Instruction Book

19-603

ACCURCON II STATIC

FIXED-FREQUENCY INVERTERS

TROUBLE SHOOTING GUIDE

APRIL 1970

Westinghouse Electric Corporation
Industrial Systems Division
Electronic Power Conversion
Buffalo, New York

TROUBLE-SHOOTING GUIDE
ACCURCON II
FIXED FREQUENCY INVERTER SYSTEMS

GENERAL

Trouble-shooting of the AccurCon adjustable-frequency inverter system is considerably simpler than other types of inverter systems, because of the unique ability of the inverter to continue operation with one or more stages missing. This permits observation of trouble symptoms while the unit is energized, thus helping to isolate the malfunction to one particular section of the inverter. This same feature also permits testing of one section at a time to locate the trouble and to verify correction of the trouble.

Since interchangeability of components is an outstanding feature of the AccurCon system which serves as a valuable tool in any necessary trouble shooting, it will prove helpful to keep an accurate log of all work done both during startup and thereafter. Logic boards bear individual identifying serial numbers, and other identifying numbers can be painted or tagged inside the power module drawers. This permits keeping a history, not only on any abnormalities that may be encountered, but also on each major component that may have been involved, even though said component may have been moved to a new location. Maintaining an accurate log is very important, especially on large installations, and in pinpointing intermittent problems.

TEST EQUIPMENT REQUIRED

1. Good dual beam oscilloscope.
2. Volt ohmmeter.

SPARES

Trouble-shooting is greatly speeded up and simplified by the use of substitution of spare components, and a few spare elements are adequate to take care of a large number of inverters. For example, it is recommended that a user maintain one each of the following elements:

Power modules, type 35 or 70
Gate modulator board
Counter-driver board
Voltage regulator board
Pulse generator board
Synchronizing board (if used)

Since most troubles on inverter systems show up by blowing of fuses, an ample supply of the specific current-limiting semiconductor fuses used should be maintained at all times. These fuses are rarely carried in stock by local supply houses and substitution of other fuses will not give proper protection or coordination. Westinghouse carries a good supply of such fuses at the factory, but even the fastest service can mean the loss of many hours downtime. The recommended quantity of fuses for customer stocking will vary with the number of inverters and the application, but at least one complete change of fuses for each inverter should be kept on hand. (During installation and initial startup of the equipment, Westinghouse will provide its own supply of fuses.)

As with any piece of equipment, the best guide to trouble-shooting is a thorough understanding of the normal functioning of the system. By careful observation, any abnormal operations can be detected and corrected. As mentioned above, trouble-shooting of the AccurCon is best done by substitution of the spare element to get back into operation without further delay. The faulty element can then be examined in detail at a workbench, and with more leisurely reference to detailed instructions in the service manual. Repair may be made by the user in emergency cases only, but in other cases, the logic board should be returned to Westinghouse through the Westinghouse Electric Service engineer. He is the best channel for either local repair or for rapid-service return to the factory.

SECTION I

LOGIC SIGNAL FLOW

The proper logic signals and their correct flow from one element to the next is the best clue to proper operation of the inverter system. This furnishes the best systematic checkout procedure for detecting any erratic operation. Refer to Figure 1, which shows the inter-relation of the various logic signal paths. Proper signal flow of the inverter logic will be described, along with a description of the effect of a malfunction in any particular block.

1. Logic Power Supply. This operates from the main DC bus voltage, and supplies regulated +40, +20, and -20 volts to all the logic boards, and also supplies the square-wave carrier to the gate modulator boards. Loss of the DC voltages will affect all of the logic boards; loss of the carrier will affect the gate modulator boards.

2. Pulse Generator Board. Supplies synchronizing pulses to the counter/driver boards to control the frequency of the inverter. It can be either free-running, or slaved to an external source. Occasionally an oven and temperature control section are used for precision control of the free-running frequency. Malfunctions of this board will affect all logic boards, resulting in fuse blowing. Malfunction of the oven controls may produce a slow drift (or even slow cycling) of inverter frequency.

3. Voltage Regulator Board. Produces a DC voltage, the level of which controls the inverter output voltage. Its regulating output is fed to the counter/driver boards to control stage pulse-width. Malfunction of this board will affect the pulse-width of all stages, probably blowing stage fuses.

4. Counter/Driver Boards. Form the ring counter for the logic, and produce gate control signals for each of the power stages. Malfunction of the counter section of this board will interrupt the ring counter, affecting all blocks. Malfunction of the driver section will affect one or both stages associated with a particular counter/driver board.

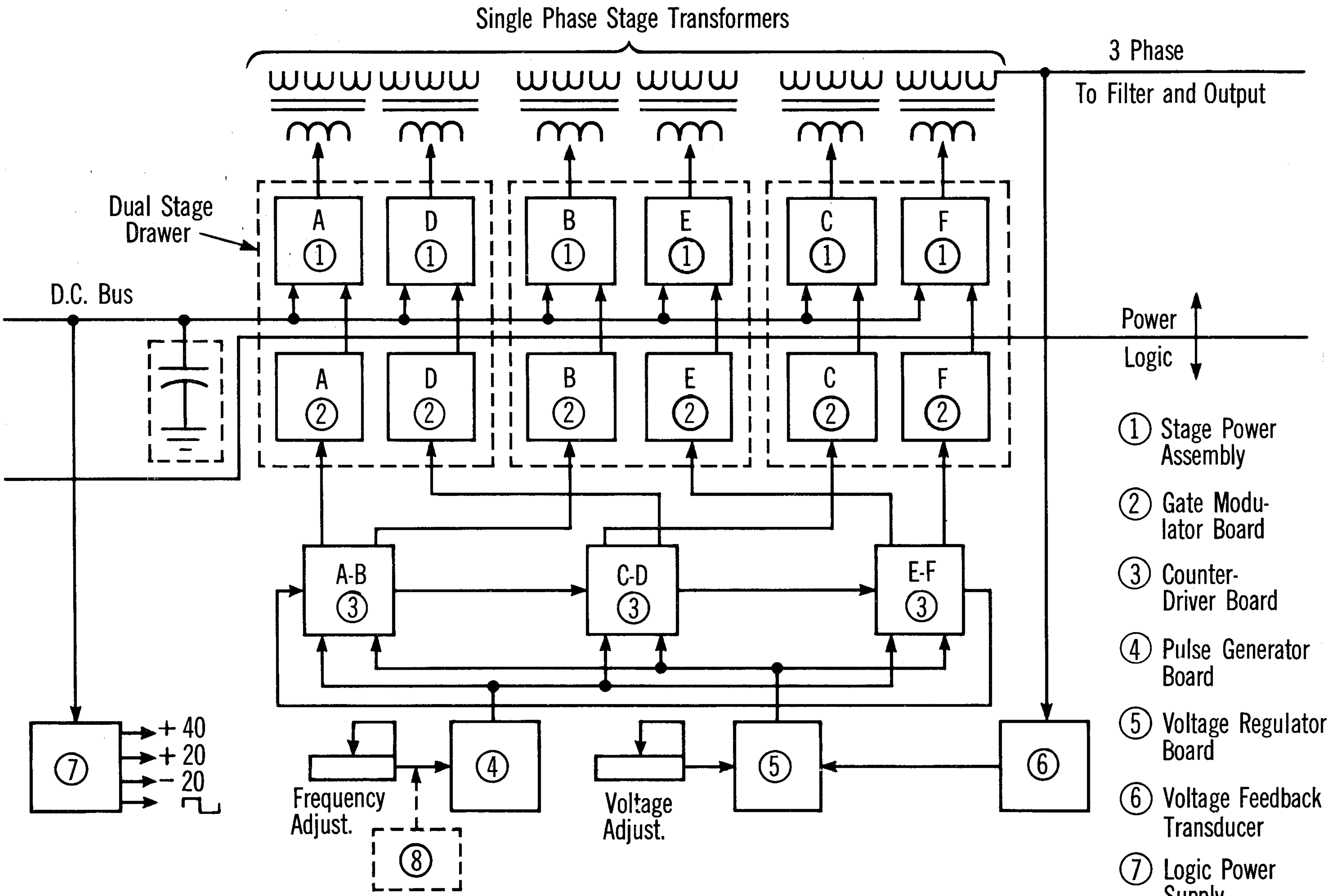
5. Gate Modulator Boards. Mix the gate control signals from the counter/driver board with the square-wave carrier, and produce isolated and shaped firing pulses for the thyristors of each stage. Malfunction of the gate modulator board will affect the associated power stage only, and will either produce erratic gate firing pulses, or no gate pulse.

