TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

BALLISTICS COMPUTER, XM21
NSN 1220-00-348-8437

This copy is a reprint which includes current pages from Changes 1 and 2.

HEADQUARTERS, DEPARTMENT OF THE ARMY

JANUARY 1980

WARNING

DANGEROUS CHEMICALS

Dry-cleaning solvent is toxic and flammable. Do not expose to open flames. Use only in a well-ventilated area. Avoid prolonged exposure to skin.

Paint and primer are toxic and flammable. Do not expose to open flames. Use only in a well-ventilated area. Avoid, prolonged exposure to skin.

Do not use nitrogen gas in a confined space, or direct nitrogen flow toward the face. Nitrogen can cause asphyxia by depleting the local oxygen supply. Nitrogen is used during purging of the gunner's control unit, ammo select unit, ballistics computer unit, rate tachometer assembly, cant unit, and output unit.

TM 9-1220-23934
C3

CHANGE

HEADQUARTERS
DEPARTMENT OF THE ARMY

No. 3

Washington, DC, 16 October 1987

DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL
FOR
BALLISTICS COMPUTER M21
NSN 1220-00-348-8437

TM 9-1220-23934, 31 January 1980, is changed as follows:

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Remove Pages	Insert Pages
i and ii	i and ii
1-3 through 1-12	1-3 through 1-12
2-7 and 2-8	2-7 and 2-8
2-33 through 2-36	2-33 through 2-36
2-36.1/(2-36.2 blank)	2-36.1/(2-36.2 blank)
3-18.1/(3-18.2 blank)	3-18.1/(3-18.2 blank)
3-23 and 3-24	3-23 and 3-24
None	5-1(5-2 blank)
B-1 and B-2	B-1 and B-2
Index-1 and Index-2	Index-1 and Index-2
FO-2	FO-2
FO-4 (1 of 2)	FO-4 (1 of 2)
FO-4 (2 of 2)	FO-4 (2 of 2)
FO-5 (1 of 2)	FO-5 (1 of 2)
FO-5 (2 of 2)	FO-5 (2 of 2)
FO-6 (1 of 3)	FO-6 (1 of 3)
FO-6 (2 of 3)	FO-6 (2 of 3)
FO-7 (1 of 2)	FO-7 (1 of 2)
FO-7 (2 of 2)	FO-7 (2 of 2)
FO-8 (1 of 2)	FO-8 (1 of 2)
FO-8 (2 of 2)	FO-8 (2 of 2)
FO-9 (1 of 2)	FO-9 (1 of 2)
FO-9 (2 of 2)	FO-9 (2 of 2)
FO-10 (1 of 2)	FO-10 (1 of 2)
FO-10 (2 of 2)	FO-10 (2 of 2)
FO-11(1 of 2)	FO-11(1 of 2)
FO-11 (2 of 2)	FO-11 (2 of 2)
FO-12	FO-12

File this sheet in the back of the publication for reference purposes.

By Order of the Secretary of the Army:

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To be distributed in accordance with DA For 12-41, Direct Support and General Support Maintenance requirements for Computer Ballistic, XM21.

**CHANGE
NO. 2**

**HEADQUARTERS
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WASHINGTON, D.C.**

8 February 1985

**DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL**

FOR

**BALLISTIC COMPUTER, M21
1220-00-348-8437**

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1-1 thru 14	1-1 thru 14
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2-3 and 24	2-3 and 24
2-11 and 2-12	2-11 and 2-12
2-37 thru 2-40	2-37 thru 2-40
3-1 thru 3-8	3-1 thru 3-8
3-11 thru 3-16	3-11 thru 3-16
3-19 thru 3-28	3-19 thru 3-28
A-1/(A-2 blank)	A-1/(A-2 blank)
FO-1	FO-1
FO-2	FO-2
FO-3	FO-3
FO4 (1 of 2)	FO-4 (1 of 2)
FO-5 (1 of 2)	FO-5 (1 of 2)
FO-5 (2 of 2)	FO-5 (2 of 2)
FO 6 (1 of 3)	FO-6 (1 of 3)
FO-6 (2 of 3)	FO-6 (2 of 3)
FO-7 (1 of 2)	FO-7 (1 of 2)
FO-8 (1 of 2)	FO-8 (1 of 2)
FO-8 (2 of 2)	FO-8 (2 of 2)
FO-9 (1 of 2)	FO-9 (1 of 2)
FO-9 (2 of 2)	FO-9 (2 of 2)
FO-10 (1 of 2)	FO-10 (1 of 2)
FO-11 (1 of 2)	FO-11 (1 of 2)
FO-11 (2 of 2)	FO-11 (2 of 2)

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CHANGE

NO. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 20 April 1983

DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE MANUAL

FOR

BALLISTICS COMPUTER, XM21
1220-00-348-8437

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Remove Pages	Insert Pages
i and ii	i and ii
2-1 through 24	2-1 through 2-4
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2-5 and 2-6	2-5 and 2-6
2-11 and 2-12	2-11 and 2-12
2-19 and 2-20	2-19 and 2-20
2-35 and 2-36	2-35 and 2-36
None	2-36.1/(2-36.2 blank)
3-13 and 3-14	3-13 and 3-14
None	3-18.1/3-18.2 blank)
B1 and B2	B1 and B2
Index-1 and Index -2	Index-1 and Index -2

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WARNING

Cleaning compound (freon) can cause skin rash and give off harmful vapors. To avoid injury, use in a well-ventilated area. Wash immediately with soap and water if compound gets on skin or clothing.

Technical Manual

No. 9-1220-239-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 31 January 1980

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

BALLISTICS COMPUTER, M21
1220-00-348-8437

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual, direct to: Commander, U.S. Army Armament, Munitions and Chemical Command, ATTN: AMSMC-MAS, Rock Island, Illinois 61299-6000. A reply will be furnished to you.

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope.

a. This manual is for your use performing direct support and general support maintenance of the ballistics comp M21 (fig 1-1), hereinafter referred to a computer system. The instructions in this manual provide maintenance information that is normally beyond the scope of organizational maintenance personnel.

b. The user of this manual may find, additional information by referring to the publications listed in appendix A.

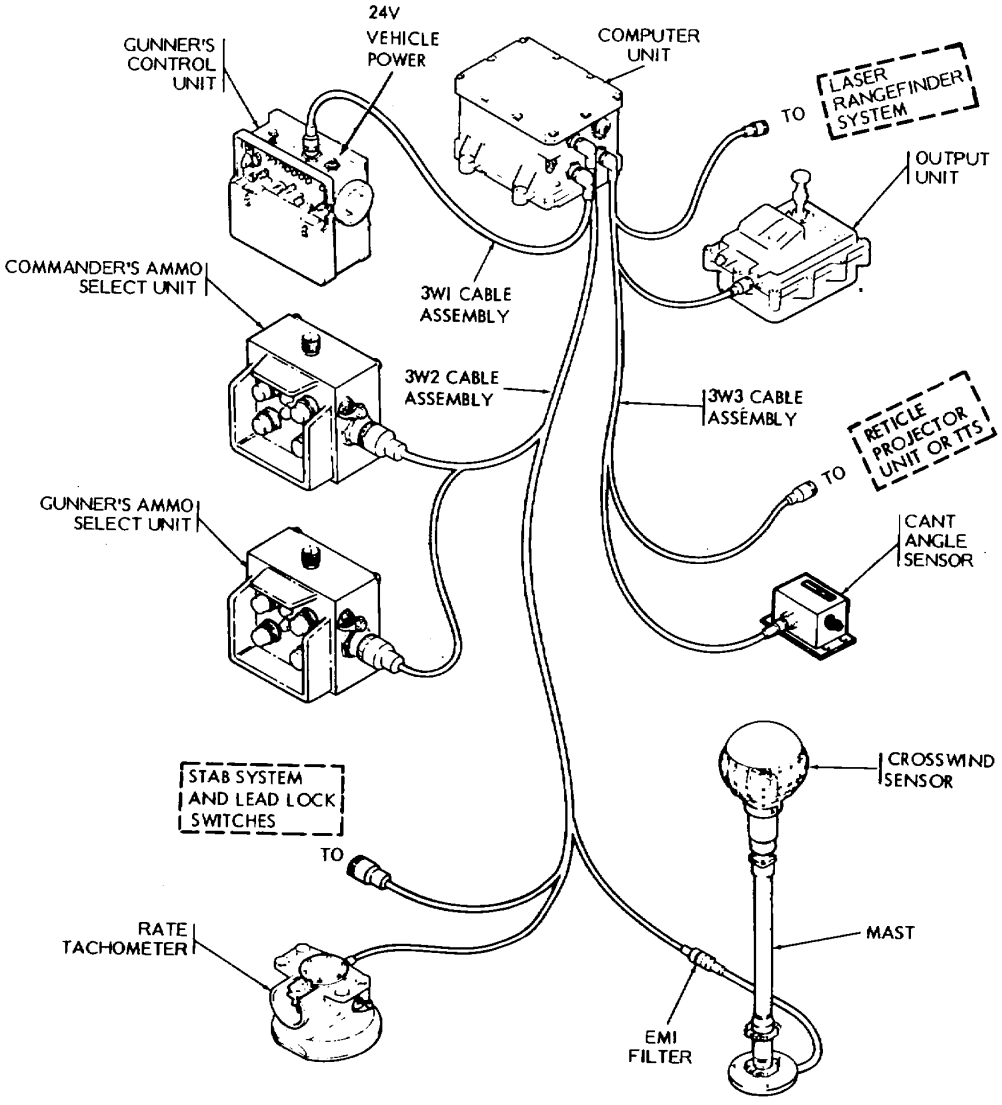

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Figure 1-1. Ballistics computer, M21 (computer system).

c. Direct support/general support maintenance of the computer system consists repairing the gunner's control unit, the am select units, and computer unit. The cant angle sensor (cant unit), the crosswind sensor and mast, cables, rate tachometer, out unit, and the electromagnetic interference (EMI) filter are either completely maintained at lower maintenance echelons, or are transferred to higher maintenance when additional repair is required.

1-2. Maintenance Forms and Records. Maintenance forms and records which you required to use are listed and explained in PAM 738-750. Accident reports are prescribed in AR 385-40.

1-3. Calibration. No computer system calibration is authorized at the direct support general support maintenance levels.

1-4. Quality Assurance/Quality Control.

a. No particular quality assurance quality control manual pertains specific to the computer system.

b. Defective material received through the supply system should be reported or Quality Deficiency Report (QDR), SF 368. Instructions for preparing QDR's are provided in AR 702-7, Reporting of Quality Deficiency Data. QDR's should be mailed to Commander U.S. Army Armament, Munitions and Chemical Command, ATTN: AMSMC-QAD, Rock Island, IL 61299-000. A reply will be furnished to you.

1-5. Reporting Equipment Improvements Recommendation (EIR). EIR's will be prepared on Standard Form SF 368. Instructions for preparing EIR's are provided in DA PAM 738750, The Army Maintenance Management System. EIR's should be mailed directly to: Commander, U.S. Army Armament, Munitions and Chemical Command, ATTN: AMSMC-QAD, Rock Island, IL 61299-6000. A reply will be furnished to you.

1-6. Use of English and Metric Units of Measure. When English measurements of pound-feet, pound-inches or ounce-inches (abbreviated lb-ft, lb.-in. and oz-in; respectively) are used in this manual, they are followed by the metric equivalent expressed in System International units in Newton meters (abbreviated N•m) in parenthesis. For example: 47-56 lb-ft (64-76 N•m). Refer to metric conversion table on inside of back cover.

Section II. DESCRIPTION AND TABULATED DATA

1-7. Description.

a. General. This section contains the functional description of the ballistics computer system and components and their relationship to the fire control system.

b. System Functional Description (Fig 1-1 and 1-2). The computer system is used with laser range finder AN/VVG-2 on the M60A3 tank to introduce gun laying corrections into the primary direct fire control system and provide control inputs to the stabilization system. The computer system receives analog voltage representing target ran from the laser range finder and, after applying corrections, provides (1) a shaft rotation representing corrected elevation, (2) two analog voltages representing correct deflection, and (3) two analog voltages representing elevation and deflection for t stabilization system. Shaft rotation applied to the super elevation actuator a ballistics drive. Deflection analog voltage are applied to the reticle projector and laser range finder mirror. These outputs can be corrected for crosswind, horizontal target motion, ammo characteristics, altitude, air temperature, gun wear, gun jump (zeroing), gun sight parallax, and trunnion cant (stationary tank only).

Crosswind corrections are made automatically by a crosswind sensor mounted on the outside of the tank or manually using the controls on the gunner's control unit (GCU). Crosswind sensor output is continuously monitored by a fail detector network which automatically inhibits its operation and lights a SENSOR FAIL indicator on the GCU if a failure occurs. Data for horizontal target motion is derived from a rate tachometer driven by the turret ring gear in power mode (or stab azimuth gyro in stab mode). Output from the rate tachometer or gyro is fed to a sample and hold circuit. When the LEAD/LOCK signal from the gunner's or commander's handles control (not part of the computer system) is received, the sample and hold network develops a signal proportional to the turret angular rate averaged over one second.

Correction for ammo characteristic is obtained by depressing one of four push buttons located on the gunner's or commander's ammo select unit (ASU). The la button depressed, regardless of unit, control the system. Four ammo types are selectable at the ASU. Selection of an ammo type causes the computer unit to develop specific ballistic and dynamic lead angle data for the target range. This data is summed with (corrected for) altitude, air temperature, gun wear, gun jump, and gun sight parallax data as applied by the gunner on the GCU. An additional correction for gun trunnion cant be applied when the tank is stationary using a switch on either ASU. All data processed in analog form. Elevation data applied to the output unit and tank stab system. The output unit, in turn, translates the data to a shaft rotation which is applied to the superelevation actuator and ballistics drive. Deflection data is applied to the reticle projector and tank stab system via or servo loop and to the laser rangefinder via second servo loop. Data applied to the reticle projector and laser rangefinder are used to shift or displace the horizontal position of the gunner's periscope reticle and LRF azimuth mirror relative to the target image. Thus, when a shifted reticle is again laid on target, the main gun is positioned to provide the correct amount of target lead.

(1) *Computer unit.* The computer unit is the central data processing unit of the M21 computer system. This unit receives various analog voltages from the sensors, the laser rangefinder and the gun stabilization electronics. (The latter two are not part of the M21 computer system.) Discrete level signals are received from the ammo select unit and the gunner's control unit. These signals are processed to give analog signals proportional to elevation and deflection corrections. The computer unit also conducts self-test of the system on command from the gunner's control unit.

(2) *Gunner's control unit.* The gunner's control unit is the main operator interface with the M21 computer system. The gunner may input corrections for air temperature,

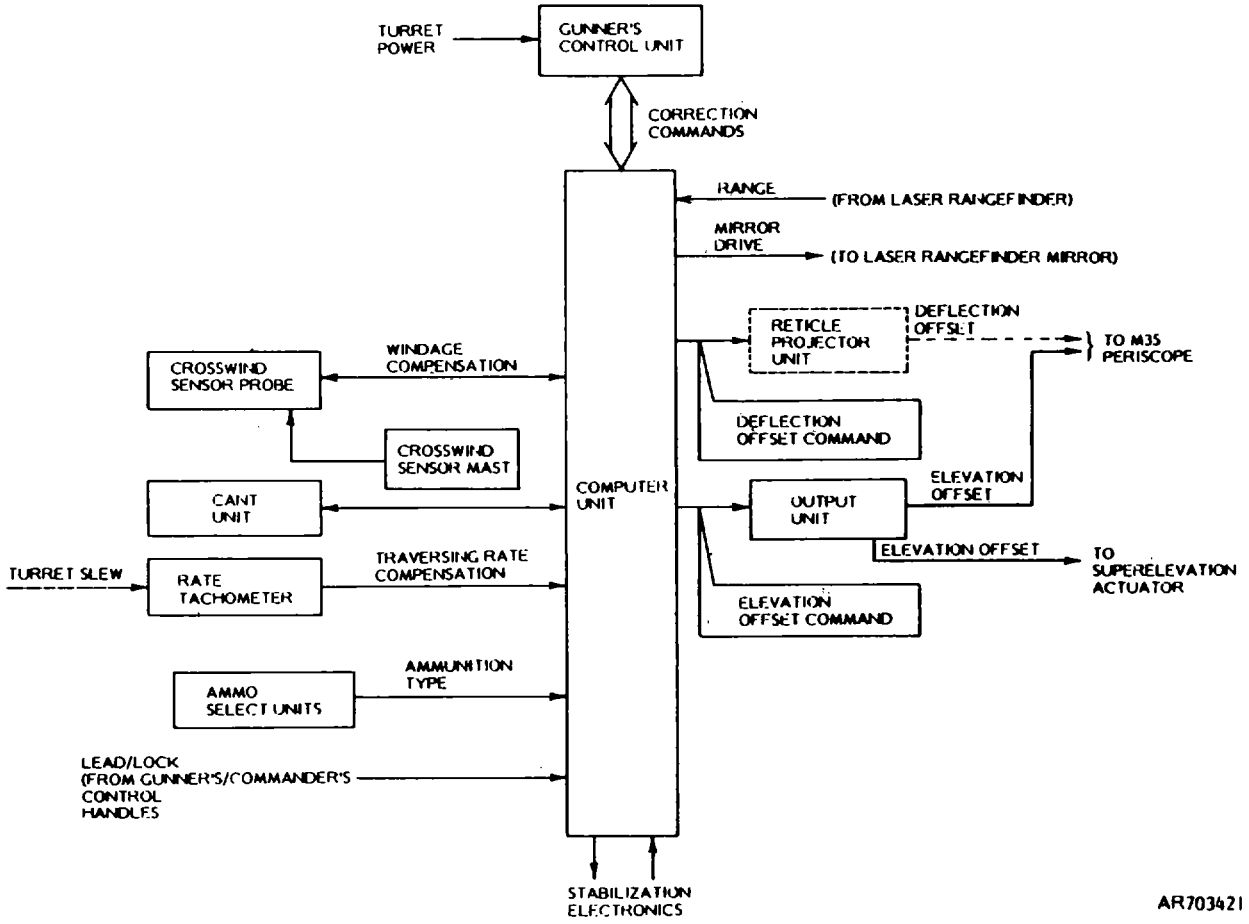


Figure 1-2. M21 computer system functional diagram.

altitude, gun tube wear, crosswind (manual, elevation zeroing, and azimuth zeroing. Either manual ranging or laser ranging may also be selected. A NORMAL-BORESIGHT switch provides a range adjusted parallax correction for boresighting. System self-test may be performed at any time using the LAMP/NORMAL/SYSTEM switch.

(3) *Ammo select unit.* The two identical ammo units are provided with the M21 ballistics computer system, one for the gunner and one for the commander. By depressing a switch, the gunner or commander may select one of four types of ammo. A switch on the bottom of each unit controls the cant unit

(4) *Rate tachometer.* The rate tachometer produces an analog voltage proportional to the angular velocity of the turret relative to the tank hull. This voltage is applied to the computer unit to provide target lead when a switch on the gunner's control handles is depressed.

(5) *Cant unit.* The cant unit contains a pendulum which positions a precision electronic resolver to measure the gun trunnion cant angle. Output from the unit modifies other ballistic corrections to compensate for the angle of the tank. When the ammo select unit MOVING indicator is lit, the cant unit is bypassed.

(6) *Crosswind sensor probe.* The cross-wind sensor probe provides a voltage proportional to the average component of wind at normal to the line-of-sight of the gunner's periscope. This voltage is applied to the computer as a correction factor if the AUTO/MANUAL switch is in AUTO position. If the switch is in MANUAL position, the gunner may input his best estimate of wind velocity.

(7) *Crosswind sensor mast.* The crosswind sensor mast provides mechanical support for the crosswind sensor probe unit.

(8) *Output unit.* The output unit converts the electrical elevation solutions from the computer unit into mechanical shaft rotation for use in the ballistics drive of the primary fire control system, and in the superelevation actuator.

c. Power Distribution. The tank battery system supplies 24 vdc power to the gunner's control unit where the power is filtered and fed to the computer unit. A power supply in the computer unit then provides various levels of dc signals for the logic networks, operational amplifier power, lamp drivers, and individual unit power requirements. An REF generator provides two ac signals: 5 vrms, 400 Hz, in-phase and 5 vrms, 400 Hz, 180 degrees out-of-phase. These reference signals provide the ac voltages for the self-test mode of operation.

A power amplifier produces a 115 vrms, 400 Hz signal for power requirements the reticle projector unit and the laser rangefinder. An interlock system precludes item operation when certain units are connected.

d. Circuit Card Assembly (CCA) Functional Description. The CCA functions together with the source and destinations of their inputs and outputs are described below. Schematic diagrams of the CCA's are located the rear of this manual.

(1) *Power supply - inverter, 15V regulator CCA A1 (fig FO-1).* The A1 CCA generates the following voltages for use in the computer system:

Voltage	Use
+15 Vdc	Operational amplifiers
-15 Vdc	Operational amplifiers
+5 Vdc	T2L logic circuits
+30 Vdc	Wind sensor power
+24 Vdc	Lamp indicator lights

The +13V, received from A2 CCA, is applied to a DC-to-AC inverter, a saturable inductor oscillator which converts the +13V a 400 Hz signal. The 400 Hz signal is then plied to transformer T1. The 400 Hz signals appearing on the secondary windings the transformer are then rectified by full-wave rectifiers and distributed throughout system. The +15V and -15V outputs are regulated.

(2) *Switching regulator and reticle project-amplifier CCA A2 (fig FO-2).* The A2 CCA contains the reticle projector amplifier circuit and the +13V switching regulator circuit.

The AC REF 2 signal, received from A4 CCA, is amplified and clipped to a square wave by the amplifier-clipper. During negative half-cycle of the input signal, output of the amplifier-clipper goes positive and is applied to one half of the push-pull driver. During the positive half cycle of the input signal, the output of the amplifier-clipper goes negative and is applied to the.

inverter circuit. The inverted output (positive) is applied to the other half of the push-pull drive. The output at the push-pull driver circuit, is coupled through step-up transformer T^2 and sent to the reticle projector unit (RPU) as the 115V, 400 Hz power source.

(3) *Reticle projector and elevation servo driver CCA A3 (fig FO-3).* The A3 CCA contains the output unit elevation servo driver circuit and the reticle projector servo driver circuit.

The E PWR AMP 1 and 2, receive from CCA A6, is applied to an OR gate consisting of CR1 and CR2, and to amplified AR3. If E PWR AMP 1 signal is low with reference to E PWR AMP 2 signal, the sign is coupled through OR gate diode CR1 to the inverting input of amplifier AR1. The output of amplifier AR1 goes high and is applied the non-inverting input of amplifier AR2. The high output of amplifier AR2, function as a follower, turns on switch control Q which turns on +24V switch Q1-Q2. With +24V switch turned on, the +24V COMP 3 voltage is applied to the reverse and forward direction switch/driver pairs, Q4-Q6 and Q8-Q10. At the same time, the high E PWR AMP 2 signal is applied to the inverting input amplifier AR3. The output of amplifier AR3 goes high and turns on forward direction switch/driver Q5-Q7. With switch/driver Q5-Q7 turned on, a ground reference is applied through parallel connected resistors R35 and R36, switch/driver Q5-Q7, parallel connect diodes CR7 and CR15, to one end of the dc motor in the output unit. The ground reference output of the forward direction switch/driver Q5-Q7 is also applied through diode CR12 to the reverse direction switch/driver Q9-Q11. This low signal will turn off the reverse direction switch/driver Q9-Q11. The reason this happens is that the forward direction switch/driver Q5-Q7 and the reverse direction switch/driver Q9-Q11 are connected in a differential amplifier configuration. With these switch/drivers connected in the differential amplifier configuration, the reverse direction switch/driver Q9-Q11 is always biased on by the +24 FILTERED power source when the E PWR AMP 1 and 2 signals are not present. The would cause the output unit's dc motor to be continuously driven in the reverse direction if the +24V COMP 3 power source was not switched by the +24V switch Q1-Q2.

The other end of the dc motor in the output unit is connected through forward direction switch/driver Q8-Q10 to the +24V switched power source. This causes the dc motor to rotate in the forward direction until a feedback signal (not part of this CCA) causes the E PWR AMP 1 and 2 signals to equalize. When the signals are equal, the +24V switch Q1-Q2 is turned off to stop the motor rotation. To drive the output unit's dc motor in the reverse direction, the E PWR AMP 2 signal is low and applied through the OR gate diode CR2 to the inverting input of amplifier AR1. The rest of the circuit functions the same way as previously described to turn on the +24V switch Q1-Q2 to apply the +24V switch power source to the forward and reverse switch driver pairs, Q4-Q6 and Q8-Q10.

The high E PWR AMP 1 signal is applied to the inverting input of amplifier AR3. The output of amplifier AR3 goes low and holds forward direction switch/driver Q5-Q7 off. This allows the reverse direction switch/driver Q9-Q11 to go full-on, which applies a ground reference through resistors R35 and R36, the reverse direction switch/-driver Q9-Q11, diodes CR10-Q16 to one end of the dc motor in the output unit. The other end of the dc motor is connected through the reverse direction switch/driver Q4-Q6 to the +24V switched power source. This causes the dc motor to rotate in the reverse direction until a feedback signal (not part of this CCA) causes the E PWR AMP 1 and 2 signals to equalize. When the signals are equal, the +24V switch Q1-Q2 is turned off to stop the motor rotation.

The overload detector AR4, connected to the common emitter resistor circuit, senses any excess current drawn by the dc motor and turns off switch control Q3 which turns off the +24V switch to remove the power source from the motor.

The reticle projector servo driver circuit receives the D PWR AMP signal from CCA A6. The D PWR AMP signal, an AC signal, is applied to the inverting input of amplifier AR5. The output of amplifier is transformer coupled to push-pull driver Q12 thru Q15. The output of the push-pull driver, D SERVO MOTOR 1 and 2 signals, is sent to the reticle projector unit. The D SERVO MOTOR 1 and 2 signals are out of phase with an ac reference signal applied to the reticle projector unit ac

motor. The D SERVO MOTOR 1 and 2 signals will drive the motor until the signals are in phase, stopping the motor. The direction of the motor rotation is determined by whether the phase of the D PWR AMP signal into the reticle projector servo driver is leading or lagging the phase of the ac reference signal applied to the ac motor in the reticle projector unit.

(4) *Lead, windage, and reference CCA A4 (fig FO-4)*. The A4 CCA contains a target lead and windage circuit and a voltage reference generating circuit.

The sine wave output of the self-starting, phase-lock loop, 400 Hz oscillator is applied to the inverting input of inverter AR3 and to the MR generator. Output of inverter AR3 is distributed in the system as the AC REF 1 signal and also applied to inverter AR4 and demodulator AR5. Output of inverter AR4 is distributed in the system as the AC REF 2 signal, which is 180 degrees out-of-phase with the AC REF 1 signal.

The MR generator, driven by the sine wave output of the 400 Hz oscillator, generates the MR1 and MR2 signals that are distributed in the system. The signals are 180 degrees out-of-phase, square wave signals that are varying from +15V to -15V. The MR1 signal is also applied to the demodulator. When the MR1 signal is positive, FET switch Q7 is turned on and grounds the non-inverting input of demodulator AR5, causing it to function as an inverter. At the same time, the sine wave output of inverter AR3 is negative and is applied to the inverting input of AR5. The output of AR5 goes positive and is applied to amplifier/filter AR6. When the MR1 goes negative, FET switch Q7 is turned off to remove the ground from the non-inverting input of AR5, which now functions as a follower. AT the same time, the sine wave output of AR3 is positive and is applied to the non-inverting input of AR5. The output of AR5 again goes positive and is applied to amplifier/filter AR6, which smoothes the pulsing dc inputs to fixed +10V output that is distributed in the system. The +10V is applied to the inverting input of inverter AR7. The output is a fixed -10V that is distributed in the system.

The MR2 output of the MR generator is applied to the 400 Hz oscillator where it is compared with the AC REF 1 signal to stabilize the frequency of the oscillator, thus forming the phase-lock loop circuit.

When the target tank is moving, the turret tachometer rate signal (w_{DT}) is coupled through normally on FET switches Q18A and Q14 to AR8 of the sample and hold (integrator) circuit. Capacitor C5 charges up to the level of the w_{DT} dc voltage which is dependent on the turret speed. The LEAD LOCK 2 signal from either the gunner's or commander's handle control when satisfied of a smooth tracking rate is applied to the inverting input of inverter AR15 and to OR gate CR6. The output of inverter AR15 goes low to turn off FET switch Q14 to block any further input of the turret tachometer rate signal. At the same time, the output of OR gate CR6 turns on FET switch Q22. With the FET switch on, the output from the sample and hold (integrator) circuit is coupled to summing resistors R66 and R67 where the signal is summed with the wind velocity (V_W)signal and an ammo constant (K_W)signal from K_W constants U1. The ammo constant signal is dependent on the type of ammo selected. The summed signal from resistors R66 and R67 is applied to the inverting input of amplifier AR9. The output of AR9 is applied to the T_F slave multiplier. The other inputs are the T_{S1} and T_{S2} signals from the T_F master multiplier. The input to the T_F master multiplier is an epsilon (ε) signal and the range (Ro(AC)) signal called the time of flight (-TF) signal. The ($-T_F$)multiplier uses the $-T_F$ signal to generate the TS1 and TS2 signals which are 180 degrees out-of-phase. The amplitude of the TS1 and TS2 signals are constant but the pulse width varies according to the amplitude of the $-T_F$ signal. The TS1 and TS2 signals control the T_F slave multiplier, which has the effect of multiplying the $-T_F$ (time-of-flight) times the $w\text{-}K_WV_W$ signal to produce the ($w\text{-}K_WV_W$) TF1 signal. This signal represents the turret angle rate (omega) minus the ammo dependent constant (K_W) times wind velocity (V_W) multiplied by the time of flight ($-T_F$).

If the M60A3 tank is moving, moving tank mode is selected, applying a high MT signal for one input of the AND gate consisting of diodes CR13, CR14, and CR15. The other inputs to the AND gate are the high $\overline{BIT}$ signal since the system is not in the self-test mode, and the high output of level shifter Q23 when the stabilization mode is selected. The high output of the AND gate is applied to inverter AR13 and FET switch Q19B. The low input of inverter AR13 turns off FET switch Q18A to block the input from the turret tachometer (ω_{DT}).

The high output of the AND gate turns on FET switch Q19B. With switch Q19B turned on, the turret angle rate input (ω DG1 and (ω DG2) is from the stabilization system gyro. These signals are coupled through amplifier AR14, FET, switch Q19B, and FET switch Q14 to the sample and hold circuit. The rest of the circuit operation is the same as described when the turret tachometer angle rate signal (ω_{DT}) was used.

During the system self-test operation, neither the turret tachometer nor the stabilization system angle rate signals are used. The $\overline{BIT}$ signal, which is low when the self-test mode is selected, is applied to and turns off FET switch Q21. Turning off switch Q21 changes the sample and hold (integrator) circuit to an amplifier circuit by removing capacitor C5 from the circuit. The low $\overline{BIT}$ signal is also applied through diode CR11 to turn off FET switch Q18A, blocking the turret angle rate input. FET switch Q19B is normally biased off and the angle rate from the stabilization system gyro is blocked. At the same time, the high BIT signal is applied through an OR gate consisting of diodes CR5 and CR6 to turn on FET switch Q22. The high BIT signal also turns on FET switch Q19A. The angle rate signal input is now the output of w_R reference constant U2 that is dependent on the type of ammo selected. This causes the generation of the (ω-$K_W V_W$) T_F signal of a fixed value that is checked daring self-test to determine a GO or NO-GO situation.

(5) *Superelevation and drift CCA A5 (fig FO-5).* The A5 CCA generates the super-elevation (epsilon) and azimuth (eta) signals that are sent via CCA A6 to the cant unit to be resolved through turret roll angle (cant) from earth reference to tank reference.

The altitude ($\overline{RoP1}$ and $\overline{RoP2}$ signals) and the air temperature ($\overline{RoTA1}$and $\overline{RoTA2}$ signals) are dialed in on the gunner's control unit (GCU) and applied to amplifier AR7 and AR11, respectively. The output of AR7 is coupled through normally on FET switch Q4B to summing circuit AR8, R40 through R43. The output of AR11 is coupled through normally on FET switch Q5B to the same summing circuit. The Ro ~~WEAR~~ (IN) (gun barrel wear) signal, dialed in on the GCU, is applied to the inverting input of amplifier AR12. The output of AR12 is coupled through normally on FET switch Q6B, multiplied by the ammo dependent gun wear K_Gw constant from circuit U1 and applied to the inverting input of AR13. The output of AR13 (nonstandard muzzle velocity, RoV) is applied to the summing circuit AR8, R40 through R43 and also to subtractor AR1, R1, and R2. An additive correction is made to muzzle velocity to correct for British APDS ammo, when selected by Beta (β) constant circuit Q10B.

The fourth input to the summing circuit consisting of amplifier AR8 and resistors R40 through R43 is the range signal that is coupled through amplifier AR6. The range signal is either from the laser rangefinder via the GCU or dialed in on the GCU. The four signals (altitude, air temperature, non-standard muzzle velocity, and range) are summed to produce the Ro(1+$\overline{M}$) master multiplier signal that is applied to demodulator circuit AR9, Q10A, R51 and C5. The DC output of the demodulator circuit is applied to the Ro(1+$\overline{M}$) master multiplier. The master multiplier functions as a time division multiplier with the outputs (RS1 and RS2 signals), which are equivalent to the Ro(1+$\overline{M}$) input signal) controlling two Ro(1+M) slave multipliers. The output of the master multiplier has a duty cycle that is proportional to the amplitude of the input signal.

The muzzle velocity correction (RoV) is subtracted from the range Ro($\overline{AC}$) signal (subtractor circuit AR1) to produce the Ro(1-$\overline{V}$). This signal is applied to Ro(1+$\overline{M}$) slave multiplier No. 1. The Ro(1-$\overline{V}$) output is also multiplied by an ammo dependent constant from A constant circuit U4 and applied to summing circuit AR14. The Ro(1+M) slave multiplier No. 1 multiplies the Ro(1+M) signal from the master multiplier and the Ro(1-V) to produce the Ro (1-V) (1+M) signal. This signal is applicable to the slave multiplier No. 2. The signal is also multiplied by an ammo dependent constant from B constant circuit U3 and applied to summing circuit AR14. The second slave multiplier multiplies the Ro(1+M) from the master multiplier and the Ro^2 (1-V) (1+M) from slave multiplier No. 1 to produce the Ro^3 (1-V) (1+M). This signal is multiplied by an ammo dependent constant from C constant circuit U2 and then applied to summing circuit AR14. The output of the summing circuit is the epsilon (superelevation) signal. The epsilon signal is also multiplied by an ammo dependent constant from K_D

constant circuit U5 and applied to summing circuit AR15. The output of the summing circuit is the eta (azimuth) signal.

(6) *Output CCA A6 (fig FO-6).* The A6 CCA amplifies the superelevation (epsilon) and azimuth (eta) signals that are sent to the cant unit resolver to be resolved through turret roll angle (cant) from earth reference to tank reference and returned to CCA A6 where they are combined with jump, zeroing, and parallax signals to produce the elevation and deflection signals for the sights.

The epsilon signal is received from CCA A5 and applied to summing circuit AR1. The minus epsilon output of the summing circuit is applied through resistor R18 to the inverting in put of amplifier AR2. The output (CRS1) of the amplifier is applied to the stator winding (S1S3) of the resolver in the cant unit. The feedback signal (CRC1) from the compensation winding around the stator winding is summed with the drive input to amplifier AR2 to provide accurate angular resolution over temperature.

The azimuth (eta) signal is received from CCA A5 and applied to the inverting input at amplifier AR11. The output (CRS2) of the amplifier is applied to the stator winding (S2-S4) in the resolver. The feedback B signal (CRC2) functions the same way as for the minus epsilon stator circuit. During normal operation FET switch Q1A is biased on grounding resistors R11 and R67 to inhibit the RX input to amplifiers AR2 and AR11.

The rotor shaft of the cant unit is connected to a pendulum. The pendulum, which swings with the roll angle of the turret, rotates the rotor shaft. The rotor position is resolved with the elevation and azimuth stator winding inputs and applied to FET switches Q3B and Q6A, respectively. These FET switches are normally on if the moving tank (MT), boresight (BS), and system test (BIT) modes are not selected. The resolved superelevation (CRR1) and azimuth (CRR2) signals are coupled through respective FET switches to summing circuits as the minus epsilon and plus eta signal, respectively.

The epsilon signal is summed with the $-J_E$ (elevation jump), $-Z_E$ (elevation zeroing), and parallax constants (correction for displacement in elevation between gun position and gunner's sight) to generate the elevation command and (ELEV) signal. This signal is summed with the output unit elevation motor shaft feedback position (E in) signal and demodulated to a dc signal. This dc signal is summed with the output unit elevation motor shaft rate feedback (E in) signal to generate the drive signals (E PWR AMP 1 and E PWR AMP 2) for the dc motor in the output unit. The motor shaft position feedback (E in) signal is also sent to the gun stabilization system to move the gun towards its proper position in elevation to minimize the amount of manual elevation required to re-aim on the target.

The azimuth (+ eta) signal is summed with the J_D (deflection jump), Z_D (deflection zeroing), and parallax constant (correction for displacement in azimuth between the gun position and gunner's sight) to generate the deflection command (-D) output of amplifier AR13. This signal is summed with the reticle projector unit azimuth motor shaft position feedback (D FEEDBACK IN) signal, and the azimuth motor shaft rate feedback (D IN) signal. The resultant signal is coupled through a phase shifter that is referenced to the 400 Hz MR1 and MR2 signal. The phase corrected signal is amplified and sent to a power driver on CCA A3 whose output drives the reticle projector unit's ac motor. The reticle projector unit's motor shaft rate feedback (D IN) signal is also demodulated to a dc voltage and sent to the turret stabilization system as the (D OUT) signal to deflect the turret to the proper position in azimuth to minimize the amount of manual azimuth deflection required to re-aim on the target.

When the moving tank mode is selected, the low MT signal is applied through an OR gate consisting of diodes CR19 and CR18 to the inverting input of amplifier AR16. The cant enabled output (CE) goes high and turns on FET switch Q6B to pass the + eta (azimuth) signal, and turns on FET switch Q3A to pass the minus epsilon (superelevation) signal. The output of AR16 is also applied to the inverting input of amplifier AR17. The output (CE) goes low to turn off FET switches Q3B and Q6A. The same switching action takes place in both the boresight (BS) and system self-test (BIT) modes.

Turning off switches Q3B and Q6B prevents the resolved output of the cant unit from causing errors in the elevation and azimuth circuits while the tank is moving, during boresight, or while performing a system self-test.

In the boresight mode, not only are the cant unit outputs and the jump and zeroing inputs inhibited, but the superelevation (epsilon and azimuth (eta) signals are also blocked. This means only the parallax constants have any effect on the output drive circuits. The parallel constant (-I/R) varies as a function of the rang signal (RoDC). This means that it is possible to boresight any of the sighting devices controlled by the computer system at any range, within the computer's operating limits.

During the BIT (system self-test) mode, known reference inputs are injected into the elevation and azimuth channels to generate expected superelevation and azimuth outputs. Again the cant unit is bypassed, but a fixed reference signal (RX) is supplied to the cant unit motor stator windings and the rotor outputs are checked for errors. The elevation jump and zeroing input and the azimuth (deflection) jump and zeroing inputs are also inhibited in the BIT operation

(7) *Ammo select CCA A7 (fig FO-7).* The A7 CCA generates a logic signal that selects the ammo dependent constants enable the computer to compute ballistic drift, time of flight, and gun barrel wear for each different ammo type.

The ammo type is selected on the ammo select unit (ASU) and the relate signal, AS9 (APDS), AS10 (HEAT), AS11(HEP/WP), and AS12 (FSDS), is received the A7 CCA. These signals determine the logic signal generated for use in the computer computation. Since the circuit operation is basically the same for all the ammo's, only the operation is described for the FSDS ammo.

The FSDS push-button is pressed on the ASU to generate the $\overline{AS12}$ signal received the A7 CCA. The signal is coupled through the ammo select gates to the J inputs of flip-flops U5A and U5B. The signal is also applied to the reset/start decoder circuit who output resets the counter U6. The MF signal (400 Hz signal) is continuously applied to the CP input of counter U6. Until the counter is reset by the output of the reset/start decoder, the MR1 signal has no effect on the counter. After resetting, the MR1 signal clocks the counter 16 times, at which time the counter overflows and the TC (terminal count) output clocks flip-flops U5A and U5B. The AS12 (FSDS) signal at the J input of both flip-flops is clocked to the Q output of each. These two outputs are decoded by the ammo decoder gates and inverters. The decoded FSDS signal is applied to lamp driver Q12 and switch Q13. The output of Q12 (FSDS LAMP) is sent to the ASU to light the FSDS indicator. The output of Q13 (AS4) is distributed throughout the computer for use in the ammo dependent constant circuits.

