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Trackguard Cargo MSR32 system for automation of train formation yards

Greater efficiency and safety in cargo transport

MSR32 – system for automation of train formation yards

Cargo transport by rail will always be an alternative to road transport if goods reach their destination more quickly, more reliably, more punctually and more economically. What does this mean for railways? Transportation must be accelerated and the transshipment time reduced. Modernization, primarily the automation of marshaling yard operations, makes a key contribution. Siemens is a reliable partner supporting railways in this area and contributing many years of experience, competence and inventiveness.

Rationalization through modern microcomputer technology

With expertise gained over 30 years

Joint investigations by German railways and Siemens have shown that the economical formation of trains is fundamentally dependent on two factors:

- the rationalization of operational sequences at all levels – from train arrival to train departure and
- the maximum possible automation of work cycles and humping / sorting operations

To this end, Siemens has developed the MSR32 microcomputer system for marshaling yards. MSR32 has mainly benefited from the precise knowledge of customer requirements and control procedures.

The result: a modular, open microcomputer system which supports adaptation to various performance requirements. This is made possible by the system structure and the powerful performance of modern microcomputer technology. This means that it is not only smaller- and medium-capacity facilities which can be equipped with the MSR32 system and if necessary expanded step by step. The system is predominantly suitable for the automation of high-capacity yards.

MSR32 is a multi-microcomputer system. Siemens' worldwide tested Sicomp / Simatic system is used.The microcomputers are connected to each other and to the operator PCs via a local data bus (LAN).

In order to minimize spare parts requirements and maintenance costs, the same printed circuit boards are used for all controller types.

Application software

We speak the right language

The application software for the MSR32 system controllers and the operator PCs works in a strictly problem-oriented way and was written in high-level programming languages. During development, particular emphasis was placed on consistently planned and well-structured programming. In the design phase, special software design tools were therefore used for the new software and further development of the software.

All system controllers are operated in real time. The software can be configured for special applications and various procedures. Specific installation and topology features are parameterized.

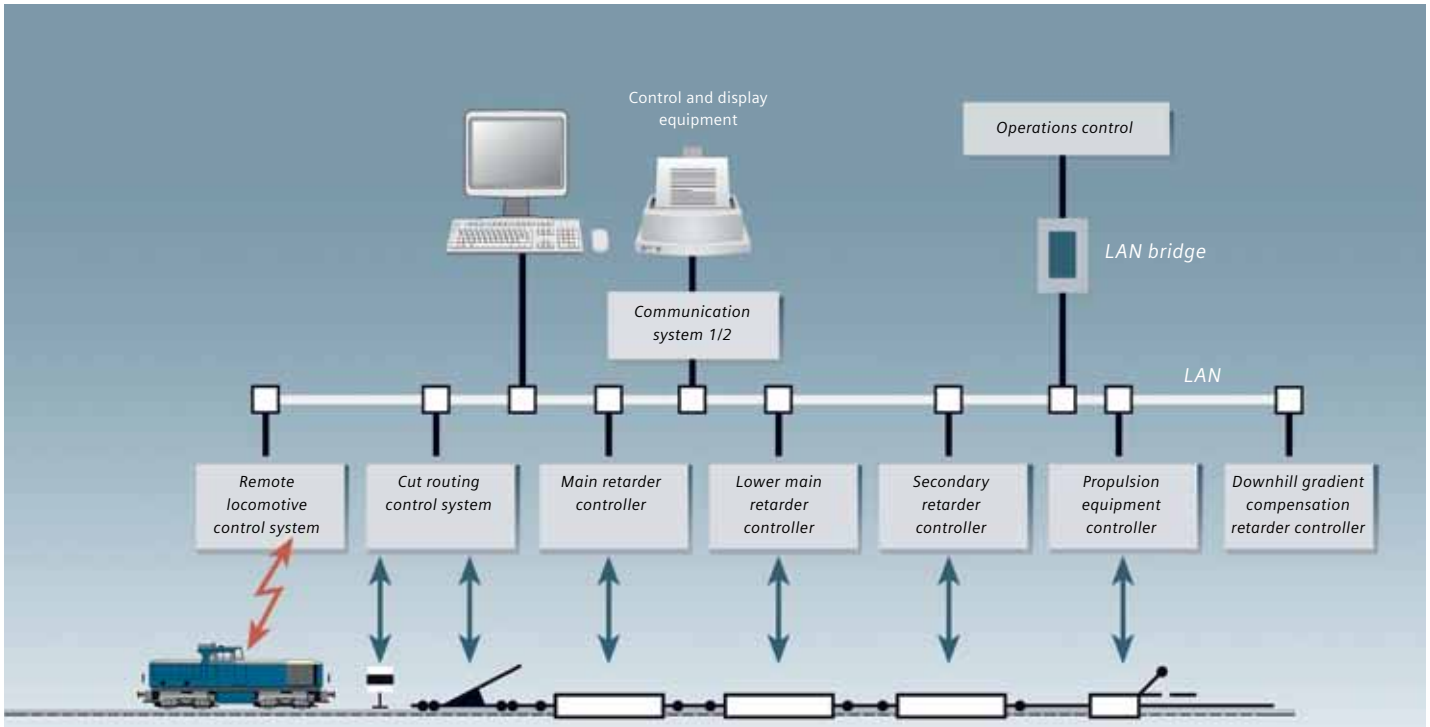
Hump control, operator control and display system (ABAS)