6. Universal Synchronizing Board. Forms the interface between the pulse generator and external source, when slaving to another source is required. Malfunction of this board will prevent the pulse generator from synchronizing properly to the external source.

7. Power Module. Produces rectangular wave power output to the stage transformer from nominal DC power input. Malfunction may result in loss of stage output, or rarely, loss of one-half of the stage output, or even loss of stage output after coming up to operating temperature.

8. Magnetic Controls. Contact closures from breaker interlocks, contactors, and control relays may occasionally malfunction. This type of malfunction generally results in an interrupted sequence of starting or shutdown.

9. Wiring, Cables, and Plugs. In attempting to isolate a malfunction to a particular block, one should not overlook the possible loss of signal caused by a bad wiring connection or pinched wire. If substitution of good blocks indicates that a malfunction lies between two good sections, then the interwiring and plug connections between these should be examined.



Accurcon Sub-System (FFI)

extender card ST 660C167

SECTION II

WAVEFORMS

The following pages show good oscillographic records of the waveforms at various check points throughout the system. By comparison of existing scope waveforms to these reference pictures, any substantial deviation can then be interpreted for purposes of trouble shooting. In all cases, the signals are digital in nature and are not particularly critical with respect to magnitude of the signal. For this reason, minor variations in amplitude of the signals should not be interpreted as significant. Ordinarily, a malfunction will result in a complete loss of signal, or very bad distortion of the wave shape.

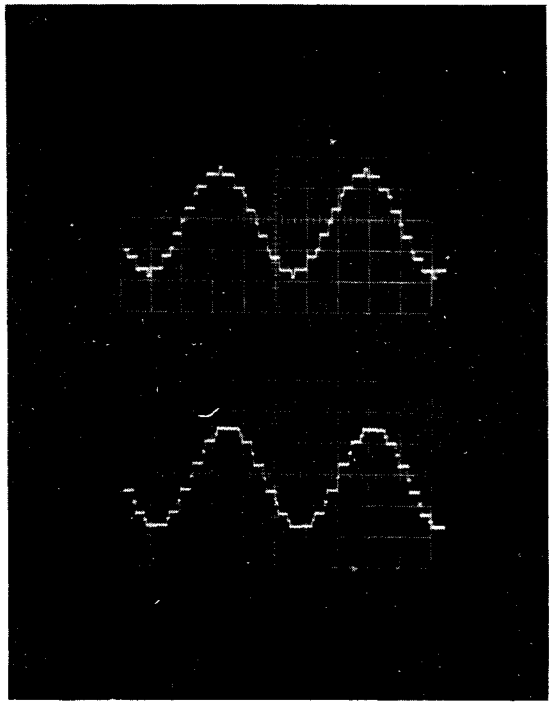
Note 1: Inverter output waveshapes are for a six-stage inverter unless otherwise marked. Other numbers of stages will show different numbers of steps in the wave. Refer to Service Manual.

Note 2: Waveshape of thyristor conduction may be seen only with drawer plugged in. Scope lead can carefully be brought through drawer gasket, or through push-out cover in center of drawer front.

Note 3: Logic signal waveform level tolerances may be found in Service Manual.

Note 4: Oscilloscope used for these tests must be isolated from power source and must be ungrounded.

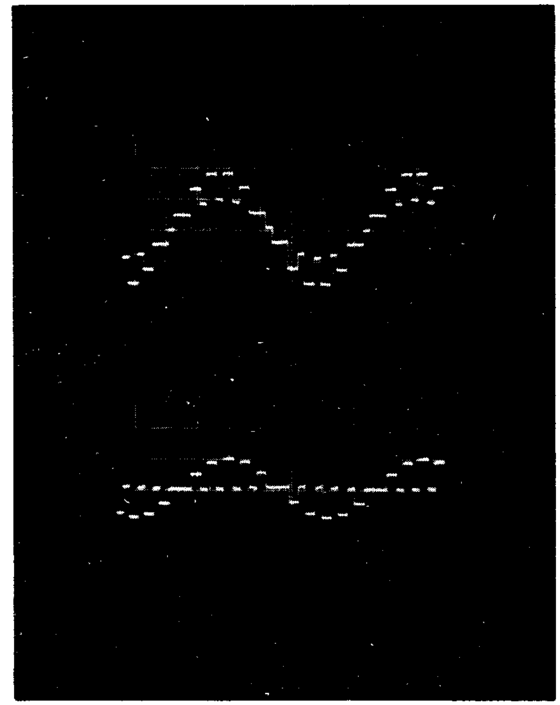
CAUTION: Oscilloscope case may be at line potential.



Scale: 5 msec/cm; 200 volts/cm.

Upper Trace: Inverter output at mid-frequency and no-load.

Lower Trace: Same, except full-load.

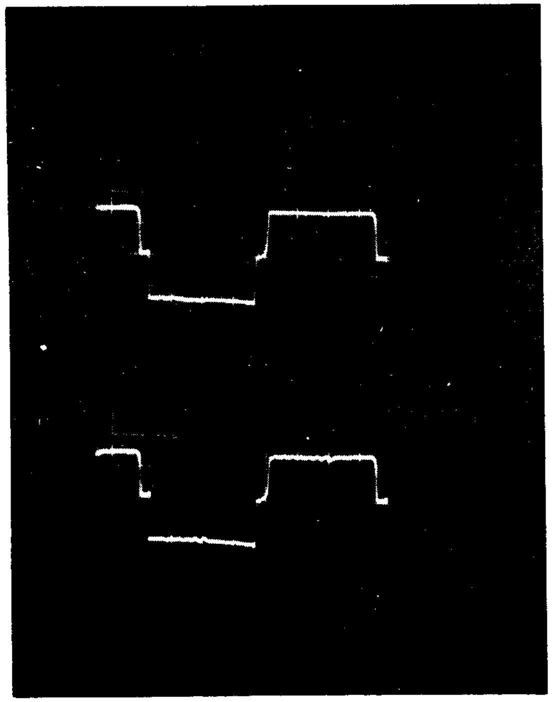


Scale: 5 msec/cm; 200 volts/cm.

Upper Trace: Inverter output at lower frequency and no-load.

Lower Trace: Same, except at lower volts/cps value to show wave separation.

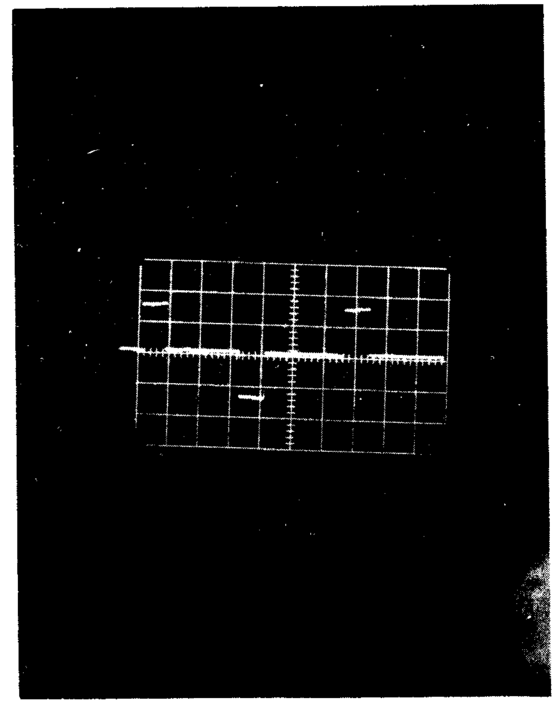
TYPICAL WAVESHAPES OF INVERTER OUTPUT VOLTAGE



Scale: 2 msec/cm; 200 volts/cm.

Upper Trace: Stage output at max. frequency, no load.

Lower Trace: Same, at full load .



Scale: 5 msec/cm; 200 volts/cm.

Stage output at minimum frequency, no load.

