ARINC

# GATE-AIRCRAFT TERMINAL ENVIRONMENT LINK (GATELINK)- AIRCRAFT SIDE

## ARINC CHARACTERISTIC 751

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# GATE-AIRCRAFT TERMINAL ENVIRONMENT LINK (GATELINK) - AIRCRAFT SIDE

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Prepared by the Airlines Electronic Engineering Committee

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# FOREWORD

## Activities of AERONAUTICAL RADIO, INC. (ARINC)

## and the

## Purpose of ARINC Characteristics

Aeronautical Radio, Inc. is a corporation in which the United States scheduled airlines are the principal stockholders. Other stockholders include a variety of other air transport companies, aircraft manufacturers and non-U.S. airlines.

Activities of ARINC include the operation of an extensive system of domestic and overseas aeronautical land radio stations, the fulfillment of systems requirements to accomplish ground and airborne compatibility, the allocation and assignment of frequencies to meet those needs, the coordination incident to standard airborne compatibility, the allocation and assignment of frequencies to meet those needs, the coordination incident to standard airborne communications and electronics systems and the exchange of technical information. ARINC sponsors the Airlines Electronic Engineering Committee (AEEC), composed of airline technical personnel. The AEEC formulates standards for electronic equipment and systems for the airlines. The establishment of Equipment Characteristics is a principal function of this Committee.

An ARINC Equipment Characteristic is finalized after investigation and coordination with the airlines who have a requirement or anticipate a requirement, with other aircraft operators, with the Military services having similar requirements, and with the equipment manufacturers. It is released as an ARINC Equipment Characteristic only when the interested airline companies are in general agreement. Such a release does not commit any airline or ARINC to purchase equipment so described nor does it establish or indicate recognition of the existence of an operational requirement for such equipment, not does it constitute endorsement of any manufacturer's product designed or built to meet the Characteristic/ An ARINC Characteristic has a twofold purpose, which is:

(1) To indicate to the prospective manufacturers of airline electronic equipment the considered opinion of the airline technical people, coordinated on an industry basis, concerning requisites of new equipment, and

(2) To channel new equipment designs in a direction which can result in the maximum possible standardization of those physical and electrical characteristics which influence interchangeability of equipment without seriously hampering engineering initiative.

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ATTACHMENTS

# 1.0 INTRODUCTION

## 1.1 Purpose of this Document

This document contains the physical form and fit dimensions, the electrical and optical interface definitions, and a description of the functional operation of Gatelink. The intent of this document is to provide general and specific design guidance for the performance and installation of Gatelink. As such, this document describes the desired operational capabilities and the use of standards necessary to achieve hardware interchangeability.

## 1.2 Gatelink Description

Gatelink is a high speed, full duplex communication link between a communication system inside the airport terminal (or at the maintenance position) and a communication system onboard a parked aircraft. In this environment, Gatelink supports a Physical Medium Dependent (PMD) to PMD FDDI connection by specifying two physical media characteristics that employ infrared (IR) and fiber optic technologies. Gatelink specifications also ensure that the system is testable and that components are interchangeable. The IR Gatelink connection between the airport terminal and the aircraft is line-of-sight infrared through an atmospheric path ("wireless") (see Figure 1-1). The advantage of this method is that an FDDI connection is established automatically during parking at the passenger boarding bridge without ground personnel intervention. The fiber Gatelink connection is established through a ground fiber optic cable that mates with a fiber optic receptacle on the aircraft (see Figure 1-2). This method depends upon the ground crew to physically connect and disconnect the fiber to and from the aircraft.

Neither method is preferred over the other, however, two units are necessary if a redundant system is desired.

As depicted in Figure 1-3, data originating from a ground based network system transits an ATN router en route to the transceivers or the umbilical. Data is transmitted to the parked aircraft at the gate via an IR beam or a fiber optic cable depending on the mode of connection selected. Attachment 2 provides a detailed diagram of the Gatelink system.

### 1.2.1 Gatelink Scope

The scope of this document is as depicted in Figure 1-3 and includes:

- the form, fit, and function of the aircraft transceiver unit (ATU),
- the IR signal in space definition between the ATU and the ground transceiver unit (GTU),
- the form and fit of the expanded beam connector receptacle, which also defines the fit requirement for the expanded beam connector plug,
- the aircraft internal fiber harness including connectors to the ATU and the ATN router.

This document should be used in conjunction with ARINC Specification 636 and 632 which describes the Onboard Local Area Network and the Ground Gatelink Environment, respectively.

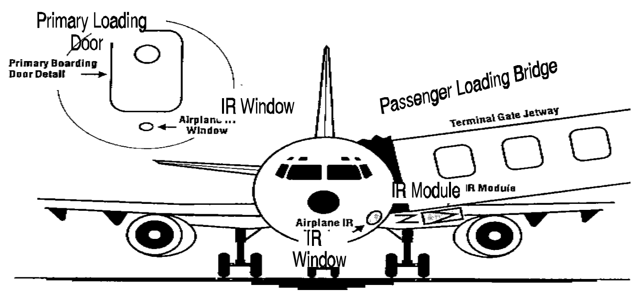



**Figure 1-1**
**IR Connection**

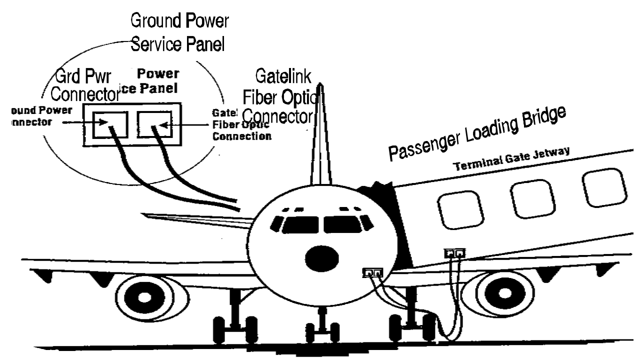



**Figure 1-2**
**Fiber Connection**

### 1.2.2 Relationship of this Document to ARINC Specifications

The aeronautical industry has recognized the need to apply internationally recognized standard protocols that were developed according to the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Basic Reference Model. The aeronautical industry has chosen to implement standard protocols that conform to the OSI Reference Model as appropriate, and to permit the use of developments in accordance with existing internationally accepted data communications standards.

## 1.0 INTRODUCTION (cont'd)

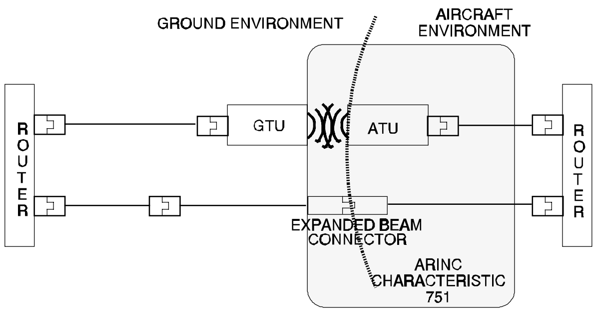



**Figure 1-3**
**Gatelink Architecture**

ARINC Characteristic 751 describes a PMD interface for ARINC Specification 636. ARINC 636 defines the first two layers and is based on two ISO standards; Fiber Distributed Data Interface protocol (ISO 9314) and Logical Link Control protocol (ISO 8802-2). Network and upper layers specifications are defined by ARINC 637 and ARINC 638, respectively. It is assumed that the reader of this characteristic is familiar with the terminology and technical details of ARINC 636 and ISO 9314. If this is not the case, the reader is encouraged to consult the documents listed in Section 1.7 of this characteristic.

### 1.3 Interchangeability

One of the primary functions of an ARINC Characteristic is to specify, in addition to performance parameters, the interchangeability desired by the airline users. Gatelink equipment designed by different manufacturers should be capable of interchangeable use in various aircraft and airport installations. This is especially important for Gatelink because of the wide variety of aircraft and passenger loading bridges used by different airlines.

While every effort is made to completely define all interface requirements, unanticipated problems may arise in the equipment development and integration programs. Manufacturers are encouraged to bring these discrepancies to the attention of the AEEC staff in order that every effort can be made to achieve interchangeability.

#### 1.3.1 Transceiver Units

The form, fit, and interface for the ATU defined in Section 2 should ensure interchangeability between different vendors' ATUs. It is not intended that ATUs should be interchangeable with GTUs.

#### 1.3.2 Umbilical

The form and fit of the umbilical is defined in Section 2 in order that any manufacturer should be able to build interchangeable connectors.

### 1.4 Interoperability

#### 1.4.1 Transceiver Units

It is the intention of this Characteristic to define the interface between the ATU and GTU to ensure interoperability between different vendors' units. This Characteristic specifies the infrared signal-in-space requirements and the location of the ATU on the aircraft. ARINC Specification 632 recommends the location of the GTU. If these guidelines are adhered to, the Gatelink system should interoperate regardless of which vendors' equipment is used.

#### 1.4.2 Umbilical

It is the intention of this Characteristic to define the umbilical connector such that any vendor may manufacture interchangeable and interoperable components.

### 1.5 Regulatory Approval

The Gatelink equipment should meet all applicable national and local aeronautical, communications, and safety regulatory requirements.

### 1.6 Definition of Terms Used in this Document

Definition of terms and abbreviations used in this document are provided in Attachment 1.

### 1.7 Applicable Documents

The following documents are referred to in this document and are applicable to the extent specified herein:

ANSI X3T9/92-067, X3t9.5/84-49, REV. 7.2; FDDI Station Management (SMT), Draft Proposed American National Standard, June 25, 1992.

ARINC Specification 429, Mark 33 Digital Information Transfer System (DITS).

ARINC Specification 604, Guidance for Design and Use of Built-In Test Equipment (BITE).

ARINC Report 404A, Air Transport Equipment Cases and Racking.

ARINC Specification 600, Air Transport Avionics Equipment Interfaces.

ARINC Specification 624, Design Guidance for Onboard Maintenance System (OMS).

ARINC Specification 626, Standard Atlas Subset for Modular Test.

