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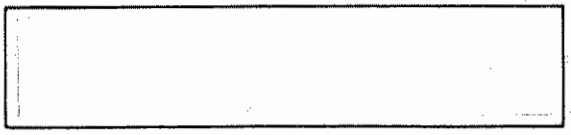
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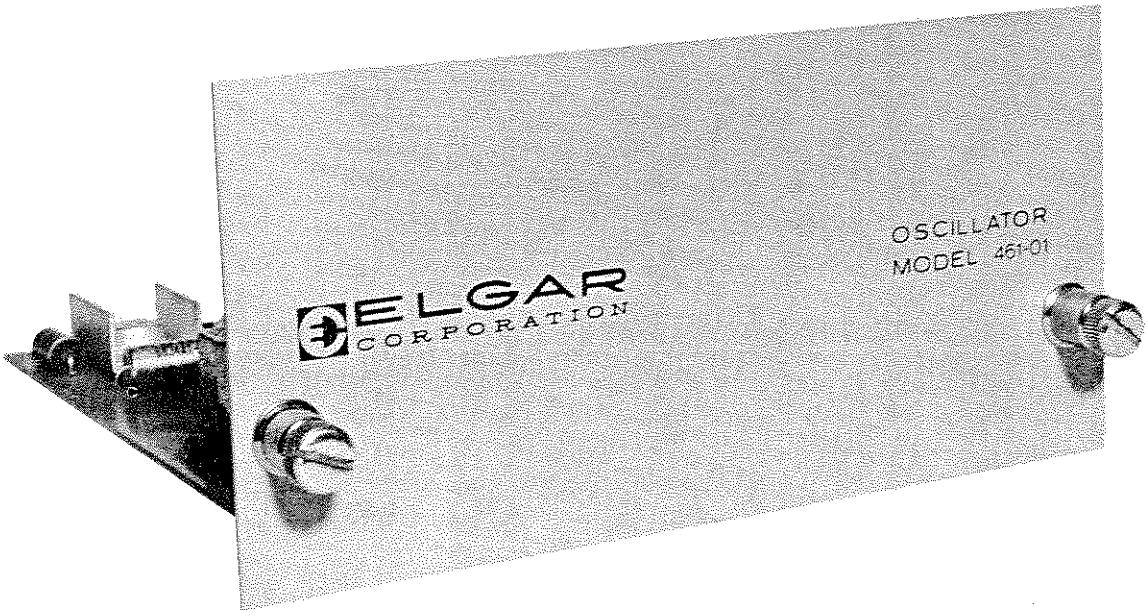
INSTRUCTION MANUAL

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SERIES 400
PLUG-IN OSCILLATORS

MODEL 442-.1

SERIAL NO. 103

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SECTION I

INTRODUCTION AND GENERAL DESCRIPTION

SCOPE OF MANUAL

This manual describes the Series 400 plug-in oscillators manufactured by Elgar Corporation for use with the Elgar Power Sources. The manual contains installation, operation, and maintenance instructions, circuit descriptions, circuit diagrams, and parts lists.

INTRODUCTION

The Elgar Series 400 plug-in oscillators provide stable input frequency signals for the Elgar Power Sources. The plug-ins provide frequency accuracy of 0.1%, 0.01%, and 0.0001% (see Figure 1-1 for an explanation of model numbering). The 0.01% and 0.0001% oscillators utilize a crystal-controlled oscillator. In the 0.1% models, a square wave is generated by positive feedback around the filter to generate the basic frequency signal which is filtered in two operational amplifier filters arranged in series. Frequency adjustments may be made from the front panel.

In the 0.01% and 0.0001% models, the crystal oscillator output is divided through a series of integrated circuit flip-flops to obtain the designed output frequency. The output of the frequency divider flip-flops is filtered in two operational filters arranged in series.

GENERAL DESCRIPTION

The Elgar oscillators are contained in a plug-in enclosure which can be inserted into the front panel opening of an Elgar power source. The plug-in enclosure contains a horizontally-mounted printed circuit board, and a terminal connector which mates with a similar connector in the power source. The 0.1% model is provided with a front panel access hole for a screwdriver frequency adjustment. The oscillators are available in 50, 60, 400, 800, 3200 and 4800 Hz output frequencies, or any frequency from 45 Hz to 10 KHz on special order.