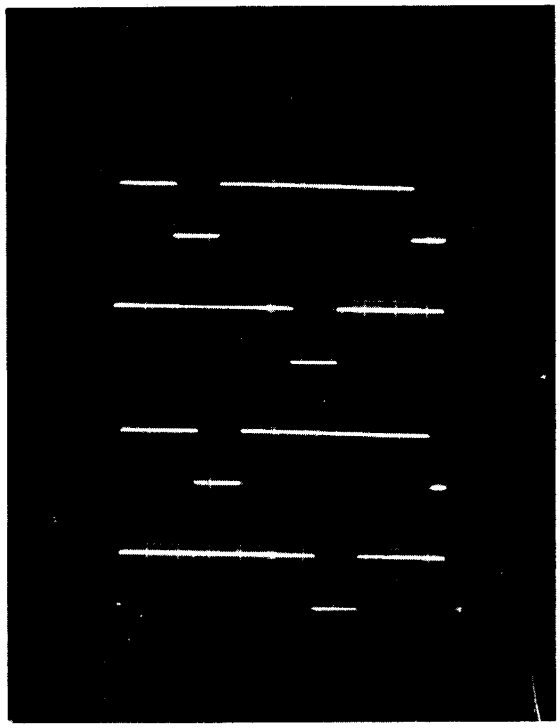
WAVESHAPES OF INVERTER STAGE OUTPUT

TP 1

TP 2

TP 3

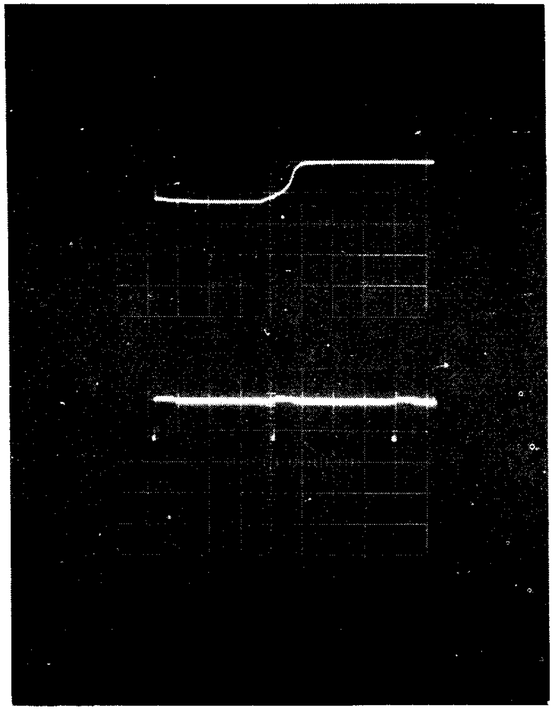
TP 4



Scale: 2 msec/cm; 10 volts/cm.

Signal voltages seen at test points of Counter/Driver Logic Board.

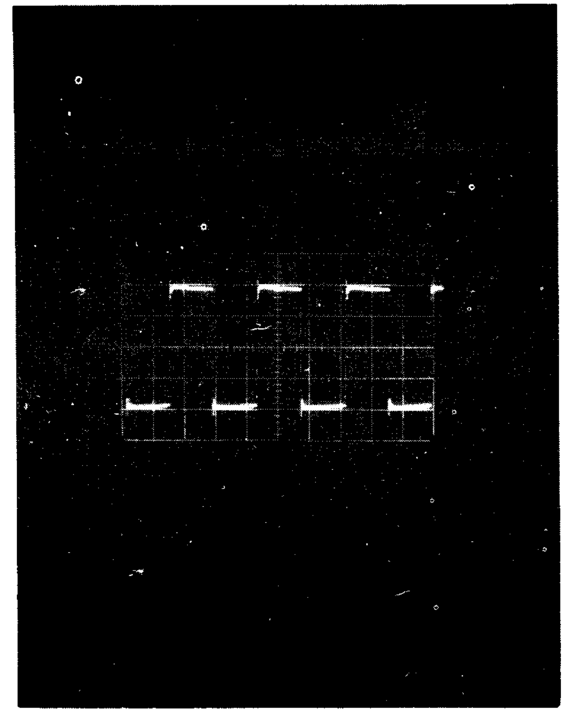
TYPICAL WAVESHAPES OF COUNTER/DRIVER BOARD



Scale: 200 usec/cm; 10 volts/cm.
2 usec/cm; 10 volts/cm.

Upper Trace: Expanded time view of AFO output signal voltage.

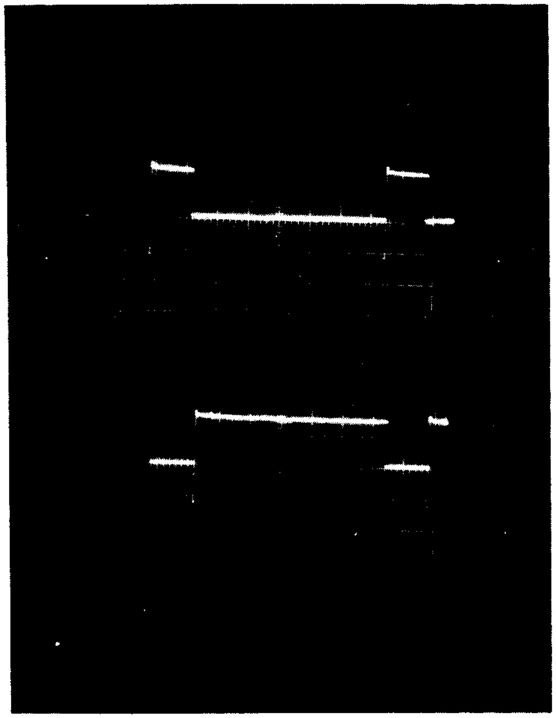
Lower Trace: Normal time view of output signal voltage from adj. freq. oscillator.



Scale: 50 usec/cm; 10 volts/cm.

Signal voltage used for carrier gating.

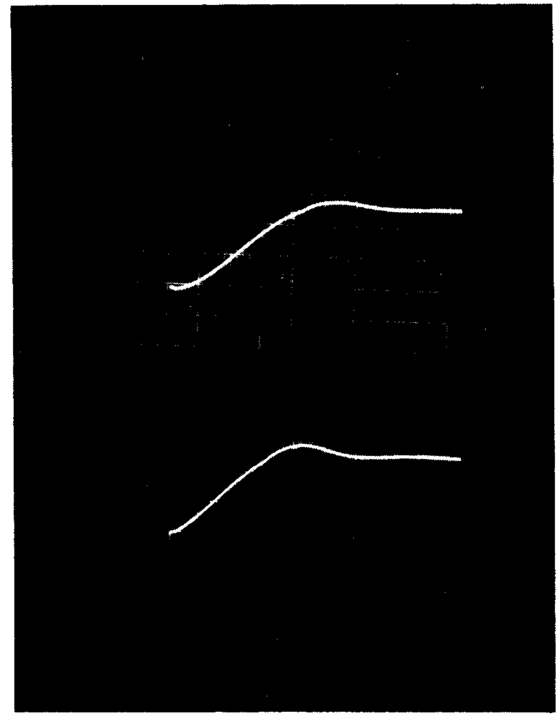
TYPICAL WAVESHAPES OF OTHER LOGIC SIGNAL VOLTAGES



Scale: 2 msec/cm; 200 volts/cm.

Upper Trace: Forward drop across ON-dominant thyristor.

Lower Trace: Same for OFF-dominant.

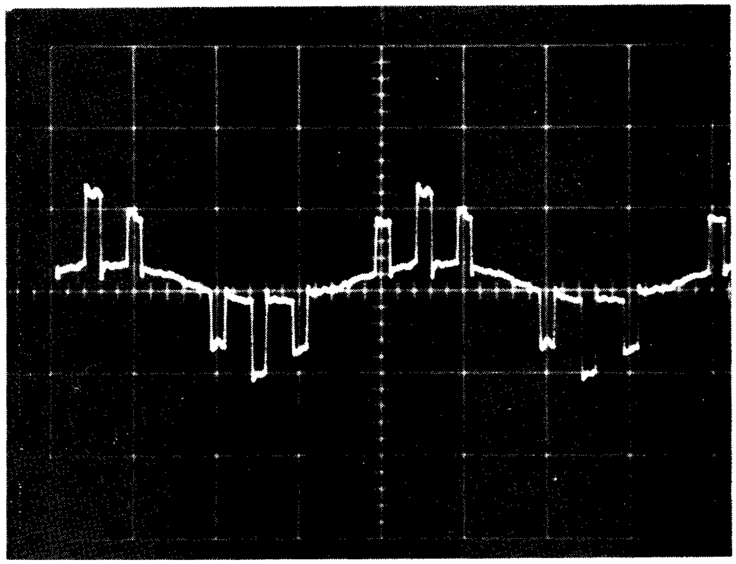


Scale: 20 usec/cm; 200 volts/cm.

