Technical Description

ASIM

Triple Technology Combination Detectors

TT 290 Series

Traffic Data Acquisition & Classification

Tri - Tech MW, US & PIR Detection

Tri - Tech detectors use three different physical detection principles and are used for traffic data acquisition applications requiring enhanced accuracy and high reliability.

The built-in digital signal processor (DSP) combines the signals from all sensor channels resulting in accurate information of all vehicles moving into or through the detection area.

Applications

Detection of vehicles with user-selectable functions determined by the installation site and specific purpose for

- **Vehicle classification**
- **Counting of all kinds of vehicles**
- **Speed of passing vehicles**
- **Presence and queue detection**
- **Occupancy and time gap detection**

in a variety of traffic data acquisition and traffic control applications including detection in lanes with alternating traffic.

The detectors are mounted above the lane and aiming along the direction of travel.

They replace inductive loops in many applications without expensive road works or disruption of traffic flow during installation.

Standard Models

- **TT 292 MW, US & PIR (2 Classes)**
- **TT 295 MW, US & PIR (5+1 Classes)**
- **TT 298 MW, US & PIR (8+1 Classes)**

Technical Features

Triple technology combining Doppler Radar, Ultrasonic and Passive Infrared with intelligent logic enables the detector to collect the relevant traffic data including static presence information in case of stationary vehicles.

Adaptive circuitry compensates for temperature and other changing environmental effects.

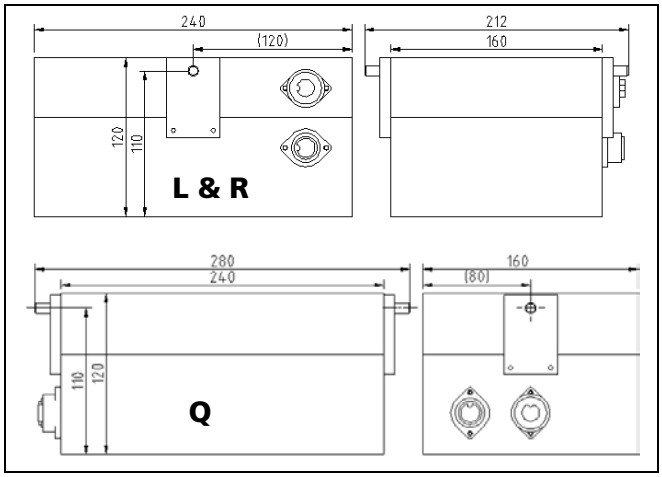
Data transfer between a data collection unit and one or more detector runs via an RS 485 data bus. The internal data buffer stores the information of all vehicles detected since the last data transfer.

Standard mounting hardware is available for quick, stable and easy installation.

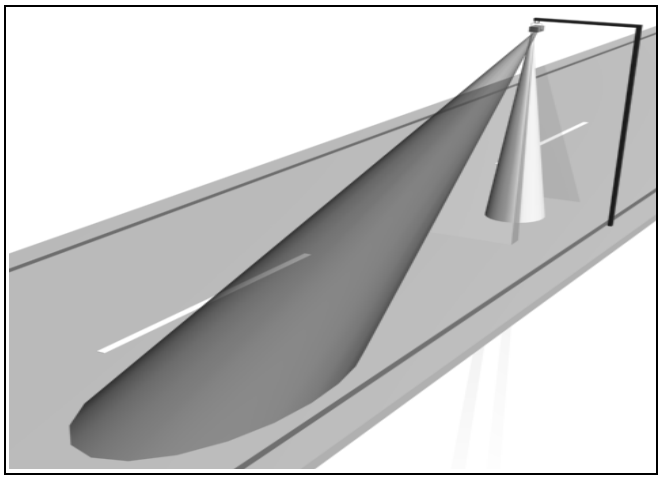
Highlights

- **Classification by Vehicle Type**
- **Accurate Speed and Count**
- **Detection of Stationary Vehicles**
- **Can Detect Alternating Traffic**
- **Detection of Wrong-Way Drivers**

Mechanical Dimensions



Field of View



Specifications

Mechanical

Dimensions	see diagram
Case material	polycarbonate, light grey
Mounting points	M8, stainless steel V2A
Weight	app. 1'700 g

Microwave

Doppler radar	K - Band 24.05 … 24.25 GHz

Ultrasonic

Frequency	50 kHz
Pulse frequency	10 … 30 Hz

Infrared

Sensors	dynamic
Spectral response	8 – 14 μm

Electrical

Supply voltage	10.5 ... 15 V DC
Power consumption	typ. 200 mA @ 12 V DC typ. 50 mA on standby
Outputs	
Data transfer	RS 485 Bus. 9600, 8, e, 1
Turn-on time	typ. 20 s from power on

Accuracy

Counting	typ. ± 3%
Speed	typ. ± 3% (> 100 km/h) typ. ± 3 km/h (≤ 100 km/h)
Classification	vehicle types according TLS (see installation manual)

The specifications refer to free traffic flow situations, detector mounted overhead, operated in frontfire mode.

