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U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

Memorandum

NHTSA-00-7699-3

Subject: Submittal of Documents for the NHTSA R&D Truck and Bus Event Data Recorder (T&B EDR) Working Group to Docket No. NHTSA-00-7699

Date: MAR 26 2001

From: Raymond P. Owings, Ph.D.
Associate Administrator for
Research and Development

Reply to
Attn. of: NRD-01

To: The Docket

THRU: John Womack
Acting Chief Counsel

Please place the following material in the subject docket:

1- Meeting minutes of the NHTSA Research and Development Truck and Bus Event Data Recorder (T&B EDR) Working Group meeting #2, held in October, 2000.

2- Meeting handouts from meeting #3, held on February 15/16, 2001.

Meeting history:

Meeting #	Date	Location
1	June 8, 2000	Linthicum, MD
2	October 25,2000	Washington, DC
3	February 15-16, 2001	Boca Raton, FL

Attachments

Approved & Final Minutes for Meeting #2
October 25,2000
Washington, DC

NHTSA Research and Development
Final Minutes for the Truck and Bus Event Data Recorder Meeting held on Wednesday, October 25, 2000 at USDOT Headquarters, 400 Seventh Street, Washington, DC 20590

Minutes prepared by Will Schaefer

Meeting Scope:

These minutes document the second (2nd) meeting of a group of industry, academic, and government representatives assembled to address event data recorders (EDRs) in heavy-duty trucks and buses. This second meeting of the Truck and Bus EDR Working Group gave attendees opportunity to see an example of a NTSB accident analysis using EDR data, an overview of an available event recording product from VDO, and a presentation of crash statistics and types of crashes where EDRs may show benefit. There was also a discussion of numerous issues surrounding event data recorders.

Notice of NHTSA's Role

Meeting Chairman John Hinch from the National Highway Traffic Safety Administration (NHTSA) convened the meeting by explaining the objectives of the group and defining limitations of the NHTSA's role. It was emphasized that this meeting has a fact finding mission and the group cannot make recommendations to regulatory agencies. It can however compile information to provide input for future decisions.

Materials

Materials circulated at the meeting included our agenda, draft minutes from the EDR Task Force of the The Maintenance Council including its draft Recommended Practice, and a white paper from Bob McElroy of Forensic Accident, Inc. Attached is a brief survey of EDR capabilities which was distributed and collected for compilation by next meeting. All materials circulated in the meeting are considered public and will be posted online through the Docket Management System (DMS). Visit **http://dms.dot.gov/search/** and search Docket Number **NHTSA-2000-7699.**

NTSB Presentation

Mr. Vernon Roberts of the National Transportation Safety Board presented the data analysis of an actual fatal crash of a tour bus. The overview showed the benefits as well as the shortcomings of analyzing data that was recorded by the engine's electronic control unit (ECU). The data analysis allowed the NTSB to make some conclusions that couldn't have been made otherwise and it raised some questions regarding the specific crash that might not have been otherwise considered.

From the crash analysis the group could see potential benefits and liabilities of the use of data recorders. In this example the data set is limited to those items recorded by the engine ECU but it still provided insight to where this group's discussion might lead.

VDO Presentation

Mr. Dan May of VDO North America, which manufacturers its Accident Data Recorder for the automotive industry, presented an overview of VDO's product including some of the data storage parameters and accident reconstruction features. Also, benefits of implementing VDO's product in a police vehicle population in Germany were shown. Mr. May's presentation offered the group a view of one commercially available event data recorder.

Mr. Tom Kowalick

Mr. Tom Kowalick of Click Incorporated presented highway crash fatality and injury statistics to show a need for more crash reduction efforts. Included in his presentation were summarized crash data as well as photographs of different types of crashes which illustrated various scenarios where EDRs may record useful information.

After these three presentations, Mr. Will Schaefer of NHTSA Research and Development gave a brief synopsis of the efforts of the EDR Task Force currently active in the Maintenance Council (TMC) of the American Trucking Associations. The TMC task force is in the process of writing a recommended practice that suggests a standard array of data elements that are readily available and uniform in format for easy comparison.

Meeting Adjourned for Lunch

Discussion

After lunch, the group addressed some of the more specific needs within industry and government for recording data elements. A survey (see attachment) of EDR capability information was distributed to the group and analyzed. The importance of each individual data element was assessed at least to some degree.

It was suggested that some data elements had more clear cut function and ease of recording than others. For example, vehicle speed is rather non-arbitrary yet one can measure it in numerous ways–wheel speed sensors, transmission output, engine speed/gear selection, radar, etc. Another example is brake application, where it could be defined as an application of the pedal or a certain pressure applied to the pedal or the simple fact that the brake light turned on. These discussions are ongoing.

Discussion Questions from Meeting #1

In the first meeting of this group, several questions were brought up and they were outlined in the minutes for the first meeting. Those questions are repeated below where they are followed by an update on continued discussion from Meeting #2.

I. **What data elements need to be recorded?** At this second meeting of the working group, we informally surveyed the attendees to catalog the perceived usefulness of several data elements. These are listed on the attached survey list. The survey list doesn't include all possible data elements and thus further discussion will occur.

II. **What is to be gained by putting recorders on a bus, given the low numbers of bus passenger deaths each year?** It was reiterated that EDRs should not necessarily be required in all vehicles.

III. **What are the benefits of event recorders?** Some of the benefits of event recorders were evident from the presentation by the NTSB where additional information that was not recorded in that particular accident could have been useful for accident reconstruction. Also, Mr. Kowalick's presentation highlighted various types of accidents where EDRs could be beneficial.

IV. **What are some of the drawbacks to event recorders?** Again, event recorders add cost to a vehicle in hardware and maintenance labor. Additionally, it was restated that not all vehicles will demonstrate an effective cost benefit because, statistically, so few of some types of vehicles such as school buses are involved in serious crashes.

V. **What is the goal of the EDR? Is it to record what the driver does or is it for finding mechanics of a crash, change in velocity, acceleration, etc.? Is it to find culpability or causes of injuries?** These questions remain as the working group continues to explore all aspects of the EDR.

VI. **Will EDR's be mandated?** This certainly is not the end goal of this working group. It was pointed out that some form of standardization will be beneficial for those who need or want EDRs.

VII. **What constitutes an event? Does the crash event occur when an air bag is deployed, or is it something else?** This question was brought up and discussed extensively and it remains to be answered. It was suggested that some key definitions for these issues are an important first step. This is a key definition that remains to be defined.

X. **Can current recording devices accept analog inputs as well as digital inputs?** Yes.

Next meeting:

The next meeting of the Truck and Bus Event Data Recorder Working Group will be hosted by Florida Atlantic University (FAU), located in Boca Raton, FL. The meeting will be held on Friday, February 16, 2001. FAU will be hosting a reception the evening of Thursday, Feb 15, 2001. Again, please note all materials circulated in the meeting will not be circulated with the minutes but are posted online through the Docket Management System. Visit: **http://dms.dot.gov/search/** and search Docket Number **NHTSA-2000-7699.**

Attendee List (combined from meetings #1 and #2).

NAME	ORGANIZATION
Raul Arbelaez	IIHS
David Bolen	New World Tours
Kris Bolte	NTSB
John Bradley	SAE International
Brad Cohen	Loss Management Services
Wanda Curtis	Thomas Built Buses
Dan D'Angelo	SAE
Ken Dodson	Thomas Built Buses
Bob Douglas	American Transportation
Steve Ezar	SAE
Charlie Gauthier	NASDPTS
Whit Harris	Thomas Bus
Kate Hartman	FMCSA
John Hinch	NHTSA-R&D
Kevin Holland	ATA
Charles Hott	NHTSA-NPS
Rich Kempf	International Truck & Engine Corp.
Tom Kowalick	Click, Inc.
Larry Kuhn	International Truck & Bus Co.
Norm Littler	UMA
Andy Mackevicus	Loss Management Services, Inc.
John Mackey	Loss Management Services, Inc.
Bill Mahorney	American Bus Association
Joe Marsh	Ford
Dan May	VDO North America
Sarah McComb	NTSB
Linda McCray	NHTSA
Bob McElroy	Forensic Accident, Inc
Douglas Mckelvey	FMCSA
Joseph Mickley	Smiths Industries
Rod Nash	Collins Industries, Inc.
Jennifer Ogle	Georgia Tech
Duane Perrin	NHTSA-R&D
Doug Read	SAE
Richard Reed	Accident Research & Analysis
Vernon Roberts	NTSB
Mary Russell	FAU
Will Schaefer	NHTSA-R&D
Larry Strawhorn	American Trucking Associations
Tom Turner	Blue Bird Body Co.
Susan Walker	FAU

Attachment: Survey

Survey of current EDR capability within industry by Working group						
				Short term: within 2-3 years		
Name:				Long term: beyond 2-3 years		
Company:						
If involved with a specific platform, indicate below:	Useful	Priority		Availability		
Vehicle Type (SB, MC, Tk, Other):	Y/N	Hi/Med/Lo		Now	Short term	Long term
lateral acceleration						
longitudinal acceleration						
vertical acceleration						
heading						
vehicle speed						
engine speed (RPM)						
driver's seat belt status						
braking input						
steering input						
gear selection						
turn signal status (left/right)						
brake light status (on/off)						
head/tail light status (on/off)						
passenger door status (open/closed)						
emergency door status (open/closed)						
hazard light status (on/off)						
brake system status (normal/warning)						
flashing red light status (on/off) (school buses)						
status of additional seat belts						
airbag deployment criteria						
airbag deployment time						
airbag deployment energy						
Other data needs						

Handouts from Meeting #3
February 15/16, 2001
Boca Raton, FL

Item Index

Items from the February15, 2001, Showcase

- Showcase Program
- Caterpillar Engine Data Report
- Cummins Engine Data Report
- Detroit Diesel Engine Data Report
- International Engine Data Report
- The Benefits of Vehicle Mounted Video Recording Systems, Evicam International, Inc.
- Florida Atlantic University Research Report - Visual Cues Provide Keys to Driverless Vehicles, Vol 1, No 1/ September 1994 w/ related articles
- Vetronix's Crash Data Retrieval System, Don J Felicella, ACTAR, Felicella Consulting Engineers, Inc.
- We are a people of Choices, Susan Walker, Esq., Kanouse & Walker, 2000
- Legal Framework for the Implementation of EDR Technology, Susan Walker, Esq., Kanouse & Walker, February 15, 2001
- VDO Kienzle - Slides on their UDS EDR system
- Who's looking out for you, Drive Cam

Items from the February 16, 2001 working group meeting.

- Agenda
- Event Data Recorder (EDR) Issues and Recommendations, Smiths Group
- Update on Current EDR Technologies
    - Status of EDR technology, Robert McElroy, Forensic Accident Investigations, Inc
    - VDO Crash recorder, VDO North America, Tony Reynolds
- Emerging Technologies and Applications
    - Safety Intelligence Systems, Ricardo Matinez
    - Solutions for a Dynamic Marketplace, Insurance Services Office, Ed Quinones

- Meeting Handouts
    - Working Group Objectives
    - Definitions
    - Survey Results
    - Data Element List

Showcase Program

NHTSA R&D Event Data Recorder
Working Group

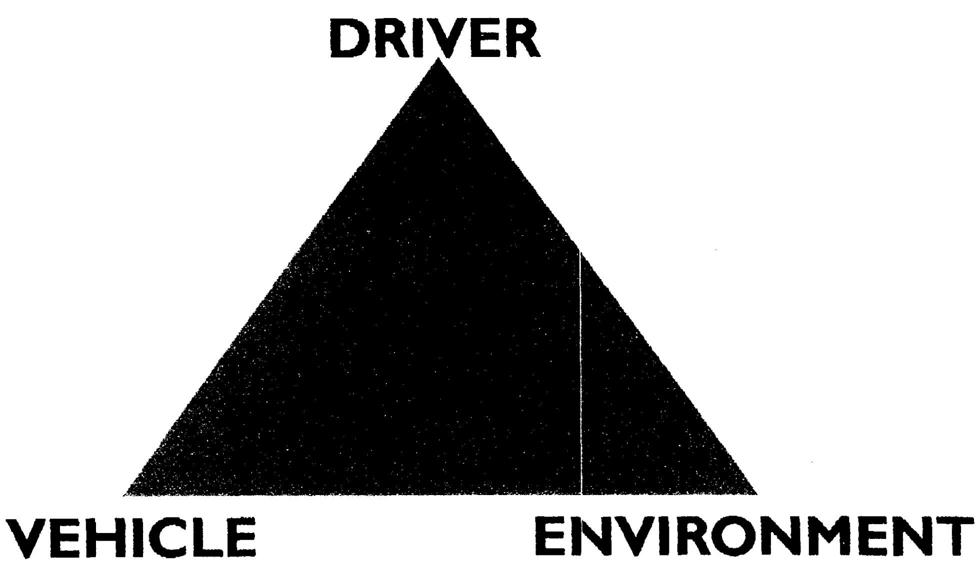
Showcase of Collision Analysis & Vehicle Data Systems for Private Passenger Vehicles, Fleet Vehicles, Trucks and Buses

Date: February 15, 2001

Time: 4:30—6:30 PM

Welcome to the Showcase of Collision Analysis & Vehicle Data Systems for Private Passenger Vehicles, Fleet Vehicles, Trucks, and Buses. The Showcase will allow guests to view state-of-the-art technologies in vehicle collision analysis. In addition, visitors will have the opportunity to meet team members from Florida Atlantic University's Event Data Recorder Project while exploring the project's components. The Showcase has been designed to allow you to move freely about the center to listen to presentations, see displays, interact with technologies, ask questions, and network with colleagues.

Factors Contributing to Driving



SHOWCASE PROGRAM

Display/ Topic	Representative / Presenter	Location
Wrecked county bus with Cummins engine	Howie Subbert– Palm Tran Jack Chavarria, Steve Ottoway, Sam Glickson– Cummins	Garage
New Peterbilt tractor trailer cab powered by Detroit Diesel	Detroit Diesel	Garage
Wrecked Chevrolet; Airbag module downloads	Donald Felicella– crash reconstructionist	Garage
UDS 2.0	Tony Reynolds VDO	Garage
i3000	Joe Dandy– Cosworth	Garage
I-Witness Drive-Cam	Jay Vitagliano	Garage
Tow truck with Caterpillar engine	Jim Sturko– Caterpillar	Garage
GIS	John Harlin / Brian Kelly	EDR Center Room 7
Driving Simulations and Traffic Models	Tom Kelly	EDR Center Room 7
Remote Data Transmission	Wayne Bullock	Garage
Loomy Driverless vehicle	Dani Raviv	Garage
Legal Issues	Susan Walker	Conf. Room
Human Aspect of Driving	Wendy Stav	Conference Room
Driver Assessments	Desiree Lanford / Wendy Stav	Driver assessment area

FAU EDR Team Members

Project Director	Dr. Mary Russell
Crash Recontructionist	Dr. Robert McElroy
Global Information System	Dr. John Harlin
Global Information System	Brian Kelly
Engineering	Dr. Dani Raviv
Engineering	Tom Kelly
Remote Data Transmission	Wayne Bullock
Legal Counsel	Susan Walker, Esq.
Driver Assessment	Wendy Stav, PhDc, OTR/L
Driver Assessment	Desiree Lanford, MOT, OT/L
Equipment Installation	Jay Vitagliano
Website design	Dr. Sam Hsu

Event Data Recorder Technology

... Saving lives through accurate data collection

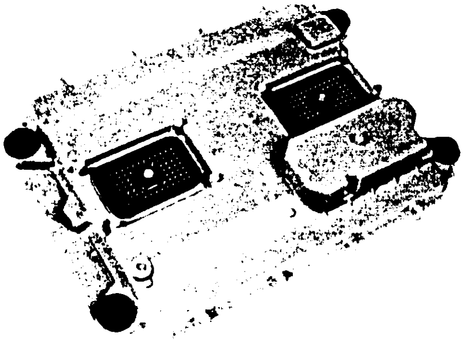
Florida Atlantic University's Event Data Recorder project is supported by funding from Loss Management Services, Incorporated.

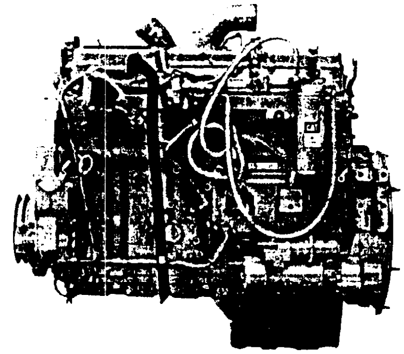
Caterpillar Engine Data Report

CATERPILLAR®

Engine Data Report

CATERPILLAR





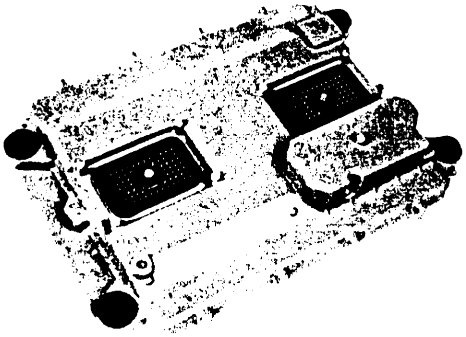
Introduction

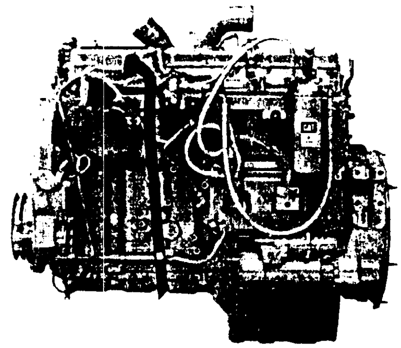
By the early 1980s, it had become evident that new engine technologies would have to be brought to bear if Caterpillars, or any other diesel engine manufacturer, was to prosper in the rapidly evolving market environment. A combination of increased government regulation prompted by legitimate environmental concerns, stronger competition, and m demanding market expectations dictated totally new approaches to diesel engine design.

In order to meet this challenge, Caterpillar embarked on an ambitious development program to create totally new diesel engines. That program resulted in the 3176 and the 340GB PEEC. Since 1987, the use of electronics on Caterpillar on-highway truck engines has grown. The model year 2000 electronic engine line includes the C-l0 C-12, 312GB, C-15, and C-l6 (Caterpillar manufactures a wide variety of electronic engines for applications as varied as locomotives and very large earth movers. This booklet covers on-highway truck engines only.)

Today, electronics do much more than control the combustion process to meet ever-toughening emission standards and customer fuel economy expectations. They allow the engine to talk to and coordinate with driveline components. They allow monitoring and control of driving habits to meet business objectives. Remote programming and monitoring ability allows minute-to-minute fleet control from an office. In today's changing economic environment a fleet manager must juggle economy and driver satisfaction. Cat electronically controlled engines allow a fleet manager to spec a driveline free of the usual compromises and then program the engines to reflect desired driving habits. The Driver Reward feature allows the manager to automatically reward drivers who meet preset fleet objectives.

Incorporation of the latest, most powerful ECM, ADEM 2000, has equipped Cat' Truck Engines with numerous electronic features. This book outlines Cat electronic features that have changed the way fleets operate. It is now possible to program fleet truck engines, and sit back and let the electronics take over.



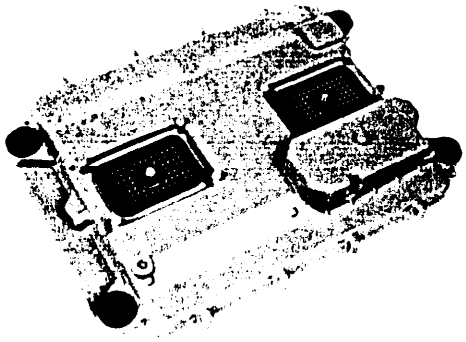


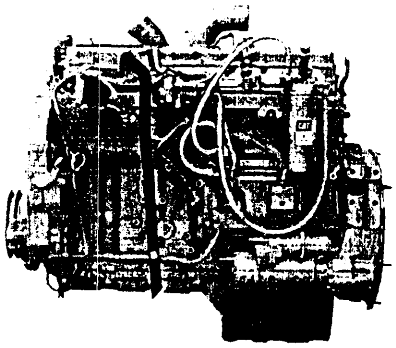
Understanding the Electronic Controls

This booklet is designed to aid you in choosing appropriate programmable values. Some features fall into a "non-programmable" or "programmable only by your authorized Cat dealer" category. While you may not need to be concerned about programming these parameters, we have included them in this booklet so you can have a greater understanding of the Caterpillar electronic system.
Cat electronic truck engines offer a wide range of features. These include but are not limited to:

- Maximum Vehicle Speed Limiting (VSL)
- Maximum engine rpm limiting
- Progressive shift prompts
- Idle-shutdown timer
- Wide variety of cruise control features
- Retarder control
- Dedicated PTO control features
- Driver Reward feature
- Engine Monitoring System (EMS)
- Engine diagnostics with fault logging including snapshot recording
- Numerous trip recording options
- Powertrain (J1922 or J1939) interface
- Powertrain (J1587) data link
- Cooling fan control including A/C high pressure

Not all of these features fall into the "customer programmable" category. Some features, like the powertrain data link, have to do with the way the engine electronics are integrated into the truck and drivetrain electronics. Another example is the setting for tachometer calibration, which comes preset from the truck factory and should not be changed. (In fact, most features come with a preset value from the factory.)
Other features, like password protection, can only be set by a customer.





In short, the programmable features fall into two basic categories:

Factory Specified parameters and features which include both;

1 - Caterpillar Standard Features.
2 - Truck manufacturers' (OEM) standard features

Customer specified parameters and specifications which include both;

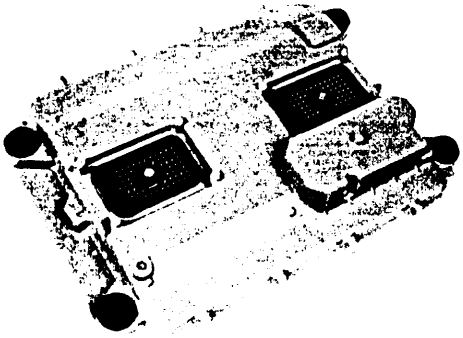
1 – OEM Data Book Features (the ones chosen as the truck is spec'd and ordered)
2 - Optional Programmable Features (parameters unique to the application and normally set after the truck is delivered.)

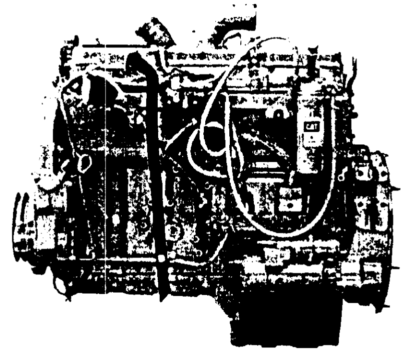
Customer programmable features with a ~ icon in the title bar can be locked for additional security. (See Customer Parameter Lockout, page 108, for details.)

Note: Since the introduction of the 3176B and 3406E engines in 1993, Caterpillar has continued to add and enhance the features available to both the fleet owner and the owner-operator. These additions and enhancements are made by changing the software in the Personality Module (PM), which is in the Electronic Control Module (ECM) on the engine. New personality module software can be installed by an authorized Caterpillar dealer. Throughout this booklet, references are made to software release dates to define when a particular feature became available. Listed below are the dates of the major personality module software updates.

Name	Date
Aug-93	August-93
Dec-93	December-93
Apr-94	April-94
Jan-95	January-95
Jun-95	June-95
Nov-95	November-95
Aug-96	August-96
Nov-96	November-96
Mar-97	March-97
Oct-97	October-97
Dec-91	December-97
Feb-98	February-98
Nov-98	November-98
Mar-99	March-99

These dates may or may not correspond to model year changes.





Factory Specified Parameters and Features

Each new engine comes with several features set at factory default settings. Some of these, like oil sump capacity, are set at the engine factory. Others, like tachometer calibration, are set by the truck manufacturer. All of these default settings fall into one of three categories.

1 - A specific value required by the engine or truck electronics for proper operation (example — oil sump capacity, tachometer calibration)
2 - A standard value set for convenience (example —PTO Ramp Rate is set at 50 rpm/sec)
3 - A value set at the upper limit of its range to ensure the specific feature does not take effect until reset by the customer (example — Vehicle Speed Limiting is set at 127 mph)

Customer Programmable Parameters and Specifications

On the following pages you will see an explanation of each electronic parameter. Along with the explanations are helpful recommendations, and in some cases, split chart examples to help in specification development. Another aid in determining parameters and specifications is Cat Truck Engine Pro software.

Customer specified parameters are divided into two groups,

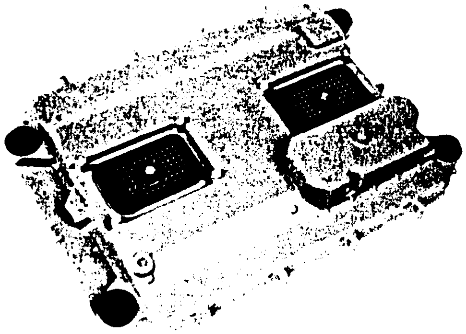
OEM Data Book Programmable Features, used to spec and order a truck, and
Optional Programmable Features, used to customize the engine for your operation.

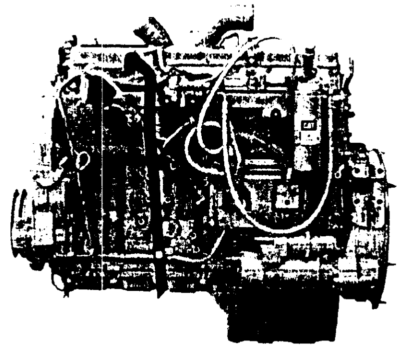
OEM Data Book Programmable Features:

- ✓ Vehicle Speed Limit (VSL)
- ✓ Cruise control parameters
- ✓ Engine/gear parameters
- ✓ PTO/fast idle features
- ✓ Idle shutdown timer
- ✓ Retarder control
- ✓ Tamper resistance
- ✓ Password protection
- ✓ Engine monitoring system

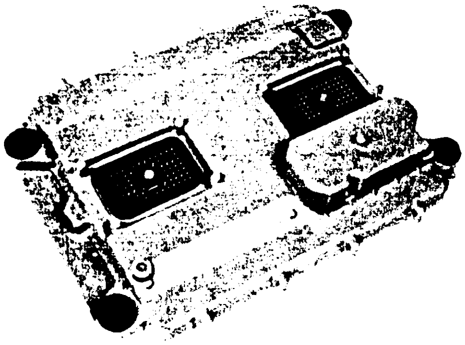
Optional Programmable Specifications

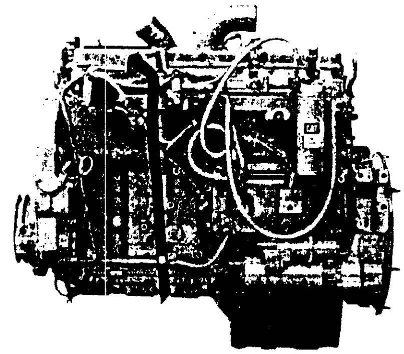
- ✓ Vehicle ID (required for Caterpillar Fleet information Software)
- ✓ Dedicated PTO features
- ✓ Fuel usage correction factor (ECM vs measured)
- ✓ Oil capacity adjustment for maintenance indicator
- ✓ Customer specified PM interval for maintenance indicator
- ✓ Programmable low idle rpm



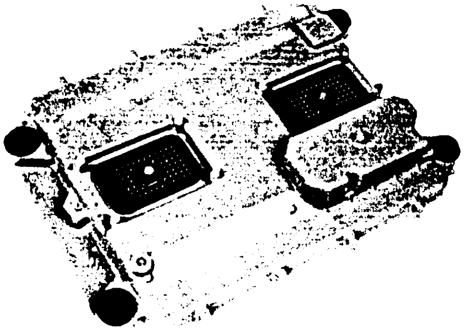


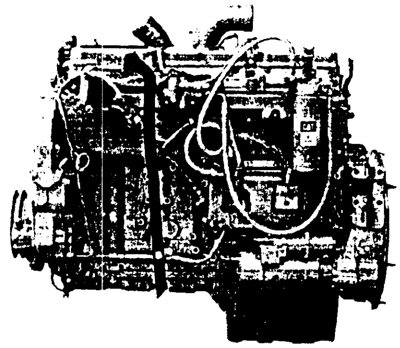
Features	3126 Basic	3126 Full Feature	C-10	C-12	C-15 & C-16
Vehicle ID	•	•	•	•	•
Vehicle Speed Calibration	•	•	•	•	•
Vehicle Speed Limit	•	•	•	•	•
VSL Protection	•	•	•	•	•
Tachometer Calibration	•	•	•	•	•
Soft Vehicle Speed Limit	•	•	•	•	•
Two-Speed Range Axle Ratio			•	•	•
Low Cruise Control Set Speed Limit	•	•	•	•	•
High Cruise Control Set Speed Limit	•	•	•	•	•
Engine Retarder	•	•	•	•	•
Engine Retarder Delay			•	•	•
Engine Retarder Minimum Vehicle Speed Limit Type			•	•	•
Engine Retarder Minimum Vehicle Speed			•	•	•
Auto Retarder in Cruise			•	•	•
Auto Retarder in Cruise Increment			•	•	•
Cruise/ldIe/PTO Switch Configuration	•	•	•	•	•
Soft Cruise Control	•	•	.	.	.
Idle Vehicle Speed Limit	•	•	•	•	•
Idle rpm Limit	•	•	•	•	•
LdIe/PTO rpm Ramp Rate	•	•	•	•	•
Ldle/PTO rpm Ramp Rate	•	•	•	•	•
Fast Idle Engine rpm #1	•	•			
Fast Idle Engine rpm #2	•	•			
PTO Configuration	•	•	•	•	•
PTO Top Engine Limit	•	•	•	•	•
PTO Engine rpm Set Speed	•	•	•	•	•
PTO to Set Speed	•	•	•	•	•
PTO Cab Throttle rpm Limit	•	•	•	•	•
PTO Vehicle Speed Limit	•	•	•	•	•
Torque Limit	•	•	•	•	•
PTO Shutdown Timer	•	•	•	•	•
PTO Activates Cooling Fan	•	•	•	•	•
Lower Gears Engine rpm	•	•	•	•	•
Lower Gears Turn Off Speed	•	•	•	•	•
Intermediate Gears Engine rpm Limit	•	•	•	•	•
Intermediate Gears Tern Off Speed	•	•	•	•	•
Gear Down Protection rpm Limit	•		•	•	•
Gear Down Protection Turn On Speed	•	•	•	•	•
Low Idle Engine rpm	•	•	•	•	•
Transmission Style	•	•	•	•	•
Eaton Top 2— Top Gear Ratio			•	•	•
Eaton Top 2—Top Gear Minus One Ratio			•	•	•
Eaton Top 2—Top Gear Minus Two Ratio			•	•	•





Features	3126 Basic	3126 Full Feature	C-10	C-12	C-15 & C-16
Eaton Top 2 Override with Cruise Control Switch		•	•	•	•
Idle Shutdown Timer	•	•	•	•	•
Allow Idle Shutdown Override			•	•	•
Minimum Idle Shutdown Outside temperature			•	•	•
Maximum Idle Shutdown Outside temperature			•	•	•
A/C Pressure Switch Fan On Time		•	•	•	•
Fan with Engine Retarder in High Mode	•	•	•	•	•
Engine Monitoring Mode	•	•	•	•	•
Coolant Level Sensor		•	•	•	•
Maintenance Indicator Mode	•	•	•	•	•
PM1 Interval	•	•	•	•	•
Engine Oil Capacity	•	•	•	•	•
Fuel Correction Factor			•	•	•
CAT ID Change Fuel Correction Factor			•	•	•
CAT ID PM1 Reset	•	•	•	•	•
CAT ID Fleet Trip Reset			•	•	•
CAT ID State Enabled			•	•	•
CAT ID Soft Cruise	•	•			
CAT ID Fast Idle #1 RPM	•	•			
CAT ID Fast Idle #2 RPM	•	•			
CAT ID Low Idle RPM	•	•			
Theft Deterrent	•	•	•	•	•
Theft Deterrent Password	•	•	•	•	•
Quick Stop Rate			•	•	•
Multi-Function Output #2			•	•	•
Multi-Function Output #3			•	•	•
Multi-Function Output #4			•	•	•
Fan Control Type		•	•	•	•
Customer Password #1	•	•	•	•	•
Customer Password #2	•	•	•	•	•
Powertrain Datalink		•	•	•	•
Customer Parameter Lockout	Some	Some	•	•	•
Current Totals			•	•	•
Fleet trip Totals			•	•	•
Driver Trip Totals			•	•	•
Histograms			•	•	•
Custom Data			•	•	•
Driver Reward Feature			•	•	•





Quick Stop Rate

Description:
The Quick Stop Rate parameter value is the threshold at which a Quick-Stop Event (date, time, and snapshot) will be logged in the ECM memory. The ECM monitors the rate of change of vehicle speed. If the rate of change is greater than or equal to the value programmed into the Quick Stop Rate parameter, a Quick-Stop Event will be logged. Quick Stop Rate value is application-sensitive; light loads may require a higher value and heavy loads, a smaller value. If the Quick Stop Rate parameter is programmed to zero, the feature is disabled and no Quick-Stop Events will be logged.

Available:
C-10, C-12, 3406E, C-15, and C-16 electronic engines with NOV95 or newer personality module software.

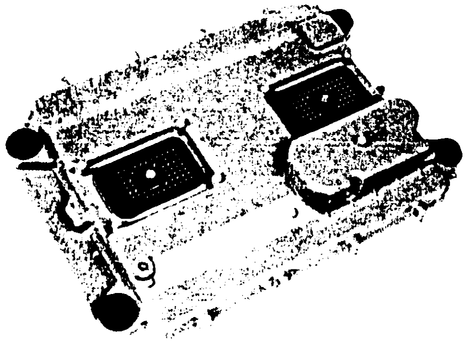
Range:

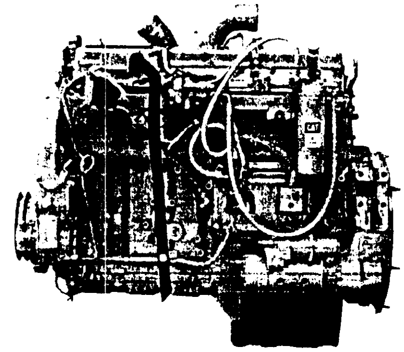
Range		Cat Default	Increment
Minimum	Maximum		
0/mph/sec	15/mph/sec	0	1 mph/sec
(0/km/h/sec)	(24/km/h/sec)		(1/km/h/sec)

Advantages:
All ECM-recorded vehicle and engine conditions can be replayed for 44 seconds before and 15 seconds after a Quick-Stop Event. This data may provide valuable information on drivetrain component wear.

Disadvantages:
None

Recommendations:
✓ Program a value of 7 mph/sec as a starting point.





Customer Parameter Lockout

Description:
If a security level higher than a customer password (see page 104) is required, either by the customer or local laws, the following parameters can be "locked out.

Parameter	C-10,C-12, 3406E, C-15, C16	3126B Basic and Full Feature	3126B Full Feature Only
Vehicle Speed Limit (VSL)	•	•	
VSL Protection	•	•	
Vehicle Speed Calibration	•	•	
High Cruise Control Speed set Limit	•	•	
Top Engine Limit (TEL)	•		
Soft Vehicle Speed Limit	•	•	
A/C Pressure Switch Fan-On Time	•		•
Transmission Style	•		•
Top Gear Ratio	•		
Top Gear Minus One Ratio	•		
Top Gear Minus Two Ratio	•		
Engine Retarder Delay	•		
Fan Control Type	•		
Driver Reward Enable (PM MAR99 and Newer)	•		
Engine Monitoring Lamps (PM Oct99 and Newer)	•		
Input # 6 (PM MAR98 and Newer)		•	
Two Speed Axle Range Ratio (PM MAR98 and Newer)	•	•	

AUG96 or newer personality module software is required

These parameters have been labeled throughout this book with the Lock Icon in the title bar.

Available:
C-10, C-12, 3406E, C-15, and C-16 electronic engines with JAN95 or newer personality module software. Some parameters can be locked out on the 3126B truck engine.

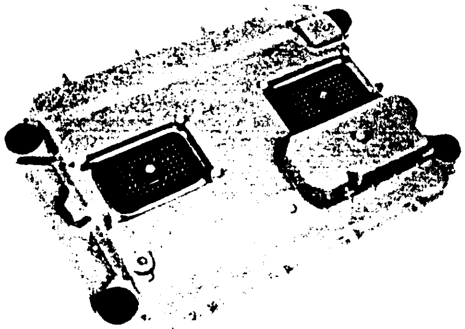
Range:

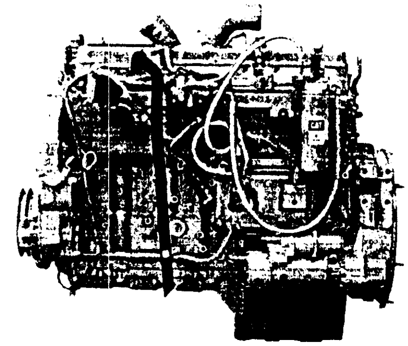
Range	Default
Unlocked	Unlocked
Locked	

Advantages:
The ability to lock certain critical parameters to comply with either local laws or customer requests

Disadvantages:
None

Recommendations:
Lock only those parameters either required by local laws or customer request.





Powertrain Data Link

Description:
The Powertrain Data Link parameter determines when or how the [CM will communicate with a powertrain device, such as a wheel-slip or anti-lock brake control. Different data links are used by the various controls depending on the manufacturer of the powertrain device. The standard ECM for the C-1O, C-12, 3406E, C-15, and C-16 engines has the SAE J1922 data link installed. If the powertrain device requires the SAE J1939 data link, an optional ECM must be installed. The optional ECM has both SAE J1922 and SAE J1939 data links. An optional ECM with a J1939 data link is available for the 3126B Full Feature truck engine.

Available:
C-10, C-12, 3406E, C-15, and C-16 electronic truck engines

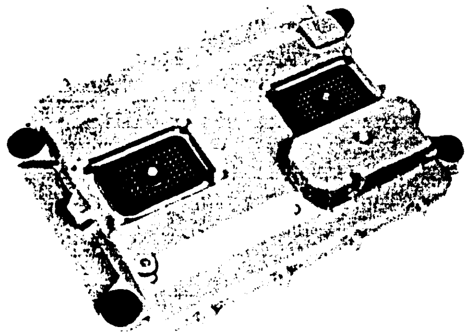
Range:

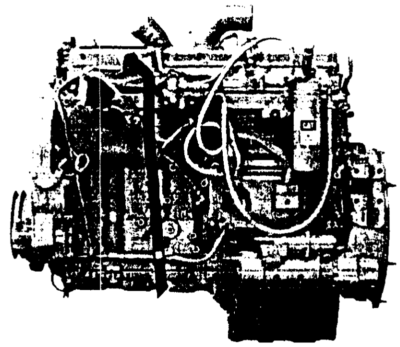
Engine	Range	Default
C-10, C12, 3406E (PM NOV98 and Earlier)	None J1922 J1939	J1922
C-10, C12, 3406E, C-15, C16 (PM NOV98 and Later	J1922 & J1939	OFF
3126 Full Feature	None J1939	None

Advantages:
The Powertrain Data Link parameter allows the [CM to work with the various "Industry Standard" data links available on powertrain devices today.

Disadvantages:
None

Recommendations:
V This parameter should be programmed to the data link necessary to communicate with the powertrain device(s) installed on the truck.





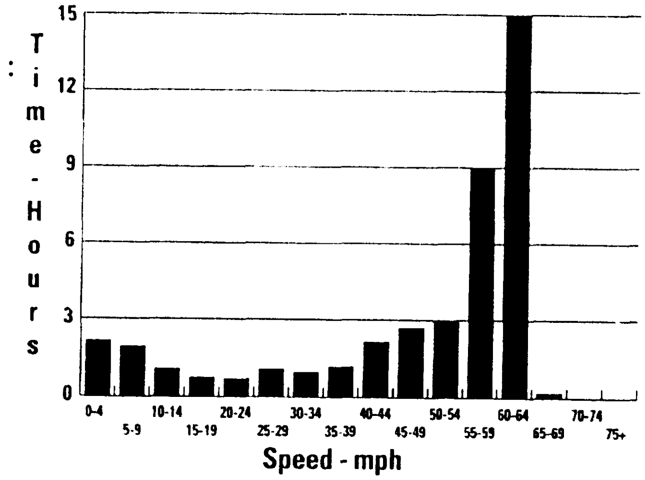
Histograms

Description:
The ECM records the amount of time that the truck has been operated at various rpm and mph. This information is stored in "buckets." The rpm buckets are 100 rpm segments. The mph are in 5 mph segments. This information is displayed on the service tool or Fleet Information Software as a bar chart called a Histogram. Fleet Information Software also displays a three-dimensional Histogram to evaluate engine operation and driver effectiveness.

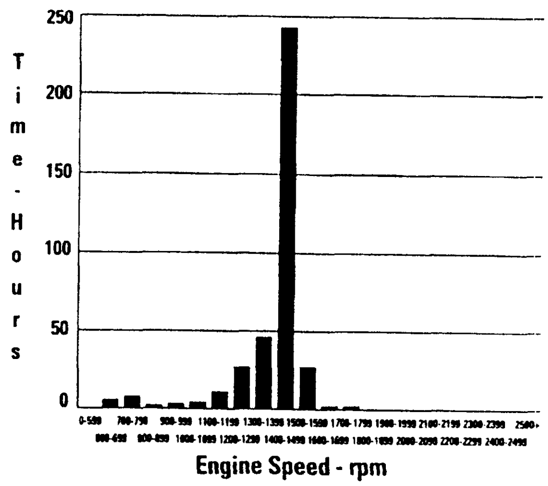
The Histogram time period is the same as the Fleet Trip data.