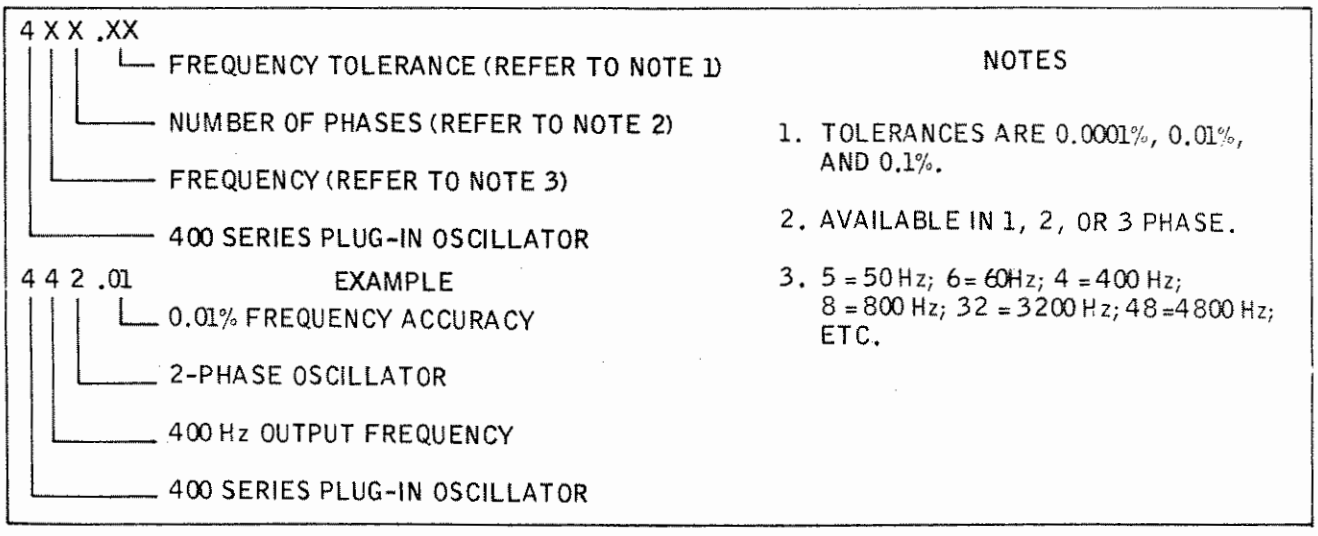


Figure 1-1. 400 Series Oscillator Model Numbering System.

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SECTION II

PRELIMINARY INSPECTION AND OPERATION

INSPECTION UPON RECEIPT

The Elgar Plug-In Oscillators are aligned, calibrated, and tested prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made, however, to assure that the instrument has suffered no damage during shipment.

1. Make a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damage should be noted on the carrier's receipt, and signed by the driver of carrier agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier and all shipping containers and filler material saved for inspection. Forward a report of damage to the Elgar Service Department, which will provide instructions for repair or replacement of the instrument.
2. Make a visual inspection of the instrument when it is removed from the shipping container.

OPERATION

Operating the plug-in oscillator requires only the following steps:

1. Set the POWER switch on the front panel of the Power Source to OFF.
2. Insert the plug-in module in the Power Source through the front panel opening; the oscillator plug-in is completely seated when the oscillator front panel and the Power Source front panel from a smooth plane.
3. Apply power to the Power Source.
4. For the 0.1% models only, use a screwdriver, inserted through the front panel access hole, to make any minor adjustment of the output frequency which may be required.

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SECTION III

THEORY OF OPERATION

GENERAL

The Elgar Series 400 plug-in oscillators all use similar low voltage power supplies and operational amplifier filters, and draw operating power from the Elgar Power Source. The amplitude of the output signal for all units is controlled by the Power Source front panel AMPLITUDE control (a potentiometer which is physically located in the Power Source enclosure). The 0.1% model uses a positive feedback square wave input to the operational active filters. The closer tolerance models contain a crystal oscillator, and a frequency dividing circuit formed by a series of integrated circuit flip-flops. The output of the oscillator is a symmetrical square wave free from even harmonics.

GENERAL CIRCUIT DESCRIPTION

The 0.01% and 0.0001% tolerance oscillators (see Figure 3-1) generate the output frequency with a crystal oscillator operating at a frequency near 100 KHz and a chain of flip-flops which divide the oscillator frequency by some power of two to generate the output frequency. For example, 400 Hz is generated by a 102.4 KHz crystal and then divided by 256 with 8 flip-flops. The square wave output of the flip-flop chain is amplitude-stabilized by zener diode and then filtered in a two-section active low-pass filter to remove the harmonic distortion and produce a pure sine wave. The active filter is tuned to peak response at the output frequency and has 180° phase shift at the output frequency.

The 0.1% tolerance oscillators (see Figure 3-2) also operate by generating a square wave and filtering it in a two-section active filter. In these oscillators, however, the square wave is generated by positive feedback around the filter through an inverting clipper. The feedback system oscillates at the frequency where the filter phase shift is 180°.

