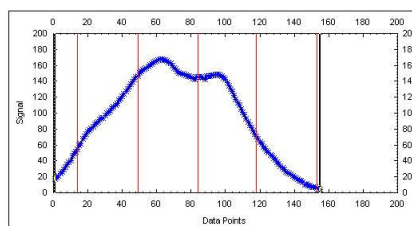


Loop Counter Classifier (RAKTEL 4010) Product Specification

MS001-56010-40

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Issue 2



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Revision History

Issue	Author	Date	Reason for Change	Authorised
1	RS	20 Oct 2009	Initial copy	CS
2	RS	19 Aug 2012	Revision page added	CS

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Introduction

The main components of the RAKTEL 4010 Mikros Systems Loop Counter Classifier system are the following:

- A RAKTEL 4010 traffic event logger (illustrated on cover)
- Inductive loops (one or two per lane)

The Mikros Systems RAKTEL-4010 is a major upgrade from the RAKTEL-4000 enhancements includes:

- Increased loop sensitivity
- Improved piezo axle detection
- Enhanced classification
- Expanded sensor diagnostics
- New power management

The Mikros Systems RAKTEL 4010 is a slightly scaled down version of the RAKTEL 8010 traffic event logger. The RAKTEL 4010 is limited to loop and axle detector applications.

The RAKTEL 4010 comes in a non-standard 12.4" 3U rack mount. Modular card configuration allows for flexible configuration and easy use.

The primary sensor of the RAKTEL 4010 is a high performance eight-channel digital loop detector. This detector is cross-talk free and can be used over a wide range of inductances. Each RAKTEL 4010 can accommodate up to two of these loop detectors. Vehicle volumes can be monitored for eight lanes using one loop detector, if the single loop per lane configuration is used. When vehicle speeds are also required, two loops per lane must be used. This means that up to eight lanes can be monitored (vehicle volumes and speeds) if two loop detectors are used.

Traffic data is recorded for each individual vehicle and is stored in a non-volatile memory in either the complete individual vehicle record or in a fixed summary format. It is also possible to store individual records and data summaries together. Data on all heavy vehicles can be stored as individual records and data on light vehicles can be summarized in hourly speed-volume-headway bins. The RAKTEL allows the user to select and suppress information to be stored.

Classification of vehicles in the single loop mode is done on the inductive profile of the vehicle as it passes over a loop. In the dual loop configuration, vehicle length is added as an additional parameter for classification.

The RAKTEL 4010 reports and stores comprehensive diagnostics on the logger performance and all the sensors connected to the logger.

Communication to the RAKTEL 4010 is primarily provided through two serial ports that function completely independently from each other. The RAKTEL 4010 is controlled and configured via the serial ports. RAKTEL 4010 has the capability to be addressed in a party line configuration where one line can be daisy chained to a number of loggers. The RAKTEL 4010 can also be used in L/WAN configuration using TCP/IP.

RAKTEL 4010 is supported by a suite of programs that communicates with the logger. The programs are used to control the logger and to process the collected data.


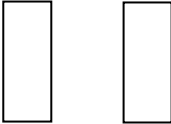
Major advantages of the Loop Counter Classifier Traffic Logging system

The Mikros Systems Loop Counter Classifier Traffic Logging system has the following features to its advantage:

- A modular design.
- Flexible configuration.
- Active lightning protection.
- **High performance cross-talk free digital loop detector.**
- Digital chassis height detection.
- **Coincidence detection (lane straddle).**
- **Tidal flow and reverse direction recording.**
- Comprehensive system performance monitoring.
- Detail sensor diagnostics capability.
- User-friendly set-up and complete diagnostics
- Length and chassis height profile classification algorithms.
- Provision for most popular data formats.
- User-modifiable parameter sets.
- Comprehensive software support.
- Low power consumption (solar charging supported).

Sensor configuration options

It should be noted that the sensor configuration is determined by the configuration options chosen for a specific logger. Each logger is configured for a particular application; therefore not all the interfaces are automatically included. Typical loop dimensions are 100cm x 300cm spaced apart 200cm in the case of dual loops per lane (other dimensions can be used).

