•003Hz to 30MHz

AM/FM/PHASE-LOCK FUNCTION GENERATOR

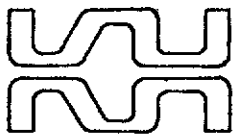
MODEL 2400

SERIAL No. 201A

PRELIMINARY

OPERATING AND MAINTENANCE

MANUAL



ILLUSTRATIONS

TABLE

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The Krohn-Hite Model 2400, shown in Figure 1-1, is a versatile, AM/FM Phase Lock Generator designed for applications in the sub-audio (.003Hz) to high frequency (30MHz) range.

The Model 2400 is actually two complete generators in one. The Main generator provides sine, square, triangle, ramp and pulse waveforms from .003Hz to 30MHz. The Main Output is 30Vp-p, open circuit, controlled by a calibrated, pushbutton dB attenuator and vernier. Dual DC offset controls provide fixed and/or variable offset capability. The variable SYMMETRY control provides a 100:1 adjustment of the Main Output waveform symmetry ratio, to generate additional pulse and sawtooth waveforms.

The Auxiliary generator provides sine, square, triangle, ramp and pulse waveforms from 0.3Hz to 300kHz. The output is adjustable up to 20Vp-p, open circuit. The SYMMETRY control provides a selection of 90:10, 50:50, or 10:90 duty-cycle for generating additional pulse and sawtooth waveforms.

Each generator may be operated independently, or combined to generate the following functions:

> Internally or externally generated AM or suppressed carrier AM signals, with modulation adjustable from 0-100%; FM signals with modulation adjustable from 0-20%; internally, externally, or manually generated pulse and burst type signals, with variable width and rep-rate; continuous, up-frequency or down-frequency sweeps, over a 100:1 range; internally, and externally controlled phase-locked outputs, with locking-capture range of 100:1 and ± 90° adjustable phase control.

The 2400 has been carefully inspected, tested, and aged before shipment. If the generator appears to have been damaged in shipment inform the freight carrier of the damage and notify KROHN-HITE or its nearest sales office immediately.

SECTION 2

OPERATION

2.1 INTRODUCTION

This section describes the basic operation of the Model 2400. It includes the proper AC power requirements, the recommended turn-on procedure and a detailed explanation of all operating controls, modes of operation and special features.

2.2 POWER REQUIREMENTS

The 2400 is designed to operate from a single phase, 50-60Hz AC power source of 90-110, 108-132, 180-220, or 216-264 volts. Complementary line switches on the rear panel allow the 2400 to be powered from one of the above 4 voltage ranges. The AC power receptacle, located on the rear panel, is a standard 3-pin connector, and complies with the European I.E.C. standard. A detachable, 3-wire line cord is provided with the instrument.

The fuse receptacle contains a properly rated fuse for the instrument's point of destination power requirements.

2.3 TURN-ON PROCEDURE

a) Check the line switches to make sure they are set for the correct voltage range. Also check to see that a fuse with the correct rating is secured in the fuse receptacle.

AC Line	120V/240V Switch	Norm/Lo Switch	Fuse
90-110	120V	Lo	3/4 Ampere
108-132	120V	Norm	3/4 Ampere
180-220	240V	Lo	3/8 Ampere
216-264	240V	Norm	3/8 Ampere

b) Check to see that the POWER switch on the front panel is in the OFF position.

c) Secure the 3-wire line cord to the rear panel AC receptacle and plug the line cord into the AC outlet.

WARNING!

The chassis of this intrument is connected to the 3rd wire (earth) ground. For safety purposes, connect the line cord to a suitably grounded, 3 terminal AC outlet.

d) Turn the POWER switch on, and allow the unit to warm up for several minutes.

CAUTION!

The covers of this instrument should not be removed while the instrument is connected to an AC power source because of the potentially dangerous voltages that exist within the unit.

2.4 OPERATING CONTROLS, CONNECTORS AND DISPLAYS (See Figure 2-1)

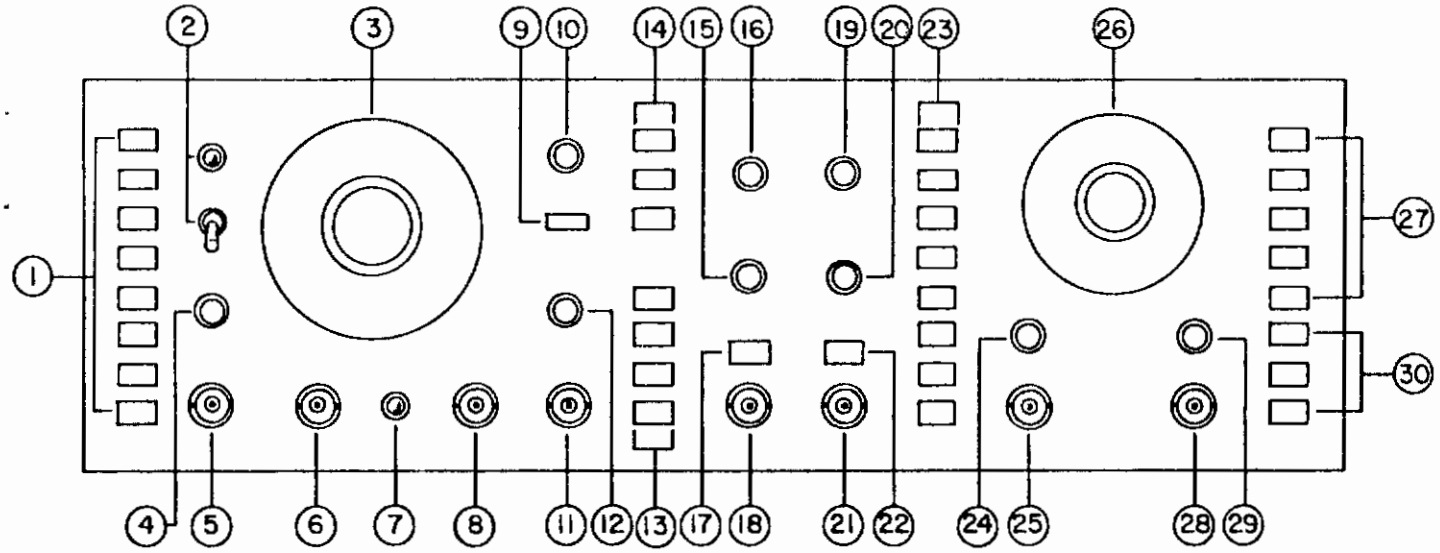
(1) MULTIPLIER: 8 station pushbutton control, calibrated in decade steps from 0.1 to 1M, multiplies FREQUENCY Hz dial setting.

(2) POWER: On-Off toggle switch with power-on indicator.

(3) FREQUENCY Hz/pos duration/SWP START dial: Adjusts frequency of Main generator in non-sweep mode; adjusts positive waveform duration when Main Generator SYMMETRY used, adjusts start frequency in SWP mode.

(4) SYMMETRY: Pull-on variable control. Adjusts Main Generator negative waveform symmetry duration, independent of positive duration. Range, 100:1.

(5) TTL OUT: TTL compatible pulse coincident with Main Generator



frequency, inverted with respect to MAIN OUT. Rise and fall less than 6ns. Impedance, 50 ohms.

(6) VC IN: Input for external voltage control of Main Generator frequency. Zero to ± 3 volts gives 1000:1 frequency control, within dial range. Input impedance, 6K ohms. Operative in all modes except Ø Lock.

(7) Ø LOCK: LED, indicates when Main and Auxiliary Generator frequencies are phase-locked.

(8) CV OUT: DC voltage, proportional to main generator frequency, + 2mV to + 3 volts, 1% accuracy over calibrated portion of FREQUENCY Hz dial. Output impedance, 2.4K ohms.

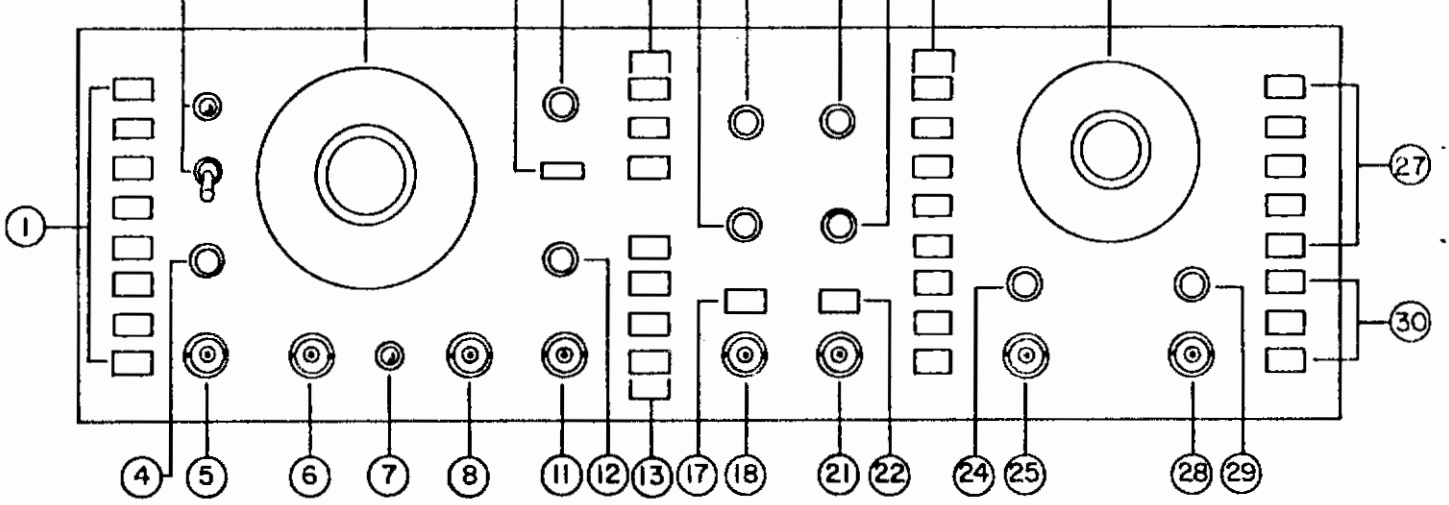
(9) FIXED DC OFFSET: 3 position slide switch selects zero, or fixed positive or negative offset.

(10) VARIABLE DC OFFSET: Single turn, pull-on control provides variable adjustment of MAIN OUTPUT offset, ± 15 volts.

(11) MAIN OUT: Main Generator output, maximum 30V p-p, open-circuit. Impedance, 50 ohms.

(12) PEAK VOLTS: Single turn potentiometer for controlling the MAIN OUTPUT voltage in each position of the AMPLITUDE ATTENUATOR.

(13) ATTENUATOR (dB): 4 position pushbutton attenuator, calibrated in dB steps from 0dB to -60dB. Attenuator accuracy, ± 0.2dB. Minimum output, less than 2 millivolts.



(14) WAVEFORM: 3 station pushbutton control selects sine, triangle or square waveforms. The selected waveform appears at the MAIN OUTPUT.

(15) %AM: Single-turn control, adjusts modulation depth, 0%-100% in AM mode; adjusts modulation envelope 0-100% in SUPP CARRIER mode.

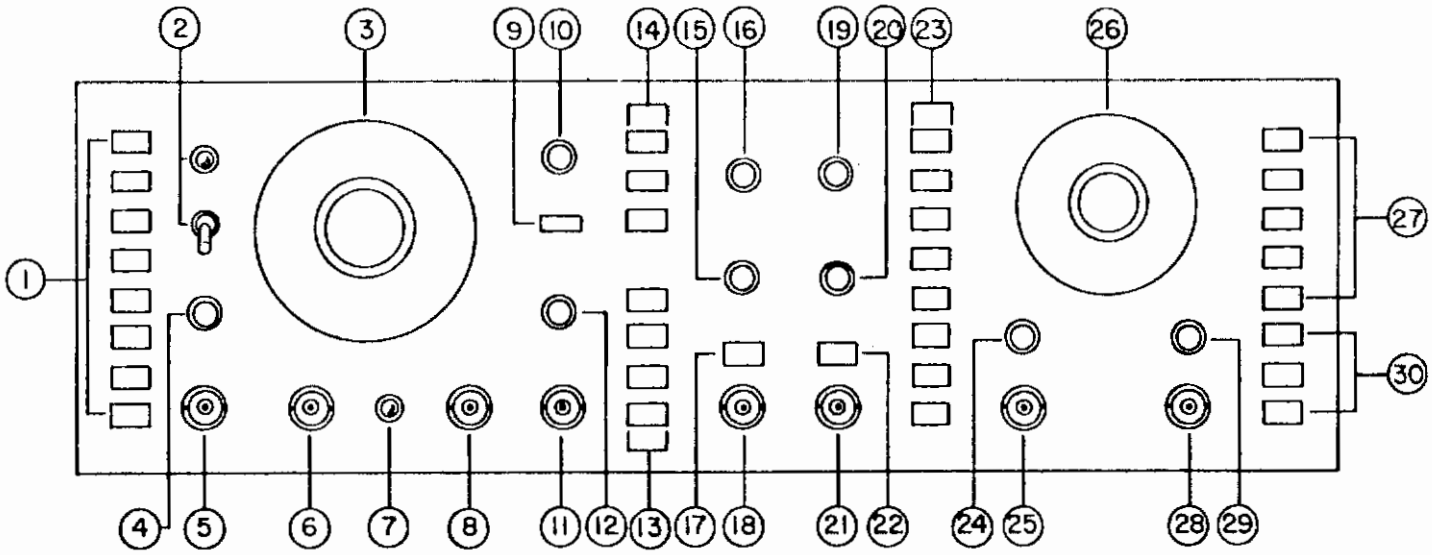
(16) %FM/SWP STOP: Single-turn control, adjusts deviation of Main Generator frequency, 0-20%, in FM mode; adjusts sweep stop frequency in SWP mode.

(17) Pushbutton Control, depress for external AM mode.

(18) AM IN: Input for external AM. 4V peak gives 100% modulation, DC to 2MHz. Impedance, 10K ohms.

(19) TRIG LEVEL/MAN TRIG: Combined single-turn control and push-release switch. Switch manually triggers single cycle of Main Generator dial frequency in (external) TRIG mode; gates Main Generator frequency on in (external) GATE mode. Control varies threshold level at Ø LOCK/GATE/TRIG input for (external) TRIG or GATE signal; varies burst on-time in (internal) GATE mode; varies MAIN OUT pulse or single cycle waveform delay with respect to AUX OUT in (internal) TRIG mode.

(20) LOCK Ø/START Ø: Single-turn control, varies phase between Main and Auxiliary outputs, ± 90°, in Ø LOCK mode; adjusts start/stop point of Main Generator sine or triangle, ± 90°, in TRIG or GATE mode.



(21) ∅ LOCK/GATE/TRIG IN: Input for external ∅ LOCK, GATE, or TRIG control signal. Input impedance, 100K ohms. For ∅ LOCK mode, 4V peak in calibrates LOCK ∅ control range. For TRIG or GATE mode, input trigger level -4V to +4V, maximum rep-rate 4MHz.

(22) Pushbutton control, depress for external ∅ LOCK, GATE or TRIG mode.

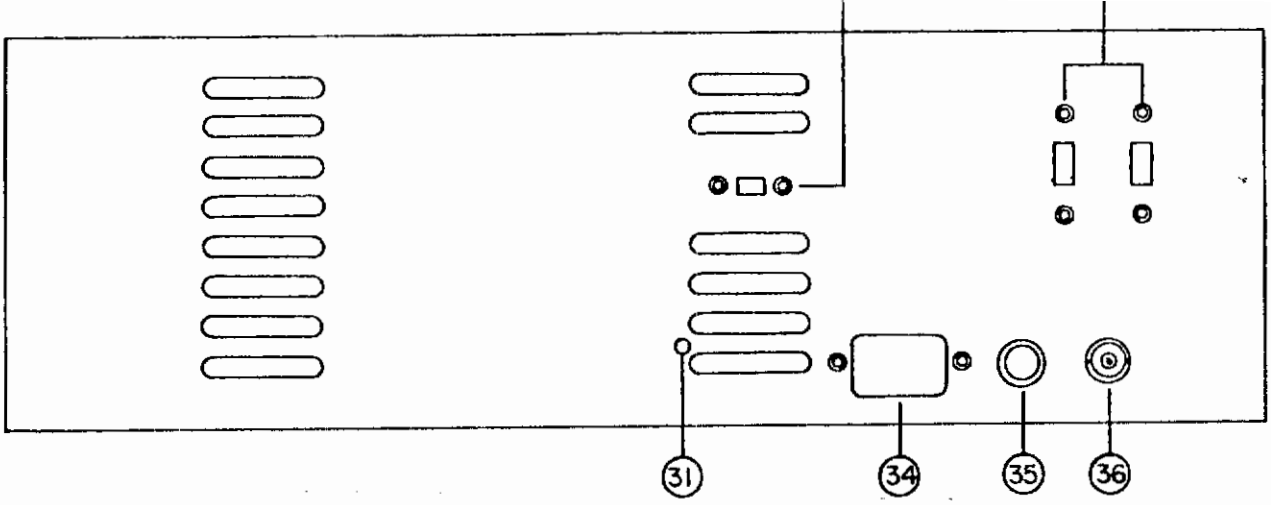
(23) MODE: 8-station, pushbutton control selects generator mode of operation. See Section 2.5.3.

