FEIG Sensors
Technologie mit Weitblick

VEK S4 Manual

Traffic Detector - VEK S4

bast certified

FEIG ELECTRONIC

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Note

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The specifications contained in this document may be changed without prior notice.

This edition replaces all earlier editions of the document.

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Since errors can never be completely precluded in spite of all our efforts, we are always grateful for corrections and suggestions.

The installation recommendations contained in this guide assume the most favorable circumstances. *FEIG ELECTRONIC* assumes no liability for perfect function of the traffic detector in a foreign system environment.

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Please read the user's guide and safety advisories carefully and in full before starting up the traffic detector!

Contents

1 Functional Description

The VEK S4 traffic detector is a dual system for the inductive detection of vehicles. Information about the speed, length and class of a vehicle can be provided using the measuring system (two loop principle) and its evaluation. The data determined in this way are compiled in a report and provided to a higher level system (host computer) for further evaluation.

Features:
- 4-channel induction loop detector
- two classification modules (for vehicle classification of, e.g. two lanes)
- automatic speed and length measurement
- vehicle classification in 8+1 classes according to TLS guidelines 2012, classification accuracy A2
- vehicle detection and classification in both directions
- recording of the net time gap (time distance between two vehicles)
- loop dimensions according to TLS guidelines[1]
- signal output can be adjusted using Open Drain in the case of excessive speed
- automatic adjustment of the system after switching on
- continuous readjustment of frequency drifts for largely eliminating environmental influences
- sensitivity independent from the loop inductance
- frequency band adjustment
- long loop supply lines possible (up to 300 m)
- simple installation using ribbon cable connection
- RS485 interface
- CANopen interface
- 4 Open Drain outputs

Other features:
- compact plastic case, mounting on DIN rail
- avoidance of reciprocal influencing of the channels using multiplexing methods
- avoidance of reciprocal influencing of several detectors using synchronisation
- LED display of the loop conditions
- insulation between loop and electronics
- gas surge arrester for improved surge resistance
- CANopen Interface

Setting options:
- five fixed frequency bands independent from the loop inductance
- head gap of the loops per classification module
- sensitivity adjustment of the loop pair per classification module
- adjustment of the vehicle length per classification module
- classification modules can be disconnected by deactivating the detector channels
- output can be set as presence signal, direction signal or general fault indicator, signal for excessive speed, class-selective signal output
- hardware addresses 2 x (0-15) can be set using DIP switch and address offset via RS485 interface

- other setting options (4-channel functions) actuation threshold per channel in 256 stages
- hysteresis drop of 20-80% per channel
- holding time 1-255 minutes and indefinite per channel
- scanning speed
- direction logic

Compatibility
- downwards compatible to the TLS and FEIG protocol of the VEK S3-1

[1] The publisher of the TLS (Technical delivery conditions for route stations) is the Federal Highway Research Institute (BASt), Bergisch Gladbach

1.1 Vehicle detection

It is established using an LC oscillator whether a metallic vehicle is in the loop area. The output of the channel is switched depending on the selected output function.
Loop head gap and loop length are freely selectable and adjustable (see 6 Technical data). The optimum loop position must be determined with appropriate measuring methods for laying the loops over reinforced roadbeds. The laying recommendations must be observed. It is recommended to use the widespread loop geometry according to TLS II.

1.2 Compensation

A calibration is performed each time the detector is powered up or by pressing the button for longer than 1 s. After a power interruption, automatic calibration is performed only if the supply voltage was absent for at least 0.5 s. The calibration time is approx. 1 s if during this time no vehicles have passed through the loop. Longer calibration times are caused by frequency instabilities; their causes must be determined and remedied.

1.3 Classification of vehicles

The VEK S4 detector has two classification modules for the vehicle recording. These can be parameterised independently from each other.

1.3.1 Vehicle data

The typical frequency change for vehicles and its time course on two induction loops with known geometric dimensions are used for deriving the following factors:

- vehicle class
- vehicle speed
- vehicle length
- net time gap between the vehicles
- occupied time of the loops
- travel direction

The vehicles are classified in 8+1 classes according to TLS guidelines 2012:

- car
- car with trailer
- truck
- truck with trailer
- van
- bus
- motorcycle
- articulated vehicle
- non-classifiable vehicles, e.g. lane changers

1.3.2 Traffic Jam Detection

The detector signals a traffic jam if the traffic is flowing too slowly <10km/h. In this state, a dummy vehicle with (Other, l = 4.0 m, v = 5 km/h) is reported. Every individual vehicle is also recognised and reported for traffic queues if the gap between the vehicles enables both loops. The jam signal will be reset when both loops become free.

Note: A correct detection of driving direction is not guaranteed for all traffic jam situations.

1.3.3 Recording in the case of loop fault

Speed and length measurement and classification is not possible in the case of a defective loop. A dummy vehicle (Other, l = 4.0 m, v = 0 km/h) is reported for every vehicle which crosses the intact loop in the case of loop malfunction.

Note: A loop fault is not reported if one or both loops have been intentionally deactivated as the classification module concerned in this case is completely switched off.

1.3.4 Tailgating

If a vehicle is driving to close to the car in front a dummy vehicle (Other, l = 4.5 m, v= last vehicle) is reported with the vehicle speed of the car in front.

Note: A correct detection of driving direction is not guaranteed for all tailgating situations.

1.4 Possible outputs

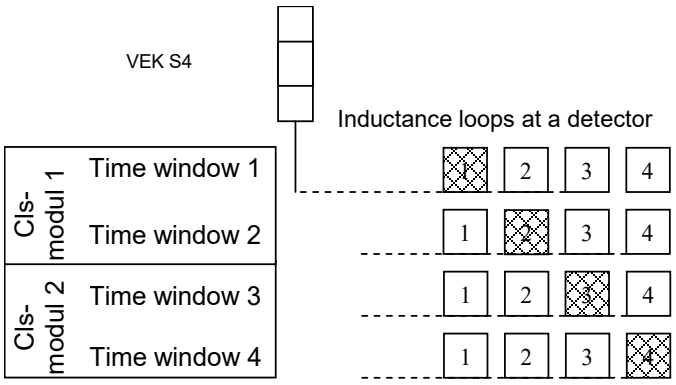
Two Open Drain outputs each are assigned to every classification module. One of the functions listed below can also be assigned to each output:

- no function (output deactivated)
- presence of a vehicle on the loops
- direction pulse signal
- pulse for vehicle crossing with vehicle class selection
- exceeding speed limit with vehicle class selection
- speed limit compliance with vehicle class selection

The function setting is made via the serial port using PC / Laptop with service program or host computer.

1.5 Multiplexing methods

The connected induction loops are switched on and off in rapid sequence, so that current flows only through one loop at a time. This prevents mutual interference between the loops of a detector. All loops connected to a detector can thus operate at the same loop frequency.



1.6 Synchronisation

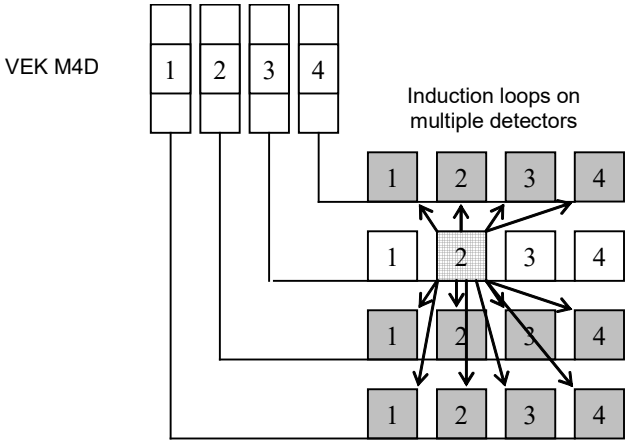
To prevent mutual interference between induction loops of multiple detectors, the latter can be synchronized with each other using a connection in the front-side ribbon cable. All detectors connected via the synchronous line process the multiplexing sequence synchronously. Only loops which are active in the same time window can affect each other. Assigning the loops to the time windows is done by setting the multiplex sequence.

Note:

- Adjacent loops should be assigned to different time windows.
- Loops in the same time window should be located physically as far away from each other as possible.

