FEIG Sensors

Technologie mit Weitblick

VEK S4C Manual

Traffic Detector - VEK S4C

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FEIG ELECTRONIC

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.

The information in this guide has been compiled to the best of our knowledge and in good faith. *FEIG ELECTRONIC* assumes no liability for the accuracy of the specifications in this guide. In particular *FEIG ELECTRONIC* cannot be held liable for consequential damages resulting from improper installation.

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 favourable circumstances. *FEIG ELECTRONIC* assumes no liability for perfect function of the traffic detector in a foreign system environment.

Please read this manual and safety instructions carefully and in full before starting up the traffic detector!

Contents

1 Functional Description

The VEK S4C traffic detector is a dual system for inductive detection of vehicles. Information about 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 assembled in a data protocol 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 2002
- vehicle detection and classification in both directions
- recording of the net time gap (time distance between two vehicles)
- loop dimensions according to TLS guidelines*
- automatic adjustment of the system after switching on
- continuous readjustment of frequency drifts for largely eliminating environmental influences
- sensitivity independent from loop inductance
- frequency band adjustment
- long loop supply lines possible (up to 300 m)
- simple installation using ribbon cable connection
- RS485 interface and
- CANopen Interface
- 4 Open Drain outputs
- 5 Bit codeable hardware address on DIN connector
- external Reset input

Other features:
- 19” plug-in board, 100 mm x 160 mm (Euro card), DIN 41612 type B connector
- avoidance of mutual influencing of loop channels by using multiplexing methods
- avoidance of mutual influencing of several detectors using synchronisation
- LED display of the loop conditions
- insulation between loop and electronics
- gas surge arresters for improved surge resistance
- 4 Opto coupler outputs and 1 general fault Opto coupler output

Setting options:
- five fixed frequency bands independent from loop inductance
- per classification module:
  - head gap of loops
  - sensitivity adjustment of loop pairs
  - adjustment of the vehicle length
- classification modules can be disconnected by deactivating unused 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 (1..254) can be set using DIP switch (2..30) or DIN connector (2..62) and address offset via RS485 interface
- other setting options (functions in 4-channel mode) :
  - actuation threshold per channel in 255 steps
  - hysteresis drop of 20-80% per channel
  - holding time 1-255 minutes and indefinite per channel
  - scanning speed
  - direction logic

* Publisher of the TLS (Technical delivery conditions for route stations) is the Federal Highway Research Institute (BASt) in Bergisch Gladbach

Compatibility:
- downwards compatible to the TLS and FEIG protocol of traffic detector VEK S3-1
- software compatible to VEK S4 with plastic housing and DIN rail mounting

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 installing the loops over reinforced underground. The installation recommendations must be considered. It is recommended to use the standard loop geometry TLS type 2 for best classification quality.

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 S4C detector has two classification modules for vehicle detection. 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 2002:
- 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 <10 km/h. In this state, a dummy vehicle with *class = Other, l = 40 dm, 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 Classification 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 (*class = Other, l = 40 dm, v = 0 km/h*) is reported for every vehicle which crosses the second intact loop. If both loops of a classification module are defect no vehicle data is reported .

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 (*class = Other, l = 45 dm, v=* $v_{last\ vehicle}$) 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:

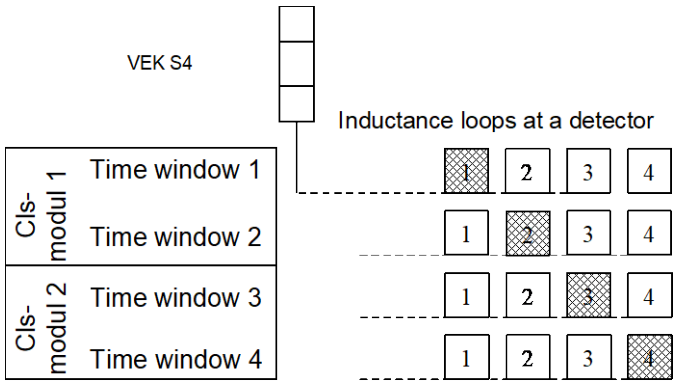
- no function (output deactivated)
- presence of a vehicle on the loops
- direction pulse signal
- pulse for vehicle crossing with vehicle class selection
- exceeding speed limit with vehicle class selection
- speed limit compliance with vehicle class selection

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

Loop faults are indicated via a general fault opto coupler output. During idle state the opto coupler is active. If a loop error occurs for longer than 1s the coupler output is deactivated. Short loop errors < 1s are ignored for the hardware outputs, but can requested via interface.

1.5 Multiplexing

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.



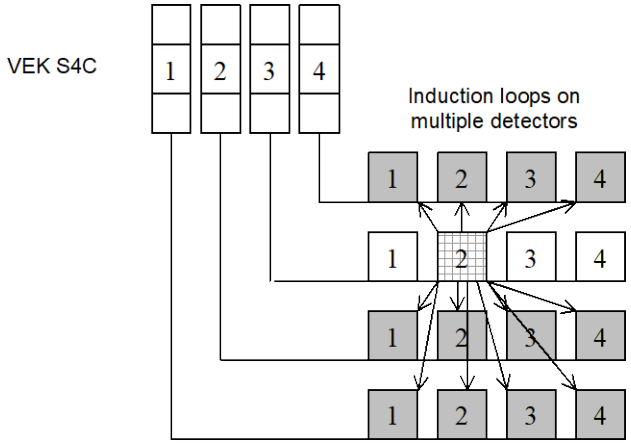
1.6 Synchronisation

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.

