AEROFLEX

Ramp Test Set MLS-801-1

Operation Manual

1002-7450-2P0

OPERATION MANUAL

RAMP TEST SET

MLS-801-1

PUBLISHED BY
Aeroflex

10200 West York / Wichita, Kansas 67215 U.S.A. / (316) 522-4981 / FAX (316) 524-2623

Cable Statements:

For continued EMC compliance, all external cables must be 3 meters or less in length.

For continued EMC compliance, all external cables must be double shielded.

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SAFETY FIRST: TO ALL SERVICE PERSONNEL

REFER ALL SERVICING OF UNIT TO QUALIFIED TECHNICAL PERSONNEL. THIS UNIT CONTAINS NO OPERATOR SERVICEABLE PARTS.

WARNING: USING THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE ACCOMPANYING DOCUMENTATION MAY IMPAIR THE SAFETY PROTECTION PROVIDED BY THE EQUIPMENT.

CASE, COVER OR PANEL REMOVAL

Opening the Case Assembly exposes the operator to electrical hazards that can result in electrical shock or equipment damage. Do not operate this Test Set with the Case Assembly open.

SAFETY IDENTIFICATION IN TECHNICAL MANUAL

This manual uses the following terms to draw attention to possible safety hazards, that may exist when operating or servicing this equipment.

CAUTION: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN EQUIPMENT OR PROPERTY DAMAGE (E.G., FIRE).

WARNING: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN PERSONAL INJURY OR DEATH.

SAFETY SYMBOLS IN MANUALS AND ON UNITS

CAUTION: Refer to accompanying documents. (This symbol refers to specific CAUTIONS represented on the unit and clarified in the text.)

AC OR DC TERMINAL: Terminal that may supply or be supplied with ac or dc voltage.

DC TERMINAL: Terminal that may supply or be supplied with dc voltage.

AC TERMINAL: Terminal that may supply or be supplied with ac or alternating voltage.

DANGEROUS VOLTAGE: Indicates electrical shock hazard due to high voltage levels.

EQUIPMENT GROUNDING PRECAUTION

Improper grounding of equipment can result in electrical shock.

USE OF PROBES

Check the specifications for the maximum voltage, current and power ratings of any connector on the Test Set before connecting it with a probe from a terminal device. Be sure the terminal device performs within these specifications before using it for measurement, to prevent electrical shock or damage to the equipment.

POWER CORDS

Power cords must not be frayed, broken nor expose bare wiring when operating this equipment.

USE RECOMMENDED FUSES ONLY

Use only fuses specifically recommended for the equipment at the specified current and voltage ratings.

WARNING: THE MLS-801-1 USES A LEAD ACID BATTERY. THE FOLLOWING WARNINGS CONCERNING LEAD ACID BATTERIES MUST BE HEEDED:

- **DO NOT RECHARGE OUTSIDE THE MLS-801-1.**
- **DO NOT CRUSH, INCINERATE OR DISPOSE OF IN NORMAL WASTE.**
- **DO NOT SHORT CIRCUIT OR FORCE DISCHARGE AS THIS MIGHT CAUSE THE BATTERY TO VENT, OVERHEAT OR EXPLODE.**

CAUTION: SIGNAL GENERATORS CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE (EMI) TO COMMUNICATION RECEIVERS. SOME TRANSMITTED SIGNALS CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICES OUT TO A DISTANCE OF SEVERAL MILES. USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION THAT RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.

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INTRODUCTION

This manual contains the information necessary to operate the MLS-801-1 Test Set.

It is strongly recommended that personnel be throughly familiar with the contents of this manual before attempting to operate this equipment.

ORGANIZATION

This manual is divided into the following Chapters and Sections:

CHAPTER 1 - OPERATION

Section 1 - DESCRIPTION

Section 2 - OPERATION (installation; description of controls, connectors and indicators; performance evaluation; and general operating procedures)

Section 3 - SPECIFICATIONS

Section 4 - SHIPPING

Section 5 - STORAGE

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CHAPTER ONE
MLS-801-1 RAMP TEST SET
OPERATION MANUAL
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LIST OF ILLUSTRATIONS

LIST OF TABLES

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SECTION 1 - DESCRIPTION

1. GENERAL DESCRIPTION AND CAPABILITIES

1.1 DESCRIPTION

The MLS-801-1 is a ruggedized ramp tester designed for ease of use, portability, reliability and long service life. The MLS-801-1 conforms to MIL-T-28800D, Type 2, Class II, Style A requirements. All power is derived from an internal battery. An ac input connection is provided for battery charging or servicing. All accessories (i.e., RF Test Cable, etc.) are stored in the Case lid.

The MLS-801-1 provides GO/NOGO verification of the Microwave Landing System angle receiver in a ramp situation. The MLS-801-1 generates a single channel, which includes all necessary AM and DPSK modulation for testing of Azimuth (AZ), Elevation (EL), Back Azimuth (BAZ) and Clearance (CLR) functions, as well as all the basic data words in their standard test conditions. Controls are provided for angle deviation with slew capability to exercise the Glideslope (G/S) and Localizer (LOC) indicators. Angle offset control is provided to test offset approach angle up to ±40°. The internal circuitry is modularized with a built-in Self Test to provide functional fault isolation. All internal components are attached to an inner chassis for easy composite removal.

1.2 FUNCTIONAL CAPABILITIES

- Complete simulation of MLS transmission cycle, including angular information and data words.
- Ruggedized construction designed to meet requirements of MIL-T-28800D in a Class II environment.
- Automatic Test Sequence mode to allow "one man" operation on ramp.
- Dynamic Slew capability at 0.05, 0.1, 0.5 and 1.0 deg/sec.
- Control Motion deflection position to test auto-pilot engagement.
- Built-In-Test (BIT) for confidence testing and fault isolation.
- Left and Right Clearance pulse simulation.
- Manual deflection controls for Azimuth and Elevation.
- Azimuth, High Rate Azimuth and Back Azimuth offset approach simulation up to 40°.
- Elevation approach angle simulation from 1° to 10°.
- Two power output levels for short and long range testing requirements.
- Fixed transmission frequency set to FAA specified channel for ground testing.
- Bright indicators with automatic dimming.
- Auxiliary RF, Video and Sync Pulse outputs for use in bench testing.
- Internal Battery allowing up to four hours of operation before recharge.
- Automatic power shutdown after approximately 15 minutes of non-use.

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SECTION 2 - OPERATION

1. INSTALLATION

1.1 GENERAL

An internal battery powers the MLS-801-1. The Test Set contains a battery charging circuit that enables the operator to recharge the battery when connected to AC Power.

NOTE: The MLS-801-1 can operate continuously on AC Power for bench tests.

1.2 BATTERY OPERATION

The internal battery is equipped to power the MLS-801-1 for 4 hours of continuous use, after which time, the MLS-801-1 battery needs recharging. When executing the Self-Test function, the "BATT" SELF-TEST Indicator indicates when the battery is usable or in need of recharging.

The MLS-801-1 contains an automatic time-out to conserve power. If a control is not changed within a 15 minute time period, the MLS-801-1 shuts OFF.

1.3 BATTERY CHARGING

The battery charger operates whenever AC Power is applied to the MLS-801-1. When the POWER Switch is switched to OFF, the battery reaches an 80% charge in approximately two hours. When the MLS-801-1 is operating, the battery charges at a slower rate. The battery should be charged every three months (minimum) and/or disconnected for long term nonactive storage periods of more than six months.

1.4 SAFETY PRECAUTIONS

The following safety precautions must be observed during installation and operation. Aeroflex assumes no liability for failure to comply with any safety precaution outlined in this manual.

1.4.1 Complying with Instructions

Installation/operating personnel should not attempt to install or operate the MLS-801-1 without reading and complying with all instructions contained in this manual. All procedures must be performed in exact sequence and manner described.

1.4.2 Grounding Requirements

WARNING: DO NOT USE A THREE-PRONG TO TWO-PRONG ADAPTER PLUG WHEN UTILIZING AC POWER. DOING SO CREATES A SHOCK HAZARD BETWEEN THE CHASSIS AND ELECTRICAL GROUND.

For AC Power, the power cord, equipped with standard three-prong plug, must be connected to a properly grounded three-prong receptacle. It is the customer's responsibility to:

- Have a qualified electrician check receptacle(s) for proper grounding.
- Replace any standard two-prong receptacle(s) with properly grounded three-prong receptacle(s).

1.4.3 Operating Safety

Due to potential for electrical shock within test equipment, the Chassis Assy must not be removed from the Case Assy. Battery replacement must only be performed by qualified service technicians.

1.4.4 CAUTION and WARNING Labels

Exercise extreme care when performing operations preceded by a CAUTION or WARNING label

CAUTION labels appear where possibility of damage to equipment exists.

WARNING labels denote conditions where bodily injury or death may result.

1.5 POWER REQUIREMENTS

The MLS-801-1 operates over a voltage range of 100 to 120 VAC or 220 to 240 VAC at 50 to 60 Hz according to the internal Line Supply Switch setting (only serviceable by a qualified technician). Refer to Battery/Voltage Instructions. The specified fuse ratings are listed in 1-2-1, Table 1.

NOTE: Factory setting for the Line Supply Switch (***115*** or ***230***) is shown on the Front Panel.

CAUTION: FOR THE CONTINUOUS PROTECTION AGAINST FIRE, REPLACE ONLY WITH FUSES OF THE SPECIFIED VOLTAGE AND CURRENT RATINGS.

INPUT VOLTAGE	F1 AND F2 FUSES
100 to 120 VAC (Line Supply Switch set to ***115***)	1.0 A, 250 V Fast Blo (Type F) (5 mm X 20 mm) (Aeroflex 5106-0000-027) (Bussman GMA-1)
220 to 240 VAC (Line Supply Switch set to ***230***)	0.5 A, 250 V Fast Blo (Type F) (5 mm X 20 mm) (Aeroflex 5106-0000-048) (Bussman GMA-500MA)

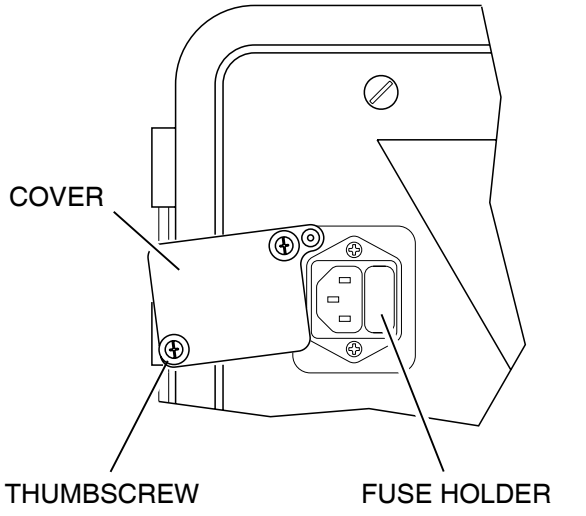
Specified Fuse Ratings
Table 1

1.6 FUSE REPLACEMENT

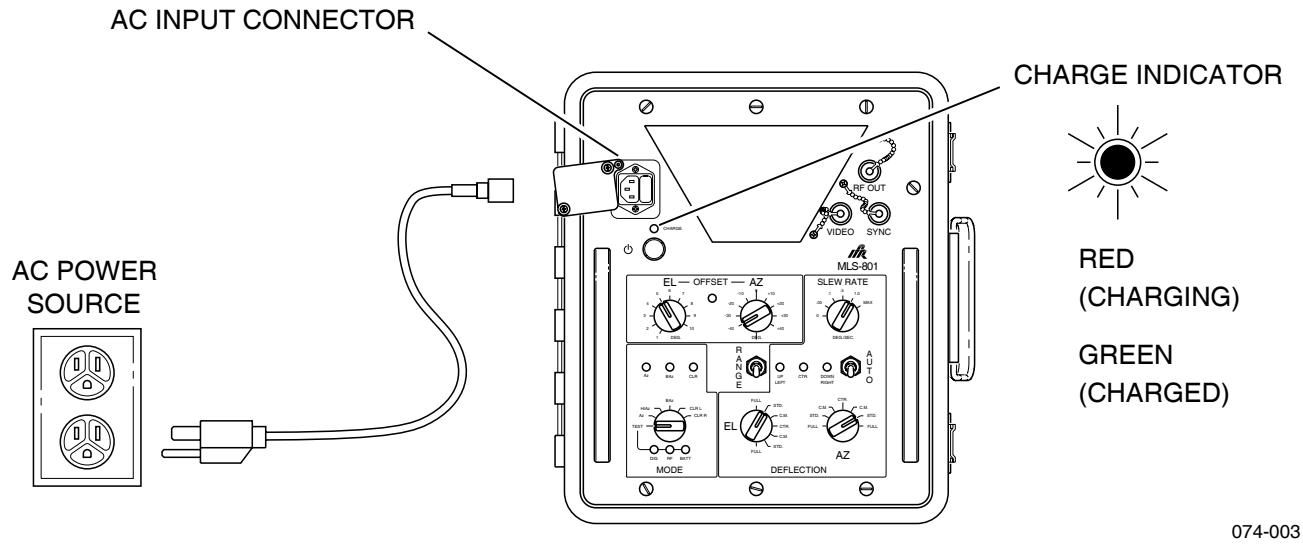
This procedure is for replacing fuses on the front panel.

