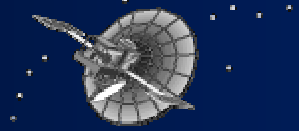


A small, detailed illustration of a satellite dish antenna, showing its parabolic shape and supporting structure, set against a background of small white stars.

Advanced technology for mobile business

An introduction to System 20 weighing systems

Automatic weighing of goods in trucks
with TS 22 weighing modules



Contents

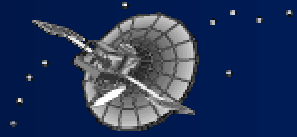
- What is System 20
- How to weigh a truck and its goods
- Presentation of the TS 22 weighing system
- Additional modules for the TS 22 weighing system
- Closing argument and questions

What is System 20

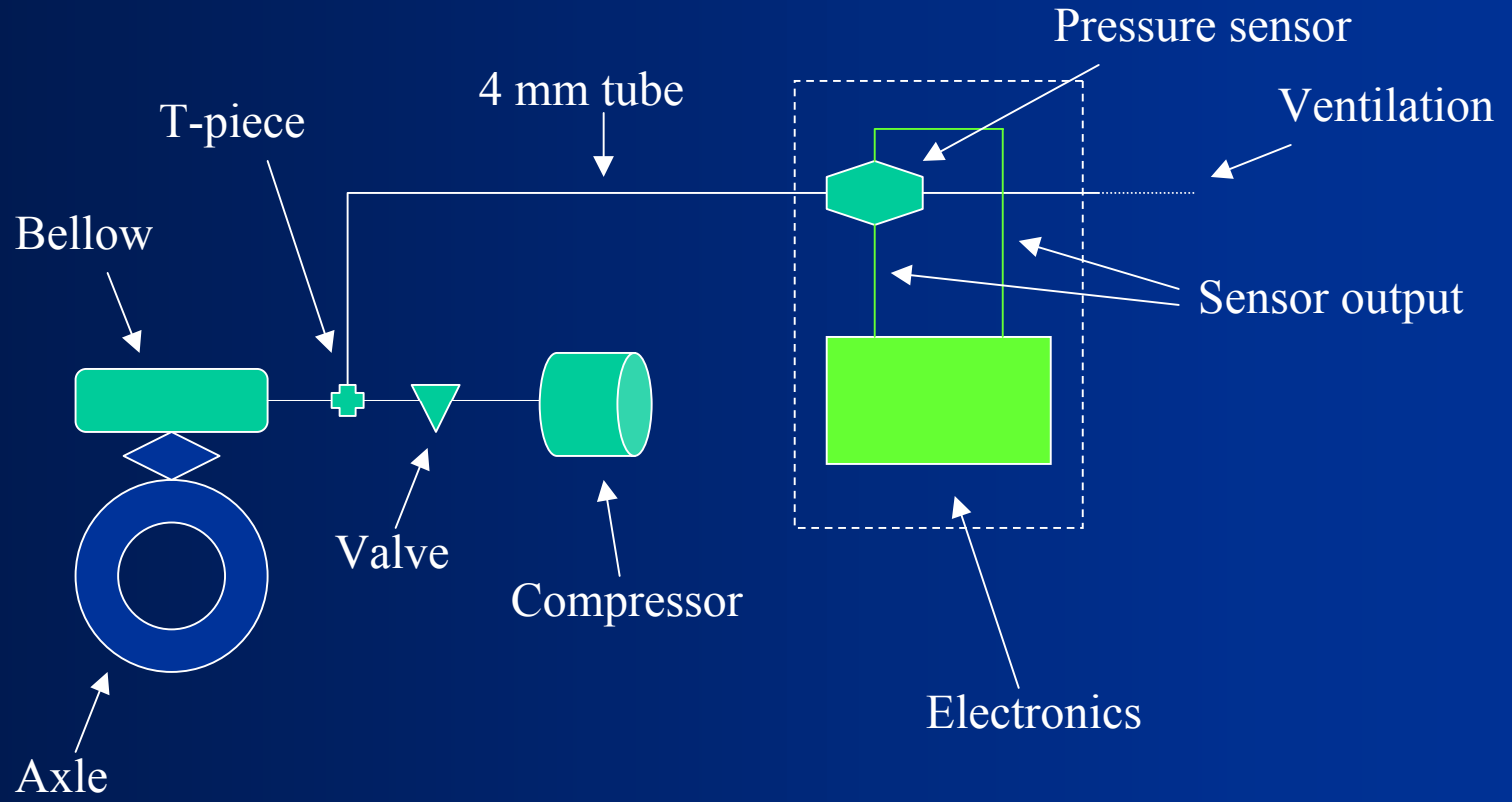
- Plug and drive modular system
- IDX network
- Interactive Data eXchange
= flexible handling of data
- Weighing modules, temperature loggers, GPS-modules, GSM/GPRS-modules, terminals, data cartridges, office systems etc.
- Module software can be updated

Weighing of trucks and goods

- Measure the air pressure in the suspension bellows.
- Compute the wheel loads from the air pressures.
- Compute the gross weight as the sum of the loads.
- Compute the payload by subtracting the trucks empty-weight.
- Before weighing of loaded/unloaded goods, reset (tare) the scales.

