Flight Data Monitoring Solutions

TELEDYNE CONTROLS
A Teledyne Technologies Company

Table of Contents

Introduction

Purpose of this brochure

Teledyne Controls has assembled this brochure in order to:

- Provide insight into the concepts and activities involved in flight data monitoring
- Outline important regulatory changes affecting flight data monitoring
- Draw attention to the tremendous safety and operational cost benefits to be gained from flight data monitoring
- Highlight the flexibility Teledyne offers as your flight data monitoring partner

What is flight data monitoring?

Depending on each country, flight data monitoring is referred to in a different way:

- Flight Data Monitoring (FDM)
- Operational Flight Data Monitoring (OFDM)
- Flight Operations Management (FOM)
- Daily Flight Operations Monitoring (DFOM)
- Flight Operations Quality Assurance (FOQA)
- Flight Operations Data Assurance (FODA)
- Maintenance Operations Quality Assurance (MOQA)

Despite the wide variety of names and acronyms used to describe flight data monitoring, the objectives and methods of these programs are essentially the same, and they are increasingly becoming an integral part of the safety and operational management system of more and more airlines and aircraft operators. For the purposes of this brochure, we will refer to these collective programs and processes as "*flight data monitoring.*"

Flight data monitoring is a **process** that includes:

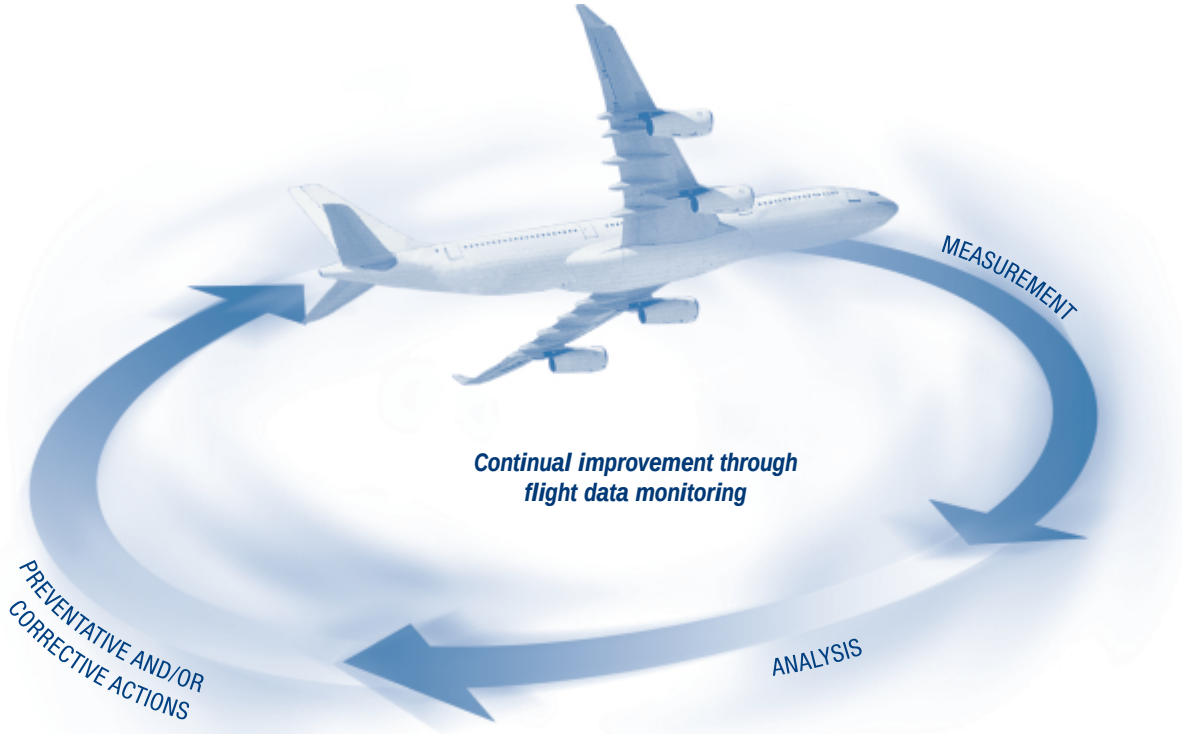
- The acquisition, measurement and analysis of flight data in order to identify, establish probable causes for, and rectify adverse trends and deviations from accepted norms of flight operations and safety
- The capability to more thoroughly understand flight operations by tracking trends, and investigating the circumstances relating to minor incidents
- The detection of flaws before they lead to major incidents, and to develop preventative and/or corrective actions such as increased training or changes in in-flight operating procedures

In short, the flight data monitoring process is a closed loop system that provides a means for the continual monitoring and improvement of the safety of flight operations and performance.

100 years since Kitty Hawk

Aviation has been a popular pastime and an important means of transportation ever since the Wright Brothers were able to sustain flight for 12 seconds over 120 feet in Kitty Hawk, North Carolina on December 17, 1903. According to the International Civil Aviation Organization (ICAO), the scheduled airlines of the world now carry more than 1.6 billion passengers annually.

With the development of the airplane have come great successes and issues that would have been unforeseeable at the start of air travel. In today's complex international and interdependent world, the need for all nations to come together and establish regulations,



laws, and navigational rules, and to disseminate this information for the purpose of standardization and particularly safety has become greater than ever.

Increase in voluntary adoption and regulations

Although it boasts one of the more enviable track records as a means of safe transportation, the aviation industry is under constant pressure to reduce accident and incident rates. Airplane accidents consistently make the headline news. Beyond the tragic human ramifications, there is the damage to consumer confidence and industry growth.

Over the past five years, airlines have increasingly recognized the economic, efficiency and safety advantages of having a comprehensive flight data monitoring program in place. In fact, the data garnered from flight data analysis has been so impressive in driving down accident rates, it is no surprise that several airlines have voluntarily adopted flight data monitoring programs. *(See: Graph 1 and Reference: Airlines With Flight Data Monitoring Programs)*

Industry regulators, in turn, are also beginning to formally mandate the use of flight data monitoring as part of a comprehensive flight safety program. This is in part due to the ICAO standard, which states that beginning on January 1, 2005, operators of large aircraft, *"…shall establish and maintain a flight data analysis programme as part of its accident prevention and flight safety programme."*

Although the monitoring by airlines of flight data is not currently mandatory, the civil aviation authorities of countries worldwide are already beginning to get in line, with China, France and Ireland being examples of countries that have imposed legal regulations. *(See Reference: Regulatory Information)*

Introduction (cont'd)

The ICAO standard, combined with the growing number of airlines who are recognizing its benefits, makes it increasingly likely that additional countries will follow suit and make flight data monitoring mandatory.

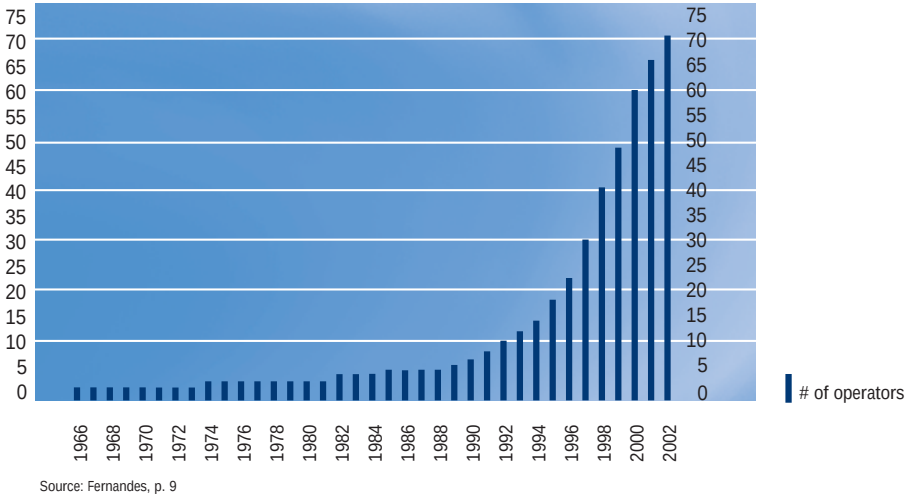
Teledyne Controls – flexible Flight Data Services

An industry leader in designing and manufacturing avionics systems, Teledyne Controls has recognized the need to assist operators with the important business of flight data monitoring.

Teledyne is working closely with operators worldwide to create proactive flight data monitoring programs by offering a line of products that provide the means to implement several of its critical building blocks.
After over 50 years in the aviation industry, Teledyne understands no one airline or operator is the same. That's why Teledyne offers comprehensive end-to-end

Flight Data Monitoring Solutions based on our series of products and services, taking into account each operator's particular aircraft fleet, equipment, and operational requirements.
In this manner, we offer the flexibility to tailor our products and services to complement any operator's flight safety, maintenance and financial strategies and goals.

Graph 1: Growth in number of airlines with flight data monitoring programs



Source: Fernandes, p. 9

Why Implement Flight Data Monitoring?

The U.S. Federal Aviation Administration (FAA) has reported that, "an effectively managed flight operations quality assurance (FOQA) program can provide the highest possible level of safety management, and is potentially the best safety tool of the 21st century."[1]

Regular flight data monitoring has been demonstrated to be a valuable proactive tool to improve the day-to-day monitoring of the condition and performance of individual aircraft and a fleet as a whole. With the necessary information in hand to follow standard operating procedures, the chances of pilots meeting with accident or incident are reduced. The fewer accidents an airline experiences, the fewer potential insurance claims on the horizon, resulting in lower insurance premiums. Consumer confidence is kept high, and bookings remain firm. Safety benefits and cost benefits, therefore, mutually reinforce each other in a cyclical manner.