Available:
C-10, C-12. 3406E, C-15, and C-16 electronic engines

Example: Vehicle Speed Histogram



Example: Vehicle Engine Speed Histogram   Example



Cummins Engine Data Report

Unleashing the Power of Cummins

Engine Data Report

CURRENT JOB IMAGE REPORT

Cummins Engine Company INSITE Professional - CELECT Plus

Job Number: 0-010214-142536 (Image Number: 2)
Job Date: Wednesday, February 14, 2001
Vehicle Unit Number:
Customer:
Description: **Cummins**

System ID/Dataplate

Advertised Power:	280 hp
RPM at Advertised Power:	2100 rpm
Governed Speed:	2100 rpm
Peak Torque:	900 ft·lb
RPM at Peak Torque:	1200 rpm
Critical Parts List (CPL):	2425
Fuel Code (FC):	0XG29
Percent Torque Rise:	0
Engine Make:	CMMNS
Engine Model:	M11-280E+
Engine Serial Number:	34959927
Engine Build Date:	50099
Vehicle Make:	NA
Vehicle Model:	None
Vehicle Serial Number:	
Vehicle Build Date:	
Customer Name:	
Customer Location:	
Customer Unit Number:	
ECM Make:	CMMNS
ECM Part Number:	3408300
ECM Serial Number:	59643
ECM CODE:	C20313.09
ECM Voltage High:	0 V
ECM Voltage Low:	0 V
Eng. Cal Time/Date Stamp:	5/10/99 10:38:42 AM
SC Option:	20003
DO Option:	2088
Calibration Voltage High:	0 V
Calibration Voltage Low:	0 V
Other Options:	

CURRENT JOB IMAGE REPORT

Cummins Engine Company INSITE Professional - CELECT Plus

Job Number: 0-010214-142536 (Image Number: 2)
Job Date: Wednesday, February 14, 2001
Vehicle Unit Number:
Customer:
Description:

Features and Parameters

Engine Serial Number:	34959927
Engine Build Date:	50099
Vehicle Make:	NA
Vehicle Model:	None
Vehicle Serial Number:	
Vehicle Build Date:	
Customer Name:	
Customer Location:	
Customer Unit Number:	
Automotive Governor OFF:	Disabled
Progressive Shift:	Disabled
Low Idle Speed Adjust Sw:	Disabled
Idle Shutdown:	Enabled
Idle Shutdown in PTO:	Disabled
Idle Shutdown Override:	No
PTO/ISC:	Enabled
PTO/Remote PTO Enabled:	Enabled
Brake/Clutch PTO Disable:	Disabled
Cruise Control:	Disabled
Auto Eng Brakes in CC:	Disabled
PTO Alternate Table Enable:	Disabled
Gear Down Protection Enable:	Disabled
Engine Protection Shutdown:	Disabled
Vehicle Speed Sensor Enable:	Enabled
Maintenance Monitor:	Disabled
Fan On During Engine Braking:	Disabled
A/C Press. Sw. Controls Fan:	Disabled
Fan Accessory Switch Input:	Disabled
VSS Anti-Tampering:	Disabled
Fan Clutch 2 Enable:	Disabled
Automatic Transmission:	No
On-Highway Type Application:	On/Off Highway
Eng Brake/Road Speed Interaction:	Disabled
Pedal Activated Engine Braking:	Disabled
Ambient Temperature Idle Shutdown Override:	Disabled
Fan/Air Cond./Road Speed Feature:	Disabled
Max Vehicle Speed - Top Gear:	72 mph
Max Gear Down Speed - Heavy:	0 mph
Max Gear Down Speed - Light:	0 mph
Max Engine Speed w/o VSS:	2500 rpm
RSG Lower Droop Width:	2 mph
RSG Upper Droop Width:	0 mph
Low Idle Speed:	650 rpm
Hot AAT For Idle Shutdown:	0.0 °F
Intermediate AAT For Idle Shutdown:	0.0 °F
Cold AAT For Idle Shutdown:	0.0 °F
Time Before Idle Shutdown:	5 min

CURRENT JOB IMAGE REPORT

Cummins Engine Company INSITE Professional - CELECT Plus

Job Number: 0-010214-142536 (Image Number: 2)
Job Date: Wednesday, February 14, 2001
Vehicle Unit Number:
Customer:
Description:

Progr. Shift-Max Engine Speed:	0 rpm
Progr. Shift-Road Spd at Max RPM:	0 mph
Min Fan on Time for A/C Prs Sw:	0 sec
Min Vehicle Speed for Eng Brake:	0 mph
Vehicle Speed Sensor Type:	Electrical
Rear Axle Ratio:	5.38
Tire Revs per Distance:	482 per mile
# of Trans Tailshaft Gr Teeth:	16
Pulses:	30000 per mile
Top Gear Transmission Ratio:	1.00
Gear Down Transmission Ratio:	1.42
Max Cruise Control Speed:	0 mph
CC Lower Droop Width:	0 mph
CC Upper Droop Width:	0 mph
CC Switch Usage:	Set/Coast
Number of Engine Brake Sets:	0
Downhill CC Brake Level 1:	0 mph
Downhill CC Brake Level 2:	0 mph
Downhill CC Brake Level 3:	0 mph
Maximum PTO Speed:	1000 rpm
Minimum PTO Speed:	650 rpm
PTO Engine SET Speed:	1000 rpm
PTO Resume Speed:	1000 rpm
Remote PTO Engine Speed:	1000 rpm
Light Load PTO % Fuel:	25 %
Maintenance Monitor Mode:	Automatic
OCM Distance Offset:	0 mi
OCM Time Offset:	0 hrs
OCM Fuel Offset:	0 gal
Default Oil Change Monitor Distance:	0 mi
Default Oil Change Monitor Time:	0 hrs
Default Oil Change Monitor Fuel:	0 gal
Maintenance Monitor Interval Factor:	0.00
Maint. Monitor Distance Threshold:	0 mi
Maint. Monitor Time Threshold:	0 hrs
Maint. Monitor Alert Percentages:	0 %
Maint. Monitor Fuel Threshold:	0 gal
Engine Time Offset:	0 hrs
Engine Distance Offset:	0 mi
Alternate Torque Enable:	Disabled
Alternate Droop/HSG:	Disabled
Alt Droop 2 Iso High Idle:	0 rpm
% Droop at Breakpoint 2:	0 %
Alternate Droop 2 Min Throttle:	0 %
Alternate Droop 2 Max Throttle:	0 %
Alt Droop 3 Iso High Idle:	0 rpm
% Droop at Breakpoint 3:	0 %
Alternate Droop 3 Min Throttle:	0 %
Alternate Droop 3 Max Throttle:	0 %
Accelerator Interlock:	Disabled
Vehicle Anti-Theft:	Disabled

CURRENT JOB IMAGE REPORT

Cummins Engine Company INSITE Professional - CELECT Plus

Job Number: 0-010214-142536 (Image Number: 2)
Job Date: Wednesday, February 14, 2001
Vehicle Unit Number:
Customer:
Description:

Trip Information System

Total Fuel Used:	24860.8 gal
Total ECM Time:	6244.6 hrs
Total Engine Hours:	6244.6 hrs
Total ECM Distance:	113863.90 mi
Total Engine Distance:	113863.90 mi
ESP High Curve-Time:	0.0 hrs
Trip Fuel Used:	24860.8 gal
Trip Fuel Rate:	3.88 gph
Trip MPG:	255.996 mpg
Trip Time:	6244.6 hrs
Trip Distance:	113863.90 mi
Trip ESP High Curve Time:	0.0 hrs
Trip ESP Distance:	0.00 mi
Trip Drive Fuel:	21099.8 gal
Trip Drive MPG:	5.395 mpg
Trip Idle Fuel:	1392.8 gal
Trip Idle Time:	958.2 hrs
Idle Percent Usage:	15.35 %
Trip PTO Fuel:	2368.0 gal
Trip PTO Time:	1589.3 hrs
Trip %PTO:	25.45 %
Number of Sudden Decelerations:	47
Brake Actuations/1000 miles:	576 per 1000 mi
Trip % Distance in CC:	0.00 %
Trip % Distance at Max Speed:	0.00 %
Trip % Distance in Top Gear:	76.65 %
Trip % Distance-Direct Drive:	12.36 %
Trip % Distance-ESP Curve:	0.00 %

Detroit Diesel Engine Data Report

DETROIT DIESEL
CORPORATION

Engine Data Report

Detroit Diesel

Frequently Asked Questions about DDEC and Diagnostic Link

What are Data Pages?

Data Pages is memory in the DDEC III ECM that records operating information about the engine and the vehicle. It is an optional feature that is available for DDEC III ECMs. It was introduced in DDEC III software Release 5.0 (R5.0).

Data is stored in daily records for a maximum of 14 days. An internal clock/calendar, which must be reset each time the vehicle's batteries are disconnected, is used for timekeeping. Data on engine performance trends, service intervals, and ECM diagnostics is also stored.

How do I extract and report Data Pages data?

Data extraction and reporting is accomplished with DDEC Reports or ProManager 2.10 software. The Remote Data Interface (RDI) may also be used for data extraction.

How do I get Data Pages turned on?

Data Pages may be activated in DDEC III ECMs that have R5.0 or later software by reprogramming the ECM. There is a one-time nominal charge for this service.

What is DDEC Data?

DDEC Data is dedicated memory in the DDEC IV ECM that records operating information about the engine and the vehicle. It is a standard feature that is included in all DDEC IV ECMs. It was introduced in DDEC IV software R20 and was substantially upgraded in R21.

DDEC Data stores three monthly records and a trip file that may be reset after it is extracted from the ECM. An internal clock/calendar, with an internal battery, is used for timekeeping. Data on daily engine usage, periodic maintenance intervals, hard brake incidents, last stop records, and ECM diagnostics is also stored.

How much does DDEC Data cost?

There is no additional charge for DDEC Data, it is included as a standard part of DDEC IV.

How do I initialize DDEC Data so that it records data?

DDEC Data is initialized at the factory, so it's recording when you receive it. Data is being recorded with default settings that will be satisfactory for most customers. The settings can be customized using DDEC Reports software.

Can I turn the recording off?

APPENDICES

Appendix A - DDEC Compatibility Table

Table 1: DDEC System Software/Hardware Compatibility Table

Recording Product	DDEC Reports		ProDriver Reports		ProManager 1.02		ProManager 2.10		RDI Extractions	
	extracts data	produces reports	extracts data	produces reports	extracts data	produces reports	extracts data	produces reports	DOS	Win 95
DDEC III "Data Pages"	X	X					X	X	X	X
DDEC IV "DDEC Data"	X	X								X
ProDriver 2.0x	X			X	X	X			X	X
ProDriver 3.0x	X		X	X						X
Data Logger	X						X	X	X	X

Appendix B - Default Settings for DDEC Data

Fleet Time Zone:	Eastern Standard (GMT - 5 hours)
Hard Brake Limit:	7 MPH/Sec
Stop Idle Limit:	5 minutes
Idle Method:	vehicle speed sensor
DDR Reset lockout:	yes
Maintenance visual reminder:	yes
Maintenance visual reminder percent: 20%	
Vehicle speed bands (mph):	10, 20, 30, 40, 50, 55, 60, 66, 71
Engine speed bands (rpm):	700, 1000, 1200, 1300, 1400, 1500, 1600, 1700, 1800
Percent load bands:	10, 20, 30, 40, 50, 60, 70, 80, 90

Appendix C - ECM Software Version Compatibility

DDDL (DDEC Reports) version 2.0: loads configurations, extracts data and produces reports from DDEC IV Release 20 software. Loads configurations, extracts data and produces partial reports from DDEC IV Release 21 and later software. (It treats it as though it were the limited data set of Release 20).

DDDL (DDEC Reports) version 2.1 and 2.11: loads configurations, extracts data and produces reports from DDEC IV Release 20 and later software.

DDDL (DDEC Reports) version 3.0: loads configurations, extracts data and produces reports (including Off-Highway) from DDEC IV Release 20 and later software.

Appendix F - Types of Reports Available from DDEC Reports

DDEC Reports produces comprehensive trip reports for service technicians and fleet managers in On-Highway, Off-Highway, and Marine formats. These reports are listed in the tables below.

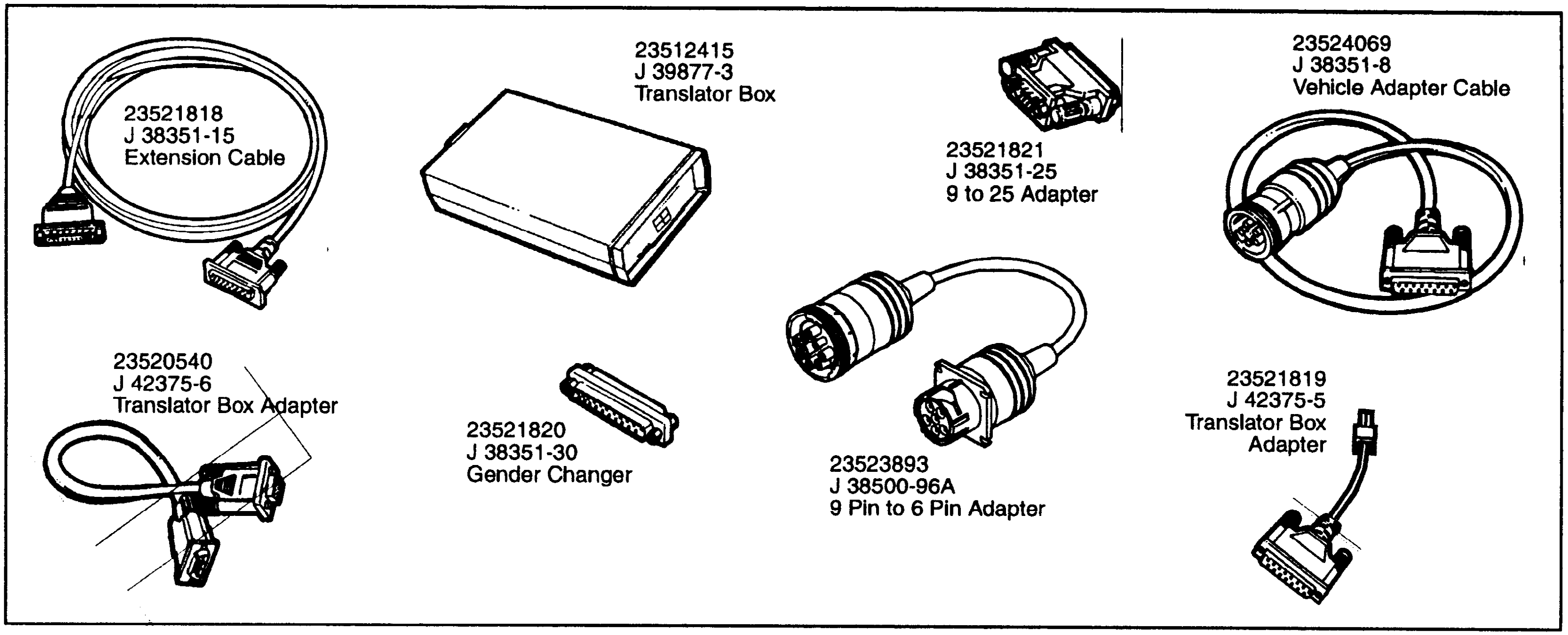
Table 2: On-Highway Reports available from DDEC Reports

Available Reports On-Highway	DDEC III Data Pages	DDEC IV R20	DDEC IV R21 or later	DDEC Reports version required
Trip Activity	X	X	X	2.0 or later
Vehicle Speed/RPM	X	X	X	2.0 or later
Overspeed/Over Rev		X	X	2.0 or later
Engine Load/RPM		X	X	2.0 or later
Vehicle Configuration	X	X	X	2.0 or later
Periodic Maintenance	X		X	2.1 or later
Hard Brake Incident			X	2.1 or later
Last Stop			X	2.1 or later
DDEC Diagnostic			X	2.1 or later
Profile	X		X	2.1 or later
Monthly Activity			X	2.1 or later
Daily Engine Usage			X	2.1 or later
Life-to-Date	X		X	2.1 or later

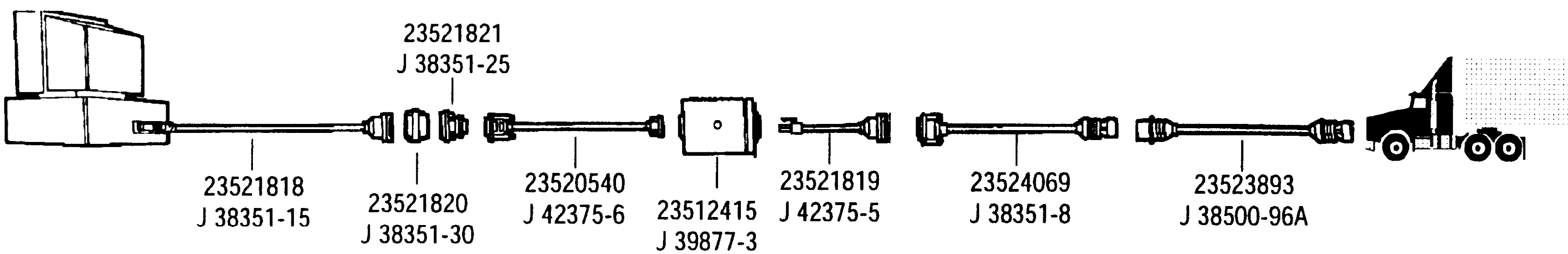
Table 3: Off-Highway Reports available from DDEC Reports

Available Reports Off-Highway	DDEC III Data Pages	DDEC IV R20	DDEC IV R21 or later	DDEC Reports version required
Period Activity		X	X	3.0
High RPM		X	X	3.0
Engine Load/RPM		X	X	3.0
Configuration		X	X	3.0
Periodic Maintenance			X	3.0
DDEC Diagnostic			X	3.0
Profile			X	3.0
Monthly Activity			X	3.0
Daily Engine Usage			X	3.0
Life-to-Date			X	3.0

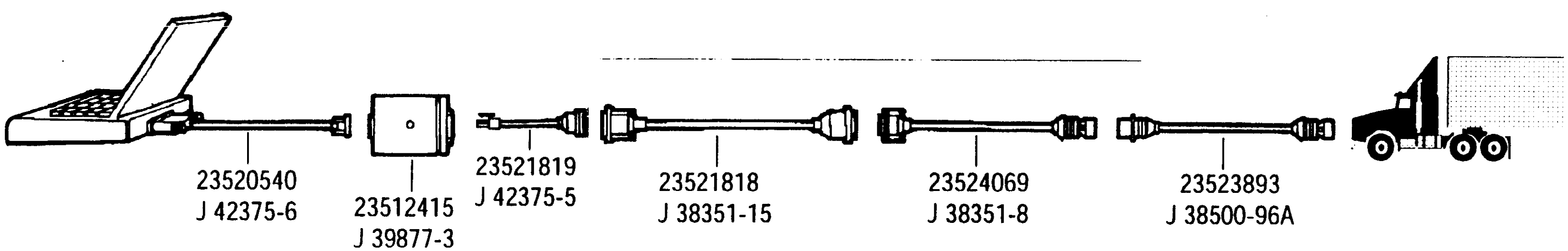
DIAGNOSTIC LINK CABLE HOOK-UP DIAGRAM



TYPICAL DESKTOP PC CONNECTION (25-PIN SERIAL PORT)



TYPICAL LAPTOP PC CONNECTION (9-PIN SERIAL PORT)



Additional cables can be purchased separately to extend connections if needed

DDC Part Numbers begin with 235 ... ***Kent-Moore Part Numbers begin with J ...***

International Engine Data Report

Engine Data Report

Section 9 – Parameter Descriptions

Programmable parameters are grouped according to control system feature. Features are listed in alphabetical order. An index is also provided for help in locating parameters.

Since interactions exist between certain control system features, text is provided at the end of each section to clarify what parameters not belonging to the given feature must be considered when programming parameters belonging to the given feature. Refer to the text in each section preceded by the heading: "Other parameters which must be considered when programming this feature:"

FEATURE NAME: ACCUMULATORS

TOTAL-FUEL (gallons)
Records total fuel usage since installation of this ECM.

ENGINE-HOURS (hours)
Records total engine on time since installation of this ECM. "On" time is defined as any time the engine is running.

TOTAL-MILES (miles)
Records total distance traveled since installation of this ECM.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: COLD AMBIENT PROTECTION

COLD AMBIENT PROTECT ENABLE
Enable/Disable of Cold Ambient Protection Feature

- 0: DISABLE, feature is turned off at all times.
- 1: ENABLE, feature is enabled and may be activated by the ECM when activation criteria are met.

Cold ambient protection permits the engine to idle at an elevated RPM when certain operating temperature conditions are met. For more information, refer to NAVISTAR publications listed in the reference section of this document.

Other parameters which must be considered when programming this feature:

IDLE SHUTDOWN MODE (Idle Shutdown Control Feature): If this parameter is programmed to enable the IST feature, CAP CANNOT be enabled. This is because the functionality of these two features conflicts.

PTO-CONTROL ON/OFF (Power Take Off Control Feature): CAP is disabled anytime PTO Control is operating in "Active" mode.

ENG-PROT-MODE (Engine Warning and Protection Control Feature): Disables CAP when coolant level is detected to be low.

TRANS_MODE (Transmission Type Feature): If this parameter is programmed to indicate a manual or Allison WT transmission, then the maximum engine speed achievable by CAP is limited to CAP_N_NLMX (parameter not yet available in Navistar EERS database). If TRANS_MODE is programmed to indicate an Allison AT/MT transmission, the maximum engine speed achievable by the CAP feature is limited by the engine control software to a non-programmable parameter value.

Other parameters which must be considered when programming this feature:
RETARDER-SERVICE-BRAKE-INTERFACE (Vehicle Retarder Feature): The Vehicle Retarder Feature should be enabled via this parameter if COOL-FAN ENABLE is programmed to a "2".

RAD-SHUT-ENABLE (Radiator Shutter Control): This parameter indicates to the ECM that the position of the radiator shutter is controlled by the ECM. This parameter must be properly programmed to ensure that the radiator shutters are opened when required to achieve engine cooling by the Engine Cooling Fan feature.

FEATURE NAME: ENGINE SERIAL NUMBER

ENG-SERIAL-NO
Engine Serial Number

Specifies the 17 alphanumeric characters that make up the engine serial number for the engine in this vehicle.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: EVENT LOGGING

EL-OVERSPEED-1 (hours)
Log of engine hour meter for either the last occurrence of an engine overspeed event, or the next to last occurrence of an engine overspeed event.

EL-OVERSPEED-2 (hours)
Log of engine hour meter for either the last occurrence of an engine overspeed event, or the next to last occurrence of an engine overspeed event.

EL-LOWOILP-1 (hours)
Log of engine hour meter for either the last occurrence of low oil pressure detected, or the next to last occurrence of low oil pressure detected.

EL-LOWOILP-2 (hours)
Log of engine hour meter for either the last occurrence of low oil pressure detected, or the next to last occurrence of low oil pressure detected.

EL-OVERHEAT-1 (hours)
Log of engine hour meter for either the last occurrence of engine overheat condition detected, or the next to last occurrence of engine overheat condition detected.

EL-OVERHEAT-2 (hours)
Log of engine hour meter for either the last occurrence of engine overheat condition detected, or the next to last occurrence of engine overheat condition detected.

EL-LOWCOOL-1 (hours)
Log of engine hour meter for either the last occurrence of low coolant level detected, or the next to last occurrence of low coolant level detected.

MAX-ENGINE SPEED (NO VSSN) (rpm)
Engine speed will be limited to this value when a vehicle speed sensor fault is present and the Road Speed Limiting feature is enabled.

VEHICLE SPEED LIMIT (mph)
Maximum vehicle speed is limited to this value when VEH-ROAD-SPD-GOV is "1" (Road Speed Limiting is enabled).

Other parameters which must be considered when programming this feature:
1) **MAXIMUM CRUISE CONTROL SPEED (Cruise Control):** In order to encourage use of cruise control for best fuel economy, the MAXIMUM CRUISE CONTROL SPEED should not be programmed to be less than the value programmed for VEHICLE SPEED LIMIT in the Road Speed Limiting feature.

FEATURE NAME: SERVICE INTERVAL

SERVICE-INT-ENABLE
Enable/disable operation of SERVICE INTERVAL feature.

- 0: DISABLE, feature is turned off at all times.
- 1: ENABLE, feature is turned on, ECM monitors accumulation of specified parameter(s) (distance in miles, operating time in hours, and/or fuel used in gallons), and activates a CHANGE OIL LAMP when the specified interval(s) is reached.

SI-FUEL-INTERVAL (gallons)
Fuel used interval at which the ECM will activate the CHANGE OIL LAMP. Setting SI-FUEL-INTERVAL = 0 will disable the FUEL INTERVAL portion of the feature.

SI-HOUR-INTERVAL (hours)
Engine operating hours interval at which the ECM will activate the CHANGE OIL LAMP. Setting SI-HOUR-INTERVAL = 0 will disable the HOUR INTERVAL portion of the feature.

SI-DIST-INTERVAL (miles)
Vehicle miles interval at which the ECM will activate the CHANGE OIL LAMP. Setting SI-DIST-INTERVAL = 0 will disable the DISTANCE INTERVAL portion of the feature.

SI-FUEL-START (gallons)
Accumulated total engine fuel (obtained from ECM ACCUMULATORS) used to reset SERVICE INTERVAL feature. This value is used by the ECM to calculate interval status by comparison with current accumulator value.

SI-HOUR-START (hours)
Accumulated total engine hours (obtained from ECM ACCUMULATORS) used to reset SERVICE INTERVAL feature. This value is used by the ECM to calculate interval status by comparison with current accumulator value.

SI-DIST-START (miles)
Accumulated total vehicle miles (obtained from ECM ACCUMULATORS) used to reset SERVICE INTERVAL feature. This value is used by the ECM to calculate interval status by comparison with current accumulator value.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: PROGRAMMING TRACE

LAST-SERVICE-TOOL1
Logs identification of last service tool used to modify a programmable parameter.

LAST-SERVICE-TOOL2
Logs most recent date when a customer service tool was used to modify a programmable parameter.

LAST-TOOL-CALIB
Identifies identification of programming tool last used to modify engine calibration data. Also indicates locations of calibration parameters modified by the service tool.

LAST-TOOL-CAL-DATE
Date when factory programming tool last downloaded calibration data.

LAST-TOOL-STRATEGY
Identifies factory programming tool last used to modify the engine control software. Also indicates memory locations modified in the control system software.

LAST-TOOL-STR-DATE
Logs most recent date when a programming tool downloaded control system software to the ECM.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: READ-ECM-FAULTS

READ-ECM-FAULTS
Query ECM memory for fault codes.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: SOFTWARE PARAMETER AUDITS

PP LIST CHECKSUM
Used by ECM to validate integrity of values programmed into memory by factory and/or customer.

S/W CALIBRATION CHECKSUM
Used by ECM to validate integrity of calibration data programmed into memory.

S/W STRATEGY CHECKSUM
Used by ECM to validate integrity of software instructions programmed into memory.

FEATURE NAME: CLEAR-ECM-FAULTS

CLEAR-ECM-FAULTS
Command ECM to clear fault codes.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: ECM-SELF-TEST

ECM-SELF-TEST
Command ECM to perform diagnostic self-test.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: ECM COMPATIBILITY DATA

PP LIST LEVEL
Indicates what powertrain control features are configured for this vehicle.

Other parameters which must be considered when programming this feature:
None

FEATURE NAME: ECM MANUFACTURING DATA

MANUFACTURING DATE
Specifies manufacturing date of this ECM.

The year, month, day, and hour of manufacture is displayed. Each of the separate fields uses two numbers. For example, the display "97013018" means this ECM was manufactured on January 30, 1997 at 6 PM.

SERIAL-NO-CEC
ECM serial number.

H/W VERSION
ECM Hardware level.

S/W STRATEGY VERSION
Level of software functionality programmed into this ECM.

S/W CALIBRATION VERSION
Calibration level programmed into this ECM.

In general, calibration refers to the set of parameters used by the control system that are not programmable by the customer or by the factory (i.e. control system gains, out-of-range thresholds, ramp rates, etc,).

Table 8.1 — Parameter Attributes Table. Information generated directly from the Navistar EERS System (Navistar EMR Report, Location Melrose Park, Rules Effective August, 1997)

Supplier Name	EERS Parameter Name	Type[1]	Units	Lower Limit	Upper Limit	Increment
82001	TRANSMISSION-TYPE	F	N/A	0	4	1
82011	ENG-FAM-RATING-CD	F	N/A	0000	FFFF	1
82021	ENG-LOW-IDLE-SPEED	F	RPM	600	875	1
82031	ENG-HI-IDLE-SPEED	F	RPM	Accept Val		1
82041	ENG-RATED-SPEED	F	RPM	1600	2800	1
82051	ENG-RATED-HP	F	BHP	135	350	1
83001	TOTAL-FUEL	F	GALLONS	0	536,870,911.875	.125
83011	ENGINE-HOURS	F	HOURS	0	214,748,364.75	.1
83021	TOTAL-MILES	F	MILES	0	429,496,729.5	.1
84001	EL-OVERSPEED-1	F	HOURS		214,748,364.75	.05
84011	EL-OVERSPEED-2	F	HOURS		214,748,364.75	.05
84021	EL-LOWOILPRS-1	F	HOURS		214,748,364.75	.05
84031	EL-LOWOILPRS-2	F	HOURS		214,748,364.75	.05
84041	EL-OVERHEAT-1	F	HOURS		214,748,364.75	.05
84051	EL-OVERHEAT-2	F	HOURS		214,748,364.75	.05
84061	EL-LOWCOOL-1	F	HOURS		214,748,364.75	.05
84071	EL-LOWCOOL-2	F	HOURS		214,748,364.75	.05
84081	EL-OVERSPEED-MI1	F	MILES		429,496,729.5	.1
84091	EL-OVERSPEED-MI2	F	MILES		429,496,729.5	.1
84101	EL-LOWOILP-MI1	F	MILES		429,496,729.5	.1
84113	EL-LOWOILP-MI2	F	MILES		429,496,729.5	.1
84121	EL-OVERHEAT-MI1	F	MILES		429,496,729.5	.1
84131	EL-OVERHEAT-MI2	F	MILES		429,496,729.5	.1
84141	EL-LOWCOOL-MI1	F	MILES		429,496,729.5	.1
84151	EL-LOWCOOL-MI2	F	MILES		429,496,729.5	.1
85001	VEHICLE-IDENT	F	N/A			1
87002	CUSTOMER PASSWORD	W	N/A	Accept Val		1
88001	ENG-SERIAL-NO	F	N/A			1

NOTE: [1] W:EST Write Only Parameter
B: EST Customer Programmable Parameter (Both EST Read and EST Write Parameter)
F: Factory Programmable Parameters (non-EST programmable).
Information shown in BOLD indicates modification from the EERS database.

The Benefits of Vehicle Mounted Video Recording Systems, Evicam International, Inc.

evicam™

The Benefits of Vehicle Mounted Video Recording Systems

By R. Jeffery Scaman, CEO

EVICAM INTERNATIONAL, INC.

1.1 INTRODUCTION

Evicam International Inc. was formed to develop advanced Video Event Data Recorders for the Transportation and Insurance Industries. We have joined the National Highway Traffic Safety Administration's Working Group on Event Data Recorders to gather information and to learn from others involved in this same area of technology. We would also like to add our thoughts and ideas for discussion, which we hope will contribute to the advancement of Event Data Recorders in the coming years. We look forward to working with the National Highway Traffic Safety Administration, Automotive Manufacturers and other EDR companies in determining the most efficient methods of utilizing this technology for social and economic benefits, while protecting the integrity of the recorded data, and the privacy of those who choose to use it.

1.2 BACKGROUND

Event Data Recorders have been introduced in vehicles over the last decade in varying forms. Manufacturers have begun installing EDR's for air bag deployment and data analysis, to be used in designing more efficient safety systems in the future. Recently, the concept of Video Event Data Recorders has been introduced. We believe that this new technology, deploying cameras to capture events surrounding a vehicular accident, will provide detailed evidence never before available. Video Event Recorders will allow faster, more accurate and more detailed investigations, which will in turn save time, money and resources.

1.3 BENEFITS OF VIDEO EVENT DATA RECORDERS

There are both social and economic benefits to be achieved by deploying EDR's. The social impact of Event Data Recorders will be fewer accidents, safer vehicles and highways, less injuries and the potential to save many lives each year. Research has shown that vehicles equipped with non-video EDR's have lower accident rates, less severe accidents and better driver behavior. We believe that Video Event Data Recorders will have a similar or superior effect.

The potential economic benefits of EDR's will be very substantial also. Insurance Companies and their policyholders will see lower costs of insurance due to the use of EDR's. These saving will be realized as a result of a reduction in insurance fraud, streamlined accident investigations, and increased efficiency in settling claims.

A number of potential benefits include:

- Lower accident rates
- More efficient and accurate accident investigations
- More detailed data available for analysis
- Safer driver behavior

- Decrease in injury and death rates
- First hand physical evidence of accident circumstances
- A reduction in "road rage" due to accountability
- A reduction in the cost of insurance
- Protection of innocent drivers' deductibles and driving records
- Higher quality customer service for policyholders and claimants
- Concrete evidence to fight fraudulent claims
- A deterrent to accident fraud, due to increased risk of prosecution
- Video evidence of hit and run incidents
- Use of accident videos for educational/training purposes
- Lower expenses for Special Investigation Units
- Fewer court cases resulting from car accidents
- Increase in efficiency of insurance company and fleet operations

1.4 OTHER CONSIDERATIONS

As discussed in earlier Working Group sessions, one of the primary drawbacks to EDR's is the use of the data that is recorded and the privacy of those drivers who choose to utilize it. If EDR's are to be widely accepted, the data that is recorded must be securely stored, accessed ONLY by authorized personnel, and protected from abuse. If drivers believe that the EDR in their own vehicle may be used against them, there will be apprehension in the use of this technology. In using EDR's, the main incentive for fleets and individuals is a financial incentive. We believe that Insurance Companies, Law Enforcement and Fleet Mangers should have access to EDR data for investigative and civil uses only, i.e. determining who pays an insurance claim and receives a citation. Only under extreme circumstances should the data be released for other than insurance and civil liability purposes. It will take cooperation on the part of Lawmakers, Automotive Manufacturers and EDR Manufacturer's, if this technology is to be widely deployed and utilized to its fullest potential.

1.5 EVICAM TECHNOLOGY

Evicam International, Inc. is developing two core technologies relating to Video Event Data Recorders. We have named two of our products "**EVICAM**" and "**EVISCAN**".

The **EVICAM,** or "evidence camera" is a completely secure, multi-camera, digital video recording system designed to operate as a vehicular accident capture system. The technical name of this product is the Secure, Vehicle Mounted, Incident Recording System. This device will capture the minutes leading up to, including and following a crash. The data is securely stored in a safe box until such time it can be transmitted offsite or downloaded by authorized personnel using access codes. It will provide accident investigators and insurance companies with a secure, permanent record of the events surrounding a crash for evidentiary purposes, while allowing very limited access to the data and protecting the privacy of those concerned.

Florida Atlantic University Research Report
Visual Cues Provide Keys to Driverless Vehicles

Vol 1, No 1   September 1994

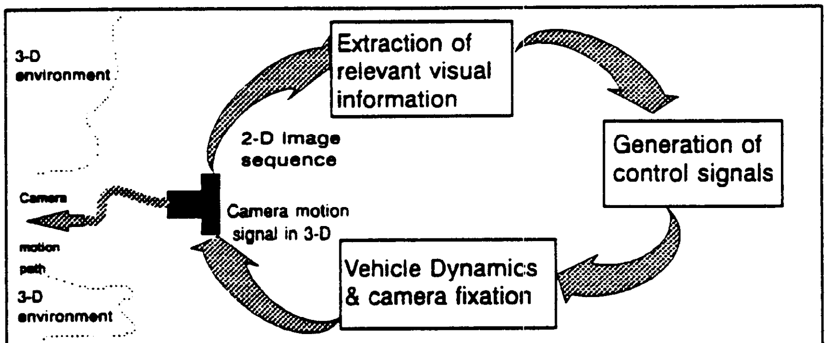
w/ related articles

Florida Atlantic University

Research Report

Office of Graduate Studies and Research Vol. 1, No. 1/September 1994

Visual Cues Provide Keys to Driverless Vehicles



2-D Visual-Cues-Based Active Navigation

Daniel Raviv believes that the best way to improve highway safety might just be to take drivers out from behind the wheel.

Raviv, a professor of electrical engineering at FAU, notes that it takes humans 1/5th of a second to respond to an impending collision or similar emergency. But when a computer – guided by a video camera – is at the controls of a vehicle, reaction times are reduced to as little as 1/30th of a second.

As part of the U.S. Department of Transportation's multimillion-dollar Intelligent Vehicle/Highway System program, Raviv and his colleagues at FAU and the National Institute of Standards and Technology (NIST) have developed technology that has been used to control a driverless Army HUMVEE safely at speeds of up to 45 miles per hour.

At the core of this seemingly improbable process, referred to as "active vision," is the study of "relevant visual cues," Raviv explains. "When dealing with a moving observer (for example, a camera), a huge amount of visual information is captured. In these projects, we are extracting relevant visual information from a sequence of images and using it as part of feedback control loops. In other words, we are refining all of the information viewed by the camera into a small set of relevant characteristics that the computer needs to control the motion of the vehicle." (See illustration.)

"We have taken a theoretical approach to understanding the basics of active vision," Raviv continues. "This formal, mathematical development of visual fields provides a quantitative scientific basis for understanding the relationships between optical-flow-based cues in the moving eye and the environment through which it moves." Understanding these collectively, he says, enables researchers to put driverless vehicles on the road.

Two key control concepts developed by the FAU and NIST researchers are the "tangent point" and "visual looming."

Unlike other studies that attempt to find out as much information as possible about the road itself in order to control vehicles, Raviv's research determined that the only road feature necessary for road following is the "tangent point" – the point on the road edge lying on an imaginary line tangent to the road edge that passes through the camera. The camera provides a flowing optical image of the road edge and the center line, supplying the data that the on-board computer requires to steer the vehicle as it moves along the road.

Welcome to Research Report

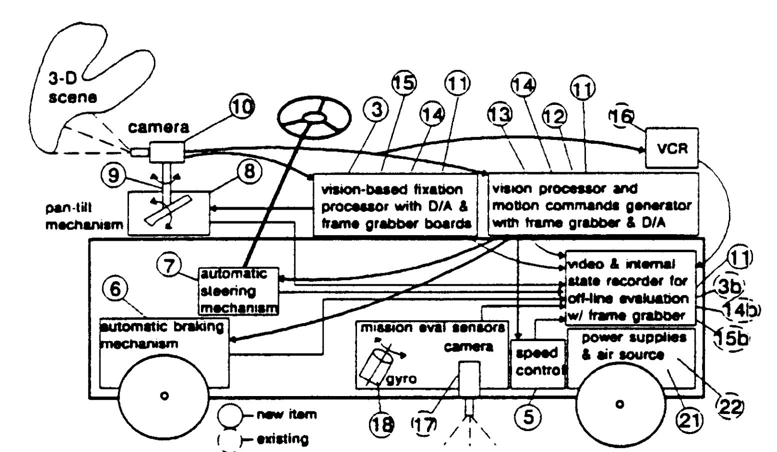
The Office of Graduate Studies and Research is pleased to send you this inaugural issue of the FAU Research Report, a monthly publication to inform faculty, the University community and the general public about the quality and scope of research activities at the University.

Beyond merely keeping a vehicle on track of course, comes the need to avoid collisions by braking, speeding up and steering. These functions are guided by the concept of "visual looming" – a principle that relates to the ways that animals' instinctive defense mechanisms lead them to behave when threatened.

The theory of visual looming, which was developed by FAU researchers, describes the time-based expansion of objects in the image plane viewed by the camera. In other words, visual looming determines the rate at which an image is being approached by or is approaching the vehicle carrying the camera. Information drawn from these observations is mathematically analyzed by the on-board computer and then translated into responses that enable the vehicle to avoid imminent collisions. Current research on this concept by Raviv and others at FAU is exploring ways to differentiate other vehicles from less relevant background information.

These basic explorations of active vision have been funded by the National Science Foundation under the direction of Dr. Howard Moraff. As the results began to show promise, Department of Transportation funding became available to put the theories into practice.

In addition, Because of Department of Defense interest in developing unmanned ground vehicles, an Army HUMVEE was provided for the FAU/NIST road test. Within four months, Raviv notes proudly, the vehicle – outfitted with the necessary camera, computers and control equipment – successfully drove autonomously on an NIST track in Maryland. Tests took place during the day, at night, and under rainy conditions.



Proposed Upgrade of the Electric Car

"The machine is a far better driver than human beings from a repeatability point of view," Raviv notes.

In order to continue this research using the facilities of the Robotics Center at FAU, the research team has outfitted an electric golf cart with control mechanisms similar to those used on the Army vehicle (see illustration). The project's next stages involve further work with visual looming and its applications to "platooning" (several vehicles closely following one another, as in a military supply convoy or between major cities on a highway), expanding the camera's view to the back and the sides, and incorporating information from road signs.

The day is not far away, Raviv believes, when "our cars will know where to go without driver intervention."

Florida Atlantic University Research Highlights

- The Advanced Marine Systems (AMS) Program in the Ocean Engineering Department, in partnership with the University of South Florida, has received two grants (for $2.5 million and $9.8 million) from the Department of Defense.
- FAU is concluding a cooperative relationship with the South Florida Water Management District. The agreement has provisions for cooperative research activities, a shared research facilities agreement and the delivery of graduate programs to the District.

Florida Atlantic University Research Report is a publication of the Office of Graduate Studies and Research. Dean John T. Jurewicz welcomes your suggestions and comments at (407) 367-3624.

Driverless cart paves new way to the future

Sun-Sentinel
PALM BEACH COUNTY
Monday, March 20, 1995 25 cents

By KIRK SAVILLE
Staff Writer

BOCA RATON — It's a great golf cart to putt around in. There's no driver.

With a golf cart, a video camera and a computer, a Florida Atlantic University professor is trying to perfect a driverless vehicle.

Eventually, the system might be used to control cars on long trips. With the computers at the wheel, cars could follow more closely, lanes could be made smaller, interstates could carry four times as many cars.

Daniel Raviv, an electrical engineering professor, wants to apply a psychological principle called "looming" to the roadways. In looming, objects appear to grow larger as they move closer. In the same way, objects moving away appear to look smaller.

The golf cart is named "Loomy" after the principle. While Loomy doesn't need a driver, it does have to follow another vehicle.

The video camera, mounted on the front of the cart, is aimed at a target, in this case a white rectangle on the back of the lead vehicle.

A computer knows the size of the target. As the golf cart follows the lead vehicle, the computer constantly compares the relative size of the target with its actual size. If the target becomes too small, the computer knows the cart is falling behind and increases its speed.

If the target appears too large, the computer knows the cart is getting too close to the lead vehicle and slows down the cart.

For turns, the computer com-

PLEASE SEE **CAR** /6A

FROM **PAGE 1A**

Road of the future might not have too many drivers

pares whether the target is centered. If it goes off center, the computer turns the car until the target is back in the center of the camera.

Raviv said a good driver can react in about a third of a second. The computer reacts about 10 times faster.

The secret to making the system work is deciding what information is vital to driving. Drivers speeding down the highway see a lot of things, such as trees, clouds and distant buildings, but none of that is necessary to driving.

"Even though the information you get is endless," Raviv said. "You only have two controls, speed and steering."

A compressed air system is used to steer the vehicle. Thomas Kelly, an engineering graduate student, is working the final bugs out of the computer system. He said the cart should be ready to be tested on campus in the next few weeks.

Raviv said the system's first widespread use would be as a warning device. With the computer sounding a signal if the driver came too close to another car. Raviv said such a system could probably be produced for as little as $200.

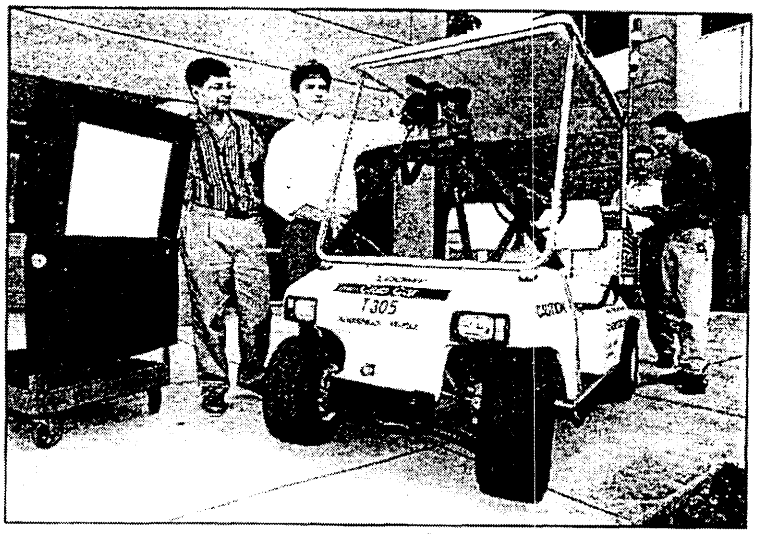
"There's a tremendous interest in this kind of technology among transportation experts," said Tom Schroder, a spokesman for the American Automobile Association of Florida. "We could pack more cars on the roads we have, instead of building expensive new roads. Imagine an interstate packed with cars, all traveling at 65 miles per hour with only two or three feet between them."

Raviv's research is financed by grants from the National Science Foundation, the National Institute of Standards and the federal transportation department. Raviv estimated the golf cart's cost at $5,000 to $6,000.

Raviv has demonstrated a system where a military vehicle has followed another on a closed course at speeds up to 65 mph.

When and to what extent the devices are acopted is less likely to be decided in the laboratory than in the courtroom, Raviv said.

"If you want to build cars like this, you can, but the liability is a problem," Raviv said. "If it gets into an accident, who is liable?"



Staff photo/NICHOLAS R. VON STADEN

FAU professor Daniel Raviv watches as graduate student Thomas Kelly adjusts the video camera on the "Loomy" cart.

Driver optional in computerized cars

By ARDEN MOORE
Staff Writer

The newest feature for motorists in the next decade or so may be smarter control.

Imagine safely putting your vehicle on automatic pilot while you nap, read a book or stretch out in the back seat during long road trips.

Within the next few years, an automatic alarm system can be installed in your car to alert you to a pending collision.

Florida Atlantic University professor Daniel Raviv is part of a national team of researchers developing innovative technology for self-guided, computer-controlled vehicles.

Eventually, this smart-car, smart-highway system would allow more vehicles to move faster on highways without danger of colliding.

Sound farfetched? Raviv points to recent test results. His computerized system, relying on a camera as the vehicle's eyes and a computer as the brain, has successfully kept an Army vehicle called a Humvee within its lanes at speeds of up to 65 mph.

A driverless Humvee also has closely followed another at 30 mph without colliding.

