AEROFLEX

ALT-8000
Radio Altimeter
Flight Line Test Set

PRELIMINARY

Maintenance Manual

ALT-8000

Radio Altimeter
Flight-line Test Set

PRELIMINARY
Maintenance Manual

PUBLISHED BY
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ELECTROMAGNETIC COMPATIBILITY

Double shielded and properly terminated external interface cables must be used with this equipment when interfacing with the RS-232 and IEEE-488.

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

NOMENCLATURE STATEMENT

In this manual, ALT-8000, Test Set or Unit refers to the Configurable Automated Test Set shipped with any of the products in the ALT-8000 Series of Test Systems, as configured for standard bench-top operation.

SCOPE

This manual applies to all products in the ALT-8000 Configurable Automated Test Set family.

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Declaration of Conformity

The Declaration of Conformity Certificate included with the Unit should remain with the Unit.

Aeroflex recommends the operator reproduce a copy of the Declaration of Conformity Certificate to be stored with the Operation Manual for future reference.

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Precautions

SAFETY FIRST - TO ALL OPERATIONS PERSONNEL

GENERAL CONDITIONS OF USE

This product is designed and tested to comply with the requirements of IEC/EN61010-1 'Safety requirements for electrical equipment for measurement, control and laboratory use' for Class I portable equipment and is for use in a pollution degree 2 environment. The equipment is designed to operate from installation supply Category II.

Equipment should be protected from liquids such as spills, leaks, etc. and precipitation such as rain, snow, etc. When moving the equipment from a cold to hot environment, allow the temperature of the equipment to stabilize before it is connected to the supply to avoid condensation forming. The equipment must only be operated within the environmental conditions specified in the performance data. This product is not approved for use in hazardous atmospheres or medical applications. If the equipment is to be used in a safety-related application, such as avionics or military applications, the suitability of the product must be assessed and approved for use by a competent person.

CASE, COVER OR PANEL REMOVAL

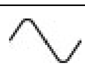
Opening the Case Assembly exposes the operator to electrical hazards that may result in electrical shock or equipment damage. Do not operate this Test Set with the Case Assembly open.

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	IDENTIFIES CONDITIONS OR ACTIVITIES THAT, IF IGNORED, CAN RESULT IN EQUIPMENT OR PROPERTY DAMAGE, E.G., FIRE.
WARNING	**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.)
	Indicates a Toxic hazard.
	Indicates item is static sensitive.
	**AC TERMINAL:** Terminal that may supply or be supplied with AC or alternating voltage.

SAFETY FIRST - TO ALL OPERATIONS PERSONNEL (cont)

EQUIPMENT GROUNDING PROTECTION

Improper grounding of equipment can result in electrical shock.

USE OF PROBES

Refer to Performance 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 or 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. Refer to Performance Specifications for fuse requirements and specifications.

INTERNAL BATTERY

This unit contains a Lithium Ion Battery, serviceable only by a qualified technician.

EMI (ELECTROMAGNETIC INTERFERENCE

CAUTION	SIGNAL GENERATORS CAN BE A SOURCE OF ELECTROMAGNETIC INTERFERENCE (EMI) TO COMMUNICATION RECEIVERS. SOME TRANSMITTED SIGNALS CAN CAUSE DISRUPTION AND INTERFERENCE TO COMMUNICATION SERVICE OUT TO A DISTANCE OF SEVERAL MILES. USER OF THIS EQUIPMENT SHOULD SCRUTINIZE ANY OPERATION THAT RESULTS IN RADIATION OF A SIGNAL (DIRECTLY OR INDIRECTLY) AND SHOULD TAKE NECESSARY PRECAUTIONS TO AVOID POTENTIAL COMMUNICATION INTERFERENCE PROBLEMS.

ELECTRICAL HAZARDS (AC SUPPLY VOLTAGE)

WARNING	**THIS EQUIPMENT IS PROVIDED WITH A PROTECTIVE GROUNDING LEAD THAT CONFORMS WITH IEC SAFETY CLASS I. TO MAINTAIN THIS PROTECTION THE SUPPLY LEAD MUST ALWAYS BE CONNECTED TO THE SOURCE OF SUPPLY VIA A SOCKET WITH A GROUNDED CONTACT.** **BE AWARE THAT THE SUPPLY FILTER CONTAINS CAPACITORS THAT MAY REMAIN CHARGED AFTER THE EQUIPMENT IS DISCONNECTED FROM THE SUPPLY. ALTHOUGH THE STORED ENERGY IS WITHIN THE APPROVED SAFETY REQUIREMENTS, A SLIGHT SHOCK MAY BE FELT IF THE PLUG PINS ARE TOUCHED IMMEDIATELY AFTER REMOVAL.** **DO NOT REMOVE INSTRUMENT COVERS AS THIS MAY RESULT IN PERSONAL INJURY. THERE ARE NO USER-SERVICEABLE PARTS INSIDE.**

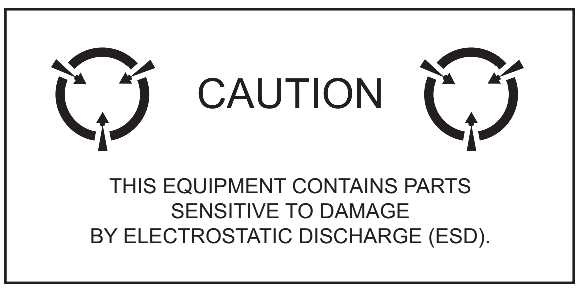
SAFETY FIRST - TO ALL OPERATIONS PERSONNEL (cont)

STATIC SENSITIVE DEVICES

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.



SAFETY FIRST - TO ALL OPERATIONS PERSONNEL (cont)

TOXIC HAZARDS

WARNING	SOME OF THE COMPONENTS USED IN THIS EQUIPMENT MAY INCLUDE RESINS AND OTHER MATERIALS WHICH GIVE OFF TOXIC FUMES IF INCINERATED. TAKE APPROPRIATE PRECAUTIONS, THEREFORE, IN THE DISPOSAL OF THESE ITEMS.

BERYLLIA

Beryllia (beryllium oxide) is used in the construction of some of the components in this equipment. This material, when in the form of fine dust or vapor and inhaled into the lungs, can cause a respiratory disease. In its solid form, as used here, it can be handled safely, however, avoid handling conditions which promote dust formation by surface abrasion.
Use care when removing and disposing of these components. Do not put them in the general industrial or domestic waste or dispatch them by post. They should be separately and securely packed and clearly identified to show the nature of the hazard and then disposed of in a safe manner by an authorized toxic waste contractor.

BERYLLIUM COPPER

Some mechanical components within this instrument are manufactured from beryllium copper. This is an alloy with a beryllium content of approximately 5%. It represents no risk in normal use.
The material should not be machined, welded or subjected to any process where heat is involved.
It must be disposed of as “special waste.”
It must NOT be disposed of by incineration.

LITHIUM

A Lithium battery is used in this equipment.
Lithium is a toxic substance so the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.
Do not attempt to recharge this type of battery. Do not short circuit or force discharge since this might cause the battery to vent, overheat or explode.

INPUT OVERLOAD

CAUTION	REFER TO PRODUCT SPECIFICATIONS FOR MAXIMUM INPUT RATING OF ANT AND T/R CONNECTORS TO AVOID INPUT OVERLOAD.

Preface

SCOPE

This Manual contains instructions for maintaining the ALT-8000.

ORGANIZATION

This manual is composed of the following chapters:

CHAPTER 1 - INTRODUCTION

Chapter contains general Test Set information and theory of operation.

CHAPTER 2 - TROUBLESHOOTING

Chapter contains system and module level troubleshooting procedures.

CHAPTER 3 - VERIFICATION/CALIBRATION PROCEDURES

Chapter describes system and module level verification and calibration procedures.

CHAPTER 4 - REMOVE/INSTALL PROCEDURES

Chapter contains procedures for removing and installing maintainable parts and assemblies.

CHAPTER 5 - SERVICEABLE PARTS LIST

Chapter identifies customer serviceable parts and assemblies.

CHAPTER 6 - ASSEMBLY AND INTERCONNECT DRAWINGS

Chapter contains system level interconnect and assembly drawings.

APPENDIX A - PIN-OUT TABLES

Contains diagrams and pin identification for external connectors.

APPENDIX B - ABBREVIATIONS

Lists acronyms and terms used throughout manual.

APPENDIX C - TEST EQUIPMENT REQUIREMENTS

Lists equipment needed to perform verification and calibration procedures.

APPENDIX D - CONTROLS & CONNECTORS

Identifies front and rear panel controls and connectors.

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Chapter 1 - Introduction

1.1 GENERAL INFORMATION

The ALT-8000 is a single channel tester, designed for testing FM/CW and Pulse Radio Altimeters in the flight-line environment.

1.1.1 Scope

Type of Manual: Maintenance Manual.

Equipment Name and Model Number: ALT-8000 Radio Altimeter Flight-line Test Set.

Purpose of Equipment: Testing installed FM/CW, CDF FM/CW and Pulse Radio Altimeters.

1.1.2 Nomenclature

Common Name: ALT-8000 , Test Set or Unit.

Official Nomenclature: Radio Altimeter Flight-line Test Set.

1.2 THEORY OF OPERATION

1.2.1 ALT-8000 Test Operation

FMCW Radio Altimeters

The ALT-8000 Test-Set analyzes the transmitted signal from a FMCW radio altimeter to derive its waveform parameters. Test-set calculates the required adjustment on received signal based on user inputs and digitally generates the echo signal to test the DUT response in multiple aspects.

For conventional FMCW signal, the Test-Set dynamically adds an adjustable frequency offset to the received signal and then generates the echo signal with a controlled power level.

For constant frequency difference FMCW signal, the Test-Set uniformly adds an adjustable frequency offset to the received signal and then generates the echo signal with a controlled power level.

Pulse Radio Altimeters

The ALT-8000 Test-Set analyzes the transmitted signal from a FMCW radio altimeter to derive its waveform parameters. Test-set calculates the required time delay based on user inputs and digitally controls the time and power level of echo pulses to be transmitted to the DUT.

1.2.2 Assemblies

Control Panel Assembly

The Control Panel Assembly provides On/Off, Home Buttons and Status LEDs.

Power Supply Assembly

The Power Supply Assembly provides power for module operation and +5 Volt bias for applied power status.

RF RX-TX Assembly

The RF RX-TX Assembly measures the Test Set's RF input signal to obtain DUT waveform parameters, and generates RF output signal with required adjustment. The Assembly connects to the Digital RadAlt Assembly using a 40-wire ribbon cable for power supply and data input/output.

PXI Backplane Assembly

The PXI Backplane Assembly routes electrical signals between the various system assemblies.

Rear Panel Assembly

The Rear Panel Assembly provides access to the Tests Set's Input/Output connectors and AC charger.

Slot 1 Controller Assembly

The Slot 1 Controller Assembly controls the PXI bus of the system assemblies and takes user input from touchscreen display.

Digital RadAlt Assembly

The Digital RadAlt Assembly is plugged into a PXI slot on the PXI Backplane Assembly. It controls the RF RX-TX Assembly through a 40 wire ribbon cable by configuring the RF RX-TX Assembly operation modes, sending and receiving test data. It communicates with the Slot 1 Controller Assembly through the PXI bus to exchange data with system software.

1.2.3 Interconnect Block Diagram

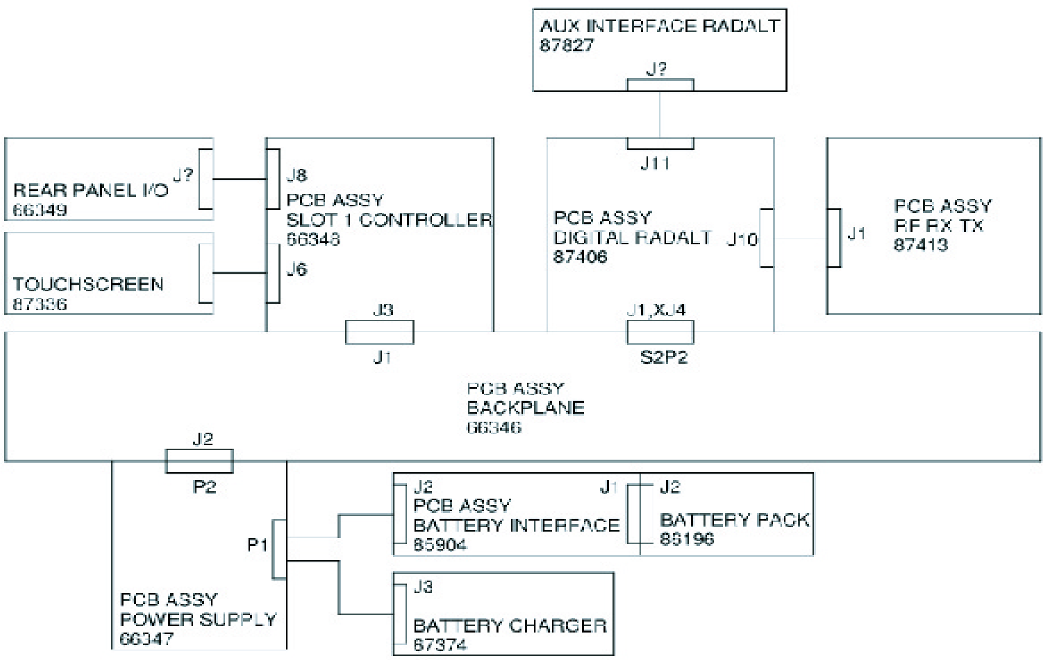


Fig. 1-1 Assembly Interconnect Block Diagram

1.2.4 Radio Altimeters

Low-Range Radio Altimeters (LRRA), are important safety and navigational tools in aircraft, which apart from displaying altitude above ground, also provide altitude inputs into other key avionics safety systems such as TCAS and GPWS (Ground Proximity Warning System) as well as auto-land systems.

Fig. 1-2 Typical FM/CWLRRA System Components
(ARINC type square antenna shown)

Radio Altimeter Types

There are generally two types operating in the allocated 4.2 to 4.4 GHz band, FM/CW and Pulse Modulated. The FM/CW type also has two variants; Conventional FM/CW and Constant Difference Frequency (CDF) FM/CW.

For air transport applications there are two applicable ARINC standards for LRRA; ARINC 552 and ARINC 707.

ARINC 552 is an older standard that utilizes a DC Altitude output to indicators and other systems. Several relay based Altitude Trips are also provided to provide discrete switching to systems such as auto-land, at predetermined altitudes.

ARINC 707 is a later digital avionics standard that provisions altitude data either on an ARINC 429 data bus or an ARINC 707 bi-phase bus. There are two data word formats; Label 164 (binary) and Label 165 (BCD). Digital Auto-land systems receive the altitude data from the LRRA and trip points are processed internally.

1.2.5 FM/CW Radio Altimeter

The main application is for instrument-based approaches and landings for larger commercial aircraft, although they are also suitable for smaller aircraft, military aircraft and even unmanned air vehicles (UAVs). All of these radio altimeters cover the range from 0 to 2500 ft and it is not uncommon for ARINC types to extend to 5,000 (ARA-52A) or 8000 (LRA-900) ft. Some military types such as the AN/APN-232 extend to 50,000 ft.

Refer to Fig 8-3. Typically separate transmit and receiver antennas are required. Transmitter power ranges typically 10 mW (+10 dBm) General Aviation Type and 500 mW (+27 dBm) to 1W (+30 dBm). The directivity of both transmit and receive antennas is limited to about 10 dBi to allow the operation of the radio altimeter at moderate pitch and bank angles of the aircraft.

For correct operation, the receiving antenna should detect only the reflected signal from the ground and not the radio signal coming directly from the transmitting antenna. The two antennas must be widely separated to avoid crosstalk.

The carrier frequency of the transmitter is swept continuously in a given frequency range. Since the received signal is delayed, the receive frequency differs from the transmitter. If the transmitter frequency rate of change is constant, the delay and altitude are directly proportional to the measured frequency difference between the transmitter and receiver. The accuracy and resolution of the FM/CW type radio altimeters is usually limited to a few feet due to the limited availability of bandwidth (200 MHz) in the 4.3 GHz range.

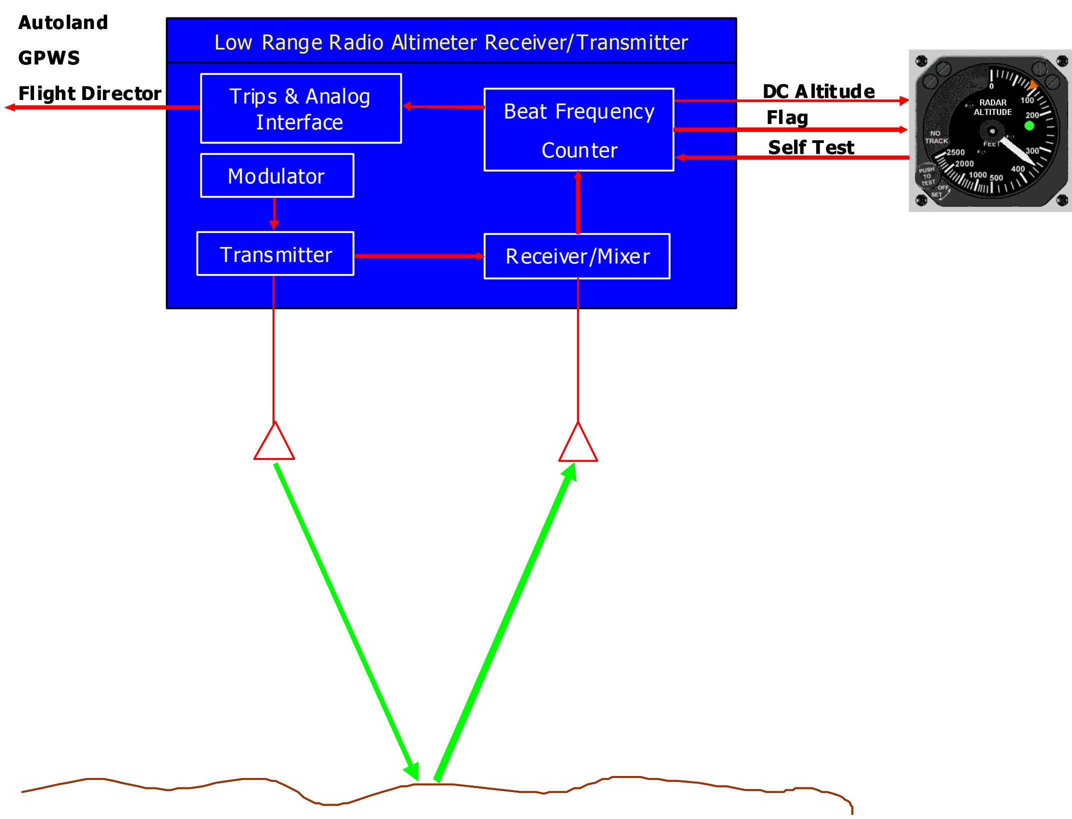
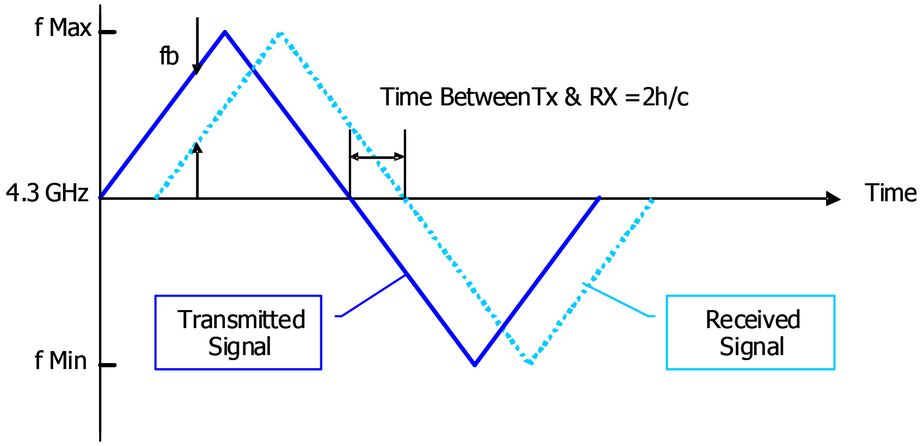


Fig. 1-3 Simplified FM/CW Radio Altimeter

1.2.5.A Conventional FM/CW Radio Altimeters

The sweep waveform is triangular and both slopes are typically used for the altitude measurement to compensate for the Doppler shift due to the vertical speed of the aircraft. The sweep frequency is usually between 50 and 300 Hz. The higher limit is imposed by the receiver thermal noise, the lower limit is the ability of the radio altimeter to eliminate the Doppler shift in the case of a descending or climbing aircraft.



$$fb = \frac{8\,fm\,\Delta f}{c}\,h$$

Fig. 1-4 Conventional FM/CW Sweep

The transmitter comprises a solid state oscillator, frequency modulated at typically 100-150Hz rate. Although most of the power is radiated from a directional antenna, a sample is fed to a mixer to beat with the received signal. The beat frequency is usually less than 1 MHz. The echo is mixed with the transmitter sample in a stripline balanced mixer to produce the beat frequency.

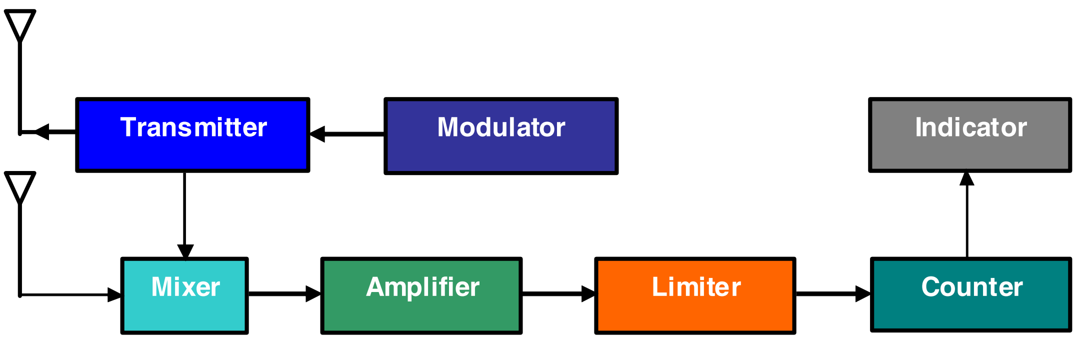


Fig. 1-5 Conventional FM/CW Radio Altimeter Block Diagram

The beat signal is filtered first, then amplified and limited. A frequency counter drives the altitude indicator and various altitude alarms if required. Transmission delays, due mainly to the cables connecting the antennas to the electronics of the radio altimeter, are know as AID (Aircraft Installation Delay). The AID is subtracted from the measured altitude. For a 0 to 2500 ft altimeter with a Δf of 100 MHz, fm of 200Hz and an AID of 57 ft, the range of the beat frequency fb would be 4.56 to 204.56 KHz. This wide bandwidth could be reduced thereby improving receiver sensitivity, if a constant beat frequency were maintained hence the development of the constant difference frequency altimeter.

Main Characteristics: Conventional FM/CW Radio Altimeter

- Continuous Wave (not pulsed), constant amplitude
- Carrier Frequency 4300 MHz (allocated to Radio Altimeter)
- Frequency Modulated with triangular waveform, Sweep Rate 50 to 160Hz
- Deviation is +/- 50 to 70 MHz (200KHz bandwidth receiver required)
- Transmission continuously varies between 4250 MHz and 4350 MHz
- Height errors due to vertical movement doppler shift, are averaged over both slope.

1.2.5.B Constant Difference Frequency (CDF) FM/CW

The Constant Difference Frequency is similar to conventional FM/CW altimeter at the RF end. The beat frequency amplifier is narrow band, with gain controlled by the loop so it increases with altitude. A tracking discriminator compares the beat frequency *f*b. with and internal reference *f*r. If the two are not the same, an error signal is fed to the loop control. The outputs of the loop control are used to set the modulator frequency, *f*m (or amplitude if deviation, Δf, is controlled), to set the gain of the amplifier and to drive the indicator. The change in *f*m (or Δf) is such as to make *f*b = *f*r. Any change in height will lead to a change in *f*b and resultant loop action to bring *f*b back to the required rate; in doing so the indicator feed will change. If *f*b and *f*r are far removed, search action is instigated whereby the modulator frequency (or Δf) is made to sweep through its range from low to high until lock on is received.

