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for
CRADA Number 93-0195

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**MODIFICATION AND VALIDATION OF
AN AUTOMOTIVE DATA PROCESSING
UNIT, COMPRESSED VIDEO SYSTEM,
AND COMMUNICATIONS EQUIPMENT**

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**MODIFICATION AND VALIDATION OF AN AUTOMOTIVE
DATA PROCESSING UNIT, COMPRESSED VIDEO
SYSTEM, AND COMMUNICATIONS EQUIPMENT**

Cooperative Research and Development Agreement
Number ORNL93-0195

Final Report

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April 1997

Purpose of the Cooperative Research and Development Agreement

The primary purpose of the "modification and validation of an automotive data processing unit (DPU), compressed video system, and communications equipment" cooperative research and development agreement (CRADA) was to modify and validate both hardware and software, developed by Scientific Atlanta, Incorporated (S-A) for defense applications (e.g., rotary-wing airplanes), for the commercial sector/surface transportation domain (i.e., automobiles and trucks). S-A also furnished a state-of-the-art compressed video digital storage and retrieval system (CVDSRS), and off-the-shelf data storage and transmission equipment to support the data acquisition system for crash avoidance research (DASCAR) project conducted by Oak Ridge National Laboratory (ORNL). In turn, S-A received access to hardware and technology related to DASCAR.

Data Acquisition System for Crash Avoidance Research

DASCAR was designed for the National Highway Traffic Safety Administration's (NHTSA) Office of Crash Avoidance Research. The primary objective of the project was to develop a portable DASCAR that will allow driver performance data to be collected using a large variety of vehicle types and that would be capable of being installed on a given vehicle type within a relatively short-time frame. DASCAR was designed and implemented in two phases. During phase I a feasibility study for designing and fabricating DASCAR was conducted. Human factors research needs were evaluated, and existing methods, measures, techniques, hardware, and software for evaluating the driver/vehicle/environment were identified. In the second phase of the program, DASCAR was actually developed, constructed, and validated. The development effort for DASCAR was driven by a number of requirements which are briefly described below.

Parameters and Measures. The data acquisition system is capable of collecting and analyzing driver-related, vehicular, and environment parameters and measures. Driver-related variables consist of driver control actions, equipment status, and physiological measures. Parameters that are currently recorded by DASCAR are exhibited in Table 1. A few of the environment parameters are sensor derived; most of them are however video derived. The data acquisition system can collect other variables if a researcher so desires. All that would have to be done would be to add additional sensors.

Off-the-Shelf and State-of-the-Art. The data acquisition system consists of both off-the-shelf hardware and software, and state-of-the-art technology. ORNL procured most of the system required equipment. The hardware was subsequently modified as appropriate for DASCAR application. Some of the hardware and software had to be designed and developed from scratch.

Portability. The data acquisition system is portable. It can be installed in a particular vehicle quickly and can rapidly be removed and placed within another vehicle. It takes between one and two weeks to install the complete DASCAR within a new automobile or truck, depending on the vehicle type and configuration.

Table 1. Parameters Currently Collected by DASCAR

<p style="text-align: center;">Driver Parameters</p> <p style="text-align: center;">Driver Control Actions Accelerator/throttle Brake pedal Steering wheel Time between accelerator release and brake application (derived)</p> <p style="text-align: center;">Equipment Status Auxiliary device (e.g., side-object detection) Brake lights Hazard flashers Headlights Horn Parking lights Rear window defogger Rear window wiper Seat belts Turn signals Windshield wipers</p> <p style="text-align: center;">Physiological Parameters Core temperature Electrocardiogram Electroencephalogram Electromyogram Electrooculogram Fidget index Galvanic skin response Respiration Skin temperature</p>
<p style="text-align: center;">Vehicle Parameters Distance traveled (derived) Elapsed time (derived) Forward velocity (derived) Heading Headway Lateral acceleration Lateral lane keeping Longitudinal acceleration Pitch Roll Tailway Time-to-collision (derived) Vehicle location Vertical acceleration Yaw</p>
<p style="text-align: center;">Environment Parameters</p> <p style="text-align: center;">Sensor Derived Illumination Lumination Noise/sound</p>

Time of day
Video Derived
Car lights
Delineation
Distracting lights, obstacles, and signs
Exits
Hand positions
Haze/dust
Head movements
Intersections
One- or two-way traffic
Parked vehicles
Pedestrians
Posted speed limits
Precipitation
Road lighting
Road surfaces
Road types
Surrounding field of view
Traffic conditions
Traffic events
Traffic lights
Turns/hills
Which lane the vehicle is in

Automobiles and Trucks. The DASCAR was designed so that it can be positioned within virtually any passenger vehicle. It can be installed within a wide range of vehicle types (compact, intermediate, and large automobiles, minivans, and small, mid-size, and large trucks) built by the three United States (U.S.) domestic vendors (General Motors, Ford, and Chrysler).

Unobtrusiveness and Inconspicuousness. The data acquisition system is both unobtrusive to the driver and inconspicuous to the outside world. Placement of hardware within a vehicle does not obstruct the driver's primary task of driving. Instrumentation, cables, and wires connecting different pieces of the system are hidden, well out of the view of the driver. Antennas, sensors, and cameras are situated on the exterior of the vehicle so that they cannot be seen by other drivers. As far as possible, the vehicle looks and drives like any other vehicle on the road.

Modularity and Flexibility. The DASCAR was modularly designed; that is to say, the system permits installation of only those data collection capabilities required for a particular study. An individual does not have to instrument the vehicle with the entire system in order to collect or record a subset of parameters. The data acquisition system was designed so that it has the flexibility to accommodate new data acquisition and sensor technologies as the state-of-the-art changes.

Three Modes of Data Collection. The DASCAR has three modes of data collection. The first consists of recording parameter data onboard the vehicle via a laptop computer. This mode provides a backup capability in the case of radio-link failure or signal corruption during data transmission. The second mode comprises radio telemetry. The radio telemetry link is used to

transmit data from the vehicle to a base station during use at a test track. The third includes cellular telephone equipment. This technology is employed to transmit data from a vehicle in an open-road situation, anywhere in the U.S., to a base station that may be located a few, to many hundreds of, kilometers away.

Extended Periods of Recording Data and Cost. The DASCAR collects parameter data over two extremes of time - from as little as 20 minutes to as much as six months. The data acquisition system was designed with cost as a main consideration. Technical capabilities - cost tradeoff analyses were performed for each part of DASCAR.

DASCAR Components

The DASCAR consists of seven components: a data acquisition platform, a data storage and transmission system, a power system, an equipment status bus (ESB), a sensor suite, a video data system, and a central data collection/analysis facility (CDC/AF). The hardware and software which were modified and furnished by S-A was included as part of the DASCAR prototype delivered to NHTSA. The S-A supplied equipment consists of microprocessor-based hardware to perform signal conditioning, execution of data storage, and communication via multimedia.

Data Acquisition Platform and Data Storage and Transmission System. The data acquisition platform is used to capture and process signals from the various sensors installed within and around the vehicle. The data storage and transmission system is composed of several components: cellular telephone equipment, radio telemetry, satellite transmission equipment, a laptop computer, docking station, and a small computer system interface (SCSI) two hard drive. The system is utilized to receive, assemble, transmit, store, integrate, analyze, evaluate, and interpret the parameter data collected via the DASCAR sensor suite.

Power System. The DASCAR power supply consists of three main components: electronic isolation from the vehicle electrical system, sealed lead-acid (gel-cell) storage batteries, and a switching precision power supply. The electronic isolation system provides total separation from the vehicle power system when the vehicle is powered down. This capability prevents the data acquisition system from draining the vehicle's battery during power-down, which could preclude the motorist from starting the vehicle. This electronic isolation component prevents fluctuations in the vehicle charging-electrical system from entering the DASCAR power supply when coupled with the gel-cell storage batteries.

The gel-cell storage batteries serve two purposes. First, they serve a power-smoothing function, absorbing any ripples and spikes which may occur as a result of irregularities in the vehicle charging system, and they compensate for lowered voltages which may occur, for example, when the vehicle sits in traffic with the air conditioning going in summer heat. These batteries also provide the power required for volatile memory preservation during power-down of the data acquisition system. The remaining power supply component is a precision direct current

switching power supply. This component provides the required voltages for the various DASCAR items.

Equipment Status Bus. The ESB is used to monitor the use of auxiliary devices, brake lights, hazard flashers, headlights, horn, parking lights, rear window defogger and wiper, seat belts, turn signals, and windshield wipers.

Sensor Suite. The DASCAR sensor suite comprises transducers, systems, devices, sensors, and meters to gather parameter data from the driver, vehicle, and environment. The sensor suite includes: linear position transducers, a pedal force transducer, an accelerometer, an ambulatory data recording system, a six degrees of freedom orientation sensor, Hall-effect sensors, an electronic compass, range sensors, radiometers/photometers, a sound level meter, a lateral-position lane tracking system, and a global positioning system (GPS) receiver.

The linear position transducers are employed to collect accelerator/throttle and steering wheel data from the vehicle. The pedal force transducer is utilized to record brake pedal application force. The accelerometer is used to collect fidget index data from the vehicle driver. The ambulatory data recording system is employed to collect core temperature, electrocardiogram, electroencephalogram, electromyogram, electrooculogram, galvanic skin response, respiration, and skin temperature data from the driver. The six degrees of freedom orientation sensor is utilized to record acceleration (lateral, longitudinal, and vertical), pitch, roll, and yaw data from the vehicle. The Hall-effect sensors are used to collect distance traveled and velocity data from the vehicle. The electronic compass is employed to record heading data from the vehicle. The range sensor is utilized to collect headway, tailway, and time-to-collision data from the vehicle. The radiometers/photometers are used to record illumination and luminance data from the environment outside the vehicle. The sound level meter is employed to collect steady state and impulse noise and sound as heard by the driver inside the vehicle. The lateral-position lane tracking system is utilized to collect lateral lane keeping data from the vehicle. The GPS receiver is used to collect vehicle location and route traveled.

Video Data System. The DASCAR video data system comprises both color and black-and-white video micro cameras, a vertical interval time code (VITC) generator, a digital quad picture processor, a digital picture transmission system, a CVDSRS encoder, and a super VHS recorder. The micro cameras are employed to record video data inside the vehicle and in the outside environment. They consist of camera heads, lenses, pick up devices, and cables. The VITC generator is utilized to time code the video output from the micro cameras and to provide video data synchronization with collected sensor data. The digital quad picture processor is used to display and record images from four video micro cameras at one time. The digital picture transmission system is employed to send high quality color pictures to the CDC/AF in near real time. Both the CVDSRS encoder and super VHS recorder are employed to collect and handle video from the micro cameras installed within and around the vehicle. The CVDSRS encoder digitizes and compresses analog video material in real time. The super VHS recorder must have a 12 volt direct current input.

Central Data Collection/Analysis Facility. The CDC/AF consists of components that support, analyze, and collect parameter data from the DASCAR prototype. Support systems include: a CVDSRS decoder, radio telemetry hardware, satellite-reception equipment, a digital quad picture processor, a super-VHS recorder, a super-VHS monitor, and a digital picture receiver system. Analysis of the acquired parameter data is facilitated by a personal computer and special supporting software. Collection of the DASCAR sensor and video data at the CDC/AF is handled in several ways: it is received through radio telemetry equipment; it is transferred via satellite equipment; and it is received through cellular/land lines. The CDC/AF also contains data storage devices compatible with the DASCAR prototype devices. They are used for archiving information and directly downloading parameter data from the DASCAR prototype.

CRADA Tasks

The technical objective of the CRADA was to modify and validate data acquisition, storage, retrieval, and communications/transmission hardware and software manufactured by S-A for application to the DASCAR which was designed and developed by ORNL. The work conducted under the CRADA was subdivided into three tasks; each is described below.

Modification of S-A Hardware and Software. The main objective of the first task was to modify the DPU developed by S-A for the Department of Defense for applicability to the data acquisition system constructed by ORNL for NHTSA. This task was performed almost entirely by S-A; ORNL, however, provided background information on DASCAR. S-A modified their DPU, both hardware and software, as appropriate for incorporation within DASCAR. The functionality of the DPU was tailored to individual DASCAR sensor requirements. Sigma delta convertors allowed elimination of most of the analog circuitry, and digital signal processing and use of techniques such as signal averaging allowed for fast, flexible diagnostic performance.

The modified DPU consists of a number of input multiplexers which permit up to 42 analog inputs per board along with four digital inputs. It is capable of high speed analog/digital data acquisition and fast Fourier transform conversion of time domain data to frequency domain data. Each board provides signal conditioning and analog-to-digital conversion, and terminates in a choice of either an RS-232 or RS-422 data bus output. The boards can be mounted in either a single-board case or a multi-board chassis with a passive backplane. The DPU contains four megabytes of flash memory, permitting nonvolatile storage of local data-collection programs and/or data, thus providing the flexibility necessary for changing sensor needs without changing hardware. This flexibility is especially important since DASCAR will be used in a variety of different research settings requiring different sensor suite configurations. In addition, software-based diagnostics can be easily upgraded as sensor technology changes over the life of the DASCAR package. Technical material on S-A's DPU is presented in the appendix.

Delivery and Integration of the S-A Hardware and Software. The major purpose of the second task was to deliver the modified equipment and other S-A hardware and software, and to integrate the equipment into DASCAR. Performance of the task was divided between S-A and

ORNL. S-A's contribution to the second task was to provide engineering services and a modified DPU to support decentralized data collection of the DASCAR data.

S-A also supplied the following material for the DASCAR prototype: cellular telephone equipment (i.e., a modem, cellular data interface, and a cellular telephone); radio telemetry hardware; satellite transmission equipment; a laptop computer, docking station, and SCSI-2 hard drive; super-VHS recorder; and CVDSRS encoder. In addition, S-A provided cabling for interconnecting the DASCAR sensor suite with the DPU and other S-A provided equipment, and system operation and maintenance manuals.

