



OPERATING MANUAL

MIREL RM1

Speed Recorder

Additional source files:

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Changes:

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Document Definition

The purpose of this document is to define the scope, method and conditions for operating the MIREL RM1 speed recorder.

This document is related to the following documentation:

	Number	Version	Name
[1]	297RM1	150325	MIREL RM1 - Technical conditions
[2]	278RM1	180208	MIREL RM1 - Maintenance and diagnostics manual
[3]	547MAP	000000	MIREL KAM - Operating manual

The **document** is intended for the following staff:

- Of the manufacturer, who are trained and authorized to conduct diagnostics and maintenance of the MIREL RM1 speed recorder
- Of the operator, who are trained to perform the operation or diagnostics and maintenance of the MIREL RM1 speed recorder and who have been delegated such activities by an authorized representative of the operator
- Of third parties involved in the production, upgrading and refurbishment of locomotives, who are trained to perform the operation or diagnostics and maintenance of the MIREL RM1 speed recorder and who have been delegated such activities by their superiors

This document does not replace the User's operating regulations for the using the MIREL RM1 speed recorder.

General Characteristics

The MIREL RM1 speed recorder is equipment specifically designed for use on railway locomotives in all forms of tractive power. The RM1 secures three basic functions: measurement of instantaneous speed, indication of instantaneous speed and additional information, registration of instantaneous speed and other operating and technical data in relation to a time and route-independent scale.

The MIREL RM1 speed recorder is composed of a central processing unit, two indicator devices and two identification devices located at the engineer's stations. The interconnection of individual equipment is via a data line with serial data transmission. Alternatively the RM1 can be operated with only one indicator device or without one. The same applies for the identification devices.

Power for the MIREL RM1 speed recorder is connected to the locomotive's battery source. Configuration of the MIREL RM1 is dependent upon the voltage of the battery source. Service of the speed recorder is performed exclusively from the engineer's station via the identification devices and control elements on the locomotive's control panel. Functionality of the identification instrument may be integrated into the control unit of a cooperating system. No entry into the locomotive's mechanical room or into the central processing unit of the equipment is required to operate the MIREL RM1 speed recorder.

The MIREL RM1 speed recorder is an electronic digital system designed on the basis of the latest electrical components where each instrument is controlled by a separate processor. The components used in the central processing unit meet demanding criteria for reliability and robustness. The central processing unit contains a processor module, power supply, registration module, module for measuring frequency inputs and a module for galvanically isolated digital inputs and outputs. The registration module is designed on the basis of large capacity semiconductor memory chips that ensure the storage of data even if disconnected from the locomotive's battery source for an extended period of time. The indication equipment contains the actual pseudo-analogue indication instrument and a digital indicator of instantaneous speed. The identification equipment comprises a 32-character alphanumeric display and a 12-button keyboard.

The MIREL RM1 speed recorder performs regular self-diagnostics and enables the performance of functional tests to re-test the correct functionality of all control system components and locomotive equipment that works with it. The equipment is maintenance free apart from performing functional tests.

Configuration of the Equipment

The basic schematic for connecting the components of the MIREL RM1 speed recorder and cooperating equipment on board the locomotive includes:

Basic components:

- Central processing unit 1x
- Indication unit 2 x
- Identification unit 2x

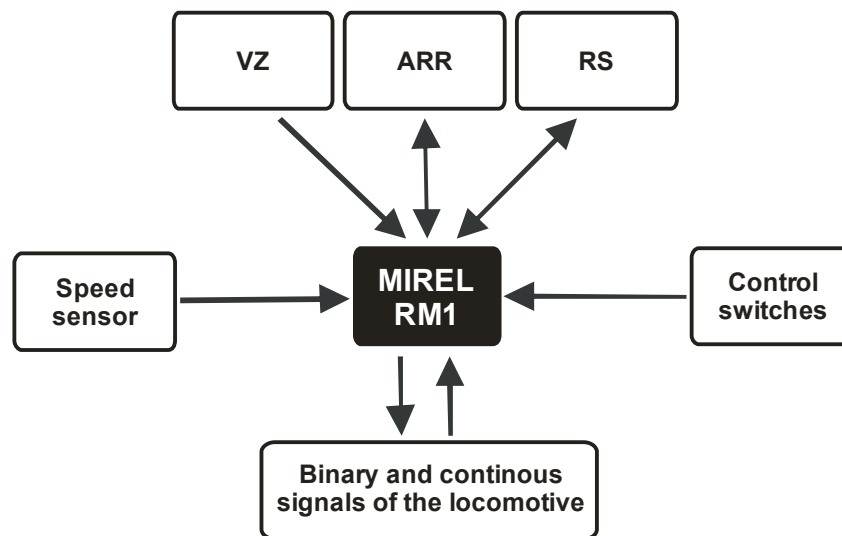
Cooperating equipment:

