

DQMusicBox - music player for people with dementia

How to build one - it's easy

14 January 2017, rosswesleyporter@gmail.com






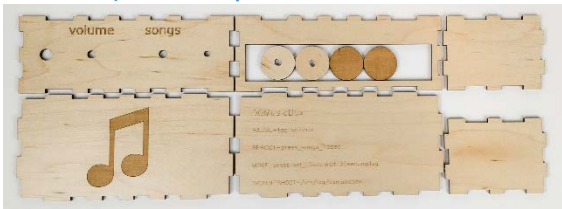
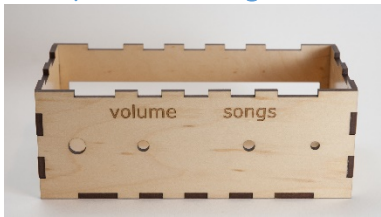
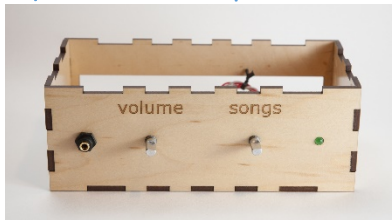

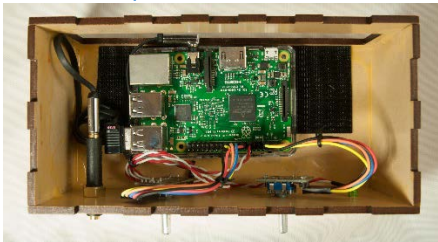

My Dad could not operate normal music players. But he could operate this music player because it operates like a familiar two-knob radio. My son & I were inspired to design this by the documentary [Alive Inside](#) which shows the profound joy felt by some people with dementia when listening to their favorite music.

It's easier than you think to make one. Everything I did (e.g. software, wood case design) is open source. This document contains all the information you need. You can order the parts online. No soldering required.

| | |
|-----------------------------|---|
| Parts cost | \$130 - \$170 depending on options + tax + shipping most parts from Amazon, includes headphones. |
| Music cost | Minimal as you should use the recipient's existing music collection. |
| Build time | About three hours, once you have the parts & music. |
| Parts source | All parts can be mail ordered, links below. |
| Soldering? | No. |
| Command-line Linux? | No. |
| Tools needed | A computer with an SD card reader, fingers. |
| Laser cutter needed? | No. You can mail order the pre-cut pieces for the wood case. |
| Beverage? | Yes. I recommend a hoppy IPA while you are assembling. |



1 Preview of the steps

| | | |
|---|--|--|
| <p>1) Order parts from Amazon, eBay, Ponoko</p>  | <p>2) Assemble recipient's favorite music</p>  | <p>3) Copy software to micro-SD card</p>  |
| <p>4) Receive parts from Ponoko</p>  | <p>5) Glue case together</p>  | <p>6) Screw in front panel items</p>  |
| <p>7) Place Pi</p>  | <p>8) Connect wires</p>  | <p>9) Enjoy</p>  |

2 No warranty

USE THESE DQMUSICBOX PLANS AND SYSTEM AT YOUR OWN RISK. THE DQMUSICBOX PLANS ARE PROVIDED AS IS WITHOUT WARRANTY OF ANY KIND EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PLANS AND SYSTEM IS WITH YOU. SHOULD THE PLANS OR SYSTEM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION. IN NO EVENT WILL ANY PARTY BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PLANS OR SYSTEM.

3 Acknowledgements

People were very generous with their time, and I really enjoyed the experience. This is certainly an incomplete list: Alex & Mike & others at [Ada's](#), the super smart staff at [Metrix](#), neighbor Randy, [Stephen Christopher Phillips](#), [Bob Rathbone](#), [Stephen Rusk](#), [Graham Hill](#), support at [Ponoko](#), and my son.

