INSTRUCTIONS

GEK-7365

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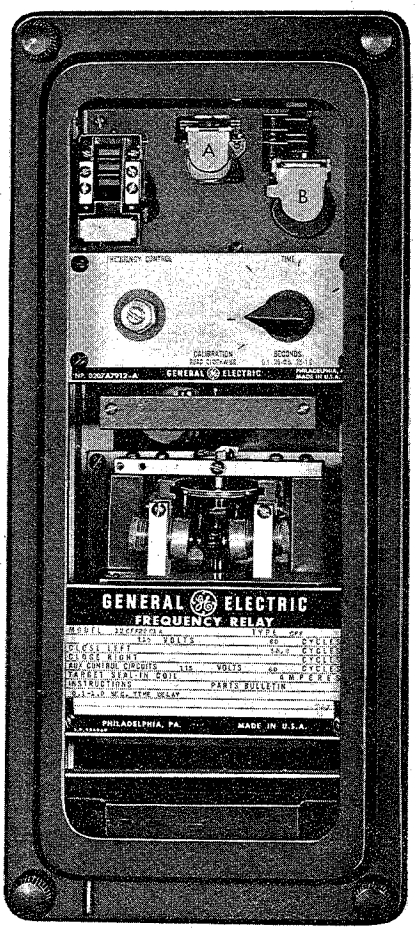
UNDERFREQUENCY RELAYS



TYPES: CFF22C
CFF23A

POWER SYSTEMS MANAGEMENT DEPARTMENT

GENERAL ELECTRIC

PHILADELPHIA, PA.

CONTENTS

Cover Photo (8038876)

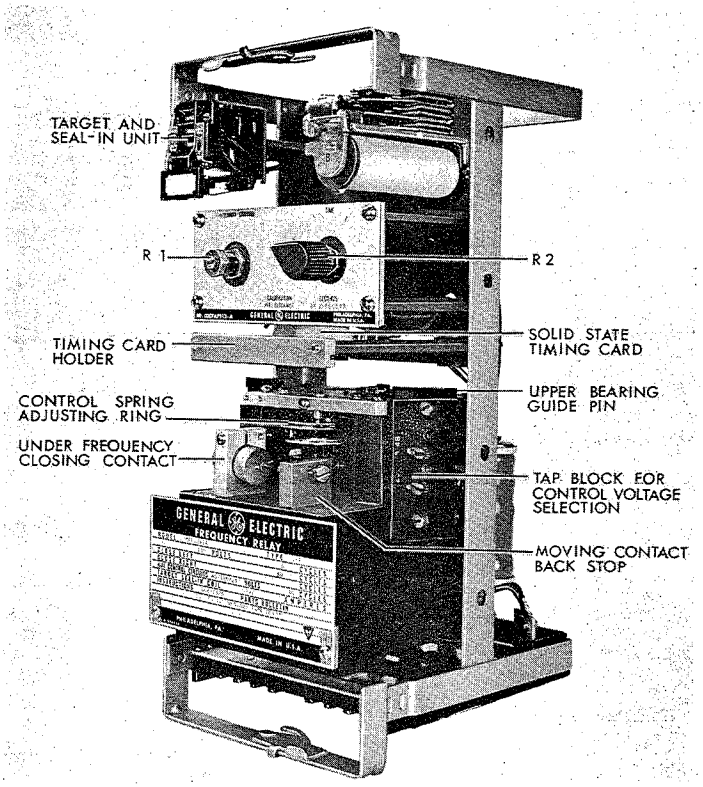


FIG. I (8040709) Relay Type CFF23A Removed From Case (Approx. 3/4 Front View)

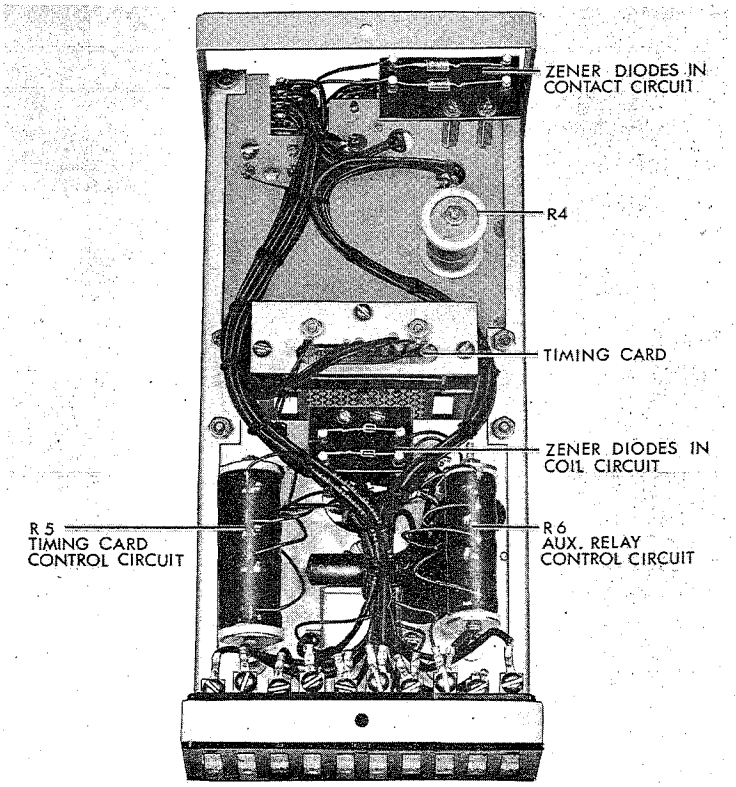


FIG. 2 (8040026) Relay Type CFF23A Removed From Case (Rear View)

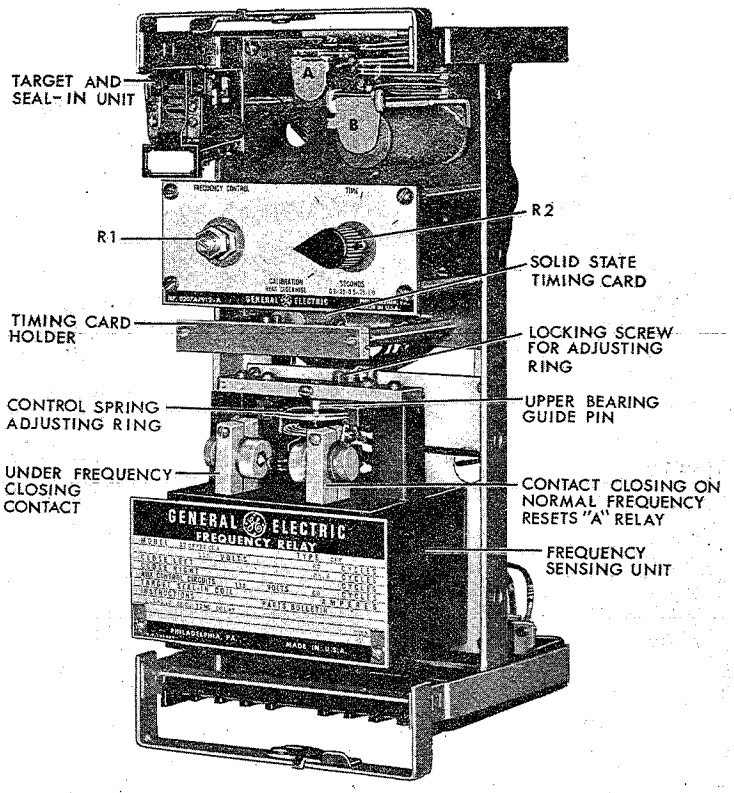


FIG. 3 (8038873) Relay Type CFF22C1A Removed From Case (Approx. 3/4 Front View)

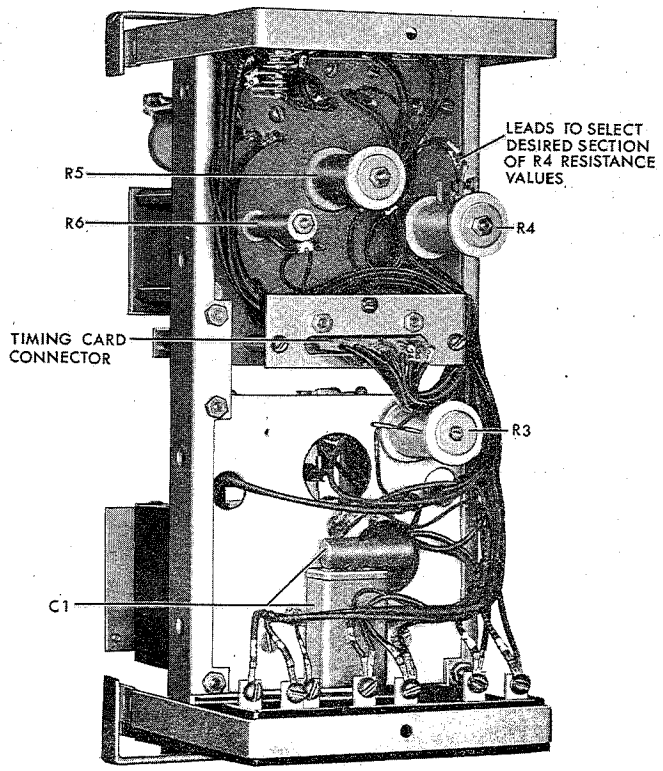


FIG. 4 (8038872) Relay Type CFF22C1A Removed From Case (Approx. 3/4 Rear View)

DESCRIPTION

The Type CFF relays are frequency sensing devices. The CFF22 relays use an induction cup assembly as the frequency sensing element. This unit controls a solid state timer via an auxiliary telephone type relay called "A". The timer provides for a delay from 6 to 60 cycles (60 Hz Basis), continuously adjustable. After a preset time delay has expired, the "B" auxiliary operates to complete the trip circuit.

These components are contained in a medium-size draw-out case.

The CFF23A is designed to operate with DC comtrol voltages having a triple rating i.e. 24/48/125 or 48/185/250 volts. See Fig. 1 and Fig. 2.

The CFF22C is designed so that all the auxiliary components function from the same supply that activates the frequency element. See Fig. 3 and 4.

The internal connection diagrams are shown in Fig. 5 for the CFF23A. Fig. 6 is for the model 12CFF22C1A only and Fig. 7 is for model 12CFF22C, with form numbers two and up.

APPLICATION

The CFF23A and 22C underfrequency relays are applied where high speed detection of underfrequency conditions is required. Specifically they are applied in underfrequency load conservation schemes. If a system disturbance results in some loss of generating capacity such that the load exceeds the generation, the system is in danger of collapse. The underfrequency relay operates to disconnect non-essential load in order to balance load and generation in the affected area. Such action must be taken promptly and must be of sufficient magnitude to conserve essential load and enable the rest of the system to recover from the underfrequency condition. By preventing a major shutdown, restoration of the entire system to normal operation is greatly facilitated and expedited.

The auxiliary time delay unit has an adjustable delay of 6 to 60 cycles. The minimum delay of 6 cycles is to prevent relay misoperation due to mechanical shock or the electrical transients which result from switching potentials to the relay or clearing a fault on the system. Additional time delay up to 60 cycles can be added for coordination purposes in the load conservation scheme.

Another application of the underfrequency relay is at industrial plants where it is necessary to trip the incoming breaker at the plant when the power company supply is tripped off. This will prevent damage to motors or local generation in the plant that could otherwise be incurred if the plant breaker were still closed when the power company automatically reclosed the supply line to the plant.