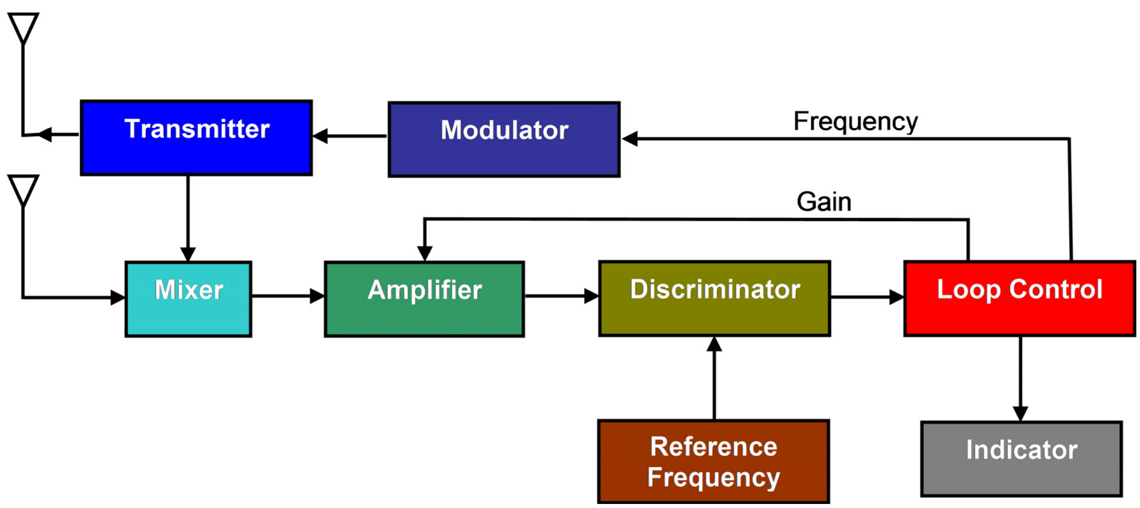


Fig. 1-6 CDF FM/CW Radio Altimeter Block Diagram

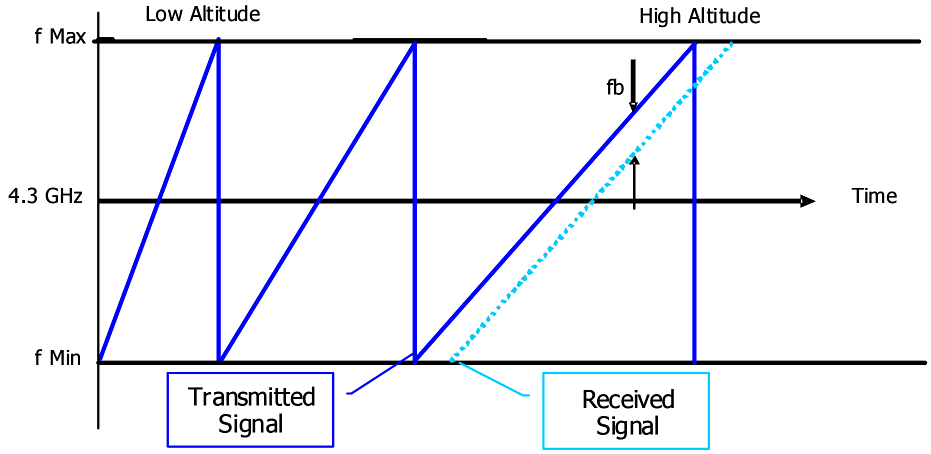


Fig. 1-7 CDF FM/CW Sweep

Characteristics: CDF FM/CW Radio Altimeter

- Continuous Wave (not pulsed), constant amplitude
- Carrier Frequency 4300 MHz (allocated to Radio Altimeter)
- Frequency Modulated with triangular waveform, Sweep Rate is proportional to altitude, maintaining a constant beat frequency.
- Constant beat frequency allows narrow bandwidth receiver

1.2.5.C Antennas

Separate antennas are provided for Transmit and Receive. The TX antenna is mounted forward and the RX Aft on the lower fuselage. Typical spacing minimum TX/RX antenna spacing is 20°. The antennas are directional types, either patches or horns, that gain typically 10 dBi, with a beam-width of 20° to 40° to accommodate aircraft pitch of up to 20° and up to 30° of roll.

Fig. 1-8 Triple LRRA Antenna Installation
(ARINC square patch type)

Fig. 1-9 LRRA Antenna Installation
(recessed horn type)

1.2.5.D Aircraft Installation Delay (AID)

The radio altimeter is calibrated to read main landing gear wheel height above the ground while in the pitch attitude associated with a normal configuration and normal approach speed at the runway threshold.

In most large transports, this means that the radio altimeter antenna, located forward of the main wheels on the fuselage, is quite a bit higher than the main wheels (Fig 6-10). When the main wheels touchdown, the radio altimeter should indicate 0 ft. However, the antenna is still several feet above the ground. As the airplane de-rotates and the nose touches down, the radio altimeter antenna continues to descend below 0 ft, for example on the B-767/757, the radio altimeter typically reads -8 ft on the ground.

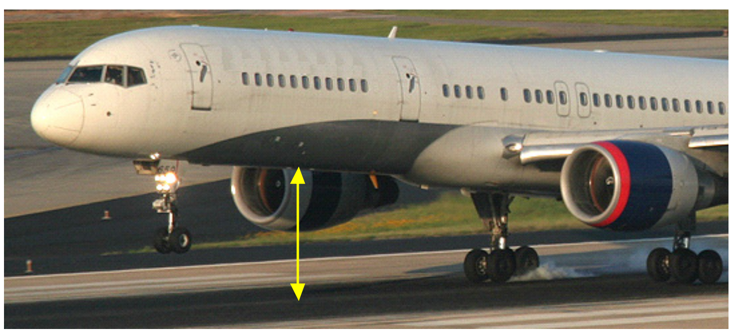


Fig. 1-10 Radio Altimeter Antenna Height at Touchdown

The Aircraft Installation Delay (AID), provides the means to ensure the radio altimeter indicates 0 ft at touch down. The AID consists of a standard length of TX and RX RF antenna feeder cable. For ARINC installations, standard AIDs are 20, 40, 57 and 80 ft depending on the size of the aircraft. The B-737, for example, uses a 57 foot AID, that's the distance from the transmit port of the transceiver, through the cable and antenna, to the ground at touchdown angle, and back through the receive antenna and cable to the receive port of the transceiver. It is usual for any extra cable length to be coiled in the belly of the plane. Jumper pins in the LRRA installation rack are used to select AID for the specific aircraft installation, introducing the necessary altitude offset in the LRRA LRU for 0 ft.

1.2.5.E Radio Altitude Digital Indicators

There are separate analog indicators for barometric and radio altitude, the EFIS (Electronic Flight Instrumentation System) displays utilized on digital flight decks, are capable of displaying both barometric and radio altitude, refer to Fig 6-11. Normally, radio altitude is only displayed below 2,500 ft. In a precision approach, the Decision Height is set dependant on the landing category of the aircraft. When the Decision Height is reached, an audible warning is also given and the pilot must make the decision to either continue with the landing approach or go around.

Category I (CAT I)

A precision instrument approach and landing with a decision height not lower than 200 ft (61 m) above touchdown zone elevation and with either a visibility not less than 800 m (2,625 ft) or a runway visual range not less than 550 m (1,804 ft).

Category II (CAT II)

Category II operation: A precision instrument approach and landing with a decision height lower than 200 ft (61 m) above touchdown zone elevation but not lower than 100 ft (30 m) and a runway visual range not less than 300 m (984 ft) for aircraft category A, B, C and not less than 350 m (1,148 ft) for aircraft category D.

Category III (CAT III) is further subdivided

Category III A

A precision instrument approach and landing with: a) a decision height lower than 100feet (30 m) above touchdown zone elevation, or no decision height (alert height); and b) a runway visual range not less than 200 m (656 ft).

Category III B

A precision instrument approach and landing with: a) a decision height lower than 50 ft (15 m) above touchdown zone elevation, or no decision height (alert height); and b) a runway visual range less than 200 m (656 ft) but not less than 75 m (246 ft). Autopilot is used until taxi-speed. In the United States, FAA criteria for CAT IIIb runway visual range allows readings as low as 150 ft.

Refer to Fig 6-11. The decision height source used may be radio altitude or barometric altitude. Barometric altitude is displayed on the right hand tape. The green arrow on the altitude scale is the barometric decision height indicator, which is active when filled with a solid green. In this example the Radio Altimeter is the active source and a Decision Height of 100 ft, is displayed alongside the Radio label.

Fig. 1-11 Typical EFIS

1.2.5.F Radio Altitude Analog Indicators

Fig 6-12 shows an example of a Dial type analog indicator. The altitude scale is non-linear. Notice that as much space on the dial is devoted to 0 to 100 ft. as is used for 1000 to 2500 ft. The low end of the scale, when near the ground, is where the greatest resolution is needed.

In this example, the green indicator shows that the Radio Altimeter is coupled to the auto-land system. The green indicator light switches to red when descending below the altitude set by the DH bug. In a CAT I or CAT II approach, the aircraft is manually flown on to the runway from the DH point. The autopilot must be switched off to allow manual flying. Fig 6-13 shows and example of a moving tape type analog indicator.

I

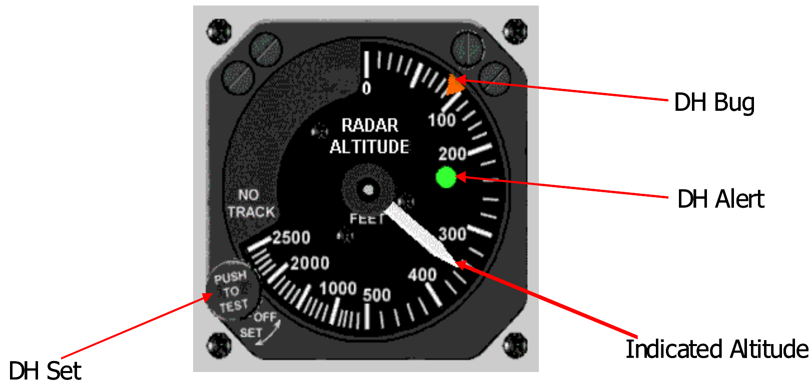


Fig. 1-12 Analog Indicator Dial Type

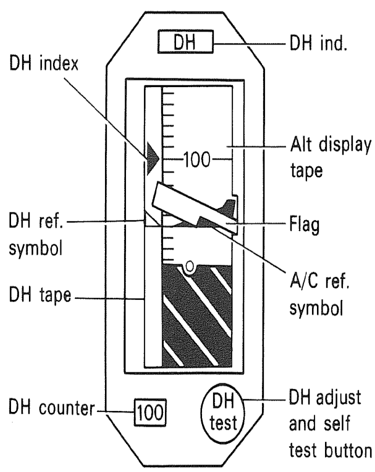


Fig. 1-13 Analog Indicator Moving Tape Type

1.2.6 Pulse Radio Altimeter Systems

The Pulse Radio Altimeter System's main (but not exclusive) application is for military aircraft. Typically these operate at a frequency of 4.3 GHz, pulse width of 25 to 75 ns, PRF 8 to 18 KHz and TX power of between 5 to 100 W peak. An example is the AN/APN-209, which has been the Standard Radar Altimeter System for U.S. Army helicopter applications in production for the last 30 years. Hover-hold performance with digital altitude and analog displays are compatible with Night Vision Goggles (NVGs). The system includes the receiver-transmitter, integrated or remote height indicators, and various antenna options.

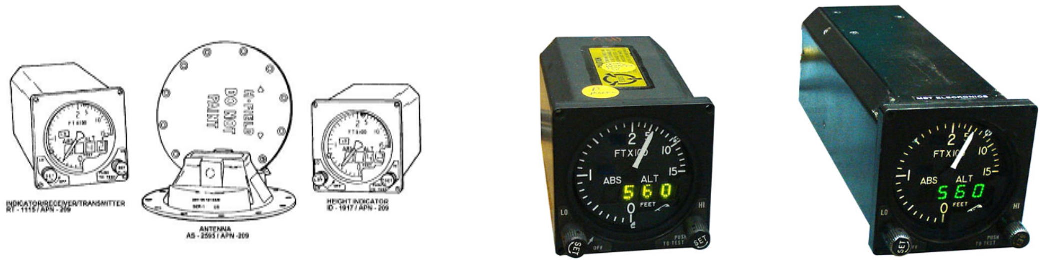


Fig. 1-14 AN/APN-209 Pulse Radio Altimeter

Altitude is determined by measuring the time delay between the transmitted pulse and the received pulse, reflected from the ground. These are medium to high range systems. Some variations have the advantage that they can use one antenna for transmit and receive.

The height given by half product of the elapsed time and the speed of light is $h = ct/2$.

h = Aircraft Altitude

c = speed of light

t = elapsed time between transmission and reception

Refer to Fig 6-15. A time reference signal, t_0, is fed from the transmitter to initiate a precision ramp generator. The ramp voltage is compared with the range voltage, VR, which is proportional to the indicated height. When the ramp voltage reaches VR, a track gate pulse is generated and fed to gate B and an elongated gate pulse is fed to gate A. The detected video pulse is also fed to gates A and B. A further gate pulse is fed to the A.G.C. circuits.

Unless a reliable signal is detected within the elongated gate pulse, the track/search circuit will signal the commencement of a search cycle and break the track loop by removing its reference current feed. During search, the search generator drive to the range circuit ensures that VR, starting from a voltage representing zero feet, runs out to a voltage representing 2,500 ft. The search cycle repeats until a reliable signal (five or six pulses) is received when the track loop becomes operational.

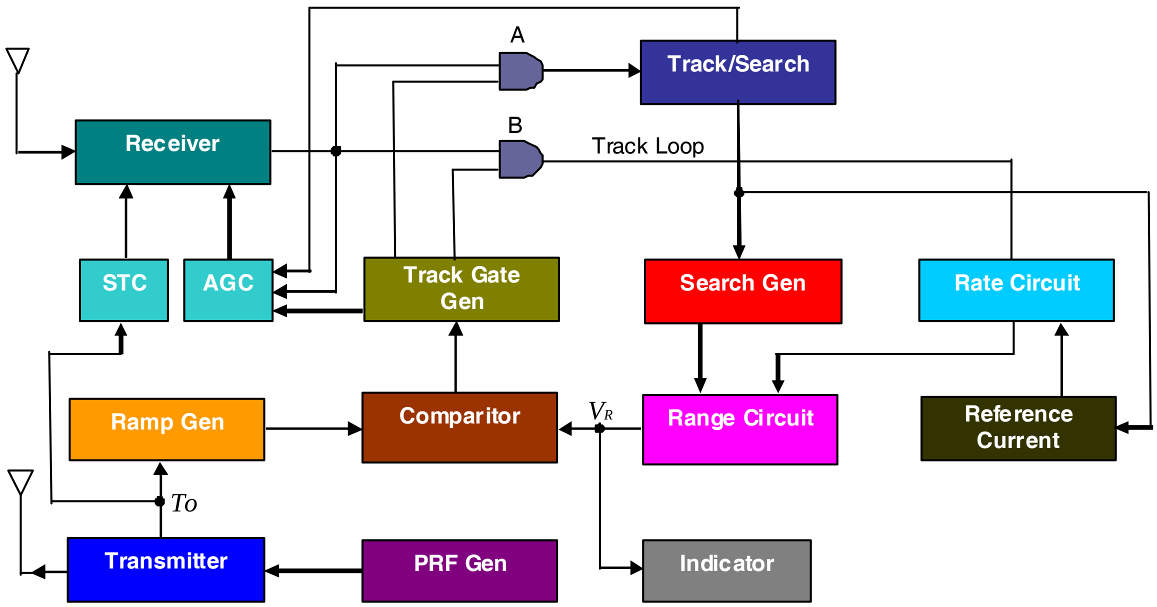


Fig. 1-15 Pulse Radio Altimeter Block Diagram

During track, the overlap of the track gate pulse and video pulse, determines the magnitude of a current which is compared with a reference (offset) current. Where the two currents are equal, the output of the rate circuit (integrator) is zero, otherwise a positive or negative voltage is fed to the range circuit. The range circuit (integrator) adjusts it's output voltage, V_R, if its input is non-zero. Since V_R, determines the timing of the track gate pulse, any change in V_R, will cause the previously mentioned overlap to alter until such time as the loop is nulled, i.e. overlap current = reference current. Any change in height will therefore result in a change in V_R, to bring the loop back to a null condition.

Automatic Gain Control (A.G.C.) and Sensitivity Time Control (S.T.C.) are fed to the receiver where they control the gain of the I.F. amplifiers. During search the A.G.C. circuits monitor the noise output of the receiver and adjust its gain so as to keep noise output constant. The S.T.C. reduces the gain of the receiver for a short time, equivalent to say 50 ft after transmission and then its control decreases linearly until a time equivalent to say 200 ft. This action prevents acquisition of unwanted signals, such as leakage, during the search mode.

During track, the A.G.C. maintains the video signal in the A.G.C. gate at a constant level. This is important to ensure precise tracking of the received signal since any variation in amplitude would cause the area of overlap to track gate and video signals to change. At low heights on track the A.G.C. reduces the receiver gain, so helping to avoid the effects of leakage. When the height increases the signal leakage signal is gated out, giving time discrimination.

1.2.7 Systems Coupled With Radio Altimeter

Auto-land Systems

The Radio Altimeter provides Auto-land Systems with altitude trip inputs to initiate functions and radio height information for generation of trip signals within the auto-flare computer. Typically the critical systems are dual or triple configurations.

Typical Auto-land Events

140 ft (RA Trip)

- Radio Altimeter Interlock Switched In
- Progressively Reduce Gain of Glide Slope Amplifier In Pitch Channel

120 ft (Auto-flare Computer)

- Preparatory Functions

90 ft (RA Trip)

- Check 140 ft Operation

50 ft (Auto-flare Computer Trip)

- Glide Slope Signal Discontinued
- Throttle Closure Initiated
- Pitch Demand Maintains Correct Descent Rate

20 ft (Auto-flare Computer Trip)

- Rudder Servo Disconnected
- Ailerons Centered

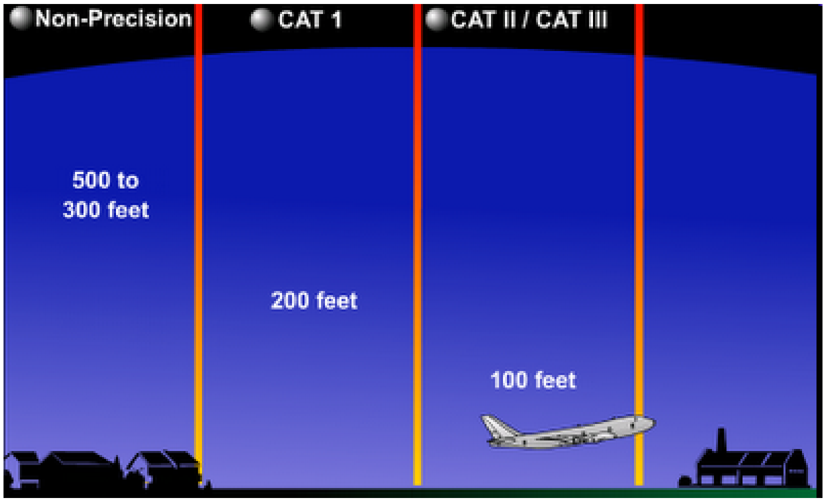


Fig. 1-16 Approach Types

1.2.7.A Terrain Awareness and Warning System (TAWS)

TAWS aims to prevent controlled flight into terrain The systems in current use are known as ground proximity warning system (GPWS) and enhanced GPWS The U.S. FAA developed the TAWS term to encompass all current and future systems which meet the relevant FAA standards. New systems, with different names than GPWS and EGPWS, may be developed which meet TAWS objectives

Fig. 1-17 Terrain Awareness and Warning System

A TAWS works by using digital elevation data and airplane instrumental values, to predict if a likely future position of the aircraft intersects with the ground. The flight crew is provided with earlier aural and visual warning of impending terrain, forward looking capability and continued operation in the landing configuration

1.2.7.B Ground Proximity Warning System (GPWS) and Enhanced Ground Proximity Warning System (EGPWS)

The GPWS/EGPWS is an important safety system that relies on altitude input from the LRRA. GPWS/EGPWS alerts the flight crew when one of the following thresholds are exceeded between 50 and 2,450 ft radio altitude:

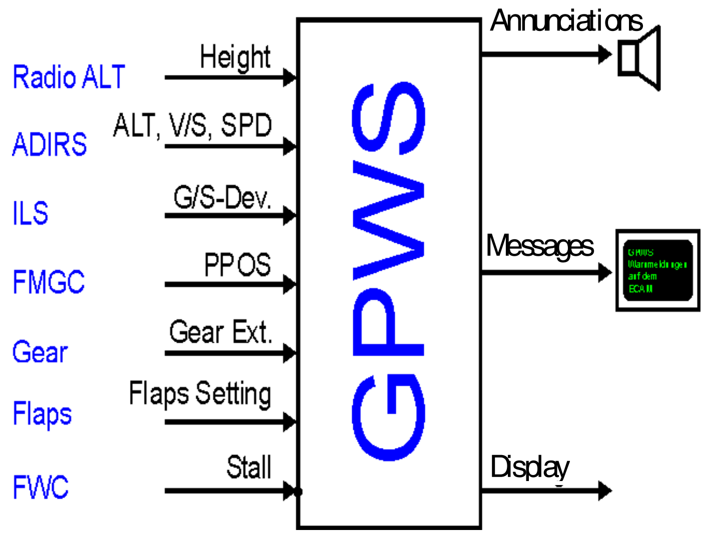


Fig. 1-18 GPWS Inputs

Mode 1 - Excessive Decent Rate [“Pull Up” “Sink Rate”]

Mode 2 - Excessive Terrain Closure Rate [“Terrain” “Pull Up”]

Mode 3 - Altitude Loss After Take - Off or Go Around or with a high power setting [“Don’t Sink”]”

Mode 4 - Unsafe Terrain Clearance [“Too Low - Terrain” “Too Low - Gear” “Too Low - Flaps”]

Mode 5 - Below Glideslope Deviation Alert [“Glideslope”]

Mode 6 - Excessively Steep Bank Angle [“Bank Angle”]

Mode 7 - Wndshear Protection [“Windshear”]

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Chapter 2 - Troubleshooting

2.1 GENERAL INFORMATION

ALT-8000 Troubleshooting procedures are divided into the Troubleshooting Table and Assembly Troubleshooting procedures.

This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. Perform tests/inspections and corrective actions in order listed.

If a malfunction is not listed or is not corrected by listed corrective actions, the troubleshooting technique (the formulation of a logical approach in locating the source of trouble) is left to the technician’s discretion.

The Troubleshooting Table lists malfunctions which may occur during Test Set operation. Assembly Troubleshooting Procedures are intended to determine whether or not an assembly is functioning properly; these procedures do not determine if an assembly is operating within specified parameters. Perform Test Set Verification Procedures to determine if an assembly is operating within specified parameters.

After the faulty assembly has been located, refer to Remove/Install Procedures for remove/install instructions.

2.1.1 Preventive Maintenance Procedures

Contains routine maintenance instructions for cleaning and inspecting the Test Set.

CAUTION	DISCONNECT TEST SET FROM AC POWER SUPPLY TO AVOID POSSIBLE INJURY TO PERSONNEL AND DAMAGE TO ELECTRONIC CIRCUITS.

2.1.1.A External Cleaning

The following procedure contains routine instructions for cleaning the outside of the ALT-8000.

- Remove grease, fungus and ground-in dirt from surfaces with soft lint-free cloth dampened (not soaked) with isopropyl alcohol.
- Remove dust and dirt from connectors with soft-bristled brush.
- Cover connectors, not in use, with suitable dust cover to prevent tarnishing of connector contacts.
- Clean cables with soft lint-free cloth.
- Paint exposed metal surface to avoid corrosion.
- Clean Front Panel display with soft lint-free cloth dampened (not soaked) with non-ammonia based glass cleaner.

2.1.1.B Internal Cleaning

Remove dust with hand-controlled dry air jet of 15 psi (1.054 kg/cm) and wipe internal chassis parts and frame with soft lint-free cloth moistened with isopropyl alcohol.

CAUTION	TO AVOID POSSIBLE DAMAGE, DO NOT NEEDLESSLY DISCONNECT CONNECTORS FROM ASSEMBLIES OR REMOVE ASSEMBLIES FROM TEST SET. DO NOT OPEN ASSEMBLIES FOR PURPOSE OF CLEANING AND INSPECTION.

