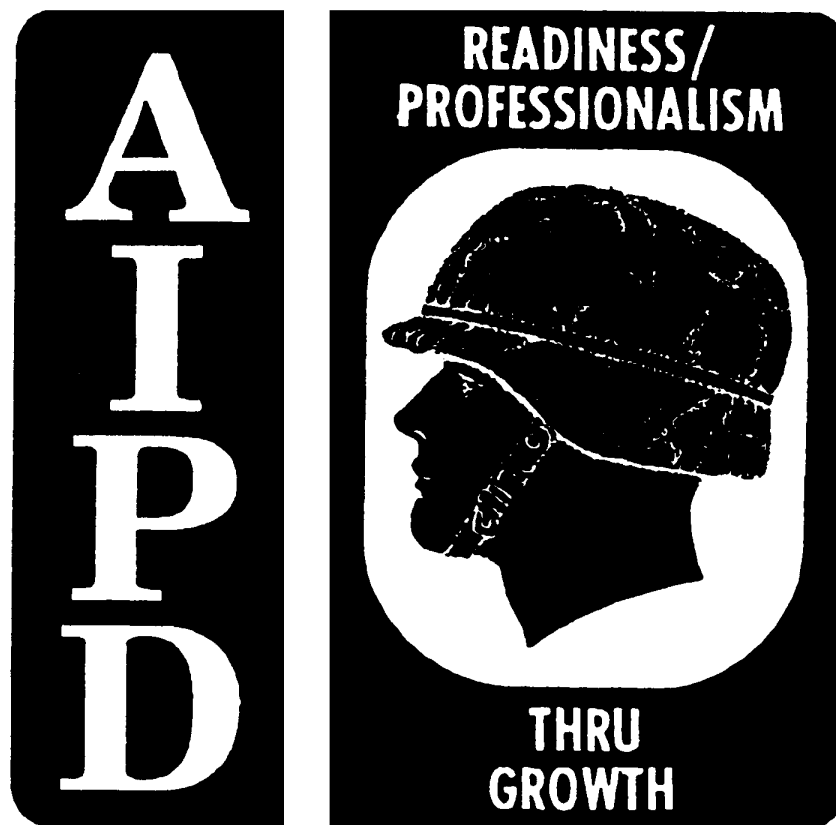


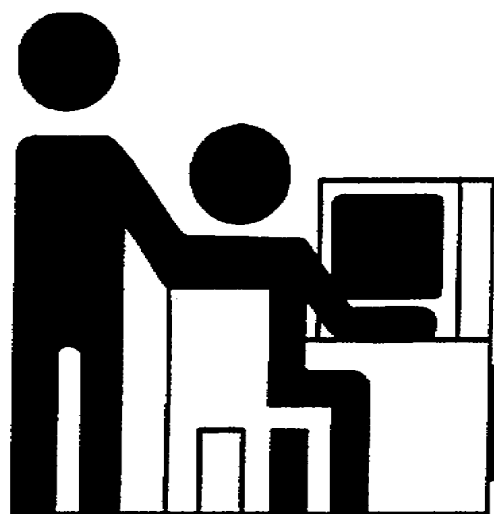
**SUBCOURSE
OD1725**

**EDITION
B**

BASIC SCHEMATIC INTERPRETATION



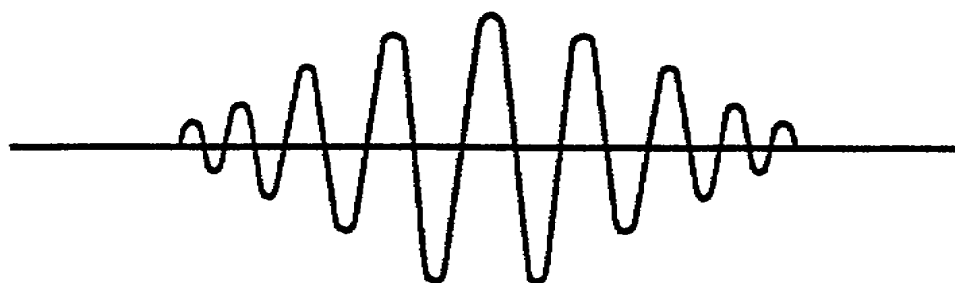
**THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT
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BASIC SCHEMATIC INTERPRETATION

Subcourse Number OD1725

Edition B
March 1996

United States Army Ordnance Center and School

5 Credit Hours

SUBCOURSE OVERVIEW

This subcourse presents basic schematic interpretation in three parts. Part A identifies basic symbols used in circuit schematics. Part B discusses typical component characteristics and their functional use within a circuit. Part C describes the methods to determine reference designators and the procedures for wire tracing in a circuit. Part C also includes a wire tracing exercise.

Terminal Learning Objective

Actions: You will recognize the various symbols used in schematic diagrams of Army technical manuals. You will understand their characteristics and how they function in typical circuit applications. You will also perform wire tracing in a practical wire tracing exercise using extracts from an Army technical manual.

Conditions: You will be given the subcourse booklet with extracts from TM 9-5855-267-24.

Standards: You will perform wire tracing procedures in accordance with TM 9-5855-267-24.

There are no prerequisites for this subcourse.

The following publications are the references for this subcourse:

FM 11-60	Basic Principles, Direct Current, November 1982.
FM 11-61	Basic Principles, Alternating Current, November 1982.

FM 11-62	Solid State Devices and Solid State Power Supplies, September 1983.
FM 11-72	Digital Computers, September 1977.
TM 9-5855-267-24	Sight, Tank Thermal AN/VSG-2, December 1980.
ANSI Y32.2	Graphic Symbols for Electrical and Electronics Diagrams, October 1975.

This subcourse contains information which was current at the time it was prepared. In your own work situation, always refer to the latest publications.

The words "he," "him," "his," and "men," when used in this publication, represent both the masculine and feminine genders unless otherwise stated.

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LESSON

BASIC SCHEMATIC INTERPRETATION

LEARNING OBJECTIVE

- Actions:
- a. Identify the symbols used in typical schematic diagrams of Army technical manuals.
 - b. Describe the characteristics and circuit functions of electrical and electronic components used in Army fire control instruments.
 - c. Wire trace a circuit using the procedures specified in an Army technical manual.
- Conditions: You will be given the subcourse booklet with extracts from TM 9-5855-267-24.
- Standards: You will perform the wire tracing procedures in accordance with TM 9-5855-267-24.

INTRODUCTION

One of the essential elements of an effective unit is the ability to effectively repair malfunctioning equipment and return it to service quickly. For the fire control systems repairer (MOS 45G), this often means the adjustment, replacement, or repair of the electrical and electronic components within the fire control instruments and their associated test equipment. In order for the technician to understand the operation of the equipment and the procedures for troubleshooting and repair, he must be able to identify components and understand how they function within that particular circuit. He must also be able to trace signals through and between circuits.

This lesson identifies typical symbols used in Army technical manuals for electrical and electronic systems. It describes their functional operation in circuit application. It also provides an exercise in wire tracing, using the procedures specified by TM 9-5855-267-24.

PART A - IDENTIFICATION OF ELECTRICAL AND ELECTRONIC SCHEMATIC SYMBOLS

In order to understand the functioning of an electrical or electronic circuit, you must be able to "read" the schematic diagram of that circuit. A schematic diagram is the road map of the circuit. In order to get from one point to another, you must be able to follow the appropriate route and understand the meanings of the various symbols found along the way.

1. Symbols. Just as the road map uses symbols to represent the highways, cities, interchanges, and other elements displayed, the schematic diagram uses symbols to represent the components used to make up a circuit. Symbols are used to indicate conductors, resistors, switches, motors, transistors, and other electrical and electronic parts. Components in a circuit schematic are generally represented by such a symbol and/or a letter designator. This part of the lesson reviews many of the symbols used by Army technical manuals in the schematic diagrams of the appropriate equipment.

2. Conductors. Basic to any schematic diagram is the use of straight lines to indicate conductors. The conductor is the "roadway" of the circuit map. The conductors interconnect the components of the circuit. Conductors often cross paths with one another in the circuit. This may occur with or without their making electrical contact. Figure 1-1 illustrates the typical methods for crossing conductors within a schematic diagram.

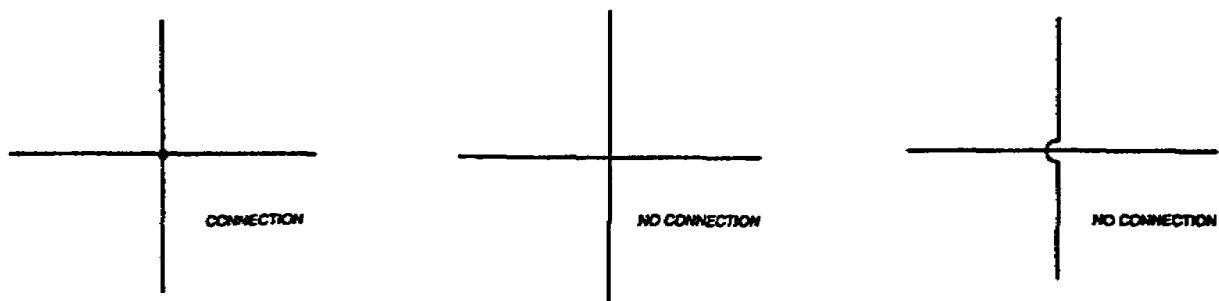


Figure 1-1. Crossing Conductors.

There are many types of conductors used in electrical and electronic circuits. They may range from the thin layers of metal foil used in printed-circuit boards to heavy cables used in power transmission. Cables generally consist of two or more conductors, usually in the same insulation jacket. A special type of conductor found in many electronic applications is the shielded wire or coaxial cable. Here, the conductor is

surrounded by a metallic shield to protect against interference from adjacent electrical influence. The shielding on the cable may or may not be grounded. Figure 1-2 shows some common symbols for shielded conductors.

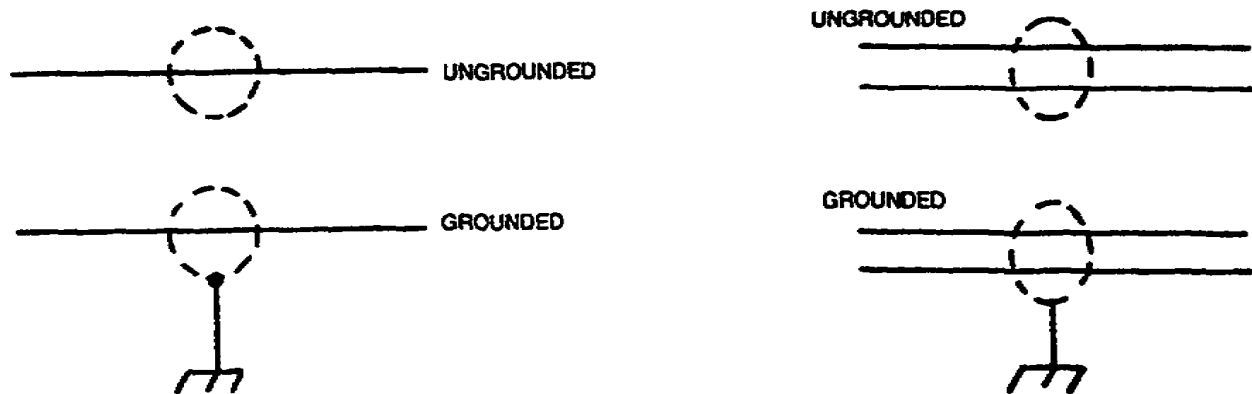


Figure 1-2. Shielded Conductors.

3. Basic Components. There are literally hundreds of different types of electrical and electronic components in use today. However, three components are widely used in a wide variety of applications. These three components are found in most circuit schematics of any complexity. The three components are (a) resistors; (b) capacitors; and (c) inductors.

a. Resistors. Resistors are unquestionably the most commonly used circuit components. They are found in almost every electrical and electronic schematic diagram. Resistors are appropriately named in that they are designed to "resist" the flow of electrical current. Resistors are typically shown in schematics by the symbol illustrated in figure 1-3.

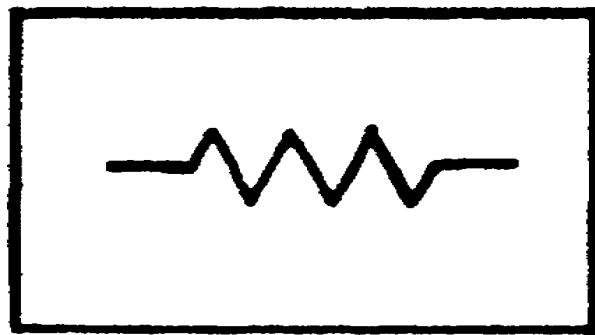


Figure 1-3. Fixed Resistors.

In addition to the symbol, the resistor is generally labeled by the letter "R" followed by a number, e.g., R1, R2, etc. The resistance value, measured in ohms, may also be indicated. If the resistance is not indicated, you can determine it by

observing the color coding used on most resistors. Figure 1-4 lists the color-coded values used in marking carbon resistors.

COLOR	SIGNIFICANT FIGURE	DECIMAL MULTIPLIER	RESISTANCE TOLERANCE	RELIABILITY LEVEL PER 1000 HRS.
BLACK	0	1	PERCENT $\pm$	
BROWN	1	10	---	1%
RED	2	100	---	.1%
ORANGE	3	1,000	---	.01%
YELLOW	4	10,000	---	.001%
GREEN	5	100,000	---	
BLUE	6	1,000,000	---	
VIOLET	7	10,000,000	---	
GRAY	8	100,000,000	---	
WHITE	9	1,000,000,000	---	
GOLD	---	.1	5	
SILVER	---	.01	10	
NO COLOR	---		20	

Figure 1-4. Color Code for Resistors.

Several variations of resistors exist. The symbol shown in figure 1-3 is that of a fixed resistor, one of a set or fixed value. Resistors also may have variable values of resistance. This may be achieved by the use of variable resistors that may be adjusted, or through the use of tapped resistors which have two or more selected values of resistance. Figure 1-5 shows the symbols commonly used to indicate variable and tapped resistors in schematic diagrams.

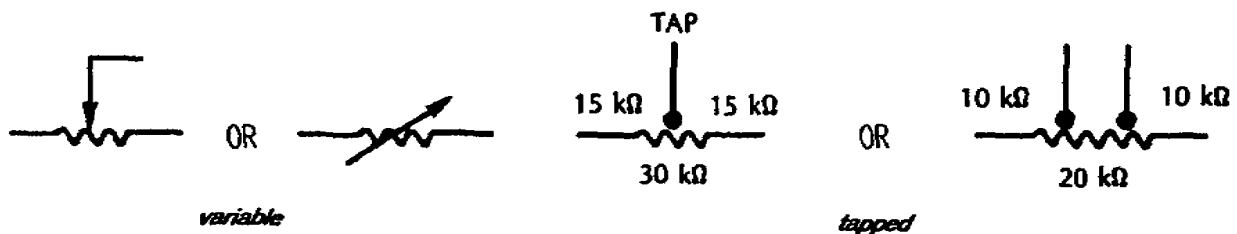


Figure 1-5. Variable and Tapped Resistors.

b. Capacitors. Next to resistors, capacitors are the most common components found in schematic diagrams. Capacitors are capable of storing electrical charges. They have the ability to block direct current (DC) while passing alternating current (AC). The standard symbols used to represent fixed capacitors are shown in figure 1-6. In addition to the symbol, a capacitor is generally labeled with the letter "C." The value of the capacitor may also be indicated. The basic unit of capacitance

is the farad; but most practical capacitors will be rated in microfarads (MF) or picofarads (PF). As with resistors, if the value is not given, determine it by observing the color coding found on many types of capacitors. Figure 1-7 is a table indicating the use of color coding for some capacitors.

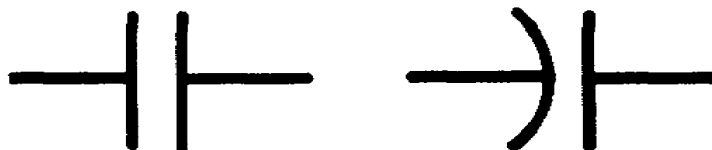


Figure 1-6. Fixed Capacitors.

COLOR	CAPACITANCE			TOLERANCE (PERCENT)	VOLTAGE RATING	
	1ST DIGIT	2ND DIGIT	MULTIPLIER		1ST DIGIT	2ND DIGIT
BLACK	0	0	1	±20	0	0
BROWN	1	1	10		1	1
RED	2	2	100		2	2
ORANGE	3	3	1,000	±30	3	3
YELLOW	4	4	10,000	±40	4	4
GREEN	5	5	100,000	±5	5	5
BLUE	6	6	1,000,000		6	6
VIOLET	7	7			7	7
GRAY	8	8			8	8
WHITE	9	9		±10	9	9

Figure 1-7. Six-Band Color Code for Capacitors.

Capacitors also come in many variations. In addition to fixed capacitors, you may often find variable, ganged variable, or electrolytic (polarized) capacitors. Figure 1-8 illustrates the symbols used for some variations of capacitors.

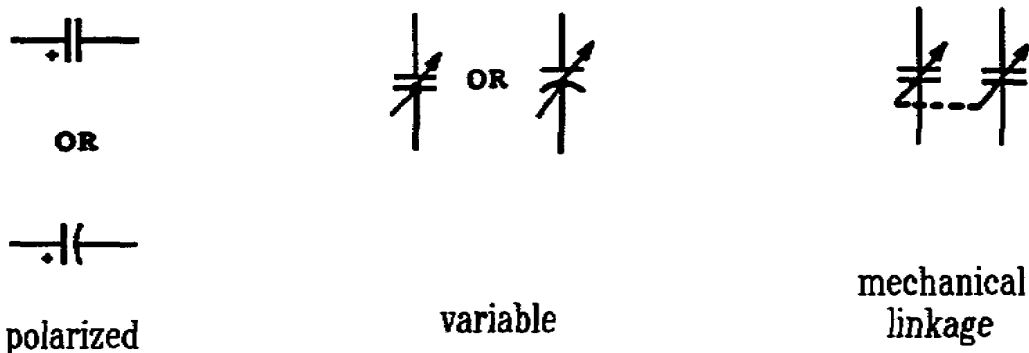


Figure 1-8. Special Purpose Capacitors.

c. Inductors. While not used as extensively as resistors and capacitors, inductors (or coils) are still a common basic component of many electrical and electronic circuits. An inductor has the property of opposing a change in the existing current. The standard symbol for an inductor is shown in figure 1-9. Inductors are generally labeled with the letter "L" and are rated in henrys, the basic unit of inductance. In most practical applications, the actual rating will be given in millihenrys or microhenrys.



Figure 1-9. Air Core Inductor.

Inductors, like the other basic components, come in a variety of configurations. They may be variable, tapped, aircore, iron core, etc. Figure 1-10 illustrates the symbols used for some variations of inductors.

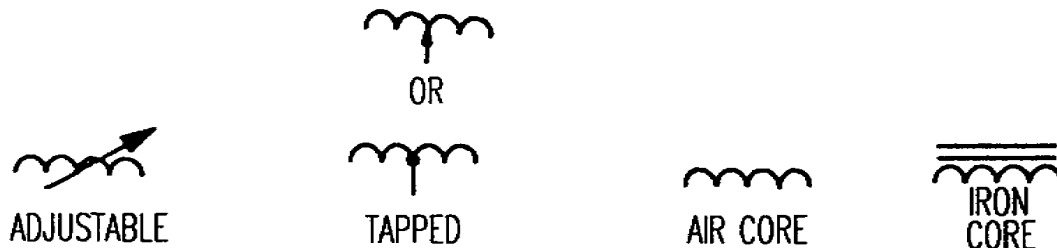


Figure 1-10. Special Purpose Inductors.

4. Power Sources. Every electrical circuit must have a source of electrical power. Some electrical and/or electronic devices have an internal power source, but most rely on some external source to supply the power necessary to operate them.

When the power source is external to the particular schematic diagram being examined, generally only the connectors bringing in the power are identified and labeled with the appropriate originating source. However, when the source of the power for a given circuit is internal to the schematic, it must be identified and represented by the appropriate schematic symbol.

Most electrical and electronic equipment is operated by "plugging" it into an external power source, or by some installed power source (usually a battery). As previously stated, external power sources are usually identified on a schematic diagram by their point of entry into the circuit.

Internal power sources must be presented as an integral component of the circuit, and are represented graphically by the appropriate symbol. Some typical power sources are discussed below.

a. Batteries. Most of us use equipment powered by batteries in our every day life. Batteries are used to power such everyday equipment as flashlights, watches, radios, and to start our cars. They may be small enough to fit inside a watch, or large enough to propel a submarine through the water. They may be dry cells, such as used in a flashlight, or wet cells, such as those found under the hood of your automobile. They may be primary batteries or secondary batteries. Primary batteries have a fixed supply of energy and must be replaced when that supply is dissipated. Secondary batteries may be recharged when their energy supply runs low.

Regardless of the type or size of the battery, the schematic symbolism is the same. Figure 1-11 illustrates the symbols used to represent batteries in schematic diagramming. In schematics, the key to interpreting batteries is the manner in which they are connected. Figure 1-11A shows a single cell battery. Most often, the polarity of the battery is labeled in the schematic by a (+) and a (-) at the appropriate pole of the battery. In the absence of this labeling, the general rule is that the long line pole is the positive side and the short line pole is the negative. Figure 1-11B shows a multicell battery. The symbol does not necessarily represent the exact number of cells in the battery.

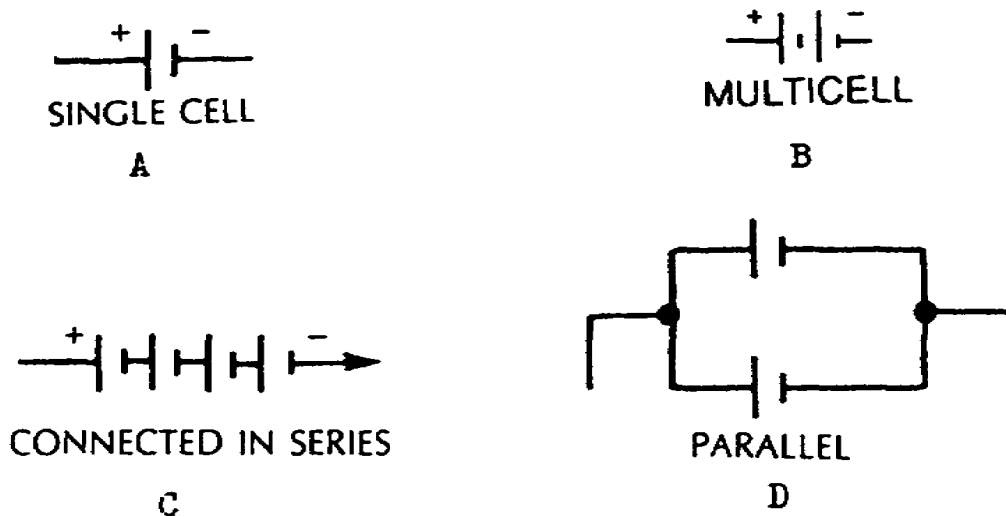


Figure 1-11. Battery Symbols.

In order to increase the voltage output of a battery power source, batteries are often connected in series. Figure 1-11C shows a series connected battery power source. In a series

connected battery source, the voltage output of the individual batteries is additive. Sometimes series connected batteries are illustrated the same way as multicell batteries. If the battery has the proper voltage rating, but lacks sufficient power for the given circuit, batteries may be parallel connected. Figure 1-11D shows a parallel connected battery power source. The output voltage of the battery power source is generally indicated on the schematic diagram.

b. Generators. Another common source of power for electrically powered equipment is the generator. Simply put, generators convert mechanical energy to electrical energy. Depending on the design and construction of the generator, the output may be set to meet the needs of the equipment supplied. Generators may be designed to provide either AC or DC power. AC generators are often referred to as alternators. Figure 1-12 shows the standard symbols used to represent generators or alternators in schematics.

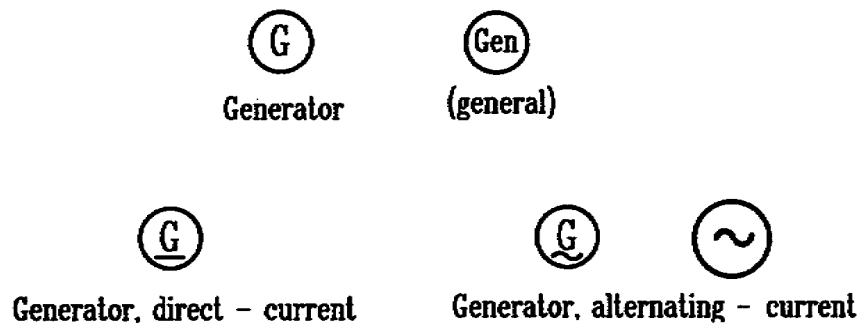


Figure 1-12. Generators.

c. Transformers. Although transformers are not a true power source, they are often the source of the voltages used in a given circuit. Typically, an external power source is applied to a transformer, which converts the input power to the voltage(s) necessary to operate the circuit supplied. Transformers are a special application of inductors, thus the similarity in the schematic symbol used. Figure 1-13 illustrates several types of transformers used in a variety of circuits.

Basically, transformers are two inductors placed in close physical proximity. The external input AC voltage is applied to the first inductor (the primary). The resulting electrical field will be "induced" onto the secondary inductor (the secondary), thus transferring the power from the primary to the secondary. The voltage and current produced in the secondary will be a factor of the relationship of the windings in the primary and the secondary. Transformers may be used to step-up

voltages, step-down voltages, or both. Disregarding the inherent losses in transformer action, the following rules apply:

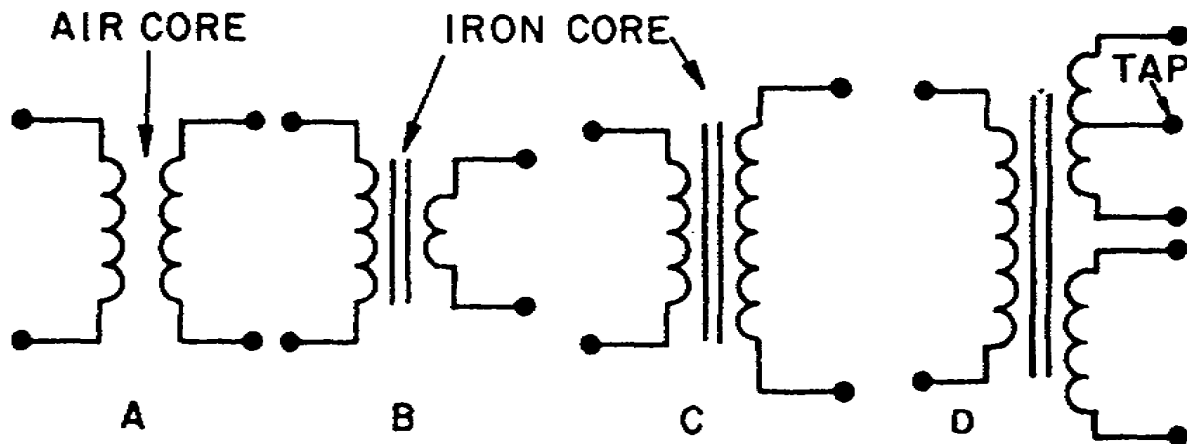


Figure 1-13. Transformers.

(1) If the number of windings in the primary and secondary is the same, the voltage and the current in the secondary will be the same as in the primary. Figure 1-13A illustrates a 1:1 ratio transformer.

(2) If the number of windings in the primary is greater than in the secondary, the voltage will be less in the secondary and the current will be greater. For example, if the number of windings in the primary is twice that of the secondary, the voltage in the secondary would be half that of the primary, and the current would be double that of the primary. Such a transformer is referred to as a step-down transformer. Figure 1-13B shows the symbol for a step-down transformer.

(3) If the number of windings in the primary is less than in the secondary, the voltage in the secondary is greater than in the primary, and the current will be less. For example, if the number of windings in the secondary are three times that of the primary, the voltage in the secondary will be three times that of the primary, and the current will be one-third. Such a transformer is referred to as a step-up transformer. Figure 1-13C shows the symbol for a step-up transformer.

Transformers have many configurations to meet the needs of the circuits they supply. Just as with inductors, transformers may have an air core, a fixed iron core, or an adjustable iron core. The output may be varied by adjusting the primary, the secondary, or the core. The secondary may be tapped to provide a variety of outputs in the secondary, or the transformer may have more than one secondary to provide separate outputs (see

figure 1-13D). In addition to the symbol, transformers are generally labeled by the letter "T."

d. Power Supplies. Like transformers, power supplies are not a true power source. They generally take an input from an external, power source and convert that source to usable voltages to operate the circuits they supply. Typically, a power supply will convert an AC input into one or more DC outputs. Most power supplies consist of four basic sections: a transformer; a rectifier; a filter; and a regulator. Figure 1-14 shows a simple block diagram of a power supply and the effects of the basic components.

