# S-Band Airborne DataLink
BES Systems Ltd.

DLS-500   Data Link System

Multiple Participant Airborne S-Band TDMA data link with up to 400 slots per second. Transmission rate is up to 714KB/sec. A typical application includes 20 airborne participants sharing 200 time slots per second. Each participant broadcasts 300 bytes of data messages 10 times per second (10Hz). While one participant transmits, the rest of the participants listen.

With an airborne omni directional antenna, the DataLink has a useful range of 60-70NM. A Ground Station with high gain antennas has ranges exceeding 120NM.
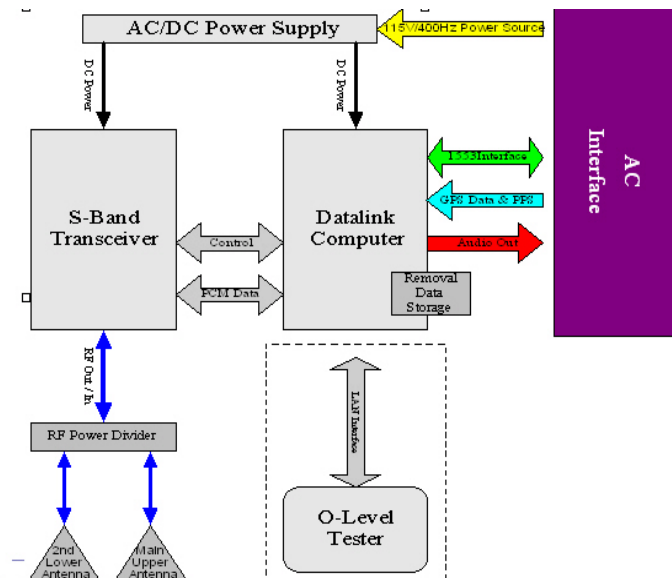
Salient Features

♦ Frequency Band: 2.2-2.35GHz
♦ Transmitter power: > 45Watt
♦ Data modulation: PCM NRZ-L
♦ Transmission: up to 714Kbit/sec
♦ Typical bits per slots: 2500 bits
♦ Slots per second: 100-400 time slots.
♦ Receiver sensitivity: -94dBm at E/N = 14dB.
♦ Control: MIL-STD-1553, RS-422, Ethernet
♦ Members: Up to 100

DataLink LRUs

The Datalink includes three air qualified LRUs:
♦ AMC-300 Processor Unit
♦ S-Band Transceiver
♦ DataLink Power Supply Unit (PSU)

45Watt Airborne FM Transceiver

The transceiver operating frequencies are in the band of 2200-2300MHz, or in the band of 2250-2350MHz. It is possible to program up to 8 operating frequencies. The transmitter has very fast transition from Transmit to Receive and vice versa. This characteristic is essential for efficient TDMA transmissions. The receiver has -94dBm sensitivity at E/N = 14dB

Dimensions: 330x100x 70 [mm], Weight: 2.5Kg

DLS Processor

The DLS Processor includes a a CPU computer, and a data link modem. The PCM (NRZ-L) data pulses are transmitted in selected time-slots. Bit stream from the FM receiver is processed by a digital BIT Synchronizer and handed over to the

application program in the airborne host computer via Ethernet, RS-422 or MIL-STD-1553.
Dimensions: 255x100x85 [mm], Weight: 2.3Kg

Power Supply

The Datalink input power is 120Watt average from 115VAC 400Hz 1 phase. Alternatively, a 28VDC supply version can be used.
Dimensions: 255x100x100 [mm], Weight: 2.5Kg

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Data Link Processor

DLS-500 Data Link is controlled by an Airborne Processor (AMC-300) running Windows NT Embedded. The salient features of the AMC-300 are:

- 300MHz Pentium CPU, 128MB RAM
- 48-256MB Disk On Chip
- Ethernet
- RS-422/RS-232 x 4
- PCMCIA Drive up to 2GB
- SoundBlaster, 8ohm or 8Kohm impedance for Audo messages to Pilot.
- MIL-STD-1553 Remote-Terminal
- Spare expansion slots.
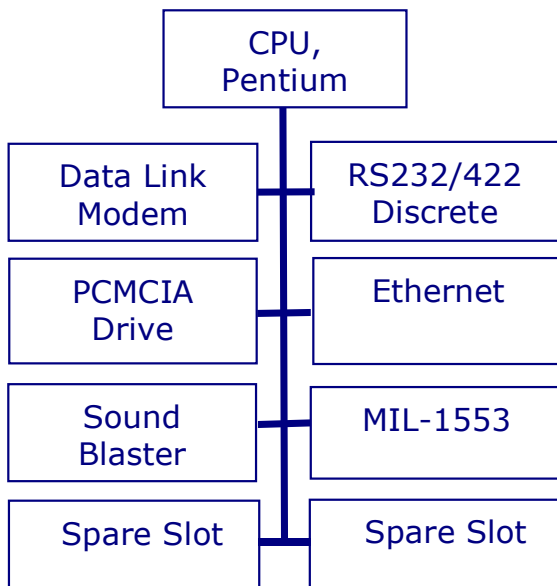
The standard interface of the Datalink to the Trainer Plane bus is via MIL-STD-1553. Additional I/Os and signals such as RS-422, discrete lines, Audio for Voice announcements to the Plane Intercommunication system, or Ethernet are available.

