

# Operating Manual

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# Stereo Synthesizer

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Model 245F

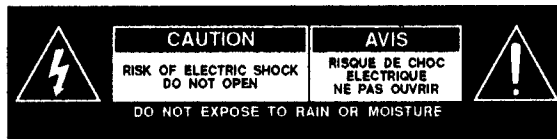
**orban**<sup>®</sup>

**IMPORTANT NOTE:** Refer to the unit's rear panel for your Model Number.

<b>Model Number:</b>	<b>Description:</b>
245F/U	Stereo Synthesizer, 115V
245F/E	Stereo Synthesizer, 230V
245F/UT	Stereo Synthesizer, 115V Output Transformer
245F/ET	Stereo Synthesizer, 230V Output Transformer

**OPTIONS:**

<b>Model Number:</b>	<b>Description:</b>
RET019	Output Transformer Retrofit Kit for 245F
SC1	Security Cover (CLEAR, BLUE, or WHITE)



**CAUTION:** TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER (OR BACK). NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

**WARNING:** TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.



This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.



This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

# Operating Manual

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Model 245F

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This Orban product has been manufactured by AKG Acoustics, Inc.

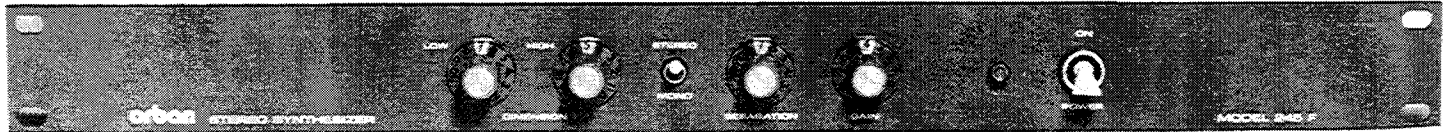
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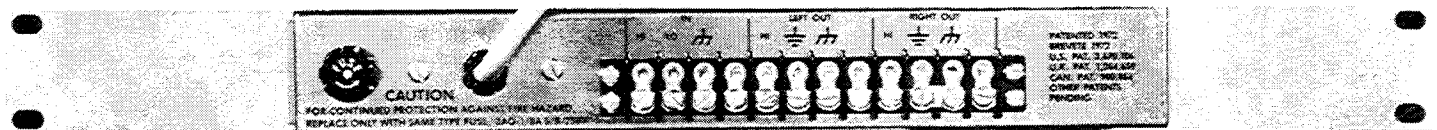
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# REGISTRATION CARD

The original purchaser should have received a postpaid Registration Card packed with this manual.

Registration is of benefit to you because it enables us to tell you of new applications, possible performance improvements, service aids, etc., which may be developed over the life of the product. It also provides us with the date of sale so that we may more promptly respond to possible claims under Warranty in the future (without having to request a copy of your Bill of Sale or other proof of purchase).

Please fill in the Registration Card and return it to us.

If the Registration Card has become lost or you have purchased the unit used, please photocopy the image of the card reproduced below and send it to us in an envelope. Use the address shown on the title page.

Registration Card			
Model # _____	Serial # _____	Purchase Date _____	
Your name _____		Title _____	
Company _____		Telephone _____	
Street _____			
City, State, Mail Code (Zip), Country _____			
Nature of your product application _____			
How did you hear about this product? _____		Purchased from _____	
Comments _____			
_____			
Which magazines do you find the most useful to your job?			
<input type="checkbox"/> Audio	<input type="checkbox"/> Broadcast Engineering	<input type="checkbox"/> Broadcast	<input type="checkbox"/> dB Magazine
<input type="checkbox"/> Electronic Musician	<input type="checkbox"/> EQ	<input type="checkbox"/> Millimeter	<input type="checkbox"/> Mix
<input type="checkbox"/> Post	<input type="checkbox"/> Pro Sound News	<input type="checkbox"/> Radio & Records	<input type="checkbox"/> Radio World
<input type="checkbox"/> RE/P	<input type="checkbox"/> Sound & Communications	<input type="checkbox"/> S & VC	<input type="checkbox"/> TV Broadcast
<input type="checkbox"/> TV Tech	_____	_____	_____
_____	_____	_____	_____
95101-000-07 1/91			

## WARRANTY

The Warranty, which applies only to the first end-user of record, is stated on the Warranty Certificate on a separate sheet packed with this manual. Save it for future reference.

Details on obtaining factory service are provided in Part B.

# Part A:

## Installation and Operation

**INTRODUCTION** You are now the owner of an Orban Model 245F Stereo Synthesizer. The 245F is one of the many high quality audio processing products manufactured for the discriminating professional user.

The Orban Stereo Synthesizer processes any monophonic sound source into pseudo-stereo quickly and easily. The pseudo-stereo does not degrade the quality of the mono recording, and possesses many attributes of true stereo, such as depth, space, directionality, stability, and good channel balance.

The synthetic stereo is created by a complementary comb filter derived by a patented phase-cancellation technique. The incoming spectrum is divided into five bands of about two octaves each. Bands are alternately placed in the left and right channels, producing a convincing stereo illusion.

The two DIMENSION controls vary the relative positioning of the bands. This facilitates achieving good subjective channel balance regardless of the average spectral balance of the program.

There is a "best compromise" DIMENSION setting (LOW=3.0; HIGH=7.5) which works well for average program material. This setting may be used if it is impractical to readjust the DIMENSION controls for each new piece of program material.

If you wish to set the DIMENSION controls permanently (so that they cannot be accidentally misadjusted), fixed resistors or Beckman 72PR25K trimmers can be installed in holes provided in the circuit board.

A STEREO/MONO switch provides quick comparison between the original mono input and the stereo-synthesized output.

A SEPARATION control allows reduction of the stereo separation by partially mixing the channels. This may be useful to permit more natural headphone listening, to reduce the vertical cutter excursion in disk cutting, and to increase mono loudness in FM stereo broadcasting.

A GAIN control is located between the active-balanced input stage and the signal processing circuitry. Thus it cannot prevent overload of the input stage due to excessive drive levels. Up to 9dB of gain is available.

Mono compatibility is assured by the following facts:

1. The electrical sum of the two output channels is proportional to the mono input to the Synthesizer. Thus, a listener can recover the original mono by summing the two stereo channels together. This removes many "purist" objections to pseudo-stereo, since the purist can choose freely between pseudo-stereo and the original mono. It also means that mono FM listeners will hear the original mono source when listening in mono to a stereo FM station, and that the lateral modulation of a stereo disk will represent the original mono signal.

2. The sum of the left and right powers (as a function of frequency) is proportional to the power in the mono input. Thus, the acoustical frequency balance of the pseudo-stereo is identical to the frequency balance of the mono: coloration is not introduced by the synthesis process.

Both (1) and (2) hold for any adjustments of the Stereo Synthesizer operating controls.

The output of the Stereo Synthesizer can drive any device requiring standard line levels and impedances. If gain balance is carefully maintained after the Stereo Synthesizer, then the following relationships will hold accurately:

1. If the Stereo Synthesizer output is recorded on tape and is later played back on a machine having substantial time delay or phase shift between the two channels, the "phasing" sound in the mono sum signal will be greatly reduced.
2. In disk cutting, the lateral cut will represent the original mono input of the Stereo Synthesizer. On playback, if the channels of the stereo pickup are paralleled, the output will represent the original mono source.
3. In FM stereo broadcasting, mono listeners will hear the original mono signal.

The input is active-balanced, bridging. The outputs are supplied unbalanced, but can be balanced by installation of a retrofit kit available from your Orban dealer or directly from Orban. The kit consists of hardware and two specially-designed transformers. Holes are provided in the chassis for quick field installation.

If the "+" input is driven positive, the output will also be driven positive. That is, the device is non-inverting ("in-phase") from input to output.

## **MECHANICAL INSTALLATION**

The 245F Stereo Synthesizer requires 1 3/4" (4.5cm/1 unit) of rack space in a 19" rack. A mounting position should be chosen which allows the operator to hear a well-balanced stereo image from the studio monitor loudspeakers, since the Stereo Synthesizer is adjusted by ear.

The Stereo Synthesizer will usually pick up its chassis ground from the rack. As with any equipment, it is good practice to be sure that the resistance between the rack and the chassis is less than 1 ohm. Sometimes it is necessary to scrape the paint from the rack and/or the back of the front panel to secure a good connection. If the Stereo Synthesizer is to be mounted in a non-conductive enclosure like a portable case, the instructions in the **Grounding** section (below) should be followed.