The cellular telephone system is used to transmit sensor suite data and digital pictures from the vehicle to the CDC/AF in near real time, and to receive data back from the facility. The radio telemetry and satellite transmission equipment support short and long-term positional monitoring and data transmission requirements. The radio telemetry is employed to transmit data from the vehicle to a base station during use at a test track. The satellite system produces two-way global data communications and precise GPS position determination. It is utilized during testing under open road conditions. The laptop computer is a 486-based system with a 545-megabyte hard drive. The docking station provides the required ISA slots for the CVDSRS encoder. The SCSI-two hard drive is utilized to assemble and integrate the video data digitized and compressed by the CVDSRS encoder. Brief material on the equipment that S-A provided for the DASCAR prototype is shown in the appendix.

S-A supplied the following hardware and software for the CDC/AF via the CRADA: CVDSRS decoder; radio telemetry; and satellite-reception equipment (i.e., Macintosh II computer, GPS receiver, Inmarsat Standard C transceiver with antenna, and Mapstar software). Mapstar is a graphic display, communications, and database-management systems for vehicle tracking applications. With this software a user is able to track vehicles, send and receive messages, establish data communications, and obtain vehicle status reports. Vehicle locations are displayed on maps, which may be customized to the human's specific requirements, providing an interface for the individual to the map display and two-way communications. Using Mapstar, the CDC/AF is able to monitor in near real time, the location and speed of all vehicles in the fleet, and send and receive messages. The appendix displays information on the S-A hardware and software furnished through the CRADA for the DASCAR CDC/AF.

Once all of the equipment, hardware, and software had been delivered, ORNL tested and evaluated each component of hardware against S-A's specifications and ORNL's own standard of expected performance. The equipment was subsequently installed on an individual basis within an ORNL vehicle. This procedure allowed ORNL to determine the most unobtrusive, inconspicuous, and cost-effective mounting location.

ORNL incorporated and integrated the S-A supplied hardware, software, and equipment with the other DASCAR components. A preliminary "shakedown" of the complete system was then carried out. The DASCAR was examined and evaluated as a complete unit. Sampling rates and

measured parameters were analyzed to ensure optimal performance and true validity of the acquired data. Once these data were gathered, ORNL adjusted and re-calibrated the system accordingly. DASCAR was subsequently removed completely and installation was repeated a number of times to gain an accurate idea of complete installation, operation, and removal of DASCAR. Upon satisfactory completion of the DASCAR construction and preliminary shakedown, ORNL provided NHTSA with an operational demonstration of DASCAR at their East Liberty, OH test facility. The demonstration included an on-the-road demonstration of the entire data acquisition system using NHTSA's test track. In addition, the demonstration also consisted of a briefing, containing the following:

- A description of the installation process and portability of the system.
- A description of the sensor technology used and their calibration.
- A description of the parameters measured.
- A description of the video system and its technology.
- A description of the data acquisition/transmission process.
- A description of the data reduction/analysis process.

Installation and Validation of the S-A Hardware and Software. The principal objective of the third task was to install the modified equipment and other S-A furnished hardware and software, along with the other DASCAR components, and validate the whole data acquisition system. This task was performed almost entirely by ORNL; S-A did, however, support installation of their equipment.

ORNL generated a plan for validating the prototype data acquisition system with regard to: removal of DASCAR from an existing vehicle, and installation and calibration in other vehicles; reliability of the sensors and systems; data collection/transmission process (data integrity); impact on the driveability of the vehicle and obtrusiveness of the system to the driver; data analysis procedures; conspicuousness of the vehicle to other drivers; and DASCAR installation and removal training and documentation. In order to identify any operational problems not captured by the systems testing and evaluation, the validation plan also addressed a short-term pilot research program to manipulate DASCAR under operational conditions using "naive" drivers. The effort exercised the full capabilities of the data acquisition system. ORNL subsequently evaluated and pilot tested the data acquisition system using the validation plan. The plan was implemented in full at the NHTSA East Liberty, OH test facility, and was carried out as a cooperative effort with the Vehicle Research and Test Center staff.

ORNL assessed the time required to remove DASCAR from a vehicle and the time required to install and calibrate the system in other vehicles. Installation and calibration in five other vehicle types were carried out and included: one compact, one full size vehicle, one minivan, one multipurpose vehicle, and one heavy vehicle. All problems encountered in the installation and removal process were documented. Since DASCAR is intended to be installed on a wide variety of vehicles with different vehicle imposed constraints, it is likely that problems with installation will be highly vehicle specific. For this reason, ORNL sampled (i.e., examined, not installed) at

least four vehicles in each class, representing a cross section of manufacturers, to identify, to the greatest extent possible, the problems that can be anticipated in installing the data acquisition system.

ORNL determined the reliability of the sensors and systems by exercising DASCAR (installed in a vehicle) under a variety of conditions including: day/night, rain, reduced visibility (e.g., fog), various roadway conditions (e.g., level, hilly, and rough), hot/cold weather, different drivers (driving styles), and different installers/repeated installations. This was used to define: the conditions under which data collection can take place; the installation, and removal practices and constraints that will maximize system/sensor reliability; and the specific limitations of conditions (if any) under which an equipped vehicle can be utilized or of the parameters that can be measured. Since installation and use in different vehicles or types of vehicles may influence system reliability and constraints, reliability was investigated for each vehicle type. For one vehicle type, ORNL evaluated systems reliability over a continuous period of 30 days with particular attention paid to maintenance of calibration and data integrity.

Data were collected under the variety of conditions defined above to determine the integrity of data from the sensors to the point of analysis. Where raw data is transmitted (i.e., not recorded onboard) to the CDC/AF, ORNL compared raw data collected directly from the sensors and analyzed separately from vehicle systems, with data collected at the data collection point using vehicle systems. This process was performed for all parameters with a sufficiently long data-collection period to be assured of data integrity.

ORNL ensured that the installed DASCAR does not impact the driveability of the vehicle, and specifically does not compromise safety from the standpoint of vehicle handling and/or visibility. ORNL further made sure that the system is as unobtrusive to the driver of the vehicle as possible. All instances where either the operation of the vehicle or performance of the driver is unavoidably compromised by DASCAR were documented. At no time, however, was the safety of the driver jeopardized.

To ensure that the characteristics, format, and variability of the collected data are compatible with the potential analysis strategies, ORNL exercised the recommended data-analysis procedures for each of the parameters measured. Given the desire to minimize the impact of an instrumented vehicle's appearance on the behavior of other drivers, ORNL assessed the conspicuousness of an instrumented vehicle and how it might influence the behavior of other drivers.

ORNL exercised the training procedures and documentation for installing, calibrating, operating, maintaining, and removing DASCAR to make sure that individuals not involved with the development and construction of the data acquisition system could successfully conduct the necessary activities.

APPENDIX

from spectral analysis → complete diagnostics. ^{PC board Diagnostic Unit} ^{PC board Diagnostic Unit} Station

SCIENTIFIC ATLANTA, INC.	DIAGNOSTIC PROCESSING UNIT BRIEFING	SIGNAL PROCESSING SYSTEMS
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DIAGNOSTIC PROCESSING UNIT

Under Current Development, ESK/00179

SCIENTIFIC ATLANTA, INC.	DIAGNOSTIC PROCESSING UNIT BRIEFING	SIGNAL PROCESSING SYSTEMS
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INTRODUCTION

THE DIAGNOSTIC PROCESSING UNIT (DPU) REPRESENTS AN EXTREMELY FLEXIBLE AND AFFORDABLE DIAGNOSTIC SYSTEM FOR MULTIPLE APPLICATIONS. THE LATEST ACQUISITION, PROCESSING AND PACKAGING TECHNOLOGY IS EMPLOYED TO ACHIEVE HIGH FUNCTIONALITY AND SMALL SIZE. KEY FEATURES INCLUDE:

REPROGRAMABILITY

4 MBYTES OF FLASH MEMORY ARE USED WHICH ALLOW THE NON-VOLATILE STORAGE OF PROGRAMS AND COLLECTED DATA. FLASH MEMORY CAN BE LOADED WITH NEW PROGRAMS WITHOUT MODIFYING HARDWARE. A COMMON HARDWARE PLATFORM CAN BE UTILIZED

FLEXIBILITY

A GENERIC ACQUISITION FRONT END ALLOWS THE COLLECTION OF BOTH VIBRATION AND ANALOG SENSOR DATA SUCH AS TEMPERATURE, PRESSURE AND TORQUE. ALL DATA IS DIGITIZED AND PROCESSED WITH A HIGH SPEED DIGITAL SIGNAL PROCESSOR ALLOWING SOFTWARE BASED DIAGNOSTICS TO BE EASILY UPGRADED AND CUSTOMIZED.

ECONOMICAL

THE DPU IS MADE AFFORDABLE BY USING THE LATEST ELECTRONIC AND SOFTWARE TECHNOLOGY.

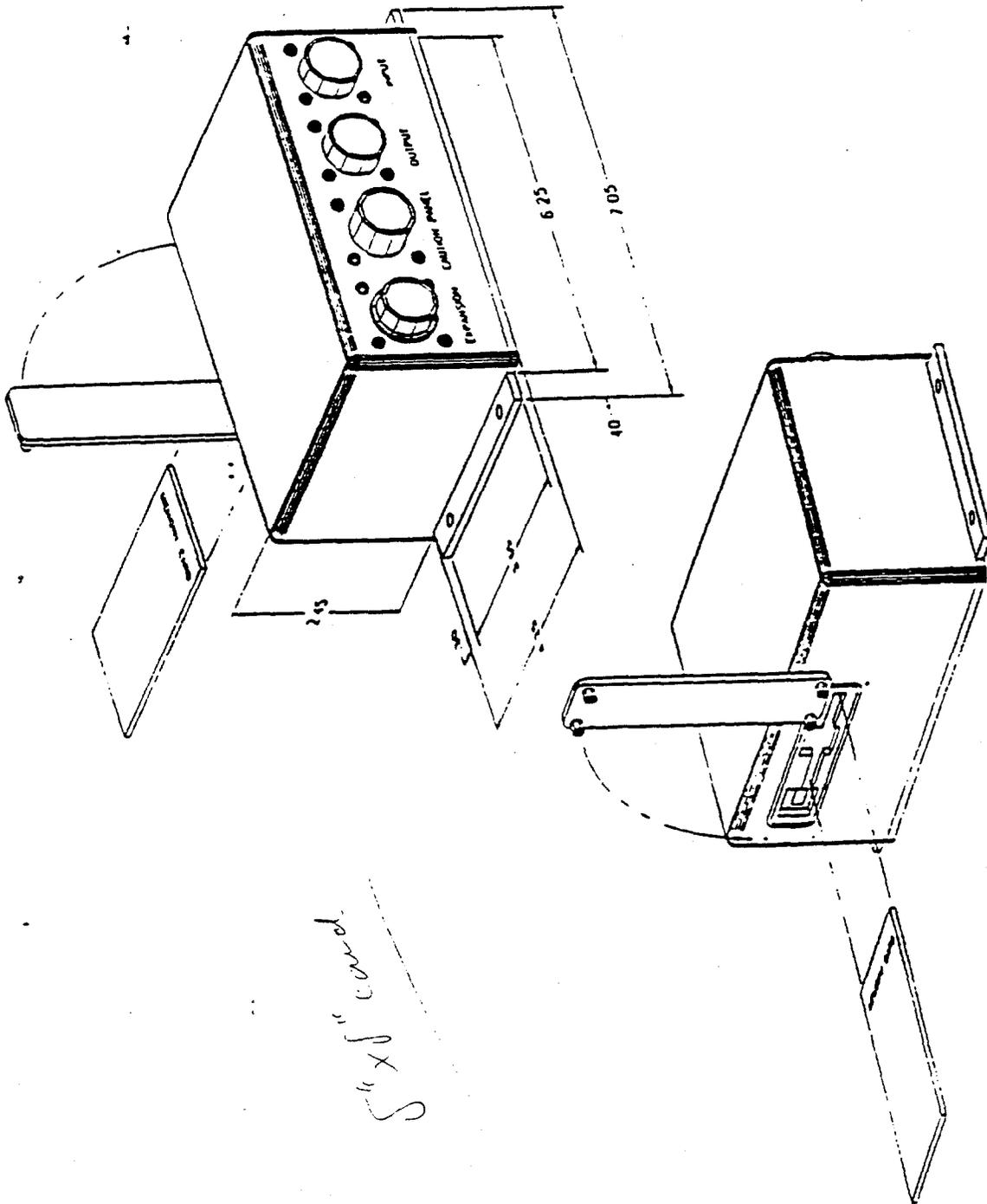
- DIGITAL SIGNAL PROCESSOR ALLOWING FAST FLEXIBLE DIAGNOSTICS
- HIGH DENSITY MEMORY ALLOWS SOFTWARE UPGRADE
- SIGMA DELTA CONVERTERS ALLOW THE ELIMINATION OF MOST ANALOG CIRCUITRY

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DIAGNOSTIC PROCESSING UNIT BRIEFING

