ORDER

AL 6000.20A

ALASKAN NATIONAL AIRSPACE SYSTEM INTERFACILITY COMMUNICATIONS SYSTEM (ANICS) MAINTENANCE HANDBOOK

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DEPARTMENT OF TRANSPORTATION
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RECORD OF CHANGES

DIRECTIVE NO. **REC NO**

CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL	CHANGE TO BASIC	SUPPLEMENTS			OPTIONAL

FOREWORD

On July 7, 1997, the Federal Aviation Administration, Alaskan Region, assumed responsibility for the ANICS sites in Alaska and Washington State. In conjunction with manufacture's instruction books and manuals, this order prescribes maintenance standards, procedures, and policy for those sites.

Alan L. Hanson
Manager, Airway Facilities Division

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CHAPTER 1. GENERAL INFORMATION AND REQUIREMENTS

1. PURPOSE. This handbook provides guidance and prescribes technical standards and tolerances and procedures applicable to the maintenance and inspection of the Alaskan National Airspace System Interfacility Communications System (ANICS). It also provides information on special methods and techniques that will enable maintenance personnel to achieve optimum performance from the equipment. This information augments information in instruction books and other handbooks and complements Order 6000.15C, General Maintenance Handbook for Airway Facilities.

2. DISTRIBUTION. This directive is distributed to branch level in the Airway Facilities Division; to all Airway Facilities field offices and facilities; and one copy to the Auburn SSC Telecommunications Unit.

3. CANCELLATION. Order 6000.20, Alaskan National Airspace System Interfacility Communications System (ANICS) Maintenance Handbook, dated July 24, 1997, is canceled.

4. MAINTENANCE AND MODIFICATION POLICY.

a. Order 6000.15C, General Maintenance Handbook for Airway Facilities, along with this order and the applicable equipment instruction book, shall be consulted and used together by the maintenance technician in all duties and activities for the maintenance of ANICS facilities and equipment. These documents shall be considered collectively as the single official source of maintenance policy and direction authorized by the Systems Maintenance Service. References located in the chapters of this handbook entitled, “Standards and Tolerances,” “Periodic Maintenance,” and “Maintenance Procedures,” shall indicate to the user whether this handbook and/or other handbook(s) shall be consulted for a particular standard, key inspection element or performance parameter, performance check, maintenance task, or maintenance procedure.

b. Order 6032.lA, Modifications to Ground Facilities Systems, and Equipment in the National Airspace System, contains comprehensive policy and direction concerning the development, authorization, implementation, and recording of modifications to facilities, systems, and equipment in commissioned status. It supersedes all instructions published in earlier editions of maintenance technical handbooks and related directives.

5. FORMS. FAA Form 6000-8. Technical Performance Record-Continuation or Temporary Record/Report Form or an approved automated data collection system shall be used.

6. COORDINATION OF MAINTENANCE ACTIVITIES. Maintenance activities shall be closely coordinated with operations personnel to preclude unanticipated interruption to the operation of ANICS facilities and equipment. This procedure is especially important where standby equipment is not immediately available. In all cases, where facility operation may be adversely affected by maintenance activities, advance notice shall be given so that appropriate Notices to Airmen (NOTAMS) can be issued. The information necessary for the preparation of such NOTAMS shall be furnished promptly. The responsible maintenance technician shall be close at hand during all scheduled shutdowns to restore service if necessary. Operations personnel are expected to recognize the need for releasing equipment for scheduled routine maintenance work and to offer cooperation in furtherance of practices that assure continuous and reliable operation.

7. CERTIFICATION REQUIREMENTS. Refer to Order 6000.15C, General Maintenance Handbook for Airway Facilities, for general guidance on the certification of systems, subsystems, and equipment. Refer to Chapter 3 of this handbook for the key performance parameters and/or key inspection elements for the ANICS equipment. The ANICS system has no specific certification requirements.

8. WAIVERS. Requests for waivers as prescribed in Order 1800.66, Appendix 1, Section 3.2, applies to equipment under configuration management as prescribed in the National Airspace System Configuration Management Document. Any changes to the documentation will be submitted to the Regional Configuration Control Board (RCCB).

9. NONSTANDARD FACILITIES. The instructions, descriptions, standards and tolerances, and procedures contained in this directive represent the Alaskan Region's baseline and standard criteria concerning ANICS. Regional procurement of equipment and devices to be used for air traffic control or navigation for which specifications have not received prior approval is prohibited by Order 1100.5B, FAA Organization - Field. The inclusion of such nonstandard equipment in this directive is for maintenance purposes only and, as such, will not be used as justification for procurement, installation, or commissioning of additional or similar equipment.

CHAPTER 2. TECHNICAL CHARACTERISTICS

Section 1. EQUIPMENT DESCRIPTION

9. GENERAL

a. ANICS is a satellite based telecommunications network that provides circuit diversity in critical facilities for the Alaska Region using two satellite paths. ANICS functions as a satellite communication system under centralized network management and control. It is the primary carrier for data/traffic in all service areas: communications, weather, surveillance, remote monitoring and control, environmental and navigational aids. It also provides a reliable and cost effective means for essential and routine operational communications.

b. The ANICS network is composed of remote sites controlled by hubs at the Anchorage Air Route Traffic Control Center (ARTCC) and the three Automated Flight Service Stations (AFSS) at Kenai, Fairbanks, and Juneau. The Network Operations Control Center (NOCC) is located at the ARTCC and is the center of all normal control operations for all sites. The AFSS Hubs can each control the remote sites within their own subnet and provide a location for emergency or backup control should it be required. Remote sites feature completely diverse paths from the remote site A/B switch to the hubs including backup multiplexer cards. The hub locations have the complete path diversity and redundancy of a remote site and additionally feature primary and backup transceivers, switching and distribution electronics, backup modems, and amplifiers for each antenna.

c. All sites have Monitor and Control Computer and Supervisory Control and Data Acquisition (SCADA) equipment. The Hub and Remote Monitor and Control Computers (HMC or RMC) provide the interface between the site's hardware and the ANICS Network Monitor and Control System computer and software. The ANICS Monitor and Control computers are networked to provide the overall system monitoring and control for the ANICS network. The SCADA equipment provides the interface to alarms (fire, smoke, and open door), the generator (when provided), and the automatic transfer switch at each site.

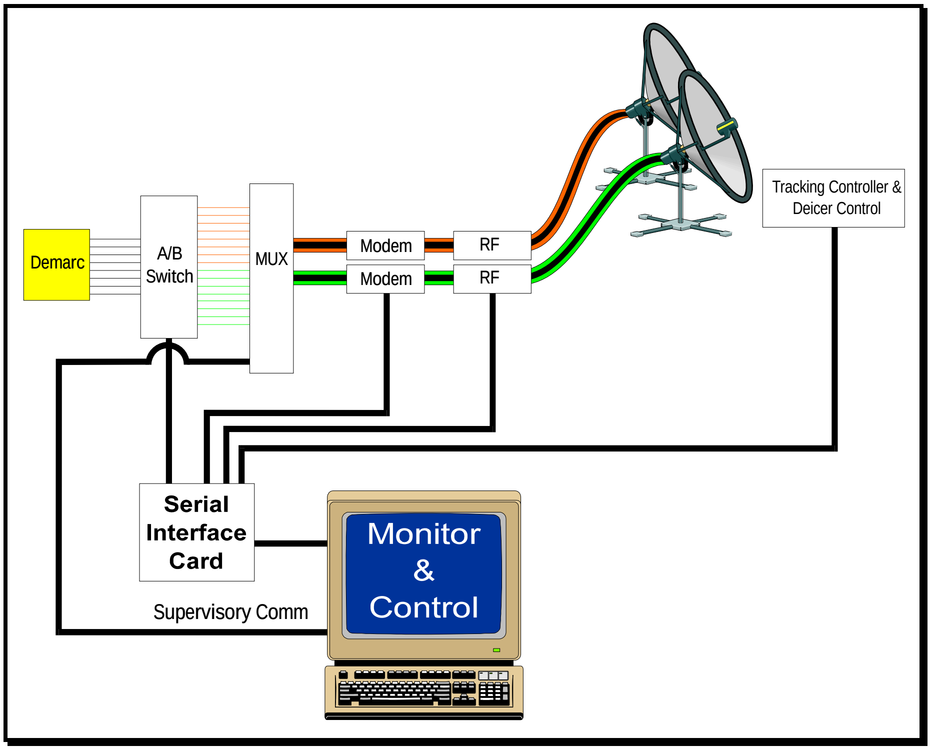

Figure 1. Block Diagram of Remote ANICS

d. ANICS is composed of three segments; the Space Segment, the Ground Segment, and the Network Monitor and Control System (NMCS) Segment. The Space Segment includes leased transponders from two C-band communication satellites.

e. Both the primary and alternate satellites carry critical and essential traffic between earth stations. The primary satellite also carries routine traffic. This provides the two paths required to achieve the high availability required for the critical and essential FAA circuits within the Alaskan region. Each duplex path between earth stations uses a unique subcarrier frequency pair in the assigned transponder. The assignment of the unique frequency pairs constitutes the Frequency Domain Multiple Access (FDMA) for ANICS. The Space Segment also includes the satellites and associated Telemetry Tracking and Control station (provided by the satellite vendor).

f. The Ground Segment includes all required equipment in each ANICS facility. At each earth station, the Time Division Multiplex (TDM) equipment combines the assigned user circuits into an aggregate data stream (and separates the aggregate into user circuits) for one transmit RF path or carrier. To maintain reliable communications, ANICS incorporates very precise timing references at each hub. Any of the nodes in the network can accept the external reference and distribute that timing to all other nodes. ANICS uses Austron Stratum 1 clock sources at each hub to ensure effective continuous network synchronization. The stratum 1 clock, working with the Transport Management System (TMS-3000) autoclock function, assures automatic clock recovery and smooth planned transfer to another stratum 1 clock, should a reference clock fail. The ARTCC hub multiplexer reference clock is the ANICS primary timing reference. In the event of failure, the network TMS multiplexer has defined an algorithm that devolves the reference to another hub. In the event of a secondary node failure, the algorithm devolves to a third hub, and then to the fourth.

g. The NMCS Segment includes the equipment and software necessary to monitor and control the Ground Segment and the links to each site. The NMCS functionality is distributed between the Network Operations Control Center (NOCC) which is located at the ARTCC hub earth station in Anchorage, three AFSS hub earth stations, and remote earth stations. The NOCC's Network Management Computer (NMC) is linked to the ZAN Hub Monitor and Control (HMC) via an Ethernet Local Area Network (LAN) and routed to each HMC computer, using two (2) dedicated 56 KBPS channels, one each on the primary and the alternate link. Each remote earth station includes a Remote Monitor and Control (RMC) computer that monitors activity at the remote site and reports status to the HMC and to the NMC through a dedicated 4.8 kbps channel. These interfaces provide the detailed information required for trouble reporting and resolution.

10. EQUIPMENT AREAS. ANICS is divided into seven functional areas, each providing a specific function. The functional areas are antenna, radio frequency equipment, modems, multiplexers, ANICS demarcation point (ADP), power, and NMCS.

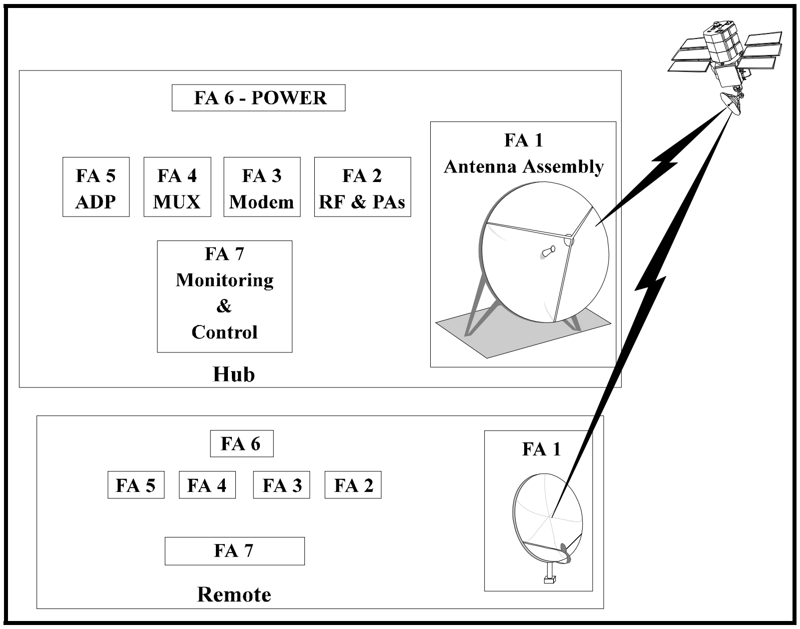

Figure 2. ANICS Functional Areas

11. ANTENNA EQUIPMENT.

a. The antenna assembly equipment includes feed horns, mountings, drive motors, resolvers, deicers, feed lines, and associated hardware. Each antenna, including supports and reflectors, is off-the-shelf and is designed for commercial satellite communications use in the wide range of environmental conditions experienced in Alaska. The hub antennas are 11.2-meters. The two remote sites at Seattle ARTCC (ZSE) and Adak have 6.1-meter Cassegrain fed antennas. All other remote site antennas are either 3.6-meter offset feed, or 4.5-meter symmetrical prime focus feed. All antennas feature feed horns with adjustable polarity. The feed assembly consists of the feed horn, the coaxial and waveguide components, the orthomode transducer (OMT), and a motor-driven polarization system. There are two feed assemblies in use:

(1) A two-port feed is used at the remote and hub sites, and on the alternate antenna at the Master Hub.

(2) A four-port feed is used at the Master Hub on the primary antenna.

b. Each antenna has azimuth, elevation, and polarization controls. Motors and resolvers are used to drive the antennas to the selected satellite positions. Each antenna also has a manual azimuth, elevation, and polarization adjustment capability. Antenna deicers are equipped with temperature and moisture sensors that will automatically activate the heating units to prevent icing. One of four types of heating units are used:

(1) Gas fired, forced air heaters (Anchorage, Kenai).

(2) Oil fired, forced air heaters (Fairbanks, Juneau, Yakutat).

(3) Electric heat, forced air (Biorka, Middleton Island).

(4) Electrical resistive tape (All others).

c. The antennas face south. The primary antenna is on the west and the alternate is on the east. The Network Management and Control System managed equipment under this functional area are:

(1) Antenna controllers made by Scientific Atlanta (SA) (only at Phase I sites, Phase II sites must be moved manually).

(2) Positioners (Indoor unit 8860), (outdoor unit 8862) (SA).

(3) Dehydrator: The Dehydrators are used at all Hubs on the Wave-Guides (SA).

(4) Antenna Deice Systems: Three heaters are provided at Anchorage and Kenai. Fairbanks and Juneau have single oil fired heaters.

d. Antenna Sizes and Locations.

(1) 11.2 meter Antenna.

(a) Scientific Atlanta Model 8007, 11.2-meter (37ft).

(b) Located at Anchorage ARTCC, Kenai, Fairbanks, and Juneau.

(c) Cassegrain fed dual reflector, high-efficiency 55 db signal gain.

(d) Integral LNA and switching assembly, dehydrators.

(2) 6.1 meter Antenna.

(a) Scientific Atlanta Model 8340, 6.1-meter (20ft).

(b) Prime focal-fed parabola single reflector, high efficiency 50 db signal gain.

(c) Located at Seattle and Adak.

(d) Radome located at Adak.

(3) 4.5 meter Antenna.

(a) Scientific Atlanta Model 8345, 4.5-meter (15ft).

(b) Located at Barrow, Cape Lisburne, Cold Bay, Dillingham, Dutch Harbor, Indian Mountain, King Salmon, Kotzebue, Shemya, Saint Paul, and all Phase II sites.

(c) Prime focal-fed parabola single reflector, high efficiency 47 db signal gain.

(d) Protected LNA and switching assembly.

(e) Radomes at Cape Lisburne, Cold Bay, Dutch Harbor, Indian Mountain and all Phase II sites.

(4) 3.6 meter Antenna.

(a) Scientific Atlanta Model 8136, 3.6-meter (12ft).

(b) Located at most remote sites.

(c) Offset fed, low side lobe, single reflector, 45 db signal gain.

(d) Protected LNA and switching assembly.

(e) 60’ radomes at Cape Newenham and Sparrevhon.

e. Antenna Controls.

(1) Scientific Atlanta Model 8860 Indoor (console) Antenna Controller.

(2) Microprocessor controlled, sends tracking commands to antenna.

(3) Controller can be accessed locally or remotely over the network by RMC at the Phase I and Hub sites.

(4) Scientific Atlanta Model 8862 Outdoor (converter) Antenna Controller.

(5) Receives electronic commands from 8860 for conversion to drive servos.

(6) Variable speed antenna AZ-EL motor position controller.

f. Dehydrators.

(1) Located at ZAN and Hub sites, requires periodic service for best performance.

(2) Removes all moisture from sealed internal waveguide chambers.

(3) Excessive moisture on transmit waveguide causes arcing and heat.

(4) Excessive moisture on receive waveguide causes high signal loss.

g. Deicing Systems.

(1) Allows earth terminal to sustain high quality links during severe weather.

(2) Ice on parabolic dish face distorts beam focal point and creates signal loss.

(3) Types: Natural gas fired, heating oil fired, electric strips, and Walton electric forced air heaters.

(a) ZAN and ENA heaters are natural gas fired units.

(b) JNU and FAI heaters are oil-fired units.

(c) ZAN and each Hub site have hot air capability to the sub deflector.

(d) Walton DDC-500 Electric forced air heaters are used at the following remotes: Biorka Island (BKA), and Middleton Island (MDO).

(e) Walton oil fired heater: Yakutat (YAK).

(f) Scientific Atlanta (SA) electric heat strips are used at the remainder of the remotes sites.

(g) Remote sites also have an electric heat strip on each feed assembly and heating to the feed aperture. The feed aperture heater is always powered on. AC voltage can be 120 or 208 VAC.

12. RF EQUIPMENT.

a. REMOTE SITE RF EQUIPMENT. The RF converter monitors and controls the solid-state power amplifiers (SSPA) and low noise amplifiers (LNA). These RF converters provide up conversion on the transmit path and down conversion on the receive path. The converter also provides 15 volts DC to the low noise amplifier.

(1) Vitacom wall mounted or exterior mounted units are used.

(2) Vitacom solid-state power amplifiers (SSPA) are used and can be 20, 30, and 50-watt amplifiers.

(3) The Seattle site uses 150-watt VertexRSI (Maxtech) amplifiers.

(4) The SSPA's are controlled and monitored by Vitacom RF Converters.

b. HUB SITE RF EQUIPMENT. The up and down converters are separate rack-mounted units. There are two units for each transmit and receive path. The 1:1 backup is accomplished via an interface between the converters, with no additional hardware required. The solid-state amplifiers are also configured 2 per link, with the 1:1 backup accomplished through an amp-to-amp interface and internal circuitry.

(1) Up and down converters are made by L3.

(2) The input and output of a converter pair is routed through combiners. Only one converter will process the signal. This is selectable through a GSIM at the NOCC.

(3) VertexRSI (Maxtech) 200 w SSPA's are used at all hubs including ZAN.

(4) SSPA's are switched in and out off the transmit path by combination coaxial/waveguide switches. This is selectable through a GSIM at the NOOC.

c. LOW NOISE AMPLIFIER (Scientific Atlanta or Kaman).

(1) High efficiency/gain and low noise initial stage downlink receive amplifiers.

(2) Located in the feed horn assemblies.

(3) Six (6) located at ARTCC (ZAN), four (4) at hubs and two (2) at remotes.

(4) Integrated switching assemblies will go to off-line unit automatically when primary fails or manually through network.

d. UP AND DOWN CONVERTERS (VitaCom and L3).

(1) "Up" converters receive (70Mhz) intermediate frequencies (IF) from modems for conversion to gigahertz frequencies prior to transmission over the uplink.

(2) "Down" converters receive gigahertz frequencies from downlink (LNA) in the antenna, and then convert the signal to (70Mhz) intermediate frequencies (IF) prior to being received by the modem.

(3) The Vitacom converters house both the up and down converters in the same unit.

(4) The rack-mounted L3 units house the up and down converters in separate units.

(5) ZAN has six (6) up converters and six (6) down converters, the hubs each have four (4) up converters and four (4) down converters, and remote sites each have two (2) up/down converters.

13. MODEMS.

a. The modems are full duplex, quadrature phase shift keying (QPSK) digital modulator-demodulator for frequency division multiple access (FDMA) satellite communication systems. Each modem contains a built-in scrambler/descrambler, a differential encoder/decoder, transmit and receive frequency synthesizer (IF unit), and a multi-rate forward error correction (FEC) convolution encoder with a Viterbi decoder. The 300 and 300A model modems also have Reed Solomon forward error correction. The modems provide high performance with narrow controlled bandwidth, automatic signal acquisition, and extensive on-line monitoring circuits.

b. The modems modulate a transmit aggregate (AGG) to IF frequency output of 70 MHz +/- 18 MHz. The demodulator receives 70 MHz +/- 18 MHz IF signal from the down converter and provides the receive aggregate to the multiplexer. The ANICS uses EF Data 650B and Comtech EF Data 300A satellite modems.

(1) There are four modems at each remote site, except for Shemya (SYA). It has only two modems both going to ZAN.

(2) All four modems at Seattle Air Route Traffic Control Center (ZSE) go to ZAN.

(3) Each remote (except SYA and ZSE) has two modems going to their Hub sites (ENA, JNU, FAI) and two modems going to ZAN.

(4) Each Hub and ZAN has two modems for each remote site. One modem is for the primary link, the other is for the alternate link. In addition, each Hub and ZAN modem rack contains a 1:8 backup modem (ZSE is an exception with two modems per satellite to ZAN only and SYA has one modem per satellite to ZAN only).

c. EF DATA REDUNDANCY SWITCH.

(1) The EF Data Redundancy switch (EF Switch) is used at the Hub sites and ZAN. Each EF Switch can control two spare modems for eight on-line modems.

(2) Whenever a new modem is brought on-line or a configuration change is made, the new configuration must be loaded in the EF Switch.

(3) The EF Switch monitors the modems for transmit, receive, and common faults.

(4) The EF Switch stores all eight modem configurations so that it can reprogram the back-up modem should any single on-line modem fail.

(5) The modems are numbered from the top to bottom. Number 1 is on top and number 8 is on the bottom. The backup priority is configurable within the modem switch.

d. MODEMS (EF Data).

(1) Modulates transmit digital baseband data from the multiplexer, to an intermediate frequency (70Mhz) for up conversion to the gigahertz frequency range in the converter.

(2) Demodulates receive intermediate frequency (70Mhz) from the down converter for the purpose of re-constructing digital baseband data for the multiplexer.

(3) Uses advanced signal conditioning and processing techniques, which enhance transmit and receive accuracy (error correction), disperses power density, and conserves transponder bandwidth (QPSK).

(4) Modems are configured such that the link is always up and available, regardless of whether the link is passing traffic or not.

14. DIGITAL MULTIPLEXING (MUX) EQUIPMENT.

a. ANICS employs commercial off-the-shelf (COTS) time division multiplexers (TDM). A multiplex system controller is located at the network operation control center (NOCC). The multiplex controller is used to make channel and aggregate assignments, and to route circuits between aggregates. It reports link status and multiplex alarms to the NMCS.

b. The mux receives the aggregate from the demodulator side of the modem and provides this data to the respective channel cards. There are Universal Data Card (UDC), Hyper UDC, Universal Voice Card (UVC), Codebook Excited Linear Predictive (CELP) and Very Low Bit Rate Voice (VLBRV) cards that provide to the respective customer services. On the transmit path voice and/or data is received into each channel card and routed through the mux to become transmit aggregate which is routed to the modulator side of the modem.

c. GDC TMS Controller. The TMS controller manages the GDC multiplexer network. It uses redundant x86-based platforms and SCO XENIX and INFORMIX databases. The GDC multiplexer network is the backbone of the ANICS. Should the NMCS functional area fail, the multiplexer is still operational. The NMCS has no control over, and can only monitor the multiplexer.

d. GDC Megamux - TMS 3000.

(1) GDC Multiplexers are the foundation of the ANICS network which use time division multiplexing (TDM) to concentrate and send aggregate bit streams.

(2) Multiplexers combine discreet data and analog channels into one aggregate output bit stream. Aggregate bit streams for transmission are then provided to the Modem functional area.

(3) Incoming receive aggregate bit streams from the modem functional area are de-multiplexed back into discreet digital and analog channels.

(4) The Megamux framing structure consists of overhead bits and repeating groups of data words to maintain bit integrity and timing synchronization throughout the network.

(5) Megamux channel cards consist of: UDC, UVC, VLRBC, and CELP coding cards.

(6) TMS controllers use redundant x86-based platforms that manage the network with SCO XENIX command software using INFORMIX databases.

(7) The network monitor and control system (NMCS) has no control over the TMS multiplex network; it can only monitor the *status* of the Multiplexers.

(8) Network clock source is derived from a Loran-C receiver providing 10 MHz timing through the external timing connector.

15. ANICS DEMARCATION POINT (ADP).

a. The ADP functional area interfaces ANICS with external circuits. All circuits enter and exit ANICS through the ADP. ADC Telecommunication A/B patch switching system AB switches are used to route critical and essential analog/digital circuit information to and from the mux. When used, AB switches provide switching from the NMCS system to route critical and essential circuits to either the primary link or the alternate link, but not both links at the same time for a given circuit. When routers are used for bandwidth and priority management, traffic flows on both links at all times. Routine circuits use only the primary link. It is critical to ANICS operation that when AB switches are installed or moved that the aggregates table in the NMCS be updated for automatic switching.

b. The ADP is the interface between external equipment and the ANICS. The panel includes:

(1) Patch panels that distribute all assigned circuits.

(2) A/B switching equipment that provides switching between the primary and alternate channels for all critical and most essential circuits.

(3) Lightning Protection – Reliable electric dual gas tube protectors in type 66 blocks are used at the entrance point of ANICS circuits.

(4) Analog Patching – Six wire RJ11 patch module provides signal access and patching for ANICS voice and analog circuits.

(5) Digital Patching – ADC Patchmate modular digital patch systems provides access and patching of digital ANICS circuits. The system supports sixteen full duplex, RS-232, RS-422, or V.35 interfaces simultaneously.

(6) A/B Switching – Alternate path switching for critical and essential channels is accomplished with ADC four-wire patch switch system. Modules provide magnetic circuit switching with manual patch cord back up. The NMC and HMC’s can control the switching of up to 256 circuits with a single control link.

16. TELCO DEMARCATION POINT (TDP). The TDP provides lightning protection, signal termination and distribution with type 66 blocks, and is also labeled as the station distribution frame (SDF).

17. POWER GENERATION EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLY (UPS).

a. The UPS and power generation equipment, where provided, are designed to provide reliable backup power to the ANICS site. The NMCS monitors prime power for loss and unacceptable levels. The UPS provides battery power when the AC power feed fails.

b. UPS and Battery Cabinet. The UPS provides continuous on-line regulated AC power to the critical equipment and provides a charging system for the batteries. The UPS is always online receiving power from the prime power source (commercial power or FAA generator) or the standby generator (when provided).

c. Standby Generator. The standby generator provides electrical power if prime power fails or is unacceptable.

d. The prime power is monitored by the Automatic Transfer Switch (ATS). The ATS will start the ANICS generator when prime power fails or falls below acceptable limits. The ATS will transfer the site load to the generator when the generator's output quality is within acceptable limits.

e. The Cyberex UPS is used at Phase I remote sites. The UPS is a 5 KVA, single-phase unit.

f. Hubs use the facility UPS to feed the ANICS equipment.

g. The NMCS only monitors UPS status. It cannot control the UPS. (When encountering UPS monitoring problems, try stopping and restarting polling. If the problem still exists, suspect the UPS interface card.)

h. Government Furnished Equipment (GFE) UPS are not monitored by ANICS.

18. MECHANICAL TRANSFER SWITCHES. There are two types of mechanical transfer switches used in ANICS, the Generac automatic transfer switch (ATS) and ASCO.

a. ATS's are used at all sites except Iliamna (ILI) and Port Heiden (PTH).

b. ASCO switches are used at ILI, PTH and ZAN. ZAN switches are located in the Tech/OPS facility and are of a different type than used at ILI and PTH.

c. ANICS transfer switches are monitored by the supervisory control and data acquisition (SCADA) interface.

d. GFE transfer switches are not monitored in ANICS.

e. ATS and ASCO switches control the ANICS generators that are monitored by the ANICS NMCS. Some facility power upgrades inhibit the ability of ANICS to monitor the system.

f. ASCO switches at ZAN are in the Tech/OPS building only and are used to feed critical power from two of three different critical power centers (CPC), CPC-A, CPC-B, and CPC-C.

g. CPC-D output is not used in ANICS.

