Section 3

TSU 1391

Technical Product Manual
MTCO EC/ NEC and TSU
Installation/ Fitting/ Checking

Any changes will be notified by service information or circular.

We reserve the right to change technical details of the descriptions, information and illustrations in this documentation.
Printed in the Federal Republic of Germany.

Responsible for the content
MSU Fleet TA43S2/PTW

Orders
Please send your orders to the following address:

Siemens VDO Trading GmbH
Postfach 62 01 27
60350 Frankfurt/ M.
Germany

Siemens VDO Trading GmbH
Postfach 16 40
78006 Villingen-Schwenningen
Germany

Internet: www.vdo.com
E-Mail: fleets@vdo.com

General safety precautions

Kienzle Tachographs and the vehicles into which the tachographs are installed are quality products manufactured to comply with recognised rules of engineering.

The products comply with the quality assurance standards currently in force and are officially authorised for use on public roads.

The products left the factory in a perfectly safe condition.

In order to maintain them in this condition you must carry out your work as an engineer

- in accordance with the descriptions in these instructions,
- correctly and with great accuracy and
- by observing the Health and Safety regulations for safety and accident prevention at work.

Designated use

Kienzle Tachographs may only be used for the purpose for which they have been constructed.

Fitting instructions

There is no need to have access to the safety technology of the vehicles to fit Kienzle Tachographs.

Correct installation will not involve any changes to or affect the structure or driving properties of the vehicle.

- Before installing the tachograph consult the vehicle documentation to find out exactly what sort of vehicle it is and whether it has any special characteristics.
- Refer to the vehicle drawings to identify the position of fuel, hydraulic and compressed air lines and electrical cables.
- Ask the vehicle owner or the driver about any (private) changes to the vehicle which must be taken into consideration when installing the unit.
- During installation and removal, avoid damaging lines and cables and severing line and cable connections.
- Only use original Siemens VDO parts and original Siemens VDO accessories for fitting.
- Only fit undamaged parts to a vehicle.
- When installing the tachograph and its cables, ensure that these parts do not affect or prevent the proper operation of the vehicle and that the parts are not damaged.

- Do not reduce the cross section of a line; this can lead to the corresponding section of the cable becoming overheated.
- Only solder the new cable connections with soft solder.
- Check all (!) vehicle functions before handing the vehicle back to the customer.

Vehicle hand-over

- Instruct the customer in the operation of the tachograph and give him the relevant operating instructions.

Summary of changes

Date	Chapter/page	Subject, change, measure

Notes

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Chapter 1
System overview

1.1 General system description

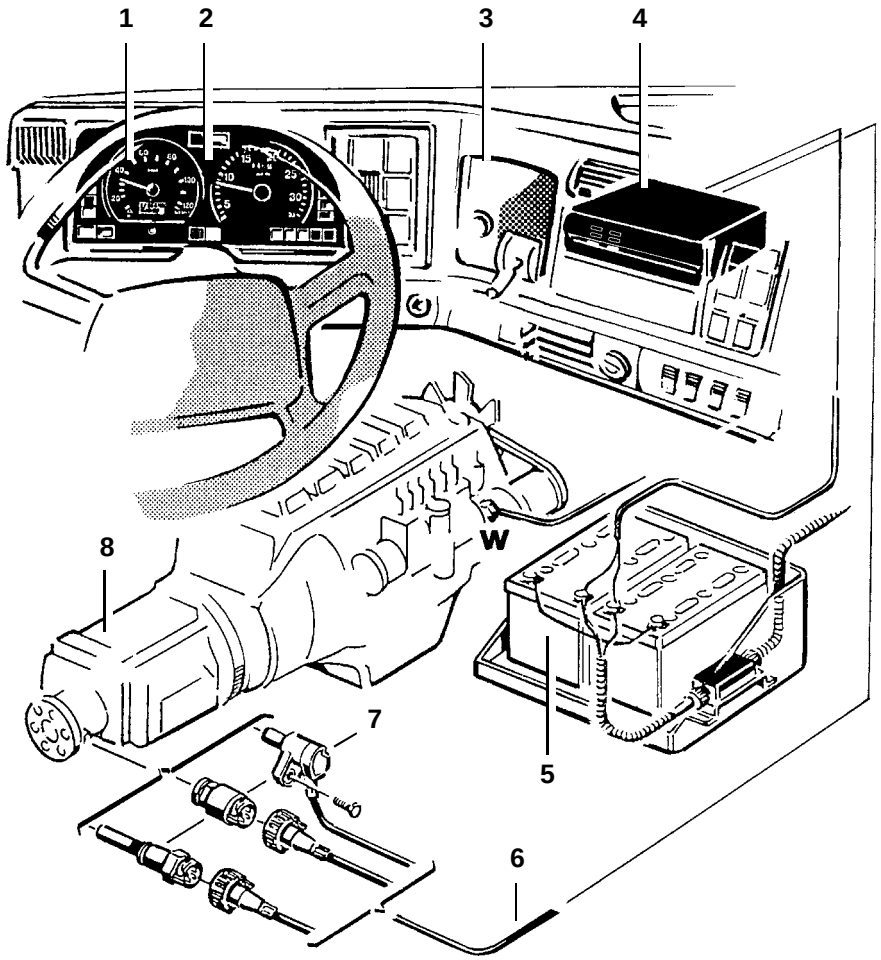

Fig. 1-1: TSU 1391 system components

1 Indicator unit (for cluster)

2 Cluster

3 Dashboard (driver's workplace)

4 TSU 1391 (in dashboard radio compartment)

5 Vehicle battery

6 Pulse/ sensor cable for KITAS 2170/ 2171 (4-wire, black)
(cable design acc. to EU Directive 95/54 EMC)

7 KITAS sensor 2170/ 2171 or pulse generator 2159

8 Gearbox

! Important

The TSU is not subject to the legally prescribed Directive (EEC) No. 3821/85 or proposed Directive (EEC) No. 2135/98 but must observe all legal standards, guidelines and directives for registering commercial vehicles.

The ”new generation” of speedometer systems has a modular structure and consists of autonomous devices:

- Interface unit: Indicator unit - speed generator
- Indicator unit
- Sensor/ pulse generator and sensor/ pulse cable.

Interface unit

In vehicles without prescribed EU control units the Speedometer Simulator Unit (TSU) 1391 provides the interface between the pulse generator and the indicator unit.

The TSU 1391 provides the data for speed, distance travelled, time and date to the indicator unit via CAN bus.

Indicator unit

The indicator unit or a permitted Cluster is in the driver’s direct line of sight.

Usually the indicator unit displays the speed (analogue) and the distance travelled (digital). Depending on the design, the daily trip recorder, data and time as well as malfunctions are also displayed.

The Cluster components are specific to the vehicle. Design and operation can differ from the indicator unit shown in this documentation. Please refer to the relevant operating instructions for detailed information.

Sensor

KITAS 2170/ 2171 (Kienzle Tachograph Sensor), the intelligent pulse generator transforms the gearbox revolutions into pulses and transmits these as real-time signals to the TSU 1391.

Sensor cable
(DIN 72551 Kfz)

A new type of sensor cable has been developed for the KITAS 2170/ 2171 sensor which can be used in motor vehicles complying with DIN 72551 Kfz.

Generator

The pulse generator converts the gearbox revolutions into double pulses and transmits these to the TSU 1391 interface unit.

! Important

An interference free (EMC) sensor/ generator connection cable with twisted wires is required for the TSU 1391.

The speedometer system with TSU 1391 **only needs** a single pulse signal to transmit the speed pulse to a separate indicator unit.

1.2 System performance characteristics

Basic characteristics

- Separate indicator and interface units
- 24 V vehicle voltage version
- TSU housing dimensions complying with the dimensions for radio compartments specified by DIN/ ISO 7736
- Additional mounting sleeve for installation into radio compartment
- Two buttons for setting the time
- Read-only memory for storing required parameters, such as housing variant, ”w”, measurement range etc.
- Battery buffered real time clock with automatic, country-specific daylight saving time/ standard time switchover settings, programmed for 5 years.
- Interfaces from interface unit to indicator unit: Data bus compliant ”CAN” interface SAE J1939, CAN 2.0B
- Special interference-free (EMC) sensor/ pulse cable with twisted wires

Options/ Additional equipment

- Possibility of connecting different ”v” pulse generators/ sensors such as pulse generator 2159, KITAS 2170/ 2171

1.3 TSU 1391 data transmission using the CAN bus

CAN (Controller Area Network) is a serial bus concept that is used to network various control units. The CAN bus provides high data transmission speed and ensures high data security. Therefore, the Can bus is particularly suitable for real-time applications. It offers the following features:

- Maximum transmission rate 1 Mbit/s
- High reliability if interference from other sources is high
- Open concept.

Data transmission. General.

Data content

When transmitting data on the Can bus no station is addressed, but the data content (e.g. speed display) is identified using a unique identifier. As well as the content identification the identifier also determines the priority level of the message. This is important for bus allocation if several stations want to access the bus.

If the CPU wants to send a message to one or several stations, it forwards the data, its identifier and the transmission request to the CAN controller. The CAN controller then creates and transmits the message. As soon as the CAN

controller has access to the bus ("send message") all the other stations on the CAN network are recipients ("receive message").

Acceptance check

After all the stations have received the message correctly, they carry out an acceptance check (”select”) and check the identifier to determine whether the data received is relevant for them or not. If the data is important for the station, the information is processed (”accept”). If not, it is ignored.

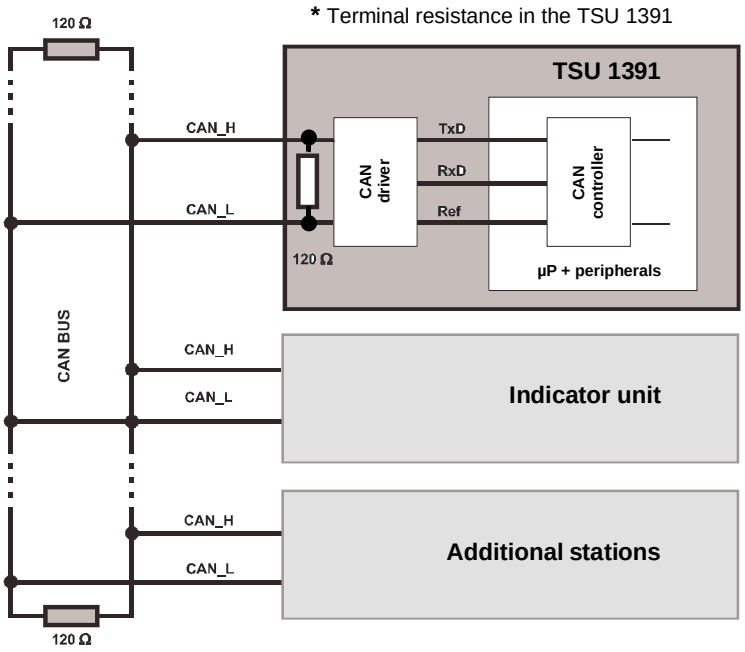

Fig. 1-2: CAN bus and TSU 1391 (diagram)

1.4 TSU - CAN bus system variant

The new speedometer system with TSU 1391 is available in a TSU - CAN-Bus and Cluster variant.

