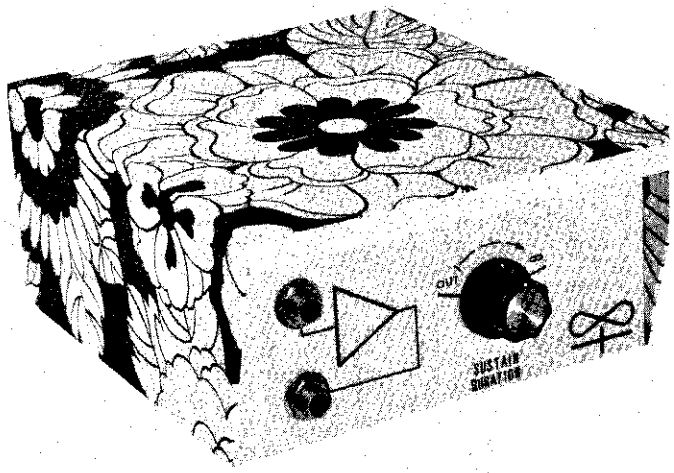
PAIA Electronics
P. O. Box 14359, Oklahoma City, OK 73114



INFINITY PLUS

low distortion SUSTAIN

Sustain is rapidly becoming one of the most often used accessories in the guitarist's bag of tricks – mainly because it is one of the few gadgets that has something to effer everyone.

Rock groups use sustain to give them biting attack and a "cranked up" sound without blowing fuses, speakers and eardrums. Beginners love the way sustain tends to fill in goofs that would otherwise come out as dead notes and the way it compensates for the poor decay characteristics typical of inexpensive guitars. A good sustain also makes possible controlled feedback techniques that allow a note to be held literally indefinitely.

The Infinity Plus is not just a fuzz box hiding under the name of sustain and it's not just another tape compressor somebody decided to plug a guitar into. From the ground up it is designed as a musical accessory and features low noise, low distortion, fast attack and release time and large dynamic range. Infinity Plus may seem like an ambitious name but once you try it you'll agree – it fits.

SOLDERING

Use care when mounting all components. Use only rosin core solder (acid core solder is never used in electronics work). A proper solder joint has just enough solder to cover the round soldering pad and about 1/16 inch of the lead passing through it. There are two improper connections to beware of: Using too little solder will sometimes result in a connection which appears to be soldered but actually there is a layer of flux insulating the component lead from the solder bead. This situation can be cured by re-heating the joint and applying more solder. If too much solder is used on a joint there is the danger that a conducting bridge of excess solder will flow between adjacent circuit board conductors forming a short circuit. Unintentional bridges can be cleaned off by holding the board up-side down and flowing the excess solder off onto a clean, hot soldering iron.

Select a soldering iron with a small tip and a power rating not more than 35 watts. Soldering guns are completely unacceptable for assembling transistorized equipment because the large magnetic field they generate can damage solid state components.

CIRCUIT BOARD ASSEMBLY

( ) Prepare for assembly by thoroughly cleaning the conductor side of the circuit board with steel wool and a scouring cleanser. Rinse the board with clear water and dry completely.

( ) To insure that the edge connector fingers on the circuit board make good electrical contact with the mating edge connector they should be tinned with a thin coating of solder. This is most easily accomplished in two steps. First apply a thin coat of solder to each conductor "finger". Wipe any excess solder from the soldering iron and with the circuit board held so that the "fingers" are pointing up use the hot soldering iron to "wipe" excess solder down from the outer edge of the circuit board. The excess solder should adhere to the hot iron and can be shaken off onto a rag. This "wiping" should be done with an even swift motion so as not to overheat the circuit board. Too much heat will cause the foil to lift from the circuit board.

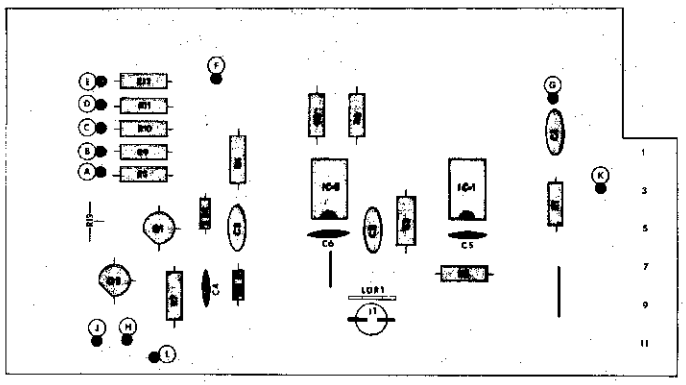
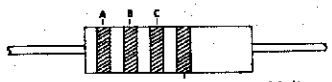


FIGURE 1

Solder each of the fixed resistors in place following the parts placement designators printed on the circuit board and the assembly detail drawing figure 1. Note that the fixed resistors are non-polarized and may be mounted with either of their two leads in either of the holes provided. Cinch the resistors in place prior to soldering by putting their leads through the holes provided and pushing them firmly against the board; on the conductor side of the board bend the leads outward to about a 45° angle. Clip off each lead flush with the solder joint as the joint is made.