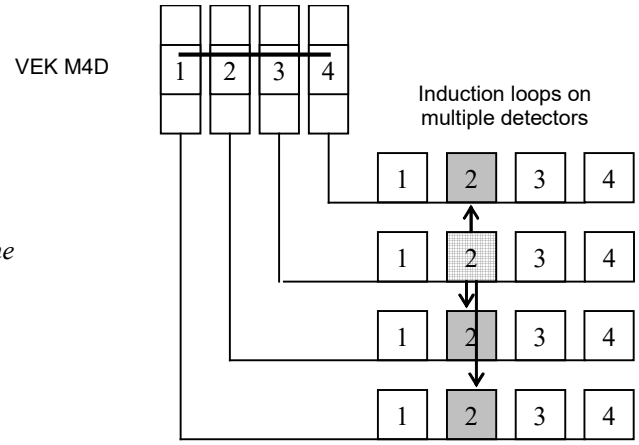
a) Example without synchronization:

Loop 2 of Detector Nr. 3 can in the worst case affect *all the loops* of Detectors 1,2,4 and themselves be affected by these loops.



b) Example with synchronization:

Loop 2 of Detector No. 3 can in the worst case only affect loops *in the same time window* of detectors 1,2,4 or be affected by these loops.



2 Settings

The settings described in the following are performed either on the RS485 interface or the CAN interface. It is recommended that the system be equipped with an operating unit for setting the detectors. The settings can also be made from a laptop. Setup programs are available from FEIG ELECTRONIC. An appropriate interface converter is also required.

2.1 Frequency selection

The working frequency is set in order to *prevent cross-coupling.*
Cross-coupling may occur with adjacent loops or loop lines on other detectors. It is therefore important that two or more detectors do not operate on the same frequency. A frequency separation of at least 10 kHz should be maintained for neighboring loops which are not connected to the same detector.

The detector operates in five frequency bands:

Band	Frequency range
0	automatic frequency setting *(Factory default setting)*
1	30 - 40 kHz
2	45 - 55 kHz
3	60 - 75 kHz
4	80 - 100 kHz
5	105 - 140 kHz

It is recommended that all four loops of *one* detector be set to the same frequency band. Multiplexing prevents cross-coupling between the 4 loops of a detector.

Note:
For loops whose inductance lies outside the recommended range (see Section 6 Technical data), the frequency band setting can be restricted. The detector may calibrate to a different frequency than shown in the above table. This is not a problem as long as there is no cross-coupling with other loops. The currently set frequencies should therefore be checked.
For long loop supply lines it is recommended to use band 2..4 for frequency setting.
If automatic frequency setting is activated, the VEK S4 uses the device address to choose one of the frequency range above. Please check the real frequency, because it can differ from the nominal frequency.

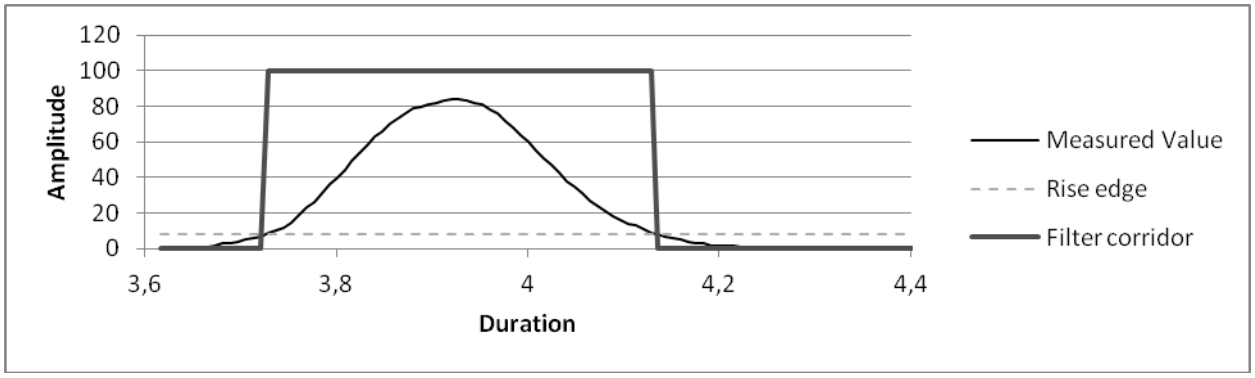
For additional notes on preventing cross-coupling → see *Section 1.6* Synchronisation

2.2 Multiplexing sequence

The default multiplexing sequence is 1-2-3-4. To prevent cross-coupling with neighboring loops of another detector in exceptional cases, you may change the sequence (e.g. 1-4-2-3). → see also *Section 1.6* Synchronisation

2.3 Peak Filter

From software version 4.0 a parametrizable peak filter was added to filter disturbances, which are injected to the loops and the loop supply lines. The filter of each loop is represented by an amplitude value (up to which detuning level) and the duration (for which period) which form together a filter corridor (see picture). If is one of both parameters Zero, the filter function is deactivated. If a detuning curve is measured within this filter corridor, no classification and vehicle counting takes place.



Example for filter corridor

Note: By improper use of this filter function is not guaranteed, that single vehicles or whole vehicle classes substantially are recognized!

2.4 Classification

Both classification modules of the VEK S4 detector have separate loop parameters so that relevant parameters per classification module can be set for the vehicle recording. The loop parameters include the head gap, the amplitude factor for the sensitivity, the constant for the length adjustment and the loop length.

- **Head gap**

The correct setting of the head gap is relevant for the accuracy of the speed measurement and the vehicle length.

- **Amplitude factor**

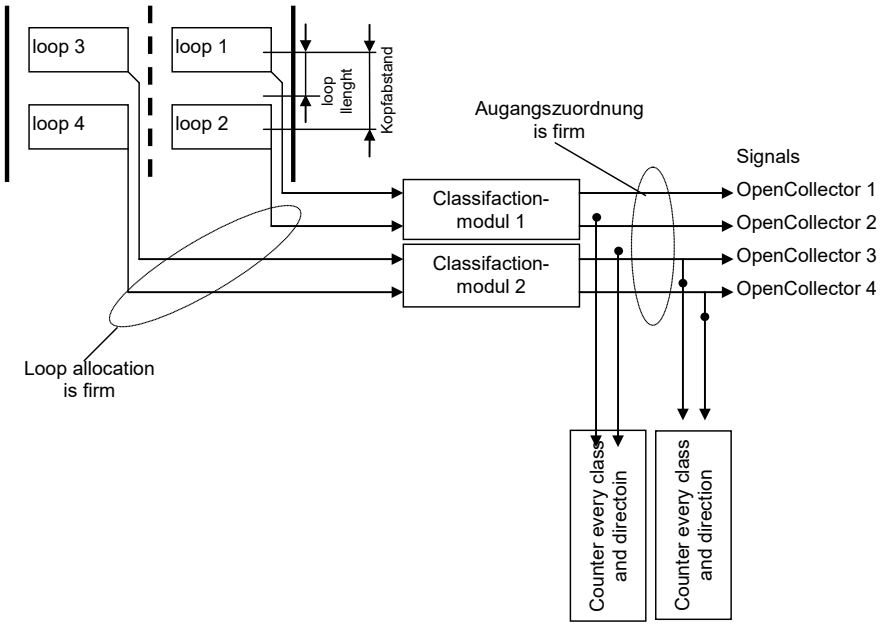
The loss of sensitivity due to abnormal loop dimensions, long loop lines or road surface reinforcements is largely compensated for using the amplitude factor. Automatic evaluation of this factor is also available.

- **Length adjustment**

The measured vehicle length is corrected with the length adjustment. No vehicle length adjustment is usually required for normal loops according to TLS with loop lines up to 100 metres.

- **Loop length**

The loop type of the connected loops is adjusted using the loop length. Currently only the loop types TLS I and TLS II according to the TLS 2012 guidelines are supported. The loop type TLS II is assumed for a length up to 125 cm. The loop type TLS I is set for lengths of more than 125 cm.



- **Output signals**

As already described in 1.4 Possible outputs, each classification module can control two outputs. Refer to the diagram above for their assignment. One of the five available functions can be set for each output. Outputs can also be deactivated.

- **Vehicle counter**

Each classification module has a 16-bit counter per vehicle class and travel direction which can be invoked via the RS485 interface. It must be noted that the counters roll over at 65535 (2^{16}) and restart from 0. It is not recommended to reset the counters otherwise vehicles can be lost at the time of the reset. The counters in the detector are not protected against power failure. The detectors must either be buffered with a UPS system or the counter readings must be regularly read and stored in the higher level system for long-term counting.

2.5 Output modes

The following output modes can be set for the four open collector outputs:

Output mode	Description
Standard output	Normal output mode for presence or direction detection
Group fault message	Output indicates loop faults from all loops
always off	Output always turned off
always on	Output always turned on
Simulation	Output switches constantly, e.g. for testing purposes

Inverted or *non-inverted* signal output can be selected for all output modes.

In the case of standard output the loop faults of the respective channel can be output together with the logical signal. Which fault is additionally indicated can be set to loop fault (break/short), loop frequency outside frequency band and calibration procedure.