## 1.0 INTRODUCTION (cont'd)

ARINC Specification 636, Onboard Local Area Network (OLAN).

ARINC Report 627, Programmers Guide for SMART™ System Using ARINC 626 ATLAS.

ARINC Specification 637, Internetworking Specification.

ARINC Specification 638, Upper Layers Specification.

ARINC Specification 632, Gate-Aircraft Terminal Environment Link - Gatelink, Airport Side.

ISO 7498, Information processing systems - Open Systems Interconnection - Basic Reference Model.

ISO 9314-1: 1989, Information processing systems- Fibre Distributed Data Interface (FDDI) - Part 1: Token Ring Physical Layer Protocol (PHY).

ISO 9314-2: 1989, Information processing systems- Fibre Distributed Data Interface (FDDI) - Part 2: Token Ring Media Access Control (PHY).

ISO 9314-3: 1990, Information processing systems- Fibre Distributed Data Interface (FDDI) - Part 3: Token Ring Physical Layer Medium Dependent (PMD).

RTCA/DO-160C, Environmental Conditions and Test Procedures for Airborne Equipment.

RTCA/DO-178B, Software Considerations in Airborne Systems and Equipment Certification.

# 2.0 INTERCHANGEABILITY STANDARDS

## 2.1 Introduction

This section sets forth the specific form factor, mounting provisions, interwiring, input/output interfaces, and power supply characteristics desired for the Gatelink equipment. These standards permit the parallel but independent design of compatible equipment and airframe and airport installations.

## 2.2 Aircraft Transceiver Unit (ATU)

The ATU provides the wireless atmospheric infrared line-of-sight path. A simplified block diagram depicting the interfaces to the ATU is shown in Figure 2-1. A detailed block diagram is provided as Attachement 3.

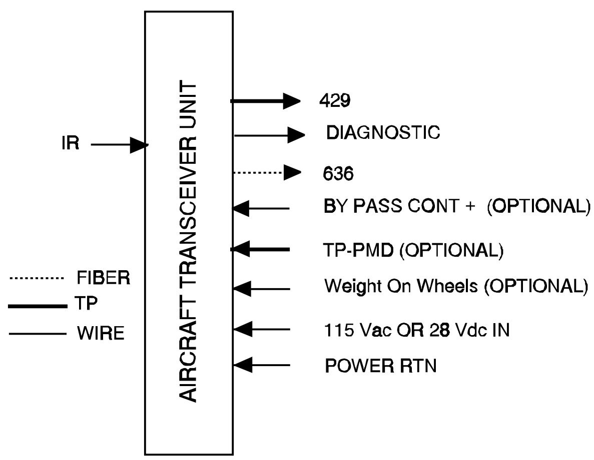



**Figure 2-1**
**Aircraft Transceiver Unit (ATU)**

COMMENTARY

> Either fiber or shielded twisted pair may be used to connect the ATU to the aircraft router. The fiber connection uses 2 fibers in accordance with ARINC Specification 636. The wire connection adheres to the TP-PMD specification (ISO 9314-6) and requires 4 pairs of shielded wires. The choice of media will depend on the installation.

### 2.2.1 Form Factor, Connector, and Index Pin Coding

The ATU module is mounted on a plate which is attached to a doubler. The doubler may be attached to either inside or outside of the surface of the aircraft skin. An example is shown in Figure 2-2. The dimensions of the mounting plate and the details of its attachment should be determined based on structural considerations for each airframe. The mounting pattern shown in Figure 2-2 ensures correct alignment when mounting the ATU.

The ATU installs from the outside. The ATU connector is a MIL-C-38999 Series III, contact arrangement 21-39, normal keying. A pin receptacle, either box mount or jam nut style, is fixed on the ATU, and mates with a socketed plug on the airplane. The connector cable should have sufficient service loop to permit the connector to be attached to the ATU before the ATU is installed. ATU orientation is fixed by one or more alignment pins.

Figure 2-2, also reproduced as Attachment 12, shows the maximum package size for the ATU. The ATU body and flange diameters should be consistent. The doubler flange should match the airframe mounting provisions for consistent alignment of the ATU. Flange thickness should be selected to be flush with the aircraft skin. Maximum length is limited by the aircraft's frame depth. The indicated 5.3" maximum is expected to fit most larger aircraft. Installation on smaller aircraft may impose additional limitations on package length.

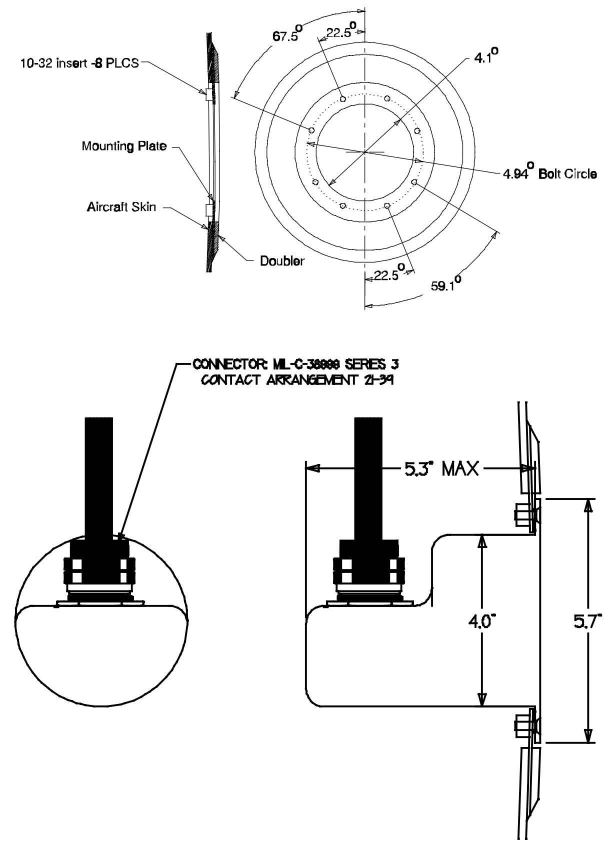



**Figure 2-2**
**ATU Maximum Size**

Connector should be selected for optimal cable routing. The connector may extend beyond the 4.0" diameter as shown, provided that corresponding clearance is provided to permit the ATU to be maneuvered through its mounting hole. The connector may be rear mounted, provided that the connector body and the cable do not exceed the maximum length for the installation.

The ATU interfaces to the other aircraft systems via a 39 pin connector. This connector supports both shielded twisted pair and optical fiber contacts. The contact arrangement for the connector is shown as Attachement 4. The pin assignments are provided in Table 1, Attachement 5.

## 2.0 INTERCHANGEABILITY STANDARDS (cont'd)

### 2.2.2 Primary Power Input

The ATU should be designed to accept 115 Vac or 27.5 Vdc power.

COMMENTARY

It may be desirable for the ATU to be switched off during flight to extend the life of the equipment. An optional input to the ATU has been defined which may be used to switch the power to the ATU. Examples of common aircraft signals that could be used are Weight_on_Wheels or Park_Brake_Set.

### 2.2.3 Power Consumption

Steady state ATU power consumption should not exceed 21 watts.

### 2.2.4 System Functions and Signal Characteristics

A list of the system functions and signal characteristics defined to ensure the desired level of interchangeability for the ATU is set forth in Sections 3 and 4.

### 2.2.5 Environmental Conditions

The ATU should meet the requirements of the current version of the RTCA DO-160C. Attachment 9 specifies the relevant environmental categories.

### 2.2.6 Cooling

The ATU should be cooled adequately via conduction to the aircraft skin.

## 2.3 Aircraft Umbilical Fiber Harness

### 2.3.1 Umbilical Receptacle Form Factor

The umbilical receptacle dimensions should comply with the envelope shown in Attachment 8.

### 2.3.2 Umbilical Receptacle Insert Arrangement

The umbilical receptacle should be multifiber and accommodate a minimum of two fiber inserts. The receptacle should comply with the fiber insert positions shown in Attachment 8.

### 2.3.3 Signal Characteristics

The signal characteristics required to ensure the desired level of interchangeability for the fiber connection are set forth in Sections 3 and 4.

### 2.3.4 Environmental Conditions

The aircraft fiber optic cable connector should meet the requirements of the current version of the RTCA Document DO-160C as described in Attachment 9.

## 2.4 Connectors

### 2.4.1 Umbilical Connector

The umbilical connector (comprised of a plug and receptacle) should be an expanded beam (lensed) type connector with a casing that protects the optical fiber elements. The casing of the fiber optic elements should incorporate a feature to prevent angular rotation of the installed termini to ensure repeatability of optical performance. The connector should incorporate keying or other suitable means to ensure that connectors of different polarizations cannot be mated. The graded index fiber type is specified to ensure adequate bandwidth over the expected aircraft cabling distances and will accommodate performance upgrades in the future.

The umbilical connector provides a push-pull type connection with a positive detent to indicate connection. The connector plug is used in ground operations and should be extremely rugged and durable. The connection mechanism should facilitate easy connection/disconnection by ground service personnel under circumstances of reduced grip, e.g., gloved hands and/or cold conditions. The ability to quickly mate and demate in conditions of impaired dexterity takes precedence over coupling strength. The coupling mechanism, however, should be capable of supporting the weight of the umbilical cable that extends between the ground and the aircraft with a significant safety margin to prevent accidental demating. The coupling mechanism should incorporate an anti-rotation feature to ensure proper mating is maintained under all conditions. Also, the coupling mechanism should ensure proper alignment of the connector, e.g., keying, before engagement of the coupling mechanism to allow blind mating.

The connector plug should be encased in a heavy duty elastomer to protect internal components from damage. The plug assembly should incorporate a dust cover that is physically attached to the plug assembly and defaults to the closed position automatically when not in use, i.e., the dust cover may be opened manually for connection but closes automatically when removed from the receptacle.

The connector receptacle should be located in the vicinity of the aircraft's Ground Power Service Panel to facilitate connection in conjunction with connection of ground electrical power to the aircraft. The umbilical connector receptacle should have an integral spring-loaded environmental cover that is physically attached to the receptacle and defaults to the closed position automatically when not in use, i.e., the cover may be opened manually for connection but closes automatically when removed from the receptacle.

