SERVICE MANUAL

DUAL ELECTRIC AND 12 VOLT REFRIGERATORS

NON-TEK II MODELS

DE 828
DE 704C
DE 728
DE 400C
DE 251D
DE 250F
DE 254
DC 230

MRFT 615B
MRFT 630B
MRFT 640B
MRFT 660
SRBD 630
TRBD 630
SCQT 6406
SCQR 6800
V2000

INTRODUCTION

Purpose of Service Manual

The purpose of this service manual is to provide a general service reference for Norcold Dual Voltage and 12 Volt refrigerators. The following sections will be concerned with general information, service instructions, major component replacement procedures, and selected wiring diagrams.

Model Designation

The Norcold Dual Voltage and 12 Volt Refrigerators are designed for the recreational vehicle/marine industry, as well as under-the-counter installations. A typical recreational vehicle installation requires the refrigerator to operate on 12 VDC while in transit and 120 VAC while parked. The Norcold Dual Voltage refrigerator converts from one power source to the other by means of an automatic relay or by changing power cords.

Terminology

The following information is distinctive to the Norcold Dual Voltage and 12 Volt refrigerators.

Dual Voltage Refrigerator: A refrigerator which operates on either 120 VAC or 12 VDC.

12 Volt Refrigerator: Models DC-254, DC-230, TRDB-630, and SRBD-630 are refrigerators which operate on 12 VDC.

40 Watt System: A refrigerator which operates with a matching 40 watt cooling unit, power supply, and thermostat.

60 Watt System: Models DE-728 and MRFT-660 refrigerators operating with a matching 60 watt cooling unit, power supply, and thermostat.

80 Watt System: This system is actually two (2) 40 watt systems combined in one refrigerator. Included in this system are two power supplies, two cooling units, and one double pole thermostat.

Power Supply: General term for the device which directs electrical energy to the cooling unit. The power supply consists of the transformer, inverter, relay, and circuit breaker.

Inverter Assembly: Consists of the transformer, oscillator, relay, circuit breaker and chatter protector. NOTE: Inverter assembly and power supply perform the same function.

Transformer Assembly: The step down transformer assures the correct AC voltage is supplied to the cooling unit. In some models the transformer assembly includes a relay and chatter protector.

Thermostat: A single thermostat controls the operation of the refrigerator on AC or DC. The higher the dial is set, the colder the temperature becomes in the refrigerator. There is no need to readjust the setting of the thermostat for dual operation. Once the desired temperature is reached., the thermostat will control the cabinet temperatures equally well on either voltage supply.

Double Pole (Thermostat): Models DE-828, DE-704C, DE-400C, DE-251D, DE-250F, MRFT-615B, MRFT-630B, and MRFT-640B are refrigerators which have a thermostat with two poles. (4 terminals).

GENERAL INFORMATION

Installation

UNIT LOCATION: The refrigerator should be located and/or secured on a solid surface within the vehicle. The refrigerator should not be installed in direct sunlight, or near a gas stove, heater, or other heat generating source.

VENTILATION: For refrigerators with 40 watt or 60 watt power supplies, vent opening combinations should equal a minimum air flow of 50 square inches of intake air and 50 square inches of exhaust air. The model with the 80 watt power supply (DE-828) requires 100 square inches of intake air and 100 square inches of exhaust air. The more air circulating over the condenser the more efficient the refrigerator will operate. Failure to provide the necessary ventilation will result in poor refrigeration, continuous compressor operation and accelerated battery discharge. (For proper venting arrangements refer to Figure 1.)

On larger built-in models (DE-828, DE-704, DE-728) a perforated access panel or kick plate is provided at the front base of the refrigerator. This panel allows air to flow under the refrigerator and over the power supply.

For outside venting purposes, a small louver type vent may be installed at the top and at the bottom of the exterior of the vehicle.

For high outside ambient temperatures, a combination of roof vent and lower vent or two side vents offer adequate ventilation.

If operation at low outside ambient temperatures is necessary all exterior venting should be covered to prevent possible compressor damage.

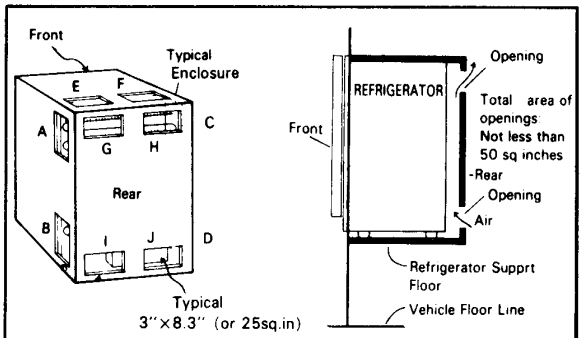


Figure 1: Approved venting arrangements - venting should be installed using any of the following cutout location combinations.

A/B	B/C	C/D	D/E	E/I	F/I	G/J	H/I
A/D	B/E	C/I	D/F	E/J			H/J
A/I	B/F	C/J	D/G				
A/J	B/G		D/H				
	B/H						

Leveling

The Norcold Dual Voltage or 12 Volt refrigerator does not require critical leveling. The system will maintain its cooling efficiency to as much as 30 degrees off level in any direction.

Power Sources

AC POWER CONNECTION: The 120 VAC power connection is made by connecting the refrigerator's AC cord to a standard 120 volt grounded receptacle. This 120 VAC supply outlet should be routed through the fuse panel or circuit breaker that protects the vehicle when an outside power source is used. This connection should be permanently wired in accordance with existing governing codes. The use of an extension cord is not recommended.

CAUTION: If AC power is supplied by an on-board generator, it is very important to hold both voltage and frequency within the tolerances stated below.

120 VAC operation: 132 volts max, 108 volts min. 61 hertz max., 59 hertz min.

DC POWER CONNECTION: The 12 VDC connection is made by connecting the 12 volt DC power source to the positive and negative DC wire located in the terminal box of the refrigerator's power supply. **(NOTE: Models MRFT-615B, MRFT-630B, MRFT-640B and V-2000 have an AC and DC power cord which must be changed when changing power sources.)** It is important the 12 VDC supply is connected to the positive and negative post of the battery. The positive battery lead must be connected to the red wire, and the negative battery lead connected to the black wire. Splices should be soldered or connected by means of an approved splice connector. The splice connections must then be tapped before replacing in the terminal box. **(NOTE: Twisting of the lead wires tend to nullify induction created by high voltage spikes.)**

12 VDC Operation: 15.4 Volts max. 10 Volts min.

The size of wire recommeded to run from the 12 VDC battery to the DC connections is dependent upon the distance between the refrigerator and the battery. Check the following wire size table.

WIRE SIZE TABLE for field supplied DC cord (to battery)		
Length of Field Supplied Wire	Wire Size 40 Watt	Wire Size 60 & 80 Watt
Less than 6 Ft.	AWG #14	AWG #14
6 Ft. to 12 Ft.	AWG #14	AWG #12
12 Ft. to 20 Ft.	AWG #12	AWG #10

The recommended wire size is to prevent a voltage drop at the refrigerator which is critical to DC performance. The use of wire sizes smaller than those listed may cause excessive DC running time and shorter battery life in addition to diminished cooling.

To protect the refigerator in the event of a short circuit, it is recommended that a 15 amp fuse be installed in the positive lead at battery.

Do not operate the refrigerator on a converter or battery charger since these devices do not supply a filtered DC source.

Disconnect positive cable from battery before applying a "fast charge" to battery. Failure to do so may result in damage to the refrigerator or other 12 volt appliances.

Trouble-Shooting Procedures When Operating The Refrigerator on 120 VAC

1. Plug refrigerator into a 120 VAC receptacle.
2. Turn thermostat to highest setting, the compressor should start to operate.
3. If the compressor does not start to operate, disconnect the AC power.
4. Reconnect AC power and listen for an audible click from the relay. NOTE: Models MRFT-615B, MRFT-630B, MRFT-640B and V-2000 do not have a relay.
5. If there is a click, use a VOM (Volt-Ohm Meter) set on the 250 VAC scale and check for 120 VAC at the primary of the transformer.
   A.) If 120 VAC is not present check the chatter protector Figure 3, thermostat Figure 4 , and Relay Figure 5. Refer to the wiring diagram for the model you are working on.
   B.) If 120 VAC is present set the VOM to 50 VAC scale and check the transformer secondary for the correct voltage, refer to Figure 11.
   C.) If the voltage is not present, disconnect AC power and refer to Figure 6 and 7.
   D. If voltage is present but reads approximately half, refer to Figure 8.

Trouble-Shooting Procedures When Operating The Refrigerator On 12 VDC

CAUTION: Do not remove the positive wire from the compressor when operating on DC this will cause damage to the power supply.

1. If the refrigerator is properly connected to a 12 VDC source and the thermostat is turned to it's highest setting, the compressor will start to operate.
2. If the compressor does not operate, check the input supply for 12 VDC.
3. Check for 12 VDC at the red wire going to the oscillator (inverter). If you do not have 12 VDC go to Step 5.
4. If you have 12 VDC, check the voltage between the brown or tan wires going to the transformer. You should measure 22 VAC.
   A.) If you have 22 VAC and the compressor does not operate, check the secondary of the transformer. The voltage should be as indicated by Figure 11.
   B.) If you do not have the correct AC voltage from the transformer, disconnect the DC source.
   C.) Check the continuity of the compressor as shown by Figure 9.
   D.) If the compressor continuity is not correct, replace the cooling unit.
   E.) If the compressor continuity is correct, replace the transformer.
5. Check for 12 VDC at the circuit breaker. If the circuit breaker has disengaged it indicates:
   A.) Reverse polarity: The positive and negative input leads are reversed.
   B.) Excessive Volttage: Over 15.4 VDC.
   C.) Shorted transistors on the oscillator (inverter) to check for shorted transistors.
      (1) Disconnect the DC power.
      (2) Set the VOM on RX 1 scale.

(3) Connect the positive meter lead to the red wire of the power supply, and the negative meter lead to the black wire. The meter should read between 3 and 45 OHMS, reading of less than 3 OHMS indicates the transistors are shorted, replace the oscillator.

6. Check for 12 VDC at the relay contacts and the thermostat, refer to the wiring diagram for the model you are working on to determine the wire colors and arrangement of the components. Figures 2, 4 and 5 show how to test the circuit breaker, thermostat, and relay.
7. If you have the 12 VDC at the red wire to the oscillator but do not have 22 VAC at the brown or tan wires to the transformer, replace the oscillator.

POTENTIAL OPERATING PROBLEMS

NOTE: Defective warranteed cooling units will be replaced by Norcold at no charge. Any attempt to recharge a warrantee cooling unit will void the refrigerator warranty. Recharging an out-of-warranty cooling unit will be at the descretion of the owner.

THE COMPRESSOR RUNS CONTINUOUSLY ON EITHER VOLTAGE SUPPLY, BUT NO COOLING IS OBSERVED:

This problem indicates that there may be low voltage, installation/environmental, loss of refrigerant (leakage), faulty compressor, or a system blockage (freeze-up).

1. Check the DC voltage supply, when the supply is 10 VDC or less the compressor will run continuously.
2. If the ambient temperature is over 100° F, increased ventilation may be required.
3. Make sure the refrigerator is not placed in direct sunlite, or near a heat generating source.

If any of the following symptoms are observed, the cooling unit has probably had either a refrigerant leak or blockage. In either case the cooling unit must be replaced.

1. The compressor runs too hot and continuously (no cycling of the thermostat).
2. The compressor draws more than 2.5 amps and less than 17.7 VAC from the transformer (refrigerant leak). The compressor draws less than 1.45 amps at 25 VAC from the transformer (system freeze up). Refer to Figures 10 and 11.
3. The condenser top half, or compressor discharge line remains at room temperature.
4. The refrigerator compartment is too warm.
5. The evaporator plate does not show frosting when the refrigerator has operated for 20 minutes with the door open.
6. There is no freezing of ice cubes.
7. Oily spots appear on the tubing, condenser drier, etc. or on the floor behind the refrigerator. (refrigerant leak.)
   A.) If there is no noticable refrigerant leak, turn off the refrigerator and let the system cool down. Restart the refrigerator, let it run for 5 minutes, and turn it off again. Restart again after 5 minutes. If the condenser does not become warm and the evaporator plate inlet does not become cold. The cooling unit must be replaced.
   B.) If a refrigerant leak is observed, the cooling unit must be replaced.

THE COMPRESSOR OPERATES ON AC, BUT NOT ON DC AND THE UNIT CYCLES INTERMITTENLY REGUARDLESS OF THE THERMOSTAT SETTING:

This is an indication that one or both of the transistors in the oscillator are shorted creating and excessive load on the dual voltage transformer. This causes the bi-metallic element in the primary of the transformer to open and close causing intermittent operation of the refrigerator. Replace the oscillator.

ABNORMALLY LOUD NOISE DURING OPERATION:

1. Check the floor boards below the refrigerator for an unstable floor.
2. Check for loose parts due to transportation vibration.
3. Check the tubes around the condenser and compressor, carefully bend the tubes and wiring to a different location.
4. When transporting or lifting the refrigerator, a metallic sound may be heard, this is normal.

EXCESSIVE FROST BUILD-UP ON THE EVAPORATOR:

1. If too much food is stored in the cabinet, the cooling air from the evaporator can be locked thus preventing proper air circulation. Rearrange the food to allow for air circulation.
2. If more than ¼ inch of frost and ice builds up on the evaporator, it will decrease the overall cooling capacity and increase the power consumption.

NO COOLING AFTER THE INITIAL INSTALLATION AND START UP:

1. Handling, shipping, and storage of the refrigerator can cause uneven distribution of the lubrication oil. In this case, run the compressor for 5 minutes, shut off for 3 minutes, restart the compressor and let it run, if no cooling is observed, look for another source of the problem.

