ASIM

Installation Manual
Tri-Tech TT 290 Series
Combination Detectors for
Traffic Data Acquisition

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)**

Highlights

- **Vehicle Count**
- **Speed Assessment**
- **Classification by Vehicle Type**
- **Detection of Stopped Vehicles**
- **Can Detect Alternating Traffic**
- **Detection of Wrong-Way Drivers**
- **Easy Mounting and Maintenance**
- **Vehicle Length Information with TT 295 / TT 298**

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1 Introduction

1.1 Triple-Technology (Tri-Tech) Detection

The combination of the Doppler Radar, Ultrasonic and Passive Infrared detection technologies results in excellent performance characteristics under all traffic and weather conditions.

1.1.1 Microwave Doppler Radar (MW)

The Doppler radar detects the frequency shift of microwave radiation reflected by a moving vehicle. This frequency shift is proportional to the speed of a vehicle and provides individual speed information for each vehicle passed.

1.1.2 Ultrasonic (US)

The Ultrasonic part operates within the inaudible acoustic frequency range at approx. 50 kHz. For the detection and classification, short bursts of ultrasound are emitted and received. The time for the echo to return provides distance information between the object's surface and the detector. A vehicle standing in the US detection area can be detected for an unlimited period of time thus providing true presence information.

1.1.3 Passive Infrared (PIR)

The Passive Infrared (PIR) detection principle detects moving objects as they cause radiation contrast changes to the background. The intensity of the radiation contrast can be either positive or negative, even a fraction of a degree can result in significant radiation contrasts.

1.2 Operation Principle of the Detectors of TT 290 Series

The detectors of the TT 290 Series combine the three technologies described above into one robust, weatherproof housing. Passing vehicles generate signals in each subsystem. These signals are separately amplified and processed by a microcontroller, providing additional redundancy resulting in increased self-check capabilities and high reliability.

The radar part measures the speed of each vehicle. The ultrasonic part scans the vehicle profile to determine the vehicle classes and separates vehicles in the traffic stream for accurate count information. The multichannel PIR provides lane-selective information and triggers the ultrasonic measurement. In power-save mode, the PIR also activates the radar.

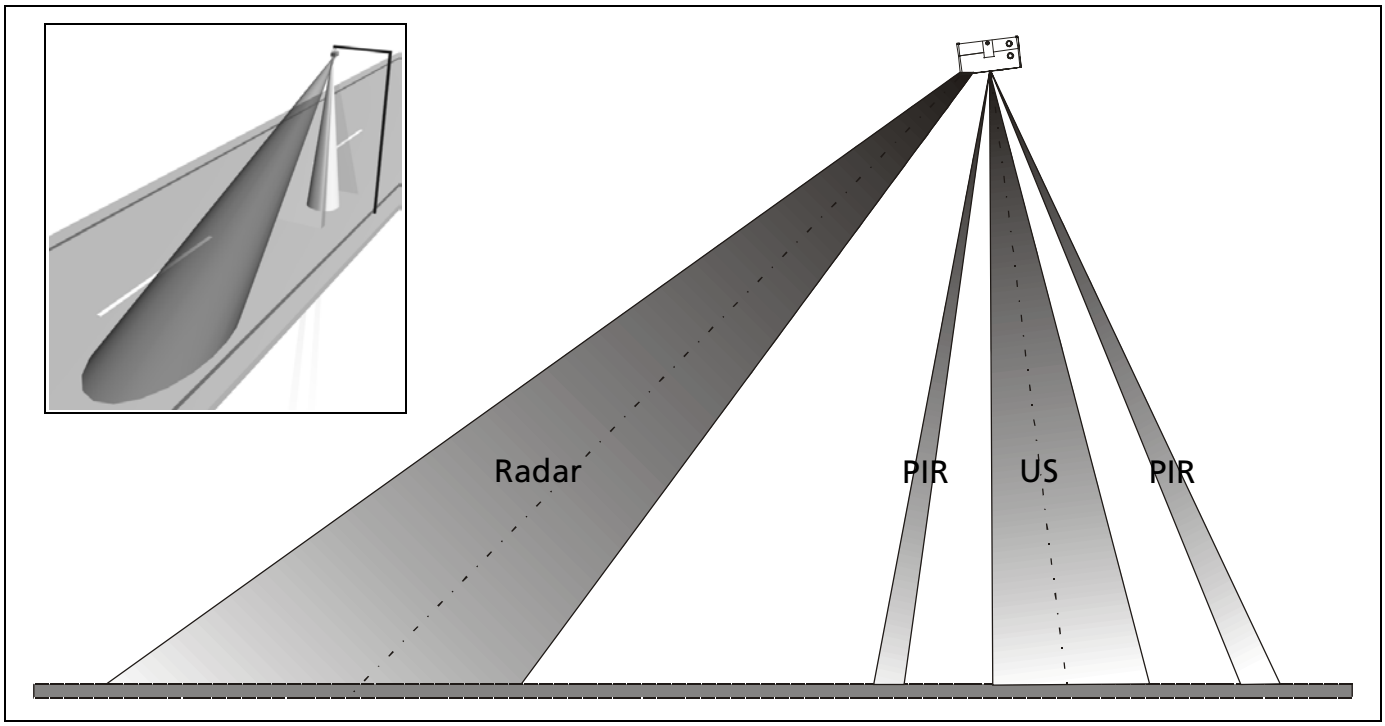
Classification is accomplished using the length and the shape of a vehicle passed. Depending on the detectors model, vehicles are divided into two classes (TT 292), five plus one classes (TT 295) and eight plus one classes (TT 298).