	DESIGNATION	VALUE	COLOR CODE A-B-C
( )	R1	4.7K	yellow-violet-red
( )	R2	150K	brown-green-yellow
( )	R3	10K	brown-black-orange
( )	R4	4.7K	yellow-violet-red
( )	R5	1 K	brown-black-red
( )	R6	470 ohm	yellow-violet-brown
( )	R7	150 ohm	brown-green-brown
( )	R8	330 ohm	orange-orange-brown
( )	R9	47 ohm	yellow-violet-black
( )	R10	47 ohm	yellow-violet-black
( )	R11	47 ohm	yellow-violet-black
( )	R12	47 ohm	yellow-violet-black



silver or gold disregard this band

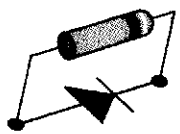
Proceed to the installation of the disk capacitors. As was the case with the fixed resistors the disk capacitors are not polarized and either lead can go in either hole provided. The value of these components is marked on the body of the part.

	DESIGNATION	DESCRIPTION
( )	C1	0.1 mfd. mylar or ceramic disk
( )	C2	0.1 mfd. mylar or ceramic disk
( )	C3	.01 mfd. ceramic disk
( )	C4	.01 mfd. ceramic disk
( )	C5	100 pico-farad ceramic disk
( )	C6	500 pico-farad ceramic disk

( ) Install 100 ohm trimmer resistor (R13) and solder in place.

Install diodes D1 and D2. Transistors, diodes and integrated circuits are heat sensitive and must be protected from temperature damage. While soldering them in place grip the lead being soldered with a pair of needle nose pliers between the body of the component and the point being soldered. Note that the diodes are polarized and their leads must be correctly oriented for them to operate properly. The schematic representation of the diodes is related to their physical appearance in the drawing below.

	DESIGNATION	DESCRIPTION
( )	D1	1N914
( )	D2	1N914



Install transistors Q1 and Q2. Orientation of the transistors is keyed by the flats on the sides of the cases and is evident from inspection of the device and the parts placement designators printed on the circuit board.

	DESIGNATION	DESCRIPTION
( )	Q1	2N5129
( )	Q2	2N5129

( ) Install J1 as shown in assembly detail figure 2. Cut both leads of the lamp to a length of 1-1/8" measured from where they enter the base and strip 1/8" insulation from the ends. Be careful not to pull the leads from the lamp during cutting and stripping.

( ) Install photoresistor LDR1. Note that the white face with the legend "VT-111" is the back of the cell. The dark surface is the sensitive area and is pointed toward I1.

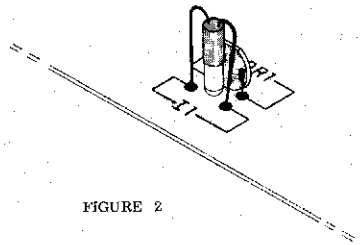


FIGURE 2

Install integrated circuits IC1 and IC2. Note that one end of each of these integrated circuits is keyed with a notch. This notch corresponds to the semi-circular key printed on the IC1 and IC2 designators on the circuit board. Be extremely careful of the orientation of these two parts; if they are installed improperly they cannot be removed without destroying them.

	DESIGNATION	DESCRIPTION
( )	IC1	type 748 operational amplifier
( )	IC2	type 748 operational amplifier

Complete circuit board component installation with the placement of the two wire jumpers indicated by the holes connected with solid lines. Use the solid wire provided, no insulation is required on these jumpers.

( )	_ _	wire jumper
( )	_ _	wire jumper

FRONT PANEL ASSEMBLY

( ) Install closed circuit phone jacks J1 and J2 as indicated in assembly detail figure 4. Use the washer supplied with the jacks underneath the mounting nut. Orient as shown in figure 4. and tighten securely.

( ) Mount the 5 position 2 pole rotary switch S1 as indicated in assembly detail figure 4. Note that the locating tab on this switch must be bent outward slightly so that it presses against the front panel as the switch is tightened in place. Use the washer provided underneath the mounting nut. Orient as shown in figure 4 and tighten securely.