## 2.5 Grounding and Bonding

The attention of equipment and airframe manufacturers is drawn to the guidance material in Section 3.2.4 of ARINC Specification 600 on the subject of equipment and radio rack grounding and bonding.

## 2.0 INTERCHANGEABILITY STANDARDS (cont'd)

2.6 Standardized Signaling

The standard electrical inputs and outputs from the systems should be in the form of a digital format or switch contact. These standards should be followed to assure the desired interchangeability of equipment.

Certain basic standards established herein are applicable to all signals and should conform with the standards set forth in the subparagraphs below.

2.6.1 ARINC 429 DITS Data Bus

ARINC Specification 429, "Mark 33 Digital Information Transfer System (DITS)," is the controlling document for data word formats, refresh rates, resolutions, etc. Material in this document on these topics is included for reference purposes only. In the event of conflict between this document and ARINC Specification 429, the latter should be assumed to be correct.

2.6.2 Standard "Open"

The standard "open" signal is characterized by a resistance of 100,000 Ohms or more with respect to signal common.

COMMENTARY

In many installations, a single switch is used to supply a logic input to several LRUs. One or more of these LRUs may utilize a pull-up resistor in its input circuitry. The result is that an "open" may be accompanied by the presence of +27.5 Vdc nominal. The signal could range from 12 to 36 Vdc.

2.6.3 Standard "Ground"

A standard "ground" signal may be generated by either a solid state or mechanical type switch. For mechanical switch-type circuitry a resistance of 10 Ohms or less to signal common would represent the "ground" condition. Semiconductor circuitry should exhibit a voltage of 3.5 Vdc or less with respect to signal common in the "ground" condition.

2.6.4 Standard "Applied Voltage" Output

The standard "applied voltage" is defined as having a nominal value of +27.5 Vdc. This voltage should be considered to be "applied" when the actual voltage under the specified load conditions exceeds 18.5 Volts (+36 Vdc maximum) and should be considered to be "not applied" when the equivalent impedance to the voltage source exceeds 100,000 Ohms.

2.6.5 Standard Discrete Input

A standard discrete input should recognize incoming signals having two possible states, "open" and "ground." The characteristics of these two states are defined in Sections 2.6.2 and 2.6.3 of this document. The maximum current flow in the "ground" state should not exceed 20 milliamperes.

The "true" condition may be represented by either of the two states (ground or open) depending on the aircraft configuration.

COMMENTARY

In past installations there have been a number of voltage levels and resistances for discrete states. The assignments of "Valid" and "Invalid" states for the various voltage levels and resistances were sometimes interchanged, and caused additional complications. In this document, a single definition of discrete levels is specified in an attempt to "standardize" conditions for discrete signals. The voltage levels and resistances used are, in general, acceptable to hardware manufacturers and airlines. This definition of discretes is also being used in the other 700-Series Characteristics; however, there are few exceptions for special conditions.

The logic sources for the discrete inputs to the ATU are expected to take the form of switches mounted on the airframe component (flap, including gear, etc.) from which the input is desired. These switches either connect the discrete input pins on the connector to airframe dc ground or leave them open circuit as necessary to reflect the physical condition of the related components. The ATU provides the dc signal to be switched. Typically, this is done through a pull-up resistor. The ATU input should detect the voltage on each input to determine the state (open or closed) of each associated switch.

The selection of the values of voltages (and resistances) which define the state of an input is based on the assumption that the discrete input uses a ground-seeking circuit. When the circuit senses a low resistance or a voltage of less than 3.5 Vdc, the current flow from the input signifies a "ground" state. When a voltage level between 18.5 and 36 Vdc is present or a resistance of 100,000 Ohms or greater is presented at the input, little or no current should flow. The input may utilize an internal pull-up to provide for better noise immunity when a true "open" is present at the input. This type of input circuit seems to be the "favorable" among both manufacturers and users.

Because the probability is quite high that the sensors provide similar information to a number of users, the probability is also high that unwanted signals may be impressed on the inputs to the ATU from other equipment, especially when the switches are in the open condition. For this reason, equipment manufacturers are advised to base their logic sensing on the "ground" state of each input.

COMMENTARY

An isolation diode could be used to electrically isolate the unit when it is not powered.

## 2.0 INTERCHANGEABILITY STANDARDS (cont'd)

### 2.6.6 Standard Discrete Output

A standard discrete output should exhibit two states, "open" and "ground", as defined in Sections 2.6.2 and 2.6.3. In the "open" state, provision should be made to present an output resistance of at least 100,000 Ohms. In the "ground" state provision should be made to sink at least 20 milliamperes of current. Non-Standard current sinking capability may be defined.

COMMENTARY

> Not all discrete output needs can be met by the standard discrete output defined above. Some discrete outputs may need to sink more current than the standard value specified above.

A discrete output may need to source current. Discrete outputs which are to source current should utilize the standard "Applied Voltage" output defined in Section 2.6.4. These special cases are noted in the text describing each applicable discrete output function and in the notes to interwiring.

COMMENTARY

> Although defined here, discrete outputs which provide a current output rather than a current sink are not "standard discrete outputs."

### 2.6.7 Standard Program Pin Input

Program pins may be assigned on the ATU service connector for the purpose of identifying a specific aircraft configuration or to select (enable) optional performance. The optional operational function may be in effect at all times or only under certain conditions, such as when the aircraft is on the ground (identified by the enabling of the air/ground discrete input).

COMMENTARY

> Program pins may be used for a variety of purposes. Program pins enable a piece of equipment to be used over a greater number of airframe types. One way this is done is by identifying the unique characteristics of the airframe in which the unit is installed. Another is to identify the location (left, right, center) of the unit. Often program pins are used to enable (turn on) options for alternate or extended performance characteristics.

The encoding logic of the program pin relies upon two possible states of the designated input pin. One state is an "open" as defined in Section 2.6.2 of this Characteristic. The other state is a connection (short circuit, i.e., 10 Ohms or less) to the pin designated as the "Program Common" pin.

COMMENTARY

> Normally, the "primary" location or "usual," "common," or "standard" function is defined by the "open" logic and the optional response is programmed (encoded) by connection to Program Common.

# 3.0 SYSTEM OVERVIEW

## 3.1 System Description

Referring to Figure 1-3, "Gatelink Architecture," data originating from a ground based computer system is transmitted through a ground based node on an airport Local Area Network (LAN) where it is converted to FDDI format and bit rates. The data is then transmitted to the parked aircraft at the gate via an infrared (IR) beam or a fiber optic cable depending on the mode of connection.

On ARINC Specification 636 Onboard LAN (OLAN) equipped aircraft, digital data is transmitted over the Gatelink connection, either through IR or fiber umbilical, to a router or gateway on board the aircraft. For retrofit Gatelink installations, a gateway may be used to convert FDDI to the appropriate protocol required to interface with onboard systems.

It is possible for aircraft to be equipped with multiple ATUs and or umbilicals. Network equipment on the aircraft may interface with multiple pairs of fibers from the umbilical, and potentially multiple pairs of fiber from the ATUs.

COMMENTARY

> The network management system of the aircraft is expected to manage the multiplicity of Gatelink "ports." Each Gatelink connection is considered a valid data network path. FDDI SMT layer will determine which data path is used.

### 3.1.1 Aircraft System Block Diagram

Attachment 6 provides an example of an ATU Interface.

## 3.2 Transmission Media

### 3.2.1 IR Connection

The Ground Transceiver Unit (GTU) and the Aircraft Transceiver Unit (ATU) communicate via an IR beam which radiates from the IR transmitters in a wide dispersion pattern allowing some alignment error, and thus flexibility in where the IR transceiver is located.

The GTU should be located under the passenger boarding bridge with the IR Transceiver directed at the ATU.

The ATU should be mounted below the primary passenger door. A small window port-hole should be specifically designed and installed in the side of the aircraft to enable optical transmission between the ATU and the GTU. This configuration provides:

1) Hands off alignment vertically and horizontally, (through the alignment of the passenger loading bridge with the aircraft door);

2) Interoperability of Gatelink with different types of aircraft (the location beneath the door with respect to the passenger loading bridge is relatively the same for most types of aircraft); and

3) Protection for the gate IR device (by locating it under the passenger bridge).

On board the aircraft, the ATU transforms the received infrared signal into an ARINC 636 compliant signal which is transmitted through a pair of fibers to the aircraft networking equipment.

### 3.2.2 Fiber Connection

#### 3.2.2.1 Fiber Umbilical

The fiber umbilical is used to establish a physical connection path to a parked aircraft. The umbilical cable should contain a minimum of two fibers; one for transmit and one for receive. One end of the umbilical should mate to airport ground network and the other end should mate to the aircraft fiber connector.

The umbilical is intended to be a line replaceable unit, therefore its attachment to the ground equipment should not be permanent.

#### 3.2.2.2 Aircraft Umbilical Connector

The aircraft should provide a fiber optic umbilical receptacle to accept the Ground fiber optic umbilical plug. A fiber pair links the aircraft connector to the aircraft network equipment.

COMMENTARY

> The aircraft fiber optic umbilical receptacle could be in the vicinity of the Ground Power Service Panel to facilitate connection in conjunction with the hook up of ground power.

# 4.0 PERFORMANCE REQUIREMENTS

## 4.1 System Requirements

The end-to-end signal transmission performance of the Gatelink system should support the FDDI Physical Media Dependent (PMD) standard and the exception requirements identified in ARINC 636. In addition, the ATU should support the minimum IR link BER requirement of 2.5 X $10^{-10}$.

