INVERTER

KS-19738

OPERATING METHODS

CONTENTS PAGE

1. GENERAL

1.01 The KS-19738 inverter provides uninterrupted ac power from a nominal 152-volt dc battery source. A battery charger normally supplies dc power to the inverter and keeps the battery charged. On loss of line power, the battery becomes the dc source for the inverter with no break in the ac output voltage. The inverter will operate with an input of 125 to 158 volts dc. The rated output is 16 kVA at 230±10 volts ac, 60±1 Hz. This inverter is initially intended for use in the 521A power plant.

1.02 This section is reissued to incorporate information in the addendum and to change the list of test apparatus to include different voltmeters. This reissue does not affect the Equipment Test List.

Caution: Voltages inside the inverter cabinet exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time, as destructive or dangerous short circuits may occur.

1.03 The abbreviations cw and ccw refer to clockwise and counterclockwise, respectively.

1.04 Routine checks are intended to detect defects, and insofar as possible, to guard against circuit failures liable to interfere with service. Checks and adjustments, other than those required by trouble conditions, should be made during a period when they will cause the least unfavorable reaction to service.

1.05 The instructions given in this practice are based on circuit schematic drawing SD-81831-01. For a detailed description of operation, see the corresponding circuit description.

1.06 For more detailed information on operation and maintenance of individual equipment or apparatus, refer to the appropriate Bell System Practice.

2. LIST OF TEST APPARATUS

CODE OR SPEC NO.	DESCRIPTION
—	Tektronix 545 Oscilloscope with CA-Type Adapter (or equivalent). Not required for normal maintenance. (See 5.02.)
—	Voltmeter, DC Weston Model 931, Ranges 300/150/75/30 Volts
—	Voltmeter, AC-DC Thermo Weston Model 622, Ranges 300/150/30/3
	or
—	Voltmeter, Hewlett Packard Model 3400A RMS, 12 Ranges, 1 Millivolt to 300 Volts
KS-14510	Volt-Ohm-Milliammeter

Note: The amplitudes of the various harmonics appearing in the KS-19738 inverter output may vary with load. Consistent voltage measurements will be obtained using the AC-DC Thermo Weston model 622 voltmeter. The Hewlett Packard 3400A voltmeter responds faster than the Weston 622 but requires an ac power connection.

3. OPERATION

3.01 *General:* This inverter is designed for continuous operation. It is suggested that the routine checks in Part 4 be performed periodically and after any trouble condition has been corrected.

3.02 To place this inverter in service, proceed as follows.

(1) Operate INPUT switch (S501) to CHARGE.

Caution: Do not operate the INPUT switch to ON until DS502 lamp lights. The DS502 lamp is located directly above the INPUT switch.

(2) When DS502 lamp lights, operate INPUT switch to ON.

Note: If DS502 lamp fails to light when the INPUT switch is in the CHARGE position, check that the LOGIC TEST switch (S1D1) is in the OFF position.

(3) Operate OUTPUT switch (S502) to ON.

3.03 To remove this inverter from service, proceed as follows.

(1) Operate OUTPUT switch (S502) to OFF.

(2) Operate INPUT switch (S501) to OFF.

4. ROUTINE CHECKS AND ADJUSTMENTS

4.01 The output voltage and frequency of the inverter should be checked monthly. These checks should be made while the inverter is in service with a load of between 5 and 16 kVA.

4.02

(a) Connect the Weston model 622 voltmeter to test jacks 301 and 302. The meter should indicate the output voltage, 230 ± 3 volts. Disconnect the meter.

(b) Connect the oscilloscope to test jacks 301 and 302. Synchronize the oscilloscope with a known 60-Hz frequency. The oscilloscope should indicate a frequency of 60 ± 1 Hz. Disconnect the oscilloscope.

Note: If the output voltage and/or frequency are/is outside of limits, refer to CD-81831-01 for proper adjustment procedure.

4.03 Check the input and output capacitor alarm fuses as follows.

(1) Replace capacitor alarm fuse F505 with a blown fuse. This will energize the alarm control circuit to the plant control board and operate an alarm there. Replace with the good fuse.

(2) Repeat the test in (1) for capacitor alarm F fuses 507, 509, 511, 513, 515, 516, 518, 520, 522, 524, 529, 531, 533, and 535.