2.1.1.C Visual Inspection

Inspect Installation:

- Ensure Test Set is properly ventilated.
- Ensure that AC Power Cord and supply connector(s) are in good condition and easily accessible.
- Ensure that the AC Power Supply Switch isolates the equipment from the AC Power Supply.
- Verify the correct rating and type of supply fuses are used.
- Examine the stability and condition of covers and handles.

Inspect Chassis for:

- Tightness of sub-assemblies and chassis mounted connectors.
- Corrosion or damage to metal surfaces.
- Check the presence and condition of all warning labels and markings and supplied safety information.

Inspect Wiring anc Connectors for:

- Loose or broken parts, cracked insulation and bad contacts.
- Broken or loose ends and connections.
- Proper dress relative to other chassis parts.
- Verify wrapped wiring is tight.

2.1.2 Troubleshooting Guidelines

Troubleshooting Procedures contain Operator Level and Maintenance Level corrective actions.

Operator Level corrective actions identify probable hardware configuration errors which may be the cause of the malfunction. Maintenance Level corrective actions list hardware issues which may be the cause of the malfunction. Maintenance Level corrective actions should only be performed by Qualified Service Personnel.

Many problems on Test Sets in service are caused by corrosion. Removing and reseating an affected cable or circuit card may correct the malfunction. Cleaning connector and/or switch contacts with alcohol repairs many types of digital and analog circuit malfunctions.

The Test Set has a automated self test to assist the technician in troubleshooting.

2.1.3 Tool Requirements

2.1.4 TBD

Equipment Inspection

The following inspection procedures are used to locate obvious malfunctions with the Test Set:

- Inspect all external surfaces of the Test Set for physical damage, breakage, loose or dirty contacts and missing components.

WARNING	**DANGEROUS VOLTAGES ARE PRESENT WITH COVERS REMOVED.**

CAUTION	DO NOT DISCONNECT OR REMOVE ANY BOARD ASSEMBLIES IN THE TEST ADAPTER UNLESS INSTRUMENT IS UNPLUGGED. SOME ASSEMBLIES CONTAIN DEVICES THAT CAN BE DAMAGED IF BOARD IS REMOVED WHEN POWER IS ON. SEVERAL COMPONENTS, INCLUDING MOS DEVICES, CAN BE DAMAGED BY ELECTROSTATIC DISCHARGE. USE CONDUCTIVE FOAM AND GROUNDING STRAPS WHEN SERVICING IS REQUIRED AROUND SENSITIVE COMPONENTS. USE CARE WHEN UNPLUGGING ICS FROM HIGH-GRIP SOCKETS.

- Inspect printed circuit board surfaces for discoloration, cracks, breaks and warping and printed circuit board conductors for breaks, cracks. cuts, erosion or looseness.
- Inspect all assemblies for burnt or loose components.
- Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.
- Inspect Test Set for disconnected, broken, cut, loose or frayed cables or wires.

2.1.5 Safety Precautions

WARNING	REMOVE ALL JEWELRY OR OTHER COSMETIC APPAREL BEFORE PERFORMING ANY TROUBLESHOOTING INVOLVING LIVE CIRCUITS. WHEN WORKING WITH LIVE CIRCUITS OF HIGH POTENTIAL, KEEP ONE HEN WORKING WITH LIVE CIRCUITS OF HIGH POTENTIAL, KEEP ONE HAND IN POCKET OR BEHIND BACK TO AVOID SERIOUS SHOCK HAZARD. USE ONLY INSULATED TROUBLESHOOTING TOOLS WHEN WORKING WITH LIVE CIRCUITS. FOR ADDED INSULATION, PLACE RUBBER BENCH MAT UNDERNEATH ALL POWERED BENCH EQUIPMENT, AS WELL AS A RUBBER MAT UNDERNEATH TECHNICIAN'S CHAIR. HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.

CAUTION

THIS EQUIPMENT CONTAINS PARTS
SENSITIVE TO DAMAGE
BY ELECTROSTATIC DISCHARGE (ESD).

CAUTION	ALL ASSEMBLIES CONTAIN PARTS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALL PERSONNEL PERFORMING TROUBLESHOOTING PROCEDURES SHOULD HAVE KNOWLEDGE OF ACCEPTED ESD PRACTICES AND/OR BE ESD CERTIFIED.

2.1.6 EMC/Safety Compliance

All assemblies, cables, connectors, plastic fasteners, gaskets, fingerstock and miscellaneous hardware within the Test Set are configured to satisfy the safety and EMC compliance standards.

CAUTION	UPON COMPLETION OF ANY MAINTENANCE ACTION; ALL ASSEMBLIES, CABLES, CONNECTORS, PLASTIC FASTENERS, GASKETS, FINGERSTOCK AND MISCELLANEOUS HARDWARE MUST BE CONFIGURED AS INSTALLED AT THE FACTORY.

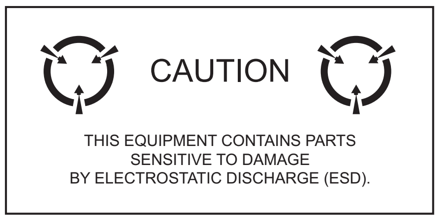
Chapter 3 - Verification/Calibration

3.1 GENERAL INFORMATION

This chapter provides step-by-step instructions for performing Test Set Calibration and Verification Procedures.

3.1.1 Testing Conditions

Calibration and Verification Procedures should be performed in an ESD environment at ambient room temperature (+20° C to +30° C).



CAUTION	ONLY PERFORM CALIBRATION PROCEDURES IN AN ESD ENVIRONMENT. ALL PERSONNEL PERFORMING CALIBRATION PROCEDURES SHOULD HAVE KNOWLEDGE OF ACCEPTED ESD PRACTICES AND/OR BE ESD CERTIFIED.

3.1.2 Required Equipment

Refer to Appendix C - Test Equipment for list of equipment required to perform Verification and Calibration Procedures.

3.1.3 Safety Precautions

Use extreme caution when working with “live” circuits. Observe all precautions when performing the Verification and Calibration Procedures.

WARNING	**HEED ALL WARNINGS AND CAUTIONS CONCERNING MAXIMUM VOLTAGES AND POWER INPUTS.**

3.2 TEST SET CALIBRATION

This section provides instructions on accessing and using the ALT-8000 Series Calibration Function. The Calibration Function is an optional feature that is only available when the ALT-8000 Calibration Option is installed on the Test Set.

The ALT-8000 Calibration Function is a user-friendly automated system that has been integrated into the Test Set. On-screen instructions guide the user through selecting, running and performing each calibration procedure.

After a calibration procedure is selected and initiated, status indicators and messages are displayed throughout the procedure which provide instructions, feedback and calibration information.

Calibration Procedures should only be performed by Technicians familiar with the setup and operation of the required test equipment.

3.2.1 Calibration Schedule

System Calibration Procedure should be performed as a result of one or more of the following conditions:

Failure to Meet Specifications	If, during the course of normal operation, the Test Set or any major function thereof fails to meet the performance specifications.
Module/Assembly Replacement	If one or more of the Test Set assemblies are replaced.
2 Year Calibration/Verification	Aeroflex recommends Calibration/Verification on the Test Set every two years to maintain proper testing standards.

3.2.2 Preliminary Procedures

Perform the calibration procedure in its entirety. The procedure should be performed in the order that the procedure specifies. Some of the steps are dependent on successful completion of previous steps.

3.2.3 Test Setup

Calibration times are approximate and may vary slightly per unit. Procedures are listed in the order they appear on the Calibration menu screen.

3.2.4 Test Equipment

The test equipment listed is suitable for performing any procedure contained in this manual.

Required Test Equipment	Model
ARB Waveform Generator	Agilent 33220A
Power Meter	Agilent E4418B
Power Sensor	Agilent E4412A
Frequency Counter	Agilent E4407B
RF Signal Generator	IFR-3416 w/opt. 006
4300 MHz Band Pass Filter	K&L 7FV30-4300-TB200
Test Fixture: 3W Power Amplifier Module +15V Power Supply	TF-267 Mini-Circuit ZVE-3W-83-S Skynet SNP-B068
3 Low loss blue cable	Aeroflex part number 62401

3.2.5 Remote Communication

The remote interface to the ALT-8000 is tested using the remote interface and sending basic commands to the ALT-8000 and verifying the information returned is correct.

STEP	PROCEDURE
1.	Set up the UUT by displaying MAINTENANCE screen and selecting NETWORK menu tab. The parameters in the following table are programmed into the appropriate locations. The commands sent via the Ethernet interface are identified in parentheses. The remote program used to communicate with the ALT-8000 is PuTTy.

Field	Data
IP Address	10.200.120.148
Subnet Mask	255.255.255.0
Network Mode	Static IP

STEP	PROCEDURE
2.	PuTTY is a free telnet/SSH client that can be downloaded from the internet free of charge. To setup PuTTY: - Set the IP address to 10.200.120.148. - Set the port to 5025 - Check TELNET - Press OPEN to establish communication with ALT-8000
3.	Via the remote interface set the UUT to direct connection (:RALT:SET:CONN DIR)
4.	Via the remote interface query the UUT connection (:RALT:SET:CONN?) and verify the UUT returns DIR.
5.	Via the remote interface set the ALT-8000 to manual UUT type selection (:RALT:SET:UUT:ADET MAN).
6.	Via the remote interface set the UUT to detect a pulse signal (:RALT:SET:UUT:TYPE PULS).

STEP	PROCEDURE
7.	Via the remote interface set the UUT to detect a pulse signal (:RALT:SET:UUT:TYPE?) and verify the UUT returns PULS.
8.	Via the remote interface set the UUT to detect a FMCW signal (:RALT:SET:UUT:TYPE FMCW).
9.	Via the remote interface query the UUT signal type (:RALT:SET:UUT:TYPE?) and verify the UUT returns FMCW.

3.2.6 Time and Date

The Time and Date procedure queries the ALT-8000 for the time and date stored in the internal clock and verifies the time is correct and the date maintained accurately.

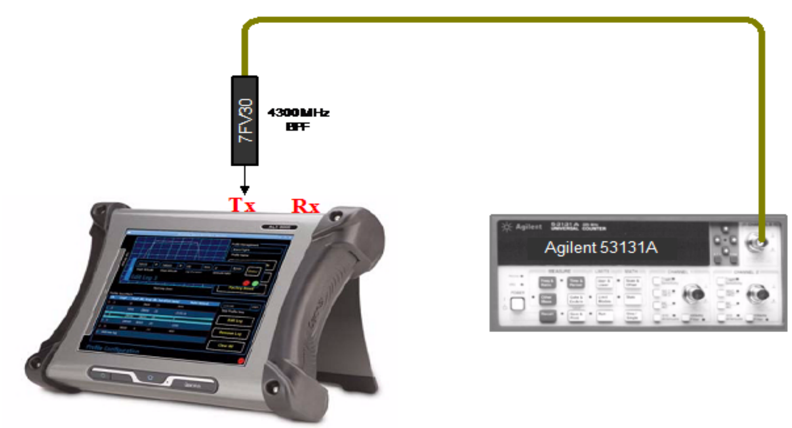
STEP	PROCEDURE
1.	Via the remote interface send the command CONF:TIME? to the UUT.
2.	Record the UUT time.
3.	Via the remote interface send the command CONF:DATE? to the UUT.
4.	Record the UUT date.
5.	Verify that the time and date of the UUT are correct. If not, correct the time and date on the UUT.

3.2.7 TCXO Calibration

The TCXO Calibration procedure tests the TCXO frequency and corrects as needed. Corrections are made by adjusting the TCXO DAC value so that the output frequency is within specifications.

EQUIPMENT: Frequency Counter
4300 MHz BPF

STEP	PROCEDURE
1.	Connect the ALT-8000 and Frequency Counter as shown:



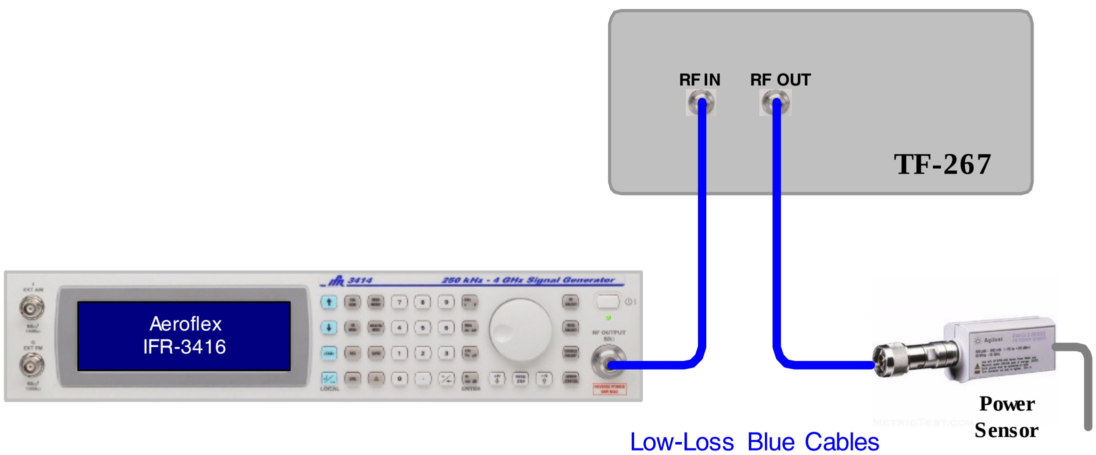
STEP	PROCEDURE
2.	Display the Maintenance menu, select Calibration menu. Enter password 9853. Start the TCXO calibration (:RALT:CAL:TCXO:STAR).
3.	Use the prompted instruction menu on the ALT-8000 to adjust the DAC value to 4300 MHz +/- 100 Hz on the counter (:RALT:CAL:TCXO:VAL value). Record the frequency shown on the Frequency Counter.
4.	When the frequency shown on the Frequency Counter is within the specification identified in Step 2, press the button to save the TCXO calibration (:RALT"CAL"TCXO"SAVE). Record the DAC value saved for the TCXO correction.

3.2.8 T1030 Receiver CW Calibration

The Receiver CW Calibration procedure adjusts the gain and offset values and ensures linearity and accuracy of the ALT-8000.

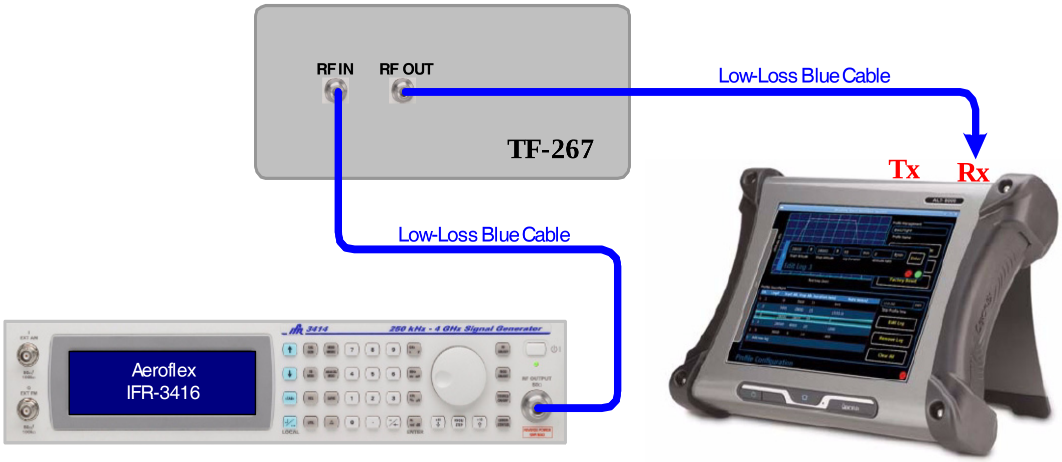
EQUIPMENT: RF Generator
Power Meter
Power Sensor
Test Fixture

STEP	PROCEDURE
1.	Make the connection as shown:



2. Set RF Generator output frequencies from 4.1 GHz to 4.5 GHz, step = 0.1 GHz, respectively. Perform the following for each frequency setting:
   - Adjust RF Generator output level (approx -15 dBm) to get 0 dBm +/- 0.02 dB on the Power Meter.
   - Record the output level of the RF Generator as P0 dBm.
   - Adjust the RF Generator output level (approx -5 dBm) to get 10 dBm +/- 0.02 dB on the Power Meter.
   - Record the output level of the RF Generator as P10 dBm.

STEP	PROCEDURE
3.	Make the connection as shown:



4.	Start RX CW calibration by entering the menu item RX CW calibration (:RALT:CAL:RCW:STAR).
5.	Follow the on screen instructions and set RF Generator output to 4.1 GHz at the value recorded for P10 dBm.
6.	Press the next button to advance to the next step (:RALT:CAL:RCW:NEXT?). Record the value displayed on the UUT screen.
7.	Set the RF Generator output to 4.1 GHz at the value recorded for P 0 dBm.
8.	Press the Next button to advance to the next step (:RALT:CAL:RCW:NEXT?). Record the value displayed on the UUT screen.
9.	Repeat steps 5 through 8 for frequencies 4.2, 4.3, 4.4 and 4.5 GHz.
10.	Press the Save button to save the RX CW calibration values (:RALT:CAL:RCW:SAVE).

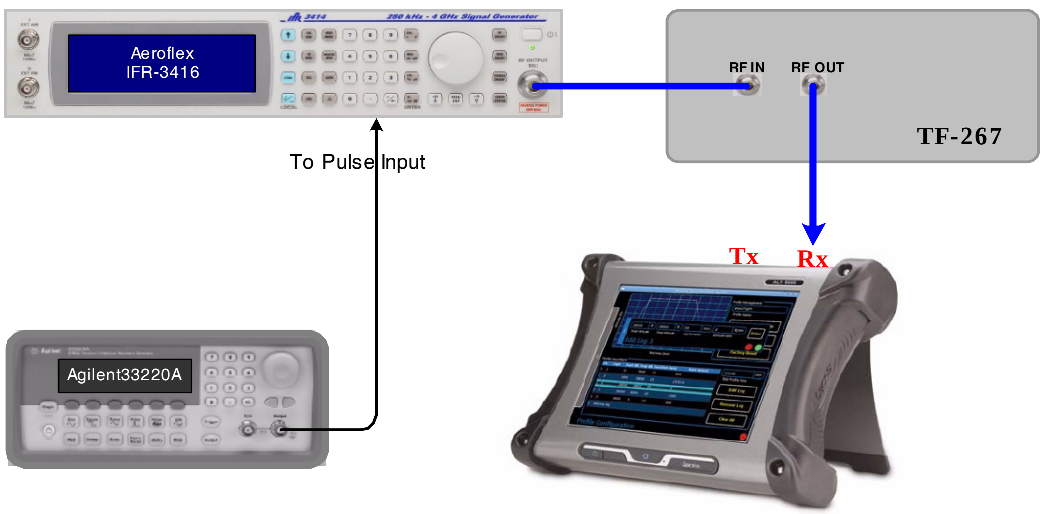
3.2.9 T1040 Receiver PULSE Calibration

The Receiver Pulse Calibration procedure provides calibration and correction of the measurements taken of pulses that are received by the ALT-8000.

EQUIPMENT: RF Generator
ARB Generator
Test Fixture

STEP	PROCEDURE

1. Make the connection as shown:



2. Setup the ARB Generator as follows:

Field	Data
Function	PULSE
Pulse Width	90 ns
Pulse Period	100 us (10 kHz PRF)
Voltage High	5.0 V
Voltage Low	0 V
Impedance	50 Ω
Output	ON

3. Set the RF Generator to 4.3 GHz at -4.7 dBm adjusting the level to get 10 dBm output at TF-267, pulse modulation on.
4. Start RX pulse calibration by entering the menu item RX pulse calibration (:RALT:CAL:RPUL:STAR).
5. Set the pulse width of the ARB Generator to 90 ns to get 70 ns at output of TF-267.
6. Record the value displayed on the UUT screen.
7. Press the Next button to advance to the next step (:RALT:CAL:RPUL:NEXT?).

STEP	PROCEDURE
8.	Set the pulse width of the ARB Generator to 320 ns to get 300 ns at output of TF-267.
9.	Record the value displayed on the UUT screen:
10.	Press the next button to advance to the next step (:RALT:CAL:RPUL:NEXT?).
11.	Turn off RF output of the RF Generator.
12.	Press the Save and Return button to save the pulse calibration (:RALT:CAL:RPUL:SAVE).

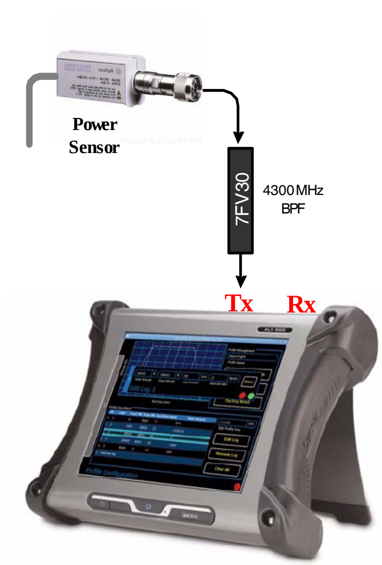
3.2.10 Transmitter Power Calibration

The Transmitter Power Calibration procedure provides power calibration for the ALT-8000.

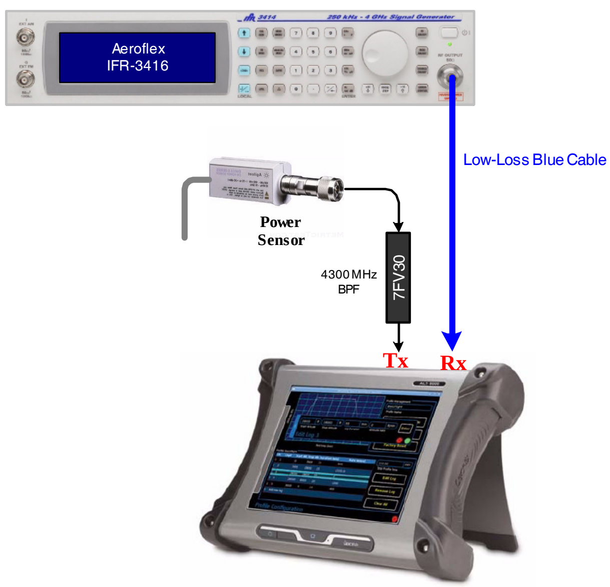
EQUIPMENT: RF Generator
Power Meter
Power Sensor
4300 MHz BPF

STEP	PROCEDURE
1.	Make the connection as shown:

2. Set RF Generator output frequencies from 4.2 GHz to 4.4 GHz, step = 0.1 GHz, respectively.
   - Adjust RF Generator output level to get 0 dBm +/- 0.02 dB on power meter.
   - Record the output level of the RF Generator as reference.
3. Make the connection as shown:



STEP	PROCEDURE
4.	Start the tX power calibration by pressing the Start button (:RALT:CAL:TRAN:STAR).
5.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach +10 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
6.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
7.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -14 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
8.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
9.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -14 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
10.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
11.	Repeat steps 2 through 6 for frequencies 4.3 GHz and 4.4 GHz.
12.	Make the connection as shown:



STEP	PROCEDURE
13.	Set the RF Generator output to 4.2 GHz, level at level recorded in step 2.
14.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach +9 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
15.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
16.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -22 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
17.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).

STEP	PROCEDURE
18.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -22 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
19.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
20.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -1 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
21.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
22.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -11 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
23.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
24.	Press the TX ATTEN Value window to access the DAC adjustment window. Adjust the DAC value up or down to reach -21 dBm +/- 0.05 dB on the Power Meter (:RAL:CAL:TRAN:TATT value).
25.	Press the Next button to advance to the next calibration point (:RALT:CAL:TRAN:NEXT?).
26.	Repeat steps 8 through 20 for frequencies 4.3 GHz and 4.4 GHz.
27.	Press the Save and Return button to save the TX calibration (:RALT:CAL:TRAN:SAVE).

3.2.11 T1055 Analog Attenuators Calibration

EQUIPMENT: Cable

STEP	PROCEDURE
1.	Make the connection as shown:

2.	Start the Analog Attenuator calibration by pressing the Start button (:RAL:CAL:VATT:STAR).
3.	The calibration of the analog attenuators cannot be stopped during the calibration. Wait until the calibration is finished.
4.	The calibration of the analog attenuators is complete and the ALT-8000 will exit the calibration menu.

3.3 TEST SET VERIFICATION

3.3.1 Verification Schedule

Verification Procedures should be performed as a result of one or more of the following conditions:

Failure to Meet Specifications	If, during the course of normal operation, the Test Set or any major function thereof fails to meet performance specifications.
Assembly Replacement	If one or more of the Test Set assemblies are replaced.
Annual Calibration/Verification	Aeroflex recommends Calibration/Verification on the Test Set every year to maintain proper testing standards.