Sensor Configuration	Remarks
	<ul style="list-style-type: none"> ▪ Single Loop per lane. ▪ Classification is based on inductive profiles profiles. ▪ Up to 16 lanes can be monitored. Information on individual vehicles and/or time sliced summaries is available.
	<ul style="list-style-type: none"> ▪ Dual Loop per lane. ▪ Classification is based on inductive profiles plus vehicle length. ▪ Up to 8 lanes can be monitored. Information on individual vehicles and/or time sliced summaries is available.

Typical configurations and optional extras

Typical configurations and optional extras for the RAKTEL 4010 Loop Counter Classifier are set out below:

Standard interfaces:

- CPU
- RAKMAN power supply card
- Loop detector card (8 channel) – up to two cards per system.
- External memory card.

Memory options: (all memory is battery backed-up)

- 128Kb – 917Kb on the CPU card only.
- External memory (2,4Mb or 8Mb).

Optional extras:

- Tamper alarm.
- Modem power control card.
- Incident output.

Short descriptions of interfaces:

CPU

The CPU card contains the processor, optional data storage memory. The memory on the CPU cannot be used with the external storage memory.

RAKMAN power supply

The power supply card can be used from 110V – 220V and also controls solar charging. The system is a 12V dc system.

Loop detector

The loop detector card is a high performance digital 8-channel unit. Up to two can be installed in a system.

External memory

The external memory card is a battery backed-up mass memory card that is available in either 2,4Mb or 8Mb.

Tamper alarm

A tamper alarm can be fitted in the housings. If the alarm is triggered the status can be monitored remotely.

Modem control card

The modem control card supplies power to an external modem. The power to the card can be software controlled. Typically the power can be set up in a number of selectable time-slots. This feature optimizes power consumption and prolongs battery life.

Incident output

In addition to the overload alarm system, incidents such as speeding can be flagged and output triggers generated. An optional "Flash" unit is available.

Termination

All terminations of cables to the RAKTEL are done via terminal boxes. Comprehensive active lightning protection is provided on all relevant inputs.

Communication to the RAKTEL 4010

A number of communication connections (and combinations thereof) to the RAKTEL 4010 are possible. A party line is available and is handy when only one remote line is available for a cluster of RAKTEL 4010's. Each RAKTEL 4010 in the line can be assigned a unique address. It can then be remotely accessed. The limitation is that only one logger can be accessed at a time. Once the contact has been established, the control is the same for all the methods mentioned below:

A: Direct on-site communication via laptop

The RAKTEL 4010 can be set up, controlled and its recorded data extracted through the TelWin program. The communication is done via a serial port.

B: Remote communication via dial-up modem

The RAKTEL 4010 can intelligently control a dial-up modem connected to it. The RAKTEL 4010 can control the power to the modem via the COMTEL interface. This feature is especially helpful when cellular modems are used that cannot go into a low power standby mode.

C: W/LAN connection via fiber optic, using TCP/IP

The RAKTEL 4010 can communicate to the TelNet program using TCP/IP. In this configuration more than one RAKTEL 4010 can be accessed at once. This can also be achieved by running more than one TelWin program.

Real-time monitoring

The following illustrates the integrated video camera function of TelWinPro.

TelWinPro can handle up to 4 cameras as synchronized input. The limitation is the actual performance of the PC that runs the program and the available hardware (frame grab cards). Cameras can be positioned to take overall and lane views and to zoom in on number plates or any configuration required.

The illustration was made using a laptop, running Windows 2000 Professional. A simple USB Web cam was used as camera. The purpose of this application was to check and verify vehicle data.

Currently the camera is triggered from the loop activation.