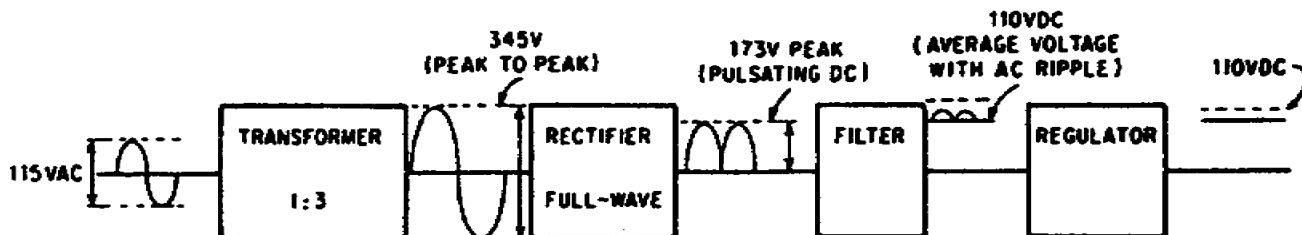


Figure 1-14. Basic Power Supply.

Power supplies may be designed to produce one or several different output voltages. Depending on the complexity of the circuit demand, power supplies may be fairly simple or they may be quite extensive. Often the power supply for a circuit will require a separate schematic diagram to illustrate the components and functional operation of the power supply. Figure 1-15 illustrates a schematic of a simple power supply. Power supplies are labeled with the letters "PS."

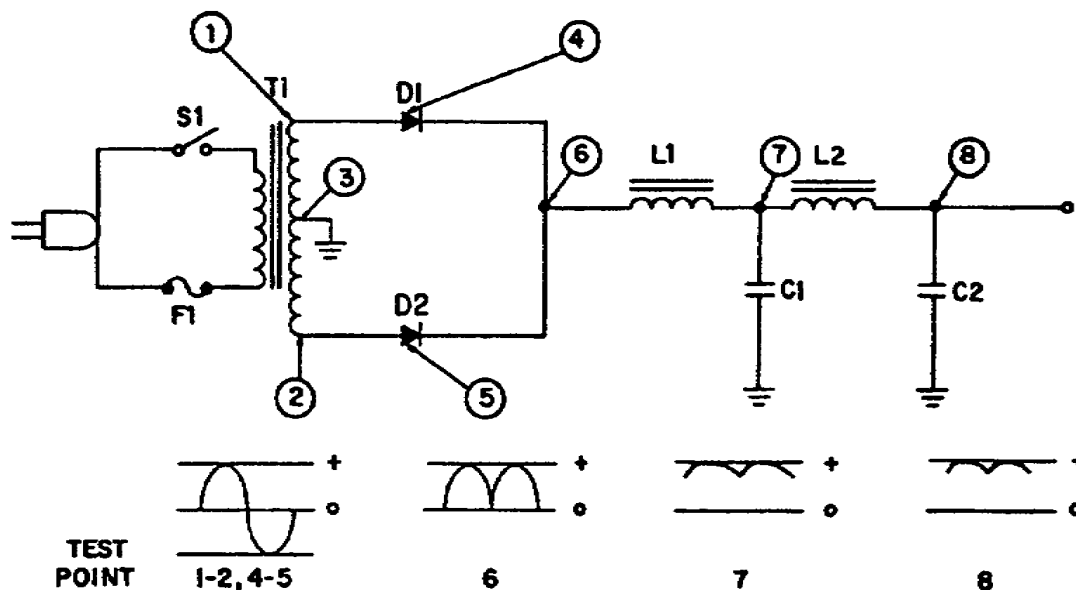


Figure 1-15. Simple Power Supply (Schematic).

5. Controls. Many electrical and electronic circuits include controls and indicators to assist the operator in the use and repair of the equipment. These controls may consist of devices such as switches, relays, fuses, plugs and jacks, test points, and indicators. These operator aids are normally represented in the circuit schematic diagram to illustrate their effect on the circuit operation.

a. Switches. Switches give the operator control over the operation of the equipment. By positioning the switch, the operator directs the operation of the circuit by routing the direction of electrical signals within the circuit. Switches may be simple, such as an on/off switch, or they may be complex, being of multiposition/multifunction design. They may be designed to be momentary action, to latch in a given position, make-before-break, or to perform any number of specific functions. While the possible designs for switches are almost limitless, figure 1-16 illustrates several commonly used switch symbols. In addition to the symbol, switches are normally labeled with the letter "S." A special type of switch is the circuit breaker. Circuit breakers normally act as on/off switches as well as providing overvoltage/overcurrent protection to the circuit. The symbol for a typical circuit breaker is shown in figure 1-16. Circuit breakers are labeled with the letters "CB."

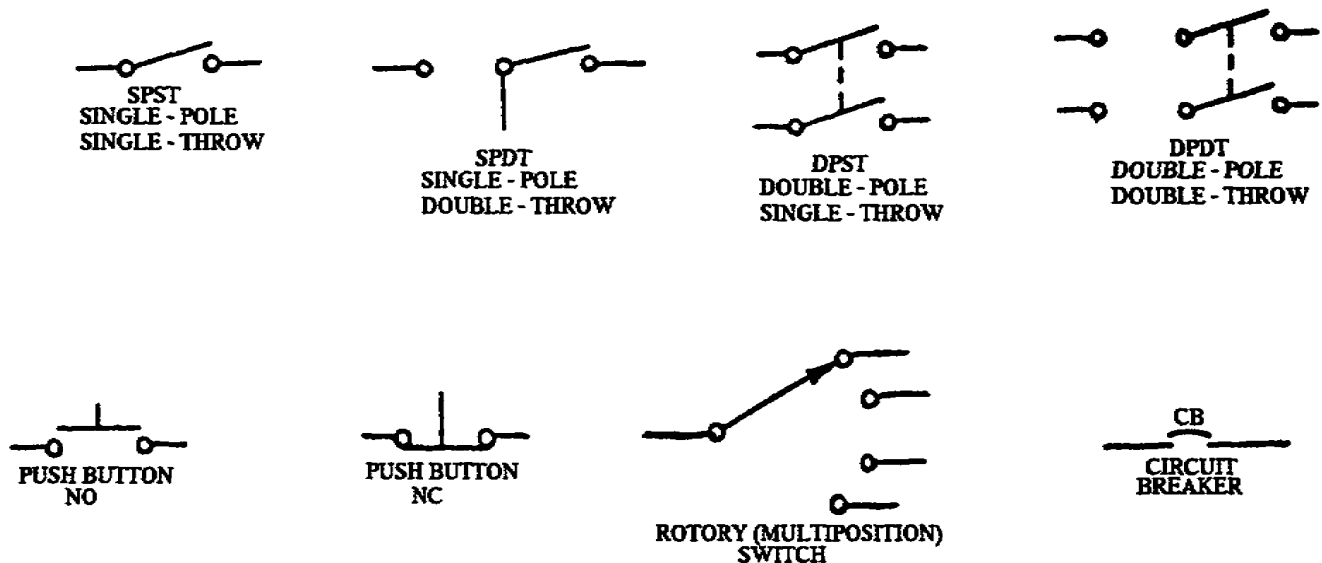


Figure 1-16. Switches.

b. Relays. The previous description of switches stated that switches direct the routing of electrical signals within a circuit. A relay functions similarly. Rather than being controlled manually by the operator, a relay is operated electrically by energizing a coil to realign the contacts of the

relay and re-route the electrical signals. Relays may be indicated in schematics only by their coil and its energizing source, only by the contacts used by the particular circuit, or by both. Contacts are normally shown in the position with the relay de-energized, unless otherwise indicated. Figure 1-17 illustrates some methods of representing relays symbolically. Relays are labeled with the letter "K."

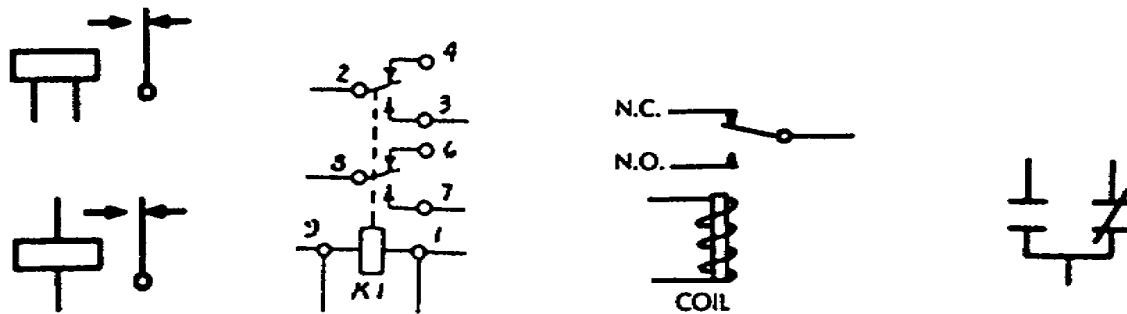


Figure 1-17. Relays.

c. Fuses. Fuses are used to protect circuits from overvoltage or overcurrent conditions. Unlike circuit breakers, which are electromechanical, fuses are thermally sensitive. When the circuit becomes overloaded, the metal alloy of the fuse melts (opens) and removes the power source from the equipment. Fuses are designed to meet the requirements of the circuits they are protecting. The symbols used for fuses are shown in figure 1-18. Fuses are labeled with the letter "F."



Figure 1-18. Fuses.

d. Plugs, Jacks, and Test Points. Plugs and jacks are generally used to connect the equipment to some external device, or to interconnect circuits and components within the equipment. Plugs and jacks may be single conductor or multiconductor. They may be permanent or removable, shielded or unshielded. Jacks and plugs often provide a convenient means to check or test critical signals. This provides an extremely useful function in troubleshooting. Where it is impossible or impractical to check a signal at a jack or plug, circuits are often designed to provide test points. These test points may be internal to the circuit or tapped off and provided at an external point. Figure 1-19 illustrates some typical symbols used for jacks, plugs, and test points. Jacks are labeled with the letter "J"; plugs with the letter "P"; and test points with the letters "TP." With

multiconductor plugs and jacks, the individual conductors are generally identified by pin or pin socket numbers.

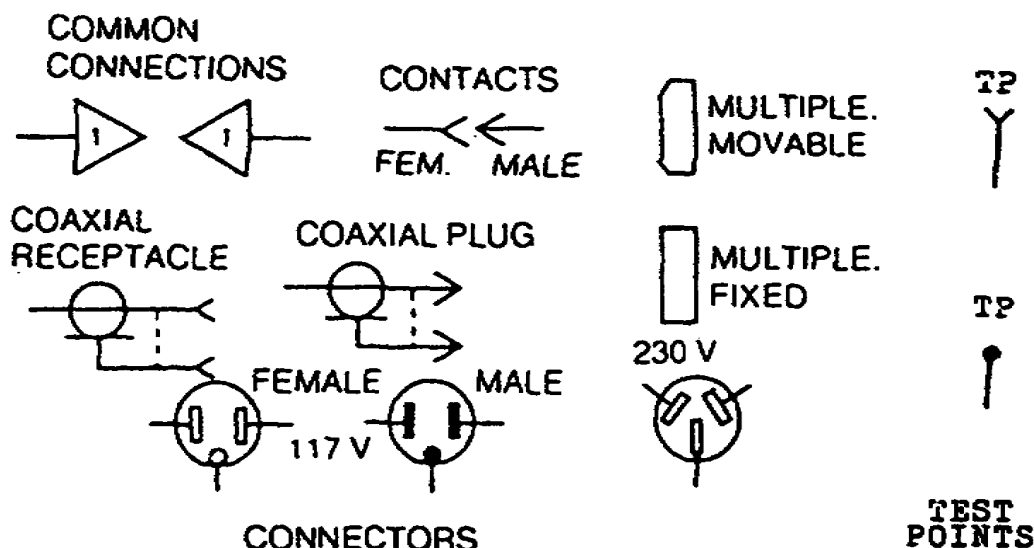


Figure 1-19. Test Connections.

e. Indicators. Indicators are generally placed in electrical or electronic circuits to provide the operator a status of some function of the equipment. The indicator may be audible, visual, or both.

(1) Audible indicators may consist of a horn, buzzer, speaker, or other noise producing device. Most often these devices are used as alarms or warnings. Figure 1-20 shows the symbols for some types of audible indicators. Audible indicators are labeled with the letters "LS."

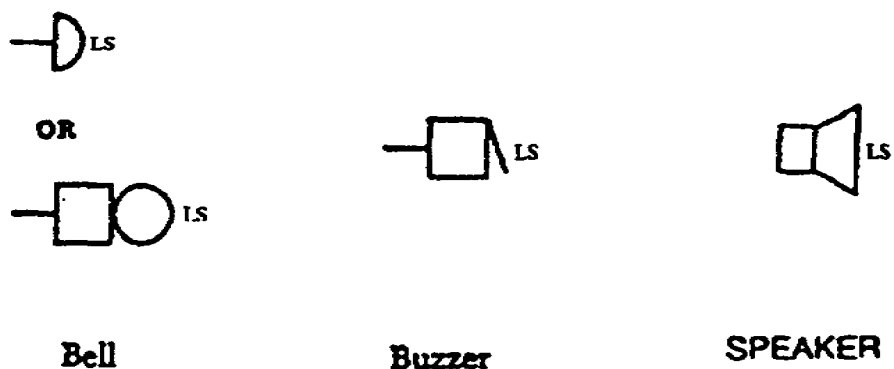


Figure 1-20. Audible Indicators.

(2) Visual indicators are typically some type of a light, dial, or meter. Visual indicators may provide a warning or present some type of status. Dials and meters are most often represented by the symbol shown in figure 1-21 with its accompanying legend.

A wide variety of light indicators are also used to provide important information to the operator. These may include such items as indicator lamps with various color lenses such as a power on indicator, a flashing neon bulb such as a high temperature alarm, a digital display such as a range readout, or a graphic display such as a screen on an oscilloscope. The light indicator may be provided by such sources as lamps, fluorescent or neon tubes, or light-emitting solid-state devices. Generally, light indicators or displays are shown on schematics by one of the symbols illustrated in figure 1-22 and are labeled with the letters "DS."

INSERT
APPROPRIATE
DESIGNATIONS

A	Ammeter 	IEC	DTR	Demand-totalizing relay	RF	Reactive factor meter
AH	Ampere-hour meter		F	Frequency meter 	SY	Synthescope
C	Coulombmeter		GD	Ground detector	t'	Temperature meter
CMA	Contact-making (or breaking) ammeter		I	Indicating meter	THC	Thermal converter
CMC	Contact-making (or breaking) clock		INT	Integrating meter	TLM	Telemeter
CMV	Contact-making (or breaking) voltmeter		μ A or UA	Microammeter	TT	Total time meter
CRO	Oscilloscope 		MA	Milliammeter	V	Elapsed time meter
DB	Cathode-ray oscillograph		NM	Noise meter	VA	Voltmeter 
DBM	DB (decibel) meter		OHM	Ohmmeter 	VAR	Volt-ammeter
DM	DBM (decibels referred to 1 milliwatt) meter		OP	Oil pressure meter	VARH	Varmeter 
			OSCC	Oscillograph, string	VI	Varhour meter
			PF	Power factor meter	VU	Volume indicator
			PH	Phasemeter 	W	Audio-level meter 
			PI	Position indicator	WH	Standard volume indicator
			RD	Recording demand meter		Audio-level meter 
						Wattmeter 
						Wattmeter 

Figure 1-21. Readout Devices.



Figure 1-22. Light Indicators.

An exception is often made when the light source is a light-emitting diode (LED) or a liquid-crystal display (LCD). These solid-state devices may be represented symbolically as above, or they may be represented by the symbols shown in figure 1-23 and labeled with the letters "CR."



Figure 1-23. Solid-State Light Indicators.

6. Vacuum Tubes. While vacuum tubes are not used to the extent that they were in the past, you may still encounter electronic circuits that use these devices. As with electronic components, vacuum tubes come in a variety of configurations. They may range from a simple two element diode to a multielement cathode-ray tube.

Each type of vacuum tube has a symbol to represent it in a circuit schematic. Vacuum tubes are indicated by a circle representing the envelope of the tube, with the elements of the device shown within. Figure 1-24 illustrates a triode vacuum tube. As shown, the element labeled 1 is the cathode heater. Element 2 is the cathode. (Sometimes a directly heated cathode will be represented by the symbol of the cathode heater alone.) The element labeled 3 is the plate or anode. Element number 4 is the control grid. Additional elements may be added depending on the circuit function of the vacuum tube. Figure 1-25 shows several symbols for various designs of vacuum tubes.

The general operating principle of a vacuum tube is control of the current flow through the tube. This is done by heating the cathode, directly or indirectly, and applying a bias voltage between the cathode and the plate. The amount of current that flows through the tube is controlled by adjusting the bias or through the use of a variety of grids. Figure 1-26 shows the triode shown in figure 1-24 hooked up in a circuit to provide voltage amplification. Vacuum tubes are labeled with the letter "V. "

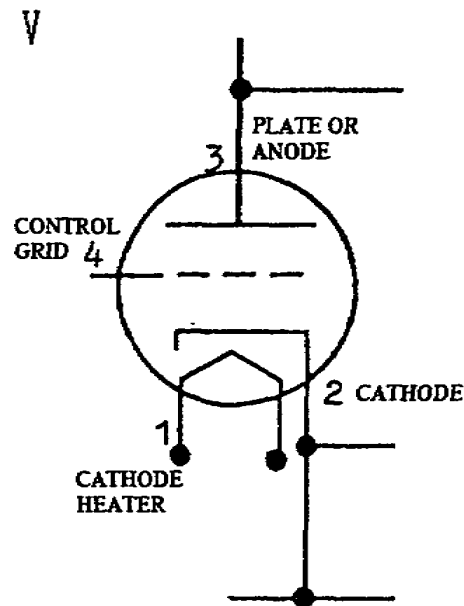


Figure 1-24. Triode Vacuum Tube.

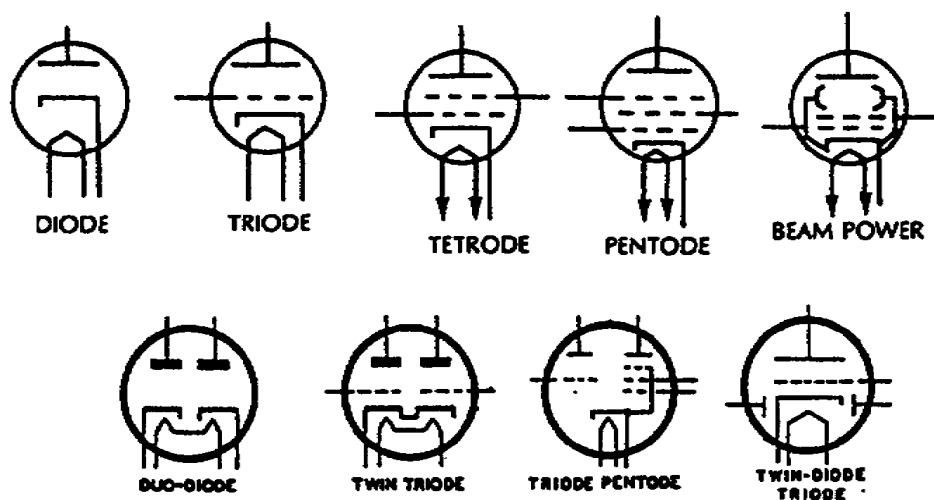


Figure 1-25. Vacuum Tubes.

A special type of vacuum tube is the cathode-ray tube (CRT). Unlike the other types of vacuum tubes, CRTs are still widely used. They are the element known as the "picture tube" in your television set. They are used as the "screen" on radar displays and oscilloscopes. CRTs have one feature that cannot be accomplished with the use of other type tubes or transistors; they can convert electrical signals to visual display. Figure 1-27 shows the symbol for a CRT.

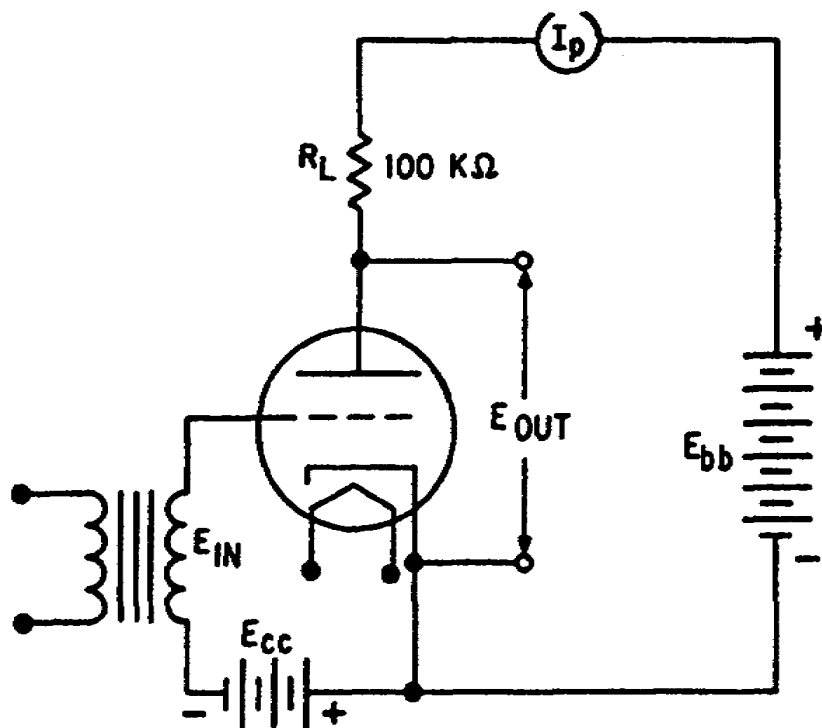


Figure 1-26. Triode Amplifier.

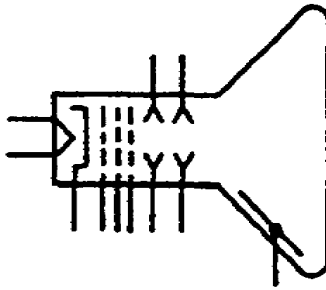


Figure 1-27. Cathode-Ray Tube (CRT)

7. Solid-State Devices. Solid-state devices (sometimes referred to as semiconductors) have, to a large extent, replaced vacuum tubes in the design of most modern electronic equipment. Solid-state devices are generally made of silicon or germanium that is "doped" with impurities to provide the desired conductivity. They may be doped to produce either p-type material (positive) or n-type material (negative). These semiconductors are used in the place of vacuum tubes due to these advantages: they are smaller, take less power to operate, usually cost less, and are more rugged.

a. Transistors. Probably the most common of these solid-state devices is the transistor. While there are numerous variations, most transistors are either pnp transistors or npn transistors. Figure 1-28 shows the symbol for a npn and a pnp transistor. The key to recognizing a npn or pnp is the direction of the arrow on the emitter. On the pnp transistor symbol, the arrow points inward; on the npn, the arrow points outward. The elements of the transistor operate much like the elements of the vacuum tube. The emitter functions much as the cathode; the collector as the plate; and the base much like the grids. Transistors are labeled with the letter "Q."

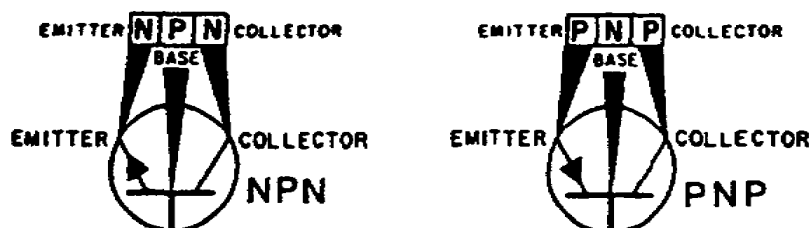


Figure 1-28. NPN, PNP Transistors.

b. Diodes. Another common solid-state component is the diode. A diode consists of one piece of p-type material and one piece of n-type material formed together to create a p-n junction. This p-n junction has the property to pass current in only one direction. Diodes are also designed in a number of

variations to meet special applications. Figure 1-29 shows the schematic symbol for some commonly used diode applications. Diodes are generally labeled with the letter "D" or the letters "CR." Exceptions are the symbol for the zener diode, which is often labeled "VR", and the light-emitting diode (LED), which may be labeled "DS."

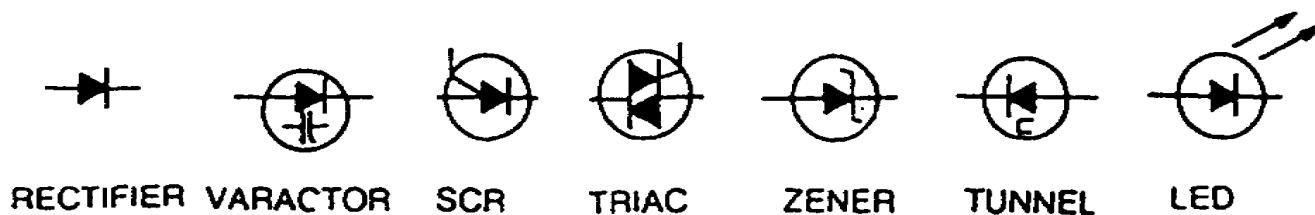


Figure 1-29. Diodes.

c. Special Purpose Devices. As indicated above, transistors and diodes may be constructed in a variety of designs to meet the needs of special applications. While it would be impractical to attempt to list them all, some of the more common special purpose solid-state symbols are shown in figure 1-30. The symbols shown are as follows:

- (1) Silicon-controlled rectifier (SCR).
- (2) Silicon-controlled switch (SCS).
- (3) Triac.
- (4) Field-effect transistor (FET).
- (5) Unijunction transistor (UJT).
- (6) Light-emitting diode (LED).
- (7) Photocell.

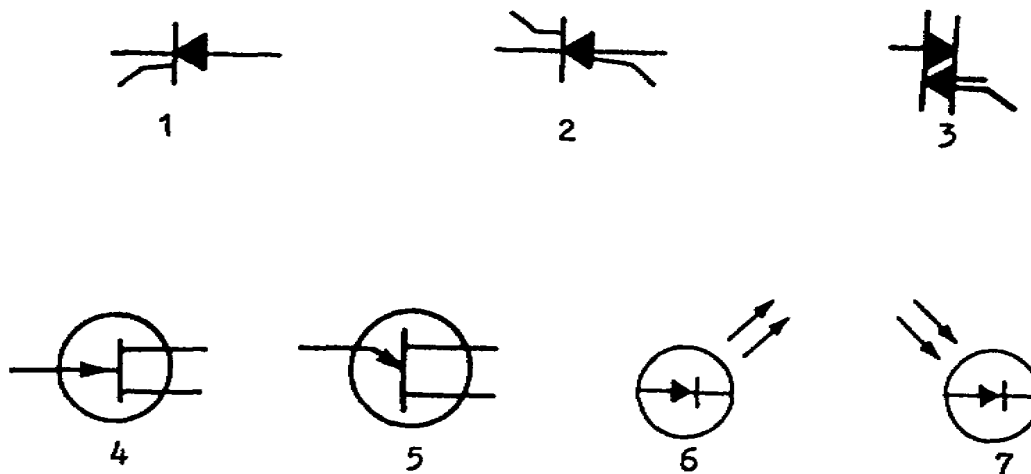


Figure 1-30. Special Purpose Solid-State Devices.

8. Digital Circuits. Many modern electronic systems rely heavily on the use of digital circuits. Digital circuits are essentially circuits within a circuit that perform a specialized function. Digital circuits make use of two distinct voltage levels, a high level and a low level, to convey information and to control functions within the circuit. These two voltage levels are known as the "logic" levels of the digital circuit. In order to understand and work with digital circuits, it is necessary to have an understanding of the binary numbering system and Boolean algebra. The details of the binary system and Boolean algebra are beyond the scope of this subcourse. For a review of these principles, see FM 11-72, Digital Computers.

The basic elements used in digital circuits are gates. Gates are special circuits that produce a high or a low output based on the high or low levels of two or more inputs. There are two primary types of digital gates, with several variations.

a. AND Gates. The AND gate is a digital circuit designed to produce a high level output when all input levels are high. If any of the input levels is low, the output of the gate will be low. AND gates are represented by the symbol shown in figure 1-31A.

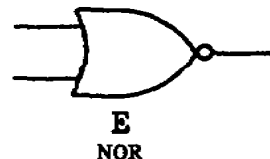
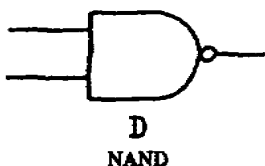
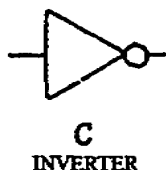
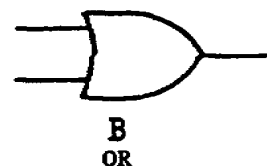
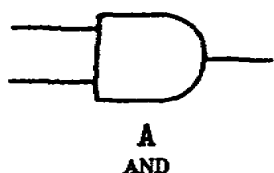


Figure 1-31. Logic Circuit Gates.

b. OR Gates. The OR gate is designed to produce a high level output when any one of the input levels is a high level. OR gates are represented by the symbol shown in figure 1-31B.