- Incremental rotation sensor 1x
- Control switch at engineer's station 2x (or 1x)
- Train control system

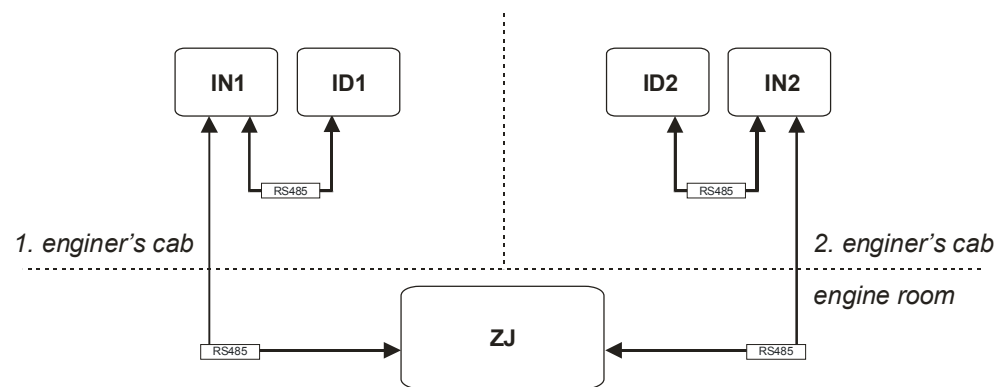
Optional cooperating equipment:

- ARR
- Control system
- etc.

Schematic for connecting the equipment to the locomotive:



Schematic for connecting MIREL RM1 speed recorder units:



Basic block diagram of the test sample

Central Processing Unit

The central processing unit secures all the operating functions of the MIREL RM1 speed recorder.

- Measuring and filtering impulses from the impulse rotation sensor
- Calculating speed
- Calculating the distance travelled
- Evaluating the distance travelled
- Variables required for registration
- Reading digital and analogue inputs
- Controlling digital outputs
- Communication with the indication and identification units at engineer stations
- Communication with connected cooperating equipment on board the locomotive
- Self-diagnostics
- Indication on the front panel

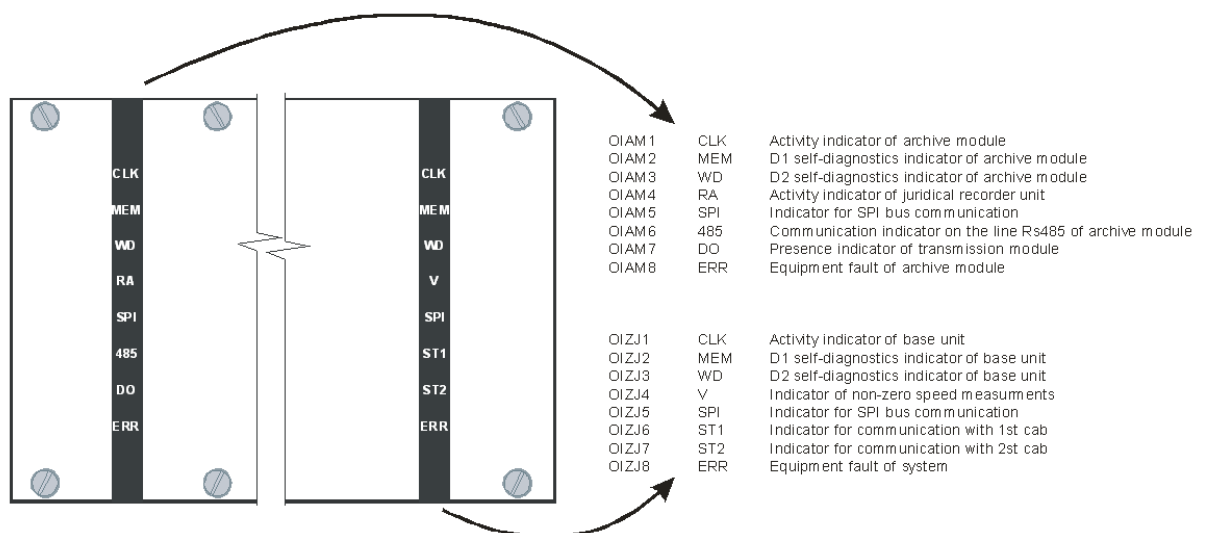
The central processing unit is furnished in two different configurations according to the type of processor and registration module:


- Basic configuration (8 MB registration module capacity), central processing unit type RM1ZJ.0.xxxxx (MIREL RM1 with type marking RM1.0.XXXX)
- Expanded registration module memory (16GB registration module capacity), central processing unit type RM1ZJ.1.xxxx (MIREL RM1 with type marking RM1.1.XXXX).

A more detailed description is given in the 297RM1 technical conditions.

A set of 16 LED indicators are installed on the front panel of the central processing unit. No control elements are located on the central processing unit and there is no need for the operator to interfere with the central processing unit during operation of the speed recorder. The central processing unit is powered from the locomotive's battery source. Power is provided through a separate breaker dedicated for the speed recorder and installed with other breakers for the locomotive or in another specific location depending on the specific type of locomotive. The other components of the MIREL RM1 speed recorder are powered by the central processing unit.

The indication elements and a 15-pin DB type connector for reading the registration unit are installed on the front panel.





The central processing unit is constructed with a 19" width to comply with the IEC 297 standard for rack-mounted equipment. The height is defined as 3U pursuant to the standard (module U = 44.45 mm). The modules of the central processing unit are installed in an AL cabinet. A 72-pin DD type industrial connector and a 25-pin DB type connector are located on the rear panel. The central processing unit will operate in any position. The central processing unit is installed inside the locomotive based on the specific type of locomotive. Access to the front panel without requiring any disassembly is sufficient for ordinary operating conditions and when maintenance is required.

Indication Unit

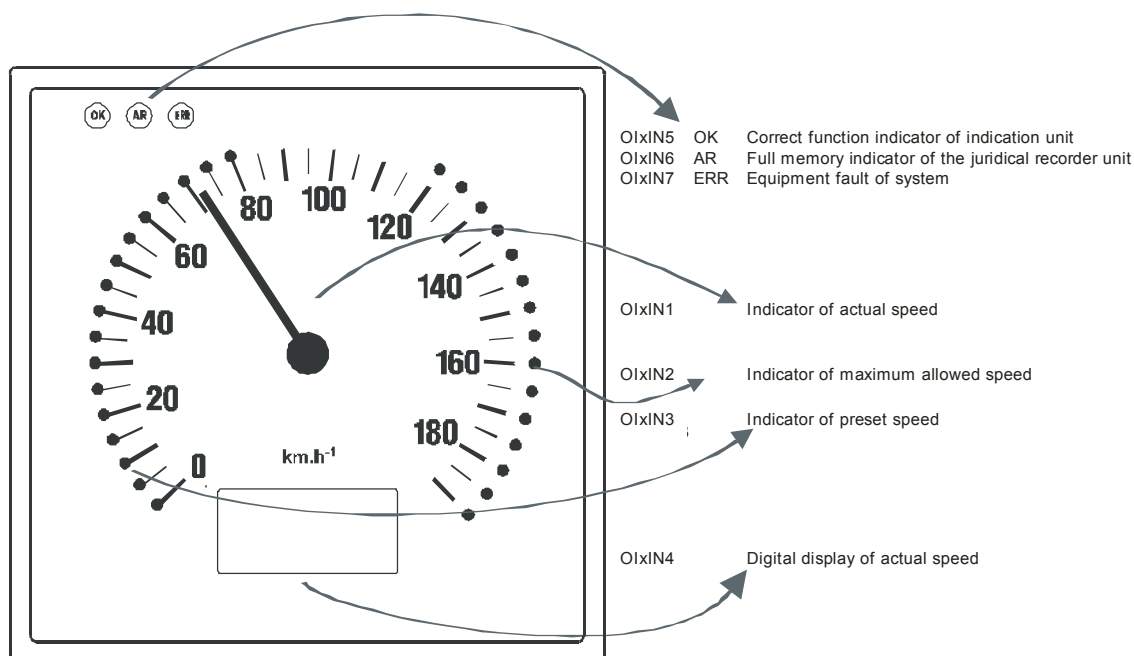
The indication unit ensures that the following data is displayed at the engineer's station:

- Instantaneous speed - a pseudo-analogue gauge, digital indicator
- Maximum allowed speed - red signal (in conjunction with MIREL VZ1)
- Pre-set speed – green signal (in cooperation with the automatic speed regulation module)

The indication unit is a single purpose computer. This computer contains a gauge indicator, number indicator, 2 signals and 3 LED indicators and a light intensity sensor. The instrument cluster is permanently backlit with brightness regulation. The brightness of the number indicator and the signals themselves is also regulated. The unit is connected to the central processing unit with a four conductor cable that powers the indication unit and secures data communication between the central processing unit and the indication unit.

The indication unit is constructed in the form of a plastic box intended for integration into the desk at the engineer's station. The indication components are installed on the front face of the box with a 7-position terminal strip located on the back. The equipment can be installed in any suitable manner based on the construction of the locomotive so long as the indication components are visible.

The digital speed indicator for the locomotive displays the instantaneous speed with maximum accuracy thanks to the speed recorder. The function of the pseudo-analogue dial gauge is to provide the operator with an instantaneous indication when checking the instantaneous speed.



Identification Unit

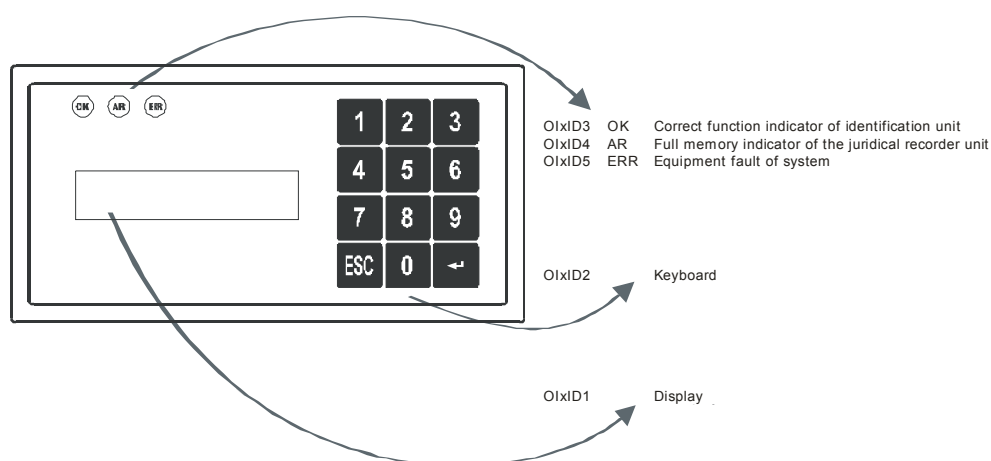
The identification unit is used to enter the engineer's data and to provide alpha-numeric information on the display. The identification unit can also be used to display the following, in addition to the login prompt:

- Instantaneous speed - numeric information
- Maximum speed - numeric information
- Pre-set speed - numeric information
- Calendar date and time in hours, minutes and seconds
- Total distance travelled in km
- Total daily distance travelled in km
- Percentage of used recording archive capacity
- Entering the engineer's identification number
- Entering the train number
- Entering train weight ¹⁾
- Entering the carrier identification number ¹⁾
- Entering the operating mode ¹⁾

¹⁾ only for the configuration with expanded memory in the registration module (MIREL RM1 with type marking RM1.1.XXXX)

The identification unit is a single purpose computer. It contains a 32-character alpha-numeric display (2 x 16 characters), 12-button keyboard, 3 LED indicators and a light intensity sensor. Display and LED brightness is regulated. The unit is connected to the central processing unit with a four conductor cable that powers the identification unit and secures data communication between the central processing unit and the identification unit.

The identification unit is constructed in the form of a plastic box intended for integration into the desk at the engineer's station. The indication elements and the keyboard are located on the front side. A 7-position terminal strip is located on the rear side. The identification unit can be installed in any suitable manner based on the construction of the locomotive so long as the indication components are visible and the keyboard is accessible.