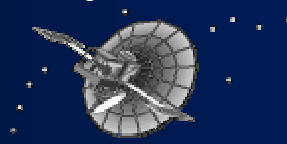


Measuring air pressures



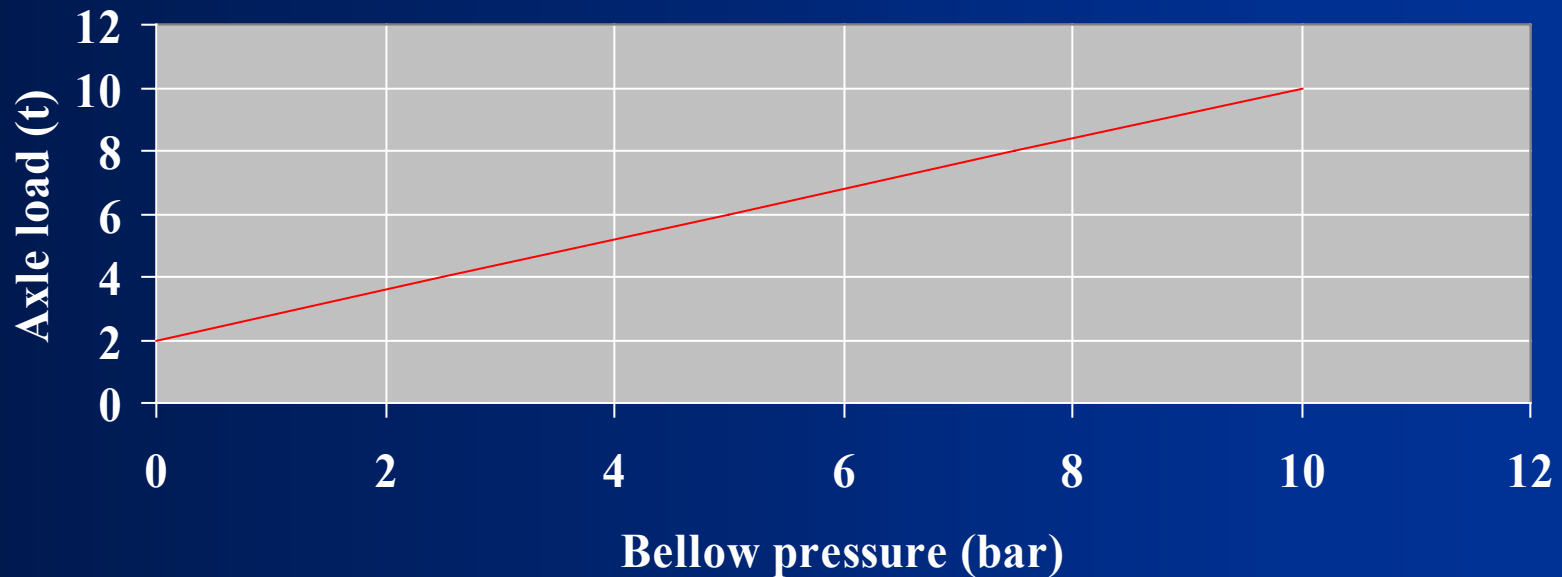
Pressure error sources

- Loss of pressure in tubes or valves
- Electrical noise on sensor wires
- Insufficient ventilation
- Temperature variations
- Malfunction or aging of sensors and electronics



Load computation

**Typical correlation between
bellow pressure and axle load**



Load error sources

- Friction in the suspension system
- Other mechanical forces between chassis and axle
- Different or changing bellow properties, aging
- Pressure dependent bellow properties
- Different bellow inflation
 - insufficient level control / uneven terrain
- Sloping terrain

