DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECT SUPPORT MAINTENANCE MANUAL

FOR

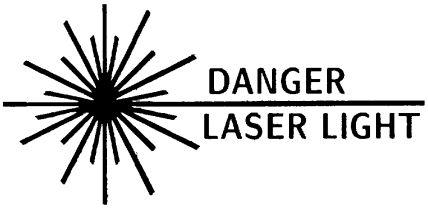
TARGET DESIGNATOR, LASER
AN/PAQ-1

This manual is incomplete without classified technical bulletin TB 9-1260-479-30

This copy is a reprint which includes current pages from Changes 1 thru 4

HEADQUARTERS, DEPARTMENT OF THE ARMY
15 NOVEMBER 1980

WARNING



LASER BEAM IS DANGEROUS AND CAN CAUSE BLINDNESS IF LASER LIGHTIT ENTERS THE EYE EITHER DIRECTLY OR REFLECTED FROM A SHINY SURFACE.

WHEN OPERATING LASER TARGET DESIGNATOR, OBSERVE THE FOLLOWING:

Wear laser goggles LGS-NDGA when around the Laser Target Designator (LTD).
Never look into laser; assume it is always dangerous.

Warn personnel before firing laser.
Operate only in designated areas.
Allow only trained personnel to operate LTD.
Do not aim laser at unprotected personnel or at reflective surfaces.
Lens covers must be on when LTD At not in use.
Follow procedures exactly.

ELECTRICAL
HAZARDOUS VOLTAGES EXIST IN THIS EQUIPMENT WHICI! CAN CAUSE SHOCK, DEATH OR INJURY. USE EXTREME CAUTION WHEN PERFORMING MEASUREMENTS WITH POWER ON. REMOVE POWER BEFORE PERFORMING MAINTENANCE.

All power must be removed from LTD before start of replacement procedures.

CHEMICAL
CLEANING SOLVENTS ARE EXTREMELY FLAMMABLE AND ARE ALSO TOXIC IF FUMES ARE INHALED DUE TO IMPROPER VENTILATION OF AREA.

Alcohol is flammable. Keep all flammable materials away from open flames.
Solvent is toxic and flammable. Keep away from heat and open flame. Use only in a well-ventilated area.
Avoid prolonged or repeated breathing of vapor. Avoid prolonged or repeated contact with the skin.

MECHANICAL
GAS CYLINDERS CONTAIN VERY HIGH PRESSURE. HIGH PRESSURE GAS CAN HURT OR KILL YOU.
The cylinders must be securely fastened to prevent them from falling and becoming an unguided missile.
Do not open cylinder valve until gas charging assembly has been properly attached.
Do not perform repair work on gas charging assembly until all pressures in assembly have been vented and assembly has been removed from pressure source.

FIRST AID DATA
IN CASE OF AN ACCIDENT - NOTIFY YOUR SUPERVISOR IMMEDIATELY AND OBTAIN MEDICAL TREATMENT FOR ALL INJURIES.
See FM 21-11 for general first aid data.
Consult medical officer for TB MED 279 data concerning laser medical practices.
Have your eyes examined immediately if you think you have been exposed to laser light.

Change)
)
No. 5)

HEADOUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *17 April 1995*

DIRECT SUPPORT MAINTENANCE MANUAL
for
TARGET DESIGNATOR, LASER
AN/PAQ-1
(1260-01-041-1567)

TM 9-1260-479-30, 15 November 1980, is changed as follows:

1. Remove old pages and insert new pages as indicated below.

2. New or changed material is indicated by a vertical bar in the margin of the page.

3. Revised illustrations are indicated by a letter suffix adjacent to the identification number.

Remove Pages	Insert Pages
i thru iv	i thru iv
1-1, 1-2	1-1, 1-2
2-1 thru 2-8	2-1 thru 2-8
2-11, 2-12	2-11, 2-12
2-15, 2-16	**2-14.1 thru 2-16**
Index 1 thru Index 3/(Index 4 blank)	Index 1 thru Index 3/(Index 4 blank)
DA Form 2028-2	DA Form 2028-2
DA Form 2028-2	DA Form 2028-2
DA Form 2028-2	DA Form 2028-2

4. File this change sheet in front of the publication for reference purposes.

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Chief of Staff

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Distribution:

To be distributed in accordance with DA Form 12-32-E, Block 1122, requirements for TM 9-1260-479-30.

Technical Manual)
)
No. 9-1260479-30)

HEADQUARTERS,
DEPARTMENT OF THE ARMY,
Washington, D.C., *15 November 1980*

DIRECT SUPPORT MAINTENANCE MANUAL
for
TARGET DESIGNATOR, LASER
AN/PAO-1
(1260-01-041-1567)

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of any 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 Missile Command, ATTN: AMSMI-MMC-LS-LP, Redstone Arsenal, AL 35898-5238. A reply will be furnished to you.

FUNCTIONAL DIAGRAMS (Located in back of manual)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS - continued

LIST OF TABLES

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope.

a This manual contains the information necessary to perform direct support maintenance of the Target Designator, Laser AN/PAO-1 (LTD) and the External Power Adapter(EPA). General information and descriptions are contained in Chapter 1, Section I through III. Functioning of equipment is described in Section IV. Direct Support maintenance instructions. including troubleshooting. and functional checkout, are contained in Chapter 2.

b This manual contains repair procedures in Chapter 3 for replacing defective components of the LTD system. Generally. repair of an item consists of removal of the item. disassembly to the level necessary for repair or replacement of the faulty part, reassembly, and final inspection (testing). In this manual, it is understood that parts damaged beyond repair are to be replaced.

c. Exploded view illustrations used in this manual may show parts that are not authorized for replacement and that are not involved with the described maintenance operation. Identification of parts on such illustrations is restricted to those parts directly involved with the described operation. The identification includes only parts that are authorized for replacement by the direct support maintenance level.

1-2. Maintenance Forms and Records.

Department of the Army forms and procedures used for equipment maintenance will be those prescribed by DA PAM 738-750. The Army Maintenance Management System (TAMMS). The DA PAM is published in the Maintenance Management UPDATE. Units may subscribe to Maintenance Management UPDATE by submitting a complete DA Form 12-9-E.

1-3. Destruction of Army Material to Prevent Enemy Use.

Evacuation, rather than destruction whenever possible, is first priority. Each using organization and/or installation having custody of LTD sets should have a standing operating procedure (SOP) for LTD set destruction including::

Priorities of demolition.
Method of demolition.
Quantities of explosives, and
Complete instructions for demolition

The demolition plan should be suitably flexible to cover any situation. Destruction method should consider the safety of friendly troops, availability of personnel, materials required, time available, etc. Methods are: gunfire, explosives, smashing, and burning after demolition.

1-4. Administrative Storage.

Administrative storage requirements are explained in TM 9-1425-2585-14, Administrative Storage.

1-5. Reporting Equipment Improvement Recommendations (EIR's).

If your equipment needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design or performance. Put it on an SF 368 (Quality Deficiency Report). Mail it to the address stated in DA PAM 738-750. We will send you a reply.

1-6. Nomenclature Cross-Reference.

The common names used throughout this manual for LTD equipment are listed in Table 1-1.

1-7. Abbreviations.

Standard abbreviations in this manual are per MIL-STD-12D. Non-standard abbreviations are listed in Table 1-2.

1-8. Reference Designations.

Reference designations are combinations of letters and numbers for identifying electrical and mechanical parts. A typical reference designation (A2A1) gives the following information: A2 is the electronics assembly, and Al is the control card within the electronics assembly. Table 1-3 lists the reference designations used in this manual.

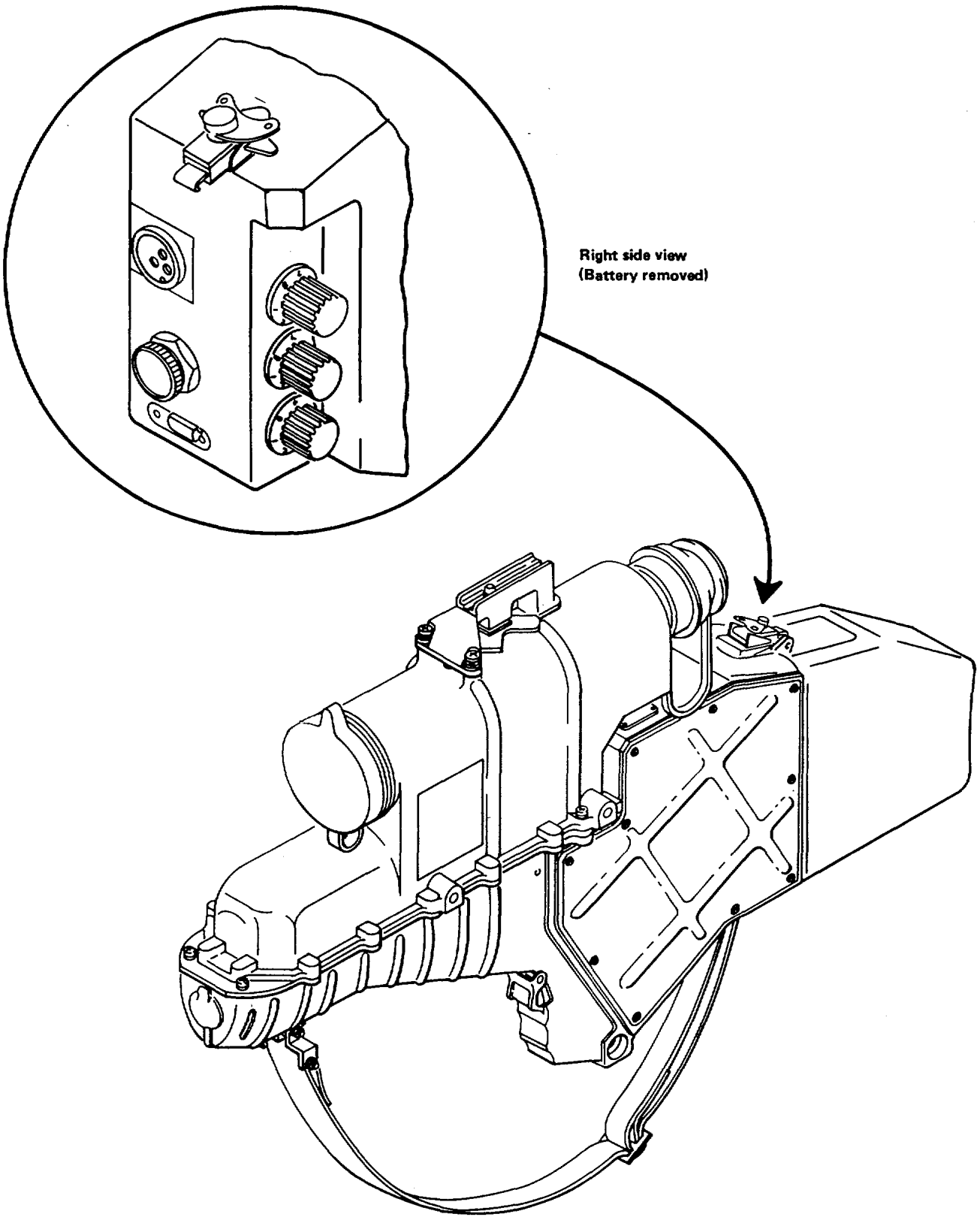


Figure 1-1. Laser Target Designator

Table 1-1. Nomenclature Cross-Reference

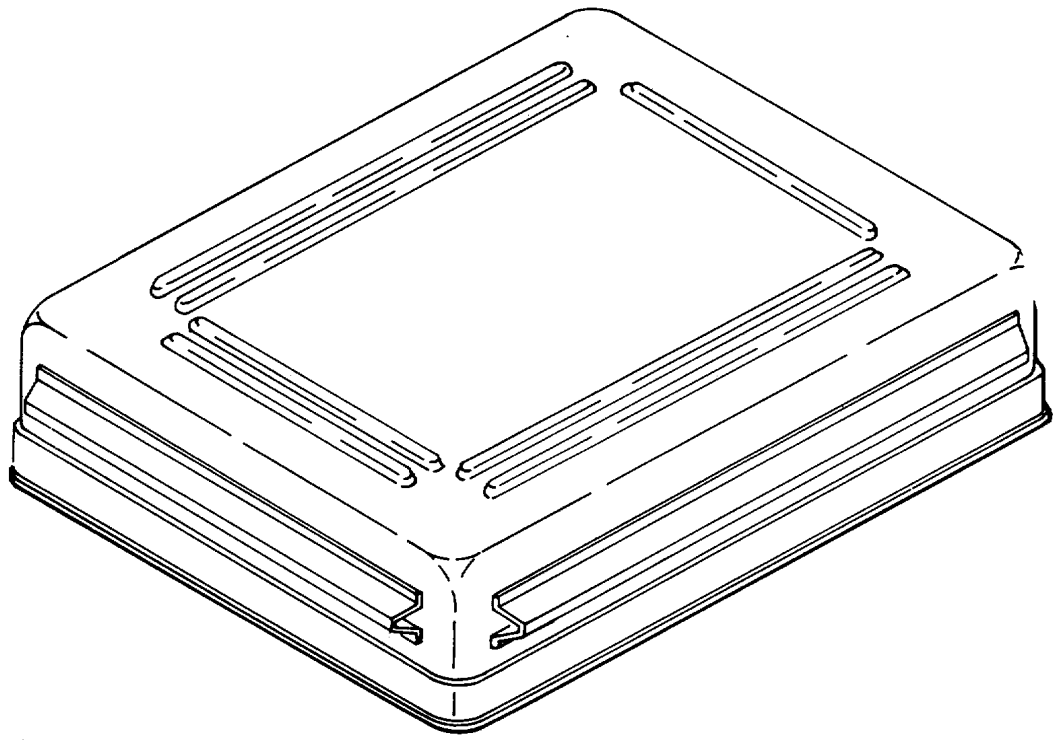
Official Nomenclature	*Part Number/ NSN*	*Common Name*
Target Designator, Laser AN/PAQ-1	13033888 1260-01-041-1567	LTD
LTD Module	13033867	LTD Module
Transmitter Components Assembly	T1298/PAQ-1 1260-01-056-0012	13033900 Transmitter
Electronic Components AssemblyMX-9715/PAQ-	113034200 1260-01-056-5348	Electronic Components Assembly
Strap Assembly	13033885	Carrying Strap
Battery, Shoulder Stock BB-699/PAQ-1	13033982 1260-01-011-9447	Battery-Shoulder Stock
Kit, Optics Cleaning, External	5952355	Cleaning Kit
Carrying Case, LTD CY7468/PAQ-1	13033889 1260-01-056-7507	LTD Transit Case
Adapter, External Power MX-9653/PAQ-1	13034435 1260-01-040-1494	External Power Adapter
Converter, External Power	13034438	External Power Converter
EMI Filter Assembly	13033990 1260-01-080-8394	EMI Filter
Cable Assembly, Power Adapter Filter, W1	13034437 1260-01-089-8804	Interconnect Cable, W1
Cable, Vehicle, W2	13033956 1260-01-071-3822	Vehicle Cable, W2
Carrying Case Assembly	13034452	EPA Carrying Case
Test Set, Target Designator AN/PAM-1	13034400 4931-01-040-3117	LTD Test Set
Adapter, Test Set Assembly	13033994	Test Set Adapter
Adapter, Fill Valve Assembly	13034406	Fill Valve Adapter
Simulator, Transmitter SM-712/PAM-1	13034410	Transmitter Simulator
Test Adapter MX-9654/PAM-1	13034420	Test Adapter
Charging Assembly, Gas	11507817 4931-01-107-6889	Gas Charging Assembly
Cable, Maintenance, Power	13033955 4931-01-015-6380	Maintenance Cable
Case, Test Set CY-7469/PAM-1	13034401	Transit Case
Adapter, Cable Assembly	11508891 1260-01-099-2419	Jeep Adapter

Table 1-2. List of Abbreviations

Abbreviation	Definition
Assy	Assembly
A-TRIG	A-Trigger
AUX	Auxiliary
EPA	External Power Adapter
F	Fahrenheit Temperature Scale
FSCM	Federal Supply Code For Manufacturer
F/T	Flash Tube
N202	Nitrogen-Oxygen Mixture
HVPS	High Voltage Power Supply
Hz	Hertz (cycles per second)
LOS	Line of Sight
LTD	Laser Target Designator
MALF	Malfunction
NSN	National Stock Number
OVERTEMP	Over Temperature
PFN	Pulse Forming Network
PS	Power Supply
QA/QC	Quality Assurance/Quality Control
Q/S	Q-Switch
RTN	Return
SCR	Silicon Controlled Rectifier
SMR Code	Source, Maintenance, Recoverability Code
TBD	To Be Determined
TOR	Turn On Reset
U/M	Unit of Measure
VDC	Volt Direct Current
VOM	Volt Ohm Meter

Table 1-3. Reference Designations

Reference Designation	Part Number	Item
A1	13033900	Transmitter
A1A1	13034020	Trigger Module
A1A2	13034105	Reticle Mount Assembly
A1A3	13034120	Cooling Module
AlA3T1	13034175	Trigger Transformer
A1A3DS1	13033999	Flashlamp
A2	13034200	Electronic Components Assembly
A2A1	13034300	Control Logic Card
A2A2	13034290	PFN Module
A2A3	13034270	PFN Charge Supply
A2A4	13034254	Air Control Assembly
A2A5	13033910	Electronic Components Assembly Housing
A2W1	13034210	Wiring Harness
A2W1S1	13034212	Code Switch (Most Significant Digit)
A2W1S2	13034212	Code Switch (Center Significant Digit)
A2W1S3	13034212	Code Switch (Least Significant Digit)
A2W1S4	13034206	Code Interlock Switch
A3	13033982	Battery-Shoulder Stock
A4	13034438	External Power Converter
A4A1	13034456	Drive Electronics Card
A4K1	MS27743-1	Relay
A4S1	MS14001-222	Power Switch
A5	13033990	EMI Filter



LEGEND

1. LTD
2. Battery—shoulder stock (4 ea)
3. LTD transit case
4. Cleaning kit
5. Operator and Organizational Maintenance Manual

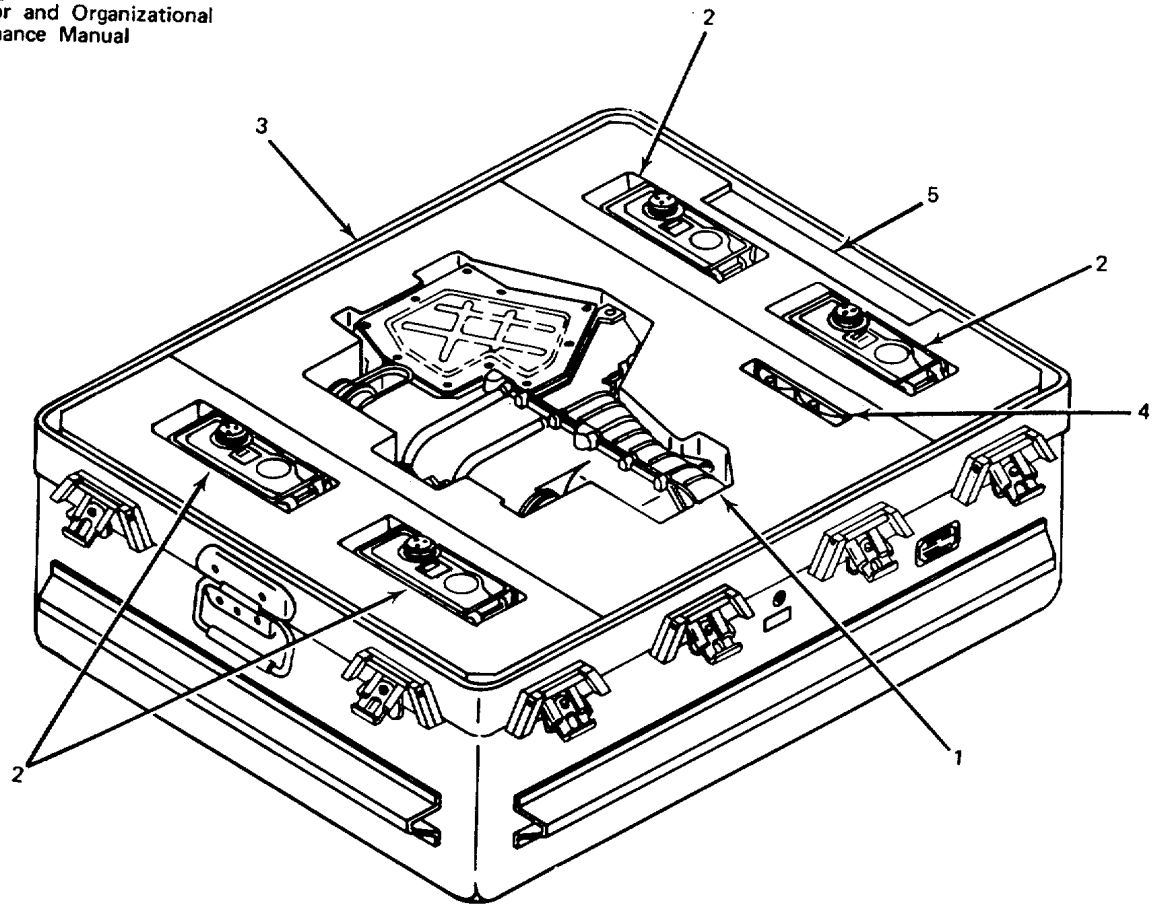


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Figure 1-2. LTD Set

SECTION II. EQUIPMENT DATA

1-9. General.

a. LTD Set. The LTD Set comprises the following units: (See figure 1-2.)

(1) Laser Target Designator (LTD) (13033867)

(2) Battery-Shoulder Stock (1303982) (four each)

(3) LTD Transit Case (13033889)

(4) External Optics Cleaning Kit (5952355)

(5) Operator and Organizational Maintenance Manual (TM 9-1260-479-12)

b. Support Equipment. The support equipment necessary for maintaining the LTD includes:

(1) Battery Charger (PP-7286) (see TM 11-6130-392-12).

(2) LTD Test Set AN/PAM-1 (13034400) (see TM 9-4931-599-13) including Battery Charger Cable (11508861).

c. External Power Adapter (13034435). The EPA is used to operate the LTD whenever batteries are not available or when the ambient temperature is below 32* F. The EPA is also used during LTD Checkout and fault isolation tasks to avoid depletion of the Battery-Shoulder Stock. The MX-9653/PAQ-1 External Power Adapter comprises the following units:

(1) External Power Converter (13034438)

(2) EMI Filter (13033990)

(3) Interconnect Cable, W1 (13034437)

(4) Vehicle Cable, W2 (13033956)

(5) EPA Carrying Case (13034452).

d. Tabulated Data. Tabulated data for the LTD set may be found in TM 9-1260-479-12, Operator and Organizational Maintenance Manual for Target Designator, Laser, AN/PAQ-1.

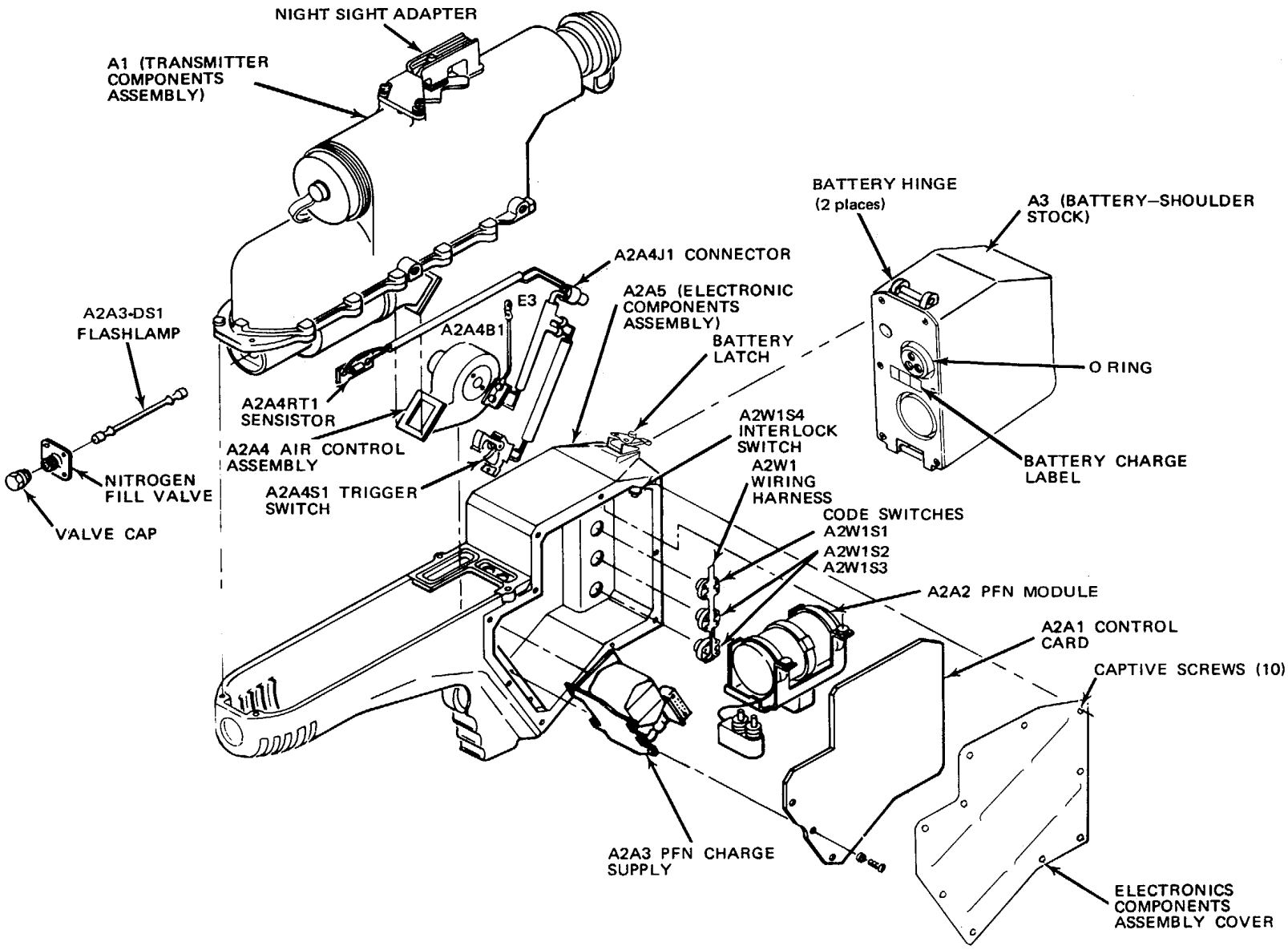

Figure 1-3. LTD Replaceable Modules

Section III. EQUIPMENT DESCRIPTION

1-10. General.

a. The LTD components are shown in Figure 1-3. The replaceable electronic components assembly (A2) consists of a control card (A2A1), PFN module (A2A2), PFN charge supply (A2A3), wiring harness switches (A2W1), air control assembly (A2A4), three code switches (A2WlS1, A2W1S2, A2W1S3), Interlock switch (A2W1S4), and the electronic components assembly housing (A2A5). The transmitter components assembly (Al) contains only one replaceable component, the flashlamp (A2A3 DS1). The battery (A3) is charged at the organizational level and limited repair is performed at Direct Support. The external power adapter consists of an external EMI filter assembly (A5), external power converter (A4), vehicle power and Interconnect cables.

b. Faulty flashlamps (A2A3-DS1), night sight adapters, code switch knobs, valve caps, fill valves, battery latches, battery hinges, batteries, carrying strap assemblies, electronic components assembly covers, and O-rings will be discarded at the Direct Support level of maintenance. Faulty transmitter components assembly (fig. 1-4), control cards (fig. 1-6), PFN modules (fig. 1-7), PFN charge supplies (fig. 1-8), electronic components assemblies (fig. 1-5), transit cases and cables (fig. 1-2 and 1-3) will be sent to Depot for repair. There will be no repair of these assemblies at the Direct Support level of maintenance. Therefore, the maintenance described In this section covers the assemblies only to the level necessary to fault locate, remove, and replace faulty modules and to verify fault correction.

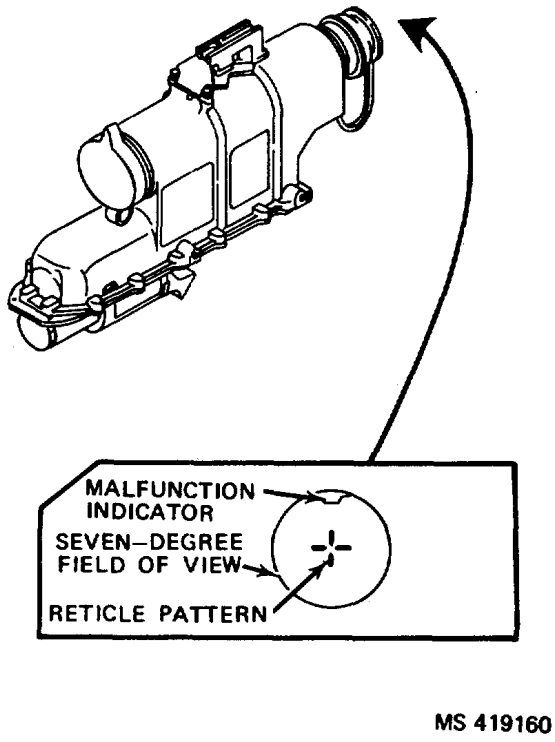

Figure 1-4. Transmitter Components Assembly

1-11. Transmitter Components Assembly (Al). (See Figure 1-4).

The transmitter module contains the laser rod, optics, and associated laser generation circuits. Refer to TM 9-1260-479-12 for the transmitter components assembly description. The flashlamp (A2A3-DS1) is the only transmitter component to be changed at the Direct Support level of maintenance. One end of the flashlamp is tapped with a No. 4-40 thread to receive a standard 4-40 inch screw. One of the four 4-40 screws from the fill valve Is Inserted Into the flashlamp and used to extract the flashlamp from the transmitter module. The other end of the flashlamp fits into a spring holding device within the transmitter module. The sighting telescope used is a fixed 6.84-power telescope with a 7-degree field of view. The telescope contains an edge-lit reticle that allows the operator to point the beam at a target. A malfunction Indicator is located Just above the reticle.

1-12. Electronic Components Housing.

(See Figure 1-5.)

The electronic components housing consists of the electronic components assembly less the control card PFN, PFN charge supply, wiring harness, and the air control assembly. Refer to TM 9-1260-479-12 for a description of the electronic components assembly.

When the housing access cover is removed, high voltages are disabled by the interlock switch and the charged capacitors are discharged. The discharge rate is controlled so that a safe voltage level is

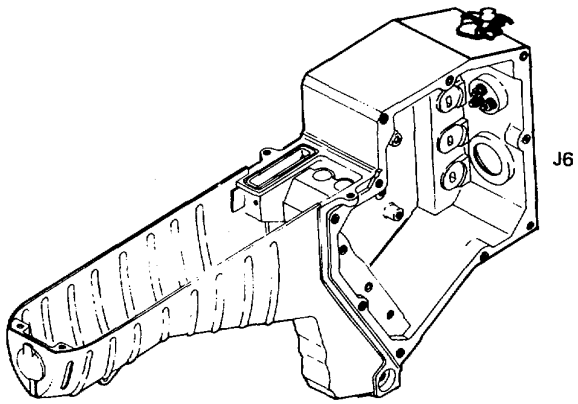

Figure 1-5. Electronic Components

reached before access can be completed. Test points for monitoring the LTD signals can be reached through the TEST connector (J6) without removing the cover. Refer to TM 9-4931-479-13 for a description of these accessible test points.

1-13. Control Card (A2A1). (See Figure 1-6).

a. The control card module is 7 inches long, 7 inches wide, 1 inch high, and weighs 0.7 pound. The control card consists of hybrid and discrete components mounted on a printed circuit board. A single connector connects the control card to the electronic components assembly. Three screws secure the control card to the electronic components assembly heat sink.

b. The control card contains the main clock oscillator, dc/dc converter, 400-volt power supply, and two hybrids and an LSI circuit, (power control, control logic code timing). The code timing LSI generates the basic timing functions. The power control hybrid generates the PFN and 400-volt Dower supply drive pulses. The control logic hybrid generates the required control and coding logic functions. The 400-volt power supply is used in the flashlamp trigger and Q-switch (Pockets cell) trigger circuits.

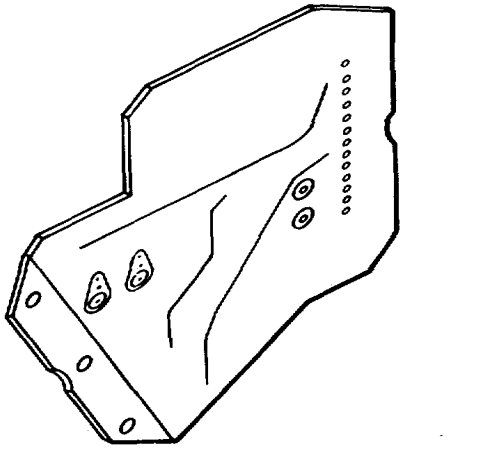

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Figure 1-6. Control Card

1-14. Pulse Forming Network (A2A2).

(See Figure 1-7.)

a. The pulse forming network module (PFN) is 3-1/2 inches long, 5 inches wide, 2-1/2 inches high, and weighs 1.1 pounds. The primary components are an inductor and a capacitor mounted to an aluminum bracket. Two connectors connect the PFN to the electronic components assembly. Two screws secure it to the top of the electronic components assembly compartment, and two fasteners secure it to the compartment side wall.

b. The PFN stores the required flashlamp energy for each laser pulse. After the PFN capacitor is charged to the desired energy level, it awaits a signal to discharge its energy into the flashlamp.

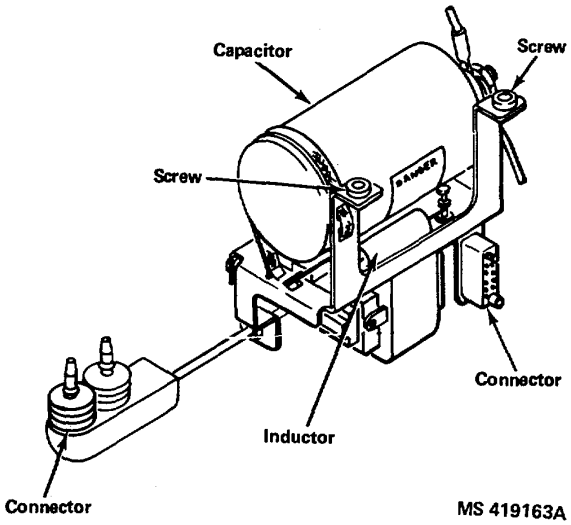


Figure 1-7. Pulse Forming Network

1-15. PFN Charge Supply (A2A3).