2 General Information

2.1 Detection Areas

The radar part of the detector features a cone shaped detection zone followed by the two PIR detection zones enclose the cone shaped ultrasonic part. The precise geometry and range of these four detection zones depends on the mounting height of the detector. It is designed to cover one lane provided the detector is mounted above the lane on a bridge or other overhead construction (see figure).

The angles between the radar cone, the ultrasonic cone and the two PIR zones are fixed and thus determine the detection geometry. The distances are interdependent, defined through mounting height and alignment angle of the detector enclosure relative to the lane surface. Please consult chapter 3.1 for further details.



2.2 Counting / Volume

The combination of the three subsystems 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.

2.3 Speed

During normal traffic flow, the speed of each vehicle is obtained. These individual values can have some tolerances, average values however are deemed to be very accurate especially if the detector is calibrated using a reference system: If speed information is systematically inaccurate, the detector can be adjusted by the corrective v-factor in the installation program ASIM-T.exe without a hardware alignment.

2.4 Vehicle Classification

Each vehicle moving or through the detection areas can be detected and classified individually. As classification criteria of the standard models, the German TLS specifications for two classes (car and lorry / truck), 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:

In Stop&Go traffic or similar situations the classification accuracy, particularly for more than 2 classes, is severely impaired.

Model		TT 292	TT 295	TT 298
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

Other classifications are available upon request.

2.5 Self-Check and Status Output

The detector features an internal self check facility whereby the data pattern and time criteria of all major functions are permanently checked and processed.

Failure of any detection subsystem of the unit will result in a fault condition, which is identified in the status byte in the protocol. This status information has to be monitored permanently during operation of the detector.

The 'scope' function in the ASIM-T.exe installation software indicates the status as follows:

Value	Status Output
1	Radar fault
2	IR1 fault
4	IR2 fault
8	Ultrasonic fault
16	Wrong-way driver
32	Queue / Traffic jam

Combination of different errors can occur and are evident as follows: status byte value of 33 corresponds to 32 (queue) + 1 (Radar fault).

Further information regarding the status output is available in the telegram specifications. Information about the Wrong-Way Driver is available under chapter 6.2.

3 Planning the Main Application

The detectors of TT 290 Series are designed for the detection of vehicles within short range. 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.