Refer to 1-2-1, Figure 1.

STEP	PROCEDURE
1.	Turn thumbscrews ccw and rotate cover to the left (as shown).
2.	Use small flat head screwdriver to pry tab and fuse holder away from Test Set.
3.	Replace fuses as needed and reinstall fuse holder and tab.



Fuse Replacement
Figure 1



Battery Recharging
Figure 2

1.7 BATTERY RECHARGING

Refer to 1-2-1, Figure 2.

STEP	PROCEDURE

1. Remove cover from AC INPUT Connector.
2. Verify fuse (para 1-2-1.5).
3. Connect AC Power Cable between AC INPUT Connector and AC Power source according to Test Set configuration. Refer to para 1-2-1.5.

   NOTE: Factory setting for the Line Supply Switch is shown on the Front Panel.

4. Verify CHARGE Indicator illuminates red.
5. Allow two hours for battery charge or until CHARGE Indicator illuminates green.

   NOTE: If the battery fails to accept a charge, the battery, serviceable only by a qualified technician, requires replacing. Refer to Battery/Voltage Instructions.

1.8 EXTERNAL CLEANING

CAUTION: DISCONNECT POWER FROM TEST SET TO AVOID POSSIBLE DAMAGE TO ELECTRONIC CIRCUITS.

STEP	PROCEDURE

1. Clean front panel buttons and display face with soft lint-free cloth. If dirt is difficult to remove, dampen cloth with water and a mild liquid detergent.
2. Remove grease, fungus and ground-in dirt from surfaces with soft lint-free cloth dampened (not soaked) with isopropyl alcohol.
3. Remove dust and dirt from connectors with soft-bristled brush.
4. Cover connectors, not in use, with suitable dust cover to prevent tarnishing of connector contacts.
5. Clean cables with soft lint-free cloth.
6. Paint exposed metal surface to avoid corrosion.

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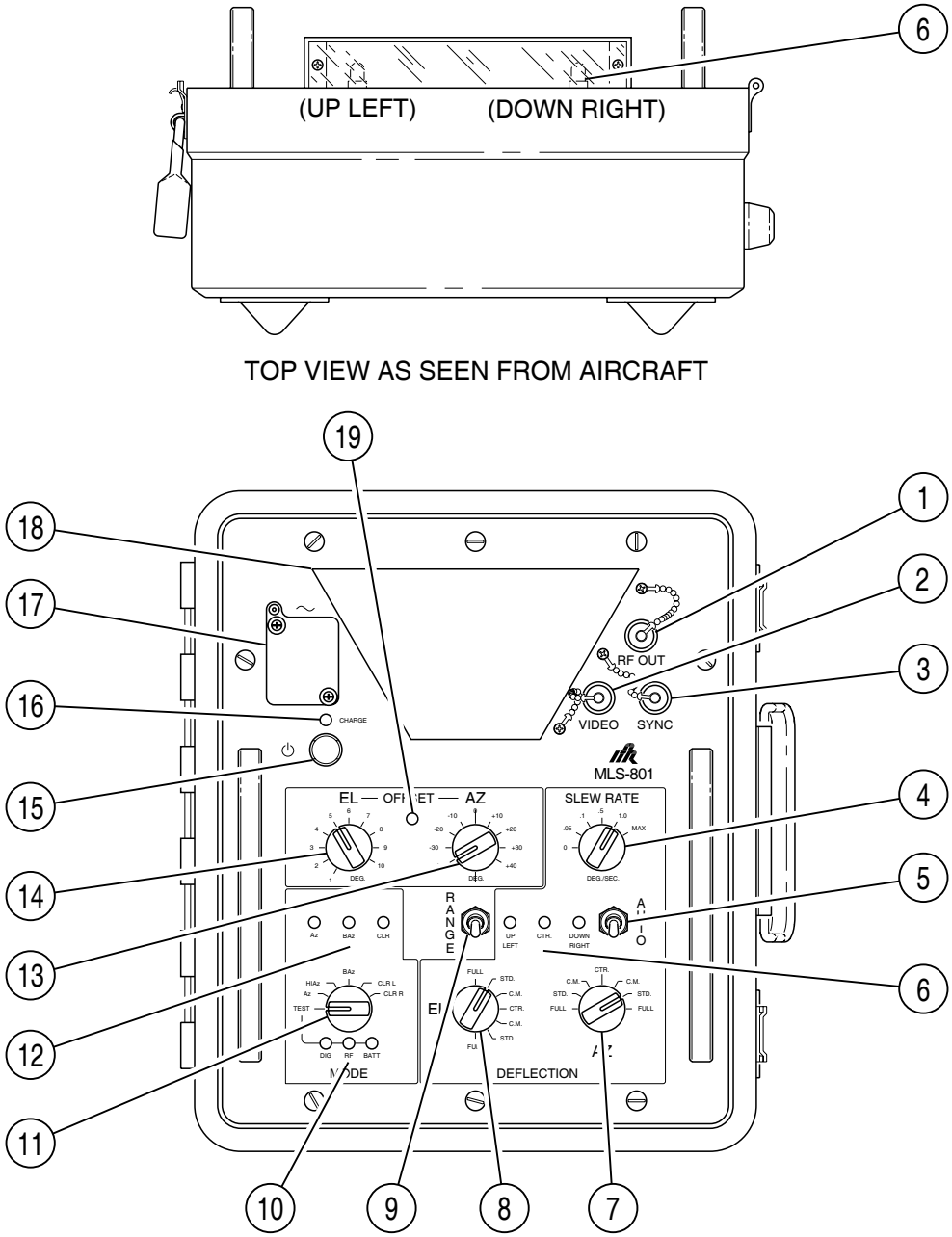
2. CONTROLS, CONNECTORS AND INDICATORS

MLS-801-1 Controls, Connectors and Indicators
Figure 3



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NUMERICAL LOCATION LIST	ALPHABETICAL LOCATION LIST	
1. RF OUTPUT Connector	AC INPUT Connector/Fuse Housing	17
2. VIDEO OUTPUT Connector	ANTENNA	18
3. SYNC OUTPUT Connector	AUTO-TEST SEQUENCE ON/OFF Switch	55
4. SLEW RATE Control	AZ DEFLECTION Control	7
5. AUTO-TEST SEQUENCE ON/OFF Switch	AZ OFFSET Control	13
6. DEFLECTION Indicators	CHARGE Indicator	16
7. AZ DEFLECTION Control	DEFLECTION Indicators	6
8. EL DEFLECTION Control	EL DEFLECTION Control	8
9. RANGE SELECT Switch	EL OFFSET Control	14
10. SELF-TEST Indicators	LED Light Sensor	19
11. MODE SELECT Control	MODE Indicators	12
12. MODE Indicators	MODE SELECT Control	11
13. AZ OFFSET Control	POWER Switch	15
14. EL OFFSET Control	RANGE SELECT Switch	9
15. POWER Switch	RF OUTPUT Connector	1
16. CHARGE Indicator	SELF-TEST Indicators	10
17. AC INPUT Connector/Fuse Housing	SLEW RATE Control	4
18. ANTENNA	SYNC OUTPUT Connector	3
19. LED Light Sensor	VIDEO OUTPUT Connector	2

ITEM	DESCRIPTION

1. RF OUTPUT Connector

   TNC Connector provides alternate RF signal output for servicing/bench use.

   NOTE: Antenna output is constantly active.

2. VIDEO OUTPUT Connector

   BNC Connector provides detected video output for servicing/bench use.

3. SYNC OUTPUT Connector

   BNC Connector provides Oscilloscope Sync for servicing/bench use.

4. SLEW RATE Control

   Selects rate of change (0, 0.05, 0.1, 0.5 and 1.0 or MAX) in deg/sec from one deflection state to another. MAX setting is free-run or instantaneous.

5. AUTO-TEST SEQUENCE ON/OFF Switch

   Selects automatic override or manual setting for control of AZ DEFLECTION Control and EL DEFLECTION Control. When set to ON, deflection follows a repetitive sequence of DOWN/RIGHT (full scale) for 6 sec, CTR (both) for 6 sec and UP/LEFT (full scale) for 6 sec. SLEW RATE Control affects rate of change between states.

   NOTE: AUTO test mode is only used when AZ, HiAZ and BAZ functions are selected. Clearance mode selection results in an error condition indicated by alternate flashing of DEFLECTION Indicators and MODE Indicators simultaneously at a 0.5 sec rate.

6. DEFLECTION Indicators

   NOTE: Additional Deflection Indicators (UP LEFT and DOWN RIGHT), located inside ANTENNA, allow operator to monitor transmitter deflection signal change from Aircraft cockpit during AUTO-TEST Sequence.

ITEM	DESCRIPTION

6. DEFLECTION Indicators (cont)

   - UP LEFT (Red)

     Indicates full scale (100%) UP Deflection for EL and (100%) LEFT Deflection for AZ.

   - CTR (Amber)

     Indicates EL and AZ Deflection is at 0% Full Scale (CTR).

   - DOWN RIGHT (Green)

     Indicates full scale (100%) DOWN Deflection for EL and (100%) RIGHT Deflection for AZ.

7. AZ DEFLECTION Control

   Selects Localizer (AZ) needle deflection as one of seven discrete values (three ± values plus a center position). SLEW RATE Control selects rate of angular change, in deg/sec, between deflection angles selected. AZ DEFLECTION Control is active only when AUTO-TEST SEQUENCE ON/OFF Switch is set to OFF.

   - FULL (±100% FSD)

     Full Scale Deflection (FSD) left or right (±3.2°).

   - STANDARD (±52% FSD)

     Standard Deflection left or right (±1.66°).

   - C.M. (±7% FSD)

     Control Motion. Small angular deflection (left or right) for testing control surfaceÿmovement when Autopilot is engaged (±0.22°).

   - CENTER (±0%)

     Centers Localizer (AZ) needle.

ITEM	DESCRIPTION

8. EL DEFLECTION Control

   Selects Glideslope (EL) needle deflection as one of seven discrete values (three ± values plus a center position). SLEW RATE Control selects rate of angular change, in deg/sec, between deflection angles selected. EL DEFLECTION Control is active only when AUTO-TEST SEQUENCE ON/OFF Switch is set to OFF.

   - FULL (±100% FSD)

     Full Scale Deflection (FSD) UP or DOWN (5/4 to 3/4 of EL Offset selected).

   - STANDARD (±52% FSD)

     Standard Deflection UP or DOWN (±1.66°).

   - C.M. (±7% FSD)

     Control Motion. Small angular deflection (up or down) for testing control surface movement when Autopilot is engaged (±0.22°).

   - CENTER (±0%)

     Centers Glideslope (EL) needle.

9. RANGE SELECT Switch

   HIGH/LOW position switch changes output level by 20 dB, which changes maximum transmitting range from approximately 300 ft (91.4 m) to 30 ft (9.1 m).

10. SELF-TEST Indicators

    Used for fault isolation of Digital Circuit, RF Circuit and Battery Charge Circuit.

    - DIG - (Green/Red)

      Indicates Digital Circuit Pass/Fail when MODE SELECT Control is set to TEST.