( ) Assemble the front panel, handle and "L" brackets with 4-40 hardware as shown in assembly detail figure 3. Note that the unthreaded holes in the "L" brackets are used in this step.

( ) Fasten the circuit board assembly to the "L" brackets by passing a 4-40 screw through the circuit board into the threaded arm of the bracket.

FRONT PANEL WIRING

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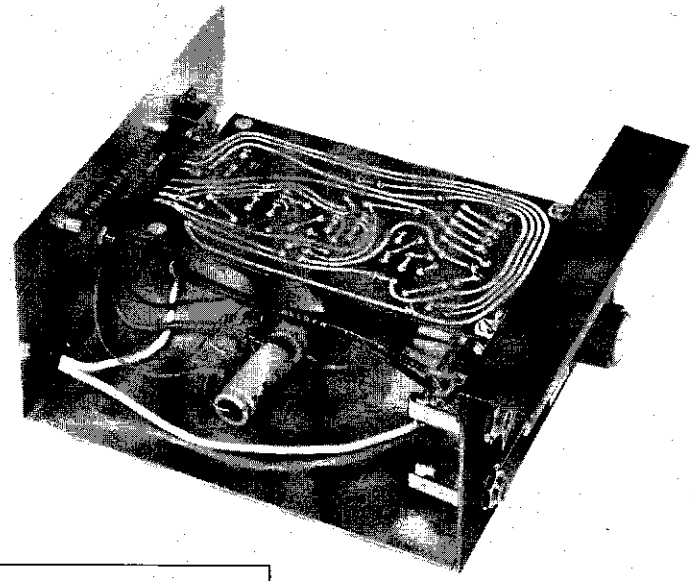
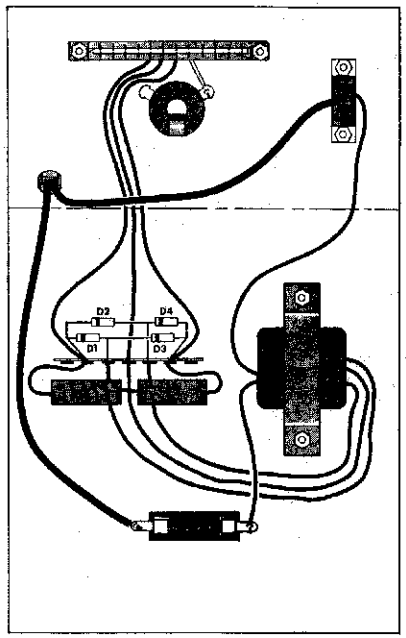


POWER POD



Begin assembly by mounting the following parts as shown in assembly detail figure 1.

( ) Mount fuse holder using one 4-40 X 1/4 bolt and one 4-40 nut.
( ) Mount the 7 lug terminal strip using one 4-40 X 1/4 bolt and one 4-40 nut.
( ) Mount transformer T1 using two 4-40 X 1/4 bolts and two 4-40 nuts.
( ) Mount slide switch S1 using two 4-40 X 1/4 bolts and two 4-40 nuts. Note: The Holes in the mounting flanges of S1 may be tapped for a 4-40 bolt, if so the nuts may be eliminated.
( ) Mount the 12 pin edge connector as shown in detail figure 2. Use two 4-40 X 3/4 bolts, two 1/4" spacers and two 4-40 nuts.
( ) Mount open circuit phone jack J1 using the 8-32 hardware supplied with the jack.

FIGURE 1

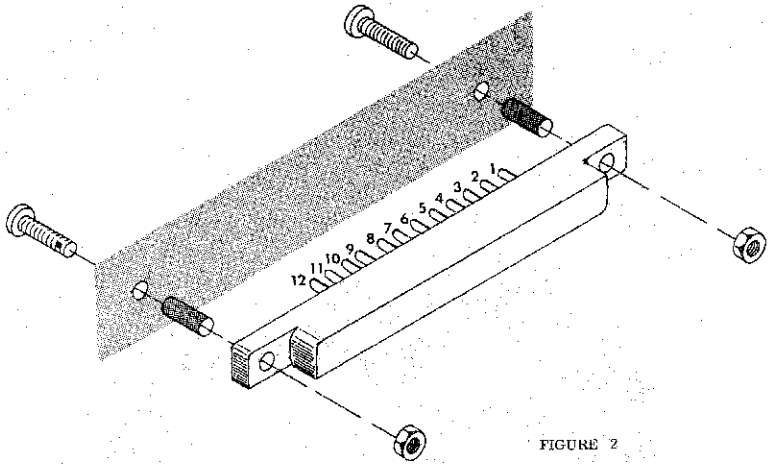


FIGURE 2

Begin wiring with the power supply terminal strip as shown in assembly detail figure 3. Be careful to note the orientation of diodes D1 through D4 and the polarity of capacitors C1 and C2.

