

No.:

1986RM2

Version

190709

System / Product:

MIREL RM2 Integrated On-Board System

Title:

Operating Manual

Further source- and enclosed files:

File	Description	Pages Connection	/
1			
2			
3			

List of document versions:

Version	Description	Compiled by	Validated by	Approved by
150701	Document introduction	Ing. Csáder	Ing. Michalec	Ing. Michalec
160530	Extension of system indication	Ing. Michalec	Ing. Michalec	Ing. Michalec
160928	Extension for safety, operational and system functions	Ing. Mandrik	Ing. Jasenčák	Ing. Michalec
161109	Extension for accord check of movement direction, vigilance confirmation with drive controllers, issue of line pulses	Ing. Jasenčák	Ing. Jasenčák	Ing. Michalec
180214	Extension of procedure in case of accident	Ing. Jasenčák	Ing. Jasenčák	Ing. Michalec
190709	Extension by operation of RM2IN.2 Indication Unit	Ing. Jasenčák	Ing. Michalec	Ing. Michalec

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1 Intended Use of the Document

The document specifies operation method and conditions of Integrated On-Board system MIREL RM2.

The document follows up and refers to documentation stated below:

No.	Version	Title
[1]	1976RM2 200603	Technical Conditions
[2]	1984RM2 190430	Technical Report
[3]	1987RM2 190709	Maintenance Manual, Diagnostics
[4]	1988RM2 200422	RM2 System Catalogue Sheet
[5]	1985RM2 200418	Specification of Configurations
[6]	2170RM2 190913	Specification of Registered Data Configuration
[7]	1992RM2 191025	Installation Manual

Document is intended for employees of:

- Producer, who are trained and authorized to perform diagnostics and service of MIREL RM2 Integrated On-Board System
- Operator, who are trained for operation or diagnostics and maintenance of MIREL RM2 Integrated On-Board System and have authorization for this activity from responsible representative of the Operator
- Third parties, acting in DRV production and reconstruction, who are trained and authorized to perform diagnostics and service of MIREL RM2 Integrated On-Board System and have the authorization for this activities from their superior

This document doesn't replace operating directive of the User for the use of MIREL RM2 Integrated On-Board System. During creation of operating rules, it is necessary to ensure compliance with the relevant standards.

2 Specification of Document Changes

Version 190709

Extension by operation of RM2IN.2 Indication Unit.

Version 180214

Extension of document about the process of reading registered data in case of accident. Update of chapter Error detection and system intervention, removal of error code tables, replacement with the reference to the document Instructions for maintenance and diagnostics. Updating values for control Vmax for values 3/5/7 km/h. Add a description of automatic logging in for operator.

Version 161109

Updates in specification of D1 diagnostic test, cooperating devices, audible indication, register of errors and emergency stop indications. Extension with check of accord between DRV movement direction with adjustment of direction controllers, vigilance confirmation with drive controllers, extension with functionality of track pulse issue. Extension of indication on ZJ modules.

Version 160928

Extension of document with safety, operating and system functions.

Version 160530

Extension of system indication on indication and identification unit.

Version 150701

Document introduction.

3 Applied Marking and Terminology

Active (driver) cab	Cab of the railway vehicle with the control switch turned on and a present driver
EPV	Electropneumatic valve
Functional property „B“	Functional property control of vigilance
Functional property „G“	Functional property GSM gate
Functional property „L“	Functional property localization (place, time)
Functional property „M“	Functional property measurement and speed indication
Functional property „R“	Functional property registration of data
Functional property „S“	Functional property registration in terms of EN62625-1
GGAM	Internal module in central unit with GPS and GSM modules
DRV	Driving rail vehicle, including train sets, steering rail vehicles, work machines and similar vehicles
IEC	International Electrotechnical Commission
Installation documentation, application documentation	Documentation compiled for application of Integrated On-Board System MIREL RM2 for specific type of railway vehicle, as a rule it comprises wiring diagram, assembly procedure, activation and configuration procedure, as well as component layout on DRV
IRC	Incremental sensor of axle rotation on rail vehicle
LSM	Device cooperating with GPS module
LCM	Device cooperating with GPS and GSM modules
Maximum design speed	Maximum speed as stated by railway vehicle producer or speed specified as maximum one after a reconstruction
Maximum speed of operating mode	Maximum speed specified for the operating mode, in which the on-board system has been switched
RM2ZJ	Central unit of MIREL RM2 system
RM2IN	Indication unit of MIREL RM2 system
RM2ID	Identification unit of MIREL RM2 system
SNUM	MIREL RM2 System No.
ST1	Engine driver cab 1
ST2	Engine driver cab 2
TST1	Technology post 1
TST2	Technology post 2
UIC	Union Internationale des Chemins de fer – International Union of Railways
↵	Command pushbutton

4 General Characteristics

The MIREL RM2 Integrated On-Board System integrates the function of DRV speedometer, on-board recording device, as well as protection device of vigilance monitoring. Basic functions are measurement of actual rolling stock driving speed, measurement of covered distance, evaluation of movement direction, calculation and indication of movement speed at driver cabs as well as record generation of mentioned quantities. Beyond mentioned quantities, the system carries out a record of actual values for other safety-related, operating and technology quantities from DRV, dependent on independent time- and distance scale in real time, in extent based on system configuration and installation method applied for a given type of rail vehicle. The system provides safety-relevant as well as safety-irrelevant output signals, dependent on measured actual speed and covered distance of the rail vehicle.

The MIREL RM2 Integrated On-Board System carries out the driver or DRV operating staff vigilance supervision, in compliance with specification of a national train protection system of Class B, type LS or eventually in compliance with specification of vigilance supervision pursuant to UIC 641.

The MIREL RM2 Integrated On-Board System fulfils the function of operating and technology data transfer via the GSM gateway to a remote server. Apart from that, the system provides for determination and registration of DRV position and for time synchronization based on GPS signal.

The actual extent of MIREL RM2 Integrated On-Board System functional properties is determined by system configuration for specific type application case.

The MIREL RM2 Integrated On-Board System can be operated on rail vehicles of all types of traction, on steering rail vehicles, work machines and similar vehicles.

Power supply of MIREL RM2 Integrated On-Board System is provided from rail vehicle battery source. The specific system modification is chosen based on voltage of the vehicle battery source. Operation and control of the MIREL RM2 Integrated On-Board System is carried out solely from driver's cab.

The MIREL RM2 Integrated On-Board System is an electronical numeric system designed based on modules of 3rd MIREL system generation. System has been designed as an open one, consisting of a secure core and application-variable extension modules. The application variability of extension modules and cooperating devices allows apart from integration with third parties systems also data transfer from DRV to central databank by means of GSM technology, as well as clock synchronization and localization with use of GPS technology.

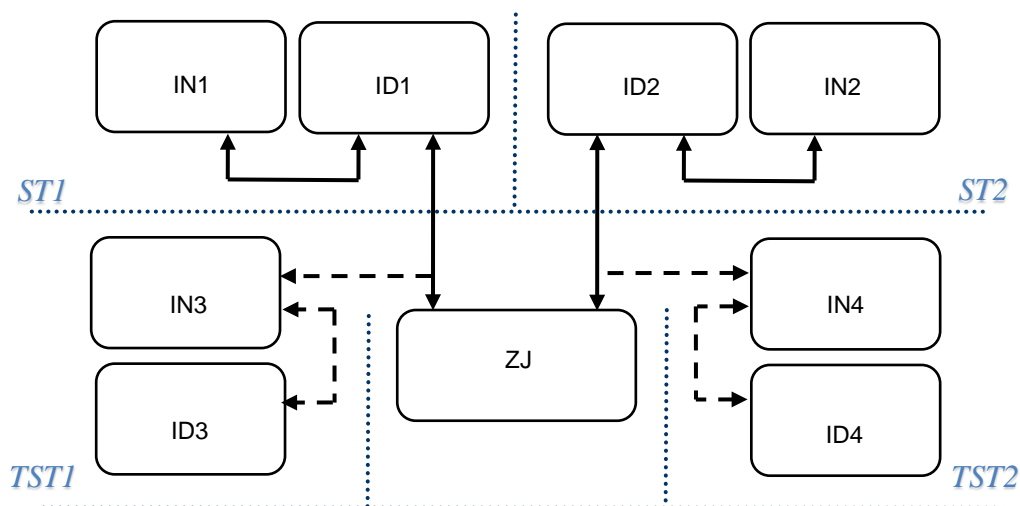
System has been conceived as a secure system with SIL4 safety integrity level for dedicated safety-relevant functions. The required safety level is achieved by means of architecture with secure core of central unit, grouping of special watchdog circuits, double-channel(quadruple-signal) measurement of speed and covered distance. In case of system modification with functional property "R" and secure system with SIL 4 is ZJ equipped with duplicated recording medium. In case of neediness completion of requirements of terms EN62625 the ZJ is equipped with functional property "S" and another recording medium which must accomplish with requirements of this term.

The MIREL RM2 Integrated On-Board System performs a one-time as well as continuous self-diagnostics and enables to carry out functional test for testing of proper function of system components and important cooperating devices. Apart from periodic execution of D3 functional test and periodical execution of D4 prophylactic inspection, the system is maintenance-free.

5 Set of System Units

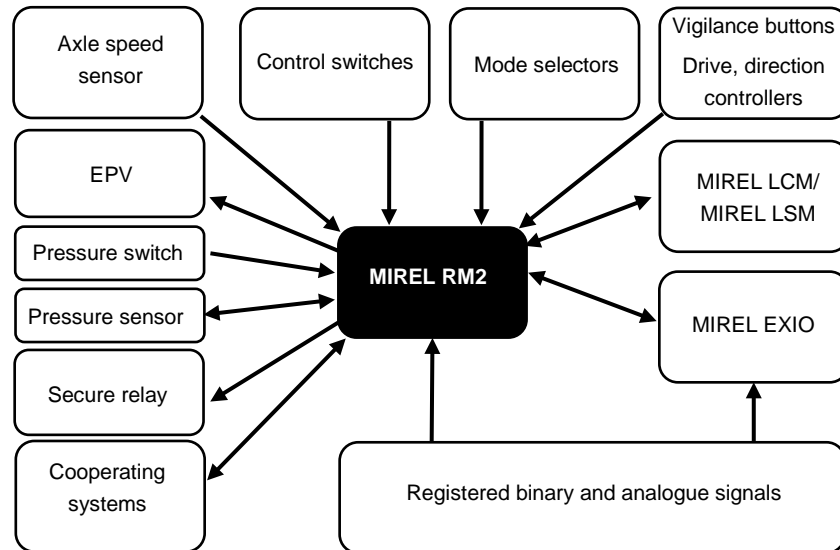
The MIREL RM2 Integrated On-Board System contains in its complete set-up following devices:

- Central unit ZJ 1
- Indication unit IN max 4
- Identification unit ID max 4



It can cooperate with following functional units:

- Incremental axle speed sensor 1x
- Control switches at cabs 2x
- Drive controllers 2x
- Direction controllers 2x
- Mode selectors at cabs 2x
- EPV electropneumatic valve 1x
- Pressure switch 1x
- Pressure sensor 2x
- Technological secure relay 3x
- Communication gateway MIREL LCM/ synchronization and localization gateway MIREL LSM 1x
- Extension devices MIREL EXIO 4x
- Cooperating systems



5.1 Central Unit

Central unit provides main operating safe and operational functions of the MIREL RM2 Integrated On-Board System:

- Speed measurement
- Calculation and saving of covered distance
- Evaluation of movement direction
- Driver vigilance supervision
- Maximum speed supervision
- Supervision of DRV movement direction
- Operational system intervention
- Data collection and registration
- Communication with connected cooperating devices of DRV
- Sensing of binary and analogue input signals
- Control of technological binary outputs
- Data provision to system communication interface
- System clock localization and synchronization (in case of modification with GGAM module or cooperating element LSM/LCM)
- Data transfer via GSM technology (in case of modification with GGAM module or cooperating element LCM)
- Wheel flange lubrication
- Issue of line pulses



The central unit has been designed as a modular system. It can be built inside of the structural system in compliance with standard IEC 297, i.e. basic width of 19". For systems without application need of larger number of internal extension modules it is possible to apply the central unit in version of a compact TUG structural system.

Indication elements on central unit's front panel

- Double-colour indicator OIZJ1 on module ZJ-A
- Double-colour indicator OIZJ2 on module ZJ-B
- Double-colour indicator OIZJ3 on module ZJ-C
- Other double-colour indicators of individual extension modules

Module status	Colour	Indication	Period	S class
Active diagnostic of functional module	red/blue/violet	flashing	1,5 s	33 % (red) 33 % (blue) 33 % (violet)
Internal error of functional module	red	flashing	300 ms	33 % (red) 67 % (exting.)

