SWARCO

TDC1-PIR

INSTALLATION MANUAL

TDC1-PIR

NON-INTRUSIVE DETECTOR FOR TRAFFIC DATA ACQUISITION

TDC1_Install_BE_20

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CONTENT

1 Introduction

On the following pages you will learn how to install and operate the device in an appropriate way.

We attach great importance to the safe, appropriate and effective handling of this device.
It is therefore important to read this manual thoroughly before using the device. In the manual you will find important instructions helping you to avoid danger and to prolong the reliability and durability of the device and the accessories.

For your own safety you should read the safety instructions. Follow the instructions closely in order to avoid danger for yourself and others or damage to the device.

If you have any questions about the Product, which are not answered in this manual, or if you have problems understanding the descriptions, please contact:

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1.1 Operation Principle of TDC1-PIR Detectors

The TDC1-PIR detectors utilize Passive Infrared (PIR) technology by monitoring multiple detection zones on the monitored lane through its array of PIR sensors. In normal traffic, passing vehicles travel through all the detection zones and in the process trigger the various sensors in sequence, enabling the TDC1 to accurately determine each vehicles' speed and length. The detector provides a classification based on the measured vehicle length.

Besides accurate traffic data, the TDC1 can be used to detect queues (traffic jams) and wrong-way driver.

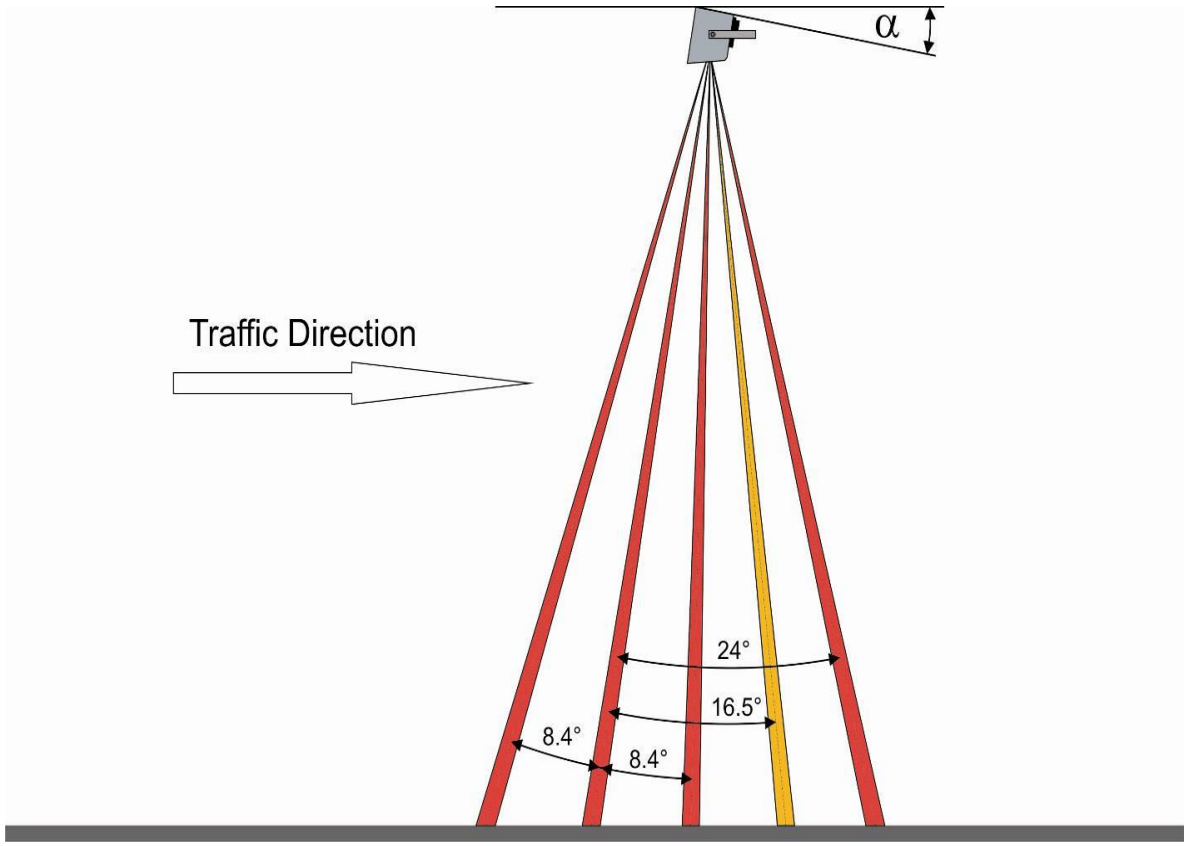
TDC1-PIR detector

2 Detection Areas

A total of five detection zones are projected onto the monitored lane, as evident from the illustration below. Vehicles travel through the detection zones whereby the time it takes for a vehicle to enter and exit the detection zones is used to determine a vehicles speed an length and whether the traffic has come to a stop.

The detector measures the temperature difference between the background and the moving target, which in all cases has a different infrared radiation than the background. Stopped traffic is detected when a vehicle enter but not leaves all the PIR detection zones. Further the detector employs a thermal sensor that captures the absolute temperature of the background and a passing car respectively.