CHECKING A CIRCUIT BREAKER

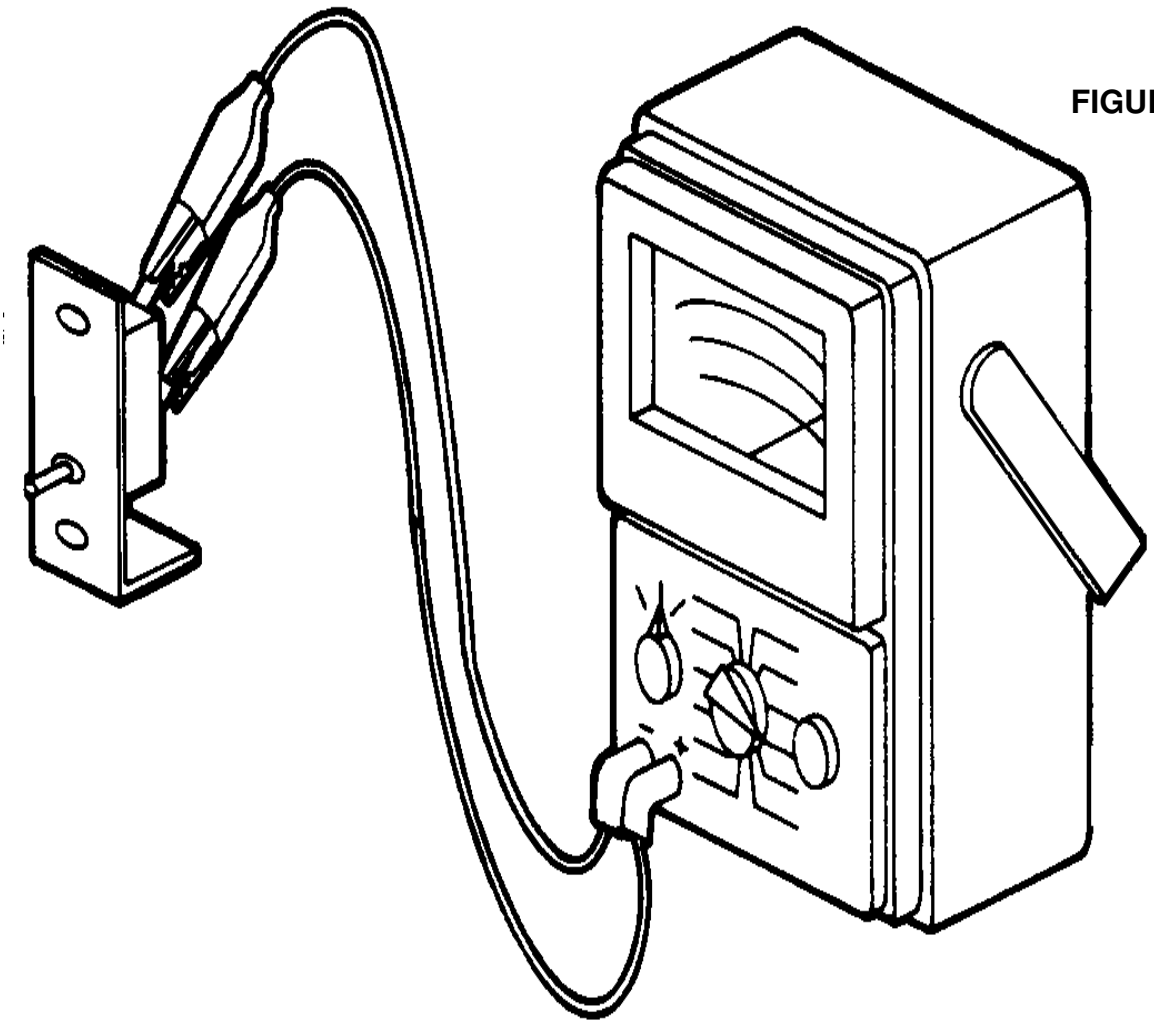
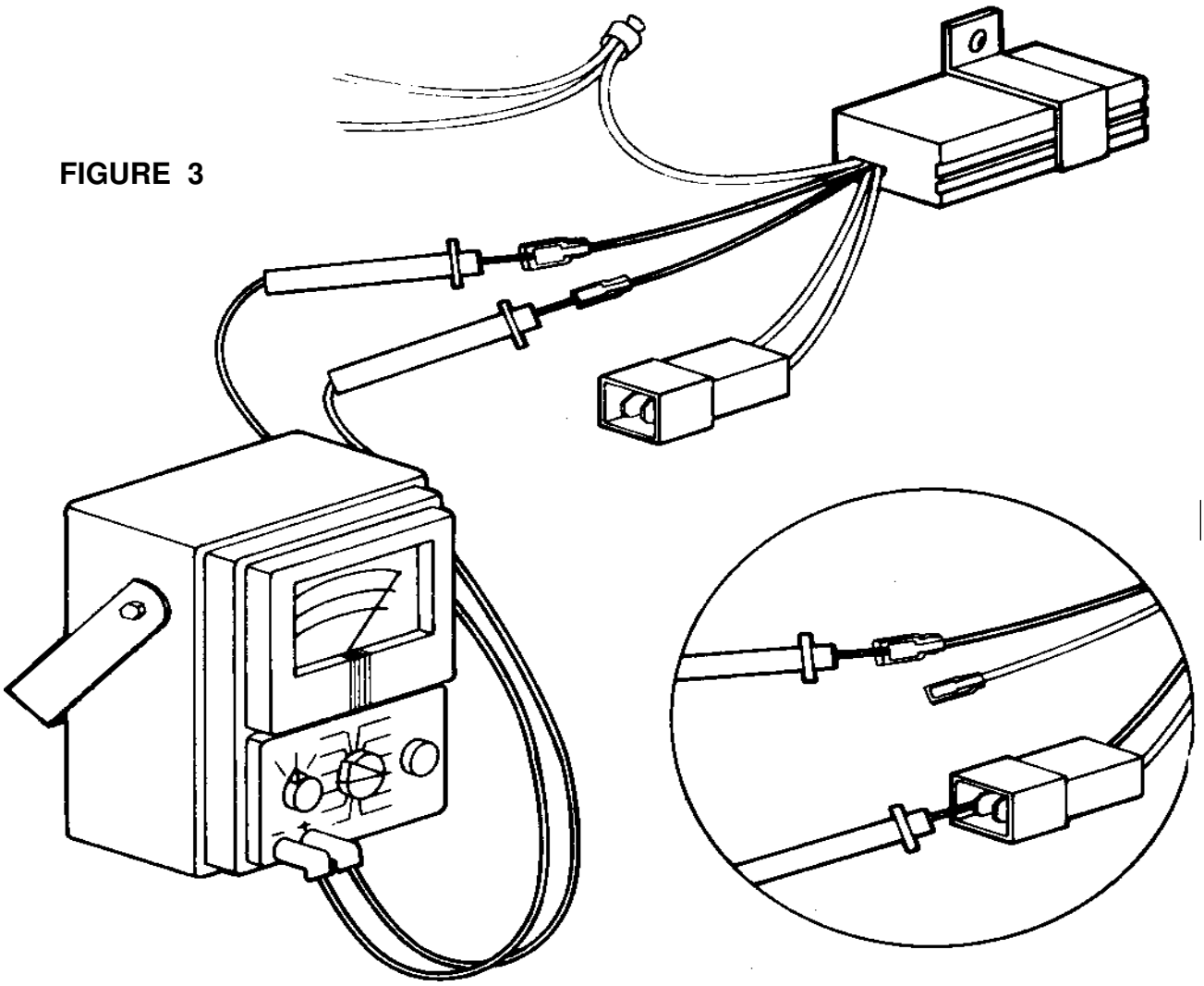


FIGURE 2

1. Set the VOM to Rx1 scale
2. Connect VOM across the terminals.
   A.) If the meter shows a short circuit the circuit breaker is good.
   B.) If the meter shows an open circuit, the overload has tripped as shown by illustration, push the button in and the meter should show a short circuit.
   C.) If this does not happen overload is defective and should be replaced.

CHECKING THE CHATTER PROTECTOR (TYPE B):

FIGURE 3



1. Set the VOM on Rx1 scale.
2. Connect the meter leads between the orange and white wires of the chatter protector.
   A.) Should read ohms one way and no ohms the other way if you reverse the meter leads.
3. Set the VOM on the Rx10k scale.
4. Connect the VOM leads to the orange wire with green strip, touch the white wire with the other lead.
   A.) The needle should go to the right and then start moving back to the left.
   B.) If this does not happen the chatter protector is defective and should be replaced.

CHECKING THERMOSTAT CONTINUITY

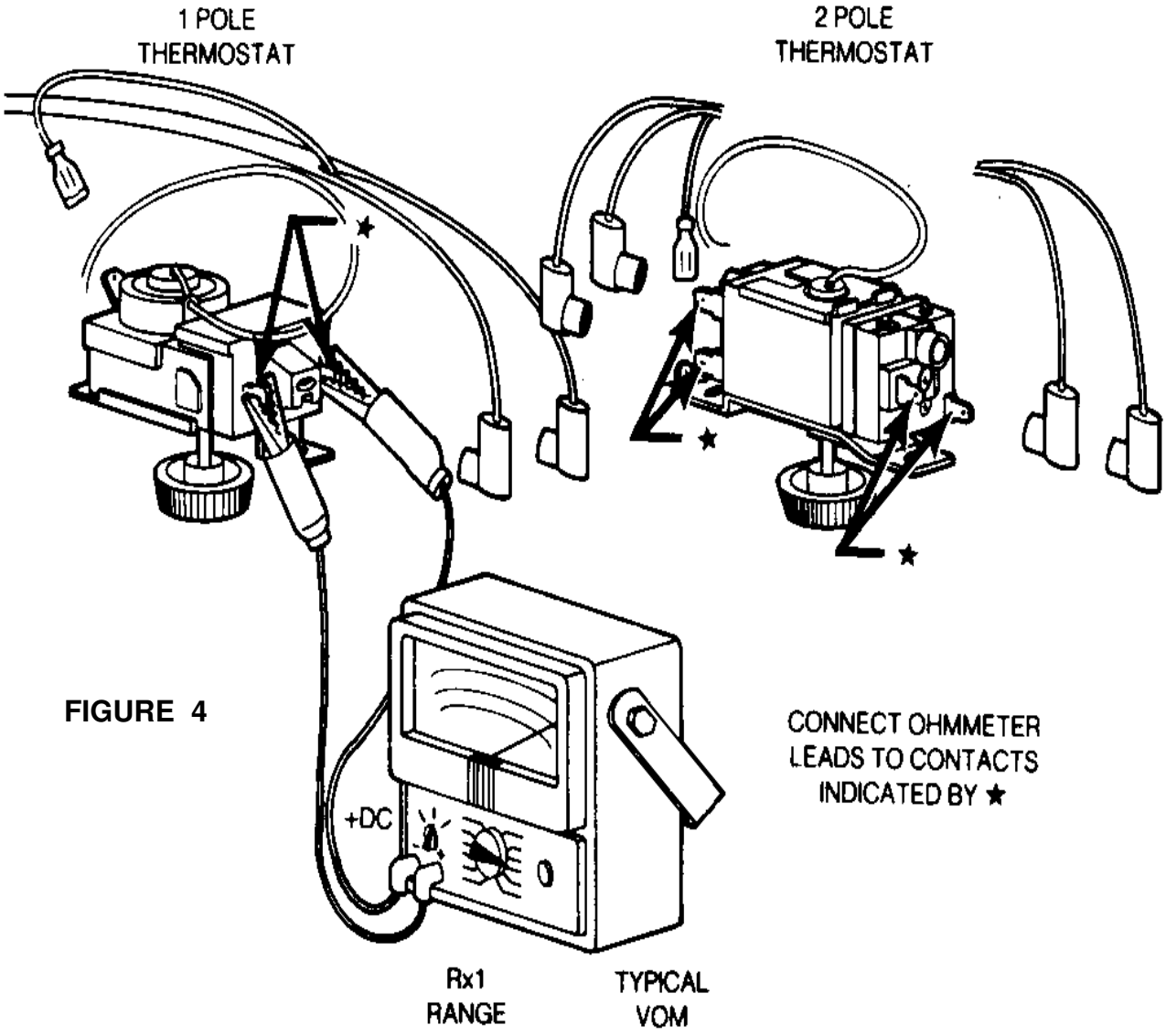


FIGURE 4

1. With the thermostat turned on (fully clockwise), the VOM should show a short circuit, as shown.
2. With the thermostat turned off (fully counterclockwise), the VOM should show an open circuit. The needle will register on the oposite side of the VOM shown in this illustration.