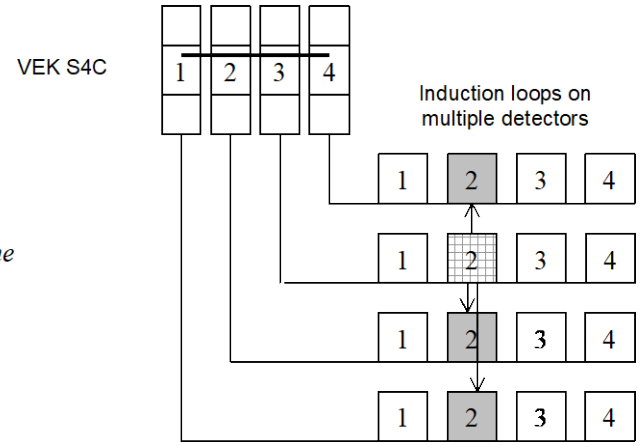
a) Example without synchronization:

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 neighbouring 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 automatically 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 S4C uses the device address to choose one of the frequency ranges 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 neighbouring loops of another detector in exceptional cases, you may change the sequence (e.g. 1-4-2-3). → see also *Section 1.6* Synchronisation.

Attention: Changing the multiplexing sequence is only valid for the 4-channel mode and not if the classification modules are used!

2.3 Classification

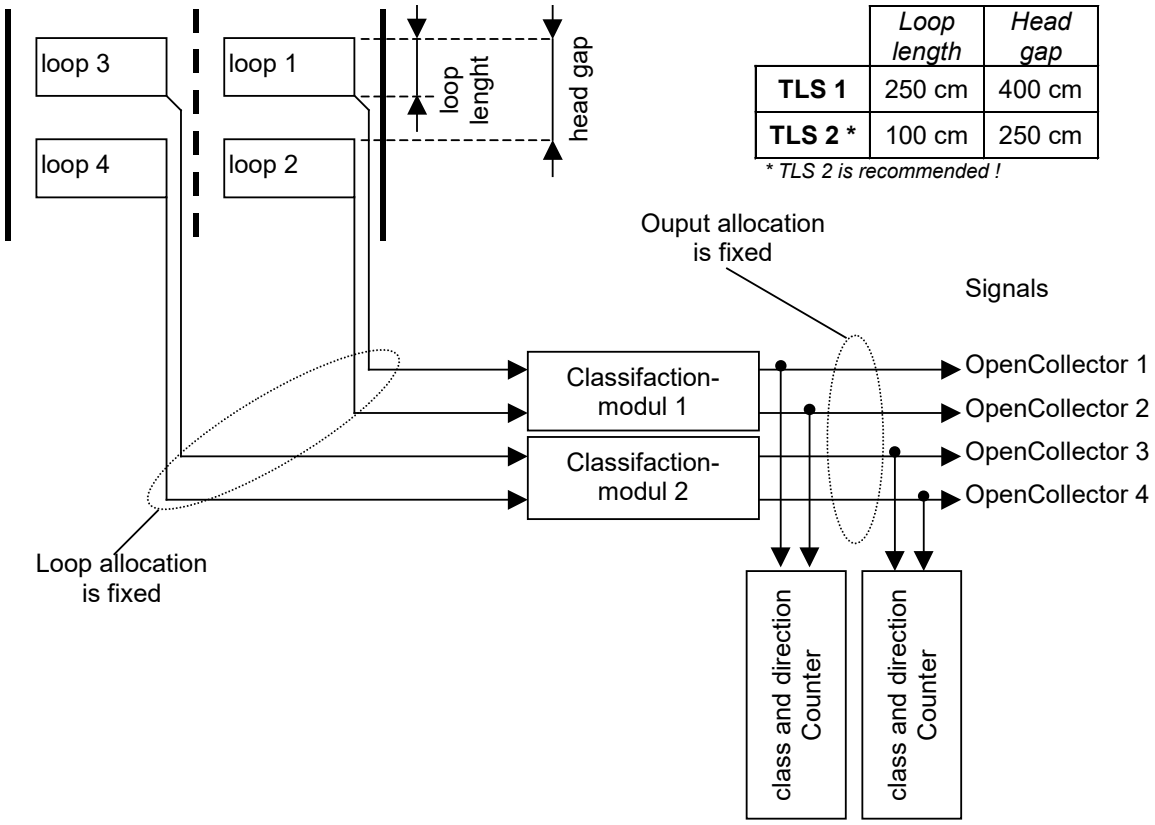
Both classification modules of the VEK S4C detector have separate loop parameters so that relevant parameters per classification module can be set for the vehicle detection. The loop parameters include the head gap, the loop length, the amplitude factor for the sensitivity and the vehicle length adjustment.

- **Head gap**

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

- **Loop length**

The loop type of the connected loops is adjusted using the loop length. Currently only the loop types TLS 1 and TLS 2 according to the TLS 2002 guidelines are supported. The loop type TLS 2 is assumed for a length up to 125 cm. The loop type TLS 1 is set for lengths of more than 125 cm.



	Loop length	*Head gap*
TLS 1	250 cm	400 cm
TLS 2 *	100 cm	250 cm

** TLS 2 is recommended !*

- **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 calculation of this factor is also available. By setting '0' for the amplitude factor the VEK S4C begins to evaluate the next 50 cars in the length range of 350...450 cm. If the evaluation process is finished the VEK S4C stores the new adjustment factor in the EEPROM. An active evaluation process is indicated by two simultaneously blinking LED for each classification module (1/2 for module 1 or for 3/4 module 2).

- **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.

- **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.

2.4 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
General 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.

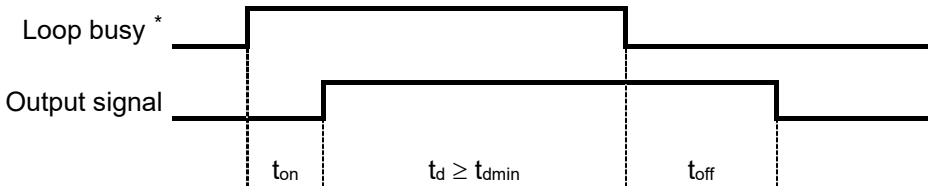
In the case of standard output the loop faults of the respective channel can be output together with the logical signal. Which fault is additionally indicated can be set to loop fault (break/short) and calibration procedure.