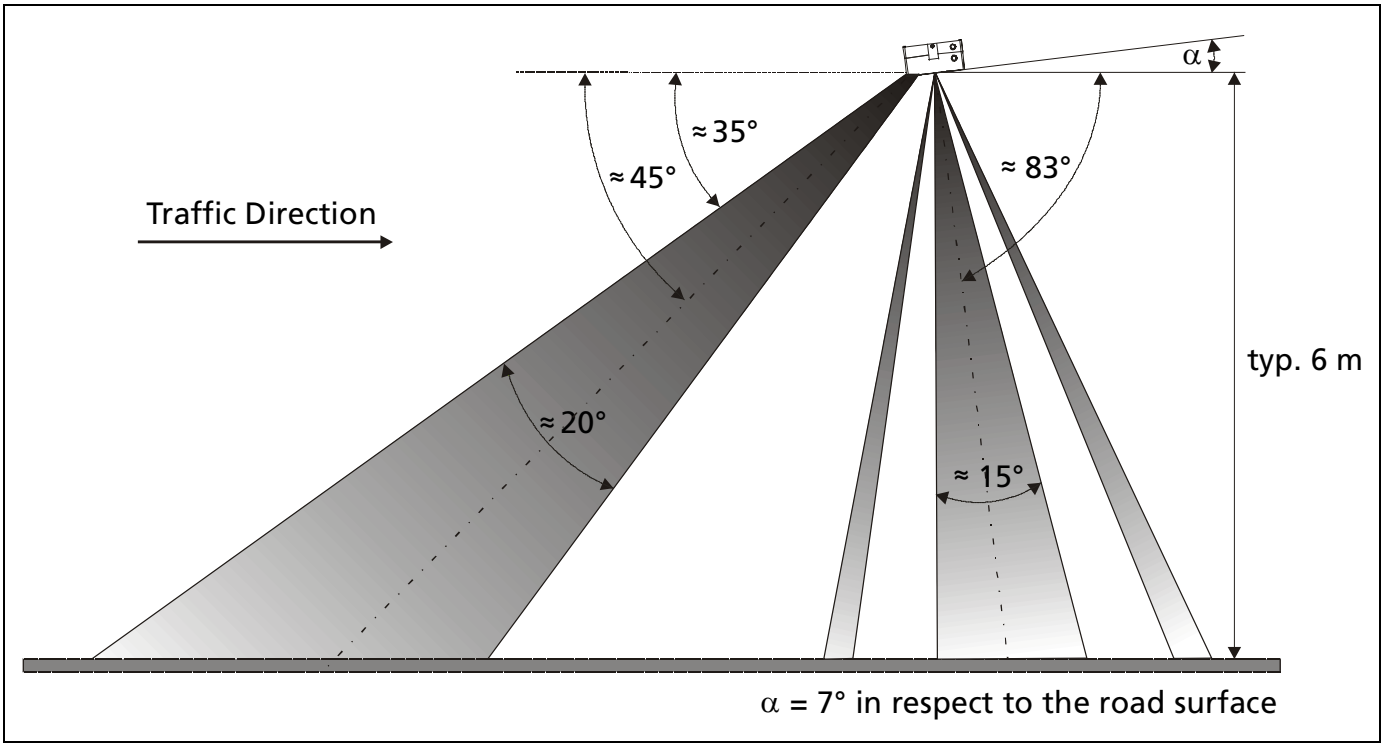
The available original mounting hardware assists in the process of mounting the detector firmly, yet it provides for the flexibility required for proper alignment.

3.1 Mounting Tips for Optimal Traffic Data Quality

For the detector to perform optimally, it is mandatory that the vehicles travel through the various detection areas (Doppler radar, ultrasonic cone and all PIR detection channels) in an orderly manner while at the same time vehicles from adjacent lanes must not travel through any of the detection areas.

The **recommended mounting height** of the **TT 292 is 5 to 7.5 m** (16 to 24 ft), for the detector models **TT 295 and TT 298 5 to 6 m** (16 to 20 ft).

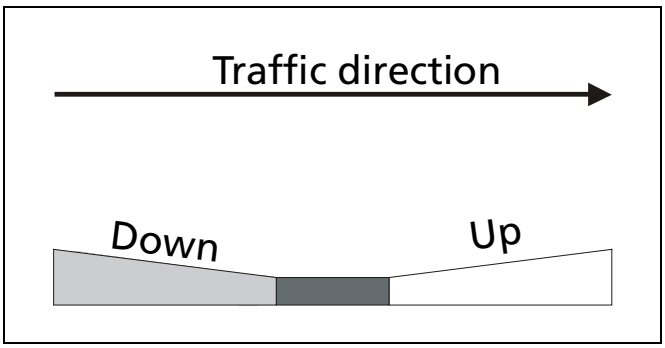
The detector is preferably operated in the frontfire-mode (radar cone faces the approaching traffic). This setup provides the most accurate traffic data.

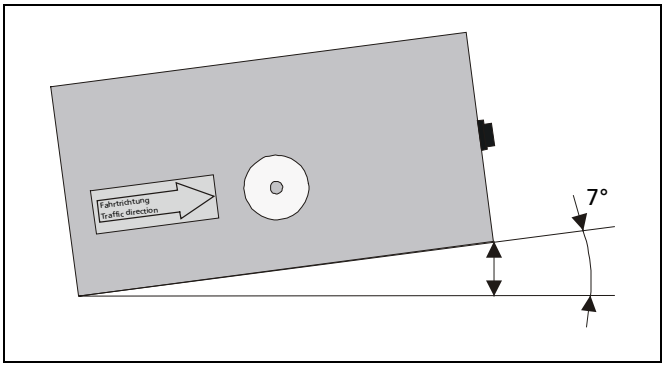


- The detector needs to be aimed at the centre of the lane to prevent vehicles in adjacent lanes from affecting the accuracy of the speed information.
- For best possible data accuracy, the detector's angle in respect to the road surface has to be set to 7 degrees according to the above graph. For this the alignment help of the mounting bracket model ZA V 290-L1 can be used.
- If the lane to be observed has a slope, the detector needs to be aligned accordingly such that the resulting angle between the detector and the lane is again 7 degrees.