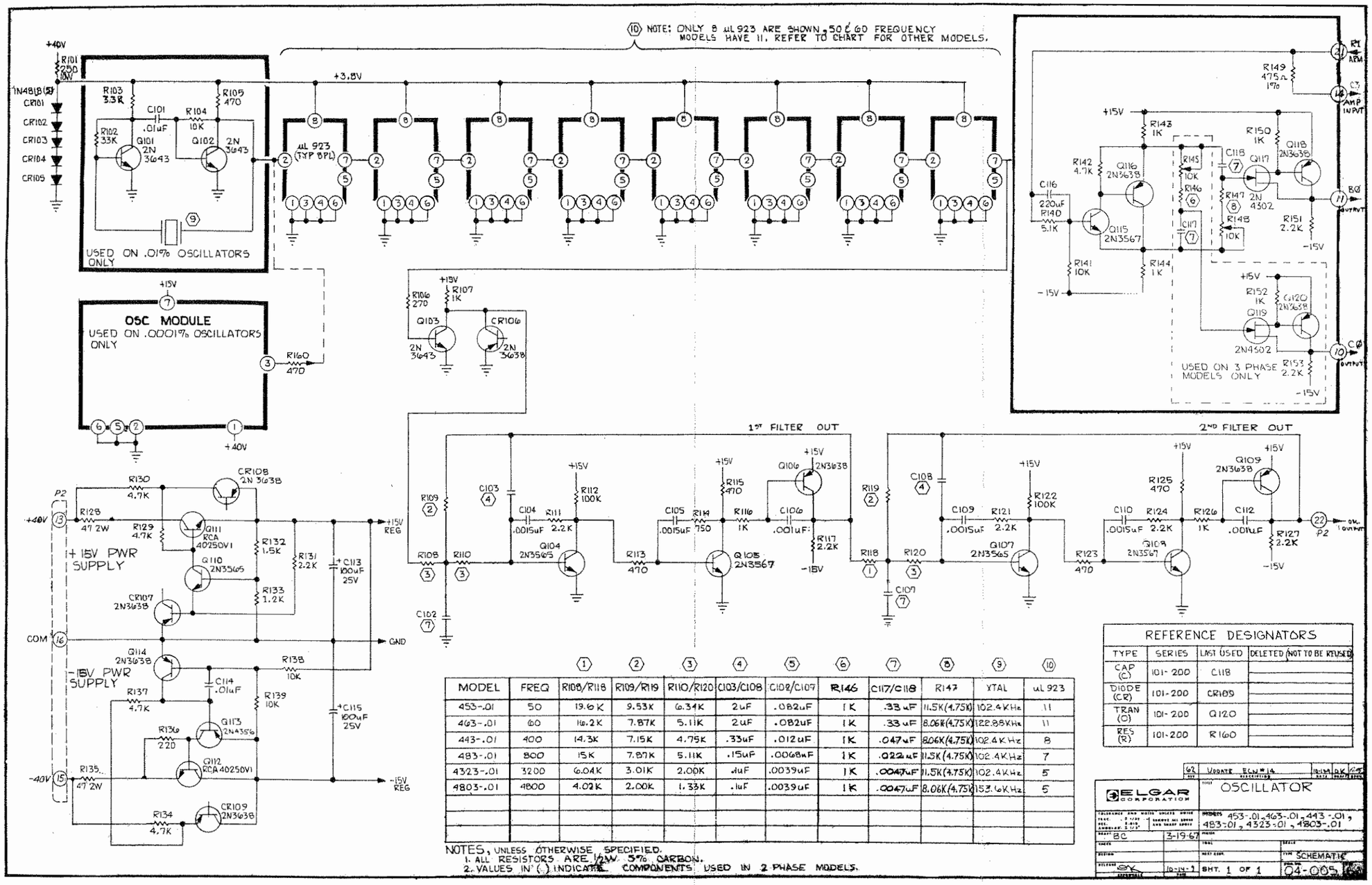
A trimpot is provided to adjust the frequency of the 0.1% oscillators. The 0.01% oscillators do not require a frequency adjustment. The 0.0001% oscillators require an adjustment to compensate for crystal aging.

In the crystal-controlled oscillators, R101 and diodes CR101 through CR105 reduce an unregulated +42 VDC input from the power source to +3.6 VDC collector voltage for the oscillator and integrated circuits. The oscillator, which does not require an oven, consists of the crystal and transistors Q101 and Q102. The square wave oscillator output is divided through an appropriate number of integrated circuit flip-flops to produce, at the base of transistor Q103, a square wave at the output frequency. The crystal frequency and number of dividing flip-flops used for any output frequency is shown on the table given in the schematic diagram. Transistor Q103 is a saturated switch which switches the output from resistor R107 to ground or across the anode of CR106, producing a symmetrical equal duty ratio square wave. Half the time the output is +6.2 volts (approximately) and the other half the time the output is ground. CR106 is a 2N3638 transistor used as a zener diode. The output from the oscillator section is applied to the active filter circuits through resistor R108, the value of which is determined by oscillator frequency.

The filter circuits consist of two similar operational amplifiers with frequency-selective feedback networks which produce the filtering action. The first filter is tuned by resistors R108, R109, and R110 and capacitors C102 and C103. The values of these components depend on the required output frequency, and can be determined by consulting the table presented on the schematic diagram. The first operational amplifier consists of transistors Q104, Q105, and Q106. The second filter, in series with the first, is tuned by resistors R118, R119, and R120 and capacitors C107 and C108. The second operational amplifier consists of transistors Q107, Q108, and Q109.

The plug-in oscillators operate on +42 VDC and -42 VDC supplied by the Power Source. The input voltage is regulated at +15 VDC and -15 VDC in the plug-in enclosure. Amplifier transistor Q110 compares the voltage developed across CR107 to the +15 VDC regulated output, divided across resistors R132 and R133. The amplifier transistor Q114 compares the +15 VDC output to the -15 VDC output. Regulation of both supplies is improved by bootstrapping the amplifier collector load with

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MODEL	FREQ	① R108/R118	② R109/R119	③ R110/R120	④ C103/C108	⑤ C102/C107	⑥ R146	⑦ C117/C118	⑧ R147	⑨ XTAL	⑩ uL 923
453-.01	50	19.6K	9.53K	6.34K	2uF	.082uF	1K	.33uF	11.5K(4.75K)	102.4KHz	11
463-.01	60	16.2K	7.87K	5.11K	2uF	.082uF	1K	.33uF	8.06K(4.75K)	122.88KHz	11
443-.01	400	14.3K	7.15K	4.75K	.33uF	.012uF	1K	.047uF	8.06K(4.75K)	102.4KHz	8
483-.01	800	15K	7.87K	5.11K	.15uF	.0068uF	1K	.022uF	11.5K(4.75K)	102.4KHz	7
4323-.01	3200	6.04K	3.01K	2.00K	.1uF	.0039uF	1K	.0047uF	11.5K(4.75K)	102.4KHz	5
4803-.01	4800	4.02K	2.00K	1.33K	.1uF	.0039uF	1K	.0047uF	8.06K(4.75K)	153.6KHz	5

NOTES, UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS ARE 1/2W 5% CARBON.
2. VALUES IN ( ) INDICATE COMPONENTS USED IN 2 PHASE MODELS.