Factory default setting: Standard output,
Signals not inverted,
Indication of loop fault

2.5 Response time of output signals

On-delay, minimum signal 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 signal duration 200 ms



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

* Internal status: Detector has detected an object on the loop (detuning > threshold level)

2.6 Simulation of output signals

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 signal 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 behaviour of the output signals this means a pulse signal of 200 ms duration and an idle time of 20 s.

2.7 RS485 interface

Baud rates: 9.6, 19.2, 38.4 kbaud
Parity: no, even, odd parity

Factory default setting: 9.6 kbaud, even parity

Refer to the RS485 documentation for the VEK S4/VEK S4C for the specification of the interface protocols.

The VEK S4C 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 S4C behaves like two separately addressable VEK S3 units. Mixed operation of VEK S3 and VEK S4C 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 kbps

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.

Factory default setting: *250 kbps*

3 Initial Start-up

1. **Installation –** The 19” rack must be grounded and PE contact on the DIN connector must connected to Ground. → *7.10* PE connection

2. **Address –** The detector address is set to 48 at the factory using the software address offset. All detectors which will be operated on a common interface must be set to different addresses before initial start-up. → *4.4* Device address

3. **RS485/CAN bus termination –** The RS485/CAN interface must be terminated at both and ends in accordance with the respective specification.
   → *4.5.1* RS485 interface bus termination */ 4.5.2 CANopen bus termination*

4. **RS485/CAN baud rate –** Select the correct baud rate for the host computer / laptop interface. When delivered, the baud rate for the RS485 interface is set to 9600 bps (CAN: 250 kbps). If the baud rate of a detector is not known, this device can be reset to 9600 bps (250 kbps) by restoring the factory settings.
   Note: 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 are assigned to the classification module 1 and Loop3 / Loop4 to the classification module 2 respectively.

6. **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.

7. **Head gap –** The head gap must be set individually for each classification module. It is usually 400 cm for TLS 1 loops and 250 cm for TLS 2 loops. We recommend using TLS 2 type loops!

8. **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 type 1 loops and 100 cm for TLS type 2 loops.

9. **Amplitude factor –** The amplitude factor must be set individually for each classification module.

   Factory setting of the amplitude factor for TLS type 1 loop is 60 and for TLS type 2 loop 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.

   The automatic setting of amplitude factor is described in section *2.3 Classification*.

10. **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.
    Note: Normally it is not necessary to set this parameter.

11. **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 behaviour 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	Synchronisation 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 (○●●○) for Synchronisation
...		
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 displayed.

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 Classification module 1 and 2 Head gap Length adjustment Amplitude factor Loop length	 250 0 100 100	 cm cm	 TLS 2 loop
Output parameters Classification module 1 Output 1 and 2 Loop assignment Output 1 and 2 Output function	 1 2 1	 Output 1: loop 1 Output 2: loop 2 Presence (classification output)	
Output parameters Classification module 2 Output 3 and 4 Loop assignment Output 3 and 4 Output function	 3 4 1	 Output 3: loop 3 Output 4: loop 4 Presence (classification output)	
Address offset	48	software settable offset	*Version dependent, if necessary!*
RS485 interface Baud rate Parity Parity detection	 4 0 1	 9600 Baud even active	
CANopen interface Baud rate	 5	 250 kbps	for further details see document *CANopen Object Dictionary*

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

4.4 Device address

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

Device address = Hardware device address + Address offset

For downward compatibility to traffic detector VEK S3 the step size for the hardware device address is 2. Address the first system/module with “device address” and the second system/module with “device address+1”.

Address setting at DIN connector has higher priority than DIP switches!

4.4.1 Addressing with DIN connector

0: connected to GND
1: not connected (internal Pull-up)
x: don’t care

DIN connector – Address bit					*DIP switch*				*Hardware-device address*		*Device address for Adr.-Offset 48 (factory setting)*
4	***3***	***2***	***1***	***0***	***1***	***2***	***3***	***4***			
0	0	0	0	0	x	x	x	x	0 *		48
0	0	0	0	1	x	x	x	x	2		50
0	0	0	1	0	x	x	x	x	4		52
0	0	0	1	1	x	x	x	x	6		54
0	0	1	0	0	x	x	x	x	8		56
0	0	1	0	1	x	x	x	x	10		58
0	0	1	1	0	x	x	x	x	12		60
0	0	1	1	1	x	x	x	x	14		62
0	1	0	0	0	x	x	x	x	16		64
0	1	0	0	1	x	x	x	x	18		66
0	1	0	1	0	x	x	x	x	20		68
0	1	0	1	1	x	x	x	x	22		70
0	1	1	0	0	x	x	x	x	24		72
0	1	1	0	1	x	x	x	x	26		74
0	1	1	1	0	x	x	x	x	28	→	76
0	1	1	1	1	x	x	x	x	30		78
1	0	0	0	0	*Not available for DIP switch addressing!*				32		80
1	0	0	0	1					34		82
1	0	0	1	0					36		84
1	0	0	1	1					38		86
1	0	1	0	0					40		88
1	0	1	0	1					42		90
1	0	1	1	0					44		92
1	0	1	1	1					46		94
1	1	0	0	0					48		96
1	1	0	0	1					50		98
1	1	0	1	0					52		100
1	1	0	1	1					54		102
1	1	1	0	0					56		104
1	1	1	0	1					58		106
1	1	1	1	0					60		108
1	1	1	1	1	*All address inputs open! → Only address setting with DIP switches possible!*						

** Note: Device address 0 is reserved for “No Station“ address. All devices have to answer for requests with address 0. Therefore device address 0 (hardware device address + address offset) is not allowed!*