Rapidly in the picture at any time

The MSR32 system is characterized by optimal operator guidance and short training and familiarization time. This is achieved using a full-graphics user interface with conventional Windows PC operation.

The special hump control, operator control and display system (ABAS) consists of two standard PCs, two monitors, one keyboard and one mouse. One of the monitors shows the track diagram at all times. It contains all the information required by the operator, such as track clear / occupied indications, point positions, retarder operating state, etc. Using a second monitor (operating monitor), the traffic control staff use a keyboard or a mouse to perform all operating actions. This involves a man-machine dialog. In addition to system and installation status displays, online help is also available.

Actuation of a function key facilitates assignment change between track diagram and operating monitor. Object-oriented operation using the mouse is then possible on the track diagram monitor.



ABAS operator console at Kornwestheim marshaling yard

System MSR32

Siemens has drawn on its many years of experience in the field of train formation in order to develop the state-of-the-art MSR32 system.

All procedures used have been tested and field-proven. The performance of installations in Germany and other countries has proven the efficiency of the system in rough marshaling yard operations.

System highlights:
state-of-the-art control procedures
automatic fault detection with graded responses to component failure
flexible response to operational irregularities and bad runners with the aim of reducing corner impacts and avoiding catch-ups
adaptation to variable weather conditions
adaptive control algorithms
approval for the control of shunting areas
all procedures successfully tested and field-proven
installation and commissioning also performed without interrupting operation
high-performance reference installations in Germany and other countries
constant improvement and expansion of the functional scope, e.g. full automatic control of the humping locomotive
MSR32 enables:
reduction in marshaling costs per wagon
reduction in rolling stock transfer times and thus a reduction in total transport times
reduction in shunting damage
fewer industrial accidents, since dangerous work is taken over by the system
competitive life-cycle costs through support of targeted, load-dependent maintenance

Optimum overview at all times

Division of ABAS operating monitor

Window switchover menu

Logging window:

list of operations executed

Indication window:

list of operating and fault indications

Window switchover menu:

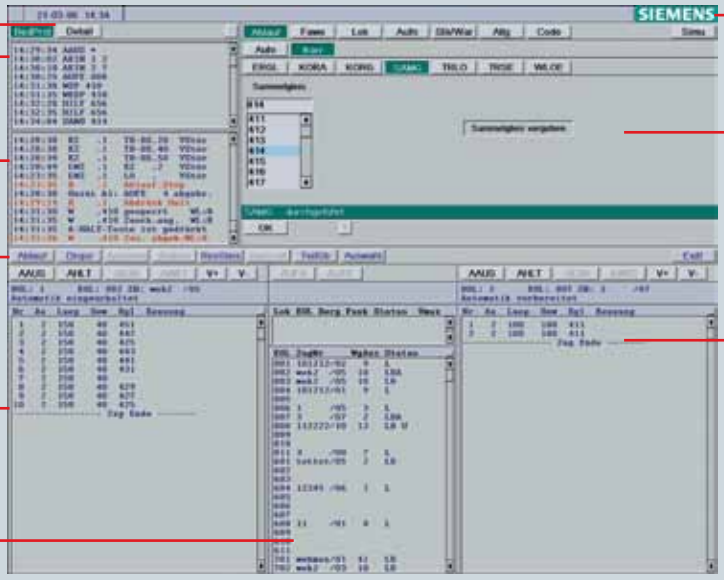
switches between splitting list and train overview windows