Factory default setting: Standard output,
Signals not inverted,
Respond to loop fault

The interface can be used to temporarily turn the outputs on or off. This allows you to implement control tasks such as controlling traffic lights or variable message signs.

In simulation mode the output is constantly repeated according to the following scheme:

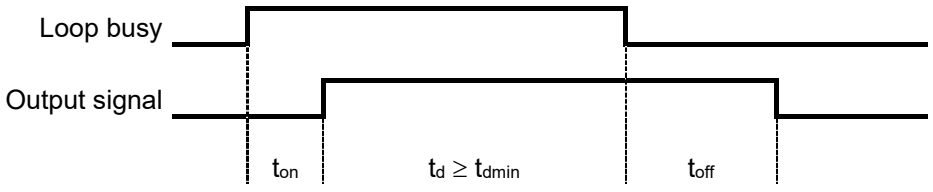
- The signal duration corresponds to the set minimum on duration
- The pause time corresponds to the set on delay. If no on-delay is set (0 ms), an idle time of 20s is assumed.

For the factory set time behavior of the output signals this means a pulse signal of 200 ms duration and an idle time of 20 s.

2.6 Time response of the output signals

On-delay, minimum on duration and off-delay for the hardware output signals can be set in 100 ms increments over a range of 0...25500ms.

Factory default setting: On-delay 0 ms
Off-delay 0 ms
Minimum on duration 200 ms



t_{on}: On delay
t_{off}: Off delay
t_{dmin} : Minimum on duration
t_d : Signal duration

2.7 RS485 interface

Baud rates: 9600, 19200, 384000 Baud
Parity: no, even, odd parity

Default or factory setting: 9600 Baud, even parity

Refer to the RS485 documentation for the VEK S4 for the specification of the interface protocols.

The VEK S4 is downwards compatible with the interface protocols defined for the VEK S3. The protocols based on the TLS defined in the VEK S3 are also supported. In these cases, one VEK S4 behaves like two separately addressable VEK S3 units. Mixed operation of VEK S3 and VEK S4 on a common bus is not recommended.

2.8 CANopen interface

The CANopen standard 301 according to CiA is supported

Baud rates: 100, 125, 250, 500, 800, 1000 kBit/s

Refer to the CANopen documentation for the VEK S4 for the specification of the CANopen protocols. Please look for CANopen basics in the specifications from the CiA (CAN in Automation) organisation.

Default or factory setting: 250 kBit/s

3 Starting up

1. **Installation –** The installation rail must be grounded. → 5 *Case* and *7.5* PE connection

2. **Address –** The detector address is set to 48 at the factory using the address offset. All detectors which will be operated on a common interface must be set to different addresses before the commissioning.
   → *4.5.1* Device address

3. **RS485 bus terminator –** The RS485 interface must be terminated at the beginning and end in accordance with the respective specification. → *4.5.2*RS485 interface bus termination
4. **RS485 baud rate –** Select the correct baud rate for the host computer / laptop port. When delivered, the baud rate for the RS485 interface is set to 9600 bps. If the baud rate of a detector is not known, this can be reset to 9600 bps by restoring the factory settings.
   Attention: All other parameters are also reset when the factory settings are restored.

5. **Loop assignment –** assign loops to the classification modules. The loops on the connections Loop1 / Loop2 and Loop3 / Loop4 are assigned to the classification module 1 or the classification module 2 respectively.

6. **Loop scanning –** Adjacent loop should not operate in the same time window. It must already be ensured during the planning that neighbouring loops not connected to the same detector are preferably assigned to different channel numbers. Otherwise the multiplexing sequence must be changed over during the commissioning.
   → *1.5* Multiplexing methods
   → *1.6* Synchronisation
   → *2.2* Multiplexing sequence

7. **Frequency selection –** The loops of a detector are usually set to the same frequency band. Neighbouring loops or loops from neighbouring detectors must be set to different frequency bands.
   →*2.1* Frequency selection.

8. **Head gap –** The head gap must be set individually for each classification module. It is usually 400 cm for TLS I loops and 250 cm for TLS II loops.

9. **Amplitude factor –** The amplitude factor must be set individually for each classification module. The displayed out of tune maximum must be checked and corrected using the amplitude factor.
   If the S4 protocol is used, the out of tune maximum for TLS I loops for vans should be between 480 and 800 and between 275 and 420 for TLS II loops. [1]
   Factory settings of the amplitude factor:

Loop TLS type I	60
Loop TLS type II	100

   Note: The amplitude factor must be set and checked for every measuring cross section. It is crucial for the quality of the vehicle classification.

10. **Loop length –** The loop length of the connected loops must be set for each classification module. The loop length is usually 250 cm for TLS I loops and 100 cm for TLS II loops.

[1] When using the downwards compatible VEK S3 protocol, the maximum for vans should be approx. 20 (+/-5) for TLS I loops and approx. 11 (+/-3) for TLS II loops.

11. **Length adjustment –** The displayed and actual lengths of a known vehicle must be compared and adjusted using the length adjustment. The adjustment of the speed and length measurements should be made with reference to average values obtained from several measuring cycles.

12. **Speed –** The speeds of the vehicles must be measured with a sufficiently accurate measuring method and compared with the detector measured values. The measured speed can be adjusted to the actual speed using corrections of the head gap for each classification module.

4 Display and Operation

4.1 Display elements

The front panel of the detector contains 4 green LEDs for indicating the respective loop state.

LED behavior in normal operation:

LED	*Description*
off	Loop free
on	Loop busy or direction pulse
flashes slowly	Frequency calibration running
flashes rapidly	Loop fault (break or short)
flashes in pairs	automatic evaluation of amplitude factor in process
Chain	Synchronization indicator in 8s rhythm

4.2 (M)ode button

The following functions can be activated by pressing the M-key on the front panel.

M-key	*LED display in binary code*	*Function*
1x short	○○○○	Uses LEDs 1-4 to display the hardware address set with DIP switches 1-4.
1x long	○○○○	Generates a hardware reset and before that displays the set hardware address
1x short, 1x long	○○○●	Generates a hardware reset
2x short, 1x long	○○●○	Polls the Master (●○○●) / Slave (○●●○)
...		
6x short, 1x long	○●●○	Resets to factory default settings

The number of short presses of the button is indicated on the LEDs in binary code – left 2^3, right 2^0

For hardware address ‚0' the flashing sequence ○●○● / ●○●○ is output.

The transition between long and short button depression is indicated after 1s by rapid flashing of all LEDs. After an additional second the LED indicators go out to indicate the function is activated. If the button is released sooner, during the flashing phase, the function is cancelled!

4.3 Factory settings

To restore the factory default parameters, proceed as follows:
1) Press button 6x briefly until ○●●○ shows on the LEDs.

2) Hold button down → After one second all LEDs flash rapidly.
After two seconds the LEDs go out.

3) Release button. → The essential detector parameters are now set as follows

Parameter	*Value*	*Description*	*Comments*
Frequency	0	automatic frequency setting	depending on device address
Hardware output Output mode Inversion Error output	 3 0 0	 normal output not inverting no loop errors	 Standard hardware output for loop assignment
Loop parameters Classif. module 1 and 2 Head gap Length adjustment Amplitude factor Loop length	 250 0 100 100	 cm cm	 TLS II loop TLS II loop TLS II loop
Output parameters Classification module 1 Outputs 1 and 2 Loop assignment Outputs 1 and 2 Output function		 Output 1: loop 1 Output 2: loop 2 Presence	
Output parameters Classification module 2 Outputs 3 and 4 Loop assignment Outputs 3 and 4 - Output function		 Output 3: loop 3 Output 4: loop 4 Presence	
Address offset	48	Offset	*version dependent if necessary !*
RS485 interface Baud rate Parity Parity detection	 4 0 1	 9600 Baud even active	
CAN interface Baud rate	 5	 250 kBit/s	

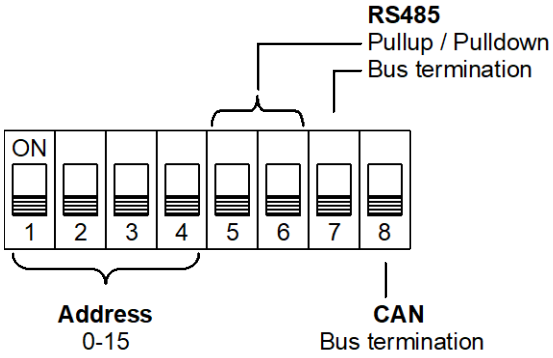
Refer to the RS485 protocol specification for the basic setting of other parameters!

4.4 Synchronisation display

Correct function of the synchronization of multiple detectors is indicated by the scrolling effect of the LEDs in an 8s rhythm. As the device address increases from left to right, the scrolling LEDs also run from left to right for all synchronized detectors.
Polling of the Master detector is also possible, as described in 4.2 (M)ode button. The Master sends the synchronization signals over the ribbon cable to the other detectors (Slaves). Selection is random.