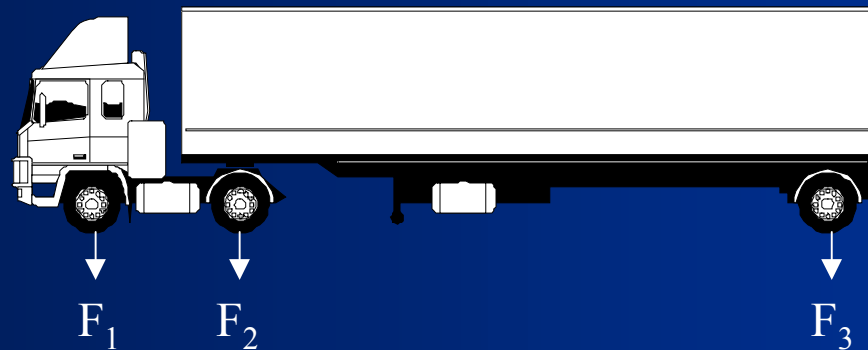
Calibration



Calibration of pressure sensors

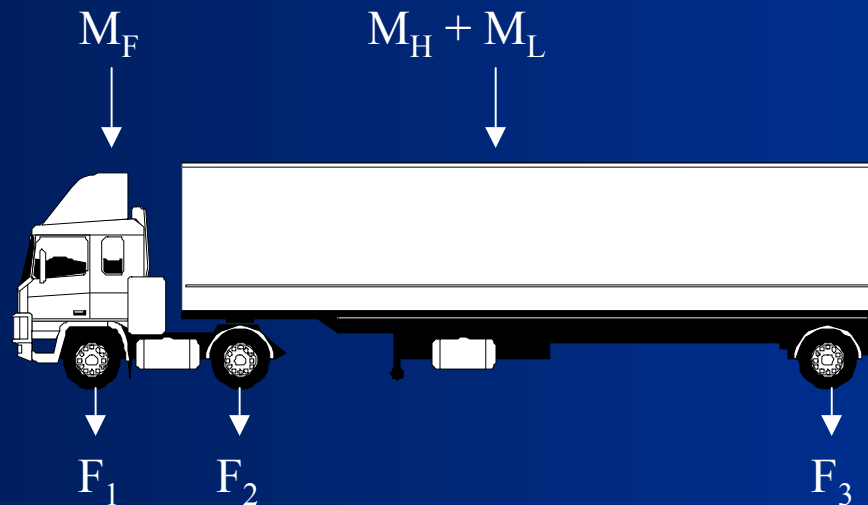
- In vehicles with linear correlation between bellow pressure and wheel load, calibration consists of defining two points on the pressure-load curve.
- Accuracy improves with growing distance between the points.
- The points are defined by entering the correct (externally measured) wheel loads at two different bellow pressure states, e.g. with empty vehicle and with fully loaded vehicle.

Gross weight computation



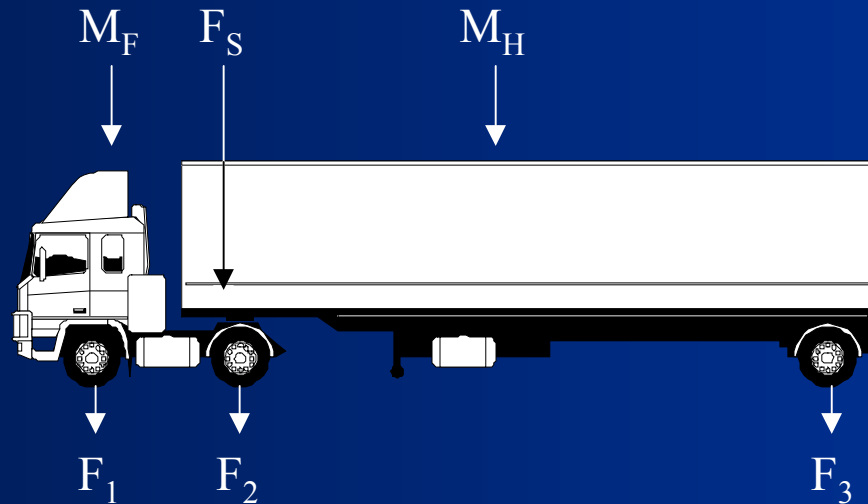
Gross weight: $M = F_1 + F_2 + F_3$

Payload computation



Payload:
$$M_L = F_1 + F_2 + F_3 - M_F - M_H$$

Empty-weight computation



Tractor:

$$M_F = F_1 + F_2 - F_S$$

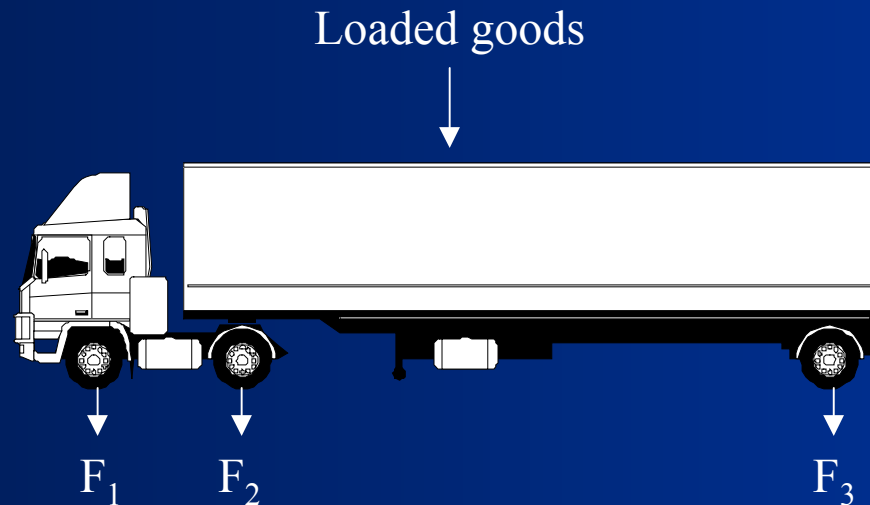
Semi-trailer:

$$M_H = F_S + F_3$$

Payload error sources

- Weight of driver
 - Diesel consumption
 - Changing superstructure or carried tools
 - Water/snow/ice
 - Changing semi-trailers
-
- So: Payload computation is potentially inaccurate and cannot rely on sensor calibration data.

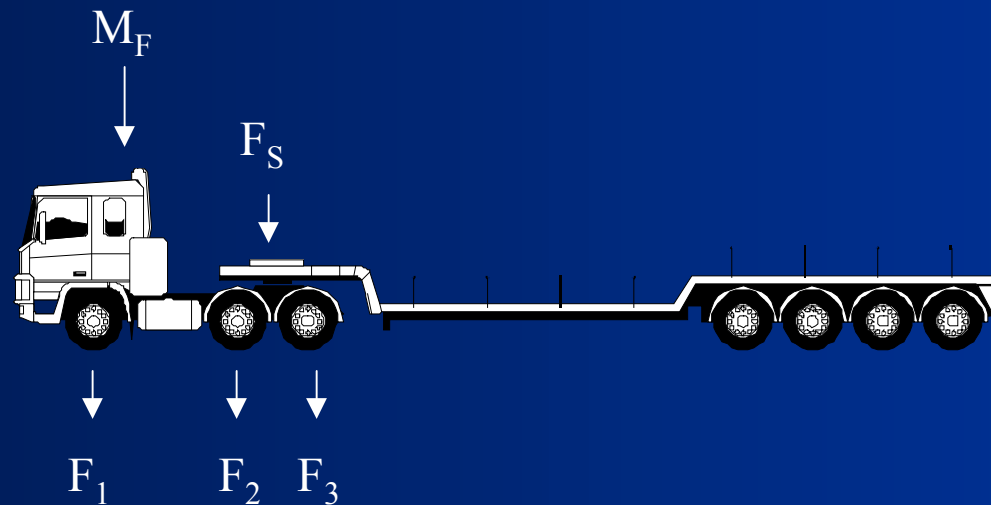
Net load computation



Before loading: $Tara = F_1 + F_2 + F_3$

After loading: $Net = F_1 + F_2 + F_3 - Tara$

Tractor with mechanical steering axle suspension



If M_F is constant, then F_1 , F_2 and F_3 depend only on F_S and the geometry, wherefore F_1 can be computed from F_2 or F_3 .

A small image of a satellite dish with a parabolic reflector and a central feed horn, set against a dark background with a few small white stars.

Mechanical suspension error sources

- Weight of driver
- Diesel consumption
- Changing superstructure or carried tools
- Changing kingpin position
- Lifted axles
- Uneven terrain
- Sloping terrain



Calibration of tractor with mechanical steering axle suspension

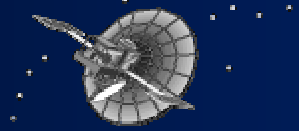
- Calibration is executed without semi-trailer and with fully loaded semi-trailer, as if the steering axle was connected to a pressure sensor.
- On tractors with liftable rear axle, calibration is executed with lowered axle.
TS 22 automatically detects lifting of the axle.
- If the kingpin position is to be moved, calibration must be executed in every wanted position (with lowered rear axle).