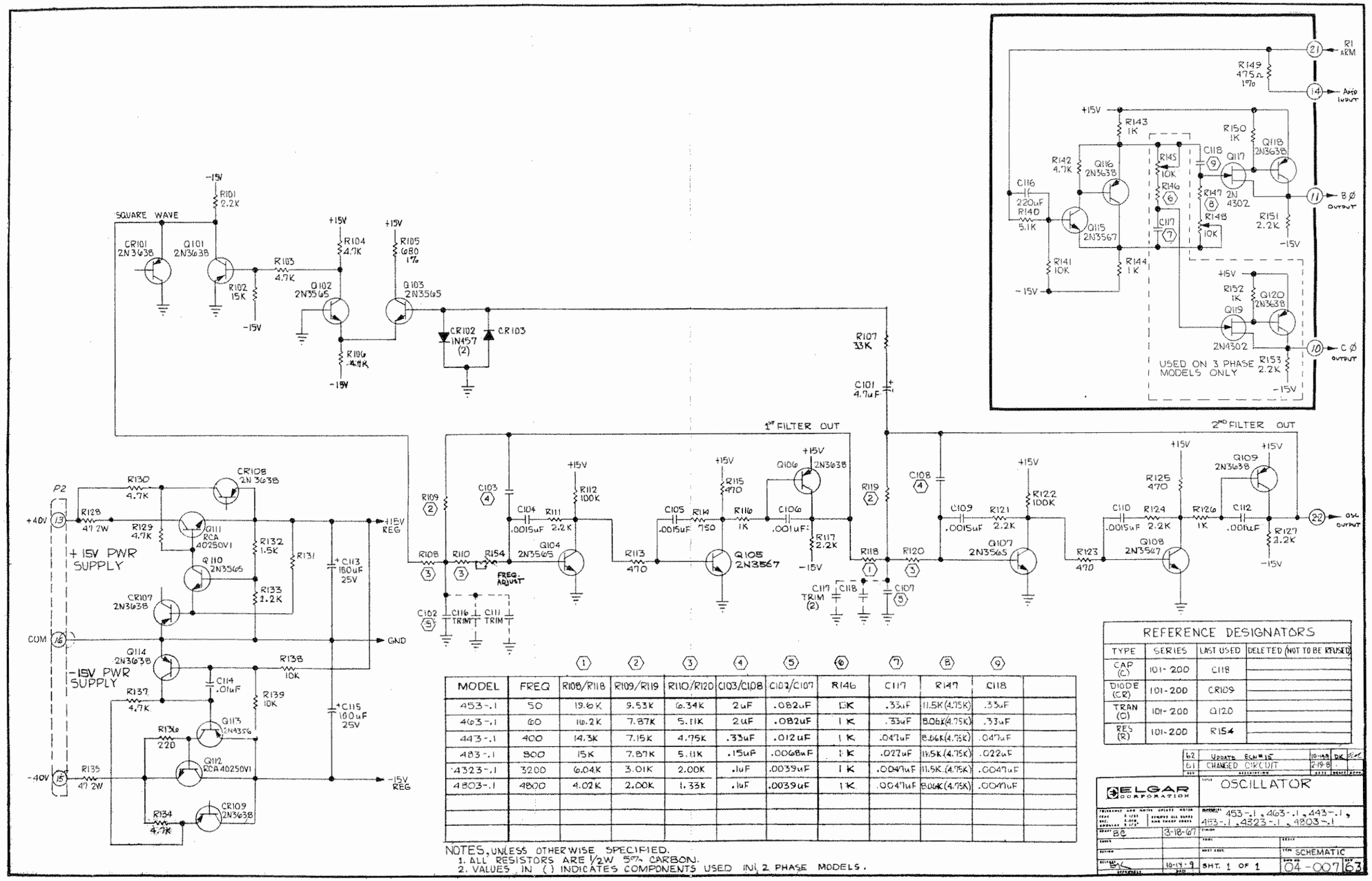
REFERENCE DESIGNATORS

TYPE	SERIES	LAST USED	DELETED (NOT TO BE REUSED)
CAP (C)	101-200	C118	
DIODE (CR)	101-200	CR109	
TRAN (Q)	101-200	Q120	
RES (R)	101-200	R160	

62	VENDOR ECN # 14	10-24-67	DK
ELGAR CORPORATION	OSCILLATOR		
DRAFT BC	3-19-67	MODELS 453-.01, 463-.01, 443-.01, 483-.01, 4323-.01, 4803-.01	
DESIGN		NEXT ASSY	TYPE SCHEMATIC
RELEASE SK	10-24-67	SHT. 1 OF 1	SIZE D 04-005

Figure 3-1. Schematic Diagram for 0.01% and 0.0001% Oscillators.

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MODEL	FREQ	① R108/R118	② R109/R119	③ R110/R120	④ C103/C108	⑤ C102/C107	⑥ R146	⑦ C117	⑧ R147	⑨ C118	
453-.1	50	19.6K	9.53K	6.34K	2uF	.082uF	1K	.33uF	11.5K(4.75K)	.33uF	
463-.1	60	16.2K	7.87K	5.11K	2uF	.082uF	1K	.33uF	8.06K(4.75K)	.33uF	
443-.1	400	14.3K	7.15K	4.75K	.33uF	.012uF	1K	.047uF	8.06K(4.75K)	.047uF	
483-.1	800	15K	7.87K	5.11K	.15uF	.0068uF	1K	.022uF	11.5K(4.75K)	.022uF	
4323-.1	3200	6.04K	3.01K	2.00K	.1uF	.0039uF	1K	.0047uF	11.5K(4.75K)	.0047uF	
4803-.1	4800	4.02K	2.00K	1.33K	.1uF	.0039uF	1K	.0047uF	8.06K(4.75K)	.0047uF	

NOTES, UNLESS OTHERWISE SPECIFIED.
1. ALL RESISTORS ARE 1/2W 5% CARBON.
2. VALUES IN ( ) INDICATES COMPONENTS USED IN 2 PHASE MODELS.