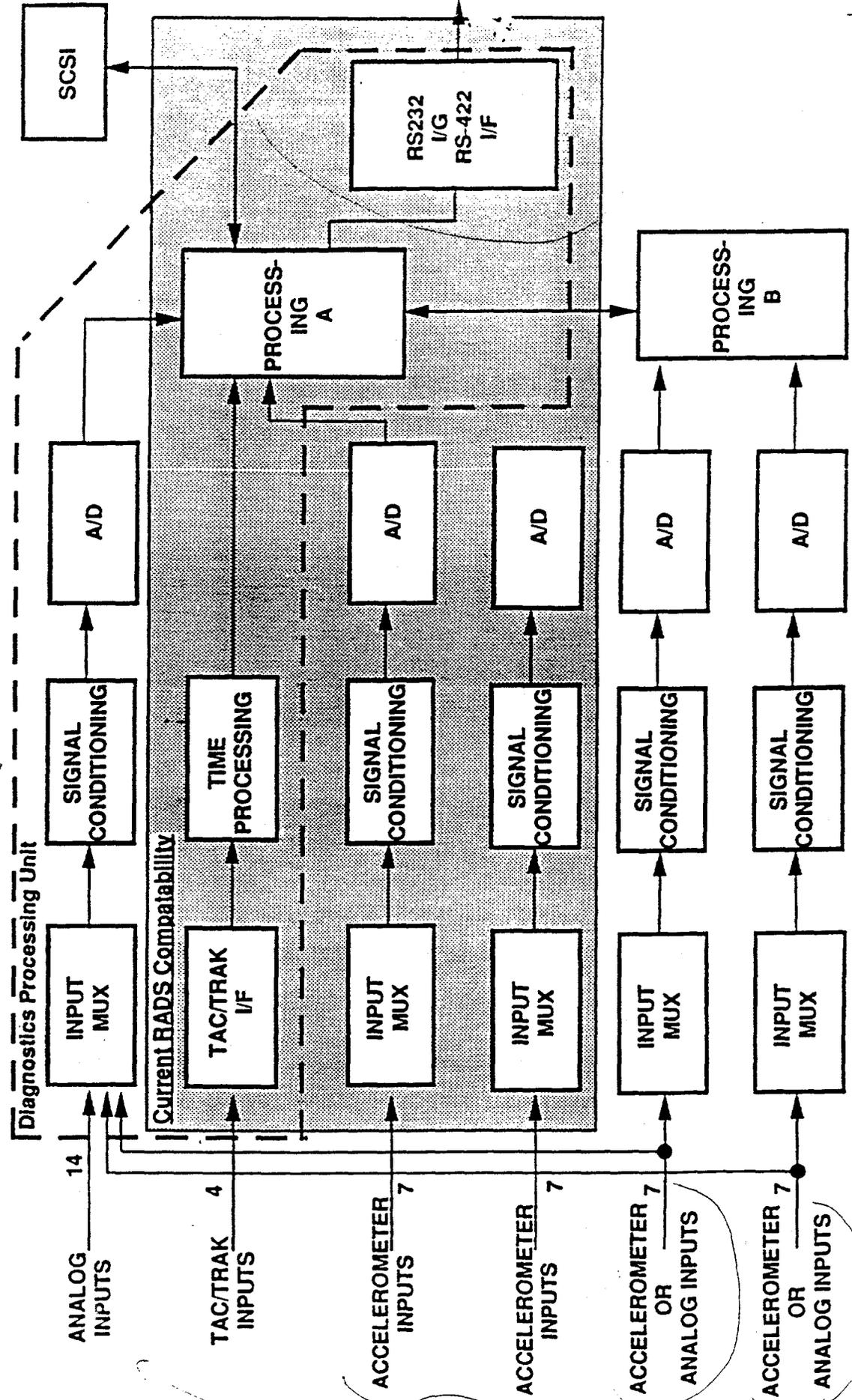
SIGNAL PROCESSING
SYSTEMS

DIAGNOSTIC PROCESSING UNIT OUTLINE DRAWING



As Flexibility Cards Can be distributed around vehicle

BLOCK DIAGRAM



10/11/82 of card...

SCIENTIFIC ATLANTA, INC.	DIAGNOSTIC PROCESSING UNIT BRIEFING	SIGNAL PROCESSING SYSTEMS
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THE FOLLOWING ARE PROPOSED DIAGNOSTIC METHODS FOR GEAR BOX VIBRATION MONITORING. MANY TECHNIQUES RELY OF SIGNAL AVERAGING TO EXTRACT THE VIBRATION FROM A PARTICULAR GEAR. THE DPU USES A SOPHISTICATED INTERPOLATION METHOD TO RESAMPLE TIME DOMAIN VIBRATION DATA TO CREATE THE SIGNAL AVERAGES.

METHOD	PATTERN	PURPOSE
FMO	Deviation from a sinusoid	General purpose detector
FM1A	Overall modulation	Misalignment, Eccentricity, Swash Failure of shaft or supporting structure
FM1B	Differences in planetpass modulation levels	Planet load sharing problems
FM2	Correlated impacts	Tooth fracture, chipping
FM3	Sub-harmonic meshing	Parametric excitation, Heavy wear
FM4A	Single impacts of moderate intensity	Spalling, Tooth Fracture
FM4B	Rise in shaft-order activity	Evenly distributed wear

SCIENTIFIC ATLANTA, INC.	DIAGNOSTIC PROCESSING UNIT BRIEFING	SIGNAL PROCESSING SYSTEMS
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METHOD	PATTERN	PURPOSE
FM5	Single impacts of low intensity	Early spalling and fatigue cracking
Narrow Band Enhancement	Phase modulation of mesh. freq	Fatigue cracking
Crest Factor	Impulsive vibration sources	General
Sideband Level Factor	Ratio of first order sideband to standard deviation of signal average	Gear shaft damage or single tooth damage
Non-harmonic to harmonic	Standard deviation of difference Signal to standard deviation of regular component.	Heavy Wear

<p>SCIENTIFIC ATLANTA, INC.</p>	<p>DIAGNOSTIC SYSTEMS BRIEFING</p>	<p>SIGNAL PROCESSING SYSTEMS</p>
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DIAGNOSTIC ANALYSIS STATION (DAS) KEY FEATURES

HARDWARE

DAS RUNS ON A STANDARD 386 OR 486 PC OR LAPTOP WITH AN 80MBYTE HARD DRIVE AND 4 MBYTES OF RAM. AN OPTIONAL CREDIT CARD READER IS AVAILABLE TO SIMPLIFY COMMUNICATIONS.

SOFTWARE

THE SOFTWARE IS BASED ON THE MICROSOFT INTERFACE WHICH MAKES IT EASY TO LEARN AND USE. ALL DATA IS STORED IN A STANDARD WINDOWS DATABASE CALL SUPERBASE 4. SIMPLE FORM TOOLS ARE AVAILABLE VIA SUPERBASE MAKING IT EASY TO MAKE UP CUSTOM REPORTS AND DATA ENTRY FORMS. EXTENSION ARE IN PROGRESS TO ADD AN INTEGRATED FAULT TREE CAPABILITY BASED ON COMMERCIALY AVAILABLE FAULT TREE TOOLS.

COMMUNICATION

COMMUNICATION IS SIMPLE WITH THE CREDIT CARD MEMORY, THE DAS AUTOMATICALLY STORES THE DATA FROM THE CREDIT CARD IN ITS INTERNAL DATABASE.

COMMUNICATION CAN ALSO BE PERFORMED VIA THE RS-232 SERIAL PORT.

THE USER CAN NOW BEGIN TO TRACK MECHANICAL COMPONENT ANOMALIES AND COMPARE ONE SYSTEM WITH ANOTHER.

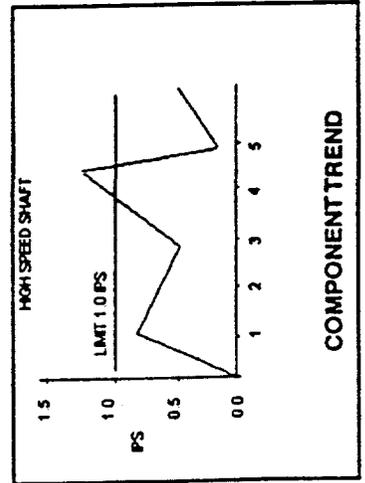
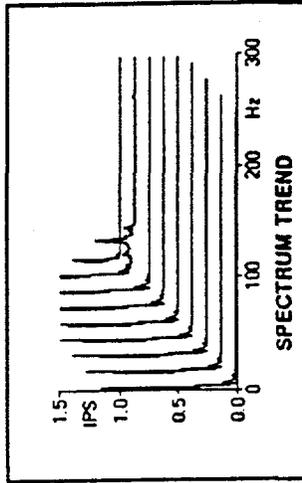
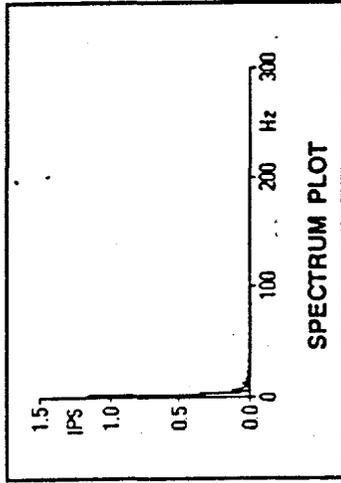
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DIAGNOSTIC SYSTEMS BRIEFING

SIGNAL PROCESSING
SYSTEMS

DAS VIBRATION ANALYSIS



- ALL SPECTRUM DATA CAN BE ARCHIVED AND DISPLAYED ALLOWING THE DEVELOPMENT OF FLEET WIDE TRENDS AND LIMITS WHERE APPLICABLE.
- KNOWN VIBRATION SOURCES ARE ANNOTATED ON THE DISPLAY.
- COMPONENTS WITH LIMITS EXCEEDANCES ARE HIGHLIGHTED.
- TREND DATA ALLOWS A COMPARISON OF SPECTRUM FROM TIME TO TIME OR COMPARE SYSTEM TO SYSTEM OF A SIMILAR TYPE.
- SIMPLE OPERATION USING A MOUSE AND WINDOWS.
- INDIVIDUAL COMPONENTS ARE TRENDED OVER TIME ON A COMPONENT BY COMPONENT BASIS. LIMITS ARE INDICATED VIA COLOR CODE.
- ALL DISPLAYS CAN BE PLACED IN WINDOWS WORD PROCESSORS FOR EASY REPORT GENERATION.
- ALL DATA AVAILABLE AS TABLES OF NUMBERS FOR USE IN OTHER REPORTS OR APPLICATIONS.
- SUPERBASE 4 HAS A VERY SIMPLE FORM AND REPORT GENERATOR FOR CUSTOM REPORTS.

DIAGNOSTIC PROCESSING UNIT (DPU)

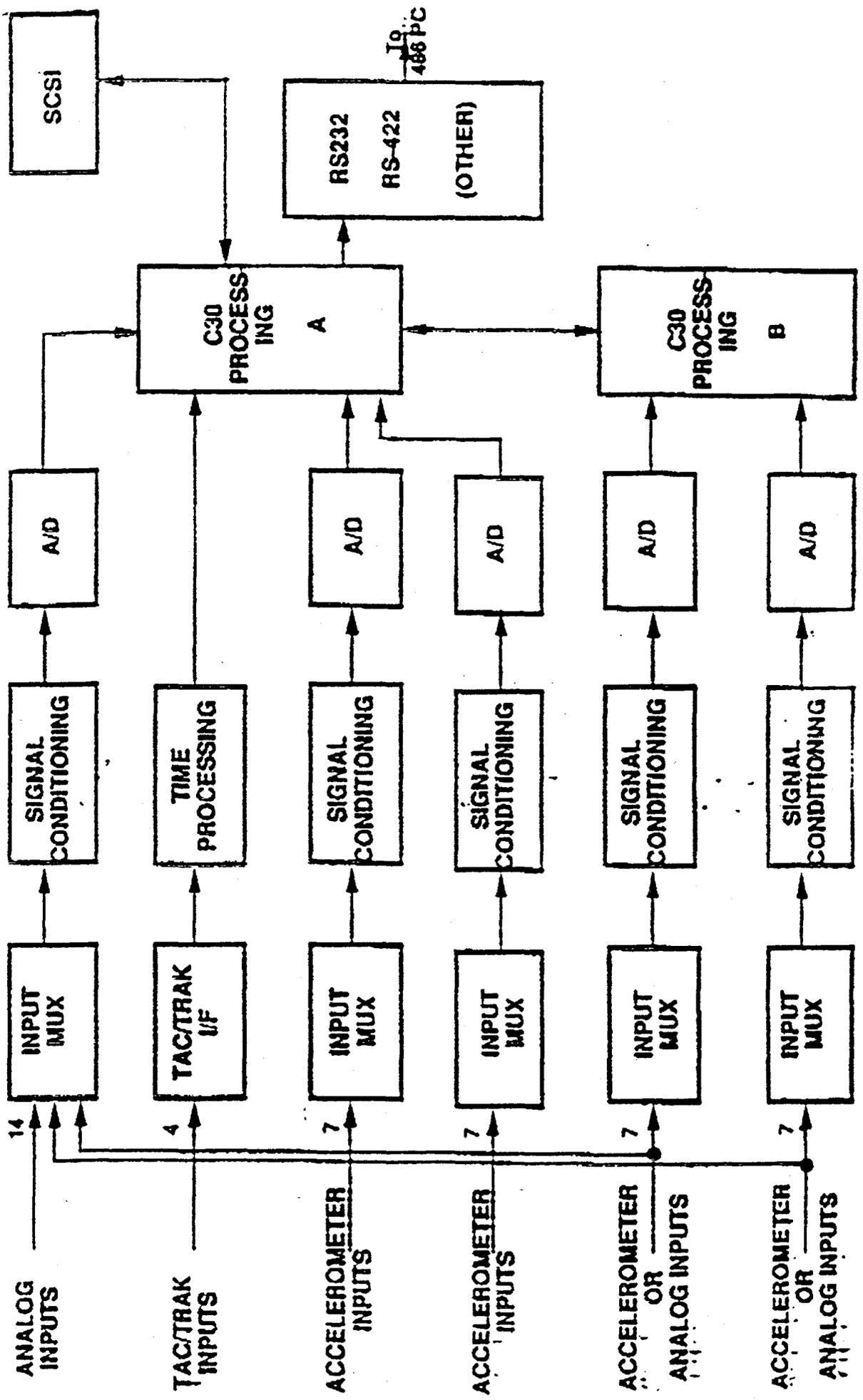


Figure 1: Diagnostic Processing Unit Functional Block Diagram



proxim

Date: July 20, 1993

Name: Don Brady
Company: Scientific Atlantic

Fax # 619-679-6200

From: Matt Aver

Dear Don:

Thank you for your interest in the ProxLink™ family of wireless asynchronous RS-232 products. Enclosed please find the information you requested.