    - RF - (Green/Red)

      Indicates RF Circuit Pass/Fail when MODE SELECT Control is set to TEST.

ITEM	DESCRIPTION

10. SELF-TEST Indicators (cont)

    - BATT - (Red/Green)

      Red indicates battery is low (approximately 25% charge) and green indicates battery is over 25% charged when MODE SELECT Control is set to TEST.

      NOTE: MODE SELECT Control does not need to be set to TEST for BATT SELF-TEST Indicator to show a low voltage indication.

      NOTE: Charging battery before use prevents low voltage shut-off.

11. MODE SELECT Control

    Selects Azimuth (AZ), High Rate Azimuth (HiAZ) or Back Azimuth (BAZ) function to be varied along with Elevation (EL) using the AZ DEFLECTION Control and EL DEFLECTION Control. Clearance Left (CLR L) or Clearance Right (CLR R) functions are fixed AZ angle tests with no AZ Deflection Control capability. MODE SELECT Control, set to TEST, initiates Built-In TEST sequence.

    NOTE: When MODE SELECT Control is set to BAZ, all controls applicable to AZ or HiAZ are applicable to BAZ.

    NOTE: EL DEFLECTION Control is still active in Clearance Mode.

    - TEST

      System Test. Tests Digital Circuit, RF Circuit and Battery Charge Circuit in MLS-801-1. System Test gives operator a GO or NOGO indication for status of MLS-801-1. "DIG" and "RF" SELF-TEST Indicators illuminate red when test is initiated, followed by green when test is successfully completed. In this mode, RF output transmission is CW.

      NOTE: "BATT" SELF-TEST Indicator indicates green unless a low voltage condition exists.

ITEM	DESCRIPTION

11. MODE SELECT Control (cont)

- AZ

  Selects normal forward Azimuth function transmitted at a 13 Hz rate (Appendix A).

- HiAZ

  Selects High Rate Azimuth function transmitted at a 39 Hz rate (Appendix A). AZ OFFSET Control and AZ DEFLECTION Control apply only to High Rate Azimuth.

- BAZ

  Selects the Back Azimuth function transmitted at a 6.5 Hz rate (Appendix A). AZ OFFSET Control and AZ DEFLECTION Control apply only to Back Azimuth.

- CLR L

  Selects Clearance Left function (Appendix A).

  AZ OFFSET Control and AZ DEFLECTION Control are overridden. EL OFFSET Control and EL DEFLECTION Control are active. Approach AZ Proportional Coverage Limits in Data Word #1 are set to ±10°. Receiver output indicates full scale left deflection without generation of warning signals.

- CLR R

  Selects Clearance Right function (Appendix A).

  AZ OFFSET Control and AZ DEFLECTION Control are overridden. EL OFFSET Control and EL DEFLECTION Control are active. Approach AZ Proportional Coverage Limits in Data Word #1 are set to ±10°. Receiver output indicates full scale right deflection without generation of warning signals.

ITEM	DESCRIPTION

12. MODE Indicators

- AZ - (Amber)

  Indicates forward Azimuth mode when MODE SELECT Control (11) is set to AZ or HiAZ.

- BAZ - (Red)

  Indicates Back Azimuth mode when MODE SELECT Control (11) is set to BAZ.

- CLR - (Green)

  Indicates LEFT/RIGHT Clearance Test is active when MODE SELECT Control (11) is set to CLR L or CLR R.

13. AZ OFFSET Control

    Selects Azimuth Offset to correspond to programmed offset approach angle (Localizer) in receiver.

14. EL OFFSET Control

    Selects Elevation Offset to correspond to programmed offset approach angle (Glideslope) in receiver.

15. POWER Switch

    Push ON/Push OFF momentary switch applies power to MLS-801-1. Green indicator inside POWER Switch indicates active status.

    NOTE: Internal automatic time-out removes all power from MLS-801-1 following ten minutes of no-switch activity.

16. CHARGE Indicator (Red/Green)

    Red indicates external power is applied to MLS-801-1 and battery is recharging. Green indicates battery is more than 80% charged.

    NOTE: Battery charger is active when ac power is applied.

ITEM	DESCRIPTION

17. AC INPUT Connector/Fuse Housing

    Provides the input for an external AC Power source (100 to 120 VAC or 220 to 240 VAC at 50 to 60 Hz) for recharging the battery or operating the Test Set. The operating voltage range depends on the Line Supply Switch Setting, only serviceable by a qualified technician. Refer to Battery/Voltage Instructions.

18. ANTENNA

    Directional paraboloidal reflector.

19. LED Light Sensor

    Dims all LEDs when covered.

3. PERFORMANCE EVALUATION

3.1 GENERAL

The MLS-801-1 is equipped with a Self-Test for testing the Digital, RF and Battery Charge Circuits. Front Panel Indicators verify Pass (Green)/Fail (Red).

Refer to 1-2-2, Figure 3 for location of controls, connectors and indicators.

3.2 SELF-TEST

STEP PROCEDURE

1. Push POWER Switch and verify switch indicator is illuminated.
2. Set MLS-801-1 controls as follows:

CONTROL	SETTING
RANGE SELECT Switch	***HIGH***
MODE SELECT Control	***TEST***

3. Verify ***DIG*** and ***RF*** SELF-TEST Indicators are ***RED***, then turn to ***GREEN*** within 7 sec.

   NOTE: The ***BATT*** SELF-TEST Indicator is not dependent upon the MODE SELECT Control set to ***TEST*** to indicate low voltage.

   NOTE: If a SELF-TEST Indicator remains ***RED***, an error exists within the circuit. Refer to para 2-2-2 in MLS-801-1 Maintenance Manual for further testing and maintenance instructions.

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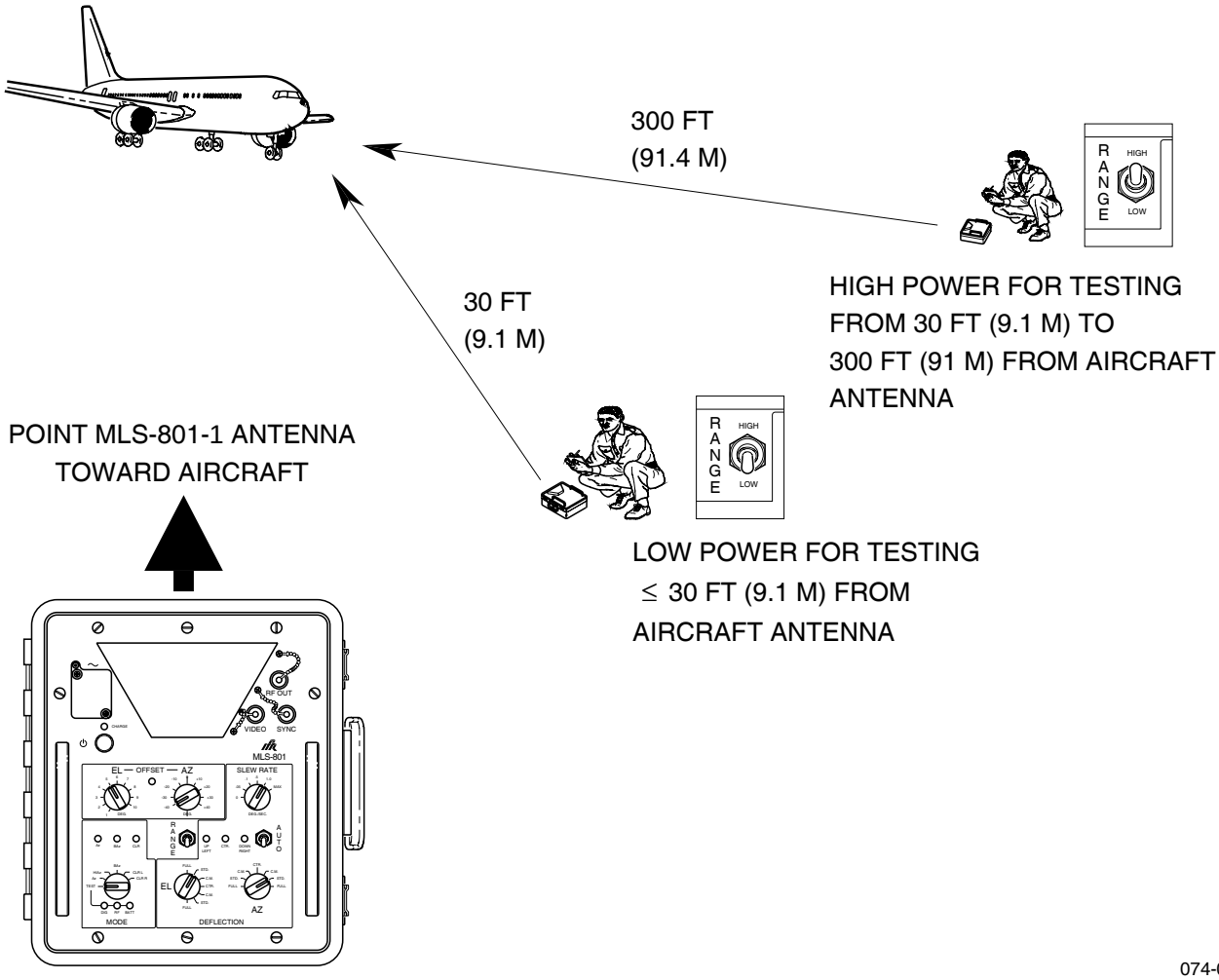
4. OPERATING PROCEDURES

This section contains operating instructions for the MLS-801-1 Ramp Test Set. General procedures identify the controls, connectors, indicators and DISPLAY screens used in individual MLS-801-1 test functions. For specific Unit Under Test (UUT) Procedures, refer to the UUT Manual.

Refer to 1-2-2, Figure 3 for location of controls, connectors and indicators.

