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Version:

210604

System / Product:

MIREL RM2 Integrated On-Board System

Title:

Maintenance Manual, Diagnostics

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. Jasenčák	Ing. Michalec	Ing. Michalec
180115	Change of conditions - D4 prophylactic inspections	Ing. Adamec	Ing. Adamec	Ing. Michalec
180214	Addition of registration module pursuant to EN62625	Ing. Jasenčák	Ing. Michalec	Ing. Michalec
180521	Addition of registration error at module ZJ-S	Ing. Jasenčák	Ing. Michalec	Ing. Michalec
180620	Hardware Supplementing for Diagnostics	Ing. Slama	Ing. Slama	Ing. Michalec
190709	Supplement of RM2IN.2	Ing. Jasenčák	Ing. Michalec	Ing. Michalec
210604	Change of D3 functional test initialization procedure	Ing. Jasenčák	Ing. Michalec	Ing. Michalec

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Purpose of Document

The document specifies the extent, method and conditions for execution of diagnostics and maintenance, execution of operational and service repair of the MIREL RM2 Integrated On-Board System, which integrates the function of DRV speedometer, on-board recording device, as well as protection device of DRV staff vigilance monitoring.

The document follows up and refers to documentation stated below:

No.	Version	Title
[1] 199M	200930	Box 144x72 Installation Conditions
[2] 460M	170717	Service Sheet
[3] 482M	200930	Box 144x144 Installation Conditions
[4] 980M	200930	Box 72x72 Installation Conditions
[5] 1068M	170516	BOXTUG Installation Conditions
[6] 1104VZ1	200617	VZ1HP Catalogue Sheet
[7] 1975M	161208	BOXU.2 Installation Conditions
[8] 1976RM2	200603	Technical Conditions
[9] 1985RM2	210225	Specification of Configurations
[10] 1986RM2	190709	Operating Manual
[11] 1989RM2	200117	RM2ZJ Catalogue Sheet
[12] 1992RM2	200813	Installation Manual
[13] 1994RM2	200924	Protocol from functional test D3
[14] 1995RM2	190709	Prophylactic Inspection D4
[15] 2170RM2	200824	Specification of Registered Data Configuration
[16] 2283M	200930	PPxD Installation Conditions
[17] 2468M	191016	BOXKOG Installation Conditions
[18] 2578MAP	210113	KAM3G User Manual
[19] 2521M	180828	MIREL Systems Diagnostics

The document is intended for:

- Producer's employees as underlying documentation for installation, configuration, activation and maintenance of the MIREL RM2 Integrated On-Board System
- Operator's employees as underlying documentation for installation, configuration, activation and maintenance of the MIREL RM2 Integrated On-Board System
- implementation of training and inspection activities

Specification of Document Changes

Version 150701

Document implementation.

Version 180115

Update of Chapter 4.4 D4 – Inspection.

Update of Chapter 8 Assembly and Disassembly.

Version 180214

Addition of registration module pursuant to standard EN62625-1.

Update of failure register, failure of module ZJ-R, failure of communication with module ZJ-R, failure of communication with VZ1.

Version 180521

Update of failure register, addition of registration failure at ZJ-S module.

Version 180620

Update of Chapter 4 System Diagnostics .

Version 190709

Supplement of RM2IN.2

Version 210604

Simplification D3 functional test initialization entry procedure.

Employed Designation and Terminology

APE	Application program equipment
DRV	Driving rail vehicle, including train sets, steering rail vehicles, work machines and similar vehicles
GPS	Global Positioning System
GSM	Global System for Mobile Communication
ID	Identification unit
IN	Indication unit
IN1	Indication unit IN at ST1
IN2	Indication unit IN at ST2
IN3	Indication unit IN at TST1
IN4	Indication unit IN at TST2
ID1	Identification unit ID at ST1
ID2	Identification unit ID at ST2
ID3	Identification unit ID at TST1
ID4	Identification unit ID at TST2
LS	Localization and synchronization
LS-GSM	Localization and synchronization, functionality of GSM data transfer
ST1	Driver cab 1
ST2	Driver cab 2
TST1	Technology post 1
TST2	Technology post 2
RM2ZJ	Central unit of the MIREL RM2 system
RM2IN	Indication unit of the MIREL RM2 system
RM2ID	Identification unit of the MIREL RM2 system
HP	MIREL HP horn
HBP	Main brake pipe
ZJ-X	Module in central unit at position X

1 Introduction

The Maintenance Manual of MIREL RM2 Integrated On-Board System is a document intended primarily for persons carrying out maintenance and service of the system. Further, the manual is intended as aid for implementation of training and inspection activities, aid for installation of the MIREL RM2 Integrated On-Board System into the locomotive technology, its activation and testing.

The Maintenance Manual specifies standard service procedures and activities during diagnostics, scheduled maintenance and unscheduled maintenance of the MIREL RM2 Integrated On-Board System in conjunction with maintenance procedure of the entire locomotive.

Staff of production, assembly, maintenance and diagnostics of the MIREL RM2 Integrated On-Board System must meet following general qualification criteria:

- specialist education in electrical engineering or focused on field of transport
- traceable training for specified activities, with periodical renewal

Specification of qualification requirements specific for individual diagnostics and maintenance levels of MIREL RM2 Integrated On-Board System is outlined in relevant chapters.

The Manual for Maintenance and Diagnostics follows-up the document 1986RM2 *Operating Manual* and document 1976RM2 *Technical Conditions*, which describe operating functions of MIREL RM2 Integrated On-Board System as well as method of its operation.

The maintenance manual of MIREL RM2 Integrated On-Board System doesn't under any circumstances replace provisions of valid legislative and operational rules and procedures related to maintenance and control of driving rail vehicles, as well as rail operation control. Valid legislative and operational rules and procedures are absolutely superior to underlying Maintenance Manual.

2 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, eventually also at technology stands, 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 allows, depending on configuration, to implement driver, or DRV staff vigilance control.

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.

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.

3 Set of System Units

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

- central unit ZJ 1x
- indication unit IN max 4x
- identification unit ID max 4x

Rail vehicle elements cooperating with MIREL RM2 Integrated On-Board System:

- incremental speed sensor
- drive controllers
- mode selector
- vigilance pushbuttons and pedals
- Steering controllers
- signalling horn MIREL HP max 2x
- electropneumatic valve of emergency brake
- pressure switch in main brake line
- pressure sensors MIREL ST
- Communication gateway MIREL LCM/
Synchronization and localization gateway MIREL LSM
- Extension device MIREL EXIO max 2x
- Train protection MIREL VZ1