ProxLink is designed for users who need to extend asynchronous connectivity to locations that are difficult or expensive to wire or have wireless connectivity requirements extending to 800 feet or more. In essence, a pair of ProxLinks acts as a wireless replacement for an RS-232 cable. The standard product supports a range of up to 500 feet, and our XR "extra range" model can operate up to 800 feet or more, depending on the operating environment.

From the factory floor to office settings to outdoor environments, no RF communication is more reliable than ProxLink's spread spectrum. Installation is easy and no FCC site license is required.

ProxLink is designed for applications such as:

- Factory floor data collection and NC downloading
- Connecting dumb terminals to a host
- Point-of-sale applications
- Building to building line-of-sight communications
- Process monitoring
- Any difficult or extended distance RS-232 connection

Enclosed please find the information you requested. If you need further information or would like the name of the Proxim Representative nearest you, please call us at (415) 960-1630.

Thank you for your interest in Proxim's ProxLink.

Sincerely,

Matt Aver
Account Manager



ProxLink™ Radio Module

Wireless RS-232 Connectivity

Overview

ProxLink provides a simple and reliable wireless replacement for any RS-232 link. Utilizing Proxim's unique spread spectrum RF technology in the FCC approved 902-928 MHz band, ProxLink units communicate through walls and other obstructions.

The standard ProxLink offers excellent intermediate range of about 500 feet, while the ProxLink/XR provides extended range capabilities of 800 feet or more, depending on the specifics of the operational environment. (These distances can be achieved, "out of the box" anywhere in the United States, without the need for an FCC site license.) ProxLinks are shipped with an antenna, RS-232 cable, power supply, and a full one year warranty.

ProxLink's multiple channel options and robust built-in network protocols support numerous modules operating simultaneously without interfering with each other. Units can be paired in a simple "pass through" point-to-point mode or operated in various other topologies, utilizing the programmable packetized mode capability.

Benefits

- *Plug-and-Play Installation* - wireless RS-232 in minutes
- *No FCC Site Licensing* - ProxLink gives the user control of their own airwaves —without government licensing.
- *Guaranteed Error-Free Communication* - Spread spectrum radio and 100% error detection ensure reliable communication every time.
- *Exceptional System Performance* - RS-232 data rates up to 19.2 Kbaud (full duplex) handle demanding serial applications.
- *Flexible Configuration Stored in EEPROM* - A wide range of baud rates and flow control options can be selected and saved in ProxLink's non-volatile memory.

Applications

- Data Collection
- Measuring Systems
- Process Monitoring
- Desktop/Laptop Computers
- Remote Printers
- Environmental Monitoring
- Security Systems

Devices

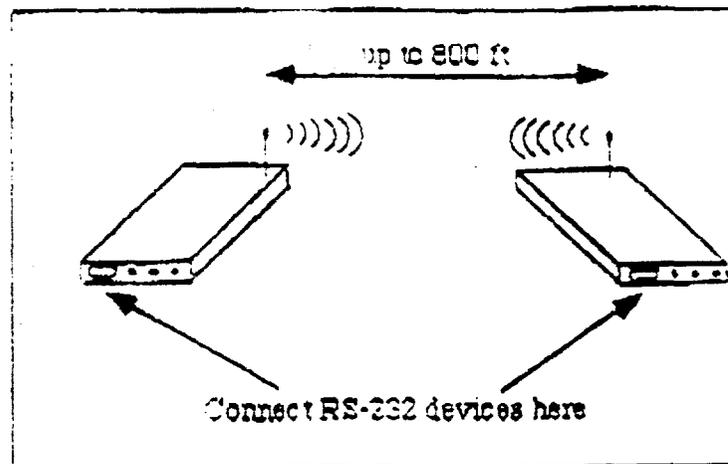
- Serial Terminals
- Card Readers
- Personal Computers
- Scanners
- Printers
- Programmable Logic Controllers
- Handheld Data Recorders



ProxLink/XR™ Q&A



Questions and Answers about ProxLink/XR Radio Modules from Proxim, Inc.



What is ProxLink?

ProxLink is a spread spectrum radio module which permits almost any RS-232 connection to be replaced with a transparent wireless connection. You simply plug your RS-232 devices into a pair of ProxLinks and obtain a wireless RS-232 link with a range of up to 800 feet with the XR version.

How does it work?

ProxLink uses spread spectrum radio signals in the 902-928 MHz range to pass the RS-232 data stream through the air. Spread spectrum technology offers excellent interference rejection and requires no user FCC license. The signal will penetrate most walls, glass, wood, plaster, and other commonly found obstructions. Unlike other wireless systems, ProxLink does not require line of sight positioning.

How would I install ProxLink?

You will need a pair of ProxLinks in order to wirelessly connect two RS-232 devices together -- one ProxLink at each end. The ProxLink units draw power from a wall outlet using the AC adapter included with each ProxLink module. Once the units are plugged in, your RS-232 devices can be connected to the serial port on each unit. Installation typically takes less than an hour.

What is the maximum and typical ranges achieved with ProxLink?

Typical ranges for ProxLink are summarized in the table below:

Environment	Range
Indoors, unobstructed environment such as a warehouse	~800 feet
Indoors, through typical indoor obstructions	~200-500 feet*
Outdoors, with line of sight	~1 mile or more

* Depends on environment

What RS-232 data rates are supported?

ProxLink supports 1200, 2400, 4800, 9600, and 19.2K baud data rates.
Data format: 8 data bits, 1 stop bit, no parity

**What if I want to operate multiple pairs of ProxLink units in the same facility?
Won't they confuse each other?**

No! Each ProxLink unit contains a high speed radio transceiver and a network controller which transmits the RS-232 data stream using rapid radio bursts that are only received by the unit that the ProxLink is paired with in the point-to-point pass through mode. If multiple pairs of ProxLink units are operating in the same area, each pair interleaves its radio bursts with the others, cooperatively sharing the radio "backbone". Four separate channels effectively quadruple the available bandwidth.

At what data rate does the ProxLink radio system actually transmit data?

Although the ProxLink unit accepts RS-232 data at a maximum rate of 19,200 baud, the radio network system upon which ProxLink is based operates at 121,000 baud. The high speed of the radio is what permits multiple pairs of ProxLink units to "share the airwaves" without slowing down or confusing each other.

What flow control options does ProxLink's serial interface support?

ProxLink supports "in-band" flow control (CTL-S, CTL-Q which is also known as XON/XOFF). ProxLink can be configured to generate XON/XOFF, recognize XON/XOFF or both generate and recognize XON/XOFF.

ProxLink can also be configured to generate the CTS signal and respond to an RTS signal.

How are these ProxLink options selected?

Each ProxLink unit contains firmware which allows the user to set the parameters which control the behavior of the ProxLink unit. To activate the configuration firmware, the user connects an ASCII terminal to the ProxLink's serial connector and presses the small configuration button on the ProxLink device. When this is done, the ProxLink unit displays a menu on the terminal (note that a PC running terminal emulation software may also serve as a terminal).

Once the ProxLink is in terminal mode, it is very easy to set the parameters which control the RS-232 configuration (flow control, baud rate, etc). As each parameter is selected and changed, the settings are recorded in the ProxLink's nonvolatile EEPROM storage. Once a configuration has been selected, the ProxLink will remember the settings, even while it is turned off.

After parameter settings have been selected, the user can start the ProxLink unit from the menu by selecting "Launch Operating Mode". The unit will start up ready to accept data in the new configuration.

What kind of warranty and support does Proxim offer?

Each ProxLink unit comes with a full one (1) year warranty. Technical support is available from Proxim at (415) 960-1630.

How can I obtain more information about ProxLink?

For information about ProxLink and the name of your local Proxim representative, contact Proxim at (415) 960-1630.

We may also be reached by FAX at (415) 964-5181.

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295 North Bernardo Avenue

Mountain View, CA 94043

Phone (415) 960-1630

Fax (415) 964-5181



The Model 9805 TerraStar-C Satellite Terminal offers global data or telex communication through the Inmarsat Standard 'C' System. The system is easy to operate and connects with either an ASCII terminal or personal computer. With the optional GPS Receiver, precise position determination is available through the same antenna.

Features

- Smallest, lightest weight Inmarsat-C terminal available
- 2-way message and data communication to any destination
- Automatic data and position reporting
- Standard interface to NMEA 0183 navigators
- GPS interface 50-ohm SMA connector

Description

The Model 9805 offers Land Mobile users fast and reliable connections to any domestic or international telex or data network. Fast and reliable 2-way transfer of any type of written message or data is supported along with data reporting transmission and automatic polling of terminal position.

Operation and control of the Model 9805 is performed via a standard RS-232 communications port. The unit can be operated from either a standard ASCII terminal or an MS-DOS based desk-top, portable, or lap-top personal computer.



INMARSAT

Scientific-Atlanta, Inc.
404-903-6001

Model 9805 TerraStar-C Satellite Terminal

System Specifications

Meets or exceeds all current and proposed Inmarsat specifications for Inmarsat-C system.

Transmit Frequency
1626.5 to 1646.5 MHz

Receive Frequency
1530.0 to 1545.0 MHz

Channel Spacing
5 kHz

Indoor Unit Specifications

Modulation
1200 symbols/second BPSK

Ambiguity Resolution
Unique word

Coding
Rate 1/2, k=7 convolutional code with interleaved code symbols

Data Rate
600 b/s

Receive Frame Length
8.6 seconds

Transmit Signalling Access Mode
Slotted ALOHA

Transmit Message Channel
TDMA & FDMA, interleaved code symbol

Terminal Interface
CCITT rec. V. 24/28, 9-pin female D-connector,
110-9600 baud, ITA-5 code, max. 100 meter cable

Printer Interface
Standard parallel Centronics, 25-pin female D-connector,
max. 4 meter cable

Navigator & Alarm Interface
CCITT Rec. V.10 Special with NMEA 0183 interface and multidrop addressing, BNC-female connector, max.
100 meter cable

Antenna Interface
Standard 50 ohm female N-connector, max.
100-meter cable

Memory
256 kbyte RAM

System Programming

EEPROM programming of installation parameters from operator's terminal

DC Power Source 10.5 to 32V dc, 9.5/80W

Ambient Temperature -25°C to 55°C operating,
-40°C to 80°C storage

Relative Humidity 95% non-condensing

Vibration

Operational Random 5 to 20 Hz, 0.02g²/Hz,
20 to 150 Hz -3 dB/Oct. (1.0 g rms)

Survival Random 5 to 20 Hz, 0.05g²/Hz,
20 to 150 Hz -3 dB/Oct. (1.7 g rms)

Shock Half sine, 20g/11 ms

Mounting Free standing cabinet with mounting brackets or optional 19 inch mounting kit

Dimensions 2.4 in (62mm) H x 8.5 in (214mm) W x 11 in (279mm) D

Weight 7.04 lbs (3.2 kg)

Antenna Specifications

Meets or exceeds all Inmarsat specifications for antenna pattern and EIRP.

Weight 4.2 lbs (2.0 kg)

Height 6.9 inches (176 mm)

Max. Diameter 5.9 inches (150 mm), Conical

Ambient Temperature -35°C to 55°C operational,
-40°C to 70°C storage

Spray Solid droplets (AU)

Ice Up to 2.5 cm (AU)

Precipitation Up to 10 cm/h (AU)

Wind Up to 100 knots (AU)

Vibration 2 to 10 Hz, 1.0 g peak

Mounting 1-1/2 inches tube mounting

Specifications and product availability are subject to change without notice.

Scientific-Atlanta, Inc.

Our customers are the winners.

United States: 4291 Communications Drive, Norcross, GA 30093, Tel: 404-903-6001, ITT Telex: 4611804
Australia: Unit 2, 2 Aquatic Drive, Frenchs Forest, N.S.W. 2086, Australia, Tel: (02)-452-3388, Telex: 177418
France: 4 Avenue Gabriel Peri, 78360 Montesson, France, Tel: 13-976-9191, Telex: 696385
Germany: Albert-Schweitzer-Strasse 66, 8000 Munich 83, Postfach 830935, Germany, Tel: 48-6780010, Telex: 5212264
Italy: Via Benedetto Croce, 19, 00142, Rome, Italy, Tel: 6-5420244, Telex: 621441
United Kingdom: Home Park Estate, Kings Langley, Herts WD4 8LZ, England, Tel: 092-326-6133, Telex: 912044

Scientific
Atlanta

SATELLITE COMMUNICATIONS

SPS
INSTRUMENTATION
GROUP

TECHNOLOGY

- Synchronous Satellites
 - Station Keeping To Within ± 0.1 Degree
 - 7 to 10 Year Life
 - Can Be As Close As 2 Degrees
 - Footprints Can Be Tailored
- Capacity (Comstar - Leased To AT&T)
 - 24 "Bent Pipe" Transponders (C Band Or Ku Band)
 - Polarized Channels -- 12 Vertical & 12 Horizontal On 40 Mhz Centers
 - Can Handle:
 - One Analog Video Channel Per Transponder (24 Total)
 - Or
 - 18,000 Voice Channels Total
 - Transponders Cost Approximately \$2M

Scientific
Atlanta

SATELLITE COMMUNICATIONS

SPS
INSTRUMENTATION
GROUP

OVERVIEW OF SATELLITE COMMUNICATION ORGANIZATIONS

- COMSAT
 - Private US Company Established By Communication Satellite Act Of 1962
 - Scientific Atlanta Is A Manufacturer Of Equipment Compatible With Comsat Services
- INTELSAT
 - International Consortium Of 110 Countries That Own & Operate Telecommunication Satellites
 - COMSAT Is A Signatory
 - Provides Point To Point Capabilities
- INMARSAT
 - International Consortium Of 65 Member Countries That Own & Operate A Network Of 10 MARISAT Satellites
 - COMSAT Is A Signatory
 - Provides Telecommunication Network Tailored To Mobile Users; Standards Permit Competitive Development Of Equipment
 - Provides Off Shore Service ("only")!

