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New solution for ON/OFF switching of level crossing systems

Hrvoje Horvat

There are many level crossing systems that use spot double-channel wheel detection for switching on/off the level crossing, usually combined with a short audio frequency track circuit, loop or axle counting section for detection of a train stopping on the road area. Today, there are even better ways to activate/deactivate the level crossing, for example using two or three axle counter sections (per single line) that cover both approach (from both sides) and road area. However, in both eastern and western Europe there are still many older level crossing systems that use spot wheel detection (without counting axles) for switching on/off the level crossing and most of these level crossings will be in operation for another 10 or 20 years, or even more. Lots of different wheel detection devices are used on such level crossings: from mechanical treadles and magnetic detectors with reed-relay to electronic inductive wheel sensors such those used in modern axle counting systems. The wheel detection system UTR/ITR based on the inductive double wheel sensor ZK24-2 is a new solution either for replacement of mechanical treadles and magnetic detectors, or for implementation in new level crossing systems.

1 Introduction

In south-eastern Europe most of the currently installed level crossing systems are old relay-based systems that use spot double-channel wheel detection for switching on/off. Such level crossings were installed during the 1960s and 1970s, and most of them still use old magnetic wheel detectors with reed-relay produced by Siemens (two detectors per switch-on point on both sides of the road and two detectors

per switch-off point), or mechanical treadles produced by Silec. The operation of such magnetic detectors relies on the permanent magnetism and good condition of the reed-relay contact already in the device, mounted on the rail. In such a long operating time period (> 30 years) the permanent magnet loses the strength of the magnetic field and the contact material of the reed-relay becomes rather worn. The maintenance and repair of the magnetic detectors becomes more difficult every year and the number of failures increases. As a replacement for these magnetic wheel detectors, the Altpro company developed the wheel detection system UTR that uses the electronic double wheel sensor ZK24-2, already proven in Altpro's axle counters BO1 and BO23. Since the wheel sensor ZK24-2 has two separate sensing systems in the same case, one sensor ZK24-2 together with the relay interface module UTR245 can replace two magnetic wheel detectors.

2 Wheel detection system UTR as a replacement for old magnetic detectors

Electronic wheel sensors do not usually have the same principle of outputting the wheel presence information as magnetic detectors and mechanical treadles; the sensor usually has current or voltage output and a magnetic detector has relay contact output. For direct replacement of magnetic detectors with electronic wheel

sensors on relay level crossing systems, the interface of current or voltage signal to relay contact or optocoupler is needed. Figure 1 shows how one switch-on detection system (e.g. on the left side of the road) is performed using the wheel detection system UTR (Figure 1)

As can be seen from Figure 1, the wheel detection system UTR consists of the wheel sensor ZK24-2 on the switch-on point on track and the interface module UTR245 located in the level crossing housing or cabinet, which provides relay and optocoupler outputs. The lightning protection module ZUT is connected between the sensor and the interface module to protect the interface module UTR245 and the rest of the level crossing system from lightning overvoltages. For the connection of the indoor and outdoor parts of the system (the distance could be up to 2 km, depending on the train speed) two wires are used per sensing system of the sensor ZK24-2, i.e. four wires total. Whether magnetic or mechanical treadles are replaced, exactly the same cabling infrastructure is already present, because two treadles are used for switching-on the level crossing (on each side of the road) for safety reasons (OR-logic: activation of any treadle will switch the level crossing on, but if only one treadle was activated, the level crossing system will indicate disturbance). Each magnetic detector is connected via one twisted pair (two wires), so two twisted pairs already exist between each switch-on point and the level crossing when one wheel sensor ZK24-2 replaces two magnetic detectors.

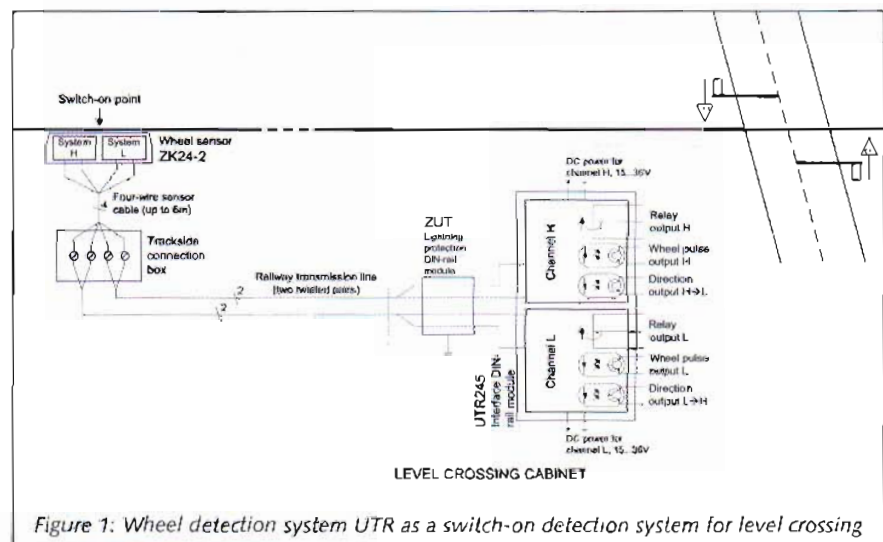


Figure 1: Wheel detection system UTR as a switch-on detection system for level crossing

