the print of the battery holder has been corrected and is shown correctly.