REFERENCE DESIGNATORS

TYPE	SERIES	LAST USED	DELETED (NOT TO BE REUSED)
CAP (C)	101-200	C118	
DIODE (CR)	101-200	CR109	
TRAN (Q)	101-200	Q120	
RES (R)	101-200	R154	

REV	DESCRIPTION	DATE	APPD
62	UPDATE ECN # 15	10-14-9	DK
61	CHANGED CIRCUIT	2-19-8	

ELGAR CORPORATION

TITLE: OSCILLATOR

DRAWING: 453-.1, 463-.1, 443-.1, 483-.1, 4323-.1, 4803-.1

DRAFT: BE 3-18-87

SIZE: C

SCALE:

ITEM: SCHEMATIC

SHT. 1 OF 1

DWG NO: 04-007163 REV

Figure 3-2. Schematic Diagram for 0.1% Oscillators.

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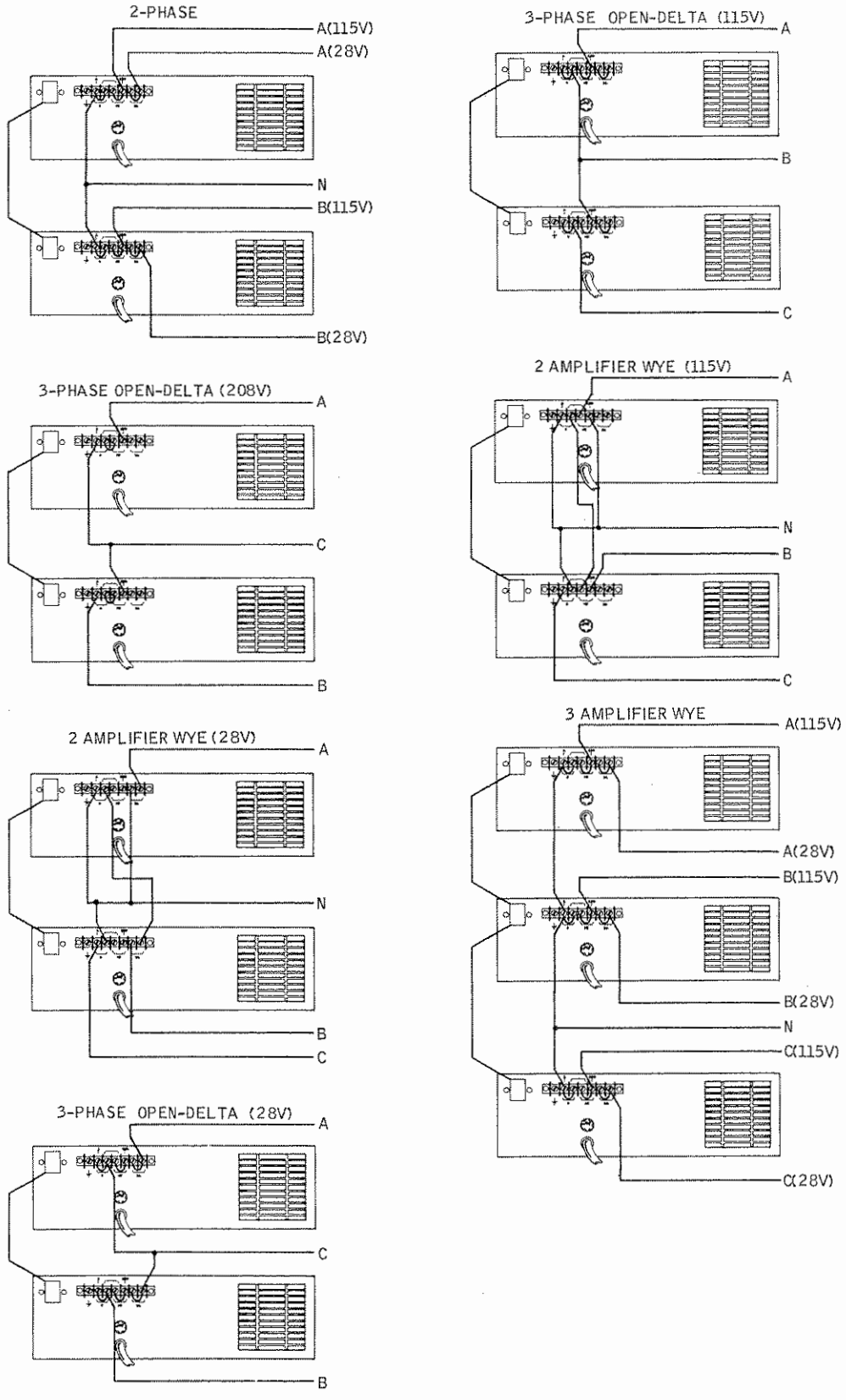


Figure 3-3. Rear Panel Connections for two or Three Phase Operation.

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zener diodes, referencing the amplifier collector load to the regulator output. CR108 is a 2N3638 transistor used as the zener for the +10 VDC regulator, and CR109 is a similar transistor used as the zener for the -10 VDC regulator.

TWO AND THREE PHASE OSCILLATORS

Two or three ELGAR AC Power Sources may be used to generate two phase or three phase AC power. Two phase or three phase signals are generated in a two phase or three phase plug-in oscillator installed in the master power amplifier. Signals from the oscillator are carried by interconnecting cables to one or two slave power amplifiers (see Figure 3-3), each of which has a dummy oscillator panel (Model 400-B or 400-C) installed in it. The front panel amplitude control on the master amplifier controls the amplitude of all the amplifier outputs simultaneously. The front panel amplitude controls of the slave amplifiers are used to set their output voltages equal to the master amplifier output.