If the detector is operated in the backfire mode (radar cone is facing departing traffic) the traffic data is likely to be less accurate.

Gradient of the Road	Angle of Tilt *
-14 %	-1.00°
-12 %	0.00°
-10 %	1.50°
-8 %	2.50°
-6 %	3.50°
-4 %	4.50°
-2 %	6.00°
0 %	7.00°
2 %	8.00°
4 %	9.50°
6 %	10.50°
8 %	11.50°
10 %	12.50°
12 %	14.00°
14 %	15.00°

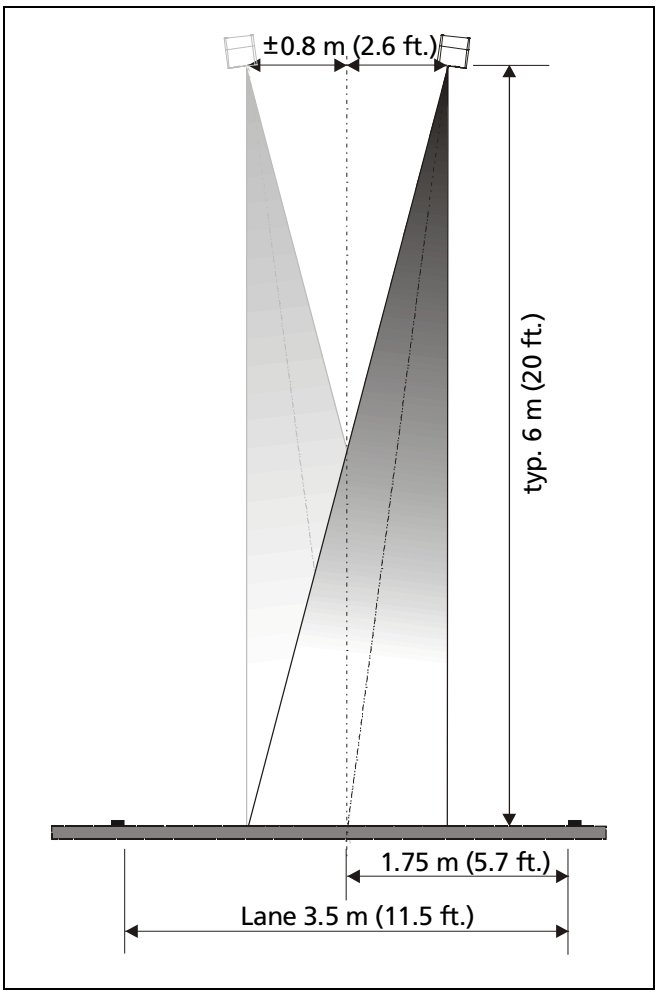




*** This information is in respect to the horizontal plane**

3.1.1 Mounting of Detector Left or Right of the Centre of the Lane

The detector can be mounted to the left or right of the centre of the lane to be monitored, up to +/- 0.8 meter (+/-2.6 feet). In this situation it is mandatory to align the detector such that it faces again to the centre of the lane. If such alignment cannot be achieved, the detector needs to be operated in the sidefire mode. (See the separate document for classification by vehicle length).



Mounting the detector left or right from the centre of the lane will likely result in less accurate traffic data.

4 RS 485 Communication

The detector provides the 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. The protocol specification is available upon request.

The data is formatted according the standard defined below; other formats are also available upon request.

To operate one or more detectors on a PC or any device featuring an RS 232 interface, an interface module IF 485 (original ASIM accessory) is required. Please refer to chapter 5 for a description of the wiring.

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 (3,300 feet) according to RS 485 specification.

There is no terminating resistor (120 Ohm) built into the detector, please see chapter 5 "Wiring Instructions for Detectors" on page 10 for instructions on how to properly terminate the RS 485 bus.

Protocol: 9600, 8, e, 1

9600	= 9600 Baud
8	= 8 Data Bits
e	= even parity
1	= 1 Stop Bit

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, 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.

Each detector has a factory-set address, stored in the EEPROM of the detector's micro controller. This address can easily be changed using ASIM-T.exe installation software.

Start-up time

The detector takes about 20 seconds after power-on to become operational. This time is valid after the detector has adjusted itself to the environment temperature.

4.1 Interface Module and Software

4.1.1 Product Description

The interface module IF 485 is an original ASIM accessory for detectors of the TT 290 Series. The interface converts the signals from the detector's RS 485 to RS 232 compatible levels. The interface is necessary for two-way communication between the detectors and a PC.

The software for the installation and setup of the detectors is part of the interface module; it is included in the interface module upon request (no additional charge applies to software).

After the start-up time of the detector has elapsed, it can be configured and calibrated using the installation software „**ASIM-T.exe**".