FAA's estimation of cost benefits

The FAA's DEMOPROJ (Demonstration Project) was started in 1995 as a three-year US $5.5 million project to facilitate the startup of voluntary airline flight data monitoring programs, and to assess the associated costs, benefits and safety enhancements.

Interestingly, DEMOPROJ found that the basic costs of establishing a flight data monitoring program are independent of aircraft size—clearly a disadvantage for smaller, regional airlines with smaller operating budgets and revenues.

To estimate total annual savings for airlines with flight data monitoring programs, they combined the average fuel savings, engine savings, and safety savings seen by the project's participating airlines. They estimated the following annual savings (in U.S. dollars):

- Nearly $500,000 for an airline with 15 aircraft
- Over $1.6 million for an airline with 50 aircraft
- Over $3.3 million for an airline with 100 aircraft

While the FAA's estimated cost benefits are impressive, a 1999 study by a European airline into the costs savings it had experienced from its own program is even more dramatic. [2]

Major benefits of flight data monitoring

The following safety and cost benefits have been experienced by flight data monitoring programs:

- Prevention of major accidents and incidents
- Improved operating procedures
- Improved fuel consumption
- Reduction in unnecessary maintenance & repairs
- Improved pilot training programs
- Increased availability of aircraft
- Improved ground conditions at airports
- Reduced insurance costs
- Reduced number of necessary ACARS messages
- Reduced reliance on flight data recorders
- Adherence to noise restrictions & reduction in fines incurred
- Improved monitoring of flight crew's cosmic radiation exposure

To see the potential hard savings associated with these benefits, and how they may affect you directly, please see *"Reference: Benefits of Flight Data Monitoring."*

Table 1: One European airline's estimate of annual savings from its FDM program

FACTOR	APPROXIMATE ANNUAL SAVINGS
Engines	4,500,000
Punctuality	1,200,000
Maintenance	1,700,000
Operations/ fuel	100,000
Sending data by ACARS	100,000
Total savings	**$ 8,200,000 (U.S. Dollars)**

Source: Fernandes, p. 61

[1] Flight Safety Digest, Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs, Vol. 17, No. 7-9, p.54
[2] Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, p.61.

The Flight Data

2 Data Recording & Storage

• Encrypt & compress data

Quick Access Recorder

Wireless GroundLink®

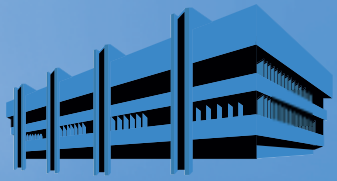
• Optical disk
• PCMCIA card

1 Data Acquisition

• Acquire aircraft data parameters

Data Acquisition Unit

Implement corrective action
& track effectiveness



Electronic delivery of reports

6 Operator's Flight Safety Program

Feedback & information-based
decision making

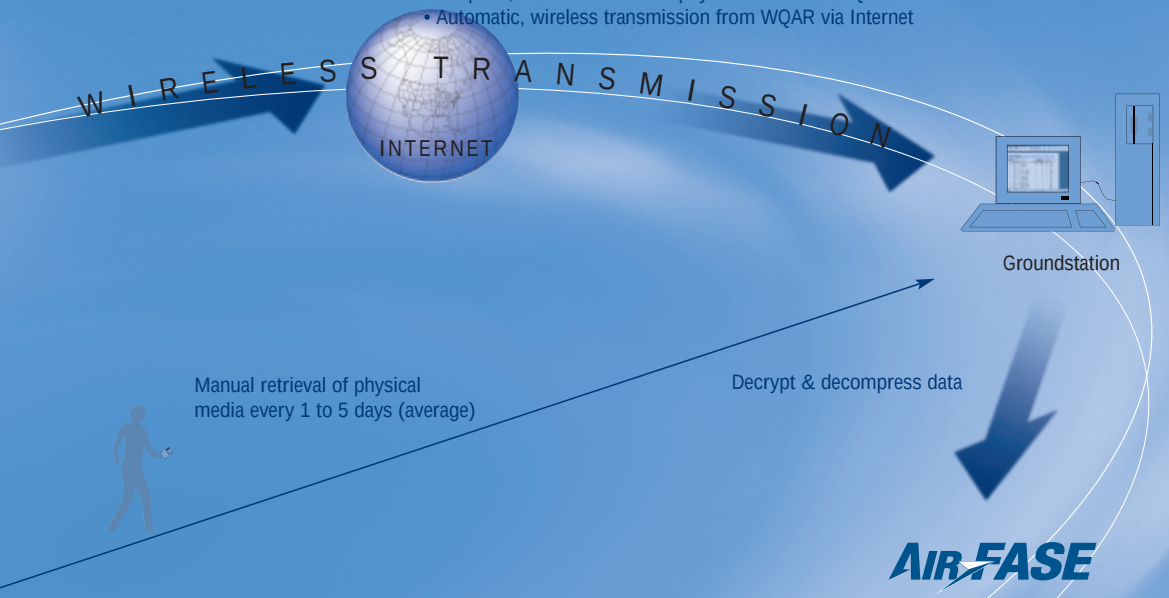
Flight Data Monitoring Team
• Safety staff
• Analysts
• Working groups

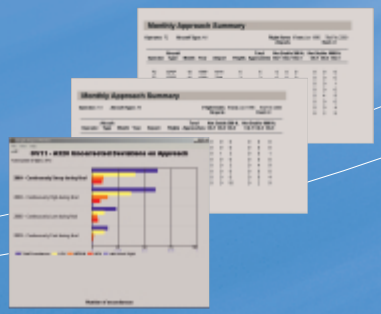
• Flight safety
• Maintenance
• Engineering
• Flight operations
• Flight training
• ATC/ airports
• Manufacturers

Monitoring Process

3 Data Transmission *(or Retrieval)*

- Frequent, manual retrieval of physical media from QAR
- Automatic, wireless transmission from WQAR via Internet





4 Data Analysis

- Data processing
- Flight analysis
- Flight visualization & animation

TELEDYNE CONTROLS
A Teledyne Technologies Company

AIRBUS

5 Information Reporting

- Statistical reports
- Trend analysis
- Risk assessment

The Flight Data Monitoring Process

The flight data monitoring process is an iterative process that exists on a continuum, where each activity will likely be occurring simultaneously. For the purposes of this discussion, however, we will break it down into six basic steps, or stages.

1 Data Acquisition

1. Data Acquisition

In Data Acquisition, which is the first step in the flight data monitoring process, the data acquisition unit (DAU) collects a large amount of data related to the aircraft's operations such as engine temperature, air speed, fuel flow, pitch angle, and hundreds of other parameters from the aircraft systems and sensors scattered about the aircraft.

Before these analog and digital parameters can be recorded, however, the DAU converts the data into digital binary format for output to the flight data recorder (FDR) in accordance with requirements of regulatory agencies. In addition to this mandatory function, a second processor — that enables it to perform Aircraft Conditioning Monitoring System (ACMS) functions, including reports— outputs the data to a recording device.

2 Data Recording & Storage

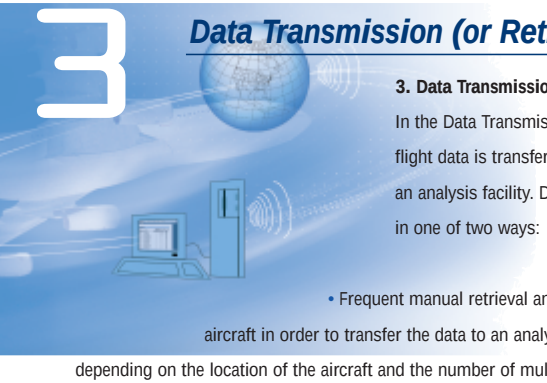
2. Data Recording & Storage

In the Data Recording & Storage stage of the flight data monitoring process, the flight data that was acquired with the DAU is sent to a device where it is recorded and stored on the aircraft.

This early recording was originally done with the FDR, and recorded just six analog parameters (time, airspeed, aircraft heading, altitude, and vertical and lateral acceleration) in the 1960s. These were embossed onto a thick metal foil made with Incanol Steel (believed to be virtually indestructible), but which could be used only once. This limited data was insufficient to aid maintenance personnel, and routine replay of recorders was found to be time-consuming and resulted in reduced life expectancy of the equipment, as well.

Thus, the "quick access" recorder (QAR) was introduced to record data using a tape cartridge that could be removed and replaced by maintenance personnel. While tapes are still being used, most up-to-date QARs use either a removable magneto-optical disks or Personal Computer Memory Card International Association (PCMCIA) to record data, which provide much greater data capacity and reliability.

Another newly introduced option for recording and storage is a wireless QAR that is a fully automated system and transmits data automatically via mobile telephone networks.



3 Data Transmission (or Retrieval)

3. Data Transmission (or Retrieval)

In the Data Transmission stage of the flight data monitoring process, the flight data is transferred from the recording device onboard the aircraft to an analysis facility. Depending on the recording device used, this happens in one of two ways:

• Frequent manual retrieval and return of physical media to and from a QAR on the aircraft in order to transfer the data to an analysis facility. Retrieval takes about 3 to 4 days depending on the location of the aircraft and the number of multiple outstations, and should be done every 1 to 5 days, or as frequently as possible

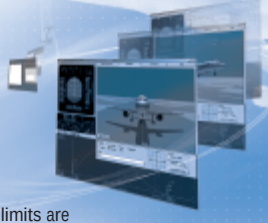
OR...