Module status	Colour	Indication	Period	S class
Serious fault of functional system	red/blue	flashing	1 s	50 % (blue) 50 % (red)
Communication error of functional module / light fault of functional system	red/blue	flashing	1 s	33 % (red) 67 % (blue)
Start-up	red	lighting	-	-
Start-up accomplishment	blue	lighting	-	-
Functional module operation with own power supply)	blue	flashing	1 s	50 % (blue) 50 % (exting.)
Functional module operation without own power supply)	extinguished	-	-	-





5.2 Indication Unit

Indication unit provides for visualization of following operation data at driver's cab:

- Movement speed (dial indicator, digital indicator, graphic display, or their combination)
- Maximum permitted speed – red light trace (only RM2IN.1, RM2IN.2)
- Preset speed – green light trace (only RM2IN.1, RM2IN.2)
- System error indication
- System indication intervention
- Vigilance confirmation indication (only RM2IN.S, RM2IN.2)

In case of system configuration with vigilance supervision functionality a numerical indication unit RM2IN.S must be installed, equipped with command pushbutton and indicator of vigilance prompting/confirmation or RM2IN.2 indication unit. The unit indicated violation of maximum speed by flashing of numerically displayed travel speed on display. Indication unit RM2IN.S doesn't indicate the maximum and preset speed. With version of analogue indication unit RM2IN.1 and indication unit RM2IN.2, the maximum and preset speed is indicated by red and green light trace, movement speed is indicated numerically on display and simultaneously by dial indicator on analogue scale. All versions of indication units have a function of brightness regulation.

5.2.1 Indication and control elements on front panel of numeric indication unit RM2IN.S

-  indicator OIIN1:
 - permanent lighting indicates condition which doesn't require vigilance confirmation by driver
- **NZ** indicator OIIN3:
 - flashing indicates emergency stop, i.e. operational system intervention, in time, when the intervention can't be terminated
 - permanent lighting indicates operational system intervention, which can be terminated by command pushbutton  or re-initializing of MIREL RM2 Integrated On-Board System.
- **S** indicator OIIN4:
 - flashing indicates serious system error and error of system safety functions
- **ERR** indicator OIIN5:
 - permanent lighting indicates a light system error
-  triple-character alphanumeric indicator OIIN6:
 - permanent lighting indicates DRV travel speed
 - indicates status of inactive cab
 - indicates reason of DRV emergency stop
 - indicates request for execution and execution status of diagnostic test D1
 - indicates status of activated diagnostic test D3
 - indicates preset operating mode of MIREL RM2 Integrated On-Board System
 - flashing indicates DRV travel speed at:
 - meeting of conditions leading to emergency stop
 - failed confirmation of request to confirm DRV staff vigilance
 - violation of DRV maximum speed
 - discrepancy between DRV movement and setting of direction controllers
 - DRV movement prior to D1 accomplishment
 - Serious system error
 - DRV movement without staff login in all operating modes of MIREL RM2 Integrated On-Board System, with exception of SHUNTING mode
-  pushbutton of command OIIN7



5.2.2 Indication and control elements on front panel of analogue indication unit RM2IN.1

- **S** indicator OIIN4:
 - Flashing indicates a serious system error and fault of system safety functions
- **ERR** indicator OIIN5:
 - permanent lighting indicates a light system error
- **571** triple-character alphanumeric indicator OIIN6:
 - permanent lighting indicates DRV travel speed
 - indicates status of inactive cab
 - indicates status of DRV emergency stop
 - indicates execution status of diagnostic test D1
 - indicates status of activated diagnostic test D3
 - indicates preset operating mode of MIREL RM2 Integrated On-Board System
 - flashing indicates DRV travel speed at:
 - meeting of conditions leading to emergency stop
 - failed confirmation of request to confirm DRV staff vigilance
 - violation of DRV maximum speed
 - discrepancy between DRV movement and setting of direction controllers
 - DRV movement prior to D1 accomplishment
 - Serious system error
 - DRV movement without staff login in all operating modes of MIREL RM2 Integrated On-Board System, with exception of SHUNTING mode
- Red light trace OIIN8:
 - Indicates maximum permitted speed
- green light trace OIIN9:
 - indicates preset speed
- dial indicator OIIN10:
 - indicates DRV travel speed





5.2.3 Indication and operating elements on front panel of RM2IN.2 indication unit

- Indicator OIIN1B:

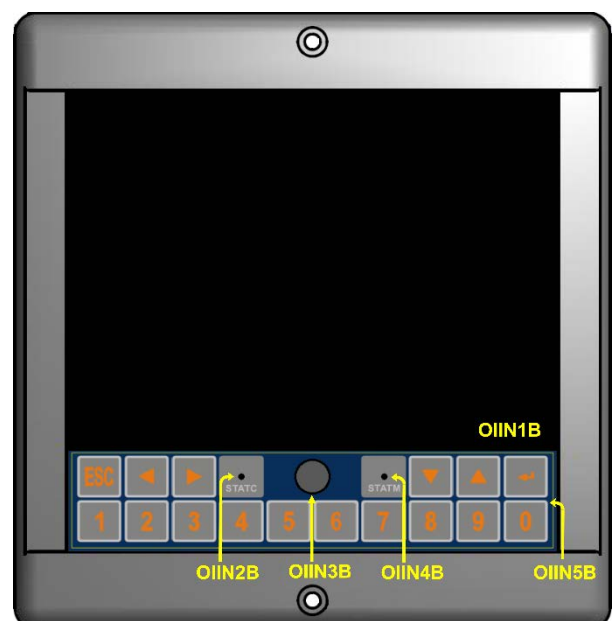
TFT display showing all operating information.
- Indicator OIIN2B:

STATC

with permanent red light it indicates a minor failure of MIREL RM2 system and an internal indication unit failure detected by channel C of indication unit. With flashing red light it indicates a serious failure of MIREL RM2 system. With simultaneously operated pushbuttons  and  it lights in green colour.
- Indicator OIIN4B:

STATM

with permanent red light it indicates a minor error of MIREL RM2 system



and an internal indication unit error detected by channel M of indication unit.

With flashing red light it indicates a serious failure of MIREL RM2 system.

With simultaneously operated pushbuttons

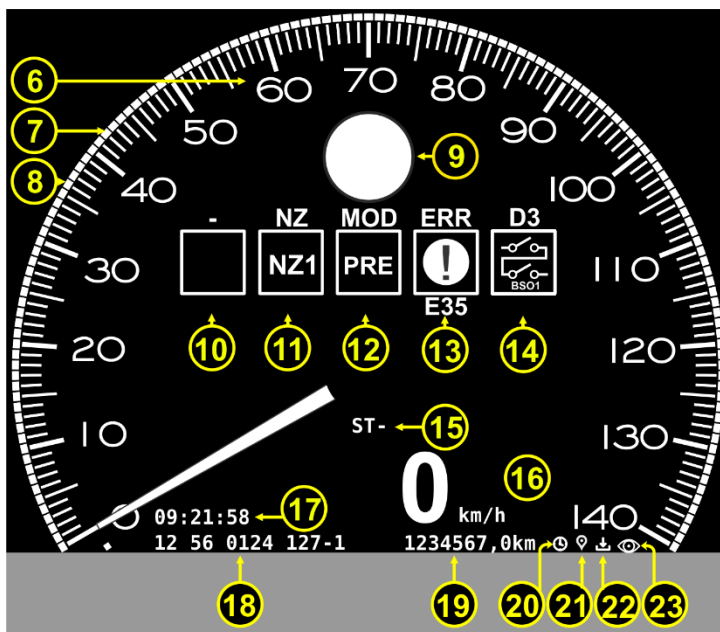
 and  it lights in green colour.

- OIIN3B Location of element sensing the external illumination intensity, based on which the background illumination intensity of OIIN1B is controlled. Pushbutton background illumination intensity isn't controlled.
- OIIN5B Indication unit keyboard allows navigation in menu, viewing and entering of system data.

OIIN1B

Display of RM2IN.2 periphery is virtually divided into lines and columns. Following objects are located on display:

- 6 (OIIN6B) – speed scale
Speed range is determined by modification of system indication unit.
- 7 (OIIN7B) – Light trace of pre-set speed
Green light indicates pre-set speed
- 8 (OIIN8B) - Light trace of maximum speed
Red light indicates maximum permitted speed
- 9 (OIIN9B) – Permanent blue light indicates status without requirement of vigilance confirmation by engine-driver

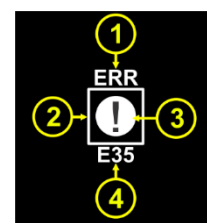


- 10 (OIIN10B) – Unified indication element, unemployed
- 11 (OIIN11B) - Unified indication element, emergency stop
- 12 (OIIN12B) - Unified indication element, RM2 mode
- 13 (OIIN13B) - Unified indication element, RM2 error
- 14 (OIIN14B) - Unified indication element, D1, D3
- 15 (OIIN15B) – Selected cab
- 16 (OIIN16B) – digital speed data
- 17 (OIIN17B) – real time in system
- 18 (OIIN18B) – DRV No.
- 19 (OIIN19B) - User / Daily / Total covered distance, user-eligible, daily covered distance is chosen after system start
- 20 (OIIN20B) - GPS data for clock synchronization are available
- 21 (OIIN21B) - GPS position data are available
- 22 (OIIN22B) – User mark registration running (1-8)
- 23 (OIIN23B) – Modification of RM2IN.2 periphery is with SIL2 safety level






















Unified Indication Elements on OIIN1B



















Multi-functional indication elements OIIN10-OIIN14 are located on OIIN1B, composed of 4 sections:
















- 1 - header
- 2 - frame
- 3 - symbol
- 4 - additional information































List of indicators on OIIN1B:

Symbol	Symbol description on OIIN1B	Designation/ Location
	Blue light. Colour: blue  - vigilance confirmation is not required dark grey  - vigilance confirmation is required	Symbol: IND-01 Line: 1 Column: 3
	Empty, unoccupied indicator, for future use. Colour: dark grey 	Symbol: IND-02 Line: 2 Column: 1
	Emergency stop inactive. Colour: dark grey  – no emergency stop. Detected by: MIREL RM2 Integrated On-Board System.	Symbol: IND-03 Line: 2 Column: 2
	Emergency stop active NZ1 – Omitted vigilance confirmation. Colour: yellow  Detected by: Central unit of MIREL RM2 Integrated On-Board System.	Symbol:IND-03-NZ1 Line: 2 Column: 2
Recommended technological procedure: After DRV has been stopped, by pressing pushbutton  issue request for NZ deletion.		
	Emergency stop active NZ2 – Maximum speed violation Colour: yellow  Detected by: Central unit of MIREL RM2 Integrated On-Board System.	Symbol:IND-03-NZ2 Line: 2 Column: 2
Recommended technological procedure: After DRV has been stopped, by pressing pushbutton  issue request for NZ deletion.		
	Emergency stop active NZ3 – Travel direction discrepancy. Colour: yellow  Detected by: Central unit of MIREL RM2 Integrated On-Board System.	Symbol:IND-03-NZ3 Line: 2 Column: 2
Recommended technological procedure: After DRV has been stopped, by pressing pushbutton  issue request for NZ deletion.		
	Emergency stop active NZ6 – Movement before accomplishment of D1 diagnostic test. Colour: yellow  Detected by: Central unit of MIREL RM2 Integrated On-Board System.	Symbol:IND-03-NZ6 Line: 2 Column: 2
Recommended technological procedure: After DRV has been stopped, by pressing pushbutton  issue request for NZ deletion.		
	Indication of acceptance concerning request for NZ deletion. Colour: yellow 	Symbol:IND-03-NZOK Line: 2 Column: 2

Symbol	Symbol description on OIIN1B	Designation/ Location
	Chosen mode of integrated on-board system is SHUNTING. Colour: light grey 	Symbol:IND-04-POS Line: 2 Column: 3
	Chosen mode of integrated on-board system is WORK. Colour: light grey 	Symbol:IND-04-PRA Line: 2 Column: 3
	Chosen mode of integrated on-board system is OPERATION. Colour: light grey 	Symbol:IND-04-PRE Line: 2 Column: 3
	Chosen mode of integrated on-board system is DEAD-IN-TOW. Colour: light grey 	Symbol:IND-04-ZAV Line: 2 Column: 3
	No error has been detected in MIREL RM2 Integrated On-Board System. Colour: dark grey 	Symbol:IND-05-BCH Line: 2 Column: 4
	One minor error has been detected in MIREL RM2 Integrated On-Board System. Colour: light grey  – minor error Additional information indicates detected error Detected by: Central unit of RM2 Integrated On-Board System.	Symbol:IND-05-L1 Line: 2 Column: 4
Recommended technological procedure: Error remedy and error confirmation with pushbutton  .		
	Multiple minor error. Colour: light grey  – minor errors Additional information indicates first detected error. Detected by: Central unit of RM2 Integrated On-Board System.	Symbol:IND-05-LV Line: 2 Column: 4
Recommended technological procedure: Error remedy and error confirmation with pushbutton  .		
	A single or multiple serious error. Simultaneously, minor errors can be detected in the system as well, indication of serious error has priority. Colour: red  – serious error. Additional information indicates first detected serious error. Detected by: Central unit of RM2 Integrated On-Board System.	Symbol: IND-05-T Line: 2 Column: 4
Recommended technological procedure: Reinitialization of MIREL RM2 Integrated On-Board System.		