4 Change log

| | |
|----------------------|---|
| v1.0, November 2015 | Original release |
| v1.1, September 2016 | <ul style="list-style-type: none">• Changed music storage from a micro-SD memory card to a conventional USB memory stick.• Changed the base Operating System from full Raspbian to DietPi – much smaller, so faster to boot, and less to go wrong. |
| V1.2, January 2017 | <ul style="list-style-type: none">• Changed from USB audio to Pi built-in audio, including a firmware update for excellent audio quality. |

5 What DQMusicBox does

5.1 For the person with dementia

| Name | Description & implementation |
|---------------|--|
| Start song | Turning either of the knobs will start music playing. |
| Change song | Turn the songs knob. |
| Change volume | Turn the volume knob. |
| Pause | Tap the volume knob. Note that this also happens automatically – music pauses if there are no knob events in one hour. |

5.2 For you

| Name | Description & implementation |
|------------------|---|
| Shut down | Pull the power plug or long hold (15-30 seconds) on the volume knob. |
| Reboot | Pull the power plug and re-insert or long hold (15-30 seconds) on the songs knob. |
| Add/remove music | By adding/removing files on the USB memory stick. |

6 Things you don't need to do

I have done a number of things for you. If you have done other projects, you might assume that you have to do the things below. But don't. Unless you want to customize.

| | |
|---|--|
| Don't connect the Pi to a monitor and keyboard | There is no need to connect the Pi to a monitor and keyboard as part of this build process. In fact, the sound system can behave differently if a monitor is connected. |
| Don't connect the Pi to a network | There is no need to connect the Pi to a network as part of this build process. Nor does the Pi need to be on a network to operate as a music player. In both cases this is deliberate – want to keep it simple and safe. That said, you can connect it to a network from time to time if you wish. |
| Don't login to the Pi | You don't need to. But if you wish to, the username=root password=dietpi i.e. unchanged from the DietPi defaults. |
| Don't go to github | Everything is in the mini distribution that you will download below. But this is an open source project, so naturally everything is in github if you want to poke around. https://github.com/rosswesleyporter/dqmusicbox |
| Don't put stain on the maple case | <p>The maple case is the default wood case (see below). It's a prefinished maple, so you don't need to stain it. In fact, I don't recommend adding stain because darkening the wood will reduce the legibility of the knob labels.</p> <p>If you order the birch case, different story. The birch case is unfinished. I suggest using a soft cloth to rub on some regular olive oil. That will provide a bit of protection and won't reduce the legibility of the knob labels. I am not a woodworker. If you are a woodworker and have a better suggestion, I'd love to hear it.</p> |

7 Ordering the parts

7.1 Create a Ponoko account

Ponoko is a company that laser cuts wood and sends you the precisely cut pieces. You don't need to use Ponoko – you are welcome to take my case design files to your local maker space and cut there. In other words, Ponoko is convenient but not necessary. To create a Ponoko account:

1. Go to <https://www.ponoko.com/>
2. Choose “Get Making”

7.2 Order the parts

| Link to order item | Notes | Alternatives |
|--|--|--|
| DQMusicBox wood case (maple veneer) | From the linked page, choose “Add to Personal Factory”. | The birch veneer case is \$25 less, but the wood is unfinished. Or do the laser cutting yourself. |
| Raspberry Pi 3 Complete Starter Kit (the brains) | Includes a Raspberry Pi 3, plastic case, power supply, micro-SD card. And an unneeded heat sink. | You can also use a Pi 2 or a Pi A+. You will need a small case, power supply and micro-SD card. |
| KY-040 rotary encoder knobs | | If no longer available from this source, you can order from Amazon , but then follow the instructions below for reversing the yellow and orange wires. |
| StarTech inductor LED | | |
| USB 2.0 8GB thumb drive | | Or use your own USB memory stick, but it needs to be physically small as there isn't much space in the wood case. |
| Female-female jumper wires | | |
| 1ft male-male headphone cable | | |
| Panel mount headphone jack | | |
| Sticky back velcro | | Or use the sticky back Velcro that you already have. |
| Elmer's wood glue | | Or use the wood glue you already have. |
| AmazonBasics Lightweight On-Ear Headphones | | Or if the recipient already has familiar good headphones, use those instead. Or for \$9 less, use these not-quite-as-nice Panasonics . |

Check to see if your computer has an SD-card reader. If not, your spouse/child/friend probably has one. If not, you can order a [USB SD-card reader](#) for your computer.