TEST EXAMPLE PAGE



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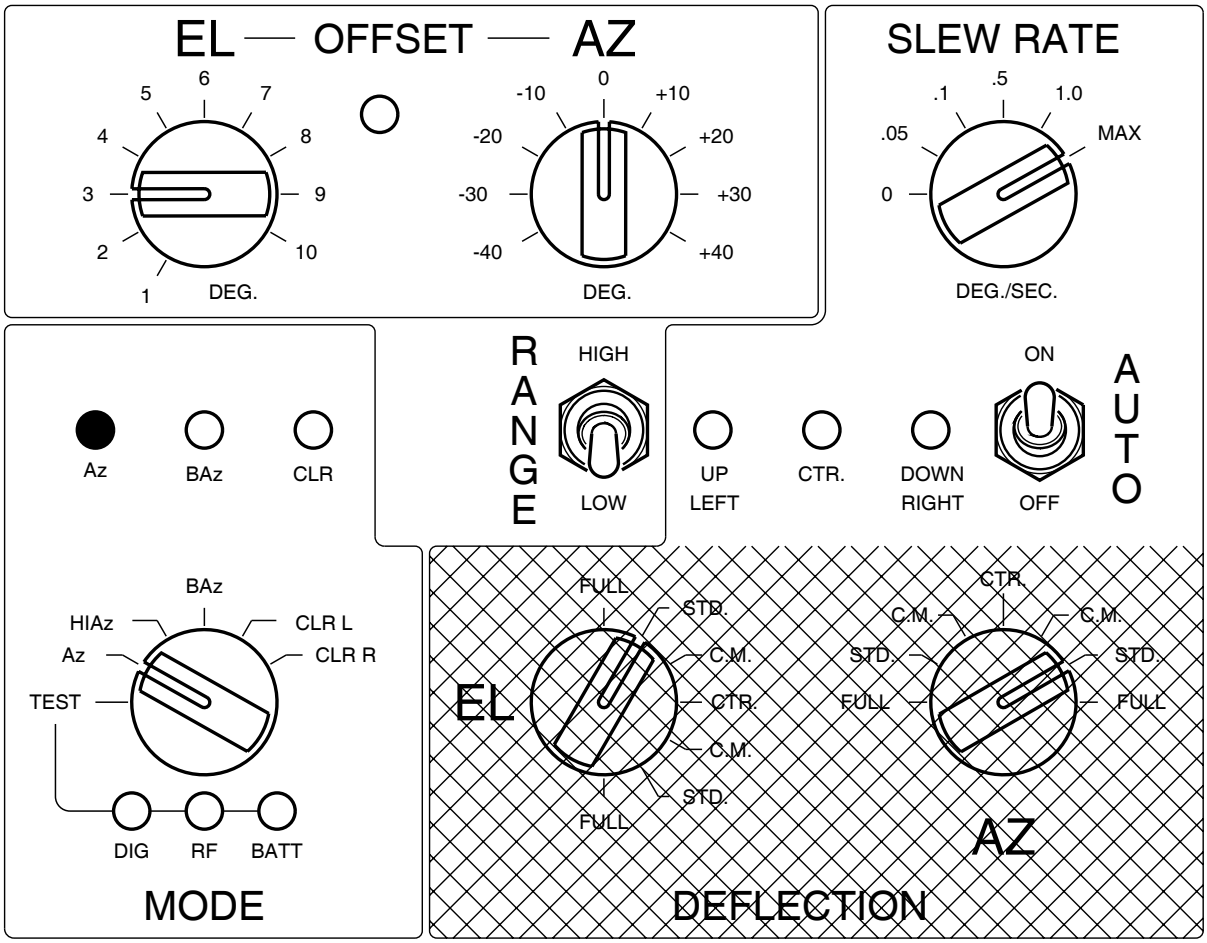
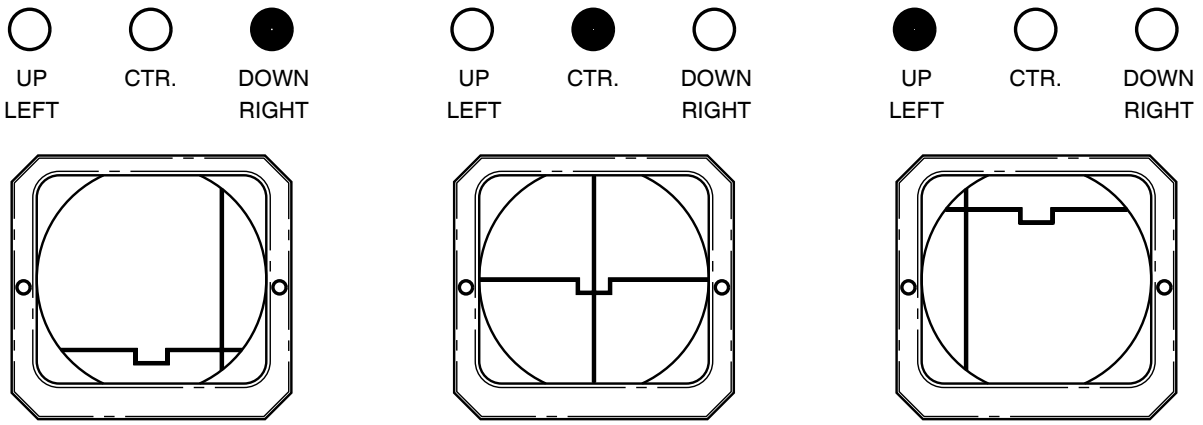
Range Select
Figure 4





AZ Low Range CDI Indications
Figure 5

4.1 AUTO TEST EXAMPLES

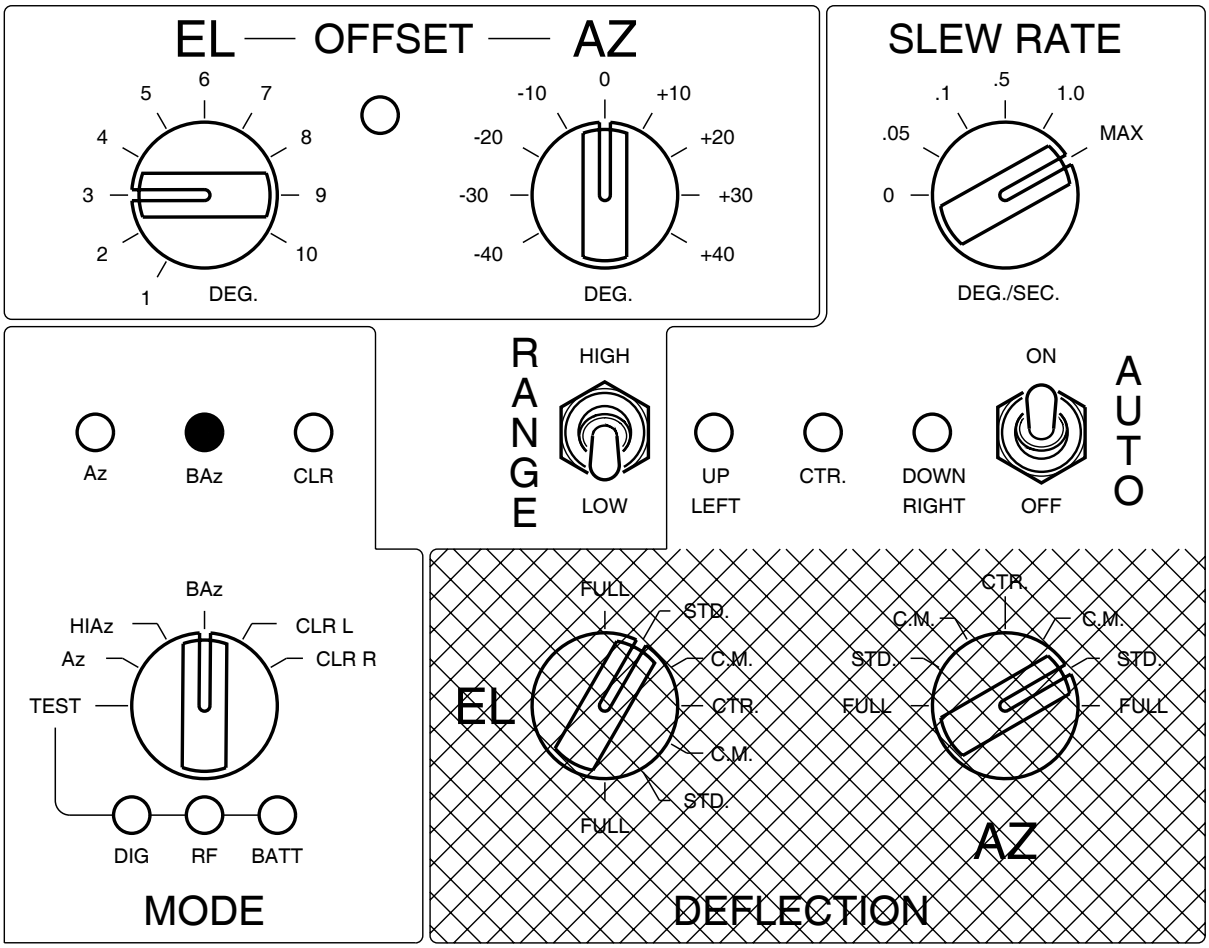
4.1.1 AZ Low Range Test Example

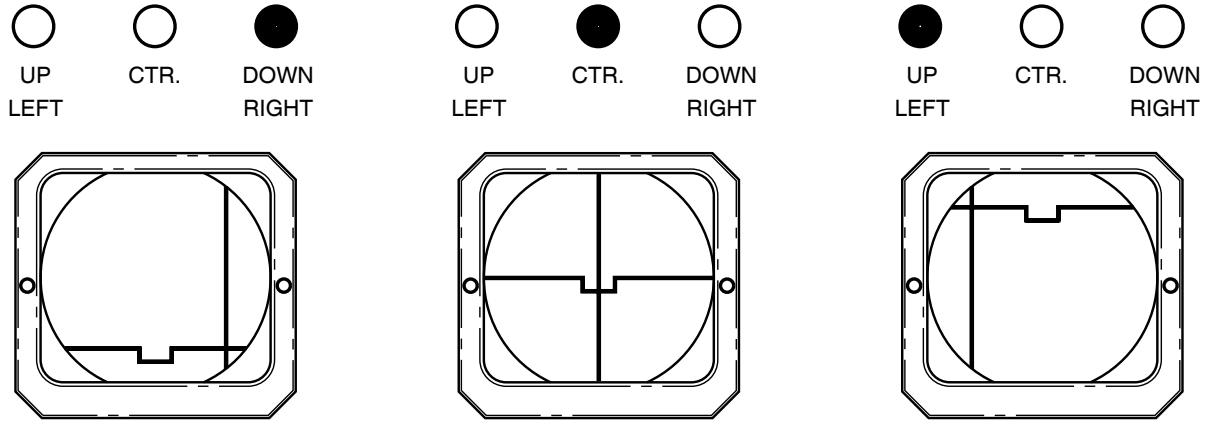
STEP	PROCEDURE

1. Set MLS-801-1 approximately 30 ft (9.1 m) from aircraft.
2. Point ANTENNA toward aircraft antenna (1-2-4, Figure 4).
3. Set MLS-801-1 controls as follows (1-2-4, Figure 5):

CONTROL	SETTING
SLEW RATE Control	***MAX***
AUTO TEST SEQUENCE ON/OFF Switch	***ON***
RANGE SELECT Switch	***LOW***
MODE SELECT Control	***AZ***
AZ OFFSET Control	***0***
EL OFFSET Control	***3***