(See Figure 1-3.)

The PFN charge supply module is 2-1/2 inches long, 1/2 inches wide, 2 inches high, and weighs 0.8 pound. The components are mounted so that the heat generated is conducted to a heat sink. A single connector connects the PFN charge supply to the electronic components assembly. Three screws secure the PFN charge supply to the electronic components assembly heat sink. The inaccessible side of the PFN charge supply is secured by two spring-loaded devices. The PFN charge supply provides selected amounts of charge to the PFN.

1-16. Air Control Assembly (A2A4).

(See Figures 1-9 and 1-10.)

a. The air control assembly Is 5 Inches long, 10 inches wide, 3 Inches high, and weighs 0.6 pounds. It consists of a blower, a sensor A2A4RT1, and a trigger switch A2A4S1. These three components are wired Into a harness with a connector, which con-

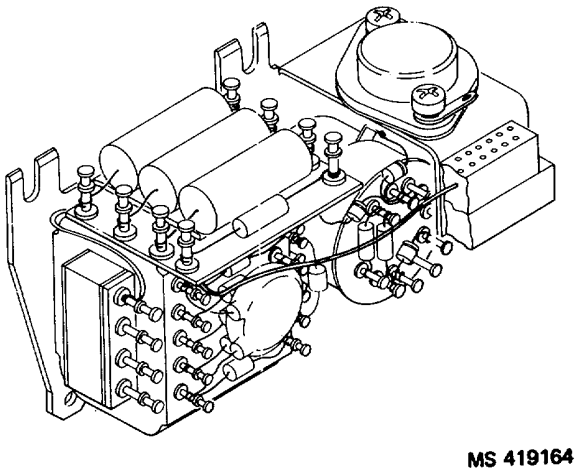


Figure 1-8. PFN Charge Supply

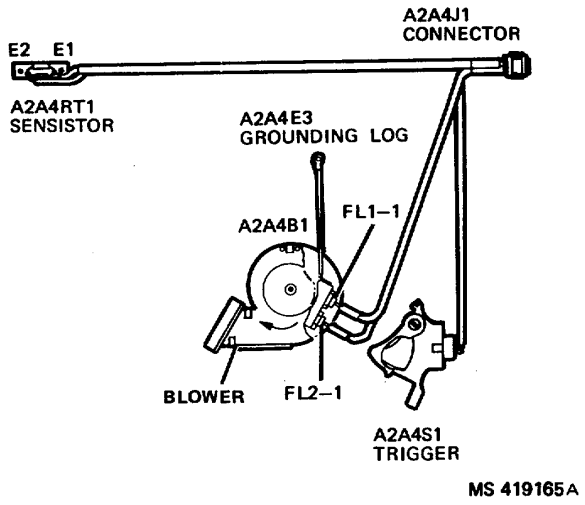


Figure 1-9. Air Control Assembly

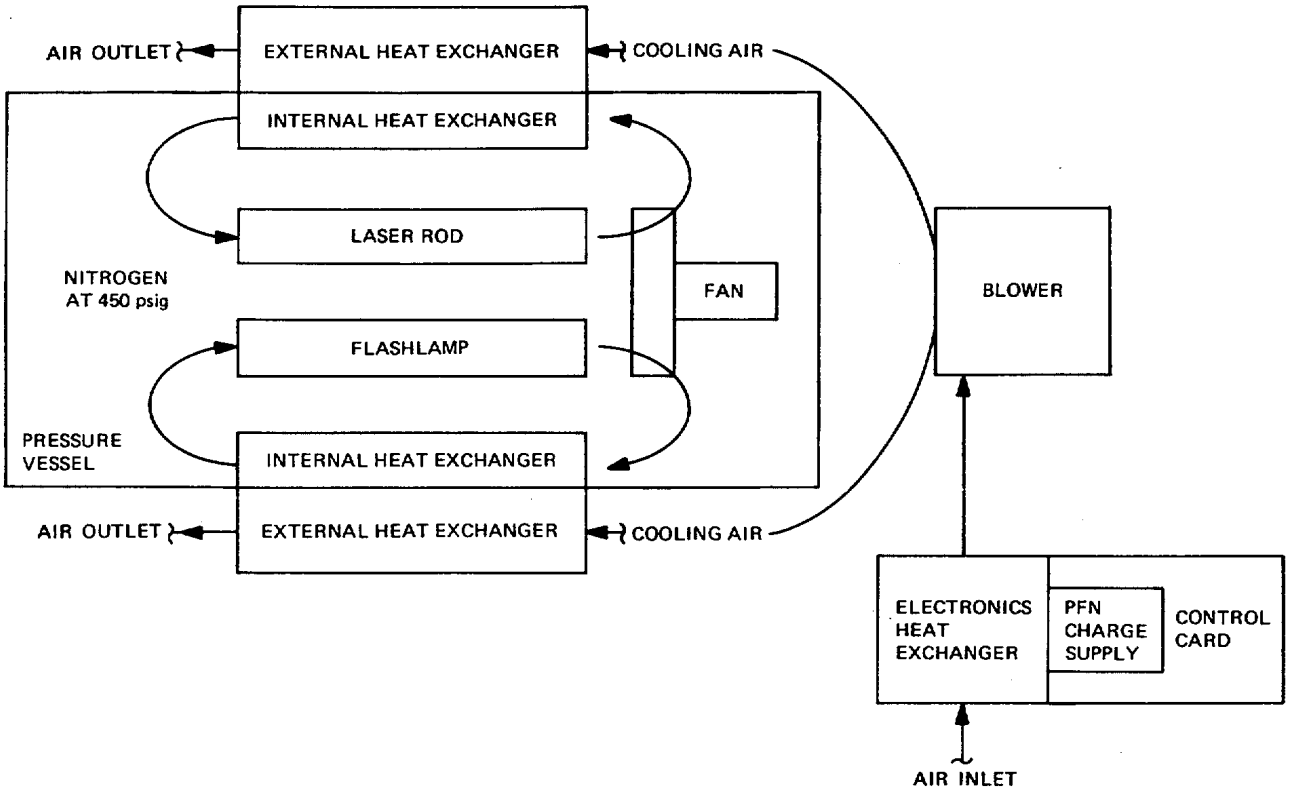


Figure 1-10. Cooling System Schematic

nects the blower assembly to the electronic components assembly. The senstistor on a bracket Is connected with two screws near the exit air stream. The trigger switch is connected with one screw. The blower is secured in the electronic components assembly Just below the transmitter components assembly.

b. A heater, internal sensistor senses the internal pressure vessel temperature. The internal sensistor and the blower assembly sensistor constantly monitor the LTD temperature. An abnormal rise in temperature results in a malfunction indication within 10 to 20 seconds.

c. The blower is an integral part of the LTD cooling system. The purpose of the cooling system is to limit the temperature rise in the pressure vessel, PFN charge supply, and control card. The pressure vessel, including the laser rod and flashlamp, is cooled with fan-circulated N_2 at 450-psi pressure. The nitrogen conducts neat to the pressure vessel internal heat exchanger. The internal heat exchanger is thermally connected to the external fins. The blower draws ambient air over an electronic heat exchanger and the external heat exchanger. The PFN charge supply and the control card are both thermally connected to the electronic heat exchanger to remove excess heat.

1-17. Wiring Harness (A2W1). (See Figure 1-11.) The wiring harness connects all of the electronic components together, and also provides an interlock switch, a terminal board, a test connector, a transmitter connector, connections to J1, J2, J3 power terminals, and the three code switches.

1-18. Battery-Shoulder Stock. (See Figure 1-12.) Input power to the LTD is supplied by a rechargeable and quick replacement type battery-shoulder stock. Refer to TM 9-1260-479-12 for battery-shoulder stock description and recharging requirements.

1-19. External Power adapter. (See Figure 1-13.)

a. The External Power Adapter consists of an external power converter (A4), an EMI filter assembly (A5), an interconnect cable, a power cable, and a carrying case. The External Power Adapter may be used Instead of the Battery-Shoulder Stock at any time, especially at temperatures below 320F (O°C). Refer to TM 9-1260479-12 for description and operating procedures.

b. The external power converter (A4) contains a power control relay and a voltage regulator. The power control relay Is wired so that turn-on is prevented if the input polarity is reversed. The voltage regulator supplies the regulated power required by the LTD. The EMI filter assembly (A5) limits the conducted electromagnetic Interference to an acceptable level.

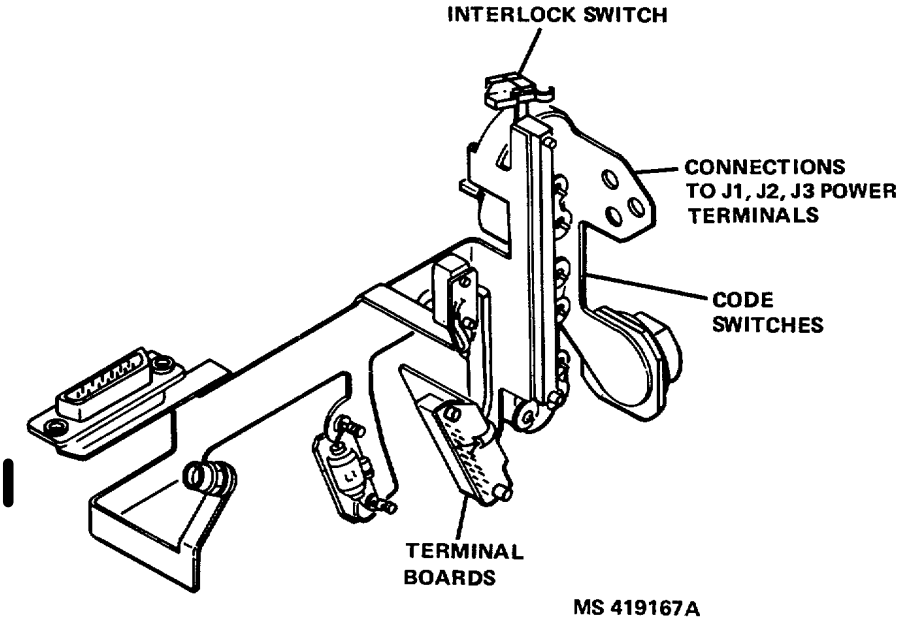


Figure 1-11. Wiring Harness

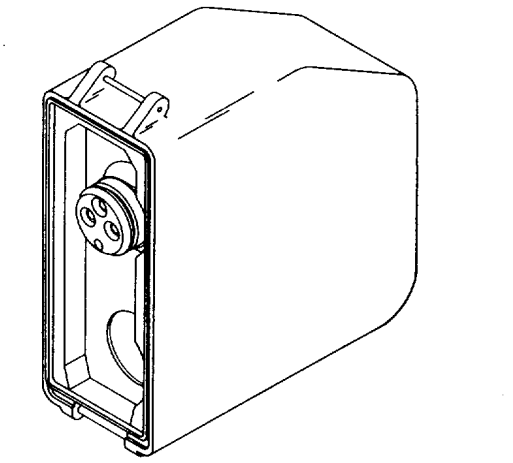


Figure 1-12. Battery-Shoulder Stock

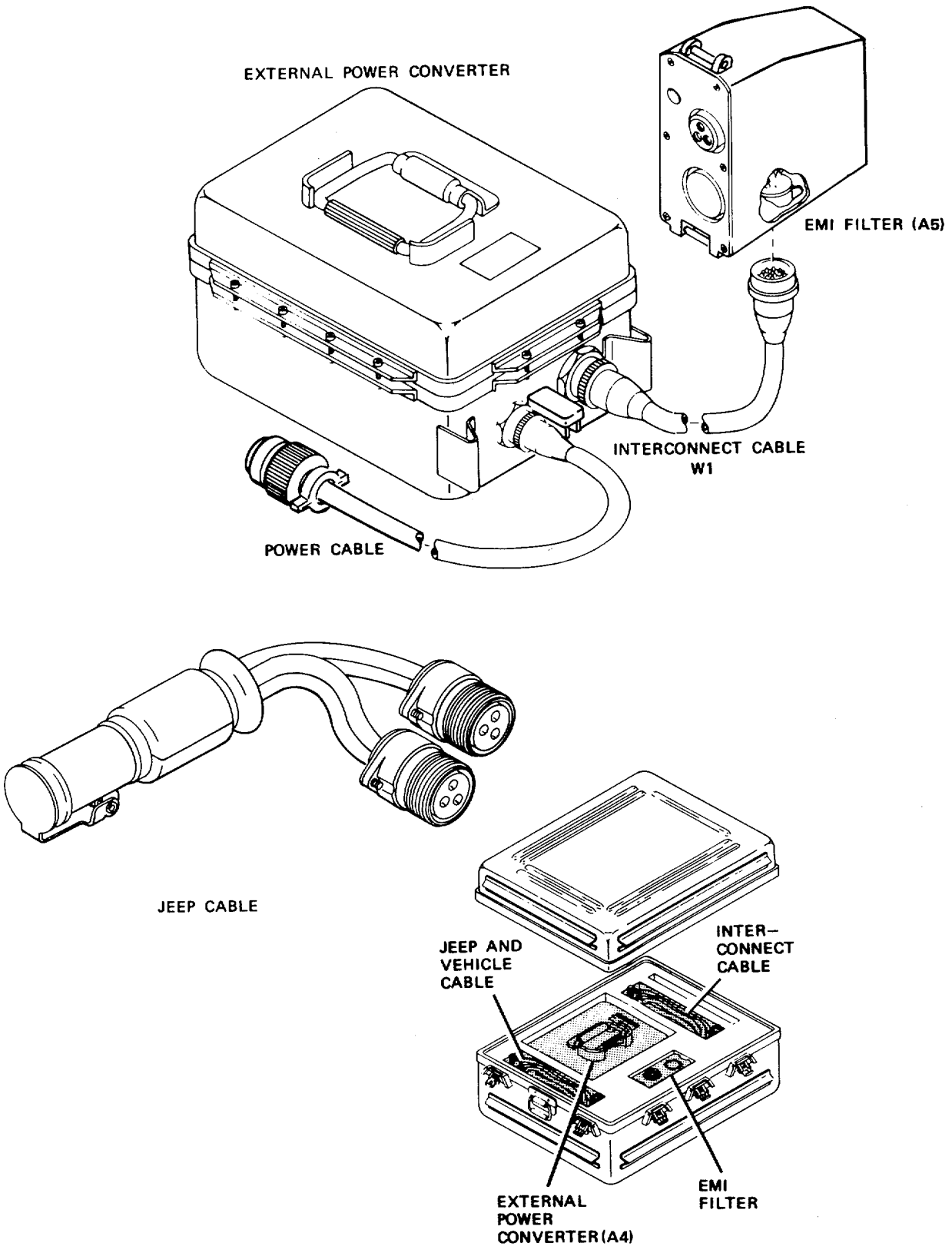


Figure 1-13. External Power Adapter

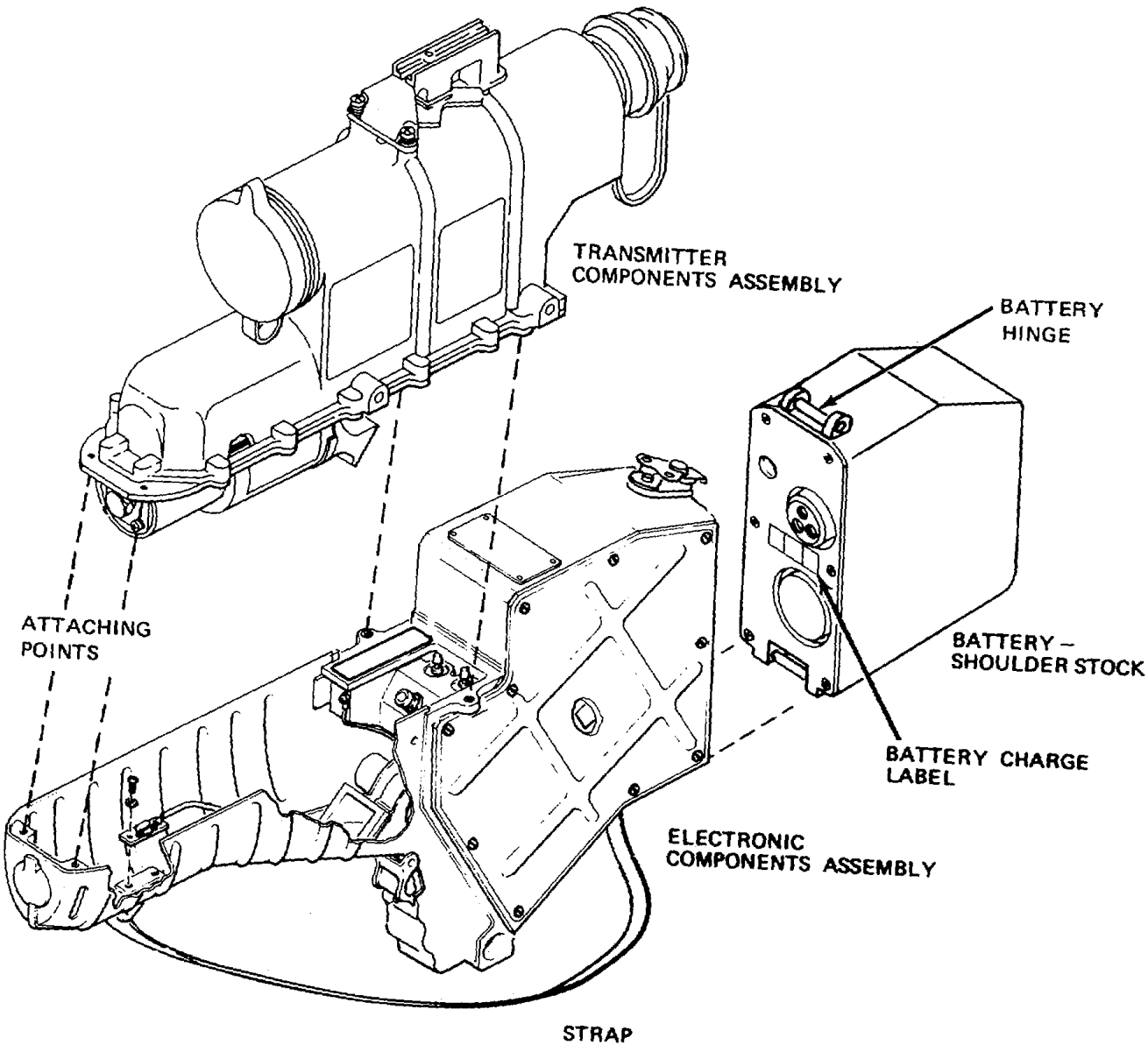


Figure 1-14. LTD Basic Components

Section IV. THEORY, BLOCK, AND FUNCTIONAL DIAFRAM

1-20. Scope.

a. This section contains the block diagrams, functional diagrams, and general theory for the LTD system. It also contains detailed theory of operation for components (including resistors, modules, printed circuit boards, etc.) replaced or repaired by Direct Support (DS) maintenance personnel. The functional diagrams identify built-in test points, external test connectors, and replaceable components authorized for replacement by DS maintenance personnel. The block diagrams are only for reference to give an

b. Figure 1-14 indicates the three major **LTD** modules. The battery shoulder-stock is attached to the electronic components assembly by a simple quick-release latch. The transmitter components assembly is attached to the electronic module by four screws. The adjustable strap is attached by a bolt at each end.

c. Figure 1-15 presents a block diagram of the LTD. It should be noted that the external power adapter may be used in place of the battery-shoulder stock without affecting the way the other modules operate.

1-21. Purpose.

The purpose of this section is to familiarize maintenance personnel with the component function of the LTD system. The information presented provides an explanation of the components to assist maintenance personnel in performing repair functions at the DS maintenance level. Refer to Chapter 3 in this manual for procedures for removing and replacing components.

1-22. How To Read Functional Diagrams.

Table 1-4 contains the symbols to be used to aid in reading the functional diagrams in this chapter.

1-23. LTD System Block Diagram.

The LTD is a battery operated, lightweight, hand-held laser transmitter. The LTD transmits a coded beam that is used to designate targets or areas. The designated targets or areas can then be detected and tracked by aircraft or other vehicles equipped with similarly coded laser trackers.

The following general operation areas are keyed to a corresponding area on the block diagram (Figure 1-15) by use of white letters placed over a black hexagonal symbol, e.g.,(A).

(A) Power is supplied to the system from the Battery-Shoulder Stock or External Power Adapter The power is converted into proper voltages and distributed throughout the system.

(B) When the trigger is pulled, power is supplied to the air control assembly and both internal and external cooling fans are turned on. 24V START is also generated directly from the trigger and initiates timing signals.

(C) The Control and Timing circuitry when turned on by 24V START interprets the code switch settings and generates all timing signals for controlling the laser output. Circuitry provides the following timing signals and controls:

a. Timing Signals
   (1) HVPS Enable
   (2) Q/S FIRE
   (3) F/T FIRE
b. Control
   (1) Energy sense (A-Trig)
   (2) Temperature sense
   (3) Reticle
   (4) Malfunction indicator

(D) Upon receipt of timing control signals, the Laser Generation circuitry produces pulses at the frequency selected by the code switches.

(1) Produces high voltage current pulse from the PFN to fire the flashlamp which optically "pumps" the laser rod.

(2) Produces high voltage control of laser optical "Q" switch.

(E) LTD laser energy output is optimized by monitoring the laser energy output with a complex network of monitor and feedback signals.

a. The Power Supply Control monitors the following signals:
   (1) Battery voltage 24 VDC
   (2) PFN Voltage and Current
   (3) HVPS Enable
   (4) Pulse Rate
   (5) Energy Error

b. Inputs to Power Supply Control are automatically varied to compensate for the following:

   (1) Battery voltage
   (2) Electronic degradation
   (3) Flashlamp degradation
   (4) Difference in transmitter assemblies

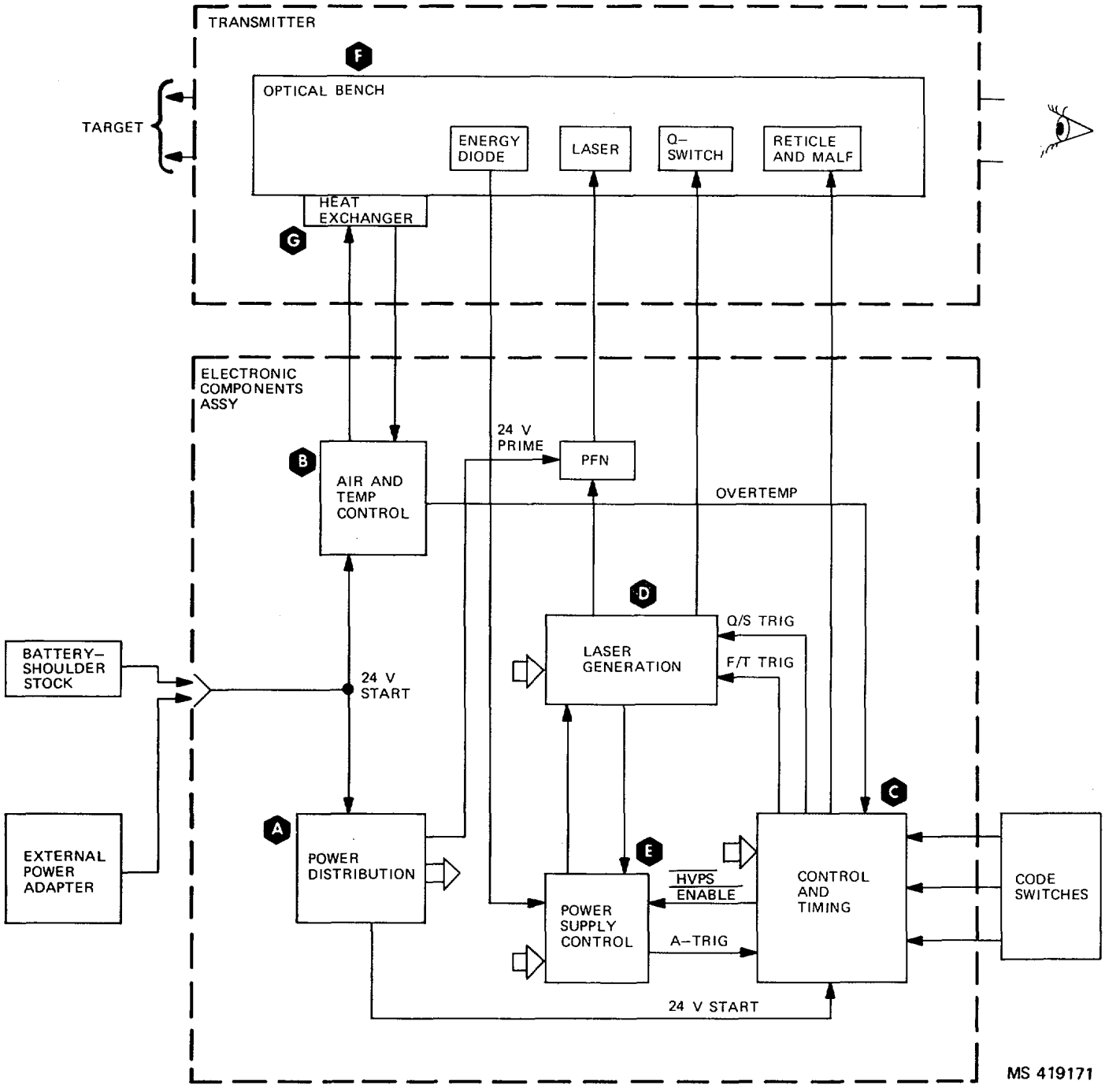
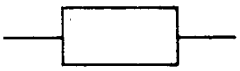
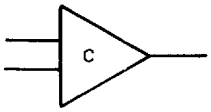
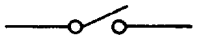
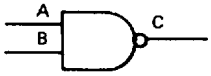


Figure 1-15. LTD System Block Diagram

Table 1-4. Symbols

Symbol	Explanation
	Indicates a complete circuit. Writing inside of box defines circuit. Refer to paragraph 1-8, Reference Designations, for nomenclature and part number of major components
	Indicates a comparator. Output is shown at the Apex of the triangle.
	Indicates a contact switch. All contact switches are shown in the open position.
	Indicates two input logical "OR" gate. A B C 0 0 0 1 0 1 0 1 1 1 1 1
	Indicates two input logical "NAND" gate. A B C 0 0 1 1 0 1 0 1 1 1 1 0
	Indicates an inverter/amplifier. Output is shown at the apex of the triangle. 
	Dashed lines indicate replaceable items.
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c. System output energy will self-correct to operate at optimum efficiency.

(F) The Optical bench provides

a. Sighting optics - a low power telescope with reticle.

b. Laser optics for development and transmission of laser beam along sighting axis of telescope.

c. Optical Q-switching of laser.

d. Malfunction indicator (visible in eyepiece).

e. Common mounting for all optical components to maintain stability, alignment and efficiency.

f. Laser energy feedback provided by the Energy Diode.

(G) The Heat Exchanger provides cooling for the laser which generates heat as a byproduct.

a. Compressed nitrogen acts as a coolant in a closed heat exchange loop (like a refrigerator).

b. An internal fan circulates the coolant around the heat exchanger.

c. An External fan passes air through the heat exchanger and past the electronics heat exchanger to remove the heat.

d. Internal and external heat sensors monitor temperatures and generate an overtemperature signal when necessary.

1-24. LTD Functional Diagrams.

As shown in the block diagram (Figure 1-15) the LTD operates upon control signals from control and timing, power control and distribution, PFN energy generation circuits, and air and temperature control. A malfunction indicator in the eyepiece reticle provides an indication of improper laser operation.

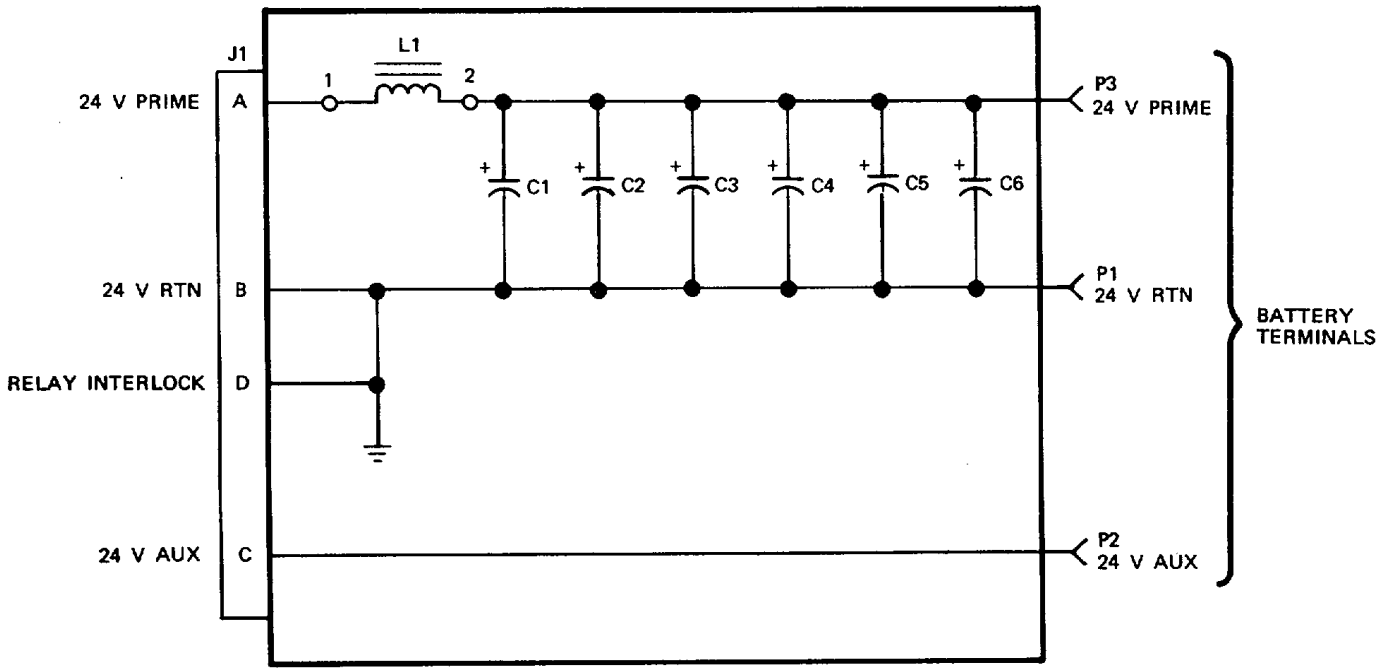
These basic areas are covered in the functional diagrams located at the back of this manual (FO-1 through FO-5). These functional diagrams provide a basic understanding of the LTD electronic circuitry and serve as an aid in repair and troubleshooting the LTD system.

1-25. EMI Filter Operation.

The purpose of the EMI filter is to limit conducted electromagnetic interference to an acceptable level and to provide an interlock path for the K1 power relay of the external power converter. A 160 microhenry inductor provides filtering against changes in current while six 86 microfarad 100V capacitors provide current storage and filtering against changes in voltage. For a schematic diagram of the EMI filter see Figure 1-16.

1-26. External Power Converter Functional Diagram.

The external power converter contains a power control relay and a voltage regulator. The power control relay is wired so that unit turn-on is prevented if the input polarity is reversed. The external power converter maintains a constant voltage output to the LTD over a wide range of input voltages. Refer to the external power converter functional diagram (Figure 1-17) for detailed theory of operation.