Environmental

Operating temp.	– 40°C to + 70°C
Humidity	95% RH max.
Sealing	IP 64 splash proof

Accessory IF 485 & Software

Interface module and software for the connection of several detectors on a PC used for installation, configuration and collection of statistical data.

Mounting Accessories

Mounting hardware and cable connectors are <u>not</u> part of the delivery. Information regarding the available accessories depending on the mounting and operation mode according to the separate list.

Ordering - Information

T T 2 9 X – X X 3 – Y Y

Detector Type
- 2 Classes **2**
- 5+1 Classes **5**
- 8+1 Classes **8**

Supply Voltage
- 10.5 ... 15.0 V DC **4**

Outputs
- RS 485 Bus **5**

Colour
- Grey **3**

Mounting
- Longitudinal standard **L**
- Perpendicular **Q**
- Longitudinal reverse **R**

Protocol
- Standard **0**

Data is based on samples and believed to be representative.

Design and specification changes reserved without prior notice.

For more specific information on the products, their installation and application please refer to the installation manual or consult the manufacturer.

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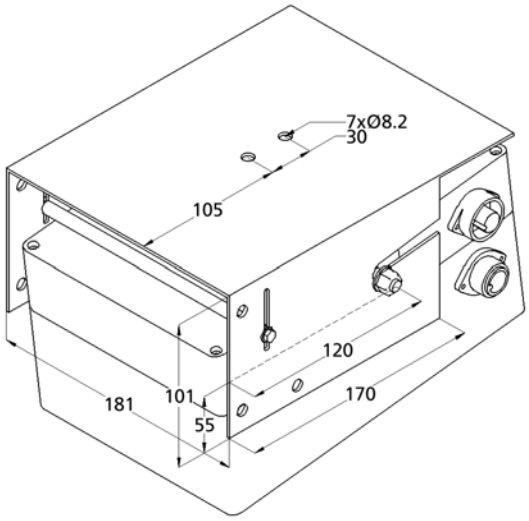
Accessories for Standard Mounting

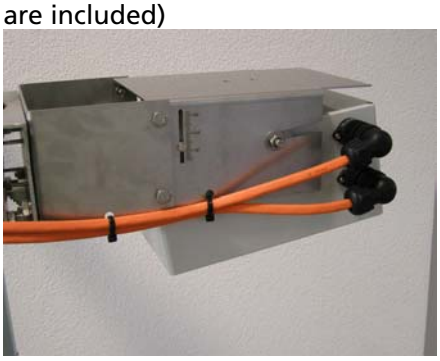
ZA V 290-L1

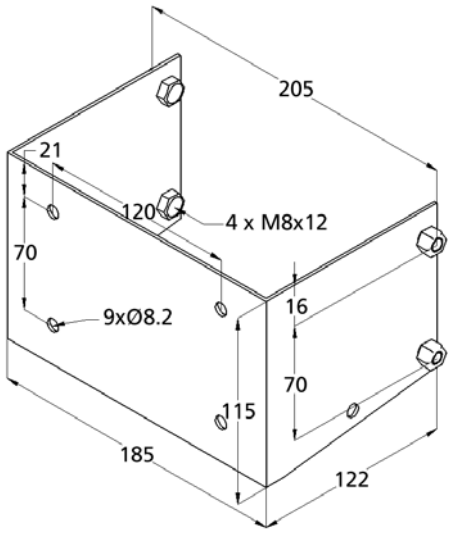
For detector models
TT 29X – XXX – **L** and
TT 29X – XXX – **R**



ZA V 290-L2

Accessory bracket for installation on gantry
(4 x screws M8 x12 with safety nut are included)

