

The SG4 project consists of a PCB (available from www.OshPark.com), a parts kit available from Mouser Electronics (shared cart ID #6A27796F55) and a pre-programmed microprocessor available at the link on DIYAudio.com.

The SG4 generates 4 low distortion, high accuracy sinewaves suitable for driving conventional audio power amps to create a multi-phase drive for turntable motors. The generator outputs a reference sinewave at 60/81Hz or 50/67.5Hz on the 0° pin. The 90° pin outputs an exact replica of the reference sinewave, but shifted +90° (Cosine) for driving 2 phase AC synchronous motors. The 120° & 240° pins output an exact replica of the reference signal, but shifted +120° and +240° respectively for driving a 3 phase motor. The SG4 is a sinewave generator only. You will need to add the necessary audio Power Amps and step-up transformers (if needed) to create the final signal to drive the motor. Low cost linear and class D amps are readily available on e-Bay and other on-line sources. ***Working with High Voltage can be dangerous. Do not attempt this part of the project if you are not trained in handling power electronics: Seek competent technical help if needed.***

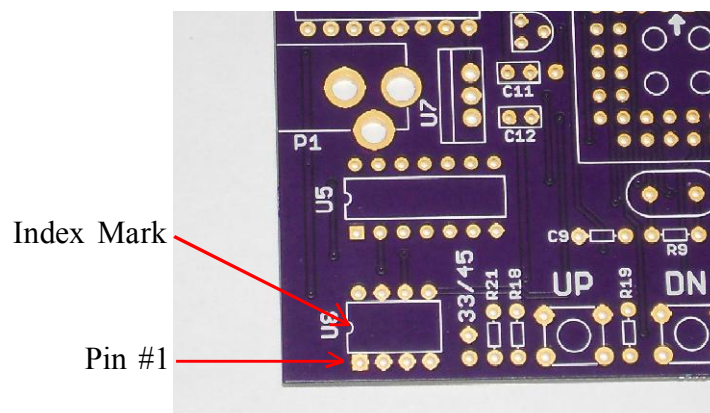
All four signals are 5VPP and DC coupled, centered at 2.5VDC. If you need to adjust the levels, potentiometers can be added between the output pins of the SG4 and the input to the amplifier. A SPST switch connected to the 33/45 RPM pins on the PCB changes between 50/67.5Hz or 60/81Hz.

The PCBs from OshPark are cut from a panel and may have stubs on the side where it connected to other PCBs. Lightly sand all 4 edges of the PCB to remove any burrs or sharp strands.

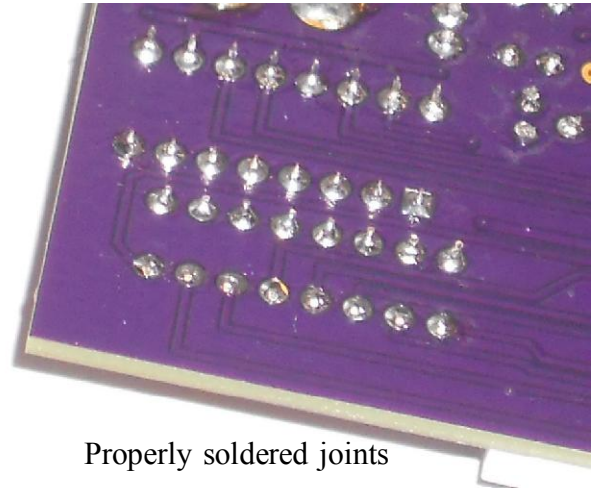
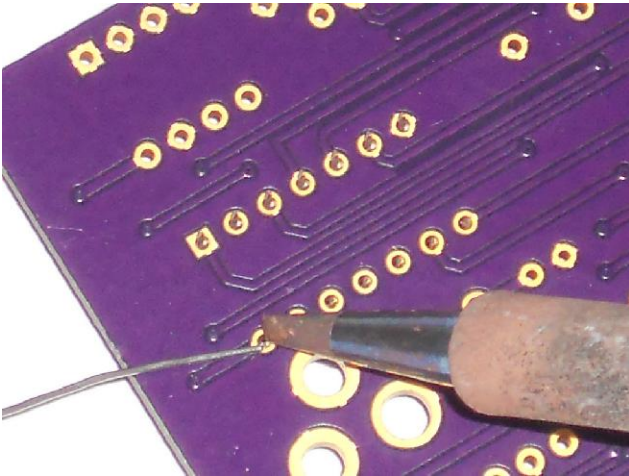
Before assembling the parts onto the PCB, take inventory and make sure all of the needed parts are present. Pre-form all of the resistors by bending the leads down in the same direction, tightly against the body of the part as shown. Pre-form the leads on all of the TO92 parts as shown (2N7000 transistors, 78L08 voltage regulator and DS1833 reset controller).