The A7 CCA also provides the signals to light the MOVING or STATIONARY indicators on the ASU. If the moving tank mode is selected, the MT turns on driver Q2 to light the MOVING indicator. If not, the $\overline{MT}$ signal is turns on driver Q3 to light the STATIONARY indicator.

The A7 CCA also supplies the BIT ENABLE 2 signal to the A6 CCA when either the APDS or HEAT ammo is selected, generating the BIT ENABLE 1 signal. The BIT ENABLE 1 signal is applied to the non-inverting input of amplifier AR1, which is functioning as a follower. The BIT ENABLE 1 received from the A6 CCA. The BIT ENABLE 1 signal is generated on the A6 CCA by either the AS1 or AS2 signal. The AS2 signal is generated in the GCU by the AS8 (HEAT) signal.

(8) *Self-test CCA A8 (fig FO-8).* The A8 CCA is used during the system self-test (BIT) mode to check the operational status of components that make up the computer system. During the test, known reference signals and constants are injected into the system and the A8 CCA checks the results. The check is made by comparing two signals by comparing a signal with a fixed reference, or by summing a number of signals and comparing the result with a fixed reference. If a component fails, signals are generated and sent to the GCU to turn off the SYSTEM OK indicator and to light the corresponding component fail indicator.

The RPU reticle position feedback (D FEEDBACK OUT) and the output unit motor position feedback (E FEEDBACK OUT) are applied to differential amplifier AR4. The output of AR4 is demodulated to a dc voltage

and applied to a comparator. The output of the comparator is the FB (feedback) OK signal which is normally high. The feedback signals should be equal for the FB OK signal to be high. If they are not equal, the FB OK signal will be low and is detected by the fail detection circuit. At the same time, the output unit motor drive signals (E MOTOR 1 and 2) and the RPU motor drive signals (D SERVO MOTOR 1 and 2) are applied to differential amplifiers AR15 and AR13, respectively. The E MOTOR 1 and 2 signals are dc voltages, whereas the D SERVO MOTOR 1 and 2 signals are ac voltages. The output of AR5 is compared by a balanced diode bridge error comparator. The output of the comparator, which is normally high, is the OU OK signal. This signal is checked by the fail detection circuit. The output of AR13 is demodulated to a dc voltage and applied to an error comparator. The output of the comparator is the RP OK signal, which is normally high, and is checked by the fail detection circuit. The combination of a feedback signal and a motor drive signal failure will be detected by the fail detection circuit and a signal will be generated to control the corresponding indicators on the GCU. For example, if the RPU failed, the D FEEDBACK OUT signal would cause the FB OK signal to go low and the D SERVO MOTOR 1 and 2 signals would cause the RP OK signal to go low. The fail detection circuit detects these two signals and generates the low RP FAIL signal to light the RETICLE PROJECTOR indicator on the GCU. At the same time, the SYSTEM OK signal goes high to turn off the SYSTEM OK indicator on the GCU.

If the output unit failed, the E FEED-BACK OUT signal will cause the FB OK signal to go low and the E MOTOR 1 and 2 signals will cause the OU OK signal to go low. The fail detection circuit detects these two signals and generates the low OU FAIL signal that lights the OUTPUT indicator on the GCU. At the same time, the SYSTEM OK signal goes high to turn off the SYSTEM OK indicator on the GCU.

The cant unit and driver electronics are checked by summing the stator inputs signals (CRS1, CRS2), the rotor output signals (CRR1, CRR2), the superelevation signal (minus epsilon), and a fixed reference signal (Rx). The sum of all the signals should equal zero within a tolerance)and. The output of the summing circuit is demodulated to a dc voltage applied to a comparator that checked for the positive and negative limits of the tolerance band. If the sum of the signals exceeds the positive limit, the driver electronics has failed and the normally high RD OK signal goes low. The fail detection circuit detects this low signal and generates the low COMP FAIL signal that lights the COMPUTER indicator on the GCU. The SYSTEM OK signal also goes high to turn off the SYSTEM OK indicator.

If the sum of the signals exceeds the negative limit, the cant unit has failed and the normally high CU OK signal goes low. This low signal is detected by the fail detection circuit to generate the signal that lights the CANT indicator and turns off the SYSTEM OK indicator on the GCU.

The COMPUTER indicator will also light f there is a loss of dc voltages (except a loss of +24V LAMP) or ac voltages.

The GCU is checked by applying a reference voltage (AC REF 1) to both ends of the jump and zeroing pots. The output of each pot, is each ammo is selected in the self-test mode, as compared to a reference level. Before being compared, the signal is demodulated to a dc voltage. The output of the comparator is the normally high GCU OK signal. If one of the pots is open or shorted, the GCU OK signal goes low. This low signal is detected by the fail detection circuit and generates the low GCU FAIL signal hat lights the GCU FAIL indicator on the GCU. The SYSTEM OK signal also goes high to turn off the SYSTEM OK indicator on the GCU.

The range signal, Ro(AC), from the rangefinder via the GCU, is demodulated to a dc voltage and applied to a comparator. The dc voltage is also sent to the A6 CCA as a dc range signal, Ro(DC). The output of the comparator is the normally high R OK signal. This signal is sent to the A10 CCA to generate the RF OK signal that is received sack by the A8 CCA. The MDE (mirror drive !electronics) OK signal is also received from he A10 CCA. If the rangefinder fails or the rangefinder mirror drive electronics fails, the RK OK or the MDE OK signal goes low. The fail detection circuit detects this low signal and generates the low RF FAIL signal that lights the RANGE FINDER indicator on the GCU. The SYSTEM OK indicator is also turned off on the GCU.

(9) *Wind electronics CCA A9 (fig FO-9).* The A9 CCA provides either the automatic, manual, or BIT wind reference for computation in the computer. The A9 electronics interface with a hot wire bridge anemometer (wind sensor probe) mounted externally on the tank.

When the system is first turned on, no voltage is applied to the probe bridge circuit and the input to amplifier/integrator AR1 is zero. The turn-on bias circuit provides the voltage input to amplifier/integrator AR1. The output of AR1 is applied to the pulse width modulator, which functions as a variable duty cycle generator. The other input to the modulator is the sawtooth waveform from the master oscillator. The output of the modulator is applied to power driver Q3.

Also, when the system is turned on self-starting restart multivibrator AR5 applies a trigger to the shutdown circuit. The multivibrator is on for 3 milliseconds and of for 300 milliseconds. The output of the shutdown circuit turns on the +30V switch Q2 and Q3. With the +30 switch turned on, the +30 volt wind sensor power is applied to the power switch. The output of the power switch (AC signal) which is controlled by the output of the pulse width modulator, is applied to the filter/rectifier circuit. The filtered output is applied to the hot wire bridge circuit. The output of the power driver is also coupled through capacitor C7 to the halfwave rectifier circuit. The dc output of the halfwave rectifier is applied to the shutdown circuit. This causes the power driver loop (consisting of the power driver halfwave rectifier, shutdown, and +30V switch circuits) to latch up.

The shutdown circuit turns off the +30V switch if the duty cycle of power driver Q4 increases to 100 percent, on all the time. This prevents damage (burn-up) of the hot wire elements (resistors) in the wind sensor probe.

As the bridge circuit's excitation voltage builds up to its normal operating point, the BRIDGE 2 signal output from the bridge circuit increases and back biases the diode in the turn-on bias circuit to inhibit the turn-on voltage.

When a crosswind exists from either direction, the resistance of temperature sensitive resistors R_{V1} and R_{V2} decrease because of the cooling effect of the wind. Depending on the wind direction, one of the resistors decreases more than the other. Decreasing the resistance causes the bridge circuit to unbalance. This unbalance is sensed by the amplifier/integrator circuit. The output of the amplifier/integrator causes the width of the pulse out of the pulse width modulator to increase. This increases the on time of power driver Q4, which increases the voltage supplied to the bridge circuit to balance it again, zeroing the input to the amplifier/integrator.

The crosswind magnitude is sensed by an amplifier in the probe. The output of the amplifier is received by the A9 CCA as the SIG A signal. This signal is applied to a function generator producing a linear output Sig -A which is then applied to the inverter/ follower AR7.

The wind direction is determined by resistors R_{V1} and R_{V2}. The BRIDGE 3/SIG B and SIG D signals represent the wind direction. Since one of the resistors decreases more than the other, one of the signals will have a higher potential than the other with the wind from one direction. If the wind changes, the signal levels will also change with respect to each other. The two signals are applied to differential amplifier AR8. The output (dc voltage) of AR8 is applied to mixer/driver AR10. The mixer/driver combines the dc voltage with the squarewave signal from the master oscillator. The output of the mixer/driver controls FET switch Q7. FET switch Q7 determines whether inverter/-follower AR7 is functioning as an inverter or a follower. If the FET switch is on, AR7 is functioning as an inverter, representing the wind for one direction. With the FET switch OFF, AR7 functions as a follower, representing the wind from the opposite direction. The output of the inverter/follower is applied to filter AR9, AR11 which removes any changes in the signal that are caused by gusts of wind. The output of the filter is coupled through normally on FET switch Q8A and distribution as the V_W (wind velocity) signal. This signal represents the wind direction and speed.

If the wind sensor probe should fail or get damaged, the manual wind mode is selected on the GCU, generating the MW and MW signals. The MW signal is coupled through an OR gate consisting of diodes CR34 and CR35 to turn on manual wind switch

Q8B. The wind signal is manually dialed in on the GCU and coupled through switch Q8B to be distributed as the V_W signal. The MW signal is coupled through an OR gate consisting of diodes CR31, CR32, and CR33 to turn off FET switch Q8A.

During BIT (system self-test) opera-ion, the wind signal is generated by the BIT wind circuit when the BIT signal is received from the GCU.

(10) *Mirror drive servo electronics CCA A10 (fig FO-10).* The A10 CCA supplies the motor drive signals for the commander's azimuth mirror positioning servo to position the reticle in azimuth.

The A10 CCA sums the reticle projector azimuth command (-D) signal with azimuth parallax correction signals from the parallax constant circuit. The parallax constant signals are generated at all times except when the BR(L) (Battle Range Laser) signal is received from the laser rangefinder. The BR(L) signal turns off FET switches Q1A and Q1B to inhibit the parallax correction signals. The parallax signals correct for displacement between the gunner's sight and laser sight. The summed signal (DL) is then summed with the motor shaft position feedback (DL FEEDBACK) signal and then applied to a noise rejection filter. One output of the filter is summed with the motor shaft rate feedback (DL) signal and applied to the power amplifier to generate the MDM1 and MDM2 motor drive signals. The other output of the noise rejection filter is applied to a comparator. The output of the comparator is applied to the fail detection circuit.

The MDM1 and MDM2 signals are also applied to a differential amplifier. The output of the amplifier is demodulated to a dc voltage and applied to a comparator whose output is applied to the fail detection circuit.

During the system self-test (BIT), the fail detection circuit checks the output of both compactors and the RANGE OK signal to determine if the motor driver electronics and the laser rangefinder are functioning properly. If the electronics fail, the MDE OK signal will go low to indicate a failure. If the rangefinder fails, the RF OK signal will go low to indicate a failure.

1-8. Tabulated Data. Physical and operational data are presented in TM 9-2350-253-10 and TM 9-2350-253-20-2.

1-9. Spares, Repair Parts, Special Tools, Special Test, Maintenance and Diagnostic Equipment (TMDE), and Other Special Support Equipment.

a. *Special Tools and Equipment*. Special tools and TMDE required for DS/GS maintenance are listed and illustrated in TM 9-1220-239-34P. The use of special tools, TMDE, and other special support equipment pertaining to direct support and general support maintenance is described in table 1-1.

b. *Spares and Repair Parts.* Spares and repair parts are listed and illustrated in TM 9-1220-239-34P, Repair Parts and Special Tools List covering direct support and general support maintenance for this equipment.

Table 1-1. Special Tools, TMDE, and Support Equipment

Item No.	Item	NSN or Reference No.	Reference		Use
			Fig No.	Para No.	
1	Cable Test Set	4931-00-629-3539 (11733300)	2-8	2-4	Test set cables W41 and W42 used to test and check out ammo select unit.
2.	Field Test Set	4931-00-629-3541 (11733200)	2-3 2-5, 2-6 2-7	2-4	Used to test and check out gunner's control unit and computer unit.
3.	Kit, Purging	4931-00-065-1110	2-1	2-3	Used to purge and charge sighting and fire control components with dry nitrogen.
4.	Tank, Dry Nitrogen	6830-00-782-2641	2-1	2-3	Used with purging kit (item 3).
5.	Power Supply, Variable DC	6130-00-435-1116	2-3 2-6 2-8	2-4	Supplies power to field test set and ammo select unit.
6.	Puller, Circuit Card	4931-00-628-1336 (11737838)		3-25	Remove computer circuit cards (part of field test set).

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

2-1. General. This section contains procedures to be performed upon receipt of a computer system component for repair. The procedures include initial inspection, test setup, purging, and checkout. Repairs should be accomplished in accordance with the general maintenance procedures (section IV), the repair procedures in chapter 3. The repair procedures specified above are the only repairs authorized for direct support and general support maintenance. If repairs beyond the scope of direct and general support maintenance are required, the component should be purged (para 2-3) and sent to higher maintenance. Lubrication, where applicable, is covered under the applicable repair procedures.

2-2. Initial Inspection. Inspection procedures are provided for the gunner's control unit, ammo select unit, and computer unit. Perform an initial inspection of the component upon receipt, followed by the associated checkout (para 2-4) as applicable. Table 2-1 provides the procedures for initial inspection.

Table 2-1. Inspection Upon Receipt

Step	Action
1.	Clean all external surfaces of component (section IV).
2.	Inspect all housing-mounted components for security of mounting. Repair if necessary.
3.	Inspect and repair housing, external shafts, machined surfaces, gears, and other mechanical parts (section IV).
4.	Check that electrical indicators are complete and that lenses are not broken, discolored, or have illegible marking. Repair or replace if necessary.
5.	Check mechanical operation of all switches. Insure toggle switches have proper snap action and that rotary switch detents provide proper switch positions without using excessive force. Insure switch guards are present, not broken, and operate properly. Repair or replace if necessary.
6.	Insure all control knobs are present, not broken, and are secure on shafts. Tighten knobs or replace as necessary.
7.	Check operation of all engaging or locking mechanisms. Repair or replace if necessary.
8.	Inspect electrical connectors for damaged threads; bent, depressed, or missing pins; pin plating or keyway wear; and signs of arcing. Straighten pins not excessively bent. Replace connector for other defects.
9.	Check that all decals and panel markings are present and legible. Repair or replace if necessary.
10.	Inspect surfaces for rust, corrosion, or paint damage. Clean or repair if necessary (section IV).

2-3. Purging and Charging. The nitrogen purging and charging procedure will be used a the completion of maintenance on computes system components. These procedures must be accomplished before returning the units to the user, supply system or higher maintenance. Table 2-2 provides instructions for set up of the nitrogen purging kit and the necessary procedures for purging the computer system components.

Table 2-2. Purging of Computer System Components

Step	Action

WARNING

Dry nitrogen used in purging the computer system is an inert gas (will not support combustion). The nitrogen bottle is colorcoded gray with two black stripes. Use extreme caution not to mistakenly use some other type gas. Use only nitrogen tank which is gray with two black bands. (6830-00-782-2641 BBN-411). Do not use oil pumped nitrogen under any circumstances.

WARNING

Do not use nitrogen in a confined space or area. Nitrogen gas can cause asphyxiation by displacing local oxygen supply. Nitrogen stored in tank may exceed' 4000 PSI. Tank must be secured to a nonmovable structure or vehicle when using or stored so as to minimize damage to tank valve if dropped. Protective cap will be secured when stored or not in use.

NOTE

Three regulator assemblies are presently in use for purging and charging fire control material. Purging kits will now contain Regulator 4820-00-001-7749. Previous purging kits contained Regulator 4931-00-558-0922 or Regulator 4820-00-724-9744, which require the use of adapters to secure the regulator to the nitrogen tank and may require adapters to secure the hose to the regulator. If you have Regulator 4820-00-001-7749, skip steps 4 and 5.

NOTE

If nitrogen tank has already been set up with regulator and hose attached, skip steps 1. through 5.

Table 2-2. Purging of Computer System Components - Continued

Step	Action

a. Nitrogen Purging Kit Setup (Fig. 2-1)

1. Obtain a tank of dry nitrogen (item 4, table 1-1) and remove threaded protective cap and cover from tank outlet (see figure 2-1).
2. Open tank valve momentarily to rid valve of any foreign matter.
3. Attach pressure regulator to tank valve using adapter, if necessary, and secure with proper wrench. Do not overtighten.
4. Install a right or left 9/16-18 npt adapter to regulator pressure port. Tighten with proper wrench.
5. Attach hose assembly to adapter and secure with wrench.
6. Rotate pressure regulator valve counterclockwise to extreme closed position. Do not use excessive force as damage to diaphragm could result.

NOTE

If indicated tank pressure is less than 100 psi obtain a replacement tank. Return empty tank with protective cap and cover.

7. Open tank valve slowly until the maximum tank pressure is registered on the high pressure gage.
8. Hold hose at free end, slowly rotate pressure regulator valve clockwise until approximately 5 psi registers on low pressure gage. Allow nitrogen to flow approximately 5 seconds to remove moisture and foreign material from hose assembly. Slowly close pressure regulator valve by rotating regulator valve counterclockwise.

b. Purging of Computer Components (Fig. 2-2).

WARNING

Components may be pressurized, remove outlet screw with caution.

NOTE

The computer system components have purging ports that are colorcoded. The color code system provides for marking inlet ports with a band of gray and outlet ports with a band of yellow.

NOTE

Procedures will be used on computer unit, gunner's control unit, and ammo select units.

Table 2-2. Purging of Computer System Components - Continued

Step	Action

1. Remove outlet screw from component. Check serviceability of screw seal. Replace if damaged.

2. Remove cap from inlet valve (gray) and connect hose assembly to inlet valve.

3. Rotate pressure regulator valve slowly, clockwise, until 8 psi is registered on low pressure gage. Purge for 5 minutes. If outlet screw contains moisture, time should be increased to remove moisture.

NOTE

Verify purging action by the escape of nitrogen at the relief port.

4. Lubricate outlet screw threads with grease (item 8, App. B).

5. Slowly rotate pressure regulator valve counterclockwise until low pressure gage registers approximately 1 psi and install outlet screw.
6. Slowly rotate pressure regulator valve counterclockwise to close off nitrogen flow.

7. Remove hose assembly from component and install inlet valve cap.

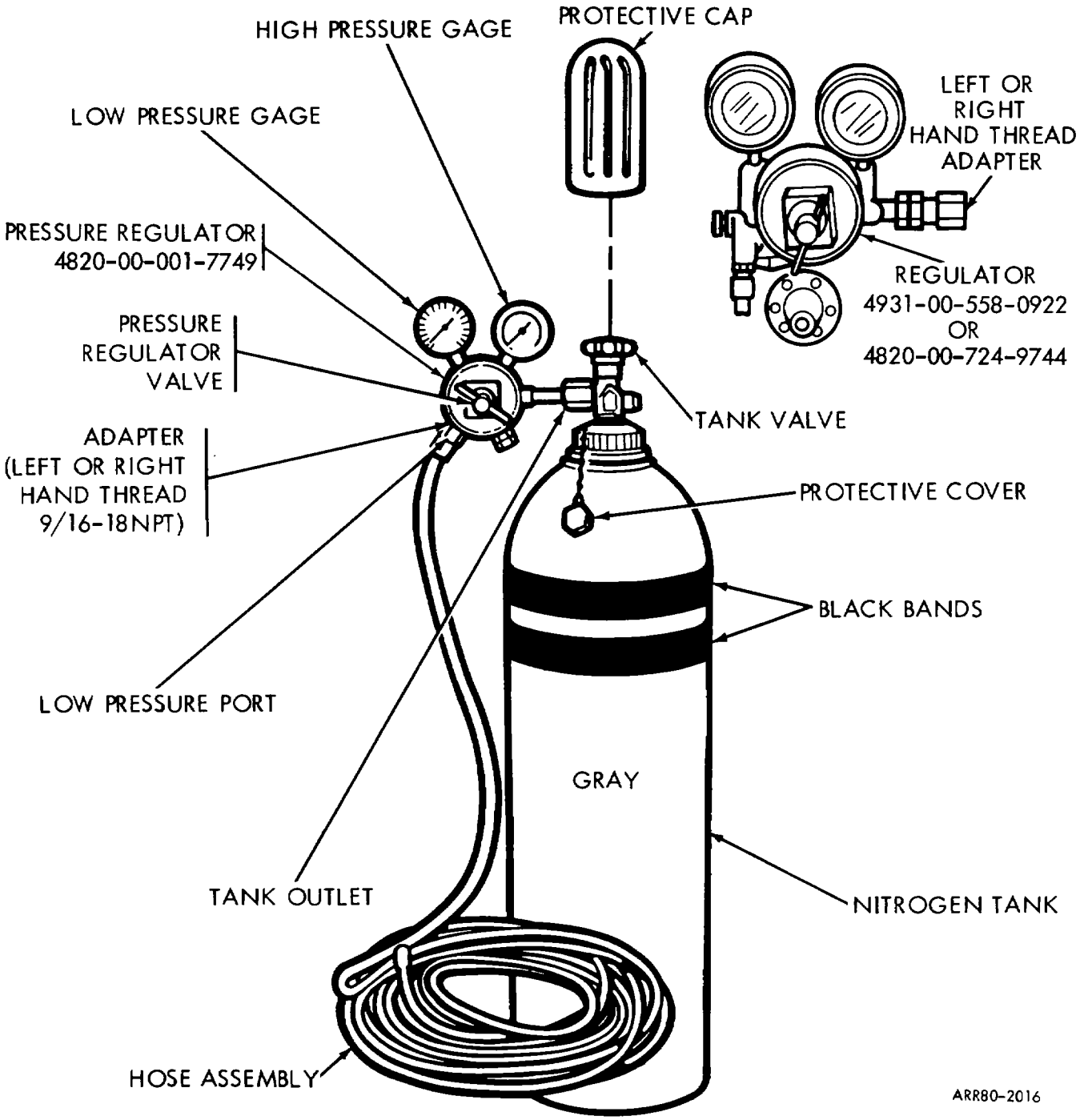


Figure 2-1. Nitrogen Purging Kit.

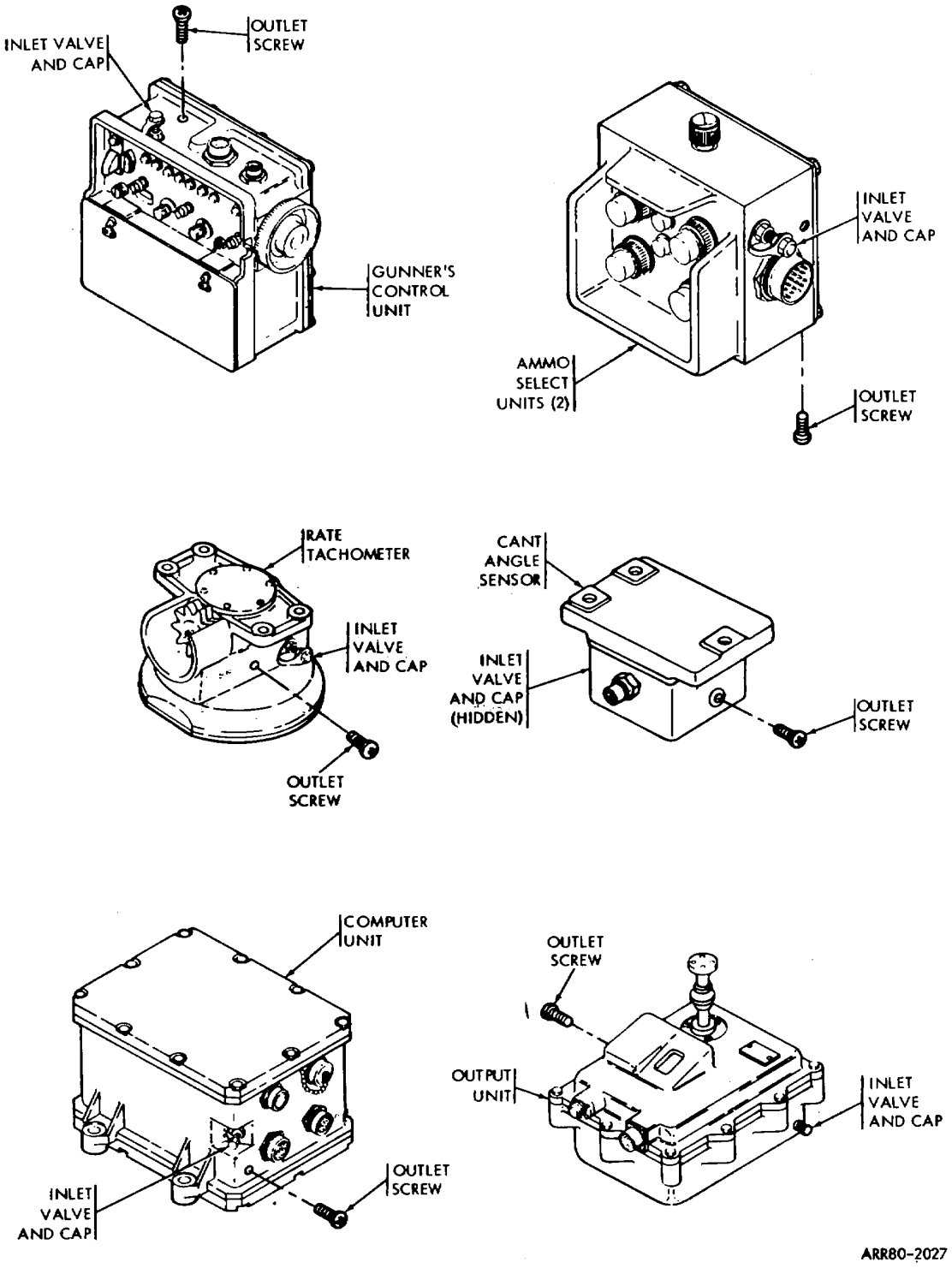


Figure 2-2. Computer system components purging connections.

2-4. Component Test Setups and Checkout.

a. General. Test setups for the gunner's control unit (GCU), ammo select unit (ASU), and computer unit are specified in the following paragraphs. Install the component in the test configuration prior to unit checkout. Preoperational tests and adjustments for the field test set (FTS) are given in TM 9-4931361-14&P.

NOTE

Do not hook up the GCU and computer unit to the FTS at the same time as erroneous malfunctions will be displayed.

b. Gunner's Control Unit Test Setup and Checkout.

(1) Connect the FTS (item 2, table 1-1), and GCU as shown in figure 2-3. Connect power cable W10 to power supply (item 5, table 1-1). Adjust prime power to read between 21.6 and 26.4 vdc. Ensure power remains constant throughout the GCU checkout for valid results.

(2) Perform the checkout procedure according to table 2-3. GCU controls and indicators are shown in figure 2-4. FTS controls and indicators applicable to GCU checkout are shown in figure 2-5. If the normal indication shown in the checkout table is not obtained, refer to troubleshooting (para 2-7). Repair procedures for the GCU are given in chapter 3. If the FTS appears defective, refer to TM 9-4931-361-14&P. When checkout is successfully completed, turn power switches off, remove prime power, and disconnect cables.

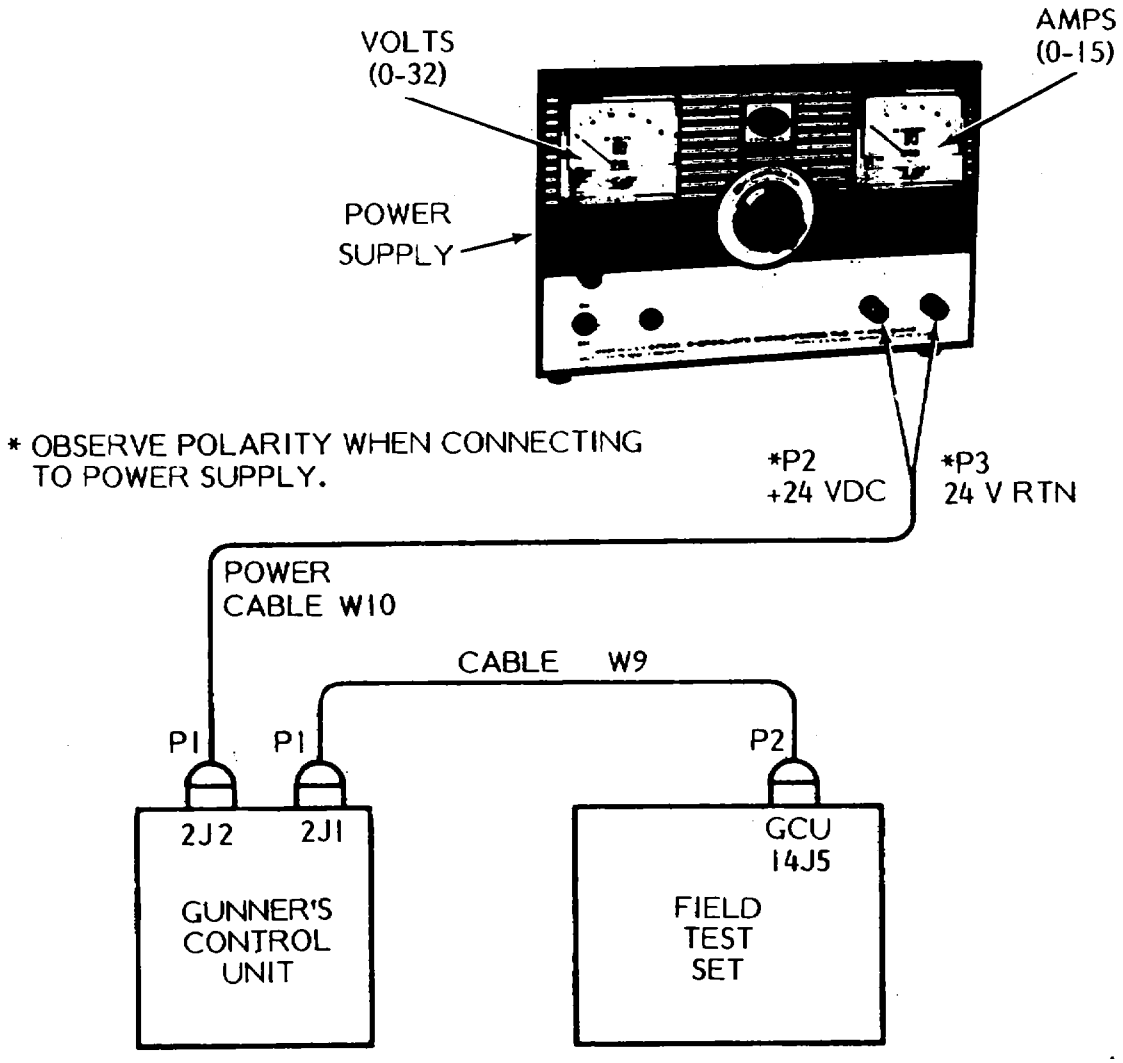


Figure 2-3. Gunner's control unit test setup AK703424

Table 2-3.: Gunner's Control Unit Checkout

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
		CAUTION **Make sure the FTS POW ER switch is in the OFF position when the GCU is.connected to the FTS. Otherwise, prime power is present and exposed on connector 14J6 of the FTS**.			
1.	FTS	POWER switch	OFF		
	FTS	UNIT SELECT switch	GCU		
2.	GCU	LIGHTS control	Fully CW		
	GCU	RANGEFINDER/ MANUAL Switch	MANUAL U		
	GCU	POWER switch	ON	Power indicator and panel illumination lamps light.	1
	FTS			POWER indicator illum inates	
	GCU	LIGHTS control	Rotate fully CCW	POWER indicator 1 and panel illumination lamps progressively dim as control is rotated.	
3.	GCU	LAMP/NORMAL/ SYSTEMi switch	Hold in LAMP position	All SELF TEST and 2 SENSOR FAIL lamps illum inate.	
			Release to NORMAL	All SELF TEST and 2 SENSOR FAIL lamps go out.	
4.	GCU	METERS X100 range dial	4		
	FTS	CONTINUITY switch	OFF		
	FTS	POTENTIOMETER switch	CONT TEST	CONTINUITY TEST meter indicates approximately 0.	

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
5.	FTS	LAMP TEST pushbutton	Press and hold	GUNNER'S CONTROL TEST indicators illuminate. Unused (-) segments will not illuminate.	
	FTS	LAMP TEST pushbutton	Release		
6.	GCU	RANGEFINDER/ MANUAL switch	RANGE-FINDER AUTO		
		CROSSWIND AUTO/MANUAL switch			
		NORMAL/ BORESIGHT switch	NORMAL		
	FTS			Following STATUS panel indicators illuminated: MODE- NORMAL SELF TEST- NORMAL WIND- AUTO RANGE- LRF	3, 4, 5
7.	FTS	AMMO TEST switch	APDS		
	GCU	AMMO: APDS switch	M392		
	FTS			AMMO TEST: APDS-M1392 indicator illurninates	6
8.	GCU	AMMO: APDS switch	M728		
	FTS			AMXMO TEST APDS-M392 indicator goes out and M728 indicator illuminates.	6

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
9.6	FTS	AMMO TEST switch	HEAT	APDS-M728 indicator goes out.	AMMO TEST:
	GCU	AMMO: HEAT switch	M456		
	FTS			AMMO TEST: HEAT: M456 indicator illuminates.	6
10.	FTS	AMMO TEST switch	HEP/WP	AMMO TEST: HEAT-M456 indicator goes out and HEP/WP indicator illum inates.	6
11.6	FTS	AMMO TEST switch	FSDS	HEP/WP indicator goes out and FSDS indicator illuminates.	AMMO TEST:
12.	GCU	NORMAL/ BORESIGHT switch	BORESIGHT		
	FTS			STATUS:MODE-NORMAL indicator goes out and BORESIGHT indicator illuminates.	3
13.	GCU	NORMAL/ BORESIGHT switch	NORMAL		
	FTS			STATUS:MODE-BORESIGHT indicator goes out and NORMAL indicator illuminates.	3
14.	GCU	LAMP/NORMAL/ SYSTEM switch	Hold in SYSTEM position		

Table 2-3. Gunner's Control Unit Checkout - Continued'

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	FTS			STATUS:SELF-TEST - SYSTEM indicator illuminates.	13
15.	GCU	LAMP/NORMAL/ SYSTEM switch	Release		
	FTS			STATUS: SELF-TEST- NORMAL indicator illuminates.	13
16.	GCU	CROSSWIND AUTO/MANUAL switch	MANUAL		
	FTS			STATUS: WIND-MAN indicator illuminates.	4
17.	GCU	CROSSWIND AUTO/MANUAL switch	AUTO		
	FTS			STATUS: WIND-MAN indicator goes out and AUTO indicator illuminates.	4
18.	GCU	RANGEFINDER/ MANUAL switch	MANUAL		
	FTS			STATUS: RANGE - MAN indicator illuminates.	5
	GCU	RANGEFINDER/ MANUAL switch	RANGE-FINDER		
	FTS			STATUS: RANGE-MAN indicator goes out and LRF indicator illuminates.	5
19.	FTS	POTENTIO-METER TEST switch	ALT		
	GCU	ALTITUDE control	Turn to -2		

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	FTS			CONTINUITY TEST meter deflects to nearly full-scale + (right).	7
	GCU	ALTITUDE control	Turn CW to 30	CONTINUITY TEST meter deflects smoothly to approximately 0.	7
	GCU	ALTITUDE control	Turn to 25	CONTINUITY TEST meter deflects to +20 ± 2.5.	7
	GCU	ALTITUDE control	Turn to 0		
20.	FTS	POTENTIOMETER TEST switch	AIR TEMP		
	GCU	AIR TEMP control	Turn to -60		
	FTS			CONTINUITY TEST meter deflects to nearly full-scale +.	7
	GCU	AIR TEMP control	Turn CW to 120		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	
	GCU	AIR TEMP control	Turn to -40	CONTINUITY TEST meter deflects to +80 ± 2.5	7
	GCU	AIR TEMP control	Turn to S		
21.	FTS	POTENTIOMETER TEST switch	MAN RANGE		
	GCU	RANGEFINDER/ MANUAL switch	MANUAL		
	FTS			STATUS: RANGE-LRF indicator goes out and MAN indicator illuminates.	5

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	GCU	METERS X 100 range dial	Rotate to 46		
	FTS			CONTIN UIT Y TEST meter de fleets to nearly full-scale +.	14
	GCU	METERS X 100 range dial	Rotate to 4		
	FTS			CONTIN UIT Y TEST meter deflects to +7.5 ± 2.5.	14
	GCU	RANGEFINDER/ MANUAL switch	RANGE-FINDER		
	FTS			STATUS: RANGE-LRF Indicator illuminates.	5
22.	FTS	POTENTIO-METER TEST switch	REMAINING TUBE LIFE		
	GCU	REMAINING TUBE LIFE control	Turn to 0		
	FTS			CONTINUITY TEST meter de-fleets to approxi-mately + 80.	8
	GCU	REMAINING TUBE LIFE control	Turn CCW to NEW		
	FTS			CONTINUITY TEST meter de fleets to approxi-mately 0.	8

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
23.	FTS	POTENTIO-METER TEST switch	AZ ZERO		
	FTS	AMMO TEST switch	APDS	AMMO TEST: APDS-M728 indicator illuminates.	6
	GCU	ZEROING: AZ - APDS control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	ZEROING: AZ- APDS control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale (left).	15
	GCU	ZEROING: AZ - APDS control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
24.	GCU	AMMO HEAT switch	M456		
	FTS	AMMO TEST switch	HEAT	AMMO TEST: HEAT - M456 indicator illuminates.	6
	GCU	ZEROING: AZ - HEAT control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	GCU	ZEROING: AZ - HEAT control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	ZEROING: AZ - HEAT control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
25.	FTS	AMMO TEST switch	HEP/WP	AMMO TEST: HEP/WP indicator illuminates.	6
	GCU	ZEROING: AZ - HEP/WP control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	ZEROING: AZ - HEP/WP control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	ZEROING: AZ - HEP/WP control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
26. 6	FTS	AMMO TEST switch	FSDS	FSDS indicator illuminates.	AMMO TEST:
	GCU	ZEROING: AZ - FSDS control	Turn to 3.5		
	FTS			CONTINUITY TEST meter de-fleets to approxi-mately full-scale +.	15
	GCU	ZEROING: AZ - FSDS control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter de-flects to approxi-mately full-scale-.	15
	GCU	ZEROING: AZ - FSDS control	Turn to 0		
	FTS			CONTINUITY TEST meter de-flects to approxi-mately 0.	15
27.	FTS	POTENTIO-METER TEST switch	EL ZERO		
	FTS	AMMO TEST	APDS	AMMO TEST: APDS-M728 indi-cator illuminates.	6
	GCU	ZEROING: EL - APDS control	Turn to 3.5		
	FTS			CONTINUITY TEST meter de-flects to approxi-mately full-scale -	15

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	GCU	ZEROING: EL - APDS control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	ZEROING: EL- APDS control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
28.6	FTS	AMMO TEST switch	HEAT	HEAT-M456 indicator illuminates.	AMMO TEST:
	GCU	ZEROING: EL - HEAT control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	ZEROING: EL- HEAT control	Turn CW to -3.5		
	FTS			TEST meter de-, flects to approximately full-scale +.	15
	GCU	ZEROING: EL- HEAT control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
29.	FTS	AMMO TEST switch	HEP/WP	AMMO TEST: HEP/WP indicator illuminates.	6
	GCU	ZEROING: EL HEP/WP control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	ZEROING: EL-HEP/WP control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	ZEROING: EL-HEP/WP control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
30. 6	FTS	AMMO TEST switch	FSDS	FSDS indicator illum inates.	AMMO TEST:
	GCU	ZEROING: EL-FSDScontrol	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	ZEROING: EL-FSDS control	Turn CW to -3.5		

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	ZEROING: EL - FSDS control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
31.	FTS	POTENTIOMETER TEST switch	AZ COMMON ZERO		
	GCU	COMMON ZERO: AZ control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	COMMON ZERO: AZ control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	15
	GCU	COMMON ZERO: AZ control	Turn to O		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
32.	FTS	POTENTIOMETER TEST switch	EL COMMON ZERO		

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	GCU	COMMON ZERO: EL control	Turn to 3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale-.	15
	GCU	COMMON ZERO: EL control	Turn CW to -3.5		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale +.	15
	GCU	COMMON ZERO: EL control	Turn to 0		
	FTS			CONTINUITY TEST meter deflects to approximately 0.	15
33.	FTS	POTENTIOMETER TEST switch	CROSSWIND		
		NOTE **Before performing the following function, observe the GCU panel for the correct LEFT and RIGHT rotation of the control.**			
	GCU	CROSSWIND MPH control	Turn to 50 LEFT		
	FTS			CONTINUITY TEST meter deflects to approximately full-scale -.	7
	GCU	CROSSWIND MPH control	Turn to 50 RIGHT		

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	FTS			CONTINUITY TEST meter defleets to approximately full-scale +.	7
	GCU	CROSSWIND MPH control	Turn to 0		
	FTS			CONTINUITY TEST meter defleets to approximately 0.	7
34.	FTS	POTENTIOMETER TEST switch	CONT TEST		
	FTS	CONTINUITY switch	1		
	GCU	AIR TEMP control	120		
	GCU	ALTITUDE control	30		
	GCU	LAMP/NORMAL/ SYSTEM switch	Hold in SYSTEM position through step 37		
	FTS			CONTINUITY TEST meter indicates between +40 and +60.	9
35.	FTS	CONTINUITY switch	2		
	FTS			CONTINUITY TEST meter indicates between +25 and +75.	10
36.	FTS	CONTINUITY switch	3		
	FTS			CONTINUITY TEST meter indicates between +25 and +75.	11

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
37.	FTS	CONTINUITY switch	4		
	FTS			CONTINUITY TEST meter indicates between +25 and +75.	11
	GCU	Release LAMP/ NORMAL/SYSTEM switch		Ignore CONTINUITY TEST meter deflection.	
38.	GCU	RANGEFINDER/ MANUAL switch	MANUAL	Ignore CONTINUITY TEST meter deflection.	
	FTS	CONTINUITY switch	5		
	FTS	LAMP TEST pushbutton switch	Press and hold	Ignore FTS indicators.	
	GCU			Following SELF 12 TEST indicators will be illuminated: OK, COMPUTER, OUTPUT, RETICLE PROJECTOR, GUNNER'S CONTROL, CANT, and WIND.	
	FTS	LAMP TEST pushbutton switch	Release		
39.	GCU	RANGEFINDER/ MANUAL switch	RANGEFINDER		
	FTS	LAMP TEST pushbutton switch	Press and hold	Ignore FTS indicators.	
	GCU			Following SELF 12 TEST and SENSOR FAIL indicators will be illuminated: OK, COMPUTER, OUTPUT, RETICLE PROJECTOR, CANT, RANGEFINDER, and WIND.	