Tests were conducted on roads at the National Institute of Standards and Technology in Gaithersburg, Md. The research is paid for by the National Science Foundation and the Federal Highway Administration.

This research represents one segment of a national campaign to develop high-tech highways and smart cars. It falls under the umbrella project called Intelligent Vehicle-Highway Systems being coordinated by the highway administration.

"The trend is definitely toward high technology on our highways," said Tom Schroder, American Automobile Association of Florida spokesman. "Technology can help people save time, save gasoline, prevent accidents

"How we really see has always been a mystery to me. My goal has been to build a system that can navigate a vehicle based on vision, not radar."
— research team member Daniel Raviv

PLEASE SEE SMART CARS /4A

SMART CARS

FROM PAGE 1A

Researchers trying to improve vehicles that drive themselves

and eliminate the need to build new highways and roads."

Also in the testing stages:

■ Intelligent cruise control — If a car ahead of you slows down, the control system would automatically adjust and decrease your car's speed to maintain the same distance between the two.

■ Computerized dashboard maps — Motorists can get step-by-step directions to destinations from a car computer. The computer could also give drivers alternate routes around congestion or accidents. A yearlong study that ended in March involved 2,000 motorists in the Orlando area, and another test is expected to involve 5,000 drivers in the Chicago area next year.

■ Automated toll collections — Motorists in Dallas, parts of Oklahoma and Louisiana are able to drive through toll booth lanes without stopping as a computer camera records the license plate and automatically deducts the charge from the motorist's credit account. The system is expected to be in operation on Florida's Turnpike in south Florida by late 1995.

"To handle the increase in traffic, the only way to go is to provide more intelligent automation," said Maris Joberts, a program manager for automated vehicle control systems for the highway administration. "A computer-controlled system can triple or quadruple the number of cars on highways as well as increase safety for all drivers."

The success of this impending technology depends on public acceptance, researchers say. Raviv's work may face the biggest roadblocks.

"I think it will be a hard sell, because some drivers may not want to give up the thrill of driving over to computers which do the steering, braking and accelerating," Schroder said.

Public acceptance will come only by a gradual, step-by-step introduction of technology's benefits to motorists, said August Burgett, an official with the National Highway Traffic Safety Administration.

"It will take time and experience for people to feel comfortable with it," he said.

There are also unanswered legal questions: Who would be at fault in an accident involving a car steered by computer?

"Legal questions — that is still a big issue that we have to tackle," said Richard Bishop, a Federal Highway Administration manager.

Raviv's contribution deals with developing "seeing" computerized cameras that can act — and react — like human eyes. The camera keeps the vehicle in its proper lane by keeping an eye on the center line and the edge of the road. It would operate much like cruise control, giving the driver the ability to regain control easily.

"How we really see has always been a mystery to me," said Raviv, an associate professor of electrical engineering. "My goal has been to build a system that can navigate a vehicle based on vision, not radar."

His research on the automated warning system would alert a driver to an imminent collision or drifting off the road by a beeping sound or flashing light. It could eliminate the "blind spot" for motorists by having seeing sensors around the vehicle. That system could cost about $1,000 per vehicle and be available within three years, Raviv said.

"This computerized vision system's reaction time is 10 times faster than that of a human," Raviv said. "Hopefully, my research can save lives and reduce the number of accidents."

Experts agree that the future puts technology in the driver's seat.

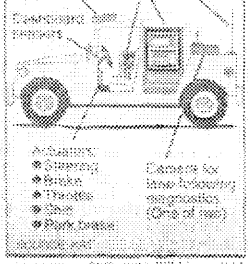
"To have all this technology tied together coast-to-coast will be quite a task," said Don Gordon, AAA project manager in Orlando. "A total automated highway system might be decades away, but people have to realize that steps are being taken today."

"A computer-controlled system can triple or quadruple the number of cars on highways as well as increase safety for all drivers."
— Maris Joberts, Federal Highway Administration

Sun-Sentinel
PALM BEACH COUNTY Monday, September 6, 1993 35 cents

Smart car

A U.S. Army Humvee equipped with a computerized camera system has successfully traveled driverless at speeds of up to 65 mph and followed a vehicle at 30 mph without colliding.



Sun-Sentinel

SOUTH FLORIDA • MONDAY • AUGUST 26, 1996

Researcher developing computerized eye at FAU

By KIRK SAVILLE
Staff Writer

BOCA RATON — Daniel Raviv is developing a set of eyes for the back of his head.

The Florida Atlantic University professor is working on a sort of computerized eye. The device someday could help the blind avoid obstacles, help control driverless cars or help guide industrial robots.

Pedestrians could even wear it to let them know what was going on behind their backs, Raviv said.

The National Science Foundation gave Raviv a $60,000 grant to develop the device. As far as grants go, $60,000 isn't a lot of money. But Raviv's grant is designed for high-risk research.

"They know the payoffs could be big," Raviv said. "But they know it could fail."

But Raviv doesn't expect to fail. He'll spend the next year designing a computer chip that can make his small artificial eye work. He hopes the device could be produced for as little as $10.

The NSF grant is the highest form of support from the federal government. Grants are judged against competitors from all over the country. "It's very prestigious," said Craig Hartley, dean of the college of engineering at FAU. "It's one of the marks of the quality of the research and the university."

Raviv has long worked on developing a driverless car, and the computerized eye is an offshoot of that research.

PLEASE SEE EYE /4B

EYE

FROM PAGE 1B

Computerized eye arose from research on driverless car

The device relies on measuring how blurry an image is.

To understand how the system would work, imagine a camera focused on an object. As long as you stand the same distance from the object, the image remains sharp.

If you move away from the object, it goes out of focus, and the image becomes blurry.

Raviv's eye would work the same way. "The change in the blur is what we're interested in," he said.

Raviv said the device would be set so the image of an object, such as a car, is blurry when the object is a safe distance away. If the object gets too close, the image would become sharper.

The computer chip would sense when the image became too sharp, meaning the object was getting too close. In a car, for example, the device could either set off a warning alarm or apply the brakes.

Raviv said the key to the research is deciding what information is crucial to avoiding a collision.

"This is something that has puzzled me for many years," Raviv said.

Daniel Raviv, a professor at Florida Atlantic University, is developing a computerized eye that could guide a driverless car or aid the blind. A National Science Foundation grant is helping him in his research.
Staff photo/ NICHOLAS R. VON STADEN

When people are driving along Interstate 95, for example, they receive tremendous amounts of information. Drivers see trees, signs, buildings and other people. But all that information is reduced by the brain to a couple of crucial pieces of information: how close you are to the car in front of you and how fast you're approaching the car.

"Who cares if it's a Mercedes or Lexus, the important thing is how fast you're approaching," Raviv said.

The blur system allows the computer chip to disregard everything but the distance between the camera lens and the object in front.

Raviv sees plenty of uses for his device. In addition to being used to control the speed of a car, the device could be put in the back of the car to warn of a vehicle approaching too fast.

Blind people might also be able to use the system to warn them of obstacles.

"Right now, the most efficient device is the stick," Raviv said.

LOCAL

Sun-Sentinel, Monday, August 26, 1996 Section B

FAU's car would do the driving for you

Florida Atlantic University researchers are building a car that can drive itself.

Their Army HUMVEE can go it alone at speeds of up to 60 miles per hour, and do so safely at night, in heavy smoke, and in rain, reports Daniel Raviv, FAU professor of electrical engineering. He published an article on the project in the August issue of Transactions on Systems, Man and Cybernetics, a journal of the Institute of Electrical and Electronics Engineers.

JACK WHEAT
RESEARCH

A videocamera on the front of the HUMVEE sends images to a computer, which determines how the HUMVEE should respond. It reacts to an impending collision or other emergency six times faster than a human, said Raviv. Human response time is one-fifth of a second. For the com-

MIAMI HERALD 9/19/94

PLEASE SEE **RESEARCH, 5B**

DEVELOPING AN AUTOPILOT AUTO: FAU's Daniel Raviv.

FAU making car that'll drive you

RESEARCH, *FROM* **1B**

puter, it's one-thirtieth of a second.

The computer makes judgments through principles of "visual looming." As objects before the camera grow or shrink, the computer figures how rapidly the changes are occuring and speeds up, slows down or stops accordingly. People drive the same way, but process the information more slowly, Raviv said.

The HUMVEE has been tested at a National Institute of Standards and Technology track in Maryland, Raviv said. Now the researchers are figuring out how to make the car able to weave in and out of traffic.

Before cars with automatic pilot make it onto Interstate 95, he says, something trickier than technical issues must be resolved — who'll be legally liable for where the car goes?

Cars on autopilot likely by 2002

FAU electrical engineering Professor Daniel Raviv is optimistic about automation on the highways.

By DON HORINE
Palm Beach Post Staff Writer

BOCA RATON — Taking a long drive by yourself? How would you like to get on the highway, put your car on autopilot, climb into the back seat and curl up with a good book or even take a snooze?

In as soon as 10 years, you might be able to.

While you rest, computers would steer, keep your car a safe distance behind the next vehicle and stop the car when necessary.

The basic technology for a self-guided car should be ready within two or three years, in the view of Daniel Raviv, a Florida Atlantic University electrical engineering professor who is one of several scientists doing the pioneer research.

Last month, an Army vehicle outfitted by Raviv drove on its own around roads at the National Institute of Standards and Technology in Gaithersburg, Md., guided by a television camera that kept an eye on the edge of the road and the center line and fed the information to a computer. At night and through heavy rain and dense smoke, the multipurpose vehicle, known as a Humvee, stayed within its lane at speeds of up to 45 mph.

Raviv is convinced that the system will work just as well at 65 mph.

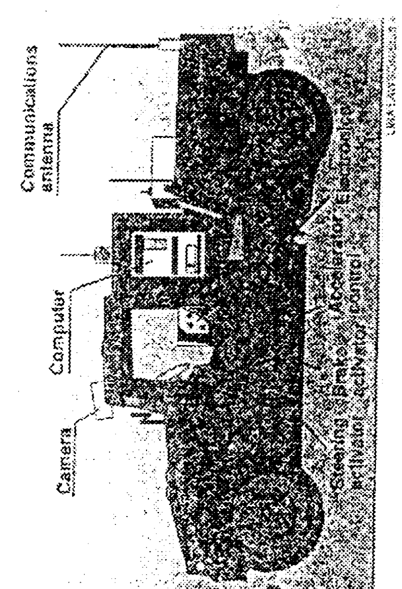
"I don't see any problems," he said. "The edge of a highway is well defined. The camera looks straight ahead, finds the edges of the highway and uses the center line to navigate the vehicle."

Within about five years, Raviv says, it should be possible to buy a car equipped with a warning system that sounds an alarm when a collision is imminent, such as when the car is following another car too closely or starts to go off the road. Raviv estimates the

Please see SMART/6A

SELF-GUIDED HUMVEE

FAU professor Daniel Raviv developed the guidance system used in a recent test by the Army. The Humvee drove itself around a test course through rain and smoke at speeds of up to 45 mph.



'Smart highways' that allow push-button navigation next

SMART/from 1A

system would cost about $1,000.

A totally automated car could be ready almost as soon and would cost about $2,000 more than a conventional car, Raviv said.

But he and other experts in the field believe it will take car manufacturers much longer to install fully automated driving systems in vehicles than it will to install warning systems.

The reason: concern about legal liabilities. If an automated car is in an accident, whose fault would it be — the driver's or the automobile manufacturer's?

Another potential problem is consumer skepticism. Before people are willing to turn control of a vehicle over to a computer, they will have to be convinced that it's safe.

"Even though airplane pilots land by instruments all the time, there's a real reluctance on the part of people to do that," said Mike Sheldrick, a distinguished industry fellow with Intelligent Vehicle-Highway Systems America, a Washington group that is advising the U.S. Department of Transportation on the development of a totally automated highway system.

Sheldrick agrees with Raviv that these obstacles will be overcome.

"We envision that one day you'll hop in your car, say 'work,' and it'll take you there," Sheldrick said last week.

Recognizing the need to make the nation's highway system more efficient, Congress has directed the Federal Highway Administration to develop a prototype automated highway system by 1997. About $660 million is to be spent on research and development, including $123 million in 1992-93.

The basic goal: to improve highway efficiency, enhance safety, conserve energy and protect the environment.

'Smart' highways to be developed

In addition to making "smart" cars, the project calls for developing "smart highways" that would allow motorists to punch a destination into a dashboard computer as they get into their cars. Based on the latest traffic information, the computer would tell them the best way to get there.

A fundamental part of the "smart cars" research is assuring that vehicles don't drift over into the next lane. The task isn't as simple as it may seem, Raviv said.

"Driving down a highway is easy for a human being, but not as easy for a machine," he explained. "A camera has to find which edges are relevant and which aren't. There are many edges — of trees, billboards, signs, many things."

After last month's road tests of the Army vehicle, Raviv returned to the robotics lab at FAU to work on the next phase: keeping a vehicle a safe distance behind another vehicle based on images the computer receives from the camera.

In its application, the concept, called "platooning," envisions packs of closely spaced, driverless cars with the same destination moving along a highway in perfect synchronization.

Raviv, working on a $225,000 Department of Defense contract, expects the platooning stage of his system to be road tested within a year.

Other vision-related research has been done by other researchers in the United States, Europe and Japan. Raviv said he believes his system is unique because of the simplicity of the method by which the computer processes the images of the road edge and objects on the road relayed by the camera.

"It is far simpler than what other people are trying

'We envision that one day you'll hop in your car, say "work," and it'll take you there.'

MIKE SHELDRICK
Intelligent Vehicle-Highway Systems America

"A lot of artificial intelligence approaches are fairly sophisticated, and extracting the information is very tedious and takes a considerable amount of time," Juberts said. "His approach is simple and extracts just the information you need to control the vehicle."

Defense Department pays for research

The Department of Defense is paying for Raviv's research because of the military applications. Entire convoys of supply vehicles might require a single human driver situated in the lead truck, explained Roger Kilmer, deputy manager of the technological institute's Intelligent Machines Program. The rest of the convoy would consist of automated trucks programmed to follow and maintain a specified distance behind the vehicle immediately ahead.

"It's quite easy to achieve," Raviv said of the technology behind so-called smart cars. "The research can be finished in two or three years. Whether you put one in your car depends on how much you value safety."

But consumers are likely to be wary.

"It could prevent a lot of off-road collisions," Sheldrick said. "For example, people who lost control of their cars would stop in front of a tree instead of running into it. But are people really going to want to have their brakes go on automatically?"

Use to be restricted to highways

At first, at least, experts agree, automated vehicles will be used only on highways, because city driving requires more sophisticated judgment calls. Most experts also believe the first generation of automated vehicles will have to have a lane or two set aside for them and will not share the highway with conventional vehicles. That system has drawbacks — a flat tire or other mechanical failure could create a huge traffic jam.

Steven Shladover, a University of California at Berkeley professor who is considered one of the foremost experts on the subject, believes the public's use of automated vehicles initially will be limited to one or two locations, so flaws can be worked out.

"I think we can get something fully automated on the road for the public to use in specific locations in 15 years," said Shladover, deputy director of a $56 million California program called Program on Advanced Technology for the Highway. "It'll probably be 15 or 20 years before they're widespread."

Automated vehicles will be much safer than human-driven vehicles, Raviv said, because a camera's attention doesn't wander, and the computer's reaction to potential danger is almost instantaneous.

"If the computer decides you're going to collide, it'll take action," Raviv said. "A human being responds in a quarter of a second to a sign of danger. A machine is far faster. It can respond in a 30th of a second."

Similar research is being conducted at several other U.S. universities, backed by domestic automakers, and in Japan and Germany.

The technology differs. Some, like Raviv's, use vision-based sensors, others use infrared sensors, ra-

Vetronix's Crash Data Retrieval System

Don J Felicella
ACTAR, Felicella Consulting Engineers, Inc.

Vetronix's Crash Data Retrieval System

Donald J Felicella, ACTAR, Felicella Consulting Engineers, Inc.

INTRODUCTION

General Motors vehicles equipped with air bags that were manufactured between 1990 and 1993 have a unit called a Diagnostic and Energy Reserve Module (DERM). One of the functions of the DERM is that it records a limited amount of data at the time of a deployment event. In 1994 General Motors air bag systems started utilizing a Sensing and Diagnostic Module (SDM). This device was able to compute and store the change in the longitudinal velocity of the vehicle during an impact. The SDM receives data from the vehicle's Powertrain Control Module (PCM) once a second regarding the vehicle's speed, engine speed and percent of throttle. Currently the SDM's do not sense lateral accelerations or forward longitudinal accelerations which may result from a rear impact.

In 1990 Vetronix developed the first Event Data Retrieval Unit (EDRU) to be used internally by General Motors. Vetronix was awarded the exclusive contract from General Motors in 1999 to develop a Crash Data Retrieval (CDR) system for use by both GM and the aftermarket. The CDR system has the availability to download data from the involved vehicle in an easy-to-read graphical and tabular format. The retrievable data includes vehicle's speed, state of warning light indicator, throttle position, engine RPM, brake switch circuit status, time from algorithm enable to deployment command, status of the front passenger's air bag suppression switch, and post crash data.

VETRONIX EQUIPMENT

The CDR unit from Vetronix consists of a CDR Interface Module, various cables, software, and power supply connections. The data can be retrieved by either connecting under the vehicle dashboard into the DLC jack or connecting direct into the air bag control module.

TYPE OF DATA

The data is compiled into two categories or events "near deployment events" and "deployment events." A near deployment event is one which is sever enough to "wake up" the vehicle's sensing algorithm but not enough to cause the air bag(s) to deploy. The typical predictive algorithm must make air bag deployment decisions within 15-50 msec after impact. The SDM can store up to one near deployment event which will be overwritten by an event that has a greater recorded velocity change. A deployment event will contain Pre-Crash and Crash data. The SDM will store up to two different Deployment Events if they occur within five seconds of one another. Once the air bag has been deployed, the data cannot be overwritten or cleared. The SDM must be replaced.

CASE STUDIES

The following are examples of cases involving a vehicle supported by the CDR system in which the data was utilized:

1999 Chevrolet Corvette:

This crash involved a 1999 Chevrolet Corvette which was traveling at a high rate of speed. The driver swerved to avoid other traffic and lost control of the vehicle, rotating approximately 55 degrees, leaving tire surface marks for approximately 177 feet prior to striking the curb and becoming airborne. The vehicle traveled approximately 34 feet prior to striking a tree 1.5 feet higher then takeoff. The driver received fatal injuries. This investigation has been completed by the governing police agency. However, the investigating officer and an accident reconstructionist are currently analyzing the evidence along with calculating the vehicle's speed during this event. Upon completion of such analysis, they will then do a comparison of the calculated speeds and the data from the SDM.

The data from the SDM indicated that the vehicle's throttle went from 100 percent at -5 seconds to 0 percent at -2 seconds during which time the vehicle's speed increased from 106 MPH to 122 MPH respectively and the engine RPM's went from 4736 to 5248. The SDM also revealed that at -2 seconds the brake switch status went to the on position. The last data recorded at -1 seconds was 82 MPH with a RPM reading of 2624.

1999 Chevrolet Camaro Z28:

This case involved a 1999 Chevrolet Camaro Z28. The vehicle was found abandoned and on fire in a remote parking lot. The vehicle also had damage to the right rear fender area from striking some round object. The police made contact with the registered owner of the vehicle who then reported it stolen. During the investigation, it was found that the vehicle was equipped with an anti-theft micro chip key. This is a special key that has a micro chip attached to it which is programed into the vehicle's ignition system. State Fire Marshals determined that the vehicle had intentionally been set ablaze. Even though the vehicle was a total loss due to the fire, the Sensing and Diagnostic Module (SDM) was intact and was removed from the vehicle. The data retrieved from the SDM indicated a "Near Deployment Event" and an "Ignition Cycle" number. The SDM also indicated that the vehicle's Brake Circuit Status was "On" and recorded a speed of zero mph.

An investigation was able to find a "witness" to the crash who confirmed that the vehicle apparently was traveling on a wet roadway at which time the driver loss control and applied the brakes skidding into a tree. The driver then fled the scene.

The data from the SDM supported these facts, the vehicle's speed was recorded as zero mph with the brake circuit status as "On." It also indicated that there was an Ignition Cycle registered by the SDM supporting that a key was used. The ignition lock assembly was examined and found that the Vehicle Anti-Theft System (VATS) wiring which contained the contacts were present and did not show any signs of tampering.

The police investigation found that only two people had keys to the involved vehicle, the owner's mother whose actions were accounted for and the owner, who was on probation and did not possess a valid driver's license. The police confronted the owner with information they were supplied with from the SDM. The owner eventually confessed to the crime.

The data from the SDM helped the local State Attorney's Office in the successful prosecution in this case.

2000 Oldsmobile Alero 2-Door Coupe:

This crash involved a 2000 Oldsmobile Alero 2-Door Coupe which was sideswiped by a motorcycle causing the driver to take evasive action and lose control veering off of the road and then striking a wooden utility pole. The question was "What was the impact speed at the utility pole?" A post crash inspection revealed that there was 1.5 feet or 18 inches of maximum crash damage to the involved vehicle. These measurements were used to manually calculate an impact speed with the pole utilizing three different energy-based equations. A comparison was then made with the data retrieved from the vehicle's Sensing and Diagnostic Module (SDM) and the calculated impact speed.

FORMULA 1: $V = D\sqrt{(395 - .062W) * (1 + \Delta E)}$

Where: V = impact speed in feet per second (fps)
D = maximum crush in feet
W = weight of a vehicle in lbs.

ΔE = increase or decrease in energy absorbed in crushing the vehicle upon impacting a wooden utility pole

Calculated speed: 21.81 fps or 14.88 mph

FORMULA 2: $V = BPO + BP1 * CRM$

Where: V = Pre impact speed in mph
BPO = Speed at which no crush is expected
BP1 = Slope of speed versus crush
CRM = Maximum crush (inches)

Calculated speed: 13.64 mph

FORMULA 3: $EBS = 1.30 * Cmax - 6.0$

Where: EBS = Equivalent barrier speed
1.30 = Consent for small front wheel drive vehicles
Cmax = Maximum crush in inches

Calculated speed: 17.4 mph

SDM: Data from the vehicles SDM indicated a speed of 14 mph.

METHOD	SPEED
Formula 1	14.8 mph
Formula 2	13.6 mph
Formula 3	17.4 mph
SDM	14 mph

References

Chidester, A.,et al. "Recording Automotive Crash Event Data" International Symposium on Transportation Recorders, NTSB, Arlington, Va. 1999.

Goebelbeck, J "Crash Data Retrieval Kit Recovers Reconstruction Data from G.M. Black Boxes" Accident Investigation Quarterly, Winter 2000.

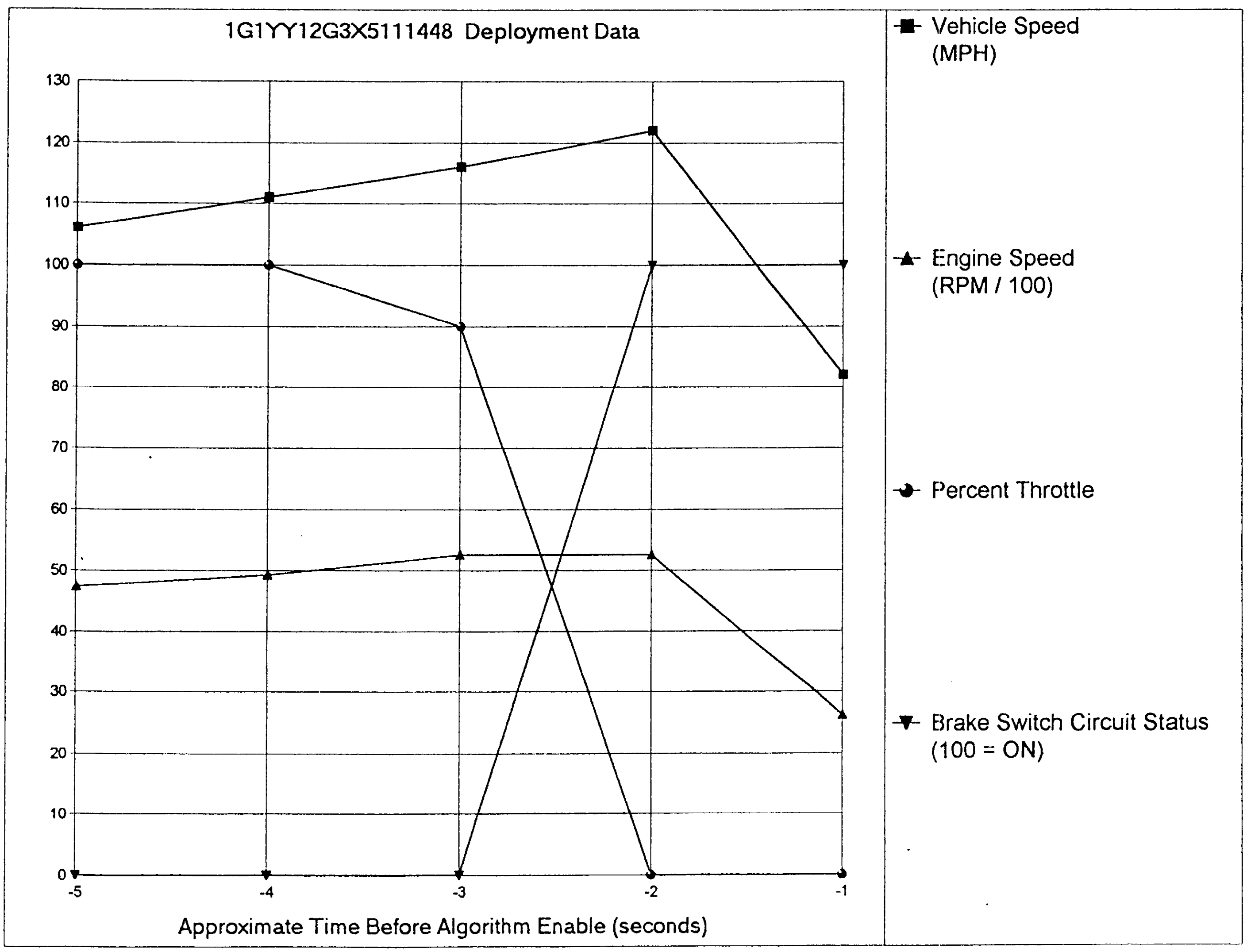
Vetronix "Viewing Data" help files

1999 Chevrolet Corvette

1G1YY12G3X5111448 System Status At Deployment	
SIR Warning Lamp Status	OFF
Passenger Front Air Bag Suppression Switch Circuit Status	ON
Ignition Cycles At Deployment	4463

PRE-CRASH DATA		Electronic Data Validity Check Status = VALID		
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	106	4736	100	OFF
-4	111	4928	100	OFF
-3	116	5248	90	OFF
-2	122	5248	0	ON
-1	82	2624	0	ON

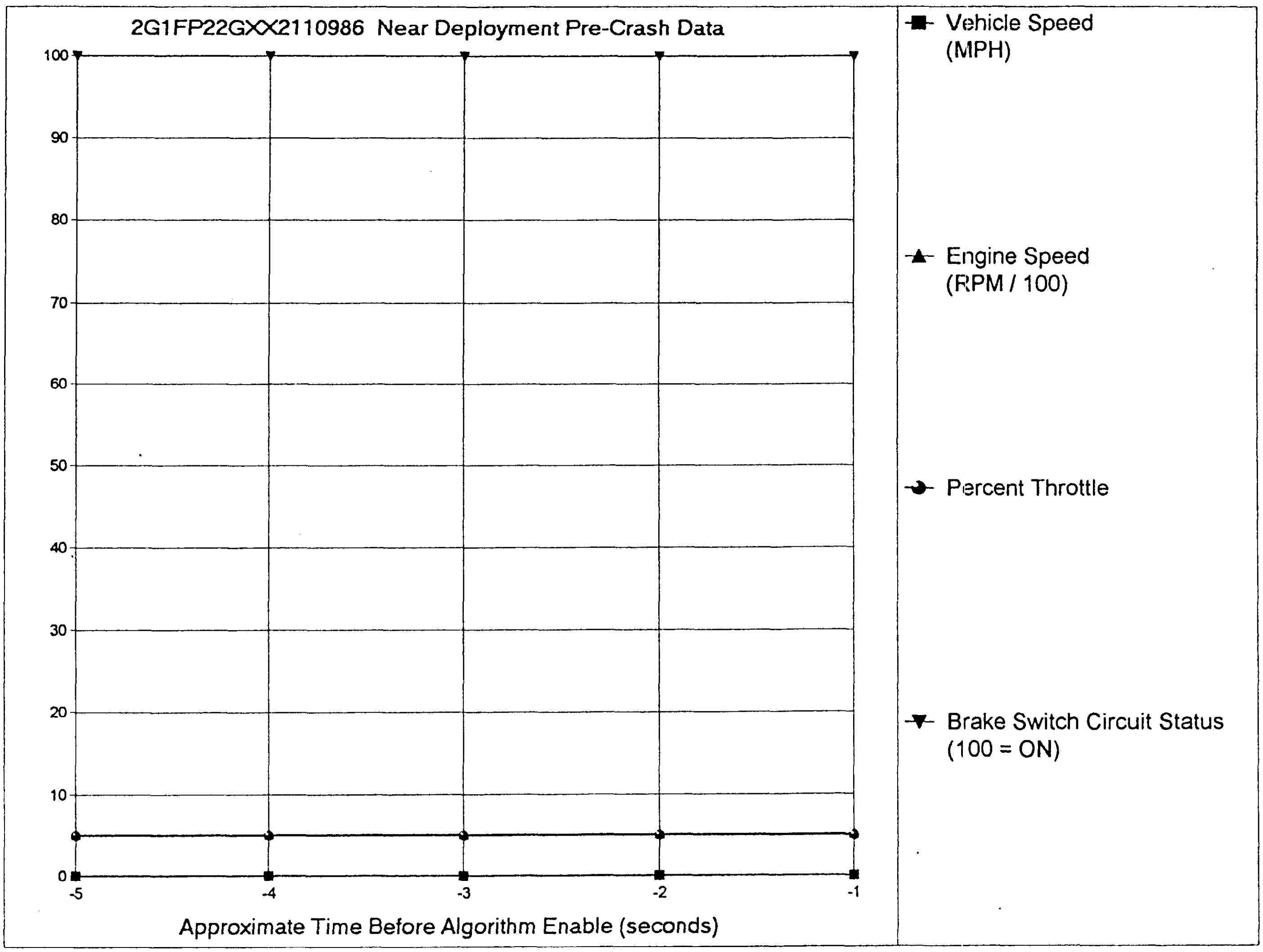
Time Between Deployment and Near Deployment Events (msec)	300



1999 Chevrolet Camaro Z28

2G1FP22GXX2110986 System Status At Near Deployment	
SIR Warning Lamp Status	OFF
Passenger Front Air Bag Suppression Switch Circuit Status	ON
Ignition Cycles At Near Deployment	4835

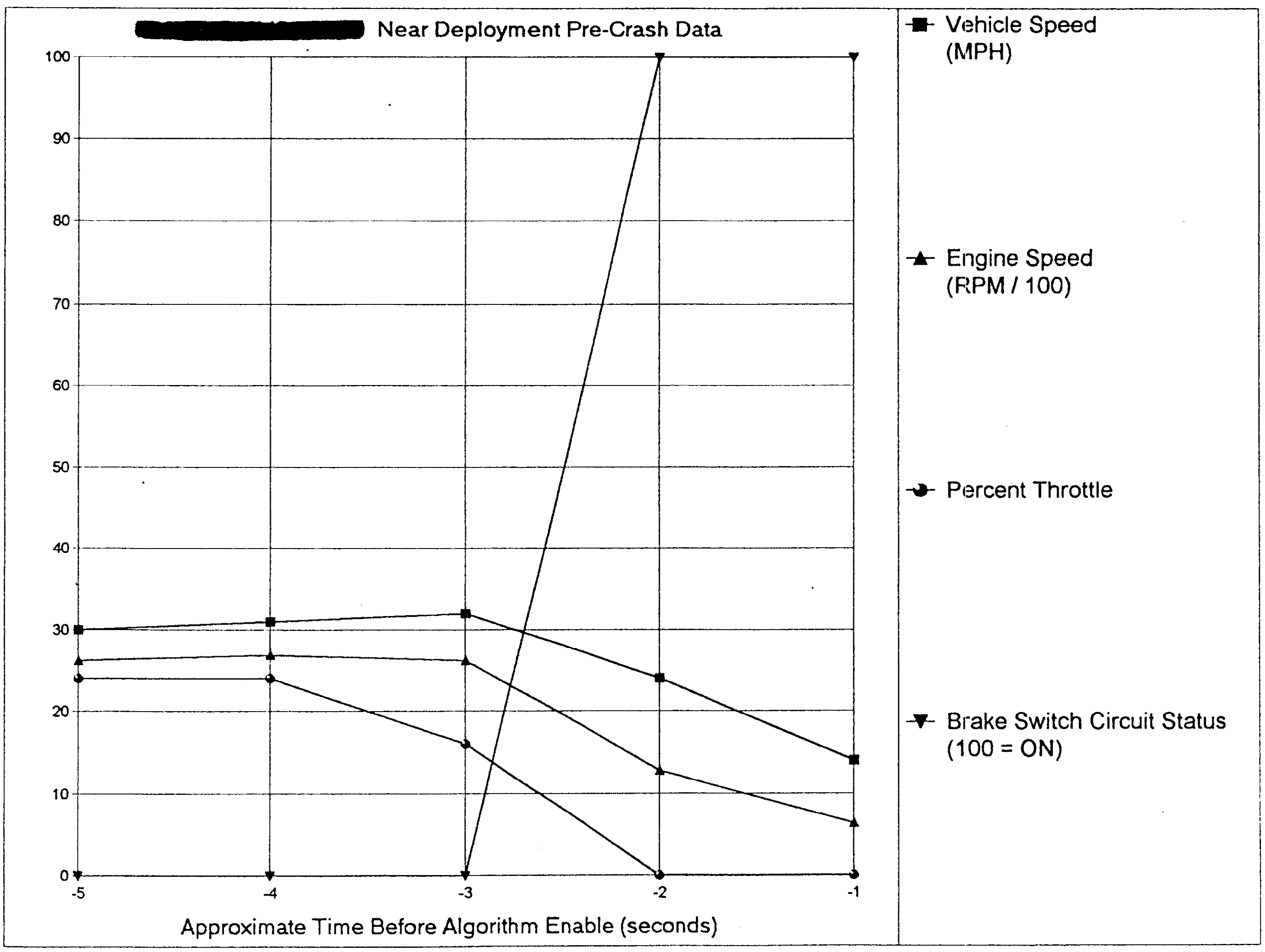
PRE-CRASH DATA		Electronic Data Validity Check Status = VALID		
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	0	512	5	ON
-4	0	512	5	ON
-3	0	512	5	ON
-2	0	512	5	ON
-1	0	512	5	ON



2000 Oldsmobile Alero 2-Door Coupe

[redacted] System Status At Near Deployment	
SIR Warning Lamp Status	OFF
Passenger Front Air Bag Suppression Switch Circuit Status	ON
Ignition Cycles At Near Deployment	188

PRE-CRASH DATA		Electronic Data Validity Check Status = VALID		
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	30	2624	24	OFF
-4	31	2688	24	OFF
-3	32	2624	16	OFF
-2	24	1280	0	ON
-1	14	640	0	ON



We are a people of Choices
Susan Walker, Esq., Kanouse & Walker, 2000

We Are a People of Choices

A legal model for the implementation of Event Data Recorder (EDR) technology was presented by representatives from Florida Atlantic University, including Susan Walker, Esq. The vision of the model retains all rights with the owner of the motor vehicle. The decision as to whether to install the EDR technology and the ownership of the data is vested with the owner of the vehicle.

It is envisioned that the data would be collected in hardware located in the motor vehicle and then in an encrypted and encoded format be wirelessly transmitted to a central data repository. The transmission of the data would occur on a regular basis and contemporaneously with an "event." No data would remain in the vehicle after an event. The central repository would be an independent agency.

With respect to airplane data the information could be collected by the Flight Operations Quality Assurance (FOQA). With respect to data transmitted from motor vehicles and vessels the central repository entity is yet to be determined. The data generated would be identified by the "vehicle identification number" (VIN #), which is given to all vehicles. The personal identity would remain confidential, unless permission was given by the owner of the information to use such data.

The central repository would be free to use the cumulative form of any data, which could be available to the public, car manufacturers, insurance companies and others. The personal information would be treated as "privileged" information, a concept similar to the patient/doctor privilege. The privilege may be "waived" by its owner, and when the privilege is waived the information may be released.

In civil court proceedings (which include individuals seeking monetary damages), the privilege could be absolute or qualified. In criminal court proceedings (which involve the state seeking criminal sanctions against an individual), the data is protected and the individual is afforded the constitutional protections including the Fifth Amendment right against self-incrimination. So too, the Fourth Amendment rights of the individual against unreasonable search and seizure would be afforded as to the collection of data.

The delicate balance between the need to save lives by obtaining and prudently using critical data and the need to respect the reasonable expectations of privacy, constitutional safeguards, and due process, must be preserved. The model envisions that personal choices be preserved for the owner of the vehicle. The model contemplates a central repository of data, where release of information is only by consent. (For example, a credit bureau in which credit history is kept and remains personal, but may be released with consent.)

An example of the model could be the following:

Vehicle 1 is a private passenger vehicle in which the owner chose to have an EDR installed to take advantage of a monetary insurance incentive in the form of a premium deduction. Vehicle 2 is a commercial/fleet vehicle in which the owner/company (after negotiations with its employees) chose to install an EDR to better track its fleet's operations. Vehicle 3 is a "common carrier" in which the owner was under the authority of a regulatory agency which decided that EDR should be installed in all its vehicles for the protection of the public safety. If an "event" occurred, all the drivers would be afforded constitutional protections and due process safeguards would come into play. However, the owner of the vehicle could waive the confidential nature or use the data if he/she so chooses.

Legal Framework for the Implementation of EDR Technology

Susan Walker, Esq.
Kanouse & Walker

February 15, 2001

Guiding You Through the Legal Maze.℠

Legal Framework

for the Implementation of

EDR Technology

Dated: February 15, 2001

One Boca Place
Suite 324 Atrium, PMB #1070
2255 Glades Road
Boca Raton, Florida 33431

Objective

The legal objective is to provide a workable framework for the use of EDR technology that balances the following principles:

- We are a people of choices and freedoms;
- The underlying constitutional protections (such as freedom from unreasonable searches and seizures, Fifth Amendment rights against self-incrimination, privacy expectations, and due process safeguards) must be respected; and
- The objective of the implementation of EDR technology will be to save lives.

Model

1. **THE OWNER OF THE VEHICLE MAKES THE DECISION TO INSTALL THE EDR.**

   a. Mass Transit/ "Common Carrier" – regulatory agency decision
   b. Commercial/Fleet Vehicle – the company decides and negotiates its decision with its employees
   c. Municipal Vehicle- municipality decides and negotiates its decision with its drivers
   d. Independent Trucker- driver decides
   e. Personal Vehicle- personal choice (An exception may exist if there is court ordered installation of an EDR for a chronic traffic offender, after due process proceedings.)

2. **EDR DATA IS TRANSMITTED TO AN INDEPENDENT AGENCY WHICH COLLECTS DATA AS TO CLASS OF VEHICLE, SUCH AS AIRPLANE OR MOTOR VEHICLE.**

   a. Airplane information to be collected by the Flight Operations Quality Assurance (FOQA).
   b. Motor vehicle information to be collected by an entity to be determined.
   c. Vessel information to be collected by an entity to be determined.

3. **EDR DATA IS TO BE IDENTIFIED BY VEHICLE IDENTIFICATION NUMBER (VIN #) OR VESSEL NUMBER.**

4. **THE EDR DATA IS OWNED BY THE OWNER OF THE VEHICLE.**

   a. The data in its cumulative form may be used by the independent agency or may be released in its cumulative form to interested entities.

   b. The data **IS PRIVILEGED IN A CIVIL PROCEEDING AND THE PRIVILEGE MAY BE WAIVED BY THE OWNER OF THE PRIVILEGE .** (The privileges may be absolute or qualified depending upon the situation.)

   c. The data **IS PROTECTED IN A CRIMINAL PROCEEDING AND THE CONSTITUTIONAL PROTECTIONS MAY ONLY BE WAIVED BY THE ACCUSED.** (The Fifth Amendment right against self-incrimination is absolutely preserved. Immunity may be granted consistent with prosecutorial guidelines.)

5. **INSURANCE COMPANIES/ CAR MANUFACTURERS MAY USE THE DATA COLLECTED IN THE AGGREGATE.**

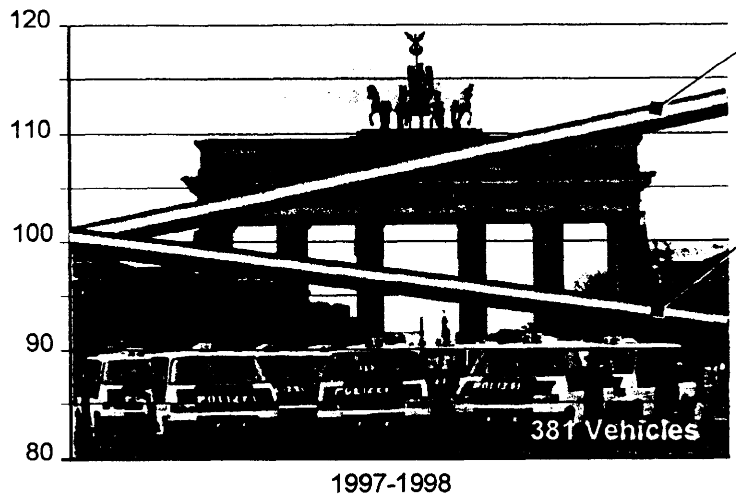
The owner of the vehicle may elect to release his or her information to its insurance company. The marketplace factors of the personal choices of owners/drivers would decide participation. For example, an insurance discount could be offered to a vehicle owner who elects to install an EDR in his or her vehicle.