Track diagram or splitting list display Train overview window:

overview of trains on arrival tracks

Splitting list window for hump 1:

contains data for trains with activated automatic control



Header:

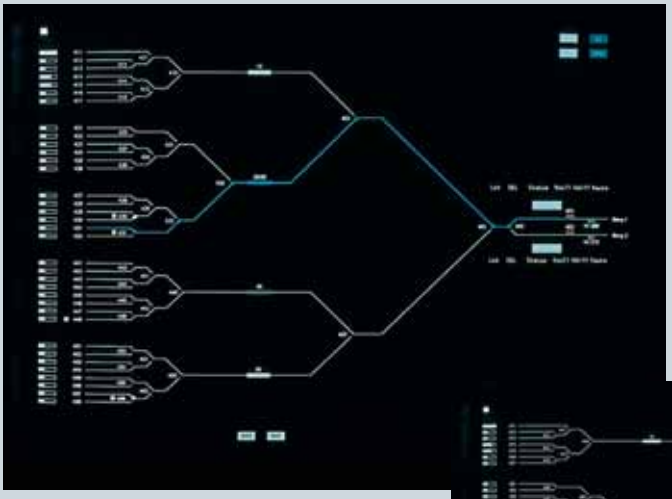
date, time, logo, computer connection

Operating window:

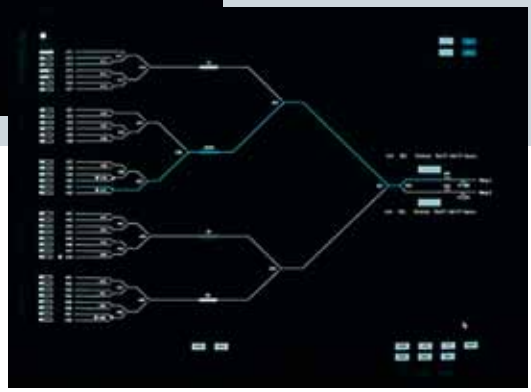
Operator action menu bars, request for associated parameters

Splitting list window for hump 2

contains data for trains with activated automatic control



Screenshot



Track diagram monitor
(object-oriented operations possible here)

Cut routing control

Danger detected – danger averted

Efficient cut routing control, i.e. fully automatic route setting for all cuts from the hump to the sorting tracks, must be both rapid and reliable.

The basis for this is the knowledge of the locations of all wagons in the hump zone. All wagon movements can be tracked using wheel detectors.

The exacting demands in terms of the availability of wheel detectors and the necessity to detect the direction of travel require the use of double wheel detectors. The cut routing control system specifies corrective measures to ensure that failure of a wheel detector does not hinder the humping operation. Based on the wheel detector indications, the cut routing control system performs a directional-type axle count and vacancy detection. This ensures that points are only operated when they are clear and not bridged by overlong wagons. The points are thrown as early as possible in order to allow the timely introduction of countermeasures, e.g. reversal of a set of points which does not reach its end position, in the event of irregularities. The cut routing control system also offers the option of diffusing dangerous situations, setting trap points with clearance and thus keeping succeeding cuts away from dangerous areas. This is the responsibility of the following system functions:

- early detection of bad runners
- cut monitoring
- "vehicle stationary" monitoring
- detection of impermissible wheel detector indications

The trap points request can be used by the cut routing control system and all other controllers within the system (e.g. retarder controllers). When automatic cut routing control is used, the operating statistics show fewer wrong runners and a provable, almost complete reduction (95 to 98%) of incidents of damage.

Marshaling yard interlocking included

One system – double the benefits

The cut routing control microcomputer can also be used to set shunting routes. The number and the path of the shunting routes are freely configurable.

This means that several shunting routes can be set simultaneously, provided they do not cross and are clear of one another. Shunting routes are usually released automatically in sections behind the departing train (vehicle). If a shunting route is set in the opposite direction, the computer automatically releases partial routes which have not been passed and have therefore not been released yet. The traffic control staff can, however, also release the shunting routes manually.

These functions enable the control of any number of shunting movements in the hump zone or other marshaling yard areas. MSR32 can thus be implemented as an inexpensive marshaling yard interlocking. In this case, the ABAS graphical user interface remains available. The track diagram and operating monitors, however, are combined into one device.