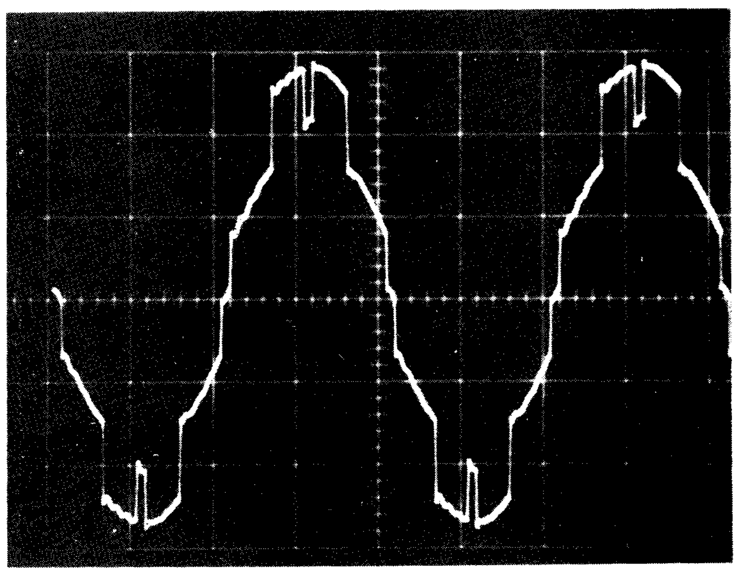
Upper Trace: Expanded time scale, showing N.L. commutation time of 42 usec.

Lower Trace: Same, showing <u>full-load</u> commutation time of 28 usec.

TYPICAL WAVESHAPES OF THYRISTOR CONDUCTION

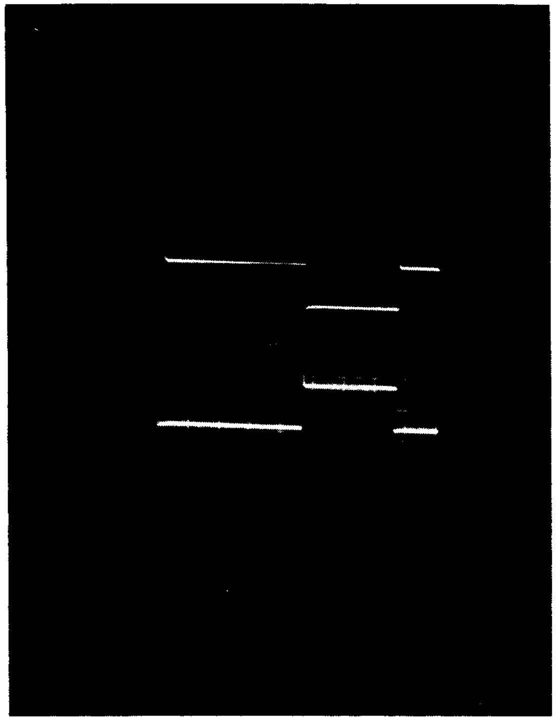


MANUAL OVERRIDE POT. SET TO GIVE MINIMUM PULSE-WIDTH



NORMAL PULSE-WIDTH UNDERVOLTAGE
REGULATOR CONTROL (No Load)

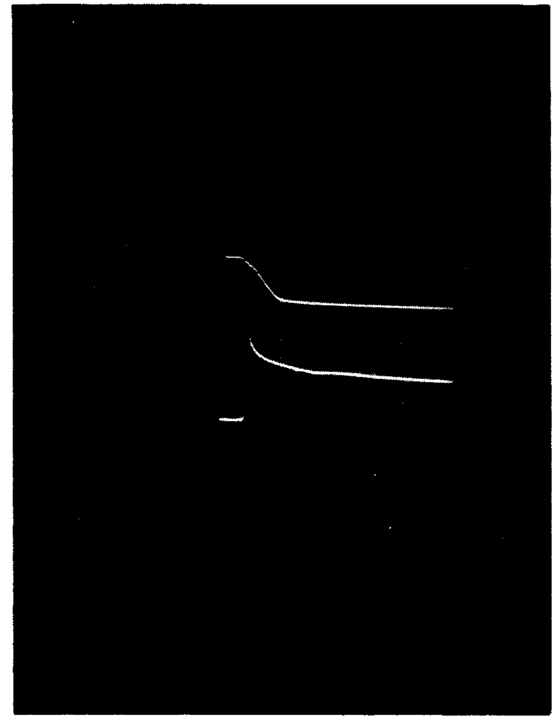
TYPICAL LINE-TO-LINE VOLTAGE SEEN
AHEAD OF POWER FILTER SECTION (4 STAGE)



Scale: 2 msec/cm; 2 volts/cm.

Upper Trace: Gate signal to ON-dominant thyristor.

Lower Trace: Gate signal to OFF-dominant thyristor.

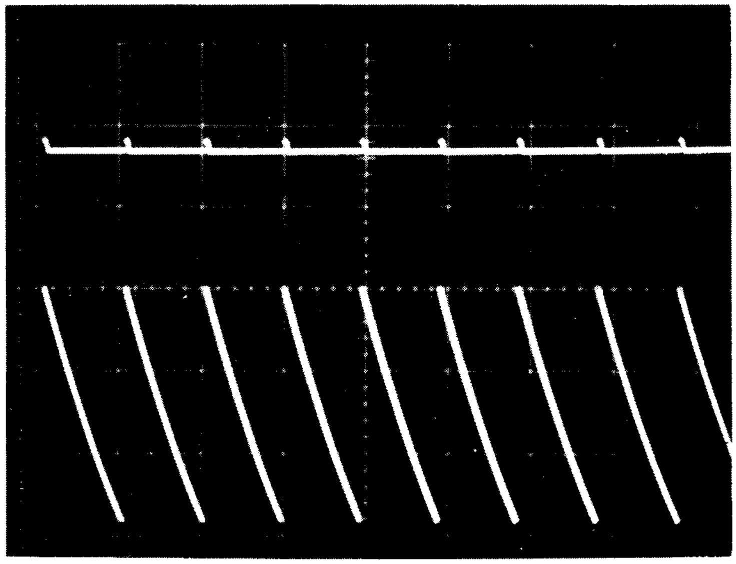


Scale: 5 usec/cm; 2 volts/cm.

Upper Trace: Expanded time view of gate signal's trailing edge.

Lower Trace: Expanded time view of gate signal's leading edge.

TYPICAL WAVESHAPES OF THYRISTOR GATE SIGNAL VOLTAGE

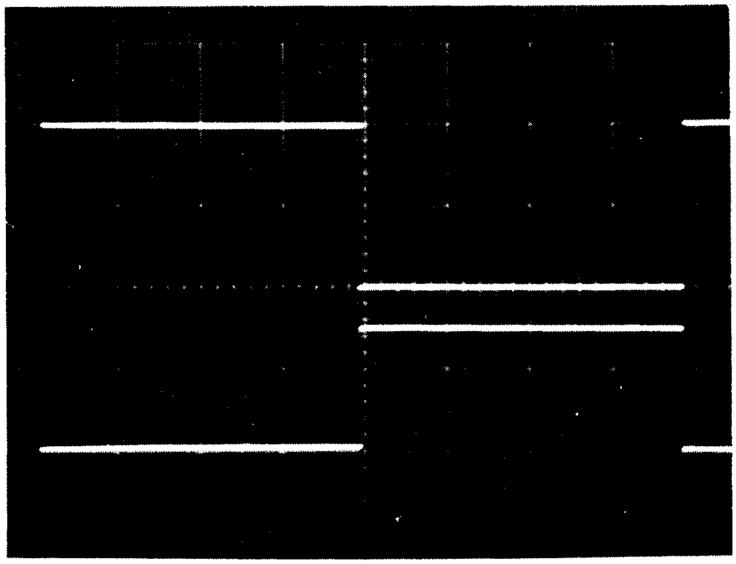


Upper Trace: COUNT signal output as seen at base of 30 Q1 to COM.