Scientific
Atlanta

INMARSAT SERVICES

SPS
INSTRUMENTATION
GROUP

VALUE-ADDED AND SPECIAL SERVICES

In addition to every Inmarsat basic communication service, we offer a number of value-added services. Examples are credit and debit card telephone services, customized billing arrangements for independent service providers, and a variety of voice, fax, data and telex store-and-forward and delivery options.

Special services have been developed to satisfy requirements for both voice and data broadcasting. One such service enhances the accuracy of GPS (the U.S. Global Positioning System) and is used to position vessels operating far at sea. Another COMSAT special service permits continuous, real-time collection of data from multiple sites using a single satellite channel.

SERVICES AVAILABLE

TERMINAL TYPE	VOICE	FAX	DATA	HIGH SPEED DATA OPTION	TELEX	AVAILABLE CONFIGURATIONS		
						TRANS- PORTABLE	PERSONAL PORTABLE	MOBILE (VEHICLE MOUNTED)
STANDARD-A	3kHz FM	4.8 - 9.6kb	2.4 - 9.6kb	56/64kb	YES	YES	NO	NO
STANDARD-B	9.6kb digital	9.6kb	16kb	56/64kb	YES	YES	NO	NO
STANDARD-M	4.8kb digital	4.8kb	2.4 - 4.8kb	NONE	YES	YES	YES	YES
STANDARD-C	NONE	"	600bps*	NONE	YES	YES	YES	YES

*store-and-forward

**COMSAT supports mobile-to-base text messaging delivered to FAX machines

Scientific
Atlanta

SCIENTIFIC ATLANTA TERRASTAR C

SPS
INSTRUMENTATION
GROUP

Scientific
Atlanta

Network Systems Group

TerraStar-C Satellite Terminal
Model 9805



Model **9805** TerraStar-C Satellite Terminal

System Specifications

Meets or exceeds all current and proposed Inmarsat specifications for Inmarsat-C system.

Transmit Frequency
1626.5 to 1646.5 MHz
Receive Frequency
1530.0 to 1545.0 MHz
Channel Spacing
5 kHz

Indoor Unit Specifications

Modulation
1200 symbols/second BPSK
Ambiguity Resolution
Unique word
Coding
Rate 1/2, k=7 convolutional code with interleaved code symbols
Data Rate
600 b/s
Receive Frame Length
8.6 seconds
Transmit Signalling Access Mode
Slotted ALOHA
Transmit Message Channel
TDMA & FDMA, interleaved code symbol
Terminal Interface
CCITT rec. V. 24/28, 9-pin female D-connector, 110-9600 baud, ITA-5 code, max. 100 meter cable
Printer Interface
Standard parallel Centronics, 25-pin female D-connector, max. 4 meter cable
Navigator & Alarm Interface
CCITT Rec. V.10 Special with NMEA 0183 interface and multidrop addressing, BNC-female connector, max. 100 meter cable
Antenna Interface
Standard 50 ohm female N-connector, max. 100-meter cable
Memory
256 kbyte RAM

System Programming

EEPROM programming of installation parameters from operator's terminal
DC Power Source
10.5 to 32V dc, 9.5/80W
Ambient Temperature
-25°C to 55°C operating,
-40°C to 80°C storage
Relative Humidity
95% non-condensing
Vibration
Operational
Random 5 to 20 Hz, 0.02g²/Hz,
20 to 150 Hz -3 dB/Oct. (1.0 g rms)
Survival
Random 5 to 20 Hz, 0.05g²/Hz,
20 to 150 Hz -3 dB/Oct. (1.7 g rms)
Shock
Half sine, 20g/11 ms

Mounting

Free standing cabinet with mounting brackets or optional 19 inch mounting kit

Dimensions

2.4 in (62mm) H x 8.5 in (214mm) W x 11 in (279mm) D

Weight

7.04 lbs (3.2 kg)

Antenna Specifications

Meets or exceeds all Inmarsat specifications for antenna pattern and EIRP.

Weight
4.2 lbs (2.0 kg)
Height
6.9 inches (176 mm)
Max. Diameter
5.9 inches (150 mm), Conical
Ambient Temperature
-35°C to 55°C operational,
-40°C to 70°C storage
Spray
Solid droplets (AU)
Ice
Up to 2.5 cm (AU)
Precipitation
Up to 10 cm/h (AU)
Wind
Up to 100 knots (AU)
Vibration
2 to 10 Hz, 1.0 g peak
Mounting
1-1/2 inches tube mounting

Specifications and product availability are subject to change without notice.

AUSTIN 486 NOTEBOOK COMPUTERS

Unique Sources

SPECIFICATIONS

PROCESSOR OPTIONS	SX/25, DX/33, DX2/50, DX2/66
COLOR DISPLAY OPTION	TFT Color, 9.5" Diagonal, 640 x 480, 256 Colors
MONO DISPLAY OPTION	STN Mono, 9.5" Diagonal 640 x 480, 64 Shades of Gray
HDD OPTIONS	130/213/340MB
FDD	1.44MB, 3.5"
MEMORY OPTIONS	4MB, 8MB, 16MB, 20MB, 32MB
VIDEO CONTROLLER	32-bit Local Bus, Windows Accelerator, 512KB DRAM
PORTS	2 Serial, 1 Parallel External Color Monitor: 640 x 480 (256 Colors) 800 x 600 (256 Colors) 1024 x 768 (16Colors) Mouse/External Keyboard
PCMCIA SLOTS	2 Type II or 1 Type III
SOFTWARE	MS-Dos 6.0 Windows 3.1
POINTING DEVICE	Built in micro trackball (16mm diameter)
INTERNAL MODEM	2400k bps Modem with 9600 bps send/receive fax, 14.4k bps Modem with 9600 bps send/receive fax
DOCKING STATION	<ul style="list-style-type: none"> • 2 Full Size, 16-bit ISA Bus Slots • 2 Serial Ports, 1 Parallel Port • External VGA • 40 Watts Power Supply
OTHER OPTIONS	Docking station, external Battery charger, car adapter
WEIGHT	6.38 lbs (2.9kg) with battery
SIZE	11.1" x 8.58" x 2.00" (color) (282 x 218 x 51mm) 11.1" x 8.58" x 1.77" (mono) (282 x 282 x 45mm)
BATTERY TYPE	NiCad / NIMH
BATTERY LIFE	2 - 3 hours
POWER REQUIREMENTS	Voltage: 115 - 230Vac Frequency: 50 - 60Hz
ENVIRONMENTAL RANGE OPERATING	Temp: 50° to 95° F (10° to 35° C) Shock: 5G Vibration: 1.0G peak, 3-200 Hz
NON-OPERATING	Temp: -4° to 140° F (-20° to 60° C) Shock: 60G Vibration: 1.5G peak, 3-200 Hz

The Austin 486 notebook is architecturally the most advanced on the market. Designed to fully utilize the entire family of powerful Intel 486 processors, Austin's notebooks pack all the speed and power of the best desktop workstation into a compact, light weight case. A unique 32-bit local bus video, with a windows accelerator, creates the best notebook graphics performance available. Technologically advanced, high-performance, glass media, hard drives, in sizes up to 340MB, set the industry standard for storage. The color models feature an active-matrix display providing crisp, clear color while running a CRT and the LCD simultaneously for impressive portable presentations. The large 16mm trackball, located front and center, affords optimal comfort and control. Two PCMCIA slots support two type II devices or one type III device at any given time. This 6.38 lbs. powerhouse gets you up and running while you are up and running.

AC
6" x 3" x 1.5"
1.1 lbs.

* 1 YR WARRANTY P.E.L
* 30 MONEY BACK

CALL TOLL FREE: 1-800-752-1577

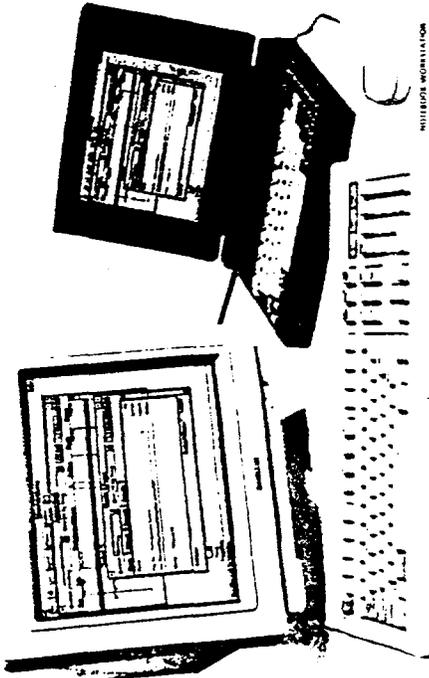
CANADA: 1-800-338-1565 • INTERNATIONAL: 512-339-3500 • FAX: 512-454-1357



The Austin Notebook. Next to you, it's the most powerful.

(And right now, it's on SALE!*)

* SALE ENDS DEC. 31, 1993



It's no longer a question of whether or not to buy a notebook to go with your desktop workstation.

It's simply buying an Austin Notebook instead of a workstation. You don't have to sacrifice work space to gain computing power. At just 11" x 8.58" x 2.0", an Austin Notebook Workstation takes up less space than a file folder and delivers outstanding performance.

Now when you leave your desk, you can take your workstation with you. No more transferring files to your portable. With an Austin Notebook, your portable is your workstation.

Ultimate Notebook Workstation

This is it. The fastest, most powerful notebook ever made, equipped with the largest notebook hard drive available. The Ultimate Notebook comes ready for desktop or portable performance with docking station, 15" high-resolution SVGA monitor, keyboard, and mouse. No portable can match it, no desktop model can beat it. And now, through the end of the year, you can get it at our special bundled sale price.

Ultimate Notebook Workstation Special Sale Package \$3,899

Includes: 340 MB hard drive • Keyboard • Mouse • Docking Station

Notebook Workstation

This is what your accountant calls a performing asset. The Notebook Workstation's 486 33 MHz processor rivals many desktop models in speed and power. And with a generous 213 MB hard drive, you have plenty of space to load it up and take it on the road. This system comes complete with an impressive and affordable desktop setup — 14" SVGA monitor, keyboard, and mouse — so you get the most out of your investment wherever you use it.

Notebook Workstation Special Sale Package \$2,999

Includes: 486SX 33 MHz processor • 8 MB memory • 213 MB hard drive • Dual Scan display • 14" SVGA Monitor • Keyboard • Mouse

The Traveler. Take your business around the world or down the hall.

The Traveler is a productivity tool the mobile worker can't afford to be without. And with our sale prices, it's even easier to afford. Two models are equipped with the power, memory, and communication tools you need while traveling, whether you're crossing the globe or crossing the street.

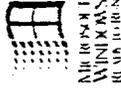
Pro Traveler

The Pro Traveler takes your first class. Nothing works faster than the 486 66 MHz processor. Nothing beats the convenience of your Canon portable printer. And with the 14,400 bps internal fax/modem, nothing comes between you and your office. All wrapped up in a luxurious leather carrying case, it's an attractive package at a very attractive price.

Pro Traveler Special Sale Package

Includes: 486DX2 66 MHz processor • 8 MB memory • 213 MB hard drive • Dual Scan display • 14,400 bps fax/modem • Portable printer • Leather carrying case

\$3,799



The Traveler

Don't leave your desk without packing this affordable portable. You'll enjoy the view on your Dual Scan color display. And with a 130 MB hard drive, you have enough memory to record everything about your travels. All you need is a phone line to send and receive data through your 2400 bps internal fax/modem. Enjoy the freedom of the road and the convenience of constant communication.

The Traveler Special Sale Package

Includes: 486SX 25 MHz processor • 4 MB memory • 130 MB hard drive • Dual Scan display • 2400 bps fax/modem • Nylon carrying case

\$2,299

A dazzling presenter and a smart study buddy.

Pro Business Presenter

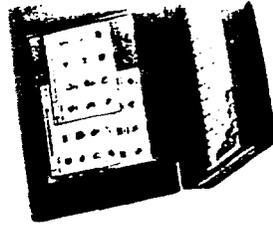
You'll deliver an impressive performance every time with this full featured presenter. The 66 MHz processor turns even the most multimedia applications with ease. A dual Scan display shows detailed graphics and the sharpest resolution. And with stereo presentation sounds as good as it looks, the Pro Business Presenter is your best bet.

Pro Business Presenter Special Sale Package

Includes: 486DX2 66 MHz processor • 8 MB memory • 340 MB hard drive • Dual Scan display • Stereo Speakers • Leather carrying case

Student Workstation

Give your educational career an extra push. Take it to class, to the library, and back home. Each battery lasts up to four hours. Upgrade increase. You can even use it to improve. Student Workstation comes with an internal and an Epson desktop printer.

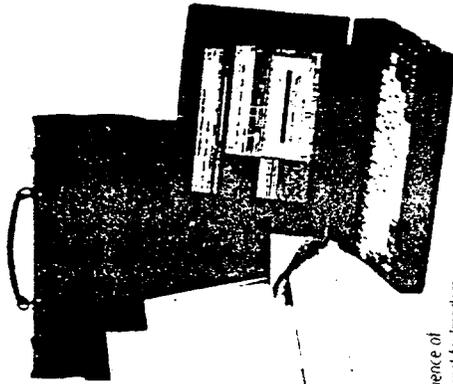


Student Workstation Special Sale Package

Includes: 486SX 25 MHz processor • 4 MB memory • 130 MB hard drive • Mouse • Desktop printer

It to you, it's the most powerful player in your office. and right now, it's on SALE!*

* SALE ENDS DEC. 31, 1993



Don't leave your desk without packing this affordable portable. You'll enjoy the view on your Dual-Scan color display. And with a 130 MB hard drive, you have enough memory to record everything about your travels. All you need is a phone line to send and receive data through your 2400 bps internal fax/modem. Enjoy the freedom of the road and the convenience of constant communication.