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Figure 2: Rail/wheel sensor ZK24-2

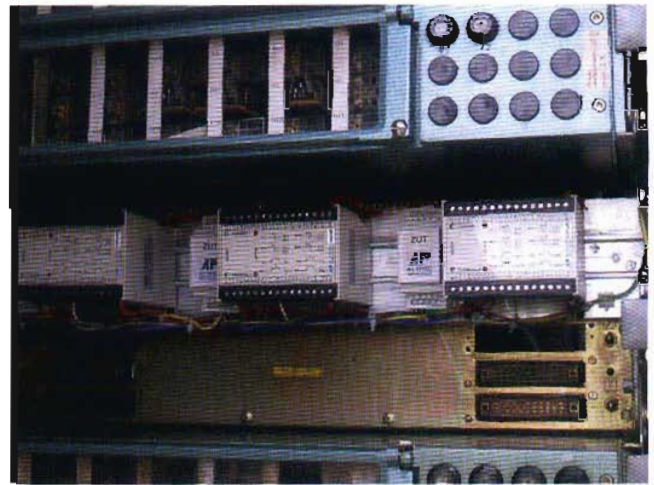


Figure 3: Interface modules UTR245/ITR245 installed in level crossing housing

3 Wheel sensor ZK24-2

The wheel sensor ZK24-2 was developed by Altpro together with the axle counter BO1 and is used as a wheel detection component in the axle counter type BO23 and BO1, which has been in regular operation in automatic block on Croatian Railways for several years. Croatian Railways recently decided to replace old magnetic detectors on relay level crossings and Altpro developed the interface module UTR245 to be able to connect the wheel sensor ZK24-2 to the relay level crossing and replace the magnetic detectors.

A crucial requirement is that the sensing systems (H and L, see Figure 1) in the sensor are completely separated, both functionally and galvanically, to be able to replace two magnetic detectors with one sensor ZK24-2. Each sensing system works independently and is based on the inductive principle with different frequency of the magnetic field for each system. Electronic circuitry for wheel signal evaluation on each system is already integrated in the sensor's case and filled with a special compound for water protection class IP68. Two wires of the four-wire sensor cable are dedicated to each sensing system; each system receives the DC power supply via these two wires and gives the wheel pulse signal to the level crossing system via the same two wires. The signal is provided as a DC current loop with higher current without the wheel presence and lower current when the wheel flange is present above the sensor. The current loop provides for a very long distance between the sensor ZK24-2 and the interface module UTR245; e.g. with wire diameter 0.9 mm the maximum distance is 17.8 km.

The sensor ZK24-2 is mounted on the inner side of the rail using the universal mounting clamp fixed to the rail foot (Figure 2) There is no need for rail drilling and the same mounting clamp can be used on rail types S45...S49...UIC54...UIC60 (including all types in between).

The big advantage of the wheel sensor

ZK24-2 is its very simple and quick installation and maintenance. Installation requires no electrical adjustment (no potentiometers or similar adjustment); only mechanical position adjustment using the plastic template is required. Maintenance is reduced to only a six-monthly position check using the plastic template. If the sensor becomes detached from the rail for any reason, both systems will output the low current state continuously (fail-safe).

4 Interface module UTR245

The interface module UTR245 contains two galvanically separated channels that convert the current loop signal from each system of the wheel sensor ZK24-2 to the safety relay and optocoupler output (see Figure 1). The box of module UTR245 is provided for mounting on a DIN-rail (99.7mm wide box) or panel anywhere in the level crossing housing or cabinet (Figure 3). Figure 3 shows three interface modules UTR245/ITR245 together with lightning protection modules ZUT (also on DIN-rail) installed in one level crossing housing on Croatian Railways (two double wheel detectors for switching on and one for switching off).

There are three types of outputs on each channel of the module UTR245: two optocouplers and one safety relay. One optocoupler provides a pulse for each wheel that passes the sensor. The safety relay operates on the first train wheel and returns to the basic state with time delay (5 s; adjustable at user's request) after the passage of the last wheel. The other optocoupler operates the same way as the safety relay, but only in one direction of train movement. The appropriate optocoupler on the other channel operates only for the other direction of train movement.