4. Verify aircraft CDI needle movements as shown in 1-2-4, Figure 5.





BAZ Low Range CDI Indications
Figure 6

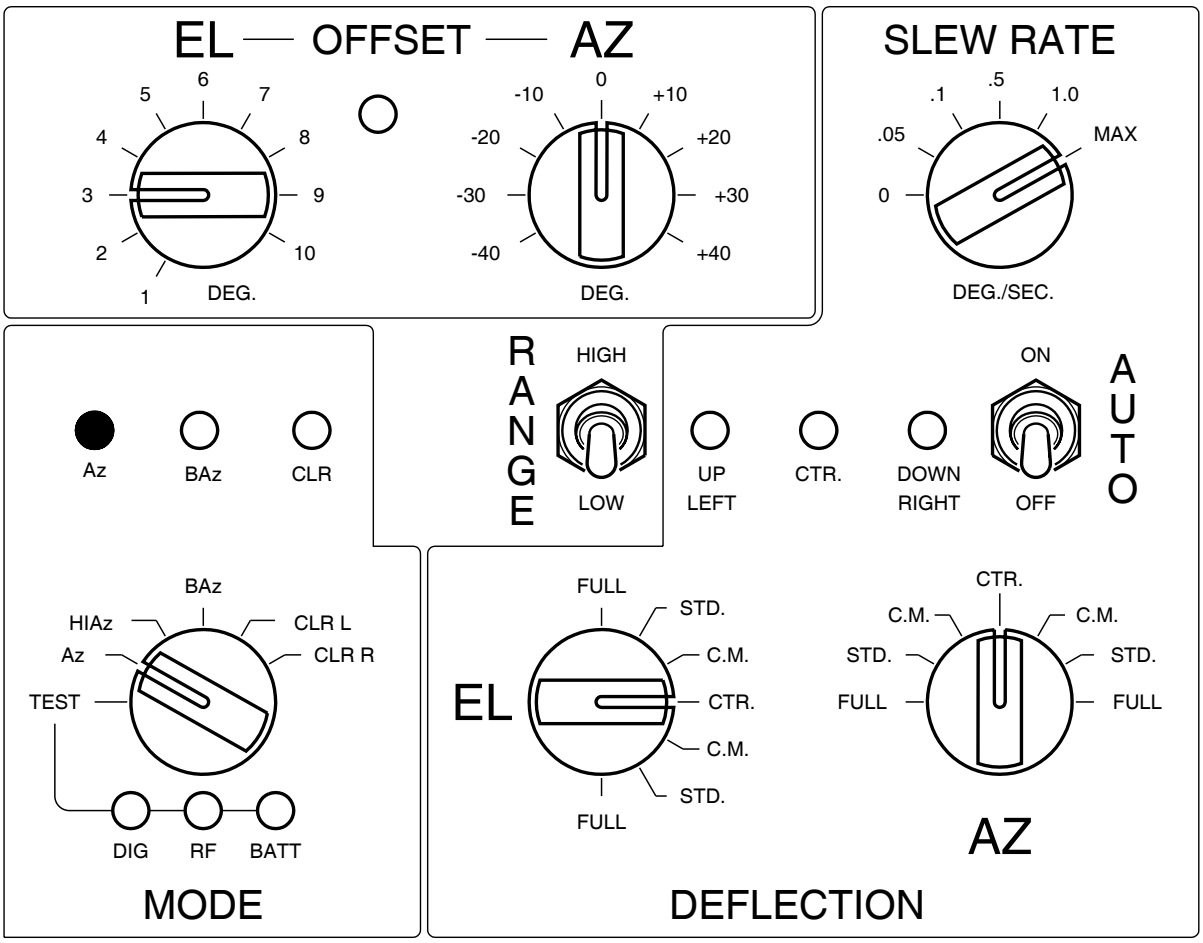
4.1.2 BAZ Low Range Test Example

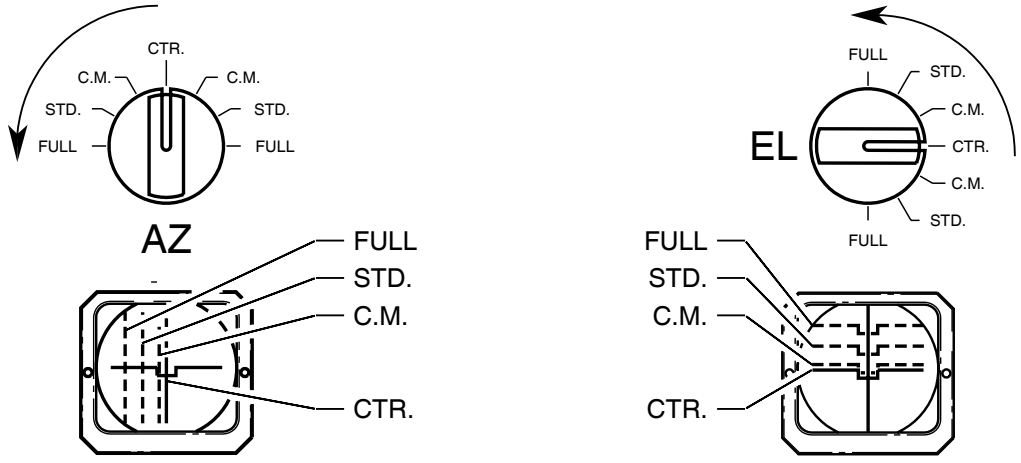
STEP	PROCEDURE

1. Set MLS-801-1 approximately 30 ft (9.1 m) from aircraft.
2. Point ANTENNA toward aircraft antenna (1-2-4, Figure 4).
3. Set MLS-801-1 controls as follows (1-2-4, Figure 6):

CONTROL	SETTING
SLEW RATE Control	***MAX***
AUTO TEST SEQUENCE ON/OFF Switch	***ON***
RANGE SELECT Switch	***LOW***
MODE SELECT Control	***BAZ***
AZ OFFSET Control	***0***
EL OFFSET Control	***3***

4. Verify aircraft CDI needle movements as shown in 1-2-4, Figure 6.





Manual UP LEFT CDI Indications
Figure 7

4.2 DEFLECTION TEST EXAMPLES

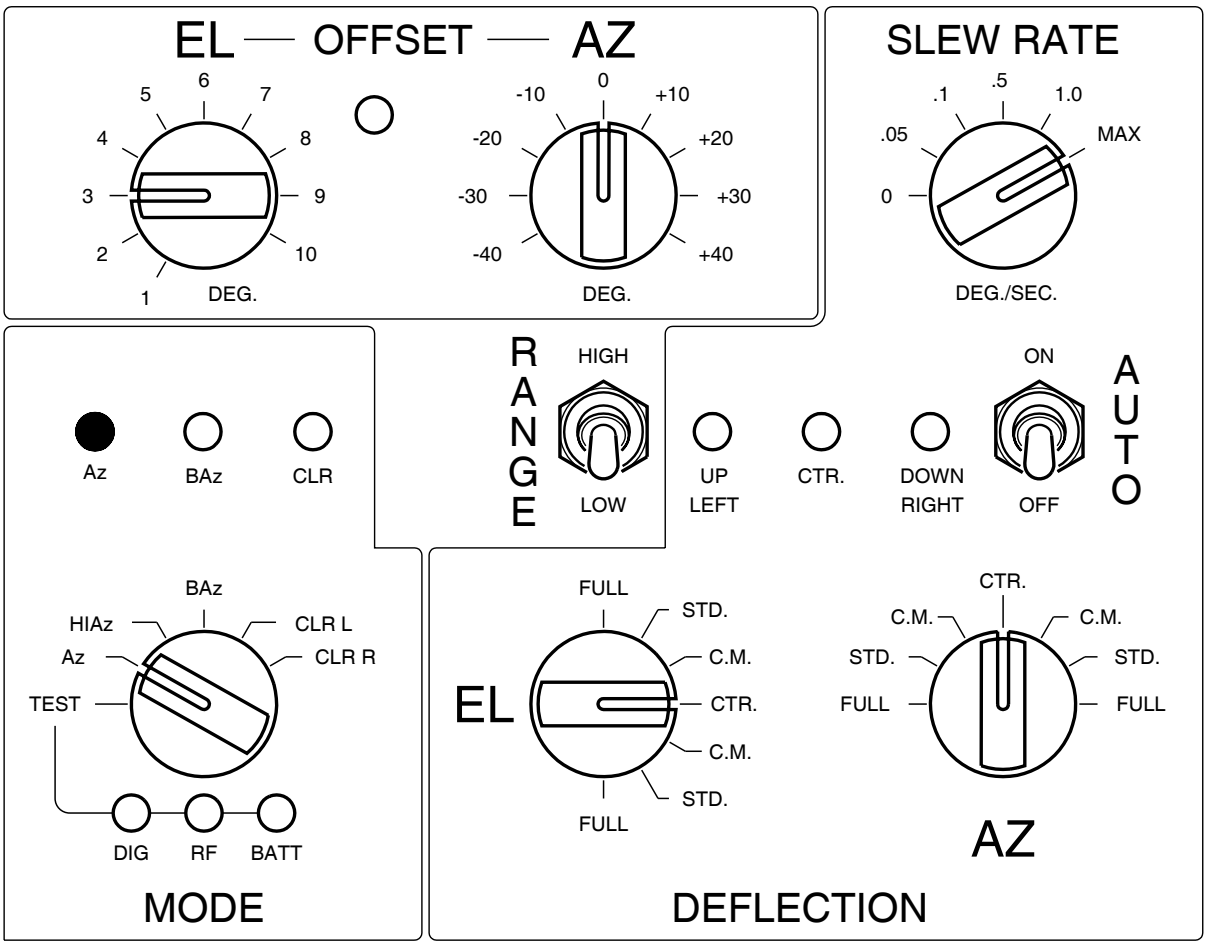
4.2.1 Manual UP LEFT Test Example

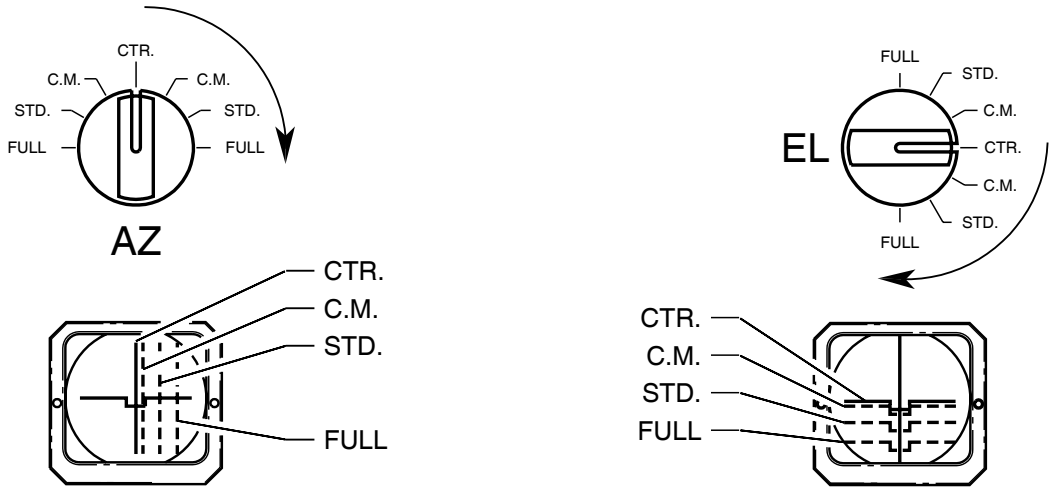
STEP PROCEDURE

1. Set MLS-801-1 approximately 30 ft (9.1 m) from aircraft.
2. Point ANTENNA toward aircraft antenna (1-2-4, Figure 4).
3. Set MLS-801-1 controls as follows (1-2-4, Figure 7):

CONTROL	SETTING
SLEW RATE Control	***MAX***
AUTO TEST SEQUENCE ON/OFF Switch	***OFF***
AZ DEFLECTION Control	***CTR***
EL DEFLECTION Control	***CTR***
RANGE SELECT Switch	***LOW***
MODE SELECT Control	***AZ***
AZ OFFSET Control	***0***
EL OFFSET Control	***3***

4. Set SLEW RATE Control to ***.1***. Verify CDI locks on to 0° AZ Deflection.
5. Rotate AZ DEFLECTION Control ***ccw*** from ***CTR*** to ***FULL***. Verify CDI needle movements as shown in 1-2-4, Figure 7.
6. Set AZ DEFLECTION Control to ***CTR***.
7. Verify CDI locks on to 0° EL Deflection.
8. Rotate EL DEFLECTION Control ***ccw*** from ***CTR*** to ***FULL***. Verify CDI needle movements as shown in 1-2-4, Figure 7.
9. Set EL DEFLECTION Control to ***CTR***.