Decentralized electric points (DEPs) can be operated using the MSR32 system. This is particularly economical if the decentralized electric points border on shunting areas.

MSR32: accurate, reliable and successful

Speed control

Time-optimized through the hump zone

Speed control ensures optimally timed braking of humped wagons without damaging freight. Hydraulic clasp retarders are generally used for braking. Depending on the system size and automation level, one to three retarder groups (main retarders, lower main retarders and secondary retarders) are installed. The BKINA (braking deceleration dependent on the kinetic energy to be dissipated) procedure, in line with which all retarder controllers work, guarantees optimum braking procedures and a high level of accuracy.

Main retarders and lower main retarders are controlled in such a way that the entry speed of the wagons in the next retarder group does not exceed the maximum permissible speed and that the distance between wagons necessary for point throwing is ensured each time. Different running times of good and bad runners are equalized.

If the hump yard is not equipped with secondary retarders, the lower main retarder is controlled using the procedure of "automatic lower main retarder control for brakesman mode". The entire hump yard can be controlled by just one person in this way. All displays and operations come under the control of the cut routing control operation and display system.

In addition, automatic lower main retarder control significantly improves shunting quality: thanks to consideration of the running qualities, a high level of accuracy is achieved when complying with the speeds calculated in the sorting track. This makes the brakeman's task easier, improves quality and also results in a high sorting track occupancy level.

The control procedure for the secondary retarders is dependent on the required humping performance of the overall system. If the system has clearance and closing-up propulsion equipment, braking is down to a constant release speed of between 1.25 and 1.5 m/s.

In medium-capacity hump yards, secondary retarder control in line with the target-shooting procedure provides the most economical mode of full automation. The cuts are retarded in such a way that they reach their target – usually the last wagon on the sorting track – without exceeding the permissible impact speed.

Variable nominal release speeds are also generated by a combination of the target-shooting procedure and closing-up propulsion equipment. The front wagon starting position can be varied on the sorting track, energy-optimized.

Propulsion equipment

High tech for the optimum

Clearance equipment is responsible for immediate clearance in high-capacity systems of the last set of classification points of long groups and the danger zone behind the secondary retarders. Closing-up propulsion equipment pushes wagons into the exact position for coupling on the sorting track.

The driving engines of both propulsion systems are supplied by frequency inverters which are controlled by intermediate circuits. This guarantees optimum efficiency of the overall system, since only the energy required for the current propulsion action is supplied. In the case of retarding and reversing procedures, energy is fed back into the intermediate circuit.
In addition, the dynamic, variable-frequency-supplied engines reduce wear and lead to longer winding cable and propulsion unit service lives. The torque / speed controls applied allow precise compliance with propulsion speeds and, for the most part, avoidance of catapult effects.

Only one closing-up propulsion unit per track is used for the clearance target-shooting and propulsion procedures, with variable starting positions.

Downhill gradient compensation retarders

Automation in the sorting track

Work on the track is generally avoided in economical system planning. The downhill gradient, for the most part already available, is thus compensated by downhill gradient compensation retarders, to ensure that there is no impermissible acceleration of heavy cuts. The MSR32 controller achieves optimum speed control of cuts on the sorting track.

Remote control of locomotives

Faster over the hump

In contrast to a system with manually controlled humping locomotives, humping performance can be increased by at least 20% with remote control of the humping locomotive for the hump approach and hump procedure.

At the start of the humping operation, the maximum permissible humping speed is calculated for each wagon. This process takes account of track parameters, the routes, and the properties of wagons and cuts.

The humping speed calculated in this way for each wagon is continuously transmitted by radio to the humping locomotive and automatically converted by the latter for the individual wagons. The humping speed is thus constantly and optimally adapted to the humping behavior of the wagons and cuts. Despite increased humping performance, this results in another considerable reduction in the risk of wrong runners and corner impact.

Logging

Fault location made easy

The MSR32 system's comprehensive logging functions mean that maintenance personnel seamlessly re-examine the events, perform an evaluation and respond early to irregularities.

All operations and responses to operations, as well as all indications of irregularities, are recorded, in addition to all events on the process control level, e.g. process inputs and outputs. The microcomputer activities for all controllers can thus be re-examined later, and any events can be localized quickly.

Logging the retarding procedures of all retarders enables constant monitoring of their status, and thus targeted maintenance.

A remote diagnostic unit is installed at Siemens via the connection of an ISDN bridge.

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