Convert 10M (33') 100 LED Sequencing Strings to Full Wave Always On.

DoItYourselfChristmas.Com
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If you search EBAY, you will find a number of vendors offering "10m 100 LED Fairy Lights". That is 33 FEET of 100 LED goodness. As of late 2011, you can find them with a "buy it now" option for as low as $5.04 with free shipping per string. These strings seem to be fairly well sealed and claim to be indoor / outdoor but the wires are thin so keep that in mind. Another issue is that these strings come with a sequencing control box that unfortunately cannot be set for all on without setting each time the strings are powered up. To run them controlled, you need to do a little surgery. That is the purpose of this document.

Items needed:

Light String
Heat Shrink Tubing (1/4" or so to seal diodes, 1/2" or so for overall heat shrinking)
OPTIONAL: Better male power plug to replace light weight one that comes with the strings. I use the male ends cut off the cheap extension cords used to get female ends for controllers when the wires are too fragile on the included one.

Tools Needed:

Solder Iron
Solder removing tool (solder sucker, solder wick, or whatever you use)
Cutters (diagonals or the like)
Knife or wire stripper

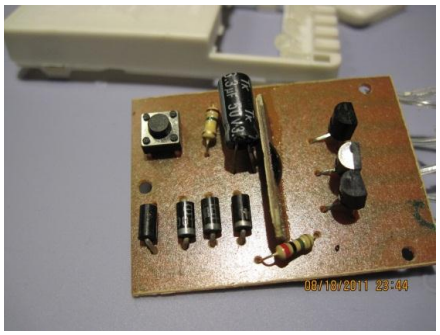
Start with the strings- here is what the ones I bought look like:

For this to work, the strings you get should have this control box that supports multiple modes (like Combination, Waves, etc.). I also can only recommend this for locations that have 110V ac but I would guess the ones for 220V countries might also work this way but I do not KNOW for sure.

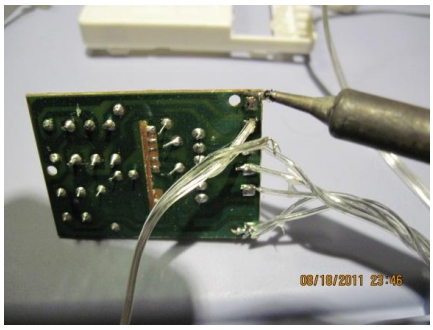
1. Test the lights FIRST to make sure all sections work. Try the different modes to find the all on to make sure no LEDS are out. Shake the wires around to make sure there are not any intermittent connections. These have three independent circuits of 33 (and one +1) lights each that run off 120-160V DC (resistors are included in some of the LEDs if you look closely at the first few LEDS on each circuit. I've found two cold solder joints on two LEDs out of around 2000 LEDs so far so quality is OK. These were repairable.

2. Once the lights check out, it is time to void an warranty on the strings. Pry open the lid of the control box. Note where the wires are attached. In the picture see how two wires are connected to one pad. That is the common for all the LEDs and you need to keep those together as you progress. Next note the top two wires run out to the AC plug. Next note the other three wires in the middle- those are the control lines for the three LED circuits. If you trace out the wires, you will see they lead to the first, second and third LED respectively. Keep that in mind if you lose track of which wire is which later in next steps.

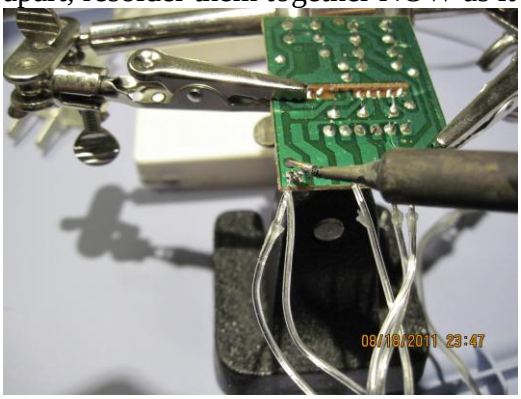
3. Next, pop the case apart and remove the board. These cases are REALLY light weight and do not take much to open. You may need to pry up hot glue but be careful not to break the fragile wires. There are some interesting parts: some light duty SCRs (??) and four IN4007 diodes used to make these full wave (!!). The black blob on the board is the control circuit for the light effects but we are not going to use those for our purposes. Could we use the SCRs for a future LED control project? Hmmm…

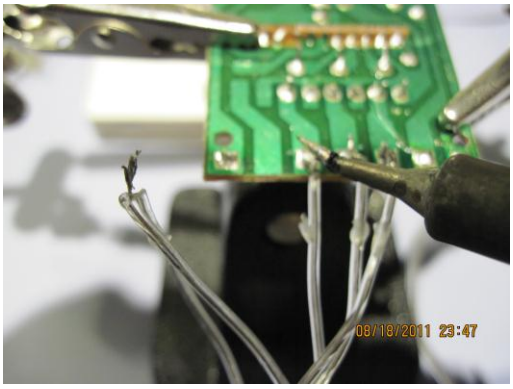


4. Next, unsolder the wires to the AC power plug at the board. It is up to you if you use this later or opt for something a bit beefier.