(24) SYMMETRY: 3 position switch, sets duty cycle of Auxiliary Generator waveform at approximately 90:10, 50:50 or 10:90 (Auxiliary generator frequency divided by approximately factor of 10 in 90:10 and 10:90 positions).

(25) TTL OUT: TTL compatible pulse, coincident with Auxiliary Generator frequency, inverted with respect to AUX OUT squarewave. Rise and fall less than 50ns. Impedance, 50 ohms.

(26) FREQUENCY Hz DIAL: Adjust Auxiliary Generator frequency; adjusts modulating frequency of Main Generator in AM and SUPP CARRIER modes; adjusts modulation and sweep rates of Main Generator frequency in FM and SWP modes respectively; captures and locks to Main Generator frequency in ∅ LOCK mode; adjusts pulse and burst rep-rate of Main Generator output in internal TRIG and GATE modes, respectively.

(27) MULTIPLIER: 5-station pushbutton control calibrated in decade



steps from 1 to 10K, multiplies Auxiliary FREQUENCY HZ dial setting.

(28) AUX OUT: Auxiliary generator output. Maximum 20V p-p, open-circuit. Impedance, 50 ohms.

(29) AMPLITUDE, PEAK VOLTS: Single-turn control adjust amplitude of Auxiliary output, up to 20V p-p, open-circuit. Minimum output less than 10mV.

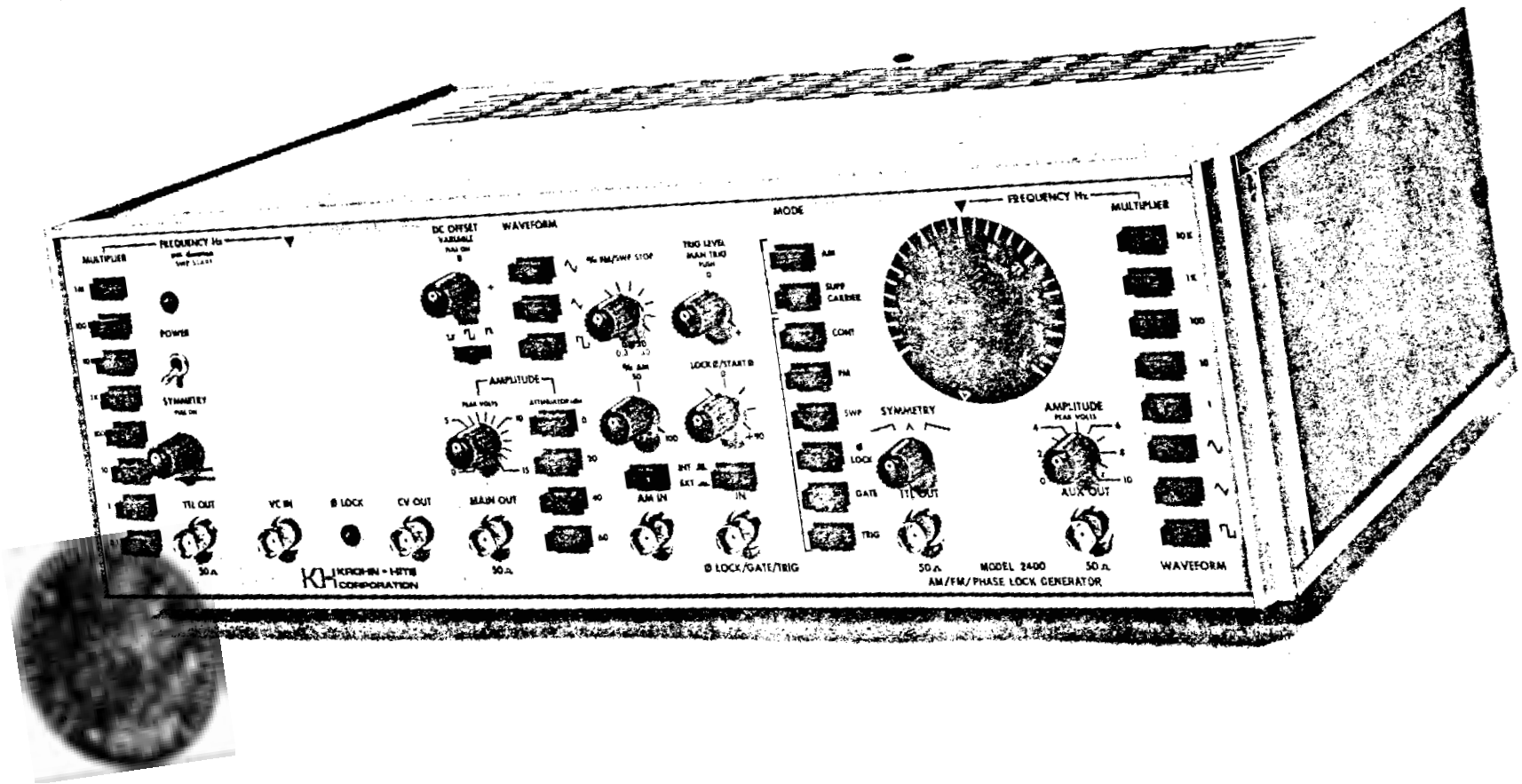
(30) WAVEFORM: 3 station pushbutton control selects sine, triangle or square waveforms. The selected waveform appears at the AUX OUT.

(31) DC LEVEL ADJ: Single turn screwdriver adjust for adjusting MAIN OUT DC level.

(32) CHASSIS/FLOATING: 2 position slide switch that disconnects signal ground (⏚) from chassis ground (⏚) when in the FLOATING position.

(33) Complimentary slide switches for selecting 120 or 240 volt operation, and normal or low line conditions. The 120/240V LINE switch determines the proper voltage range (90-132V or 180-264V), while the NORM/LO LINE switch selects normal (108-132V, 216-264V) or low (90-110V, 180-220V) line voltage.

(34) AC POWER RECEPTACLE: Standard 3-prong connector. A detachable 3-wire line cord is included.


FREQUENCY Hz
MULTIPLIER
POWER
SYMMETRY
DC OFFSET
WAVEFORM
AMPLITUDE
MODE
AM
SUPP CARRIER
CONT
FM
SWP
Ø LOCK
GATE
TRIG
TTL OUT
VC IN
Ø LOCK
CV OUT
MAIN OUT
AM IN
EXT IN
Ø LOCK/GATE/TRIG
AUX OUT
50Ω
KH KROHN-HITE CORPORATION
MODEL 2400
AM/FM/PHASE LOCK GENERATOR

GENERATOR model 2400

SPECIFICATIONS

MAIN GENERATOR

Waveforms: Sine, square, triangle, positive and negative pulses and ramps, AM, supp carrier AM, FM, sweep, phase lock, gate, trigger.

Frequency Range: 0.003Hz to 30MHz in 8 ranges.

Frequency Control: Dial calibrated linearly from 1 to 30, and an 8 position pushbutton multiplier switch.

BAND	MULTIPLIER	FREQUENCY RANGE	ϕ LOCK CAPTURE AND SWP RANGE
1	.1	0.003Hz-3Hz	0.03Hz-3Hz
2	1	0.03Hz-30Hz	0.3Hz-30Hz
3	10	0.3Hz-300Hz	3Hz-300Hz
4	100	3Hz-3kHz	30Hz-3kHz
5	1K	30Hz-30kHz	300Hz-30kHz
6	10K	300Hz-300kHz	3kHz-300kHz
7	100K	3kHz-3MHz	30kHz-3MHz
8	1M	30kHz-30MHz	300kHz-30MHz

Frequency Accuracy: 2% of full scale on bands 1-7, 3.5% of full scale on band 8.

Frequency Stability:

10 minutes	0.05% bands 1-7
24 hours	0.25% bands 1-6, 1% bands 7-8
vs line	0.01% for 10% line change
jitter (cycle to cycle)	0.025%

Maximum Output: 30V p-p (15V p-p into 50 ohms).

Impedance: Constant 50 ohms, ±2%.

Amplitude Control: Pushbutton attenuator calibrated in 20dB steps to 60dB and vernier. dB attenuator accuracy ±0.2dB. Minimum output less than 2mV.

DC Component: Zero ±100mV, ±4mV/°C, reduced in proportion to dB attenuator setting.

Frequency Response: Sinewave; 0.1dB to 300kHz, 0.2dB to 3MHz, 1dB to 30MHz. Triangle, 0.1dB to 300kHz, 1dB to 3MHz, 3.5dB to 30MHz.

Sinewave Distortion: Less than 0.5% 0.1Hz to 300kHz, 2% to 3MHz. All harmonics at least 22dB down to 30MHz.

Squarewave and Pulse: Rise and fall time less than 10ns, total aberrations less than 5% with 50 ohm matching load.

Triangle Linearity: 99% 0.1Hz to 300kHz, 98% to 3MHz, 90% to 30MHz.

Time Symmetry: 99% on bands 1-7, 90% on band 8.

VARIABLE SYMMETRY: Potentiometer for adjusting negative duration of pulses and positive slope of ramps. Main tuning dial controls positive duration of pulses and negative slope of ramps. Symmetry ratio adjustable 100:1.

VC (EXTERNAL VOLTAGE CONTROL): Frequency controlled about the dial setting with zero to ±3 volts. Range 1000:1. Slew rate 0.2V/us. Impedance 6k ohms. Upper frequency limited to maximum of selected band.

DC OFFSETS:
Fixed offset sets the waveform to one half its p-p amplitude and sets the plus peak at zero for negative offset, and the minus peak at zero for plus offset. Variable offset allows setting about ground to ±15 volts peak. (Fixed and variable offsets may be used simultaneously; Maximum peak output limited to ±15 volts).

AUXILIARY GENERATOR

Waveforms: Sine, square, triangle, pulses and ramps.

Frequency Range: 0.3Hz to 300kHz in 5 ranges.

Frequency Control: Single turn dial calibrated linearly from 3 to 30, and a 5 position, pushbutton multiplier switch.

BAND	MULTIPLIER	FREQUENCY RANGE
1	1	0.3Hz-30Hz
2	10	3Hz-300Hz
3	100	30Hz-3kHz
4	1K	300Hz-30kHz
5	10K	3kHz-300kHz

Frequency Accuracy: 10% of full scale.

Maximum Output: 20V p-p (10V p-p into 50 ohms).

Impedance: Constant 50 ohms, ±2%.

Amplitude Control: Single turn vernier. Minimum output less than 100 ~~10~~mV.

Frequency Response: 0.1dB to 100kHz, 0.2dB to 300kHz.

Sine Wave Distortion: <1% to ~~30~~ 12kHz, <2% to ~~300~~ 50kHz, < 3% to 100kHz.

Square Wave and Pulse: Rise and fall times less than 500ns.

Triangle Linearity: 99%, bands 1-4, 90% on band 5.

Time Symmetry: 98%, bands 1-4, 90% on band 5.

SYMMETRY CONTROL: Sets waveform duty cycle for 10% or 90% and divides output frequency by factor of 10.

MODULATION CHARACTERISTICS

AM and SUPPRESSED CARRIER AM

Modulation Factor: 0% to >100%.

Modulation Frequency: 0.3Hz to 300kHz, internal. DC to 2MHz external.

Carrier 3dB Bandwidth: .003Hz to 30MHz.

Carrier Distortion (0% MOD): Less than 1% to 300kHz, 2% to 3MHz.

External Input Sensitivity: 4V peak for 100% modulation.

Impedance, 10K ohms.

FM

Deviation: 0% to 20%.

Modulation Frequency: 0.3Hz to 300kHz.

SWEEP CHARACTERISTICS

Range: 100:1

Rate: 0.3Hz to 10kHz (3.33s to 0.1ms)

Start and stop frequencies independently selected by SWP START and SWP STOP controls. Auxiliary Generator frequency and waveform controls determine sweep parameters.

PHASE LOCK CHARACTERISTICS

Locking Frequency Range: ±90° 10Hz to 300kHz, internal; ±90° 10Hz to 1MHz, ±75° to 3MHz, <±75° to 30MHz, external.

Capture Range: 1/3 to 30 times Main Generator MULTIPLIER.

External Input: Control calibrated for 4V peak sine or triangle. Minimum voltage, .8V peak. Input impedance, 100K ohms.

TRIG/GATE CHARACTERISTICS

Manual, internal or external. Waveform start/stop point adjustable ±90° to 15MHz. Input trigger level variable from -4V to +4V. Triggers on positive slope. Maximum trigger frequency 5MHz. Maximum triggered output frequency, ~~15MHz~~ 10MHz. Input impedance 100K ohms.

AUXILIARY OUTPUTS

MAIN GENERATOR:

CV (control voltage) OUT: 2mV to 3 volts, proportional to generator frequency. Accuracy 1% bands 1-7. Impedance, 2.4K ohms.

TTL OUT: Frequency and symmetry same as Main Output. Drives up to 10 TTL loads. Rise and fall time less than 6ns. Total aberrations less than 10%. 180° out of phase with Main squarewave output. Impedance 50 ohms.

AUXILIARY GENERATOR:

TTL OUT: Frequency and symmetry same as Aux Output. Drives up to 10 TTL loads. Rise and fall time less than 50ns. Total aberrations less than 10%. 180° out of phase with Auxiliary squarewave output. Impedance 50 ohms.

GENERAL

Operating Temperature Range: 0°C to 50°C

Power Requirements: Switch selectable 90-110, 108-132, 180-220 or 216-264 volts, single phase, 50-400Hz, 60 watts.

Floating Ground Operation (Rear Panel): Switch disconnects signal ground from chassis ground.

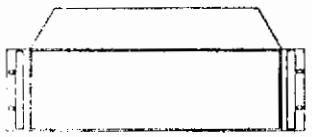
Dimensions and Weights:

Cabinet Size/Weight	H	W	D	Net	Gross
US	5 1/4"	16 5/8"	11 1/2"	13 lbs	15 lbs
Metric	13.3cm	42.2cm	29.2cm	5.9 kgs	6.8 kgs

Specifications apply at 25°C ±5°C, CONT mode, Main and Auxiliary Generators at maximum output voltage, Main dial set between 1 and 30, Auxiliary dial set between 3 and 30 and both SYMMETRY controls off.

Optional Rack Mounting Kit:

Part No. RK-519; permits installation of the Model 2400 into a standard 19" rack spacing.



Specifications subject to change without notice.

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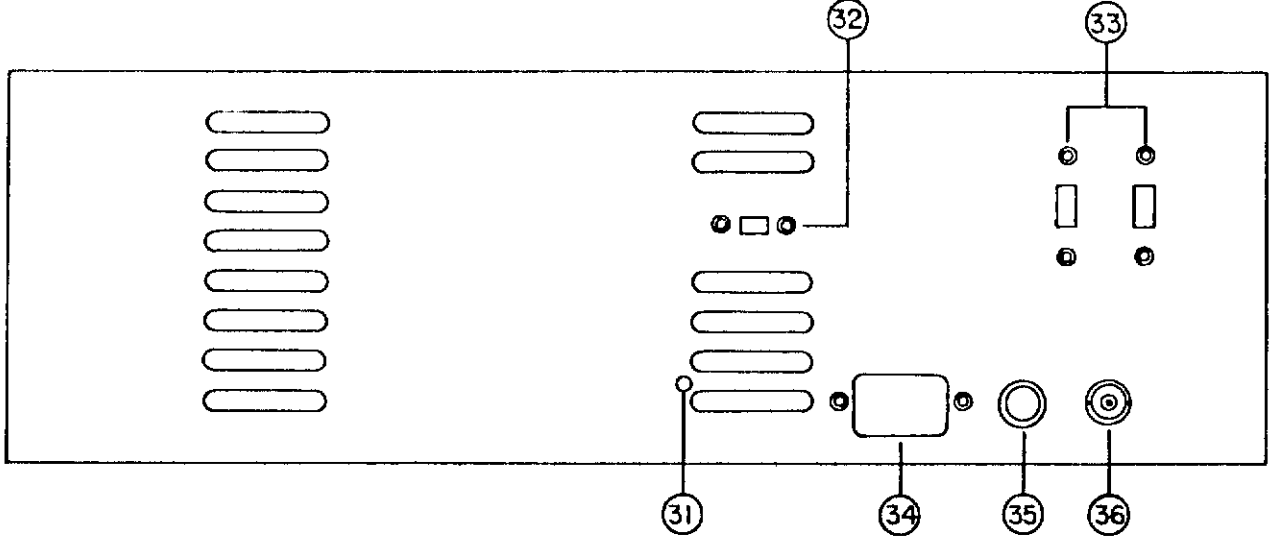


(35) FUSE RECEPTACLE: 3/4A slow blow fuse for 90-132V operation, 3/8A slow blow fuse for 180-264V operation.

(36) SYNC INPUT: A 2 volt p-p signal applied to this input will lock the Main Generator frequency to the external SYNC frequency within 1 3% locking range. (Not applicable to Ø Lock mode).