It is unwise to mount the Stereo Synthesizer directly over large heat-producing devices like vacuum-tube power amplifiers, because component life can be shortened. Ambient temperature should not exceed 50 degrees C when the unit is powered.



## **OPTIONAL BALANCED OUTPUT TRANSFORMER INSTALLATION**

If transformers were not installed at the factory, refer to the installation instructions furnished with the transformer retrofit kit, available through your Orban dealer or directly from Orban. The transformers supplied with this kit have been designed to have a negligible effect on published specifications. Should you wish to use some other transformers, it would be wise to make careful performance measurements with special attention to LF distortion and HF response at high output levels, thus determining the output level achievable with performance acceptable for your application. A transformer meeting Orban standards should produce approximately +20dBm (limited by clipping in the output amplifier) without significantly compromising performance.

The **ELECTRICAL INSTALLATION** section describes alternate grounding procedures in the event transformers are used.

## **ELECTRICAL INSTALLATION**

Connecting the 245F to other equipment is quite straightforward. Relatively uncomplicated systems (such as home playback systems, "semi-pro" recording studios, electronic music studios, etc.) tend to come together without serious grounding problems even if the wiring practices are somewhat casual, provided that high RF fields are not present. Unusual situations can be analyzed if you are familiar with the standard rules governing grounding and interfacing between balanced and unbalanced systems.

The instructions below will apply to the majority of cases. A comprehensive discussion of interconnections and grounding can be found in **Appendix B**.

### **Input**

The electronically-balanced input of the 245F is compatible with most professional and semi-professional sound equipment, balanced or unbalanced, whose source impedance is 600 ohms or less. If it is greater (as in some vacuum-tube audiophile preamps), a minor modification may be made to the input to accommodate the situation. Refer to **Appendix B** for further details.

The headphone jack of any modern television receiver is a suitable source for the 245F. This output can ordinarily be run over relatively long distances via shielded cable and connected either to the 245F input directly, or to a stereo preamp which is in turn interfaced to the 245F through the preamp's tape monitor loop.

Nominal input level to the 245F is between -10 and +4dBm. The absolute overload point is +26dBm. Care should be taken to avoid overloading the 245F input since the GAIN control is not at the input.

When the GAIN control is fully clockwise, the 245F will produce approximately 9dB of gain in MONO mode. In STEREO mode, peak gain at certain frequencies will be 14dB.

### **Output**

The two outputs of the 245F are unbalanced (unless fitted with the optional transformers), and the source impedance is 47 ohms in parallel with 1000pF to the chassis (for RFI suppression).

If the optional output transformers are not installed, it is neither necessary nor desirable to terminate the 245F outputs with 600 ohms when driving bridging inputs.

If the output transformers are installed, the total load impedance on each 245F output should be 600 ohms, +10%. If the 245F is driving bridging inputs, this impedance may be supplied by means of a 620 ohm +5% 1/4 watt carbon film resistor connected across each 245F output.

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## Wiring the 245F With Two-Conductor Shielded Cable

We recommend wiring with two-conductor shielded cable (such as Belden 8451 or equivalent) because signal current flows through the two conductors only. The shield does not carry signal, is used only for shielding, and is ordinarily connected to ground at one end only. The following table and diagram are applicable to a great majority of installations.

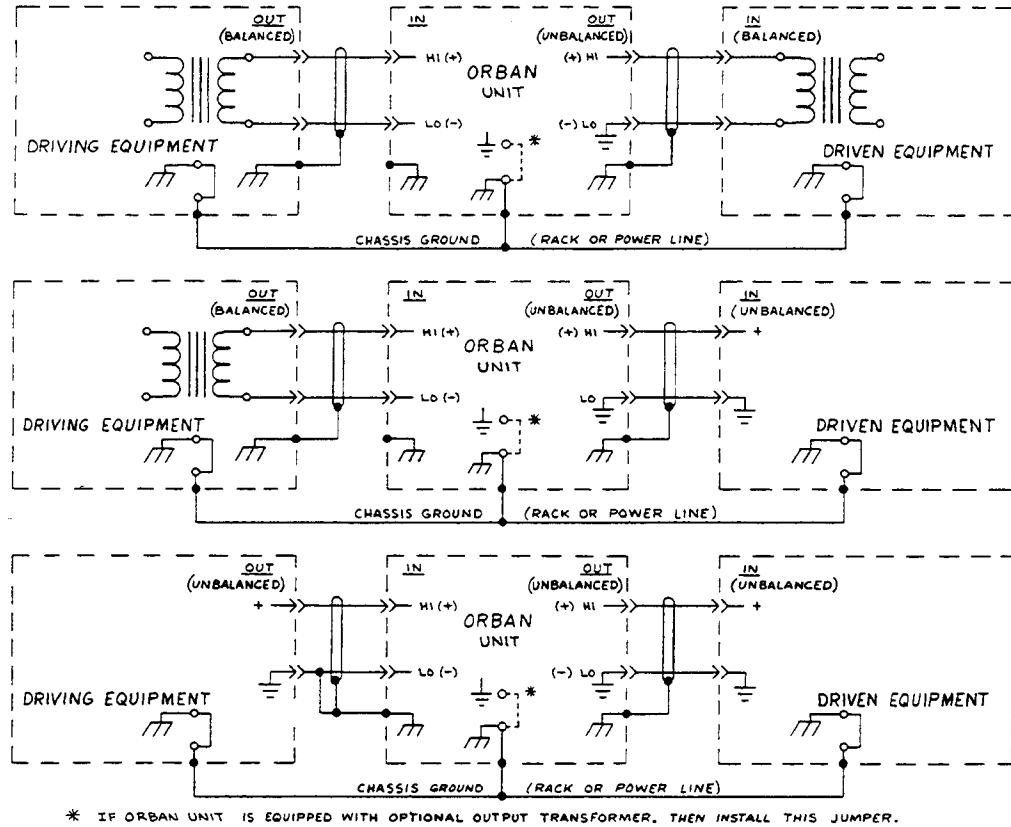


Fig. 1: GROUNDING

TABLE I:  
TYPICAL INPUT/OUTPUT CONNECTION RULES

### INPUT

- 1) Always use "+" and "-" as the two input terminals to the 245F.
- 2) When the 245F is driven from an unbalanced source, connect shield both to circuit ground of source, and to chassis ground of 245F.
- 3) When the 245F is driven from a balanced source, connect shield at source end to chassis ground. Do not connect shield at 245F end.

### OUTPUT

- 1) On the 245F outputs, connect shield at 245F end to chassis ground (whether driving balanced or unbalanced). Do not connect shield at other end.
- 2) When driving a balanced load, jumper circuit ground to chassis ground on 245F (on rear panel). When driving an unbalanced load, do not attach jumper.
- 3) If optional output transformers are installed on 245F, jumper the circuit ground to chassis ground on the 245F.

## GENERAL

- 1) 245F chassis should always be earth-grounded (i.e. through third wire in power cord or through rack). For maximum protection from shock, float this ground only as a last resort.

Because it is not always possible to determine if the pieces of equipment driving or being driven by the 245F have their circuit grounds internally connected to their chassis grounds (which are always connected to the ground prong of the AC line cord), and because the use of the AC power line ground often introduces problems because it can be noisy or otherwise imperfect, the wiring techniques in the diagram are not universally applicable.

If you follow the diagram and hum or noise appears, don't be afraid to experiment. If the noise sounds like a low-level crackling buzz, then probably there isn't enough grounding. Try connecting the "-" input of the 245F to the chassis ground terminal on the 245F's barrier strip and see if the buzz goes away. You can also try strapping the 245F's chassis and circuit grounds together, and see if this helps.

A ground loop usually sounds like a smooth, steady hum rather than a crackly buzz. If you have a ground loop, you can often break it by disconnecting the jumper between circuit and chassis grounds on the 245F's rear-panel barrier strip. In either case, think carefully about what is going on, and keep in mind the general principle: one and only one circuit ground path should exist between each piece of equipment! (Bear in mind that the circuit grounds of the two output channels of the 245F are connected together internally, and could conceivably introduce a ground loop if you do not take this connection into account in planning your wiring.)

**Wiring The 245F With Single-Conductor Shielded Cable:** Sometimes, particularly if you are using the 245F with musical instruments or home-type equipment, you will find yourself with no time to correctly connect the 245F, and will find instead that you must use single-conductor shielded cables. If this happens, connect the inner conductors of the shielded cables to the "+" sides of the 245F input and outputs. Connect the shields to the "-" sides.