Symbol	Symbol description on OIIN1	Designation/ Location
	D1 diagnostic test has been accomplished /diagnostic test D1 is not required	Symbol::IND-06-OK Line: 2 Column: 5
	Accomplishment of all steps is required within the D1 framework. Following items are required: 1) Both control switches positioned into zero position. 2) Mode selector positioned in zero position. 3) Execution of EPV opening ability check by channel M. 4) Execution of EPV opening ability check by channel C. Colour: yellow 	Symbol:IND-06-K0 Line: 2 Column: 5
	Recommended technological procedure: Execution of step 1 of D1 diagnostic test. DRV movement before accomplishment of D1 diagnostic test causes NZ6.	
	Step 1 has been successfully accomplished within the D1 framework. 1) Both control switches positioned into zero position. Colour: yellow 	Symbol:IND-06-D1K1 Line: 2 Column: 5
	Recommended technological procedure: Execution of step 2 of D1 diagnostic test. DRV movement before accomplishment of D1 diagnostic test causes NZ6.	
	Steps 1 and 2 have been successfully accomplished within the D1 framework. 1) Both control switches positioned into zero position. 2) Mode selector positioned in zero position. Colour: yellow 	Symbol:IND-06- D1K2 Line: 2 Column: 5
	Recommended technological procedure: Execution of step 3 of D1 diagnostic test. DRV movement before accomplishment of D1 diagnostic test causes NZ6.	
	Steps 1, 2 and 3 have been successfully accomplished within the D1 framework. 1) Both control switches positioned into zero position. 2) Mode selector positioned in zero position. 3) Execution of EPV opening ability check by channel M. Colour: yellow 	Symbol:IND-06- D1K3 Line: 2 Column: 5
	Recommended technological procedure: Execution of step 4 of D1 diagnostic test. DRV movement before accomplishment of D1 diagnostic test causes NZ6.	
	Steps 1, 2, 3 and 4 have been successfully accomplished within the D1 framework: Colour: yellow  – short-term status after accomplishment of all steps Colour: yellow  + flashes – time for repeated diagnostic test has expired, test D1 can be postponed.	Symbol:IND-06- D1K4 Line: 2 Column: 5
	Information concerning approaching duty to execute a repeated D1 diagnostic test. Additional information indicates remaining time in format min of detected error. Colour: light grey  during countdown Colour: yellow  + flashes – time for repeated diagnostic test has expired, test D1 can be postponed by 15 min	Symbol:IND-06-D1DT Line: 2 Column: 5
	Recommended technological procedure: Execute repeated D1 test upon next standstill, or postpone test by 15min.	

Symbol	Symbol description on OIIN1	Designation/ Location
	Integrated On-Board System is in D3 functional test mode Colour: yellow 	Symbol:IND-06-D3-T0 Line: 2 Column: 5
	The execution of functional test steps can be carried out by means of TEST3G.	
	Integrated On-Board System is in D3 functional test mode and inspection test concerning functionality of optical indicators – optotest – has been chosen. Colour: yellow 	Symbol:IND-06-D3-T1 Line: 2 Column: 6
	Test concerning check of BSO1 secure output has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3- T2 Line: 2 Column: 6
	Test concerning check of BSO2 secure output has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3- T3 Line: 2 Column: 6
	Test concerning check of BSO3 secure output has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3- T4 Line: 2 Column: 6
	Test concerning check of BSO1 outputs has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3- T5 Line: 2 Column: 6
	Test concerning check of BSO2 outputs has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3-T6 Line: 2 Column: 6
	Test concerning check of BSO3 outputs has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3-T7 Line: 2 Column: 6
	Wheel flange lubrication test by output No.1 has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3-T8 Line: 2 Column: 6
	Wheel flange lubrication test by output No.2 has been chosen within the D3 functional test mode. Colour: yellow 	Symbol:IND-06-D3-T9 Line: 2 Column: 6


Symbol	Symbol description on OIIN1	Designation/ Location
	Test concerning issue of wheel flange lubrication error signalization has been chosen within the D3 functional test mode. Colour: yellow 	symbol:IND-06-D3-T10 Line: 2 Column: 6
	Test concerning issue of speed output No.1 has been chosen within the D3 functional test mode. Colour: yellow 	symbol:IND-06-D3-T11 Line: 2 Column: 6
	Test concerning issue of speed output No.2 has been chosen within the D3 functional test mode. Colour: yellow 	symbol:IND-06-D3-T12 Line: 2 Column: 6
	Test concerning issue of signal by output for 4imp/m has been chosen within the D3 functional test mode. Colour: yellow 	symbol:IND-06-D3-T13 Line: 2 Column: 6

Putting into Operation

After powering the device, text **MIREL RM2 Loading** is displayed on the indication unit screen and permanent background pushbutton illumination is lit. Indication unit initialization runs during the text representation. On indication unit without SIL2 implementation, the text ceases to be shown upon initialization accomplishment. On indication unit with SIL2 implementation, the text changes upon initialization accomplishment to **MIREL RM2 Testing** and a switch-off of the display takes place twice for a short moment, as well and indication elements OIIN2 and OIIN3 are lit as well. Indication elements OIIN2 and OIIN3 are lit in red colour and afterwards in green colour. The indication unit verifies by means of tests the ability to switch into a safe state. The pointer subsequently traverses the entire speed scale and returns into zero position. In this way, the indication unit start-up is accomplished and indication unit switches into operating state.

Login, Navigation within Menu and Log-off

Language Version Selection

The chosen text is indicated in the left top login window corner and by means of cyclical operation of the pushbutton  , the DRV staff has the option to change the language version.


Login

Upon system powering, the staff is prompted on indication unit RM2IN.2 of the active driver cab to login into the system. In case of repeated system start-up within 10 minutes without any log-out, the previous login is applied, as well as the entered identification parameters.



Login can be carried out in two different ways.

- 1) By means of electronic ID-card supported by indication unit.
Indication unit features an integrated NFC/RFID reader, by means of which the staff login can be accomplished with use of compatible cards, where the ID of used card shall be applied as login data value.
- 2) By means of manual staff. No. entering.

Following steps have to be carried out in order to login:

Upon login prompting it is necessary to operate the pushbutton  . The field Staff No. switches to editing mode and the icon RFID is illuminated.


Attaching the ID with illuminated RFID icon causes the staff login.

With manual input, the staff No. entering is carried out with pushbuttons 0 through 9. The entered value must be confirmed with pushbutton , or abort with pushbutton . Upon aborting, system returns to the login prompting screen. Upon confirmation of the entered staff No., the indication unit indicates the valid value of staff No. With a valid (non-zero) staff No., the indication unit allows menu navigation by means of indicated pushbuttons on navigation bar.


If the DRV staff doesn't log-out before system switch-off and its repeated powering within 10 minutes time, the login data remain valid and system doesn't require any login after start.

Menu

The staff can access internal system data by means of menu. Data can be accessible for viewing and for editing. System configuration decides the access type, as well as the fact whether the access is carried out at active cab.

Data are in each menu arranged in a way, that editable data are located in the lower menu fields and individual items are accessible by sequential operation of pushbutton .

Entry into Menu

Entry into menu is allowed only with DRV at standstill and is done by operating the pushbutton . Indication unit retains internally the last menu and with repeated menu recall it return to the one menu, from which the retreat has been done.

Menu Termination

Menu is terminated by pressing the pushbutton , if cursor isn't positioned in any editing field.

Regardless of editing status, DRV movement terminates the menu as well. Unconfirmed data shall not be accepted.

Menu Navigation

A navigation bar with pushbuttons indicating context-applicable keys forms part of menu. In case of entering the staff login, the symbol RFID is displayed, indicating the possibility to carry out login by means of attaching of staff ID-card.



Movement across individual menu is allowed by means of left/right arrows or by means of selection digits 1 – 4 on keyboard.

Data are divided into four different menus

- 1) 1. Identification
- 2) 2. DRV
- 3) 3. Operating data
- 4) 4. Errors

Menu 1. Identification

Menu comprises following items

Item	Editable	Description, meaning, options, units, format
Train length	YES	[m]
Train weight [t]	YES	[t]
DRV mode	YES	Unknown, Train, Helper, Banking, Shunting, Failure, Service, LV. Selection is carried out by means of sub-menu.
Forwarder No.	YES	Maximum length = 4 digits
Train No.	YES	Maximum length = 12 digits
Staff No.	YES	Maximum length = 12 digits

Menu 2.DRV

Menu comprises following items

Item	Editable	Description, meaning, options, units, format
Snum	NO	System No.
Diameter	NO	Wheel flange diameter in mm.
RM2 mode	YES	Shunting, Operation, Work, Dead-in-Tow. Selection is done by means sub-menu. Selection is possible only in case, that mode hasn't been selected by means of mode selector. With selector in position "1", the mode selection isn't possible and the mode is determined by system configuration. Modes, which are unavailable in system, can't be selected..

Menu 3.Operating Data

Menu comprises following items




Item	Editable	Description, meaning, options, units, format
Latitude	NO	Latitude from GPS data, format dd°mm'ss,ss".
Longitude	NO	Longitude from GPS data, format dd°mm'ss,ss".
Eng.hours1	NO	Engine hours1 – set by system configuration.
Eng.hours2	NO	Engine hours2 – set by system configuration.
Eng.hours3	NO	Engine hours3 – set by system configuration.
Eng.hours4	NO	Engine hours4 – set by system configuration.
Date	NO	Date, format dd.mm.rrrr.
Time until D1	NO	Time remaining until repeated D1 funct. test, format hh:mm.
U-journey	YES, clearing	User journey, value is user-clearable.
D-journey	YES, clearing	Daily journey, value is user-clearable.
T-journey	NO	Total journey.

Menu 4 Errors

Menu displays

- 1) Error count.
- 2) Number of first error.
- 3) Error numbers in system.
- 4) Indication of detected errors

Log-out

By holding key  pressed for 2s with DRV at standstill, the request for log-out is induced. Request for log-out can be confirmed with key , or cancelled with key . Log-out can be done also by entering the number 0 as staff No.

Serious Error

Serious system error is indicated as follows:

- Indication is implemented by means of symbol IND-05-T on screen of active indication unit.
- With flashing illumination of digitally indicated DRV travel speed.
- With flashing illumination of indicator (OIIN2B, OIIN3B) in red colour in the respective channel.

Minor Error


Minor system error is indicated as follows:

- Indication is implemented by means of symbol IND-05-L1 or IND-05-LV on screen of active indication unit.
- With permanent illumination of indicator (OIIN2B, OIIN3B) in red colour in the respective channel.
- In the menu "4.Errors" on the screen of active indication unit, there is indication of total number of actually detected system errors, together with the code of first detected error and a list of all detected errors.

Indication of System Errors

If there are multiple errors in the system, codes of all errors can be displayed by means of menu 4.Errors.

Error Reset

The staff has the option to reset an attribute of minor error from active driver cab under condition that the error/reason for error signalling has ceased. After clearing the attribute, the indication of minor error goes out. Clearing of minor error attribute is carried out by operating the pushbutton . Clearing causes zeroing attributes of all minor discontinued errors.

Error Codes

Table of error codes is listed in [3]1987RM2 *Maintenance Manual, Diagnostics*.

D1 One-Time Diagnostic Test


Execution procedure of D1 one-time diagnostic test has been defined in Chapter 6 *Putting into Operation and Termination of Operation*.

Status and progress of D1 one-time diagnostic test is indicated by following symbols:

IND-06-OK, IND-06-K0, IND-06-K1, IND-06-K2, IND-06-K3, IND-06-K4

Repeated D1 One-Time Diagnostic Test

System, as well as indication unit require the execution of repeated daily test. The staff is notified 60 minutes before the need to carry out the repeated diagnostic test about this fact by indicating the symbol IND-06-D1DT in light grey colour. Countdown of remaining time until the execution of repeated daily test takes place in minutes in additional information.

The additional information goes out upon time expiry and frame of indication element flashes in yellow colour. The D1 repeated daily test can be postponed for 15 minutes by pressing the pushbutton . Postponement can be done repeatedly, but the maximum time period of 28 hours shall not be exceeded.

Remark: The remaining time is displayed as remaining minutes, i.e. last 59 seconds are displayed as 0m.

Execution procedure of repeated D1 one-time diagnostic test has been defined in Chapter 6 *Putting into Operation and Termination of Operation*.

Mode Selection of MIREL RM2 Integrated On-Board System

Mode selection by means of indication unit is implemented via sub-menu RM2 Mode. The selected mode is indicated in menu, as well as permanently indicated on indicator OIIN1B with symbols IND-04-POS, IND-04-PRA, IND-04-PRE, IND-04-ZAV.

D3 Function Test


Indication unit notifies staff on indicator OIIN1B the selection of individual tests by means of symbols IND-06-D3-0, IND-06-D3-T1 - IND-06-D3-T13.

A detailed description of D3 function test execution has been specified in document 1987RM2 *Maintenance Manual, Diagnostics*.

NZ Signalling



Emergency stop is signalled on indicator OIIN1B by means of symbols IND-03-NZ, IND-03-NZ1, IND-03-NZ2, IND-03-NZ3, IND-03-NZ6.

NZ Reset

After stopping the DRV, the signalling can be terminated by operating the key . Reset confirmation is displayed on indicator OIIN1B with symbol IND-03-NZOK.

Selection of Indicated Journey in status line and Clearing of Journey Counters



Selection of journey, which shall be displayed on indicator OIIN1B during operation, can be carried out by means of menu with following procedure:

- 1) Positioning on cell of journey which we require to set or clear.
- 2) Operating the key  implements setting, which is indicated with symbol on selected journey
- 3) The clearing of respective journey counter is implemented by keeping the key  pressed for 5s.

User Mark Registration

8 user marks can be registered by means of indication unit. Registration is carried out by pressing one of keys 1 – 8. Procedure of keeping key pressed is registered.

Verification in Case of Inoperative Indication Unit

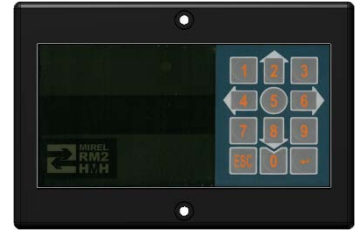
If the indication unit display doesn't get illuminated upon powering, OIIN2B a OIIN3B can be lit in green colour any time by simultaneous keeping keys  and  pressed.