• Automatic, wireless transmission from a wireless QAR to the analysis facility in two seamless steps after the aircraft is at the gate (transmission happens automatically from anywhere in the world, and takes about 20 to 30 minutes):

1) The device automatically makes the call to the Internet Service Provider (ISP), and then transmits the raw flight data over a secure Internet connection in an encrypted, compressed format to the Groundstation (where it is decrypted and decompressed)

2) Automatic wireless transmission of data from the Groundstation to the analysis facility, where it can be analyzed immediately

4 Data Analysis



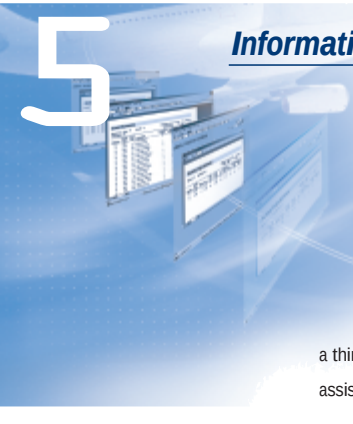
4. Data Analysis

Airplanes already record a certain number of flight data parameters, but recording flight data is not enough. In order to be truly effective as a tool to improve operational efficiency, an operator must be committed to analyzing its flight data.

The primary goal of the Data Analysis step is to identify any events or deviations from pre-defined limits ("excedences") that may have occurred during flight. These limits are determined by the combination of the aircraft manufacturer, flight manuals and an operator's flight operations procedures, and changed when necessary. Since there can be over 100 such events defined by an operator that must be checked for every flight, sophisticated computer analysis software is used to scan for events where flight operations limitations may have been exceeded.

Software with the ability to visualize flight routes and patterns provide an even more powerful aid in identifying flight segments with high-risk potential. Depending on operator policy, excedences that have been identified by the software can be stored for further analysis or deleted.

5 Information Reporting



5. Information Reporting

Data analysis is incomplete without the generation of reports. Data by itself is only so helpful; turning data into *information* is where the real value resides for airlines.

In the Information Reporting stage of flight data monitoring, trained, qualified flight analysts and computer literate personnel use the analysis software to generate easy to understand information reports that yield statistical information, trend analysis, and risk assessment on a routine, periodic basis. If a third party has done the analysis and reporting, the information reports are easily sent electronically to the operator to assist them in interpreting flight data.

6. Operator's Flight Safety Program

The receipt of the information reports by the operator's Flight Safety Program is not the final stage in the flight data monitoring process, but it is a critical one, as the reports empower the operator by giving it the necessary information to improve the overall operational maintenance and safety of their aircraft.

A flight data monitoring team comprised of various flight safety staff, analysts and working groups, can now review key issues and events, confirm their validity, and further investigate the circumstances behind events if necessary. The involvement of the pilot in command of the aircraft at the time of the event greatly improves the value of the information. An operator must, therefore, support an open, non-punitive reporting culture that encourages participation in flight data monitoring without fear of recrimination. This will ensure full participation of pilots and others within the organization.

With this information, an operator now has the ability to provide meaningful feedback and make information-based decisions that affect critical areas within the organization such as flight safety, maintenance, engineering, flight operations, flight training, as well as to functions outside the organization such as air traffic control/ airports, and manufacturers. It is also equipped to implement preventative and corrective actions, and to track the ongoing effectiveness of these actions.

Teledyne's Flexible Flight Data Monitoring Solutions

It's all about flexibility. Teledyne doesn't just offer parts of the process— we offer comprehensive, end-to-end Flight Data Monitoring Solutions based on our series of products, taking into account each operator's particular aircraft fleet, equipment, and operational requirements. As a result, we offer the flexibility to tailor a program that will complement virtually any operator's flight safety, operational, maintenance and financial strategies and goals. There is really no limit to the ways in which a flight data monitoring program can be set up.

1. Products for Data Acquisition

Teledyne has been providing Data Acquisition equipment to airlines and operators for over 30 years. Today, Teledyne is the leader in this market, supplying nearly 60% of the world's data acquisition units, including:

Digital Flight Data Acquisition Unit (DFDAU)

The Teledyne Digital Flight Data Acquisition Unit (DFDAU) offers operators of Boeing aircraft the most advanced Aircraft Condition Monitoring System (ACMS) available in the world today at a cost comparable to current day DFDAUs.

DFDAU capabilities:

- An easily programmable dual processor
- Increased I/O capability to support the interface requirements of multiple aircraft types
- Interchangeable across multiple aircraft types in single unit
- Dual processor design ensures isolation and allows full ACMS user programmability using Teledyne's Windows® -based Application Generation Station (AGS), without recertification. Key in implementing a flight data monitoring program
- Cockpit Voice Recorder time synchronization output
- Integrated QAR/DAR comes with unit

Data Management Unit (DMU)

Integral to new DFDAUs, the stand-alone Data Management Unit (DMU) is the central hub of airborne data. It was designed for the intense data monitoring requirements of the B737, B747-400, B757, B767, MD-11 and A310.

DMU capabilities:

- Process digital and discrete inputs
- Generate raw data output to QAR
- Generate and output ASCII formatted reports
- Fully User-Programmable via PC based Application Generation Station (AGS)
- Uploadable on aircraft via Airborne Data Loader (ADL)

Flight Data Interface Management Unit (FDIMU)

Teledyne's Flight Data Interface Management Unit (FDIMU) represents the latest in state-of-the-art airborne technology for Airbus aircraft. Through the Teledyne concept of Line Replacement Unit (LRU) Compression™, it combines multiple traditionally separate functions into one system.

It combines the functions of the Flight Data Interface Unit (FDIU – mandatory data acquisition), the Data Management Unit (DMU – engine / aircraft condition monitoring) and the Access Recorder (QAR/DAR – maintenance and FOQA data recording) into a single LRU system.

FDIMU capabilities:

- Dual independent Power PC processors
- Combines mandatory, ACMS and QAR recording capabilities in one LRU
- Software loadable using ARINC 615 Airborne Data Loader (ADL/PDL)
- ACMS software fully user programmable using Teledyne Controls Windows®-based Application Generation Station (AGS)
- Integral PCMCIA module for recording flight data monitoring data as well as DFDR data

Flight Data Interface Unit (FDIU)

The Teledyne Flight Data Interface Unit (FDIU) provides operators of the Airbus A330-200/300 and A340-200/300 with the only certified unit capable of meeting the latest mandatory Digital Flight Data Recorder (DFDR) recording requirements, including the 88 Parameter FAR 121.344, JAR-OPS 1.715 and parameters defined in the new ED112.

FDIU capabilities:

- Acquires and formats critical flight parameters and supplies them to the external DFDR for recording in an ARINC-717 Bi-Phase data output
- Provides an ARINC-717 Bipolar data output for an (optional) external Quick Access Recorder (QAR), with the data frame identical to the DFDR output
- Provides a Cockpit Voice Recorder (CVR) time synchronization output
- Allows software update via a Portable Data Loader (PDL) or a Multifunction Disk Drive Unit (MDDU)

Mini Flight Data Acquisition Unit (MFDAU)

Developed for the business and regional aircraft market, Teledyne's enhanced Mini Flight Data Acquisition Unit (MFDAU) is based on a recent DFDAU design implemented for the next generation Boeing and Airbus aircraft.

MFDAU capabilities:

- Dual independent Power PC processors
- Combines mandatory ACMS and recording capabilities
- ACMS software is fully user-programmable using Teledyne's Windows®-based Application Generation Station (AGS)
- Integral PCMCIA module for recording flight data monitoring data as well as copy of DFDR data
- Capable of interfacing with ASCB (Version A, B or C) and CSDB busses
- Capable of merging existing ARINC 573/717 DFDR stream with additional acquired parameters

2. Products for Data Recording & Storage

If this function is not already integral to an aircraft's DAU, Teledyne Controls offers two hardware options for aircraft Data Recording and Storage:

Quick Access Recorder (QAR)

Teledyne Controls' Quick Access Recorder (QAR), available in optical (OQAR) and PCMCIA (PQAR) options, performs the function of a maintenance and flight data monitoring recorder. It records continuous raw data as supplied from the DFDAU on Boeing Aircraft, and the FDIMU or DMU on Airbus aircraft, and makes that data readily available for aircraft maintenance and/or flight data monitoring programs.

QAR capabilities:

- Supports various capacities of magneto-optical disks and PCMCIA cards
- Reduced maintenance cost—no scheduled maintenance required. On-condition maintenance
- Tolerance of environmental extremes - temperature monitoring and disk drive power control system ensure that the disk drive only operates when the drive temperature is between 10º C and 40º C

Wireless GroundLink® (WQAR)

The Teledyne Controls Wireless GroundLink® (WQAR) eliminates manual handling, managing and transporting of data media, reduces data lag, and provides data in a timelier manner than traditional QARs.

It is a system with unprecedented reliability, over which operators can send flight data for near real-time analysis of air vehicle and flight crew performance, and it provides aircraft operators with a reliable and cost-effective solution that can be implemented immediately without the significant cost or schedule impacts of airport upgrades.

