3PS-02A60 60Hz 3-Phase Signal Generator Kit

Basic knowledge of electronics and soldering experience is required to assemble this kit. Use a 25 watt soldering iron with a pencil tip and good quality solder. Verify that each component is inserted correctly before soldering. Observe the orientation of the IC's and the polarity of the capacitors C9 and C10.

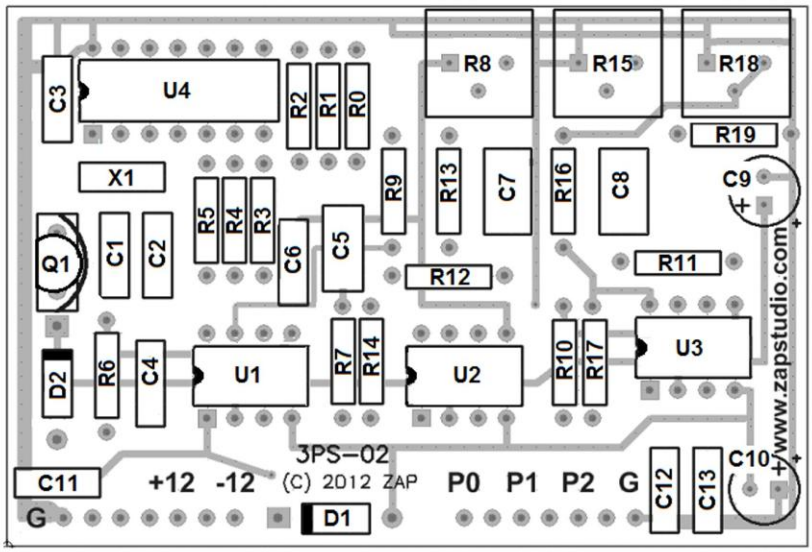
Assembly Instructions

1. Mount and solder the two headers. The plastic part should firmly touch the top side of the board.

2. Mount U1, U2, U3, and U4 on the top side of the circuit board. Observe the location of IC pin 1.

3. Mount the pots R8, R15, and R18. Solder the parts and cut off excess leads. Mount and solder diodes, D1and D2. Observe the location of the cathode band.

4. Use the resistor color code to identify the resistors. Use the ohmmeter if in doubt.



1 Brown	6 Blue
2 Red	7 Violet
3 Orange	8 Grey
4 Yellow	9 White
5 Green	

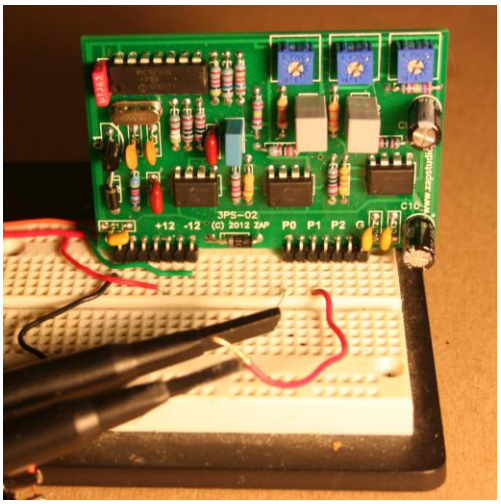
5. Insert and solder the resistors. Insert Q1. Cut off excess leads. Insert the capacitors. Observe the polarity of C9 and C10. Solder and cut off excess leads. Insert and solder the crystal X1 and cut off excess leads..

Parts List

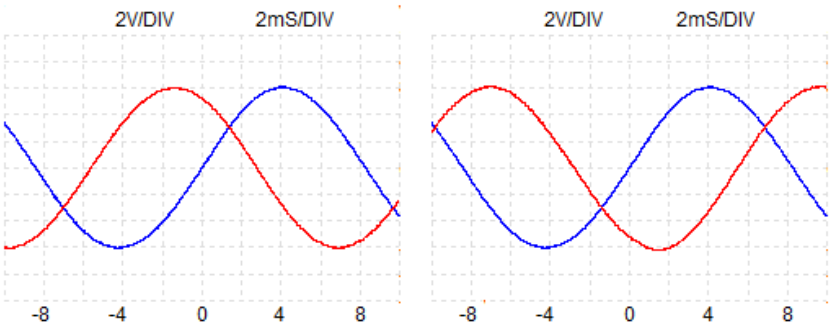
U1, U2, U3: L272	C3: 100nF	C11, C12, C13: 220nF	R3: 20.0K, 1%	R8, R15, R18: 20K
U4: PIC 16F610	C4, C6: 47nF	X1: 8MHz, 20pF, XTL	R4, R10, R11: 10K, 1%	R9, R19: 27.4K, 1%
Q1: LM78L05	C5: 470nF	R0: 162K, 1%	R5: 4.99K, 1%	R12: 82.0K, 1%
D1, D2: 1N4001	C7, C8: 56nF, 2%	R1: 80.6K, 1%	R6: 4.02K, 1%	R13, R16: 39k, 5%
C1, C2: 22pF	C9, C10: 100uF, 25V	R2: 40.2K, 1%	R7: 18.2K, 1%	R14, R17: 47k, 5%