5.3 Identification Unit

Identification data of engine driver, driving railway vehicle and train are entered by identification unit. Simultaneously, the identification unit provides for a more detailed indication of operation data than indication unit. Driver's ID, train ID, forwarder ID, operating mode of driving vehicle, train weight and length are entered. Vehicle movement speed, maximum speed, preset speed, total covered distance, user's covered distance, distance covered since system start, date and time, set wheel flange diameter, system number, system errors are indicated and in case of localization module, the actual geographical DRV position as well. On the introductory identification unit screen of MIREL RM2 Integrated On-Board System, the DRV staff has the option to select device language for communication. By repeated pushing the ESC pushbutton on indication unit, the language version is sequentially changed. Slovak, Polish and Hungarian languages are available. After repeated system start-up, the language option, which has been active before switching off the MIREL RM2 Integrated On-Board System shall automatically be activated. The identification unit is equipped with a 12-pushbutton keyboard for navigation in menu and for entering of data. Brightness intensity of display and indication LEDs is regulated automatically dependent on external illumination intensity.

Indication and control elements on front panel of identification unit

- **S** indicator OIID2:
 - flashing indicates a serious system error and fault of system safety functions
- **ERR** indicator OIID3:
 - permanent lighting indicates a light system error
- double-line fluorescence display OIID4:
 - ensures interaction with staff when entering/display of login, operational and diagnostic information
- numeric keyboard OIID5:
 - provides for navigation within main menu and individual submenus of identification unit
 - provides for operating mode of MIREL RM2 Integrated On-Board System
 - provides for command issue for zeroing of daily and user distance, command for error reset and input commands
 - comprises following pushbuttons with navigation meaning
 - pushbutton 2 – movement upwards (thereinafter as ↑)
 - pushbutton 4 – movement to the left (thereinafter as ←)
 - pushbutton 6 – movement to the right (thereinafter as →)
 - pushbutton 8 – movement downwards (thereinafter as ↓)
 - pushbutton ESC – return
 - pushbutton ↵ – command pushbutton



The identification unit serves for entering of identification data by the driver and provision of alphanumeric information on display. Apart from login dialogue, following items can be displayed on identification unit:

- calendar date and time – numeric value [h, min, s]
- time until repeated diagnostic check D1
- motohours
- total covered distance of DRV – numeric value [km]
- distance covered since system start – numeric value [km]
- user's covered distance – numeric datum [km]
- movement speed – numeric value [km/h]
- maximum speed – numeric value [km/h]
- preset speed – numeric value [km/h]
- geographical position DRV [geographical length, geographical width]
- entered personnel ID – numeric value [-]
- entered train ID – numeric value [-]
- entered forwarder ID – numeric value [-]
- entered DRV operating mode – numeric and text datum
- entered train weight – numeric value [kg]
- entered train length – numeric value [m]
- DRV number – numeric value [-]
- system number SNUM [-]
- wheel flange diameter – numeric number [mm]

6 Putting into Operation and Termination of Operation



The MIREL RM2 Integrated On-Board System is put into operation by switching on the railway vehicle battery source. No further operations are needed for putting into operation.

The functionality of MIREL RM2 Integrated On-Board System after switch-on is indicated as follows:


- Indicators OIZJ1, OIZJ2, OIZJ3 and other indicators on ZJ in start-up status light in red colour, upon system integrity verification they light in blue colour. Start-up accomplishment is indicated on central unit by flashing indicator OIZJ1 in blue, with a frequency of 1 Hz and extinguished indicators OIZJ2, OIZJ3 and others, depending on system hardware configuration.
- Indication unit RM2IN.x indicates after switching-on the start-up status by gradual lighting up of all indicators, subsequently D1 is shown on display, as well as indication of execution procedure for individual steps of D1 diagnostic.
- Identification unit RM2ID indicates after switching-on the start-up status by gradual lighting up of all indicators and subsequently indicates on display OIID4 unlogged status.

After switching on the MIREL RM2 Integrated on-Board system, the pressure switch must be in status corresponding pressure in main brake line under the level of 3,5 bar (status corresponding with DRV with engaged brake).

After switching on, the system performs a one-time diagnostic test D1, within its framework the communication functionality inside the central unit undergoes diagnostics, as well as the central unit communication functionality with indication and identification units, functionality of control elements at driver's cab and functionality of EPV and of emergency brake pressure switch. The DRV staff is notified about the requirement for execution of D1 diagnostic test by audible signalization ZS11.

The one-time diagnostic test D1 is performed with each switching on the system into operation and during uninterrupted system operation repeatedly every 24 hours (daily test). Repeated start of D1 diagnostic test is carried out automatically, without any staff intervention. Time remaining until subsequent daily test is indicated in operating data of the identification unit. Repeated start of D1 diagnostic test is carried out after meeting the conditions as follows:

- Upon first stopping of DRV after expiry of 24 hours from last accomplishment of D1 diagnostic test starts again. 15 seconds before the repeated D1 test start, the staff is notified about this fact by flashing D1 indication on indication unit, as well by audible signal from ZS10 horn at active cab.

During this interval, the staff has the option, by pushing the command button  at indication unit RM2IN.S or by operating the external command pushbutton, to postpone the repeated start of D1 diagnostic test by another 15 minutes. If a postponement isn't initiated within 15 seconds after notification, the D1 diagnostic test is automatically started and subsequently it must be entirely executed.

- Shouldn't DRV achieve zero speed within a time interval of 24 to 28 hours from accomplishment of last D1 diagnostic test, system detects a serious failure, which leads to system intervention. System must be subsequently initialized.
- The system enables also prematurely performing repeated diagnostic test D1 with the following procedure:

In case of using the ENTER button on identification unit it is not necessary to have the button permanently in compressed state, however it is necessary to maneuver with the control switch or eventually turning the system off in configuration without control switch until 10 seconds after releasing the button.

- System with installed indication units IN.S holding a pressed command button on the indication unit IN.S in combination with maneuver of turning off and on of control switch in active cab

- System with installed indication units RM2ID
pressing the button ENTER on identification unit in combination with maneuver turning off and on of control switch in active cab
- System with installed terminals connected to CAN interface
exposing an external command from terminals connected via CAN interface in combination with the maneuver of turning off and on of control switch in active cab
- System with installed buttons of external command
button of external command in combination with maneuver of turning off and on of control switch in active cab

The DRV staff is notified about the necessity to perform a repeated diagnostic test D1 by audible signalization ZS10.


In modification of system with functional property "B" is a part of diagnostic test D1 functionality check of EPV and simultaneously of emergency brake pressure switch. System activates twice the opening of emergency brake EPV, which manifests itself by a brief pressure drop in main brake line. A prerequisite for execution of emergency brake EPV functionality inspection is an accomplished test of control switch at active cab and releasing of the self-acting pneumatic DRV brake by pressure increase in the main line beyond the level necessary for condition change of pressure switch. The MIREL RM2 Integrated On-Board System in configuration without indication and identification unit indicates the process of diagnostic test on board terminals wired to communication interface of MIREL RM2 Integrated On-Board System.

The one-time diagnostic test D1 provides for diagnostics of control elements at DRV cabs wired to MIREL RM2 Integrated On-Board System in extent required for initialization of MIREL RM2 Integrated On-Board System. The staff is notified about the necessity of an enforced operation of control elements by indication of D1 on both IN indication units. For a successful execution of control elements check at cab within the D1 diagnostic test it is required, that steering switches and the mode selector of MIREL RM2 Integrated On-Board System achieve the zero position. Subsequent step of diagnostic test D1 is the check of pressure drop in main brake line by opening the EPV, which can be carried out only with chosen active cab. Active cab is selected by respective control switch. In course of D1 test, the staff at active cab must carry out maneuvers described below:

- pressure increase in the main brake line beyond the level necessary for condition change of pressure switch (usually ca. 4,2 bar)
- the RM2 system opens the EPV after 2 s by channel M
- pressure in main brake line occurs and at a level usually of ca. 3,5 bar the status of pressure switch changes. Based on change of signals from pressure switch, the EPV is closed by channel M
- pressure increase in the main brake line beyond the level necessary for switching of pressure switch (usually ca. 4,2 bar)
- the RM2 system opens the EPV after 2 s by channel C
- pressure in main brake line occurs and at a level of usually ca. 3,5 bar the status of pressure switch changes. Based on change of signals from pressure switch, the EPV is closed by channel C.

Herewith the check of EPV and pressure switch by channels M and C is accomplished.

The execution sequence of individual steps of diagnostic test is indicated at indication unit by a 3-dot horizontal line in front of **D1** indication. If the line is lit, the respective step hasn't been carried out. If the respective line extinguishes, the prerequisites for execution of respective step have been met. The meaning of individual lines is as described below:

	Position	Description
	4 th line from bottom	control switches have reached zero position
	3 rd line from bottom	mode selectors have reached zero position

Position	Description
2 nd line from bottom	in first part of test the pressure has dropped by opening EPV by channel M and the required response of pressure switch in the main brake line has occurred
1 st line from bottom	in second part of test the pressure has dropped by opening EPV by channel M and the required response of pressure switch in the main brake line has occurred

After execution of all above-mentioned steps, the D1 indication at indication unit extinguishes and system switches to operation mode based on following rules:

- With mode selector in zero position, the system switches to mode SHUNTING / OPERATION, dependent on system configuration.
- With mode selector in a non-zero position, the system switches to mode WORK / DEAD-IN-TOW, dependent on system configuration.

After accomplishment of D1 diagnostic test, the maximum DRV speed is determined based on DRV maximum design speed, maximum speed of working mode and maximum speed from cooperating device MIREL VZ1.

If the configuration of MIREL RM2 Integrated On-Board System permits function of driver vigilance supervision and DRV movement occurs during the execution of D1 diagnostic test, the system intervenes by opening the emergency brake EPV. During movement, the DRV speed is indicated on indication unit IN. After DRV halts, emergency stopping indication NZ6 is displayed on indication unit. All previously executed steps of D1 test lose their validity and after DRV comes to a halt, the staff must carry out the D1 test in full extent. After operating the command pushbutton, the emergency brake EPV closes, displayed text NZ6 changes on indication unit IN to an indication notifying about necessity of execution of D1 diagnostic test.

In case that the diagnostics of MIREL RM2 Integrated On-Board System detect a serious system error, it is displayed on indication and identification units of the system and in case of modification of the system with functional property "B" the system is switched into a safe condition by means of emergency brake EPV activation from both output channels. In case, that after a new switch-on of the system the error is repeatedly detected, it's forbidden for staff to put the rolling stock into operation. In case, that the vehicle is already in operation and system repeatedly detects an error, staff must follow valid directives of Operator intended for such case.




Switching off the MIREL RM2 Integrated On-Board System after accomplishment of operation is carried out by switching off the battery source of the driving railway vehicle. No further actions are necessary to switch off the system from operation in any of the operating modes.

7 Driver Cab Activation

Setting and operation of RM2 Integrated On-Board System is possible only from an active cab. The active cab is selected with control switches. If none of control switches are in ON position, the MIREL RM2 Integrated On-Board System hasn't any cab activated and driver's cabs are inactive. A condition of simultaneous switch-on of two control switches is evaluated by the system like if none of the switches would be engaged.

Indication on identification and indication units at active cab is described in following sections of Operating Manual.

Indication at inactive cab of indication unit:

-  none or both cabs have engaged control
-  control has been engaged at cab No.1
-  control has been engaged at cab No.2
- Depending on system configuration, the indication unit at inactive cab allows equal indication like at active cab, without the option to enter a command to terminate a system intervention.
- Indication at inactive cab of identification unit:
 - control is enabled on none or both cabs

A	k	t	í	v	n	e													
s	t	a	n	o	v	i	š	t	e						S	T	-		

- control is enabled at cab No.1

A	k	t	í	v	n	e													
s	t	a	n	o	v	i	š	t	e						S	T	1		

- control is enabled at cab No.2

A	k	t	í	v	n	e													
s	t	a	n	o	v	i	š	t	e						S	T	2		

- Depending on system configuration, the identification unit at inactive cab allows an equal indication of identification and operation data like at the active cab, without possibility to issue commands to central unit of MIREL RM2 Integrated On-Board System. In such case, the sign ENTER, which indicates to staff the possibility to enter into indication mode, isn't displayed in the right top corner.

A	k	t	í	v	n	e													↵
s	t	a	n	o	v	i	š	t	e						S	T	1		

- If no pushbuttons is pressed on the keyboard of the identification unit for 120 seconds
 - at active cab, the identification unit switches to saving mode, in which the display OIID4 indicates time and date values moving on display.
 - at inactive cab, the identification unit switches to saving mode, in which the display OIID4 is switched off.

8 Login, Navigation in Menu and Logoff

Login

After system startup, the staff at identification unit of the active cab is prompted to system login.

In case of repeated system start-up within 10 minutes without any log-out, the previous login is applied, as well as the entered identification parameters.

Login is carried out by means of identification unit. If indication unit RM2IN.2 is used in the system, login is carried out by means of RM2IN.2.

Following steps must be done for login:

- Operate any of keys on identification unit in case, when the screen saving mode indicating time and date has already been activated, see Figure. Grey fields represent structure of indicated information and orange fields represent movement limitation for time displayed on screen. Movement of displayed time is slow and ensures a more balanced load of fluorescent display pixels.

