HAMMOND AO-41

VIBRATO PHASE SHIFT AMPLIFIER

+270V

+225V

R123 2200

C109 40/400

R119 47000

R103 10000 5%

R109 10000 5%

R114 10000 5%

C102 .47

R104 15000

C104 .47MF

R110 15000

C106 .47

R115 15000

GAIN 5.5X @130 CPS

C108 .047

C120 0.00015

C121 0.00015

C122 0.00015

+165V .12VAC*

+165V .058VAC*

+165V .045VAC*

+105V .24VAC*

BK

R101 .22M

R102 .82M

C119 .01

11VAC*

V2 12AU7

C103 .01

V2 12AU7

C105 .01

V3 12AU7

C107 .01

V3 12AU7

R135 .33M

R105 1.2M

R106 470

+45V

R111 1.2M

+61V

R112 470

+65V

R116 1.2M

R117 470

13V

R120 1M

R121 1200

+9.5V

R122 3300

+42V

R137 8000

R107 10000 5%

SR101

R113 10000 5%

+38V

SR102

R118 10000 5%

+61V

SR103

C101 .001

R108 1.8M

150 V

R128 .1M

V4 12AX7

+120V

YEL

V4 12AX7

+150V .35VAC***

R136 33000

BN

BL

VIBRATO CHORUS

C112 0.1

13V AC

C116 .1

NORMAL VIBRATO

.85VAC***

V5 6C4

1/2

C110 40/400

C113 0.047

C114 0.027

C115 0.01

R124 .15M

R125 .33M

R126 1.5M

R127 2.2M

1.3V

R129 3900

R402 6.8M

R404 3.9M

R403 2.2M

SMALL VIBRATO

SH

GN

R131 1M

R132 1200

+5.5V

+12.3V

100/50 C111

R134 4700

+4.3V

R133 4700

C118 .05

C117 .1

R130 .39M

THIS RESISTOR SELECTED TO PROVIDE PROPER VIBRATO RATE 6.6 – 7.0 CPS

VIBRATO OSCILLATOR

COMPONENTS WITHIN THIS DOTTED AREA ARE LOCATED IN CONTROL TABLET ASSY.

THIS RESISTOR SELECTED TO PROVIDE PROPER VIBRATO WIDTH

BL

BN

R227 .68M

R228 .47M

SECTION II
THEORY OF OPERATION

2–3. VIBRATO PHASE SHIFT AMPLIFIER (See Figures 5–1 through 5–4). – The vibrator system varies the frequency of the tones by continuously shifting their phase. Circuit components include three series-connected vacuum tube phase shifter stages (V2A, V2B, and V3A), associated saturable reactors (SR101, SR102, SR103), voltage amplifier (V3A), vibrato oscillator (V4A), and driver stages (V4B, V5).

A single low frequency oscillator (V4) provides the rate for the vibrato system (approx. 6.8 CPS). With either the normal or small vibrato tab in use, this oscillator impresses its signal on V4, a cathode follower and isolation stage. Positive pulses now appear on the grid of driver tube V5. The plate circuit of this tube is in series with three saturable reactors located in the plate and cathode circuits of the phase shift stages. Irrespective of which vibrato stop is used, the rate remains constant, but the degree of vibrato is determined by the amplitude of the positive pulse on the driver tube.

The continuous phase shift is accomplished by using 180° out-of-phase signals from the plate and cathode of each shifter stage and controlling them with the saturable reactors. Plate and cathode resistors are of equal value and consequently signals are equal in amplitude in each plate and cathode circuit. The saturable reactors serve as a means of providing a varying composite of signals from both plate and cathode of each stage, ranging from virtually full cathode signal to full plate signal.

The driver tube plate current varies from about .5ma to 5ma. at vibrato rate. This current varies the degree of saturation in the reactor cores and results in a smoothly varying impedance.

At minimum driver current (when the voltage feeding driver tube V5 is negative and driver tube is nearly cut off) the reactor impedances are maximum and are large compared to the 15000 ohm plate. circuit series resistors R104, R110, R115.

Therefore, under this condition most signal will emanate from the plate. (The reactors being virtually short circuited by the plate circuit series resistors) and phase shift will be maximum – approaching 180° – since plate voltage is 180° out of phase with grid voltage.

At maximum driver current (when voltage feeding driver tube V5 is positive and driver tube is conducting maximum current) the reactors are saturated and their impedance is a minimum –small compared to the 15000 ohm plate circuit series resistors R104, R110, R115. Therefore, most signal will emanate from the cathode (the saturated and low impedance reactors virtually short circuit the plate circuit series resistors) and phase shift will be a minimum – approaching 0° – since cathode voltage is in phase with input grid voltage.

Between these extremes, the phase varies smoothly under control of the saturable reactors.

The continuous change in phase is equivalent to a continuous frequency variation, and thus the frequency varies up and down at vibrato rate.

HAMMOND AO-47

VIBRATO PHASE SHIFT AMPLIFIER

+200 V
R123 5000 5W
+ 235 V
R103 10000 5%
R109 10000 5%
R114 10000 5%
R118 47000
C109 Δ 30/350
C102 .47
R104 15000
C104 .47MF
R110 15000
C106 .47
R115 15000
GAIN 5.5 X @ 130 CPS
C108 .047
C120 0.00015
C121 0.00015
C122 0.00015
.17VAC*
.13VAC*
.98VAC*
.25VAC*
C119 .01
C103 .01
C105 .01
C107 .01
BK
R101 .22M
R102 .18M
.21VAC*
V2 12AU7
V2 12AU7
V3 12AU7
V3 12AU7
R135 .33M
R105 1.0M
R106 470
R112 470
R116 1. M
R117 470
R120 1.0M
R121 1200
R140 .56M
R107 10000 5%
R113 10000 5%
R118 10000 5%
R122 8200
R136 56000 W
SR101
SR102
SR103
C101 .001
SELECTED
R108 1.8M
C113 .02
R128 .15M 1%
V4 7247
C116
V4 7247
BN
VIBRATO CHORUS
C114 .02
C115 .02
R130 .47M
R402 6.8M
R404 3.9M
NORMAL VIBRATO
C111 Δ 40/400
BL
C110 40/450
R125 47M
R126 47M
R127 47M
C112 .0018
R129 1200 *
R403 2.2M
SMALL VIBRATO
R131 500K
R132 1000
VIBRATO WIDTH
R1
R138
THIS RESISTOR SELECTED TO PROVIDE PROPER VIBRATO RATE 6.6 - 7.0 CPS
VIBRATO OSCILLATOR
R139 1.0M
C118 .047
R133 FACTORY SELECTED OR MAY BE OMMITED
BL
BN
R227 .68M
R228 .47M
COMPONENTS WITHIN THIS DOTTED AREA ARE LOCATED IN CONTROL TABLET ASSY.