VDO Kienzle
Slides on their UDS EDR System

Benefits

VDO KIENZLE

For the Fleet (Example: the Berlin Police Department)

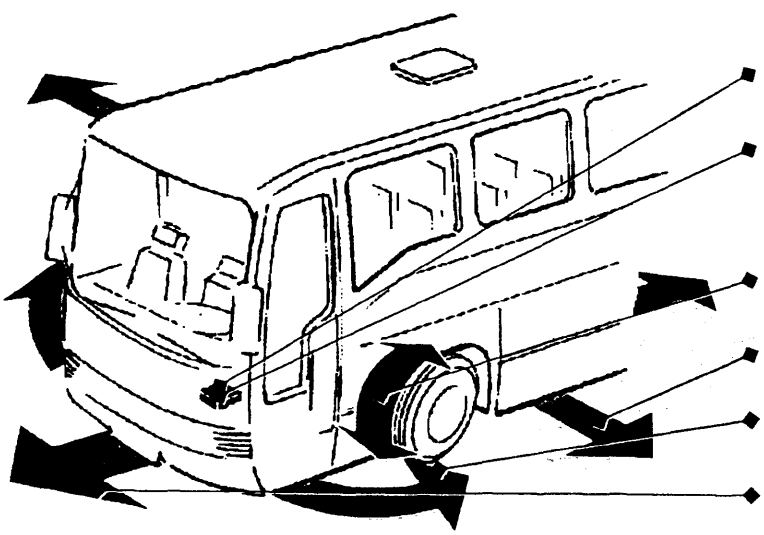


- Damage cases involving vehicles not equipped with the UDS (+13.1%)
- Damage cases involving vehicles equipped with the UDS (-8.4%)

Decrease in direct comparison: approx. 20%

Sensors and Status Inputs

VDO KIENZLE



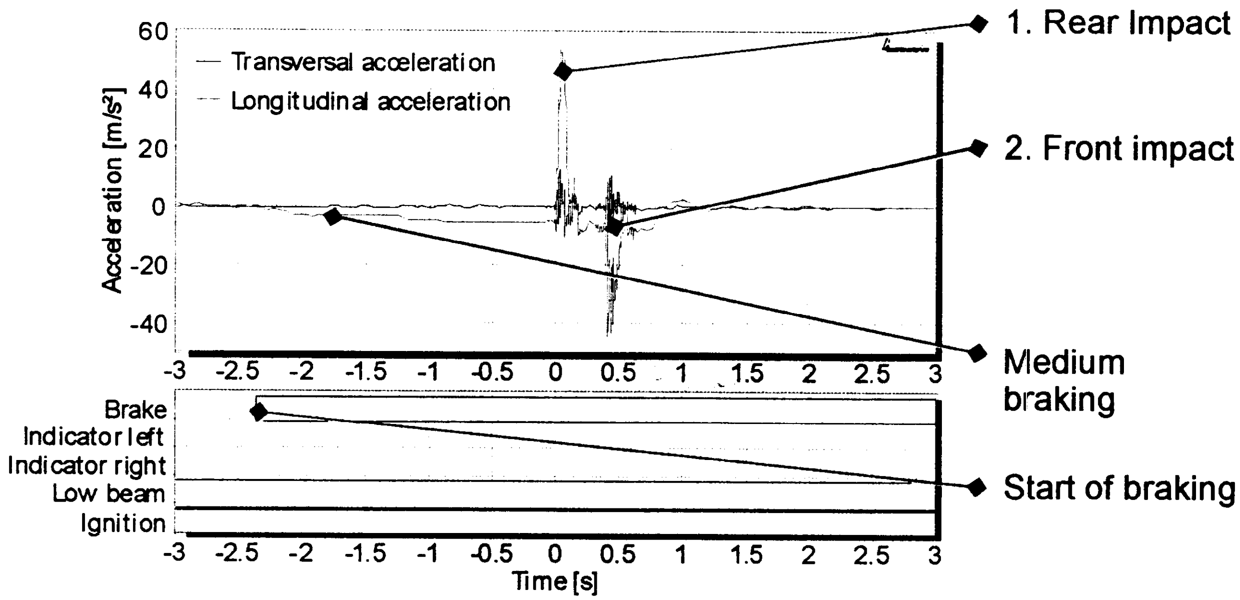
- Date/time
- Status inputs (ignition, light, and so on - up to 10)
- Wheel speed
- Transverse acceleration
- Change of direction
- Longitudinal acceleration

UDS20_001001 6 10 2000 Kast KI43V1/PRO

Example serial collision

VDO KIENZLE

Information in detail



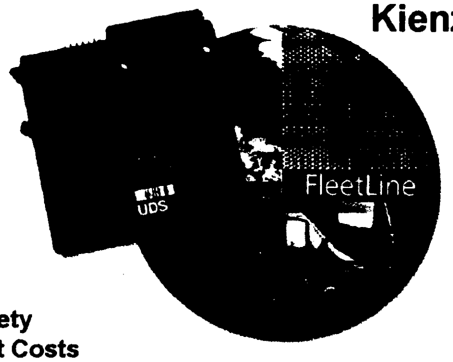
Benefits

VDO KIENZLE

For the fleet

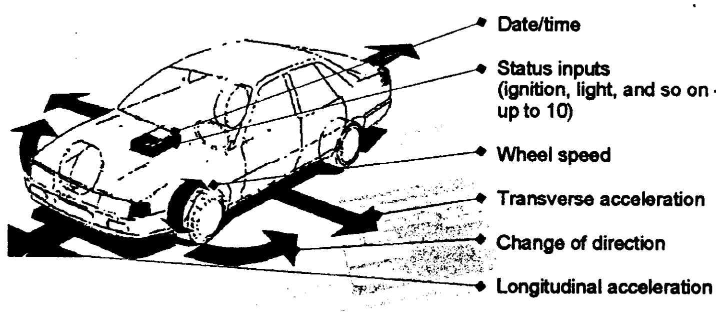
- Economic benefits
- Legal security for the company and its employees
  Transparency in the investigation of damages
  Preventive effect on driving style
- Image
- System for fleet, risk, and accident management

Kienzle UDS

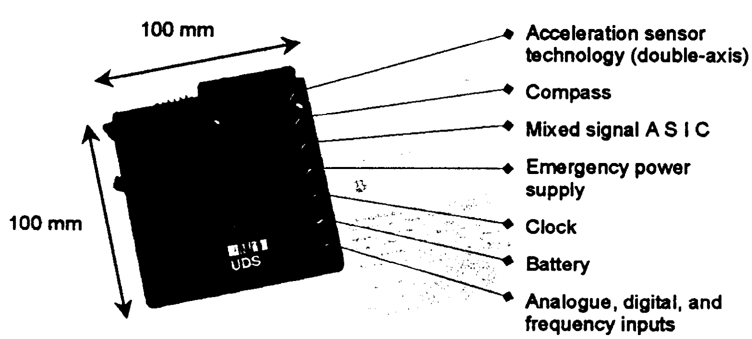


Increase Safety
Reduce Fleet Costs

Sensors and Status Inputs

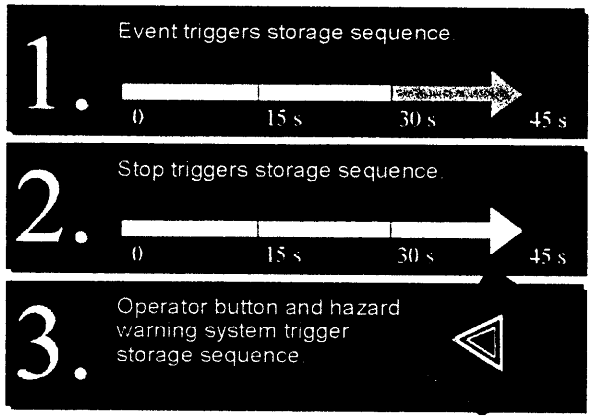


Structure



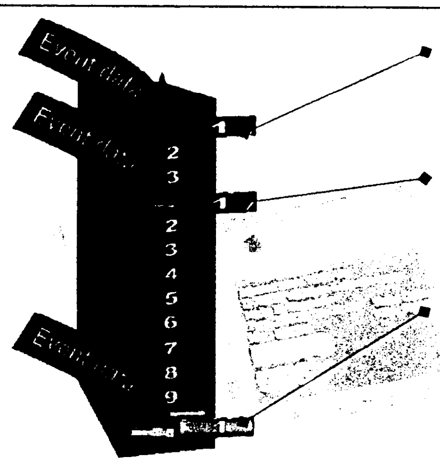
Event Storage

VDO KIENZLE



Memory Size

VDO KIENZLE



Evaluation Design

VDO KIENZLE

- Stationary memory and statistic memory are cyclically overwritten
- Automatically recognised results remain in the memory regardless of their severity

The more severe a result is the longer it remains in the memory

The evaluation and devaluation of the results prevents the memory being blocked by old data which was saved automatically and is no longer required

Statistical Data

VDO KIENZLE

- Ignition on/off (200)
- Events (100)
- Impact (jolt) while stationary
- Activation of the operator button
- Loss of battery current
- Retrieval processes
- Error
- Deletion processes

The date, time and mileage are retained
Use of the statistical data is optional

Technical Data

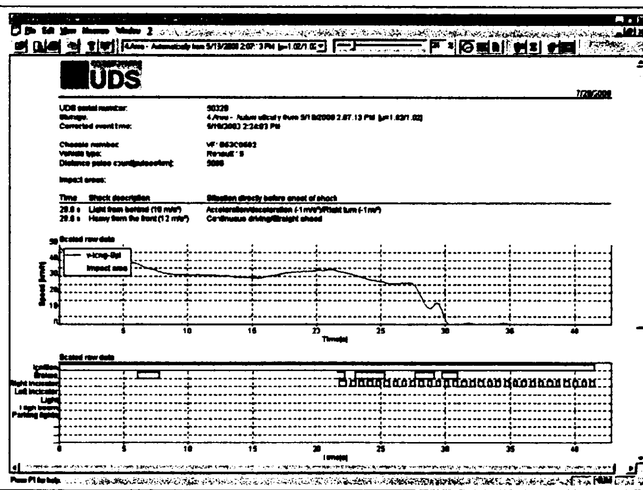
VDO KIENZLE

Dimensions:	100x100x30 (mm)
Weight:	175 g
Voltage range:	10.5-30 V
Power consumption:	3-40 mA
Working temperature range:	-40° bis +85° C
Interfaces:	2 RS 232, signal transmitter, external key
Memory volume:	up to 12 stored records
Storage forms:	automatic, manual, external
Duration of recording	each approx. 45 s + 100 m
Resolution:	16/32/64/256 Hz
Measurement range:	+/- 500 m/s², > 250 km/h

Fleet Software

VDO KIENZLE

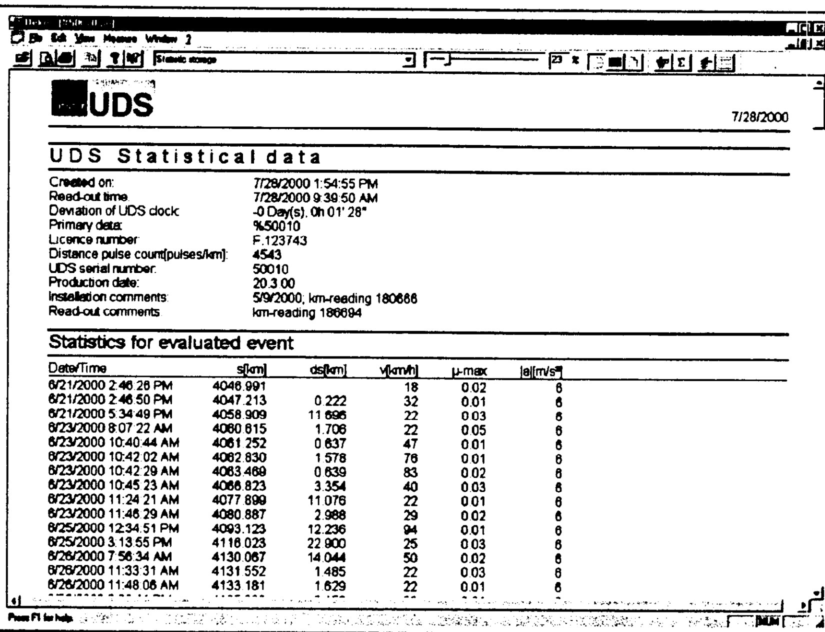
UDShow



Fleet Software

VDO KIENZLE

UDShow



UDS

7/28/2000

UDS Statistical data

Created on:	7/28/2000 1:54:55 PM
Read-out time	7/28/2000 9:39:50 AM
Deviation of UDS clock	-0 Day(s), 0h 01' 28"
Primary data	%50010
Licence number	F.123743
Distance pulse count[pulses/km]:	4543
UDS serial number	50010
Production date:	20.3.00
Installation comments:	5/9/2000; km-reading 180666
Read-out comments	km-reading 186694

Statistics for evaluated event

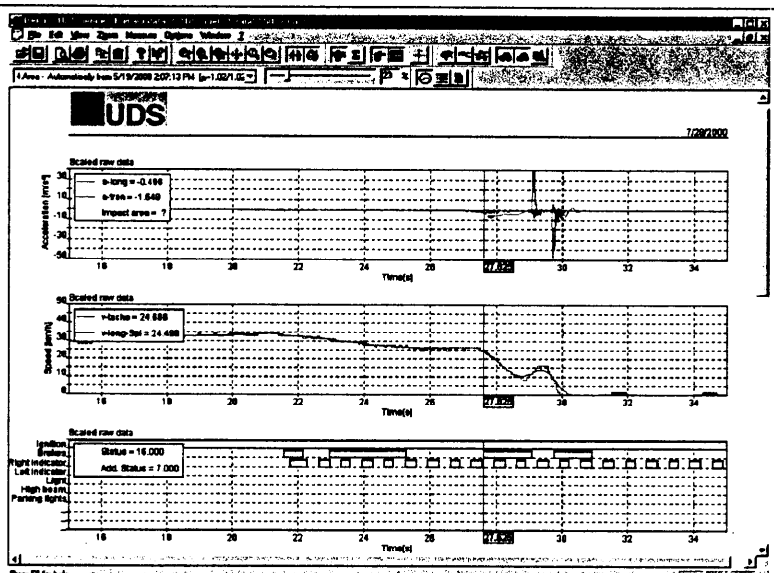
Date/Time	s[km]	ds[km]	v[km/h]	µ-max	|a|[m/s²]
6/21/2000 2:46:26 PM	4046.991		18	0.02	6
6/21/2000 2:46:50 PM	4047.213	0.222	32	0.01	6
6/21/2000 5:34:49 PM	4058.909	11.696	22	0.03	6
6/23/2000 8:07:22 AM	4060.615	1.706	22	0.05	6
6/23/2000 10:40:44 AM	4061.252	0.637	47	0.01	6
6/23/2000 10:42:02 AM	4062.830	1.578	76	0.01	6
6/23/2000 10:42:29 AM	4063.469	0.639	83	0.02	6
6/23/2000 10:45:23 AM	4066.823	3.354	40	0.03	6
6/23/2000 11:24:21 AM	4077.899	11.076	22	0.01	6
6/23/2000 11:46:29 AM	4080.887	2.988	29	0.02	6
6/25/2000 12:34:51 PM	4093.123	12.236	94	0.01	6
6/25/2000 3:13:55 PM	4116.023	22.900	25	0.03	6
6/26/2000 7:56:34 AM	4130.067	14.044	50	0.02	6
6/26/2000 11:33:31 AM	4131.552	1.485	22	0.03	6
6/26/2000 11:48:06 AM	4133.181	1.629	22	0.01	6

Press F1 for help

Evaluation Software

VDO KIENZLE

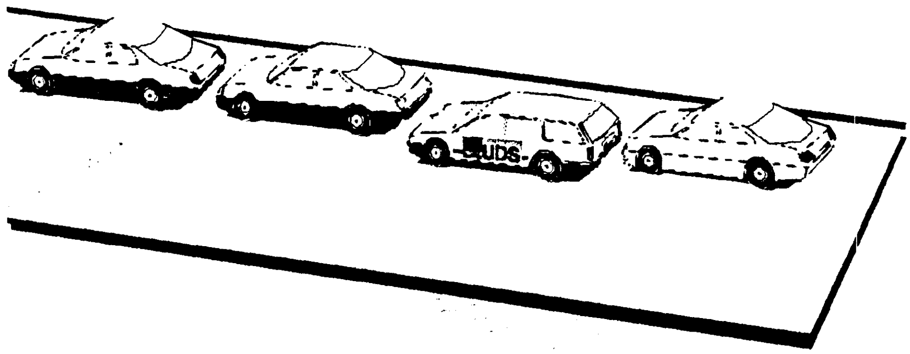
UDScience



Example serial collision

VDO KIENZLE

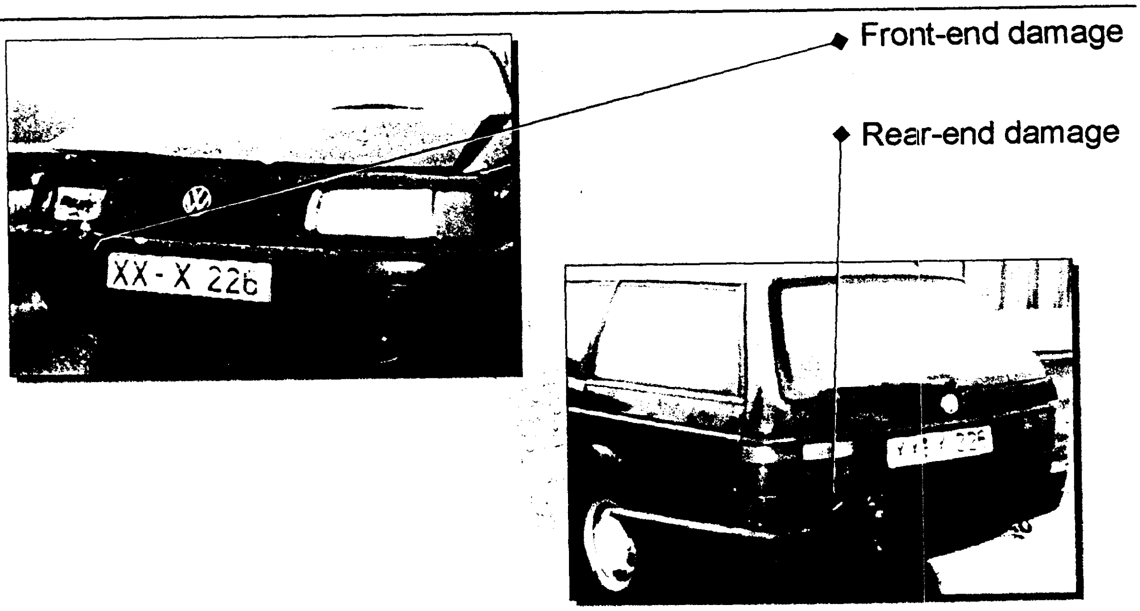
Accident Situation



Serial Collision Example

VDO KIENZLE

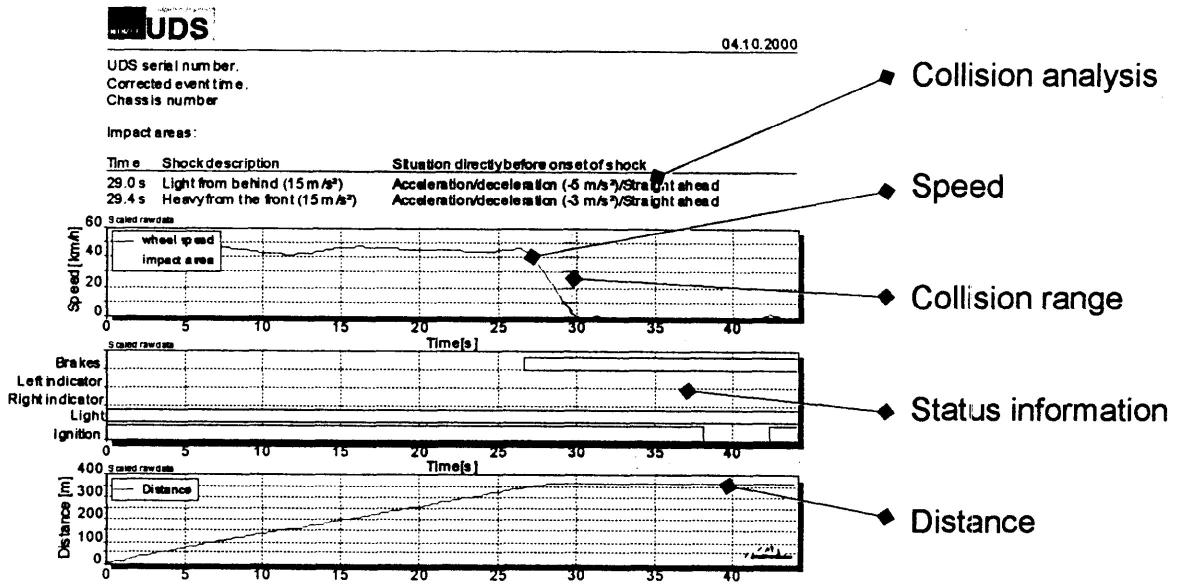
Damages



Serial Collision Example

VDO KIENZLE

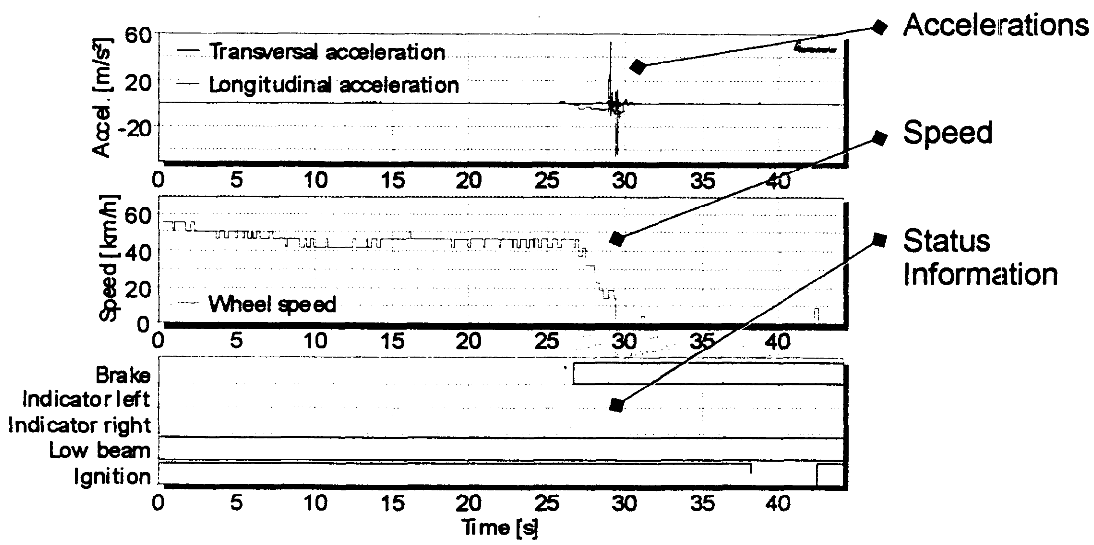
Overview (Immediate Information)



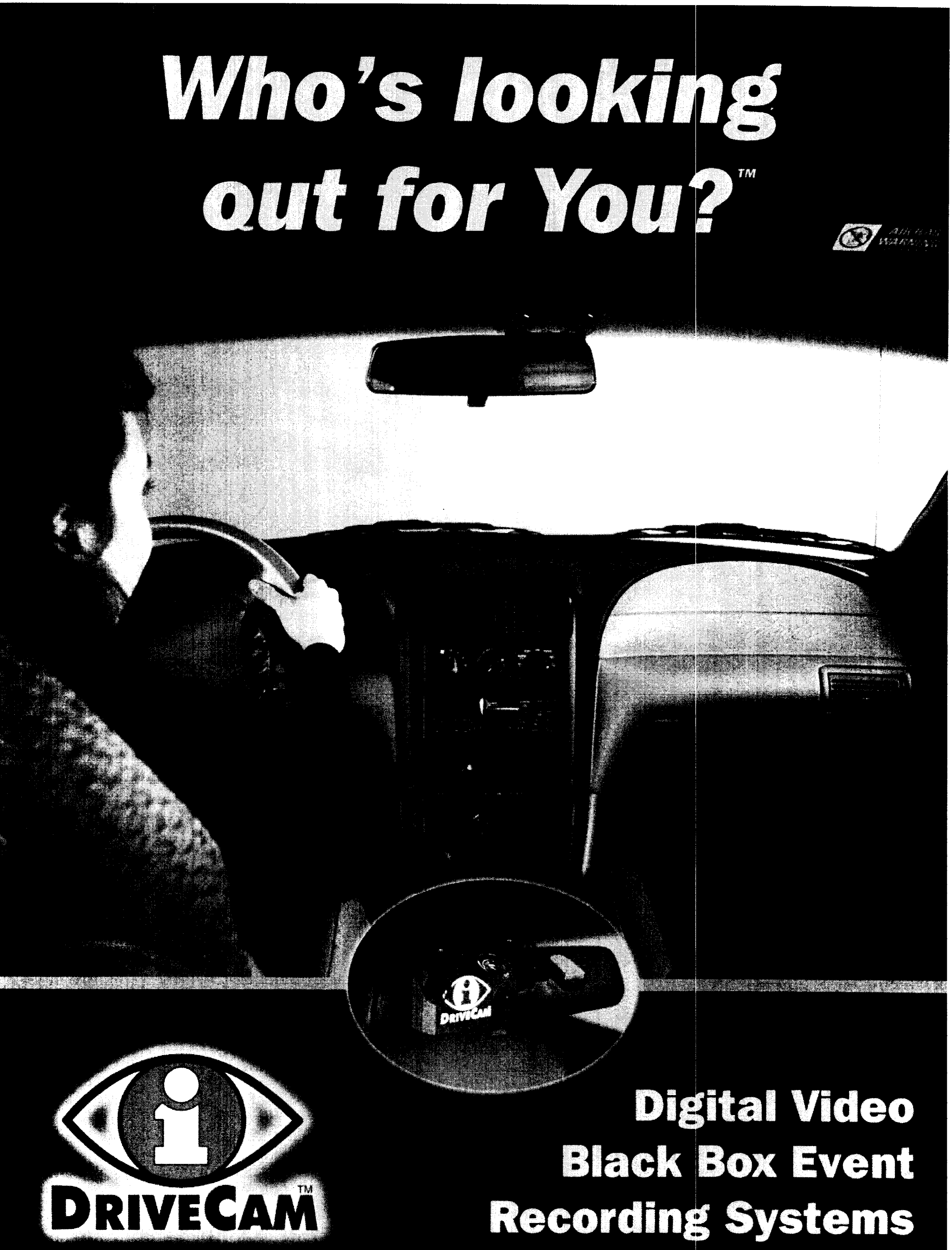
Example serial collision

VDO KIENZLE

Overview ("Raw data")



Who's looking out for you, Drive Cam


Who's looking out for You?™
DRIVECAM
DRIVECAM™
Digital Video
Black Box Event
Recording Systems

What is DriveCam?

DriveCam is a digital video black box recorder that is an effective tool to reduce your fleet operating and liability costs, while preserving property and improving driver safety. DriveCam continuously records video, audio, and four directions of G-forces into a looping digital memory.

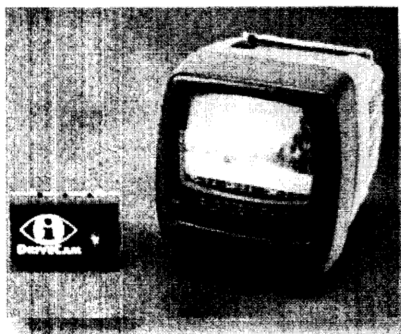
DriveCam automatically records everything that the driver could see, hear, and feel (G-forces) in the 20 second period prior to, during, and after a crash or near miss event. The entire unit is fully self contained in a tiny, rugged black box and installs unobtrusively behind the rear view mirror. The wide angle camera provides the approximate field of view of the driver.

)riveCam installs simply and nobtrusively behind the rearview nirror. DriveCam is watching out the ont windshield every mile you travel.

DriveCam automatically records near-misses or erratic driving habits such as hard braking, acceleration and harsh cornering by sensing excessive G-forces. Identifying these high risk driving habits enables fleet managers to use the video footage for employee training and preventative education to proactively prevent crashes while protecting property and lives.

DriveCam may also be triggered manually by pressing a button to capture any event of interest such as robbery, safety threat, or serious road rage.

No special technical knowledge is required to operate DriveCam. It has the same familiar 'Rewind, Play, Fast-Forward' controls as a VCR and replays on a standard television. When you press the play button, you will see a replay of the 20 second period before, during, and after the recorded event. DriveCam virtually puts you in the drivers seat at the time of the incident. On replay, you experience the same information that the driver had, in order to make his driving decisions. No expert interpretation is required as the video replay is easily understood by anyone, since it is from a human perspective.



)riveCam can be replayed at any ocation with a TV, and may be ecorded to videotape. DriveCam has ne same familiar buttons as a VCR.

A fleet manager may plug an inexpensive portable battery powered TV into DriveCam at any time or place to replay events. This may be done at the scene of the crash or at the depot. DriveCam may also be removed from the vehicle and replayed indoors. DriveCam's replay can be recorded directly onto videotape for long-term storage.

DriveCam is completely digital, with no maintenance required, and has no moving parts to wear out. There are no videotapes to change or rewind.

Vhen it comes to the crunch,)riveCam delivers a crisp, clear video, udio, and G-Force replay before, uring, and after the incident.)riveCam gives you the full picture.

What's in it for the Driver?

Traditionally, when a fleet driver is involved in a crash, they may be put on probation, suspension, or administrative work while the crash investigation is pending. If suspended, they will lose their income during the investigation. If it is determined that the fleet driver was responsible (Either correctly or incorrectly determined), they may be terminated or no longer allowed to drive. Their driving record and insurance rating would also be adversely affected, along with their income.

DriveCam is rugged, compact and fully self contained. Installation is very simple.

Prior to DriveCam, crash investigators based their determination of responsibility on 'educated best guesses' derived from human witnesses, skid marks, and vehicle damage. All of these methods are prone to wide interpretation or variability. Human eyewitness testimonies are notoriously unreliable. Due to the rapid and shocking nature of witnessing crashes, two honest individuals often give conflicting testimonies.

Having the hard, clear ***FACTS***, being able to ***SEE*** exactly what happened will prevent innocent drivers from being incorrectly blamed. DriveCam can exonerate and protect the jobs and records of good drivers who would have been otherwise incorrectly accused of being responsible for crashes.

Be prepared for the unexpected. DriveCam can be triggered automatically or manually to record events of interest ***after*** they have occurred.

DriveCam improves transportation safety for drivers by facilitating better driver training and education, which aids in reducing the frequency and severity of crashes. DriveCam promotes conscientious driving.

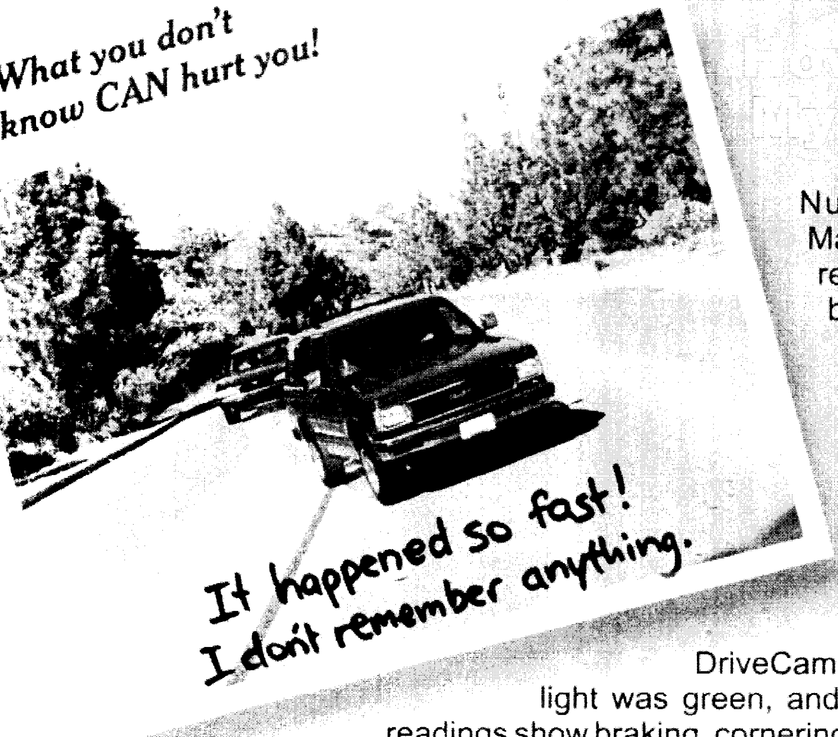
How can DriveCam Reduce My Fleet Operating Costs?

DriveCam is designed to actively reduce the largest unnecessary fleet operational costs. Fraudulent claims, staged crashes, or incorrect blame for crashes can be extremely costly to companies when lawsuits and large payouts are involved. Unfortunately, it is often assumed that companies have 'deep pockets', and they often end up paying. It is not uncommon to hear of a company going out of business from a single large lawsuit. Staged crashes are common. According the National Insurance Crime Bureau (NICB) 17-20% of insurance payouts go towards paying fraudulent or exaggerated claims.

DriveCam records from a human perspective - everything the driver could see, hear and feel. The video replay is easily understood by anyone, without the need for expert interpretation or technical knowledge.

DRIVECAM™

We are looking out for You



How can DriveCam [illegible] My Fleet Operating [illegible]

Numerous studies in Europe by VDO-Mannesmann have consistently shown a **20-30%** reduction in crashes in vehicles fitted with black box recorders. Drivers are aware that they are being held accountable, and correspondingly drive more responsibly. Damage reductions alone could pay for DriveCam in a short period of time. Many insurance companies will give rate discounts for black box or video recording systems.

DriveCam can prevent your company from being incorrectly blamed for crashes. DriveCam's video replay can clearly show that the traffic light was green, and the drivers position in the lane. The G-force readings show braking, cornering, evasive maneuvers, and the magnitude of any impacts. The video replay is very simple for anyone to understand and does not require expert interpretation. The replay shows the incontrovertible facts in a time sequential manner. The evidence is more powerful than human eyewitness testimonies - which may be distorted. DriveCam can pay for itself by saving on insurance rates and deductible payments due to incorrect blame.

DriveCam is designed to be a crash prevention tool as well as a legal defense tool. DriveCam can be set to identify and record erratic driving or 'near-miss' events such as hard cornering, acceleration, or hard braking. All of these events are 'high risk' styles of driving and indicate either reckless, erratic driving, or inattentiveness. This harsh style of driving increases fuel consumption, wear and tear, freight damage, and greatly increases the risk of being in a crash. DriveCam allows fleet managers to identify habitually higher risk drivers to address their ongoing risk to the company.

There are Many Ways that DriveCam Reduces Fleet Operating Costs:

- **Lower fleet risk of liability in crashes.**
- **Eliminate fraudulent claims and identify staged accidents.**
- **Reduce vehicle wear and tear by encouraging smoother, safer driving.**
- **Reduce crashes and repair costs by promoting safe driving due to greater accountability.**
- **Use recordings for employee training and proactive crash prevention education.**
- **Enable knowledgeable defense of lawsuits when your driver is at fault.**
- **Identify erratic drivers - reduce ongoing risk to the company.**
- **Record criminal events such as robbery or serious road rage.**
- **Reduce damage to fragile freight caused by harsh driving.**
- **Improve employee moral by preventing incorrect blame.**
- **Eliminate unnecessary payout of deductibles.**
- **Reduce insurance premium rates through discounts for recording technology.**

WITNESS INCORPORATED™

DriveCam Video Systems
9550 Ridgehaven Court
Suite A
San Diego, CA 92123 USA

Phone: (858) 430-4000
Fax: (858) 430-4001
Email: 'info@drivecam.com'
Web: 'www.drivecam.com'

Committed to Transportation Safety

DriveCam Speeds Processing and Reduces Costs of Insurance Claims

- Video event recording system helps identify fault and promote safe driving -

SAN DIEGO, Calif. – January 19, 2001 – DriveCam Video Systems, an innovator in vehicle safety systems, today announced that the company's DriveCam video event recorder has been proven to reduce the administrative and investigative costs in processing insurance claims for fleet operators. A component of the company's complete driver safety program, DriveCam is a palm-sized video recorder mounted behind a vehicle's rearview mirror that captures everything a driver sees and hears in the 20 seconds before, during and after an accident. The unit's wide-angle camera is triggered by G-forces caused by unsafe driving or an accident, referred to as an "event."

DriveCam's digital recording allows police and insurance investigators to easily view an event on a TV, VCR or personal computer. Seeing and hearing an event just as the driver did provides them with information critical to determining fault. DriveCam's event recordings are being used to dramatically reduce the time required to process insurance claims, thus lowering costs for insurance companies and the fleets they insure.

Cloud 9 Shuttle of San Diego has used the DriveCam event recordings to settle insurance claims, including a multiple vehicle accident. In several cases, the Cloud 9 van was first accused of causing the accident. However, the DriveCam video clearly showed that another vehicle was at fault. Cloud 9's insurance claims representative used the video and amended police reports to quickly negotiate the claim.

"Settling these claims without the DriveCam recording would have taken months and would have resulted in our insurance carrier making payments for the other vehicles," said Mike Forbush, vice president of operations for Cloud 9 Shuttle. "With just one driver's word against another, the insurance carrier usually pays at least 50 percent of the damage. In a multiple vehicle collision, that can include every vehicle that was damaged and any bodily injury. With the DriveCam recording, our carrier was able to settle these claim in days, without making a payment."

In addition to lowering claims processing costs, DriveCam has the potential to significantly lower the amount of fraudulent claims. According to an Insurance Information Institute report, property/casualty insurance fraud totaled an estimated $24 billion in 1999, or about 10 percent of claims. The report states that fraud is more prevalent in auto insurance, where the large number of relatively small claims that must be processed by insurance companies within a short period of time provide opportunities for fabricating medical and auto repair bills or auto theft reports.

"One of the problems in reducing fraud is that it is difficult to determine who is at fault," said Ed Andrew, president of DriveCam Video. "Our DriveCam video event recording system captures the human experience and provides an objective view of what occurred that is indisputable."

The DriveCam video event recorder was developed to promote driving safety, security and accountability. DriveCam is used by fleets as a part of a complete Driving Feedback System that provides drivers and their managers with accurate, unbiased feedback on their driving performance. The program includes a manager's guide, driver guide, videotape and Event Manager software for logging and tracking vehicle events. Fleets using this program have experienced a reduction in accidents due to increased driver awareness and training.

About DriveCam Video Systems

DriveCam Video Systems is an innovator in the development of vehicle safety products that improve driver and traffic safety. Based in San Diego, the company's DriveCam video event recorder is part of a complete Driving Feedback System used by vehicle fleets to promote safety and reduce accidents. Additional information is available at www.drivecam.com.

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Media Contacts:

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DriveCam Video Systems
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eandrew@drivecam.com

Valerie Chereskin
PR Consultant
(760) 942-3116
vcmail@ix.netcom.com

ACE USA
Claims
55 Haddonfield Rd.
Suite 210
Cherry Hill, NJ 08002

(856)755-6301 *tel*
(856)755-6088 *fax*

www.ace-ina.com

Tami Millaway
Claims Representative

December 20, 2000

Mr. Ed Andrew, President
DriveCam Video Systems
9550-A Ridgehaven Ct.
San Diego, CA 92123

Dear Mr. Andrew:

Recently, a fleet vehicle insured by our company and protected by one of your DriveCam units was involved in a 3-vehicle collision. There was conflicting testimony about who was responsible for causing the collision. The investigating law enforcement officer filed his initial report indicating our insured's driver at fault. After reviewing the DriveCam recording, the officer realized that one of the other drivers had given false information and was responsible for causing the collision. The police officer then filed an amended report exonerating our insured and their driver. Our insured provided me with a copy of the DriveCam recording, which I used in negotiating this claim.

Settling this claim without the DriveCam recording would have taken me several months and surely would have cost us a large payout to the other vehicles. By having irrefutable proof that our insured driver was not negligent in any way, I saved time and expense. With the DriveCam recording we were able to settle this claim in several days with no expense and without making a payment.

I also just received another claim file wherein the other party contended that our insured vehicle rearended his vehicle. The damage to both vehicles certainly would have supported his contentions. However, in viewing the DriveCam recording of the accident, it was proven that the other party changed lanes directly into our insured's vehicle, thus causing the accident. The other party's claim has been denied, and our insured is now going through the other insurance carrier for the damages sustained to their vehicle. Again, the outcome of this case would have been very different had it not been for the DriveCam system.

I wanted to let you know that your DriveCam system is fabulous! It has protected and benefited our insured, their drivers and us.

Good luck in the future!

Very truly yours,

Tami Millaway

Tami Millaway
Claims Representative

MONMOUTH–OCEAN HOSPITAL SERVICE CORPORATION
151 INDUSTRIAL WAY EAST • BUILDING C • EATONTOWN, NEW JERSEY 07724
PHONE: 732-578-9800 • FAX: 732-578-9822 • INTERNET: WWW.MONOC.ORG

A Cooperative Venture to Improve Health Care and Reduce Costs

July 21, 2000

Brent Haywood
Drive Cam Inc.
5985 Dandridge Ln.
#110
San Diego, California 92115

Dear Brent:

I wanted to pass along to you our positive experiences with your product. When we first installed the cameras into our ambulances, our staff thought it was a way management would be watching them. They soon realized that unless they drove our vehicles inappropriately, we were not watching them. In the beginning, we had some employees attempt to trigger the camera by driving the vehicle erratically. When those employees were brought into my office to review the video, they quickly realized how foolish their actions were. Any future incidents were followed up with disciplinary action. Suddenly, there were no more incidents of abuse.

Having the cameras in the vehicles makes our staff drive the vehicles as they were intended to be driven. This saves on fuel, brakes and general wear and tear expenses. I must tell you that the camera helped us investigate a motor vehicle accident, which occurred while one of our ambulances was responding to an emergency call. Our unit approached an intersection with lights and sirens activated. The unit came to a complete stop because the light was red. After all vehicles yielded to our ambulance, they proceeded though the intersection and were struck by a vehicle that passed the stopped cars. When the police arrived, the gentleman who hit our ambulance told them that we did not have our lights and sirens on and that we ran the red light. The police officer came to our office and reviewed the video, which showed the ambulance making a complete stop at the red light and proceeding cautiously through the intersection. He was also able to hear the sirens blaring and the lights reflecting off the hood of the ambulance. The driver of the car that struck our ambulance was issued a failure to yield to an emergency vehicle as well as inattentive driving and passing on the right.

We will be budgeting for additional units for next years capital budget. I am certain they will provide similar positive experiences. Thanks again!

Sincerely,

JBehm

Jeff Behm
Director of Operations

TRAN-STAR EXECUTIVE

TRANSPORTATION SERVICES INC.

P.O. BOX 2574 N.BABYLON, NY 11703 • (516) 243-3800 OR (800) 894-STAR

Mr. Brent Heywood
DriveCam Video Systems
3505 Camino Del Rio South
Suite 350
San Diego, California, 92108

November 29, 2000

Dear Brent,

I wanted to write to share some exciting news with you. After 2 months of having the DriveCam Video Cameras in our vehicles, the results have surpassed our wildest expectations. Our rate of collisions have decreased dramatically. We were averaging 1 at fault collisions per week with our fleet of 65 vehicles. I can honestly say that we have not had an at-fault collision in the past 6 weeks. The mere presence of the cameras in the vehicles has forced our Drivers to operate the vehicles in a safer manner. We also expect to realize maintenance savings as well. We haven't had to send a vehicle for alignment in the past month. I know that I was a skeptic, and now you have convinced me. **THE SYSTEM WORKS!!**

Please feel free to use my company <u>at any time</u> as a reference. I have spent 35 years in this business and I have never seen a product work this well! My congratulations and my THANK YOUs!