2.5 OPERATION

2.5.1 Main Generator

a) The Main Generator produces sine, triangle and square waveforms, and covers a frequency range of .003Hz to 30MHz. The FREQUENCY Hz dial is a single turn dial with a concentric 5:1 vernier, and is calibrated in Hertz on a linear scale from 1 to 30 (.03 to 1 uncalibrated). The effective dial range is 1000:1. The MULTIPLIER is an 8-station, pushbutton control calibrated in decade steps from 0.1 (10^{-1}) to 1M (10^{6}).

The FREQUENCY Hz dial and MULTIPLIER determine the frequency or period of the MAIN OUTPUT waveform in the AM, SUPP CARRIER, CONT, FM, GATE and TRIG modes. In the SWP mode, the dial determines the sweep start frequency. In the Ø LOCK (phase-lock) mode, the dial has no effect; the Main Generator frequency is controlled by the Auxiliary Generator.

The dial also independently controls the squarewave positive duration and sine and triangle negative slopes, when the SYMMETRY-neg duration control is engaged, in all modes except SWP and Ø LOCK.

b) The Main Generator frequency may also be controlled by an external voltage applied to the VC (voltage control) input connector. A control voltage range of zero to 3 volts will vary the Main Generator frequency about the dial setting (within the dial range) up to a maximum of 1000:1 limited by the maximum dial frequency on the MULTIPLIER range selected. The VC voltage will vary the dial frequency at a ratio of approximately 10Hz per volt times the MULTIPLIER setting. The VC has slew rate of 0.2V/us; input impedance is 6k ohms.

c) The SYMMETRY-neg duration control is a single-turn control that independently varies the Main Generator square wave negative duration and sine and triangle positive slopes. The SYMMETRY ratio is adjustable 100:1 on each MULTIPLIER range. The SYMMETRY control can be used to generate additional pulse or sawtooth waveforms.

d) The output of the Main Generator is determined by the pushbutton waveform selector. The selected waveform appears at the MAIN OUT connector.

e) The MAIN OUTPUT voltage is controlled by a single turn PEAK VOLTS control and pushbutton attenuator calibrated 0, 20, 40, and 60 dB steps. Maximum output is 30Vp-p, open-circuit. Output impedance is 50 ohms.

f) The FIXED DC OFFSET control is a 3 position slide switch that selects fixed positive (⎍), zero (⎍) or fixed negative (⎍) DC offset. When the FIXED OFFSET is used, the amplitude of the MAIN OUTPUT waveform is halved; the negative peak of the waveform is set at zero for positive offset, and the positive peak of the waveform is set to zero for negative offset.

g) The VARIABLE DC OFFSET control is a pull-on potentiometer that varies the MAIN OUTPUT DC level ± 15V. The maximum combined peak AC plus DC should not exceed ± 15V, otherwise clipping of the waveform will occur. When both the FIXED and VARIABLE offset controls are used the amplitude of the MAIN OUTPUT waveform will be halved, and is positive or negative peak may be set between zero

and ± 15 volts with the VARIABLE OFFSET control. A particular application for this would be to generate ECL or TTL compatible pulses.

h) The CV (control voltage) OUTPUT is a DC voltage proportional to the Main Generator frequency. Output is+2mV to+3 volts. Accuracy is approximately 1% of output frequency, on bands 1-7 (.1 to 100k) of the MULTIPLIER. Output impedance is 2.4k ohms.

2.5.2. Auxiliary Generator

a) The Auxiliary Generator produces sine, triangle, and square waveforms and covers a frequency range of 0.3Hz to 300kHz. The FREQUENCY Hz dial is a single turn dial, calibrated in Hertz on a linear scale from 3 to 30 (.3 to 3 uncalibrated). The effective dial range is 100:1. The MULTIPLIER is a 5 station, pushbutton control, calibrated in decade steps from 1 to 10k.

The Auxiliary Generator operates independent of the Main Generator in the CONT mode of operation; in all other modes, the Auxiliary Generator controls the Main Generator as described under Operating Modes, Section 2.3.3.

The Auxiliary SYMMETRY control is a 3 position switch that selects the symmetry of the Auxiliary waveform to 90:10 (⟋), 50:50 (⋀) or 10:90 (⋀). When the 90:10 or 10:90 position is used the frequency of the Auxiliary generator, as indicated by the dial and MULTIPLIER is divided by 10. The SYMMETRY control is useful for generating additional pulse and sawtooth waveforms.

b) The output of the Auxiliary generator is determined by the pushbutton WAVEFORM selector. The selected waveform appears at the AUX OUT connector.

c) The Auxiliary output voltage is controlled by a single turn PEAK VOLTS CONTROL that covers approximately 60 dB of attenuation. Maximum output is 20Vp-p, open-circuit. Output impedance is 50 ohms.

2.5.3. Operating Modes

The Model 2400 provides a selection of 8 basic modes of operation, as determined by the pushbutton MODE selector: AM, SUPP CARRIER, CONT, FM, SWP, Ø LOCK, GATE and TRIG. The AM, Ø LOCK, GATE and TRIG modes may be generated internally by the Auxiliary Generator, or by an external source applied to the respective external input connectors.

1) AM MODE: The Main Generator determines the carrier frequency, waveform and amplitude; the Auxiliary Generator determines the modulating frequency and waveshape. The modulation factor (modulation depth) is controlled by the % AM control; the range is 0%-100%. The amplitude modulated wave is at the MAIN OUT connector.

For external AM control, the INT/EXT pushbutton above the external input labelled "AM IN" is depressed; applying a 4V peak AC signal to the AM IN connector will calibrate the % AM control for 100% modulation; the modulation factor may then be controlled by varying the % AM control.

The external voltage to % modulation is approximately linear in relationship, i.e. zero to 4V peak gives 0%-100% modulation.

2) SUPP CARRIER MODE: For suppressed carrier operation, depress the SUPP CARRIER mode in addition to the AM mode, and adjust all controls as above.

3) CONT MODE: In the CONT (continuous) mode, the Main Generator and Auxiliary Generator are independent of each other.

4) FM MODE: In the FM mode, the Main Generator determines the carrier frequency, amplitude, and waveform; the Auxiliary generator determines the modulating frequency and waveshape. The FM deviation is controlled by the % FM/SWP STOP CONTROL, and has a range of 0-20%. The frequency modulated wave is at the MAIN OUT connector.

5) SWP MODE: In the SWP (sweep) mode of operation, the Main Generator FREQUENCY Hz dial and MULTIPLIER set the sweep start frequency; the sweep stop frequency is adjusted by the %FM/SWP STOP CONTROL. The frequency may be swept up or down. The maximum sweep range is limited to the maximum dial range in each MULTIPLIER position. The sweep rate is determined by the Auxiliary FREQUENCY dial and MULTIPLIER. The sweep characteristic is determined by the Auxiliary waveform selected. If the Auxiliary SYMMETRY control is engaged to generate a linear ramp sweep, the sweep rate will be divided by a factor of 10.

The start of the frequency sweep will correspond to the negative peak of the selected Auxiliary waveform for an up frequency sweep, and to the positive peak of the selected Auxiliary waveform for a down frequency sweep. The swept frequency is at the MAIN OUT.

6) Ø LOCK MODE: The Ø LOCK (phase-lock) mode provides two signals of the same frequency that are phase-locked over a ± 90° range. In the Ø LOCK mode, the Main Generator FREQUENCY Hz dial is disabled; the Main Generator frequency is captured and locked by the Auxiliary Generator. The locking frequency range is determined by the Main Generator MULTIPLIER, as indicated below:

MULTIPLIER	Ø LOCK CAPTURE RANGE	
0.1	.03Hz - 3Hz	Internal
1	0.3Hz - 30Hz	and
10	3Hz - 300Hz	External
100	30Hz - 3kHz	
1K	300Hz - 30kHz	
10K	3kHz - 300kHz	
100K	30kHz - 300kHz	
100K	300kHz - 3MHz	External
1M	300kHz - 30MHz	only

The Auxiliary Generator will capture and lock the Main Generator frequency over a 100:1 range within each range determined by the MULTIPLIER setting. The Ø LOCK light, located beneath the Main Generator FREQUENCY dial, will indicate when a locking condition exists.

The phase-locked outputs are taken from the MAIN OUT and AUX OUT connectors. The amplitude and waveform of each output are independently selected.

The LOCK Ø/START Ø control varies the phase of the AUX OUT with respect to the MAIN OUT, between -90° and +90°, if the two output waveforms are similar, or if one is a sine wave and the other a triangle. If the MAIN OUT is a sine or triangle wave and the AUX OUT is a square wave, +90° must be added to the LOCK Ø setting. Conversely, if the AUX OUT is a sine or triangle wave and the MAIN OUT is a square wave, -90° must be added to the LOCK Ø setting.

The internal Ø LOCK mode is limited to the upper frequency of the Auxiliary Generator (300kHz). For external phase lock operation of the INT/EXT selector located above the input labelled "Ø LOCK/GATE/TRIG" is depressed; a 4V peak external sine or triangle wave will phase-lock the Main Generator and calibrate the LOCK Ø/START Ø control for ± 90°. The minimum locking voltage required is .8V peak.

7) GATE (BURST) MODE: In the GATE mode of operation, the Main Generator frequency is gated on and off by the Auxiliary Generator. The internal GATE mode is also referred to as the BURST mode. The Main Generator FREQUENCY dial and MULTIPLIER determine the burst frequency. The burst rep-rate is determined by the Auxiliary FREQUENCY dial and MULTIPLIER. The burst on-time is controlled by the TRIG LEVEL control when the Auxiliary WAVEFORM selector is set to sine or triangle. When the Auxiliary squarewave is selected, the burst on-time will be set at 50% of the burst rep-rate. If the Auxiliary SYMMETRY control is used, the burst rep-rate, indicated by the Auxiliary FREQUENCY dial, will be divided by a factor of 10. The LOCK Ø/START Ø control adjusts the start/stop point of the first and last cycle of the burst by ± 90°. The burst itself always contains an integral number of cycles of the Main Generator dial frequency.

For external gate operation, depress the button located above the Ø LOCK/GATE/TRIG input. The Main Generator will be gated on during the positive transition of the external gate signal. The TRIG LEVEL

control will adjust the gate threshold level between -4V and +4V.

For manual gating of the Main Generator, the INT/EXT button is released; depressing the TRIG LEVEL/MAN TRIG control will gate the Main Generator on for as long as the control is depressed.

8) TRIG (PULSE) MODE: In the internal TRIG or pulse mode of operation, the Main Generator is internally triggered by the Auxiliary generator. The Main generator FREQUENCY dial and MULTIPLIER determines the single cycle or pulse period. The single cycle or pulse rep-rate is controlled by the Auxiliary FREQUENCY dial and MULTIPLIER. The LOCK Ø/START Ø control varies the start/stop point of the haversine or havertriangle waveforms. The TRIG LEVEL control will delay the start of the pulse with respect to the AUX OUT.

   If the Auxiliary SYMMETRY control is used the pulse rep-rate will be divided by approximately 10.

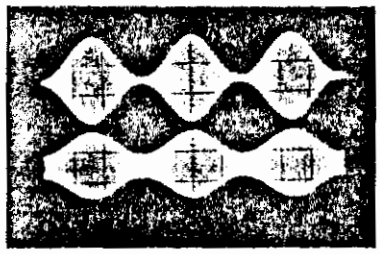
   For external triggering, the same conditions apply as in external gate operation (7). Maximum trigger frequency is limited to 5MHz and the Maximum Main Generator frequency that may be triggered is 15MHz.

   For manual triggering, one cycle of the Main Generator frequency will be produced each time the TRIG LEVEL/MAN TRIG button is depressed.

Table 2.1 on pages 2-14 thru 2-16 briefly describes how to use the controls for each desired mode of operation; a set of illustrative waveforms for each mode are also included.

AM

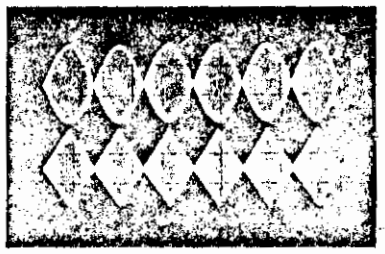
1) Depress AM.
2) Depress CONT.
3) Set carrier frequency with Main Generator FREQUENCY Hz dial and MULTIPLIER.
4) Select carrier waveform with Main Generator WAVEFORM switch.
5) Adjust carrier amplitude with Main Generator PEAK VOLTS and ATTENUATOR dB controls.
6) Select internal or external AM.
7) If internal AM is used, select modulating frequency with Auxiliary Generator frequency controls.
8) Select modulating waveform with Auxiliary Generator WAVEFORM switch.
9) If external AM is used feed 4V peak into AM IN for 100% modulation.
10) Adjust modulation depth with % AM control.



upper trace: 100%
lower trace: 50%

SUPP CARRIER

1) Depress AM and SUPP CARRIER.
2) Repeat steps 2 thru 9 above.
3) Adjust PEAK VOLTS and ATTENUATOR dB controls for desired CW amplitude in CONT mode, adjust % AM for envelope amplitude.



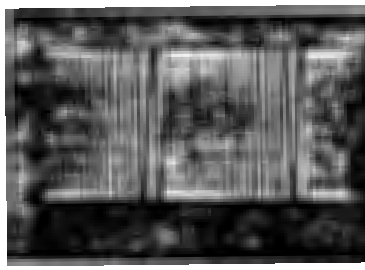
upper trace: sine mod
lower trace: triangle mod

FM

1) Depress FM.
2) For AM/FM or SUPP CARRIER AM/FM, also depress AM or AM and SUPP CARRIER.
3) Select Main Generator frequency, amplitude and waveform. (Main Generator frequency should be $\geq$ 10 times modulation rate.)
4) Adjust % deviation 0-20% with % FM/SWP STOP control.
5) Adjust FM rate with Auxiliary Generator frequency controls.
6) Select modulating waveform with Auxiliary WAVEFORM switch.
7) If SYMMETRY control used (90:10, 10:90) modulating rate $\div$ 10.
8) If external FM is desired, use CONT mode and VC input.

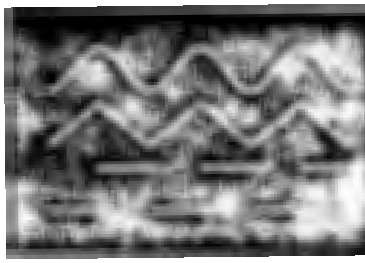
SWP

1) Depress SWP.
2) Select Main Generator waveform and amplitude as desired.
3) Select start frequency with Main Generator dial.
4) Select stop frequency with SWP STOP control.
5) Select sweep rate with Auxiliary Generator frequency controls.
6) Select sweep characteristic with Auxiliary Generator WAVEFORM and SYMMETRY control.
7) If SYMMETRY used, sweep rate ÷ 10.



CONT

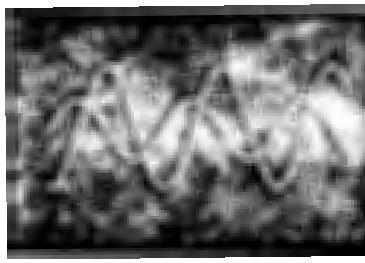
1) Depress CONT.
2) Main and Auxiliary Generators are independent of each other.
3) Select desired frequency, waveform and amplitude of each generator.
4) Main Generator may be voltage controlled by the VC input.



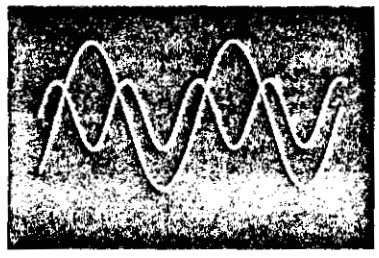
top to bottom: sine triangle, square

Ø LOCK

1) Depress Ø LOCK.
2) Select Main Generator frequency, amplitude and waveform as desired.
3) Set Auxiliary Generator MULTIPLIER to same band as Main Generator.
4) Set Auxiliary Generator frequency close to Main Generator frequency until Ø LOCK indicator light comes on. Both outputs will now be the same frequency.
5) Frequency of both generators is now controlled by Auxiliary Generator.
6) Adjust Ø LOCK control for ±90°.
(Phase control indicates Auxiliary output with respect to Main Output, i.e. +90° Auxiliary leads Main.)
7) To double Main Generator frequency and maintain phase lock, depress AM and SUPP CARRIER.



Ø-locked outputs

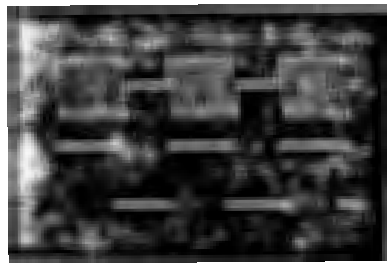


Ø Lock w/Frequency doubling

GATE (Burst)

1) Depress GATE.
2) For GATED AM or GATED SUPP CARRIER AM, also depress AM or AM and SUPP CARRIER.
3) Set GATED (Burst) frequency and waveform with Main Generator.
4) Select internal or external GATE.
5) If internal GATE is used, set GATE (Burst) on-time with trig level/man trig control.
6) Select gating waveform from Auxiliary Generator.
7) Adjust GATE (Burst) rep-rate with Auxiliary frequency.
8) If external gate is used, adjust threshold level with TRIG LEVEL control.
9) Adjust start Ø control as desired.