NOTE: C1–C6 = 86 μF
L1 = 160 μH

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Figure 1-16. EMI Filter Schematic Diagram

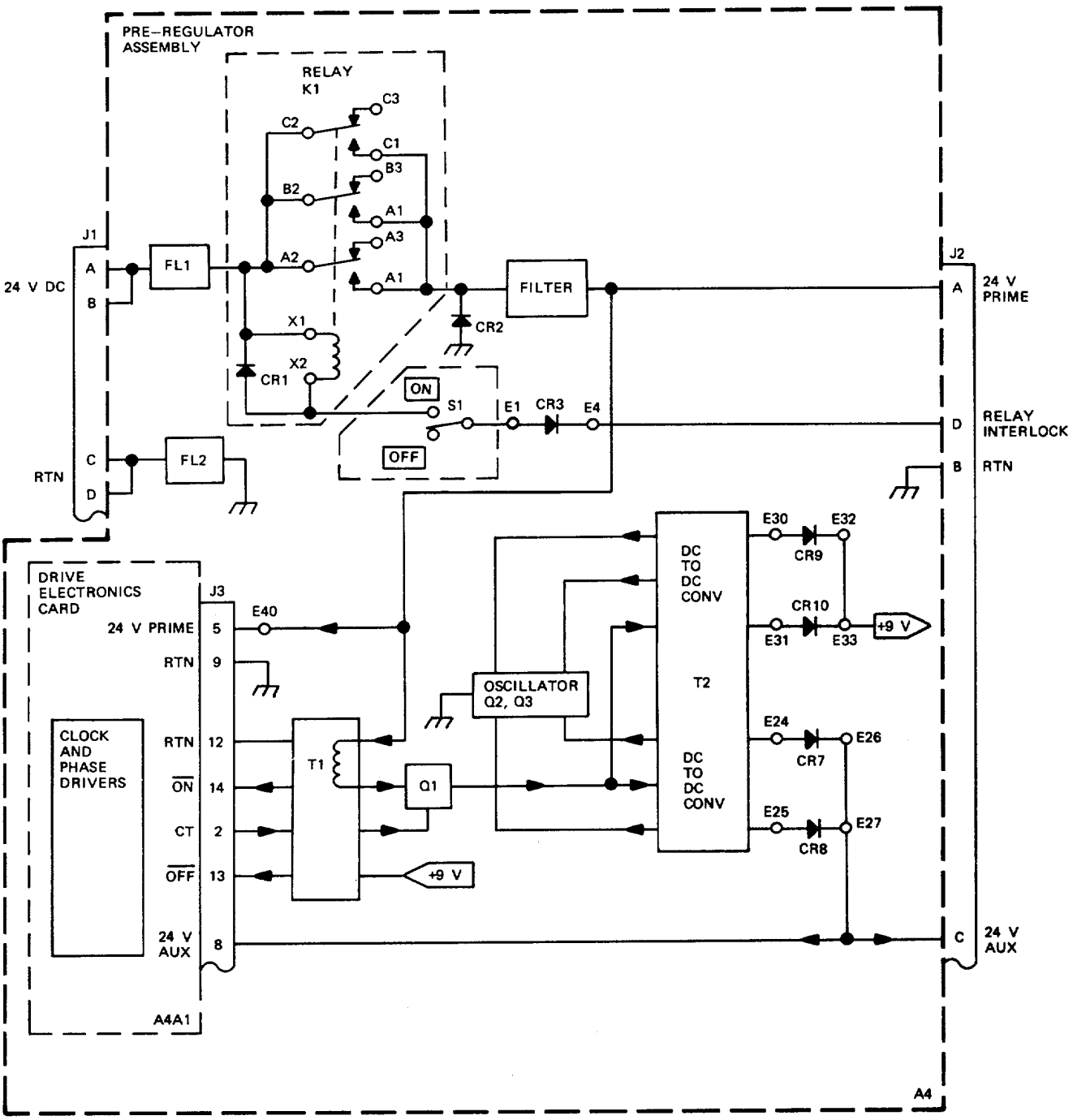

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Figure 1-17. External Power Converter Functional Diagram

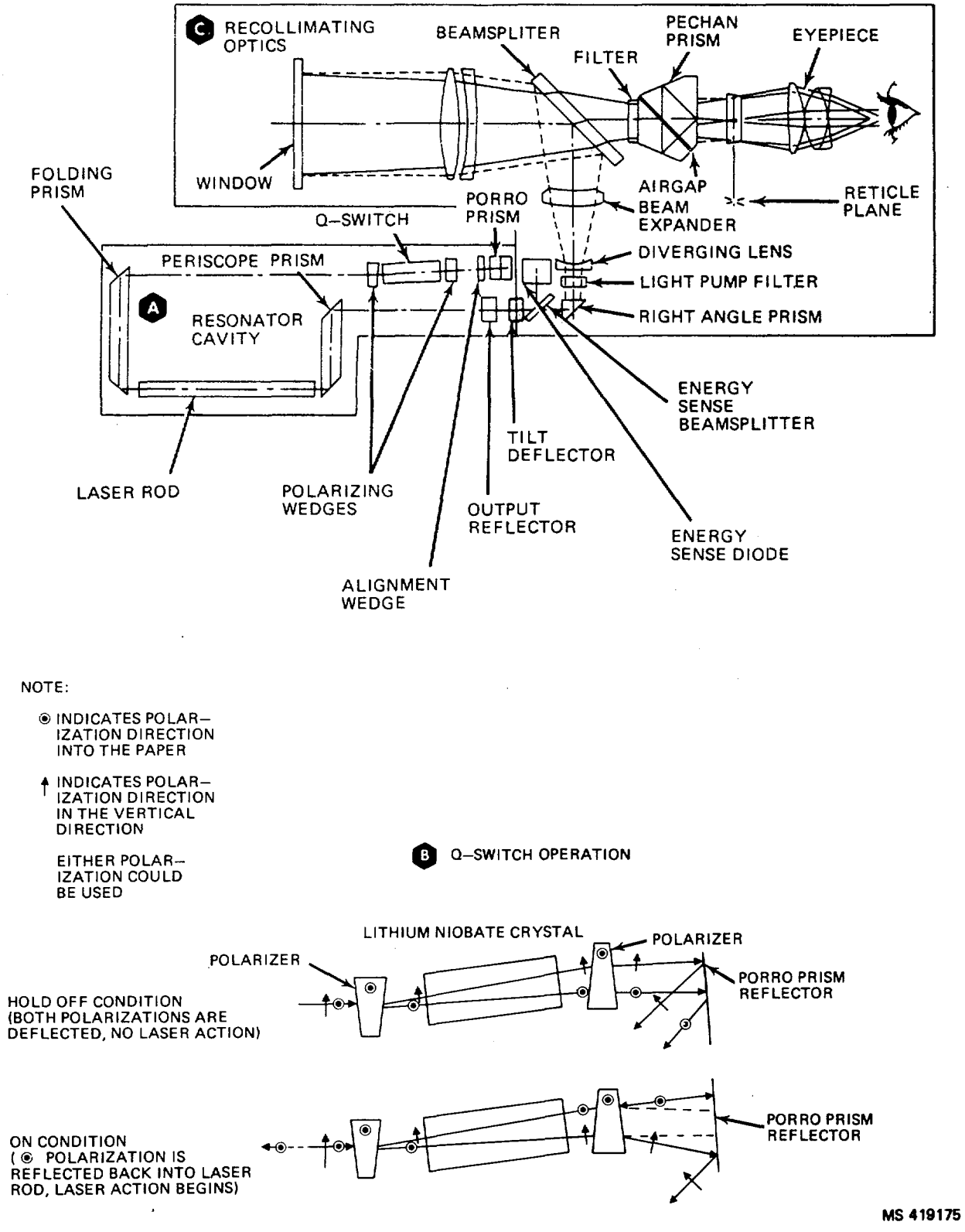

Figure 1-18. LTD Optics Diagram

1-27. LTD Optics Block Diagram.

The purpose of this paragraph is to provide a general understanding of the LTD optical layout. The LTD optics provide a 6.84-power sighting telescope for visual observation and target tracking, and a resonator cavity containing the laser rod. The laser rod produces a very narrow high energy pulse of light for designating point or area targets which can be detected and attacked by aircraft or munitions with similar laser trackers.

The following general operation theory areas are keyed to a corresponding area on the block diagram (Figure 1-18) by use of white letters placed over a black hexagonal symbol, e.g., **(A)**.

(A) The resonator cavity is formed by a partially reflecting output reflector, optical path prisms and a 100% reflecting porro prism.

a. The porro prism serves as a 100% reflector at the rear of the resonator cavity. It is a retro-reflector, where the incident beam is reflected exactly back on itself.

b. The folding prism deflects the beam 18W--degrees. It is also a retro-reflector but the reflected beam is displaced from the incident beam. This allows for the total optical path length to be folded in half and still maintain proper polarization.

c. Since the porro prism and the output reflector are fixed, an alinement wedge provides for small angular alinement.

d. The laser rod consists of YAG (Yttrium-Aluminum Garnet) as a host material doped with a 1% concentration of neodymium. The neodymium ions in the rod allow light energy from the flashlamp to be absorbed and stored as potential laser output. A population inversion exists in the rod when more atoms are in the excited state than in the normal ground state. This condition exists just after the flashlamp has been fired.

When the Q-switch (see **(B)**) is triggered, photons in the rod start to resonate between the output optics and the porro prism as a consequence of atoms changing states. Stimulated emission occurs when a photon passes an atom in an excited state and causes that atom to decay and emit a second photon identical to the first (same frequency and polarization). Thus, in each pass through the rod the number of photons which have the same frequency and polarization as the first photon increases.

This regenerative process continues until the energy stored in the rod is exhausted. The result is a light pulse 15-20 nanoseconds wide. This light is monochromatic and coherent.

(B) The Q-switch consists of two polarizing wedges and a LiNbO3 (Lithium Niobate) crystal. The Q-switch acts as a fast light switch for generation of high energy, narrow width laser pulses.

Operation of the Q-switch is achieved by refraction and displacement of the laser beam.

a. Hold-off condition In this condition there is no voltage on the LiNbO3 crystal. Unpolarized light from the laser rod passes through the first polarizing wedge and is split into two beams with an angle between them. The two beams then pass through the second wedge and are refracted parallel to their initial direction. However, the laser beam is purposely electro-optically misalign so that no lasing occurs.

b. On condition On Q-switch trigger command, the crystal is energized by a 5000V pulse which causes the polarization of the beams to rotate 90-degrees. This causes them to refract differently through the second polarizer and one of the polarized beams comes out alined parallel to the roof of the resonator cavity. Lasing action then commences for this polarization. (Either polarization could be used.)

(C) Once the light leaves the resonator it enters the recollimating optics through the tilt deflector which provides lateral optical centerline alinement to cause the resonator output to be precisely injected along the recollimating optics centerline. The purpose of the recollimating optics is to combine laser optics and visual optics through a common objective output lens. The two major units found within the recollimating optics are the energy sense beamsplitter and the transmitting/sighting telescope.

a. Energy sense beamsplitter As the laser pulse enters the recollimating optics the energy sense beamsplitter provides a sample of the laser output to energy sense circuits which adjust the PFN energy to keep the laser output energy at a constant level.

b. Transmitting telescope Once past the energy sense beamsplitter, the laser pulse enters a beam expander which is used to reduce the beam divergence to aid in collimating the beam. A beamsplitter then directs the beam through a focusing lens and onto the target.

c. Sighting telescope The sighting telescope used is a fixed, 6.84 power telescope with a 7 degree field of view. The telescope contains an edge lit reticle that allows for visual observation and target tracking. A malfunction indicator is located just above the reticle. An eye protection filter in front of the eyepiece protects the operator from eye damage by providing 60 db attenuation of the reflected laser light.

CHAPTER 2

GENERAL MAINTENANCE AND TROUBLESHOOTING PROCEDURES

Section I. LTD/EPA SYSTEM CHECK OUT

2-1. General.

a. The Maintenance Allocation Chart (MAC) found in Appendix B of TM 9-1260-479-12 authorizes categories of maintenance for the Laser Target Designator (LTD) and External Power Adapter (EPA). Only perform specific maintenance actions on those items identified by letters "O" or "F" in the Maintenance Function column of the MAC. Part numbers for items which are ORG or DS level replaceable are found in Repair Parts and Special Tools List manual TM 9-1260-479-24P.

b. This section describes procedures for system checkout of the LTD and EPA. Table 2-1 lists test equipment. Tables 2-3 through 2-5 list procedures for checking the LTD. Tables 2-7 through 2-9 list procedures for checking the EPA.

c. These procedures are designed to isolate the source of malfunctions to a replaceable assembly. In some cases, it is not possible to definitely identify a particular component as the source of a malfunction. In these instances, two or more assemblies will be listed in order of most likely failure and should be replaced, one at a time, until the malfunction has been eliminated.

d. Table 2-3 provides a functional checkout procedure for the LTD. Table 2-7 provides a functional checkout of the EPA. When a malfunction is observed, the table will provide corrective action information.

e. Tables 2-2 and 2-6 provide listings of fault indications for the LTD and EPA. For each malfunction listed, there is a reference to probable causes of failure.

f. Tables 2-4 and 2-5 contain the procedures for isolating malfunctions discovered during functional checkout of the LTD. Tables 2-8 and 2-9 contain procedures for isolating malfunctions discovered during functional checkout of the EPA. Each step contains the complete troubleshooting procedure for a particular malfunction.

2-2. Test Equipment and Special Tools.

Tools and test equipment required for test of the LTD are listed in Table 2-1. Alternate test equipment having equivalent characteristics may be used in place of the listed equipment. Before proceeding to the troubleshooting section, refer to TM 9-4931-599-13 to familiarize yourself with the operation of the LTD test equipment.

Table 2-1. Maintenance and Test Equipment Required

Part Number/NSN	Nomenclature	Common Name
6625-00-106-5581	Oscilloscope Tektronix 7633	Oscilloscope
6625-01-258-0022	Oscilloscope OS-291/G	Oscilloscope
6625-01-271-3012	Digital Electronic Counter AN/USM-459A	Counter
6625-01-139-2512	Multimeter, AN/PSM-45	Multimeter
5895-01-080-7940	Pulse Generator, Hewlett-Packard Model HP214B	Pulse Generator
5180-01-048-8570	Laser Systems Field Maintenance Tool Kit	Tool Kit
4931-01-040-3117 (13034400)	Test Set, Target Designator Laser AN/PAM-1	LTD Test Set or PAM-1
None Assigned	Electronic Shop, Shelter Mounted, AN/ASM-146B	Electronic Shop Shelter
6130-00-249-2748	Power Supply, Hewlett-Packard Model HP6268B (0 - 30 Vdc, 0 - 30 A)	Shop Power Supply
1260-01-040-1494 (13034435)	External Power Adapter MX-9653/PAQ-1	External Power Adapter (EPA)
None Assigned	Resistor, 10-kilohm, 2-Watt (Approx.)	
None Assigned	50-ohm Coax Termination	
None Assigned	4 RG50 Coax Cables, 36-inch	
None Assigned	1 RG58 50-ohm Coax Cable	

Table 2-2. LTD Fault Indications

Indication	Fault	Probable Causes
Malfunction Indicator - FULL ON	(a) High temperature	(a) Faulty blower, internal fan, nitrogen coolant pressure (in pressure vessel) too low, or air inlet blockage.
	(b) No laser output energy	(b) Faulty control card, PFN charge supply, PFN, or optical misalinement.
	(c) Low battery output	(c) Battery depleted.
Malfunction Indicator - Flashing	Low laser output energy	Faulty flashlamp, or improper laser energy correction logic (control card or PFN charge supply).
Reticle OFF	(a) No reticle crosshair display	(a) Faulty trigger switch, control card, or reticle assembly LEDs in transmitter.
	(b) Low battery output	(b) Battery depleted.
Laser-Guided Munitions Fail to Impact Target	Improper correlation between LTD and laser-guided munitions	Coding instability (faulty control card, code switches) or faulty optics or boresight misalinement (transmitter).

Section II. LTD TROUBLESHOOTING AND FUNCTIONAL CHECKOUT

2-3. Procedures.

LTD functional checkout is contained in Table 2-3. LTD troubleshooting procedures are contained in Tables 2-4 and 2-5. If all normal indications are obtained as required in the table, the LTD has passed functional checkout.

a. If a normal indication is not obtained as required, immediately perform the corrective action(s) indicated. When more than one assembly could cause the malfunction, replace items (or take specified action) in the order listed.

b. If any corrective action is taken, retest the LTD as follows:

(1) If oscilloscope (Tektronix model 7633) is being used, restart at step 16 of Table 2-3.

(2) If oscilloscope OS-291/G is being used, restart at step 108 of Table 2-3.

c. Continue repeating the procedure until every normal indication is obtained without corrective action interruption. If all corrective actions at a step are performed and a fail indication is still obtained, refer LTD to Depot for repair.

d. Interconnecting wiring and connectors are fault isolated by using functional diagrams Figures FO-1 thru FO-5 at the rear of the manual and the wire list contained in Appendix D.

2-4. Observable Malfunction Indications.

Table 2-2 contains a list of observable malfunction indications which could occur during functional checkout or field use. The information is given to acquaint DS maintenance personnel with a basic understanding of LTD failure modes and probable causes.

2-5. LTD Test Setup.

The system shall be tested inside the truck- mounted electronics shop shelter (AN/ASM-146B). Troubleshooting the LTD is based on the test equipment indications found during the checkout procedures in Table 2-3.

2-6. Initial Switch Settings (Figure 2-1).

Set test adapter selector switch to OFF. Check that shop power supply and external power converter switch (S1) are set to OFF. Set transmit- ter simulator selector switch to OFF.

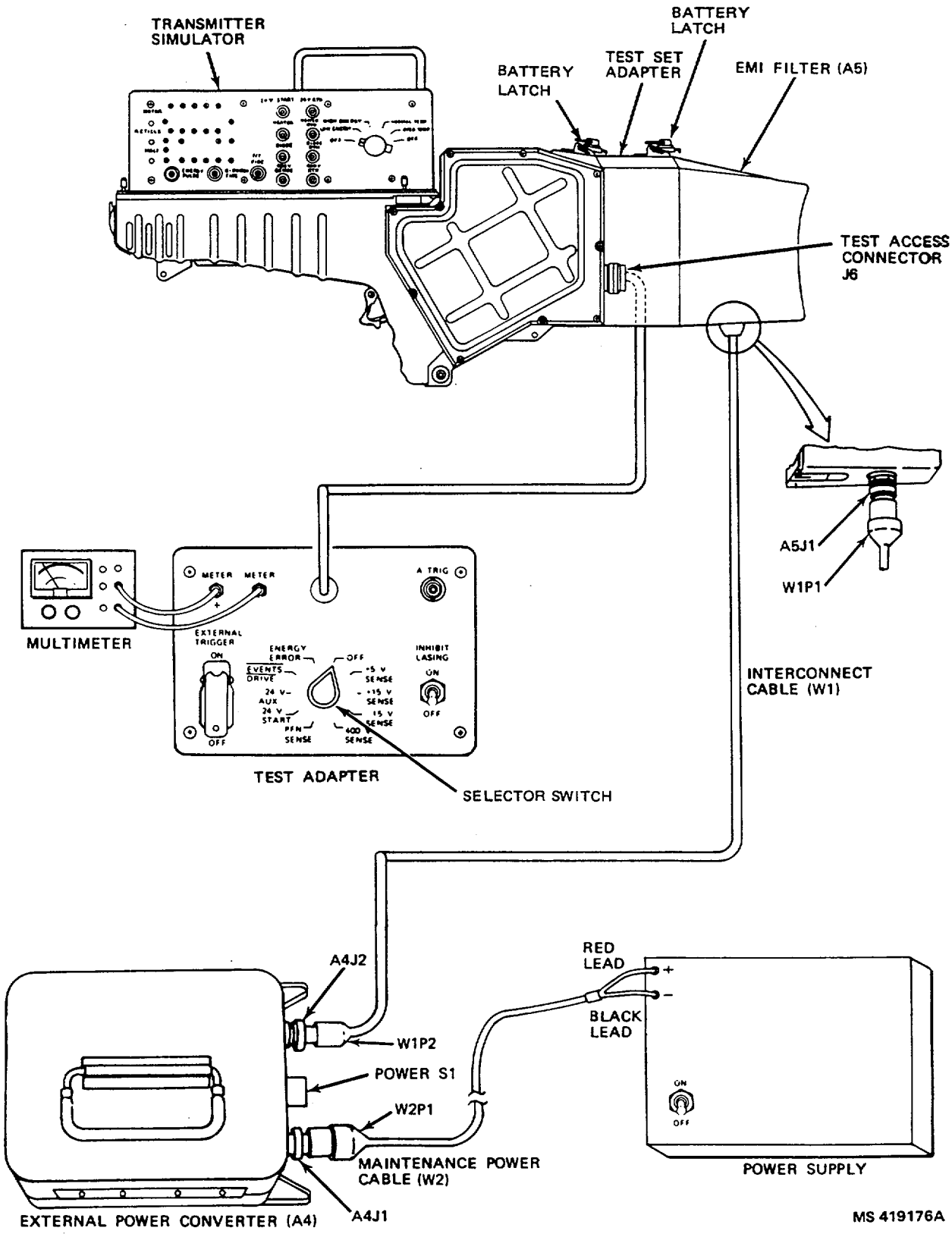

Figure 2-1. LTD Test Equipment Setup

Table 2-3. LTD Functional Checkout

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
	NOTE If oscilloscope OS-291/G is to be used, skip steps 1 thru 92 and begin testing at step 93. If oscilloscope (Tektronix Model 7633) is to be used, perform steps 1 thru 92 only.		
1	Place LTD on bench.		
2	Remove transmitter. (Refer to paragraph 3-4a.)		
3	Install transmitter simulator as follows: Refer to Figure 2-2.		
a	Holding electronic components assembly in one hand and transmitter simulator in the other, mate transmitter simulator connector P1 with mating connector J4 on electronic components assembly.		
b	Gently push assemblies together while watching for correct engagement or connectors. Tighten four captive screws on transmitter simulator until both assemblies are securely seated together.		
4	Remove protective cap from LTD test access connector J6.		
5	Pass cable of test adapter through test set adapter. (Refer to Figure 2-1.)		
6	Connect test adapter cable to LTD test access connector J6.		
7	Aline pin on test set adapter with hinge on LTD housing and engage test set adapter with LTD.		
8	Turn wingnut on LTD housing cw to secure test set adapter. Fold wingnut flat against housing.		
9	Aline pin on EMI filter with hinge on test set adapter and engage EMI filter on test set adapter.		
10	Turn wingnut on test set adapter cw to secure EMI filter. Fold wingnut flat against test set adapter housing.		
11	Connect interconnect cable W1 connector P1 to connector J1 on EMI filter.		

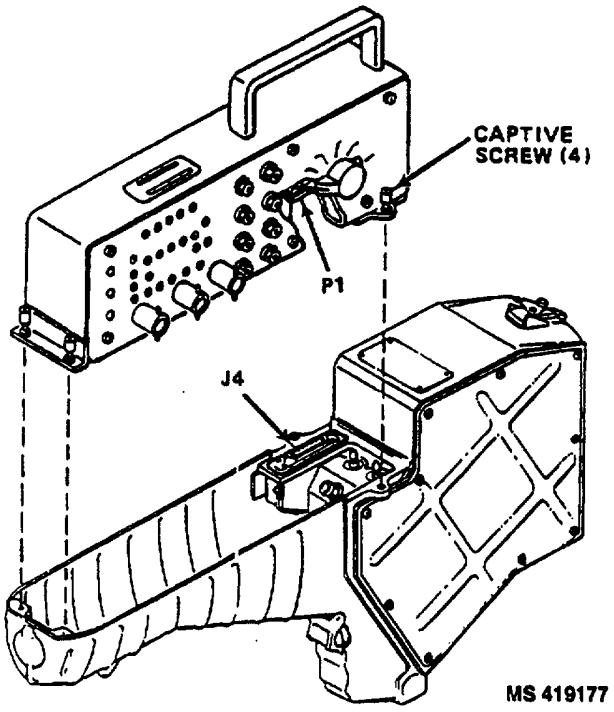

Figure 2-2. Installation of Transmitter Simulator

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
12	Connect interconnect cable Wi connector P2 to connector J2 on external power converter.		
13	Connect maintenance power cable (from LTD Test Set) connector P1 to external power converter connector J1. **WARNING** High voltages can cause electrical shock. Make sure shop power supply is off before proceeding.		
14	Connect maintenance power cable to shop power supply.		
15	Set MULTIMETER to 200 Vdc range. Connect + lead (red) to + and - lead (black) to - on the power supply. Turn power supply on and set voltage to 24 Vdc as shown on multimeter. Set current limit to maximum.		
16	Connect multimeter test leads to METER jacks + and - on test adapter.		
17	On external power converter, set POWER switch (S1) to ON.		
18	On test adapter, set INHIBIT LASING switch to ON.		
19	On transmitter simulator, set selector switch to NORMAL TEMP.		
20	Set multimeter to 200 Vdc range.		
21	On test adapter, set selector switch to 24 V AUX Vdc to LTD.	Multimeter indicates between 23 and 25 Vdc	(a) Check that test equipment is supplying 24 (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
22	On test adapter, set selector switch to 24 V START.		
23	On LTD, lift trigger safe guard, squeeze and hold trigger while observing multimeter, then release trigger	Multimeter indicates between 23.5 and 24.5 Vdc	(a) Replace air control assembly A2A4 including trigger switcah. (Refer to paragraph 3-8.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
24	On test adapter, set selector switch to +5 V SENSE.		
25	Set multimeter to 20 Vdc range.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
26	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 4.5 Vdc and 5.5 Vdc	(a) Replace control card A2A1. (Refer paragraph to 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
27	Set multimeter to 200 Vdc range		
28	On test adapter, set selector switch at + 15 V SENSE		
29	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 13 Vdc and 17.5 Vdc	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
30	Reverse multimeter test leads.		
31	On test adapter, set selector switch at -15 V SENSE.		
32	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch	Multimeter indicates between 13 Vdc and 17.5 Vdc	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
33	Set meter for measuring current.		
34	Reverse multimeter test leads and set multimeter to 100 microamp range.		
35	On test adapter, set selector switch at 400 V SENSE.		
	NOTE It is necessary to activate the Interlock Switch before replacing the control card A2A1 or Wiring Harness A2W1 if the electronics component assembly cover has been removed and replaced prior to this step.		
36	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 18.5 and 22 microamps	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.
37	On test adapter, set selector switch at PFN SENSE.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
38	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 30 and 46 microamps	(a) If no output is measured, go to Table 2-4. (b) If some output is measured but is not as required, replace control card A2A1. (Refer to paragraph 3-5.) (c) If control card A2A1 has been replaced in step (b), reinstall original card A2A1 and install a new PFM charge supply A2A3. (Refer to paragraph 3-7.) (d) If indication is not normal after (b) and (c) actions, replace wiring harness A2W1. (Refer to paragraph 3-11.)
39	Set multimeter to 20 Vdc range and connect (+) lead to HEATER jack and (-) lead to HEATER RTN jack on transmitter simulator.		
40	Hold test adapter EXTERNAL TRIGGER switch at ON; observe multimeter; release EXTERNAL TRIGGER switch	Multimeter measurement indicates between 4.6 and 5.4 Vdc	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
41	Set multimeter to 200 Vdc range and connect (+) lead to DIODE jack and (-) lead to DIODE RTN jack on transmitter simulator.		
42	Hold test adapter EXTERNAL TRIGGER to ON; observe multimeter; release EXTERNAL TRIGGER switch	Multimeter indicates between 11 and 19 Vdc	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
43	Connect channel A on oscilloscope to F/T FIRE connector on transmitter simulator and connect channel B to Q/SWITCH FIRE connector. (See Figure 2-3.)		

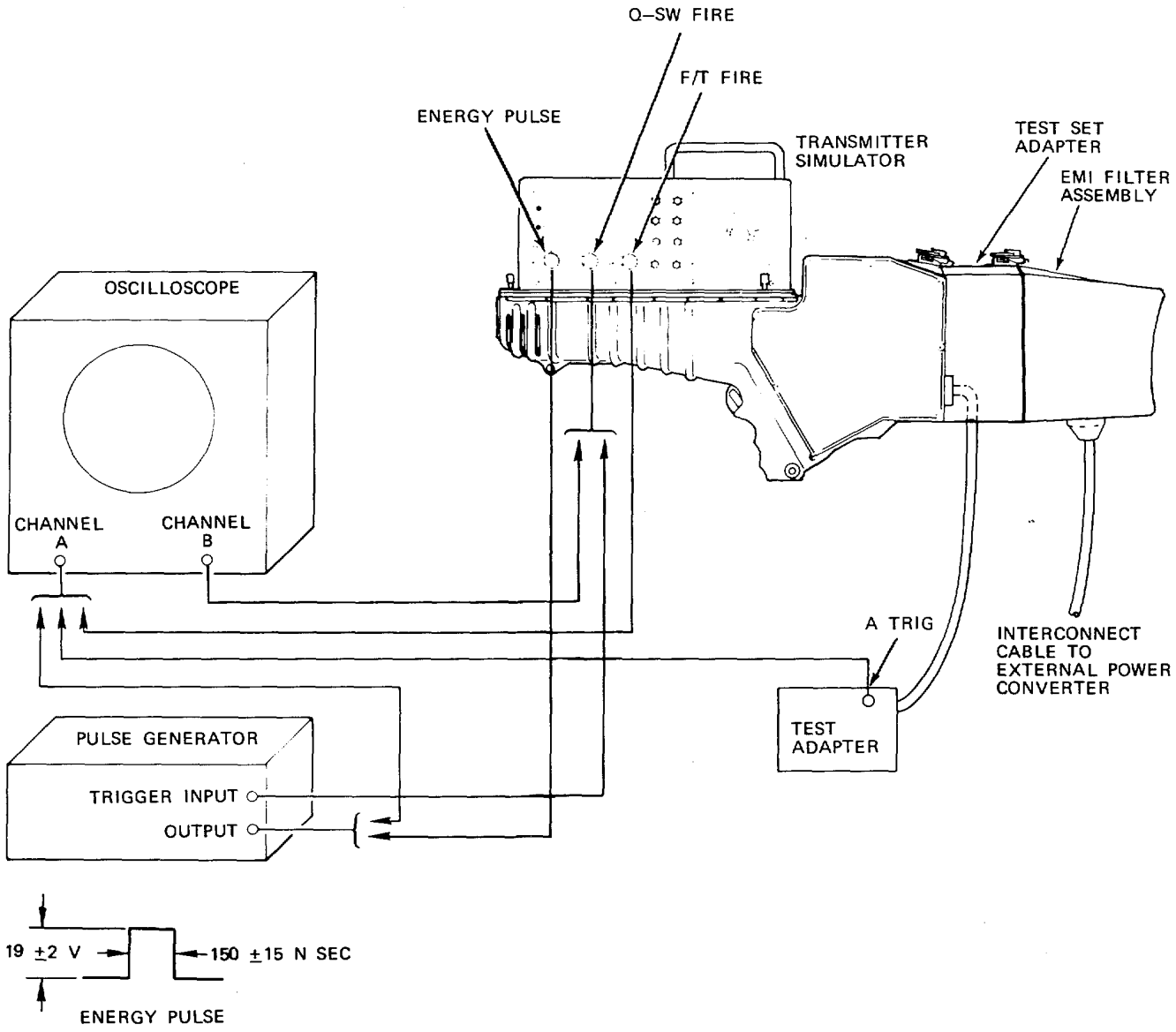

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Figure 2-3. Test Set-up with Oscilloscope

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
44	Set up scope to measure pulses shown in Figure 2-4 below.		
45	Set test adapter INHIBIT LASING switch at OFF.		
46	Hold test adapter EXTERNAL TRIGGER switch to ON; observe oscilloscope for Q/SWITCH and F/T FIRE timing pulses. Release test adapter EXTERNAL TRIGGER switch	Oscilloscope displays timing pulses shown in Figure 2-4	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
47	Set transmitter simulator selector switch to OVERTEMP.		
48	Hold test adapter EXTERNAL TRIGGER switch to ON; observe MALF light (on transmitter simulator) and oscilloscope for Q-SWITCH and F/T FIRE pulses; release switch	(a) MALF indicator is full on. MOTOR and RETICLE indicators are lit (b) Oscilloscope displays: 0.0 to 0.8 Vdc (no output)	(a) Go to table 2-5. (b) If a fail indication is obtained after performing table 2-5, replace wiring harness A2W1. (Refer to paragraph 3-11.)

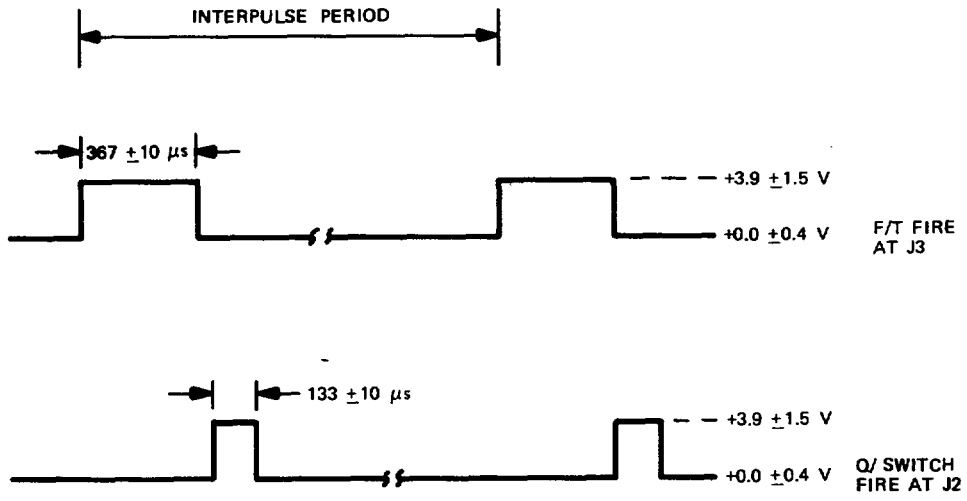

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Figure 2-4. Transmitter Simulator Outputs

Table 2-3. LTD Functional Checkout (Continued)

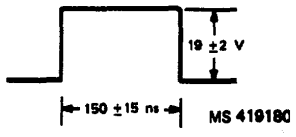
Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
49	Disconnect leads between oscilloscope and transmitter simulator.		
50	Set transmitter simulator to NORMAL TEMP. Connect Q-SWITCH FIRE connector on transmitter simulator to the pulse generator TRIGGER INPUT connector. (See Figure 2-3.)		
51	Connect pulse generator OUTPUT to oscilloscope channel A. Terminate connection at oscilloscope in a 50 ohm load.		
52	Set oscilloscope to display Figure 2-5 waveform.		
53	Set pulse generator to the following positions: PULSE ADVANCE/PULSE DELAY/ DOUBLE PULSE switch to PULSE DELAY TRIGGER MODE to EXT INT REP RATE to .01 to .1 PULSE POSITION to 0 to 1 ps PULSE WIDTH to .05 to 1 Jps PULSE AMPLITUDE to 50 volts PULSE OUTPUT to "+" TRIGGER INPUT to "-" GATE INPUT (+) to NORM Turn power on.		
54	Hold EXTERNAL TRIGGER switch on test adapter at ON; adjust pulse generator controls to obtain a 17 to 21 V 150 + 15 ns pulse; release EXTERNAL TRIGGER switch.	Oscilloscope displays Figure 2-5 waveform.  *Figure 2-5. Energy Pulse*	
55	Disconnect lead between oscilloscope channel A and OUTPUT of pulse generator and remove 50 ohm terminator.		
56	Set transmitter simulator switch at HIGH ENERGY.		
57	Connect OUTPUT of pulse generator to ENERGY PULSE connector on transmitter simulator. (See Figure 2-3.)		
58	Connect oscilloscope channel A to A-TRIG connector on test adapter. (See Figure 2-3.) Set oscilloscope to display Figure 2-6 waveform.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
59	Hold Test adapter EXTERNAL TRIGGER switch at ON; observe oscilloscope; re-	Oscilloscope displays Figure 2-6 waveform	(a) Replace control card A2A1. (Refer to para-
60	Set transmitter simulator switch at LOW ENERGY.	*Figure 2-6. A-Trig.*	
61	Hold test adapter EXTERNAL TRIGGER switch at ON; observe MALF indicator or transmitter simulator; release EXTERNAl TRIGGER switch.	MALF indicator ligh is flashing after approximately 20 seconds	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to para graph 3-11.)
62	Set transmitter simulator switch at HIGH ENERGY.		
63	Disconnect lead between oscilloscope channel A and A-TRIG connector on test adapter.		
64	Set code switches to select code numbe 241.		
65	Set multimeter to 20 Vdc range and connect (+) lead to (+) METER terminal on test adapter; connect (-) lead to (-) METER terminal on test adapter.		
66	Set test adapter test select switch at ENERGY ERROR.		
	CAUTION Multimeter reading in the next step may be positive or negative. Care should be taken to prevent pegging meter when measurement is taken.		
	NOTE In the next step multimeter indication will vary, but must be within the limits of OV to + 5 V after approximately 20 seconds (if code select switches are set to 241).		
67	Hold EXTERNAL TRIGGER switch to ON; observe multimeter for approximately 20 seconds; release EXTERNAL TRIGGER switch.	Multimeter indication should be at + 4.5 V + 0.5 Vdc at end of 20 seconds	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
68	Set transmitter simulator switch at LOW ENERGY.		
69	Reverse multimeter leads connected to test adapter METER terminals.		
70	Hold EXTERNAL TRIGGER switch on test adapter to ON; observe multimeter; release EXTERNAL TRIGGER switch.	Multimeter indication should be at - 4.5V--0.5 VDC at end of 20 seconds	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
71	Perform code timing check found in TB 9-1260-479-30.		
72	Turn power off on all test equipment, and disconnect leads between oscilloscope, pulse generator, and transmitter simulator.		
73	Remove transmitter simulator from electronics assembly by loosening four captive screws on transmitter simulator.		
74	Install LTD transmitter module per paragraph 3-4.		
75	Turn power supply on and adjust power supply voltage to 14.5 + .5 VDC		
76	Set POWER switch of external power converter to ON.		
77	Remove eyepiece lens cover.		
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observe WARNING inside front cover of this manual before proceeding.		
78	Squeeze and hold trigger; observe eyepiece; release trigger	MALFUNCTION indicator comes on	Replace transmitter module per paragraph 3-4.
79	Set power supply voltage to 24 VDC.		