\$3,799

14,400 bps fax/modem

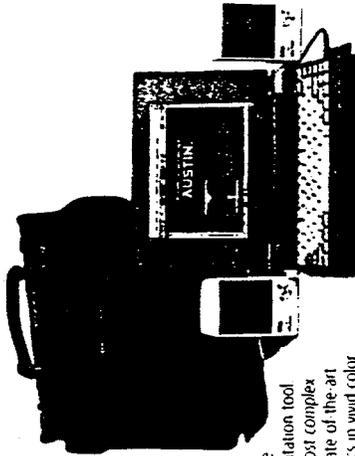


The Traveler

Don't leave your desk without packing this affordable portable. You'll enjoy the view on your Dual-Scan color display. And with a 130 MB hard drive, you have enough memory to record everything about your travels. All you need is a phone line to send and receive data through your 2400 bps internal fax/modem. Enjoy the freedom of the road and the convenience of constant communication.

Special Sale Package

25 MHz processor • 4 MB memory • 130 MB hard drive • Dual-Scan display • fax/modem • Nylon carrying case



A dazzling presenter and a smart study buddy.

Pro Business Presenter

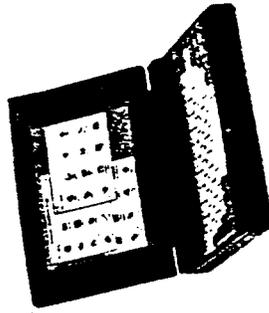
You'll deliver an impressive performance every time with this full-featured presentation tool. The 66 MHz processor runs even the most complex multimedia applications with ease. A state-of-the-art dual scan display shows detailed graphics in vivid color and the sharpest resolution. And with stereo speakers, your presentation sounds as good as it looks. If you take your show on the road, the Pro Business Presenter is your best vehicle.

\$3,599

Pro Business Presenter Special Sale Package
Includes: 486DX2-66 MHz processor • 8 MB memory • 340 MB hard drive • Dual-Scan color display • PCMCIA multimedia card • Stereo Speakers • Leather carrying case • Complete cabling

Student Workstation

Give your educational career an extra advantage with a full-function, low-cost Notebook. Take it to class, to the library, and back home. With Austin's power management system, each battery lasts up to five hours. Upgrade your Notebook as your needs increase. You can even use it to impress your first boss! The hard-working Student Workstation comes with an internal 2400 bps fax/modem and an Epson desktop printer.



Student Workstation Special Sale Package

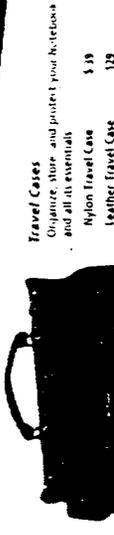
Includes: 486SX-25 MHz processor • 4 MB memory • 130 MB hard drive • Monochrome display • 2400 bps fax/modem • Desktop printer

\$1,949

Don't see exactly what you want?

We have a wide variety of other configurations to suit your needs and your budget. Select from 25 MHz to 66 MHz 486 processors, 130 to 340 MB hard drives, monochrome, dual- or color active matrix color displays. They're all available, and they're all priced right. Call us toll free. Our sales consultants will be happy to help you select the system that's right for you.

Accessories



Travel Cases
Organize, store, and protect your Notebook and all its essentials.
Nylon Travel Case \$ 39
Leather Travel Case 139

Docking Station

Turn your Notebook into an expandable desktop system with two drive bays, keyboard, and mouse ports.
Docking Station \$ 399

Fax/Modems

Send and receive faxes on the road, and connect quickly to on-line services.

Fax/Modem 9,600/2,400 \$ 199
Fax/Modem 14,400/14,400 299

Network Adapters

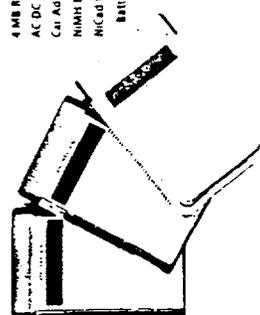
These PCMCIA adapters connect your Austin Notebook to your organization's network.

Ethernet Adapter \$ 399
Token Ring Adapter 650

Other Accessories

PCMCIA 16 Bit Stereo Sound Card 3299
4 MB RAM Upgrade 279
AC DC Adapter 79
Car Adapter 59
NiMH Battery Pack 149
NiCad Battery Pack 99
Battery Charger 49

The docking station adds desktop extension capabilities to your Austin Notebook.



Bring it home



1 Promotional pricing
* Sale ends December 31, 1993

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AUSTIN (COMPUTER SYSTEMS) - 14000 COMPANY • 10000 MERRICK BLVD • AUSTIN, TX 78758
FAX 512 458 1537 • HOURS: 9:00 AM - 5:00 PM • TOLL FREE 1-800-246-7037

Clear your desk before it's too late.

Does your computer have more room to work than you do?

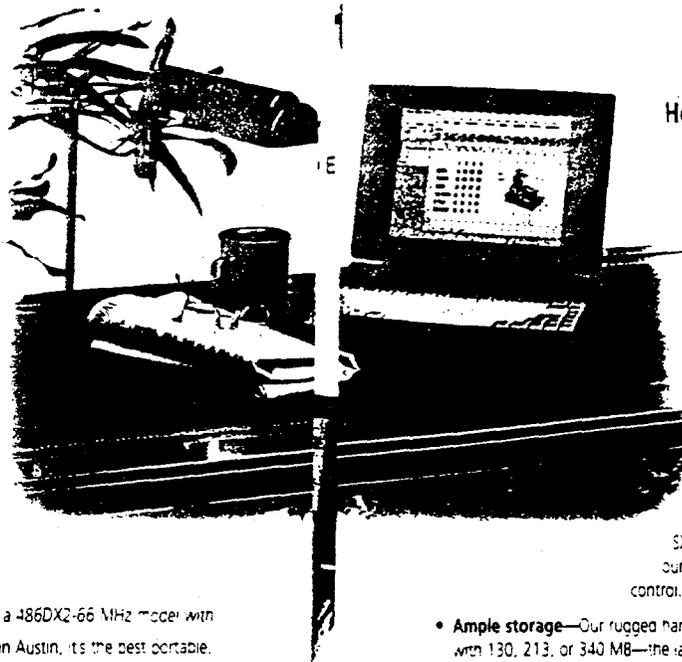
Now you can gain more desktop space without sacrificing power, performance, or memory. Whether you need a tower or power or a back-to-school basic, we have an Austin Notebook for you. And through December 31, you can save on special Notebook bundles designed to deliver the greatest value at the lowest price.

Let's make a deal.

Austin's super selection of Notebooks starts with our top-of-the-line Ultimate Notebook Workstation, a 486DX2-66 MHz model with a 340 MB hard drive. It's not only the best portable in Austin, it's the best portable, period! No other notebook matches the processing speed and memory capacity. And no desktop model can beat it.

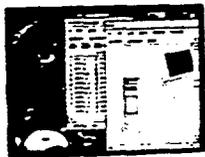
Are you spending more time away from your desk? Are your presentations falling flat? Would a portable put you at the head of the class? We have models for you, too.

And if we haven't made your dream machine, we'll let you make your own. Just mix and match the features you want and phone in your order. See inside for "build-your-own" details.



Here's what you get with an Austin Notebook!

- **Lightning-fast video**—Your presentations score on the power of our 32-bit local-bus video accelerator with 1 MB Video RAM. And with simultaneous output to an external monitor, you can show off your show in the office, in the classroom, or on the road.
- **Your choice of displays**—Choose a top-of-the-line Active Matrix display for the most demanding color applications. Get cost-effective color with a Dual-Scan display. Or opt for razor-sharp resolution with our affordable monochrome display.
- **Peak performance**—Austin Notebooks run on Intel's powerhouse 486 processor. You can choose the level of performance and speed you want—from SX to DX2 and from 25 to 66 MHz. Even at top speeds, our integrated cooling system keeps temperatures under control.
- **Ample storage**—Our rugged hard drives feature glass-media construction. Load up with 130, 213, or 340 MB—the largest drives on the market!
- **Future expandability**—Add-on devices (two Type II or one Type III) plug instantly into two PCMCIA slots. You also have the capacity for additional RAM and ROM.
- **Auto stop**—One touch puts your system into Standby Mode and back into Active Mode. You can return to work exactly where you left off, without waiting for the system to boot.
- **Sophisticated power management**—What good is a portable if you're tied to a power source? Austin Notebooks use less energy, our batteries last longer, and you have more time to work (or play) unplugged.
- **Energy efficient operation**—Austin Notebooks meet EPA Energy Star™ guidelines, providing the full power of a desktop system at only a fraction of the electricity. It's good for the environment, and it's good for your bottom line.
- **Strong service and support**—Austin provides free expert consultation, lifetime toll-free technical support, and a full one-year warranty on all our award-winning systems. We are a five-time winner of the PC Magazine Editors' Choice Award and a recent recipient of the PC Magazine Readers' Choice award for excellent service and reliability. PC World rated Austin #1 in service and support. No wonder 70% of our orders are from repeat customers.



The best of both worlds!
Connect your Notebook to a large-screen monitor when you're at your desk. You get the benefits of a bigger display and the advantages of a high-performance portable.



ULTIMATE NOTEBOOK WORKSTATION



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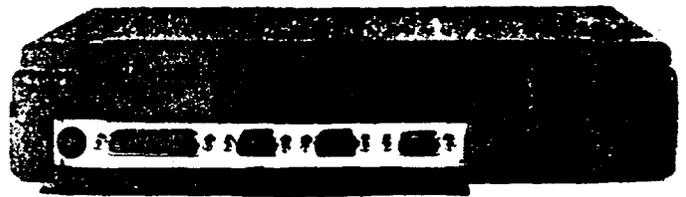
AUSTIN COMPUTER SYSTEMS, AN IPC COMPANY, 2555 METERS BLVD., AUSTIN, TX 78768
FAX: 512/454-9157 • CIRCLE 15 ON CARD



Here's what you get with an Austin Notebook!

- **Lightning-fast video**—Our presentations score on the power of our 32-bit local-bus video accelerator with 1 MB video RAM. And with simultaneous output to an external monitor, you can show off your show in the office, in the classroom, or on the road.
- **Your choice of displays**—Choose a top-of-the-line Active Matrix display for the most demanding color applications. Get cost-effective color with a Dual-Scan display. Or opt for razor-sharp resolution with our affordable monochrome display.
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Specifications

Processor	32-bit Intel 486-SX, DX, or DX2 25, 33, or 66 MHz	Trackball	Integral 16mm, front-center mounted
Hard Drive	130 MB 14ms IDE 213 MB 13ms IDE 340 MB 12ms IDE	PCMCIA	Two PCMCIA Type II or one PCMCIA Type III
Memory	4 MB standard, upgradable to 32 MB	I/O Ports	One parallel, two serial, SVGA
Display Interface	32-bit local-bus Windows accelerator, 1 MB RAM	Diskette Drive	3.5", 1.44 MB
Active Matrix Color LCD	9.5" TFT Active-Matrix display, 256 color with simultaneous VGA monitor output	Power Usage	<10 watts in Standby Mode, conforms to EPA Energy Star guidelines
Dual-Scan Color LCD	Dual-Scan Passive-Matrix display, 256 color	Battery Life	2 to 5 hours
Mono LCD	Edge-fit superhsvst with 16-level gray scale	Preinstalled Software	MS-DOS 6.0 Microsoft Windows 3.1
Keyboard	Full-sized 85-key, with cursor keys in inverted T	Dimensions	11.1" x 8.58" x 2.0"
		Weight	6.3 lbs.
		Regulatory	UL and CSA Approved FCC Class B
		Warranty	One year



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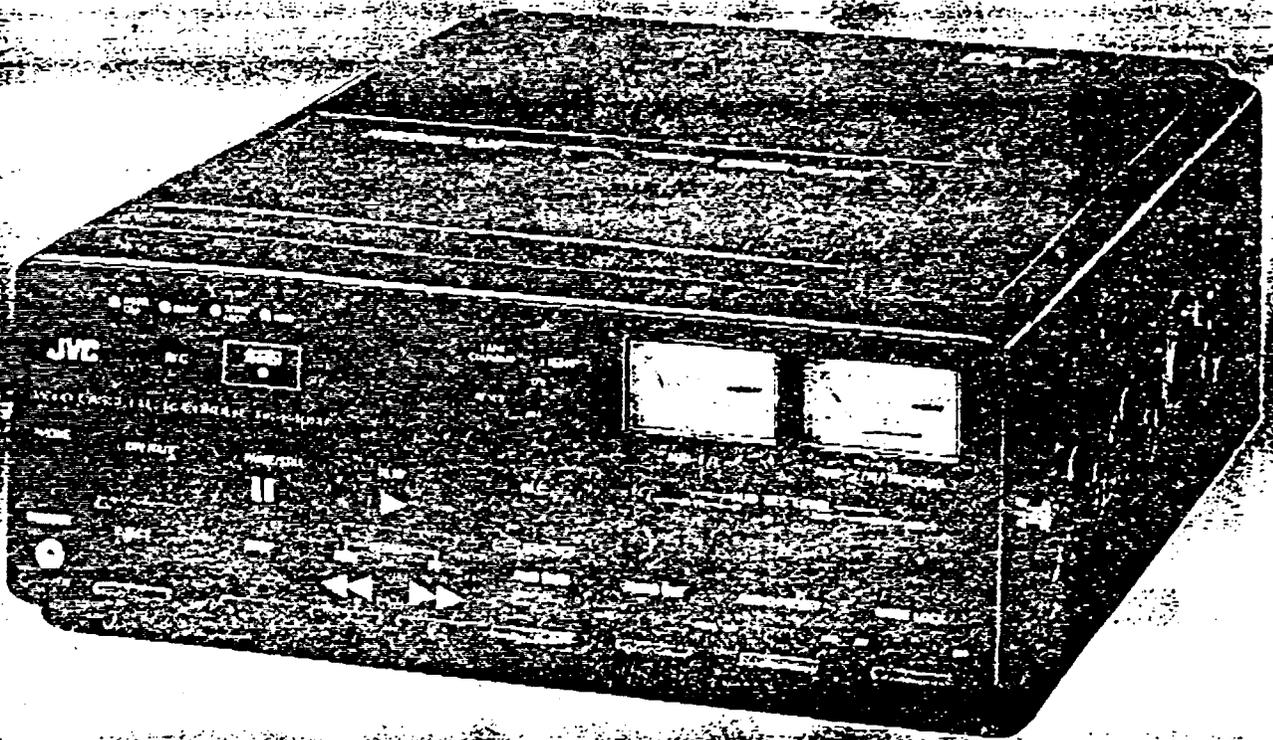
JVC
PROFESSIONAL

S VHS

PORTABLE S-VHS
RECORDER

BR-S405U

A separate portable professional
S-VHS recorder ideal for use
with any existing stand-alone
camera.