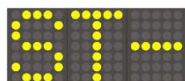


Start Up and Shut Down

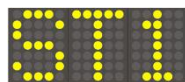
Start Up:

The MIREL RM1 speed recorder is placed into operation when the locomotive's battery source is powered up. No additional steps or action are needed to place the unit into operation. Once on the speed recorder conducts the start-up self-diagnostic test during which the equipment is prepared for use. The speed recorder can only be configured from the station at which the locomotive's control switch has been turned on.

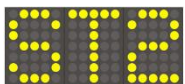
Indication of the active station:



Control is not turned on at either station



Control is turned on at Station 1



Control is turned on at Station 2

Operating values are displayed on the indication and identification units at the active station.

Speed recorder functionality is signalled as follows once start up is complete:

- The identification unit at the active station displays the operator login prompt
- The numeric display on the indication unit at the active station displays the speed of the locomotive while the coloured signals indicate the maximum and pre-set speed
- The dial indicator on the indication unit at the active station begins to indicate the instantaneous speed of the locomotive 10 seconds after being switched on
- The identification unit at the inactive station displays "STx" where x stands for the number of the active station
- Central processing unit indicator OIZJ1 flashes at a frequency of 1 Hz,
- Central processing unit indicator OIZJ2 is lit constantly,
- Central processing unit indicator OIZJ3 is lit constantly,

The speed recorder is placed into undefined operator mode when switched on, which is indicated on the red signal with a maximum speed of 40 km.h^{-1} .

Shutting down the speed recorder:

After operations are complete, the equipment is shut-down by disconnecting the locomotive's battery source. No additional steps are needed to switch off the equipment.

Configuring Modes of Operation

The MIREL RM1 speed recorder works in the following working modes:

- **IDENTIFICATION** mode (undefined operator)
- **OPERATION** mode (defined operator)

The modes are selected by the operator by entering the login and logout dialogues into the identification unit at the active station. The mode can only be changed when the locomotive is completely stopped.

Operator login:

Basic configuration (MIREL RM1 with type marking RM1.0.XXXX):

The following data must be entered in order to complete the login dialogue:

- The engineer's identification number (maximum of eight characters)
- Train number (maximum of eight characters)

The CONFIRM button is used to move on to the next step with regards to data entry.

Data that has just been entered is deleted by pressing the ESC button.

The login dialogue automatically terminates if the operator does not press any buttons for 10 seconds when completing the dialogue and the equipment remains in undefined operator mode.

Once the login dialogue is completed, the identification unit display at the active station displays the date and time; the red signal on the indication unit at the active station begins to indicate the maximum speed, either from the train control system or the maximum design speed of the locomotive.

Configuration with expanded memory (MIREL RM1 with type marking RM1.1.XXXX):

The following data must be entered in order to complete the login dialogue:

- The engineer's identification number (maximum of ten characters)

Once the login dialogue is completed, the identification unit display at the active station displays the date and time; the red signal on the indication unit at the active station begins to indicate the maximum speed, either from the train control system or the maximum design speed of the locomotive.

Other details are entered once logged in to the OPERATION mode:

- Train identification number (maximum of ten characters)
- Train weight (maximum of four characters)
- Carrier identification number (maximum of four characters)
- Operating mode (TRAIN, MULTIPLE UNIT, HELPER, SHUNTING, FAILURE, MAINTENANCE)

Buttons TL1 to TL5 are used to move between the entered data with the CONFIRM button used to confirm the entered data. The data is modified using numbered buttons TL0 to TL9 (the operating mode is changed using button TL5). Data that has just been entered is deleted by pressing the ESC button. Changes in the data are saved by pressing the CONFIRM button. To return to the basic date and time display, press TL0.

Operator logout:

Press the ESC button to execute the logout dialogue in order to bring up the logout dialogue and then press the CONFIRM button to actually execute the logout.

Basic configuration: the logout dialogue is terminated and the equipment remains in the defined operator mode if the operator does not press any button for 10 seconds when completing the dialogue.

After the logout dialogue is executed the display of the identification unit on the active station displays the login prompt and the red signal on the indication unit of the active station displays a maximum speed for the locomotive of 40 km.h⁻¹.