The TS 22 weighing system

- TS 22 weighing system functions
- TS 22 weighing system configuration
- How to use the TS 22 weighing system
- How to calibrate the TS 22 weighing system
- How to install the TS 22 weighing system

TS 22 weighing module

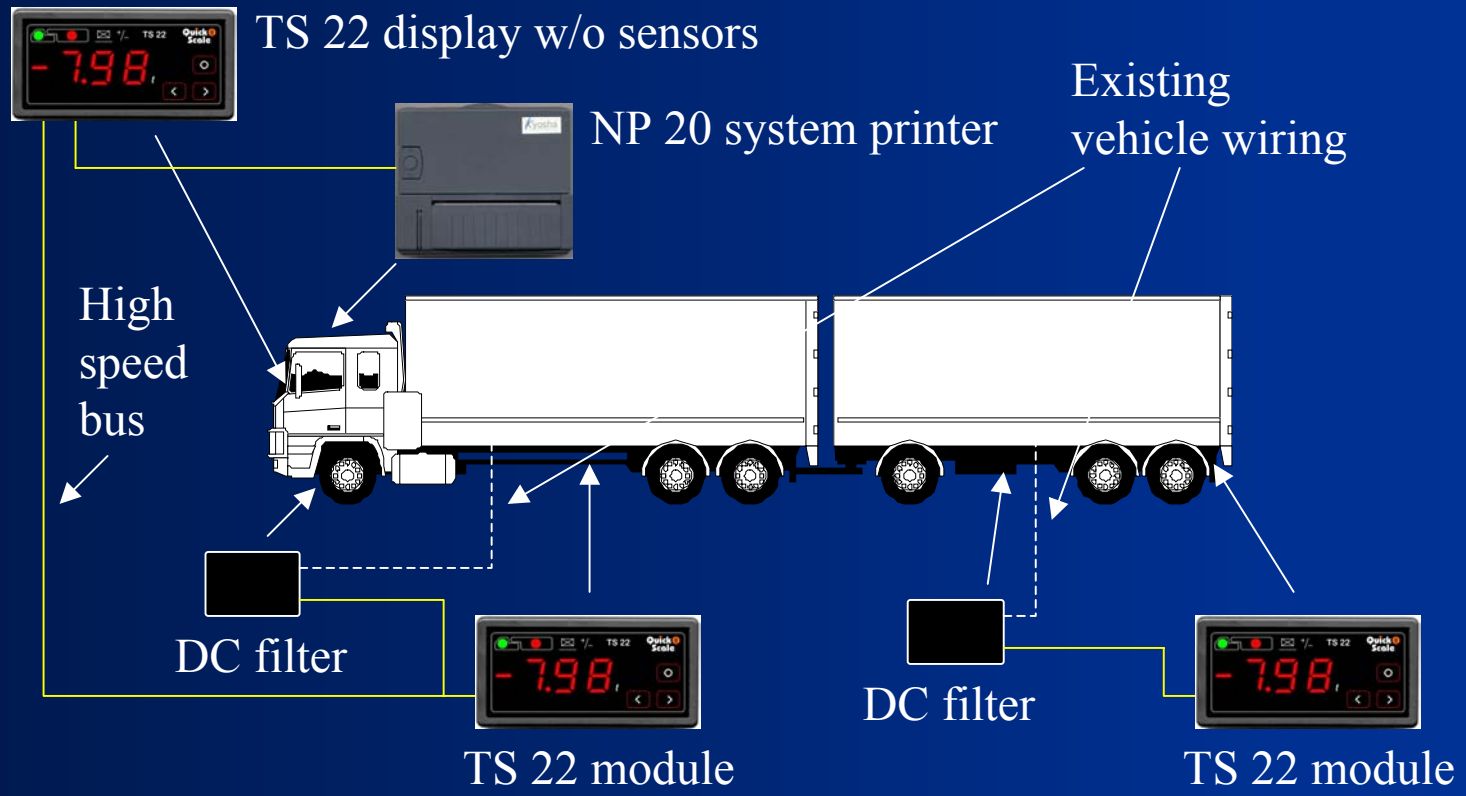




TS 22 functions

- Measuring of bellow pressures on any number of axles and computation of corresponding axle loads
- Estimation of load on mechanical steering axle
- Computation and display of gross weight, payload and net load for truck, trailer and total vehicle
- Alarm near/at overload and display of remaining capacity
- Automatic handling of changing trailers

TS 22 weighing system



TS 22 module types

- Ordering information: TS 22-XYZ
- X = number of sensors: 0, 2, 4, 6 or 8
- Y = D: module with display and keys
Y = B: black-box module w/o display
(no 0-sensor version)
- Z = E: exterior module with pigtail connector
Z = C: cabin module with built-in connector

TS 22 general properties

- 1+3 digit LED display and 3 keys.
- All functions can be executed and all data viewed on all modules (except black-box versions).
- Additional modules can be added without changing already installed modules.
- Communication partly takes place through the vehicle's existing wiring.
- The modules can be combined arbitrarily.