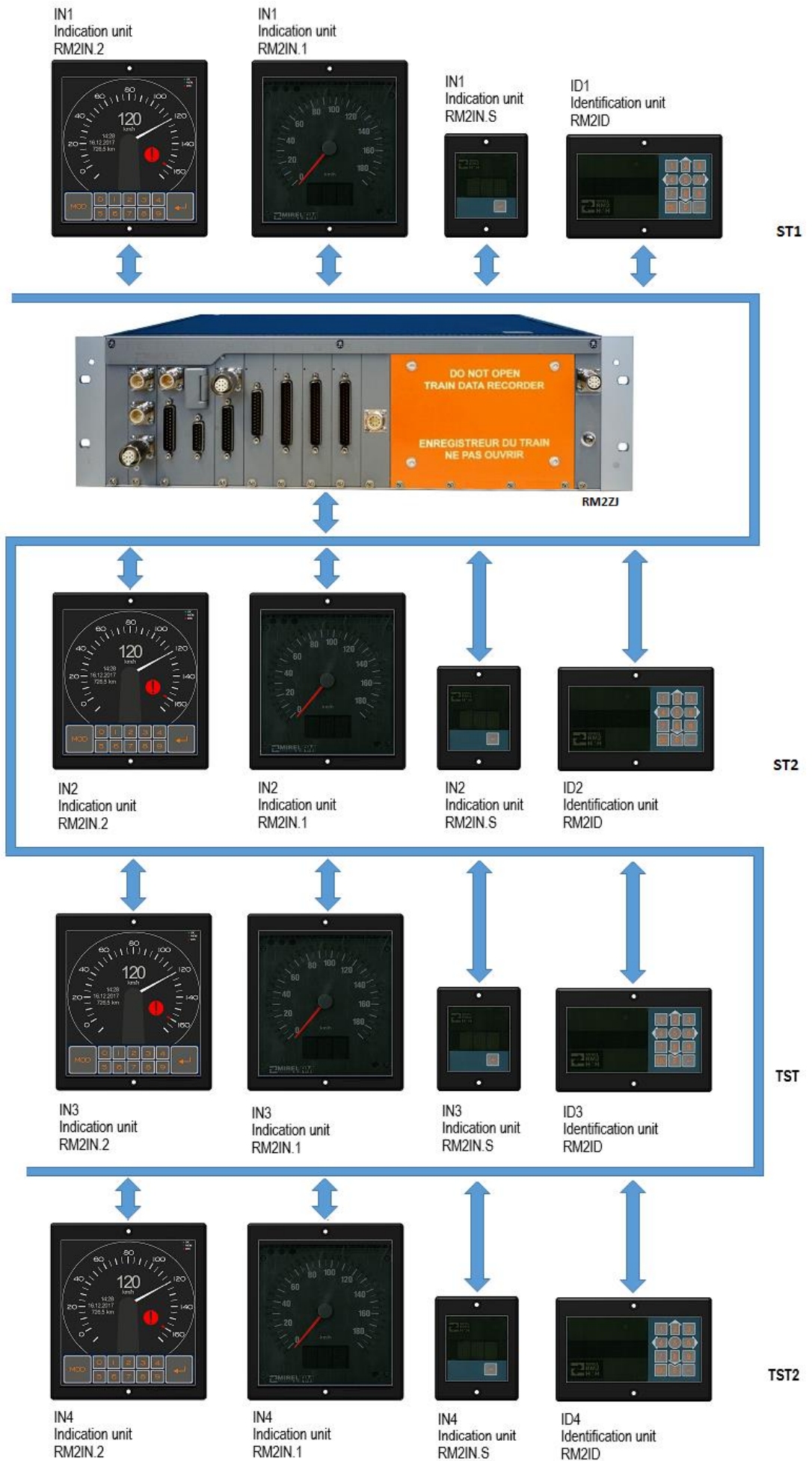


Fig. 3-1 Composition of MIREL RM2 Integrated On-Board System

4 System Diagnostics

Diagnostics of MIREL RM2 Integrated On-Board System features four levels

D1	One-time diagnostic inspection
D2	Continuous diagnostic inspection
D3	Functional test
D4	Prophylactic inspection

Levels D1 and D2 run automatically after switching on the MIREL RM2 Integrated On-Board System. Staff intervention of staff is required for performance of D1 diagnostic test if the MIREL RM2 Integrated On-Board System is in modification with vigilance monitoring function. In case of MIREL RM2 Integrated On-Board System failure detection when running the D1 and D2 test, the staff is notified about such fact and MIREL RM2 Integrated On-Board System switches itself to a safe status dependent on character of the detected failure. If the detected failure doesn't allow further operation of the integrated on-board system, a measure takes place to prohibit further DRV operation. Based on character of the detected failure, an operational system repair (S1), eventually a system service repair (S2) must be carried out.

The functional test (D3) of system is usually carried out by a trained employee of the Operator. During the functional test, the basic system functionality in all operating functions is inspected. Functionality of input-output circuits, cooperation with main DRV functional units, as well as functionality of indication elements and keyboards is inspected. In case of failure detection, an operational system repair (S1), eventually a system service repair (S2) must be carried out.

The prophylactic inspection (D4) of the system is carried out periodically by the producer of integrated on-board system, or by an authorized and trained subject. Apart from functional test, an in-depth inspection of the entire system is carried out. Inspection is carried out in terms of full functionality verification and wear status. Should a connection failure of integrated on-board system to DRV technology be revealed, an operational repair (S1) is necessary. When an internal failure of the integrated on-board system is detected, a service repair (S2) is necessary.

System diagnostics within the framework of D3, D4, S1 a S2 is carried out by means of MIREL MAP software, which is started on service-PC. Computer connection is effectuated by means of ATM transfer module and diagnostics cables. Software description is provided in 974MAP and type of employed diagnostics cables in 2521M.

Each person performing the diagnostics of integrated on-board system must be instructed in terms of occupational safety, traceably trained for this activity and must have a verifiable authorization to carry out individual levels of system diagnostics.

4.1 D1 – One-Time Self-Diagnostic Device Inspection

Aim of diagnostics:

A one-time verification of condition, integrity and system functionality during its start-up. Should continuous system operation exceed 24 hours, the D1 fulfils the function of a daily test.

Performed by:

When the MIREL RM2 Integrated On-Board System is in modification without vigilance inspection, the test runs autonomously, without necessity of DRV staff intervention. When the MIREL RM2 Integrated On-Board System is in modification with, intervention of DRV staff is necessary.

Schedule:

With each switching on the MIREL RM2 Integrated On-Board System, repeatedly after 24 hours of system operation, with postponing option, but must be carried out within 28 hours of permanent system operation. Test must be carried out within 4h from switching on the MIREL RM2 Integrated On-Board System .

Description:

After switching on, the system carries out a one-time diagnostic test D1, within its framework the communication functionality on internal central unit bus-bar, functionality of basic unit communication with indication and identification units, functionality of control elements at driver's cab are submitted to diagnostics, as well as functionality of emergency brake EPV and of pressure switch in main brake line.

Should the diagnostics of MIREL RM2 Integrated On-Board System detect a serious system failure, the system switches itself to a safe status, a serious failure is indicated on indication and identification units of the system and system is set to a safe status by activation of emergency brake EPV.

List of tests during the one-time diagnostic inspection:

Program integrity check: Central unit modules, as well as identification units IN and indication units ID calculate separately FLASH memory checksums. They compare them with anticipated values. Should a FLASH memory error be detected, a system failure is indicated. Device isn't functionally operative in this test.

Functionality check of processor operating register – The device performs a recording and reading test for all processor operating registers in central unit modules as well as in all connected peripherals. Test is performed with selected data bit combinations. Should a failure of operating registers be detected, a system failure is indicated. Device isn't functionally operative in this test .

SRAM memories functionality check – The device performs a recording and reading test for the entire field of processor static RAM in modules at positions ZJ-A, ZJ-B and ZJ-C. Test is performed with selected data bit combinations. Should an error of SRAM memory be detected, a system failure is indicated. Device isn't functionally operative in this test.