Table 2-3. LTD Functional Checkout (Continued)

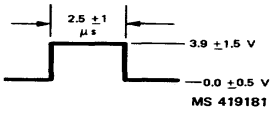
Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observe WARNING inside front cover of this manual before proceeding. **NOTE** The fan has a high pitch (internal fan inside pressure vessel) and the blower (in plenum housing) has a low pitch. A stethoscope or other listening device may be used, if required, to verify internal fan operation.		
80	Hold EXTERNAL TRIGGER switch to ON for approximately 60 seconds; listen for internal fan operation; observe Malfunction indicator in eyepiece reticle; release EXTERNAL TRIGGER switch	(a) Internal fan noise is heard (b) Reticle is lit (c) MALF indicator is not lit	(a) If indication (a) is not obtained replace transmitter module per paragraph 3-4. (b) If indication (b) is not obtained replace transmitter module per paragraph 3-4 (c) If indication (c) is not obtained remove and replace the flashlamp per paragraph 3-12 and retest. If MALF indicator is still lit perform nitrogen purge and fill procedures per paragraph 2-15 and retest. If still abnormal remove and replace transmitter module per paragraph 3-4.
81	Install eyepiece lens cover.		
82	Connect oscilloscope Channel A to A-TRIG connector on test adapter. (Set oscilloscope to display Figure 2-7 waveform).		
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observer WARNING inside front cover of this manual before proceeding.		
83	Hold test adapter EXTERNAL TRIGGE witch to ON. Observe oscillocope; then release switch.	Oscilloscope display Figure 2-7 waveform. 	

Figure 2-7. A-Trig

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
84	LTD has passed functional checkout.		
85	Turn off external power converter and shop power supply.		
86	Disconnect lead betwen oscilloscope channel A and test adapter.		
87	Disconnect cable from external power converter and EMI filter.		
88	Disconnect cable from shop power supply and external power converter.		
89	Remove EMI filter from test set adapter.		
90	Remove test set adapter from LTD.		
91	Replace protective cover on LTD test access connector J6.		
92	Return components to their individual transit cases.		
	NOTE If oscilloscope OS-291/G is to be used, skip steps 1 thru 92 and begin testing at step 93. If oscilloscope (Tektronix Model 7633) is to be used, perform steps 1 thru 92 only. Steps 93 thru 184 are identical to steps 1 thru 92 except for oscilloscope OS-291/G setups.		
93	Place LTD on bench.		
94	Remove transmitter (Refer to paragraph 3-4a.)		
95	Install transmitter simulator as follows: Refer to Figure 2-7.1.		
a	Holding electronic components assembly in one hand and transmitter simulator in the other, mate transmitter simulator connector P1 with mating connector J4 on electronic components assembly.		
b	Gently push assemblies together while watching for correct engagement of connectors.		
c	Tighten four captive screws on transmitter simulator until both assemblies are securely seated together.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
96	Remove protective cap from LTD test access connector J6.		
97	Pass cable of test adapter through test set adapter. (Refer to Figure 2-1.)		
98	Connect test adapter cable to LTD test access connector J6.		
99	Align pin on test set adapter with hinge on LTD housing and engage test set adapter with LTD.		
100	Turn wingnut on LTD housing cw to secure test set adapter Fold wingnut flat against housing.		
101	Align pin on EMI filter with hinge on test set adapter and engage EMI filter on test set adapter.		
102	Turn wingnut on test set adapter cw to secure EMI filter. Fold wingnut flat against test set adapter housing.		
103	Connect interconnect cable W1 connector P1 to connector J1 on EMI filter.		
104	Connect interconnect cable W1 connector P2 to connector J2 on external power converter.		
105	Connect maintenance power cable (from LTD Test Set) connector P1 to external power converter connector J1. **WARNING** High voltages can cause electrical shock Make sure shop power supply is off before proceeding.		
106	Connect maintenance power cable to shop power supply.		

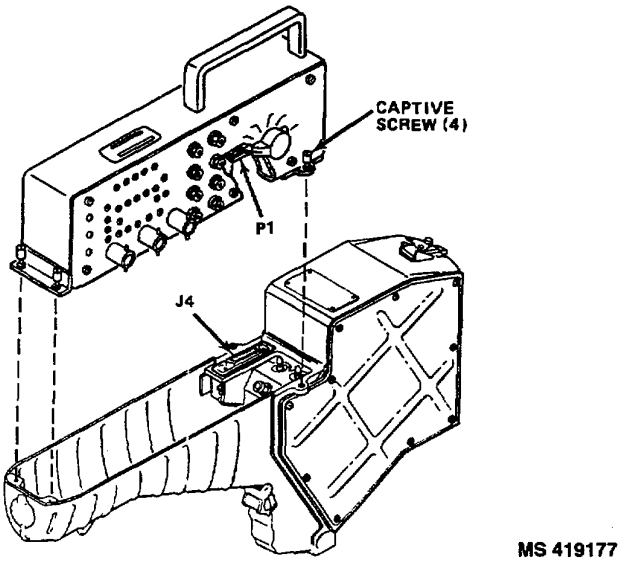


Figure 2-7.1. Installation of Transmitter Simulator

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
107	Connect multimeter test leads to METER jacks + and - on test adapter.		
108	On shop power supply, set voltage to 24 VDC, set current limit to maximum, turn power supply on.		
109	On external power converter, set POWER switch (S1) to ON.		
110	On test adapter, set INHIBIT LASING switch to ON.		
111	On transmitter simulator, set selector switch to NORMAL TEMP.		
112	Set multimeter to 50 Vdc range.		
113	On test adapter. set selector switch to 24 V AUX	Multimeter indicates between 23 and 25 Vdc	(a) Check that test equipment is supplying 24 Vdc to LTD. (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
114	On test adapter, set selector switch to 24 V START.		
115	On LTD, lift trigger safe guard, squeeze and hold trigger while observing multimeter, then release trigger.	Multimeter indicates between 23.5 and 24.5 Vdc	(a) Replace air control assembly A2A4 including trigger including trigger switch. (Refer to paragraph 3-8.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
116	On test adapter, set selector switch to +5 V SENSE.		
117	Set multimeter to 10 Vdc range.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
118	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter Release switch.	Multimeter indicates between 4.5 and 5.5 Vdc	(a) Replace control card A2A1. (Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
119	Set multimeter to 50 Vdc range.		
120	On test adapter, set selector switch to +15 V SENSE.		
121	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 13 and 17.5 Vdc	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
122	Reverse multimeter test leads.		
123	On test adapter, set selector switch to -15 V SENSE.		
124	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 13 and 17.5 Vdc	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
125	Set multimeter for measuring current.		
126	Reverse multimeter test leads and set multimeter to 100 microamp range.		
127	On test adapter, set selector switch to 400 V SENSE.		
	NOTE It is necessary to activate the Interlock Switch before replacing the control card A2A1 or wiring harness A2W1 if the electronic components assembly cover has been removed and replaced prior to this step.		
128	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter	Multimeter indicates between 18.5 and 22 microamps Release	(a) Replace control card A2A1. (Refer to paragraph 3-5.) switch. (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
129	On test adapter, set selector switch to PFN SENSE.		

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
130	On test adapter, lift switch guard and actuate EXTERNAL TRIGGER switch while observing multimeter. Release switch.	Multimeter indicates between 30 and 46 microamps	(a) If no output is measured, go to (b) If some output is measured, but it is not as required, replace control card A2A1. (Refer to paragraph 3-5.) (c) If control card A2A1 has been replaced in step (b), reinstall original card A2A1 and install a new PFN charge supply A2A3(Refer to paragraph 3-7.) (d) If indication is not normal after (b) and (c) actions, replace wiring harness A2W1. (Refer to paragraph 3-11.)
131	Set multimeter to 10 Vdc range and connect (+) lead to HEATER RTN jack on transmitter simulator.		
132	Hold test adapter EXTERNAL TRIGGER switch ON; observe multimeter; release EXTERNAL TRIGGER switch.	Multimeter indicates between 4.6 and 5.4 Vdc	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
133	Set multimeter to 50 Vdc range and connect (+) lead to DIODE jack and (-) lead to DIODE RTN jack on transmitter simulator.		
134	Hold test adapter EXTERNAL TRIGGER switch ON: observe multimeter; release EXTERNAL TRIGGER switch	Multimeter indicates between 11 and 19 Vdc	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
135	Connect oscilloscope CH 1 to F/T FIRE connector on transmitter simulator and connect oscilloscope CH 2 to O-SWITCH FIRE connector. (See Figure 2-7.2.)		

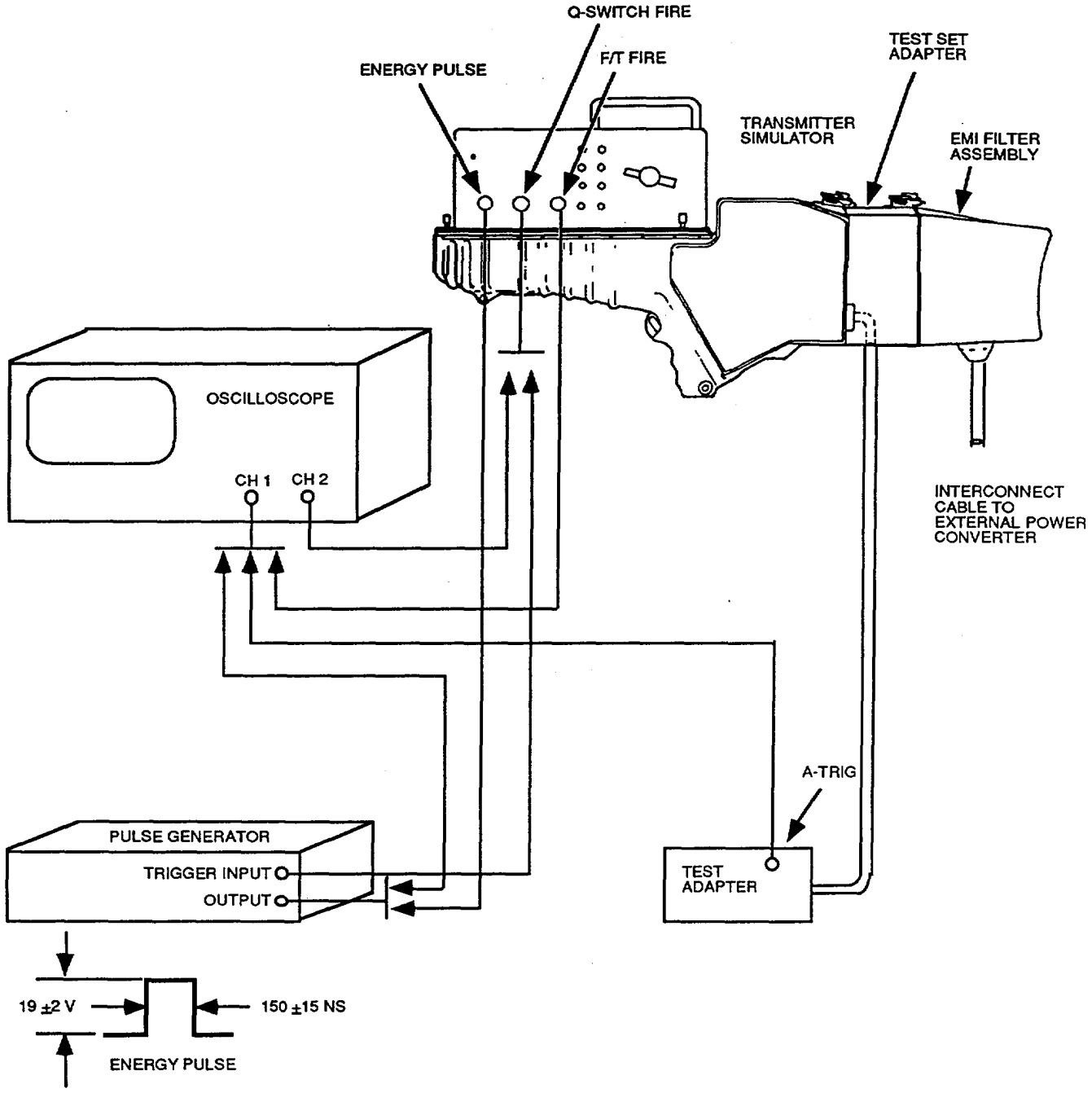


Figure 2-7.2. Test Setup with Oscilloscope 05S-291/G

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
	NOTE For additional information on operation of oscilloscope OS-291/G. refer to TM 11-6625-3241-12.		
136	Set up oscilloscope as follows: Press SETUP PRGM button Select INIT PANEL on menu Press VERTICAL MODE button Select CH 1 AND CH 2 on menu Set CH 1 VOLTS/DIV to 2 V Set CH 2 VOLTS/DIV to 2 V Set A AND B SEC/DIV to 50 es/div Press TRIGGER SOURCE button Select CH 1 on menu		
137	On test adapter, set INHIBIT LASING switch to OFF.		
138	On test adapter, hold EXTERNAL TRIGGER switch to ON: observe oscilloscope for Q-SWITCH and F/T FIRE timing pulses. Release EXTERNAL TRIGGER switch	Oscilloscope displays timing pulses shown in Figure 2-7.3	(a) Replace control card A2A1(Refer to paragraph 3-5.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)

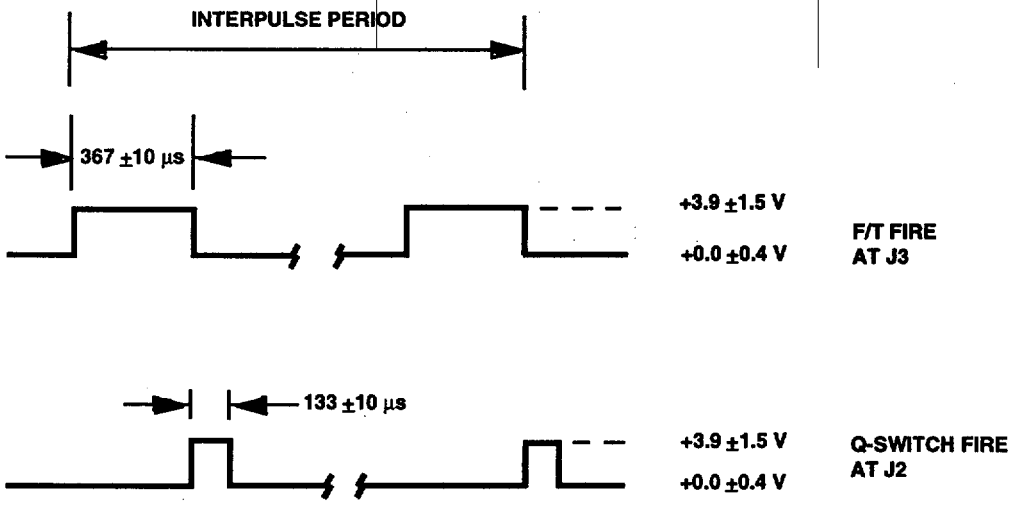


Figure 2-7.3. Transmitter Simulator Outputs

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
139	On transmitter simulator, set selector switch to OVERTEMP.		
140	On test adapter, hold EXTERNAL TRIGGER switch to ON; observe MALF indicator (on transmitter simulator) and oscilloscope for Q-SWITCH and F/T FIRE timing pulses. Release EXTERNAL TRIGGER switch output.)	(a) MALF indicator is full on MOTOR and RETICLE indicators are lit (b) Oscilloscope displays: 0.0 to 0.8 Vdc (no	(a) Go to Table 2-5. (b) If fail indication is obtained after performing Table 2-5, replace wiring harness A2W1. (Refer to paragraph 3-11.)
141	Disconnect leads between oscilloscope and transmitter simulator.		
142	On transmitter simulator, set selector switch to NORMAL TEMP. Connect Q-SWITCH FIRE connector on transmitter simulator to the pulse generator TRIGGER INPUT connector. (See Figure 2-7.2.)		
143	Connect pulse generator OUTPUT to oscilloscope CH 1. Terminate connection at oscilloscope in a 50-ohm load.		
	NOTE For additional information on operation of oscilloscope OS-291/G, refer to TM 11-6625-3241-12.		
144	Set oscilloscope to display Figure 2-7.4 waveform as follows. Press SETUP PRGM button Select INIT PANEL on menu Set CH 1 VOLTS/DIV to 2 V Set A AND B SEC/DIV to 1Is		
145	Set pulse generator to the following positions: PULSE ADVANCE/PULSE DELAY/DOUBLE PULSE switch to PULSE DELAY TRIGGER MODE TO EXT INT REP RATE to 0.1 ms to 1 ms PULSE POSITION to 10 lis to 0.1 ms PULSE WIDTH to O.l1s to l1s PULSE AMPLITUDE 10 volts to 30 volts PULSE OUTPUT to "+" TRIGGER INPUT to "-" GATE INPUT (+) to NORM Turn power on.		

Table 2-3. LTD Functional Checkout (Continued)

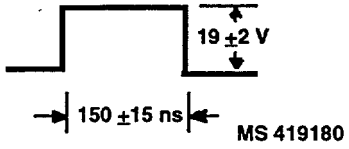
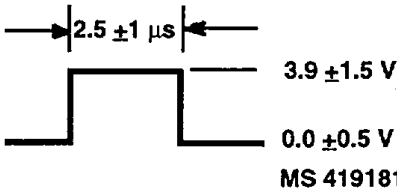
Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
146	Hold EXTERNAL TRIGGER switch on test adapter to ON; adjust pulse generator controls to obtain a 17 to 21 V, 150 ±15 ns pulse; releas EXTERNAL TRIGGER switch.	Oscilloscope displays Figure 2-7.4 waveform.  *Figure 2-7.4. Energy Pulse*	
147	Disconnect lead between oscilloscope CH 1 and OUTPUT of pulse generator and remove 50-ohm terminator.		
148	Set transmitter simulator switch t HIGH ENERGY.		
149	Connect OUTPUT of pulse generator to ENERGY PULSE connector on transmitter simulator. (See Figure 2-7.2.)		
	NOTE For additional information on operation of oscilloscope 0S-291/G, refer to TM 11-6625-3241-12.		
150	Connect oscilloscope CH 1 to A-TRI connector on test adapter. (See Figure 2-7.2.) Set oscilloscope t display Figure 2-7.5 waveform as follows: Press SETUP PRGM button Select INIT PANEL on menu Press VERTICAL MODE button Select CH 1 on menu Set CH 1 VOLTS/DIV to 2 V Set A AND B SEC/DIV to 1ls Press TRIGGER MODE button Select NORMAL on menu Press TRIGGER SOURCE button Select CH 1 on menu Adjust TRIGGER LEVEL to approximately +2.0 V		
151	Hold EXTERNAL TRIGGER switch at ON; observe oscilloscope; release EXTERNAL TRIGGER switch. Oscilloscope displays	Oscilloscope display Figure 2-7.5 waveform.  *Figure 2-7.5. A-Trig*	(a) Replace control card A2A1. (Refer to paragraph 3-9.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
152	Set transmiter simulator switch to LOW ENERGY.		
153	Hold EXTERNAL TRIGGER switch to ON: observe MALF indicator on transmitter simulator: release EXTERNAL TRIGGER switch.	MALF indicator light is flashing after approximately 20 seconds	(a) Replace control card A2A1. (Refer to paragraph 3-9.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
154	Set transmitter simulator switch to HIGH ENERGY.		
155	Disconnect lead between oscilloscope CH 1 and A-TRIG connector on test adapter.		
156	Set code switches to select code number 241.		
157	Set multimeter to 10 Vdc range and connect (+) lead to (+) METER terminal on test adapter: connect (-) lead to (-) METER terminal on test adapter.		
158	On test adapter, set selector switch to ENERGY ERROR.	**CAUTION** Multimeter reading in the next step may be positive or negative. Care should be taken to prevent pegging meter when measurement is taken. **NOTE** In the next step multimeter indications will vary, but must be between 0 and +5 V after approximately 20 seconds (if code select switches are set to 241).	
159	Hold EXTERNAL TRIGGER switch at ON; observe multimeter for approximately 20 seconds; release EXTERNAL TRIGGER switch	Multimeter indicates +4.5 ±0.5 V at end of 20 seconds	(a) Replace control card 2A1(Refer to paragraph 3-9.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)
160	Set transmitter simulator switch to LOW ENERGY.		
161	Reverse multimeter leads connected to test adapter METER terminals.		
162	Hold EXTERNAL TRIGGER switch at ON: observe multimeter: release EXTERNAL TRIGGER switch	Multimeter indicates -4.5 ±0.5 V at end of 20 seconds	(a) Replace control card A2A1(Refer to paragraph 3-9.) (b) Replace wiring harness A2W1. (Refer to paragraph 3-11.)

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
163	Perform code timing check found in TB 9-1260-479-30.		
164	Turn power off on all test equipment, and disconnect leads between oscilloscope, pulse generator, and transmitter simulator.		
165	Remove transmitter simulator from electronic components assembly by loosening four captive screws on transmitter simulator.		
166	Install LTD transmitter per paragraph 3-4.		
167	Turn on shop power supply and adjust shop power supply voltage to 14.5 +0.5 VDC.		
168	Set power switch of external power converter to ON.		
169	Remove eyepiece lens cover.		
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observe WARNING inside front cover of this manual before proceeding.		
170	Squeeze and hold trigger; observe eyepiece; release trigger	Malfunction indicator comes on.	Replace transmitter per paragraph 3-4.
171	Set shop power supply voltage to 24 VDC.		
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observe WARNING inside front cover of this manual before proceeding.		
	NOTE The fan has a high pitch (internal fan inside pressure vessel) and the blower (in the plenum housing) has a low pitch. A stethoscope or other listening device may be used, if required to verify internal fan operation.		
172	Hold EXTERNAL TRIGGER switch ON for approximately 60 seconds; listen for internal fan operation; observe malfunction indicator in eyepiece reticle; release EXTERNAL TRIGGER switch is not lit	(a) Internal fan noise is heard (b) Reticle is lit (c) Malfunction indicator not obtained, replace transmitter per paragraph 3-4.	(a) If indication (a) is not obtained, replace transmitter per paragraph 3-4. (b) If indication (b) is

Table 2-3. LTD Functional Checkout (Continued)

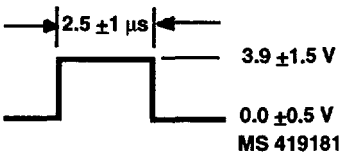
Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
			(c) If indication (c) is not obtained, remove and replace flashlamp per paragraph 3-12 and retestIf malfunction indicator is still lit, perform nitrogen purge and fill procedure per paragraph 2-15 and retest. If still abnormal, replace transmitter per paragraph 3-4.
173	Install eyepiece lens cover.		
	NOTE For additional information on operation of oscilloscope os-291/G. refer to TM 11-6625-3241-12.		
174	Connect oscilloscope CH 1 to A-TRIG connector on test adapter. Set oscilloscope to display Figure 2-7.6 waveform as follows: Press SETUP PRGM button Select INIT PANEL on menu Set CH 1 VOLTS/DIV to 2 V Set A AND B SEC/DIV to ls		
	WARNING Laser will be fired in the next step. Insure that the transmitter window lens cover is installed. Observe WARNING inside front cover of this manual before proceeding.		
175	Hold test adapter EXTERNAL TRIGGER switch to ON Observe oscilloscope; then release switch.	Oscilloscope display Figure 2-7.6. waveform.  *Figure 2-7.6. A-Trig*	Replace transmitter per paragraph 3-4.

Table 2-3. LTD Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
176	LTD has passed functional checkout.		
177	Turn off external power converter and shop power supply.		
178	Disconnect lead betwen oscilloscope CH 1 and test adapter.		
179	Disconnect cable from external power converter and EMI filter.		
180	Disconnect cable from shop power supply and external power converter.		
181	Remove EMI filter from test set adapter.		
182	Remove test set adapter from LTD.		
183	Replace protective cover on LTD test access connector J6.		
184	Return components to their individual transit cases.		

Table 2-4. Troubleshooting Procedures - Laser Output Energy Fault

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
1	Make sure power supply and external power converter switches are set at OFF.		
2	Remove electronic components assembly cover and control card per paragraph 3-5.		
3	Connect multimeter probes between wiring harness connector A2WlJl pins 27 and 28, (see figure 3-2). Monitor resistance across terminals by physically actuating interlock switch.	Multimeter measurement indicates less than 1.0 ohm 3-10.	Replace interlock switch A2W1S4 per paragraph
4	Remove PFN connector A2W1P1 (see Figure 3-3) per paragraph 3-6a, steps 1 and 2 only.		
5	Using multimeter, measure resistance between J1-9 and 31-3 on PFN one minute.	Multimeter measurement indicates between 0.9 and 1.1 megohms after approximately	Replace PFN A2A2 per paragraph 3-6.
6	Using multimeter, measure resistance between J1-g and J1-1 on PFN minute.	Multimeter measurement indicates between 1.32 and 1.62 megohms after approximately one	Replace PFN A2A2 per paragraph 3-6.
7	Using multimeter, measure resistance between J1-1 and Jl1-3 on PFN	Multimeter measurement indicates between 430 K and 490K ohms.	Replace PFN A2A2 per paragraph 3-6.
8	Reconnect PFN connector A2W1P1 to PFN.		
9	Replace PFN charge supply A2A3 per paragraph 3-7 and retest per table 2-3 replace control card A2A1 per paragraph 3-5.	Multimeter indicates between 30 and 46 microamps at step 38 of table 2-3	Reinstall original PFN charge supply A2A3 per paragraph 3-7; and

Table 2-5. Troubleshooting Procedures - Temperature Control Fault

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
1	Set POWER switch of power supply and external power converter at OFF.		
2	Remove transmitter simulator from electronic components assembly by loosening four captive screws on transmitter simulator.		
3	Unscrew and disconnect air control assembly connector, A2A4P1 (fig. 3-5) per paragraph 3-8a, step 4.		
4	Using multimeter, measure resistance between pins A2A4Pl-1 and -2	Multimeter indicates between 870 and 1070 ohms to paragraph 3-8.)	Replace air control assembly A2A4(Refer
5	Reconnect air control assembly connector A2A4P1 to its mating receptacle per paragraph 3-8b, step 5.		
6	Air control assembly sensistor checks out OK. Perform the following actions: (a) Replace control card A2A1 per paragraph 3-5. (b) Retest per table 2-3 beginning with step 15.		

Section III. EPA TROUBLESHOOTING AND FUNCTIONAL CHECKOUT

2-7. Procedures.

EPA functional checkout is contained in Table 2-7. EPA troubleshooting procedures are contained in Tables 2-8 and 2-9.

a. If a normal indication is not obtained, as required, immediately perform the corrective action(s) indicated.

b. If any corrective action is taken, retest the EPA.

c. Continue repeating the procedure until every normal indication is obtained without corrective action interruption. If all corrective actions at a step are performed and a fail indication is still obtained, refer EPA to Depot for repair.

d. Interconnecting wiring and connectors are fault isolated by using functional diagram (Figure 1-7) are wire list Appendix D.

2-8. Observable Malfunction Indications.

Table 2-6 contains a list of observable malfunctions which could occur during functional checkout or field use. This information is given to acquaint DS maintenance personnel with a basic understanding of EPA failure modes and probable causes.

2-9. EPA Test Setup. (See Figure 2-8.)

The EPA shall be tested inside the truck-mounted electronic shop shelter (AN/ASM -146B).

Troubleshooting of the EPA is based upon the test equipment indications observed during the checkout procedure. This procedure requires a dc source of power (shop power) variable between 20 and 30 volts DC.

2-10. Initial Switch Settings.

Set POWER switch on external power converter A4 at OFF. Make sure that power switch on shop power supply is set at OFF.

Table 2-6.EPA FAULT INDICATIONS

Indication	Fault	Probable Causes
No power output	(a) No measurable power between EMI connectors P3 and P1 (b) No measurable power between EMI connectors P2 and P1	1 No shop power. 2 Faulty maintenance cable. 3 Faulty interconnect cable W1. 4 Short or open circuit in EMI filter. 5 Faulty external power converter power relay A4K1. 6 Faulty pre-regulator assembly. 7 Faulty drive electronics card A4A1 (b fault only). 8. Faulty power switch A4S1. 9. Reverse polarity of shop power supply.
Low power output	AUX voltage at EMI connectors P2 and P1 is below requirement	1 Faulty drive electronics card. 2 Faulty pre-regulator assembly.
Improper filtering (Table 2-7, step 21.)	Ripple voltage across EMI connectors P2 and P1 exceeds one volt peak-to-peak.	1 Faulty drive electronic card.

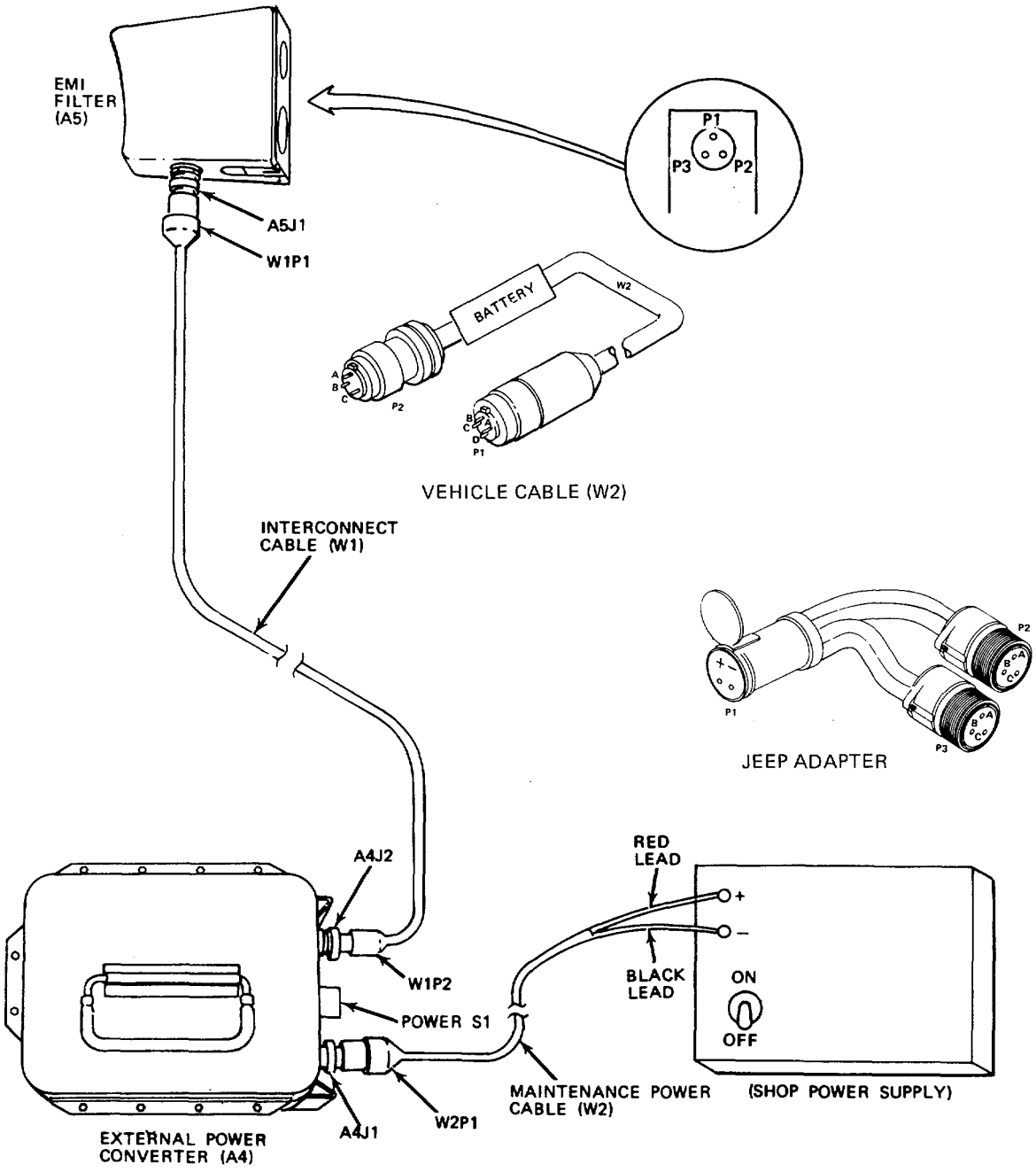


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Figure 2-8. EPA Test Setup

Table 2-7. Troubleshooting Procedures - EPA Functional Checkout

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
1	Remove EMI filter, external power converter, and cables Wi and W2 from the EPA transit case Remove the maintenance power cable from the LTD test set transit case (fig 2-8).		
2	Using multimeter set to measure resistance, check interconnect cable, Wi, for continuity, as follows:		
	FROM — TO		
	W1P1A — WIP2A	Less than one ohm.	Replace WI cable.
	W1P1B — W1P2B	Less than one ohm.	Replace W1 cable.
	W1P1C — W1P2C	Less than one ohm.	Replace W1 cable.
	W1PID — WlP2D	Less than one ohm.	Replace W1 cable.
	W1PlA — W1PIB	Open circuit.	Replace W1 cable.
	W1P1C — WIPIB	Open circuit.	Replace W1 cable.
	W1PID — WIPIB	Open circuit.	Replace W1 cable.
3	Using multimeter, check vehicle cable, W2 (13033956), for continuity as follows:		
	FROMTO		
	W2P2-A — W2P1-A	Less than one ohm	Replace W2 cable.
	W2P2-A — W2P1-B	Less than one ohm	Replace W2 cable.
	W2P2-B — W2P1-C	Less than one ohm	Replace W2 cable.
	W2P2-B — W2Pl-D	Less than one ohm	Replace W2 cable.
	W2P2-B — W2Pl-A	Open circuit	Replace W2 cable.
	Using multimeter, check cable adapter assembly 11508891 for continuity as follows:		
	FROMTO		
	P1 (+)P2-A — Less than one ohm		Replace cable adapter assembly.
	P1 (+)P3-A — Less than one ohm		Replace cable adapter assembly.
	P1 (-)P2-B — Less than one ohm		Replace cable adapter assembly.
	P1 (-)P3-B — Less than one ohm		Replace cable adapter assembly.
	NOTE **In the next step, the filter should be discharged by applying 10,000 ohms of resistance between P1 and P3 for approximately 30 sec.**		
4	Safely discharge filter by shorting P1 to P3.		