The shield will ordinarily receive chassis ground from the external equipment which it is connecting to the 245F. The chassis ground/circuit ground jumper on the rear barrier strip of the 245F should be left in whichever configuration gives minimum hum or buzz. To minimize hum or buzz, it may be necessary to jumper one or more shields to chassis ground. Because use of single-conductor cables virtually eliminates any possibility of carefully controlling the system grounding scheme, it is not recommended for professional applications.

## OPERATING INSTRUCTIONS

1. After connecting the Stereo Synthesizer to your system (following the installation instructions above), move to a point equidistant between the monitor speakers.
2. Introduce mono program to the input of the Stereo Synthesizer. Put the MODE switch in MONO. Advance the GAIN control until both channels are peaking about -4 VU (0 dBm) on a standard VU meter. Balance the audio chain following the Stereo Synthesizer for equal left/right levels. You may test for adequate monitor balance by making sure that, when the Stereo Synthesizer is in MONO mode, a well-defined point-source virtual image is heard exactly mid-way between the speakers.
3. Turn the SEPARATION control to 10. Turn the MODE switch to STEREO. Adjust the two DIMENSION controls in different combinations until the stereo image seems well-balanced from left to right, and does not "bunch up" to one side. Do not be disturbed if the stereo VU meters in the following audio system indicate unbalanced levels; you are adjusting for psychoacoustical balance.

With practice, this adjustment will take only a few seconds. For best results, it should be repeated for each new piece of program material. In certain applications, like "in line" in a broadcast automation system following a bank of mono cartridge reproducers, it is not feasible to readjust the DIMENSION controls for each new piece of program material. We have experimented extensively, and feel that a good compromise setting in such a case is HIGH DIMENSION=7.5; LOW DIMENSION=3.0.

4. Adjust the SEPARATION control for the amount of separation desired. Separation may be reduced if the effect sounds exaggerated, as it often does when listening through headphones. If separation is reduced, peak levels at the output will be reduced. The GAIN control can be turned up to restore the desired level.

The SEPARATION control operates such that the stereo sum signal (L+R: the main channel in FM stereo broadcasting and the lateral modulation in disk cutting) remains constant for any setting, and the stereo difference signal (L-R: the stereophonic subchannel in FM stereo broadcasting and the vertical modulation in disk cutting) is increased from zero to a level equal to the sum signal as the SEPARATION control is advanced from 0 to 10. At "10", the peak level on each channel increases 6dB with reference to a "0" setting; subjective loudness increases 3dB.

FM stereo broadcasters should note the following: As with any stereo program, total perceived loudness decreases as separation is increased (assuming a constant peak level in both channels). The highly competitive FM stereo station may therefore wish to reduce the setting of the SEPARATION control in order to sound louder in both stereo and mono. This provides an interesting technique for controlling voice/music balance in FM stereo broadcasting: if the announce microphone (and/or other voice material) is processed through the Stereo Synthesizer, its loudness relative to the music may be controlled by adjusting the setting of the SEPARATION control.

# Part B: Maintenance

**Introduction:** This part of the manual provides instructions on how to maintain the 245F, how to make sure that it is working according to specifications, and how to repair it if something goes wrong.

Factory service is available throughout the life of the 245F. Please refer to **Factory Service** subsection of **MAINTENANCE AND SERVICE** below for further information.

## 1: PERFORMANCE EVALUATION

This section provides a series of thorough, definitive bench tests which will verify whether or not the 245F is operating normally. The 245F has no internal trims and requires no alignment.

### Power Supply:

#### Equipment Required:

- 1) VTVM or DVM
- 2) Oscilloscope

### CAUTION

The installation and servicing instructions in this manual are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.



The following tests will verify correct operation of the Power Supply:

- 1) Using the DC voltmeter, measure the voltage from circuit ground to both positive and negative unregulated supplies. This can be readily measured across the two large filter capacitors C12 and C13. This voltage may be expected to vary widely depending on line voltage; it should measure between  $\pm 18$  and  $\pm 26$  volts DC.
- 2) Measure the voltage between circuit ground and the outputs of the positive and negative voltage regulators, IC5 and IC6. The supplies should put out between  $\pm 14.25$  and  $\pm 15.75$  VDC. If either supply exceeds 15.75 VDC, it implies that its associated IC regulator is defective. If either supply is lower than 14.25 VDC, refer to the **Power Supply** portion of the **CIRCUIT DESCRIPTION** in this section for troubleshooting hints.
- 3) Using the oscilloscope, measure the ripple and noise on the regulated positive and negative power busses. Ripple and noise should be less than 2mV peak on each bus.

### Signal Processing Circuitry:

#### Equipment Required:

- 1) Oscilloscope with DC-coupled display
- 2) Audio sweep generator with sinewave output and logarithmic sweep (A Tektronix 5L4N Low-Frequency Spectrum Analyzer in a Tektronix 5111 Bistable Storage mainframe may be substituted for items (1) and (2).)
- 3) 20-20,000Hz bandpass filter, 18dB/octave slopes
- 4) VTVM or DVM
- 5) Harmonic distortion analyzer with built-in 400Hz and 80kHz filters and residual THD below 0.0015%
- 6) Low-distortion oscillator with residual THD below 0.0015%

(A Sound Technology 1700A or H-P 339 will satisfy (5) and (6))

For the following tests, a 600 ohm resistor must be connected across each 245F output. 620 ohm 1/2 watt 5% carbon resistors are suitable.

- 1) Connect the low-distortion sinewave oscillator to the input of the Stereo Synthesizer. Turn the STEREO/MONO switch to MONO. Adjust the oscillator output level and Stereo Synthesizer GAIN control to produce approximately +18 dBm at each output. Measure the Total Harmonic Distortion at 20 Hz, 1 kHz, and 20 kHz. It should not exceed 0.1% at any frequency, and will typically be 0.02% or below.
- 2) Remove the oscillator and turn the GAIN control to "0". Measured through a 20-20,000 Hz bandpass filter with 18 dB/octave Butterworth (maximally flat) skirts, the noise should not exceed -80 dBm from either output channel. Be careful that no hum is introduced by ground loops in the measurement setup.
- 3) Set both DIMENSION controls to "5". Set the SEPARATION control to "10". Turn the STEREO/MONO switch to STEREO. Measure the frequency response of the left and right channels (using the sweep generator and scope, or the Tektronix 5L4N). The frequency responses of the two channels should resemble those shown in Fig. 2. Note that the DIMENSION controls will affect the frequencies of the nulls shown in Fig. 2.

If these tests are passed, there is a high probability that the Stereo Synthesizer is operating properly.

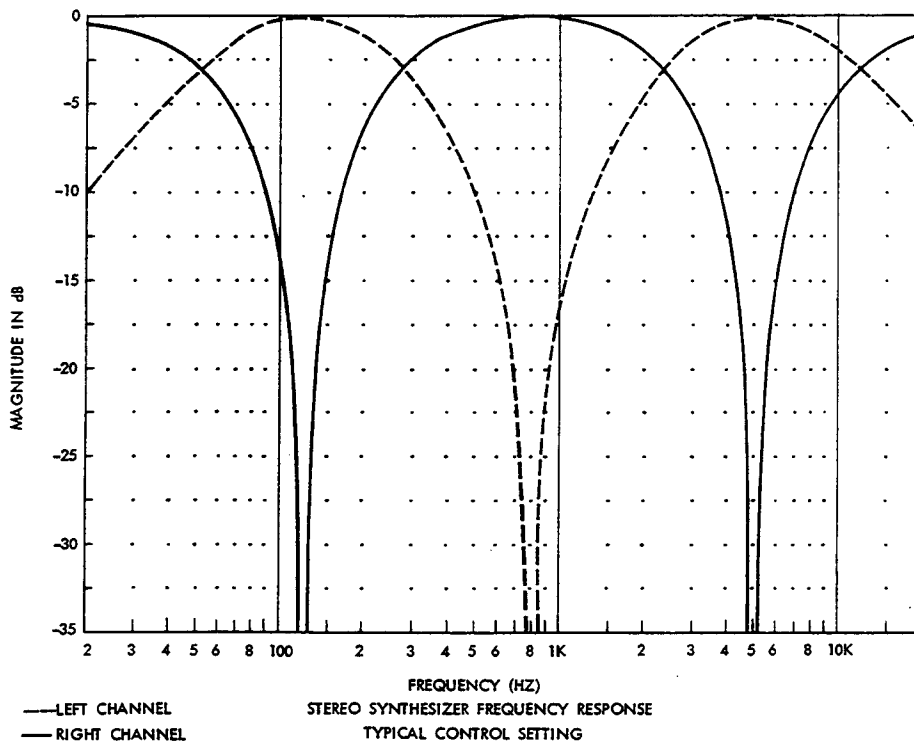


Fig. 2: STEREO SYNTHESIZER FREQUENCY RESPONSE,  
TYPICAL CONTROL SETTINGS

## 2: MAINTENANCE AND SERVICE

### Preventive Maintenance

The front panel may be cleaned with a mild household detergent. Stronger solvents should be avoided, as they may damage the paint, the silk-screened lettering, or the plastic control knobs.