The complete vehicle-by-vehicle information is synchronized with each picture. The following TelWinPro display serves as illustration:

The screenshot displays the TelWin Pro Ver 1.00B software interface. The window title is "TelWin Pro Ver 1.00B - [View RUN Files]". The menu bar includes "File", "Window", "SiteBase", "SiteInfo", "SiteData", "Logger", "Options", "Setup", and "Help". The interface is divided into several sections:

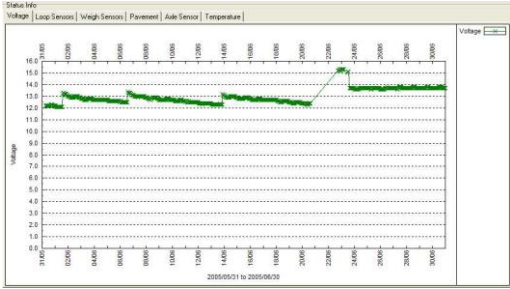
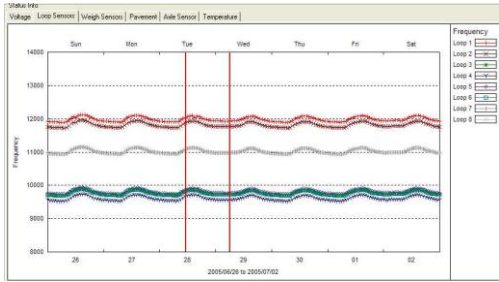
- Basic Information:** Fields for Date & Time (2004/08/31 15:35:21:000), Record No. (1213), Physical Lane (1), Speed (57 km/hr), Logical Lane (1), Length (1620 cm), Direction (Forward), Axles (6), Chassis Code (High), Norm. VAC (32), Class Scheme (RSA Vehicle), Peak VAC (56), Class (Cls 13), Occupancy (1085 ms), Description (Six axle single trailer), Failure Code (0), Internal Class (28), J-Factor (0), and Tagged (checkbox).
- Diagram:** A schematic diagram of a vehicle with six axles, showing the positions of the loop sensors.
- Weight and Spacing Data:**

Min	85	200	90	320	90	90	100
Act		326	138	662	136	136	
Max	200	700	265	1300	265	265	250
Min Typ	2.0	1.5	1.5		0.8	0.8	0.8
Max Typ	5.2	7.2	5.0		5.0	5.0	5.0
Min Act	15.0	17.0	17.0		17.0	17.0	17.0
Max Act				1000			
				1620			
				2500			
- Which Picture:** Radio buttons for 1, 2, 3, and 4, with 1 selected.
- Video Feed:** A live video image showing a truck with a crane on a road, viewed through a chain-link fence.
- Control Panel:** Buttons for Close, Load, Live (checkbox), Vehicle File (Show, ReLoad), and Vehicles (First, Last).

(NOTE: Axle weight and spacing information is not available for applications where only loops are used)

Comprehensive system performance monitoring

One of the most powerful features of the Mikros Systems RAKTEL loggers is that it provides a continuous and visual status monitor of system and sensor performance. This greatly enhances the integrity of the recorded data. The user can see at a glance that all systems are functioning correctly. By having a long-term trace of the important system and sensor status instantly available any possible anomalies are detected immediately.