Displaying data on the identification unit:

Basic configuration (MIREL RM1 with type marking RM1.0.XXXX):

Pressing the CONFIRM button cycles through and displays other data (instantaneous speed, maximum speed, date, time, etc.) in OPERATION mode or buttons 0 to 7 can be used to display such content directly.

Configuration with expanded memory (MIREL RM1 with type marking RM1.1.XXXX):

Buttons TL7, TL8, TL9 and TL0 are used to cycle the display through the additional data (instantaneous speed, maximum speed, date, time, etc.) in OPERATION mode.

The daily travel distance can be zeroed out by pressing the TL8 button for 2 seconds.

Functions of the Keyboard on the Identification Unit

Basic configuration (MIREL RM1 with type marking RM1.0.XXXXX):

Functions of the keyboard in IDENTIFICATION mode:

Character	Description
0	Entering the number "0" when entering the identification dialogue
1	Entering the number "1" when entering the identification dialogue
2	Entering the number "2" when entering the identification dialogue
3	Entering the number "3" when entering the identification dialogue
4	Entering the number "4" when entering the identification dialogue
5	Entering the number "5" when entering the identification dialogue
6	Entering the number "6" when entering the identification dialogue
7	Entering the number "7" when entering the identification dialogue
8	Entering the number "8" when entering the identification dialogue
9	Entering the number "9" when entering the identification dialogue
↵	Proceed to the next step in the identification dialogue
ESC	Delete the number that was just entered

Functions of the keyboard in OPERATION mode:

Character	Description
0	Displaying date and time
1	Displaying the instantaneous speed of the locomotive
2	Displaying the pre-set speed of the locomotive
3	Displaying the maximum speed of the locomotive
4	Displaying the counter for travelled kilometres
5	Displaying the entered operator number
6	Displaying the entered train number
7	Status of used recording archive memory capacity
8	Unused
9	Unused
↵	Cycling between displayed data / confirmation of logout dialogue
ESC	Calling up the logout dialogue

Configuration with expanded memory (MIREL RM1 with type marking RM1.1.XXXX):

Functions of the keyboard in IDENTIFICATION mode:

Character	Description
0	Registration status, number of failure / entering "0" in the identification dialogue
1	Registration status, number of failure / entering "1" in the identification dialogue
2	Registration status, number of failure / entering "2" in the identification dialogue
3	Registration status, number of failure / entering "3" in the identification dialogue
4	Registration status, number of failure / entering "4" in the identification dialogue
5	Registration status, number of failure / entering "5" in the identification dialogue
6	Registration status, number of failure / entering "6" in the identification dialogue
7	Registration status, number of failure / entering "7" in the identification dialogue
8	Registration status, number of failure / entering "7" in the identification dialogue
9	Registration status, number of failure / entering "9" in the identification dialogue
↵	Proceed to identification dialogue / confirming the entered data
ESC	Delete the number that was just entered

Functions of the keyboard in OPERATION mode:

Character	Description
0	Displaying date and time
1	Displaying and modifying the engineer's identification number
2	Displaying and modifying the identification number of the train
3	Displaying and modifying train weight
4	Displaying and modifying the carrier's identification number
5	Displaying and modifying the operating mode
6	Unused
7	Displaying the instantaneous speed of the locomotive Displaying the pre-set speed of the locomotive Displaying the maximum speed of the locomotive
8	Displaying the counter for total distance travelled Displaying the counter for total daily distance travelled
9	Status of used recording registration memory capacity
↵	CONFIRM
ESC	Calling up the logout dialogue

Overview of Operating Functions in the Individual Modes

Mode	Identification	Operation
Indication of instantaneous speed on the OIxIN1 gauge	Yes	Yes
Indication of instantaneous speed on the OIxIN4 numeric indicator	Yes	Yes
Indication of maximum permitted speed - red signal OIxIN2	Constant signal, max. speed of 40 km.h ⁻¹	Yes
Indication of pre-set speed – green signal OIxIN3	Yes	Yes
Indication of instantaneous speed on the OIxID1 display of the identification unit	No	Yes
Indication of maximum speed on the OIxID1 display of the identification unit	No	Yes
Indication of pre-set speed on the OIx-ID1 display of the identification unit	No	Yes
Indication of date and time on the OIx-ID1 display of the identification unit	No	Yes
Indication of distance travelled on the OIxID1 display of the identification unit	No	Yes
Indication of the engineer's identification number on the OIxID1 display of the identification unit	No	Yes
Indication of the train number on the OIxID1 display of the identification unit	No	Yes
Identification dialogue	Yes	No
Logout dialogue	No	Yes
Registration of recorded data	Full range	Full range