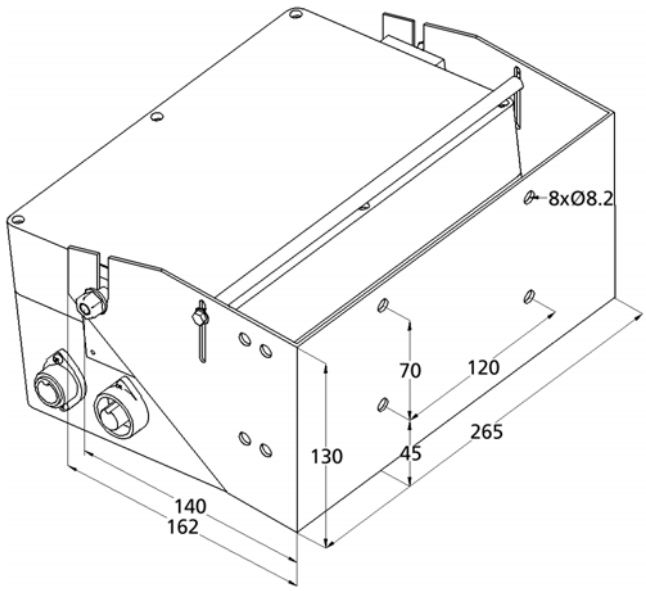




Accessories for Mounting Perpendicular to Traffic Direction

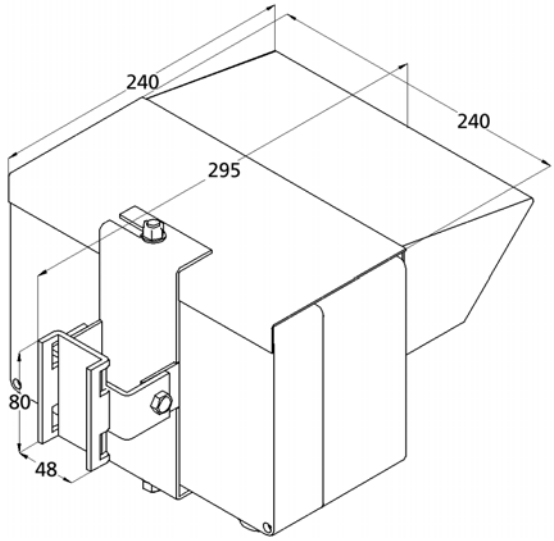
ZA V 290-Q1

For detector model
TT 29X – XXX – **Q**



Accessories for Sidefire Mounting

ZA V 290-L3



Electrical Accessories for Standard Mounting

402054
Receptacle, right angle

402058
Plug, right angle

Electrical Accessories for Sidefire Mounting

402039
Receptacle

402035
Plug

Miscellaneous Accessories for all Mountings

402059
Dust Cap, Box Mounting Receptacle

Supplied with detector

402055
Dust Cap, Box Mounting Plug

Telegram Specification for TT 262 / 265 / 268 and TT 292 / 295 / 298

Contents

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1 Minimum requirements for bus communication

1.1 General rules for the use of IEC TC57/5

According to IEC TC 57 1, only format class FT 1.2 with the following main properties is used: Hamming distance 4, asynchronous, byte-oriented.
Only the unsymmetrical transmission process (unbalanced) is allowed. All the data is binary coded. No special coding rules are required.

1	2	3	4	5	6	7	8	9	10	11	Bit sequence on the line
0	Header								P	1	Identification of the protocol type
0									P	1	
0	Application data								P	1	Control byte, address byte, data bytes
0									P	1	
0	Checksum modulo 256								P	1	Built over the application data
0	End character								P	1	End
Start	LSB							MSB	Parity	Stop	

Transmission rules:

R1 Idle condition on line equals 1-signal

R2 Every character has a start bit (0-signal), 8 information bits, an even parity bit and a stop bit (1-signal).

R3 No idle state is allowed between the signals in a telegram.

R4 The sequence of the user's data characters is terminated by a checksum of modulo 256.

R5 The recipient checks:

per character: Start bit, stop bit and even parity

per telegram:
- the defined starting character
- that the two length bytes 1 and 2 have the same value
- the checksum of the telegram
- the end character

If one of these check results is negative, the telegram will be discarded.

R6 After receiving a telegram, a response can only be sent after an idle state of at least 33 bit (3.3 ms) has elapsed.

A response must be sent no later than 10 ms thereafter (response delay time).