TS 22 display functions

- Switch between truck, total vehicle and trailer with [$<$] and [$>$] keys.
- Switch between gross weight, remaining capacity, payload and net load with [O].
- Reset (tare function) by pressing and holding [O].
- Switch off display by pressing and holding [$<$].
- Invoke menu by pressing and holding [$>$].
- Selection is indicated by green LEDs.

TS 22 alarm functions

- Maximum allowed load and warning threshold can be set individually for the truck, the trailer, the total vehicle and the kingpin.
- Overload is indicated by flashing red LED.
- Warning is indicated by flashing yellow LED.
- Beeper can be activated on overload and warning.
- Remaining capacity is computed in relation to the maximum allowed load.

TS 22 menu navigation

- Roll menu with [O].
- Invoke submenu or editor with [>].
- Select digit in editor with [>].
- Roll value or digit with [O].
- Reset value by pressing and holding [O].
- Execute function/save by pressing and holding [>].
- Leave submenu or editor with [<].
- Leave main menu by pressing and holding [<].

TS 22 menu functions

- Receipt printing
- Change of empty-weight
- Change of kingpin position
- Setup of display, beeper etc.
- Editing of maximum and warning loads
- Calibration
- Configuration of sensors

Receipt printing

- Receipt layout is stored in the printer.
- Receipt layout can be edited with dedicated PC software and adapter for the printer.
- When printing, user can select from available receipt layouts.
- Printing can be initiated from all weighing modules with display.
- Axle and bogie loads can be printed from TS 22.

Change of empty-weight

- Empty-weight is entered directly in kg or set automatically to current gross weight.
- In the latter case, empty-weight for a semi-trailer is also computed automatically.
- Automatic tractor empty-weight computation is executed without a connected semi-trailer.
- Automatic semi-trailer empty-weight computation is executed with connected tractor.

Change of kingpin position

- This function is only used in tractors with mechanically suspended steering axle.
- Before weighing with the kingpin in other positions than the drive position, the position must be entered by the driver.
- Only calibrated positions are available.
- Weighing can be executed in up to 9 positions in front of (+) and 9 positions behind (–) the drive position.

Setup of display etc.

- Display brightness
- Number of decimals (1 or 2)
- Key press sound (off, short, long)
- Warning sound
- Overload sound
- Sound cancelling with key press
- Standard receipt layout
- Tractor gross weight or traction bogie load

Editing of maximum loads

- Load thresholds are stored in each car (truck or trailer).
- Weighing modules in truck and trailer exchange load thresholds at connection.
- Up to 8 different alarm sets can be stored for e.g. specific roads or countries.



Calibration

- The sensors are pressure calibrated in the factory, so TS 22 can be used as a simple manometer.
- Load calibration is recommended at least every 1/2 year as well as after changes on the vehicle's suspension system.
- Truck and trailer can be calibrated independent of each other and in arbitrary order.
- Calibration without load (E) and with full load (F) can be executed in arbitrary order.

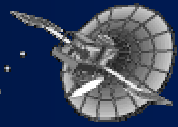
Sensor calibration

- Each wheel must be calibrated individually.
- The wheels can be calibrated in arbitrary order.
- 1) Select without load (E) or full load (F).
- 2) Select the desired wheel.
- 3) Enter the externally measured wheel load in kg.

A small, detailed illustration of a satellite dish antenna, showing its parabolic shape and supporting structure, set against a dark background with small white dots representing stars.

Calibration of tractor and semi-trailer

- Calibration can be executed in arbitrary order, but the following order ensures the minimum number of loads/unloads:
 - 1) The tractor is calibrated alone (E).
 - 2) A fully loaded semi-trailer is connected to the tractor, and both the tractor and the semi-trailer are calibrated (F).
 - 3) The semi-trailer is emptied and calibrated (E).



Calibration of tractor with mechanically suspended steering axle

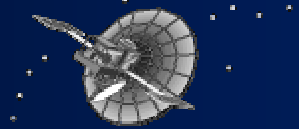
- TS 22 creates a "virtual" sensor, which is calibrated in the same way as real sensors.
- On tractors with liftable rear axle calibration is executed with lowered axle. TS 22 automatically detects the axle position.
- Alternative kingpin positions are calibrated with full load without the use of external weigh bridge.

Kingpin calibration

- 1) The loaded vehicle is placed on a levelled surface with the kingpin in drive position.
- 2) The kingpin calibration is activated.
- 3) The kingpin is moved to the wanted position.
- 4) The corresponding position is selected in TS 22 and the kingpin calibration is activated.
- 5) Steps 3 and 4 are repeated for wanted positions.