## 4.2 Fiber Optic Interface

### 4.2.1 Fiber Optic Umbilical Active Output Interface (Aircraft to Ground)

The Active Output Interface should exhibit the following characteristics:

The reference plane for the measurements is any plane between the umbilical connectors at the aircraft and the transition connector.

| Characteristic | Min | Max | Units |
|---|---|---|---|
| Center Wavelength | 1270 | 1380 | nm |
| Average Power | -19.0 | -11.0 | dBm |
| Rise Time (10-90%) | 0.6 | 3.5 | ns |
| Fall Time (10-90%) | 0.6 | 3.5 | ns |
| Duty Cycle Distortion | | | |
| Peak-to-Peak | 0.0 | 1.0 | ns |
| Data Dependent Jitter | | | |
| Peak-to-Peak | 0.0 | 0.6 | ns |
| Random Jitter | | | |
| Peak-to-Peak | 0.0 | 0.76 | ns |
| Extinction Ratio | 0.0 | 5.0 | % |

### 4.2.2 Fiber Optic Umbilical Active Input Interface (Ground to Aircraft)

The Active Input Interface shall exhibit the following characteristics:

| Characteristic | Min | Max | Units |
|---|---|---|---|
| Center Wavelength | 1270 | 1380 | nm |
| Average Power | -26.0 | -15.5 | dBm |
| Rise Time (10-90%) | 0.6 | 5.0 | ns |
| Fall Time (10-90%) | 0.6 | 5.0 | ns |
| Duty Cycle Distortion | | | |
| Peak-to-Peak | 0.0 | 1.0 | ns |
| Data Dependent Jitter | | | |
| Peak-to-Peak | 0.0 | 1.2 | ns |
| Random Jitter | | | |
| Peak-to-Peak | 0.0 | 0.76 | ns |
| Extinction Ratio | 0.0 | 5.0 | % |

## 4.3 IR Transceivers

### 4.3.1 IR Signal in Space

At the GTU-to-ATU spacing of .75 meters, the IR transmitter illuminates a footprint, and the receiver has a field of view that covers the optical footprint established by the alignment requirements. The field of view is defined as 32° (H) by 24° (W) at a distance of .75 meters.

| Characteristic | Min | Max | Units |
|---|---|---|---|
| **IR Transmitter Output** | | | |
| Center Wavelength | 820 | 890 | nm |
| Average Power (Note 1) | 120 | 240 | nw/mm$^2$ |
| Rise Time (10-90%) | 0.6 | 4.5 | ns |
| Fall Time (10-90%) | 0.6 | 4.5 | ns |
| Duty Cycle Distortion | | | |
| Peak-to-Peak | 0.0 | 1.0 | ns |
| Data Dependent Jitter | | | |
| Peak-to-Peak | 0.0 | 1.0 | ns |
| Random Jitter | | | |
| Peak-to-Peak | 0.0 | 0.76 | ns |
| Extinction Ratio | 0.0 | 10 | % |
| **IR Receiver Input** | | | |
| Average Signal (Note 4) | 12.0 | 240 | nw/mm$^2$ |
| Total Avg Ambient Light | N/A | 10.1 | W/M$^2$-SR |
| Rise Time (10-90%) | 0.6 | 4.5 | ns |
| Fall Time (10-90%) | 0.6 | 4.5 | ns |
| Duty Cycle Distortion | | | |
| Peak-to-Peak | 0.0 | 1.0 | ns |
| Data Dependent Jitter | | | |
| Peak-to-Peak (Note 2) | 0.0 | 1.2 | ns |
| Random Jitter | | | |
| Peak-to-Peak (Note 3) | 0.0 | 0.76 | ns |
| Input Optical Wavelength | | | |
| Filter | RG780 | - | - |

NOTE:

1 Average optical power shall be measured with the test pattern in ISO/IEC 9314-3 Annex A at a distance of 0.75 m with a RG780 optical input filter. The required beam power profile is shown in Figure 4-1.

2 Data dependent jitter is for the test pattern in ISO/IEC 9314-3 Annex A. The annex also provides possible test methods.

3 Random jitter is specified as the peak-peak value where the probability of exceeding that value is equal to 2.5 x $10^{-10}$.

## 4.0 PERFORMANCE REQUIREMENTS (cont'd)

4.3.1 IR Signal in Space (cont'd)

4 Average optical signal power shall be measured with the test pattern in ISO/IEC 9314-3 Annex A at a distance of 0.75 m with a RG780 optical input filter

at maximum ambient light conditions. The required beam power profile is shown in Figure 4-1.

The average ambient light falls in the 780 to 1100 Nanometer range.

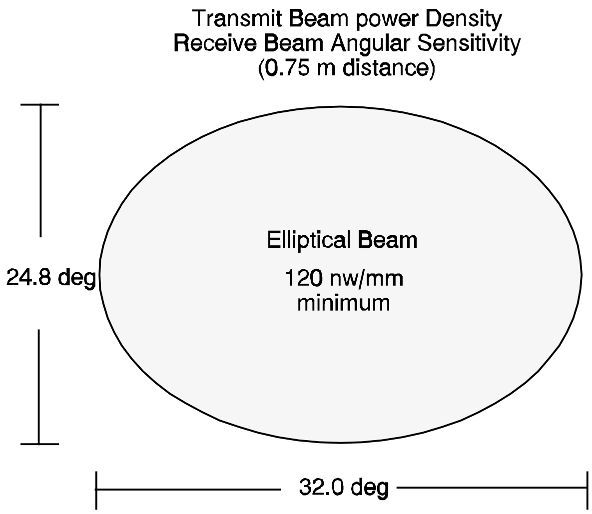



**Figure 4-1**
**Transmitter Beam and Receiver Beam Power Density Pattern Rqmts**

4.3.2 ATU Location

The ATU should be located 0.437 meters (17.2 inches) below the scuff plate of the passenger boarding door, and 0.163 meters (6.4 inches) forward of the centerline of the door.

The location of the ATU will vary slightly between aircraft models because of variations in aircraft structure and limitations due to structural stresses. The three manufacturers of transport aircraft provided structural information for their major model types with respect to potential ATU locations. That information is depicted graphically in Attachment 10. The ATU will mount within a bay that is defined by frames (vertical members) and stringers (horizontal members). Typically there is room within the bay to reposition the ATU. The target location for the ATU is 17.2 inches (0.437 meters) below the door, and 6.4 inches (0.163 meters) forward of the centerline of the door. All major aircraft models (excluding models with airstairs) are within +/- 0.9 inches horizontally and +/- 1.43 inches vertically of this target.

Aircraft with airstairs installed will not be able to use the infrared Gatelink connection. Their only option will be to use the umbilical.

4.3.2.1 Infrared Footprint

The infrared footprint is based on the variation of the ATU location across different model aircraft, and the alignment variation of aircraft to passenger loading bridge mating. The alignment variation between aircraft and loading bridge is dependent on the care used when mating the loading bridge to the aircraft. If an alignment methodology is used, as discussed in ARINC Characteristic 632, the variation will be minimized.

Table 4-2 summarizes the potential variations used to determine the infrared footprint. The footprint is 17 inches vertical and 13 inches horizontal. Table 4-3 identifies the maximum loading bridge angles measured. The parallel angle is measured by placing a level on the floor of the bridge parallel to the bridge bumper (or parallel to the aircraft). The perpendicular angle is measured by placing a level on the floor of the bridge perpendicular to the bridge bumper.

**Table 4-2 Infrared Footprint Build-up (Inches)**

| VARIATION | HORIZONTAL | VERTICAL |
|---|---|---|
| ATU Location | 1.8 | 2.85 |
| Aircraft-Loading Bridge | 14.9 | 7.96 |
| Total | 16.7 | 10.81 |
| Footprint | 17.0 | 13.0 |

**Table 4-3 Maximum Loading Bridge Angles**

| MAXIMUM ANGLE | MAX (DEG) | MIN (DEG) |
|---|---|---|
| Parallel | 4.5 | -4.82 |
| Perpendicular | 4.1 | -7.2 |

4.3.3 GTU Location

The GTU should be attached beneath the articulated floor of the passenger loading bridge nose section. The proposed location is 0.75 meters behind the front of the bumper.

4.3.4 Alignment between the ATU and the GTU

The mating of the passenger loading bridge to the parked aircraft should cause the ATU and GTU to be aligned well enough to establish a reliable link. As discussed in ARINC Characteristic 632, an alignment methodology should be used when parking the passenger loading bridge to minimize the alignment variation.

The ATU's internal alignment and normal field of view should include sufficient range to accomodate the body curvature angle below the loading door on most aircraft.

## 4.0 PERFORMANCE REQUIREMENTS (cont'd)

COMMENTARY

Airlines prefer a single part number for all ATU's within their fleet. The ATU implementation in conjunction with the doubler, should accomodate all aircraft. The ATU manufacturer should recognize that the implementation of the ATU and the doubler should maintain a continous surface with respect to the outer skin of the aircraft.

The mating of the jetbridge to the parked aircraft should cause the ATU and GTU to be aligned well enough to establish a reliable link. Passenger loading bridge is expected to be designed to handle maximum misalignment from nominal of .38 meters horizontally and .2 meters vertically. The angularity tolerances are described in Table 4-3.

### 4.4 Aircraft Umbilical Fiber Harness

The aircraft umbilical fiber harness includes the aircraft umbilical connector receptacle and the internal fiber harness (including both the fiber optic cabling and the connectors) between the umbilical receptacle and the aircraft router.

### 4.4.1 Umbilical Connector

The function of the umbilical connector is to mate the umbilical cable with the parked aircraft.

### 4.4.1.1 Configuration

The umbilical connector (comprised of a plug and receptacle) is an expanded beam (lensed) type connector with a casing that protects the optical fiber elements. The casing of the fiber optic elements incorporate a feature to prevent angular rotation of the installed termini to ensure repeatability of optical performance. The optical termini should terminate 100/140 micrometer graded index optical fiber with a numerical aperture (NA) of 0.29 as specified below:

Optical Fiber Specifications

Fiber Construction: Graded Index

Core Material: Germania Doped Silica
Cladding Material: Pure Silica

Fiber Geometry:

Core Diameter: 100 ±4 microns
Cladding Diameters: 140 ±2 microns

Core Non-Circularity: 1.0% Max
Core Clad Concentricity: 1.0% Max

Fiber Performance:

Numerical Aperture: 0.29 ±.015
Proof Test: 100 kpsi
Loss @1300 nm: 3.0 dB/km Max
Bandwidth @1300 nm: 100 MHz-km Min

The connector should incorporate keying or other suitable means to ensure that connectors of different polarizations cannot be mated. The graded index fiber type is specified to ensure adequate bandwidth over the expected aircraft cabling distances and accommodate performance upgrades in the future.