4.5 DIP switches

The 8-pole DIP switch is used for selecting the device address and for enabling termination for the CAN bus and RS485 interface. The DIP switches are located inside the enclosure. As shipped all DIP switches are in the OFF position.



Note! Before startup check all DIP switches for the correct position! Improper setting can damage the interfaces.

4.5.1 Device address

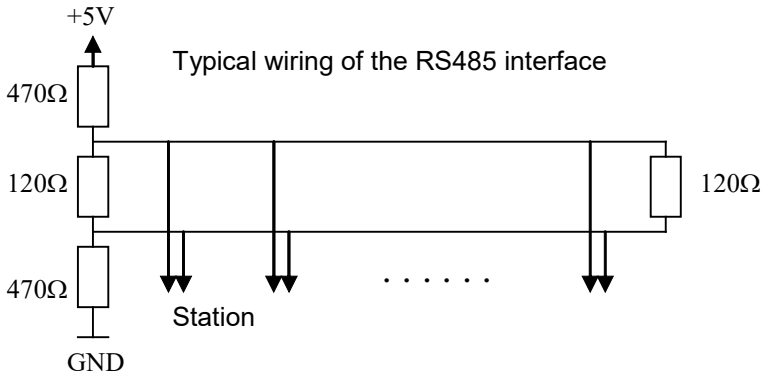
The device address results from the hardware device address set using the DIP switches and the software settable address offset.

DIP switch				*Hardware device address*
1	2	3	4	
0	0	0	0	0
1	0	0	0	2
0	1	0	0	4
1	1	0	0	6
0	0	1	0	8
1	0	1	0	10
0	1	1	0	12
1	1	1	0	14
0	0	0	1	16
1	0	0	1	18
0	1	0	1	20
1	1	0	1	22
0	0	1	1	24
1	0	1	1	26
0	1	1	1	28
1	1	1	1	30

Device address = Hardware device address + Address offset

For downward compatibility to VEK S3 the step size for address offset is 2

4.5.2 RS485 interface bus termination



The shown resistors are mounted inside the detector and switch able by the help of the DIP-switches

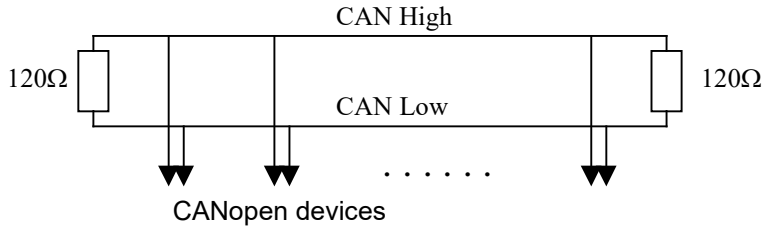
DIP switch	*Description*
5	470Ω-Pull-up resistor on RS485 B+
6	470Ω-Pull down resistor on RS485 A-
7	Bus termination 120Ω between RS485 B+ and A-

The RS485 bus must be terminated on the front end (control device or repeater) and back end (last detector) with a 120Ω resistor. Set DIP switch 7 to ON in the last detector.

In addition the two RS485 signal lines B+ and A- must be connected once to 5V resp. to GND with a 470Ω resistor each. If this has not been done on the control device or repeater, the circuit can be activated on the last detector using DIP switches 5 and 6.

As shipped the DIP switches are in the ‚OFF' position.

4.5.3 CANopen bus termination

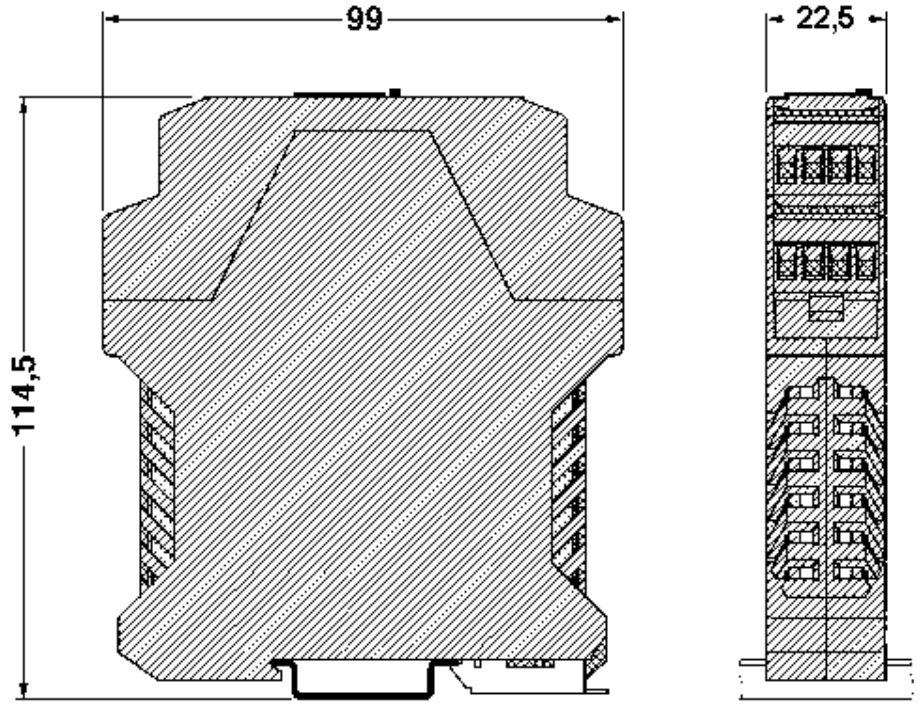


DIP switch	*Description*
8	Bus termination 120Ω between CAN-High and CAN-Low

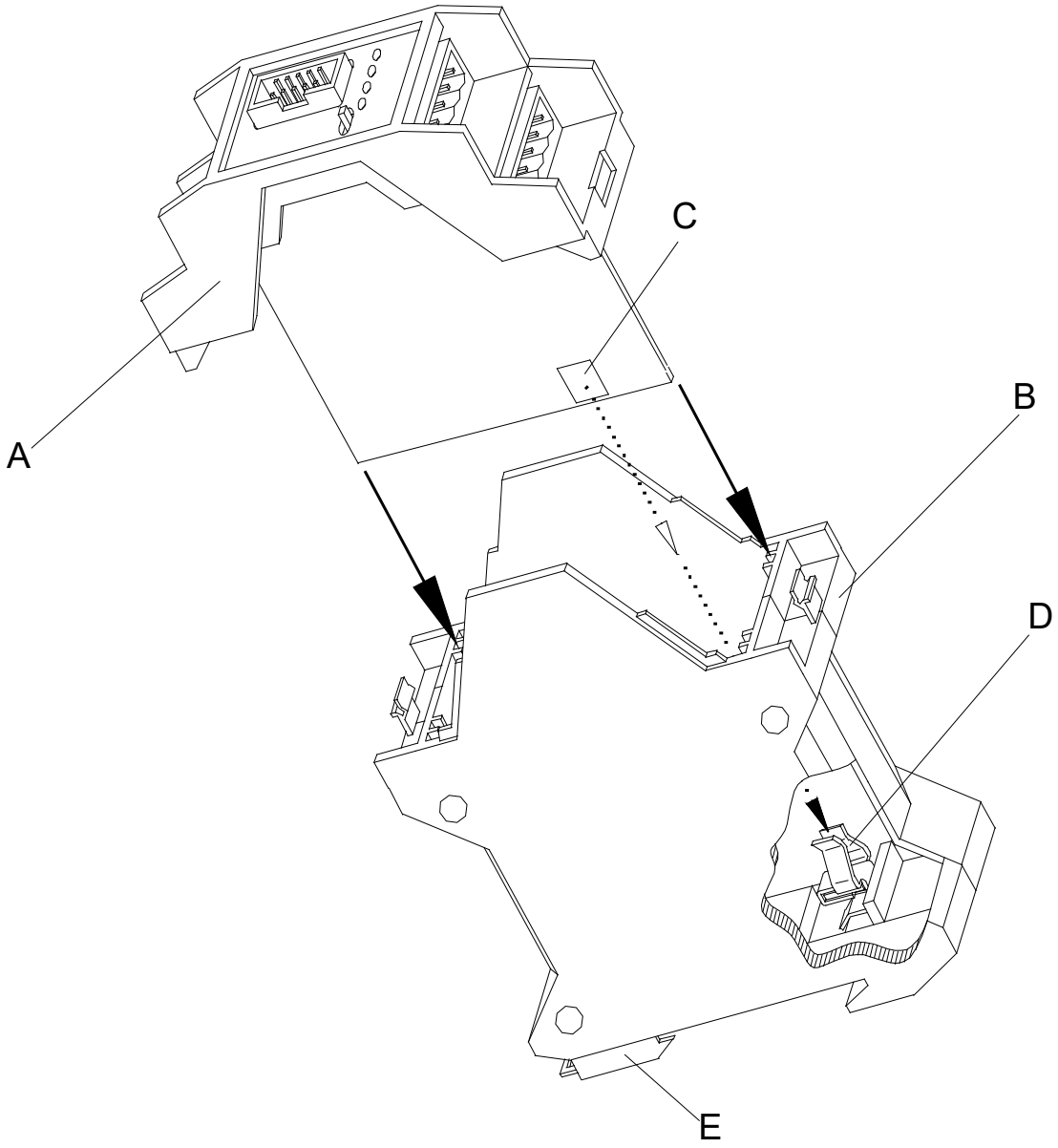
The CAN bus must be terminated on the front end (control device or repeater) and back end (last detector) with a 120Ω resistor. Set DIP switch 8 to ON in the last detector.