Sensor configuration

- Configuration is executed once at installation.
- First car type is selected: Truck, tractor, semi-trailer, trailer, fixed tractor-trailer combination (air tube from tractor to semi-trailer) or dolly.
- Then, the number of axles in each bogie is entered.
- Finally, the connected axles and vehicle sides (left/right hand) are entered for each sensor.



Locking of data

- TS 22 is equipped with a lock function which prevents unauthorised change of configuration and calibration data.
- The lock function can be setup to prevent change of maximum and warning loads as well.
- The lock is opened by entering a user-selectable 3-digit code.
- The lock engages automatically 10 minutes after leaving the main menu.

Diagnostic functions

- Display of wheel loads
- Display of sensor pressures
- Display of sensor temperature
- Display of serial numbers
- Display of data communication errors
- Display of configuration and calibration errors

Installation of TS 22 modules

- The TS 22 module is mounted on a flange or a swivel fixture.
- Power supply (10 A fuse) and high-speed bus are connected via the TS 22 connectors.
- An adapter cable is required for cabin versions.
- TS 22 can be supplied from the high-speed bus.
- The modules are connected with prefabricated cables with built-in branching.
- Bus terminators are installed in the cable system.

Sensor connection

- Each air circuit is connected to a separate sensor.
- The pressure tube leading to the bellow is opened (cut) and a T-piece inserted.
- A 4 mm tube is inserted into the T-piece and the other end inserted into the TS 22 snap-in fittings.
- The snap-in fittings are protected against dirt.
- Finally, sensor configuration is executed via the TS 22 menu.

Additional modules

- PL 20 DC filter
- VT 210 vehicle terminal
- NP 20 system printer
- TR 20 tracker
- HT 20 wireless handheld terminal
- RF module for wireless remote control by HT 20 and possibility for remote calibration from external weigh bridge

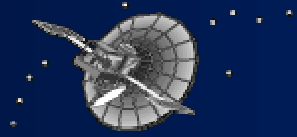


PL 20 DC filter

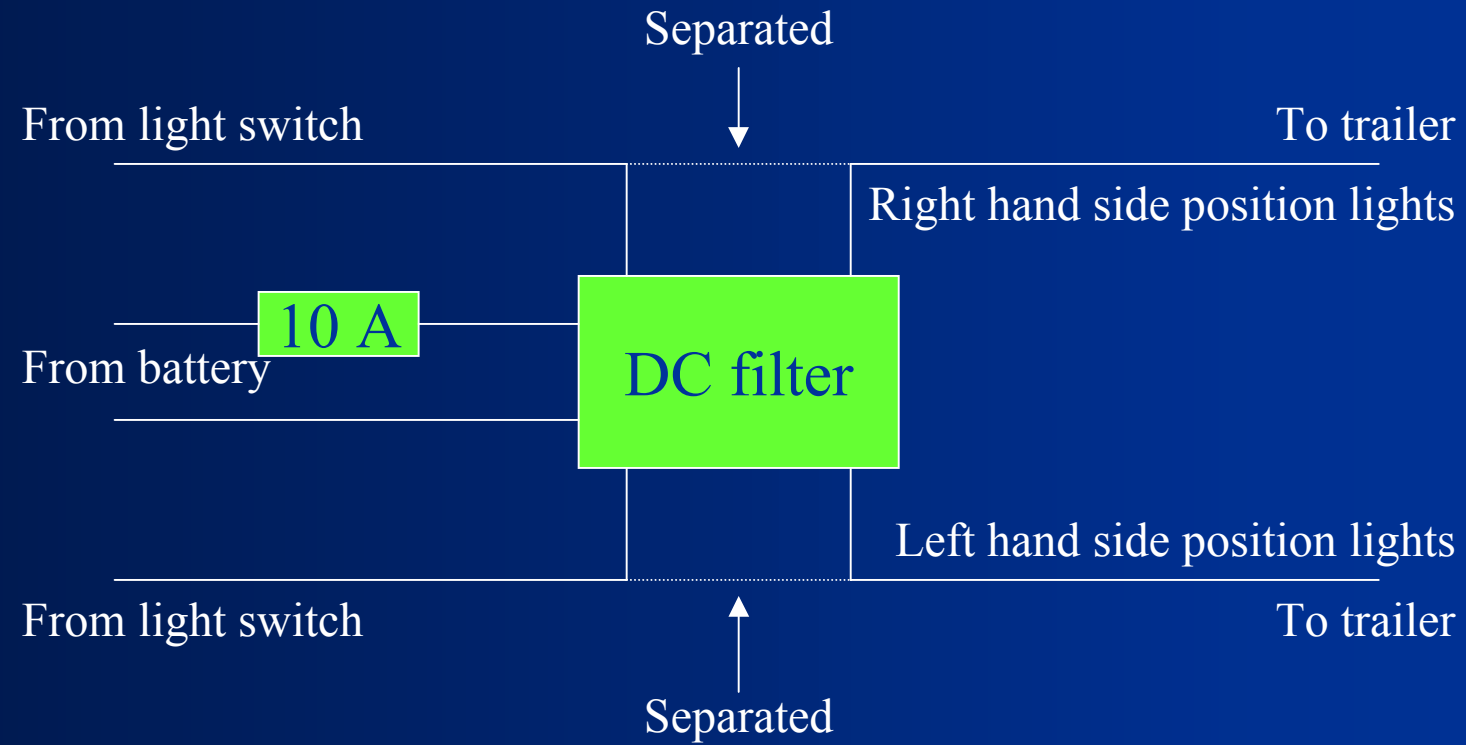
- The DC filter transfers the high-speed signals to/from the vehicle's existing wiring.
- Allows exchange of data between truck and trailer through the existing trailer connector.
- The DC filter is typically installed close to power wiring and is thus ideal for supplying the TS 22 modules via the high-speed bus.
- The power supply must be fused at max. 10 A.