The illustration below shows the mounting and setup of the TDC1-PIR detector.



α = 10° in respect to the road surface

3 Planning the Main Application

The TDC1-PIR is designed for the detection of vehicles within short range. If the detector is mounted according to specification, the width of the various detection zones allows for lane-selective detection.

For accurate data, the detector must be mounted firmly on a stable structure. Especially vibrations and movement caused by wind etc. must be kept to a minimum.

The available **original mounting hardware** assists in the process of mounting the detector firmly, while providing the flexibility required for proper alignment.

For details about the models available, their specific mountings and setups, please refer to chapter 11.

3.1 Mounting Tips for Optimal Traffic Data Quality

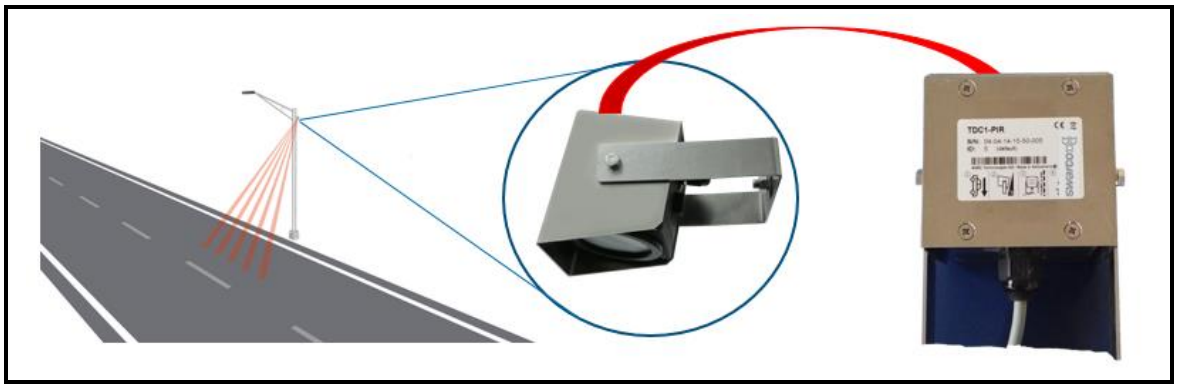
For the detector to perform optimally, it is mandatory that the vehicles travel through all the PIR detection areas in an orderly manner while at the same time detections from vehicles in adjacent lanes must be kept to a minimum and shadowing caused by tall vehicles must be avoided.

A separate software tool is available to assist the engineer in the planning process. The alignment help TDC-AH is specifically designed for assisting the installer in quickly and reliably align the TDC1-PIR detector. Further details available in section 12.3.

The **maximum mounting height** is **5.5 … 18 m (18 … 59 ft)**. The **maximum angle** (vs. the vertical plain) is **45º.**

Important: Applications in which detectors are mounted outside the SWARCO-specified mounting height may result in reduced detection quality, detection of vehicles in adjacent lanes and abnormal status messages.

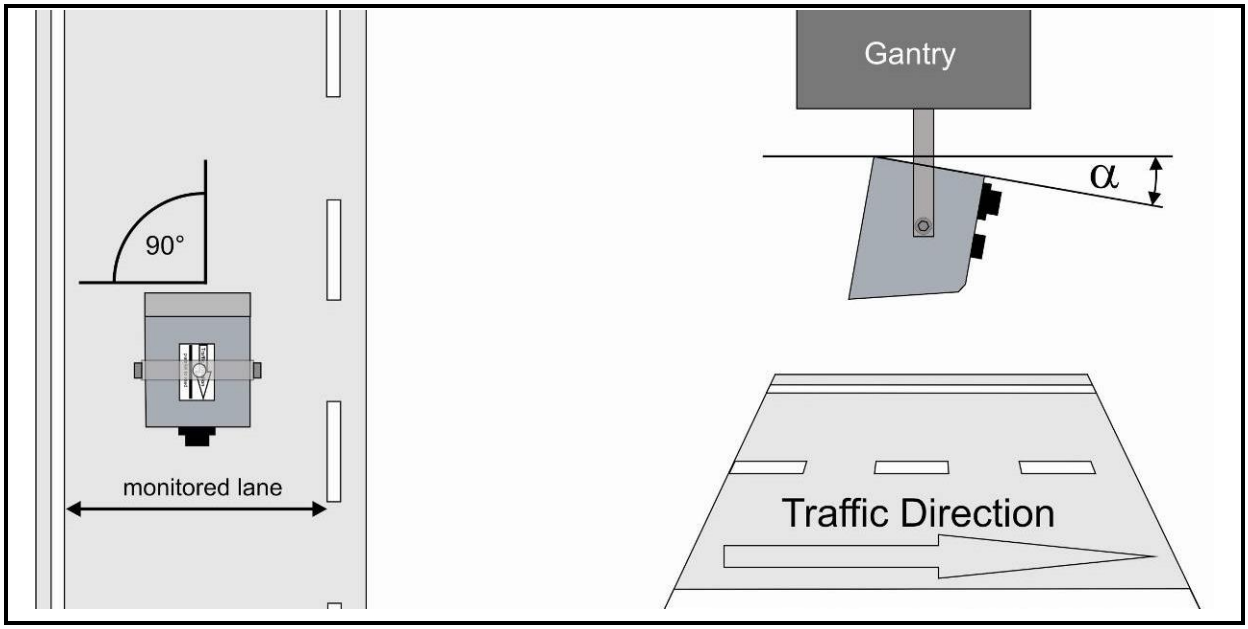
- The detector must always be operated in the frontfire-mode with traffic direction corresponding to the label on the detector enclosure:



- The detector has to be firmly mounted between 0° (right above centre of the monitored lane) and 45° (to either side of the monitored lane) not exceeding the maximum distance of 20 m permitted between the detector and the centre of the lane under surveillance.
- When the detector is mounted on the side of the road to monitor the far lane, shadowing of that lane by tall vehicles in the near lane will affect data accuracy. A significantly increased minimum mounting height applies to minimize or eliminate data errors from tall vehicles in the near lane

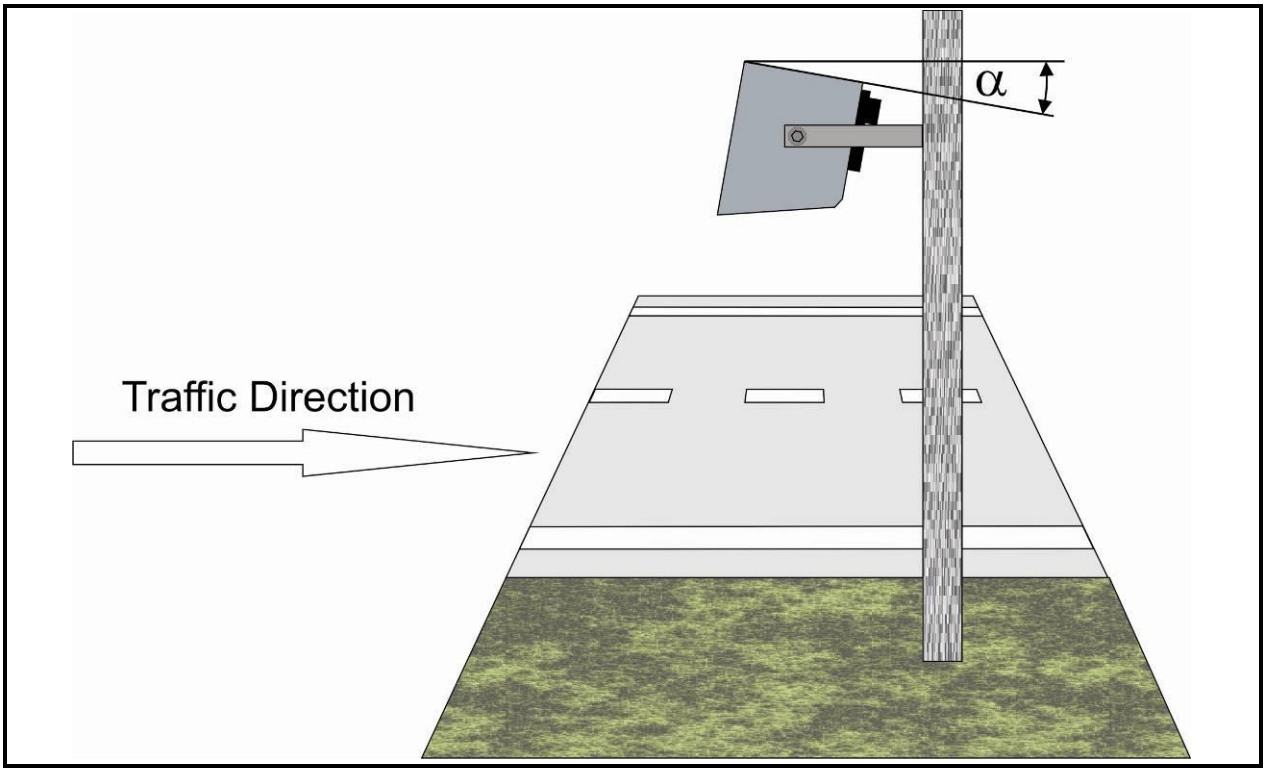
3.2 Overhead Mount: Installation Steps

1) The detector must be securely mounted at the gantry or other stable structure straight above the middle of the lane to be monitored
2) The “Traffic Direction” label on the detector’s housing corresponds to the actual traffic direction, the parallel to road line is parallel to the direction of the traffic.
3) The detector must be tilted by 10º vs. the road surface, as shown in the right-hand side illustration below.
4) Pay special attention to the detection zones geometry and ensure that all of the detection zones have line-of-sight from the road surface to the front-window of the detector.

