TDM WI - Wireless Intersection Control System

Technical Manual

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Content

1 Foreword

TDM WI sensors can be integrated in traffic lights control systems and therefore are proposed as an efficient alternative to the inductive loops.

The intersections, which are often characterized by the presence of queuing vehicles, represent an ideal application for TDM WI sensors due to the excellent performance of the device in congested traffic conditions. The sensors can be placed even at considerable distances from the crossing, without the need for expensive wire connections that are necessary in case of use of magnetic loops.

Wireless transmission at 868 MHz enables a direct communication from sensors to the hub even at great distances from traffic controller (beyond 150 meters) without radio repeaters nor wired connections, typical of inductive loops.

The signal transmitted by sensors is directly received by the hub.

The hub can also be embedded on the Traffic Light Interface Card, which is a 16 channels dry contact card. In this way the events collected from the sensor trigger the activation of dry contacts exactly as inductive loops. The possibility to connect up to 16 sensors to each card allows to manage medium and large road intersections using a single interface card, so to make this system highly competitive if compared to traditional inductive loop traffic control systems.

The systems described above are based on local transmission of traffic data. It is also possible to send these data on the server at the same time, using an Access Point.

The main features of the system are:

- **Quick and easy installation** - the wireless technology allows the installation of a sensor in about 15 minutes, using standard equipment and materials for road works
- **Completely independent power** - the sensor battery life is 5 years guaranteed
- **Easy maintenance** - the presence of an outer casing allows a simple and quick replacement of the sensor in less than 5 minutes
- **Excellent performance** - even in presence of queuing vehicles or in congested traffic conditions, the principle of operation, the electronics and the detector algorithm allow a correct and reliable vehicle detection

2 System architecture

2.1 Local transmission through serial port

The minimal system architecture configuration is set so that the sensor, which is installed in the road surface, will communicate the detected traffic data to a hub which is typically placed into the traffic light controller box.

The components of a basic configuration for traffic light control system are:

- **TDM WI sensors - at least one for each traffic lane**
- **TDM WI hub managing up to 16 sensors**

Traffic data are available through UART serial ports. Third-party companies can choose their own devices to interface and acquire data in order to manage traffic light controllers. The integration with third-party components is extremely simple, thanks to the data transfer and decoding protocols that we provide to system integrators, upon request.

2.2 Local transmission through dry contacts

The hub can also be plugged on our contact card called Traffic Light Interface Card, in order to replicate the same system that is usually triggered by the traffic detection loops.

The Traffic Light Interface Card converts the signal coming from the serial port in a output of 16 optically isolated dry contacts.

In this configuration, the components needed for the traffic light control are:

- **TDM WI sensors - at least one for each traffic lane**
- **TDM WI hub (managing up to 16 sensors) and Traffic Light Interface Card**

The typical system architecture is shown on Fig. 2.1.