Check of communication establishment between the block controlling communication on bus-bar and other central unit modules: The master processor block transmits a SYNC pack necessary for communication establishment with processor blocks of safe core and with all hubs on communication bus-bar. If the communication isn't established within 10s, a system failure is indicated. Device is functional in this test .

Check of communication establishment between central units and peripherals: The processor block controlling the communication on central unit's bus-bar, transmits a SYNC pack necessary for communication establishment with indication unit IN and identification unit ID. If the communication with indication unit IN or identification unit ID isn't established within 10s, a system failure is indicated. Device is functional in this test.

Functionality check of emergency brake EPV: Within the D1 diagnostic test, the system performs check of EPV control by both channels.

When switching the MIREL RM2 Integrated On-Board System on, the pressure switch must be in a condition corresponding the pressure in main brake line under the level of 3,5 bar (condition corresponding with engaged brakes of DRV).

The one-time diagnostic test D1 is performed with each switching on the system into operation, repeatedly after 24 hours (daily test) of continuous system operation, with postponing option, but within 28 hours latest. 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/indication unit RM2IN.2. Repeated start of D1 diagnostic test is carried out after meeting the conditions as follows:

- The test is started again after first stopping of DRV after expiry of 24 hours from last accomplishment of D1 diagnostic test. 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 operating the command button ← at indication unit RM2IN.S/RM2IN.2, operating the external command pushbutton or by external command on CAN communication interface, to postpone the repeated start of D1 diagnostic test by another 15 minutes. If D1 isn't postponed after notification, the D1 diagnostic test is automatically started and its complete execution is necessary.
- 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 DRV staff is notified about the necessity to perform a repeated diagnostic test D1 by audible signalization ZS10.


A component of diagnostic test D1 is 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 pressure drop in main brake line. Prerequisite for execution of emergency brake EPV functionality check is an accomplished test of zero position achievement of control switches, 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 means of 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 manoeuvres described below:

- pressure increase in the main brake line beyond the level necessary for condition change of pressure switch (usually 4,2 bar)
- the RM2 system opens after 2s the EPV by means of channel M
- pressure in main brake line occurs and at a level 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 4,2 bar)
- the RM2 system opens after 2s the EPV by means of 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 means of channels M and C is accomplished.

The execution sequence of individual steps of diagnostic test is indicated at indication unit by a 3-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
1) 	4 th line from bottom	control switches have reached zero position
	3 rd line from bottom	mode selectors have reached zero position
	2 nd line from bottom	in first part of test the pressure has dropped by opening EPV by means of 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 means of channel M and the required response of pressure switch in the main brake line has occurred

1) On RM2IN.2, the indication of D1 process flow is done on display and the indication colour is yellow.

After execution of all above-mentioned steps, the D1 indication at indication unit vanishes and system switches to operation mode.

With a system configuration without Control switch, the step “control switches have reached zero position” is automatically met.

Execution protocol:

Isn't compiled.

Handling of detected failures:

After any failure occurrence during the one-time self-diagnostic test, by switching off the power supply for a time period min. 5 seconds and subsequent powering, the system is re-initialized. If an error is indicated repeatedly, then such device failure occurred, which excludes further operation. An operational system repair (S1) is necessary.

4.2 D2 – Continuous Diagnostic Inspection

Aim of diagnostics:

Continuous verification of condition, integrity and system functionality during its operation.

Performed by:

The MIREL RM2 Integrated On-Board System automatically, without intervention of operating or maintenance staff.

Schedule:

Continually during the operation of MIREL RM2 Integrated On-Board System.

Description:

The MIREL RM2 Integrated On-Board System continuously compares results of processor modules channels M and C. Should differences be detected between channels, the continuous self-diagnostics detects system failure and switches the MIREL RM2 Integrated On-Board System to a safe condition. Further activity, which is continuously submitted to diagnostics by MIREL RM2 Integrated On-Board System, is the communication of central unit with identification and indication units, based on chosen configurations. In case of serious communication failure with indication unit of active cab (the cab with control ON), the MIREL RM2 Integrated On-Board System doesn't permit further operation. If the communication failure is detected on identification or indication unit of the inactive cab, further system operation is allowed in restricted extent and the MIREL RM2 Integrated On-Board System requires operational repair.

Tests executed during continuous self-diagnostic inspection:

Test by watchdog circuits – Module processor blocks at positions ZJ-A, ZJ-B and ZJ-C as well as indication units IN and identification units ID feature a pair of watchdog circuits. Watchdog circuits supervise the correct activity of processors proper, correct program run, activity of timers and functionality of processor interruption systems. Watchdog circuits operate with a time baseline of 1,2s, 1,6s and 34,1ms. Upon error detection, the watchdog circuit causes re-initializing of respective functional module, which subsequently generates an error message for the entire system.

Communication functionality test – Each unit of MIREL RM2 Integrated On-Board System monitors the functionality of data communication at RS485 line. In case, that a successful communication fails for a period longer than 3 seconds for identification and indication units, 5 seconds for LSM and LCM external modules, the system reports a communication failure with given module.

Speed measurement test – dependent on individual modification, the speed measurement is performed by a double-channel or quadruple-channel incremental speed sensor. Instantaneous actual velocity is calculated in M channel from signals A and B and in C channel from signals C and D. Such calculated velocities are compared between each other and the higher of them is utilized further. If within a time period of 10s the difference between calculated channel speeds is bigger than 10 km.h⁻¹ without change of travel movement direction, as well as in a case, when one channel evaluates the DRV travel speed as zero one and the other channel evaluates the DRV travel speed as non-zero for a period of more than 3s, the system indicated an error.

Test of actual movement direction evaluation – like with the speed measurement, the accord of evaluated direction is tested. Should a discrepancy between evaluated directions be detected for 3s, the system indicates error. Check takes place only during the DRV run-up.

Movement test prior accomplishment of D1 one-time diagnostics

In case of a configuration without vigilance function during DRV movement prior accomplishment of D1 one-time diagnostics, the system indicates error. In case of a configuration with vigilance function during DRV movement prior accomplishment of D1 one-time diagnostics, the system initiates emergency stop.

Test of EPV upon intervention

With an insufficient or slow pressure drop in main brake line upon intervention, the system indicates error.

Test of power supply and wiring integrity of individual signals from IRC

The integrity of IRC and of individual signal conductors wiring is checked by PC module. Upon detection of integrity violation, the system indicates error.

Test of decoding and of instruction file instruction execution

The system continuously checks functionality of decoding and of execution of critical sets of instructions. In case of inconsistency indication, the system indicates error of the respective module.

Configuration integrity test

Configuration data in FRAM are secured by checksums. In case. When an integrity violation of configuration security is identified, system indicates error.

Data integrity test in FRAM

Data in FRAM are secured by checksums. When an integrity violation of security is identified, system indicates error .

Test of real time clock (RTC) functionality

In case of real time clock stop detection, or eventual detection of time change prior defined time in the past, the system detects error.

Test of registration functionality

If a failure is detected in the process of registration, the system indicates an error.

Test of processor module restart by supervising circuits of watchdog type

In case of module restart detection by supervising circuits of watchdog type, the system indicates a combined error of respective module.

Execution protocol:

Isn't compiled.