To provide variations to the two basic gates, inverters are used at either the input or the output of the gate. The inverter is used to change the logic level of the input or output from a high to a low, or from a low to a high. The symbol for a logic

inverter is shown in figure 1-31C. Inverters, when placed at the input or output of the basic gates, may provide a variety of combinations. When the inverter is used with the basic gate, only the small circle of the inverter symbol is used in the schematic diagram. Figure 1-31D shows an AND gate with an inverter at its output. The result is a NAND gate. Similarly, placing an inverter at the output of an OR gate will produce a NOR gate (figure 1-31E). Figure 1-32 shows the variations of two-variable AND gates and OR gates, and the resulting "truth table" for their output.

AND	OR	A	B	X
		H	H	H
		H	L	L
		L	H	L
		L	L	L
		H	H	L
		H	L	L
		L	H	L
		L	L	H

Two Variable, AND and OR Function

Figure 1-32. Two-Variable Truth Table.

9. Other Symbols. Many other symbols exist and may be found on schematic diagrams. It would be impractical to attempt to illustrate them all. However, the symbols discussed below are components that are likely to be found in Army fire control applications.

a. Grounds. The circuit return or completion is normally accomplished through the use of grounds. Grounds are usually of two types:

(1) Earth ground is a direct conducting connection to the earth or some structure. The symbol used to represent earth ground is shown in figure 1-33A.

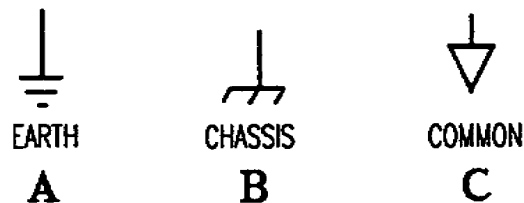


Figure 1-33. Ground Connections.

(2) Chassis ground is a conducting connection to the chassis or frame of the equipment or circuit. The chassis ground may not be at the same potential as the earth ground. The symbol for a chassis ground is shown in figure 1-33B.

A third symbol may be used to indicate a ground connection when all identically annotated return connections are at the same potential. The symbol for these common-ground connections is shown in figure 1-33C.

b. Antennas. Many electronic devices require the use of an antenna to receive input signals. The types of antennas used vary greatly, based on the function of the equipment. Figure 1-34 illustrates some of the common symbols used for antennas.

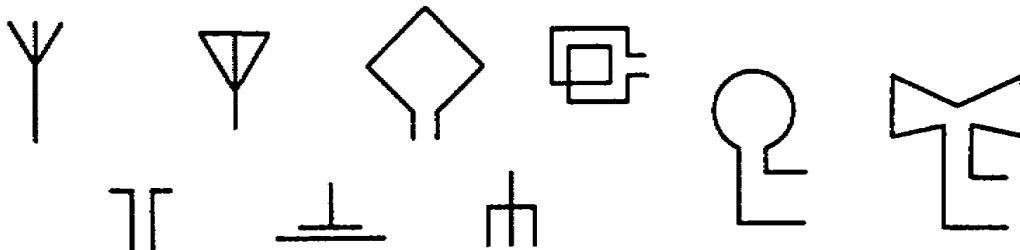


Figure 1-34. Antenna Symbols.

c. Microphones and Headphones. Some types of electronic devices permit audio inputs or outputs. Audio inputs are typically accomplished through the use of a microphone. The symbol for a microphone is shown in figure 1-35A. Audio outputs may be produced by the use of audio indicators such as discussed in paragraph 5e(1) or through the use of headphones. Headphones may be single or double. The symbols for single and double headphones are shown in figure 1-35B and 1-35C respectively.

d. Motors. Many electrical or electronic circuits are affected by drive motors. Motors are the electrical opposite of generators discussed in paragraph 4b. Motors convert electrical energy to mechanical energy. Like generators, motors may be either AC or DC. Figure 1-36 shows the symbols for motors.

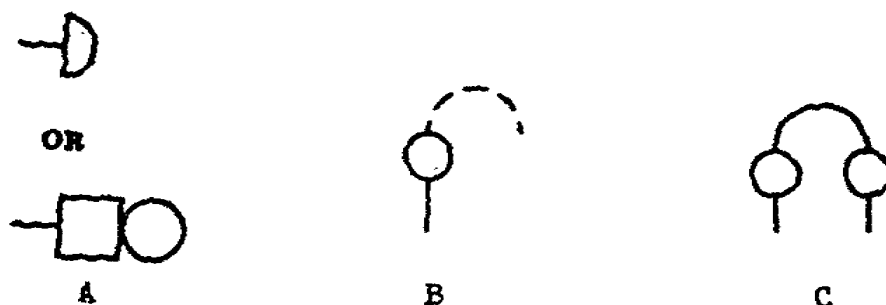


Figure 1-35. Microphones, Headsets.

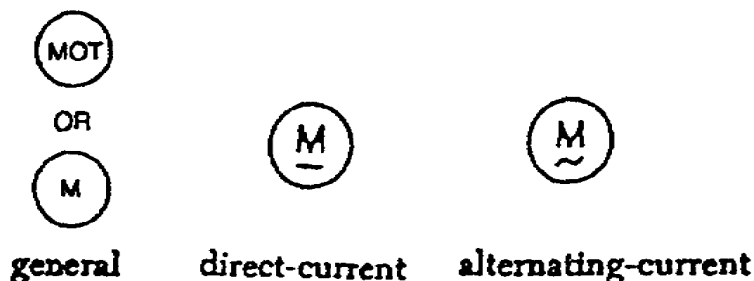


Figure 1-36. Motors.

PART B - COMPONENT CHARACTERISTICS AND FUNCTIONAL USE

Electrical and electronic circuits are made up of a variety of circuit components selected for their individual electrical properties. These components are arranged and connected within the circuit to produce the designed output. The schematic diagram is the road map of the circuit design. The symbols discussed in part A of this lesson to identify each component used to make up the circuit. Each component is placed into the circuit

to create the desired effect within the circuit. This part of the lesson will discuss some of the characteristics of the components and how their electrical properties are used in typical electrical and electronic circuits.

1. Basic Circuits. Electrical and electronic circuits may range from simple one-line circuits to extremely complex specialized systems. Probably the most simple practical circuit is that of the ordinary flashlight. Figure 1-37 illustrates the schematic diagram for a single cell battery powered flashlight.

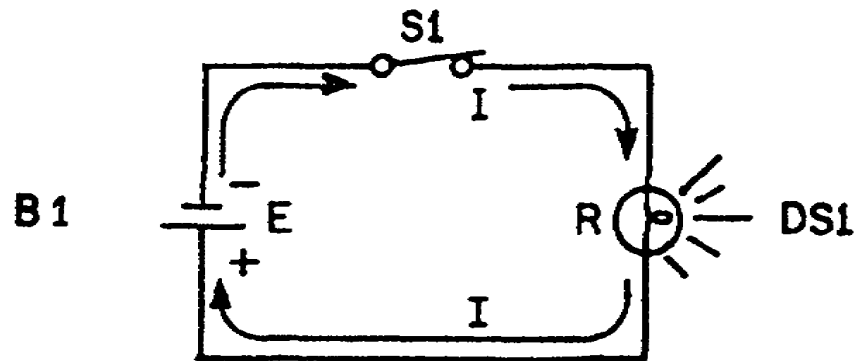
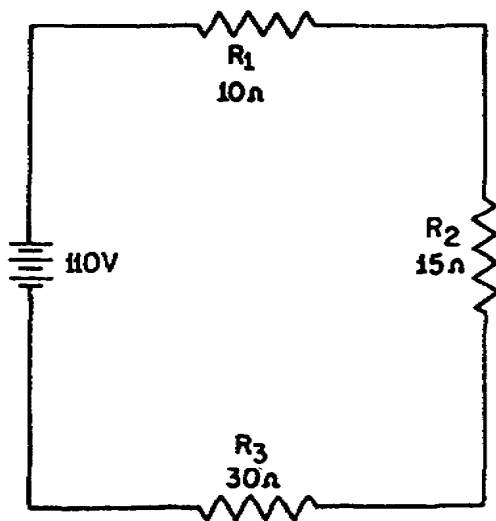


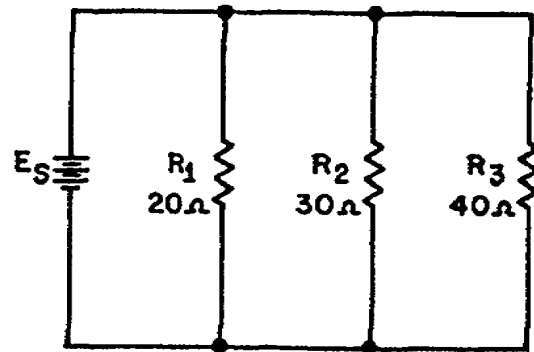
Figure 1-37. Flashlight Circuit.

The components are illustrated by their symbols. When the switch (S1) is closed, current flows through the conductor from the battery (B1) to the lamp (DS1) and back to the battery. Thus, the circuit is completed. The filament of the lamp acts as a resistor in this simple circuit. By resisting the current flow, the filament produces heat and the lamp lights. Resistors are used to control the amount of current in a circuit and to provide a voltage drop. Resistors may be connected in series or in parallel with other resistors or other electrical components to obtain the desired output. Figure 1-38 illustrates series and parallel connected resistors in a simple circuit.

Capacitors are components that have the ability to store electrical energy, block direct current, and permit the flow of alternating current. This unique ability to pass AC while blocking or isolating DC makes the capacitor a key component in filter networks. Inductors (or coils), on the other hand, offer considerable opposition to AC, but little to DC. Inductors are also used in filter circuits extensively. Through selecting the proper set of components, filtering circuits may be designed to produce the required output for the circuits they supply. Figure 1-39 illustrates the schematic of a simple filter circuit employing resistors, capacitors, and inductors.



SERIES CIRCUIT



PARALLEL CIRCUIT

Figure 1-38. Series and Parallel Connected Resistors.

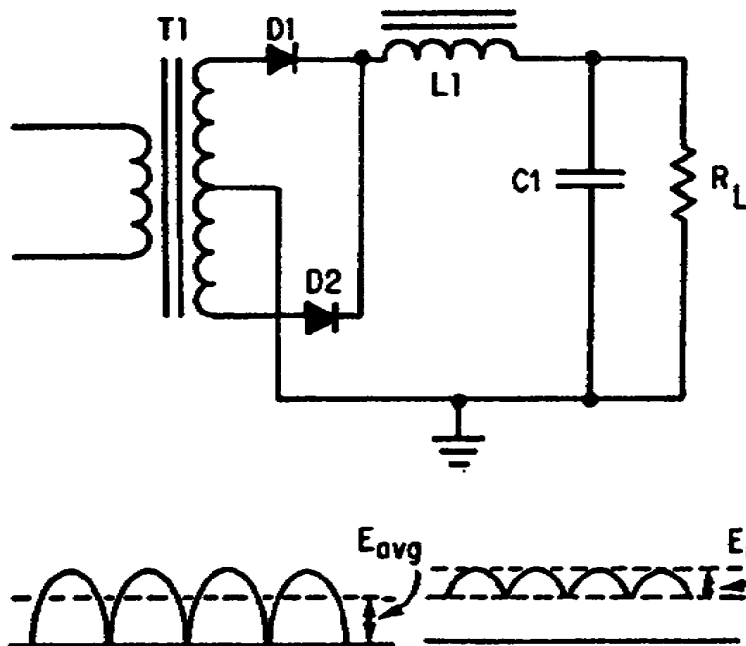


Figure 1-39. Filter Circuit.

Inductors are also elements of the transformer used in the circuit in figure 1-39. The primary of T_1 induces its AC voltage onto the secondary of T_1 . In this case the secondary of the transformer is center tapped to provide dual outputs in the secondary. Transformers may be designed to produce a variety of outputs relative to their input. Figure 1-40 shows a typical power transformer with outputs of 5, 6.3, 350, and 700 volts from a 110 volt input.

2. Rectifiers. The purpose of most power supply units is to convert some AC input to the desired DC output(s) in order to operate the circuits supplied. In figure 1-41 you can see that this conversion takes place in the element labeled as the rectifier. Rectification may be half-wave or full-wave. Figure 1-41A illustrates the schematic for a simple half-wave rectifier and its resultant waveform. Figure 1-41B shows a full-wave rectifier diagram and waveform.

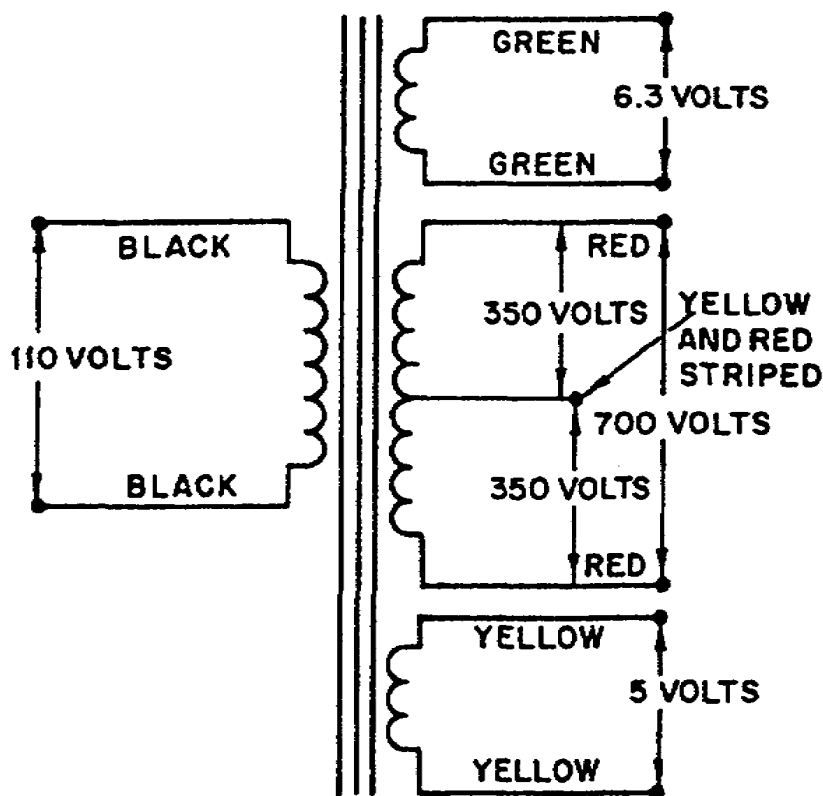


Figure 1-40. Power Transformer.

The component common to almost all types of rectifiers is the diode. The diode may be a vacuum tube diode or a solid-state diode. Since a diode has the property of passing current in only one direction, it is ideally suited for converting AC to DC. In half-wave rectification, only one direction of current flow is used. In full-wave rectification, the diodes are so connected as to make use of the AC current in both directions, thus resulting in the waveforms shown in figure 1-41. Solid-state diodes are used in almost all modern applications.

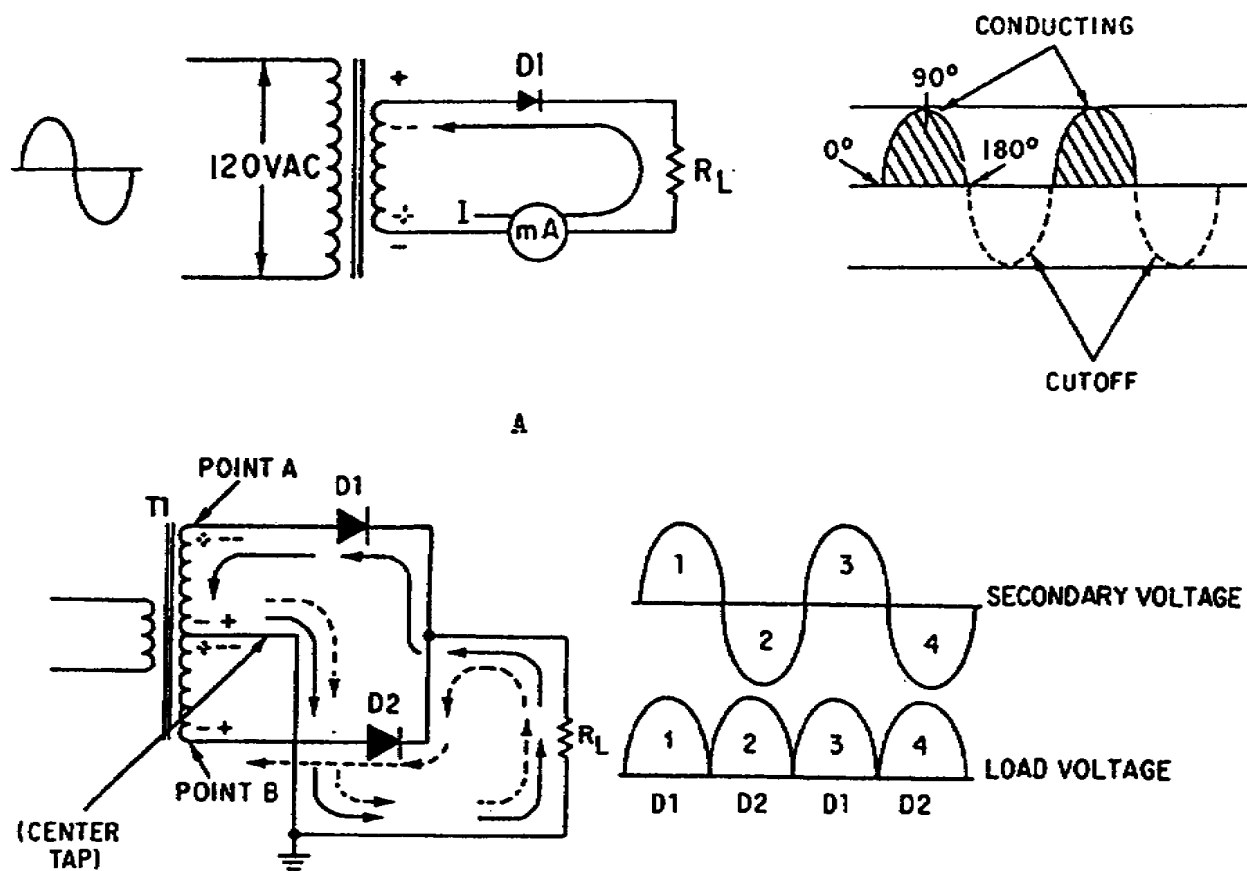


Figure 1-41. Rectifier Circuits.

3. Regulators. The fourth element of the power supply unit shown in figure 1-42 is the regulator. The purpose of the regulator is to provide an output voltage with little or no variation. Regulators sense changes in output and compensate for the changes. Regulators may also be designed to regulate the current flow. Voltage regulators may be classified as series or shunt (parallel), depending on their relative location in the circuit. Figures 1-42A and 1-42B show a shunt regulator and a series regulator respectively. In most modern practical applications, solid-state devices are used in regulator circuits. Figures 1-42C and 1-42D show shunt and series regulators employing solid-state components. Zener diodes are used extensively in regulator circuits. A zener diode blocks current until a specified voltage is applied. When the zener voltage is reached, the zener diode conducts, thus regulating the voltage developed across it.

4. Transistors. Probably no single event has had the impact on electronics as has the discovery of the transistor. Transistors have virtually replaced vacuum tubes in most modern electronic applications. Additionally, transistors have been designed to perform functions not previously attainable with vacuum tubes.

The most basic and the most common application of transistors is as an amplifier. Transistors may be configured to amplify voltage, current, or power as needed. Figure 1-43 shows a basic transistor amplifier circuit.

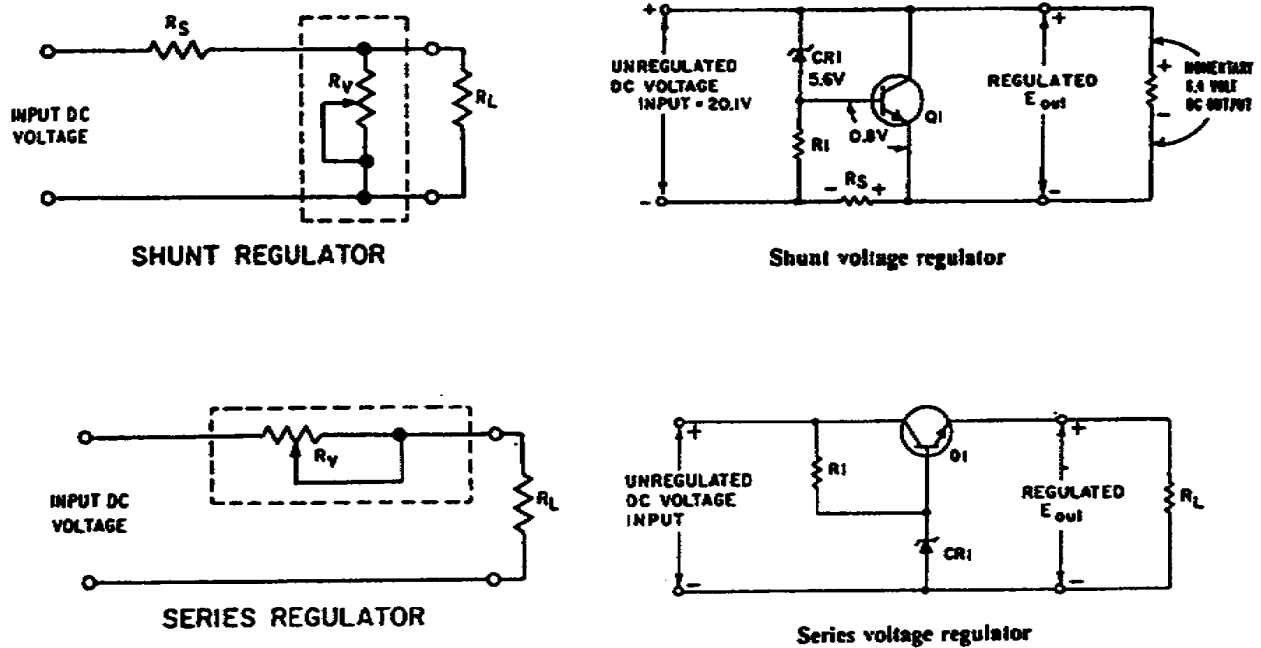


Figure 1-42. Regulator Circuits.

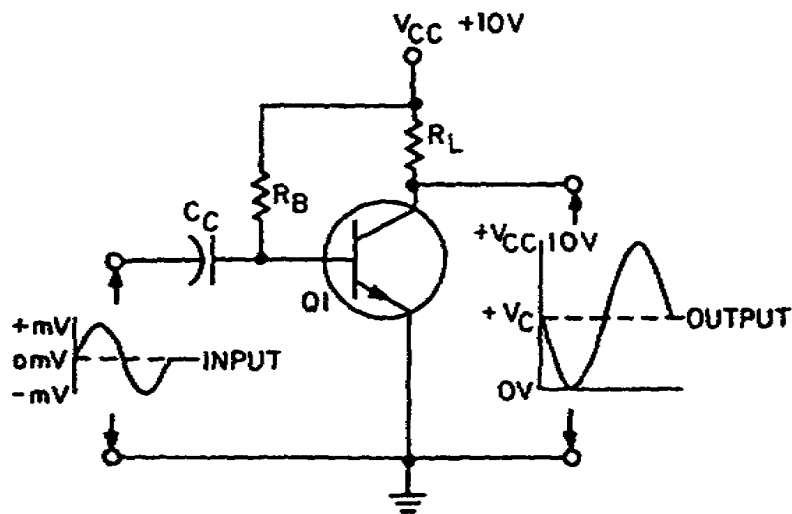


Figure 1-43. Transistor Amplifier.

Many types of special purpose transistors have been developed (and continue to be developed). The identification of transistors is often critical in the repair of electronic equipment. Transistors used in military applications can generally

be identified by a Joint Army-Navy (JAN) designation marked on the case of the transistor. Always replace transistors with ones that have the identical markings or a correct substitute. To ensure that you use an identical replacement or correct substitute, consult the equipment manual.

5. Digital Circuits. Digital circuits have been employed in an ever increasing number of applications. A digital circuit may operate as an electronic switch and is capable of making decisions or logic. Such a logic circuit represents a relationship between two or more variable inputs and a resultant output. Digital logic circuits form the basis for most types of computers. Digital circuits use gates, flip-flops, registers, and matrixes to perform a variety of functions. Digital circuits are often used in Army fire control instruments as counters, registers, displays, and other logic functions. Figure 1-44 illustrates a digital parallel counter.

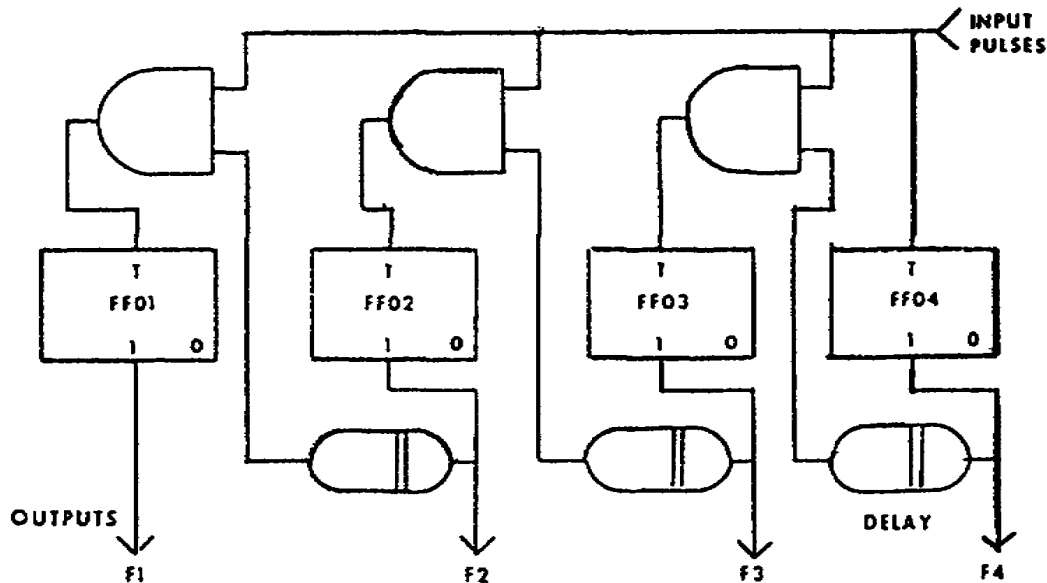


Figure 1-44. Parallel Binary Counter.

6. Complex Circuits. Most schematic diagrams you will find in equipment technical manuals will be much more complex than the simple circuits illustrated in this lesson thus far. Most circuits are a combination of the simpler circuits, arranged in a configuration to provide a series of electrical events, in order to produce some desired output or outputs. Figure 1-45 illustrates such a circuit. Input signals are introduced into the circuit through plug P1, processed through a series of electrical and electronic components, and output, again through plug P1.

Figure 1-45. Complex Schematic Diagram.

At this point, you should be able to readily identify most of the symbols and annotations on the schematic diagram shown in figure 1-45.

PART C - WIRE TRACING

In addition to being able to "read" the schematic diagram of a circuit, it is often necessary to trace the source and/or the destination of a signal coming into the circuit or exiting from it. This is normally accomplished through a process of wire tracing. Depending on the design and construction of the equipment, wire tracing may be simple and confined to the internal parts of the equipment; or it may be complex and extend to distant external components.

Wire tracing procedures may vary greatly from one type of equipment to another. Probably the key to success in wire tracing is to have an understanding of the reference designators used to identify and locate equipment components. It is important to note that not all systems use the same methodology for assigning reference designators. Prior to performing wire tracing on actual equipment, refer to the appropriate technical manual.

NOTE: The following reference designator information is applicable to the tank thermal sight (TTS), AN/VSG-2. The wire tracing steps refer to the extracts from TM 9-5855-267-24 found in appendix c. The wire tracing sequences found in this lesson use table 3-2 of appendix C for solution. These procedures are for training only.

1. Reference Designators. Most equipment that requires the repairer to trace signals from one unit to another have some type of reference designator system. These reference designators are assigned to assist the repair technician in locating and identifying components as necessary for testing and repair.

The TTS, AN/VSG-2 uses the system described below to assign reference designators:

a. The first number in the reference designator represents the major unit in which the component is located. The major units of the TTS, AN/VSG-2 are:

- (1) Head assembly.
- (2) Gunner's display.
- (3) Commander's display.

- (4) Power converter.
- (5) Mount assembly.
- (6) Test set (TS-3681/VSG-2).

b. The second part of the reference designator is used to identify the location within the major unit, i.e., W1 for a wire harness, A2 for a unit subassembly, etc.

c. The third part of the designator locates the actual component, i.e., S1 for a switch, J2 for a jack, etc.

d. Following the reference designator, you will often find a pin or pin socket identifier for marking the exact circuit point for testing or troubleshooting.

e. The following examples are given to illustrate the use of reference designators in the TTS, AN/VSG-2.

(1) 2 W1 S1. This reference designator indicates S1 (mode switch) on the wiring harness W1 in the gunner's display.

- 2 - Gunner's display (unit 2).
- W1 - Wire harness W1.
- S1 - Switch 1 (mode switch).

(2) 4 A6 J1. This reference designator indicates connector jack J1 of the auxiliary regulator (subassembly A6) in the power converter.

- 4 - Power converter (unit 4).
- A6 - Auxiliary regulator.
- J1 - Connector J1.

(3) 2 W1 P4 (2 A3 J4). This reference designator indicates that the plug P4 of the wiring harness W1 in the gunner's display mates with jack J4 of the RPU assembly (A3) in the gunner's display.

