A Digital Equipment for Measuring, Recording and Control of the Railway Vehicles' Speed

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Abstract: this paper present a computing system designed to measure and record the speed, space and time and to supervise the speed of the railway vehicles according to the type of the train and the railway signals. The system is implemented on the locomotives produce in our country, to achieve the new standards for circulation's safety introduced in the European Union.

Key words: speed measure, record and control, railway vehicles, digital equipment

The equipment is composed of a processing unit, a rotation transducer and two speed indicators placed in driver's cab. The processing unit is connected with the speed indicators by two serial data buses, to transmit speed and time information.
The equipment is connected with INDUSI equipment already placed on the locomotives, which detect the railway signals.
The data recorded in the equipment memory can be downloaded, using a RS 232 interface, to a transfer unit or to a PC for analysis and archive.
The processing unit is developed around the SIEMENS SAB 80C517A microcontroller, compatible with the Intel 80C51 family. The rotation transducer generates digital pulses having a frequency depending the vehicle speed. The speed is calculated using the pulses frequency and the wheels diameter. The electric diagram of the equipment is presented in figure 1.
The application program is stored in an EPROM memory of 64 Kbytes and for the data store it's used a static RAM of 512 Kbytes. The current time generate by a real time circuit EPSON RTC 72421. When the equipment's power supply is off the RAM and RTC circuits are supplied from a 3V battery by the supervisor circuit MAX 691.
The INDUSI equipment generate data according to the railway signals detected (500 Hz, 1000 Hz, or 2000 Hz) and received information about the speed value, for the

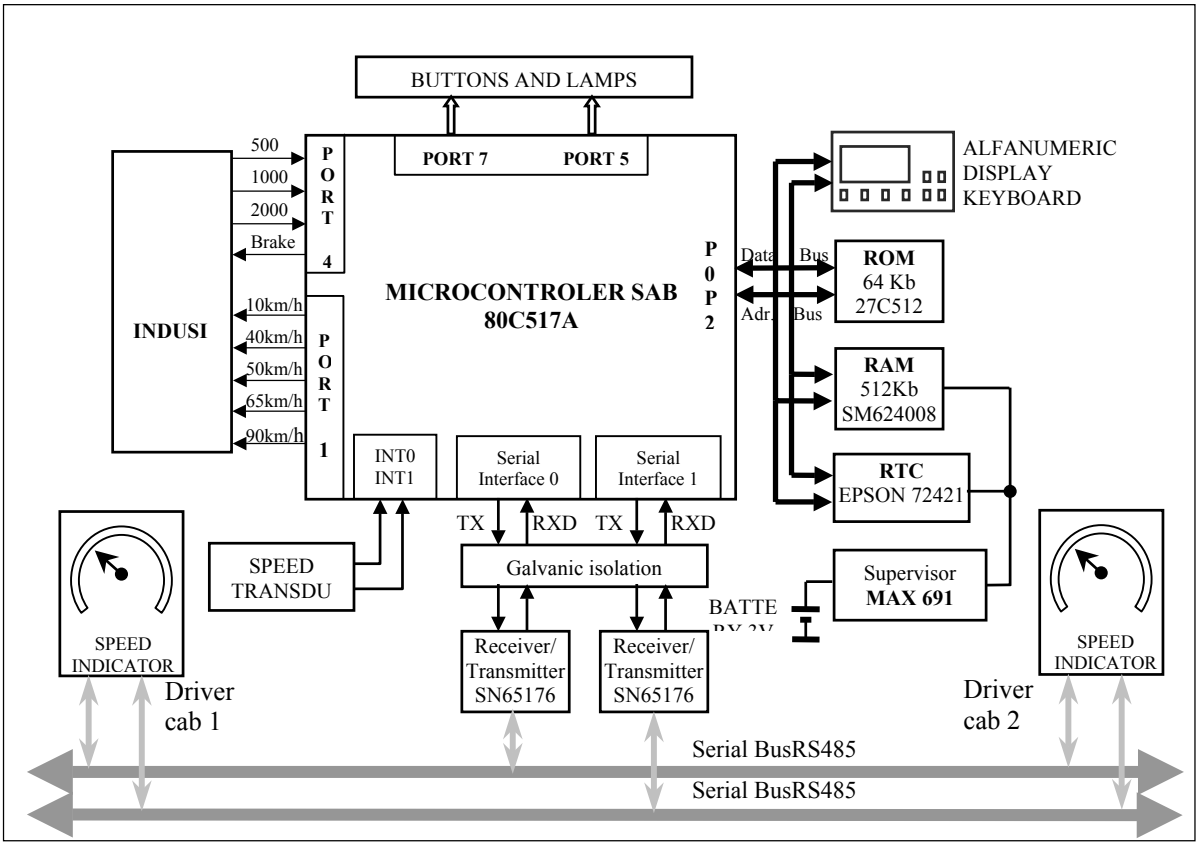

Figure 1. Electric diagram of the equipment

existing models, or only a brake command for the new models which will be introduce in our country to increase the circulation's safety.
The speed control means the continuous compare of the vehicle speed with a maximum admissible speed for a type of train, command the train brake and attention the driver, until the vehicle speed is under the maximum admissible speed allowed.
The speed is also supervised for some distance if appear a railway signal, how it is presented in figure 2.
At a 1000 Hz signal it is verified the action of the "Attention" button in 4 seconds and it is commanded a forced brake until the train is stopped if the button isn't activated. If the "Attention" button is pushed, the speed is reduce so that, for example, a speed train will have in 23 seconds a speed of 85 km/h and it will be kept constant for 1250 m from the signal, or until the mechanic push a button to annulated the speed supervise.
At a 500 Hz signal the maximum speed allowed is calculated using the formulas:

- Speed train: $V_{\lim} = 3{,}6 * \sqrt{1{,}11 * (294 - s)}$

- Passenger train: $V_{\lim} = 3{,}6 * \sqrt{0{,}64 * (301 - s)}$

- Freight train: $V_{\lim} = 3{,}6 * \sqrt{0{,}50 * (247 - s)}$

s = space from the 500 Hz signal

When the train reach $V_{\lim}$, the speed is kept constant till 250 m from the signal.
A 2000 Hz signal means "Stop" command immediately a forced brake until the train is stopped. The signal can be inhibited and the train will not be stopped if the mechanic press the button "Ordinate Pass" and the train has a speed less than 40 km/h and this action will be memorise.

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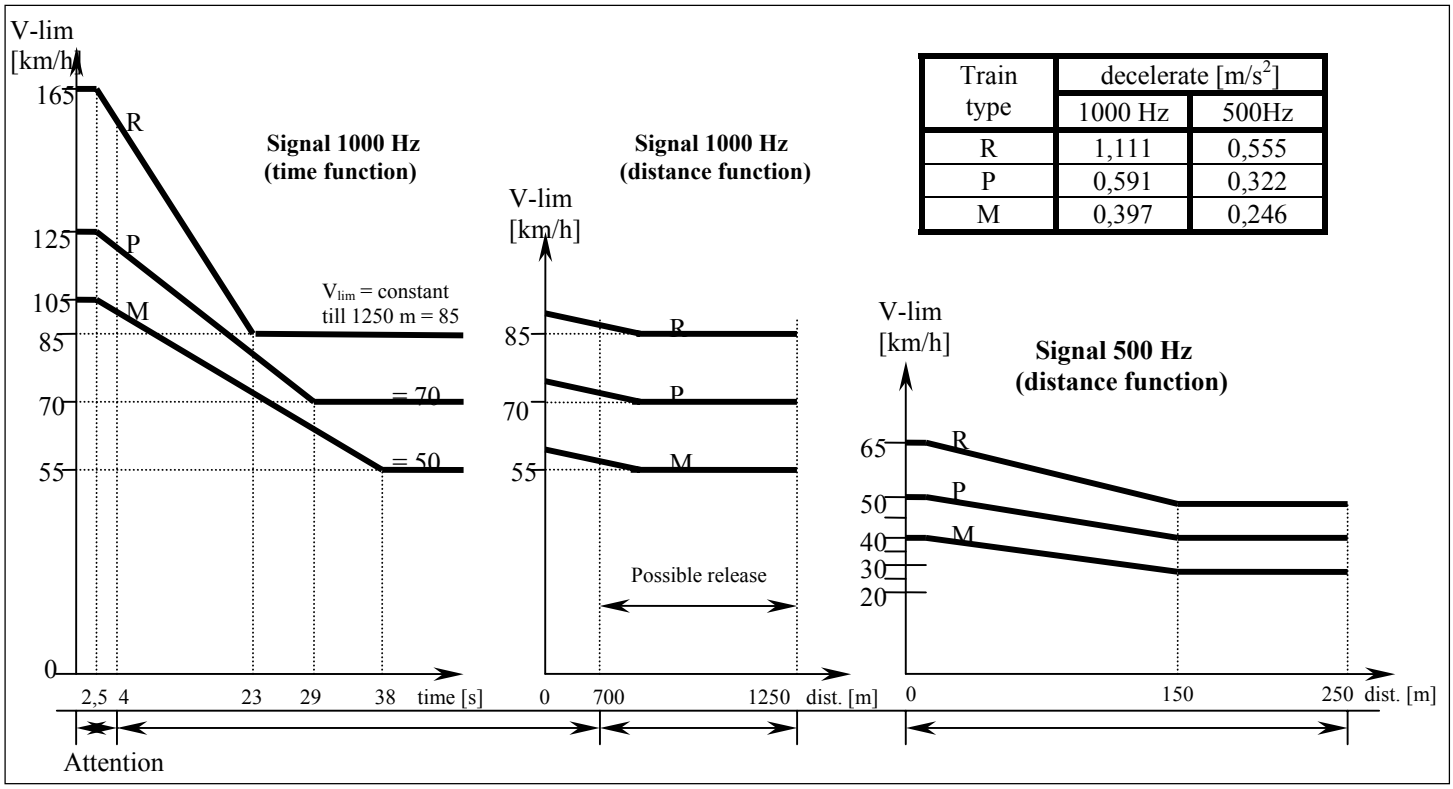

Train type	decelerate [m/s^2]	
	1000 Hz	500Hz
R	1,111	0,555
P	0,591	0,322
M	0,397	0,246

Figure 2.Supervising functions after the 1000Hz and 500Hz signals