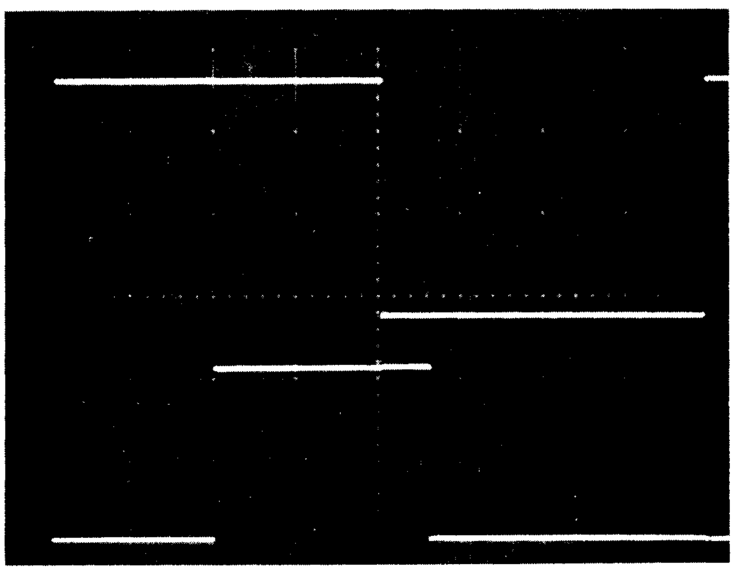
Lower Trace: Ramp signal as seen at upper end of 37C1 to COM.

NOTE: Use of extender board is required to observe these signals.

TYPICAL WAVEFORMS OF PULSE GENERATOR BOARD



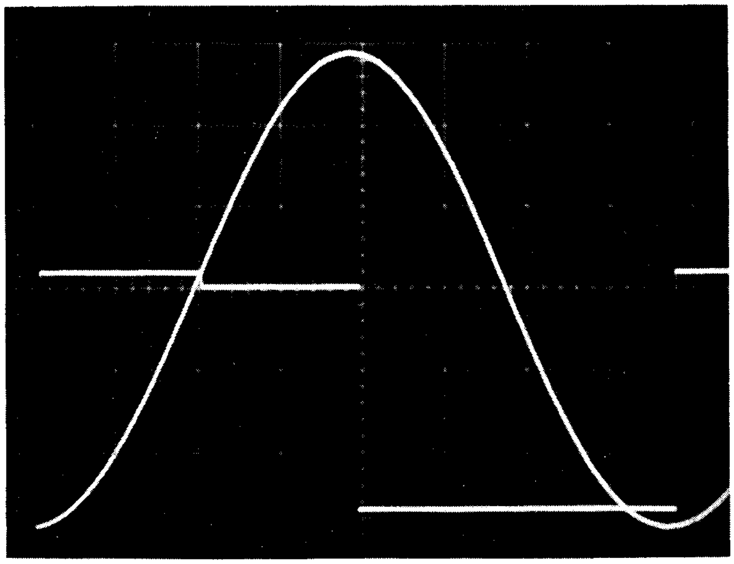
Upper Trace: TP2-COM (Reference)
Lower Trace: TP3-COM



Upper Trace: TP2-COM (Reference)
Lower Trace: TP4-COM

Testpoint signals with no external sync signal.

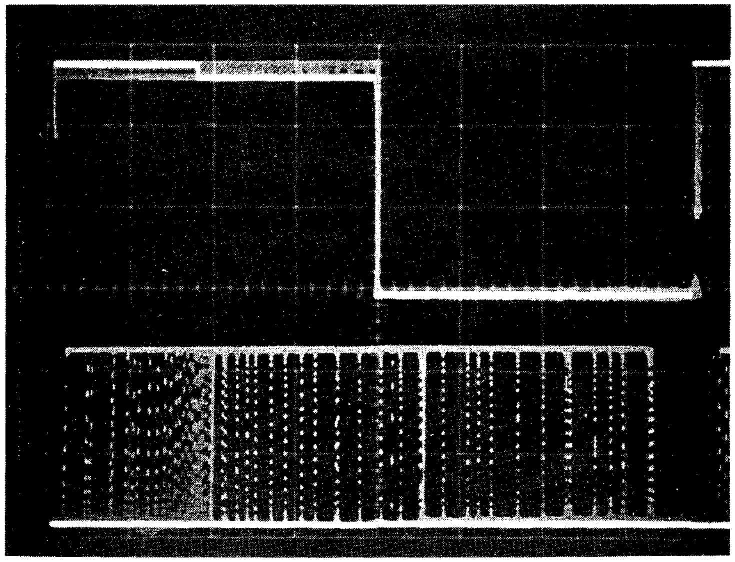
TYPICAL WAVEFORMS OF UNIVERSAL
SYNCHRONIZING BOARD



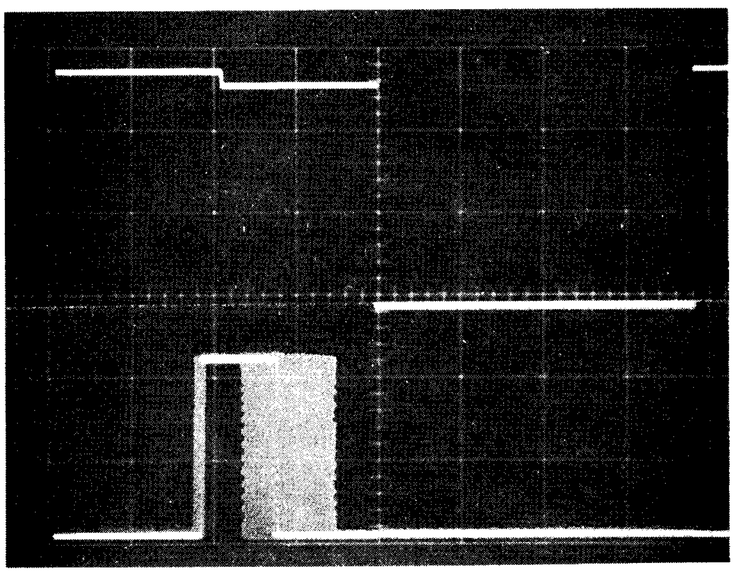
Upper Trace: TP2 to COM square wave
Lower Trace: External sync signal

Correct phase relationship shown for normal synchronizing condition.

TYPICAL WAVEFORMS OF UNIVERSAL SYNCHRONIZING BOARD



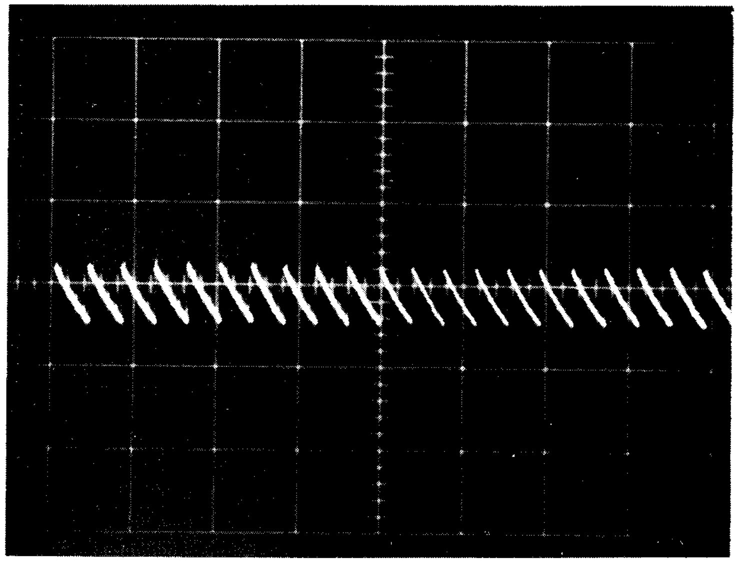
External sync signal first applied.



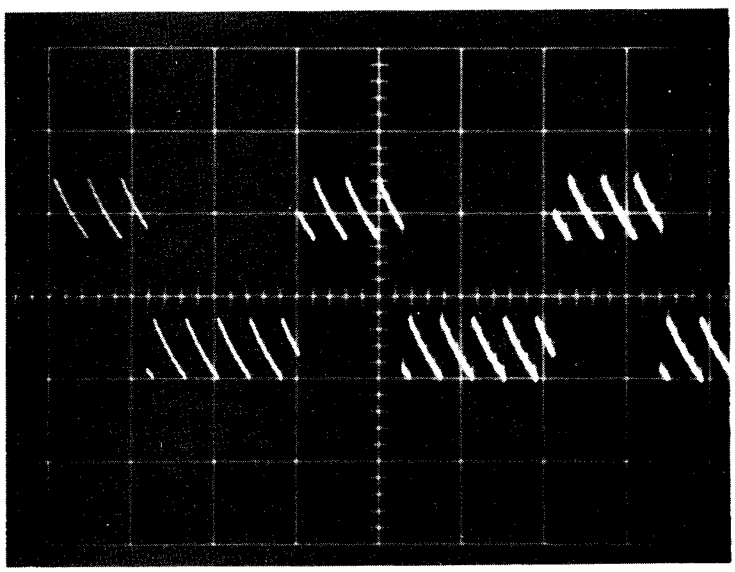
Phase-locked to external sync signal
and regulating.