- 2 - Gunner's display (unit 2).
- W1 - Wire harness W1.
- A3 - RPU assembly.
- P4 - Connector plug P4.
- J4 - Connector jack J4.

2. Voltage Measurements. One procedure that requires an understanding of reference designators in the TTS AN/VSG-2 is taking voltage measurements. Figure 1-46 is the voltage measurement table for the power converter. The probe connections for the measurements are indicated by the use of reference designators.

NOTE

a. Always connect the LO (black) lead before you connect the HI (red) lead.
 A. Tolerances for voltages in table 3-1 are ± 10 percent unless otherwise noted.

(See PO-12 for Location of Assemblies 4A1 through 4A2 and 4A9T1)

Item	Component checked	DMM probe connections		Voltage reading	
		LO (BLACK)	HI (RED)	ac (Tolerances $\pm 10\%$)	dc
1	Inverter 4A1			115	
2	115 vac, 400 Hz	4A1J3	4A1J2		
3	+5.0 vdc	4A1J13	4A1J7		+5.0
4	+14.0 vdc	4A1J13	4A1J8		+14.0
5	Controller 4A2				
6	-15.0 vdc	4A2J10	4A2J12		-15.0
7	+15.0 vdc	4A2J10	4A2J14		+15.0
8	18 to 30 vdc	4A2J10	4A2J15		+18 to +30
9	+5 vdc	4A2J10	4A2J16		+5.0
10	Video rectifier and filter 4A3				
11		4A3J2	4A3J1	18.8	
12		4A3J5	4A3J4	17.5	
13		4A3J5	4A3J8	19.1	
14		4A3J7	4A3J11	15.6	
15		4A3J10	4A3J3		20.9
16		4A3J2	4A3J6		19.1
17		4A3J8	4A3J9	18.3	
18		4A3J11	4A3J10		-17.1
19	Auxiliary rectifier and filter 4A4				
20		4A4J2	4A4J1	10.0	
21		4A4J4	4A4J5	10.0	
22		4A4J8	4A4J7	23.1	
23		4A6J11	4A4J10	23.0	
24		4A4J13	4A4J14	21.4	
25		4A6J2	4A4J3		7.4
26		4A6J4	4A4J6		-7.5
27		4A6J8	4A4J12		19.1
28		4A6J10	4A4J15		-19.6
29		4A2J10	4A4J9		18.9
30	Video regulator 4A5				
31		4A5J2	4A5J1		+20.8
32		4A5J2	4A5J3		+10.74
33		4A5J5	4A5J6		+19.00
34		4A5J5	4A5J6		+9.93
35		4A5J8	4A5J7		+18.25
36		4A5J8	4A5J9		+10.12
37		4A5J11	4A5J10		-17.07
38		4A5J11	4A5J12		-8.05
39	Auxiliary regulator 4A6				
40		4A6J2	4A6J1		+7.45
41		4A6J2	4A6J3		+5.02
42		4A6J4	4A6J5		-7.52
43		4A6J6	4A6J5		-4.93
44		4A6J8	4A6J7		+19.15
45		4A6J8	4A6J9		+14.7
46		4A6J10	4A6J11		-19.06
47		4A6J12	4A6J11		-14.6
48	Transformer 4A9T1				
49		4A9T1-4	4A9T1-5	19.4	
50		4A9T1-6	4A9T1-7	17.9	
		4A9T1-8	4A9T1-9	19.4	
		4A9T1-10	4A9T1-11	16.4	
		4A9T1-12	4A9T1-13	10.3	
		4A9T1-14	4A9T1-15	10.3	
		4A9T1-16	4A9T1-17	23.7	
		4A9T1-18	4A9T1-19	22.2	
		4A9T1-20	4A9T1-21	23.8	

Figure 1-46. Voltage Measurement Table.

3. Continuity Checks. Continuity checks can be made between various points in a circuit using a meter and wiring diagrams. However, continuity charts are provided for ease in performing the checks. These charts use reference designators as a basis for their format. Appendix C is such a continuity chart for the TTS, AN/VSG-2. It consists of table 3-2 and included figures from TM 9-5855-267-24.

NOTE: All continuity checks are made with a DMM set at 2K ohms.

In appendix C, the circuit points used to conduct continuity checks are found in the two left hand columns. These circuit points are identified by their reference designators. In this table, the reference designators are indicated in one of two ways:

a. Refer to page 3-5 of appendix C. At the top of the page, the statement is made, "prefix all test points 3W4." Only the remainder of the reference designator is indicated in the circuit point columns.

b. Refer to page 3-10 of appendix C. The entire reference designator is represented in the circuit point columns.

The center column of table 3-2 of appendix C (signal function or name) identifies the signal carried on the wire being checked. The remaining columns provide information pertaining to the conductor.

4. Signal Tracing. Many signals produced in one unit of the equipment are sent or applied to another unit of the equipment. Often it is necessary for the repairer to "trace" these signals from one unit to the other. This is accomplished by wire tracing. Table 3-2 and its accompanying figures may be used to trace various signals from unit to unit within the TTS, AN/VSG-2 and its test set. The following example will demonstrate signal tracing in the TTS, AN/VSG-2.

NOTE: All page numbers identified in the wire tracing sequences below refer to appendix C.

The following procedures will be used to trace the WFOV CMD from circuit point 2W1P4-20 to 1W1XA4-8:

a. The reference designator 2W1P4-20 indicates that this circuit point is located in the gunner's display. Therefore, you will locate the circuit point in the gunner's wire harness

chart (page 3-13). You must now locate the circuit point 2W1P4-20. It is found in the middle of page 3-14. You will find that the WFOV CMD travels from circuit point 2W1P4-20 to 2W1J1->D.

b. Since 2W1J1 is an external connection (see page 3-11), it is necessary to refer to the interface diagram (page 3-4). You will find that J1 of the gunner's display meets with the interface cable at 3W4P4.

c. To locate the connecting circuit point on the tank interface cable, you use the tank interface cable chart beginning on page 3-5. The WFOV CMD meets with 3W4P4 at 3W4P4->D (page 3-7). The WFOV CMD signal travels from 3W4P4->D to 3W4P3-Y.

d. Since 3W4P3 connects to the head assembly at head assembly J1, you will need to refer to the head assembly wire harness (page 3-27). You will find that the WFOV CMD meets 1W1J1 at the circuit point 1W1J1-Y (page 3-27). From 1W1J1-Y, the WFOV CMD signal travels to 1W1XA4-8, the terminal location of this signal.

e. The above wire tracing sequence is represented as indicated below:

- (1) 2W1P4-20.
- (2) 2W1J1->D.
- (3) 3W4P4->D.
- (4) 3W4P3-Y.
- (5) 1W1J1-Y.
- (6) 1W1XA4-8.

5. In order to ensure that you understand the method of wire tracing in the TTS, AN/VSG-2, trace the following signals as indicated. Fill in the missing circuit point designators.

a. Trace the CMDR CABLE BITE signal from 3W1P1-3 to 4W1XA6-24.

- (1) 3W1P1-3
- (2)
- (3)
- (4)
- (5)
- (6) 4W1XA6-24

b. Trace the STBY CMD from 4W1XA10-20 to the mode switch on the gunner's display.

- (1) 4W1XA10-20
- (2)
- (3)
- (4)
- (5)
- (6)

The solutions to these wire tracing sequences are found at the end of this lesson. If you are unsuccessful in tracing these two signals, reread paragraph 4 and attempt the wire tracing sequences again.

Remember, the procedures for assigning reference designators and for wire tracing vary with different equipment. Always refer to the current technical manual for the specific equipment you are working on.

6. Wire Tracing Sequence Solutions. The solutions to the wire tracing sequences in paragraph 5 were listed below with the page numbers from table 3-2 of appendix C. If you are successful, proceed to the Practice Exercise following this lesson.

a. Trace the CMDR CABLE BITE signal from 3W1P1-3 to 4W1XA6-24.

- (1) 3W1P1-3 (3-10)
- (2) 3W1J1-R (3-10)
- (3) 3W4P5-R (3-7)
- (4) 3W4P1-Z (3-7)
- (5) 4W1J2-Z (3-17)
- (6) 4W1XA6-24 (3-17)

b. Trace the STBY CMD from 4W1XA10-20 to the mode switch on the Gunner's Display.

- (1) 4W1XA10-20 (3-23)
- (2) 4W1J2->W (3-23)
- (3) 3W4P1->W (3-5)
- (4) 3W4P4-R (3-5)
- (5) 2W1J1-R (3-13)
- (6) 2W1S1-2 (3-13)

LESSON

PRACTICE EXERCISE

Read the following situation and use that information to answer the items in this Practice Exercise. Check your answers with the answers that follow.

Situation: You are the Fire Control maintenance NCO (MOS 45G20) at Headquarters, Headquarters Company, 3/78th Battalion (mechanized). You are conducting training for your unit technicians to prepare them for maintenance procedures required at the organizational level.

1. Transformers operate based upon which of the following principles?
 - A. Inductance.
 - B. Resistance.
 - C. Varactance.
 - D. Capacitance.
2. Typically, a power supply is employed to provide what function?
 - A. Convert a DC input to an AC output.
 - B. Convert an AC input to a DC output.
 - C. Increase a DC input to a higher DC output.
 - D. Increase an AC input to a higher AC output.
3. An audible alarm would be indicated on a schematic diagram by what letter identifier?
 - A. A.
 - B. S.
 - C. AA.
 - D. LS.
4. Which of the following vacuum tubes is still widely used today?
 - A. Beam power tubes.
 - B. Cathode-ray tubes.
 - C. Cold cathode tubes.
 - D. Diode rectifier tubes.

5. The most common use for transistors is?
- A. Filtration.
 - B. Regulation.
 - C. Amplification.
 - D. Rectification.
6. Digital circuits are referred to as "logic" circuits and rely on which of the following numbering systems?
- A. Octal.
 - B. Binary.
 - C. Decimal.
 - D. Alphanumeric.
7. The reference designator for 1W1J1-4 in the TTS AN/GVS-2 would indicate that the circuit is located in what major unit?
- A. Test set.
 - B. Head assembly.
 - C. Power converter.
 - D. Gunner's display.
8. In order to check the continuity for the GUNNERS FAIL LIGHT signal in the gunner's wire harness, you would place the test probes at 2W1J3-5 and?
- A. 2W1P3-5.
 - B. 2W1P3-6.
 - C. 2W1XA2-32.
 - D. 2W1XA2-36.

LESSON

PRACTICE EXERCISE ANSWER KEY AND FEEDBACK

Compare your answers to the following solutions. If you answered any item incorrectly, review the page(s) and paragraph(s) referenced until you understand the instruction.

<u>Item</u>	<u>Correct Answer and Feedback</u>
1.	A. Inductance. Transformers are basically two inductors placed in close physical proximity. The electrical field of the primary is induced unto the secondary, thus transferring the power. (page 8, para 4c)
2.	B. Convert an AC input to a DC output. Typically a power supply takes an AC input and converts it to a DC output through use of a transformer, rectifier, filter and regulator. (page 10, para 4d)
3.	D. LS. Audible indicators may be a horn, buzzer, speaker, etc. and are designated by "LS." (page 13, para 5e(1))
4.	B. Cathode-ray tube. Cathode-ray tubes are used to present a video display such as in a TV screen or radar display. This unique feature of the CRT cannot be duplicated by the use of transistors. Thus, they are still widely used today. (page 19, para 6)
5.	C. Amplification. The most basic and the most common use of transistors is to amplify voltage, current, or power. (page 27, para 4)
6.	B. Binary. Digital circuits use two distinct voltage levels, producing "1" and "0" logic levels. This results in a binary (two digits) numbering system. (page 19, para 8)

<u>Item</u>	<u>Correct Answer and Feedback</u>
-------------	------------------------------------

7.	B. Head assembly.
----	-------------------

The first number of the reference designator used in the TTS AN/VSG-2 represents the major unit. The major unit represented by the number 1 is the head assembly. (page 30, para 1a(1))

8.	C. 2W1XA2-32.
----	---------------

The other end of the connector designated to carry the GUNNERS FAIL LIGHT is found in the continuity check wiring table found in appendix C. (page 3-13)

CONTINUE TO THE NEXT PAGE.

APPENDIX A
LIST OF ACRONYMS AND ABBREVIATIONS

AC	Alternating Current.
CRT	Cathode-Ray Tube.
DC	Direct Current.
DMM	Digital Multimeter.
FET	Field-Effect Transistor.
JAN	Joint Army-Navy.
LCD	Liquid-Crystal Display.
LED	Light-Emitting Diode.
SCR	Silicon-Controlled Rectifier.
SCS	Silicon-Controlled Switch.
TTS	Tank Thermal Sight.
UJT	Unijunction Transistor.

CONTINUE TO THE NEXT PAGE.

APPENDIX B
LIST OF DESIGNATION LETTERS

<u>Letter Code</u>	<u>Terminology</u>
C	Capacitor.
CB	Circuit Breaker.
CR	Semiconductor Diode.
D	Diode.
DS	Light Indicator.
F	Fuse.
J	Jack.
K	Relay.
L	Inductor.
LS	Audible Indicator.
P	Plug.
PS	Power Supply.
Q	Transistor.
R	Resistor.
S	Switch.
T	Transformer.
TB	Terminal Board.
TP	Test Point.
V	Vacuum Tube.
W	Cable.

CONTINUE TO THE NEXT PAGE.

APPENDIX C

TM 9-5855-267-24

Technical Manual

No. 9-5855-267-24

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 12 December 1980

**ORGANIZATIONAL, DIRECT SUPPORT, AND
GENERAL SUPPORT MAINTENANCE MANUAL
SIGHT, TANK THERMAL
AN/VSG-2
(NSN 5855-01-060-8521)**

REPORTING OF ERRORS

You can help improve this manual. If you find any mistakes, or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028, Recommended Changes to Publications and Blank Forms, or DA Form 2028-2, located in the back of this manual, direct to: Commander, U.S. Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock Island, IL 61299. A reply will be furnished to you.

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CHAPTER 3

DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

3-1. Scope of Direct Support Maintenance

Direct support maintenance for the TTS requires testing, alignment, adjustment, and troubleshooting. Troubleshooting to an electrical assembly, mechanical assembly or chassis mounted electrical/mechanical component may be necessary.

3-2. Authorized Maintenance

Authorized direct support maintenance is listed in the maintenance allocation chart (MAC), appendix B of this manual.

3-3. Voltage and Resistance Measurements

The digital multimeter (dmm), Fluke 8020A (or equivalent) is used for measuring voltages and resistances.

Voltage measurements are listed in table 3-1. The item column is provided so specific measurements may be easily referenced. The "component checked" column designates which component or assembly can be checked by using the data provided for that item. The "dmm probe connections LO and HI" columns specify where the low and high probes are connected to check the corresponding item component. The "dmm indication (volts) ac and dc" columns are on the voltage measurement table contain the dmm ac or dc voltage obtained for the item component checked. Unless otherwise specified, tolerances are ± 10 percent.

Figure 3-1. Not Used

Table 3-1. Voltage Measurements

NOTE

a. Always connect the LO (black) lead before you connect the HI (red) lead.

b. Tolerances for voltages in table 3-1 are ± 10 percent unless otherwise noted.

(See FO-12 for Location of Assemblies 4A1 through 4A2 and 4A9T1)

Item	Component checked	DMM probe connections		Voltage reading	
		LO (BLACK)	HI (RED)	ac (Tolerances $\pm 10\%$)	dc
1	Inverter 4A1				
	115 vac, 400 Hz	4A1J3	4A1J2	115	
2	+5.0 vdc	4A1J13	4A1J7		+5.0
3	+14.0 vdc	4A1J13	4A1J8		+14.0
	Controller 4A2				
4	-15.0 vdc	4A2J10	4A2J12		-15.0
5	+15.0 vdc	4A2J10	4A2J14		+15.0
6	18 to 30 vdc	4A2J10	4A2J15		+18 to +30
7	+5 vdc	4A2J10	4A2J16		+5.0
	Video rectifier and filter 4A3				
8		4A3J2	4A3J1	18.8	
9		4A3J5	4A3J4	17.5	
10		4A3J5	4A3J8	19.1	
11		4A5J7	4A3J11	15.6	
12		4A3J10	4A3J3		20.9
13		4A5J2	4A3J6		19.1
1		4A3J8	4A3J9	18.3	
1		4A5J11	4A3J10		-17.1

3-4. Reference Designator Assignments

Unit No.	Description
1	Head Assembly
2	Gunner's Display
3	Commander's Display
4	Power Converter
5	Mount Assembly
6	Test Set (TS -3681/VSG-2)

All other reference designators are assigned in accordance with ANSI Y32.16-1968 (USA standard reference designators for electrical and electronic parts and equipment).

EXAMPLE 1 Mode Switch, Gunner's Display

2 W1 S1

S1 - Switch S1 (mode switch)

W1 - W1 wire harness

2 - Gunner's Display (unit 2)

To Be Read As: Switch S1 (mode switch) is on the W1 wire harness in the Gunner's Display (unit 2).

EXAMPLE 2 RPU Connector and Mate

2 W1 P4 (2 A3 J4)

P4 - Connector P4 J4 - Connector J4

W1 - W1 wire harness A3 - RPU Assembly

2 - Gunner's Display (unit 2) 2 - Gunner's Display (unit 2)

To Be Read As: Connector P4 on the W1 wire harness in the Gunner's Display (unit 2) mates with the J4 connector on the A3 (RPU Assembly) in the Gunner's Display (unit 2).

EXAMPLE 3 Gunner's BITE Board and Mate

2 W1 XA2 (2 A2 P1)

XA2-XA2 connector P1 - P1 connector

W1 - W1 wire harness A2 - Gunner's BITE PWB

2 - Gunner's Display (unit 2) 2 - Gunner's Display (unit 2)

To Be Read As: Connector XA2 on the W1 wire harness in the Gunner's Display (unit 2) mates with connector P1 on the A2 (Gunner's BITE PWB) in the Gunner's Display (unit 2).

3-5. Continuity Checks

Routine continuity checks between various points in the circuitry can be made using the digital multimeter and wiring diagrams; however, a list of continuity checks is provided in table 3-2 to ensure a complete continuity check of the system without reference to wiring diagrams. The function column designates the signal function of the specific wire being checked. Details of wire harnesses with associated connectors and controls appear in figure 3-2 through figure 3-9 to speed identification of wires for continuity checks.

NOTE

All continuity checks shall be made with the DMM set to the 2K Ω range.

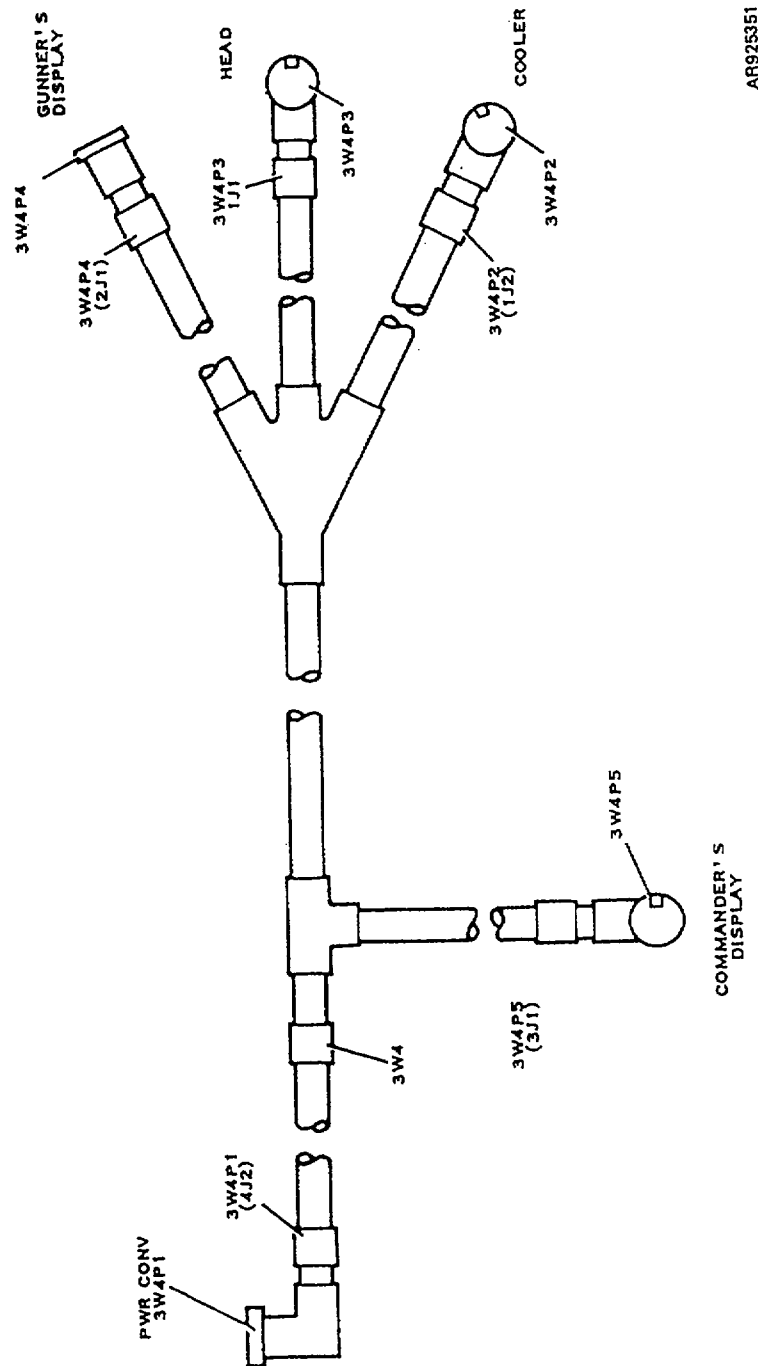


Figure 3-2. Tank interface cable.

TABLE 3-2. CONTINUITY CHECKS-

TANK INTERFACE CABLE.

PREFIX ALL TEST POINTS 3W4 (FIG. 3-2).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
P1		JACKET FOR WIRE NO 1			94	
P1-		+10.5 VDC	20	9	1A	S 1
P1- A	P3- A	+10.5 VDC RTN	20	96	18	
P1- B	P3- B	+10.0 VDC (LED #1)	20	92	3	T 4
P1- C	P3- P	+10.0 VDC RTN (LED #2)	20	94	4	T 3
P1- D	P3- L	+10.0 VDC (LED #2)	20	95	5	T 6
P1- E	P3- M	+10.0 VDC RTN (LED #2)	20	97	6	T 5
P1- F	P3- >G	+10.0 VDC (POST)	20	98	7	T 8
P1- G	P3- >H	+10.0 VDC RTN (POST)	20	901	8	T 7
P1- H	P3- >I	-9.0 VDC	20	902	9	T 10
P1- J	P3- >X	-9.0 VDC RTN	20	903	10	T 9
P1- K	P3- >N	+5.0 VDC (SC1)	20	904	11	T 12
P1- L	P3- >P	+5.0 VDC RTN (SC1)	20	905	12	T 11
P1- M	P4- >K	+5.0 VDC (12 GUN)	20	906	13	T 14
P1- N	P4- >T	+5.0 VDC RTN (12 GUN)	20	907	14	T 13
P1- P	P5- U	+5.0 VDC (12 CMDR)	20	908	15	T 16
P1- R	P5- V	+5.0 VDC RTN (12 CMDR)	20	912	16	T 15
P1- S	P3- >K	-5.0 VDC (SC1)	20	913	17	T 18
P1- T	P3- >H	-5.0 VDC RTN (SC1)	20	914	18	T 17
P1- U	P3- S	+15.0 VDC (HEAD)	20	915	19	T 20
P1- V	P3- T	+15.0 VDC RTN (HEAD)	20	916	20	T 19
P1- W	P3- >Y	-15.0 VDC (HEAD)	20	917	21	T 22
P1- X	P3- >Z	-15.0 VDC RTN (HEAD)	20	918	22	T 21
P1- Y	P5- R	CMDR CABLE BITE	20	923	23	
P1- Z	P5- A	CMDR INTLK	20	924	24	
P1- >A	P3- GG	HEAD CABLE BITE	20	925	25	
P1- >B	P4- W	SPARE	20	926	26	
P1- >C	P5- T	+5.0 VDC BITE RTN (CMDR)	20	927	27	
P1- >D	P4- >N	POWER CONV FAIL #1	20	928	28	
P1- >E	P4- >P	CABLE FAIL	20	934	29	
P1- >F	P2- O	SPARE	20	935	30	
P1- >G	P3- >R	+5.0 VDC BITE (HEAD)	20	937	32	T 33
P1- >H	P3- CC	+5.0 VDC BITE RTN (HEAD)	20	938	33	T 32
P1- >I	P4- U	+5.0 VDC BITE (GUN)	20	945	34	T 35
P1- >J	P4- T	+5.0 VDC BITE RTN (GUN)	20	946	35	T 34
P1- >K	P2-	JACKET FOR WIRE NO 36		947	36	S 36
P1- >L	P2- A	COOLER PHASE A	20	9	36A	
P1- >M	P2- B	COOLER PHASE B	20	0	36B	
P1- >N	P2- C	COOLER NEUT	20	2	36C	
P1- >O	SHIELD 36	COOLER SHIELD	20	9	36S	
P1- >P	P2-	JACKET FOR WIRE NO 37		948	37	S 37
P1- >Q	P2- H	FAN PHASE A	20	9	37A	
P1- >R	P2- J	FAN PHASE B	20	0	37B	
P1- >S	P2- K	FAN NEUT	20	2	37C	
P1- >T	SHIELD 37	FAN SHIELD	20	9	37S	
P1- >U	P4- R	STBY CMD	20	956	38	
P1- >V	P4- S	OP CMD	20	957	39	
P1- >W	P4- Z	18-30 VDC RTN (STBY GUN)	20	958	40	T 41
P1- >X	P4- >A	18-30 VDC (STBY GUN)	20	967	41	T 40
P1- >Y	P4- Y	18-30 VDC (OP GUN)	20	968	42	T 43
P1- >Z	P4- X	18-30 VDC RTN (OP GUN)	20	978	43	T 42
P1- AA	P5- C	18-30 VDC (OP CMDR)	20	9012	44	T 45
P1- AB	P5- D	18-30 VDC RTN (OP CMDR)	20	9013	45	T 44
P1- AC	P4- >J	COOLER SENSE HI TEST	20	9014	46	T 47
P1- AD	P4- >I	COOLER SENSE LO TEST	20	9015	47	T 46
P1- AE	P3- R	DET COOLING LIGHT #1	20	9016	48	
P1- AF	P4- J	DET COOLING LIGHT #2	20	9017	49	
P1- AG						
P1- AH						
P2		JACKET FOR WIRE NO 36			947	36
P2-	P1-	COOLER PHASE A	20	9	36A	S 36
P2- A	P1- >N	COOLER PHASE B	20	0	36B	
P2- B	P1- >P	COOLER NEUT	20	2	36C	
P2- C	P1- >Q		20			