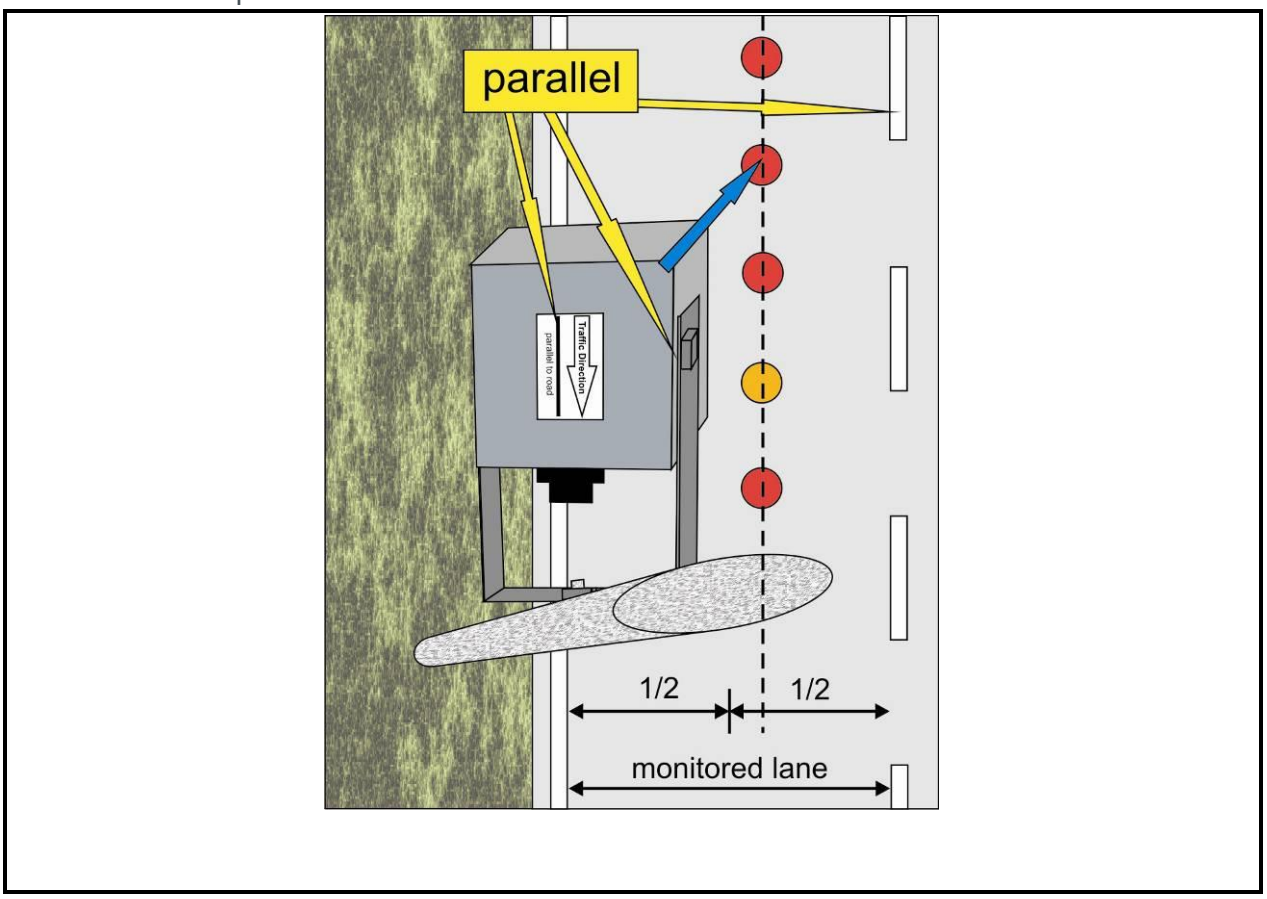


3.3 Side Mount: Installation Steps

1) The detector is mounted at the pole on the road-side.
2) The “traffic direction” sticker on the housing must match the traffic direction on the monitored lane, in addition the line “parallel to road” must be aligned parallel to the lane direction.
3) The detector must be tilted towards the approaching traffic by α=10º vs. the lane surface (see below).



1) Turn the detector so that the edge (blue arrow) points approximately **0.5 m beyond the middle of the lane to be monitored** at the same time be sure that the “parallel to road” line remains parallel to the road.



4 Traffic Data

4.1 Counting / Volume

The combination of the five detection zones ensures highly accurate volume information of all vehicle classes. Occasional over or under counting can occur in special situations such as slow-moving (Stop&Go) traffic.

4.2 Speed

During normal traffic flow, the speed of each vehicle is measured. These individual speed values are subject to some tolerances. Systematic offsets resulting from mounting and alignment inaccuracies can be virtually eliminated **through the corrective v-factor which can be configured remotely** in the installation and commissioning software DET-SOFT, eliminating the need to change the hardware alignment.