		:		:													
		.		.													

- After login prompting, it is necessary to push the key ↵. Chosen language is indicated in right top corner, as well as system version of MIREL RM2. By cyclical pushing the key ESC, the DRV staff is given the possibility to change language and subsequently to confirm selected language by key ↵.

M	I	R	E	L		R	M	2	[	S	K	]	v	0	1		
P	r	i	h	l	á	s	t	e	s	a							↵

M	I	R	E	L		R	M	2	[	P	L	]	v	0	1		
Z	a	l	o	g	u	j		s	i	ę							↵

M	I	R	E	L		R	M	2	[	H	U	]	v	0	1		
J	e	l	e	n	t	k	e	z	z	e	n						↵

- Then the staff is prompted to enter the staff ID, which has to be entered with keys 0 to 9. The entered value is necessary to confirm by pushing the key ↵ or cancel with ESC key. By cancelling, the screen with prompting the login appears again.

Č	í	s	l	o		o	b	s	l	u	h	y					
		-															↵

- After confirmation of entered staff ID the identification unit indicates the valid value of staff ID No. With a valid (non-zero) staff ID, the identification unit allows navigation on screens in its menu by displayed pushbuttons ↑, ↓, ↵ and unindicated ESC pushbutton.

Č	í	s	l	o		o	b	s	l	u	h	y		↵	↑		
																↓	

If the operator of DRV does not log off before turning off the system and turning it on in 10 min, the logins remain valid and system does not require logging in again.

Navigation in Menu

With a valid (non-zero) staff ID, the identification unit allows navigation on screens in its menu by displayed pushbuttons ←, ↑, ↓, →, ↵ and unindicated ESC pushbutton. Navigation in menu follows rules provided below:

- Main menu items are numbered and movement among them is possible with help of navigation pushbuttons:
 - ← movement to the left until first item No. 1
 - → movement to the right until last item No. 1
 - ↓ shifting to submenu of respective item in main menu
 - ESC inducement of logoff prompting
- Items in submenu aren't numbered and movement among them is possible with help of navigation pushbuttons:
 - ↑ upward movement up to the highest submenu item and subsequently jog to corresponding main menu item
 - ↓ downward movement down to the lowest submenu item
 - ESC return to main menu

Logoff

Logoff allows the staff a fast deleting of all entered identification data. DRV staff logoff can be carried out as follows:

- At any position in menu staff 2x operates the ESC pushbutton.
- Staff enters the changed staff ID and confirms staff No. 0.

Logoff by pressing the ESC pushbutton results an indication of logoff confirmation screen:

S	k	u	t	o	č	n	e										
o	d	h	l	á	s	i	ť	?									↵

In case of logoff confirmation with pushbutton ↵ the identification unit switches to login prompting screen. If the logoff dialogue is cancelled with ESC pushbutton, the identification unit switches to first item of main menu. Logoff inducement by entering of number 0 and subsequent confirmation of staff ID in submenu, the staff is logged off immediately.

Staff identification is enabled on identification unit at active cab of MIREL RM2 Integrated On-Board System or on board terminals wired to communication interface of MIREL RM2 Integrated On-Board System depending on system configuration.

Menu Identification („1.Identifikácia“) on identification unit allows entering of below provided data:

- Operating staff ID
- Train No.
- Forwarder ID
- DRV mode
- Train weight
- Train length

Menu Identification („1.Identifikácia“) comprises also items, which can be displayed but can't be edited

- DRV No.
- Snum – system number of MIREL RM2
- Diameter – wheel flange diameter

Operating staff ID

DRV staff logs in MIREL RM2 Integrated On-Board System by entering a non-zero value into item Staff ID („Číslo obsluhy“). Other items in group Identification („1.Identifikácia“) are optional and become zeroed after DRV staff logoff.

The item Staff ID („Číslo obsluhy“) is accessible from main item Identification („1.Identifikácia“) by pushing the key ↓. The item edit mode is induced with pushbutton ↵. Item can contain maximum 12 digit number. DRV staff logoff is possible from any item in main menu after pushing ESC key and confirmation with pushbutton ↵.

Train No.

The item Train No. („Číslo vlaku“) from main item Identification („1.Identifikácia“) is accessible with 2x push the key ↓. The item edit mode is induced with pushbutton ←↵. Item can contain maximum 12 digit number. The item Train No. is for operation of MIREL RM2 Integrated On-Board System optional.

Forwarder ID

The item Forwarder ID („Číslo dopravcu“) from main item Identification („1.Identifikácia“) is accessible with 3x push the key ↓. The item edit mode is induced with pushbutton ←↵. Item can contain maximum 4 digit number. The item Forwarder ID is for operation of MIREL RM2 Integrated On-Board System optional.

DRV Mode

The item DRV Mode („Režim HDV“) from main item Identification („1.Identifikácia“) is accessible with operating 4x the key ↓. By pushbutton ←↵ the item edit mode is induced. The item can obtain values below:

- TRAIN („VLAKOVÝ“) (pushbutton 1)
- BIASING („PRÍPRAŽNÝ“) (pushbutton 2)
- BANKING („POSTRKOVÝ“) (pushbutton 3)
- SHUNTING („POSUNOVACÍ“) (pushbutton 4)
- FAULT („PORUCHA“) (pushbutton 5)
- SERVICE („SERVIS“) (pushbutton 6)
- LV (pushbutton 7)
- USER MODE 1 („UŽIVATEĽSKÝ REŽIM 1“) (pushbutton 8)
- USER MODE 2 („UŽIVATEĽSKÝ REŽIM 2“) (pushbutton 9)
- NON-ASSIGNED („NEZADANÝ“) (pushbutton 0)

The item DRV Mode is for operation of MIREL RM2 Integrated On-Board System optional.

Train Weight

The item Train Weight („Hmotnosť vlaku“) from main item Identification („1.Identifikácia“) is accessible with 5x pushing the key ↓. The item edit mode is induced with pushbutton ←↵. Item can contain maximum 4 digit number indicating the train weight in tons. The item Train Weight is for operation of MIREL RM2 Integrated On-Board System optional.

Train Length

The item Train Length („Dĺžka vlaku“) from main item Identification („1.Identifikácia“) is accessible with 6x pushing the key ↓. The item edit mode is induced with pushbutton ←↵. Item can contain maximum 4 digit number indicating the train length on metres. The item Train Length is for operation of MIREL RM2 Integrated On-Board System optional.

DRV No.

The item DRV No. („Číslo HDV“) from main item Identification („1.Identifikácia“) is accessible with 7x pushing the key ↓. Each railway vehicle gets assigned a unique 12 digit number, which identifies the vehicle in operation. The number is displayed in UIC format. The item is inserted into system by Producer in course of system installation configuration.

Snum and Diameter

The item Snum and Diameter („Snum“ a „Priemer“) from the main item Identification („1.Identifikácia“) is accessible with 8x pushing the key ↓. Each MIREL system is assigned a unique number, which system gets from the system manufacturer. The Diameter indicates the value of the actual set diameter of the wheel flange in the system. The item is inserted to the system during configuration of the system.

9 Selection of System Operating Mode

Start-up into Operating Mode

After accomplishment of D1 diagnostic test, the system switches to operating mode based on rules stated below.

- If mode selector is in the zero position, the system switches to SHUNTING / OPERATION („POSUN / PREVÁDZKA“) mode, dependent on system configuration.
- If mode selector is in a non-zero position, the system switches to WORK / DEAD-IN-TOW („PRÁCA / ZÁVES“) mode, dependent on system configuration.

Operating Mode Indication

The actual operating mode of MIREL RM2 Integrated On-Board System is indicated as follows:

- On indication unit:
 - After system start-up and accomplishment of D1 diagnostic test before putting DRV into movement
 - 3 seconds after DRV stops
- On identification unit:
 - In main menu of identification unit in item 2.RM2Mode (“2.Režim RM2”).

Operating modes are indicated on indication unit as follows:

- Operating mode SHUNTING („POSUN“) is indicated with abbreviation "POS"
- Operating mode OPERATION („PREVÁDZKA“) is indicated with abbreviation "PRE"
- Operating mode WORK („PRÁCA“) is indicated with abbreviation "PRA"
- Operating mode DEAD-IN-TOW („ZÁVES“) is indicated with abbreviation "ZAV"

Change of Operating Mode

Change of MIREL RM2 Integrated On-Board System operating mode follows rules stated below.

- Should DRV be motionless and the system mode selector is switched to zero position, system switches to SHUNTING („POSUN“) mode.
- Should DRV be motionless and the system mode selector is switched to a non-zero position, system switches to WORK / DEAD-IN-TOW („PRÁCA / ZÁVES“) mode, dependent on system configuration.
- Should DRV be in motion and the system mode selector is switched to zero position, system switches to SHUNTING („POSUN“) mode only after DRV stops.
- Should DRV be in motion and the system mode selector is switched to a non-zero position, system switches to WORK / DEAD-IN-TOW („PRÁCA / ZÁVES“) mode, dependent on system configuration, only after DRV stops.
- If the mode selector is in a non-zero position, switching of mode on identification unit of active cab isn't possible. The operating mode is set by configuration.
- If the mode selector is in zero position, switching of mode on identification unit of active cab is enabled.

The mode change is effectuated on identification unit as follows:

- By selecting item No. 2 in main menu of identification unit

←	2	.	R	e	ž	i	m	R	M	2			↵	→
			X	:										↓

- Subsequent operating the pushbutton ↵ for access to entry screen of system operating mode.

R	e	ž	i	m	R	M	2							
													↵	

- With selection of pushbuttons 1 to 4 the corresponding operating mode is selected and indicated:
 - SHUNTING („POSUN“) operating mode (pushbutton 1)
 - OPERATION („PREVÁDZKA“) operating mode (pushbutton 2)

- WORK („PRÁCA“) operating mode (pushbutton 3). The selection of WORK („PRÁCA“) operating mode is enabled only if it is permitted by system configuration.
 - DEAD-IN-TOW („ZÁVES“) operating mode (pushbutton 4)
- With operating mode selection and subsequent confirmation by pushbutton ← the system switches to chosen mode.
 - Operating mode change by identification unit is possible only with a motionless DRV.

9.1 SHUNTING OPERATING MODE

The Integrated On-Board System MIREL RM2 operates in the SHUNTING („POSUN“) mode when DRV is operated within stations, yards and when shunting with the driving vehicle. The modus is intended for DRV movement at low speeds, with frequent driver's cab change.

Vigilance Supervision

In SHUNTING („POSUN“) operating mode, the engine-driver is obliged to demonstrate vigilance by operating vigilance pushbuttons in following cases, as stated below:

- One-time after driving vehicle start
- Cyclically, starting from movement speed of 20 km/h
- Increased cyclical supervision after violating the maximum speed by more than 1 km/h.

If the engine-driver fail to confirm his vigilance after vigilance prompting, a system intervention (NZ1) takes place and emergency brake gets activated.

System allows to confirm vigilance also with drive controllers, if wired to ZJ secure inputs and system features configured function of vigilance confirmation with drive controllers.

Maximum Speed Supervision

In the SHUNTING („POSUN“) operating mode, the MIREL RM2 Integrated On-Board System supervises the DRV travel speed in comparison with DRV maximum speed. When violating maximum speed by more than 3 km/h, numeric indicator of actual speed OIIN6 starts flashing. When violating maximum speed more than 5 km/h the acoustic signalling of the maximum speed is activated and after violating maximum speed of 7 km/h a system intervention (NZ2) takes place by means of emergency brake activation.

Maximum speed in a given moment is determined as the lowest among following ones:

- maximum vehicle design speed, determined by configuration
- maximum speed for operating mode
- maximum speed determined by cooperating device MIREL VZ1

Maximum speed for SHUNTING („POSUN“) operating mode has been set to 40 km/h and the engine-driver hasn't any possibility to alter this maximum speed.

Supervision of Accord Between Actual and Selected Travel Direction

In the SHUNTING („POSUN“) operating mode, the RM2 supervises accord of actual travel direction with selected one. Discord is evaluated for each movement of driving vehicle. Accord is required for movement with any speed exceeding 5 km.h⁻¹. At drive vehicle travel in a direction, which isn't in accord with the selected travel direction, up to a speed of 5 km/h the audible signalization ZS3 is activated with horn of RM2 and in case when speed is exceeded by more than 5 km/h, after 10 m a system intervention (NZ3) takes place and emergency brake gets activated. With turned off control switch at both rail vehicle driver's cabs, any movement is evaluated as movement in contrary with the selected travel direction. The compliance is evaluated once at the start of the DRV.

9.2 OPERATION Operating Mode

In the OPERATION („PREVÁDZKA“) operating mode, all checking functionalities of MIREL RM2 Integrated On-Board System are activated. The mode is used during a standard operational drive of DRV.

Vigilance Supervision

In the OPERATION („PREVÁDZKA“) operating mode, the engine-driver is obliged to demonstrate vigilance by operating the vigilance buttons in situations as follows:

- One-time after the driving vehicle sets to motion

- Cyclically during DRV movement
- Increased Cyclical Supervision when maximum speed is violated by more than 1 km/h

Should the engine driver fail to confirm vigilance after vigilance prompting by pushing the vigilance pushbutton or pedal, a system intervention (NZ1) takes place by emergency brake activation.