An overall conservation scheme can be arranged to trip off non-essential or interruptible load as follows:

a. Trip off blocks of load in several steps with several relays set at successively lower frequency values.

b. Trip off blocks of load in several steps on a time basic at one level of frequency, so that as each time step is reached additional load is dropped.

A tapped subtransmission or distribution substation which has a heavy preponderance of motor load may require special consideration for proper time coordination. If the transmission sources to such a substation were tripped out for any reason, the motor loads would tend to maintain the voltage for a short time while the frequency decreased as the motors were slowing down. It will be necessary to delay the tripping of the underfrequency relay for 15 to 30 cycles to ride over this condition and avoid tripping breakers needlessly.

In applying the underfrequency relay in a system load conservation program, it must be recognized that a low frequency condition does not begin to be corrected until a circuit breaker operation occurs to disconnect some load. The family curves shown in Fig. 8 are constructed to show frequency vs. time to open the breaker after the disturbance starts for a number of different rates of change of frequency. These curves include:

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

To the extent required the products described herein meet applicable ANSI, IEEE and NEMA standards; but no such assurance is given with respect to local codes and ordinances because they vary greatly.

1. An allowance of six cycles for total breaker clearing time.

2. Various frequency pickup settings on the relay.

If any of these factors change, then a new curve should be plotted. The curve can be read directly to determine the system frequency at which the load is actually removed.

Typical external connection diagrams are shown in Fig. 9 & 10 for the CFF23A and CFF22C respectively.

RATINGS

INDUCTION CUP UNIT

The frequency sensing units in both the CFF23A and CFF22C are identical. They are suitable for use at their rated nameplate voltage and within their rated adjustable range of frequency.

The table "A" lists the range of frequency which the relays may be calibrated.

TABLE A

RATED FREQUENCY	MINIMUM FREQUENCY	MAXIMUM FREQUENCY
60 HZ	56.0 HZ	59.5 HZ

The contacts on the induction cup unit require no specific rating since they, in their function, have the capacity to carry the currents called for in the auxiliary relay circuits.

AUXILIARY RELAYS, A AND B

The coil circuit voltage ratings are on a continuous basis. The relay "A" being equal to the rating of the CFF relay. Relay "B" rating is related to the timing card voltage in the nominal nine volt section.

The contact ratings of the "B" relay are of interest to the user. These contacts can carry three amperes continuously or 30 amperes for two seconds.

The current interrupting capabilities for either AC or DC are shown in table B.

TABLE B

VOLTS	INDUCTIVE (*)	NON-INDUCTIVE
115-AC	0.75 AMPS	2.0 AMPS
230-AC	0.50 AMPS	1.5 AMPS
48-DC	1.0 AMPS	3.0 AMPS
125-DC	0.5 AMPS	1.5 AMPS
250-DC	0.25 AMPS	1.0 AMPS

(*) Inductance based on an average trip coil.

TARGET SEAL-IN UNIT

The coil circuits of these assemblies when used in an AC control circuit such as in the CFF22C are also on a continuous voltage basis equal to the rating of the CFF relay. The DC control circuits in the CFF23A, however, normally use current coils with ratings shown in table "C".

The contacts in either the AC or DC ratings are alike and have a capability of closing 30 amperes for tripping duty.

TABLE C

TARGET SEAL-IN COIL RATINGS			
	NOMINAL TAP RATINGS		
CONDITIONS	0.2	0.6	2.0
CONTINUOUS RATING	0.3 AMPS	1.5 AMPS	3.5 AMPS
CARRY 30 AMPS	0.1 SECONDS	0.5 SECONDS	4.0 SECONDS
DC RESISTANCE	7.0 OHMS	0.3 OHMS	0.13 OHMS

BURDENS

The burdens imposed on the potential transformers by the frequency sensing unit varies slightly with the calibration setting. The burden is maximum with a frequency setting at the upper limit. The burden on the CFF22C includes the load of the auxiliaries and hence is somewhat greater than the CFF23A as shown in Table "D".

TABLE D

MODEL	VOLTS	FREQUENCY	WATTS	VOLT-AMPS
CFF23A	120	60 Hz	12.0	15.0
CFF22C	120	60 Hz	17.5 27.0	19.0 * 30.0

* The 19 V.A. is the normal burden under no underfrequency conditions.
The 30 V.A. is the total burden when the auxiliary units pick-up on underfrequency.

CHARACTERISTICS

OPERATING PRINCIPLES

The frequency sensing unit is an eight pole induction cup assembly that responds to the magnitude and phase angle of the fluxes produced by the two sets of coil circuits each occupying 4 of the poles.

When the fluxes are inphase the unit exhibits zero torque. Under normal conditions of rated voltage and frequency, the phase-displacement between the flux of one circuit with respect to the other produces torque to hold the lefthand (F.V.) contacts open. When an underfrequency condition appears, approaching the calibration frequency, the phase angle first decreases to zero, leaving only spring torque to hold the contact open. As the frequency continues to fall a phase displacement again appears this time to produce contact closing torque. When the frequency reaches the calibrated underfrequency setting, the magnitude of electrical torque is sufficient to overcome the control spring torque closing of the lefthand contact. The closing of this contact operates relay "A" in a so called "PICK UP AND KNOCK DOWN" circuit, that is, "A" PICKS UPS and seals around the contact that picked it up. The operation of "A" activates the solid state timer , which in turn causes relay "B" to function if the underfrequency condition persists longer than the time delay setting. The operation of "B" energizes the trip circuit and the target seal-in unit which provides a seal around the "B" contact. Should the frequency restore to normal before the prescribed time delay expires, the righthand contact of the sensing unit will close shorting-out relay "A" causing it to drop-out. The drop-out of "A" discharges the timing card capacitor, thereby providing a quick reset to normalize the circuit for the next underfrequency condition. The Type CFF23A does not use the pick-up knock down circuit. Zeners across the "A" coil prevents false operation and quick reset.

The solid state timer which is activated by the operation of the "A" auxiliary relay, applies voltage to the R-C timing circuit. The magnitude of the time delay is under the control of the rheostat R-2. The transistor Q3 and Q4 are in the scheme to achieve the delay with relatively small R and C values. When the charge on the capacitor reaches the proper voltage level, transistors Q1 and Q4 turn on to pick-up the "B" auxiliary relay thereby completing the timing function.

OPERATING CHARACTERISTICS

The CFF relays operate to close their contacts when the applied source frequency is below the present value. The 60 cycle frequency-voltage curve is shown in Fig. 11. Two characteristics are shown, with and without the use of zeners in one of the coil circuits. The change in the opening frequency is plotted in Delta Hz.

Fig. 12 is also a frequency-voltage curve and indicates the maximum change that may occur with respect to ambient temperatures. These are relays without zeners. Fig. 13 is a similar set of characteristics on relays which use zeners diodes.

Fig. 14 is so called "COLD PICKUP" characteristic. This characterisitc endeavors to show the change in calibration on a relay de-energized for time long enough to have all its components return to the ambient temperatures indicated. The operating frequency at the first instant power is reapplied to the relay will be higher as shown by the curve, hence, there is the danger of a false trip in setting the calibration too close to the power system frequency.

All models of the 12CFF23A relays are supplied with zeners.

The model 12CFF22C1A, does not have zeners, however, all other CFF22C relays with form numbers of two and aobve use zeners, i.e. 12CFF22C2A. C3A, etc.

CONSTRUCTION

The frequency sensing unit houses a cup and shaft assembly that carries the moving contact. This assembly is supported on the bottom by a non-magnetic and rust proof pivot resting on a synthetic spring mounted jewel bearing. The compression spring acts to prevent jewel damage should the moving system be subjected to mechanical shock. At the upper end of the shaft, a stainless steel guide pin rides in a polished bronze bushing assembly. This tops bearing serves to keep the cup and shaft assembly properly aligned in the unit as well as controlling the desired end play.

The moving contact assembly is a moulded hub, that supports the contacts and a spiral spring. The spiral spring assembly is affixed to an adjustable metal ring, which sets directly above the control spring. The ring, after adjustment may be locked in position in its moulded assembly by a hex stud located directly behind the upper pivot.

Barrel type stationary contact assemblies are located on either side of the moving contact. These stationary contacts house a silver contact mounted on a flexible bronze disc which provides for the desired amount of wiping action. The assembly also houses a steel ball that rests against a metal disc, directly behind the contact. The presence of the ball minimizes contact bounce should torque levels exceed the forces to totally compress the flexible contact spring. The stationary contacts are held in position by a screw which holds the barrels secure in the contact support. The entire barrel may be removed by loosening the clamping screws.

The target-seal-in unit is located at the upper lefthand side of the relay. It consists of a hinged armature type of assembly operated by either a voltage or current coil depending upon the rating of the relay. The operation of the relay causes the armature and its contact to complete the trip circuit and also to expose the target. The target is reset by a rod assembly located at the lower lefthand corner of the cover.

The auxiliary relays "A" and "B" are located to the right of the target assembly. These units are typical telephone type relays, designed to operate with minimum time delay.

Rheostats R-1 and R-2 are mounted on a panel just below the aforementioned units.

R-1 is on the left just under the nameplate stamping "Frequency Control". This rheostat along with the tapped Resistor R-4 provides the control for setting the underfrequency unit to the desired calibration. The rheostat has a lock nut to secure the adjustable arm after the setting has been made.

R-2 is on the right just under the nameplate stamping "Time". This rheostat controls the level of the time delay required and is also provided with a means to lock its arm after the setting has been made.

The solid state timing card is just below the rheostat panel, and is held in position at the front by a notched block that supports the card. The card may be removed by first removing the front supporting block and then carefully disengaging it from its rear control block.

The case is suitable for either surface or semiflush panel mounting and an assortment of hardware is provided for either mounting. The cover attaches to the case and also carries the reset mechanism. Each cover screw has provision for a sealing wire.

The case has studs and screw connections at the bottom for the external connections. The electrical connections between the relay unit and the case studs are made through spring backed contact fingers mounted in stationary moulded inner and outer blocks between which nests a removable connecting plug which completes the circuits. The outer blocks, attached to the case carries the studs for the external connections, and the inner block carries terminals for the internal connections.

The relay mechanism is mounted in a steel framework called the cradle and is a complete unit with all leads being terminated at the inner block. This cradle is held firmly in the case with a latch at the top and the bottom and by a guide pin at the back of the case. The case and cradle are so constructed that the relay cannot be inserted in the case upside down. The connecting plug, besides making the electrical connections between the blocks of the cradle and the case, also locks the latch in place. The cover, which is fastened to the case by thembscrews, holds the connecting plug in place.

To draw out the relay unit the cover is first removed, and the plug pulled out. The latches are then released, and the relay can be easily drawn out. To replace the relay, the reverse order is followed.

A seperate testing plug can be inserted instead of the connecting plug to test the relay in place on the panel either from its own source of voltage, or from other sources. Or, the relay can be drawn out and replaced by another which has been tested in the laboratory.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay in order that none of the parts are injured or the adjustments disturbed.

If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

ACCEPTANCE TESTS

The following are recommended mechanical checks to insure that the relay is in proper working order:

The Induction Cup Unit

The moving contact assembly should be resting against the right hand stationary contact. The contact gap should be approximately 1/16 inch. Each full turn of the contact barrel alters its position by 1/32 of an inch, hence serves as a convenient means to check or set the contact gap.