Table 2-3. Gunner's Control Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
	FTS	LAMP TEST pushbutton switch	Release		
40.	FTS	CONTINUITY switch	6		
	FTS	LAMP TEST pushbutton switch	Press and hold	Ignore FTS indicators.	
	GCU			GUNNER'S CONTROL indicator illuminates.	12
	FTS	LAMP TEST pushbutton switch	Release		
	GCU			GUNNER'S CONTROL indicator goes out.	12
		NOTE:			
		When checkout is completed, turn power switches to OFF, remove prime power, and disconnect cables.			

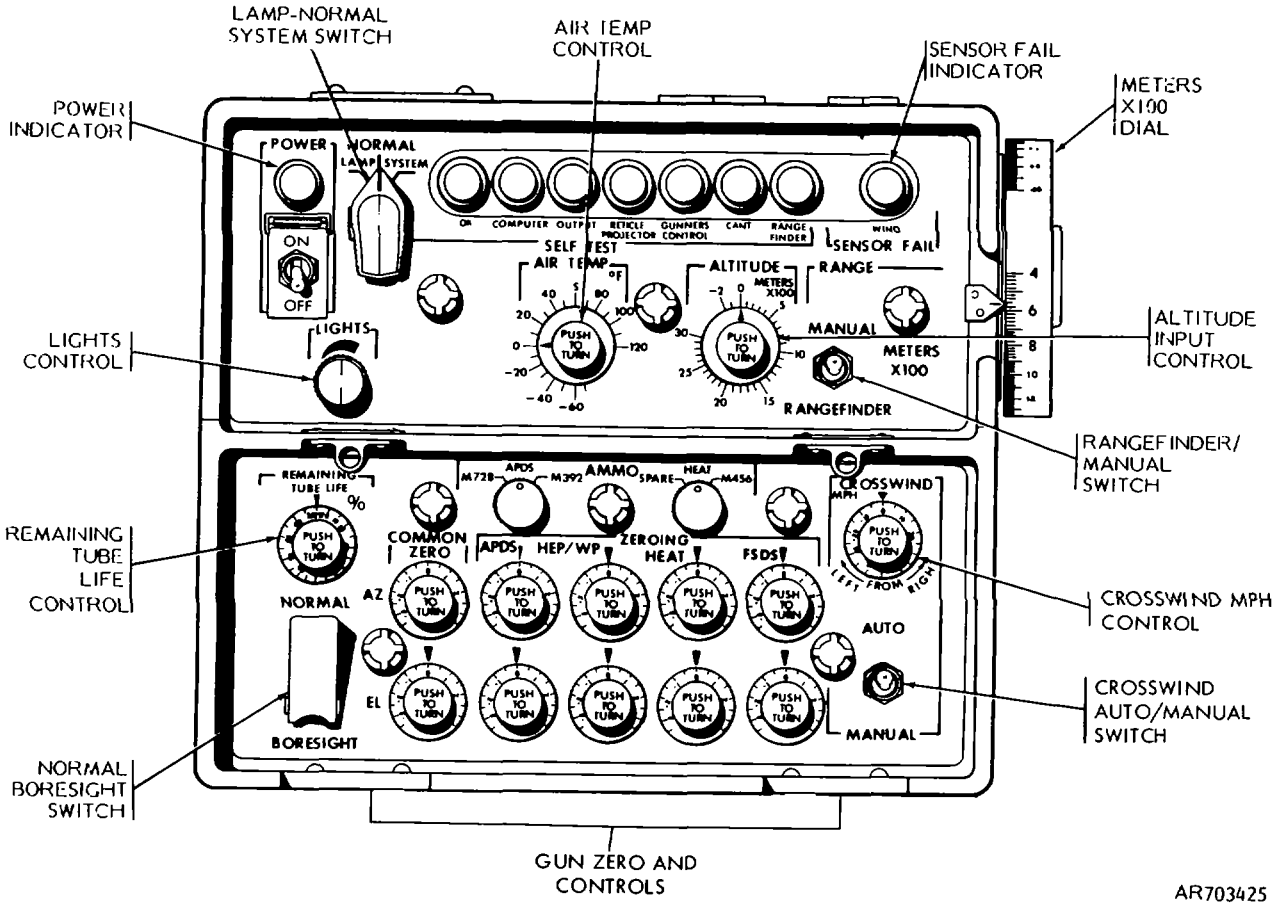


Figure 2-4. Gunner's control unit controls and indicators.

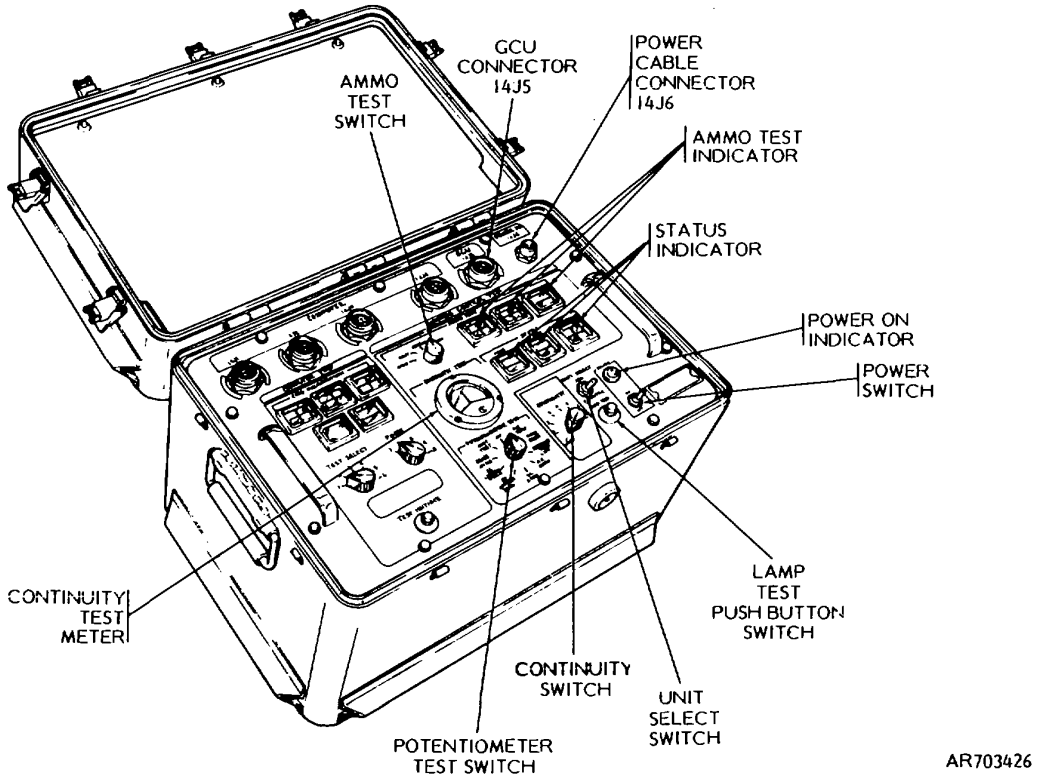
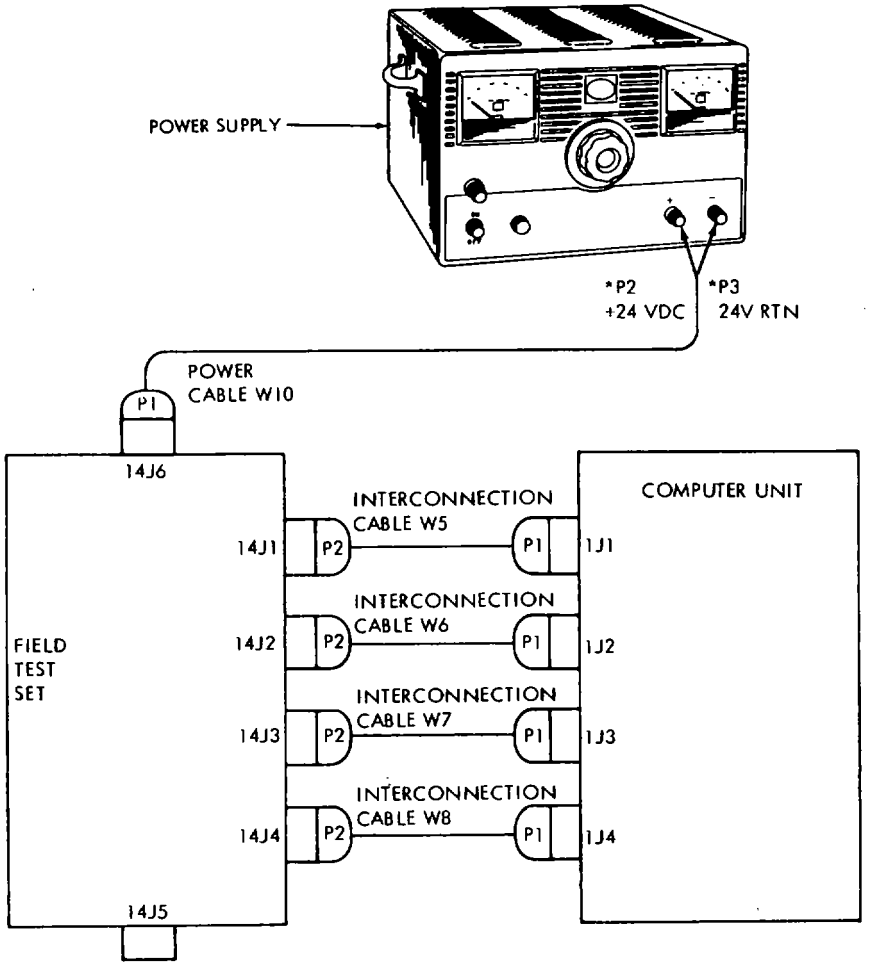


Figure 2-5. Field test set controls and indicators, gunner's control unit checkout.

c. Computer Unit Test Setup and Checkout.

(1) Connect the computer unit and the FTS (item 2, table 1-1) as shown in figure 2-6. Connect power cable W10 to power supply (item 5, table 1-1) 24 vdc, 5 amp power source. Adjust prime power to read between 21.6 and 26.4 vdc. Ensure power remains constant throughout the computer unit checkout for valid results.



* OBSERVE POLARITY WHEN CONNECTING TO POWER SUPPLY.

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Figure 2-6. Test bench setup for testing computer unit with field test set.

(2) Perform the checkout procedure according to table 2-4. If an error is made or a test result is questionable, checkout procedure must be repeated from the beginning. Each test must be passed for succeeding tests to be valid. Do not leave PHASE switch in position 2 or 5 any longer than necessary to complete the test. When test is passed, move PHASE switch to next position, or position 1 as applicable. (The A6 or A4 CARD MALFUNCTION indication may illuminate if this procedure is not followed. Place FTS POWER switch in OFF position for 5 minutes before repeating checkout, if this happens). FTS (item 2, table 1-1) controls and indicators applicable to computer unit checkout are shown in figure 2-7. If the normal indication shown in the checkout table is not obtained, refer to troubleshooting (table 2-6). Repair procedures for the computer unit are given in chapter 3. If the FTS appears defective, refer to TM 9-4931361-14&P. When checkout is successfully completed, turn power switches off, remove prime power and disconnect cables.

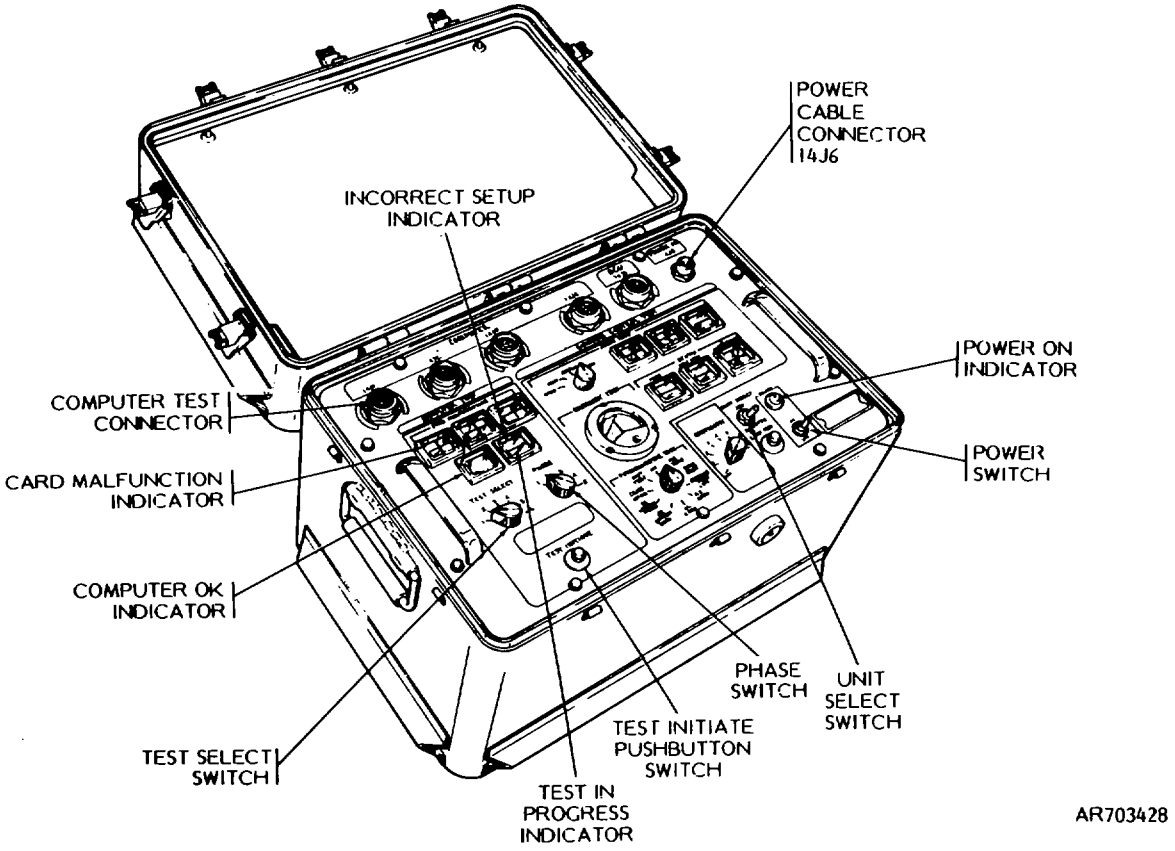

Figure 2-7. Field test set controls and indicators, computer unit checkout.

Table 2-4. Computer Unit Checkout

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
		NOTE **After correcting a malfunction, perform the complete checkout procedure.** **NOTE** **Ignore any momentary lighted indicators when changing switch positions.**			
1.		UNIT SELECT switch	COMPUTER		
		TEST SELECT switch	1		
		CONTINUITY switch	OFF		
		PHASE switch	1		
		POWER switch	ON	POWER indicator illuminates.	
		LAMP TEST pushbutton	Press and hold	COMPUTER TEST indicators illuminate.	
		LAMP TEST pushbutton	Release		
2.		TEST INITIATE pushbutton switch	Press and release	TEST IN PROGRESS indicator illuminates. After approximately 25 seconds, TEST IN PROGRESS indicator goes out and COMPUTER OK indicator illuminates.	20, 21, 22, 23
3.		TEST SELECT switch	2		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21, 22, 23

Table 2-4. Computer Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
4.		TEST SELECT switch	3		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21, 22, 23
5.		TEST SELECT switch	4		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21, 22, 23
6.		TEST SELECT switch	5		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21, 22
		NOTE **TEST SELECT switch must be in position 4 to be able to use PHASE switch positions 2 through 5.**			
7.		TEST SELECT switch	4		
		NOTE **Do not leave PHASE switch in position 2 or 5 any longer than necessary to complete test. When test is passed, move PHASE switch to next position or position 1 as applicable. The A6 or A4 CARD MALFUNCTION indicator may illuminate if this procedure is not followed. If this happens, place FTS POWER switch in OFF position before repeating checkout.**			
		PHASE switch 2			
		PHASE switch	2		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21, 22
8.		PHASE switch	3		
		TEST INITIATE pushbutton switch	Press and release	Same as test 20 No. 2	
9.		PHASE switch	4		
		TEST INITIATE pushbutton switch	Press and release	Same as test No. 2	20, 21

Table 2-4. Computer Unit Checkout - Continued

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
			NOTE **Do not leave PHASE switch in position 2 or 5 any longer than necessary to complete test. When test is passed, move PHASE switch to next position or position 1 as applicable. The A6 or A4 CARD MALFUNCTION indicator may illuminate if this procedure is not followed. If this happens, place FTS POWER switch in OFF position before repeating checkout.**		
10.		PHASE switch	5		
		TEST INITIATE pushbutton switch	Press and release.	Same as test No. 2	20, 21
11.		PHASE switch	1		
		CONTINUITY switch	1	CONTINUITY TEST meter indicates -25 to +25	24
12.		PHASE switch	5	CONTINUITY TEST indicates +25 to +75	22
13.		CONTINUITY switch	2	Same as test No. 12	Same as test No. 12
14.		CONTINUITY switch	3	Same as test No. 12	Same as test No. 12
15.		CONTINUITY switch	4	Same as test No. 12	Same as test No. 12
			NOTE **Continuity switch positions 5 through 7 not used.**		
			NOTE **When checkout is completed, turn power switches to OFF, remove prime power, and disconnect cables**.		

d. Ammo Select Unit (ASU) Test Setup and Checkout (Fig 2-8 and 2-9).

(1) Connect ASU to cables W41 and W42 (part of cable test set, item 1, table 1-1) as shown in figure 2-8. Then connect power cable W41 to variable dc power supply (item 5, table 1-1) and adjust between 24 + 6 vdc. Ensure power remains constant throughout the ASU checkout for valid results.

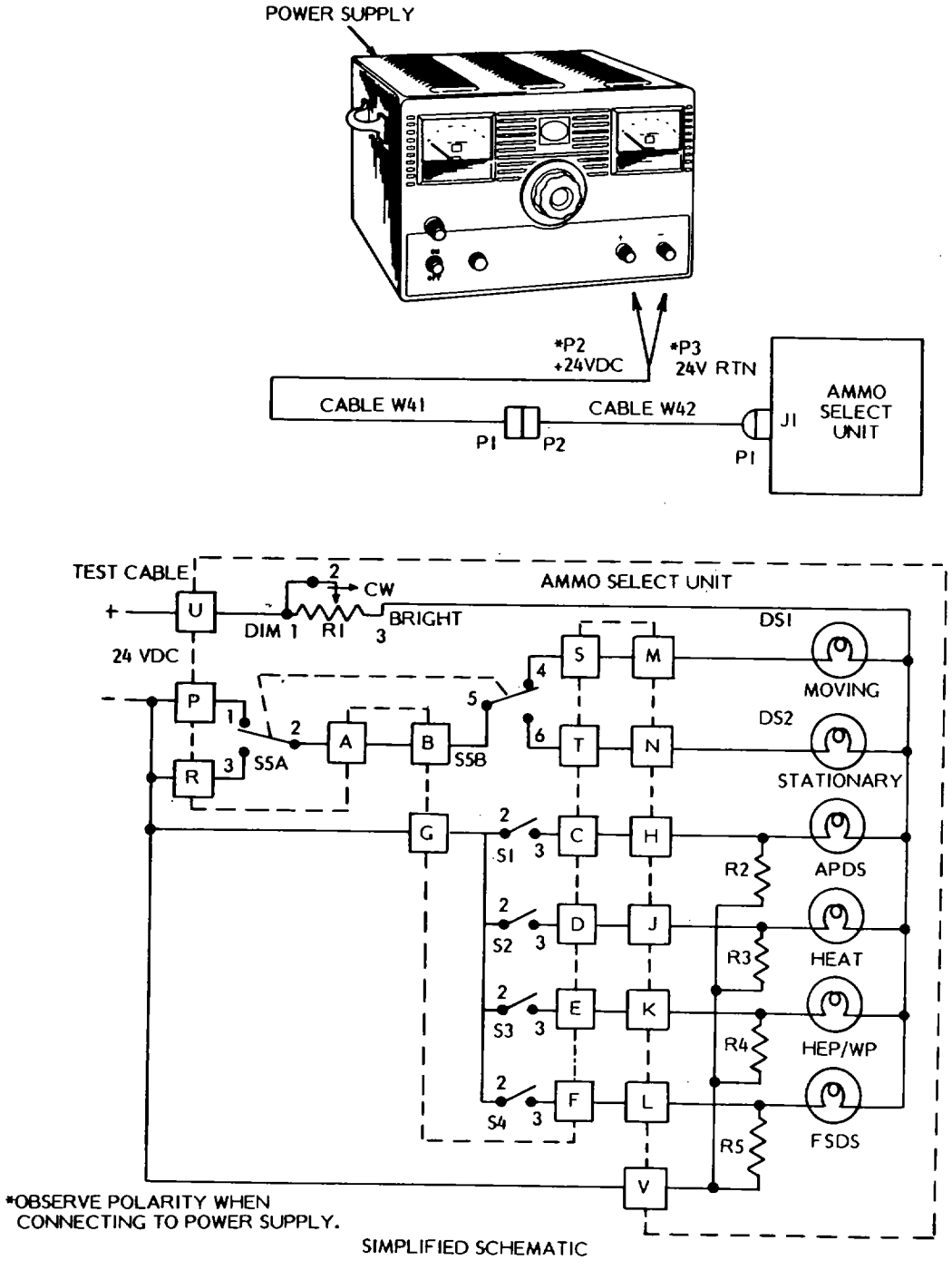

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Figure 2-8. Test bench setup for testing ammo select unit.

(2) Perform the checkout according to table 2-5. ASU controls and indicators are shown in figure 2-9. If the normal indication shown in the checkout table is not obtained, refer to troubleshooting (table 2-6). ASU repair procedures are given in chapter 3.

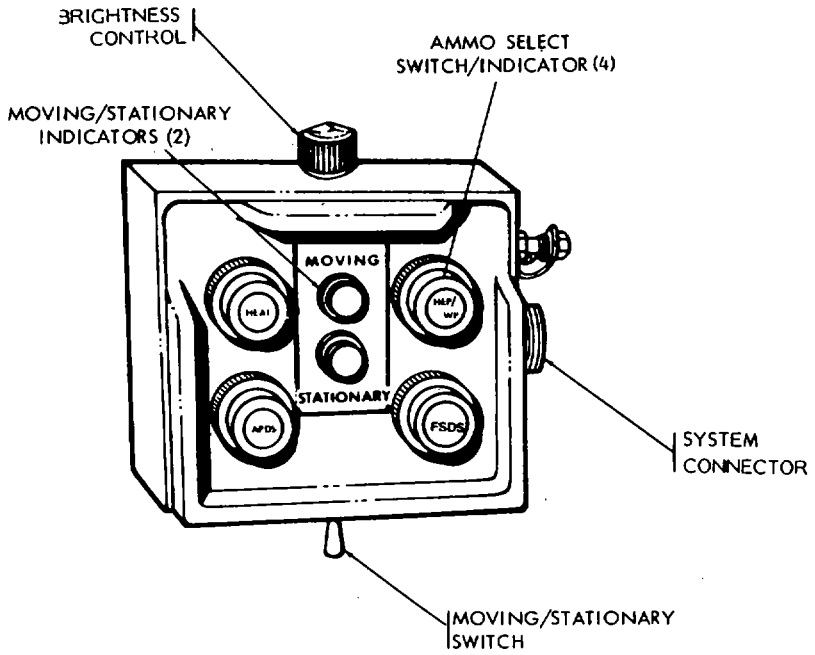

Figure 2-9. Ammo select unit controls and indicators.

Table 2-5. Ammo Select Unit Checkout

Test No.	Unit	Action		Normal Indication	Malfunction (Refer to Table 2-6)
		Control	Position		
1.		Brightness control	Fully CW	Four ammo indicators illuminate.	16
2.		MOVING/ STATIONARY switch	As necessary to light MOVING indicator	MOVING indicator illuminates.	17
		MOVING/ STATIONARY switch	As necessary to light STATIONARY incicator	STATIONARY indicator illuminates.	17
3.		HEAT switch indicator	Depress and release	HEAT indicator illuminates brightly while switch is depressed and dims when switch is released.	18, 19
4.		HEP/WP switch indicator	Depress and release	HEP/WP indicator illuminates brightly while switch is depressed and dims when switch is released.	18, 19
5.		FSDS switch indicator	Depress and release	FSDS indicator illuminates brightly while switch is depressed and dims when switch is released.	18, 19
6.		APDS switch indicator	Depress and release	APDS indicator illuminates brightly while switch is depressed and dims when switch is released.	18, 19
7.		Brightness control	Rotate fully CCW	STATIONARY and four ammo indicators dim smoothly as control is rotated.	16
		NOTE **When checkout is completed, turn power switches to OFF, remove prime power, and disconnect cable.**			

Section II. PREEMBARKATION INSPECTION OF MATERIEL IN UNITS ALERTED FOR OVERSEAS SHIPMENT

2-5. General. To be furnished at a later date.

Section III. TROUBLESHOOTING

2-6. General.

a. This section contains the troubleshooting information for locating and correcting troubles which may develop in the computer system units. Each malfunction for an individual unit is followed by a list of tests or inspections which will help you to determine the corrective action to take. You should perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all possible malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed (except when malfunction and cause are obvious), or is not corrected by listed corrective actions, notify your supervisor.

c. Troubleshooting is performed by connecting the computer system component in the applicable test setup (para 2-4) and performing the associated checkout procedure (para 2-4). Malfunctions noted during the procedures can be isolated by referring to the appropriate malfunction listed in table 2-6.

d. In the computer unit troubleshooting procedure, CCA's A1, A2, and A7 must be operational before other malfunction indications are valid. If the FTS indicates an Al, A2, or A7 failure, replace these CCA's first, tag the original CCA in the event that card replacement does not affect repair. Units returned to higher maintenance must contain original CCA's. Purge all units (para 2-3) before returning to supply system or higher maintenance.

e. Special tools and test equipment required during troubleshooting are shown in table 1-1. Repair parts and special tools, except fabricated special tools, are to be requisitioned in accordance with TM 9-1220-239-34P, which is the authority for requisitioning replacements.

2-7. Troubleshooting Table.

a. General. Troubleshoot the computer system components in accordance with table 2-6. Table 2-6 lists the malfunctions together with related tests or inspections, and corrective actions. The corrective actions provide instructions for correcting the fault, reference to an appropriate paragraph for repair, or instructions to return the defective assembly to the next higher maintenance level. The troubleshooting table, table 2-6, does not list malfunctions .which become obvious through a simple visual check or those malfunctions involving more than one component. See your supervisor if malfunctions occur that cannot be corrected. Malfunctions reported by the user should be verified, if possible, by performing the associated checkout (para 2-4).

b. Troubleshooting Notes.

(1) *Prime power source.* Check power source occasionally to ensure adequate power, otherwise faulty test results may be obtained.

(2) *Test equipment and measurements.* Stated voltage values and other test point criteria are based on the use of a 20, 000 ohm/volt multimeter (URM 105 or equivalent). Test measurements are to chassis ground reference unless specified otherwise. Disconnect primary power for all resistance or continuity checks.

Table 2-6. Troubleshooting

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

NOTE

To use this table, you must have located the malfunction by performing the checkout procedures in paragraph 2-4.

GUNNER'S CONTROL UNIT

1. POWER INDICATOR AND PANEL ILLUMINATION LIGHTS DO NOT OPERATE. SELF TEST INDICATORS OK.

   Step 1. With GCU LIGHTS potentiometer fully CW, hold LAMP/NORMAL/SYSTEM switch in LAMP position. Lights should illuminate.
   a. If indicators illuminate, replace R16 (para 3-8).
   b. If indicators do not illuminate, return GCU to higher maintenance.

   Step 2. Check continuity of POWER switch. Continuity should be present.
   a. If present, return to higher maintenance.
   b. If not present, replace switch (para 3-4).

2. INDICATORS DO NOT OPERATE PROPERLY DURING LAMP TEST.

   Step 1. Check for +24 vdc at terminal 2 of POWER switch S5.
   a. If present, proceed to step 2.
   b. If not present, return unit to higher maintenance.

   Step 2. Check for +24 vdc at terminal 1 of POWER switch S5 with switch in ON position.
   a. If present, return unit to higher maintenance.
   b. If not present, replace S5 (para 3-4).

3. NORMAL AND BORESIGHT FUNCTION NOT SELECTABLE.

   Step 1. Check for continuity between pins 1 and 2 of NORMAL-BORESIGHT switch S4 with switch in BORESIGHT position.
   a. If present, proceed to step 2.
   b. If not present, replace switch (para 3-11).

   Step 2. Repeat step 1 using terminals 2 and 3 of switch with switch in NORMAL position.
   a. If continuity is present, proceed to step 3.
   b. If continuity is not present, replace switch (para 3-11).

   Step 3. Replace A1 CCA (para 3-14).
   a. If unit passes GCU checkout, return to service
   b. If unit fails GCU checkout, return to higher maintenance.

4. CROSSWIND AUTO/MANUAL SWITCH FUNCTIONS NOT SELECTABLE.

   Step 1. Check continuity of AUTO/MANUAL switch. Continuity should be present.
   a. If present, return unit to higher maintenance.
   b. If not present, replace switch (para 3-9).

Table 2-6. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
Step 2. Replace A1 CCA (para 3-14). Unit should pass GCU checkout. a. If yes, return to service. b. If no, return to higher maintenance.
5. RANGEFINDER/MANUAL SWITCH FUNCTION NOT SELECTABLE.
Step 1. Check continuity of RANGEFINDER/MANUAL switch. Continuity should be present. a. If not present, replace switch (para 3-9). b. If present, proceed to step 2.
Step 2. Replace A1 CCA (para 3-14). Unit should pass GCU checkout. a. If yes, return to service. b. If no, return to higher maintenance.
6. APDS OR HEAT AMMO NOT PROPERLY SELECTED.
Step 1. Check continuity of AMMO switch. Continuity should be present. a. If present, proceed to step 2. b. If not present, replace switch (para 3-13).
Step 2. Replace circuit card Al (para 3-14) and retest. If malfunction is still present, return unit to higher maintenance.
7. ALTITUDE, AIR TEMPERATURE, OR CROSSWIND CONTROL NOT PROVIDING CORRECT OUTPUTS. Check that knob is properly installed and calibrated (para 3-12) and locks and unlocks properly. A smooth indication should be obtained on CONTINUITY TEST meter when control is turned. a. If control does not operate properly, replace A1 CCA (para 3-14). If control operates properly, return to service. b. If control still does not operate properly, replace control. If repair is not effected, return unit to higher maintenance. If knob operates properly, replace control.
8. REMAINING TUBE LIFE CONTROL NOT PROVIDING CORRECT OUTPUTS.
Step 1. Check that knob is installed properly (para 3-10), and locks and unlocks properly. a. If knob is installed properly, proceed to step 2. b. If knob is not installed properly, reinstall knob (para 3-10).
Step 2. Rotate REMAINING TUBE LIFE Control R17 when checking the voltage at pin 2 of the control. Voltage should vary smoothly between 0 and +15 vdc. a. If voltage varies smoothly, return unit to higher maintenance. b. If voltage does not vary smoothly, replace control (para 3-10). c. If repair is effected, return to service.
9. FTS INDICATES CONTINUITY TEST FAILURE IN POSITION 1. Replace circuit card A1 (para 3-14) and retest. If malfunction is still present, return unit to higher maintenance.

Table 2-6. Troubleshooting- Continued

Malfunction Test or Inspection Corrective Action

11. FTS INDICATES CONTINUITY TEST FAILURE IN POSITION 3 or POSITION 4.

    Return unit to higher maintenance.

12. CORRECT SELF-TEST LAMPS FAIL TO ILLUMINATE DURING CONTINUITY TEST IN POSITION 5.

    Return unit to higher maintenance.

13. STATUS SELF TEST INDICATOR DOES NOT ILLUMINATE, LAMP/NORMAL/SYSTEM SWITCH IN SYSTEM OR NORMAL POSITIONS.

    Step 1. Check output of CCA A-Z for 12 VDC ± .12 VDC with voltmeter from pin 22.

    Adjust R41 if out of tolerance.

    Step 2. On CCA A-1, connect voltmeter to pin 6.

    Adjust R15 to 15 VDC ± .15 VDC.

    Step 3. On CCA A-1, connect voltmeter to pin 14, reading should be 5.2 VDC ± .5 VDC.

    Step 4. On CCA A-1, connect voltmeter to pin 22; reading should be 30.6 VDC ± 2.0 VDC.

    Step 5. On CCA A-1, connect voltmeter to pin 24; reading should be 22.6 VDC ± .15 VDC.

    Step 6. On CCA A-1, connect voltmeter to pin 25.

    Adjust R22 to -15 VDC ± .15 VDC.

    Replace A1 CCA. If repair is not effected, return GCU to higher maintenance.

14. CONTINUITY METER DOES NOT MOVE LINEARLY OR IS ERRATIC WHEN METERS X100 DIAL IS ROTATED.

    Check if meters X100 dial is loose on shaft of potentiometer (R4).

    a. For early model dial secured with setscrews, if loose, perform dial adjustment (para 3-16.1).
    b. For late model dial secured with collet, if loose, return unit to higher maintenance.
    c. If problem has been resolved, return GCU to service.
    d. If problem has not been resolved, return GCU to higher maintenance.

Table 2-6. Troubleshooting- Continued

Malfunction Test or Inspection Corrective Action

15. ZEROING CONTROLS NOT PROVIDING CORRECT OUTPUTS. Remove control knob and check control calibration. Control should be calibrated and give a smooth indication on CONTINUITY TEST meter when turned (para 3-16).

    If not present, replace control or calibrate (para 3-16).
    If defect is not corrected, return unit to higher maintenance.

AMMO SELECT UNIT

16. BRIGHTNESS CONTROL DOES NOT FUNCTION.
    Step 1. Check for +24 vdc at terminal 1 of brightness control R1.
        a. If present, proceed to step 2.
        b. If not present, return unit to higher maintenance.
    Step 2. Check for 0 to +24 vdc at terminal 3 of brightness control R1 as control is varied. Voltage should vary smoothly.
        a. If present, return unit to higher maintenance.
        b. If not present, replace control (para 3-20).

17. MOVING OR STATIONARY INDICATOR WILL NOT ILLUMINATE.
    Step 1. Check for continuity between terminals 2 and 1 when STATIONARY/MOVING switch is in one position, and between terminals 2 and 3 when switch is in the other position.
        a. If present, proceed to step 2.
        b. If not present, replace switch (para 3-18).
    Step 2. Repeat step 1 using terminals 5 and 4, then terminals 5 and 6.
        a. If continuity is present, return unit to higher maintenance.
        b. If continuity is not present, replace switch (para 3-21).

18. AMMO-TYPE SWITCH/INDICATOR WILL NOT SHOW DIM ILLUMINATION.

    Replace switch (para. 3-18).

19. AMMO-TYPE SWITCH/INDICATOR WILL NOT BRIGHTEN WHEN HELD DOWN.

    Replace switch (para. 3-18).

Table 2-6. Troubleshooting - Continued

Malfunction Test or Inspection Corrective Action

COMPUTER UNIT

20. FTS DISPLAYS ONE CIRCUIT CARD DEFECTIVE ("A1", "A2", "A7", "A8", "A9", OR "A10").
    a. Replace circuit card that is displayed by FTS (para 3-25).
    b. Perform test No. 1 thru No. 10 (table 2-4).
    c. If fault is not corrected, proceed to malfunction 21.

21. FTS DISPLAYS "A5" DEFECTIVE.
    a. Replace circuit card A5 (para 3-25). If new A5 does not correct the problem, replace card A6 (also leave new A5 card in place).
    b. If fault is corrected by replacing card A6, put the original A5 card back.
    c. If fault is not corrected when both A5 and A6 are substituted, proceed to malfunction 22.

22. FTS DISPLAYS ANY ONE OF "A3", "A4", "A5", OR "A6".
    Step 1. If replacing the indicated circuit card by itself does not correct the problem (and replacing the second card indicated in malfunction 21 still does not correct the problem), replace additional cards until all four cards (A3, A4, A5, and A6) have been replaced.
    a. If malfunction is still present with all four cards replaced, put the original set of cards back in, and send the computer unit to depot maintenance.
    b. If malfunction is corrected when all four cards have been substituted, proceed to step 2.
    Step 2. Replace original cards, one at a time, until the malfunction indication reappears. The last card replaced is then defective. Return the three original cards to the computer, replacing only the defective card.

23. FTS DISPLAYS BOTH "A3" AND "A6".
    Step 1. Replace card A6 by itself (these two cards are in a feedback loop).
    a. Return computer to service if malfunction is corrected.
    b. Proceed to step 2 if the problem is still present.
    Step 2. Replace card A3 also, still leaving new A6 installed.
    a. If malfunction is still present, reinstall both original cards and send computer to higher maintenance.
    b. If malfunction is corrected, proceed to step 3.
    Step 3. Reinstall original A6 back into computer, and check operation.
    a. If malfunction returns, both A3 and A6 were defective. Return computer to service after again installing replacement A6 card.
    b. If malfunction does not return, only card A3 was bad. Return computer to service.

24. COMPUTER UNIT FAILS ANY CONTINUITY TEST.
    Send computer unit to higher maintenance for any failure of continuity test.

Section IV. GENERAL MAINTENANCE

2-8. Scope. This section contains cleaning, inspection, painting, and repair instructions which are common to several repair procedures and are included here to avoid repetition. Special or additional instructions applicable to a repair procedure are given with the particular repair procedure. The general maintenance procedures are discussed in paragraphs 2-9 through 2-14. Refer to table 2-7 for a list of these procedures. General maintenance procedures for the computer test equipment are contained in TM 9-4931-360-14&P and TM 9-4931-361-14&P.

Table 2-7. General Maintenance Procedures List

2-9. General Cleaning Instructions.

WARNING

Drycleaning solvent is toxic and flammable. Use only in well ventilated areas and keep away from sparks or open flames. Avoid prolonged or repeated breathing of the vapors or contact with the skin.

The computer system components should be cleaned before touching up painted surfaces and before access covers are removed. Special attention to exterior surface cleanliness before removing access covers will prevent foreign material (dirt, grease, paint chips, or other) contamination. Specific cleaning instructions are as follows:

a. Machined Parts.