### 4.4.1.2 Connector Shell

The connector shell should provide a push-pull type connection with a positive detent to indicate connection. The connector plug should be used in ground operations and is expected to be extremely rugged and durable. The connection mechanism should facilitate easy connection/disconnection by ground service personnel under circumstances of reduced grip, e.g., gloved hands and/or cold conditions. The ability to quickly mate and demate with impaired dexterity takes precedence over coupling strength. The coupling mechanism, however, shall be capable of supporting the weight of the umbilical cable that extends between the ground and the aircraft with a significant safety margin to prevent accidental demating. The coupling mechanism should incorporate an anti-rotation feature to ensure proper mating is maintained under all conditions. Also, the coupling mechanism should ensure proper alignment of the connector before engagement of the coupling mechanism.

### 4.4.1.2.1 Connector Plug

The umbilical connector plug should be encased in a heavy duty elastomer to protect internal components from damage. The plug assembly should incorporate a dust cover that is physically attached to the plug assembly and defaults to the closed position automatically when not in use, i.e., the dust cover may be opened manually for connection but closes automatically when removed from the receptacle.

### 4.4.1.2.2 Connector Receptacle

The umbilical connector receptacle should be located in the vicinity of the aircraft's Ground Power Service Panel to facilitate connection in conjunction with connection of ground electrical power to the aircraft. The umbilical connector receptacle has an integral spring-loaded environmental cover that is physically attached to the receptacle and defaults to the closed position automatically when not in use, i.e., the cover may be opened manually for connection but closes automatically when removed from the receptacle.

### 4.4.1.3 Performance

The maximum umbilical connector loss should be no more than 2 dB under all alignment and environmental conditions throughout the life time of the connector. The connector should be designed for a large number of mate/demate operations (in excess of 20,000) in extreme environmental conditions without significant degradation of performance or maintenance requirements.

## 4.0 PERFORMANCE REQUIREMENTS (cont'd)

#### 4.4.1.3.1 Connector Plug

The plug portion of the umbilical connector should be capable of withstanding shock associated with repeated drops from 12 feet in any orientation onto a concrete surface of 4-inch minimum thickness without suffering any broken, bent, or misaligned pieces, increase in insertion loss, or any damage to finishes that would result in the connector being unable to meet acceptable corrosion requirements.

#### 4.4.1.3.2 Connector Receptacle

The receptacle portion of the umbilical connector should have an integral spring-loaded environmental cover. Leak paths should not exist through the terminus locations because of contamination affecting optical performance.

#### 4.4.1.4 Maintenance

The fiber optic beam expanding lenses of the umbilical connector should have an IR coated protective cover glass. The cover glass should provide an environmental seal for the lenses and should be field removable and replaceable. The exposed surface of the cover glass should be scratch resistant to repeated wiping with normally available materials i.e., cotton rags or paper based tissue.

### 4.4.2 Aircraft Internal Fiber Harness

The function of the aircraft internal fiber harness is to interconnect the aircraft umbilical connector receptacle with an onboard router unit.

COMMENTARY

> The intent of this section is to identify key component design characteristics of the aircraft internal fiber harness that ensures adequate optical performance for Gatelink. Fiber and connector types are not specifically defined to allow airlines and aircraft manufacturers the maximum flexibility in designing the aircraft internal fiber harness.

#### 4.4.2.1 Umbilical Fiber Cable

The aircraft optical fiber should be compatible with the fiber characteristics and performance defined in ARINC 636.

#### 4.4.2.2 Inline Connectors

If production breaks are necessary within the aircraft fuselage, inline connectors should be used for the aircraft internal fiber harness. The maximum end of life loss for all inline connectors combined should not exceed 1.0 dB. Individual inline connectors should be capable of 100 mate/demate cycles over the life of the connector and should meet the environmental conditions for onboard aircraft operation.

### 4.5 Ground Environment

The ground Gatelink interface is defined in ARINC Specification 632.

# 5.0 PROVISION FOR TEST

## 5.1 Aircraft IR Transceiver Unit (ATU)

### 5.1.1 Minimum Requirements

Because the Aircraft IR Transceiver Unit is designed as a single module, a means should be provided to determine if the IR transmitter and associated circuitry or the IR receiver and associated circuitry have failed. The bite should be capable of detecting and annunciating a minimum of 95% of the faults or failures which can occur within the ATU. Additionally, the Built In Test Equipment (BITE) should be able to discriminate between genuine ATU faults and failures and the loss of data or IR signal due to conditions external to the aircraft and ATU. The ATU BITE design and functions should conform to the BITE functions described in ARINC Report 604 as a minimum.

Since the ATU is a simple repeater device on the FDDI bus, it is not required to directly report its status on the FDDI. The ATU provides an ARINC 429 interface for fault reproting. An optional 429 interface is provided to permit and end system to control the ATU. It is recommended, however, that some form of failure status indication be provided to the on-board router. The ATU's on-board maintenance system (OMS) interface may be connected to the router, in which case, the router will report overall status to the OMS.

Provision have been made for the ATU connector for the implementation of a Bypass test mode. Bypass is envisioned to consist of wrapping the FDDI receive (Rx) signal input back out the FDDI transmit (Tx) output. The purpose of this feature is to enable the router to test the signal path. Activation of the Bypass control inputs enables the Bypass test mode. 10.8 - 16.5 Vdc at 125 mA should be used in accordance with ARINC Specification 636.

COMMENTARY

> The ATU supplier is encouraged to provide the signal bypass point as close as possible to the IR output, such that a reasonably complete test of the signal path is performed.

## 5.2 Built-In Test Equipment

The ATU should contain BITE capability in accordance with ARINC Report 624, "Design Guidance for Onboard Maintenance System (OMS)."

ARINC Report 624 sets forth a general philosophy, basic guidance, and certain specific recommendations for the design and use of an OMS.

The OMS described incorporates the traditional areas of failure monitoring and fault detection, BITE, BITE access, and an airplane condition monitoring system (ACMS), formerly known as aircraft integrated data system (AIDS). It further describes the capability to provide onboard maintenance documentation (OMD) and the need for total integration of these functions. It describes the needs for all elements of the OMS, including a central maintenance computer (or CMC function) and all the member systems which interface with it.

ARINC Report 624 is intended to provide a better mutual understanding among the designers and users of the specified OMS, including all its member systems, with a view toward achieving an optimum balance between critical factors such as BITE effectiveness, operator interface simplicity, cost, and system complexity. A description of one possible architecture for an OMS is also included in the document. This description is not intended to delineate the design for an OMS but to provide an example for understanding the requirements for such a system.

ARINC Report 624 discusses the role of an OMS in the airlines' maintenance concept and the fault detection and BITE characteristics desirable in all avionics equipment to support the broader goals of an OMS. Beyond the guidance applicable to BITE, this document provides specific guidance for the design of an OMS which provides for:

- A standardized, English language-based user interface for performing all BITE tests and line maintenance functions on the airplane.
- Where appropriate, storage of BITE reported fault data within a line replaceable unit's (LRU) nonvolatile memory (NVM) for later use.
- Reporting of fault status in the air and on the ground via operator displays and/or electronic/magnetic communications links.
- Integration of the fault isolation design to provide complete coverage, from fully automatic BITE through interactive, BITE-assisted fault isolation to manual troubleshooting procedures.
- Ground-test capability for fault isolation and performance of LRU replacement tests, functional tests, and system tests.
- Airplane condition monitoring function integrated with the BITE/line maintenance function design.

Airframe and equipment designers are encouraged to take advantage of this guidance information, beginning with the earliest design phases of new equipment.

Users may also find this information helpful in standardizing maintenance planning and procedures and in securing appropriate recognition for such procedures from the regulatory agencies. It is particularly important that the guidelines set forth in ARINC Report 624 should be considered in terms of the overall perspective of the users' needs, rather than some more limited objective.

## 5.3 Fault Reporting

### 5.3.1 OMS Fault Reporting

The ATU should contain fault reporting capability in accordance with ARINC Report 624. Attachment 11

## 5.0 PROVISION FOR TEST (cont'd)

5.3.1 OMS Fault Reporting (cont'd)

contains the list of BITE codes which should be used for ATU fault reporting.

Since the ATU may be installed in aircraft which do not contain an OMS, to provide maximum interchangeability, as an option to the user, the ATU may also need to support either or both of the fault reporting capabilities described in Sections 5.3.2 and 5.3.3.

5.3.2 Optional Character-Oriented BITE Fault Reporting

The ATU should, as an option to the user, provide fault reporting capability in accordance with the character-oriented fault reporting protocol contained in ARINC Report 604, "Guidance for Design and Use of Built-In Test Equipment (BITE)."

COMMENTARY

New equipment designs should be produced in accordance with ARINC Report 624. ARINC Report 624 supersedes ARINC Report 604. The optional use of ARINC Report 604 may provide guidance for retrofit installations where an OMS is not present and interaction with an ARINC 604 Centralized Fault Display System (CFDS) is required.

5.3.3 Optional Bit-Oriented BITE Fault Reporting

The ATU should, as an option to the user, provide fault reporting capability in accordance with the bit-oriented fault reporting protocol contained in ARINC Report 604.

COMMENTARY

New equipment designs should be produced in accordance with ARINC Report 624. ARINC Report 624 supersedes ARINC Report 604. The optional use of ARINC Report 604 may provide guidance for retrofit installations where an OMS is not present and interaction with an ARINC 604 CFDS is required.

### 5.4 Automatic Test Equipment

To enable Automatic Test Equipment (ATE) to be used in the bench maintenance, internal circuit functions not available at the unit service connector and considered by the equipment manufacturer necessary for automatic test purposes may be brought to pins on an auxiliary connector of a type selected by the equipment manufacturer. This connector should be fitted with only that number of contacts needed to support the ATE functions. The connector should be provided with a protective cover suitable to protect these contacts from damage, contamination, etc. while the unit is installed in the aircraft. The manufacturer should observe ARINC Specification 600 standards for unit projections, etc., when choosing the location for this auxiliary connector.