4.04 Electrolytic capacitors should be maintained in accordance with Section 032-110-701.

5. TROUBLES

General

5.01 When any kind of trouble is encountered, decide whether to locate the trouble with the equipment operating or de-energized. These inverters have been designed to make some parts accessible for testing with the power connected. The test jacks are available when the front doors are open. Trouble is easier to find if the equipment can be fully energized. However, if the trouble is of a nature that causes excessive output from the equipment, perform the initial steps with the system de-energized, and energize it for short periods only while electrical measurements are made. Also, operation for more than a few minutes at a time while trouble exists, even though the output may not be excessive, may result in overheating of some components. It is essential, when testing, to be alert to the need for quickly shutting down the inverter at any time until the trouble is localized and cleared.

5.02 This troubleshooting procedure is based upon the use of signals available at the test points. In general, the signals to be monitored at these points are waveforms to be observed on an oscilloscope. The oscilloscope with the adapter has the facility to present two inputs, A and B. The polarity switch on the oscilloscope is to be set to A + B; input A on the adapter to + and input B to −. The oscilloscope is to be grounded. Test probe A is to be connected to the first test point given, and test probe B to the second.

Caution: High voltage may be present on the oscilloscope case if it is not grounded. Do not connect a ground lead to any nongrounded portion of the inverter when the oscilloscope is grounded, as components may be damaged.

5.03 In checking circuit packs and semiconductor devices, refer to Section 032-173-301.

5.04 The following component checks should indicate the most likely source of trouble and are not all-inclusive. The basic faults that can occur fall into three main categories:

(a) No output voltage

(b) Low output voltage

(c) High output voltage.

In all checks of the inverter, the OUTPUT switch (S502) should be OFF. Switch (S102) should be OFF except where indicated otherwise.

Preliminary Checks

5.05 Operate INPUT switch (S501) to the OFF position. Check all the 500-series fuses for a blown fuse. If any 70-type fuse is blown, check the associated capacitor(s) for a short. If F503 is blown, check the associated components for an open or short. If F501 or F526 is blown, remove F526 and ensure that F501 is a good fuse. Check the resistance between TP502 and TP507 in both directions. A reading of zero in both directions indicates one or more of CR501, CR502, CR503, and CR504 are defective. If F502 or F527 is blown, remove F527 and ensure that F502 is a good fuse. Check the resistance between TP504 and TP510 in both directions. A reading of zero in both directions indicates one or more of CR505, CR506, CR507, and CR508 are defective. The SCRs and rectifiers are probably good if the meter reading is near zero in one direction and at least 1K ohms in the opposite direction. The SCRs may also be checked by disconnecting their gate leads at TB513-5, TB514-5, TB517-5, and TB518-5. Ensure that fuses F501, F502, F526, and F527 are good. Operate switch S502 to OFF, S101 and S102 to ON. Operate S501 to CHARGE. Using the KS-14510 meter, check for 30 volts dc between TP502-TP507, TP503-TP507, TP504-TP510, and TP506-TP510. If the voltage is near zero, one or more of CR501 through CR508 is defective. The faulty component(s) can be further isolated by operating S501 to OFF and removing F526. Operate S501 to CHARGE. Using the KS-14510 meter, check for 30 volts dc between TP504-TP510 and TP506-TP510. If the meter indicates 30 volts or more, the defective unit is one or more of CR501 through CR504. If the voltage is low, the defective unit is one or more of CR505 through CR508. Operate S501, S101, and S102 to OFF and replace F526. Reconnect the SCR gate leads. To isolate the particular faulty SCR and/or rectifier, disconnect either the anode or cathode of each unit and check with the ohmmeter. The SCRs should read at least 1K in each direction.

5.06 Operate INPUT switch (S501) to CHARGE, S101 to ON, and S102 to OFF. Using the KS-14510 meter, check for 30 ± 1VDC between TP104 (+) and TP103 (−) and 152VDC nominal (battery terminal voltage) between TP102 (+) and TP103 (−). If TP104-TP103 reads zero, check fuses F101, F102, and F103. If the fuses are good and TP102-TP103 reads 152VDC, disconnect P201 from the master logic board. If TP104-TP103 now reads 30 ± 1VDC, check for possible shorts in the master logic board (Q202, Q203) and/or slave logic board (Q402, Q403). If the voltage between TP104-TP103 is still low or zero, check the voltage across CR101 and CR102 (15 volts across each). Check C102 for a short. Reconnect P201 to the master logic board if the power supply board is working satisfactorily. Using the oscilloscope, check the waveform between TP501-TP507 and TP508-TP507. If presentation is not similar to Fig. 1, the trouble is most likely in the master logic board, or a shorted gate to cathode in CR501 or CR502. Check the waveform between TP509-TP510 and TP505-TP510. If presentation is not similar to Fig. 1, the trouble is most likely in the master logic and/or the slave logic boards or a shorted gate to cathode in CR505 or CR506. If the trouble has not been located,

continue checking as given in 5.07 and/or 5.08 as appropriate.

