RECOMMENDATION 300 01/92

Integrated On-Board Information System (IBIS)

Overall revision:

Committee on Mass Transit Rolling Stock

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Contents

This VDV recommendation replaces VDV recommendation 04.05.4, including Supplements of 8/87 and 7/91.

List of the current appendices

Preface

This recommendation was drawn up as a result of the BON research project, which was carried out by ÜSTRA at Hannover, as well as the "IBIS Solingen Test Bus" project in conjunction with the industry. In spite of the specification in great detail, some changes for a particular application may be needed.

We refer to

- Report AP 2510 of the BON research project
  "Beschreibung der Gesamt-Fahrzeuganlage"("Description of Overall Vehicle System")

- Report AP 2172 of the BON research project
  "Bedienung des Fahrerterminals"("Operation of Driver Terminal")

All additions or changes to these specifications shall be cleared by the VDV in order to maintain compatibility.

These specifications are therefore updated periodically.

System overview see appendix 1.

1. General

The Integrated-on-Board-Information-System, IBIS, is designed for data processing and transmission of data in vehicles and trains of public transports for the following:

- Information of passengers concerning location, time and destination
- Information of the control center concerning location, destination and loading of the vehicle
- Information of the drivers concerning deviation from schedule, operational orders and technical problems

The advantages of IBIS are

- The handling of large amounts of data within the vehicle and also between coupled vehicles, using a limited number of lines and contacts on the couplers.
- The minimization of the necessary manipulations by the driver through centralization of the control of all peripherals.
- The standardization of the manipulations as well as the layout of the equipment of different origin.
  This applies for different types of vehicles in different modes of operation (Rail vehicles, busses, trolley busses) line operation, demand-responsive operation; single or multiple unit operation; uni- or bi-directional vehicles
- Modular and expandable design at a small initial investment

The aim of this recommendation is to define the interface between a central unit with an integrated or external terminal and peripherals in the vehicles. This definition includes software as well as hardware.

According to the requirements the following units can be controlled:

- Drivers terminal
- Ticket cancellers
- Ticket vending machines
- Line (route) indicator
- Destination indicator
- Display of next stop
- Announcement of next stop
- Data transmission system (wayside to vehicle)
- Acquisition of technical faults

Data exchange is possible

- within the vehicle including a trailer (via Vehicle-BUS)
- with similar IBIS-systems in coupled units (via Train-BUS)
- with control center via AVLC (Automatic Vehicle Location/Control) systems

System overview see appendix 1.

Possibilities for extension and its limits

IBIS permits to implement additional functions as long as

- the number of 32 peripherals is not exceeded and

- the limits of the data transmission are observed

These limits are, that a maximum of 26 information exchanges between IBIS and the connected peripherals are possible. Dead times of 175 ms are possible. In certain applications these may exceed one second.
IBIS therefore is not suited to control a large number of peripherals within short intervals of time, e.g. several door controllers of a vehicle or one peripheral with very short intervals, e.g. control of traction/braking.

Additionally, the data transmission may not be used for security related functions despite a hamming-distance of the transmission protocol of d = 4.

The relevant standards and recommendations must be taken into account, especially the following:

- DIN VDE 0115 "Bahnen, Allgemeine Bau- und Schutzbestimmungen"("General Construction and Safety Regulations for Railways")

- DIN 43321 "Regeln für elektronische Einrichtungen auf Schienenfahrzeugen"("Regulations for Electronic Installations in Rail Cars")

VDV Recommendations

- 70.61.1 Operational requirements for data controlled operating control systems

- 420 Technical Requirements for Automatic Vehicle Location/Control systems. Radio data transmission.

- 04.05.2 Technical requirements for local beacon systems

- 04.05.3 Technical requirements for radio equipment for speech and data transmission

- 04.05.5 Data transmission - Interface (version BON)

- 04.06.1 Technical requirements for stop announcement equipment

- 06.20.1	Devices for fault detection, fault registration and fault reporting (FERM) in light rail and rapid transit trains
- 06.20.2	Operational and technical recommendations for mobile or stationary ticket cancelling machines and remote control of ticket cancelling machines.
- 20.81.1	Guideline for the design of electrically powered ticket machines.
---------	Type recommendation for standard line bus

2. Central Unit

2.1 Functions

The central unit organizes the data exchange on all closed channels, processes received data and generates instructions and displays. Data output is event-oriented - in response to an input - or time-related.

The modular design means that any standard version can be expanded as desired to maximum size. The central unit is designed so that IBIS can operate without an AVLC system on a temporary or permanent basis.

The standard version comprises:

- Data exchange with peripheral equipment via shared lines (Vehicle-BUS, section 5)
- Date and time generation
- Processing of locating criteria, e.g. for automating stop announcement and stop indication.

The following expansion options are available:

- Data exchange with other central units in train (Train-BUS, section 6)
- Communication between AVLC system and driver or vehicle in the case of scheduled services (interface with data transmission radio, see VDV recommendations 420 and 04.05.3).
- Expansion of functions and data management for non-scheduled services or combined scheduled/nonscheduled services.
- Output of requests via radio link in cases where an AVLC system has not been installed (e.g. traffic light control).
- Display of technical faults

A parameter field is provided for storing any operator-specific characteristics. Modifications can be made by means of external loading, the time and cost involvement being at an acceptable level.

The unit is self-monitoring and automatically carries out a defined restart after malfunctions (Watchdog).

An integrated central test program facilitates system maintenance.

In cases where the supply power is interrupted or drops below the acceptable undervoltage limit value, the latest data is retained. For operational reasons, the data must be deleted after 60 minutes. The time and parameter fields must be available for at least 1000 hours. (In cases where trailers are linked as slaves - section 7 - local data is deleted instantly). The unit must restart automatically on restoration of power (power-on reset).

In contrast to VDE 0115, the minimum voltage level is defined as 25% of the nominal voltage ($U_{betr.}$). Any voltage drops below this limit must not result in undefined operating states. The output of requests to peripheral devices is stopped immediately.

The central unit is directly connected to the battery by means of a separate line via the ignition or the vehicle master switch. The unit must not be destroyed if the voltage exceeds the high voltage limit defined in VDE 0115. A permanent switch-off is permissible. Radio interference level N must be complied with.
The unit must be based on the climatic conditions specified in VDE 0115 part 1. Since the vehicles are frequently left outside, it must be ensured that the unit does not become damaged even if the stipulated minimum climatic conditions are not provided.

2.2 Driver terminal

The standard version of the central unit comprises an operating and display unit integrated in the housing which is defined as the driver terminal in this document. The central unit must thus be installed in the driver's cab and has been sized accordingly.

The driver terminal comprises 22 buttons, 10 of which are dual-purpose function and numeric keys, and a pressure-resistant 2 line LCD dot matrix display for 32 characters (16 per line). The dual-purpose function and numeric keys are designed so that the first button pressed always identifies the function and any buttons pressed afterwards represent the corresponding numbers. The driver terminal also houses an acoustic signal buzzer, which annunciates the display of a new message as well as the departure command.

2.3 Installation regulations

In order to ensure that central units, even if made by different manufacturers, can be replaced without any limitations, the following definitions are applicable.

Principal design and dimensions, see appendix 2.

The central unit is mechanically installed and locked in the associated slide-in bracket in the vehicle (see appendix 3).

The standardized slide-in bracket is mounted in the instrument panel or in any suitable location of the vehicle structure by means of vehicle type-specific components.

In order to adapt the slide-in bracket to the specific installation conditions, it can be fitted with a collar (for installations protruding from the instrument panel) and/or panels for non-instrument panel installations.

The bracket comprises electrical components for external filtering and backup supply; see appendix 4 for circuit diagrams and sizing.

The side facing the driver (driver terminal) must comply with protection standard IP 54 (in accordance with DIN 40 050). IP 52 is sufficient for the other sides including the plug connection.

The electrical connection is established by means of two 50-pin connectors (D-type, Cannon or equivalent) and prepared cable harnesses (high.twisted multi.core, minimum cross section 0.5 mm^2, common screen) via flat connectors to the vehicle distribution board. The pin layout of the connectors is detailed in appendix 5. The vehicle address programming is carried out by means of up to 12 wire jumpers between contact No. 213 (Address Common) and the associated address bit on the connector strip in the bracket. A jumper is defined as logic 1. If the number of address bits is even, the number of jumpers is increased to produce an odd number by connecting the parity input (contact No. 250).

3. Remote Driver Terminal

In the case of bidirectional vehicles, a further driver terminal is located in the second driver's cab. This remote terminal is connected to the Vehicle-BUS and is handled by the central unit as a peripheral device.
The principal design, housing and mounting are almost identical to the central unit; see appendix 6.

Section 2.3 applies for installation.

The unit is fitted with only one 50-pin plug; see appendix 7 for the pin layout.

Like the central unit, the remote driver terminal is switched on by means of an external, voltage-free contact. The vehicle must be designed so that only one terminal can be active at a time. If this condition cannot be fulfilled, it must be ensured that the devices are not damaged. Data traffic interferences are acceptable.

4. Peripheral Devices

Peripheral devices exchange data with the central unit via the Vehicle-BUS. The peripheral devices are powered via the on-board electrical system. The dielectric strength of the electrical isolation between the electrical system of the vehicle and the Vehicle-BUS must be 0.5 kV.

The voltage peaks in the supply lines, which are defined in accordance with DIN 43 321, must not damage the transmitters or receivers. It must also be ensured that voltage levels exceeding the high supply voltage limit specified in VDE 0115 for long periods do not result in any damage. Permanent switch-off is permissible.

In cases where failures are caused by undervoltage, it must be ensured that the data connection with the Central unit does not fail before the functions so that the functions are always controlled.

Peripheral devices should be connected by means of either of the following connections:

- 12-pin male connector in accordance DIN 41 622. The pin layout must be in accordance with appendix 8, sheet 1. The address is programmed on the socket connector of the vehicle if required. The jumper is logic 1.

- 19-pin UT Bantam type plug connector for more stringent requirements in terms of protection class.
  The pin layout must be carried out in accordance with appendix 8, sheet 2. Address programming is as set out in the paragraph above.

5. Vehicle-Bus

5.1 Electrical data

The wiring of the Vehicle-BUS is typically designed as a four-wire, multi-core cable twisted in pairs (50 twists/m) with a common shield. This cable must not be used for other non-system related circuits.

Appendix 9 illustrates the principal circuit diagram.

5.2 Data transmission

All connected devices are operated by means of polling. The devices respond on request and output the required data or an acknowledgment. The time conditions are detailed in appendix 10.

There are also data records with general data which are designed for several peripheral devices (such as line number). There are no acknowledgments for these records. In order to ensure however, that these records are received by the relevant devices, even when transmission is affected by interferences, they are transmitted cyclically.

Polling is performed partially in cycles and partially in accordance with external events.

5.3 Data record structure

The characters used comply with DIN 66 003 (ISO-7-bit code), see appendix 12.

Each data record starts with an identifier (mnemonic lower case letter) which indicates the address of the called unit and/or the type of a general data record. The identifier is followed by data containing upper case letters, numeric characters and special symbols. A standardized record length is not efficient in terms of time owing to the different data volumes. The lower case letters at the beginning of the individual data records and the constant number of symbols per data record identification are used for block synchronization.

This does not apply to the transmission of characters to and from the driver terminal. A fixed length is not provided owing to the varying number of characters.

A control character (CR) is transmitted after each data record transmission. This control character enables the data communication on the Vehicle-BUS to be tested easily by means of commercially available equipment. Such terminal/laptop test equipment does not generate test characters (horizontal parity). Peripheral devices must therefore be fitted with a switch, which disables the evaluation and generation of these test characters.

In order to improve the signal-to-noise ratio, a test character, consisting of horizontal parity bits, is generated and transmitted at the end. The Hamming distance is thus increased to 4 taking into account the vertical parity protection of the individual ASCII characters (see appendix 12).

5.4 Scanning control

Basic scanning is performed in cycles with two different cycle times. General data is sent six times per minute and the scanned data of the keyboard of the driver terminal, registered as active, once per second.
The fault detection system as well as different status messages must be scanned 6 times per minute.
Higher frequencies are acceptable in case of data records with higher priority levels (see appendix 11).

All other data records are transmitted in accordance with external events.

All general data are also transmitted spontaneously if a value changes.

The average number of characters for transmission in a fully expanded system version has a sufficient reserve capacity when selecting a Baud rate of 1200, which corresponds to approx. 6,500 characters per minute. A hidden reserve means that it is acceptable to extend scanning cycles in critical situations.

At a Baud rate of 1200, the entire IBIS system can be tested with non-complex devices. The relatively low data transmission speed also has a positive effect on interference immunity.

6. Train-Bus

In cases where trains are comprised of autonomous individual vehicles fitted with IBIS, it is necessary to coordinate the individual systems by setting the central unit in the first car to the so-called Master status.
Since the first car is typically used by the driver, the valid criterion in this case is an unlocked driver's cabin.
The other IBIS central units are set to slave or fault status. In the event that several IBIS central units in the train assume the master function, this must not damage the transmitters and receivers. Trains comprise up to 6 units. The difference between the Train-BUS and the Vehicle-BUS is that the train BUS operates at a significantly higher signal level in order to manage the contact problems. It also uses an additional address assignment procedure in order to identify the position of the individual vehicles in the train as well as the vehicle number. The reduction of data exchange by combining individual interrogations to global interrogations enables simplex operation and thus the reduction of train lines and coupling points. The time conditions are detailed in appendix 13.

6.1 Electrical data

In order to ensure that data is transmitted reliably across coupling contacts, it is necessary to generate a 60V _ (+20% -25%) auxiliary voltage UH. If the voltage drops below the tolerance limit, the master central unit stops to request data from the other controllers.

Appendix 14 illustrates the principal circuit diagram. Each BUS connection to a central unit has two receiver inputs E1 and E2. The Train-BUS is interrupted by switch "a" until initialization is completed, thus enabling the address assignment procedure described in section 6.2 to be implemented. The receiver inputs and the auxiliary voltage supply must be electrically isolated. The dielectric strength must be 0.5 kV.

6.2 Data transmission

6.2.1 Initialization (address assignment procedure)

When the operating voltage is connected, the devices initially assume a neutral state (Train-BUS open, switch "a" in position 2) unless there is a fault in the equipment. The central units do not initially know where this equipment is located in the train. When the driver's panel is switched on, the associated central unit assumes the master function in the train. This status is recognized by the position of the enable key switch or by means of the driver terminal response in the other driver's cab. In order to enable data communication to take place on the Train-BUS, a symbolic address must be assigned to all other central units. The master unit first checks to determine whether one, both or no couplers are connected (coupling criterion).

If all couplers are disconnected, the vehicle is identified as an individual vehicle and the Train-BUS is not operated. If both couplers are used, the master unit is untypically located in the center of the train (locomotive at rear or center of train). The address assignment procedure described in the paragraph below passes through coupling end B and then through coupling end A.

In the event that only one coupler is connected, the change-over switch "a" is set to "1" in order to enable transmission in both directions and to switch only one receiver input off (see appendix 14). The next vehicle is assigned the symbolic address "1" by means of the first data record (No. 230, see appendix 15). The central unit in the next vehicle then responds with its vehicle code and with the status of its second coupler (data record No. 330). Please note that the change over switch "a" must be set to "1" for the duration of this data record. If data transmission is completed without any errors, the master unit issues a confirmation (data record No. 231). The next central unit subsequently uses the change-over switch "a" (position 1) to connect the Train-BUS. If the second coupling in the next train is connected, the master unit uses data record No. 230 to transmit the symbolic address 2 to the next but one central unit. This procedure is continued until the last vehicle (criterion no reply from any more vehicles) has been identified. Since trains normally comprise up to 6 units, the upper limit of this symbolic address range is 5.

In the event of a discrepancy between the number of responding central units and the coupling criteria, an error message must be output to the driver.

If both couplings are busy in the vehicle with the master unit, the procedure described is completed via coupling B before setting the change-over switch "a" to "1". The address assignment procedure is then continued via coupling A. The central units connected to the Train-BUS via coupling B receive these data records but do not respond because they have already been assigned a symbolic address.

The symbolic addresses for the central units connected to the other coupling end (A) are assigned in descending order starting with 7. However, the total number of vehicles which are allocated an address does not exceed 5, which means that up to 6 loads can occur in electrical terms. A higher number is not provided for in order to ensure that the Train-BUS drivers are sized efficiently.

The number of vehicles belonging to the train, established in manner described above, is displayed to the driver for control purposes.

Central units with a symbolic address assume the slave state and can thus participate in the general data traffic taking place on the Train-BUS. In this status, slaved central units use the date and time stored in the master unit (data records 205 + 206) of the train.

6.2.2 Changing the train length

In cases where trains are shortened or extended and the central unit, defined as master, is switched off directly or loses its master status because the driver's cab is located in a different vehicle, the initialization procedure for the ready train is completed as described above. In all other cases cyclic status scanning results in the following responses:

- the vehicle that previously came last reports a changed coupling status if the train has been extended

- the last vehicle reports a changed coupling status if the train has been shortened (disconnected vehicles do not respond).

The master unit then suspends the data request on the Train-BUS for 5 secs.

Central units which do not receive any data via the Train-BUS for more than 3 secs reset to the neutral state. (Master units which do not receive a response from the driver terminal for more than 3 secs. suspend the data traffic on the train BUS and also assume the neutral state). The initialization procedure can then be completed normally.

6.2.3 Data exchange in controlled condition

All central units in the train initially receive the same general data as the Vehicle-BUS (No. 001 to 009).