5 Case

5.1 Dimensions



5.2 Opening the case



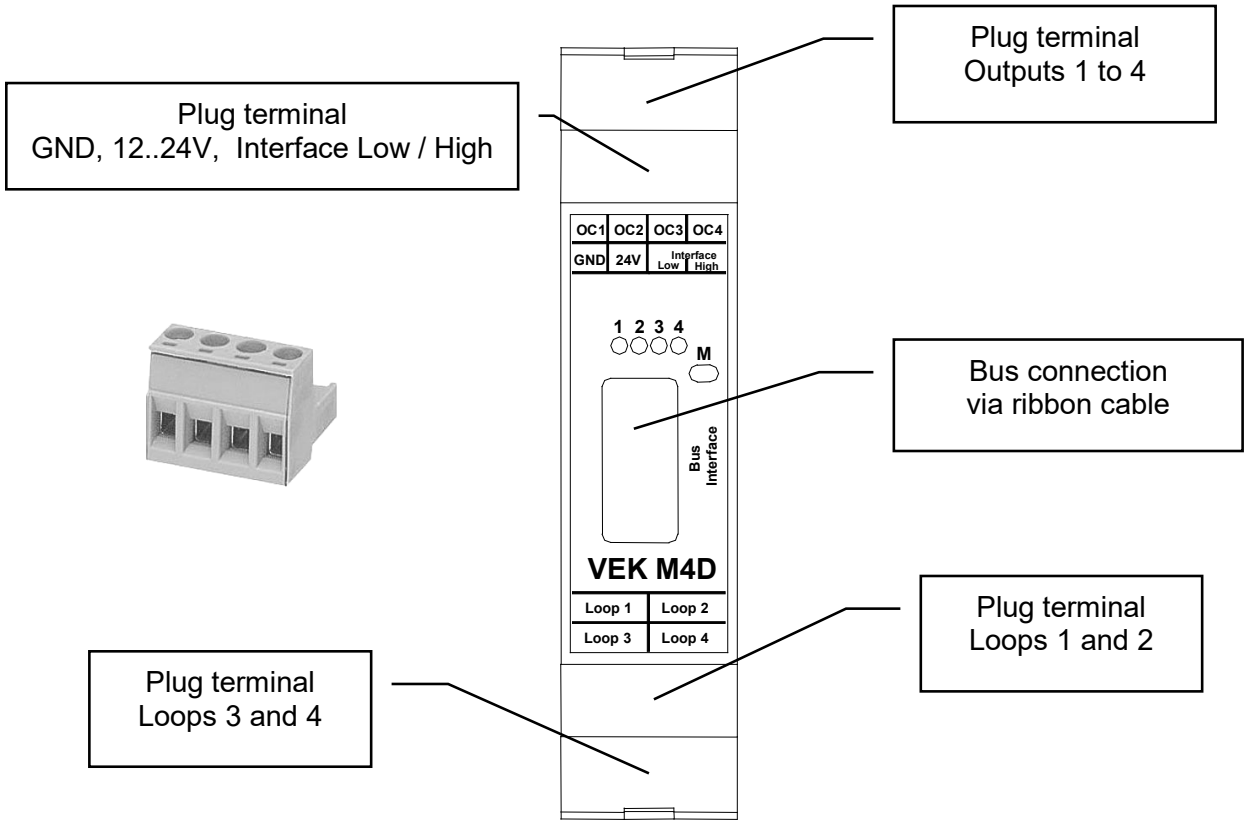
Opening :
- Loosen upper section A by gently pressing with a screwdriver on the side springs at B.
- Remove upper section.

Closing:
- Check orientation, note contact surface C and PE contact D
- Guide circuit board into rear slot
- Latch upper and lower sections into place

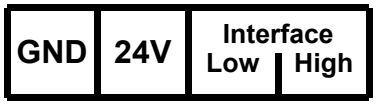
6 Technical data

Supply voltage:	12 to 24 V DC +/- 20 % SELV, limited power sources according to EN 62368-1
Power consumption:	typ. 900 mW, max. 1,2 W
Ambient temperature:	-20 °C to +70 °C
Storage temperature:	-40 °C to +85 °C
Humidity:	max. 95% non-condensing
Loop inductance range:	25 – 1200 µH, recommended 80 – 300 µH
Working frequency	30 – 140 kHz
Sensitivity	
max. loop cable length	300 m
max. loop internal resistance	30 Ω (incl. cable)
Loop inputs	galv. isolated (1kV), 90V gas tube arresters to PE contact
Cycle time	8 ms
Loop geometry	Head gap: 250 cm and 400 cm Length: 100 cm and 250 cm Both loops must have an identical design.
Speed measurement	Measuring range 10 km/h to 255 km/h Tolerance under 100 km/h, +/-3 km/h Tolerance over 100 km/h, +/-3% Resolution 1 km/h
Length measurement	10 dm to 250 dm for constant vehicle speed Tolerance +/- 3 dm
Vehicle classification 8+1 classes	TLS classification accuracy: A2 Car, car with trailer, truck, truck with trailer, van, bus, motorcycle, articulated vehicle and unclassifiable vehicle
Outputs	Low-Side Switch Open Drain, short-circuit protected max. 45 V / 350 mA, R_{on} = > 4 Ω
Enclosure	Plastic housing, IP 30 for DIN rail mounting Polyamide PA 6.6, blue 22.5 x 99 x 114.5 mm (W x H x D, excl. connector) Integrated function ground contact via DIN rail
Weight	125 g (260 g with packaging)
Connections	
Loops 1-4,	4-pole plug terminals, 0.2 – 2.5 mm² (AWG 24-14)
altern. CAN-/RS485- Bus and supply voltage	Phoenix Combicon MSTBT 2.5, blue
Open Drain outputs 1-4 (Option)	
Supply voltage, RS485, Synchronisation	10-pole IDC plug with flat cable on front side
Interface	
RS 485	2400, 4800, 9600 Baud, 19200, 38400, 57600 Baud, 8E1 Termination 120 Ω, Pull-up / Pull down 470 Ω switchable
CAN	100, 125, 250 kBit/s, 500, 800 kBit/s, 1 MBit/s, Termination 120 Ω switchable

7 Connector and pin assignment

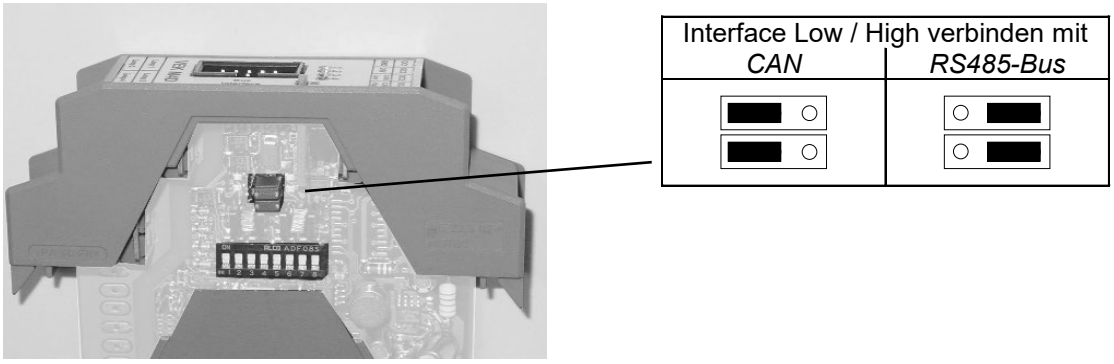


7.1 Power supply and interface screwless terminals

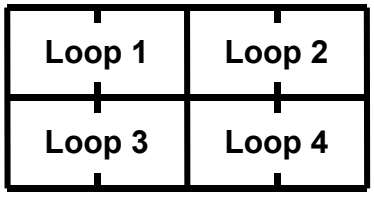


The plug terminal contacts are also connected to contacts of the front-side ribbon cable terminal. This means the supply and interface connections can also be made either using the plug terminal or ribbon cable. When multiple detectors are involved, it is practical to combine the plug terminal and ribbon cable, i.e., connection is made via the plug terminal of one detector, and the additional detectors are connected using ribbon cable (see also section 8).