WARNING

Drycleaning solvent is toxic and flammable. Use this material in a well ventilated area only and keep away from sparks or open flames.

Remove dirt and other foreign material from metal surfaces by cleaning with a cloth or soft bristle brush soaked in drycleaning solvent (item 13, App. B). Remove any remaining foreign matter from recessed areas using stiff bristled brush or scraper.

b. Rubber, Vinyl and Plastic Parts. Clean rubber, vinyl, and plastic parts using a mild detergent and warm water solution.

NOTE

If temperature is below 32°F (0°C), use dry clean cloth to clean these parts.

c. Electrical Parts.

(1) *Electrical contacts.*

(*a*) Remove loose dirt, corrosion and other foreign matter from all parts with a stiff bristle brush and dry compressed air.

WARNING

Cleaning compound can cause skin rash and can give off - harmful vapors. To avoid injury, use in a well-ventilated area. Wash immediately with soap and water if compound gets on skin or clothing.

(*b*) Spray liberal amount of cleaning compound (freon, item 2, App. B) on surface to be cleaned.

(*c*) Wipe off surfaces with a soft lintless cloth or lens tissue (item 16, App. B).

(*d*) Apply a second coat of freon and allow to air dry.

(2) Other electrical parts.

WARNING

Drycleaning solvent is toxic and flammable. Use this material in a well ventilated area only and keep away from sparks or open flames. Avoid prolonged or repeated breathing of the vapors.

Remove loose dirt, corrosion and other foreign matter with a stiff bristle brush saturated in drycleaning solvent (item 13, App. B).

2-10. General Painting Procedure.

CAUTION

Optical elements and bearings, rubber, plastic and glass parts must be masked off or removed from the equipment to be painted. Care must be taken to prevent paint, primer, or. drycleaning solvent from contaminating the interior of assemblies exposed by the removal of parts. Use masking tape to ensure that no paint is applied to mating machined surfaces, bearing surfaces, performed packing grooves, bolt holes, countersinks, counterbores, and areas treated with solid film lubricant.

a. Remove blistered paint, rust or corrosion with a wire brush or coarse sandpaper.

b. Smooth surface and feather edges of affected areas with fine abrasive paper.

WARNING

Paint, primer, and drycleaning solvent are toxic and flammable. Use these materials in well ventilated areas only and keep them away from sparks or open flames. Avoid prolonged or repeated breathing of the vapors and contact with the skin.

c. Clean area to be painted with a wiping cloth dampened in drycleaning solvent (item 13, App. B).

d. Mask off area to be protected from paint.

NOTE

When painting with a brush, apply primer and paint as issued, and in accordance with instructions cited on the containers.

e. Apply primer coat (item 10, App. B) and let air dry for a minimum of 1/2 hour.

f. Apply one coat of black paint (item 4, App. B), olive drab (item 5, App. B), or white paint (item 6, App. B).

2-11. Inspection and Repair.

a. Inspection and Repair of Cast Parts and Machined Surfaces.

(1) Inspect cast parts for cracks or fractures. Inspect interiors for scores and burrs.

(2) Inspect machined surfaces for cracks, fractures, galling, pitting, scoring, or corrosion.

WARNING

Drycleaning solvent is toxic and flammable. Use this material in a well ventilated area only and keep away from sparks or open flames. Avoid prolonged or repeated breathing of the vapors.

(3) Remove minor scores and burrs from machined surfaces and interiors of cast parts with a fine stone or crocus cloth (item 3, App. B) that has been dipped in drycleaning solvent (item 13, App. B). Replace part if it is cracked, fractured, or excessively scored, worn or burred.

b. Inspection and Repair of Shafts and Splines.

(1) Inspect shafts for cracks, fractures, scores, and deformation. Remove minor nicks with a fine stone or crocus cloth (item 3, App. B). Replace shafts if they are cracked, fractured, scored, or deformed.

(2) Inspect splines for chipped areas, cracks, fractures, and deformation. Remove minor nicks with a fine stone or crocus cloth (item 3, App. B). Replace any splined parts if splines do not permit proper fit, or for any other defect.

c. Inspection and Repair of Threaded Parts.

(1) Inspect threaded parts for worn or damaged threads.

(2) Repair damaged threads by chasing with a tap or die.

(3) Inspect fit of repaired parts. Replace parts if fit is unsatisfactory.

d. Inspection of Snaprings. Replace snaprings if damaged; do not attempt repair.

2-12. Heat Shrink Sleeving. Perform the following procedure for heat shrinking:

a. Ensure that the items on which the heat shrinking material is to be applied are clean and free of sharp protrusions.

b. Place heat shrinking casing over material to be encased. Casing should be in firm contact with the material over which it is being applied.

c. Dress and shape the material being covered so that there is no pulling or straining once the casing is shrunk.

d. Heat shrink quickly at a high temperature. The method of heat application shall be selected by the cognizant maintenance personnel.

e. Ensure that the casing is uniformly and completely shrunk, and that the casing is free from cracks, splits, punctures, blisters, and burned areas.

2-13. Replacement of Cushioning Material.

WARNING

Rubber adhesive is flammable and toxic. Use this material in well ventilated area and keep away from open flames. Avoid prolonged exposure to adhesive fumes.

a. Scrape damaged cushioning material, cemented seals, or gaskets from area being repaired.

b. Remove paint from surfaces to be bonded.

WARNING

Drycleaning solvent is toxic and flammable. Use this material in a well ventilated area only and keep away from open flames. Avoid prolonged or repeated breathing of the vapors.

c. Remove oil, grease, moisture or other contaminants from mating surfaces using a clean soft cloth moistened with drycleaning solvent (item 13, App. B).

NOTE

Cementing should be accomplished at a minimum room temperature of 65 °F. Do not use tape to temporarily hold parts together during cementing operation.

d. Use a brush or other suitable applicator to apply a thin coat of adhesive (item 1, App. B) to mating surfaces of each part. Allow adhesive to set for about 15 minutes before joining parts.

2-14. Replacement of Pneumatic Components.

a. Removal (Fig 2-10).

(1) Remove valve cap from valve stem.

(2) Remove valve core.

(3) Remove valve stem and strap.

(4) Remove anti-seize tape from mounting hole and valve stem threads.

(5) Remove seal screw as necessary.

b. Installation (Fig 2-10).

(1) Wrap installation threads of valve stem with anti-seize tape (item 14, App. B). Exercise care not to get tape on filter.

(2) Position strap on valve stein end, as shown in figure 2-10, and install valve stem in mounting hole. Tighten to 20 lb-in (2.3 N•m).

(3) Install strap onto cap, using notched hole.

(4) Install valve core into valve stem. Be sure core is seated in stem.

(5) Install cap onto stem.

(6) Lubricate packing on seal screw with grease (item 8, App. B). Apply sealing compound (item 7, App. B) to threads of seal screw and install in housing tighten securely.

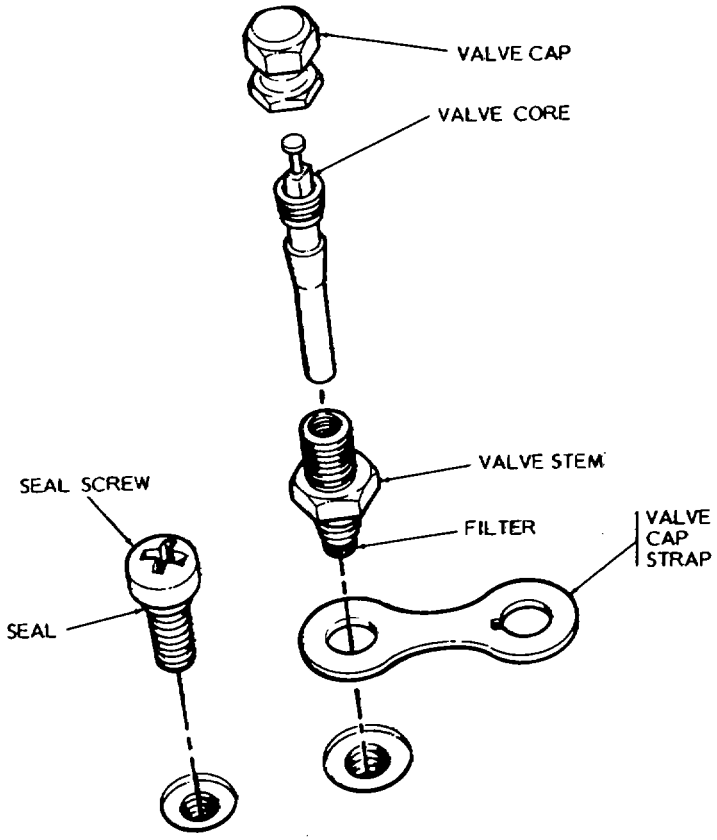

Figure 2-10. Replacement of pneumatic components

CHAPTER 3
REPAIR INSTRUCTIONS

Section I. GENERAL

3-1. Scope.

a. With the exception of the general cleaning, painting, inspection and repair instructions contained in chapter 2, this chapter contains the instructions for repairing all computer system components authorized to direct support and general support by the maintenance allocation chart (MAC). Repair instructions in this chapter are authorized at the direct and general support levels. Instructions that apply only to the general support level are so noted. Repair procedures for the computer system at organizational maintenance level, and the MAC chart, are contained in TM 9-2350-253-20-2.

b. This chapter contains references to or step-by-step procedures for removal, disassembly, inspection, cleaning, lubrication, and replacement/repair of components, as applicable. In the disassembly procedures provided, accomplish only those steps necessary to remove the parts determined to be faulty through visual inspection or troubleshooting. Test all repaired components using the procedures in chapter 2. A description of the component is provided in the application repair section.

3-2. Repair Instructions for Computer System Test Equipment. Repair procedures for the cable test set and the field test set, which are used for checkout and troubleshooting the computer system cables and components, are contained in TM 9-4931-360-14&P and TM 9-4931-361-14&P, respectively.

Section II. REPAIR OF GUNNER'S CONTROL UNIT

3-3. Description (Fig 3-1).

a. The gunner's control unit (GCU) is the device used to manually input data to the ballistics computer system. The GCU receives manual inputs from the control positions set by the gunner, electrical inputs from the computer unit, and primary power from the tank electrical system. The GCU outputs include ammo and mode select signals, range and range correction signals, filtered prime power for other system components, and displays self-test status. The GCU is made from a one-piece aluminum housing which includes the front panel. Controls on the front panel are divided into two sections. The upper section contains controls most frequently used. The lower section controls are less frequently used and are housed behind a hinged panel secured by twist-lock fasteners.

b. A pressure tight rear cover and gasket provide access for maintenance. Components mounted through the housing walls are installed with gaskets that seal the interior. A pneumatic valve and seal-screw installed through the housing wall enable the interior to be purged and pressurized with dry nitrogen gas. The interior of the housing contains electronic components and assemblies that function with the panel-mounted items. A printed wiring circuit board mounted within the. housing contains isolating diodes, integrated circuits, and other electronic components. An 85-pin connector enables the circuit board to be easily replaced if necessary. A wiring harness interconnects the controls, indicators, electronic components, and the circuit board and terminates in two multipin connectors, which, in turn, enable the gunner's control unit to be connected into the computer system.

3-4. POWER Circuit Breaker (S5) and Switch Guard.

a. Removal (Fig 3-2).

WARNING

Rear cover may be under pressure.

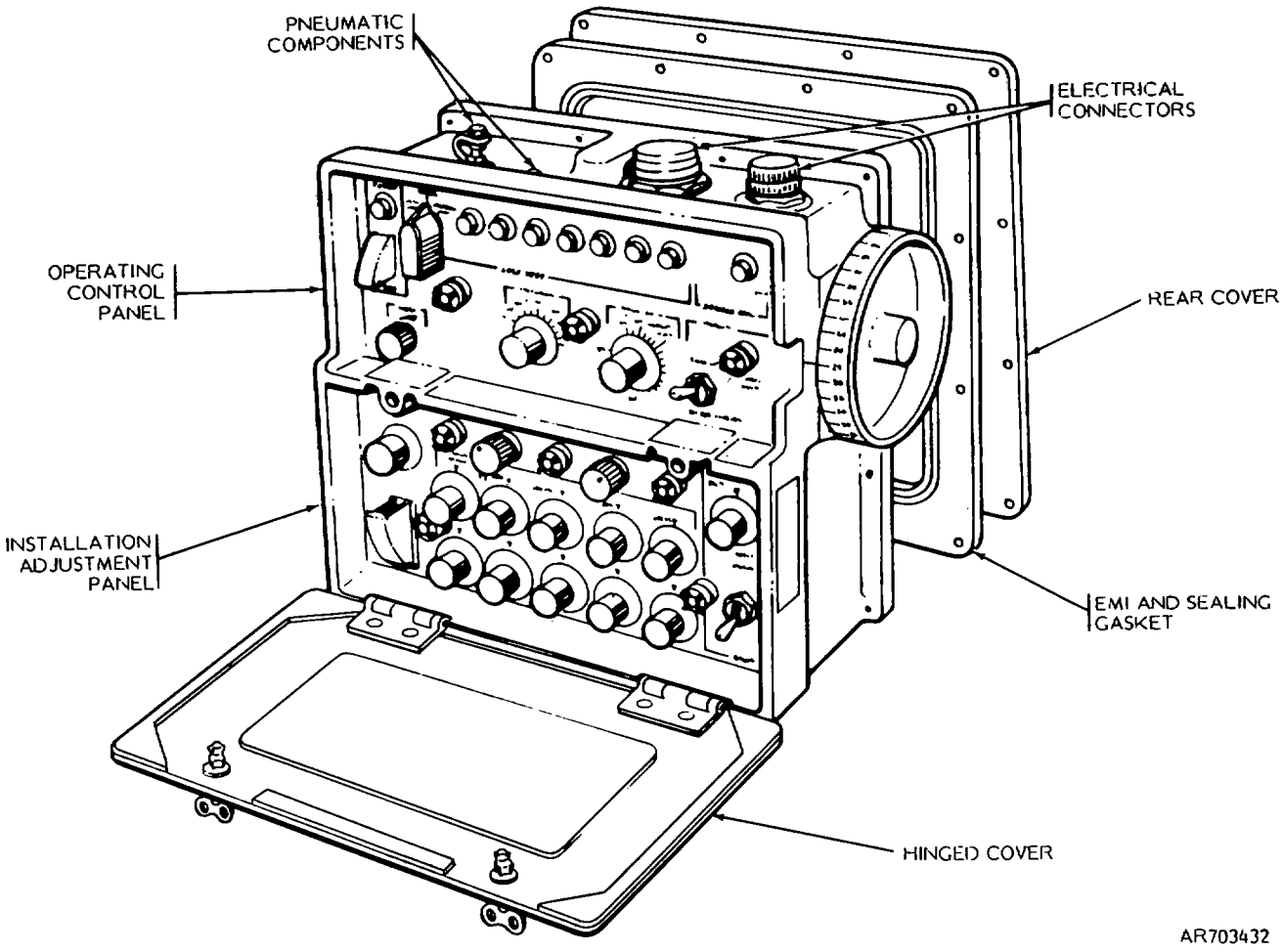

Figure 3-1. Gunner's control unit.

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Disconnect wires from back of circuit breaker.

(3) Remove nut, lockwasher, and switch guard from front panel; remove circuit breaker from housing.

(4) Remove retainers and washer from circuit breaker.

b. Installation (Fig 3-2).

(1) Remove and discard ON-OFF plate and tabbed washer supplied with replacement circuit breaker.

(2) Lubricate seal with grease (item 8, App. B).

(3) Insert circuit breaker through panel with seal against inside face of panel. Position circuit breaker so that keyway in threaded shank is upward.

(4) Secure circuit breaker with nut and lockwasher supplied. Tighten nut to 23-32 lb-in (2.6-3.6 N•m).

(5) Solder wires to terminals using lead alloy solder (item 12, App. B).

(6) Test to verify repair (para 2-4).

(7) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(8) Purge and pressurize unit (para 2-3).

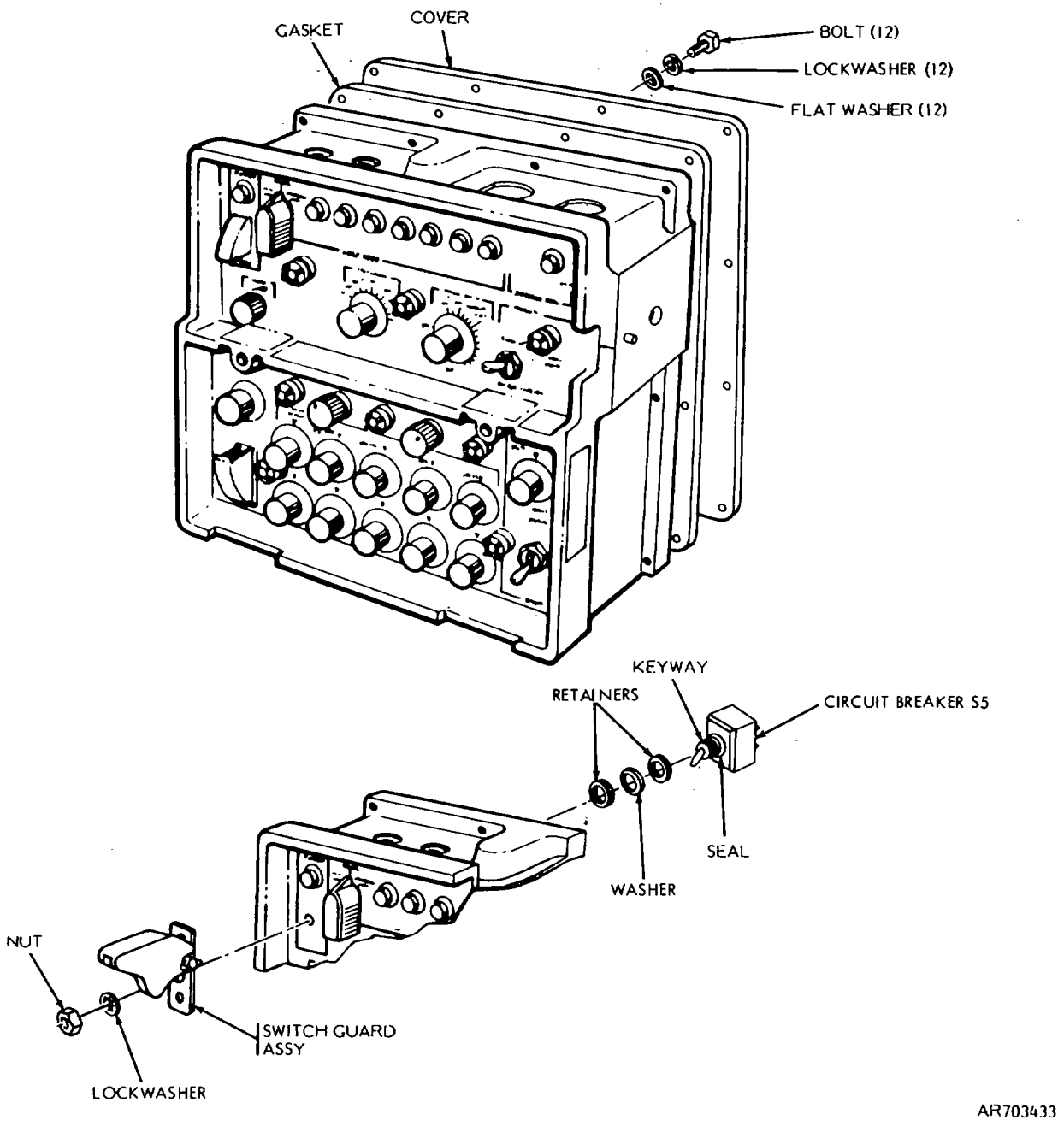

Figure 3-2. POWER circuit breaker (S5) and switch guard removal and installation.

3-5. POWER, SELF TEST, and SENSOR FAIL Indicator Lights. The procedures described in this paragraph are performed at GS level only.

a. Removal (Fig 3-3).

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) If necessary for access, remove EMI filter from housing (para 3-6). Do not remove electrical connections.

(3) Unscrew cap assembly and remove from front panel. Remove lamp from cap assembly.

(4) Remove sealing compound from terminals of indicator light body, exercising care not to damage wires.

(5) Remove lacing tape from wires.

(6) Tag and disconnect wires from terminals.

(7) Remove nut and lockwasher; remove indicator light with O-ring packing from front panel.

b. Installation (Fig 3-3).

(1) Lubricate O-ring packing with grease (item 8, App. B) and position on indicator light body.

(2) Insert indicator light through front panel.

(3) Position light so that terminals are in alinement with other lights.

(4) Secure light with lockwasher and nut supplied with light. Tighten nut to 7-9 lb-in. (0.791-1.017 N•m).

(5) Solder wires with lead alloy solder (item 12, App. B) to terminals according to tags. Remove tags from wires.

(6) Using lacing tape (item 15, App. B), tie wires down to indicator light body near terminal slots.

(7) Install cap assembly with lamp into indicator light.

(8) Test to verify repair (para 2-4).

(9) Sea] (pot) terminals of indicator light with sealing compound, (item 11, App. B).

(10) Lubricate cover gasket with grease (item 8, App. B).

(11) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(12) Purge and pressurize unit (para 2-3).

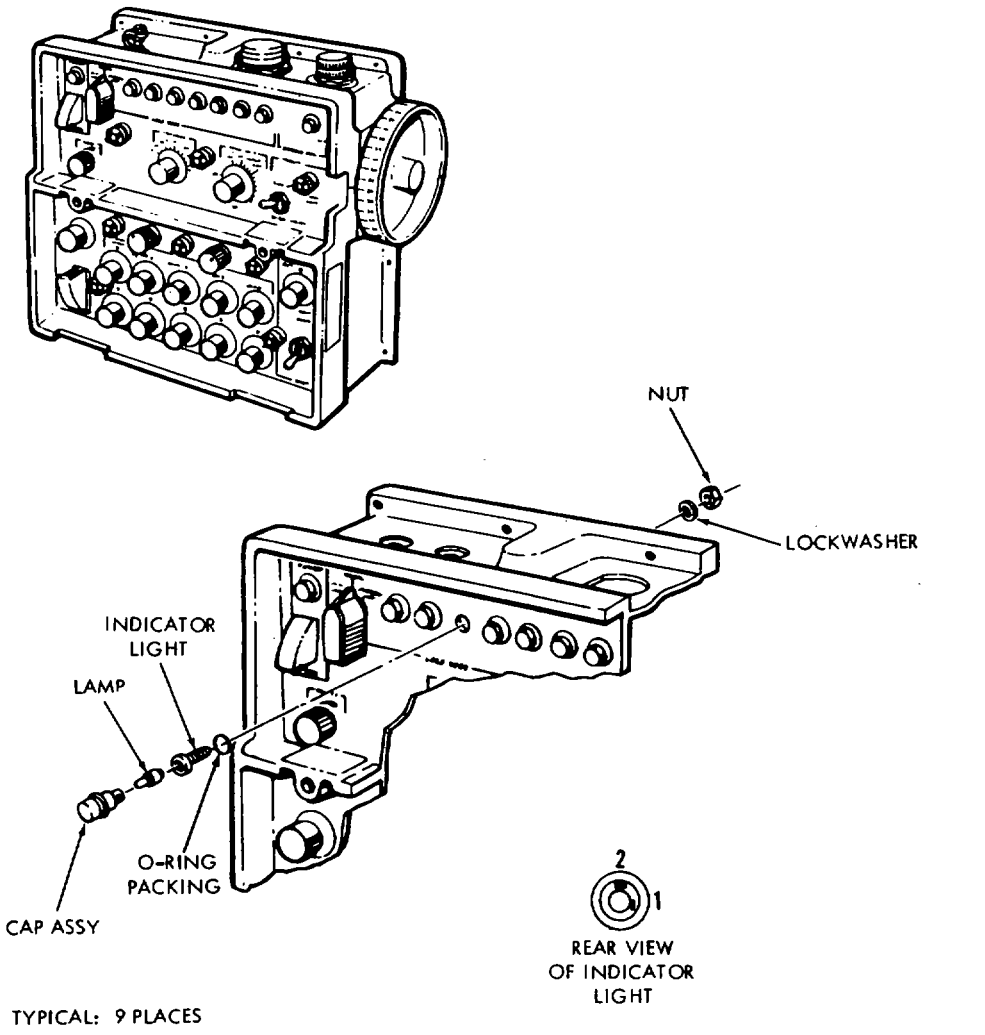

Figure 3-3. POWER, SELF TEST, and SENSOR FAIL indicator lights (XDS1 through XDS9) removal and installation.

3-6. Electromagnetic Interference (EMI) Filter. The procedures described in this paragraph are performed at GS level only.

a. Removal (Fig 3-4).

(1) Remove 12 bolts, lockwashers, and washers securing rear cover and gasket to housing.

(2) Remove and tag four electrical connections to EMI filter.

(3) Remove two screws, lockwashers, and clamp securing bracket to EMI filter.

(4) Remove two screws and lockwashers securing bracket to housing.

(5) Remove lockwire securing connector nut and remove nut. Remove filter from housing (lower bracket may have to be loosened in some housings).

b. Installation (Fig 3-4).

(1) Position EMI filter in housing. Secure loosely with connector nut.

(2) Position bracket to EMI filter and secure with two screws, lockwashers, and clamp.

(3) While holding filter in position, tighten connector nut. Then tighten two screws and lockwashers securing bracket to housing.

(4) Solder wires to terminals with lead alloy solder (item 12, App. B). Remove tags.

(5) Tighten connector nut to 140-150 lb-in. (15.8-16.9 N•m) and install lockwire (item 17, App. B).

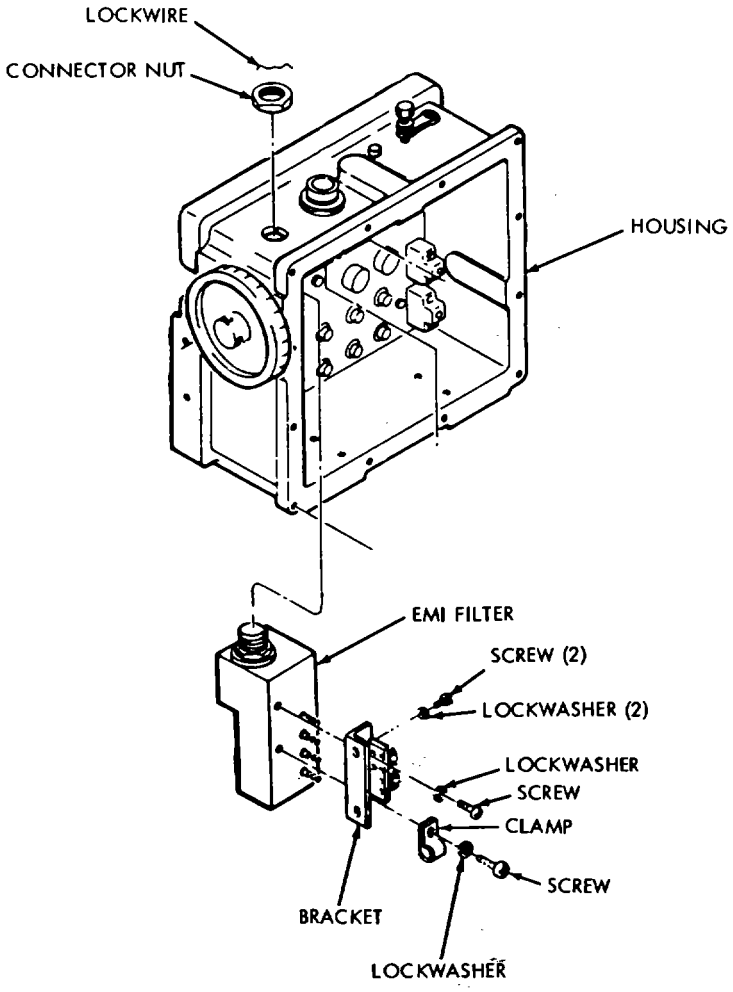

Figure 3-4. Electromagnetic interference (EMI) filter removal and installation.

3-7. Panel Lights (XDS10 through XDS17). The procedures described in this paragraph are performed at GS level only.

a. Removal (Fig 3-5).

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Remove sealing compound from terminals of panel light body, exercising care not to damage wires.

(3) Remove lacing tape from wires.

(4) Tag and disconnect wires from terminals.

(5) Remove nut and lockwasher and remove panel light with O-ring packing from front panel.

(6) Remove cap assembly with lamp from panel light. Remove O-ring from panel light.

b. Installation (Fig 3-5).

(1) Lubricate O-ring packing with grease (item 8, App. B) and position on indicator light body.

(2) Position indicator light through front panel so that terminals are next to wires.

(3) Secure light with lockwasher and nut supplied with light. Tighten nut to 7-9 lb-in. (0.791-1.017 N•m).

(4) Solder wires with lead alloy solder (item 12, App. B) to terminals according to tags and remove tags from wires.

(5) Using lacing tape (item 15, App. B), tie wire down to indicator light body near terminal slots.

(6) Install cap assembly with lamp into panel light.

(7) Test to verify repair (para 2-4).

(8) Sea] (pot) terminals of panel light with sealing compound (item 11, App. B).

(9) Lubricate cover gasket with grease (item 8, App. B).

(10) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(11) Purge and pressurize unit (para 2-3).

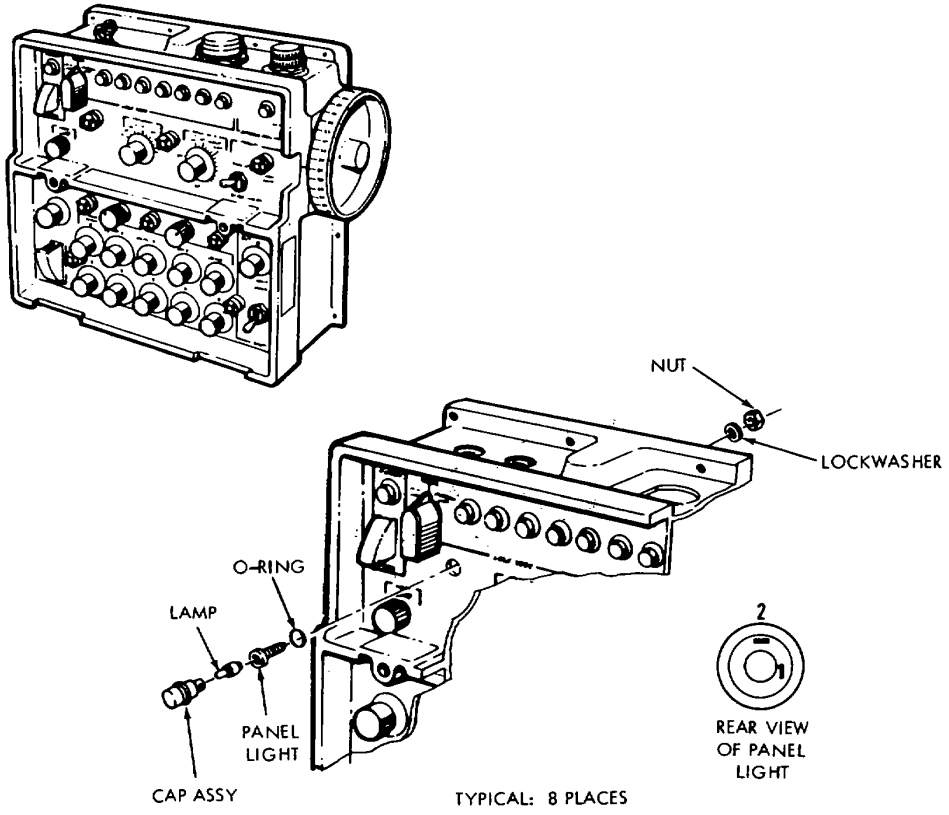

Figure 3-5. Panel lights (XDS10 through XDS17) removal and installation.

3-8. LIGHTS Control (R16).

a. Removal (Fig 3-6).

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Tag and disconnect wires from terminals of control.

(3) Loosen two setscrews and remove knob.

(4) Remove boot (seal nut) securing control to front panel; remove variable resistor along with flat washer from housing.

b. Installation (Fig 3-6).

(1) Solder piece of bus wire between terminals 1 and 2 of variable resistor.

NOTE

Two washers are preferred configuration. One washer may be used to ensure that a minimum of two threads are showing.

(2) Position flat washer(s) on variable resistor shaft and insert resistor into panel mounting hole. Be sure locating tab enters locating hole and a minimum of two threads show past the housing.

(3) Secure control with boot (seal nut). Tighten boot 10 to 15 lb-in. (1.1 to 1.7 N•m).

(4) Install knob on shaft and tighten setscrews.

(5) Solder wires with lead alloy solder (item 12, App. B) to terminals according to tags. Remove tags from wires.

(6) Test to verify repair (para 2-4).

(7) Lubricate cover gasket with grease (item 8, App. B).

(8) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(9) Purge and pressurize unit (para 2-3).

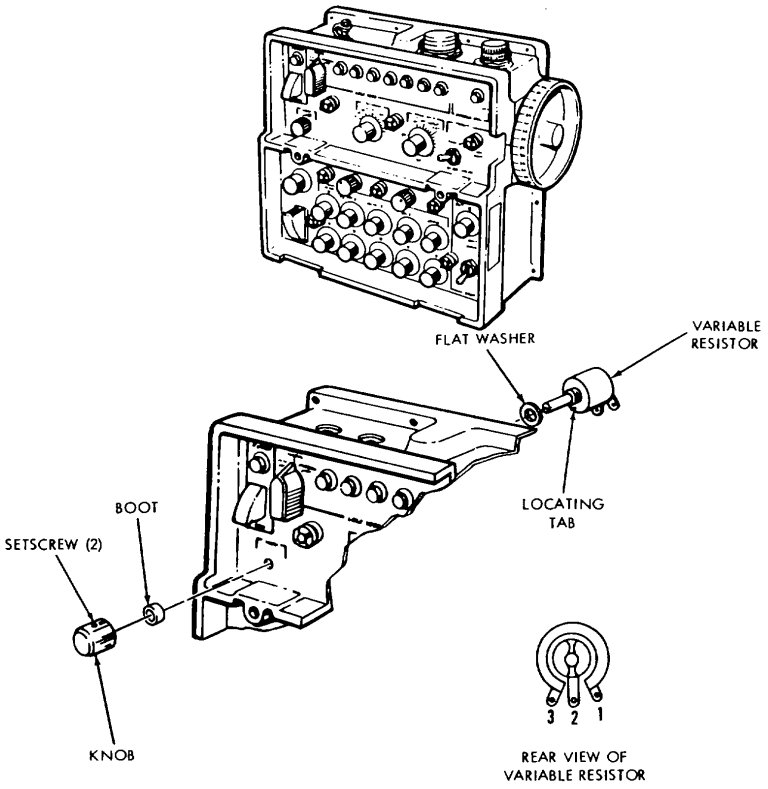

Figure 3-6. LIGHTS control (R16) removal and installation.

3-9. RANGEFINDER/MANUAL and CROSSWIND AUTO/MANUAL Switches.

NOTE

The following procedure describes replacement of RANGE-FINDER/ MANUAL switch S1. CROSSWIND AUTO/MANUAL switch S3 is replaced in a similar manner.

a. Removal (Fig 3-7).

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) For access to RANGEFINDER/-MANUAL switch, remove EMI filter (para 3-6).

(3) Tag and disconnect wires from back of switch.

(4) Remove nut and lockwasher securing switch to front panel; remove switch with packings and washer from housing.

b. Inspection.

(1) Inspect terminals attached to wires to be sure they are securely attached and wires are not broken.

(2) Replace terminals as necessary.

c. Installation (Fig 3-7).

(1) Remove installation hardware supplied with replacement switch. Discard locking ring (tabbed washer).

(2) Lubricate two packings with integral retainers with grease (item 8, App. B).

(3) Place one packing with retainer onto threaded shank of switch. Next, place flatwasher, and then second packing with retainer, onto shank.

(4) Insert switch with packings and washer into panel mounting hole. Position switch so that keyway in threaded shank is downward.

(5) Secure switch to pane] with nut and lockwasher supplied with switch. Tighten nut to 10-15 lb-in. (1.1-1.7 N•m).

(6) Attach wires to switch. Terminals according to tags. Remove tags from wires.

(7) Test to verify repair (para 2-4).

(8) Lubricate cover gasket with grease (item 8, App. B).

(9) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(10) Purge and pressurize unit (para 2-3).

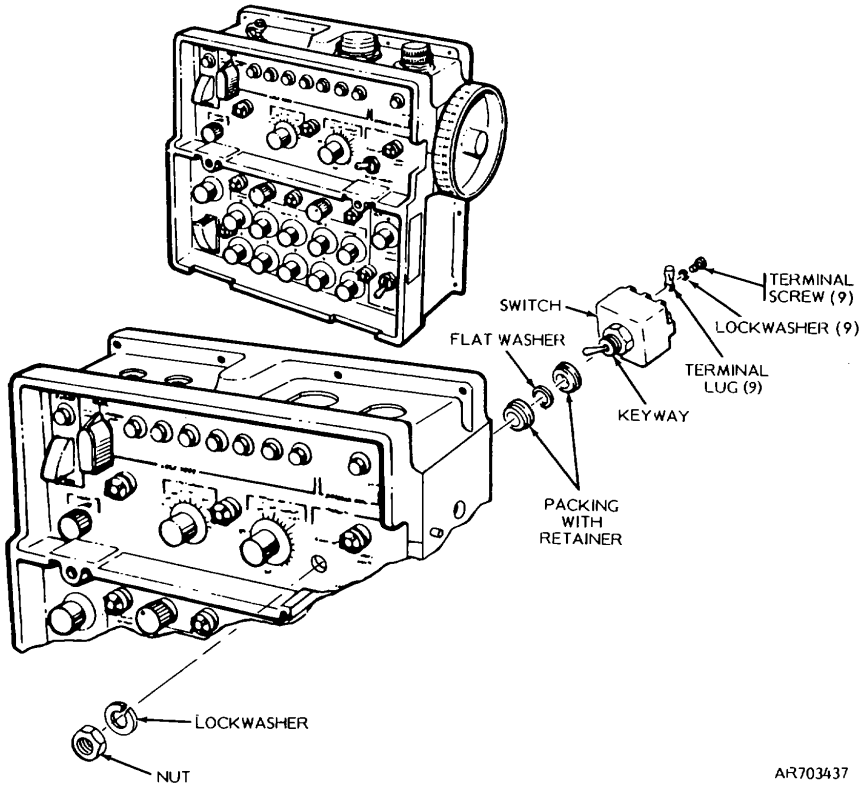

Figure 3-7. RANGEFINDER/MANUAL switch (S1) removal and installation.

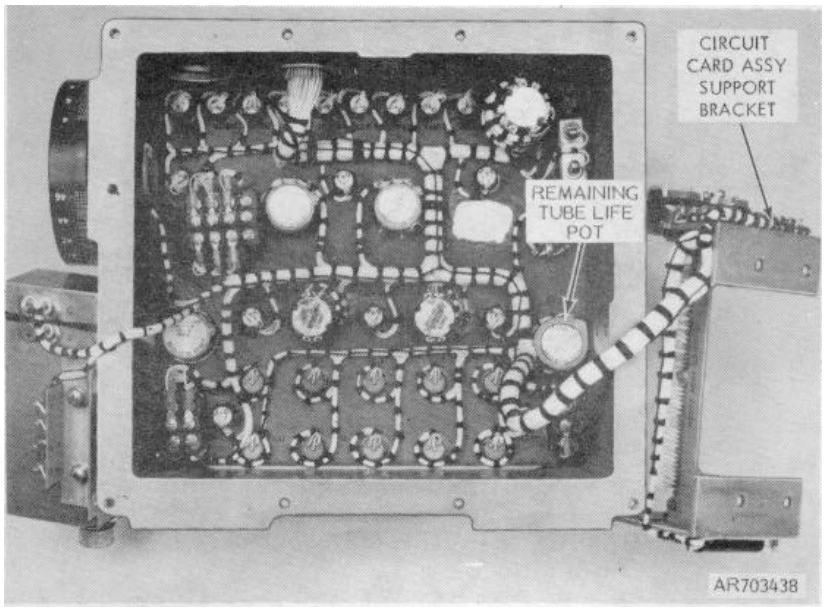

Figure 3-8. REMAINING TUBE LIFE control (R17) removal and installation (1 of 2).