TSU - CAN bus and Cluster

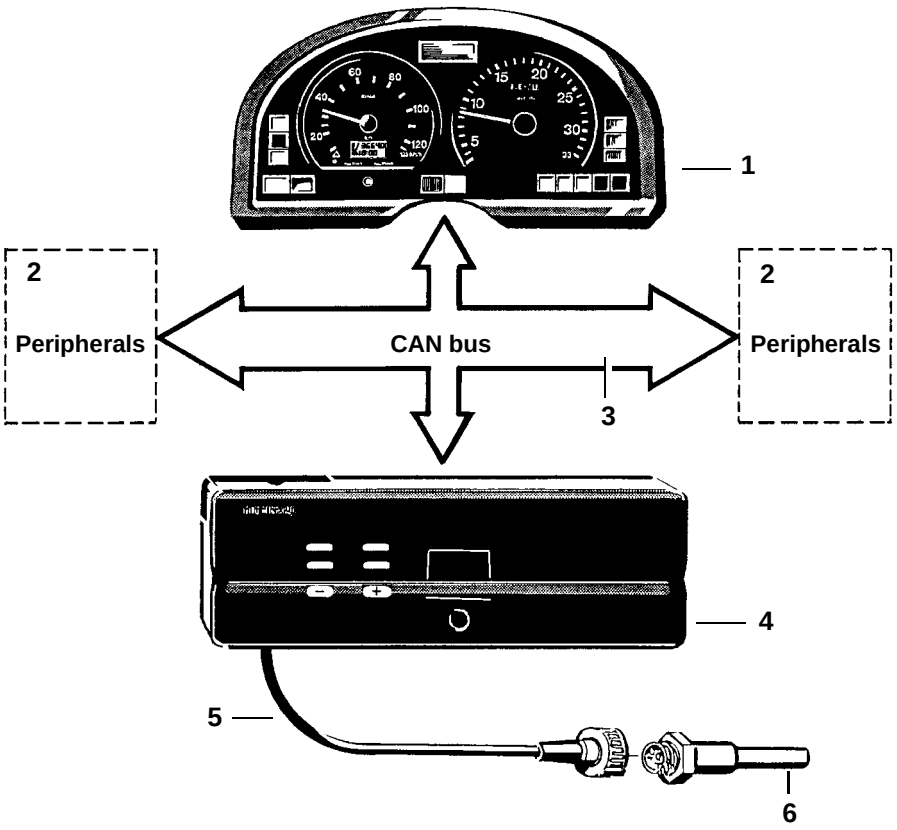

Fig. 1-3: TSU - CAN bus and Cluster system variant

1	Cluster	**4**	TSU 1391
2	Further vehicle instruments	**5**	Sensor/ pulse cable
3	CAN bus (serial interface)	**6**	KITAS sensor 2170/ 2171 or pulse generator 2159

CAN bus

CAN is a standard synchronous serial interface. It is used to network several control units using the so-called CAN bus. The CAN bus provides high data transmission speed and ensures high data security. Therefore, it is suitable for real-time applications.

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Chapter 2
Product description/ description of functions

2.1 TSU 1391

2.1.1 Product description

The dimensions of the modular TSU 1391 correspond to the dimensions prescribed for DIN/ ISO 7736 radio compartments. Thus, the TSU 1391 can be integrated into the dashboard of modern commercial vehicles. Depending on the type of vehicle, the unit features a customised front cover and customised instruments.

Adjusting the speed of the TSU 1391 can be programmed with an MTC/ATC:

Setting ranges

- Speed: 4000 - 25000 imp/km

Displaying malfunctions

Auto-diagnosis function

The TSU 1391 carries out a constant auto-diagnosis to check for:

- voltage breaks
- defects in the KITAS sensor/ pulse generator and its cable
- communication errors between the TSU 1391 and the indicator unit
- system errors.

! Important

The auto-diagnosis function is only performed when the ignition is on.

If the TSU 1391 detects a malfunction it does not differentiate between malfunctions or warning messages. Regardless of the cause of the fault, the TSU 1391 always:

- adds an entry to the event or error protocols
- triggers the warning LED on the indicator unit (if available).

Displaying malfunctions

The driver will be made aware of system malfunctions by the warning LED on the indicator unit (if available).

Additional information

Detailed information on error messages as well as recommended measures for error correction can be found in *Chapter 6 "Fault analysis"*.

TSU 1391 device description

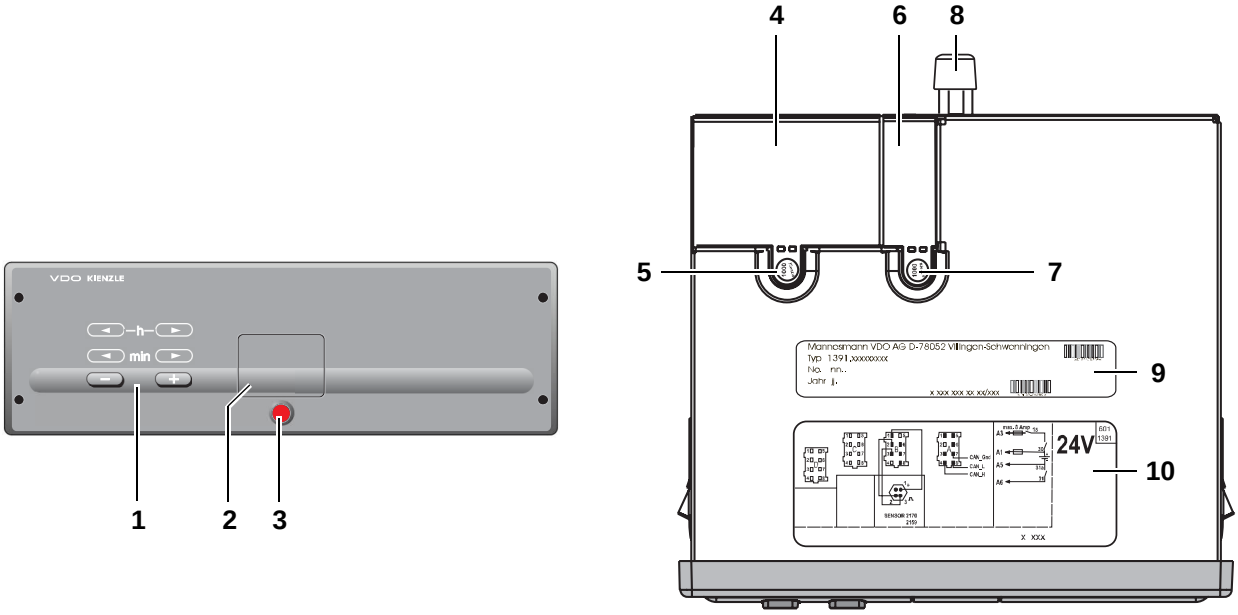


Fig. 2-1: TSU 1391: Front and bird's eye view of the unit

1 Keys for setting the clock:
- Key + selects the next menu item
- Key − selects the previous menu item

2 Test and programming interface

3 Unit seal

4 Connector hood: to cover the connectors

5 Connector hood seal

6 Battery compartment: Buffer battery

7 Battery compartment seal (sealed at the factory)

8 Fixing screw with cap (radio compartment)

9 Type plate

(a) Manufacturer
(b) Device type
(c) Serial number
(d) EMC approval sign
(e) Third party item number

10 Circuit diagram with voltage indication, serial no., device type (label)

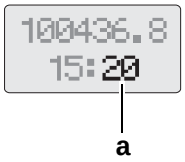
2.1.2 Operation, setting the clock

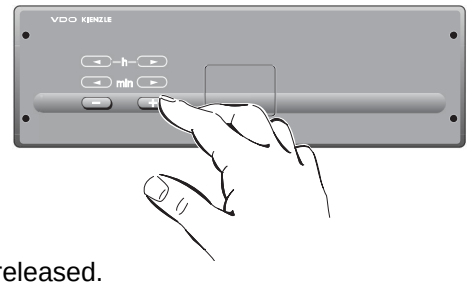
! Important

The date will be corrected automatically when setting the clock back or forward (0.00 hours).

Changing the minutes

1 **Press the + or − key and keep it held down until the required minute (a) is displayed on the indicator instrument.**

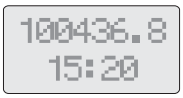


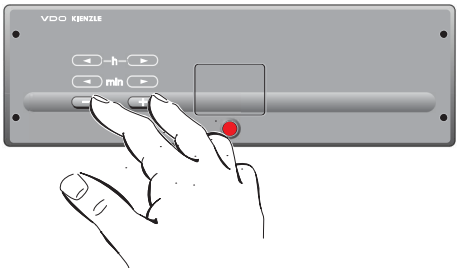


The minutes are set when the key is released.

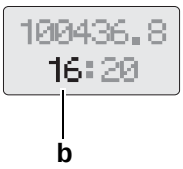
Changing the hours

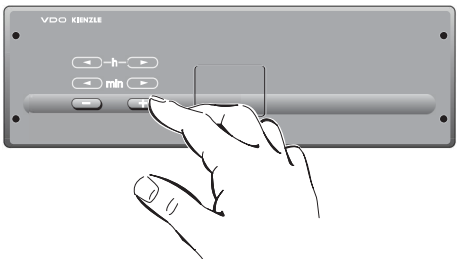
2 **Press the key + and − keep it down for three seconds.**





3 **Press the + or − key within three seconds and keep it held down until the required hour (b) is displayed on the indicator instrument.**





The hours are set when the key is released. After three seconds the TSU 1391 switches back to the original mode.