The cup-shaft end play has been set to be between 0.015 inches and 0.020 inches. If resetting is necessary keep the end play within these limits.

Check to see that there is some contact deflection or wipe in the flexible stationary contact. The deflection is in the order of the 0.005 inches to 0.010 inches.

Target Seal-In Unit

Operate the armature by hand and note that the bridging contacts make at about the same time with some wiping action before the armature comes to rest against the pole piece. During this operation the target should come into view and latch in before the total travel is exhausted. The reset lever should reset the target.

Auxiliary Telephone Relays "A" and "B"

All normally open contacts should have a contact gap of at least 0.010 inches.

Operate the closing armatures by hand and note that the closing contacts make and deflect at least 0.005 inches before the end of the armature travel.

Frequency and Time Control Rheostats

The locking nuts for both the R-1 and R-2 rheostats should be tight.

Position of the Voltage Control Taps

The control circuit for the auxiliary units in the CFF23A relay are operated from a DC power supply. Two tap blocks with triple voltage ratings are located on either side of the lower unit; one for the auxiliary relays, the other for the timing circuit.

Check to see that the tap leads are in the proper voltage position and tightened securely.

The following are the general procedures for checking the relay electrically:

Target Seal-In Units

The unit used in the CFF23A relays are current operated devices, usually dual rated i.e. 0.2/2.0 or 0.6/2.0 amperes. These seal-in units should pick-up at a value equal to or less than the tap rating. Upon picking-up, the contacts should wipe fully, and the target should drop. Both tap ratings should be checked. In the process of transferring to the other tap, do not remove the screw from the tap being used first, rather remove one of the screws from the opposite stationary contact and insert this in the other current tap. Then replace it with the screw used in the first test tap. This procedure keeps the stationary contacts in their original position thereby preserving proper contact alignment.

The unit used in the Model 12CFF12C is an AC voltage operated device. The pickup voltage of this unit should be 70% or less than the voltage rating.

Auxiliary Unit "A"

These relays are voltage operated devices and should pick-up at 70% or less than the control circuit rating. The voltage rating in the case of the CFF23A depends upon the voltage tap selection. Carefully check which tap should be used before proceeding with this test. The same percentage pick-up values apply to the AC control relays in the CFF22C.

Auxiliary Unit "B"

These units are related to the timing circuit and the operating value is the same in either of the Models 12CFF23A or 22C. Normally, this unit need not be tested since it will be checked indirectly during the test on the static timer. However, in the event of some question as to its performance it may be checked by first removing the timing card from the circuit, and applying a low level of DC voltage across the coil. The relay should pick-up at three volts or less.

Solid State Timer Checks

This unit is tested at the factory to see that the controls provide for a continuously adjustable time range from 6 to 60 cycles, via Rheostat R-2. Refer to test diagrams Fig. 17 for the CFF23A and Fig. 18 for the CFF22C.

To check the operating time, block the normally open contacts of the frequency sensing unit closed and close the test switch to apply power to the relay and timing circuit simultaneously.

To test time values other than the present setting, first loosen the locknut just in back of the rheostat knob. After the time check and settings have been finalized, carefully relock the rheostat shaft.

The operating time is not critical with respect to the voltage applied to the relay, since the timing circuit is under the control of voltage regulating zeners.

Fig. 15 and Fig. 16 are photographs of the timing card for the CFF23A and CFF22C respectively.

The Induction Cup Unit

This frequency sensing unit has been calibrated at the factory to close its trip contact at the frequency stamped on the nameplate.

To check this value apply rated voltage and frequency to the relay as indicated in the Test Diagrams: Fig. 19 for the CFF23A and Fig. 20 for the CFF22C.

Permit the relay to heat up for at least one hour with rated voltage and frequency to stabilize the calibration before checking the operating frequency.

In the process of checking or setting the calibration of these relays, be sure that the relay is sitting in a level position, i.e. as it will be when mounted on a relay panel.

The frequency setting of the unit is under the control of the rheostat R-1 and the tapped resistor R-4. The latter permits additional resistance to be added to the circuit as required, since resistance of R-1 is not sufficient to cover the rated range of frequency settings.

The test procedure for resetting the calibration should be as follows:

In this case it is assumed that the relay has not been energized for some time, hence all its components are at room temperature.

1. Set leads on R-4, for zero resistance.

2. Set R-1 in its mid position.

3. Apply rated voltage and frequency for about ten minutes, then set the calibration by R-1 and a section of R-4 if necessary to within ±0.1 Hz of the required setting. This preliminary setting will place the calibration control resistance near its final value during the self-heating period.

4. Permit the relay to self-heat for at least one hour at rated voltage and frequency, then finalize the calibration to the desired value within ±0.02 Hz and lock the rheostat.

5. Check the operating value at other voltage levels.
   a. The operating frequency on relays without zeners should not fall more than 0.3 Hz at 80 volts. If it does, reduce the control spring setting to just reach this level. The control spring wind-up must be great enough to be sure that the right hand contact will close when no power is applied to the relay, hence do not weaken it more than necessary. See Fig. 11 and Fig. 12.

   b. On relays that use zeners, check the operating frequency down to 60 volts in about 15 volt steps, to determine the flatness of the characteristic. With a minimum wind-up of the control spring the operating frequency will rise as the voltage is reduced due to the zeners. Increasing the control spring tends to flatten the curve. In general making the 60 volt setting close to the rated voltage should yield a characteristic within +0.05 to -0.1 Hz from 60 to rated volts. See Fig. 11 and Fig. 13.

The control spring setting at 59 Hz calibration will be greater than at 57 Hz, hence it is adviseable to shoot this voltage characteristic if frequency change in the order of 0.5 Hz or more is planned in order to keep the variation of the operating frequency with respect to voltage to a minimum. See characteristics shown in Fig. 11.

LOCATION

INSTALLATION

The location should be clean and dry, free from dust and excessive vibration, and well lighted to facilitate inspection and testing.

MOUNTING

The relay should be mounted on a vertical surface. The outline and panel drilling for either surface or semiflush panel mounting is shown in Fig. 21.

One of the mounting studs or screws should be permanently grounded by a conductor not less than No. 12 B & S gage copper wire or its equivalent.

CONNECTIONS

Internal connection diagrams for the relays are shown in Figs. 5 and 6. A typical wiring diagram is shown in Fig. 9 for the Type CFF23A and in Fig. 10 for the Type CFF22C.

ADJUSTMENTS

The relays are calibrated at the factory and should not require any further adjustment. If it is desirable to check the frequency characteristic, follow the procedure outlined under MAINTENANCE.

INSPECTION

At the time of installation, the relay should be inspected for tarnished contacts, loose screws, or other imperfections. If any trouble is found, it should be corrected in the manner described under MAINTENANCE.

MAINTENANCE

The relays are adjusted at the factory, and it is advisable not to disturb the adjustments. If for any reason they have been distrubed, the following points should be observed in restoring them.

SHAFT AND BEARINGS

The lower jewel screw can be removed from the unit by means of an offset screw driver or an end wrench. The jewel may be tested for cracks by exploring its surface with the point of a fine needle.

The lower jewel bearing should be screwed all the way in until its head engages the end of the threaded core. The upper bearing should be adjusted to allow about 1/64 inch end play of the shaft.

To check the clearance between the iron core and the inside of the rotor cup, press down on the contact arm near the shaft, and thereby depress the spring mounted jewel until the cup strikes the iron. The shaft and cup should move about 1/16 inch.

CUP AND STATOR

If it is necessary to remove the rotor from the unit, the following procedure should be followed.

The leads should first be removed from the contact structure and tagged for identification in reconnecting. Then remove the three flat head screws which fasten the unit to the mounting plate from the back.. Tilt the stator forward and remove the four corner screws which hold the contact head to the stator. The entire top structure with the rotor can then be lifted away from the stator to give access to the assembly. Care should be taken not to strain the leads entering the back of the stator. Unless there is reason for removing the stator from the cradle, these leads need not be disconnected.

To remove the shaft and rotor from the contact head assembly, the spring clip at the top of the shaft must be pulled out, and the clutch adjusting screw and spring taken out of the molded contact arm.

The rotor should be handled carefully while it is out of the unit, and the stator should be protected to keep it free from dust or metallic particles.

In reassembly, the rotor will go into the air gap easily if the parts are hold in proper alignment.

CONTACT CLEANING

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files, or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts and thus prevent closing.

The burnishing tool described is included in the standard relay tool kit obtainable from the factory.

CONTACT ADJUSTMENT

Should it be necessary to change the stationary contact mounting spring, remove the contact barrel and sleeve as a complete unit after loosening the screw at the front of the contact block. Unscrew the cap. The contact and spring may then be removed.

The moving contact may be removed by loosening the screw which secures it to the contact arm and sliding it from under the screw head.

The contact gap may be adjusted by slightly loosening the screw at the front of the contact block. It should be loose enough only to allow the contact barrel to rotate in its sleeve.

The right contact should hold the moving contact arm in a neutral position, i.e. with it pointing directly forward. Bring the left stationary contact up until it just touches the moving contact by rotating the barrel. Then back it away two full turns to obtain 1/16 inch contact gap. Tighten the screws which secure the contact barrels.

CLUTCH ADJUSTMENT

If for any reason the moving contact arm has been removed or loosened from the rotor shaft it will be necessary to reset the clutch. The screw on the side of the contact arm should be tightened to bottom the internal compression spring, then back-off two turns and lock with nut.

CALIBRATION PROCEDURE

Refer to section on Acceptance Tests.

PEROIDIC TESTING

An operational test and inspection of the relay at intervals of six months is recommended. The calibration need not be checked, but operation of the auxiliary circuits should be tested.

In testing relay Types CFF23A an adjustable resistor should be substituted for the breaker trip coil. It should be set to draw current equal to 95 per cent of tap setting of the target seal-in unit. When testing relay Types CFF22C, an indicating lamp should be used in place of the breaker trip coil.

To check operation of the auxiliary circuits follow the sequence tabulated on Table E.

TABLE E

	OPERATE SUCCESSIVELY BY HAND			
RELAY	1. Close Left Contacts	2. Open Left Contacts	3. Close Right Contacts	4. Open Trip Circuit
	RESULT			
CFF23A	Telephone relay "A" then "B" picks up, target seal-in picks up, trip current flows.	Relays "A" and "B" Drop Out	No Right Contact	Target seal-in drops out. Target remains exposed.
CFF22C	Telephone relay "A" then "B" picks up, target and auxiliary relay picks up, indicating lamp lights.	No Action	Telephone relays drop out, target and auxiliary relay drops out, target remains exposed, indicating lamp extinguishes.	No Action

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken, or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specify quantity required, name of part wanted, and give complete nameplate data of the relay. If possible, give the General Electric Company requisition number on which the relay was furnished.