2047300-

TABLE 3-2. CONTINUITY CHECKS-

TANK INTERFACE CABLE. (CONTINUED) PREFIX ALL TEST POINTS 3W4 (FIG. 3-2).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
P2- D	P1- >G	SPARE	20	935	30	
P2- E	P4- K	FAN BITE PHASE B	20	96	508	
P2- F	P4- L	COOLER BITE PHASE A	20	93	50C	
P2- G	P4- J	JACKET FOR WIRE NO 50		946	50	S 50
P2- H	P4- M	COOLER BITE PHASE B	20	9	50A	
P2- J	P1- >S	JACKET FOR WIRE NO 37		948	37	S 37
P2- K	P1- >T	FAN PHASE A	20	9	37A	
P2- L	P1- >U	FAN PHASE B	20	0	37B	
P2- M	P1- >V	FAN NEUT	20	2	37C	
P2- N	P4- N	BITE NEUT	20	95	50D	
P3	P1- >G	JACKET FOR WIRE NO 1		94	1	S 1
P3- A	P1- A	+10.5 VDC	20	9	1A	
P3- B	P1- B	+10.5 VDC RTN	20	96	1B	
P3- C	P4- G	FOV CMD RTN	20	93	56	T 57
P3- D	P4- >C	NFOV CMD	20	96	57	T 68
P3- E	P4- H	1X RET H	20	908	58	T 59
P3- F	P4- >B	1X RET L	20	912	59	T 58
P3- G	P5- K	CMOR LEVEL H	20	926	60	T 61
P3- H	P5- L	CMOR LEVEL	20	928	61	T 62
P3- J	P5- M	CMOR LEVEL L	20	934	62	T 60
P3- K	P5- B	CMOR POL RTN	20	935	63	T 74
P3- L	P1- E	+10.0 VDC (LED #2)	20	95	5	T 6
P3- M	P1- F	+10.0 VDC RTN (LED #2)	20	97	6	T 5
P3- N	P1- C	+10.0 VDC (LED #1)	20	92	3	T 4
P3- P	P1- D	+10.0 VDC RTN (LED #2)	20	94	4	T 3
P3- R	P1- GG	DET COOLING LIGHT #1	20	9016	48	
P3- S	P1- V	+15.0 VDC (HEAD)	20	915	19	T 20
P3- T	P1- W	+15.0 VDC RTN (HEAD)	20	916	20	T 19
P3- U	P4- P	+5.0 VDC (GUN)	20	923	64	T 76
P3- V	P5- P	SPARE	20	936	65	
P3- W	P4- >H	18-30 VDC	20	90	66	T 67
P3- X	P4- >G	18-30 VDC RTN	20	91	67	T 66
P3- Y	P4- >D	NFOV CMD	20	947	68	T 56
P3- Z	P4- C	GUN GAIN H	20	948	69	T 78
P3- >A	P5- G	CMOR GAIN H	20	945	70	T 79
P3- >B	P4- F	GUN LEVEL H	20	9012	71	T 72
P3- >C	P4- E	GUN LEVEL	20	9013	72	T 73
P3- >D	P4- D	GUN LEVEL L	20	9018	73	T 71
P3- >E	P5- N	CMOR POL CMD	20	946	74	T 63
P3- >F	P4- >R	GUN POL RTN	20	9023	75	T 81
P3- >G	P1- G	+10.0 VDC (POST)	20	98	7	T 8
P3- >H	P1- H	+10.0 VDC RTN (POST)	20	901	8	T 7
P3- >I	P1- J	-9.0 VDC	20	902	9	T 10
P3- >J	P4- >H	+5.0 VDC RTN (GUN)	20	9024	76	T 64
P3- >K	P1- T	-5.0 VDC (S&I)	20	913	17	T 18
P3- >M	P1- U	-5.0 VDC RTN (S&I)	20	914	18	T 17
P3- >N	P1- L	+5.0 VDC (S&I)	20	904	11	T 12
P3- >P	P1- M	+5.0 VDC RTN (S&I)	20	905	12	T 11
P3- >Q	P4- V	SCAN MALF	20	9025	77	
P3- >R	P1- >I	+5.0 VDC BITE (HEAD)	20	937	32	T 33
P3- >S	P4- B	GUN GAIN	20	9026	78	T 83
P3- >T	P5- H	CMOR GAIN	20	956	79	T 80
P3- >U	P5- J	CMOR GAIN L	20	957	80	T 70
P3- >V	P4- >S	GUN POL CMD	20	9027	81	T 75
P3- >W	P5- E	CMOR INTLK RTN	20	958	82	T 84
P3- >X	P1- K	-9.0 VDC RTN	20	903	10	T 9
P3- >Y	P1- X	-15.0 VDC (HEAD)	20	917	21	T 22
P3- >Z	P1- Y	-15.0 VDC RTN (HEAD)	20	918	22	T 21
P3- CC	P1- >J	+5.0 VDC BITE RTN (HEAD)	20	938	33	T 32
P3- DD	P4- A	GUN GAIN L	20	9028	83	T 69
P3- EE	P5- F	CMOR INTLK	20	967	84	T 82
P3- FF	P4- >F	WHT HOT CMD	20	9034	85	T 86
P3- GG	P1- >B	HEAD CABLE BITE	20	925	25	

TABLE 3-2. CONTINUITY CHECKS-

TANK INTERFACE CABLE. (CONTINUED) PREFIX ALL TEST POINTS 3W4 (FIG. 3-2).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
P3- HH	P4- >E	BLK HOT CMD	20	9035	86	T 85
P4						
P4- A	P3- DD	GUN GAIN L	20	9028	83	T 69
P4- B	P3- >S	GUN GAIN	20	9026	78	T 83
P4- C	P3- Z	GUN GAIN H	20	948	69	T 78
P4- D	P3- >D	GUN LEVEL L	20	9018	73	T 71
P4- E	P3- >C	GUN LEVEL	20	9013	72	T 73
P4- F	P3- >B	GUN LEVEL H	20	9012	71	T 72
P4- G	P3- C	FOV CMD RTN	20	93	56	T 57
P4- H	P3- E	1X RET H	20	908	58	T 59
P4- J	P1- MH	DET COOLING LIGHT #2	20	9017	49	
P4- K	P2- E	FAN BITE PHASE B	20	96	50B	
P4- L	P2- F	COOLER BITE PHASE A	20	93	50C	
P4- M	P2- G	JACKET FOR WIRE NO 50	20	946	50	S 50
P4- N	P2- L	COOLER BITE PHASE B	20	9	50A	
P4- P	P2- U	BITE NEUT	20	95	50D	
P4- R	P3- U	+5.0 VDC (GUN)	20	923	64	T 76
P4- S	P1- >W	STBY CMD	20	956	38	
P4- T	P1- >X	OP CMD	20	957	39	
P4- U	P1- >H	+5.0 VDC BITE RTN (GUN)	20	946	35	T 34
P4- V	P1- >K	+5.0 VDC BITE (GUN)	20	945	34	T 35
P4- W	P3- >Q	SCAN HALP	20	9025	77	
P4- X	P1- >C	SPARE	20	926	26	
P4- Y	P1- BB	18-30 VDC RTN (OP GUN)	20	978	43	T 42
P4- Z	P1- AA	18-30 VDC (OP GUN)	20	968	42	T 43
P4- >A	P1- >Y	18-30 VDC RTN (STBY GUN)	20	958	40	T 41
P4- >B	P1- >Z	18-30 VDC (STBY GUN)	20	967	41	T 40
P4- >C	P3- F	1X RET L	20	912	59	T 58
P4- >D	P3- D	NFOV CMD	20	96	57	T 68
P4- >E	P3- Y	WFOV CMD	20	947	68	T 56
P4- >F	P3- HH	BLK HOT CMD	20	9035	86	T 85
P4- >G	P3- FF	WHT HOT CMD	20	9034	85	T 86
P4- >H	P3- X	18-30 VDC RTN	20	91	67	T 66
P4- >I	P3- W	18-30 VDC	20	90	66	T 67
P4- >J	P1- FF	COOLER SENSE LO TEST	20	9015	47	T 46
P4- >K	P1- EE	COOLER SENSE HI TEST	20	9014	46	T 47
P4- >L	P1- N	+5.0 VDC (12 GUN)	20	906	13	T 14
P4- >M	P3- >J	+5.0 VDC RTN (GUN)	20	9024	76	T 64
P4- >N	P1- >E	POWER CONV FAIL #1	20	928	28	
P4- >O	P1- >F	CABLE FAIL	20	934	29	
P4- >P	P5- S	CMOR BITE	20	95	87	
P4- >Q	P3- >F	GUN POL RTN	20	9023	75	T 81
P4- >R	P3- >V	GUN POL CMD	20	9027	81	T 75
P4- >T	P1- P	+5.0 VDC RTN (12 GUN)	20	907	14	T 13
P5						
P5- A	P1- >A	CMOR INTLK	20	924	24	
P5- B	P3- X	CMOR POL RTN	20	935	63	T 74
P5- C	P1- CC	18-30 VDC (OP CMOR)	20	9012	44	T 45
P5- D	P1- DD	18-30 VDC RTN (OP CMOR)	20	9013	45	T 44
P5- E	P3- >W	CMOR INTLK RTN	20	958	82	T 84
P5- F	P3- EE	CMOR INTLK	20	967	84	T 82
P5- G	P3- >A	CMOR GAIN H	20	945	70	T 79
P5- H	P3- >T	CMOR GAIN	20	956	79	T 80
P5- J	P3- >U	CMOR GAIN L	20	957	80	T 70
P5- K	P3- G	CMOR LEVEL H	20	926	60	T 61
P5- L	P3- H	CMOR LEVEL	20	928	61	T 62
P5- M	P3- J	CMOR LEVEL L	20	934	62	T 60
P5- N	P3- >E	CMOR POL CMD	20	946	74	T 63
P5- P	P3- V	SPARE	20	936	65	
P5- R	P1- Z	CMOR CABLE BITE	20	923	23	
P5- S	P4- >Q	CMOR BITE	20	95	87	
P5- T	P1- >D	+5.0 VDC BITE RTN (CMOR)	20	927	27	
P5- U	P1- R	+5.0 VDC (12 CMOR)	20	908	15	T 16

TABLE 3-2. CONTINUITY CHECKS-

TANK INTERFACE CABLE. (CONTINUED) PREFIX ALL TEST POINTS 3W4 (FIG. 3-2).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
P5- V	P1- S	+5.0 VDC RTN (I2 CHDR)	20	912	16	T 15

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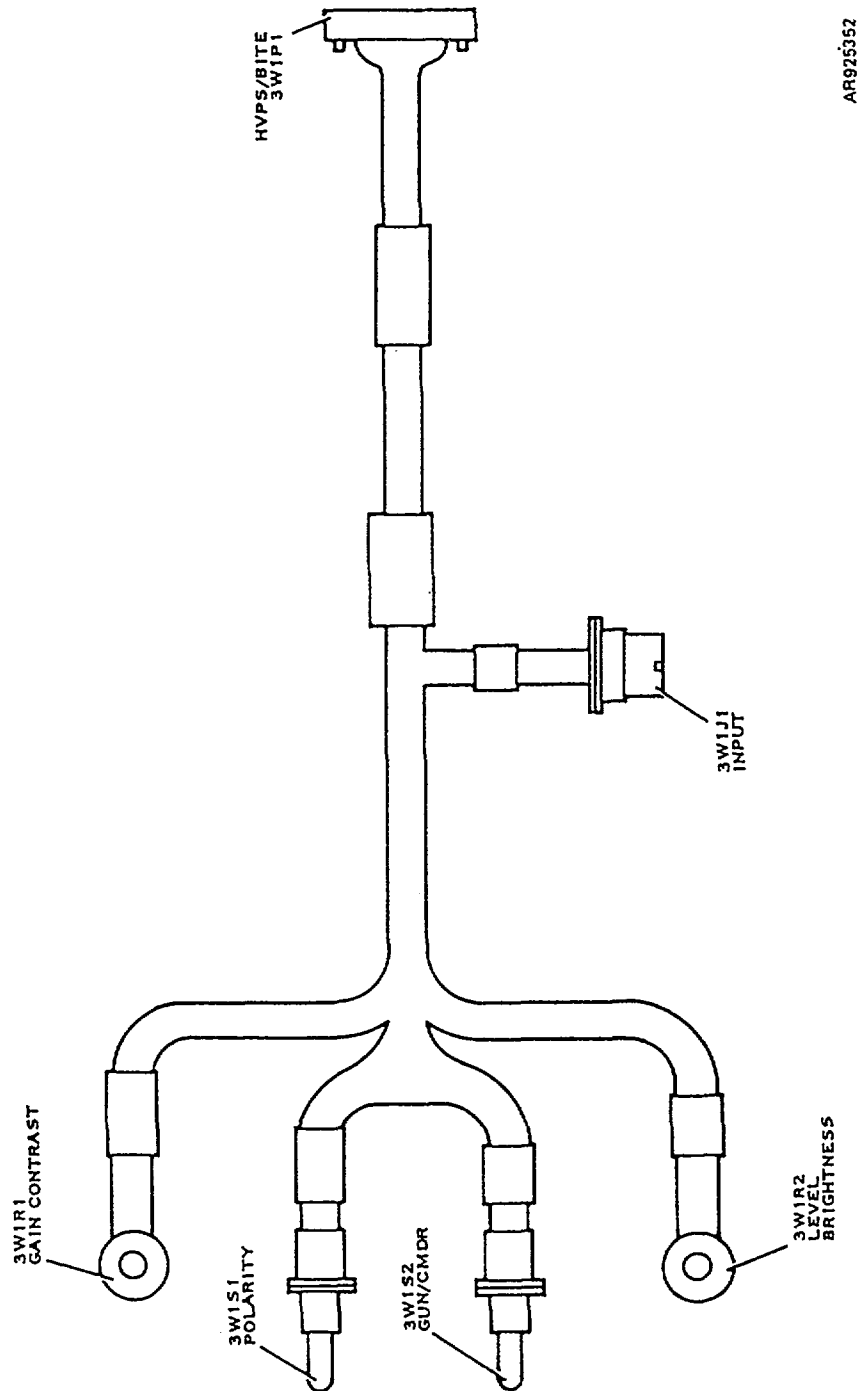
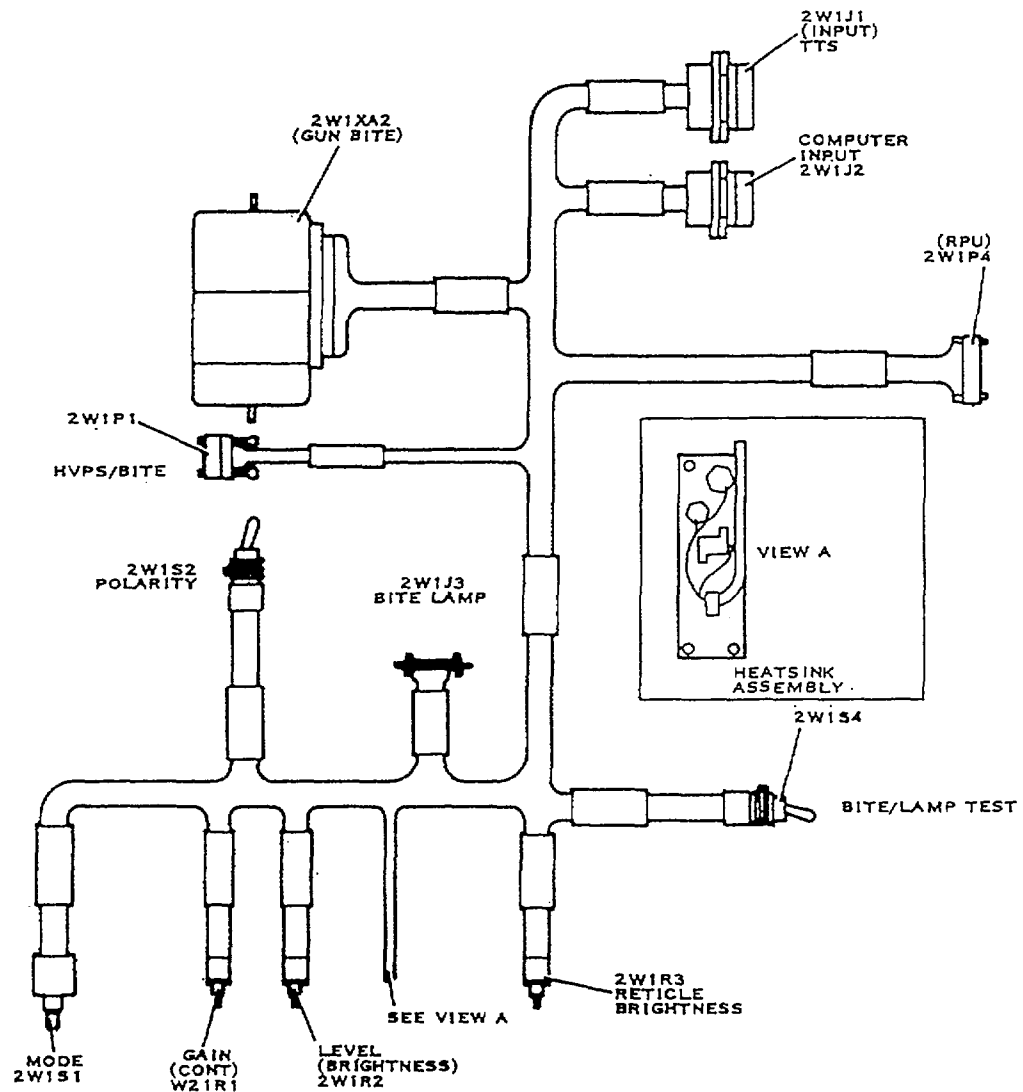


Figure 3-3. Commander's wire harness.

TABLE 3-2. CONTINUITY CHECKS-CMDR'S WIRE HARNESS (FIG. 3-3).

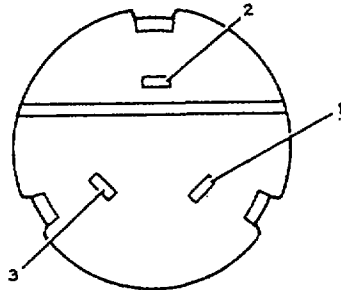
CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
3W1P1						
3W1P1- 1	3W1J1- Y	+5.0VDC RTN (I2 CMDR)	24	907	16	T 15
3W1P1- 2	3W1J1- U	+5.0VDC (I2 CMDR)	24	906	15	T 16
3W1P1- 3	3W1J1- R	CMOR CABLE BITE	24	903	12	
3W1P1- 4	3W1J1- T	+5.0VDC BITE RTN(CMDR)	24	905	14	
3W1P1- 5	3W1J1- S	CMOR BITE	24	904	13	
3W1P1- 6	3W1J1- D	+18 -30VDC RTN (OP CMDR)	24	93	4	T 3
3W1P1- 7	3W1J1- C	+18 -30VDC (OP CMDR)	24	92	3	T 4
3W1S2						
3W1S2- 2	3W1J1- E	CMOR INTLK RTN	24	908	17	T 18
3W1S2- 2	3W1J1- A	CMOR INTLK	24	90	1	
3W1S2- 3	3W1J1- F	CMOR INTLK	24	912	18	T 17
3W1S1						
3W1S1- 2	3W1J1- B	CMOR POL RTN	24	91	2	T 11
3W1S1- 3	3W1J1- N	CMOR POL CMD	24	902	11	T 2
3W1R2						
3W1R2- 1	3W1J1- M	CMOR LEVEL LOW	24	901	10	T 8
3W1R2- 2	3W1J1- L	CMOR LEVEL	24	98	9	T 10
3W1R2- 3	3W1J1- K	CMOR LEVEL HIGH	24	97	8	T 9
3W1R1						
3W1R1- 1	3W1J1- J	CMOR GAIN LOW	24	96	7	T 5
3W1R1- 2	3W1J1- H	CMOR GAIN	24	95	6	T 7
3W1R1- 3	3W1J1- G	CMOR GAIN HIGH	24	94	5	T 6
3W1J1						
3W1J1- A	3W1S2- 2	CMOR INTLK	24	90	1	
3W1J1- B	3W1S1- 2	CMOR POL RTN	24	91	2	T 11
3W1J1- C	3W1P1- 7	+18 -30VDC (OP CMDR)	24	92	3	T 4
3W1J1- D	3W1P1- 6	+18 -30VDC RTN (OP CMDR)	24	93	4	T 3
3W1J1- E	3W1S2- 2	CMOR INTLK RTN	24	908	17	T 18
3W1J1- F	3W1S2- 3	CMOR INTLK	24	912	18	T 17
3W1J1- G	3W1R1- 3	CMOR GAIN HIGH	24	94	5	T 6
3W1J1- H	3W1R1- 2	CMOR GAIN	24	95	6	T 7
3W1J1- J	3W1R1- 1	CMOR GAIN LOW	24	96	7	T 5
3W1J1- K	3W1R2- 3	CMOR LEVEL HIGH	24	97	8	T 9
3W1J1- L	3W1R2- 2	CMOR LEVEL	24	98	9	T 10
3W1J1- M	3W1R2- 1	CMOR LEVEL LOW	24	901	10	T 8
3W1J1- N	3W1S1- 3	CMOR POL CMD	24	902	11	T 2
3W1J1- R	3W1P1- 3	CMOR CABLE BITE	24	903	12	
3W1J1- S	3W1P1- 5	CMOR BITE	24	904	13	
3W1J1- T	3W1P1- 4	+5.0VDC BITE RTN(CMDR)	24	905	14	
3W1J1- U	3W1P1- 2	+5.0VDC (I2 CMDR)	24	906	15	T 16
3W1J1- V	3W1P1- 1	+5.0VDC RTN (I2 CMDR)	24	907	16	T 15

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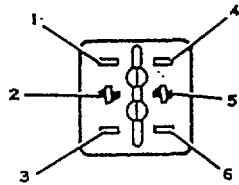


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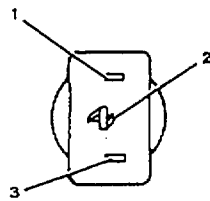
Figure 3-4. Gunner's wire harness.



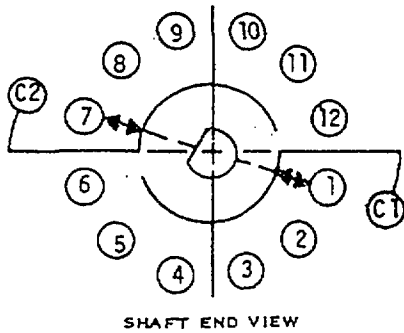
2W1
R1, R2, R3 CONTROL
TERMINAL LOCATION



2W1S4 BITE/LAMP TEST SWITCH
TERMINAL LOCATION



2W1S2 POLARITY SWITCH
TERMINAL LOCATION



2W1S1 MODE SWITCH
TERMINAL LOCATION

AR925354

Figure 3-5. Terminal identification.

TABLE 3-2. CONTINUITY CHECKS-GUNNER'S WIRE HARNESS

(FIG. 3-4).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
2W1J1						
2W1J1- A	2W1R1- 1	GUN GAIN LOW	24	90	1	T 2
2W1J1- B	2W1R1- 2	GUN GAIN	24	91	2	T 3
2W1J1- C	2W1R1- 3	GUN GAIN HIGH	24	92	3	T 1
2W1J1- D	2W1R2- 1	GUN LEVEL LOW	24	94	4	T 5
2W1J1- E	2W1R2- 2	GUN LEVEL	24	95	5	T 6
2W1J1- F	2W1R2- 3	GUN LEVEL HIGH	24	97	6	T 4
2W1J1- G	2W1S1- C2	FOV CMD RTN	24	901	7	T 18
2W1J1- H	2W1XA2- 34	1X RET HIGH	24	908	14	
2W1J1- J	2W1XA2- 20	DET COOLING LIGHT #2	24	948	63	
2W1J1- K	2W1XA2- 22	FAN BITE PH B	24	902	8	T 9
2W1J1- L	2W1XA2- 2	COOLER BITE PH A	24	903	9	T 10
2W1J1- M	2W1XA2- 1	COOLER BITE PH B	24	904	10	T 11
2W1J1- N	2W1XA2- 21	BITE NEUT	24	905	11	T 8
2W1J1- R	2W1S1- 2	STBY CMD	24	906	12	T 13
2W1J1- S	2W1S1- 9	OP CMD	24	907	13	T 12
2W1J1- T	2W1XA2- 29	+5.0 VDC BITE RTN (GUN)	24	912	15	T 16
2W1J1- U	2W1XA2- 10	+5.0 VDC BITE (GUN)	24	913	16	T 15
2W1J1- V	2W1XA2- 4	SCAN MALF	24	914	17	T 62
2W1J1- X	2W1S4- 4	18-30 VDC RTN (OP GUN)	22	916	19	T 20
2W1J1- Y	2W1S4- 2	18-30 VDC (OP GUN)	22	917	20	T 19
2W1J1- Z	2W1S1- C1	18-30 VDC RTN (STBY GUN)	22	915	18	T 7
2W1J1- >A	2W1J3- 1	18-30 VDC (STBY GUN)	22	918	21	T 24
2W1J1- >B	2W1P4- 13	1X RET LOW	24	98	22	
2W1J1- >C	2W1P4- 14	NFOV CMD	24	937	34	
2W1J1- >D	2W1P4- 20	WFOV CMD	24	938	35	
2W1J1- >E	2W1P4- 19	BLK HOT CMD	24	945	36	
2W1J1- >F	2W1P4- 18	WHT HOT CMD	24	946	37	
2W1J1- >G	2W1S1- C1	18-30 VDC RTN (STBY HEAD)	22	923	23	
2W1J1- >H	2W1J3- 2	18-30 VDC (STBY HEAD)	22	924	24	T 21
2W1J1- >K	2W1P1- 2	+5.0 VDC (12 GUN)	24	927	27	T 33
2W1J1- >M	2W1XA2- 28	+5.0 VDC RTN (GUN)	24	947	62	T 17
2W1J1- >N	2W1XA2- 33	PWR CNV FAIL #1	24	928	28	
2W1J1- >P	2W1XA2- 35	CABLE FAIL	24	934	29	
2W1J1- >Q	2W1XA2- 26	CMOR BITE	24	935	30	
2W1J1- >K	2W1S2- 2	GUN POL RTN	24	93	31	T 32
2W1J1- >S	2W1S2- 1	GUN POL CMD	24	96	32	T 31
2W1J1- >T	2W1P1- 1	+5.0 VDC RTN (12 GUN)	24	936	33	T 27
2W1J2						
2W1J2- A	2W1P4- 8	E2	24	98	76	
2W1J2- B	2W1P4- 2	MGI-YEL	24	902	77	T 71
2W1J2- C	2W1P4- 3	MGI-BLK	24	93	71	T 72
2W1J2- D	2W1P4- 5	MGI-GRN	24	94	72	T 73
2W1J2- E	2W1E1	+18-30 VDC RTN (N S)	24	908	61	
2W1J2- F	2W1P4- 6	MGI-RED	24	95	73	T 75
2W1J2- G	2W1XA2- 6	+18-30 VDC (N S)	22	917	55	
2W1J2- H	2W1P4- 7	S3-C	24	96	74	
2W1J2- J	2W1P4- 9	R1-CW	24	91	69	T 70
2W1J2- K	2W1P4- 10	R1-CCW	24	92	70	T 68
2W1J2- L	2W1P4- 4	MGI-BLU	24	97	75	T 77
2W1J2- M	2W1P4- 1	R1 WIPER	24	90	68	T 69
2W1J2- W	2W1J2- X	CTS INTERLOCK	24	903	78	
2W1J2- X	2W1J2- W	CTS INTERLOCK	24	903	78	
2W1J3						
2W1J3- 1	2W1J1- >A	18-30 VDC (STBY GUN)	22	918	21	T 24
2W1J3- 2	2W1J1- >H	18-30 VDC (STBY HEAD)	22	924	24	T 21
2W1J3- 4	2W1XA2- 36	COOLER BITE/HEAD FAIL LIGHT	24	95	38	
2W1J3- 5	2W1XA2- 32	GUNNERS FAIL LIGHT	24	96	39	
2W1J3- 6	2W1XA2- 16	PWR CNV FAIL LIGHT	24	97	40	
2W1J3- 7	2W1XA2- 17	CABLE FAIL LIGHT	24	937	41	
2W1J3- 8	2W1XA2- 30	CMOR FAIL LIGHT	24	938	42	
2W1J3- 9	2W1XA2- 39	DETECTOR COOLING LIGHT	24	98	51	

TABLE 3-2. CONTINUITY CHECKS-GUNNER'S WIRE HARNESS (CONTINUED) (FIG. 3-4).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
2W1J3- 10	2W1S4- 3	S4-3	24	90	57	
2W1P1						
2W1P1- 1	2W1J1- >T	+5.0 VDC RTN (12 GUN)	24	936	33	T 27
2W1P1- 2	2W1J1- >K	+5.0 VDC (12 GUN)	24	927	27	T 33
2W1P1- 4	2W1XA2- 9	BITE RTN	24	945	66	T 67
2W1P1- 5	2W1XA2- 11	GUNNERS DISPLAY BITE	24	946	67	T 66
2W1P1- 6	2W1S4- 4	+18-30 VDC RTN (OP GUN)	24	94	64	T 65
2W1P1- 7	2W1S4- 2	+18-30 VDC (OP GUN)	24	95	65	T 64
2W1P4						
2W1P4- 1	2W1J2- M	R1 WIPER	24	90	68	T 69
2W1P4- 2	2W1J2- B	MG1-YEL	24	902	77	T 71
2W1P4- 3	2W1J2- C	MG1-BLK	24	93	71	T 72
2W1P4- 4	2W1J2- L	MG1-BLU	24	97	75	T 77
2W1P4- 5	2W1J2- D	MG1-GRN	24	94	72	T 73
2W1P4- 6	2W1J2- F	MG1-RED	24	95	73	T 75
2W1P4- 7	2W1J2- H	S3-C	24	96	74	
2W1P4- 8	2W1J2- A	E2	24	98	76	
2W1P4- 9	2W1J2- J	R1-CW	24	91	69	T 70
2W1P4- 10	2W1J2- K	R1-CCW	24	92	70	T 68
2W1P4- 11	2W1XA2- 18	IR RETICLE	24	901	52	
2W1P4- 12	2W1E1	18-30 VDC RTN (N S)	24	904	60	
2W1P4- 13	2W1J1- >B	1X RET LOW	24	98	22	
2W1P4- 14	2W1J1- >C	NFOV CMD	24	937	34	
2W1P4- 17	2W1XA2- 15	8X RETICLE HIGH	24	927	83	
2W1P4- 18	2W1J1- >F	WHT HOT CMD	24	946	37	
2W1P4- 19	2W1J1- >E	BLK HOT CMD	24	945	36	
2W1P4- 20	2W1J1- >D	WFOV CMD	24	938	35	
2W1XA2						
2W1XA2- 1	2W1J1- M	COOLER BITE PH B	24	904	10	T 11
2W1XA2- 2	2W1J1- L	COOLER BITE PH A	24	903	9	T 10
2W1XA2- 4	2W1J1- V	SCAN HALF	24	914	17	T 62
2W1XA2- 5	2W1R4- 1	R4-1	22	967	50	T 79
2W1XA2- 6	2W1J2- G	+18-30 VDC (N S)	22	917	55	
2W1XA2- 7	2W1R3- 3	RETICLE BRIGHTNESS HIGH	22	906	47	
2W1XA2- 8	2W1S4- 4	+18-30 VDC RTN (OP GUN)	24	915	53	T 54
2W1XA2- 9	2W1P1- 4	BITE RTN	24	945	66	T 67
2W1XA2- 10	2W1J1- U	+5.0 VDC BITE (GUN)	24	913	16	T 15
2W1XA2- 11	2W1P1- 5	GUNNERS DISPLAY BITE	24	946	67	T 66
2W1XA2- 12	2W1Q1- B	Q1 BASE	22	957	44	T 45
2W1XA2- 13	2W1R3- 2	RETICLE BRIGHTNESS	22	907	48	
2W1XA2- 14	2W1Q1- E	Q1 EMITTER	22	958	45	T 43
2W1XA2- 15	2W1P4- 17	8X RETICLE HIGH	24	927	83	
2W1XA2- 16	2W1J3- 6	PHR CNV FAIL LIGHT	24	97	40	
2W1XA2- 17	2W1J3- 7	CABLE FAIL LIGHT	24	937	41	
2W1XA2- 18	2W1P4- 11	IR RETICLE	24	901	52	
2W1XA2- 19	2W1Q2- E	Q2 EMITTER	22	978	80	T 81
2W1XA2- 20	2W1J1- J	DET COOLING LIGHT #2	24	948	63	
2W1XA2- 21	2W1J1- N	BITE NEUT	24	905	11	T 8
2W1XA2- 22	2W1J1- K	FAN BITE PH B	24	902	8	T 9
2W1XA2- 24	2W1Q2- 8	Q2 BASE	22	9012	81	T 82
2W1XA2- 25	2W1S4- 2	+18-30 VDC (OP GUN)	22	916	54	T 53
2W1XA2- 26	2W1J1- >Q	CHDR BITE	24	935	30	
2W1XA2- 27	2W1E1	RETICLE BRIGHTNESS LOW	22	918	49	
2W1XA2- 28	2W1J1- >M	+5.0 VDC RTN (GUN)	24	947	62	T 17
2W1XA2- 29	2W1J1- T	+5.0 VDC BITE RTN (GUN)	24	912	15	T 16
2W1XA2- 30	2W1J3- 8	CHDR FAIL LIGHT	24	938	42	
2W1XA2- 31	2W1R4- 2	R4-2	22	968	79	T 50
2W1XA2- 32	2W1J3- 5	GUNNERS FAIL LIGHT	24	96	39	
2W1XA2- 33	2W1J1- >N	PHR CNV FAIL #1	24	928	28	
2W1XA2- 34	2W1J1- H	1X RET HIGH	24	908	14	
2W1XA2- 35	2W1J1- >P	CABLE FAIL	24	934	29	
2W1XA2- 36	2W1J3- 4	COOLER BITE/HEAD FAIL LIGHT	24	95	38	