Test and Calibrate

Plug the 3PS-02A60 into a standard breadboard with 0.1 inch pin spacing. Connect the ±12VDC power supply but do not turn it on yet. Use short wires to connect the channel 1 oscilloscope probe to P0 and ground and channel 2 oscilloscope probe to P1. See the picture on the right.



Set the oscilloscope to observe a 60Hz, 12V p-p sine wave. Trigger on channel 1. Refer to the display below. P1 leads P0 by 5.56mS and P2 lags P0 by 5.56mS.

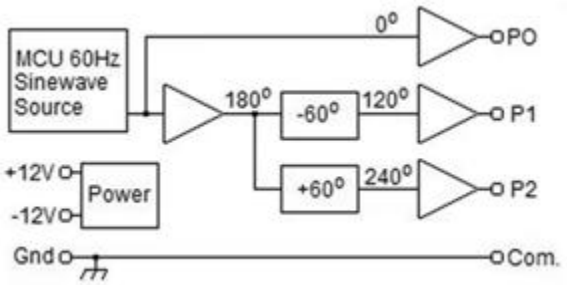


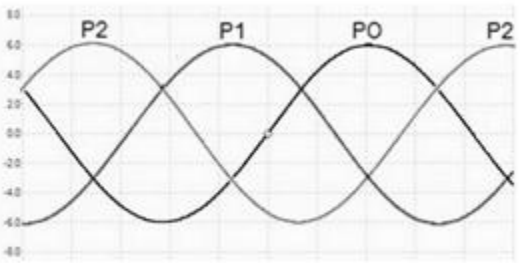
Amplitude Adjustment

Pot R8 is adjusted first to set the amplitude of P0 to 12.0V p-p. Pot R15 sets the amplitude of P1 to 12V p-p. Pot R18 sets the amplitude of P2 to 12V p-p. Connect channel 2 oscilloscope probe to P2 to adjust P2 amplitude with pot R18. Check that that P1 leads P0 by 5.56mS and P2 lags P0 by 5.56mS.

3PS-02A60 3-Phase Signal Generator Description

The 3PS-02A60 uses a PIC 16F610 microcontroller and a digital to analog converter to synthesize a 60Hz sine wave. Precision phase shift circuits are used to generate sinusoids that are $+120^0$ and -120^0 out of phase with the synthesized sinusoid. The output amplitude of each phase is set to 12V p-p. A block diagram of the circuit and a graph of the outputs is shown below.





This power supply is intended to supply safe, low voltage, 3-phase power for 3-phase electric circuits experiments and demonstrations, such as may be performed in freshman and sophomore electric circuits labs. It can simulate a 4-wire wye source, three wire wye source, or a delta source.

Load Limitations

Loads may be any configuration with the limitation that the power should not exceed 250mW per phase. At 12V p-p this is about 60mA RMS per phase. Each phase output is supplied by a very low output impedance power op-amp. Excessive current will cause the op-amp to over heat and shut down. The op-amp may resume operation when the excessive current is removed and the op-amp cools down.

The lowest impedance per phase that can be connected to the power supply depends on the load configuration. For example, the lowest impedance for a 4-wire wye would be about 70 ohms per phase (4.24VRMS/0.06ARMS). As a general rule, any impedance greater than 100 ohms per phase is safe to use with any load configuration. ***The op-amps will get hot and should not be touched with loads above 100mW per phase.***

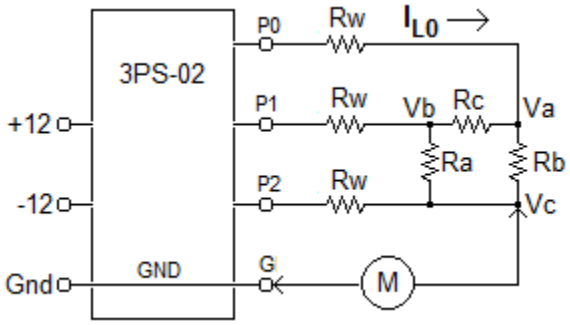
Another consideration is the power dissipation of the load components. Lab experiments using ¼ watt resistors should be designed so that the resistors don't get too hot. To avoid hot op-amps and hot ¼ watt resistors, use impedances greater than 200 ohms per phase.