In cases where it is of advantage to the request structure of the central units, it is possible to transmit the general data together with the data on the Vehicle-BUS, because this does not invoke the slave units to issue a confirmation. This data must be transmitted promptly after every change but at least once per minute.

During the remaining time, the slave units are polled selectively to establish their status (data record No. 240). The individual central units can then transmit errors occurring in their unit, occupancy changes or changes of the coupling status etc. (340). Each central unit transmitting a message, receives a confirmation (240) and is interrogated until it transmits zero status (no further messages). If the confirmation is not transmitted, there is a communication error and the previous message is repeated.

The response signals also contain the symbolic call address. Owing to the simplex operation on the BUS, the individual slave units cannot automatically distinguish between requests from the master and responses transmitted by other slaved central units. The deviating symbolic addresses, however, ensure that they do not respond to such data records.

6.3 Data record structure

Same as Vehicle-BUS.

The data records used are listed in appendix 15.

7. Individual Connections

Depending on the system version, additional digital inputs and outputs are required. All inputs and output are implemented by a small number of interface types, which are defined in annex 16. The interface types and signal names are listed in connector pin layout tables (appendix 5).

- Door criterion
  A signal is applied from the time a door is enabled or opened until the last door is closed.

- Coupling criterion
  In the case of bidirectional vehicles, one signal is used per coupling to indicate whether a further vehicle fitted with an IBIS Train-BUS is coupled.

- Control inputs and outputs
  2 bits each can be used for the control of any (except safety relevant) equipment in the "master to slave(s)" and "Slave(s) to master" direction.

- Driver terminal A on
  In the case of bidirectional vehicles, a signal is used to indicate that the driver's cab, which houses the central unit, is occupied.

- Testing
  The test system is started by means of an external switch which is protected against unauthorized use by means of a key or is placed in a concealed location.

- Route pulses (odometer pulses)
  Resolution 1 pulse / m ± 10%.
  Pulse duty factor 1 : 1 to 1 : 10 (pulse : pause).
  It must be ensured that the resolution can be adjusted in the parameter field in increments of e.g. 2% in the range of 1..4 pulse / m.

In cases where an AVLC system is used, the following additional connections are provided:

- Fault
  AVLC system section is switched off. Change-over to open radio telephony by external, possibly protected, switch.

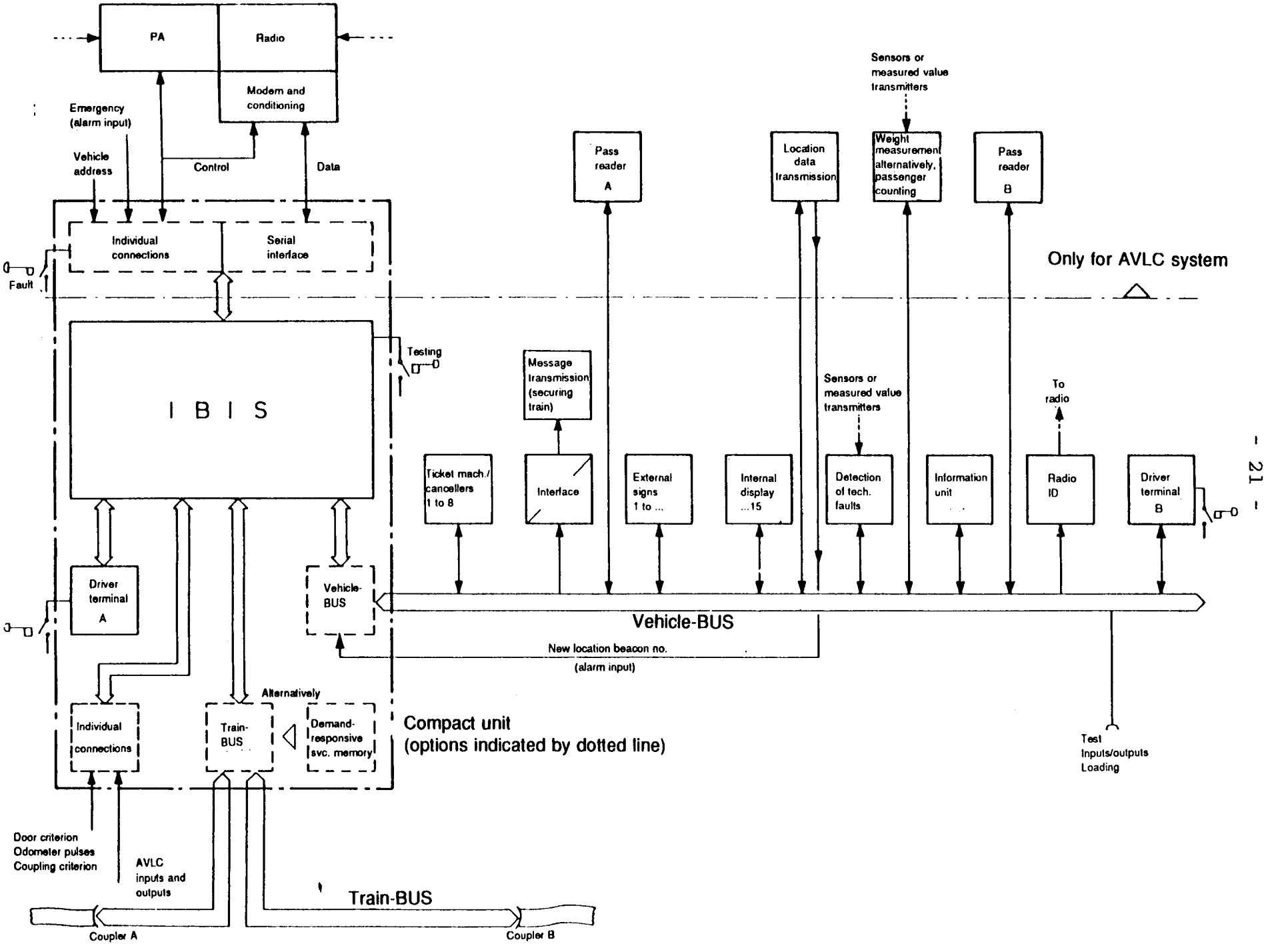
- Emergency call
  Triggered by hidden push button(s).

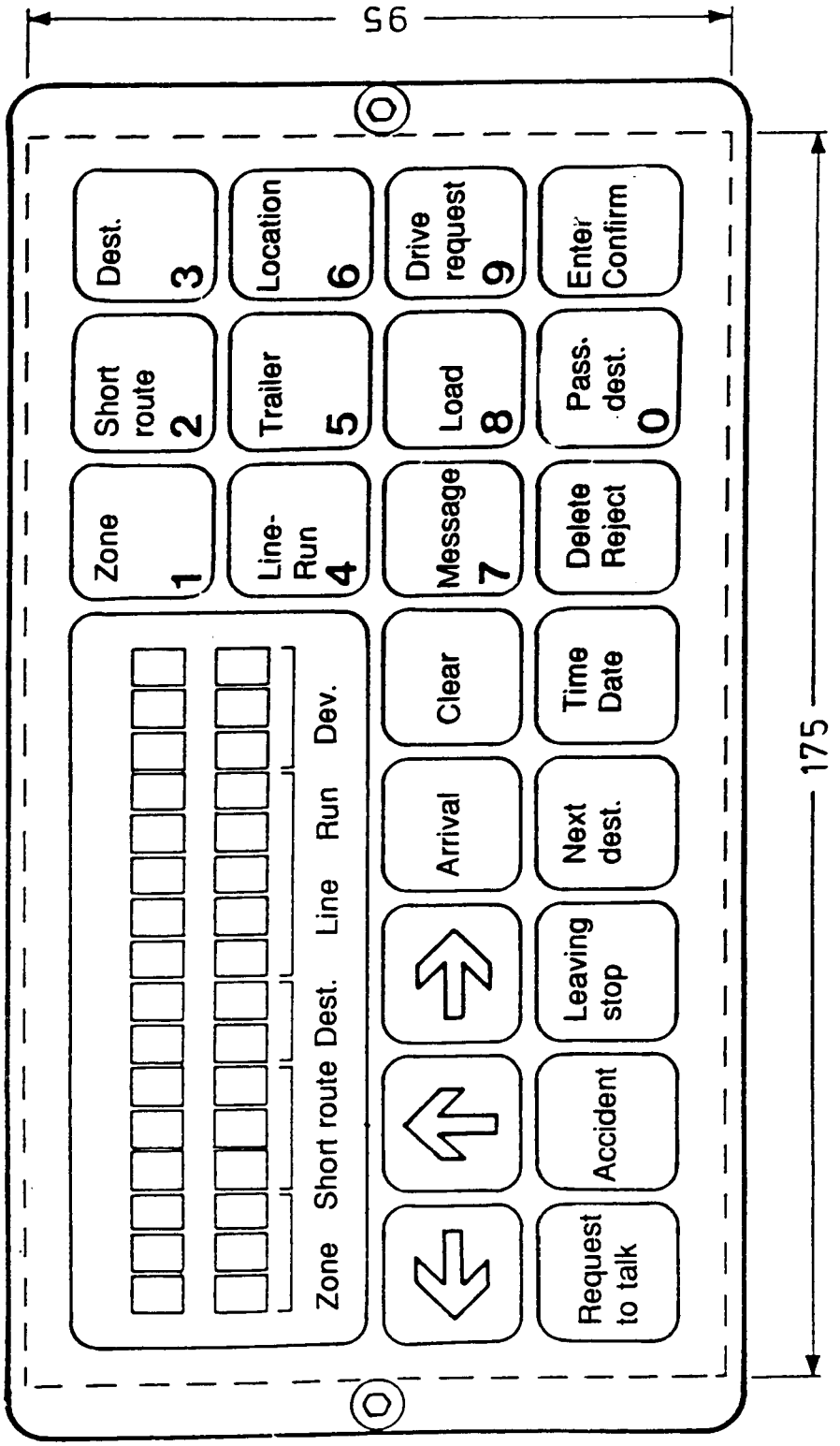
- Vehicle address
  12 bit used as call address of AVLC system.

- Control of radio and PA
  Channel selection, transmitter scanning, radio to vehicle, cyclic data input and output. For detailed specifications, see VDV document 04.05.3

- New beacon
  When a new location beacon is identified, the location code receiver transmits a signal. The signal is reset to logic "0" when the receiver was addressed with data record 061.

IBIS System overview (Integrated on-Board Information System)





Keyboard division 19.05 mm ≈ 3/4"

Depth 150±0.2 mm incl. plug connections

Other operating elements located elsewhere:

Emergency call

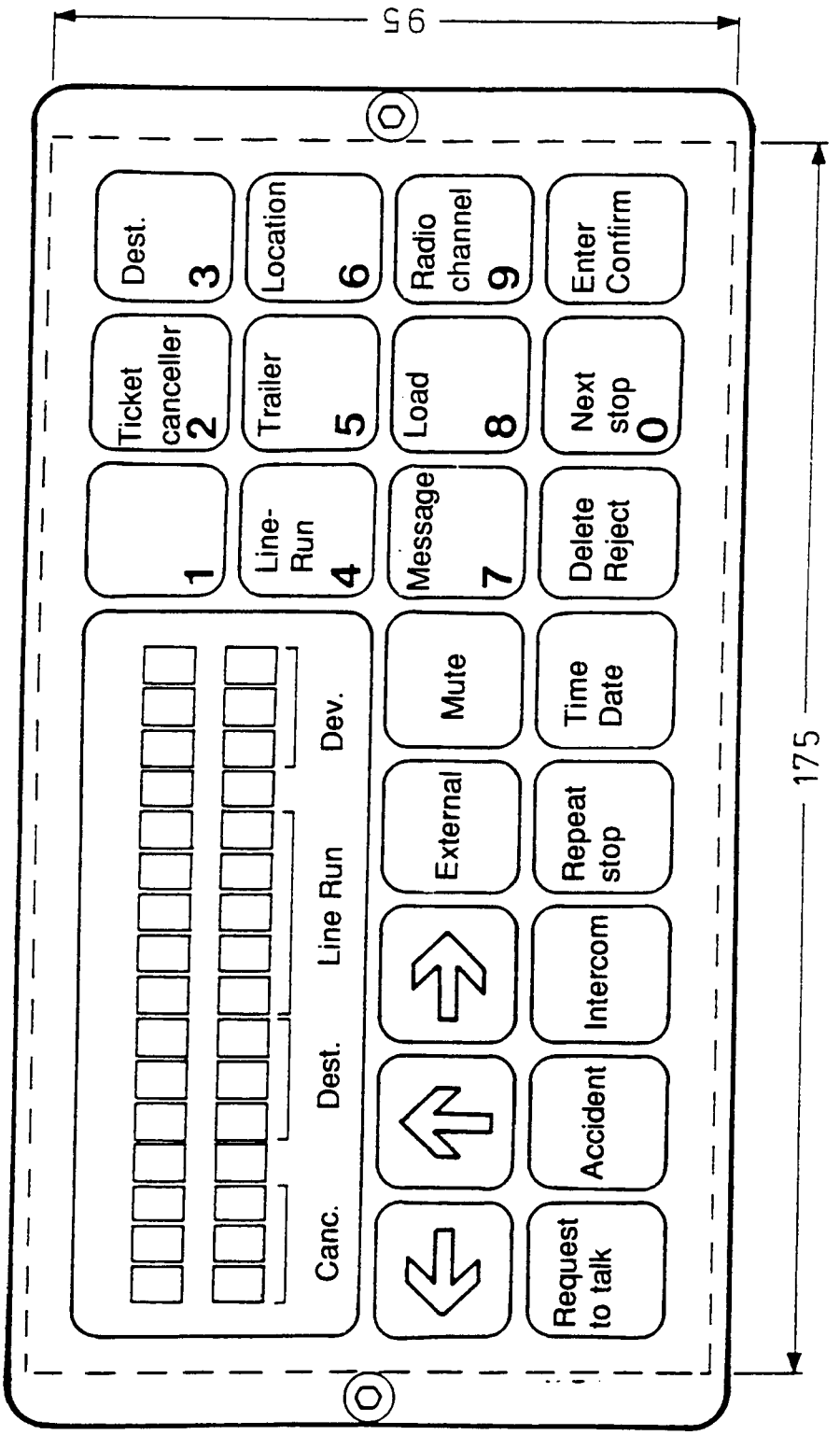
Transmission / public address button

Volume control for driver's public address system

Ticket identification unit

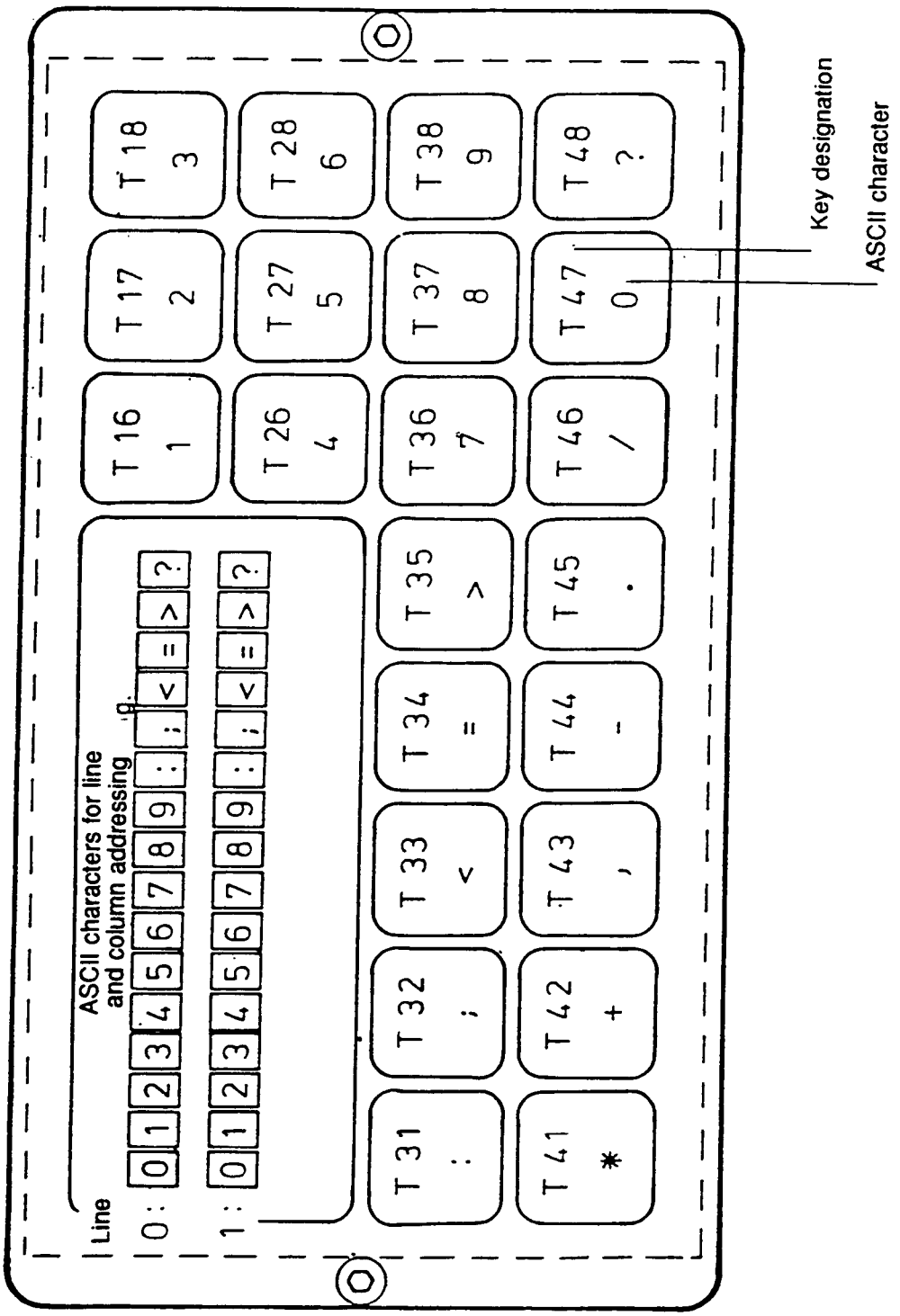
Central unit with integrated driver terminal
Example 1 for key allocation