CHECKING THE RELAY

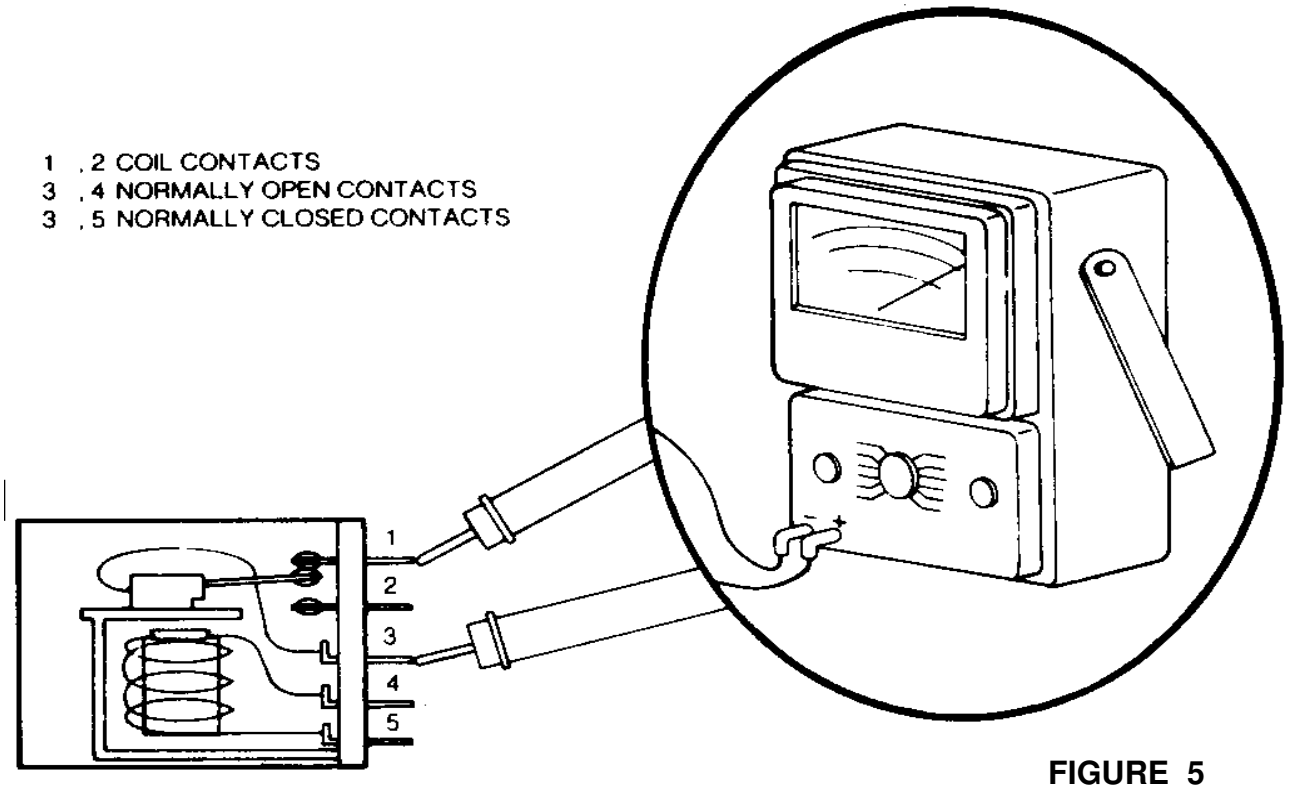


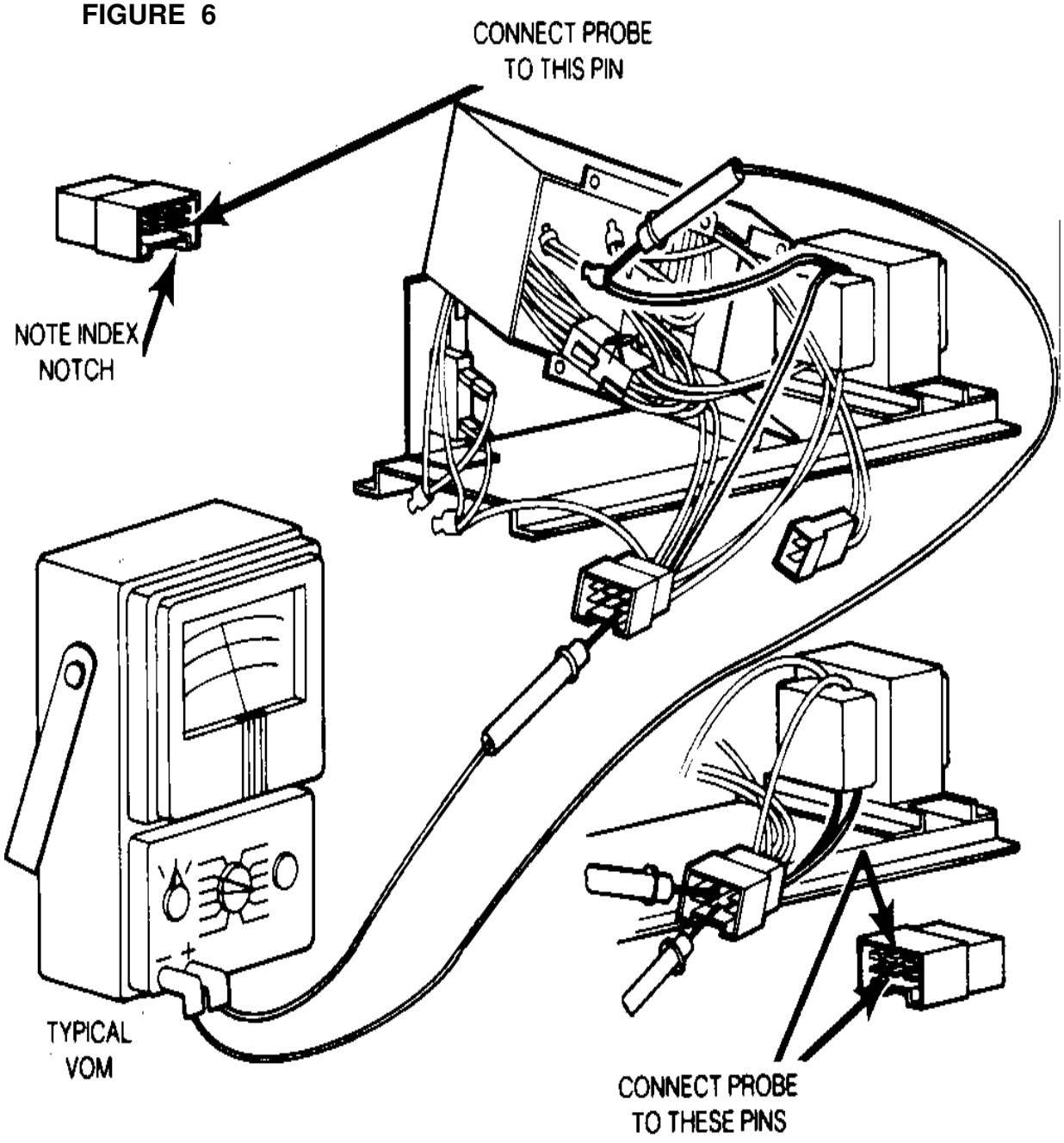
FIGURE 5

CHECKING THE RELAY (out of the circuit):

1. Check the relay for the correct coil voltage, the voltage should be printed on the plastic cover.
2. Apply the correct voltage to the coil of the relay and you should be able to see the contacts of the relay change from the normally closed position to the normally open position.
3. Set the VOM on the Rx1 scale and connect the leads across the normally closed contacts, the contacts should show an open circuit, if not the relay's coil is open or the contacts are shorted together.
4. Connect the VOM across the normally open contacts, they should show a short circuit, if not the contacts are pitted and are not making contact and the relay must be replaced.

CHECKING TRANSFORMER PRIMARY WINDINGS

FIGURE 6



VOM should measure 12 ohms.

CHECKING TRANSFORMER SECONDARY WINDINGS

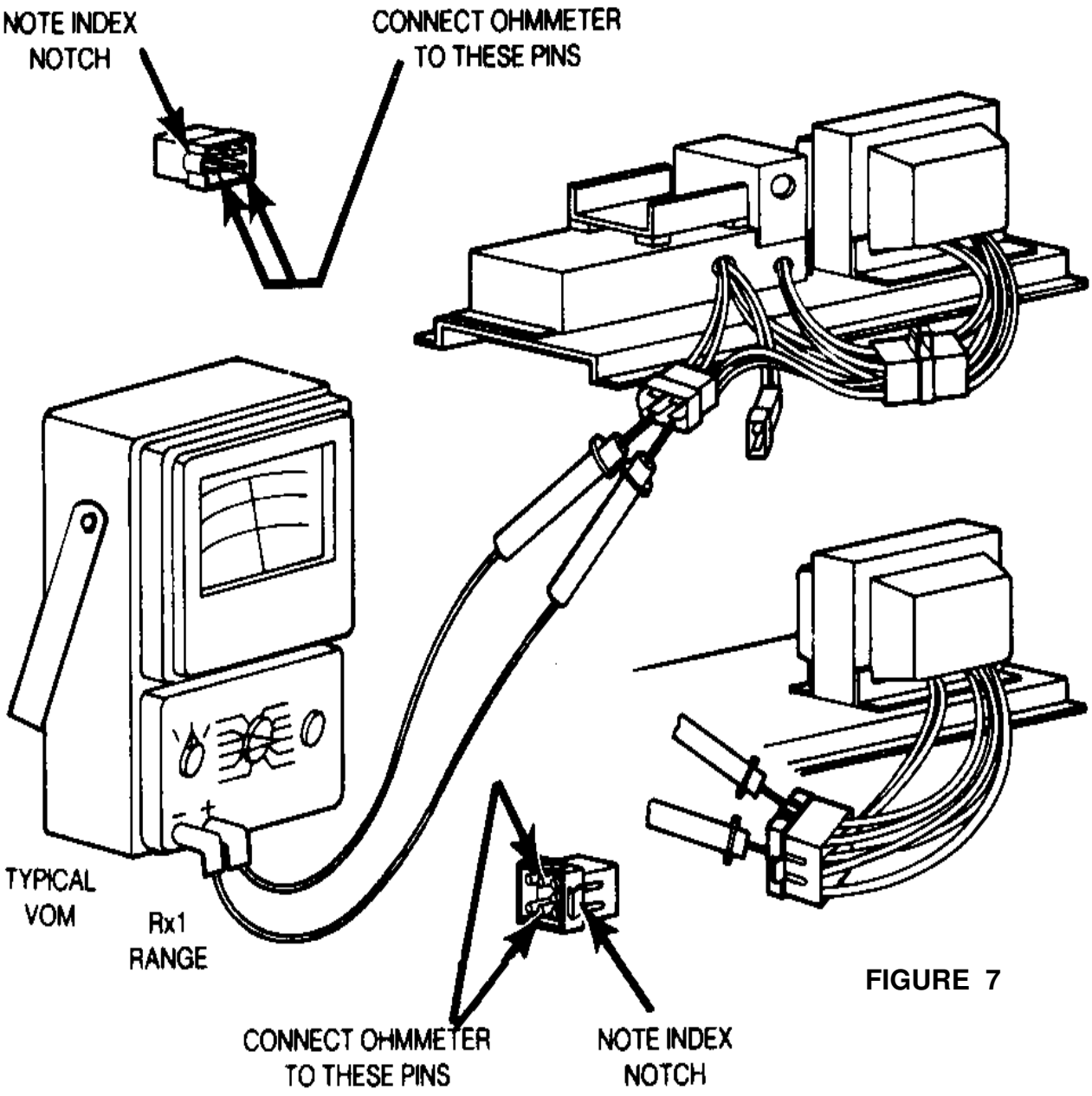


FIGURE 7

1. Set VOM on Rx1 scale.
   A.) The VOM should read 1 ohm for a 40 watt inverter.
   B.) The VOM should read ¾ ohm for a 60 watt inverter.