MEMOSCOPE WAVEFORMS OF TESTPOINT SIGNALS
OF UNIVERSAL SYNCHRONIZING BOARD

Upper Traces: TP2-COM (Reference)
Lower Traces: TP4-COM



No external sync signal



Phase-locked to external
signal and regulating.

Output signal at terminal U4, showing
ripple riding on DC level (4-12 volts DC)

TYPICAL WAVEFORMS OF UNIVERSAL
SYNCHRONIZING BOARD OUTPUT

SECTION III

GENERAL

Prior to any trouble-shooting efforts, some general comments are in order.

1. Logic Voltages

   Always check for proper operation of the logic power supply. When operating, the DC chopper section may be heard as a high frequency whine. The output voltages can be easily checked at the terminals, located near the test switch, which are brought out specifically for this purpose. +20, +40, -20 and the square-wave voltages should be within tolerances given in the Service Manual.

2. Test Switch

   A convenient logic test switch (three position) permits observation of the logic signals for test purposes. Position #1 is the normal position which allows inverting to begin after the proper magnetic sequencing during startup. Position #2 removes the hold-off signal (HO) and allows the ring counter to function. Narrow pulses may be observed at the counter/driver and gate modulator board test points. Position #3 releases the soft-start signal. The pulses will widen to the value determined by the pulse-width control (voltage regulator).

   NOTE: ALWAYS RETURN TEST SWITCH TO POSITION #1 AFTER COMPLETING TESTS AND BEFORE OPERATING THE INVERTER.

3. Start Sequence Circuit (Internal to LPS)

   When the logic power supply is first energized, test signals will appear momentarily at the counter/driver and gate modulator boards. This is a reset operation to assure that all SCR gates are in a "ready" condition for normal starting.

4. Logic Boards

   As a general precaution, do not remove or insert any logic boards with the logic power supply running. Printed circuit board damage or fuse blowing may result.

5. Charging Circuit

   During trouble shooting, fuse blowing may be avoided by placing the logic test switch in Position #3 and using the charging circuit to apply power to the inverter. Voltage levels will be low enough to avoid fuse blowing while still allowing observation of the stage and inverter outputs.

SECTION IV

SYMPTOMS AND CURES

This section contains a list of typical symptoms of possible malfunctions, as well as the procedure for diagnosing and correcting them. It is offered as a guide for trouble-shooting and cannot possibly anticipate all conceivable malfunctions. It is based, however, on circuit analysis, as well as test floor experience and experience in service on production operation. Reference to this list and to specific drawings for the inverter involved, should enable one to diagnose most troubles.

1. DC Bus Will Not Come Up to Voltage

   If during the normal CHARGING sequence of starting, the DC bus fails to come up to the proper value as indicated by the neon light, the cause may be due to: (a) main DC supply not operating, (b) a short circuit across the DC bus, (c) an open circuit in the charging path, or (d) malfunction of magnetic devices, etc.

   a. Verify that main DC bus voltage is available and turned ON. If not, the trouble lies in the DC power supply which should be checked separately.

   b. Short Circuit Across the DC Bus

      1. Verify that the ring counter-counter/driver boards - has been properly reset by the start sequence circuit. If the ring counter is not properly reset, several SCR's may be in the ON condition, causing a short circuit to appear across the bus. The ring counter may be reset by placing the logic test switch into position #2, which allows the ring to count. When the test switch is returned to position #1, the ring should be reset properly.

      2. Withdraw one power stage drawer at a time, and attempt to CHARGE. When bus voltage finally comes up, the last drawer removed contains the defective element. Check for correct gate signals at the gate modulator board test points. Replace this drawer with a good spare drawer, and proceed to check the bad drawer with an ohmmeter. If bus voltage fails to come up after all drawers are withdrawn, including a capacitor drawer if used, proceed to step (c).

   c. Open Circuit in Charging Path. Check for continuity from the line side of the DC breaker, through the CHARGE pushbutton, through the CHARGING resistor, and to the load side of the DC breaker.

2. DC Bus Charges But DC Breaker Trips Out

Refer to the inverter schematic and examine which contacts actuate the breaker (or contactor) trip coil. If either relay UV or UV trip device of the breaker binds, or fails to function properly, the starting sequence is interrupted and tripout will occur.

The input breaker is also provided with a magnetic only trip unit. If the trip unit is set too low, or if UV is improperly set, the breaker may trip due to the surge current into the filter capacitors when the breaker is closed prematurely.

3. Capacitor or Line Fuses Blown

Blown capacitor drawer fuse. If a capacitor fuse is blown, improper inverter operation may follow. Possible causes of fuse blowing are: shorted capacitors, improper charging sequence, improper voltage-sensing relay setting, or DC bus overload.

Line Output Fuses. These fuses should never blow unless a bad paralleling operation has taken place, resulting in abnormally high circulating currents.

4. Output Breaker Tripped

The output breaker is designed to trip out only under the action of relay UV, which detects the minimum DC bus voltage for survival. This tripout is made to produce an orderly shutdown without wholesale fuse blowing, which could otherwise result from loss of input power. Tripout of the load breaker (and/or DC breaker) is therefore good evidence that a plant voltage disturbance of excessive duration has occurred. Note that it is possible for some inverters to survive operation while others shut down, since different current loading will affect UV relay dropout.

It is possible, however, that a malfunction in the UV relay or its wiring could produce the same result. This circuit should be checked only if the inverter fails to restart properly.

5. Blown Fuses in One Stage - Consistent

If fuses consistently blow on the same stage, the trouble is most likely located within that stage. Items should be checked which are associated with the offending stage only, such as thyristors, diodes, gate modulator board, counter/driver board, and the wiring associated with these elements.

a. Possible Bad Diode. Replace fuses, and with load breaker open, attempt to charge the DC bus. If bus will not come up to voltage, then drawer has a shorted element. Replace the drawer. Check the bad drawer with an ohmmeter to locate and replace defective device. Look for possible cause of device failure, especially lost surge suppressor.

b. Possible Bad or Marginal Thyristor

1. Check gate signal at each thyristor to be sure that this is not the cause of malfunction.

2. Check gate voltage of each thyristor and compare with the initial value recorded at startup. Any appreciable change means that the thyristor has been degraded. Look for possible causes of degradation, such as poor seating to the heat sink, mechanical stress, lost surge suppressor. In any event, replace the thyristor, and make periodic check of gate voltage to detect possible further deterioration.

c. Possible Lost Gate Signal

1. With oscilloscope, observe gate signal at each thyristor. Do this at no load with drawer withdrawn to the test position, and test switch in position #2 or #3. Gate signal should be as shown in Section II.

   If not, check to see that gate control signal from the counter/driver board is present. If it is, then trouble lies within the gate modulator board. If not, trouble lies in the driver section of the counter/driver board, or the interwiring. Replace the defective board.

2. The above checks should be repeated with gentle tapping or wiggling of the gate board, the wiring from gate board to thyristors, control plug at the drawer, or cabling to drawer. This should reveal any intermittent short or open or grounded conditions.

d. Intermittent or Loose Connection. Intermittent or loose connections may result in these symptoms. Inspect closely the wiring to and from the logic plug, and the wiring to the gate-modulator assembly receptacle, and from that point to the individual gate signals. This may be effectively checked by withdrawing the drawer to the test position, having gate signals operating, and by gently tapping or wiggling the suspicious wiring.

e. Improper Pulse-Width Balance. If the positive and negative half-cycles of the stage outputs do not have the same pulse-width, there will be present a DC component which may cause transformer saturation and fuse blowing. Observe the waveform of the stage output for uniformity. Refer to the Service Manual for proper adjustment and alignment of the counter/driver board to correct this condition.

   NOTE: Each counter/driver section should be balanced, but not necessarily with other counter/driver sections.

6. Blown Fuses on One Stage - Random Stage

If fuse failures are not consistently in the same stage, the randomness suggests electrical "noise" as the most likely cause. Since the inverter has been specifically checked for "noise" and fitted with suppressors on likely "noise" generators, it may be that a surge suppressor has been lost. Noise generators include relays, trip coils on breakers, contactors, (if used), microswitch elements, etc. Refer to the overall inverter schematic diagram to check out the location of suppression devices such as RC elements, diodes, etc.