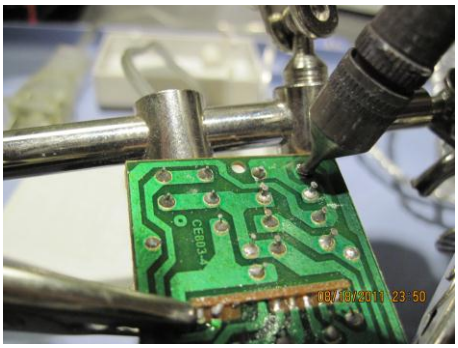
5. Next, unsolder the pair of common LED power wires. Be sure to keep these together. If they come apart, resolder them together NOW as it is important to keep these two wires paired!

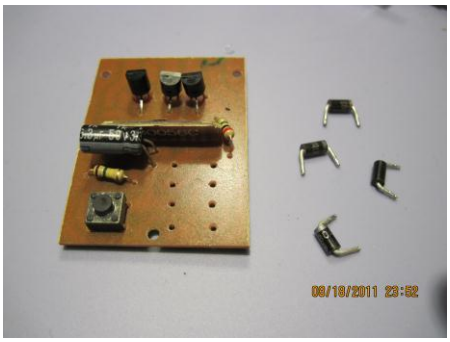




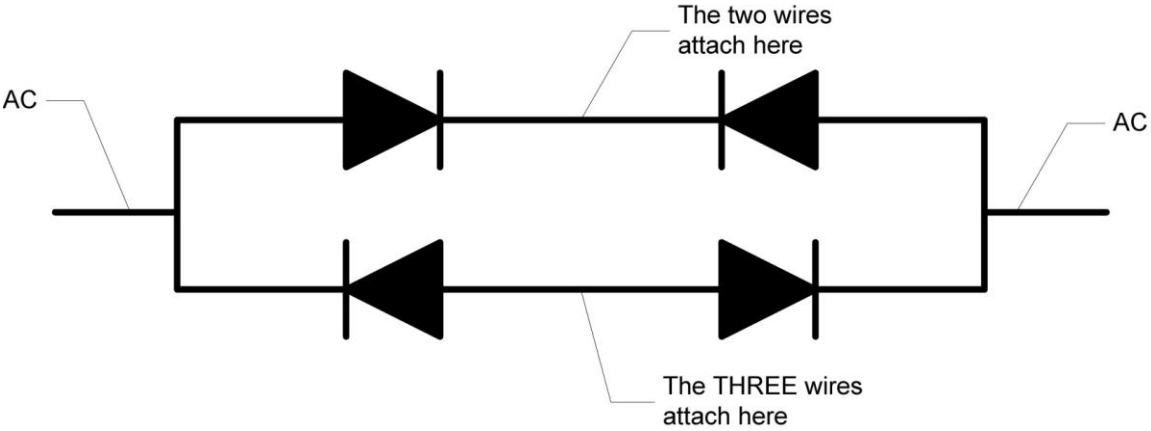
6. Now, unsolder the remaining three wires, and solder them together as a set of three. Set the LEDs aside for now.

7. Now we need to get some diodes to make our full wave rectifier. Conveniently, there are four usable ones on the board that we can repurpose or if you have some appropriate 1N4004 through 1N4007 diodes around you can just uses those and skip this step. If you are cheap (like me) unsolder the 4 diodes from the control board. The picture shows me using my vacuum desoldering station (I love my desoldering station- it smells like victory), but solder wick or a manual solder sucker can be used also. If you have none of those, I guess you could heat up a connection and whack the board on the table to remove the solder if you are so inclined. Note, look carefully at the diodes before removing as I've seen some where the white band is obscured on the diode (see picture of board above)- if you have this situation, note which end is the white band end by observing the other diode orientations- they all are on the board in the same orientation.