INTERCONNECTIONS FOR TWO AND THREE PHASE OPERATION

Two phase operation requires two power amplifiers. Three phase operation may be accomplished with three amplifiers in "Wye" connection, or with two amplifiers in either "Wye" or open Delta connection. For the two amplifier "Wye" connection, the two secondaries on each output transformer are separated; one winding from the master amplifier gives the phase "A" output. One winding from the slave amplifier gives the phase "C" output. The remaining windings from the two amplifiers are connected in series to give the phase "B" output which is the negative vector sum of the phase "A" and phase "C" output.

A block diagram of circuitry used to generate two or three phase signals is provided in Figure 3-4. The single phase signal from the Oscillator is attenuated by the master amplifier front panel amplitude control R1. This control acts as a master control to adjust all the signal amplitudes simultaneously.

The signal from R1 is also connected to the signal splitter, Q1 and Q2, which develops signal voltages across R3 and R4 which are equal in amplitude and opposite in phase. These signals are applied to all-pass phase-shifting networks R5-C1 and R6-C2 which provides 120° phase lead and 120° phase lag respectively. The phase shift networks are isolated from their respective power amplifier inputs by unity-gain buffer amplifiers.

For two phase operation, the R5-C1 network is omitted, together with its buffer amplifiers and R6-C2 components are chosen for 90° phase-shift.

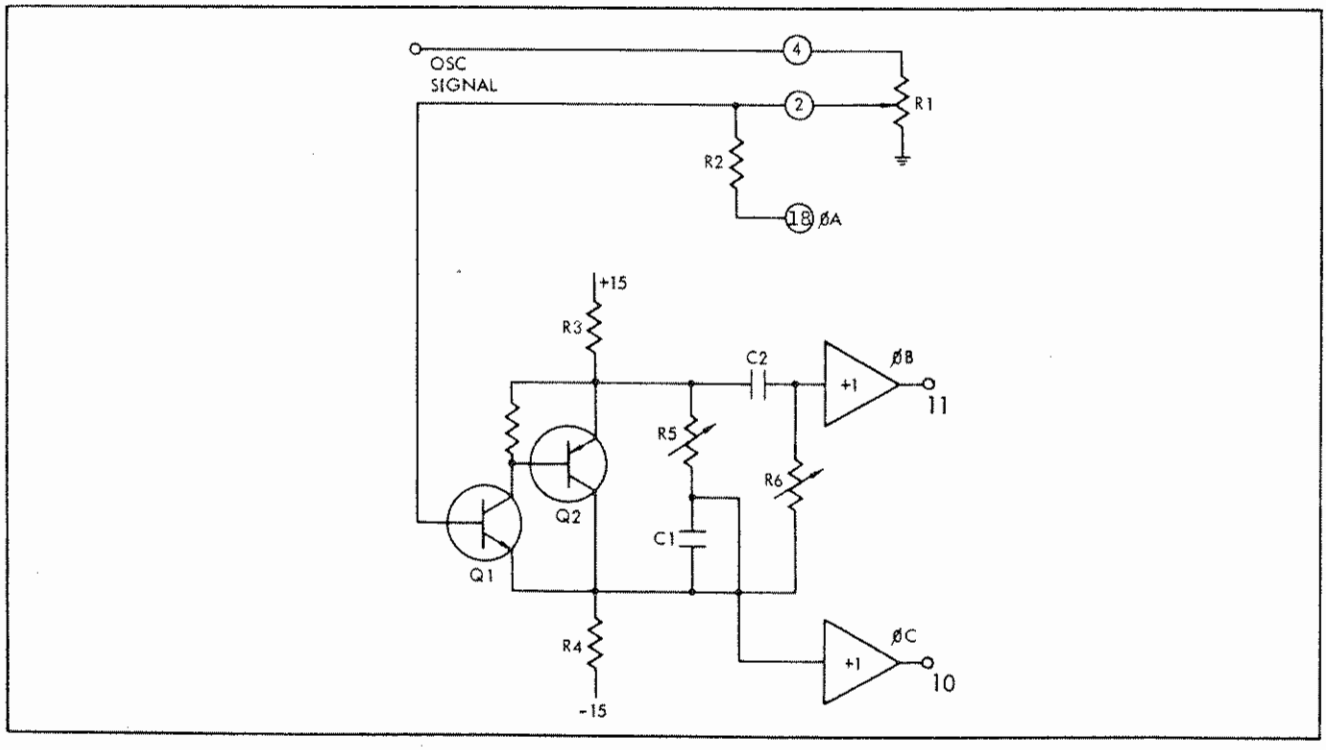


Figure 3-4. Two and Three Phase Circuit Block Diagram.

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SECTION IV

MAINTENANCE

SERVICE INFORMATION

Questions concerned with the operation, repair, or servicing of this instrument should be directed to the nearest Elgar representative or to the Service Department, Elgar Corporation, 8046 Engineer Road, San Diego, California 92111. INCLUDE THE MODEL NUMBER AND SERIAL NUMBER in any correspondence concerning the instrument.

FACTORY REPAIR

Should it be necessary to return an instrument to the factory for repair, please contact the Elgar Corporation Service Department for authorization to make shipment.

DO NOT RETURN THE UNIT FOR REPAIR WITHOUT AUTHORIZATION.