NOTE: Do not overlook the possibility of noise on external customer circuitry, such as for alarm or annunciator systems. These elements may introduce signal noise or pickup which can be remedied by the addition of suitable RC elements. Intermittent grounds in the load may also cause noise.

For continuing difficulty of this type, refer to Section 9. Another possible cause of this symptom may rarely be caused by incorrect setting of the gain pot on the voltage regulator board. Response time set too fast may result in this kind of fuse blowing.

7. Blown Fuses on Two Stages

Loss of two stages may be the result of a very short overload, such as might occur during the clearing of a load short circuit. If customer's load fuse coordination is inadequate or marginal, the clearing of a load fuse may cause an overload of such short duration that only one or two stages will misfire. If any load fuses have blown, it is safe to assume that this was the cause.

If the two stages are those controlled from a single counter/driver board, it is possible that this board has malfunctioned. At no load, check the output of the suspected counter/driver board feeding the two stages, and tap or wiggle the board to reveal any intermittent defects. If signals show any erratic behavior, replace the counter/driver board and repeat the test with the new counter/driver board.

If the two stages are not those controlled from a single counter/driver board, treat the incident as coincidental blowing of fuses and proceed as for "BLOWN FUSES ON ONE STAGE."

8. All Stage Fuses Blown

Certain logic blocks are common to the operation of all stages, and these are the points which should be first checked. Refer to Section I which discusses certain elements common to the operation of all. In particular, the logic power supply voltages should be first checked, the voltage feedback transducer, and the interlocking signals from the magnetic control relays. Some possible causes of this type of malfunction and their checkout procedure are listed below.

a. Overload of the Inverter. Check operating personnel to discover the case of excessive loading. If load circuit switching was in progress at the time of fuse blowing, it may be assumed that this was the cause.

Check to see if any system changes were being made at the time of fuse blowing. Rapid changes can result in excessive loading.

See if any branch load fuses were blown. If so, it is reasonable to assume that improper fuse coordination existed with the motor or branch fuse, resulting in sudden overload of the inverter.

b. DC Line Disturbance. If other loads exist on the DC bus along with the inverter, disturbances caused by these loads could cause fuse blowing. Motor starting on the DC bus, for instance, might cause a transient voltage dip below the minimum acceptable voltage for inverter operation. Other types of loads such as DC contactors and trip coils can generate noise when operated which might cause the inverter logic to malfunction.

c. Ring Counter Malfunction

1. Malfunction of the ring counter will interrupt the inverting operation, and blow all stage fuses. At no load and with all stages withdrawn, observe the test point output of a counter/driver board. Check this while tapping or wiggling the several counter/driver boards. If erratic operation is noted, substitute a spare counter/driver board for one at a time, and repeat the test. Do not overlook the possibility of a loose wire at the rear of the logic cage or plug, since interconnection between the counter/driver boards is made here.

2. The ring is designed to be held OFF during certain operating conditions, such as starting or shutdown. Signal HO (hold off) is fed to the counter/driver boards for this purpose. The relay ST normally removes this hold-off signal when the relay picks up. Check the appropriate contact on relay ST, or the relay ST itself, for erratic operation.

d. Adjustable-Frequency Oscillator Malfunction. Loss of signals from the AF oscillator will interrupt proper operation of the ring counter and will probably blow all fuses. While checking the counter/driver boards as in paragraph (c) above, tap or wiggle the oscillator board as well, to see that this is not the source of trouble. Check the frequency of the AF oscillator.

e. Pulse-Width Board Malfunction. Voltage control is common to all stages, and a malfunction here will probably result in loss of all stage fuses. Sudden change in inverter output voltage, or excessive pulse-width change, will blow stage fuses.

1. While checking the counter/driver test point waveforms, look for any erratic behavior while tapping or wiggling the pulse-width board, and interwiring at the rear of the cage.

2. Several external signals go to the voltage regulator board, and these circuits should be verified also. MANUAL OVERRIDE is a test circuit normally left in the full "out" condition except during certain testing. Check that this potentiometer is in the "out" (CCW) position. If so, check this same circuit for continuity, etc.

3. The voltage feedback signal to the voltage regulator is derived from the voltage feedback transducer, which in turn is fed from the inverter output. Check these circuits for integrity.

4. A soft-start signal SS goes to the voltage regulator board to assure proper limits of pulse-width during initial startup of the inverter. Relay ST and the test switch have contacts in this circuit, thus circuit continuity should be checked here as well.

f. Logic Power Supply Malfunction. Loss of logic power for even an instant will probably cause all fuses to blow. The logic power supply is protected by an input fuse, which will protect the supply from malfunctions. If however, a short circuit is placed on the SWA-SWB, the square-wave section will shut off or blow its protective fuses. To reset the SWA-SWB, input power must be disconnected from the logic power supply, and re-applied after the short circuit has been removed.

9. Intermittent Fuse Blowing - Long Term

An intermittent fault may be extremely difficult to isolate, since so little evidence is present. In such a case, the modular construction of the AccurCon can greatly assist trouble shooting by interchanging of modules.

For example, the first fuse blowing might draw suspicion to one power drawer, one gate modulator board, and one counter/driver board. By appropriate interchanging of parts, a second fuse blowing should definitely pinpoint which item is at fault. Refer to Figure 2.

While this method is not foolproof, it can go far in isolating a difficult problem. One cannot overlook such possible causes as: pinched wire in gate modulator receptacle, logic cable and plug assembly, or logic cage pin connections.

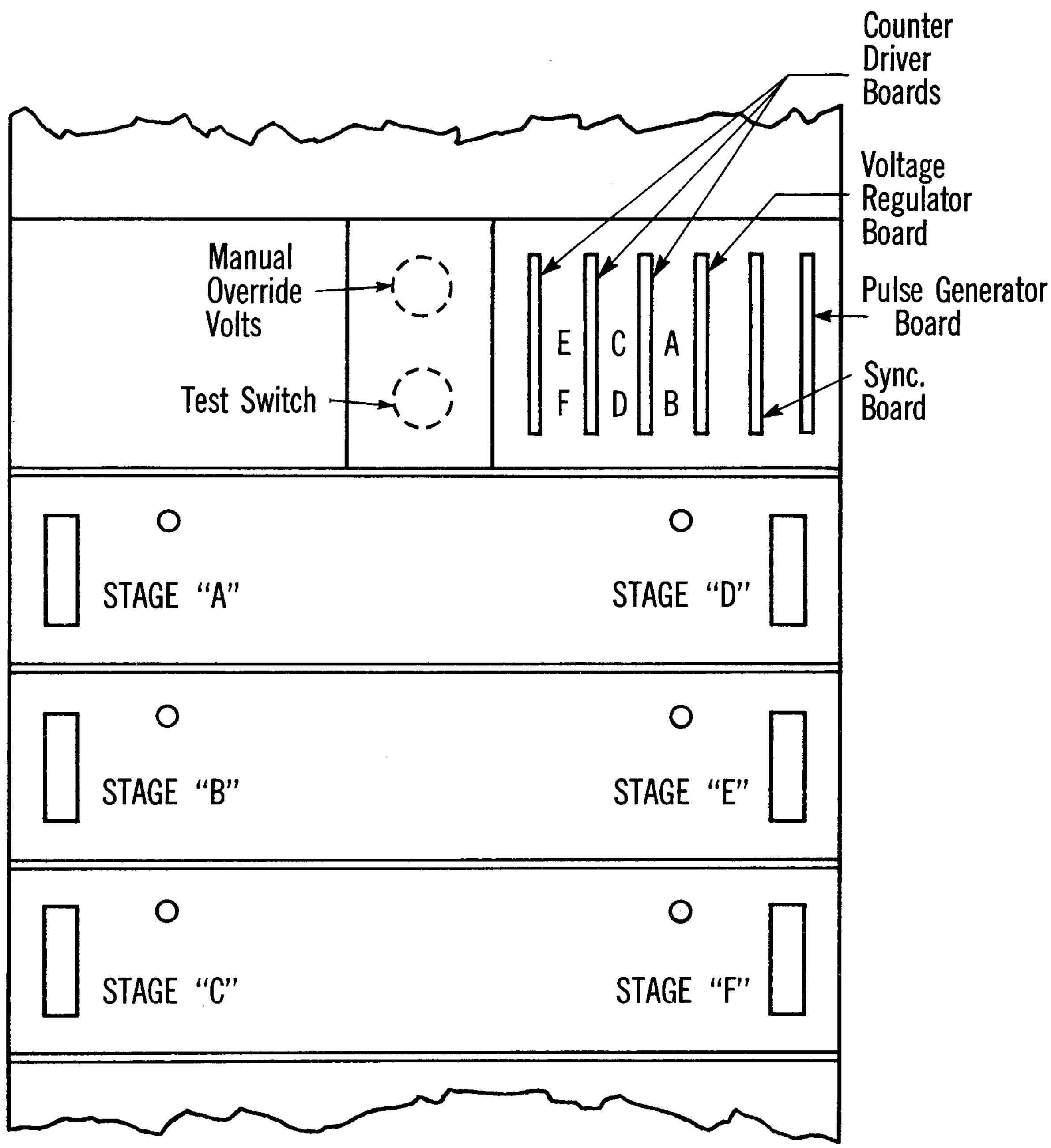


FIGURE 3 - IDENTIFICATION AND CORRELATION OF LOGIC BOARD ARRANGEMENT (FFI)
(Letters on Logic Board Indicate Associated Stage Controlled)