Appendix 2
Sheet 1



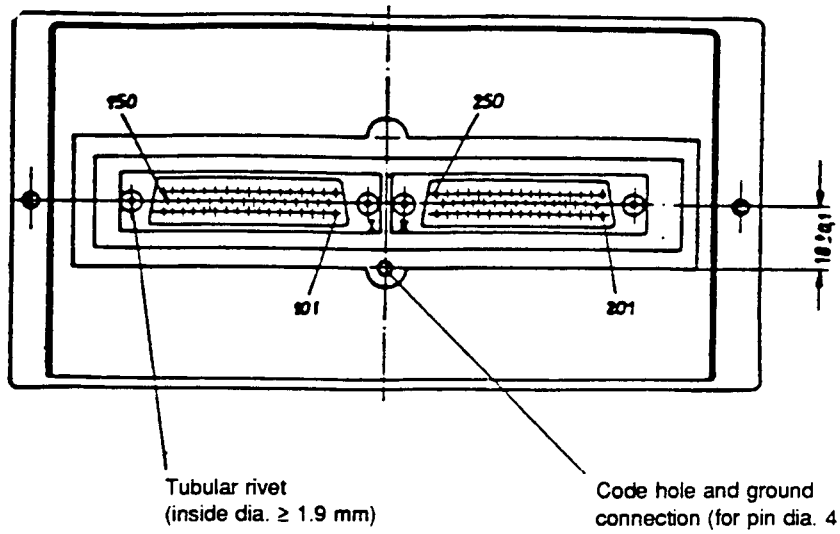
Central unit with integrated driver trminal
Example 2 for key allocation

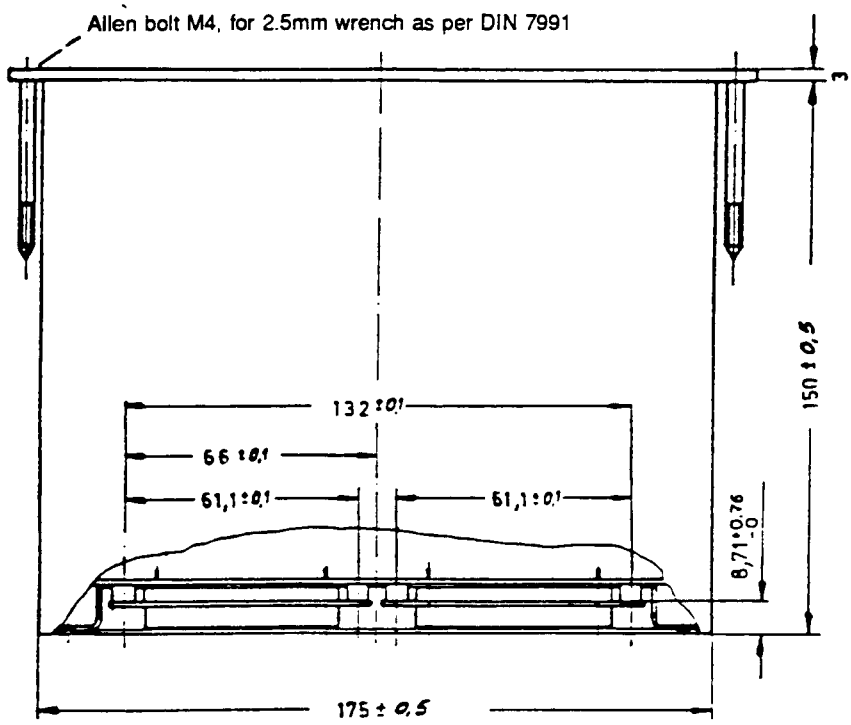
Appendix 2
Sheet 2

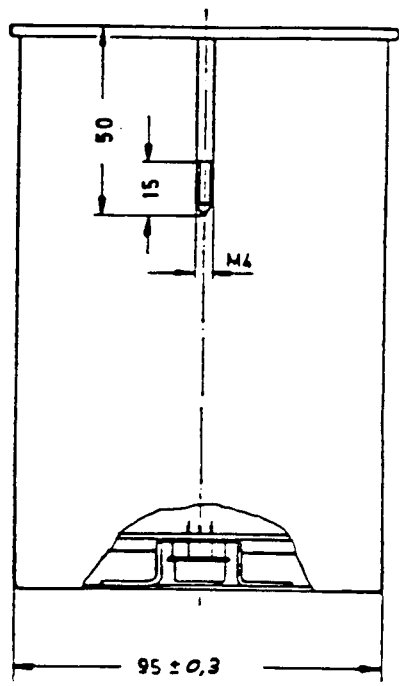


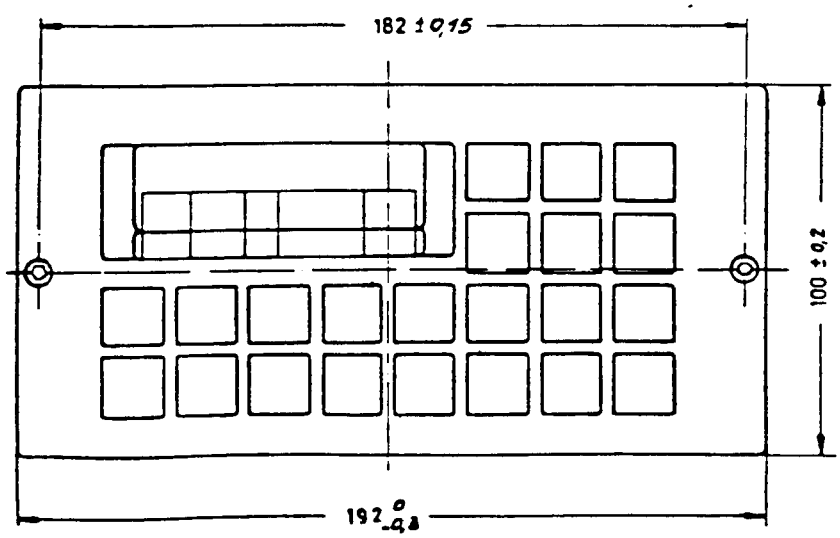
Key designations and coding
Display - Addressing

Appendix 2
Sheet 3



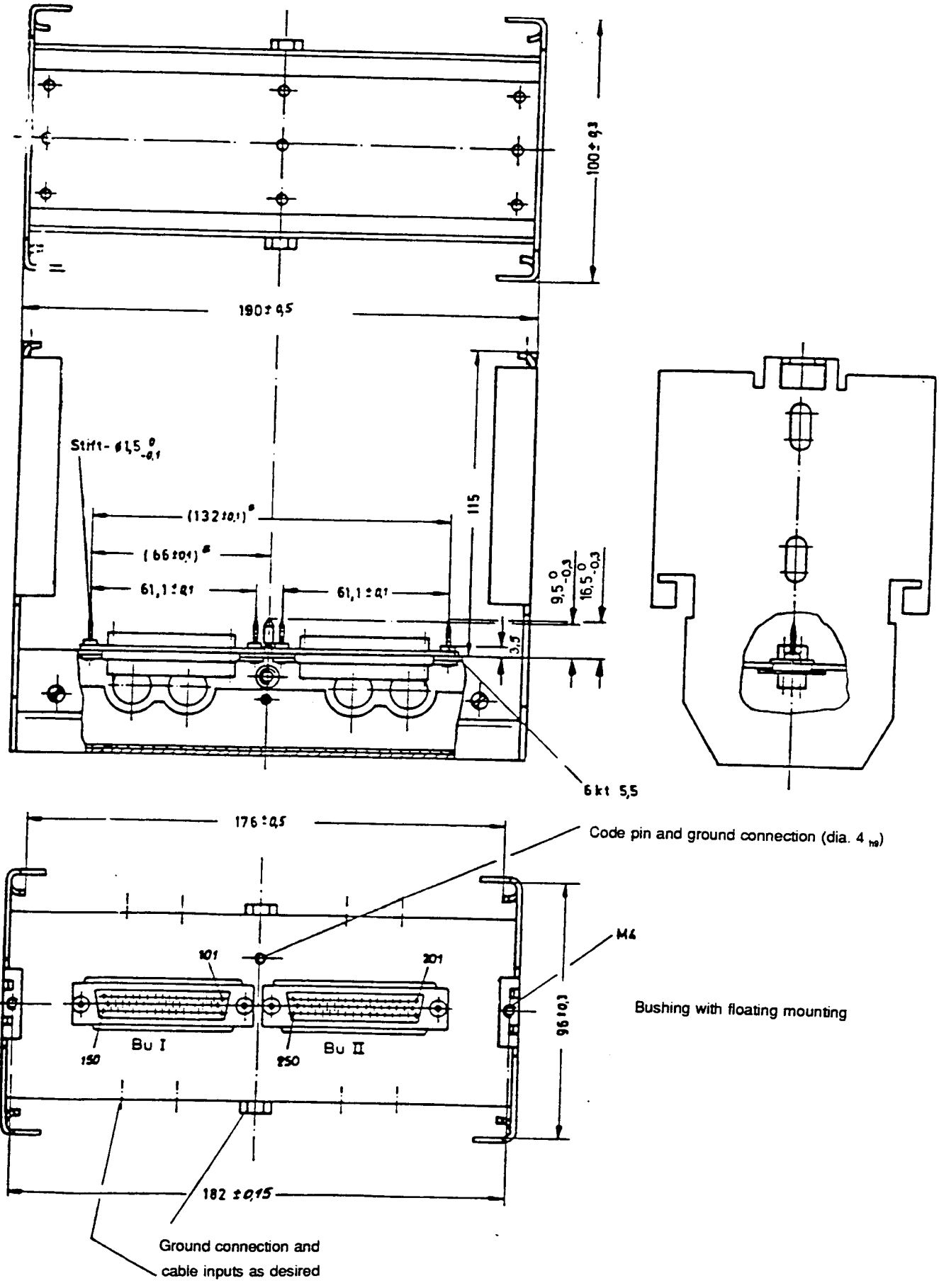






Central Unit, Plug-In Unit

Appendix 3
Sheet 1



Central unit, bracket

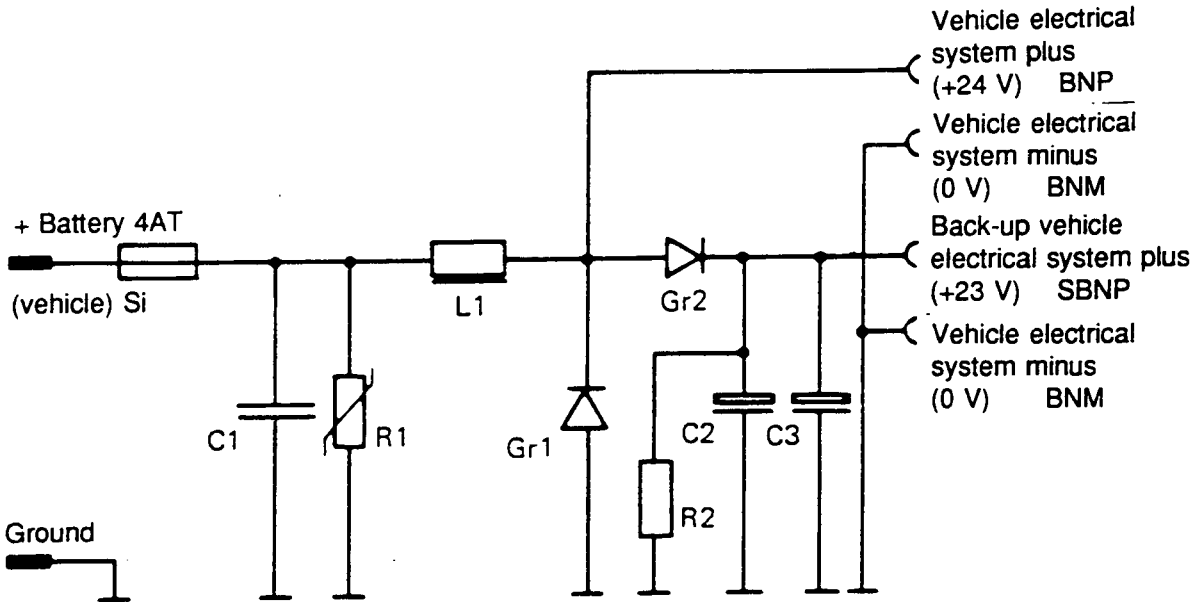
Appendix 3
Sheet 2

Technical Data
Input Protection and Filterin
for the BON/IBIS Central Unit

Operating Voltage:	18-28.8 V 32 V (max. 5 Min.)
Maximal Power:	3 A (Filtered from +24 V and 23 V Current)
Idle Power:	< 3 mA
Voltage Limitation:	< 52 V with max. 1 ms with 29 A
Testing for Electrical Overload:	7 kV 0.1 µs Ri 500 Ohm) 4 kV 1 µs Ri 500 Ohm) following 3 kV 5 µs Ri 500 Ohm) DIN 43321 1.5 kV 45 µs Ri 500 Ohm) section 0.8 kV 100 µs Ri 500 Ohm) 12 and 22

Maximum Electrical Overload Exiting the Test for Electrical Overload at 25°C (Adverse Circumstances)

with Ri = 500 Ohm U = 8.5 V
with Ri = 50 Ohm U = 12.0 V



BON/IBIS Input Protection and Filtering

C1	1 µF 400 V MKC(MKT) Mylar Cap.
C2,C3	2200 µF 40 V
Gr1	N 5646 A
Gr2	MR 751
L1	0.47 mH
R1	Si0V - S14K25 Zinc Oxide Res.
Si	4AT Slo-Blo fuse
R2	2 kΩ

Example of circuits for external filtering and back-up supply

Appendix 4 Sheet 2

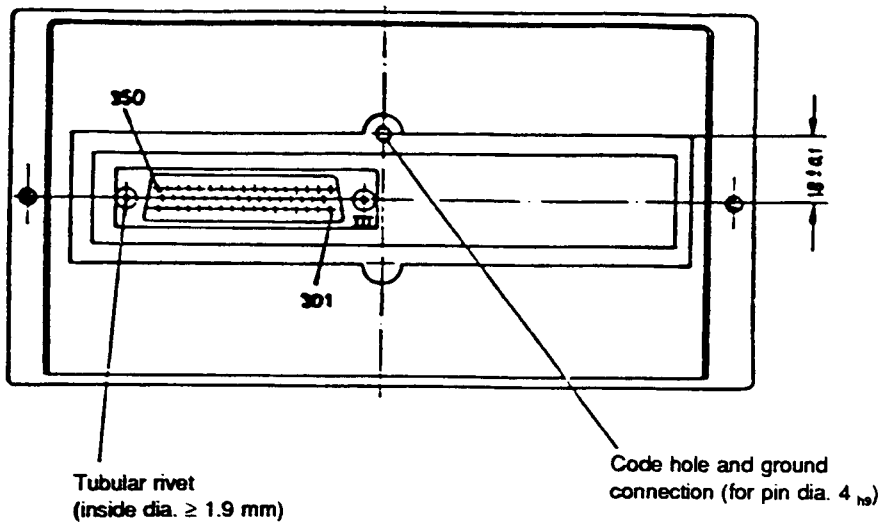
Example of Circuits for Appendix 4
External Filtering and Back-up Supply Sheet 2
Pin Layout at Central Unit
50 Pin Connector I