System allows to confirm vigilance also with drive controllers, if wired to ZJ secure inputs and system features configured function of vigilance confirmation with drive controllers.

Maximum Speed Supervision

In the OPERATION („PREVÁDZKA“) operating mode, the MIREL RM2 Integrated On-Board System supervises the DRV travel speed in comparison with DRV maximum speed. When violating maximum speed by more than 3 km/h, numeric indicator of actual speed OIIN6 starts flashing. When violating maximum speed more than 5 km/h the acoustic signalling of the maximum speed is activated and after violating maximum speed of 7 km/h a system intervention (NZ2) takes place by means of emergency brake activation.

Maximum speed in a given moment is determined as the lowest among following ones:

- maximum vehicle design speed, determined by configuration
- maximum speed determined by cooperating device MIREL VZ1

Maximum design speed is determined by configuration and the engine-driver hasn't any possibility to alter this maximum speed.

Supervision of Accord Between Actual and Selected Travel Direction

In the OPERATION („PREVÁDZKA“) operating mode, the RM2 Integrated On-Board System supervises accord of actual travel direction with selected one. Discord is evaluated for each movement of driving vehicle. Accord is required for movement with any speed exceeding 5 km.h⁻¹. At drive vehicle travel in a direction, which isn't in accord with the selected travel direction, after 10 m a system intervention (NZ3) takes place and emergency brake gets activated. With turned off control switch at both rail vehicle driver's cabs, any movement is evaluated as movement in contrary with the selected travel direction. The compliance is evaluated once at the start of the DRV.

9.3 WORK Operating Mode

The Integrated On-Board System MIREL RM2 operates in operating mode WORK („PRÁCA“) during execution of technological activities with driving rail vehicle. The mode is suitable for duty, measurement and other special railway vehicles, where the staff operates in work mode the technological section of vehicle.

Vigilance Supervision

In the WORK („PRÁCA“) operating mode, the engine-driver is obliged to demonstrate vigilance by pushing the vigilance buttons in situations as follows:

- Cyclically starting from speed as set in configuration, but maximum starting from speed of 40 km/h
- Increased Cyclical Supervision when maximum speed is violated by more than 1 km/h

Should the engine driver fail to confirm vigilance after vigilance prompting by pushing the vigilance pushbutton or pedal, a system intervention (NZ1) takes place by emergency brake activation.

System allows to confirm vigilance also with drive controllers, if wired to ZJ secure inputs and system features configured function of vigilance confirmation with drive controllers.

Maximum Speed Supervision

In the WORK („PRÁCA“) operating mode, the MIREL RM2 Integrated On-Board System supervises the DRV travel speed in comparison with DRV maximum speed. When violating maximum speed by more than 3 km/h, numeric indicator of actual speed OIIN6 starts flashing. When violating maximum speed more than 5 km/h the acoustic signalling of the maximum speed is activated and after violating maximum speed of 7 km/h a system intervention (NZ2) takes place by means of emergency brake activation.

Maximum speed in a given moment is determined as the lowest among following ones:

- maximum vehicle design speed, provided by configuration
- maximum speed for operating mode in WORK („PRÁCA“) mode
- maximum speed determined by cooperating device MIREL VZ1

Maximum design speed for WORK („PRÁCA“) operating mode is determined by configuration and the engine-driver hasn't any possibility to alter this maximum speed.

Supervision of Accord Between Actual and Selected Travel Direction

In the operating mode PRA RM2 doesn't supervise accord and discord between actual and chosen travel direction.

9.4 DEAD-IN-TOW Operating Mode

The integrated on-board system operates in the DEAD-IN-TOW („ZÁVES“) operating mode during banking of driving railway vehicle or on train DRV when more DRVs are arranged at the train front.

Vigilance Supervision

In the DEAD-IN-TOW („ZÁVES“) operating mode, the engine driver's vigilance isn't supervised.

Maximum Speed Supervision

In the DEAD-IN-TOW („ZÁVES“) operating mode, the MIREL RM2 Integrated On-Board System supervises the DRV travel speed in comparison with DRV maximum design speed. When violating maximum speed by more than 3 km/h, numeric indicator of actual speed OIIN6 starts flashing. When violating maximum speed more than 5 km/h the acoustic signalling of the maximum speed is activated and after violating maximum speed of 7 km/h a system intervention (NZ2) takes place by means of emergency brake activation.

Maximum design speed is determined by configuration and the engine-driver hasn't any possibility to alter this maximum speed.

Supervision of Accord Between Actual and Selected Travel Direction

In the operating mode ZAV RM2 doesn't supervise accord and discord between actual and chosen travel direction.

10 Overview of System Functions

The MIREL RM2 Integrated On-Board System implements safety, operational and system functions in extent as provided in summary below. Apart from that, the availability of individual functions can be limited by required configuration of system functional properties.

Description of Function	POS	PRE	PRA	ZAV
SAFETY OPERATIONAL FUNCTIONS				
Odometry	✓	✓	✓	✓
Movement speed indication	✓	✓	✓	✓
Cyclical vigilance supervision	✓	✓	✓	
Increased cyclical vigilance supervision	✓	✓	✓	
One-time vigilance supervision after setting DRV into movement	✓	✓		
Maximum design speed supervision	✓	✓	✓	✓
Supervision of maximum speed for operating mode	✓	✓	✓	✓
Operational system intervention	✓	✓	✓	✓
Control of safety outputs	✓	✓	✓	✓
Provision of safety-relevant data to communication interface	✓	✓	✓	✓
OPERATIONAL FUNCTIONS				
Indication of maximum permitted speed	✓	✓	✓	✓
Indication of preset speed	✓	✓	✓	✓
Data collection from technology interface	✓	✓	✓	✓
Data collection from communication interface	✓	✓	✓	✓
Operating data registration	✓	✓	✓	✓
System data registration	✓	✓	✓	✓
Communication via GSM gateway	✓	✓	✓	✓
Control of technological binary outputs	✓	✓	✓	✓
Provision of data to communication interface	✓	✓	✓	✓
GPS localization	✓	✓	✓	✓
Train remote stop	✓	✓	✓	✓
Check of DRV movement direction in relation to direction controller setting	✓	✓		
SYSTEM FUNCTIONS				
Clock synchronization	✓	✓	✓	✓
System start-up	✓			

Selection of active cab	✓	✓	✓	✓
Setting of operating modes	✓	✓	✓	✓
Audible indication	✓	✓	✓	✓
Visual indication	✓	✓	✓	✓
Indicator brightness regulation	✓	✓	✓	✓
Termination of system operation	✓	✓	✓	✓
Error detection and system intervention	✓	✓	✓	✓
One-time diagnostic test D1	✓			
Repeated daily diagnostic test D1	✓	✓	✓	✓
Continuous diagnostic test D2	✓	✓	✓	✓
Functional test D3	✓	✓	✓	✓

11 Safety Operation Functions

11.1 Odometry

System carries out all odometry measurements by means of incremental sensor IRC. Technical parameters as well as measurement evaluation method have been specified in document 1976RM2 *Technical Conditions*.

11.2 Movement Speed Indication

The indication of actual movement speed is one of fundamental functions of MIREL RM2 Integrated On-Board System. The DRV movement speed is interpreted in km/h in a way dependent on employed indication device.

Actual speed can be interpreted as follows:

- In analogue method on dial speed indicator and simultaneously as an integer on triple-character alphanumeric indicator OIIN6 on indication device RM2IN.1 or RM2IN.2
- as an integer on triple-character alphanumeric indicator OIIN6 on indication device RM2IN.S
- numerically in submenu of main item Oper.data („3.Prev. údaje“). - „DRV Movement Speed“ on identification unit RM2ID
- on board terminals wired to communication interface of MIREL RM2 Integrated On-Board System.

11.3 Vigilance Supervision

The MIREL RM2 Integrated On-Board System carries out, dependent on system configuration, the driver’s vigilance supervision by providing optical/audible vigilance promptings, which must be confirmed by engine driver with vigilance pushbuttons or pedals. The system allows vigilance confirmation also with drive controllers, if wired to ZJ secure inputs and system features configured function of vigilance confirmation with drive controllers. If the MIREL RM2 Integrated On-Board System provides for function of vigilance supervision, on each rail vehicle cab a combination of vigilance pushbuttons and/or vigilance pedals is located. If control switch has been engaged at respective cab, all pushbuttons and pedals in this cab are equal and vigilance can be confirmed by anyone of them.

The system allows vigilance confirmation also with drive controllers, if wired to ZJ secure inputs and system features configured function of vigilance confirmation with drive controllers.

Vigilance pushbutton or pedal must be pressed for a period of at least 100 ms. A permanent pressing of pushbutton or pedal doesn’t result in repeated vigilance confirmation. The maneuver with drive controllers confirms vigilance if the transition between positions will last for at least 100 ms.

Vigilance confirmation is possible only if, blue light ● isn’t lit on indication unit RM2IN.S. Vigilance confirmation is signaled on indication unit RM2IN.S by lighting-up the blue light. Should the engine-driver operate a vigilance pushbutton or pedal when the blue light is lighting, system audibly notifies driver about unrequired vigilance confirmation (ZS8). 3,5 seconds prior to expiry of interval for vigilance confirmation, the system provides to driver an audible vigilance prompting (ZS1), the horn (HP1 / HP2) is activated with a permanent tone. The audible vigilance prompting alerts the engine-driver about the acute obligation to confirm vigilance. If he/she fails to do so until end of set time interval, a system intervention (NZ1) occurs by brake EPV opening, which results in DRV emergency braking.

The vigilance supervision can be a cyclical one or one-time and is carried out dependent on active system operating mode. Based on needs of system operator, the vigilance supervision can be influenced by system configuration, e.g. it can be entirely de-activated in specific cases.

Function implementation in the given operating mode	POS	PRE	PRA	ZAV
Cyclical vigilance supervision	✓	✓	✓	–
Increased cyclical vigilance supervision	✓	✓	✓	–

Function implementation in the given operating mode	POS	PRE	PRA	ZAV
One-time vigilance supervision after setting DRV into movement	✓	✓	–	–

11.4 Cyclical Vigilance Supervision

Cyclical vigilance supervision is a standard way of driver's vigilance supervision, which is implemented when operating system in operating modes SHUNTING („POSUN“), OPERATION („PREVÁDZKA“), WORK („PRÁCA“) and DEAD-IN-TOW („ZÁVES“) according to following rules:

Operating mode	Prerequisites of function implementation in a given operating mode
POS	Cyclical vigilance supervision is required when meeting of following condition: <ul style="list-style-type: none"> ■ DRV speed ≥ 20 km/h
PRE	Cyclical vigilance supervision is required when meeting of following condition: <ul style="list-style-type: none"> ■ DRV speed > 0 km/h
PRA	Cyclical vigilance supervision is required when meeting of following condition: <ul style="list-style-type: none"> ■ Cyclically, starting from speed set by configuration, but maximally from speed of 40 km/h
ZAV	In the DEAD-IN-TOW („ZÁVES“) operating mode, the driver's vigilance isn't supervised

The interval of cyclical vigilance supervision depends on DRV speed, where the interval length of vigilance supervision as well as length of lit blue light is specified in Table below:

DRV speed [km.h ⁻¹]	Time period of lit blue light [s]	Time to activation of audible signalization [s]	time (t_{ob}) until intervention [s]
up to 30	6,0	20,5	24,0
up to 46	5,7	19,2	22,7
up to 62	5,3	17,8	21,3
up to 78	5,0	16,5	20,0
up to 94	4,7	15,2	18,7
up to 110	4,3	13,8	17,3
over 110	4,0	12,5	16,0

11.5 Increased Cyclical Vigilance Supervision

The increased cyclical vigilance supervision is a way of driver's vigilance supervision in operating situations requiring increased alertness and is carried out based on following rules:

Operating mode	Conditions of function implementation in a given operating mode
POS	Upon violation of maximum speed by more than 1 km.h ⁻¹
PRE	Upon violation of maximum speed by more than 1 km.h ⁻¹
PRA	Upon violation of maximum speed by more than 1 km.h ⁻¹

Operating mode	Conditions of function implementation in a given operating mode
ZAV	In the DEAD-IN-TOW („ZÁVES“) operating mode, the driver’s vigilance isn’t supervised.

The interval of cyclical vigilance supervision doesn’t depend on DRV speed. Interval length and length of lit blue light is specified in Table below:

DRV speed [km/h]	Time period of lit blue light [s]	time to activation of audible signalization [s]	time (t_{ob}) until intervention [s]
for all speeds	8,5	8,5	12

11.6 One-Time Vigilance Check after Setting DRV into Motion

The function of one-time vigilance check after setting DRV into motion is active in operating modes SHUNTING („POSUN“) and OPERATION („PREVÁDZKA“) and provides to engine-driver exactly one standard vigilance prompting based on following rules:

Operating mode	Prerequisites of function implementation in a given operating mode
POS	A one-time vigilance check is required when meeting following prerequisite: <ul style="list-style-type: none"> ■ after setting DRV into motion
PRE	A one-time vigilance check is required when meeting following prerequisite: <ul style="list-style-type: none"> ■ after setting DRV into motion

Based on needs of system operator, the one-time vigilance check can be influenced by system configuration.

11.7 Maximum Design Speed Supervision

The maximum design speed is predetermined by DRV type on which the MIREL RM2 Integrated On-Board System has been installed. Maximum design speed is constituent part of parameters, which make up the system configuration. In course of initial system activation, the configuration is stored in system memory by means of a service intervention.