19. GENERATORS. Phase I ANICS sites with contractor-supplied generators use Generac generators. GFE generators are not Generac generators. There are two different size generators used at ANICS Phase I facilities. The 30 KW and 50 KW generators are used at remote sites and the facility engine generator is used at the hubs. Phase II sites have 15KW Lister-Petter diesel generators. Generators can be started and stopped remotely. If the ATS starts the generator, it cannot be stopped remotely by the NMCS. GFE generators are not monitored in ANICS. ZAN and ZSE use the ARTCC facility generators and UPS. Likewise, each hub site uses the AFSS facility generators and UPS.

20. UPS SYSTEMS. The UPS operates on batteries when neither commercial and/or generator power is present. If the transfer switch doesn't switch the generator on-line, or the generator doesn't start, the site has limited time to operate on batteries. Length of battery backup varies at remote sites and hubs.

a. Cyberex UPS systems used at Phase I remote sites have one to four hours of run time.

b. All hub sites and ZSE use both the local facility UPS and engine generator for standby power.

21. NETWORK MONITORING AND CONTROL SYSTEM.

a. The network management operational concept is based upon a hierarchical distributed computing configuration. This allows the processing load to be shared among the network's elements, which include the Network Monitor and Control (NMC) computers, the Hub Monitor and Control (HMC) computers, and the Remote Monitor and Control (RMC) computers. These computers are allocated one or more of the following operations and maintenance tasks: Monitoring, Configuration and Access Control, Maintenance of Operational Records, Hardware Diagnostics, Repair and Reporting, System Performance, Analysis and Reporting.

b. Network Monitor Control System Function.

(1) Distributes management and control of ANICS.

(2) Monitors all functional areas for health and status.

(3) Gathers, filters, and reports alarms.

(4) Reports equipment faults and link outages to the NOCC.

(5) Allows remote maintenance and control of unmanned sites.

(6) Presents a unified graphics display in multiple locations.

c. NMCS Equipment.

(1) Remote Sites. RMC and Puleo SCADA unit with a 16-port hostess board and remote PC reset card.

(2) Hub Sites. HMC, Puleo SCADA unit, Cisco port terminal server, Cisco router, and RS-232 to RS-422 converter.

(3) ZAN. HMC, Puleo SCADA unit, Cisco port server terminal, RS-232 to RS-422 converters.

(4) NOCC. NMC, Cisco network router, color printer, and Sun work stations.

d. NMCS OPERATION.

(1) ANICS Ethernet equipment, HMC, NMC, routers, and terminal servers are monitored through the Simple Network Management Protocol (SNMP) by the NMC.

(2) RMC are controlled remotely through Serial Interface Process Communications (SIPC) over both links.

(3) TMS controller is monitored through the login port.

(4) NMCS servers (RMC, HMC, and NMC) monitor the SCADA.

SCADA ALARMS	
Green	Systems operational within normal parameters.
Yellow	Systems operational, but out of normal parameters
Red	Systems non-operational and are not carrying traffic.

Section 2. SYSTEM THEORY

22. GENERAL. The following is a brief discussion on general ANICS theory essential for understanding the operation of the system. For a more detailed description of specific equipment, refer to the theory of operation section of the applicable equipment instruction book.

23. ANTENNA ASSEMBLIES.

a. The parabolic antennas are built for high gain and focus within a broad frequency spectrum to provide a narrow beam to a satellite. The feed horn of the antenna can be rotated by the antenna control and positioning equipment to provide orthogonal frequency band separation. A directional coupler divides the feed into transmit and receive paths. The antenna functional area of each earth station includes one or two antennas. Each antenna consists of structures (including supports, reflectors, and RF feed assemblies), controllers, drives, and deicing assemblies. Each antenna is an off-the-shelf item that is designed for commercial satellite communications use in the wide range of environmental conditions experienced throughout Alaska. Via Sat (formerly Scientific Atlanta) provides the majority of antennas used within ANICS.

b. Each antenna provides optimal gain, sidelobe patterns, and reflector surface stiffness. The ANICS antennas meet all regulatory requirements of EIA-411-A and comply with FCC CFR 47 Part 25, paragraph 25.209 in the transmit band. The antennas (identified by the diameter of the large reflector and by the form) selected for each site are:

(1) Hubs - 11.2-meter dual reflector.

(2) Remotes - 3.6-meter offset feed or 4.5-meter symmetrical prime focus.

(3) Seattle and Adak - 6.1-meter prime focus feed.

c. Antenna Structures. Each antenna structure consists of a support, one or two reflectors, and a RF feed assembly. The FAA has selected structures that are proven in the environmental extremes present in Alaska. Each fixed support includes a ground mount (foundations, piers, or platforms provided as part of the site preparation) and an antenna mount provided during installation.

d. Antenna Supports.

(1) Antenna supports used in the ANICS network include both ground mount and antenna mount, so that deep snow does not interfere with antenna operation. The antenna mount provides firm support in extreme weather conditions and establishes the fixed reference for the elevation over azimuth drive elements.

(2) As part of each site survey, the FAA has identified the proper ground mount for the conditions found at that site. The available ground mount styles include, but are not be limited to:

(a) Multiple piling ground mount.

(b) Grade slab ground mount.

(c) Frost pile ground mount.

(d) Permanent form caisson ground.

(e) Load frame ground mount.

(f) Rock anchored ground mount.

(3) The antenna mounts for the hub and remote antennas position the actuators well above the ground. The antenna mount for each of the selected antennas is steel. The antenna type, height of the activators above baseline, and mount style are:

3.6-meter	King post and pipe type elevation over azimuth mount.
4.5-meter	Tube constitution tripod support type elevation over azimuth mount.
6.1-meter	King post and pipe type elevation over azimuth mount.
11.2-meter	Truss frame structural steel tower (17'x10') hot-dip galvanized ASTM-36 steel except lower azimuth bearing housing and azimuth turntable are cadmium plated with chromate conversion.

e. Antenna Reflectors. The antenna reflector assembly focuses the RF energy received from the satellite. Each reflector assembly includes the structural members to support the reflecting surface. The segmented reflectors are assembled on site. The reflector assemblies' panels for each antenna type are described as follows:

3.6-meter	Three stretch formed aluminum panels with industrial grade white enamel.
4.5-meter	Twelve precision stretch stamped galvanized steel panels painted with high quality paint, structural backup ribs with tubular steel support struts.
6.1-meter	Twelve precision stretch stamped galvanized steel panels painted with high quality paint, structural backup ribs with tubular steel support struts.
11.2-meter	All aluminum including panels, backup structure, hub, subreflector and supports high reflective white paint over chromate conversion coating.

f. Antenna RF Feed Assemblies.

(1) The orthomode transducer (OMT) gives isolation between the uplink and the downlink. It operates as a duplexer providing bi-directional communication. The focus of the antenna is determined by the positioning of the feed horn. Vertical or horizontal polarization is selected to match the satellite transponder in use. The coaxial and waveguide components provide a low loss transmission path to and from the antenna.

(2) The manufacturer has applied proper coating (galvanizing) to prevent corrosion and electrolysis when dissimilar metals are used in conjunction. The reflector assembly moves in azimuth around the antenna mount and in elevation above the mount. The reflector structure also provides anchor points for supports of primary focus feeds or subreflectors.

(3) The RF feed assembly provides isolation between the uplink and the downlink and enables bi-directional (up and down) communication at the same time. The feed assembly includes the coaxial or waveguide transmission lines and provides a mount for the low noise amplifiers. The RF feed assembly may contain two or four RF ports to accommodate the two satellites and to provide for contingencies in the future. ANICS uses the RF feed assemblies as:

(a) Two-port feed: Primary and alternate antenna at each AFSS hub and each remote site, alternate at ZAN.

(b) Four-port feed: Primary antenna at ARTCC (ZAN). The four-port feed enables the simultaneous use of two differently polarized transponders on the same satellite.

(4) Some of the RF feed assemblies include support struts that position the feed properly in relation to the reflector. The struts also provide support for the coaxial and waveguide transmission lines. Each of the receive ports in the feed assembly allows effective mounting for the low noise amplifier and related switching that are part of the RF equipment functional area.

g. Antenna Deice Controls.

(1) This equipment provides for deicing the antenna, feed assembly, and for hub antennas, the sub-reflector. The 11.2-meter antenna uses three forced air heaters that heat the plenum on the back of the antenna and the feed assembly and sub-reflector. The 3.6 and 4.5-meter antennas use either forced air heaters or electric strip heaters. The electric strip heaters are wired such that the upper and lower heater panels can be turned on or off independently. The antenna feed heater is wired to the lower panel. The heater units use temperature and humidity sensors to turn the heaters on and off automatically.

(2) Arctic conditions found in Alaska have made it necessary for full dish deicing during each winter site visit. They will select either self-limiting electric heating strips or forced hot air deicing units. The system has controllers and sensors that energize the heaters when needed and allow the operator to override the control and command the deicing units "on" and "off" as desired from the NOCC. Each deice controller reports status to the NOCC.

h. Antenna Drives and Controls.

(1) Antennas are positioned by motors and resolvers with the microprocessor-based antenna control unit, or with the antenna-tracking controller. The antenna-tracking controller is a microprocessor-controlled unit that commands the antenna controller via switches on the front panel of the outdoor unit or remotely by the indoor antenna controller unit, RMC, HMC or NMC.

(2) ANICS provides three axes (azimuth, elevation, and polarization) of drive on each of the 3.6-meter, 4.5-meter, 6.1-meter, and 11.2-meter antennas. Antenna drives use motors or motorized jackscrews on Phase I sites while Phase II sites have manual drives. Each drive is remotely controllable by the NOCC operators as needed or locally controllable by the site technician at the earth station. Control levels include:

(a) “jog”: Move on axis by a small angular increment on command.

(b) “go to”: Set the axis to defined angle.

(c) “tracking”: ANICS uses this only to keep the 11.2-meter antenna aimed at the proper satellite.

(3) When the antenna control is active at the local site, all remote commands are inactive for safety purposes.

(4) ANICS uses the Scientific Atlanta 8860/8862 control system with each of the Scientific Atlanta antennas. The 8862 is located at the antenna and communicates with the 8860. The 8860 communicates with the RMC, providing current status and control interfaces. It also has antenna-positioning control access for “jog,” “go to,” and “tracking functions.” At hub sites, the 8860 also receives an input from the beacon receiver to track the satellite and maintain position of the 11.2-meter antenna.

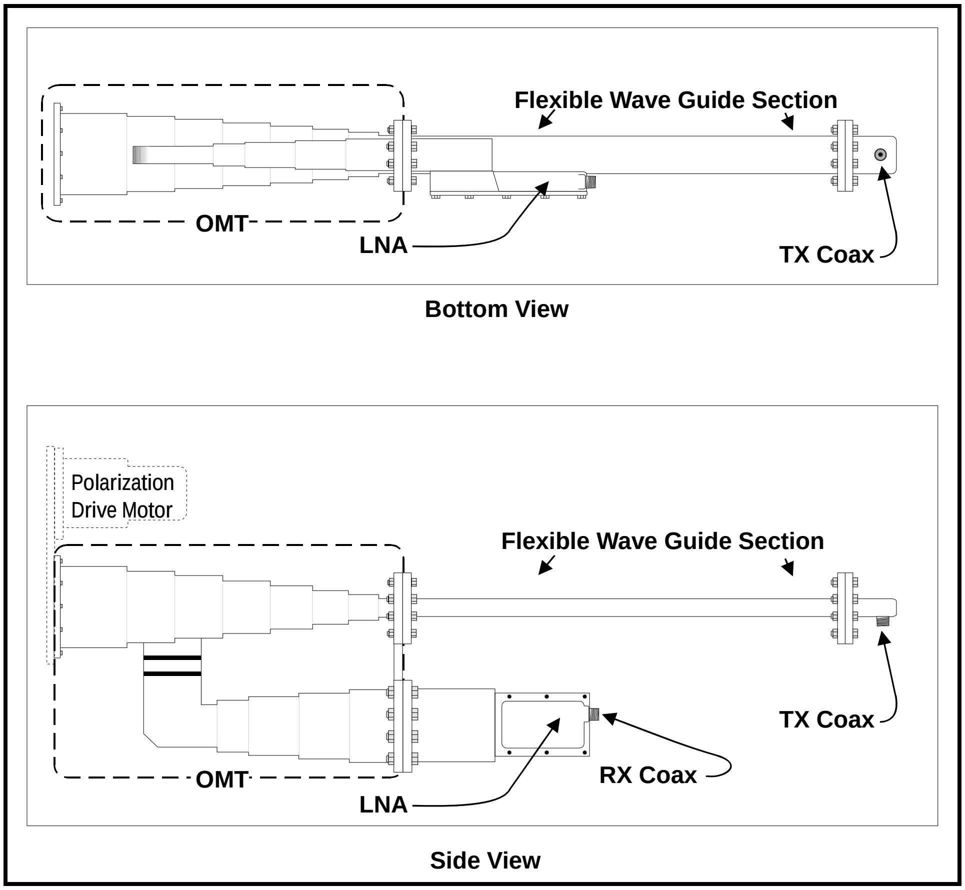

Figure 3. 2 Port Orthomode Transducer

24. RF EQUIPMENT.

a. The RF electronics functional area of each earth station includes two sets of transmit electronics, two sets of receive electronics, as well as RF electronics controls and distribution. Vitacom provides the majority of RF equipment. VertexRSI (Maxtech SSPA's) are used at the hub sites and Seattle. L3 Communications up and down converters are used at the hub sites. Kaman (ITT) LNA's are used at hub sites and a few remote sites. The LNA switches and up and down converters at the hub sites are controlled by a LNA channel select and monitor unit (LCS&M). The Vitacom G-7100 transceiver is the basic unit in all RF chains. ANICS provides redundant units in both transmit and receive electronics at the hub earth stations.

b. Transmit Electronics.

(1) Power amplifiers increase signal strength for transmission to the satellite of the up-converted RF signal of 5925 to 6425 MHz. Transmit electronics are similar at the hubs and the remotes. ANICS uses 200 W solid-state power amplifiers (SSPA's) at the hubs, and 20, 30, 50 and 150 W SSPA's at the remotes. The converter and SSPA are sometimes mounted on the antenna support structure at the remote sites and sometimes are mounted in the MEB.

(2) The up/down converter converts IF to RF for transmit and RF to IF for the receive signal. The 70 MHz IF output from the modem is connected to a double conversion up converter and the low level RF (in the 6 GHz band) is applied to the power amplifier (SSPA). The RF signal exiting the power amplifier is transmitted to the RF feed on the antenna using either low-loss coaxial cable or waveguide. The RF power level coming out of the power amplifier depends on the link budget and can be controlled remotely from the NOCC.

c. Receive Electronics. The 4 GHz downlink signal from the satellite is amplified by the low noise amplifier (LNA) and is coupled to the output port of the RF feed assembly of the antenna. The hub sites have a redundant LNA with appropriate switching. The LNA provides a 55 db gain of the 3700 to 4200 MHz received signal to the down converter. The remote sites have one LNA on each antenna. Coaxial cable carries the amplified RF signal to the dual conversion down converter. The converter 70 MHz (+/- 18 MHz), 75 ohm, IF output is sent to the IF distribution panel. The IF panel is a breakout point for maintenance and troubleshooting. All carries on the transponder are available on the downlink signal. From the IF panel, the signal goes to the appropriate modem IF input port.

25. MODEMS.

a. The modem converts multiplexed aggregate data into modulated intermediate frequency (IF) signals which are distributed via the IF distribution panel, switches, and combiners to the RF converters for uplink. It also converts the downlink modulated IF signal to baseband aggregate data for use by the multiplexers. The IF Distribution Panel provides intermodulation pass-band filtering along with the capability of selecting several combinations of path and equipment configurations.

b. ANICS uses E.F. Data modems at hub sites, the E.F. Data modem protection switches to provide "1 for n" redundancy protection and IF distribution. They also include any intermediate frequency (IF) distribution needed at the station within this functional area. The modem switch used at the hubs provides “1 for 8” redundancy protection.

c. Digital Modems. All units are E.F. Data modem models SDM 650B or 300/A. The modem accepts an aggregate data stream from the time division multiplexer (TDM), adds control data, forward error correction (QPSK), modulates a 70 MHz IF signal, and forwards it to the up converter. The modem also receives a QPSK modulated 70 MHz IF signal from the RF down converter, demodulates it, and sends a controlled aggregate data stream to the multiplexer. The modem unit collects status and issues messages to the RMC at remote sites and the HMC at the hubs.

d. Modem Protection Units and Controls. ANICS provides “1 for 8” protection for modems at each hub site. The E.F. Data 1:n Modem Protection Switch, model SMS 658, provides the control and switching of the aggregate, IF, and monitor and control signals from a failed modem to the on-line spare. Switching modules in the SMS 658 enable repair for one switch channel without interruption of the on-line modems. The modem protection switches can be configured manually from the control panel on the switch or remotely via the HMC. Each switch receives the aggregate and IF inputs and outputs for all modems within the switch. Link status, configuration data, and control signals for each modem is accomplished by an RS-232 connection between the switch and each modem. The switch controls the units and reports to the site as needed. At a remote site, each modem operates under direct control of the remote management computer (RMC). Modem protection is not used at Phase I remote sites because there are two complete equipment strings, primary and alternate. At Phase II sites, one for two modem protection switches are used.

26. DIGITAL MULTIPLEXING EQUIPMENT.

a. Multiplexing is the process where multiple channels are combined for transmission over a single transmission path. ANICS uses time division multiplexing (TDM). With TDM, multiple channels of data are converted into a common aggregate based upon time-share for transmission over a common trunk. Refer to the manufacturer’s operating and installation manual for a complete and detailed description of the multiplexer system functionality.

b. ANICS incorporates the General Data Comm (GDC) Megamux Transport Management System (TMS) for all ANICS applications. In addition, the multiplexer functional area uses Austron Stratum 1 clock sources at each hub. Redundant Megamux TMS system controllers in the ARTCC hub provide the interface with the ATNM network manager and independent control of all the multiplexer processes in the ANICS. The multiplexer equipment at each remote earth station comprises a "node." The hub sites have multiple nodes, one for each remote site. Seattle has two nodes (ZSE1 and ZSE2).

c. TDM Nodes.

(1) Each TMS Megamux node consists of a common logic shelf, common logic cards, aggregate control cards (ACC), channel interface cards (CIC), expansion cards, channel card chassis, and channel cards. Together these elements form a transport mechanism for ANICS voice and data circuits. The modular scalable architecture allows ANICS to use the same hardware for hub and remote earth station nodes. When the quantity of channels within a node exceeds the capacity of a single rack, additional sets of Aggregate and Channel Interface Cards are added in the common shelf, while the additional channel card chassis are added in an expansion rack.

(2) The ANICS multiplexer is modular and fault tolerant. Common logic cards and power supplies are redundant to enhance availability. Redundant aggregate cards are used on all primary path connections to provide the high availability for critical and essential circuits. The alternate path does not have a redundant ACC.

d. TDM Controls.

(1) ANICS achieves multiplexer network management via two TMS multiplexer controllers at the ARTCC hub connected to separate nodes. Both TMS controllers communicate with the ZAN HMC computer as well as with all mux nodes. The ANICS system provides alarm and status continually to the NOCC. The NOCC operator initiates all circuit reroute decisions and node configuration activities and the TMS controller executes the actions.

(2) One of the TMS controllers is designated the Master controller, all others operate as slaves or subordinates. Circuit and node configuration changes can only be done on the Master. Subordinates receive update information from the Master controller approximately every 15 minutes. When a controller is reconnected after being removed from the network for a time, the Master controller automatically updates the returning unit with the latest alarm and configuration data.

27. ANICS DEMARCATION POINT (ADP).

a. The ADP consists of analog and digital patching and A/B switching equipment. The multiplex equipment provides full duplex operation on each channel, routine, essential, and critical. The A/B switching equipment provides for switching to the redundant path for the essential and critical channels providing maximum circuit availability. Analog patching is provided with RJ11 patch panels and the digital patching is via RS-232, RS-422, and V.35 connectivity.

b. The ADP functional area consists of COTS equipment that protects and distributes all assigned channels at the ANICS location. Since the GDC mux is full duplex, half duplex circuits are converted prior to the mux.

c. The equipment in the ADP functional area includes racks, distribution panels, lightning protection, analog and digital patching, analog-to-digital and digital-to-analog conversion, 2-wire termination, auto-dial backup, and A/B switching. The actual connection of the elements depends on the type of channel. Typical connections are discussed and illustrated below. ANICS splits each critical and essential channel and provides redundant full duplex channels for high availability.

d. ADP Channel Equipment.

(1) ANICS protects each of the user circuits with a Reliable Electric dual gas-tube protector in a 66-type protector block at the physical interface. Prewired 66-type punch blocks provide signal termination, distribution, and cross-connection. The 66-type blocks comprise the ANICS site distribution frame (SDF) and the intermediate distribution frame (IDF).

(2) Sets of six-wire RJ11 patch modules provide signal access and patching for all digital and analog circuits. ADC PATCHMATE modular digital patch systems provide access and patching for all digital signals. The ADC PMCH-2 chassis supports RS232, RS422, and V.35 modules and the PMAC-C-CH supports RS449 modules.

(3) The Tellabs 6131X modular two-wire to four-wire conversion system (which is mounted in the GDC multiplexer rack) provides proper termination of two-wire circuits and ensures correct operation of E and M functions for all voice circuits.

(4) The FAA may identify some critical circuits and order standby autodial backup for those circuits, via a public switched telephone network or a private telephone system as designed and provided by the FAA. The MX-1-100, with MX-1-500 software at each hub, provides the capability to dial and control more than 1000 nodes (critical circuits).

e. ADP Control.

(1) Most of the equipment in the ADP is passive. The operating condition is set at installation. Patch panels are provided for local testing. When required, modems provide analog-to-digital and digital-to-analog conversion. The modem operating conditions are set at installation.

(2) The site RMC computer controls the A/B switching of critical and essential channels. The NOCC operator controls the switching to restore service. If the primary link has incurred a degraded status, traffic will be switched to the alternate link automatically, and will be returned to the primary link upon two hours of clean service.

28. POWER GENERATION EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLY (UPS).

a. Prime power is monitored by the Automatic Transfer Switch (ATS) for loss or degradation. Power for the critical electronics is fed through the UPS. Because of battery backup in the UPS, the critical equipment should never lose power. If the prime power exceeds preset values, the ATS will transfer to the standby source.

b. The ANICS power conditioning/UPS equipment draws power from the primary site utility during normal use. A surge suppressor protects the power system from serious excursions on the power source prior to distribution and use in the ANICS equipment. Depending on the site configuration, the transfer switch may select generator power or unconditioned power from the utility for short time use. A digital monitor system in the ATS senses the loss of the prime power and, after a short delay, activates the generator at sites so equipped. The system is designed to preclude erratic transfer and retransfer of power sources as well as frequent starting and stopping of the generator. The ANICS equipment operates from the UPS inverter output and there is no interruption on the critical power buss during loss or transient activity on the utility.

c. Power Conditioning Sets. The UPS provides conditioning of incoming power, prime or standby, to ensure the critical electronics are supplied with a continuous, stable power source. It provides battery backup to maintain the power to the critical equipment until power is restored. The number of batteries is determined by site load requirements. The power conditioning sets include a transfer switch and bypass control, main and tech power-distribution panels, surge suppressors, a line voltage regulator, and an uninteruptable power supply with battery backup. The tech power distribution provides protected power to the key electronic units while the main distribution supplies utility power to antennas positioning equipment and motors, etc., as well as providing a source for the power units that provide the protection and conditioning for the tech power. The UPS applies pulse width modulation (PWM) of the output power that is inherently tolerant of nonlinear loads that are typical of the switching power supplies common in modern electronic equipment. The UPS consists of rectifiers, battery chargers, inverters, a static transfer switch, a manual bypass switch, the digital monitoring system, and manual controls.

d. Battery Backup. The batteries are maintenance free, do not require venting, and operate well throughout the Alaskan temperature range. The number and connection of the battery banks depends on the load to be supported and the run-time requirement.

e. Generators.

(1) The engine generator is the standby power source for most remote sites. It will run and be shut down on command from the ATS. The generator can also be started and shut down from the NMCS (the NMCS cannot transfer station load to or from the generator at Phase I sites). The engine generator size varies and is determined by site load requirements. In-depth information is available in the equipment technical manuals.

(2) At Phase I sites, Generac generators were provided upon installation where required. Phase II sites were supplied with Lister-Petter generators. Facility upgrades have resulted in non-standard generators at some locations. The capacity of the generator depends on the expected load. Each of the generator sets is designed and rated for the Alaskan environment. The generator group includes a five-day fuel tank, heaters, enclosures, remote controls, and automatic status and fault monitoring. Each site configuration will define the needed environmental protection considerations.

29. NETWORK MONITORING AND CONTROL SYSTEMS.

a. The Network Monitor and Control System (NMCS) monitors all elements in the ANICS network. It also provides the network operator the capability to fully control the network. The reliability for circuits using the network is increased through automatic control of the A/B switching function to switch traffic from failed or degraded satellite paths to good satellite paths.

b. The NMCS is a distributed management process centrally controlled from the NOCC. The NMCS consists of the NMC, HMC in each of the four hub earth stations, RMC at each of the remote earth stations with the possibility of extending monitor and control functionality through various tail circuits. Each of these computers operates in the UNIX environment. The power of the network manager allows network “operation by exception." The NMCS accomplishes much of the ANICS operation without operator intervention.

c. The ANICS network operations control center (NOCC) is located at the Anchorage ARTCC (ZAN). The NOCC is the operations center for the ANICS. The NOCC equipment set includes the NMC, Ethernet backbone, workstations, printers, a bridge/router, built in test equipment (BITE), including a spectrum analyzer station, and a virtual instruments process called Labview. Labview is a software application designed to allow development of virtual instruments (VI) to enhance remote maintenance and monitoring control. A separate communication channel exists between the ARTCC and each AFSS hub. The HMC computer processes monitor and control of circuits and paths unique to a remote hub pair and exception alarms are sent to the NOCC.

d. The ATNM (Air Traffic Network Manager) network management and control system software is resident in the on-line NMC computer. The NMCS software provides, as a minimum, the circuit configuration control (CCC), equipment configuration control (ECC), and maintenance monitoring and control (MMC) processes and includes the modules needed for effective operation and support of ANICS.

e. Network Management Computer (NMC). The NMC manages the network globally. It responds to reported faults and anomalies that require system level response. The NMC provides all commands for circuit rerouting, reconfiguration, and coordination between sites. The NMC contains and controls the configuration database, provides all user interfaces, and generates reports.

f. Earth Station Monitor and Control Computers.

(1) The two types of earth station monitor and control computers are the remote monitoring computer (RMC) and the hub monitoring computer (HMC). The RMC is a Pentium based 300 MHz workstation and the HMC is a Sun Ultra 2 workstation.

(2) A remote monitoring computer provides both the human interface to the equipment for maintenance and the computer-to-computer interface between the network management computer and the remote earth station equipment. The RMC communicates with element controllers in the antennas, the antenna positioning controllers, de-icing equipment, RF equipment, modems, ADP, power equipment, and supervisory control and data acquisition equipment (SCADA).

(3) The HMC performs similar functions to the RMC, however, the number of units controlled is greater. The HMC also provides supervisory functions for assigned sub-nets of remote earth stations.

g. NOCC Communications Equipment. The distributed NMCS elements communicate over a standard bridged Ethernet. ANICS has allocated bandwidth on each satellite for primary communication between the NMCS computing platforms. An extension of the NMC Ethernet to the ARTCC HMC computer and bridge-routers communicating with the AFSS HMC computers ensure effective use of the distributed NMCS process. The terminal servers at each hub are connected to the HMC via a LAN Ethernet and communicate with the assigned RMC platforms using RS232 ports.

h. NOCC Peripheral Equipment.