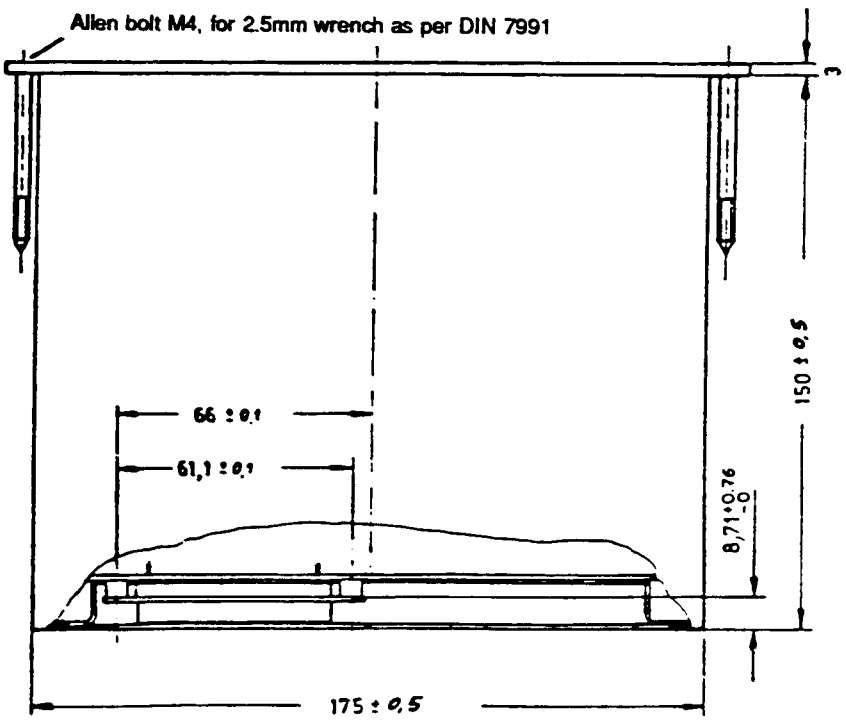
Consc No.	Contact No.	Assignment	Interface Type No (See Append 16)	Signal Name	Output Signal
1	101	assigned for Test Purposes		TST 1	
2	102	assigned for Test Purposes		TST 2	
3	103	not assigned		spare	
4	104	not assigned		spare	
5	105	not assigned		spare	
6	106	not assigned		spare	
7	107	not assigned		spare	
8	108	not assigned		spare	
9	109	Shield for Individual Connections		S	
10	110	Shield for Individual Connections		S	
11	111	Common Input		CE 2	
12	112	do not use		-	
13	113	Vehicle-BUS minus (transmit)	3	WBMS	
14	114	Vehicle-BUS minus (receive)	4	WBME	
15	115	Vehicle Electrical System Minus (0V)		BNM	
16	116	Vehicle Electrical System Minus (0V)		BNM	
17	117	Vehicle Electrical System Plus (+ 24V)		BNP	
18	118	assigned for test purposes		TST 3	
19	119	Door Criterion	1	TK	CE 1
20	120	Test Function Switch	1	TFS	CE 1
21	121	Control Input 2	1	SE 2	CE 1
22	122	Control Input 4	1	SE 4	CE 1
23	123	Control Output 1 b	2	SA 1B	CE 1
24	124	Control Output 2 b	2	SA 2B	CE 1
25	125	Control Output 3 b	2	SA 3B	CE 1
26	126	Control Output 4 b	2	SA 4B	CE 1
27	127	Terminal On-Switch	1	TEIN	CE 1
28	128	Odometer Pulse	1	WI	CE 1
29	129	do not use		-	
30	130	Vehicle-BUS Shield		S	
31	131	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
32	132	Vehicle Electrical System Minus (0V)		BNM	
33	133	Vehicle Electrical System Minus (0V)		BNM	
34	134	assigned for Test Purposes		TST 4	
35	135	Common Output		CE 1	C E1 = CE 2 = CE 3
36	136	Emergency	1	UEB	
37	137	Control Input 1	1	SE 1	
38	138	Control Input 3	1	SE 3	
39	139	Control Output 1 a	2	SA 1A	
40	140	Control Output 2 a	2	SA 2A	
41	141	Control Output 3 a	2	SA 3A	
42	142	Control Output 4 a	2	SA 4A	
43	143	Fault Switch (BON)	1	STR	CE 1
44	144	Location Beacon Data	1	OBI	CE 1
45	145	Vehicle-BUS Transmit Data	3	WBSD	WBMS
46	146	Vehicle-BUS Receive Data	4	WBED	WBME
47	147	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
48	148	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
49	149	Vehicle Electrical System Minus (0V)		BNM	
50	150	Vehicle Electrical System Plus (+ 24V)		BNP	

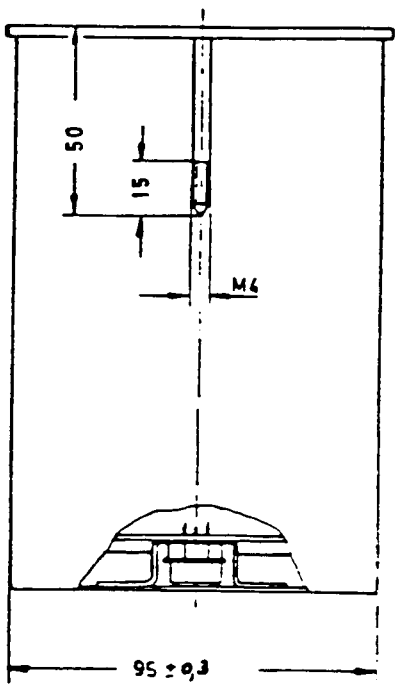
Pin Layout at Central Unit

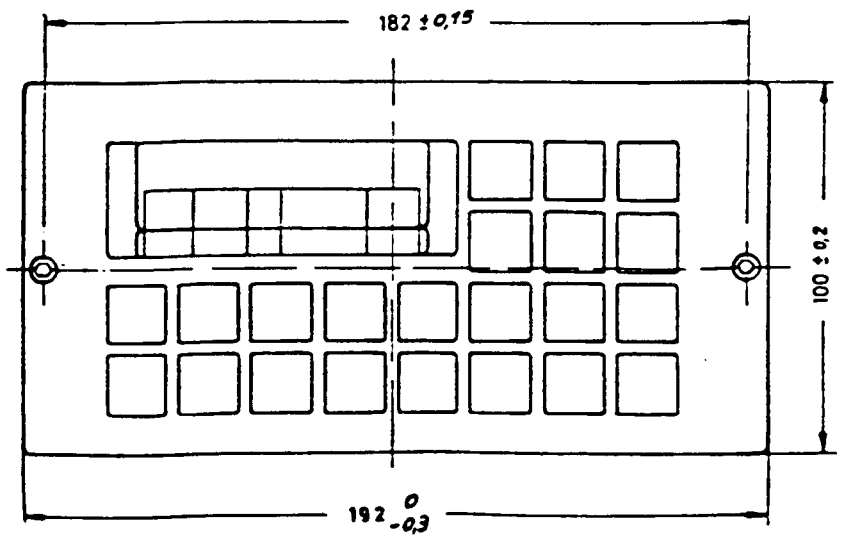
50 Pin Connector II

Consc No.	Contact No.	Assignment	Interface Type No (See Append 16)	Signal Name	Output Signal
1	201	Train-BUS A Data	5	ZBAD	ZBAM
2	202	cannot be used		-	
3	203	Train-BUS A Minus	5	ZBAM	
4	204	Coupler connected A	1	KBA	CE 1
5	205	cannot be used		-	
6	206	Common Input		CE 3	CE 3 = CE 1 = CE 2
7	207	Common Radio Transmission		CFS	
8	208	Control Unit Operable(Meas. Output, Option)	6	WD	
9	209	Radio Channel Parity (uneven)	6	KP	CFS
10	210	Radio Channel 2^1	6	K2	CFS
11	211	Transmitter Keying	6	S2	CFS
12	212	Transmission Clock	6	T1	CFS
13	213	Address Common		AC	
14	214	Address 2^2	8	A2	AC
15	215	Address 2^5	8	A5	AC
16	216	Address 2^8	8	A8	AC
17	217	Address Range 2^1	8	A11	AC
18	118	cannot be used		-	
19	219	Shield		S	
20	220	Shield		S	
21	221	cannot be used		-	
22	222	cannot be used		-	
23	223	Shield		S	
24	224	Common Radio Reception		CFE	
25	225	Radio Set to Vehicle Public Address System	6	FAW	CFS
26	226	Radio Channel 2^0	6	K1	CFS
27	227	Radio Channel 2^3	6	K8	CFS
28	228	Receiver Clock	7	T4	CFE
29	229	Transmission Data	6	D1	CFS
30	230	Address 2^1	8	A1	AC
31	231	Address 2^4	8	A4	AC
32	232	Address 2^7	8	A7	AC
33	233	Address Range 2^0	8	A10	AC
34	234	Train-BUS B Data	5	ZBBD	ZBBM
35	235	cannot be used		-	
36	236	Train-BUS B Minus	5	ZBBM	
37	237	Coupler Connected B	1	KBB	CE 1
38	238	cannot be used		-	
39	239	cannot be used		-	
40	240	not assigned		spare	
41	241	not assigned		spare	
42	242	Data Operation	6	DBE	CFS
43	243	Radio Channel 2^2	6	K4	CFS
44	244	Ready to Receive	7	M5	CFE
45	245	Receive Data	7	D2	CFE
46	246	Address 2^0	8	A0	AC
47	247	Address 2^3	8	A3	AC
48	248	Address 2^6	8	A6	AC
49	249	Address 2^9	8	A9	AC
50	250	Address Parity (uneven)	8	AP	AC



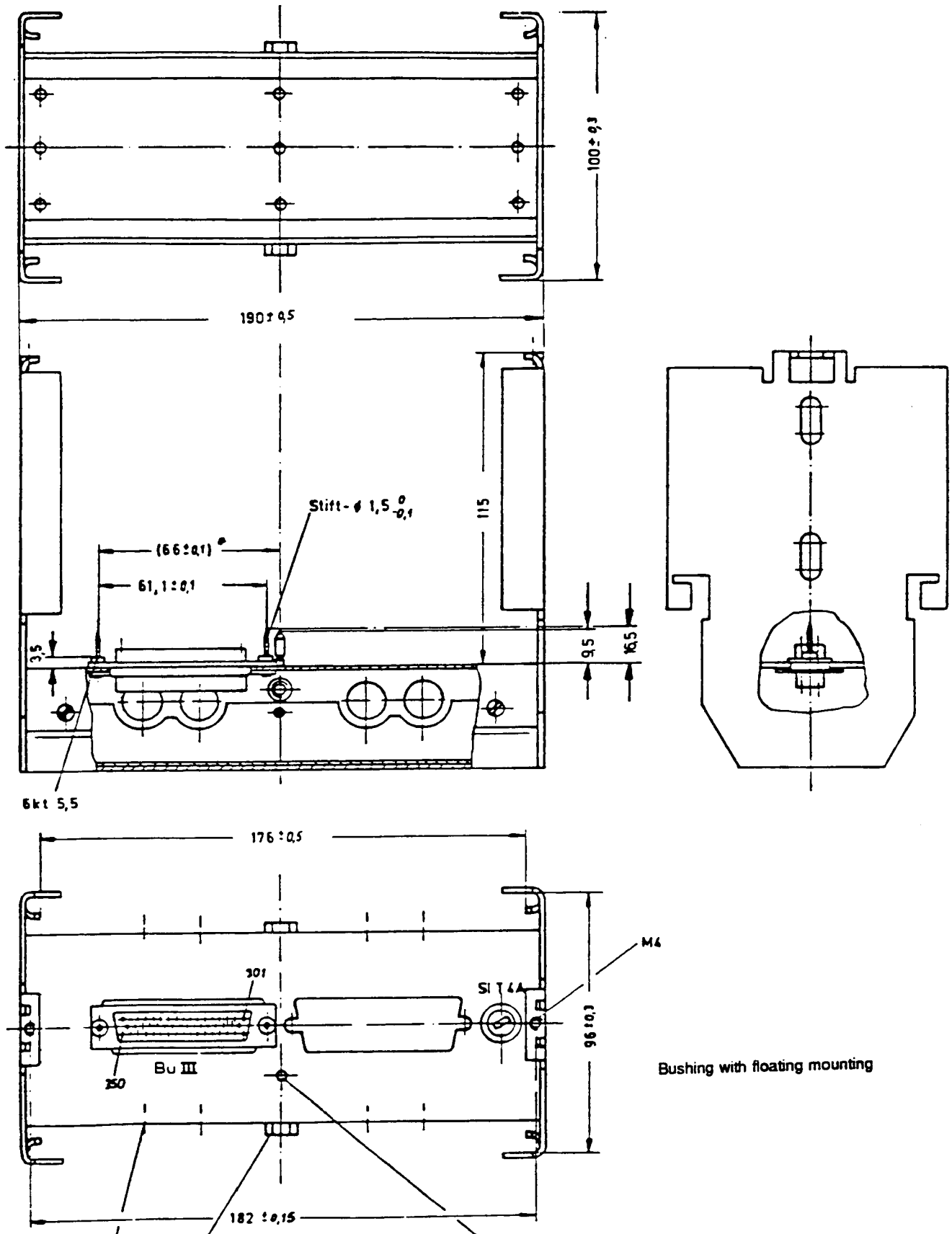






Remote Driver's Terminal, Plug-In Unit

Appendix 6
Sheet 1



Bushing with floating mounting

Remote Driver's Terminal, bracket

Appendix 6
Sheet 2

Remote Driver's Terminal, Bracket Sheet 2
Pin Layout at Remote Driver Terminal
50 Pin Connector III

Consc No.	Contact No.	Assignment	Interface Type No (See Append 16)	Signal Name	Output Signal
1	301	assigned for Test Purposes		TST 5	
2	302	assigned for Test Purposes		TST 6	
3	303	not assigned		spare	
4	304	not assigned		spare	
5	305	not assigned		spare	
6	306	not assigned		spare	
7	307	not assigned		spare	
8	308	not assigned		spare	
9	309	not assigned		spare	
10	310	not assigned		spare	
11	311	Common Input		CE 4	
12	312	cannot be used		-	
13	313	Vehicle-BUS Minus (Call)	3	WBMS	
14	314	Vehicle-BUS Minus (Response)	4	WBME	
15	315	Vehicle Electrical System Minus (0V)		BNM	
16	316	Vehicle Electrical System Minus (0V)		BNM	
17	317	Vehicle Electrical System Plus (+ 24V)		BNP	
18	318	assigned for Test Purposes		TST 7	
19	319	cannot be used		-	
20	320	cannot be used		-	
21	321	cannot be used		-	
22	322	cannot be used		-	
23	323	cannot be used		-	
24	324	cannot be used		-	
25	325	cannot be used		-	
26	326	cannot be used		-	
27	327	Terminal On-Switch	1	TEIN	CE 4
28	328	cannot be used		-	
29	329	cannot be used		-	
30	330	cannot be used		-	
31	331	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
32	332	Vehicle Electrical System Minus (0V)		BNM	
33	333	Vehicle Electrical System Minus (0V)		BNM	
34	334	assigned for Test Purposes		TST 8	
35	335	cannot be used		-	
36	336	cannot be used		-	
37	337	cannot be used		-	
38	338	cannot be used		-	
39	339	cannot be used		-	
40	340	cannot be used		-	
41	341	cannot be used		-	
42	342	cannot be used		-	
43	343	cannot be used		-	
44	344	cannot be used		-	
45	345	Vehicle-BUS Data (Call)	3	WBSD	WBMS
46	346	Vehicle-BUS Data (Response)	4	WBED	WBME
47	347	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
48	348	Back-Up Veh. Elec. Sys. Plus (+ 23V filtered)		SBNP	
49	349	Vehicle Electrical System Minus (0V)		BNM	
50	350	Vehicle Electrical System Plus (+ 24V)		BNP	

Pin Layout at Peripherals

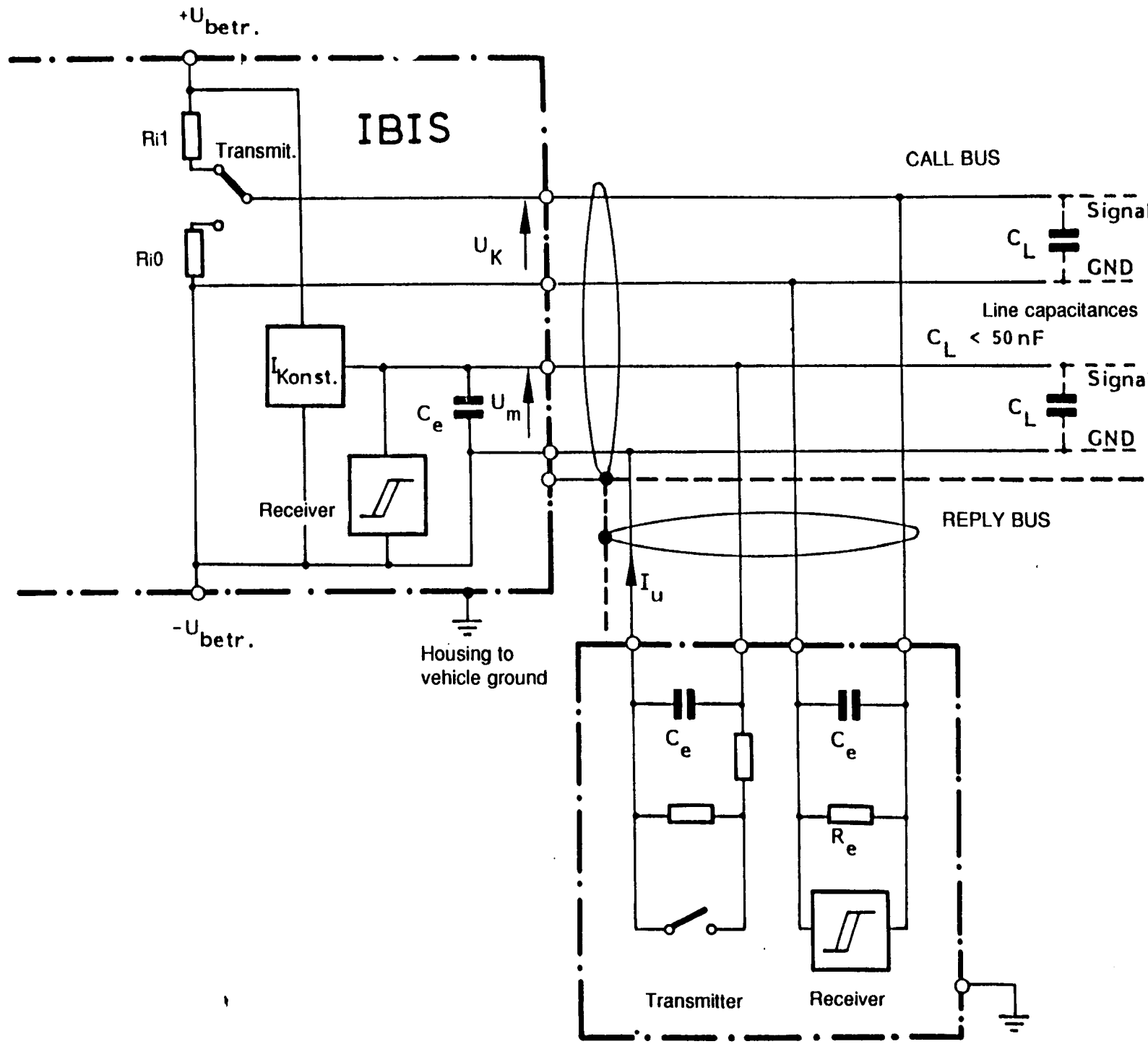
12 Pin Connector as per DIN 41622

Consc No.	Contact No.	Assignment	Signal Name	
1	a 1	Address 2^0		
2	b 1	Address 2^1		
3	a 2	Address 2^2		
4	b 2	Address 2^3		
5	a 3	+ U Betr.		
6	b 3	- U Betr.		
7	a 4	Call-BUS Signal	WBSD	
8	b 4	GND Call-BUS	WBMS	
9	a 5	Housing Ground		
10	b 5	Response-BUS Signal	WBED	
11	a 6	Address (Common)		
12	b 6	GND Response-BUS	WBME	

Pin Layout at Peripherals

19 Pin Connector (Burndy UT-Bantam)

Consc No.	Contact No.	Assignment	Signal Name	
1	A	GND Call-BUS	WBMS	
2	B	GND Response-BUS	WBME	
3	C			
4	D	Address 2^0		
5	E	Address 2^1		
6	F	Address 2^2		
7	G			
8	H			
9	J			
10	K			
11	L			
12	M	prepared for Housing Connection		
13	N	Call-BUS Signal	WBSD	
14	P	Response-BUS Signal	WBED	
15	R	Address (Common)		
16	S	Address 2^3		
17	T	- U Betr.		
18	U			
19	V	+ U Betr.		