Note that this project uses the built-in headphone jack on the Raspberry Pi. And it makes use of some new software from the Raspberry Pi Foundation that makes for excellent audio quality. Previous versions of this project used a USB audio adapter, but that's not necessary any more.

8 Assemble the personalized collection of music

8.1 Choosing the music – go for familiar favorites

This is the most important step. The personalized (familiar) music is the fundamental magic. You don't need much music, perhaps 6-10 albums. But only familiar favorites. One of the few benefits of dementia is that you don't remember what you just listened to and thus don't get tired of your favorite albums. In my case, my Mom mailed me my Dad's favorite CDs. It will take two weeks for the parts above to arrive, so you have time to do this well.

8.2 Put the music on the USB memory stick

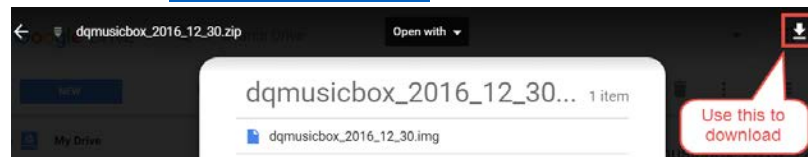
Organize the digitized music into folders on the USB memory stick, one folder per album. MP3, iTunes, and FLAC files are supported i.e. files with extensions .mp3, .m4a, .flac. In the end, you should have a set of folders that looks something like this:

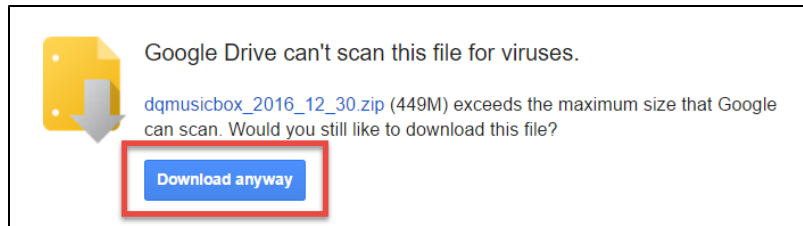
| Name | Date modified | Type |
|--|--------------------|-------------|
| A_Beethoven9 | 10/24/2015 6:25 PM | File folder |
| B_Eli_Porter_-_Eli_Porter | 10/24/2015 6:25 PM | File folder |
| C_Mozart_-_Overtures | 10/24/2015 6:25 PM | File folder |
| D_Tchaikovsky_-_Concerto for Violin i... | 10/24/2015 6:25 PM | File folder |
| E_Vivaldi_Telemann_Bach_Mercadante... | 10/24/2015 6:25 PM | File folder |
| F_Samuel Barber_-_Barber; Adagio for ... | 10/24/2015 6:26 PM | File folder |
| G_James Galway_-_Serenade | 10/24/2015 6:26 PM | File folder |
| H_Giacomo Puccini_-_Madama Butter... | 10/24/2015 6:26 PM | File folder |
| I_Giacomo Puccini_-_Madama Butterfl... | 10/24/2015 6:26 PM | File folder |
| J_Giacomo Puccini_-_Madama Butterf... | 10/24/2015 6:26 PM | File folder |
| K_Leontyne Price_-_Arias | 10/24/2015 6:26 PM | File folder |

9 Prepare the micro-SD memory card

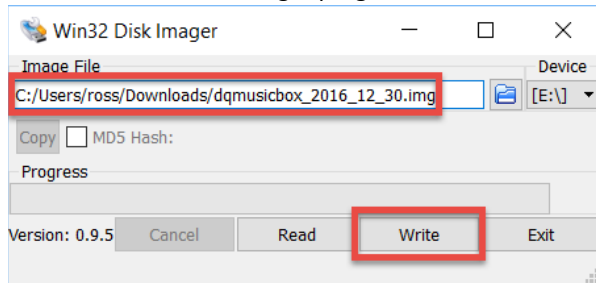
I prepared a disk image for you. Your job is to download this disk image and then write it to the micro-SD card. The steps:

1. If you are using Windows, install [Win32 Disk Imager](#). This is what I use. If you are using a Mac, try [Etcher](#). Or try [ApplePi-Baker](#) (if a recent version e.g. v1.9.4 doesn't work for you, try v1.5.1).
2. Download the [DQMusicBox disk image](#). 449MB.