2.1.3 Interfaces

Overview of interfaces

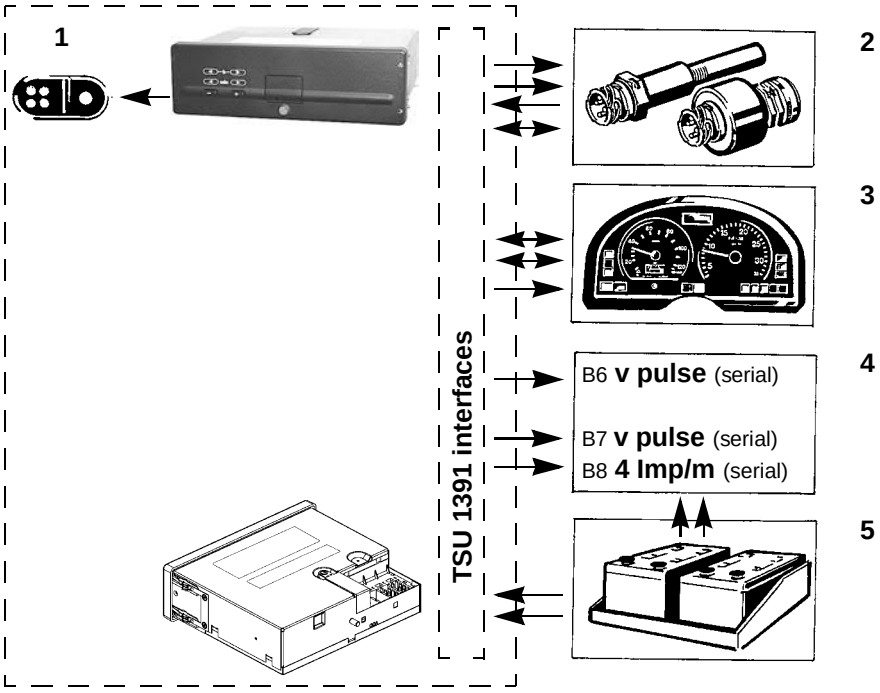


Fig. 2-2: TSU 1391: Overview of interfaces (all interfaces connected, not possible in real-time operation)

1 Test and programming interface

2 Speed sensor or speed pulse generator

3 CAN bus for Cluster

4 Outputs (e.g. ”v” pulse, 4 imp/m)

5 Vehicle supply voltage (vehicle battery)

CAN interface

CAN is a standard synchronous serial interface. It is used to network several control units using the so-called CAN bus. The CAN bus has a high data transmission speed. Therefore, it is suitable for real-time applications.

An identifying address which identifies the message content (e.g. engine speed) is assigned to the data transmitted on the CAN bus. A station connected to the CAN bus interprets the address to find out whether the data is relevant or not. If so, the data is processed; otherwise the message is ignored.

2.1.4 Interface specification

Connector A

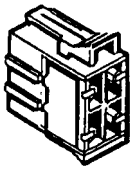
Connector contact	Parameters	Values min.	Values typ.	Values max.	[Unit]	Remarks
						Connector A (natural white) 
A1 O						T. 30 constant voltage (relating to A5)
Battery +	**24 V**					
	Voltage	20	24	30	V	
				32		Short term (max. 1 h)
	Current		38		mA	”v” standby
				48	mA	Total ”v” current
Standby definition: no RPM, work status on break time and ignition off						
A2						
A3 O						T. 15 (relating to A6)
Battery + ignition	**24 V**					
	Voltage	20	24	30	V	
				32		Short term (max. 1 h)
	Current			22	mA	Total ”v” current
The total current is defined including tray discharge.						
A4 O						(relating to A7)
CAN_H						Technical description according to ISO/WD 16844
A5 O						T. 31a (relating to A1)
Battery -						
A6 O						T. 31 (relating to A2, A3)
GND						
A7 O						(optional)
CAN_GND						Galvanised/ capacitive connection
A8 O						(relating to A7)
CAN_L						Technical description according to ISO/WD 16844

Table 2-1: Interfaces: Connector A (current and CAN bus connection)

Connector B

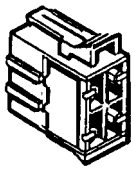
Connector contact	Parameters	Values min.	Values typ.	Values max.	[Unit]	Connector B km/h MPH (yellow)  Remarks
B1 O						KITAS sensor reference
	Voltage	6,5		9	V	
B2 O						
	Battery "–"					T. 31, minus internal bridge with A5
B3 I						Sensor and generator reference
"v" signal (real time)	Voltage Low			1,0	V	I = -250 µA
	Voltage High	3,8				I = -150 µA
B4						
B5						
B6 O						Standard (cf. definition of B7) or customised
"v" pulse						
B7 O						Instrument interface/ K-Line (relating to A6)
"v" pulse	Voltage Low			1,5	V	I = 1 mA
	Voltage High	5,5				I = -1 mA
	Frequency			1,5	kHz	
	Pulse length	0,64		4	ms	±1%
	Tachograph constant	4000		25000	imp/km	
B8 O						
4 imp/m	Voltage Low			1.5	V	I = 1 mA
	Voltage High	5.5				I = -1 mA
	Frequency			244	Hz	v = 220 km/h
	Pulse length	1.6			ms	

Table 2-2: Interfaces: Connector B "km/h MPH"

Connector C (not used)

Connector D (not used)

2.1.5 Type key

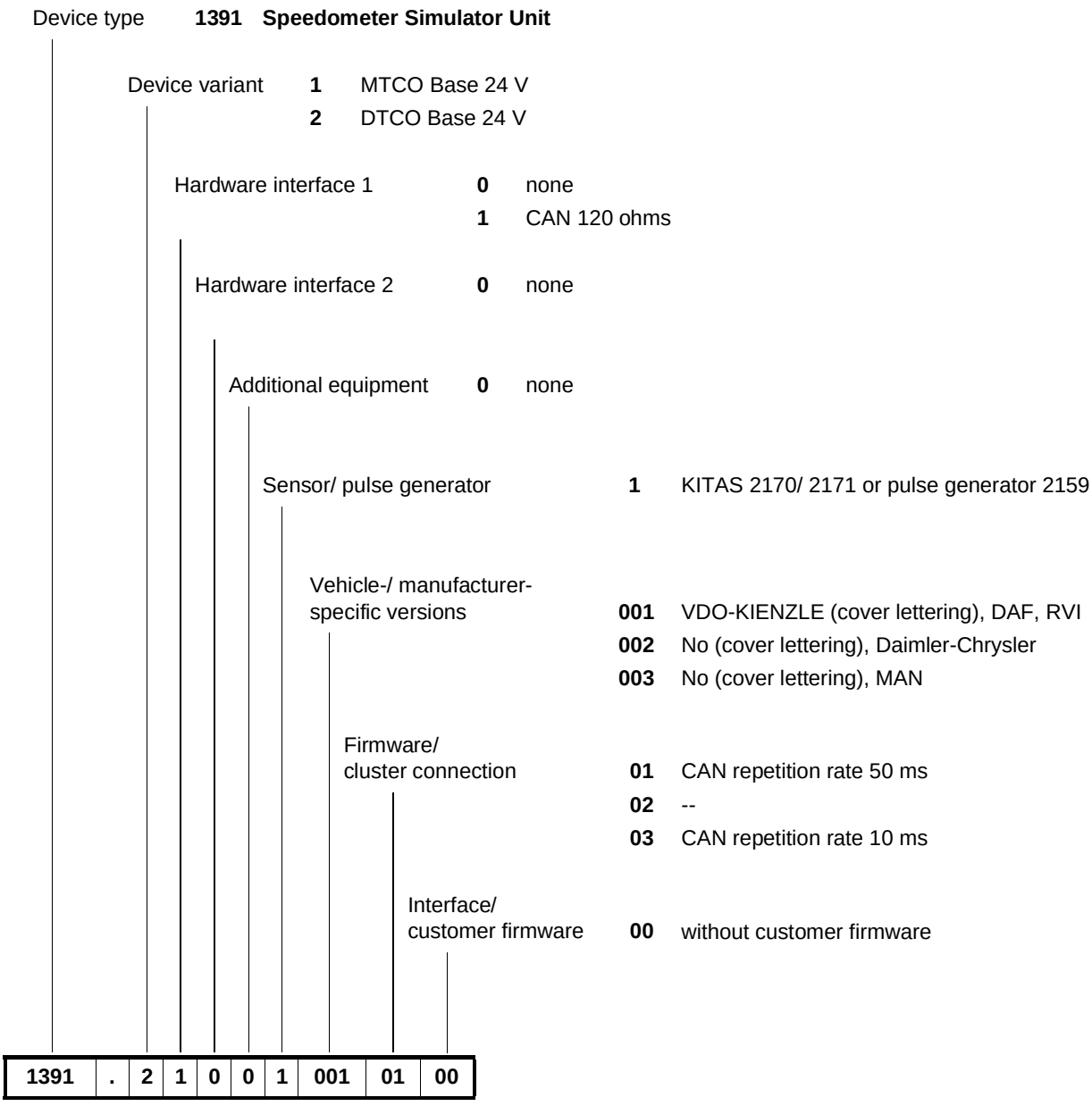


Table 2-3: TSU 1391: Type key

2.1.6 Technical data

Measuring range	up to 220 km/h
Operating voltage	24 V_{DC}
Current consumption (on connector ”A1”)	Stand by typically 38 mA Operation max. 50 mA
External fuse (on PINs ”A1” and ”A3”)	7.5 A
Operating temperature	-25 °C to +70 °C
Storage temperature	-40 °C to +85 °C
v pulse range	3000 to 25000 imp/km
Maximum v frequency	1,5 kHz
Inputs	v generator
Outputs	2 x ”v” pulses, 1 x 4 imp/m
Interfaces	Test and programming interface, CAN interface
Accuracy	Speed ± 3 km/h Distance ± 1 % Time (electronic) ± 5 s/day
EMC	Directive 95/54/EU ISO 7637 e1 021416
Noise	5 to 150 Hz; 0.02 g^2/Hz = 1.7 g RMS
Buffer battery	Lithium
Housing	Galvanised sheet steel
Earth	~ 650 g

2.2 Speed sensor/ generator

2.2.1 KITAS 2170/ 2171

Sensor cable acc. to DIN 72551 Kfz

A new type of sensor cable has been developed for the KITAS 2170/ 2171 sensor which can be used in motor vehicles complying with DIN 72551 Kfz. Main differences between the new sensor cable and existing pulse cables:

- The cable can only be used up to 50 V direct voltage; existing cables can be used up to 230 V alternating voltage.
- The cables are twisted 15 revolutions per metre which means that the sensor cable complies with EU Directive 95/54 EMC.