The safety relay contact output is suitable for connection with older relay level crossing systems; using the relay outputs, the wheel detection system UTR can directly

replace two magnetic or mechanical treadles, which also have relay contact as output. Two galvanically isolated potential-free change-over contacts of the safety relay on each channel are provided on the interface module UTR245. Since the wheel detection system can be used for either switching on or switching off the level crossing system, there are two types of interface module: UTR245 and ITR245. The only difference between these two types of module is that module UTR245 has safety relays picked-up in the basic state (when there is no wheel above the sensor), and module ITR245 has safety relays released in the basic state. The wheel detection system (UTR) with interface module UTR245 is therefore provided for switching the level crossing on, and the wheel detection system (ITR) with interface module ITR245 is provided for switching the level crossing off.

The interface module UTR245 also provides the optimal power supply for the wheel sensor ZK24-2 (48V DC, separate power for each channel). The power supply for each sensing system on the sensor is galvanically isolated from the main channel power (15 V...36 V DC) and has continuous short-circuit protection.

5 Application

Besides the replacement of the mechanical and magnetic treadles (which was the main reason for development) mostly used on relay level crossing systems, the wheel detection system UTR can be applied in newer microprocessor level crossing systems. There is a pulse optocoupler output on each channel that gives a pulse for each wheel passage over the sensor and microprocessor system can use these outputs to count axles, to determine the movement direction, etc. Even the train movement direction determination does not need to be implemented in the software of the system because the interface module UTR245 also has direction dependent optocoupler outputs. One direction output ac-

tivates only for train movement from system H to system L of the sensor ZK24-2, and the other direction output activates only for train movement from system L to system H. Using both direction dependent optocoupler outputs and pulse optocoupler outputs on both channels (total of four digital inputs on microprocessor system per wheel detection point) can make the software of the level crossing system very simple and safe (Figure 4).

Level crossing systems have many different hardware structures; many systems have two completely separate hardware channels including the power supply system and batteries. On some types of level crossings the two power supply channels are galvanically isolated. The wheel detection system UTR has two galvanically isolated channels, both in the wheel sensor and in the interface module, so one channel can be connected to the first power supply of the level crossing, and the other channel can be connected to the second power supply. Examples of this are relay level crossings on Croatian Railways; they have two completely separated systems with separate power supply for each system, and one magnetic detector is provided on the switch-on point for each system (two detectors in total per switch-on point). Thanks to galvanic separation of channels



Figure 4: Wheel sensor ZK24-2 replaces old magnetic detector (not yet removed on the left) on relay level crossing

in the wheel detection system UTR, both magnetic detectors can be replaced with only one wheel sensor ZK24-2 and interface module UTR245.

There are many other signalling systems where the wheel detection system UTR can be applied, in both safety systems and non-safety systems. A very practical solution is to use the wheel detection system

UTR for train announcements at stations. The train announcement is usually required to announce the train (by bell and light) to the station operator when the train is 3 km away from the station, but only when moving in the direction of the station, not in the opposite direction (departing). One direction dependent output on the interface module UTR245 can be directly used for

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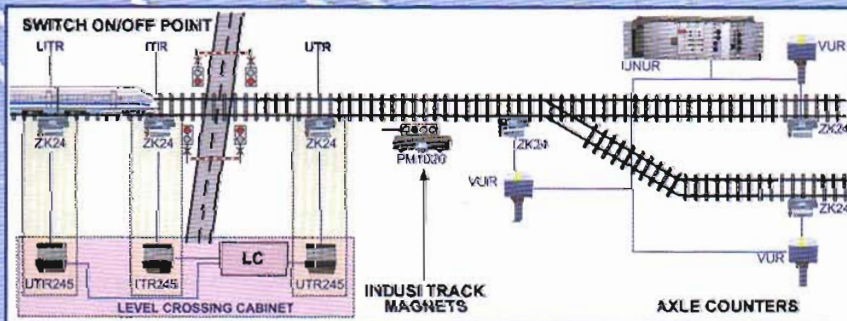
TRAIN DETECTION SYSTEM UTR/ITR FOR LC (LEVEL CROSSING) SWITCH ON/OFF APPLICATION



SENSOR ZK24
EVALUATION SUBSYSTEM ITR245/UTR245 INSIDE CABINET



LEVEL CROSSING SWITCH ON/SWITCH OFF SYSTEM UZ11



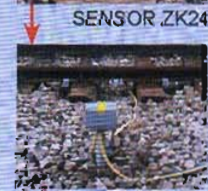
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INDOOR EQUIPMENT BO23 - UNUR 6 SECTIONS 8 COUNTING POINTS



OUTDOOR EQUIPMENT VUR



INDOOR EQUIPMENT BO1 - UNUR 1 SECTION 3 COUNTING POINTS

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Wheel detection system UTR

train announcement because the output will activate in only one train movement direction.