Handling of detected errors:

After any error occurrence during the continuous self-diagnostic test, by switching off the power supply for a time period min. 5 seconds and subsequent powering, the system is re-initialized. If the error is indicated repeatedly, it is a matter of system error, which excludes any further system activity in case of a serious error. Operational repair (S1) is necessary.

4.3 D3 – Functional Test

Aim of diagnostics:

Verification of basic functionality and integrity of operated system. Verification of odometry, system input-output circuits, functionality verification of interface to operating staff and real time circuits of the system.

Performed by:

A trained person of MIREL RM2 Integrated On-Board System Operator, or any other traceably authorized and trained person.

Schedule:

Regularly every 6 months, with a tolerance of 1 month. An execution of D4 prophylactic inspection substitutes the execution of D3 functional test.

In case of unscheduled execution of D3 functional test, a new six-month period starts to run.

First deadline for functional test D3 starts to run with system activation date on DRV.

Description:

The aim of functional test D3 is to verify the basic functional correctness of MIREL RM2 Integrated On-Board System. Carried out in static mode, under excluded possibility of DRV movement. No parts of DRV are decoupled during function test, with exemption of IRC and connection of diagnostic PC to RM2ZJ.

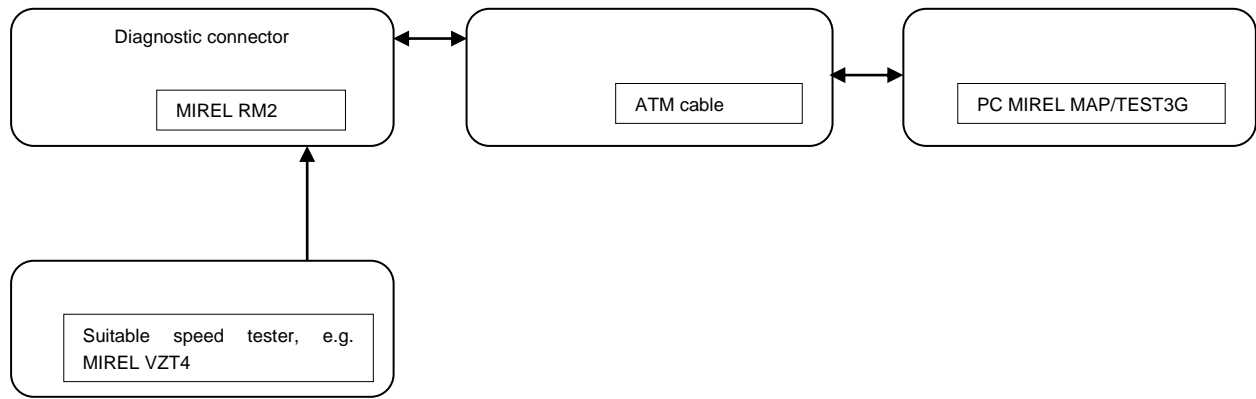
Following items are verified within the extent of functional test:

- functionality of signal transfer from speed sensors
- proper operation of RTC/time synchronization
- proper operation of optical and mechanical indication elements on ID, IN
- proper operation of automatic ID, IN brightness regulation
- proper operation of control elements on ID and IN
- proper operation of MIREL RM2 system horns located at DRV cabs
- proper operation of data transfer via CAN bus-bar for external indication system
- proper operation of emergency brake EPV
- proper operation of EXIO interlinked devices
- proper operation of secure and other binary outputs

Utilized means:

- PC with MIREL MAP application software - Test3G executive module, eventually also TSM3G
- ATM cable
- Proper diagnostic cable for connection to RM2ZJ
- Tester suitable for speed simulation, e.g. VZT4

Wiring diagram:



Initializing of D3 Functional Test

Conditions:

- HDV in standstill.
- Activation of D3 mode is allowed only within 2 minutes after switching on the system.
- The switch- ON and –OFF manoeuvre of control switch must have a duration of at least 2s.

Procedure:

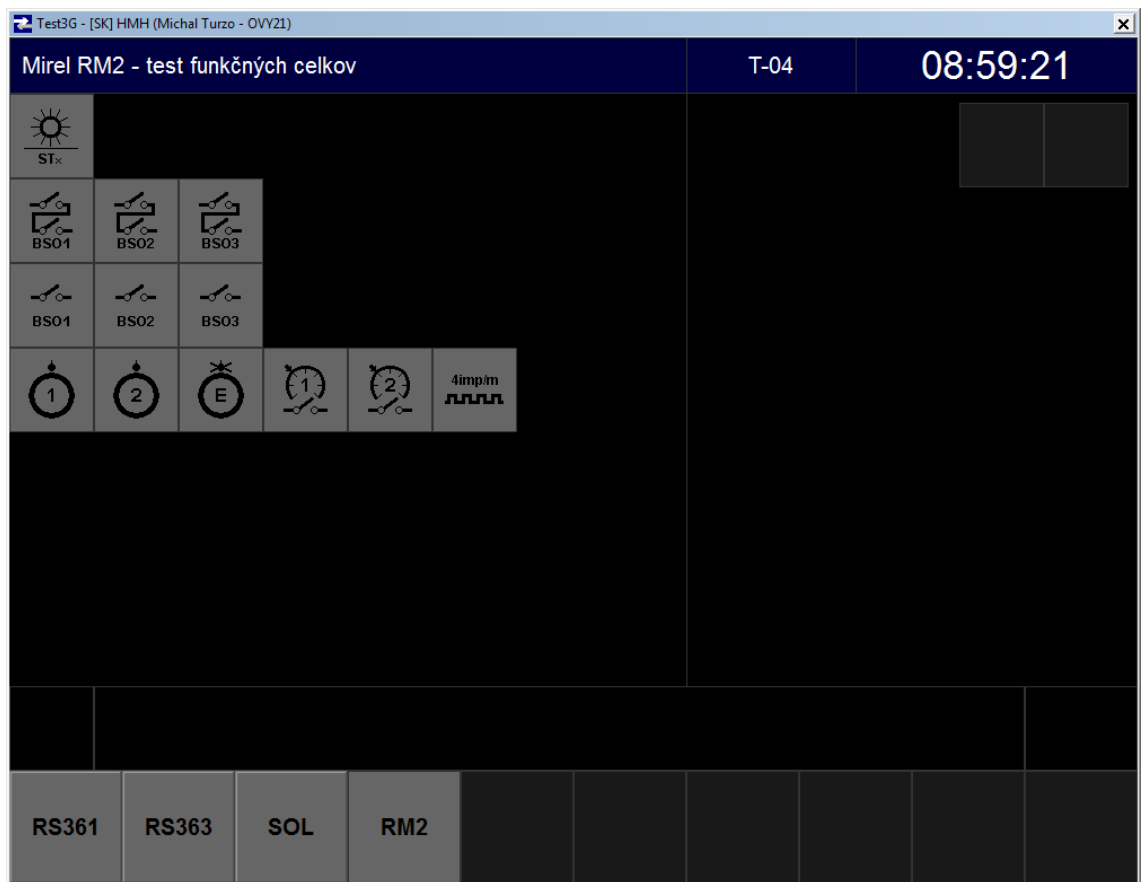
- PC connection to MIREL MAP application software by means of ATM cable to connector RM2ZZ piece with wired internal communication bus. Please use diagnostic cable for specific Central Unit modification for connection.
- Start of Test3G diagnostic module and selection of MIREL RM2 system.
- IRC disconnection and connection of suitable speed simulation test device, e.g. VZT.4. Step isn't necessary for D3 mode initialization.
- Switching on the power supply of the system with the battery switch/switching on the circuit breaker.
- If the system didn't switch to D3 mode upon accomplishment of preceding steps, below shown procedure must be followed.
- Initialization of request on D3 from driving rail vehicle technology is allowed with one of following options, dependent on system setup:
 - System with installed RM2IN.S or RM2IN.2 indication units by keeping pressed the command pushbutton on indication unit, in combination with control switch switching-off and –on manoeuvre at active driver's cab
 - System with installed RM2ID identification units by pressing the Enter pushbutton on identification unit, in combination with switch-off manoeuvre and switching on the drive control switch at active engine driver stand within 10s from operation of Enter pushbutton
 - System with installed terminals connected via CAN interface by issuing external command from terminals connected via CAN interface, in combination with control switch switching-off and –on manoeuvre at active driver's cab
 - System with installed external command pushbuttons by external command pushbutton, in combination with control switch switching-off and –on manoeuvre at active driver's cab
- In case of configuration without control switch, the input to D3 diagnostic test is initialized dependent on system setup with one of following options:
 - System with installed RM2IN.S or RM2IN.2 indication units by keeping pressed the command pushbutton on IN.S indication unit, in combination with MIREL RM2 on-board power supply switching-off and –on manoeuvre
 - System with installed RM2ID identification units by pressing the Enter pushbutton on identification unit, in combination with MIREL RM2 on-board power supply switching-off and –on manoeuvre