(1) The workstations in the network operations control center (NOCC) are Sun Ultra 2 processors and operate on reduced instruction set code (RISC) based Sun SPARC terminals. The units implement the X-windows capability and are fully Motif compatible. ANICS operators can use either of the two workstations in the NOCC for operation and for maintenance. There are additional workstations in the ANICS area in the ZAN Tech-OPS wing basement.

(2) The NOCC equipment includes two printers. A HP bubble-jet color printer allows detailed capture of color graphic screens for off-line use. A HP Laser Jet printer provides draft and letter quality printing for reports. Each printer is connected to the network management computer.

i. Network Monitor and Control System Equipment.

(1) The HMC and RMC computers are high performance UNIX platform processors. The HMC is a Sun Ultra 2 commercial grade processor with the high-resolution 1024x768 color display; the HMC is fully compliant with the System VR4 UNIX and X-window standards. The RMC is a Pentium based HP workstation. The workstation includes 256 KB RAM cache, 32 MB RAM, 500-MB hard disk, and a 1024x768 graphics system.

(2) The NMC functional area equipment at the hub and remote earth stations also includes applicable SCADA equipment. The SCADA equipment consists of elements that monitor discrete contact closures, generate status words, and communicate with the HMC or RMC using a single RS232 interface. Contact closures report status from such devices as smoke detectors, intrusion sensors, temperature sensors, and other event and alarm indicators.

j. Network Timing Reference.

(1) Network synchronization is achieved through the placement of redundant stratum level 1 clock sources at each hub location. Loran C receivers supply the stratum level 1 clock source. ANICS uses both Austron and Locus Cs Sync and SatMate receivers. The external timing source is fed to ZAN Phase 1 nodes, 30 and 42, and all Phase 2 nodes. The Locus Cs Sync has the capacity to automatically tune to another Loran chain if the current chain should go down for any reason.

(2) Hub nodes that do not receive external timing are set to slave mode and receive timing from the external masters. All remote site nodes are designated Master Facility and, as such, receive timing via one of the aggregates. Each node selects the most stable aggregate for timing with a priority of ZAN primary, Hub primary, ZAN alternate, and finally, Hub alternate.

(3) There are currently 5 programmed clocking levels in the TMS-3000. The first level is the normal configuration with the external masters at each hub. The second level is ZAN 30 as an internal master for the whole network. Level 3 is a failure of the master timing source at ZAN, causing the network to fallback to internal master at Kenai AFSS, Fairbanks AFSS, or Juneau AFSS, in that order (order of fallback is programmable). In this way, any hub can be a level 1 network timing reference hub, assuring a level of performance that exceeds the network requirements.

(4) In the event of a single, up to all but one external master node loosing it’s external source, the affected nodes will step through a search sequence to reestablish stable timing.

(a) Determine if a neighbor node is phase locked to a higher timing level than itself. If so, the node will phase lock to the receive aggregate from that node.

(b) Should all neighbor nodes be on the same timing level, the node selects the aggregate that has the least hops between it and a master timing node.

(c) If all hop counts are equal, the node selects an aggregate based on a preference number programmable in the node configuration.

(5) In a situation of catastrophic level 1 timing source loss, the network can "fall through" levels of networking timing. If this occurs, each node becomes an "automaster" after falling through the lowest clock level. The node reverts to internal timing and remains so until it detects an automaster neighbor node with a lower node address. An automaster node with a higher node address always phase locks to an automaster node with a lower node address. Network timing is then resolved to phase lock to the lowest node address in the network or to some node that is configured as a master timing node.

CHAPTER 3. STANDARDS AND TOLERANCES

30. GENERAL. This chapter prescribes the standards and tolerances for ANICS as defined and described in Order 6000.15C. All key performance parameters and/or key inspection elements are clearly identified by an arrow (→) placed to the left of the applicable item. Note: Only those items identified by (*) are done on-site, all other actions are accomplished remotely from the NOCC during equipment testing in the Training and Test facility (TTF) or at site acceptance.

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
31. ANTENNA ASSEMBLY				
a. De-icing Equipment	AL 6000.20A Para 54	Auto mode 18° - 42° F	+/- 5° F	Same as standard
b. Waveguide Pressurization (11m ONLY)	AL 6000.20A Para 55	0.25 to 0.5 psi.	Same as standard	Same as standard
c. Isolation				
→ **(1)** Cross Polarization	AL 6000.20A Para 57	30db Min. (operational) 35 db Min. (antenna only -site acceptance tests-)	Same as standard Same as standard	Same as standard Same as standard
(2) TX port to RX port *	AL 6000.20A App B IV	30db Min.	Same as standard	Same as standard
d. VSWR for antenna and feedlines	AL 6000.20A Para 59	1.5:1 Max.	Same as standard	Same as standard
32. UP CONVERTERS/ PAs/ LNA/DOWN CONVERTERS				
a. Up Converters				
(1) IF input frequency	AL 6000.20 Para 61	50 - 90 MHz, 70 MHz nominal	Same as standard	Same as standard
(2) IF input level	AL 6000.20 Para 61	-30 to -5 dbm, -25 dbm nominal	Same as standard	Same as standard
→**(3)** TX Frequency	AL 6000.20 Para 61, (Para 60 onsite)	5925 – 6425 MHz	+/- 600 Hz	+/- 4.5 kHz (90 days)
(4) Gain Flatness	AL 6000.20 Para 61	2.5 db/500 MHz , +/- 1.0 db/36 MHz	Same as standard	Same as standard
(5) Gain Slope	AL 6000.20 Para 61	0.1 db/MHz (typical)	Same as standard	Same as standard

Parameter	Reference Paragraph	Standard	Tolerance/Limit	
			Initial	Operating
(6) Phase Noise (measured off-set from carrier)	AL 6000.20 Para 61			
(a) .1 kHz		-60 dbc/Hz	Same as standard	Same as standard
(b) 1 kHz		-70 dbc/Hz	Same as standard	Same as standard
(c) 10 kHz		-80 dbc/Hz	Same as standard	Same as standard
(7) Spurious Output (max)	Equipment manual	Terminal RF receive band: -130 dbw	Same as standard	Same as standard
		2^{nd} harmonic: -100 dbw	Same as standard	Same as standard
		3^{rd} harmonic: -120 dbw	Same as standard	Same as standard
b. Power Amplifiers (SSPA's)				
(1) Bandwidth	AL 6000.20A Para 62	500 MHz	Same as standard	Same as standard
→**(2)** Saturated Power Output	AL 6000.20A Para 62			
(a) 20 W amplifier		+ 43 dbm	Same as standard	Same as standard
(b) 30 W amplifier		+ 44.8 dbm	Same as standard	Same as standard
(c) 50 W amplifier		+ 46 dbm	Same as standard	Same as standard
(d) 150 W amplifier		+ 51 dbm	Same as standard	Same as standard
(e) 200 W amplifier		+ 53 dbm	Same as standard	Same as standard
(3) Maximum Power Out	AL 6000.20A Para 62	Saturation -3 db	Same as standard	Same as standard
(4) Output Power Monitoring	AL 6000.20A Para 62	Coupled port -40 dbc (typical)	Same as standard	Same as standard
(5) Intermodulation w/2 Equal Carriers	AL 6000.20A Para 63			
(a) Saturation		C/I = -9 dbc	Same as standard	Same as standard
(b) 7 db below saturation		C/I = -16 dbc	Same as standard	Same as standard
(c) 14 db below saturation		C/I = -27 dbc	Same as standard	Same as standard
c. Low Noise Amplifier				
(1) Gain	AL 6000.20A Para 64	60 db min	Same as standard	Same as standard
(2) Gain Flatness	AL 6000.20A Para 64	+/- 0.5 db	Same as standard	Same as standard
(3) Current	AL 6000.20A Para 64	120 mA nominal	Same as standard	110 to 320 mA

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
d. Down Converters				
(1) RF Bandwidth	AL 6000.20A Para 65	500MHz	Same as standard	Same as standard
(2) Output Frequency	AL 6000.20A Para 65	50-90 MHz	Same as standard	Same as standard
(3) Output Level	AL 6000.20A Para 65	30 to -60 dbm, -40 typical	Same as standard	Same as standard
(4) Gain Slope	AL 6000.20A Para 65	0.1 db/MHz	Same as standard	Same as standard
(5) Gain Flatness	AL 6000.20A Para 65	2 db max	Same as standard	Same as standard
(6) Phase Noise (measured offset from carrier)				
(a) 0.1 kHz	AL 6000.20A Para 65	-60 dbc/Hz	Same as standard	Same as standard
(b) 1 kHz		-70 dbc/Hz	Same as standard	Same as standard
→**(c)** 10 kHz		-80 dbc/Hz	Same as standard	Same as standard
(7) Spurious Response	Equipment Manual	<-50 dbm/4 kHz @ IF output	Same as standard	Same as standard
33. MODEMS				
a. Frequency Synthesizer				
→**(1)** Output Stability	Equipment Manual	1×10^{-6}	Same as standard	Same as standard
(2) Spurious Output	Equipment Manual	-40 dbc in-band -35 dbc out of band	Same as standard Same as standard	Same as standard Same as standard
b. Modulator				
(1) Output Level	Equipment Manual	-5 to -30 db -18 db (typical)	Same as standard	Same as standard
(2) Level Stability	Equipment Manual	+/- 0.5 db	Same as standard	Same as standard
→**(3)** IF Output Frequency Range	Equipment Manual	50 MHz – 90 MHz	Same as standard	Same as standard
(4) Frequency Stability	Equipment Manual	+/- 10 ppm, (+/-.001 %)	Same as standard	Same as standard
(5) Spurious Outputs	Equipment Manual	-50 dbc (50 – 90 MHz) in band -50 dbc out of band -60 dbc harmonics	Same as standard Same as standard Same as standard	Same as standard Same as standard Same as standard
c. Demodulator				
(1) Input Level	Equipment Manual	-30 to -60 db	Same as standard	Same as standard
(2) Acquisition Range	Equipment Manual	+/- 25 kHz	Same as standard	Same as standard

Parameter	*Reference Paragraph*	*Standard*	*Tolerance/Limit*	
			Initial	*Operating*
→d. Bit Error Rate	AL 6000.20A Para 66	1 x 10^{-5} error rate	Same as standard	Same as standard
e. Modem Redundant Switch	AL 6000.20A Para 66	< 20 seconds for modem switching and lockup	Same as standard	Same as standard
→**f.** Modem Eb/No	AL 6000.20A Para 73			
(1) 300/A		12.0 db +/- 2.0 db	Same as standard	Same as standard
(2) 650B		9.0 db to 9.7 db	Same as standard	Same as standard
34. MUMTIPLEXER				
a. Data Transmission Rates				
(1) Synchronous	Equipment Manual	1200 bps to 1,544 Mbps	Same as standard	Same as standard
(2) Asynchronous	Equipment Manual	300 bps to 19.2 kbps	Same as standard	Same as standard
(3) Voice Transmission Rate	Equipment Manual	16K bps to 64 kbps	Same as standard	Same as standard
(a) CELP		9.6 kbps	Same as standard	Same as standard
(b) VLBRV		9.6 kbps	Same as standard	Same as standard
35. CIRCUIT INTEGRITY				
→**a.** Redundancy Switching	AL 6000.20A Para 68	< 30 seconds maximum, 20 seconds average	Same as standard	Same as standard
b. Phase and gain hits inter-modulation test	AL 6000.22	Chapter 3	Same as standard	Same as standard
c. Digital Channels **NOTE:** Evaluates 1.44Mbs or more.	AL 6000.20A Para 70	Zero errors for five minutes at 4.8 kbps or faster data rate	Same as standard	Same as standard
		Zero errors for 10 minutes at 2.4 kbps	Same as standard	Same as standard
		Zero errors for 20 minutes at 1.2 kbps	Same as standard	Same as standard
		Zero errors for 80 minutes at 300 bps	Same as standard	Same as standard
36. LINK INTEGRITY				
a. RF carrier to noise floor ratio. (down link view at NOCC)	AL 6000.20A Para 72			
(1) Hub transmits.		20 db +/- 2db	Same as standard	As determined in link budget handbook
(2) Remote transmits.		14 db +/- 2 db	Same as standard	As determined in link budget handbook

CHAPTER 4. PERIODIC MAINTENANCE

37. GENERAL

a. This chapter establishes all the maintenance activities that are required for the ANICS system on a periodic basis, and the schedules for their accomplishment. It is divided into three sections. The first section identifies the on site performance checks (i.e., tests, measurements, and observations) of normal operating controls and functions, which are necessary to determine whether operation is within established tolerances/limits. The second section identifies the remote maintenance and various routine duties required to maintain the ANICS system on a day-to-day basis. The third section identifies tasks to be performed on an as-required basis, prevent deterioration and/or ensure reliable operation.

b. The activities and schedules listed below are intended to provide only the minimum maintenance required keeping the equipment in a satisfactory operating condition. Under some conditions, additional maintenance may be required. The schedules reflect the maximum permissible intervals between successive accomplishments to ensure that the performance of the equipment is reliable and within tolerance.

c. ALL on-site maintenance **SHALL** be coordinated through the NOCC prior to beginning work.

Section 1. ON-SITE MAINTENANCE CHECKS (All Sites)

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
38. ANTENNA SYSTEMS - ANNUAL		
a. All Sites		
(1) Corrosion control.	N/A	Equipment Manual
(2) Azimuth and elevation jack screws. Perform lubrication service.	N/A	Equipment Manual
(3) Deicer. Verify operation within specified temperature range.	31	54
(4) Feed horn fasteners. Inspect and verify torque values if necessary.	N/A	Equipment Manual
(5) Feed horn mylar/plexiglass. Inspect for damage and moisture.	N/A	Equipment Manual
(6) Azimuth/elevation resolvers and limit switches. Inspect and verify proper operation and stop limits.	N/A	Equipment Manual
(7) Antenna in- and out-door controllers.		
(a) Inspect and test 3-phase controllers.	N/A	Equipment Manual
(b) Test local and remote positioning.	N/A	Equipment Manual

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
b. Hubs only.		
(1) Waveguide pressurization. Inspect and verify proper operation.	31	55
(2) Tracking and control test. Inspect and verify proper tracking operation.	31	58
39. CABLES AND CONNECTORS - ANNUAL		
a. Perform Anristsu cable tests on all IF and RF signal paths.	N/A	59
b. Perform insulation and DC resistance tests.	N/A	Order 6580.5
c. Inspect for moisture and corrosion damage.	N/A	Order 6950.22
d. Inspect for loose connections.	N/A	Order 6950.22
e. Inspect/replace labeling.	N/A	Order 6950.22
40. RF EQUIPMENT - ANNUAL		
a. All Sites.		
(1) Solid state power amplifiers. Inspect and verify proper fan operation.	N/A	Equipment Manual
(2) Up converter frequency. Measure up converter output frequency.	32	60
b. VertexRSI (Maxtech) SSPA's. Verify configuration settings with NOCC.	N/A	Link Budget Handbook
c. Hubs only.		
(1) Verify in service/standby configuration with NOCC.	N/A	N/A
(2) Verify up and down converter configuration settings with NOCC.	N/A	Link Budget Handbook
41. IF EQUIPMENT - ANNUAL		
a. All Sites.		
(1) Inspect modem blowers for proper operation.	N/A	Equipment Manual
(2) Clean blower filters.	N/A	Equipment Manual
(3) Replace modem memory battery.	N/A	Equipment Manual
b. Hubs only. - Replace modem switch battery.	N/A	Equipment Manual

Performance Checks	*Reference Paragraph*	
	Standards and Tolerances	*Maintenance Procedures*
42. MULTIPEXER - SEMI-ANNUAL		
a. Inspect and clean filters.	N/A	Equipment Manual
b. Check blower and rack fans.	N/A	Equipment Manual
43. ANICS DEMARCATION POINT (ADP) - ANNUAL		
a. RJ-11 connectors.		
(1) Inspect for dust and corrosion and clean as necessary.	N/A	Order 6950.22
(2) Verify proper operation.	N/A	Order 6950.22
b. Orderwire. Test and verify proper operation where applicable.	N/A	Equipment Manual
44. ENGINE GENERATORS - Sites with separate ANICS Engine Generators. - Refer to 6980.11C Section 2, Subsection 1, for all engine generator maintenance.	N/A	Order 6980.11C
45. UNUNTERRUPTIBLE POWER SUPPLY – Remote Sites		
a. QUARTERLY - Perform checks listed in 6980.29A paragraph 407.	N/A	Order 6980.29A
b. ANNUAL		
(1) Perform system alignment.	N/A	75
(2) Perform checks listed in 6980.29A paragraph 409.	N/A	Order 6980.29A
46. SUPERVISORY CONTROL AND DATA AQUISITION (SCADA) - ANNUAL		
a. Inspect and verify connections.	N/A	Equipment Manual
b. Test and verify proper operation.	N/A	76
47. MEBS AND RADOMES - ANNUAL		
a. Inspect for corrosion and clean as necessary.	N/A	Order 6930.25A
b. Inspect for penetrations (leaks) and repair as necessary.	N/A	Order 6930.25A
c. Inspect interior and exterior cabling and repair as necessary.	N/A	Order 6950.22
d. Replace fire alarm battery.	N/A	Equipment Manual
e. HVAC		
(1) Inspect and test fans and repair as necessary.	N/A	74
(2) Inspect for corrosion and clean as necessary.	N/A	Order 6970.3A
(3) Clean or replace filters.	N/A	Order 6970.3A

Section 2. NOCC MAINTENANCE ACTIVITIES

Performance Checks	Reference Paragraph	
	Standards and Tolerances	*Maintenance Procedures*
48. NOCC OPERATIONS		
a. DAILY AS REQUIRED		
(1) System monitoring. Perform 24/7 system monitoring, adjustments and remote troubleshooting as required to maintain system operation.	N/A	NOCC Handbook
(2) Script management. Perform and verify operational scripting.	N/A	SPS Handbook
(3) Database management. Perform database administration.	N/A	SPS Handbook
(4) System administration. Perform system administration.	N/A	SPS Handbook
(5) Network administration/security. Perform network administration and security verification.	N/A	SPS Handbook
b. REOCCURING AS REQUIRED		
(1) Link budget management. Perform link budget management.	36	71, 72 & 73
(2) Equipment replacement. Perform equipment configuration and verification with SSPA, converter, modem and LNA equipment replacement.	N/A	NOCC Handbook
(3) Coordinate circuit cutover and removal activities.	N/A	NOCC Handbook
(4) A/B switching for individual circuits. Perform A/B switching.	N/A	NOCC Handbook
(5) Multiplexer monitoring, control, and configuration.		
1 Perform multiplexer switching.	N/A	NOCC Handbook
2 Perform multiplexer bandwidth management.	N/A	NOCC Handbook
3 Change aggregate data rates.	N/A	NOCC Handbook
4 Create and remove circuit connectivity between nodes, per circuit orders.	N/A	NOCC Handbook
5 Perform alarms backups.	N/A	NOCC Handbook
6 Perform configuration backups.	N/A	NOCC Handbook
7 Manage TMS.	N/A	NOCC Handbook
(6) Modem configuration and switching.		
1 Control and configure modems.	N/A	NOCC Handbook
2 Control redundant modem switching.	N/A	NOCC Handbook
(7) RF output parameter management and weather compensation. (Link integrity)	N/A	NOCC Handbook

Performance Checks	Reference Paragraph	
	Standards and Tolerances	*Maintenance Procedures*
(8) Antenna management and control.		
1 Perform antenna deicing.	N/A	NOCC Handbook
2 Perform antenna positioning.	N/A	NOCC Handbook
(9) Perform antenna polarization.	31	NOCC Handbook
(10) Link switching. Perform link switching.	N/A	NOCC Handbook
(11) RF interference management. Perform RF interference management.	N/A	NOCC Handbook
(12) Space configuration management. Perform configuration management.	N/A	NOCC Handbook
(13) UPS and generator. Perform UPS and generator monitoring and control.	N/A	NOCC Handbook

Section 3. AS REQUIRED MAINTENANCE CHECKS

Performance Checks	Reference Paragraph	
	Standards and Tolerances	*Maintenance Procedures*
49. ANTENNA SYSYEM - PARABOLIC DISH		
a. Cross polarization. Test and adjust as needed for proper operation.	31	57
b. Check torque values on all antenna fasteners.	N/A	Equipment Manual
50. RF EQUIPMENT		
a. UP CONVERTERS **-** Perform up converter tests.	32	61
b. SSPA’S		
(1) Perform power amplifier tests.	32	62
(2) Perform power amplifier intermodulation tests.	32	63
c. LNA **-** Perform LNA tests.	32	64
d. DOWN CONVERTER **-** Perform down converter tests.	32	65
51. IF EQUIPMENT -MODEMS		
a. Modem bit error rate test (BERT).	33	66
b. Modem redundancy switch test.	33	68
52. ANICS DEMARCATION POINT (ADP) - CIRCUIT INTEGRITY		
a. Phase and gain hits intermodulation test.	35	69
b. Digital grade channel test.	35	70

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CHAPTER 5. MAINTENANCE PROCEDURES

Section 1. INTRODUCTION

53. GENERAL. This chapter establishes the procedures for accomplishing the essential maintenance activities not specifically cited in manufacturer manuals and handbooks. The ANICS network is a commercial off the shelf (COTS) system and contains a wide array of equipment manufactured by various vendors. When available, refer to the operators or equipment manual to the fullest extent possible. The primary goal of this chapter is to describe procedures involving performance measurements for the system overall with emphasis placed on individual components where required. This chapter is organized by functional area and divided into sections titled radio frequency equipment, modem equipment, antennas, baseband equipment and general.

Section 2. ANTENNA EQUIPMENT

54. SATELLITE ANTENNA DEICING TEST.

a. Objective. This procedure verifies that the antenna deicing system is fully functional and in compliance with the reference standards.

b. Discussion. The procedure will exercise the automatic and manual mode of operation. Manual operation will simply activate the system and verify that the heating elements are activated. Automatic operation will involve simulating the ice detector sensor and verifying operation of the elements.

c. Test Equipment. Canned cold spray.

d. Conditions. Normally operating facility.

e. Detailed Procedures.

(1) At the deicing unit controller, activate manual operation and turn the deicing elements on.

(2) At the antenna, verify that the heating element device is providing heat. On forced hot air systems, check to see that the blowers are providing warm air. On electric resistive strip heater systems, observe the antenna for indications (melting snow, ice, or frost) that the heaters are working. You may also feel the surface of the antenna to see if warm spots can be detected. If warm spots can't be felt (because of ambient temperature, moisture, snow, or ice), measure the current in the wires feeding the strip heaters with a clamp-on ammeter to be sure that power is being supplied to the heater strips.

(3) At the deicing unit controller, turn the elements off and select automatic operation.

(4) At the deicing system sensor, simulate an icing condition. This may be done by the most convenient method, i.e., using cold spray application into sensor assembly or disconnecting the sensor cable and providing the ground or contact closure as required by the particular system. Heater operations require the presence of water in the sensor cup in conjunction with cold spray applied to the sensor body.

(5) At the antenna, verify that the heating element device is providing heat. At the controller, verify the proper alarm indication.

(6) Remove ice simulation.

(7) Return station equipment to its operational configuration.

55. SATELLITE ANTENNA FEED PRESSURIZATION TEST (HUBS ONLY).

a. Objective. This procedure verifies that feed and waveguide pressurization is sufficient to maintain positive pressure at all sites with 11-meter antennas. The waveguide dew point must be maintained at less than the lowest expected outside ambient temperature. The pressurization system must supply a failure alarm.

b. Discussion. The basic approach for this test is to monitor the pressure at the dehydrator. Bleed the dehydrator and verify the alarm condition with the NMCS.

c. Conditions. Normally operating facility.

d. Detailed. Procedures.

(1) Ensure dehydrator is in proper working order and that 0.25 to 0.5 psi. pressurization is achieved and maintained. View dehydrator display.

(2) Verify no pressure alarms on the HMC.

(3) Bleed the dehydrator by removing hose at the waveguide transition above the RF rack until pressurization falls below .25 psi.

(4) Verify the HMC receives a low waveguide pressure alarm. Verify alarm with the NOCC.

(5) Upon verification of the alarm, reconnect the dehydrator hose and re-establish proper pressurization. The alarm in the HMC must clear. Verify the alarm clears with the NOCC.

(6) Ensure station equipment is returned to its operational status.

56. BORESIGHT ANTENNA POSITIONING.

a. Object. This procedure describes the steps necessary to place an antenna on the satellite from an undetermined start point.

b. Discussion. The antenna controllers store the coordinates of the satellites and the current position of the antenna. If this information is lost or becomes unusable for any reason, the antenna must be put back on the satellite manually. Several different methods of accomplishing this task are included.

c. Test Equipment.

(1) Inclinometer.

(2) Compass.

(3) Look angle for site.

(4) Spectrum analyzer with 4 GHz range.

(5) DC Block and ‘N’ type tee (for Vitacom LNA’s only).

d. Conditions. Reduced service outage on the affected links.

e. Detailed Procedures.

CAUTION: Ensure the transmit *RF power* is turned off and the transmit hairpin is removed *before* moving the dish!

(1) ROUGH ANTENNA POSITIONING.

(a) Use a compass to position the antenna in azimuth plane.

1 Align using the feed can and center seam from the front.

2 Compass reading is look angle +180 degrees.

3 Look angle and elevation can be found in the site FRDF, obtained from the NOCC or link budget.

(b) Use inclinometer to set elevation.

1 Center Feed Antennas.

aa. Set the inclinometer on top of the hub behind the dish.

bb. Adjust to the look angle as published.

2 Offset Antennas.

aa. Set the inclinometer on a flat part of the feed boom and adjust the dish to the published look angle.

bb. Lower the dish till you see the satellite, at approximately look angle – 6 degrees (see spectrum analyzer setup in 'Peaking up AZ and EL' steps 1 and 2).

(2) PEAKING THE ANTENNA.

(a) Using a DC block (for Vitacom LNA's), view the receive signal between the LNA and the down converter.

1 Insert an 'N' type tee in the receive line between the LNA and down converter.

2 Connect the DC block to the 3rd port of the tee and the spectrum analyzer to the DC block (see figure 4).

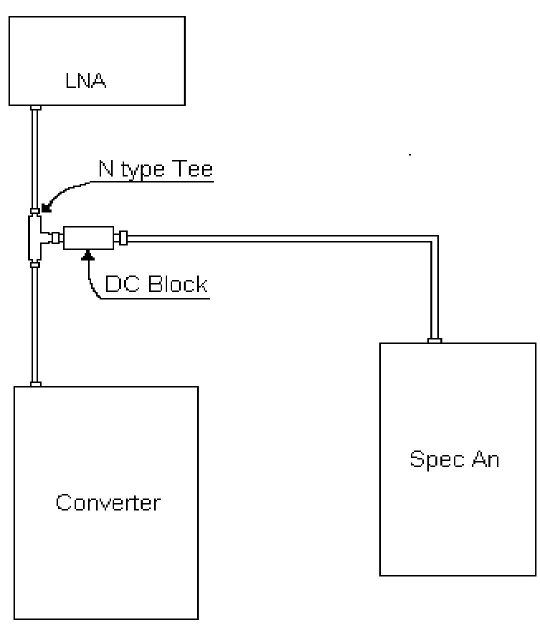

Figure 4. DC Block configuration

CAUTION: DC voltage greater than 1 volt on the input of the spectrum analyzer will damage the front end of the spectrum analyzer. Use of the DC block is imperative when spectrum analyzer is used between the LNA and Converter!

NOTE: The DC block can be inserted either way: however, the center pin on end labeled LNA is connected to the wire terminals on the side of the block and the –15 vdc will be present on them if LNA end is connected to the tee.

(b) Use the following spectrum analyzer settings to view the satellite.

1 Frequency:

aa. Primary 3840.

bb. Alternate 4060.

2 Amplitude Ref Lvl -80 db.

3 Amplitude scale 5 db/div.

4 Span 500 Mhz.

5 Res B/W auto.

6 Vid B/W auto.

7 Sweep on auto (Note: should be around 10 sec).

(c) Several transponders should be visible (not to be confused with several carriers!).

(d) To refine the antenna position, you need to also refine your view of the satellite. There are two beacons on each satellite, one at 3700.5 MHz and the other at 4199.5 MHz.

(e) Set the spectrum analyzer to view the appropriate beacon as follows:

1 Frequency:

aa. Primary 4199.5.

bb. Alternate 3700.5.