	RESISTANCE			
	24V	48V	125V	250V
R5	150	450	1.5K	3.5K
R6	100	650	2.3K	5K
R4	3.7K TAPPED AT 1.2K			

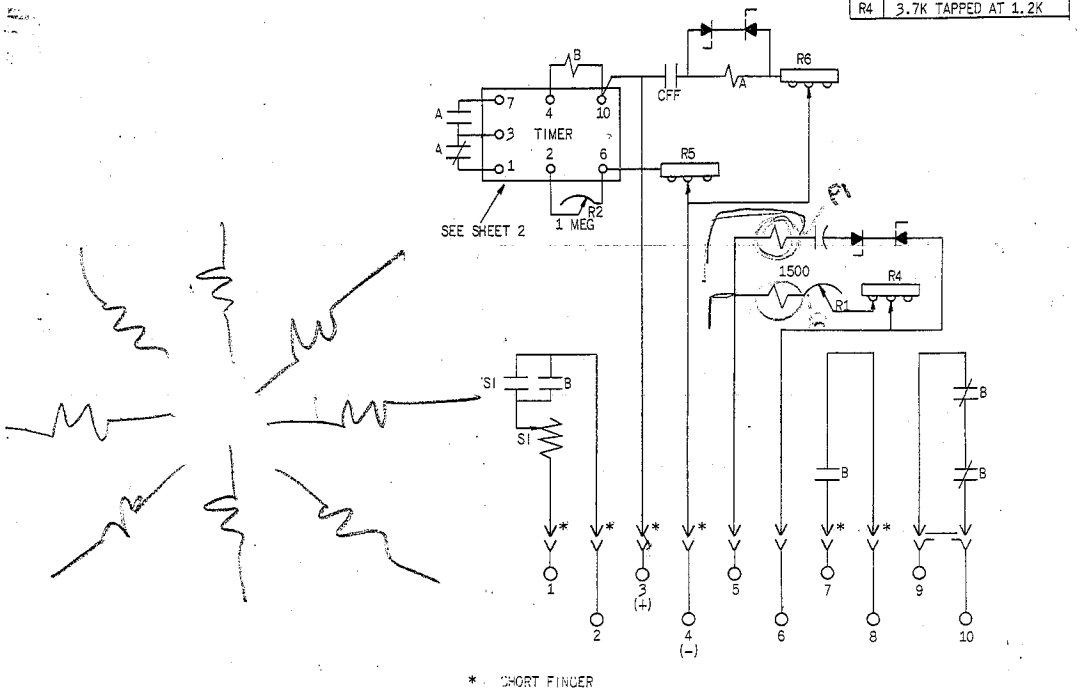
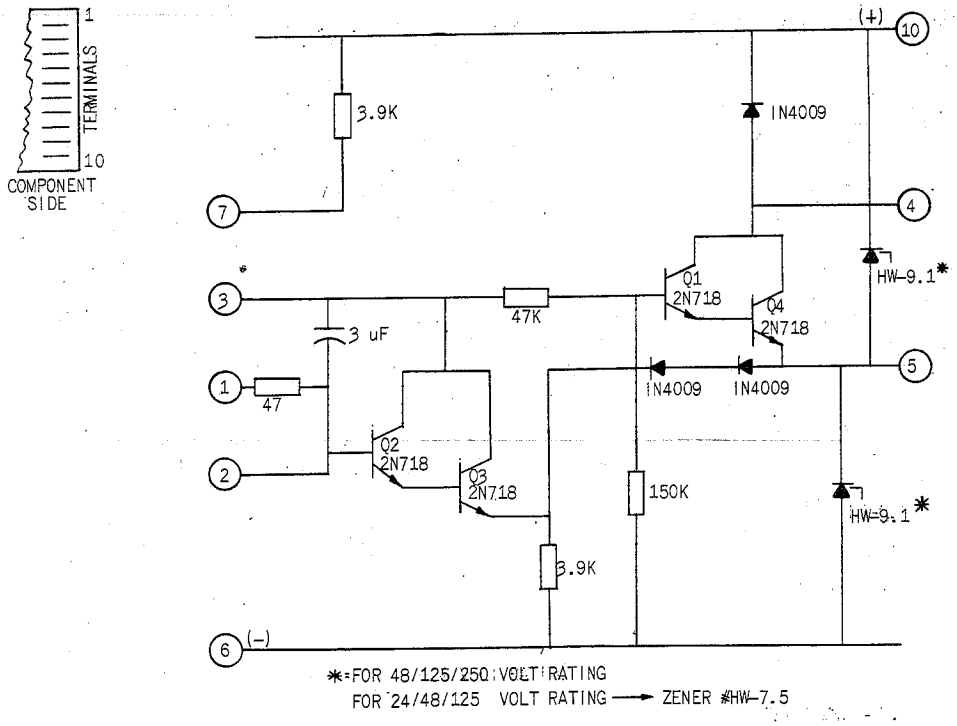


FIG. 5A (0226A7222-1) Sh. 1 Internal Connections Diagram For The CFF23A Relay (Front View)



P.C. CARD 0165B1991 GR-1

FIG. 5B (0226A7222-0) Sh. 2 Internal Connections Cont'd.

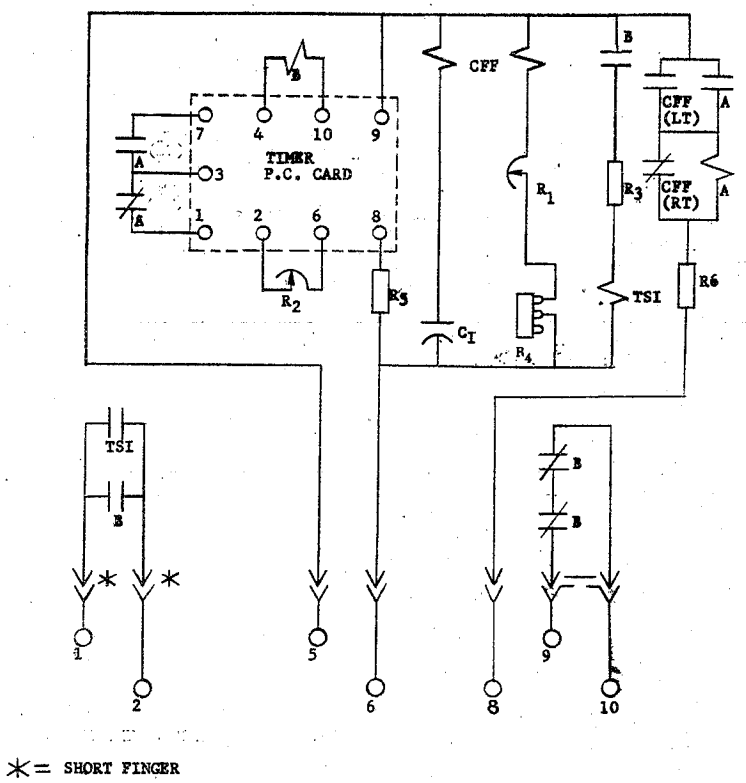


FIG. 6A (0207A7839-3) Sh. 1 Internal Connections Diagram For The CFF22C (Form 1 Only) (Front View)

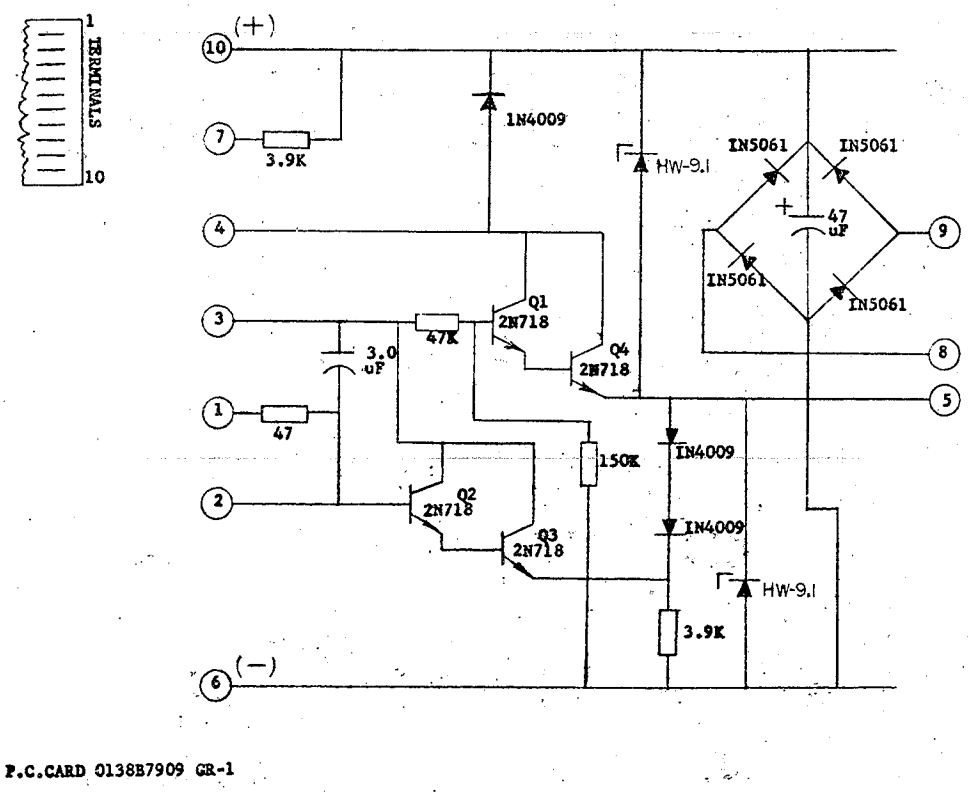
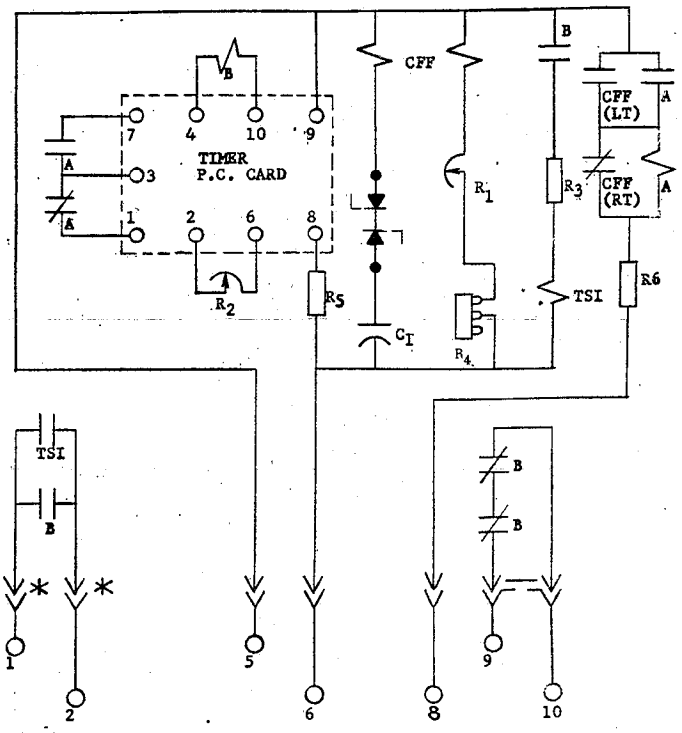
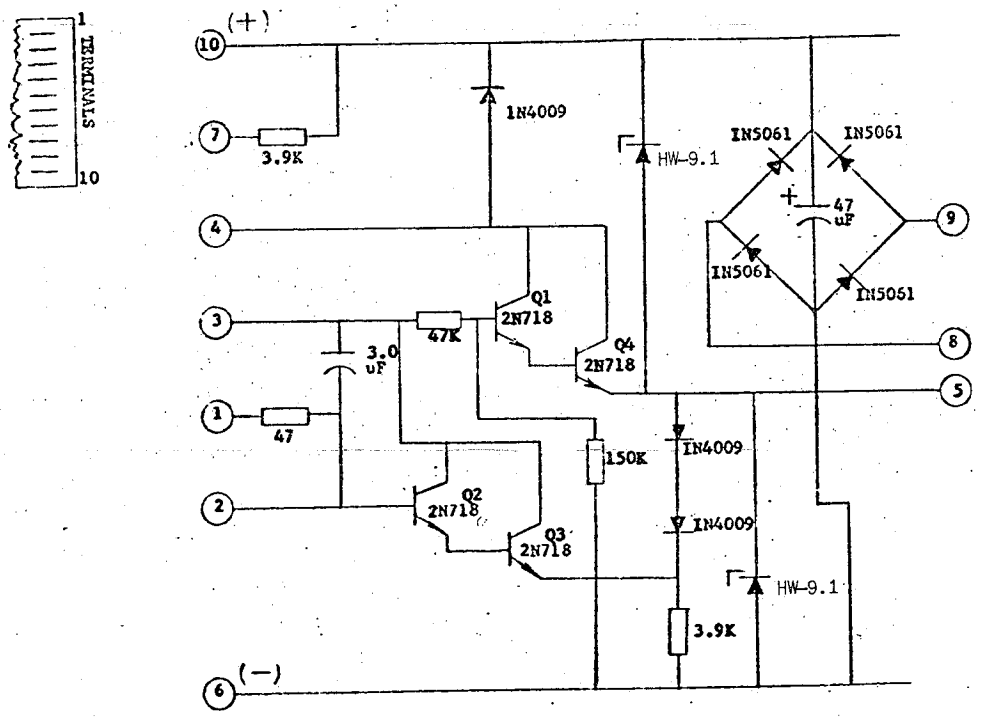