( ) Mount diode D1 between terminal points 2 (color band) and 3. Do not solder any connections.
( ) Mount diode D2 between terminal points 2 (color band) and 5. Do not solder.
( ) Mount diode D3 between terminal points 3 (color band) and 6. Do not solder.
( ) Mount diode D4 between terminal points 5 (color band) and 6. Do not solder.
( ) Mount capacitor C1 between terminal points 2 (positive end) and 4. Do not solder.
( ) Mount capacitor C2 between terminal points 4 (positive end) and 6. Do not solder.

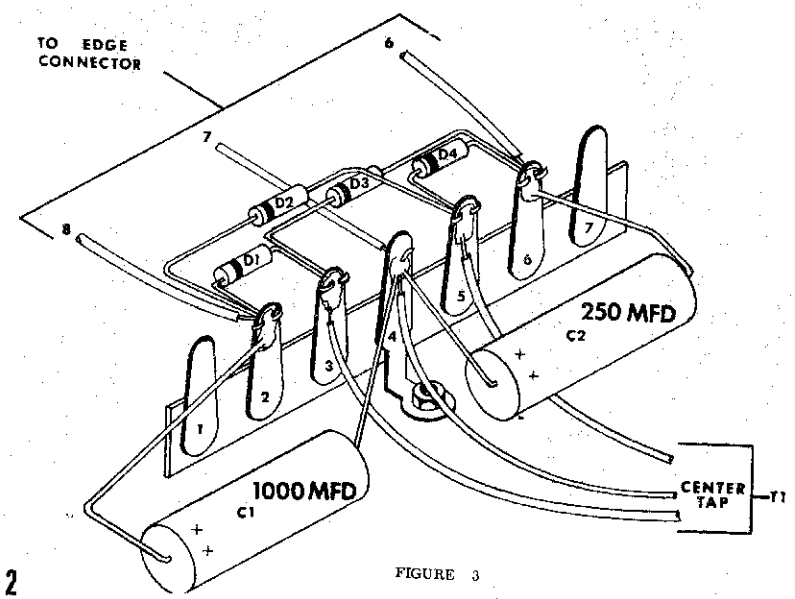
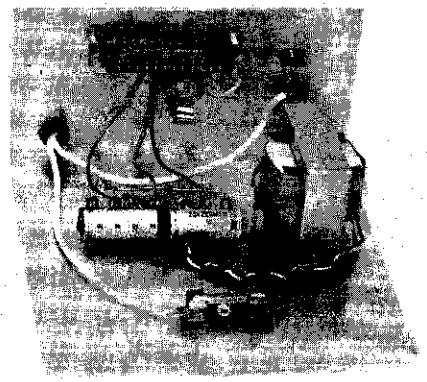


FIGURE 3



COMPLETED POWER POD

NOTE: On the following wire lists assume that 1/4" of insulation is to be stripped from the ends of the wire unless otherwise specified.

( ) Connect one end of a 5" piece of #22 stranded hook-up wire to terminal strip point 2. Solder the 4 wires at this point.
( ) Connect one end of a 5" piece of #22 stranded hook-up wire to terminal strip point 4. Do not solder.
( ) Connect one end of a 5" piece of #22 stranded hook-up wire to terminal point 6. Solder the four wires at this point.
( ) Connect the other end of the wire connected to terminal strip point 2 to edge connector pin 8. Solder this connection and beware of shorting between adjacent edge connector pins and the edge connector pins and the case.
( ) Connect the other end of the wire from terminal strip point 4 to pin 7 of the edge connector. Solder this connection.
( ) Connect the other end of the wire from terminal strip point 6 to edge connector pin 6. Solder this connection.

Braid or twist together the three secondary leads from transformer T1. These are already cut to the proper length.