IBIS PERIPHERAL device 1.32

Vehicle-BUS
Principal Circuit Diagram

Appendix 9
Sheet 1

Controller

Driver

- Logic 1: UK ≥ $U_{betr.}$ -3V
- Logic 0: UK ≤ 3 V with Rio ≤ 30 Ω
- Load: Ril ≥ 30 Ω, C ≤ 66 nF
- Short-circuit proof
- Skirt selectivity tan ≤ 50 µs (from 10 to 90%)
  tab ≤ 50 µs (from 90 to 10%)

Receiver and Power Source

- Power Supply Ikonst = 100 mA ± 10%
  Um≥ 15 V
- Operating Points
  = Logic 1: Um≥ 12 V
  = Logic 0: Um≤ 6 V
- Input capacitance Ce ≤ 500 pF

Peripheral devices

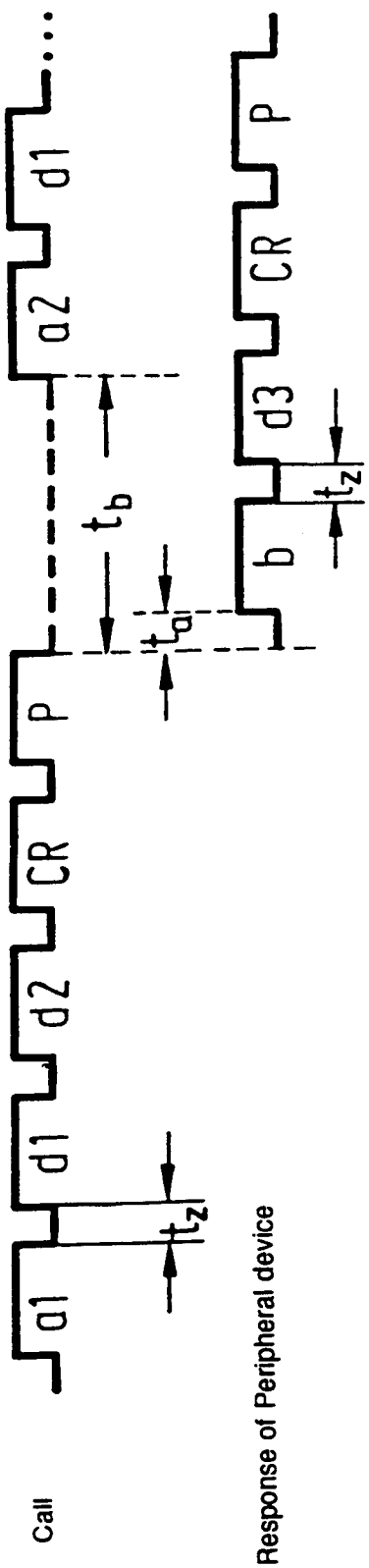
Transmitter (switch)

-	Logic 1:	$U_{max} = U_{operation}$ IU ≤ 100 µA (leakage current)
-	Logic 0	UM ≤ 2 V $I_{U\,max}$ = 120 mA
-	Load:	C ≤ 66.5 nF (all passive transmitters of the peripheral devices also act as load)
-	Input capacitance:	Ce ≤ 500 pF
-	Current slew rate:	tan ≤ 50 µs (from 10 to 90%) tab ≤ 50 µs (from 90 to 10%)

Receiver

-	Logic 1:	U ≥ 12 V
-	Logic 0:	U ≤ 6 V
-	Load:	Re ≥ 1 kΩ Ce ≤ 500 pF

Data structure and call organisation; time conditions



with

a	=	ASCII characters for address or date identification
d1, d2	=	ASCII characters for date or command
P	=	Special characters of horizontal parity bits
CR	=	Control character (ASCII character "Carriage Return")
b	=	ASCII character for sender (= address of substation)
d3...	=	ASCII character for date, acknowledgment of receipt or status
P	=	as above
CR	=	as above
t_z	=	Space between two transmission characters: Call undefined, zero targeted, reply = zero
t_a	=	Response reaction time 0..0.83 ms (at least 9.2 ms of the test character are available for preparation)
t_b	=	Time between two call blocks (dependent on anticipated duration of current response); at least 9.2 ms for synchronisation.

Data records Vehicle-BUS **Appendix 11**

Identification of the data according to Appendix 12, sheet 1

a Signs	n Vehicle number
b Loading	o Location unit
c Data Loading unit	p Pass (identification) reader
d Date, year	q
e Canceller	r AVLC (Radio)
f Error detection	s (for Train-BUS)
g Status request	t Terminal B
h HIG (stop infor. unit)	u Time
i (for Train-BUS)	v Preannouncement
j	w Train length
k Run number	x Preannouncement No.
l Line number	y
m Terminal A	z Destination number

Structure of the data messages, abbreviations used (transmitted sequence in the representation from left to right)

1. Data identification

(small letter according to above table) signifies address or "general datum" (AD)

2. Data blocks

with Z = Digit (0...9)
H = Hexadecimal digit (0...?)
C = Text character (A...Z, numbers and special characters) according to Appendix 12, sheet

1. Digits in front of the characters designate the number where "n" means a variable number.
Significance of the digits and bits decrease from left to right.

Prefixed capital letters have the represented, fixed significance. Characters in quotation marks (" ") have signficance shown in the coloumn at right.

LSB is the lowest-valued bit of a message.

In the figure the characters are numbered from left to right.

3. Format control character F

Here the ASCII-character "CR" is used (not represented in the following!)

4. Control character P

It is generated according to Appendix 12, sheet 3 (not represented in the following!)

An "X" before the message number means that this dataset was changed or redefined since the last edition.

Consec. No.	Coding	used for	Content	permissible answer
001	IZZZ	External displays Transmission unit Ticket canceller Radio address Beacon transponder	AD line number	none
001a	IEZZ Z1,2 "00"	Line No. indicator	AD special display 99 special characters (E, S etc.) Normal line No. display	none
002	kZZ	possible external displays Transmission unit Radio address	AD route number	none
003	zZZZ	External displays Internal displays Transmission unit Beacon transponder	AD destination number	none
003a	zAHnC	External displays (text)	AD dest., route Data set length in 16 C Number of 16-char. blocks allowed as identification of a new line Unrepresentable control characters follow.	none
X003b	zRZZZ	Inductive data transmission (IMU)	AD dest. number for track request	none
X003c	zIHnC H n	Internal displays	AD stop name Data set length in 4-C n = 4*H	none
004	e6Z Z1...3 Z4...6 "000" Z6 "1" "2" >"2"	Ticket canceller Ticket printer Ticket vending units	Cancellation features i.e. rate zone i.e. short route "Sweep" (or raid) mode (cancellation blocked) Direction, if provided Direction 1 or "H" Direction 2 or "R" if need be, other directions	none

004a	eA4Z	as DS004 is this does not suffice	AD additional cancellation features	none
	Z3		composite range (1...9)	
	Z4		Direction, as replacement for Z6 from DS004	
005	u4Z	Ticket canceller Ticket printer Ticket vending units Fault detection system	AD time of day	none
	Z1,2		Hour (00...23)	
	Z3,4		Minute (00..59)	
006	d5Z	Ticket canceller Ticket printer Ticket vending units Fault detection system	AD calendar date	none
	Z1,2		Date (01..28/29/30/31)	
	Z3,4		Month (01...12)	
	Z5		Year end digit (0...9)	
007	wZ	Fault detection system	Ad train lenth	none
	"1"		Singel car(s)	
008	nHHH	Fault detection system	AD car address	none
009	v16C	Preliminary announcement stop name	AD stop name	none
010	x4Z	Preliminary stop announcement (string of pearls) Stop announcement Running time analysis unit	AD stop No.	none
020	aH	Displays (internal and external)	Status inquiry	120
	H		Address (1...?)	
X 020l	aVH	Displays (internal and external)	Version inquiry	120l
	H		Address (1...?)	
021	aAHHnC	Outside displays (text)	Dest., track	120
	H		Address (1...?)	
	HnC		Content as DS003a	
030	hS	Stop announcement unit (HAG) Stop information unit	Status inquiry	130

X 0301	hV	Stop announcement unit Stop information unit (HIG)	Version inquiry	1301
031	hM	HAG/HIG	Monitor (mute advancement)	130
032	hN	HAG/HIG	Next stop	130
033	hR	HAG/HIG	repeat stop	130
034	hC	HIG	Send text (name of next stop)	134
035	hD	HIG	Send stop data (i.e. fare features)	135
036	hP4Z	HAG/HIG	Number of next stop (in general as in DS010)	130
036a	hE8Z	HAG	Extended stop announcement	130
	Z1..4		Number of next stop (in general as in DS010)	
	Z5..8		Supplement announcement	
	"0000"		No supplemental announcement	
040a	mSC	Driver terminal A, (integrated in compact unit)		140a 141a 142a
	C		Termimal control sign	
	"0"		Not flash, No DS received Function mode	
	"1"		ditto, numerical mode	
	"2"		DS received, function mode	
	"3"		ditto, numerical mode	
	"4"		Flashing representation no DS received; function mode	
	"5"		ditto, numerical mode	
	"6"		DS received; function mode	
	"7"		ditto, numerical mode	
041a	mVS	Driver Terminal A, Enter Version inquiry		143a

043	mACHHH	as above	Flashing switch on/off	140a 141a 142a
	C		Terminal control character	
	HHH		Positioning	
	Hl		Number of places +1	
	H2		Dest. number uppermost line	
	"0"			
	H3		Position in line (0..?)	
044a	mCCHHHnC	as above	Show text	140a 141a 142a
	C		Terminal control sign	
	HHH		Position, as above	
	n		Number of signs (1..16) (Characters that do not fit in line are ignored)	
045a	mKCH	as above	Operate buzzer	140a 141a 142a
	C		Terminal control sign	
	H		(Number (o..? = 1 to 16)	
04xb	t...	Driver terminal B	DS and meanings analogously to driver terminal A	14xb
050	pS	Pass reader	Status inquiry	150
X0501	pV	as above	Version inquiry	1501
051	pD	as above	Data inquiry	151
X055	fCS	Fault detection system	Status inquiry (interrogation) travel direction (A or B)	155
	C			
X0551	fCV	as above	Version inquiry	1551
X056	fCD	as above	Ask error group	156
X057	fCC	as above	Ask error text	157
060	oCS	Location unit, inductive train influencing	Status inquiry	160
	C		Travel direction	
	"A"		Travel direction A	
	"B"		Travel direction B	
	"C"		Address: ZUB	

X0601	oCV	as above	Version inquiry as DS060	1601
061	oCD C	as above	Data inquiry as DS060	161
062	oCRZ C Z "0" "1" "2" "3" "4" "5" "6" "7"	as above	Order direction Travel direction as DS 060 Direction control character When not running late: No request Direction "straight ahead" Direction "left" Direction "right" When running late: No request Direction "straight ahead" Direction "left" Direction "right"	160
063	oCE C	IR beacon transponder	Switch on transmitter (again) Travel direction as DS060	160
064	oCA C	as above	Switch off transmitter Travel direction as DS060	160
X 065	oCF16C 16C	inductive train-influencing	Error reports Applic.-specific fault reports	160
070	gZ Z	Ticket canceller, Ticket printer	Status inquiry (without code letter S!) Address (1..8)	170
X 0700	gZS	as above	Status inquiry (in future with introduction of DS 0701)	17
X 0701	gZV	as above	Version inquiry (only use of DS0700!)	1701
X 080	bT	loading degree measurement unit Passenger counting unit	Prepare measurement (open door)	181

X 0801	bV	as above	Version inquiry	1801
081	bM	as above	Carry out measure-ment (door has closed)	181
082	bF	as above	Movement started	181
083	bE	as above	Measurement result inquiry	182 183
090	cT	Data loading unit	loading date and time of day	190 191 192 193
099	cS	as above	Loading parameter field	199
X 4xx	rC..	AVLC-capable radio unit radio data unit for request systems	to AVLC/radio to data radio receiver(s)	5xx

Consec. No.	Coding	Meaning
120	aZ	Acknowledgement and status
	"0"	Unit intact, fault-free state
	"1"	Destination is shown
	"2"	Destination is sought
	"3"	Disturbance (destination does not run in)
	"6"	Input implausible
X 1201	aV6C	Current version
130	hZ	Acknowledgement and status
	"0"	Unit intact, fault-free state
	"1"	Search run
	"2"	End of data file reached
	"3"	Undefined state (i.e. cassette is missing)
	"4"	Acoustic announcement disturbed
	"5"	System fault (trouble)
	"6"	Input implausible
X 1301	hV6C	Current version
134	h16C	Name of the next stop
135	h10H3C	stop-related data
	H1..6	Ticket canceller features as in DS004
	H7..10	Stop name as in DS010
	CCC	Abbreviation of the destination designation for display at driver terminal
140a	mQ	Acknowledgement, no input ensues
141a	mA	Acknowledgement, terminal not active (TEIN=0)
142a	mFCnZ	Acknowledgement, input occured
	C	Function code corresp. Appendix 2, sheet 3
	n	Lenght of the input field
X 143a	mV6C	Current version
14xb	t...	Answers driver terminal B corresponding to DS 140a...143a
150	pSZ	Acknowledgement and status
	"0"	No identification badge inserted
	"1"	Identification badge inserted
	"2"	Identification changed (up to DS051) was received; then Z=1)
	"3"	Fault
X 1501	pV6C	Current version of the unit
151	pD5Z	Driver ID (00001...99999)
		Passenger count of high resolution relative

155	fSZ	Acknowledgement and status
	"0"	Units intact, unchanged state
	"1"	Error flag set
	"2"	Error text waiting
	"3"	Error group and error text waiting
	"4"	Fault
X 1551	fV6C	Current version
156	fDZ	Error group
157	fC16C	Error text with 16 alphanumeric characters
160	oSZ	Acknowledgement and status
	"0"	Unit intact, no information read
	"1"	Information read
	"2"	Information has changed (beacon interrupt set) until DS061 was received, then Z = 1
X 1601	oV6C	Current version
161	oD8H	Received message
	8H	corresponding to VDV recommendation 04.05.2
170	gZ	Acknowledgement and status
	"0"	Unit intact, error-free state (also in the case of ticket inspection circuit)
	"1"	Disturbance of the setting after loading of data
	"2"	Paper shortage
	"3"	Change (money) shortage
	"4"	Cassette full
X 1701	gV6C	Current version
X 1801	bV6C	Current version
181	bC	Acknowledgement and identification
	"F"	Passenger counting
	"H"	High-resolution weight measurement both for transmission with DS 183
	"G"	Coarse-step weight measurement for transmission with DS 182
182	bZ	Loading degree (relative weight)
	Z	6 steps (0...5 = 0,20 ...100%)
183	b4H	Passenger count or high resolution relative weight
	H1,2	8 bit boarding passengers or "00" in weight measurement
	H3,4	8 bit alighting passengers or 7 LSB relative weight
190	cU6Z	Time of day
	Z1..4	Hour, minute as in DS005
	Z5, 6	Second (00...59)

191	cD6Z	Calendar date
	Z1,2	Day (01...31)
	Z3,4	Month (01...12)
	Z5,6	Year; tens and ones
192	cS4Z	Next beginning of daylight saving time
	4Z	as Z1 to 4 in DS191
193	cM4Z	Next end of the daylight saving time
	4Z	as Z1 to 4 in DS191
199	cL...	Manufacturer-specific data all characters except "CR" allowed
X 5xx	rC...	Data from radio / AVLC system

ASCII characters in ISO-7 bit code in accordance with DIN 660033 with agreed limited character set
German reference version (with Umlauts)