1.2 Telegram types

Long frame (LF) Telegram with variable length			Short frame (SF) Telegram with fixed length=5			Single char (SC) Telegram with fixed length=1
1	**68h**	Start	1	**10h**	Start	**E5h**
2	Length (=2+**n**)	Len	2	control byte	Ctrl	
3	Length (=2+**n**)	Len	3	address byte	Adr	
4	**68h**	Start	4	∑ Checksum mod 256	Σ	
5 . . n+6	control byte address byte Data bytes [**n**]	Ctrl Adr Dat	5	**16h**	End	
n+7	∑ Checksum mod 256	Σ				
n+8	**16h**	End				

Control byte	Function which controls the secondary by the primary see 1.4 Control byte
Address byte	[1-254] Secondary address adjustable OSI2
Data bytes [n] n: 0-40	[0-255] Data bytes

1.3 Realisation of primitives

Send / No reply		Send / Confirm		Request / Respond	
Long frame	---	Long frame	Short frame	Short frame	Long frame
		Long frame	Single char	Short frame	Short frame
				Short frame	Single char

1.4 Control byte

Primary ⇨ **S**econdary								**S**econdary ⇨ **P**rimary							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
0	PRM	FCB	FCV	Function [x]				0	PRM	ACD	DFC	Function [x]			
0	**1**	FCB	FCV	Request/send 0: Reset communication and standardisation of FCB-bit 3: Transfer user data 8: Traffic data 9: Detector status				**0**	**0**	ACF	DFC	Respond/confirm 8 : Traffic data 11: Detector status			

PRM	**Primary Message** 1: indicates a message from the primary 0: indicates a message from the secondary
FCB	**Frame Count Bit** The FCB-bit is an alternating bit for consecutive send/confirm and request/respond telegrams per station. In the first telegram with the FCV – bit = 1 a primary sends to a secondary, the FCB – bit is log. 1. A change in the logical status of the FCB - bit indicates to the secondary that the telegram (or acknowledge character E5h) has been received properly. No change means that the telegram needs to be repeated. The FCB - bit is controlled and administered for every secondary in the primary. It only makes sense for function code 8 (get traffic data) and is not necessary for function codes [0, 3, 9]
FCV	**FCB - Frame Count Bit Valid** 1: Evaluate FCB – bit 0: The FCB – bit is invalid and can not be evaluated
ACF	**Access Demand** 1: a secondary request to the primary to transmit data of class 1 0: no demand
DFC	**Data Flow Control** 1: receive not ready 0: receive ready

2 Telegram description

In the following description all examples has been made with detector address 01h.

2.1 Function [9] detector status

Depending on the communication requirements, the factory settings of the detector can be programmed for function code [9] "on" or "off".

If this function is enabled (function code [9] "on") the following must be sent after each power-on-reset in order to enable the functions 0, 3 or 8.

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	49h	01h	4Ah	16h	Enabling function 0, 3 or 8

Respond	Start	Ctrl	Adr	∑	End	Description
S ⇨ **P**	10h	0Bh	01h	0Ch	16h	Standard response Note 1)

Response	Start	Len	Len	Start	Ctrl	Adr	Status	∑	End	Description
S ⇨ **P**	68h	3	3	68h	0Bh	01h			16h	Status information Note 2)

Note:
1) Version equal or less than 1.3
2) Version 1.4 or higher

2.2 Function [0] reset communication

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	40h	01h	41h	16h	- Initialises frame count bit (FCB) - Clears all traffic data in the data buffer

Respond	SC	Description
S ⇨ **P**	E5h	Data buffer is emptied Note 1) FCB=0

2.3 Function [3] transfer user data

This function writes user data resistant into the detector and it is optional to use.

Send	Start	Len	Len	Start	Ctrl	Adr	ID	Dat	∑	End
P ⇨ **S**	68h	04h	04h	68h	73h	01h				16h

Description	00h	Detection Mode	00h Frontfire mode 01h..FFh Backfire mode								
	01h	Enable status bit information 0: disable 1: enable 3Fh = Enabling all information Note 1)	bit 8	7	6 Queue	5 Wrong-way driver	4 Ultrasonic fault	3 IR 2 fault	2 IR 1 fault	1 Radar fault	
	0Eh	Reset wrong-way driver flag	00h Reset of wrong-way driver information								

Confirm	SC	Description
S ⇨ **P**	E5h	The send command has taken effect

Note:
1) By factory setting all information is enabled

2.3.1 Set mode frontfire / backfire

Send	Start	Len	Len	Start	Ctrl	Adr	ID	Dat	∑	End
P ⇨ **S**	68h	04h	04h	68h	73h	01h	00h	00h	74h	16h