FIG. 6B (0207A7839-4) Sh. 2 Internal Connections Cont'd.



*= SHORT FINGER

FIG. 7A (0208A2359-1) Sh. 1 Internal Connections Diagram For The CFF22C2 And Up (Front View)



P.C.CARD 0138B7909 GR-1

FIG. 7B (0208A2359-0) Sh. 2 Internal Connections Cont'd.

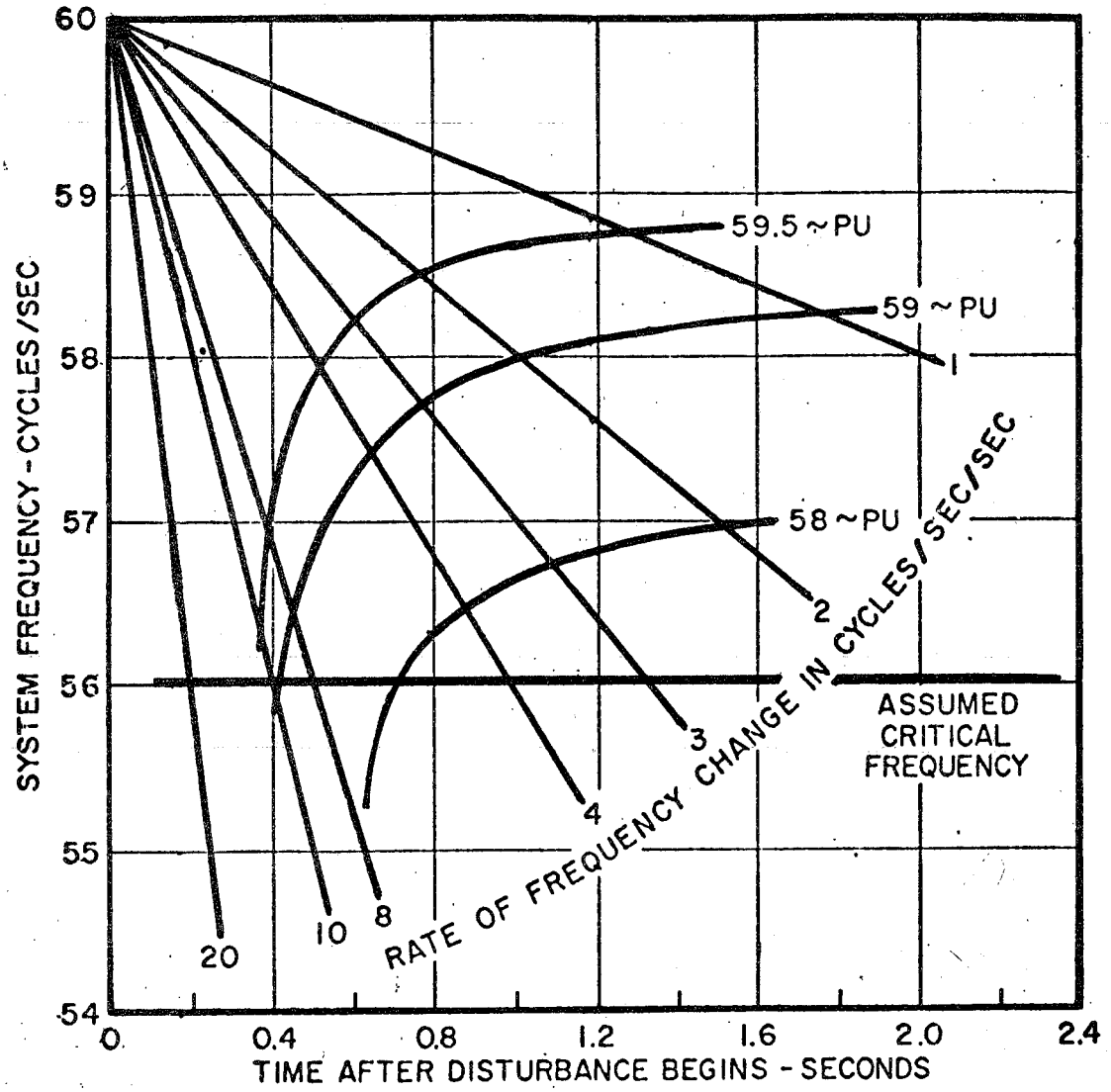


FIG. 8 (0208A2413-0) Frequency VS Time Characteristic For Total Clearing Time

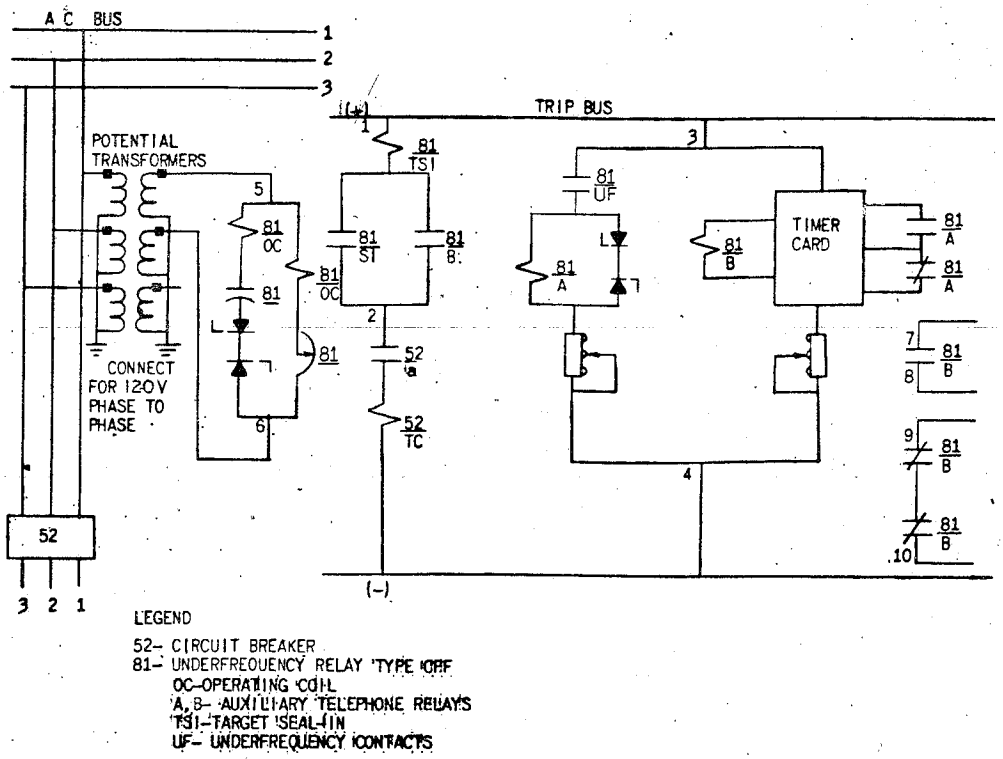


FIG. 9 (0227A2520-0) External Connections Diagram For The CFF23A Relay