Bit b_7	b_6	b_5	b_4	b_3	b_2	b_1	Line \ Column	0	1	2	3	4	5	6	7
								0	0	0	0	1	1	1	1
								0	0	1	1	0	0	1	1
								0	1	0	1	0	1	0	1
0	0	0	0				0	NUL	TC (DLE	SP	0	§	P		p
0	0	0	1				1	TC_1 (SOH)	DC_1	!	1	A	Q	a	q
0	0	1	0				2	TC_2 (STX)	DC_2	"	2	B	R	b	r
0	0	1	1				3	TC_3 (ETX)	DC_3	#	3	C	S	c	s
0	1	0	0				4	TC_4 (EOT)	DC_4	$	4	D	T	d	t
0	1	0	1				5	TC_5 (ENQ)	TC_8 (NAK)	%	5	E	U	e	u
0	1	1	0				6	TC_6 (ACK)	TC_9 (SYN)	&	6	F	V	f	v
0	1	1	1				7	BEL	TC_{10} (ETB)	'	7	G	W	g	w
1	0	0	0				8	FE_0 (BS)	CAN	(	8	H	X	h	x
1	0	0	1				9	FE_1 (HT)	EM	)	9	I	Y	i	y
1	0	1	0				10	FE_2 (LF)	SUB	*	:	J	Z	j	z
1	0	1	1				11	FE_3 (VT)	ESC	+	;	K	Ä	k	ä
1	1	0	0				12	FE_4 (FF)	IS_4 (FS)	,	<	L	Ö	l	ö
1	1	0	1				13	FE_5 (CR)	IS_3 (GS)	-	=	M	Ü	m	ü
1	1	1	0				14	SO	IS_2 (RS)	.	>	N	^	n	ß
1	1	1	1				15	SI	IS_1 (US)	/	?	O	_	o	DEL

Special characters

Format control characters

Permissible characters (C)

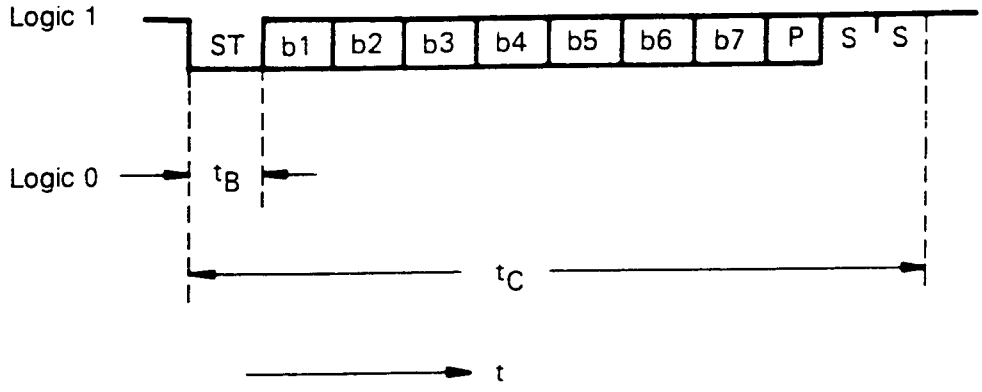
Digits (Z = 0..9) and/or Hexadecimal digits (H = 0..?)

Data identifiers

Character representation and transmission

Appendix 12
Sheet 1

Representation of ASCII characters in serial transmission



where

ST = Start bit (logic 0)

b1 = Least significant bit (LSB)

.

.

.

b7 = Most significant bit (MSB)

P = Parity bit (even = increases the number of logic units from B0 to B6 to an even result)

S = Stop bit (logic 1)

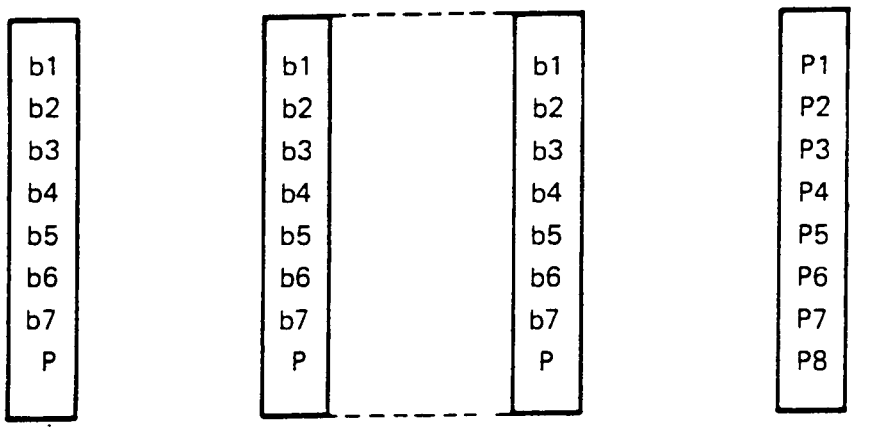
t_B = Bit duration. 0.833 ms equivalent to 1200 Baud

t_C = Transmission time of a character = 9.16 ms equivalent to 6545 characters per minute

Character representation and transmission

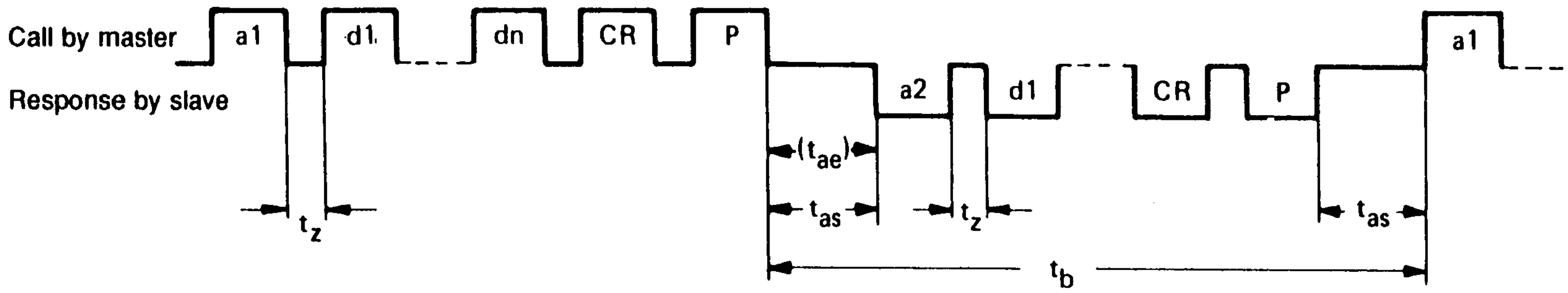
Appendix 12
Sheet 2

Horizontal parity bit generation (schematic representation) of a data record



Parity bit P1 increases all logic ones in the information bit b1 of the data block to give an odd number, etc.

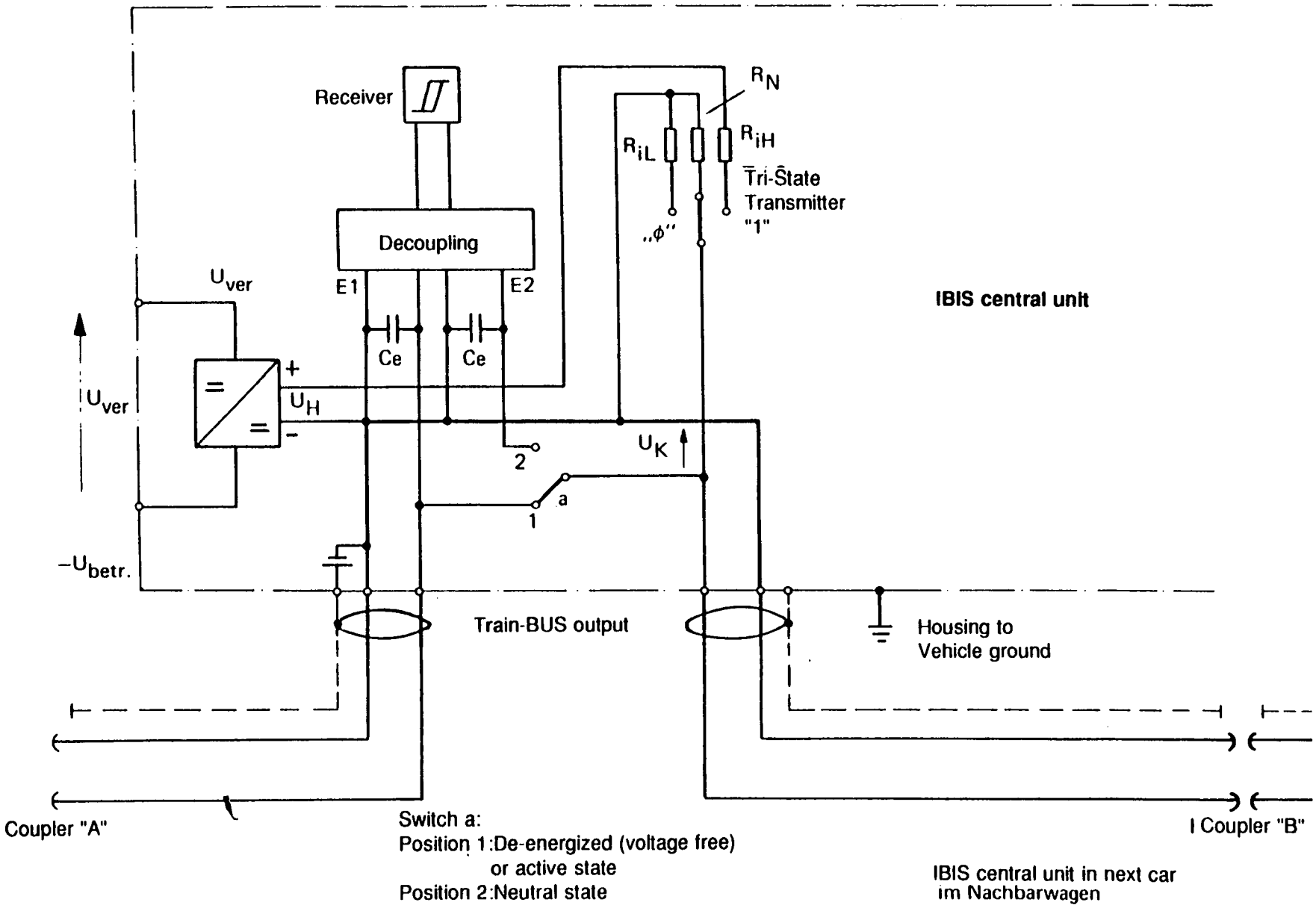
Parity bit P increases all logic ones in the parity bits of the data block to give an odd number, thus also creating the parity bit of the test character.



where

a1,2	=	ASCII lower case letter for data block identification
d1..n	=	Data block, with selective request and response, starting with symbolic address A (A = 1..7)
P	=	Special characters of horizontal parity bits, as with Vehicle-BUS
CR	=	Control character (ASCII character "Carriage Return")
t_z	=	Space between two transmission characters: Call undefined, zero targeted, reply = zero
t_{as}	=	response reaction time, incl. changeover time from transmit to receive mode Transmission start 20..40 ms
t_{ae}	=	Ready to receive 0..19.9 ms
t_b	=	Time between two call blocks (dependent on anticipated duration of current response); at least 9.2 ms for synchronization.

Train-BUS
Principal circuit diagram



Appendix 14
Sheet 1

Tristate transmitter

- Logic 0: $U_K \geq U_H - 6$ V
- Logic 1: $U_K \leq 6V$
- Neutral: $R_N \geq 100$ kΩ
- Load: $R \geq 2.5$ KΩ; $C \leq 45$ nF
- Short circuit proof
- Slew rate $t_{an} \leq 50$ µs (from 10 to 90%)
  $t_{ab} \leq 50$ µs (from 90 to 10%)

Receiver with electrical isolation

- Logic 0: $U \geq 30$ V
- Logic 1: $U \leq 15$ V
- Load: $R_e \geq 15$ kΩ; $C_e \leq 500$ pF

Consc. No.	Call code	To	Content	Transmission Criterion	No. Min.	Consc. No.	Resp. Code	Content
201	lZZZFP	all cars	gen'l. data LINE NO.	cyclic & change	6	-	-	-
202	kZZZFP	all cars	gen'l. data RUN NO.	cyclic & change	6	-	-	-
203	zZZZFp	all cars	gen'l. data DEST. NO.	cyclic & change	6	-	-	-
204	e6ZFP	all cars	gen'l.data ZONE SHORT RTE, DIR	cyclic & change	6	-	-	-
205	u4ZFP	all cars	gen'l. data TIME	cyclic & change	6	-	-	-
206	d5ZFP	all cars	gen'l. data DATE	cyclic & change	6	-	-	-
209	v16CFP	all cars	gen'l. data STOP	twice when change	2	-	-	-
230	iZAFP	subsq. car	Symb. addr. Z = 1...7	initialization	< 1	330	jHHHZFP	Car code(3H=12 bit), coupling criterion Z%
231	iZQFP	car Z	acknowledgement	reception of DS 330	< 1	331	jZQFP	Acknowledgement of symbolic address Z
240	sZHFP	car Z	Status scan & control command	continuous with free Train-BUS	> 60	340	qZ...FP	Status message %
241	sZQFP	car Z	acknowledgement	reception of DS 340 with status not equal to 0	1	340		

A. Data record structure

Principal structure as with Vehicle-BUS

The data blocks in the data records starting from 230 are preceded by a decimal digit address code. This address is assigned to the slaved devices in the car(s) during the initialisation procedure.

B. Fixed meaning and comments

201 to 206, 209, 210: as with DS 001 to 006, 009, 010 of Vehicle-BUS

330 Z = 0 Both couplings free
1 Coupling A connected
2 Coupling B connected
3 Couplings A and B connected

240 H = 4 bit for 4 control outputs of slaved devices
LSB = control output 1
Logic 1 = output closed
Logic 0 = high impedance output

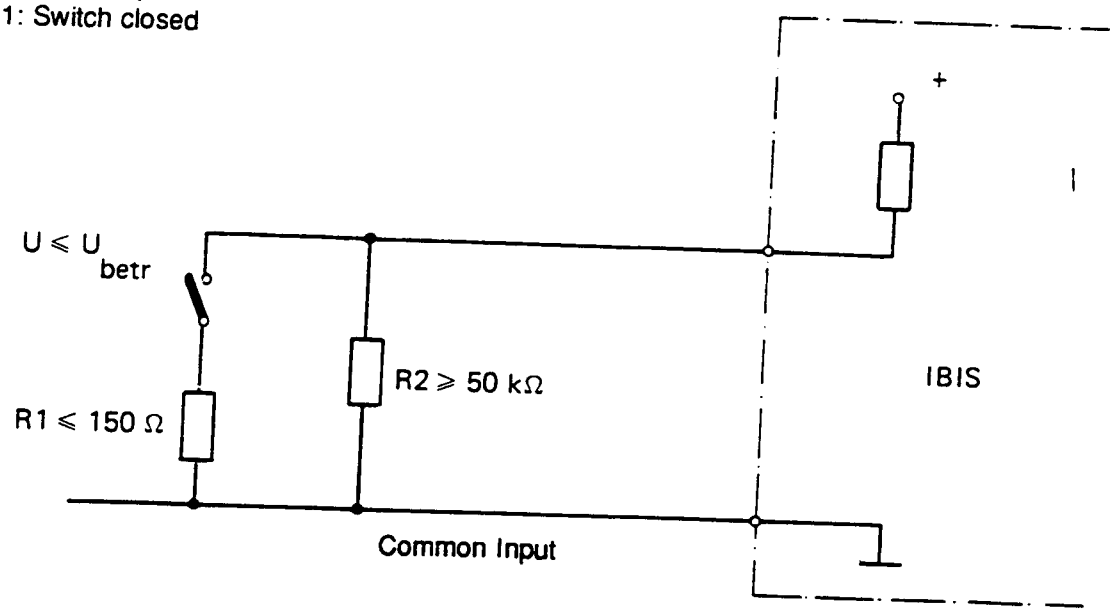
340....contains

- With error messages: lower case letters, device number and data block of the data record on the Vehicle-BUS identifying the error.
- With response failures from the peripheral devices: status 9; with passenger counters or occupancy measurement equipment: status S9
- With changes in occupancy density: lower case letters and data block of DS 183 of vehicle- BUS
- With coupling state changes: jZ where Z as in DS 330
- With messages from slaved control inputs: mH where
  H = 4 bits for 4 slaved outputs of the master unit
  LSB = control output 1
  Logic 1 = output closed
  Logic 0 = high impedance output
- With zero state: 0

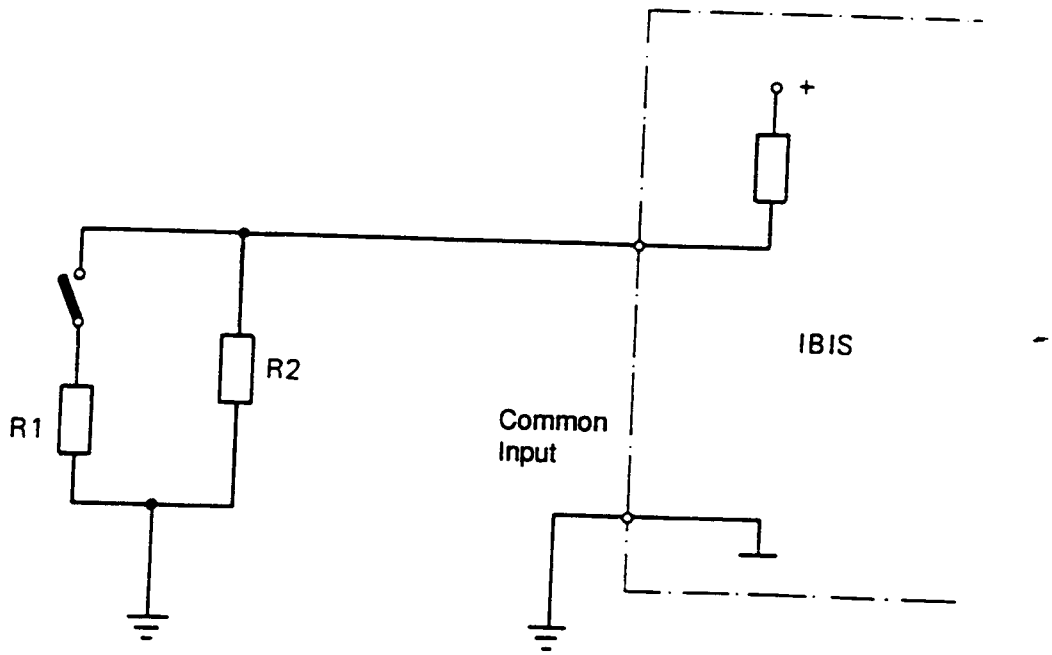
Interface Type Summary

Type 1: Contact input (possibly also solid state switch)