Note: All illustrations are ***typical*** waveforms.

No Output Voltage

5.07 If the waveform at TP501-TP507, TP508-TP507 was not similar to that shown in Fig. 1, perform the following checks. Using the KS-14510 meter, check the voltage between TP205-TP204. If the voltage is not 30 volts dc, relay S201 is probably faulty. Connect the oscilloscope to TP201-TP204. If the waveform is not as shown in Fig. 2, check Q201. Check that the waveform between TP202-TP204 and TP203-TP204 is similar to Fig. 3. If the waveforms are not similar to that shown in Fig. 3, check Q202 and Q203. If the waveform is still incorrect, replace the master logic circuit pack. If the waveform at TP501-TP507 and TP508-TP507 is now correct, check the waveform at TP509-TP510 and TP505-TP510. If these are not correct, check the waveform between TP402-TP404 and TP403-TP404 for similarity to Fig. 3. If these are correct, check for defective CR409 through CR414 and CR423. If the waveform is not correct, continue checking as in 5.08(a) and/or (b).

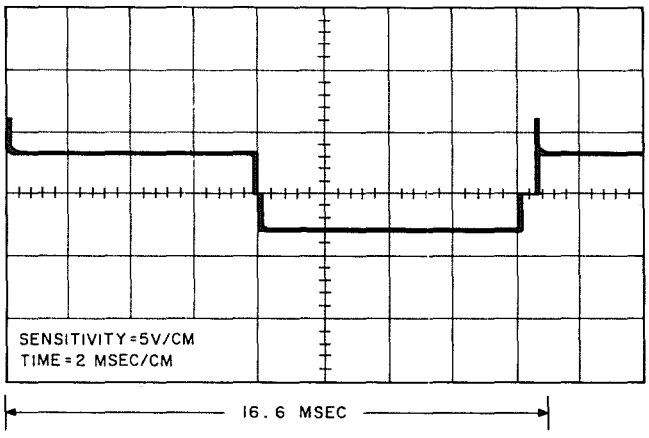

Fig. 1—Gate Waveform

Low Output Voltage

5.08 If the output voltage is low, follow the procedure in (a) or (b) as appropriate.

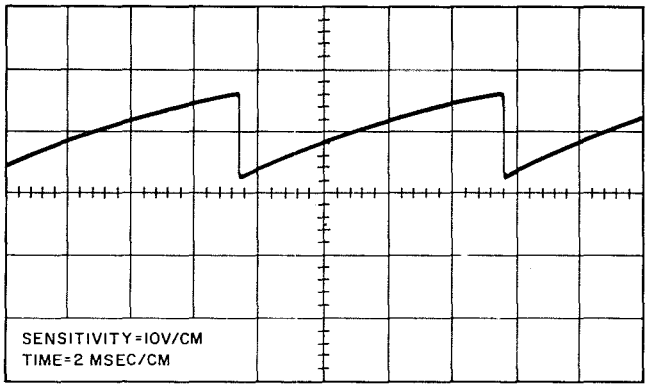

Fig. 2—Master Oscillator Waveform

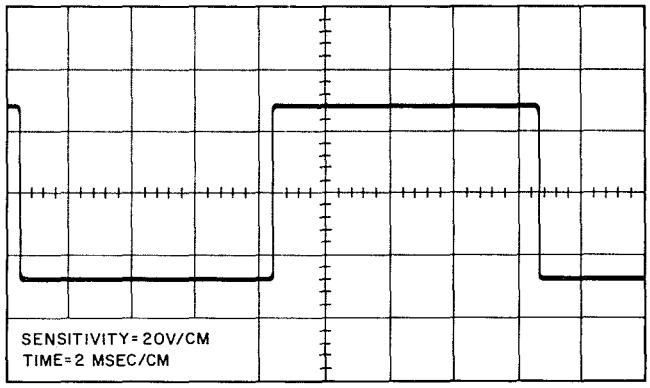

Fig. 3—Master and Slave Oscillator Drive Waveforms

(a) ***No Blown Fuses:*** If no blown fuses were found, operate INPUT switch (S501) to ON and switch S101 to OFF. Check that the unfiltered inverter output waveform at TP511-TP512 is similar to Fig. 4. If the waveform is approximately as shown, with a symmetrical shape and a fairly high ratio of positive or negative time to zero time, the trouble may be in the output filter. Check C513-C515 for a short. If the waveform is symmetrical but with a high percentage of zero time, turn INPUT switch (S501) to CHARGE and S101 to ON. Check that the waveform between TP401-TP406 is similar to Fig. 5. If the waveform shows the same peak voltage but too rapid a rise, check Q301 and CR312 (should have approximately 8 volts across it). If the trouble is not found, replace the regulator circuit pack. If there is little or no rise to the peak level shown, check for a defective CR314, Q401,

CR407, CR408, or shorted C401. If the trouble is not found, replace the slave logic pack. If there is severe distortion or no zero time, continue checking as given in 5.08(b).