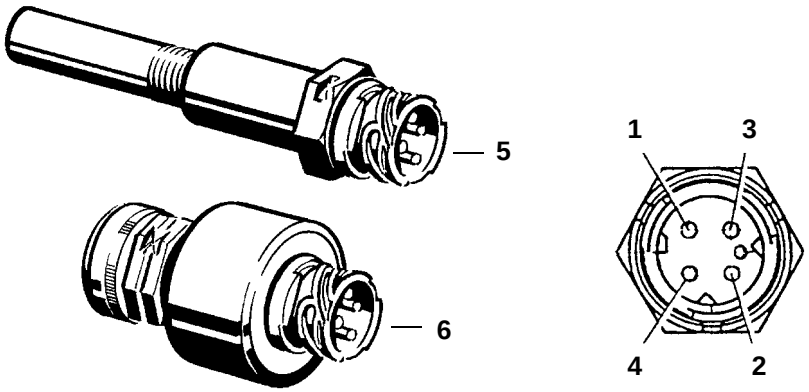


Fig. 2-3: Sensors: KITAS 2170/ 2171

1	Sensor supply (+ U_E)	**4**	Data signal I/O (is **not used**)
2	Sensor supply (- U_0)	**5**	Integrated sensor
3	”v” real time signal	**6**	Standard sensor

! Important

An interference free (EMC) connection cable with twisted wires is required for the TSU 1391.

The speedometer system with TSU 1391 **only needs** a single pulse signal to transmit the speed pulse to a separate indicator unit.

Additional information

You will find detailed information on KITAS 2170/ 2171 in *Section 4 ”Sensors and pulse generators”*, *Chapter 1 ”Kienzle sensors”*.

2.2.2 Kienzle pulse generator 2159

The pulse generator converts the gearbox revolutions into double pulses and transmits these to the TSU 1391.

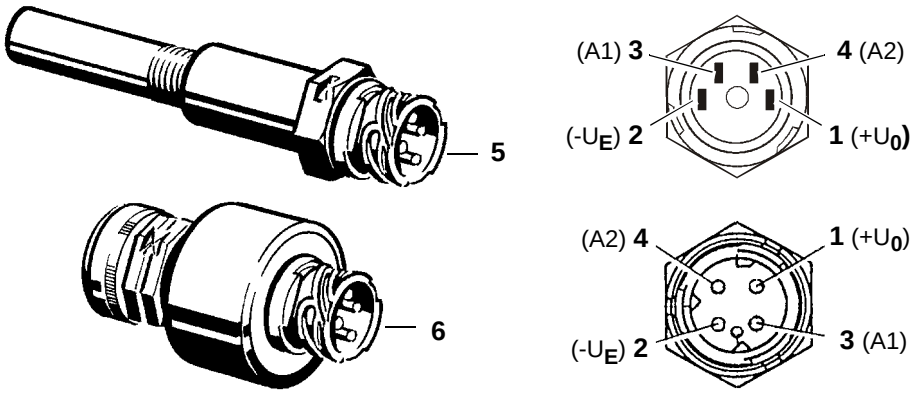


Fig. 2-4: Generator: Kienzle pulse generator 2159

1	Generator supply (+ U_E)	**4**	**A2**- is **not used**
2	Generator supply (- U_0)	**5**	Integrated generator
3	**A1** output signal (_▮_▮)	**6**	Standard generator

! Important

An interference free (EMC) connection cable with twisted wires is required for the TSU 1391.

The speedometer system with TSU 1391 **only needs** a single pulse signal to transmit the speed pulse to a separate indicator unit.

Additional information

Detailed information on pulse generator 2159 can be found in *Section 4 "Sensors and pulse generators"*, *Chapter 2 "Kienzle pulse generator"*.

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Chapter 3
Installation instructions

3.1 Necessary equipment

3.1.1 Service Diagnosis Systems

The following service diagnosis systems can be used for setting the parameters for and checking the TSU 1391 speedometer system:

- MTC (checking/ parameter setting inside the vehicle)
- ATC (checking/ parameter setting inside the vehicle)
- STC (checking/ parameter setting outside the vehicle).

Additional information

Additional information on the MTC can be found in *Section 6, Chapter 1 "Test equipment and service diagnosis systems"* as well as in the separate *"MTC 1602.04" operating instructions and supplements.*

Upgrade kit for TSU 1391

An upgrade kit can be used for retrofitting the above service diagnosis systems for use in combination with the speedometer system with TSU 1391.

Interface firmware version 06.00

The upgrade kit for the TSU 1391 is based on the interface firmware version 06.00. Interfaces with older firmware versions must be updated to version 06.00 (see circular dated 14.08.1997).

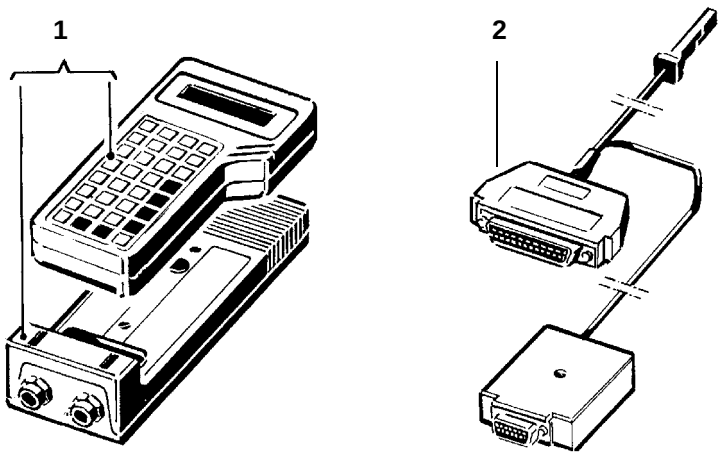


Fig. 3-1: Service diagnosis systems MTC/ ATC and upgrade kit for TSU 1391

1 MTC or ATC consisting of interface and BTC

2 Upgrade kit for TSU 1391

The TSU 1391 upgrade kit includes:

- a programming cable
- BTC software version **07.xx**
- TSU 1391 programming instructions.

Additional information

The order numbers for the various diagnosis systems and accessories can be found in the appendix Section 6.

3.1.2 Special tools/ sealing tools

Special tools

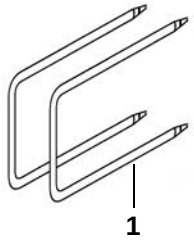


Fig. 3-2: Special tools for TSU 1391

1 Special tools for removing the TSU 1391

! Important

To disassemble dashboard components vehicle specific tools may be required.

Sealing tools

Original Siemens VDO tools and sealing equipment must be used for sealing (if prescribed by law).

! Important

The prescribed and required/ necessary seals for operating the TSU 1391 speedometer system according to the law are subject to national laws and regulations.

Check the legal regulations prevailing in your country to find out whether the test and programming interface on the TSU 1391 must be sealed.

Nevertheless, we recommend that you seal the speedometer system with TSU 1391 for security reasons.

Additional information

A complete overview of the necessary sealing tools can be found in *Section 6, Chapter 2.2 "Special tools"*, from page *2-5*.

3.2 Installation workflow

3.2.1 Check list

				Chap./ page
1	**Determine the installation site/ installation position**	Speedometer system 1391	• Determine (when retrofitting)	**3-5**
2	**Running cables and making connections**	TSU 1391	• Determine the connector allocation and wiring diagram • Run	**3-6**
		Sensor/ generator	• Running the sensor/ pulse cable	**3-11**
3	**Installing the sensor/ generator**	KITAS 2170/ 2171, pulse generator 2159	• Install • Seal (if applicable)	**3-11**
4	**Installing the tachograph**	TSU 1391	• Connect the unit using the connectors • Seal the back of the unit • Install	**3-13**
5	**Commissioning the speedometer system**	TSU 1391 and sensor/ generator	• Adjust the units to each other	**3-17**
		Characteristic coefficient	• Determine "w" [imp/km]	**3-20**
		TSU 1391	• Programming installation data	**3-21**
6	**Vehicle with TSU 1391**	in roadworthy condition	• Hand the vehicle back to the customer	

Table 3-1: Installation check list

3.2.2 Installation site requirements

The speedometer system must be fitted to the vehicle in such a way that:

- the driver can set the clock easily from the driving seat and
- all components including the transmission elements are protected against accidental damage.

3.3 Overview of installation site/ position

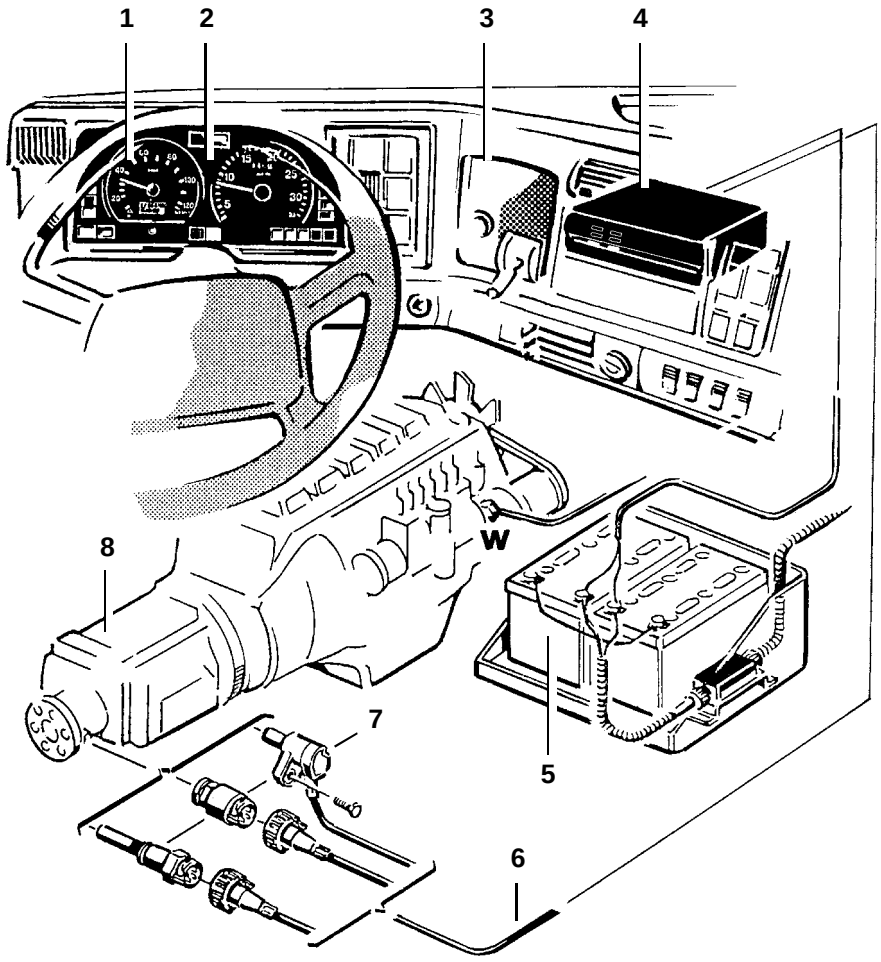


Fig. 3-3: TSU 3191: Speedometer system installation overview

1 Indicator unit (for cluster)

2 Cluster

3 Dashboard (driver's workplace)

4 TSU 1391 (in dashboard radio compartment)

5 Vehicle battery

6 Pulse/ sensor cable for KITAS 2170/ 2171 (4-wire, black)
(cable design acc. to EU Directive 95/54 EMC)

7 KITAS sensor 2170/ 2171 or pulse generator 2159

8 Gearbox

! Important

Refer to the current ordering documents for complete order numbers and spare part types.