( ) Connect one of the red leads from transformer T1 to terminal strip point 3. Solder 3 wires at this point.
( ) Connect the white lead from transformer T1 to terminal strip point 4. Solder 4 wires at this point.
( ) Connect the remaining red lead from transformer T1 to terminal strip point 5. Solder 3 wires at this point.
( ) Cut one of the primary (black) leads of transformer T1 to a length of 3" and connect this lead to one end of the fuse holder as shown in figure 1. Solder this connection.
( ) Connect the remaining black lead of T1 to slide switch S1 as shown in figure 1. Solder this connection.
( ) Connect one end of a 1-1/2" length of #22 stranded wire to jack J1 as shown in detail figure 1. Solder this connection.
( ) Connect the other end of the above wire to edge connector pin 5. Solder this connection.
( ) Insert line cord and strain relief in the rear panel hole provided as illustrated in figure 1. Allow 6" of line cord to protrude on the inside of the case.
( ) Connect one side of the line cord to the remaining terminal of the fuse holder. Solder this connection.
( ) Connect the other side of the line cord to switch S1 as shown in figure 1.
( ) Using one 4-40 X 1/4 bolt and one 4-40 nut fasten the small "L" bracket to the Power Pod frame as shown in figure 4.
( ) Snap a 1/2 a. fuse into the fuse holder.
( ) Slide the cover in place and secure with four #4 sheet metal screws as shown in figure 4. Note that these same screws also hold the 4 rubber feet in place.

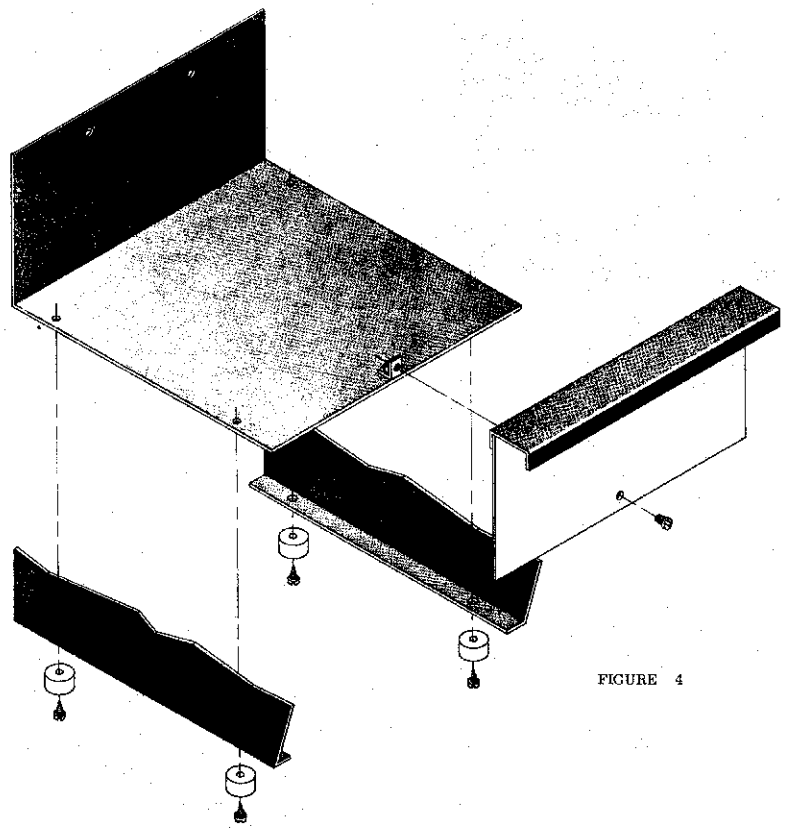
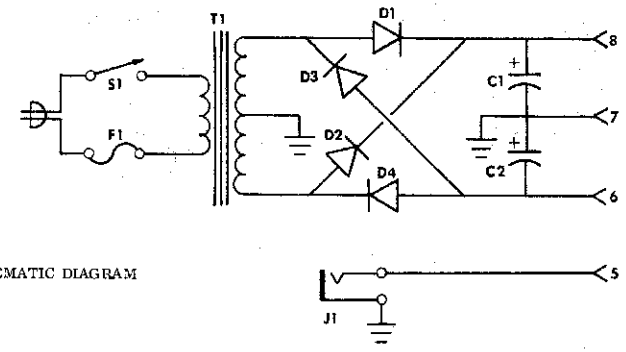