- System with installed terminals connected via CAN interface
by issuing external command from terminals connected via CAN interface, in combination with MIREL RM2 on-board power supply switching-off and –on manoeuvre
- System with installed external command pushbuttons
by external command pushbutton (if present in DRV wiring) in combination with MIREL RM2 on-board power supply switching-off and –on manoeuvre.

Control of D3 Functional Test by Means of APV Test3G.

In the D3 mode it is possible by means of pictogram menu in MAP application program equipment, module Test3G, to start test of optical indicators IN and ID, issue secure outputs, as well as technological outputs and based on the result to evaluate the correct execution of required issue of binary outputs.

An assembly of RM2 tests serves for execution of functional test in Test3G. Screen for set of RM2 tests is as follows.



Extent of implemented tests is specified by Table below.

Index	Icon position	Number of steps	Step	Test/Step Name	Description
1	11	1		Check of indication elements on IN and ID	Test sequentially switches-on and -off indication elements of installed units IN, ID. Operating staff carries out check of proper functioning.
			1	Sequential lighting up of indicators on IN and ID	Indication elements of indication units IN, ID are sequentially switched-on and –off. Staff carries out inspection.
2	21	4		Check of binary outputs BSO1M and BSO1C with SIL	Test based on configuration closes safe output 1 and evaluates its status.

Index	Icon position	Number of steps	Step	Test/Step Name	Description
			1	Issue of BSO1M	Connects BSO1M and disconnects BSO1C and evaluates status of back-coupling.
			2	Issue of BSO1M and BSO1C	Connects BSO1M and connects BSO1C and evaluates status of back-coupling
			3	Issue of BSO1C	Disconnects BSO1M and connects BSO1C and evaluates status of back-coupling
			4	BSO1M and BSO1C disconnect	Disconnects BSO1M and disconnects BSO1C and evaluates status of back-coupling.
3	22	4	Check of binary outputs BSO2M and BSO2C with SIL		Test based on configuration closes safe output 2 and evaluates its status.
			1	Issue of BSO2M	Connects BSO2M and disconnects BSO2C and evaluates status of back-coupling.
			2	Issue of BSO2M and BSO2C	Connects BSO2M and connects BSO2C and evaluates status of back-coupling
			3	Issue of BSO2C	Disconnects BSO2M and connects BSO2C and evaluates status of back-coupling
			4	BSO2M and BSO2C disconnect	Disconnects BSO2M and disconnects BSO2C and evaluates status of back-coupling.
4	23	4	Check of binary outputs BSO3M and BSO3C with SIL		Test based on configuration closes safe output 3 and evaluates its status.
			1	Issue of BSO3M	Connects BSO3M and disconnects BSO3C and evaluates status of back-coupling.
			2	Issue of BSO3M and BSO3C	Connects BSO3M and connects BSO3C and evaluates status of back-coupling
			3	Issue of BSO3C	Disconnects BSO3M and connects BSO3C and evaluates status of back-coupling
			4	BSO3M and BSO3C disconnect	Disconnects BSO3M and disconnects BSO3C and evaluates status of back-coupling.
5	31	2	Check of binary outputs BSO1M and BSO1C without SIL		Based on configuration, test connects binary outputs BSO1M and BSO1C. Modul Test3G doesn't carry out output issuance check.
			1	Issue of BSO1M	Closes BSO1M and opens BSO1C
			2	Issue of BSO1C	Opens BSO1M and closes BSO1C
6	32	2	Check of binary outputs BSO2M and BSO2C without SIL		Based on configuration, test connects binary outputs BSO1M and BSO1C. Modul Test3G doesn't carry out output issuance check.
			1	Issue of BSO2M	Closes BSO2M and opens BSO2C
			2	Issue of BSO2C	Opens BSO2M and closes BSO2C
7	33	2	Check of binary outputs BSO3M and BSO3C without SIL		Based on configuration, test connects binary outputs BSO1M and BSO1C. Modul Test3G doesn't carry out output issuance check.
			1	Issue of BSO3M	Closes BSO3M and opens BSO3C
			2	Issue of BSO3C	Opens BSO3M and closes BSO3C

Index	Icon position	Number of steps	Step	Test/Step Name	Description
8	41	1		Check of binary output BO1	Test issues technological binary output BO1. Modul Test3G doesn't carry out output issuance check.
			1	Issue of wheel flange lubrication 1.	Issues BO1 – wheel flange lubrication signal in travel direction 1
9	42	1		Check of binary output BO2	Test issues technological binary output BO2. Modul Test3G doesn't carry out output issuance check
			1	Issue of wheel flange lubrication 2.	Issues BO2 – wheel flange lubrication signal in travel direction 2
10	43	1		Check of binary output BO3	Test issues technological binary output BO3. Modul Test3G doesn't carry out output issuance check
			1	Lubrication issuing error	Issues BO3 – signal of wheel flange lubrication error
11	44	1		Check of binary output BO4	Test issues technological binary output BO4. Modul Test3G doesn't carry out output issuance check.
			1	Issue of speed output 1	Issues BO4 – signal to speed output 1
12	45	1		Check of binary output BO5	Test issues technological binary output BO5. Modul Test3G doesn't carry out output issuance check.
			1	Issue of speed output 2	Issues BO5 - signal to speed output 2
13	46	1		Check of binary output BO6	Test issues technological binary output BO6. Modul Test3G doesn't carry out output issuance check.
			1	Issue of track signal	Issues BO6 – signal for track pulse output

Results of individual functional test steps are recorded in protocol 1994RM2 Protocol from functional test D3, which is part of prepared methodology. Functional test can be carried out partially as well.