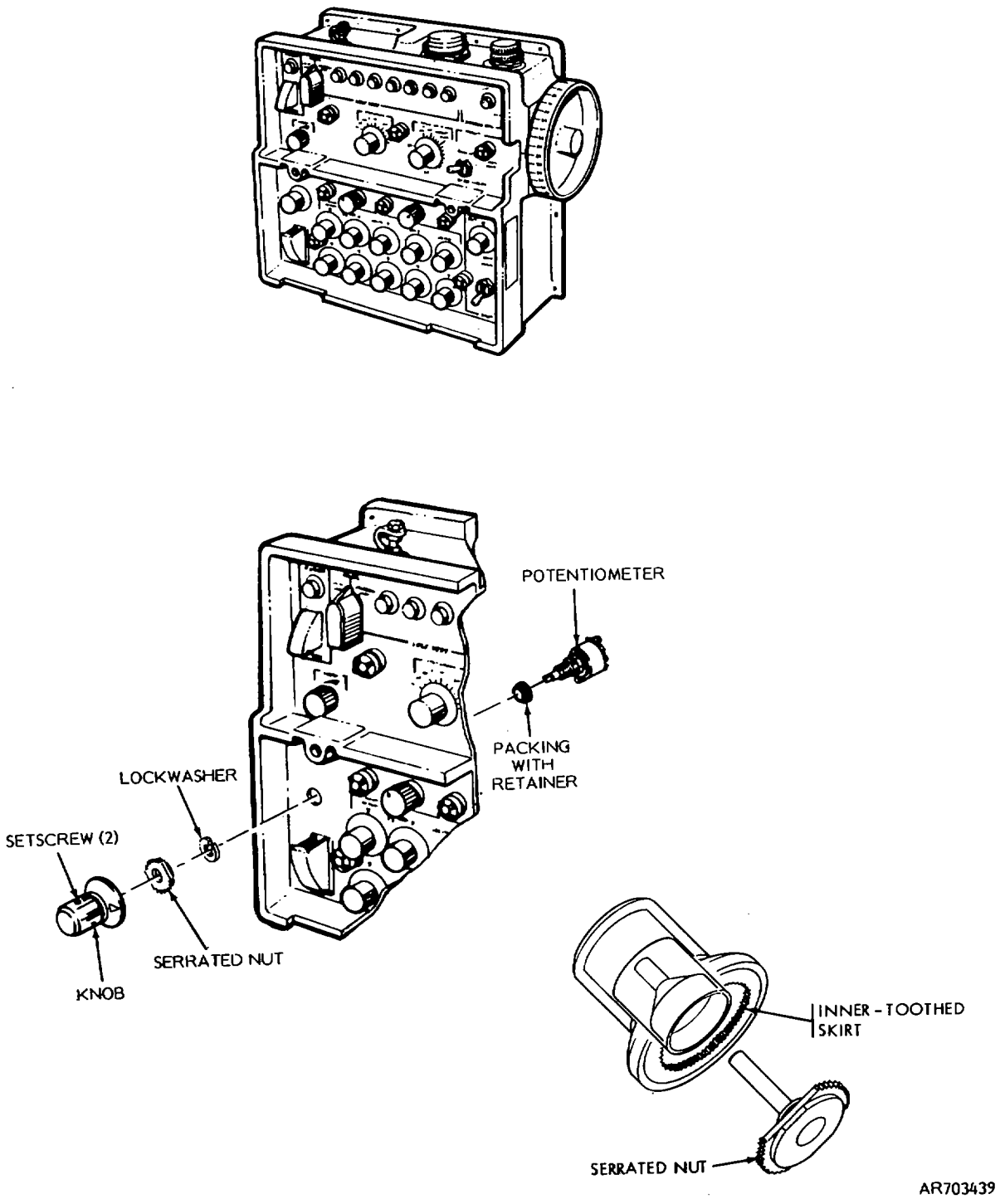

Figure 3-8. REMAINING TUBE LIFE control (R17) removal and installation (2 of 2).

3-10. REMAINING TUBE LIFE Control (R17). The procedures described in this paragraph are performed at GS level only.

a. Removal (Fig 3-8).

(1) Remove 12 bolts, lockwashers, and flatwashers, and remove rear cover and gasket.

(2) Remove four bolts and flat washers securing CCA support bracket to housing. Slide bracket aside to gain access to R17 control (remaining tube life potentiometer).

(3) Loosen two setscrews and remove knob.

(4) Remove serrated nut and lockwasher, remove potentiometer with packing from housing.

(5) Tag and disconnect wires from back of potentiometer.

b. Installation (Fig 3-8).

(1) Remove and discard installation hardware supplied with replacement potentiometer.

(2) Solder wires with lead alloy solder (item 12, App. B) to potentiometer terminals according to tags. Remove tags from wires.

(3) Lubricate packing with retainer with grease (item 8, App. B) and position packing on threaded shank of potentiometer.

(4) Insert potentiometer with packing into panel mounting hole. Position potentiometer so that terminals are adjacent to wires.

(5) Secure potentiometer to panel with lockwasher and serrated nut. Tighten nut to 15-18 lb-in. (1.7-2.0 N•m).

(6) Set up gunner's control unit for bench test (para 2-4).

(7) Perform test 22 of GCU test (table 2-3), using screwdriver in slot on shaft end to adjust potentiometer.

(8) Adjust potentiometer so that FTS CONTINUITY TEST meter indicates +80.

(9) Install knob on potentiometer so that 0 mark on skirt is at index mark. Push knob onto shaft until inner toothed skirt is fully engaged with teeth of serrated nut: tighten two setscrews to secure knob between .006 and .045 inch from GCU front surface. Exercise care not to disturb setting of potentiometer.

(10) Repeat step 22 of GCU test (table 2-3) to verify installation. Loosen setscrews and adjust position of knob as necessary.

(11) Remove GCU from test bench setup (para 2-4).

(12) Position CCA support bracket to housing and secure with four bolts and flat washers.

(13) Lubricate cover gasket with grease (item 8, App. B).

(14) Attach rear cover and gasket with 12 bolts, lockwashers and flat washers. Tighten bolts to 23-32, lb-in. (2.6-3.6 N•m).

(15) Purge and pressurize unit (para 2-3).

3-11. NORMAL/BORESIGHT Switch (S4).

a. Removal (Fig 3-9).

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Remove four screws and flatwashers securing CCA support bracket to housing. Slide bracket aside to gain access to switch S4.

(3) Tag and disconnect terminals from back of switch.

(4) Remove nut and lockwasher securing switch to front panel; remove switch guard from front panel. Remove switch with packings and washer from housing.

b. Inspection.

(1) Inspect terminals attached to wires to be sure they are securely attached and wires are not broken.

(2) Replace terminals as necessary.

c. Installation (Fig 3-9).

(1) Remove installation hardware supplied with replacement switch. Discard locking ring (tabbed washer).

(2) Lubricate two packings with integral retainers with grease (item 8, App. B).

(3) Place one packing with retainer onto threaded shank of switch. Next, place flat washer and then second packing with retainer onto shank.

(4) Insert switch with packings and washer into panel mounting hole. Position switch so that keyway in threaded shank is downward.

(5) Place mounting plate of switch guard over protrusion of threaded shank of switch on front panel. Position guard so cover opens downward.

switch on front panel. Position guard so cover opens downward.

(6) Secure switch and switch guard with nut and lockwasher supplied with switch. Tighten nut to 23-32 lb-in. (2.6-3.6 N•m).

(7) Attach terminals to switch terminals according to tags; remove tags from terminals.

(8) Position CCA support bracket to housing and secure with four screws and flat washers.

(9) Test to verify repair (para 2-4).

(10) Lubricate cover gasket with grease (item 8, App. B).

(11) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(12) Purge and pressurize unit (para 2-3). Be sure there are no leaks around replaced component.

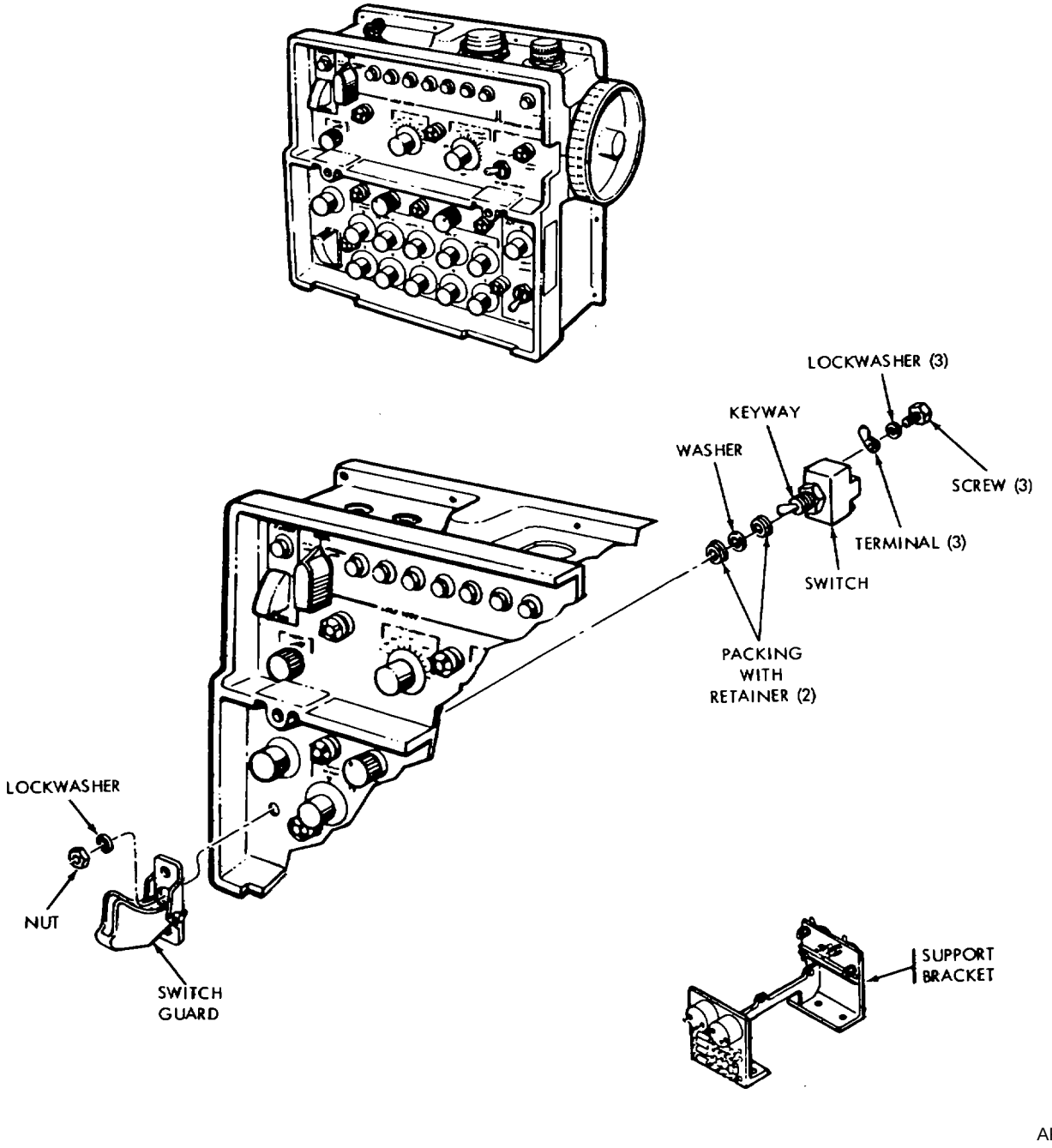

Figure 3-9. NORMAL/BORESIGHT switch removal and installation.

3-12. AIR TEMP, ALTITUDE, or CROSSWIND Control Knobs.

a. Removal (fig 3-10). Loosen two setscrews and remove knob.

b. Installation of AIR TEMP Control Knob (fig 3-10).

(1) Set up gunner's control unit for bench test (fig 2-3).

(2) Set POWER switch on FTS to OFF.

(3) Set UNIT SELECT switch on FTS to GCU.

(4) Set POTENTIOMETER TEST switch on FTS to AIR TEMP.

(5) Set POWER switch on GCU to ON.

(6) Adjust AIR TEMP control on GCU so that FTS CONTINUITY TEST meter indicates +20.

(7) Install knob on control so that index mark on skirt points to +100. Push knob onto shaft until inner-toothed skirt is fully engaged with teeth of serrated nut; tighten two setscrews to secure knob between .006 and .045 inch from GCU front surface. Exercise care not to disturb settings of control.

(8) Adjust AIR TEMP control on GCU until index pointer on knob is at -40. FTS CONTINUITY TEST meter indicates +80 + 2.5.

(9) Adjust AIR TEMP control to S and remove GCU from test bench setup.

c. Installation of ALTITUDE Control Knob (fig 3-10).

(1) Set up gunner's control unit for bench test (fig 2-3).

(2) Set POWER switch on FTS to OFF.

(3) Set UNIT SELECT switch on FTS to GCU.

(4) Set POTENTIOMETER TEST switch on FTS to ALT.

(5) Set POWER switch on GCU to ON.

(6) Adjust ALTITUDE control on GCU so that FTS CONTINUITY TEST meter indicates +60.

(7) Install knob on control so that index mark on skirt points to 10. Push knob onto shaft until inner-toothed skirt is fully engaged with teeth of serrated nut; tighten two setscrews to secure knob between .006 and .045 inch from surface. Exercise care not to disturb setting of control.

(8) Adjust ALTITUDE control on GCU until index pointer on knob is at 25. FTS CONTINUITY TEST meter indicates +20 ±2.5.

(9) Adjust ALTITUDE control to 0 and remove GCU from test bench setup.

d. Installation of CROSSWIND Control Knob (fig 3-10).

(1) Set up gunner's control unit for bench test (fig 2-3).

(2) Set POWER switch on FTS to OFF.

(3) Set UNIT SELECT switch on FTS to GCU.

(4) Set POTENTIOMETER TEST switch on FTS to CROSSWIND.

(5) Set POWER switch on GCU to ON.

(6) Adjust CROSSWIND control on GCU so that FTS CONTINUITY TEST meter indicates 0.

(7) Install. knob on control so that index mark on skirt points to 0. Push knob onto shaft until inner-toothed skirt is fully engaged with teeth of serrated nut; tighten two setscrews to secure knob between .006 and .045 inch from GCU front surface. Exercise care not to disturb setting of control.

(8) Adjust CROSS WIND control on GCU until index pointer is at 30 LEFT. FTS CONTINUITY TEST meter indicates -60 ±2.5.

(9) Adjust CROSSWIND control to 0 and remove GCU from test bench setup.

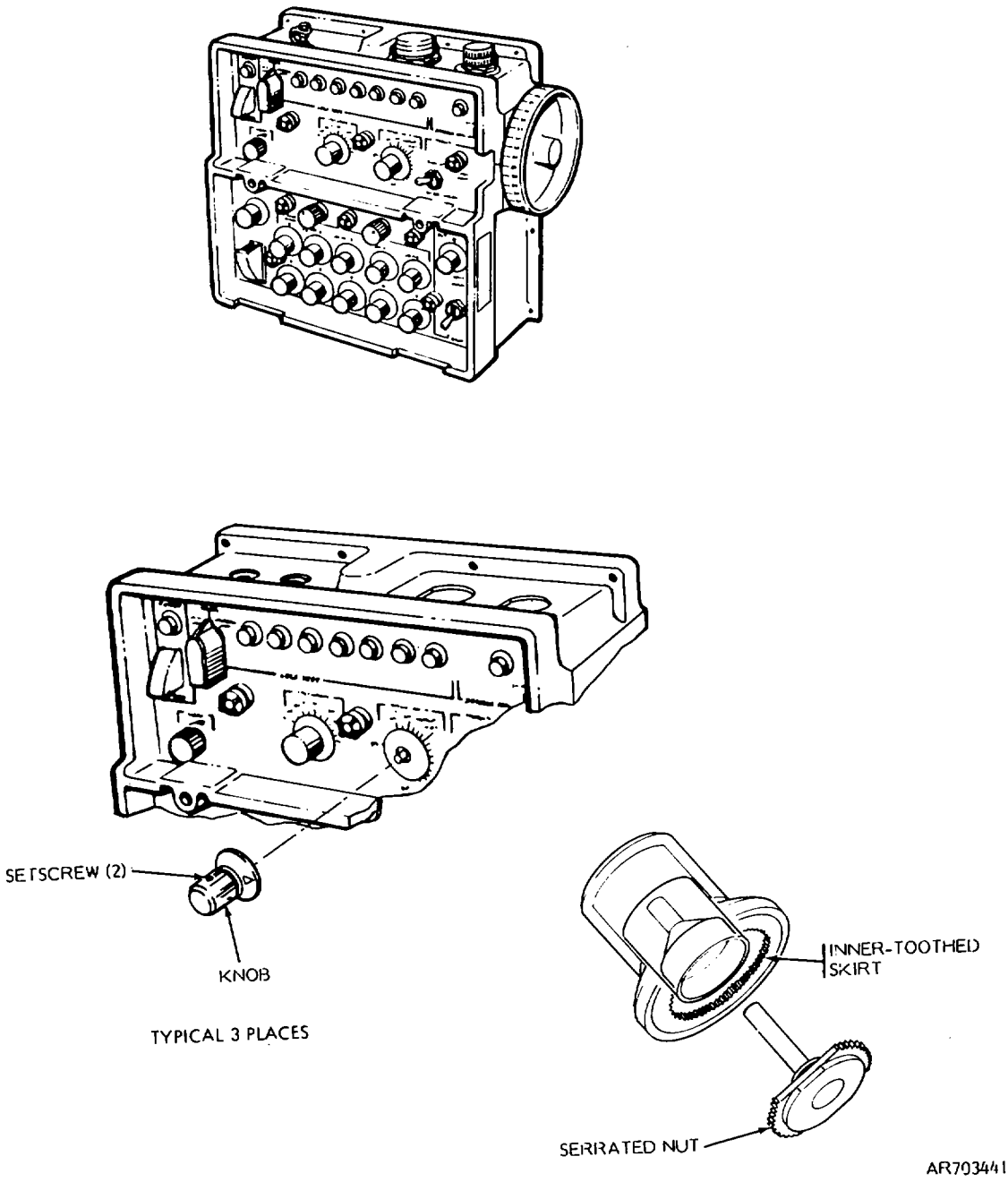

Figure 3-10. AIR TEMP, ALTITUDE, or CROSSWIND control knobs removal and installation.

3-13. Ammo Selector Rotary Switch (APDS or HEAT).

a. Removal (Fig 3-11).

(1) Remove 12 screws, lockwashers, and flat washer securing rear cover and gasket of the GCU.

(2) Loosen setscrews on ammo selector switch knob and remove knob.

(3) Unsolder and tag all connecting wires to ammo selector switch and disconnect wires.

(4) Remove retainer nut and lockwasher; pull ammo selector switch assembly out from GCU panel.

b. Installation (Fig 3-11).

(1) Lubricate packing with retainer with grease (item 8, App. B) and position on switch shaft.

(2) Insert ammo selector switch assembly into GCU panel.

(3) Solder wires with lead alloy solder (item 12, App. B) to terminals on ammo selector switch.

(4) Position lockwasher on switch shaft and install retainer nut. Tighten nut to 10-15 lb-in. (1.1-1.7 N•m).

(5) Install ammo selector knob on shaft of switch and tighten knob setscrews.

(6) Lubricate cover gasket with grease (item 8, App. B).

(7) Install rear cover and gasket; tighten 12 screws, lockwashers, and flat washers.

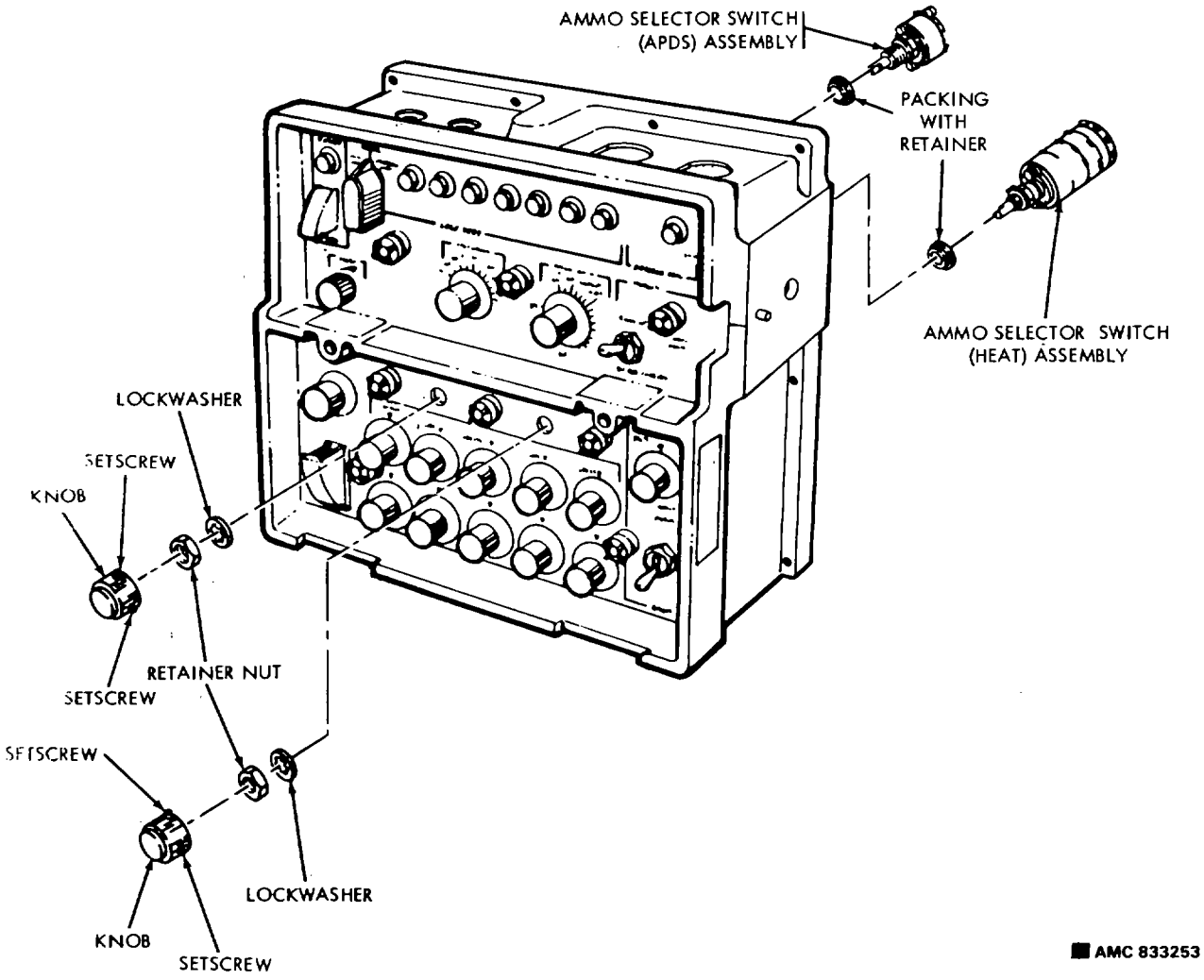

Figure 3-11. Ammo selector rotary switch (APDS or HEAT).

3-14. Circuit Card Assembly (A1).

a. Removal.

(1) Remove 12 bolts, lockwashers, and flat washers, and remove rear cover and gasket (fig 3-12).

(2) Remove circuit card assembly carefully from support bracket (fig 3-13).

b. Installation.

(1) Position circuit card assembly in guides of support bracket.

(2) Check to be sure card assembly is properly alined with support bracket and install to full depth.

(3) Test to verify repair (para 2-4).

(4) Lubricate cover gasket with grease (item 8, App. B).

(5) Attach rear cover and gasket with 12 bolts, lockwashers, and flat washers (fig 3-12). Tighten bolts to 23-32 lb-in. (2.6-3.6 N•m).

(6) Purge and pressurize unit (para 2-3).

3-15. Repair of Gunner's Control Unit Housing.

a. General. The gunner's control unit housing is repaired by replacing components as shown in figure 3-12.

b. Pneumatic Components. Refer to paragraph 2-14 for details of replacing pneumatic components.

3-16. Common ZERO or ZEROING, AZ or EL, Controls. The procedures described in this paragraph are performed at GS level only.

a. Removal.

(1) Loosen two setscrews (fig 3-14) securing knob to control shaft and remove knob.

(2) Remove 12 screws and washers securing rear cover to housing and remove cover and gasket (fig 3-12).

(3) Locate circuit card support bracket (fig 3-13). If necessary to remove bracket to reach control, pull out circuit card in direction shown by arrow. Remove four bolts and washers securing bracket to housing, and remove bracket.

(4) Carefully remove and tag wires from control (potentiometer).

(5) Note position of control terminals relative to housing. New control must be installed in same relative position.

(6) While holding potentiometer (fig 3-14) from rear, remove nut and lockwasher securing potentiometer to case and remove potentiometer.

b. Installation.

(1) Lubricate packing with integral retainer with grease (item 8, App. B). Position packing on potentiometer shaft.

(2) Position potentiometer in housing with terminals positioned like former installation.

(3) Position lockwasher on shaft and secure control with serrated nut. Torque nut to 15-18 lb-in. (1.7 - 2.0 N•m).

(4) Remove tags from wires and solder appropriate wire with lead alloy solder (item 12, App. B) to proper terminal of control.

(5) If circuit card support bracket (fig 3-13) was removed, reinstall bracket in housing with four bolts and washers. Install circuit card in bracket.

(6) Perform GCU checkout. When steps occur for control checkout, turn control shaft for a 0 indication on meter. Install knob such that 0 is indexed and repeat checkout steps. Meter should indicate full scale right when specified in the checkout procedure.

(7) Lubricate cover gasket with grease (item 8, App. B).

(8) If repair is correct, position cover and gasket to housing and secure with 12 screws and lockwashers (fig 3-12).

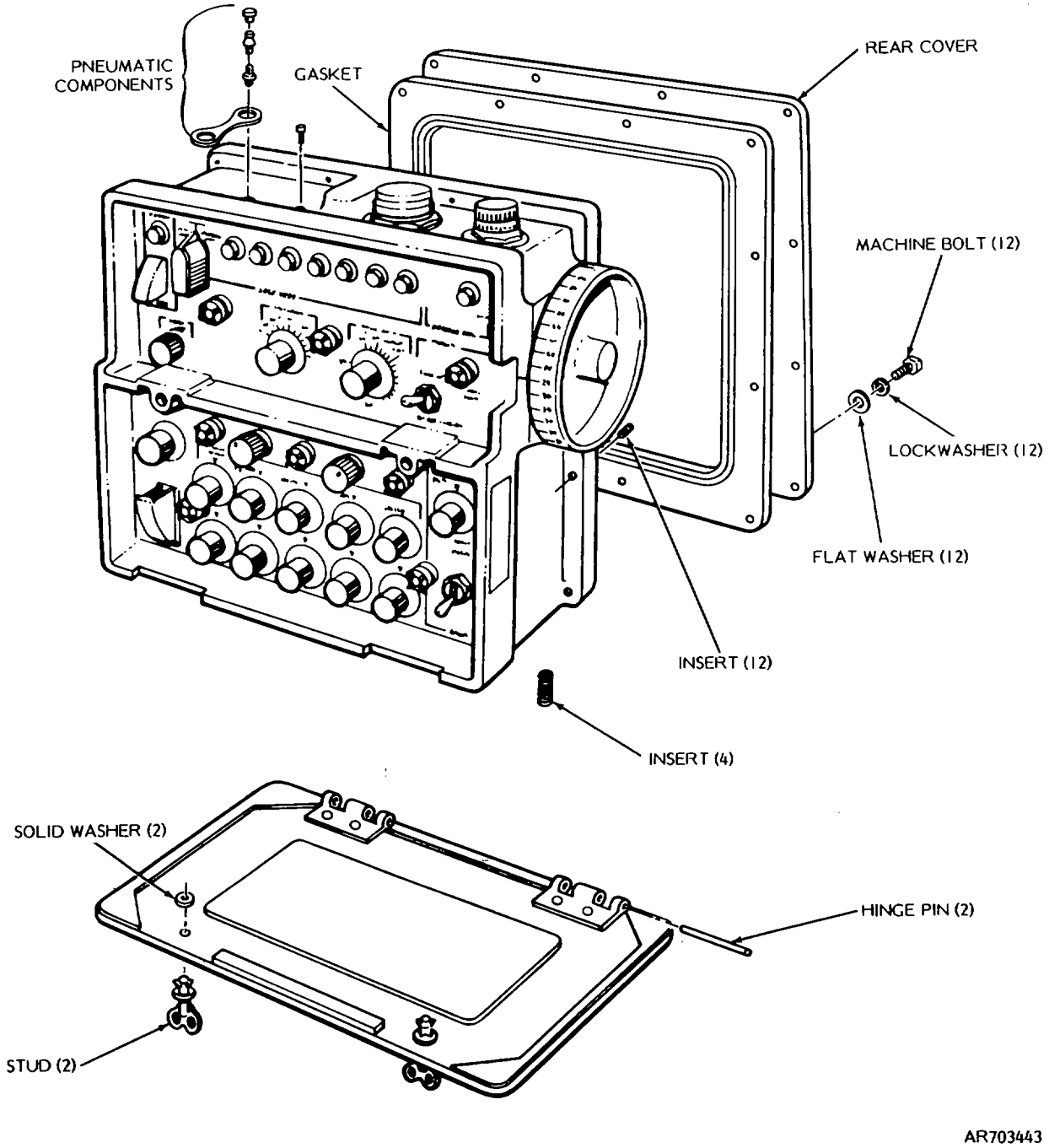

Figure 3-12. Repair of gunner's control unit housing.

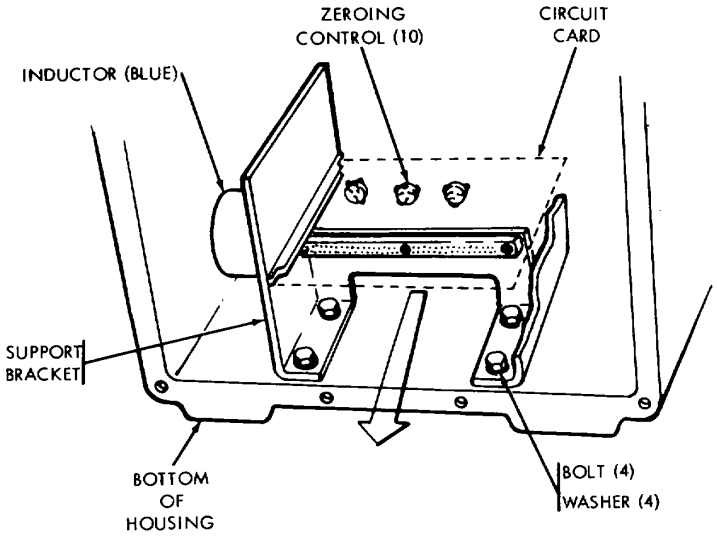

Figure 3-13. Circuit card assembly removal and installation.

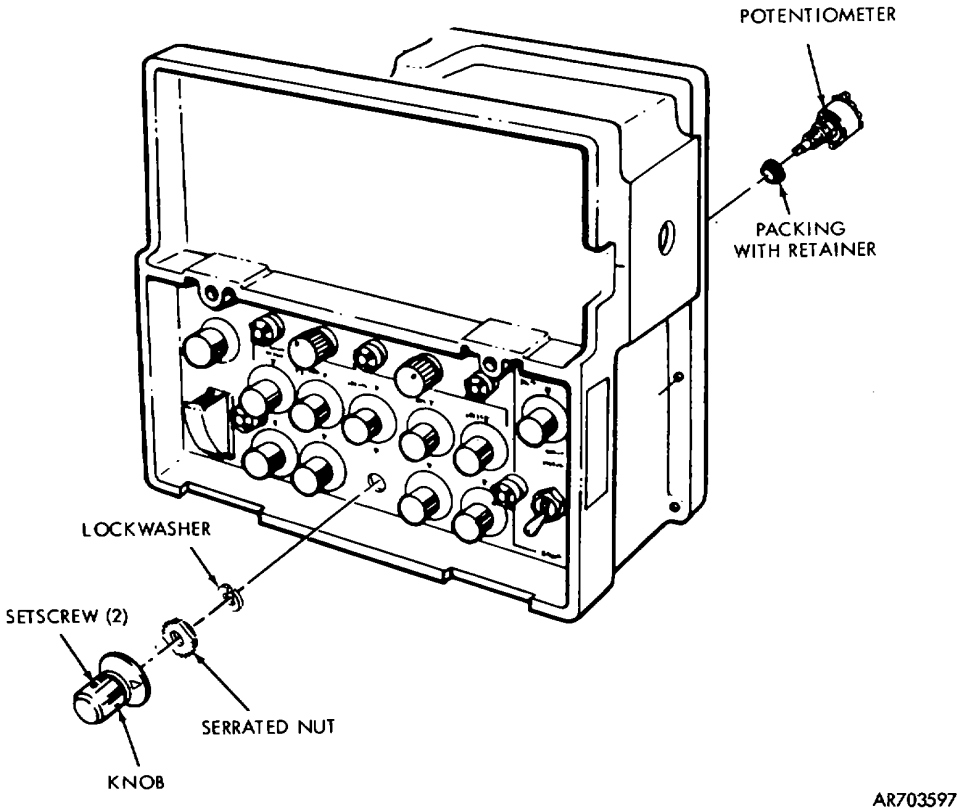

Figure 3-14. ZEROING control removal.

3-16.1 Meters X100 Range Dial Adjustment (Fig. 3-14.1).

CAUTION

Do not adjust collet (late model) dial on gunner's control unit. Damage to dial, could result. Adjust only the dial that has set screws (early model).

a. Connect field test set to GCU (para 2-4).
b. Set FTS POWER switch to ON.
c. Set GCU POWER switch to ON.
d. Set GCU RANGEFINDER/MANUAL switch to MANUAL position.

NOTE

Before removing set screws (early model) securing dial to shaft, apply toluene (Appendix B, Item 13.1) to soften sealing compound on screws. Let set 15 minutes then remove set screws.

e. If FTS continuity meter does not indicate + 7.5 ± 2.5, loosen two set screws (early model) securing dial to shaft.
f. While holding dial on 4, use screwdriver and rotate shaft until continuity meter indicates + 7.5 ± 2.5.
g. While holding dial on 4, tighten two set screws.
h. Perform GCU checkout test 21 (Table 2-3), repeat steps d through g as required to adjust dial. After adjustment is completed, apply sealing compound (Item 7, App. B) to set screws.

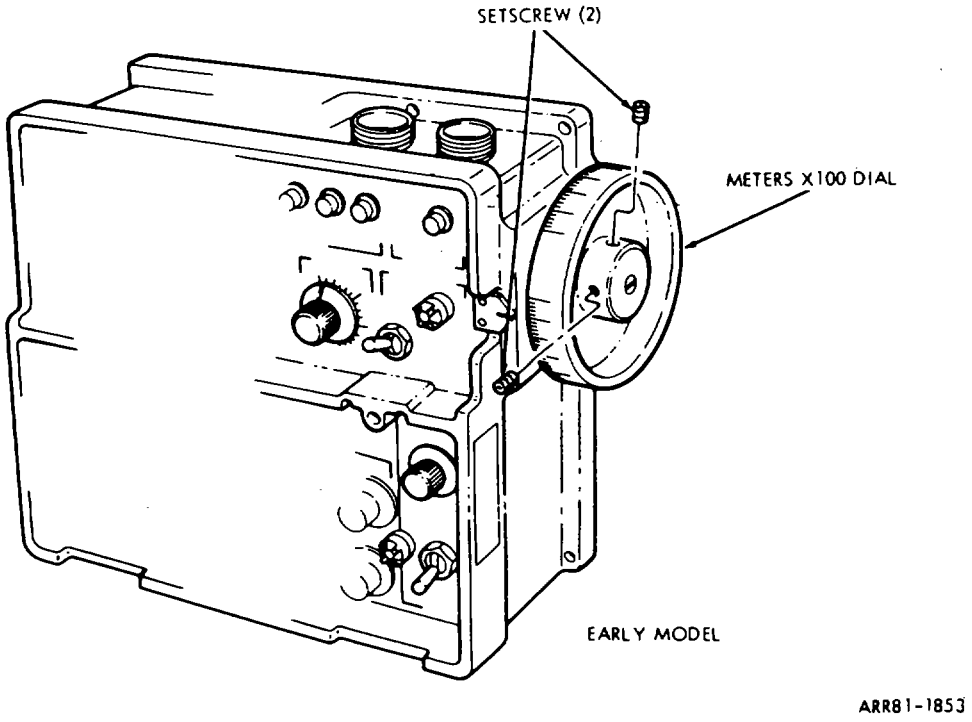

Figure 3-14.1. Securing Meter X100 Dial.

Section III. REPAIR OF AMMO SELECT UNIT

3-17. Description (Fig 3-15).

a. The commander's and gunner's stations each has an ammo select unit (ASU) which is used to select the ballistics computer corrections for ammunition type and vehicle motion. The front panel of the ammo select units contains four color-coded pushbutton switch-indicators and two firing-tank mode indicators. A toggle switch mounted on the bottom panel operates in conjunction with the other ammo select unit to select the moving or stationary vehicle mode. The last selection is indicated on the firing tank mode indicators. A variable resistor mounted on the top of the unit controls the brightness of all indicators.

b. Tank MOVING mode causes the computer solution to bypass the cant angle sensor, while tank STATIONARY mode provides tank cant corrections. In a tank, the two ASU's are interconnected in such a way that the computer is in STATIONARY mode if both toggle switches are in the same position, and in MOVING mode if they are in opposite positions. Operating either switch, one at a time, will change the computer mode.

c. The test setup checks an ASU individually. Setting switch toward front causes MOVING to light, and setting switch to rear causes STATIONARY to light.

d. The unit is made from a machined aluminum alloy casting. A rear cover and gasket provide access to internal components, radio frequency interference shielding, and pressure sealing. Components mounted through the housing walls are installed with gaskets that seal the interior. A pneumatic valve and seal screw installed through the housing enable the interior to be purged and pressurized with dry nitrogen gas. A terminal board attached to the back panel supports current-limiting resistors for the indicator section of the switch indicators. A wiring harness interconnects the controls and indicators and terminates in a multipin connector which enables the ammo select unit to be connected into the computer system.

3-18. APDS, HEAT, HEP/WP, and FSDS Switches. The procedures described in this paragraph are performed at GS level only.

NOTE

The four switches are replaced in the same manner.

a. Removal (Fig 3-15 and 3-16).

(1) Remove four bolts, lockwashers, and flat washers, and separate rear cover and gasket from unit, as shown in figure 3-15.

(2) Remove sealing compound from terminals of switch (fig 3-16), exercising care not to damage wires.

(3) Tag and disconnect wires from terminals.

(4) Unscrew seal from switch.

(5) Remove lens assembly by pulling straight outward.

(6) Remove adapter nut from switch; remove switch with rubber washer from housing.

(7) Remove lamp from lens assembly and retain for use in replacement switch.

b. Installation (Fig 3-15 and 3-16).

(1) Remove sealing compound from mounting hole and surrounding area; use wooden spatula or similar soft, dull tool so metal surface is not abraded.

(2) Coat threads of switch (fig 3-16) with sealing compound (item 7, App. B).

(3) Insert switch with rubber washer through front panel. Be sure locating pin enters positioning hole.

(4) Secure switch to front panel with adapter nut. Tighten nut to 15-20 lb-in. (1.7-2.3 N•m).

(5) Install lamp into lens assembly.

(6) Install lens assembly onto switch by alining keying tab on lens with slot on switch and pushing lens inward.

(7) Install seal onto switch. Tighten seal until there is no gap between seal and panel face.

(8) Solder wires with lead alloy solder (item 12, App. B) to terminals according to tags; remove tags from wires.

(9) Test to verify repair (para 2-4).

(10) Seal terminals of switch with insulating compound (item 9, App. B).

(11) Lubricate cover gasket with grease (item 8, App. B).

CAUTION

Exercise care not to pinch wires between rear cover and housing.

(12) Attach rear cover and gasket (fig 3-15) with four bolts, lockwashers, and flat washers. Tighten bolts to 23-30 lb-in. (2.6-3.4 N•m).

(13) Purge and pressurize unit (para 2-3).