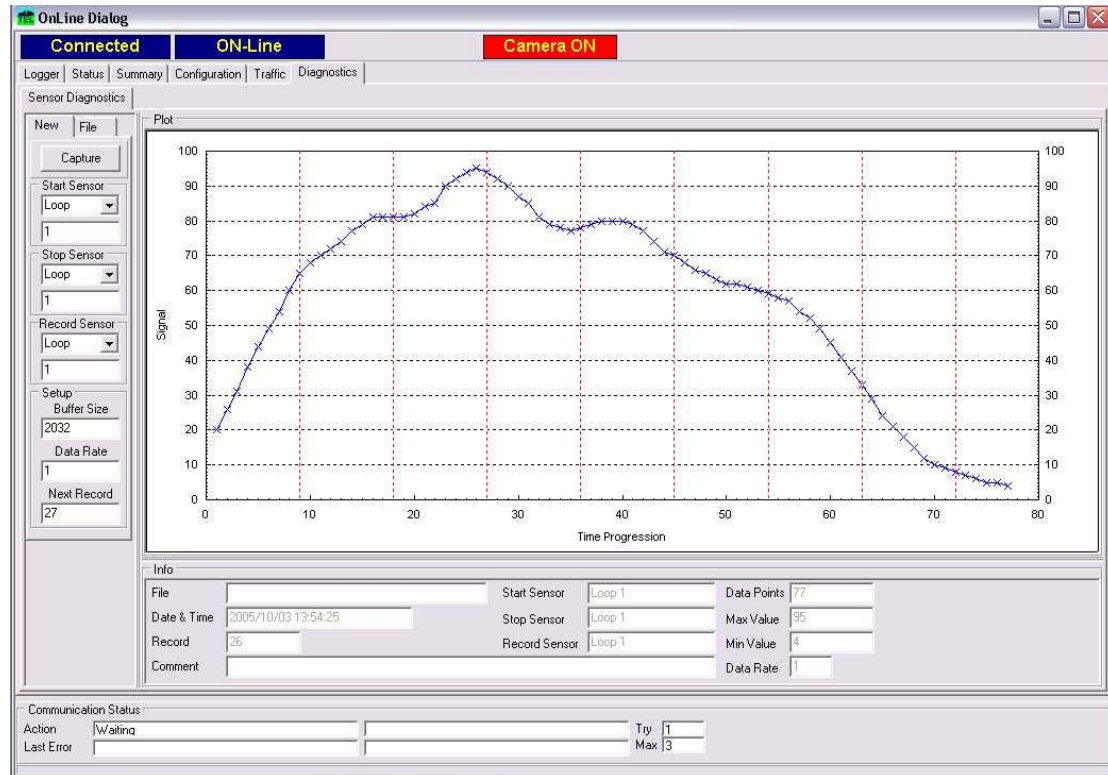
Status trace:	Comments
	<p>Continuous battery status monitored for a month.</p> <p>In this plot it can be clearly seen when batteries were changed and mains power permanently connected.</p> <p>The Y-axis indicates the current voltage.</p>
	<p>Continuous inductive loop stability (frequency) monitored for one week.</p> <p>The plot shows the normal daily fluctuations with loop errors indicated by the vertical lines.</p>

Detailed sensor diagnostic mode

This mode is a digital scope mode that allows the user to capture detailed sensor response profiles on all of the sensors connected to the RAKTEL.

This function is used to verify the correct signals response from each sensor.

A digital trace is plotted of the response of a sensor as a vehicle passes over it. This profile can be stored for quality assurance purposes.



A typical sensor response of a light vehicle over a loop.

Digital vehicle chassis height determination

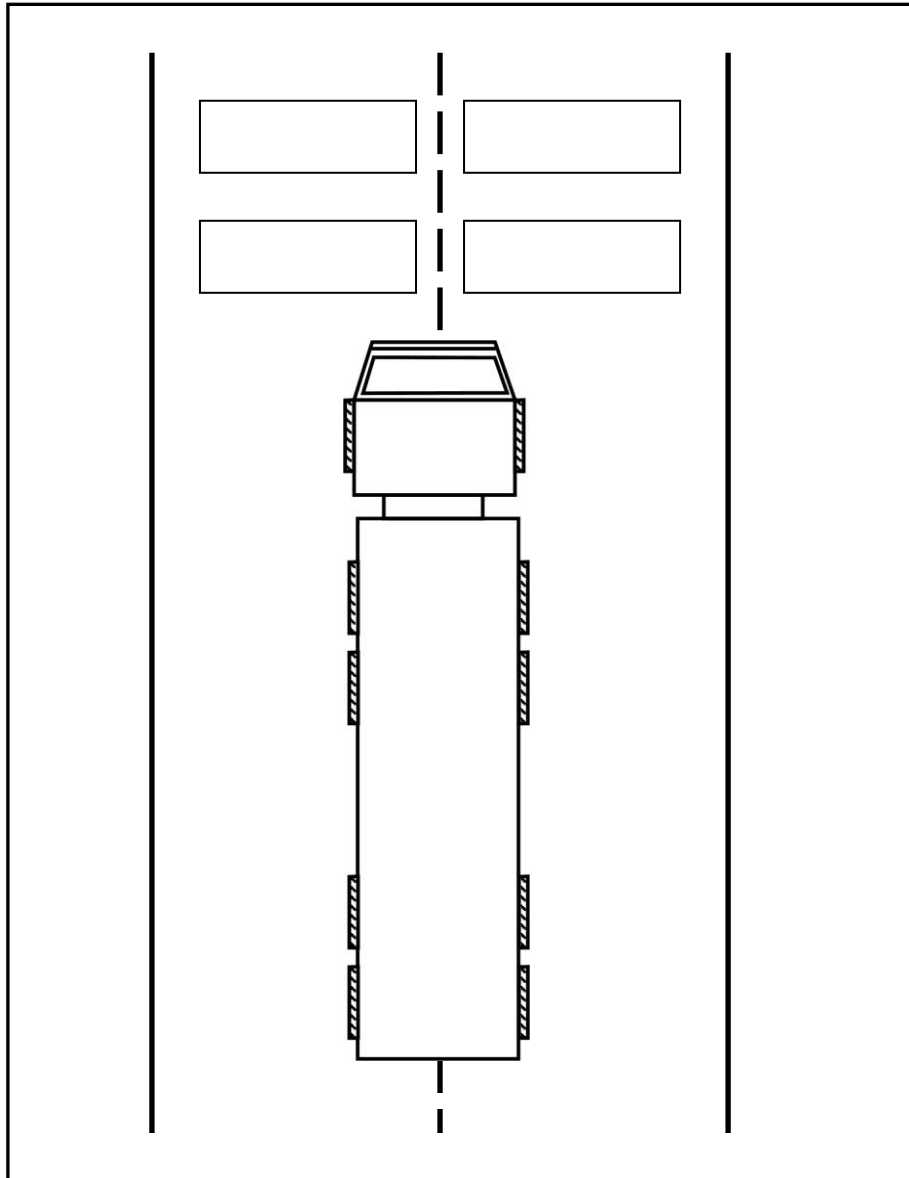
The loop detector provides in addition to the presence and timing signals a vehicle chassis height indication. This parameter is an automatically scaled value that is divided into three categories. The boundary values of these height categories are user selectable.