5.4.1 ATE Testing

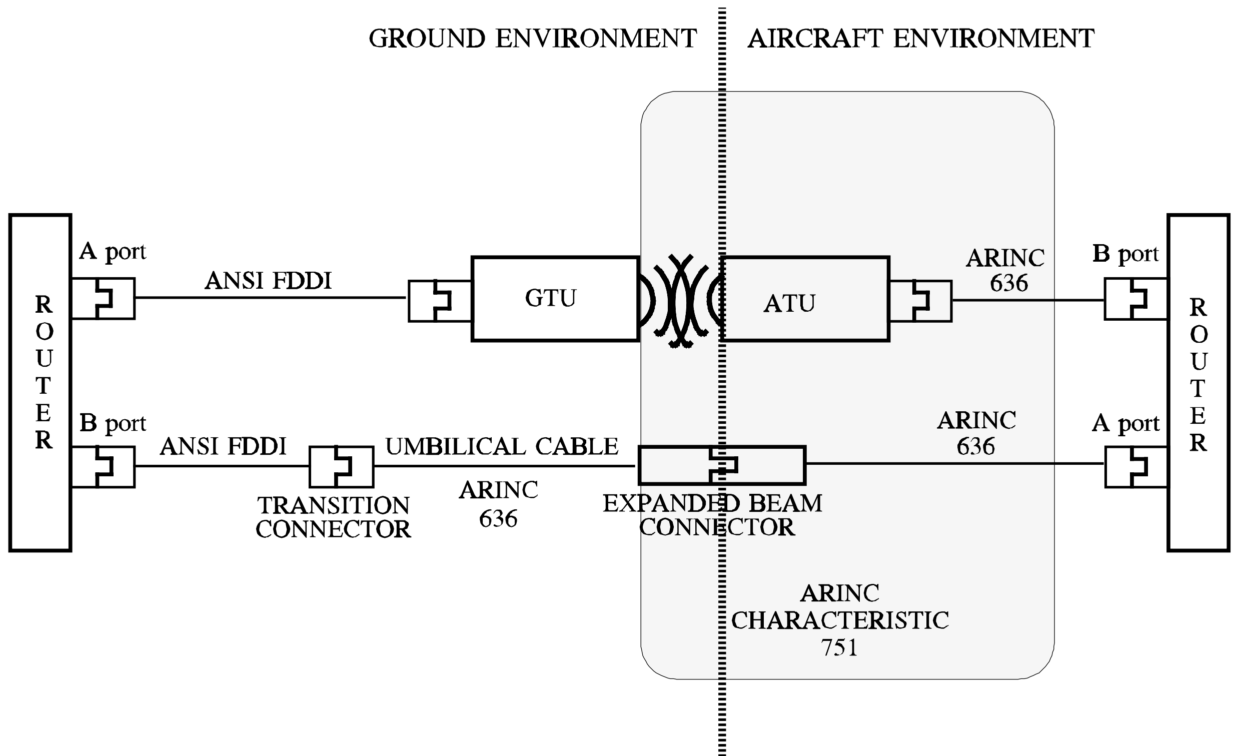
The ATU should be ATE testable and should have a test program written using the ATLAS language elements of ARINC Specification 626, "Standard ATLAS Subset for Modular Test" developed in accordance with ARINC Report 627, "Programmers Guide for SMART® System Using ARINC 626 ATLAS."

The ATLAS test procedure should be shown to work on a test system built to comply with ARINC Specification 608A, "Design Guidance for Avionics Test Equipment." The airlines desire that any test program provided should be capable of executing without modification on SMART® test systems.

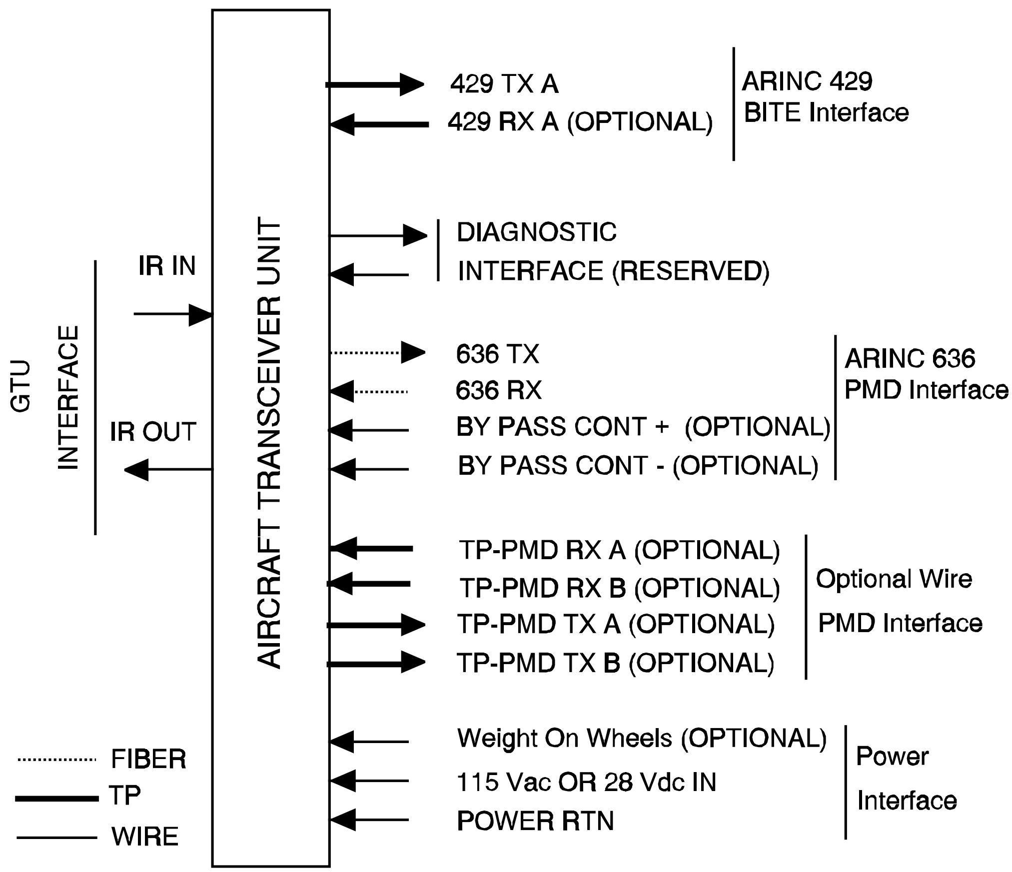
## ATTACHMENT 1
## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ATU | Aircraft Transceiver Unit |
| FDDI | Fiber Distributed Data Interface, an ANSI standard network based on Timed Token Rotation but operating at 100Mb/s |
| FWHM | Frequency width at half maximum |
| GTU | Ground Transceiver Unit |
| IR | Infrared |
| LAN | Local Area Network |
| OLAN | Onboard LAN |
| PMD | Physical Media Dependent, a sublayer of the OSI Physical layer. |

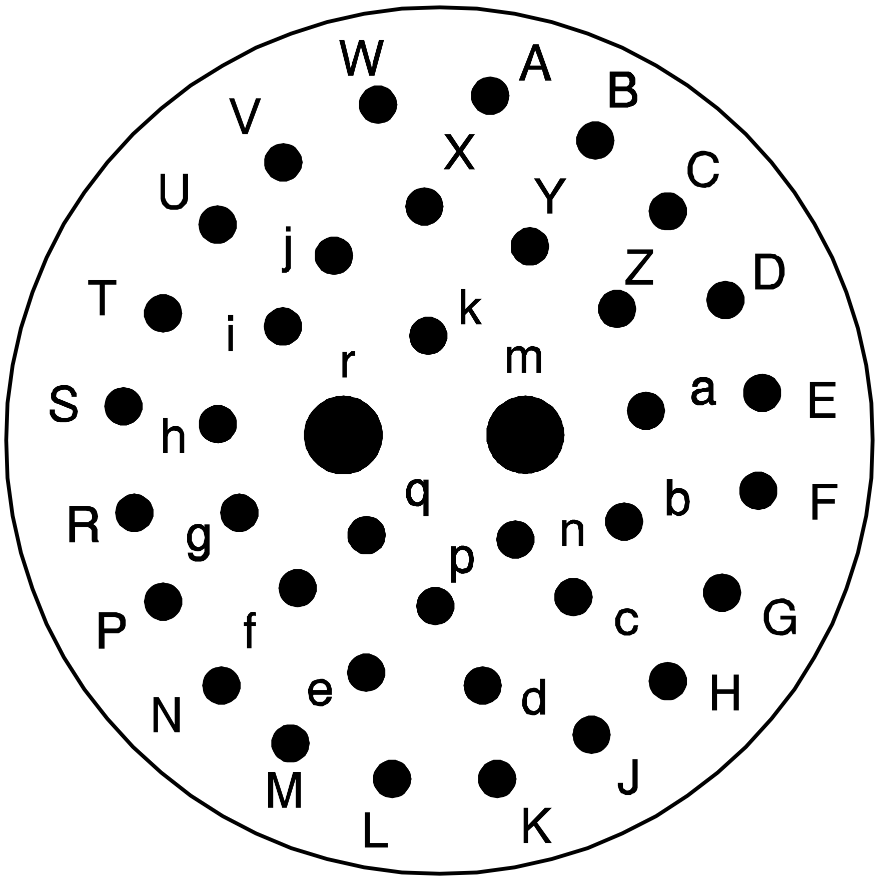
## ATTACHMENT 2
## GATELINK ARCHITECTURE