### Replacement of Components on Printed Circuit Boards

It is important to use the correct technique for replacing components mounted on PC boards. Failure to do so will result in possible circuit damage and/or intermittent problems.

**Removal:** It is sometimes more convenient (although less workmanly) to cut each of the leads of an offending component from its body while the leads are still soldered into the board. The component is then discarded, and each lead is heated independently and pulled out of the board with long nose pliers. Each hole may then be cleared of solder by carefully heating with a low-wattage soldering iron and sucking out the remaining solder with a spring-activated desoldering tool.

Another technique is:

- 1) Use a 30 watt soldering iron to melt the solder. Do not use a soldering gun or a high-wattage iron! As soon as the solder is molten, vacuum it away with a spring-actuated desoldering tool like the Edsyn "Soldapull". AVOID OVERHEATING THE BOARD; overheating will almost surely damage the board by causing the conductive foil to separate from the board. Use a pair of fine needle-nose pliers to wiggle the lead horizontally until it can be observed to move freely in the hole.
- 2) Repeat step (1) until each lead to be removed has been cleared of solder and freed.
- 3) Now lift the component out.

### Installation:

- 1) Bend the leads of the replacement component until it will fit easily into the appropriate PC board holes. Using a good brand of rosin-core solder, solder each lead to the board with a 30 watt soldering iron. Make sure that the joint is smooth and shiny.
- 2) Cut each lead of the replacement component close to the board with a pair of diagonal cutters.
- 3) Remove all residual flux with a cotton swab moistened with a solvent like 1,1,1 trichloroethane, naphtha, or 99% isopropyl alcohol. The first two solvents are usually available in supermarkets under the brand name "Engerine" fire-proof spot remover and regular spot remover, respectively. The alcohol, which is less effective, is usually available in drug stores. Rubbing alcohol is highly diluted with water and is ineffective.

It is good policy to make sure that this defluxing operation has actually removed the flux and has not just smeared it so that it is less visible. While most rosin fluxes are not corrosive, they can slowly absorb moisture and become sufficiently conductive to cause progressive deterioration of performance.



## Troubleshooting IC Opamps

IC opamps are usually operated such that the characteristics of their associated circuits are essentially independent of IC characteristics and dependent only on external feedback components. The feedback forces the voltage at the (-) input terminal to be extremely close to the voltage at the (+) input terminal. Therefore, if the technician measures more than a few millivolts between these two terminals, the IC is probably bad.

Exceptions are IC's whose outputs have been saturated due to excessive input voltage because of a defect in an earlier stage. Also, be sure that the voltmeter is not interacting with these sensitive points and affecting the measured voltage. However, if an IC's (+) input is more positive than its (-) input, yet the output of the IC is sitting at -14 volts, this almost certainly indicates that it is bad. The same holds if the above polarities are reversed.

A defective opamp may appear to work, yet it may have extreme temperature sensitivity. If parameters appear to drift excessively, freeze-spray may aid in diagnosing the problem. Freeze-spray is also invaluable in tracking down intermittent problems. But, use sparingly, because it can cause resistive short circuits due to moisture condensation on cold surfaces.

Because the characteristics of the 245F are essentially independent of opamp AC characteristics, an opamp can usually be freely replaced by another opamp with the same part number. However, noise and distortion are not guaranteed by the opamp manufacturer, and it is wise after servicing the 245F to perform the **PERFORMANCE EVALUATION** procedure above to verify that the 245F is meeting its specifications.

(Factory-screened replacement opamps with verified noise and distortion characteristics are available directly from Orban.)

## Factory Service

Please refer to the terms of your Limited One-Year Standard Warranty, which extends to the first end-user. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. Returned units will be returned C.O.D. if the unit is not under warranty. Orban will pay return shipping if the unit is still under warranty. In all cases, transportation charges to the factory (which are usually quite nominal) are paid by the customer.

After a formal Return Authorization number is obtained from the factory, units should be shipped to CUSTOMER SERVICE at the address shown on the front page of this manual.

**YOUR RETURN AUTHORIZATION NUMBER MUST BE SHOWN ON THE LABEL,  
OR THE PACKAGE WILL NOT BE ACCEPTED!**

Telephone: (1) 510/351-3500

or Fax: (1) 510/351-1001

## Shipping Instructions

If the original packing material is available, it should be used. Otherwise, a carton of at least 200 pounds bursting test and no smaller than 22" x 9" x 5" should be employed.

The 245F should be packed so that there is at least 1-1/2" of packing material protecting every point. A plastic wrap around the chassis will protect the finish. Cushioning material such as Air-Cap, Bubble-Pak, foam "popcorn", or fibre blankets are acceptable. Folded newspaper is not suitable. Blanket-type materials should be tightly wrapped around the 245F and taped in place to prevent the unit from shifting out of its packing and contacting the walls of the carton.

The carton should be packed evenly and fully with the packing material filling all voids such that the unit cannot shift in the carton. Test for this by closing but not sealing the carton and shaking vigorously. If the unit can be felt or heard to move, use more packing.

The carton should be well-sealed with 3" reinforced sealing tape applied across the top and bottom of the carton in an "H" pattern. Narrower or parcel-post type tapes will not stand the stresses applied to commercial shipments.

The package should be marked with the name of the shipper, and the words in red: DELICATE INSTRUMENT, FRAGILE! Even so, the freight people will throw the box around as if it were filled with junk. The survival of the unit depends almost solely on the care taken in packing!

### **3: CIRCUIT DESCRIPTION**

**Input Buffer:** The signal enters the 245F in balanced form. C1, C2 shunt RF from the input leads to the chassis. These capacitors are not effective at VHF and higher frequencies. Therefore, ferrite beads have been placed around the input and output leads to suppress such high frequency RF. It should be noted that this degree of RF-proofing is moderate but adequate for a vast majority of installations. However, installation next to a high-power transmitter may still cause problems. Additional RF suppression, careful examination of the grounding scheme, and other considerations familiar to the broadcast engineer may have to be used in conjunction with the 245F's built-in RF suppression.

The filtered signal is applied to IC1A, a low-noise opamp configured as a differential amplifier with a gain of 0.5. When both non-inverting and inverting inputs are driven by a source impedance which is small with respect to 100K (such as 600 ohms or less), the amplifier is essentially insensitive to signal components that appear equally on the non-inverting and inverting inputs (such as hum), and responds with full gain to the difference between the non-inverting and inverting inputs. Thus it serves as an "active transformer". Ordinarily, best results are obtained for unbalanced signals if the non-inverting input is grounded and the inverting input is driven.

The GAIN control is located after IC1. Therefore, IC1A will overload if its differential input exceeds approximately +26dBm.

The output of IC1A is attenuated by R5, the GAIN control. The non-inverting 9dB-gain buffer IC1B which follows R5 provides light loading for R5. It also provides low impedance drive for R6 (the SEPARATION control) and for matrix resistors R21, R22.

R6 drives a chain of four phase shifters. These have a frequency response which is flat, but a phase response which changes as a function of frequency. The phase-shifted signal produced by these phase shifters becomes the stereo difference signal (L-R), while the original mono signal from the output of IC1B becomes the stereo sum signal (L+R). Matrixing of the sum and difference signals to provide the left and right channels occurs in the circuitry associated with IC4, and will be described below.

R6 (SEPARATION) is an L-R gain control. Its output is buffered by IC2A. The output of IC2A drives a two-pole active phase shifter consisting of R7-11, C4, C5 and IC2B. The network connected to IC2B's "+" input is a bandpass filter. By subtracting 2x the bandpass filter's input signal from its output in IC2B, an allpass function results: its frequency response is flat, but its phase response varies with frequency. Thus the frequency response at the output of IC2B should be flat  $\pm 1$  dB from 20-20,000 Hz. Substantial deviation from flatness implies a failure or severe drift in one or more of the components associated with IC2B. Since all of the components interact, each component must be individually removed and tested with an impedance bridge to determine the cause of the problem.