CHECK FOR DEFECTIVE INVERTER OR OSCILLATOR

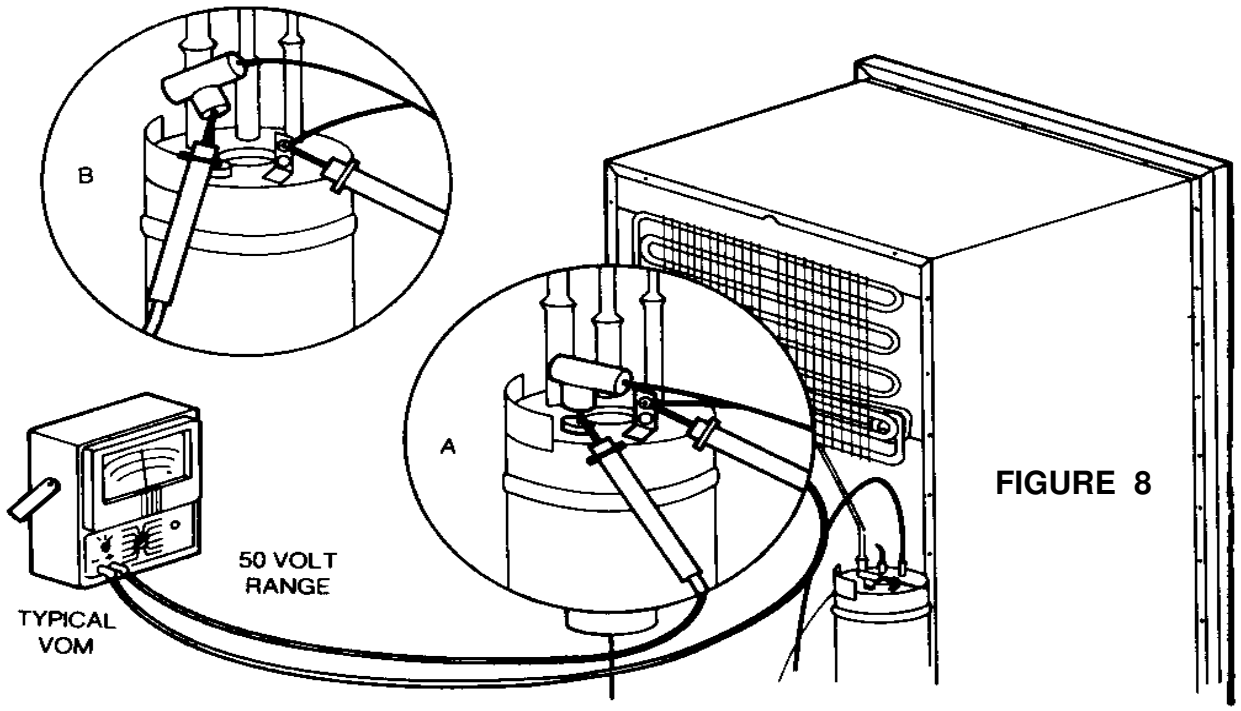


FIGURE 8

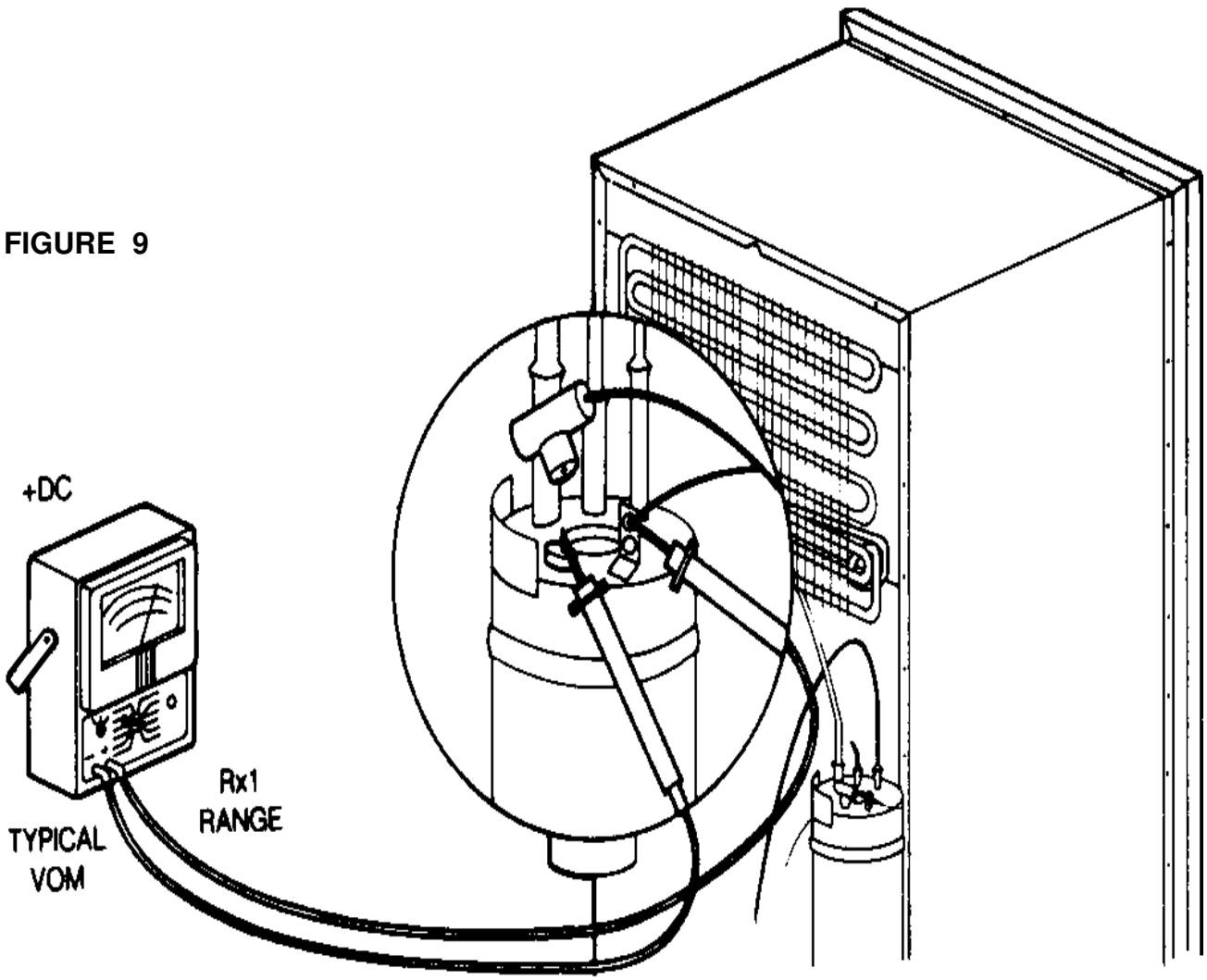
Compressor Voltage should be:
(All test made with 120 VAC voltage supply)

With Wire Attached (Illustration A)	
	Reading
40 Watt	17.6 - 20.6 VAC
60 Watt	20.6 - 23 VAC with U-65A transformer
60 Watt	22.4 - 25 VAC with U-64A transformer

With Wire Removed (Illustration B)	
	Reading
40 Watt	25 - 26 VAC
60 Watt	32 - 38 VAC with U-65A transformer
60 Watt	34 - 40 VAC with U-64A transformer

CHECKING COMPRESSOR CONTINUITY

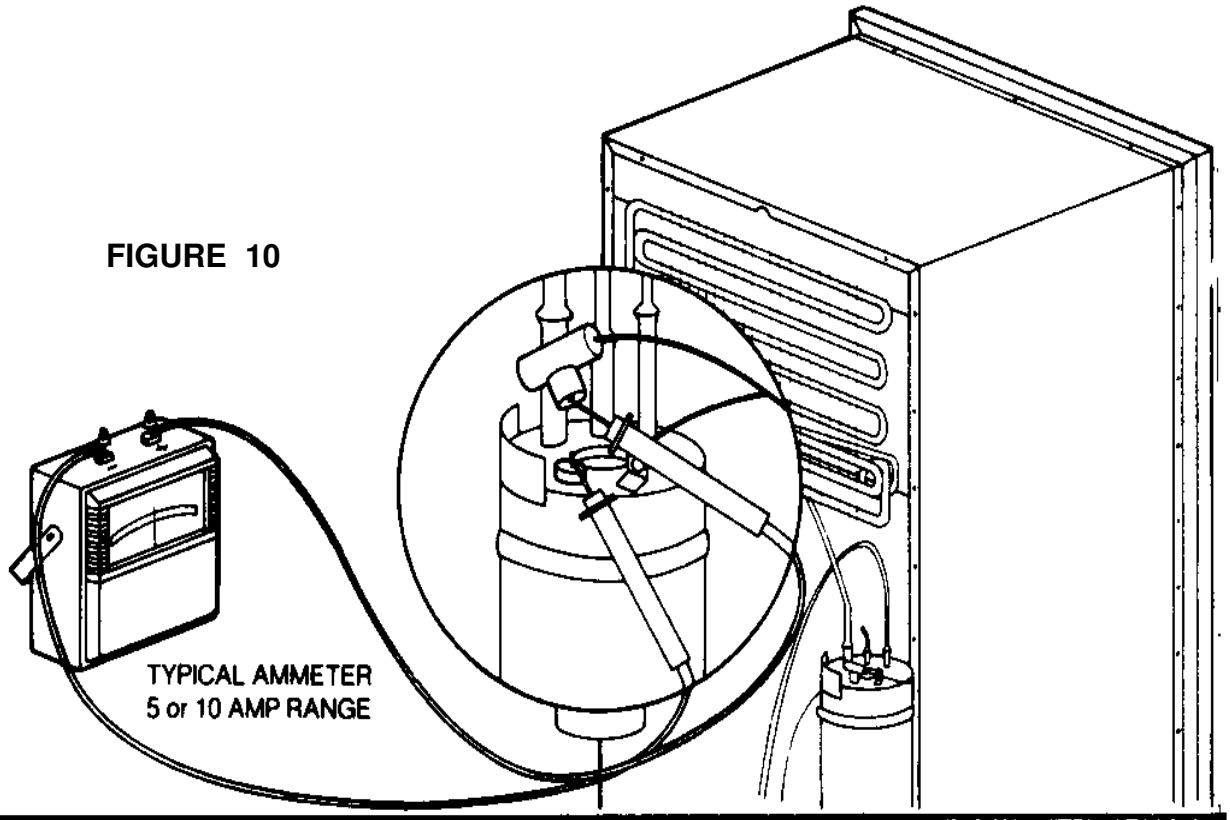
FIGURE 9



VOM should read 2.0 to 3.5 ohms for both 40 and 60 watts.

COMPRESSOR CURRENT MEASUREMENT

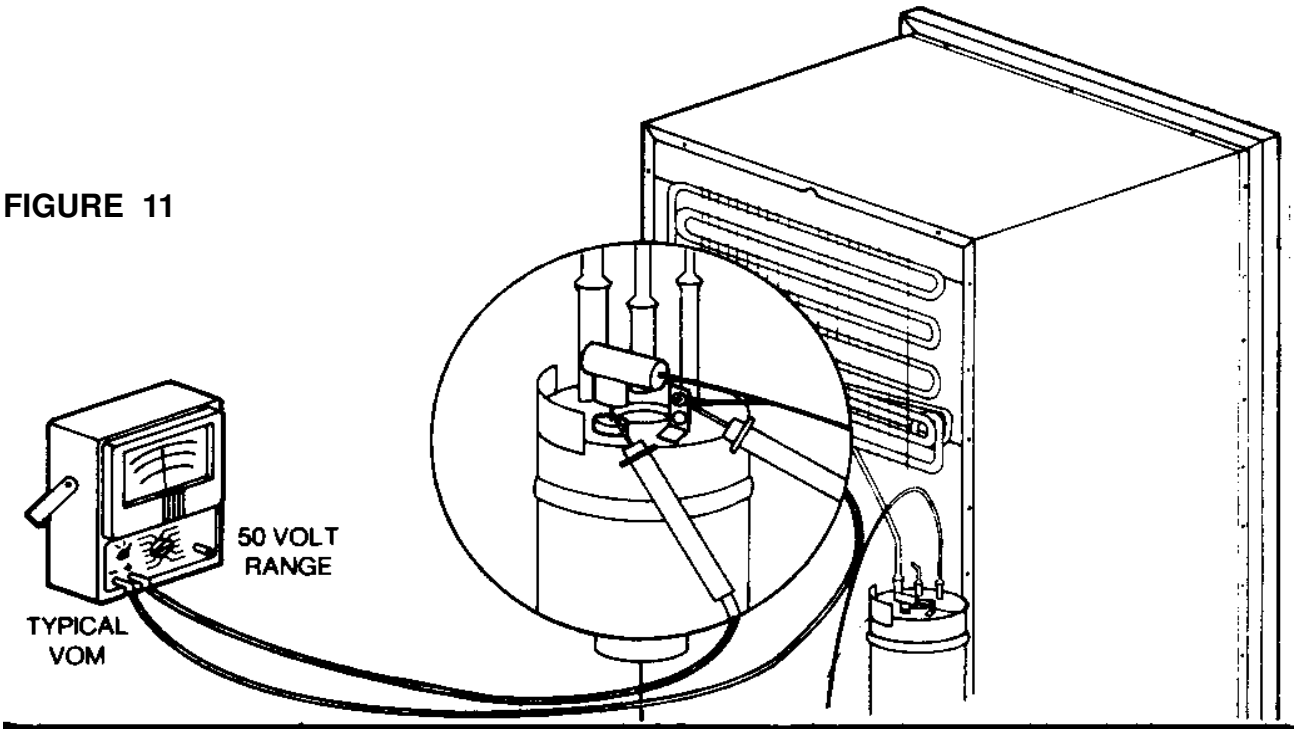
FIGURE 10



Compressor current should be:		
Source	Reading	
	40 Watt	60 Watt
120 VAC	1.45 - 2.3 AMPS	2.2 - 2.6 AMPS
12 VDC	1.6 - 2.2 AMPS	2.1 - 2.5

COMPRESSOR VOLTAGE MEASUREMENT

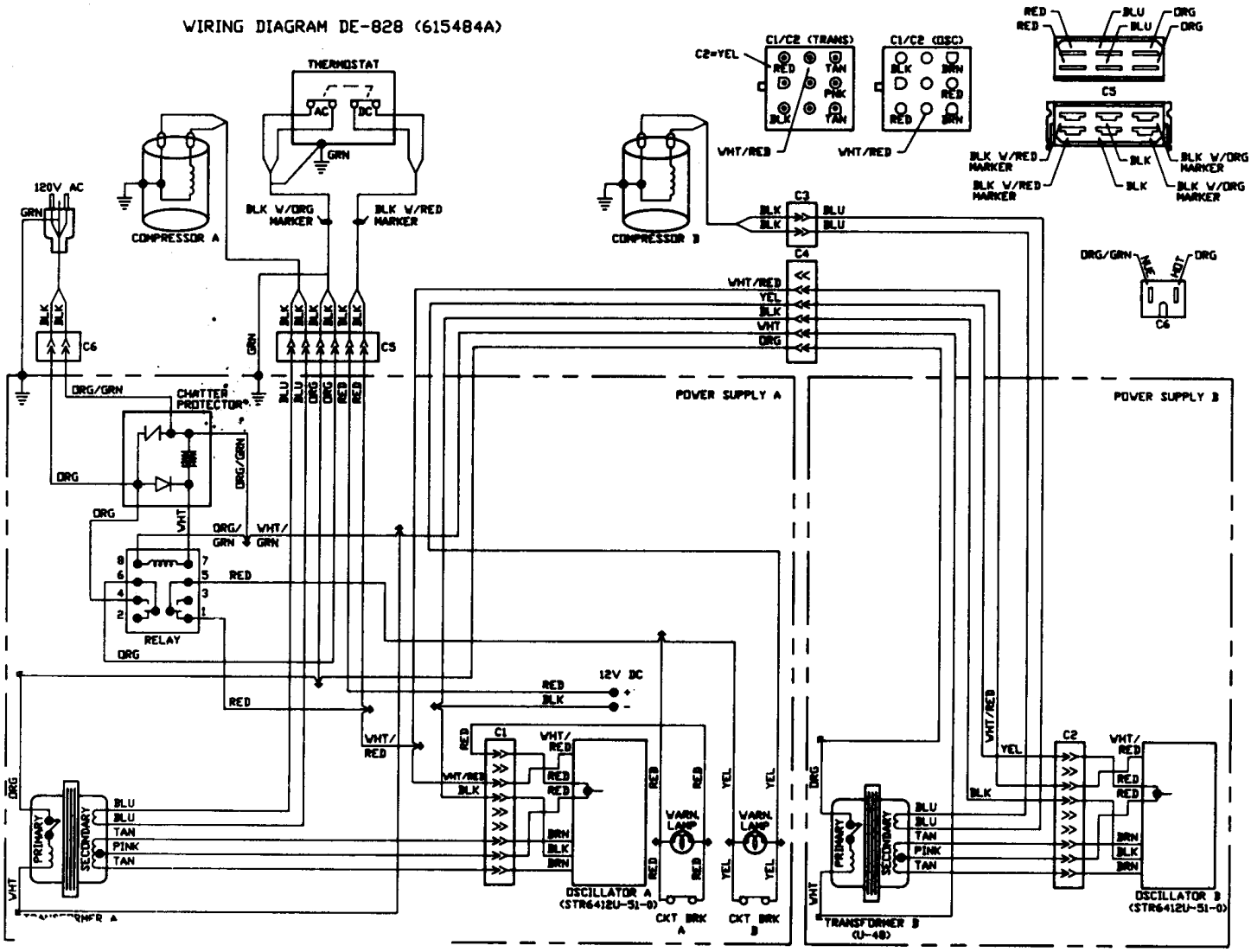
FIGURE 11



Compressor Voltage should be:		
Source	Reading	
	40 Watt	60 Watt
120 VAC	17.6 - 20.6 VAC	22.4 - 25 VAC
12 VDC	20.6 - 23 VAC	20.6 - 23 VAC with U-65A Trans
		28.5 - 32.5 VAC with U-64A Trans