4.4.2 Addressing with DIP switch

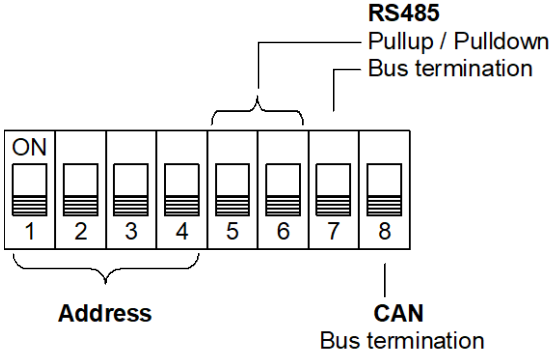
0: Off
1: On

DIN connector	*DIP switch* 1	2	3	4	*Hardware device address*		*Device address for Adr.-Offset 48 (factory setting)*
Only valid, if address pins on DIN connector are not connected! → *"1 1 1 1"*	0	0	0	0	0 *	→	48
	1	0	0	0	2		50
	0	1	0	0	4		52
	1	1	0	0	6		54
	0	0	1	0	8		56
	1	0	1	0	10		58
	0	1	1	0	12		60
	1	1	1	0	14		62
	0	0	0	1	16		64
	1	0	0	1	18		66
	0	1	0	1	20		68
	1	1	0	1	22		70
	0	0	1	1	24		72
	1	0	1	1	26		74
	0	1	1	1	28		76
	1	1	1	1	30		78

** Note: Device address 0 is reserved for "No Station" address. All devices have to answer for requests with address 0. Therefore device address 0 (hardware device address + address offset) is not allowed!*

4.5 DIP switches

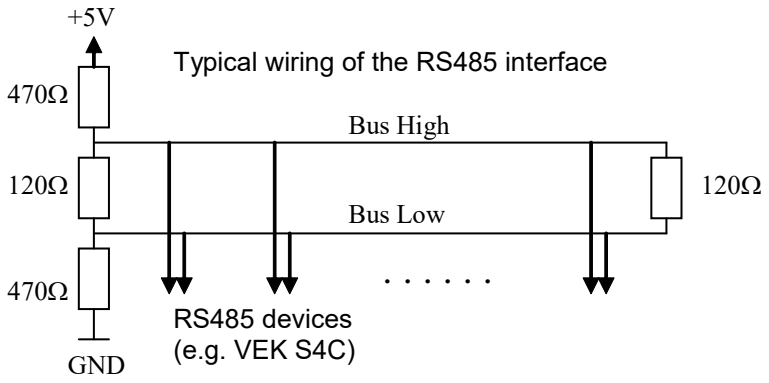
The 8-pole DIP switch is used for selecting the device address and for enabling termination for the CAN bus and RS485 interface. The DIP switches are located on the bottom of printed circuit board. As shipped all DIP switches are in the OFF position.



DIP-Switch address is only valid, if no address on DIN-connector is coded!

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

4.5.1 RS485 interface bus termination



The shown resistors are switchable by the help of the DIP-switches

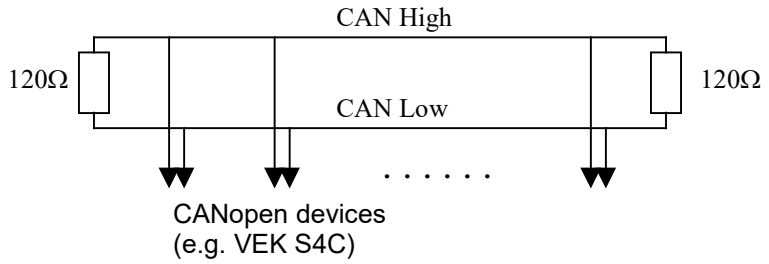
DIP switch	*Description*
5	470 Ω-Pull-up resistor on RS485 B+
6	470 Ω-Pull down resistor on RS485 A-
7	Bus termination 120 Ω between RS485 B+ and A-

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

In addition the two RS485 signal lines B+ and A- must be connected once to 5V resp. to GND with a 470 Ω 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.

4.5.2 CANopen bus termination



DIP switch	*Description*
8	Bus termination 120 Ω 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 120 Ω resistor. Set DIP switch 8 to ON at the last detector.