The output of IC2B drives a single-pole adjustable phase shifter consisting of R12-15, C6, and IC3. The 90 degree phase shift frequency of this circuit is in the lower midrange. The exact 90 degree frequency is adjustable with R14, the LOW DIMENSION control. This circuit is a bridge. IC3 acts as a differential amplifier to convert the output to a ground-referenced voltage signal.

The output of IC3 drives a final phase shifter, consisting of R16-19, C7, and IC4A. The operation of this phase shifter is fundamentally similar to its predecessor, and incorporates the HIGH DIMENSION control R18. However, IC4A is also the left channel output driver amplifier. It contains an internal high-current output stage capable of driving 600 ohm loads, and it has an extra input: the original input signal is added through R21 to the phase shifted signal. Therefore, the output of IC4A is actually the phase shifted signal added to the original signal, yielding the synthesized left channel. This left channel has a frequency response consisting of several dips. The typical frequency response is shown in Fig. 2 (above, in Part I of this section). The depth of the dips is controlled by the SEPARATION control, R6.

The output of IC4A consists of the phase-shifted difference signal plus the inverted sum signal, since R21 is connected to the (-) input of IC4A. The right channel is synthesized by adding two times the inverted sum signal to the inverted left channel. Thus the right channel contains two components:

- 1)  $-2S - (-S) = -S$ ; and
- 2)  $-D$

where S is the sum (L+R) signal, and D is the difference (L-R) signal.

(The  $-2S$  component is supplied through R22; R23 supplies the left channel component.)

Thus both left and right channels contain  $-S$ , but both S components are in-phase with each other. In addition, the left and right channels contain difference components that are out-of-phase with each other. Mathematically,

$$\begin{aligned}L &= -S + D \\R &= -S - D\end{aligned}$$

The overall Stereo Synthesizer can be operated inverting or non-inverting by choosing a normal or inverted connection to the 245F's balanced input. The (+) and (-) terminals have been labeled to correspond to overall non-inverting and inverting operation respectively.

**Power Supply:** Unregulated voltage is supplied by two pairs of full wave diode rectifiers CR1, CR3 and CR2, CR4 operating into a pair of energy storage capacitors C12, C13. The power transformer T1 is strappable for either 115 volt or 230 volt operation; the two sections of the primary are paralleled for 115 volt operation and connected in series for 230 volt operation.

The nominal unregulated voltage is  $\pm 22$  volts DC at rated line voltage. This will vary widely with line voltage variations. Regulator dropout will occur if the unregulated voltage falls below about  $\pm 17.8$  volts.

Regulated voltages are supplied by a pair of overrated 500mA "three terminal" IC regulators IC5, IC6. Because they are operated so conservatively, they can be expected to be extremely reliable. Therefore, before replacing the regulators, check to see whether other abnormalities in the circuitry (such as a shorted IC) have caused excessive current demand which is causing the regulator IC's to go into either of their two built-in protective modes: current limiting or thermal shutdown.

The regulators IC5 and IC6 are frequency-compensated by C14, C15 at their outputs to prevent high frequency oscillations. If C14 or C15 are ever replaced, be sure to use low-inductance aluminum electrolytics. Tantalums can fail because the current-delivering capacity of the power supply can cause a runaway condition if the dielectric is punctured momentarily; high-inductance aluminums can fail to prevent the regulators from oscillating. It is therefore necessary to check for oscillation on the power bus with an oscilloscope if C14 or C15 is replaced. In addition, small 0.10uF/25V ceramic capacitors bypass the power busses to ground locally throughout the board to prevent signal-carrying IC's from oscillating due to excessive power-lead inductance.

# Appendix A: Specific Applications

## RECORDING STUDIOS

1. Save tracks by recording strings, horns, drums, etc. on single tracks and then spatially expanding them in the mix.
2. Create stereo depth from mono sources like mono-miked voice, electronic music synthesizers, string synthesizers, guitar or bass amplifiers, electronic organs, etc.
3. Obtain a stereo echo return from a mono echo chamber, plate, or spring reverb.
4. Use one output channel to create phasing effects by manipulating the DIMENSION controls while signal is being passed.
5. Create a stereo effect from old mono master tapes, disks, or even 78's.

## BROADCASTING

1. Create a stereo effect from a mono announce microphone to avoid the image shifting caused by the announcer's moving his head in front of a pair of stereo microphones. Use the SEPARATION control to determine voice/music balance.
2. If stereo cart machines are used: Record all mono material through the Stereo Synthesizer before it is recorded on cartridge. The phase cancellations in the mono mix heard by mono listeners will be greatly reduced compared to cancellations heard when the same mono signal is recorded on both tracks. This is because most frequencies appear unequally on left and right channels; thus most frequencies can't cancel out effectively in mono.
3. If mono cart machines are used: Place the Stereo Synthesizer on the output of the entire bank of machines, using the compromise adjustment: LOW DIMENSION=3.0; HIGH DIMENSION=7.5. Mono phase cancellations will be eliminated entirely; stereo listeners will hear highly effective pseudo-stereo.
4. Process mono agency spots, network feeds, optical film tracks for TV stereo, and remotes to create a "total stereo" format.

## TELEVISION RECEIVERS

The effectiveness of television sound (projection or otherwise) can be quite spectacularly augmented by employing the Stereo Synthesizer to create pseudo-stereophonic sound. The Stereo Synthesizer is equally applicable to commercial installations like bars or restaurants, or to home installations.

The audio outputs of mono VCR's and video disk players can be enhanced. Disks and/or tapes for stereo-equipped units often have mono soundtracks; these soundtracks can be synthesized as well.

## CABLE TV

Create one or more premium "stereo-enhanced" audio channels from Pay-TV and/or other satellite-distributed services by synthesizing the mono audio feed from the satellite and modulating the synthesized stereo onto a standard FM stereo channel, such that it can be received and reproduced on the consumer's FM stereo receiver.

# Appendix B: Interconnections and Grounding

Small systems usually come together easily because cable runs are usually short and the interconnections between various pieces of equipment are not terribly complex. Therefore, do not be intimidated by the seeming complexity of the discussion on interconnections and grounding below. This is more information than most people will ever need to successfully install a small system; we have included it in case things don't work right and you need to find out why.

## DRIVING THE 245F FROM HIGH-IMPEDANCE/ HIGH-LEVEL SOURCES

Both "+" and "-" sides of the 245F input are bypassed to chassis ground for RF through 1000pF capacitors. To assure common mode rejection, and to assure that these capacitors do not affect the frequency response of the system, the output impedance of the equipment driving the 245F should be 600 ohms or less. Most professional and semi-professional sound equipment will satisfy this requirement.

The 245F can be driven by unbalanced sources up to 10,000 ohms (such as the outputs of some vacuum tube preamps) by removing the 1000pF capacitor from the "+" input, and driving this input from the hot side of the driving equipment's output. (See the section below on **Grounding** for an explanation of balanced and unbalanced connections.)

If the 1000pF capacitor is left in place and the source impedance is 10K, the capacitor will cause a high frequency rolloff which is 3dB down at 16kHz, and which rolls off at 6dB/octave thereafter.

The absolute clipping level of the 245F input is +26dBm. If levels greater than +26dBm are expected, an external loss pad must be used before the 245F input. The Audio Cyclopedia, Section 5, contains instructions for making such pads. (Tremaine, H.M.: The Audio Cyclopedia, Second Edition, Indianapolis, Howard W. Sams & Co., Inc., 1969).

## GROUNDING

Grounding serves two purposes: it joins the ground references of various pieces of electronic equipment, and it shields the electronics from various electric fields (RFI and hum).

(Interference caused by magnetic fields is not decreased by conventional shielding, and special magnetic shielding materials must be used where hum is a problem. In audio, such shielding is ordinarily used with low-level magnetic transducers like tape heads, magnetic phono cartridges, and dynamic microphones, and with low-level transformers. Line-level processors such as the 245F are not normally sensitive to this sort of interference.)

There are two types of ground: circuit and chassis. Circuit ground serves as a ground reference for the electronics. Chassis ground permits use of the chassis as a shield in the same way that the shield on shielded cable protects the inner conductors. Whether the circuit and chassis grounds are identical, are separate, or are intentionally joined depends on the type of equipment and the interconnecting scheme.

In professional systems correct grounding is important. The general principles are these:

- 1) In an audio system, the chassis of each piece of equipment must be connected to a good common ground point (ideally a cold water pipe or a rod driven into the earth) by one and only one wire.
- 2) Meanwhile, there must be one and only one circuit ground path between each piece of equipment.