The "ASIM-T.exe" software allows generation of 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.

If the detector is commissioned using the "auto-configuration" function in the ASIM-T.exe software, a log-file is created in the "Dat" folder. This file illustrates the actual configuration and the traffic data obtained during the self-configuration period.

Comment on software version:

It is recommended always to use the latest available version. Earlier versions may have reduced features and should therefore be deleted.

IF 485

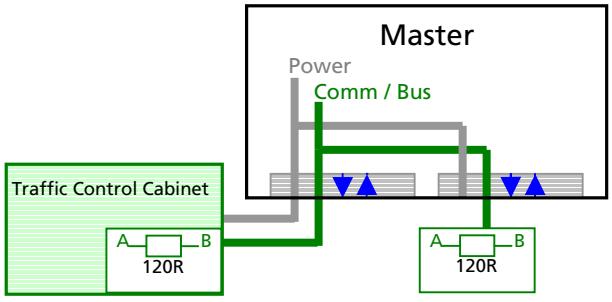
Technical Data IF 485

Dimensions (L x W x H)	100 x 65 x 35 mm (3.93 x 2.55 x 1.38 inches)
Weight	app. 250 g (8.8 oz)
Cable – Length	2.5 m (8.2 feet), stripped on one end. Maximum length no to exceed 1000m (3300 feet)
Cable – Colours	White – RS 485 A Yellow – RS 485 B Brown – Ground (optional)
Cable to PC	9-pin serial, straight-through cable 3 m (10 feet) long
Power	External, 9 to 24 V DC (adapter cable included, tip is plus)
Power consumption	app. 16 mA

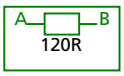
5 Wiring Instructions for Detectors

5.1 Single Detector Application (Master)

Standard version with plug and socket



Comment:
The communication bus has to be properly terminated with 120 Ω at both ends.



Terminating resistor of 120 Ohm connecting RS 485 A and RS 485 B data bus lines

5.2 Operation of Multiple Detectors at the Same Data Bus

5.2.1 Master/Slave Wiring Using Two-Connector Devices

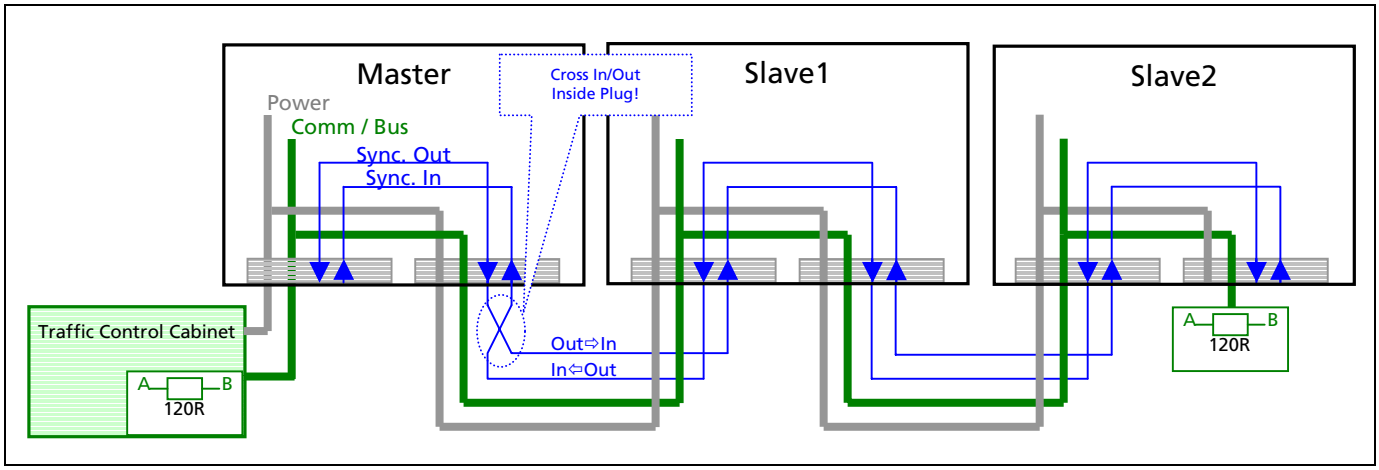
Up to 32 detectors can be operated on the same RS 485 data bus. To ensure proper communication, each detector **needs to be assigned a different address**. Using the ASIM-T.exe installation software, this can be done easily **prior** connecting the detectors to the bus to avoid data collision or after the installation at any time.

If multiple detectors are mounted in close proximity, **they need to be synchronized** using the master/slave synchronization input/output. This ensures that the detectors' range measurement process works properly and the ultrasonic signals do not affect each other. In this situation, one detector is chosen to be the master, the others the slaves. Please also see the function "auto configuration" of the ASIM-T.exe software.