3.3.2 Precautions

The Verification Procedures are performed with the Test Set covers in place. No internal adjustments or probing points are required.

3.3.3 Test Equipment

The test equipment listed is suitable for performing any procedure contained in this manual.

Required Test Equipment	Model
Measuring Receiver	Rhode & Schwarz FSMR-26
Measuring Receiver Sensor	Rhode & Schwarz NRP-Z27
Counter	Agilent 35181A
Oscilloscope	Tektronix DPO3034
Peak Power Meter	Agilent N1911A
Peak Power Sensor	Agilent N1921A
RF Power Amplifier	ifi GT84-500
RF Signal Generator	IFR-3416 with option 006
ARB Generator	Agilent 33220A
Directional Coupler	Narda 3004-20
30 dB Pad	Aeroflex Model 1

3.3.4 Remote Communication

The Remote Communication procedure checks the ALT-8000 ethernet, USB port and internal drive operation. The parameters are programmed into the appropriate locations. The commands sent via the Ethernet interface commands are identified in parentheses. The remote program used to communicate with the ALT-8000 is PuTTY. PuTTY is a free Telnet/SSH Client that can be downloaded free of charge.

EQUIPMENT: Ethernet Cable

STEP	PROCEDURE
1.	Connect an ethernet cable from the ALT-8000 to a local area network hub.
2.	Setup the ALT-8000 and enter the following: IP address: 10.200.120.148 Subnet Mask: 255.255.255.0 Network Mode: Static IP Ensure the controller has a similar IP address (i.e. 10.200.120.140)
3.	Invoke PuTTY. Set the following: IP address: 10.200.120.148 Port: 5025
4.	Check the TELNET item.
5.	Press the OPEN button to establish the communications conduit to the ALT-8000. The PuTTY program opens a DOS window to allow the operator to enter the appropriate commands.
6.	Establish the communication with the UUT and verify it is OK. Send the *IDN? command once to clear the bus. The UUT will not respond to the first command sent.
7.	Send command “*IDN?” to the UUT.
8.	Record the system software version for test report.
9.	Send command “:CONF:VERSIONS?” to the UUT.
10.	Record the firmware versions for test report.
11.	Set the UUT to direct connection (:RALT:SET:CONN DIR).
12.	Query the UUT connection (:RALT:SET:CONN?) and verify the UUT returns “DIR”.
13.	Set the UUT to detect pulse signal (:RALT:SET:UUT:TYPE PULS).
14.	Query the UUT signal type (:RALT:SET:UUT:TYPE?) and verify the UUT returns “PULS”.
15.	Set the UUT to detect FMCW signal (:RALT:SET:UUT:TYPE FMCW).
16.	Query the UUT signal type (:RALT:SET:UUT:TYPE?) and verify the UUT returns “FMCW”.

3.3.5 T1020 TX CW Output Frequency

The RF Output Frequency procedure measures the CW output frequency of the different frequencies generated by the ALT-8000.

EQUIPMENT: Measuring Receiver
Coaxial Cable

STEP PROCEDURE

1. From the Launch bar select Maintenance, then Diagnostics from the drop down menu. Enter data as follows:

Field	Setting
Output Signal Mode	CW
Output Power	0 dBm
Output Frequency	4200 MHz to 4400 MHz
Output Status	ON

2. Connect the Measuring Receiver Sensor to the UUT TX port.
3. Set output frequency at 4200, 4255, 4300,and 4400 MHz, respectively.
4. At each frequency setting, verify:
Measured Frequency = Setting Frequency +/- 1 ppm.

Test Frequency MHz	Measured Frequency	Tolerance
4200		+/- 4200 Hz
4255		+/- 4255 Hz
4300		+/- 4300 Hz
4345		+/- 4345 Hz
4400		+/- 4400 Hz

3.3.6 T1025 TX CW Output Power @ 4200 MHz

The T1025 TX CW Output Power @ 4200 MHz procedure measures the CW output power at different test levels.

EQUIPMENT: Measuring Receiver

STEP PROCEDURE

1. From the Launch bar select Maintenance, then Diagnostics from the drop down menu. Enter data as follows:

Field	Setting
Diagnostic Mode	CW
Output Power	-073 dBm to + 17 dBm dBm
Output Frequency	4200 MHz
Output Status	ON

2. Connect the Measuring Receiver Sensor to the UUT TX port.
3. Set output level from 0 dBm to 8 dBm, step to 2 dB.
4. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
0 dBm		+/- 3 dB
2 dBm		+/- 3 dB
4 dBm		+/- 3 dB
6 dBm		+/- 3 dB
8 dBm		+/- 3 dB

5. Set output level from 17 dBm to - 73 dBm, step to 10 dB.
6. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
17 dBm		+/- 3 dB
7 dBm		+/- 3 dB
-7 dBm		+/- 3 dB
-17 dBm		+/- 3 dB
-27 dBm		+/- 3 dB
-37 dBm		+/- 3 dB
-47 dBm		+/- 3 dB
-57 dBm		+/- 3 dB
-67 dBm		+/- 3 dB
-73 dBm		+/- 3 dB

3.3.7 T1030 TX CW Output Power @ 4300 MHz

The T1030 TX CW Output Power @ 4300 MHz procedure measures the CW output power at different test levels.

EQUIPMENT: Measuring Receiver

STEP PROCEDURE

1. From the Launch bar select Maintenance, then Diagnostics from the drop down menu. Enter data as follows:

Field	Setting
Diagnostic Mode	CW
Output Power	-073 dBm to + 17 dBm dBm
Output Frequency	4300 MHz
Output Status	ON

2. Connect the Measuring Receiver Sensor to the UUT TX port.
3. Set output level from 0 dBm to 8 dBm, step to 2 dB.
4. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
0 dBm		+/- 3 dB
2 dBm		+/- 3 dB
4 dBm		+/- 3 dB
6 dBm		+/- 3 dB
8 dBm		+/- 3 dB

5. Set output level from 17 dBm to - 73 dBm, step to 10 dB.
6. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
17 dBm		+/- 3 dB
7 dBm		+/- 3 dB
-7 dBm		+/- 3 dB
-17 dBm		+/- 3 dB
-27 dBm		+/- 3 dB
-37 dBm		+/- 3 dB
-47 dBm		+/- 3 dB
-57 dBm		+/- 3 dB
-67 dBm		+/- 3 dB
-73 dBm		+/- 3 dB

3.3.8 T1035 TX CW Output Power @ 4400 MHz

The T1035 TX CW Output Power @ 4400 MHz procedure measures the CW output power at different test levels.

EQUIPMENT: Measuring Receiver

STEP PROCEDURE

1. From the Launch bar select Maintenance, then Diagnostics from the drop down menu. Enter data as follows:

Field	Setting
Diagnostic Mode	CW
Output Power	-073 dBm to + 17 dBm dBm
Output Frequency	4400 MHz
Output Status	ON

2. Connect the Measuring Receiver Sensor to the UUT TX port.
3. Set output level from 0 dBm to 8 dBm, step to 2 dB.
4. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
0 dBm		+/- 3 dB
2 dBm		+/- 3 dB
4 dBm		+/- 3 dB
6 dBm		+/- 3 dB
8 dBm		+/- 3 dB

5. Set output level from 17 dBm to - 73 dBm, step to 10 dB.
6. At each step verify that Measured Level = Setting Level +/- 3 dB.

Power Setting on UUT	Measured Power Output	Tolerance
17 dBm		+/- 3 dB
7 dBm		+/- 3 dB
-7 dBm		+/- 3 dB
-17 dBm		+/- 3 dB
-27 dBm		+/- 3 dB
-37 dBm		+/- 3 dB
-47 dBm		+/- 3 dB
-57 dBm		+/- 3 dB
-67 dBm		+/- 3 dB
-73 dBm		+/- 3 dB

3.3.9 T1040 TX CW Loop-Back Power @ 4200 MHz

The T1040 TX CW Loop-Back Power @ 4200 MHz procedure measures the power output at different output power levels.

EQUIPMENT: Measuring Receiver
Signal Generator

STEP PROCEDURE

1. Setup a test signal using the Signal Generator with the following parameters:

Field	Setting
Mode	CW
TX output level	0 dBm
TX Output Frequency	4200 MHz

2. Connect the Signal Generator output to the UUT RX connector.
3. Setup the UUT Test Setup menu as follows:

Field	Setting
Detect Mode	Manual
Connection Type	Direct
UUT Type	FMCW
Level Mode	Manual
RX Cable Loss	0 dB
TX Cable Loss	0 dB

4. Setup the Measuring Receiver as follows:

Field	Setting
Measuring Receiver	RF Level Screen
Receiver Frequency	4200 MHz

5. Display the Simulation screen.
6. Run simulation on the UUT. Ensure that the UUT parameters reflect the Signal Generator characteristics. The power level measurement will be at the power level set on the Signal Generator minus the cable loss.
7. Set UUT TX output = -7 to -13 dBm, Step = 2 dB.
8. At each step verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-7 dBm		+/- 4 dB
-9 dBm		+/- 4 dB
-11 dBm		+/- 4 dB
-13 dBm		+/- 4 dB

STEP	PROCEDURE
9.	Set UUT TX output = -23 to -83 dBm, Step - 10 dB.
10.	At each step, verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-23 dBm		+/- 4 dB
-33 dBm		+/- 4 dB
-43 dBm		+/- 4 dB
-53 dBm		+/- 4 dB
-63 dBm		+/- 4 dB
-73 dBm		+/- 4 dB
-83 dBm		+/- 4 dB

3.3.10 T1045 TX CW Loop-Back Power @ 4300 MHz

The T1045 TX CW Loop-Back Power @ 4300 MHz procedure measures the power output at different output power levels.

EQUIPMENT: Measuring Receiver
Signal Generator

STEP	PROCEDURE

1. Setup a test signal using the Signal Generator with the following parameters:

Field	Setting
Mode	CW
TX output level	0 dBm
TX Output Frequency	4300 MHz

2. Connect the Signal Generator output to the UUT RX connector.
3. Setup the UUT Test Setup menu as follows:

Field	Setting
Detect Mode	Manual
Connection Type	Direct
UUT Type	FMCW
Level Mode	Manual
RX Cable Loss	0 dB
TX Cable Loss	0 dB

4. Setup the Measuring Receiver as follows:

Field	Setting
Measuring Receiver	RF Level Screen
Receiver Frequency	4300 MHz

5. Display the Simulation screen.
6. Run simulation on the UUT. Ensure that the UUT parameters reflect the Signal Generator characteristics. The power level measurement will be at the power level set on the Signal Generator minus the cable loss.
7. Set UUT TX output = -7 to -13 dBm, Step = 2 dB.
8. At each step verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-7 dBm		+/- 4 dB
-9 dBm		+/- 4 dB
-11 dBm		+/- 4 dB
-13 dBm		+/- 4 dB

STEP	PROCEDURE
9.	Set UUT TX output = -23 to -83 dBm, Step - 10 dB.
10.	At each step, verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-23 dBm		+/- 4 dB
-33 dBm		+/- 4 dB
-43 dBm		+/- 4 dB
-53 dBm		+/- 4 dB
-63 dBm		+/- 4 dB
-73 dBm		+/- 4 dB
-83 dBm		+/- 4 dB

3.3.11 T1050 TX CW Loop-Back Power @ 4400 MHz

The T1050 TX CW Loop-Back Power @ 4400 MHz procedure measures the power output at different output power levels.

EQUIPMENT: Measuring Receiver
Signal Generator

STEP	PROCEDURE

1. Setup a test signal using the Signal Generator with the following parameters:

Field	Setting
Mode	CW
TX Output Level	0 dBm
TX Output Frequency	4400 MHz

2. Connect the Signal Generator output to the UUT RX connector.
3. Setup the UUT Test Setup menu as follows:

Field	Setting
Detect Mode	Manual
Connection Type	Direct
UUT Type	FMCW
Level Mode	Manual
RX Cable Loss	0 dB
TX Cable Loss	0 dB

4. Setup the Measuring Receiver as follows:

Field	Setting
Measuring Receiver	RF Level Screen
Receiver Frequency	4400 MHz

5. Display the Simulation screen.
6. Run simulation on the UUT. Ensure that the UUT parameters reflect the Signal Generator characteristics. The power level measurement will be at the power level set on the Signal Generator minus the cable loss.
7. Set UUT TX output = -7 to -13 dBm, Step = 2 dB.
8. At each step verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-7 dBm		+/- 4 dB
-9 dBm		+/- 4 dB
-11 dBm		+/- 4 dB
-13 dBm		+/- 4 dB

STEP	PROCEDURE
9.	Set UUT TX output = -23 to -83 dBm, Step - 10 dB.
10.	At each step, verify that Measured Level = Setting Level +/- 4 dB.

Power Setting on UUT	Measured Power Output	Tolerance
-23 dBm		+/- 4 dB
-33 dBm		+/- 4 dB
-43 dBm		+/- 4 dB
-53 dBm		+/- 4 dB
-63 dBm		+/- 4 dB
-73 dBm		+/- 4 dB
-83 dBm		+/- 4 dB

11. Stop test on the UUT.

3.3.12 T1055 TX FMCW Output Signal

The T1055 TX FMCW Output Signal procedure measures the deviation of the output waveform.

EQUIPMENT: Measuring Receiver
Spectrum Analyzer
Test Fixture
Low Loss Cable

STEP PROCEDURE

1. Setup the Spectrum Analyzer as follows:

Field	Setting
Max Hold	
Span	250 MHz
Center Frequency	4300 MHz
Resolution Bandwidth	20 KHz
Video Bandwidth	50 KHz
Amplitude Reference Level	0 dBm

2. Setup the UUT as follows:

Field	Setting
Diagnostic Mode	FMCW
Output Power	0 dBm
Output Frequency	4300 MHz
Output Status	ON

3. Connect UUT TX port to the RX port of the Test Fixture using the low loss cable.
4. Connect Measuring Receiver Sensor to the PULSE RX port of the Test Fixture.
5. Verify the following:

Test Performed	Measurement	Tolerance
+ Peak Deviation		+95 MHz +/- 1 MHz
- Peak Deviation:		-95 MHz +/- 1 MHz

6. Stop test on the UUT.

3.3.13 T1070 TX PULSE Output Pulse Width

The T1070 TX PULSE Output Pulse Width procedure sets the ALT-8000 for a specific pulse width in diagnostic mode and verifies the pulse width is within tolerance.

EQUIPMENT: Pulse Detector
Oscilloscope

STEP PROCEDURE

1. Setup the UUT as follows:

Field	Setting
Diagnostic Mode	PULSE
PRF	5 kHz
Pulse Width	20 to 400 ns
Output Power	10 dBm
Output Frequency	4300 MHz
Output Status	ON

2. Connect UUT TX port to Scope CH1 through the BPF and Pulse Detector.
3. Set the UUT pulse widths at 20, 60, 100, 200, 300 and 400 ns, respectively.
4. At each setting, verify that Measured PW = Setting PW +/- 10 ns.

Power Width Setting	Measurement	Tolerance
100 ns		Measured PW = Setting PW +/- 10 ns
200 ns		Measured PW = Setting PW +/- 10 ns
300 ns		Measured PW = Setting PW +/- 10 ns
400 ns		Measured PW = Setting PW +/- 10 ns

3.3.14 T1075 TX PULSE Output PRF

The T1070 TX PULSE Output Pulse Width procedure sets the ALT-8000 for a specific pulse width repetition frequency in diagnostic mode and verifies the pulse width is within tolerance.

EQUIPMENT: Pulse Detector
Counter

STEP	PROCEDURE

1. Setup the UUT as follows:

Field	Setting
Diagnostic Mode	PULSE
PRF	2 to 30 kHz
Pulse Width	200 ns
Output Power	10 dBm
Output Frequency	4300 MHz
Output Status	ON

2. Connect UUT TX port to CounterCH1 through the BPF and Pulse Detector.
3. Set the UUT pulse PRF at 2, 3, 5, 10, 20 and 30 kHz respectively.
4. At each setting, verify that Measured PW = Setting PW +/- 1%.

PRF Setting	Measurement	Tolerance
2 KHz		Measured PRF = Setting PRF +/- 1%
3 KHz		Measured PRF = Setting PRF +/- 1%
5 KHz		Measured PRF = Setting PRF +/- 1%
10 KHz		Measured PRF = Setting PRF +/- 1%
20 KHz		Measured PRF = Setting PRF +/- 1%
30 KHz		Measured PRF = Setting PRF +/- 1%

3.3.15 T1080 TX PULSE Output Power

The T1080 TX PULSE Output Power procedure sets the ALT-8000 for a specific pulse output power in diagnostic mode and verifies the pulse output power is within tolerance.

EQUIPMENT: Measuring Receiver

STEP	PROCEDURE
1.	Connect the Measuring Receiver Sensor directly to the UUT TX port.
2.	Setup the Measuring Receiver as follows:

Field	Setting
Spectrum Analyzer Screen	
Receiver Frequency	4300 MHz
Zero Span	
RBW	10 MHz
VBW	10 MHz
Sweep Time	1 us (100 ns/div.)
Trigger Video at Offset	99.25 us
2 dB Scale	

3. Setup the UUT as follows:

Field	Setting
Diagnostic Mode	PULSE
PRF	5 kHz
Pulse Width	400 ns
Output Frequency	4300 MHz
Output Status	ON

4. Set output power at 17 dBm to - 50 dBm, step at 10 dB.

STEP	PROCEDURE
5.	At each step verify Measured Level = Setting Level +/- 4 dB.

Power Setting	Measurement	Tolerance
17 dBm		Measured Level = Setting Level +/- 4 dB
10 dBm		Measured Level = Setting Level +/- 4 dB
0 dBm		Measured Level = Setting Level +/- 4 dB
-10 dBm		Measured Level = Setting Level +/- 4 dB
-20 dBm		Measured Level = Setting Level +/- 4 dB
-30 dBm		Measured Level = Setting Level +/- 4 dB
-40 dBm		Measured Level = Setting Level +/- 4 dB
-50 dBm		Measured Level = Setting Level +/- 4 dB

3.3.16 T1090 RX FMCW Frequency Measurement

The T1090 RX FMCW Frequency Measurement procedure tests the ability of the UUT to measure the frequency of a FMCW signal accurately.

EQUIPMENT: RF Signal Generator

STEP PROCEDURE

1. Connect the RF Signal Generator to the RX port using the low loss cable.
2. Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	100 Hz

3. Setup the UUT as follows:

Field	Setting
Test Mode	FMCW
Connection	Direct

4. Start test on the UUT.
5. Set the RF Signal Generator output frequency at 4.2 GHz to 4.4 GHz, step at 50 MHz. Output frequency is set by setting the TX Offset frequency.
6. At each setting, verify that the UUT Measured Frequency = Setting Frequency +/- 5 MHz.

Frequency Setting	Measurement	Tolerance
4200 MHz		Measured Freq= Setting Freq +/- 5 MHz
4250 MHz		Measured Freq= Setting Freq +/- 5 MHz
4300 MHz		Measured Freq= Setting Freq +/- 5 MHz
4350 MHz		Measured Freq= Setting Freq +/- 5 MHz
4400 MHz		Measured Freq= Setting Freq +/- 5 MHz

7. Stop test on the UUT.

3.3.17 T1100 RX FMCW Sweep Rate and Deviation Measurement at 50 Hz

The T1100 RX FMCW Sweep Rate and Deviation Measurement procedure measures the sweep rate and deviation of the test signal.

EQUIPMENT: RF Signal Generator

STEP	PROCEDURE

1. Connect the RF Signal Generator to the RX port using the low loss cable.
2. Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	50 Hz

3. Setup the UUT to manual FMCW Test Mode, direct connection.
4. Run test on the UUT and verify the measurements:
   FM Deviation = 30 +/- 5 MHz
   Sweep Rate = 50 +/- 5 Hz
5. Verify the FM deviation is within the tolerance listed and the sweep rate is 50 +/- Hz for the following:

Deviation Setting	FM Deviation Measurement	Sweep Rate Measurement	Tolerance
30 MHz			FM Deviation = 30 +/- 5 MHz Sweep Rate = 50 +/- 5 MHz

6. Stop test on the UUT.

3.3.18 T1105 RX FMCW Sweep Rate and Deviation Measurement at 100 Hz

The T1105 RX FMCW Sweep Rate and Deviation Measurement procedure measures the sweep rate and deviation of the test signal.

EQUIPMENT: RF Signal Generator

STEP	PROCEDURE
1.	Connect the RF Signal Generator to the RX port using the low loss cable.
2.	Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	100 Hz

3. Setup the UUT to manual FMCW Test Mode, direct connection.
4. Run test on the UUT and verify the measurements:
   FM Deviation = 30 +/- 5 MHz
   Sweep Rate = 100 +/- 5 Hz
5. Verify the FM deviation is within the tolerance listed and the sweep rate is 100 +/- Hz for the following:

Deviation Setting	FM Deviation Measurement	Sweep Rate Measurement	Tolerance
30 MHz			FM Deviation = 30 +/- 5 MHz Sweep Rate = 100 +/- 5 Hz

6. Stop test on the UUT.

3.3.19 T1110 RX FMCW Sweep Rate and Deviation Measurement at 200 Hz

The T1110 RX FMCW Sweep Rate and Deviation Measurement procedure measures the sweep rate and deviation of the test signal.

EQUIPMENT: RF Signal Generator

STEP	PROCEDURE

1. Connect the RF Signal Generator to the RX port using the low loss cable.
2. Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	200 Hz

3. Setup the UUT to manual FMCW Test Mode, direct connection.
4. Run test on the UUT and verify the measurements:
   FM Deviation = 30 +/- 5 MHz
   Sweep Rate = 200 +/- 5 Hz
5. Verify the FM deviation is within the tolerance listed and the sweep rate is 200 +/- Hz for the following:

Deviation Setting	FM Deviation Measurement	Sweep Rate Measurement	Tolerance
30 MHz			FM Deviation = 30 +/- 5 MHz Sweep Rate = 200 +/- 5 Hz

6. Stop test on the UUT.

3.3.20 T1115 RX FMCW Sweep Rate and Deviation Measurement at 300 Hz

The T1115 RX FMCW Sweep Rate and Deviation Measurement procedure measures the sweep rate and deviation of the test signal.

EQUIPMENT: RF Signal Generator

STEP PROCEDURE

1. Connect the RF Signal Generator to the RX port using the low loss cable.
2. Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	300 Hz

3. Setup the UUT to manual FMCW Test Mode, direct connection.
4. Run test on the UUT and verify the measurements:
   FM Deviation = 30 +/- 5 MHz
   Sweep Rate = 300 +/- 5 Hz
5. Verify the FM deviation is within the tolerance listed and the sweep rate is 300 +/- Hz for the following:

Deviation Setting	FM Deviation Measurement	Sweep Rate Measurement	Tolerance
30 MHz			FM Deviation = 30 +/- 5 MHz Sweep Rate = 300 +/- 5 Hz

6. Stop test on the UUT.

3.3.21 T1120 RX FMCW Sweep Rate and Deviation Measurement at 400 Hz

The T1120 RX FMCW Sweep Rate and Deviation Measurement procedure measures the sweep rate and deviation of the test signal.

EQUIPMENT: RF Signal Generator

STEP	PROCEDURE

1. Connect the RF Signal Generator to the RX port using the low loss cable.
2. Setup the RF Signal Generator as follows:

Field	Setting
Center Frequency	4200 MHz
Output Level	0 dBm
FM Deviation	30 MHz
Shape	Triangle
Sweep Rate	400 Hz

3. Setup the UUT to manual FMCW Test Mode, direct connection.
4. Run test on the UUT and verify the measurements:
   FM Deviation = 30 +/- 5 MHz
   Sweep Rate = 400 +/- 5 Hz
5. Verify the FM deviation is within the tolerance listed and the sweep rate is 400 +/- Hz for the following:

Deviation Setting	FM Deviation Measurement	Sweep Rate Measurement	Tolerance
30 MHz			FM Deviation = 30 +/- 5 MHz Sweep Rate = 400 +/- 5 Hz

6. Stop test on the UUT.

3.3.22 T1130 Time Delay Measurement

The T1130 Time Delay Measurement procedure verifies the ALT-8000 correctly calculates the delay of a 20 ft cable and the additional 20 ft of the length of the test cable. There is a 19 ns delay within the ALT-8000 that must be accounted for in the calculations.