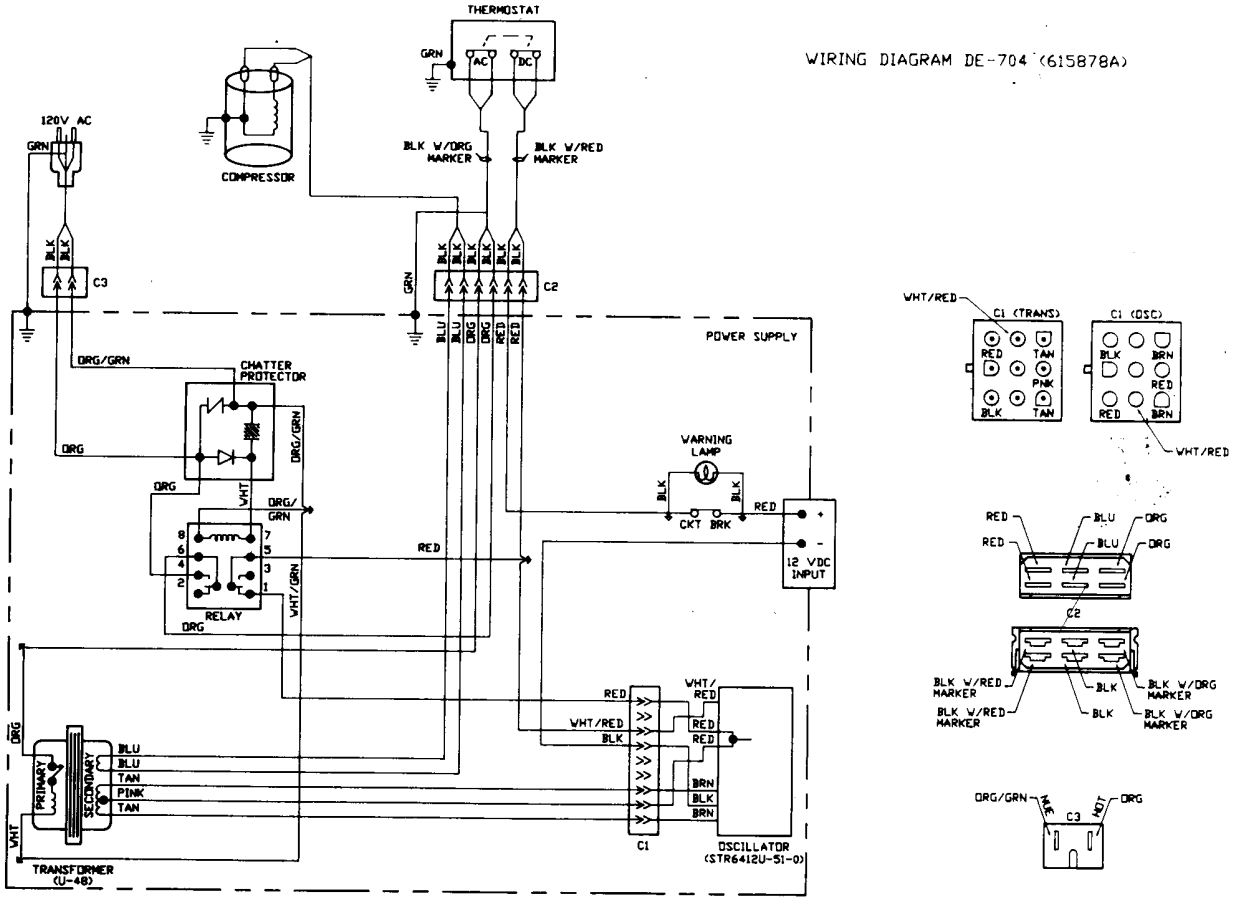
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DE-828

POWER SUPPLY: 615501A, 615501B
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48



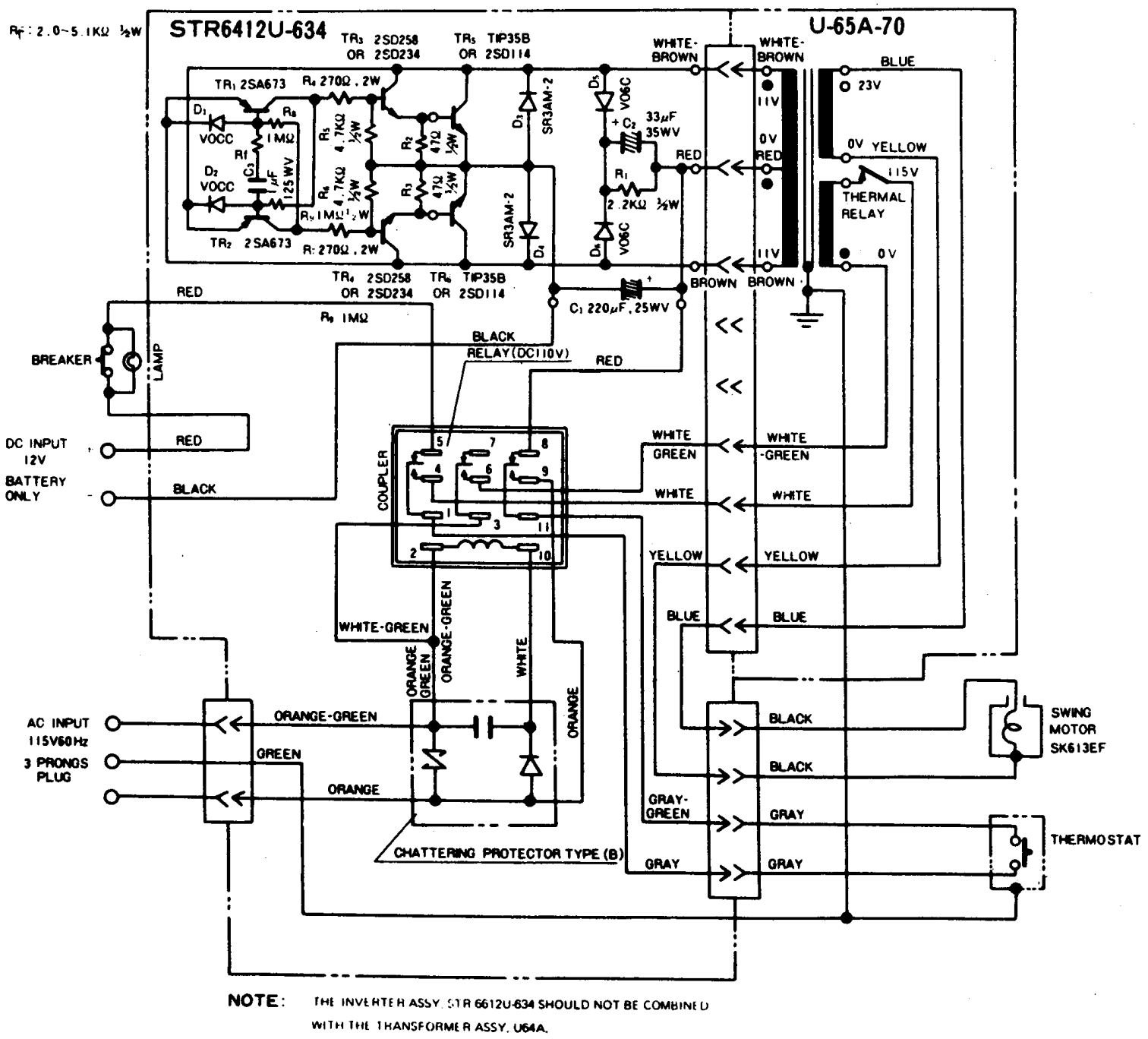
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DE-704C

POWER SUPPLY: 1601-035-10
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48BJ



CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DE-728

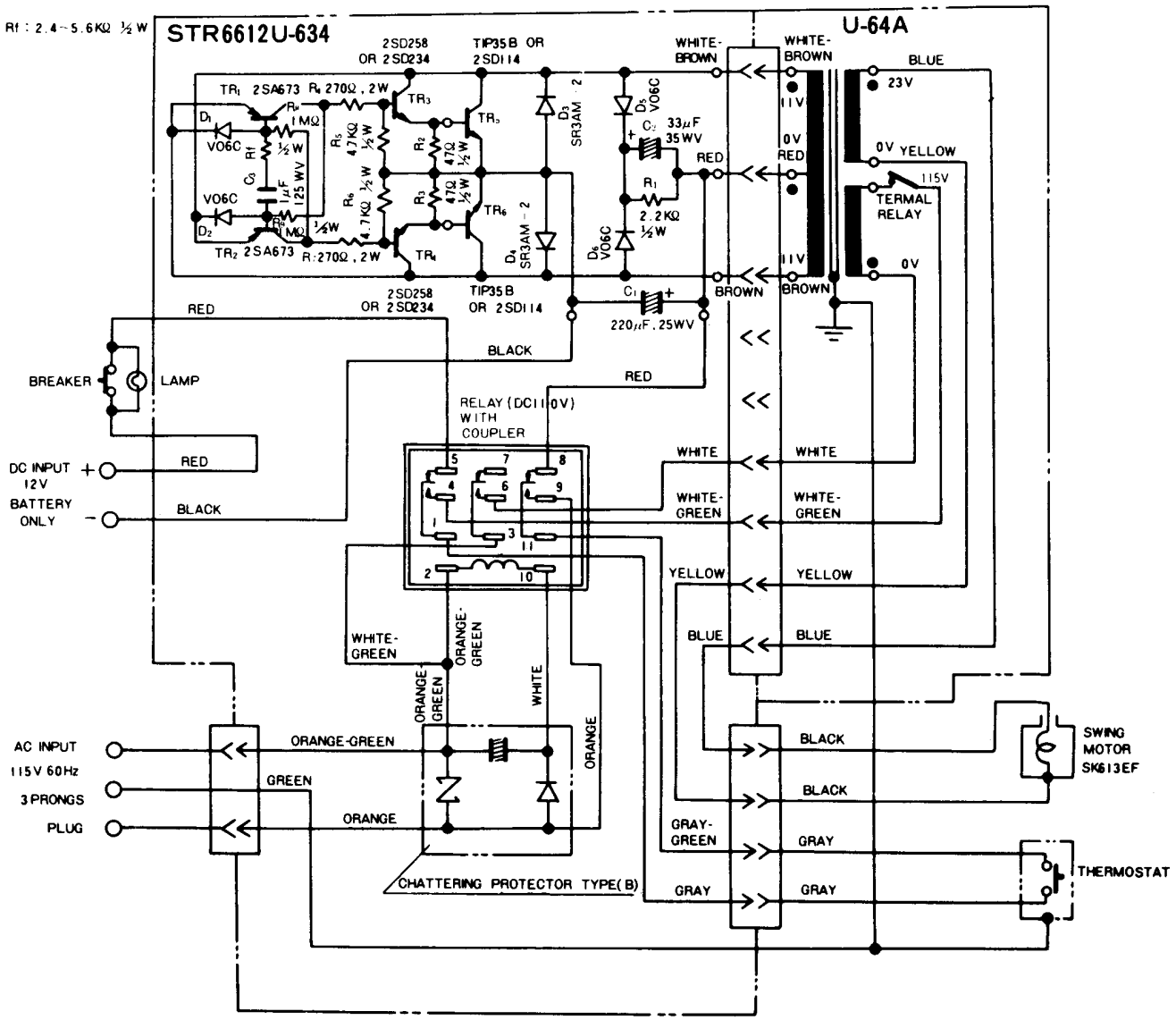
POWER SUPPLY: 613684-9600
INVERTER ASSEMBLY: STR6612U-634
TRANSFORMER ASSEMBLY; U-65A-70



NOTE: THE INVERTER ASSY. STR 6612U-634 SHOULD NOT BE COMBINED WITH THE TRANSFORMER ASSY. U64A.

CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DE-728

POWER SUPPLY: 613684-96034
INVERTER ASSEMBLY: STR6612U-634
TRANSFORMER ASSEMBLY: U-64A

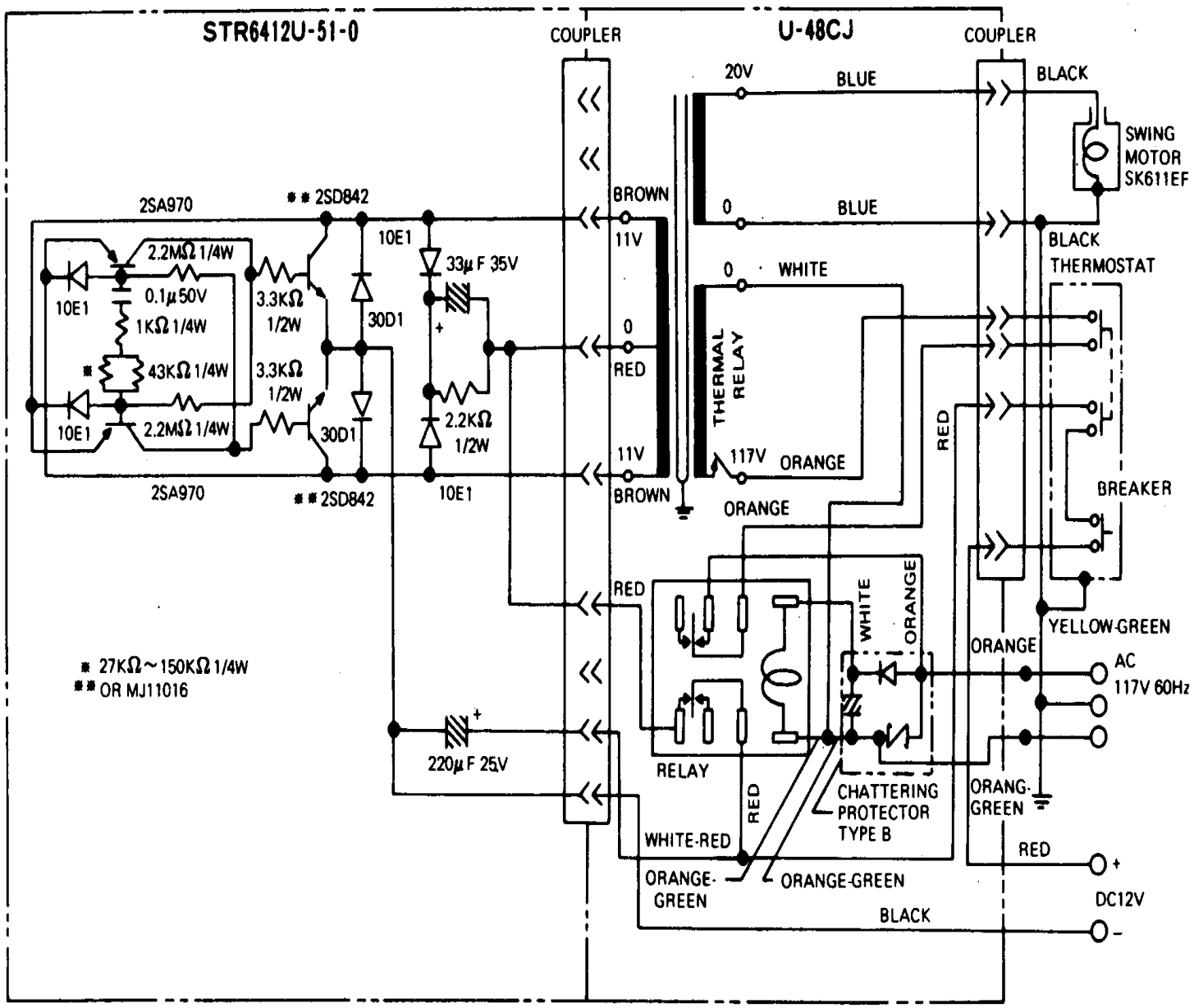


NOTE: WHEN ONLY THE TRANSFORMER U64A IS REPLACED TO U-65A-70, RESISTOR Rf IN 634 SHOULD BE CHANGED AS FOLLOWS.

Rf WAS INSTALLED IN 634 COMBINED WITH U-64A	Rf TO BE CHANGED, COMBINED WITH U-65A-70
2.4KΩ	2.0KΩ
2.7 "	2.2 "
3.0 "	2.4 "
3.3 "	2.7 "
3.6 "	3.0 "
3.9 "	3.3 "
4.3 "	3.9 "
4.7 "	4.3 "
5.1 "	4.7 "
5.6 "	5.1 "

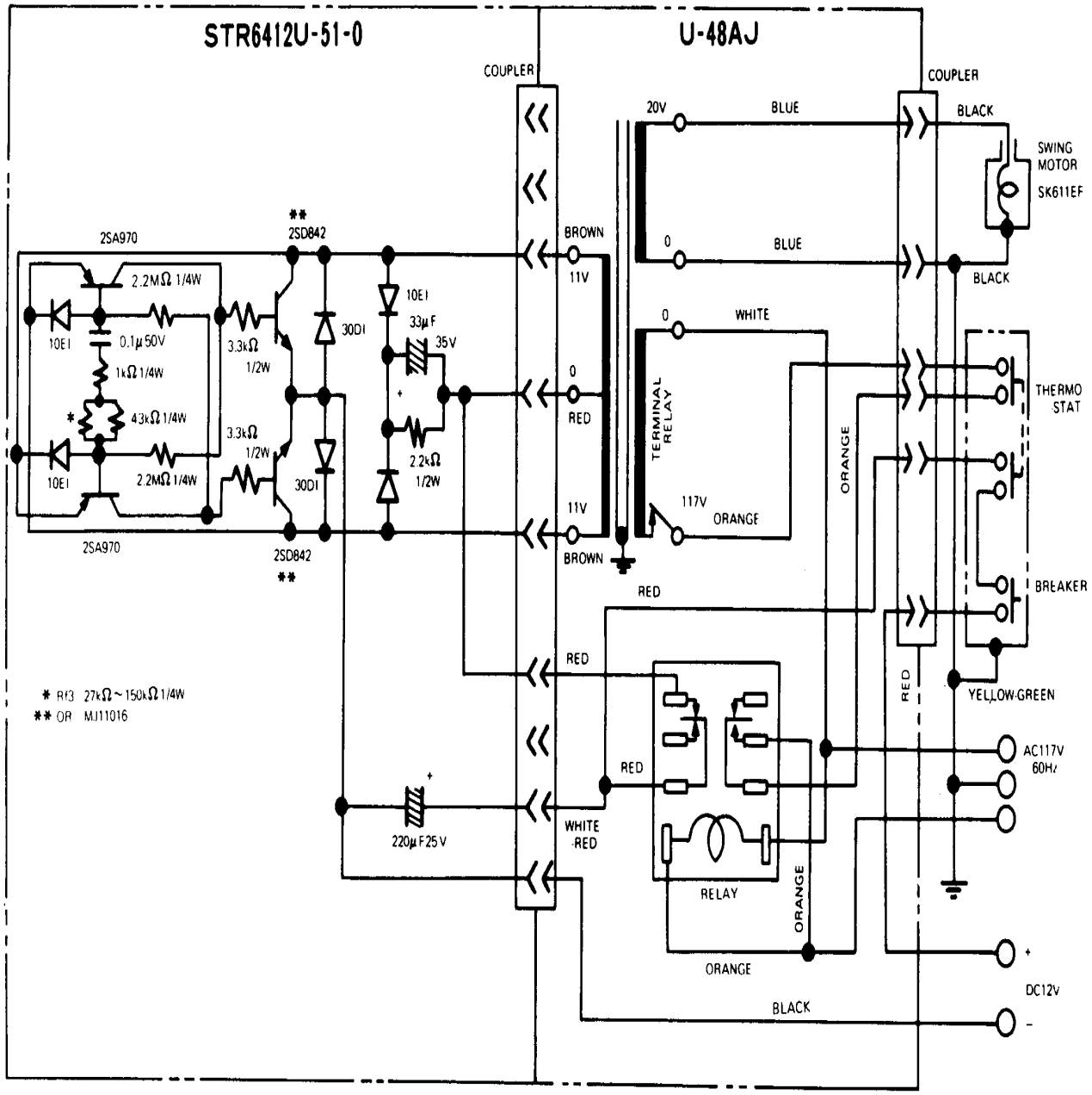
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DE-400C

POWER SUPPLY: 1601-046-0009
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48CJ



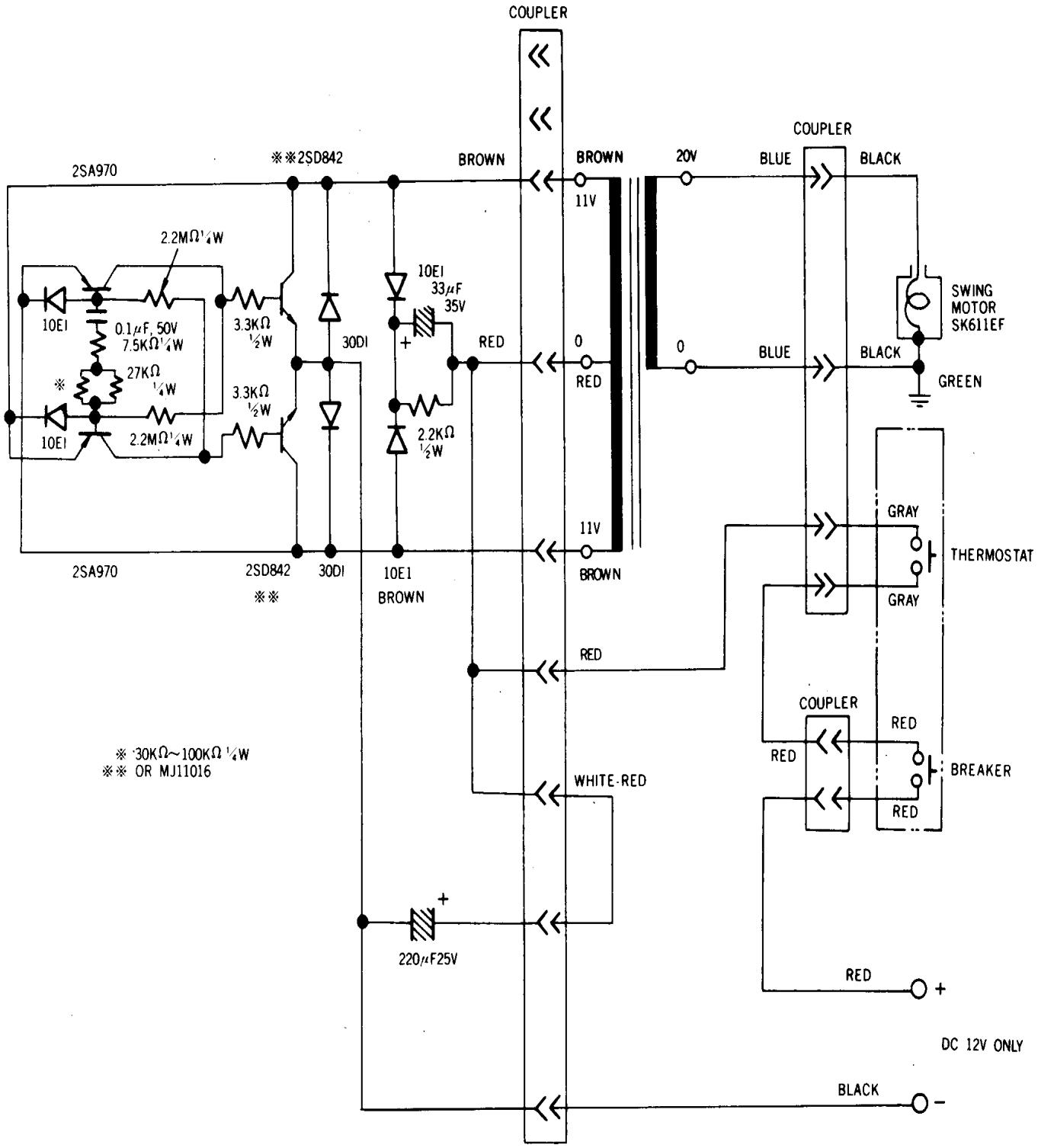
CIRCUIT DIAGRAM OF REFRIGERATOR MODELS: DE-250F, DE-251D

POWER SUPPLY: 1601-046-00 (AC RELAY)
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48AJ