Table 2-7. Troubleshooting Procedures - EPA Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
5	Using multimeter set to measure resistance, check EMI Filter, AS, for continuity, as follows:		
	FROM TO		
	A5J1-A A5P3	Less than one ohm	Replace EMI Filter.
	A5J1-C A5P2	Less than one ohm	Replace EMI Filter.
	A5J1-B A5P1	Less than one ohm	Replace EMI Filter.
	A5J1-B A5J1-D	Less than one ohm	Replace EMI Filter.
	A5J1-B A5J1-C	Open circuit	Replace EMI Filter.
6	Connect WIPl of interconnect cable W1 to connector Ji of EMI filter A5.		
7	Connect W1P2 of interconnect cable to connector J2 on external power converter.		
8	Connect maintenance cable to connector J1 of external power converter.		
9	Check that power switch on power supply is set to OFF.		
10	Connect maintenance cable to shop power supply.		
11	Set multimeter to measure DC voltage.		
	WARNING **The External Power Converter and EMI Filter, together contain over 1000 uf of capacitance and may retain a voltage between A5P1 and A5P3 You can receive severe burns or shock if these pins are accidentally shorted together.**		
12	Connect multimeter + lead to EMI Filter connector A5P3 (PRIME).		
13	Connect multimeter - lead to EMI Filter connector A5P1 (RTN).		
14	Set External Power Converter POWER switch to ON.		
15	Set shop power supply switch at ON and varry supply voltage between 20 and 30 volts DC and observe multimeter.	20 to 30 volts DC procedure.	Perform table 2-8

Table 2-7. Troubleshooting Procedures - EPA Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
16	Set External Power Converter POWER switch at OFF and observe multimeter.	Approximately zero volts	Perform table 2-8 procedure.
17	Connect multimeter - lead to A5P1 (RTN).		
18	Connect Multimeter + lead to A5P2 (AUX).		
19	Set supply voltage at 20 VDC.		
20	Set External Power Converter switch at ONObserve multimeter and note reading	22.5 to 27 VDC	Perform table 2-9 procedure If still abnormal, replace pre-regulator assembly and reconnect old Drive Electronics Card (Refer to paragraph 3-16.) Return the new Drive Electronics Card to stock.
21	Set shop power supply voltage at 30 VDC and observe multimeter	Multimeter indication is within one volt of indication in step 20	Perform table 2-9 procedureIf still abnormal, replace pre-regulator assembly and reconnect old Drive Electronics Card (Refer to paragraph 3-16.) Return the new Drive Electronics Card to stock.
22	Set External Power Converter POWER switch at OFF.		
23	Set shop power switch at OFF.		
24	Reverse maintenance cable black and red connectors. (Black to supply + and red to supply -.)		
25	Connect multimeter + lead to A5P3 (PRIME) and - lead to A5P1 (RTN).		
26	Set shop power switch at ON and set supply voltage at 24 VDC (approx.)		
27	Set External Power Converter POWER switch at ON	Approximately zero volts	Replace CR1 diode on K1 relay (Refer to paragraph 3-16 and Figure 3-12 to gain access to relay.)

Table 2-7. Troubleshooting Procedures - EPA Functional Checkout (Continued)

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
28	Set External Power Converter POWER switch at OFF.		
29	Set shop power switch at OFF.		
	NOTE **Your EPA has passed functional checkout.**		
30	Disconnect cables and return components to transit case.		

Table 2-8. Troubleshooting Procedures - No PRIME Power

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
1	Set shop power switch at OFF.		
2	Disconnect interconnect cable W1 and maintenance power cable from External Power Converter.		
3	Remove Pre-regulator assembly from External Power Converter housing (Refer to paragraph 3-16a.)		
4	Set POWER switch at ON.		
5	Check for continuity between A451 switch terminals 1 and 2 and Figure 3-13 to gain access to switch.)	Less than one ohm (Refer to paragraph 3-17	Replace power switch S1.
6	Check for an open circuit between A4S1 switch terminals 1 and 3 gain access to switch.)	Open circuit (Refer to paragraph 3-17 and Figure 3-13 to	Replace power switch S1.
7	Locate diode CR3 on underside of pre-regulator chassis. Refer to Figure 3-13 for diode location.		
8	Connect (+) multimeter lead to terminal E1l and (-) multimeter lead to terminal E4 on underside of pre-regulator chassis.	Multimeter indicates forward bias	Replace diode CR3 per paragraph 3-20.
9	Reverse multimeter leads across terminals El and E4 and measure continuity.	Multimeter indicates reverse bias (open)	Replace diode CR3 per paragraph 3-20.
10	Reconnect maintenance power cable between shop power supply and external power converter.		
	WARNING **In the next two steps power is applied to preregulator assembly and high voltage is present. Use CAUTION to avoid electrical shock.**		
11	Reconnect interconnect cable between EMI filter and external power converter.		
12	Set shop power switch at ON and set voltage at 24 VDC		
13	While listening for sound of K1 relay operation, set external power converter POWER switch at ON, then at OFF	Relay K1 produces an audible click when POWER switch is set to ON	Replace relay K1. (Refer to paragraph 3-19 and Figure 3-13 to gain access to relay.)

Table 2-8. Troubleshooting Procedures - No PRIME Power

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
14	Set shop power switch at OFF.		
15	Replace pre-regulator into housing. (Refer to paragraph 3-16.)		
16	Retest by performing Table 2-7 procedures.		

Table 2-9. Troubleshooting Procedures - No AUX Power

Step	Procedure	Normal Indication	Corrective Action (Indication not normal)
1	Set shop power switch to OFF.		
2	Disconnect W1 and maintenance power cable from converter.		
3	Replace Drive Electronics Card with a new Drive Electronics Card taken from stock (Refer to paragraph 3-16.)		
4	Repeat Table 2-7 procedures.		

Section IV. GENERAL MAINTENANCE

2-11. General.

This section provides general maintenance procedures for the LTD and EPA.

NOTE

As a general maintenance procedure the LTD pressure vessel should be vented, purged, and filled (paragraph 2-15) within 180 days of its last maintenance service.

2-12. Cleaning and Painting Procedures.

Refer to TM 9-1260-479-12 for procedures to clean and paint the LTD and EPA.

2-13. Materials Used in General Maintenance.

The materials used in general maintenance are listed in Table 2-10.

2-14. Recharging Battery-Shoulder Stock.

WARNING

- **Batteries may explode if improperly charged. Do not charge batteries while stored in the transit case. Do not stack batteries while charging.**

- **Bubbles raised under the battery encasement material during charging which are smaller than a 1/2 dollar coin are of no serious concern. If bubbles are larger than 1/2 dollar coin, the batteries should be placed on the shelf for a few days until the bubbles disappears. If it does not disappear, puncture with a sharp object.**

- NICAD battery electrolyte is Potassium Hydroxide (KOH), a caustic base. You should avoid contact with skin or clothing. In situations of abuse, (excessive overcharging), KOH may be present on the outside surface of the battery. After thorough, careful cleaning, the battery can be returned to service in all but the most severe abuse situations.

Inspect O-ring on battery-shoulder stock connector for damage. Replace if necessary. Lubricate O-ring with lubricant (3, Table 2-10). Refer to TM 11-6130-392-12 for battery charging instructions. The type battery charger used is the PP-7286 which allows the operator to charge as many as five batteries at one time. The LTD uses a nickel-cadmium battery pack of 24 volt capabity. Typical charging information is marked on the battery-shoulder stock. The charging information is marked on the BB-699 battery as follows:

300 ma FOR 7 HOURS AT ROOM AMBIENT.

This means that your LTD battery should be charged at a rate of 300 milliamps for 7 hours at room temperature.

2-15. Transmitter Components Assembly High Pressure Purge and Fill Procedures. (Figure 2-9).

a. General.

Before performing purge and fill procedures refer to TM 9-4931-599-13 to familiarize yourself with the operation of the LTD test set gas charging assembly and accessories.

Table 2-10. Materials Used in General Maintenance

Item No	Name	Part Number/NSN/Spec
	NOTE **When item 1 is not available through normal supply channels this gas mixture may be obtained through local commercial sources Nitrogen. oxygen pre-mix composition must meet requirements detailed in Appendix E.**	
1	Nitrogen-Oxygen Gas Mixture (N202) in 231 Cu Ft cylinder	6830-01-124-1435
2	Lubricant, O-ring	MIL-L-4343

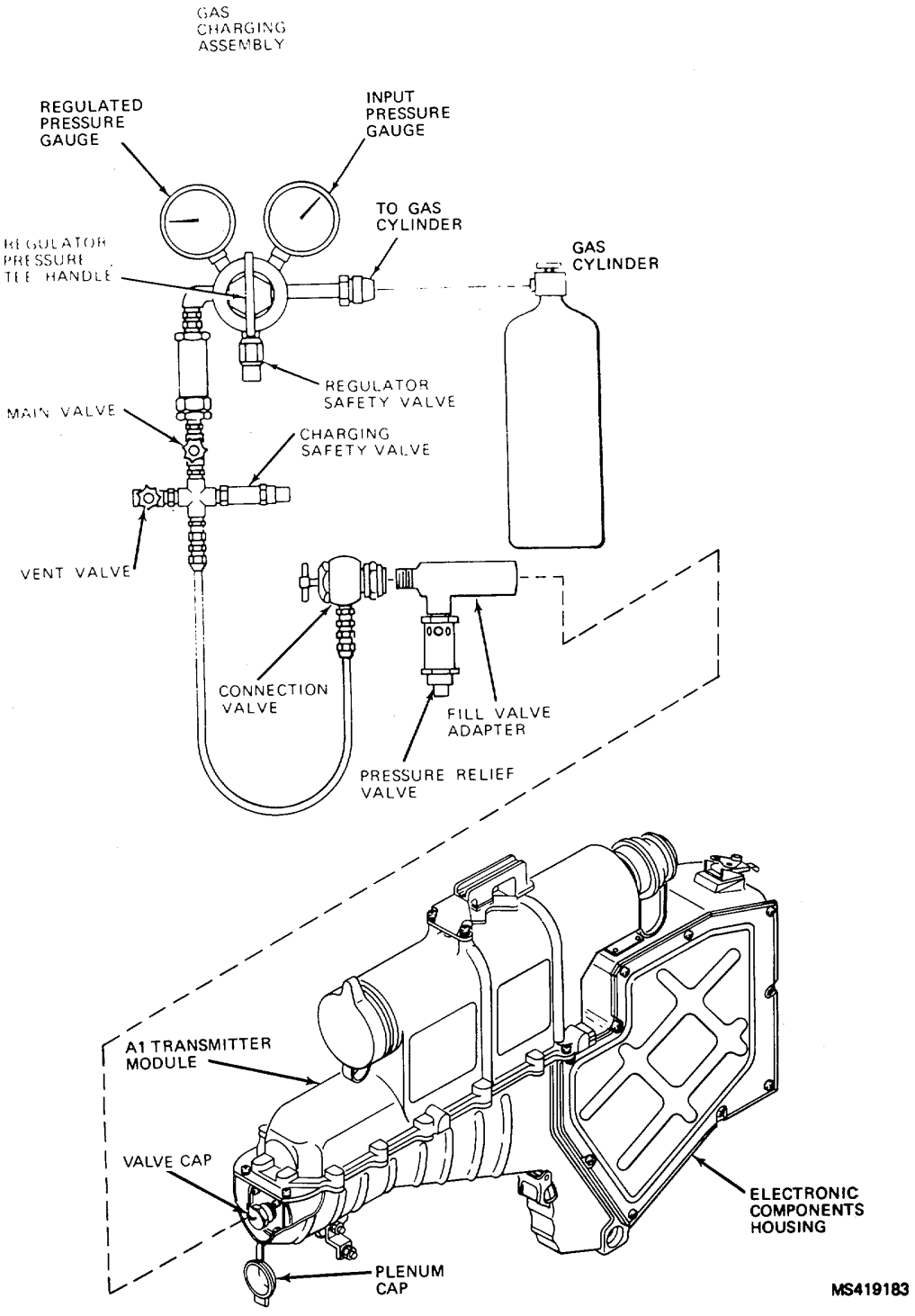


Figure 2-9. Setup for Purge and Fill

b. High Pressure Purge and Fill.

WARNING

High pressures are present in gas cylinders. Adequate handling preCAUTIONs for personnel safety shall be exercised at all times.

CAUTION

Damage or equipment degradation may result if the LTD pressure vessel is not properly purged and filled.

(1) Place the LTD on the bench.
(2) Turn regulator handle on gas charging assembly fully cc* to close position (handle will spin freely).
(3) Turn main valve of gas charging assembly fully cw to closed position.
(4) Turn vent valve handle on gas charging assembly fully cw to closed position.

WARNING

The gas cylinder must be securely fastened to keep it from falling. If the cylinder should fall it could become an unguided missile causing serious injury or death.

(5) Fasten a nitrogen-oxygen pre-mix cylinder (1, or 2, Table 2-10) to a support (in an upright position). Remove the protective cap.
(6) Check that the inlet and outlet ports are clear of mud or debris, then attach gas charging assembly to gas cylinder outlet valve. (Do not overtighten coupling nut).

CAUTION

If particulate matter enters the transmitter module pressure vessel equipment damage/degration could result. Steps (7) through (11) purge (clean) the gas charging assembly of any particulate matter which might flow into the transmitter module pressure vessel while it is being repressurized.

WARNING

During application of pressure, be alert for escaping gas. If assembly is faulty, leakage from any part of assembly could cause blindness, injury, or death. If leakage occurs, close cylinder valve (fully cw) immediately.

(7) Slowly turn handle of nitrogen-oxygen pre-mix cylinder until it is fully open (fully ccw). If inlet pressure gauge on regulator indicates less than 475 psig, perform steps (29) through (35); obtain a new gas cylinder and return to step (5).
(8) Turn main valve handle fully ccw to open position.
(9) Grasp connection valve in one hand and place thumb over connection valve opening. Point connection valve opening away from body.

WARNING

In the following step, high pressure gas is used. Do not point any pressure outlet at yourself or any other person, or allow debris to be blown about. Blindness, injury, or death can result.

(10) Turn regulator handle slowly cw until escaping gas can be felt at connection valve opening.
(11) Allow gas to flow through gas charging assembly for approximately two minutes.

(12) Turn regulator handle fully ccw to closed position (handle will spin freely).
(13) Turn main valve handle fully cw to closed position. Place connection valve on work bench.
(14) Remove plenum cap from front end of electronic components assembly.
(15) Unscrew fill valve cap from front end of the transmitter module.
(16) Connect the fill valve adapter to the fill valve on the LTD. (Do not overti ghten).
(17) Turn connection valve handle fully ccw.

CAUTION

Do not allow fill valve adapter to rotate when tightening connection valve union nut.

(18) Connect the connection valve to the fill valve adaptor by tightening union nut.

WARNING

During application of pressure, be alert for escaping gas. If assembly is faulty, leakage from any part of assembly could cause blindness, injury, or death. If leakage occurs, close cylinder valve (fully cw) immediately.

(19) Turn regulator handle slowly cw until regulated pressure gauge indicates 450 psig.

NOTE

Step (20) raises the pressure in the gas charging assembly hose so that the opening of the fill valve (in step (21)) will not cause a rapid change in LTD pressure vessel pressure.

CAUTION

In steps (20), (21), (22), and (23), operate valves slowly to prevent physical shock to LTD pressure vessel due to too rapid a change in pressure.

(20) Slowly turn main valve handle fully ccw (open).
(21) Slowly turn connection valve handle cw until LTD fill valve is fully open (handle stops turning).
(22) Turn main valve handle fully cw (closed).

WARNING

Pressurized gases will be vented in the next step. Stay clear of vent valve outlet. Blindness, injury, or death can result.

(23) Slowly turn vent valve handle fully ccw (open).
(24) After gasses stop venting, turn vent valve handle fully cw (closed).
(25) Slowly turn main valve handle fully ccw (open).
(26) After approximately 30 seconds, turn main valve handle fully cw (closed).
(27) Purge the LTD pressure vessel by repeating steps (23) through (26) three more times.
(28) Turn connection valve fully ccw to close LTD pressure vessel.
(29) Turn handle of valve on nitrogen-oxygen pre-mix cylinder fully cw (closed).
(30) Turn handle of main valve fully ccw (open).

WARNING

Pressurized gases will be vented in the next step. Stay clear of vent valve outlet. Blindness, injury, or death can result.

(31) Slowly turn vent valve handle fully ccw (open). Allow venting to continue until both regulator gauges indicate zero psig.
(32) Turn regulator handle fully ccw to closed position (handle will spin freely).
(33) Turn main valve handle fully cw to closed position.
(34) Turn vent valve handle fully cw to closed position.
(35) Remove gas charging assembly from nitrogen-oxygen pre-mix cylinder. Install protective cap over cylinder supply valve.

CAUTION

In the next step do not allow the fill valve adapter to rotate while removing connection valve from fill valve adapter.

(36) Remove connection valve from fill valve adapter.
(37) Remove fill valve adapter from LTD fill valve.
(38) Install fill valve cap on LTD fill valve. Tighten cap one-half turn past finger tight.
(39) Install plenum cap on front end of LTD electronic components assembly.
(40) Insure that date of high pressure purge and charge has been recorded on your DA label 80 and is affixed to the LTD.

CHAPTER 3

REPAIR OF LTD AND EPA

Section I. GENERAL REPAIR

3-1. General.

Repair of the LTD (Laser Target Designator) and the EPA (External Power Adapter) consists of removal and replacement of defective components. Repair procedures for the LTD are presented in Section II. Repair procedures for the EPA are presented in Section III. These procedures present complete disassembly instructions in step-by-step format where each component is identified by an item number in an accompanying illustration. You are to perform only those procedures that are required. Requirements are indicated by corrective action statements in the troubleshooting procedures in Chapter 2, and/or by visual inspection. Upon completion of a repair procedure, you are to perform the applicable functional checkout procedure (LTD, Table 2-3; EPA, Table 2-7).

3-2. Materials Used in Repair Procedures.

Materials used in repair procedures are listed in Table 3-1.

3-3. Tools Used in Repair Procedures.

Tools required for DS level repair are contained in Laser Systems Maintenance Tool Kit, NSN 5180-01-048-8570.

Table 3-1. Materials Used in Repair

Item No	Name	Part Number/NSN/Spec
1	Compound, Staking	MIL-E-22118
2	Insulation, Sleeving, Shrinkable	M23053/5-204-C
3	Lubricant, O-ring	MIL-L-4343
4	Solder SN-63	QQ-S-571
5	Rags, Cotton Wiping	7920-00-205-1711

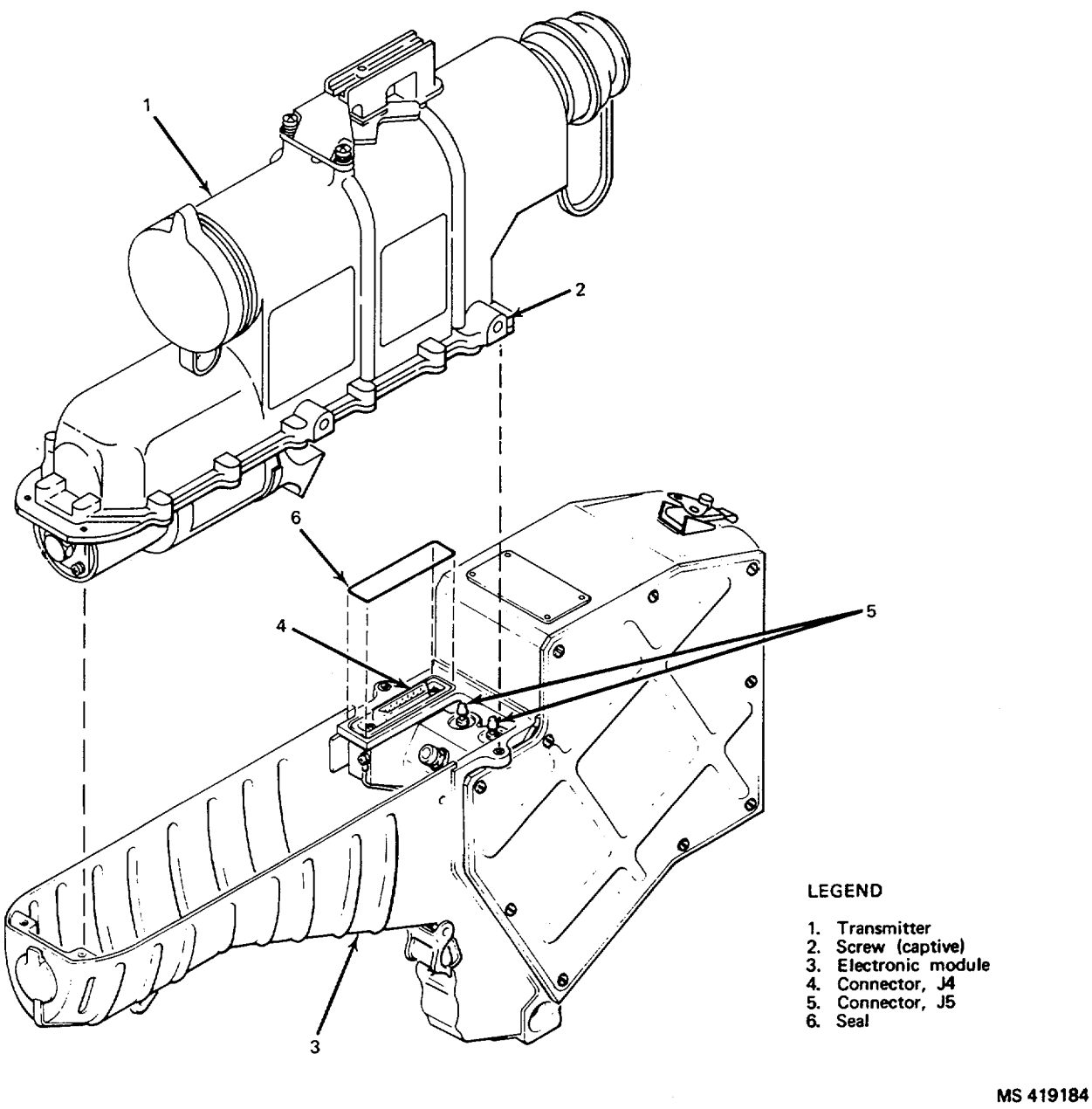


Figure 3-1. Removal and Installation of Transmitter

SECTION II. REPAIR OF LTD

3-4. Removal and Installation of Transmitter (A1) (See Figure 3-1).

WARNING

Check that POWER switches on power supply and external power converter are set to OFF (see fig. 2-1). High voltages can cause shock, injury or death.

a. Remove transmitter (1) as follows:

1. Unscrew and remove four screws (2) each with lock washer and flat washer. The screws are located at the corners where transmitter (1) mates with electronic components assembly (3).

2. Hold electronic components assembly (3) with one hand (just above trigger) and hold transmitter (1) with other hand.

WARNING

Do not touch contacts of connector J5 (5, see Figure 3-1). High voltages can be present even if power (battery, EPA, etc.) is removed. High voltage can cause shock, injury, or death.

3. Gently pull transmitter (1) straight out from electronic components assembly (3). Continue pulling assemblies apart until connectors J4 (4) and J5 (5) are completely separated.

4. Lay assemblies on work bench.

5. If transmitter components assembly (1) is defective, send it to depot for repair/disposition.

b. Install transmitter (1) as follows:

1. Inspect exposed surface of seal (6). Surface of seal should be supple and undamaged.

2. If seal (6) is supple and undamaged, lubricate exposed surface with a small amount of lubricant (3, Table 3-1), then proceed to step 4.

3. If seal (6) is stiff or has cracks or other damage, replace it as follows:

NOTE

As an aid of removal of seal, a starting hole is located in the seal groove towards centerline of assembly.

(a) Using a small probe or pick, very gently lift seal (6) at starting hole. Lift seal until it can be grasped with fingers then gently pull seal from groove. Throw seal away.

(b) Lubricate a new seal (6) with lubricant (3, Table 3-1).

(c) Carefully install the new seal in groove. Lay seal on groove, then starting at starting hole, work seal into groove with fingers.

CAUTION

Do not force assemblies together. Forcing can damage connectors.

4. Holding electronic components assembly (3) in one hand and transmitter (1) in the other, insert front end of transmitter into other assembly (3). Carefully rock rear portion of transmitter towards the assembly while alining center rubber pins of connector J5 (5) with mating receptacles on transmitter (1). Gently push assemblies together fully while watching for correct engagement of connectors. Make sure assemblies are seated together before performing next step.

CAUTION

To avoid damaging the transmitter mating flange, torque four screws (2) evenly a few turns at a time until transmitter is fully mated to the electronic components assembly.

5. Install four screws (2), each with lock washer and washer. Tighten four screws (2) evenly a few turns at a time until transmitter is fully mated to the electronic components assembly. After the transmitter is properly mated tighten each screw to between 6 and 8 inch-pounds of torque.

3-5. Removal and Installation of Electronic Components Assembly Cover and Control Card A2A1. (See Figure 3-2.)

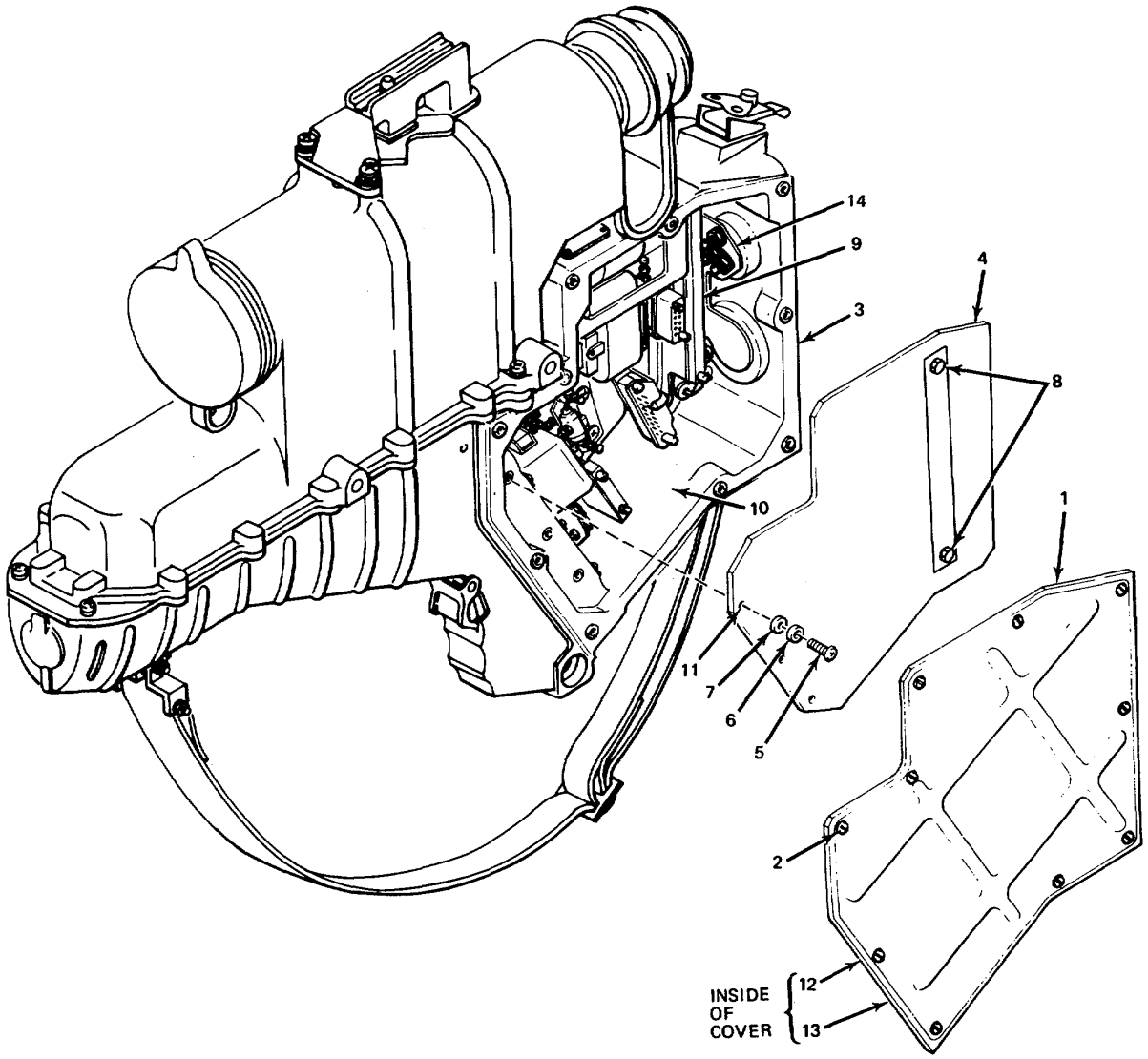
WARNING

Check that POWER switches on power supply and external power converter are set to OFF (see fig. 2-1). High voltages can cause shock, injury or death.

a. Remove cover (1) as follows:

1. Remove battery-shoulder stock (if attached).

2. Place LTD on its right side.



1. Cover
2. Screw (captive)(10 places)
3. Housing
4. Control card A2A1
5. Screw (3 places)
6. Lockwasher (3 places)
7. Washer (3 places)
   8 Screw (jack)
9. Connector W1P2
10. Electronic components compartment
11. Hole (in control card) (3 places)
12. Seal
13. Seal groove
14. Connector A2W1J1

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Figure 3-2. Removal and Installation of Electronic Components Assembly Cover and Control Card

3. Loosen ten captive screws (2).

4. Lift cover (1) from electronic components assembly housing (3).

b. Remove control card (4) as follows:

CAUTION

A wrist ground strap must be worn prior to removing the control card to prevent damage to static sensitive components mounted on card. After removal, care should be taken to insure that control card is properly isolated from static charge. Place card in antistatic bag.

1. Remove electronic components assembly cover (1). (Refer to step 3 above).

2. Remove three screws (5) with lock washers (6) and flat washers (7). (Do not lift card (4) at this time.)

CAUTION

In the next step, loosen the two captive jack screws evenly. The connector can be damaged if the screws are loosened unevenly.

3. Loosen two captive jack screws (8) evenly until connector (9) is separated from mating part of control card (4).

4. Lift control card (4) from electronic components assembly housing (3).

5. Place card (4) on bench, component side down.

NOTE

If control card (4) is faulty, refer to Depot for repair/disposition.

c. Install control card (4) as follows:

1. Inspect electronic components compartment (10) for debris and any obvious faults.

2. Place control card (4), connector side down, in electronic components compartment (10).

CAUTION

In the next step, tighten the two captive jack screws evenly. The connector can be damaged if the screws are tightened unevenly.

NOTE

In the next step, it may be necessary to lift the wiring harness slightly (about one-half inch) to enable mating of connectors. Use care to prevent damage to harness and connectors.

3. Mate connector (9) to matinq part of control card (4), then tighten jack screws (8) evenly, one turn at a time, until connector is fully mated.

4. Tighten screws (8) to between 2 and 3 inch-pounds of torque.

5. Install three screws (5), each with a lock washer (6) and a flat washer (7), through holes (11) in connector card (4).

6. Tighten screws (5) evenly to between 5 and 6 inch-pounds of torque.

d. Install cover (1) as follows:

1. Inspect cover seal (12). If seal is damaged, proceed as follows:

(a) Pull seal (12) from its groove (13). Throw seal away.

(b) Lubricate new seal (12) with lubricant (3, Table 3-1).

(c) Carefully push new seal (12) into groove (13). Make sure seal is not twisted.

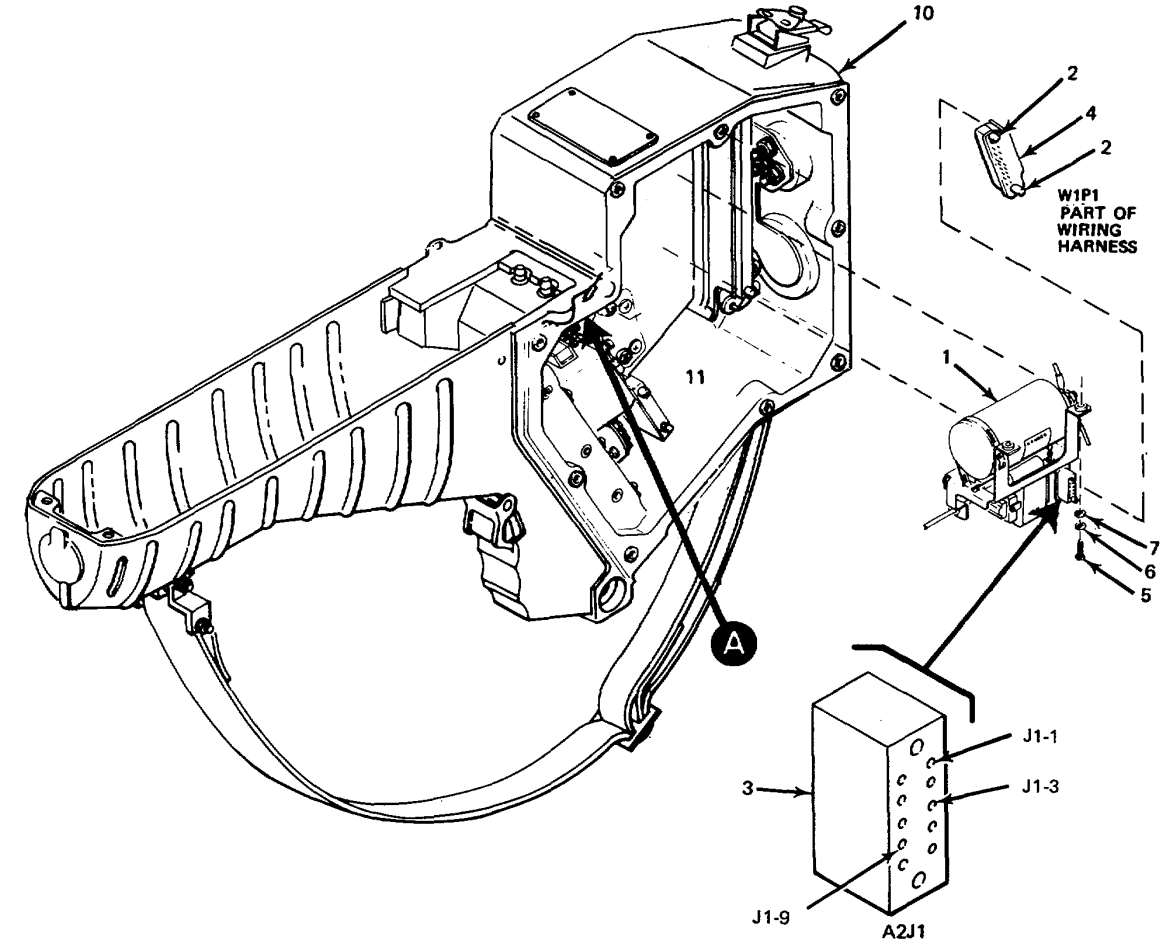
2. Place cover (1) on housing (3) and align screws (2) with holes in housing.