The chassis height parameter is used in the classification and coincidence algorithms of the logger.

Coincidence detection (lane straddling)

The cross talk free loop detector of the RAKTEL allows for close loop spacing between adjacent lanes (500mm typical). This makes it possible for the logger to detect a vehicle that straddles between two adjacent lanes. A requirement for this is that loops are installed abreast of each other.

This reduces double counting of vehicles on sites where lane discipline is a problem.



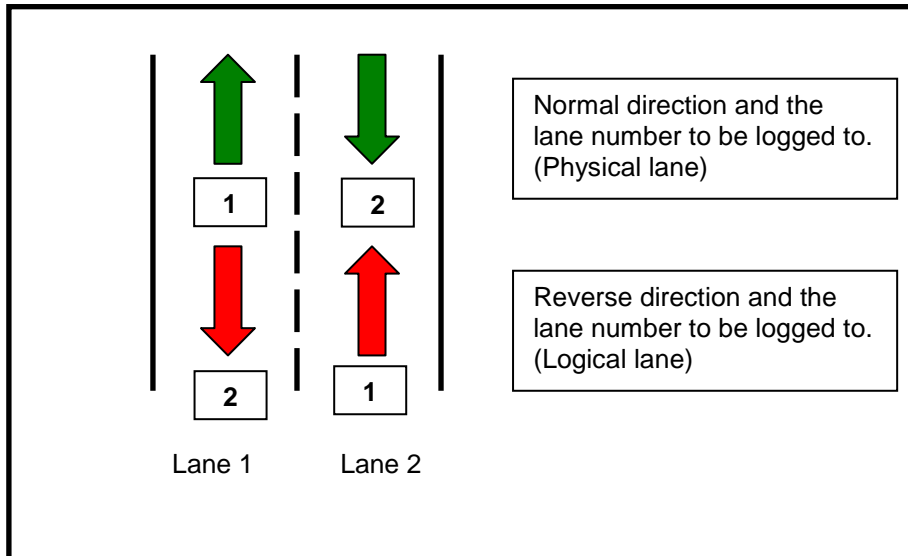
- Close loop separation allowed for.
- User selectable parameters to optimize for local conditions.
- Default standard parameter values installed.

Tidal flow and reverse direction logging

By assigning the reverse direction travel on a lane to a other than the physical lane in which a vehicle is traveling, separate logical lanes can be specified to record these incidents.