Execution protocol:

Protocol about functional test execution must comprise items as follows:

- date, time and place of execution
- No. of DRV, on which the system has been installed
- Serial No. of system and central unit
- name of the person which carried out the test
- functional test result (without errors / with errors / overall result)
- in case of error detection, their description
- signature of the person, v

Handling of detected errors:

In case of error detection an operational repair (S1) of the system is necessary.

4.4 D4 – Prophylactic Inspection

Aim of diagnostics:

In-depth verification of condition, integrity and functionality of the system, with respect to its safety and reliability. Verification of system condition and cooperation with DRV. Functional test execution in D3 extent.

Performed by:

A trained person of the Producer, or other person traceably authorized by Producer, trained for this purpose by Producer.

Schedule:

Always after execution of main DRV repair, but latest after 120 months. First period for D4 prophylactic inspection starts to flow on date of the final inspection during shipment and connected peripherals, dependent on system modification from Producer. If mentioned components aren't shipped together, the period starts to flow dependent on event which occurred first.

Should the entire system, its central unit or any identification or indication unit of the MIREL RM2 Integrated On-Board System be out of operation longer than 12 months, prior to putting the system into service it is necessary to carry out activation, or repeated activation of all components, which have been out of operation longer than 12 months. Activation must be carried out at least in extent corresponding with assembly level Z2. The term „out of operation“ means, that central unit or a periphery hasn't been installed on DRV even with a test status, or it has been installed, but the system hasn't been for this period powered.

A new interval starts to flow in case of an unscheduled execution of D4 prophylactic inspection.

If prophylactic inspection D4 hasn't been carried out as a whole within one service activity, but at various times on central unit, peripherals, check of system cooperation with DRV, then the new interval of D4 prophylactic inspection D4 starts to flow based on the D4 part which has been carried out as first.

Place of execution:

D4 prophylactic inspection of MIREL RM2 On-Board System can be executed in one of following ways:

- on DRV
 - in Producer's service centre. The prophylactic check of system cooperation with DRV shall be carried out on DRV. Device dismantling and assembly aren't part of prophylactic inspection D4 .
-

Description:

The execution of prophylactic inspection D4 follows provision of internal Producer's guidance for in-depth system inspection. Methodology of prophylactic inspection D4 execution takes into account installation differences for individual rolling stock series, on which the MIREL RM2 Integrated On-Board System has been installed. In case of future installations where conditions and differences shall have effect on extent and method of D4 prophylactic inspection execution, such adjustment shall be incorporated into a general methodology for execution of D4 prophylactic inspection.

Methodology and template of protocol about execution of D4 prophylactic inspection on MIREL RM2 Integrated On-Board System have been outlined in document 1995RM2 *Prophylactic Inspection D4*.

The prophylactic inspection D4 is considered as accomplished only if it has been carried out in full extent. "In full extent" means, that a prophylactic inspection of system central unit, prophylactic inspection of identification and indication units, as well as prophylactic inspection of system cooperation with DRV have been carried out.

Execution protocol:

Protocol about prophylactic inspection execution must comprise items as follows:

- Execution date, or execution dates for individual parts, eventually
- Place or places of execution
- Serial No. of system and of individual components
- DRV-No., on which the system has been installed
- name and function of persons, which have carried out the inspection
- results of prophylactic inspection
- if any detected, description of discrepancies, errors, problems and deficiencies
- signature of executing persons

Handling of detected errors:

In case of error detection an operational repair (S1) of the system or a service repair (S2) is necessary, dependent on character of detected discrepancy.

5 System Maintenance

All parts of MIREL RM2 Integrated On-Board System are maintenance-free. No part needn't be periodically replaced, tuned or set.

Maintenance of MIREL RM2 Integrated On-Board System features two levels

S1	operational repair
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S2	service repair
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Operational repair (S1) is carried out by a trained employee of Operator. A repair is carried out in case of failure detection on MIREL RM2 Integrated On-Board System when executing any level of diagnostic inspection (D1 to D4) or in case of error detection during operation. The aim of an operational repair is to eliminate failures in wiring, in connection of cooperating devices on rolling stock. During operational repair, no interventions are made inside of the central unit and in indication and identification units.

Service repair (S2) is carried out by Producer or by him trained and authorized subject. A service repair is carried out if it isn't possible to eliminate a failure by means of operational repair (S1). Service repair is usually carried out by replacement (replacement of central unit or indication or identification unit, with subsequent repair by Producer). The aim of a service repair is to eliminate failures in central unit and in peripheral devices of MIREL RM2 Integrated On-Board System.

Each person performing maintenance of MIREL RM2 Integrated On-Board System must be instructed in terms of occupational safety, traceably trained for this activity and must have a verifiable authorization to carry out individual levels of system maintenance.

5.1 S1 – Operational Repair

Performed by:

A trained person of MIREL RM2 Integrated On-Board System Operator, or any other traceably authorized and trained person

Schedule:

In case of failure detection on MIREL RM2 Integrated On-Board System when executing any level of diagnostic inspection (D1 to D4) or in case of error detection during operation of MIREL RM2 Integrated On-Board System.

Description:

The aim of operational repair is to eliminate failures, which have occurred on:

- central unit power supply
- power supply of identification units ID
- power supply of indication units IN
- connection of incremental speed sensor
- connection of pressure sensor in main line
- connection of pressure sensors
- connection of technology inputs and outputs
- connection of vigilance pushbuttons
- connection of drive controllers
- connection of direction controllers
- cable wiring
- connector connections
- mechanical fastening

Prior to operational repair S1 it is recommended to carry out parts of D3 functional test, which can help to a more precise error specification. In case of error on ZJ central unit of MIREL RM2 Integrated On-Board System, on indication unit IN or on identification unit ID, the repair is done by replacement of the respec-

tive part. During the execution of operational repairs, the repair worker must have available approved technical documentation of the device and apart from maintenance manual he/she must follow provisions provided in technical documentation.

If it wasn't possible to eliminate all errors by operational repair S1, a service repair S2 of MIREL RM2 Integrated On-Board System is required. In case, that all errors have been eliminated by operational repair S1, it is necessary to carry out D3 system functional test.

The course of operational repair must be documented on a service sheet. A template of service sheet is provided in documentation 460M.

Document about Execution – Service Sheet:

Service sheet about execution of operational repair must comprise following items:

- date and time
- place of execution
- System No. of MIREL RM2 Integrated On-Board System
- DRV-No., on which the system has been installed
- name and function of person, which has carried out the operational repair
- description of eliminated failures, outlining their reason (if known)
- description of failures, which couldn't be eliminated by operational repair
- Serial Nos. of disassembled and assembled components
- signature of person, which has carried out the repair

5.2 S2 – Service Repair

Performed by:

Trained employee of Producer

Schedule:

When a failure has been detected on MIREL RM2 Integrated On-Board System, which couldn't be eliminated by operational repair S1

Description:

The aim of service repair is to eliminate failures, which have occurred on:

- the central unit ZJ of MIREL RM2 Integrated On-Board System
- identification unit ID
- indication unit IN
- cooperation of MIREL RM2 Integrated On-Board System with cooperating devices and other DRV parts, which couldn't be eliminated by operational repair S1

After accomplishment of service repair it is necessary to carry out functional test D3 with the preparation of relevant execution protocol.