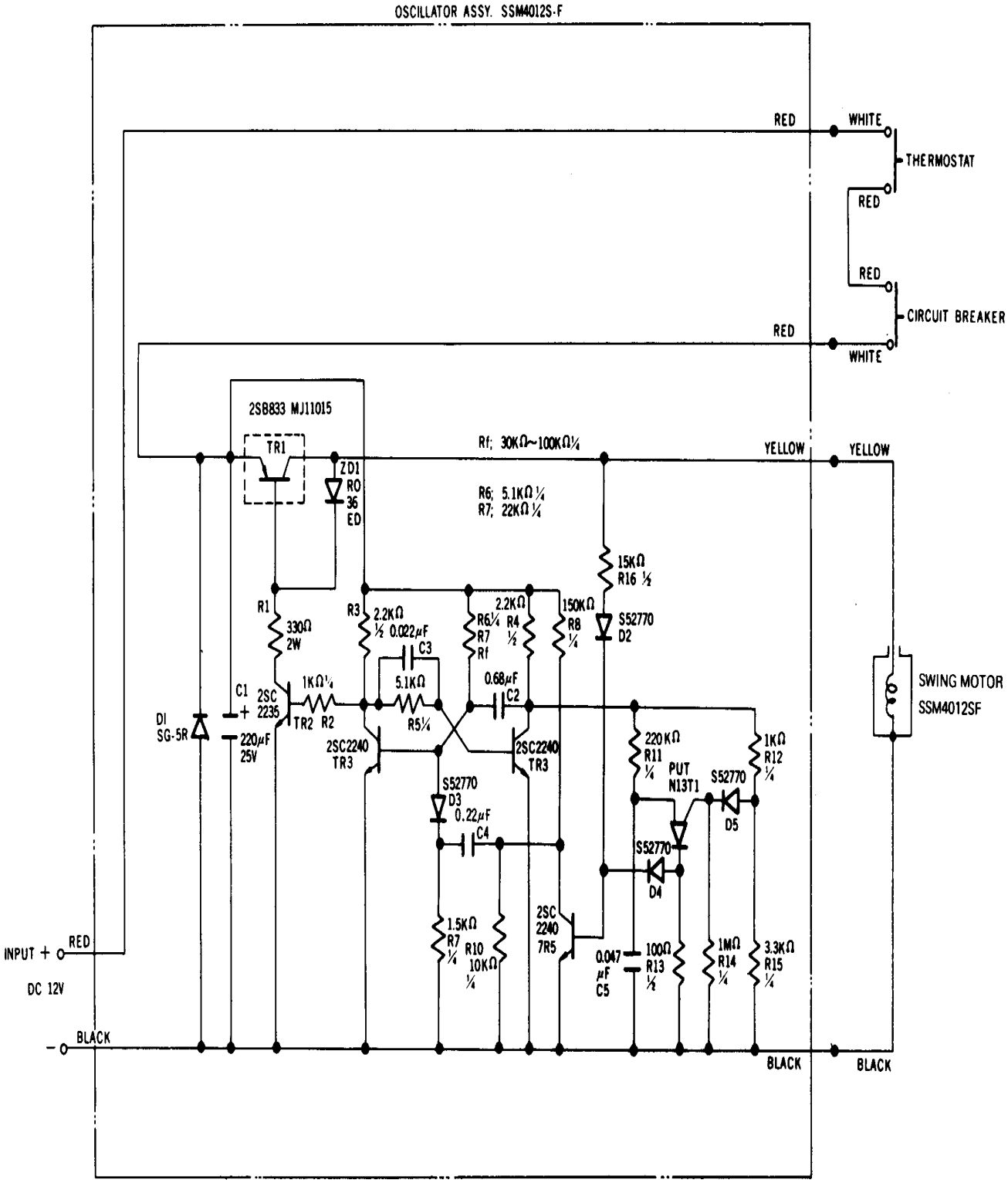
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DC-254

POWER SUPPLY: 1601-046-00 (AC RELAY)
OSCILLATOR ASSEMBLY: STR6412D-0
TRANSFORMER ASSEMBLY: U-48AJ



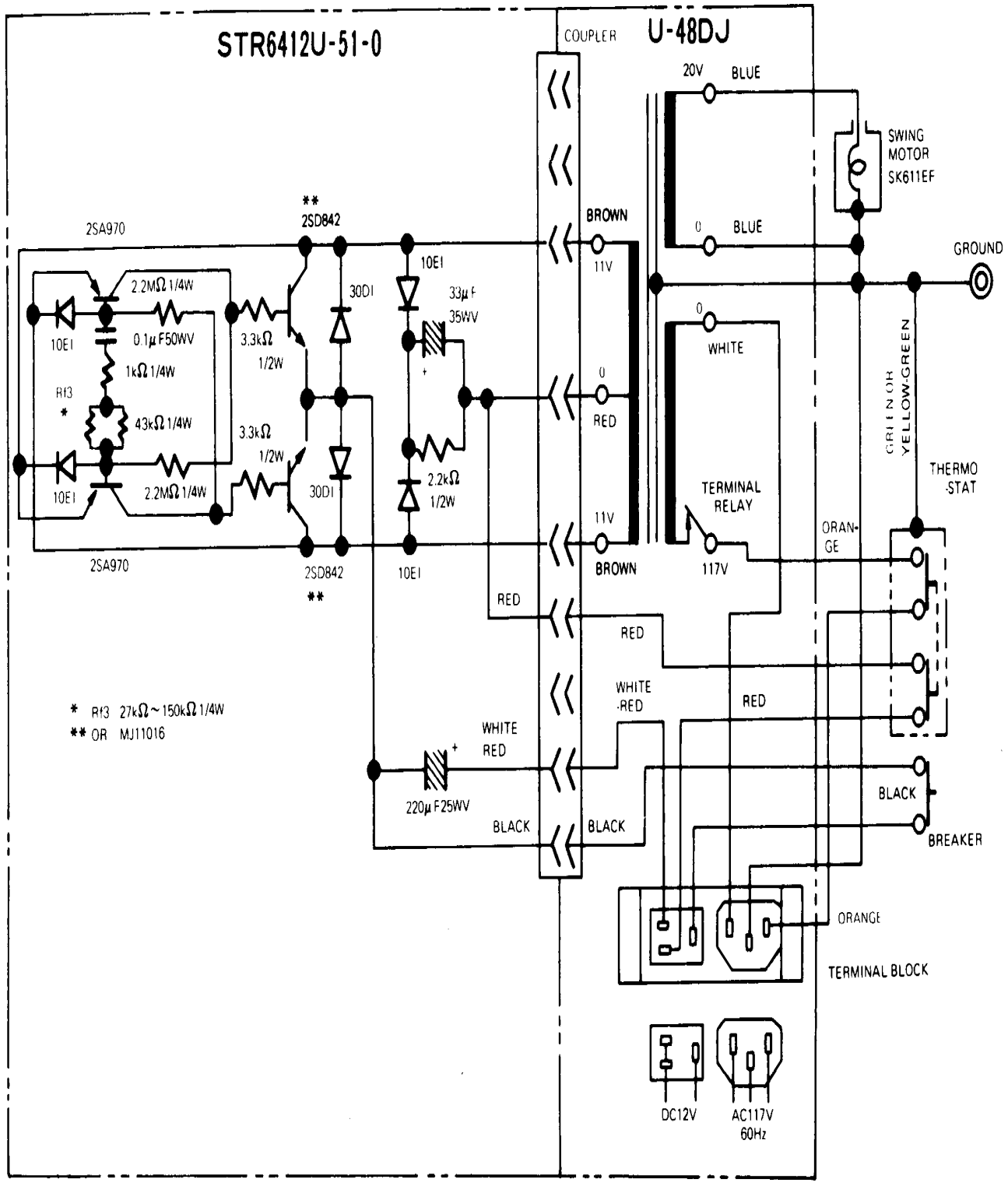
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: DC-230

POWER SUPPLY: 1630-053-20
OSCILLATOR ASSEMBLY: SSM4012S-F



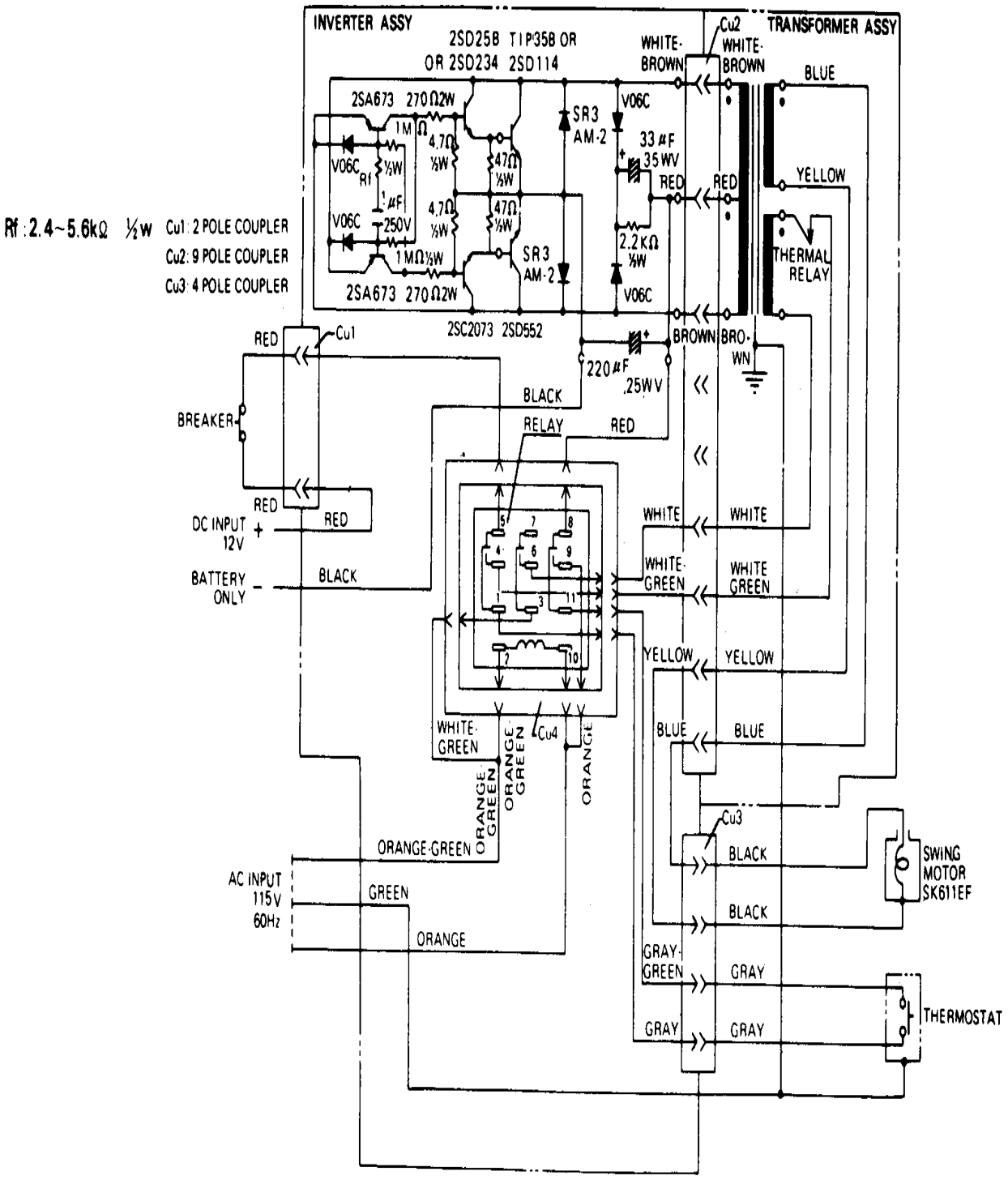
CIRCUIT DIAGRAM OF REFRIGERATOR MODELS: MRFT-615B, MRFT-630B, MRFT-640B

POWER SUPPLY: 1601-041-00, 1601-040-00, 1601-040-00
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48DJ



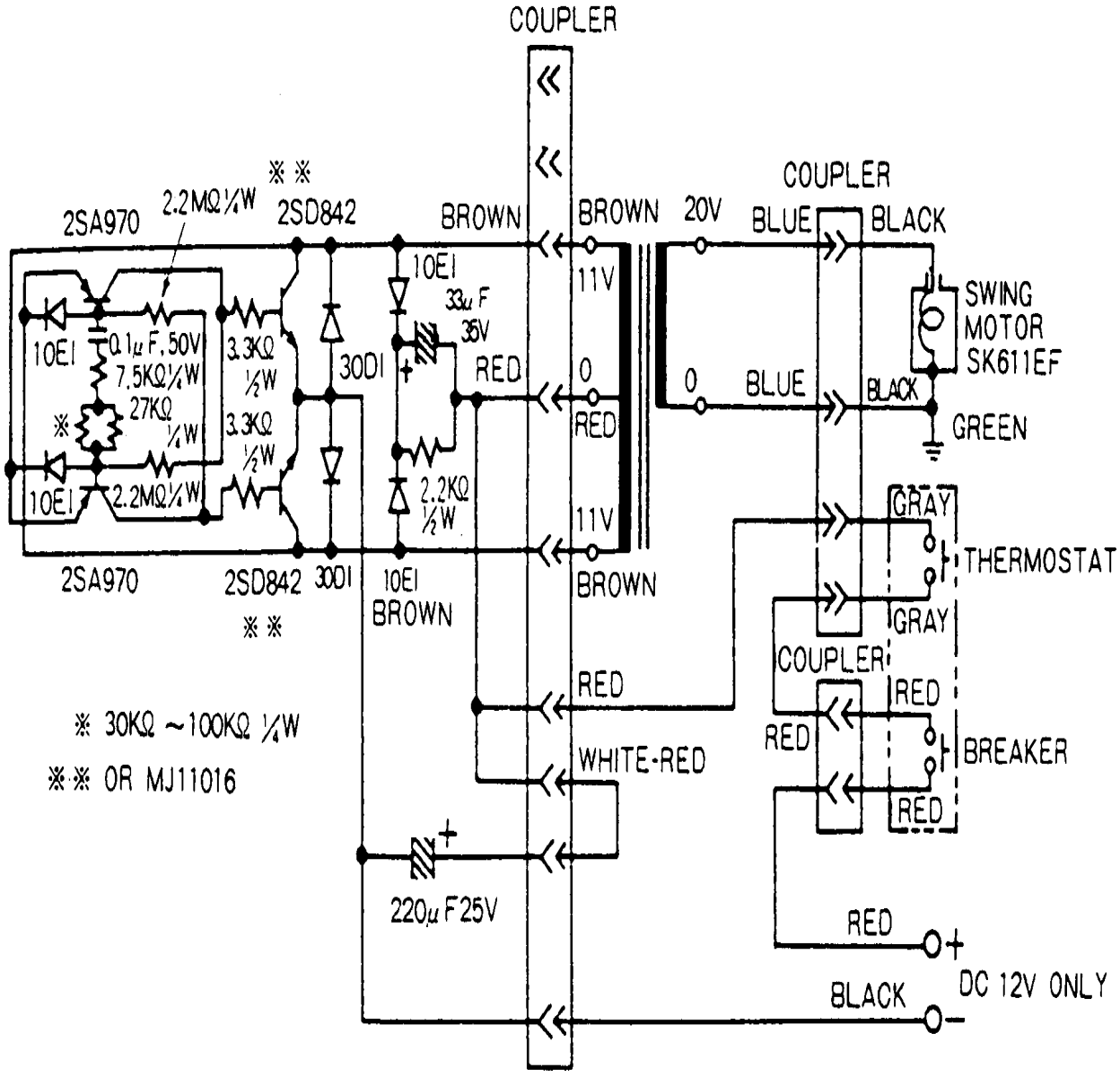
CIRCUIT DIAGRAM OF REFRIGERATOR/FREEZER MODEL: MRFT-660