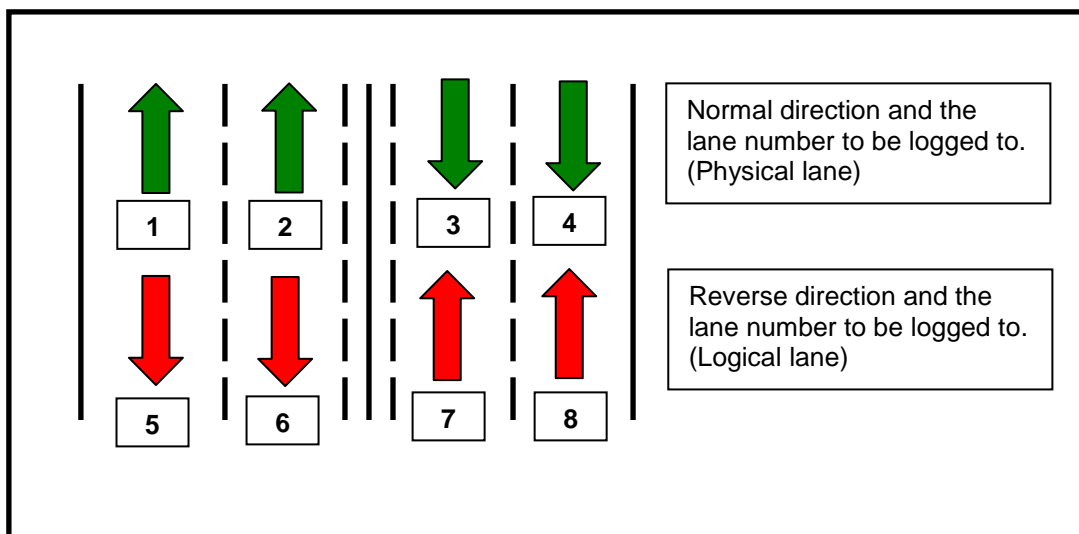
There are normally two cases where this is applicable:

1. For an undivided roadway where overtaking vehicles can drive in the reverse direction on the oncoming lane(s).



In this case a vehicle traveling in the reverse direction on lane two will be logged to lane one, and vice versa.

2. When tidal flow (or contra flow) is allowed, this can automatically be recorded by assigning separate lanes for reverse direction flow.



Up to a maximum of 8 physical lanes can be re-assigned for a total of 16 logical lanes.

The RAKTEL 4010 data structure

Mikros Systems uses a binary file structure in the RAKTEL 4010. Information on this structure is generally not published for two main reasons. Firstly, it allows Mikros Systems to add to the data without having to keep track of backward compatibility. It therefore simplifies configuration control. Secondly, the binary or so-called 'image' information can be used as an integrity check on the recorded data. The 'image' data contains the complete record of the recorded traffic data as well as the complete set-up information of the logger and comprehensive hardware status information (sensors, power, memory and communications parameters). In addition to this, any error that may occur during logging is 'injected' into the 'image' data when it occurs.

The 'image' data gets translated into the most popular standard text formats (e.g. the US Federal Highway Association's card types and the RSA Standard Traffic Data Collection Format). Mikros Systems also provided standard formats (TXT and XTX). These formats are completely documented.

Data recording modes

The basic mode of data recording is to record individual vehicle-by-vehicle (VBV) information.

The following basic information is typically recorded:

- Departure date and time to the nearest 1/10th of a second
- Physical Lane of travel
- Re-assigned Logical Lane of travel
- Direction in the lane of travel (forward/reverse) (dual loops).
- Vehicle class (for selected scheme)
- Chassis height code
- Vehicle length (1/10th meter) (dual loops)
- Vehicle speed (km/h) (dual loops)

The data recording modes allow for the selected recording of vehicle information by:

- Vehicle type (light/heavy)
- Lane number
- Violation

This means that, for example, the logger can be configured so that only individual vehicle information of heavy vehicles is recorded.