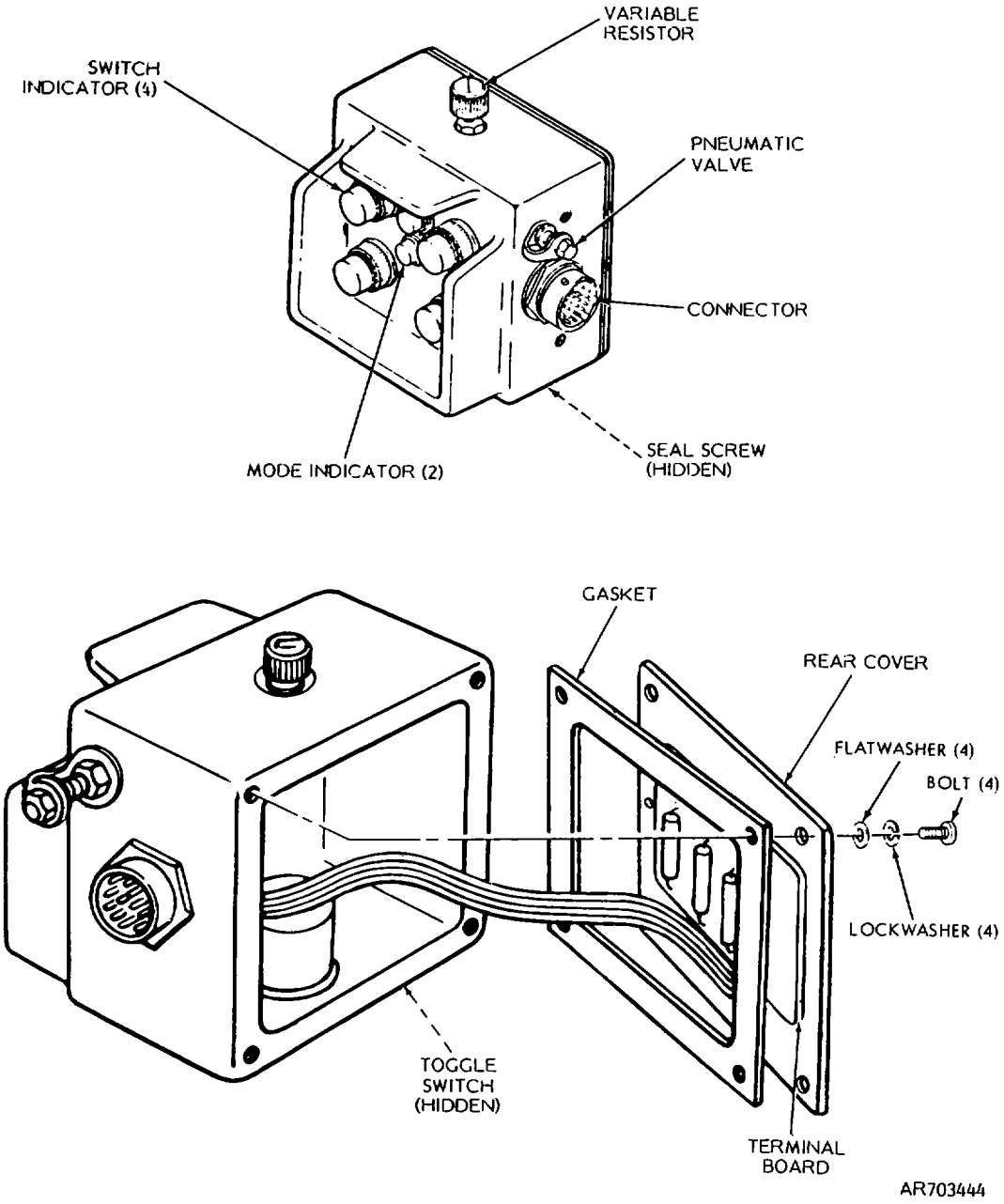

Figure 3-15. Ammo select unit.

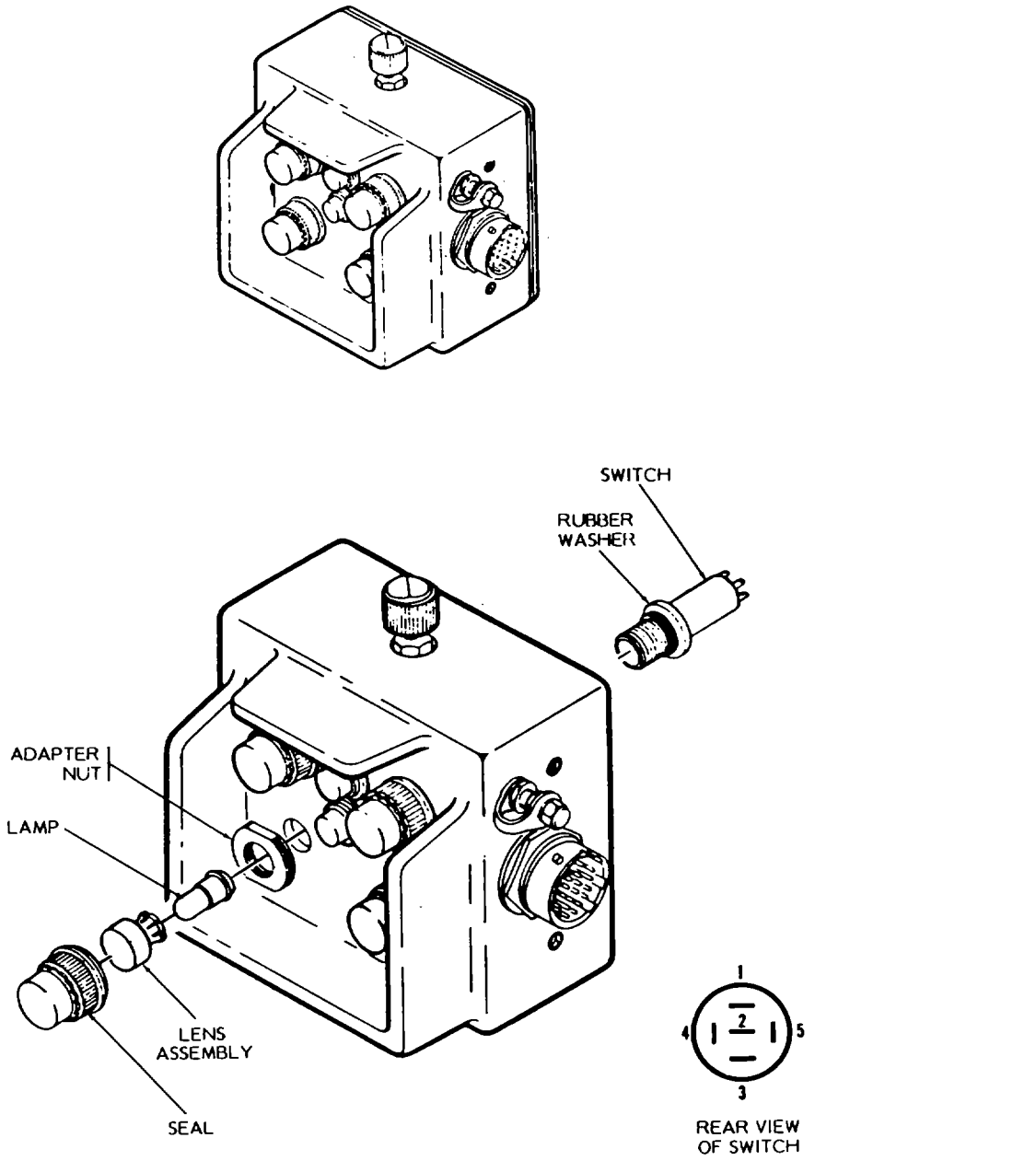

Figure 3-16. APDS, HEAT, HEP, and FSDS switches S1 through S4 removal and installation.

3-19. MOVING/STATIONARY Indicator Lights. The procedures described in this paragraph are performed at GS level only.

NOTE

The two indicators are replaced in the same manner.

a. Removal (Fig 3-17).

(1) Remove four bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Remove sealing compound from terminals of indicator light housing, exercising care not damage wires.

(3) Tag and disconnect wires from terminals.

(4) Unscrew cap assembly, and remove from front panel. Remove lamp from cap assembly.

(5) Remove nut and lockwasher; remove indicator light with rubber washer from front panel.

b. Installation (Fig 3-17).

(1) Insert indicator light with rubber washer through front panel.

(2) Position light so that terminals are convenient to wires.

(3) Secure light with lockwasher and nut supplied with light. Tighten nut to 10-13 lb-in. (1.13-1.5 N•m).

(4) Solder wires to terminals according to tags; remove tags from wires.

(5) Install cap assembly with lamp into indicator light.

(6) Test to verify repair (para 2-4).

(7) Seal terminals of indicator light with insulating compound (item 9, App. B).

(8) Lubricate cover gasket with grease (item 8, App. B).

CAUTION

Exercise care not to pinch wires between rear cover and housing.

(9) Attach rear cover and gasket with four bolts, lockwashers, and flat washers. Tighten bolts to 23-30 lb-in. (2.6-3.4 N•m).

(10) Purge and pressurize unit (para 2-3).

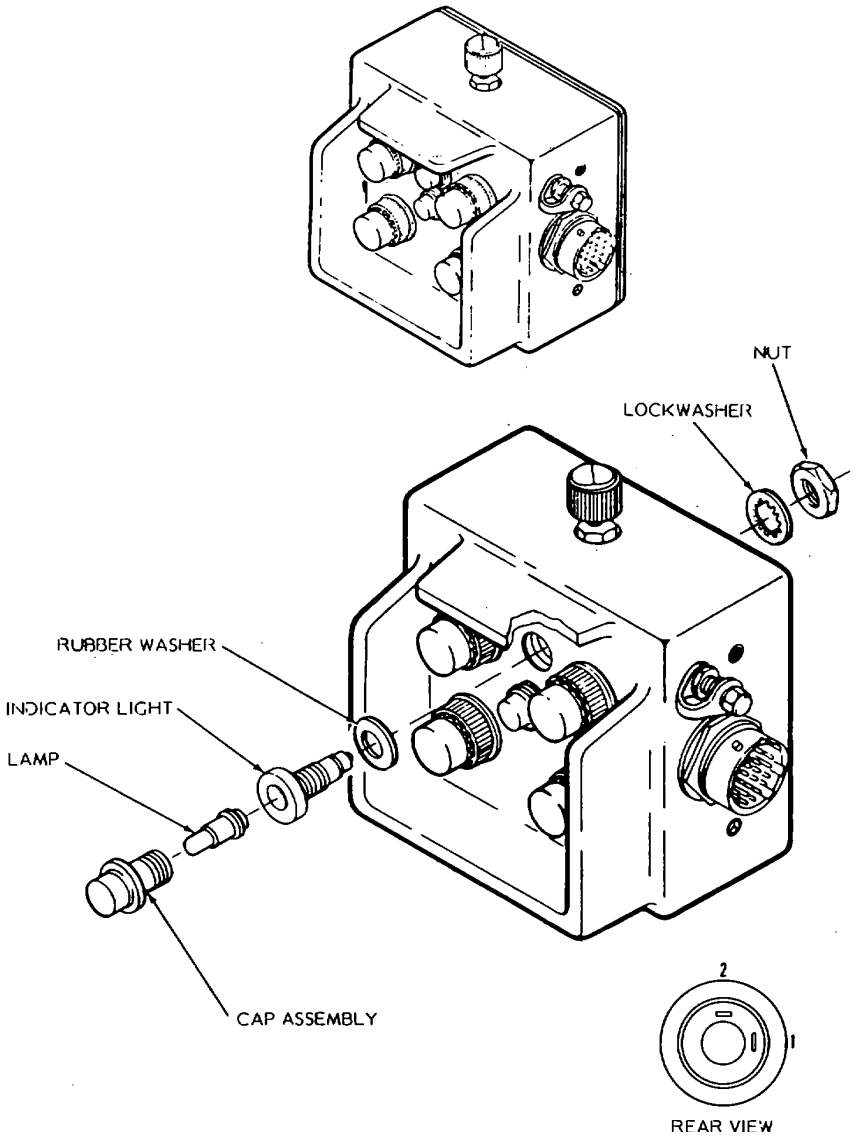

Figure 3-17. MOVING/STATIONARY indicator lights XDS1 and XDS2 removal and installation.

3-20. Brightness Control (R1). The procedures described in this paragraph are performed at GS level only.

a. Removal (Fig 3-18).

(1) Remove four bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Tag and disconnect wires from terminals.

(3) Loosen two setscrews and remove knob.

(4) Remove boot (seal nut) securing variable resistor to wall. Remove variable resistor with flat washer from housing.

b. Installation (Fig 3-18).

(1) Remove and discard nut supplied with replacement variable resistor.

(2) Solder bare jumper wire between terminals 1 and 2.

(3) Slip flat washer over resistor shaft. Insert variable resistor into mounting hole; be sure locating tab on resistor enters positioning hole in housing wall.

(4) Secure variable resistor with boot (seal nut). Tighten boot to 10-13 lb-in. (1.11.5 N•m).

(5) Install knob on shaft and tighten setscrews.

(6) Solder wires with lead alloy solder (item 12, App. B) to terminals according to tags. Remove tags from wires.

(8) Lubricate cover gasket with grease (item 8, App. B).

CAUTION

Exercise care not to pinch wires between rear cover and housing.

(9) Attach rear cover and gasket with four bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.6 N-m).

(10) Purge and pressurize unit (para 2-3). Be sure there are no leaks around replaced component.

3-21. MOVING/STATIONARY Switch. The procedures described in this paragraph are to be performed at GS level only.

a. Removal (Fig 3-19).

(1) Remove four bolts, lockwashers, and flat washers, and remove rear cover and gasket.

(2) Remove nut and lockwasher securing switch to wall.

(3) Remove switch with packing and retainer from housing to the limit of attached wires. Exercise care not to put excessive strain on wires.

(4) Tag and disconnect wires from switch.

b. Inspection.

(1) Inspect terminal lugs attached to wires to be sure they are securely attached. Replace lugs as necessary.

(2) Inspect for broken wires. If wires are broken, replace with new wire (item 18, App. B). Use old wire for pattern.

c. Installation (Fig. 3-19).

(1) Remove installation hardware supplied with replacement switch. Discard one nut and locking ring (tabbed washer).

(2) Attach wires to switch terminals according to tags. Remove tags from wires.

(3) Lubricate packing with retainer with grease (item 8, App. B).

(4) Install lubricated packing with retainer onto threaded shank of switch

(5) Insert switch with lubricated packing into mounting hole.

(6) Position switch so that keyway in threaded shank is toward front panel and secure with nut and lockwasher supplied with switch. Tighten nut to 10-13 lb-in. (1.1-1.5 N-m).

(7) Test to verify repair (para 2-4).

(8) Lubricate cover gasket with grease (item 8, App. B).

CAUTION

Exercise care not to pinch wires between rear cover and housing.

(9) Attach rear cover and gasket with four bolts, lockwashers, and flat washers. Tighten bolts to 23-32 lb-in. (2.6-3.4 N-m).

(10) Purge and pressurize unit (para 2-3).

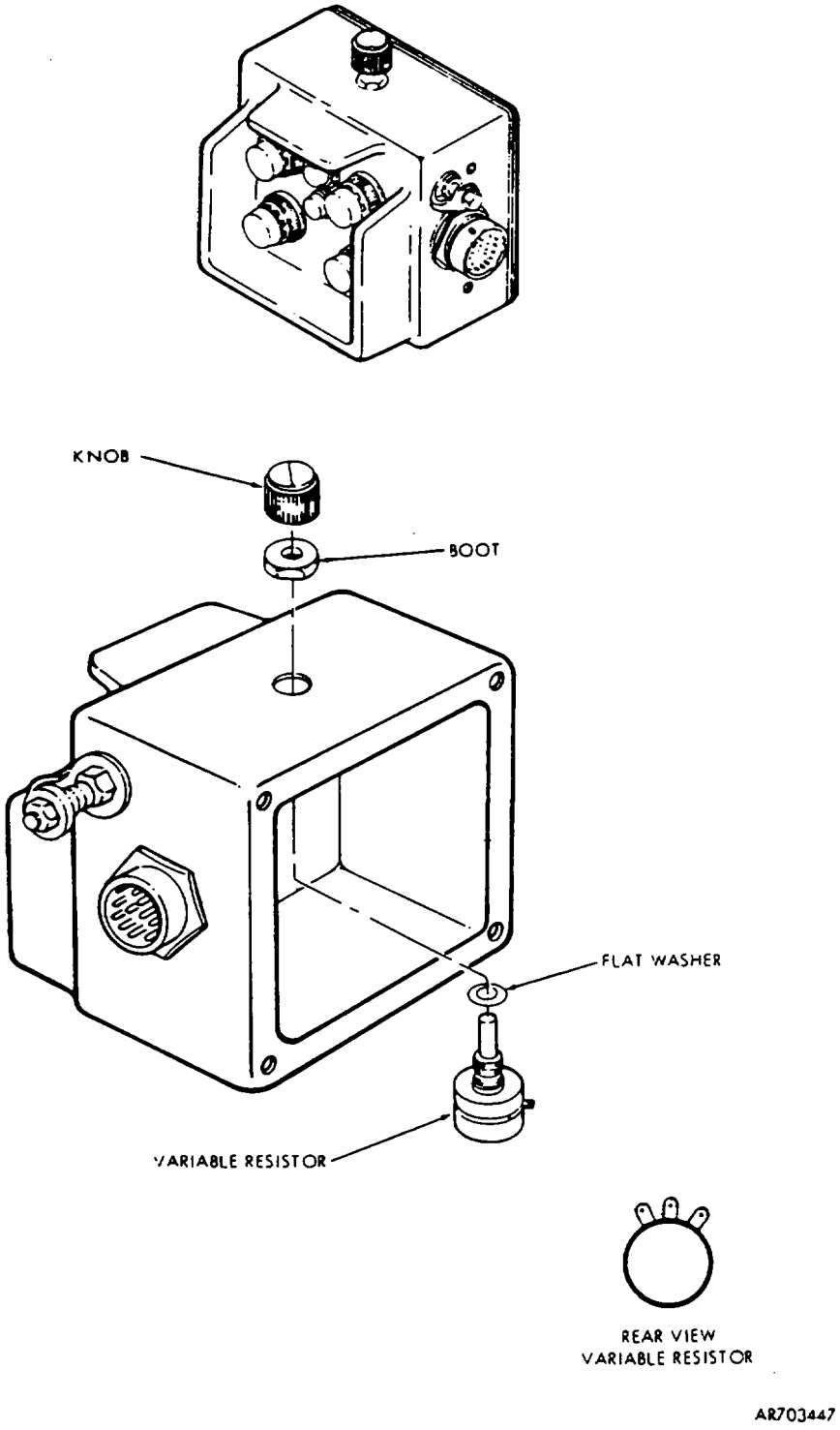

Figure 3-18. BRIGHT/DIM control (RI) removal and installation.

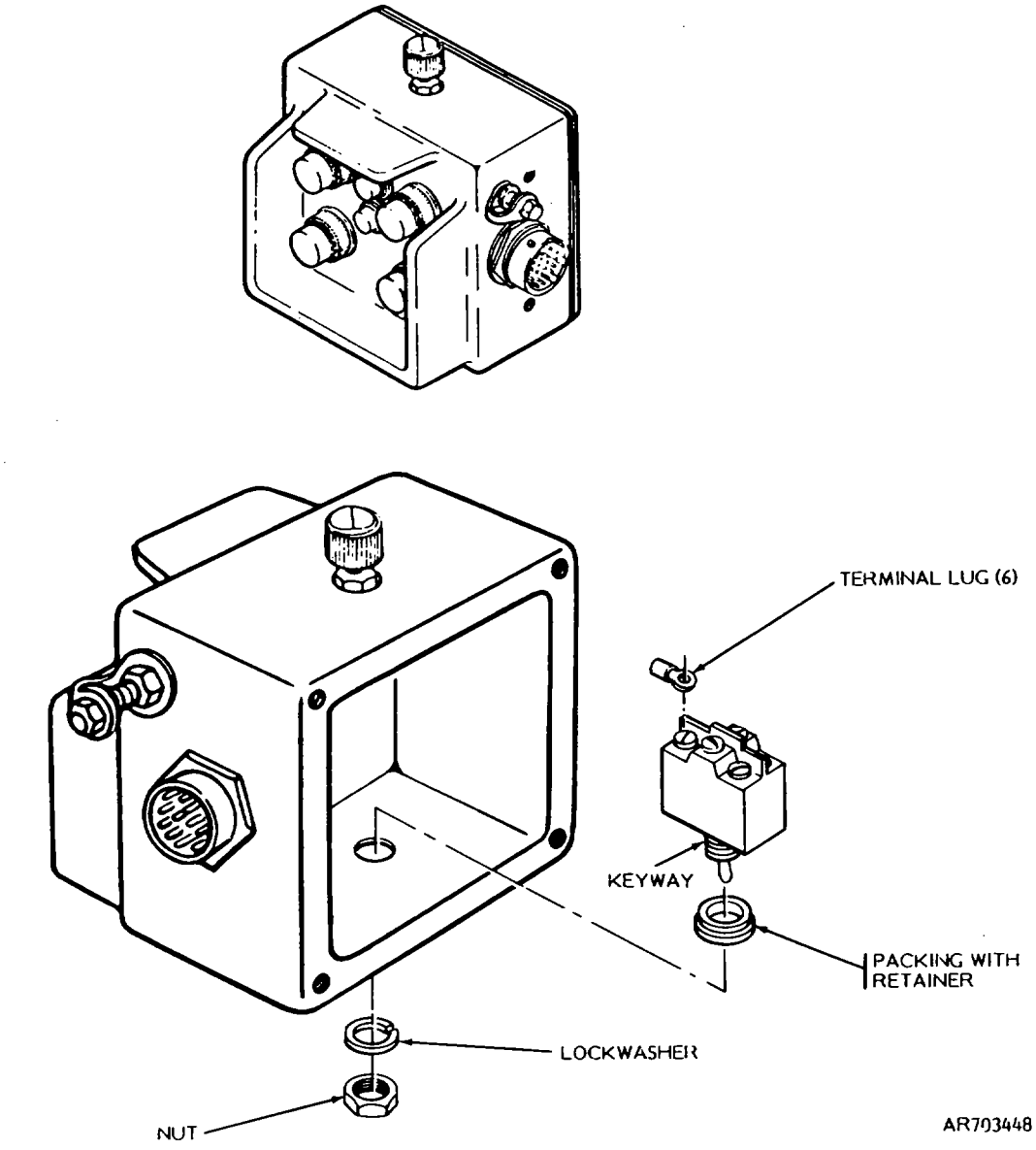

Figure 3-19. MOVING/STATIONARY switch removal and installation.

3-22. Repair of Terminal Board Assembly (TB1).

a. Disassembly

NOTE
Disassemble only to extent necessary to remove defective resistor or board.

(1) Remove four screws, lockwashers, flat washers, and separate rear cover and gasket, as shown in figure 3-15.

(2) If necessary for access, remove screw, washer and nut (fig 3-20) securing harness retaining clamp to terminal board.

(3) Unsolder resistor or jumper wire, as necessary.

b. Assembly (Fig 3-20).

(1) Install replacement resistor or jumper wire in same manner as removed component using lead alloy solder (item 12, App. B).

(2) If previously removed, secure clamp to terminal board assembly with screw, washer, and nut.

(3) Test to verify repair (para 2-4).

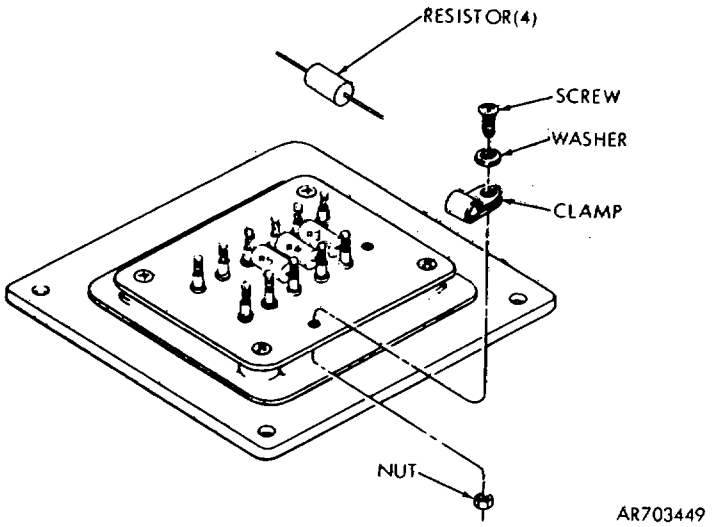

Figure 3-20. Repair of terminal board assembly (TB1).

(4) Lubricate cover gasket with grease (item 8, App. B).

CAUTION

Exercise care not to pinch wires between rear cover and housing.

(5) Attach rear cover and gasket (fig 3-15) with four bolts, lockwashers, and flat washers. Tighten bolts to 23-30 lb-in. (2.63.4 N•m).

(6) Purge and pressurize unit (para 2-3).

3-23. Repair of Ammo Select Unit Housing.

a. General. The ammo select unit housing is repaired by replacing components as shown in figure 3-21. Purge and pressurize the unit (para 2-3) whenever the rear cover is removed and installed, or when the unit is returned to the supply system or higher maintenance.

b. Pneumatic Components. Refer to paragraph 2-14 for details of replacing pneumatic components.

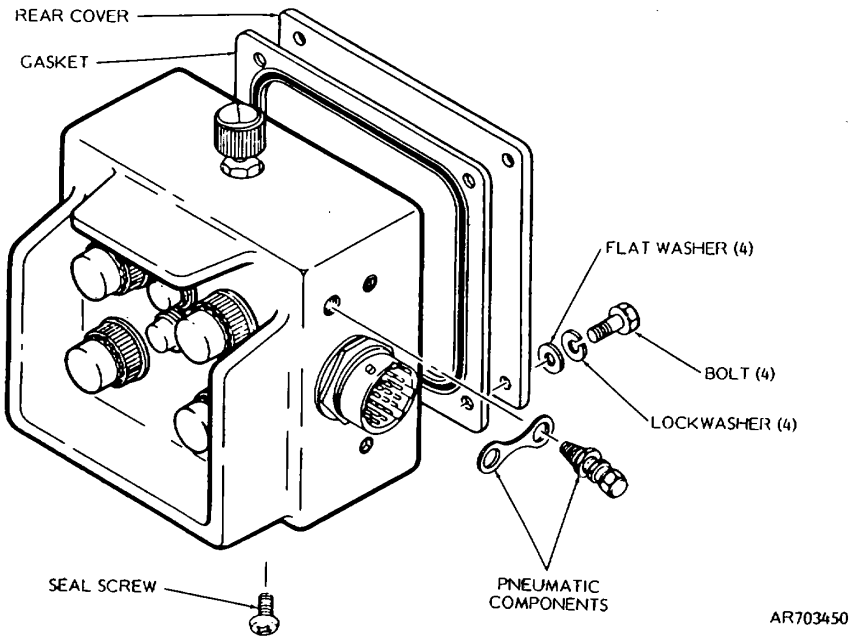

Figure 3-21. Repair of ammo select unit housing.

Section IV. REPAIR OF COMPUTER UNIT

3-24. Description.

a. The computer unit is the data processing unit of the computer system. The computer unit is a preprogrammed analog computer that develops elevation and deflection correction factors which are used to modify gun aim. The computer unit receives both digital and analog signals from the control units and sensors. The signals are processed by the electronic circuits of the computer unit to produce correction factors appropriate to the ballistic parameters. The computer unit generates a continuous output which is updated instantaneously when input signals change.

b. The computer unit is constructed of a heavy-weight, machined, aluminum alloy casting. The top and bottom covers are similarly heavy plates bolted to the housing through special sealing and electromagnetic interference gaskets. Four multipin connectors mounted on one end of the housing enable the computer unit to be connected into the computer system. The connectors are installed with gaskets that seal the interior. A pneumatic valve and a seal screw installed through the housing wall enable the interior to be purged and pressurized with dry nitrogen gas. Ten circuit card assemblies are mounted inside the housing. The circuit card assemblies are connected to each other and to the housing connectors through 50-pin connectors and a wire-wrap terminal board.

Circuit card assemblies A1, A2, and A3 are high-power boards and therefore incorporate heat sinks to dissipate heat generated during operation. Two screw-actuated plungers press each assembly heat sink against the housing to facilitate heat dissipation. The plungers must be loosened before the card assemblies can be removed. The card extracting tool (item 6, table 1-1) should be used when removing a card from the housing.

3-25. Circuit Card Assemblies or Shield.

a. Removal (Fig 3-22).

(1) Remove 10 bolts, lockwashers, and flat washers, and remove top cover.

(2) To remove circuit card assembly A1, A2, or A3, loosen heat sink pressure screws CCW until top of card assembly is loose in guides.

(3) Attach card extracting tool (item 6, table 1-1) to card (all card assemblies).

(4) Squeeze handle on extracting tool to disconnect chassis connector.

(5) Pull tool straight upward and remove circuit card from housing.

(6) Disengage extracting tool from circuit card assembly.

(7) Remove shield by pulling straight upward; exercise care not to disturb wiring at rear of connectors.

b. Installation (Fig 3-22).

(1) Install shield by positioning in guides and pushing gently but firmly downward until shield is seated in housing. Exercise care not to disturb wiring at rear of connectors.

(2) Position circuit card assembly in guides in housing.

(3) Using equal pressure on both sides of top edge of card assembly, gently but firmly press assembly into housing until card connector is just above housing connector.

(4) Check to be sure card assembly connector is properly alined with housing connector; shift position of card assembly in guides as necessary.

(5) Gently but firmly press top edge of card assembly until connector is fully seated.

(6) To secure circuit card assembly A1, A2, or A3, turn heat sink pressure screws CW until heat sink side of card is pressed against housing.

(7) Test to verify repair (para 2-4).

(8) Lubricate cover gasket with grease (item 8, App. B).

(9) Attach top cover and gasket with 10 bolts, lockwashers, and flat washers. Tighten bolts to 20 lb-in. (2.26 N•m).

(10) Purge and pressurize unit (para 2 -3).

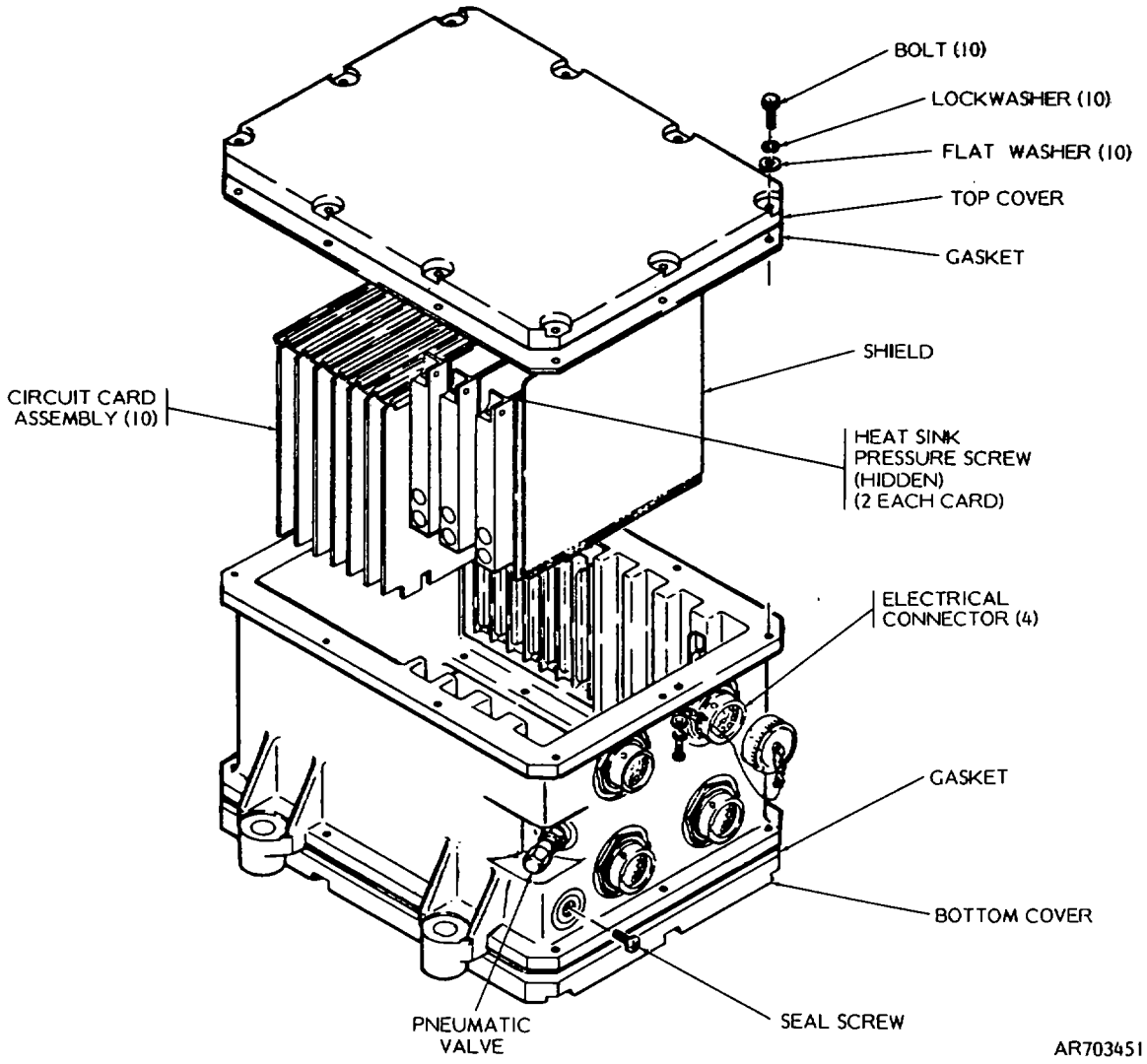

Figure 3- 22. Circuit card assemblies and shield removal and installation.

3-26. Repair of Computer Unit Housing.

a. General. The computer unit housing is repaired by replacing components as shown in figure 3-23. Note that the top and bottom covers and gaskets are interchangeable. Tighten cover bolts to 20 lb-in. (2.3 N•m). Purge and pressurize the unit after it has been opened for maintenance.

b. Pneumatic Components. Refer to paragraph 2-14 for details of replacing pneumatic components.

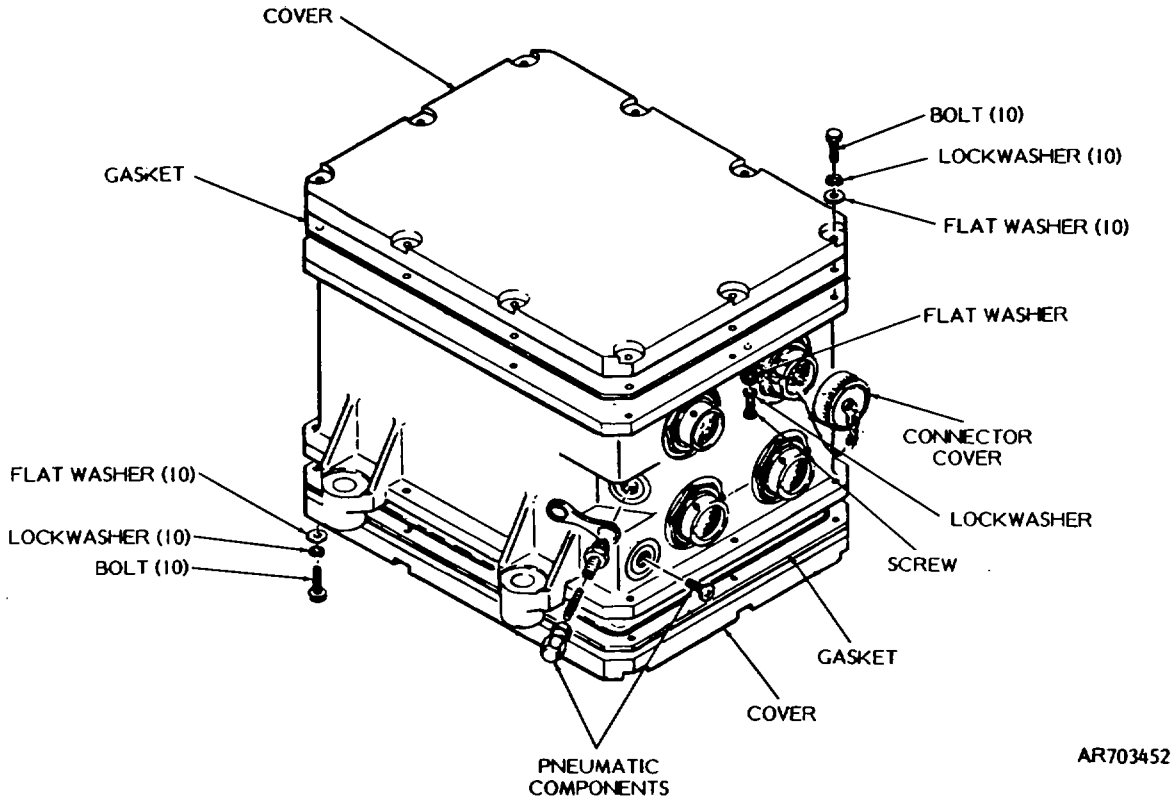

Figure 3-23. Repair of computer unit housing.

3-29 (3-30 Blank)

CHAPTER 4

FINAL INSPECTION

4-1. General. Final inspection of components of the Ballistics Computer XM21 will be performed according to the procedures given throughout chapter 2. Components which have passed the initial (visual) inspection and system checkout procedures in chapter 2 are to be considered serviceable.

CHAPTER 5

PREPARATION FOR STORAGE AND SHIPMENT

5-1. General. Ballistic computer components are delicate and expensive and must be protected during shipment and storage. It is recommended that the original packing materials received with new components be retained and reused for shipment and storage of the computer components.

5-2. Packaging. If the original packaging materials are not available, package the computer components separately as follows.

a. Wipe component clean using clean dry rag (item 10.1, App B).

b. Wrap component in barrier material (item 1.1, App B). Close and seal barrier material with heat or tape (item 15.1, App B).

c. Carefully surround component with a minimum of two inches of cushioning material (item 7.1, App B). Place component in appropriate size fiberboard or wooden box. Continue to add cushioning material until component is immobilized.

d. Close box and seal with tape (item 15.1, App B).

e. Mark box with the following:

1. National Stock Number
2. Nomenclature
3. 1 each - date packaged
4. Weight

f. If more than one computer component is to be shipped:

1. Place packaged components in a wooden or triple wall fiberboard box.

2. Surround component boxes with cushioning material (item 7.1, App B) and continue to add cushioning material until component boxes are immobilized.

3. Mark box to identify contents.

APPENDIX A

REFERENCES

A-1. Publication Indexes. The following indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this technical manual:

DA PAM 310-1	Consolidated Index of Army Publications and Blank Forms
DA PAM 738-750	The Army Maintenance Management System (TAMMS)

A-2. Publication References. The following is a list of publications and forms referenced in this manual and/or likely to be required by the manual user:

AR 702-7	Reporting of Quality Deficiency Data
AR 380-5	Department of the Army Supplement to DOD 5200.1-2
DA Form 2028	Recommended Changes to Publication and Blank Forms
DA Form 2028-2	Recommended Changes to Equipment Technical Manuals
DA Form 2407	Maintenance Request
SC 4931-95-CL-154	Purging Kit, Fire Control: Organization Maintenance (4931-00-065-1110)
TM 9-214	Inspection, Care and Maintenance of Antifriction Bearings
TM 9-1220-239-34P	DS and GS Maintenance Manual (including RPSTL) for Ballistic Computer, M21
TM 9-2350-253-10	Operator's Manual for Tank, Combat, Full-Tracked: 105-MM Gun, M60A3 (2350-04) -148-6548)
TM 9-2350-253-20-2	Organizational Maintenance Manual for Tank, Combat, Full-Tracked: 105-MM Gun, M60A3 (2350-00-1486548) Turret
TM 9-4931-360-14&P	Operator's, Organizational, DS, and GS Maintenance Manual (including RPSTL) for Cable Test Set (4931-00-629-3529)
TM 9-4931-361-14&P	Operator's, Organizational, DS, and GS Maintenance Manual (including RPSTL) for Field Test Set (4931-00-629-3541)
TM 55-2350-215-10-15	Transportability Guidance, Tank, Combat, Pull-Tracked, M60 Series
TM 740-90-1	Administrative Storage of Equipment
TM 7 50-244-6	Procedures for Destruction of Tank-Automotive Equipment to Prevent Enemy Use

APPENDIX B

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

1. Scope. This appendix lists expendable supplies and materials you will need to operate and maintain the (ballistic computer system). These items are authorized to you by CTA 50-970, Expendable Items (Except Medical, Class V, Repair Parts, and Heraldic Items).

2. Explanation of Columns.

a. Column I 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 cleaning compound, item 5, App. D").

b. Column 2 Level. This column identifies the lowest level of maintenance that requires the listed item.