6 Conclusion

For replacing old mechanical or magnetic wheel detection devices, the wheel detection system UTR offers several benefits:

- Much more simple maintenance and much lower failure rate (no mechanical moving parts and no permanent magnetic field)
- Much longer life cycle of the output safety relays (relay activates on the whole train, not on each axle)
- More reliable fail-safe function in case of becoming detached from the rail
- Less equipment on track (one wheel sensor ZK24-2 replaces two magnetic/mechanical wheel detectors)
- No speed limit to 160 km/h (as with usage of magnetic detectors) since the maximum train speed for the sensor ZK24-2 is 350 km/h
- Short-circuit protection, i.e. fail-safe action in case of short-circuit of the twisted pair on track; magnetic detectors with reed-relay contact on track can switch to a permanent unsafe state in case of short circuit of the twisted pair.

By providing a replacement for older devices together with the possibility of usage in new microprocessor signalling systems, the wheel detection system UTR/ITR has a very universal application in railway signalling.

References

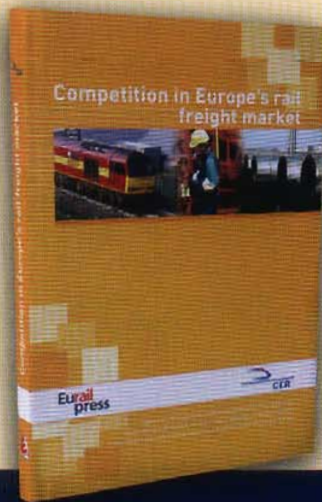
- [1] Allpro: Train detection system UTR/ITR Operating Instructions, Zagreb 2006
- [2] Hrvoje Horvat: Multiple Applications with a Single Subrack of Multi-section Axle Counter B023, Signal+Draht 07+08/2006

ZUSAMMENFASSUNG

Radsensorsystem UTR für Bahnübergangssicherungsanlagen

Viele Bahnübergangssicherungsanlagen (BÜ), die heute verwendet werden, nutzen die punktförmige zweikanalige Radsensorik für die Ein-/Ausschaltung des Bahnüberganges, üblicherweise mit audiofrequenten Gleisstromkreisen, Gleisschleifen oder Achszählabschnitten zur Erkennung der Besetzung des Bahnüberganges durch einen Zug. Daneben gibt es jedoch auch bessere Lösungen für die Aktivierung/Deaktivierung des Bahnüberganges, z.B. mit zwei oder drei Achszählabschnitten (pro Gleis), die den gesamten Bereich des Bahnüberganges vom Einschaltpunkt auf der einen Seite bis zum Einschaltpunkt auf der anderen Seite überdecken. In Osteuropa, wie auch in Westeuropa, gibt es noch immer viele ältere Eisenbahnkreuzungssicherungsanlagen. Diese werden noch in den nächsten 10 bis 20 Jahren, einige noch länger, in Betrieb sein. Viele verschiedene Radsensorsysteme werden bei diesen BÜ verwendet, von mechanischen Pedalen und Magnetschienenkontakten (MSK) mit Relaisausgangskontakten bis zu elektronischen induktiven Radsensoren, welche in modernen Achszählssystemen eingesetzt werden. Das System Raddetektion (Schienenkontakt) UTR/ITR, welches auf dem elektronischen induktiven Radsensor ZK24-2 basiert, ist eine neue Lösung sowohl für den Ersatz mechanischer Pedale und MSK, als auch für die Implementierung in neue BÜ-Systeme.

Competition in Europe's rail freight market



Wie sieht die Zukunft für den Schienengüterverkehr aus und was wird sie bringen?

Diese und viele weitere Fragen stellen sich zurzeit viele Experten. Mit der Markttöffnung im Januar 2007 steht ein bedeutendes Jahr für die Branche bevor. Bezüglich dieses Ereignisses haben sich Akademiker, Führungskräfte der Industrie und Politiker mit den wichtigsten Fragen zur Zukunft des Güterverkehrsmarktes befasst.

Das englischsprachige Buch „Competition in Europe's rail freight market“, herausgegeben von der CER – Gemeinschaft der Europäischen Bahnen und Infrastrukturgesellschaften, beschreibt die Möglichkeiten, Herausforderungen und Entwicklungen des europäischen Schienengüterverkehrs.

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