FIGURE 4



SCHEMATIC DIAGRAM

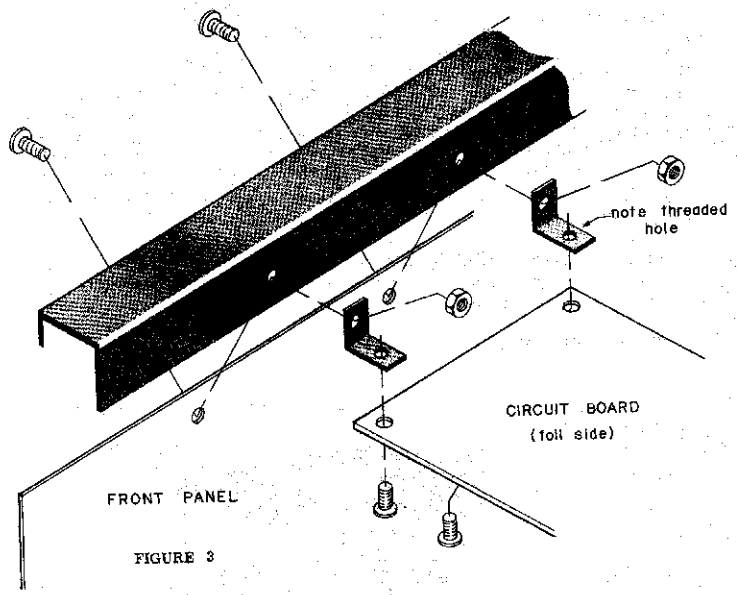


FIGURE 3

FRONT PANEL WIRING

( ) Using six 2" lengths of the bare wire provided, make the connections from the circuit board points "A" through "F" as shown in assembly detail figure 4. Pass the wire through the circuit board and solder the free end to the switch terminals. When all connections have been soldered at the switch, solder the circuit board ends and cut off any excess wire flush with the solder joint. Each of these wires should be insulated with a piece of the tubing provided.

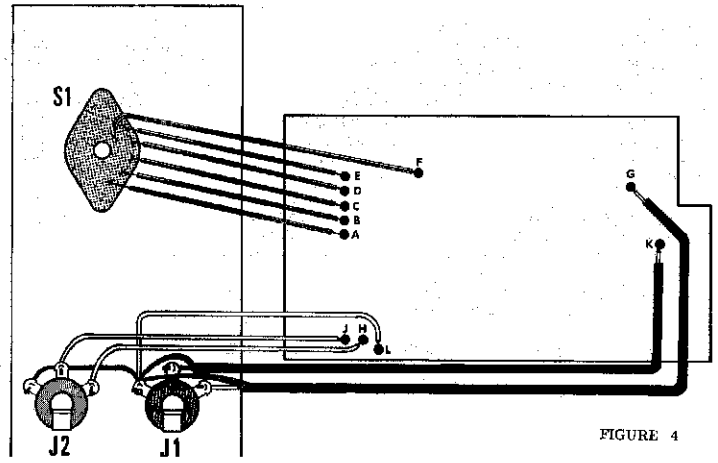
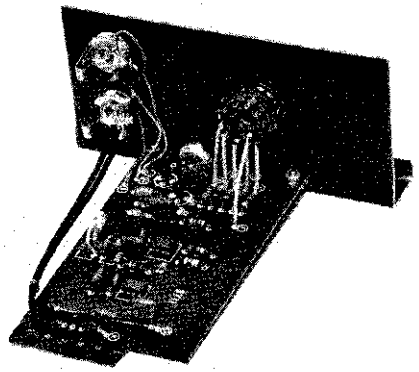


FIGURE 4

Make the following connections from J1 and J2 as shown in assembly detail figure 4. Use the stranded hook-up wire provided.

( ) a 2-1/2" wire from "H" to J2
( ) a 3" wire from "J" to J2
( ) a 2-1/2" wire from J1 to J2 (do not solder the connection at J1 at this time)
( ) a 2-1/2" wire from "L" to J1 (do not solder the connection at J1 at this time)
( ) Using a 7" length of the RG-174/U co-ax provided make the connection from circuit board point "G" to J1 as shown. Do not solder the shield to J1 at this time. Note that the shield is completely cut off at the circuit board end of this lead and makes no connection to the board.
( ) Using a 6" piece of RG-174/U make the connection from J1 to circuit board point "K". Note that the shield is completely cut off at the circuit board end of this lead and makes no connection to the board.
( ) Solder the 4 leads connected to the ground lug of J1.
( ) Rotate the shaft of S1 fully counter-clockwise as viewed from the front and orient the control knob such that its pointer indicates the "out" position. Use a small screw driver to secure this knob.

THIS COMPLETES ASSEMBLY OF THE SUSTAIN MODULE.



SET-UP AND OPERATION

With the sustain module oriented so that the edge connector fingers are pointing toward you, use a small screwdriver to turn the adjusting slot on the trimmer potentiometer R13 to about the midway point of its rotation. Slip the black cardboard light shield provided over the LDR1 - I1 combination. Tension holds this shield in place.