SHIPPING DAMAGE

It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, notify the carrier immediately. The carrier's claim agent will prepare a report of damage to be forwarded to the Elgar Service Department. You will be advised as to the action necessary to have the instrument repaired or replaced.

TEST POINTS

Test points on the plug-in oscillator printed circuit board are shown in figures 3-1 and 3-2. These test points are accessible by removing the bottom cover of the power source.

The outputs of the various test points are as follows:

Square Wave	≈ 6V p-p
First Filter	≈10V p-p
Second Filter	≈10V p-p
B Phase	≈10V p-p sine wave
C Phase	≈10V p-p sine wave

TROUBLESHOOTING

Whenever trouble is suspected in the plug-in unit, substitution of a unit known to be good will provide a quick check. If it is determined that trouble does exist in the plug-in unit, the first step is a check of the +15 VDC and -15 VDC. If the output is greatly reduced, check the oscillator operation at the collector of Q103. If a square wave of the proper frequency and amplitude is present, the trouble may be in the filter. Check the output of the first filter section at Q106.

NOTE

If a crystal-controlled oscillator is not working, check the crystal. Dropping the unit, or other rough handling may fracture the crystal.

Troubleshooting is accomplished by signal tracing at the test points on the underside of the circuit board. For the crystal-controlled models, test for a signal at the crystal oscillator, the flip-flop dividers, a square wave at CR106 and a sine wave at the two filter outputs, and at the B and C phase outputs.

If no output is present on the 0.1% model, inject a 3 VRMS signal at appropriate frequency through a 3.3K resistor to the base of Q103. Check for 5.2V p-p signal at CR101 and for correct signals at the filter and B and C phase outputs.

The output frequency of the 0.0001% oscillator is adjustable by a screwdriver adjustment at the top of the oscillator module. Access is gained to this adjustment by removing the top cover of the power source. Allow a 30 minute warmup period. Do not change frequency setting unless a frequency standard of adequate accuracy is available for comparison.

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PHASE ANGLE ADJUSTMENT

The phase angle adjustments are set at the factory and should not be disturbed unless appropriate test equipment is available to determine the output phase angles. If an accurate phase angle meter is not available, phase angles may be determined by line-to-line voltage measurements. The front-panel voltmeters in the Elgar power sources are only accurate to ±3% and are not suitable for precision phase angle adjustment.

Open Delta Connection: Set the two amplifier outputs E_{CA} and E_{CB} to 120V. Adjust BØ, R148, until the open-leg voltage, E_{AB} is 120V. The CØ adjustment, R145, has no effect.

2-Amplifier Wye Connection: Set the two amplifier outputs, E_{NA} and E_{NB}, to 120V. Adjust BØ, R148, until the line-to-line voltage, E_{AB}, equals 207.84 volts. The CØ adjustment, R145 has no effect.

3-Amplifier Wye Connection: Set all the amplifier outputs, E_{NA}, E_{NB} and E_{NC}, to 120V. Adjust BØ, R148, for line-to-line voltage E_{AB} equals to 207.84 volts. Adjust CØ, R145, for line-to-line voltage E_{AC} equal to 207.84 volts.

2-Phase Connection: Set both amplifier outputs to 120V. Adjust BØ, R148, until line-to-line voltage E_{AB} equals 169.71 volts.

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SECTION V
PARTS LIST

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SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER NAME	MANUFACTURER PART NO.
PARTS COMMON TO ALL OSCILLATORS					
CAPACITORS					
C 102, C 107	SEE TABLE	POLYCARB	100V 5%	IMB	BIA . . . F
C 103, C 108	SEE TABLE	POLYCARB	100V 5%	IMB	BIA . . . F
C 104, C 105, C 109, C 110	0.0015 uf	CER DISC		ERIE	811Z5V152P
C 106, C 112	0.001 uf	CER DISC		ERIE	811Z5V102P
C 113, C 115	100 uf	ELECT	25V	SPRAGUE	TE1211
C 114	0.01 uf	CER DISC		ERIE	
RESISTORS					
R 108, R 118	SEE TABLE	MET FILM	1/8W 1%	TEXAS INST.	RN60C
R 109, R 119	SEE TABLE	MET FILM	1/8W 1%	TEXAS INST.	RN60C
R 110, R 120	SEE TABLE	MET FILM	1/8W 1%	TEXAS INST.	RN60C
R 111, R 114, R 117, R 121, R 124, R 127, R 133, R 131	2.2K	CARB COMP	1/2W 5%	OHMITE	
	1.2K				
R 112, R 122	100K	CARB COMP	1/2W 5%	OHMITE	
R 113, R 115, R 123, R 125	470	CARB COMP	1/2W 5%	OHMITE	
R 116, R 126	1K	CARB COMP	1/2W 5%	OHMITE	
R 128, R 135	47	CARB COMP	2W 5%	OHMITE	
R 129, R 130, R 131, R 134, R 137	4.7K	CARB COMP	1/2W 5%	OHMITE	
R 132	1.5K	CARB COMP	1/2W 5%	OHMITE	
R 136	220	CARB COMP	1/2W 5%	OHMITE	
R 138, R 139	10K	CARB COMP	1/2W 5%	OHMITE	
R 114	750	CARB COMP	1/2W 5%	OHMITE	
SEMI CONDUCTORS					
Q 104, Q 105, Q 107, Q 108, Q 110	2N3565	TRANSISTOR		FAIRCHILD	
Q 106, Q 109, CR 107, CR 108, CR 109, Q 114	2N3638	TRANSISTOR		FAIRCHILD	
Q 111, Q 112	40250V1	TRANSISTOR		RCA	
Q 113	S17889	TRANSISTOR		FAIRCHILD	
Q 105, Q 108	2N4356			FAIRCHILD	
	2N3567				