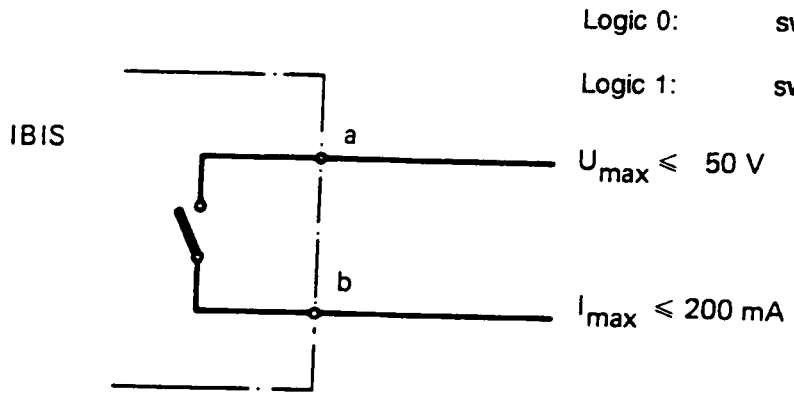
logic 0: Switch open
logic 1: Switch closed



substitute external elements



Type 2: Contact output



Type 3: Vehicle-BUS, call channel
Description, see item 5, diagram 1 of this VDV standard

Type 4: Vehicle-BUS, response channel
Description, see item 5, diagram 1 of this VDV standard

Type 5: Train-BUS
Description, see item 7, diagram 2 of this VDV standard

Type 6: See VDV Standard 04.05.3, Figure 2 (page 6) - IBIS is transmitter

Type 7: See VDV standard 04.05.3, Figure 2 (page 6) - IBIS is receiver

Type 8:

Appendix 17

Operation Layer Control of Ticket Cancellers (Option 1)

TASKS:
A Control of ticket cancellers
B Collection of statistical data
C Control of ticket cancellers by means of infrared beacons according to VDV 04.05.3
D Control of ticket cancellers by means of radio data transmission (VDV 420)

Task A

The route-specific cancelling parameters are set by:

- the driver (see appendix...)
  or stored:
- in a memory in a central unit with IBIS interface
- in an information unit for stops (HIG) according to VDV 04.06.3

Each ticket canceller takes the necessary data from the following general data messages:

001: Line (Route) number (if necessary)
002: Run number (if used as ticket canceller parameter)
003: Destination number (if used as ticket canc. parameter)
004: A maximum of six digits to designate a location, e.g.
three digits for zone, blocks or similar parameters
three digits for route sections, tariff zone, etc.
For direction, the least significant digit is to be used

004a: Used if 004 does not contain all parameters
For inter-network parameters the digit next to the least significant digit is used.
For direction of travel the least significant digit is to be used. In that case it does not appear in 004.

005: Time in hours and minutes.
It has to be considered that without an AVLC system, the accuracy is limited.
Rounding has to be performed in the ticket canceller.

006: Date in day, month and least significant digit of year.

These general data messages are sent cyclicly with a typical cycle time of ten seconds. Additionally, they are sent spontaneously within one second if their contents have changed. The order of transmission is not defined.

After the unit is switched on, the ticket canceller is activated only after all the necessary data have been received.

The ticket cancellers are cyclicly polled (typically ten seconds) with 070 to interrogate their status. These interrogations start after the general data messages have been sent twice. The unit replies only if the polling address coincides with the address which is cabled in its connector. The response is # 170. If after several status requests within a certain time (typically 3s) no response is received, the unit is recognized as faulty.

After the first transmission of the general data messages or the first status request, the further cyclic polling is supervised by the ticket canceller. If these data messages are missing for a predetermined time (typ. 30s) the unit goes into "fault" status.

The unit sends recognized internal faults as status messages until the fault is cleared. These faults are displayed to the driver only once after the first appearance.

If the message 004 with the content Z4..6 = "0" is received, the ticket cancelling function is suspended until this content is no longer "0". The necessary manipulations are described in appendix ...If 004a is used for this application, the least significant digit is used for this function.

Task B (Transmission of statistical data)

In preparation

Task C

The route specific ticket canceller parameters are transmitted to the vehicle by means of beacons according to VDV 04.05.2. Manual inputs by the driver are possible (e.g. to correct for beacons which have not been read or a faulty vehicle transponder).

In the parameter field of the IBIS central unit, the following is stored:

- if a received parameter is instantly transmitted on the Vehicle-BUS
  or
- if this takes place only after arrival at a stop (doors open)

Generally, the latter possibility is used because it leaves more freedom to place the beacons.

The beacon transmits to the vehicle message B17 which contains the six digits of the location. These are transmitted in message 004 on the Vehicle-BUS. The order of transmission is the same in both messages.

If the ticket canceller parameters are displayed to the driver, they are updated on each change without the aid of the driver.

Further, the specifications of task A apply.

Task D

In an AVLC system the location-specific ticket canceller parameters may be transmitted to the vehicle by radio. The driver may introduce these parameters as well since there is not always a 100 % radio coverage attainable.

The AVLC control center transmits, aside from date and time, the following data to the vehicle:

- with C01, SD = 0100, the 3 higher order digits of 004
- with C01, SD = 0101, the 3 lower order digits of 004

on the Vehicle-BUS. Both values may be transmitted independently of each other and are also evaluated independently.

Since transmission by an AVLC system cannot take place at predefined locations and/or times, the transmitted data may become active only after the next opening of the doors of the vehicle.

With C01, SD = 1000 the least significant digit of 004 may be changed. At the same time, the location of the vehicle is transmitted at which the new digit shall be active (the location is based on the internal odometer counter, in ten meter increments.)

If the ticket canceller parameters are displayed to the driver, they are updated on each change without his aid.

Further, the specifications of task A apply.

Appendix 17

Operation layer passenger information (Option 2)

Tasks:

A Control of exterior displays:
- A1 Line (route) number
- A2 Destination
- A3 Route

B Control of interior displays
- B1 Alphanumeric displays
- B2 String-of-pearls displays

C Control of stop announcement units
- C1 with digital speech storage
- C2 with tape cassettes

D Control via radio data transmission according to VDV 420

General specifications for displays of tasks A and B

The necessary data for passenger information are introduced by the driver.

All displays decode their information from the general data messages.

These general data messages are transmitted cyclicly (typically every 10s) but also spontaneously within 1 second if their contents have changed. Their order of transmission is not defined.

The setting of the displays takes place only after all relevant data has been received.

All displays are interrogated cyclicly (typically 10s) with the status request 020. These status requests start after all general data have been sent twice. The units respond only to these messages where the address corresponds to the wired address of the unit. (this address is wired in the connector where a jumper to common indicates a logical "1"). The unit responds with 120. If on several status requests within a certain time (typically 3s) the unit does not reply, it is considered faulty. If the unit detects internal faults, it transmits this condition on each status request until the fault is cleared. The faults are displayed to the driver only once.

After the first transmission of the relevant general data or the first status request, the displays supervise the cyclic polling by themselves. If the data are missing for a predetermined time (minimum 60s), the displays go into default mode and show a predetermined pattern (e.g. blanks). A status request is replied to with status "6".

Display according to A1 (line number)

Line number displays receive the number or the special characters to be displayed by the general data messages:

001: Line number (3 digits) or
001a: Special characters (99 different possibilities)
002: Run number (2 digits)
003: Destination number (3 digits)

Leading zeros of 001 are displayed as blanks. A line # "000" results in a blank display.

According to the application, the above mentioned messages can be modified, e.g. leading special characters or special symbols.

The way in which these special characters are introduced by the driver has to be specified (e.g. by introducing an additional digit in front of the line number.

Display according to A2 (Destination) and A3 (Route)

According to the application, the distinction must be made between
- central storage of data and
- decentralized storage of data (in the display units themselves)

Displays of the latter kind receive the destination number from message 003: Destination number (3 digits).

The conversion of a destination number into the text to be displayed (destination, route or both) is done within the display. Therefore, different displays with different control characters may be connected to the
same data line (Vehicle-BUS).

In the case of rolling band displays, the destination number indicates the band positioning. Several destination numbers may be assigned to the same band position.

The destination numbers with regard to destination and route must be unambiguous.

In a display-system with centralized data storage, 003a or 021 are to be used. Both are identical. They only differ in the labelling character "a", "z" and that 021 contains an address character. 021 also must be acknowledged. 003a is basically a cyclicly transmitted, not to be acknowledged, data message. Because of its length, however, it shall not be transmitted cyclicly but only after each change three times with a pause of 10s in between.

If displays with different texts are used (e.g. bus: front destination, side destination and route) the texts are usually transmitted singly with 021. A repetition (texts unchanged) is only necessary in case of disturbances (faulty or missing acknowledgement).

Details are specified according to the application.

General remarks to task B (interior displays)

The interior display, which shows the next stop of the route, shall operate automatically in order to relieve the driver from these manipulations. The criteria for this function are opening the doors and odometer pulses. The driver has to act only if stops are passed without opening of the doors or the doors are operated between two stops. Therefore, it is necessary that the driver be able to check which stop is being displayed. If there does not exist a parallel announcement unit according to task C, the next stop must be displayed on the IBIS unit. Therefore, it is reasonable to centrally store the names and the numbers of the stops as well as to store the general data messages in the displays which receive the text to be displayed parallel to the drivers display.

A purely manual operation is also possible.

When reaching a stop (criterion: doors open), the name of the next stop along the route must already be displayed to the drivers. This is to avoid requiring the driver to check or change the display while driving.

Task B1: Control of alphanumeric interior displays

These displays receive the text from general data message 009:
Preannouncement of next stop (16 characters)

This message contains the name of the next stop in 16 characters. If the name is longer, abbreviations are used. When departing the stop (criterion: doors closed), 009 is to be filled with blanks so that a name which is no longer valid is not shown. Only after the vehicle has travelled a certain distance, which is stored as a parameter in the IBIS unit (typically 100 meters) the name of the next stop is transmitted by the message 009.

A manual setting by the driver however is transmitted without delay.

Task B2: Control of string-of-pearls display

String-of-pearls displays are controlled by:

010: Preannouncement of stop (4 digits)
001: Line number (3 digits)
003: Destination number (3 digits)

From message 010, the dot to be illuminated is selected.

The band of the route is selected according to the application from 001 or 003. The direction is decoded from 003.

In the centralized data base, care has to be taken that there are no contradictions in the data for line, route and stops.

Concerning the operation, the remarks of B1 apply but the next stop is already transmitted on closing of the doors. Despite that, the odometer counter has to be taken into account, such that several door openings at the same stop do not lead to erroneous displays (distance travelled < 100m).

Task C: Control of announcement units (speech), general

Announcement units (HAG) use the following message to control the acoustical announcement

036: Preannouncement of stop

Similar to 010 it contains the number of the stop to be announced. It is transmitted after a certain distance travelled (typically 300m) which is stored in the IBIS unit, and must be acknowledged with message 130.
The announcement starts immediately. If the transmission of the acknowledge message is disturbed, 036 is repeated. The resulting, double announcement in this case, is accepted. An announcement, which has started, may not be interrupted.

Additionally, the general remarks stated at the beginning of this appendix apply with the following deviations:

Status request is 030, its response is 130. In a fault condition, all announcements are suppressed.

Task C1: Control of digital HAG

No additional specifications

Task C2: Control of HAG using tape cassettes

To search for the proper position a certain time is required. Therefore, the number of the stop after the next is transmitted with 036. This also starts the announcement of the present position. At the end of the announcement the HAG searches the position according to the new stop number. This eliminates the search time before announcing the next stop.

If necessary, repetitions are controlled by 033. To accommodate this function, the HAG always stores the last position used. Control of the reverse search function over several stops is performed in the IBIS unit.
If the repeat key is not pushed again for a predetermined time (typ. 3s), the number of the stop is transmitted with 036 (or 033 when repeated once) to the HAG. In this situation a search time is always
needed.

Delayed transmission of 036 also takes place when searching in forward direction.

Task D: Control by radio data transmission

The basic data (line, run and destination number) for the above information may be transmitted by radio in an AVLC system. After transmission they are first displayed to the driver who has to acknowledge them by pushing the appropriate key. Only after that they are transmitted on the Vehicle-BUS as general data messages.

Appendix 17

Detection of loading degree and passenger counting (option 3)

Tasks:
- A Transmission of loading-degree values of coarse resolution
- B Transmission of loading-degree values of fine resolution
- C Transmission of passenger counting data
- D Use of operations event-recording apparatuses

TASK A

With presence of an AVLC system (RBL) a quasi continuous knowledge of the degree of loading of the observed vehicles is desirable for corrective action. For this purpose, measurement of the weight determined by appropriate equipment in the vehicles (which is approximately proportional to the loading) in 6 steps is sufficient.

For as accurate as possible a measurement, weight measurement equipment requires the particular vehicle status. This is transmitted by the IBIS central unit. There the software (application) in the IBIS central unit is to be adapted to the manufacturer-specific measuring process. This is possible in detail only in mutual agreement and is not to be further treated here.

With DS 085 it is communicated to the weight detection equipment (GEG), that the vehicle is not at present occupied by passengers; the GEG thereupon undertakes an internal zero setting. (A generally valid criterion for this cannot be given; it is to be agreed upon with the manufacturers by the operator based on consideration of his experiences and environmental conditions.) The GEG answers thereupon with DS 181, in which the type of equipment is contained. Distinction is made between:

- coarse weight measurement (as described here);
- high resolution weight measurement, as described under task B;
- passenger counting, as described under task C.

This initialization is optional--if in an application only uniform equipment is in use, their type can also be set in the parameter field or in the program of the IBIS central unit.

The measuring process proper is controlled by the IBIS central unit through the DS 080 (criterion: Door was opened or unlocked for passenger use), DS 081 (criterion: Movement started--i.e. the odometer pulse generator has delivered one or more pulses/parameters). The GEG answers each call-DS with DS 181, content as above.

The use of this DS is a component of the measuring process and must be attuned accurately between IBIS producer and GEG producer.

A predetermined time after causing of the measurement(parameter) but also cyclically, for example every 10 seconds, the IBIS central unit sends a status request to the GEG (DS 084). It is answered by the GEG with DS 184.

By this the lBIS central unit can recognize whether:

- fault is present (then report error to AVLC with DS R02, ME = 0101),
- the measurement is not yet completed or
- the measurement result is recall-ready.

In the latter case the IBIS central unit asks the GEG with DS 083 to report the measurement result. The GEG thereupon answers with DS 182.

The measurement result thus obtained as stage 0 (empty) to 5 (full load) is then reported in each DS R00 to the AVLC central, until its value changes in a later measurement.

The status request is optional if a fixed time can be agreed upon between the triggering of a measurement and the availability of the measurement result (measuring process!).

DS not answered by the GEG are repeated. If more than n answers/ parameters are omitted, the apparatus is regarded as faulty and reported to the AVLC control center.

Task B

For statistical evaluation in the scope of the possibilities of an AVLC system there is requried the most accurate possible (fine resolution) degree of loading of selected vehicles. For this a resolution in one percent stages is provided.

Control and data exchange occur essentially in the same way as in task A with the following differences:

- the GEG sends the code latter "H" in DS 181 to mark for a high-resolution weight measurement.

- The GEG answers on DS 083 ("report measurement result") with DS 183. In this DS there are 16 bits available in 4 hex characters. The highest value 9 bits are to be set on 0, the remaining 7 lower-value bits represent the measurement result binary coded from 000 0000 (empty) to 110
  0100 (100% load).

- The value received by the IBIS central unit is transmitted with R03 to the AVLC system only until an acknowledgement occurs (as a rule only once).

The simultaneous use of coarse and fine-resolution weight measurement is not provided on the vehicle side. If this is desired, the IBIS central unit converts the high resolution value transmitted with DS R03 into a stage value (0, 20, ... 100%) with rounding and transmits this additionally in each DS R00 to the AVLC system.

Task C

Measurement of the degree of loading on the basis of the respective vehicle weight is affected by the uncertainty of a non-constant mean weight of the individual passenger. Furthermore, passenger exchange (which determines the dwell time), cannot always be perceived, because the number of boarding and alighting passengers balance each other. For this reason there are counting units (FGZ) available which detect and count the passengers with light beams, photosensors or treadle mats.

Control and data exchange occur likewise fundamentally as described in task A with the following differences:

- The triggering of the measurement can be simplified, but likewise must be finely-tuned between the manufacturers of the and IBIS.

- An FGZ sends the code letter "F" in the DS 181.