EQUIPMENT: Two 20 ft Coaxial Cables, +/- 1 in
TNC-to-TNC Adapter

STEP	PROCEDURE
1.	Connect the 20 ft cable to the UUT TX and RX ports.
2.	Run Delay Calibration and record the results for both FMCW and PULSE.
3.	Verify that $FMCW_{Ref}$ = 45 +/- 5 ns.
4.	Add the second 20 ft cable using TNC-to-TNC adapter, creating a total cable length of 40 ft.
5.	Run Delay Calibration and record the results for both FMCW and PULSE.
6.	Verify that FMCW - $FMCW_{Ref}$ = 20 ft Cable Delay +/- 1 ns.

Cable Length	CW delay -19 ns ALT -8000 delay	Pulse delay -19 ns ALT -8000 delay	Tolerance
20 ft			30 +/- 5 ns
40 ft*			20 ft cable result +/- 1 ns

* Total delay of 40 ft calibration minus the 20 ft calculation in the previous step, minus the 19 ns delay through the ALT-8000 = 20 ft cable result +/- 1 ns.

Note: Time delay of coaxial cable is approx 1.5 ns/ft.

3.3.23 T1140 RX Port Pre-test Impedance

The T1140 RX Port Pre-test Impedance procedure verifies the input impedance for the RX port is the proper value.

EQUIPMENT: DMM

STEP	PROCEDURE
1.	Connect the DMM to the RX port.
2.	Verify the resistance is 51 +/- 1 Ohms.

Measurement	Tolerance
	51 +/- 1 Ohms

3.3.24 T1200 RX PULSE Power Measurement

The T1200 RX PULSE Power Measurement procedure verifies the incoming pulses are within the prescribed accuracy.

EQUIPMENT:
RF Signal Generator
RF Amplifier
Power Meter
Power Sensor
Coupler
30 dB Pad

STEP	PROCEDURE

1. Make the connection as follows:

2. Set UUT to manual PULSE Test Mode direct connection.
3. Set the RF Generator to -43 dBm at 4300 MHz I/Q modulation mode. ALC mode is frozen.
   The RF Generator is setup with a pulse file to output a pulse at 100 ns at a prf of 20 KHz. The pulse file can be generated using Aeroflex I/Q Creator with the parameters specified at the end of the test procedure section.
4. Adjust the RF Generator's output level to have the amplifier's output = 300 dBm +/- 0.5 dB (monitored by the Power Meter).
5. Run test and verify the UUT measured power is within the power meter's value +/- 2 dB.
6. Repeat for a power level of 50 dBm.

Frequency	Measured Power	Tolerance
30 dBm		+/- 2 dBm
50 dBm		+/- 2 dBm

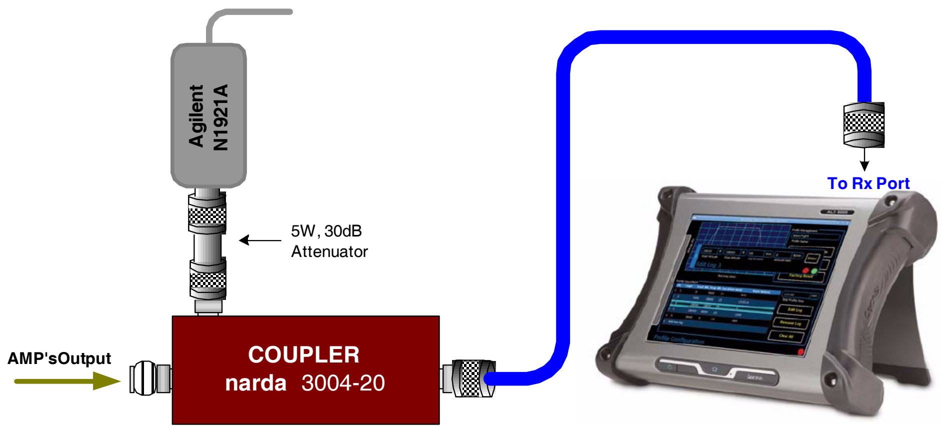
7. Stop test.

3.3.25 T1220 RX PULSE Frequency Measurement

The T1220 RX PULSE Frequency Measurement procedure verifies the incoming pulses are within the prescribed accuracy.

EQUIPMENT: RF Signal Generator
RF Amplifier
Coupler

STEP	PROCEDURE
1.	Make the connection as follows:



2. Set UUT to manual PULSE Test Mode direct connection.
3. Set RF Generator to -43 dBm at 4300 MHz I/Q modulation mode. ALC mode is frozen.
   The RF Generator is setup with a pulse file to output a pulse at 100 ns at a prf of 20 KHz. The pulse file can be generated using Aeroflex I/Q Creator with the parameters specified at the end of the test procedure section.
4. Set the RF Generator to -24 dBm at 4300 MHz pulse modulation mode.
5. Set the RF Generator output frequency to 4200, 4300 and 4400 MHz respectively. At each setting, run test and verify that the UUT Measured Frequency = Setting Frequency +/- 10 MHz.

Frequency	Frequency Measurement	Tolerance
4200 MHz		Measured Frequency = Setting Frequency +/- 10 MHz
4300 MHz		Measured Frequency = Setting Frequency +/- 10 MHz
4400 MHz		Measured Frequency = Setting Frequency +/- 10 MHz

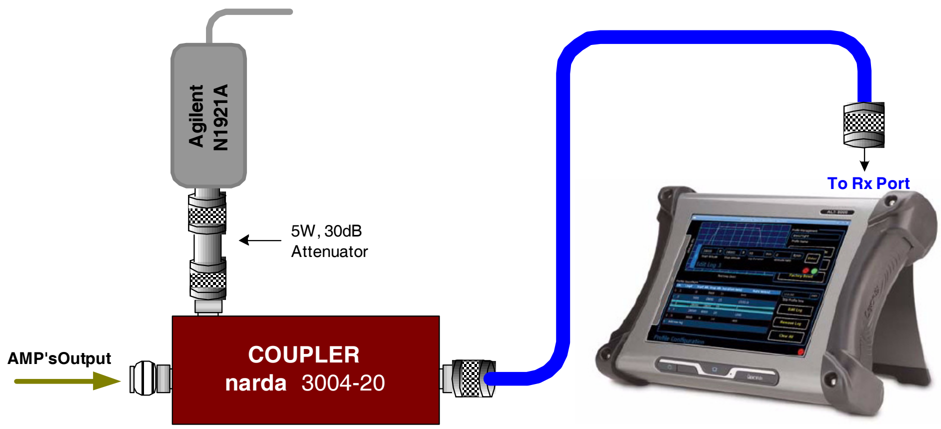
6. Stop test.

3.3.26 T1230 RX PULSE Width Measurement

The T1230 RX PULSE Width Measurement procedure verifies the incoming pulses are within the prescribed accuracy.

EQUIPMENT: RF Signal Generator
RF Amplifier
Coupler

STEP	PROCEDURE
1.	Make the connection as follows:



2. Set UUT to manual PULSE Test Mode direct connection.
3. Set RF Generator to -43 dBm at 4300 MHz I/Q modulation mode. ALC mode is frozen.
   The RF Generator is setup with a pulse file to output a pulse at 100 ns at a prf of 20 KHz. The pulse file can be generated using Aeroflex I/Q Creator with the parameters specified at the end of the test procedure section.
4. Set the RF Generator to -24 dBm at 4300 MHz pulse modulation mode. Verify that the UUT Measured PW = Setting PW +/- 10 ns.

Pulse Width Setting	Measured Pulse Width	Tolerance
100 ns		Measured PW = Setting PW +/- 10 ns

5. Stop test.

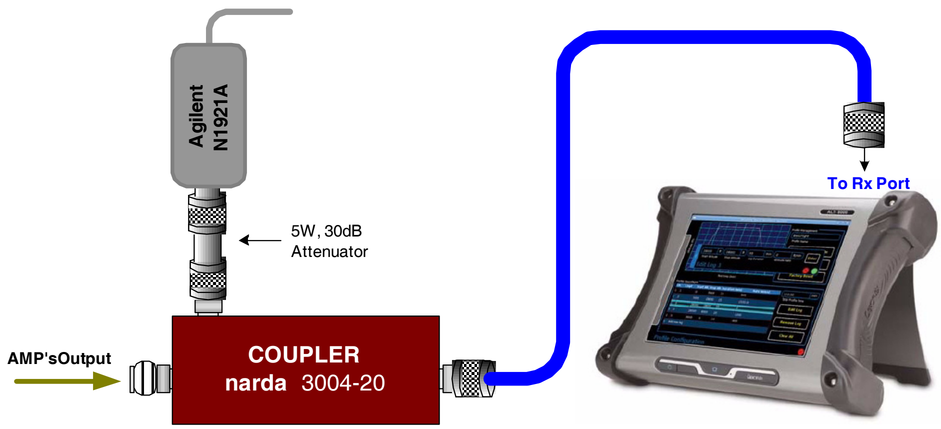
3.3.27 T1240 RX PULSE PRF Measurement

The T1240 RX PULSE PRF Measurement procedure verifies the incoming pulse PRF is within the prescribed accuracy.

EQUIPMENT: RF Signal Generator
RF Amplifier
Coupler

STEP	PROCEDURE

1. Make the connection as follows:



2. Set UUT to manual PULSE Test Mode direct connection.
3. Set RF Generator to -43 dBm at 4300 MHz I/Q modulation mode. ALC mode is frozen.
   The RF Generator is setup with a pulse file to output a pulse at 100 ns at a prf of 20 KHz. The pulse file can be generated using Aeroflex I/Q Creator with the parameters specified at the end of the test procedure section.
4. Set the RF Generator to -24 dBm at 4300 MHz pulse modulation mode.
5. At each setting, run test and verify that the UUT Measured PRF = Setting PRF +/- 1 %.

PRF Setting	Measured PRF	Tolerance
20 KHz		+/- 1 %

6. Stop test.

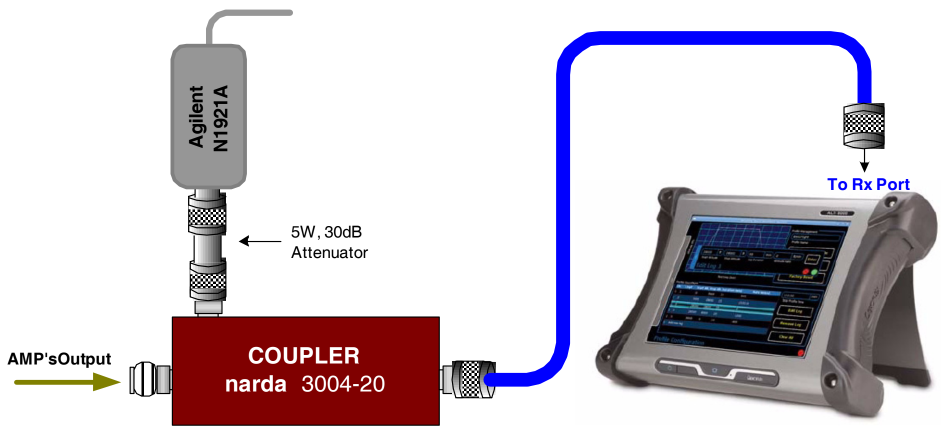
3.3.28 T1250 RX CW Power Measurement

The T1250 RX CW Power Measurement procedure verifies the incoming CW signal is within the prescribed accuracy.

EQUIPMENT: RF Signal Generator
RF Amplifier
Power Meter
Power Sensor
Coupler

STEP	PROCEDURE

1. Make the connection as follows:



2. Set UUT to manual FMCW Test Mode direct connection.
3. Set RF Generator to -40 dBm at 4300 MHz CW.
4. Adjust the RF Generator's output level to have the amplifier's output = 200 dBm +/- 0.5 dB (monitored by the Power Meter).
5. Run test and verify the UUT measured power is within the power meter's value +/- 2 dB.

Power Applied	Frequency Measured	Tolerance
20 dBm		+/- 2 dBm
30 dBm		+/- 2 dBm
50 dBm		+/- 2 dBm

6. Stop test.

3.3.29 Generating a Pulse ARB file in IQ Creator for the Signal Generator

Signal characteristics are:
Pulse Width: 100 ns
PRF: 20 KHz

STEP	PROCEDURE
1.	Download and install the latest version of IQ Creator at www.aeroflex.com.
2.	Launch IQ Creator.
3.	Using the drop down menu, navigate to Modulation/Archiver ICQ Version 8/Tones.
4.	In the Tones window uncheck Auto Settings and enter the following settings:

Setting	Enter
File Length	50 us
Sample Rate	60 MHz
Number of Samples	3000

5. Select the first tone in the table.
6. Click the Edit button and change the Frequency to 0 kHz.
7. Click OK.
8. Select the Markers tab.
9. Click the check box Use Markers.
10. Select Marker Type Burst Control.
11. Configure the following settings:

Setting	Enter
Burst Control Type	RF Bursting
Rise/Fall Profile Shape	None

12. Click the Add button.
13. Configure the following settings:

Setting	Enter
Marker On Time	0
Marker Off Time	6
Attenuation	0

14. Click OK.
15. Using the drop down menu, navigate to Generate AIQ File/Current Settings.
16. Click Browse to select a location for the file generation and enter the desired file name in the File Name text box.
17. Click Save.
18. Select the Destination Hardware that matches the Generator being used for this test.
19. Click Generate.
20. Close the report file.
21. The AIQ file can now be transferred to the RF Signal Generator for use.

Chapter 4 - Remove/Install Procedures

4.1 GENERAL INFORMATION

This chapter contains Operator Level and Technician Level Maintenance procedures.

Operator Level Procedures can be performed by Operator Personnel. Technician Level Maintenance Procedures should only be performed by qualified Service Personnel. Prerequisite and follow-up instructions are identified as needed.

4.2 PRELIMINARY CONSIDERATIONS

4.2.1 Tools Requirements

TOOL	SIZE
Hex Screwdriver	2 mm, 2.5 mm, 3 mm
6” & 10” Screwdriver	Cross-recessed

Table 4-1 Remove/Install Tool Requirements

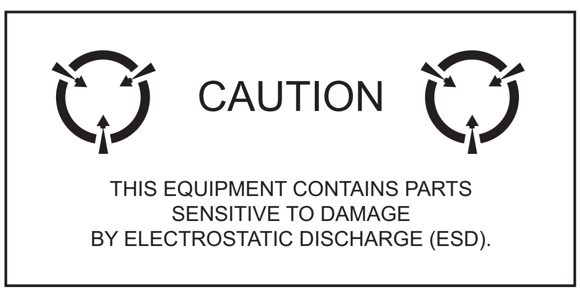
4.2.2 ESD and Safety Precautions

4.2.2.A Safety Precautions

Disconnect Test Set from AC Power Source before initiating any procedure.

WARNING	DANGEROUS VOLTAGES ARE PRESENT WHEN CASE ASSEMBLY IS REMOVED AND POWER IS PRESENT.

4.2.2.B ESD Precautions



CAUTION	THE TEST SET CONTAINS PARTS SENSITIVE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD). ALL PERSONNEL PERFORMING DISASSEMBLY/REASSEMBLY PROCEDURES SHOULD HAVE KNOWLEDGE OF ACCEPTED ESD PRACTICES AND/OR BE ESD CERTIFIED.

4.2.3 Specified Replacement Screws

Specified replacement screws are pre-treated with grip adhesive.

4.2.4 Inverting Test Set

The Test Set can be inverted and stood on the Front Handles to remove/install the Case Assembly. The Test Set should not be left in an inverted position to perform any other remove/install procedures.

CAUTION	TO AVOID DAMAGING FRONT PANEL CONNECTORS, DO NOT INVERT THE ALT-8000 IF THE FRONT HANDLES HAVE BEEN REMOVED.

4.2.5 Connectors and Cables

CAUTION	USE CARE WHEN DISCONNECTIONG CABLES TO AVOID DAMAGING CONNECTORS.

4.2.6 Preliminary Procedures

Aeroflex recommends that the Test Set's internal Calibration Files be saved to a USB device prior to servicing the unit.

Chapter 5 - Serviceable Parts List

5.1 GENERAL INFORMATION

This chapter identifies ALT-8000 serviceable parts and assemblies. Contact Aeroflex Customer Service regarding items not listed in this chapter.

Fig. 5-1 ALT-8000 Radio Altimeter Test Set

5.2 PARTS LIST

5.2.1 Ship Unit, ALT-8000 (A1)

87001			A
ITEM	PART NUMBER	CAGE CODE	DESCRIPTION
4	89069	51190	HEATSINK, SLOT 1 TORPEDO
5	87823	51190	GASKET,O-RING,HOUSING
8	87059	51190	LABEL, LEFT CONNECTOR, ALT-8000
9	87060	51190	LABEL, RIGHT CONNECTOR, ALT-8000
14	87758	51190	SM, M4 X .7 X 30, ABT, A2, AB, TL
15	88354	51190	SM, M4 X .7 X 50, ABT, A2, PA, TL
16	88356	51190	SM, M4 X .7 X 25, ABT, A2, PA, TL
19	36272	51190	WASHER,NYL,.312OD,.171ID,.032T
22	87189	51190	SM, M4 X .7 X 45, ABT, A2, PA, TL
23	89066	51190	GAP PAD, .5 X .5, .100 THK
25	89070	51190	THERMAL TAPE, .5 X .5
26	89136	51190	TAPE,ACETATE CLOTH,4560
28	89493	51190	SPACER, BATTERY
A01	87014	51190	MECH ASSY, TOP
A02	86995	51190	MECH ASSY, BASE, RAD/ALT
BT01	86196	51190	BATTERY PACK LITHIUM ION 14.4V,6.75AHr
W01	88606	51190	PURCH CABLE ASSY,TOUCHSCREEN

Refer to Fig. 6-2 for part location.

5.2.2 Mechanical Assembly (A1A1)

87014			A
ITEM	**PART NUMBER**	**CAGE CODE**	**DESCRIPTION**
1	87872	51190	ENCLOSURE,TOP,"MACHINED"
2	86490	51190	BRACKET,LID SENSOR
3	87016	51190	GASKET, TOUCH SCREEN
4	34253	51190	GASKET,SILICON SEAL,.25W,062TH
5	86593	51190	SHIELD, DISPLAY
6	86173	51190	MAGNET 3/8 X 1/4
7	71387	51190	WASHER NYLON .228 OD .122 ID .
8	36238	51190	WASHER,LOCK,INT TOOTH,4
9	37769	51190	NUT,HEX,REG PAT,4-40
10	87387	51190	WSHR, M3 INTL LK, 6MM O.D., .4MM THK, A2
11	87190	51190	SM, M3 X .5 X 5, ABT, A2, PA, TL
12	86971	51190	SM, M3 X .5 X 6, ABT, A2, PA, TL
13	87416	51190	ADHESIVE, ACRYLIC, LOCTITE 331 MAGNET
14	7092	51190	7387 ACTIVATOR
15	7090	51190	TAPE, SCOTCH VHB 1/2" WIDE
16	89136	51190	TAPE,ACETATE CLOTH,4560
A01	88607	51190	PURCH ASSY,DRIVER BD,LED,LOW PROFILE,8W
A02	87732	51190	PURCH ASSY,PANEL,CONTROL
A03	88608	51190	PURCH,168,COLOR,12.1" SVGA TFT,1000 NITS
A04	88609	51190	PURCH,TOUCH SCREEN,12.1",RESISTIVE,GLASS
A05	88610	51190	PURCH ASSY,CONTROLLER,TOUCHSCREEN, 5W,USB

Refer to Fig. 6-4 for part location.

5.2.3 Rad/Alt Base Mechnical Assembly (A1A2)

86995			A
ITEM	**PART NUMBER**	**CAGE CODE**	**DESCRIPTION**
1	87871	51190	ENCLOSURE,BASE,MACHINED,RAD/ALT
2	87818	51190	COVER,RUBBER,BNC/TNC
3	87820	51190	COVER,RUBBER,44 PIN
4	87416	51190	ADHESIVE, ACRYLIC, LOCTITE 331 MAGNET
5	7092	51190	7387 ACTIVATOR
6	88286	51190	DUST COVER,USB,BLACK
7	88285	51190	DUST COVER,MINI USB,BLACK
8	87387	51190	WSHR, M3 INTL LK, 6MM O.D., .4MM THK, A2
9	89136	51190	TAPE,ACETATE CLOTH,4560
10	87713	51190	CONN,44 PIN SUB-D WDD44F3C8AT70
11	86971	51190	SM, M3 X .5 X 6, ABT, A2, PA, TL
12	86500	51190	KIT, ub D locking with hardware
13	86173	51190	MAGNET 3/8 X 1/4
14	86594	51190	GASKET,BATTERY CAVITY
15	10259	51190	COVER,MINI POWER JACK
16	87852	51190	COVER,ETHERNET
17	86973	51190	SM, M3 X .5 X 4, ABT, A2, PA
18	89192	51190	SM,M3 X .5 X10,ABT,A2,PA,CS
19	88052	51190	LABEL,DC IN
20	35530	51190	SCREW,2-56 X 1/4 PPHM
21	89194	51190	SM,2-56 x 3/8,P BH,SS,PA, TL,CS
22	87386	51190	NUT, HEX, M3 X .5, THIN, A2
23	71038	51190	NUT HEX #2 SM PAT SS
A01	66349	51190	PCB ASSY,HHCP REAR PANEL I/O
A02	86999	51190	MECH ASSY, CHASSIS, RAD/ALT
A03	85904	51190	PCB ASSY, BATTERY INTERFACE,HHCP
J02	20952	51190	CONN,F,TNC,BH,ADP,SMA,WTRPRF
J03	20952	51190	CONN,F,TNC,BH,ADP,SMA,WTRPRF
W01	87002	51190	CABLE ASSY, POWER, "Y"
W03	87479	51190	COAX ASSY,CONF,TX OUT,RAD/ALT
W04	87442	51190	COAX ASSY,CONF,RF IN,RAD/ALT
W05	87450	51190	RIBBON ASSY,40P,RAD/ALT,HHCP
W06	85895	51190	PCB, REAR I/O FLEX CABLE

Refer to Fig. 6-4 for part location.