It is when these two requirements become confused, omitted, or redundant that problems may develop. If there is a connection missing, hum and noise will result. If more than one ground path exists, then a "ground loop" may develop.

A ground loop can be viewed as a single turn of a giant transformer. Because 60Hz AC magnetic fields exist throughout every location served by mains power, the ground loop will have a hum current induced in it by stray AC magnetic fields. Because the ground wire has appreciable impedance, this current will cause a hum voltage to appear between different parts of the ground system. If great care is not taken, this hum voltage can intrude on the audio signal.

How grounding is accomplished depends on whether the equipment to be interconnected is balanced or unbalanced.

An unbalanced connection uses two terminals: "hot" and ground. Wires used in such connections are typically single-conductor shielded. (RCA plugs and two-conductor phone plugs are often used to terminate such cables.) If, because of stray fields or ground loops, a hum voltage appears between "hot" and ground, then this hum will be mixed into the desired signal since the unbalanced connection cannot distinguish between the desired signal and hum.

In the case of balanced connections, audio is applied to the "+" and "-" terminals; the input responds to the difference between the voltages at the two terminals. A third terminal is connected to chassis ground and is available for the connection of the shield of the two-conductor shielded wire that would be used (Belden 8451, for example). If a hum voltage is developed between the shield and both audio wires, then the balanced input would reject this "common mode" voltage, since the input responds only to the difference in voltage between the audio wires. This ability to reject hum and noise is the primary advantage of a balanced configuration.

Referring back to the **ELECTRICAL INSTALLATION** section, notice how these rules are applied in the table and diagram.

For involved systems such as arena-type sound reinforcement, professional recording studios, or large broadcasting facilities, a formal and systematic "transmission ground system" should be worked out for the entire system. See Section 24 of The Audio Cyclopedia for details (op. cit.).

(Interesting digression: The "balanced" technique was first perfected by the telephone company, which has to run miles of unshielded cables close to each other and also close to high voltage AC lines without pickup of excessive hum or crosstalk from other circuits. Originally, telephone circuits were unbalanced on single wires, with the earth providing the ground return. As soon as electric lighting became popular and power lines were placed on telephone poles, the power lines interfered with the telephone service so badly as to render conversation impossible. The telephone company embarked on a research program which led to both the balanced line technique, and to the choice of the familiar 600 ohm impedance as the optimum compromise between rejection of electrical and magnetic interference. Today, the telephone company's specification for maintenance of line balance is extremely tight, as proper common mode rejection is vital to the success of the entire system.)

# Appendix C: Specifications

**Frequency Response of the Stereo Sum Signal:**  $\pm 1$  dB (re mono input)

**Frequency Response of the Sum of the Right and Left Channel Powers:**  $\pm 1$  dB (re mono power)

**Total Harmonic Distortion** (+19 dBm, 20-20,000 Hz): less than 0.1%; 0.02% typ.

**Noise** (Unweighted, 20-20,000 Hz): less than -80 dBm; -83 dBm typ.

**Available Gain:** approximately 9 dB (MONO); 14 dB peak (STEREO)

**Input:** greater than 100 K ohms, balanced bridging. Absolute overload occurs at +26dBm.

**Output:** approximately 47 ohms unbalanced. Will drive greater than +19 dBm, 20-20,000 Hz into 500 ohms or higher load impedance. Optional transformer-balanced output available.

**Input/Output Connector:** Type 140-Y barrier strip (#5 screw)

**Power Requirements:** 115-230 volt 50-60 Hz AC,  $\pm 10\%$ , 2 VA. Supplied with "U-Ground" grounding-type plug to United States standards.

**Mounting:** requires 1 3/4" (4.5 cm/1 unit) of vertical space in an EIA standard 19" (48.3 cm) rack.

**Shipping Weight:** 7 pounds (3.2 kg)



# Parts List

Parts are listed by part class (such as "Resistors"), by assembly (such as "Card #5"), in Reference Designator order. Exceptions are certain widely-used common parts such as

- Fixed Resistors
- 3/8" Square Trimmer Resistors
- Signal Diodes

which are described generally. Such parts must be checked against the appropriate Schematic Diagram or physically examined to determine their exact value.

## Obtaining Spare Parts

Because special or subtle characteristics of some components are exploited to produce an elegant design at reasonable cost, it is unwise to make substitutions for listed parts. It is also unwise to ignore notations in the Parts List indicating "Selected" or "Realignment Required" when replacing components. In such cases, the factory should be consulted to help you maintain optimum performance.

Orban ordinarily maintains an inventory of tested, exact-replacement spare parts to supply any present or normally-expected future demand quickly at a fair price.

If you order parts from the factory, please supply all of the following information:

- The Orban Part Number, if you can determine it
- The Reference Designator (like R6) for the part
- A brief description of the part
- And, from the Serial Label on the rear panel:
  - The exact Model Number
  - The Serial Number
  - The "M" number, if any

Orban can supply standardized Spare Parts Kits for this product during its production life. Consult your dealer or the factory to obtain a list of the prices and contents of such kits.

To ease future maintenance, parts for this unit have been chosen from the catalogs of well-known manufacturers. Their U.S. headquarter addresses are listed at the end of the Parts List. Most manufacturers have extensive distribution facilities throughout the world and can often be contacted through local offices.

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	QUAN/ SYS.	NOTES
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CAPACITORS

Chassis Assembly

C1	Ceramic, .001uF, 1000V, 10%	21112-210	CRL	DD-102		6	
C2	Same as C1						
C8- C11	Same as C1						

PCB Main Assembly

C3	Mica, 10pF, 500V, +.5pF	21017-010	CD	CM05-Style	Many	1	
C4	Polypropylene, .0047uF, 50V, 2.5%	21702-247	WIM	FKP263V254700		2	
C5	Mica, 1000pF, 500V, ±1%	21022-210	CD	CM06-Style		1	
C6	Metallized Polyester, .047uF, 100V, 5%	21440-347	PLE	60C473250		1	
C7	Same as C4						
C12	Aluminum, 470uF, 40V	21224-747	SIE	81000		2	
C13	Same as C12						
C14	Aluminum, 100uF, 25V, +100% -20%	21206-710	PAN	ECE-A1EV101S		2	
C15	Same as C14						
C16	Ceramic, Monolithic, 0.1uF, 20%	21123-410	SPR	1C25Z5U104M050B		4	
C17	Same as C16						
C18	Same as C16						
C19	Same as C16						

DIODES

PCB Main Assembly

CR1- CR4	Rectifier, 1N4004	22201-400		1N4004	Many	4	
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Chassis Assembly

CR5	LED, Green (Power)	25104-000	FSC	FLV-355		1	
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INTEGRATED CIRCUITS

PCB Main Assembly

IC1	Linear, Dual Opamp, TL072	24206-202	TI	TL072CP		2	
IC2	Same as IC1						
IC3	Linear, Single Opamp, TL071	24013-202	TI	TL071CP		1	
IC4	Linear, Dual Opamp, 5533	24210-302	SIG	NE5533N		1	
IC5	D.C. Regulator, 78M15UC	24304-901	FSC	uA78M15UC		1	
IC6	D.C. Regulator, 79M15AUC	24303-901	FSC	uA79M15AUC		1	

FOOTNOTES:

- (1) See last page for abbreviations  
(2) No Alternate Vendors known at publication  
(3) Actual part is specially selected from part listed, consult Factory  
(4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR  
REPLACEMENT PARTS  
STEREO SYNTHESIZER MODEL 245F  
Rev. 02 11/85  
CAPACITORS/DIODES/INTEGRATED CIRCUITS

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	QUAN/ SYS.	NOTES
------------	-------------	-----------	------------	------------	--------------------------	---------------	-------

INDUCTORS

Chassis Assembly

L1	Inductor, 1mH	29502-000	MIL	4662(Sleeved)		2	
L2	Same as L1						

RESISTORS

Replace resistors only with the same style and with the exact value as marked on the resistor body, lest performance or stability be compromised. If the resistor is damaged, consult the factory or refer to the Schematic to obtain the value.