WQAR capabilities:

- A cost effective way to move data on & off the aircraft
- Retrieve QAR data from aircraft without human involvement
- Data accumulated during the flight is compressed and encrypted for security
- Same unit may have multiple radios for worldwide operation
- Multiple radio transmission reduces data transfer time
- Data delivered over the Internet worldwide
- No investment in the infrastructure—uses existing cell phone infrastructure
- Operates in controlled frequency spectrum worldwide, protected from interference

3. Services for Data Transmission (or Retrieval)

Manual retrieval of physical media from QAR

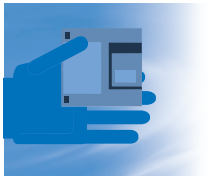
Teledyne can provide the conventional method of data retrieval from a QAR, which involves:

- Removal of the physical recording media (optical disk or PCMCIA card) from the aircraft
- Replacing the media in the recorder with a new one
- Packaging the removed media in a shipping container
- Shipping the media package to the analysis facility

- Erasing and returning the media after the data content is transferred to our analysis facility computer

Disadvantages to manual retrieval:

- Long delays between time of flight and analysis due to the time required to send data from remote outstations (which can take up to 3 to 4 days depending on locations and number of outstations)



- Large amounts of data must be recorded and retrieved on a regular basis (typically must be repeated an average of every 1 to 5 days)
- The cost of physically retrieving media can become expensive in terms of the man-hours involved
- Up to 30% data loss can be experienced as a result of damaged, lost, misplaced or stolen media

Wireless transmission by WQAR

Wireless transmission by WQAR replaces the traditional need for manual retrieval of physical media with all its inherent disadvantages. Once considered to be future technology, Teledyne's future is *now,* with our fully functional Wireless GroundLink® (WQAR) already successfully operating at airlines.

Qantas, for example, has been flying Teledyne's Wireless GroundLink successfully onboard a Boeing 747-400 since July 16, 2001. Upon landing, the aircraft immediately transmits flight data information to Qantas' base station in Sydney, where the data is carefully monitored. Qantas has consistently experienced 100% data recovery.

Teledyne can set up and manage all services related to the wireless transmission of data from your WQAR to our Data Analysis Facilities in Scotland, UK or Los Angeles, CA; this involves:

- Configuring fleet to provide proper data to support a flight data monitoring program
- Set-up and management of Internet Service Provider (ISP), SIMS and Airtime accounts
- Flexibility to allow the airline to obtain/intercept data directly from the Groundstation (either encrypted/compressed or decrypted/decompressed) and proceed with their own data analysis

Advantages of wireless transmission:

- Eliminates need for media handling, human intervention and associated overhead costs
- Eliminates overhead and logistics in storing and recycling large quantities of removable media
- Data can be downloaded immediately after every flight rather than several days later, thus improving the effectiveness of a flight data monitoring program
- Rapid transmission of data -- the standard flight data recording from a 12-hour flying day can be transmitted in just over 20-30 minutes
- Data from aircraft anywhere in the world can be sent to a single analysis facility
- Provides near real-time access to data for identification of short-term trends, leading to improved safety benefits and engineering advantages
- Aircraft can transmit data from problem aircraft from outstations anywhere in the world, and have data

within minutes in order to determine whether or not aircraft is serviceable

- Reduces the loss of data due to faulty QARs or damaged, lost or misplaced media
- Minimizes airborne ACARS messaging costs for non-critical messages
- *Operators can expect to experience 100% data recovery*

4.5.

4 & 5. Product and Services for Data Analysis & Information Reporting

With Data Analysis and Information Reporting being such vital steps in flight data monitoring, Airbus and Teledyne, both leaders in the aviation industry, have partnered to bring you AirFASE (Aircraft Flight Analysis & Safety Explorer).

AirFASE (Aircraft Flight Analysis & Safety Explorer)

AirFASE is a powerful measurement, analysis and reporting software tool created especially to support flight data monitoring objectives. It was designed for early identification of risk precursors in flight operations by the continuous monitoring of deviations from normal operations, and was created to be used directly by pilots, analysts and maintenance engineers for flight analysis and the generation of information reports.

AirFASE performs 3 major functions:

(1) Data Processing:

- Collects raw data recorded by the on-board Flight Data Recorder
- Processes raw data and transcribes into engineering values to automatically generate a Flight Database
- Prints the curves and graphs associated to the Flight Data
- Compares the Flight Data to the Flight Profiles (AirFASE is delivered embedded with the Airbus Standard Flight Profile Specifications corresponding to the operator's fleet)
- Detects events that deviate from the normal and safe operations and highlights the potential risk situations
- Validates the detected events and potential risk situations and stores them in a SQL database
- Replays the flight on cockpit-like instruments similar to those seen by pilots in actual flight

(2) Flight Analysis & Animation:

Analysis

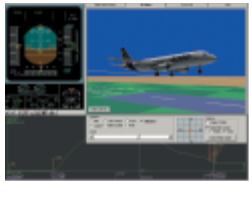
The severity level of the events and risk precursors are color-coded as follows:

- Yellow events denote low severity
- Amber events denote medium severity
- Red events denote high severity

Statistical analysis determines the trends and highlights the precursors of the incident/accident to be corrected.

Flight Animation

The Flight Animation in AirFASE incorporates the most advanced and sophisticated 3-D flight replay. These animations are aircraft data driven and high fidelity. AirFASE's flight animation function has been designed by pilots for pilot analysts, with easy to use cockpit-centered functions.



TELEDYNE CONTROLS
A Teledyne Technologies Company

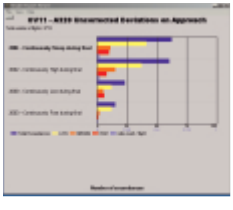
AIRBUS

Animation features include:

- Flight Path with graphic representations of color-coded deviations
- Cockpit-like instruments synchronized to all other display forms
- Special close-ups for critical phases of flight, e.g. 3000ft to touchdown, landing and roll out
- 3-D view with 360 degrees vertically and horizontally with zoom and flight path trace view
- Cockpit view from Captain and First Officer seat
- VCR type replay (■▶) plus second-by-second manual Forward and Back. All functions are synchronized to all graphs through cursors
- Animation can be recorded either on VCR or used with other applications like PowerPoint™ (excellent for safety, training, investigations, & familiarization demos)

(3) Information Reporting

- Automatic access by simple clicks to ready-to-use reports in different configurable formats
- Creation of customized reports using the integrated **Report Editor** (all reports can be displayed on the screen or printed)



- Automatic periodic reports in MS Word™ format are integrated into the software
- Data can be exported to other software applications
- Display and detailed analysis of the different stages of approach and landing allows quick and accurate understanding
- User can easily select between graphical or numeric display

Benefits of AirFASE

For the flight data monitoring team:

- First level of risk analysis is done automatically
- Ready to use, with user-friendly interfaces
- Multi-level user access mechanism allows for definition of user groups, ensuring secure data access
- Minimizes daily workload:

- Graphic tools reduce time spent on data transcription to save time for event analysis
- Report analysis module automates generation of statistical reports and trending
- Creating ready-to-print reports in MS Word™ format
- Facilitating data exchange
- Replaying all flights with a simple click of the mouse

- Ability to customize reports according to addressees
- Training on-site by pilot and engineer

For the Operator's Flight Safety Program:

- Risk recognition. (e.g. High Energy Situation in Approach, Tail Strike Risk at Take Off)
- Direct access to meaningful information (e.g. Routine Event Detection, Trend by Quarter, by Type of Aircraft, by Airport)
- Risk assessment and decision-making support
- Ability to optimize recurrent training
- Identification of non-adapted ATC procedures
- Validation or modification of Standard Operating Procedures

Services for Data Analysis and Information Reporting

Teledyne recognizes some operators may not wish to invest in the required infrastructure to maintain a fully functioning in-house program. That's why Teledyne offers flexible end-to-end management services for data

acquisition, recording, transmission, analysis and reporting, depending on the individual needs of the operator. In this way, our staff can diminish some of the workload, allowing you to concentrate on the core flight data monitoring responsibilities of correcting flight operational issues.

Setup and maintenance of AirFASE

- Analyze operator's specific needs and adapt AirFASE to meet them
- Provide all related computer hardware to support the system, regardless of its physical location
- Analyze data from physical media—Teledyne can handle practically every type of media in use today
- Provide qualified operator and engineering support—to define, process and debug the initial AirFASE installation

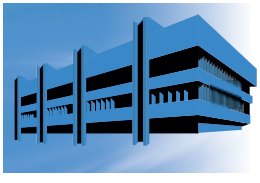
Delivery of information reports

- Set up and manage AirFASE analysis and reporting as an outsource service—data in the evening, reports in the morning
- Send reports electronically in order to achieve a timely response to the results of the analysis from flight safety and operations
- Place reports on a secure FTP site, where the client has ready access to the information—for additional security, report folders can be protected by password access control
- Establish a Virtual Private Network (VPN) in order to establish a connection between the Teledyne Data Analysis Facility and the client site
- Distribute flight animation reviews on CD-ROM

Secure access to information

- Provide access to the processing facility via authorized access control
- Provide access to the computer systems via password protection access
- Isolate each customer's data – storage media is dedicated to each customer, and media (drives) are not shared between customers
- Provide secure distribution of reports and data

6. Services for an Operator's Flight Safety Program



One of the biggest mistakes most operators make is underestimating the internal infrastructure required to manage a flight data monitoring program. According to DEMOPROJ, personnel costs can comprise up to 80% of the total operating costs of setting up a flight data monitoring program, and these numbers have been duplicated by a number of airlines. Operators must carefully estimate the number of qualified, trained, computer-literate personnel they will require, and take into account the necessary equipment, and other infrastructure needed to support a flight data monitoring program.

In terms of data security or protection, operators can enjoy a definite advantage from outsourcing data analysis. The International Federation of Air Line Pilots' Associations (IFALPA) website cites two cases in which the use of a third party helped smaller airlines preserve the distinction between flight safety and flight operations, as well as the anonymity of aircrew within the airline. These issues were easier to manage when specialists who were not personally familiar with the airline personnel carried out the data analysis off-site and separately from the organization.

Conclusion

Timely access to information is critical in today's highly competitive environment. Whether you have a single aircraft or a large fleet, the process of flight data monitoring allows you to capture raw data and translate it into actionable information.

Imagine— being able to make informed decisions based on meaningful information instead of merely hunches or conjecture. And, with cost and safety savings more than justifying the cost of setup and maintenance, today's operator can't afford NOT to implement a flight data monitoring program.