Chapter 6 - Assembly and Interconnect Drawings

6.1 DRAWINGS LIST

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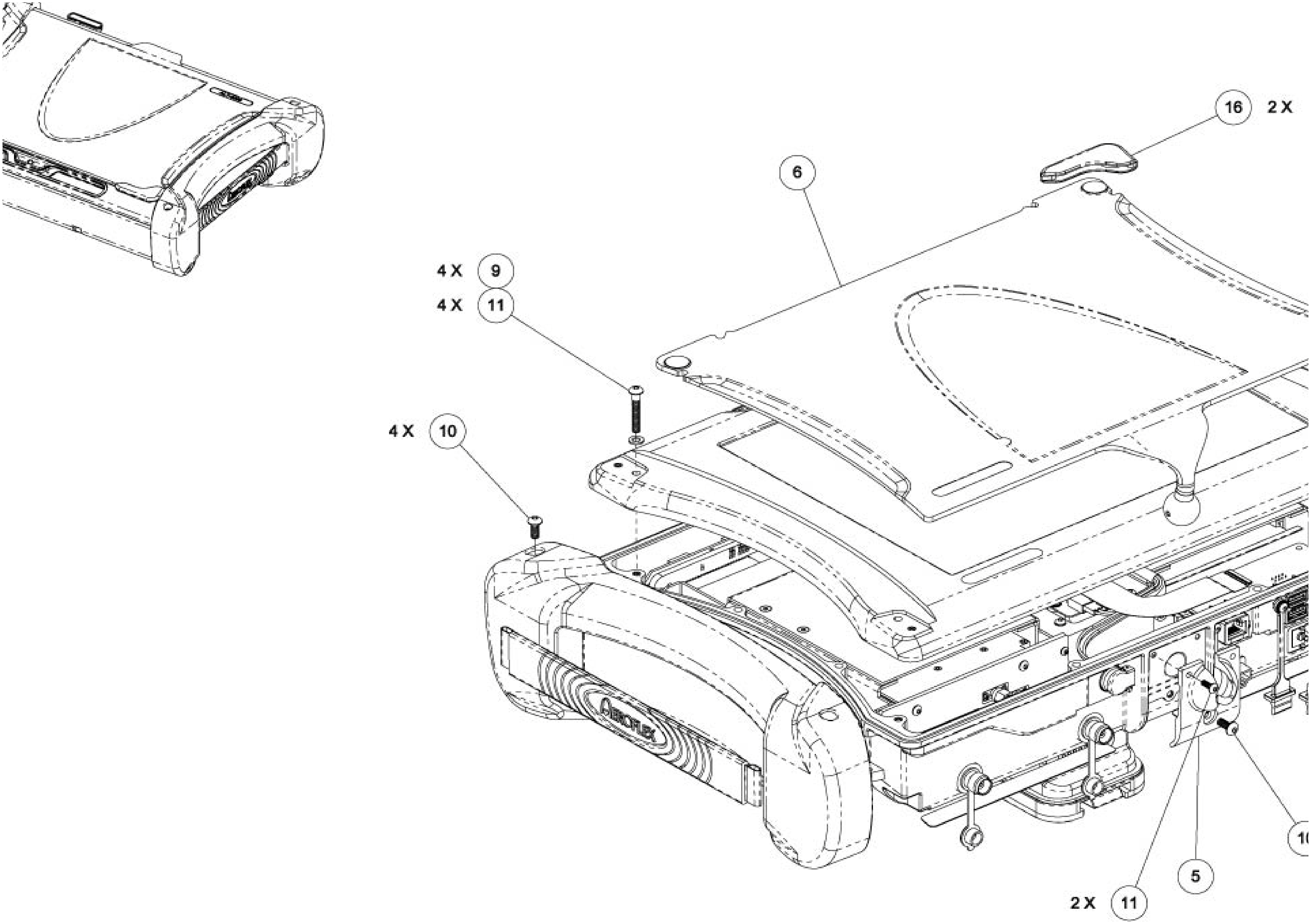


Fig. 6-1 ALT-8000 Ship Unit (A1)

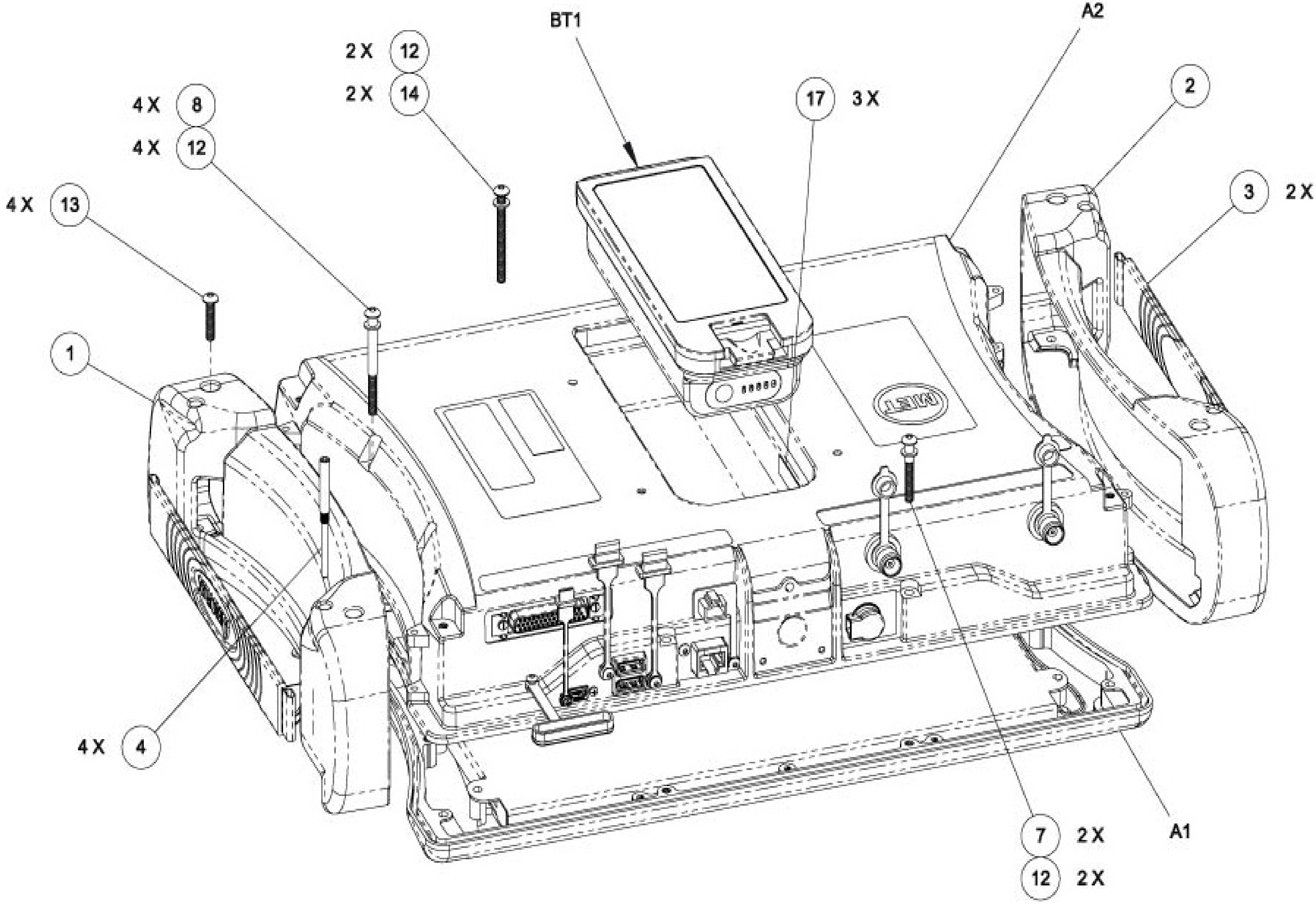


Fig. 6-2. ALT-8000 Ship Unit (A1)

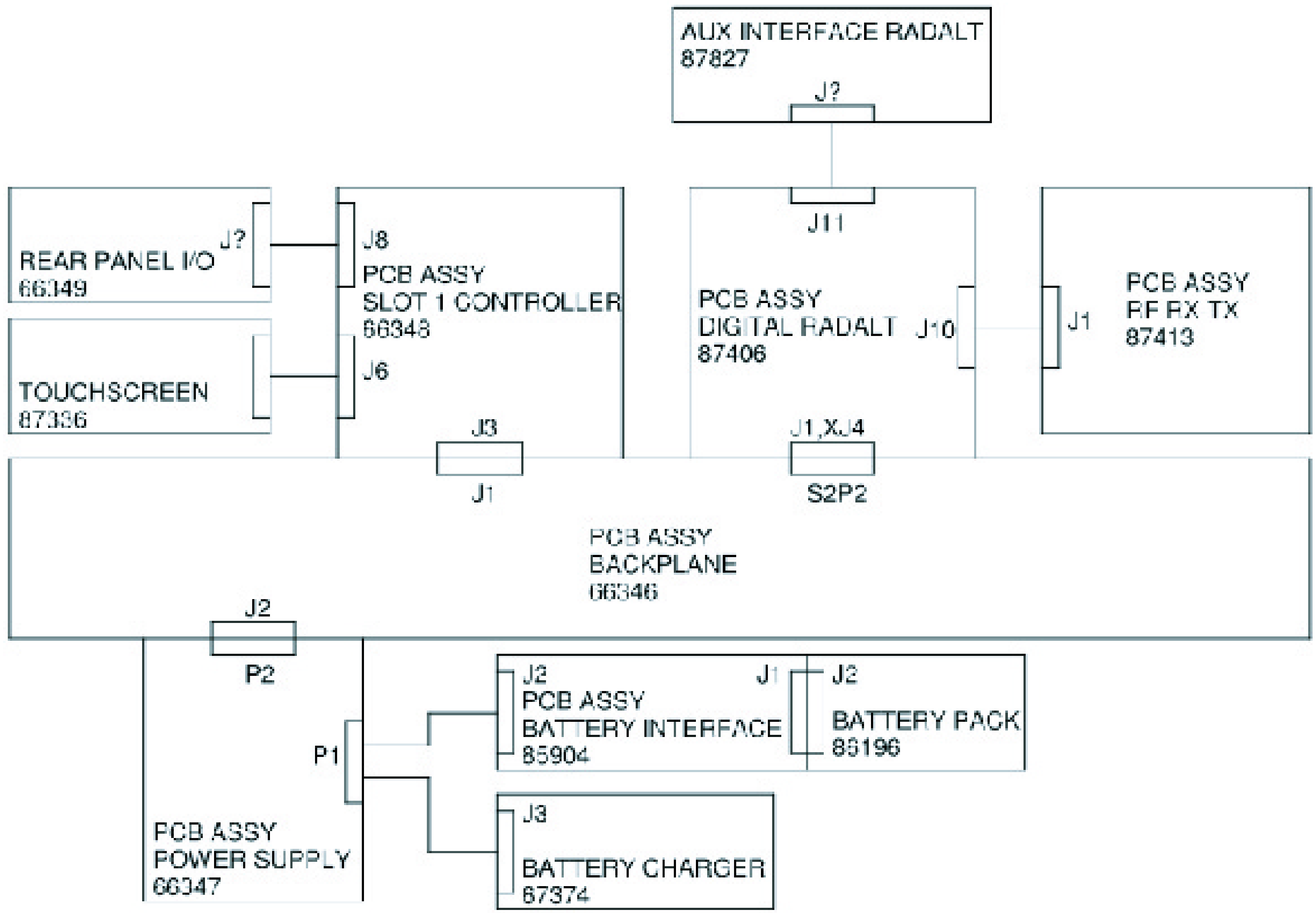


Fig. 6-3. ALT-8000 Interconnect and Block Diagram (A1)

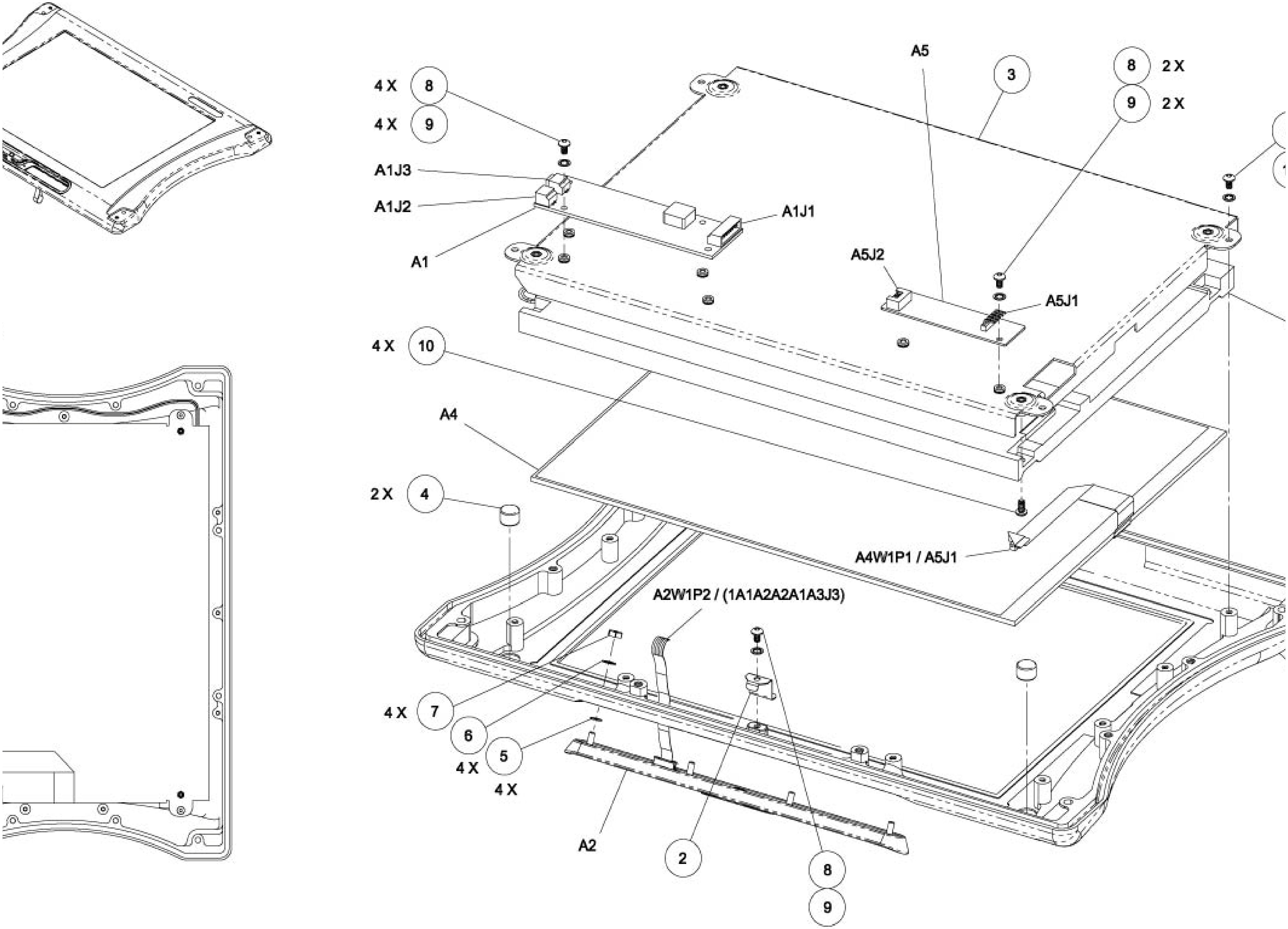


Fig. 6-4. ALT-8000 Top Assembly (A1A1)

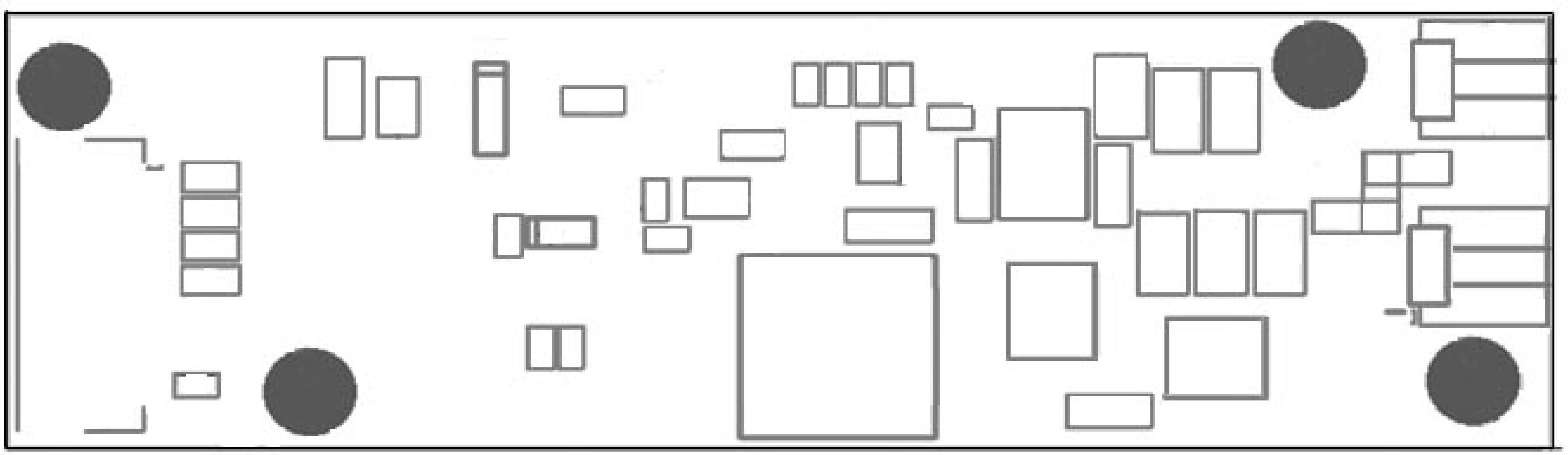


Fig. 6-5 ALT-8000 Driver Board Assembly (A1A1A1)

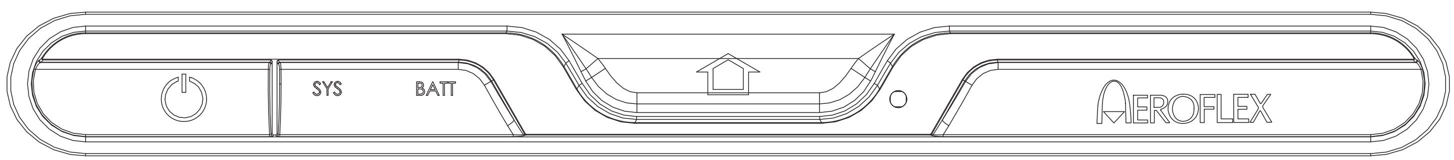


Fig. 6-6 ALT-8000 Panel Control Assembly (A1A1A2)

Fig. 6-7. ALT-8000 168 Color, 12.1” SVGA TFT, 1000 NITS Assembly (A1A1A3)

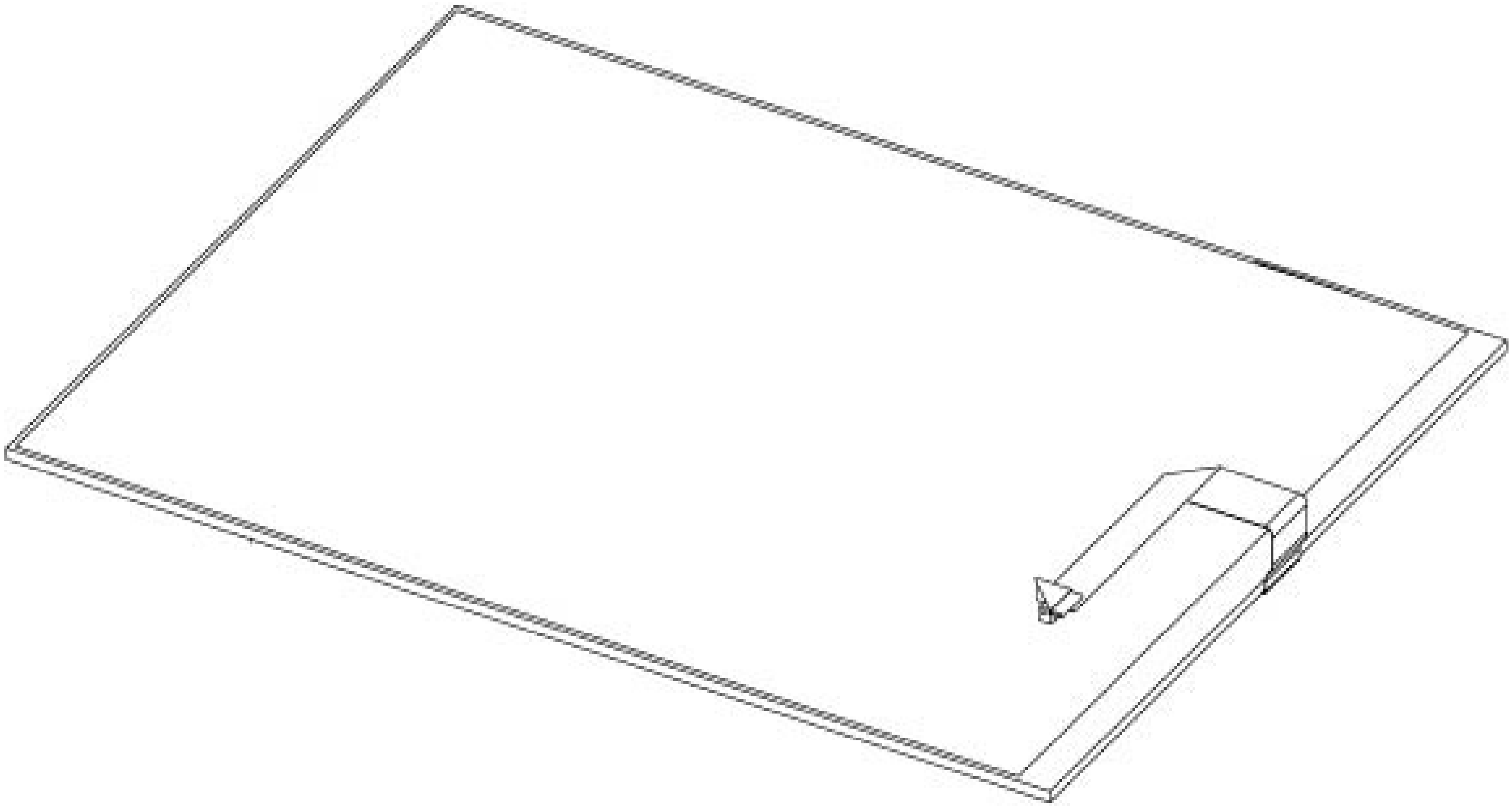


Fig. 6-8 ALT-8000 Touchscreen Assembly (A1A1A4)

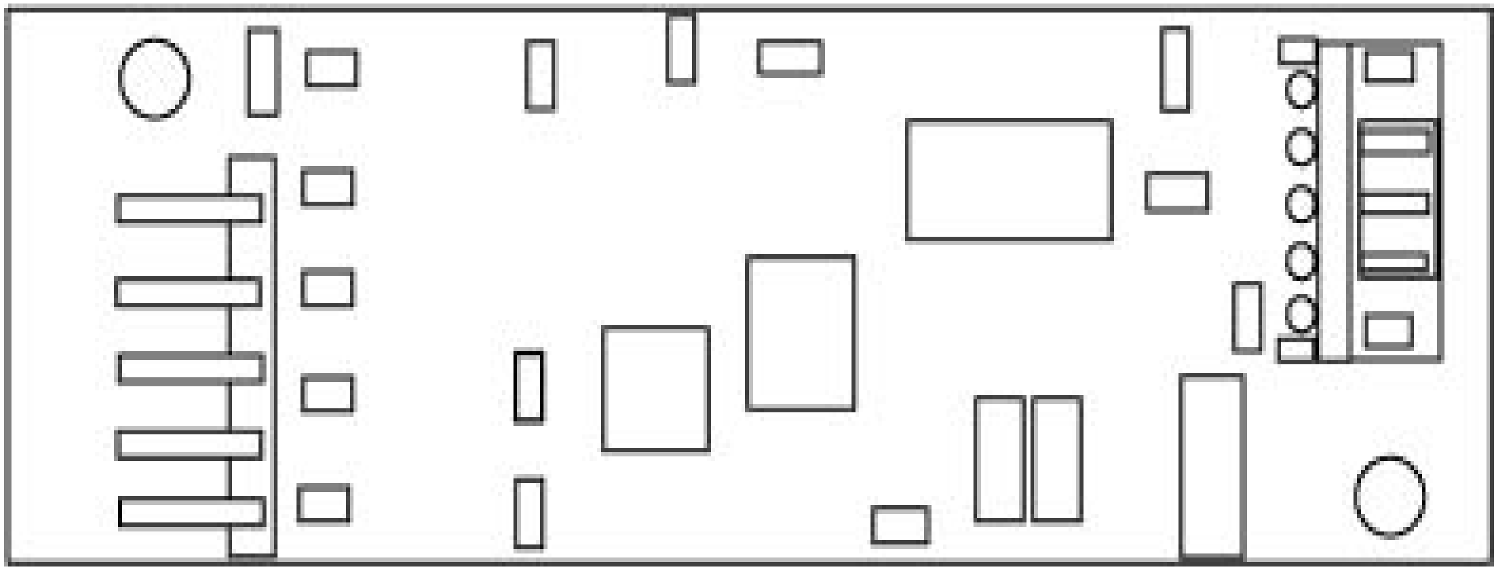
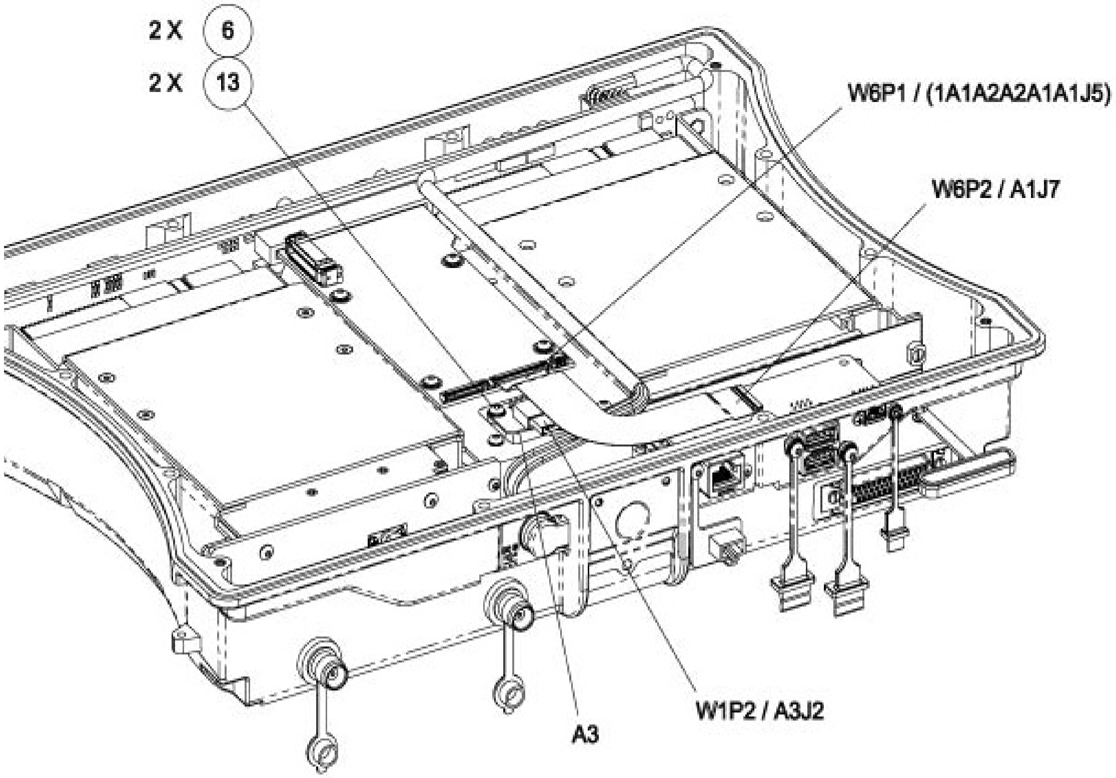
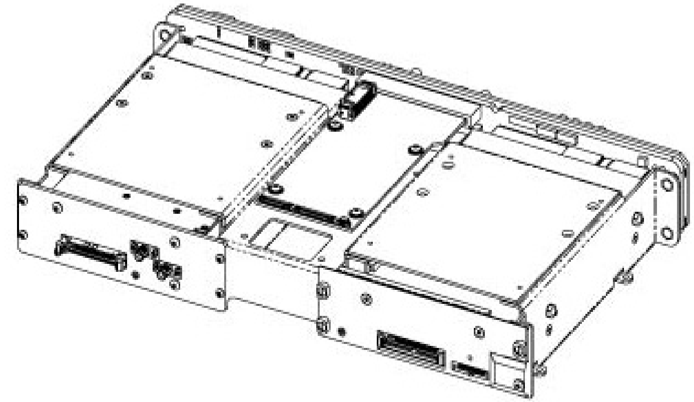
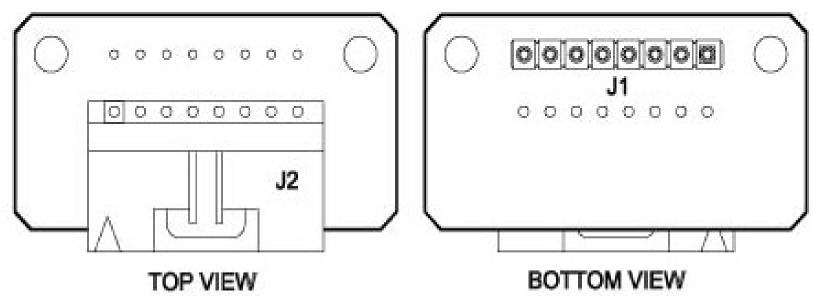