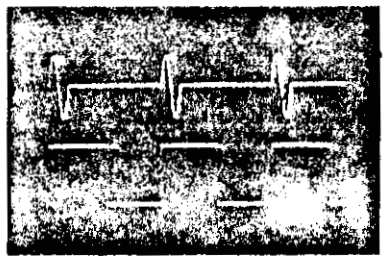
NOTE: Depressing MAN TRIG causes Main Generator to free run.



upper trace: Main Out
lower trace: Ext Gate

TRIG (Pulse)

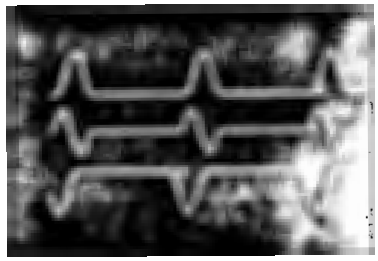
1) Depress TRIG.
2) Select internal or external TRIG.
3) Set pulse period with Main Generator frequency controls.
4) Set Main Generator to desired waveform and amplitude.
5) If internal TRIG is used set pulse rep-rate with Auxiliary frequency.
6) If external trigger is used, adjust threshold level with TRIG LEVEL control.
7) Adjust START Ø control as desired.
8) To manually trigger, depress MAN TRIG button.



upper trace: Main Out
lower trace: Ext Trig

VARIABLE START Ø (Main Output)

Used with GATE or TRIG mode.



Main out, top to bottom:
-90°, 0°, +90°

SECTION 3

INITIAL ACCEPTANCE AND ROUTINE PERFORMANCE TESTS

3.1 INTRODUCTION

The following procedure may be used to verify the generator's performance specifications, both for incoming acceptance and for routine servicing. All tests should be made with the cover in place and secured.

3.2 EQUIPMENT REQUIRED

Refer to the Appendix on page A-1.

3.3 INITIAL TURN-ON

FAMILIARIZE YOURSELF WITH SECTION 2.2, POWER REQUIREMENTS AND SECTION 2.3, TURN-ON PROCEDURE BEFORE OPERATING THIS INSTRUMENT.

3.4 PRELIMINARY SET-UP

After the instrument has been allowed to warm up for several minutes, set the controls initially to the following positions:

MAIN GENERATOR (LEFT SIDE):

FREQUENCY Hz dial	30
MULTIPLIER	100
SYMMETRY	Off
DC OFFSET, VARIABLE	Push off
DC OFFSET, FIXED	⎍
WAVEFORM	∿
AMPLITUDE	0dB (ATTENUATOR)
	MAX CW (PEAK VOLTS)

AUXILIARY GENERATOR (RIGHT SIDE):

FREQUENCY Hz dial	30
MULTIPLIER	100
MODE	CONT
SYMMETRY	⋀
AMPLITUDE	MAX CW
WAVEFORM	∿

MISCELLANEOUS:

%FM/SWP STOP	Centered
TRIG LEVEL/MAN TRIG	Centered
% AM	50
LOCK Ø/START Ø	0
AM IN button	INT (out)
Ø LOCK/GATE/TRIG IN button	INT (out)

CAUTION!

The covers of this instrument should not be removed when the instrument is connected to an AC power source, because of the potentially dangerous voltages that exist within the unit.

3.5 PERFORMANCE TESTS

3.5.1 Main Generator

1) WAVEFORMS AND AMPLITUDE CONTROLS:

Connect the oscilloscope to the generator's MAIN OUT; operate the WAVEFORM switch and observe that the sine (∿), triangle (⋀) and square waveforms are approximately 30Vp-p, and undistorted. Return to triangle (⋀).

Vary the PEAK VOLTS control from maximum to minimum; the waveform amplitude should be reduced by more than 40dB. Return the PEAK VOLTS control to maximum. Operate the ATTENUATOR switch and observe the waveform amplitude is attenuated in 20dB steps. The ATTENUATOR has

an accuracy of ± 0.2dB per 20dB step.

2) FIXED AND VARIABLE DC OFFSETS:

Set the PEAK VOLTS control to maximum, ATTENUATOR to 0dB. Switch the FIXED OFFSET control to the ⌐¬ (positive) offset position; the waveform p-p amplitude should be halved and its negative peak should start at zero volts. Switch the FIXED OFFSET control to the ¬⌐ (negative) offset position; waveform p-p amplitude should be halved, and its positive peak should start at zero volts. Return the FIXED OFFSET control to the ⌐¬ (zero) position.

Turn the PEAK VOLTS control to its minimum position. Pull the VARIABLE DC OFFSET on, and rotate it from its CCW end to its CW end; output offset should vary from -15V to +15V. Push the VARIABLE OFFSET off.

3) SYMMETRY:

Select ⌐¬ . Pull the SYMMETRY control on; you should be able to vary the squarewave negative duration, independent of its positive duration, which is controlled by the FREQUENCY dial. Symmetry range on each MULTIPLIER position is approximately 100:1. Push the SYMMETRY control off.

4) FREQUENCY CALIBRATION:

Connect a frequency counter to the MAIN OUT WAVEFORM to ⌐¬ . Check the accuracy of the FREQUENCY dial on the X100 MULTIPLIER position; tolerance is ±2% of full scale, or ±60Hz.

Adjust the FREQUENCY dial for a reading of exactly 3,000Hz. Operate the MULTIPLIER switch and check the frequency accuracy in each position. Tolerance, ±2% of full scale, X .1 - X100K positions, ±3.5% of full scale, X 1M position.

5) AMPLITUDE FLATNESS (FREQUENCY RESPONSE):

The specifications for amplitude flatness apply to sinewave and triangle only. The specification may be checked by the use of a thermal converter (Fluke Model A55) and either a DC Differential Voltmeter (Fluke Model 895A) or a DC Null Detector (Fluke Model 845A) with a stable, DC reference supply. (Figure 3-1.)

A suitable AC voltmeter that will measure amplitude variations of less than 0.1dB to 300kHz, 0.2dB to 3MHz and 1dB to 30MHz may be used as an alternate, if one is available.

Peak to peak variations should be within the tolerances indicated below:

Frequency	Tolerances ∿	Tolerances ∿
<300kHz	0.1dB	0.1dB
300kHz - 3MHz	0.2dB	1.0dB
3MHz - 30MHz	1.0dB	3.5dB

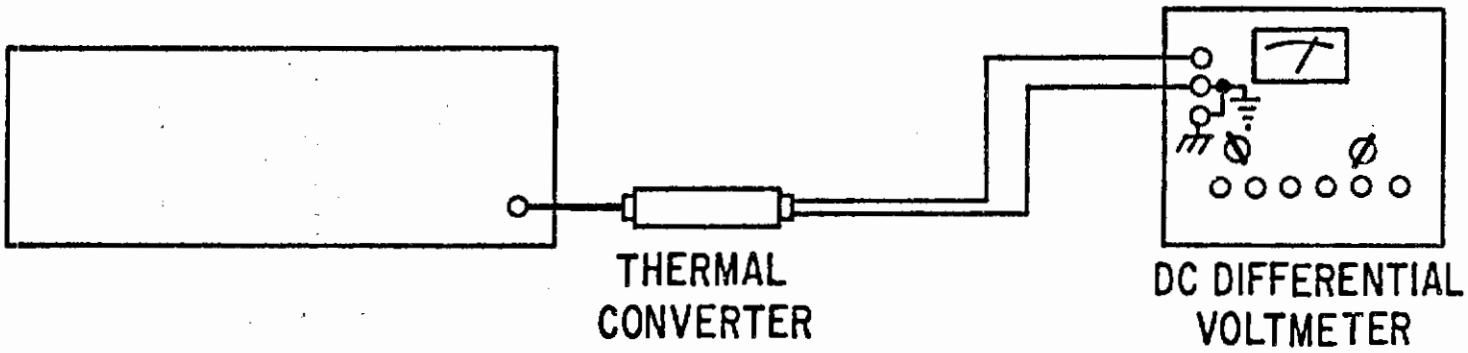


Figure 3-1. Test Set-up for Amplitude Flatness Measurements.

6) SINEWAVE DISTORTION:

Connect the Distortion Analyzer to the MAIN OUT, WAVEFORM on ∿. Measure the total harmonic distortion; it should be less than 0.5% (-46dB) to 100kHz.

Above 100kHz, the use of a Wave or Spectrum Analyzer is recommended. Total harmonic distortion is specified at less than 0.5% (-46dB) to 300kHz, 2% (-34dB) to 3MHz and -22dB to 30MHz.

7) SQUAREWAVE RESPONSE:

Connect the MAIN OUT to the scope vertical input, with a 50 ohm terminator at the scope input. Set the Main Generator frequency to 3MHz (30 x 100K), WAVEFORM switch to ⎍.

Verify the following squarewave parameters:

Parameter	Tolerance
Rise and fall time	<10ns
Preshoot, overshoot and ringing	<5% of p-p amplitude

8) TTL OUT:

Connect the Main Generator TTL OUT to the scope vertical input, without the 50Ω terminator. Set the Main Generator frequency to 3kHz (30 x 100) and verify the TTL OUT levels are approximately +2 to +5 volts (high) and zero to +1 volt (low).

9) VC (VOLTAGE CONTROL) INPUT:

The VC (Voltage Control) Input allows you to control the frequency of the Main Generator with an external voltage.

Connect a frequency counter to the MAIN or TTL OUT, and a variable DC source (zero to ± 3V) to the VC IN. Vary the DC source and observe the generator frequency varies.

Disconnect the DC source from the VC IN.

10) CV (CONTROL VOLTAGE) OUT:

The CV (Control Voltage) OUT is a DC voltage proportional to the Main Generator dial setting. Connect a voltmeter to the CV OUT and verify the CV voltage is approximately +3V for 30 on the dial, +2V for 20 on the dial, etc.

3.5.2 Auxiliary Generator

1) WAVEFORMS AND AMPLITUDE CONTROL:

Connect the oscilloscope to the AUX OUT; operate the WAVEFORM switch and observe that the sine ( ) triangle ( ) and squarewave are at least 20Vp-p and undistorted. Return to .

Vary the PEAK VOLTS, control from maximum to minimum; amplitude should be reduced by more than 40dB. Return the PEAK VOLTS control to maximum.

2) SYMMETRY:

Select , switch the SYMMETRY control to (90% duty cycle) and verify with the scope. Switch SYMMETRY to (10% duty cycle) and verify on the scope. Return SYMMETRY control to (50% duty cycle) position.

3) FREQUENCY CALIBRATION:

Connect a frequency counter to the AUX OUT, WAVEFORM to . Check the accuracy of the dial and multiplier on all ranges. Tolerance, ±10% of full scale, 0.3Hz to 300kHz.

4) AMPLITUDE FLATNESS (FREQUENCY RESPONSE):

The specifications for amplitude flatness apply to sinewave, only. The test set-up shown in Figure 3-1 may be used, except that the Thermal Converter is connected to the AUX OUT. (The WAVEFORM switch should be on).

Peak to peak variations should be less than 0.1dB (1.0%) to 100kHz and less than 0.2dB (2.0%) to 300kHz.

5) SINEWAVE DISTORTION:

Connect the Distortion Analyzer to the AUX OUT, WAVEFORM on ∿ . Measure the total harmonic distortion, it should be less than 1% to 10kHz, less than 2% to 50kHz, less than 3% to 100kHz.

6) TTL OUT:

Set the Auxiliary Generator frequency to 3kHz (30 x 100) and verify that the TTL OUT levels are between +2 and +5 volts (high) and zero and +1 volts (low).

3.5.3. Modes of Operation

Refer to Table 2.1 on pages 2-14 thru 2-16 to verify that the respective modes of operation are working properly.

SECTION 4

CIRCUIT DESCRIPTION

Section 4, Circuit Description, is in its final stages of preparation, and will be included in the final Operating and Maintenance Manual for the Model 2400.

A copy of the complete Operating and Maintenance Manual for the Model 2400 will be sent to you when it is ready.

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PUBLICATIONS NOTICE 2400-1-481

SECTION 5

MAINTENANCE

Section 5, MAINTENANCE, is in its final stages of preparation, and will be included in the final Operating and Maintenance Manual for the Model 2400.

A copy of the complete Operating and Maintenance Manual for the Model 2400 will be sent to you when it is ready.

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SECTION 6

CALIBRATION

6.1 INTRODUCTION

The following procedure provides for the calibration and adjustment of the generator in the field, and adherence to this procedure should restore the generator to its original performance specifications. If the generator cannot be calibrated by the procedure given, refer to MAINTENANCE, Section 5, or consult our Factory Service Department. The location of all test points and adjustable components may be found in the circuit layout drawing at the rear of this manual.

WARNING!

This calibration procedure should be performed by qualified personnel only. Remove the covers before connecting the instrument to the AC source and use only insulated probes and/or tools.

6.2 EQUIPMENT REQUIRED

Refer to the Appendix on page A-1.

6.3 TURN-ON PROCEDURE

After removing the instrument covers, follow the recommended turn-on procedure outlined in Section 2.3 and allow the instrument to warm up for at least 15 minutes.

6.4 TEST PROCEDURE

6.4.1 Main Generator (Left Side)

Set the Main Generator controls initially to the following positions:

FREQUENCY Hz dial	30
MULTIPLIER	1K
SYMMETRY	Push off
DC OFFSET, VARIABLE	Push off
DC OFFSET, FIXED	⊓
WAVEFORM	∿
AMPLITUDE	0dB (ATTENUATOR) MAX CCW (PEAK VOLTS)
MODE	CONT
CIRCUIT GROUND (Rear Panel)	CHASSIS

1) Regulated DC Power Supplies:

Connect the HI end of the DVM to the +25 volt test point; connect the LO end of the DVM to the -25 volt test point on PC591. Adjust R107 for a reading of +50 volts, exactly.

CAUTION!

DVM LO (COMMON) input should be isolated from the 3rd wire (earth) ground.

Connect the LO end of the DVM to signal ground (⏚) and check the following voltages on PC591:

Test Point	Tolerance
+25V	+25.00V, ± 0.25V
-25V	-25.00V, ± 0.25V
+5.5V	+5.50V, ± 0.16V
-5.5V	-5.50V, ± 0.16V

2) DC Voltage Levels:

Connect the DVM to test point +20V on PC592 and adjust R541 for +20.0V, ± 0.2V.

Connect the DVM across either R567 or R576 (18ohm, 1W collector re-

sistors) on PC592; adjust R566 for a voltage drop of 0.8 volts, ± 0.03 volts.

CAUTION!

DVM LO (COMMON) input should be isolated from the 3rd wire (earth) ground.

Connect the DVM to the MAIN OUT; adjust R536 for zero, ± 10 millivolts.

DUE TO INTERACTION, REPEAT ADJUSTMENT OF R541, R566 and R536.

Connect the DVM to test point TO on PC590 and adjust R223 for zero, ± 1 millivolt.

Connect DVM to MAIN OUT; readjust R536 for zero volts, if necessary. Turn PEAK VOLTS control to Max CW and adjust R528 for a DVM reading of zero, ± 20 millivolts. Set the PEAK VOLTS control for mid-range; adjust R532 for a DVM reading of zero, ± 20 millivolts. Return PEAK VOLTS to Max CW.

Set the FREQUENCY Hz dial to its low end stop. Connect the scope to the MAIN OUT, and release all the MULTIPLIER buttons; this will inhibit the generator's oscillating loop. Observe the DC level on the scope and adjust R241 for a DC level of approximately zero. The level may slowly drift off after adjustment. This is normal.

Set the MULTIPLIER for 10K and connect the DVM to the CV output. Adjust R319 for plus (+) 2 millivolts.

3) Minimum Frequency and Symmetry Adjust:

Connect the scope to the Main OUT; connect the frequency counter to the TTL output. Adjust R331 for a frequency reading of 200 Hz, and R326 for a symmetrical triangle.

4) Band Calibration (Part 1):

Connect the DVM to the CV OUT and adjust the FREQUENCY Hz dial for a CV voltage of +3.00 volts, ± 0.01 volts. Adjust the generator frequency on each band as follows:

Band	Adjustment	Tolerance
10K	R144	300kHz, ± 300Hz
1K	R148	30kHz, ± 30Hz
100	R149	3kHz, ± 3Hz
10	R154	3.333ms, ± .003ms (period)

5) Dial Calibration:

Set the MULTIPLIER for 10K. Adjust the Frequency Hz dial for a CV voltage of + 0.3 volts ± 0.001 volts. The generator frequency should be between 29.9 kHz-30.1kHz. Adjust the dial for exactly 30kHz; loosen the dial set screws and set dial so that the 3.0 mark lines up with the dial indicator arrow. Tighten dial set screws and recheck frequency reading.

Set the frequency dial to 30; adjust R312 for a CV voltage of +2.997V to +3.003V. Frequency reading should be between 299.4kHz-300.6kHz.