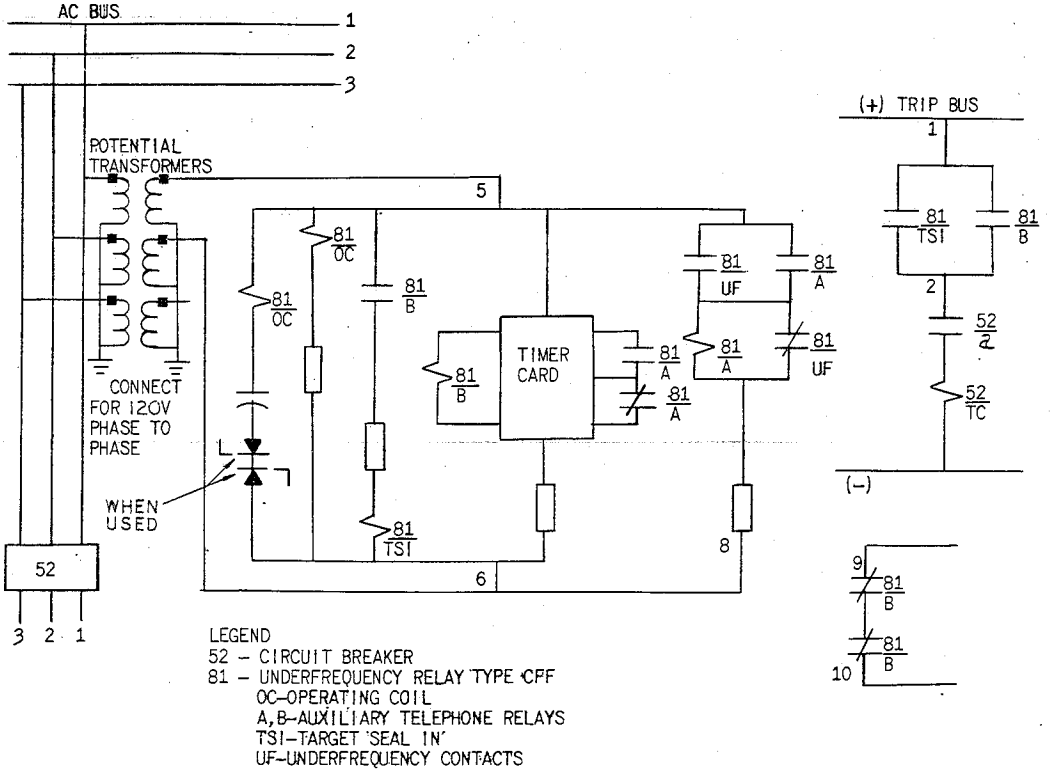


FIG. 10 (0208A2410-2) External Connections Diagram For The CFF22C Relay

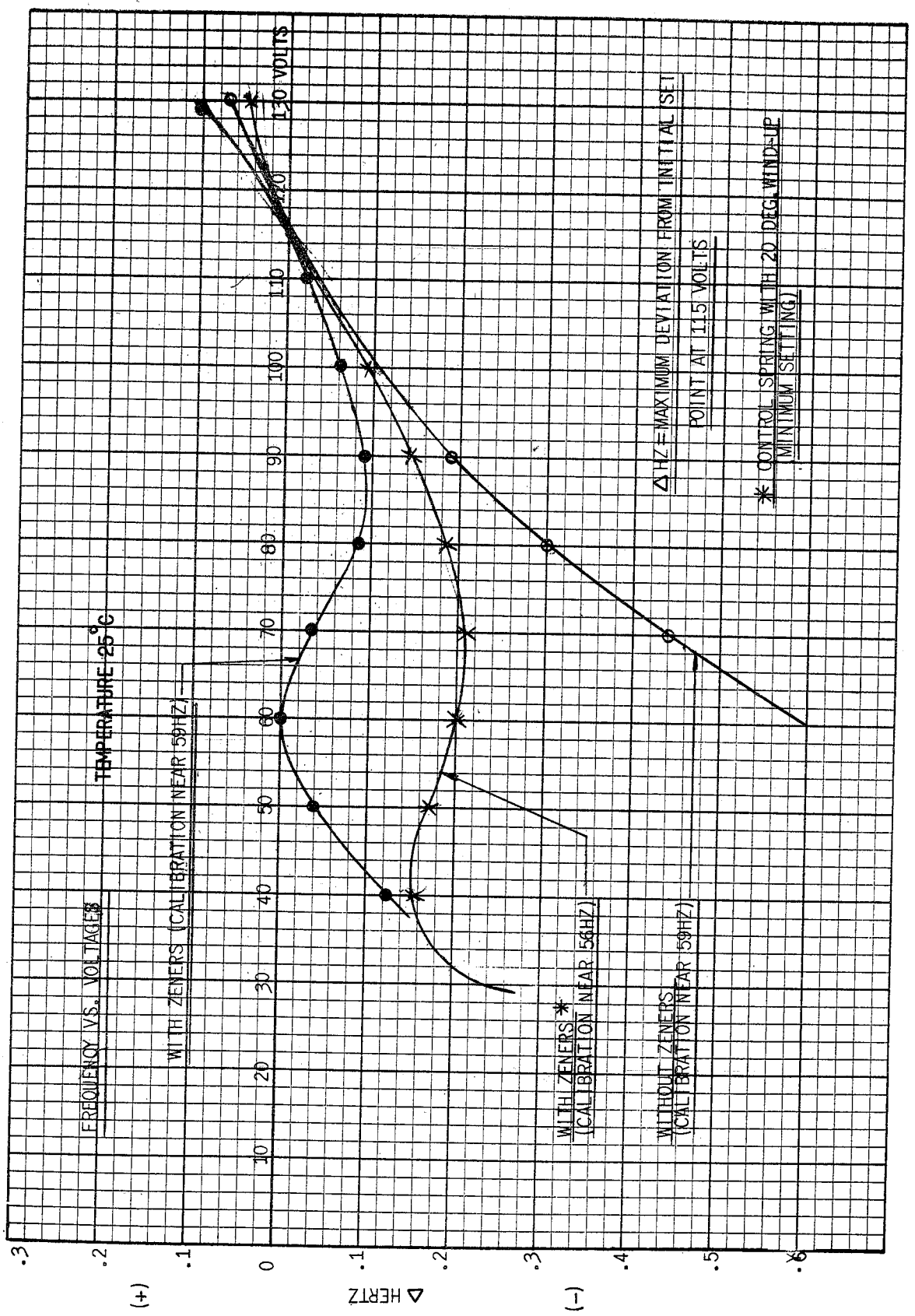


FIG. 11 (0226A6951-0) Frequency VS Voltage Characteristic

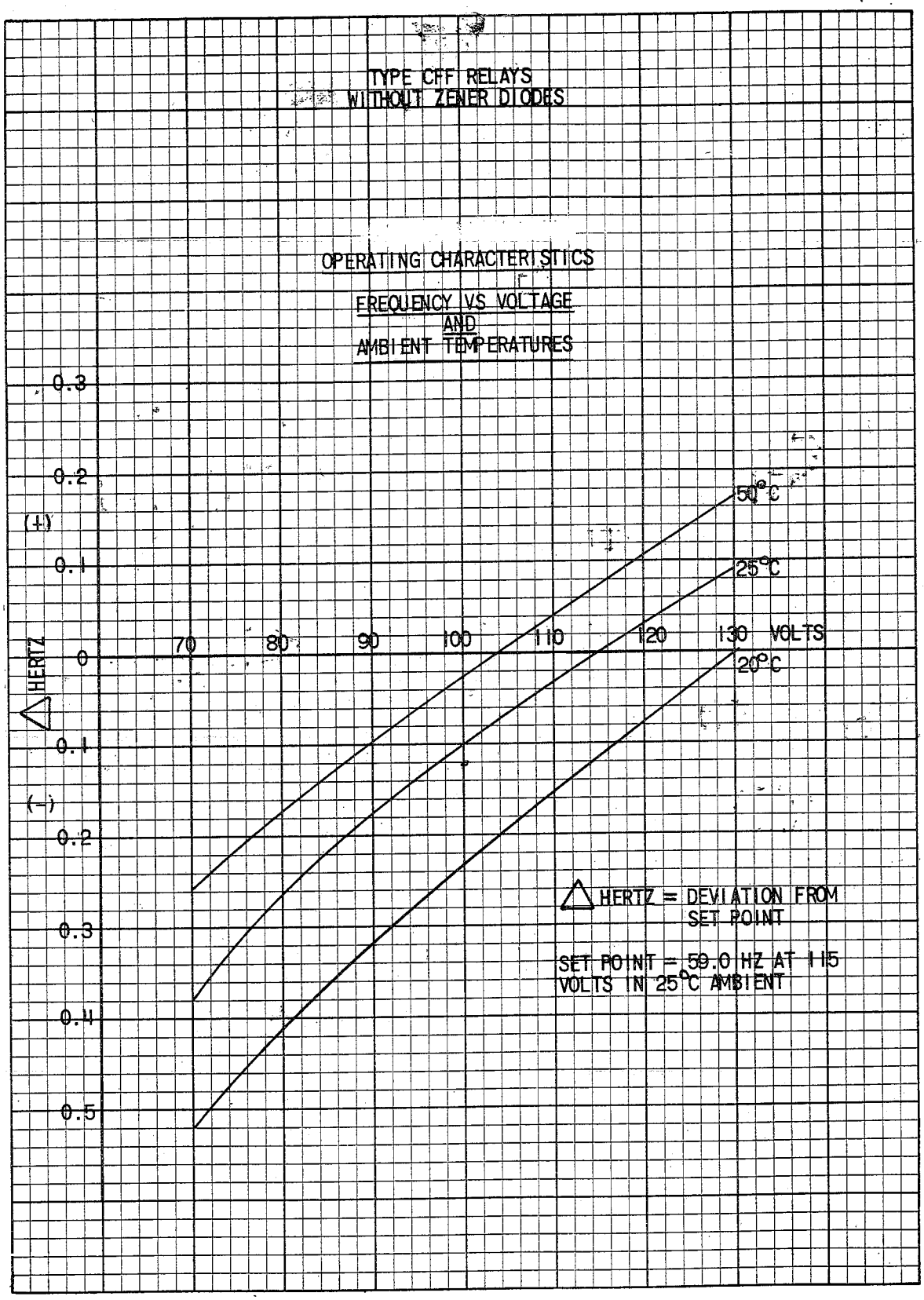


FIG. 12 (0226A6950-1) Frequency VS Voltage And Ambient Temperature (Without Zener Diodes)

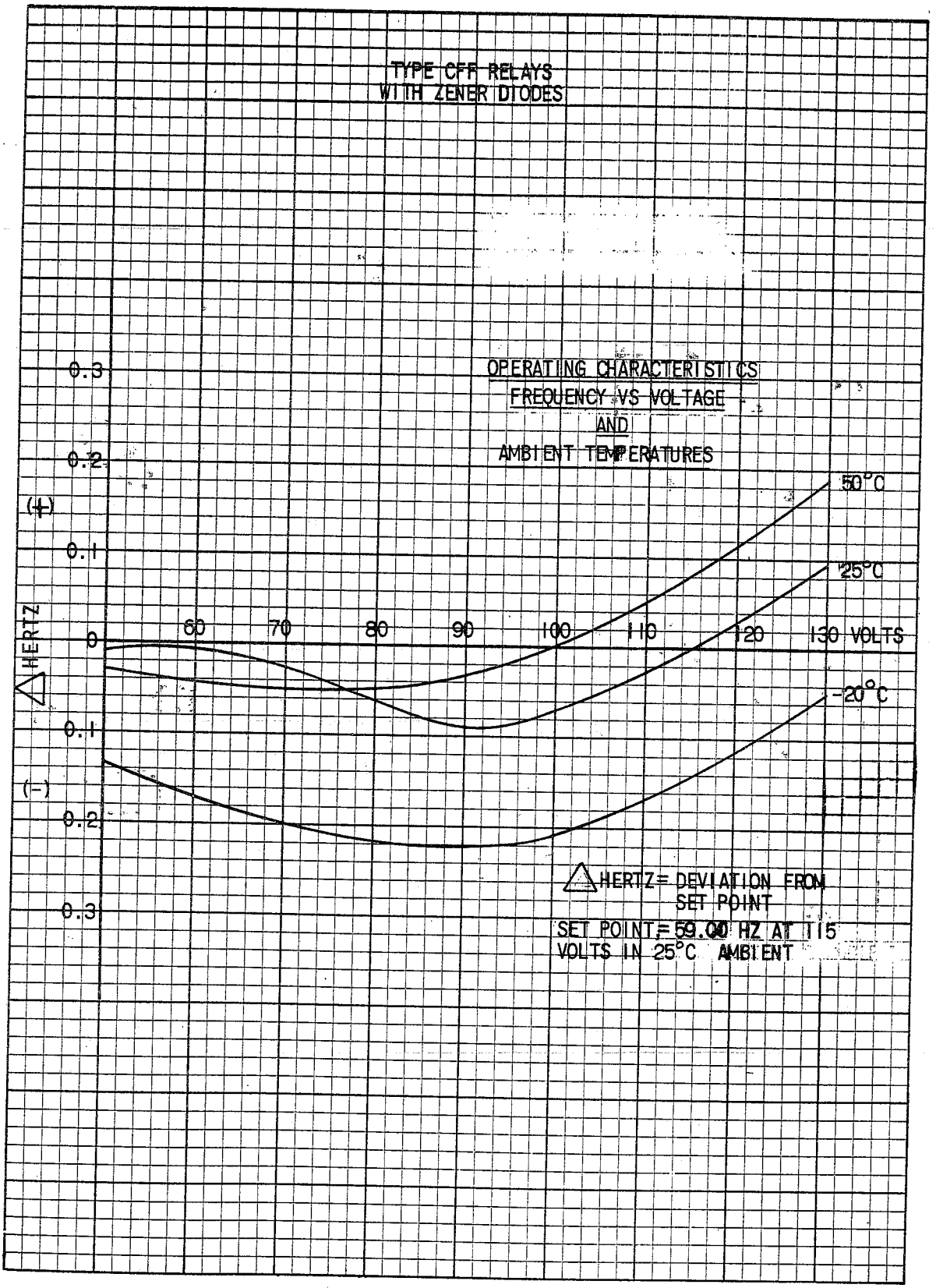


FIG. 13 (0226A6952-1) Frequency VS Voltage And Ambient Temperature (With Zener Diodes)