Manual DOWN RIGHT CDI Indications
Figure 8

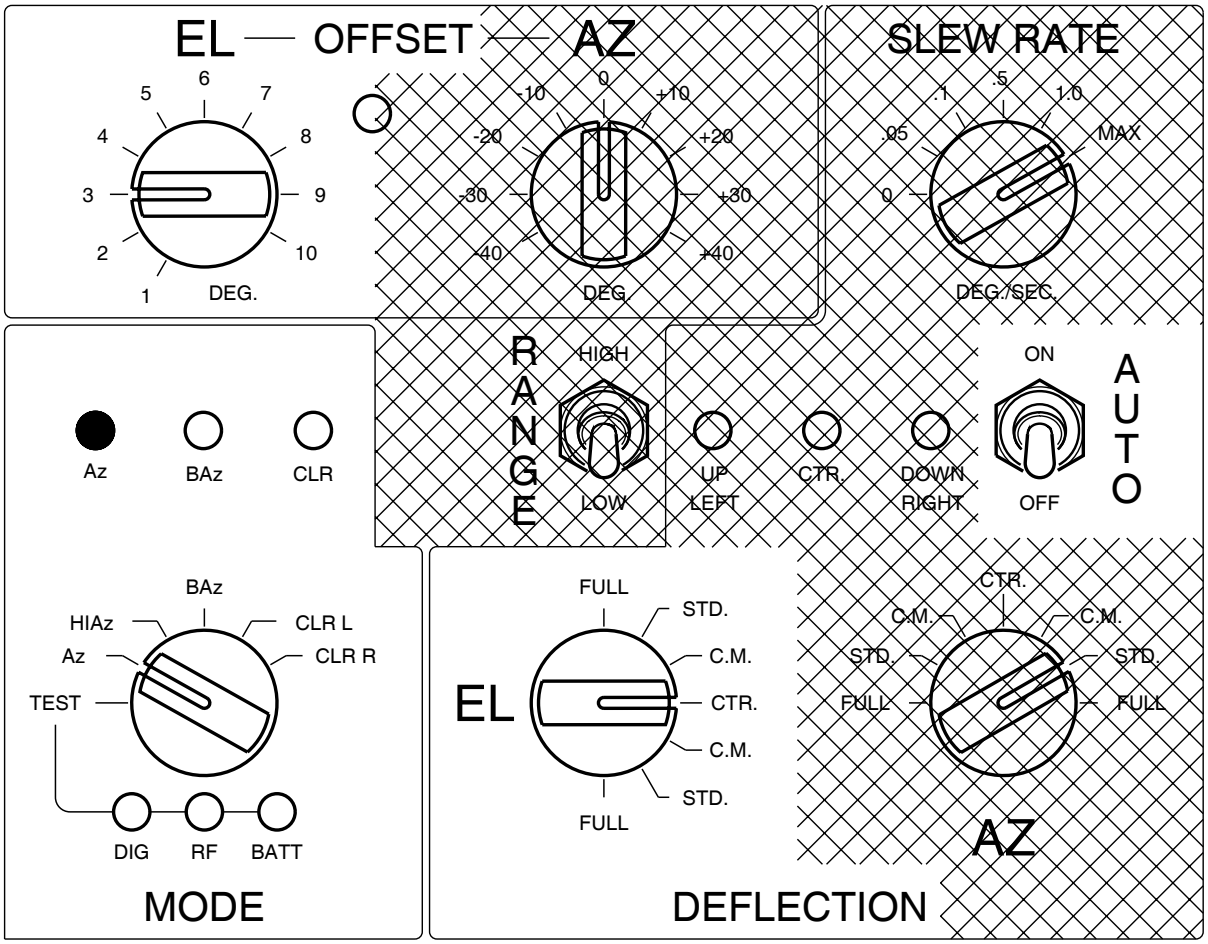
4.2.2 Manual DOWN RIGHT Test Example

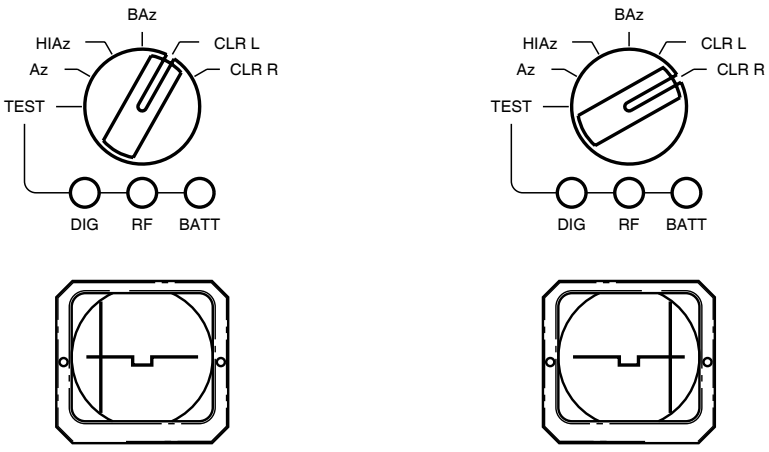
STEP	PROCEDURE

1. Set MLS-801-1 approximately 30 ft (9.1 m) from aircraft.
2. Point ANTENNA toward aircraft antenna (1-2-4, Figure 4).
3. Set MLS-801-1 controls as follows (1-2-4, Figure 8):

SLEW RATE Control	***MAX***
AUTO TEST SEQUENCE ON/OFF Switch	***OFF***
AZ DEFLECTION Control	***CTR***
EL DEFLECTION Control	***CTR***
RANGE SELECT Switch	***LOW***
MODE SELECT Control	***AZ***
AZ OFFSET Control	***0***
EL OFFSET Control	***3***

4. Set SLEW RATE Control to ***.1***. Verify CDI locks on to 0° AZ Deflection.
5. Rotate AZ DEFLECTION Control ***cw*** from ***CTR*** to ***FULL***. Verify CDI needle movements as shown in 1-2-4, Figure 8.
6. Set AZ DEFLECTION Control to ***CTR***.
7. Verify CDI locks on to 0° EL Deflection.
8. Rotate EL DEFLECTION Control cw from ***CTR*** to ***FULL***. Verify CDI needle movements as shown in 1-2-4, Figure 8.
9. Set EL DEFLECTION Control to ***CTR***.





Clearance CDI Indications
Figure 9

4.3 CLEARANCE TEST EXAMPLE

STEP PROCEDURE

1. Set MLS-801-1 approximately 30 ft (9.1 m) from aircraft.
2. Point ANTENNA toward aircraft antenna (1-2-4, Figure 3).
3. Set MLS-801-1 controls as follows (1-2-4, Figure 12):

CONTROL	SETTING
AUTO TEST SEQUENCE ON/OFF Switch	***OFF***
EL DEFLECTION Control	***CTR***
MODE SELECT Control	***AZ***
EL OFFSET Control	***3***

4. Set MODE SELECT Control to ***CLR L***. Verify CDI needle movement as shown in 1-2-4, Figure 13.
5. Set MODE SELECT Control to ***CLR R***. Verify CDI needle movement as shown in 1-2-4, Figure 13.

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SECTION 3 - SPECIFICATIONS

(Specifications and features are subject to change without notice.)

GENERATOR RF

Frequency:	Single Frequency tuned to Channel 500 (5031 MHz)
Frequency Accuracy:	±10 kHz
Antenna Output Level (at preamble):	
CAL Position:	
HIGH:	-69.5 dB (W/m2 at 30 ft (9.14 m)
LOW:	-89.5 dB (W/m2 at 30 ft (9.14 m)
Level Accuracy:	±2 dB
RF Output Connector Level (at preamble):	
HIGH:	-69 dBm
Accuracy:	±3 dB
LOW:	-89 dBm
Accuracy:	±3 dB
Phase Noise:	<0.2 Radian Peak measured in a 300 Hz to 15 kHz Bandwidth

RANGE

HIGH:	300 ft (91.4 m) typical (Refer to 1-3-1, Table 1.)
LOW:	30 ft (9.14 m) typical (Refer to 1-3-1, Table 1.)

Antenna Gain, MLS-801-1	10.5 dB
Antenna Gain, Aircraft	00.0 dB
Cable Loss, Aircraft	-11.0 dB
*Path Loss at 30 ft	-65.5 dB
*Path Loss at 9.14 m	-65.5 dB
*Path Loss at 300 ft	-85.5 dB
*Path Loss at 91.4 m	-85.5 dB
Receiver Sensitivity	-106.0 dBm
* = (1/(4*pi)*λ/D)**2	
Where pi = 3.14159 λ = Wavelength in ft (m) D = Distance in ft (m)	

Assumptions for Range Calculations
Table 1

DPSK MODULATION

Phase Accuracy:	180° (±10°)
Transition Time:	≤8 μs

BEAM CHARACTERISTICS

Standard Functions (Appendix A):

Beam Level:	Fixed at 6 dB above preamble.
Beam Level Accuracy:	±2 dB
Beam Width:	
AZ:	1.0° measured at -3 dB point
HiAZ:	3.0° measured at -3 dB point
BAZ:	1.0° measured at -3 dB point
EL:	1.0° measured at -3 dB point
Beam Width Accuracy:	±10%
Angle Offset:	
Azimuth:	±40° in 10° Steps
Elevation:	1 to 10° in 1° Steps
Angle Accuracy:	±0.1°

Clearance Functions (Appendix A):

Pulse Levels:	
CLR L:	+6 dB (left), -4 dB (right)
CLR R:	-4 dB (left), +6 dB (right)
Width:	1/2 (1°) Beam plus Clearance Pulse at -3 dB point = 75 μs
Position:	Pulses fixed at -12.5° left and +12.5° right

DEFLECTION

Center:	0% Full Scale Deflection (FSD)
Center Accuracy:	±0.1°

NOTE: FSD in Elevation is from 3/4 to 5/4 of reference angle or ±0.75° at a 3° offset.

NOTE: FSD in Azimuth assumes a linear proportional coverage of ±350 ft (106.7 m) at runway threshold with an Azimuth-to-Threshold distance (Data Word #1) computed by formula: "tan -1 (350/D)" or "tan -1 (106.7/D)." For maximum resolution in angle of 0.05°, FSD equals ±3.2°.

Full:	100% FSD
Standard:	52% FSD
Control Motion:	7% FSD
Slew Rate:	0.0, 0.05, 0.1, 0.5 and 1.0 deg/sec
Slew Rate Accuracy:	±0.05 deg/sec

INPUT POWER

Voltage and Frequency:	100 to 120 VAC or 220 to 240 VAC at 50 to 60 Hz
Mains Supply Fluctuations:	≤10% of nominal voltage
Transient Overvoltage:	Installation Category II
Maximum Power Consumption:	50 W Maximum

ENVIRONMENTAL

Use:	Pollution Degree 2
Operating Temperature:	(-40°F to +131°F (-40°C to +55°C)
Storage Temperature:	(-40°F to +160°F (-40°C to +71°C)
Humidity:	≤80% for temperatures up to 88°F (31°C), decreasing linearly to 50% at 104°F (40°C)
Altitude:	≤13,124 ft (4000 m)

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SECTION 4 - SHIPPING

1. SHIPPING TEST SETS

1.1 INFORMATION

Test Sets returned to factory for calibration, service or repair must be repackaged and shipped according to the following conditions:

Authorization

Do not return any products to factory without first receiving authorization from Aeroflex Customer Service Department.

CONTACT: Aeroflex
Customer Service

Phone: (800) 835-2350
FAX: (316) 524-2623
email: *service@aeroflex.com*

Tagging Test Sets

All Test Sets must be tagged with:

- Identification and address of owner
- Nature of service or repair required
- Model Number
- Serial Number

Shipping Containers

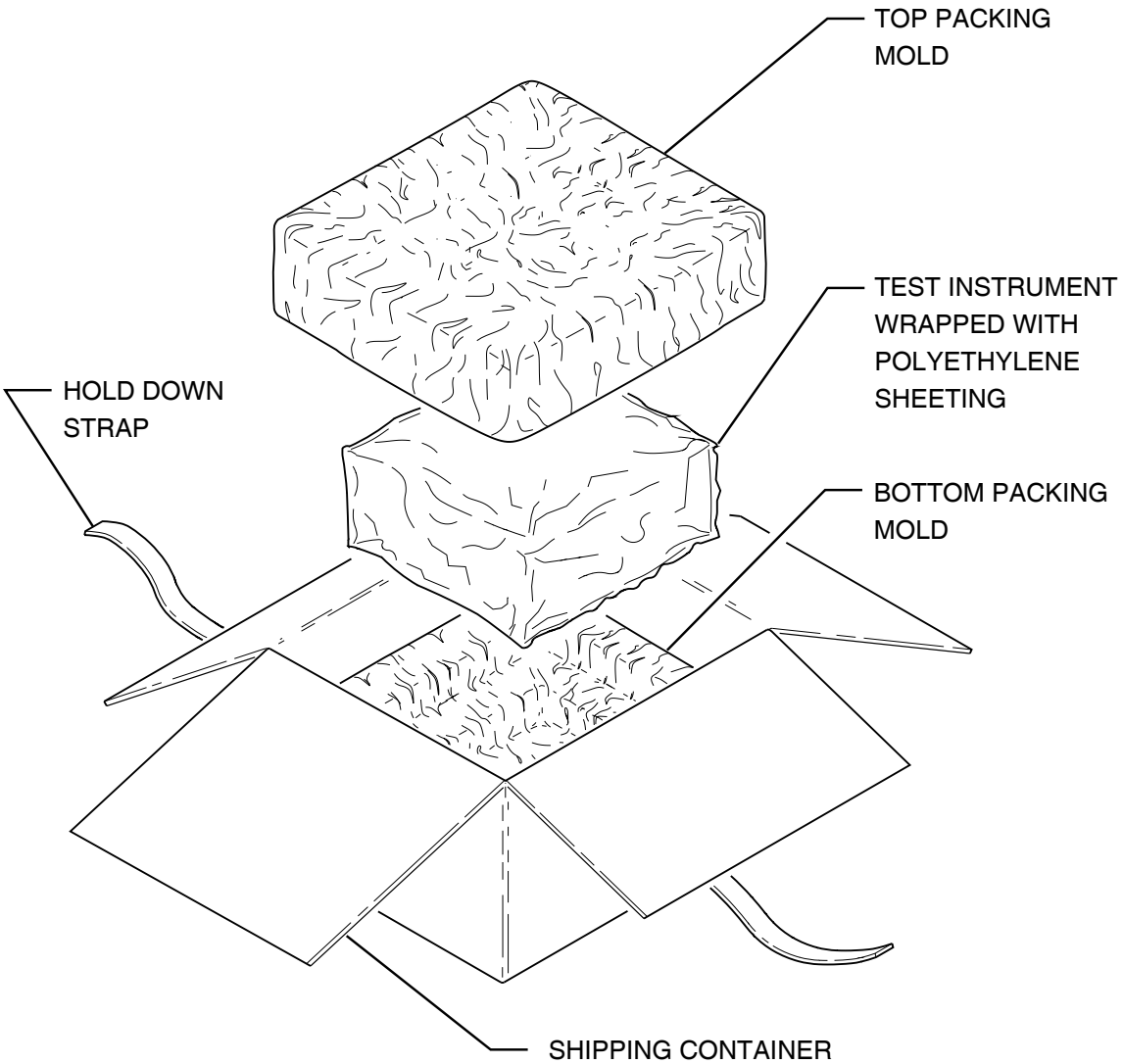
Test Sets must be repackaged in original shipping containers using Aeroflex packing molds. If original shipping containers and materials are not available, contact Aeroflex Customer Service for shipping instructions.