6) Band Calibration (Part 2):

Set MULTIPLIER for 100K. Adjust the FREQUENCY dial for a CV voltage of +.999V to +1.001V. Adjust R141 for a frequency reading of .999MHz-1.001MHz.

Set dial for a CV voltage of +2.997V to +3.003V; adjust C221 for a reading of 2.997MHz-3.003MHz.

Reset the dial for a CV voltage of +.2997V to +.3003V. Switch MULTIPLIER to X1M and adjust R140 for a frequency reading of 2.99 MHz - 3.01MHz.

Set FREQUENCY dial for 30. Adjust C208 for a frequency reading of 29.9 MHz-30.1MHz.

DUE TO INTERACTION, REPEAT STEP 6.

7) Sine Shaper Adjustment:

Set the WAVEFORM switch to ∿ and set the generator frequency to 3.0 x 1K. (3 kHz). Connect the distortion analyzer to the MAIN OUT. Connect the DVM to test point TO on PC590 and readjust R223 for zero ± 1 millivolt. Adjust R401 and R404 for a distortion reading of less than 0.25%.

8) Main Output Level Readjust:

Disconnect the distortion analyzer and set the WAVEFORM switch to ∿. Set the PEAK VOLTS control to Max CCW. Set the generator frequency to 5 x 100 (500 Hz), and connect the DVM to the MAIN OUT. Readjust for zero, ± 20 millivolts (R532).

Set the PEAK VOLTS control to Max CW and readjust R528 for zero, ± 20 millivolts.

9) Waveform Amplitude and DC Level Adjustments:

Switch the DVM to the AC mode of operation. With the WAVEFORM switch still on ∿, adjust R548 for a triangle amplitude of 8.33 volts to 8.50 volts.

Set the WAVEFORM switch to ⊓. Adjust R211 for a squarewave amplitude of 16.66 volts to 17.00 volts. Switch the DVM to DC operation; adjust R202 for a reading of zero, ± 2 millivolts. Due to interaction, R211 and R202 may have to be readjusted.

Switch the DVM to AC operation, and set the WAVEFORM switch to ∿; adjust R407 for a sinewave amplitude of 10.6 volts to 10.8 volts. Switch the DVM to DC operation; adjust R444 for a reading of zero, ± 20 millivolts. Due to interaction, R407 and R444 may have to be readjusted.

10) Fixed DC Offset Adjust:

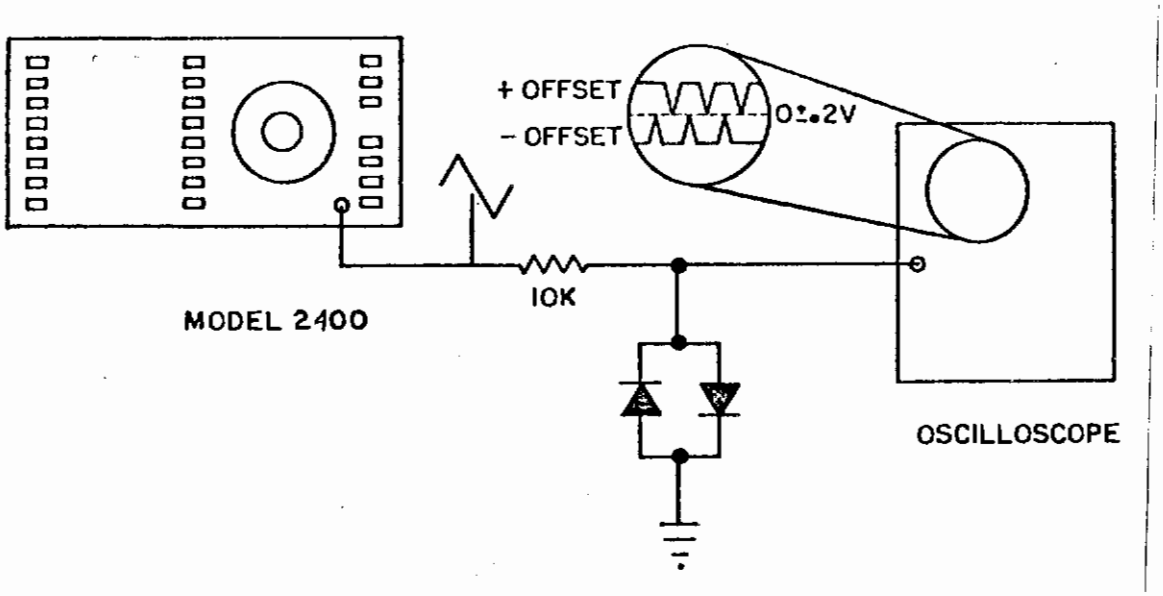


Figure 6-1. Test Circuit for FIXED OFFSET Adjust.

Set the WAVEFORM switch to ∿ frequency to 500 Hz. Switch the DVM to AC operation, and switch the FIXED OFFSET control to the ⎍ (+) position; adjust R509 for an AC reading of 4.16 volts to 4.25 volts. Return the FIXED OFFSET to the ⎍ (off) position. Switch the DVM to DC operation and readjust R528 for a reading of zero, ±20 millivolts. Disconnect the DVM and connect the generator MAIN OUT to the scope through the clipping Circuit shown in Figure 6-1. The circuit consists of a 10k ohm resistor (carbon or film) in series with the MAIN OUT and the scope input, plus two (2) back-to-back diodes across the scope input terminals. Return the FIXED OFFSET control to the (+) position; set the scope vertical input sensitiv ity to 0.2V/cm., DC coupled, horizontal to 1 ms/cm cal.

Initially adjust R513 so that the negative peak of the triangle is at zero volts DC. Switch the FIXED OFFSET control between ⎍ (+) and ⎍ (-) and readjust R513 so that the positive and negative peaks fall on the same line; the line itself should be within ±1 cm. (±0.2V) of zero. Remove the clipping circuit.

11) Main Output Squarewave Adjust:

Connect the scope to the MAIN OUT, using a 50Ω terminator and cable (terminator at scope end). Set the WAVEFORM selector to ⊓⊔ PEAK VOLTS control to Max CW, FREQUENCY Hz controls to 3 MHz (3X1M). Adjust both R550 and C517 for optimum squarewave shape.

12) Sinewave Amplitude Flatness Adjustment:

Set the Main and Auxiliary Generator controls as follows:

MAIN GENERATOR:

FREQUENCY Hz dial	1
MULTIPLIER	1M
WAVEFORM	∿
AMPLITUDE	dB (ATTENUATOR)

AUXILIARY GENERATOR:

FREQUENCY Hz dial	3
MULTIPLIER	1K
WAVEFORM	∿
AMPLITUDE	Max CW
SYMMETRY	◿ (90:10)
MODE	SWP
% FM/SWP STOP	Max CW (30)

connect the MAIN OUT to the scope vertical (y-Axis) input with a 50Ω terminator at the scope end. Connect the AUX OUT to the scope horizontal (x-Axis) input. Set the scope horizontal time base for external sweep. Adjust the scope vertical gain for a displayed sweep amplitude of 8 cm at the start of the sweep (left). Adjust the Auxiliary Generator frequency to optimize the horizontal sweep rate.

Adjust C409 for an optimum sinewave response (peak deviations less than 0.4 cm).

Disconnect the AUX OUT from the scope horizontal input, and return the scope horizontal time base to normal sweep mode.

6.4.2 Auxiliary Generator (Right Side)

Set the Auxiliary Generator controls initially to the following positions:

FREQUENCY Hz	10
MULTIPLIER	100
WAVEFORM	
SYMMETRY	 (50:50)
MODE	CONT

1) Regulated DC Power Supplies:

Connect DVM to test point #5 (TP5); adjust R781 on PC241 for +12 volts.

Connect DVM to TP6; adjust R785 for -12 volts.

2) Waveform Symmetry:

Set WAVEFORM to ⌐⌐. Set Auxiliary frequency to 300Hz (0.3x1K). Connect the AUX OUT to the scope. Adjust R720 for a symmetrical SQUAREWAVE.

Set FREQUENCY dial to 30, multiplier to 100. Adjust R711 for a symmetrical SQUAREWAVE.

3) Output DC Level Adjust:

Set Auxiliary frequency to 10 x 100. (1kHz). Rotate AMPLITUDE control max CCW, and release all WAVEFORM switches. Connect DVM to TPA, PC241 and adjust R764A for zero, ±10 millivolts.

Connect DVM to AUX OUT; set AMPLITUDE pot to mid-range and adjust R767 for zero, ±10 millivolts.

4) Dial Calibration:

Rotate Auxiliary dial clockwise to stop. If necessary, loosen set screw and align ▲ on dial with indicator. Tighten set screw.

Connect frequency counter to Auxiliary TTL OUT; Turn dial to 3 and adjust R702.

Tolerance: 300Hz ± 3Hz
333ms ± 3ms

Set dial to 30 and adjust R708.

Tolerance: 3,000Hz ± 30Hz
33.3ms ± 0.3ms

Repeat adjustment at 3 on the dial.

5) Band Calibration:

Set Auxiliary frequency to 30 x 1K. Adjust C718. Tolerance, 29.7kHz - 30.3kHz.

Set Auxiliary frequency to 3 x 10K. Adjust R701 Tolerance: 29.7kHz - 30.5kHz.
Tune dial to 30 and adjust C716. Tolerance

Readjust at 3 and 30 until both are correct.

6) Sinewave Adjustment:

Set the Auxiliary frequency to 10 x 100 (1kHz). Adjust AMPLITUDE control maximum CW. Connect the AUX OUT to the distortion analyzer input; set the WAVEFORM switch to ∿.

Connect a jumper from TP3 to top end of R745 (pin 6 of U748). Adjust R723 and R726 for minimum distortion reading.

Switch MULTIPLIER to 1k. Connect DVM to TP2 and adjust R746 for zero ± 10 millivolts DC.

Switch MULTIPLIER to 10K. Adjust R747 for zero ± 10 millivolts DC at TP2.

Switch MULTIPLIER to 100. Remove jumper from between TP3 and pin 6 of U748. Adjust R744 for minimum distortion reading. Readjust R723 and R726 for minimum distortion reading. (.85%).

Tune dial to 3; adjust R720 for minimum distortion reading (.85%).
Tune dial to 30; adjust R711 for minimum distortion (.85%).

Set dial to 10. Connect DVM to TP2. Readjust R746 for zero ± 10 millivolts. Set MULTIPLIER to 10k. Readjust R747 for zero ± 10 millivolts. Switch MULTIPLIER to 100. Connect DVM to TP3. Adjust R748 for zero, ± 10 millivolts.

Disconnect Distortion Analyzer.

Connect ACVM to AUX OUT, and adjust R756 for SINEWAVE Amplitude of 7.13 volts, ± .07 volts.

7) Triangle Wave Adjustment:

Set WAVEFORM seitch to ∿ , AMPLITUDE control to maximum. Connect DVM to AUX OUT. Adjust R758 for zero ± 10 millivolts DC.

Connect ACVM to AUX OUT and adjust R754 for a triangle amplitude of 5.61 volts, ± .06 volts.

8) Square Wave Adjustment:

Set WAVEFORM switch to ⊓ , AMPLITUDE to maximum. Preset R752 maximum CW. Connect DVM to AUX OUT. Adjust R759 for zero ± 10 millivolts DC.

Connect ACVM to AUX OUT and adjust R752 for SQUAREWAVE Amplitude of 11.22 volts, ± .11 volts.

Recheck DC level and readjust R752, if necessary.

9) Symmetry Control Adjustment:

Connect scope to AUX OUT. Set scope horizontal time base for .5ms/cm. Switch SYMMETRY control to ∧ : adjust Auxiliary FREQUENCY dial and scope horizontal sweep time to obtain a 1 centimeter positive pulse, and 1 cycle exactly every 10 centimeters.

Switch SYMMETRY control to ◿ : adjust R719 until 1 cycle covers 10 centimeters exactly. (You should have a 1 centimeter negative pulse, also).

Reset SYMMETRY control to ∧ .

6.4.3. Operational Modes

1) Sweep Mode Adjust:

Set the Auxiliary frequency to 100Hz (10 x 10) WAVEFORM switch to ⌐⌐ . Set % FM/SWP STOP control to 30, Mode switch to CONT.

Connect the scope to the Main Generator CV OUT; connect the frequency counter to the Main TTL OUT. Set the Main Generator frequency to 300kHz (30 x 10k) and note counter reading.

Switch Mode to SWP and observe the CV OUT on the scope; you should see approximately +3 volts DC with a small SQUAREWAVE AC component.

Slowly adjust the % FM/SWP STOP control until the SQUAREWAVE component at the CV OUT is minimized. Adjust R904 for the same frequency counter reading as previously observed.

Set the Main Generator dial to 1, Mode switch to CONT. Set the Auxiliary Generator to 3Hz (3 x 1), WAVEFORM to ⌐⌐ , SYMMETRY to ⋀ , % FM/SWP STOP to 1/4 of its range.

Connect Main TTL OUT to counter and note reading. Switch Mode to SWP and observe MAIN OUT on scope; You will observe the Main Generator switching from a low to high frequency, the low frequency remaining on 90% of the time.

Adjust R913 until the lower frequency is approximately the same as observed in the CONT mode.

Rotate the % FM/SWP STOP control between its 1/4 Range and 3/4 Range points; Readjust R913 for minimum change in the low frequency reading.

2) FM Mode Adjust:

Select FM mode. Set Main Generator frequency to 100kHz (10 x 10k), WAVEFORM to ⋀ . Set the Auxiliary Generator frequency to 1kHz (10

X 100), WAVEFORM to ⊓⊔.

Connect the DVM and scope to the Main Generator CV OUT; set the scope sensitivity to 50mV/cm, AC coupled. Adjust the Main FREQUENCY dial for + 1 volt DC on the CV OUT. Rotate the % FM/SWP STOP control maximum CW; adjust R911 for a 200mV p-p SQUAREWAVE at the CV OUT.

3) Trigger/Gate Mode Adjust:

Set Main Generator frequency to 10kHz (1 x 10k), WAVEFORM to ∿. Set Auxiliary Generator frequency to 1kHz (10 x 100), WAVEFORM to ∿, Mode switch to CONT. Set the TRIG LEVEL and Lock Ø/Start Ø controls to the center of their range (0).

Connect the scope to pin 6 of U802 (PC240); adjust R824 for a maximum amplitude SQUAREWAVE.

Connect DVM to test point "A"; adjust R827 for +3.5 volts DC.

4) Amplitude Modulation (AM) Adjust:

Set the Main Generator frequency to 100kHz (1 x 100k), WAVEFORM to ∿. Set the Auxiliary Generator frequency to 1kHz (10 x 100), WAVEFORM to ∿. Set % AM control to maximum CW.

Connect the scope to test point 14; set horizontal time base for .2 ms/cm. Connect the ACVM to test point 12. Depress the AM, SUPP CARRIER and CONT MODE buttons.

Adjust R915 for an amplitude of 1.155V, ± .005V at test point 12.

Deactivate the AM Mode switch and press FM; adjust R944 for a null at TP14. Switch to CONT Mode; adjust R936 for zero ± 10 millivolts DC at TP 14.

Deactivate SUPP CARRIER MODE switch and depress AM. With % AM Control maximum CW, adjust R921 and R929 (R921 and R929 interract),

for > 100% modulation @ 3V peak signal.

Set % AM control to minimum (CCW). Depress SUPP CARRIER MODE switch; adjust R920 for a null at TP14. Set % AM control to maximum CW; adjust R944 for equal positive peaks at TP14. Adjust R948 for equal negative peaks at TP14.

5) Lock Ø/Start Ø Adjust:

Connect the MAIN OUT to the scope vertical input with a 50Ω terminator. Set the Main Generator WAVEFORM to ∿, AMPLITUDE to maximum, frequency to 2kHz (20 x 100).

Set the Auxiliary Generator frequency to 2kHz (20 x 100), WAVEFORM to ⊓⊔.

Depress AM, SUPP CARRIER and Ø LOCK MODE buttons.

Set the % AM control to maximum (100%) CW and; set the LOCK Ø/START Ø control to the maximum CCW (-90°) end. Adjust R844 for a negative ramp on the scope with no flat spot on top and a small flat spot on the bottom. (Figure 6.2.a).

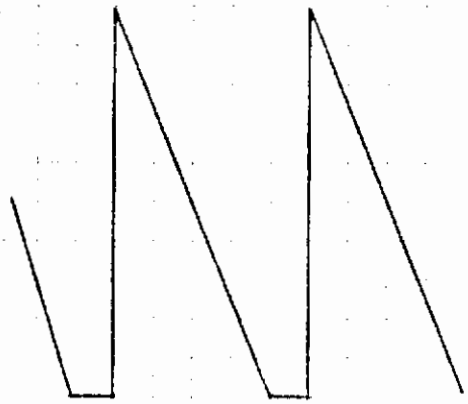
Set the LOCK Ø/START Ø control to the maximum CW (+90°) end; adjust R838 for a positive ramp on the scope with no flat spot on top and a small flat spot on the bottom (Figure 6.2.b).