Two jumpers are used to connect the RS485 or CAN bus to the plug terminal. The jumpers are located inside the enclosure. *Both jumpers may be inserted only together for CAN or for RS485 !*

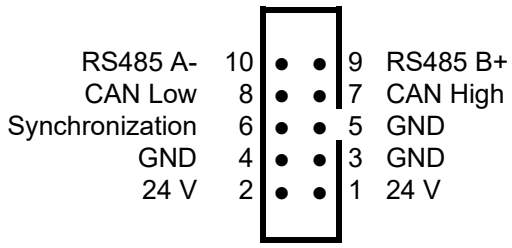


7.2 Loop connections



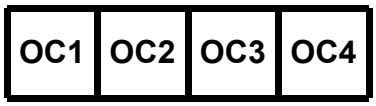
7.3 2x5-pole pin connector for ribbon cables

Front view

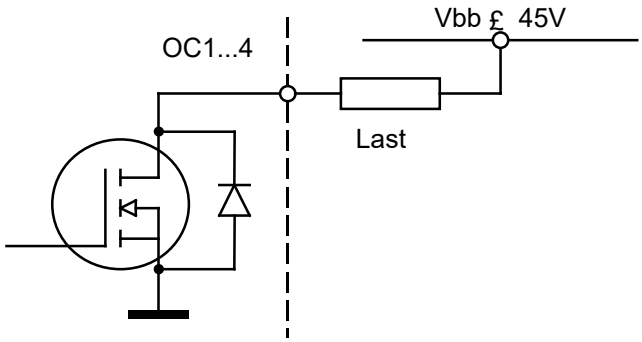


The ribbon cable connection is used to synchronize the detectors with each other and to provide the supply voltage and interface connection. The supply and interface connection to the control device can be made either using the ribbon cable or a plug terminal (see 7.1 Power supply and interface screwless terminals).

7.4 Outputs



The Open-Collector outputs are short-circuit protected. When a signal is output the outputs switch on (Low active).



7.5 PE connection

Overvoltages on the loop inputs are diverted to PE using the integrated gas tube arrester. For this there is a function ground contact on the enclosure bottom (see also 5.2 Opening the case– Part D), which connects the inserted circuit board with the DIN rail. When the circuit board is inserted, be sure that contact surface C fits in the PE contact spring D of the enclosure! The DIN rail must be connected to PE in the system with low impedance!

Noise immunity of the VEK S4 cannot be guaranteed without a PE connection to the DIN rail !

8 Standard equipment, accessories

The **single unit** includes four 4-pole plug terminals. This allows you to make all the connections including the serial interface.

For larger systems the connection between the detectors is generally made using a ribbon cable. Therefore the **10-pack** includes only the terminals for the loop connections. Additional connection parts must be ordered depending on which connection option is selected.

What you need:
- For connecting multiple detectors together a 10-pole ribbon cable with a corresponding number of spring action contacts
- For the supply voltage and communications interface either a plug terminal or a longer ribbon cable per system
- If using the open collector outputs an additional plug terminal per detector

The following accessory sets are available:

8.1 VEK M4D – connection kit

Contents: 4 plug terminals, configured 1m ribbon cable with 16 spring action contacts and an additional spring action contact

The ribbon cable is trimmed to length by the user for the number of detectors. If the power is provided through the plug terminals this set allows you to equip e.g. 4 systems with 4 detectors each. Using the additional spring action contact you can alternatively provide power directly through the ribbon cable. Additional plug terminals are required if using the detector outputs!

8.2 VEK M4D accessories, 10 screwless terminals

For additional connections or as a spare part for the loop connections

8.3 Service software

The traffic detector can be parameterised using the *S4Com* service program. As the VEK S4 is downwards compatible and supports the interface protocols of the VEK S3, the *S3ComWin* service program can also be used. Please pay attention here to the special features of the addressing. → 4.5.1 Device address

Note:
In order to avoid bus conflicts, the host computer must be disconnected from the RS485 bus while the service program is being used.

9 Safety instructions and warnings

- The device should only used for the applications described by the manufacturer.
- Please keep this operation instruction always accessible and hand it over to every user.
- Inadmissible modifications to the device, use of repair parts and supplementary equipment which are not sold or recommended by the manufacturer can cause burning, electric shock and injuries. Therefore the manufacturer has no liability and this excludes all demands of warranty.
- The warranty regulations of the manufacturer are valid in the version of the purchase date for that device. There is no liability for not suitable, wrong manual or automatic adjustments also regarding no suitable applications of the device.
- Repairs may only made by the manufacturer.
- The power supply must be fulfill the requirements for SELV and limited power sources according to EN 62368-1.
- All connections, the start-up, maintenance, measurements and adjustment operations to the detector have to be made from electrical specialists who have special know-how in the prevention of accidents.
- For the use of devices which have contact to electrical power, please pay attention to the valid security instructions and all prevention orders of fire and accidents.
- Observe valid VDE regulations when handling devices that are exposed to electrical voltage. In particular, but not limited to, these are VDE 0100, VDE 0550/0551, EN 62368 (VDE 0868), EN 60065 (VDE 0860), EN 50110 (VDE 0105), as well as the fire and accident prevention regulations DGUV.
- The user is responsible for an installation, which has conformity to all technical rules in the country where the device is mounted, and also to all regional valid orders. For that the dimension of cabling, fuse protection, connection to ground, switch off, disconnection, isolation controlling and the protection for overload current have to be regarded in detail.
- The detector can not be used as a security device regarding to the security instructions of electrical machines. Using in systems with high danger potential it is necessary to include additional protection devices!
- All work on the device must be carried out in accordance with the national electrical codes and regional regulations.
- The device must not be used as a safety unit in accordance with the Machinery Directive 2006/42 / EC, the Construction Products Directive 305/2011/EU or any other safety regulation. In systems with potential risks, additional safety equipment is required!

10 4-channel functions

The VEK S4 detector can also be used for presence detection with flexible direction recognition due to its integrated 4-channel functions (4Ch). The parameters for use as a presence detector are explained in this chapter.

Please note that changing the following parameters can influence the classification results or deactivate classification modules.

10.1 Scanning speed (4Ch)

The response time of the detector is dependent on the number of active loop channels and the adjustable interference filter. The scanning speed is doubled respectively by changing the multiplexer to two loop or single loop operation. The scanning speed can be further increased by deactivating the interference filter whereby the response time can be reduced from to normal 16 ms to 2 ms.

Attention: The interference resistance of the system is also reduced for fast response times. Activating the interference filter adversely affects the classification behaviour of the classification modules.

Scanning mode	Interf. filter	Response time	
4 loops	on	16 ms	
2 loops	on	8 ms	
1 loops	on	4 ms	
4 loops	off	8 ms	(Default or factory setting)
2 loops	off	4 ms	
1 loop	off	2 ms	

It is also possible to deactivate individual loops without changing the reaction time. It must be noted that the time window of the deactivated loop is assigned to another active loop. Distances between loops must also be complied with here to avoid couplings which operate in the same time window.

Attention: When a loop is deactivated, the classification module concerned is also deactivated.

10.2 Response sensitivity (4Ch)

The sensitivity for every channel in the range from 0.02% - 10.63% $\Delta f/f$ can be selected in 256 steps. In order to minimise interference, the sensitivity should be set as high as is necessary, i.e. the response sensitivity should be set as high as possible.