(b) ***Blown Power Fuse (F501, F502, F526, or F527):*** Operate INPUT switch (S501) to CHARGE, switch S101 to ON, and S102 to OFF. Compare all gate waveforms (TP501-TP507, TP508-TP507, TP505-TP510, and TP509-TP510) with Fig. 1. Be sure the waveforms go both positive and negative; there is a slight hesitation at zero when switching from one polarity to the other with the positive portion beginning with a relatively high spike. If the waveform at TP501-TP507 and/or TP508-TP507 is not correct, check that the waveform between TP202-TP204 and TP203-TP204 is similar to Fig. 3. If the waveform is correct, check for a defective CR208 through CR213 or CR222. If the waveform is not correct, check Q201, Q202, and Q203. If the defective component is not found, replace the master logic pack. If the waveform at TP505-TP510 and/or TP509-TP510 is not correct, check that the waveform between TP402-TP404 and TP403-TP404 is similar to Fig. 3. If the waveform is correct, check for a defective CR409 through CR414 or CR423. If the defective component is not found, replace the slave logic circuit pack. If the waveform is not correct, check as given in 5.08(a). If one or more of fuses F501, F502, F526, or F527 continues to blow when the inverter is turned ON and all waveforms are correct, the problem could be an SCR breaking down at high voltage. If F501 or F526 blows, high-voltage breakdown could be occurring in CR501 and/or CR502. If F502 or F527 blows, high-voltage breakdown could be occurring in CR505 and/or CR506.

> ***Note:*** If the replacement of the appropriate SCRs results in satisfactory inverter operation, high-voltage SCR breakdown was the problem. One of the two SCRs removed from the inverter may be satisfactory. Check these components for conformity to the breakdown voltage requirements in accordance with their data sheet.

High Output Voltage

5.09 With INPUT switch (S501) in the OFF position, check fuses F301 and F302. If F301 and/or F302 are/is blown, check CR301 and CR302 for shorts. Operate OUTPUT switch (S502) and switch S101 to OFF and INPUT switch (S501) to ON. Connect the KS-14510 meter to TP301-TP302. After checking the ac output voltage, operate INPUT switch (S501) to OFF and disconnect the meter. If no voltage was indicated, check wiring and connections from inverter output to the regulator circuit pack. If voltage is present, operate INPUT switch (S501) to CHARGE and switch S101 to ON. Check CR312 (approximately 8.2 volts across it) and Q301. If the defective component cannot be found, replace the regulator circuit pack.

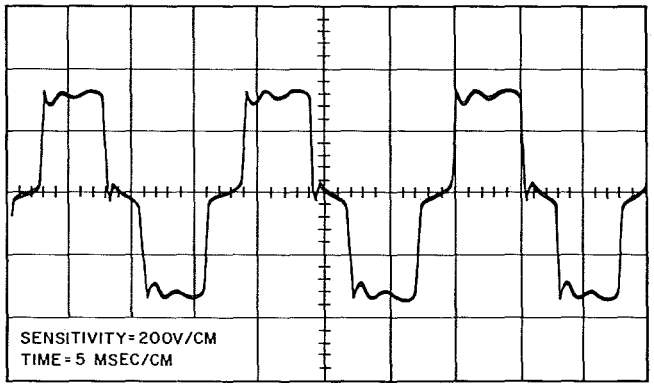

Fig. 4—Unfiltered Inverter Output Waveform

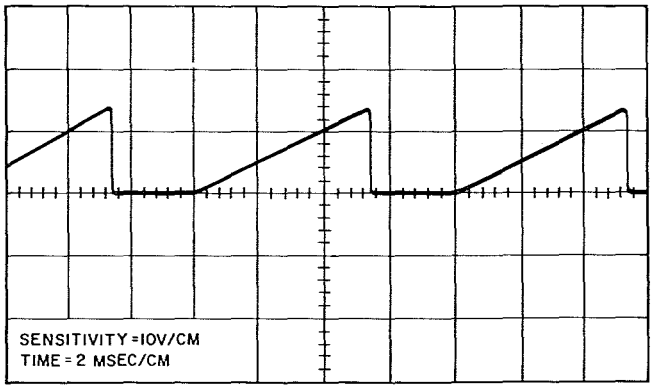

Fig 5—Slave Oscillator Waveform