The detector above the lane with the highest traffic volume should be configured as "master". All other detectors are configured as "slaves". This also applies in situations where both directions at the same spot are monitored.

If several lanes in both directions are monitored in the same location, one detector configured as "master" gives the synchronisation, all other detectors have to be configured as "slaves". It has to be considered, however, that in case of a failure of the "master" all detectors at this location would stop working properly.

If the distance is ≥ 8 m between the nearest detectors of the two directions it is recommended to configure the two directions separately with one "master" each.



If the master unit fails, it is crucial to replace the detector as soon as possible in order for the data acquisition process to proceed. If however a slave stops working, it can be removed as long as the two connectors leading to the unit are plugged together once the unit has been removed.

5.3 Bus-Terminating Resistors

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 IF 485 interface module features a built-in terminating resistor. This resistor is factory set to terminate the bus, it can, however, be turned on or off using the DIP-Switches S1, S2 and S3 on the IF 485 PCB.

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

5.4 Electrical Connections of the Detectors of the TT 290 Series

Each detector of the TT 290 Series is equipped with a male and female connector socket as illustrated in the picture below. Matching connectors are not part of the delivery but available as original accessories.

Male Connector Socket

Female Connector Socket

1 Positive Supply Voltage, Vcc
2 Synchronization Out
3 GND, Vss
4 Synchronization In
5 RS 485 Signal A
6 RS 485 Signal B
7 NC

5.4.1 Recommendations for Cabling

- Polyurethane (PUR) Cable with shield and twisted pair wiring
- Wire cross-section: 0.25 … 0.34 mm^2 (AWG 22 or AWG 23) braided or twisted filament *)
- Cable entry assembly of plug PG 9: 6 … 9.5 mm (0.24 … 0.37 inches)
- Supply: 12 V DC nominal: 2 wires, twisted pair
- RS 485 communication: 2 wires, twisted pair
- Synchronization: 2 wires, twisted pair **)
- Shield: Connect to ground at the end facing the control device

*) The diameter needs to be such that at a current of 200 mA per detector, the resulting voltage across the connector at the detector is at least 11 V DC

**) Necessary for installations where detectors are mounted along adjacent lanes, 8 m (26 feet) or closer to each other

Important note:

When using long cables from the power supply significant voltage drops may occur over the whole length of the supply line to the detectors. Make sure that the effective voltage at the last detector in the chain is well within the specified supply voltage.

Verify by measuring the actual voltage between pins 1 and 3 on the female connector of the last detector on the chain before sealing it with the terminating resistor plug available as original accessory.

6 Special Functions

6.1 Power Save Mode

For situations where power is limited, the detector can be directed to operate in power-save mode. When using the low power mode, the detector needs to be mounted as backfire, aiming at the departing traffic. In this configuration, the PIR subsystem activates the ultrasonic and radar subsystems. This configuration results in significant power savings especially during times with low traffic volume (see chapter 9 for detailed specification).

When the wrong-way driver mode (detecting vehicles travelling in the wrong direction) is activated, the power savings mode is turned off automatically to enable continuous monitoring.

6.2 Wrong-Way Driver Mode (Wrong-Way Vehicle Detection)

The detectors of the TT 290 Series can detect vehicles driving in the wrong direction. In order for the corresponding status-bit to become signal such an event, the Wrong-Way Driver detection needs to be activated accordingly through the "configuration" menu in the ASIM-T.exe software.

For the wrong-direction status bit to be flagged, a few conditions need to be met in order to virtually exclude false detection: the radar detects a vehicle in the wrong direction, the IR channels are triggered in the wrong sequence and the ultrasound detects an event. These conditions need to be met within a certain timeframe and the last few vehicles' average speed needs to be 60 km/h (38 mph) or higher.

If all these conditions are met, i.e. a vehicle travelling in the wrong direction has been detected; the appropriate status bit is set. Subsequent vehicles travelling in the correct direction do not clear the bit; instead, the bit needs to be reset using the proper command (consult the protocol specification for details, available on request).