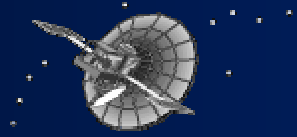
Installation of DC filter

- In the truck, the DC filter is inserted into e.g. the supply wires for the left and right hand side trailer position lights.
- The DC filter is inserted on the trailer side of the light switch.
- In the trailer, the DC filter is connected directly to the corresponding wires.
- The bus connector of the DC filter is connected to the TS 22 modules with prefabricated cables.



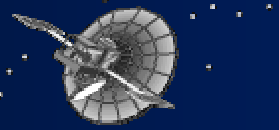
DC filter wiring





VT 210 vehicle terminal





VT 210 vehicle terminal

- Same functions as TS 22
- Can be inserted into existing TS 22 installation
- 6 digit LED display - loads displayed in kg
- 2 line backlit LCD display for display of menu texts and dynamic vehicle symbol
- Display of load and remaining capacity as well as overload and near-overload alarms for individual axles and bogies (fourth key)

VT 210 module types

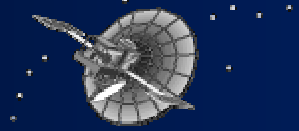
- Ordering information: VT 210-ZM
- Z = C: cabin version with built-in connector
Z = E: exterior version with pigtail connector
- M = flash memory: 0, 1, 2 or 4 MByte
(required in fleet management applications)
- All types have built-in real-time clock with power backup.
- Special versions of VT 210 can be used during installation and maintenance of TS 22 systems.

NP 20 system printer



NP 20 system printer

- Is connected directly to the high-speed bus.
- Versions available with built-in memory for logging of printed receipts.
- Dedicated PC software (optional) and adapter allow editing of receipt layout and retrieval of logged data from the NP 20 - directly or via data cartridge.
- When printing from TS 22 or VT 210, the user can select available receipt layouts.



TR 20 tracker

- Built-in GPS receiver
- If connected to tachograph, starts and stops as well as arrivals and departures at customers etc. are registered automatically.
- Supplies precise time to VT 210 clock
- Supplies position and/or customer data to receipts
- Is required in fleet management applications

TS 22 advantages

- Independent sensors
- Pressure calibrated in factory
- Potted sensors and electronics
- No connectors inside - no loose ends
- Short wires between sensors and electronics
- Ventilation on back side of module
- Built-in heater minimises temperature drift
- Built-in beeper

TS 22 advantages

- Clear display and bright LEDs
- Unambiguous indication of selections and alarms
- Automatic brightness control
- Easy-to-use function to switch display off
- Easy to use with menu guided special functions
- Tare, payload and remaining capacity functions
- Up to 9 different alarm sets
- Manual and automatic setting of empty-weight

TS 22 advantages

- Automatic estimation of load on mechanically suspended steering axle (tractor)
- Automatic computation of payload with changing semi-trailers
- Automatic exchange of data through the vehicle's existing wiring
- Built-in manometer and other diagnostic functions
- Advanced protection against overvoltage and voltage transients

TS 22 advantages

- Calibration loads entered with 1 kg resolution
- Code lock on alarm thresholds and calibration data
- Customisable receipts with system printer
- Software can be updated
- Built-in serial number chip
- Can be combined with other System 20 modules
- IDX compatible - "plug and drive"

TS 22 buzz words

- Flexible
- Precise
- Automatised
- User friendly
- Safe
- Robust