4.3 Example of Traffic Data (Standard Protocol)

address	time stamp [hh:mm:ss]	speed [km/h] (mph)	vehicle length (dm)	class	occupancy [s]	time gap / headway [s]	status	counter
1	12:47:20	126	39	32	0.11	22.36	0	57341

4.4 Self-Check and Status Output

The detector features full self check capability. All signal patterns and timing criteria are permanently checked and adjusted. A failure of any detection channel in the unit triggers a fault condition, which is communicated in the status byte of the communications data packet. This status information has to be monitored permanently during operation of the detector. Following error conditions are reported:

PIR fault
Thermo fault
HW fault
Supply Voltage Low
Wrong-way driver
Queue / Traffic jam

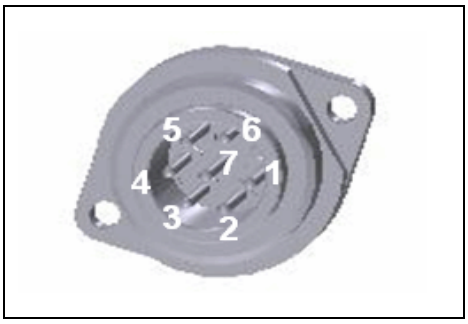
5 Wiring

5.1 Electrical Connections of the TDC1-PIR Detector

Version with Connector Socket

Each TDC1-PIR detector is equipped with a male connector socket as illustrated in the picture below. Matching connector is part of the delivery. For details refer to chapter 12.

Male Connector Socket



Pin Definition for Male Connector Socket

1 Positive Supply Voltage, Vcc
2 Option Trigger Output
(special version, available on request)
3 GND
4 Do not use!
5 RS 485 Signal A
6 RS 485 Signal B
7 Do not use!

Version with Cable

Green:	Positive Supply Voltage, Vcc
Brown:	GND
White:	RS 485 Signal A
Yellow:	RS 485 Signal B

5.2 Recommendations for Cabling

- Polyurethane (PUR) Cable with shield and twisted pair wiring
- Wire cross-section: 0.34 … 0.52 mm2 (AWG 22 or AWG 20) braided or twisted filament *)
- Cable entry assembly of plug PG 9: Diameter 6 … 12.5 mm (0.24 … 0.47 inches)
- Maximum wire cross-section of receptacle and plug: 0.75 mm²
- Supply (5.5 V DC … 30 V DC nominal): 2 wires
- RS 485 communication: 2 wires, twisted pair
- Shield: Connect to ground at the end near the control device.

The RS 485 standard requires a bus topology (vs. ring or star topologies). To ensure proper communication, **the data bus must be terminated on both ends**.

The USB IF 485 interface module, available as original accessory features a built-in terminating resistor. This **resistor is factory** set to terminate the bus.

The **last detector on the bus**, on the opposite end of the USB IF 485 interface module, also needs a **terminating resistor of 120 Ω**. This can be accomplished simply by adding a resistor between the **wires RS 485 A / RS 485 B**.

5.3 RS 485 Communication

The detector provides the traffic data through its RS 485 data bus connection. The data needs to be actively polled. The traffic data can be acquired and analysed by any data acquisition equipment or by a PC equipped with proper software that implements the protocol specification. **For details see the protocol specification.**

To operate one or more detectors on a PC or any device featuring an USB interface, an interface module USB-IF485 (original SWARCO accessory) is required.

Using proper wiring, the two-way RS 485 communication between detectors and the data aggregation module is designed to operate over total distance of up to 1'000 meters (3'280 ft) according to RS 485 specification.

Protocol: 9600, 8, E, 1

9600	= 9600 Baud
8	= 8 Data Bits
E	= Even parity
1	= 1 Stop Bit

5.4 Data Buffer

The internal data buffer of the detector can keep information of up to four vehicles. If more than four vehicles have passed since the last polling event, **only the last four vehicles'** data is transmitted. It is therefore important to select the polling interval short enough to ensure no data is lost, especially in situations with high traffic volume.

6 Interface Module and Software

6.1 Interface Module USB-IF485

The interface module USB-IF485 is an original SWARCO accessory for the TDC1-PIR detector. The interface converts the signals from the detector's RS 485 to USB compatible levels. The interface is necessary for two-way communication between the detectors and a PC.

6.2 Software for the TDC1-PIR Detector

The Windows-based installation software DET-SOFT is a useful tool for the commissioning, configuration and for statistical purposes or fault finding. The software for the installation and setup of the detectors is normally supplied with the USB-IF485.

Before starting the program, it is imperative that the detectors are electrically stabilised and have adjusted to the environmental temperature. Allow at least 30 minutes for the thermal stabilisation.

Applications of the Installation Software

The installation software is a very helpful tool for modifying and verifying a detector's configuration remotely and to verify the alignment. It greatly improves the optimisation process of an installation and reduces the time to accommodate the requirements of a given location. The configuration function is a self-calibration process considering the site conditions (mounting height, distance to the centre of the observed lane) for achieving the optimum settings which are saved into each participating detectors non-volatile memory. **It is mandatory to run the configuration for each installation!**

If the detector is commissioned using the "configuration" function in the DET-SOFT software, a log-file is created in the user selected folder. This file contains the actual configuration and the traffic data obtained during the self-configuration process.

Examination and interpretation of the information collected by the installation software greatly assists in identifying the most effective steps to optimize the solution either by adjusting the alignment and/or the settings of the detector or by removing disturbance sources from within the field of view.

The **DET-SOFT** software features a statistical function to collect statistical data from each of the detectors connected to the data aggregation module. The data is stored in text-files on a per day, per detector basis thus allowing for easy long-term data acquisition.