Sincerely,

Steven F. Paul
President and CEO
Tran-Star Executive

Agenda

NHTSA R&D - Truck and Bus Event Data Recorder WG
Meeting # 3
Florida Atlantic University, Boca Raton, FL

February 16, 2001, 8:30 am – 4 pm
(Tom Oxley Athletic Complex Building)

Morning

8:30 Coffee & Bagels

9:00 Welcome
- Host (FAU and Forensic Accident Investigations)
- Self introductions - please sign in

Docket Information - Public process - handouts will go in docket
- dms.dot.gov Docket# 7699
  - -Item 1–August 9, 2000 (Meeting 1 agenda, copy of TMC RP1212, Crash Survivable Module for Trucks and Buses - Smiths Industries, MAC Box description)
  - -Item 2–October 25, 2000 (Minutes from Meeting #1, VDO Presentation, NTSB Presentation, Enhanced Highway Safety via Event Data Recorders, Transportation Event Data Recorders)

9:30 TMC activities - Draft RP discussion
- William Schaefer (NHTSA)

9:45 Smiths Industries
- Barry Casey and Jim Elliott

10:15 Break

10:30 Update on Current EDR Technologies
- Robert McElroy, President, Forensic Accident Investigations
- Tony Reynolds, VDO North America

11:15 Emerging Technologies & Applications
- Ricardo Martinez, CEO, Loss Management Services
- Frank Coyne, President, Insurance Services Office

12 Lunch (*Provided*)

Afternoon

1:00 Objectives of working group - objective handout

1:30 Data and Definitions

Discussion Data Variables
- Review of survey - survey handout
- Additional data needs - full list handout

Data Definitions
- What data and related names need to be defined
- Discuss definitions

Break out sessions
- 6-10 interested participants
- 2-3 mini meetings (Mar-Aug)

3:30 General Discussion - New Business
- Next meeting - Location - Date - (possible Washington DC area in the Fall)
- Topics for next meeting - results of breakout sessions
- EDR Draft Report - copies on disk
- Round Robin test series of EDRs at VRTC, East Liberty, OH

Event Data Recorder (EDR) Issues and Recommendations
Smiths Group

Smiths Group

Event Data Recorder (EDR) Issues & Recommendations

IMS Division Of Smiths Group

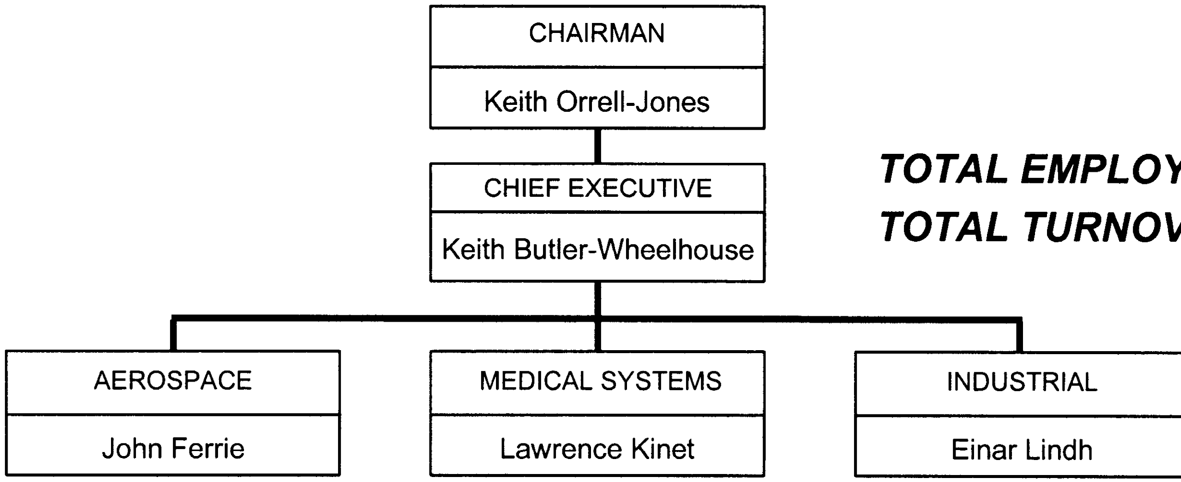
February - 2001

Outline

- **Smiths Aerospace - IMS Overview**
- **Recorder History & Evolution**
- **Most Wanted Transportation Safety Improvements**
- **EDR Design Issues**

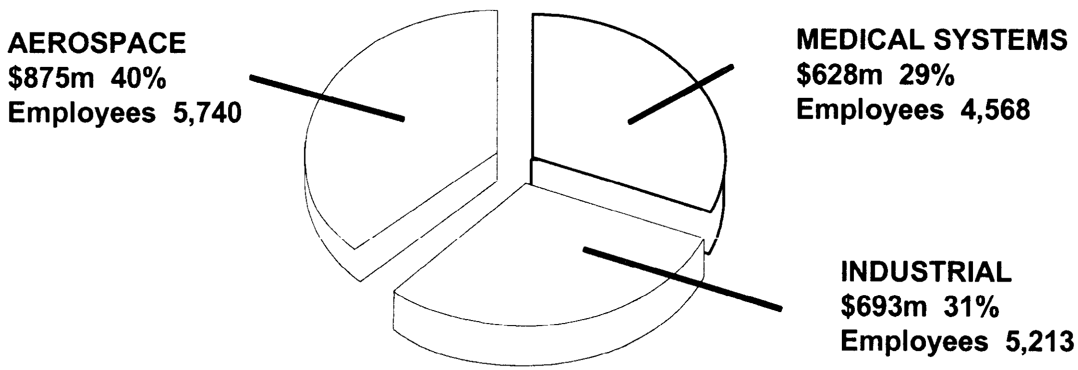
  Crash survivability
    - impact shock
    - penetration
    - crush
    - fire
    - fluid immersion
    - some statistics
- **Negligible cost differential to crash protect the memory**
- **Overall Summary & Recommendations for EDR**

Smiths Group plc



TOTAL EMPLOYEES 15,500

TOTAL TURNOVER $2.19b



World Class Management

"Best Managed Mid-sized Aerospace Company"

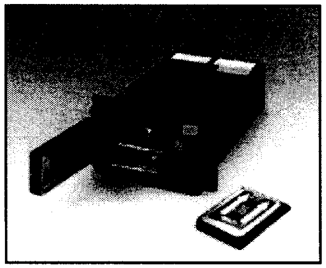
Aviation Week & Space Technology - 1998 & 1999

"The World's 100 Best-Managed Companies"

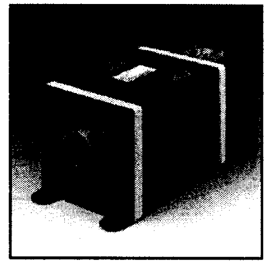
Industry Week - 1997, 1998, 1999 & 2000

IMS Data Management Systems

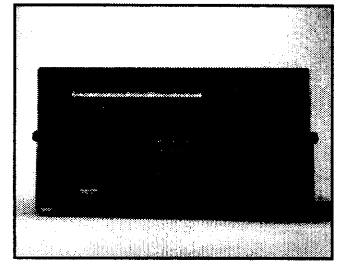
Data Transfer Systems

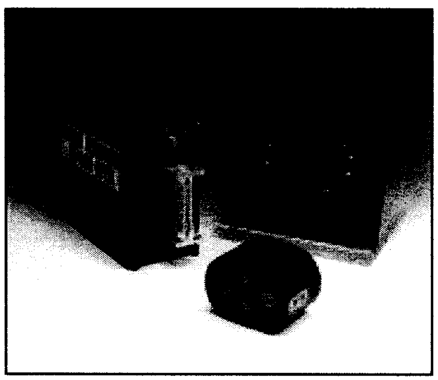


Data/Voice/Video Acquisition & Recording

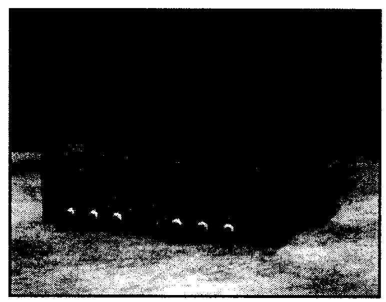


Engine Balancing Systems

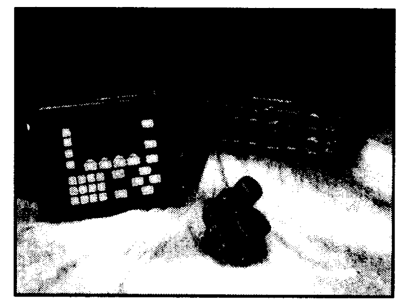




Health & Usage Monitoring Systems



Gear Box Diagnostics Systems & Structural Fatigue Monitoring Systems



Rotor Track and Balance Systems

Recorder History & Evolution

- **The "Black Box"**
- **Aviation Recorders in existence over 40 years**
- **FDR 25 hour record requirement**
  - ⇨ Based on the round trip distance from NY to Japan
  - ⇨ Based on the round trip distance from LA to Europe
- **Evolution of crash survivability requirements**
  - ⇨ Impact Shock Levels
    - 100g
    - 1000g
    - 1700g
    - 3400g
  - ⇨ Fire Levels
    - 30 minutes 1100 deg C flame
    - 60 minutes 1100 deg C flame
    - 10 hr 260 deg C

Recorder History & Evolution (Cont'd)

- **Number of recorded parameters expands**
  - ⇨ 5 parameters on 1st generation FDRs
  - ⇨ 11 Parameters
  - ⇨ 17 - 34 parameters (depends on A/C passenger size)
  - ⇨ 57 - Transports manufactured after 2000
  - ⇨ 88 - Transports manufactured after 2002
  - ⇨ (Current capability exceeds 1400 parameters)
- **Evolution of recording media**
  - ⇨ Metal foil
  - ⇨ Magnetic tape
  - ⇨ Semiconductor devices (dramatic density and reliability improvements)
- **Addition of audio recording (1966/67)**
- **10 minute power supply hold up (RIPS)**
- **Proposed inclusion of video imagery recording**

Most Wanted Transportation Safety Improvements

NTSB Re: Commercial Truck and Bus Safety Recommendations

- **H-99-53 (NHTSA) Require that all school buses and motorcoaches manufactured after January 1, 2003, be equipped with on-board recording systems that record vehicle parameters.............The on-board recording system should record data at a sampling rate that is sufficient to define vehicle dynamics and should be *capable of preserving data in the event of a vehicle crash or an electrical power loss.***

Most Wanted Transportation Safety Improvements (Cont'd)

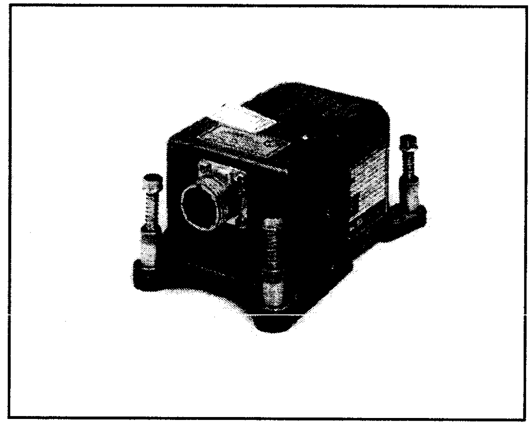
NTSB Re: Commercial Truck and Bus Safety Recommendations

- **H-99-54 (NHTSA) Develop and implement, in cooperation with other government agencies and industry, standards for on-board recording of bus crash data that address, at a minimum, parameters to be recorded, data sampling rates, duration of recording, interface configurations, data storage format, incorporation of fleet management tools, *fluid immersion survivability, impact shock survivability, crush and penetration survivability, fire survivability*, independent power supply, and ability to accommodate future requirements and technological advances.**

Crash Survivability - Physics of Crash Environment

- Impact
- Penetration
- Static Crush
- Fire
- Fluid Immersion

→ **Only the Memory Requires Protection**



Crash Environment Comparisons

Crash Sequence*	Aircraft	Ships	Trucks / Busses
Impact Shock	3400g, 6.5 msec	50g, 11 msec	300g, 50 msec
Penetration	0.25" pin, 500 lb, 10 ft	3.94" pin, 551 lb, 9.84 ft	0.50 pin, 200 lb, 3 ft
Static Crush	5000 lb, all angles	None	500 lb, all angles
High Level Fire	1100 deg C, 1 hr	1100 deg C, 1 hr	900 deg C, 20 min
Low Level Fire	260 deg C, 10 hrs	260 deg C, 10 hrs	260 deg C, 5 hrs
Deep Sea Immersion	20,000 ft, 30 days	20,000 ft, 30 days	100 ft, 10 days
Fluid Immersion	Various Fluid Types	None	Various Fluid Types

***Crash Sequences and Levels for Aircraft & Ships are established standards, and hardware is currently built to these numbers**

Levels for Trucks / Busses are our recommended levels

Crash Survivability for EDR

- **Large truck crash statistics indicate the need for EDR crash survivability**
  - ⇨ 412,000 Crashes Involved Large Trucks in 1998 (4,935 Fatal)
  - ⇨ 444,000 Crashes Involved Large Trucks in 1997 (4,871 Fatal)
- **Due to their severity and the resultant loss of life, fatal crashes will have the most attention focused on prompt and reliable recovery of the data**
- **Crashes involving <u>Fire Occurrence</u>, <u>Front Initial Point of Impact</u>, and <u>Rollover</u> pose the greatest threat to the survivability of the EDR data**

Large Truck Front Initial Point of Impact Collisions

- **Potential to Induce Mechanical Damage to the EDR**
  - ⇨ 1998 - 62.0% of Large Truck Fatal Crashes Involved Front Initial Point of Impact
  - ⇨ 1998 - 123,000 Front Initial Point of Impact for All Crash Severities (Fatal/Injury/Property Damage)
  - ⇨ 1997 - 63.0% of Large Truck Fatal Crashes Involved Front Initial Point of Impact
  - ⇨ 1997 - 122,000 Front Initial Point of Impact for all Crash Severities (Fatal/Injury/Property Damage)

Large Truck Rollovers

- **Potential to Induce Mechanical Damage to the EDR**

  ⇨ 1998 13.8% of Large Truck Fatal Crashes involved Rollover Occurrence

  ⇨ 1998 19,000 Rollovers for all Crash Severities (Fatal/Injury/Property Damage)

  ⇨ 1997 14.0% of Large Truck Fatal Crashes involved Rollover Occurrence

  ⇨ 1997 16,000 Rollovers for all Crash Severities (Fatal/Injury/Property Damage)

Large Truck Fire Occurrence

- **Potential to Induce Thermal Damage to the EDR**

⇨1998 5.7% of Large Truck Fatal Crashes involved Fire Occurrence

⇨1998 2,000 Large Truck Fire Occurrences for all Crash Severities (Fatal/Injury/Property Damage)

⇨1997 4.5% of Large Truck Fatal Crashes involved Fire Occurrence

⇨1997 1,000 Large Truck Fire Occurrences for all Crash Severities (Fatal/Injury/Property Damage)

Cost Differential for Crash Protection

- Current design is a 3” cube
- Retains the last 96 hours of data
- Cost differential to crash protect this design is minimal

The cost differential to crash protect the EDR memory is negligible and will increase the probability of recovering vitally needed data!

Overall Summary & Recommendations for EDR

- We recommend making the EDR memory Crash Survivable
- The additional cost for crash survivability is insignificant
- The additional cost to store 96 hours of data or more is insignificant
- Identify most survivable EDR installation location, however, crash survivability allows more installation flexibility

Overall Summary & Recommendations for EDR (Cont'd)

- Common data bus for parameter acquisition needed
- Analog sensors for data acquisition are already in place
- Identify data retrieval process
- Data recovery should be standardized (fewer H/W & S/W tools for NTSB or recovery team)
- Multipurpose use for recorded data (maintenance, usage, performance, time logger)
- Central repository for data storage

Status of EDR Technology

Robert McElroy
Forensic Accident Investigations, Inc

EDR - Event Data Recorder Update

Robert C. McElroy, Ph.D.

Forensic Accident Investigations, Inc.

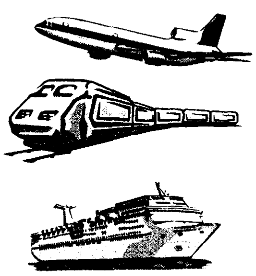
February 16, 2001

NHTSA R&D - Truck & Bus EDR WG Mtg. #3WG #3 2/16/2001 1

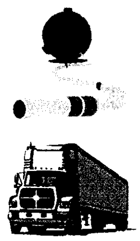
Pandora's Box -- ???

2

Transportation Recorders



- Aviation
- Railroad
- Marine
- Pipeline
- Highway



3

Flight Data Recorders

- First regulation calling for FDR, 1940
- Rescinded in 1944 due to lack of suitable recorder
- First commercially available FDR 1953

4

Rail Data Recorder

- Onboard and wayside locations
- Records engineer action & train condition
- Records rail & environmental condition
- Remote testing & predictive maintenance
- Field based & office based tools
- Integrated office & field alarm reporting and management system

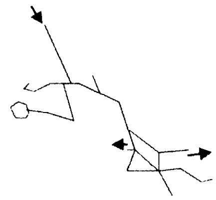
5

Voyage Data Recorder

- NTSB promoted use of event recorders since 1970's.
- Voyage data recorders provide accident data and serve as a management tool.
- 95% of world's trade, in weight, travels by sea.

6

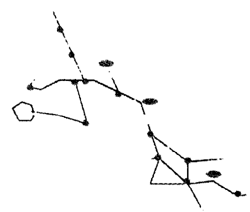
Oil & Gas Pipeline Data Recorders



- Large geographical area
- Wellhead to distribution
- Nationwide grid
- Continuous monitoring
- Environmental
- Strategic movement
- Regulatory data

7

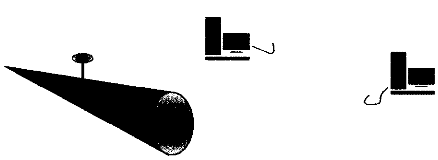
Transmission System Components



- Pipeline
- Valves
- Compressors
- Storage

8

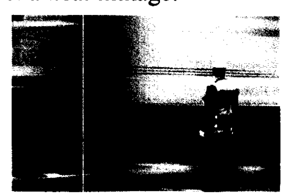
Pipeline Data



9

Technology Advance

- Computer on wheels.
- Elimination of mechanical linkage.
  - Throttle-by-wire.
  - Steer-by-wire.
  - Brake-by-wire.
  - Shift-by-wire.



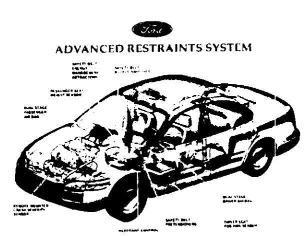
10

EDR Technologies

- Tachographs
  - Traditional
  - Electronic
- On Board Computer
  - Engine data
  - Trip
- EDR -- Event Data Recorder

11

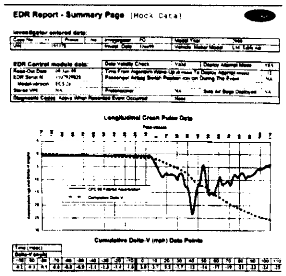
Ford Type I EDR Event Data Recorder



Ford EDR
- 2000 Taurus
- 2000 Sable
- 2000 F-150

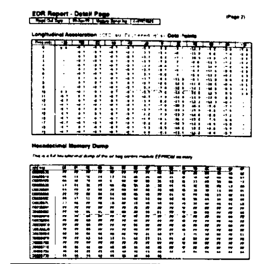
12

Longitudinal Crash Pulse Data



13

Numeric Data



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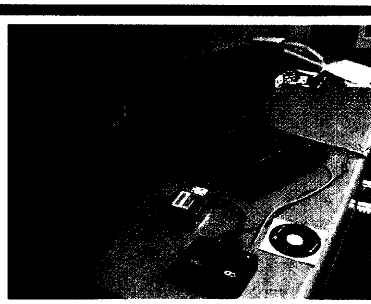
Equipment



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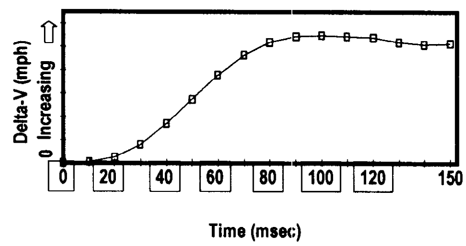
Crash Pulse



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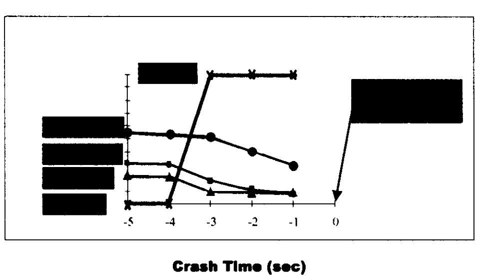
Pre-Impact Data



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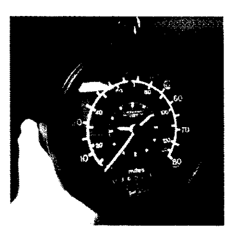
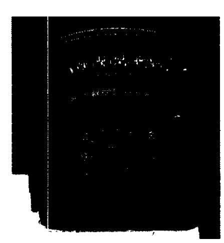
Traditional Tachographs





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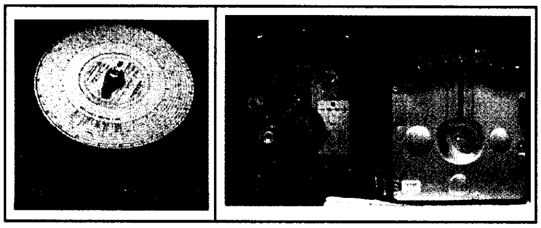
Tachograph Technology



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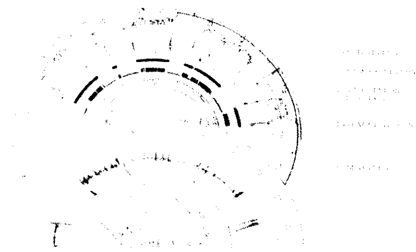
Tachograph Analysis



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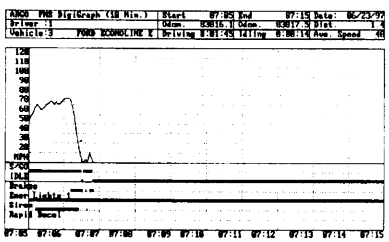
Electronic Tachograph



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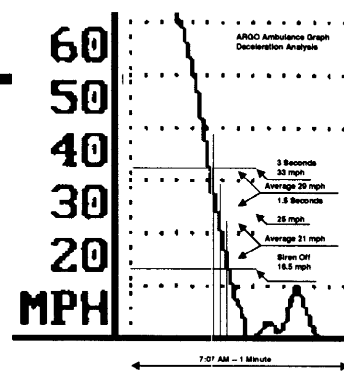

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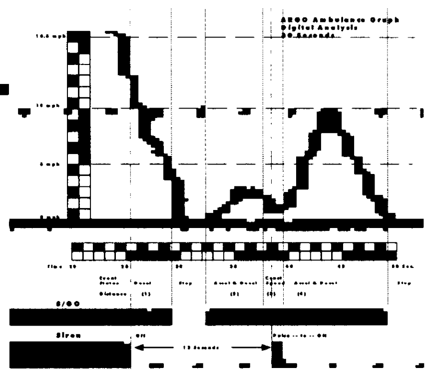

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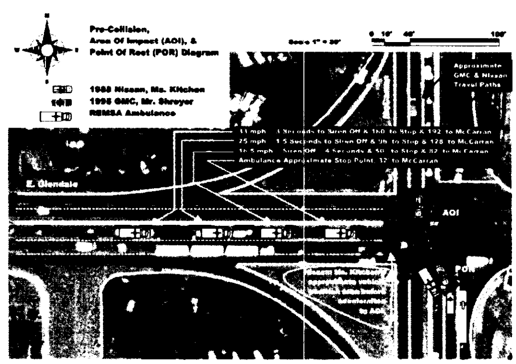

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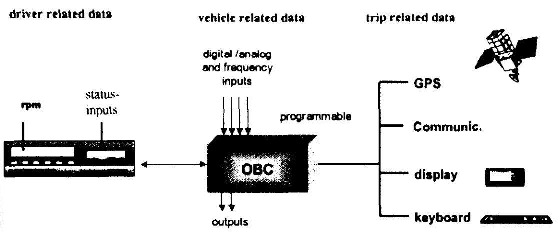
On-Board Computer



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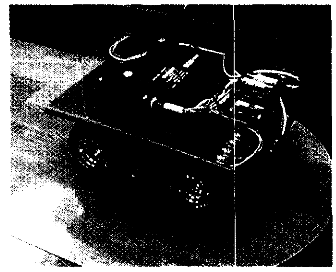
VDO EDR Test Model



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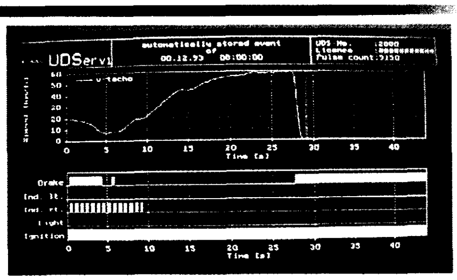
General EDR Data



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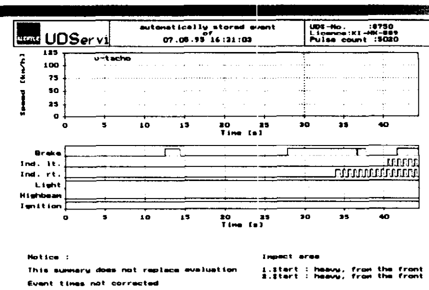
Event Diagram



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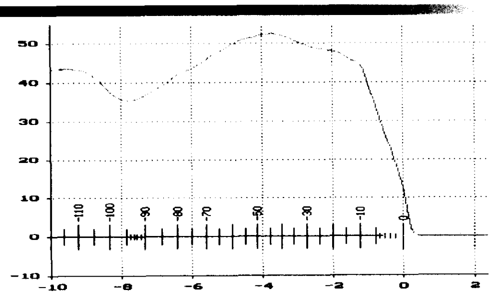
High Resolution Data



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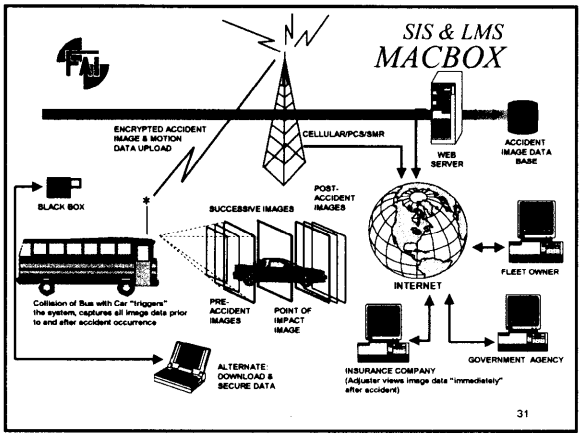
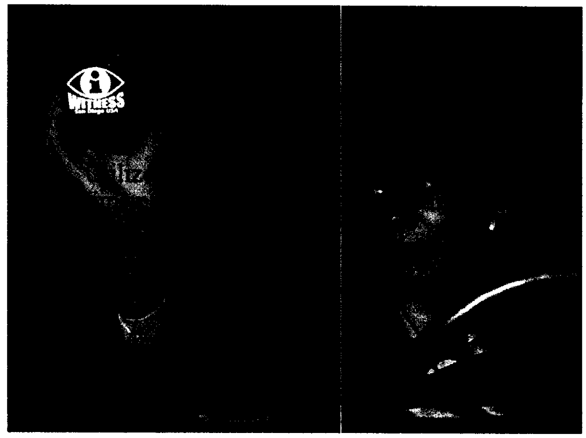
Safety Intelligence Systems LMS, Inc.

- EDR with video.
- Wireless encrypted transmission.
- ISO database event data storage.
- Collision data for OEM's & Safety.
- Reduce fraudulent insurance claims.
- Legal & liability privacy concerns.
- Automatic collision notification.

30





Eyewitness Drive-Cam

- Driver's eye video
- 10 seconds before
- 10 seconds after
- Auto & Manual events
- Simple installation

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EVICAM

- "Evidence Camera"
- VEDR- Video event data recorder
- Multiple events
- Multiple cameras
- Time frame – pre & post 1 minute

34

Cosworth

- Prototype system
- Colorado based

35

Smith Industries

- Aviation EDR.
- Automotive EDR physical protection.

36

Independent Witness

- EDR
- 3 Axis accelerometer
- Self contained
- Crash pulse

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North American Crash Analysis Center

mannesmann VDO Kienzle
KIENZLE
Argo
Siemens
Bosch

- FAI selected in 1998 by Tier 1 Supplier VDO to provide EDR analysis for:
  - United States
  - Canada
  - Mexico
- World Wide Analysis Network

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EDR Update – Today's Pathway to Tomorrow

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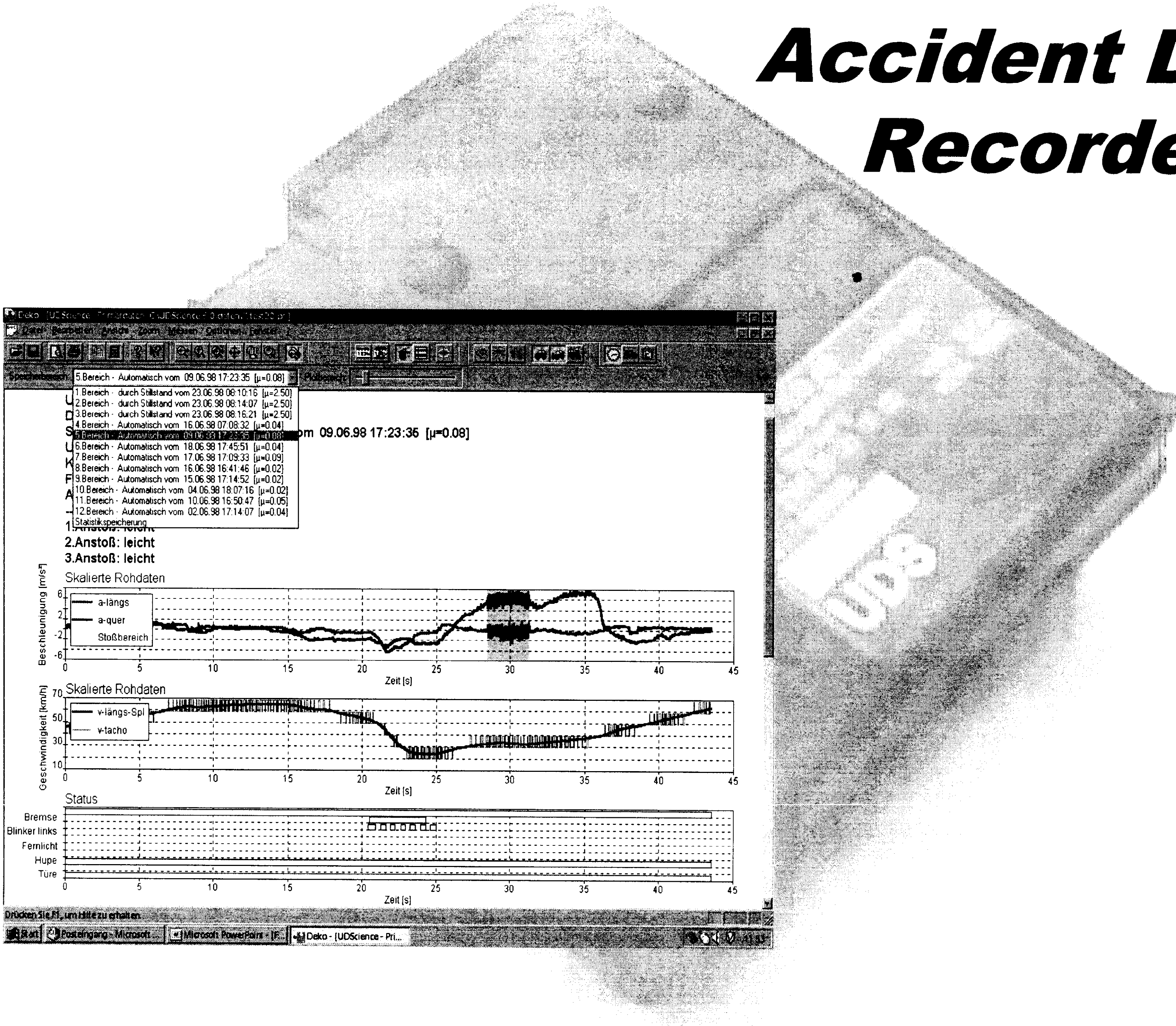
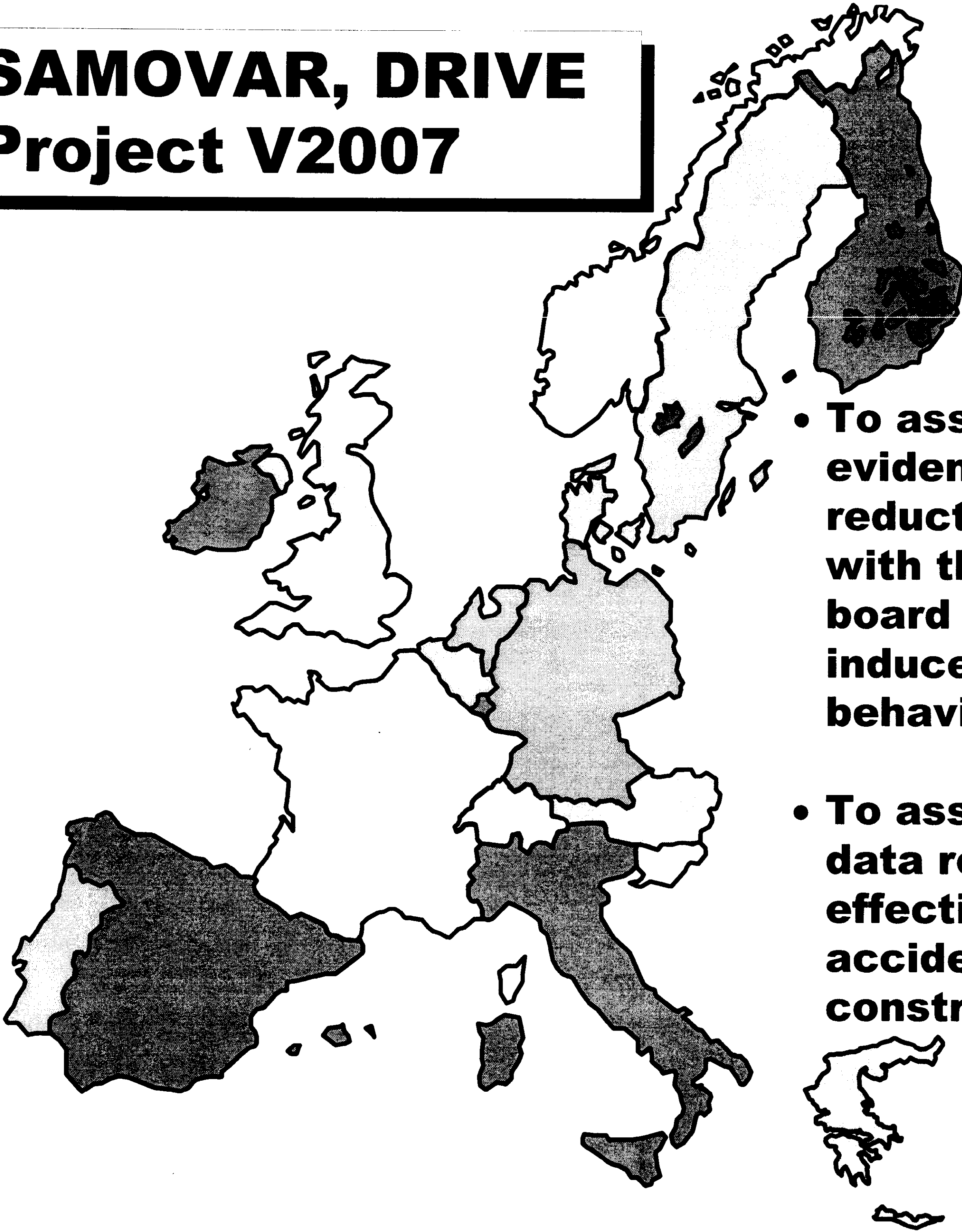
VDO Crash Recorder
Tony Reynolds
VDO North America

Accident Data Recorder



VDO KIENZLE

SAMOVAR, DRIVE Project V2007



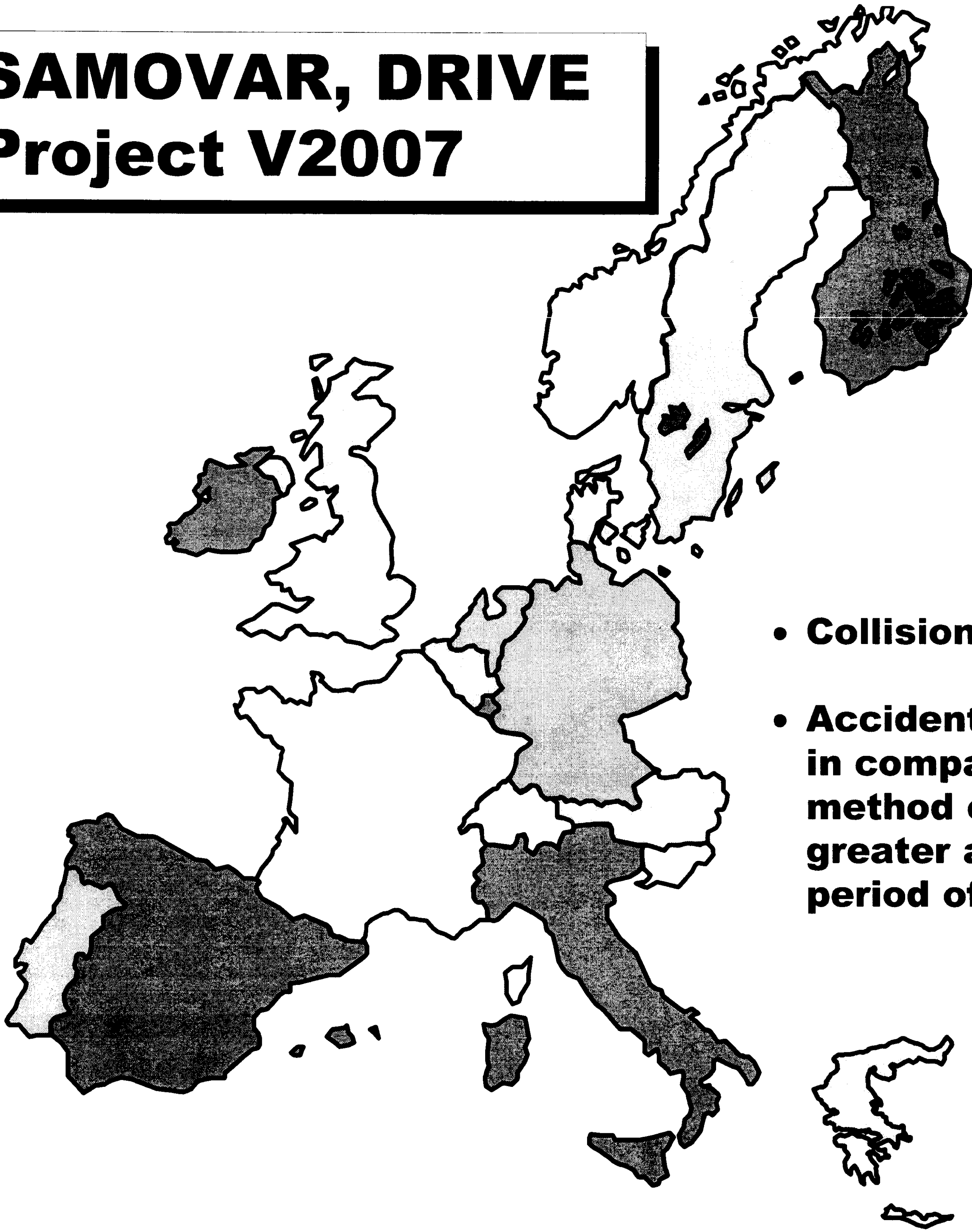
- **To assess whether there is evidence of any collision reduction potential associated with the introduction of on-board data recorders used to induce changes in driver behaviour.**

- **To assess the use of on-board data recorders to improve the effectiveness and accuracy of accident investigation and construction.**

[1] Safety Assement Monitoring on Vehicle with Automatic Recordung, Deliverable D10, October 1995 One-year field trial in UK, Netherlands, and Belgium. 7 fleets with 443 vehicles participated.

VDO KIENZLE

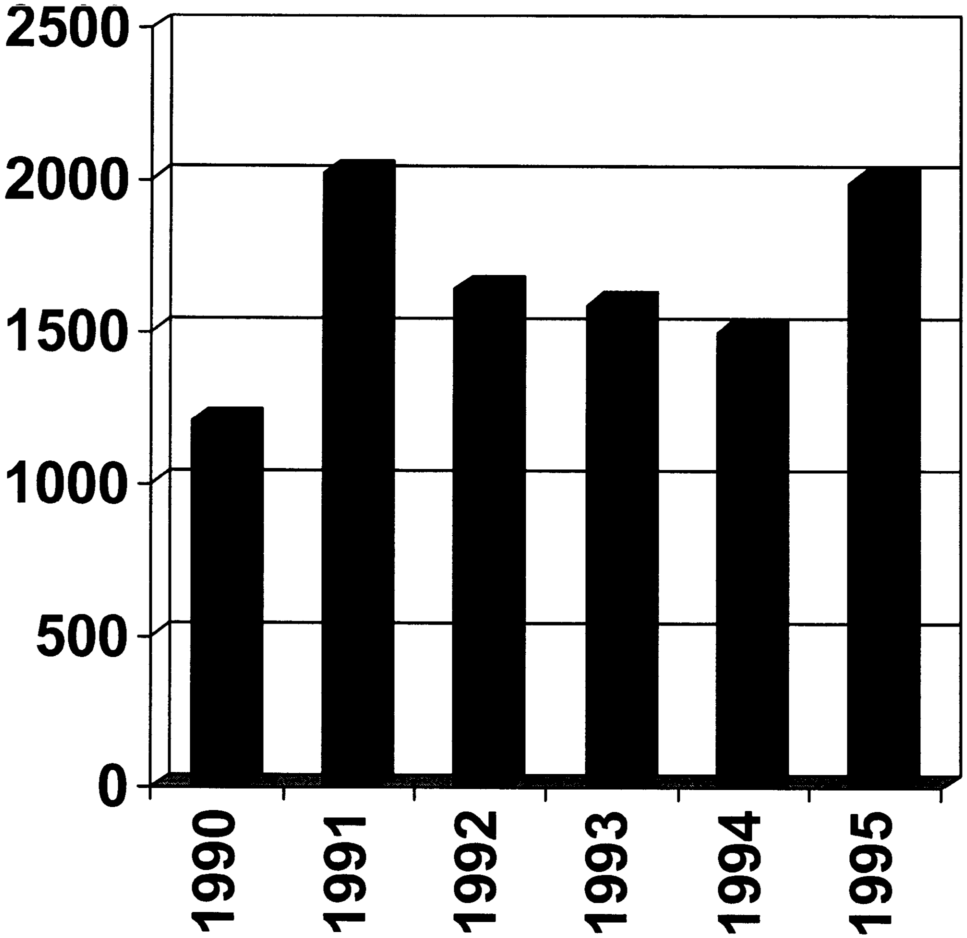
SAMOVAR, DRIVE Project V2007

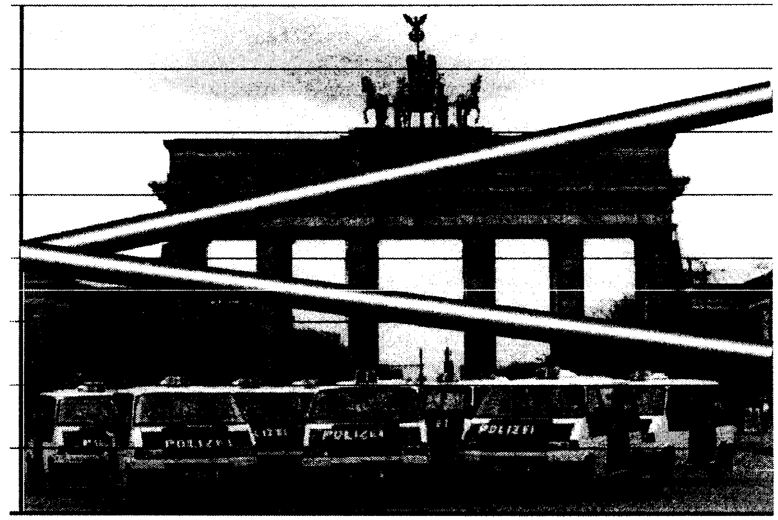


- **Collision reduction of approx. 28 %**
- **Accident reconstruction with IDR in comparison with traditional method could be carried out with greater accuracy and in a shorter period of time.**

VDO KIENZLE

The Berlin Police Project





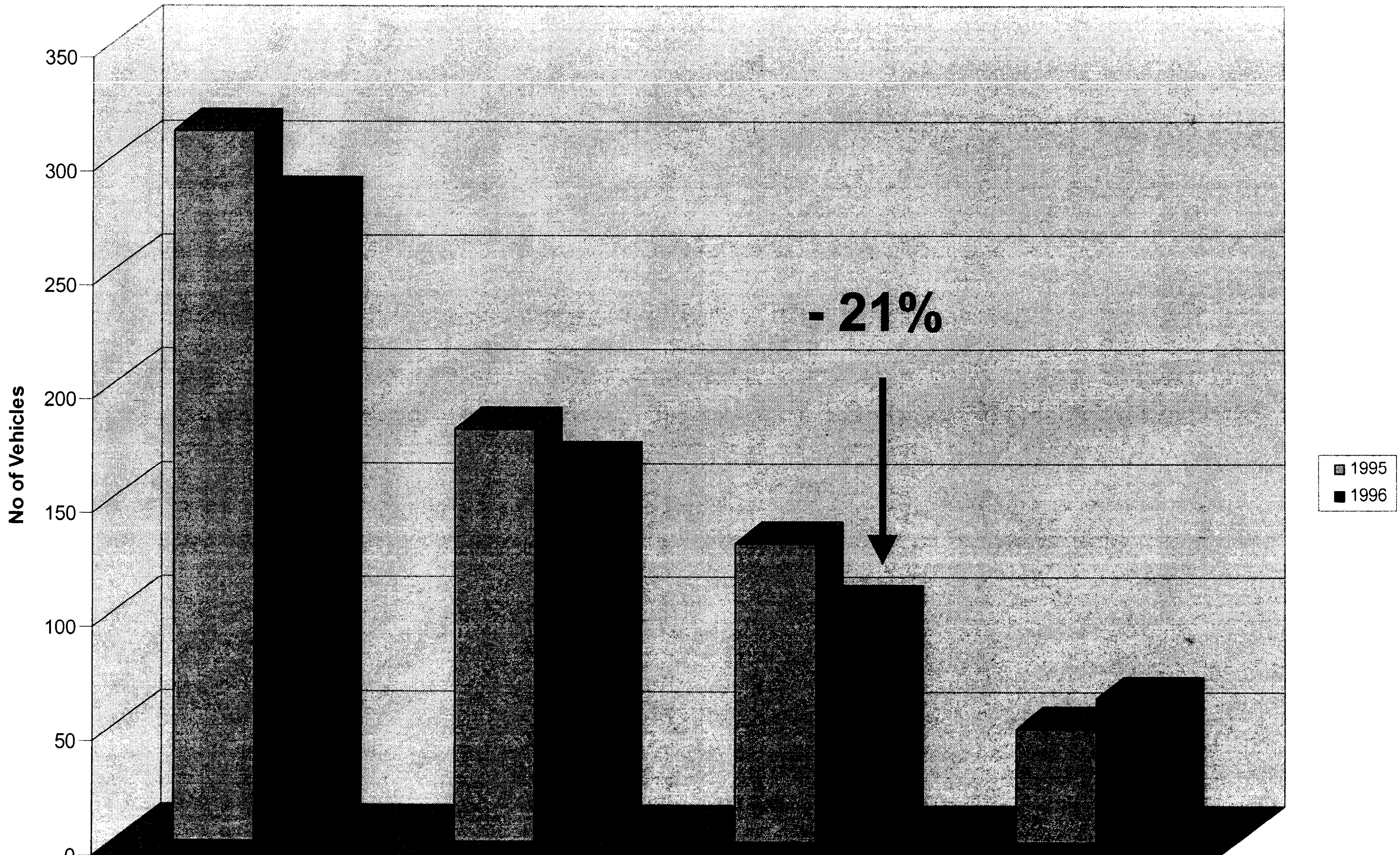
* Source: Final report of Pilot Phase II by Prof. Dr. Rau, Office for Accident Reconstruction