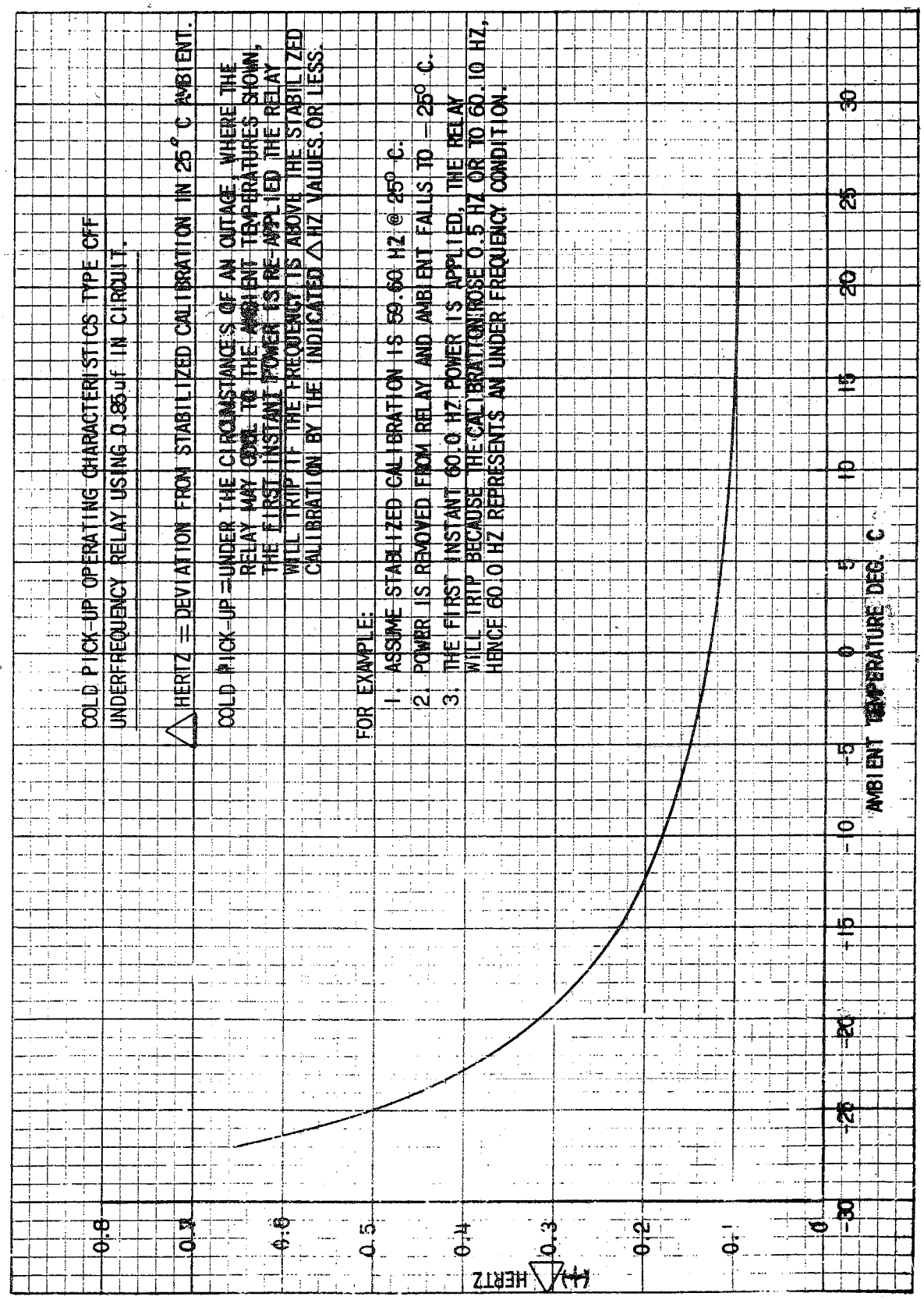


FIG. 14 (0108A5552-1) Cold Pick-up Operating Characteristic

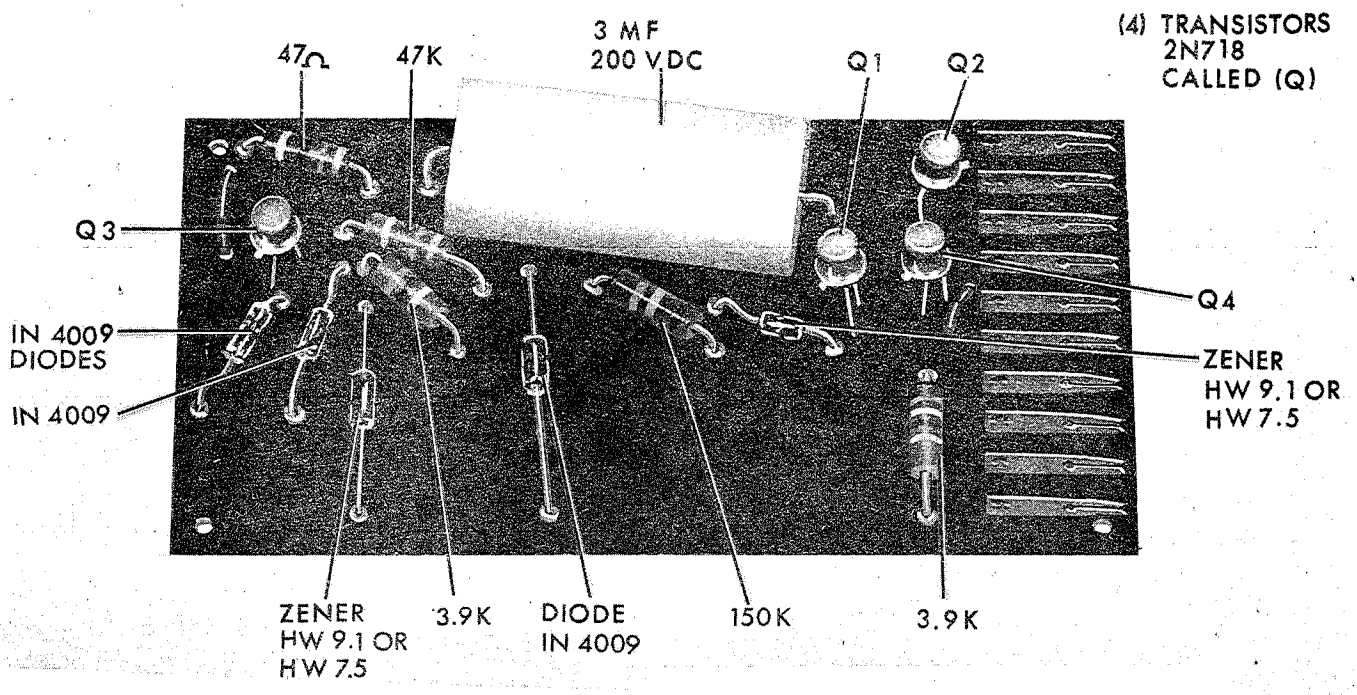


FIG. 15 (8039227) Solid State Timing Card For The CFF23A Relay

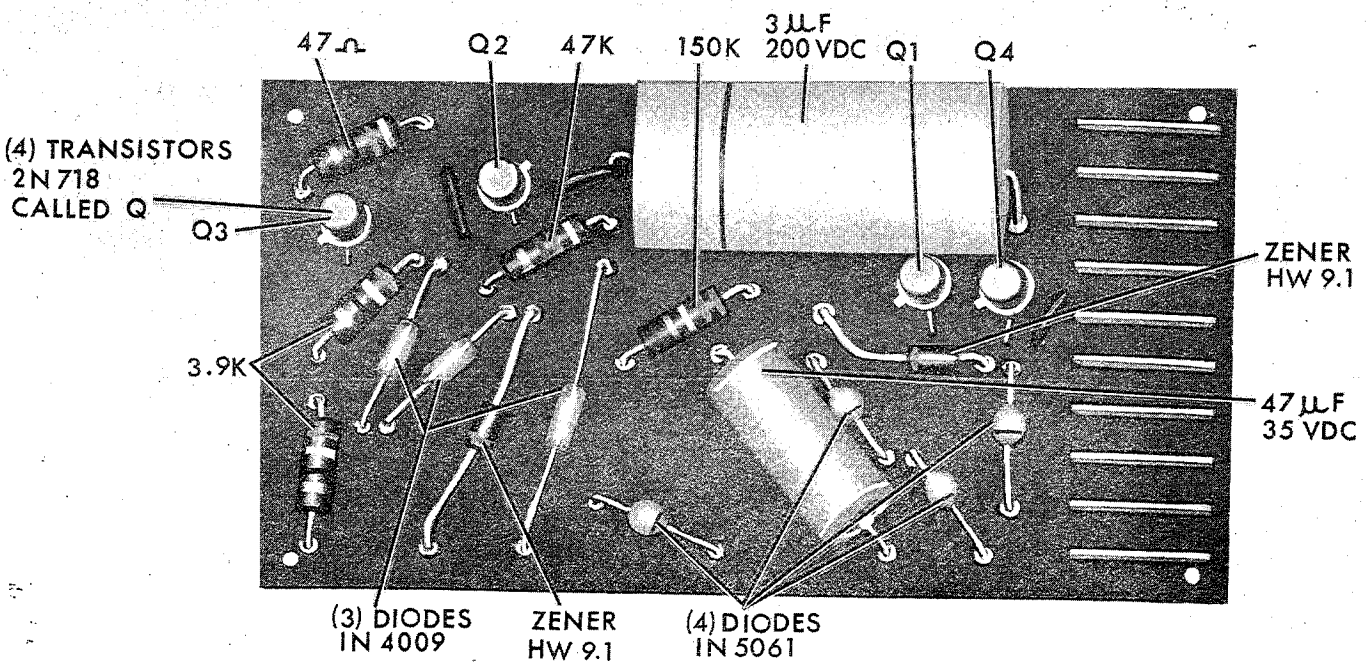
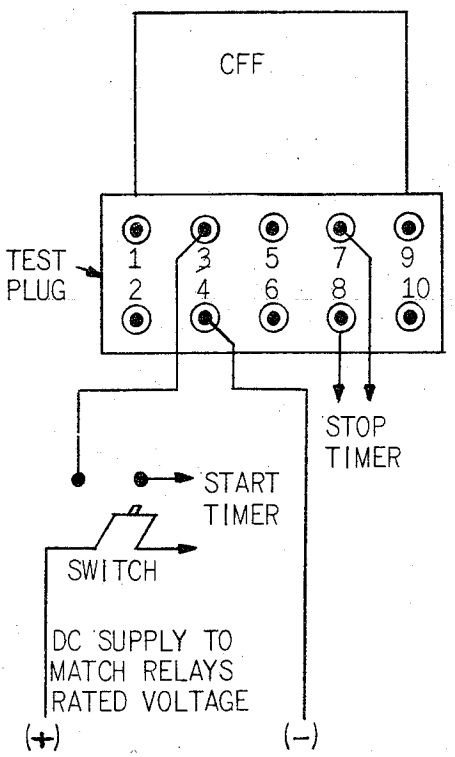