3.4 Running cables and making connections

Connection cables are necessary:

- for connecting the TSU 1391 to the vehicle battery
- the indicator unit connection
- for transmitting data/ pulses (e.g. ”v” pulses, electronically triggered special equipment etc.).

3.4.1 Safety precautions

! Important

Read the vehicle manufacturer’s instructions before modifying the electrical system.

Disconnecting the vehicle battery can have undesired ”side effects” such as deleting:

- the radio’s security code
- engine control data (error memory) or
- parameters for intelligent vehicle diagnosis systems.

When disconnecting the battery terminals, make sure that:

- you switch off all electrical consumers first and
- disconnect the negative battery terminal before the positive battery terminal.

3.4.2 Making connection cables

Important

Electrical connection leads must have a cross section of 0.75 mm ^{2}.

All ”positive” wires must be protected with 8 A with a 24 V operating voltage.

Depending on the conditions in the vehicle, you must make your own connection cables or adapt the cables contained in the accessory kit.

Example: TSU 1391 connection cables

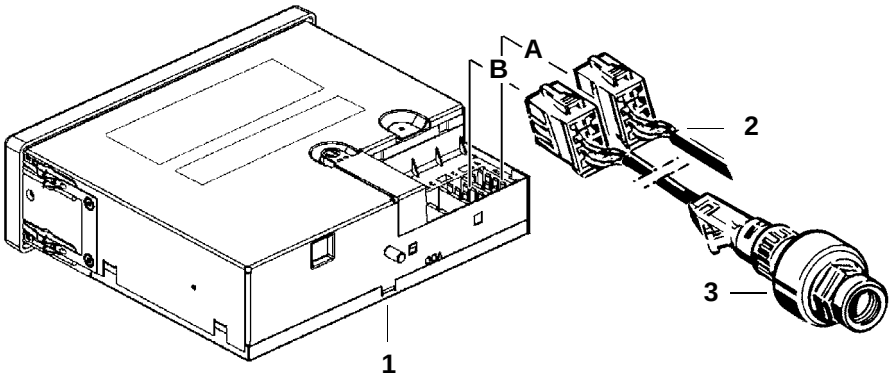


Fig. 3-4: TSU1391: Connection cable overview

1 TSU 1391 connector sockets

2 Connector with connection cable: CAN bus and voltage supply

3 Sensor/ generator with connection cable

Making connection cables

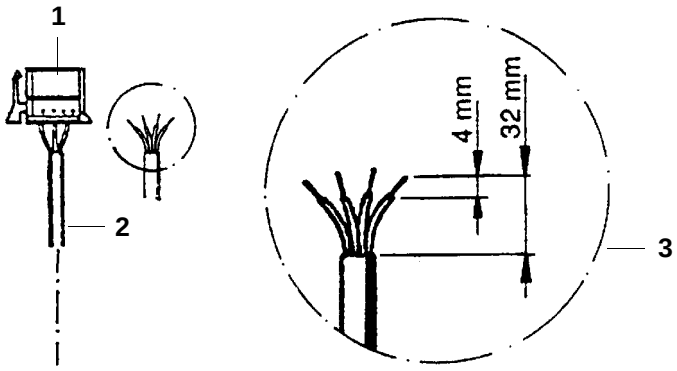


Fig. 3-5: Making connection cables (example)

1 Connector
2 Connection cables connectors A and B
3 Cable sheathing (bared ends)

1 Cut the connection cable to the required length.

2 Strip the insulation on the lead ends as shown in the figure.

3 Crimp the cable shoes onto the lead ends and insert them into the connector socket until they lock into place.

Disengaging the mini-timer connector

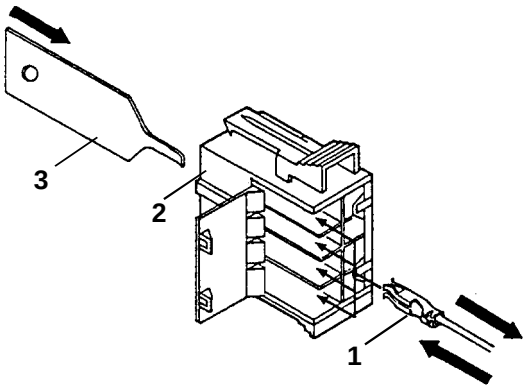


Fig. 3-6: Disengaging the mini-timer connector

1 Cable shoe (with lead)
2 AMP connector socket
3 Disengaging tool

1 Insert the disengaging tool (3) into the correct connector socket.

2 Pull the lead out of the AMP connector socket (2).

3.4.3 CAN bus connection diagram

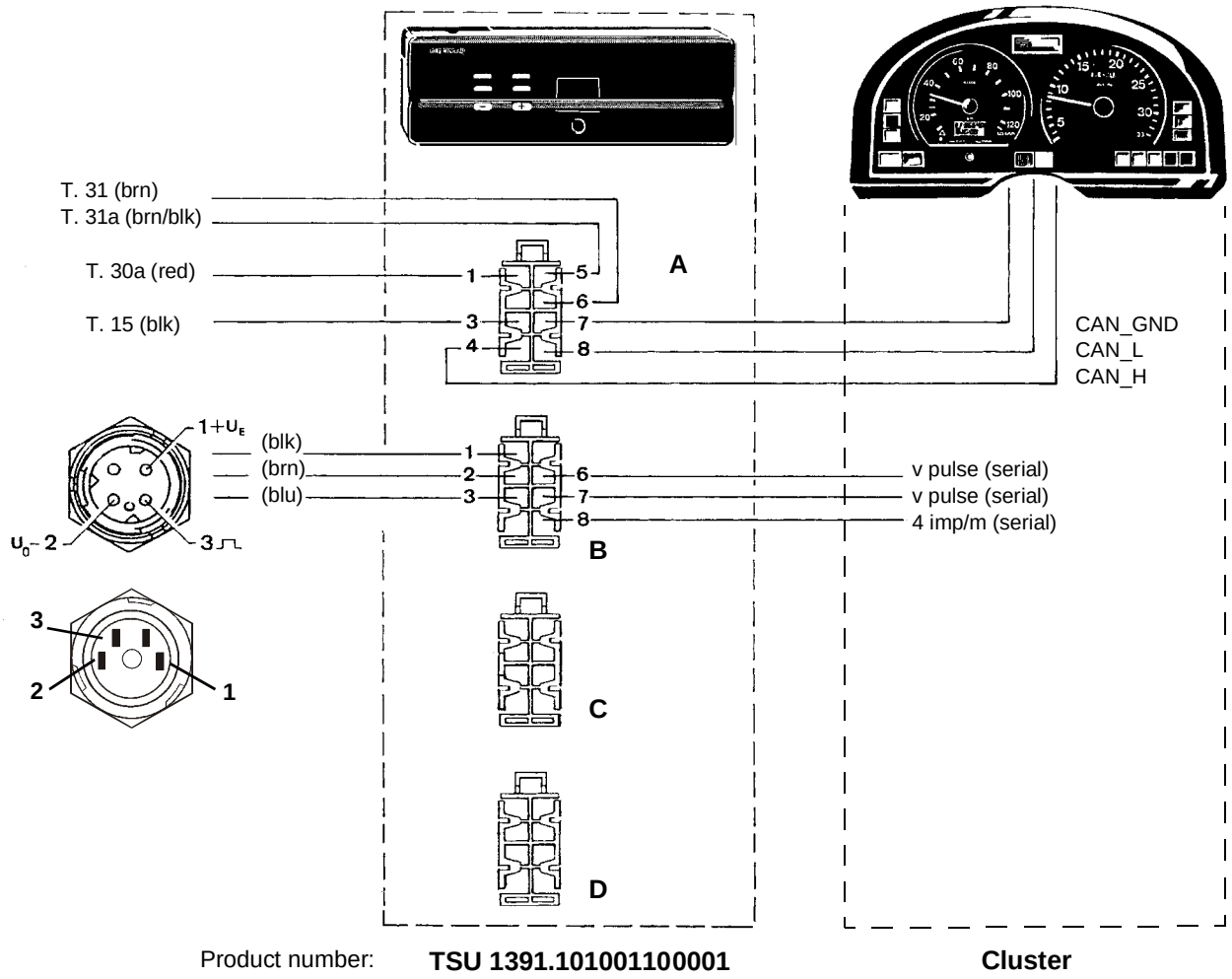
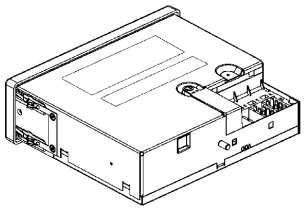


Fig. 3-7: TSU system 1391: CAN busconnection diagram



TSU 1391

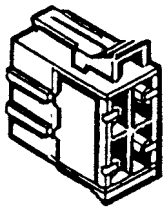
A 1 -	T. 30a (red)	Constant voltage
A 2	not used	
A 3 -	T. 15 (blk)	Ignition
A 4 -		**CAN_H**
A 5 -	T.31a(brn/blk)	Minus
A 6 -	T. 31 (brn)	Earth
A 7 -		**CAN_GND**
A 8 -		**CAN_L**

B 1 -	+	(blk)	”v” sensor supply
B 2 -	–	(brn)	”v” sensor supply
B 3 -		(blu)	Real-time signal
B 4	not used		
B 5	not used		
B 6 -			”v” pulse output
B 7 -			”v” pulse output
B 8 -			4 imp/m signal output

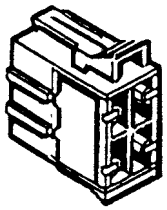
C 1	not used
C 2	not used
C 3	not used
C 4	not used
C 5	not used
C 6	not used
C 7	not used
C 8	not used

D 1	not used
D 2	not used
D 3	not used
D 4	not used
D 5	not used
D 6	not used
D 7	not used
D 8	not used

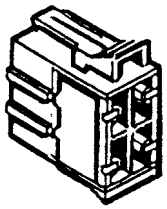
Connector A white



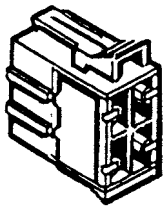
Connector B yellow

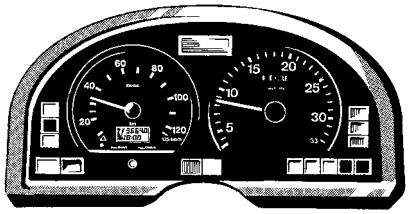


Connector C red



Connector D brown





Cluster

T. 30	Constant voltage
T. 58d	Illumination
T. 15	Ignition
T. 31	Earth
	CAN_H
	CAN_L
	CAN_GND
	Warning LED

Table 3-2: TSU 1391: CAN bus connector assignment with Cluster

3.4.4 Running connection and sensor cables

Connection cables

Condition

Before running connection cables the following information must be available:

- Speedometer system components
- Special conditions for running the cables in the vehicle such as exhaust, shift axle, tiltable cabin...