2 Amplitude Ref Lvl -80 db (adjust as required to view noise floor).

3 Amplitude scale 2 db/div.

4 Span 150 KHz.

5 Res B/W 10 KHz.

6 Vid B/W 30 HZ.

7 Sweep time 2 sec.

8 Display Line to ‘On’ and set to peak of beacon.

(f) Peak up the dish using the jogging switches on the in or outdoor controller. Adjust the display line as necessary. Remember to allow time for the antenna movement between jogs.

(g) Adjust both azimuth and elevation twice, alternately, in this manner for max peak.

(h) Record the final position info in the FRDF and save it in the antenna controller. Also mark the azimuth and elevation pivot points on the dish itself also. (Note: This has already been marked on most Phase I sites.)

(3) ALTERNATE SPECTRUM ANALYZER VIEW.

(a) Use above set up procedures steps 56 (2) (a) through (d).

(b) Set the spectrum analyzer to view the appropriate beacon as follows:

1 Frequency:

aa Primary 4199.5.

bb Alternate 3700.5.

2 Amplitude Ref Lvl -80 db (adjust as required to view noise floor).

3 Amplitude scale 1 db/div.

4 Res B/W 10 KHz.

5 Vid B/W 30 Hz.

6 Sweep time 40 sec.

7 Span ‘Span Zero’.

(c) Center the beacon and put the marker at the peak, (with the span set to Span Zero, the signal displayed is almost a flat line that represents signal level at the point of the marker).

(d) Peak up the dish using the jogging switches on the outdoor controller. Move the antenna only in small increments.

(e) Adjust both azimuth and elevation twice, alternately, in this manner for max peak.

(f) Record the final position info in the FRDF and save it in the antenna controller. Also mark the azimuth and elevation pivot points on the dish itself also. (Note: This has already been marked on most Phase I sites.)

(4) PEAKING ANTENNA USING RECEIVE IF SIGNAL.

CAUTION: Ensure the TRANSMIT *RF power* is turned off and the TRANSMIT hairpin is removed *before* moving the dish!

NOTE: This procedure allows antenna to be peaked in the azimuth and elevation axis from inside the building. Contact the NOCC prior to using this method to have them put their modem in CW mode.

(a) Insert a tee at the appropriate receive input to the IF panel or modem. The signal here is ‘video’ (~70 Mhz).

(b) Connect the spectrum analyzer to the 3rd port of the tee (see figure 5).

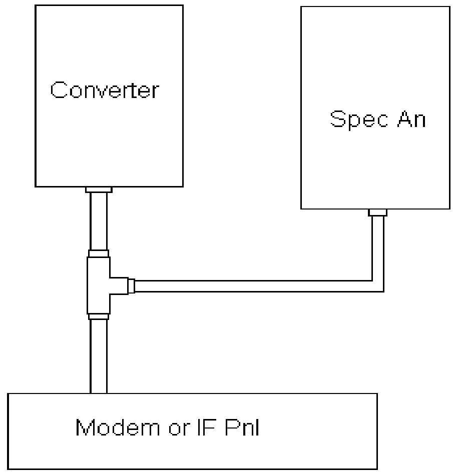

Figure 5. Antenna positioning using RX IF

(c) Set up the spectrum analyzer as follows:

1 Frequency assigned modem frequency.

2 Amplitude Ref Lvl -60 db (adjust as required to view noise floor).

3 Amplitude scale 4 db/div.

4 Span 200 khz.

5 Res B/W 10 kHz.

6 Vid B/W 30 Hz.

7 Sweep time 2 sec.

8 Display Line to On and set to peak of modem CW.

(d) Peak up the dish using the jogging switches on the indoor controller. Adjust the display line as necessary. Remember to allow time for the antenna movement between jogs.

(e) Adjust both azimuth and elevation twice, alternately, in this manner for max peak.

(f) Record the final position info in the FRDF and save it in the antenna controller. Also mark the azimuth and elevation pivot points on the dish itself. (Note: This has already been marked on most Phase I sites.)

57. SATELLITE ANTENNA CROSS-POLARIZATION ISOLATION TEST

a. Objective. The cross-polarization check is to ensure that the antenna feed is properly polarized to transmit and receive maximum signal to the satellite. It also ensures no signal is transmitted that will interfere with the transponder of the same frequency on the opposite polarization. This procedure measures linear cross-polarization isolation of the site under test and adjusts the polarization such that the cross-polarized signal is at a value acceptable for transmission on the satellite.

b. Discussion. This procedure is done at the LNA/converter connection because the converter removes the signal from the two satellite beacons. The best case adjustments are made by minimizing the opposite polarity beacon while viewing the downlink. Same polarity beacon can be maximized; however, this method is not as precise.

c. DO NOT use the site transmit carriers to adjust cross polarization. This adjustment is made using receive signals only.

d. Test Equipment required.

(1) Spectrum analyzer.

(2) DC block.

e. Conditions. Reduced service outage on affected links.

f. Detailed Procedure.

CAUTION: Ensure the transmit *RF power* is turned off and the transmit hair pin is removed *before* proceeding.

(1) Using a DC block, view the receive signal between the LNA and the down converter.

(2) Insert an 'N' type tee in the receive line between the LNA and down converter.

(3) Connect the DC block to the 3rd port of the tee and the spectrum analyzer to the DC block (see figure 6).

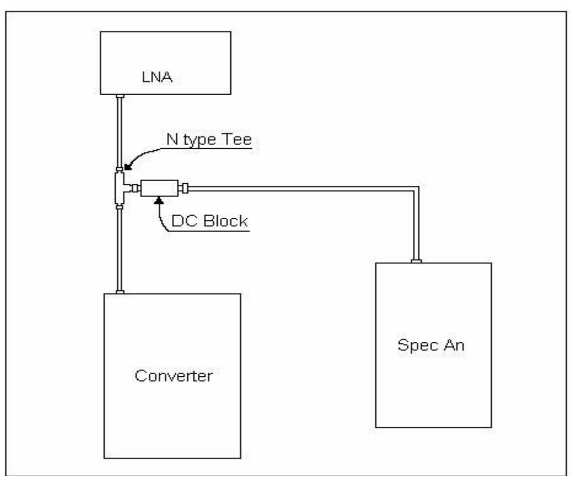

Figure 6. DC Block configuration

CAUTION: DC voltage greater than 1 volt on the input of the Spectrum analyzer will damage the front end of the Spectrum analyzer. Use of the DC block is imperative when Spectrum analyzer is used between the LNA and Converter!

NOTE: The DC block can be inserted either way; however, the center pin on end labeled LNA is connected to the wire terminals on the side of the block and the –15 vdc will be present on them if LNA end is connected to the tee.

(4) Use the following spectrum analyzer settings to view the satellite.

(a) Frequency: NOTE that the frequencies are reversed from azimuth and elevation peak procedure.

1 3700.5 for Primary.

2 4199.5 for Alternate.

(b) Amp Ref Lvl -75 (Adjust as required to view noise floor).

(c) Amplitude scale 1 db/div.

(d) Span 150 khz.

(e) Res B/W 10 kHz.

(f) Vid B/W 30 Hz.

(g) Sweep 2 sec.

(5) The beacon on the opposite polarity should now be visible if the antenna is not fully aligned for the correct polarity. If no signal is visible, you can verify your setup by selecting the opposite beacon. It should be approximately 10+db on the 3.6 dishes.

(6) If adjustment is necessary, set Amplitude Scale to 1 db/div and center the beacon. Now set Span to 'Span Zero' and Sweep to 40 sec.

(7) Drive Pol Feed 2 to minimum. Check the minimum by driving past and coming back to it.

(8) Verify the minimum level meets standards and tolerances in paragraph 31c(1).

(9) Disconnect test equipment, return site to operational status.

(10) This test may also be performed using a CW signal from ZAN and rotating the feed to obtain a maximum and a null.

58. SATELLITE ANTENNA TRACKING AND CONTROL TEST.

a. Objective. This procedure verifies that remote control of the antenna is possible via the antenna controller and demonstrates precise movement to a given position or satellite. In addition, the ability of the hub station antenna to perform step-track (auto-track) maneuvers will be shown. This tracking ability will ensure that the antenna is properly aimed at the satellite at regular intervals to ensure maximum signal level.

b. Discussion. First, the ability of the antennas to be moved in azimuth, elevation, and polarization will be tested. This can be done directly from the front panel of the antenna controller. Second, the ability of the antennas to be moved to a particular location and satellite remotely by the NOCC and by entering a value with the numeric keypad will be demonstrated. Finally, the auto-tracking ability of the antenna system at the hub sites will be demonstrated by moving the antenna off of its current position and allowing the tracking system to bring the antenna back to an optimized position based on the level of the satellite beacon.

c. Test Equipment. Spectrum analyzer.

d. Conditions. Reduced service outage on affected links.

e. Detailed Procedures.

(1) Enter the menu on the antenna controller that allows moving of the antenna in azimuth. Verify that movement in both the "up" and "down" directions is possible.

(2) Enter the menu on the antenna controller that allows moving of the antenna in elevation. Verify that movement in both the "up" and "down" directions is possible.

(3) Enter the menu on the antenna controller that allows moving of the polarization angle of the feed. Verify that movement in both the "up" and "down" positions is possible.

(4) Enter the "AZ" menu on the antenna controller from the main menu. Note the current position of the antenna, and subtract 10 degrees from this value. Move the antenna to this new position by entering the value using the numeric keypad. Verify that the antenna moves to this new position

(5) Enter the "EL" menu on the antenna controller from the main menu. Move the antenna to an elevation angle of 35º by entering this value using the numeric keypad. Verify that the antenna moves to the new position.

(6) Enter the "POL" menu on the antenna controller from the main menu. Note the current position of the antenna, and subtract 35º from this value. Move the antenna to this new position by entering the value using the numeric keypad. Verify that the feed moves to the new position.

(7) Using the antenna controller "Move to Satellite" menu, command the antenna to move to another satellite. Verify that the antenna moves to this position by viewing the azimuth and elevation indicators.

(8) Connect a spectrum analyzer to the RF patch panel, or to any other source of direct RF downlink signal.

(9) Command the antenna to move as in step e. (4).

(10) At the antenna controller, command the antenna to the mid-point of the azimuth axis and elevation axis.

(11) At the antenna controller, command the antenna to move to its azimuth limit in either direction.

(12) Observe the antenna and verify that it moves to its azimuth limit in the direction commanded.

(13) At the antenna controller, command the antenna to move its limit in the opposite direction.

(14) Observe the antenna and verify that it moves to its azimuth limit in the direction commanded.

(15) Return the antenna to its mid-azimuth position.

(16) At the antenna controller, command the antenna to move its elevation limit in either direction.

(17) Observe the antenna and verify that it moves to its elevation limit in the direction commanded.

(18) At the antenna controller, command the antenna to move to its limit in the opposite direction.

(19) Observe the antenna and verify that it moves to its elevation limit in the direction commanded.

(20) Return the antenna to its mid-elevation position.

(21) At the antenna controller, command the antenna to move to its polarization limit in either direction.

(22) Verify that the polarization unit is at one of its limit positions.

(23) At the antenna controller, command the polarization unit to move to its limit in the opposite direction.

(24) Observe the polarization unit and verify that it moves to its travel limit in the direction commanded. Return unit to original polarization location after completion of test.

f. AUTO TRACKING - Hub sites only.

(6) Set the spectrum analyzer to view the applicable beacon (either 3700.5 MHz or 4199.5 MHz).

(7) Manually adjust the antenna for peak signal strength on the beacon using the movement controls as described earlier. Record the level of the voltage from the beacon receiver as indicated on the antenna controller. Also record the level of the beacon as indicated on the spectrum analyzer and the azimuth and elevation angle values.

(8) Using the beacon signal level as a guide, move the antenna until the beacon level is reduced by 2 dB from its maximum value.

(9) Initiate “auto track” mode for satellite item 1 using the “no search” option.

(10) When all antenna motion has stopped, record both the level of the beacon as indicated on the spectrum analyzer and the voltage level from the beacon receiver as indicated on the antenna controller. Also record the azimuth and elevation angles. Compare these values to the values obtained in step f. (2).

(11) Repeat steps f. (1) through (5) above for the other antenna system.

(12) Disconnect all test equipment and ensure that no alarms are present on the system status screen.

(13) Return station equipment to operational configuration.

Section 3. RADIO FREQUENCY (RF) EQUIPMENT

59. RF DISTIBUTION SYSTEM VOLTAGE STANDING WAVE RATIO (VSWR) TEST

a. Object. This procedure measures the RF Distribution System’s VSWR. The measured value must be within manufacturer’s specification and engineering link budget allocations. The specification applies to the antenna feed ports. The antenna contribution to the total VSWR is less than 1.3:1. On the transmit side at a hub site, waveguide goes from the feed port to the PA rack. On the transmit side at a remote, a heliax transmission line is connected to the feed. The VSWR of the combination of the waveguide and feed is measured in this procedure. On the receive side, the LNA is connected to the receive port of the feed. There are coaxial components and a heliax cable connected from the output of the LNA to the down converters. The VSWR of these components is measured in this procedure. The overall limit on the measured VSWR of these components is 1.5:1. Perform Anritsu test on the cable.

b. Discussion. The Anritsu Sitemaster 810A measures a cable by sending out a series of short CW pulses between the lower and upper frequencies set by the user. Therefore, the cable is tested at the operating frequencies it is used. The minimum frequency for the 810A is 3.3 GHz and the upper limit is 10.0 GHz. This covers the uplink and downlink frequencies of our C-band RF equipment. The frequency range chosen by the user is divided into 130 steps and a separate pulse is sent on each of these step frequencies.

c. The Sitemaster then measures the amplitude and phase of each echo that comes back. These measurements are displayed on charts which indicate the distance to, and characteristics of, each place in the cable where it is different from a new (undamaged) cable.

d. The accuracy of the measurements depends on having the correct cable characteristics (cable loss and velocity) programmed into the instrument. A list of standard cable types (such as LDF4-50A) is available on the calibration menu. These numbers can also be changed by the user, and saved using the "Save Setup command." Up to 8 setups can be saved.

e. The maximum distance that the Sitemaster will measure depends on the range of frequencies (F2 - F1) that is set by the user. To measure longer cable, you need to use a smaller range of frequencies. A good range of frequencies (F2 - F1) to use might be 1 MHz each side of the operating frequency, so a cable used at 4.0 GHz would be measured from 3.999 to 4.001 GHz. This gives a maximum length measured of 1630 feet. A 40 MHz range (the width of a C-band transponder) will limit your measurements to about 1385 feet.

f. The operating range of the Sitemaster is much higher than our 70-MHz IF frequency, but the instrument is still capable of finding faults in cables used at that frequency. Cables typically perform better at lower frequencies, so our tests will show the cable to be worse than it really is. Anyway, use the lower ranges (around 3.3 GHz).

g. Test Equipment Required. Anritsu Sitemaster 810A.

h. Conditions. Reduced service outage for the affected links.

i. Detailed Procedures.

(1) CALIBRATION - The Sitemaster must be calibrated whenever:

(a) A different extension cable is used, or if use is switched between extension cable and no cable.

(b) The operating frequency is changed. (Instrument will indicate this has happened.)

(c) The operating temperature changes more than 10 degrees C as indicated by the startup screen. (A warning will appear on the screen when this happens.)

(d) A different cable type is tested.

(2) To re-calibrate, do the following:

(a) Turn instrument on and wait 5 minutes for temperature to stabilize.

(b) Select “MODE.”

(c) Select “DTF-SWR.”

(d) Press “ENTER.”

(e) Press “DIST.”

(f) Press “DTF AID.”

(3) The next screen will have several numbers to fill in:

(a) “D1” – The minimum distance to measure (usually zero).

(b) “D2” – The maximum expected distance (use the estimated length of the cable plus a few feet).

(c) “CABLE” – Select your cable type here.

(d) “EXIT – START RECALIBRATION.”

(e) Now press “ENTER.”

(4) Follow the instructions at bottom of screen:

(a) Connect 22N50 open, then press ENTER.

(b) Connect 22N50 short, then press ENTER.

(c) Connect 28N50 load, then press ENTER.

NOTE: This calibration can be saved in memory and will be good unless the temperature changes more than 10 degrees C or different cable type or frequencies are chosen.

(5) OPERATION - To find a cable fault, do the following steps:

(a) Set the mode to DTF-VSWR and select cable length and frequency.

(b) Re-calibrate, if required.

(c) Find the end of the cable by placing the short at the far end (if possible). An open circuit (nothing attached) at the end will work, but it will make finding the end very difficult. Place a screen marker at the end.

(d) Replace the short with the dummy load. Notice that the spike under the marker will get much smaller, but other spikes will remain the same or get larger. The dummy load should be kept at the same temperature (within 10 degrees C) as it was during calibration.

(e) Any spikes seen along the cable between the instrument and the far end will indicate things like connectors, cuts, shorts, moisture, kinks, or other damage.

(f) The height of the spike can be measured by placing a marker on it. The markers will only go to the 130 data points, so peaks could be higher than the nearest data point.

(g) Connectors should typically show a spike of much less than 1.0 on the VSWR scale. Big impedance mismatches will show a VSWR much greater than 1. (Connecting a 75-ohm cable to a 50-ohm cable caused a VSWR spike of 10.0.)

(h) Moisture in the cable could show up as a wide spike, depending on how much cable is wet, but the beginning of the wet area (as seen from the instrument) may mask (hide) the area behind it. Foam filled coax may spread out the moisture like a wick, while other types will accumulate moisture in low spots in the cable.

(i) Small ripples in the plot are caused by "directional effects" (wave interference) and are not cause for concern. These can occur in new cable.

(j) Change the distance settings and <displayed y-range> to zero-in on individual peaks. This can also be done later using the computer software.

60. ON SITE UP CONVERTER FREQUENCY TEST

a. Object. This procedure measures the transmit frequency of the upconverter onsite and verifies it is within the standards and tolerances.

b. Discussion. A frequency counter is used to measure the output frequency of the up converter in the field. A CW signal is fed to the converter from a signal generator or one of the modems (while the other modem is terminated or otherwise removed from the transmit path).

c. Test Equipment Required. Frequency counter capable of counting signals up to 6.175 GHz.

d. Conditions. Reduced service outage for the affected links.

e. Detailed Procedures.

(1) Shut off the modems for the link under test and pull the hairpin connector.

(2) Shut off the up converter and SSPA.

(3) Disconnect the RF "pigtail" between the upconverter and the SSPA.

(4) Connect a counter capable of counting frequencies up to 6.175 GHz to the RF output of the upconverter.

(5) Reapply a/c power to the converter and SSPA.

(6) Turn on one of the modems and place it in CW mode. Set the RF power out to minimum (-30db).

(7) Replace the hairpin and adjust the modem power out for a stable reading on the counter.

(8) Verify the frequency measured by the counter is within the standards and tolerances in paragraph 32a(3).

(9) Return all equipment to normal operating conditions.

61. UP CONVERTER TESTS.

a. Object. These procedures measure the up converter saturation point, max gain, gain flatness, IF bandwidth and phase noise. Specifications for these tests are listed in paragraph 32a.

b. Discussion. A signal generator is utilized to provide RF drive to the up converter. The signal generator is set to sweep the up converter input range of 50 - 90 MHz at the nominal input level. The spectrum analyzer is connected to the up converter output port and the output sweep is observed for proper bandwidth and output level. Results are documented on standard FAA forms.

c. Test Equipment Required.

(1) Sweep signal generator.

(2) Spectrum analyzer, HP 8563E or equivalent.

(3) Step attenuator.

d. Conditions. Reduced service outage for the affected links.

e. Detailed Procedures.

(1) U/C -1 DB GAIN COMPRESSION TEST.

(a) Ensure **RF power** in the up converter is turned **off**. Connect the signal generator RF output to the up converter input. Connect the up converter output to the spectrum analyzer input (see figure 7).

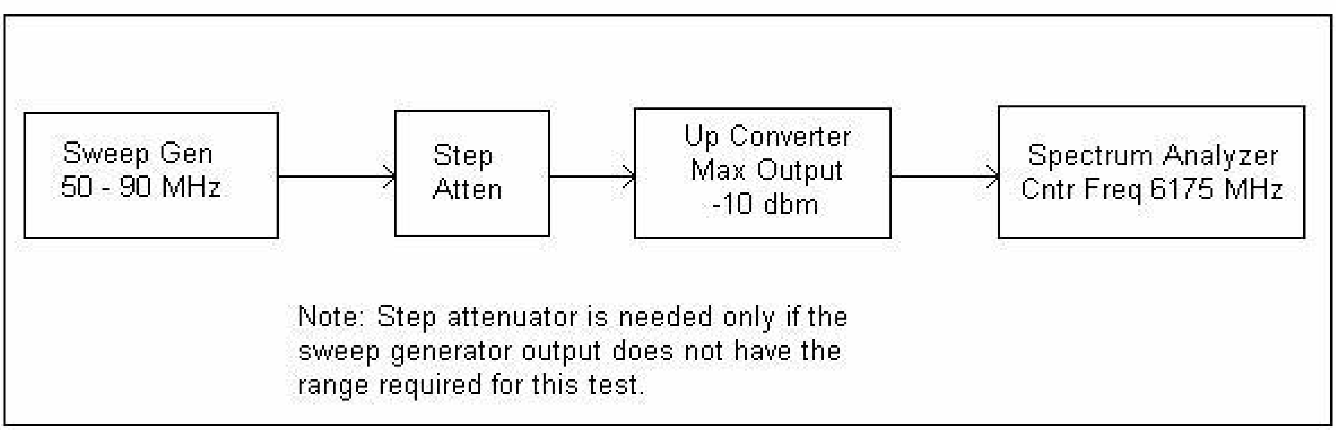

Figure 7. Gain Flatness Test Configuration.

(b) Set up converter **attenuator** to **0 db** and **frequency** to **6175 MHz**.

(c) Set the signal generator to 70 MHz **CW**. Set signal generator level to -60 dBm. Use a step attenuator if necessary.

(d) Turn the up converter RF power out **ON** and observe the spectrum analyzer. Increase the signal generator output until the up converter output reaches its maximum value and stops increasing or -10 dBm, whichever comes first. Note this value is the point of saturation.

(2) U/C GAIN FLATNESS, GAIN SLOPE, and BANDWIDTH TESTS.

(a) Reduce signal generator so up converter **output is approximately -20 dBm**.

(b) Set signal generator to:

1 Center frequency 70 MHz.

2 Delta frequency 36 MHz.

3 Sweep time 75 to 100 sec.

(c) Set the spectrum analyzer as follows:

1 Center frequency 6175 MHz.

2 Span 600 MHz.

3 Res B/W 100 kHz.

4 Vid B/W 100 kHz.

5 Amplitude scale 1 db/div.

6 Sweep time 20 to 100 ms.

(d) Select **Trace** on the spectrum analyzer and then **Max Hold.**

(e) Allow the spectrum analyzer trace to plot the carrier peak across the complete bandwidth.

(f) Print the spectrum analyzer waveform. Verify gain flatness, gain slope, and bandwidth meet standards and tolerances in paragraph 32a.

(3) U/C PHASE NOISE TEST.

(a) Set up the spectrum analyzer.

1 Center frequency 6175 Mhz

2 Span 50 kHz.

3 Res B/W 100 Hz

4 Vid B/W 100 Hz.

5 Amplitude scale 10 db/div.

6 Set spectrum analyzer for video averaging with 10 samples.

(b) Record the level relative to the carrier at 10 kHz offset from the carrier. This is the noise in a 100 Hz bandwidth. The noise in a 1 Hz bandwidth is 20 dB lower than this, so subtract the reading you got to obtain the noise in a 1 Hz bandwidth.

(c) Print the spectrum analyzer display. Verify phase noise meet standards and tolerances in paragraph 32a.

(4) Disconnect all test equipment and return equipment to its operational configuration.

62. SOLID STATE POWER AMPLIFIER TESTS.

a. **Object.** This procedure verifies the SSPA phase noise, gain slope and bandwidth meet specification, and design requirements listed in the reference standards in paragraph 32b.

b. Discussion. For the gain slope and gain flatness measurement, a sweep signal generator is utilized to provide drive to the converter. The signal generator is set to sweep the transmit band in 50 MHz segments at a level sufficient to drive the PA to l0 dB below rated output power. The spectrum analyzer is connected to the directional coupler in the transmit path and a power meter is connected to the PA monitor port. Each sweep is stored and printed. For the phase noise measurements, a stable signal generator in CW mode is connected to the transmitter. The transmitter output is observed on a spectrum analyzer and documented.

c. This carrier will be swept across the complete band of the satellite; therefore, care must be taken to ensure the CW carrier is not transmitted to the satellite. This may be accomplished either by terminating the transmit RF prior to the antenna or moving the antenna off the satellite. To move the antenna, use the Elevation control and shift it to +35 degrees. No satellites are at this elevation as seen from any ANICS sites.

d. Test Equipment Required.

(1) Signal generator.

(2) Spectrum analyzer HP 8563E or equivalent.

(3) Power meter.

e. Conditions.

(1) Reduced service outage on affected links.

(2) Antenna positioned off the satellite + 35 ° or transmit RF terminated prior to the antenna.

f. Detailed Procedures.

(1) PA –1 DB GAIN COMPRESSION TEST.

(a) Connect test equipment (per figure 8). It is not necessary to set the frequency in the SSPA because it works across the whole satellite bandwidth.

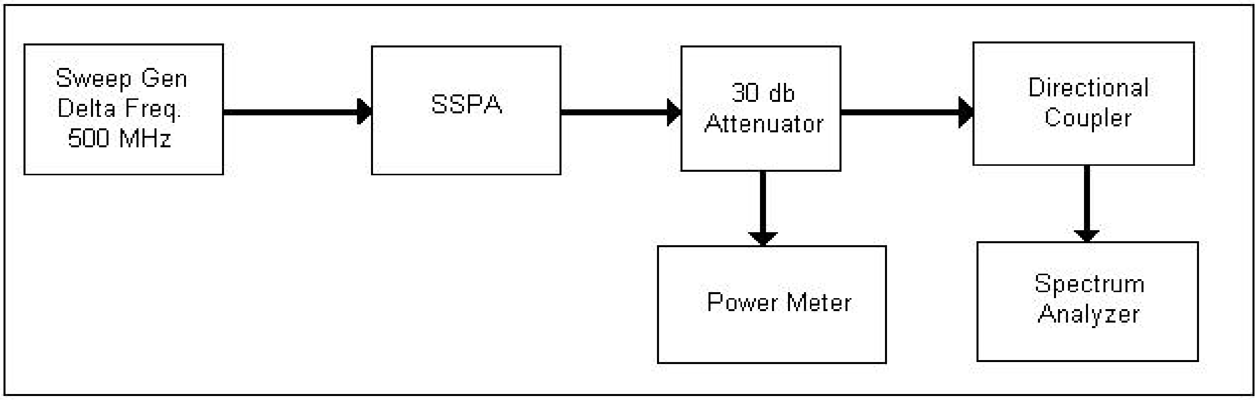

Figure 8. SSPA -1 db Gain Compression Test Configuration.

(b) Calibrate power meter for 6175 MHz. Attach power meter to the 30 db attenuator.

(c) With at least 40 dB in the step attenuator and sweep generator power level at 0 dBm, set the signal generator to generate a CW signal at 70 MHz.

(d) Set PA RF power output ON.

NOTE: Do not drive PA beyond rated power. The attenuator *MUST* be rated for the amount of the power emitted by the SSPA's.

(e) Increase the signal generator drive l dB at a time and observe the power meter. Continue increasing drive until the l dB gain compression point or rated power is reached, whichever comes first (see figure 9).