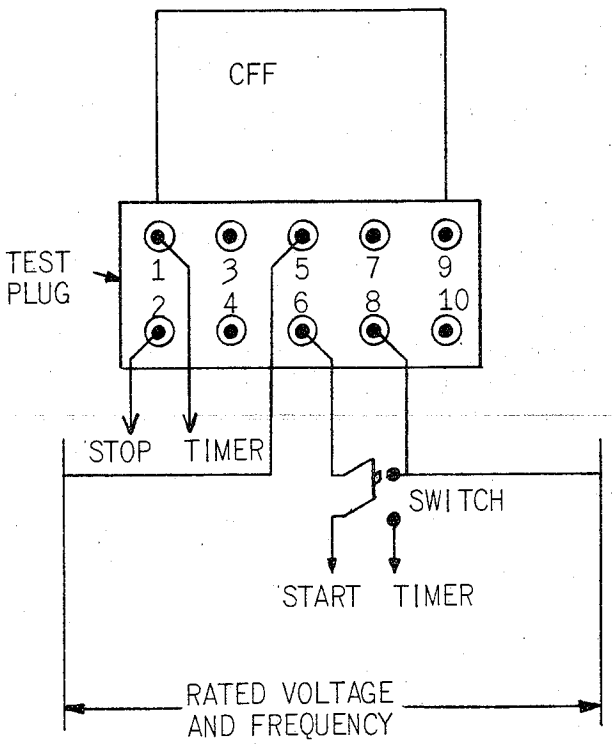
FIG. 16 (8038871) Solid State Timing Card For The CFF22C Relay



BLOCK LEFT HAND (FV) CONTACTS OF FREQUENCY SENSING UNIT CLOSED.

CLOSING SWITCH WILL START BOTH SOLID STATE TIMER IN RELAY AND TIME MEASURING DEVICE SIMULTANEOUSLY.

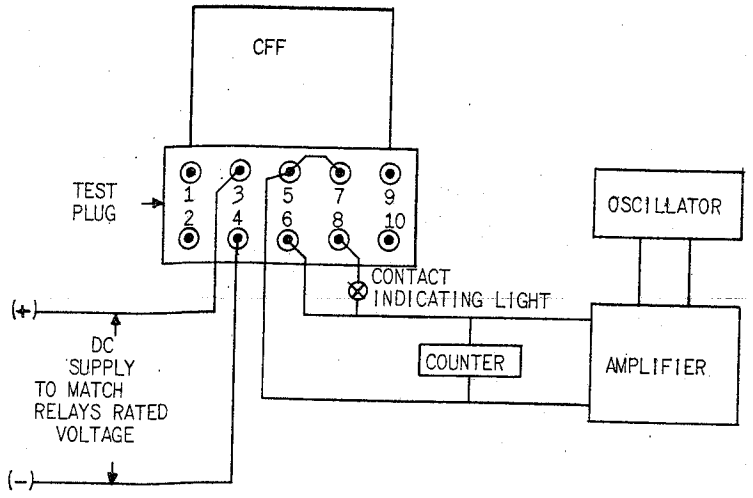
FIG. 17 (0208A2470-1) Solid State Timer Test Circuit For The CFF23A Relay



BLOCK LEFT HAND (FV) CONTACTS OF FREQUENCY SENSING UNIT CLOSED.

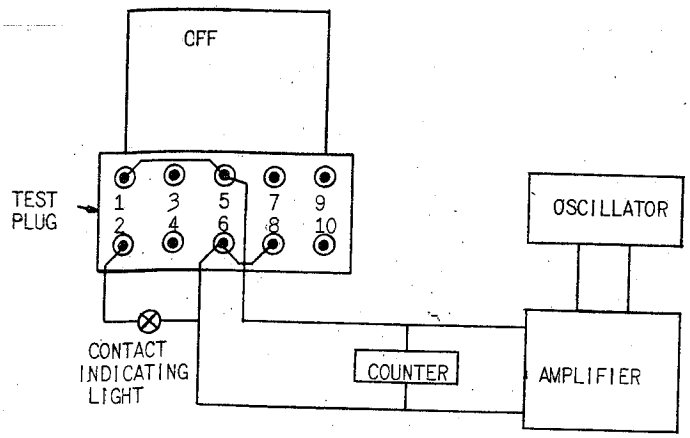
CLOSING SWITCH WILL START BOTH SOLID STATE TIMER IN RELAY AND TIME MEASURING DEVICE SIMULTANEOUSLY

FIG. 18 (0208A2469-0) Solid State Timer Test Circuit For The CFF22C Relay



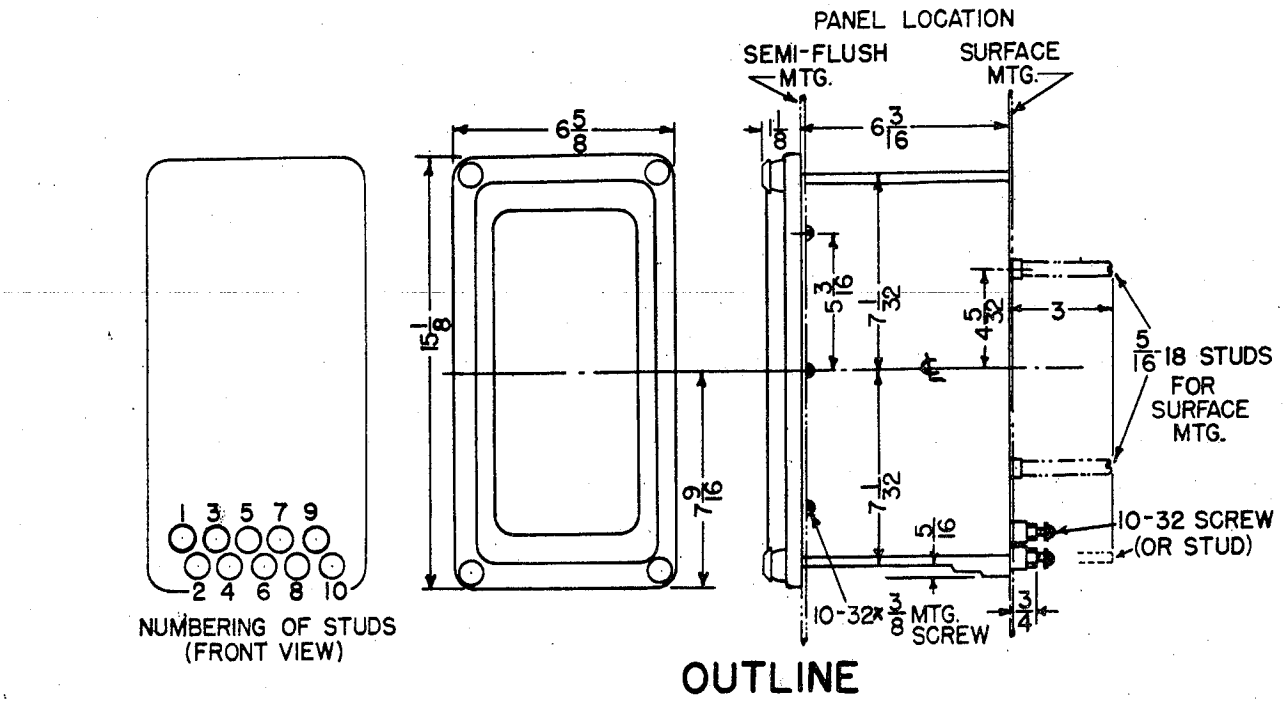
	TEST GEAR	
OSCILLATOR	HEWLETT PACKARD CAT. – 241A	OR EQUIVALENT
AMPLIFIER	BEHLMAN – INVAR CAT – 161	
COUNTER	HEWLETT PACKARD CAT – 5223 – L	

FIG. 19 (0208A2468-1) Frequency Unit Test Circuit For The CFF23A Relay

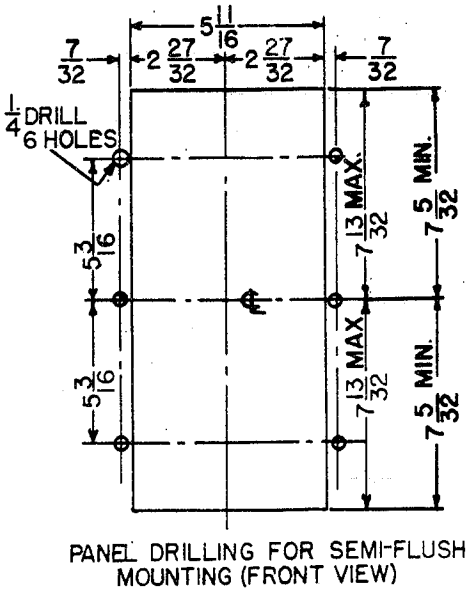


	TEST GEAR	
OSCILLATOR	HEWLETT PACKARD CAT. – 241A	OR EQUIVALENT
AMPLIFIER	BEHLMAN – INVAR CAT. – 161	
COUNTER	HEWLETT PACKARD CAT. – 5223 – L	

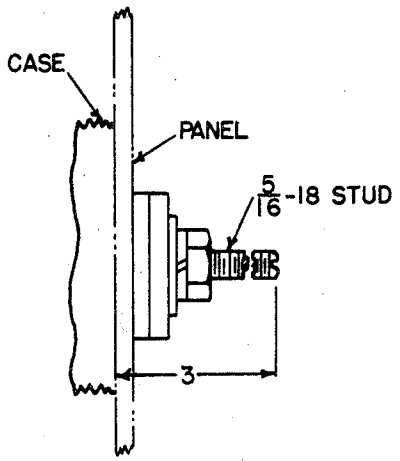
FIG. 20 (0208A2467-0) Frequency Unit Test Circuit For The CFF22C Relay



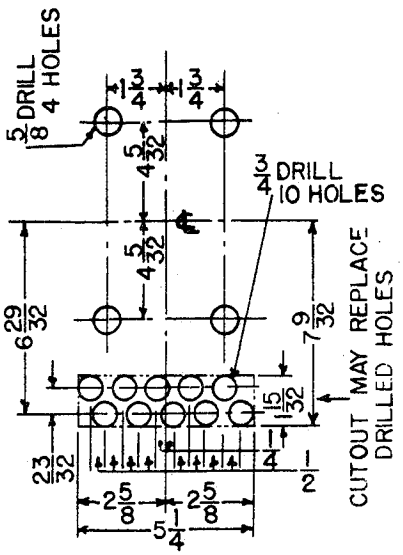
OUTLINE



PANEL DRILLING FOR SEMI-FLUSH MOUNTING (FRONT VIEW)



VIEW SHOWING ASSEMBLY OF HARDWARE FOR SURFACE MTG. ON STEEL PANELS



PANEL DRILLING FOR SURFACE MOUNTING (FRONT VIEW)

FIG. 21 (K-6209273-2) Outline And Panel Drilling Dimensions For Type CFF Relays

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