POWER SUPPLY: 1630-041-40
INVERTER ASSEMBLY: 634
TRANSFORMER: U-65B-70



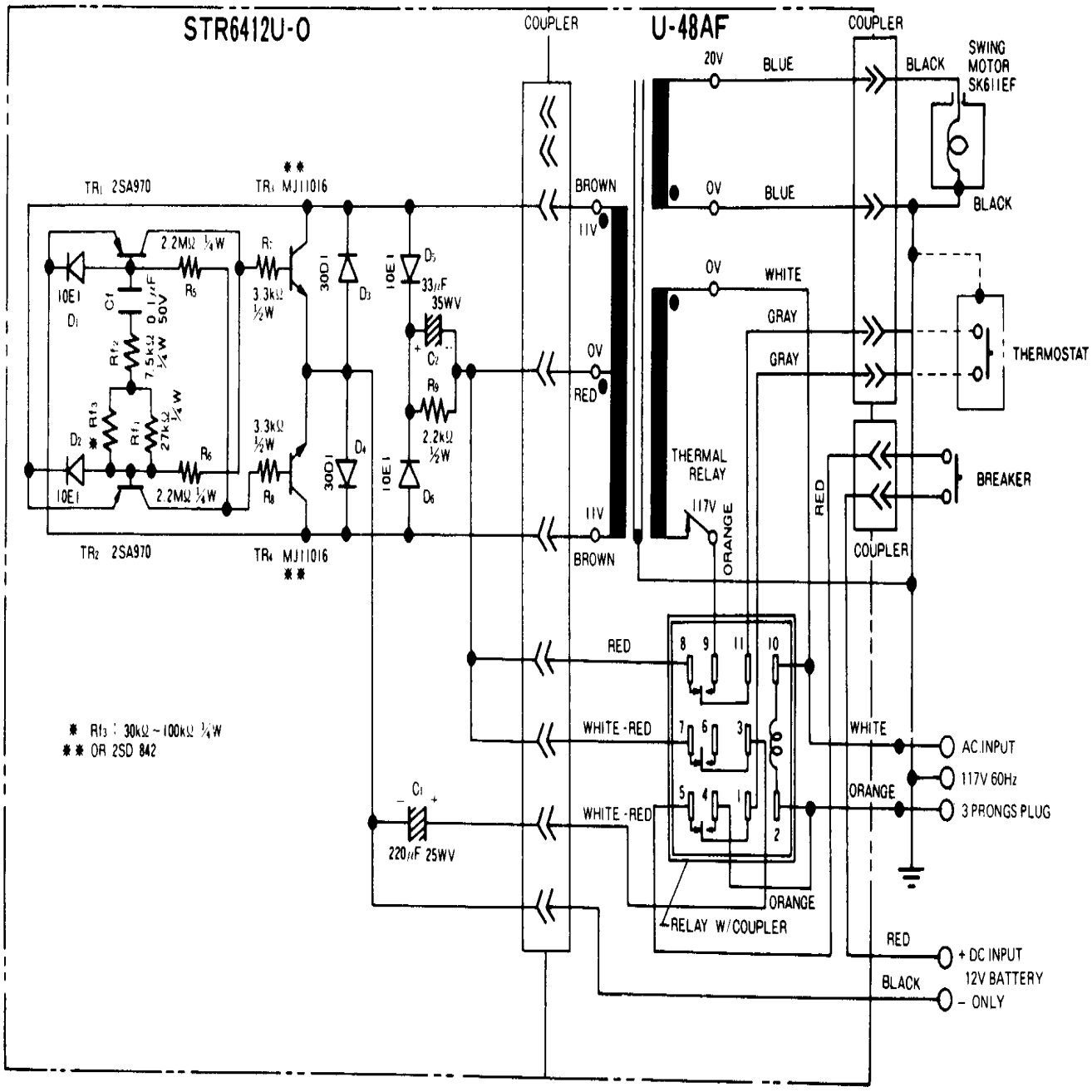
CIRCUIT DIAGRAM OF REFRIGERATOR MODELS: SRBD-630, TRBD-630

POWER SUPPLY: 1601-105-500
OSCILLATOR ASSEMBLY: STR6412D
TRANSFORMER ASSEMBLY: D-48AH (SRBD-630, TRBD-630)



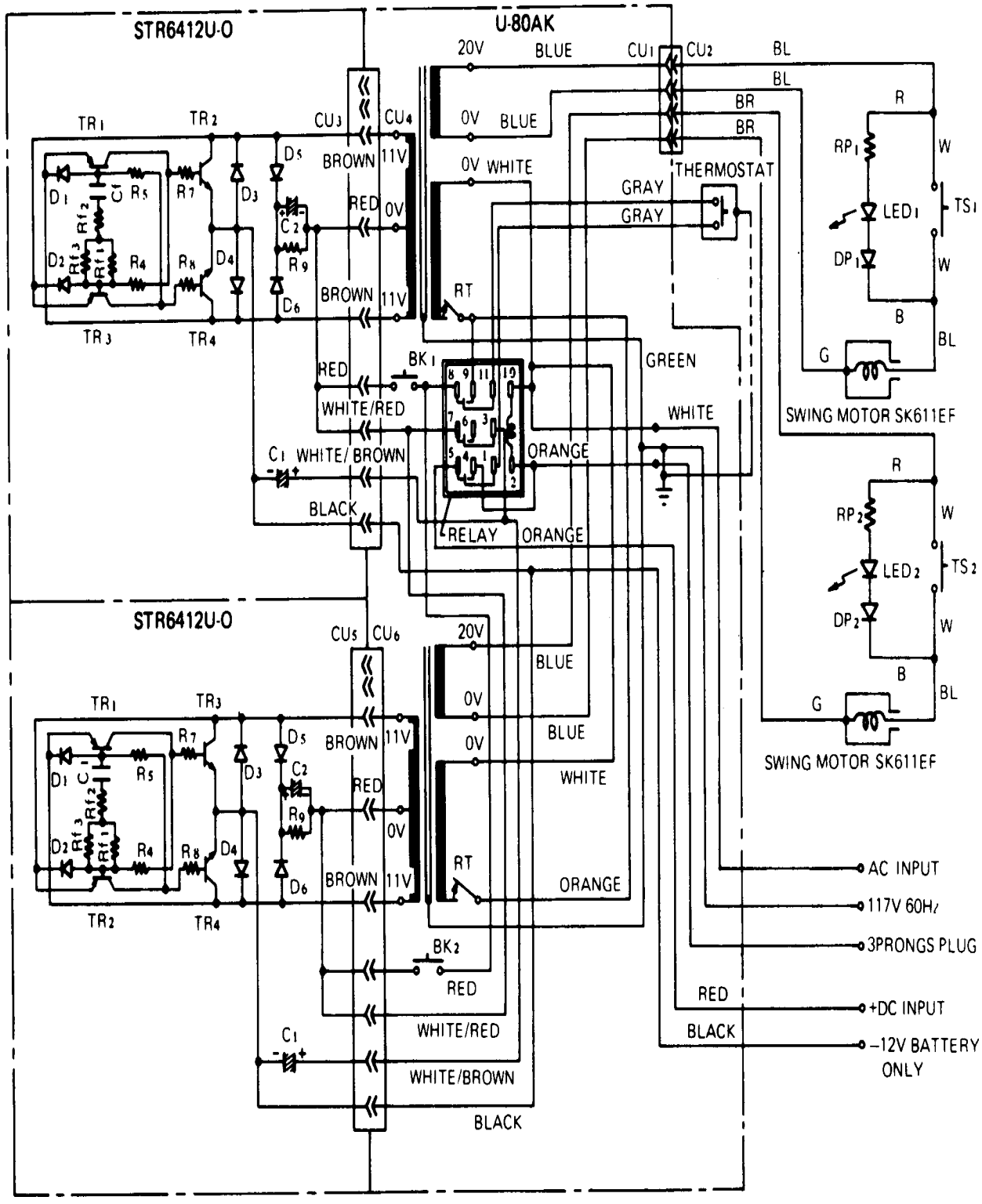
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: SCQT-6406

POWER SUPPLY: 1601-062-00
OSCILLATOR ASSEMBLY: STR6412U-0
TRANSFORMER ASSEMBLY: U-48AF



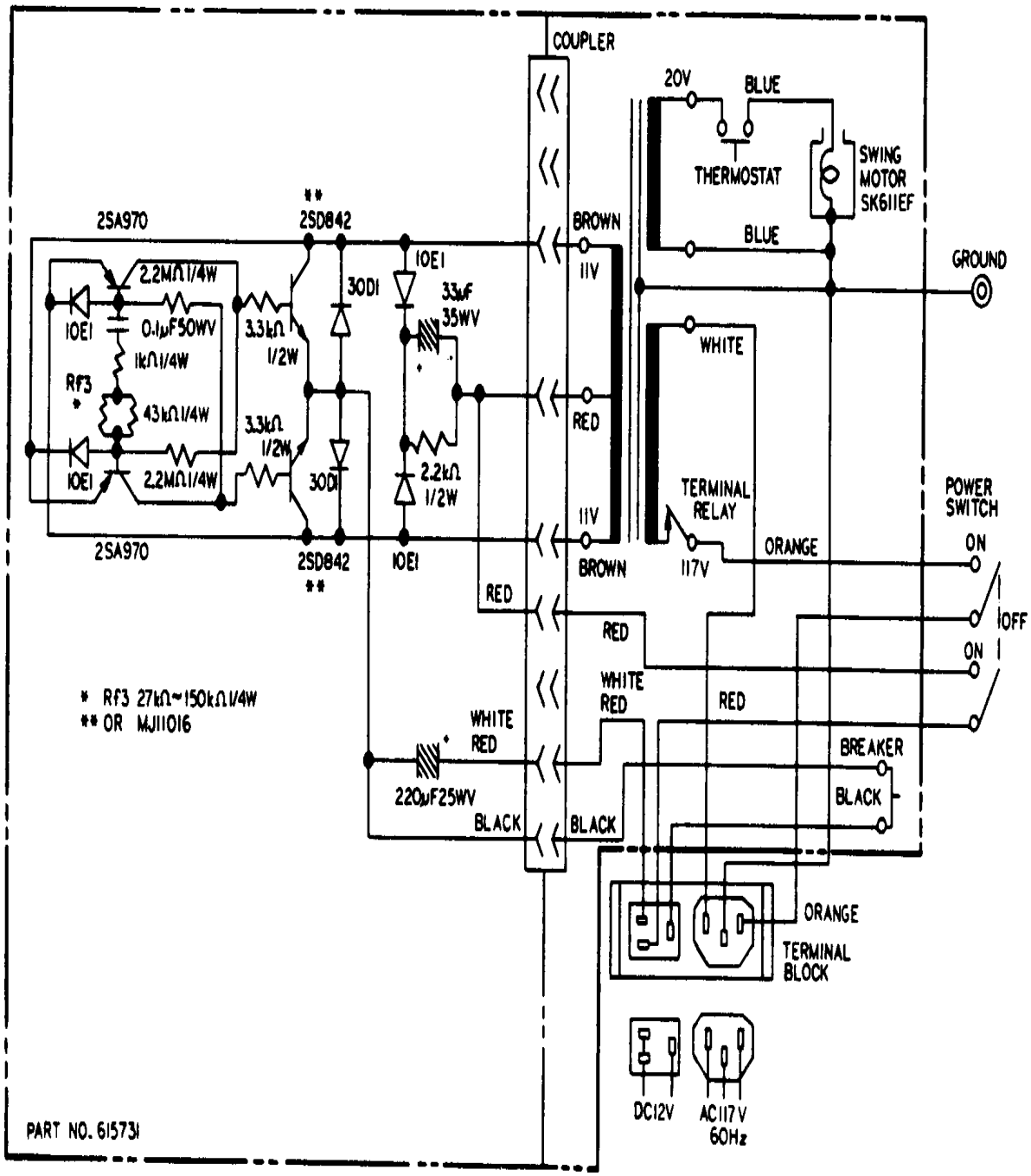
CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: SCQT-6800

POWER SUPPLY: 1601-060-00
OSCILLATOR ASSEMBLY: STR6412U-0
TRANSFORMER ASSEMBLY: U-80AK



CIRCUIT DIAGRAM OF REFRIGERATOR MODEL: V2000

POWER SUPPLY: 615751
OSCILLATOR ASSEMBLY: STR6412U-51-0
TRANSFORMER ASSEMBLY: U-48DS



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Service manuals provided with the understanding that persons using them are well versed in proper safety practices, and are familiar with basic safety procedures, including, but not limited to safety procedures dealing with 120 volt electricity, high amperage 12 volt circuits an LPG (propane) systems.

If in doubt, consult a professional (better safe than sorry).