ALL COMMON RESISTORS NOT LISTED ARE GENERALLY SPECIFIED THUS:

Metal Film Resistors

Body: conformally-coated  
 I.D.: five color bands or printed value  
 Orban P/N: 2004X-XXX  
 Power Rating: 1/8 Watt @ 70°C  
 Tolerance: 1%  
 Temperature Coefficient: 100PPM/°C  
 U.S. Military Spec.: MIL-R-10509, Style RN55D  
 Manufacturers: R-Ohm (CRB-1/4FX), TRW/IRC, Beyschlag,  
 Dale, Corning, Matsushita

Carbon Composition Resistors

Body: molded phenolic  
 I.D.: four color bands  
 Orban P/N: 2001X-XXX  
 Power Rating: (70°C) 1/4 Watt (Body 0.090"x0.250")  
 1/2 Watt (Body 0.140"x0.375")  
 Tolerance: 5%  
 U.S. Military Spec.: MIL-R-11, Style RC-07 (1/4W)  
 or RC-20 (1/2W)  
 Manufacturers: Allen-Bradley, TRW/IRC, Stackpole,  
 Matsushita

Carbon Film Resistors

Body: conformally-coated  
 I.D.: four color bands  
 Orban P/N: 20001-XXX  
 Power Rating: 1/4 Watt @ 70°C  
 Tolerance: 5%  
 Manufacturers: R-Ohm (R-25), Piher, Beyschlag,  
 Dale, Phillips, Matsushita

20

Chassis Assembly

R5	Potentiometer, Single, 25K(5050), "Gain"	20743-000	CTS	270 Series		4	
R6	Potentiometer, Single, 25K(5050), "Separation"	20743-000	CTS	270 Series			
R14	Potentiometer, Single, 25K(5050), "Lo Dim"	20743-000	CTS	270 Series			
R18	Potentiometer, Single, 25K(5050), "Hi Dim"	20743-000	CTS	270 Series			

MISCELLANEOUS

Chassis Assembly

F1	Fuse, 3AG, Slo-Blo, 1/8A	28004-113	LFE	313000			
T1	Transformer, Power, 38VCT, 3.1VA	29005-000	ORB			1	
S1	SPDT, "Stereo/Mono"	26037-001	C&K	7101		1	
S2	SPST, White, "Power"	26002-001	CH	CH 8280K		1	

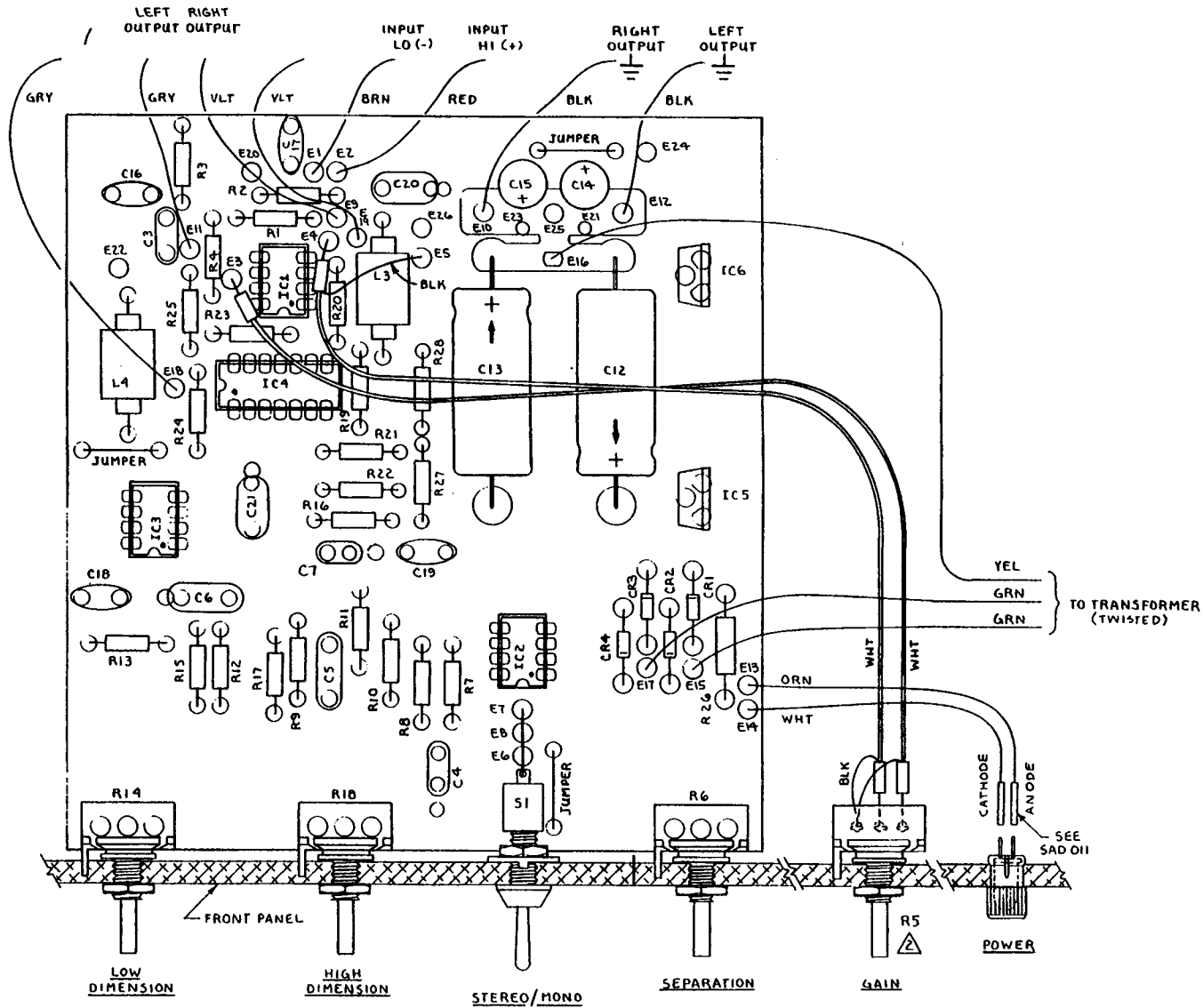
FOOTNOTES:

- |  |  |
|--|--|
| (1) See last page for abbreviations  | (4) Realignment may be required if replaced,<br>see Circuit Description and/or<br>Alignment Instructions |
| (2) No Alternate Vendors known at publication                              |  |
| (3) Actual part is specially selected from<br>part listed, consult Factory |  |

SPECIFICATIONS AND SOURCES FOR  
 REPLACEMENT PARTS  
 STEREO SYNTHESIZER MODEL 245F  
 Rev. 02 11/85  
 INDUCTORS/RESISTORS/MISCELLANEOUS