Confirm	SC	Description
S ⇨ **P**	E5h	Frontfire mode has been activated

Send	Start	Len	Len	Start	Ctrl	Adr	ID	Dat	∑	End
P ⇨ **S**	68h	04h	04h	68h	73h	01h	00h	01h	75h	16h

Confirm	SC	Description
S ⇨ **P**	E5h	Backfire mode has been activated

2.3.2 Enabling status information

Send	Start	Len	Len	Start	Ctrl	Adr	ID	Dat	∑	End
P ⇨ **S**	68h	04h	04h	68h	73h	01h	01h	3Fh	B4h	16h

Confirm	SC	Description
S ⇨ **P**	E5h	All status information bits are enabled

2.3.3 Clearing wrong-way driver information

Send	Start	Len	Len	Start	Ctrl	Adr	ID	Dat	∑	End
P ⇨ **S**	68h	04h	04h	68h	73h	01h	0Eh	00h	82h	16h

Confirm	SC	Description
S ⇨ **P**	E5h	Wrong-way driver information has been cleared

2.4 Function [8] traffic data request

The function code 8 allows getting traffic data from the detector. The detector keeps up to 4 vehicles in the data buffer (first in first out). If there was no event in the call interval, the secondary sends the acknowledge character E5h to the primary. Otherwise the information on up to 4 vehicles will be sent by secondary.

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	58h[1)]	01h	59h	16h	Request for traffic data

a) No data in the buffer

Response	SC	Description
S ⇨ **P**	E5h	no traffic data available (data buffer is empty)

b) Data in the buffer
There is a maximum of 4 events for TT 2X2, TT 2X5 and 3 events for TT 2X8 in the data buffer

Response	Start	Len	Len	Start	Ctrl[2)]	Adr	Status	Counter	Vehicle information [1..4]	∑	End
S ⇨ **P**	68h			68h	08h	01h					16h

c) The status information change of the detector will be sent as respond on the next data request. If there is no traffic since last request the secondary provides the response as mentioned below (provided by detector version 1.4 and higher only).

Response	Start	Len	Len	Start	Ctrl[2)]	Adr	Status	∑	End
S ⇨ **P**	68h	3	3	68h	08h	01h			16h

Note:
1) To toggle the FCB Bit is recommend to get complete traffic data
2) If function code [9] = OFF the Ctrl-Byte of the response is always 00h otherwise 08h. It indicates the configuration of function code [9].

Attribute		Range	Description							
		bit	8	7	6	5	4	3	2	1
Status ≈note 1)		00h-03Fh	/	/	Queue	Wrong-way driver	Ultrasonic fault	IR 2 fault	IR 1 fault	Radar fault
Counter ≈note 2)		00h-FFFFFFFFh 0 - 2^{32}	The vehicle counter is saved resistant twice a day. After reaching the maximum value the counter starts again at 1.							
Vehicle		The following data block is for each vehicle and could be repeated up to 4 times								
	Speed	00h – FFh 0 - 255	Speed information with the unit [km/h] or [mph] configured by SW. 0 = queue state 255 = speed can not be measured							
	Class	01h-21h 1-33	As classification criteria of the standard models, the German TLS specification for two classes, five plus one and eight plus one classes are used as a guideline. The classification and number of classes depends on the model and is shown in the table below							
	Occupancy ≈note 2)	00h - FFFFh 0 - 655.35s	Occupancy time in increments of [10 ms]							
	Gap ≈note 2)	00h - FFFFh 0 - 655.35s	Time gap between two vehicles in increments of [10 ms]							
	Length see note 3)	00h – FFh 0 - 255	Length of the vehicle in increments of [0.1 m]							

Note:
1) All enabled status information bits will be advisable (see function code 3).
The wrong-way driver bit will be set after the event and remains until the primary resets the information bit.
2) High byte first / low byte last
3) The length information can be added, if this setting is configured with the installation software.

Model		**TT 2X2**	**TT 2X5**	**TT 2X8**
Class Description		**2**	**5+1**	**8+1**
	car	32	1	7
	motorcycle			10
	delivery van			11
	not identified		6	6
	lorry / truck	33	3	3
	lorry / truck with trailer		4	8
	articulated lorry / semi-trailer			9
	Bus		5	5
	car with trailer		2	2

2.4.1 Example: first request

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	78h	01h	79h	16h	FCV = 1 / FCB = 1 Request for traffic data

Respond	SC	Description
S ⇨ **P**	E5h	No vehicle in the data buffer

2.4.2 Example: second request

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	58h	01h	59h	16h	FCV = 1 / FCB = 0 Acknowledge from first request was received properly and is indicated to the secondary by toggling the FCB – bit.