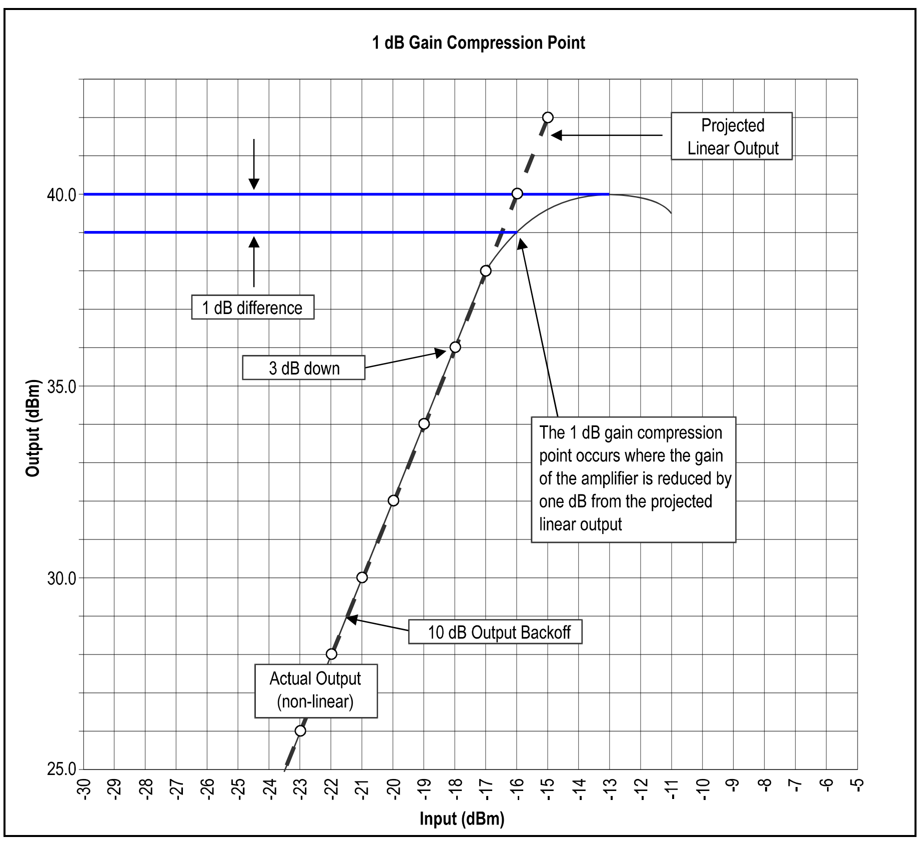

Figure 9. Gain Compression Point

NOTE: The 1 db gain compression point (1 db GCP) is the point on the gain transfer curve where the power level of the input signal causes a 1 db gain compression, that is an output that is reduced 1 db from the linear gain line. The gain compression point is a measure of non-linearity of an amplifier; the higher the input signal power level at the 1 db GCP, the more linear the amplifier.

(f) Note the signal generator level and the PA power out level. Verify this level is within the reference standard, paragraph 32.

(g) Decrease the drive until the PA output level drops l0 dB.

(2) PA GAIN FLATNESS, GAIN SLOPE, and BANDWIDTH TESTS.

(a) Set the sweep generator as follows.

1 Center frequency 6175 MHz.

2 Delta frequency 500 MHz.

3 Sweep time 100 sec.

(b) Connect spectrum analyzer to directional coupler and observe the PA output with the following settings:

1 Center frequency 6175 MHz.

2 Span 600 MHz.

3 Res B/W 100 kHz.

4 Vid B/W 100 kHz.

5 Amplitude scale 1 dB/div.

6 Sweep time 20 ms.

(c) Select Trace on the spectrum analyzer then Max. Hold. Allow the trace to plot the display. Mark the high and low points on the curve using the Marker function of the spectrum analyzer.

(d) Observe the bandwidth of the transmitter output at mid-band (6175 MHz). Verify that it complies with the reference standard paragraph 32b.

(e) Verify that the gain slope and gain flatness requirements are met and repeat steps 62. (2) a. through d. for RF frequencies of 5945 MHz and 6405 MHz.

63. POWER AMPLIFIER INTERMODULATION TEST.

a. **Object.** This procedure ensures that the average power of any intermodulation (IM) products, generated by the transmission of multiple carriers, are not in excess of the reference standards listed below.

b. Discussion. The procedure utilizes an up converter and the PA. Two carrier frequencies are selected (70 MHz and 71 MHz). Using a modem, the RF group is set up to transmit at a frequency of 6175 MHz. A spectrum analyzer is connected to a directional coupler in the path of the uplink signal. A power meter is connected to the PA monitor port. The PA RF power out is turned on and the carrier levels are made equal. PA power is adjusted to saturation, initially (in the following, “saturation” should be interpreted as the 1 dB gain compression point for PAs). PA power is then adjusted to 7 dB below saturation and then to 14 dB below saturation. Intermodulation levels are taken at all three of these PA output power levels. Observe the spectrum analyzer display to be sure that the intermodulation products are in compliance with the reference standards.

c. These CW carriers can cause interference on the satellite, and care must be taken to ensure they are not transmitted to the satellite. This may be accomplished either by terminating the transmit RF prior to the antenna or moving the antenna off the satellite. To move the antenna, use the Elevation control and shift it to +35 degrees. No satellites are at this elevation as seen from any ANICS sites.

d. Test Equipment Required.

(1) Spectrum analyzer.

(2) Power meter.

e. Conditions.

(1) Reduced service outage on affected links.

(2) The antenna **must** be positioned off the satellite + 35 degrees or the transmit RF must be terminated prior to the antenna.

f. Detailed Procedures.

(1) Configure a modem such that it is in "dual mode" (a test mode available with the modem).

(2) Connect the spectrum analyzer to a directional coupler in the path of the uplink signal. This may be either a waveguide or coaxial cross guide coupler. Adjust the spectrum analyzer to an acceptable frequency range to observe the IM products (see figure 10).

(3) Connect a power meter to the monitor port of the PA under test.

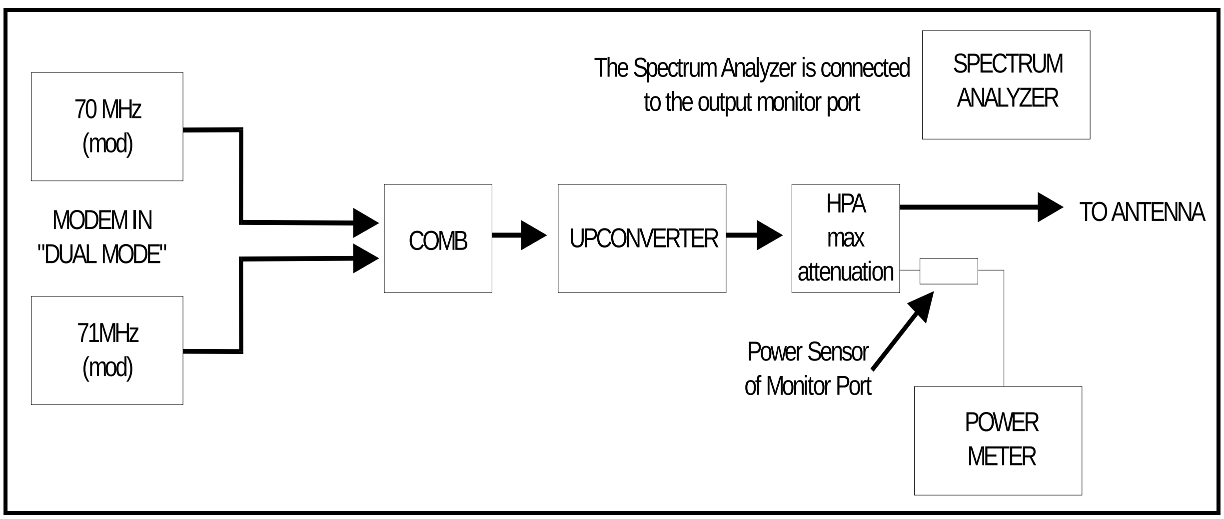

Figure 10. Power Amplifier Intermodulation Test Configuration

(4) Set the up converter frequency to 6175 MHz.

(5) Set the PA RF power out ON and note the levels of the carriers on the spectrum analyzer. If necessary, adjust the power levels of the carriers until the carrier power levels are identical. Carrier power levels are adjusted via the modem.

(6) Increase the output power of the PA until the saturation or rated power is reached, whichever comes first. Monitor the power meter to determine when one of the above conditions is reached. **Should either of these conditions be met, do not increase the power further.**

(7) Measure the levels of the IM products with respect to the carrier and compare to the specification of -9 dBc. Print the resulting spectrum when this test is done as a bench test.

(8) Repeat steps f. (6) and (7) by adjusting the output power of the PA until a level of 7 dB below saturation is reached and compare to the specification of -14 dBc.

(9) Repeat steps f (6) and (7) by adjusting the output power of the PA until a level of 14 dB below saturation is reached and compare to the specification of -27 dBc.

(10) Return the modem to its normal operational configuration.

(11) Disconnect all test equipment and return station equipment to operational configuration.

64. LNA TESTS.

a. Object. This procedure verifies that the RF Receiver System meets specifications and design requirements which are listed in paragraph 52c.

b. Discussion. This procedure is to be performed on the RF receiver subsystem. The spectrum analyzer is connected to the LNA output monitor port. The LNA bandwidth sweeps are documented on standard FAA forms.

c. Test Equipment Required.

(1) Spectrum analyzer.

(2) DC block.

(3) Printer.

d. Conditions. Reduced service outage on the affected links.

e. Detailed Procedures.

(1) Coordinate with the NOCC to schedule a reduced service outage on links to be tested and to ensure all traffic is moved to the links not under test RF power.

(2) At hub sites, disconnect the RF input from the 4-way splitter.

(3) Connect the RF downlink to a spectrum analyzer through a DC block. Set the sweep and the bandwidth of the spectrum analyzer such that about 520 MHz may be seen (3690 MHz to 4210 MHz) and such that the noise floor of the spectrum analyzer is much less than the noise floor of the LNA (see figure 11).

(4) Verify that the entire satellite spectrum is visible. This is a 500 MHz span (3700 MHz to 4200 MHz).

(5) Obtain the gain slope from the tilt of the LNA noise floor.

(6) Record the results.

(7) Disconnect all test equipment and return station equipment to operational configuration.

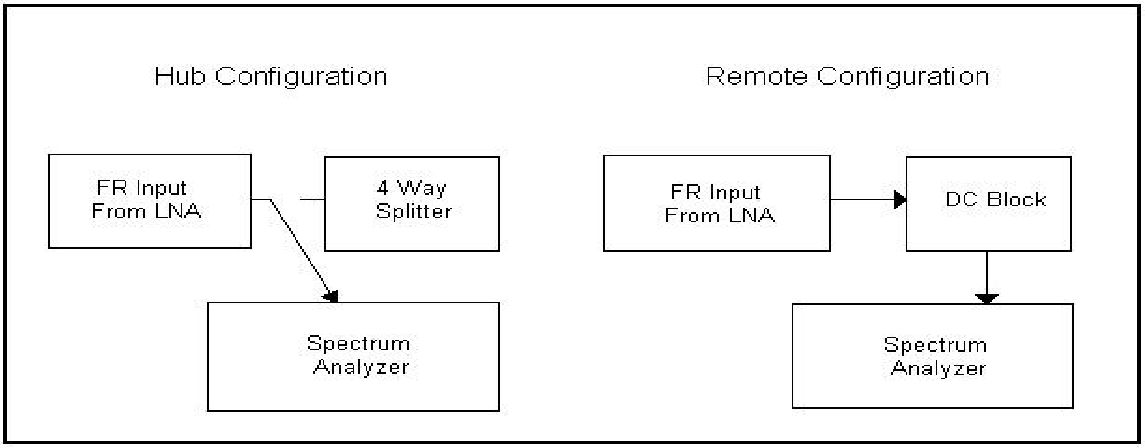

Figure 11. LNA Bandwidth Test Configuration

65. DOWN CONVERTER TESTS.

a. Object. This procedure verifies bandwidth, gain and phase noise characteristics of the down converter.

b. Discussion. Bandwidth, gain flatness and phase noise are the most important parameters of the receive subsystem. As with the transmit subsystem, a sweep generator will be used to check bandwidth and gain flatness and a stable generator will be used to verify the phase noise is within tolerance..

c. Test Equipment.

(1) Stable signal generator.

(2) Sweep generator.

(3) Spectrum analyzer HP 8563E or equivalent.

d. Conditions. Reduced service outage on affected links.

e. Detailed Procedures.

(1) Connect the spectrum analyzer to the down converter output at the IF patch panel with the following settings (see figure 12).

(a) Center frequency 70 MHz.

(b) Span 36 MHz.

(c) Res B/W 10 kHz.

(d) Vid B/W 30 Hz.

(e) Amplitude scale 1 dB/div.

(f) Sweep time 20 ms.

(2) Set the sweep generator as follows and connect it through a DC block to the down converter input (see figure 12).

(a) Center frequency 3950 MHz.

(b) Delta frequency 500 MHz.

(c) Sweep time 75 to 100 sec.

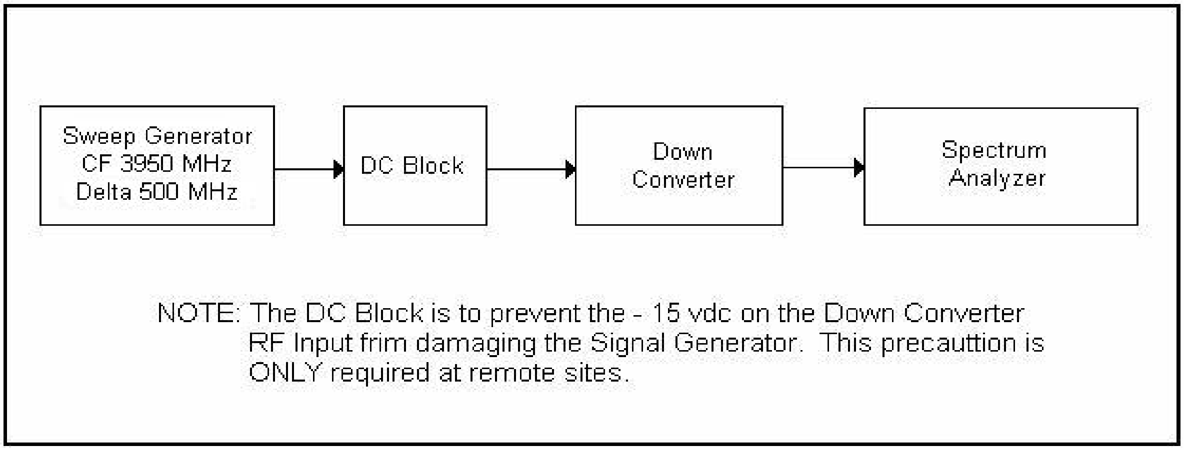

Figure 12. Down Converter Gain and Bandwidth Test Configuration

(3) Select Trace on the spectrum analyzer then Max. Hold. Allow the trace to plot the display. Mark the high and low points on the curve using the Marker function of the spectrum analyzer.

(4) Observe the bandwidth of the transmitter output at mid-band (3950 MHz) Verify that it complies with the reference standard paragraph 32d.

(5) Verify that the gain slope and gain flatness requirements are met. Repeat steps e. (2) through (5) for RF frequencies of 3750 MHz and 4150 MHz.

(6) Connect the stable signal generator though the DC block to the input of the down converter (see figure 13).

(7) Set up the spectrum analyzer as follows:

(a) Center frequency 70 MHz.

(b) Span 20 kHz.

(c) Res B/W 100 Hz.

(d) Vid B/W 100 Hz.

(e) Amplitude scale 10 db/div.

(f) Set spectrum analyzer for video averaging with 10 samples.

(8) Plot the resulting spectrum and note the difference between the signal level and the noise level at 10 KHz offset from the carrier.

(9) Record the level of phase noise (dBc/100 Hz). Subtract 20 db from the measured value. This is the level for db/Hz. Record the value on the data sheet.

(10) Ensure that measured level of phase noise meets the reference standards.

(11) Disconnect all test equipment and return equipment to original configuration.

Section 4. MODEM EQUIPMENT

66. SATELLITE MODEM BIT ERROR RATE TEST.

a. Object. This procedure verifies all hardware on a specific path or link is fully operational and meets the required bit error rate (BER). The discussion below describes the test setup at a hub. The test at a remote site is done on the primary or alternate equipment. The test also uses a BERT connected to "the baseband channel." The baseband channel is the aggregate data input to the satellite modem.

b. Discussion. This test requires the RF be looped back through the satellite. At some sites, such as Shemya, the available signal is not sufficient to use the loopback though the satellite. In these cases the BER measurement will be made at ZAN. The satellite signal levels are set at operational levels. A pattern generator is connected to the input of the baseband channel and a BER counter is connected to the output of the baseband channel. The BER counter counts the bit errors for design levels of Eb/No for each channel under test. Acquisition range is verified by setting the demodulator IF frequency at an offset 25 KHz from the modulator IF frequency.

> **NOTE:** At a few sites, e.g., Shemya, the available signal is not sufficient to use a loopback through the satellite. The BER measurement will have to be made straight to ZAN.

c. Test Equipment Required:

(1) Bit error rate test set.

(2) Power meter.

d. Conditions. Reduced service outage on affected link.

e. Detailed Procedures.

(1) BIT ERROR RATE TEST (BERT).

(a) Configure the RF equipment under test for loopback through the satellite.

(b) Connect the pattern generator to the baseband input of the modem (channel) under test. Connect the baseband output of the modem (channel) under test to the BER counter. Connect a power meter to the directional coupler sample port (see figure 13).

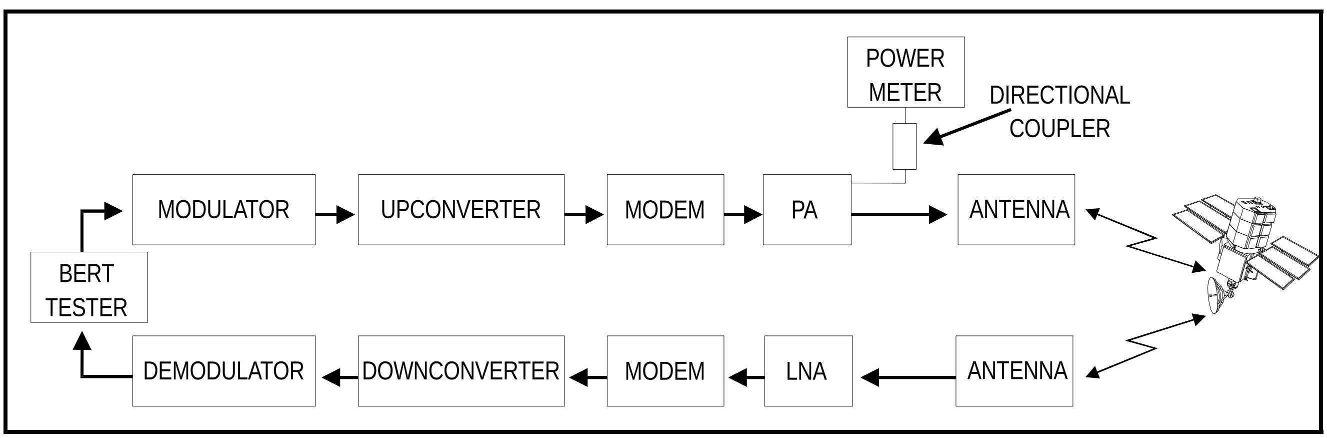

Figure 13. Satellite Modem Bit Error Rate Configuration

(c) Configure the modem under test in its normal operational status, i.e., frequency, coding, power level, etc.

(d) Set the pattern generator to generate a pattern consistent with the channel type under test. Set up the BER counter to monitor this pattern.

(e) Observe and record Eb/No and corrected BER displayed by the demodulator (modem). Monitor the BER counter and record the measured BER on the data sheet as indicated. Record PA power level as indicated on the power meter.

(f) Reduce PA power until modem demodulator breaks carrier detect. Record PA power level as indicated on the power meter. Observe and record Eb/No and corrected BER displayed by the demodulator.

(g) Increase PA power in 0.5 db increments until carrier detect is present on modem under test. Record PA power level as indicated on the power meter. Observe and record Eb/No and corrected BER displayed by the demodulator.

(h) Increase PA power in 0.5 db increments until BER of 1 x 10^{-6} is obtained. Record PA power level, demod Eb/No, corrected demod BER, and BERT BER.

(i) Observe the recorded data. Verify BER of 1x10^{-6} or better was achieved in the channel BERT.

NOTE: In order to get 10 errors at a BER of 10^{-6} requires (on average) 2.6 minutes at 64 Kbps and 6.5 seconds at 1.544 Mbps.

(2) ACQUISITION RANGE.

(a) Configure as in steps 1. (a) through (e) above.

(b) Tune the demodulator IF frequency to a 25 kHz offset from the modulator. Verify that the demodulator is set for ±25 kHz acquisition sweep.

(c) Verify that the demodulator acquires and locks. Record the data on the test sheet.

(d) Return site to operational status.

67. PATH DIVERSITY TEST.

a. Object. This procedure verifies the ANICS ability to accurately determine a failed path and automatically switch traffic to the alternate path.

b. Discussion. This procedure is performed on a complete, end-to-end, circuit.

c. Test Equipment. Transmission Impairment Measurement Set HP-4934A (TIMS).

d. Conditions.

(1) Normally operating facility.

(2) A test circuit is required or the circuit chosen for testing must be removed from service.

e. Detailed Procedures.

(1) At the NMC/HMC, select the associated hub for the site under test on the “ANICS Top Level” screen. Select the remote’s icon that is under test. Verify that the primary links are active and alternates are inactive on the “Connect Screen.” Ensure links are green.

(2) Connect TIMS to the circuit end-to-end and send a 1004 Hz tone at -13 dBm. Verify that it is received.

(3) Simulate a path failure at the site under test by turning off the power on the Primary path satellite modem to the associated hub. Start timer.

(4) Simulated failure is detected at RMC and sent to HMC and NMC via alternate NMCS path. Observe primary path switchover is completed. Stop timer when connection is reestablished (will be receiving 1004 Hz at -13 dBm). Record the time (time elapsed should not exceed 30 seconds maximum, 20 seconds average).

(5) Verify that all required A/B switches switch. A “Pop-up Screen” at the NMC will show which switches are configured. The circuit that is in loopback can be verified by disconnecting the RJll jack on the ADP that belongs to the primary path.

(6) Verify that the associated hub is red on the “ANICS Top Level” screen. Verify that the remote's icon is red on the hub “Subnet” screen. Verify that the primary link turns red on the “Connect Screen.” The alternate path should remain green on the “Connect Screen,” indicating that this path is not simultaneously in an alarm condition.

(7) Show modem as red and all other icons, except MLTX, as green. MLTX is yellow to show a “soft” failure. This is a result of screen and latch software that examines all faults and selects the correct failure out of all possible failures for display.

(8) Restore the power to the failed modem.

(9) Observe that the associated modem’s icons turn green. The primary link will turn amber until the implement processing algorithms are complete and the link is declared available.

(10) Return the site to operational status.

68. SATELLITE MODEM REDUNDANT SWITCH TEST (Hubs).

a. Object. This procedure verifies the performance specifications of the redundancy switching.

b. Discussion. This procedure uses the modems, RF equipment, and antennas. A carrier is set up between two modems via the RF equipment, antenna, and satellite. The test uses an “on line” modem and a standby modem; both connected to the modem switch under test and a third support modem. The support modem can be either at another site or at the same site. The test verifies that when the on-line modem is failed, the modem switch configures the standby modem, and that it is switched in to replace the failed modem. The time required to switch and the times required for both the standby modem and the support demodulators to lock up are measured.

c. Test Equipment Required. Stop watch.

d. Conditions. Normally operating facility.

e. Detailed Procedures.

(1) Set up a carrier between the on-line modem and a support modem at another (or the same) site, using a path going through the satellite (see figure 14).

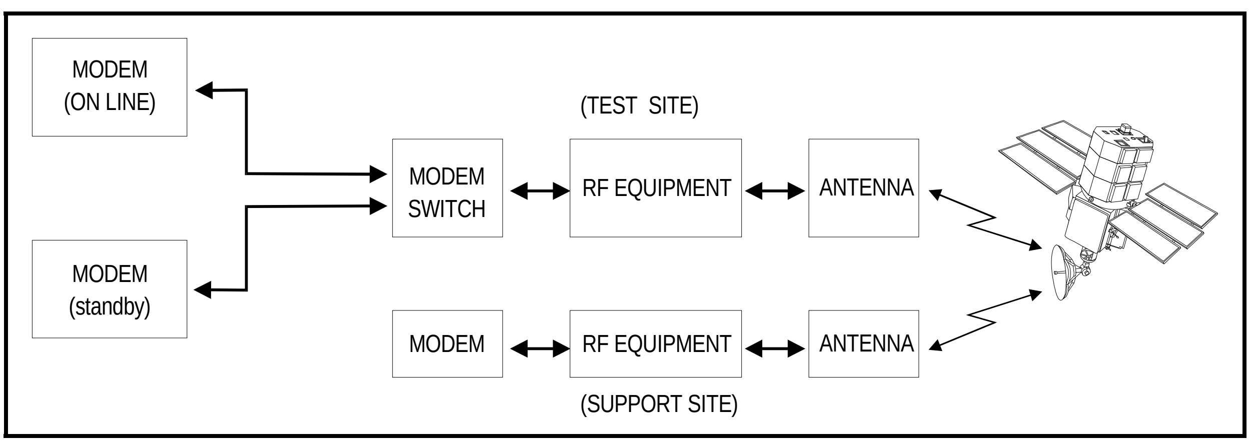

Figure 14. Satellite Modem Redundant Switch Test Configuration

(2) Verify that the standby modem is configured differently from the modem under test.

(3) Turn the on-line modem power "off."

(4) Verify that the standby modem is switched into the link.

(5) Measure and record the time required for the switch, the time required for the standby demodulator to lock up, and the time for the support demodulator to lock up.

(6) Verify that the standby modem is now configured the same as the original on-line modem.

(7) Repeat steps e. (1) through (6) above, for each modem switch to be tested.

(8) Return the system to its operating configuration.

Section 5. BASE-BAND EQUIPMENT

69. CHANNEL PHASE HITS, GAIN HITS, AND INTERMODULATION DISTORTION TEST.

a. Object. This test procedure is to be performed at the network level as an end-to-end channel test. This procedure encompasses related measurements all using the same testing device and basic set up cabling.

b. Discussion. This measurement determines the operating systems parameters of the circuit in reference to phase hits, gain hits, and intermodulation distortion. A satellite loop at the hubs will have a TIMS unit attached and monitor performance of the link.

c. Test Equipment Required. Transmission impairment measurement set (HP 4934A).

d. Conditions. Circuit under test will be looped at the far end via the TMS 3000 such that no outage is required where possible.

e. Detailed Procedures.

(1) Contact NMCS to coordinate testing and to place a loopback in the circuit. Idntify the circuit by ANICS circuit name, i.e., ENAZAN 01.

(2) The settings prescribed here are specific to the test equipment used (if a test set other than the HP 4934A is used, then the settings must be changed accordingly).

(3) Use **MEAS** to select Level/Freq/Parameter on CLR.

(4) Set **TRMT** to -13.0 dBm/1004 Hz.

(5) Use **DISPLAY** to view RCV level. Record on CLR.

(6) Use 404, 2713, and 2804 Hz and repeat steps 4 and 5 for each level. Compare to values on CLR.

(7) Verify recorded values are within parameters.

(8) Use **MEAS** to select Noise/C-MSG. Parameter on CLR.

(9) Use **DISPLAY** to view RCV level. Record on CLR**.**

(10) Use **MEAS** to select Noise with Tone/C-MSG. Parameter on CLR.

(11) Set **TRMT** to -13.0 dBm/1004 Hz.

(12) Use **DISPLAY** to view RCV level. Record on CLR**.**

(13) Use **MEAS** to select Sig-to-Noise/C-MSG. Parameter on CLR.

(14) Set **TRMT** to -13.0 dBm/1004 Hz.

(15) Use **DISPLAY** to view RCV level. Record on CLR**.**

(16) Use **MEAS** to select Impulse Noise/C-MSG. Parameter on CLR.

(17) Set **TRMT** to -13.0 dBm/1004 Hz.

(18) Use **DISPLAY** to view RCV level.

(19) Use **PERIOD** to set for 15 min.

(20) Use blue **DISPLAY** to set timer.

(21) Use **START/RESET** to start test.

(22) Observe timer countdown to zero in left window.

(23) When left window displays zero, record right window counts on CLR.

(24) Use **MEAS** to select P/AR. Expect a ten second delay.

(25) Set **TRMT** to -13.0dBm.

(26) Use **DISPLAY** to view RCV level. Record on CLR.

(27) Use **MEAS** to select N.T. GND/3 KHz filter.

(28) Use **DISPLAY** to view RCV level. Record on CLR**.**

(29) Disconnect test equipment.

(30) Contact NMCS to return site to operational status.