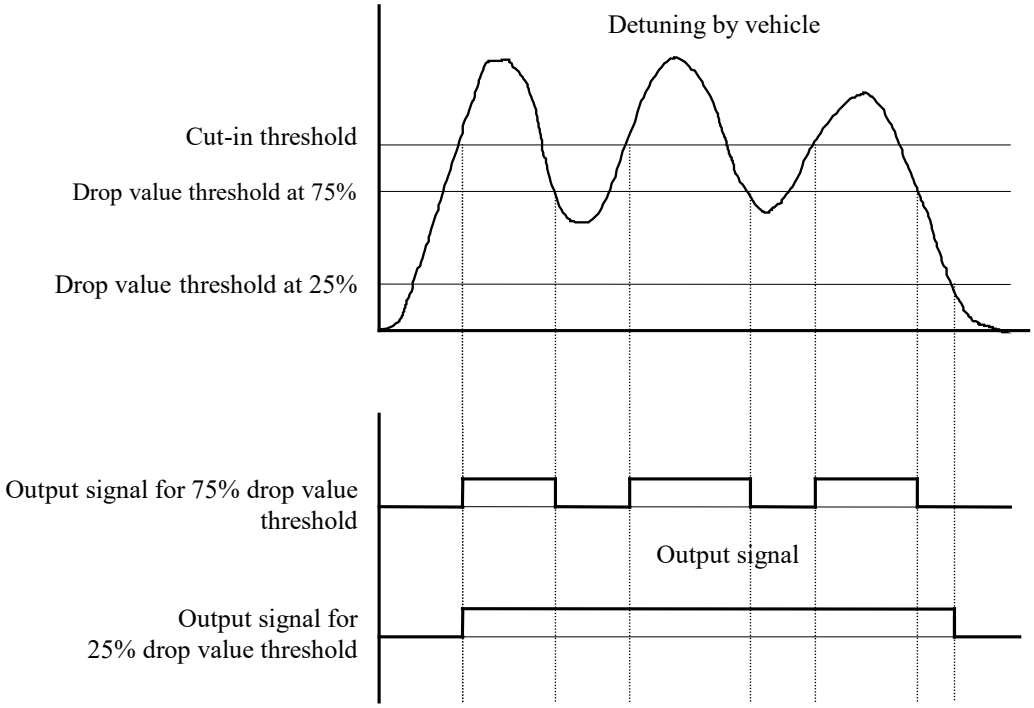
The sensitivity setting is usually adjusted in large steps and the response threshold values are nor selected higher than 120. Settings above 120 and fine adjustments are used for applications where vehicle differentiations are required. For example, buses can be selectively detected with a large loop with the dimensions 10.0 m x 2.5 m.

Parameter value	Response threshold value	Sensitivity (Δ f/f)
0	4	0.02 % *maximum* sensitivity
1	10	0.04 %
2	20	0.08 %
3	30	0.13 %
4	40	0.17 %
5	50	0.20 %
:	:	
11	110	0.46 %
12	120	0.5 % (Factory setting)
13	130	0.54 %
:	:	
41	410	1.71 %
42	420	1.75 %
43	430	1.79 %
:	:	
100	1000	4.17%
:	:	
255	2550	10.63 % *lowest* sensitivity

*Note: The response thresholds of the VEK S4 are different from the response threshold of the VEK M4D for the same sensitivity (*Δ f/f).

10.3 Hysteresis drop (4Ch)

In order to avoid an intermediate loss of the occupied signal for vehicles with a high undercarriage such as articulated buses, trams, trucks with trailers etc, it is possible to modify the switching hystereses. An interruption-free detection of critical vehicles is then also possible with low closure resistance setting. The drop value threshold factory setting is 75%.



10.4 Holding time (4Ch)

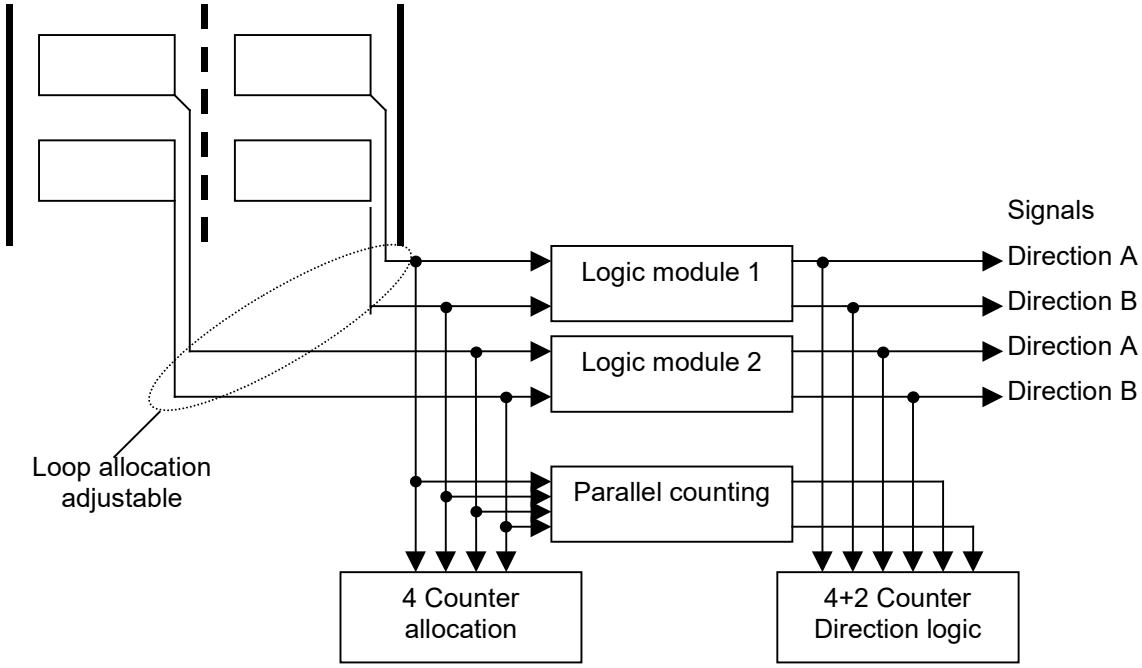
Separate holding times between 1 and 255 minutes can be set for each channel on the detector. A zero setting means infinite waiting time. If the loop of a detector channel is occupied longer than the set holding time, the detector channel tunes again.

Factory setting: 20 minutes

10.5 Direction recognition (4Ch)

In addition to the simple direction recognition present in the classification modules, the VEK S4 detector has two parameterisable logic modules for the direction-dependent recording of vehicles. Complex evaluation algorithms using double loops are integrated in the detector. The direction logic generates logical output signals which can be output via a hardware output or via an interface depending on the setting. The logic signals are also counted in parallel in the detector independently.

Two direction logic modules each with 2 inputs (double loops) and 2 outputs (directions A and B) are integrated in the detector. The assignment of the loops to the logical inputs and the assignment of the logical outputs to the Open Drain outputs can be adjusted.



The assignment meters can be invoked via the interface. For counting in time intervals, the counting result must be determined from the meter readings at the start and at the end of the time interval. It must be noted that the counters roll over at 65535 (2^{16}) and restart from 0. It is not recommended to reset the counters otherwise vehicles can be lost at the time of the reset. The counters in the detector are not protected against power failure. The detectors must either be buffered with a UPS system or the counter readings must be regularly read and stored in the higher level system for long-term counting.

In addition to the double loop counting, a four loop counting which counts parallel passages is integrated. If needed, the total count can be corrected by the assumed lane-changers in the superordinate system using these count values.

Depending on the application, several different evaluation logics can be set for each of the four logical outputs. The different logics for the direction recognition are shown briefly below. The detailed method of working for different traffic situations follows afterwards.

<table>
<tr><th>Direction logic</th><th>Signal output</th><th>Signal waste</th><th>Remark</th></tr>
<tr><td>D1 - Continuous signal 1</td><td rowspan="2">Allocation 1. loop</td><td>left 1. loop</td><td rowspan="3">Signal output in opposite direction takes place only again if both loops were free before-</td></tr>
<tr><td>DB - Continuous signal both loops</td><td rowspan="2">left 2. loop</td></tr>
<tr><td>D2 – Continuous signal 2</td><td>Allocation 2. loop</td></tr>
<tr><td>F1 – Wrong driver 1 (Factory setting)</td><td rowspan="3">Allocation 2. loop</td><td rowspan="5">Expenditure for impulse with adjusted minimum signal period

(Standard 200ms)</td><td rowspan="2">Correct behaviour with column traffic and maneuverer. Different behaviour with wrong driver situations (see appendix).</td></tr>
<tr><td>F2 – Wrong driver 2</td></tr>
<tr><td>BS - both loops</td><td>Correct behaviour with column traffic should not seem to maneuverer.</td></tr>
<tr><td>FE – Feig</td><td>left 1. loop</td><td>Correct behaviour with column traffic and maneuverer</td></tr>
<tr><td>SF – loop freely</td><td>left 2. loop</td><td>Collection of single vehicles and maneuverer. Columns should not occur</td></tr>
<tr><td>PB – Park bay</td><td>related to the direction</td><td>For short in and exits (see appendix)</td></tr>
</table>

With all logics the loop occupied first determines the counting and/or expenditure direction. I.e. for example loop 1 is occupied first, takes place expenditure and counting for direction A.