IF YOU DON'T NEED A CAMCORDER, WHY U

JVC's BR-S405U Portable S-VHS Recorder Is Designed Exclusively For Use In Separate System Configurations

Not everybody who needs a portable recorder, needs a camcorder. If you prefer a separate system — whether it's for long-duration on-location shooting or it's because your assignment requires you to mount the camera on a dolly and the recorder on a cart — then why compromise with a recorder that's not really designed to do the job?

For maximum efficiency and professional results, you need a portable recorder designed specifically for separate use. You need JVC's BR-S405U Portable S-VHS Recorder. Free from the kind of design characteristics that can make a dual-purpose (dockable/portable) recorder less than ideal for use as a separate system, the BR-S405U features optimally positioned controls, easy connection to any existing camera, plus a handy mode lock function and an audio preset switch to ensure worry-free operation in any situation.

So when you need separate system portability, don't compromise. Choose the recorder that's designed to do the job. The BR-S405U. With its superior S-VHS picture quality and Hi-Fi VHS stereo sound, full range of professional features, and separate system flexibility, it'll make it easy for you to get the job done right.

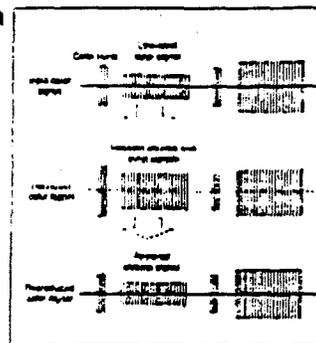
HIGH-QUALITY PICTURES

High-quality S-VHS pictures

To provide pictures with the detail and clarity demanded by broadcast acquisition and industrial applications, the BR-S405U incorporates JVC's advanced S-VHS technology for high-quality pictures with resolution of more than 400 lines. VHS recording is also available.

Built-in chroma noise reduction

To further improve picture quality, an advanced ALU (Automatic Level Up) recording circuit is used to improve the chroma signal-to-noise ratio. This sophisticated system increases signal level and color burst in recording, then reduces the signal to its original level in playback, thus maintaining the original chroma level while reducing chroma noise.



Separate Y/C input and output

In addition to permitting connection with any existing camera, the BR-S405U's 14-pin camera connector can accept separated Y/C signals, making it possible to build a high-quality field acquisition system by combining the BR-S405U with a professional camera equipped with separate Y/C output. And, to ensure that the picture that goes out is as good as the picture that goes in, the BR-S405U is also equipped with separate Y/C output* to deliver high-quality color pictures with reduced Y/C interference.

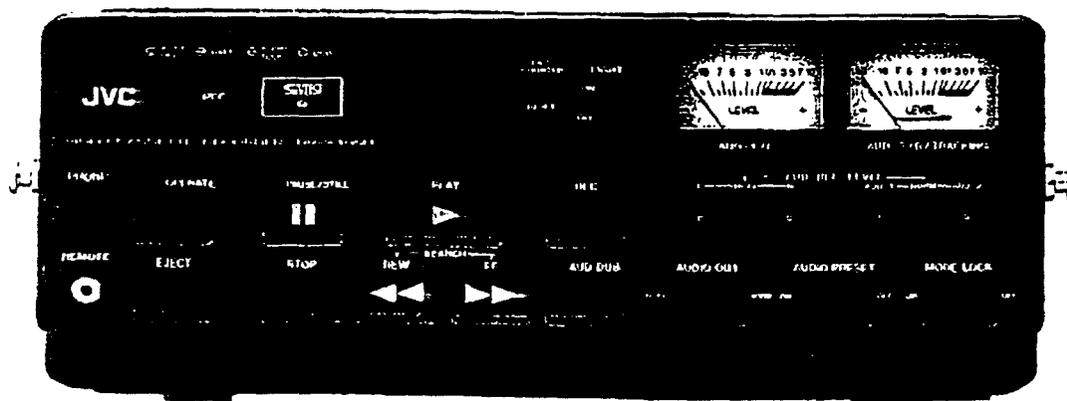
Reduced jitter

To improve picture quality still further, the BR-S405U incorporates two impedance rollers in the tape path to stabilize tape transport. This greatly reduces jitter components to ensure a clear, stable picture.

Rotary erase heads and AEF function

A pair of rotary erase heads are mounted on the head drum to ensure clean, professional-quality recordings. During re-recording, each rotary head scans a single field on the video track, erasing the field prior to re-recording and preventing chroma beats and picture distortion at edit points. For clean assemble editing with no overlapping, automatic backspacing is provided by the AEF (Automatic Editing Function) mechanism.

* Y/C filtering technique incorporated under license from Furudaira Laboratories Inc.



E A CAMCORDER DECK?

HIGH-QUALITY SOUND

Hi-Fi Stereo sound

Using two rotary FM-audio heads to record Hi-Fi audio signals on a separate layer of tape, the Hi-Fi VHS system assures you of superb sound quality with extended frequency response of 20 Hz to 20 kHz, a dynamic range in excess of 80 dB and minimal wow and flutter. A Hi-Fi REC switch is provided to defeat recording on the Hi-Fi track.

Balanced XLR input connectors

A set of XLR balanced audio input connectors is provided to provide levels of audio reception performance. Input levels are switchable between -60 dB, -20 dB, and +4 dB to allow connection of professional microphones for interviews and other applications.

Audio Preset switch

For added convenience when you need to set up quickly, an Audio Preset switch is provided. When set to ON, this automatically sets audio input to rated levels. Manual level adjustment is also possible with independent controls provided for each track.

Audio Dubbing

The BR-S405U's stereo normal audio track features audio dubbing capability, using either Channel 2 only or both channels together.

MOBILITY

Large REC indicator

A large red REC indicator located on the BR-S405U's front panel blinks during recording, making visual confirmation of recording easy even from a distance.

LCD lap timer with 10-hour memory backup

The BR-S405U's 4-digit tape counter can be switched to a 5-digit lap timer displaying elapsed tape time in hours, minutes, and seconds. A BACKLIGHT ON/OFF switch is provided for easy viewing in lowlight situations while 10-hour memory backup ensures continued accuracy even after power switch-off.

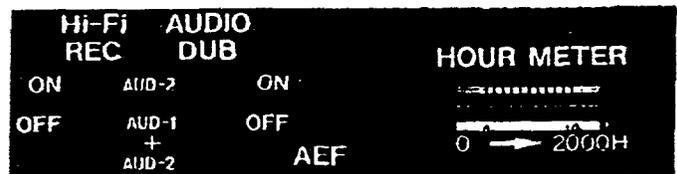
Rugged construction

To meet the rigorous demands made on a portable professional recorder, the BR-S405U's critical components are housed in a rugged diecast aluminum casing capable of withstanding severe shocks and vibrations.

RELIABILITY

Mode lock function

When you want to prevent accidental or deliberate mishandling of the recorder's controls, simply set this switch to ON after setting all necessary controls. You'll be able to concentrate on camera operations without worrying about mishaps. Especially convenient in situations where you can't keep a close eye on the recorder or have to leave it unattended in a crowded area.



2000H hour meter

To facilitate scheduling of maintenance, a meter is provided which shows operating time up to 2000 hours.

Comprehensive warning system

To ensure trouble-free operation and minimize downtime, LED indicators warn of problems such as servo lock failure, depleted battery, condensation, and automatic shut-off due to malfunctioning tape transport. An audible warning is simultaneously output from the earphone jack.

AV output terminals

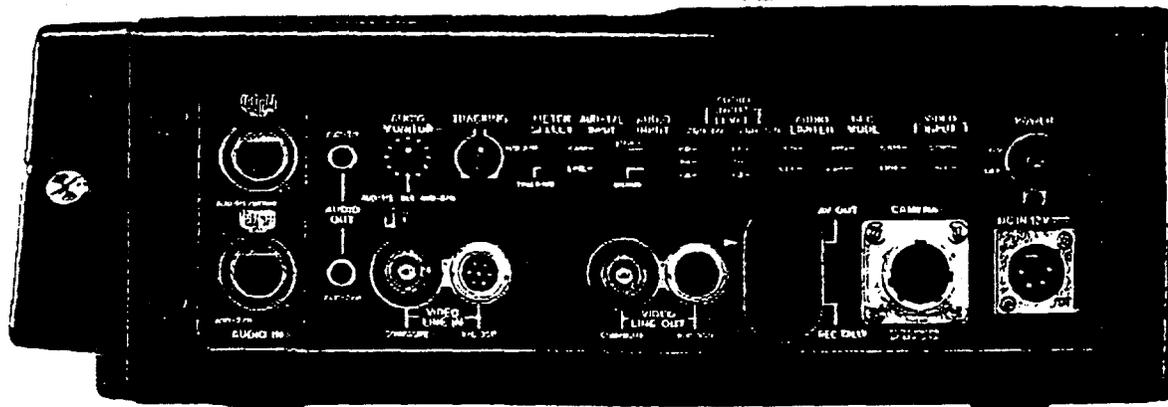
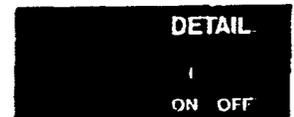
In addition to Y/C 358 output, the BR-S405U is equipped with composite video and 8-pin AV outputs. Independent L/R audio output terminals are also provided.

High-speed shuttle search

For more search flexibility in the field or in the studio, shuttle search at 7 times normal speed in either direction is possible.

Large backlit audio level meters

For easy monitoring of audio levels even in dark or dimly-lit conditions, two large backlit VU meters are provided.



SPECIFICATIONS

Format: VHS/S-VHS standard
 Recording system: Luminance/FM recording
 Color: Down-converted subcarrier
 Separate Y/C signals
 Signal system: NTSC
 Tape speed: 33.33 mm/sec
 Record/play time: 120 minutes (with E-120/S-120 cassette)
 FF/RW time: Within 4 minutes (with E-120 cassette)
 Power source: 12 VDC
 Power consumption: 19 W
 Dimensions: 280(W) x 112.5(H) x 324(D) mm
 (11-1/16" x 4-7/16" x 12-13/16")
 Weight: 4.3 kg (9.5 lbs.) (5.2 kg (11.5 lbs.) with NB-G1U and tape)
 Operating temperature: 0°C to 40°C
 Storage temperature: -10°C to 60°C

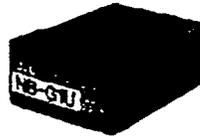
Video
 Input: 0.5 to 2.0 Vp-p, 75 ohms, unbalanced
 Output: 1.0 Vp-p, 75 ohms, unbalanced
 Y/C input: Y: 1.0 Vp-p, 75 ohms, unbalanced
 C: 0.286 Vp-p, 75 ohms, unbalanced (burst)
 Y/C output: Y: 1.0 Vp-p, 75 ohms, unbalanced
 C: 0.286 Vp-p, 75 ohms, unbalanced (burst)
 Horizontal resolution: More than 240 lines (VHS color)
 More than 400 lines (S-VHS color)
 S/N ratio: 46 dB (S-VHS)
 45 dB (VHS) (Detail SW OFF)
 (Police and Schwarz noise meter)

Audio
 Number of channels: 2 Hi-Fi channels
 2 normal channels
 Input: -60 dBs (3 k-ohms)/-20/+4 dBs (10 k-ohms), balanced (Hi-Fi and normal)
 Output: -6 dBs, 1 k-ohm, unbalanced (Hi-Fi and normal)
 Headphone output: -45 to -25 dBs, 8 ohms
Hi-Fi audio
 Frequency response: 20 Hz - 20,000 Hz
 Dynamic range: More than 80 dB
 Wow & flutter: Within 0.007% WRMS
Normal audio
 Frequency response: 40 Hz - 12,000 Hz
 S/N ratio: More than 44 dB
 Wow & flutter: Within 0.25% RMS
 Accessories: Carrying handle x 1, Shoulder strap x 1, NB-G1U x 1

OPTIONAL ACCESSORIES



AA-G10U
 Battery Charger/AC Power Adapter
 Charges four NB-G1U battery
 (X100R)

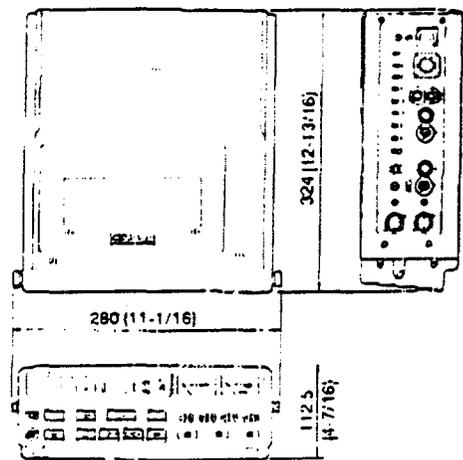


NB-G1U
 Rechargeable Battery Pack
 One NB-G1U is provided with the GR-S405U as a standard accessory.



Professional-S Tapes
 ST-120PRO (2 hours recording)
 ST-60PRO (1 hour recording)
 ST-30PRO (30 minutes recording)
 High-performance S-VHS tape with increased durability and higher-density magnetic particles designed especially for professional use

DIMENSIONS



Unit: mm (inches)

Design and specifications subject to change without notice

JVC®

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 JVC CANADA INC.