70. DIGITAL CHANNEL TEST.

a. Object. Bit error rate testing measures data path integrity. It accomplishes an end-to-end test of the circuit through all devices with zero eroded seconds. Injection of planned errors from one end should be detected and recorded at the other end. This test is invasive and requires an outage on the circuit to be tested.

b. Discussion. BER testers are attached to both ends at the appropriate parameters. NOTE: The test is then started and displayed on each BER tester. This test should run for up to two hours to allow sufficient time to get enough bits to accurately assess the bit error rate. If the target BER is $1x10^{-6}$, you should evaluate $1x10^{7}$ bits (f necessary, this test can be accomplished with one tester and the circuit in loopback at the distant end ADP). NOTE: Internal multiplex loopbacks will not fully test all channel components.

c. Test Equipment Required.

(1) Two BER testers.

(2) Cables appropriate for circuit interface.

d. Conditions. Outage required on the circuit under test.

e. Detailed Procedures.

(1) Coordinate with NOCC or MCC for circuit release.

(2) Determine circuit A/B switch or patch panel slot from circuit layout records and attach BER tester to each end in the 'Comp' jack at the ADP (see figure 15).

(3) Set BER tester transmit parameters the same on both ends as follows for RS-232:

(a) Synth Freq – match the rate of the circuit under test.

(b) Intf Setup – RS-232, Emulate DTE.

(c) Test Interval – 10-7$^{th.}$

(d) Char Format – 8, None, 1.

(e) Gen Clk – Intf.

(f) Timing Mode- asynchronous or synchronous depending on circuit under test.

(4) Set the receive side to monitor the following parameters:

(a) Time – Elapsed Sec.

(b) Error – Bit Errors.

(5) Begin test and let it run for thirty seconds with zero errors. Then, inject errors at one end and determine if they were received at other end. Clear the errors from both testers.

(6) Begin test and let it run for two hours without manually introducing errors.

(7) Disconnect test equipment and return site to operational configuration.

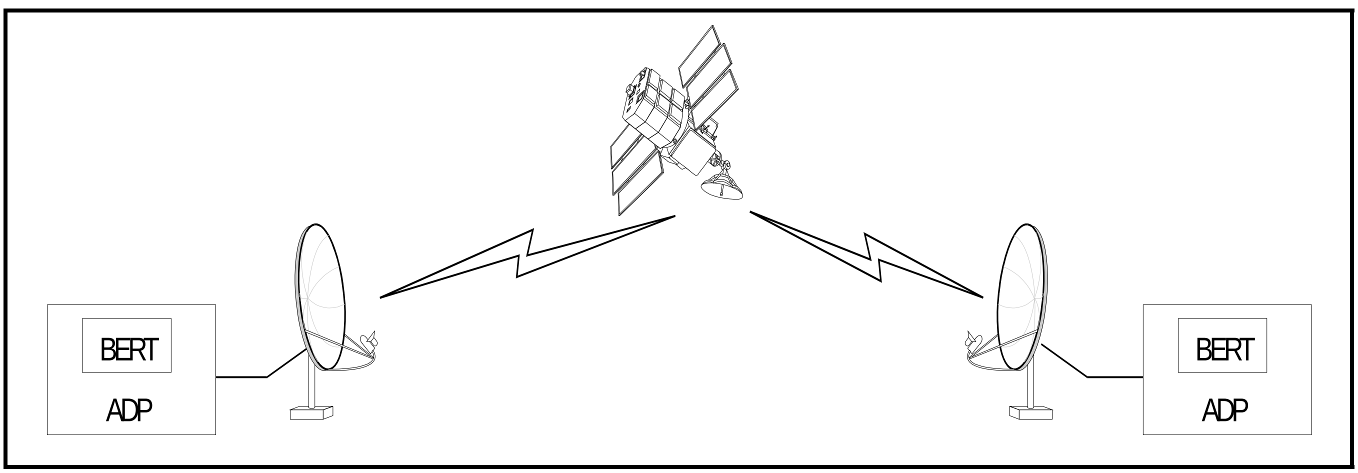

Figure 15. Digital Grade Channel Test Configuration.

Section 6. LINK INTEGRITY

71. TRANSMIT CARRIER ASSIGNED POSITION.

a. Objective. This procedure ensures that the Transmit carrier position (in frequency) meets the requirements of the reference standards.

b. Discussion. FAA has leased two full satellite transponders for use by the ANICS system with the point of management and control being the NOCC. Individual carriers may be moved or repositioned for various reasons such as testing or due to noise interference within it's assigned frequency slot. This test verifies permanent changes are tracked, the link budget handbook is updated, and the individual carriers are in their assigned positions within the transponders.

c. LabView is an application program that can set up parameters for various types of test equipment. The NOCC has as a control tool, a LabView application named Spectrum that contains a list of each carrier, and all relevant parameters to view the selected carrier on a spectrum analyzer. Using this tool, a carrier can be evaluated.

d. Test Equipment.

(1) Workstation with LabView application.

(2) Spectrum analyzer.

(3) Link budget handbook.

e. Conditions. Normally operating facility.

f. Detailed Procedure.

(1) Use LabView application to select the link to be evaluated. This will display the signal associated to the link on the spectrum analyzer.

(2) Observe the center frequency reported on the spectrum analyzer and compare it to the frequency listed in the link budget handbook.

(3) If the frequency **does not match,** report the mismatch to the appropriate SPS for correction of either the carrier's position or the link budget handbook.

72. CARRIER-TO-NOISE RATIO MEASUREMENT.

a. Objective. This procedure ensures that the ratio of the carrier power and the noise power of a given carrier meets the requirement of the reference standards.

b. Discussion. The ratio of carrier power to the noise floor (C/N) is an indication of how well the signal will be received and how error free it will be when processed. When carriers are placed on a transponder the noise floor is raised. Excess power on the satellite will raise the noise floor and reduce the C/N ratio. The proper balance of C/N must be maintained to provide the maximum use of the transponder bandwidth and error free transmission.

c. Test Equipment Required.

(1) Workstation with LabView application installed.

(2) Spectrum analyzer.

(3) Link budget handbook.

d. Conditions. Normal operating conditions.

e. Detailed Procedures.

(1) Use LabView application to select the link to be evaluated. This will display the signal associated to the link on the spectrum analyzer.

(2) Span the display of the spectrum analyzer out to obtain the satellite noise floor.

(3) Measure the difference (in db) between the carrier average peak level and the noise floor.

(4) Verify the measured C/N meets current link budget +/- 2db.

73. EB/NO MEASUREMENT.

a. Objective. This procedure ensures that the Energy per bit (Eb) to the Spectral Noise Density (No) ratio meets the requirements of the reference standards.

b. Discussion. Eb/No is measured at the input to the receiver and is used as the basic measure of the strength of a given carrier. This procedure will use the remote monitoring capability of ATNM to measure Eb/No.

c. Test Equipment. A workstation with ATNM installed.

d. Conditions. Normal operating conditions.

e. Detailed Procedure.

(1) Using GSIM, go to the "Connect Screen" of the link to be evaluated and select the receive end of the link. This will open the site's "Functional Area Screen."

(2) Select the <Modem> functional area.

(3) Select the modem associated with the link. This will open the "Modem Fault Screen."

(4) Select <Diagnostics> button.

(5) Refresh the Eb/No field to retrieve current value.

(6) Verify the current Eb/No value meets the standards and tolerances.

Section 7. GENERAL

74. MODULAR EXPANDABLE BUILDING (MEB) ENVIRONMENTAL CONTROL ADJUSTMENTS.

a. Objective. This procedure sets the environmental controls at a remote MEB.

b. Discussion. There are four thermostat controls within the ANICS MEB labeled T1 (Damper / Exhaust), T2 (Supply Fan), T3 (Heater), and T4 (Alarm). Some sites may also have thermostat controls in the generator room.

c. Tools Required.

(1) 1/8 inch Allen wrench.

(2) 5/32 inch Allen wrench.

d. Procedure.

(1) Adjust T1 (Damper / Exhaust) with a 1/8 inch Allen wrench for 75 degrees.

(2) Adjust T2 (Supply Fan) with a 5/32 inch Allen wrench for 60 degrees.

(3) Adjust T3 (Heater) with a 5/32 inch Allen wrench for 65 degrees.

(4) T4 has two adjustments (high / low) adjust high (cool) side for 90 degrees and the low (heat) side for 45 degrees.

NOTE: T1, T2, and T3 have Allen wrench type adjusters. There should be a brown plastic knob to adjust T2 and T3.

75. ON SITE CYBEREX ADJUSTMENT.

a. Objective: This procedure provides steps for starting up, system bypass, and shutting down the UPS when on-site. Local procedures used in the NOCC for UPS alignments are found in the NOCC operations handbook.

b. Discussion. The UPS is a vital part of the ANICS system. It provides the standby power to maintain the links when the local commercial power fails and an engine generator is not yet on line. **Due to the high AC and DC Voltages and currents present in the Cyberex UPS equipment, safety is a prime concern. Throughout these procedures are notes, cautions and warnings that must be followed to prevent harm to the technicians and equipment.**

c. Test Equipment. Voltmeter.

d. Conditions. Normal A/C power to tech power panel.

e. Detailed Procedures.

(1) START UP PROCEDURE.

WARNING: This procedure EXPOSES PERSONNEL to ELECTRICAL SHOCK and HIGH VOLTAGE HAZARD. **Practice safety**.

(a) Ensure the maintenance bypass switch (MBS) is in BYPASS ISOLATE.

(b) Close CB-201 (Rectifier Input).

(c) Check DC link voltage (121# on the keypad).

(d) Wait (up to 30 seconds) until the DC bus voltage has reached its final value. The DC link voltage should not exceed 280 VDC. If this is not accomplished, the battery fuse will blow when CB-202 is closed.

(e) Select Time Equalize Reset. This puts the battery charger in Float Mode. DC voltage must not exceed 270 VDC.

(f) Close CB-202 (Battery).

(g) Check rectifier current limit (123# on the keypad). Current must not exceed 23 amps.

(h) Move maintenance bypass switch to the BYPASS position. At this time, the fans will start and, after a short time, the SYNC MONITO LED will illuminate.

(i) Clear alarms and allow the system to warm up (15 minutes).

(j) Ensure that S-SW TRANSFER SWITCH is in the INITIATE position (right).

(k) The next three (3) steps require the door to be opened, ensure this is possible.

(l) Toggle inverter start. Verify the SYNC MONITOR LED extinguishes.

(m) Ensure all four (4) LED's on the gate drive boards illuminate at the same time. If LED's do not illuminate, shutdown inverter now, press INVERTER STOP**.**

(n) Listen for inverter to start, whine should level off and remain steady. If inverter whine varies, shutdown inverter now, press INVERTER STOP**.**

(o) Check inverter voltage (#100 on the keypad) 121 VAC (No tolerance allowed). Verify SYNC MONITOR LED is off, this verifies phase lock.

(p) Toggle S-SW transfer switch to AUTO. Verify ON INVERTER LED is illuminated and SYNC MONITOR LED is OFF.

(q) Toggle S-SW transfer switch back to INITIATE. Verify ON ALT LED is illuminated.

CAUTION: NEVER operate Maintenance Bypass Switch with Inverter operating through the Static Switch, ensure S-SW Transfer Switch is in the Initiate position.

(r) Move maintenance bypass switch to NORMAL.

(s) Toggle S-SW transfer switch to the AUTO position. Verify ON INVERTER LED is illuminated and Sync Monitor LED is off.

(t) Reset alarms.

(u) Reset alarm silence to enable audible alarms.

(v) Check output voltage (102# on the keypad) 120VAC.

(w) Clear alarm LED on system control board (Yellow Button).

(2) START UP PROCEDURE WITH NO DISPLAY.

(a) Ensure the MBS is in Bypass Isolate.

(b) Close CB-201 (Rectifier Input).

(b) Check DC link voltage (Positive lead of meter to left side of R-207 negative lead to negative bus bar of DC Link.). DC link voltage should not exceed 280vdc.

(c) Select Time Equalize Reset. This will place battery charger in float mode. DC voltage not to exceed 270vdc.

(d) Close CB-202 (Battery).

(e) Check rectifier current limit (move negative lead to right side of R-207 and set meter to millivolts and) 1.67 mV dc = 1 amp of charge current. Current not to exceed 38.5 mV dc = 23 amps.

(f) Move maintenance bypass switch to the Bypass position. At this time, fans will start and, after a short, time the Sync monitor LED will illuminate.

(g) Clear alarms and allow the system to warm up (15 minutes).

(h) Ensure that S SW transfer switch is in the initiate position (right).

(i) Ensure the door can be opened for the next three (3) steps.

(j) Toggle Inverter Start. Verify synchronous monitor lamp extinguishes.

(k) Ensure ALL 4 LED's on gate drive boards illuminate at the same time.

(l) If LED's do not illuminate shutdown inverter now (press INVERTER STOP).

(m) Listen for inverter to start, whine should level off and remain steady.

(n) If Inverter whine varies, shutdown inverter now (press INVERTER STOP).

(o) Check Inverter Voltage (connect negative lead to chassis ground and the positive lead to 'inverter' side of static switch (see figure 16) 121acv (No Tolerance allowed).

(p) Verify Sync Monitor light is off, this verifies phase lock.

(q) Toggle S SW transfer switch to AUTO.

(r) Verify ON INVERTER LED is illuminated and SYNC MONITOR LED is OFF.

(s) Toggle S SW transfer switch back to INITIATE.

(t) Verify ON ALT LED is illuminated.

CAUTION: NEVER operate Maintenance Bypass Switch with Inverter operating through the Static Switch, ensure S-SW Transfer Switch is in the Initiate position.

(u) Move maintenance bypass switch to Normal.

(v) Toggle S SW transfer switch to the AUTO position.

(w) Verify ON INVERTER LED is illuminated and Sync Monitor LED is off.

(x) Reset alarms.

(y) Reset alarm silence to enable audio alarms.

(z) Check Output Voltage (leave negative lead on meter connected to chassis and connect positive lead to output side of the static switch (see figure 16) 120vac.

(aa) Clear Alarm LED's on System Control board (Yellow Button).

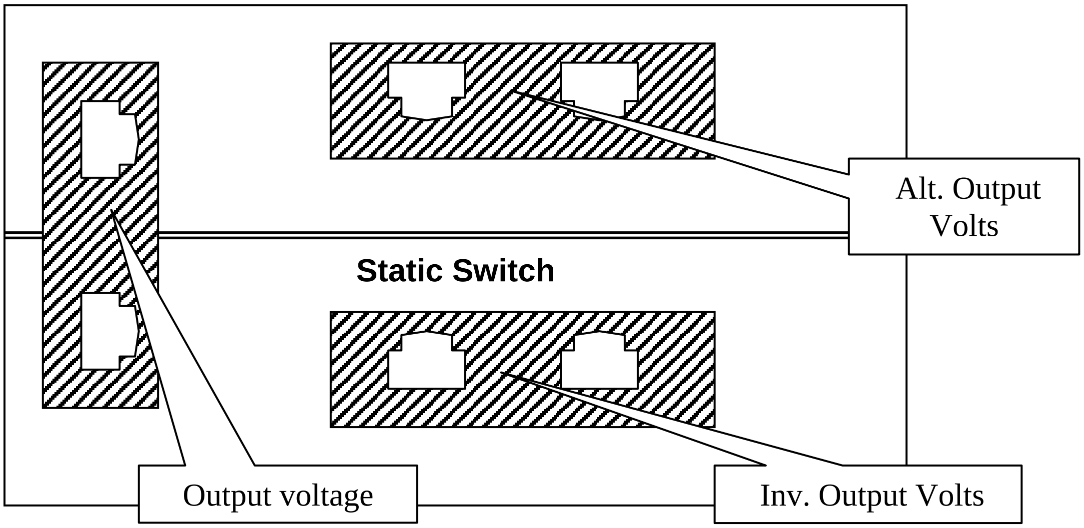

Figure 16. Voltage Test Points Diagram

(3) SHUTDOWN PROCEDURE.

(a) Check static switch position LED's.

(b) If ON INVERTER LED is illuminated and SYNC MONITOR LED is OFF, go to step (c).

(c) ONLY if ON ALTERNATE is illuminated and ON INVERTER LED is OFF, go to step (d).

(d) Toggle S-SW transfer switch to the INITIATE position, this will transfer UPS to the alternate source.

(e) Verify that the ON ALTERNATE LED is illuminated.

(f) Move maintenance bypass switch to BYPASS.

(g) At this time the AC load is on bypass.

(h) Press INVERTER STOP to turn OFF inverter.

(i) Move maintenance bypass switch to BYPASS ISOLATE.

(j) Open CB-201 (Rectifier Input).

(k) Open CB-202 (Battery).

(4) RECTIFIER CONTROL BOARD CURRENT LIMIT ADJUSTMENT.

NOTE: All of the following procedures are to be accomplished with Cyberex on Facility load.

(a) Attach DC volt meter leads to terminals R207A1 (DC) and R207A2 (Ground).

(b) Open CB 201 (Rectifier Input), allow the batteries to discharge below 254 VDC.

(c) Monitor DC link Voltage during this process, as batteries may be weaker than you think and may discharge rapidly.

(d) If batteries discharge very rapidly, this may indicate a problem with Cyberex battery pack.

(e) Once the ON BATTERY LED comes on (254 V dc), wait approximately one (1) minute then switch CB 201 on.

(f) On the rectifier control board, *be ready* to adjust R-8 current limit (C/L) to obtain a meter reading of 38.5 mV dc = 23 amps.

(g) Repeat if necessary. After rectifier is on for a short while, the voltage across R-207 will begin to drop as the batteries are being charged.

(5) INVERTER AND GATE DRIVE ADJUSTMENTS.

NOTE: Prior to doing any adjustments, High-Voltage MUST be removed.

(a) Perform shutdown procedure on UPS.

(b) Wait for five minutes (this allows capacitors to completely discharge).

(c) At F-102 and F-103, remove black # 10 wire from the left side of both fuses (this removes high voltage from transistor packs Q 101, 102, and Q 103,104).

(d) Ensure small white wire is still connected and tighten.

(e) Perform start-up procedure on UPS and stop short of transferring maintenance bypass switch to NORMAL.

(6) OVER AND UNDER FREQUENCY ADJUSTMENTS.

(a) On TB-1 1and 2, check incoming AC Frequency for 60 Hz ± 0.1.

(b) On system control board, connect positive lead to TP-8 and negative lead to TP-1.

(c) Set DVM for DC volts.

(d) On system control board, adjust R-1 looking for a high to low transition. (+15 to 0 volts)

(e) Readjust R-1 for a low to high transition. At this transition, adjust R-1 an additional one half turn. This sets the under frequency threshold.

(f) Over frequency: Move positive lead of meter to TP-9 and repeat above adjustments for R-4, this sets the over frequency threshold.

(7) GATE DRIVE ADJUSTMENTS.

(a) With the high voltage removed from F-102 and F-103, press INVERTER STOP.

(b) On the A-1 gate drive board, connect positive lead of DVM to either side of R –15 and the negative lead to the Anode of D –15.

(c) Set DVM for DC Volts.

(d) Press INVERTER START.

(e) Allow voltage reading to stabilize.

(f) Adjust R-24 for 4.5 volts.

(g) Once adjustment is completed, press INVERTER STOP.

(h) Repeat procedure for the A-2, A-3, and A-4 Gate drive boards.

(i) Upon completion of adjustments, perform shutdown procedure and return equipment to normal.

(j) Set DVM for AC volts connect to inverter side of static switch and adjust for 121 AC volts.

(8) FLOAT AND EQUALIZE ADJUSTMENTS.

(a) Press Timed Equalized Reset toggle switch (Float).

(b) Connect voltmeter across DC Bus + to -.

(c) With inverter on the load, open CB 202.

(d) Adjust R-32 on rectifier control Board for 270 vdc ± 1 volt on voltmeter.

(e) Press Timed Equalized Initiate toggle switch (equalize).

(f) Adjust R-34 on rectifier control board for 280 vdc ± 1 volt on voltmeter.

(g) Close battery breaker CB-202.

(9) CURRENT LIMIT ADJUSTMENT.

(a) Connect voltmeter leads across R-207 and select milli-volts scale.

(b) Open CB-201 for 5 minutes (this will cause batteries to discharge and go into current limit).

(c) Close CB-201.

(d) Adjust rectifier control board R-8 for 38.5 milli-volts ± 1mv across R-207.

76. SCADA ENVIRONMENTAL ALARMS.

a. Object. This procedure provides directions for troubleshooting the SCADA and environmental alarms. Refer to connection diagram (remotes) drawing ALD-XXX-754-XXX for pictorial and the SCADA manual labeled Puleo Electronics, Inc. This procedure can also be used in troubleshooting hub alarms. Values can be obtained by taking measurements from the PB 7 and 8 (protection block is located above the Cyberex UPS in 8 ft. wide MEB's and on south wall of 10' MEB's).

(6) Discussion. While no links are directly affected by any of these test procedures, coordination with the ANICS NOCC is still required.

(7) Conditions. Normally operating facility.

d. Detailed Procedure.

(1) SCADA not responding. If the SCADA does not respond and alarms are present at the ANICS NOCC monitor, this condition can be caused by a faulty ground connection. The ground wire (1W503 typically black wire) is located in PB 8 row 25. This needs to be inspected or punched down and manipulated before replacing the SCADA unit.

(2) Door Alarms.

(a) Normal condition (door closed) = 0 volts DC (measured on punch down block).

(b) Alarm condition (door open) = 5 volts DC (measured on punch down block).

(c) Door intrusion alarm 1 (left door in graphics) = punch down row 8.

(d) Door intrusion alarm 2 (right door in graphics) = punch down row 10.

NOTE: In some cases, both doors are punched down to row 8.

(e) The following steps can be used to simulate an active door alarm that can be seen on the graphics at ZAN NOCC or measured on the punch down row:

1 Ensure the door is closed.

2 On the SCADA protection, remove the carbon plug that is associated with the corresponding punch down. This will result in an active (open) door alarm on the graphics at the NOCC.

(3) Over and Under Temperature Alarms.

(a) Normal condition = 5 volts DC (measured on the punch down block).

(b) Alarm condition = 0 volts DC (measured on the punch down block).

(c) Under temperature alarm = punch down block row 11.

(d) Over temperature alarm = punch down row 9.

(e) Temperature alarms can be simulated three different ways (alarms will show up at ZAN NOCC graphics or can be measured on the punch down row):

1 For an under temperature alarm, move the under temperature adjustment (left control) above the current room temperature.

2 For an over temperature alarm, move the over temperature adjustment (right control) below the current room temperature.

3 Pull the associated carbon plug associated with the corresponding punch downs.

(4) Fire and Smoke Alarms.

(a) Normal condition = 5 volts DC (measured on punch down block).

(b) Alarm condition = 0 volts DC (measured on punch down block).

(c) Fire alarm = punch down row 14.

(d) Smoke alarm = punch down row 13.

(e) Simulate alarms by shorting associated punch down block to ground PB 8 row 25 (1W503). Using the test button on the smoke alarm can also simulate smoke alarms. All simulated alarms can be verified at ZAN NOCC on the graphics or measured on the punch down row.

APPENDIX 1. SITE ACCEPTANCE TESTS

1. Purpose. The purpose of this appendix is to specify the minimum required tests for all additional ANICS installation site acceptances.

2. Discussion. In addition to the test procedures included in Chapter 4, Periodic Maintenance, the following tests must be performed on site**.**

NOTE: This section identifies the performance checks (i.e., tests, measurements and observations) of normal operating parameters that are necessary to determine whether operation is within established tolerances and limits. These tests are conducted during the Site Certification (JAI) process in addition to other pertinent checks.

NOTE: These tests must be conducted jointly at the remote sites, from the NOCC, and from the associated hub facility. They include all environmental alarm testing and operational conditions.

PERFORMANCE CHECK	**REFERENCE PARAGRAPH**	
	STANDARDS AND TOLERANCE	**MAINTENANCE PROCEDURES**
3. SITE ACCEPTANCE TESTS		
Transmitter.		
a. Transmitter gain linearity.	32	62
b. Power amplifier output power.	32	62
c. Power amplifier intermodulation.	32	63
d. Satellite modem redundant switching (Hubs).	33	68
e. Satellite modem.		
(1) BIT error rate.	33	66
(2) Acquisition range.	33	66
f. Channel intermodulation distortion.	35	69

PERFORMANCE CHECK	REFERENCE PARAGRAPH	
	STANDARDS AND TOLERANCE	MAINTENANCE PROCEDURES
3. SITE ACCEPTANCE TESTS		
g. Circuit integrity.		
(1) Voice channels.	35	69
(2) Digital channels.	35	70
(3) Redundancy switching.	35	69
h. RF subsystem fault monitor.	N/A	AL 6000.20A App B Para. VI
i. Receiver RF bandwidth.	32	65
j. Antenna isolation test.	31	57

NOTE: These tests should include AAL-473(ANICS Program Office) and implementation contractor personnel. A baseline will be established and recorded detailing site configuration, operating parameters, and exceptions, if any.

NOTE: The tests listed in this appendix are not all inclusive. A completed list of tests will be determined under the contract.

4. SATELLITE ANTENNA ISOLATION TEST

a. Objective. This procedure verifies that the receive side of the RF group is isolated from the transmit side well enough to prevent transmit energy from overloading the LNA. The procedure will verify that induced transmit signals meet the reference standards. A second test checks the effect of both transmit energy passing through the OMT to the receive side (LNA gain compression), and of 4000 MHz noise generated in the PA (noise increase).

b. Discussion. This procedure is to be performed on the feed and OMT. The isolation should be adequate such that the OMT, together with the transmit reject filter, will reduce the transmit level at the LNA to a level that will not increase receive noise temperature.

c. Test Equipment:

(1) Spectrum analyzer.

(2) Signal generator or modem.

(3) Printer or plotter.

CAUTION: This is a LIVE test.

d. Detailed Procedure.

(1) Note the date, time, and site location on the data sheet.

(2) Point the antenna to 35º elevation.

(3) Turn the PA off. Set up test equipment as shown in figure A-1.

(4) Note and plot LNA noise floor.

(5) Turn on PA and set at 3 dB back off from 1 dB GCP for the SSPA under test.

(6) Note change in noise floor; plot results. The change in the noise floor should not exceed 0.2 dB.

(7) Return equipment to normal operational configuration.

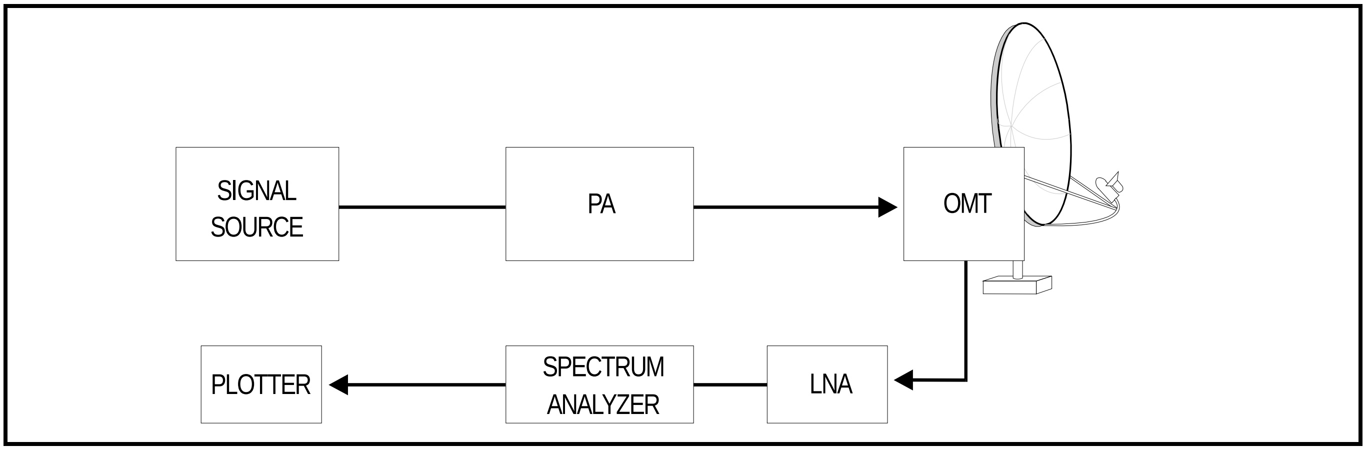

Figure A-1. Satellite Antenna Isolation Configuration

5. RF TRANSMIT EQUIPMENT TESTS.

a. **Object.** This procedure verifies the transmit section (up converter - PA) phase noise, gain slope and bandwidth meet specification, and design requirements listed in the reference standards.

b. Discussion. For the amplitude response, gain slope, and gain variation measurement, a sweep signal generator is utilized to provide drive to the converter. The signal generator is set to sweep the transmit band in 50 MHz segments at a level sufficient to drive the PA to l0 dB below rated output power. The spectrum analyzer is connected to the directional coupler in the transmit path, and a power meter is connected to the PA monitor port. Each sweep is stored and plotted. For the phase noise measurements, a stable signal generator in CW mode is connected to the transmitter. The transmitter output is observed on a spectrum analyzer and documented.

c. Test Equipment Required.