Indication of Used Recording Memory Capacity

The immediate status of the operating registration memory is displayed by the identification unit in OPERATION mode by pressing button 7 (*basic configuration, MIREL RM1 with type marking RM1.0.XXXX*) and button 9 (*configuration with expanded memory, MIREL RM1 with type marking RM1.1.XXXX*). The value is presented in %. A value of 0 % means that the entire memory of the recording registration unit is full and is ready to record. A value of 100 % means that the recording registration unit is completely full. This value is set to 0 % after reading data from the speed recorder and unlocking the memory.

The IOxID4 indicator on the indication unit and IOxIN6 indicator on the identification unit flash when recording registration capacity is filled to a level of 75 % or higher in order to alert the operator of such condition. The equipment remains fully functional in this instance.

The IOxID4 indicator on the indication unit and IOxIN6 indicator on the identification unit are constantly on when recording registration capacity is filled to a level of around 98 % in order to alert the operator of such condition. The text "ArP" will flash on the digital indicators of the indication unit. The equipment in this instance is not functional and cannot be operated. Data is not stored in the recording registration unit. Instantaneous, pre-set and maximum speed indication on the indication unit remains functional. This value is set to 0 % after reading data from the speed recorder and unlocking the memory and the equipment is once again fully functional.

Transmission of Data from the Speed Recorder

The transmission of data from the MIREL RM1 speed recorder is completed using:


- The MIREL ATM transmission module (basic configuration, MIREL RM1 with type marking RM1.0.XXXX)
- The KABUSB cable (configuration with expanded registration module memory, MIREL RM1 with type marking RM1.1.XXXX)

For the purposes of simplicity, both are presented using a common name - the transmission module. The transmission module is a component of the MIREL ARKTUR assessment and registration suite.

The transmission module must be connected to the SAI connector on the front panel of the speed recorder's central processing unit in order to read the registered data. The establishment of communication is signalled as follows:

- The indicator for the registration module of the central processing unit IOAM7 shows the text "OD"
- The LINK indicator on the ATM transmission module shows the text "LINK" (the KABUSB cable does not have any indication).

The transmission module must be connected to the speed recorder within 15 seconds of power being applied to the speed recorder, when the speed recorder can accept such connection. After this initial period, the speed recorder will ignore the connection of the transmission module and the speed recorder will remain in its normal mode of operation.

The current read status is displayed on the screen during transmission of data from the speed recorder to the assessment computer. Successful completion of transmission is signalled with an audio alert and the following symbol .

Once data transmission is complete, the ATM transmission module is disconnected from the SAI connector on the front panel of the central processing unit. The speed recorder must be restarted in order to place it back into normal operation. If the assessment suite is configured to unlock the recording unit of the speed recorder, the memory of the speed recorder is released for subsequent recording.

Depending on the configuration of the assessment computer, the transmission module automatically sets the time and date in the speed recorder. Daylight savings are also configured at the same time.

In an emergency case when the previous method of transmission cannot be used and when data must be secured immediately (e.g. in the event of an accident), the registration module can be removed from the speed recorder and it can be read by the MIREL ARKTUR assessment system away from the locomotive itself. The protective seal must be removed and the four (4) M4 bolts must be removed from the front panel of the registration module in order to remove the registration module from the equipment; then simply pull on the module and release the connector on the back side of the registration module.

More details information on the procedure for transferring data from the MIREL RM1 speed recorder to the MIREL ARKTUR assessment suite and the method of their assessment and registration are located in the operating manual for the assessment suite.

Fault Signalling



Speed recorder faults are divided into two groups. Specifically these groups are faults that prevent subsequent use of the speed recorder and faults that restrict subsequent use of the speed recorder.

In the case of a **fault that prevents subsequent use of the speed recorder**, the equipment on the front panel on the indication unit and on the identification unit indicates a fault (ERR). In the case of any such fault, the operator should first switch off the breaker for the speed recorder for at least 1 second and then switch the breaker back on in order to re-initialize the speed recorder. A serious fault will not be cleared in this manner and the error message will be displayed again.