Transceiver

- Antenna impedance: 50W nominal
- Modulation: FM Transceiver
- Output Power: 47dbm
- Number of frequencies: 8 programmable.
- If bandwidth: -3 dB 0.7 MHz min., -60 dB 3.0 MHz max.
- Image and spurious rejection: 60 dB min. Dynamic range: 50 dB min.
- Audio output impedance 75Ω
- PCM output level 2V p-p ±10% for 175 kHz peak deviation
- PCM output response: 10 Hz to 350 kHz ±1.5 dB at 175 kHz peak deviation
- PCM output distortion: 5% max. up to 350 kHz modulation and 175 kHz peak deviation.
- Sensitivity: -94 dBm for (S + N)/N = 14db at peak deviation of 175KHz.
- Signal strength indication: 1.4V into ±10KW load (Linear monotonic voltage for RF signal range of -90.4 to -40dBm.

Data Link Block Diagram
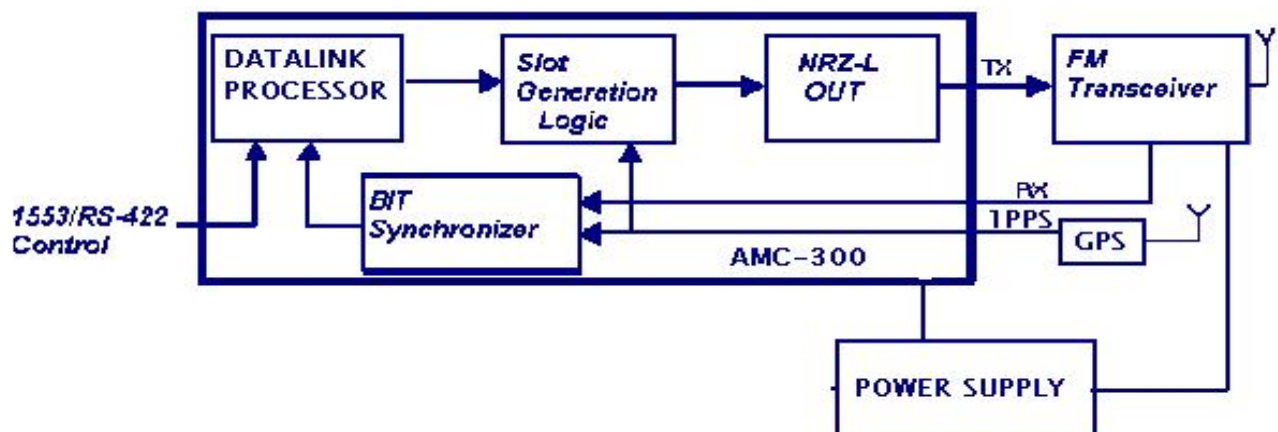
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Antennas

Two Omni directional S-Band Airborne antennas are used for spherical coverage. The upper front Antenna installed on the nose transmits approximately 35W. It provides coverage to the front and sides of the plane; A lower AFT antenna connected via a power divider, transmits approximately 7W. It's purpose to provide coverage to rear side of the plane.

Ground Station

The Ground Transmission Station (GTS) is one of the participants in the Data Link Net. The implementation of the GTS resembles the airborne components except that it is built for ground installation.

The GTS communicates via Data Link Transceiver to the Data Link network and receives same airborne messages as other airborne members. GTS can inject data as well as simulated targets to the Net. The GTS receives all the participants that are within its antenna range and angular coverage simultaneously.

The GTS might be used to increase the useful range of airborne participants by relaying data The GTS sends (via TCP/IP) the received data to a Debriefing Ground Station for real-time monitoring.

The GTS is built from two parallel systems, each one includes Transceiver, Antenna and processing unit. In order to provide hemispheric coverage with radius of 100-120NM, A targets received in both antennas is merged by the GTS software into a single target. The software extracts the flight data received in real time and communicates it via TCP/IP to Debriefing Ground Station.

The Dual Omni antennas are housed in one unit and provide 360º coverage for data link communication. One of the Omni antennas has high gain (8dB) beam in elevation angle from 0º to 8º. The second Omni antenna has low gain (3dB) beam in elevation angle from 0º to 50º.