Adjust the LOCK Ø/START Ø control for a triangle waveform on the scope. Loosen the LOCK Ø/START Ø knob, set for zero and tighten knob.

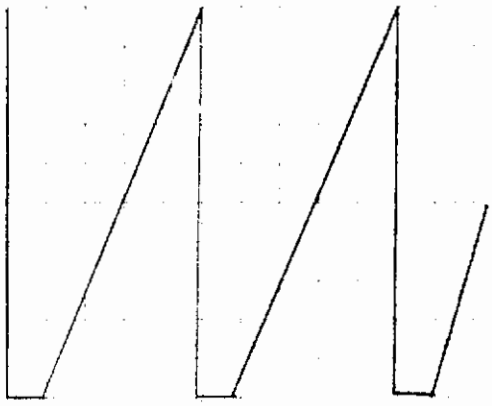
Deactivate AM and SUPP CARRIER MODE switches.

Switch Mode to TRIG and change Auxiliary Generator frequency to 100Hz (10 x 10). Connect the MAIN OUT to the scope; center the trace on the screen. Adjust R851 so the "off" level of the triggered WAVEFORM is exactly at zero volts.

-END OF TEST PROCEDURE-



(a)



(b)

Figure 6.2. Lock Ø/Start Ø Waveform Adjust

APPENDIX

The following is a list of recommended test equipment for use with the Model 2400:

1) Oscilloscope, bandwidth from DC to 150MHz, vertical sensitivity 5mV/cm, AC/DC coupled.

2) Frequency counter capable of frequency and period measurements from 0.003Hz and 30MHz, with 0.1% accuracy. General Radio Model 1192-B, or equivalent.

3) True RMS Voltmeter, 0.5% accuracy at 1kHz. Fluke Model 8920A, or equivalent.

4) Distortion Analyzer, bandwidth of at least 500kHz, capable of measuring total harmonic distortion down to 0.1% (-60dB) below 100kHz. Krohn-Hite Model 6800, or equivalent.

5) Spectrum Analyzer, bandwidth at least 100MHz, to measure harmonic distortion of frequencies between 300kHz and 30MHz. (Hewlett Packard Model 141T Display CRT, with Model 8553B Spectrum Analyzer, or equivalent).

6) Amplitude Flatness measuring equipment:

   a) Fluke Model A55 Thermal Converter, and either a DC Differential Voltmeter (Fluke Model 895A) or a DC Null Detector (Fluke Model 845A) with a stable DC voltage source (Analogic Model AN-3100) or the equivalent of any of the above instruments,

OR

   b) Any suitable AC Voltmeter that will measure amplitude variations of less than 0.5% to 100kHz, and less than 3% to 5MHz.

7) DC Voltmeter, zero to 20 volts, 1 millivolt resolution. Fluke Model 8040A or equivalent.

8) 50Ω terminator.

9) (1) 10k ohm resistor.

10) (2) Silicon diodes.

11) Insulated test clips.

WAVEGUARD[tm]

OUTPUT PROTECTION CIRCUIT

(OPTION 001)

INTRODUCTION:

The optional, WAVEGUARD[tm] circuit installed in this generator is designed to protect the generator's output amplifier stage from damage, if an external voltage is inadvertently placed across the generator's output terminals. The circuit is designed to reset automatically after the external voltage is removed.

CIRCUIT CONFIGURATION:

The circuit consists of a triac, Q521, transistor Q520 that drives the triac gate, and transistors Q518 and Q519 that act as current sensing elements.

The generator's output current determines the voltage drop across the output stage collector resistors, R567 and R576. When the IR drop across either R567 or R576 exceeds 5 volts, it will turn on Q518 or Q519, which will turn on Q520. Q520 will, in turn, fire the triac clamps the generator's output to ground, preventing any excess current from the external source from flowing back into the generator's output stage. A fast blow fuse, F503 is inserted in series with the generator's output BNC to prevent the triac from exceeding its maximum continuous rating. The fuse will blow if the external source current exceeds the fuse rating.

OPERATING SPECIFICATIONS:

Maximum, reverse voltage applied to output: ±50 volts.

Maximum reverse voltage and current which will trip output protection circuit: Typically 13 volts peak @ 260mA peak, worst case, no output signal.

Maximum continuous reverse current: 1.1 amperes peak. (Applies when the 0.3 ampere fuse (F503) is replaced with a 0.82Ω, 1W resistor).

When installed with the existing .3 ampere output fuse, the fuse will blow and disconnect the main output amplifier from the reverse applied voltage.

If repetitive accidents are expected a 0.82Ω, 1W resistor can be used to replace the fuse, but reverse current will be limited to 1.1 amperes continuous.

REVISED PERFORMANCE SPECIFICATIONS:

The following generator performance specifications will be changed when the WAVEGUARD[tm] circuit is installed in the unit:

Maximum output amplitude, 28Vp-p, open circuit.

Output impedance: 47 ohms, ±2%.

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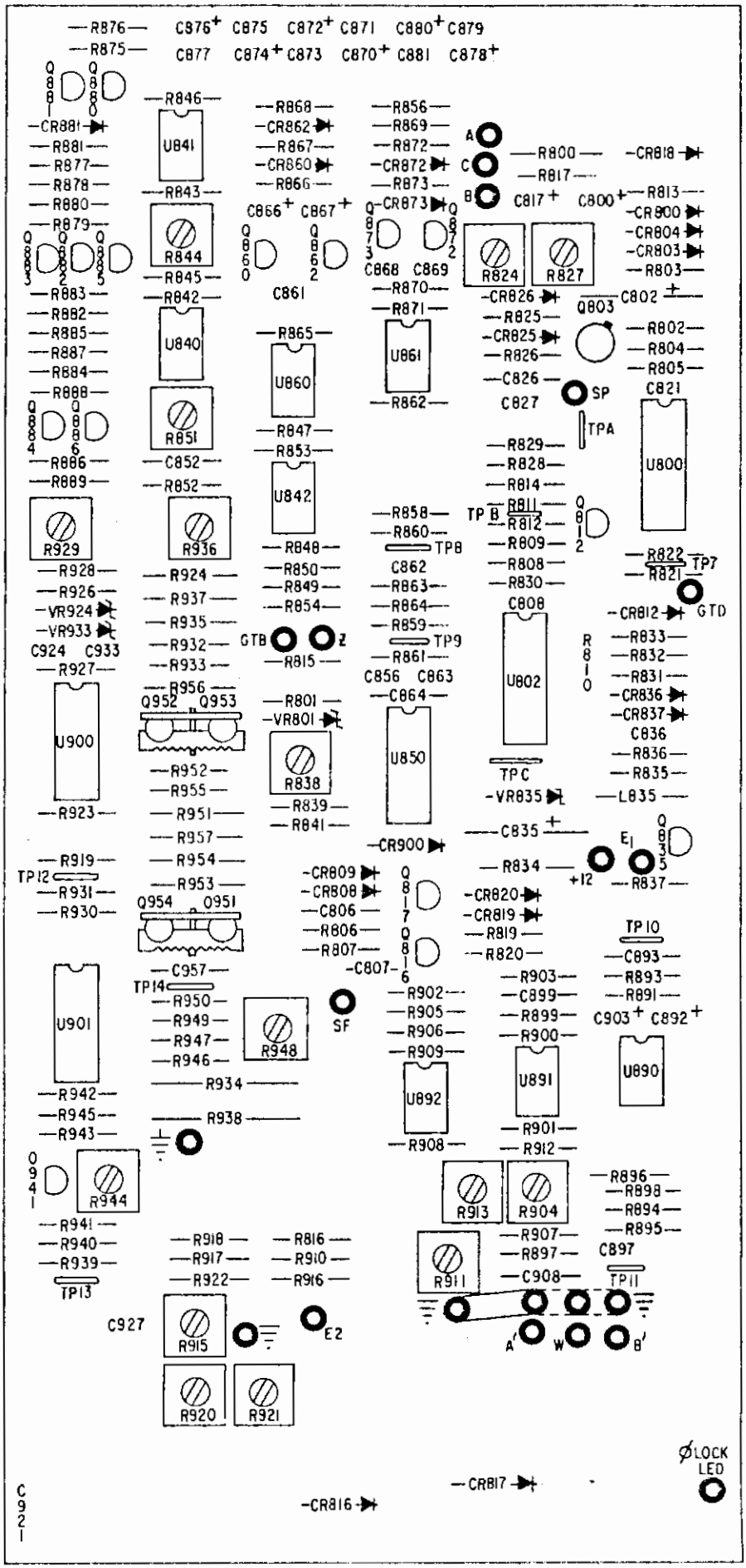
R876
R875
C876+ C875 C872+ C871 C880+ C879
C877 C874+ C873 C870+ C881 C878+
Q880
Q881
CR881
R881
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R878
R880
R879
Q883
Q882
Q885
R883
R882
R885
R887
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R929
R928
R926
VR924
VR933
C924 C933
R927
U900
R923
R919
TP12
R931
R930
R846
U841
R843
R844
R845
R842
U840
R851
C852
R852
R936
R924
R937
R935
R932
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R956
Q952 Q953
R952
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Q954 Q951
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R940
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CR860
R866
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Q862
C861
R865
U860
R847
R853
U842
R848
R850
R849
R854
GTB
R815
R801
VR801
R838
R839
R841
R918
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R910
R916
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E2
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CR872
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CR808
C806
R806
R807
Q817
Q816
C807
R902
R905
R906
R909
SF
U892
R908
A
C
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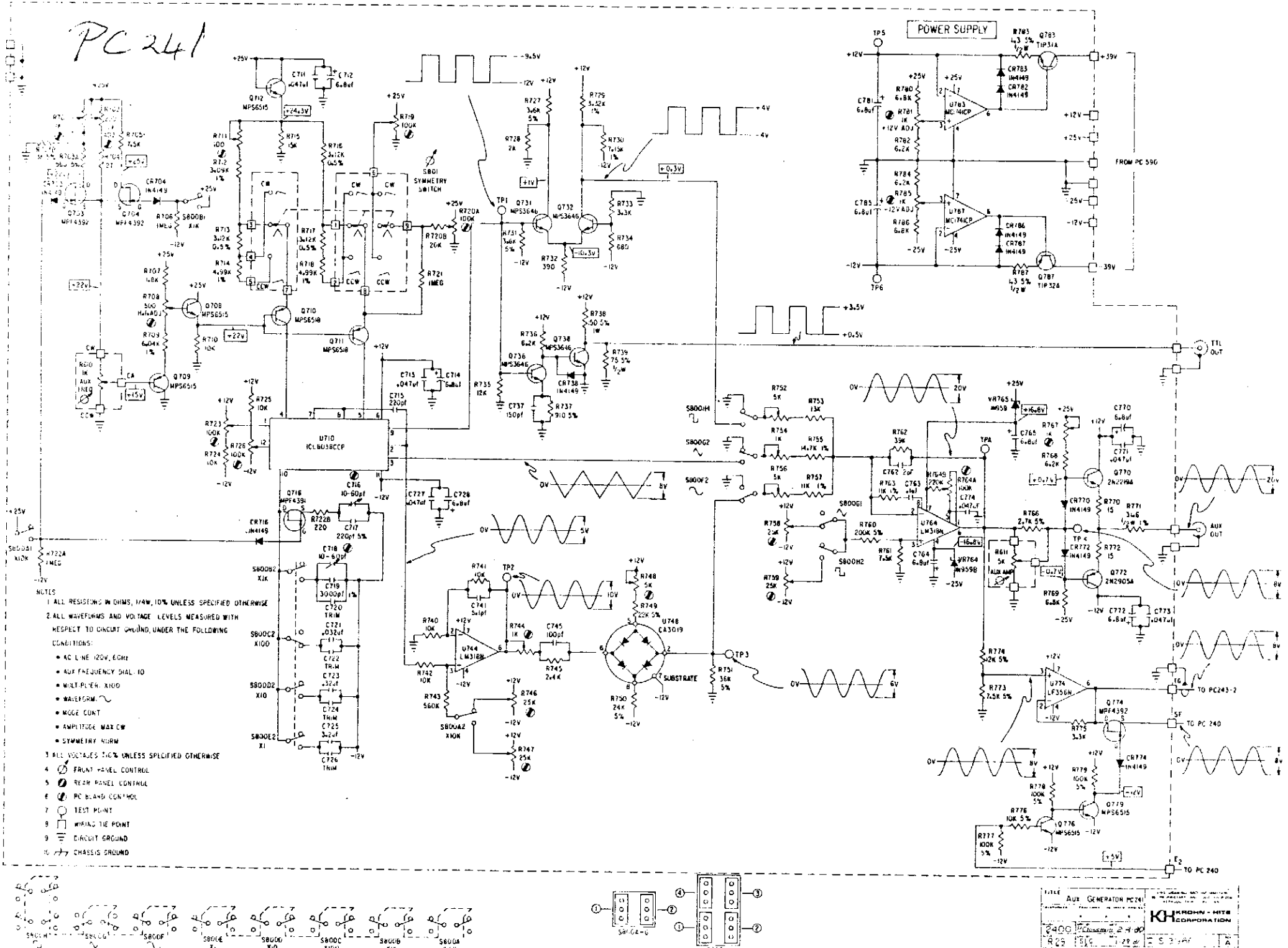
R800
R817
C817+
R824
R827
CR826
R825
CR825
R826
C826
C827
SP
TPA
R829
R828
R814
R811
R812
R809
R808
R830
TP B
Q812
C808
U802
TPC
VR835
C835
R834
CR820
CR819
R819
R820
R903
C899
R899
R900
U891
R901
R912
R913
R904
R907
R897
C908
R911
R896
R898
R894
R895
C897
TP11
A' W B'
C800+
R813
CR800
CR804
CR803
R803
C802
Q803
R802
R804
R805
C821
U800
R822
TP7
R821
CR818
CR812
GTD
R810
R833
R832
R831
CR836
CR837
C836
R836
R835
L835
Q835
E1
+12
R837
TP10
C893
R893
R891
C903+ C892+
U890
CR817
CR816
ØLOCK LED
C921

PC 240

(E)

PC 241



NOTES

1. ALL RESISTORS IN OHMS, 1/4W, 10% UNLESS SPECIFIED OTHERWISE
2. ALL WAVEFORMS AND VOLTAGE LEVELS MEASURED WITH RESPECT TO CIRCUIT GROUND, UNDER THE FOLLOWING CONDITIONS:
   - AC LINE 120V, 60Hz
   - AUX FREQUENCY DIAL 10
   - MULTIPLIER X100
   - WAVEFORM ~
   - MODE CONT
   - AMPLITUDE MAX CW
   - SYMMETRY NORM
3. ALL VOLTAGES ±10% UNLESS SPECIFIED OTHERWISE
4. ⌀ FRONT PANEL CONTROL
5. ⌀ REAR PANEL CONTROL
6. ⌀ PC BOARD CONTROL
7. ○ TEST POINT
8. □ WIRING TIE POINT
9. ⏚ CIRCUIT GROUND
10. ⏚ CHASSIS GROUND

TITLE: AUX GENERATOR PC241

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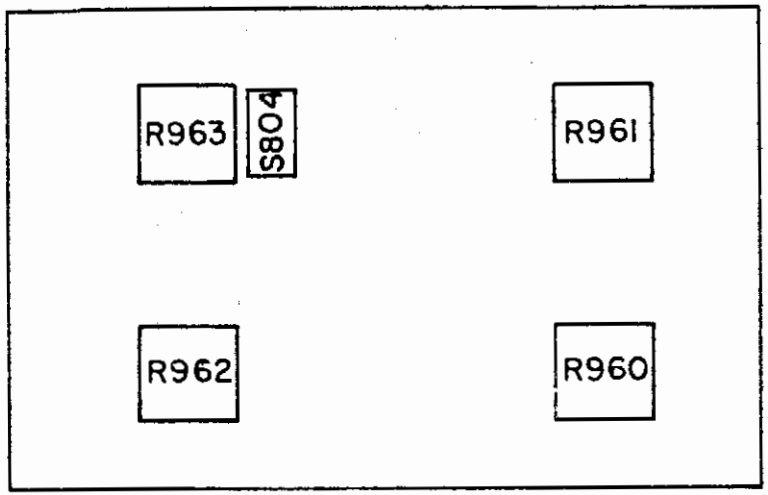
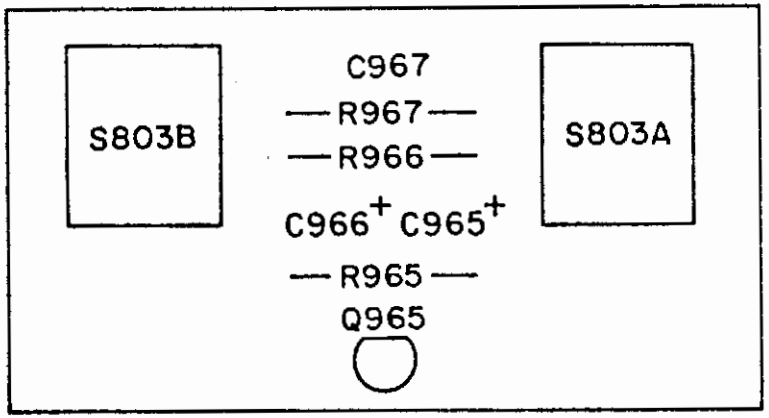
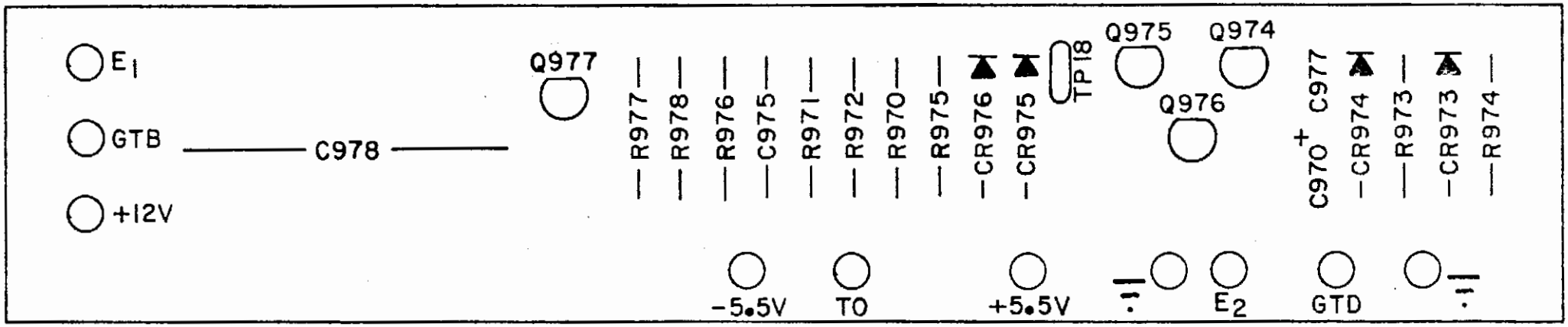
SIZE B | DWG NO. 5400 | REV A | SHEET 2 OF 2



PC 242



PC 243-2



PC 243-1

NOTES

1. When ordering parts, please specify the following:
   a. Instrument model number and serial number.
   b. Schematic reference.
   c. Manufacturer's part number.
2. Any engineering modifications will be found at the rear of this manual.
3. The part numbers listed are either the actual parts used or direct replacements.

CAPACITORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
C711	.047µF 20% 50V	ITT	413347
C712	6.8µF 20% 35V	ITT	471568
C713	.047µF 20% 50V	ITT	413347
C714	6.8µF 20% 35V	ITT	471568
C715	220pF 10% 500V	KGN	423122
C716	10-60pF TRIMMER	STT	482010
C717	220pF 10% 500V	KGN	423122
C718	10-60pF TRIMMER	STT	482010
C719	300pF 1% 500V	KGN	421130
C721	.032µF 0.5% 200V	KH	452332
C723	.32µF 0.5% 200V	KH	452432
C725	3.2µF 0.5% 50V	KH	441532
C727	.047µF 20% 50V	ITT	413347
C728	6.8µF 20% 35V	ITT	471568
C729	120pF 5% 500V	KGN	422122
C737	150pF 10% 500V	KGN	422115
C741	5.1pF 10% 500V	QC	411951
C745	100pF 10% 500V	KGN	422110
C762	8.2pF 10% 500V	QC	411982
C763	.1µF 20% 100V	ITT	413410
C764	6.8µF 20% 35V	ITT	471568
C765	6.8µF 20% 35V	ITT	471568
C770	6.8µF 20% 35V	ITT	471568
C771	.047µF 20% 50V	ITT	413347
C772	6.8µF 20% 35V	ITT	471568
C773	.047µF 20% 50V	ITT	413347
C781	6.8µF 20% 35V	ITT	471568
C785	6.8µF 20% 35V	ITT	471568
C800	6.8µF 20% 35V	ITT	471568
C802	15µF 20% 50V	SP	471615
C806	10pF 10% 500V	QC	411011
C807	.01µF 20% 500V	SP	412310
C808	.01µF 20% 500V	SP	412310
C817	6.8µF 20% 35V	ITT	471568
C821	.01µF 20% 500V	SP	412310
C826	10pF 10% 500V	QC	411011
C827	100pF 10% 500V	KGN	422110
C835	15µF 20% 50V	SP	471615
C836	9.1pF 10% 500V	QC	411911
C852	7.5pF 10% 500V	QC	411975
C856	.01µF 20% 500V	SP	412310
C861	1µF 20% 100V	ITT	412510
C862	.47µF 20% 100V	ITT	413447
C863	.47µF 20% 100V	ITT	413447
C864	1µF 20% 100V	ITT	412510
C866	6.8µF 20% 35V	ITT	471568
C867	6.8µF 20% 35V	ITT	471568
C868	.1µF 20% 100V	ITT	413410
C869	.047µF 20% 50V	ITT	413347
C870	6.8µF 20% 35V	ITT	471568
C871	.1µF 20% 100V	ITT	413410
C872	6.8µF 20% 35V	ITT	471568
C873	.1µF 20% 100V	ITT	413410
C874	6.8µF 20% 35V	ITT	471568
C875	.1µF 20% 100V	ITT	413410
C876	6.8µF 20% 35V	ITT	471568
C877	.1µF 20% 100V	ITT	413410
C878	6.8µF 20% 35V	ITT	471568
C879	.1µF 20% 100V	ITT	413410
C880	6.8µF 20% 35V	ITT	471568
C881	.1µF 20% 100V	ITT	413410
C892	6.8µF 20% 35V	ITT	471568
C893	4.7pF 10% 500V	QC	411947
C897	.047µF 20% 50V	ITT	413347
C899	4.7pF 10% 500V	QC	411947
C903	6.8µF 20% 35V	ITT	471568
C908	6.8µF 20% 35V	ITT	471568
C921	150pF 10% 500V	KGN	422115

CAPACITORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
C924	.047µF 20% 50V	ITT	413347
C927	.047µF 20% 50V	ITT	413347
C933	.047µF 20% 50V	ITT	413347
C957	.82pF 10% 500V	QC	411908
C965	6.8µF 20% 35V	ITT	471568
C966	6.8µF 20% 35V	ITT	471568
C967	100pF 10% 500V	KGN	422110
C970	6.8µF 20% 35V	ITT	471568
C975	.68pF 10% 500V	QC	411906
C977	.1µF 20% 100V	ITT	413410
C978	100µF 10% 25V	MAL	471712

DIODES

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
CR703	DIODE, SWITCHING, 1N4149	APD	234149
CR704	DIODE, SWITCHING, 1N4149	APD	234149
CR716	DIODE, SWITCHING, 1N4149	APD	234149
CR738	DIODE, SWITCHING, 1N4149	APD	234149
CR770	DIODE, SWITCHING, 1N4149	APD	234149
CR772	DIODE, SWITCHING, 1N4149	APD	234149
CR774	DIODE, SWITCHING, 1N4149	APD	234149
CR782	DIODE, SWITCHING, 1N4149	APD	234149
CR783	DIODE, SWITCHING, 1N4149	APD	234149
CR786	DIODE, SWITCHING, 1N4149	APD	234149
CR787	DIODE, SWITCHING, 1N4149	APD	234149
CR803	DIODE, SWITCHING, 1N4149	APD	234149
CR804	DIODE, SWITCHING, 1N4149	APD	234149
CR808	DIODE, SWITCHING, 1N4149	APD	234149
CR809	DIODE, SWITCHING, 1N4149	APD	234149
CR812	DIODE, SWITCHING, 1N4149	APD	234149
CR816	DIODE, SWITCHING, 1N4149	APD	234149
CR817	DIODE, SWITCHING, 1N4149	APD	234149
CR818	DIODE, SWITCHING, 1N4149	APD	234149
CR819	DIODE, SWITCHING, 1N4149	APD	234149
CR820	DIODE, SWITCHING, 1N4149	APD	234149
CR825	DIODE, SWITCHING, 1N4149	APD	234149
CR826	DIODE, SWITCHING, 1N4149	APD	234149
CR836	DIODE, SWITCHING, 1N4149	APD	234149
CR837	DIODE, SWITCHING, 1N4149	APD	234149
CR856	DIODE, SWITCHING, 1N4149	APD	234149
CR860	DIODE, SWITCHING, 1N4149	APD	234149
CR861	DIODE, SWITCHING, 1N4149	APD	234149
CR862	DIODE, SWITCHING, 1N4149	APD	234149
CR872	DIODE, SWITCHING, 1N4149	APD	234149
CR873	DIODE, SWITCHING, 1N4149	APD	234149
CR881	DIODE, SWITCHING, 1N4149	APD	234149
CR900	DIODE, SWITCHING, 1N4149	APD	234149
CR973	DIODE, SWITCHING, 1N4149	APD	234149
CR974	DIODE, SWITCHING, 1N4149	APD	234149
CR975	DIODE, HOT CARRIER, MBD501	MOT	200501
CR975	DIODE, HOT CARRIER, MBD501	MOT	200501
VR764	DIODE, ZENER, 8.2V, 1N959B	APD	230959
VR765	DIODE, ZENER, 8.2V, 1N959B	APD	230959
VR801	DIODE, ZENER, 8.2V, 1N959B	APD	230959
VR835	DIODE, ZENER, 18V, 1N967B	APD	230967
VR924	DIODE, ZENER, 8.2V, 1N959B	APD	230959
VR933	DIODE, ZENER, 15V, 1N965B	APD	230965

INDUCTORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
L835	15µHy 10% .4W	DEL	001008

RESISTORS

SCHEM. REF.	DESCRIPTION			MFR.	KH PART NUMBER
R610	1K	POT		KH	619210
R611	5K	POT		KH	620324
R701	1K	POT	1/2W	BKM	658211
R702	200	POT	1/2W	BKM	658120
R703A	560	5%	1/4W	AB	927156
R703B	3K	5%	1/4W	AB	927230
R704	27	10%	1/4W	AB	928027
R705	7.5K	5%	1/4W	AB	927275
R706	1M	5%	1/4W	AB	927510
R707	1.8K	5%	1/4W	AB	927218
R708	500	POT	1/2W	BKM	658150
R709	6.04K	1%	1/4W	PRP	850260
R710	10K	5%	1/4W	AB	927310
R711	100	POT	1/2W	BKM	658110
R712	3.09K	1%	1/4W	PRP	850230
R713	3.12K	1%	1/4W	PRP	850231
R714	4.99K	1%	1/4W	PRP	850249
R715	15K	5%	1/4W	AB	927315
R716	3.12K	1%	1/4W	PRP	850231
R717	3.12K	1%	1/4W	PRP	850231
R718	4.99K	1%	1/4W	PRP	850249
R719	100K	POT	1/2W	BKM	658410
R720A	100K	POT	1/2W	BKM	658410
R720B	20K	5%	1/4W	AB	927320
R721	1M	5%	1/4W	AB	927510
R722A	1M	5%	1/4W	AB	927510
R722B	220	5%	1/4W	AB	927122
R723	100K	POT	1/2W	BKM	658410
R724	10K	5%	1/4W	AB	927310
R725	10K	5%	1/4W	AB	927310
R726	100K	POT	1/2W	BKM	658410
R727	3.6K	5%	1/4W	AB	927236
R728	2K	5%	1/4W	AB	927220
R729	3.32K	1%	1/4W	PRP	850233
R730	7.15K	1%	1/4W	PRP	850271
R731	3.6K	5%	1/4W	AB	927236
R732	390	5%	1/4W	AB	927139
R733	3.3K	5%	1/4W	AB	927233
R734	680	10%	1/4W	AB	928168
R735	12K	5%	1/4W	AB	927312
R736	6.2K	5%	1/4W	AB	927262
R737	910	5%	1/4W	AB	927191
R738	150	5%	1W	AB	947113
R739	75	5%	1/2W	AB	937075
R740	10K	5%	1/4W	AB	927310
R741	10K	5%	1/4W	AB	927310
R742	10K	5%	1/4W	AB	927310
R743	560K	5%	1/4W	AB	927456
R744	1K	POT	1/2W	BKM	658211
R745	2.4K	5%	1/4W	AB	927224
R746	25K	POT	1/2W	BKM	658326
R747	25K	POT	1/2W	BKM	658326
R748	5K	POT	1/2W	BKM	658250
R749	22K	5%	1/4W	AB	927322
R750	24K	5%	1/4W	AB	927324
R751	36K	5%	1/4W	AB	927336
R752	5K	POT	1/2W	BKM	658250
R753	13K	5%	1/4W	AB	927313
R754	1K	POT	1/2W	BKM	658211
R755	14.7K	1%	1/4W	PRP	850314
R756	5K	POT	1/2W	BKM	658250
R757	11K	1%	1/4W	PRP	850308
R758	25K	POT	1/2W	BKM	658326
R759	25K	POT	1/2W	BKM	658326
R760	200K	5%	1/4W	AB	927420
R761	7.5K	5%	1/4W	AB	927275
R762	39K	5%	1/4W	AB	927339
R763	11K	1%	1/4W	PRP	850308
R764A	100K	POT	1/2W	BKM	658410
R764B	220K	5%	1/4W	AB	927422
R766	2.7K	5%	1/4W	AB	927227
R767	1K	POT	1/2W	BKM	658211
R768	6.2K	5%	1/4W	AB	927262
R769	6.8K	5%	1/4W	AB	927268
R770	15	10%	1/4W	AB	928015

RESISTORS

SCHEM. REF.	DESCRIPTION			MFR.	KH PART NUMBER
R771	31.6K	1%	1/4W	PRP	850331
R772	15	10%	1/4W	AB	928015
R773	7.5K	5%	1/4W	AB	927275
R774	12K	5%	1/4W	AB	927312
R775	3.3K	5%	1/4W	AB	927233
R776	10K	5%	1/4W	AB	927310
R777	100K	5%	1/4W	AB	927410
R778	100K	5%	1/4W	AB	927410
R779	100K	5%	1/4W	AB	927410
R780	6.8K	5%	1/4W	AB	927268
R781	1K	POT	1/2W	BKM	658211
R782	6.2K	5%	1/4W	AB	927262
R783	1.3	5%	1/2W	AB	937913
R784	6.2K	5%	1/4W	AB	927262
R785	1K	POT	1/2W	BKM	658211
R786	6.8K	5%	1/4W	AB	927268
R787	1.3	5%	1/2W	AB	937913
R800	3.3	5%	1/2W	AB	937933
R801	510	5%	1/4W	AB	927151
R802	47	10%	1/4W	AB	928047
R803	10K	5%	1/4W	AB	927310
R804	1.5K	5%	1/4W	AB	927215
R805	510	5%	1/4W	AB	927151
R806	10K	5%	1/4W	AB	927310
R807	4.99K	1%	1/4W	PRP	850249
R808	360	5%	1/4W	AB	927136
R809	510	5%	1/4W	AB	927151
R810	1K	5%	1/4W	AB	927210
R811	1.3K	5%	1/4W	AB	927213
R812	680	10%	1/4W	AB	928168
R813	47	10%	1/4W	AB	928047
R814	510	5%	1/4W	AB	927151
R815	1.5K	5%	1/4W	AB	927215
R816	10K	5%	1/4W	AB	927310
R817	3.6	5%	1/4W	AB	927936
R819	100K	5%	1/4W	AB	927410
R820	100K	5%	1/4W	AB	927410
R821	510	5%	1/4W	AB	927151
R822	510	5%	1/4W	AB	927151
R824	5K	POT	1/2W	BKM	658250
R825	3.9K	5%	1/4W	AB	927239
R826	10K	5%	1/4W	AB	927310
R827	1K	POT	1/2W	BKM	658211
R828	510	5%	1/4W	AB	927151
R829	510	5%	1/4W	AB	927151
R830	510	5%	1/4W	AB	927151
R831	510	5%	1/4W	AB	927151
R832	510	5%	1/4W	AB	927151
R833	510	5%	1/4W	AB	927151
R834	430	5%	1/2W	AB	937143
R835	1.43K	1%	1/4W	PRP	850214
R836	10K	5%	1/4W	AB	927310
R837	430	5%	1/4W	AB	927143
R838	25K	POT	1/2W	BKM	658326
R839	56K	10%	1/4W	AB	928356
R841	11K	5%	1/4W	AB	927311
R842	6.34K	1%	1/4W	PRP	850263
R843	1.5K	5%	1/4W	AB	927215
R844	500	POT	1/2W	BKM	658150
R845	10K	5%	1/4W	AB	927310
R846	1.6K	5%	1/4W	AB	927216
R847	150K	5%	1/4W	AB	927415
R848	100K	5%	1/4W	AB	927410
R849	100K	5%	1/4W	AB	927410
R850	100K	5%	1/4W	AB	927410
R851	1K	POT	1/2W	BKM	658211
R852	200K	5%	1/4W	AB	927420
R853	150K	5%	1/4W	AB	927415
R854	10K	5%	1/4W	AB	927310
R856	100K	5%	1/4W	AB	927410
R857	100	5%	1/4W	AB	927110
R858	10K	5%	1/4W	AB	927310
R859	100	5%	1/4W	AB	927110
R860	510	5%	1/4W	AB	927151
R861	510	5%	1/4W	AB	927151