The Berlin Police Project - Project History

Phase	Year	Details	
Phase II	1996	Number of vehicles:	62 Police cars
		Type of vehicles:	All VW Buses and civil cars of one department
		Location of vehicles:	Police Department 7 in Berlin-Marzahn
Phase III	04/97 - 03/98	Number of vehicles:	417 Police cars
		Type of vehicles:	All 380 VW Buses T2/T4 of Berlin and 37 civil cars of one department
		Location of vehicles:	All Police Departments (1 to 7) in Berlin

VDO KIENZLE

The Berlin Police Project - No of Traffic Collisions Berlin Police (Precinct 7)

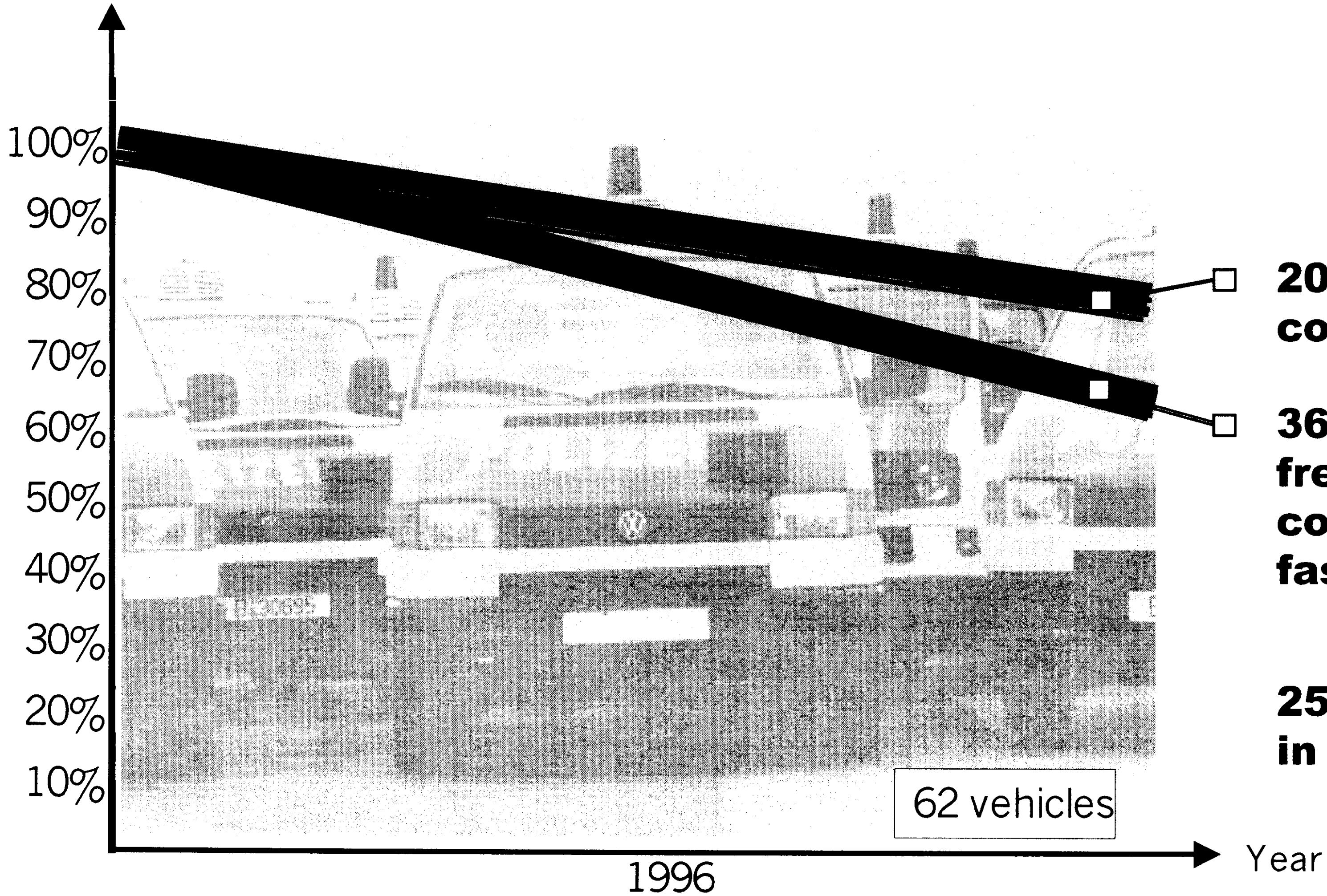


	Total Vehicles	Driver Faults	Med Patrol Cars - Driver Faults	Other Cars - Driver Faults
1995	312	181	131	50
1996	282	166	103	63

VDO KIENZLE

Background

The Berlin Police Project - Pilot phase II

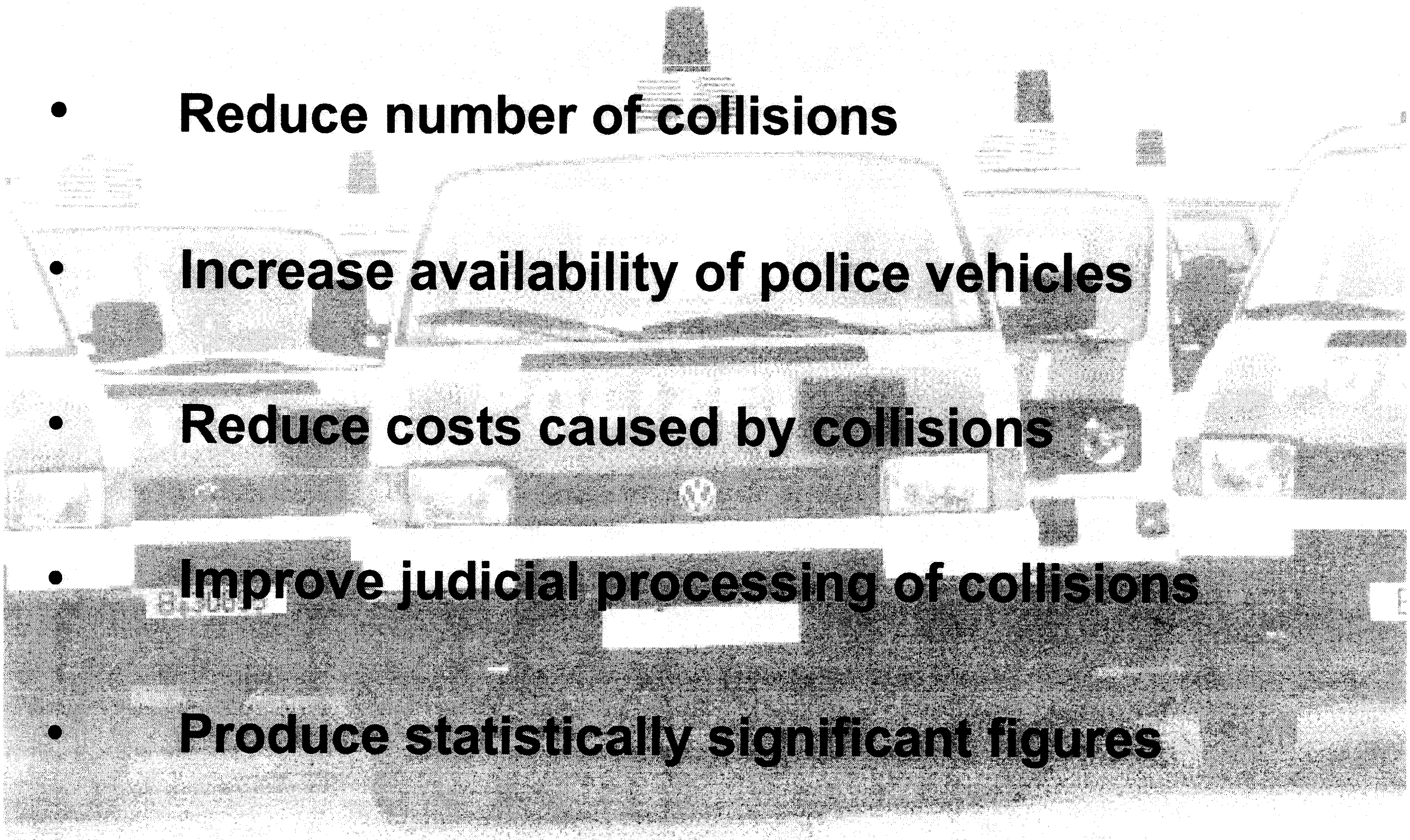


20 % reduction in collision cases

36 % reduction in frequency of collisions during fast response trips

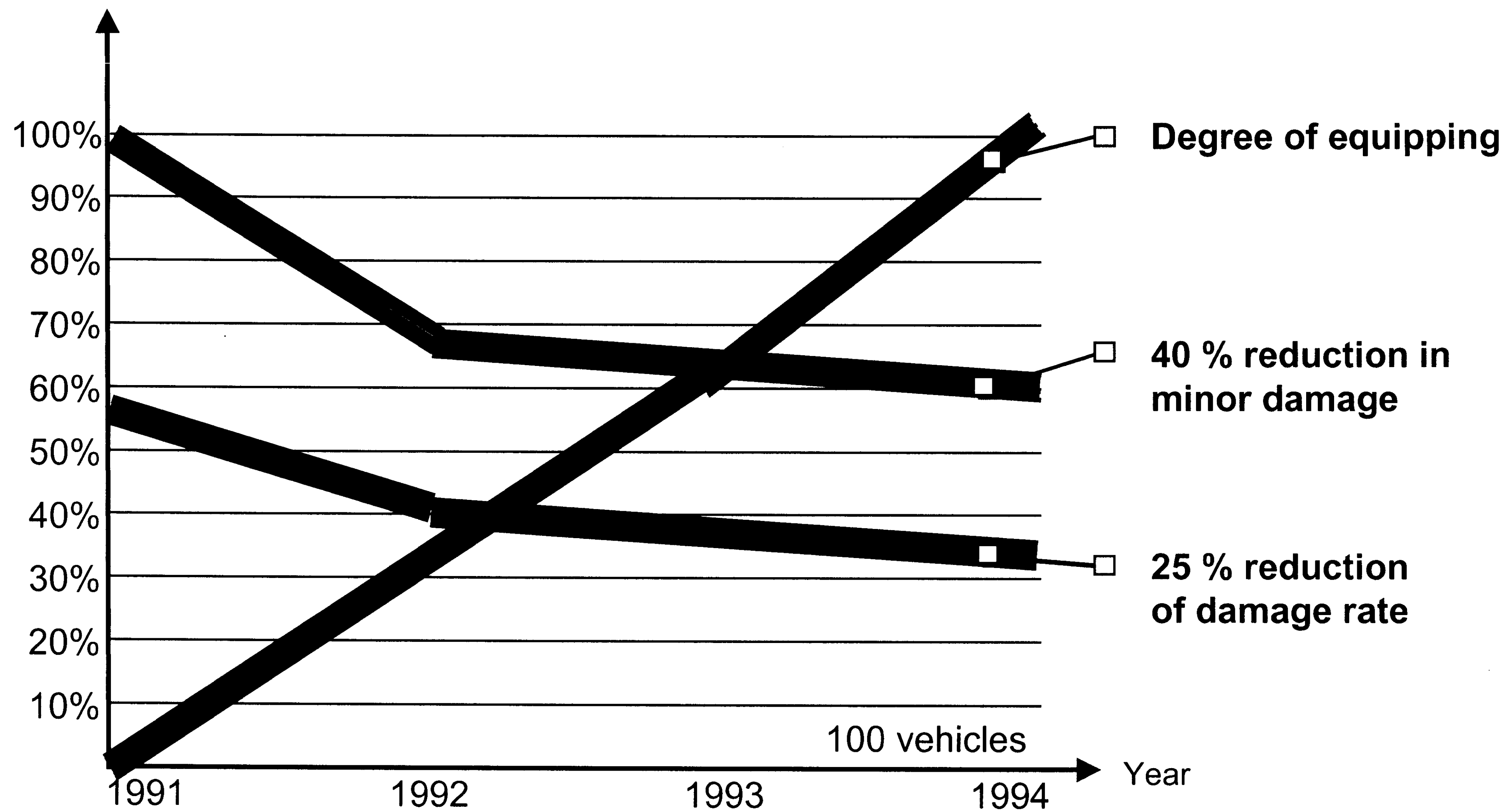
25% reduction in costs

The Berlin Police Project - Objectives of Phase III



- Reduce number of collisions
- Increase availability of police vehicles
- Reduce costs caused by collisions
- Improve judicial processing of collisions
- Produce statistically significant figures

WKD Pinkerton Security, Bisingen, Germany



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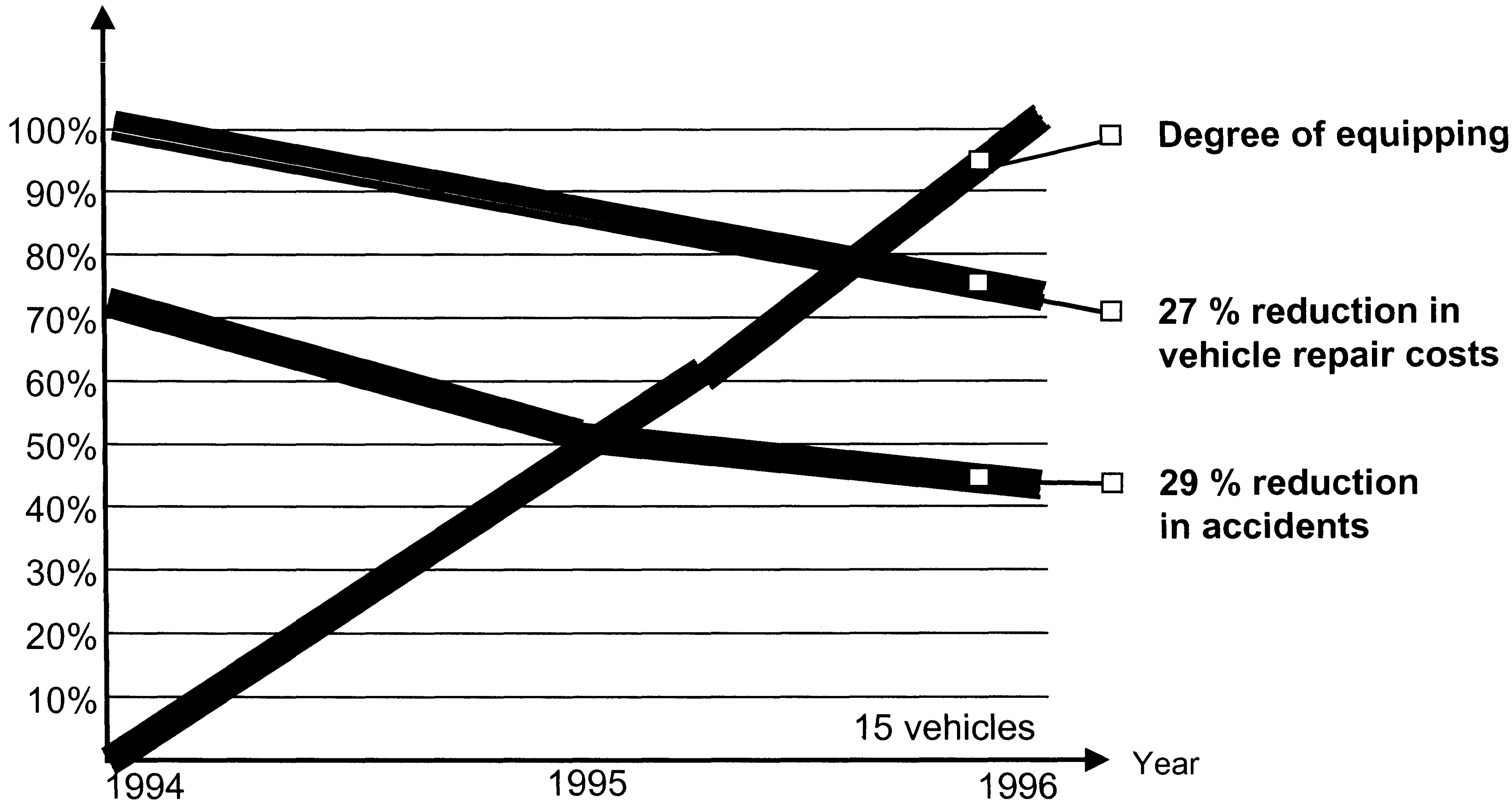
Hatscher Taxi Company, Oldenburg, Germany



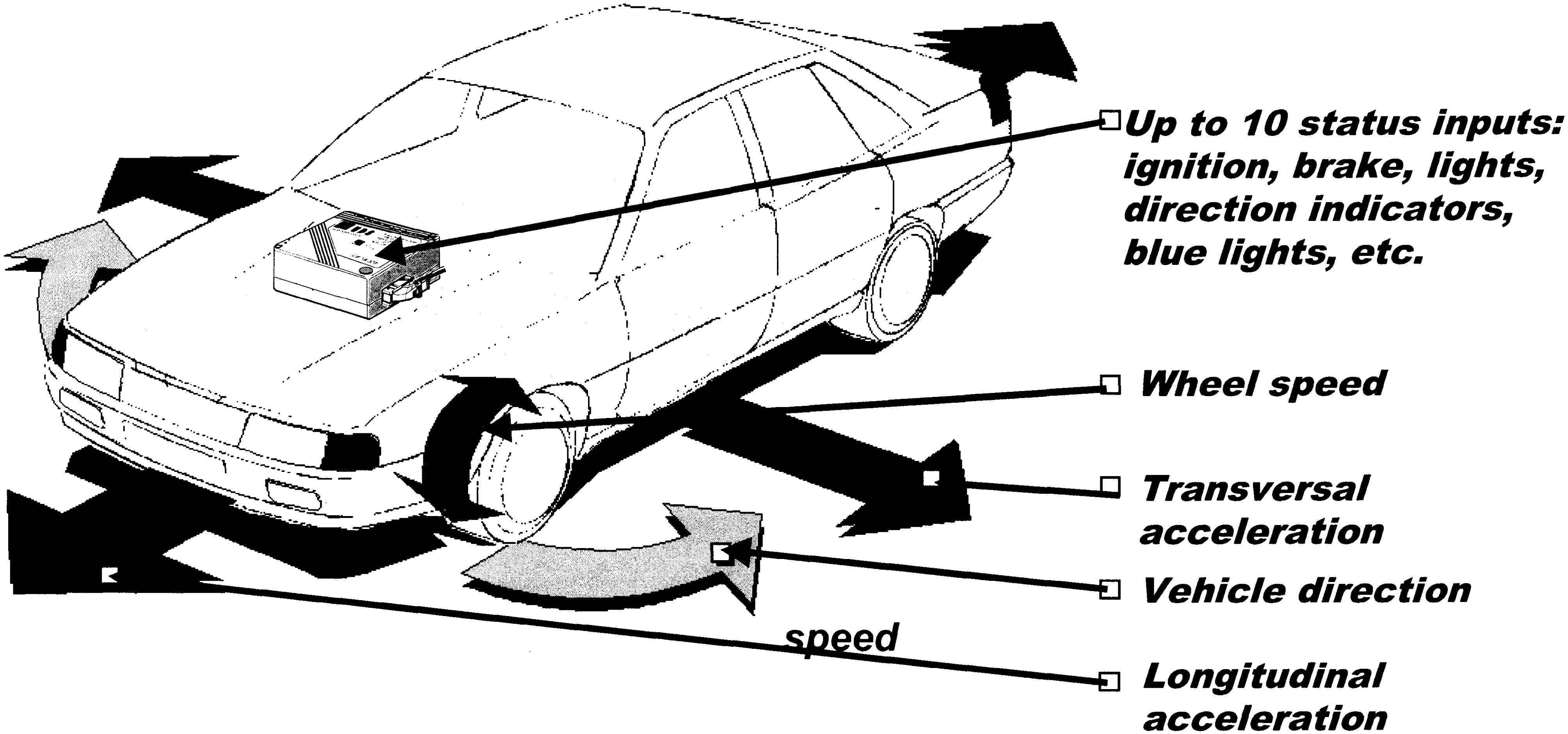
VDO KIENZLE

Accident Data Recorder Functions

- ***Recording of vehicle-specific data***
- ***High-resolution representation of an incident***
- ***Determines collision and initial speeds***
- ***Follow-up collisions recorded***
- ***Automatic and manual event recording***
- ***Up to 10 status inputs***
- ***Changes in vehicle direction***
- ***Speed and course of the vehicle, even under wheel lock***
- ***Stores exact time of incident***

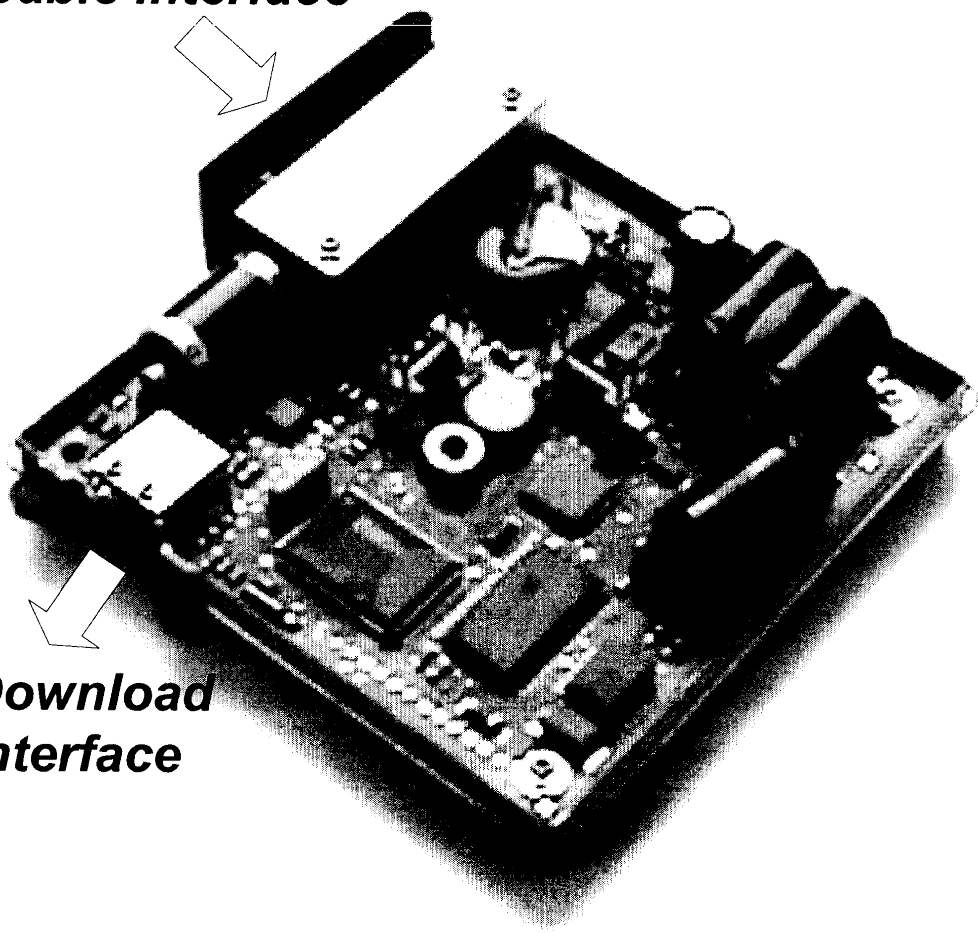
Accident Data Recorder Functions

Sensors and Status Inputs



VDO KIENZLE

ADR System Technology



Sensor system

Battery

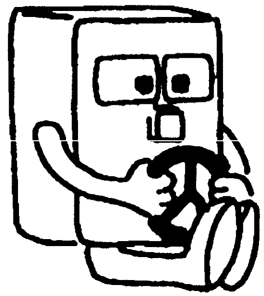
Emergency power supply

Compass

Clock

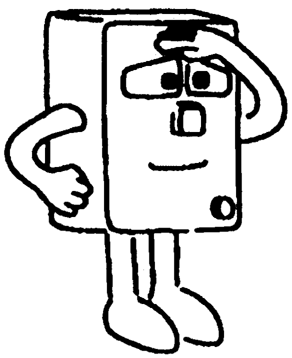
Processor

ADR System Technology
Operating Modes



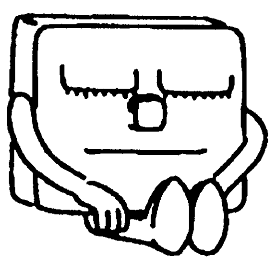
Driving Mode

Normal operating mode when the vehicle is driven



Parking Mode

Approx. 5 mins after the ignition is switched off the IDR is more sensitive

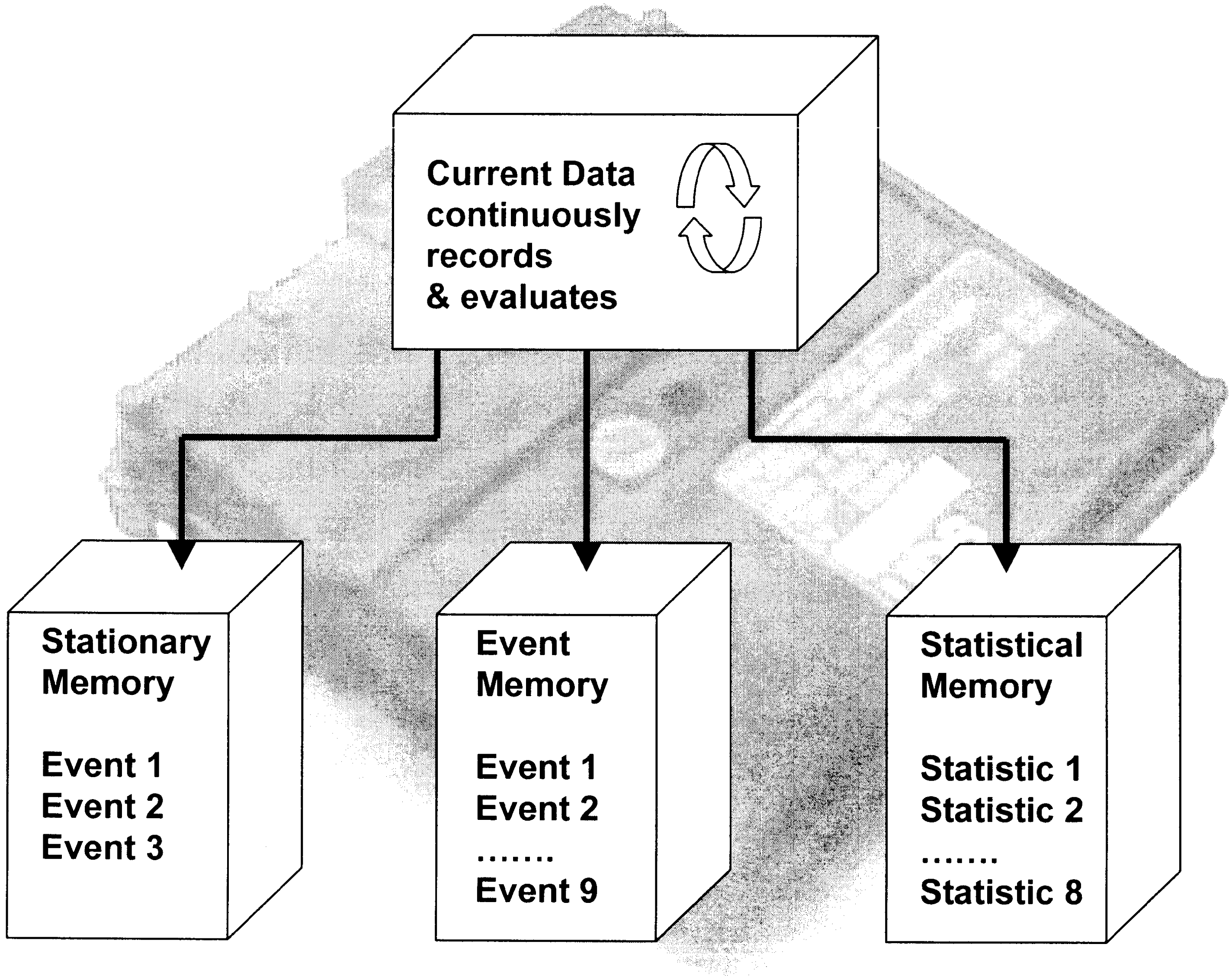


Sleep Mode

If the ignition remains off for more than 3 days, the IDR reverts from parking mode to sleep mode and switches off

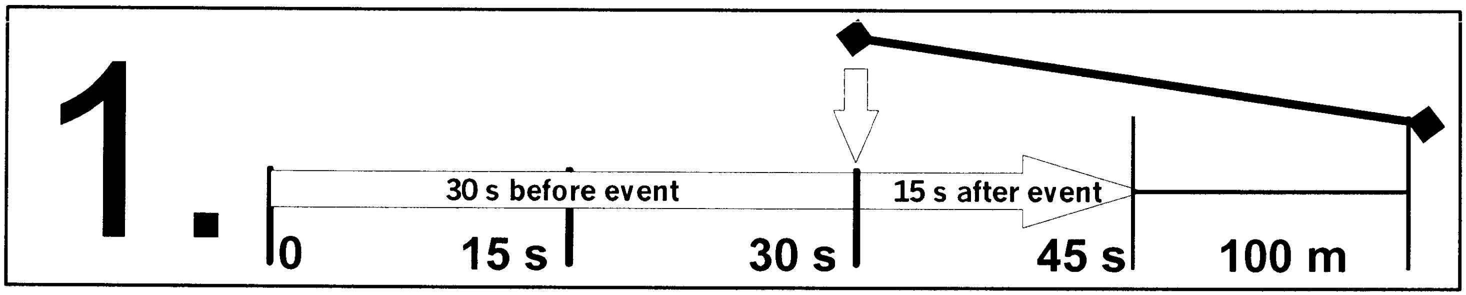
VDO KIENZLE

ADR System Technology

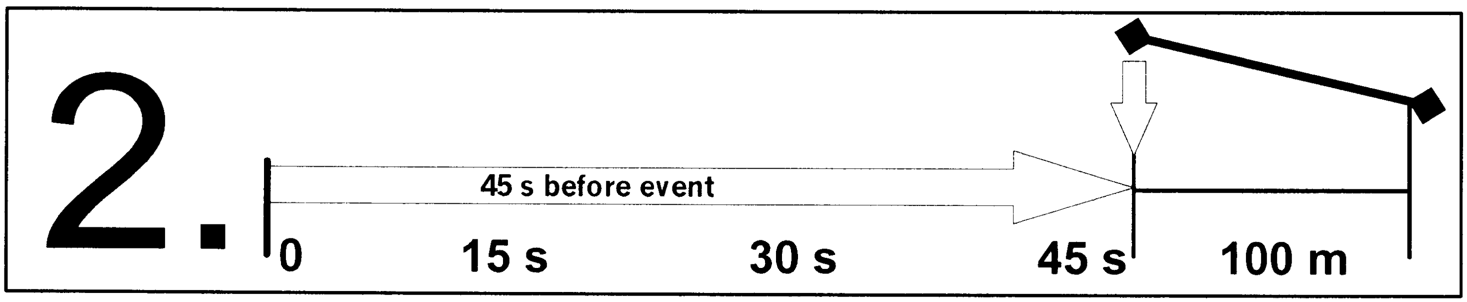


ADR System Technology

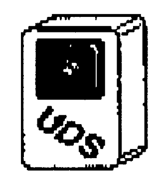
Data Recording Storage

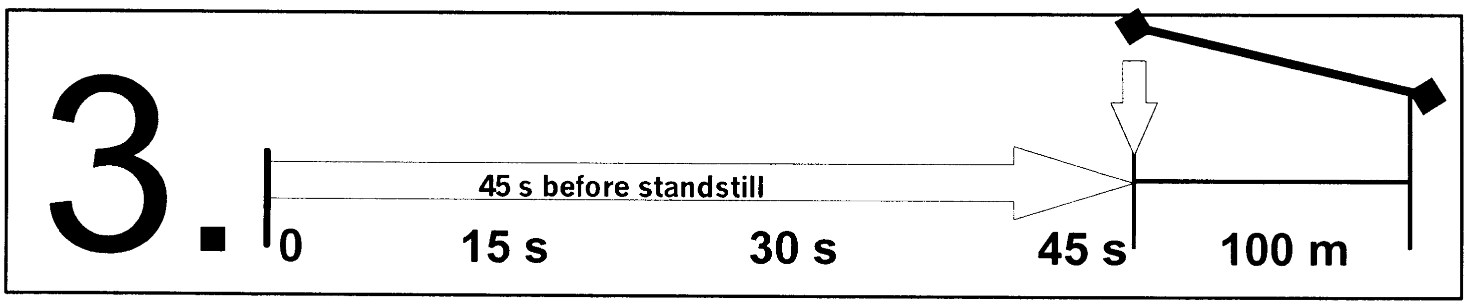


Storage initiated by the collision



Manual temporary storage by operating a touch button



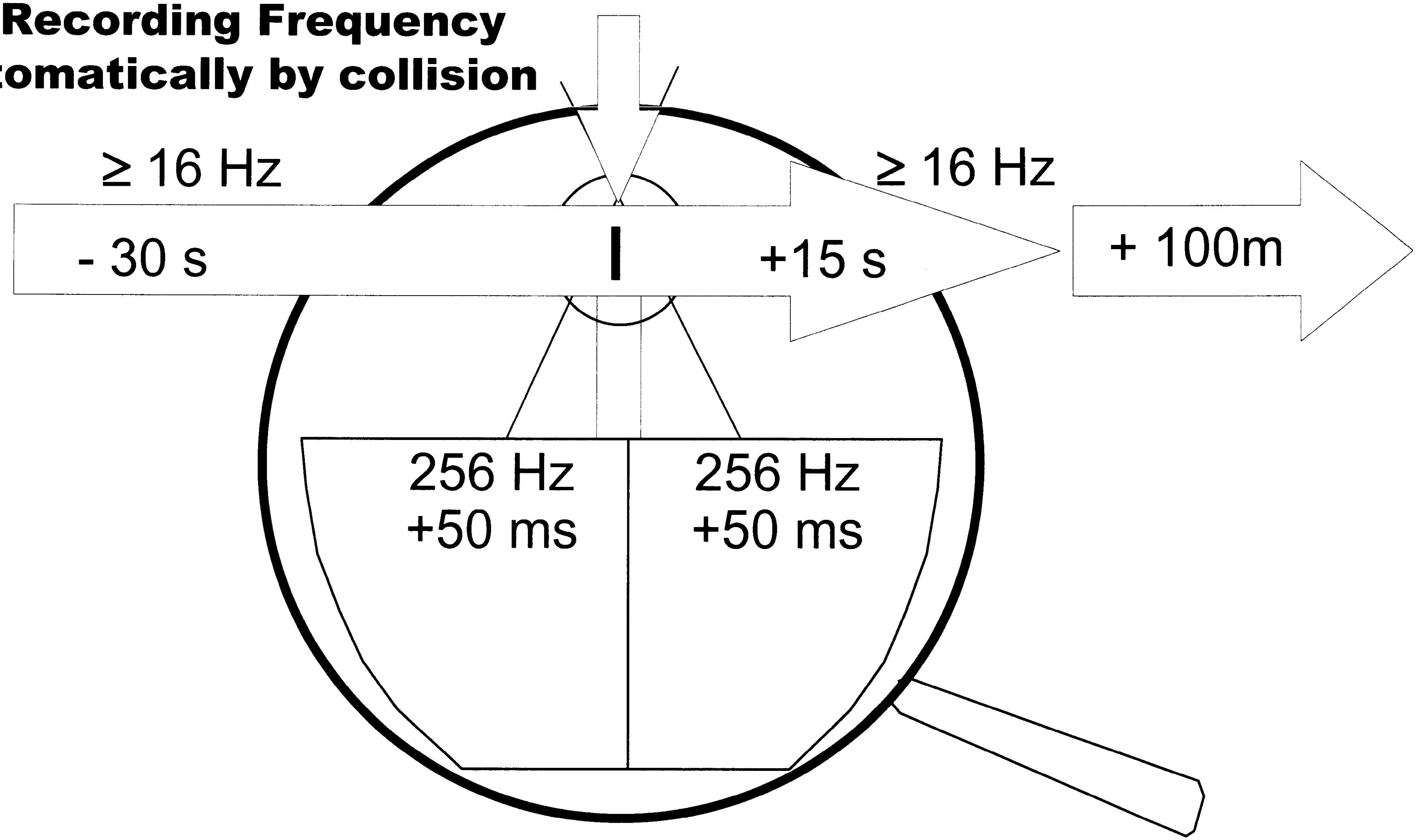


Stationary Storage

ADR System Technology

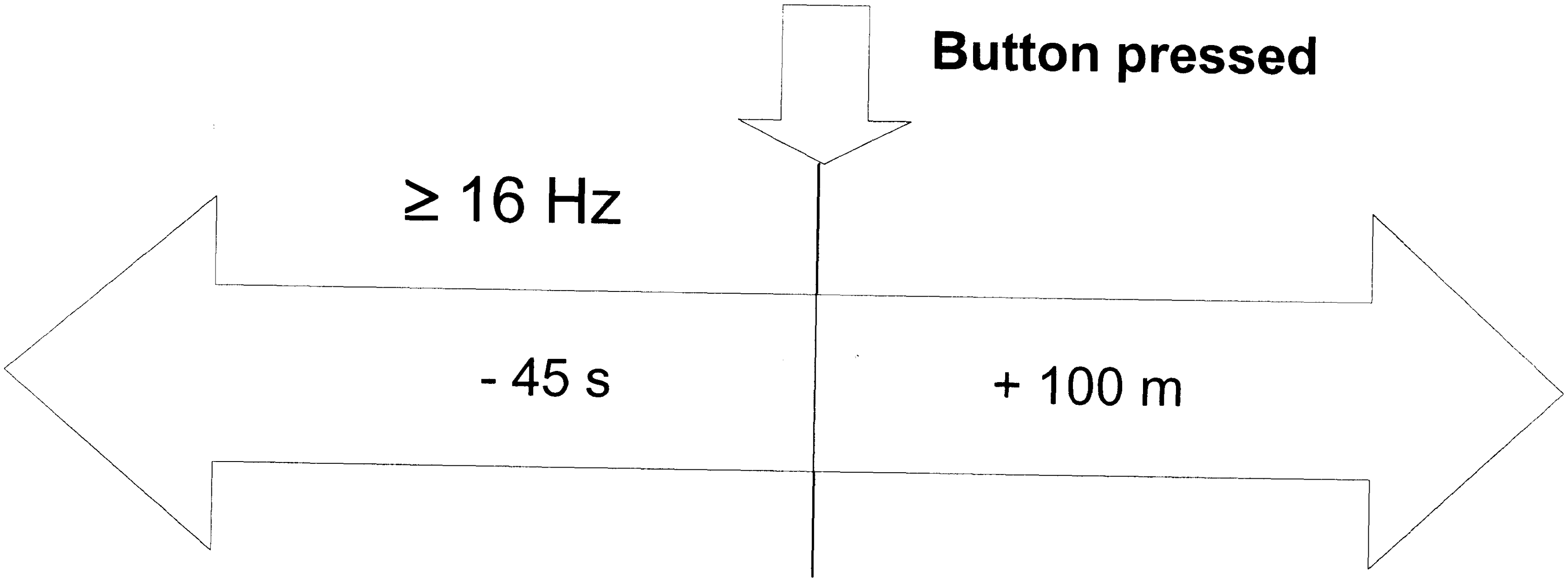
Data Recording Frequency

- **automatically by collision**



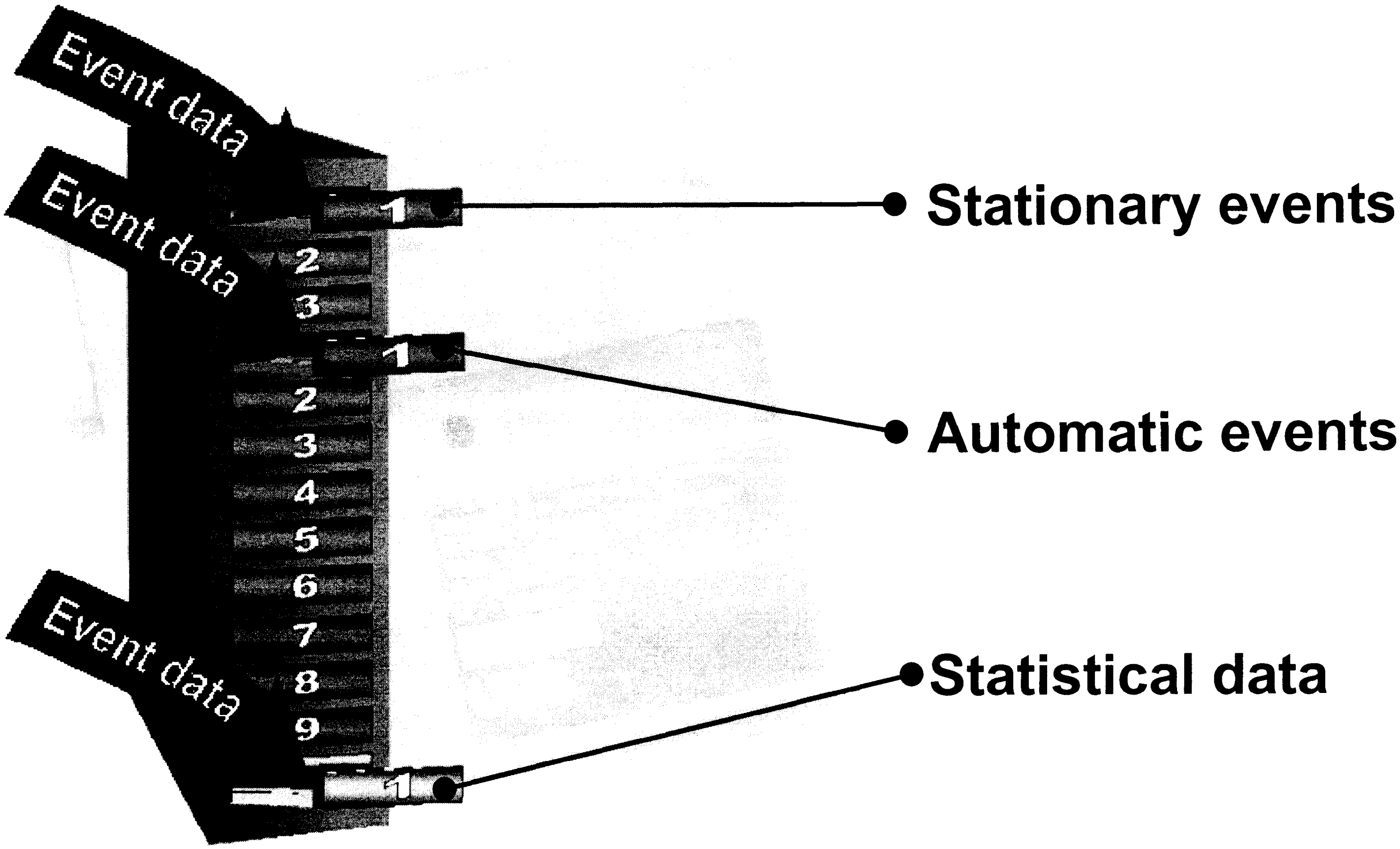
ADR System Technology

- by using the touch button



ADR System Technology

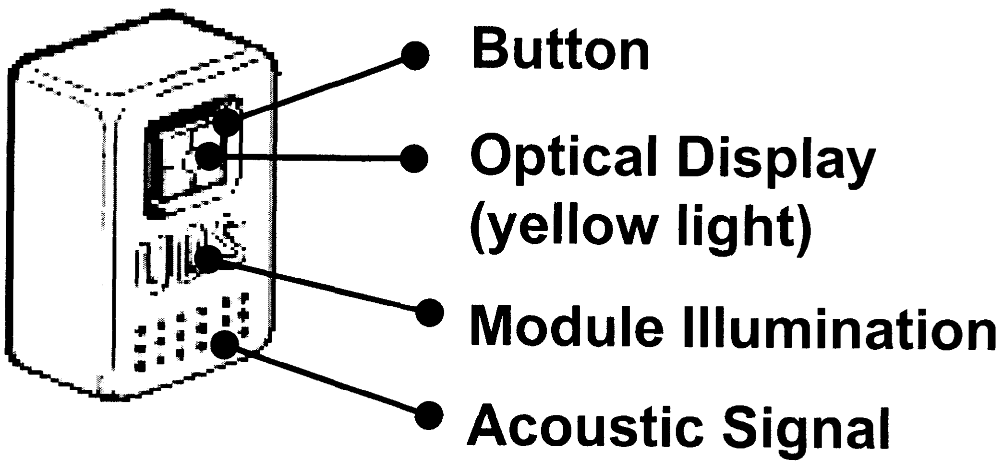
Number of possibilities for storing events

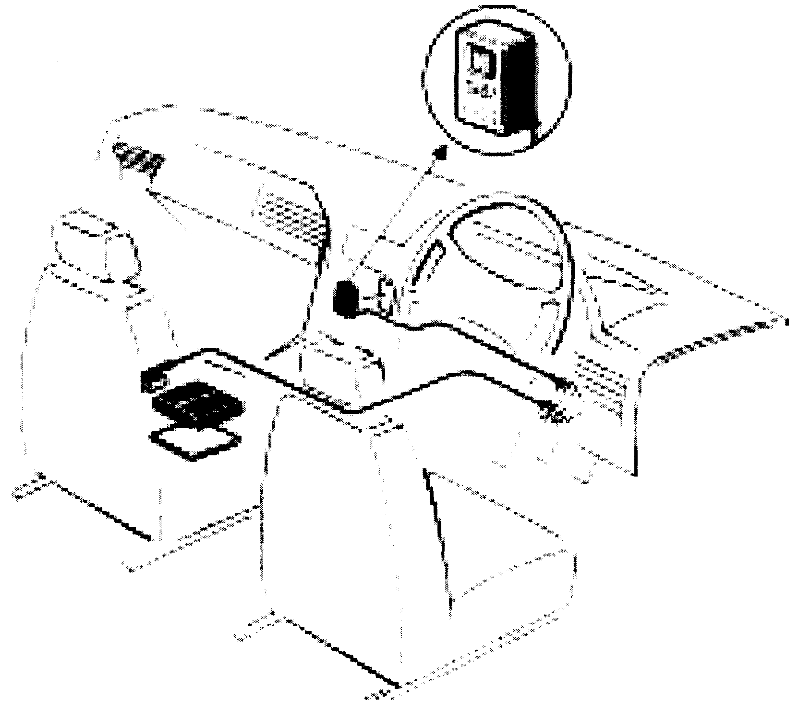


ADR System Technology

Acoustic & Visual Signals

Touch button





ADR System Technology

Touch Button Operating Signals - ignition switched on

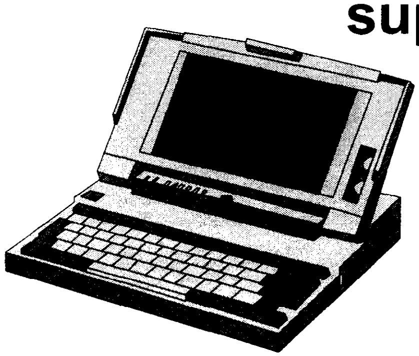
1 x short bleep	The IDR is OK, no events stored
illuminates & 1 x short bleep	At least one event is stored The IDR is OK
4 long bleeps	IDR recognised a parking jolt The IDR is OK
illuminates & 8 x short bleeps	The storage capacity of the IDR is nearly full
10 x short bleeps or ? no signal	The IDR has a fault!