## ATTACHMENT 3
## AIRCRAFT TRANSCEIVER UNIT (ATU)



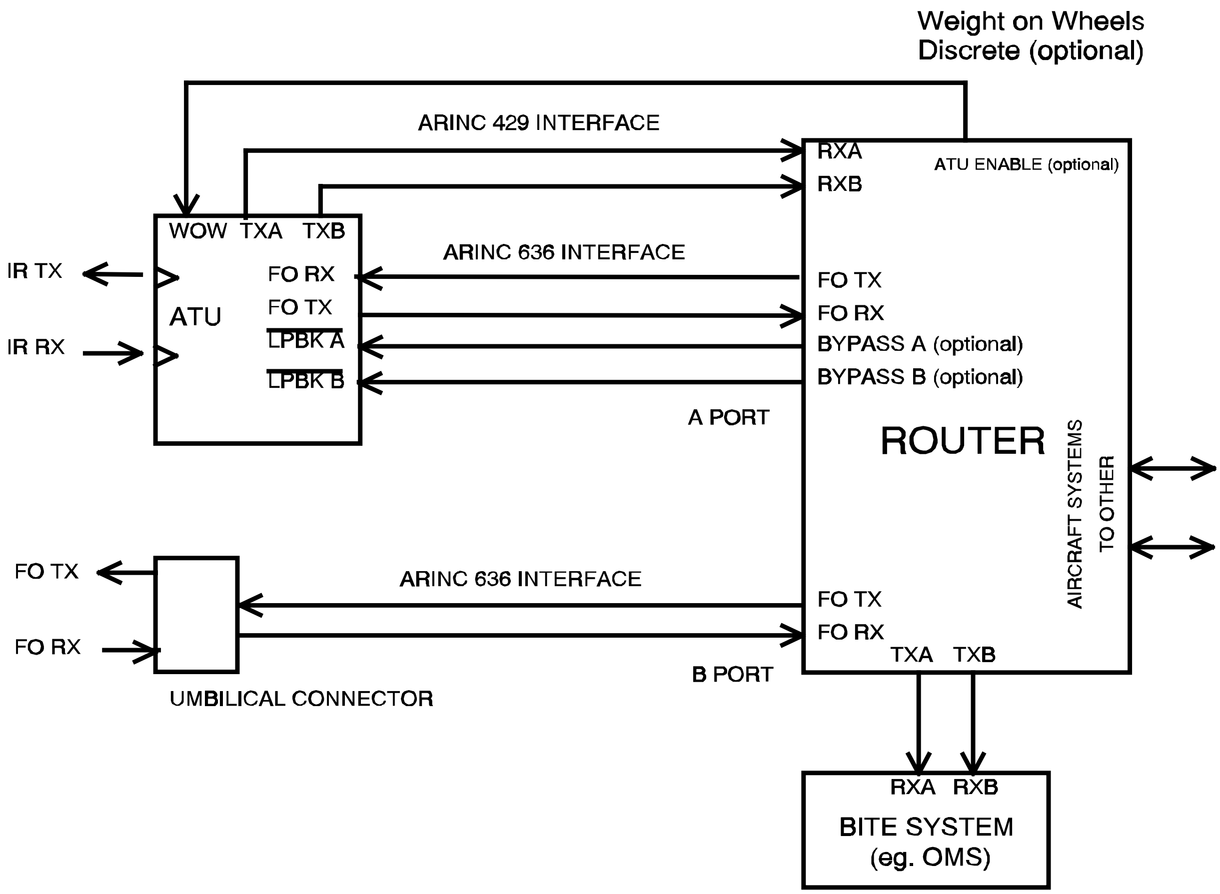
**ATTACHMENT 4**
**CONTACT ARRANGEMENT 21-39 FOR MIL-C-38999 CONNECTOR**



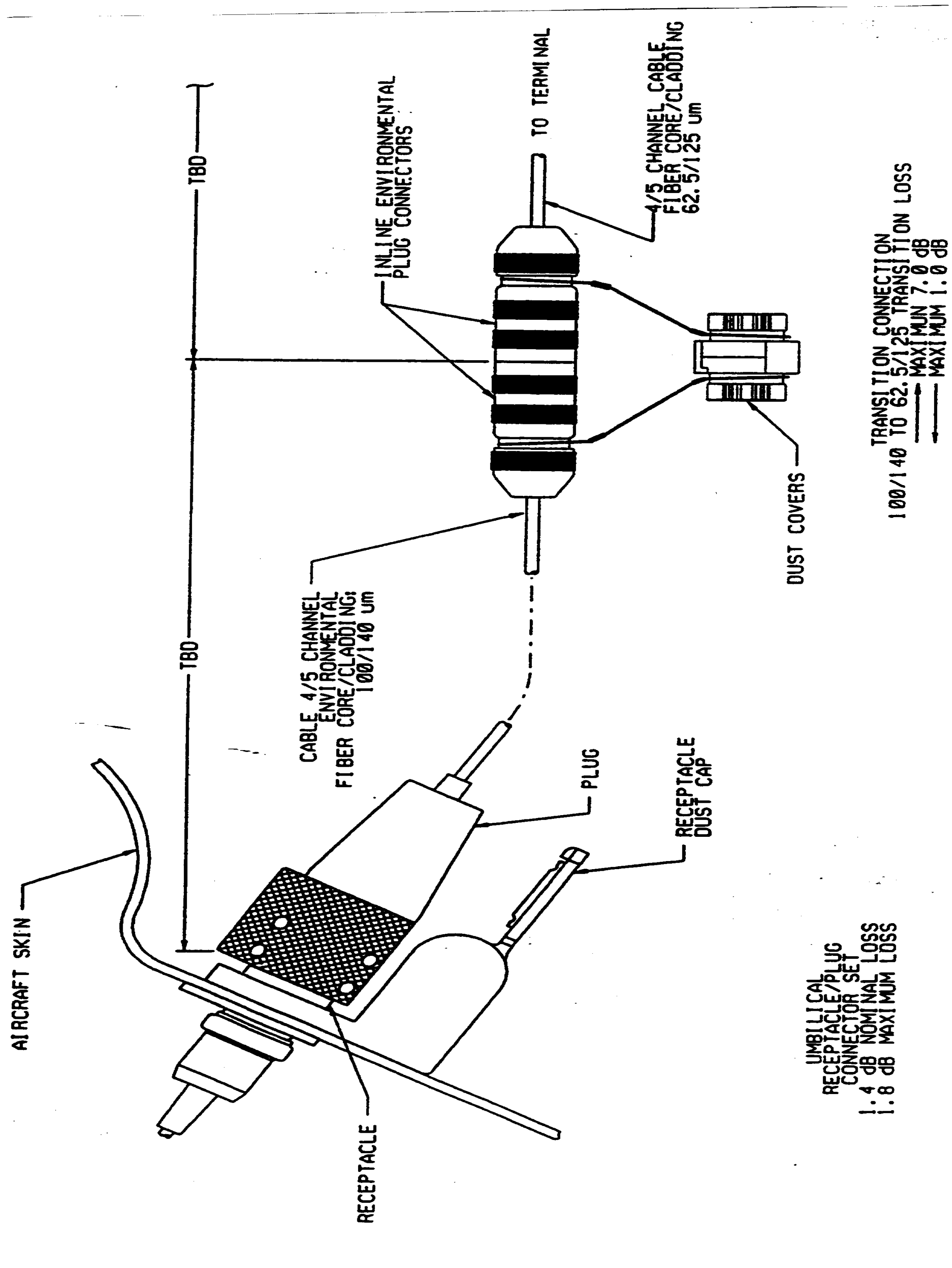
## ATTACHMENT 5
## PIN ASSIGNMENTS FOR ATU CONNECTOR

| Pin # | Signal Name | Interface Levels | Function |
|---|---|---|---|
| A | FDDI - TP TX A | ISO 9314 Wire PMD | Optional serial data wire output + |
| B | FDDI - TP TX A RTN | ISO 9314 Wire PMD | Optional serial data wire output + |
| C | FDDI - TP TX B | ISO 9314 Wire PMD | Optional serial data wire output - |
| D | FDDI - TP TX B RTN | ISO 9314 Wire PMD | Optional serial data wire output - |
| E | FDDI - TP RX A | ISO 9314 Wire PMD | Optional serial data wire input + |
| F | FDDI - TP RX A RTN | ISO 9314 Wire PMD | Optional serial data wire input + |
| G | FDDI - TP RX B | ISO 9314 Wire PMD | Optional serial data wire input - |
| H | FDDI - TP RX B RTN | ISO 9314 Wire PMD | Optional serial data wire input - |
| K | BY PASS CONTROL | ARINC 636 | Optional By Pass Control signal |
| L | BY PASS CONTRO_RTN | ARINC 636 | Optional return for By Pass Control |
| M | Reserved | | User Defined Functions |
| N | Reserved | | User Defined Functions |
| P | Reserved | | User Defined Functions |
| R | Reserved | | User Defined Functions |
| S | 429 Grd | ARINC 429 | Ground |
| T | 429 TX A | ARINC 429 | Optional General data Bus Output+ |
| U | 429 TX B | ARINC 429 | Optional General Data Bus Output- |
| V | 429 RX A | ARINC 429 | Optional General Data Bus Input+ |
| W | 429 RX B | ARINC 429 | Optional General Data Bus Input- |
| X | FDDI - TP | | Ground |
| Y | Reserved | TBD | Diagnostic Interface |
| Z | Reserved | TBD | Diagnostic Interface |
| a | Reserved | TBD | Diagnostic Interface |
| b | Reserved | TBD | Diagnostic Interface |
| c | Reserved | TBD | Diagnostic Interface |
| d | Chassis | | Ground |
| e | Future Spare | | |
| f | Future Spare | | |
| g | Future Spare | | |
| h | Future Spare | | |
| i | Future Spare | | |
| j | 115 Vac In | 200 mA | 115 Vac Power In |
| k | 115 Vac Return | | 115 Vac Power Return |
| m | 636 RX | ARINC 636 | Serial Data Fiber Optic Data Input |
| n | 28 Vdc IN | 0.75 A | 28 Vdc Power in |
| p | 28 Vdc RTN | | 28 Vdc Power Return |
| q | WOW | discrete input | Optional Weight on Wheels discrete input |
| r | 636 TX | ARINC 636 | Serial Data Fiber Optic Output |