Important

When running and connecting connection cables make sure that the connection cables are:

- fixed at short intervals (approx. every 500 mm) and in such a way that they do not vibrate
- not exposed to tensile, compressive or shearing forces
- protected with rubber grommets when run through sheet metal or plastic.

Sensor/ pulse cable

Important

When running and connecting the sensor/ pulse cable make sure that:

- the sensor cable is run in front of the hinging point on vehicles with tiltable cabins
- the sensor cable is not run close to those parts of the vehicle that can damage it, such as the exhaust etc.

An interference free (EMC) connection cable with twisted wires is required for the TSU 1391.

The speedometer system with TSU 1391 **only needs** a single pulse signal to transmit the speed pulse to a separate indicator unit.

3.4.5 Installing the sensor/ pulse generator

Additional information

More detailed information and instructions on making connection cables and installing the KITAS sensor and pulse generator can be found *Section 4 "Sensors and pulse generators"*.

3.5 Installing/ removing the TSU 1391

3.5.1 Fitting dimensions

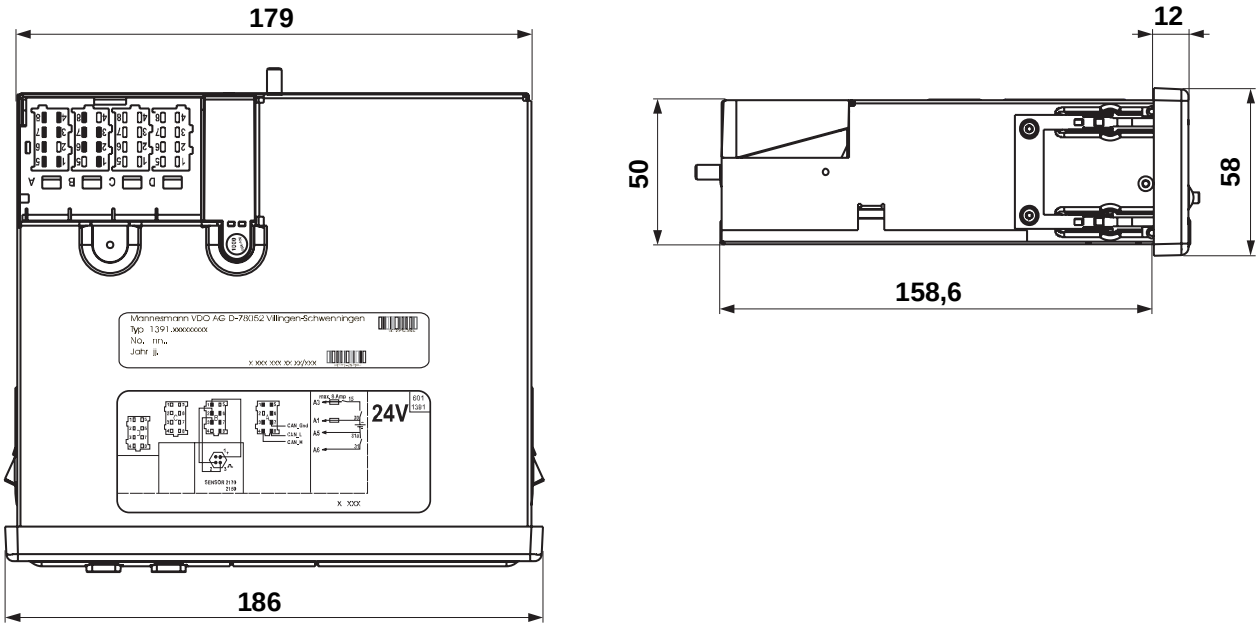


Fig. 3-8: TSU1391: Housing dimensions

! Important

Dimensions acc. to DIN/ ISO 7736 radio compartment.

3.5.2 Installation instructions

The TSU 1391 installation site depends on the vehicle. Observe the instructions contained in the service manual of the vehicle when installing the device.

Before fitting the unit

! Important

Before installing the components into the driver's cabin, run all necessary connection cables. When installing the TSU 1391 into the radio compartment, the connection cables must be shortened so that they can be connected and removed safely.

Installing the mounting frame into the radio compartment

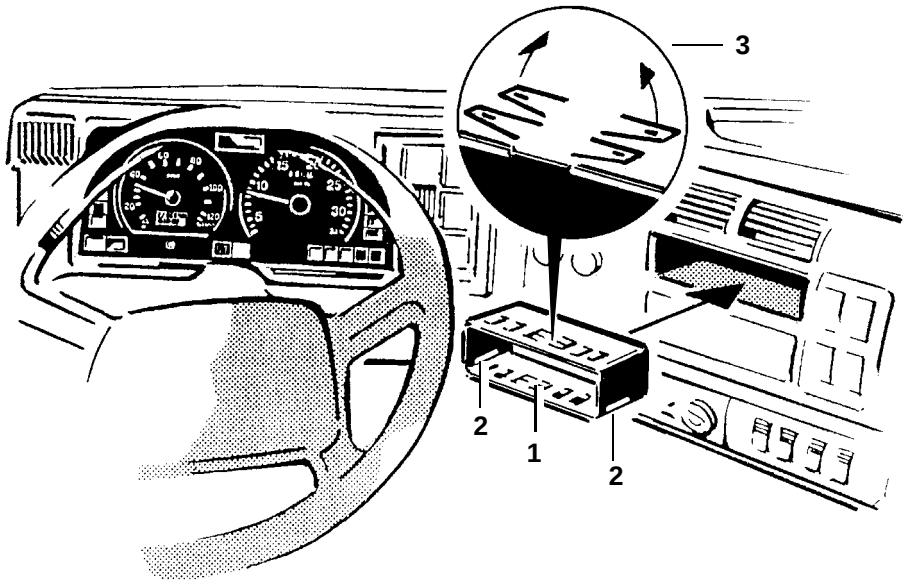


Fig. 3-9: TSU1391: Mounting frame for radio compartment

1 Mounting frame
2 Catch springs
3 Tabs

1 Slide in the mounting frame (1).
Make sure that the catch springs **(2)** are at the bottom.

2 Bend the tabs (3) up using a screw driver to secure the frame in the dashboard.
The mounting frame must sit firmly in the radio compartment.

Connecting and sealing the TSU 1391

1 **Plug connectors A and B into the TSU 1391's sockets on the back.**
For connector assignments and connections refer to the "*Tachograph system wiring diagrams" Fig. 3-7* from page *3-9*.

2 **Put the seal hood on and seal it.**

Installing the TSU 1391

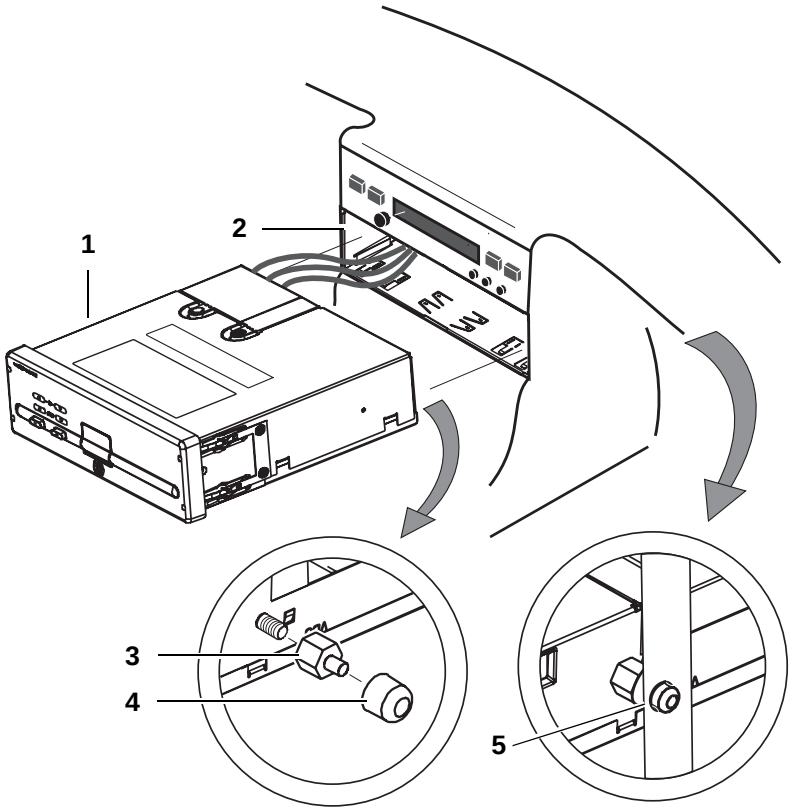


Fig. 3-10: TSU 1391: Installing into the radio compartment

1 TSU 1391
2 Radio compartment
3 Threaded bolts
4 Fixing cap
5 Holding bracket in radio compartment

1 **Screw the threaded bolts (3) onto the back of the TSU 1391 (1) and press the fixing cap (4) on.**

2 **Slide the TSU 1391 (1) into the radio compartment (2) until the unit locks into place and the front cover is flush with the dashboard.**
Generally, there is a holding bracket **(5)** with a drilled hole on the radio compartment's back panel. When sliding the TSU 1391 into the radio compartment, the fixing cap **(4)** fits into this hole and holds the unit in place.

3.5.3 Removal instructions

The steps for removing the TSU 1391 depend on the vehicle. Observe the instructions contained in the vehicle's service manual when removing the unit.

Before removal

! Important

Before removing the TSU 1391 you will have to determine the following:

- Current odometer reading of the vehicle
- The following additional details in case of warranty claims:
  - Installation date
  - Kilometre reading (mileage) of the TSU 1391.

■ **Determine the vehicle's current total odometer reading and write it down:**

- **Refer to the display reading on the indicator unit.**
- **When the display is defective ask the vehicle owner.**

■ **In case of a warranty claim, use an MTC to determine the date of installation via the "INSTALLATION DATA" program.**

The "INSTALLATION DATA" program description can be found in *Chapter 3.6.3 "Programming the TSU 1391"* from page *3-21*.