6.3 Vehicle Profile Information

A **special version** of the TT 295 and TT 298, available upon request, provides vehicle profile information instead of the built-in classification information. The profile information cannot be polled but is automatically transmitted each time after a vehicle has passed. Therefore, such a detector must not share an RS 485 data bus with any other detector. Profile information is made available as a series of numbers that correspond to the height of the vehicle as it passes underneath the detector. Profile information is transmitted in addition to the vehicle class described in chapter 2.4. Speed, occupancy and time-gap information is available in the same manner as it is provided in the standard version of the detector. For further information please contact the manufacturer. The following excerpt shows a sample of a vehicle profile information output file:

Zeit ;	Kl.;	Gesch.;	L [m];	Zeitl.[s];	Bel. [s] ;	Profil(1..30)[dm];								
11:40:31;	7;	121;	4.8;	2.45;	0.14;	11	13	13	10	2	0	0	0	
11:41:06;	7;	120;	4.8;	13.95;	0.14;	8	13	13	13	2	0	0	0	
11:41:11;	7;	116;	4.6;	4.07;	0.14;	12	14	13	12	1	0	0	0	
11:41:20;	7;	121;	4.8;	9.58;	0.14;	11	12	11	7	0	0	0	0	
11:41:22;	7;	118;	4.7;	1.17;	0.14;	12	13	13	11	0	0	0	0	
11:41:25;	7;	124;	4.9;	3.06;	0.14;	10	15	15	15	0	0	0	0	
11:41:30;	8;	87;	17.9;	4.50;	0.71;	33	36	32	39	39	39	39	39	3

7 Special Traffic Situations

7.1 Alternating Traffic

Detectors of the TT 290 Series are especially suited for applications involving alternating traffic flow. During installation, the detector is setup to aim at either the approaching (frontfire) or the receding traffic (backfire) on a certain lane. The regular direction can remotely be switched using the two-way RS 485 communication.

7.2 Queue / Traffic Jam

If a vehicle stays in the detection area for more than 6 seconds and is continuously being detected, the detector sets the status bit "Queue". The maximum time the detector holds the status can be configured using the ASIM-T.exe software. After the configured wait-time has been exceeded, the detector clears the presence information, which is only reactivated after the next vehicle moves into the detection zone and stays there for more than 6 seconds. The following example illustrates the information issued by the detector:

- Data output begin of queue:

  Counter = *unchanged*
  Speed = 0
  Class (TT 292) = 32 (car)
  Class (TT 295/8) = 6 (not identified)
  Occupancy = Time elapsed since queue has been detected
  Time gap = Time between queue detection begin and last event prior

- Data output during queue:

  Counter = *unchanged*
  Speed = 0
  Class (TT 292) = 32 (car)
  Class (TT 295/8) = 6 (not identified)
  Occupancy = Time elapsed since last data poll
  Time gap = 0.00 seconds

- Data output at end of queue

  Counter = increase by 1
  Speed = 0 ... 20 km/h (0 … 12 mph)
  Class (TT 292) = 32 (car)
  Class (TT 295/8) = 6 (not identified)
  Occupancy = Time since last poll until end of queue
  Time gap = 0.00 seconds

7.3 Stop&Go

Data acquired in Stop&Go traffic flow are 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 vehicles length, the length information and thus the entire classification information tends to be less accurate compared to free flowing traffic.

8 Software for the Detectors of the TT 290 Series

8.1 Introduction

The Windows-based installation software ASIM-T.exe is a most useful tool for the alignment, configuration and data acquisition for statistical purposes. The software supports detectors of the 250, 260 and 290 Series.

If more than one detector is operated on the same data bus, it is mandatory that each detector is assigned a unique address.

For use of the software on a standard PC, a converter transforming the RS 232 signals to RS 485 signals is necessary. The interface module "IF 485" is available as an original accessory.

8.2 Applications of the Installation Software

The installation software is a very helpful tool to modify and verify a detector's configuration remotely and to verify the alignment. It greatly facilitates the optimisation process of an installation to meet the requirements of a given location. The auto configuration function is a self-calibration in function of the given conditions (mounting height, master-slave wiring) whereby the optimum settings are determined and saved into the detectors. **It is recommended to run the auto configuration for each installation**.

The program is capable of displaying the actual parameter settings as well as the analog signals of the selected detector. The information supplied by the PC display should be used to monitor the detection performance of the detector and make adjustments if required.

Monitoring and interpreting the information supplied by the installation software will help finding the best solution either by adjusting the alignment and/or settings of the detector or by removing disturbance sources from within the field of view.

8.3 Traffic Data

The software ASIM-T.exe includes a statistic feature that continuously displays the traffic data as it is obtained from each detector. At the same time, the data is logged to a text file. Please consult the software manual for a detailed description of the software's features. Detailed protocol specification of the TT 290 Series detectors is available upon request.