The following information summaries can also be recorded (injected into the data) in addition to individual vehicle information:

- Class summaries
- Speed bin summaries
- Vehicle length bin summaries
- Headway bin summaries

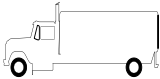
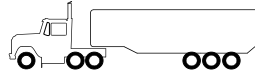
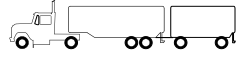
This can be recorded per time interval (1- 60 minutes, in whole fractions of 60 minutes).

Classification schemes supported by RAKTEL 4010

The Mikros Systems Loop Counter Classifier system classifies according to the RSA Light Heavy scheme.

In addition to the standard schemes parameter values, an expert user can also adjust parameters to adapt to local conditions.

The following classification scheme is supported in Loop Counter Classifier RAKTEL 4010:

SHORT TRUCK	MEDIUM TRUCK	LONG TRUCK
Rigid	Articulated	Train
		

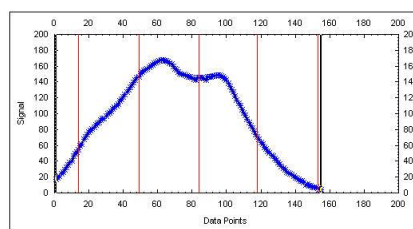
Short Light*	Long Light if VS** = "Light" Otherwise: Short Truck	Medium Truck	Long Truck
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Vehicle length: 4,9m 10,5m 16,8m

* All vehicles shorter than 4,9m are considered light.

** VS is the inductive vehicle signal.

The following graph illustrates a typical light vehicle inductive signal:



Typical housing

A secure housing can be used at sites where security is a concern. The picture below serves as illustration:



:

Summary of RAKTEL 4010 specifications

<ul style="list-style-type: none"> • Sensor inputs <ul style="list-style-type: none"> Primary sensors Secondary sensors 	<p>8 Channel self tuning loop detector (up to 16 channels)</p> <ul style="list-style-type: none"> - 8 channel I/O card
<ul style="list-style-type: none"> • Multiple Logging Modes <ul style="list-style-type: none"> Individual and/or data summaries (in metric or imperial units) Data summaries 	<p>Basic information captured:</p> <ul style="list-style-type: none"> - Arrival time (one tenth of a second) - Lane on travel - Direction in lane (reverse direction logging) - Vehicle speed - Chassis profile - Vehicle length - Classification code - Variable logging period (1 to 60 minutes) - Lane summaries - Classification bins - Speed bins (up to 20) - Headway bins (up to 20) - User pick list and data suppression table
<ul style="list-style-type: none"> • Memory options 	<ul style="list-style-type: none"> - Up to 8Mb battery backed-up RAM
<ul style="list-style-type: none"> • Control, data extraction and communication 	<ul style="list-style-type: none"> - Two RS232 ports (300 – 19 200 baud) - Local via laptop - Remote via modem, network or direct fiber links
<ul style="list-style-type: none"> • Diagnostics 	<ul style="list-style-type: none"> - Complete local and remote sensor & system status - Dynamic sensor diagnostics
<ul style="list-style-type: none"> • Power management 	<ul style="list-style-type: none"> - High efficiency solar charge regulator - Mains power supply and charger (110V – 220V) - 12V DC - <1.4 Watt (loops only unit nominal) - External power (300mA) to ancillary devices (2) - Hot-swap battery plugs
<ul style="list-style-type: none"> • Temperature range 	<ul style="list-style-type: none"> - - 20°C to 65° C
<ul style="list-style-type: none"> • Weight and dimensions 	<ul style="list-style-type: none"> - Non-standard 12.4" 3U rack - 315mm x 320mm x 140 mm - 7,8kg - 6 slots maximum
<ul style="list-style-type: none"> • Options 	<ul style="list-style-type: none"> - Modem control & lightning surge protection - Expanded memory - Contact closure outputs from loops - Violation outputs
<ul style="list-style-type: none"> • Support software 	<ul style="list-style-type: none"> - TelWin & TelWinPro for logger setup, control and data conversions to popular data formats such as FHWA card types. Also exports to data bases and spread sheets. - TelNet for network applications (incident detection and ramp metering) - TelDial automatic list dialer - TrafBase extended data validation, storage, archiving and reporting program.

Mikros Systems reserves the right to change product specification at any time without prior notice.