4.6 Synchronisation display

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

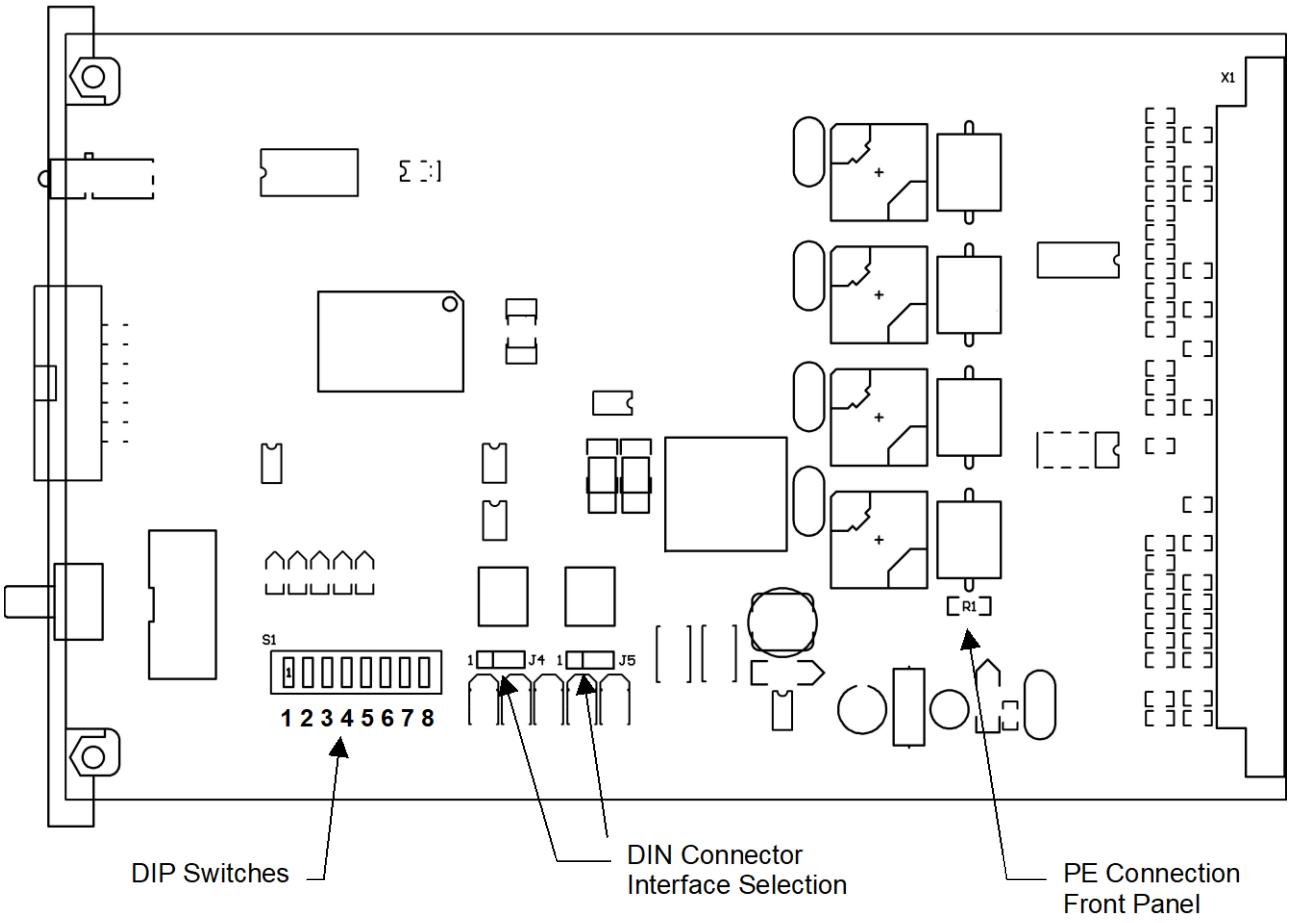
5 Mechanical data

5.1 Dimensions

PCB: 19” plug-in board, 100 x 160 x 19 mm

Total: 125 x 186 X 25 mm,
Front panel 3HE / 5TE

5.2 Board elements



6 Technical data

Supply voltage		12 .. 24 V DC ±20 % SELV, limited power sources according to EN 62368-1
Power consumption		typ. 900 mW, max. 1,2 W
Dimensions		3HE / 5TE, EURO card, 100 mm x 160 mm
Weight		150 g (250 g with packaging)
Ambient temperature		-20 °C .. +70 °C
Storage temperature		-40 °C .. +85 °C
Humidity		max. 95 % non-condensing
Loop inductance	range	25 .. 1200 µH
	recommended	80 .. 300 µH
Working frequency		30 .. 140 kHz
Sensitivity (for 4 channel functions)		0,017 % .. 10,625 % (∆f/f) in 256 steps
Loop cable	length	max. 300 m
	internal resistance	max. 25 Ω (incl. cable)
Loop inputs		galvanic isolated (1 kV), 90 V gas tube arresters to PE contact / front panel
Cycle time		8 ms (4 channel)
Loop geometry	Head gap	250 cm and 400 cm
	Length	100 cm and 250 cm
		Both loops must have identical design and environment!
Speed measurement	Range	10 .. 255 km/h (or mph)
	Tolerance	<100 km/h, +/-3 km/h (or mph) >100 km/h, +/-3 % (or mph)
	Resolution	1 km/h (or mph)
Length measurement	Range	10 .. 250 dm for constant vehicle speed
	Tolerance	+/- 3 dm
	Resolution	1 dm
Vehicle classification 8+1 classes		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, Ron = > 4 Ω
	Opto coupler	max. 45 V / 20 mA
Connectors	back side	DIN 41612 connector, Type B, 64-pole
	front side	14-pole IDC plug for flat ribbon cable
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

6.1 Approval / Standards

EMC requirements	Immunity	EN 61000-6-2: 2005
	Emission	EN 61000-6-3: 2007
Safety	Low Voltage	EN 62368-1: 2006
Waste		WEEE - 2002/96/EC
Hazardous Substances		RoHS - 2002/95/EC

6.2 Current consumption

Values in the following table are *typical* values, which can differ for special conditions!

Operation mode	12 V	24 V
free loops	70 mA	35 mA
covered loops	100 (80) mA	50 (40) mA
RS485	+10 mA	+5 mA
CAN	+10 mA	+5 mA

(): Current consumption without optional photo coupler outputs.

7 Connectors and pin assignment

7.1 DIN connector

Connector: DIN 41612
Type B

a	*Pin*	*b*
*	**1**	*
Open drain 1	**2**	Opto coupler 1-
Opto coupler 1+	**3**	
	4	Opto coupler Fault+ [b]
Loop 1a	**5**	
	6	Loop 1b
Opto coupler Fault+ [a]	**7**	
*	**8**	*
Opto coupler 2-	**9**	Open drain 2
	10	Opto coupler 2+
Opto coupler Fault-	**11**	
	12	Loop 2b
Loop 2a	**13**	Synchronisation
	14	PE (ground front panel)
*	**15**	*
Open drain 3	**16**	Opto coupler 3-
Opto coupler 3+	**17**	
	18	
Loop 3a	**19**	
	20	Loop 3b
	21	Address bit 0
*	**22**	*
Opto coupler 4-	**23**	Open drain 4
internal Jumper a [c]	**24**	Opto coupler 4+
internal Jumper b [c]	**25**	RS 485 B or CAN High
	26	Loop 4b
Loop 4a	**27**	
RS 485 A or CAN Low	**28**	*
external Reset input	**29**	Address bit 1
Address bit 2	**30**	12 .. 24V DC
	31	Address bit 3
Address bit 4	**32**	GND

*: *reserved for future implementations*

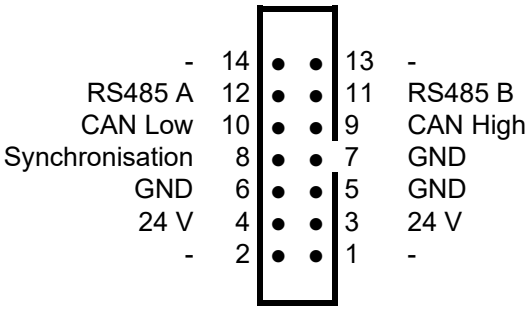
[a] acc. TR 0100

[b] custom specific

[c] contacts 24a and 25a are internally connected

7.2 2x7-pole pin IDC connector for ribbon cable

Front view



The ribbon cable connection is used to synchronise the detectors with each other and to provide the supply voltage and interface connection. The supply, synchronisation and interface connection to the control device can be made either using the ribbon cable or the backside DIN connector (see 7.3 Power supply).