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 name 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.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
1	F	8040-00-664-4318	Adhesive, general purpose, synthetic rubber, MMM-A-1617	PT
1.1	F	8135-00-292-9719	Barrier material, MIL-B-121	YD
2	F	6850-00-105-3084	Cleaning compound, solvent, 16 oz can, pressurized (freon)	OZ
3	F	5350-00-221-0872	Cloth, abrasive, crocus, P-C-458 pkg	SH
4	F	8010-01-030-7254	Coating, epoxy-polyamide, paint, black, MIL-C-22750C, color number 37038	KT
5	F	8010-117-9992	Coating, epoxy-polyamide, paint, olive drab, MIL-C-22750C, color number 34087	KT

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST - Continued

(1) ITEM NUMBER	(2) LEVEL	(3) NATIONAL STOCK NUMBER	(4) DESCRIPTION	(5) U/M
6	F	8010-00-082-2439	Coating, epoxy-polyamide, paint, white, MIL-C-22750C, color number 17875	KT
7	F	8030-01-013-9306	Compound, sealing, MIL-S-22473 grade E	BT
7.1	F	8135-00-116-1443	Cushioning material, MIL-P-26514	FT
8	F	9150-00-422-8066	Grease, aircraft and instrument, fuel and oxidizer resistant MIL-G-27617C, type I	OZ
9	H	5970-00-825-7255	Insulating compound, electrical, imbedding, MIL-I-16923G	KT
10	F	8010-00-082-2450	Primer coating, MIL-P-23377	KT
10.1	F	7920-00-205-1711	Rag, wiping, A-A-531	LB
11	H		Sealing compound, temperature resistant, high-adhesion, MIL-S-8802D	KT
12	F	3439-00-003-8601	Solder, lead alloy, QQ-S-571, SN60 or SN63	CN
13	F	6850-00-281-1985	Solvent, drycleaning, PD-680, type II, SD-2	GL
13.1	F	6810-00-290-0048	Solvent, Toluene Technical, TT-T-5480, Type II	GL
14	F	8030-00-889-3534	Tape, antiseize, MIL-T-27730, size 1	YD
15	F	4020-00-753-6555	rape, lacing, MIL-T-43435, type I, finish B, size 3	YD
15.1	F	7510-00-297-6655	Tape, paper backed, water-resistant, PPP-T-76	YD
16	F	7920-00-721-8884	Towel, paper (lens tissue), 40 square inch sheet	EA
17	H	9505-00-221-2650	Wire, nonelectrical, corrosion-resistant steel, .020 inch nominal diameter	LB
18	F	6145-00-552-3591	Wire, electrical, M16878/4-22-4	RL

INDEX

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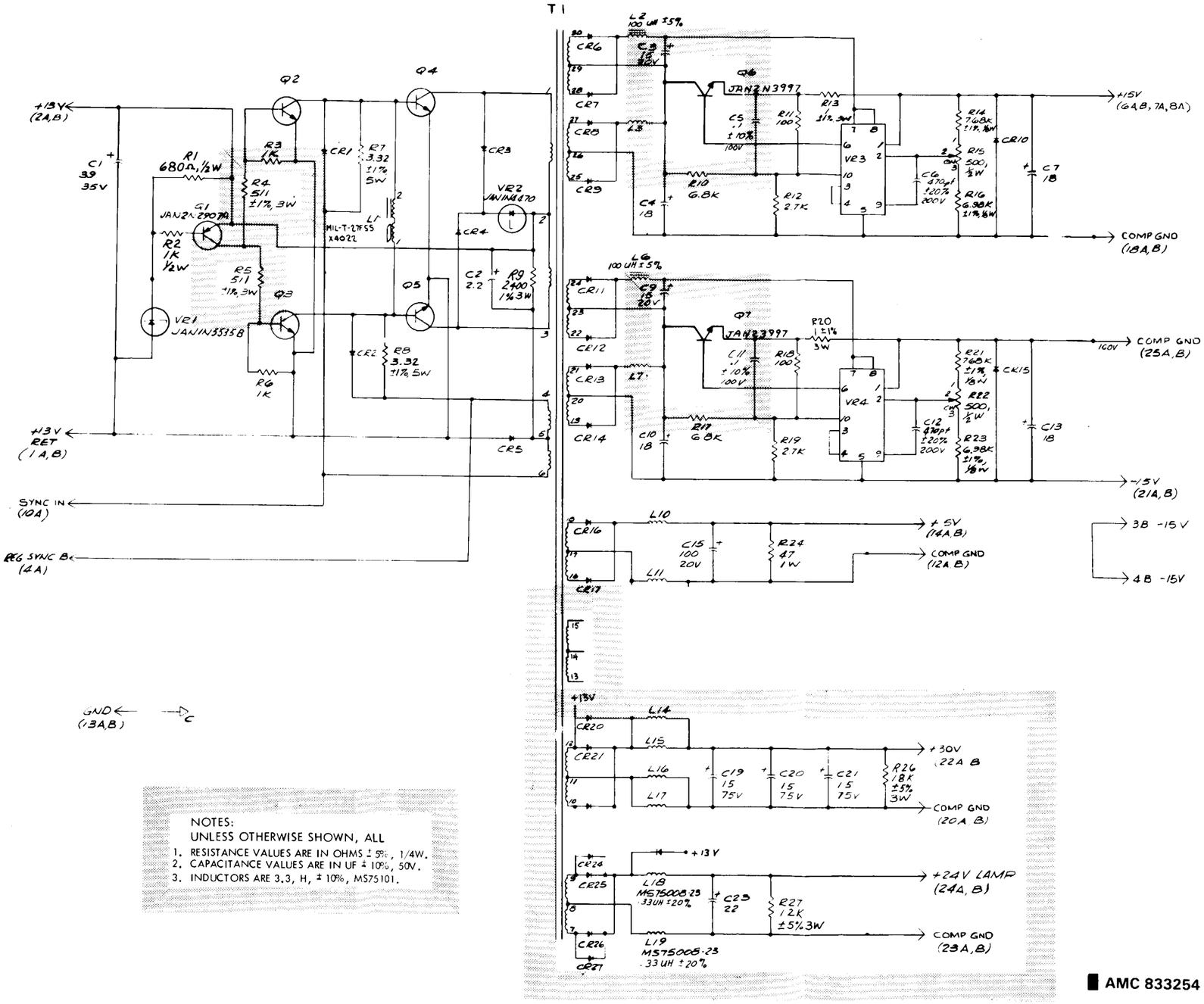


AMC 833254

Figure FO-1. Power supply inverter, +15V regulator schematic diagram

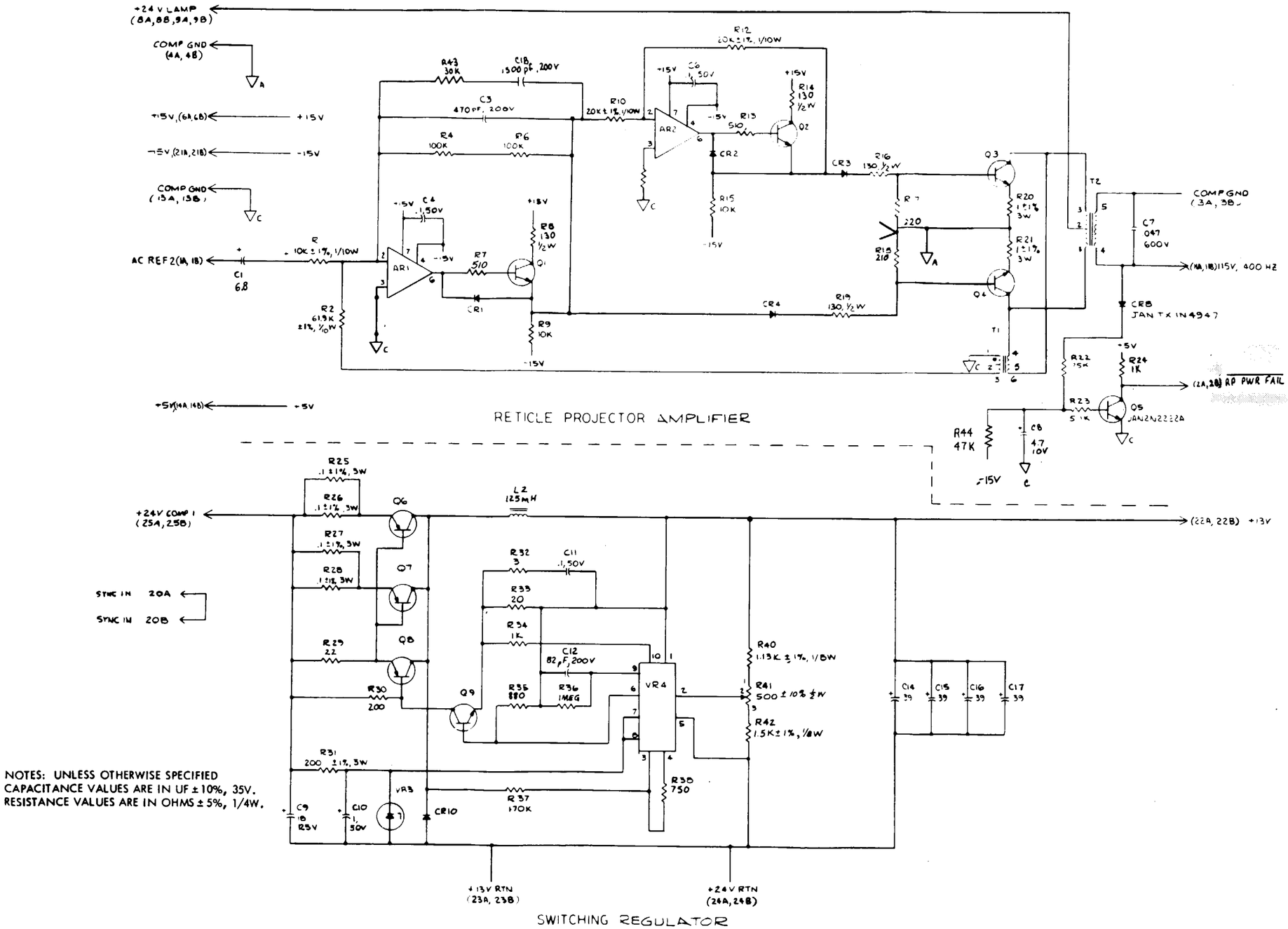
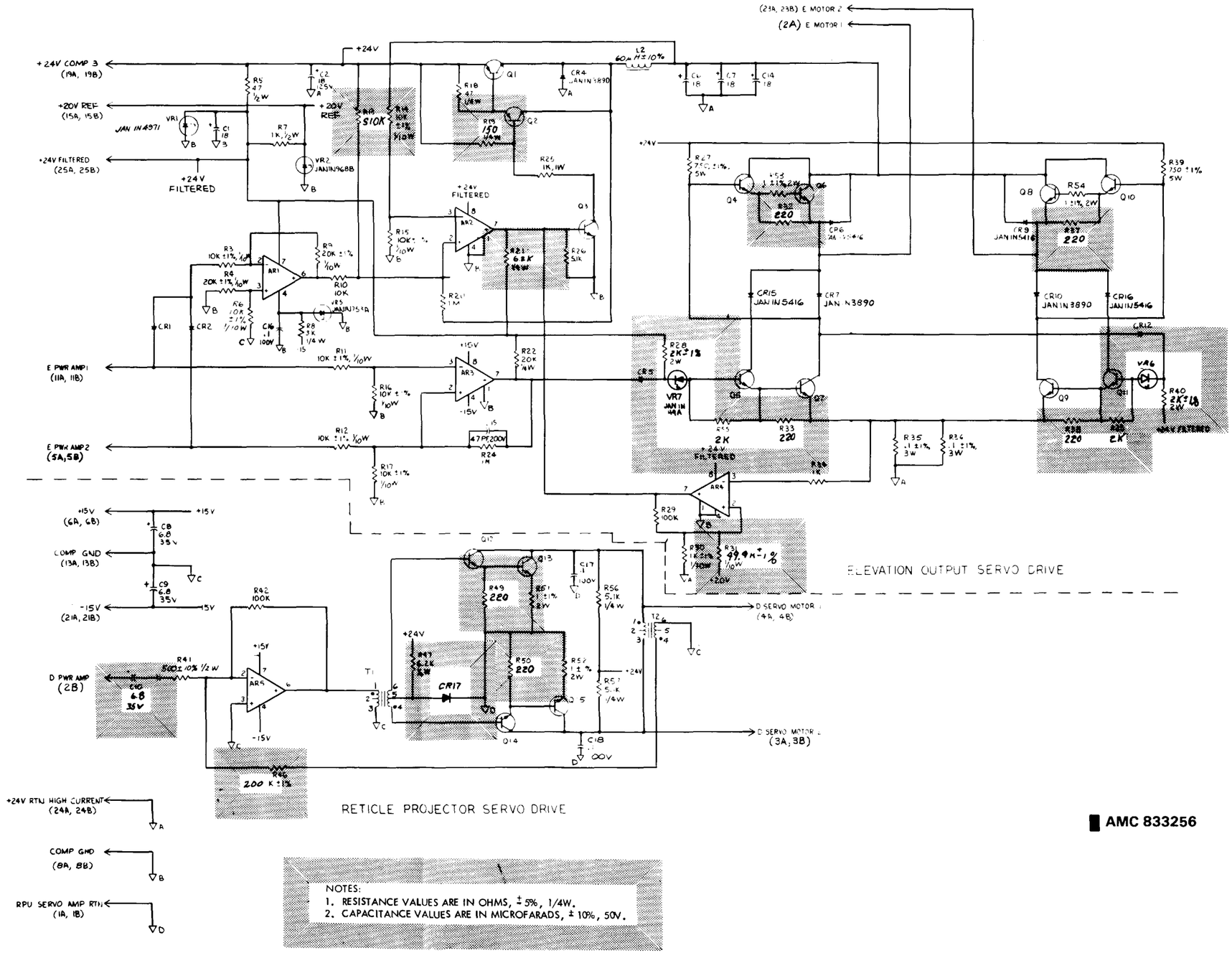


Figure FO-2. Switching regulator and reticle projector amplifier schematic diagram



AMC 833256

Figure FO-3. Reticle projector and elevation servo drives schematic diagram

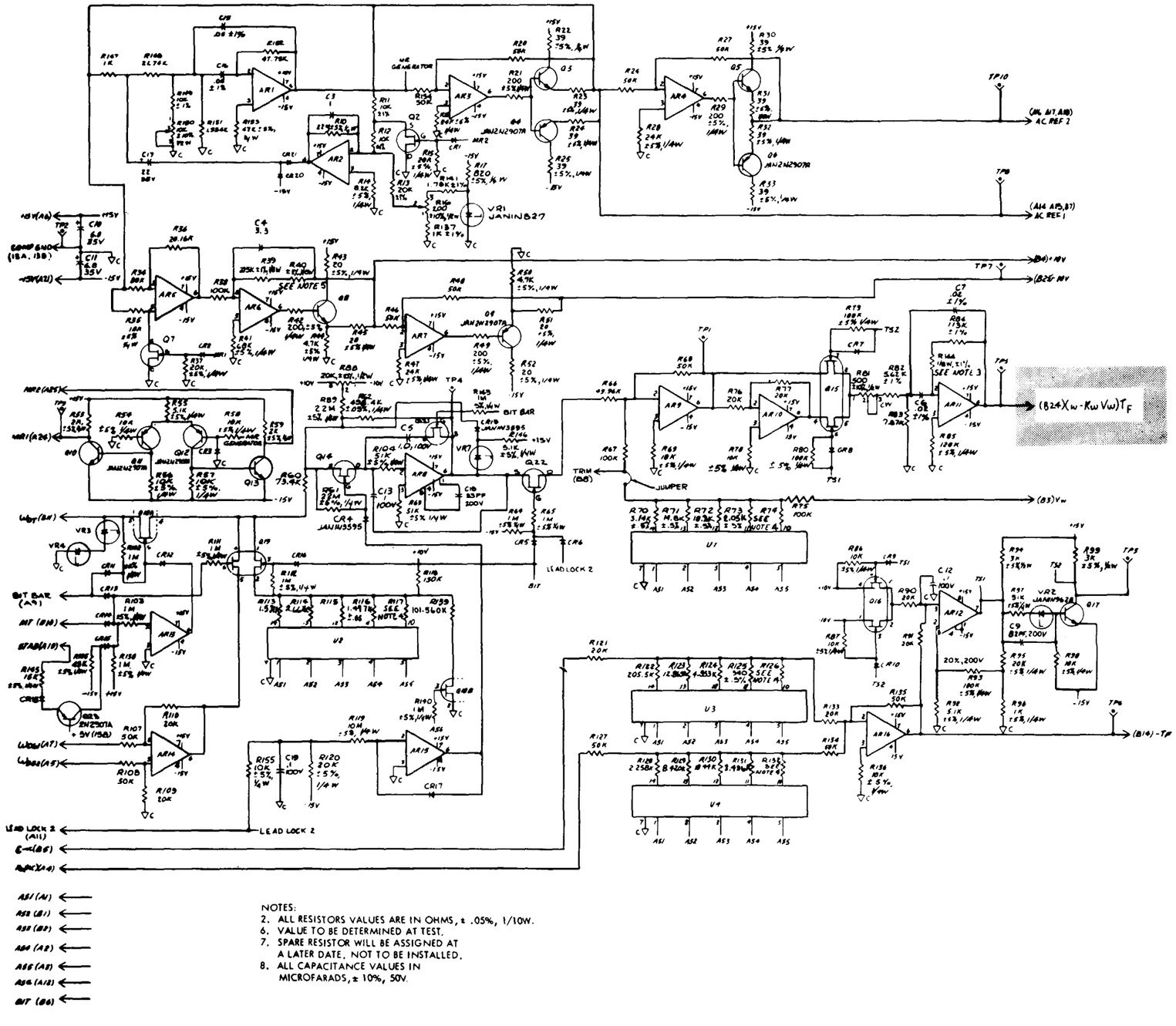


Figure FO-4. Lead windage and reference schematic diagram (1 of 2)

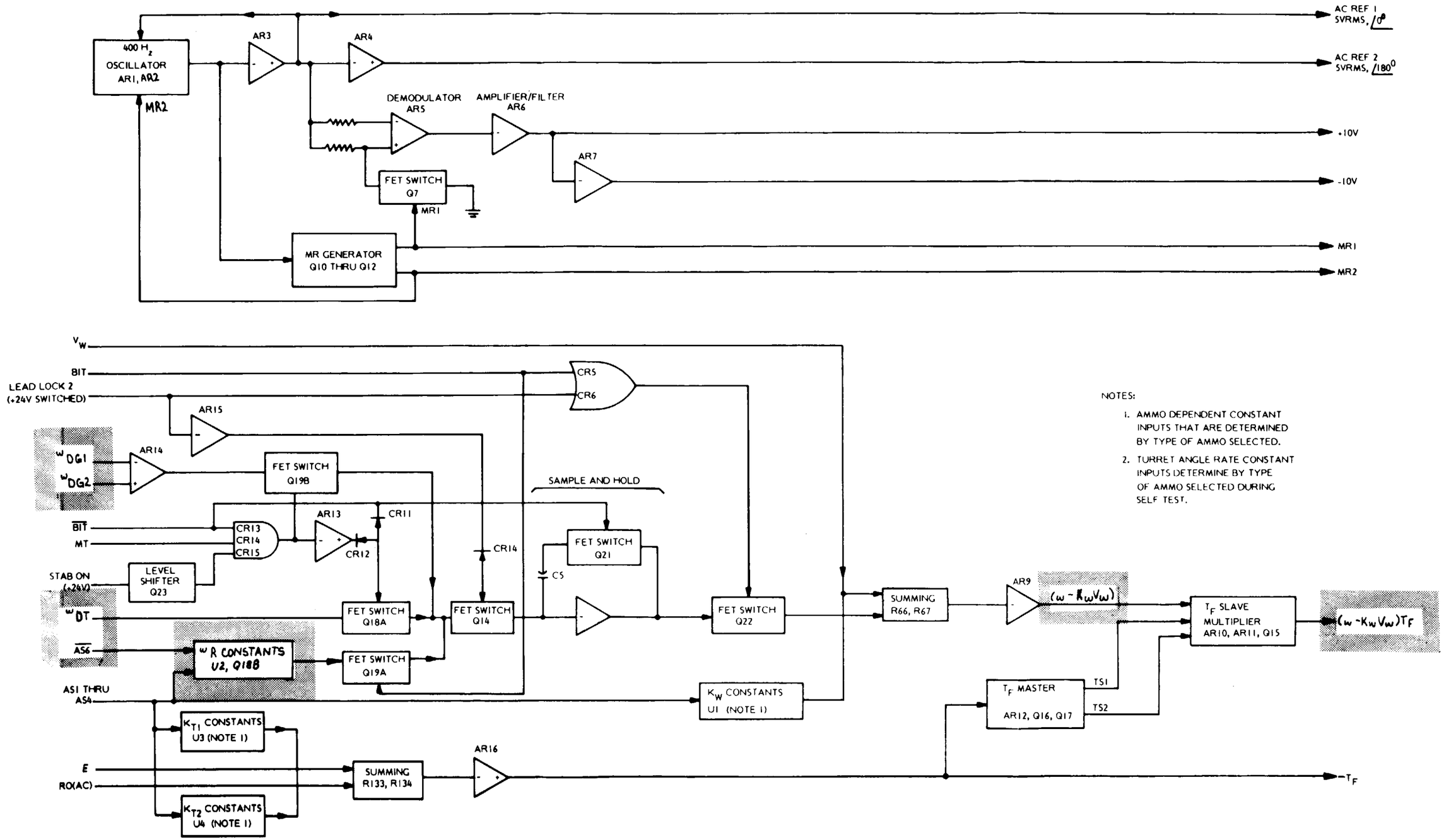
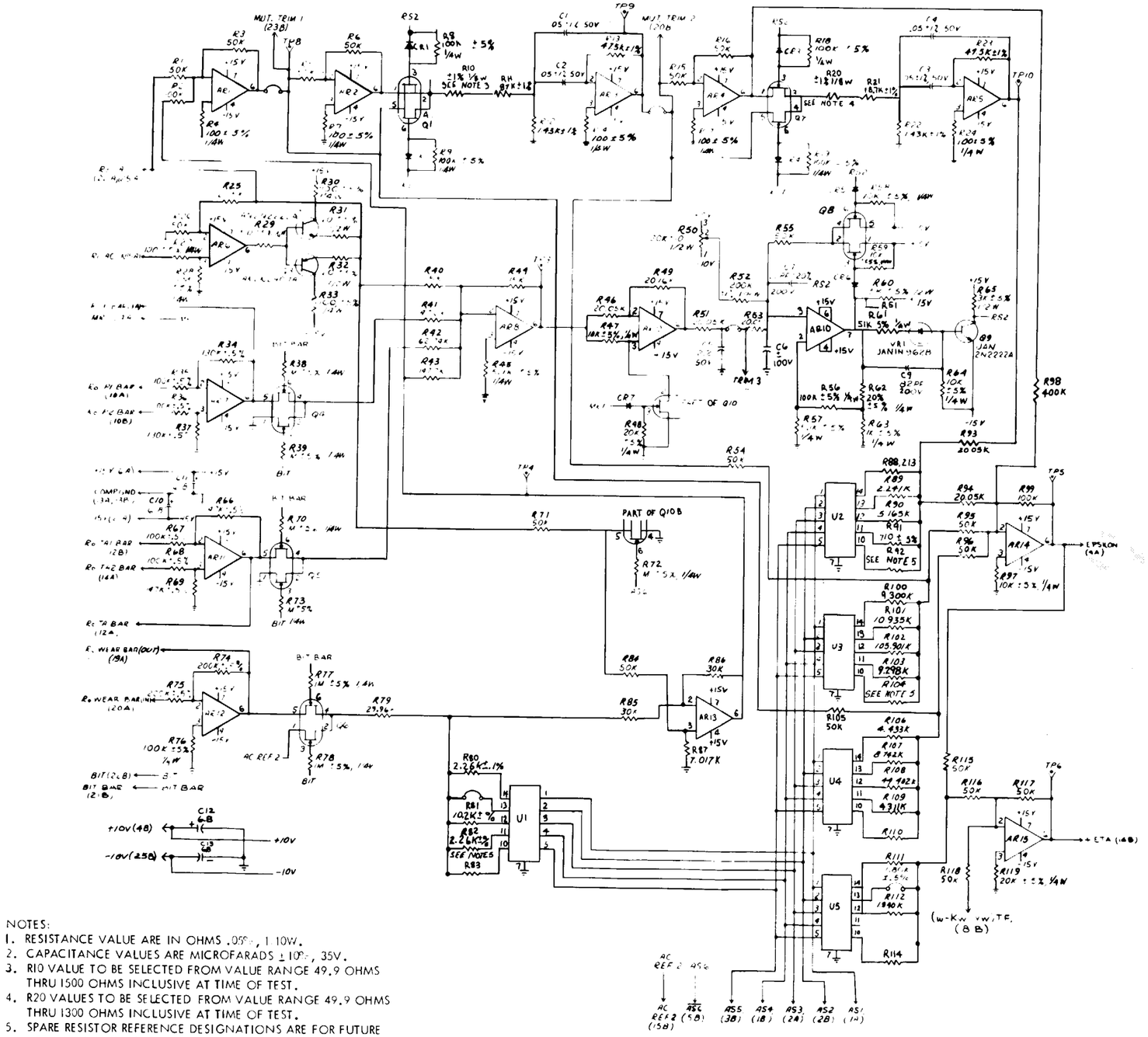


Figure FO-4. Lead windage and reference block diagram (2 of 2)



NOTES:
1. RESISTANCE VALUE ARE IN OHMS .05%, 1.10W.
2. CAPACITANCE VALUES ARE MICROFARADS ± 10%, 35V.
3. R10 VALUE TO BE SELECTED FROM VALUE RANGE 49.9 OHMS THRU 1500 OHMS INCLUSIVE AT TIME OF TEST.
4. R20 VALUES TO BE SELECTED FROM VALUE RANGE 49.9 OHMS THRU 1300 OHMS INCLUSIVE AT TIME OF TEST.
5. SPARE RESISTOR REFERENCE DESIGNATIONS ARE FOR FUTURE USE ONLY AND HAVE NO AFFECT ON PRESENT CIRCUIT STATUS.

Figure FO-5. Superelevation and drift schematic diagram (1 of 2)

Change 3

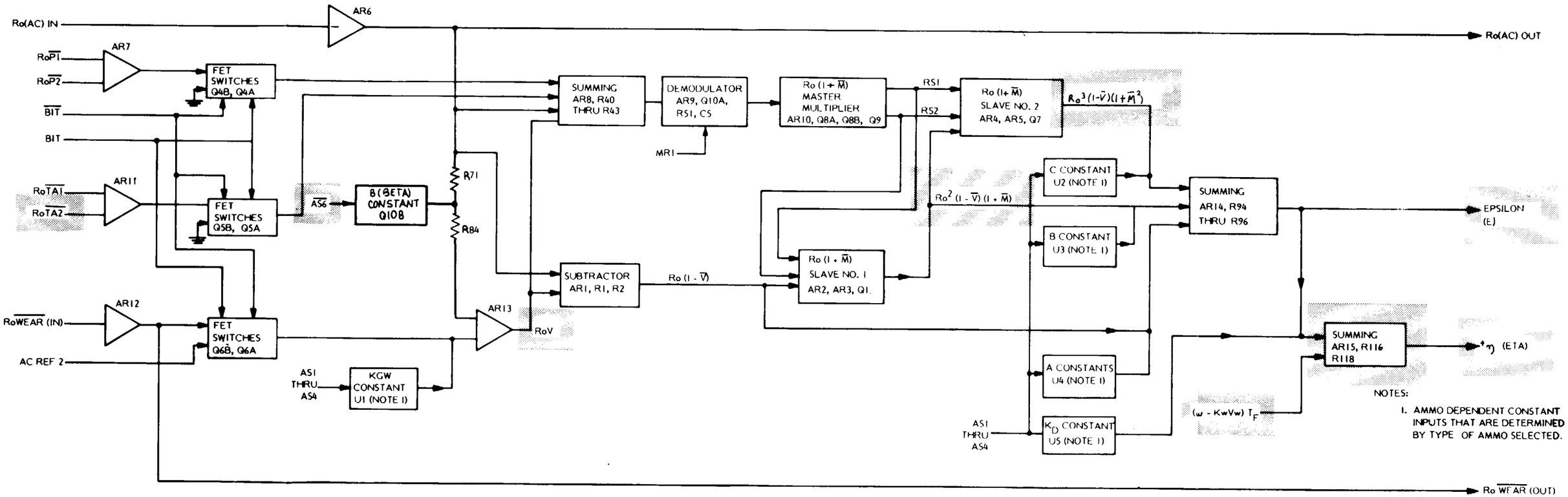


Figure FO-5. Superelevation and drift block diagram (2 of 2)

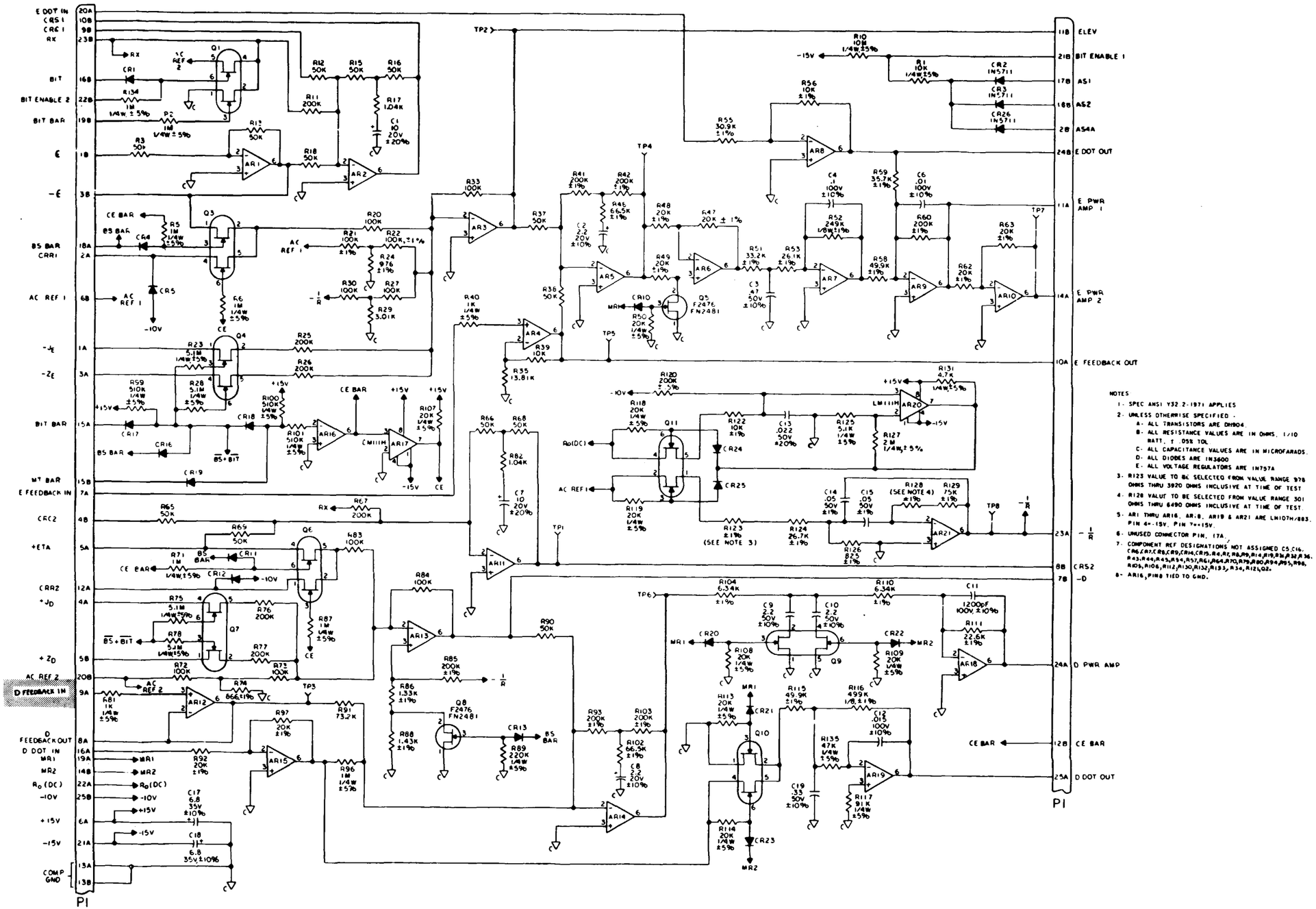


Figure FO-6. Output schematic diagram (1 of 3)

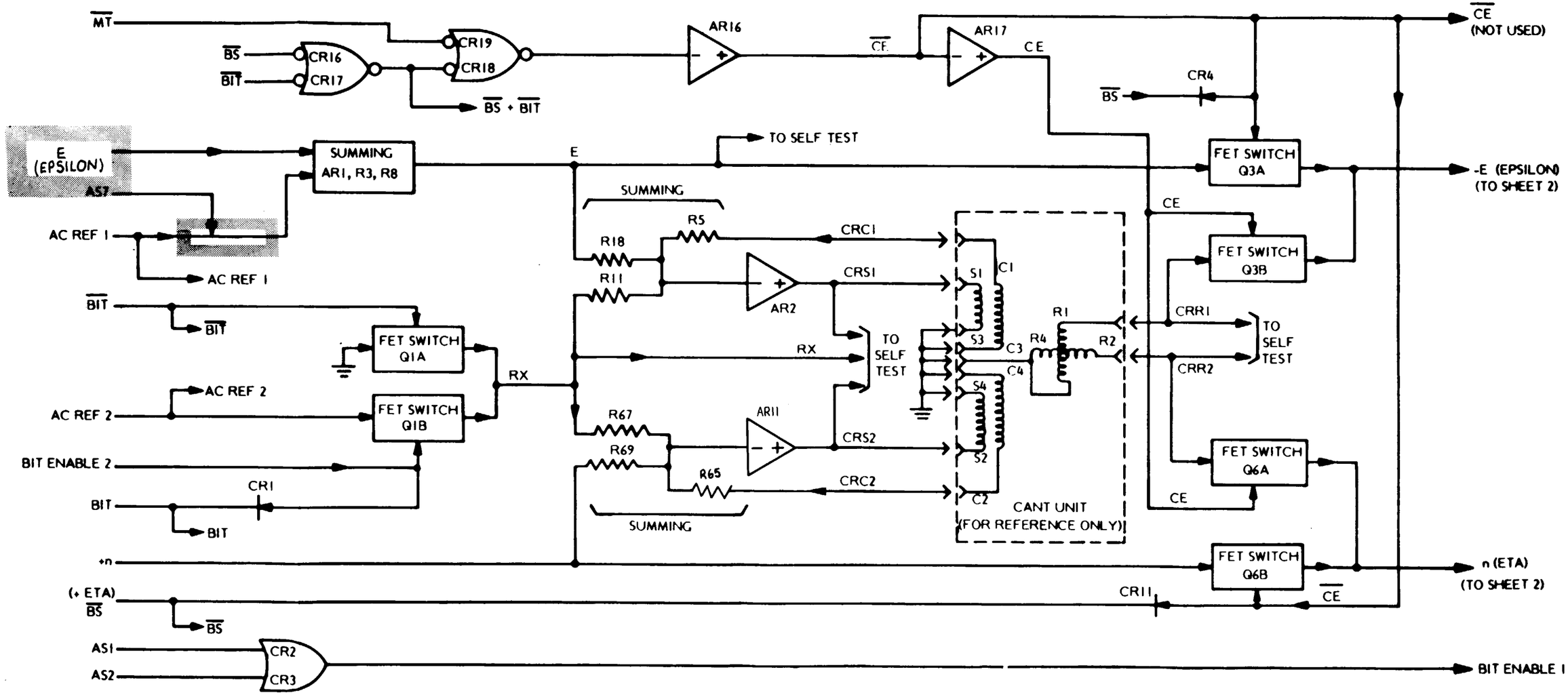


Figure FO-6. Output block diagram (2 of 3)

Change 3

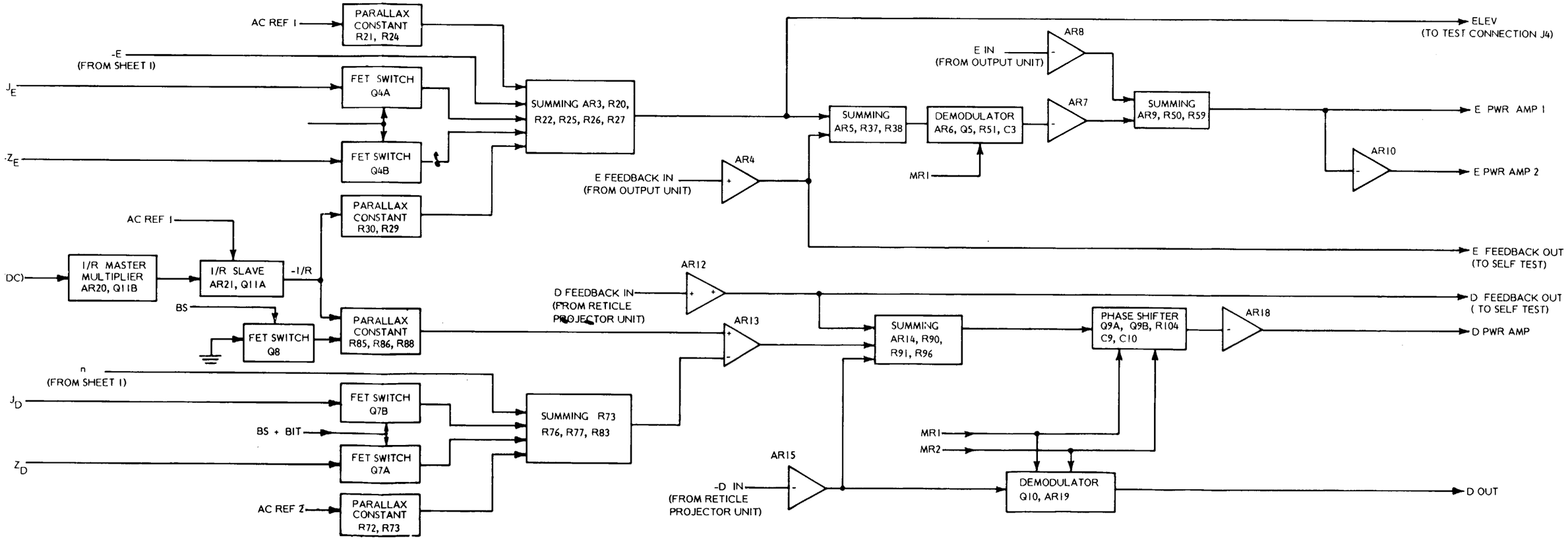


Figure FO-6. Output block diagram (3 of 3)

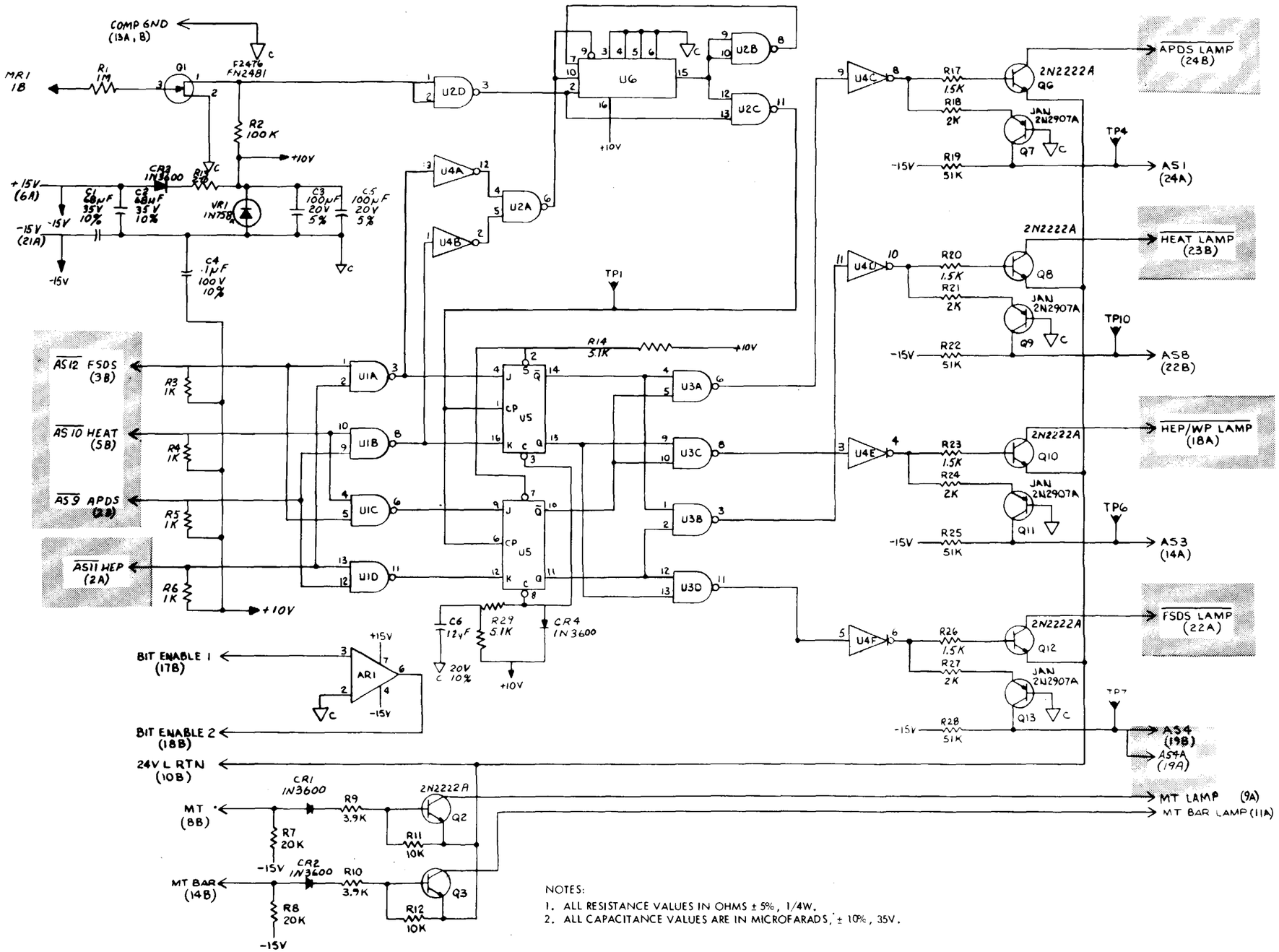


Figure FO-7. Ammo select schematic diagram (1 of 2)