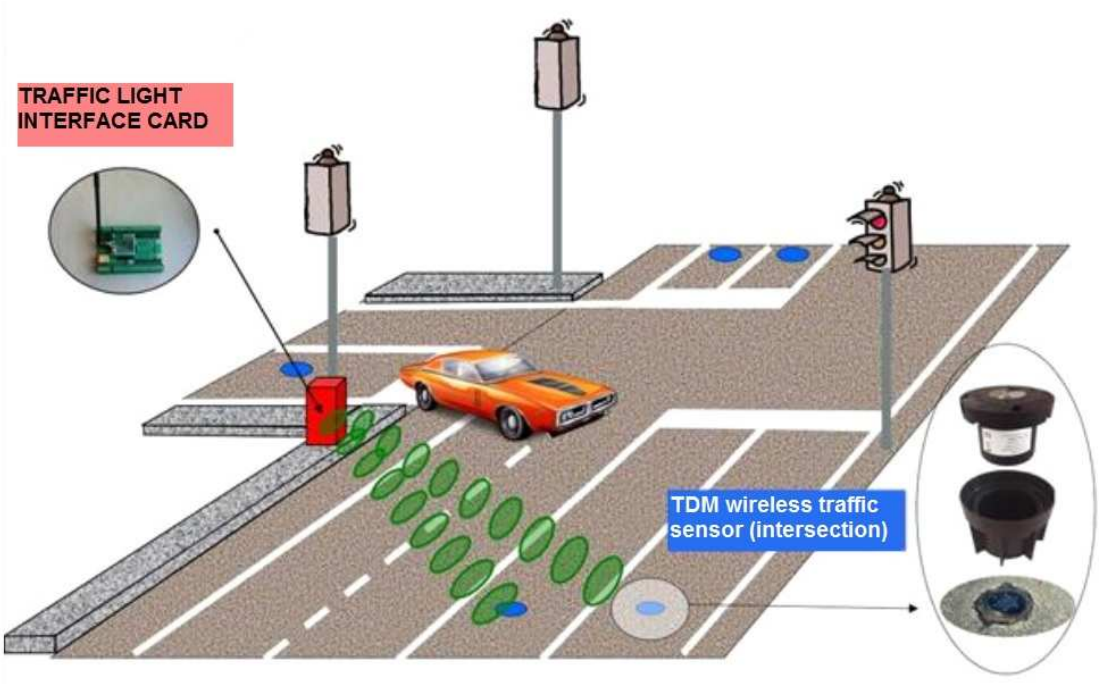

Fig. 2.1. *TDM WI - System Architecture for Traffic Light Control*

2.3 Local and web server transmission

In some installations, the customer may need to receive the data also on the server, e.g. for management purposes or for traffic statistics.

In this case, a gateway (Access Point) is placed into the cabinet of the traffic light controller with the Traffic Light Interface Card. The Access Point sends data to the server via GPRS or Ethernet.

TIP.

Further information about this data transmission system is given in a separate document

Refer to Fig. 2.2 for a typical hub, Traffic Light Interface Card and Access Point installation.

Fig. 2.2. *TDM WI - Hub, T.L.I.C. & Access Point installation*

3 System components

3.1 System Hub

The Hub is a concentrator for wireless data acquisition from the sensors.

It is really small (39 mm x 29 mm) and can manage up to 16 sensors (if more sensors are needed, it is possible to install more hubs, in different radio channels, so that they are able to work in the same area).

All the data about traffic events (start/presence and end of the traffic event, with time-stamp) are available through UART serial ports.

Third-party companies can choose their own devices to interface and acquire data directly from the Hub.

Fig. 3.1. *TDM WI - Hub*

3.2 Traffic Light Interface Card

The Traffic Light Interface Card 868 integrates the features of the a.m. Hub and of a 16 channel dry contact card.

In this way the events collected from the sensors trigger the activation of dry contacts exactly as inductive loops.

Results can be output on two RS232 serial interfaces and on sixteen ON/OFF optically isolated dry contacts, in order to emulate traffic detection loops.

A DC/DC converter allows system to be powered from any DC source, ranging from 10 V to 26 V. Furthermore the T.L.I.C. has an input for a solar panel and an integrated NI-MH battery charger.

The T.L.I.C. has sixteen optically isolated dry contacts. Channels are independent from each other and are referred to by number (1 to 16). Any detection event generated by one sensor in the network causes a transition on the corresponding contact. Contact Actions ("Open on Event" or "Close on Event") may be individually configured via software.

Furthermore, a set of sensors may be associated to an auxiliary output that react to a combination of Events (For example an OR logic can be implemented).

Two channels are available for diagnostics (sensor failure and power supply failure).

The T.L.I.C. 868 provides the following features:

- Receiving and decoding of messages from sensors (hub features)
- Synchronization of deferred messages due to the sensor latency
- Recovery of slippage of the system clock
- Cancellation of too short events
- Implementation of policies to associate many sensors in "OR" logic in order to create virtual magnetic loops of wider dimension

Power can be supplied through an external voltage between 10 and 26 Vdc. Total energy consumption is around 60 mA (including Hub).