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SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER NAME	MANUFACTURER PART NO.
PARTS PECULIAR TO 0.1% OSCILLATORS					
CAPACITORS					
C 101	4.7	TANT	35V	SPRAGUE	CS13-BF475M
RESISTORS					
R 101	2.2K	CARB COMP	1/2W 5%	OHMITE	
R 102	15K	CARB COMP	1/2W 5%	OHMITE	
R 103, R 104, R 106	4.7K	CARB COMP	1/2W 5%	OHMITE	
R 105	680	CARB COMP	1/2W 5%	OHMITE	
R 107	3.3K	CARB COMP	1/2W 5%	OHMITE	
R 140	500	TRIMPOT		BOURNS	275-1-501
SEMI CONDUCTORS					
Q 101, CR 101	2N3638	TRANSISTOR		FAIRCHILD	
Q 102, Q 103	2N3565	TRANSISTOR		FAIRCHILD	
CR 102, CR 103	1N457	DIODE		SYLVANIA	
PARTS PECULIAR TO 0.0001% OSCILLATORS					
OSCILLATOR					
OSC	OSCILLATOR MODULE - SEE TABLE FOR FREQUENCY				
RESISTORS					
R 101	250	WW	10W	WARD-LEONARD	10XM250
R 106	270	CARB COMP	1/2W 5%	OHMITE	
R 107	1000	CARB COMP	1/2W 5%	OHMITE	
R 160	470	CARB COMP	1/2W 5%	OHMITE	
SEMI CONDUCTORS					
CR 101- CR 105	1N4818	DIODE	1A200V	WESTINGHOUSE	
CR 106	2N3638	TRANSISTOR		FAIRCHILD	
Q 103	2N3643	TRANSISTOR		FAIRCHILD	
	UL 923	FLIP-FLOP	See Table A for Number	FAIRCHILD	

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SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER NAME	MANUFACTURER PART NO.
PARTS PECULIAR TO 0.01% OSCILLATORS					
CAPACITORS					
C 101	0.01 uf	CER DISC		ERIE	811Z5V103P
RESISTORS					
R 101	250	WW	10W	WARD-LEONARD	10XM250
R 102	33K	CARB COMP	1/2W 5%	OHMITE	
R 103	3.3K	CARB COMP	1/2W 5%	OHMITE	
R 104	10K	CARB COMP	1/2W 5%	OHMITE	
R 105	470	CARB COMP	1/2W 5%	OHMITE	
R 106	270	CARB COMP	1/2W 5%	OHMITE	
R 107	1K	CARB COMP	1/2W 5%	OHMITE	
SEMI CONDUCTORS					
CR 101-CR 105	1N4818	DIODE		WESTINGHOUSE	
Q 101, W102, Q 103	2N3643	TRANSISTOR		FAIRCHILD	
CR 106	2N3638	TRANSISTOR		FAIRCHILD	
	UL923	FLIP-FLOP	See Table A for Number	FAIRCHILD	
MISCELLANOUS					
X 1		CRYSTAL	See Table A for Frequency	MONITOR	
PARTS PECULIAR TO 2 & 3 PHASE OSCILLATORS					
RESISTORS					
R 140	5.1K	CARB COMP	1/2W 5%	OHMITE	
R 141	10K	CARB COMP	1/2W 5%	OHMITE	
R 142	4.7K	CARB COMP	1/2W 5%	OHMITE	
R 143, R 144	1K	CARB COMP	1/2W 5%	OHMITE	
R 150, R 152					500-1K
R 145, R 148	10K	TRIMPOT		IRC	
R 146	See Table A	MET FILM	1/8W 1%	TEXAS INST	
R 147	See Table A	MET FILM	1/8W 1%	TEXAS INST	
R 149	475	MET FILM	1/8W 1%	TEXAS INST	RN60C4750F
R 151, R 153	2.2K	CARB COMP	1/2W 5%	OHMITE	
CAPACITORS					
C 116	220uf	TANTALUM	10V	SPRAGUE	196B227X001068
C 117	See Table A				
C 118	See Table A				

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SCHEMATIC DESIGNATION	VALUE	DESCRIPTION OR TYPE	RATING	MANUFACTURER NAME	MANUFACTURER PART NO.
PARTS PECULIAR TO 2 & 3 PHASE OSCILLATORS					
SEMI CONDUCTORS					
Q 115		TRANSISTOR		FAIRCHILD	2N3567
Q 116, Q 118, Q 120		TRANSISTOR		FAIRCHILD	2N3638
Q 117, Q 119		FET		AMELCO	2N4302

TABLE A

FREQUENCY	XTAL	NO. OF UL923 USED	R108/R118	R109/R119	R110/R120	C103/C108	C102/C107	R146	C117/C118	R147
50	102.4KHz	11	19.6K	9.53K	6.34K	2 uf	0.082 uf	1K	0.33	11.50K
60	122.88KHz	11	16.2K	7.87K	5.11K	2 uf	0.082 uf	1K	0.33	8.06K
400	102.4KHz	8	14.3K	7.15K	4.75K	0.33 uf	0.012 uf	1K	0.047	8.06K
800	102.4KHz	7	15K	7.87K	5.11K	0.15 uf	0.0068 uf	1K	0.022	11.50K
3200	102.4KHz	5	6.04K	3.01K	2.00K	0.1uf	0.0039 uf	1K	0.0047	11.50K
4800	153.6KHz	5	4.02K	2.00K	1.33K	0.1uf	0.0039 uf	1K	0.0047	8.06K

All 2-phase oscillators use 4.75K for R147

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