Pins 1, 2, 13 and 14 are not connected. Therefor pins 3..12 are compatible to the 2x5-pole pin connector of VEK S4 with plastic housing.

7.3 Power supply contacts

The power supply contacts on the DIN connector are also connected to contacts of the front-side IDC connector. This means the supply and interface connections can be made either using the DIN connector or ribbon cable.

7.4 Interface contacts

Two jumpers J4 and J5 are used to connect the RS485 or CAN bus to the back-side DIN connector. The jumpers are located on the board. (see 5.2 Board elements)

Interface Connection on 25b / 28a		
	J4	J5
RS485		
CAN		

Both jumpers may be inserted only together for CAN or for RS485 !

7.5 Reset input

Connect the external Reset input pin to GND for a short time to activate a device reset.

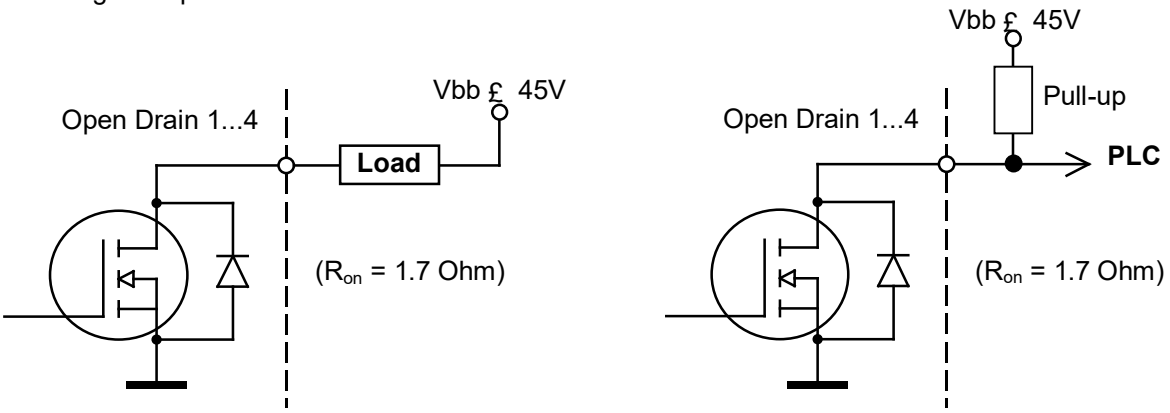
7.6 Synchronisation connection

The synchronisation connection is used to synchronise the loop multiplexing of several device. The connection can be made either using the DIN connector or ribbon cable. (see also *1.6 Synchronisation*)

7.7 Open Drain Outputs

The Open-Drain outputs 1..4 are short-circuit protected. When a signal is output, the outputs switch to GND (Low active).

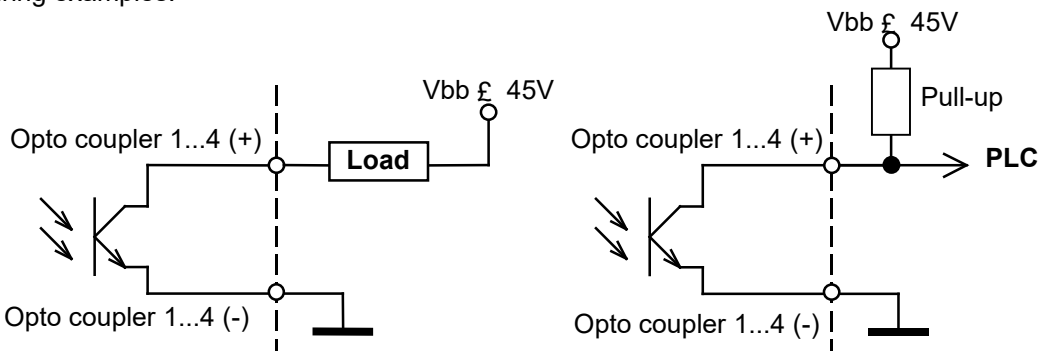
wiring examples:



7.8 Opto coupler Outputs

The Opto coupler 1..4 switch on ,when a signal is output.

wiring examples:



7.9 Fault Output

The general fault output is an Opto coupler output. Its normal state is on. In case of a loop error for more than 1s the Opto coupler is switched off.

7.10 PE connection

Overvoltages on the loop inputs are diverted to PE using the integrated gas tube arresters. For this, there is a PE contact on the back side DIN-connector (pin 14b).
Alternatively you can connect the circuit board to ground via grounding the front panel, if the 0-ς resistor R1 is placed on the board. (see also *5.2, Board elements)*

Noise immunity of the VEK S4C cannot be guaranteed without a PE connection!

8 Accessories

8.1 VEK S4C – connection kit

Contents: configured 1 m 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. Using the additional spring action contact you can alternatively provide power directly through the ribbon cable.

8.2 Service software

The traffic detector can be parameterised using the *S4Com* service program. As the VEK S4C 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. → *4.4 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 Functions in 4-channel mode

The VEK S4C 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.

Attention!
Please note, that changing the following parameters can influence the classification results or deactivate classification modules!
Change parameter of the 4-channel mode only if vehicle classification is not used!

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 normal 8 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	Interference 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 a deactivated loop is assigned to another active loop. Local distances between loops must also be complied with here to avoid couplings with loops, which operate in the same time window.