Apply power to the sustain either from an external supply (see Custom Installation section) or by mating it with the PAIA #9710 Power Pod. Plug your guitar into the input jack J1 and jumper output J2 to the input of your amp. Set the amplifier volume at a moderate level and fully advance the guitar volume control.

Set Sustain Duration control S1 to the "out" position and strike a chord. If any distortion (fuzz) can be heard reduce the guitar gain until the distortion disappears. This setting of the guitar volume control is the optimum operating point for your instrument and a mental note should be made of the setting for future reference. Since there is considerable amplification by the sustain this reduced setting of the guitar volume will not cause reduced total output from your amplifier. In fact, you will probably notice a slight boost in overall volume.

Very few pieces of special effects equipment are as easy to operate as the sustain. Clockwise rotation of the Sustain Duration switch increases the sustaining action. With the Sustain Duration control in the "out" position there is no sustain action and all guitar controls will operate normally. Unless fuzz is desired the guitar volume control should not be advanced beyond the optimum point determined above.

With the Sustain Duration control set to any of the sustaining positions, reducing the guitar volume below the optimum level will have the effect of reducing sustain duration. Any changes you may wish to make in overall volume while the sustain is in operation will have to be made at the amplifier controls.

One of the gimmicks you can pull with the Infinity Plus is "controlled feed-back". Set the Sustain Duration control to maximum sustain, the guitar volume to the optimum point, and stand close to your speakers. Now strike a note and hold it. As the vibrations of the string die away the Infinity Plus will bring up the volume until the point is reached at which the sound from the amp is enough to keep the string vibrating. This resonant condition results in an infinitely sustained note, only deadening the string will stop it.

As you become more familiar with the use of the sustain you may notice that there is a slight sustaining action even when S1 is set to the "out" position. This can be corrected by clockwise rotation of the adjusting slot of internal trimmer potentiometer R13. Counter-clockwise rotation of this control will cause an increase in the sustaining action of each of the settings of the Sustain Duration control.

A jack is provided at the rear of the Power Pod for a foot switch or other remote control device. Closing a set of contacts connected to this jack will over-ride the Sustain Duration control and switch the sustain out.

DESIGN ANALYSIS

A schematic of the sustain is shown in figure 5. Operational amplifier IC1 serves as both a pre-amp and impedance matcher. The gain of the second op-amp is set by the internal resistance of photo-resistor LDR1 which is in turn dependent on the illumination supplied by lamp I1. Part of the output of IC2 is tapped off by R4 and C3 and applied to the peak detector D1, D2 and C4. The output of the peak detector is the input for the darlington pair Q1 and Q2 and these transistors drive lamp I1.

Assume an input signal that is increasing in amplitude. As the signal at the output of IC2 tries to increase it supplies a greater voltage to the peak detector which turns on Q1 and Q2 thereby causing I1 to glow more brightly. When I1 gets brighter it causes the internal resistance of LDR1 to decrease which consequently decreases the gain and output of IC2. The net effect of this balancing act is that the output of IC2 stays practically constant. As in any feedback circuit there is a slight error (feedback wouldn't work if there weren't) but thanks to the high gain of the darlington pair this error is minimal.

Resistors R8 through R13 serve a dual purpose. Most importantly they maintain a slight current flow through I1 at all times. This current keeps the filaments warm and minimizes the thermal inertia which would otherwise show up as considerable attack lag during the tremendous increase in signal when a guitar string if first plucked. Secondly, these resistors set the maximum system gain by setting a lower limit of illumination for I1. When S1 is in the "out" position there is a current path from I1 through R8 and R13 to ground. Under these conditions R13 can be adjusted so that the loudest anticipated passages cause no increase in illumination of I1; consequently there is no sustain action and the guitar sound is natural. As more resistors in the chain R9 - R12 are switched in the minimum brilliance of the bulb is lowered and consequently the maximum gain of the amp is raised. As the maximum gain to which the amp can go is increased the length of time the sustain can hold a note is increased.

IN CASE OF DIFFICULTY

Recheck the wiring with the parts placement diagram & control wiring diagram. Check the value of the parts to make sure that the proper part has been installed in each position. Check polarity of the diode and transistor basing. Many kits which are returned for repair are malfunctioning due to poor solder connections. Look over all solder connections to see that they are as described in the assembly section of this manual. Finally check for solder bridges, wire bits or other foreign matter which may be lodged in the wiring or across conductors on the circuit board.