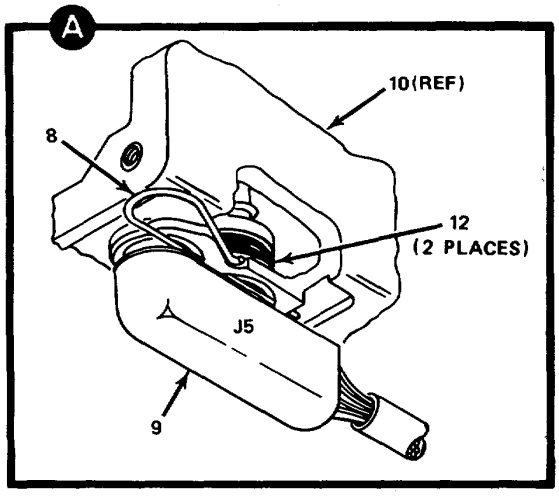
3. Tighten screw (2), in random order, to between 5 and 6 inch-pounds of torque.

3-6. Removal and Installation of Pulse Forming Network, A2A2. (See Figure 3-3).

a. Remove pulse forming network (PFN) (1), as follows:

1. Remove transmitter, electronic components assembly cover and control card, A2A1. (Refer to paragraphs 3-4 and 3-5.)





LEGEND

1. Pulse forming network
2. Screw
3. Connector, A2J1
4. Plug, W1P1
5. Screw
6. Lockwasher
7. Washer
8. Locking pin
9. Connector, J5
10. Electronic components housing
11. Electronic components compartment
12. O–ring packings

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Figure 3-3. Removal and Installation of Pulse Forming Network (A2A2)

WARNING

The PFN capacitor may retain sufficient voltage to cause shock or injury. Do not touch exposed terminals.

CAUTION

In the next step, loosen the two captive jack screws evenly . The connectors can be damaged if the screws are loosened unevenly.

2. Loosen captive jack screws (2) evenly until connector A2J1 (3) is separated from WiPI (4).
3. Carefully short together pins 3 and 9 of connector A2J1 (3), then remove short.
4. Remove four attach screws (5) with lock washers (6) and flat washers (7).
5. Using pliers, pull locking pin (8) from connector J5 (9).
6. Carefully pull connector J5 (9) free of electronic components housing (10).
7. Lift PFN (1) from electronic components compartment (11), keeping it clear of wiring harness.
8. Send PFN (1) to Depot for repair/disposition.

b. Install pulse forming network (PFN) (1), as follows:

1. Lubricate O-ring packings (12) on connector J5 (9) with lubricant (3, Table 3-1).
2. Put new PFN (1) in electronic components compartment (11) and aline mounting holes.

CAUTION

In the next step, take care to aline connector with holes in housing. Forcing connector at an angle can result in damage to packings.

3. Push connector J5 (9) into holes in electronic components housing (10).
4. Install four attach screws (5) each with a lock washers (6) and a flat washer (7).
5. Tighten screws (5) to between 14 and 18 inch-ounces of torque.
6. Install locking pin (8) to lock connector J5 (9) in place.

CAUTION

In step 7, mate plug WlP1 and connector A2J1 evenly. The plug and connector can be damaged by uneven or forced movement.

7. Mate plug WlP1 (4) to connector A2J1 (3). Do not force parts together.
8. Tighten screws (2) evenly, one turn at a time, to between 2 and 3 inch-pounds of torque.
9. Install control card A2A1, cover, and transmitter. (Refer to paragraphs 3-4 and 3-5).

3-7. Removal and Installation of PFN Charge Supply, A2A3. (See Figure 3-4.)

a. Remove PFN charge supply (1) as follows:

1. Remove electronic components assembly cover and control card, A12A1. (Refer to paragraph 3-5.)

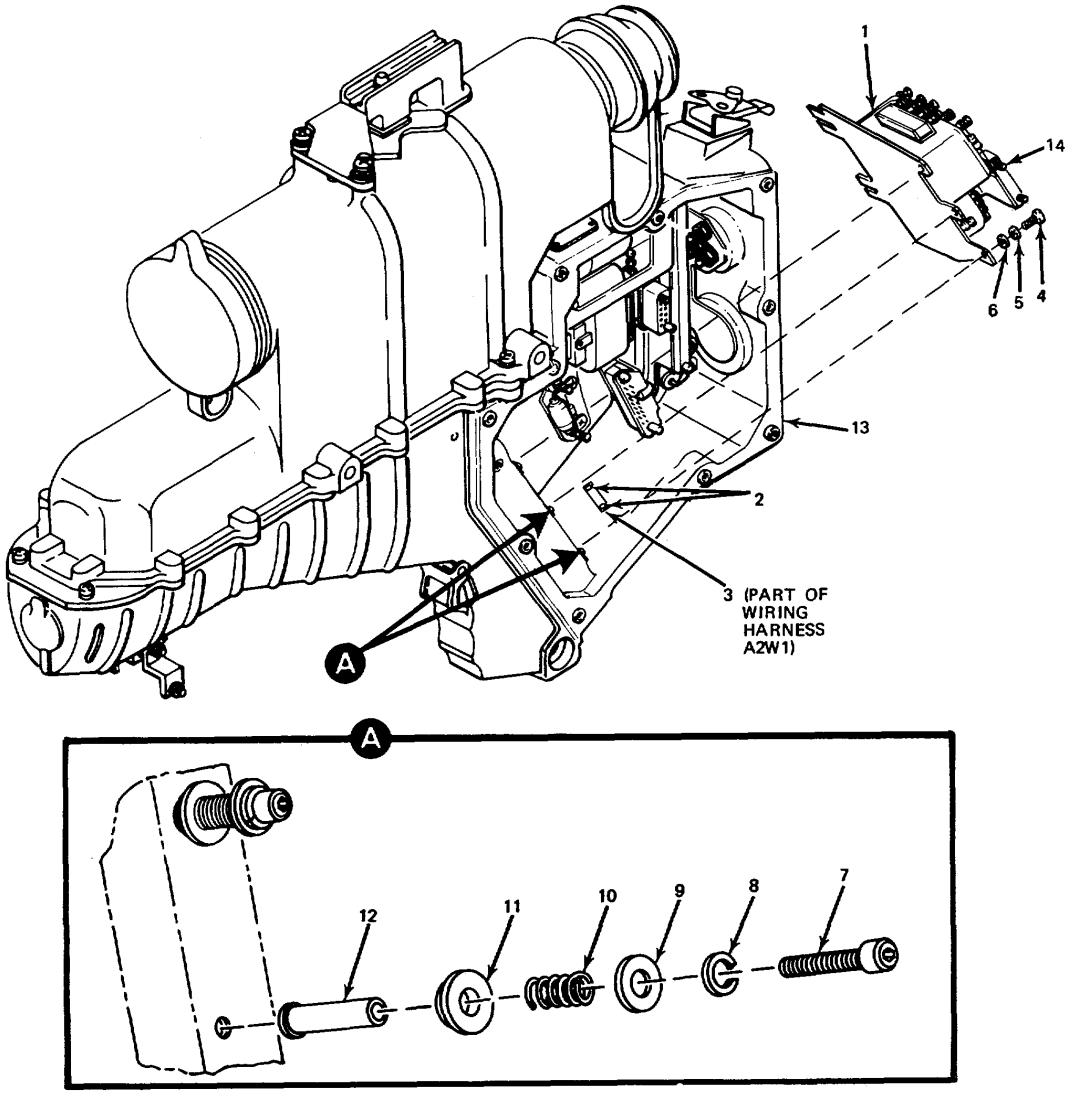
CAUTION

In the next step, loosen the two captive jack screws evenly. The connector can be damaged if the screws are loosened unevenly.

2. Loosen two captive jack screws (2) evenly until connector W1P2 (3) is separated from connector A3J1 on PFN charge supply (1).
3. Remove three screws (4) each with lock washer (5) and flat washer (6).
4. Carefully pull PFN charge supply (1) up parallel to mounting surfaces to release unit from two spring-loaded studs (7) then lift unit free of electronic components housing (8).
5. Send PFN charge supply (1) to Depot for repair/disposition.
6. Inspect spring loaded studs (7). Replace studs if they appear to be damaged.

b. Install PFN charge supply (1) as follows:

1. Slide the bottom rear of new PFN charge supply (1) under the two spring-loaded studs (7) in electronic components housing (8).
2. Push PFN charge supply (1) into place so that the three holes are alined with mounting holes, and wiring harness ground strap E3 is on top of bracket.
3. Install three screws (4), each with a lock washer (5) and a flat washer (6), through holes in PFN charge supply (1) and into mounting holes. The topmost screw also goes through lug of ground strap E3.



LEGEND

1. PFN charge supply (A2A3)
2. Screw (jack)
3. Connector W1P2
4. Screw
5. Lockwasher
6. Washer
7. Spring loaded stud
8. 'Lockwasher
9. Washer
10. Spring
11. Spacer
12. Post
13. Electronic components housing
14. Connector A3J1

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Figure 3-4. Removal and Installation of PFN Charge Supply

4. Tighten screws (4) to between 5 and 6 inch-pounds of torque.

CAUTION

In the next step, tighten the two captive jack screws evenly. The connector can be damaged if the screws are tightened unevenly.

5. Inspect connector (3) for obvious physical damage. Replace wiring harness per paragraph 3-11 if damage is present.

6. Mate connector (3) to mating part of PFN charge supply unit (1), then tighten jack screws (2) evenly (one turn at a time) until connector is fully mated.

7. Tighten screws (2) to between 2 and 3 inch-pounds of torque.

8. Install control card A2A1 and cover. (Refer to paragraph 3-5.)

3-8. Removal and Installation of Air Control Assembly, A2A4. (See Figure 3-5.)

a. Remove air control assembly (1) as follows:

1. Remove transmitter. (Refer to paragraph 3-4.)

2. Remove two screws (2) with lock washers (3) and flat washers (4) from air control sensitor A21A4RT1 (5).

3. Remove screw (6) with lock washer (7) and flat washer (8) from grounding lug A2A4E3 (9).

4. Unscrew coupling nut and disconnect plug A2A4P1 (10) from receptacle W1J2 (11).

CAUTION

In the next step, lift blower out of housing gently to avoid breaking wires which are still attached to the trigger switch.

NOTE

- **Air control assembly (1) consists of blower (12), trigger (14), sensistor (5), plug (10), and connecting wires.**

- **The blower is held in place by Velcro fastener strips. It may be necessary to use slight force and a rocking motion to pull blower free.**

5. Carefully pull blower (12) free of fastener strips (15).

6. Remove screw (16), with lock washer (17) and flat washer (18). Screw holds trigger (14) to housing (13).

7. Remove air control assembly (1) from housing (13).

8. Send air control assembly (1) to Depot for repair/disposition.

b. Install air control assembly (1), as follows:

1. Place assembly (1) in housing (13) and slip trigger (14) into opening in housing (from the inside). Make sure top edge of opening is seated in groove at top of trigger frame.

2. Install screw (16) with lock washer (17) and flat washer (18) to secure trigger (14) to housing (13).

3. Tighten screw (16) to between 5 and 6 inch-pounds of torque.

NOTE

The blower will be properly located (in the next step) when the outlet horn is centered (side to side) and seated on the blower retaining clip.

4. Seat the blower (12) on fastener strips (15) by pushing rearward and downward with a slight force. The flange of blower housing is to be centered and set into recess on front of wedge shaped bracket.

5. Aline keyways and connect plug A2A4P1 (10) to receptacle W1J2 (11). Tighten coupling nut finger tight.

6. Insert screw (6), with lock washer (7) and flat washer (8) through grounding lug (9) and into housing (13).

7. Tighten screw (6) to between 5 and 6 inch-pounds of torque.

8. Place sensistor (5) on pad at forward end of housing (13).

9. Install two screws (12), each with a lock washer (3) and a flat washer (4).

10. Tighten screws (2) to between 2 and 3 inch-pounds of torque.

11. Install transmitter. (Refer to paragraph 3-5.)

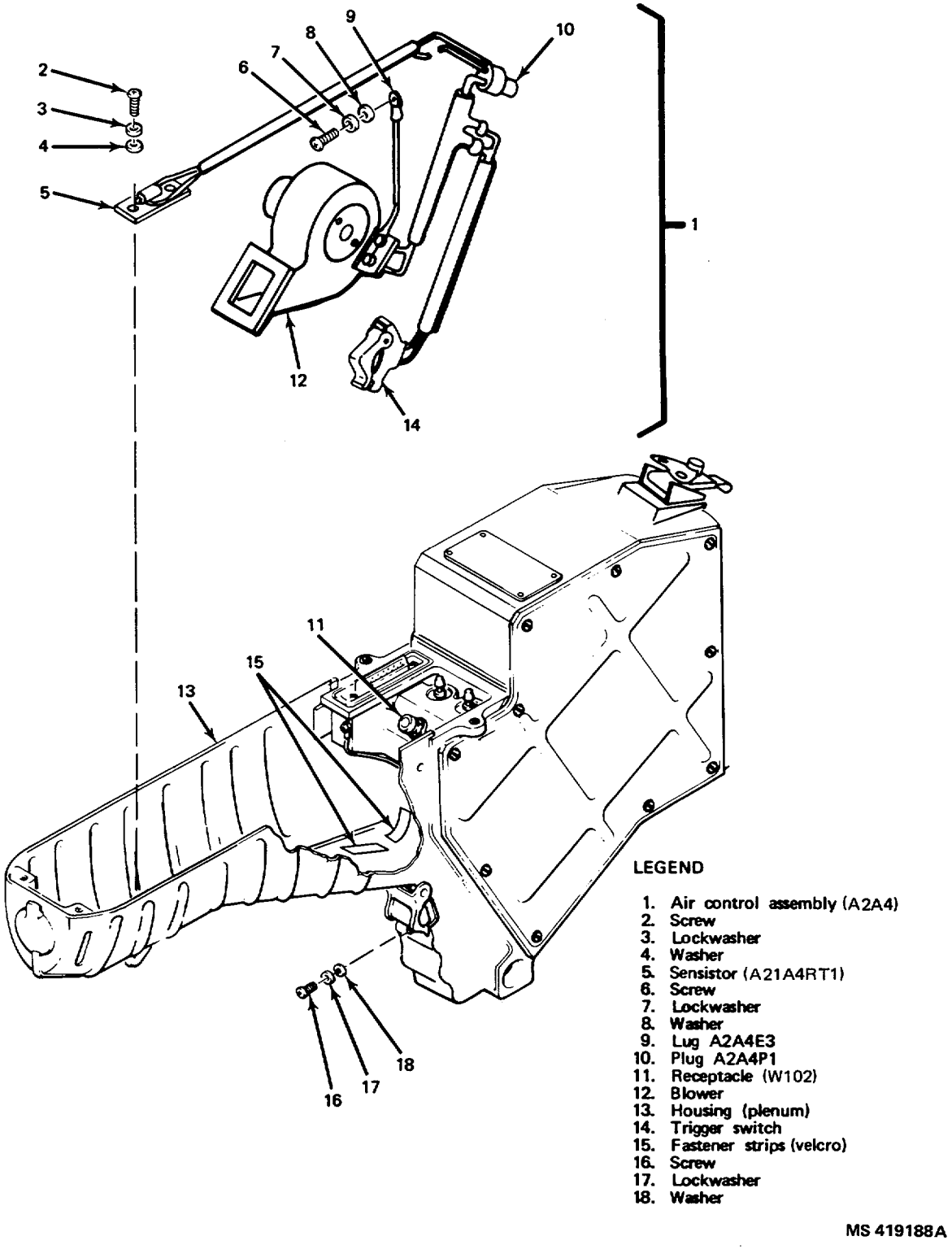


Figure 3-5. Removal and Installation of Air Control Assembly (A2A4)

3-9. Removal and Installation of Code Swtiches A2WlS1, A2W1S2, A2W1S3 (See Figure 3-6.)

a. Remove one or more code switches (1), as follows:

CAUTION

Observe chemical warning in front of manual.

1. Clean staking compound from set screws (2) (two on each code switch knob (3)) using a craftsman's knife, acetone, and cotton wiping rags.

2. Loosen set screws (2) and remove knobs (3).

3. Remove electronic components assembly cover and control card A2A1. (Refer to paragraph 3-5).

CAUTION

Avoid excess heat when removing solder. Wiring harness could delaminate if excessive heat is used.

4. Unsolder the twelve connections between wiring harness (4) and the three code switches (1).

5. Remove nut (5) and lock washer (6) from each code switch (1) that is to be replaced.

CAUTION

In the next step, use care in removing switches.

6. Gently move harness (4) aside and remove code switches (1) and O-ring seals (7).

b. Install code switches (1), as follows:

1. Remove nut (5) and lock washer (6) from each new switch (1).

2. Lubricate O-ring seals (7) with lubricant (3, Table 3-1) and seat seal in groove (8) in shaft end of each switch (1).

3. Turn shaft of each switch (1) to full ccw position (when viewed from shaft end of switch).

CAUTION

In the next step, use care in installing each switch. Make sure that O-ring seal is still in its groove when each switch is in its place.

4. Insert shaft end of switch (1) through hole (9) in housing (10). Make sure flat side on shaft is toward index mark (11) before threaded collar of switch enters hole.

5. Install lock washer (6) and nut (5) on switch (1).

6. Tighten nuts (5) 2 to 3 inch pounds.

7. Repeat steps 4, 5, and 6 for other two switches (as necessary).

CAUTION

Avoid excess heat when soldering wiring harness. Wiring harness could delaminate if excessive heat is used.

8. Install wiring harness over all 12 switch terminals (12) and solder each connection.

9. Install control card A2A1 and cover. (Refer to paragraph 3-5.)

c. Installing knobs (3).

1. Aline flat inside of a knob (3) with flat side on shaft of one switch (1) and push knob onto shaft.

2. Tighten both set screws (2) to between 2 and 3 inch-pounds of torque.

3. Rotate knob (3) to check that it does not rub against housing (10). (if it does rub, loosen set screws (2), pull knob slightly to clear housing, then repeat steps 2 and 3).

4. Rotate knob (3) to check that number "1" is at index mark (11) when knob is turned fully ccw.

5. Repeat steps 1 through 4 for other two switches as necessary.

6. Using staking compound (1, table 3-1), fill set screw holes in each knob (3).

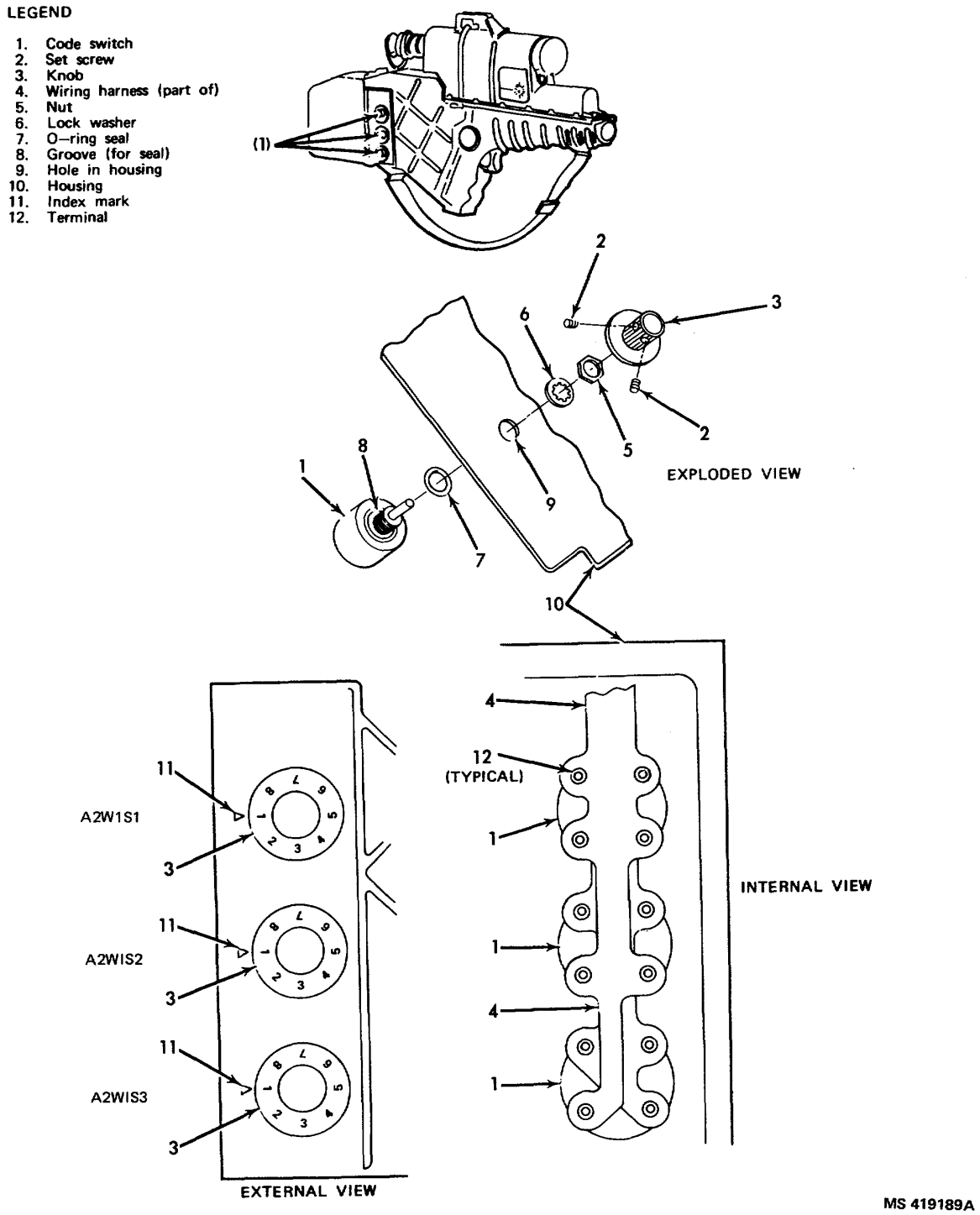


Figure 3-6. Removal and Installation of Code Switches

3-10. Removal and Installation of Interlock Switch, A2W1S4. (See Figure 3-7.)

a. Remove interlock switch (1) as follows:

1. Remove electronics components assembly (A2A5) cover and control card, A2A1. (Refer to paragraph 3-5.)

2. Remove two screws (2) with lock washers (3) and flat washers (4).

CAUTION

Avoid excess heat when removing solder. Wiring harness could delaminate if excess heat is used.

3. Unsolder three connections (5) between wiring harness (6) and switch (1) and remove switch.

b. Install interlock switch (1), as follows:

CAUTION

Avoid excess heat when soldering wiring harness. Wiring harness could delaminate if excessive heat is used.

NOTE

Before soldering connections, temporarily place switch in installed position to make sure that actuating arm will be extended out of housing after installation.

1. Attach wiring harness (6) to switch (1) and solder three connections (5) using solder (4, Table 3-1).

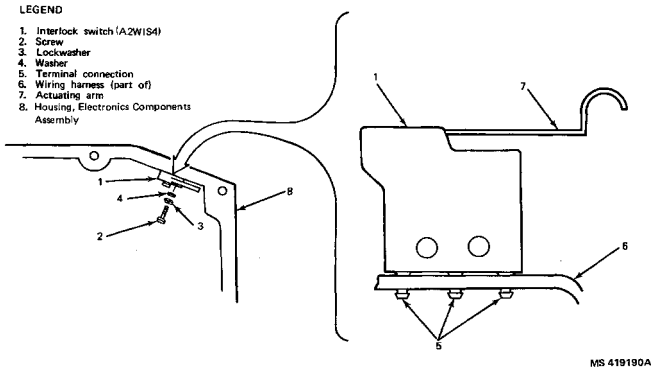


Figure 3-7. Removal and Installation of Interlock Switch (A2W1S4)

2. Place switch (1) in position in housing (8) and install two screws (2) each with a lock washer (3) and a flat washer (4).

3. Tighten screws (2) to between 2 and 3 inch-pounds of torque.

4. Temporarily place cover on housing (8). Do not install cover.

5. Press down and release cover several times while listening for actuating click of interlock switch (1).

6. Remove cover (1). If click could not be heard (in step 5), loosen screws (2), reposition switch (1) and repeat steps 3 through 6.

NOTE

If results of step 7 are not as required, troubleshoot switch (1), wiring harness (6), and solder connections (5) between switch and harness.

7. Using multimeter set for checking continuity, test interlock switch (1) as follows:

(a) Check for continuity between connector W1J1 pins 28 and 25.

(b) Check for no continuity between connector W1J1 pins 28 and 27.

(c) Press down and hold actuating arm (7) to keep switch (1) actuated.

(d) Check for continuity between connector WiJ1 pins 28 and 27.

(e) Check for no continuity between connector W1Jl pins 28 and 25.

(f) Release actuating arm (7).

8. Install control card A2A1 and cover. (Refer to paragraph 3-5.)

3-11. Removal and Installation of Wiring Harness, A2W1. (See Figure 3-8.)

a. Remove wiring harness 41), as follows:

CAUTION

Handle wiring harness with care to avoid tearing laminations apart.

1. Remove transmitter module. (Refer to paragraph 3-4).

CAUTION

Observe chemical warning in front of manual.

2. Clean staking compound from all six set screws (2), (two on each code switch knob (3) using craftsman's knife, acetone and cotton wiping rags.

3. Loosen all six set screws (2) and remove three knobs (3).

4. Remove nut (4) and lock washer (5) from each of three code switches (6).

5. Remove electronic components assembly cover and control card A2A1. (Refer to paragraph 3-5.)

6. Remove interlock switch (7). Do not unsolder connections. (Refer to paragraph 3-10.)

7. Remove PFN (A2A2). (Refer to paragraph 3-6.)

8. Remove PFN Charge Supply (A2A3). (Refer to paragraph 3-7).

9. Remove two screws (8), each with a lock washer (9) and flat washers (10 and 11), from terminal board (12).

10. Unscrew and remove nut (13) from TEST connector J6 (14).

11. Unscrew and remove nut (15), lock washer (16) and flat washer (17) from each of three power terminal posts, J1, J2, and J3.

12. Unscrew coupling nut and disconnect air control plug A2A4P1 (18) from receptacle W1J2 (19).

13. Unscrew and remove nut (20) from receptacle W1J2 (19).

NOTE

The three code switches, test connector J6, and air control receptacle W1J2 each have an O-ring seal (22), (28), (38).

14. Push the three code switches (6), test connector J6 (14), and air control receptacle W1J2 (19) into housing (21). If any O-ring seals (22) fall loose, remove them from housing.

15. Pull wiring harness (1) free of power terminals J1, J2, and J3. Remove three washers (23).

16. Unscrew and remove two screws (24), each with lock washer (25) and flat washer (26), from transmitter connector J4 (27).

17. Carefully tilt forward end of connector (27) up, then push rear of connector around mounting bosses and down through hole in housing (21).

18. Remove wiring harness (1) from housing (21).

19. Loosely reinstall lock washers and nuts on connectors W1J2 (19) and J6 (14), and on the three coding switches (6).

20. Send wiring harness assembly (1) to Depot for repair/disposition.

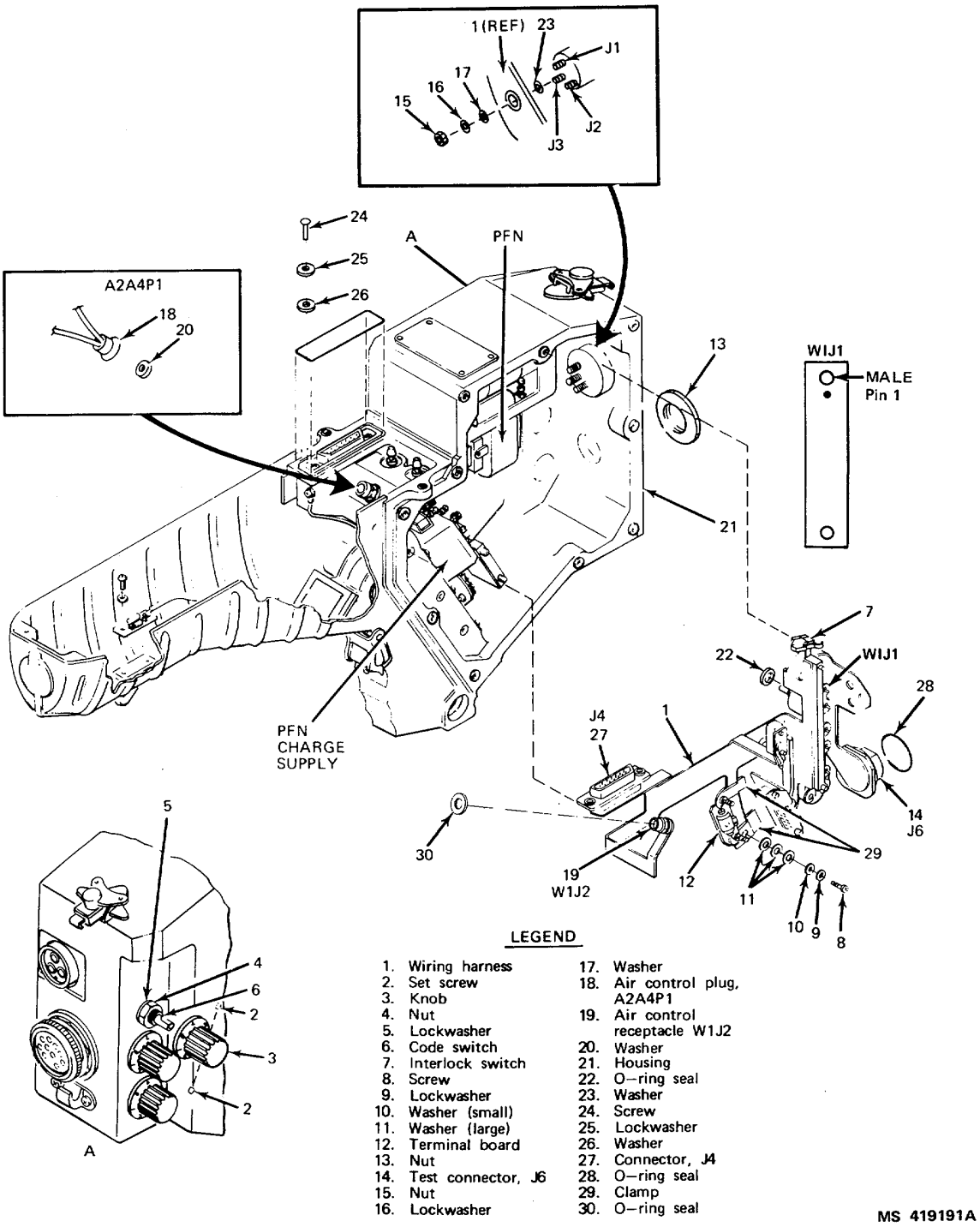


Figure 3-8. Removal and Installation of Wiring Harness (A2W1)

b. Install wiring harness (1) as follows:

CAUTION

Handle wiring harness with care to avoid tearing laminations apart.

1. Place wiring harness (1) in housing (21), code switches (6) first, so that connectors, terminal board, and switches are each near their proper positions.

2. Insert transmitter connector J4 (27) into opening (for J4) in housing (21), forward end first. Carefully pull connector through opening until rear end of connector is clear of mounting bosses. Aline connector holes with mounting holes and install two screws (24) each with a lock washer (25) and flat washer (26).

3. Install three code switches (6). (Refer to paragraph 3-9, step b, substeps 1 through 7.) 4. Lubricate O-ring seal (28) for TEST connector J6 (14), with lubricant (3, Table 3-1) and seat seal in groove of connector.

CAUTION

In the next step, make sure that O-ring seal is still in its groove when connector is in place.

5. Push TEST connector J6 (14) through hole in end housing (21).

6. Install nut (13) on test connector J6 (14).

7. Tighten nut (13) 50 to 55 inch-pounds.

8. Make sure that there is one flat washer (23) on each power terminal J1, J2, and J3.

9. Push wiring harness (1) onto power terminals J1, J2, and J3.

10. Install a flat washer (17), a lock washer (16), and nut (15) on each power terminal J1, J2, and J3.

11. Tighten nuts (15) to between 5 and 6 inch-pounds of torque.

12. Install PFN. (Refer to paragraph 3-6.)

13. Install PFN Charge Supply. (Refer to paragraph 3-7.)

14. Install wiring harness terminal board (12) as follows:

(a) Aline mounting holes in terminal board (12) with matching holes in housing (21).

(b) Install a clamp (29) over high voltage wire so that mounting hole of clamp is over one mounting hole of terminal board.

(c) Place lock washer (9), small flat washer (10) and three large washers (11) on screw (8) and install screw through clamp (29), terminal board (12) and into housing (21).

(d) Repeat substeps b and c for other clamp (29).

(e) Tighten screws (8) to between 5 and 6 inch-pounds of torque. Make sure high-voltage wire is still flexible and not over-stressed.

15. Delete.

16. Delete.

17. Tighten screws (24) to between 2 and 3 inch-pounds of torque.

18. Lubricate O-ring seal (30) for air control receptacle W1J2 (19) with lubricant (3, Table 3-1), and seat seal in groove of receptacle.

CAUTION

In the next step, make sure that O-ring seal is still in its groove when receptacle is in place.

19. Push receptacle W1J2 (19) through hole in housing (21).

20. Install nut (20) on air control receptacle W1J2 (28).

21. Tighten nut (20) until O-ring seal is fully compressed.

22. Aline keyways and connect air control assembly plug A2A4P1 (18) to receptacle W1J2 (19). Tighten coupling nut finger tight plus one half turn.

23. Install interlock switch (7). (Refer to paragraph 3-10.)

24. Install control card A2A1 and cover. (Refer to paragraph 3-5.

25. Install code switch knobs (3). (Refer to paragraph 3-9, step c.)

26. Delete.

3-12. Removal and Installation of Flashlamp. (See Figure 3-9).

a. Remove flashlamp (1), as follows:

1. Remove transmitter module. (Refer to paragraph 3-4.)

WARNING

Pressure vessel (2) on transmitter module (3) contains gas under pressure. Do not depress core of fill valve (4) or attempt to remove fill valve until required (step 11).