- An FGZ answers DS 083 ("report measurement result") with DS 183. Within this DS, 4 hex characters are available in 16 bits. In the highest value 8 bits, there is reported, in each case binary coded, the number of boarding passengers; in the lowest value 8 bits, the number of alighting passengers of the last measurement is reported.

The value received from the IBIS central unit is transmitted with DS R03 to the AVLC central until an acknowledgement occurs (as a rule, therefore, once).

The simultaneous use of a GEG and of an FGZ is not provided.

Task D

Also, operating event-recording equipment for running-time analysis, possibly supplemented by passenger counting, can be connected to the IBIS Vehicle-BUS in order to use data of IBIS and to avoid double inputs. These systems are generally used if no AVLC system is available.

Normally the general data are used to make it possible to allocate the records (protocols) in the evaluation to the completed trips.

These are:

- Line number (DS 001)
- Run number (DS 002)
- Destination number (DS 003)
- under some circumstances ticket canceller features from DS 004, in order to determine the traveling direction or to make it possible to check the location determination for plausibility
- Time of day (DS 005)
- Calendar date (DS 006)
- Stop number (DS 010), in order to support the location determination

Selective-DS can also be used in the individual case in order to supplement or to support the evaluation.
These, however, are very application-specific and, therefore, to be worked out in the individual case.

A status inquiry should be omitted, so that the systems--IBIS and running-time analysis-remain cleanly delimited. Also the hardware realization of an answer transmitter in the FGZ is dispensed with.

An additional utilization of the passenger counting function of an analysis system for an AVLC system is conceivable, as described under task C. In this case the data exchange is additionally to be realized on the IBIS Vehicle-BUS as in task C. To this then, there also belong the status request and possible version request; error (fault) situations can thereby be transmitted for further handling by means of radio to the AVLC system.

Appendix 17

Electronic pass printer (option 4)

TASKS:
- **A** Use of an electronic ticket printer (EFD) as slave
- **B** Use of an EFD as remote driver terminal
- **C** Use of an EFD as master

Task A

In this case, all the operation-specific data are inputted over IBIS (possibly also via radio data from the AVLC system), and only the sales-specific or accounting-specific data are inputted to the EFD manually or through data carriers (driver module).

In order to achieve this and thus to avoid double inputs, the EFD must be connected as slave to the IBIS Vehicle-BUS. It receives the general data from IBIS insofar as they are relevant. In general these will be the data sets:

001	Line number
003	Destination number
004	Cancellation features, possibly supplemented by DS 004a
005	Time of day
006	Date

It is possible to dispense with a status request, because the EFD has an indication capability of its own, and this is also observed during the sales processes.

For the electrical connection the statements of this VDV recommendation for peripherals are available. The plug pin layout is especially to be observed in respect to a preliminary run operation corresponding to task C.

Task B

If in uses corresponding to task A value is placed only on one operating surface, the EFD can also take over the functions of the so-called remote driver terminal in the IBIS analogously to the statements of this VDV recommendations. The dimensions, input keyboard and display necessarily deviate there and must, like the operating run-offs, be established for specific applications. Appendix 20 can serve as orientation assistance.

To fullfill the requirements the specification of task A and VDV recommendation 701 (formerly VöV recommendation 6.06.2) apply. In addition, the EFD must have further keys for the functions going beyond sales. The display should have a greater scope than that required for IBIS, in order to avoid conflicts during the sales processes and easy observation by the operator.

The data transmission for the terminal functions (displays and inputs) is specified in data sets 040a to 045a (call) or 140a to 143a (answers). In two-directional vehicles with identical EFD units, it is to be made certain at both driver places that only one EFD always takes part actively in the data exchange with IBIS (IBIS signal TEIN). Thereby it is possible to dispense with the use of the data sets 040b to 045b including the otherwise necessary (logical) switch-over.

Task C

In the case of small number and variety of peripheral units on an IBIS Vehicle-BUS it can be economical and purposeful from the viewpoint of the operation, to use a correspondingly equipped EFD as master of an IBIS.

The typical case of application for this is a bus, in which exclusively the ticket cancellers as well as the external displays are to be controlled over IBIS. In the introduction the question is to be cleared up of whether later there is to be reckoned with the use of another IBIS central unit, because, for example, an AVLC system or traffic signal preemption is to be introduced by means of data radio. In this case provisions are to be made on the EFD in order to make it possible to modify it in a later use corresponding to taske A or B as represented in this appendix.

To this belong, besides the conversion of the function, which can be brought about by the exchange of the memories containing the software, the adaptation of the Vehicle-BUS interface. For this, the hardware corresponding to Appendix 9 must be switched over from master to slave operation. Expediently there also the Vehicle-BUS on the connecting plug is turned - i.e. call-BUS and answer-BUS are exchanged with one another - so that in the transition time or in tests for the maintenance no electrical problems can occur.

For such a use all the stipulations for the IBIS central unit hold with the exception of the dimensions and the operating surface. Operation and display must be established application-specifically. Furthermore there suffices for the use a selection of the data messages specified in Appendix 11, which must be matched to the scope of the peripheral units. In the above-mentioned example these are the data messages:

001	Line number, supplemented if need be by DS 001a
003	Destination number
004	Cancellation features, possibly supplemented by DS 004a
005	Time of day
006	Date
020	Status interrogation of the outside displays
070	Status interrogation of the cancellers

Appendix 18

Central unit, parameters

1. IBIS central unit, internal functions

Uni- or bi-directional vehicle (remote driver terminal yes/no)	
Train-BUS operation	(yes/no)
Daylight saving time beginning	(4 decimal digits)
Daylight saving time end	(4 decimal digits)
Decade of year	(1 decimal digit)

2. Vehicle peripherals

Ticket canceller and ticket vending units, number	(0=none, max. 8)
Input zone number	(yes/no)
Input short route	(yes/no)
External or internal displays,number	(0=none, max. 15)
Input destination number	(yes/no)
Input route number	(yes/no)
Supplying of the external displays with destination number or text string,	
Text string as AD or selective:	DS 003, 003a or 021
Badge reader present	(yes/no)
Request insert of badge	(yes/no)
Stop announcement operation (HAG)	(yes/no)
Stop display information apparatus (HIG)	(yes/no)
Route-run or shift number with text for internal display	(yes/no)
with canceller features	(yes/no)
automatic advancement (stepping)	(yes/no)
distance after door closing to next announcement/display	
Event recorder present	(yes/no)
Fault detection system present	(yes/no)

3. AVLC (RBL) system functions

AVLC operation	(yes/no)
Demand-responsive operation	(yes/no)
Time of day exclusively from AVLC system	(yes/no)
Number of beeps in order to depart	(1... 8)
Default radio data channel when switching-on	(1...15)
Speech channel(fall-back channel)	(1...15)
Reaction time (see VDV recommendation 420)	(0...15 ms)
Transmitter keying-up time	(0...31 ms)
Time-out for data radio reception	(10...150 s in 10 s steps)
Time-out for address checking	(0 = no resp. 1...7 min in min steps)

Time-out for text reception with C13/C14	(1...15 s)
Correction factor for odometer count	(5..80 pulses/ 10 m in 15 steps)
Calibration factor for distance measurement	(+/- 10% in 255 stages)
Load measurement or FGZ present	(yes/no)
Time after door-closing on load measuring unit	
Time after door-closing until measurement value inquiry	

4. Traffic signal preemption, beacon transponder

Beacon transponder present	(0, 1 or 2)
(2 relevant only in the case of bi-directional vehicle)	
Distance to switch-on command	(0...150 m in 10-m steps)
Send priority request message	(no, once, several times 0, 1... 7 times)
Radio channel for request message	(0 or 1...15)
(In the case of 0 the transmitting occurs synchronously on the AVLC answer channel)	
Reduce transmitting power	(yes/no)
Channel switch-over delay	(2...62 ms in 2-ms steps)

5. Further parameters

are to be stipulated application-specifically if needed.

Appendix 19

Central unit, test functions

1. General

Test functions serve, on the one hand, for the function control and error search in the event of trouble; on the other hand, hereby there can be performed important operative functions, such as the setting of the vehicle-specific parameters, the setting or correcting of the internal clock or the setting of the summer/winter switch-over.

The following sets forth the minimum requirements.

The switching-on of the test function has to occur by switching of contact point 120 (Appendix 5 sheet 1) against common of input, contact point 135. The individual test functions are to be selected by the numbers 1 ... 9. thru further inputs one arrives in subfunctions or on address fields or finally at data fields.
If need be, it is possible, over renewed number inputs, to "climb over" into other test function levels.

By pressing of the "Enter" key the input value is taken over and the next function step opened.

By pressing of the "Delete" the value in question taken out or the function or subfunction concerned is closed and simultaneously the next step in the level in question is opened.

Pressing the "Delete" key twice leads correspondingly into the next-higher level.

By separating contact 120 from Common the test function is ended.

All displays have to occur statically (statisch) in each case in the upper line.

In number indications there are in binary form the values 0 and 1 and decimally 0...9 and hexadecimally 0...F. "Off" is represented by 0 and "On " by 1.

2. Test Function 1:

Display and erasure of peripheral faults

With this function faults, on peripheral units that have arisen during operation can be recognized and the success of servicing operations can be checked. All faults arising during operation on external apparatuses are entered into an internal error table. After entering the test function 1 there appears on the display the last error (fault) entered in the error table.

The peripheral unit which has caused this error is now polled every second about its status. If this error is eliminated, then after 20 seconds there appears on the display an IO for "In order".

With the enter key the next fault can now be taken out of the table for processing. This holds regardless of whether the last error was eliminated or not. Corrected errors are deleted here and uncorrected ones reinserted in the table at the end.

3. Test function 2:

Display of the individual entries as well as of the vehicle address

Characters 1 ... 12 of the upper line are used in a sequence to be established for the individual entries, the characters 13 ... 15 for the vehicle address and the character 16 for the parity with the address.

4. Test function 3:

Radio channel choice

Channel No. 1 ... 9 is to be input by operation of the digit keys, channels Nos. 10 ... 15 by operation of the keys A ... F .

After input of channel No. (0 ... F) and pressing of the enter key the corresponding channel is set and switched to voice operation. Hereby, for example, it is also possible to listen into the data channel.

5. Test function 4:

Display of the data for the location detection

This function makes possible the observation of the internal data for vehicle location, such as odometer counter and beacon code reception. These data, insofar as it is a matter of dynamic data, are reread and displayed every second.

Representation decimally for 10-m counter.

Representation hexadecimally for messages of the beacon transponder, of the number of overflows of the 10-m counter and the calibration factor.

Setting of the vehicle total mileage on change of IBIS central units.

6. Test function 5:

Charging of the parameter field

Because of the often different parametrization for streetcars and buses as well as of different vehicle types and varyng use of the IBIS unit, it is recommended to load automatically with a charging unit.

After selection of the test function and start of the loading unit, the charge of the parameters occurs automatically.

If a special "identification signal" is sent by the charging unit, then the test function is automatically terminated and a new test function is requested.

Manual termination is possible by pressing of the delete key, but not during the charging process.

7. Test function 6:

Time, date and daylight saving time set via charging apparatus

With the aid of this test function the internal clock (including date as well as beginning and end of daylight saving time) can be set with the aid of the special charging apparatus over the Vehicle-BUS. After the start of the charging unit , automatic activation of date, time as well as start and end of daylight saving time are stored.

8. Test function 7:

Time, date and daylight saving time to be input manually

With the aid of this test function the internal clock (including date as well as start and end of daylight saving time) can be stored and displayed.

9. Test function 8:

Charging of the operating parameters via the terminal

Over this test function number, it must be possible to input the parameters (see parameter list) individually or to change them.

10. Test function 9:

Initial setting of the parameter field accessible through test function 8

With this test function it is to be possible to select a parameter block from at least 4 predefined parameter blocks (stored in PROMs) and to copy it it into the parameter field (RAM).

The designation of the parameter blocks given in advance by the user is displayed on the terminal with maximally 12 characters.

11. Test function 10:

Display of the software version

With this function there are displayed the check sum (hexa-cross sum) over all the memories of the central unit and those of the peripheral units. In the latter the version numbers can also be agreed upon.

Insofar as in the IBIS unit network data are stored, the check sum of these memories is to be given separately.

After display of the software version of the central unit there follows the interrogation of the peripheral unit in the sequence of the parameter field. The pinpointed calling-up according to the line number of the parameter field is to be possible. The display is to occur analogously as in the fault report (with 7 characters for the unit concerned and 6 characters for the version number).

12. Test function 11:

Observing the radio traffic with the control center

With this test function it is possible to obsrve the realtime data radio communication (traffic) between the control center and the IBIS unit. The data message traffic from and to the control center, as well as the control signals for the radio unit is to be represented with utilization of both lines of the display and updated in each case after one second.

Appendix 20

Principles for the operation of IBIS installations

In the first drafting of standards it was intended to define precisely and uniformly also the operating surface of the integrated on-board information system.

Already in the first applications it showed, however, that the demands and peripheral conditions with the individual operators deviated too strongly from one another. For this reason there are to be given only a few principles for the input by the operator and for the display in generally valid form

1. Operating surface

Each operating apparatus in an IBIS comprises

- a key field with, as a rule, 22 keys,
- a display with, as a rule, 2 lines for each 16 characters,
- a buzzer for attention signals,
- possibly an acoustic feedback for the keys.
  (see in this connection also Appendix 2, sheets 1 and 2)

The key field consists of a ten digit block as well as additional function keys.

Because of the similarity to communication by telephone, the digit arrangement with the digit 1 at the top left should be as in this latter. Only for compelling reasons should there be chosen the pocket calculator subdivision (digit 9 to the right top).

The digit 0 is located in both versions in the lowest row in the middle (of the digit keys).

To the left beside the zero there is an delete key (negative input), to the right, beside it, an enter key (positive input).

In order to limit the number of keys (space requirement, clarity), with the digit keys in general function can also be addressed (see point 2, input).

This ten-block is located to the right beside the display, in order not to cover this in the case of right-handed input Further function keys are located underneath the display.

By this arrangement it is possible to achieve, with good operability and visibility, an aspect ratio of almost 2:1, which again complies with the width development in driver stands.

The keys are 19 x 19 mm in size and therewith good to operate and to mark.

2. Inputs by the operator

The operator will in general be a driver. But also for the maintenance (test functions, Appendix 19) the same operating principles hold.

At the beginning of each operating action, first the desired function must be selected by actuation of the corresponding function key. Since this can also be one of the digit keys, these have in basic position the significance of function keys.

In a number of functions the operation is already completed with the selection of the function--a further key actuation is then no longer required (request-to-talk, direction key for track-switch setting or traffic signal preemption, etc.).

Other functions require after selecting the input of numerical parameters with a different number of digits (line-run number, destination number, coded report etc.).

For the clarity (unambiguousness) of the operation, in the upper line of the display the selected function is displayed. The acknowledgement occurs by a colon. Between colon and line end there are to be kept free as many character places as digits are expected for the required parameter (input field).

If for the selected function a valid parameter is present, then it is displayed in the input field.

The digit block switches logically over from function keys to digit keys. If a valid parameter is present, then its display is erased with the first actuation of a digit key.

Each digit is displayed "flush-right" and pushes digits present to the left until the place before the colon is reached. All further digit inputs are ignored.

The input is concluded by actuation of the input key. A valid parameter possibly previously present is overwritten. If fewer digits were inputted than the input field is long, then the high-value places are filled with zeros -the input of leading zeros is therefore not required.

For the event of error in the input, the delete key is provided. The actuation and therewith the breaking-off of an input procedure occurs in several stages:

> If before the first actuation of the delete key a start was already made with the digit input, then only the digits hitherto inputted are deleted--the digit mode remains preserved-i.e. it is possible to proceed immediately with the renewed input of digits.

If, however, the delete key is actuated with an empty input field or before a digit input, then also the selected function is abandoned. A valid parameter possibly previously present remains preserved, even if it was deleted in the display.

If a parameter is in actual fact to be deleted (set on zero), after the function choice a zero must be input and the dialog cut off with the enter key (!). This is to be prevent a parameter from being inadvertently deleted.

Fundamentally, each key actuation should evoke at least one character on the display. Exceptions are the "emergency call" (external key) and possibly the direction keys.

Inputs that are to be transmitted in the scope of an AVLC syatem to the Central, are to be displayed until the Central has acknowledged the reception - at least, however, 10 seconds (The operator, in the case of too rapid acknowledgement and deletion, could see himself forced to make a renewed input).

The messages of the control center are to be displayed as abbreviation in the lower line - for example instead of the line-run number known as a rule to the operator - flashing.

3. Displays

The two lines of the display have separate assignments:

- In the.upper line there are displayed the information items current for the operator.
- In the lower line there are constantly shown operation-relevant information data (for example line-run number, schedule deviation, etc.).

Displays of the upper line especially important for the operator require acknowledgement. They are displayed in flashing form. After actuation of the enter key (if no function was selected) they go over into a static display. They can then be erased by actuation of the delete key or also all to stand as "notice entries."

The upper display line has a background memory for at least 4 display texts.

The display texts have three priorities (named in decreasing sequence):

- Texts and input fields in conjunction with an input
- Acknowledgement-demanding (flashing) information data
- Static information data

A new text overwrites a present text with equal or higher priority. The overwritten text is displaced into the background memory. If this is already full, the oldest lower-priority text is deleted.

A scrolling of this background memory on the display line is not provided.

4. Transferability

These fundamental stiplulations for displays and operation can be applied analogously also for other units and operating surfaces. This holds especially for units that perform the master function of an IBIS over the serial Vehicle-BUS specified in this recommendation.