Building on over 50 years of experience in the aviation industry, Teledyne Controls is pleased to offer a comprehensive line of innovative products and flexible Flight Data Monitoring Solutions to meet ICAO recommendations and standards, local regulations, and your organization's specific requirements.

With special emphasis on value added to your organization, Teledyne offers you the flexibility to tailor an end-to-end program from the ground up, or fill in any gaps in your existing program— all with appreciably less aggravation and cost than most in-house solutions.

Do you already have the hardware and existing infrastructure and are just looking for someone to provide the data analysis and reporting piece of the puzzle? Or, are you looking for help in building an in-house flight data monitoring program that your own flight safety team can run? Or, would you like to sit back and enjoy the advantages of outsourcing a comprehensive end-to-end program, complete with hardware, software and all associated services?

Whatever your safety, operational, maintenance and financial needs are, Teledyne can work with you to structure a program that will meet your requirements. We look forward to helping you design your flight plan for success by maximizing the value of your flight data to ensure quality in your flight operations and safety, and to gain a competitive edge.

Benefits of Flight Data Monitoring

None of the following individual benefits stand in isolation; most are interrelated and reinforce each other. As a result, the cumulative safety and cost benefits can be massive and dramatic. Operators that are sophisticated in their use of flight data have shown that the cost savings of implementing and running such a program more than cover its costs. If even a single accident can be prevented, a flight data monitoring program will have paid for itself many times over.

• Reduction of costs associated with major accidents and incidents

Although the world airline safety record is enviable compared to automobile transportation, an annual average of 1,409 people have lost their lives in airline accidents and incidents since 1990. Operators that experience accidents and incidents likewise see drops in reservations, ridership and flying time, as well as increased maintenance, resulting in significant revenue loss. Flight data monitoring is an effective way to help reduce these associated costs, as well as the incalculable toll on human life.

In the mid-1990s, one U.S. airline crashed during its descent for landing. Of the approximately 165 passengers and crew members on board, only four passengers survived. Although it had already been insured for a full US $34 million, the airline set aside a US $41 million provision in order to cover liability that was not already covered by third-party insurers. With the accident totaling at least US $75 million, any program that can help prevent losses of this kind is worth serious consideration.

One European airline started putting flight data monitoring to work in 1962, with clear results. For the 26-year period of 1952 to 1978, the airline experienced 30 hull losses. But in the following 30-year period from 1972 to 2002, they experienced only two hull losses. A comparable U.S. airline, on the other hand, which has not had such a program, experienced 17 and 12 hull losses during the same periods.

In a comparison of hull loss rates between airlines with flight data monitoring programs, research shows that the longer airlines have been using flight data monitoring programs, the lower their accident rates. *(See Graph 2)*

• Improved operating procedures

Data from flight data monitoring programs may show consistent deviations from standard operating procedures that are significant enough to lead to potentially hazardous situations. The knowledge of potential risks and the ability of pilots to get trained to recognize these risks offer the chance to minimize them. This improves the overall level of operations, which in turn creates an environment in which an airline is less likely to have a potentially fatal accident. In instances of take-off, approaches and landing where most incidents are typically seen, the ability to address these issues and apply preventative and corrective action on an incremental basis is extremely valuable.

[1] Airclaims, Case 2 "The Ultimate Aviation Database," Feb 2003
[2] NTSB Accident Database & Synopsis, http://www.ntsb.gov/NTSB/brief.asp?ev_id=20001207X04990&key=1 (as of March, 1, 2003)
[3] Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, p.53.
[4] Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, p.7.

• Improved fuel consumption

Given that fuel can make up about half of an operator's direct operating costs, the ability to optimize fuel consumption can be particularly valuable. One large carrier estimates savings of US $750,000 annually on one international route alone, just from having the ability to identify and make adjustments to specific aircraft with unusually high fuel burn rates. "For proven safety benefits, as well as demonstrated cost savings, the chairman of this airline praised [flight data monitoring] as being 'the most valuable management tool we have.'"[5]

• Reduction in unnecessary maintenance & repairs

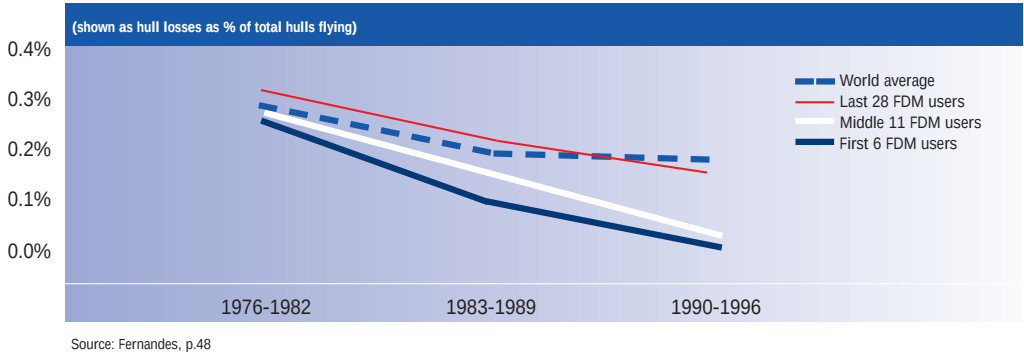
According to a one study, a 1% savings are possible from flight data monitoring through a reduction in unscheduled engine removals.[6] With engines being one of the highest individual cost item on an aircraft besides the aircraft itself, and engine maintenance taking up to a quarter of direct operating costs, savings in engine maintenance can be immediate and substantial.

Reduced maintenance activity can also be translated into cost benefits in areas like brake wear and hard landings. By monitoring aircraft brake usage, another study indicates that a 1% extension in the brake replacement cycle is possible. The same study shows that hard-landing inspections may be reduced by 10% as tangible payback from data received from monitoring programs.[7]

• Improved pilot training programs

Regular monitoring and analysis of flight data may highlight a recurring event, and as a result, lead to the need to adjust pilots' training programs. Alternatively, flight data may highlight consistently excellent performance, resulting in the ability to reduce recurring training required, leading to significant savings in the training budget.

Graph 2: Comparison of hull loss rates between airlines with flight data monitoring programs



Source: Fernandes, p.48

[5] Flight Safety Digest, Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs, Vol. 17, No. 7-9, p. 54.
[6] Transportation Development Centre, Transport Canada, Overview – Statistics, http://fdm.cbu.xwave.com/overview.html (as of February 28, 2003)
[7] Transportation Development Centre, Transport Canada, Overview – Statistics, http://fdm.cbu.xwave.com/overview.html (as of February 28, 2003)

Benefits of Flight Data Monitoring (cont'd)

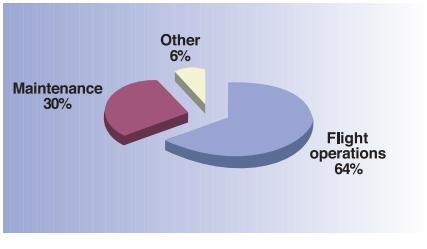
• Increased availability of aircraft

Flight data monitoring can aid maintenance personnel in catching conditions that may result in unscheduled maintenance or a major accident, both of which would put the aircraft out of service and disrupt flight schedules.

Unscheduled maintenance is a major cause of flight cancellations—at one large airline, nearly one-third of cancellations was caused by maintenance issues that required resolution before the aircraft was available for additional operations *(See Graph 3)*.[8]

Similarly, if flight data shows how conditions that appear to be dangerous deviations at first glance, are actually within normal limits, unscheduled maintenance or cancellations can be avoided. This was seen in the case of one European airline whose crew refused to fly an aircraft with a reported fuel imbalance. Upon analysis, however, flight data revealed that the fuel balance was within normal limits, and the crew accepted the aircraft—savings in cases such as these have resulted in the airline estimating their cost savings at about US $170,000 per year through a reduction in delays and increased aircraft availability.[9]

Graph 3: Main Causes of Cancellations [8]



• Improved ground conditions at airports

In certain cases, airlines can use the data captured from their flight data monitoring programs to exert pressure on air traffic control and airports. Captain Jeff Bayless, an Airbus A320 pilot and FOQA manager at United Airlines says, "We want our FOQA data to drive the process of fixing the [aviation] system." According to Bayless, United is doing just that, using data on taxiing speed or taxiway roughness "…to tell air traffic control that they need to repave."[10]

Almaty Airport in Kazakhstan, is an example of an airport that has received such pressure. One airline was able to use the data collected from their flight data monitoring program to pressure Almaty into resurfacing their runway. The poor condition of Almaty's runway had meant more frequent landing gear inspections were required for aircraft flying into the airport. Once the resurfacing had taken place, not only did the airline see direct results in terms of their data, but the gear inspection restriction was lifted. In this case, flight data monitoring gave the airline the power to drive infrastructure change, as well as save in terms of reduction in landing gear inspections.[11]

[8] Rockwell Collins, Integrated Information System (I2S), http://www.rockwellcollins.com/content/pdf/1282.pdf, p.4., (as of March 7, 2003)
[9] Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, pp. 52, 55.
[10] Flight Safety Digest, Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs, Vol. 17, No. 7-9, p.29.
[11] Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, p. 50.

• Reduced insurance costs

According to an online introductory guide to airline insurance, the main aviation risks are for hull and aviation liability.[12] Given the demonstrated reduction in hull losses in airlines with flight data monitoring programs as seen in Graph 2, a reduction in insurance costs can be extrapolated easily. Cost savings would also be seen through a reduction in liability claims. The online guide further states that, "By showing that the airline is proactive in safety matters and works with the latest techniques to reduce claims on its policy, the airline will gain in whatever market conditions that prevail during renewal negotiations."