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TABLE 3-2. CONTINUITY CHECKS-GUNNER'S WIRE HARNESS (CONTINUED) (FIG. 3-4).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
2W1XA2- 37	2W1Q2- C	Q2 COLLECTOR	22	9013	82	T 80
2W1XA2- 38	2W1S4- 5	S4-5	24	93	46	
2W1XA2- 39	2W1J3- 9	DETECTOR COOLING LIGHT	24	98	51	
2W1XA2- 40	2W1Q1- C	Q1 COLLECTOR	22	956	43	T 44
2W1Q1						
2W1Q1- 8	2W1XA2- 12	Q1 BASE	22	957	44	T 45
2W1Q1- C	2W1XA2- 40	Q1 COLLECTOR	22	956	43	T 44
2W1Q1- E	2W1XA2- 14	Q1 EMITTER	22	958	45	T 43
2W1Q2						
2W1Q2- 8	2W1XA2- 24	Q2 BASE	22	9012	81	T 82
2W1Q2- C	2W1XA2- 37	Q2 COLLECTOR	22	9013	82	T 80
2W1Q2- E	2W1XA2- 19	Q2 EMITTER	22	978	80	T 81
2W1R1						
2W1R1- 1	2W1J1- A	GUN GAIN LOW	24	90	1	T 2
2W1R1- 2	2W1J1- B	GUN GAIN	24	91	2	T 3
2W1R1- 3	2W1J1- C	GUN GAIN HIGH	24	92	3	T 1
2W1R2						
2W1R2- 1	2W1J1- D	GUN LEVEL LOW	24	94	4	T 5
2W1R2- 2	2W1J1- E	GUN LEVEL	24	95	5	T 6
2W1R2- 3	2W1J1- F	GUN LEVEL HIGH	24	97	6	T 4
2W1R3						
2W1R3- 1	2W1E1	RETICLE BRIGHTNESS LOW	22	9013	84	
2W1R3- 2	2W1XA2- 13	RETICLE BRIGHTNESS	22	907	48	
2W1R3- 3	2W1XA2- 7	RETICLE BRIGHTNESS HIGH	22	906	47	
2W1R4						
2W1R4- 1	2W1XA2- 5	R4-1	22	967	50	T 79
2W1R4- 2	2W1XA2- 31	R4-2	22	968	79	T 50
2W1S1						
2W1S1- 2	2W1S1- 3	SWITCH S1 JUMPER	24	BUS	59	
2W1S1- 2	2W1J1- R	STBY CMD	24	906	12	T 13
2W1S1- 3	2W1S1- 2	SWITCH S1 JUMPER	24	BUS	59	
2W1S1- 9	2W1J1- S	OP CMD	24	907	13	T 12
2W1S1- C1	2W1S1- C2	SWITCH S1 JUMPER	24	BUS	58	
2W1S1- C1	2W1J1- >G	18-30 VDC RTN (STBY HEAD)	22	923	23	
2W1S1- C1	2W1J1- Z	18-30 VDC RTN (STBY GUN)	22	915	18	T 7
2W1S1- C7	2W1S1- C1	SWITCH S1 JUMPER	24	BUS	58	
2W1S1- C2	2W1J1- G	FOV CMD RTN	24	901	7	T 18
2W1S2						
2W1S2- 1	2W1J1- >S	GUN POL CMD	24	96	32	T 31
2W1S2- 2	2W1J1- >R	GUN POL RTN	24	93	31	T 32
2W1S4						
2W1S4- 1	2W1S4- 3	SWITCH S4 JUMPER	24	BUS	56	
2W1S4- 2	2W1P1- 7	+18-30 VDC (OP GUN)	24	95	65	T 44
2W1S4- 2	2W1J1- Y	18-30 VDC (OP GUN)	22	917	20	T 19
2W1S4- 2	2W1XA2- 25	+18-30 VDC (OP GUN)	22	916	54	T 53
2W1S4- 3	2W1S4- 1	SWITCH S4 JUMPER	24	BUS	56	
2W1S4- 3	2W1J3- 10	S4-3	24	90	57	
2W1S4- 4	2W1J1- X	18-30 VDC RTN (OP GUN)	22	916	19	T 20
2W1S4- 4	2W1P1- 6	+18-30 VDC RTN (OP GUN)	24	94	64	T 65
2W1S4- 4	2W1XA2- 8	+18-30 VDC RTN (OP GUN)	24	915	53	T 54
2W1S4- 5	2W1XA2- 38	S4-5	24	93	46	
2W1E1						
2W1E1	2W1P4- 12	18-30 VDC RTN (N S)	24	904	60	
2W1E1	2W1J2- E	+18-30 VDC RTN (N S)	24	908	61	
2W1E1	2W1R3- 1	RETICLE BRIGHTNESS LOW	22	9013	84	

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TABLE 3-2. CONTINUITY CHECKS-GUNNER'S WIRE HARNESS. (CONTINUED) (FIG. 3-4).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
2W1E1	2W1XA2- 27	RETICLE BRIGHTNESS LOW	22	918	49	

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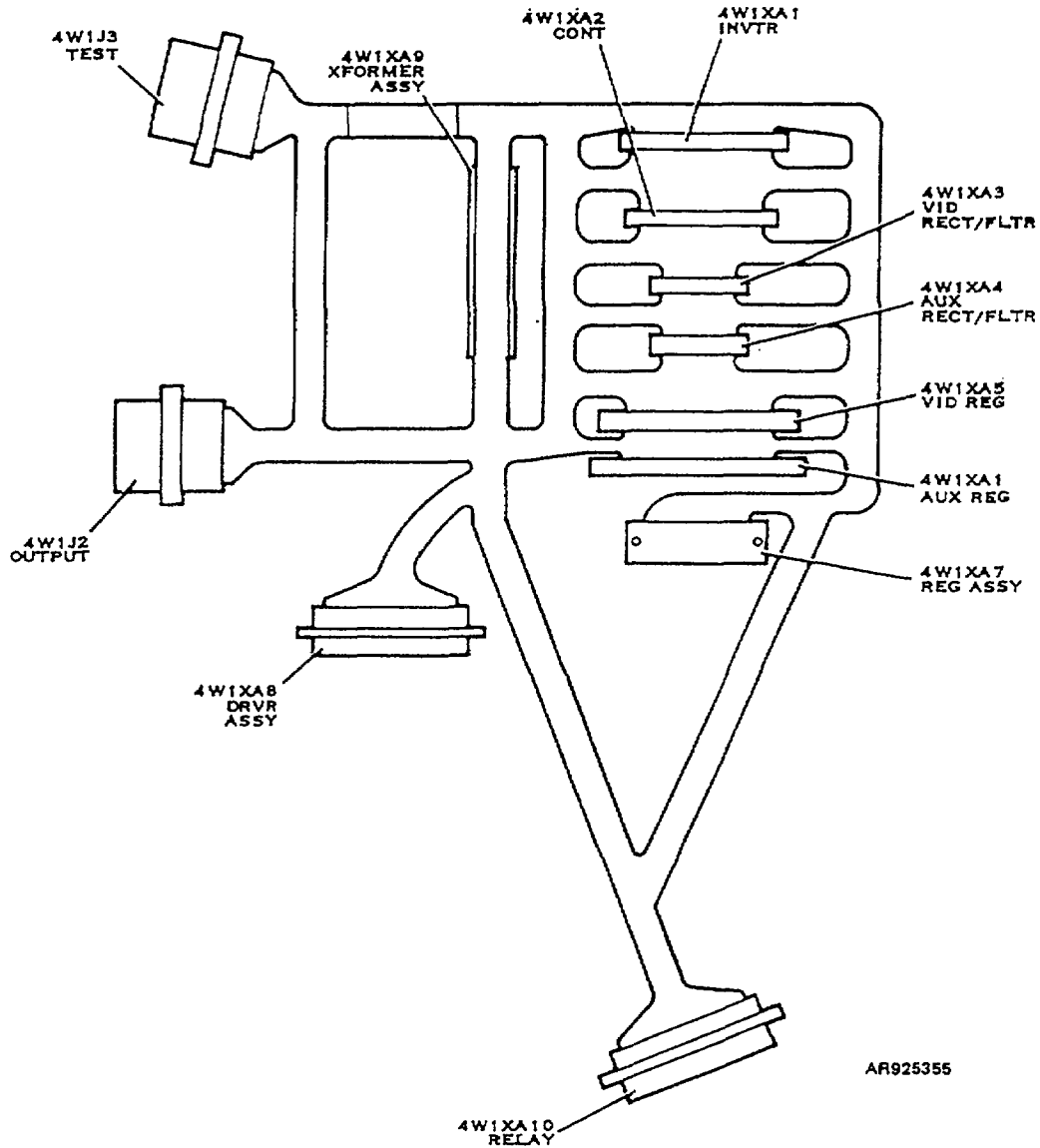


Figure 3-6. Power converter harness.

TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS

(FIG. 3-61.)

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS	
4W1J2							
4W1J2-	A	4W1XA5- 25	+10.5VDC	22	904	109	T110
4W1J2-	B	4W1XA5- 31	+10.5VDC RTN	22	916	110	T109
4W1J2-	C	4W1XA5- 13	+10.0VDC (LED #1)	22	917	111	T112
4W1J2-	U	4W1XA5- 11	+10.0VDC RTN (LED #1)	22	918	112	T111
4W1J2-	E	4W1XA5- 35	+10.0VDC (LED #2)	22	923	113	T114
4W1J2-	F	4W1XA5- 34	+10.0VDC RTN (LED #2)	22	924	114	T113
4W1J2-	G	4W1XA5- 27	+10.0VDC (POST)	22	925	115	T116
4W1J2-	H	4W1XA5- 4	+10.0VDC RTN (POST)	22	926	116	T115
4W1J2-	J	4W1XA5- 21	-9.0VDC	22	927	117	T118
4W1J2-	K	4W1XA5- 39	-9.0VDC RTN	22	928	118	T117
4W1J2-	L	4W1XA6- 32	+5.0VDC (SCI)	22	90	119	T120
4W1J2-	M	4W1XA6- 36	+5.0VDC (SGI)	22	91	120	T119
4W1J2-	N	4W1XA6- 33	+5.0VDC (12 GUN)	22	92	121	T122
4W1J2-	P	4W1XA6- 37	+5.0VDC RTN (12 GUN)	22	94	122	T121
4W1J2-	R	4W1XA6- 34	+5.0VDC (12 CHDR)	22	95	123	T124
4W1J2-	S	4W1XA6- 38	+5.0VDC RTN (12 CHDR)	22	97	124	T123
4W1J2-	T	4W1XA6- 4	-5.0VDC (SCI)	22	98	125	T126
4W1J2-	U	4W1XA6- 6	-5.0VDC RTN (SCI)	22	901	126	T125
4W1J2-	V	4W1XA6- 41	+15.0VDC (HEAD)	22	902	127	T128
4W1J2-	W	4W1XA6- 12	+15.0VDC RTN (HEAD)	22	903	128	T127
4W1J2-	X	4W1XA6- 43	-15.0VDC (HEAD)	22	935	129	T130
4W1J2-	Y	4W1XA6- 19	-15.0VDC RTN (HEAD)	22	936	130	T129
4W1J2-	Z	4W1XA6- 24	CHDR CABLE BITE	22	937	131	
4W1J2-	>A	4W1XA6- 26	CHDR INTLK	22	938	132	
4W1J2-	>B	4W1XA6- 27	HEAD CABLE BITE	22	945	133	
4W1J2-	>U	4W1XA6- 53	+5.0VDC BITE RTN (CHDR)	22	946	134	
4W1J2-	>E	4W1XA6- 51	POWER CONV FAIL #1	22	947	135	
4W1J2-	>F	4W1XA6- 21	CABLE FAIL	22	956	136	
4W1J2-	>I	4W1XA2- 24	+5.0VDC BITE (HEAD)	22	957	137	T138
4W1J2-	>J	4W1XA2- 13	+5.0VDC BITE RTN (HEAD)	22	958	138	T137
4W1J2-	>K	4W1XA2- 23	+5.0VDC BITE (GUN)	22	967	139	T140
4W1J2-	>M	4W1XA2- 14	+5.0VDC BITE RTN (GUN)	22	968	140	T139
4W1J2-		4W1XA9-	JACKET FOR WIRE NO 84		948	84	S 84
4W1J2-	>N	4W1XA9- 45	COOLER PH A	20	9	84A	
4W1J2-	>P	4W1XA9- 46	COOLER PH B	20	96	84B	
4W1J2-	>Q	4W1XA9- 47	COOLER NEUT	20	93	84C	
4W1J2-	>R	SHIELD 84	COOLER SHIELD	22	9	84F	
4W1J2-		4W1XA9-	JACKET FOR WIRE NO 83		934	83	S 83
4W1J2-	>S	4W1XA9- 29	FAN PH A	20	9	83A	
4W1J2-	>T	4W1XA9- 30	FAN PH B	20	96	83B	
4W1J2-	>U	4W1XA9- 31	FAN NEUT	20	93	83C	
4W1J2-	>V	SHIELD 83	FAN SHIELD	22	9	83F	
4W1J2-	>W	4W1XA10- 20	STBY CKD	20	914	20	
4W1J2-	>X	4W1XA10- 21	OP CKD	20	915	21	
4W1J2-	>Y	4W1XA10- 14	18-30VDC RTN (STBY GUN)	20	905	14	T 15
4W1J2-	>Z	4W1XA10- 15	18-30VDC (STBY GUN)	20	906	15	T 14
4W1J2-	AA	4W1XA10- 16	18-30VDC (OP GUN)	20	907	16	T 17
4W1J2-	BB	4W1XA10- 17	18-30VDC RTN (OP GUN)	20	908	17	T 16
4W1J2-	CC	4W1XA10- 18	18-30VDC (OP CHDR)	20	912	18	T 19
4W1J2-	DD	4W1XA10- 19	18-30VDC RTN (OP CHDR)	20	913	19	T 18
4W1J2-	GG	4W1J2- HH	DET CLG LT GG #1, HH#2	20	9012	200	
4W1J2-	HH	4W1J2- GG	DET CLG LT GG #1, HH#2	20	9012	200	
4W1J3							
4W1J3-	A	4W1XA5- 26	+10.5VDC TEST	22	905	143	T144
4W1J3-	B	4W1XA5- 32	+10.5VDC RTN TEST	22	906	144	T143
4W1J3-	C	4W1XA5- 28	+10.0VDC TEST (POST)	22	907	145	T146
4W1J3-	D	4W1XA5- 5	+10.0VDC RTN TEST (POST)	22	908	146	T145
4W1J3-	E	4W1XA5- 12	+10.0VDC TEST (LED)	22	912	147	T148
4W1J3-	F	4W1XA5- 33	+10.0VDC RTN TEST (LED)	22	913	148	T147
4W1J3-	G	4W1XA5- 42	-9.0VDC TEST	22	914	149	T150
4W1J3-	H	4W1XA5- 40	-9.0VDC RTN TEST	22	915	150	T149
4W1J3-	J	4W1XA6- 35	+5.0VDC TEST	22	93	151	T152

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TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1J3- K	4W1XA6- 39	+5.0VDC RTN TEST	22	96	152	T151
4W1J3- L	4W1XA6- 3	-5.0VDC TEST	22	926	153	T154
4W1J3- M	4W1XA6- 7	-5.0VDC RTN TEST	22	927	154	T153
4W1J3- N	4W1XA6- 42	+15.0VDC TEST	22	928	155	T156
4W1J3- P	4W1XA6- 40	+15.0VDC RTN TEST	22	934	156	T155
4W1J3- R	4W1XA6- 45	-15.0VDC TEST	22	948	157	T158
4W1J3- S	4W1XA6- 47	-15.0VDC RTN TEST	22	957	158	T157
4W1J3- T	4W1XA2- 17	CONT BASE DR 1 TEST	22	92	159	T161
4W1J3- U	4W1XA2- 1	CONT DR CT TEST	22	97	160	T159
4W1J3- V	4W1XA2- 16	CONT BASE DR 2 TEST	22	98	161	T160
4W1J3- W	4W1XA2- 28	+5.0VDC BITE TEST	22	903	162	
4W1J3- X	4W1XA1- 13	+14.0VDC TEST	22	94	163	T164
4W1J3- Y	4W1XA1- 11	+14.0VDC RTN TEST	22	95	164	T163
4W1J3- Z	4W1XA1- 8	INVTR BASE DR 1 TEST	22	901	165	T167
4W1J3- >A	4W1XA1- 7	INVTR DR CT TEST	22	902	166	T165
4W1J3- >B	4W1XA1- 4	INVTR BASE DR 2 TEST	22	956	167	T166
4W1J3- >C	4W1XA1- 22	PH A XFORMER BITE TEST	22	958	168	T169
4W1J3- >D	4W1XA1- 20	NEUT XFORMER BITE TEST	22	967	169	T168
4W1J3- >G	4W1XA10- 22	STBY CMD TEST	20	916	22	
4W1J3- >H	4W1XA10- 23	OP CMD TEST	20	917	23	
4W1J3- >I	4W1XA10- 24	18-30VDC (STBY TEST)	20	918	24	
4W1J3- >J	4W1XA10- 25	18-30VDC (OP TEST)	20	923	25	
4W1J3- >K	4W1XA10- 26	18-30VDC TEST	20	924	26	T 27
4W1J3- >M	4W1XA10- 27	18-30VDC RTN TEST	20	925	27	T 26
4W1XA1						
4W1XA1- 1	4W1XA6- 55	INVTR BITE	22	9018	193	
4W1XA1- 2	4W1XA2- 15	+5.0VDC BITE RTN (INVTR)	22	912	195	T194
4W1XA1- 3	4W1XA2- 22	+5.0VDC BITE (INVTR)	22	905	194	T195
4W1XA1- 4	4W1J3- >B	INVTR BASE DR 2 TEST	22	956	167	T166
4W1XA1- 6	4W1XA8- 13	INVTR DR CT	22	904	44	T 43
4W1XA1- 7	4W1J3- >A	INVTR DR CT TEST	22	902	166	T165
4W1XA1- 8	4W1J3- Z	INVTR BASE DR 1 TEST	22	901	165	T167
4W1XA1- 9	4W1XA8- 14	INVTR BASE DR 2	22	906	45	T 44
4W1XA1- 10	4W1XA8- 12	INVTR BASE DR 1	22	903	43	T 45
4W1XA1- 11	4W1J3- Y	+14.0VDC RTN TEST	22	95	164	T163
4W1XA1- 12	4W1XA9- 42	TIMER CMD	22	945	80	
4W1XA1- 13	4W1J3- X	+14.0VDC TEST	22	94	163	T164
4W1XA1- 14	4W1XA8- 20	SW REG #1	22	914	50	T 51
4W1XA1- 15	4W1XA8- 21	SW REG #2	22	916	52	T 53
4W1XA1- 16	4W1XA10- 31	INVTR STBY CURRENT SENSE	22	934	31	
4W1XA1- 17	4W1XA8- 27	SW REG (PASS Q5-C #1)	22	924	56	T 57
4W1XA1- 18	4W1XA8- 28	SW REG (PASS Q5-C #2)	22	925	57	T 56
4W1XA1- 19	4W1XA9- 14	PH A XFORMER BITE	22	946	81	T 82
4W1XA1- 20	4W1J3- >D	NEUT XFORMER BITE TEST	22	967	169	T168
4W1XA1- 21	4W1XA9- 15	NEUT XFORMER BITE	22	947	82	T 81
4W1XA1- 22	4W1J3- >C	PH A XFORMER BITE TEST	22	958	168	T169
4W1XA1- 23	4W1XA9- 28	+14.0VDC RTN #1	22	936	77	T 76
4W1XA1- 24	4W1XA9- 44	+14.0VDC RTN #2	22	938	74	T 78
4W1XA1- 25	4W1XA10- 7	18-30VDC RTN (STBY INVTR #1)	22	96	7	T 6
4W1XA1- 26	4W1XA10- 9	18-30VDC RTN (STBY INVTR #2)	22	98	9	T 8
4W1XA1- 27	4W1XA8- 23	DIODE GND #1	22	915	51	T 50
4W1XA1- 28	4W1XA8- 24	DIODE GND #2	22	917	53	T 52
4W1XA1- 29	4W1XA10- 33	+14.0VDC PTCRTN (INVTR SW REG)	22	968	199	T198
4W1XA1- 30	4W1XA10- 32	+14.0VDC PROTECT (INVTR SW REG)	22	957	198	T199
4W1XA1- 31	4W1XA9- 27	+14.0VDC #1	22	935	76	T 77
4W1XA1- 32	4W1XA9- 43	+14.0VDC #2	22	937	78	T 79
4W1XA1- 33	4W1XA8- 25	SW REG F8 (PASS Q5-E)	22	918	54	
4W1XA1- 34	4W1XA10- 6	18-30VDC (STBY INVTR #1)	22	93	6	T 7
4W1XA1- 35	4W1XA10- 8	18-30VDC (STBY INVTR #2)	22	97	8	T 9
4W1XA1- 36	4W1XA8- 26	SW REG (PASS Q5-B)	22	923	55	

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TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1XA2						
4W1XA2-1	4W1J3-U	CONT DR CT TEST	22	97	160	T159
4W1XA2-2	4W1XA8-7	CONT DR CT	22	95	39	T38
4W1XA2-3	4W1XA10-29	18-30VDC (OP CONT HI-C)	22	927	29	T30
4W1XA2-4	4W1XA8-9	CONT BASE DR 2	22	96	40	T39
4W1XA2-5	4W1XA8-5	CONT BASE DR 1	22	94	38	T40
4W1XA2-7	4W1XA8-18	CONT ERROR LO	22	908	47	T46
4W1XA2-8	4W1XA6-46	-15.0VDC RTN (CONT)	22	9017	192	T191
4W1XA2-9	4W1XA10-11	18-30VDC RTN (OP CONT)	22	902	11	T10
4W1XA2-10	4W1XA8-3	+5.0VDC BITE RTN (VR1-CASE)	22	93	34	T33
4W1XA2-11	4W1XA5-36	+5.0VDC BITE RTN (VIDEO REG)	22	956	187	T186
4W1XA2-12	4W1XA6-52	+5.0VDC BITE RTN (AUX REG)	22	924	190	T189
4W1XA2-13	4W1J2->J	+5.0VDC BITE RTN (HEAD)	22	958	138	T137
4W1XA2-14	4W1J2->M	+5.0VDC BITE RTN (GUN)	22	968	140	T139
4W1XA2-15	4W1XA1-2	+5.0VDC BITE RTN (INVTR)	22	912	195	T194
4W1XA2-16	4W1J3-V	CONT BASE DR 2 TEST	22	98	161	T160
4W1XA2-17	4W1J3-T	CONT BASE DR 1 TEST	22	92	159	T161
4W1XA2-18	4W1XA10-30	18-30VDC RTN (OP CONT HI-C)	22	928	30	T29
4W1XA2-20	4W1XA8-1	18-30VDC UNREG (VR1-1)	22	90	32	T34
4W1XA2-21	4W1XA10-10	18-30VDC (OP CONT)	22	901	10	T11
4W1XA2-22	4W1XA1-3	+5.0VDC BITE (INVTR)	22	905	194	T195
4W1XA2-23	4W1J2->K	+5.0VDC BITE (GUN)	22	967	139	T140
4W1XA2-24	4W1J2->I	+5.0VDC BITE (HEAD)	22	957	137	T138
4W1XA2-25	4W1XA6-56	+5.0VDC BITE (AUX REG)	22	923	189	T190
4W1XA2-26	4W1XA5-38	+5.0VDC BITE (VIDEO REG)	22	948	186	T187
4W1XA2-27	4W1XA8-2	+5.0VDC BITE REG (VR1-2)	22	91	33	T32
4W1XA2-28	4W1J3-W	+5.0VDC BITE TEST	22	903	162	
4W1XA2-29	4W1XA8-16	CONT ERROR HI	22	907	46	T47
4W1XA2-30	4W1XA6-44	-15.0VDC (CONT)	22	925	191	T192
4W1XA3						
4W1XA3-1	4W1XA9-38	15.0VAC (LED)	22	908	62	T63
4W1XA3-2	4W1XA5-9	+12.5VDC RTN (LED)	22	945	175	T174
4W1XA3-3	4W1XA5-18	+12.5VDC (LED)	22	938	174	T175
4W1XA3-4	4W1XA9-39	15.0VAC RTN (LED)	22	912	63	T62
4W1XA3-7	4W1XA9-37	15.0VAC RTN (POST)	22	907	61	T60
4W1XA3-8	4W1XA5-8	+12.5VDC (POST)	22	936	172	T173
4W1XA3-9	4W1XA5-3	+12.5VDC RTN (POST)	22	937	173	T172
4W1XA3-10	4W1XA9-36	15.0VAC (POST)	22	906	60	T61
4W1XA3-11	4W1XA9-41	14.0VAC RTN	22	914	65	T64
4W1XA3-12	4W1XA9-40	14.0VAC	22	913	64	T65
4W1XA3-13	4W1XA5-19	-11.5VDC RTN	22	946	176	T177
4W1XA3-14	4W1XA5-43	-11.5VDC	22	947	177	T176
4W1XA3-17	4W1XA5-1	+13.0VDC	22	934	170	T171
4W1XA3-18	4W1XA5-30	+13.0VDC RTN	22	935	171	T170
4W1XA3-19	4W1XA9-35	15.5VAC RTN	22	92	59	T58
4W1XA3-20	4W1XA9-34	15.5VAC	22	91	58	T59
4W1XA4						
4W1XA4-1	4W1XA9-21	20.0VAC #1	22	918	70	T71
4W1XA4-2	4W1XA6-16	-17.5VDC	22	9014	184	T185
4W1XA4-3	4W1XA6-10	+17.5VDC RTN	22	9013	183	T182
4W1XA4-5	4W1XA6-14	+17.5VDC	22	9012	182	T183
4W1XA4-6	4W1XA9-23	20.0VAC #2	22	924	72	T73
4W1XA4-7	4W1XA9-24	20.0VAC RTN #2	22	925	73	T72
4W1XA4-8	4W1XA6-20	-17.5VDC RTN	22	9015	185	T184
4W1XA4-10	4W1XA6-1	-7.5VDC	22	968	180	T181
4W1XA4-11	4W1XA9-20	10.0VAC RTN #2	22	917	69	T68
4W1XA4-12	4W1XA9-19	10.0VAC #2	22	916	68	T69
4W1XA4-13	4W1XA9-5	25.0VAC (FB)	22	927	74	T75
4W1XA4-14	4W1XA9-22	20.0VAC RTN #1	22	923	71	T70
4W1XA4-15	4W1XA8-17	+22.5VDC (FB)	22	912	48	T49
4W1XA4-16	4W1XA9-6	25.0VAC RTN (FB)	22	928	75	T74
4W1XA4-17	4W1XA8-19	+22.5VDC RTN (FB)	22	913	49	T48