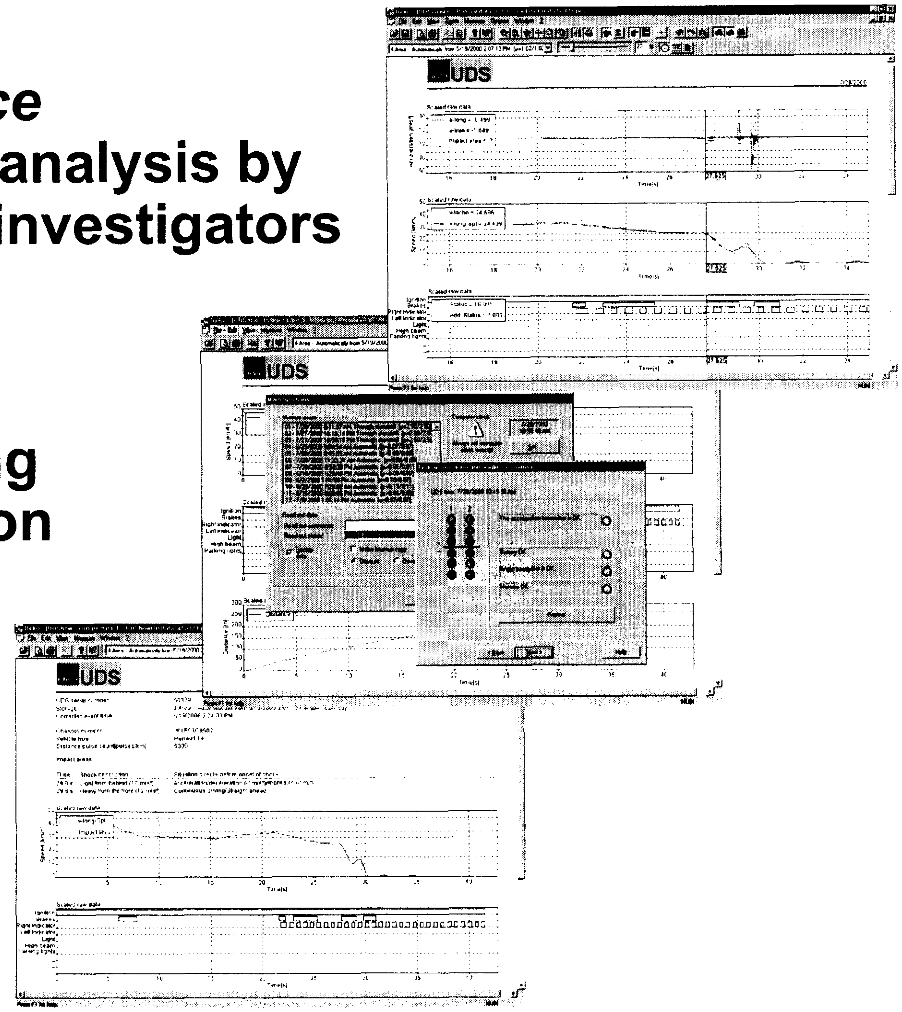
ADR Software Products

Step 3: UD*Science*
Collision analysis by accident investigators

Step 2: UD*Servi*
Installation Testing & data presentation

Step 1: UD*Show*
Data retrieving (securing) and presentation by traffic supervisors

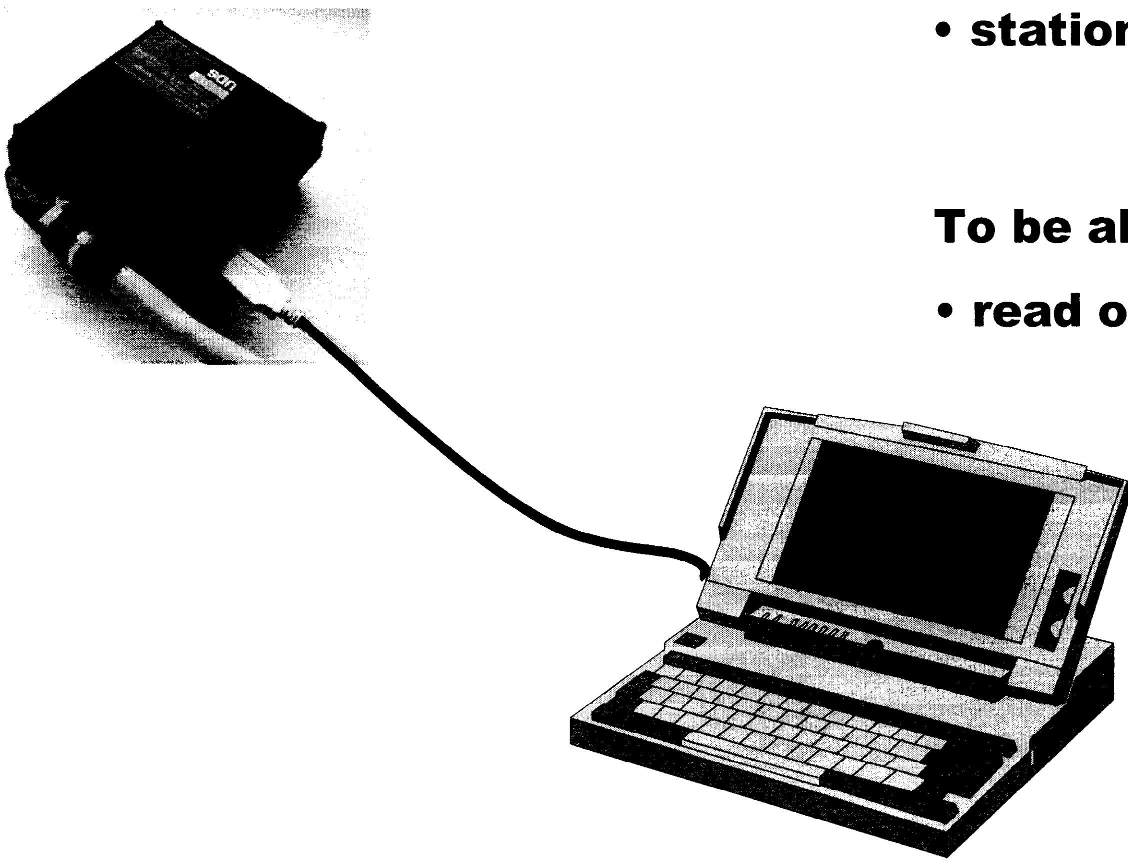




VDO KIENZLE

Software Products - UDShow

Communication Lead for data downloading



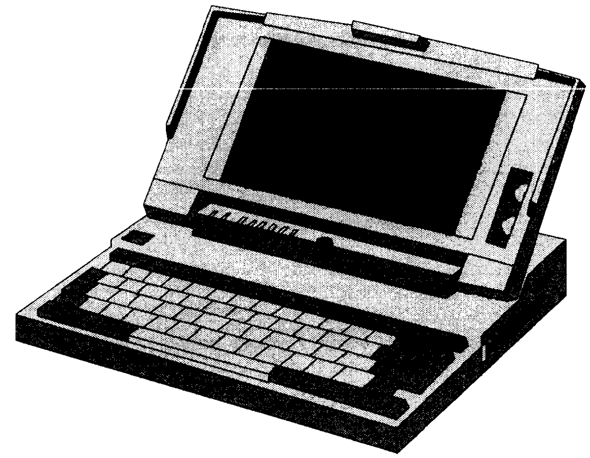
Communication with the IDR:

- mobile in the vehicle or
- stationary in the office

To be able to:

- read out and display data

Software Products - UDShow



- Event time and date
- Archiving of IDR-data
- Allows first inspection of data:

  Speed versus time graph

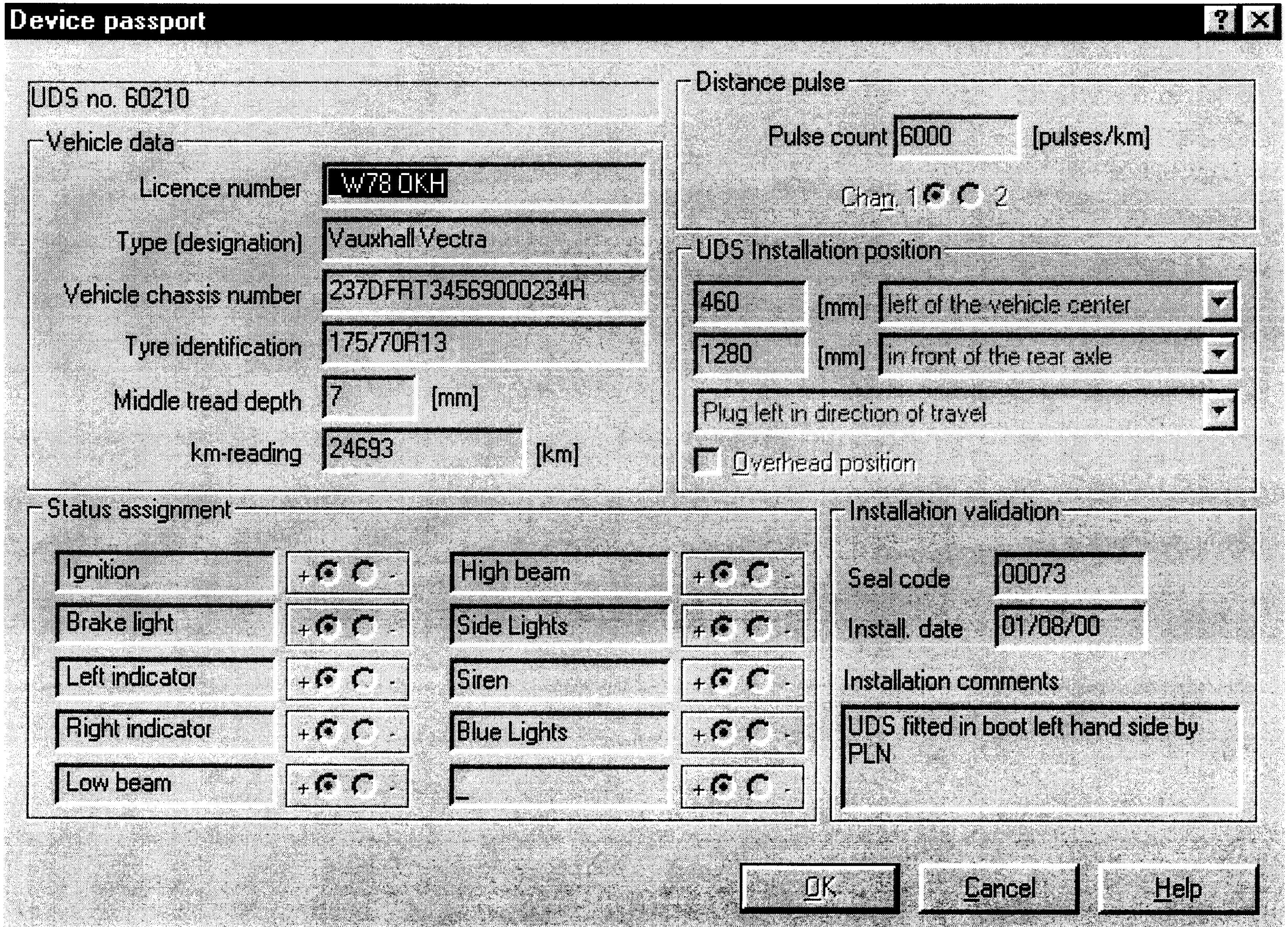
  Speed versus distance graph

  Operation of the status inputs

- Erasure of the stored data possible

Software Products - UDShow

Equipment passport



VDO KIENZLE

Software Products - UDShow

KIENZLE UDS

20/08/00

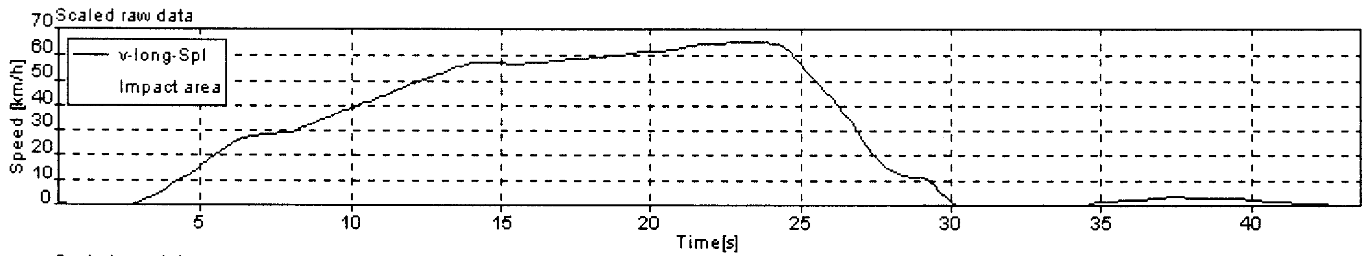
UDS serial number: 2000
Storage: 1.Area - 1.Automatic - from02/02/94 08:05:03
Corrected event time: 02/02/94 08:05:45

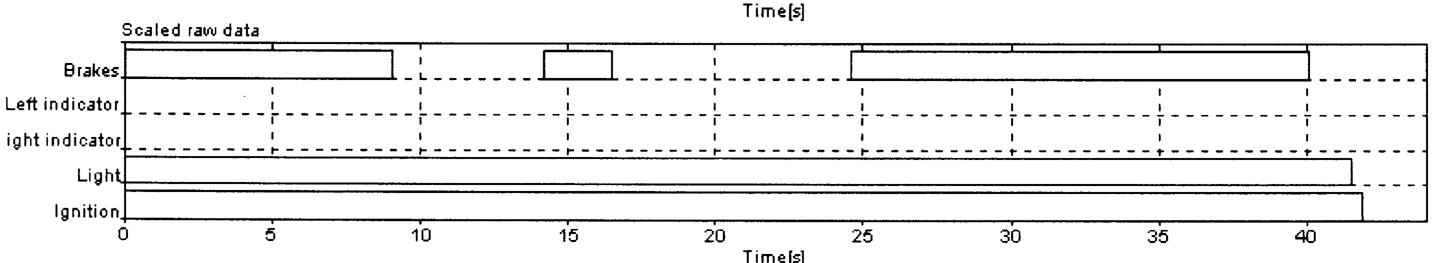
Licence number: Beispiel 1
Chassis number

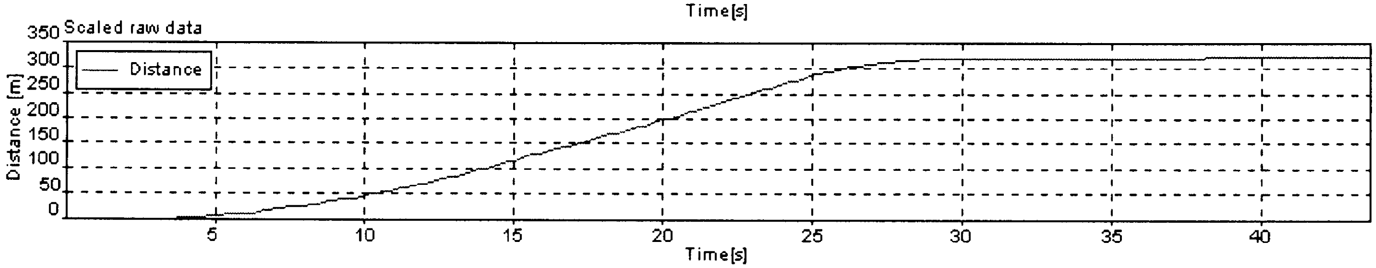
Vehicle type:
Distance pulse count[pulses/km]: 6090

Impetus areas:

Time	Shock description	Situation directly before onset of shock
29.0 s	LightFrom behind(13 m/s²)	Acceleration/delay(-4 m/s²)/Straight ahead
29.5 s	LightFrom the front(15 m/s²)	Acceleration/delay(-2 m/s²)/Left turn(+3 m/s²)







VDO KIENZLE

Software Products - UDShow

Speed/Time graph

KIENZLE UDS

20/08/00

UDS serial number:	2000
Storage:	1.Area - 1.Automatic - from02/02/94 08:05:03
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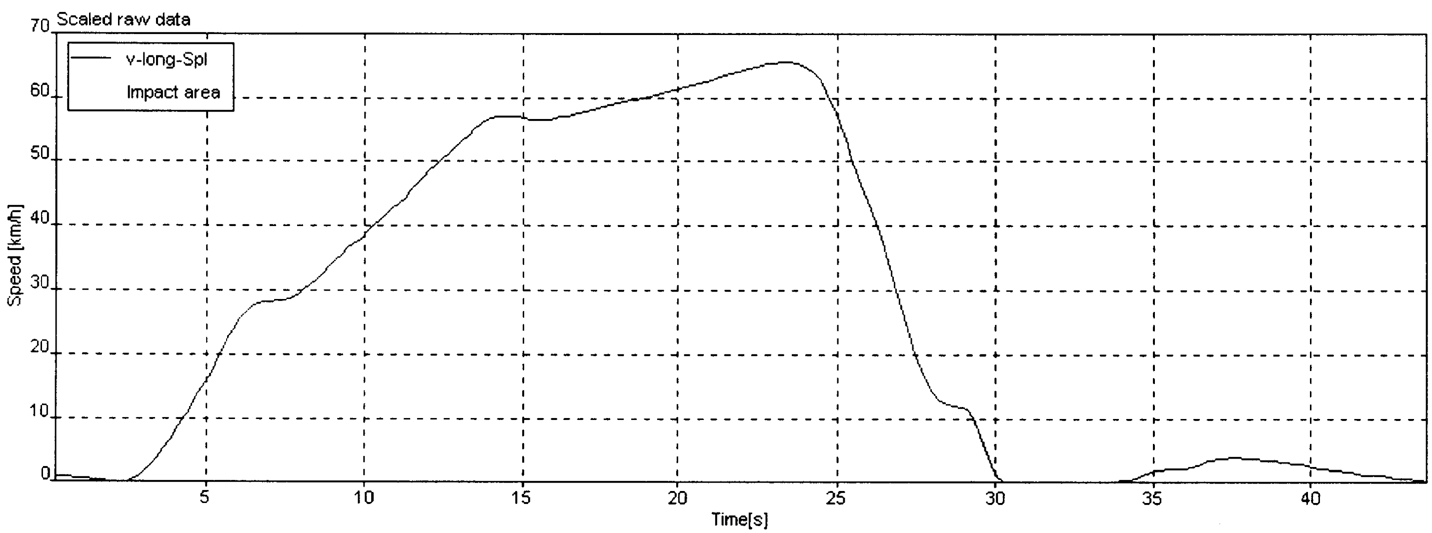

VDO KIENZLE

Software Products - UDShow

Status Inputs

20/08/00

UDS serial number:	2000
Storage:	1.Area - 1.Automatic - from02/02/94 08:05:03
Corrected event time:	02/02/94 08:05:45
Licence number:	Beispiel 1
Chassis number	
Vehicle type:	
Distance pulse count[pulses/km]:	6090

Impetus areas:

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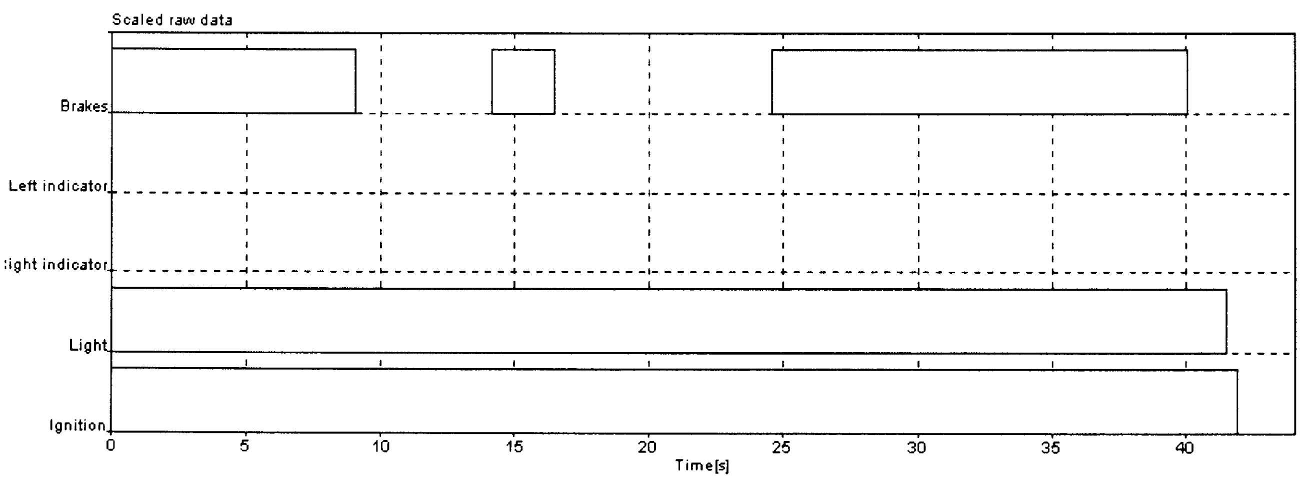

Distance/Time graph

UDS

20/08/00

UDS serial number:	2000
Storage:	1.Area - 1.Automatic - from02/02/94 08:05:03
Corrected event time:	02/02/94 08:05:45
Licence number:	Beispiel 1
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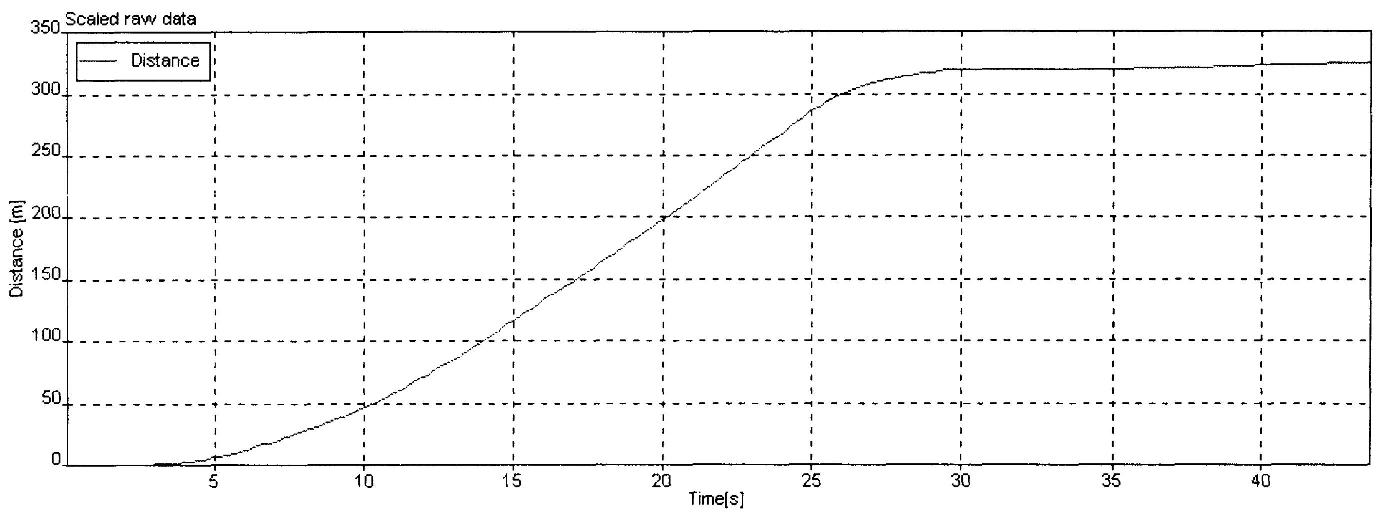


UDShow - Statistical Data

- Ignition on/off (200)
- Events (100)
- Impact (jolt) while stationary
- Activation of the touch button
- Loss of battery power
- Download processes
- Errors
- Deletion processes

UDShow - Statistical Data

Statistical Data - Change in ignition status

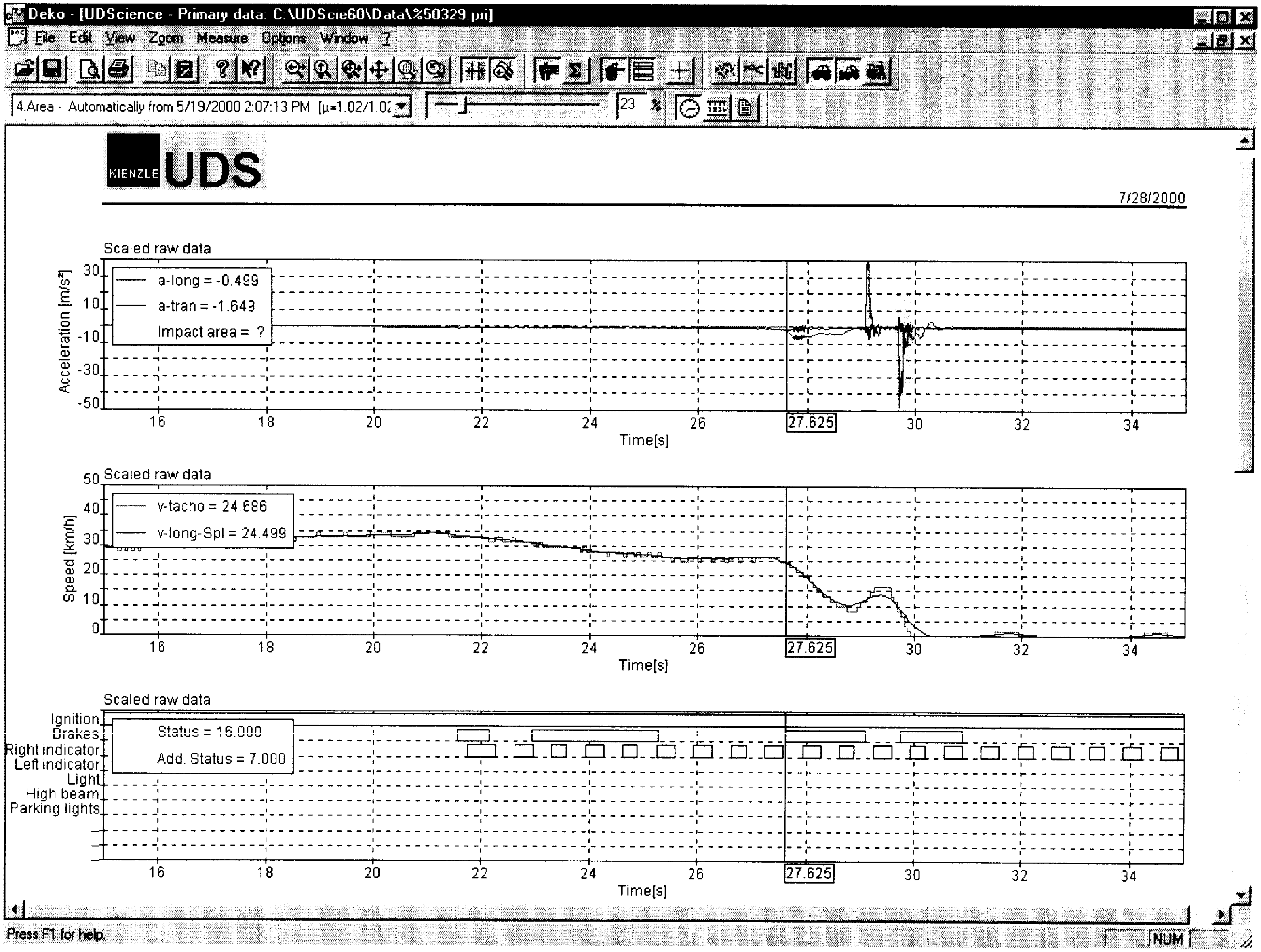
Date/Time	dt[h:m:s]	s[km]	ds[km]	Ignition
26.06.1999 10:50		5247,8		**ON**
26.06.1999 10:53	00:02:39	5248,8	0,973	**OFF**
26.06.1999 17:54	07:00:59	5248,8	0	**ON**
26.06.1999 18:05	00:10:37	5259,4	10,597	**OFF**
26.06.1999 18:10	00:05:14	5259,4	0	**ON**
26.06.1999 18:44	00:33:51	5286,7	27,372	**OFF**
27.06.1999 09:20	14:35:34	5286,7	0	**ON**
27.06.1999 09:23	00:03:01	5287,8	1,089	**OFF**
27.06.1999 09:29	00:06:21	5287,8	0	**ON**
27.06.1999 09:31	00:02:25	5288,9	1,091	**OFF**
27.06.1999 10:43	01:11:52	5288,9	0	**ON**
27.06.1999 10:51	00:07:35	5295,8	6,879	**OFF**
27.06.1999 10:54	00:03:26	5295,8	0	**ON**
27.06.1999 11:09	00:14:29	5305,8	10,009	**OFF**

UDShow - Statistical Data

Statistical Data - Events

Date/Time	s[km]	ds[km]	v[kph]	**µ-max**
17.05.1999 20:05	3278,093		25	**0,03**
17.05.1999 21:21	3381,454	103,361	112	**0,02**
18.05.1999 08:03	3398,061	16,607	25	**0,02**
18.05.1999 08:07	3402,636	4,575	61	**0,05**
21.05.1999 19:23	3415,862	13,226	25	**0,01**
23.05.1999 16:52	3461,595	45,733	68	**0,07**
23.05.1999 17:19	3474,828	13,233	29	**0,01**
23.05.1999 17:22	3475,895	1,067	22	**0,01**
24.05.1999 09:30	3492,561	16,666	29	**0,01**
24.05.1999 18:37	3493,351	0,790	29	**0,05**
24.05.1999 19:14	3503,413	10,062	36	**0,01**
24.05.1999 19:15	3504,292	0,879	47	**0,08**
24.05.1999 20:12	3538,873	34,581	58	**0,02**
25.05.1999 16:07	3549,717	10,844	40	**0,10**

ADR Software - UDScience



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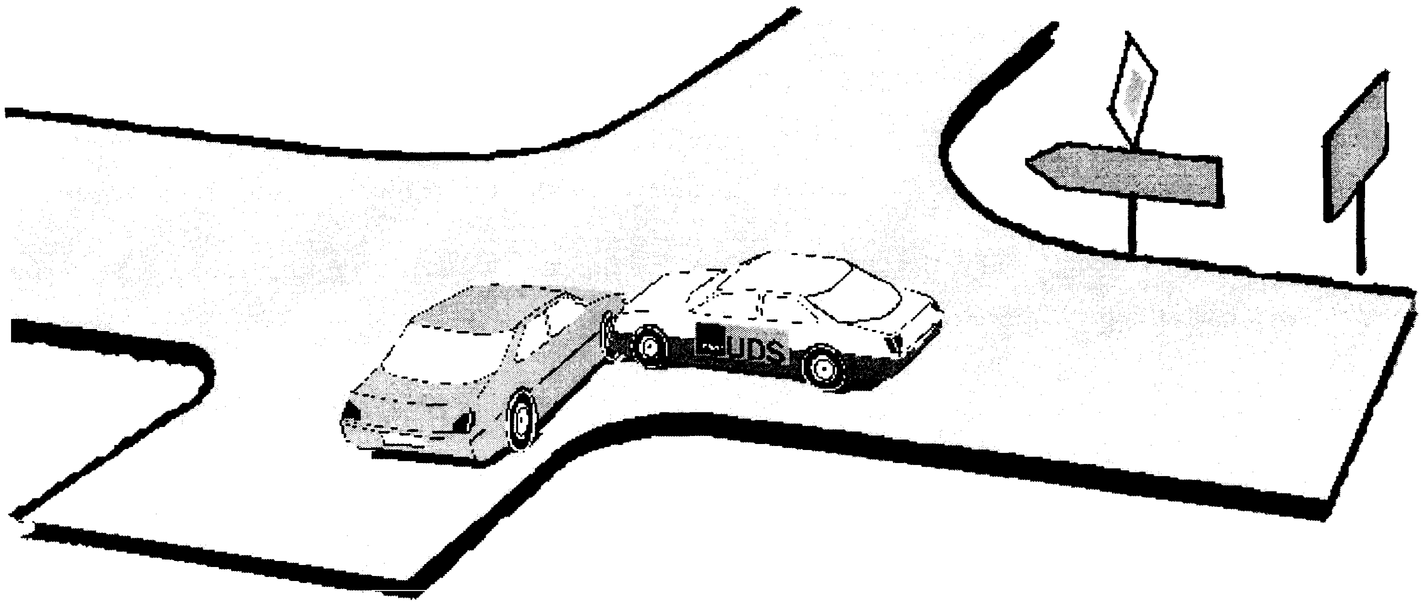
Example of a Collision Analysis

Intersection Collision



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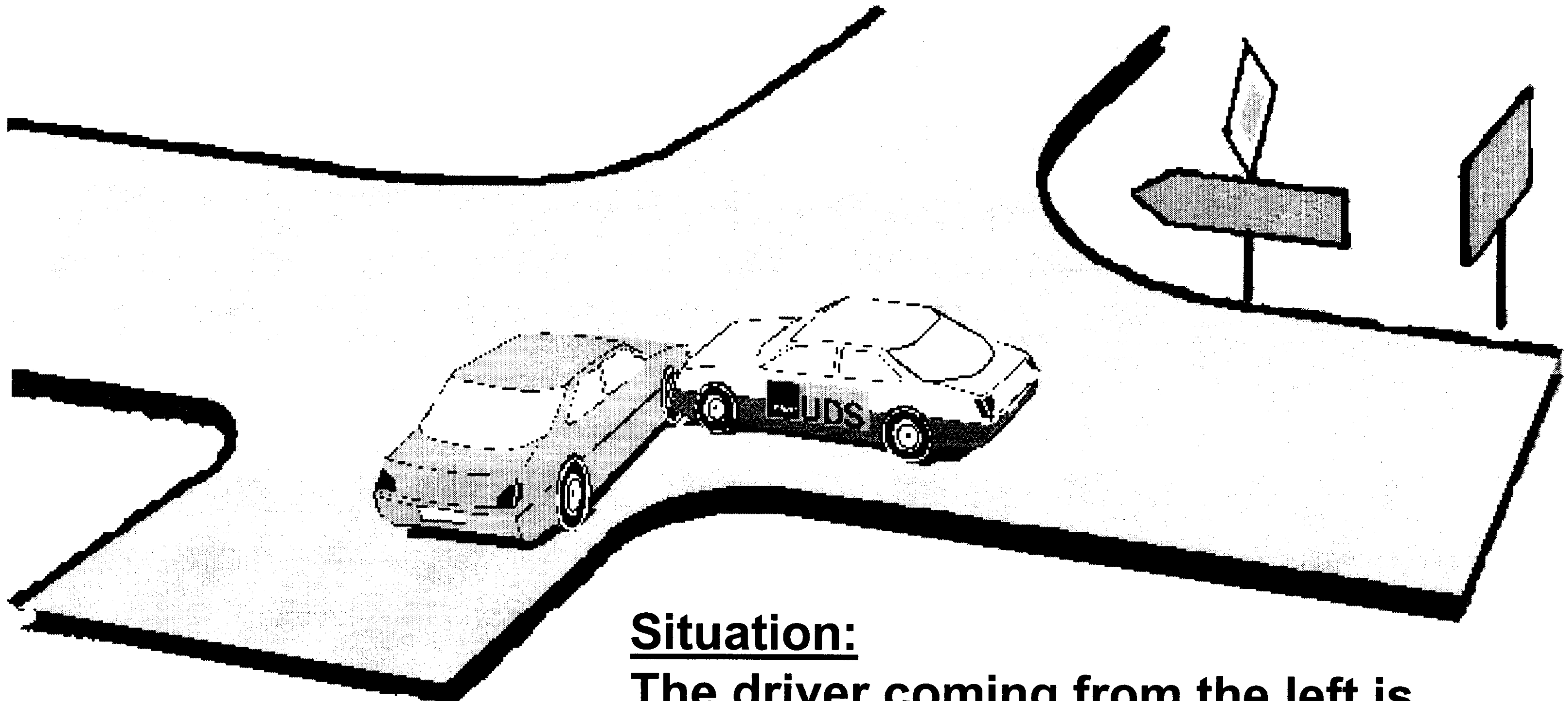
Intersection Collision



Situation:

The driver coming from the left is accusing the driver coming from the right that:

- **He was driving too fast**
- **He was turning on the right indicator**

Questions - Intersection Collision

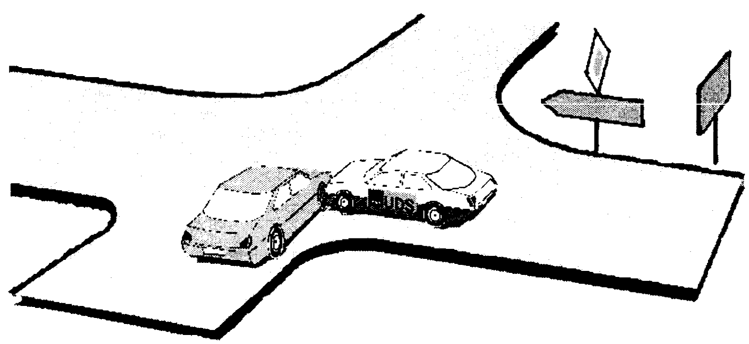
What was the initial speed?

What was the collision speed?

Did the driver Brake?

Was the approach speed excessive?

Did the driver have the right indicator on?