• Reduced number of necessary ACARS messages

ACARS was established to send important air-to-ground data, and operates via costly per-message radio communications. While it cannot replace ACARS, flight data monitoring equipment can limit the need to use ACARS to process and send engine trending and some aircraft reports. In some cases, some of the non-critical data that is sent (e.g. take-off reports, stable cruise reports) can be acquired, recorded and transmitted via flight data monitoring equipment, mitigating the costs associated with the use of ACARS.

• Reduced reliance on flight data recorders

In the absence of a flight data monitoring program, data is typically captured by an aircraft's flight data recorder (FDR). With the time of retrieval from an FDR, taking several hours, reliance on FDRs can be costly. If data is transmitted automatically via Wireless GroundLink® technology over the Internet, the costs can be mitigated. In the case of ASRs, data is often acquired from FDRs manually. Depending on the number of ASRs an airline receives, substantial savings could be realized from automatic transmission and analysis of this data.

• Adherence to noise restrictions & reduction in fines incurred

According to NASA's Aerospace Technology Enterprise, "Analysis of the relationship between airport efforts to reduce aircraft noise intrusion and the efficiency of air carrier operations shows conclusively that airlines incur significant costs related to noise abatement."[13]

In England, the British Airport Authority (BAA) monitors and combats noise pollution in Great Britain using a Noise and Flight Track monitoring system (known as NTK)[14] as well as a complaints system called AIRVIRON.[15] Between 1993 and 2000, the BAA fined airlines that exceeded noise limits to the tune of over £1.25 million (approximately a quarter of a million US dollars).[16]

And, in the United States in the late nineties, Denver International Airport in Colorado faced US $3.5 million

[12] Bannister, Jim, Airline Insurance, An Introductory Guide, http://www.generali.com/library/airline/ (as of February 28, 2003)
[13] NASA's Aerospace Technology Enterprise, Airport Noise Abatement and the Aviation Industry, http://aero-space.nasa.gov/library/encompat/workshop4/Schiphol.htm (as of February 28, 2003)
[14] BAA Noise Strategy 2000-2005, p.3, http://www.baa.co.uk/pdf/lhr_noisestrategy.pdf, (as of February 28, 2003)
[15] AGI, Monitoring and Combating Noise Pollution in Great Britain, http://www.agi.org.uk/case-studies/noise-pollution.pdf, (as of March 1, 2003)
[16] BAA Noise Strategy 2000-2005, p.3, http://www.baa.co.uk/pdf/lhr_noisestrategy.pdf, (as of February 28, 2003)

Benefits of Flight Data Monitoring (cont'd)

in noise violation fines from its local county. An increasing sensitivity to noise pollution makes flight data monitoring a welcome tool in helping operators adhere to noise restrictions in terms of being able to verify or deny actually infringement, and to avoid incurring fines.

- **Improved monitoring of flight crew's cosmic radiation exposure**

On May 13, 1996, the Council of the European Union adopted Directive 96/29/Euratom. Article 42 of the Directive imposed requirements related to assessing exposure, informing crew members of their potential exposure, and scheduling crew to limit exposure. Member States were expected to comply by May 13, 2000.[17]

The Earth's atmosphere provides some protection from cosmic radiation, but exposure increases at higher altitudes and latitudes toward the magnetic poles. In fact, "cosmic radiation is approximately 100 times higher at typical cruise altitudes than it is at ground level."[18] Flight data monitoring can assist in tracking radiation exposure and thus, record keeping and compliance with this directive. As a note, the occupational limits (the maximum acceptable exposure level) differ from country to country; they also differ if the subject is pregnant.

[17] Department of Transport, Implementation of Article 42 of Council Directive 96/29 Euratom Consultation Document, http://www.aviation.dft.gov.uk/consult/a42/ (as of March 1, 2003)

[18] Institute for Environment and Health, A Consultation on the Possible Effects on Health, Comfort and Safety of Aircraft Cabin Environments, Final Report for the Department of Environment, Transport and the Regions, p. 11, January 2001.

Glossary of Acronyms

Acronym	Definition
3-D	Three-Dimensional
A/C	Aircraft
ACARS	Aircraft Communications Addressing and Reporting System
ACMS	Aircraft Condition Monitoring System
ADL	Airborne Data Loader
AGS	Application Generation Station
AirFASE	Aircraft Flight Analysis and Safety Explorer
AQP	Advanced Qualification Program
ARINC	Aeronautical Radio Incorporated
ASCB	Avionics Standard Communication Bus
ASR	Air Safety Report
ATC	Air Traffic Control
BAA	British Airport Authority
CAA	Civil Aviation Authority
CAAC	Civil Aviation Administration of China
CASE	Airclaims' Client Aviation System Enquirey
CDMA	Code-Division Multiple Access
CD-ROM	Compact Disc, Read-Only-Memory
CSDB	Commercial Standard Digital Bus
CVR	Cockpit Voice Recorder
DAR	Digital ACMS Recorder
DAU	Data Acquisition Unit
DEMOPROJ	FAA's Demonstration Project
DFDAU	Digital Flight Data Acquisition Unit
DFDR	Digital Flight Data Recorder
DMU	Data Management Unit
EU	European Union
FAA	Federal Aviation Administration
FAP	Flight Analysis Program
FDAU	Flight Data Acquisition Unit
FDIMU	Flight Data Interface Management Unit

Acronym	Definition
FDIU	Flight Data Interface Unit
FDM	Flight Data Monitoring
FDR	Flight Data Recorder
FODA	Flight Operations Data Assurance
FODCOM	CAA's Flight Operations Department Communication
FOM	Flight Operations Management
FOQA	Flight Operations Quality Assurance
FSF	Flight Safety Foundation
GAIN	Global Aviation Information Network
GSM	Global System for Mobile Communication
I/O	Input/ Output
ICAO	International Civil Aviation Organization
ISP	Internet Service Provider
JAR	Joint Airworthiness Regulations
LRU	Line Replaceable Unit
MDDU	Multifunction Disk Drive Unit
MOQA	Maintenance Operations Quality Assurance
NG	Next Generation
NPA	Notice of Proposed Amendment
NTSB	National Transportation Safety Board
OFDM	Operational Flight Data Monitoring
OQAR	Optical Quick Access Recorder
PC	Personal Computer
PCMCIA	Personal Computer Memory Card International Association
PDL	Portable Data Loader
QAR	Quick Access Recorder
SQL	Structured Query Language
SRG	Safety Regulation Group
USD	United States Dollars
VCR	Video Cassette Recorder

Regulatory Information

The following is a summary of regulations relating to the establishment of flight data monitoring and flight safety programs. Please contact the respective organization or authority for additional information, regulatory initiatives and latest amendments.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

Amendment 26 to ICAO Annex 6: Operation of Aircraft, Part 1 of the ICAO Convention on Civil Aircraft (excerpts):

3.6 Recommendation—Accident prevention and flight safety programme

Note.— Guidance on accident prevention is contained in the Accident Prevention Manual (Doc 9422) and in the Preparation of an Operations Manual (Doc 9376).

3.6.1 An operator shall establish and maintain an accident prevention and flight safety programme.

3.6.2 From 1 January 2002, an operator of an aeroplane of a maximum certificated take-off mass in excess of 20,000 kg should establish and maintain a flight data analysis programme as part of its accident prevention and flight safety programme.

3.6.3 From 1 January 2005, an operator of an aeroplane of a maximum certificated take-off mass in excess of 27,000 kg shall establish and maintain a flight data analysis programme as part of its accident prevention and flight safety programme.

Note— An operator may contract the operation of a flight data analysis programme to another party while retaining overall responsibility for the maintenance of such a programme.

3.6.4 A flight data analysis programme shall be non-punitive and contain adequate safeguards to protect the source(s) of the data.

Note.— Guidance on flight data analysis programmes is contained in the Accident Prevention Manual (Doc 9422).

Notes:

- All countries part of ICAO must adhere to this amendment, or they must file "a letter of difference" with ICAO indicating they will not comply by 1 Jan 2005
- ICAO emphasizes that data analysis should not be used in a non-punitive way
- Each country (ICAO has more than 180 Contracting States) is responsible for its own civil legislation to implement the ICAO recommendation, and to establish internal safeguards to prevent abuse of programs
- Operators may utilize third-party organizations to run their flight data monitoring programs

JOINT AVIATION AUTHORITIES (JAA)

JAR-OPS 1.037 – Accident prevention and flight safety programme

(a) An operator shall establish an accident prevention and flight safety programme, which may be integrated with the Quality System, including:

(1) Programmes to achieve and maintain awareness by all persons involved in operations; and

(2) An occurrence reporting scheme to enable the collaboration and assessment of relevant incident and accident reports in order to identify adverse trends or to address deficiencies in the interests of flight safety. The scheme shall protect the identity of the reporter and include the possibility that reports may be submitted anonymously. (See ACJ OPS 1 (a) (2); and

(3) Evaluation of relevant information relating to incidents and accidents and the promulgation of related information, but not the attribution of blame, and

(4) The appointment of a person accountable for managing the programme.

(b) Proposals for corrective action resulting from the accident prevention and flight safety programme shall be the responsibility of the person accountable for the programme.

(c) The effectiveness of changes resulting from the proposals for corrective action identified by the accident and flight safety program shall be monitored by the Quality Manager.