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TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1XA4- 20	4W1XA6- 50	+7.5VDC RTN	22	967	179	T178
4W1XA4- 21	4W1XA6- 29	+7.5VDC	22	958	178	T179
4W1XA4- 22	4W1XA9- 1	10.0VAC #1	22	90	66	T 67
4W1XA4- 23	4W1XA9- 18	10.0VAC RTN #1	22	915	67	T 66
4W1XA4- 24	4W1XA6- 8	-7.5VDC RTN	22	978	181	T180
4W1XA5- 1	4W1XA3- 17	+13.0VDC	22	934	170	T171
4W1XA5- 2	4W1XA7- 1	+10.5VDC UNREG (VR1-1)	22	90	85	T 87
4W1XA5- 3	4W1XA3- 9	+12.5VDC RTN (POST)	22	937	173	T172
4W1XA5- 4	4W1J2- H	+10.0VDC RTN (POST)	22	926	116	T115
4W1XA5- 5	4W1J3- D	+10.0VDC RTN TEST (POST)	22	908	146	T145
4W1XA5- 6	4W1XA7- 5	+10.0VDC (POST VR2-2)	22	94	89	T 88
4W1XA5- 7	4W1XA7- 6	VR2-CASE	22	95	90	T 89
4W1XA5- 8	4W1XA3- 8	+12.5VDC (POST)	22	936	172	T173
4W1XA5- 9	4W1XA3- 2	+12.5VDC RTN (LED)	22	945	175	T174
4W1XA5- 11	4W1J2- D	+10.0VDC RTN (LED #1)	22	918	112	T111
4W1XA5- 12	4W1J3- E	+10.0VDC TEST (LED)	22	912	147	T148
4W1XA5- 13	4W1J2- C	+10.0VDC (LED #1)	22	917	111	T112
4W1XA5- 14	4W1XA7- 8	+10.0VDC (LED VR3-2)	22	97	92	T 91
4W1XA5- 15	4W1XA6- 54	VID REG BITE	22	9016	188	
4W1XA5- 16	4W1XA7- 9	VR3-CASE	22	98	93	T 92
4W1XA5- 17	4W1XA7- 7	+10.0VDC UNREG (LED VR3-1)	22	96	91	T 93
4W1XA5- 18	4W1XA3- 3	+12.5VDC (LED)	22	938	174	T175
4W1XA5- 19	4W1XA3- 13	-11.5VDC RTN	22	946	176	T177
4W1XA5- 20	4W1XA7- 11	-9.0VDC (VR4-2)	22	902	95	T 94
4W1XA5- 21	4W1J2- J	-9.0VDC	22	927	117	T118
4W1XA5- 22	4W1XA7- 12	-9.0VDC UNREG (VR4-1)	22	903	96	T 95
4W1XA5- 23	4W1XA7- 3	VR1-CASE	22	92	87	T 86
4W1XA5- 24	4W1XA7- 2	+10.5VDC (VR1-2)	22	91	86	T 85
4W1XA5- 25	4W1J2- A	+10.5VDC	22	904	109	T110
4W1XA5- 26	4W1J3- A	+10.5VDC TEST	22	905	143	T144
4W1XA5- 27	4W1J2- G	+10.0VDC (POST)	22	925	115	T116
4W1XA5- 28	4W1J3- C	+10.0VDC TEST (POST)	22	907	145	T146
4W1XA5- 29	4W1XA7- 4	+10.0VDC UNREG (POST VR2-1)	22	93	88	T 90
4W1XA5- 30	4W1XA3- 18	+13.0VDC RTN	22	935	171	T170
4W1XA5- 31	4W1J2- B	+10.5VDC RTN	22	916	110	T109
4W1XA5- 32	4W1J3- B	+10.5VDC RTN TEST	22	906	144	T143
4W1XA5- 33	4W1J3- F	+10.0VDC RTN TEST (LED)	22	913	148	T147
4W1XA5- 34	4W1J2- F	+10.0VDC RTN (LED #2)	22	924	114	T113
4W1XA5- 35	4W1J2- E	+10.0VDC (LED #2)	22	923	113	T114
4W1XA5- 36	4W1XA2- 11	+5.0VDC BITE RTN (VIDEO REG)	22	956	187	T186
4W1XA5- 38	4W1XA2- 26	+5.0VDC BITE (VIDEO REG)	22	948	186	T187
4W1XA5- 39	4W1J2- K	-9.0VDC RTN	22	928	118	T117
4W1XA5- 40	4W1J3- H	-9.0VDC RTN TEST	22	915	150	T149
4W1XA5- 42	4W1J3- G	-9.0VDC TEST	22	914	149	T150
4W1XA5- 43	4W1XA3- 14	-11.5VDC	22	947	177	T176
4W1XA5- 44	4W1XA7- 10	VR4-CASE	22	901	94	T 96
4W1XA6- 1	4W1XA4- 10	-7.5VDC	22	968	180	T181
4W1XA6- 2	4W1XA7- 19	VR6-CASE	22	912	102	T101
4W1XA6- 3	4W1J3- L	-5.0VDC TEST	22	926	153	T154
4W1XA6- 4	4W1J2- T	-5.0VDC (SEG)	22	98	125	T126
4W1XA6- 5	4W1XA7- 18	-5.0VDC RTN (VR6-2)	22	908	101	T100
4W1XA6- 6	4W1J2- U	-5.0VDC RTN (SEG)	22	901	126	T125
4W1XA6- 7	4W1J3- M	-5.0VDC RTN TEST	22	927	154	T153
4W1XA6- 8	4W1XA4- 24	-7.5VDC RTN	22	978	181	T180
4W1XA6- 9	4W1XA7- 17	-5.0VDC UNREG (VR6-1)	22	907	100	T102
4W1XA6- 10	4W1XA4- 3	+17.5VDC RTN	22	9013	183	T182
4W1XA6- 11	4W1XA7- 22	VR7-CASE	22	915	105	T104
4W1XA6- 12	4W1J2- W	+15.0VDC RTN (HEAD)	22	903	128	T127
4W1XA6- 13	4W1XA7- 21	+15.0VDC (VR7-2)	22	914	104	T103
4W1XA6- 14	4W1XA4- 5	+17.5VDC	22	9012	182	T183
4W1XA6- 15	4W1XA7- 20	+15.0VDC UNREG (VR7-1)	22	913	103	T105

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TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1XA6-16	4W1XA4-2	-17.5VDC	22	9014	184	T185
4W1XA6-17	4W1XA7-25	VR8-CASE	22	918	108	T107
4W1XA6-18	4W1XA7-24	-15.0VDC RTN (VR8-2)	22	917	107	T106
4W1XA6-19	4W1J2-Y	-15.0VDC RTN (HEAD)	22	936	130	T129
4W1XA6-20	4W1XA4-8	-17.5VDC RTN	22	9015	185	T184
4W1XA6-21	4W1J2->F	CABLE FAIL	22	956	136	
4W1XA6-24	4W1J2-Z	CMDR CABLE BITE	22	937	131	
4W1XA6-26	4W1J2->A	CMDR INTLK	22	938	132	
4W1XA6-27	4W1J2->B	HEAD CABLE BITE	22	945	133	
4W1XA6-29	4W1XA4-21	+7.5VDC	22	958	178	T179
4W1XA6-30	4W1XA7-14	+5.0VDC UNREG (VR5-1)	22	904	97	T 99
4W1XA6-31	4W1XA7-15	+5.0VDC (VR5-2)	22	905	98	T 97
4W1XA6-32	4W1J2-L	+5.0VDC (SEL)	22	90	119	T120
4W1XA6-33	4W1J2-N	+5.0VDC (I2 GUN)	22	92	121	T122
4W1XA6-34	4W1J2-R	+5.0VDC (I2 CMDR)	22	95	123	T124
4W1XA6-35	4W1J3-J	+5.0VDC TEST	22	93	151	T152
4W1XA6-36	4W1J2-M	+5.0VDC (SEL)	22	91	120	T119
4W1XA6-37	4W1J2-P	+5.0VDC RTN (I2 GUN)	22	94	122	T121
4W1XA6-38	4W1J2-S	+5.0VDC RTN (I2 CMDR)	22	97	124	T123
4W1XA6-39	4W1J3-K	+5.0VDC RTN TEST	22	96	152	T151
4W1XA6-40	4W1J3-P	+15.0VDC RTN TEST	22	934	156	T155
4W1XA6-41	4W1J2-V	+15.0VDC (HEAD)	22	902	127	T128
4W1XA6-42	4W1J3-N	+15.0VDC TEST	22	928	155	T156
4W1XA6-43	4W1J2-X	-15.0VDC (HEAD)	22	935	129	T130
4W1XA6-44	4W1XA2-30	-15.0VDC (CONT)	22	925	191	T192
4W1XA6-45	4W1J3-R	-15.0VDC TEST	22	948	157	T158
4W1XA6-46	4W1XA2-8	-15.0VDC RTN (CONT)	22	9017	192	T191
4W1XA6-47	4W1J3-S	-15.0VDC RTN TEST	22	957	158	T157
4W1XA6-48	4W1XA7-23	-15.0VDC UNREG (VR8-1)	22	916	106	T108
4W1XA6-49	4W1XA7-16	VR5-CASE	22	906	99	T 98
4W1XA6-50	4W1XA4-20	+7.5VDC RTN	22	967	179	T178
4W1XA6-51	4W1J2->E	POWER CONV FAIL #1	22	947	135	
4W1XA6-52	4W1XA2-12	+5.0VDC BITE RTN (AUX REG)	22	924	190	T189
4W1XA6-53	4W1J2->D	+5.0VDC BITE RTN (CMDR)	22	946	134	
4W1XA6-54	4W1XA5-15	VID REG BITE	22	9016	188	
4W1XA6-55	4W1XA1-1	INVTR BITE	22	9018	193	
4W1XA6-56	4W1XA2-25	+5.0VDC BITE (AUX REG)	22	923	189	T190
4W1XA7-1	4W1XA5-2	+10.5VDC UNREG (VR1-1)	22	90	85	T 87
4W1XA7-2	4W1XA5-24	+10.5VDC (VR1-2)	22	91	86	T 85
4W1XA7-3	4W1XA5-23	VR1-CASE	22	92	87	T 86
4W1XA7-4	4W1XA5-29	+10.0VDC UNREG (POST VR2-1)	22	93	88	T 90
4W1XA7-5	4W1XA5-6	+10.0VDC (POST VR2-2)	22	94	89	T 88
4W1XA7-6	4W1XA5-7	VR2-CASE	22	95	90	T 89
4W1XA7-7	4W1XA5-17	+10.0VDC UNREG (LED VR3-1)	22	96	91	T 93
4W1XA7-8	4W1XA5-14	+10.0VDC (LED VR3-2)	22	97	92	T 91
4W1XA7-9	4W1XA5-16	VR3-CASE	22	98	93	T 92
4W1XA7-10	4W1XA5-44	VR4-CASE	22	901	94	T 96
4W1XA7-11	4W1XA5-20	-9.0VDC (VR4-2)	22	902	95	T 94
4W1XA7-12	4W1XA5-22	-9.0VDC UNREG (VR4-1)	22	903	96	T 95
4W1XA7-14	4W1XA6-30	+5.0VDC UNREG (VR5-1)	22	904	97	T 99
4W1XA7-15	4W1XA6-31	+5.0VDC (VR5-2)	22	905	98	T 97
4W1XA7-16	4W1XA6-49	VR5-CASE	22	906	99	T 98
4W1XA7-17	4W1XA6-9	-5.0VDC UNREG (VR6-1)	22	907	100	T102
4W1XA7-18	4W1XA6-5	-5.0VDC RTN (VR6-2)	22	908	101	T100
4W1XA7-19	4W1XA6-2	VR6-CASE	22	912	102	T101
4W1XA7-20	4W1XA6-15	+15.0VDC UNREG (VR7-1)	22	913	103	T105
4W1XA7-21	4W1XA6-13	+15.0VDC (VR7-2)	22	914	104	T103
4W1XA7-22	4W1XA6-11	VR7-CASE	22	915	105	T104
4W1XA7-23	4W1XA6-48	-15.0VDC UNREG (VR8-1)	22	916	106	T108
4W1XA7-24	4W1XA6-18	-15.0VDC RTN (VR8-2)	22	917	107	T106
4W1XA7-25	4W1XA6-17	VR8-CASE	22	918	108	T107

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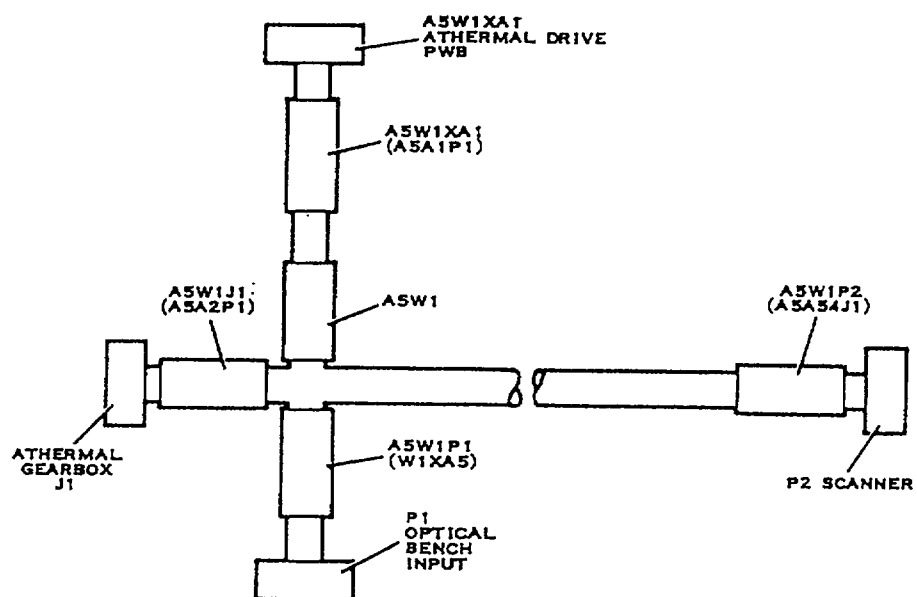
TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1XA8						
4W1XA8-1	4W1XA2-20	18-30VDC UNREG (VR1-1)	22	90	32	T 34
4W1XA8-2	4W1XA2-27	+5.0VDC BITE REG (VR1-2)	22	91	33	T 32
4W1XA8-3	4W1XA2-10	+5.0VDC BITE RTN (VR1-CASE)	22	93	34	T 33
4W1XA8-4	4W1XA9-2	CONT DR T1-1	20	97	35	T 37
4W1XA8-5	4W1XA2-5	CONT BASE DR 1	22	94	38	T 40
4W1XA8-7	4W1XA2-2	CONT DR CT	22	95	39	T 38
4W1XA8-8	4W1XA9-4	CONT EMIT LO	20	98	36	T 35
4W1XA8-9	4W1XA2-4	CONT BASE DR 2	22	96	40	T 39
4W1XA8-10	4W1XA9-3	CONT DR T1-3	20	901	37	T 36
4W1XA8-11	4W1XA9-17	INVTR DR T2-1	20	902	41	T 42
4W1XA8-12	4W1XA1-10	INVTR BASE DR 1	22	903	43	T 45
4W1XA8-13	4W1XA1-6	INVTR DR CT	22	904	44	T 43
4W1XA8-14	4W1XA1-9	INVTR BASE DR 2	22	906	45	T 44
4W1XA8-15	4W1XA9-33	INVTR DR T2-3	20	905	42	T 41
4W1XA8-16	4W1XA2-29	CONT ERROR HI	22	907	46	T 47
4W1XA8-17	4W1XA4-15	+22.5VDC (FB)	22	912	48	T 49
4W1XA8-18	4W1XA2-7	CONT ERROR LO	22	908	47	T 46
4W1XA8-19	4W1XA4-17	+22.5VDC RTN (FB)	22	913	49	T 48
4W1XA8-20	4W1XA1-14	SW REG #1	22	914	50	T 51
4W1XA8-21	4W1XA1-15	SW REG #2	22	916	52	T 53
4W1XA8-23	4W1XA1-27	DIODE GND #1	22	915	51	T 50
4W1XA8-24	4W1XA1-28	DIODE GND #2	22	917	53	T 52
4W1XA8-25	4W1XA1-33	SW REG FB (PASS Q5-E)	22	918	54	
4W1XA8-26	4W1XA1-36	SW REG (PASS Q5-B)	22	923	55	
4W1XA8-27	4W1XA1-17	SW REG (PASS Q5-C #1)	22	924	56	T 57
4W1XA8-28	4W1XA1-18	SW REG (PASS Q5-C #2)	22	925	57	T 56
4W1XA8-32	4W1XA9-16	INVTR EMIT LO	20	956	196	
4W1XA9						
4W1XA9-1	4W1XA4-22	10.0VAC #1	22	90	66	T 67
4W1XA9-2	4W1XA8-4	CONT DR T1-1	20	97	35	T 37
4W1XA9-3	4W1XA8-10	CONT DR T1-3	20	901	37	T 36
4W1XA9-4	4W1XA8-8	CONT EMIT LO	20	98	36	T 35
4W1XA9-5	4W1XA4-13	25.0VAC (FB)	22	927	74	T 75
4W1XA9-6	4W1XA4-16	25.0VAC RTN (FB)	22	928	75	T 74
4W1XA9-7	4W1XA10-12	18-30VDC (OP XFORMER)	20	903	12	T 13
4W1XA9-8	4W1XA10-13	18-30VDC RTN (OP XFORMER)	20	904	13	T 12
4W1XA9-14	4W1XA1-19	PH A XFORMER BITE	22	946	81	T 82
4W1XA9-15	4W1XA1-21	NEUT XFORMER BITE	22	947	82	T 81
4W1XA9-16	4W1XA8-32	INVTR EMIT LO	20	956	196	
4W1XA9-17	4W1XA8-11	INVTR DR T2-1	20	902	41	T 42
4W1XA9-18	4W1XA4-23	10.0VAC RTN #1	22	915	67	T 66
4W1XA9-19	4W1XA4-12	10.0VAC #2	22	916	68	T 69
4W1XA9-20	4W1XA4-11	10.0VAC RTN #2	22	917	69	T 68
4W1XA9-21	4W1XA4-1	20.0VAC #1	22	918	70	T 71
4W1XA9-22	4W1XA4-14	20.0VAC RTN #1	22	923	71	T 70
4W1XA9-23	4W1XA4-6	20.0VAC #2	22	924	72	T 73
4W1XA9-24	4W1XA4-7	20.0VAC RTN #2	22	925	73	T 72
4W1XA9-25	4W1XA10-28	18-30VDC (STBY COOLER START)	20	926	28	
4W1XA9-27	4W1XA1-31	+14.0VDC #1	22	935	76	T 77
4W1XA9-28	4W1XA1-23	+14.0VDC RTN #1	22	936	77	T 76
4W1XA9-29	4W1J2-35	JACKET FOR WIRE NO 83		934	83	S 83
4W1XA9-30	4W1J2-37	FAN PH A	20	9	83A	
4W1XA9-31	4W1J2-38	FAN PH B	20	96	83B	
4W1XA9-32	4W1J2-39	FAN NEUT	20	93	83C	
4W1XA9-33	SHIELD 83	FAN SHIELD	22	9	83S	
4W1XA9-34	4W1XA8-15	INVTR DR T2-3	20	905	42	T 41
4W1XA9-35	4W1XA3-20	15.5VAC	22	91	58	T 59
4W1XA9-36	4W1XA3-19	15.5VAC RTN	22	92	59	T 58
4W1XA9-37	4W1XA3-10	15.0VAC (POST)	22	906	60	T 61
4W1XA9-38	4W1XA3-7	15.0VAC RTN (POST)	22	907	61	T 60
4W1XA9-39	4W1XA3-1	15.0VAC (LED)	22	908	62	T 63
4W1XA9-39	4W1XA3-4	15.0VAC RTN (LED)	22	912	63	T 62

TABLE 3-2. CONTINUITY CHECKS-POWER CONVERTER HARNESS (CONTINUED) (FIG. 3-6).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
4W1XA9-40	4W1XA3-12	14.0VAC	22	913	64	T 65
4W1XA9-41	4W1XA3-11	14.0VAC RTN	22	914	65	T 64
4W1XA9-42	4W1XA1-12	TIMER CMD	22	945	80	
4W1XA9-43	4W1XA1-32	+14.0VDC #2	22	937	78	T 79
4W1XA9-44	4W1XA1-24	+14.0VDC RTN #2	22	938	79	T 78
4W1XA9-45	4W1J2- >N	JACKET FOR WIRE NO 84		948	84	S 84
4W1XA9-46	4W1J2- >P	COOLER PH A	20	9	84A	
4W1XA9-47	4W1J2- >Q	COOLER PH B	20	96	84B	
4W1XA9-48	SHIELD 84	COOLER NEUT	20	93	84C	
4W1XA9-49	4W1XA10-4	COOLER SHIELD	22	9	84S	
4W1XA9-50	4W1XA10-5	PH A ETN XFORMER	20	94	4	T 5
		NEUT ETN XFORMER	20	95	5	T 4
4W1XA10-4	4W1XA9-49	PH A ETN XFORMER	20	94	4	T 5
4W1XA10-5	4W1XA9-50	NEUT ETN XFORMER	20	95	5	T 4
4W1XA10-6	4W1XA1-34	18-30VDC (STBY INVTR #1)	22	93	6	T 7
4W1XA10-7	4W1XA1-25	18-30VDC RTN (STBY INVTR #1)	22	96	7	T 6
4W1XA10-8	4W1XA1-35	18-30VDC (STBY INVTR #2)	22	97	8	T 9
4W1XA10-9	4W1XA1-26	18-30VDC RTN (STBY INVTR #2)	22	98	9	T 8
4W1XA10-10	4W1XA2-21	18-30VDC (OP CONT)	22	901	10	T 11
4W1XA10-11	4W1XA2-9	18-30VDC RTN (OP CONT)	22	902	11	T 10
4W1XA10-12	4W1XA9-7	18-30VDC (OP XFORMER)	20	903	12	T 13
4W1XA10-13	4W1XA9-8	18-30VDC RTN (OP XFORMER)	20	904	13	T 12
4W1XA10-14	4W1J2- >Y	18-30VDC RTN (STBY GUN)	20	905	14	T 15
4W1XA10-15	4W1J2- >Z	18-30VDC (STBY GUN)	20	906	15	T 14
4W1XA10-16	4W1J2-AA	18-30VDC (OP GUN)	20	907	16	T 17
4W1XA10-17	4W1J2-BB	18-30VDC RTN (OP GUN)	20	908	17	T 16
4W1XA10-18	4W1J2-CC	18-30VDC (OP CMOR)	20	912	18	T 19
4W1XA10-19	4W1J2-DD	18-30VDC RTN (OP CMOR)	20	913	19	T 18
4W1XA10-20	4W1J2->W	STBY CMD	20	914	20	
4W1XA10-21	4W1J2->X	OP CMD	20	915	21	
4W1XA10-22	4W1J3->G	STBY CMD TEST	20	916	22	
4W1XA10-23	4W1J3->H	OP CMD TEST	20	917	23	
4W1XA10-24	4W1J3->I	18-30VDC (STBY TEST)	20	918	24	
4W1XA10-25	4W1J3->J	18-30VDC (OP TEST)	20	923	25	
4W1XA10-26	4W1J3->K	18-30VDC TEST	20	924	26	T 27
4W1XA10-27	4W1J3->M	18-30VDC RTN TEST	20	925	27	T 26
4W1XA10-28	4W1XA9-25	18-30VDC (STBY COOLER START)	20	926	28	
4W1XA10-29	4W1XA2-3	18-30VDC (OP CONT HI-C)	22	927	29	T 30
4W1XA10-30	4W1XA2-18	18-30VDC RTN (OP CONT HI-C)	22	928	30	T 29
4W1XA10-31	4W1XA1-16	INVTR STBY CURRENT SENSE	22	934	31	
4W1XA10-32	4W1XA1-30	+14.0VDC PROTECT (INVTR SW REG)	22	957	198	T 199
4W1XA10-33	4W1XA1-29	+14.0VDC PICTRTN (INVTR SW REG)	22	968	199	T 198

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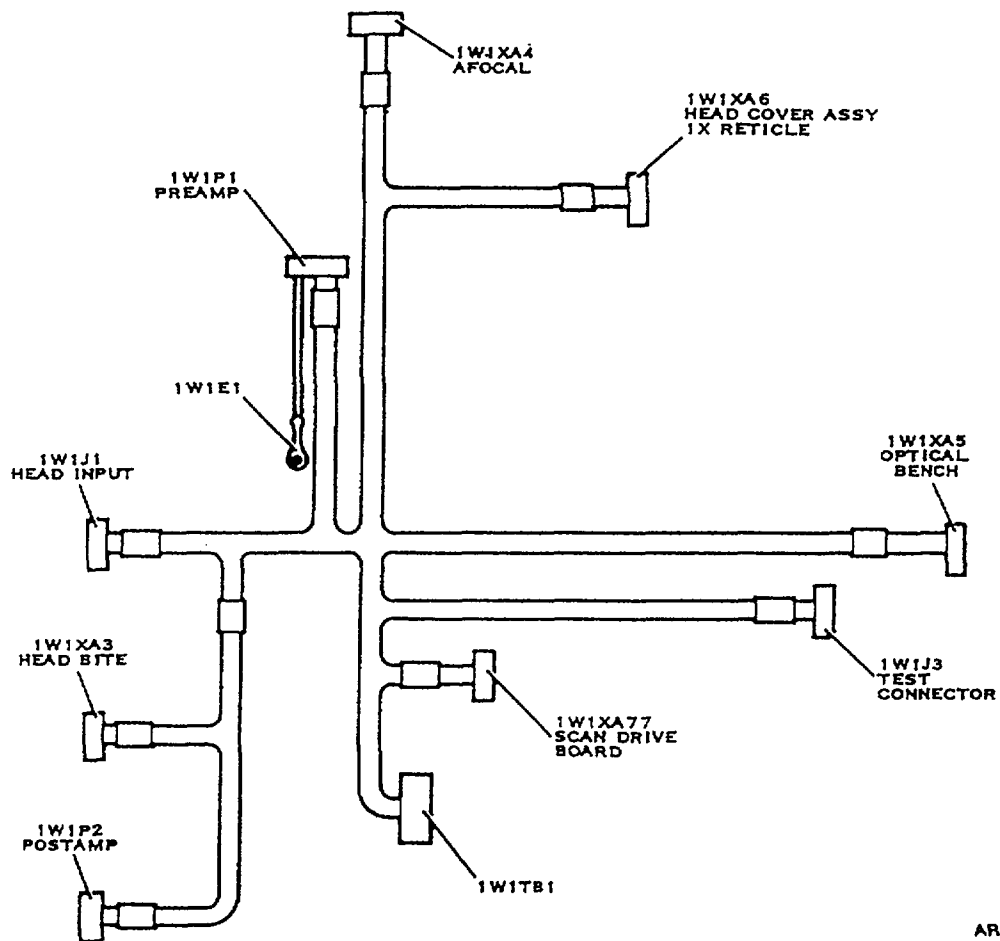
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Figure 3-7. Connector locations for optical bench cable assembly.