(1) Signal generator.

(2) Spectrum analyzer HP 8563E or equivalent.

(3) Power meter.

NOTE: This test will transmit a CW carrier across the full bandwidth of the satellite.
MOVE THE ANTENNA OFF THE SATELLITE (35º ELEVATION).

d. Detailed Procedure.

(1) Coordinate with the NOCC to schedule a reduced service outage on links to be tested and to ensure all traffic is moved to the links not under test.

(2) 1 DB GAIN COMPRESSION OR SATURATION TEST.

NOTE: Do not drive PA beyond rated power.

(a) Connect test equipment per figure A-2. Set up converter frequency to 6175 MHz and transmit attenuation to 0db.

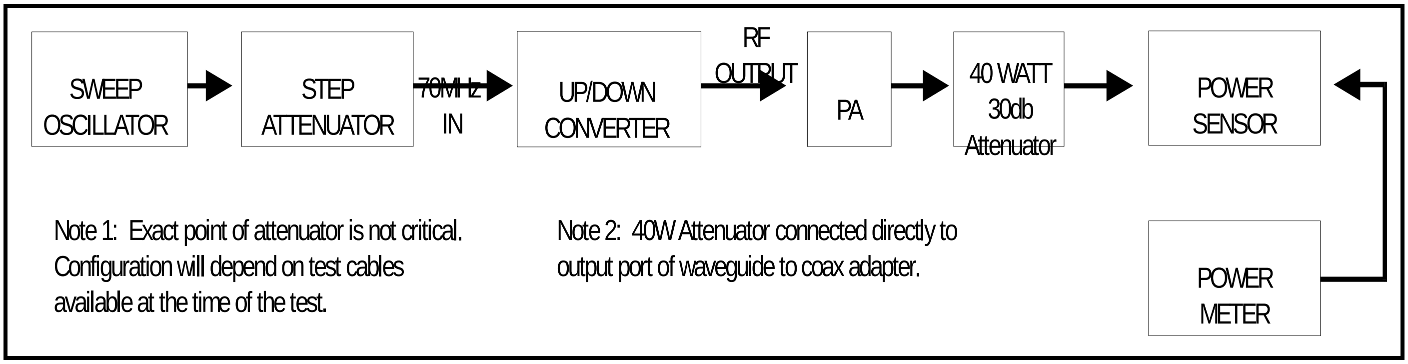

Figure A-2. -1 db Gain Compression Configuration

(b) Calibrate power meter for 6175 MHz. Attach power meter to attenuator.

(c) With at least 40 dB in the step attenuator and sweep generator power level at 0 dBm, set the signal generator to generate a CW signal at 70 MHz. Set PA RF power output ON.

(d) Increase the signal generator drive l dB at a time and observe the power meter. Continue increasing drive until the l dB gain compression point or rated power is reached, whichever comes first (see figure A-3).

(e) Decrease the drive until the PA output level drops l0 dB.

(f) Place PA RF power off.

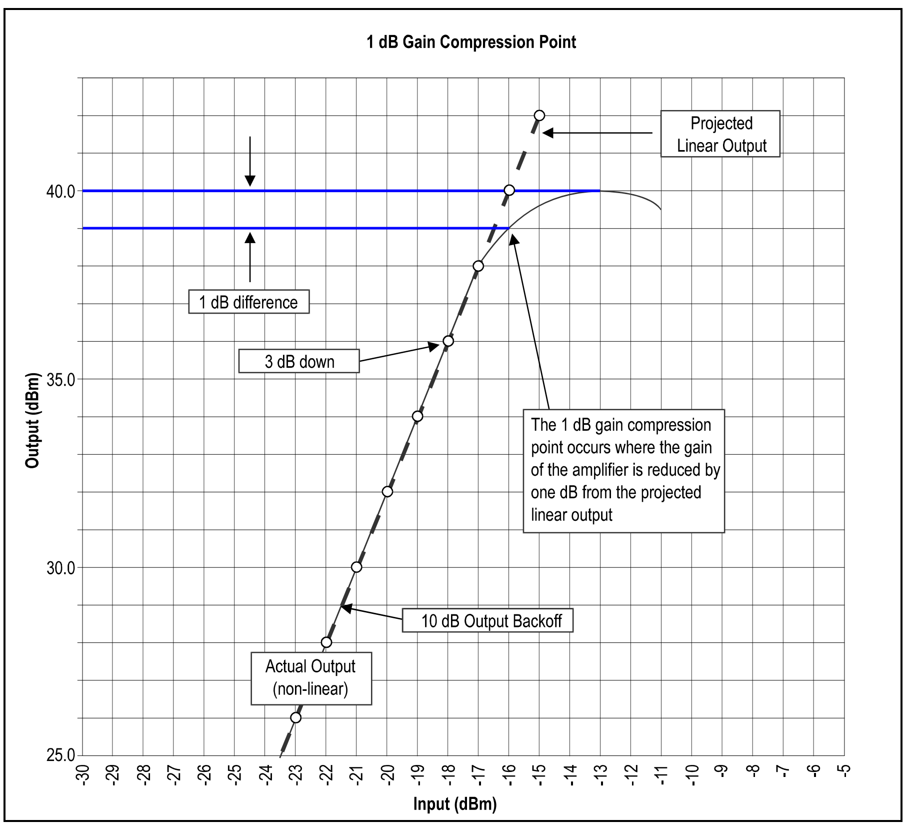

Figure A-3. Gain Compression Point

Note: The 1 dB Gain Compression Point (1 dB GCP) is the point on the gain transfer curve where the power level of the input signal causes a 1 dB gain compression, that is an output that is reduced 1 dB from the linear gain line. The gain compression point is a measure of non-linearity of an amplifier; the higher the input signal power level at the 1 dB GCP, the more linear the amplifier.

(4) BANDWIDTH AND GAIN FLATNESS TESTS.

(a) Set the signal generator to generate a sweep 40 MHz wide. Set the up converter to 5945 MHz.

(b) Turn the PA RF power on. The PA should be at approximately 10 dB output.

(c) Connect spectrum analyzer to directional coupler and observe the PA output with the following settings:

<u>1</u> Res B/W 100 kHz.

<u>2</u> Vid B/W 10 kHz.

<u>3</u> Span 500 MHz.

<u>4</u> Sweep time 20 ms.

<u>5</u> Amplitude scale 1 dB/div.

<u>6</u> Center Frequency 5945 MHz.

(d) Set the spectrum analyzer for Max. Hold and allow trace to plot the display.

(e) Verify that the gain slope and gain flatness requirements are met, and repeat steps (a) through (d) above, for RF frequencies of 6175 MHz and 6405 MHz.

(f) Observe the bandwidth of the transmitter output at mid-band (6175 MHz). Verify that it complies with the reference standard paragraph 32a.

(g) Turn PA RF power OFF.

(5) PHASE NOISE TEST.

(a) Set up test equipment as in figure A-4. A modem set for 70 MHz transmit frequency may be used for the input of the up converter.

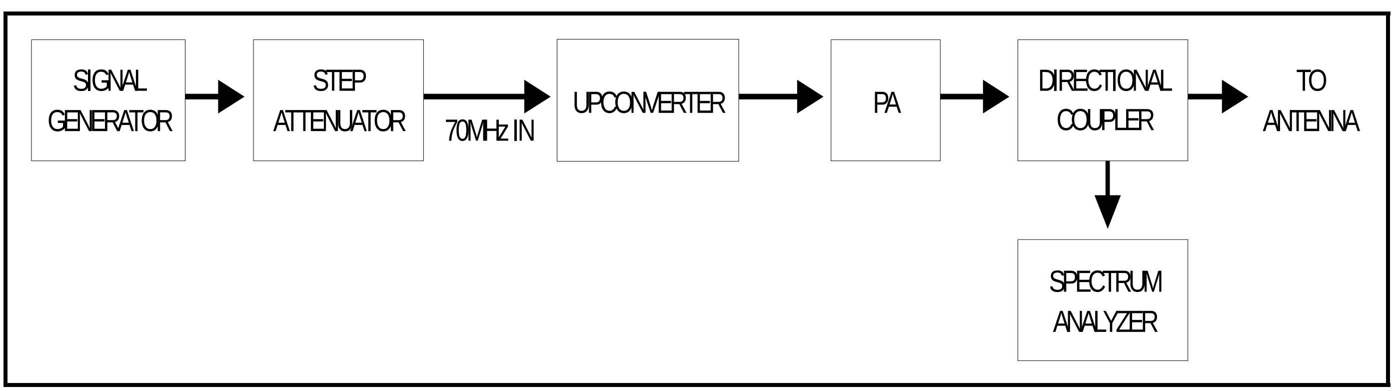

Figure A-4. Gain Linearity / Phase Noise Configuration

(b) At the PA, connect the spectrum analyzer to the cross-guide coupler monitor port.

(c) Set up the spectrum analyzer as follows:

1 Center Frequency 6175 MHz.

2 Span 50 kHz.

3 Res B/W to 100 Hz.

4 Vid B/W to 100 Hz.

5 Adjust the sweep time for a calibrated output.

(d) Turn the PA RF power ON.

(e) Record the level relative to the carrier at 10 kHz offset from the carrier. This is the noise in a 100 Hz bandwidth. The noise in a 1 Hz bandwidth is 20 dB lower than this.

(f) Print the spectrum analyzer display.

6. RF SUBSYSTEM FAULT MONITOR TEST.

a. Object. This procedure verifies proper operation of the PA, up converter synthesizer, and power supply fault indictors.

b. Discussion. This procedure verifies fault indication by initiating alarm conditions.

c. Test Equipment Required. Spectrum analyzer.

d. Detailed Procedure (HUB SITES).

CAUTION: Figure 5 shows the PA terminated into a dummy load. This test must be done off-line (RF output terminated) or, at the very least, off-satellite. If this test is done live and on satellite, you will interfere with any carrier on your test frequencies.

(1) Enter the date, time, and site location as indicated on the data sheet. Connect the test equipment as shown in figure A-5.

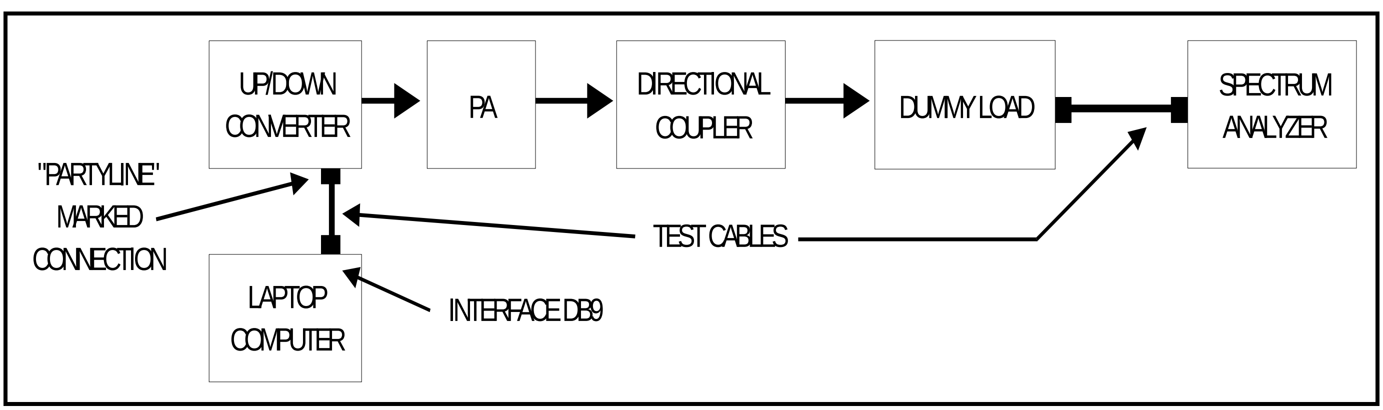

Figure A-5. RF Subsystem Fault Monitor Configuration (Remote)

(2) Perform this test from the NMC and HMC on the primary and alternate RF links. Notify the ZAN NOCC before any steps are taken.

(3) At the NMC/HMC, select the "Hub" icon under test at the bottom of the "connect screen." This will access the RF and antenna functional area screen. Select "RF Equipment" icon.

(4) Note the status of the hub's "RF Screen" for the primary and alternate equipment strings.

(5) Select the "RF Synthesized Converter" icon for the primary and alternate equipment strings. All up converters, down converters, SSPA's, LCS&M's, and dehydrators should be represented and have no alarms (status green).

(6) UP CONVERTER FAULT VERIFICATION TESTS.

(a) EACH RF CONVERTER SHOULD BE TESTED.

(b) Select the up converter to be tested. Overall status should be green, and the last poll date and time should be current with the system clock. All alarm sub-resources should be green. The channel should be set to a value other than 0, and a frequency should be assigned. The unit should be muted and off-line, or un-muted and on-line. The unit should be in remote mode. Switching should be set to auto mode. Control status is indeterminate.

(c) Note the unit status, including any alarms, the last poll time and date, channel number, frequency, the unit's mute and on-line status, remote or local mode and the switching mode.

(d) Check the redundant unit and verify the mute and on-line state is opposite this unit.

NOTE: Record all parameters and equipment settings on Data Sheet prior to making any changes.

(e) Use the Attenuation button to set the attenuation to each of these values: 0, 9, 10,16, 17, 20, 29, 30. Allow time for a polling cycle between each change and verify the update is reported.

(f) Select the Frequency icon and view the converter frequency screen.

(g) Using the Refresh List button, refresh the Channel Frequency lists.

(h) Use the Frequency Store button to store the following frequencies. Update the frequency lists each time and verify the change was recorded.

Frequency	Channel
6065	1
5845	17
6725	29
6201	30

(i) Use the Select Channel to verify each channel is saved and selectable.

(j) Use the right mouse button to return to the main up converter screen.

(k) Using the unit's front panel controls put the converter in Local.

(l) Observe this change is reported in the next poll. The list box will change to a yellow alarm status.

(m) Return the unit to Remote mode with the front panel controls and verify the screen displays this change.

(n) On the screen display, select the Switch Mode Auto. Verify the Auto/Manual box reads Auto on the next polling cycle.

(o) Use the Switch Mode button to place the converter in manual mode and verify the change is reported and a yellow alarm is displayed on the next polling cycle.

(p) Return the converter to Auto and verify the alarm indication clears on the next poll.

(q) Use the demand button labeled Switch Off-line to place the converter off-line. Check the output and status of the converter has changed.

(r) Use the Switch On-line button to place the unit on-line. Verify the output and status of the converter has switched to on-line. Switch the converter back to off-line.

(s) Use the Mute button to mute the output, verify the output is muted.

(t) Un-mute the converter and verify it's status and output are un-muted.

(u) Place the converter on-line. Fail the unit by removing all power and verify the redundant converter goes to on on-line status, while the "failed" converter goes into a red alarm status.

(v) Return power to the converter under test and verify the alarm condition clears.

(w) Return all parameters to original values using data sheet documentation.

(x) Return site to operational condition or continue testing additional converters.

(7) DOWN CONVERTER FAULT MONITOR TESTS.

(a) EACH DOWN CONVERTER SHOULD BE TESTED.

(b) Select the down converter to be tested. Overall status should be green and the last poll date and time should be current with the system clock. All alarm sub-resources should be green. The unit should be muted and off-line, or un-muted and on-line. The unit should be in remote mode. Switching should be set to auto mode. Control status is indeterminate.

(c) Note the unit status, including any alarms, the last poll time and date, channel number, frequency, the unit's mute and on-line status, remote or local mode and the switching mode.

(d) Check the redundant unit and verify the mute and on-line state is opposite this unit.

NOTE: Record all parameters and equipment settings on Data Sheet prior to making any changes.

(e) Use the Attenuation button to set the attenuation to each of these values: 0, 8, 18,16, 18, 21, 29, 30.Allow time for a polling cycle between each change and verify the update is reported.

(e) Select the Frequency icon and view the converter frequency screen.

(f) Using the Refresh List button, refresh the Channel Frequency lists.

(g) Use the Frequency Store button to store the following frequencies. Update the frequency lists each time and verify the change was recorded.

Frequency	Channel
3840	1
3700	17
4200	29
4057	30

(h) Use the Select Channel to verify each channel is saved and selectable.

(i) Use the right mouse button to return to the main down converter screen.

(j) Using the unit's front panel controls, put the converter in Local.

(k) Observe this change is reported in the next poll. The list box will change to a yellow alarm status.

(l) Return the unit to Remote mode with the front panel controls and verify the screen displays this change.

(m) On the screen display, select the Switch Mode Auto. Verify the Auto/Manual box reads Auto on the next polling cycle.

(n) Use the Switch Mode button to place the converter in manual mode and verify the change is reported and a yellow alarm is displayed on the next polling cycle.

(o) Return the converter to Auto and verify the alarm indication clears on the next poll.

(p) Use the demand button labeled Switch Off-line to place the converter off-line. Check the output and status of the converter has changed.

(q) Use the Switch On-line button to place the unit on-line. Verify the output and status of the converter has switched to on-line. Switch the converter back to off-line.

(r) Use the Mute button to mute the output, verify the output is muted.

(s) Un-mute the converter and verify it's status and output are un-muted.

(t) Place the converter on-line. Fail the unit by removing all power and verify the redundant converter goes to on on-line status, while the "failed" converter goes into a red alarm status.

(u) Return power to the down converter under test and verify the alarm condition clears.

(v) Return all parameters to original values using data sheet documentation.

(w) Return site to operational condition or continue testing additional converters.

(8) SSPA FAULT MONITOR TESTS

(a) EACH SSPA SHOULD BE TESTED.

(b) Select the SSPA to be tested. Overall status should be green, and the last poll date and time should be current with the system clock. All alarm sub-resources under the Alarm screen should be green. The redundant unit should have no major alarms and the Major Faults text should read “Other unit no major fault.”

(c) Check on-line status of this unit and the redundant unit. One should be on-line while the other is in standby mode.

(d) Verify the SSPA output level, SSPA current, gain, mode status, and mute status. Check the heat-sink temperature, power supply voltages, to ensure they are reasonable values, and verify via the front panel

(e) Check the redundant unit and verify the mute and on-line state is opposite this unit.

NOTE: Record all parameters and equipment settings on Data Sheet prior to making any changes.

(f) Select the set gain button and set gain to –20.0 db.

(g) Verify the Gain text box reads –20.0 db after the polling cycle.

(h) Repeat steps(8) (e) and (f) for each of the following gain values: -19.9, -10.0, -1.9, -1.0, -0.1, and 0.0 db.

(i) Using the unit’s front panel controls, put the SSPA in Local.

(j) Observe this change is reported in the next poll. The Local/Remote sub resource will change to a yellow alarm status.

(k) Return the unit to Remote mode with the front panel controls and verify the screen displays this change.

(l) On the screen display, select the Switch Mode Auto. Verify the Auto/Manual box reads Auto on the next polling cycle.

(m) Use the Switch Mode button to place the SSPA in manual mode and verify the change is reported and a yellow alarm is displayed on the next polling cycle.

(n) Return the SSPA to Auto and verify the alarm indication clears on the next poll.

(o) Use the demand button labeled Switch Off-line to place the SSPA off-line. Check the output and status of the SSPA has changed.

(p) Use the Switch On-line button to place the unit on-line. Verify the output and status of the SSPA has switched to on-line. Switch the unit back to off-line.

(q) Use the Mute button to mute the output, verify the output is muted.

(r) Un-mute the SSPA and verify it’s status and output are un-muted.

(s) Place the SSPA on-line. Fail the unit by removing all power and verify the redundant SSPA goes to on on-line status, while the “failed” SSPA goes into a red alarm status.

(t) Return power to the unit under test and verify the alarm condition clears.

(u) Return all SSPA parameters to original values using data sheet documentation.

(v) Return site to operational condition or continue testing additional SSPA's.

(9) LCS&M FAULT MONITOR TESTS.

(a) EACH LCS&M UNIT SHOULD BE TESTED.

(b) Select the LCS&M to be tested. Overall status should be green and the last date and time should be current with the system clock. All alarm sub-resources should be green. One unit should be on-line, the other off-line. Local/Remote mode should be remote, and Auto/Manual mode should be in auto mode. Demand Script status is indeterminate.

(c) Disconnect the Power Supply A power cord. Verify the unit indicates a red alarm status on the next polling cycle.

(d) Return Power Supply A to service and verify the alarm condition clears with the next poll.

(e) Repeat steps (9) (c) and (d) for Power Supply B.

(f) From the front panel, place the unit in Local mode. Verify Local/Remote indicator reads "Local."

(g) From the front panel, place the unit in Remote mode. Verify Local/Remote indicator now reads "Remote" with the next poll.

(h) Using the Manual button, place the switch in manual mode. Verify Auto/Manual text box is updated with the next poll and a yellow alarm is generated.

(i) Using the Auto button, place the switch in auto mode. Verify Auto/Manual text box is updated with the next poll and the yellow alarm is clear.

(j) Return the unit to Manual. Using the Switch Unit On-line button, place LNA A on-line. Verify LNA A is on-line, while LNA B is off-line.

(k) Use the Switch Unit B On-line to place LNA B on-line. Verify both LNA's have switched.

(l) Place LNA A back on-line and verify both LNA A and B status.

(m) Return all parameters to original configuration using data sheet documentation.

(n) Return site to operation or continue testing.

e. **Procedure:** REMOTE SITES.

NOTE: Perform this test from the NMC and HMC on both the Primary and Alternate circuits. Notify ZAN NOCC *before* any steps are taken.

(1) Enter the date, time, and site location as indicated on the data sheet.

(2) At the NMC/HMC, go to the up/down converter Parameter screen and turn PA beam "off."

(3) At the circuit breaker, turn the power off to the PA and converter. Turn the RF "OFF" on the front panel of the modem. (Note: Matches step 10 below.)

(4) Connect a test cable to "partyline" connector on bottom of up/down converter.

(5) Connect a laptop computer to the test cable in step e. (4) above.

(6) Connect a spectrum analyzer to the monitor point of the dummy load.

(7) Use the Windows terminal in "Accessories" to communicate. If problems occur, refer to the up/down converter manual for assistance. The default settings are as follows:

(a) Baud rate - 9600.

(b) Parity - None.

(c) Data Bits - 8.

(d) Stop Bits - 1.

(e) Flow Control - Xon/Xoff.

(f) Terminal Emulation - VT100.

(8) Once up/down converter is communicating, type "R" to refresh the screen before any parameter changes occur. Print (or otherwise record) the up/down converter operating parameters before proceeding.

(a) LAPTOP SCREENS. There are three screens which are accessible by the user: Use the up or down arrow to switch screens.

(b) The technician at the remote site will have to remove the cable plugged into the serial port of the up converter and restore the serial connection to the RMC, which will restore communications to the NMCS and allow the hub or ZAN to monitor equipment status at the remote site. This step must be done each time access to the remote site equipment via the NMCS is needed. The technician at the remote site will have to restore the connection established in step e. (4) above, each time local (remote site) access to the up/down converter is required. You may want to do the parameter changes below in bulk to minimize the number of times that the tech has to swap serial connections.

(9) Turn the power to the up/down converter equipment "ON" at the circuit breaker. The up/down converter will come up with the PA RF "on" after a short time delay.

(10) On the spectrum analyzer, enter the normal transmit frequency of one of the modems on the path under test. Turn the RF "ON" on the front panel of the modem. Observe the carrier on the spectrum analyzer.

(11) At the NMC/HMC, select the "RF Equipment" icon on the "Functional Areas" screen of the remote under test.

(12) Note the status of the remote's "RF Screen" for Primary and Alternate equipment strings.

(13) At the NMC/HMC, select the "RF synthesized converter" icon for the Primary/Alternate link. Select the "Get Current Values" icon to refresh the screen. The status window below the PS + 15 VDC will display "gathering fault data" until the graphics update. Then it will display "done" when it has finished. View the ARIM alarm screen "Warning Messages" for the command status. Ensure that the "Status" and "Fault History" windows for each parameter update.

(14) Observe the status of the five parameters at the top of the screen. "Converter Automode" icon should be amber in normal operation. "Converter Local Control" should be gray. It will be amber if a tech at the remote site used a laptop and left the converter in local control.

(15) Select the "Control Screen" icon. Select the "Refresh" icon to show current parameters. The status window below the PS +15 VDC will display "gathering fault data" until the graphics update. Then it will display "Done" when it has finished. View the ARIM alarm screen Warning messages for the command status. Ensure that the "Value" windows for each parameter update.

(16) Note ALL parameter settings BEFORE making changes. DO NOT ADJUST THE TX ATTENUATOR. It is adjusted during installation to provide -25 dBm to the up converter for maximum output power. Verify the –25dbm drive level before relying on the value for other purposes.

(17) Turn the modem's RF "OFF."

(18) At the NMC, select the “PA Status” update button. An “RF Power Amp Control” screen will pop up. Type “2” for “OFF.” Press “Enter.” Monitor the spectrum analyzer for proper carrier response.

(19) Observe that the state of the PA changes on screen 1, item 13, to OFF on the laptop. Refresh screen if necessary.

(20) At the NMC/HMC, observe that the “Control Screen,” “PA Status” updates to “OFF.”

(21) At the NMC, select the “RX Attenuator” update button. An “RF” screen will pop up. Type a level between 0 to 15 dB or “C” to cancel. Press “Enter.”

(22) Observe that the state of the “RX Attenuator” changes on screen 1, item 8, on the laptop.

(23) At the NMC/HMC, observe that the “Control Screen, “ “RX Attenuator” updates to new figure.

(24) At the NMC, select the “Up Converter Freq” update button. An “RF” screen will pop up. Type a frequency between 5925.0 to 6425.0 MHz; in 2.5 MHz steps. Press “Enter.”

(25) Observe that the state of the “Up Converter Freq” changes on screen 1, item 10, on the laptop. Refresh screen if necessary.

(26) At the NMC/HMC observe that the “Control Screen,” “Up Converter Freq” updates to new figures.

(27) At the NMC, select the “DN Converter Freq” update button. An “RF” screen will pop up. Type a frequency between 3700.0 MHz to 4200.0 MHz in 2.5 MHz steps. Press “Enter.”

(28) Observe that the state of the “DN Converter Freq” changes on screen 1, item 11, on the laptop. Refresh screen if necessary.

(29) At the NMC/HMC, observe that the “Control Screen,” “DN Converter Freq” updates to new figures.

(30) At the NMC, select the “Save” button.

(31) At the circuit breaker, turn power off to the up/down converter units.

(32) At the NMC/HMC, verify that the SSPA and Converter turn “red” on the “RF Screen.”

(33) At the circuit breaker, return power to the up/down converter units.

(34) At the NMC/HMC, verify that the SSPA and Converter turn “green” on the “RF Screen.”

(35) At the NMC/HMC, refresh the “Control Screen.” Verify that the new parameter changes were saved.

(36) Review screen 1 of the laptop and verify that the changes were saved. Refresh the screen if necessary.

(37) At the NMC, select the “RX Attenuator” update button. Change to original parameter. Press “Enter.”

(38) Observe that the state of the “RX Attenuator” changes on screen 1, item 8, on the laptop. Refresh screen if necessary.

(39) At the NMC/HMC, observe that the “Control Screen,” “RX Attenuator” updates to new figures.

(40) At the HMC, select the “Up Converter Freq” update button. Change to original parameter. Press “Enter.”

(41) Observe that the state of the “Up Converter Freq” changes on screen 1, item 10, on the laptop. Refresh screen if necessary.

(42) At the NMC/HMC, observe that the "Control Screen," "Up Converter Freq" updates to new figures.

(43) At the HMC, select the "DN Converter Freq" update button. Change to original parameter. Press "Enter."

(44) Observe that the state of the "DN Converter Freq" changes on screen 1, item 11, on the laptop. Refresh screen if necessary.

(45) At the NMC/HMC, observe that the "Control Screen," "DN Converter Freq" updates to new figures.

(46) At the HMC, select the "Save" button.

(47) At the circuit breaker, remove power from the up/down converter units. Wait 30 seconds.