Note: It is recommended to always use the latest available installation software to ensure all detector features and functions are fully supported.

7 Special Traffic Situations

7.1 Wrong-Way Driver (Wrong-Way Vehicle Detection)

The TDC1-PIR detector can detect vehicles driving in the wrong direction. In order for the corresponding status-bit to signal such an event, the Wrong-Way Driver detection needs to be activated in the “configuration” menu of the DET-SOFT.

If all conditions are met, the corresponding bit in the status byte is set. Subsequent vehicles travelling in the correct direction clear the bit (factory setting). Accommodating other requirements and policies, the detector can be also configured to require the bit be reset using the proper command. **Consult the protocol specification for details.**

7.2 Queue / Traffic Stand Still

If a vehicle comes to a stop and remains in the detection area for more than 6 seconds (factory setting), the detector sets the status bit “Queue”.

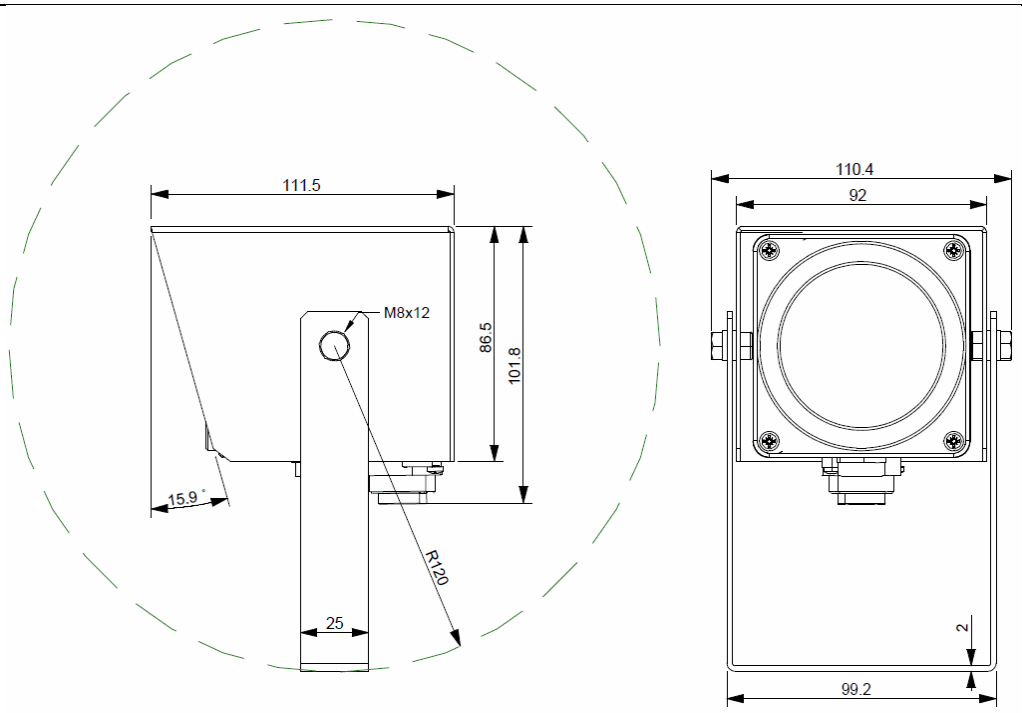
7.3 Stop&Go

Data acquired in Stop&Go traffic flow is less accurate because vehicles tend to accelerate or decelerate within or between the detection areas resulting in inaccurate speed information. Since speed information is used to determine a vehicle’s length, the length information and thus the entire classification information tends to be less accurate compared to free flowing traffic.

8 Specification TDC1-PIR

Electrical	
Supply Voltage	5.5 … 30 V DC
Power Consumption	typ. 10 mA @ 6 V DC
Output (Data Transfer)	RS 485 (other options on request)
Turn-on Time	typ. 20 s from power on
Mechanical	
Dimensions	see drawing
Case Material	Polycarbonate, dark grey
Weather Protection Enclosure	stainless steel V4A
Weight	app. 800 g incl. bracket
Detection	
PIR Sensors	5 channel PIR
PIR Spectral Response	6.5 … 14 µm
Accuracy	
Counting	typ. ± 3%
Speed	typ. ± 5% (> 100 km/h) typ. ± 5km/h (≤ 100 km/h)
Classification	3 standard classes, each 95% The specifications refer to free traffic flow, detector operated in recommended setup.
Environmental	
Operating Temperature	–40°C to +70°C (–40 to +158ºF)
Humidity	95 % RH max.
Sealing	IP 64 splash proof

8.1 Mechanical Dimensions



Dimensions in mm

9 Disclaimer

Despite the construction and assembly according to the latest technological advances, absolute reliability and information accuracy cannot be guaranteed due to the nature of the passive infrared detection principle.

The traffic data accuracy strongly correlates to the exact alignment and proper configuration, the environmental conditions, in particular the prevalent thermal contrast and to the form and shape of an object's surface.