Example

```
Adr.; time    ;  v ; L   ; cl;    tOcc.;     tGap;  space;status; counter


+ 15;TT 295 1.60 -----
 15;10:46:58; 119;      ;  1;      0.13;      6.01;        ; 00;    53450;
 15;10:47:12; 120;      ;  1;      0.13;      5.53;        ; 00;    53451;
 15;10:47:21; 101;      ;  1;      0.13;     13.55;        ; 00;    53452;
 15;10:47:22;  97;      ;  4;      0.74;      8.14;        ; 00;    53453;
```

9 Specification TT 290 Series

Mechanical

Dimensions	see chapter 9.1
Enclosure	polycarbonate, light-grey
Mounting points	M8, stainless steel V2A
Weight	app. 1'700 g (4 lbs)

Microwave

Doppler Radar	K - Band 24.05 … 24.25 GHz

Ultrasonic

Frequency	50 kHz
Pulse frequency	10 … 30 Hz

Infrared

Sensors	pyroelectric differential, dynamic
Spectral Response	8 – 14 µm

Electrical

Supply voltage	10.5 ... 15 V DC
Current consumption	typ. 200 mA @ 12 V DC typ. 50 mA in Standby (power save mode)
Outputs	
Data exchange	RS 485 Bus at 9600 baud, 8, e, 1
Turn-on time	typ. 20 s after power-on

Accuracy

Volume	typ. ± 3 %	
Speed	above 100 km/h (60 mph):	typ. ± 3 %
	below 100 km/h (60 mph):	typ. ± 3 km/h (2 mph)
Classification	Depending on model, refer to chapter 2.4	

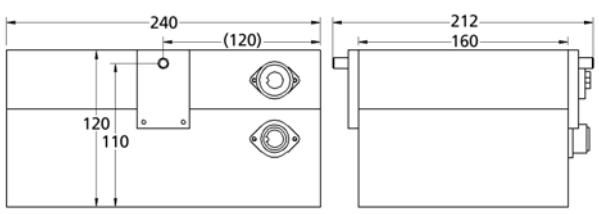
The speed accuracy above applies only to situations with free-flowing traffic when the detector is properly mounted above the middle of the lane to be observed. Speed accuracy tends to be lower in other conditions including, but not limited to Stop&Go traffic.

Environmental

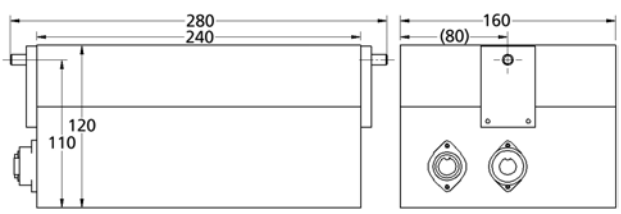
Operating Temperature	– 40°C to + 70°C (– 40°F to +160°F)
Humidity	95 % RH max.
Sealing, Enclosure	IP 64 splash proof

9.1 Mechanical Dimensions

Longitudinal



Perpendicular



10 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**

11 Disclaimer

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

The reliability strongly correlates to the exact alignment and proper configuration, the prevalent thermal contrast and to the form and shape of an object's surface.

ASIM Technologies assumes no liability, direct or indirect, resulting from the installation or use of any detector of the TT 290 Series. 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. ASIM Technologies reserves the right to change product information and specification without prior notification.

MO9062-21

I DESCRIPTION

A K-Band Doppler transceiver consisting of a Gunn Diode oscillator and two Schottky barrier diode mixers assembled into a diecast waveguide package, designed for commercial applications in directional motion sensing.

II SPECIFICATIONS

Frequency:	24.125GHz ± 5 MHz
Output Power:	4.6 mW minimum
Frequency Stability:	1 MHz/°C
Operating Voltage:	+5.0 Vdc ± .15 V
Operating Current:	97 mA max @ +25°C, 110 mA max @ -30°C
Mixer Sensitivity: (6)	-93dBc max for IF bandwidth of 10 - 1000 Hz
Mixer Diode DC Return:	1000 ohms resistor to case ground (Recommended but not supplied)
Mixer Diode/Output Noise: (6)	6 µV Rms max for IF bandwidth of 10-1000 Hz
Mixer Phasing:	60° minimum, 120° maximum
Temperature Range:	-30 to +70°C
DC Bias (Gunn): (2)	Solder Pin
Mixer Output: (2)	Solder Pin
Mixer Output Polarity:	Negative
RF Output:	WR 42 waveguide mates with UG-595/U flange
Power Variation/Temp:	3.0 dB maximum

NOTES

1) Units will be packaged in ESD Safe trays with 40 units per tray.

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2) Maximum solder temperature to pins is 250ºC max for a 5 second duration.

3) Units are extremely ESD sensitive. Parts should only be handled in an appropriate ESD protected manner. Failure to do so may void manufacturer warranty.

4) All parameters of this specification are tested into a calibrated standard Test stand.

5) The filter supplied with this product shall meet the requirements of Drawing 3129: .050 ± .001 thick.

6) As measured at the output of a standard low noise amplifier with a voltage gain of 60 dB. Amplifier bandwidth is 10 Hz to 1000 Hz.