(48) Restore power to the up/down converter units.

(49) At the NMC/HMC, refresh the "Control Screen." Verify that the changes back to the original parameter values were saved.

(50) Review screen 1 of the laptop and verify that the changes were saved. Refresh the screen if necessary.

(51) Remove test equipment and laptop.

(52) At the NMC, select "PA Status," type "1" for "ON," press "Enter."

(53) While monitoring the spectrum analyzer at the IF patch panel, with NOCC's permission turn the modem's RF "ON."

(54) Return site to operational status.

APPENDIX 2. GLOSSARY

A...

ADP
ANICS Demarcation Point.

ADPCM
Adaptive Differential Pulse Code Modulation.

Address
(a) A character or group of characters that identifies a register, a specific part of storage, or some other data source or destination. (b) To refer to a device or an item of data by its address.

Administrator
A person responsible for managing or supervising someone or something (user, hardware, operating system, ATNM software or application). The Administrator managing the ATNM software is titled the ATNM Administrator for the purposes of this document. The person responsible for an ATNM application is titled an Application Administrator for the purposes of this document.

Agent
A TCP/IP device that runs SNMP agent software.

Amplifier
A device used to boost the strength of an electronic signal.

Analog
A signal of continuous energy flow, which varies along one or more of its parameters, amplitude, frequency, and phase.

Analog-to-Digital Conversion (ADC)
Process of converting analog signals to a digital representation. Digital to analog (DAC) represents the reverse translation.

ANICS
Alaskan NAS (National Airspace System) Interfacility Communications System.

ANSI
American National Standards Institute.

Antenna
A device for transmitting and receiving radio waves. Depending on their use and operating frequency, antennas can take the form of a single piece of wire, a di-pole, a grid, such as a yagi array, a horn, a helix, a sophisticated parabolic-shaped dish, or a phase array of active electronic elements of virtually any flat or convoluted surface.

Alert
An alarm or warning signal that a problem has occurred. An alert is a message that indicates a problem condition of some type exists, the type of problem and the severity of the problem.

Alert Threshold
A certain level or boundary that must be reached for an alert condition.

Aperture
A cross sectional area of the antenna which is exposed to the satellite signal.

Apogee
The point in an elliptical satellite orbit which is farthest from the surface of the earth. Geosynchronous satellites which maintain circular orbits around the earth are first launched into highly elliptical orbits with apogees of 22,237 miles. When the communication satellite reaches the appropriate apogee, a rocket motor is fired to place the satellite into its permanent circular orbit of 22,237 miles.

Application
A computer program developed to solve a particular need.

Application Administrator
The person responsible for a particular ATNM application or program.

Architecture
The design and construction of a product.

AIRM
Alarm Reporting Interface Module. A set of GUI and background processes that provide two basic functions: means to monitor and control non-TCP/SNMP devices, and a means to view system messages concerning the status of network circuits and equipment.

Assembly
A number of subassemblies, or any combination thereof, joined together to perform a specific function and capable of disassembly.

Asynchronous Alerts
The alerts that are detected on the asynchronous communication port (TTY) by polling devices or by receiving unsolicited alerts from a device.

Asynchronous Communication
A TTY pod used by ARIM to send and receive serial data.

ATNM
Air Traffic Network Manager.

ATNM Administrator
The person responsible for loading and managing the ATNM software. The ATNM Administrator is responsible for assigning application administrators.

Attenuation
The loss in power of electromagnetic signals between transmission and reception points.

AZ/EL Mount
Antenna mounts that provide for adjustments in the horizontal and vertical axes to move from one satellite to another.

Azimuth
An angle of horizontal rotation from a known reference point.

B...

Band Pass Filter
An active or passive circuit that allows signals within the desired frequency band to pass through, but impedes signals outside this pass band from getting through.

Bandwidth
A measure of spectrum (frequency) use or capacity. For instance, a voice transmission by telephone requires a bandwidth of about 3000 cycles per second (3KHz). A TV channel occupies a bandwidth of 6 million cycles per second (6 MHz) in terrestrial Systems. In satellite-based systems, a larger bandwidth of 17.5 to 72 MHz is used to spread, or "dither," the television signal in order to prevent interference.

Baseband
The basic direct output signal of the multiplex and direct input signal to the modem

Baud
The rate of data transmission based on the number of signal elements or symbols transmitted per second.

Beacon
Low-power carrier transmitted by a satellite that supplies the controlling engineers on the ground with a means of monitoring telemetry data, tracking the satellite, or conducting propagation experiments. This tracking beacon is usually a horn or omni antenna.

Beamwidth
The angular measurement of the shape of the signal transmitted from the antenna. Large antennas have narrower beamwidths and can pinpoint satellites in space or dense traffic areas on the earth more precisely. Tighter beam-widths thus deliver higher levels of power and, thus, greater communications performance.

Bird
Informal language for satellite.

Bit
A single binary digital unit of information – binary unit.

Bit Error Rate (BER)
The fraction of a sequence of message bits that are in error. A bit error rate of 10-6 means that there is an average of one error per million bits.

Bit Rate
The speed of a digital transmission, measured in bits per second.

Broadcast
The sending of one transmission to multiple users in a defined group (compare to unicast).

C...

C
A Computer programming language. All of the ATNM software was written in C.

Category Maintenance Program
An ATNM application that is used to define types and categories to be used in Scene Builder.

Carrier to Noise Ratio (C/N)
The ratio of the received carrier power and the noise power in a given bandwidth, expressed in db. This figure is directly related to G/T and S/N; higher C/N results a in better signal.

Carrier
The basic center of frequency for the transmitted signal. The carrier in an analog signal is modulated by manipulating its amplitude (making it louder or softer), its frequency (shifting it up or down) in relation to the incoming signal, or its phase. Satellite carriers operating in the digital mode are usually phase modulated.

Carrier Frequency
The main frequency on which a voice, data, or video signal is sent. Microwave and satellite communications transmitters operate in the band from 1 to 14 GHz (a GHz is one billion cycles per second).

Cassegrain Antenna
The antenna principle that utilizes a subreflector at the focal point that reflects energy to or from a feed located at the apex of the main reflector.

C Band
This is the band between 4 and 8 Ghz with the 6 and 4 Ghz band being used for satellite communications. Specifically, the 3.7 to 4.2 Ghz satellite communication band is used as the downlink frequencies in tandem with the 5.925 to 6.425 Ghz band that serves the uplink.

CDMA
Code division multiple access. Refers to a multiple-access scheme where stations use spread-spectrum modulations and orthogonal codes to avoid interfering with one another.

CELP
Code excited linear prediction. A bandwidth compression algorithm used for voice transmission.

Channel
A frequency band in which a specific broadcast signal is transmitted, the basic unit of transmission path between two points (can be voice of data), or a communication path providing one-way or two-way transmission between two end points.

Communications Controller Card
The intelligent system dedicated to the control of communications lines and devices.

Configuration
The arrangement of a computer system or network as defined by the nature, number, and the chief characteristics of its functional elements. The functional or physical characteristics (or both) of systems hardware/software.

Connectivity
An established circuit.

Common Carrier
Any organization which operates communications circuits used by other people. Common carriers include the telephone companies as well as the owners of the communications satellites, RCA, Comsat, Direct Net Telecommunications, ATandT and others. Common carriers are required to file fixed tariffs for specific services.

Companding
A noise-reduction technique that applies signal compression at the transmitter and complementary expansion at the receiver.

Conus
Contiguous United States. In short, all the states in the U.S. except Hawaii and Alaska.

Coverage
Zone where the satellite's signals can be received (see footprint).

Cutover
The transfer of a circuit from one routing to another route.

C/No
Carrier-to-noise ratio measured either at the Radio Frequency (RF) or Intermediate Frequency (IF).

Cross Modulation
A form of signal distortion in which modulation from one or more RF carrier(s) is imposed on another carrier.

CSU
Channel service unit. A digital interface device that connects end-user equipment to the local digital telephone loop. CSU is frequently coupled with DSU (see below) as CSU/DSU.

C/T
Carrier-to-noise-temperature ratio.

D...

DAC
Digital to analog conversion (see ADC).

DAMA
Demand-Assigned Multiple Access - A highly efficient means of instantaneously assigning telephony channels in a transponder according to immediate traffic demands.

DBS
Direct Broadcast Satellite. Refers to service that uses satellites to broadcast multiple channels of television programming directly to home-mounted, small-dish antennas.

dBi
The dB power relative to an isotropic source.

dBW
The ratio of the power to one Watt expressed in decibels.

Decibel (dB)
The standard unit used to express the ratio of two power levels. It is used in communications to express either a gain or loss in power between the input and output devices.

Declination
The offset angle of an antenna from the axis of its polar mount as measured in the meridian plane between the equatorial plane and the antenna main beam.

Delay
The time it takes for a signal to go from the sending station through the satellite to the receiving station. This transmission delay for a single hop satellite connection is very close on one-quarter of a second.

Demodulator
A satellite receiver circuit that extracts or "demodulates" the "wanted " signals from the received carrier.

Digital
Binary code used to represent information.

Downlink
The satellite-to-earth half of a 2-way telecommunications satellite link. Often used to describe the receive dish end of the link.

DSU
Data services unit. A device used in digital transmission that adapts the physical interface on a DTE device to a transmission facility such as T1 or E1. The DSU is also responsible for such functions as signal timing. DSU is frequently coupled with a CSU (see above) as CSU/DSU.

Duplex Transmission
Capability for simultaneous data transmission between a sending station and receiving station.

Device
An entity in the network that is to be monitored, usually a piece of hardware.

E...

Earth Station
A ground-based antenna and associated equipment used to receive and/or transmit telecommunications signals via satellite.

Echo Canceller
An electronic circuit which attenuates or eliminates the echo effect on satellite telephony links. Echo cancellers are largely replacing obsolete echo suppressors.

EIRP
Effective Isotropic Radiated Power - This term describes the strength of the signal leaving the satellite antenna or the transmitting earth station antenna, and is used in determining the C/N and S/N. The transmit power value in units of dBW is expressed by the product of the transponder output power and the gain of the satellite transmit antenna, as compared to that of an antenna that radiates equally in all directions.

Elevation
An angle of vertical rotation from a known reference point.

Encoder
A device used to electronically alter a signal so that it can only be viewed on a receiver equipped with a special decoder (see scrambler).

Equatorial Orbit
An orbit with a plane parallel to and concentric with the earth's equator.

E & M
Ear and Mouth. “E” lead receives signal from distant end. “M” lead sends signal to distant end.

Ethernet Card
This card provides the interface to the TCP/IP network.

F...

FDR
Frequency Domain Reflectometer. (Anritsu)

FDMA
Frequency Division Multiple Access. Refers to the use of multiple carriers within the same transponder where each uplink has been assigned frequency slot and bandwidth.

Feed
This term has at least two key meanings within the field of satellite communications. It is used to describe the transmission of video programming from a distribution center. It is also used to describe the feed system of an antenna. The feed system may consist of a subreflector plus a feed horn or a feed horn only.

Focal Length
Distance from the center feed to the center of the dish.

Focal Point
The area toward which the primary reflector directs and concentrates the signal received.

Footprint
A map of the signal strength showing the EIRP contours of equal signal strengths as they cover the earth's surface. Different satellite transponders on the same satellite will often have different footprints of the signal strength. The accuracy of EIRP footprints or contour data can improve with the operational age of the satellite. The actual EIRP levels of the satellite, however, tends to decrease slowly as the spacecraft ages.

Forward Error Correction (FEC)
Adds unique codes to the digital signal at the source so errors can be detected and corrected at the receiver.

Frequency
The number of times that an alternating current goes through its complete cycle in one second of time. One cycle per second is also referred to as one hertz; 1000 cycles per second, one kilohertz; 1,000,000 cycles per second, one megahertz: and 1,000,000,000 cycles per second, one gigahertz.

Frequencies (GHz if not specified)

HF-band	1.8 - 30 MHz
VHF-band	50 - 146 MHz
P-band	0.230 - 1.000
UHF-band	0.430 - 1.300
L-band	1.530 - 2.700
FCC's digital radio	2.310 - 2.360
SHF-band	3 - 30
S-band	2.700 - 3.500
C-band	Downlink: 3.700 - 4.200 Uplink: 5.925 - 6.425 Standard US chart (horizontal) Standard US chart (vertical)
X-band	Downlink: 7.250 - 7.745 Uplink: 7.900 - 8.395
Ku-band (Europe)	Downlink: FSS: 10.700 - 11.700 DBS: 11.700 - 12.500 Telecom: 12.500 - 12.750 Uplink: FSS and Telecom: 14.000 - 14.800 DBS: 17.300 - 18.100
Ku-band (America)	Downlink: FSS: 11.700 - 12.200 DBS: 12.200 - 12.700 Uplink: FSS: 14.000 - 14.500 DBS: 17.300 - 17.800
Ka-band	has multiple acceptations... roughly: 18 - 31 GHz
EHF-band	30 - 300
V-band	36 - 51.4

Frequency Band
A part of the radio spectrum used by the FAA to carry communications between controllers and pilots.

Frequency Allocation
Designated frequency bands for use by ANICS. ANICS = “C” band 3700-4200 MHz to receive and 5950-6450 MHz for transmit.

Front-End Processor
A communications controller. The front-end processor is attached to the channels of one or more host systems, and it accepts data from its host processes for subsequent transmission to the appropriate devices. It also accepts data from the terminal devices or other communications controllers for routing to the proper host system.

Full Image
Pertaining to a disk or tape; a faithful likeness of the subject matter on the original.

Functional Areas
The functional breakout of the ANICS system.

Functional Area 1
Antenna System

Functional Area 2
Radio Frequency (RF) Equipment

Functional Area 3
Satellite Modems

Functional Area 4
Multiplexer (Mux)

Functional Area 5
ANICS Demarcation Point (ADP)

Functional Area 6
Power Systems

Functional Area 7
Network Monitor and Control (NMC/HMC/RMC)

G...

Gain
A measure of signal increase expressed in dB.

Gateways
The devices that serve as bridges between different types of networks.

Geostationary
Refers to a geosynchronous satellite angle with zero inclination; the satellite appears to hover over one spot on the earth's equator. The rotation speed of the satellite is the same as earth’s.

Geosynchronous
The elliptical orbit in the Clarke belt above the equator. For a planet, the size, mass, and rotational speed of the earth, this point is 22,237 miles above the surface.

Gigahertz (GHz)
One billion cycles per second. Signals operating above 3 Gigahertz are known as microwaves: above 30 GHz they are know as millimeter waves. As one moves above the millimeter, waves signals begin to take on the characteristics of light waves

Graphical User Interface
User interfaces that enable users to manipulate objects on the computer screen in much the same way they manipulate objects on their desk.

GSIM
See Graphical Subsystem Interface Module

G/T
A figure of merit of an antenna and low noise amplifier combination expressed in dB. "G" is the net gain of the system and "T" is the noise temperature of the system. The higher the number, the better the system.

Graphical Subsystem Interface Module (GSIM)
An ATNM application that presents the Operator with a graphical Module (GSIM) display of the network.

GUI
Graphical User Interface.

H...

Hertz (Hz)
A measurement of frequency in cycles per second. An electromagnetic wave completes a full oscillation from its positive to its negative pole and back again, in what is known as a cycle. A single Hertz is thus equal to one cycle per second.

Hostess Multiport Serial Card
An IBM compatible PC expansion card built by Hostess. It provides multiple serial ports for access to several serial devices while using only one expansion slot.

Hub
A central station where communications paths are concentrated and command and control is done.

I...

Icon
A small graphical image that represents something. For example, an icon can represent a type of device in the network or an icon can represent an application.

Inclination
The angle between the orbital plane of a satellite and the equatorial plane of the earth.

INTELSAT
The International Telecommunications Satellite Organization operates a network of satellites for international transmissions.

Interference
Received energy that modifies the reception of the desired signals, such as fading of signals reflected off of airplanes, RF interference from adjacent channels, or ghosting from reflecting objects such as mountains and buildings.

Informix
A relational database product that is used by the ATNM software.

Intercom
A type of call that provides stations (positions) intra-facility communications on a voice switch.

J…

J-7 Database
FAA-provided database listing circuits that may be used in the ANICS network.

K...

KBPS
Kilobits Per Second. Refers to transmission speed of 1,000 bits per second.

Kelvin (K)
The temperature measurement scale used in the scientific community. Zero K represents absolute zero, and corresponds to minus 459 degrees Fahrenheit or minus 273 Celsius. Thermal noise characteristics of LNA are measured in degrees Kelvin.

Kilohertz (kHz)
Refers to a unit of frequency equal to 1,000 Hertz.

Ku Band
The frequency range from 10.9 to 17 GHz.

L...

LAN
See Local Area Network.

L-Band
The frequency range from 0.5 to 1.5 GHz. Also used to refer to the 950 to 1450MHz used for mobile communications.

Leased Line
A dedicated circuit typically supplied by the local exchange carrier.

LED
Light Emitting Diode, used to indicate status of equipment.

Low Noise Amplifier (LNA)
This is the preamplifier between the antenna and the earth station receiver. For maximum effectiveness, it must be located as near the antenna as possible, and is usually attached directly to the antenna receive port. The LNA is especially designed to contribute the least amount of thermal noise to the received signal.

Local Area Network (LAN)
A network confined to a limited geographical area with moderate to high data rates.

Lowest Repairable Unit (LRU)
An equipment module within ANICS which can be replaced or repaired as a unit.

LRU (Lowest Repairable Unit)
See lowest repairable unit.

M...

Manager Module
An ATNM application that monitors devices. The ATNM Manager Modules are SNMP Manager and Alarm Reporting Interface Module.

Megahertz (MHz)
Frequency equal to one million Hertz, or cycles per second.

Microwave
Line-of-sight, point-to-point transmission of signals at high frequency.

Microwave Interference
Interference that occurs when earth's station aimed at a distant satellite picks up a second, often stronger signal, from a local telephone terrestrial microwave relay transmitter. Microwave interference can also be produced by nearby radar transmitters as well as the sun itself. Relocating the antenna by only several feet will often completely eliminate the microwave interference.

Modulation
The process of manipulating the frequency or amplitude of a carrier in relation to an incoming video, voice or data signal.

Modulator
A device that modulates a carrier.

Modular System
A system composed of many components that can be independently executed.

Module
A limited aggregate of LRUs, data, and contiguous codes that performs independent functions. Typically, modules are used repeatedly in the construction of the system.

Monitored Device
Any device that is monitored using the ATNM Manager Modules.

Motif
The user environment based on the X Windows System. It assists in creating and manipulating windows on your screen.

Multicast
Multicast is a subset of broadcast that extends the broadcast concept of one to many by allowing "the sending of one transmission to many users in a defined group, but not necessarily to all users in that group."

Multiplexer (Mux)
Electronic equipment that combines two or more signals on one communications circuit.

Multiplexing
Techniques that allow a number of simultaneous transmissions over a single path.

Multi-Domain Network
A network with more than one System Service Control Point (SSCP). A SSCP activates, controls, and deactivates network resources that have been defined to that SSCP as being in its domain.

Multi-Tasking
The ability to run several processes simultaneously.

Multi-Vendor Network
A network that consists of devices from many different vendors.

Multiport Serial Card
See Hostess Multiport Serial Card.

Mux
See multiplexer.

N...

Network
Two or more computers connected by a communication system that allows exchange of information between them.

Noise
Any unwanted and unmodulated energy within a signal.

Network Operations Control Center (NOCC)
The operating location that monitors and controls the ANICS network. Comprised of Network Management Computers (NMC), Hub Management Computers, Remote Management Computers, Routers, and ATNM software communicating via the TIPC and SIPC processes.

Noise Figure (NF)
A term that is a figure of merit of a device, such as an LNA or receiver, expressed in dB, which compares the device with an ideal device.

Network Management Control System (NMCS)
Distributed system that monitors and controls the ANICS network.

O…

Operator
The ATNM Administrator and the Application Administrators have set up any person who uses the ATNM software after it.

P...

Packet Switching
Data transmission method that divides messages into standard-sized packets for greater efficiency of routing and transport through a network.

Parabolic Antenna
The most frequently used satellite antenna, it takes its name from the shape of the dish described mathematically as a parabola. The function of the parabolic shape is to focus the weak microwave signal hitting the surface of the dish into a single focal point in front of the dish. It is at this point that the feedhorn is usually located.

Perigee
The orbital point were the satellite is closest to the earth.

Polarization
A technique used by the satellite designer to increase the capacity of the satellite transmission channels by reusing the satellite transponder frequencies. In linear cross-polarization schemes, half of the transponders beam their signals to earth in a vertically polarized mode; the other half horizontally polarize their down links. Although the two sets of frequencies overlap, they are 90 degrees out of phase, and will not interfere with each other. To successfully receive and decode these signals on earth, the earth station must be outfitted with a properly polarized feedhorn to select the vertically or horizontally polarized signals as desired. In some installations, the feedhorn has the capability of receiving the vertical and horizontal transponder signals simultaneously, and routing them into separate LNA's for delivery to two or more satellite television receivers. Unlike most domestic satellites, the Intelsat series uses a technique known as left-hand and right-hand circular polarization.

Polar Orbit
An orbit with its plane aligned in parallel with the polar axis of the earth.

Pulse Code Modulation
A time division modulation technique in which analog signals are sampled and quantified at periodic intervals into digital signals. The values observed are typically represented by a coded arrangement of eight (8) bits of which one may be for parity.

Program Control
The interaction between the software and the hardware of the switching system that determines the time and sequence in which processing occurs. The relationship between a set of instructions and the electronics incorporated into the design of the switching system that enables that system to recognize and perform tasks by interactive user commands or without further intervention by a system user.

PSK
Phase shift keying is used by modems to transmit digital signals over analog phone lines.

Q...

QPSK - Quadrature Phase Shift Keying
System of modulating a satellite signal that translates digital 1's and 0's into each quadrent (90 degrees) of the transmit IF frequency.

R...

Rain Outage
Loss of signal due to absorption and increased sky-noise temperature caused by heavy rainfall.

Receiver (Rx)
An electronic device which receives a radio signal and is capable of decoding an encoded message.

Receiver Sensitivity
Expressed in dBm this tells how much power the detector must receive to achieve a specific baseband performance, such as a specified bit error rate or Eb/No ratio.

Relational Database Engine
A database product based on a relational model. Data can be accessed using Structured Query Language (SQL).

Router
Network layer device that determines the optimal path along which network traffic should be forwarded. Routers forward packets from one network to another based on network layer information.

S...

Satellite
A microwave receiver, repeater, regenerator in orbit above the earth.

SCO XENIX
Operating system within the ANICS network used in the TMS Controller.

SCO UNIX
Operating system within the ANICS network used the RMC.

Scrambler
A device used to electronically alter a signal so that it can only be viewed or heard on a receiver equipped with a special decoder (see encoder).

Script Files
Any file that contains a series of commands to be executed.

Serial Interface Process Communications (SIPC)
Communications protocol used at the remote sites between the RMC and peripheral equipment.

Severity of an Alarm
The status of a device. A color is associated with the severity's to represent the status of a device when displayed in the Fault Management System. There are six severity's that are recognized by the ATNM software.

Severity	Color	Description
5	Red	The highest severity, usually the most critical.
4	Yellow	The second highest severity, usually used to represent a warning.
3	Gray	Severity's 2 and 3 are supplemental severities used by the Application Administrators to make the Operators aware of a special status.
2	Rust	Severity's 2 and 3 are supplemental severity's used by the Application Administrators to make the Operators aware of a special status.
1	Green	The lowest color represented severity, usually to represent a good status.
0	None	Sends informational messages to the Extended Network Manager alert screen.

Sidelobe
Off-axis pattern of an antenna.

Signal to Noise Ratio (S/N)
The ratio of the signal power to noise power.

Simple Network Management Protocol (SNMP)
A protocol for managing network devices.

Single Point of Failure
A failure of a single item that has the effect of failing an entire service or system.

SIPC
See serial interface process communications.

SL-GMS
The dynamic graphics software that is used by GSIM. It is software developed by Sherril Lubinsky-Corporation.

Slot
That longitudinal position in the geosynchronous orbit into which a communications satellite is "parked." Above the United States, communications satellites are typically positioned in slots that are based at two to three-degree intervals.

S/N
See signal to noise ratio.

Solar Outage
Solar outages occur when an antenna is looking at a satellite, and the sun passes behind or near the satellite and within the field of view of the antenna. This field of view is usually wider than the Beamwidth. Solar outages can be exactly predicted as to the timing for each site.

Spectrum
The range of electromagnetic radio frequencies.

Spot Beam
A focused antenna pattern sent to a limited geographical area. Domestic satellites use spot beams to deliver certain transponder signals to geographically, well-defined areas such as Hawaii, Alaska, and Puerto Rico.

SDPM
See system degradation performance monitor.

SNMP
See simple network management protocol.

SQL
Structured query language; used in relational database management systems.

SSPA
Solid state power amplifier.

Subassembly
Two or more parts that form a portion of an assembly or a unit replaceable as a whole, but having part or parts that are individually replaceable.

Stationkeeping
Minor orbital adjustments that are conducted to maintain the satellite's orbital assignment within the allocated "box" within the Geostationary arc.

Synchronization (Sync)
The process of orienting objects or processes so that they can be made to work in unison.

System Performance Degradation Monitor (SPDM)
Software application within the ATNM program that monitors link performance characteristics andANICS alarms then relays this information to the GSIM monitors in the NOCC.

T...

T1
The transmission bit rate of 1.544 millions bits per second.

T3 Channel (DS-3)
In North America, a digital channel which communicates at 45.304 Mbps.

TCP/IP
Transmission control protocol/internet protocol. Part of the internet suite of computer-communication protocols.

TIPC
TCP Interface Process Communications. Communications protocol used within the ANICS network between the major hubs and the remote sites.

TMS
Transport Management System.

TMS Controller
A device (PC) used to monitor, gather, store and forward link performance and alarm information to the NMC and HMC at ZAN. Monitors bit error rate throughout the multiplexer network.

Top-Level Scene
The top screen in a GSIM.

Transmitter
Equipment that sends radio signals to the outside world that are picked up by receivers.

TDMA
Time Division Multiple Access. Refers to a form of multiple access where a single carrier is the shared by many users. Signals from earth stations reaching the satellite consecutively are processed in time segments without overlapping.

Transmitter
An electronic device consisting of oscillator, modulator, and other circuits that produce a radio or television electromagnetic wave signal for radiation into the atmosphere by an antenna.

Transponder
A combination receiver, frequency converter, and transmitter package, physically part of a communications satellite. Transponders have a typical output of five to ten watts, operate over a frequency band with a 36 to 72 megahertz bandwidth in the L, C, Ku, and sometimes Ka Bands or, in effect, typically in the microwave spectrum, except for mobile satellite communications. Communications satellites typically have between 12 and 24 onboard transponders although the INTELSAT VI at the extreme end has 50.

TTY
Serial communications port or devise.

Tweaking
The process of adjusting an electronic device to optimize its performance.

U...

UDC
Universal data card.

Uplink
The link from an earth station up to a satellite.

Unit
An assembly or any combination of parts, subassemblies, and assemblies mounted together, normally capable of independent operation in a variety of situations.

UNIX
A multi-user, multi-tasking operating system. UNIX

UNIX System Administrator
The person responsible for managing a UNIX server. The responsibilities include adding and deleting users, system configuration, network communications, backups and restores.

Unsolicited alert
Alerts that are automatically received without polling.

Utility Program
A computer program in general support of the processes, cornpldeq, e.g., loading shodhg race routines, or copong data from one storage device to another.

UVC
Universal Voice Card.

V...

V.35
ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and in Europe, and is recommended for speeds up to 48 KBPS.

VLBRV
Very Low Bit Rate Voice.

VSWR
Voltage Standing Wave Ratio. A measurement of mismatch in a cable, waveguide, or antenna system.

W...

Waveguide
A metallic microwave conductor used to carry microwave signals into and out of microwave antennas.

X...

X/Open
An independent, worldwide, open systems organization supported by most of the world's largest information system suppliers, user organizations and software companies. Its goal is to bring greater value to users through the practical implementation of open systems. To achieve this goal, it sets standards that are needed to support open systems. Open systems ensure portability and connectivity of applications and allow users to easily move between systems.

X terminals
Network display stations or advanced graphics terminals that include a high resolution bit-mapped display, a keyboard, a mouse, and supports version 11 of the X Window System.

XENIX
SCO version of UNIX software used within ANICS in the TMS Controller.