10.5.1 Direction detection in various traffic situations

Various traffic situations are shown in the following for Loops 1 and 2. The evaluation of the direction signal is performed in the same manner in the reverse direction of travel as well for Loops 3 and 4 or other loop combinations.

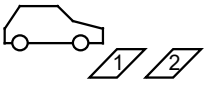
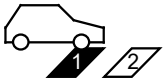
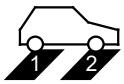
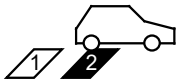
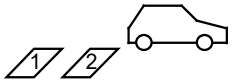
Explanations for the table:

xx	Direction logic, gray = logic with incorrect count in this traffic situation.

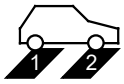
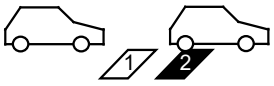
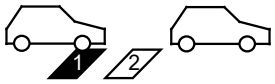
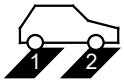
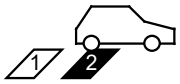
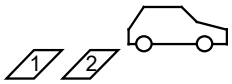
Imp → Direction pulse $\overline{\text{Imp}}$ → Direction pulse in the opposite direction
on → Continuous signal on off → Continuous signal off

The direction signal is output on the channel of the first loop to be traversed.

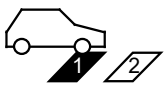
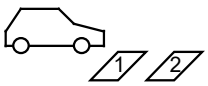
10.5.1.1 Single vehicle

	D2	***D1***	***DB***	***F1***	***F2***	***FE***	***SF***	***BS***	***PB***	
									Ri1	***Ri2***
										
		on	on							
	on	| | |	| | |	Imp	Imp			Imp		
	| | |	off	| | |			Imp				Imp
	off		off				Imp		Imp	

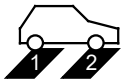
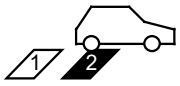
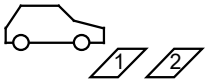
10.5.1.2 Traffic line

	D2	*D1*	*DB*	*F1*	*F2*	*FE*	*SF*	*BS*	*PB* *Ri1*	*PB* *Ri2*
		on	on							
	on	| | |	| | |	Imp	Imp			Imp		
	| | |	off	| | |			Imp				Imp
	| | |	on	| | |							
	off	| | |	| | |						$\overline{\text{Imp}}$	
	on	| | |	| | |	Imp	Imp			Imp		
	| | |	off	| | |			Imp				Imp
	off		off				Imp		Imp	

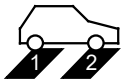
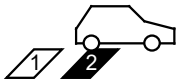
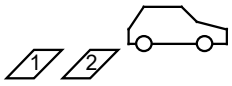
10.5.1.3 Wrong-way driver 1

	D2	*D1*	*DB*	*F1*	*F2*	*FE*	*SF*	*BS*	*PB* *Ri1*	*PB* *Ri2*
		on	on							
	on	| | |	| | |	Imp	Imp			Imp		
	off	| | |	| | |							
		off	off	$\overline{\text{Imp}}$	$\overline{\text{Imp}}$					

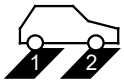
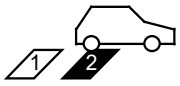
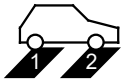
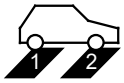
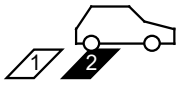
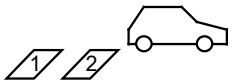
10.5.1.4 Wrong-way driver 2

	D2	D1	DB	F1	F2	FE	SF	BS	PB Ri1	PB Ri2
		on	on							
	on	┆	┆	Imp	Imp			Imp		
	┆	off	┆			Imp				Imp
	┆	on	┆							
	off	┆	┆						$\overline{\text{Imp}}$	
		off	off		$\overline{\text{Imp}}$					

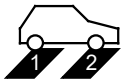
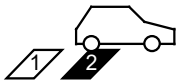
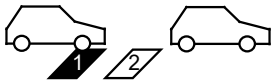
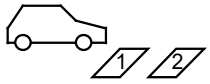
10.5.1.5 Maneuverer 1

	D2	D1	DB	F1	F2	FE	SF	BS	PB Ri1	PB Ri2
		on	on							
	on	┆	┆	Imp	Imp			Imp		
	off	┆	┆							
	on	┆	┆							
	┆	off	┆			Imp				Imp
	off		off				Imp		Imp	

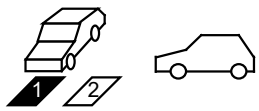
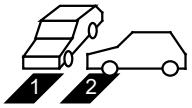
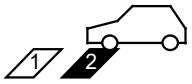
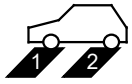
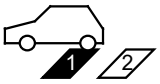
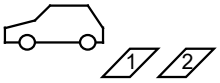
10.5.1.6 Maneuverer 2

	D2	*D1*	*DB*	*F1*	*F2*	*FE*	*SF*	*BS*	*PB*	
									Ri1	*Ri2*
		on	on							
	on	|	|	Imp	Imp			Imp		
	|	off	|			Imp				Imp
	|	on	|							
	off	|	|						Imp	
	on	|	|	Imp	Imp			Imp		
	|	off	|			Imp				Imp
	off		off				Imp		Imp	

10.5.1.7 Wrong-way driver in traffic line

	D2	D1	DB	F1	F2	FE	SF	BS	PB Ri1	PB Ri2
		on	on							
	on	┆	┆	Imp	Imp			Imp		
	┆	off	┆			Imp				Imp
	┆	on	┆							
	off	┆	┆						$\overline{\text{Imp}}$	
		off	off		$\overline{\text{Imp}}$					

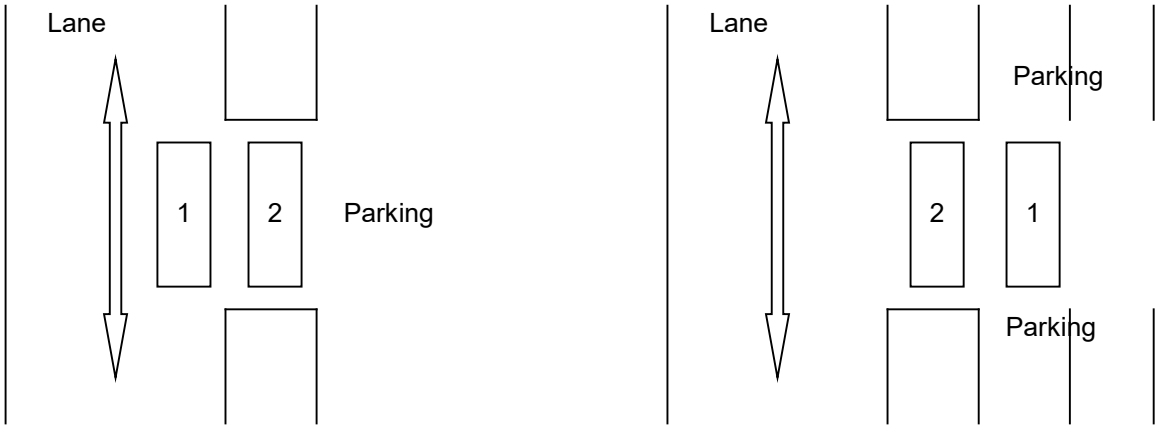
10.5.1.8 Cross-traffic

	D2	D1	DB	F1	F2	FE	SF	BS	PB Ri1	PB Ri2
		on	on							
	on	┆	┆	Imp	Imp			Imp		
	┆	off	┆			Imp				Imp
	┆	on	┆							
	off	┆	┆						$\overline{\text{Imp}}$	
		off	off		$\overline{\text{Imp}}$					

All logics except for PB in Direction 1 will result in incorrect counts in this traffic situation, since they count in instead of out.

10.5.2 Direction logic „Parking Bay“

This direction logic is used for short entrances and exits. This logic suppresses compromising of the count by cross-traffic on Loop 1. This means it is non-critical whether Loop 1 is placed in the passing lane or in the maneuvering area.



The placing of the loops depends on which travel direction backups are anticipated in. In travel direction 1 → 2 no backups are permitted! In travel direction 2 → 1 even vehicles in traffic line situations are correctly counted, whereby the vehicle gap must always enable a loop.

Logic for travel direction 1 → 2

- The counter pulse arrives when both loops have been fully traversed
- Correct count for individual vehicles
- Correct count for maneuvering as well
- Traffic jam situation and traffic lines may not occur for travel direction 1 -> 2!

Logic for travel direction 2 → 1

- The counter pulse arrives as soon as Loop 2 is left in the direction of Loop 1
- Correct count for cross-traffic as well
- Correct count for traffic lines
- Correct count even for maneuvering of a single vehicle
- No maneuverers are allowed within a traffic line!

11 Notes