Removal

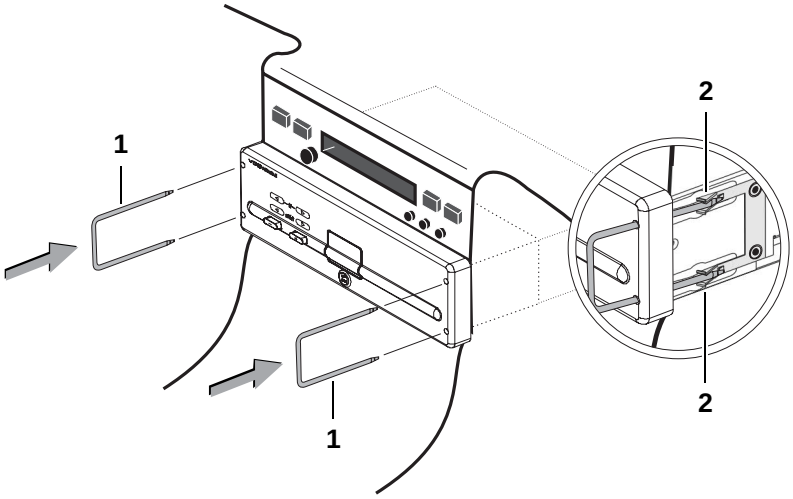


Fig. 3-11: Removing the TSU 1391, step 1

1 Special removal tools **2** Catch springs

1 Push the special removal tools along both sides of the TSU 1391 (1) until the catch springs (2) on the TSU 1391 disengage.

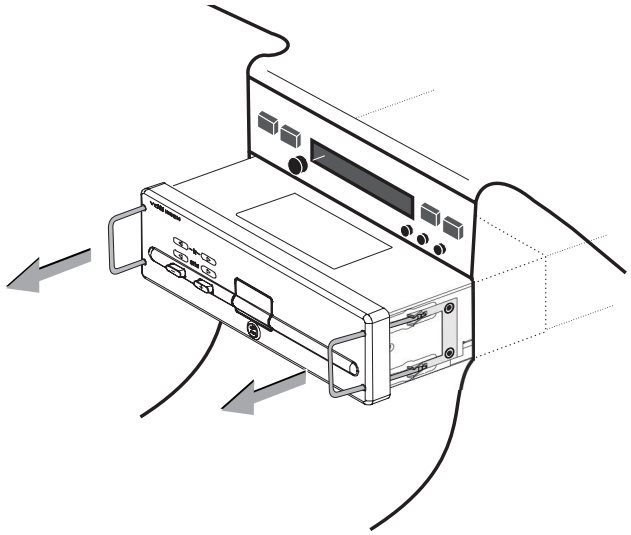


Fig. 3-12: Removing the TSU 1391, step 2

2 Then pull the TSU 1391 out of the radio compartment with the special removal tools.

3.6 Commissioning the speedometer system

During the initial operation all modular components of the TSU 1391 speedometer system are adjusted. This ensures that the speedometer system forms a unit that is ready for operation.

The commissioning completes the initialisation of the individual components which have already been pre-set at the factory. It is carried out when programming the system using an MTC/ ATC.

The following service diagnosis systems are used to set the parameters for and program the TSU 1391 in the vehicle:

- MTC 1602.04, including the following accessories:
  - Interface with software version 6.00
  - BTC software version 07.xx
  - Programming cable (1602-78-170-00)
  - Diagnosis cable (1602-78-171-00)
- Automatic measuring track, including MTC accessories such as light barrier, Start/ Stop reflectors and light barrier cable or
- Rolling Road Test Computer (ATC) with programming cable.

Additional information

Additional information on the MTC can be found in *Section 6, Chapter 1.3 "Mobile Test Computer (MTC)"* from page *1-8* as well as in the separate *"MTC 1602.04" operating instructions and supplements.*

Commissioning workflow

! Important

When the speedometer system is fitted to the vehicle and all electrical connections are made, the vehicle must be put in a roadworthy condition again so that it can be moved safely.

1 **Prepare programming.**

2 **Determine the wheel circumference and the vehicle's characteristic coefficient "w" (imp/km).**

3 **Set the parameters for the TSU 1391:**
- **Enter/ set the determined vehicle and installation data.**
- **Set the date and the clock.**

MTC 1602.04 menu structure

MTC MEASUREMENT

- AUTOM. MEAS. TRACK
- MANUAL MEAS. TRACK
- CHECK K MEASURING
- W-ADAPTED
- DEVICE TESTING
- **PROGRAMMING**
  - **MTCO installation data**
    - v constant
    - Wheel circumference
    - Distance counter
    - VIN (vehicle identification number)
    - Configuration
    - CAN configuration
    - Product code
    - Drive shaft PPR
    - Initial installation
    - Calibration date
    - Seal number
    - Maximum speed
    - RPM recording
    - Rear axles
  - **Date - Time**
    - TCO programming
      - Prog-Time zone
      - Prog-System time
    - BTC programming
      - Time zone
      - Change-over times 01/ 05
  - **Activate KITAS**
  - **Manufacturing data**
  - **Distance covered**
  - **Erase error memory**

3.6.1 Before programming

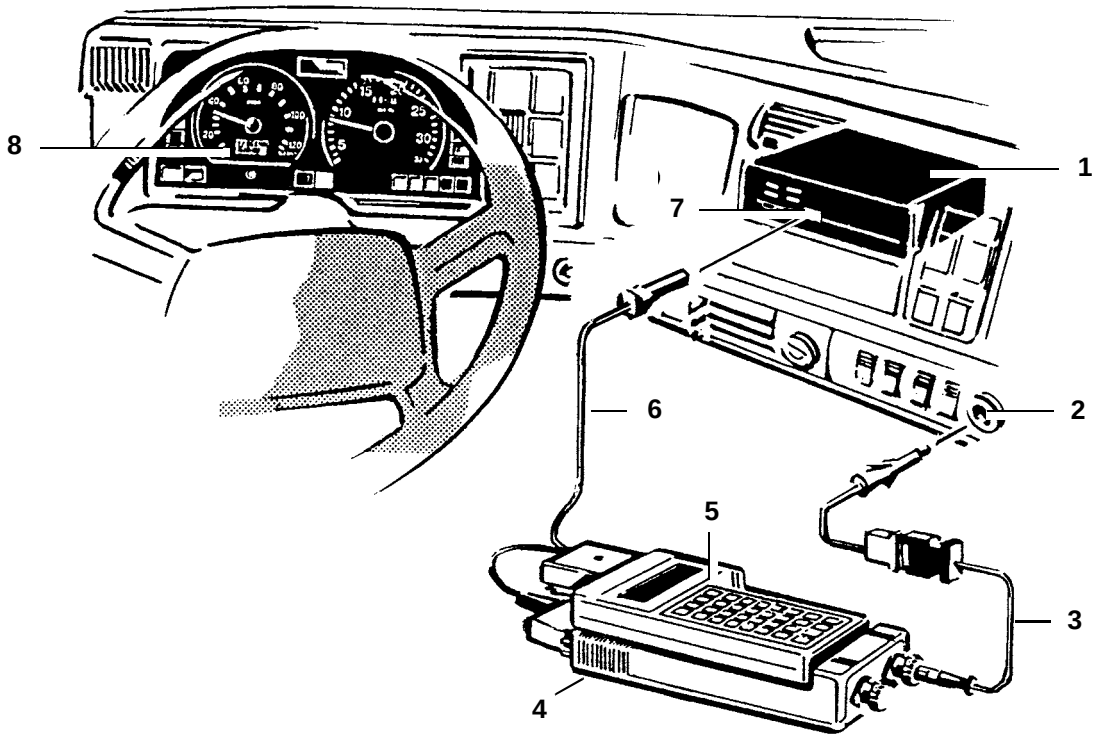


Fig. 3-13: TSU 1391: MTC connection overview

1	TSU 1391	**5**	BTC
2	Cigarette lighter	**6**	Test cable
3	Power cable	**7**	Test and programming interface
4	MTC interface	**8**	Indicator unit/ Cluster

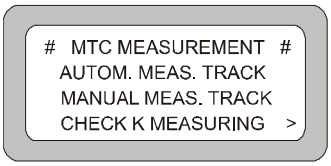
1 Turn the ignition on.

2 Access the programming interface (7) on the TSU 1391.

3 Connect the MTC to the TSU's programming interface (7) using the test cable (6).

4 Connect the MTC to the vehicle's electrical system using the power cable (3).
When the MTC is connected to the vehicle's electrical system, the programme starts automatically and the main menu is displayed.

5 Start programming.



Use the DOWN arrow key to move the cursor to the next page of the main menu.