A repair service is available should you be unable to determine the difficulty. Before sending a unit back for repair please write:

PAIA Electronics, Inc.
Service Department
P. O. Box 14359
Oklahoma City, OK 73114

Give as full a description of the malfunction as possible. It is possible that some malfunctions can be diagnosed by mail but if no diagnosis can be made you will be supplied with a repair address and shipping instructions. Repairs are charged at the rate of $4.00 / hr. plus parts and shipping. Repairs ordinarily take from an hour to and hour and a half but repair times in specific cases cannot be estimated in advance.

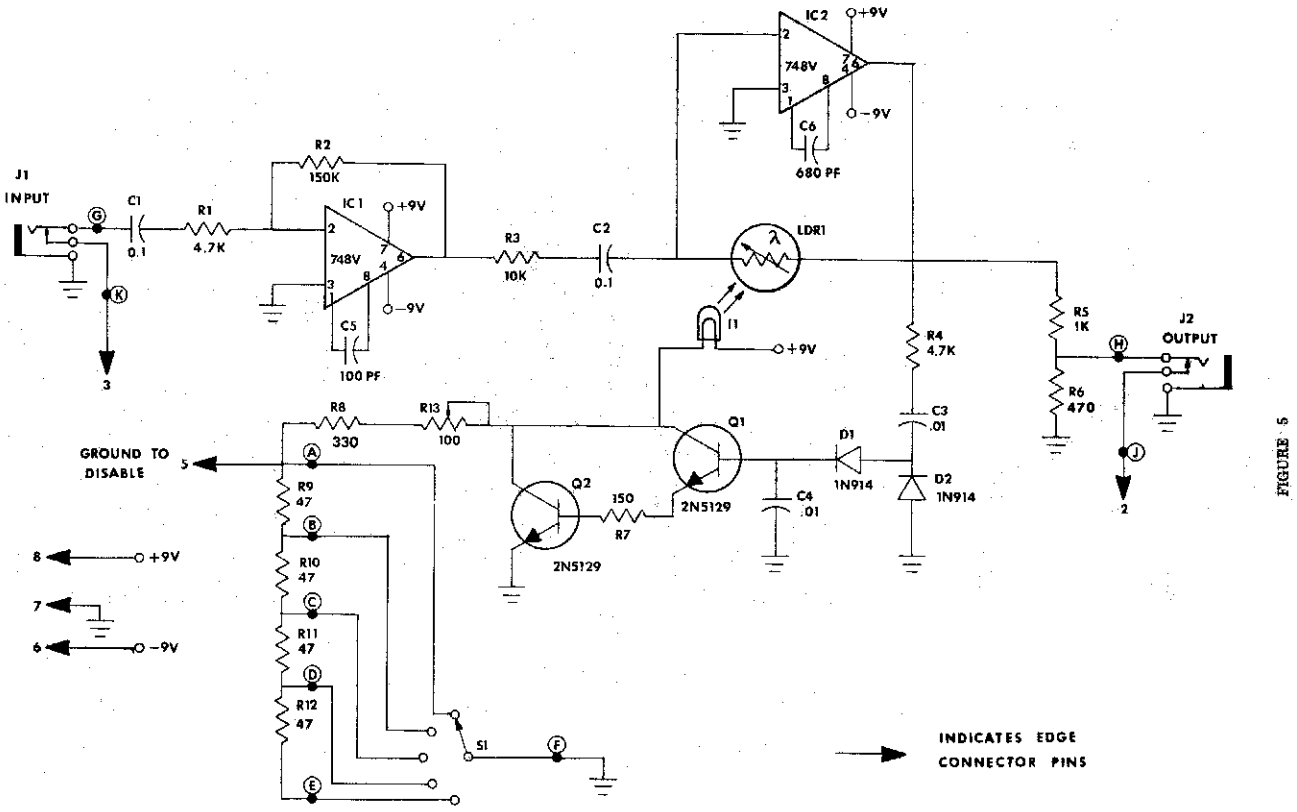

J1
INPUT
C1
0.1
R1
4.7K
R2
150K
IC1
+9V
748V
-9V
C5
100 PF
R3
10K
C2
0.1
IC2
+9V
748V
-9V
C6
680 PF
LDR1
I1
+9V
R4
4.7K
R5
1K
R6
470
J2
OUTPUT
C3
.01
D1
1N914
D2
1N914
C4
.01
Q1
2N5129
Q2
2N5129
150
R7
R8
330
R13
100
GROUND TO
DISABLE
5
R9
47
R10
47
R11
47
R12
47
S1
8
+9V
7
6
-9V
3
2
INDICATES EDGE
CONNECTOR PINS

FIGURE 5