Ground Transmission System (GTS)
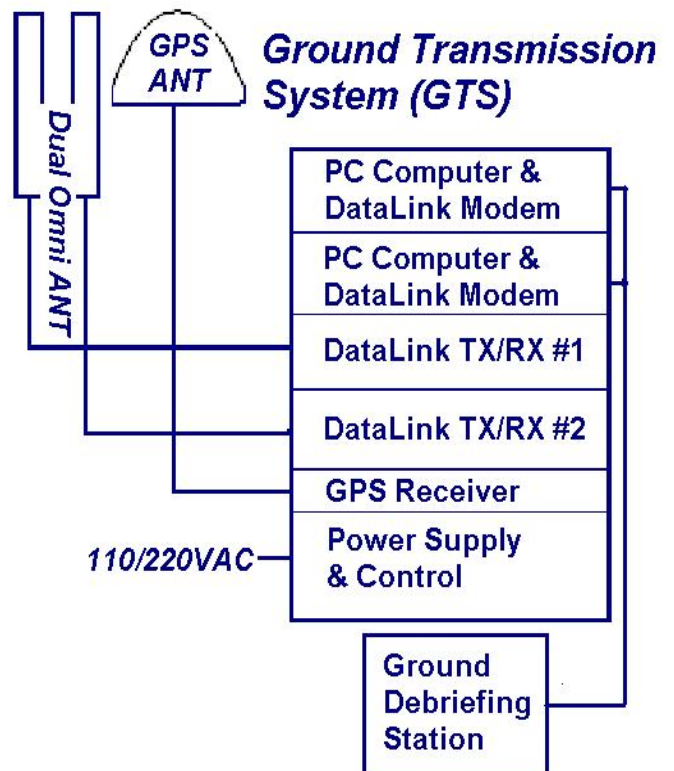
PCM TDMA Time-Slots

The following demonstrates implementation of a DataLink for Virtual Radar.

In this Datalink, one second is divided to 200 time slots, (5msec per slot). The time slots are synchronized to GPS 1PPS. The transmission rate is 625Kb/sec.

A range of 100NM has a propagation delay of 0.63msec. Therefore the transmission is only 4.37msec out of 5msec slots.

The number of transmitted pulses is; 4.37msec x 625000bits/sec=2731 bits. Each slot includes 9 minors, each minor contains 27 bytes of useful data + 3 bytes for synchronization and 2 bytes for error detection (CRC). The system supports dynamic allocation of timeslots.

The system supports 20-25 static Net participants, (or more when dynamic allocation of slots is being used). The software uses relay techniques to increase link reliability

The system can be programmed for more time slots, dynamic allocation of slots etc'.

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Thermal Design

The cooling of the LRUs of the DataLink is accomplished by heat natural convection from their surfaces.

Environmental Conditions

Temperature:

The DataLink LRUs will not be damaged or affected by the effects of ambient air temperature as follows:

Operating: The DataLink shall meet performance requirements specified herein after exposure to temperatures from -40° to +71°C

Non-operating: (Storage/transportation) from -54° to 85°C.

Relative humidity

Operating: 95% relative humidity (RH) with no condensation.

Non-operating: 95% RH.

Vibration

According to MIL-STD-810E for airborne environment.

Shock

According to MIL-STD-810E, 40g for duration of 11msec.

Electromagnetic Interference

The DataLink LRUs complies to the requirements of MIL-STD-461C.

Fungus

The AMC-300 is non-nutrient to fungus growth according to the requirements in MIL-STD-810E.

Sand and Dust

The DataLink LRUs shall operate as specified herein while and after being subjected to sand and dust as encountered in dry arid arias according to the requirements of MIL-STD-810E.

Salt Fog

The DataLink LRUs are resistant to the corrosive effects of salt fog environment according to MIL-STD-810E.

Reliability

MTBF

The DataLink LRUs have an MTBF of 4000 hours.

MTTR

Mean Time To Repair (MTTR) does not exceed 30 minutes.
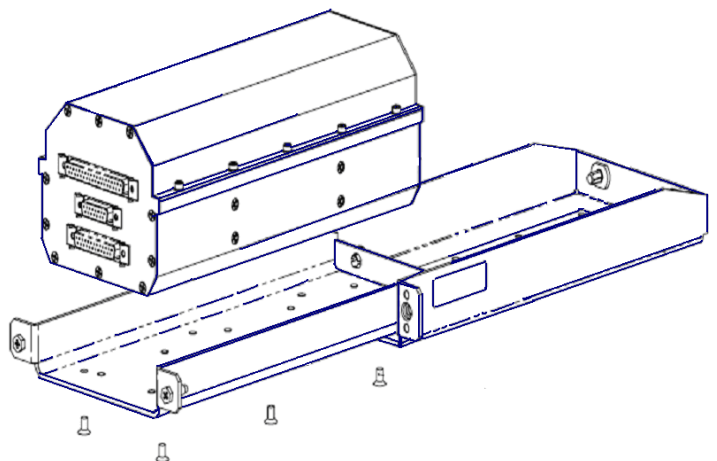
Compliance with MIL-STD-704A

The primary Power source of the DataLink is provided from the 115VAC/400Hz/1Ô aircraft Power source.

The input Power characteristics shall be in accordance with Table I of MIL-STD-704A, for Category B equipment.

Minimum	88VAC 400Hz
Nominal	115VAC 400 Hz
Maximum	125VAC 400 Hz
Power Hold-Up Time	50 mSec
Momentary peak	(0.5 sec) 135 v ac 400Hz
Input Frequency	365 Hz - 420 Hz

Installation

LRU locations in the plane are not critical. It is recommended that the Transceiver will be close to the upper antenna. LRUs can be supplied with trays and mounts however, the units can be attached to a metal panel using 4 screws for each LRU.