A numbered code indicating the fault in the equipment is displayed on the identification unit in order to more clearly define the exact reason for the fault in the equipment.

Faults that prevent subsequent use of the speed recorder:

E00	Permanent loss of communication between the central processing unit and the indication unit or identification unit
E01	Watchdog failure
E02	Program integrity failure (FLASH and EEPROM memory integrity)
E04	Communication error between central processing unit and indication unit at the 1st station
E05	Communication error between central processing unit and indication unit at the 1st station
E06	Communication error between central processing unit and identification unit at the 1st station
E07	Communication error between central processing unit and identification unit at the 1st station
E08	General failure of active indication unit <ul style="list-style-type: none">■ Watchdog failure■ Program integrity fault (FLASH and EEPROM memory integrity)■ Indication unit communication fault■ Fault in integrity of configuration parameters
E09	General failure of active identification unit <ul style="list-style-type: none">■ Watchdog failure■ Program integrity failure (FLASH and EEPROM memory integrity)■ Identification unit communication fault
E10	Combined module error in BBC at position A <ul style="list-style-type: none">■ Start-up error of watchdog circuits■ Program integrity error (FLASH and EEPROM memory integrity)■ Integrity error of configuration parameters■ Communication error between module and central unit Error of communication with control system on CAN bus
E11	Combined module error in BBC at position B <ul style="list-style-type: none">■ Start-up error of watchdog circuits■ Program integrity error (FLASH and EEPROM memory integrity)■ Integrity error of configuration parameters■ Communication error between module and central unit Error of communication with control system on CAN bus
E12	Communication error between central unit and BBC-A gateway
E13	Communication error between central unit and BBC-B gateway

E20	Speed measurement fault
E21	Fault in assessment of actual direction of travel
E22	Power fault in incremental rotation sensor
E23	Power fault in analogue input
E24	Sensor fault, analogue input 1
E25	Sensor fault, analogue input 2
E33	Fault in integrity of configuration parameters
E34	Communication fault in SPI link
E40	Incorrect date fault in registration module
E41	<p>Combined module error in EXIO / BBC cooperating device at position A</p> <ul style="list-style-type: none"> ■ Start-up error of watchdog circuits ■ Program integrity error (FLASH and EEPROM memory integrity) ■ Integrity error of configuration parameters ■ Error of communication with control system on CAN bus <p>Error of communication with diesel oil consumption system</p>
E42	<p>Combined module error in EXIO cooperating device at position B</p> <ul style="list-style-type: none"> ■ Start-up error of watchdog circuits ■ Program integrity error (FLASH and EEPROM memory integrity) ■ Integrity error of configuration parameters <p>Error of module communication with module on EXIO-A position</p>
E43	<p>Combined module error in EXIO cooperating device at position C</p> <ul style="list-style-type: none"> ■ Start-up error of watchdog circuits ■ Program integrity error (FLASH and EEPROM memory integrity) ■ Integrity error of configuration parameters <p>Error of module communication with module on EXIO-A position</p>
E44	<p>Combined module error in EXIO cooperating device at position D</p> <ul style="list-style-type: none"> ■ Start-up error of watchdog circuits ■ Program integrity error (FLASH and EEPROM memory integrity) ■ Integrity error of configuration parameters <p>Error of module communication with module on EXIO-A position</p>
E45	Error of communication between registration module with cooperating device
E50	Watchdog fault in the registration module
E51	Communication parameters integrity error of registration module
E52	Error of initialization or entry on SD-card of the registration module
E53	Real-time circuit error of the registration module

In the case of a **fault that restricts subsequent use of the speed recorder** there is no indication on the front panel of the central processing unit or on the indication and identification units at the active station. Such faults involve the indication and identification units at the inactive station. These faults restrict the activity of the speed recorder at the station at which the indication and identification units are operating correctly.

Faults restricting the subsequent use of the speed recorder are indicated on the indication or identification units of the inactive station:

E00

General fault in the indication or identification unit

- Watchdog fault in the indication or identification unit
 - Memory fault in the indication or identification unit
 - Permanent loss of communication between the central processing unit and the indication unit or identification unit
 - Communication fault involving the indication or identification unit
-



Notes