Model D5200 DSR MPEG Encoder

PROPRIETARY

SCIENTIFIC-ATLANTA, INC.
PROPRIETARY INFORMATION



Technical Specifications

Mechanical

Power	A automatic sensing Universal Input accepting 98 to 240VAC at 50 to 60 Hz
Size	177.8 mm (7.0 in.) high, 483 mm (19 in.) wide, 533 mm (21 in.) deep
Weight	approximately 9.1 kg (20.0 lbs)
Storage temperature	-20°C to 125°C
Operating temperature	0°C to 40°C
Operating humidity range	10% to 90% non-condensing

Video Encoder Board

Resolution	704 x 480 30 Hz NTSC
Bit rates	5.3 Mbps - 8.3 Mbps
Bit stream protocol	MPEG Video Layer (CL950 Compatible)

Video Input Board

Video input	NTSC (RS 170)
Video input level	1V p-p ± 1V
Input impedance	75Ω
Input return loss	20 dB
Input connector type	BNC

Technical Specifications

MPEG Audio Encoder Board

Input type	Balanced, XLR inputs
Impedance	High impedance (.10K Ω) driven by a 600 Ω source
Input level	+18 dBu nominal
Input adjustment range	+12 dBu to +24 dBu
Frequency response	± 0.25 dB from 20 Hz to 20 KHz
THD	<0.25%, full scale, 20 Hz to 20 KHz
Hum and noise	<86 dB, A-weighted
Crosstalk isolation	>75 dB, 20 Hz to 20 KHz, reference in other channel
Encode algorithm	MPEG I, Layer 2, Psycho-Acoustic Model #1, Dual Channel Mode
Sampling rate	48 KHz
Compressed data rate	256,000 bps
Emphasis	None

Simple Mux Board

Connection type	Differential terminated
Levels/Protocol	RS-485
Duplex	Synchronous
Data bits	8
Data rate	3.14×10^6 bps

Serial Data - Status/Control link

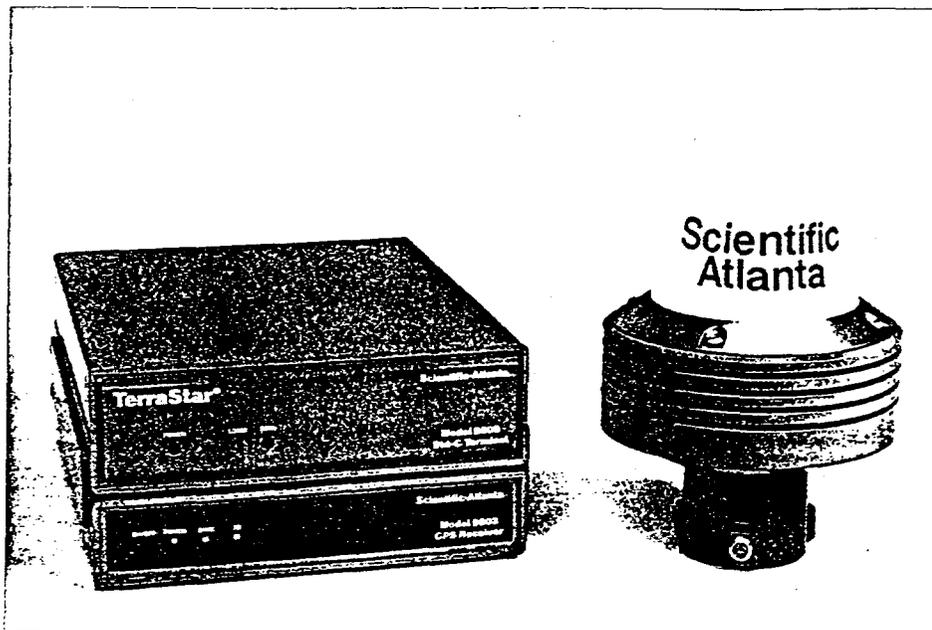
Baud rate	57,600
Parity	No Parity
Data bits	8
Stop bits	1
Duplex	Half Duplex
Levels/Protocol	RS-232C

PROPRIETARY

SCIENTIFIC-ATLANTA, INC.
 PROPRIETARY INFORMATION

MapStar™ Automatic
Vehicle Location Software

Scientific-Atlanta's MapStar™ Automatic Vehicle Location (AVL) software package provides the dispatcher interface for fleet communications and tracking. Utilizing the global satellite system, Inmarsat, a consortium of 65 countries, MapStar™ is connected with Scientific-Atlanta's MariStar™ or TerraStar™ products to provide real or near real time two-way communications between the dispatch office and mobile vehicles anywhere in the world.



Scientific-Atlanta's TerraStar™-C/MariStar™-C Terminal is one example of an Inmarsat Earth Station that can be used to communicate with the mobile vehicle/vessel using MapStar™.

Features

MapStar™ has a number of flexible features including:

- Vehicle/Vessel Tracking for Entire Fleet
- Cartographic Flexibility
- Variable Communications Interface
- Two-way Communications
- Stand-alone Configuration
- Front-end Communications for Midrange and Mainframe
- Compatibility with TerraStar-Hub™ Network Router

Description

MapStar™ is a graphic display, communications, and database management system for vehicle tracking applications. Users will be able to track vehicles, send and receive messages, establish data communications, and obtain vehicle status reports.

Vehicle locations are displayed on maps, which may be customized to the user's specific requirements, providing an interface for the user to the map display and two-way communications. Using MapStar™, the dispatcher can monitor in real time the location, speed and ETA for all vehicles in the fleet, and send and receive messages.



INMARSAT
System Provider

Scientific-Atlanta, Inc.
Fax - 404-903-5346

Full Features of MapStar™

Vehicle/Vessel Tracking

- Receives position data and plots vehicle's exact location on map or chart
- Position options available:
 - Latest position
 - Last known/communicated position
 - 1 to 24 hour period
 - Archive Files
- Supports the following services:
 - GPS Lat/Long, course & velocity
 - Time and date sent
 - Time and date received
 - Sensor status reports
 - Forms filing
 - Fuel management data
 - Trip record data

Cartographic Flexibility

- Display of numerous vector based maps
- Zoom up to 7X for detail
- Allow any digital or hard copy map to be used as background map
- Maps are in multiple overlays
- User editable overlay
- Receives electronic file update

Variable Communications Interface

Basic map engine receives packets from many types of communications networks

Two-Way Communications

- No additional programs are necessary to exchange messages with mobiles through the network
- All handshake and protocol conversion is automated
- Operates in batch or real time

Map is Human Interface to Communications

- Communications are originated by pointing at vehicle or selecting vehicle from list
- Exact destination transmitter ID is always input when vehicle is selected
- All log keeping is automated

Stand Alone Configuration

The program is complete within itself and optimized to run in a stand-alone configuration

Front-End Communications Processor for Midrange and Mainframe

For those applications where the newly received message and position information is useful in another computer which is running an operations package. The program is designed to prepare the data for transfer to these other systems and to serve as a front-end communications processor for them. This can be accomplished in a direct connection to the other computer or via a network

Back-End Cartographic Terminal for Midrange and Mainframe

For those applications where the new dynamic data is received by the operations package in an existing computer, the program can very nicely receive the position information from the computer and display the positions on the electronic maps. This prevents the need for putting cartography on the host computer.

Low Cost

Perhaps the most cost-effective solution to vehicle tracking in the world. Plus built-in two-way communications and many other extras.



MapStar™ Gives You The Big Picture

Friendly Operation

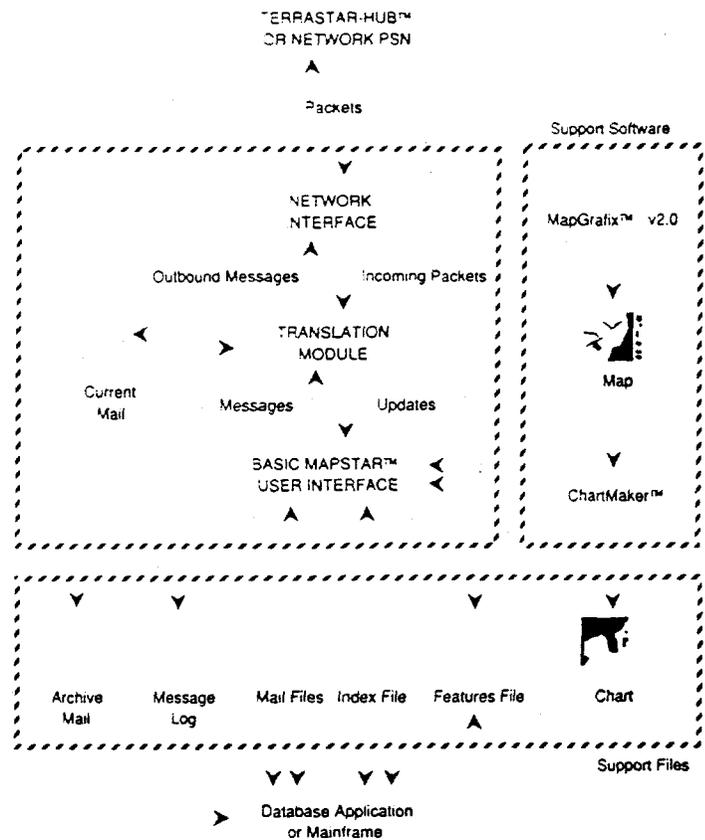
GUI-Geographical User Interface: the startlingly easy way to operate a complex and powerful computer. The ease of use and training saves even millions of dollars over time depending upon number of workstations and use.

Network Management

The optional TerraStar-Hub™ routing, store-and-forward switch gives carriers full network parameters and flexibility without compromising performance or cost effectiveness.

Benefits of MapStar™

The financial benefits of equipping a fleet with a Scientific-Atlanta MariStar™ or TerraStar™ terminal are varied depending upon the application. In a typical trucking application, benefits accrue to all interested parties.



The Trucking Company/Operator

- Cost savings lead to a payback of less than one year
 - More revenue mile per truck
 - Decreased and predictable telecommunications cost
 - Decreased out of route and deadhead miles
- MapStar™ is a marketing tool
 - Offers a competitive edge
 - A proactive rather than reactive customer service plan
- Improves management reporting capabilities
- Reduces accidents and lowers fuel consumption
- Reduces insurance premiums by 7-15%

The Driver

- Near real-time communication between the driver and the dispatcher is accomplished easily from any location
- Quicker transit times
- With the optional Mobile MapStar™ interface the driver can see his location at all times. The software gives a numeric latitude/longitude indication of current position. Vectorized maps are also available for the vehicle with a suitable display device
- Increases number of loads and revenue miles
- Emergency assistance is always available
- Eliminates filling out complex driver logs

The Shipper

- Greater degree of Quality Control
- Increases control of high-value consignments
- Precise status and shipment information
- Accurate delivery time with position reporting. Tighter ETAs can result in Just-In-Time service to customers
- Rapid response to customer request and/or order. In-transit redirects and expedited deliveries are easy to effect
- Coordinate operations with shipping personnel to maximize efficiencies and productivity

System Hardware Requirements

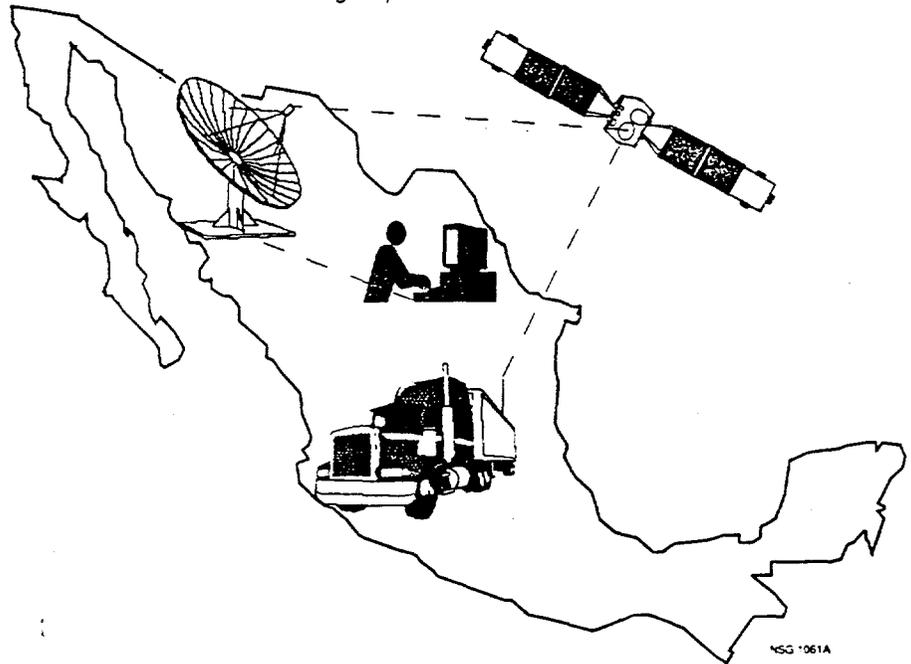
MapStar™ is designed to operate with the following system hardware:

- Scientific-Atlanta MariStar™ or TerraStar™ Inmarsat Standard-C and/or -M Terminals
- Apple Computer, Inc. Macintosh™ systems, including Macintosh II, IIx, IIcx, IIci, IIfx, and Quadra 700 and 950 computers, using System 6.0.5 or greater
- Any telecommunications network equipment that is able to connect to the specified Inmarsat Land or Coastal Earth Station
- Optional TerraStar-Hub™ for use in multiple dispatcher networks.

Macintosh is a trademark licensed to Apple Computer, Inc.

Throughout the world, shippers can rely on Scientific-Atlanta's AVL and Inmarsat systems expertise. After providing the first Inmarsat coastal earth stations, and more than 3,000 Inmarsat terminals, the transport industry has come to rely on Scientific-Atlanta since 1976 to provide mobile communications solutions worldwide.

Illustration showing typical transportation application using MapStar™



Scientific-Atlanta, Inc.

Our customers are the winners.

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