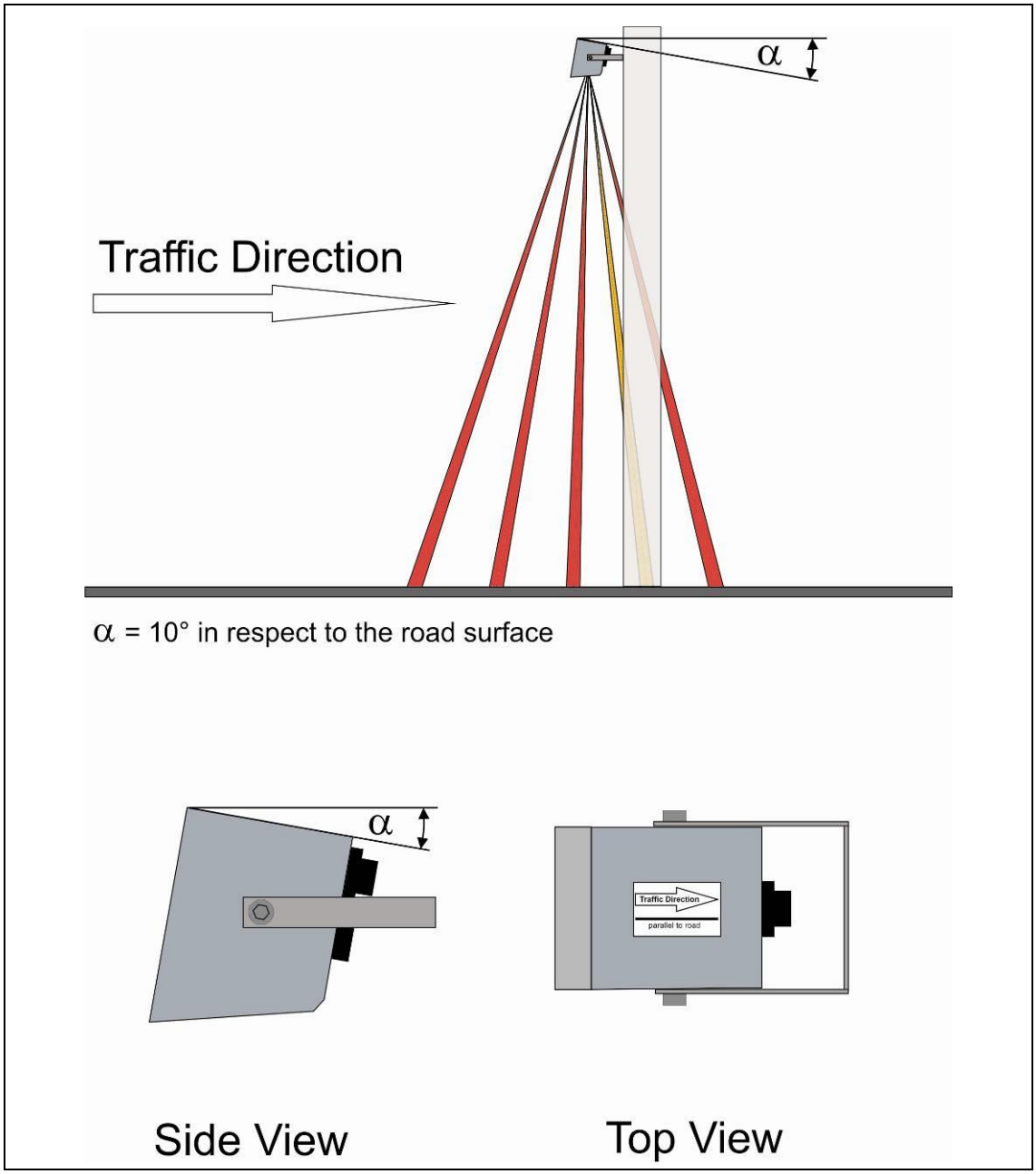
The TDC1-PIR detector has been tested under the **recommended mounting conditions as defined in section 11.1** of this manual and in accordance with the TLS 2002 and the conditions defined therein (loose free flow traffic in the centre of the lane). Depending on the real operating and traffic conditions smaller or larger deviations from the true traffic data can occur.

SWARCO assumes no liability, direct or indirect, resulting from the installation or use of any TDC1-PIR detector. The technical information provided in this product manual is based on a sample population taken from regular production units and is believed to be representative for the entire population. SWARCO reserves the right to change product information and specifications without notice.