Freight Costs

All freight costs on non-warranty shipments are assumed by the customer. (See “Warranty Packet” for freight charge policy on warranty claims.)

1.2 REPACKING PROCEDURE

- Make sure bottom packing mold is seated on floor of shipping container.
- Carefully wrap Test Set with polyethylene sheeting to protect finish.
- Place Test Set into shipping container, making sure Test Set is securely seated in bottom packing mold.
- Place top packing mold over top of Test Set and press down until top packing mold rests solidly on Test Set.
- Close shipping container lids and seal with shipping tape or an industrial stapler. Tie all sides of container with break resistant rope, twine or equivalent.



Repacking Procedure
Figure 1

SECTION 5 - STORAGE

Perform the following storage precautions whenever the Test Set is stored for extended periods:

- Disconnect Test Set from any electrical power source.
- Disconnect and store ac power cable and other accessories with Test Set.
- Cover Test Set to prevent dust and debris from covering and entering Test Set.

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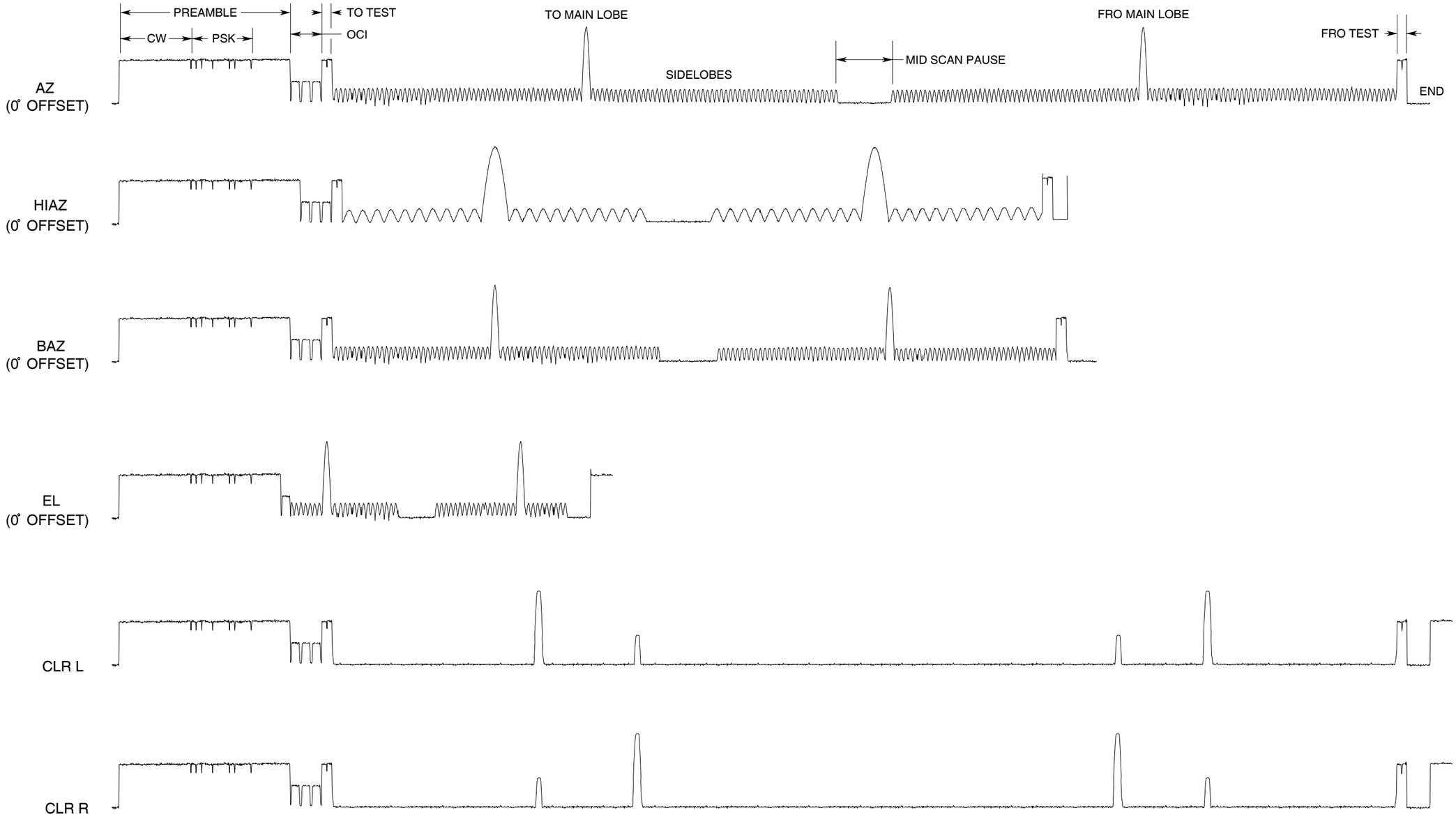
APPENDIX A - MLS-801-1 BEAMS



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APPENDIX B - TABLE OF CONNECTORS

CONNECTOR	SIGNAL TYPE
AC INPUT	AC
RF OUTPUT	RF
SYNC OUTPUT	TTL
VIDEO OUTPUT	VIDEO

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APPENDIX C - MLS-801-1 DATA WORDS

AZ and HiAZ Data Words

Data Word #1
AZ to Threshold Distance = 1900 Meters Proportional Coverage Limit = -40° to +40° Clearance Signal Type = Pulse Parity = Odd Update Rate = 1 Hz
Data Word #2
Minimum Glide Path = 3.0° BAZ Status = 1 (radiated) DME Status = 11 (FA Mode, Standard 2, available) Approach AZ Status = 1 1 (radiated) Parity = Odd Update Rate = 6.25 Hz
Data Word #3
Approach AZ Beamwidth = 1.0° (AZ and BAZ) 3.0° (HiAZ) Approach EL Beamwidth = 1.0° DME Distance = 0 Meters Parity = Odd Update Rate = 1 Hz
Data Word #4
Approach AZ Magnetic Orientation = 0° BAZ Magnetic Orientation = 180° Parity = Odd Update Rate = 1 Hz
Data Word #6
MLS Ground Equipment ID = "IFR" Parity = Odd Update Rate = 1 Hz
Data Word A1
Approach AZ Antenna Offset = 0 Meters Approach AZ to MLS Datum Point = 0 Meters Approach AZ Antenna Alignment w/Runway Centerline = 0° Approach AZ Antenna Coordinate System = 0 (conical) Parity = Even Update Rate = 1 Hz
Data Word A2
Approach EL Antenna Offset = 0 Meters MLS Datum Point to Threshold Distance = 0 Meters Approach EL Antenna Height = 0 Meters Parity = Even Update Rate = 1 Hz

AZ and HiAZ Data Words (cont)

Data Word A3
DME Offset = 0 Meters DME to MLS Datum Point = 0 Meters Parity = Even Update Rate = 1 Hz when AZ function is selected, 0.25 Hz when BAZ function is selected

BAZ Data Words

Data Word #5
BAZ Prop. Coverage Limit = ±40° BAZ Beamwidth = 1.0° BAZ Status = 1 (radiated in normal mode) Parity = Odd Update Rate = 1 Hz
Data Word A4
BAZ Antenna = 0 Meters BAZ to MLS Datum Point Distance = 0 Meters BAZ Antenna Alignment w/Runway Centerline = 0° Parity = Even Update Rate = 0.75 Hz when BAZ is selected, 0.25 Hz when AZ is selected

Clearance Data Words

Clearance Left
Same as AZ Setup except on Data Word #1: Approach AZ Proportional Coverage Limit = -10° to +10°
Clearance Right
Same as AZ Setup except on Data Word #1: Approach AZ Proportional Coverage Limit = -10° to +10°

APPENDIX D - METRIC/BRITISH IMPERIAL CONVERSION TABLE WITH NAUTICAL DISTANCE CONVERSIONS

TO CONVERT:	INTO:	MULTIPLY BY:	TO CONVERT:	INTO:	MULTIPLY BY:
cm	feet	0.03281	meters	feet	3.281
cm	inches	0.3937	meters	inches	39.37
feet	cm	30.48	m/sec	ft/sec	3.281
feet	meters	0.3048	m/sec	km/hr	3.6
ft/sec	km/hr	1.097	m/sec	miles/hr	2.237
ft/sec	knots	0.5921	miles	feet	5280
ft/sec	miles/hr	0.6818	miles	km	1.609
ft/sec^2	cm/sec^2	30.48	miles	meters	1609
ft/sec^2	m/sec^2	0.3048	miles	nmi	0.8684
grams	ounces	0.03527	miles/hr	ft/sec	1.467
inches	cm	2.54	miles/hr	km/hr	1.609
kg	pounds	2.205	miles/hr	knots	0.8684
kg/cm^2	psi	0.0703	nmi	feet	6080.27
km	feet	3281	nmi	km	1.8532
km	miles	0.6214	nmi	meters	1853.2
km	nmi	0.5396	nmi	miles	1.1516
km/hr	ft/sec	0.9113	ounces	grams	28.34953
km/hr	knots	0.5396	pounds	kg	0.4536
km/hr	miles/hr	0.6214	psi	kg/cm^2	0.0703
knots	ft/sec	1.689	100 ft	km	3.048
knots	km/hr	1.8532	100 ft	miles	1.894
knots	miles/hr	1.1516	100 ft	nmi	1.645

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APPENDIX E - ABBREVIATIONS

A	
A	Ampere
ac	Alternating Current
AM	Amplitude Modulation
Assy	Assembly
AZ	Azimuth
B	
BATT	Battery
BAZ	Back Azimuth
BIT	Built-In Test
C	
C	Celsius
ccw	Counterclockwise
CDI	Course Direction Indicator
CLR	Clearance
CLR L	Clearance Left
CLR R	Clearance Right
cm	Centimeter
C.M.	Control Motion
CTR	Center
cw	Clockwise
CW	Continuous Wave
D	
dB	Decibel
dBm	Decibels Relative to Milliwatts
deg	Degree
DIG	Digital
DME	Distance Measuring Equipment
DPSK	Differential Phase Shift Keying
E	
EL	Elevation
F	
F	Fahrenheit
FSD	Full Scale Deflection
ft	Feet
G	
GHz	Gigahertz
G/S	Glideslope
H	
HiAZ	High Azimuth
hr	Hour
Hz	Hertz
I	
ILS	Instrument Landing System
I/O	Input/Output
K	
kg	Kilogram
kHz	Kilohertz
km	Kilometer
L	
L	Left
LOC	Localizer
LSD	Least Significant Digit
M	
m	Meter
MAX	Maximum
MHz	Megahertz
MIN	Minimum
MLS	Microwave Landing System
ms	Millisecond
N	
nmi	Nautical Mile
ns	Nanosecond
O	
OCI	Out of Coverage Indicator
P	
psi	Pounds per Square Inch
R	
R	Right
RF	Radio Frequency
S	
Sec	Second
STD	Standard
V	
V	Volt
VAC	Volts Alternating Current
Vdc	Volts Direct Current
W	
W	Watt

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INDEX

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FOR QUALIFIED SERVICE PERSONNEL ONLY

BATTERY/VOLTAGE INSTRUCTIONS

WARNING:

HIGH VOLTAGE EQUIPMENT

THIS EQUIPMENT CONTAINS CERTAIN CIRCUITS AND/OR COMPONENTS OF EXTREMELY HIGH VOLTAGE POTENTIALS, CAPABLE OF CAUSING SERIOUS BODILY INJURY OR DEATH. WHEN PERFORMING ANY OF THE PROCEDURES CONTAINED IN THIS MANUAL, HEED ALL APPLICABLE SAFETY PRECAUTIONS.