2. Unscrew and remove fill valve cap (5) from front end of pressure vessel (2).

3. Connect fill valve adapter (6) (LTD Test Set) to fill valve (4).

4. On gas charging assembly (7) (LTD Test Set), turn main valve (8) and vent valve (9) handles fully cw (closed).

5. On gas charging assembly, turn connection valve (10) handle fully ccw.

6. While holding fill valve adapter (6) to keep it from turning, connect gas charging assembly connection valve (10) to fill valve adapter (6).

CAUTION

Fill valve core must be depressed slowly. Sudden pressure changes can damage pressure vessel or flashlamp.

7. On gas charging assembly, very slowly turn connection valve (10) handle fully cw (to depress core of fill valve (4) and release pressure from pressure vessel into gas charging assembly hose (11)).

WARNING

During next step, gas will be escaping from vent valve (9) outlet. Stay clear of outlet. Blindness, injury, or death could result.

8. Slowly open vent valve (9) (turn handle ccw). Do not preceed to next step until gas flow stops.

9. While holding fill valve adapter (6) to keep it from turning, remove gas charging assembly connection valve (10) from fill valve adapter.

10. Remove fill valve adapter (6) from fill valve (4).

11. Unscrew and remove four fill valve attach screws (12) with lock washer (13) and flat washers (14).

12. Turn fill valve (4) one-eighth turn ccw and pull valve straight out from pressure vessel (2).

13. Using one of the four attach screws (12), insert screw into tapped hole in front end of flashlamp (1).

WARNING

Do not force flashlamp. A broken flashlamp can injure you.

CAUTION

Brace hands so as to avoid breaking flashlamp when it suddenly becomes free of snap-in retainer clamp.

14. Using screw (12), pull flashlamp (1) straight out of pressure vessel (2).

15. Remove screw (12) from flashlamp (1).

16. Discard old flashlamp (1).

b. Install new flashlamp (1), as follows:

WARNING

Do not force flashlamp into pressure vessel. A broken flashlamp can injure you.

CAUTION

Do not handle flashlamp (1) with fingers. Residue from fingers can shorten life of flashlamp and/or decrease its output.

1. Insert one fill valve attach screw (12) into tapped hole at end of flashlamp (1).

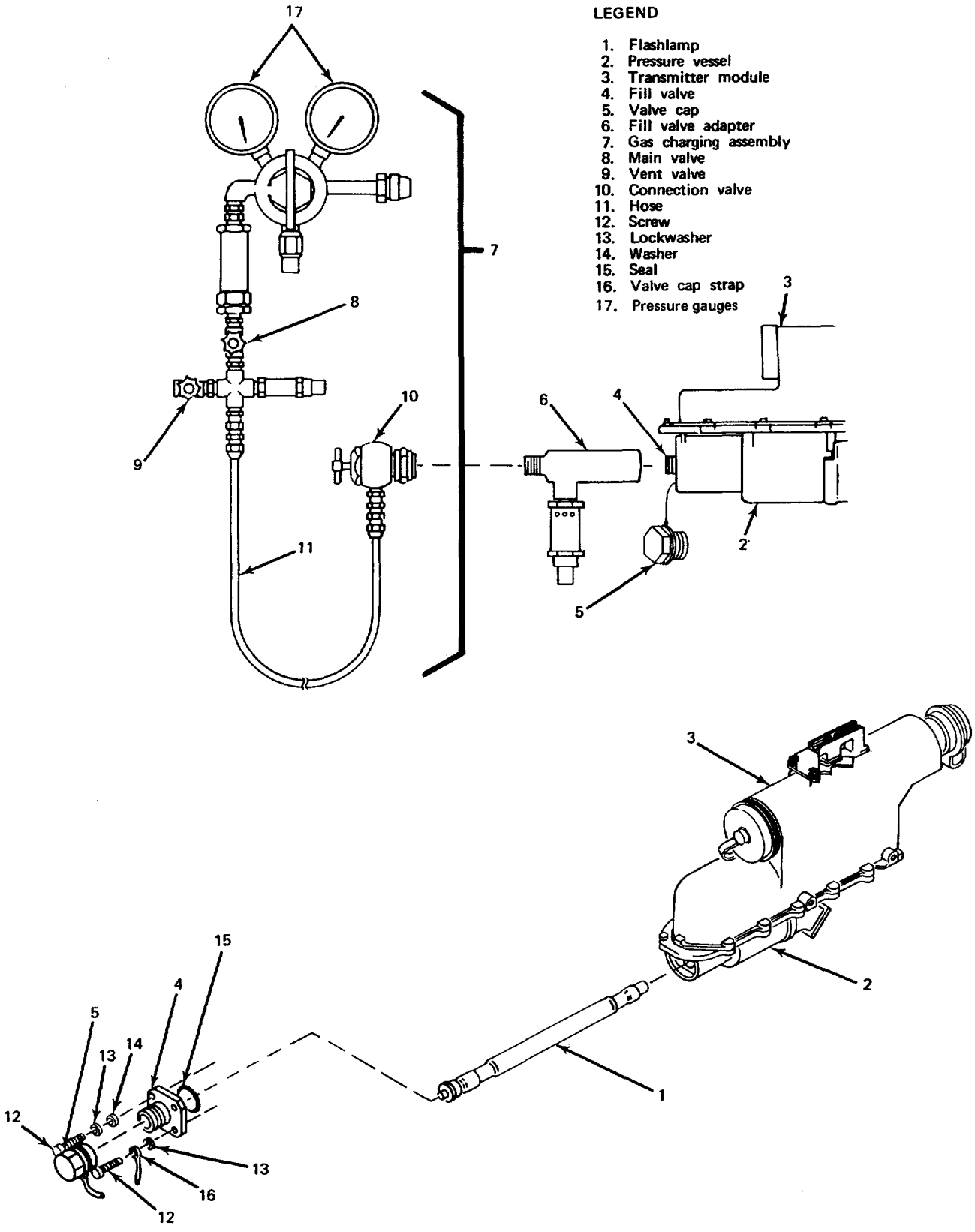


Figure 3-9. Removal and Installation of Flashlamp

2. Using a clean cloth (5, Table 3-1), gently wipe away any dust or lint particles on flashlamp (1).

3. Holding screw (12), very carefully insert flashlamp (1) into pressure vessel (2).

4. Gently push flashlamp (1) into pressure vessel retaining clamp until you feel a slight snap.

5. Pull very gently on screw (12) to make sure flashlamp (1) is properly seated in clamp.

6. Remove screw (12).

7. Lubricate O-ring seal (15) with lubricant (3, table 3-1).

8. Make sure O-ring seal (15) is properly seated on nitrogen fill valve (4).

CAUTION

Do not force nitrogen fill valve. Forcing valve could break flashlamp.

9. Insert nitrogen fill valve (4) into pressure vessel (2) opening and turn it one-eighth turn cw until screw holes are alined.

10. Insert three attach screws (12), each with lock washer (13) and flat washer (14), through flange of nitrogen fill valve (4).

11. Put lock washer (13) and lug of valve cap strap (16) on fourth screw (12) and insert it through flange of valve (4).

12. Tighten screws (12) to between 7 and 9 inch-pounds of torque.

13. Purge and fill pressure vessel. (Refer to paragraph 2-15.) 14. Install transmitter. (Refer to paragraph 3-5.

3-13. Removal and Installation of Carrying Strap. (See Figure 3-10.

a. Remove strap (1), as follows:

1. Holding screw (2), unscrew and remove nut (3) and flat washer (4.).

2. Remove screw tL) from brackets (5) on end of strap (1) and remove strap from support lug (6) on LTD.

3. Tapping lightly (if necessary) with a hammer, drive spacer (7) from support lug (6).

4. Repeat steps 1, 2, and 3 to remove other end of strap (1) from LTD.

b. Install new strap (1), as follows:

1. Holding screw (2), unscrew and remove nut (3) and washer (4) from one end of strap (1).

2. Remove screw (2) and spacer (7), from same end of strap (1).

NOTE

Before performing steps 3 and 4, make sure that strap slider (8) will be faced away from body of LTD.

3. Insert one spacer (7) in support lug (6).

4. Position brackets (5) over support lug (6) and aline holes.

5. Insert screw (2) through brackets (5) and spacer (7).

6. Install flat washer (4) and nut (3).

7. Holding screw (2) torque nut (3) between 6 and 8 inch-pounds.

8. Repeat steps 1 through 7 for other end of strap (1). Loosen strap slider (8) as necessary for strap to reach other support lug (6).

9. Adjust strap slider (8) to take up any slack.

3-14. Removal and Installation of Battery Latch. (See Figure 3-11.)

a. Remove latch (1) as follows:

1. Remove two screws (2), lock washer (3), and flat washer (4).

2. Remove latch (1) from LTD housing.

b. Install latch (1) as follows:

1. Install new latch (1) on LTD housing using two screws (2), lock washers (3), and flat washers (4).

2. Torque screws (2) 6 to 7 inch pounds.

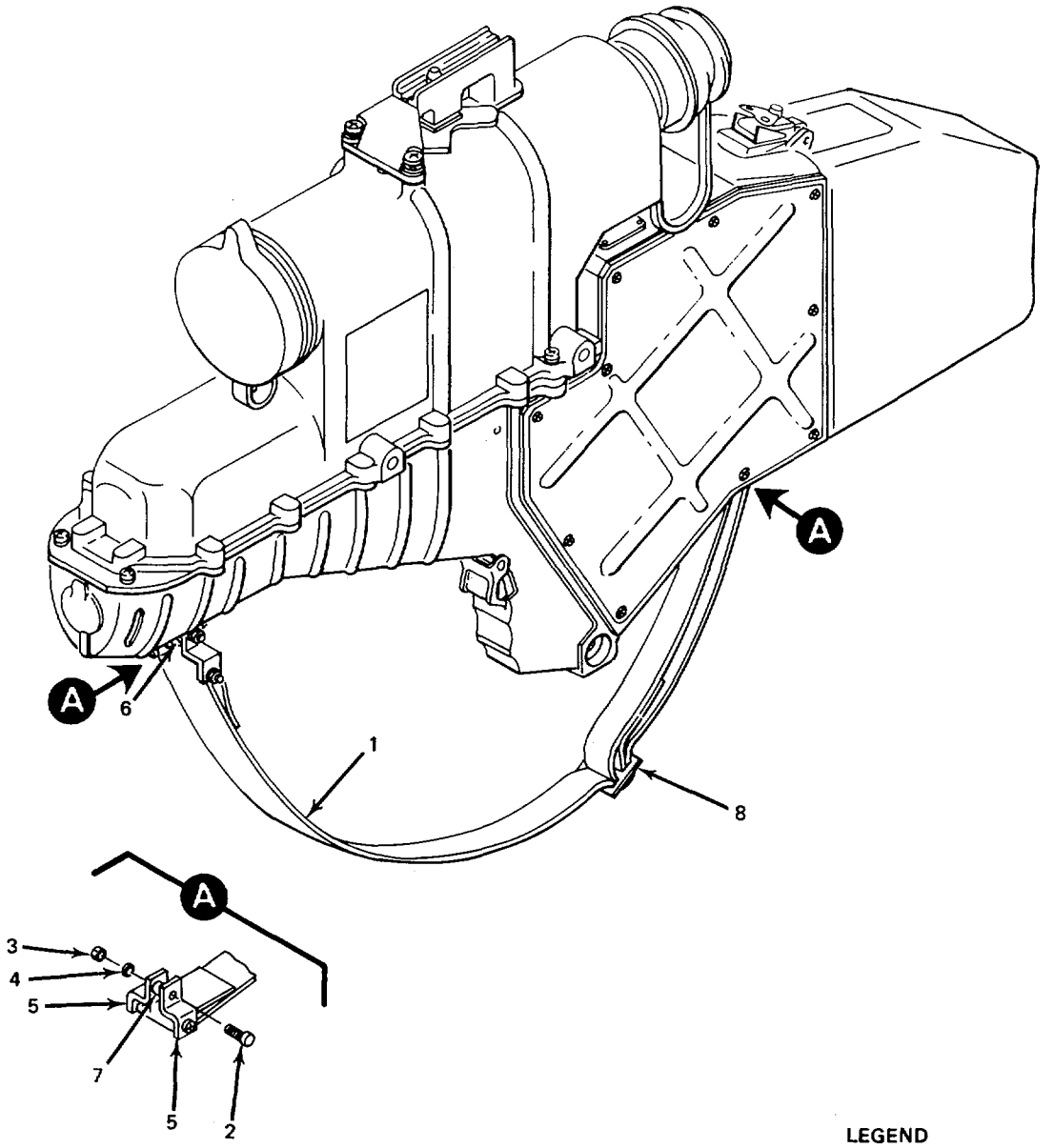


Figure 3-10. Removal and Installation of Carrying Strap

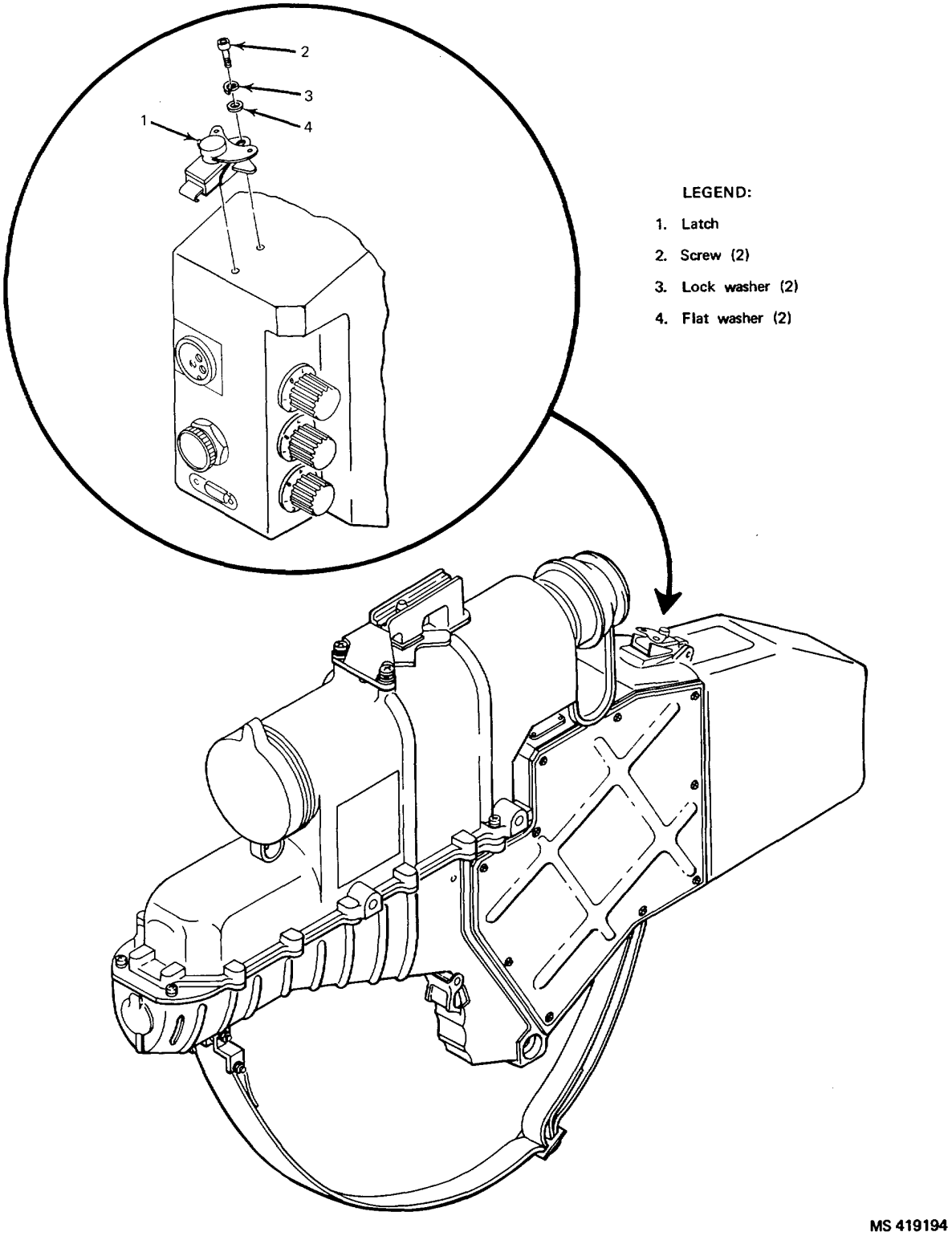


Figure 3-11. Removal and Installation of Battery Latch

Section III. REPAIR OF EPA

3-15. External Power Adapter Inspection. (See Figure 3-12.)

a. Release 10 latches of EPA carrying case (1) an- lift off cover.

b. Remove and visually inspect the external power converter (2), EMI filter (3), interconnect cable W1 (4), jeep cable (6), and power cable W2 (5). Inspect for any physical damage that might impair operation or safety of a component.

c. If damage is found:

1. Replace cables as required.
2. Send EMI filter to Depot for repair/disposition.
3. Repair converter as required. (Refer to paragraph 3-16.)

3-16. Repair of External Power Converter. (See Figure 3-13.)

CAUTION

A wrist ground strap must be worn prior to removing the pre-regulator assembly and drive electronics card to prevent damage to static sensitive components mounted on drive electronics card. After removal care should be taken to insure that the card is isolated from static charge. Place card in antistatic bag.

a. Remove pre-regulator assembly (1) with drive electronics card, A4A1 (2) from housing (3), as follows:

1. Loosen 12 captive screws (4) and remove cover (5).
2. Remove nuts (6) and lock washers (7) from cnnectors J1 (8) and J2 (9). Push connectors into housing (3).
3. Remove nut (10), lock washer (11) and guard (12) from POWER switch S1 (13). Push switch into housing (3).
4. Unscrew and remove six screws (14), each with a lock washer (15) and washer (16), from pre-regulator chassis (17).
5. Lift pre-requlator assembly (1) from housing (3). (Assembly consists of chassis (17), connectors (8 and 9), switch 13) and drive electronics card (2)).

b. Remove drive electronics card A4A1 (2) from ore-regulator assembly (1), as follows:

CAUTION

Unscrew jack screws evenly. Connector can be damaged if screws are loosened unevenly.

1. Unscrew two captive jack screws (18) evenly, one turn at a time, until connector A4J3 (19) is separated from drive electronics card (2).
2. Holding screws (20) remove nuts (21), lock washer (22) and flat washers (23) at seven places that secure card (2) to chassis (17).
3. Separate card (2) from chassis (17) and remove seven spacers (24), flat washers (25), and screws (20) from card.
4. If faulty refer drive electronics card A4A1 to Depot for repair/disposition.

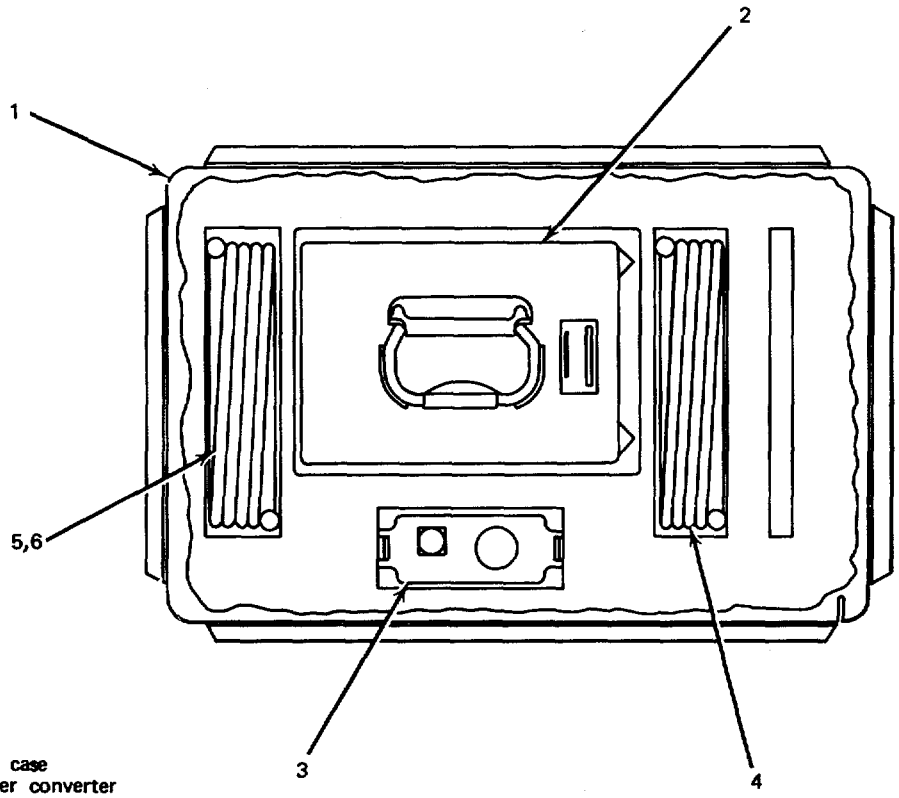
c. Install drive electronics card A'A1 (2), as follows:

1. Place a flat washer (25) on each of seven screws (20) and insert screws through holes in drive electronics card (2) from components side of card. (A small piece of tape placed over head of each screw will aid in keeping screws in place when card is turned over in next step.
2. Tilt drive electronics card (2) and place a spacer (24) on each of the seven screws (20) extending through card (2).
3. Assemble card (2) to pre-regulator chassis (17) so that each screw (20) protrudes through to component side of chassis. Make sure all seven spacers (24) are still in place on screws.
4. Install flat washer (23), lock washer (22), and nut (21) on each of the seven screws (20).
(Remove tape, if used.
5. Tighten screws (20) to between 9 and 12 inch-pounds of torque.

CAUTION

In the next step, tighten jack screws evenly. Connector can be damaged if screws are tightened unevenly.

6. Mate connector A4J3 (19) to receptacle on drive electronics card (2) and tighten jack screws (18), one turn at a time, until connector is fully mated.
7. Tighten jack screws (18) to between 2 and 3 inch-pounds of torque.



LEGEND

1. EPA carrying case
2. External power converter
3. EMI filter
4. Interconnect cable, W1
5. Power cable, W2
6. Jeep cable

Figure 3-12. External Power Adapter (Cover Removed)

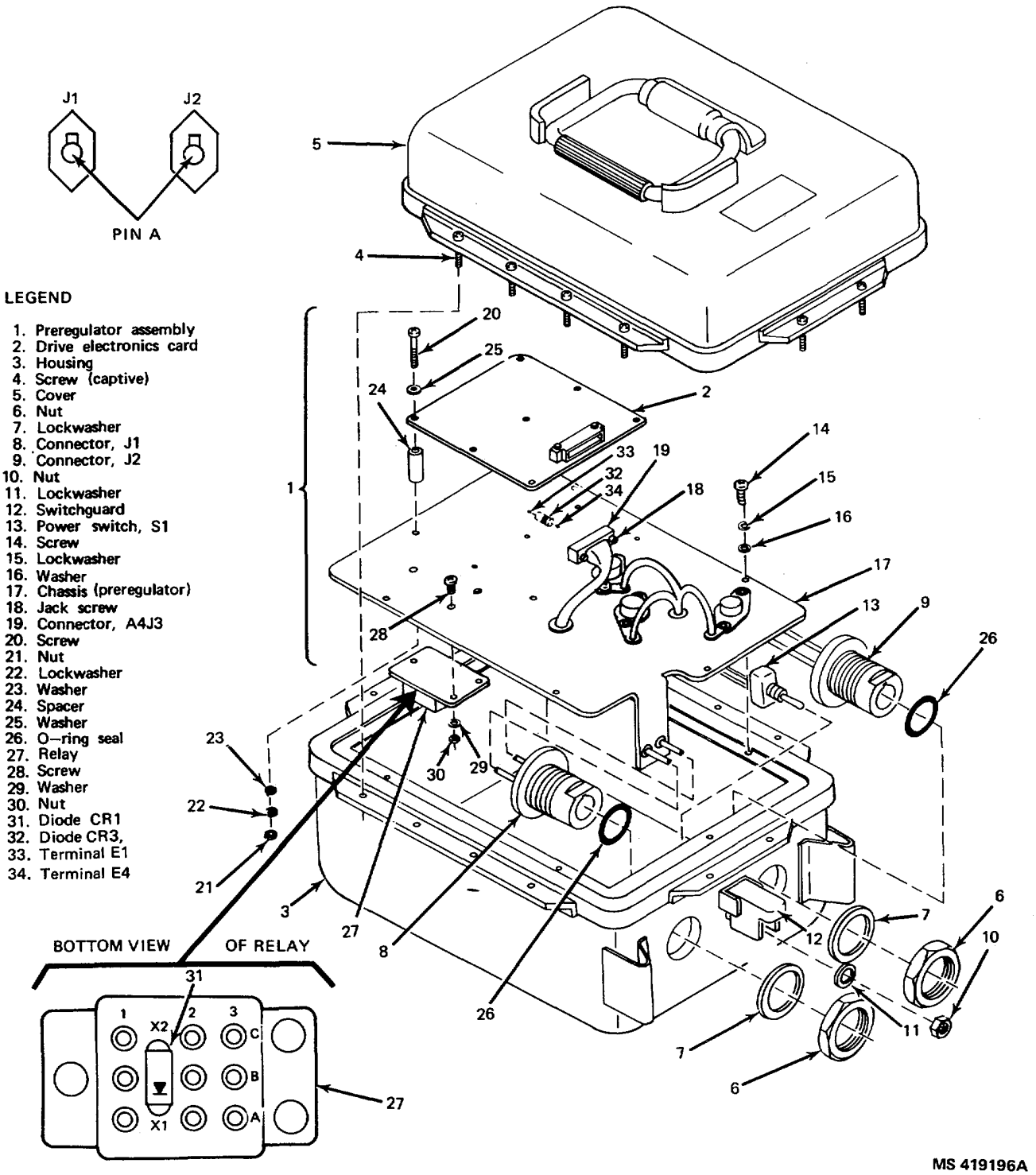


Figure 3-13. Repair of External Power Converter

d. Install pre-regulator assembly (1) in housing (3T, as follows:

1. Lubricate O-ring seals (26) on connectors J1 (8) and J2 (9) with lubricant (3, Table 3-1).

2. Place pre-regulator assembly (1) over housing (3) so that switch (13) and connectors (8 and 9) may be inserted through holes in housing.

3. Make sure OFF position of POWER switch S1 (13) toggle is toward bottom of housing (3) and push switch through housing.

NOTE

Switch (13) and connectors (8, 9) are keyed by shape of hole in housing (3).

4. Place guard (12) over switch (line up table with groove on switch) and install lock washer (11) and nut (10).

5. Make sure pin A is toward top of housing (3) and push connector J1 (8) through hole in housing.
Install lock washer (7) and nut (6).

6. Make sure pin A is toward top of housing (3) and push connector J2 (9) through hole in housing.
Install lock washer (7) an nut (6).

7. Place pre-regulator assembly (1) in housing (3) and install six screws (14), each with lock washer (15) and washer (16).

8. Tighten screws (14) to between 18 and 23 inch-pounds of torque.

9. Install cover (5) on housing (3) and tighten the 12-captive screws (4).

10. Test External Power Converter in order to insure unit is functioning properly. (Refer to Table 2-6.)

WARNING

Insure that the external power converter and power supply switches are OFF before disassembling the external power converter.

3-17. Removal and Installation of Power Switch S1. (See Figure 3-13.)

a. Remove power switch (13), as follows:

1. Remove pre-regulator assembly (1) from the external power converter per paragraph 3-16a.

2. Tag and disconnect the two wires connecting switch (13) to the pre-regulator assembly (1) and remove switch (13).

b. Install new power switch (13), as follows:

NOTE

New switch includes mounting hardware consisting of two nuts and a lock washer.

1. Remove one nut (10) and the lock washer (11) from the new switch (13).

2. Cut two 3/4 inch lengths of shrink sleeving (2, Table 3-1) and slip over the two wires to be soldered to new switch.

3. Using tag information, connect the two tagged wires to terminals 1 and 3 of switch. Remove 4. Slide shrink sleeving up over switch terminals and heat shrink sleeving to terminals using heat gun.

5. Reinstall pre-regulator assembly per paragraph 3-16d.

6. Dispose of faulty switch (13).

WARNING

Insure that the external power converter and power supply switches are OFF before disassembling the external power converter.

3-18. Removal and Installation of Connectors J1 and J2. (See Figure 3-13.)

a. Remove connectors J1 (8) and J2 (9) as follows:

1. Remove pre-regulator assembly (1) from external power converter per paragraph 3-16a.

2. Tag, unsolder, and remove the two wires from defective connector(s) J1 (8) and/or J2 (9).

3. Discard defective connector(s).

b. Install connectors J1 (8) and J2 (9), as follows:

1. Cut two 3/4 inch lengths of shrink sleeving (2, Table 3-1) for each defective connector and slip over two disconnected wires.

2. Connect and solder the two wires to the defective connector(s).

3. Slide shrink sleeving up over connector terminals and shrink sleeving to terminals using heat gun.

4. Install pre-regulator assembly (1) in external power converter per paragraph 3-16d.

WARNING

Insure that external power converter and power supply switches are OFF before disassembling the external power converter.

3-19. Removal and Installation of Relay K1 and Diode CR1. (See Figure 3-13.)

a. Remove relay (27), as follows:

1. Remove pre-regulator assembly (1) from the external power converter per paragraph 3-16a.

2. Tag and unsolder wires from relay (27) terminals.

3. While holding screw (28) with screwdriver, remove nut (30) and washer (29) from relay (27).

4. Remove relay (27) from pre-regulator chassis (17).

b. Install new relay (27), as follows:

NOTE

Diode CR1 must be installed on new relay.

1. Cut diode (31) leads as short as possible but with sufficient length so that diode (31) can be securely soldered to relay (27) terminals X1 and X2.

CAUTION

Improper connection of diode (31) to relay (27) can result in equipment damage. Insure diode (31) is properly installed on relay (27).

2. Connect anode of diode (31) to relay (27) terminal X2. Connect cathode of diode (31) to relay (27) terminal X1.

3. Solder diode (31) to relay (27), using solder (4, Table 3-1).

4. Install relay (27) in pre-regulator chassis (17). Secure relay (27) to pre-regulator chassis (17) using three screws (28), washers (29), and nuts (30).

5. Cut 3/4 inch length of shrink sleeving for disconnected wires.

6. Remove tags, slide shrink sleeving over wires and solder wires to corresponding relay (27) termi nal s.

7. Slide shrink sleeving up over relay (27) terminals and shrink sleeving using heat gun.

8. Install pre-regulator assembly (1) in external power converter per paragraph 3-16d.

3-20. Removal and Installation of Diode CR3. (See Figure 3-13.)

a. Remove diode CR3 as follows:

1. Remove pre-regulator assembly (1) from the external power converter per paragraph 3-16a.

NOTE

The location of diode CR3 (32) is marked on underside of pre-regulator chassis (27). Refer to Figure 3-13 for item location.

2. Unsolder diode (32) leads from pre-regulator chassis (27).

3. Remove diode (32) from pre-regulator chassis (17).

b. Install diode CR3 as follows:

1. Cut diode (32) leads as short as possible but with sufficient length so that diode (32) can be securely soldered to pre-regulator chassis (17) terminals E1 and E4 on underside of pre-regulator chassis (17).

CAUTION

Improper connection of diode (32) can result in equipment damage. Insure diode (32) is properly installed on pre-regulator chassis (17).

2. Connect anode of diode (32) to terminal E1 on underside of pre-regulator chassis (17). Connect cathode of diode (32) to terminal E4 on underside of preregulator chassis (17).

3. Solder diode (32) to pre-regulator chassis (17) using solder (4, Table 3-1).

4. Install pre-regulator assembly (1) in the external power converter per paragraph 3-16d.

APPENDIX A

FORMS, RECORDS, AND SUPPORTING DOCUMENTS

A-1. GENERAL.

You should: Consult publication indexes frequently for:
Updates.
Changes/revisions to those listed below.
New publications relating to material in this manual.

A-2. PUBLICATIONS INDEXES.

Index of Administrative Publications ..... DA PAM 310-1
Index of Army Motion pictures, Television Recordings, and Film Strips ..... DA PAM 108-1
Index of Blank Forms ..... DA PAM 310-2
Index of Doctrinal, Training and Organizational Publications ..... DA PAM 310-3
Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders ..... DA PAM 310-4
Index of Modification Work Orders ..... DA PAM 310-7

A-3. TECHNICAL MANUALS.

Operator and Organizational Maintenance Manual for Battery Charger; PP-7286 11-6130-392-12
Operator and Organizational Maintenance Manual for Target Designator, Laser, AN/PAQ-1 ..... TM 9-1260-479-12
Organizational, Direct Support, and Depot List of Parts Illustration for Target Designator, Laser AN/PAQ-1 ..... TM 9-1260-479-24P
Operator, Organizational, and Direct Support Maintenance Designator, Laser AN/PAM-1 ..... TM 9-4931-599-13
Technical Bulletin (Classified) TB-9-1260-479-30
Intermediate Maintenance Manual Battery Charger; PP-7286 11-6130-392-34

A-4. FORMS.

You will need to complete:
Forms required by TM 38-750.
Forms listed below.
Recommended Changes to DA Technical Manuals, Parts List or Supply Manual ..... DA Form 20
Report of Damage or Improper Shipment ..... DD Form 6

A-5. OTHER PUBLICATIONS.

Accident Reporting and Records ..... AR 385-40
Administrative Storage of Equipment ..... TM 740-90-1
Army Safety Program ..... AR 385-10
Chemical, Biological, and Radiological (CBR) Decontamination ..... TB 3-220
Control of Health Hazards from Laser Radiation ..... TB MED 279
First Aid for Soldiers ..... FM 21-11
Noise and Conservation of Hearing ..... TB MED 251
Policies and Procedures for Firing Ammunition for Training, Target Practice and Combat ..... AR 385-63
Safeguarding Defense Information ..... AR 380-5
Safeguarding Defense Information in Movement of Persons and Things ..... AR 385-55
Safety ..... AR 385-62
Small Unit Procedures in Nuclear, Biological, and Chemical Warfare ..... FM 21-40
The Army Maintenance Management System (TAMMS) ..... TM 38-750

APPENDIX B
TOOLS AND TEST EQUIPMENT

B-1. Tools and test equipment necessary for maintenance of the LTD are listed in table B-1.