The course of service repair must be documented on a service sheet. A template of service sheet is provided in documentation 460M *Service sheet*.

Document about Execution – Service Sheet:

Service sheet about execution of service repair must comprise following items:

- date, time and place of execution
- Serial number of system and repaired components
- DRV-No., on which the system has been installed
- name of person, which has carried out the service repair
- description of eliminated failures, outlining their reason (if known)
- in case of replacement of any parts, the serial numbers of disassembled and assembled components
- signature of person, which has carried out the repair

6 Signalization of Errors

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 switched DRV into secure condition by means of opening EPV, which results in emergency brake activation, if the system modification allows it.

A serious error is indicated as follows:

- by flashing of S indicator (OIIN4) on indication units IN and by flashing indicator (OIID2) on identification units ID, by indicator flashing (OIIN2B/ OIIN4B) on indication units RM2IN.2 in red colour
- on display of indication unit RM2IN.2 (OIIN1B) on main screen as well as in menu „4.Errors“
- on screen of active identification unit in menu „4.Errors“

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 permanent lighting of ERR indicator (OIIN5) on indication units RM2IN.1/S and identification units ID
- on display of indication unit RM2IN.2 (OIIN1B) on main screen as well as in menu „4.Errors“
- on screen of identification unit in menu „4.Errors“.

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.1/S and identification units ID, by permanently lit indicator (OIIN2B/OINN4B) on indication units RM2IN.2 in red colour
- on display of indication unit RM2IN.2 (OIIN1B) on main screen as well as in menu „4.Errors“
- on screen of identification unit in menu „4.Errors“.

List of system errors can be figured out on identification unit RM2ID in menu „4.Errors“ and on indication unit RM2IN.2 in menu “4.Errors”. RM2ID as well as RM2IN.2 indicate an error and display the numerical code of system error. List of errors, as detected by system within the framework of diagnostic tests, is provided in Table below.

Table of Error Codes

(EC – error code, SE – serious error, LE – light error, OSE – operating staff error)

EC	Error Description	SE	LE	OSE
E00	Permanent loss of communication between indication or identification unit and central unit.	✓		
E02	Error of unaccomplished D1 due to DRV movement without vigilance function		✓	
E03	Error in IRC circuit/wiring	✓		
E04	Discrepancy error of command and status BSO1 in local channel	✓		
E05	Discrepancy error of command and status BSO2 in local channel	✓		
E06	Discrepancy error of command and status BSO3 in local channel	✓		
E07	Discrepancy error with movement speed evaluation between channels M and C	✓		

E08	EPV fault during intervention – insufficient or slow pressure drop in main brake line	✓		
E09	Closed cock error, system intervention by means of EPV isn't possible	✓		✓
E10	EPV blow-off error by channel M in self-diagnostics D1	✓		
E11	EPV blow-off error by channel C in self-diagnostics D1	✓		
E12	Discrepancy error of travel direction evaluation between channels M and C	✓		
E13	Discrepancy error for pressure evaluation in HP between channels M and C	✓		
E14	Mode ambiguity error in MIREL RM2 system (between channels M and C, between ZJ and ID, between ZJ and external commands at CAN interface)	✓		
E15	Communication loss error of M or C module	✓		
E20	Error of unaccomplished D1 pursuant to preset conditions	✓		✓
E21	Discrepancy error at performance of D3 diagnostic test between channels M and C	✓		
E22	Discrepancy error of DRV movement direction with setting of direction levers	✓		
E24	Inconsistency error of D1 or reset of other channel	✓		
E33	System configuration error	✓		
E34	Real time clock functionality error (RTC)		✓ ₁₎	
E35	Registration error	✓ ₂₎		
E36	Communication error on internal bus I2C (FRAM, temperature sensor)		✓	
E37	Data inconsistency error in FRAM		✓ ₃₎	
E38	Error of registration by module ZJ-R		✓	
E39	System start-up error		✓ ₃₎	
E40	Error of IN at active cab	✓		
E41	Compound internal module error in MIREL RM2 system at position ZJ-A		✓ ₃₎	
E42	Compound internal module error in MIREL RM2 system at position ZJ-B	✓		
E43	Compound internal module error in MIREL RM2 system at position ZJ-C	✓		
E44	Compound internal module error in MIREL RM2 system at position ZJ-D		✓ ₃₎	
E45	Compound internal module error in MIREL RM2 system at position ZJ-E		✓ ₃₎	
E46	Compound internal module error in MIREL RM2 system at position ZJ-F		✓ ₃₎	
E47	Compound internal module error in MIREL RM2 system at position ZJ-G		✓ ₃₎	
E48	Compound internal module error in MIREL RM2 system at position ZJ-H		✓ ₃₎	
E49	Compound internal module error in MIREL RM2 system at position ZJ-J		✓ ₃₎	
E50	Compound internal module error in MIREL RM2 system at position ZJ-K		✓ ₃₎	
E51	Compound internal module error in MIREL RM2 system at position ZJ-L		✓ ₃₎	
E52	Compound internal module error in MIREL RM2 system at position ZJ-M		✓ ₃₎	
E53	Compound internal module error in MIREL RM2 system at position ZJ-N		✓ ₃₎	
E54	Compound internal module error in MIREL RM2 system at position ZJ-P		✓ ₃₎	

E55	Compound internal error of external time localization and clock synchronization module		3)	
E56	Compound internal module error in MIREL RM2 system at position ZJ-R			
E58	Issue error of technological outputs			
E59	Compound internal error of indication unit IN1 at ST1		3), 4)	
E60	Compound internal error of indication unit IN2 at ST2		3), 4)	
E61	Compound internal error of indication unit IN3 at TST1		3), 4)	
E62	Compound internal error of indication unit IN4 at TST2		3), 4)	
E63	Compound internal error of identification unit ID1 at ST1		3), 4)	
E64	Compound internal error of identification unit ID2 at ST2		3), 4)	
E65	Compound internal error of identification unit ID3 at TST1		3), 4)	
E66	Compound internal error of identification unit ID4 at TST2		3), 4)	
E68	Error of command integrity from CAN interface			
E69	Error of communication with cooperating device EXIO1			
E70	Error of communication with cooperating device EXIO2			
E71	Error of communication with module ZJ-A			
E72	Error of communication with system VZ1			
E74	Error of communication with module ZJ-D			
E75	Error of communication with module ZJ-E			
E76	Error of communication with module ZJ-F			
E77	Error of communication with module ZJ-G			
E78	Error of communication with module ZJ-H			
E79	Error of communication with module ZJ-J			
E80	Error of communication with module ZJ-K			
E81	Error of communication with module ZJ-L			
E82	Error of communication with module ZJ-M			
E83	Error of communication with module ZJ-N			
E84	Error of communication with module ZJ-P			
E85	Communication error of external module LS or LS-GSM			
E86	Error of communication with module ZJ-R			
E88	Registration error at ZJ-S module			
E89	Error of ZJ communication with indication unit IN1 at ST1		4)	
E90	Error of ZJ communication with indication unit IN2 at ST2		4)	
E91	Error of ZJ communication with indication unit IN3 at TST1		4)	
E92	Error of ZJ communication with indication unit IN4 at TST2		4)	
E93	Error of ZJ communication with identification unit ID1 at ST1		4)	
E94	Error of ZJ communication with identification unit ID2 at ST2		4)	
E95	Error of ZJ communication with identification unit ID3 at TST1		4)	
E96	Error of ZJ communication with identification unit ID4 at TST2		4)	

1) – RTC error in single channel is defined as light error. After elimination of RTC error the fault signalization can be set to zero. In case of simultaneous RTC error in channels M and C, the fault is defined as a serious error and system intervention is carried out.