Respond	LF (long frame)	Description
S ⇨ **P**	Vehicle information 2.4 Function [8] traffic data	The vehicle information in the data buffer is sent as response.

2.4.3 Example: third request

Request	Start	Ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	58h	01h	59h	16h	FCV = 1 / FCB = 0 FCB has not been changed because the second request has not been received correctly.

Respond	LF (long frame)	
S ⇨ **P**	Vehicle information 2.4 Function [8] traffic data	The vehicle information from the second request will be sent again. Additional vehicles during the request time would also be added to the response.

2.4.4 Example: fourth request

Request	Start	ctrl	Adr	∑	End	Description
P ⇨ **S**	10h	78h	01h	79h	16h	FCV = 1 / FCB = 1 FCB was toggled to indicate the correctly received data. The secondary can manage its data buffer.

Respond	SC	Description
S ⇨ **P**	E5h	Data buffer is emptied.

2.5 Startup telegram sequence after a power-on reset

There are two start-up sequences depending on the configuration of the function code [9] in the detector, which can be selected with the ASIM-T.exe program. The following steps have to be done after each power-on reset to get traffic data. It is a general exception handling of power faults, after which the detector needs about 45 seconds to be ready again.

Step	TLS reset code [9] = OFF	TLS reset code [9] = ON note 1)
1	**Function code [0]** ↓ reset communication 2.2 Function [0] reset communication	**Function code [9]** ↓ enabling function code [0,3,8] 2.1 Function [9] detector status
2	**Function code [8]** ⇄ get traffic data 2.4 Function [8] traffic data	**Function code [0]** ↓ reset communication 2.2 Function [0] reset communication
3		**Function code [3]** ↓ set user data (optional) 2.3 Function [3] transfer user data
4		**Function code [8]** ⇄ get traffic data 2.4 Function [8] traffic data

Note:
1) Factory setting.

3 Special traffic situations

3.1 Queue

If a vehicle is staying for more than 6 seconds within the detection area, a queue will be detected (status byte, bit [5] = 1).

The following cases are possible:

a) Request to send data within 0 … 6 seconds from begin of the queue

No event in the data buffer (acknowledge character "E5h")

b) Request to send data after more than 6 seconds from begin of the queue

- Speed = 0
- Class = 32 (car) for TT 262 & TT 292 or Class = 6 (not identified) for TT 265/268 & TT 295/298
- Occupancy time = time since begin of queue
- Time gap = time from the last event to begin of queue
- Counter: unchanged

c) Next request(s) to send data while queue situation persists

- Speed = 0
- Class = 32 (car) for TT 262 & TT 292 or Class = 6 (not identified) for TT 265/268 & TT 295/298
- Occupancy time = call interval (time since last request to send data)
- Time gap = 0.00 seconds
- Counter: unchanged

When the vehicle leaves the detection area, the queue information will be cleared (status byte, bit [5] = 0).

- Speed = 0 … 255 (no meaningful speed information, has to be discarded)
- Class = 32 (car) for TT 262 & TT 292 or Class = 6 (not identified) for TT 265/268 & TT 295/298
- Occupancy time = time from last call to end of queue
- Time gap = 0.00 seconds
- Counter: incremented by 1

3.2 Wrong-way driver

The wrong-way driver detection function can be switched on or off with function code [3].

If this function is enabled and a vehicle is driving through the detection areas in the wrong direction an event with the following data will be written into the data buffer:

- Speed = speed of the vehicle
- Class = class of vehicle
- Occupancy time = occupancy time inside the detection area
- Time gap = time since the last event

Provided that:

- The status byte for the wrong-way driver information was cleared
  ☞2.3 Function [3] transfer user data
- The average speed before this event was above 20 km/h (or 12 m.p.h.)
- The two IR channels respond in the opposite order
- The radar unit detects a negative speed (wrong-way driver)
- The time gap is ≥ 5 seconds

The wrong-way driver information in the status byte has to be cleared with function code [3]. Otherwise the wrong-way driver information remains (even if the next vehicles are driving in the correct direction).