Start populating the PCB by inserting each IC into the proper location on the PCB and soldering the leads from the bottom. Solder all the pins on each IC before inserting the next part. Take care that each IC is inserted properly; pin one of the IC is denoted on the PCB by a square pad where all the other pins are round. The silk screen on the PCB shows an index mark for proper orientation of the part.



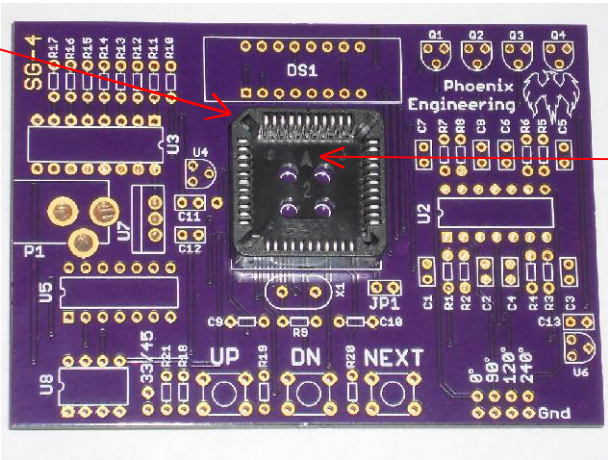
Soldering is all about heat transfer. A small beveled soldering tip works best; keep the tip clean by wiping it often on a damp sponge. In order to make a clean solder joint, both the pin and PCB pad need to be heated before applying solder. Make contact with both the pin and pad with the soldering iron for 1-2 seconds, then touch the end of the solder where all three meet (pad, pin and soldering tip). The solder should flow evenly into the PCB hole and form a convex solder joint with the pin. A proper solder joint will be smooth and shiny; if it is dull and chalky, you are applying too much heat and the joint is oxidizing. If the solder only adheres to the pad or pin and not both, you are not equally heating both elements. In either case, reflow the joint by following the above procedure.



Properly soldered joints

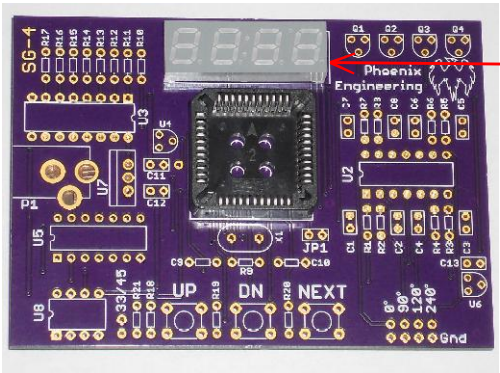
After all of the IC's are soldered, install the PLCC socket for U1 making sure to properly orient the part as shown. Solder all 44 pins of the socket.

Beveled Corner



Arrow points to Pin 1

Install the LED display onto the PCB and solder the pins as before. The display can only be inserted one way into the PCB. If you use a socket to elevate the display, you will need to remove pin 10 as there is no hole on the PCB for this pin. Be sure to properly insert the display into the socket.



Decimal Points
on bottom of display

Next, install all of the resistors, one at a time on the PCB. Insert the part and press it down so it sits flat on the PCB; bend the leads slightly outward on the other side of the PCB to hold the part in place while you solder it. Clip the leads close to the pad before installing the next part.

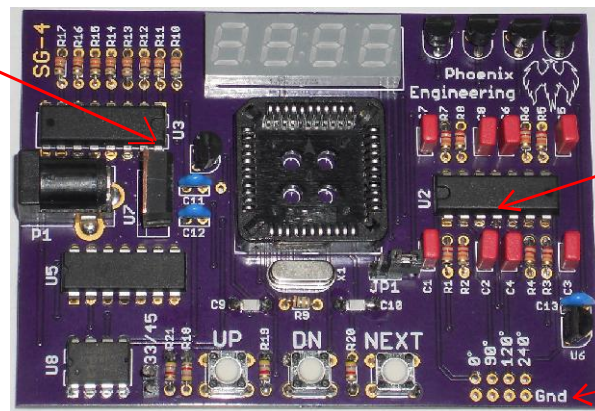
Install all of the capacitors next observing the same precautions as before. Install the TO92 parts next in the same manner. Install crystal X1 using the same technique.