Fig. 6-9. ALT-8000 Touchscreen Control Assembly (A1A1A5)

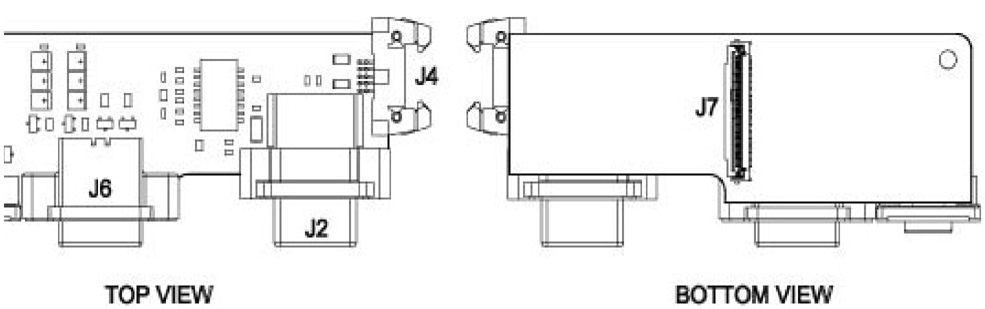




A2 CHASSIS ASSY



A3 BATTERY INTERFACE PCB ASSY



A1 REAR PANEL I/O PCB ASSY

Fig. 6-10 ALT-8000 RAD/ALT Base Mech Assembly (A1A2)

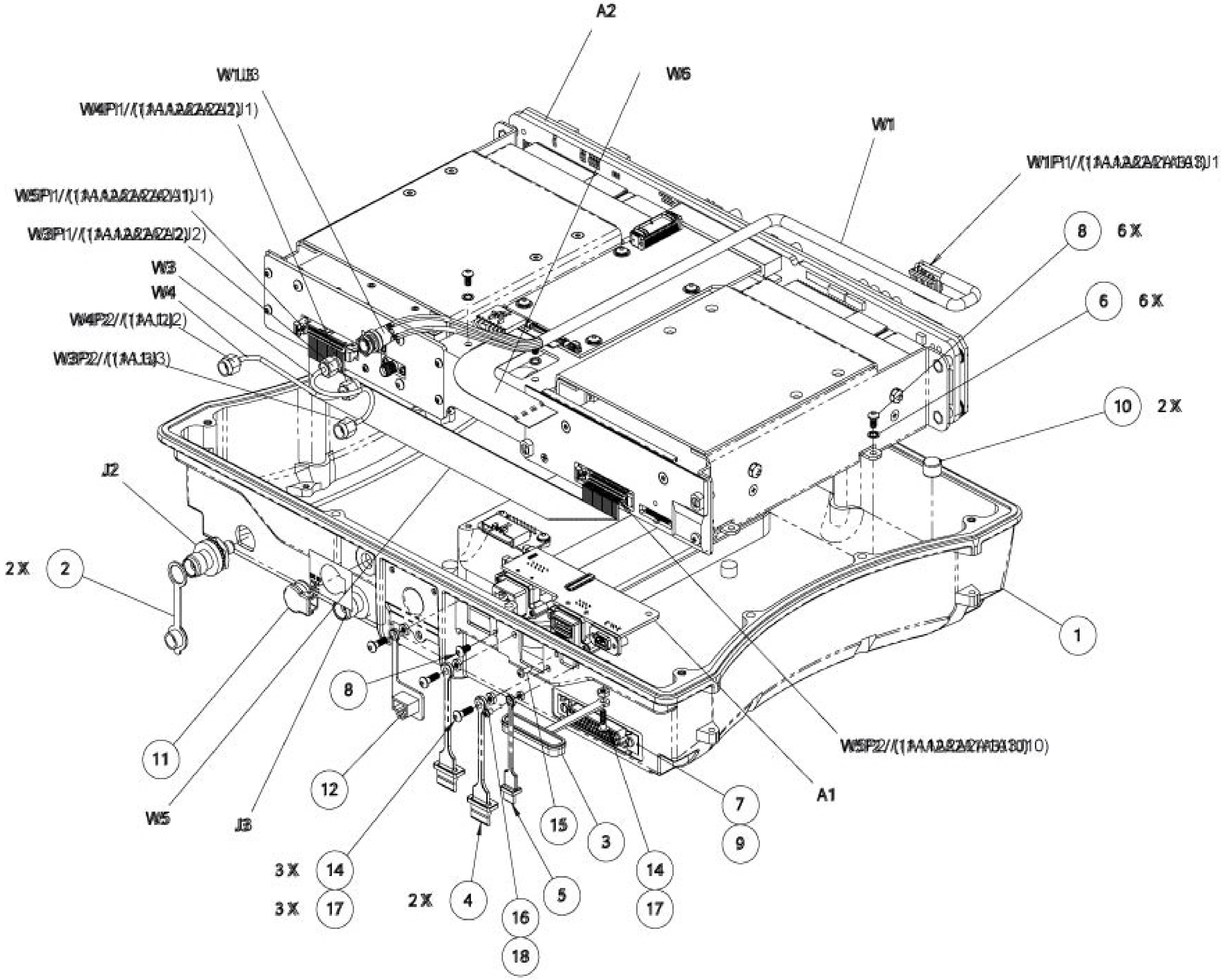


Fig. 6-11 ALT-8000 RAD/ALT Base Mech Assembly (A1A2)

(Sheet 2 of 2)

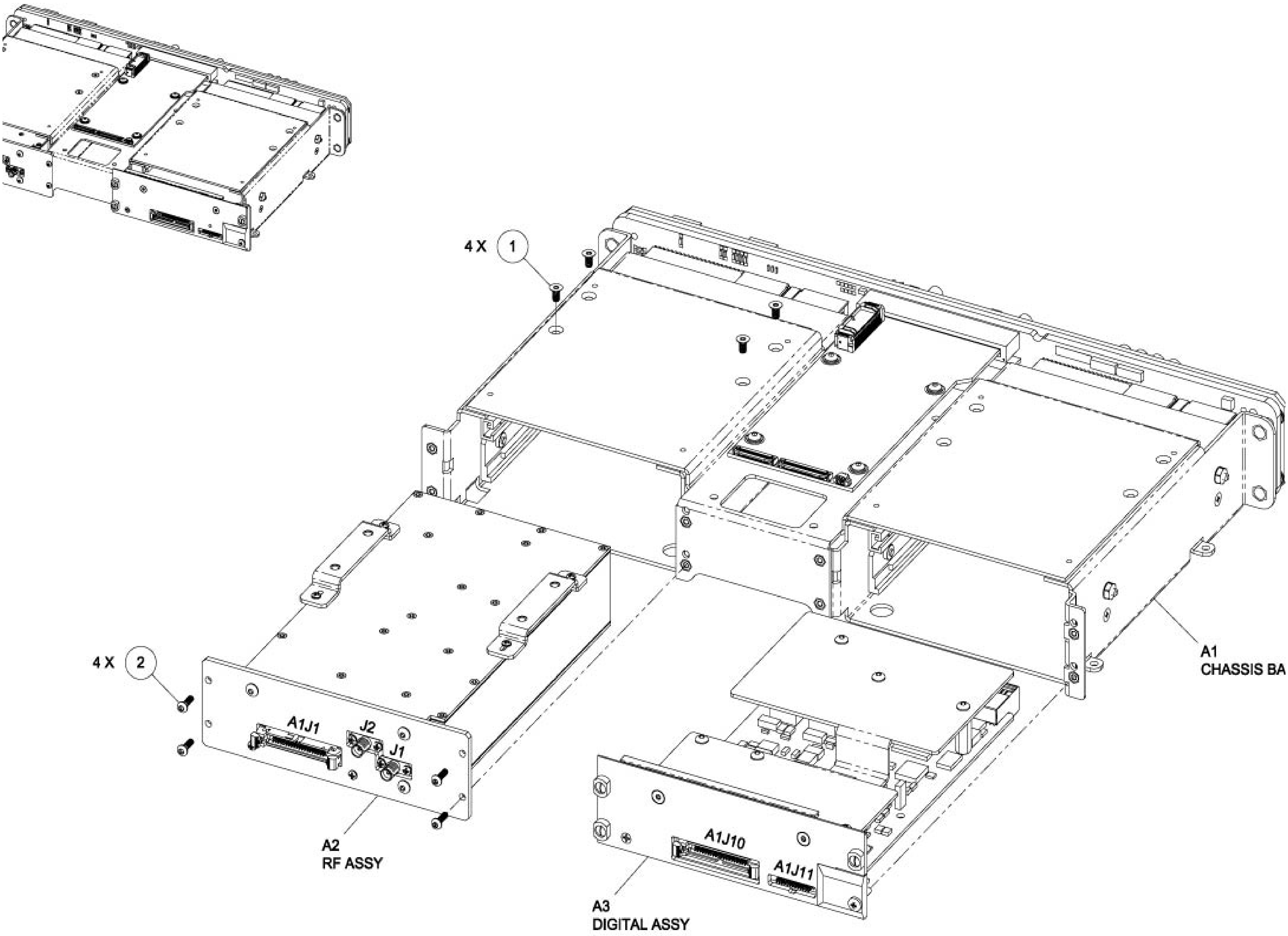


Fig. 6-12 ALT-8000 Chasis RAD/ALT Mech Assembly (A1A2A3)

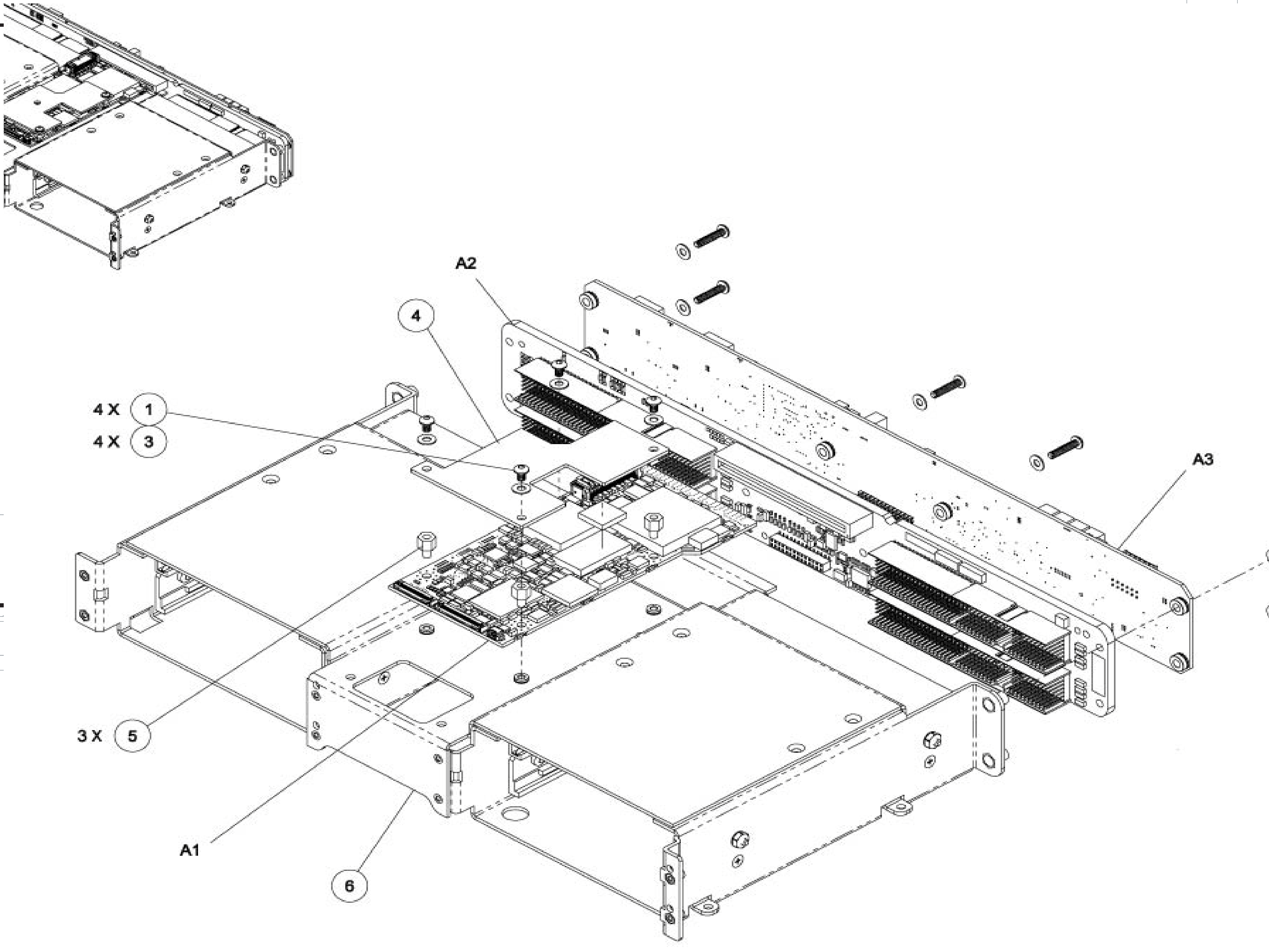
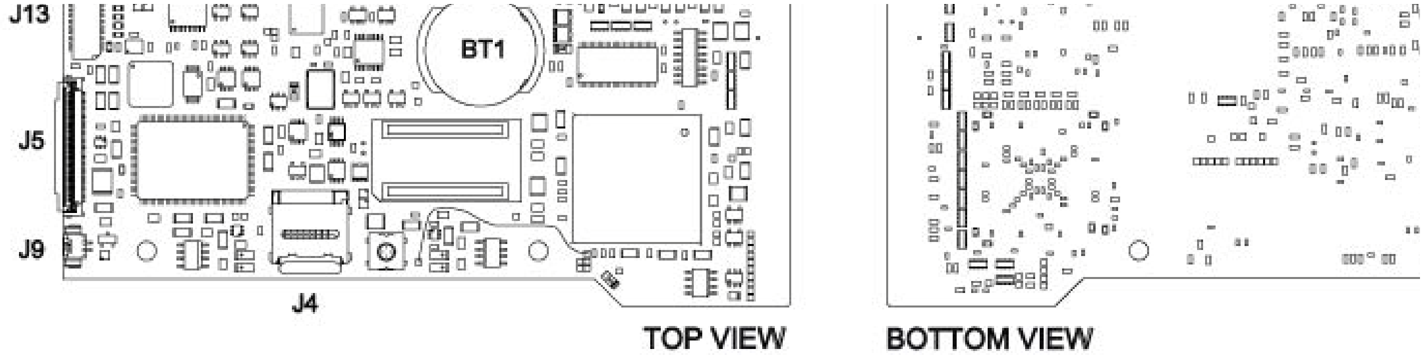
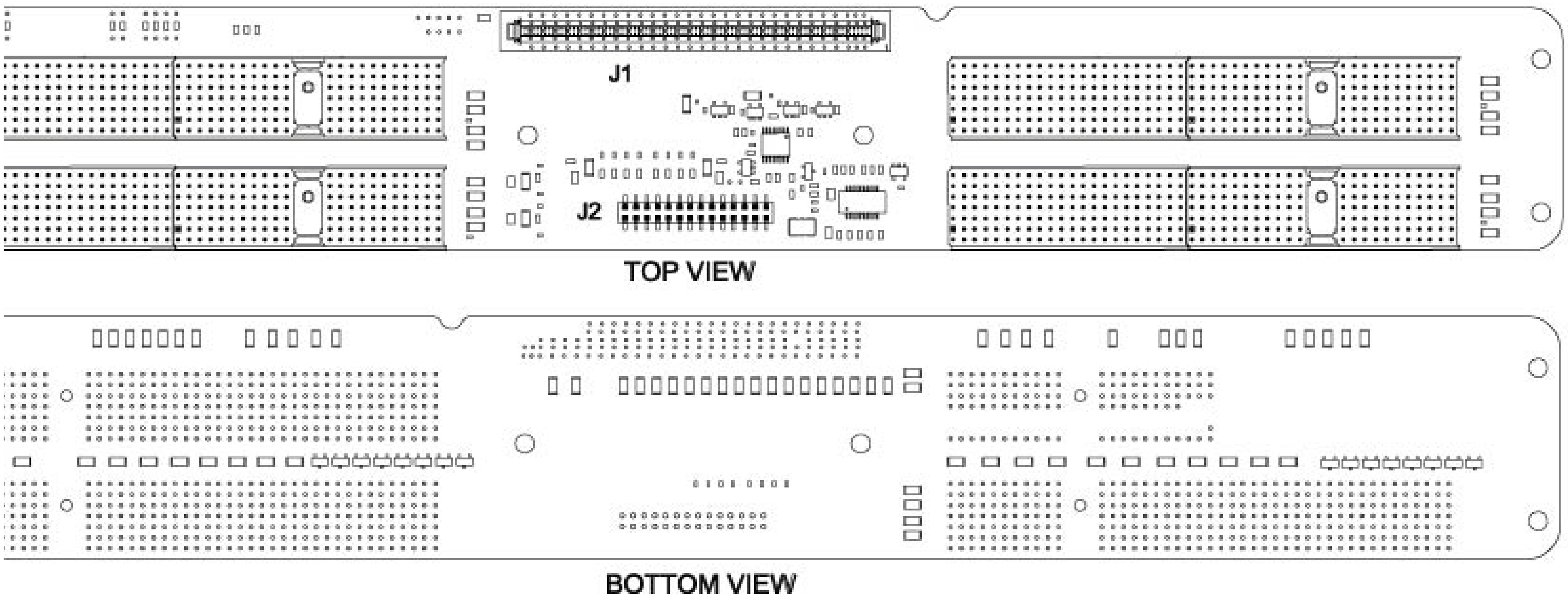


Fig. 6-13 ALT-8000 RAD/ALT Base Card Cage Mech Assembly (A1A2A2A1)

A1 SLOT 1 CONTROLLER PCB ASSY





A2 PXI BACKPLAI

ER SUPPLY CHARGER
ASSY

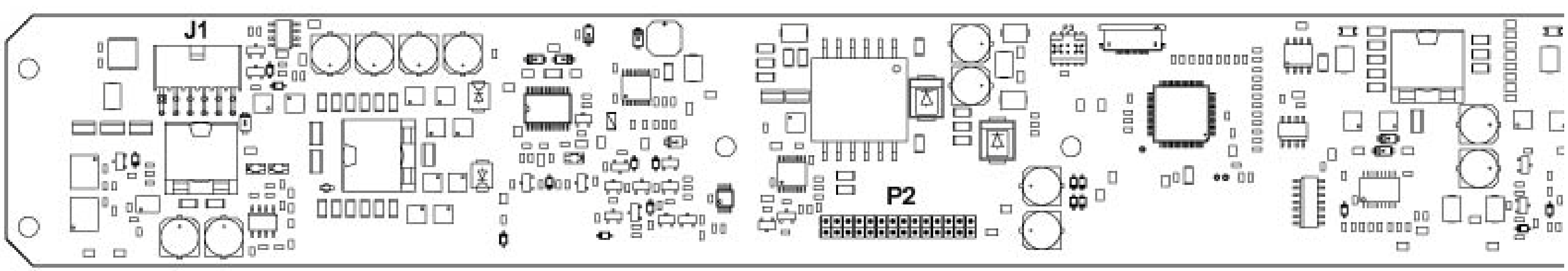
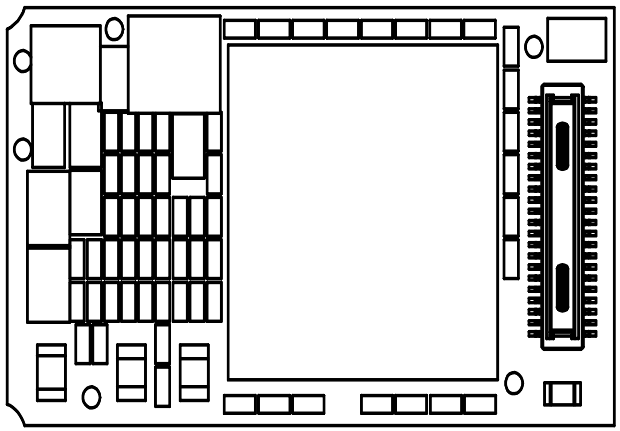
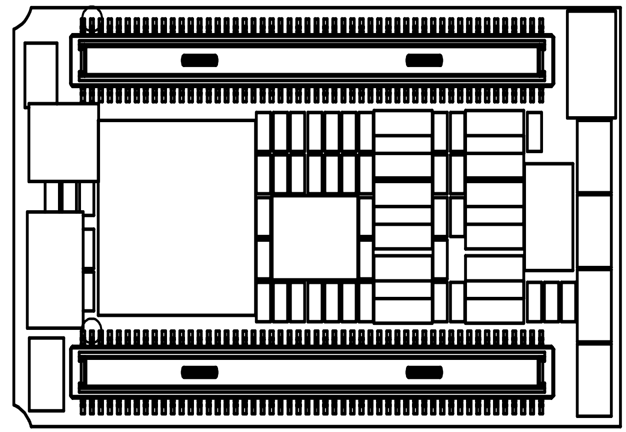


Fig. 6-14. ALT-8000 RAD/ALT Base Card Cage Mech Assembly (A1A2A2A1)