RESISTORS

SCHEM. REF.	DESCRIPTION			MFR.	KH PART NUMBER
R862	10K	5%	1/4W	AB	927310
R863	10K	5%	1/4W	AB	927310
R864	910	5%	1/4W	AB	927191
R865	1K	5%	1/4W	AB	927210
R866	4.7K	5%	1/4W	AB	927247
R867	10K	5%	1/4W	AB	927310
R868	270K	10%	1/4W	AB	928427
R869	7.5K	5%	1/4W	AB	927275
R870	8.2K	5%	1/4W	AB	927282
R871	10K	5%	1/4W	AB	927310
R872	100K	5%	1/4W	AB	927410
R873	100K	5%	1/4W	AB	927410
R875	51K	5%	1/4W	AB	927351
R876	910	5%	1/4W	AB	927191
R877	51K	5%	1/4W	AB	927351
R878	1.6K	5%	1/4W	AB	927216
R879	3K	5%	1/4W	AB	927230
R880	1K	5%	1/4W	AB	927210
R881	10K	5%	1/4W	AB	927310
R882	51K	5%	1/4W	AB	927351
R883	27K	10%	1/4W	AB	928327
R884	10K	5%	1/4W	AB	927310
R885	100K	5%	1/4W	AB	927410
R886	5.1K	5%	1/4W	AB	927251
R887	3.9K	5%	1/4W	AB	927239
R888	3.9K	5%	1/4W	AB	927239
R889	10K	5%	1/4W	AB	927310
R891	100K	1%	1/4W	PRP	850410
R893	100K	1%	1/4W	PRP	850410
R894	499K	1%	1/4W	PRP	850449
R895	100K	1%	1/4W	PRP	850410
R896	100K	5%	1/4W	AB	927410
R897	1.5K	5%	1/4W	AB	927215
R898	24.9K	1%	1/4W	PRP	850324
R899	100K	1%	1/4W	PRP	850410
R900	100K	1%	1/4W	PRP	850410
R901	100K	1%	1/4W	PRP	850410
R902	100K	1%	1/4W	PRP	850410
R903	10K	5%	1/4W	AB	927310
R904	1K	POT	1/2W	BKM	658211
R905	24.9K	1%	1/4W	PRP	850324
R906	24.9K	1%	1/4W	PRP	850324
R907	24.9K	1%	1/4W	PRP	850324
R908	24.9K	1%	1/4W	PRP	850324
R909	10K	5%	1/4W	AB	927310
R910	820	5%	1/4W	AB	927182
R911	100	POT	1/2W	BKM	658110
R912	330	5%	1/4W	AB	927133
R913	200	POT	1/2W	BKM	658121
R915	5K	POT	1/2W	BKM	658250
R916	5.1K	5%	1/4W	AB	927251
R917	4.99K	1%	1/4W	PRP	850249
R918	3.01K	1%	1/4W	PRP	850229
R919	510	5%	1/4W	AB	927151
R920A	5K	POT	1/2W	BKM	658250
R920B	5.1K	5%	1/4W	AB	927251
R921A	5K	POT	1/2W	BKM	658250
R921B	10K	5%	1/4W	AB	927310
R922	3.9K	5%	1/4W	AB	927239
R923	1.5K	5%	1/4W	AB	927215
R924	1.2K	10%	1/4W	AB	928212
R926	7.5K	5%	1/4W	AB	927275
R927	1K	5%	1/4W	AB	927210
R928	240	5%	1/4W	AB	927124
R929	1K	POT	1/2W	BKM	658211
R930	120	10%	1/4W	AB	928112
R931	120	10%	1/4W	AB	928112
R932	47	10%	1/4W	AB	928047
R933	47	10%	1/4W	AB	928047
R934	2.2K	10%	1/4W	AB	928222
R935	1K	1%	1/2W	PRP	835210
R936	200	POT	1/2W	BKM	658121
R937	1K	1%	1/2W	PRP	835210
R938	2.2K	10%	1/4W	AB	928222
R939	91	5%	1/4W	AB	927091

RESISTORS

SCHEM. REF.	DESCRIPTION			MFR.	KH PART NUMBER
R940	620	5%	1/4W	AB	927162
R941	4.7K	5%	1/4W	AB	927247
R942	510	5%	1/4W	AB	927151
R943	3K	5%	1/4W	AB	927230
R944	1K	POT	1/2W	BKM	658211
R945	3K	5%	1/4W	AB	927230
R946	620	5%	1/4W	AB	927162
R947	3.6K	5%	1/4W	AB	927236
R948	25K	POT	1/2W	BKM	658326
R949	91	5%	1/4W	AB	927091
R950	130	5%	1/4W	AB	927113
R951	1.07K	1%	1/2W	PRP	835211
R952	330	5%	1/4W	AB	927133
R953	2.55K	1%	1/2W	PRP	835225
R954	2.55K	1%	1/2W	PRP	835225
R955	330	5%	1/4W	AB	927133
R956	681	1%	1/4W	PRP	850168
R957	1.07K	1%	1/2W	PRP	835211
R960	5K	POT		KH	631251
R961	1K	POT		KH	631210
R962	25K	POT		KH	620323
R963	5K	POT		KH	631250
R965	3.9K	5%	1/4W	AB	927239
R966	100K	5%	1/4W	AB	927410
R967	6.2K	5%	1/4W	AB	927262
R970	4.7K	5%	1/4W	AB	927247
R971	1.2K	5%	1/4W	AB	927212
R972	620	5%	1/4W	AB	927162
R973	2.4K	5%	1/4W	AB	927224
R974	33	5%	1/4W	AB	927033
R975	430	5%	1/4W	AB	927143
R976	240	5%	1/4W	AB	927124
R977	1K	10%	1/4W	AB	928210
R978	1K	10%	1/4W	AB	928210

TRANSISTORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
Q703	FET, N-CHANNEL, MPF4392	MOT	204392
Q704	FET, N-CHANNEL, MPF4392	MOT	204392
Q708	TRANSISTOR, NPN, MPS6515	MOT	206515
Q709	TRANSISTOR, NPN, MPS6515	MOT	206515
Q710	TRANSISTOR, PNP, MPS6518	MOT	206518
Q711	TRANSISTOR, PNP, MPS6518	MOT	206518
Q712	TRANSISTOR, NPN, MPS6515	MOT	206515
Q716	FET, N-CHANNEL, MPF4391	MOT	204391
Q731	TRANSISTOR, NPN, MPS3646	MOT	203646
Q732	TRANSISTOR, NPN, MPS3646	MOT	203646
Q736	TRANSISTOR, NPN, MPS3646	MOT	203646
Q738	TRANSISTOR, NPN, MPS3646	MOT	203646
Q770	TRANSISTOR, NPN, 2N2219A	MOT	202219
Q772	TRANSISTOR, PNP, 2N2905A	MOT	202905
Q774	FET, N-CHANNEL, MPF4392	MOT	204392
Q776	TRANSISTOR, NPN, MPS6515	MOT	206515
Q779	TRANSISTOR, NPN, MPS6515	MOT	206515
Q783	TRANSISTOR, NPN, TIP31A	MOT	200031
Q787	TRANSISTOR, PNP, TIP32A	MOT	200032
Q803	TRANSISTOR, NPN, 2N2219A	MOT	202219
Q812	FET, N-CHANNEL, MPF4392	MOT	204392
Q816	FET, N-CHANNEL, MPF4392	MOT	204392
Q817	FET, N-CHANNEL, MPF4392	MOT	204392
Q835	TRANSISTOR, NPN, MPS3646	MOT	203646
Q856	FET, N-CHANNEL, MPF4392	MOT	204392
Q860	FET, N-CHANNEL, MPF4392	MOT	204392
Q861	FET, N-CHANNEL, MPF4392	MOT	204392
Q862	TRANSISTOR, NPN, MPS6515	MOT	206515
Q872	FET, N-CHANNEL, MPF4392	MOT	204392
Q873	FET, N-CHANNEL, MPF4392	MOT	204392
Q880	TRANSISTOR, NPN, MPS6515	MOT	206515
Q881	TRANSISTOR, NPN, MPS6515	MOT	206515
Q882	TRANSISTOR, PNP, MPS6518	MOT	206518
Q883	TRANSISTOR, PNP, MPS6518	MOT	206518
Q884	TRANSISTOR, PNP, MPS6518	MOT	206518
Q885	TRANSISTOR, NPN, MPS6515	MOT	206515
Q886	TRANSISTOR, PNP, MPS6518	MOT	206518
Q941	TRANSISTOR, NPN, MPS2369	MOT	202369

TRANSISTORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
Q951	TRANSISTOR, PNP, MPS4258	MOT	204258
Q952	TRANSISTOR, PNP, MPS4258	MOT	204258
Q953	TRANSISTOR, PNP, MPS4258	MOT	204258
Q954	TRANSISTOR, PNP, MPS4258	MOT	204258
Q965	TRANSISTOR, PNP, MPS6518	MOT	206518
Q974	TRANSISTOR, PNP, MPS6518	MOT	206518
Q975	TRANSISTOR, PNP, MPS3640	MOT	203640
Q976	TRANSISTOR, PNP, MPS3640	MOT	203640
Q977	TRANSISTOR, NPN, MPS3646	MOT	203646

SEMICONDUCTORS

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
U710	GENERATOR, ICL8038CCPP	IN	208038
U744	OP AMP, LM318N	NS	200318
U748	BRIDGE DIODE, CA3019	RCA	220319
U764	OP AMP, LM318N	NS	200318
U774	OP AMP, LF356N	NS	200356
U783	OP AMP, MC1741CP	MOT	201741
U787	OP AMP, MC1741CP	MOT	201741
U800	DUAL, D-TYPE FF, MC10131P	MOT	201013

SEMICONDUCTORS

SCHEM. REF.	DESCRIPTION	MFR.	K-H PART NO.
U802	3-LINE RECEIVER, MC10116P	MOT	201011
U840	OP AMP, MC1741CP	MOT	201741
U841	OP AMP, MC1741CP	MOT	201741
U842	OP AMP, MC1741CP	MOT	201741
U850	PLL DETECTOR, MC12040	MOT	201204
U860	OP AMP, MC1741CP	MOT	201741
U861	OP AMP, MC1741CP	MOT	201741
U890	OP AMP, LF356N	NS	200356
U891	OP AMP, LF356N	NS	200356
U892	OP AMP, LF356N	NS	200356
U900	4-QUAD MULT, MC1595L	MOT	201595
U901	QUAD ARRAY, MPQ2369	MOT	202369Q

MISC.

SCHEM. REF.	DESCRIPTION	MFR.	KH PART NUMBER
S800	SWITCH, PUSHBUTTON, B3897	KH	343231
S801	SWITCH, ROTARY, B3843	KH	340451
S802	SWITCH, PUSHBUTTON, B3898	KH	343243
S803	SWITCH, PUSHBUTTON, B3896	KH	343253
S804	SWITCH, MOMENTARY, B3857	KH	343233

MANUFACTURER'S CODE

CODE	NAME	FSCM
AV	Aavid Engineering, Laconia, NH	30161
AB	Allen Bradley Co., Milwaukee, WI	01121
AD	Analog Devices Inc., Norwood, MA	24355
ALC	Alco Electronic Products Inc. Div. of Augat Inc., North Andover, MA	95146
AMP	Amphenol North America, Div. of Buker-Ramo, Oak Brook, IL	29587
AMZ	American Zettler, Irvine, CA.	
APD	American Power Devices, Andover, MA	50273
AS	Atlantic Semiconductor, Northridge, CA	17545
ATM	Amatom Electronics Hardware, Windsor Locks, CT	06540
AVX	Aerovox Inc., New Bedford, MA	00656
BKM	Beckman Helipot Div., Fullerton, CA	73138
BUS	Bussman, Div. of McGraw-Edison Co., St. Louis, MO	71400
CA	Circuit Assembly, Costa Mesa, CA.	
CC	Coto-Coil Co., Providence, RI	71707
CD	Cornell-Dubilier Electronics, Newark, N.J.	14655
CDI	Compensated Devices Inc., Melrose, MA	
CGW	Corning Glass Works, Wilmington, NC	27167
CK	C&K Components Inc., Newton, MA	09353
CLX	Clairex Corp., Mt. Vernon, NY	
CPC	Components Corp, Denville, NJ	26364
CW	CW Industries, Warminster, PA	79727
DE	Dale Electronics Inc, Columbus, NE	91637
DLV	Delevan Corp., East Aurora, NY	99800
DL	Dialight Corp., Brooklyn, NY	72619
ECI	Electronic Concepts Inc, Eatontown, NJ	50558
FCD	Fairchild, Semiconductor Grp. Mountain View, CA	07263
FXC	Ferroxcube Corp., Div. of N.A. Phillips Saugerties, NY	02114
GI	General Instrument Corp., Semiconductor Div., Hicksville, NY	11711
HG	Hi-G Co., Windsor Locks, CT	02289
ITT	ITT Components-Capacitors, Santa Ana, CA	
KGN	Kahgan Electronics Corp., Hempstead, NY	57582
KH	Krohn-Hite Corp., Avon, MA	88865
KLN	Kelvin Industries, Fajardo, PR	
KNG	Kings Electronics, Tuckahoe, NY	91836
KRL	KRL Electronics Inc., Manchester, NH	18235
LFI	Littlefuse Inc., Des Plaines, IL	75915
MAL	Mallory Capacitor Co., Indianapolis, IN	90201
MON	Monsanto, Electronics Div., Palo Alto, CA	26483
MOT	Motorola Inc. Semiconductor Group, Phoenix, AZ	04713
MT	M-Tron Industries Manuf. Inc., Van Nuys, Ca	31649
NS	National Semiconductor Corp., Semiconductor Div., Santa Clara, CA	27014
PRP	Precision Resistive Products Inc., Mediapolis, IA	
QC	Quality Components Inc., St. Mary's, PA	
RCA	RCA Solid State Div., Somerville, NJ	02735
RCL	RCL Electronics, Div. of AMF, Electro-Components Grp., Pompano Beach, FL	
RI	Resistors Inc., Chicago, IL	83827
SCH	ITT Schadow Inc., Eden Prarie, MN	
SLX	Siliconix Inc., Sunnyvale, CA	100010
STL	Stackpole Components Co., Raliegh, NC	
SP	Sprague Electric Co., N. Adams, MA	56289
STT	Stettner-Trush Inc., Cazenovia, NY	52763
SUP	Superior Electric Company, Bristol, CT.	
SWC	Switchcraft Inc., Chicago, IL	82389
TD	Teledyne Semiconductor, Mountain View, CA	15818
TI	Texas Instruments, Dallas, TX	01295
TMY	Thermalloy, Dallas, TX	13103
TOR	Torin Corp., Torrington, CT	60399
TRW	TRW Capacitors, Cqallala, NE	84411
YSA	Yuasa Battery, Santa Fe, CA	

MODIFICATION SHEET

MODEL NO. 2400	SCHEMATIC DATE 10/22/1981	DATE 10/07/1982

Serial Nos.	Change and/or Modification
172 and up	Changed the distortion specs from 2% to 3MHz, to 3% to 3MHz. Added R709A, 270K, 1/4W, 10%, carbon resistor, from the center arm of R610 to pin 2 of U710. Changed R811 to a 680 ohm, 1/4W, 5%, carbon resistor. Changed C957 to a 3.3pF, 10%, 500V ceramic capacitor. Added R914, 3.3K, 1/4W, 10%, carbon resistor, from the cathode end of CR900 to ground. Changed R753 to a 10K, 1/4W, 5%, carbon resistor. Changed R841 to a 4.7K, 1/4W, 5%, carbon resistor. Changed R837 to a 390 ohm, 1/4W, 5%, carbon resistor.
197 and up	General Description - Specifications: "CV (Control Voltage) Output should read 2mV to +3 volts, proportional to generator frequency. 1% accuracy on ranges 1-7 from .1 volts to +3 volts. Output impedance, 2.4K ohms. Changed R711 to a 200 ohm trim pot.

KROHN-HITE CORPORATION
Avon Industrial Park / Bodwell St., Avon, Mass. 02322 U.S.A.
Telephone 617/580-1660 — TWX 710-345-0831

MODIFICATION SHEET

MODEL NO. 2400	SCHEMATIC DATE 10/22/1981	DATE 10/07/1982

Serial Nos.	Change and/or Modification
	Changed frequency response specification: from 0.1dB to 100kHz, 0.2dB to 300kHz to 0.2dB to 100kHz, 0.4dB to 300kHz.
	Removed C715, 220pF
	Removed C763, .1uF
	Removed R763, 11K, 1/4W, 1%
	Added a .47pF, 500V, 10%, ceramic capacitor from the collector of Q952 to it's base.
	Changed CR973 from a 1N4149 diode to a 160 ohm 1/4W 5% resistor.
	Changed R837 to a 430 ohm, 1/4W, 5%, carbon resistor.
All units:	Changed R534 to a 1.1K, 1/4W, 5%, carbon resistor.
	Changed R762 to a 39.2K, 1/4W, 1%, film resistor.

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