Install the 3 tact switches into the PCB by carefully pushing them flat, being careful not to damage the leads. Rocking the part back and forth will facilitate insertion. When all 3 parts are inserted into the PCB, you can solder them on the back side.

Install regulator U7 and solder the 3 pins. Install P1 and hold it flat against the PCB while you solder one of the pins. Do not solder all 3 pins yet. Turn the PCB right side up and confirm that P1 is flat and even with the edge of the PCB. With only one pin soldered, some adjustment can be made without reflowing the solder joint. If the part is not seated correctly, reheat the solder joint and correct it. When the part is fitted correctly, solder the other 2 pins.

Before installing the uP, visually inspect all of the parts for proper location & orientation and all solder joints for proper connection. When you are sure everything is correct, connect power to P1 and confirm that you have 5VDC on pin 16 of U3. Confirm you have 8VDC on pin 4 of U2. Disconnect power from P1.

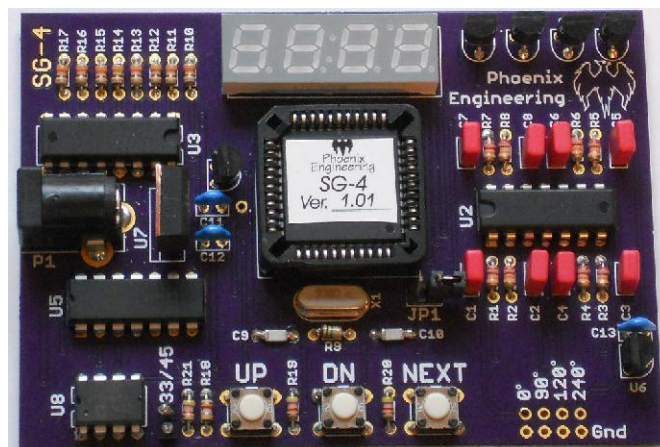
U3 Pin 16: 5VDC



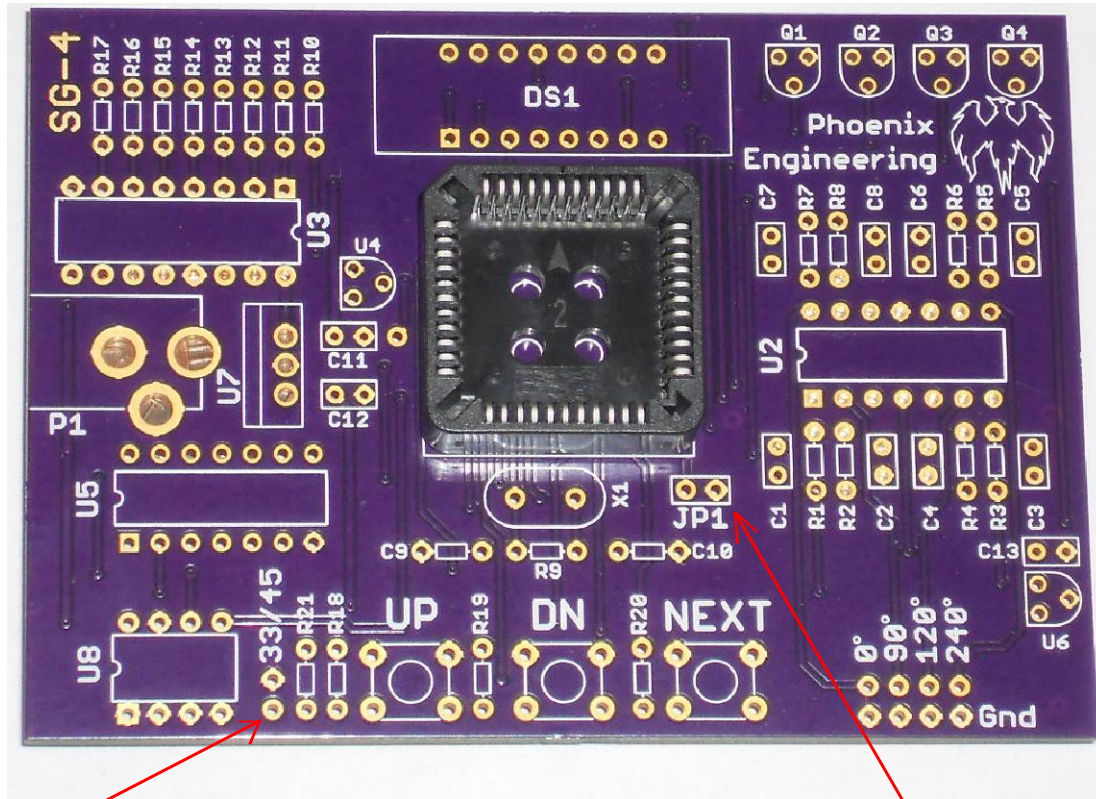
U2 Pin 4: 8VDC

Ground

Confirm the PLCC socket is installed correctly so that pin 1 is pointing at the center of the LED display. Carefully place the uP onto the top of the socket and gently apply pressure so the part is flat and just starting to seat itself into the socket. Lightly push down, keeping the part level as it sinks into the socket. **Do not force the part into the socket.** The part is fully inserted when it is at or just below the level of the socket and is flat with respect to the PCB. If you have to remove the uP, use a PLCC extractor, do not pry it out.



Apply power to P1 again. When the generator first powers up, the EEPROM will be blank; the uP detects this and immediately enters factory default mode to load all of the default parameters. JP1 determines if the default parameters are 50Hz/67.5Hz or 60Hz/81Hz. Factory defaults can be restored at any time by pressing and holding both the UP/DN buttons while applying power. JP1 is only looked at during factory default mode; shorting/removing it during normal operation has no effect. When factory defaults are restored, the display will show “done”. The SG4 will then return to standby operation.



SPST: Open=33 RPM
Closed=45 RPM

JP1: Open=60Hz
Closed=50Hz

Solder a pair of wire leads to the SPST switch. Solder the other end of the leads to the PCB marked “33/45”. When the switch is open 33 RPM is selected (50/60Hz). When the switch is closed 45 RPM is selected (67.5/81Hz).

Basic Operation

The SG4 powers up in standby mode and the outputs are all off, centered at 2.5VDC. Use the ***STBY*** button to exit/enter standby mode. The output voltage can be programmed to automatically revert to a reduced level after 5 seconds to help reduce motor vibration.