3.3 TDM WI sensor

The wireless sensor is embedded in the surface of the roadway, in the center of a lane. The installation takes place in a short time using resins or cement and upon the removal of a asphalt core of 130 mm of diameter and a 80 mm depth.

After the placement, the sensor is able to auto calibrate itself without any intervention by the operator.

The housing is made to create a waterproof rigid volume which is able to protect the electronics from rainwater and from mechanical stresses caused by the passing vehicles. The features of these housings allow a simple extraction of the sensors, making possible a rapid maintenance work. See Fig. 3.2.

Fig. 3.2. *TDM WI sensor*

4 Technical specifications

4.1T.L.I.C.

Physical characteristics

- Operating temperature: from -40 to +85°C
- Size: 72x20x135 mm
- Weight: 150 g
- Power supply: from 10 to 26 VDC via clamp
- Relative humidity: from 5% to 90% non-condensing
- External ports: UART, RS232 (x2)
- Mounting: DIN-rail

Data transmission

- Detection Output:
  16 opto-isolated dry contacts via clamps
  "close on event" or "open on event"
  16 LED outputs
- Auxiliary Output:
  2 opto-isolated dry contacts via clamps and LED alert
  "close on event" or "open on event" suitable for OR logic
- Error Output:
  2 opto-isolated dry contacts via clamps and LED alert
  "close on event" or "open on event"
  "sensor failure" and "power supply failure" alerts
- Sensors to Connect: Max 16
- Communication range: 150 meters
- Frequency 868 MHz
- Radio channels: 10

European Conformity (CE)

- Directive 1999/5/CE (R&TTE)
- ETSI EN 301 489-1 (Electromagnetic compatibility and Radio spectrum Matters - EMC standard for radio equipment and services-Common technical requirements)

- ETSI EN 301 489-3 (Electromagnetic compatibility and Radio spectrum matters - Specific conditions for SRD operating from 9KHz to 40GHz)
- EN 300 440-1 (Short Range Devices. Radio equipment used from 1GHz to 40GHz: technical characteristics and test method)
- CEI EN 55022 (radiated emissions)
- CEI EN 61000-4-2 (electrical discharge immunity)
- CEI EN 61000-4-3 (radiated electromagnetic field immunity)

4.2TDM WI sensor

Physical characteristics

- Operating temperature: -20 ~ +80°C
- External size: Ø 110 mm, H 85 mm
- Installation hole: Ø 130 mm
- Casing material: fiber reinforced nylon
- Weight: 1000 g
- Power supply: thionyl chloride battery (3,6 V - 19Ah)
- Battery life: 5 years
- Average consumption < 1mW

Data capture

- Detection mode: incident ambient light variation (Italian patent n°0001379287)
- Sampling rate: 128Hz
- Self-adaptive detection sensitivity depending on the natural light conditions
- Effectiveness without natural light thanks to its embedded infrared emitter

Data transmission

- Data transfer protocol via radio: proprietary TDMA, in compliance with IEEE802.15.4
- Working frequency: 868 MHz (ISM - unlicensed band)
- Number of programmable channels: 10
- Individual channel width: 100 KHz
- Transmitter power: 14dBm
- Receiver sensitivity: -110dBm
- Useful radio range: > 150 m

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5 Installations examples

The following pictures shows some of the installations made using TDM technology.

Fig. 5.1. *TDM WI sensors for a light railroad control*

Fig. 5.2. *TDM WI sensors detecting vehicles approaching an intersection*

Fig. 5.3. *TDM WI sensors detecting vehicles approaching an intersection*

Fig. 5.4. *TDM WI sensors detecting vehicles approaching an intersection & System Hub*

Fig. 5.5. *TDM WI sensors detecting vehicles approaching an intersection & System Hub*

Fig. 5.6. *TDM System Hub & Access Point*