Notes:

- The Joint Aviation Authorities (JAA) is an associated body of the European Civil Aviation Conference (ECAC) representing the civil aviation regulatory authorities of a number of European States
- Although the JAA has already developed common civil aviation safety regulatory standards and procedures (JARs), legally it is only a co-operative body of the civil aviation regulatory authorities of a number of European States. Thus, its rules and regulations have no binding character. To achieve that, JARs have to be transformed into national or EU law
- JAA has indicated that ICAO standards will be met via an amendment of JAR-OPS 1. A NPA (Notice of Proposed Amendment) is likely to appear this year to say how and when the JAA plans to implement this ICAO requirement
- JAA will continue until EASA is finally established

EUROPEAN AVIATION SAFETY AGENCY (EASA)

The EASA website states:

"The adoption on 15 July 2002 of a European Parliament and Council Regulation (EC) No 1592/2002… opens the way for a new Community system of air safety and environmental regulation and for the establishment of the European Aviation Safety Agency (EASA), which will start operating in September 2003."

Notes:

- EASA is an Agency of the European Union (EU) in the early stages of setting up. When this happens, all JAA rules will become enforced law across EU states, but this could take several years

EUROPEAN COMMISSION

Response to the ICAO Amendment 26:

- As indicated in its White Paper on Transport, which was published in September 2001, the European Commission has now asked the Council to authorize negotiations for the European Community's accession to the ICAO
- Has responded with a letter from the European Commission Energy and Transport Department indicating that all members will respond favorably to ICAO's recommendations

Regulatory Information (cont'd)

UNITED KINGDOM: Civil Aviation Authority (CAA)

UK response to ICAO Amendment 26:

The UK agrees with the recommendations of the Accident Investigation and Prevention (AIG) divisional Meeting 1999 for amendment of Annex 6—Operation of Aircraft. The UK response to ICAO stated:

"It is believed that whilst safety proactive operators will implement such programmes without a standard those likely to benefit most will not. However, once a recommended practice, any operator not having a fully functional programme in place could be seen as not making "best endeavours" and hence culpable after an accident."

From CAA Flight Operations Department Communications (FODCOMs) (20/2001):

Regarding ICAO Amendment 26 to ICAO Annex 6 Part I paragraph 3.6.2

Flight Operations Department Communication (FODCOM) 18/2001 contained the Letter of Intent to amend CAP 360 to include this Recommendation.

Regarding ICAO Amendment 26 to ICAO Annex 6 Part I paragraph 3.6.3

The CAA wishes to inform operators that it intends to introduce this ICAO Standard into the Air Navigation Order in the near future. A Letter of Consultation together with a Regulatory Impact Assessment will be published at a later date to allow interested parties in Industry the opportunity to comment on this proposal.

Notes:

- The CAA supports the ICAO recommendations and is actively encouraging the adoption of Operational Flight Data Monitoring (OFDM) by all operators as an integrated part of a Safety Management System (particularly of aircraft under 27,000kg and for helicopters.)

UNITED STATES: Federal Aviation Authority (FAA)

14 CFR Part 13: Flight Operational Quality Assurance Program; Final Rule (excerpts), effective November 30, 2001:

- *"This rule codifies enforcement protection for Flight Operational Quality Assurance (FOQA) programs. It states that except for criminal or deliberate acts, the Administrator will not use an operator's FOQA data or aggregate FOQA data in an enforcement action against that operator or its employees when such FOQA data or aggregate FOQA data is obtained from a FOQA program that is approved by the Administrator. The rule requires air carriers participating in approved FOQA programs to submit aggregate FOQA data to the FAA for use in monitoring safety trends."*

- *"This final rule does not require any operator to implement a FOQA program, nor does it require any operator who desires to voluntarily implement such a program to obtain FAA approval to do so, or to submit FOQA information from such an internal*

program to the FAA. However, in order to qualify for the enforcement protection afforded by this rule, the rule provides that FAA initial and continuing approval of the proposed program would be required, as well as the submission of aggregate FOQA information to the FAA."

Flight Safety Digest, Aviation Safety: U.S. Efforts To Implement Flight Operational Quality Assurance Programs, July- September 1998 (excerpt):

• *"FAA expects to continue supporting FOQA as a voluntary safety program that airlines may choose to adopt, rather than mandate the program." (*Thomas M. Longridge, manager of FAA's Advanced Qualification Program (AQP) and DEMOPROJ)

Notes:

• FOQA programs are managed by the Air Transportation Division of the FAA Flight Standards Service Office. The FAA, ATA and NASA are working together to determine FOQA program specifications and 'information sharing' frameworks.

FRANCE: Civil Aviation Authority (DGAC)

Notes:

• France's flight data monitoring requirement became mandatory in 2000

• It applies to aircraft with a MCTOM over 10,000kg or more than 19 seats and it is linked to JAR-OPS-1.037 (see United Kingdom)

CHINA: Civil Aviation Administration of China (CAAC)

Notes:

• The Civil Aviation Administration in China was the first world authority to make flight quality monitoring programs mandatory.

• Airlines are required to submit flight data monitoring results to the government (China is the only country required to do so).

IRELAND: Irish Aviation Authority (IAA)

From the IAA website:

• *"Operating Standards Department (OSD) is responsible for the approval and ongoing surveillance of the operational safety standards of all Irish airlines. OSD also regulates standards in the organisation of airspace, flight procedures and aeronautical charts.*

• *"OSD conforms with Annex 6 to the Convention on International Civil Aviation (ICAO) and Joint Aviation Authorities requirements."*

Organizations

Organizations		
Acronym	**Name of Organization**	**Website**
AGI	Association for Geographic Information	http://www.agi.org.uk/
AOPA	Aircraft Owners and Pilots Association	http://www.aopa.org/
ASN	Aviation Safety Network	http://aviation-safety.net/
BAA	British Airport Authority	http://www.baa.co.uk
ECAC	European Civil Aviation Conference	http://www.ecac-ceac.org/
ERA	European Regions Airline Association	http://www.eraa.org/
EUROPA	European Union On-line	http://europa.eu.int/
FSF	Flight Safety Foundation	http://www.flightsafety.org/
IATA	International Air Transport Association	http://www.iata.org/
ICAO	International Civil Aviation Organization	http://www.icao.org/
IFALPA	International Federation of Air Line Pilots' Associations	http://www.ifalpa.org/
JAA	Joint Aviation Authorities	http://www.jaa.nl
n/a	Transportation Development Centre (Transport Canada)	http://fdm.cbu.xwave.com
NASA	National Aeronautics and Space Administration	http://www.nasa.gov/
NTSB	National Transportation Safety Board	http://www.ntsb.gov/
UKFSC	The United Kingdom Flight Safety Committee	http://www.ukfsc.co.uk/

Civil Aviation Authorities		
Country	**Name of Organization**	**Website**
Australia	Civil Aviation Safety Authority	http://www.casa.gov.au/
Austria	Civil Aviation Authority	http://www.bmv.gv.at/
Bolivia	Dirección General de Aeronáutica Civil	http://www.dgac.gov.bo/
Bosnia and Herzegovina	Department of Civil Aviation	http://www.bhdca.gov.ba/
Brazil	Civil Aviation Department	http://www.dac.gov.br/
Brunei	Department of Civil Aviation	http://www.civil-aviation.gov.bn/
Canada	Transport Canada Civil Aviation	http://www.tc.gc.ca/
Chile	Dirección General de Aeronautic Civil	http://www.dgac.cl/
China	Civil Aviation Authority of China	www.caac.gov.cn/
Colombia	Aeronautica Civil	http://www.aerocivil.gov.co/
Czech Repub.	Civil Aviation Authority	http://www.caa.cz/
Denmark	Danish Civil Aviation Authority	http://www.slv.dk/
Estonia	Civil Aviation Authority	http://www.ecaa.ee/atp/
Finland	Civil Aviation Administration	http://www.ilmailulaitos.com/
France	Direction Generale de L'Aviation Civile	http://www.dgac.fr/
Germany	Luftfahrt-Bundesamt	http://www.lba.de/englisch/englisch.htm
Ghana	Civil Aviation Authority	http://www.gcaa.com.gh/
Hong Kong	Civil Aviation Department	http://www.info.gov.hk/cad/
Hungary	Civil Aviation Authority	http://www.caa.hu/
Iceland	Icelandic Civil Aviation Administration	http://www.caa.is/
India	Directorate General of Civil Aviation	http://dgca.nic.in/
Ireland	Irish Civil Aviation Authority	http://www.iaa.ie/
Italy	Ministero dei Trasporti e della Navigazione	http://www.trasportinavigazione.it/
Jordan	Civil Aviation Authority	http://www.jcaa.gov.jo/
Kuwait	Directorate General of Civil Aviation	http://www.kuwait-airport.com.kw/

Civil Aviation Authorities (cont'd)		
Country	**Name of Organization**	**Website**
Latvia	Civil Aviation Administration	http://www.caa.lv/
Lebanon	Directorate General of Civil Aviation	http://www.beirutairport.gov.lb/airport/dgca/dgca.htm
Macedonia	Civil Aviation Authority	http://www.ucvp.gov.mk/ang/index_ang.htm
Malaysia	Department of Civil Aviation	http://www.dca.gov.my/
Netherlands	Dutch Directorate General of Civil Aviation	http://www.luchtvaartbeleid.nl/
New Zealand	Civil Aviation Authority	http://www.caa.govt.nz/
Norway	Civil Aviation Authority	http://www.luftfartstilsynet.no/
Oman	Directorate General of Civil Aviation	http://www.dgcam.com.om/
Pakistan	Civil Aviation Authority	http://www.caapakistan.com/
Panama	Dirección de Aeronáutica Civil	http://www.aeronautica.gob.pa/
Peru	Dirección General de Aeronáutica Civil	http://www.mtc.gob.pe/transportes/aereo/dgac.htm
Poland	General Inspectorate of Civil Aviation	http://www.gilc.gov.pl/GILC.htm
Romania	Civil Aviation Authority	http://www.caa.ro/
Russia	State Civil Aviation Authority	http://www.avia.ru/english/join/faar.shtml
Singapore	Civil Aviation Authority	http://www.caas.gov.sg/
Slovak Republic	Civil Aviation Authority	http://www.caa.sk/
Slovenia	Civil Aviation Authority	http://www.caa-rs.si/eindex.htm
South Africa	Civil Aviation Authority	http://www.caa.co.za/
Sweden	Civil Aviation Administration	http://www.lfv.se/
Switzerland	Federal Office for Civil Aviation	http://www.aviation.admin.ch/e/index.htm
Taiwan	Civil Aeronautics Administration	http://www.caa.gov.tw/eng-main.htm
Tanzania	Civil Aviation Authority	http://www.aviationauthority.org/
United Arab Emirates	General Civil Aviation Authority	http://www.gcaa-uae.com/
United Kingdom	Civil Aviation Authority	http://www.caa.co.uk/
United States of America	Federal Aviation Administration	http://www.faa.gov/

Airlines With Flight Data Monitoring Programs

While not exhaustive, the following table lists airlines known by the author sourced below to have an operating flight data monitoring program, along with the date from which they first had the software to implement such a program.