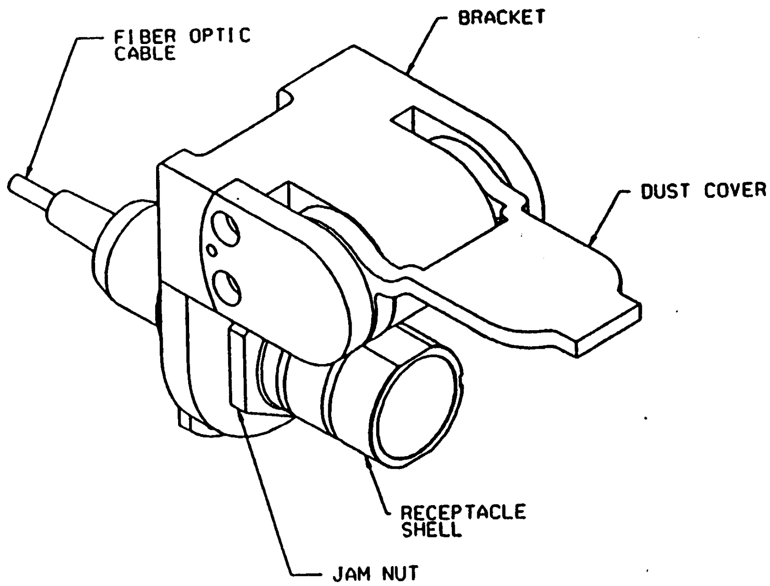
## ATTACHMENT 6
## EXAMPLE OF AN ATU INTERFACE



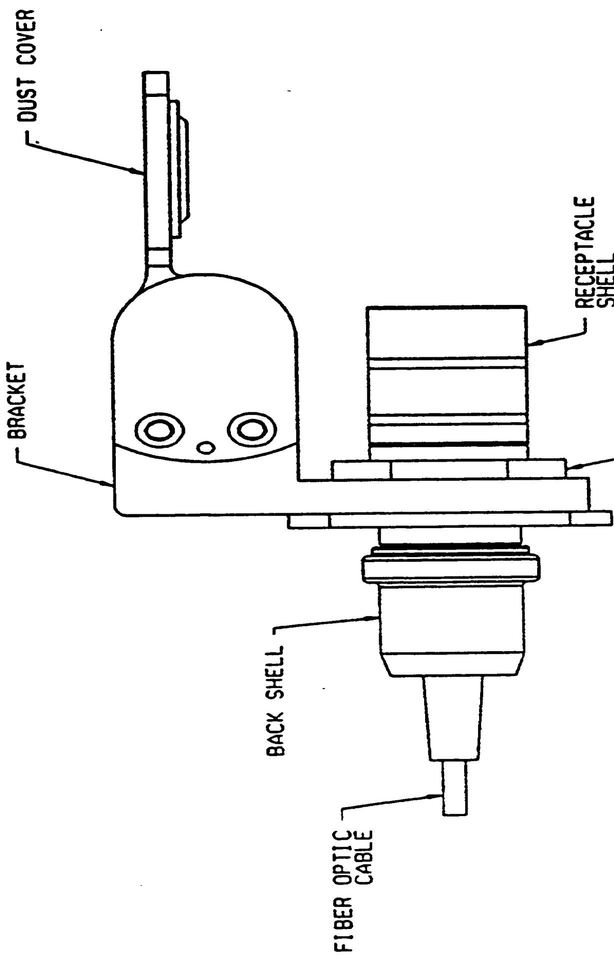
## ATTACHMENT 7
## GATELINK AIRCRAFT-TO-TERMINAL FIBER OPTIC UMBILICAL CABLE ASSEMBLY



**ATTACHMENT 8-1**
**AIRCRAFT CONNECTOR: RECEPTACLE**



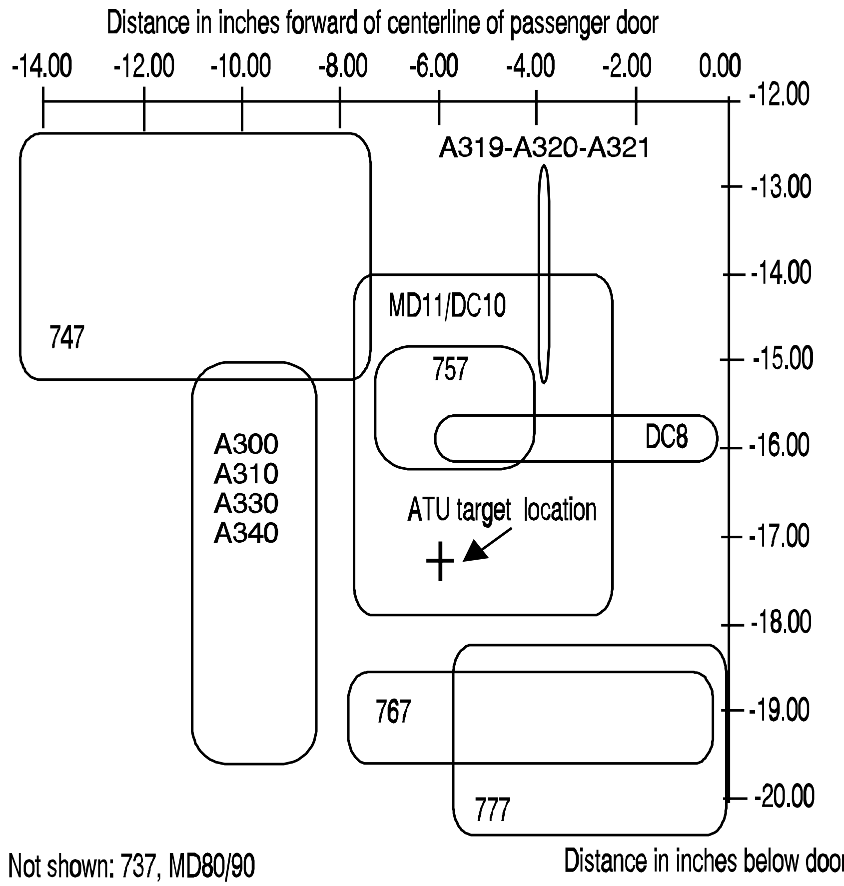
**ATTACHMENT 8-2**
**AIRCRAFT CONNECTOR: RECEPTACLE**



## ATTACHMENT 9
## ATU ENVIRONMENTAL REQUIREMENTS

| ENVIRONMENT | DO-160C SECTION | CATEGORY | NOTES |
|---|---|---|---|
| Temperature and Altitude | 4 | D2 | -55° to 70° C oper., +85° C survival, 0 to 50K ft altitude |
| Temperature Variation | 5 | A | external equipment (10° C/min) |
| Humidity | 6 | C | external humidity environment |
| Oper. Shocks and Crash Safety | 7 | | equipment orientation known and fixed |
| Vibration | 8 | C | fixed wing fuselage, 4.12 grms random, standard test |
| Explosion Proofness | 9 | E1 | environment II |
| Waterproofness | 10 | S | for externally exposed surfaces only |
| Fluids Susceptibility | 11 | F | for externally exposed surfaces only,<br>Isopropyl Alcohol 25°C/5 Min<br>Denatured Alcohol 25°C/5 Min<br>Trichloroethelene 25°C/5 Min<br>Freon 20°C/5 Min<br>Alkaline Detergent 70°C/5 Min |
| Sand and Dust | 12 | D | for externally exposed surfaces only |
| Fungus Resistance | 13 | F | non-nutrient materials |
| Salt Spray | 14 | S | for externally exposed surfaces only |
| Magnetic Effect | 15 | X | not required |
| Power Input | 16 | A | DC power from constant AC source |
| Voltage Spike | 17 | A | high degree of protection against voltage spikes |
| Audio Frequency Conducted Susceptibility - Power Inputs | 18 | A | DC power from constant AC source |
| Induced Signal Susceptibility | 19 | A | interference free operation desired |
| Radio Frequency Susceptibility (radiated and conducted) | 20 | V | moderate electromagnetic environment |
| Emission of Radio Frequency Energy | 21 | Z | interference free operation required |
| Lightning Induced Transient Susceptibility | 22 | K | moderate electromagnetic environment |
| Lightning Direct Effects | 23 | X | not required |
| Icing | 24 | C | external environment |
| Ambient Light | N/A | | 0 - 10.1 $W/M^2$ - S operating, 64.5 $W/M^2$ - S survival |

## ATTACHMENT 10
## ATU LOCATIONS FOR VARIOUS AIRFRAMES



## ATTACHMENT 11
## MAINTENANCE WORDS DEFINITIONS

The ATU should generate maintenance data words having the label 350 (17 HEX) at a rate of once per second when the ATU is powered. The label 350 data word bit definitions are shown below.

| BIT | DEFINITION | CODING | | NOTES |
|---|---|---|---|---|
| | | VALUE | CODING | |
| 1 | 1st Digit (MSB) | 3 | 1 | 1 |
| 2 | 1st Digit (LSB) | | 1 | |
| 3 | 2nd Digit (MSB) | 5 | 1 | |
| 4 | 2nd Digit | | 0 | |
| 5 | 2nd Digit (LSB) | | 1 | |
| 6 | 3rd Digit (MSB) | 0 | 0 | |
| 7 | 3rd Digit | | 0 | |
| 8 | 3rd Digit (LSB) | | 0 | |
| 9 | SDI | | 0 | 2 |
| 10 | SDI | | 0 | |
| | | ONE (1) | ZERO (0) | |
| 11 | TBD | | | |
| 12 | TBD | | | |
| 13 | TBD | | | |
| 14 | TBD | | | |
| 15-29 | Spare | | | |
| 30 | Sign Status Matrix (SSM) | 0 | 0 | 3 |
| 31 | Sign Status Matrix (SSM) | | 0 | |
| 32 | Parity | Odd | | |

Notes:

1. This data word definition is provided for the reader's convenience. ARINC Report 604 defines this word and shall have precedence.

2. The Source/Destination Identifier is not used.

3. The SSM will always indicate normal operation (00).

## ATTACHMENT 12
## ATU DIMENSIONS