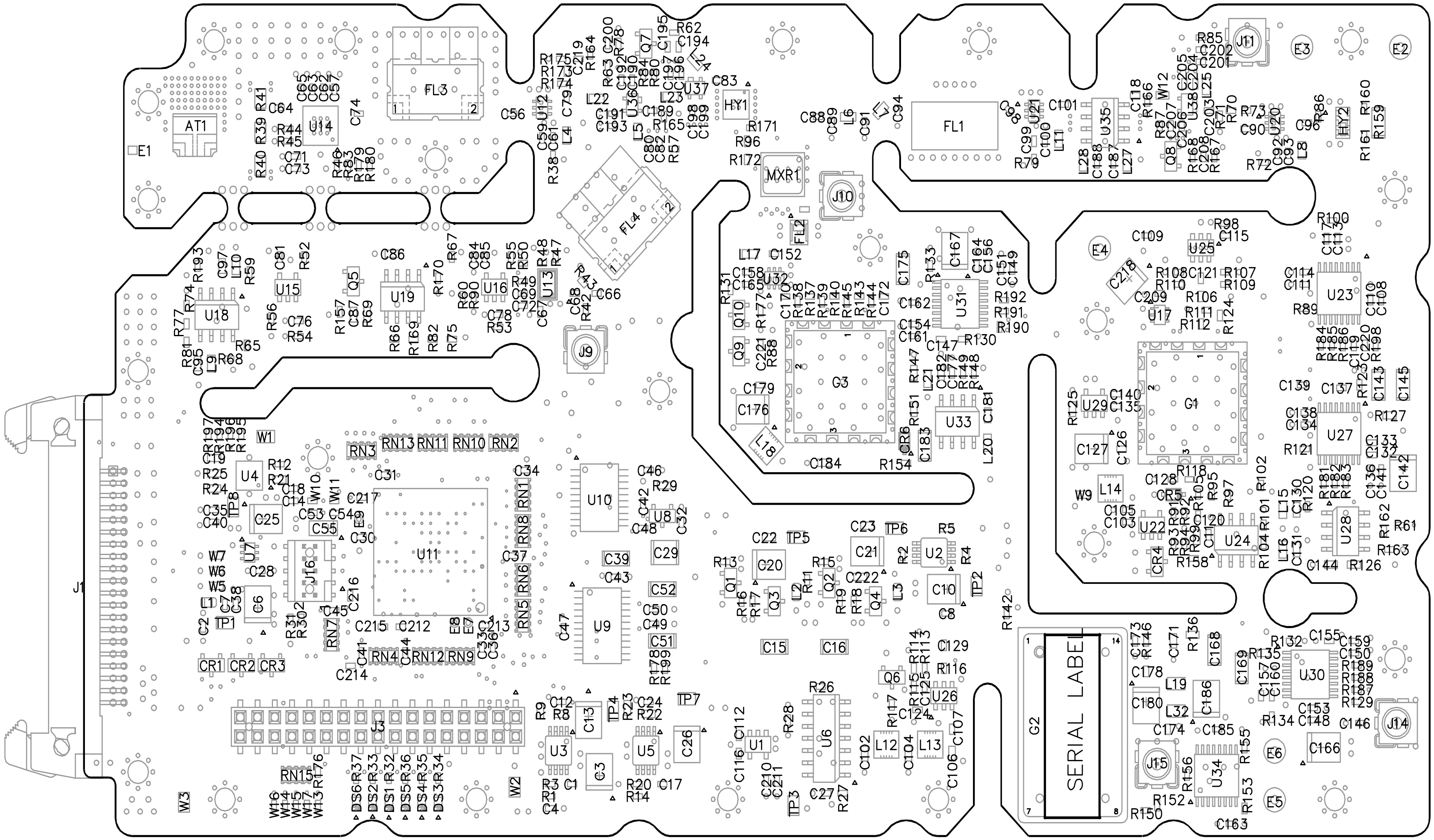


TOP



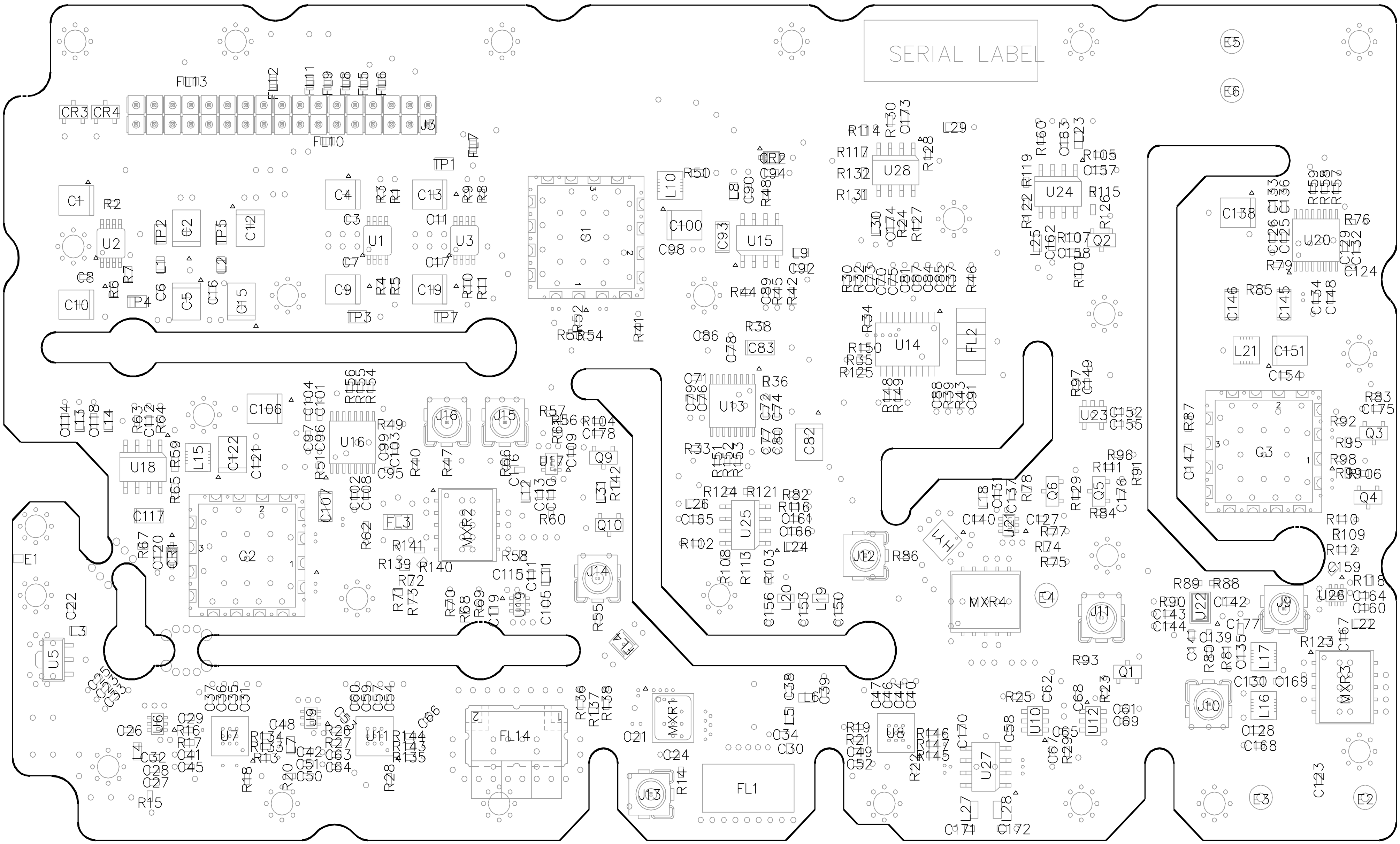
BOTTOM

Fig. 6-15 ALT-8000 Torpedo Assembly (A1A2A2A1A1A1)



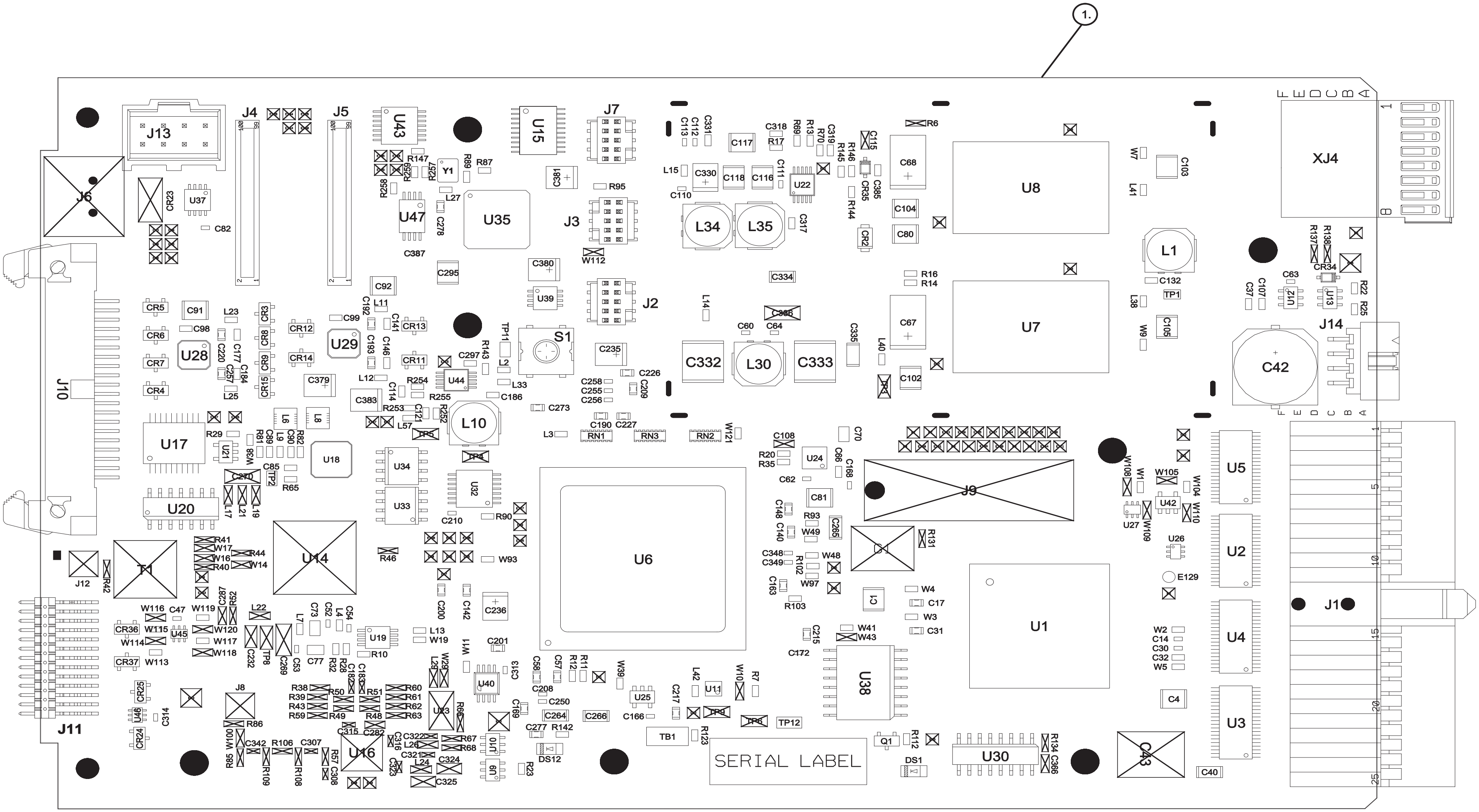
CAUTION:
CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO
DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

Fig. 6-16 ALT-8000 RF Receiver PCB Assembly (A1A2A2A2A1)



CAUTION:
CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO
DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

Fig. 6-17. ALT-8000 RF XMTR PCB Assembly (A1A2A2A2A2)



TOP VIEW

Fig. 6-18 ALT-8000 Digital RAD/A:T PCB Assembly (A1A2A2A3A1)

Drawing not avialable

Fig. 6-19 ALT-8000 Auxiliary Interface RAD/ALT PCB Assembly (A1A2A4)

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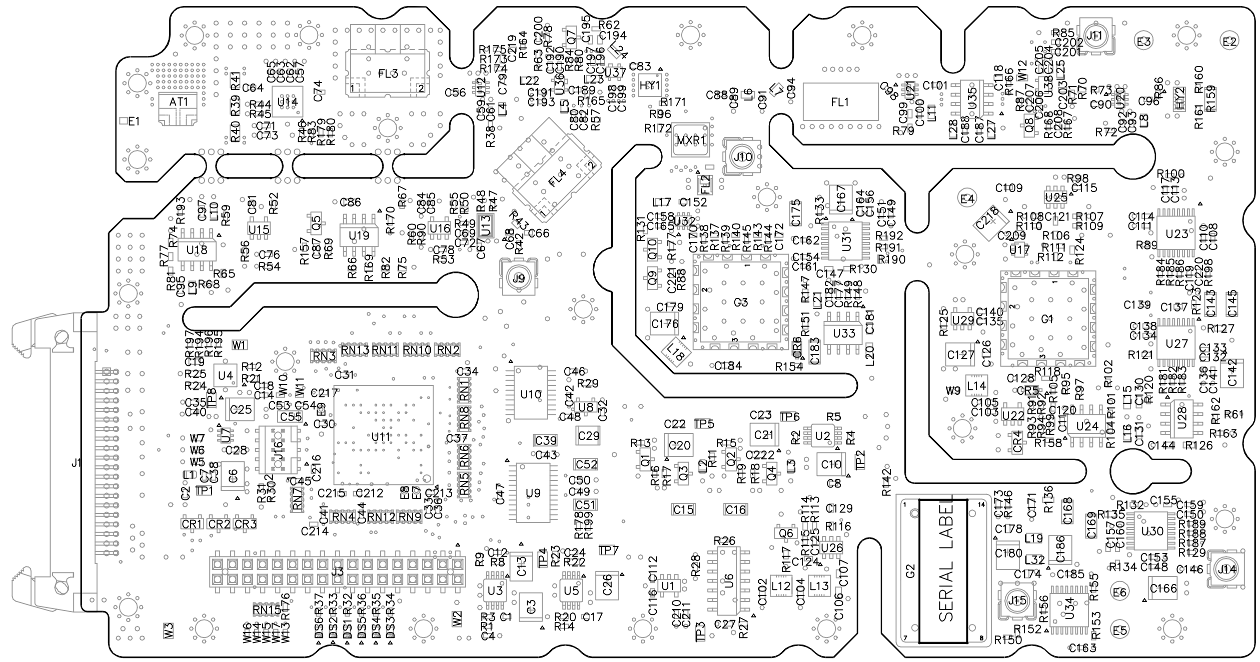
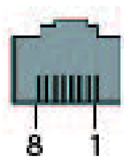


CAUTION:
CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO
DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).

Appendix A - Pin-Out Tables

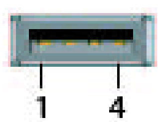
ETHERNET CONNECTOR



Pin Number	Signal Type	Signal Type	Function
1	Data	Transmit +	Ethernet TX +
2	Data	Transmit -	Ethernet TX -
3	Data	Receive +	Ethernet RX +
4	NC	NC	
5	NC	NC	
6	Data	Receive -	Ethernet RX -
7	NC	NC	
8	NC	NC	

Table A-1 Ethernet Pin-Out Diagram

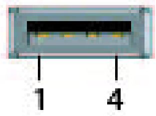
USB HOST 1 CONNECTOR



Pin Number	Signal Type	Signal Type	Function
1	Power	VCC	USB Power
2	Data	Data -	USB Data -
3	Data	Data +	USB Data +
4	GND	GND	Ground

Table A-2 USB Host 1 Pin-Out Diagram

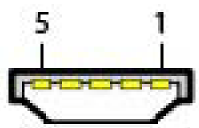
USB HOST 2 CONNECTOR



Pin Number	Signal Type	Signal Type	Function
1	Power	VCC	USB Power
2	Data	Data -	USB Data -
3	Data	Data +	USB Data +
4	GND	GND	Ground

Table A-3 USB Host 2 Pin-Out Diagram

USB OTG CONNECTOR



Pin Number	Signal Type	Signal Type	Function
1	Power	VCC	USB Power
2	Data	Data -	USB Data -
3	Data	Data +	USB Data +
4	Control	ID	Identify
5	GND	GND	Ground

Table A-4 USB OTG Pin-Out Diagram

DC POWER CONNECTOR

Pin Number	Signal Type	Signal Type	Function
Inner	Power	VCC	HHCP Power
Outer	GND	GND	Ground

Table A-5 DC Power Connector Pin-Out Diagram

AUX CONNECTOR

Currently not in use.

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Appendix B - Abbreviations

B.1 ABBREVIATIONS

A2D	Analog to Digital
AC	Alternating Current
ADPLL	All Digital Phase Locked Loop
AF	Analog Frequency
ANT	Antenna
APLL	Analog Phase Locked Loop
BPF	Bandpass Filter
Cal	Calibration
CPU	Central Processing Unit
D2A	Digital to Analog
dB	Decibel
DC	Direct Current
DMM	Digital Multimeter
EMI	Electromagnetic Interference
ESD	Electro Static Discharge
FPGA	Field Programmable Gate Array
GEN	Generator
GHz	Gigahertz
GPIB	General Purpose Interface Bus
Hz	Hertz
I/O	Input/Output
IPMB	Intelligent Platform Management Bus
kHz	kilo hertz
LPF	Lowpass Filter
MHz	Megahertz
PCI	Peripheral Component Interconnect
PCIe	Peripheral Component Interconnect Express
PWM	Pulse Width Modulation
PXI	PCI eXtensions for Instrumentation
RF	Radio Frequency
RSSI	Residual Signal Strength Indicator
SATA	Serial Advanced Technology Attachment
sRIO	Serial Rapid IO

T/R	Transmit/Receive
TACH	Tachometer
USB	Universal Service Bus
VGA	Video Graphics Adapter

Appendix C - Test Equipment

C.1 CALIBRATION EQUIPMENT

The following table identifies test equipment required to perform 7200 calibration procedures. Due to the remote command structure of the calibration software, other equipment meeting the specifications of the equipment listed in this Appendix may not be substituted for the required models.

EQUIPMENT	MANUFACTURER	MODEL
Adapter, N Male to BNC Female	Pasternack	PE9002
Adapter, TNC Male to N-Female	Pasternack	PE9447
Attenuator, Fixed Coaxial, 3 dB	Weinschel	Model 1-03
Attenuator, Fixed Coaxial, 10 dB	Weinschel	Model 1
Power Sensor	Rohde & Schwart	NRP-Z91
Power Sensor Module	Rohde & Schwart	NRP-Z37
Power Sensor USB Adapter (passive)	Rohde & Schwart	NRP-Z4
Power Divider, Resistive	Weinschel	1870A
RF Signal Generator (base unit)	Rohde & Schwart	SMA100A
Frequency Range 9 kHz to 3 GHz	Rohde & Schwart	SMA-B103
FM/PM Modulation	Rohde & Schwart	SMA-B20

C.2 VERIFICATION EQUIPMENT

The following table identifies test equipment required to perform 7200 verification procedures. Other equipment meeting the specifications of the equipment listed in this Appendix may be substituted for the required models.

EQUIPMENT	MANUFACTURER	MODEL
Adapter, N Male to BNC Female	Pasternack	PE9002
Adapter, TNC Male to N-Female	Pasternack	PE9447
Attenuator, Fixed Coaxial, 3 dB	Weinschel	Model 1-03
Attenuator, Fixed Coaxial, 10 dB	Weinschel	Model 1
Measuring Receiver (base unit)	Rohde & Schwart	FSMR26
OCXO	Rohde & Schwart	FSU-B4
Electronic Attenuator, 20 dB, PreAmp (3.6 GHz)	Rohde & Schwart	FSU-B25
YIG Preselection, 3.6 to 26.5 GHz	Rohde & Schwart	FSMR-B223
App Firmware for Phase Noise Measurements	Rohde & Schwart	FS-K40
19" Adapter, 4HU	Rohde & Schwart	ZZA-411
Power Sensor (Average)	Rohde & Schwart	NRP-Z91
Power Sensor Module	Rohde & Schwart	NRP-Z37
Power Sensor USB Adapter (passive)	Rohde & Schwart	NRP-Z4
Power Divider, Resistive	Weinschel	1870A
RF Signal Generator (base unit)	Rohde & Schwart	SMA100A
Frequency Range 9 kHz to 3 GHz	Rohde & Schwart	SMA-B103
FM/PM Modulation	Rohde & Schwart	SMA-B20

Appendix D - Controls and Connectors

D.1 FRONT PANEL CONTROLS AND CONNECTORS

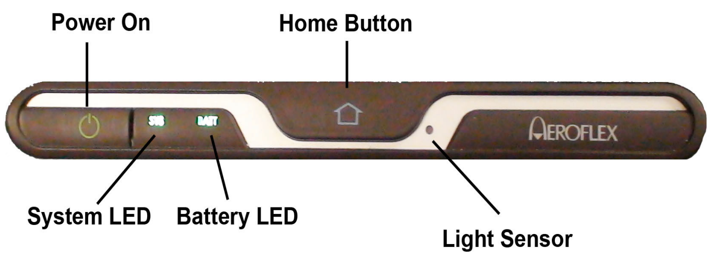
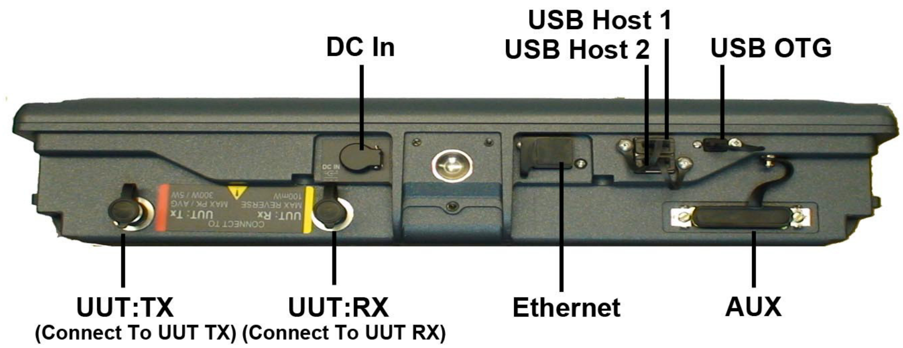


Fig. D-1 Front Panel Controls

Control	Description
Power ON/OFF	The Power On/Off Button is used to power the Test Set on and off.
System LED	**Powered On** (green) Indicates the unit is in an operational status.
	Failure (red) Some form of failure has occurred which precludes using the display to indicate the problem (e.g. main processor failure, power supply fault, etc.).
	Boot (blinking blue) Unit is booting and is not yet able to indicate status on the display (during initial OS and application load).
	Off/Standby (orange) Unit is off, but power is supplied to the power supply from the AC power supply.
	Off w/o External Supply (off) Unit is off, no external power supplied.
Home Button	Pressing and holding the Home Button for 5 sec sets the backlight to maximum brightness.
Light Sensor	Monitors the ambient light and adjusts the display brightness. The light sensor is not operational at this time. Currently the display brightness must be set manually.
Magnetic Sensor	Detects if the display cover is open or closed and used to turn off the display as part of power management.

Control	Description
Battery LED	**Battery Voltage Low** (red) The unit turns off within one minute without charger **Battery Pre-Charge** (flashing yellow) Trickle charge during extremely low voltage on the battery. **Battery Charging** (flashing green) Charge in progress **Battery Fully Charged** (green) **Battery Temperature Extreme** (blue) Temperature <0° C or >45° C can't charge battery **Battery Error** (red) Problem with the battery or charging system. **Battery Missing** (Off) AC applied without battery in place. **Battery Suspended Charge** (flashing Red) AC applied w/ battery charging suspended

D.2 REAR PANEL CONTROLS AND CONNECTORS



NOTE: On earlier units TX port was marked RX and RX port was marked TX.

Fig. D-2 Test Set Rear Panel Controls and Connectors

Connector	Description
USB Host 1	USB standard connection that allows connection of USB devices (e.g. a USB memory stick or Network connectors). Recommended USB memory device is Aeroflex PN 67325.
USB Host 2	USB standard connection that allows connection of USB devices (e.g. a USB memory stick or Network connectors). Recommended USB memory device is Aeroflex PN 67325.
USB OTG	USB On The Go, for future expansion.
GPS Rx Ant	External Antenna connection for Test Set internal GPS receiver.
GPS Tx Direct	RF output for direct connection to receiver under test. AC coupled, Maximum DC 50 V.
GPS Tx Coupler	RF output for connection to Antenna Coupler.
REF In 10MHz	The 10MHz In (5V p-p Max) Connector, is a BNC connection, used to connect the Test Set to an external frequency standard, providing a TTL signal.
REF Out 10MHz	The10MHz Out (1.5V p-p Nom) Connector, is a BNC connection, providing an output of the internal 10MHz reference Oscillator.
Ethernet	Standard Base T RJ45 connection. This connection can be used for software upgrades and for remote operation.
Aux	26 pin D type, providing ARINC 429 I/O, RS-232 I/O, a 3.3 VDC LVTTL trigger input and a 1PPS TTL L1 C/A code frame sync output.

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