Attention: When a loop is deactivated, the classification module concerned is also deactivated. Don't change the setting for Scanning mode if you use classification modules !

10.2 Response sensitivity (4Ch)

The sensitivity for every channel in the range from 0.02% .. 10.63% ∆f/f can be selected in 256 steps. In order to minimise interference, the sensitivity should be set as low as is necessary, i.e. the response threshold 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.

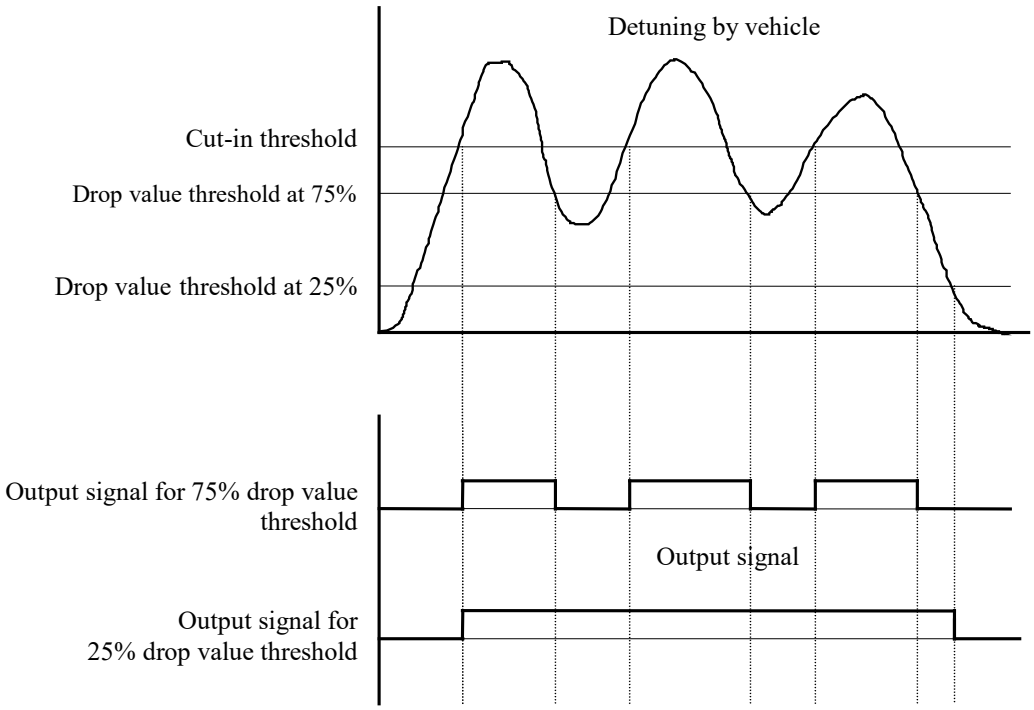
Parameter value	Response threshold value	Sensitivity (∆ f/f)	Sensitivity (∆ f/f)
0	4	0.02 % *maximum* sensitivity	0,04 %
1	10	0.04 %	0,08 %
2	20	0.08 %	0,16 %
3	30	0.13 %	0,26 %
4	40	0.17 %	0,34 %
5	50	0.20 %	0,39 %
:	:		
11	110	0.46 %	0,91 %
12	120	0.5 % (Factory setting)	0,99 %
13	130	0.54 %	1,07 %
:	:		
41	410	1.71 %	3,33 %
42	420	1.75 %	3,41 %
43	430	1.79 %	3,49 %
:	:		
100	1000	4.17%	7,85 %
:	:		
255	2550	10.63 % *lowest* sensitivity	18,29 %

Note: The response thresholds of the VEK S4C are different from the response threshold of the VEK M4D for the same sensitivity (∆ 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 hysteresis. An interruption-free detection of critical vehicles is then also possible for low sensitivity setting.

Factory setting: 75%



10.4 Holding time (4Ch)

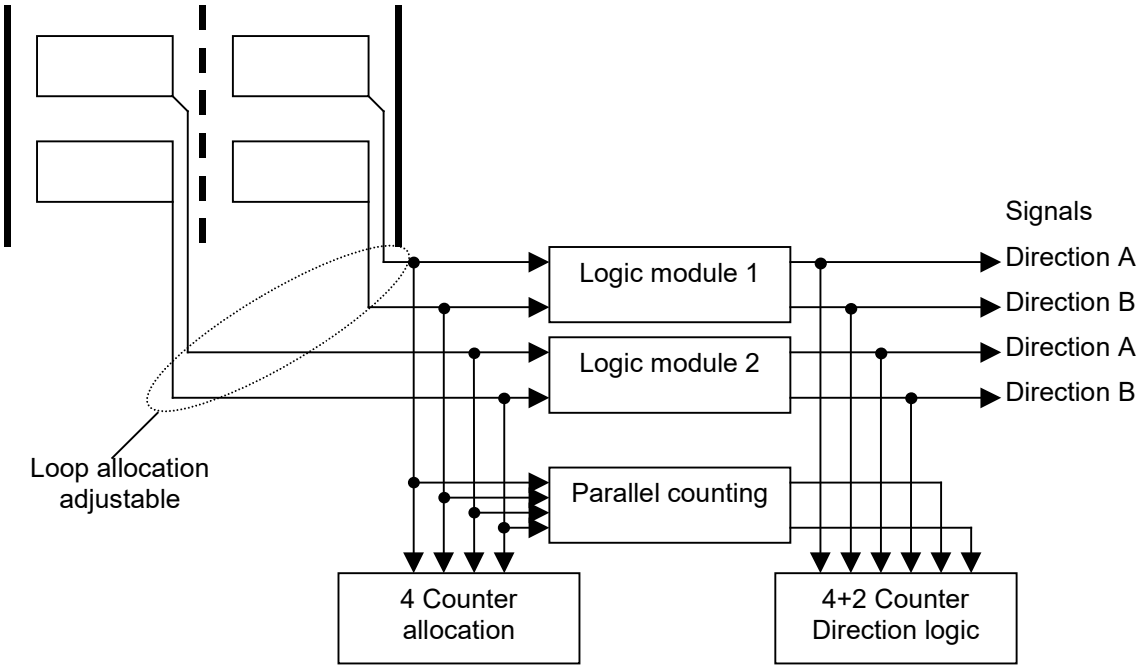
Separate holding times between 1 and 255 minutes can be set for each channel on the detector. A zero setting means infinite waiting time. If the loop of a detector channel is occupied longer than the set holding time, the loop channel retunes again.