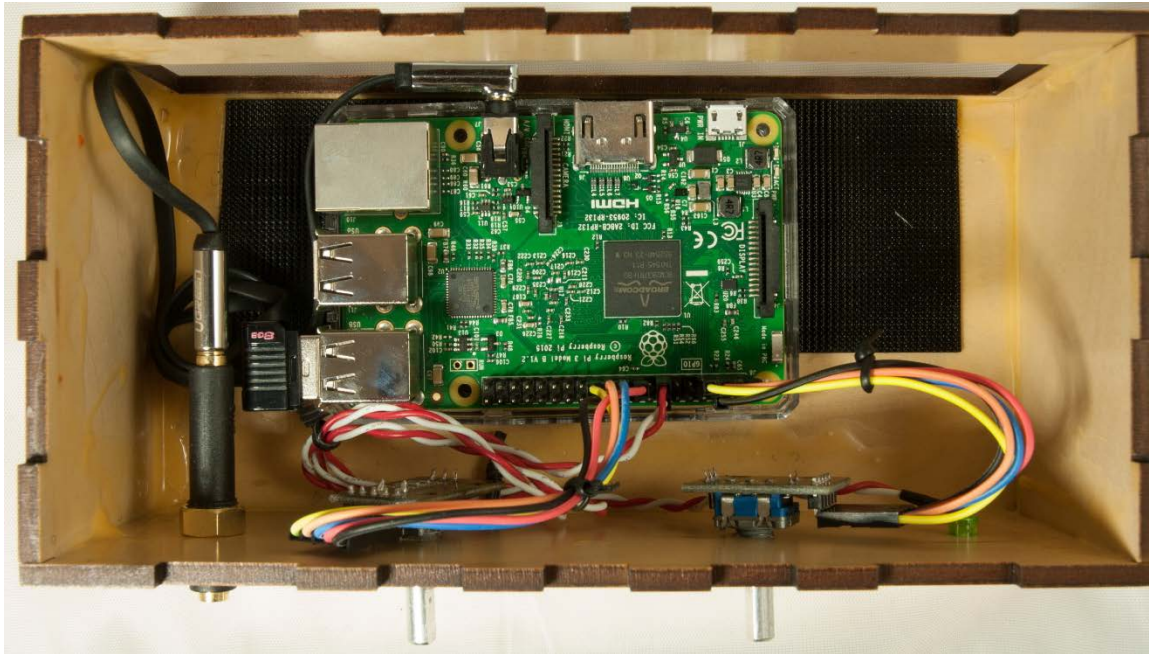
3. Unzip to extract dqmusicbox_2016_12_30.img.
4. Put the micro-SD memory card into the SD card adapter i.e. put the tiny card into the larger card.
5. Put the SD card adapter into the SD reader/writer in your computer.
6. Start the Win32 Disk Imager program, instruct it to write the image file to the SD card:



7. Wait for the writing to complete, ~10 minutes. This would be a good time to make a sandwich.

10 Put it all together

What you should end up with (with top removed):