2) – Registration error in a single channel is defined as light error. Registration error signalization can be eliminated only if the reason of error has been incorrect insertion of recording medium in M module and subsequent correct insertion of recording medium in M module slot. In case of simultaneous registration error in channels M and C, the fault is defined as a serious error and system intervention is carried out.

3) – light system error, its signalization can't be deleted even after elimination of the error reason.

Error numbers evaluated by channel M are in range from 0 to 96.

Error numbers evaluated by channel M are in range 100 –196.(these errors are identical with errors for channel M, with value shift by 100).

4) - In case of RM2IN.2 application, identification unit functions are integrated in indication unit and errors of indication and identification units are errors of indication unit.

7 System Configuration

Configuration of MIREL RM2 Integrated On-Board System is carried out with a computer with installed MIREL MAP with module KAM3G. ATM cable connected to computer communicates with central unit via RS485 line. Wiring of ATM and central unit is effectuated with supplied cable, specific for the given modification. The establishing of communication between diagnostic computer and MIREL RM2 Integrated On-Board System is indicated on computer display. During configuration, the staff follows procedure outlined in document 2301MAP KAM3G User Manual.

Complete configuration of the integrated on-board system comprises

- DRV registration No.
- System serial No.
- DRV axle diameter
- track interval of wheel flange lubrication:
value given by set of configuration parameters, 200m, 400m, 600m, 800m, 1000m, 1200m, 1500m
- set of system configuration parameters, corresponding with specific system application
- registration configuration
- registration configuration in accordance with standard EN62625-1.

The competence of a given service facility can be limited, dependent on actual requirements, only to some of above-mentioned items. This means, that it's not possible to configure all parameters at given facility.

The periodicity of axle diameter adjustment is specified by directive of the Operator. The underlying maintenance instruction specifies the procedure how to set a new diameter, but doesn't specify procedures and rules for schedule of a new diameter setting.

7.1 Configuration of RM2IN.2 Stand

Configuration of RM2IN.2 indication unit stand is carried out by means of below described procedure:

- 1) for transition to configuration mode for setting of RM2IN.2 periphery stand, the requisite must be met, that the RM2IN.2 periphery has remained 8s without external communication and subsequently the pushbutton "0" has been pressed for 5s
- 2) upon meeting the prerequisite for transition to config mode, the actual setting presents itself by a specific count of beeps
 - 1 beep tone of ST1
 - 2 beep tones of ST2
 - 3 beep tones of TST1(technological stand 1)
 - 4 beep tones of TST2(technological stand 2)
- 3) short pushbutton release and repeated pressing (within 1s) the stand setting changes sequentially, where the change is audibly signalized in accordance with item 2)
- 4) after each change, the setting is stored in FRAM and the setting shall be applied upon periphery restart

8 Assembly and Dismantling

After accomplishment of assembly operation it is necessary to carry out D3 functional test.

Assembly and Dismantling of Central Unit:

The central unit ZJ of MIREL RM2 Integrated On-Board System is actually available in two constructive versions:

- constructive system with BOXTUG box
- constructive system with BOXU box
- constructive system with BOXKOG box

The choice of constructive system is given by specific modification of MIREL RM2 Integrated On-Board System. Available constructive box versions are provided in document 1989RM2 RM2ZJ Catalogue Sheet, specifications of mechanical properties and installation conditions are provided in document 1068M BOXTUG Installation Conditions, in document 1975M BOXU.2 Installation Conditions and in document 2468M BOXKOG Installation Conditions. Requirements on central unit installation are provided in document 1992RM2 Installation Manual.

During assembly and dismantling, the central unit of MIREL RM2 Integrated On-Board System must be disconnected from battery power source by means of battery de-coupler or by switching-off the circuit breaker of MIREL RM2 Integrated On-Board System.

- quantity, types and method of mechanical connector arresting depend on system modification
- individual connectors are marked with module position, connector No. on module and in case of Hummel connectors with direction of connector rotation leading to fixation

The assembly procedure is as follows:

- fastening of central unit on DRV pursuant to installation conditions
- connection of in advance prepared wiring to central unit by means of connectors positioned on individual modules, accessible at front face of the central unit
- definitive arresting of all connectors by elements of individual connectors intended for this purpose

Dismantling is carried out in reverse order of steps.

Assembly and Dismantling of ID Identification Unit:

The identification unit has been constructively inserted into cover part of the DRV panel. A terminal board for wiring of electrical cables is positioned on rear side of the identification unit. Specification of mechanical properties and installation conditions are provided in 199M *Box 144x72 Installation Conditions*. Requirements on identification unit installation are provided in document 1992RM2 *Installation Manual*.

As the identification unit RM2ID is powered from central unit of MIREL RM2 Integrated On-Board System, when assembling or dismantling it, the central unit ZJ must be disconnected from battery power source by means of battery de-coupler or by switching-off the circuit breaker of MIREL RM2 Integrated On-Board System.

The assembly procedure is as follows:

in case of installation into panel, fastened from rear side

- fastening of identification unit pursuant to installation conditions
- connection of in advance prepared wiring to identification unit at rear side of the identification unit
- positioning of cover part into desired position
- fixation of cover part to cab panel (depending on DRV type)

in case of installation into panel, fastened from front side

- connection of in advance prepared wiring to identification unit at rear side of the identification unit
- fastening of identification unit pursuant to installation conditions, fixation by means of two screws M4

Dismantling is carried out in reverse order of steps.

Assembly and Dismantling of IN Indication Unit:

The choice of indication unit is given by specific modification of MIREL RM2 Integrated On-Board System. The indication unit has been constructively inserted into cover part of the DRV panel. A terminal board for wiring of electrical cables is positioned on rear side of the indication unit RM2IN.1 and RM2IN.S. Depending on modification, one or two HUMMEL connectors are located on back side of RM2IN.2 indication unit for wiring of electrical cabling. Specifications of mechanical properties and installation conditions are provided in documents 482M Box 144x144 Installation Conditions, 980M Box 72x72 Installation Conditions and 980M PPxD Installation Conditions. Requirements on indication unit IN installation are provided in document 1992RM2 Installation Manual.

As the indication unit IN is powered from central unit of MIREL RM2 Integrated On-Board System, when assembling or dismantling it, the central unit ZJ must be disconnected from battery power source by means of battery de-coupler or by switching-off the circuit breaker of MIREL RM2 Integrated On-Board System.

The assembly procedure is as follows:

in case of installation into panel, fastened from rear side

- fastening of indication unit pursuant to installation conditions
- connection of in advance prepared wiring to indication unit at rear side of the indication unit
- positioning of cover part into desired position
- fixation of cover part to cab panel (depending on DRV type)

in case of installation into panel, fastened from front side

- connection of in advance prepared wiring to indication unit at rear side of the indication unit
- fastening of indication unit pursuant to installation conditions, fixation by means of two screws M4

Dismantling is carried out in reverse order of steps.

9 Notes