Factory setting: 20 minutes

10.5 Direction recognition (4Ch)

In addition to the simple direction recognition present in the classification modules, the VEK S4C 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 connections 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 drop off</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 way driver 1 (Factory setting)</td><td rowspan="3">Allocation 2. loop</td><td rowspan="5">Pulse output with adjusted minimum signal period

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

With all logics the loop occupied first determines the counting and/or output direction.
(e.g. loop 1 is occupied first, takes place output and counting for direction A)

10.5.1 Direction detection in various traffic situations

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

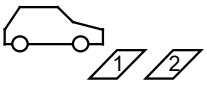
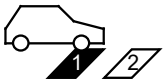
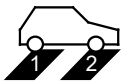
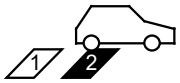
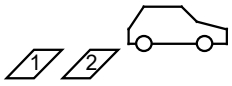
Explanations for the table:

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

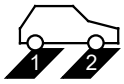
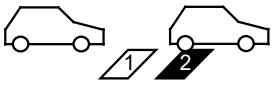
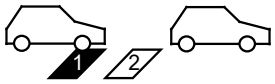
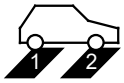
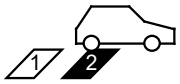
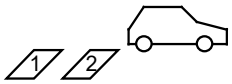
Imp → Direction pulse $\overline{\text{Imp}}$ → Direction pulse in the opposite direction
on → Continuous signal on off → Continuous signal off

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

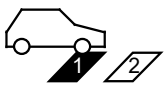
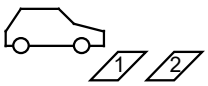
10.5.1.1 Single vehicle

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

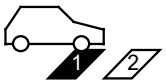
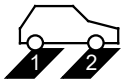
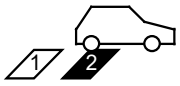
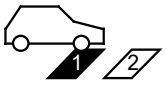
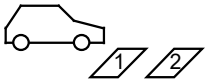
10.5.1.2 Traffic line

	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	

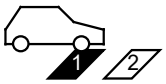
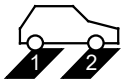
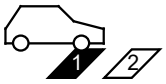
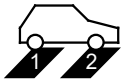
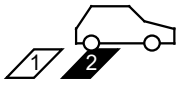
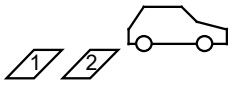
10.5.1.3 Wrong-way driver 1

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

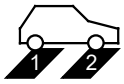
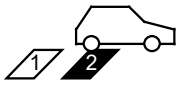
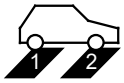
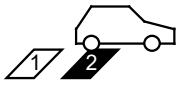
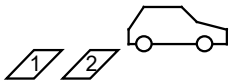
10.5.1.4 Wrong-way driver 2

	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		$\overline{\text{Imp}}$					

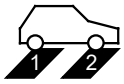
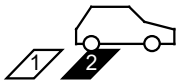
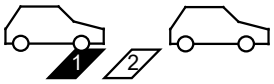
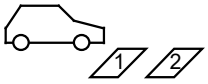
10.5.1.5 Maneuverer 1

	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	

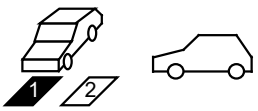
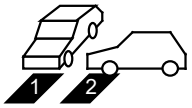
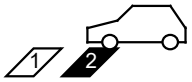
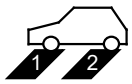
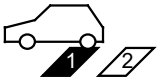
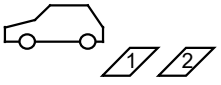
10.5.1.6 Manoeuverer 2

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

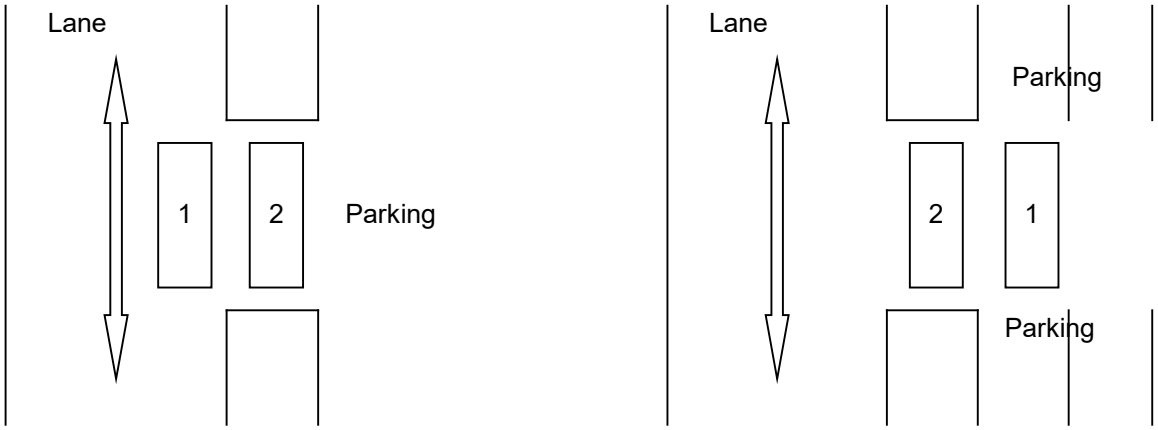
10.5.1.8 Cross-traffic

	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 manoeuvring 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 manoeuvring 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 manoeuvring of a single vehicle
- No manoeuverers are allowed within a traffic line!

11 Notes