SAFETY FIRST: TO ALL SERVICE PERSONNEL

REFER ALL SERVICING OF UNIT TO QUALIFIED TECHNICAL PERSONNEL.

WARNING: USING THIS EQUIPMENT IN A MANNER NOT SPECIFIED BY THE ACCOMPANYING DOCUMENTATION MAY IMPAIR THE SAFETY PROTECTION PROVIDED BY THE EQUIPMENT.

CASE, COVER OR PANEL REMOVAL

Removing the Chassis Assy from the Case Assy exposes the technician to electrical hazards that can result in electrical shock or equipment damage.

SAFETY IDENTIFICATION IN TECHNICAL MANUAL

This manual uses the following terms to draw attention to possible safety hazards, that may exist when operating or servicing this equipment.

CAUTION: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN EQUIPMENT OR PROPERTY DAMAGE (E.G., FIRE).

WARNING: THIS TERM IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN PERSONAL INJURY OR DEATH.

SAFETY SYMBOLS IN MANUALS AND ON UNITS

CAUTION: Refer to accompanying documents. (This symbol refers to specific CAUTIONS represented on the unit and clarified in the text.)

AC OR DC TERMINAL: Terminal that may supply or be supplied with ac or dc voltage.

DC TERMINAL: Terminal that may supply or be supplied with dc voltage.

AC TERMINAL: Terminal that may supply or be supplied with ac or alternating voltage.

DANGEROUS VOLTAGE: Indicates electrical shock hazard due to high voltage levels.

EQUIPMENT GROUNDING PRECAUTION

Improper grounding of equipment can result in electrical shock.

USE OF PROBES

Check specifications for the maximum voltage, current and power ratings of any connector on the Test Set before connecting it with a probe from a terminal device. Be sure the terminal device performs within these specifications before using it for measurement, to prevent electrical shock or damage to the equipment.

POWER CORDS

Power cords must not be frayed, broken nor expose bare wiring when operating this equipment.

USE RECOMMENDED FUSES ONLY

Use only fuses specifically recommended for the equipment at the specified current and voltage ratings.

WARNING: THE MLS-801-1 USES A LEAD ACID BATTERY. THE FOLLOWING WARNINGS CONCERNING LEAD ACID BATTERIES MUST BE HEEDED:

- **DO NOT RECHARGE OUTSIDE THE MLS-801-1.**
- **DO NOT CRUSH, INCINERATE OR DISPOSE OF IN NORMAL WASTE.**
- **DO NOT SHORT CIRCUIT OR FORCE DISCHARGE AS THIS MIGHT CAUSE THE BATTERY TO VENT, OVERHEAT OR EXPLODE.**

CAUTION: INTEGRATED CIRCUITS AND SOLID STATE DEVICES SUCH AS MOS FETS, ESPECIALLY CMOS TYPES, ARE SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGES RECEIVED FROM IMPROPER HANDLING, THE USE OF UNGROUNDED TOOLS AND IMPROPER STORAGE AND PACKAGING. ANY MAINTENANCE TO THIS UNIT MUST BE PERFORMED WITH THE FOLLOWING PRECAUTIONS:

- BEFORE USE IN A CIRCUIT, KEEP ALL LEADS SHORTED TOGETHER EITHER BY THE USE OF VENDOR-SUPPLIED SHORTING SPRINGS OR BY INSERTING LEADS INTO A CONDUCTIVE MATERIAL.
- WHEN REMOVING DEVICES FROM THEIR CONTAINERS, GROUND THE HAND BEING USED WITH A CONDUCTIVE WRISTBAND.
- TIPS OF SOLDERING IRONS AND/OR ANY TOOLS USED MUST BE GROUNDED.
- DEVICES MUST NEVER BE INSERTED INTO NOR REMOVED FROM CIRCUITS WITH POWER ON.
- PC BOARDS, WHEN TAKEN OUT OF THE SET, MUST BE LAID ON A GROUNDED CONDUCTIVE MAT OR STORED IN A CONDUCTIVE STORAGE BAG. REMOVE ANY BUILT-IN POWER SOURCE, SUCH AS A BATTERY, BEFORE LAYING PC BOARDS ON A CONDUCTIVE MAT OR STORING IN A CONDUCTIVE BAG.
- PC BOARDS, IF BEING SHIPPED TO THE FACTORY FOR REPAIR, MUST BE PACKAGED IN A CONDUCTIVE BAG AND PLACED IN A WELL-CUSHIONED SHIPPING CONTAINER.

CAUTION: SIGNAL GENERATORS CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE (EMI) TO COMMUNICATION RECEIVERS. SOME TRANSMITTED SIGNALS CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICES OUT TO A DISTANCE OF SEVERAL MILES. USERS OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION THAT RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND ENSURE COMPLIANCE WITH INSTRUCTIONS IN FAA CIRCULAR AC 170-6C, DATED FEBRUARY 19, 1981.

FOR QUALIFIED SERVICE PERSONNEL ONLY

BATTERY REPLACEMENT (Figure 1)

STEP	PROCEDURE

1. Verify MLS-801-1 is OFF and is not connected to AC Power source.
2. Remove 12 securing screws and lift Chassis Assy from Case Assy.
3. Disconnect battery connector.
4. Remove two battery cover screws, open battery cover and remove battery.

WARNING: MLS-801-1 CONTAINS A SEALED LEAD-ACID BATTERY PACK. DISPOSE OF OLD BATTERY PACK IN ACCORDANCE WITH STANDARD SAFETY PROCEDURES.

⚠ **CAUTION:** REPLACE ONLY WITH THE BATTERY SPECIFIED BY AEROFLEX. DO NOT ATTEMPT TO INSTALL A NON-RECHARGEABLE BATTERY.

5. Install new battery, close battery cover and install two battery cover screws.
6. Connect battery connector.
7. Install Chassis Assy in Case Assy.
8. Install 12 securing screws.

CAUTION: REPLACING NYLON WASHERS IS RECOMMENDED TO MAINTAIN WATER RESISTANCE CAPABILITY WHEN REINSTALLING CHASSIS ASSY IN CASE ASSY.

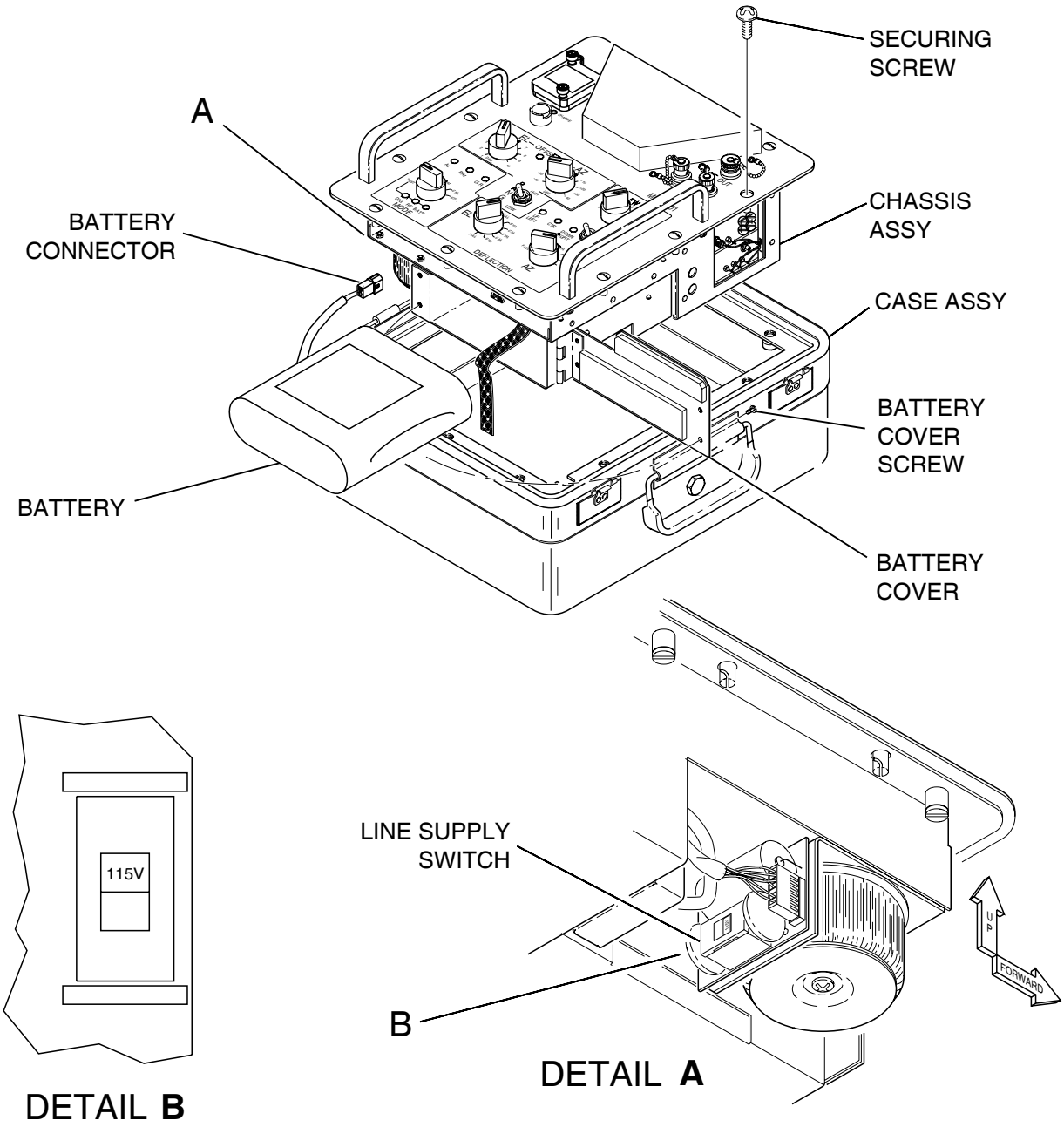
LINE SUPPLY SWITCH (Figure 1)

STEP	PROCEDURE

1. Verify MLS-801-1 is OFF and is not connected to AC Power Source.
2. Remove 12 securing screws and lift Chassis Assy from Case Assy.
3. Position Chassis Assy for access to Line Supply Switch.
4. If AC Power Source is 100 to 120 VAC at 50 to 60 Hz, set LIne Supply Switch to ***115***.

   If AC Power Source is 220 to 240 VAC at 50 to 60 Hz, set LIne Supply Switch to ***230***.
5. Install Chassis Assy in Case Assy.
6. Install 12 securing screws.

CAUTION: REPLACING NYLON WASHERS IS RECOMMENDED TO MAINTAIN WATER RESISTANCE CAPABILITY WHEN REINSTALLING CHASSIS ASSY IN CASE ASSY.



074-006

Battery Removal and Line Supply Switch Location
Figure 1

As we are always seeking to improve our products, the information in this document gives only a general indication of the product capacity, performance and suitability, none of which shall form part of any contract. We reserve the right to make design changes without notice.

CHINA	Tel: [+86] (10) 6467 2716	Fax: [+86] (10) 6467 2821
FRANCE	Tel: [+33] 1 60 79 96 00	Fax: [+33] 1 60 0177 69 22
HONG KONG	Tel: [+852] 2832 7988	Fax: [+852] 2834 5364
SCANDINAVIA	Tel: [+45] 9614 0045	Fax: [+45] 9614 0047
SPAIN	Tel: [+34] (91) 640 11 34	Fax: [+34] (91) 640 06 40
UNITED KINGDOM	Tel: [+44] (0) 1438 742200	Fax: [+44] (0) 1438 7276
	Toll Free: 0800 282388 (UK only)	
USA	Tel: [+1] (316) 522 4981	Fax: [+1] (316) 522 1360
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AEROFLEX

Our passion for performance is defined by three attributes represented by these three icons: solution-minded, performance-driven, customer-focused.