3.6.2 Determining the vehicle's wheel circumference and characteristic coefficient "w" (imp/km)

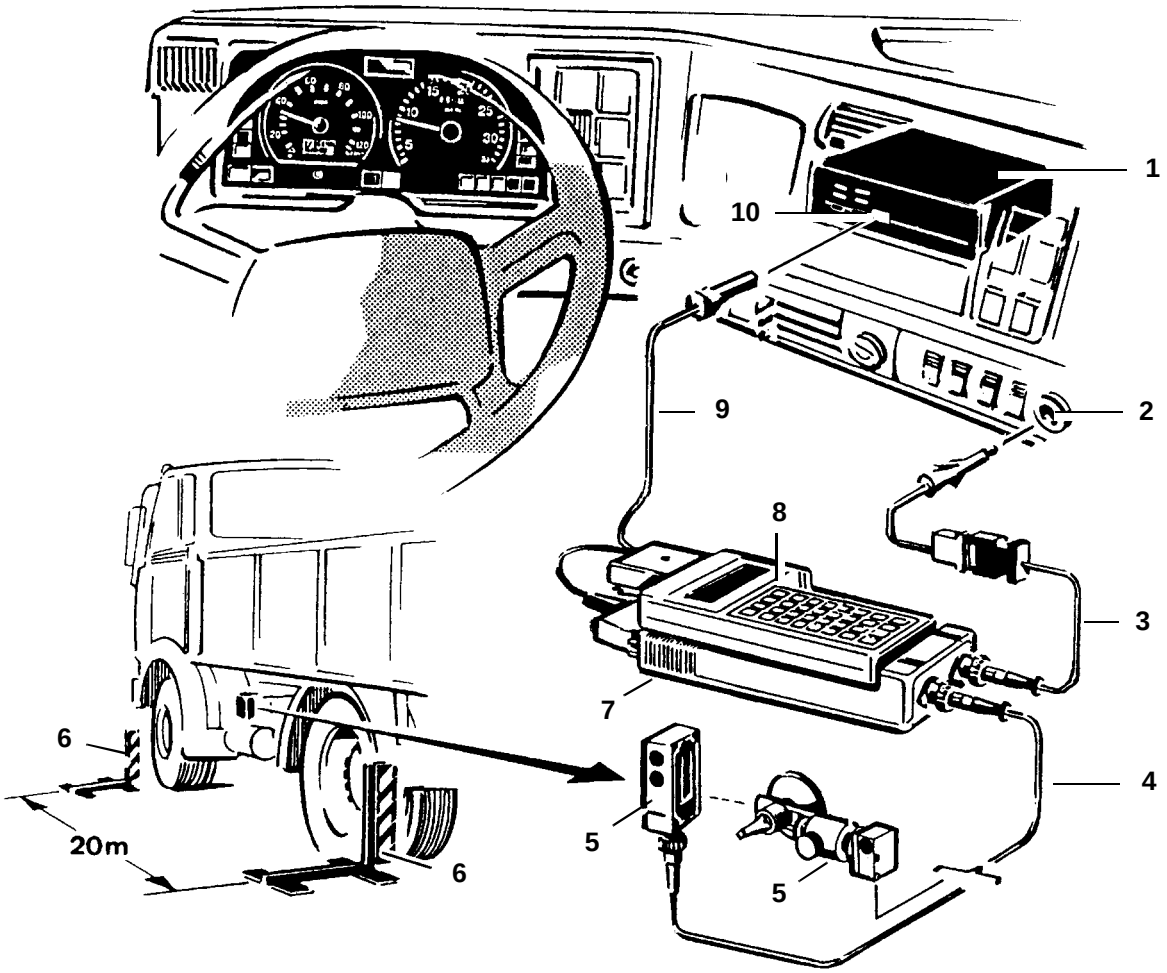


Fig. 3-14: TSU 1391: MTC connection overview with automatic measuring track

1	TSU 1391	**6**	Start/ Stop reflectors
2	Cigarette lighter	**7**	MTC interface
3	Power cable	**8**	BTC
4	Light barrier cable	**9**	Test cable
5	Light barrier	**10**	Test and programming interface

1 Attach the light barrier (5) to the vehicle and connect it to the MTC using the light barrier cable (4).

2 Check that the measuring track is set up correctly.

Additional information

A detailed description of the measurement workflow and instructions on how to determine the wheel circumference and the vehicle's characteristic coefficient "w" can be found in the corresponding SDS MTC/ATC testing unit instructions.

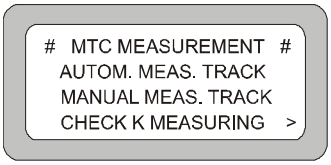
3.6.3 Programming the TSU 1391

Condition

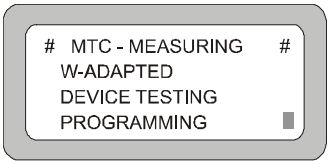
Make sure that:

- the MTC and the TSU 1391 are connected by the test cable
- the ignition is turned on.

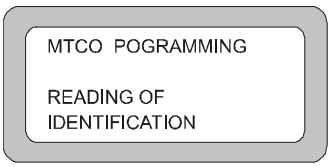
■ **Start programming.**



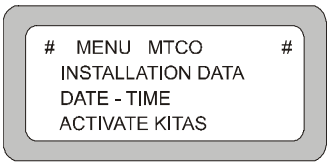
Use the DOWN arrow key to move the cursor to the next page of the main menu.



Select the ”PROGRAMMING” menu and press **[Enter]** to confirm.



When ”PROGRAMMING” is selected this mask is displayed for approx. 2 seconds.



The ”INSTALLATION DATA” menu is already selected. If not, select it and press **[Enter]** to confirm.

TSU 1391 installation data

■ **Program the installation data:**

Summary

1	**v constant**	**7**	**Product code**
2	**n constant**	**8**	**Drive shaft PPR**
3	**Wheel circumference**	**9**	**Initial installation**
4	**VIN** (vehicle identification number)	**10**	**Calibration date**
5	**Configuration**	**11**	**Seal number**
6	**CAN configuration**		

Important

When programming the TSU 1391 proceed as for the MTCO 1324 (see *Section 1 ”MTCO 13245” Chapter 3.8.4 ”Programming the MTCO 1324”*, from *Page 3-31*). Programming functions that do not apply to the TSU 1391 will not be listed.

Chapter 4
Sealing

Important

There is no legislation for sealing speedometer systems with TSU 1391 (Regulation (EC) No. 1056/97).

Chapter 5
Test instructions

! Important

Installing and operating speedometer systems with TSU 1391 are not subject to legal testing obligations.

Section 3: TSU 1391 • Edition 03/2002

Chapter 6
Fault analysis

6.1 Error message procedure

Regardless of the cause of an event, the TSU 1391 does not differentiate between operating errors, malfunctions and system and unit errors. There is the same internal mechanism for each event.

When the TSU 1391 detects an event that occurs both in the unit and in communicating with the system components, it makes an entry in the error log. The TSU 1391 continually scans this log. If there is an entry there it is further processed using a control table.

It is processed using: Output to CAN bus (tachograph status)

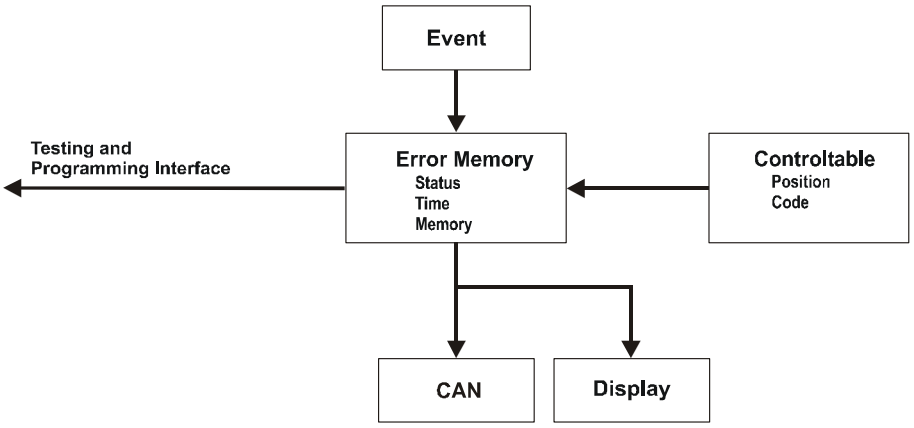


Fig. 6-1: Error message on the system, diagram

! Important

It is also possible to read out or delete the error memory using the test and programming interface.

6.2 Error code list

Code	Meaning
A00C	Electronics error, e.g. FRAM defective/ clock defective Internal error Program memory error
A400	Voltage cut
A411	Communication error between TSU 1391 and the indicator unit (Cluster)
900A	Other errors during CAN transmission (CAN Rest)
900B	CAN bus transmission error (CAN bus off)
9430	”v” pulse output error (B7)

Table 6-1: Error list: System/ speedometer errors

Chapter 7
Maintenance

7.1 Replacing TSU 1391 buffer battery

Depending on load, temperature, humidity etc., the life of the battery which supplies the clock module (system time) and buffers the date, time and switchover settings for beginning/ end of daylight saving time can be reduced. According to the manufacturer the battery has a service life of approx. 10 years if voltage is supplied constantly.

! Important

If no voltage is supplied to the unit and if the clock stops on the indicator unit in combination with TSU 1391 the battery **must** be replaced and the current date and time be programmed again using an MTC/ ATC.

Detailed information and instructions on how to program ”Date-Time” can be found in *Section 1 Chapter 3.8.4 ”Programming the MTCO 1324”*, *section ”Adjusting date and time”*, from page *3-39*.

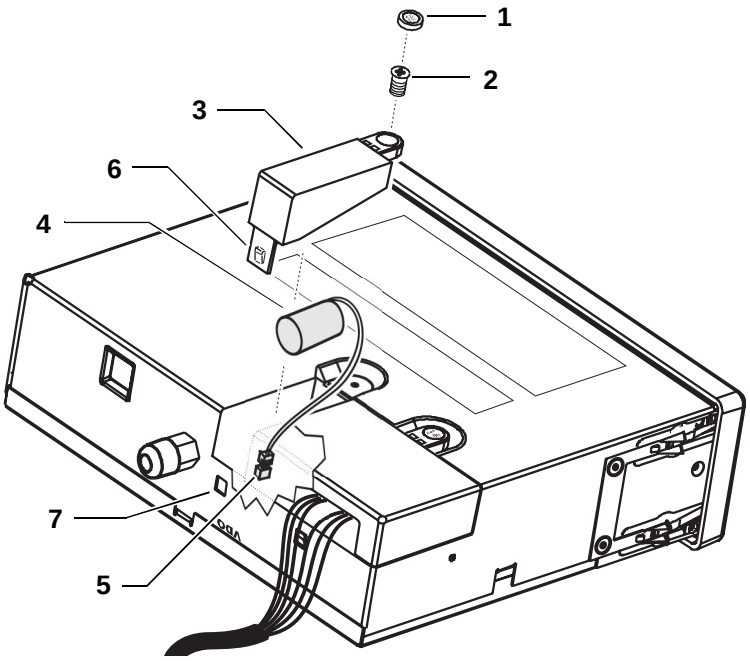


Fig. 7-1: TSU 1391: Removing the buffer battery

1	Seal cap (battery compartment)	**5**	Socket
2	Screw (battery compartment)	**6**	Cover catch lug
3	Battery compartment cover	**7**	Locking opening in unit housing
4	Buffer battery (lithium battery)		

1 Remove the TSU 1391 from the radio compartment.

2 Remove the seal cap (1) and unscrew the screw (2) underneath it.

3 Pull out the battery compartment cover (3).

4 **Take the lithium battery (4) out of the battery compartment and pull the plug carefully out of the socket (5) on the circuit board.**

5 **Carefully put the plug of the new battery into the socket (5) on the circuit board and insert the battery into the battery compartment.**

6 **Then push the cover (6) into the housing until it locks into place.**
When closing the battery compartment ensure that the cover lug **(6)** locks into the locking opening (slit) **(7)** in the housing and that the battery lead is not caught up.

7 **Then fasten the battery compartment again with the screw (2).**

8 **Stamp the new seal cap (1) and press it into the seal cup.**

9 **Then slide the TSU 1391 into the fitting/ radio compartment and adjust the time and date.**

10 **Finally, check that the TSU 1391 is working properly.**