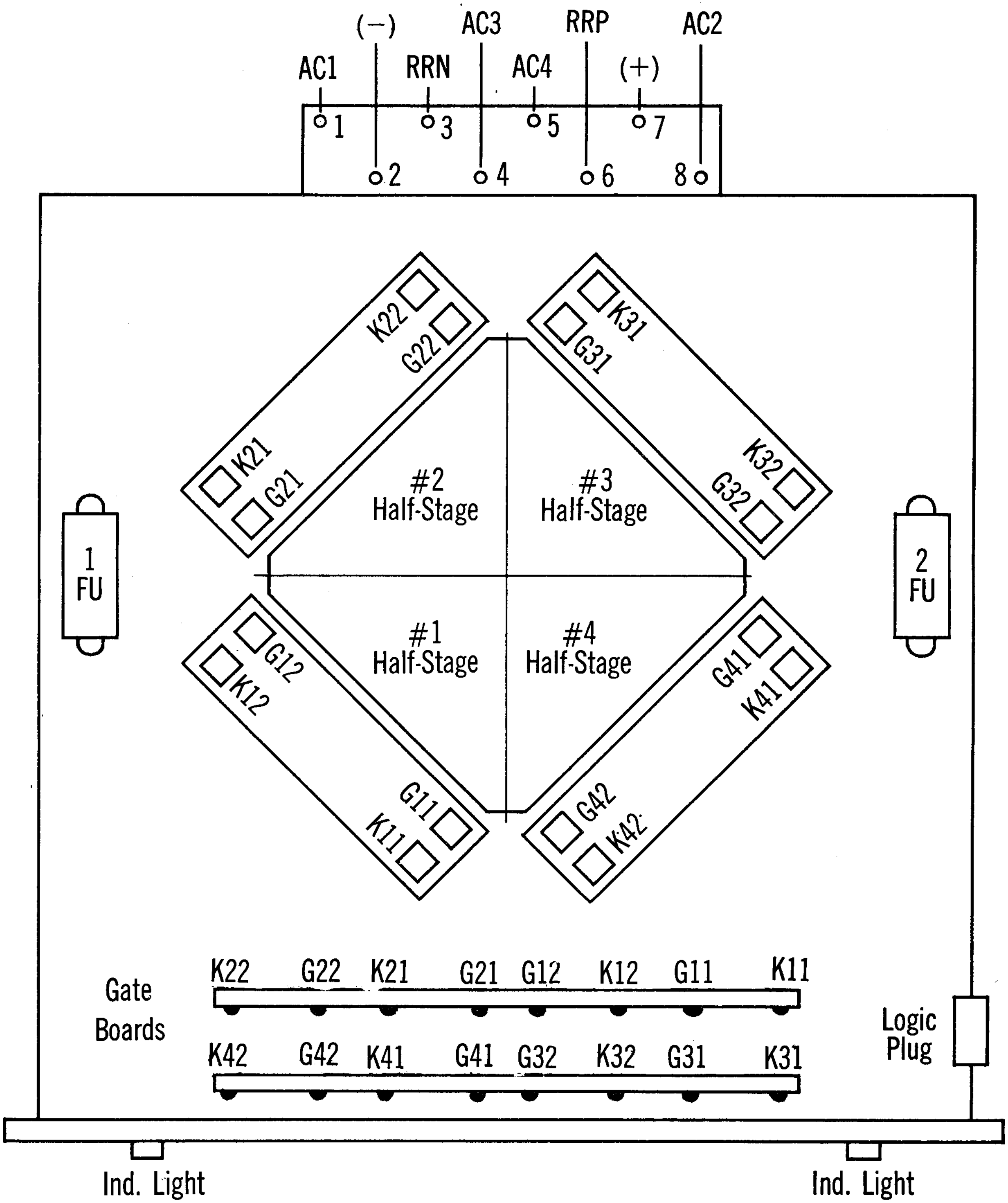
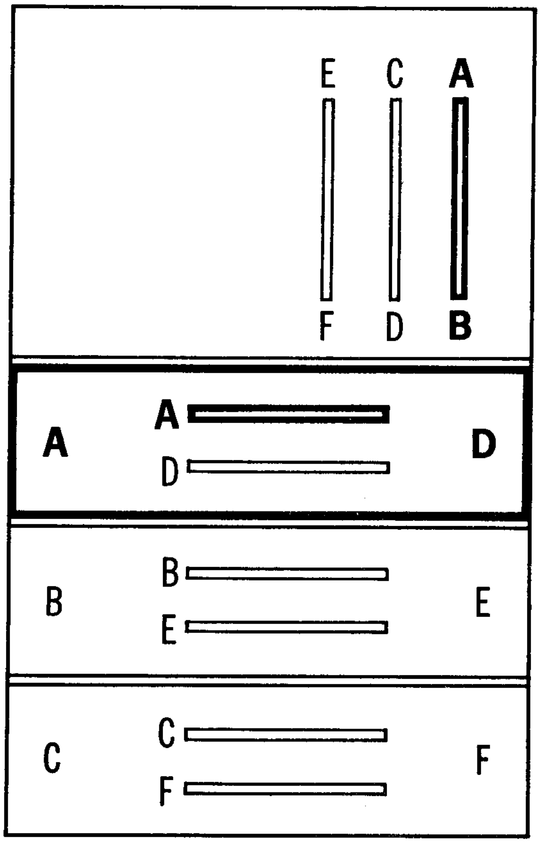


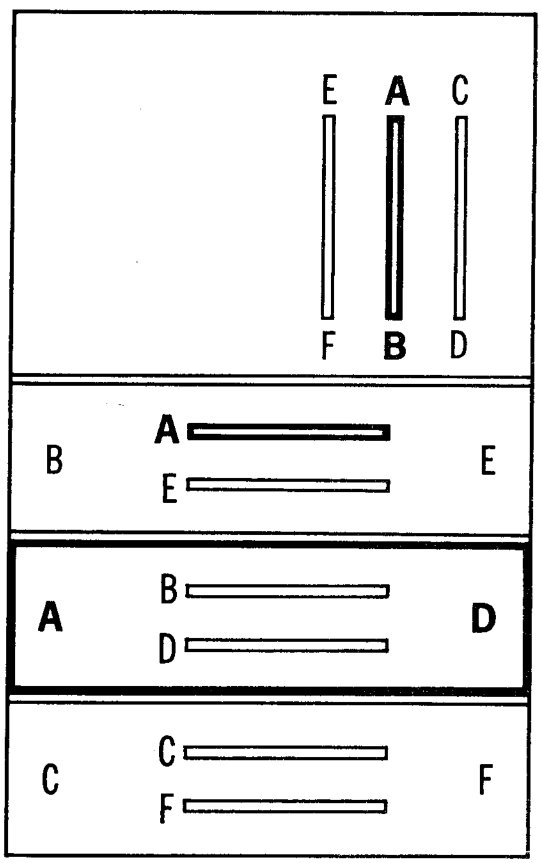
Diagram Showing Relationship of
Gate Board Testpoints and Stage Thyristors



- A -

If the stage A fuse blows, suspicion is directed to: Power drawer AD, gate modulator board A, and counter-driver board AB.

By interchanging parts as shown below, a prediction table can be determined as follows:



- B -

(1) If counter-driver AB is intermittent, stage fuse in position C should blow.

(2) If gate modulator A is intermittent, fuse in position A should blow.

(3) If power drawer AD is intermittent, fuse in position B should blow.

NOTE: Position refers to the fixed location rather than the component.

FIGURE 2