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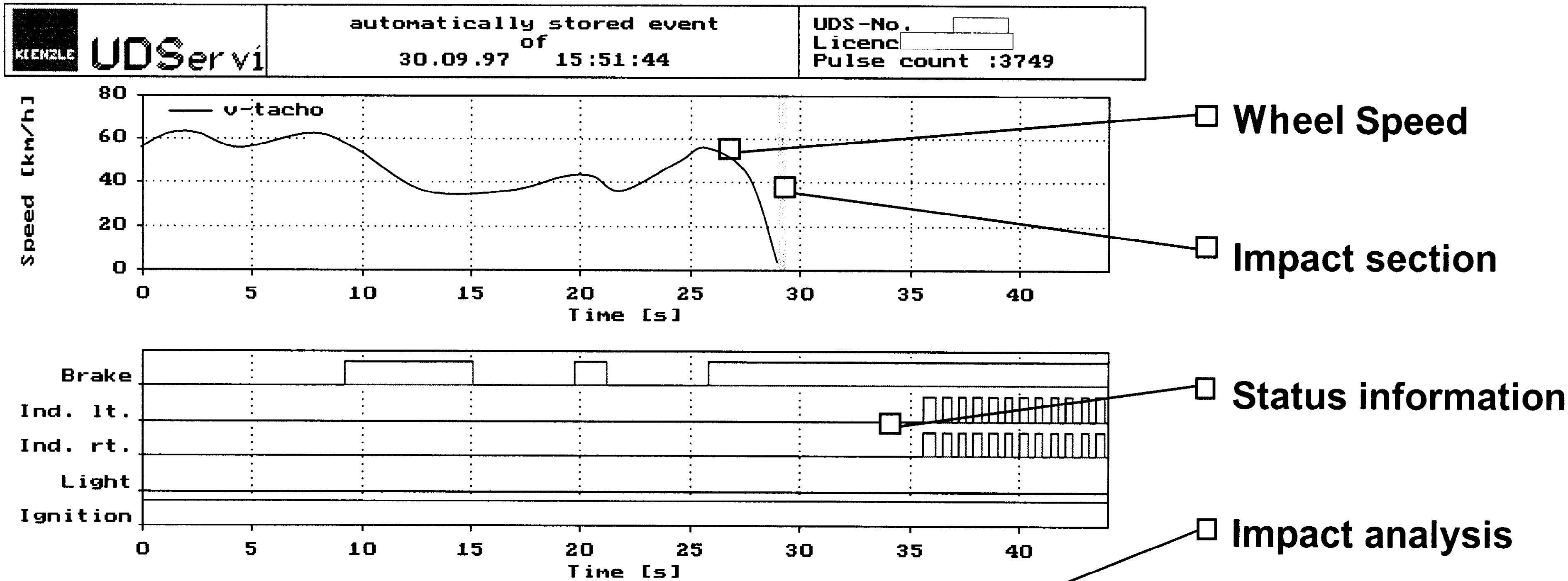
Intersection Collision
Immediate Information via UDShow



Notice :

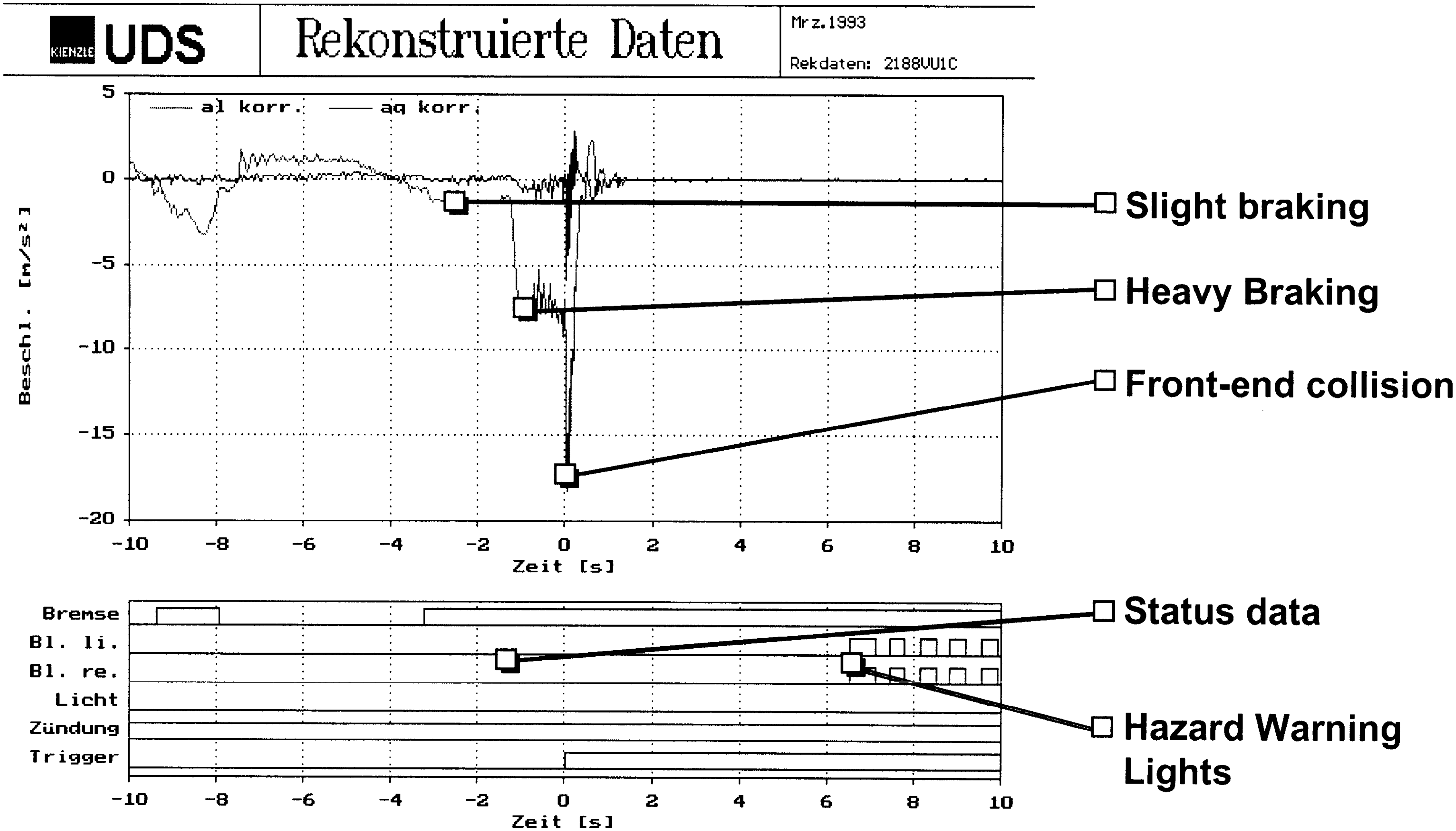
This summary does not replace evaluation

Event times not corrected

Impact area

1.Start : slight, from the front

Intersection Collision
Detailed information



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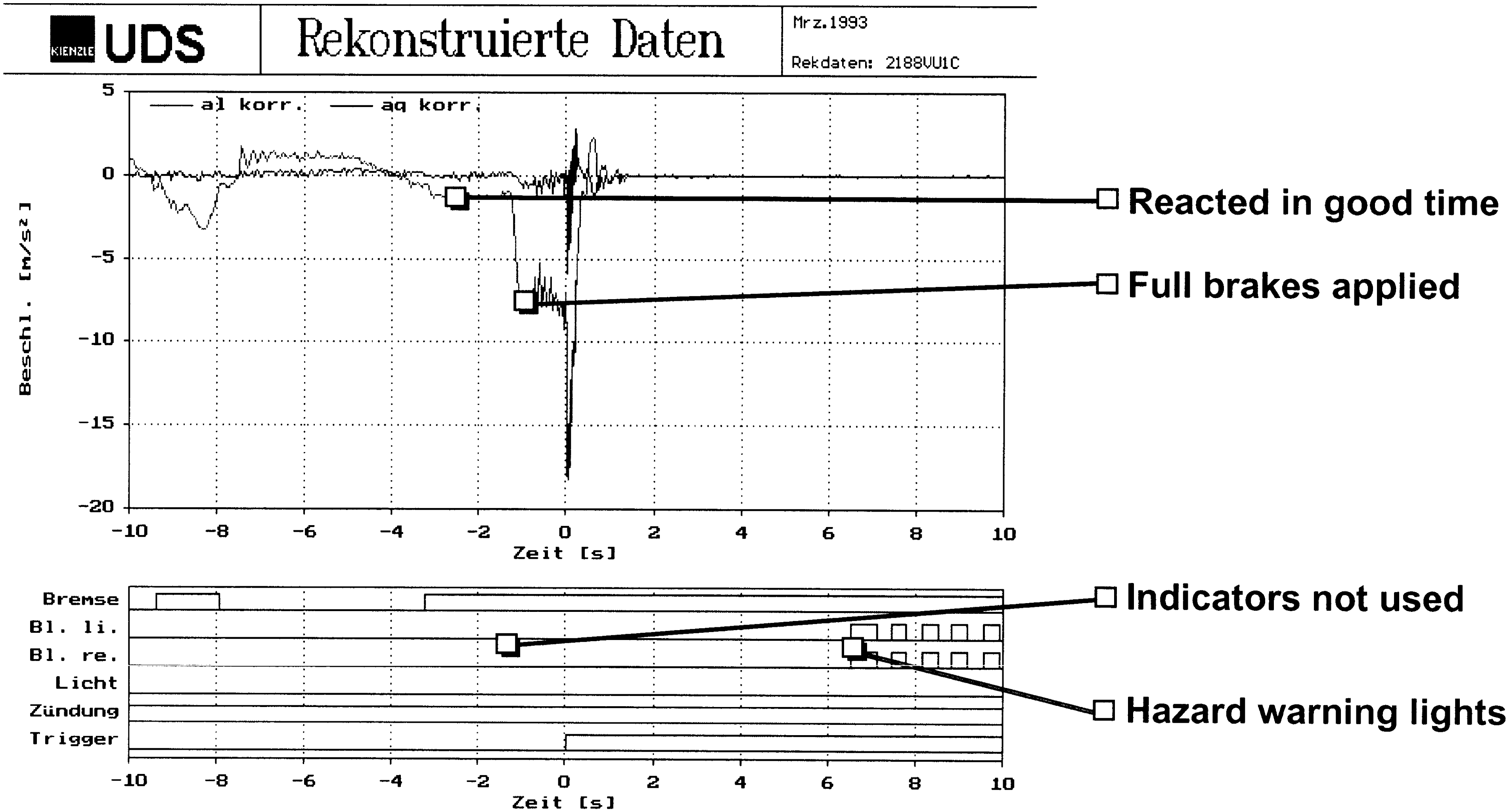
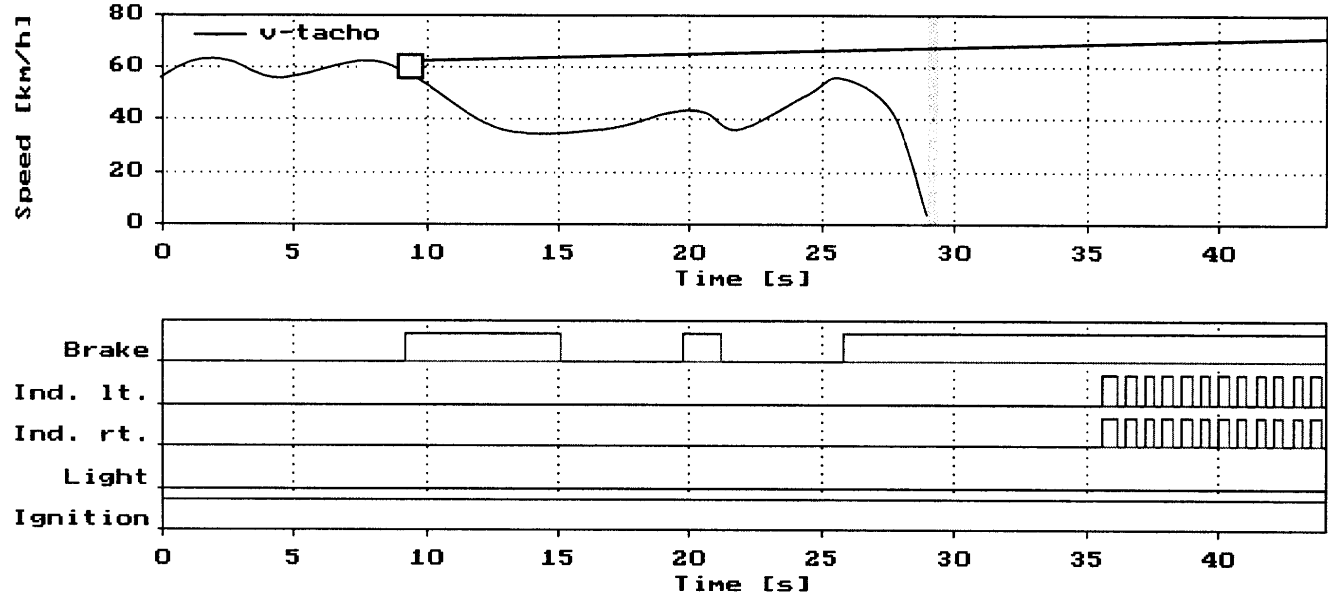
Intersection Collision
The Results



Intersection Collision
The Results

KIENZLE UDServi	automatically stored event of 30.09.97 15:51:44	UDS-No. Licenc Pulse count :3749



Approach speed not too fast

Notice :

This summary does not replace evaluation

Event times not corrected

Impact area

i.Start : slight, from the front

VDO Kienzle GmbH Villingen 05.11.1997

Benefits to the Accident Investigator

- If there are no skid marks due to wet road or the operation of ABS
- Where no other objective evidence is available
- Manner of driving shown immediately before a collision
- Cost benefits (reduced costs of reconstruction)
- The availability of evidence which would be difficult to dispute

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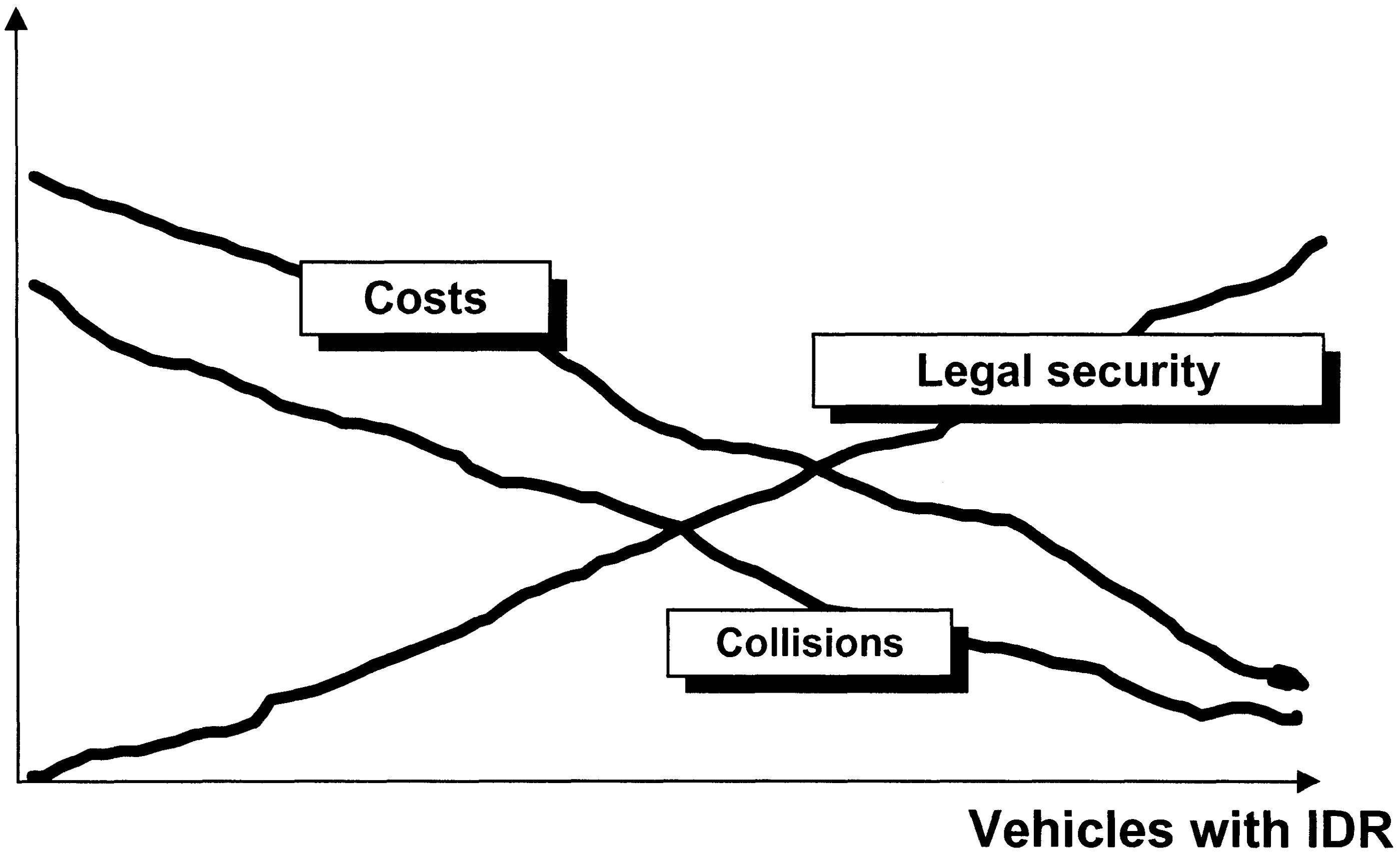
Contribution to Road Safety



- **IDR's provide reliable objective information**
- **Reduction in collisions and severity of collisions**

VDO KIENZLE

Benefits to Fleets

- **Improved driver behaviour (drivers knowing their actions would be accurately recorded)**
- **A reduction in and severity of accidents**
- **Reduction in operating costs**
- **Advantages to insurance companies and reduced premiums.**
- **Driver accountability improved. (the recording of status inputs such as horns, lights, brakes etc.)**

Safety Intelligence Systems
Ricardo Matinez

Safety Intelligence Systems

"Knowing"

February 16, 2001
Boca Raton, Florida

A Simple Plan...

- Event Data Recorder, with video

↕

- Wireless encrypted transmission

↕

- Trusted Database

Opportunity Knocks: A Better Way

- Insurance Industry
- Automotive Industry
- Vehicle Fleets
- Rental Companies
- Trucking Fleets
- Highway Safety
- Legal Profession

Safety Intelligence Systems

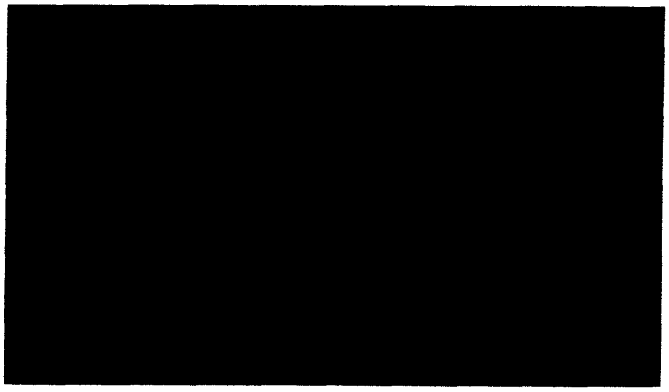
Automotive Industry: Improving Safety and Engineering

- Crash investigation has been problematic and costly
- Currently, only serious or problem crashes investigated - skewed data
- Vehicles are more complex; more data
- Quality and quantity of data have been issues
- Have always been looking in the rear view mirror - years later

S.I.S. enables effective design evaluation using quality and complete accident data.

Safety Intelligence Systems

Highway Safety



U.S. Department of Transportation
Federal Highway Administration

Safety Intelligence Systems

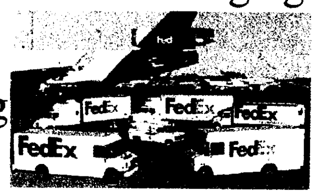
Insurance Industry

- Fraudulent claims
  - date, time, severity
- False injury claims for low speed crashes
- Lowered reconstruction costs and enhanced knowledge
- Pre and post-crash images
- Decreased legal and processing costs
- Better claims analysis and adjustment

Safety Intelligence Systems

Fleet Managers/Rental Companies

- Non-reported crashes and damage
- Resolution of conflicting accounts
- Fraudulent claims
- Workers Compensation issues
- Crash reconstruction and imaging costs
- Fleet safety
- Vehicle tracking



Safety Intelligence Systems

Corporate Issues

- Access to data at arms length
- Privacy concerns
- Liability issues
- Improved data
- Legal defense
- Quality assurance/recalls/warranties

Safety Intelligence Systems

[redacted]

- Data
- Analysis
- Knowledge
- Reports

Customers

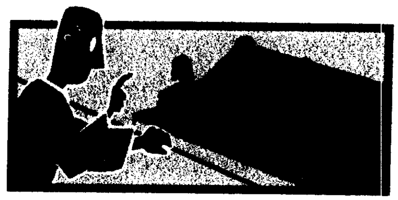
Safety Intelligence Systems

Challenges

- Costs
- Competition
- Technology and Coverage
- Privacy
- Legal
- Legislative/Political

Safety Intelligence Systems

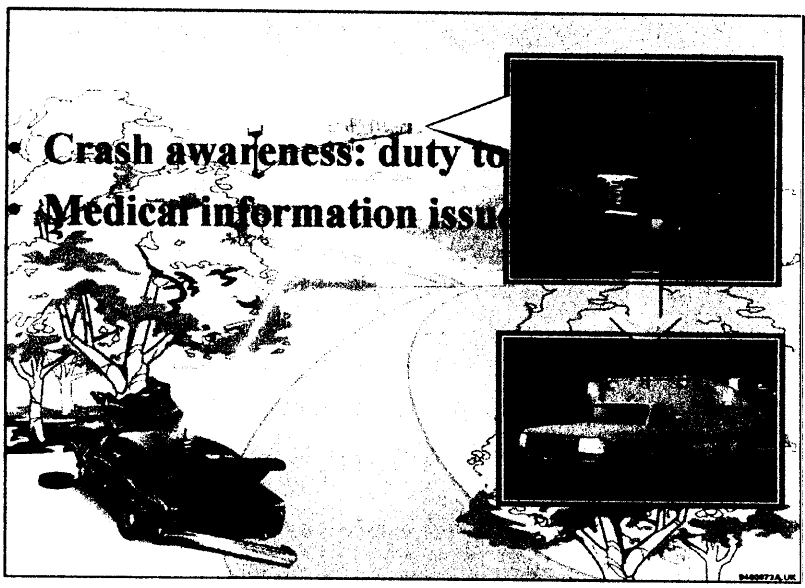
Legal/Liability Concerns



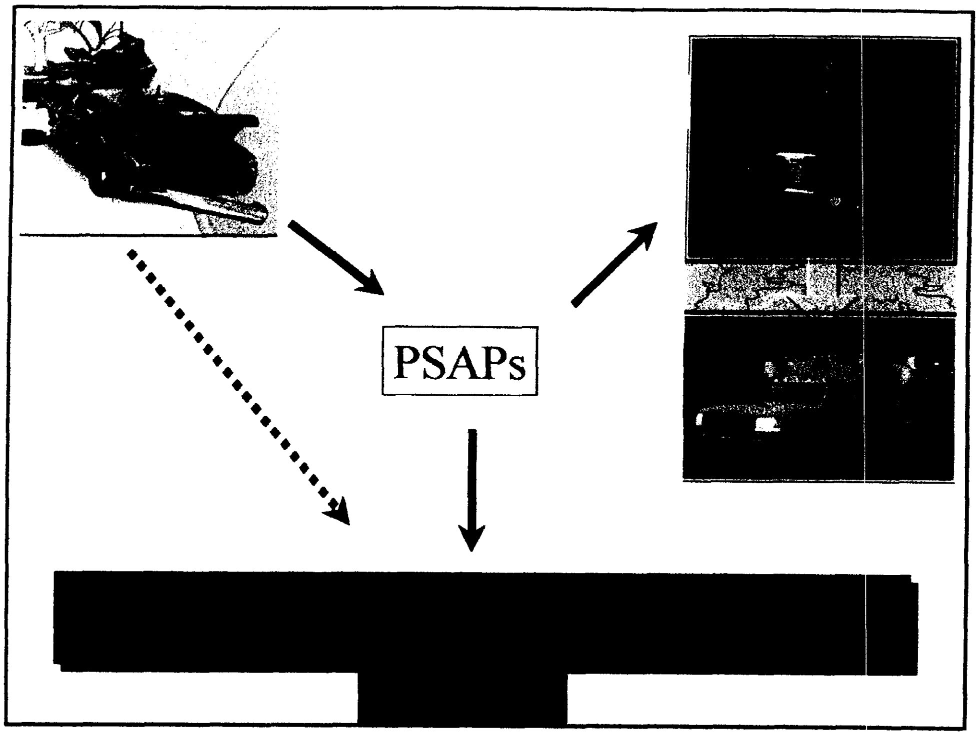
- Quality of data
- Informed consent
- Privacy issues
- Who pays
- Who gets access
- Identification of problem issues

Safety Intelligence Systems

Automatic Collision Notification



Safety Intelligence Systems



Public Policy Imperative for Information

- Outcome from Ford/Firestone hearings in 2000:
  - "All parties [automakers, insurance companies, NHTSA] have a responsibility to make sure that, in another 20 years, this Committee is not confronted by the same problems and failures we see today."
    - **U.S. Rep. John Dingell (D-MI)**
  - "It is my intention… to develop legislation to reform the process used to detect, investigate and recall defective vehicles."
    - **U.S. Senator John McCain (R-AZ)**
  - "We're not as interested in trying to assess blame as we are in trying to get a complete understanding of what went wrong."
    - **U.S. Rep. Billy Tauzin (R-LA)**

Safety Intelligence Systems

Public Policy Imperative for Information

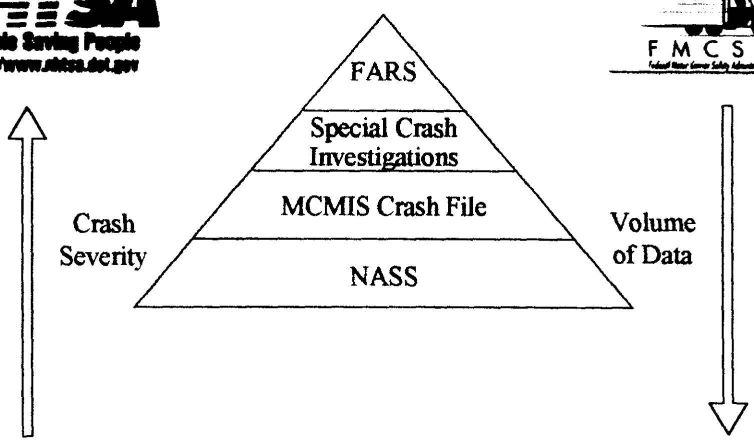
- The onus for better information is on the insurance and automotive industries:
  - Insurance industry today does not have the necessary systems
  - Automotive industry data is received with skepticism
- NHTSA has been an active proponent of passenger vehicle Electronic Data Recorders (EDRs) for almost a decade.

Safety Intelligence Systems

Federal Data

NHTSA People Saving People http://www.nhtsa.dot.gov

FMCSA

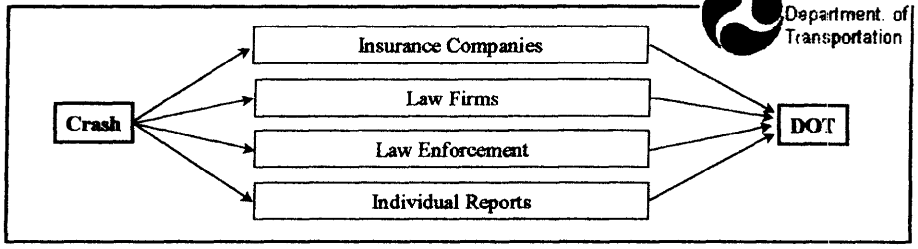


Safety Intelligence Systems

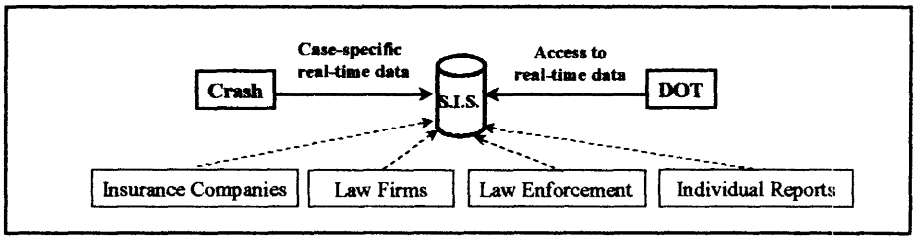
Safety Data – Immediate, Reliable and Secure

PAST: Recurring safety issues may take years to uncover...

United States Department of Transportation



FUTURE: DOT has access to real-time data with a broader view



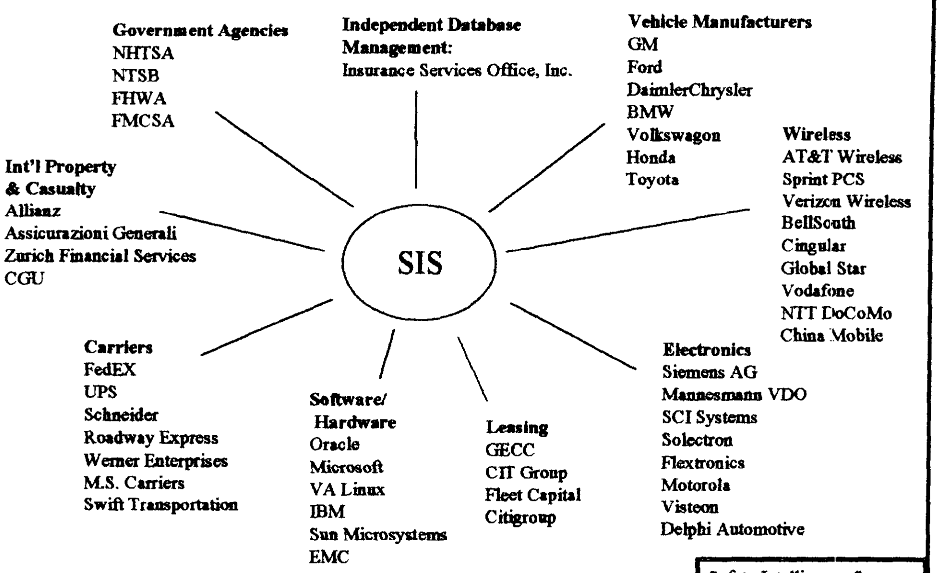
Safety Intelligence Systems

Patent Summary

- Patent number 6,141,611 gives Safety Intelligence Systems the exclusive right to record, store, and transmit wireless encrypted vehicular crash data and to make the data available to authorized parties
  - Issued in October 2000 with priority date of December 1998
  - Transmitted wireless medical data is required to have 128-bit encryption per the Health Insurance Portability and Accountability Act of 1996 (HIPAA)
  - Wireless transmission allows for simultaneous notification to emergency rescue vehicles

Safety Intelligence Systems

Strategic Partner Platform



Safety Intelligence Systems

Status Matrix

	Partners	Policy/Legal Issues	Implementation Barriers	Costs	Timeframe
Database	ISO	- ACN interface - Privacy	-Minimal	TBD	8-12 months
Transmission	TBD	- ACN interface	-Bandwidth for video -Coverage / standardization	TBD	18-32 months
MacBox	Technology: - GA Tech - iData Scale Prod'n: - Pending	-Informed consent -Duty to inform	-Quality after-mkt. installation	TBD	24-36 months

Safety Intelligence Systems

Summary

- Safety Intelligence Systems' approach complements NHTSA, FMCSA, and the carrier industry's safety and economic initiatives
  - Real data in real time
  - Improved safety
  - Reduced cost

Safety Intelligence Systems

Solutions for a Dynamic Marketplace

Ed Quinones
Insurance Services Office

Insurance Services Office, Inc.

Solutions for A Dynamic Marketplace

ISO

ISO Vision

To be the recognized leader in providing information-based products and services of such value they are an integral component of our customers' critical processes and decision making.

ISO Mission

- Provide risk decision products and services enhancing the capability and productivity of our customers in functions critical to their success
- Attract and retain innovative and creative people to an encouraging work environment offering challenging and financially rewarding career opportunities
- Reward our shareholders with long-term value creation
- Develop and distribute products and services through state-of-the-art technologies
- Operate in domestic and global markets — serving customers where we can profitably deliver value
- Invest and align to build and sustain best-in-class capabilities to develop products and provide services

ISO

Values

- Honesty, integrity, ethics and individual respect in all aspects of business
- Excellence in serving customers
- Commitment, teamwork and an entrepreneurial spirit
- Individual accountability, opportunity and rewards based on merit
- Highest product quality and reliability
- Continual improvement in all that the company does — in ideas, in quality, in customer satisfaction
- Demonstrate our stewardship through responsible management of data entrusted to our care

ISO

Information

- Breadth
- Accuracy and credibility
- Delivery options

Loss Costs

- Expected losses
  - By line
  - By class
  - For specific risks

ISO

Policy Forms

- Standardized Coverage Programs
  - 18 lines of insurance available from ISO
- Latest additions
  - Employment-Related Practices Liability
  - Market Segments
  - Commercial Umbrella

ISO

Rules

- Conditions for underwriting risks
  - Territories
  - Classification definitions

ISO

*ISOnet*SM

- Primary delivery vehicle for ISO information
- Compatibility with company processes

ISO

Information on Specific Properties and Communities

- **On-site surveys of individual properties**
- **Loss costs for specific properties**
- **Evaluation of municipalities' fire suppression capabilities**
- **Evaluation of municipalities building-code enforcement**
- **GUS: Address specific information for evaluating risks**

ISO

Statistical-Agent Service

- Reports required statistics to states
- Meets other state data calls for insurers

Data Products

- Actuarial Services
- Detailed Class Information
- ISO Market Profiler / ISO Pinpoint / ISO Risk Profiler
- Workers Compensation Data Reporting Services

ISO

ISO Data Management

- Serves more than 2,900 insurers, reinsurers, brokers & risk managers
- 1.5 billion stat records per year
- 6 billion stat records stored
- Stat data bases stored up to 20 years for some lines of business
- 200,000+ claims submitted per day on line

ISO

ISO Data Management

- Protects proprietary information
- Stringent data quality and security procedures
- Systems integrity
- Regular internal and external audits

ISO

ISO Statistical Agent Functions

- Data Collection
- Front end edit maintenance
- Data base design

ISO Statistical Agent Functions
(cont'd)

- Data quality reviews
- Data Analysis
- Report system development
- Report production

ISO Data Quality

- Field edits
- Relationship edits
- Distributional edits
- Report review

What We Can Do

- Design and implement data collection systems
- Systems design and development
- Report production
- Ensure data quality
- Data and actuarial analyses

Trustedinter Intermediary

- Safeguards private nature of information
- Compliance with federal & state privacy legislation
- NAIC Privacy Protection Model Act

Entities Who Trust ISO

- Insurers
- NICB, Insurance Company SIU's, state fraud bureaus and the FBI
- Designated as an Advisory Organization by state regulators
- NAIC for special proprietary data studies (e.g. Closed Claim)

Who Are ISO's Experts?

- **52 Fellows and Associates of the Casualty Actuarial Society (CAS)**
- **CAS and IDMA members with extensive data management experience**
- **80 business data managers**
- **120 CPCU's**
- **About 370 data processing professionals**

ISO

ISO Consulting Services

- Actuarial
- Policy forms and rules
- Filing and compliance

ISO Consulting Services

- Catastrophe
- Dynamic financial analysis (DFA)
- Data management
- Risk management
- Workers compensation
- Claims

Claims Information

ISOClaimSearch®

- An integrated all-claims database combines data from
  - Property Insurance Loss Register (PILR)
  - INDEX System
  - Databases acquired from National Insurance Crime Bureau
- Provides claims data in all lines of business
- Offers proactive fraud detection capabilities
  - NetMap *for Claims*
  - ViewLink Manager

  } Link analysis/data visualization tools
- Will provide access to public records through alliance with First Data Solutions.

ISO

Claims Information

A-PLUS™

- Claims information for underwriters' use in evaluating property and liability risk
- Serves personal and commercial lines
- To launch a new auto underwriting system in 2001

ISO

Technical Services

- Catastrophe-claims management
- Loss control
- Premium audit

Global Initiatives

- London
  - Lloyd's licensing agreement
  - Customized data solutions for Lloyd's syndicates
- Venezuela — ISO ClaimSearch
- Israel — auto data collection

ISO's World-Class Staff

ISO's staff includes:

- **More than 200 actuarial professionals with 26 Fellows and 26 Associates**
- **120 Chartered Property Casualty Underwriters**

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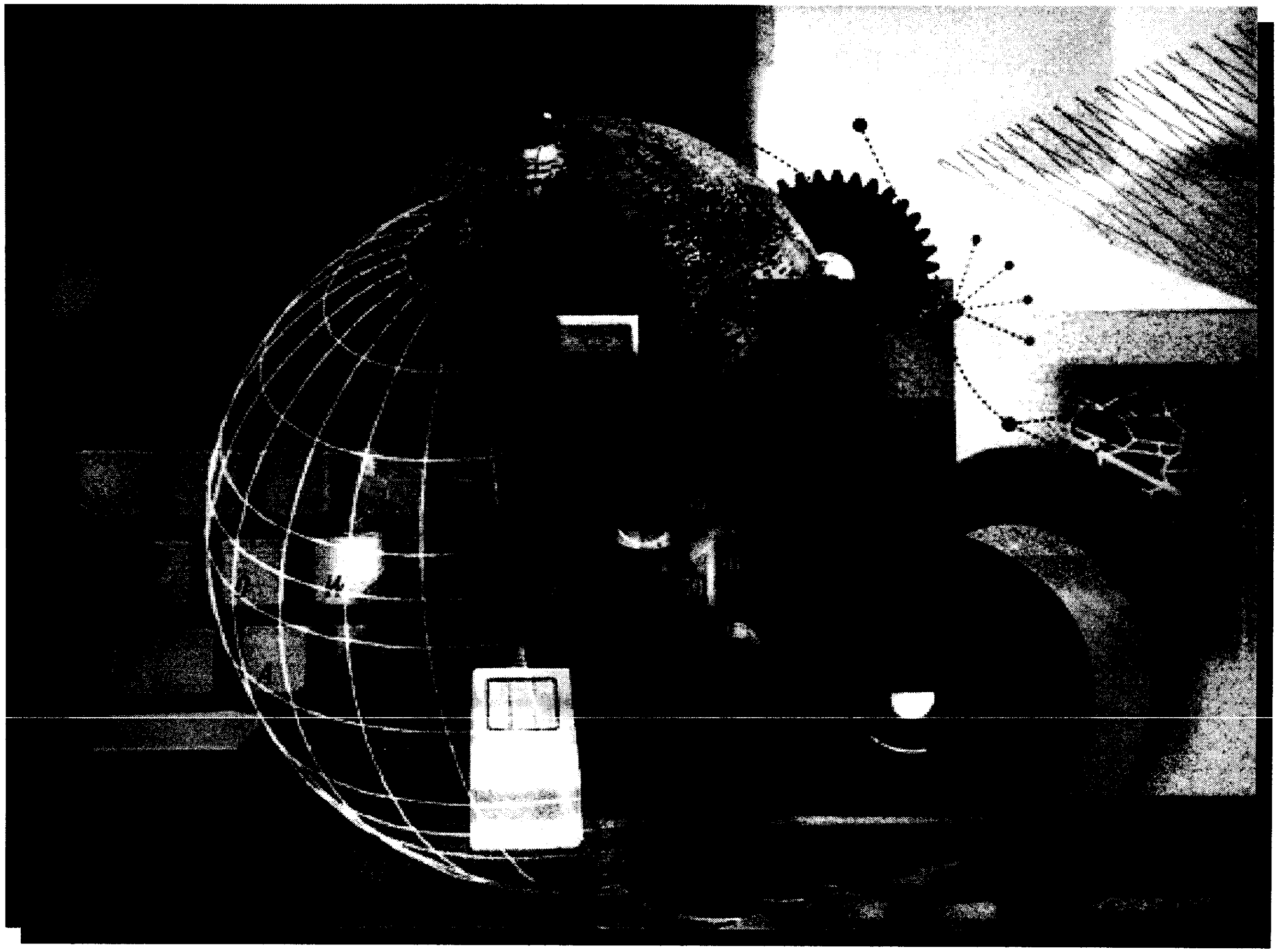

ISO

Working Group Objectives

WORKING GROUP OBJECTIVES February 16, 2001

- Minutes for the first two meetings presented in the form of answering several questions posed during the first meeting.
- Eight questions are:

1. What data elements need to be recorded?
2. What is to be gained by putting recorders on a school bus, given the low number of school bus passenger deaths each year?
3. What are the benefits of event data recorders?
4. What are some of the drawbacks to event data recorders?
5. What is the goal of the EDR? Is it to record what the driver does or is it for finding mechanics of a crash, change in velocity, acceleration, etc.? Is it to find culpability or causes of injuries?
6. Will EDR's be mandated?
7. What constitutes an event? Does the crash event occur when an air bag is deployed, or is it something else?
8. Can current recording devices accept analog inputs as well as digital inputs?

- These questions do not form specific objectives for the working group
- They pose a set of inputs that objectives should be tailored to.
- Possible set of objectives:

1. Data elements

   a. List of data elements
   b. Priorities for data elements
   c. Definitions for data elements
   d. Define a minimum set of data elements which all event data recorders should be capable of collecting
   e. Define special data needs for trucks, motorcoaches, & school buses

2. Benefits (drawbacks) of event data recorders

   a. Develop a list of benefits for event data recorders
   b. Develop a list of drawbacks related to event data recorders
   c. Develop a cost for various types of event data recorders

3. Technical specifications for event data recorders.

   a. Amount of data to be collected prior to, during, and after the crash
   b. What constitutes an event
   c. Data storage format
      Analog vs. digital systems
   d. Data sample rate for various data elements.
   e. Event data recorder survivability
      i. Fire
      ii. Immersion

iii. Shock
iv. Crush
v. Penetration

f. Interface configurations

g. data downloading
   i. direct connection
   ii. data link (cell communication)

g. Future requirements and technological advances

h. Incorporation of fleet management tools

i. Independent power supply

4. Privacy and Legal issues

a. Will data from event data recorders to be used against (or for) vehicle operators?

b. Who owns the data?

c. NHTSA's position is the owner of the vehicle owns the data

Definitions

Definitions February 16, 2001

Definitions from TMC

EVENT	Anything of interest that may occur during the operation of the vehicle.
INCIDENT	Any event in which the safety of the vehicle or any person is threatened.
A TRIGGER	Either any data parameter that exceeds a predefined threshold or external input. A trigger initiates the capture of data.
CAPTURE	The process of saving recorded data.

Other Sources:

- **SAE - J211 and others**
- **TRB - A2A04 crash test procedures (NCHRP report 350)**
- **NHTSA test protocals**
    - NCAP
    - Compliance
    - Research Tests
- **NTSB**
    - Other modes (air, rail, voyage)
    - Current highway data collection (trucks)

Survey Results

SURVEY RESULTS
October 25, 2000

- Survey of the data parameters
- Selected by NTSB for inclusion on motorcoach and school bus EDRs
- 14 persons responded
- Almost unanimous agreement that these data would be useful
- Priority was noted as Hi, Med, or Low
- 1=H, 2=M, 3=L
- The following table ranks from highest to lowest, with average score.

Parameter	**Priority**
Vehicle Speed	1.2
Longitudinal Acceleration	1.2
Braking Input	1.2
Lateral Acceleration	1.4
Brake System Status (Normal/Warning)	1.5
Engine Speed (RPM)	1.7
Driver's Seat Belt Status	1.7
Steering Input	1.7
Turn Signal Status (Left/Right)	1.8
Vertical Acceleration	1.8
Heading	1.8
Flashing Red Light Status (On/Off) (School Buses)	1.9
Brake Light Status (On/Off)	1.9
Gear Selection	1.9
Head/Tail Light Status (On/Off)	1.9
Hazard Light Status (On/Off)	2.0
Passenger Door Status (Open/Closed)	2.2
Emergency Door Status (Open/Closed)	2.4
Status of Additional Seat Belts	2.4
Air Bag Deployment Criteria	2.6
Air Bag Deployment Time	2.6
Air Bag Deployment Energy	2.6

Data Element List

Data Element List from EDR WG Draft Final Report	
#	Description
1	2 vs. 4 Wheel Drive
2	Active Suspension Measurements
3	Advanced Systems
4	Air Bag Deploy Time (Time from Start of Crash to Start of Air Bag Inflation)
5	Air Bag Status
6	Air Bag Lamp Status
7	Air Bag On/Off Switch Position (Suppression System Status)
8	Auto Distance Control
9	Auto Collision System
10	Automatic Collision Notification
11	Battery System Voltage
12	Belt Status - Each Passenger
13	Brake Effort - Service
14	Brake Pressure
15	Brake Status - ABS
16	Brake Stop Lamp Status
17	Clutch Status
18	Collision Avoidance, Braking, Steering, Etc.
19	Crash Pulse - Longitudinal
20	Crash Pulse - Lateral
21	Cruise Control Active
22	Child Safety Seat Presence Indicator
23	Delta-V - Longitudinal
24	Delta-V - Lateral
25	Digital Imaging
26	Door Ajar Switch On
27	Door Lock State
28	Electronic Compass Heading
29	Electric Steering Functional
30	Engine Throttle Status
31	Engine RPM
32	Environment - Ice
33	Environment - Wet
34	Environment - Inside Temperature
35	Environment - Outside Temperature
36	Environment - Lumination
37	Environment - Other
38	Exhaust Brake Status
39	Fuel Level
40	Ignition Cycle Counter
41	Lamp Status (Headlight and Tail Lamps On/Off)
42	Lateral Acceleration Just Prior to Crash Longitudinal Acceleration Just Prior to Crash

Data Element List from EDR WG Draft Final Report	
#	**Description**
43	Location - GPS Data
44	Number of Occupants
45	Occupant Weight Sensor - Front Passenger
46	Pre-Tensioners
47	Phone Status
48	Principal Direction of Force
49	Roll Angle
50	Roll Rate
51	Rollover (# 1/4 turns)
52	Seat Position - Driver
53	Service Engine Soon Lamp On
54	Service Vehicle Soon Lamp On
55	Stability Control
56	Steering Wheel Angle
57	Steering Wheel Tilt Position
58	Steering Wheel Rate
59	Stop Lamps Status - School Bus
60	Trailer Status
61	Throttle Position
62	Throttle-by-Wire
63	Time/Date
64	Tire Pressure Warning Lamp On
65	Traction Control
66	Traction Coefficient (Estimated from ABS Computer)
67	Transmission Selection (PRNDL Position)
68	Turn Signal Operation
69	Vehicle Mileage
70	Vehicle Speed
71	VIN
72	Wheel Speeds
73	Windshield Wiper Status
74	Yaw Rate