Measurements

This is a wye-connected source. Its common ground is also the ground for the power supply and op-amps. Connecting non-isolated instrument grounds to the output of an op-amp could cause a short circuit. **Measurements must be made with respect to the ground, G, unless the measuring instrument is known to be isolated.**

Example:

A delta load (Ra, Rb, Rc) is connected to the 3PS-02A60 as shown on the right. Resistors Rw represent line resistance. If your measuring instrument is not isolated (most oscilloscopes are not) all measurements must be made with respect to the common ground (G).



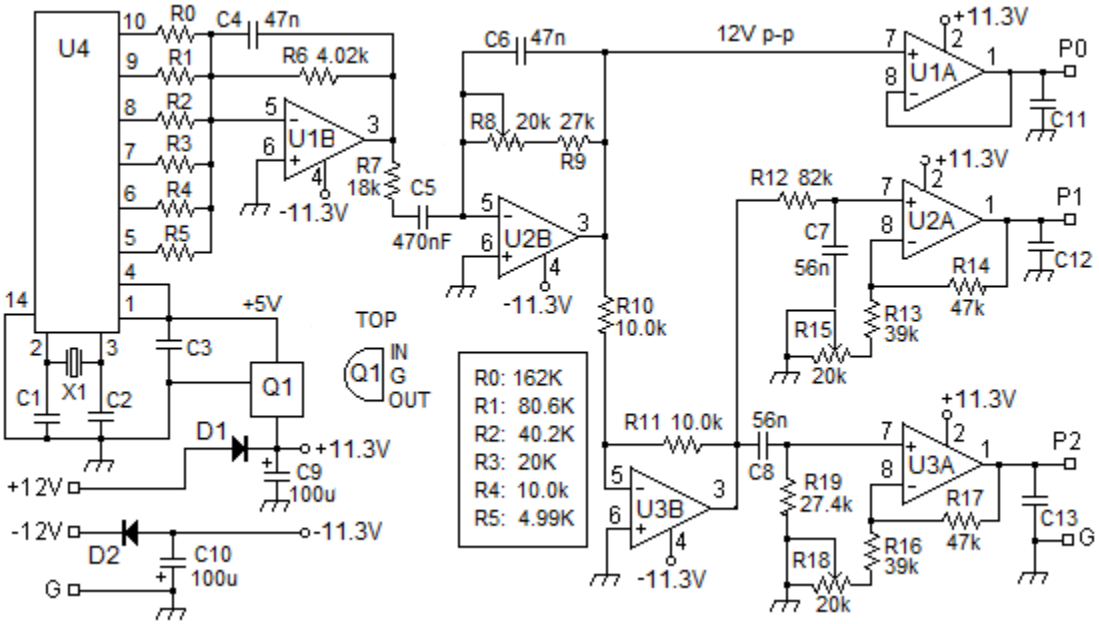
Line voltages and currents can be determined by phasor calculations:

$V_{bc} = V_b - V_c$ $\quad I_{L0} = \frac{V_{P0} - Va}{Rw}$ $\quad 0^0$ reference phase may be V_{P0}.

Specifications: 3PS-02A60

Output voltage: 12V p-p (4.24V RMS), each phase output, P0, P1, P2 to common, G.
Output voltage: 20.8V p-p (7.35V RMS), phase-to-phase outputs.
Maximum current: 60mA RMS, each phase output, P1, P2, P3.
Output frequency: 60Hz, ±0.2%. P0 = 0 deg. P2 = 120 deg. P3 = 240 deg.
Harmonic distortion: less than 1%.
Input power: +9 to +12VDC and -9 to -12VDC, 150mA maximum.

3PS-02A60 Schematic Diagram



Limited Warranty

ZAP Studio kit warranty is limited to the replacement of defective parts. The correct assembly and soldering of a kit is the responsibility of the assembler.

ZAP Studio will, without charge, replace missing or defective component parts for a period of 60 days after the date of purchase. Defective parts under warranty must be shipped to *ZAP Studio* with a copy of the original invoice or receipt, at the purchaser's expense. *ZAP Studio* will ship the replacement parts at its expense.

To report missing or defective parts, contact support: support@zapstudio.com

Exclusion: This warranty does not apply in the case of misuse or abuse of this kit product.

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