TABLE 3-2. CONTINUITY CHECKS-
OPTICAL BENCH CABLE. PREFIX ALL TEST POINTS 1A5W1 (FIG. 3-7).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
J1						
J1- 5	XA1- 6	POT RTN	22	97	23	T 22
J1- 6	XA1- 4	POT HI	22	96	22	T 23
J1- 8	XA1- 8	HTR HI M2	22	95	21	T 20
J1- 9	XA1- 14	HTR LO M1	22	94	20	T 21
P1						
P1- 2	P2- 17	INTERLACE SOL #2 LO	22	907	16	T 7
P1- 3	P2- 7	INTERLACE SOL #2 HI	22	96	7	T 16
P1- 5	P2- 9	SCAN HTR DRV LO #1	22	98	9	T 18
P1- 6	P2- 19	SCAN HTR DRV HI #1	22	912	18	T 9
P1- 7	P2- 1	SCAN POS XDCR LO	22	94	5	T 6
P1- 8	P2- 2	SCAN POS XDCR HI	22	95	6	T 5
P1- 11	P2- 18	INTERLACE SOL #1 LO	22	908	17	T 8
P1- 12	P2- 8	INTERLACE SOL #1 HI	22	97	8	T 17
P1- 13	P2- 10	SCAN HTR DRV LO #2	22	901	10	T 19
P1- 14	P2- 20	SCAN HTR DRV HI #2	22	913	19	T 10
P1- 15	P2- 12	SCAN MOD BRIDGE HI	22	903	12	T 11
P1- 16	P2- 11	SCAN MOD BRIDGE LO	22	902	11	T 12
P1- 17	SHIELD CA		22	9	24	
P1- 18	P2- 16	CHASSIS GND	22	906	15	
P1- 20	XA1- 2	+15 VDC	22	90	1	T 2
P1- 21	XA1- 5	+15 VDC RTN	22	91	2	T 1
P1- 22	XA1- 1	-15 VDC	22	92	3	T 4
P1- 23	XA1- 11	-15 VDC RTN	22	93	4	T 3
P1- 24	P2- 13	INTERLACE POS XDCR LO	22	904	13	T 14
P1- 25	P2- 14	INTERLACE POS XDCR HI	22	905	14	T 13
P2						
P2- 1	P1- 7	SCAN POS XDCR LO	22	94	5	T 6
P2- 2	P1- 8	SCAN POS XDCR HI	22	95	6	T 5
P2- 7	P1- 3	INTERLACE SOL #2 HI	22	96	7	T 16
P2- 8	P1- 12	INTERLACE SOL #1 HI	22	97	8	T 17
P2- 9	P1- 5	SCAN HTR DRV LO #1	22	98	9	T 18
P2- 10	P1- 13	SCAN HTR DRV LO #2	22	901	10	T 19
P2- 11	P1- 16	SCAN MOD BRIDGE LO	22	902	11	T 12
P2- 12	P1- 15	SCAN MOD BRIDGE HI	22	903	12	T 11
P2- 13	P1- 24	INTERLACE POS XDCR LO	22	904	13	T 14
P2- 14	P1- 25	INTERLACE POS XDCR HI	22	905	14	T 13
P2- 16	P1- 18	CHASSIS GND	22	906	15	
P2- 17	P1- 2	INTERLACE SOL #2 LO	22	907	16	T 7
P2- 18	P1- 11	INTERLACE SOL #1 LO	22	908	17	T 8
P2- 19	P1- 6	SCAN HTR DRV HI #1	22	912	18	T 9
P2- 20	P1- 14	SCAN HTR DRV HI #2	22	913	19	T 10
XA1						
XA1- 1	P1- 22	-15 VDC	22	92	3	T 4
XA1- 2	P1- 20	+15 VDC	22	90	1	T 2
XA1- 4	J1- 6	POT HI	22	96	22	T 23
XA1- 5	P1- 21	+15 VDC RTN	22	91	2	T 1
XA1- 6	J1- 5	POT RTN	22	97	23	T 22
XA1- 8	J1- 8	HTR HI M2	22	95	21	T 20
XA1- 11	P1- 23	-15 VDC RTN	22	93	4	T 3
XA1- 14	J1- 9	HTR LO M1	22	94	20	T 21

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Figure 3-8. Connectors locations for head harness.

TABLE 3-2. CONTINUITY CHECKS-

HEAD WIRE HARNESS.

PREFIX ALL TEST POINTS 1W1 (FIG. 3-8).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
J1						
J1- A	P1- 1	+10.5VDC (PRE AMP)	22	90	1	T 2
J1- B	P1- 5	+10.5VDC RTN (PRE AMP)	22	91	2	T 1
J1- C	XA4- 3	FOV CMD RTN (C)	24	978	45	T 44
J1- D	XA4- 7	NFOV CMD (NC)	24	9012	46	T 47
J1- E	XA6- 3	1X RETICLE HI	24	967	43	T 44
J1- F	XA6- 7	1X RETICLE LO	24	968	44	T 43
J1- G	XA3- 41	COMMANDER LEVEL HI	24	928	30	T 31
J1- H	XA3- 17	COMMANDER LEVEL	24	934	31	T 32
J1- J	XA3- 44	COMMANDER LEVEL LO	24	935	32	T 30
J1- K	XA3- 34	CMOR POLARITY RTN	24	946	37	T 36
J1- L	P2- 29	+10.0VDC (LED #2)	22	96	7	T 8
J1- M	P2- 14	+10.0VDC RTN (LED #2)	22	97	8	T 7
J1- N	P2- 30	+10.0VDC (LED #1)	22	92	3	T 4
J1- P	P2- 15	+10.0VDC RTN (LED #1)	22	93	4	T 3
J1- R	XA3- 54	DET COOLING LIGHT #1	22	9018	52	
J1- S	TB1- 1	+15.0VDC (HEAD)	22	908	17	T 18
J1- T	TB1- 2	+15.0VDC RTN (HEAD)	22	912	18	T 17
J1- U	TB1- 5	+5VDC	22	9016	50	T 51
J1- W	XA3- 25	+18 TO +30VDC	24	9014	48	
J1- X	E2	+18 TO +30VDC RTN	24	9015	49	
J1- Y	XA4- 8	WFOV CMD (ND)	24	9013	47	T 45
J1- Z	XA3- 12	GUNNER GAIN HI	24	915	21	T 22
J1- >A	XA3- 11	COMMANDER GAIN HI	24	918	24	T 25
J1- >B	XA3- 40	GUNNER LEVEL HI	24	925	27	T 28
J1- >C	XA3- 18	GUNNER LEVEL	24	926	28	T 29
J1- >D	XA3- 43	GUNNER LEVEL LO	24	927	29	T 27
J1- >E	XA3- 23	CMOR POLARITY CMD	24	945	36	T 37
J1- >F	XA3- 45	GUNNER POLARITY RTN	24	956	40	T 39
J1- >G	P2- 1	+10.0VDC (POST AMP)	22	98	9	T 10
J1- >H	P2- 7	+10.0VDC RTN (POST AMP)	22	901	10	T 9
J1- >I	P2- 12	-9.0VDC (POST AMP)	22	94	5	T 6
J1- >J	TB1- 6	+5VDC RTN	22	9017	51	T 50
J1- >K	TB1- 8	-5.0VDC (S & I)	22	906	15	T 16
J1- >M	TB1- 7	-5.0VDC RTN (S & I)	22	907	16	T 15
J1- >N	TB1- 5	+5.0VDC (S & I)	22	904	13	T 14
J1- >P	TB1- 6	+5.0VDC RTN (S & I)	22	905	14	T 13
J1- >Q	XA77- 7	SCAN MALF	24	936	33	
J1- >R	XA3- 19	+5.0VDC 8ITE (HEAD)	22	902	11	T 12
J1- >S	XA3- 21	GUNNER GAIN	24	916	22	T 23
J1- >T	XA3- 20	COMMANDER GAIN	24	923	25	T 26
J1- >U	XA3- 36	COMMANDER GAIN LO	24	924	26	T 24
J1- >V	XA3- 22	GUNNER POLARITY CMD	24	948	39	T 40
J1- >W	XA3- 46	CMOR INTERLOCK RTN	24	938	35	T 34
J1- >X	P2- 21	-9.0VDC RTN (POST AMP)	22	95	6	T 5
J1- >Y	TB1- 4	-15.0VDC (HEAD)	22	913	19	T 20
J1- >Z	TB1- 3	-15.0VDC RTN (HEAD)	22	914	20	T 19
J1- CC	XA3- 14	+5.0VDC 8ITE RTN (HEAD)	22	903	12	T 11
J1- DD	XA3- 37	GUNNER GAIN LO	24	917	23	T 21
J1- EE	XA3- 49	CMOR INTERLOCK	24	937	34	T 35
J1- FF	XA3- 48	WHITE HOT CMD	24	957	41	T 42
J1- GG	XA3- 15	HEAD CABLE 8ITE	24	947	38	
J1- HH	XA3- 47	BLACK HOT CMD	24	958	42	T 41
P1						
P1- 1	J1- A	+10.5VDC (PRE AMP)	22	90	1	T 2
P1- 2	E1	VIDEO GND	22	9	107	
P1- 3	E1	VIDEO GND	22	9	108	
P1- 4	E1	VIDEO GND	22	9	109	
P1- 5	J1- B	+10.5VDC RTN (PRE AMP)	22	91	2	T 1
P1- 7	XA3- 27	TEMP SENSE HI	24	9015	117	T 118
P1- 8	XA3- 29	+10.5VDC (PRE AMP 8ITE)	24	92	53	T 54
P1- 9	E1	VIDEO GND	22	9	110	
P1- 10	E1	VIDEO GND	22	9	111	

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TABLE 3-2. CONTINUITY CHECKS-

HEAD WIRE HARNESS. (CONTINUED) PREFIX ALL TEST POINTS 1W1 (FIG. 3-8).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
P1- 11	E1	VIDEO GND	22	9	112	
P1- 12	XA3- 33	+10.5VDC RTN (PRE AMP BITE)	24	93	54	T 53
P1- 14	XA3- 51	TEMP SENSE LO	24	9014	118	T117
P2						
P2- 1	J1- >G	+10.0VDC (POST AMP)	22	98	9	T 10
P2- 2	XA3- 52	POLARITY LO	24	978	68	T 67
P2- 3	XA3- 38	IR GAIN LO	24	913	63	T 61
P2- 4	XA3- 13	IR GAIN HI	24	908	61	T 62
P2- 5	XA3- 39	IR LEVEL HI	24	914	64	T 65
P2- 6	XA3- 53	POLARITY HI	24	968	67	T 68
P2- 7	J1- >H	+10.0VDC RTN (POST AMP)	22	901	10	T 9
P2- 11	XA3- 31	+10VDC RTN (POST AMP BITE)	24	907	60	T 59
P2- 12	J1- >I	-9.0VDC (POST AMP)	22	94	5	T 6
P2- 13	XA3- 32	+10VDC RTN (EMITTER BITE)	24	91	56	T 55
P2- 14	J1- M	+10.0VDC RTN (LED #2)	22	97	8	T 7
P2- 15	J1- P	+10.0VDC RTN (LED #1)	22	93	4	T 3
P2- 16	XA3- 1	+10VDC (POST AMP BITE)	24	906	59	T 60
P2- 17	J3- 1	VIDEO GATE LO	24	902	69	T 70
P2- 18	XA3- 50	IR GAIN CONTROL	24	912	62	T 63
P2- 19	XA3- 16	IR LEVEL CONTROL	24	936	65	T 66
P2- 20	XA3- 42	IR LEVEL LO	24	967	66	T 64
P2- 21	J1- >X	-9.0VDC RTN (POST AMP)	22	95	6	T 5
P2- 25	XA3- 30	-9VDC RTN (POST AMP BITE)	24	905	58	T 57
P2- 26	J3- 2	VIDEO GATE HI	24	903	70	T 69
P2- 27	XA3- 2	-9VDC (POST AMP BITE)	24	904	57	T 58
P2- 28	XA3- 28	+10VDC (EMITTER BITE)	24	90	55	T 56
P2- 29	J1- L	+10.0VDC (LED #2)	22	96	7	T 8
P2- 30	J1- N	+10.0VDC (LED #1)	22	92	3	T 4
XA3						
XA3- 1	P2- 16	+10VDC (POST AMP BITE)	24	906	59	T 60
XA3- 2	P2- 27	-9VDC (POST AMP BITE)	24	904	57	T 58
XA3- 3	TB1- 6	+5VDC RTN (SCAN BITE)	24	95	90	T 89
XA3- 4	TB1- 7	-5VDC RTN (SCAN BITE)	24	97	92	T 91
XA3- 5	TB1- 3	-15VDC RTN (SCAN BITE)	24	9013	96	T 95
XA3- 6	TB1- 5	+5VDC (SCAN BITE)	24	94	89	T 90
XA3- 7	TB1- 2	+15VDC RTN (SCAN BITE)	24	901	94	T 93
XA3- 8	TB1- 1	-5VDC (SCAN BITE)	24	96	91	T 92
XA3- 9	TB1- 4	+15VDC (SCAN BITE)	24	98	93	T 94
XA3- 10	TB1- 4	-15VDC (SCAN BITE)	24	9012	95	T 96
XA3- 11	J1- >A	COMMANDER GAIN HI	24	918	24	T 25
XA3- 12	J1- 2	GUNNER GAIN HI	24	915	21	T 22
XA3- 13	P2- 4	IR GAIN HI	24	908	61	T 62
XA3- 14	J1- CC	+5.0VDC BITE RTN (HEAD)	22	903	12	T 11
XA3- 15	J1- GG	HEAD CABLE BITE	24	947	38	
XA3- 16	P2- 19	IR LEVEL CONTROL	24	936	65	T 66
XA3- 17	J1- H	COMMANDER LEVEL	24	934	31	T 32
XA3- 18	J1- >C	GUNNER LEVEL	24	926	28	T 29
XA3- 19	J1- >R	+5.0VDC BITE (HEAD)	22	902	11	T 12
XA3- 20	J1- >T	COMMANDER GAIN	24	923	25	T 26
XA3- 21	J1- >S	GUNNER GAIN	24	916	22	T 23
XA3- 22	J1- >V	GUNNER POLARITY CMD	24	948	39	T 40
XA3- 23	J1- >E	CHDR POLARITY CMD	24	945	36	T 37
XA3- 24	E2	+18 TO 30VDC RTN	24	9015	121	
XA3- 25	J1- W	+18 TO +30VDC	24	9014	48	
XA3- 27	P1- 7	TEMP SENSE HI	24	9015	117	T118
XA3- 28	P2- 28	+10VDC (EMITTER BITE)	24	90	55	T 54
XA3- 29	P1- 8	+10.5VDC (PRE AMP BITE)	24	92	53	T 54
XA3- 30	P2- 25	-9VDC RTN (POST AMP BITE)	24	905	58	T 57
XA3- 31	P2- 11	+10VDC RTN (POST AMP BITE)	24	907	60	T 59
XA3- 32	P2- 13	+10VDC RTN (EMITTER BITE)	24	91	56	T 55
XA3- 33	P1- 12	+10.5VDC RTN (PRE AMP BITE)	24	93	54	T 53
XA3- 34	J1- K	CHDR POLARITY RTN	24	946	37	T 36
XA3- 36	J1- >U	COMMANDER GAIN LO	24	924	26	T 24

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TABLE 3-2. CONTINUITY CHECKS-

HEAD WIRE HARNESS. (CONTINUED) PREFIX ALL TEST POINTS IW1 (FIG. 3-8).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
XA3- 37	J1- 00	GUNNER GAIN LO	24	917	23	T 21
XA3- 38	P2- 3	IR GAIN LO	24	913	63	T 61
XA3- 39	P2- 5	IR LEVEL HI	24	914	64	T 65
XA3- 40	J1- >B	GUNNER LEVEL HI	24	925	27	T 28
XA3- 41	J1- G	COMMANDER LEVEL HI	24	928	30	T 31
XA3- 42	P2- 20	IR LEVEL LO	24	967	66	T 64
XA3- 43	J1- >D	GUNNER LEVEL LO	24	927	29	T 27
XA3- 44	J1- J	COMMANDER LEVEL LO	24	935	32	T 30
XA3- 45	J1- >F	GUNNER POLARITY RTN	24	956	40	T 39
XA3- 46	J1- >W	CMOR INTERLOCK RTN	24	938	35	T 34
XA3- 47	J1- HH	BLACK HOT CMD	24	958	42	T 41
XA3- 48	J1- FF	WHITE HOT CMD	24	957	41	T 42
XA3- 49	J1- EE	CMOR INTERLOCK	24	937	34	T 35
XA3- 50	P2- 18	IR GAIN CONTROL	24	912	62	T 63
XA3- 51	P1- 14	TEMP SENSE LO	24	9014	118	T117
XA3- 52	P2- 2	POLARITY LO	24	978	68	T 67
XA3- 53	P2- 6	POLARITY HI	24	968	67	T 68
XA3- 54	J1- R	DET COOLING LIGHT #1	22	9018	52	
T81						
T81- 1	XA3- 8	-5VDC (SCAN BITE)	24	96	91	T 92
T81- 1	XA5- 20	+15VDC	22	902	83	T 84
T81- 1	XA77- 23	+15VDC	22	925	102	T103
T81- 1	J1- 5	+15.0VDC (HEAD)	22	908	17	T 18
T81- 1	XA3- 9	+15VDC (SCAN BITE)	24	98	93	T 94
T81- 2	XA3- 7	+15VDC RTN (SCAN BITE)	24	901	94	T 93
T81- 2	T81- 3	JUMPER	22	805	115	
T81- 2	XA77- 26	+/-15VDC	22	926	103	T104
T81- 2	J1- 7	+15.0VDC RTN (HEAD)	22	912	18	T 17
T81- 2	XA5- 21	+15VDC RTN	22	903	84	T 83
T81- 3	J1- >Z	-15.0VDC RTN (HEAD)	22	914	20	T 19
T81- 3	XA5- 23	-15VDC RTN	22	916	86	T 85
T81- 3	XA3- 5	-15VDC RTN (SCAN BITE)	24	9013	96	T 95
T81- 3	T81- 2	JUMPER	22	805	115	
T81- 4	J1- >Y	-15.0VDC (HEAD)	22	913	19	T 20
T81- 4	XA3- 10	-15VDC (SCAN BITE)	24	9012	95	T 94
T81- 4	XA77- 24	-15VDC	22	927	104	T102
T81- 4	XA5- 22	-15VDC	22	915	85	T 86
T81- 5	J1- >N	+5.0VDC (S & I)	22	904	13	T 14
T81- 5	XA3- 6	+5VDC (SCAN BITE)	24	94	89	T 90
T81- 5	XA77- 11	+5VDC	22	917	97	T 98
T81- 5	J1- U	+5VDC	22	9016	50	T 51
T81- 6	XA77- 8	+/-5VDC RTN	22	918	98	T 99
T81- 6	J1- >P	+5.0VDC RTN (S & I)	22	905	14	T 13
T81- 6	XA3- 3	+5VDC RTN (SCAN BITE)	24	95	90	T 89
T81- 6	J1- >J	+5VDC RTN	22	9017	51	T 50
T81- 6	T81- 7	JUMPER	22	805	116	
T81- 7	XA3- 4	-5VDC RTN (SCAN BITE)	24	97	92	T 91
T81- 7	T81- 6	JUMPER	22	805	116	
T81- 7	J1- >M	-5.0VDC RTN (S & I)	22	907	16	T 15
T81- 8	XA77- 10	-5VDC	22	923	99	T 97
T81- 8	J1- >K	-5.0VDC (S & I)	22	906	15	T 16
T81- 9	XA5- 13	SCAN MOTOR DRIVE LO	22	98	100	T101
T81- 9	XA77- 6	SCAN MOTOR DRIVE LO HI	22	92	79	T 80
T81- 9	XA5- 5	SCAN MOTOR DRIVE LO	22	92	73	T 74
T81- 10	XA5- 14	SCAN MOTOR DRIVE HI	22	901	101	T100
T81- 10	XA77- 13	SCAN MOTOR DRIVE HI	22	93	80	T 79
T81- 10	XA5- 6	SCAN MOTOR DRIVE HI	22	93	74	T 73
XA77						
XA77- 2	XA5- 24	INTERLACE POSN XDCR LO	22	90	87	T 88
XA77- 3	XA5- 25	INTERLACE POSN XDCR HI	22	91	88	T 87
XA77- 4	XA77- 17	JUMPER	24	9013	106	
XA77- 6	T81- 9	SCAN MOTOR DRIVE LO HI	22	92	79	T 80
XA77- 7	J1- >Q	SCAN HALF	24	936	33	

TABLE 3-2. CONTINUITY CHECKS-

HEAD WIRE HARNESS. (CONTINUED) PREFIX ALL TEST POINTS 1W1 (FIG. 3-81).

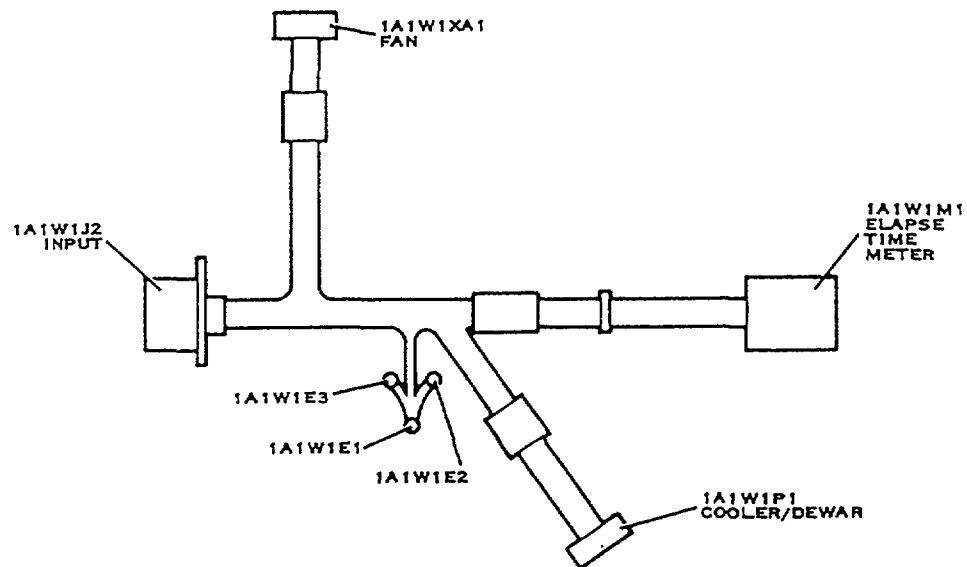
CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
XA77- 0	T81- 6	+/-5VDC RTN	22	918	98	T 99
XA77- 10	T81- 8	-5VDC	22	923	99	T 97
XA77- 11	T81- 5	+5VDC	22	917	97	T 98
XA77- 12	XA5- 15	SCAN MODULE BRIDGE HI	22	904	81	T 82
XA77- 13	T81- 10	SCAN MOTOR DRIVE HI	22	93	80	T 79
XA77- 14	XA5- 7	SCAN POSN XDCR LO	22	94	75	T 76
XA77- 15	XA5- 8	SCAN POSN XDCR HI	22	95	76	T 75
XA77- 16	SHIELD CA	BRIDGE LO SHIELD	22	9	120	
XA77- 17	XA77- 4	JUMPER	24	9013	106	
XA77- 20	J3- 1	VIDEO GATE LO	22	903	113	T114
XA77- 21	J3- 2	VIDEO GATE HI	22	902	114	T113
XA77- 23	T81- 1	+15VDC	22	925	102	T103
XA77- 24	T81- 4	-15VDC	22	927	104	T102
XA77- 25	XA5- 11	INTERLACE SOLENOID #1 LO	22	96	77	T 78
XA77- 26	T81- 2	+/-15VDC	22	926	103	T104
XA77- 27	XA5- 2	INTERLACE SOL #2 LO	22	906	71	T 72
XA77- 28	XA5- 12	INTERLACE SOLENOID #1 HI	22	97	78	T 77
XA77- 29	XA5- 3	INTERLACE SOL #2 HI	22	907	72	T 71
XA77- 33	XA77- 34	JUMPER	24	9012	105	
XA77- 34	XA77- 33	JUMPER	24	9012	105	
XA4- 3	J1- C	FOV CMD RTN (C)	24	978	45	T 46
XA4- 7	J1- D	NFOV CMD (NC)	24	9012	46	T 47
XA4- 8	J1- Y	WFOV CMD (NO)	24	9013	47	T 45
XA6- 3	J1- E	1X RETICLE HI	24	967	43	T 44
XA6- 7	J1- F	1X RETICLE LO	24	968	44	T 43
XA5- 2	XA77- 27	INTERLACE SOL #2 LO	22	906	71	T 72
XA5- 3	XA77- 29	INTERLACE SOL #2 HI	22	907	72	T 71
XA5- 5	T81- 9	SCAN MOTOR DRIVE LO	22	92	73	T 74
XA5- 6	T81- 10	SCAN MOTOR DRIVE HI	22	93	74	T 73
XA5- 7	XA77- 14	SCAN POSN XDCR LO	22	94	75	T 76
XA5- 8	XA77- 15	SCAN POSN XDCR HI	22	95	76	T 75
XA5- 11	XA77- 25	INTERLACE SOLENOID #1 LO	22	96	77	T 78
XA5- 12	XA77- 28	INTERLACE SOLENOID #1 HI	22	97	78	T 77
XA5- 13	T81- 9	SCAN MOTOR DRIVE LO	22	98	100	T101
XA5- 14	T81- 10	SCAN MOTOR DRIVE HI	22	901	101	T100
XA5- 15	XA77- 12	SCAN MODULE BRIDGE HI	22	904	81	T 82
XA5- 16	SHIELD CA	SCAN MODULE BRIDGE LO	22	905	82	T 81
XA5- 20	T81- 1	+15VDC	22	902	83	T 84
XA5- 21	T81- 2	+15VDC RTN	22	903	84	T 83
XA5- 22	T81- 4	-15VDC	22	915	85	T 86
XA5- 23	T81- 3	-15VDC RTN	22	916	86	T 85
XA5- 24	XA77- 2	INTERLACE POSN XDCR LO	22	90	87	T 88
XA5- 25	XA77- 3	INTERLACE POSN XDCR HI	22	91	88	T 87
J3- 1	P2- 17	VIDEO GATE LO	24	902	69	T 70
J3- 1	XA77- 20	VIDEO GATE LO	22	903	113	T114
J3- 2	XA77- 21	VIDEO GATE HI	22	902	114	T113
J3- 2	P2- 26	VIDEO GATE HI	24	903	70	T 69
E1	P1- 3	VIDEO GND	22	9	108	
E1	P1- 4	VIDEO GND	22	9	109	
E1	P1- 9	VIDEO GND	22	9	110	
E1	P1- 10	VIDEO GND	22	9	111	
E1	P1- 11	VIDEO GND	22	9	112	
E1	P1- 12	VIDEO GND	22	9	107	

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TABLE 3-2. CONTINUITY-CHECKS-
HEAD WIRE HARNESS. (CONTINUED) PREFIX ALL TEST POINTS 1W1 (FIG. 3-8).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
E2						
E2	XA3- 24	+18 TO 30VDC RTN	24	9015	121	
E2	J1- X	+18 TO +30VDC RTN	24	9015	49	

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Figure 3-9. Connector locations for cooler/Dewar harness.

TABLE 3-2. CONTINUITY CHECKS-
COOLER/DEWAR HARNESS (FIG. 3-9).

CIRCUIT POINT	CIRCUIT POINT	SIGNAL FUNCTION OR NAME	AWG	COLOR	WIRE NO	REMARKS
1A1W1J2						
1A1W1J2- A	1A1W1E1	COOLER, PHASE A	20	901	8	T 9
1A1W1J2- B	1A1W1E2	COOLER, PHASE B	20	96	9	T 10
1A1W1J2- C	1A1W1E3	COOLER, NEUTRAL	20	98	10	T 8
1A1W1J2- E	1A1W1XA1- 2	FAN BITE, PHASE B	20	95	4	T 1
1A1W1J2- F	1A1W1E1	COOLER BITE, PHASE A	20	91	5	T 6
1A1W1J2- G	1A1W1E2	COOLER BITE, PHASE B	20	92	6	T 7
1A1W1J2- H	1A1W1XA1- 7	FAN, PHASE A	20	905	1	T 2
1A1W1J2- J	1A1W1XA1- 3	FAN, PHASE B	20	906	2	T 3
1A1W1J2- K	1A1W1XA1- 8	FAN, NEUTRAL	20	97	3	T 4
1A1W1J2- L	1A1W1E3	COOLER NEUTRAL	20	90	7	T 5
1A1W1P1						
1A1W1P1- A	1A1W1E1	COOLER, PHASE A	22	903	11	T 12
1A1W1P1- B	1A1W1E2	COOLER, PHASE B	22	904	12	T 13
1A1W1P1- D	1A1W1E3	COOLER, NEUTRAL	22	902	13	T 11
1A1W1XA1						
1A1W1XA1- 2	1A1W1J2- E	FAN BITE, PHASE B	20	95	4	T 1
1A1W1XA1- 3	1A1W1J2- J	FAN, PHASE B	20	906	2	T 3
1A1W1XA1- 7	1A1W1J2- H	FAN, PHASE A	20	905	1	T 2
1A1W1XA1- 8	1A1W1J2- K	FAN, NEUTRAL	20	97	3	T 4
1A1W1E1						
1A1W1E1	1A1W1J2- A	COOLER, PHASE A	20	901	8	T 9
1A1W1E1	1A1W1P1- A	COOLER, PHASE A	22	903	11	T 12
1A1W1E1	1A1W1M1- 2	115V, 420HZ	22	94	14	T 15
1A1W1E1	1A1W1J2- F	COOLER BITE, PHASE A	20	91	5	T 6
1A1W1E2						
1A1W1E2	1A1W1J2- B	COOLER, PHASE B	20	96	9	T 10
1A1W1E2	1A1W1P1- B	COOLER, PHASE B	22	904	12	T 13
1A1W1E2	1A1W1J2- G	COOLER BITE, PHASE B	20	92	6	T 7
1A1W1E3						
1A1W1E3	1A1W1J2- C	COOLER, NEUTRAL	20	98	10	T 8
1A1W1E3	1A1W1P1- D	COOLER, NEUTRAL	22	902	13	T 11
1A1W1E3	1A1W1M1- 1	NEUTRAL	22	93	15	T 14
1A1W1E3	1A1W1J2- L	COOLER NEUTRAL	20	90	7	T 5
1A1W1M1						
1A1W1M1- 1	1A1W1E3	NEUTRAL	22	93	15	T 14
1A1W1M1- 2	1A1W1E1	115V, 420HZ	22	94	14	T 15

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