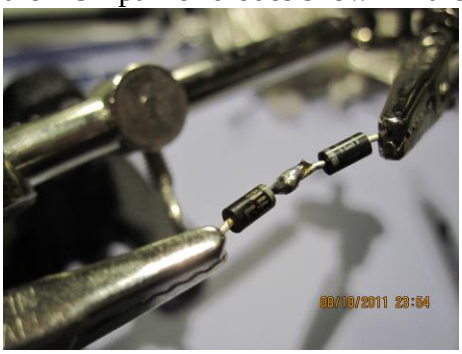




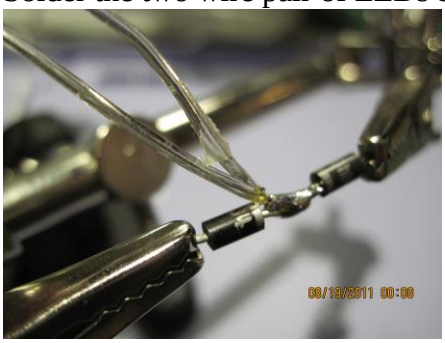
8. In the next steps, we are going to create the full wave bridge rectifier at this point per this schematic:



9. Now we are going to solder two of the diodes end to end with the white strip ends attached together (like the TOP pair of diodes shown in the schematic).



10. Solder the two wire pair of LEDs between the diodes- that is half the bridge rectifier circuit done.



11. Now solder the other two diodes with the white bands AWAY from each other

12. And attach the three wire set between the diodes. This is the other half of the bridge rectifier.

13. Now we start putting the two halves together. Solder either end of one half of the bridge diodes to either end of the other set of diodes (order does not matter):

14. Now we need to insulate the two halves of the bridge with two lengths of the ¼" (or so) heat shrink tubing. I'm not sure the specific size, but it should be large enough heat shrink to just slide over the diodes plus wire. Make it long enough to cover the diodes end to end:

15. Now connect and solder the loose/unsoldered ends of the diodes (oops- I am missing a picture for the specific step- ignore the extra wires in this picture as they are from the next steps but see how the loose ends of the diodes are now soldered together leaving no diode ends unsoldered but the middles where the wires to the LEDs are insulated from each other!!) :

16. We need AC power now. I used the power core we unsoldered from the control board way above. These tend to be really low quality and light weight but the do work. You can use any two prong male plug and wire as the LEDs do not pull much power at all. Go ahead and slide on a length of the ½" (or so) heat shrink tubing and a smaller length of the ¼" (or whatever will slide easily over the wires you use)

17. Now attach one lead of the power to one end of the bridge and the other lead to the other end of the bridge- the orientation is not important for AC as there is no polarity to the input- the diodes assure the polarity of the output of the bridge and we attached the LEDs appropriately above for the correct polarity. (Does this first picture look familiar? NOW notice the power leads being attached to the "ends" of the diodes in the bridge). The second picture shows using the cutoff male end of the cheap extension cords mentioned before. Note how the one power lead is shorter than the other to make this as compact as possible.

18. Now we are going to do the final heat shrinking. First slide up the smaller tubing to insulate the one end of the AC power connection to the bridge and heat shrink it in place. Next slide the bigger tubing up and over everything to make an insulted blob in the wire. Plug in and test. Careful, you may have an AC short if the diode leads poke through the heat shrink wrap!!! I did- twice on the same set (I was tired and hurrying and was not careful at the attaching the AC lead step. This one works!!

Trouble Shooting:

All the lights do not work	Are the lights plugged in, and are they on a live power socket?
	Broken wire on one of the wires on the two wire pairs at the diode? Need to un-shrink wrap everything and fix the connection.
	Your string has the LEDs wired up for reverse polarity from the ones I have used? You need to un-shrink wrap everything and switch around where the two wire and three wire sets attach to the diodes in steps 10 and 12.
One (or two?) out of the three LED circuits does not light	Intermittent/ loose connection at an LED? I find my intermittent LED connections by going along to each of the dark LEDS and wiggling the wires and kind of pushing the wires into the LED to see if I can get the lights to come on momentarily. Once the bad connection is found, I cut away the clear heat shrink at that LED, resolder the connection, then heat shrink the LED again. I've used black heat shrink to reseal the LEDs and it looks fine. Clear is better.
	Broken wire in the set of three wires to the diodes? Need to un-shrink wrap everything and fix the connection.
No pair of wires together at step 2	Improperly manufactured set? I've found one set wired this way. I discovered that the two outermost wires on the side of the wiring away from the AC power connection (what would be the bottom two wires in the picture on step 2) are supposed to be wired together and I've just gone ahead and put those together.
Sparks after assembling	Short in the blob? On one set of LEDs, I managed to miss that a diode wire on an AC connection was sticking out through the shrink wrap and when I did the final assembly it shorted causing sparks. I rewired that string and did it AGAIN, necessitating replacing the diodes and it was the SECOND time that it worked fine.
What about a capacitor needed for full wave rectifying?	A cap would eliminate any possibility of on flicker of the LEDs, but would impact dimming capability, and could raise the average DC out of the bridge to an unacceptably high value. Try it without, I think you will find like I did that a cap is NOT necessary and could actually harm operation. The original circuit of the control box does NOT use a cap directly for the light power as the cap on the circuit is after the drop resistor used to get 5V for the logic circuit under the black blob on the board.