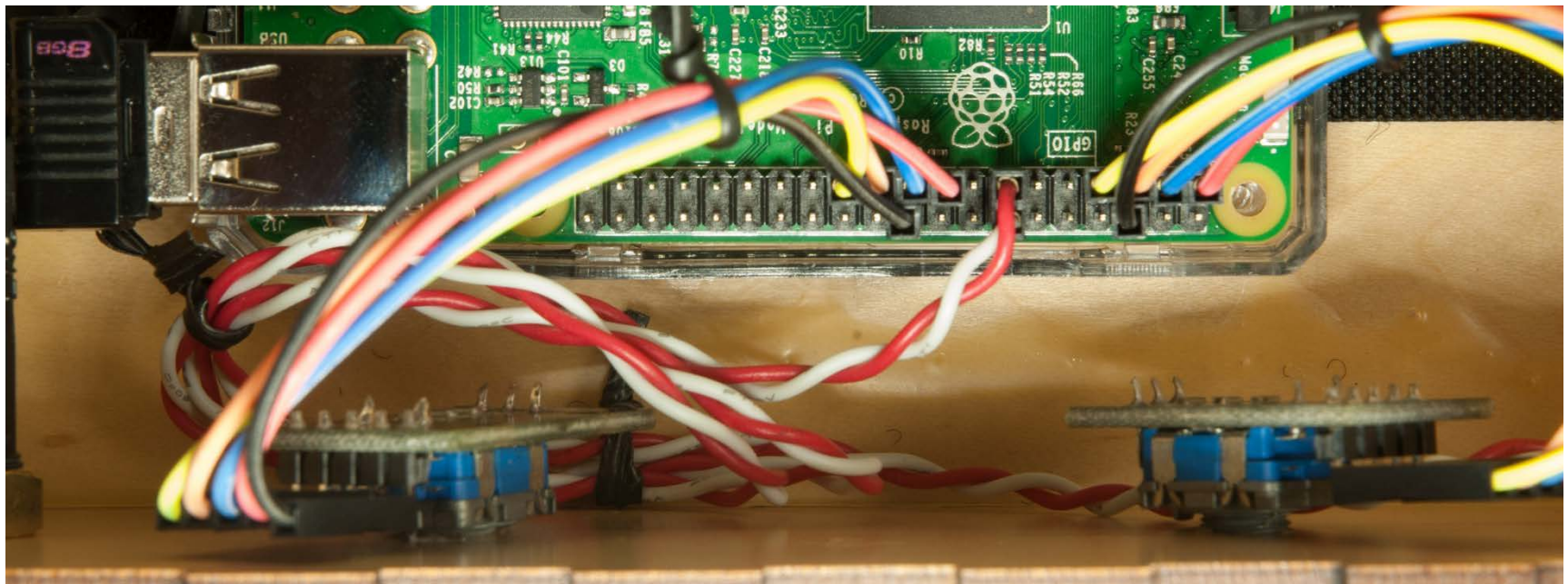
I don't think you need all the steps listed out. But here are a few tips for putting it all together:

1. Glue the bottom and sides of the wood case. Put the top on, but don't glue it. Use painter's tape or other to hold the box together while the glue dries.
2. Put the Raspberry Pi into the plastic case.
3. Insert the USB memory stick into a USB port on the Raspberry Pi.
4. Put the micro-SD memory card into the Raspberry Pi memory card slot.
5. Use Velcro to hold the plastic case (and its contents) in place in the wood case.
6. Mount the rotary encoders in the two medium-sized holes in front panel.
7. Mount the headphone jack in the large hole on the front panel.
8. Connect the headphone jack on the Pi to the headphone jack that you just installed in the case.
9. Find the indicator LED labeled HDD. Push this LED into the small hole in the front panel, it should fit snugly.
10. Mount the headphone jack connector in the large hole in the front panel.
11. Now add the wires:

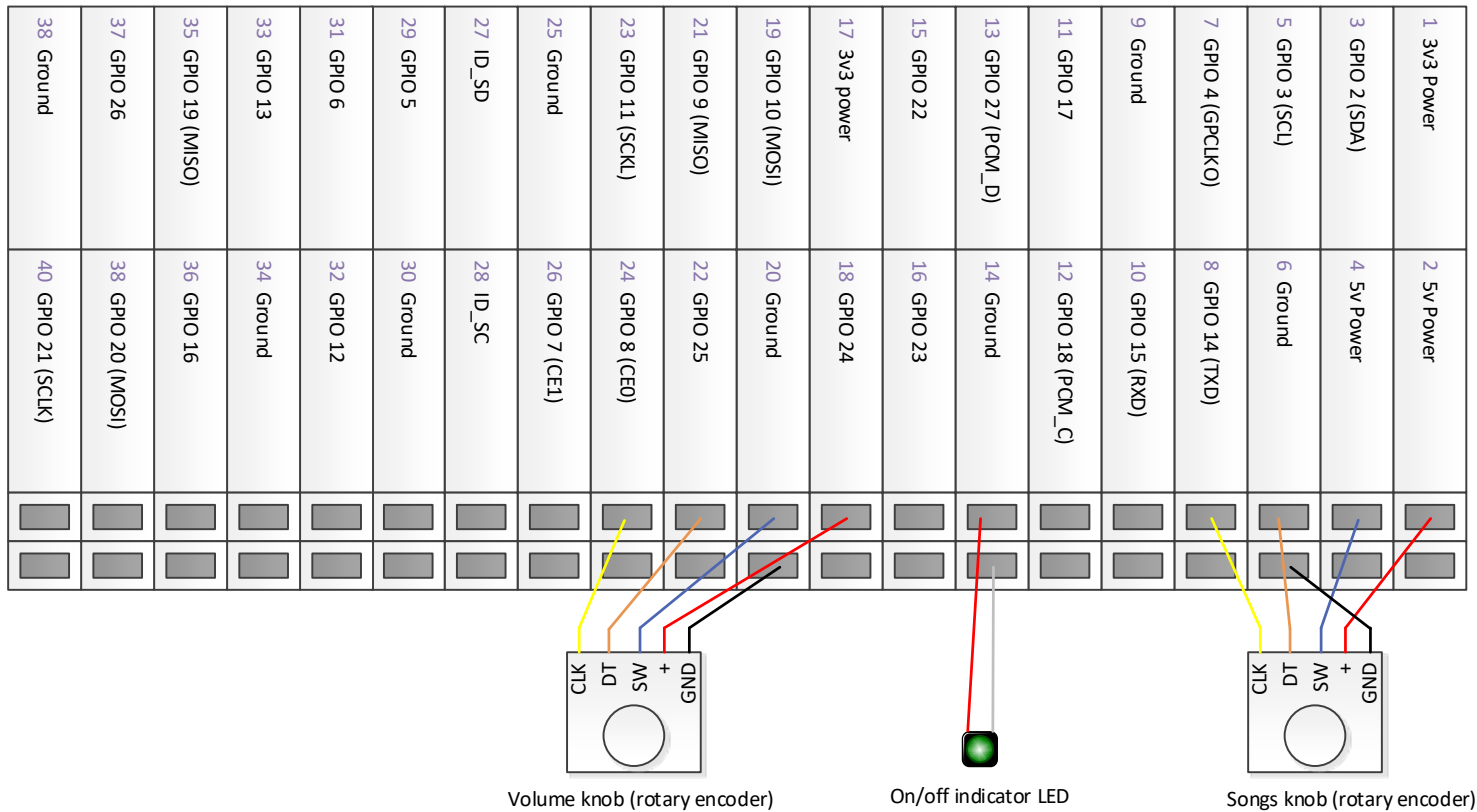
You'll start from the unused pins on the Pi, which are arranged in two rows of twenty pins:



Your goal is to make it look like this:



Use the wiring diagram below to make the right connections. Just push the jumper cables in place – no soldering unless you really want to.



Note: the various rotary encoder manufacturers don't seem to agree on which pin indicates clockwise and which pin indicates counter-clockwise. If your music box is so reversed (e.g. if a clockwise turn *decreases* volume), then just change the orange & yellow wires on the rotary encoders:

- For the volume knob rotary encoder:
 - Leave the orange wire on pin 9 on the Pi, but now connect the orange wire to the CLK pin on the rotary encoder.
 - Leave the yellow wire on pin 11 on the Pi, but now connect the yellow wire to the DT pin on the rotary encoder.
- For the songs knob rotary encoder:
 - Leave the orange wire on pin 3 on the Pi, but now connect the orange wire to the CLK pin on the rotary encoder.
 - Leave the yellow wire on pin 4 on the Pi, but now connect the yellow wire to the DT pin on the rotary encoder.

11 Test cases

Now that you have assembled everything, it is time to test.

| Test | Description & Expectation |
|----------------------------|--|
| Light 15sec after power on | The indicator LED turns on when DQMusicBox is ready to play music, which is generally about 15 seconds after power on. |
| Start song | Turning either of the knobs will start music playing. |
| Change song | Turn the songs knob. If you go forward and backward through the song list as expected, then all is well. |
| Change volume | Turn the volume knob. If the volume goes up and down as expected, then all is well. |
| Pause | Tap the volume knob, song should pause. Tap the songs knob, this should also pause the song. |
| Unpause | Tap a knob |

12 Congratulations

Congratulations! You should have a fully functional DQMusicBox.