	Airline	Start Date
1	British Airways	1966
2	Air France	1974
3	All Nippon Airways	1974
4	Japan Airlines	1982
5	TAP Air Portugal	1985
6	Qantas	1989
7	Air Canada	1990
8	Adria Airways	1991
9	Air Liberte	1991
10	Cathay Pacific Airways	1992
11	Britannia Airways	1993
12	Singapore Airlines	1993
13	China Airlines	1994
14	EVA Airways	1994
15	Canadian	1995
16	Continental Airlines	1995
17	Meridian Airlines	1995
18	United Airlines	1995
19	US Airways	1995
20	Biman Bangladesh Airlines	1996
21	China SouthWest Airlines	1996
22	Gulf Air	1996
23	Aero Lloyd	1997
24	British International Helicopters	1997
25	Delta Air Transport	1997
26	GB Airways	1997
27	Lufthansa	1997
28	Swissair	1997
29	Turkmenistan Airlines	1997
30	Wideroe Flyveselskap	1997
31	Air Macau	1998
32	Alaska Airlines	1998
33	British Midland	1998
34	Cargolux	1998
35	China Eastern Airlines	1998
36	Delta Air Lines	1998
37	Dragonair	1998
38	El Al Israel Airlines	1998
39	KLM	1998
40	Monarch Airlines	1998
41	TWA	1998
42	Air China International	1999
43	Asiana Airlines	1999
44	China Xinhua Airlines	1999
45	Hainan Airlines	1999
46	Jet Express	1999
47	Korean Air	1999
48	Thai Airways	1999
49	Virgin Atlantic	1999
50	Air Hong Kong	2000
51	America West Airlines	2000
52	Braathens ASA	2000
53	KLM uk	2000
54	Maersk Air UK	2000
55	Mount Cook Airline	2000
56	MyTravel Airways	2000
57	Northwest Airlines	2000
58	Philippine Airlines	2000
59	TACA International Airlines	2000
60	UPS Airlines	2000
61	Air 2000	2001
62	Alitalia Express	2001
63	British Regional Airlines	2001
64	National Jet Italia	2001
65	Polar Air Cargo	2001
66	Southwest airlines	2001
67	DHL	2002
68	European Aviation	2002
69	Malev Hungarian Airlines	2002
70	Novair Nova Airlines	2002
71	Silkair	2002

Source: Fernandes, Rui Vaz, September 2002, An Analysis of the Potential Benefits to Airlines of Flight Data Monitoring Programmes, pp. A-1, A-2.

Teledyne's Flight Data Monitoring Solutions Product Offering

The following table indicates Teledyne Controls' product offering for Flight Data Monitoring Solutions. Please note this shows availability, and does not necessarily denote existing status onboard a particular aircraft type.

Air Transport

Aircraft		Data Acquisition					Data Recording & Storage		Data Analysis & Information Reporting
A/C Mfr	A/C Type	FDAU	DFDAU	DMU	FDIU	FDIMU	WQAR	QAR	AirFASE
Airbus	A300	x	x	x	-	-	x	x	x
Airbus	A310	-	x	x	-	-	x	x	x
Airbus	A318	-	-	-	-	x	x	x*	x
Airbus	A319	-	-	-	-	x	x	x*	x
Airbus	A320	-	-	-	-	x	x	x*	x
Airbus	A321	-	-	-	-	x	x	x*	x
Airbus	A330	-	-	-	x	x	x	x*	x
Airbus	A340	-	-	-	x	x	x	x*	x
Boeing	B727	x	-	-	-	-	x	x	x
Boeing	B737Classic	x	x	-	-	-	x	x*	x
Boeing	B737NG	-	x	-	-	-	x	x*	x
Boeing	B747	x	-	x	-	-	x	x	x
Boeing	B757	-	x	-	-	-	x	x*	x
Boeing	B767	-	x	-	-	-	x	x*	x
Boeing	B777	-	-	-	-	-	x	x	x
Boeing	DC-10	x	-	-	-	-	x	x	x
Boeing	MD-11	-	x	x	-	-	x	x	x
Boeing	MD-80	x	x	-	-	-	x	x	x
Fokker	F-28	x	-	-	-	-	x	x	x

- Not applicable to this aircraft

* Can be integral to DAU or stand alone

Business & Commuter Aviation

Aircraft		Data Acquisition	Data Recording & Storage	Data Analysis & Information Reporting
A/C Mfr	A/C Type	MFDAU	WQAR	AirFASE
Bombardier	Challenger	x	x	x
Bombardier	Learjet	x	x	x
CASA	CN235	x	x	x
Cessna	Citation	x	x	x
Cessna	Citation III	x	x	x
Cessna	Citation Excel	x	x	x
Dassault	Falcon 50/900/2000	x	x	x
De Havilland	DHC-8	x	x	x
Embraer	120	x	x	x
Embraer	135/145	x	x	x
Gulfstream	G IV	x	x	x
Gulfstream	G V	x	x	x
Gulfstream	Galaxy	x	x	x
Raytheon	Beechjet 400A	x	x	x
Raytheon	Hawker 450	x	x	x
Raytheon	Hawker 800	x	x	x
Raytheon	Hawker 800XP	x	x	x
Raytheon	Hawker Horizon	x	x	x
Raytheon	Premier 1	x	x	x
SAAB	340	x	x	x

Contact Information

The Teledyne Controls Sales & Service team consists of knowledgeable, capable and experienced personnel, ready to assist you in your purchasing, product or performance inquiries. Please locate your representative for your region, or contact us about our Field Representatives, who are located throughout the world and are available to meet with you at your convenience.

EUROPE & CIS

Mr.Warren Hechinger
Director, Sales & Service
Europe & CIS
Tel. +1-310-442-4169
Email: warren_hechinger@teledyne.com

Mr. William Cecil
Manager, Sales & Service
Europe & CIS
Tel. +44-123-6458555
Email. william_cecil@teledyne.com

Mr. Hans-Juergen Neufert
Senior Manager, Sales & Service
Europe & CIS
Tel. +49-173-6109115
Email. hans-juergen_neufert@teledyne.com

SOUTHERN EUROPE/ MIDDLE EAST/ AFRICA

Mr. Jean-Louis Lugan
Director of Sales & Service
Southern Europe/ Middle East/ Africa
Tel. +33-5-6199-3530
Email: jean-louis_lugan@teledyne.com

LATIN AMERICA, CARIBBEAN & FLORIDA

Mr. Emilio H. Morales
Sr. Regional Manager
Latin America, Caribbean & Florida
Tel. +1-310-442-4382
Email. emilio_morales@teledyne.com

ASIA-PACIFIC

Mr. George Casper
Director, Sales & Service
Asia-Pacific
Tel. +1-310-442-4155
Email. george_casper@teledyne.com

Mr. Chuck Tamburo
Assistant Director, Sales & Service
Asia-Pacific
Tel. +1-310-442-4275
Email. chuck_tamburo@teledyne.com

NORTH AMERICA

Mr. Keith Lockwood
Director, Sales & Service
North America – Airline Accounts
Tel. +1-310-571-2646
Email. keith_lockwood@teledyne.com

Mr. Anas Bennani
Manager, Sales & Service
North America
Tel. +1-310-571-2612
Email. anas_bennani@teledyne.com

Mr. Dennis Markert
Manager, Sales & Service
North America
Tel. +1-310-571-2621
Email. dennis_markert@teledyne.com

Mr. John Canton
Director, Marketing, Sales & Service
Government Programs
Tel. +1-310-442-4216
Email. john_canton@teledyne.com

BUSINESS & COMMUTER AVIATION

Mr. Mark Shoemaker
Director, Sales & Service
Business Aviation
Tel. +1-310-571-2620
Email. mark_shoemaker@teledyne.com

Mr. John Kobielusz
Manager, Sales & Service
Business Aviation
Tel. +1-310-442-4368
Email. john_kobielusz@teledyne.com

Teledyne Controls—Corporate Office
12333 West Olympic Boulevard
Los Angeles, California 90064
U.S.A.
Tel. +1-310-820-4616
Fax. +1-310-442-4324
Email. info@teledyne.com
Web. http://www.teledynecontrols.com

Teledyne Controls—Europe
9-13 Napier Road, Wardpark North Industrial Estate,
Cumbernauld, Glasgow
G68 OEF, Scotland
Tel. +44-123-6458555
Fax. +44-123-6722616

Notes

Notes

Design: Vera Design, veradzn@sbcglobal.net

TELEDYNE CONTROLS

A Teledyne Technologies Company