Table B-1. Tools and Test Equipment

Tool or Equipment	Lowest Maintenance Category	Nomenclature	NSN/PN
1	F	Battery Charger (PP-7286)	6130-01-041-3490
2	F	Oscilloscope, Tektronix 7633	6625-01-106-5581
3	F	Multimeter, AN/PSM-6B	6625-00-957-4374
4	F	Pulse Generator, Hewlett Packard Model HP214B	5895-01-080-7940
5	F	Test Set, AN/PAM-1, Target Designator, Laser	4931-01-040-3117 (13034400)
6	F	Tool Kit, Laser System Field Maintenance	5180-01-048-8570
7	F	External Power Adapter	1260-01-040-1494

APPENDIX C
EXPENDABLE SUPPLIES AND MATERIALS

This appendix lists expendable supplies and materials you will need to operate and maintain the set. These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items). The following is an explanation of each applicable column.

a. Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use staking compound, item 13, App. C").

b. Column 2 - Level. This column identifies the lowest level of maintenance that requires the listed item. (enter as applicable)

C - Operator/Crew
O - Organizational Maintenance
F - Direct Support Maintenance
H - General Support Maintenance

c. Column 3 - National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4 - Description. Indicates the Federal item named and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. Column 5 - Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Table C-1. Expendable Supplies and Materials

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION PART NO. AND FSCM	(5) UNIT OF MEAS.
1	0	6505-00-514-6513	Alcohol, Isopropyl TT-I-735	ea
2	0		Bag, Plastic PP-8-26, Type II, Style 3, internal dimensions 4.5 x 5.2 inches	ea
3	0	10193091	Bottle, Plastic, PP-B-26 Type I, Finish 2, (18876)	ea
4	0	7920-00-514-2417	Brush, Acid Swabbing	ea
5	0	11507787	Brush, Dusting, Lens, Retractable (18876)	ea
6	0	7920-00-205-1711	Rags, Cotton Wiping	ea
7	0	---	Solution:	
		6505-00-514-6513	Alcohol, Isopropyl TT-I-735	qt
		---	Water, Distilled	qt
8	0	7920-00-672-1884	Tissue, Lens, Cleaning Booklet, 3 x 5 inches NN-P-40	50 sh
9	0	---	Water, Distilled	
10	0	TT-P-1757	Primer, Sealing	qt
11	0	MIL-E-52798	Enamel, Forest Green	gl
12	0	MIL-L-4343	O-ring Lubricant	qt
13	F	MIL-E-22118	Compound, Staking	
14	F	---	Gloves or Finger Cots	pr/ea
15	F	M23053/5-204-C	Insulation, sleeving, Shrinkable	
16	F	MIL-L-4343	Lubricant	ea
17	F	7920-00-205-2711	Rags, Nylon or Dacron	ea
18	F	QQ-S571	Solder SN-63	ea
19	F	6830-01-124-1435	Nitrogen-Oxygen Gas Mixture (N_2 0_2)	cy

APPENDIX D

LTD AND EPA WIRE LIST

Table D-1 presents a wire list according to the signals carried. For each signal, the pin numbers of each connector that carries that signal is shown in adjacent columns. to check wire continuity, check between each pin number listed for the signal on that wire. If discontinuities are found, replace the cable.

Table D-2 presents similar information for the EPA.

Table D-1. Laser Target Designator Wire List

Wire or Signal	Control Card W1J1	Air Control W1J2	PFN Charge Supply W1P2	Transmitter J4	Test J6	Other Connection Points
24V RTN	29,63	8	3,12,13	25	3	J1, A2A4P1-8, E3 (GND)
24V AUX	4	2				J2, A2A4P1-4, L1, CR1
24V PRIME	62		1,2,11			J3
24V START	64	6		13	1	A2A4P1-6
Shield	2	2		A2A4P1-2		
Shield	3	24				
Shield	4	1	6			
INHIBIT LASING	6				10	
A TRIG	8				8	
Shield	9				9	
DC RTN	10					A2WlS1-C, A2W1S2-C, A2W1S3-C
+15 SENSE	14				6	
MALF (+)	15			15		
RETICLE DRIVE	16			1		
RETICLE (+)	7			14		
Shield	18			8,9		
-15 SENSE	20				7	
ENERGY ERROR	21				13	
HEATER (+5 VDC)	22			23		
DC RTN	23			11		
+5V SENSE	24				5	
+5V1 PULL UP	25					A2W1S4-NC
DIODE BIAS	26			4		
HVPS ENABLE (OUT)	27	A2W1S4-NO				

Table D-1. Laser Target Designator Wire List

Wire or Signal	Control Card W1J1	Air Control W1J2	PFN Charge Supply W1P2	Transmitter J4	Test J6	Other Connection Points
HVPS ENABLE (IN)	28					A2W1S4-C
CT	31		10			
400V SENSE	33				11	
400V DC	35			21		
INTERNAL SENSISTOR	36		12			
EXTERNAL SENSISTOR	37				A2A4P1-1	
LASER DISABLE	38,39					
I-O	41	A2W1S3-1				
I-1	42	A2W1S3-2				
I-2	43					A2W1S3-4
I-3					44	A2W1S2-1
I-4					45	A2W1S2-2
I-5	46					A2W1S2-4
I-6	47					A2W1S1-1
I-7	48					A2W1S1-2
I-8	49					
A2W1S1-4						
MALF DRIVE	50			2		
Q-SWITCH FIRE	51			7		
V REF	52			18		
FLASHTUBE FIRE	53			10		
EVENTS DRIVE	54				4	
ENERGY ERROR	55,56					
Shield			17			
I-SENSE (-)	57		8			
I-SENSE (+)	58		18			
PFN SENSE	59		4			
Shield	60			5		
ENERGY DIODE	61		17			
OFF	65	9				
DRIVE RTN	66			20		

Table D-1. Laser Target Designator Wire List

Wire or Signal	Control Card	Air Control	PFN Charge Supply	Transmitter	Test	Other Connection Points	
	W1J1	W1J2	W1P2	J4	J6		
ON	67		19				
Shield	68			20			
PFN SENSE TEST					12	A2W1P1-1	
PFN CAP			15			A2W1P1-9	
PFN COM			7			A2W1P1-3	J5-2
PFN COIL							J5-1

Table D-2. External Power Adapter Wire List

Wire	Vehicle Cable		Ext. Power Connector		Interconnect Cable		EMI Filter	
24 VDC	W2P2	W2P1	J1	J2	W1P2	W1P1	J1	-
SOURCE	Q	A,B	A,B					
PRIME				A	A	A	A	P3
RTN	B	C,D	C,D	B	B	B	B	P1
AUX			C	C	C	C		P2
INTERLOCK			D	D	D	D		P1

APPENDIX E
NITROGEN-OXYGEN PRE-MIX COMPOSITION

NOTE

The gas bottle may be refilled by local vendors qualified to satisfy the requirements of the following table and MIS 30398.

Table E-1. Pre-Mix Composition Requirements

Item	Description	Mixed N_20_2 Requirement
	99.5% pure oxygen containing maximum levels of impurity as follows: 5 ppm H20 10 ppm CO2 10 ppm Hydrocarbon 4 ppm N20 2 ppm Refrigerants 0.2 ppm Solvents 0.2 ppm Misc.	2.0 ± 0.2% by volume
2	Gaseous hydrocarbons as methane volume maximum.	10 ppm by
3	Moisture 5 ppm by volume maximum.	
4	98% Pure nitrogen containing maximum levels of impurity as follows: 500 ppm 02 5 ppm H20 10 ppm Hydrocarbon Trace - Argon, Neon, Helium	Balance

NOTE: **1. Items 2 and 3 must be verified by sampling the filled bottle.**

2. Items 1 and 4 must be odor free and filtered to ten microns nominal.

INDEX

NOTE

References are to figures, tables, and paragraphs unless the reference contains a Roman numeral in which case the reference is to chapter and section: 2-III means Chanter 2. Section III.

U.S. GOVERNMENT PRINTING OFFICE: 1995-633-220/00150

By Order of the Secretary of the Army:

E. C. MEYER
General, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-32, Section III, DS and GS Maintenance requirements for LASER Target Designator, AN/PAQ-1.

*U.S. GOVERNMENT PRINTING OFFICE: 1994 - 533-072/00216

Figure FO-1. POWER CONTROL AND DISTRIBUTION FUNCTIONAL DIAGRAM

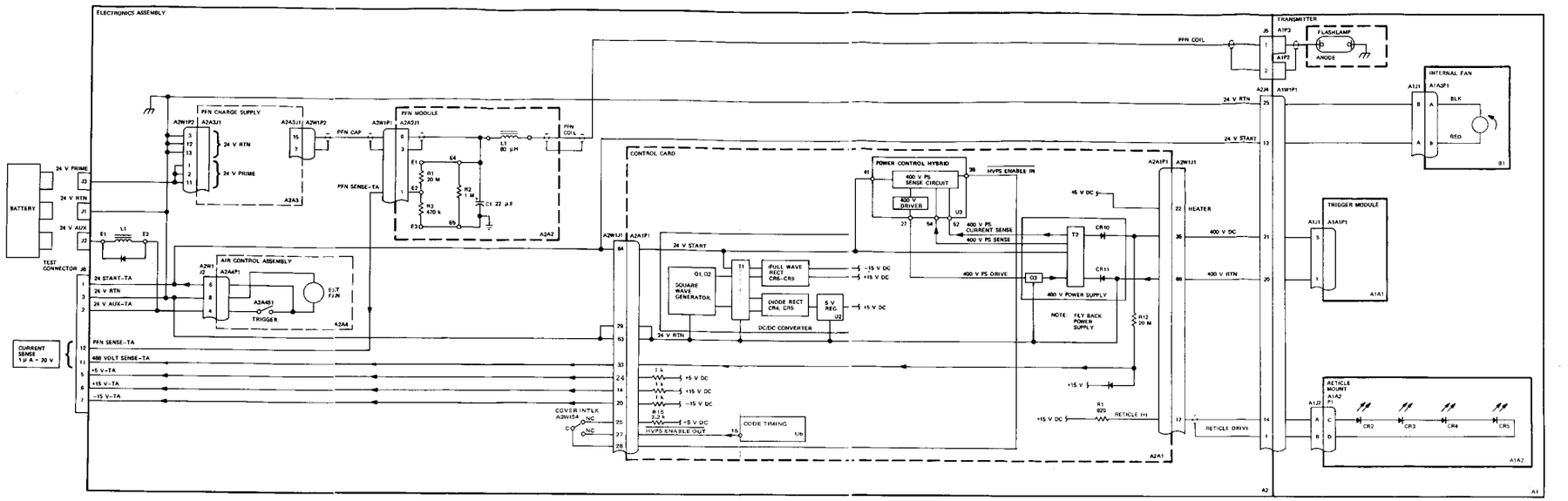
This functional diagram covers the basic circuitry related to input power conversion and distribution.

Locate the power input connectors J1, J2, J3 on this diagram. Power is available to the system but no internal power is generated until the trigger is pulled. Locate the Air Control Assembly A2A4. When the trigger is pulled 24V START is created which turns on the external fan in the air control assembly and the internal fan in the transmitter. When the 24V START signal reaches the A2A1 card timing and control signals will start at the end of the TDK signal (see Laser Control and Timing Functional, Figure FO-2).

Locate the DC/DC converter on the A2A1 card. When the 24V START signal arrives oscillators Q1 and Q2 drive transformer T1. The transformer secondary produces 15V, -15V, and 8V. The secondary squarewaves are rectified and filtered to provide +15 VDC and +8 VDC. The +8 VDC is inputted to a regulator that provides a +5 VDC output.

Locate the 400 VDC power supply on A2A1. 24V START is applied to transformer T2 which is switched on and off through Q3. The 400V power supply output voltage and switching current are monitored by sensing circuits on Power Control Hybrid U3 which feed a 400V power supply driver to generate the 400 VDC output.

Locate the PFN charge supply A2A3. The PFN charge supply receives the 24V PRIME power input from the battery or EPA and generates a high voltage/current pulse which is fed to the PFN module A2A2. The PFN module shapes the pulse and inputs the shaped PFN COIL pulse to the anode of the flashlamp. The resulting light output of the flashlamp is then used to optically "pump" the laser rod.



MS 419197 B

Figure FO-1. Power Control and Distribution Functional Diagram

Figure FO-1. Power Control and Distribution Functional Diagram

Figure FO-2. PFN ENERGY GENERATION FUNCTIONAL DIAGRAM

This functional diagram covers the basic circuitry related to generation of the PFN energy pulse and PFN output adjustment.

Locate the PFN charge supply A2A3 on this diagram. 24V Prime applies power to transformer T2 which transfers energy to the PFN. T2 is driven by a combination of T1 and Q1. With an ON signal, Q1 is turned on and current flows through T2 storing energy in its magnetic field. When proper peak current is detected at I SENSE (+), Q1 is turned off by removing the ON signal and applying the OFF signal. During the OFF signal time T2 transfers its energy into capacitor C4. This charging cycle continues until the PFN SENSE circuits on Power Control Hybrid U3 indicate a fully charged capacitor.

Locate the PFN module A2A2. The PFN capacitor C1 stores the charge developed by the PFN charge supply. The inductor and capacitor circuit L1 and C1 shape the PFN current pulse (PFN CAP) to provide for maximum efficiency of flashlamp firing. From the PFN module the shaped current pulse (PFN COIL) enters the transmitter assembly and is fed to the anode of the flashlamp. The flashlamp will not, however, trigger on the PFN voltage alone, ionization must first take place within the tube to conduct the current pulse (PFN COIL) from the PFN. The tube is ionized by trigger pulses generated by the timing circuitry at the selected pulse repetition frequency (PRF) (see Laser Control and Timing Functional, FO-3). First pulse laser output energy is set according to each individual transmitter assembly. A resistor (R2) is adjusted at Depot level to set this value.

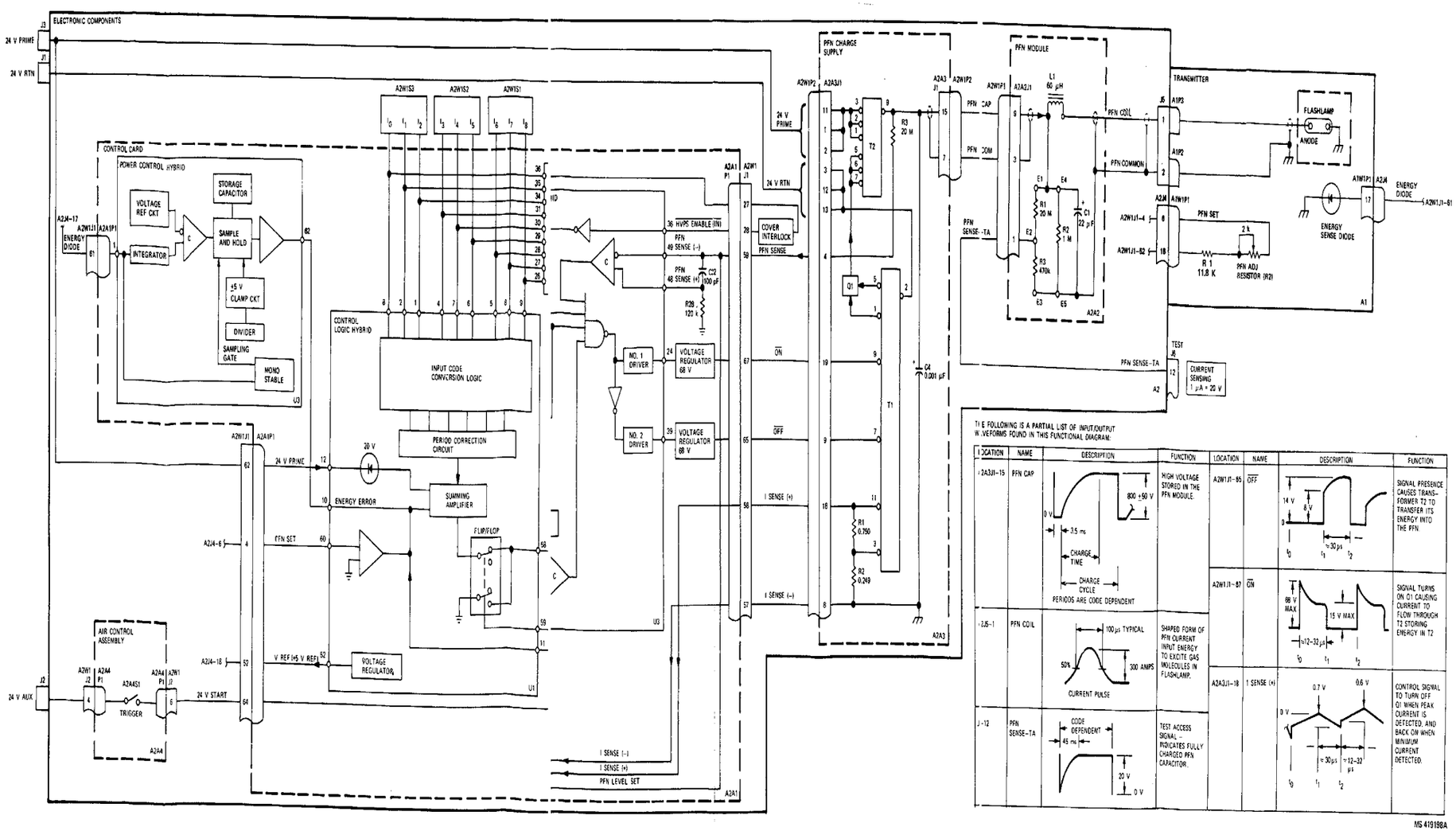


Figure FO-2. PFN Energy Generation Functional Diagram

Figure FO-3. LASER CONTROL AND TIMING FUNCTIONAL DIAGRAM

This functional diagram covers the basic circuitry describing the timing sequence of the LTD control circuitry.

Locate Control Logic Hybrid U1 and Code Timing LSI U6 on control card A2A1. The majority of the control and timing circuitry is contained in this hybrid and LSI.

The 24V START signal enters the Control Logic hybrid U1 and initiates the Turn-On-Reset (TOR) generator. At the rising edge of TOR, the LASER DISABLE signal is generated on U1 and inputted to Control Timing LSI (U6). At this point all timing signals are initiated.

A 200 khz clock provides the basic timing reference. At the tactical frequency selected by the code select switches W1S1, W1S2, and W1S3 the following two control signals are generated: HVPS ENABLE and TMG GATE. HVPS ENABLE provides for control of the PFN and 400 VDC supplies. It also generates the F/T FIRE signal. The combination of F/T FIRE and TMG GATE produces Q/S FIRE. On U1 F/T FIRE becomes F/T FIRE at A2A1P1-53 and Q/S FIRE becomes Q/S FIRE at A2A1P1-51.

Locate the trigger module A1A1 on this diagram. The trigger module receives the code timing signals F/T FIRE and Q/S FIRE and utilizes the power supplied by the 400 VDC power supply. Normally C8 on A1A1 is charged to 400 VDC. When F/T FIRE occurs, an SCR trigger circuit discharges C8 and produces a negative voltage spike of 325 V (F/T TRIGGER) which is fed to the flashlamp trigger transformer T1 on cooling module A1A3. The flashlamp trigger transformer produces approximately -25 KV which ionizes the gas in the flashlamp, forming a conducting path allowing the PFN to release its energy to the flashlamp (see PFN ENERGY GENERATION FUNCTIONAL, FO-2). This energy is then used to optically "pump" the laser rod just prior to laser firing.

It is important to note that the laser energy is not generated without the optical "Q" switch. A device known as a Pockels cell acts as a fast light switch for the generation of the accurate laser pulse repetition frequency. It is an electro-optic device that consists of a lithium niobate crystal placed between two wedge type polarizers (see LTD Optics Block Diagram, paragraph 1-27). In the hold-off condition, the laser beam is misaligned, so that no lasing action takes place. The Pockel's cell is kept closed until the maximum energy is available in the laser rod. When Q/S FIRE occurs, an SCR trigger circuit located on the trigger module discharges the energy in the PFN through T1's primary which causes a large voltage spike of -5 KV to be generated in the secondary of T1 (Q-SWITCH TRIGGER). The Q-SWITCH TRIGGER pulse "opens" the Pockel's cell and allows photons to reflect through the laser rod where they stimulate a very large number of photons to be emitted in one short intense burst of energy.

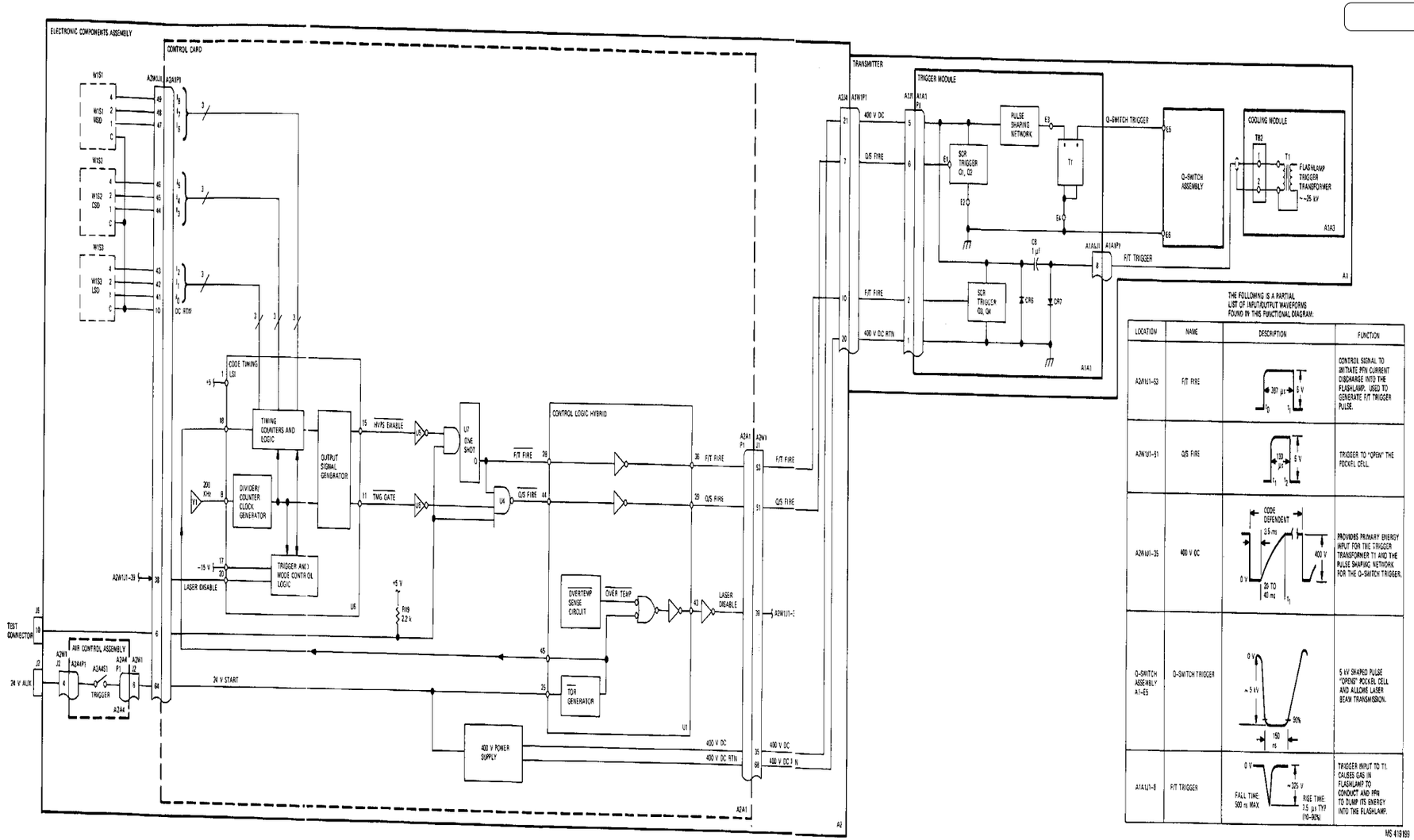


Figure FO-3. Laser Control and Timing Functional Diagram

Figure FO-4. Air and Temperature Control Functional

This functional diagram shows the basic circuitry related to cooling and temperature control for the LTD electronics.

Locate the cooling module on this diagram. The heat exchange operation is performed by an internal fan and an external cooling blower. Nitrogen coolant at 450 psig is circulated around the flashlamp and laser rod and pumped through an internal heat exchanger where the heat is then conducted out to the external heat exchanger. Cooling air is then blown through the external heat exchanger to remove the heat. Cooling of the electronic circuits is accomplished by drawing ambient air across the electronics heat sink (not shown).

Locate two sensistors (internal sensistor on A1A3A1 and the external sensistor on A2A4). These sensistors provide temperature feedback to monitor the internal temperature of the cooling module and the temperature of the external air. This temperature feedback is fed to the Overtemp Sense Circuit on control card A2A1. This circuit compares the analog equivalent of temperature difference which exists between the interior of the cooling module and the ambient air. If this temperature difference exceeds the system operational limit an OVERTEMP signal is generated and fed to the Malf Sense Circuit. This circuit forces the MALF DRIVE signal low and causes the malfunction indicator to come on full red. In addition, an overtemperature condition will cause a Laser Disable circuit to automatically shut off the laser firing circuitry (see Malfunction Indicator Logic Functional, FO-5).

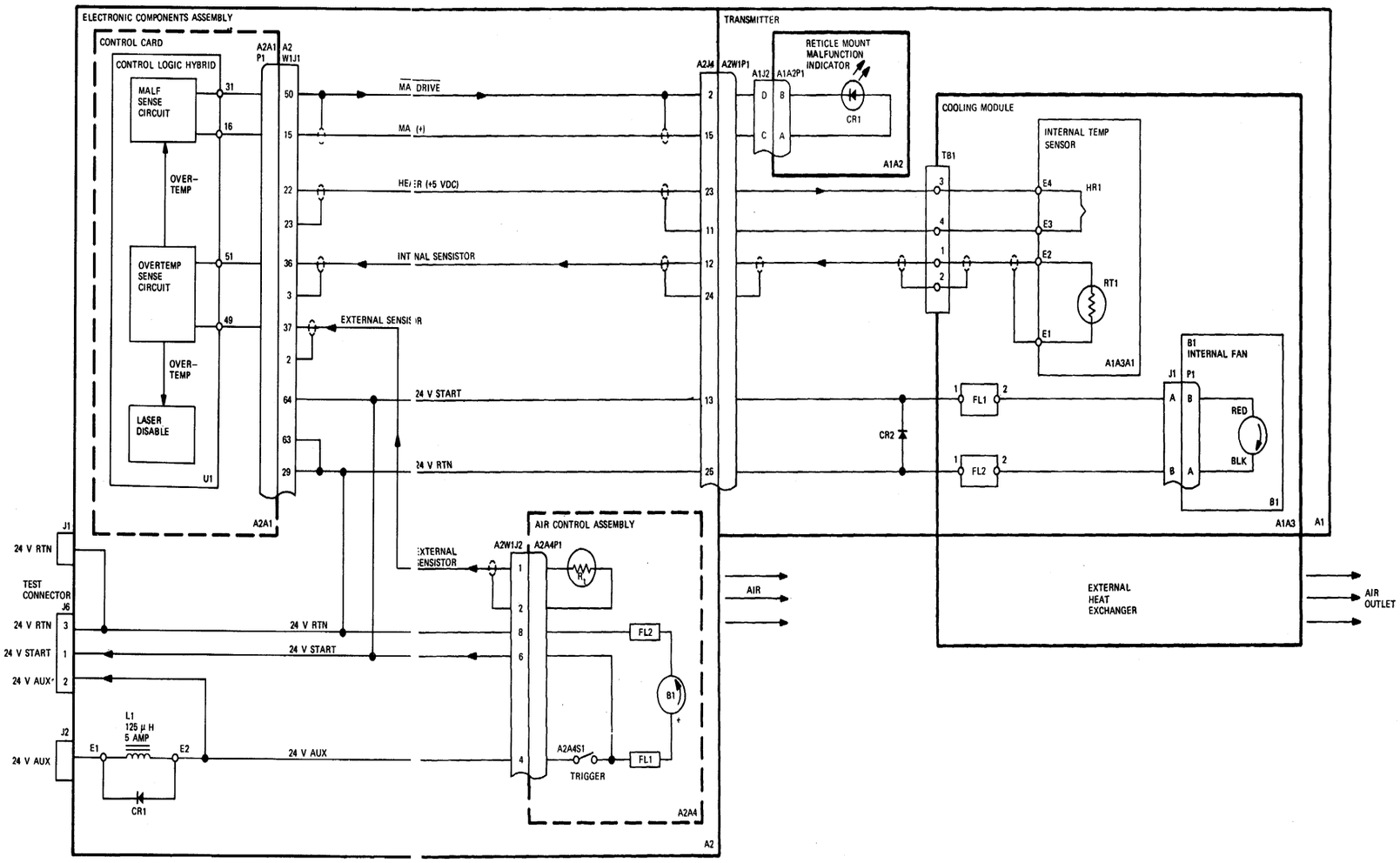


Figure FO-4. Air and Temperature Control Functional Diagram

Figure FO-5. MALFUNCTION INDICATOR LOGIC FUNCTIONAL DIAGRAM

This functional diagram covers the basic circuitry related to the four malfunction indications associated with your LTD: No Laser Output, Overtemp, Battery Low, and Energy Control Warning.

Locate the energy sense diode A1CR1 on this diagram. This diode samples the laser energy output and produces a signal called ENERGY DIODE. A portion of this signal is fed to a monostable on Power Control Hybrid U3 which produces a signal called A-TRIG. A-TRIG is used to reset a flip-flop on Control Logic Hybrid U3. The $\overline{Q}$ output of this flip-flop is one of four signals which control the MALF DRIVE input to the malfunction indicator. If no A-TRIG is generated the malfunction indicator will come on full. Another portion of the ENERGY DIODE signal goes to an integrator on Power Control Hybrid U1. This signal is used as a reference signal to provide an indication of the laser pulse energy. The output of the integrator is compared to a pre-set voltage established by a voltage reference circuit. The comparator output then goes to a sample and hold. When the sample is read it is added to the voltage on a capacitor on the output of the sample and hold. This voltage level then becomes the ENERGY ERROR signal and is used to control the PFN voltage in order to regulate laser output energy. The limits of the ENERGY ERROR voltage are -5V to +5V. The ENERGY ERROR signal is fed to a comparator circuit which determines if the ENERGY ERROR signal is within the proper operating range for the system. At a -4.5V level of energy error an ENERGY WARNING signal is generated by the comparator to indicate that the energy control circuits are near the limit of their control range. When this occurs the malfunction indicator will begin flashing at a 1 Hz rate.

Locate the internal and external sensistor inputs to control card A2A1. These signals are fed into an Overtemperature sensing circuit which provides a condition of either normal or overtemperature. If an overtemperature condition is sensed the OVERTEMP signal goes low and turns on MALF DRIVE and LASER DISABLE goes high. When this occurs the malfunction indicator comes on full red and the laser firing circuitry is disabled.

An Undervoltge Generator on Control Logic Hybrid U1 is provided to sense low battery voltage. When the battery voltage becomes too low for normal operation, a signal UNDERVOLTAGE is generated which is used to turn MALF DRIVE on providing a return path for current through the malfunction LED turning the malfunction indicator full on.

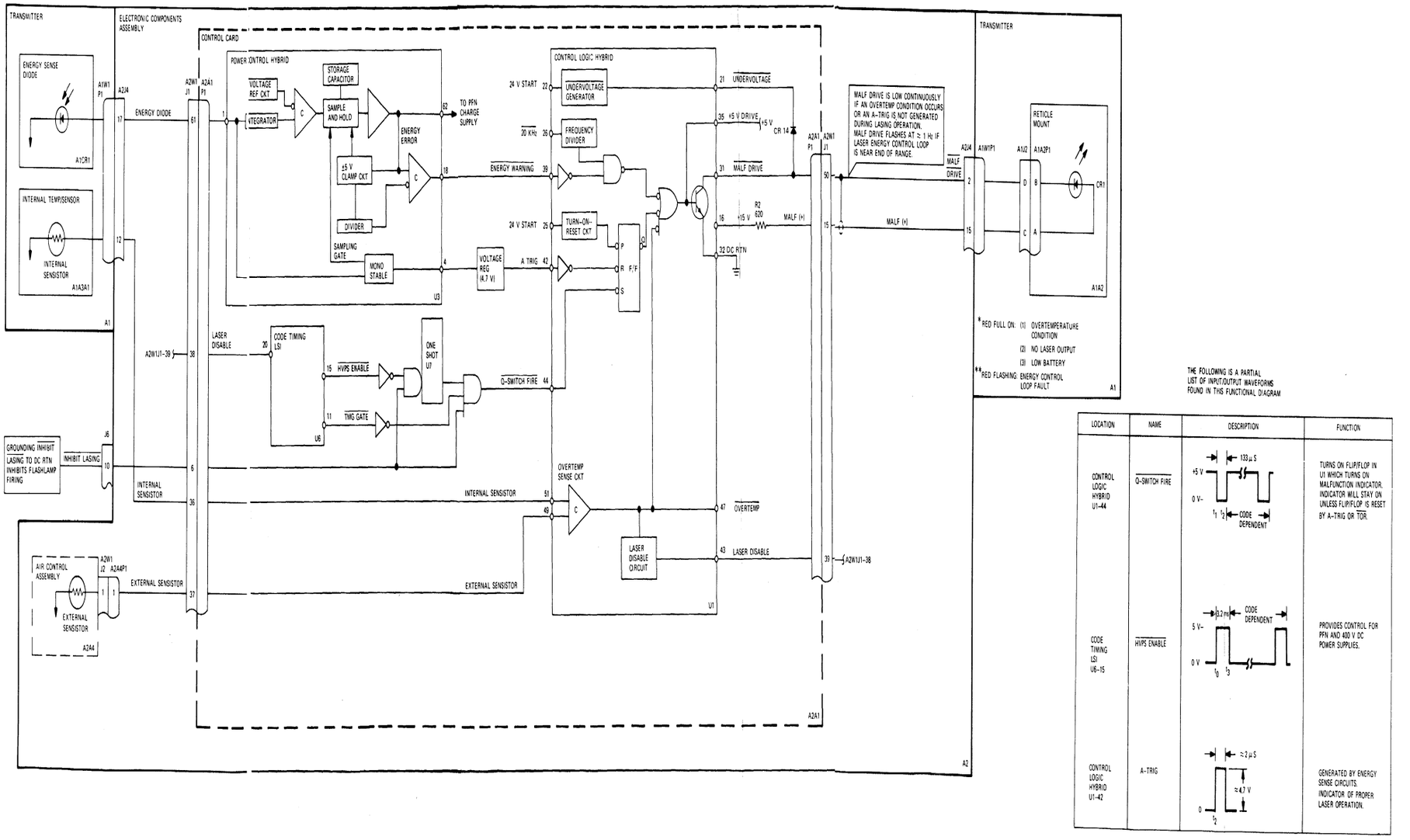


Figure FO-5. Malfunction Indicator Logic Functional Diagram

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