Change 3

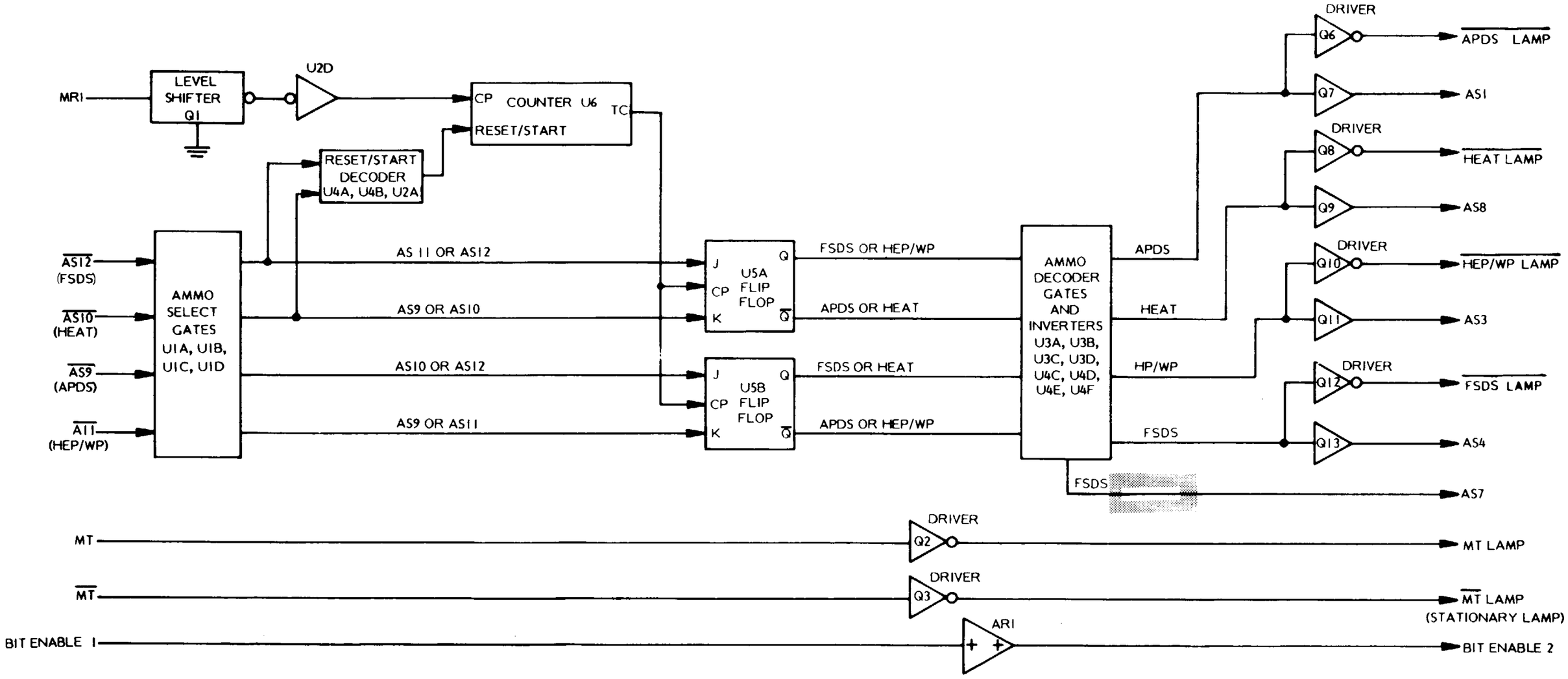
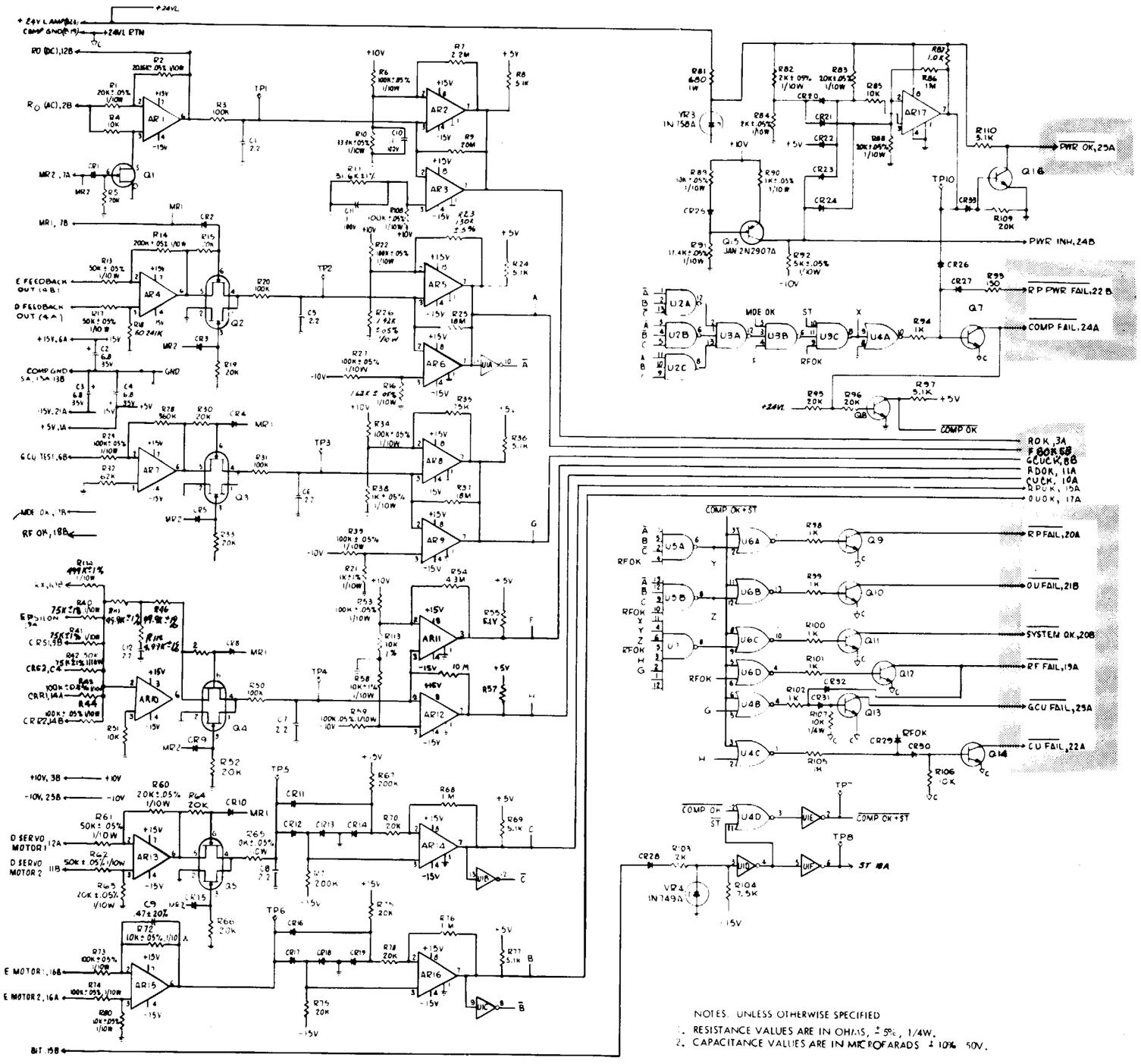


Figure FO-7. Ammo select schematic diagram (2 of 2)

Change 3



NOTES. UNLESS OTHERWISE SPECIFIED
1. RESISTANCE VALUES ARE IN OHMS, ± 5%, 1/4W.
2. CAPACITANCE VALUES ARE IN MICROFARADS ± 10% 50V.

Figure FO-8. Self test schematic diagram (1 of 2)

Change 3

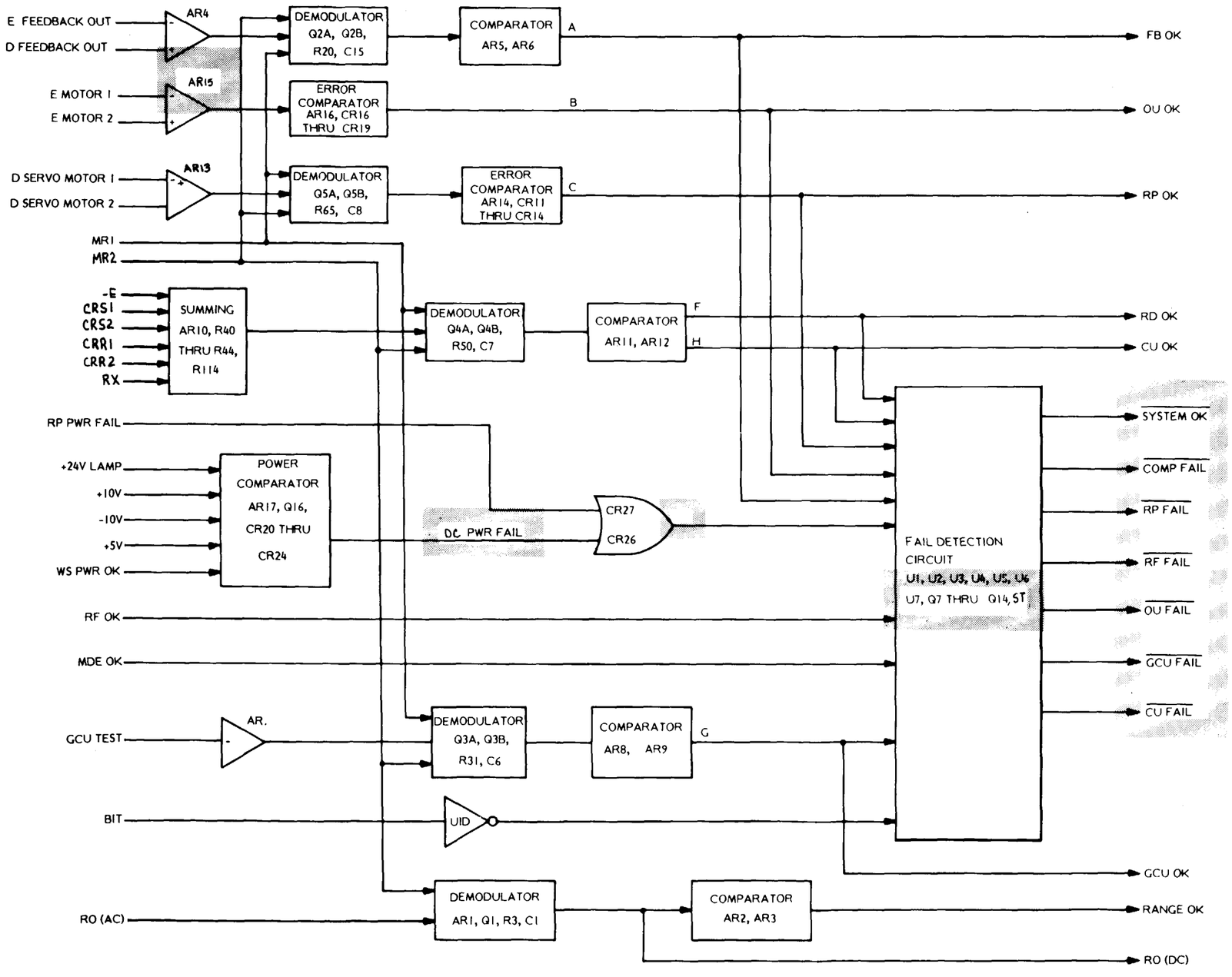


Figure FO-8. Self test block diagram (2 of 2)

Change 3

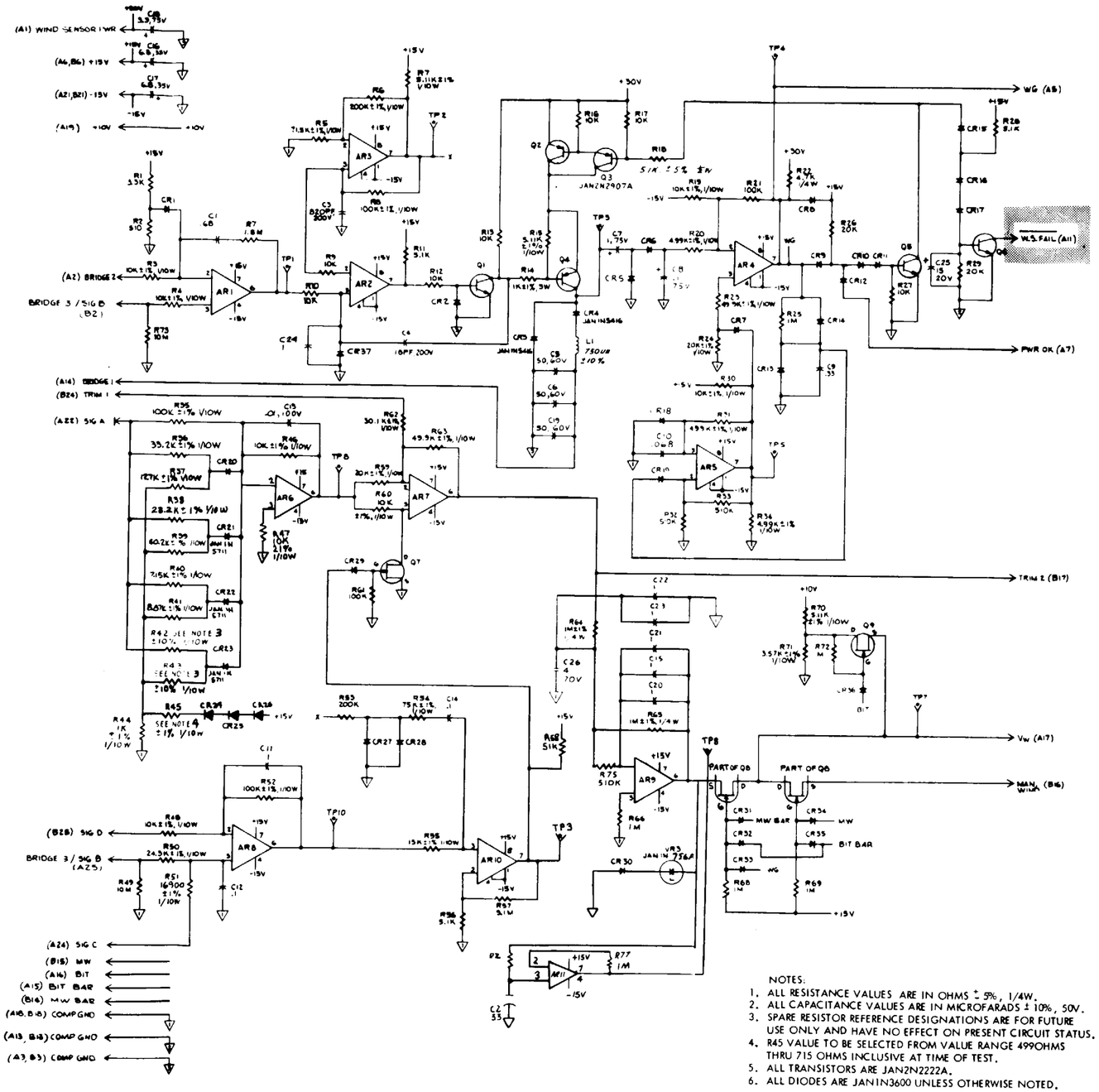


Figure FO-9. Crosswind sensor electronics schematic diagram (1 of 2)

Change 3

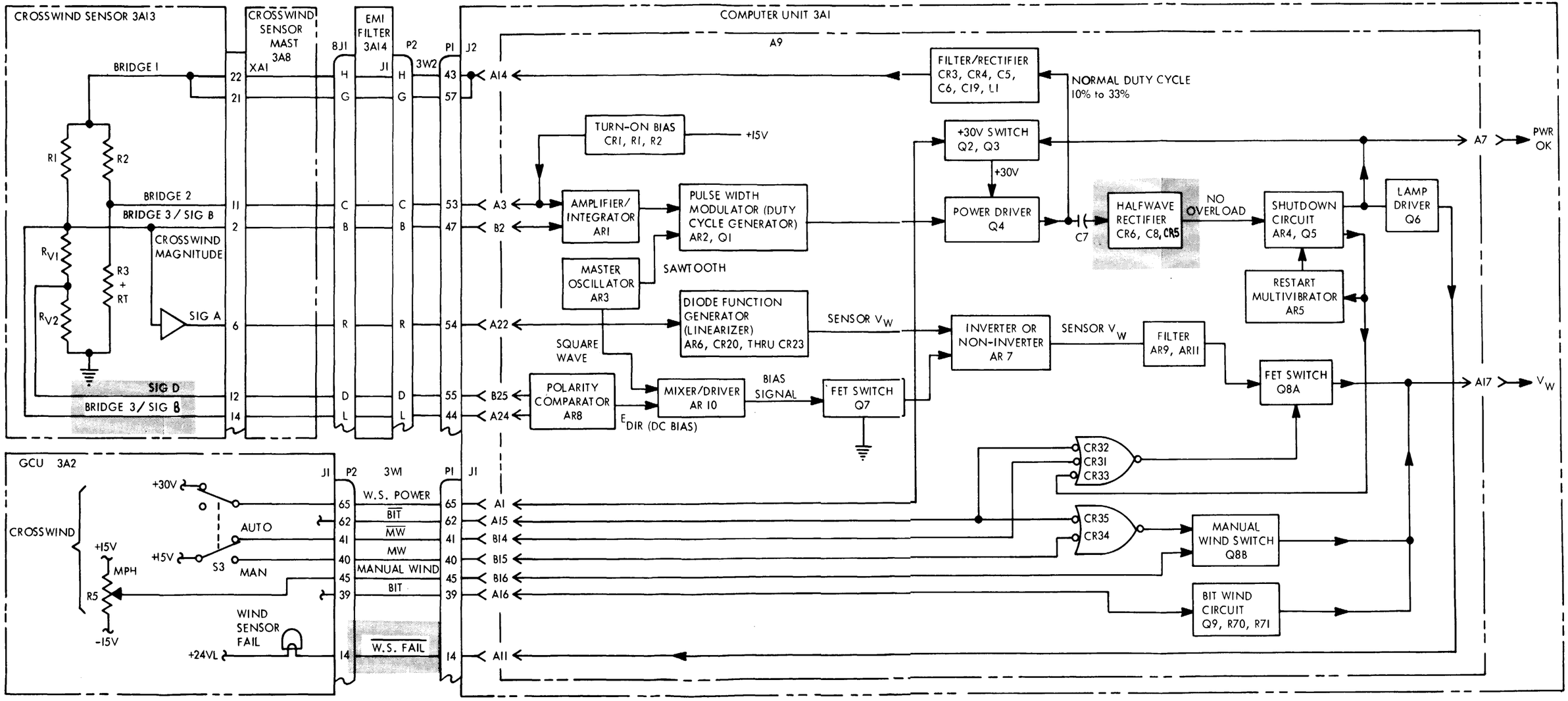


Figure FO-9. Crosswind sensor electronics block diagram (2 of 2)

Change 3

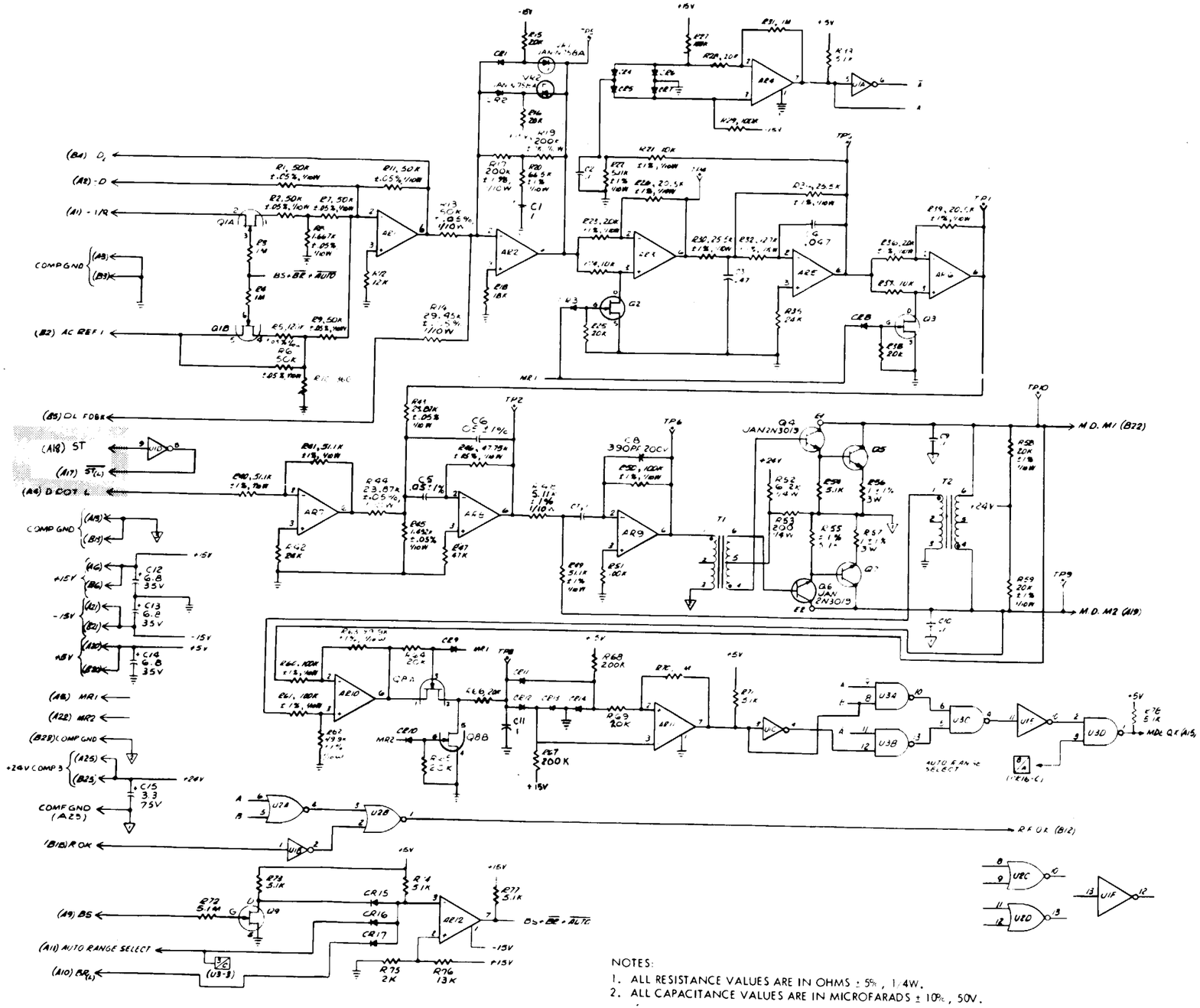


Figure FO-10. Mirror drive servo electronics schematic diagram (1 of 2)

Change 3

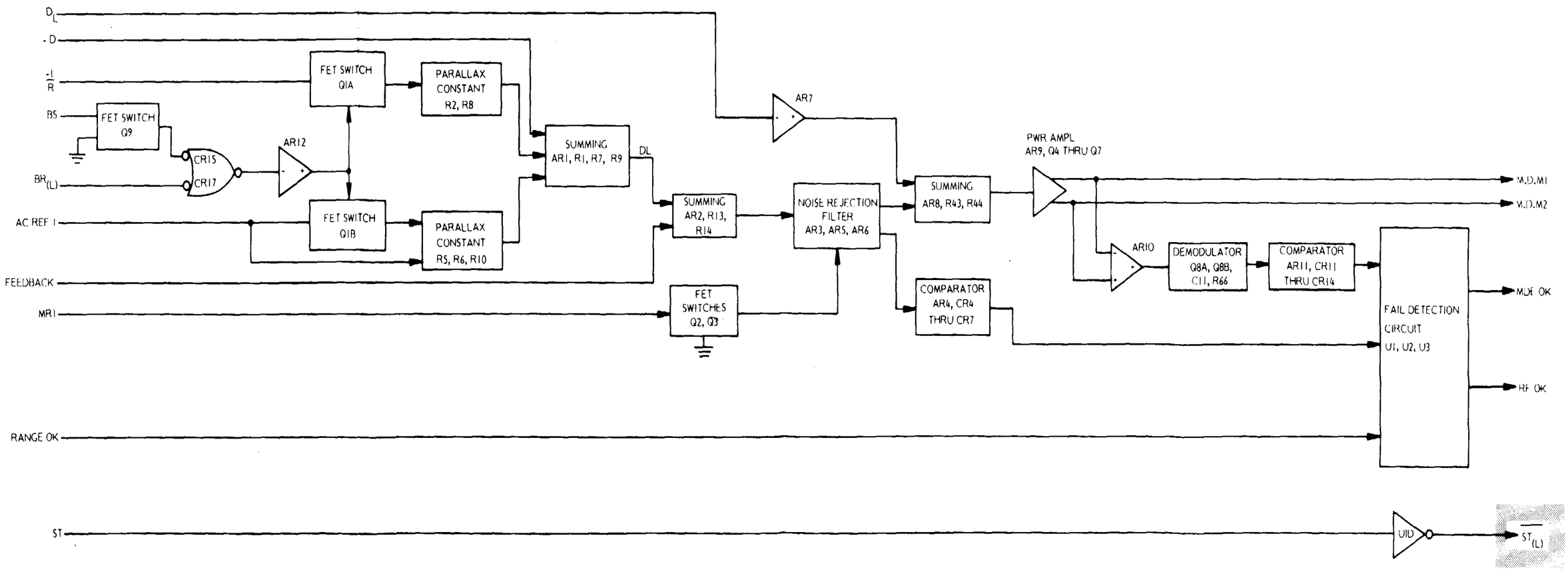
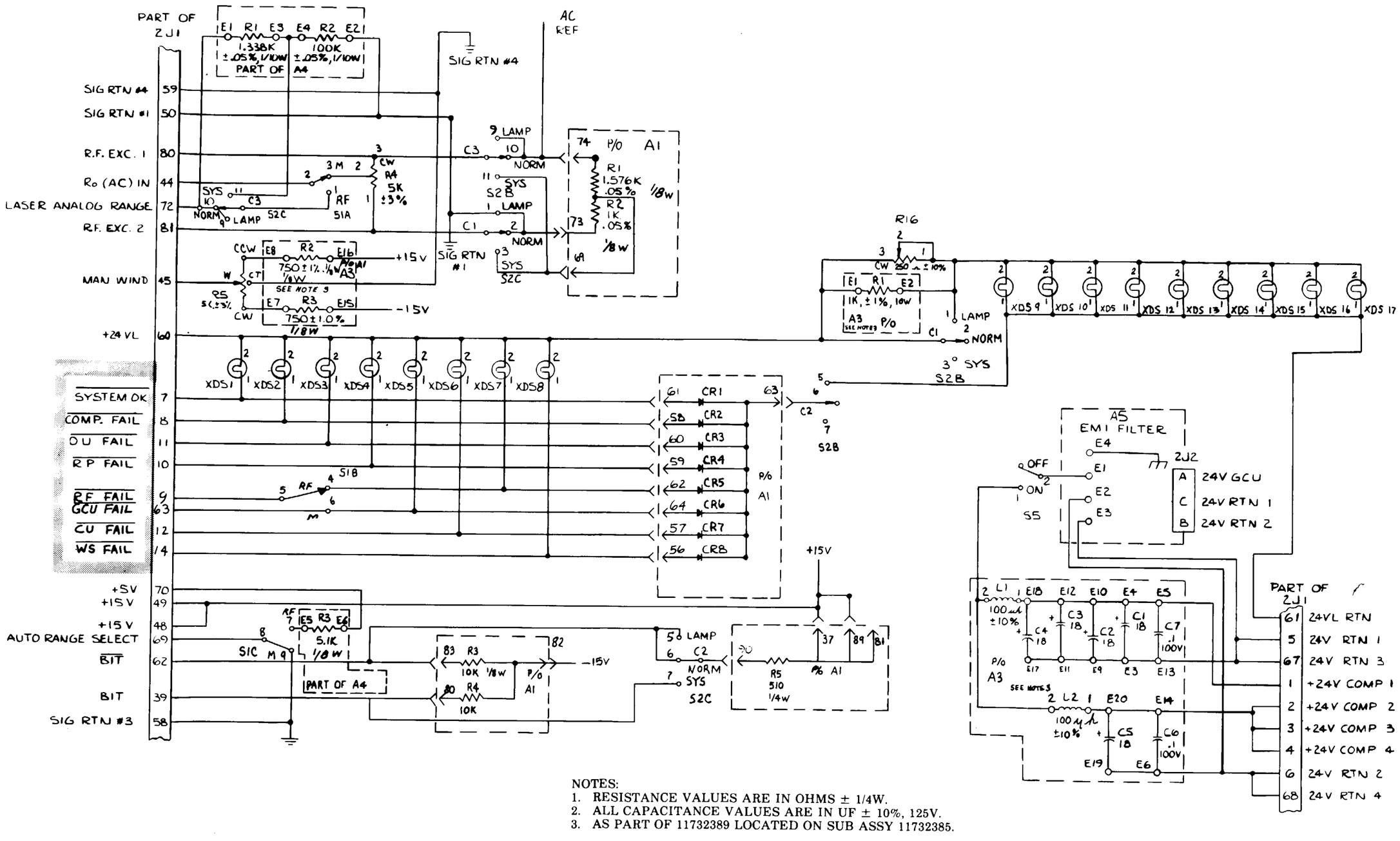


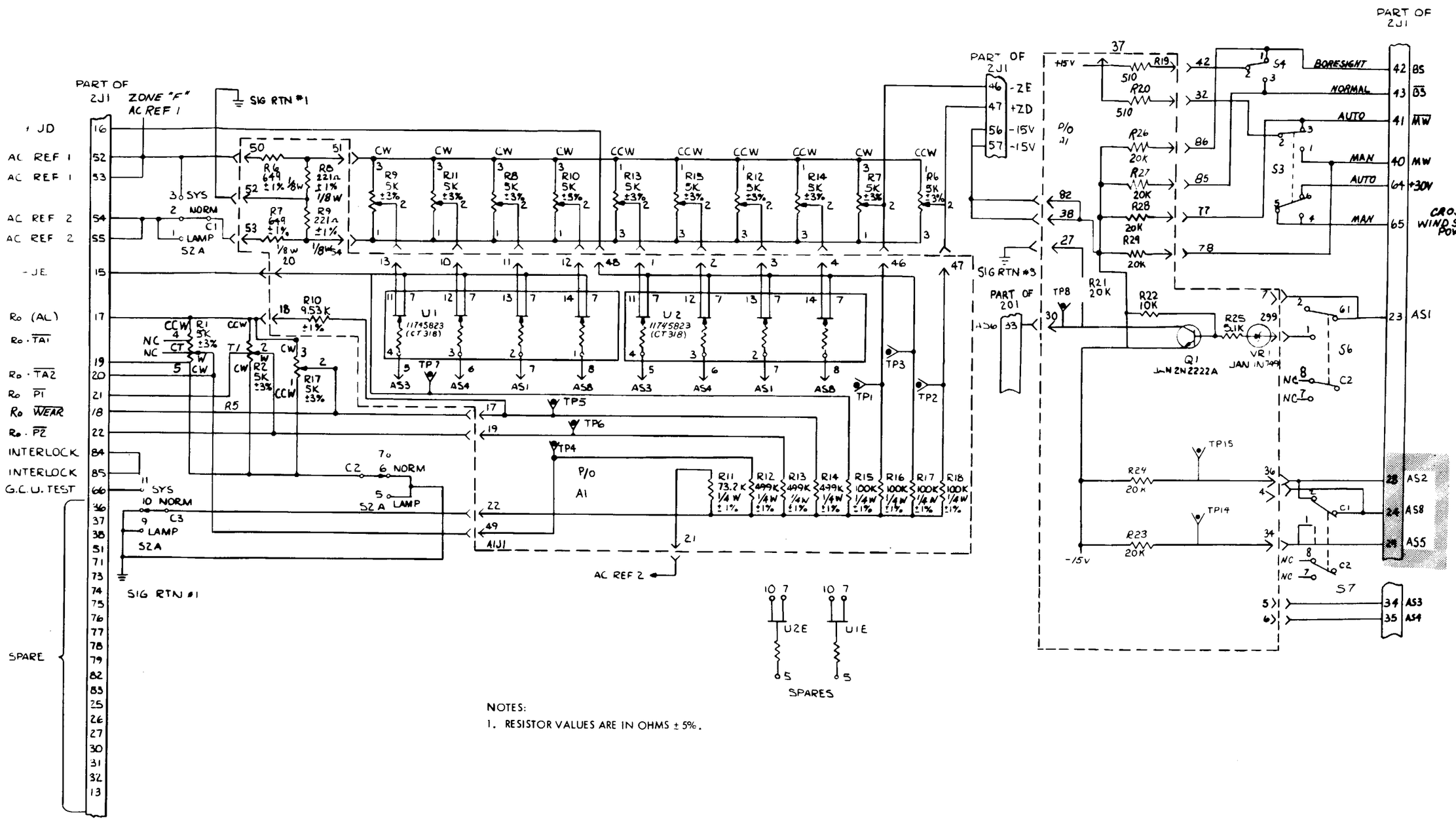
Figure FO-10. Mirror drive servo electronics block diagram (2 of 2)

Change 3



NOTES:
1. RESISTANCE VALUES ARE IN OHMS ± 1/4W.
2. ALL CAPACITANCE VALUES ARE IN UF ± 10%, 125V.
3. AS PART OF 11732389 LOCATED ON SUB ASSY 11732385.

Figure FO-11. Gunner's control unit schematic diagram (1 of 2)



NOTES:

1. RESISTOR VALUES ARE IN OHMS ± 5%.

Figure FO-11. Gunner's control unit schematic diagram (2 of 2)

NOTES:
RESISTOR VALUES ARE IN OHMS, + 5%, 1W.

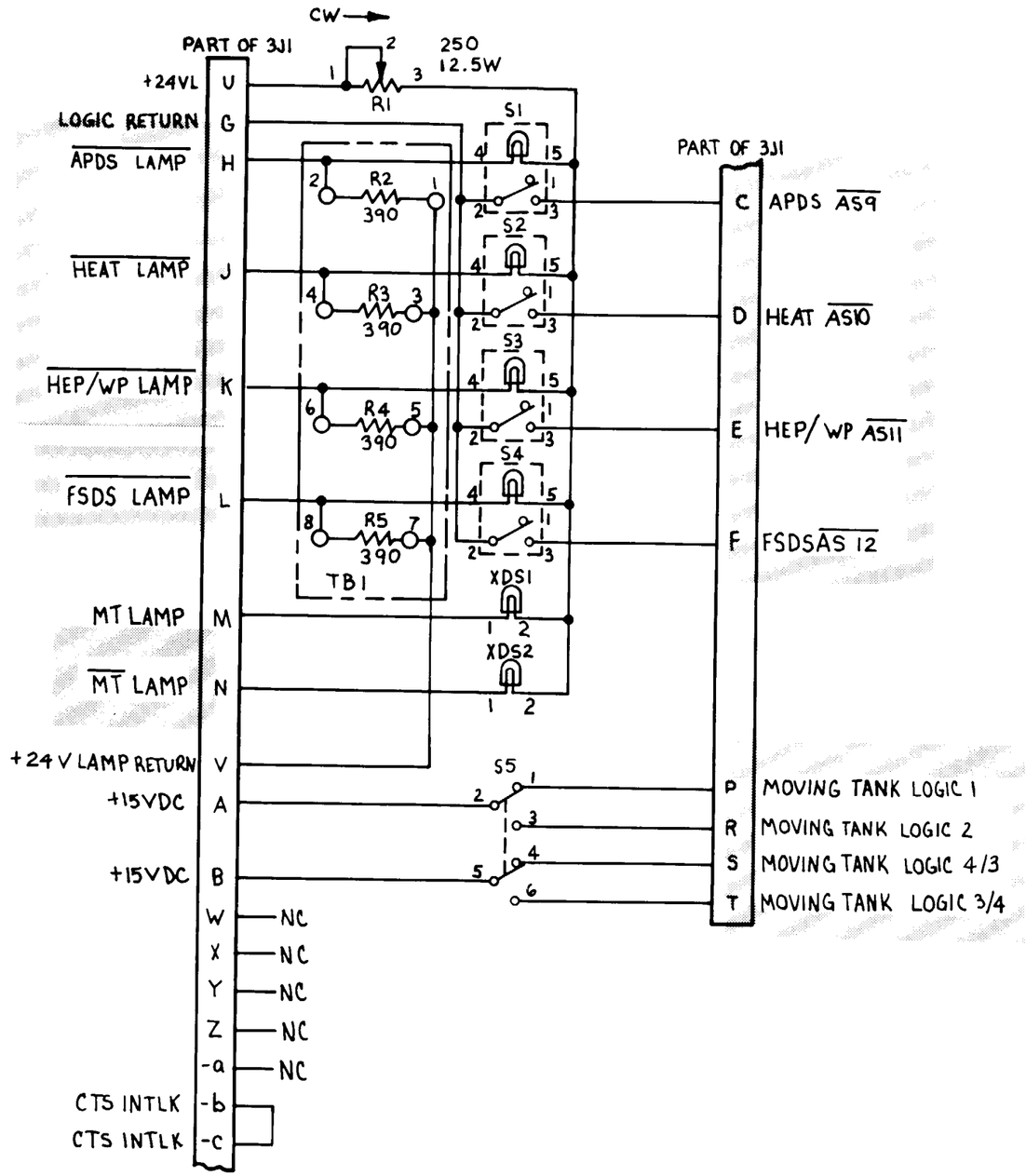


Figure FO-12 Ammo select unit schematic diagram

THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb.
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq. Centimeter = 100 Sq. Millimeters = 0.155 Sq. Inches
1 Sq. Meter = 10,000 Sq. Centimeters = 10.76 Sq. Feet
1 Sq. Kilometer = 1,000,000 Sq. Meters = 0.386 Sq. Miles

CUBIC MEASURE

1 Cu. Centimeter = 1000 Cu. Millimeters = 0.06 Cu. Inches
1 Cu. Meter = 1,000,000 Cu. Centimeters = 35.31 Cu. Feet

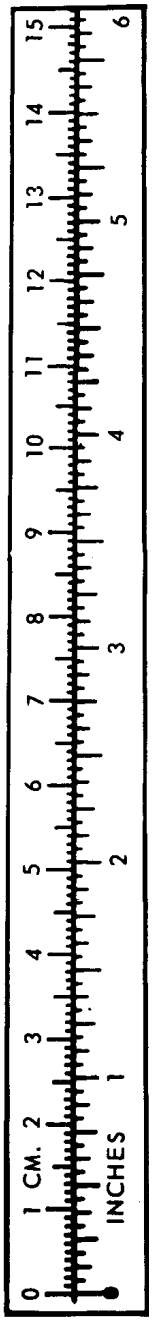
TEMPERATURE

5/9 (°F - 32) = °C
212° Fahrenheit is equivalent to 100° Celsius
90° Fahrenheit is equivalent to 32.2° Celsius
32° Fahrenheit is equivalent to 0° Celsius
9/5 (°C + 32) = °F

APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	Miles per Hour	0.621



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