It is not possible to alter the maximum DRV design speed, as stored in system, during system operation. When railway vehicle properties change, or system is implemented on a different DRV type, the system configuration can be altered by means of a new system intervention.

The maximum design speed is entered into system in km/h. The highest possible value of maximum design speed, which can be configured, is 160 km/h. The function of maximum design speed supervision is active in PRE and ZAV operating modes.

11.8 Supervision of Maximum Speed for Operating Mode

All operating modes have a predefined maximum speed. Maximum speed for an operating mode is determined by configuration and the neither driving vehicle staff, nor the service personnel have any possibility to change it. Maximum speed values for operating modes are provided in Table below:

Operating mode	Prerequisites of function implementation in a given operating mode
POS	<ul style="list-style-type: none"> ■ Integrated On-Board System MIREL RM2 checks the actual DRV movement speed compared with DRV maximum speed for this mode, which has been set to 40 km.h⁻¹. ■ When violating maximum speed by more than 3 km.h⁻¹, actual speed indicator starts flashing. ■ When violating maximum speed by more than 5 km.h⁻¹, the acoustic signalization starts ■ When violating maximum speed by more than 7 km/h error of maximum speed violation is detected and emergency brake is subsequently activated (NZ2).

Operating mode	Prerequisites of function implementation in a given operating mode
PRE	<ul style="list-style-type: none"> ■ Integrated On-Board System MIREL RM2 checks the actual DRV movement speed compared with DRV maximum design speed, which is predestined by configuration. ■ When violating maximum speed by more than 3 km.h⁻¹, actual speed indicator starts flashing. ■ When violating maximum speed by more than 5 km.h⁻¹, the acoustic signalization starts ■ When violating maximum speed by more than 7 km/h error of maximum speed violation is detected and emergency brake is subsequently activated (NZ2).
PRA	<ul style="list-style-type: none"> ■ Integrated On-Board System MIREL RM2 checks the actual DRV movement speed compared with DRV maximum speed for this mode, which is determined by configuration. When violating maximum speed by more than 3 km/h actual speed indicator starts flashing. ■ When violating maximum speed by more than 5 km.h⁻¹, the acoustic signalization starts ■ When violating maximum speed by more than 7 km/h error of maximum speed violation is detected and emergency brake is subsequently activated (NZ2).
ZAV	<ul style="list-style-type: none"> ■ Integrated On-Board System MIREL RM2 checks the actual DRV movement speed compared with DRV maximum design speed, which is predestined by system configuration and the engine-driver hasn't any possibility to change this maximum speed. ■ When violating maximum speed by more than 3 km.h⁻¹, actual speed indicator starts flashing. ■ When violating maximum speed by more than 5 km.h⁻¹, the acoustic signalization starts ■ When violating maximum speed by more than 7 km/h error of maximum speed violation is detected and emergency brake is subsequently activated (NZ2).

11.9 Operational System Intervention

Reason of intervention of MIREL RM2 Integrated On-Board System is the occurrence of any from following events:

Indication on OIIN6 indicator	Indication on OIIN3 indicator	Indication on OIIN4 indicator	Reason
NZ1	NZ		Missing vigilance confirmation required by provided vigilance prompting
NZ2	NZ		Maximum speed violation
NZ3	NZ		Discord between movement speed and direction controllers
NZ6	NZ		DRV motion before D1 accomplishment

The MIREL RM2 Integrated On-Board System intervenes by opening EPV, which results in DRV emergency brake activation. The intervention of MIREL RM2 Integrated On-Board System is indicated by flashing indicator **NZ** (OIIN 3) on indication unit RM2IN. During DRV movement, the system intervention is indicated by flashing speed value on indicator OIIN6 until complete vehicle halt. After DRV halt, the sign **NZ** is displayed on indicator OIIN6 as well as index of reason leading to emergency stop.

The intervention can be terminated only after elimination of reasons leading to intervention and, along with it, the DRV has achieved zero speed.

Reason for intervention **NZ1** is missing DRV staff vigilance confirmation by operating the vigilance pushbutton or vigilance pedal at active cab in determined time. Staff is alerted to obligation of vigilance confirmation by means of an audible prompting ZS1. Should the vigilance confirmation not occur within 3,5 s after audible prompting, a system intervention occurs by EPV opening.

During DRV braking action:

- indicator OIIN3 displaying **NZ** flashes and after DRV halts, it switches to permanent displaying of **NZ**.
- indicator OIIN6 displays DRV movement speed and after DRV halts, NZ1 is displayed.

Only after complete DRV halt, the staff can terminate intervention by pushing the command pushbutton ↵ (OIIN7) on indication unit RM2IN.S of active cab. Along with end of intervention, the display **NZ** on indicator (OIIN3) goes off and the text NZ1 on indicator (OIIN6) will be replaced by indication of chosen mode. Railway vehicle is ready for operation.

Reason for intervention **NZ2** is violation of maximum permitted DRV speed in a given mode. If the maximum permitted DRV speed is violated by more than 5 km/h, the DRV staff is alerted about this fact by audible prompting ZS2. After violation of maximum permitted DRV speed by more than 7 km/h, a system intervention occurs by opening of EPV.

During DRV braking action:

- indicator OIIN3 displaying **NZ** flashes and after DRV halts, it switches to permanent displaying of **NZ**.
- indicator OIIN6 displays flashing DRV movement speed and after DRV halts, NZ2 is displayed.

Only after complete DRV halt, the staff can terminate intervention by operating the command pushbutton ↵ (OIIN7) on indication unit RM2IN.S of active cab. Along with end of intervention, the display **NZ** on indicator (OIIN3) goes off and the text NZ2 on indicator (OIIN6) will be replaced by indication of chosen mode. Railway vehicle is ready for operation.

Reason for intervention **NZ3** is a discrepancy between direction controller and actual direction of DRV movement.

During DRV braking action:

- indicator OIIN3 displaying **NZ** flashes and after DRV halts, it switches to permanent displaying of **NZ**.
- indicator OIIN6 displays flashing DRV movement speed and after DRV halts, NZ3 is displayed.

Only after complete DRV halt, the staff can terminate intervention by pushing the command pushbutton ↵ (OIIN7) on indication unit RM2IN.S of active cab. Along with end of intervention, the display **NZ** on indicator (OIIN3) goes off and the text NZ3 on indicator (OIIN6) shall be replaced by indication of chosen mode.

Reason for intervention **NZ6** is DRV motion prior to accomplishment of D1 diagnostic test. Intervention is effectuated by opening EPV.

During DRV braking action:

- indicator OIIN3 displaying **NZ** flashes and after DRV halts, it switches to permanent displaying of **NZ**.
- indicator OIIN6 displays flashing DRV movement speed and after DRV halts, NZ6 is displayed.

Only after complete DRV halt, the staff can terminate intervention by operating the command pushbutton ↵ (OIIN7) on indication unit RM2IN.S of active cab. Along with end of intervention, the display **NZ** on indicator (OIIN3) goes off and the text NZ6 is displayed on indicator (OIIN6). Already accomplished steps of D1 are invalid, system requires execution of a complete D1 test, staff is informed about this fact by indication D1 on display (OIIN6).

Each intervention MIREL RM2 Integrated On-Board System creates a registered record.

11.10 Control of Safety Outputs

The MIREL RM2 Integrated On-Board System features three safety outputs BSO1, BSO2 and BSO3. Function of safety outputs is configurable dependent on required system properties.

Specification method of prerequisites for issuance of safety output has been defined in document *1985RM2 Specification of Configurations*.

11.11 Provision of Safety-Relevant Data to Communication Interface

Specification for provision of safety-relevant data to communication interface has been defined in document *1976RM2 Technical Conditions*.

12 Operational Functions

12.1 Indication of Maximum Permitted Speed

Indication of maximum permitted speed is identical with lowest one of speeds provided below

- Maximum speed for chosen mode
- Maximum DRV design speed
- Maximum speed provided by MIREL VZ1 Train Protection

Maximum permitted speed is indicated on indication device RM2IN.1 and RM2IN.2 by a red lighting trace. The trace lights within circular section determined by maximum permitted speed and end limit of indication instrument scale. Maximum speed isn't indicated on indication device RM2IN.S.

12.2 Indication of Preset Speed

MIREL RM2 Integrated On-Board System enables registration allows registration and in case with application solution with indication device RM2IN.1 and RM2IN.2 also indication of preset speed with a green lighting trace. The trace lights within circular section determined by zero speed and preset speed. Preset speed isn't indicated on indication device RM2IN.S. Indication of preset speed requires cooperation of Integrated On-Board System MIREL RM2 with module of automatic speed regulation ARR or with control system of driving railway vehicle. If value of railway vehicle's preset speed isn't available, zero preset speed is indicated. Preset speed value is accessible in submenu of main item 3.Oper.data – presp. („3.Prev. údaje“ - „Vpredv“) on identification unit RM2ID.

12.3 Data Collection from Technology Interface

Technology interface of MIREL RM2 Integrated On-Board System enables collection and subsequent registration of application-specific data from DRV technology, which have a direct linkage with DRV technology. The function doesn't require staff cooperation.

12.4 Data Collection from Communication Interface

The Integrated On-Board System MIREL RM2 carries out data collection from communication interfaces of MIREL RM2 on-board system for the purpose of their processing and subsequent registration of application-specific data from cooperating DRV elements.

The function doesn't require staff cooperation.

12.5 Registration of Operational and System Data

The Integrated On-Board System MIREL RM2 with functional property "R" provides for registration of operational and system data according to security level on one (SIL0) or simultaneously on two (SIL4) data storage, due to which the data availability is ensured also in case of problems with one storage medium. User has access only to storage medium in central unit on position of module B. It is prohibited to manipulate with this medium when system is ON. In case of functional property "S" the data are stored on another storage medium according to term EN62625-1. Data range registered to this medium is given by the configuration of registration and it does not have to be identical to range of registration on operating medium.

Data Transfer from Integrated On-Board System

Data registered by integrated on-board system are recorder on SD-type card. Recorded data can be obtained for evaluation from MIREL RM2 Integrated On-Board System in following ways:

- Taking out the user-accessible storage medium of MIREL RM2 Integrated On-Board System. Data download into PC can be carried out by an authorized person of Operator, Producer of MIREL RM2 Integrated On-Board System and other persons according to valid rules

- Taking out the backup storage medium of MIREL RM2 Integrated On-Board System. Handling with media is permitted only to a person authorized by Producer of MIREL RM2 Integrated On-Board System.
- From central database, where data are stored online by sending registered data via GSM communication gateway to server.

Evaluation of Registered Data

Module MAN from the MIREL MAP application program equipment serves for evaluation of registered data.

12.6 Communication via GSM Gateway

The Integrated On-Board System MIREL RM2 enables, dependent on chosen configuration, transfer of operational and system parameters to remote server of the LANIX system. Data transfer can be carried out by module wired to the Integrated On-Board System MIREL RM2 via serial interface RS485. Utilized can be cooperating device MIREL LCM or internal module MIREL GGAM, which is installed directly in central unit of MIREL RM2 Integrated On-Board System.

MIREL LCM as well as MIREL GGAM contain GSM communication module, through which it is possible to send online data to remote server. Data transfer runs automatically, without need for DRV staff intervention.

12.7 Control of Technological Binary Outputs

Dependent on needs of DRV Operator, the Integrated On-Board System MIREL RM2 can be equipped with module of technology outputs. Control of technological binary outputs is, pursuant to needs of DRV Operator, implemented dependent on independent time and track scale in real time and is predestined by system configuration.

Technological binary outputs are utilized in applications with meaning:

BO1 – technological output for wheel flange lubrication

BO2 – technological output wheel flange lubrication

BO3 – technological output for error issue of wheel flange lubrication

BO4 – technological speed output 1

BO5 – technological speed output 2

BO6 – technological output error issue of wheel flange lubrication (4 imp/m)

Function parameters of wheel flange lubrication are predestined by system configuration. The function is autonomous and doesn't require staff cooperation.

Function parameters of speed outputs are predestined by system configuration. The function is autonomous and doesn't require staff cooperation.

Issue of track pulses is activated by system configuration. The function is autonomous and doesn't require staff cooperation.

12.8 Data Provision to Communication Interface

The MIREL RM2 Integrated On-Board System provides available on identification unit or eventually on communication interface following basic data for board terminals:

- System time
- Time remaining until D1
- Operating hours 1 (utilization based on system configuration)
- Operating hours 2 (utilization based on system configuration)
- Operating hours 3 (utilization based on system configuration)
- Operating hours 4 (utilization based on system configuration)
- DRV daily covered distance

- DRV user-covered distance
- Total DRV- covered distance
- DRV movement speed
- Maximum permitted speed
- Preset speed
- Wheel flange diameter
- DRV position

System Time

System time and date is indicated in item Time („Čas“), which is located in submenu of main item Oper.data („3.Prev. údaje“). The item Time („Čas“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing the key ↓. The time item indicates the actual date and time of system. Time is provided in format hh:mm:ss. Date is provided in format DD.MM.YYYY.

Time Remaining Until D1

Time remaining until D1 is indicated in item time remaining until D1 („Čas do D1“), which is located in submenu of main item Oper.data („3.Prev. údaje“). The item time remaining until D1 („Čas do D1“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 2x the key ↓. The item Time Remaining until D1 indicates time remaining until initializing the subsequent daily self-diagnostic test D1. Time is provided in format hh:mm:ss.