# Vendor Codes

AB	Allen-Bradley Co. 1201 South Second Street Milwaukee, WI 53204	CTS	CTS Corporation 905 North West Blvd. Elkhart, IN 46514	ME	Mepco/Electra, Inc. Columbia Road Morristown, NJ 07960	SAE	Stanford Applied Eng. 3520 De La Cruz Blvd. Santa Clara, CA 95050
AD	Analog Devices, Inc. Route 1, Industrial Park P.O. Box 280 Norwood, MA 02062	ECI	Electrocube 1710 South Del Mar Avenue San Gabriel, CA 91776	MIL	J.W. Miller Division Bell Industries 19070 Reyes Avenue P.O. Box 5825 Compton, CA 90221	SCH	ITT Schadow, Inc. 8081 Wallace Road Eden Prairie, MN 55343
AM	Amphenol North America An Allied Company 2122 York Road Oak Brook, IL 60521	ERE	Erie Tech. Products, Inc. 644 West Twelfth Street Erie, PA 16512	MOT	Motorola, Inc. P.O. Box 20912 Phoenix, AZ 85036	SIE	Siemens Components Division 186 Wood Avenue, South Iselin, NJ 08830
BEK	Beckman Instruments, Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634	EXR	Exar Integrated Systems, Inc. P.O. Box 62229 Sunnyvale, CA 94088	NAT	National Semiconductor Corp. 2900 Semiconductor Drive Santa Clara, CA 95051	SIG	Signetics Corporation A Sub. of US Philips Corp. P.O. Box 9052 Sunnyvale, CA 94086
BEL	Belden Corporation Electronic Division Richmond, IN 47374	FDY	F-Dyne Electronics Company 449 Howard Avenue Bridgeport, CT 06605	NOB	Noble Teikoku Tsushin Kogyo Co. Ltd. 335, Kariyado, Nakahara-ku Kawasaki 211, JAPAN	SPR	Sprague Electric Co 125 Marshall Street North Adams, MA 01247
BRN	Bourns, Inc. Trimpot Products Division 1200 Columbia Avenue Riverside, CA 92507	FSC	Fairchild Camera & Instr. Corp. 464 Ellis Street Mountain View, CA 94042	OHM	Ohmite Manufacturing Company A North American Philips Co. 3601 Howard Street Skokie, IL 60076	STK	Stackpole Components Co P.O. Box 14466 Raleigh, NC 27620
BUS	Bussmann Manufacturing Div. McGraw-Edison Company P.O. Box 14460 St. Louis, MO 63178	GI	General Instruments Optoelectronics Div. 3400 Hillview Avenue Palo Alto, CA 94304	ORB	Orban Associates, Inc. 645 Bryant Street San Francisco, CA 94107	SUL	Sullins Elec. Corp. P.O. Box 757 San Marcos, CA 92069
CD	Cornell-Dubilier Electronics 150 Avenue "L" Newark, NJ 07101	HP	Hewlett-Packard Corporation 1501 Page Mill Road Palo Alto, CA 94304	PAK	Paktron Div. of Illinois Tool Works Inc. 900 Follin Lane, S.E. Vienna, VA 22180	SYL	Sylvania Conn. Prod. Op. GTE Products Corp. Box 29 Titusville, PA 16354
CK	C & K Components, Inc. 15 Riverdale Avenue Newton, MA 02158	INS	Intersil, Inc. 10710 North Tantau Avenue Cupertino, CA 95014	PAN	Panasonic Electronic Components Div. P.O. Box 1503 Seacaucus, NJ 07094	TI	Texas Instruments P.O. Box 225012 Dallas, TX 75265
CRL	Centralab, Inc. A North American Company 5757 North Green Bay Ave. Milwaukee, WI 53201	IRC	TRW/IRC Resistors 401 North Broad Street Philadelphia, PA 19108	RAY	Raytheon Semiconductor Division 350 Ellis Street Mountain View, CA 94042	WES	Westlake 5334 Sterling Ctr Drive Westlake Village, CA 91361
COR	Corcom, Inc. 1600 Winchester Road Libertyville, IL 60048	LFE	Littelfuse A Subsidiary of Tracor 800 East Northwest Highway Des Plaines, IL 60016	RCA	RCA Solid State Division Route 202 Somerville, NJ 08876	WIM	WIMA P.O. Box 2345 Augusta-Anlage 56 D-6800 Mannheim 1 GERMANY
		MAL	Mallory Timers Company Enhart Electrical/Electronic Gr. 3029 East Washington Street Indianapolis, IN 46206				



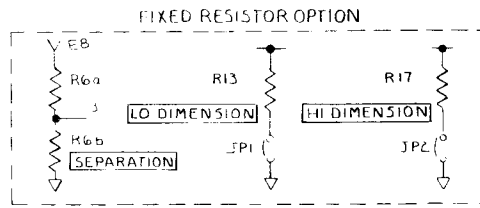
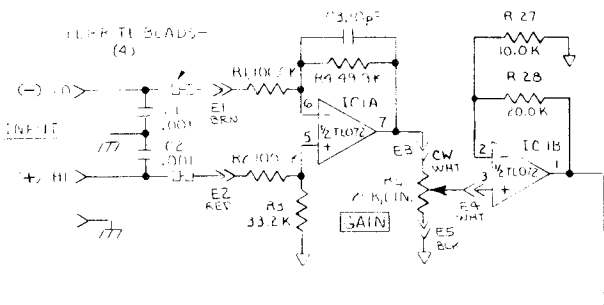
4. E24, E25, E26 ARE FOR FUTURE APPLICATIONS.

▲ INSTALL TWO FERRITE BEADS ON EACH LINE, REFER TO SCHEMATIC.

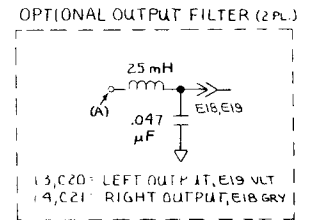
▲ WIRES TO POTENTIOMETER 'R5' ARE SHIELDED.

NOTES: 1. ALL WIRES ARE 24 AWG.

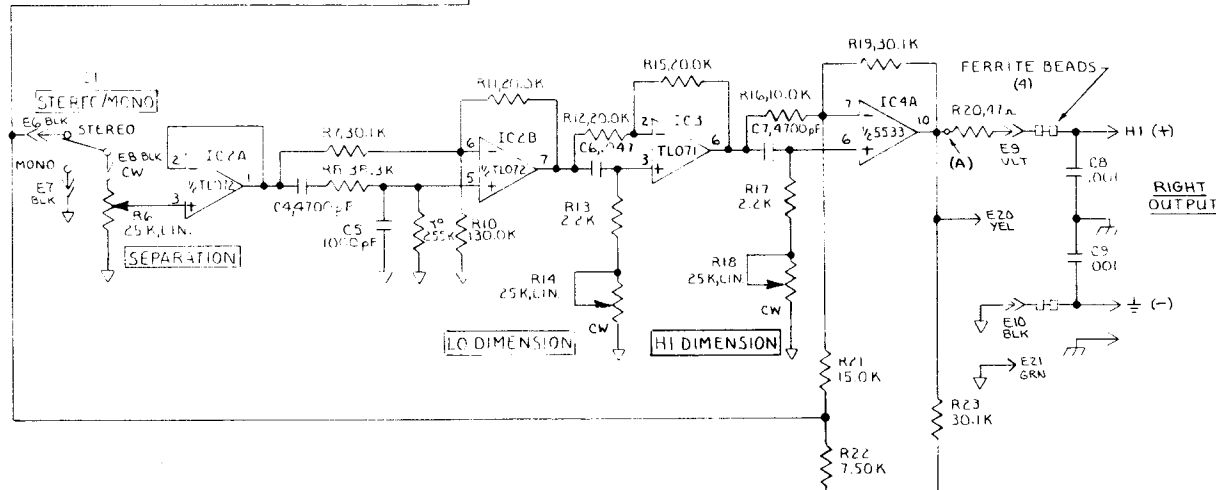
<b>urban</b>	
TITLE:	ASSEMBLY DRAWING MODEL 245F 30575-000-03



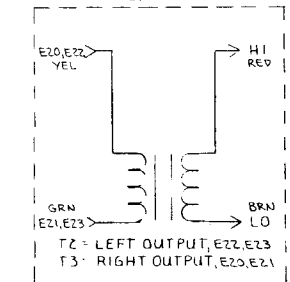
NOTE - SWITCH SI (STEREO/MONO) MAY BE REPLACED BY JUMPER JP3 IF REQUIRED.  
- RESISTOR VALUES SELECTED AS REQUIRED.



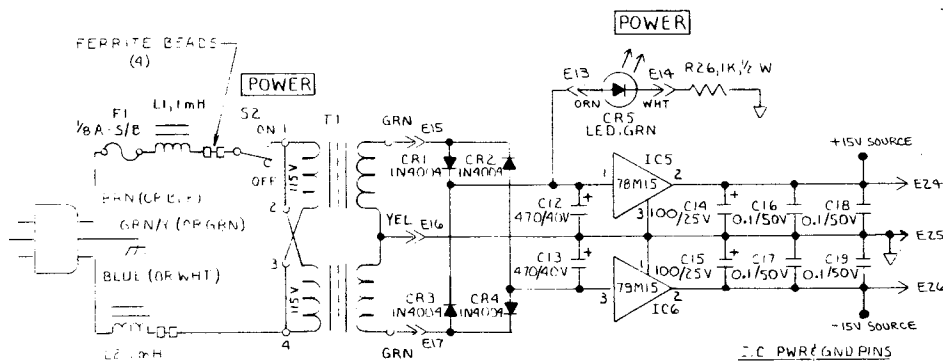
NOTE: RESISTORS R20 & R25 MAY BE REMOVED.



OPTIONAL BALANCED OUTPUT (2 PL)



NOTE: RESISTORS R20 & R25 MAY BE REMOVED.



I.C. POWER GND PINS


DEVICE	+V	-V	GND
TL072	6	4	-
5533	11	4	-
TL071	7	4	-

REF. DESIGNATORS

ITEM	AS USED	NOT USED	ITEM	AS USED	NOT USED
C	21	-	L	4	-
CR	5	-	R	26	-
F	1	-	S	2	-
IC	6	-	T	3	-
E	26	-			

- 3) E24, E25, E26 ARE FOR FUTURE APPLICATIONS.
- 2) ALL CAPACITANCE IS IN MICROFARADS.

NOTES: 1) ALL RESISTORS ARE 1/8 WATT, 1% MF (RN55D).  
(UNLESS OTHERWISE SPECIFIED)



TITLE: SCHEMATIC  
MODEL 245F  
60047-000-03