10 Appendix to Mounting and Ordering Information

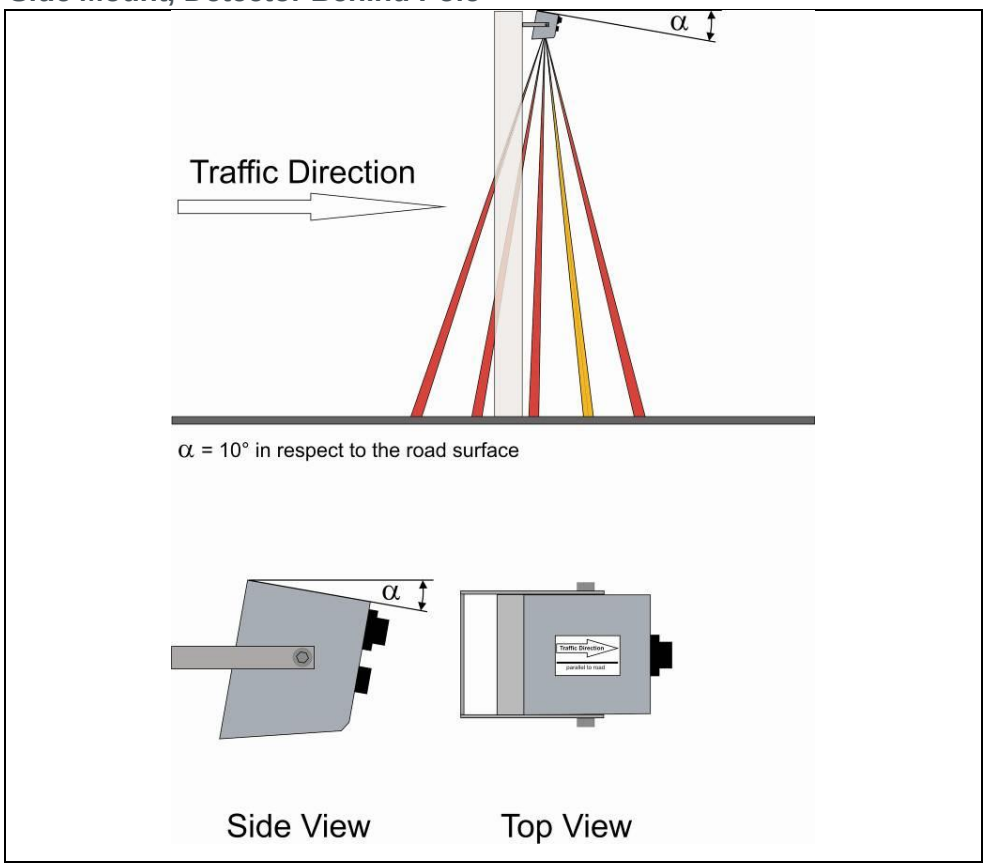
The TDC1-PIR detector has been tested under following recommended mounting conditions:

10.1 Side Mount, Detector in Front of Pole



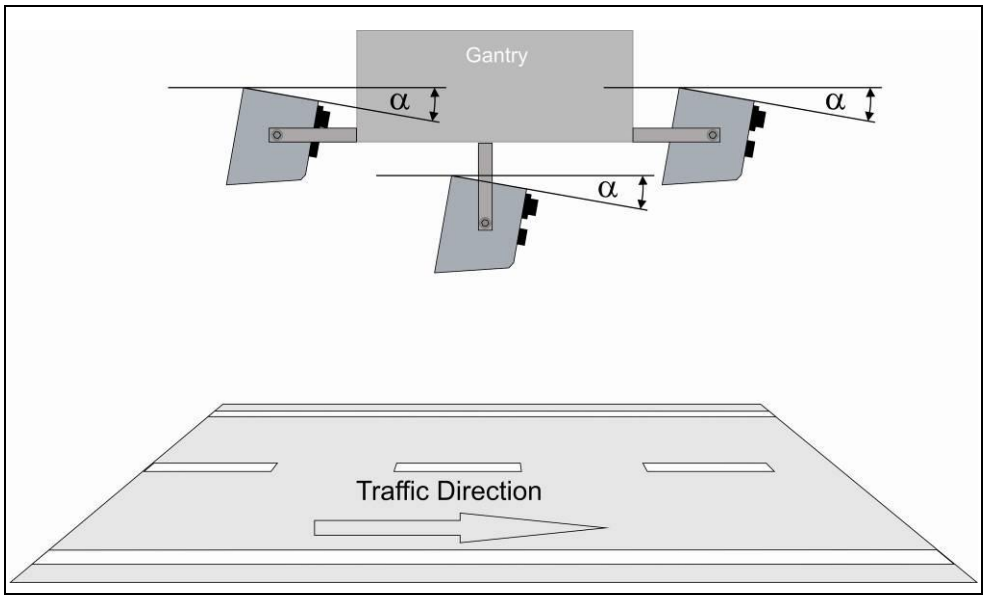
10.2 Alternative Mounting Locations and Alignment

Side Mount, Detector Behind Pole



Important: If the detector is mounted **behind the pole** make sure that **it does not obstruct** the view of the detector to the detection zones!

Mounting Overhead at Gantry



10.3 Detector Model and Ordering Information

Model	Ordering number	Description
TDC1-PIR	D.000.400.046	3 Classes, Frontfire

11 Appendix to Accessories

11.1 Pole Mount Adapter

TDC-PMA to easily mount the detector on a pole
Ordering number: D.000.604.475

11.2 Connector

Female Cable Connector Right Angled
Ordering number: D.000.605.013

11.3 Interface Module RS 485/USB with DET-Soft

USB-IF485
Ordering number: D.000.605.011

11.4 Alignment Help for TDC1-PIR

TDC-AH
Ordering number: D.000.400.047

11.5 Base Station with Solar Panel, Battery and 2G/3G Modem

BS2-TS
Ordering number: D.000.604.618