Operating Hours 1, 2, 3 and 4

Operating Hours 1, 2, 3 and 4 are indicated in items Operating Hours 1 („Motoh1“) through Operating Hours 4 („Motoh4“), which are located in submenu of main item Oper.data („3.Prev. údaje“). The item Motohours 1, 2 („Motohodiny 1, 2“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 3x the key ↓. The item „Motohodiny 3, 4“ from main item Oper.data („3.Prev. údaje“) is accessible by pushing 4x the key ↓. Operating hours indicate time in format hhhh:mm. Conditions for time calculation are dependent on system configuration.

User Signs

User signs are indicated in item User Sign („Uživ. značka“), which is located in submenu of main item Oper.data („3.Prev. údaje“). The item User sign („Uživ. značky“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 5x the key ↓. During analysis of data from registration module, the user signs are displayed in form of a binary signal on time and track axis. User has available 8 user signs. User signs allow user to register on command a sign/signs to registration archive. Issue procedure of time sign:

- User sign screen selection.

U	ž	i	v	.		z	n	a	č	k	a		↵	↑
														↓

- Access to editing mode of user signs by operating pushbutton ↵.

U	ž	i	v	.		z	n	a	č	k	a			
													↵	

- Entering of user sign combination by selection of pushbuttons 1 to 8 and issue of command for registration by operating the pushbutton ↵.

After issue of command to register user signs, the preset user signs are registered in registration archive.

DRV Daily Covered Distance

The DRV daily covered distance is indicated in item „Sd“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item DRV daily covered distance („Ubehnutá denná dráha HDV“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 6x the key ↓. The daily covered distance is indicated in kilometres with a precision of three decimal places, i.e. with a precision of one meter. The daily covered distance is zeroed by switching on the system.

DRV User-Covered Distance

The DRV user-covered distance is indicated in item „Su“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item DRV user-covered distance („Ubehnutá uživatelská dráha HDV“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 6x the key ↓. The user-covered distance is indicated in kilometres with a precision of three decimal places, i.e. with a precision of one meter. The user covered distance is zeroed by switching on the system and command from staff by pushing the pushbutton ←↓ on relevant screen of active identification unit.

Total DRV-Covered Distance

The total DRV-covered distance is indicated in item „S“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item Total DRV-covered distance („Ubehnutá celková dráha HDV“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 7x the key ↓. The total covered distance is indicated in kilometres with a precision of one decimal place, i.e. with a precision of hundred metres. The total covered distance isn't zeroed by any staff command.

DRV Movement Speed

The DRV speed is indicated in item „V“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item DRV Movement Speed („Rýchlosť pohybu HDV“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 7x the key ↓. The DRV movement speed is indicated in km/h with a precision of one decimal place.

Maximum Permitted Speed

The maximum permitted speed is indicated in item „Vmax.“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item Maximum Permitted Speed („Maximálna povolená rýchlosť“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 8x the key ↓. Maximum permitted speed is indicated in km/h. The value of maximum permitted speed is determined as the lower one of maximum design speed and maximum speed of chosen RM2 mode.

Preset Speed

The preset speed is indicated in item „Vpredv.“, which is located in submenu of main item Oper.data („3.Prev. údaje“). The item Preset Speed („Predvolená rýchlosť“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 8x the key ↓. The preset speed is indicated in km/h. The value of preset speed represents the speed required for system providing for automatic speed regulation at DRV.

DRV Position

The DRV position is indicated in items „ZŠ“ and „ZD“, which are located in submenu of main item Oper.data („3.Prev. údaje“). The item DRV Position („Poloha HDV“) from main item Oper.data („3.Prev. údaje“) is accessible by pushing 10x the key ↓. Indication of actual DRV position is split into two items:

- Indication of geographical latitude „ZŠ“
- Indication of geographical longitude „ZD“

The position is indicated in format SS°mm'ss,ff" (degrees, minutes, seconds, hundreds of seconds).

12.9 GPS Localization

If the gateways MIREL LCM, MIREL LSM are wired to Integrated On-Board System MIREL RM2 or when the localization and synchronization module GGAM is present directly in central unit of the integrated on-board system, the system is able to record the railway vehicle position, when the GPS signal is received. The actual position is simultaneously provided on communication interface and indicated on identification unit in menu Oper.data („3.Prev. údaje“) under item Geographical length / Geographical width („Zem. Š / Zem. D“).

12.10 Remote Train Stop

Decoding of train stop radio signal is carried out by the DRV radio station. The remote option stop is conditioned by organizational settlement of this function on infrastructure side, as well as by technical equipment of radio station at DRV. The Producer recommends in Installation Manual 1992RM2 the method of connection and signal path to registration of train remote stop signal by a radio station.

12.11 Check of Accord Between Actual and Preset Direction

The MIREL RM2 Integrated On-Board System evaluates the movement direction of driving vehicle from signals of axle speed sensor. Such evaluated movement direction is compared with direction selected by direction controller at active driver's cab. Their accord or discrepancy is checked. One of following 5 different cases can emerge during operation of driving vehicle.

1. If the rail vehicle moves, after setting into motion, in the direction, which is corresponding with the direction chosen at active cab by the driver, then such movement direction is classified as permitted. This permission of movement direction applies until the next stopping of drive vehicle, independent from eventual further manoeuvres carried out with direction controllers by the driver.
2. If the movement direction, after setting railway vehicle into motion, wasn't classified as permitted one, and an opposite direction to actual one has been previously chosen at active cab, after covering a

distance of 3 m the system activates audible signal ZS3 and after covering a distance of 10 m system intervention NZ3 takes place, as well as emergency brake activation.

3. If the movement direction, after setting railway vehicle into motion, wasn't classified as permitted one, and no direction has been chosen at active cab, then:
 - a) in PRE and VYL operating modes the system behaves identically like if the opposite direction would have been set according to paragraph 2,
 - b) in POS and ZAV operating modes the accord isn't checked.
4. If the diagnostic test D1 hasn't been accomplished and pressure in main brake line is lower than 3,5 bar, then any vehicle movement direction is considered as permitted.
5. With steering control switch in OFF position on both cabs, save operating situation stated in clause 4, any railway vehicle movement is evaluated like travel in prohibited direction and system feedback is according to clause 2.

13 System Functions

13.1 Clock Synchronization

If the gateways MIREL LCM, MIREL LSM are wired to Integrated On-Board System MIREL RM2 or when the localization and synchronization module GGAM is present directly in central unit of the integrated on-board system, the system is able to synchronize the system clock pursuant to world time, when the GPS signal is received. This synchronization takes place:

- During system start-up
(if a difference of >10 s has been detected during system run, the difference detected during last RM2 run shall be applied)
- If system runs longer than 24 h and motionless DRV longer than 1/2 hour.
The actually detected difference between on-board time and GPS time is applied

On-board time in RTC is UTC and RM2 carries out its conversion to local time. Conversion is unequivocal like with transition from summer to winter time and vice-versa.

The MIREL RM2 Integrated On-Board System provides the actual local time to communication interface and indicates it on identification unit in menu Oper.data („3.Prev. údaje“) under item Time („Čas“).

13.2 System Start-Up

System start-up has been described in Chapter 6 *Putting into Operation and Termination of Operation*.

13.3 Selection of Active Driver's Cab

Selection of active driver's cab has been described in Chapter **Chyba! Nenašiel sa žiaden zdroj odkazov.** *Cab Activation*.

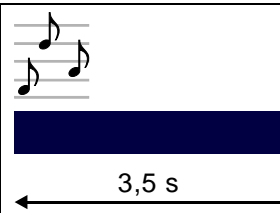
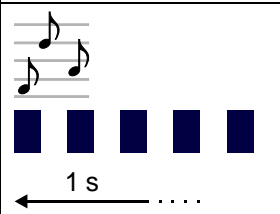
13.4 Operation Mode Setting

Setting of operation modes has been described in Chapter **Chyba! Nenašiel sa žiaden zdroj odkazov.** *Selection of System Operating Mode*.

13.5 Audible Indication

Each railway vehicle cab is equipped with a horn of MIREL RM2 Integrated On-Board System, which audibly alerts the driver about necessity of a control action, or notifies him/her about conditions, which emerge in MIREL RM2 Integrated On-Board System. Horn is available in two design options, as a separate device, or a device to be fitted into control panel.

Audible signalling:

ZS1		One-Time/Standard vigilance prompting	
		start	3,5 s before expiry of vigilance control interval
		termination	upon vigilance confirmation
		type	permanent horn tone without fade-out
ZS2		Maximum speed violation	
		start	upon maximum speed violation, with respective tolerance (more than 5,5 km.h ⁻¹)
		termination	upon speed decrease under limit maximum speed + tolerance (intervention of MIREL RM2 Integrated On-Board

			System due to maximum speed violation isn't a reason to terminate signalling of maximum speed violation)
		type	fast interrupted horn tone 2,5 Hz with 1:1 buzz ratio
ZS3		Discrepancy between selected and actual DRV movement direction	
		start	after covering a distance of 6 m in prohibited direction, 10 s before time interval expiry for start of DRV setting into motion
		termination	after covering a distance of 10 m in prohibited direction and RM2 intervention, or after achieving accord between actual and selected movement direction
		Type	slow interrupted horn tone 1,25 Hz with 3:1 buzz ratio
ZS8		Notification about unrequested vigilance confirmation	
		start	after pressing vigilance pushbutton or pedal, when blue light is lit
		termination	One-time signal
		type	Audible signal with motive 1 pulse (0,2 s)
ZS10		Notification about repeated D1 execution	
		start	15 s before automatic repeated start-up of D1 diagnostic test
		termination	upon start of D1 diagnostics, by postponing the D1 diagnostics execution for additional 15 minutes
		type	short slow interrupted horn tone 1 Hz with 1:9 buzz ratio
ZS11		Start of D1 diagnostics	
		start	upon putting system into operation, after repeated D1 start
		termination	one-time signal
		type	4 brief pulses (0,1 s)

The audible indication is enabled also by every identification and indication unit of MIREL RM2 Integrated On-Board System. After operating any of pushbuttons, the unit issues a brief tone indicating to staff that a pushbutton has been operated. With simultaneous operating of two or more pushbuttons, the unit doesn't issue any tone.

13.6 Visual Indication

The visual indication is enabled indication and identification units of MIREL RM2 Integrated On-Board System, their quantity and types are dependent on chosen modification. Description of control and indication elements of mentioned units is provided in Chapters 5.2 *Indication Unit* and 5.3 *Identification unit* of underlying document.

13.7 Regulation of Indicator Brightness

Each identification and indication unit of MIREL RM2 Integrated On-Board System is equipped with an illumination intensity sensor. Indicator brightness regulation on indication and identification units is fully automatic. Each identification and indication unit ensures the brightness regulation in autonomous way based on light conditions in place of unit installation.

13.8 Termination of System Operation

Termination of system operation is described in Chapter 6 *Putting into Operation and Termination of Operation*.

13.9 Error Detection and System Intervention

Errors of MIREL RM2 Integrated On-Board System have been divided in two groups. Serious errors, which make further operation of MIREL RM2 Integrated On-Board System impossible and light errors, which limit further operation of MIREL RM2 Integrated On-Board System.

Serious Error

Serious error makes further operation of MIREL RM2 Integrated On-Board System impossible. Upon detection of a serious error, the MIREL RM2 Integrated On-Board System is switched into secure condition. In case of modification of the system with functional property "B", the secure condition is realized by means of opening EPV, which results in emergency brake activation.

A serious error is indicated as follows:

- by flashing of **S** indicator (OIIN4) on indication units RM2IN and of indicator (OIID2) on identification units RM2ID
- by flashing of indicated DRV movement speed on indication unit
- on screen of active identification unit in Errors („4.Poruchy“) there is an indication how many actually detected system errors are pending, along with code of first detected errors.

←	4	.	P	o	r	u	c	h	y					↵	
			K	ó	d	:				E					↓

Light Error

Upon origination of a light error, limiting further operation of RM2 Integrated On-Board System, system permits operation with limitations based on error character.

A light error is indicated as follows.

- By permanently lit **ERR** indicator (OIIN5) on indication units RM2IN and identification units RM2ID
- on screen of active identification unit in Errors („4.Poruchy“) there is an indication how many actually detected system errors are pending, along with code of first detected errors

←	4	.	P	o	r	u	c	h	y					↵	
			K	ó	d	:				E					↓

Due to incorrect operation of DRV staff, specific conditions can occur, which are indicated by system as operating staff error.

Operating staff error is indicated as follows:

- by permanently lit **ERR** indicator (OIIN5) on indication units RM2IN and identification units RM2ID
- on screen of identification unit in menu Errors („4.Poruchy“).

D	1		p	r	e	r	u	š	e	n	á			o	↑
D	1		n	e	v	y	k	o	n	a	n	á		o	↓

K	o	h	ú	t		u	z	a	v	r	e	t	ý	o	↑
K	ó	d	y		p	o	r	ú	c	h	:			o	↓

14 Procedure in case of accident

If MIREL has functional property “R” or “R” and “S” it is possible to reconstruct the situation before an accident by reading the registered data, parameters of drive and evaluate the correctness of the executions performed by the DRV operator. If the accident has not caused irreversible damage of removable registration medium in module ZJ-B, reading the data or the removal of the medium for the competent authorities shall be carried out by the responsible operator. If this medium is damaged, reading the data is realized by the manufacturer of the system, which proceeds according to the internal regulation referred to [2]1984RM2 Technical reference.



15 Notes