Change between 33 and 45 RPM using the SPST switch. When the switch is closed, 45 RPM is selected. When the switch is open, 33 RPM is selected.

Change frequency using the ***UP/DN*** buttons. Each press of the buttons will increase/decrease the current frequency by 0.01 Hz. Pressing and holding the ***UP/DN*** buttons will automatically repeat the increase/decrease of the frequency starting at 1.5 times/sec and increasing in speed the longer you hold the button, up to a maximum speed of 40 times/second.

The frequency for each speed can be changed accordingly to achieve the exact platter speed desired. The frequencies are automatically remembered in non-volatile memory and are unaffected by power loss.

Phase Adjustment

Enter phase calibration mode by holding the ***UP*** button while exiting standby mode. The display will show “PHAS” until the buttons are released, then briefly show the current frequency, then display the phase setting for 90 deg. Change the phase using the ***UP/DN*** buttons; the phase is adjustable in 0.5° steps with a maximum offset of $\pm 15^\circ$.

Select the other phase settings by pressing and releasing the ***STBY*** button. All 3 phases can be displayed and adjusted for the currently selected frequency. Use the SPST switch to select the phases for the other frequency. When all 6 phases are adjusted correctly, press and hold the ***STBY*** button until “SAVE” is displayed. The SG4 will then return to standby operation.

The phases are stored in non-volatile memory and are unaffected by power loss.

Reduced Voltage Adjustment

Enter voltage calibration mode by holding the ***DN*** button while exiting standby mode. The display will show “VOLT” until the buttons are released, then briefly show the current frequency, then display the attenuator setting for the current frequency. Change the attenuator using the ***UP/DN*** buttons; the attenuator is adjustable from 128 (maximum output 5VPP) to 64 (2.5VPP).

Use the SPST switch to select the other frequency and adjust the output voltage as before. When both voltages are adjusted correctly, press and hold the ***STBY*** button until “SAVE” is displayed. The SG4 will then return to standby operation.

The voltage settings are stored in non-volatile memory and are unaffected by power loss.

Factory Default Mode

The factory default settings can be restored at any time by holding both the UP & DN buttons while applying power. The display will show “FAC”. Release the buttons and the display will show “Done” and return to standby mode.

JP1 selects whether the default frequency is 50Hz (JP1 installed) or 60Hz (JP1 open). The phases are set to 90/120/240 for both frequencies and the output voltage is set for maximum (128) for both frequencies.

Note:  *Factory default mode should be performed whenever updated firmware is installed.*