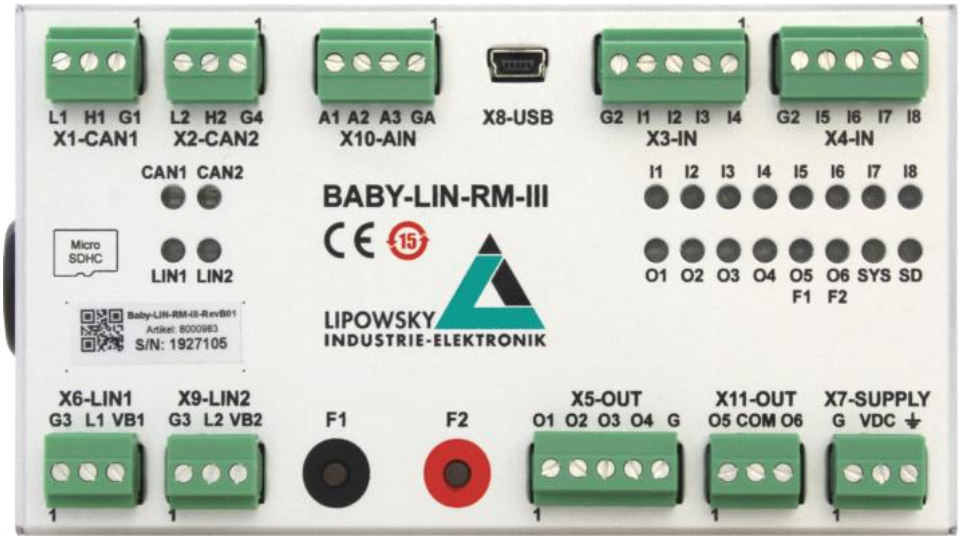

Baby-LIN-RM-III

User Manual V2.0

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1 Imprint

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The hardware, firmware, software and documents of the Baby-LIN-RM-III are subject to change without prior notice. Lipowsky Industrie-Elektronik GmbH thereby has no obligations.

2 Glossary

ADC	Ampere Direct Current. This is the unit of DC current values.
CAN	Controller Area Network
CAN-HS	CAN high speed. Theses are CAN interfaces with high data rates according to ISO-11898.
CAN-LS	CAN low speed. Theses are CAN interfaces with fault tolerant low data rates according to ISO-11519.
CD	Compact Disk
DBC	Database CAN: A file that contains the description of a CAN bus. It contains nearly the same information as a ARXML file.
DLL	Dynamic Link Library. It can be used to execute the DLL functions in custom applications.
ECU	Electronic control unit
EOL	End of line
ESD	Electro static discharge. The sudden flow of electricity between two electrically charged objects caused by e.g. contact.
EU	European Union. The Lipowsky Industrie-Elektronik GmbH resides inside the EU. Therefor shipping within the EU can be done without customs duties. You should definitely check out our worldwide distributors. Check chapter Distributors for more information.
LIN	Local Interconnect Network
LINWorks	Application software suite to configure the Baby-LIN devices.
PC	Personal Computer
PLC	Programmable Logic Controller
PWM	The pulse-width modulation is a modulation technique used to encode a value into a pulsing signal.
RTC	Real-time clock.
SD	Secure Digital Memory Card. This is a type of non-volatile memory cards.
SDF	Session Description File
SID	Service identifier. This number identifies a protocol service.
USB	Universal Serial Bus
VDC	Voltage Direct Current. This is the unit of DC voltage values.

3 Safety instruciotns

3.1 Warning signs

The following warning signs are used for safety precautions:

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE NOTICE is used to address practices not related to physical injury.

SAFETY INSTRUCTIONS Safety instructions signs indicate specific safety related instructions or procedures.

The following notice types are used to give you non safety precaution related information, e.g. software or configuration related problems:

Attention
This notice type signals possible problems, you should definitely pay attention to. Ignoring them probably lead to unexpected behaviour or data loss.

Version Incompatibility
This notice type signals possible version incompatibilities and may lead to unexpected behaviour. These incompatibilities can be caused by old or incompatible software or firmware versions as well as missing activation codes.

Warning
This notice type signals possible problems, you should pay attention to. Ignoring them may lead to unexpected behaviour or data loss.

Attention
This notice type should inform you about useful information, that help you understand the Baby- LIN-RM-III better.

Attention
This notice type should give you tips, that help to reduce your expense and time to implement.

3.2 Safety precautions

Despite compliance with the relevant laws and regulations, residual risks can not be excluded. The following safety precautions define the hazards that can occur when operating the Baby-LIN-RM-III

DANGER 	Mortal danger by automatic start of connected devices. • Prepare for actions from connected devices. • Study safety precautions of connected devices.
WARNING 	Mortal danger by electric shock. • Operate the Baby-LIN-RM-III only within dry conditions. • Do not touch the Baby-LIN-RM-III if powered. • Do not touch the Baby-LIN-RM-III if damaged.
CAUTION 	• Do not touch the Baby-LIN-RM-III if wet. Injury by damaged battery. • Operate the device only within the defined operating temperature. • Observe the correct polarity when inserting the battery. • Do not touch the battery if damaged. • Do not touch the battery if wet.
NOTICE	Please recycle or dispose the battery safely and properly according to local laws and regulations.

4 Preface

4.1 Updates

4.1.1 Update philosophy

The functionality and features of the Baby-LIN-RM-III are defined by the installed firmware as well as the used versions of the LINWorks and Baby-LIN-DLL.

As we are permanently working on product improvements, the software and firmware are updated periodically. These updates make new features available and solve problems, which have been discovered by our internal tests or have been reported by customers with earlier versions.

All the firmware updates are done in a way, that the updated Baby-LIN-RM-III will continue to work with an already installed, older LINWorks installation. So updating the Baby-LIN-RM-III firmware does not mean, that you necessarily have to update your LINWorks installation as well.

Therefor it is highly recommended to always update
your Baby-LIN-RM-III to the latest available firmware version.

We also recommend to also update your LINWorks software and Baby-LIN-DLL, if new updates get available. Since new versions of the SessionConf may introduce new features to the SDF format, it is possible that older firmware, SimpleMenu or Baby-LIN-DLL versions are not compatible. Therefor you should also update them.

If you update your LINWorks it is highly recommended updating
the firmware of your Baby-LIN-RM-III to the latest available firmware version
as well as distributed the used versions of the Baby-LIN-DLL.

So the sole reason to stay with an older LINWorks version should be, that you use a Baby-LIN-RM-III with outdated firmware version, which you can't upgrade for whatever reason.

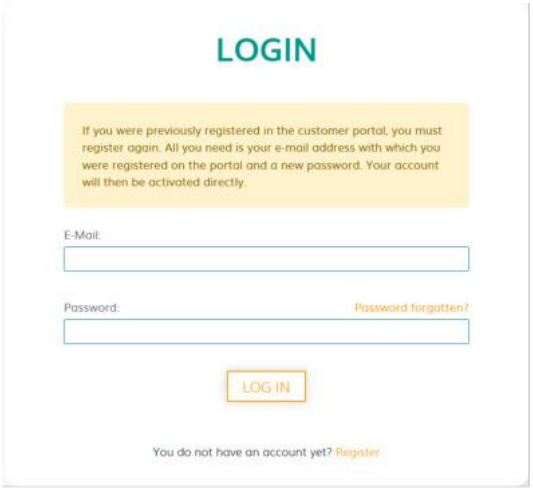
It is highly recommended updating the
Baby-LIN driver to the latest version.

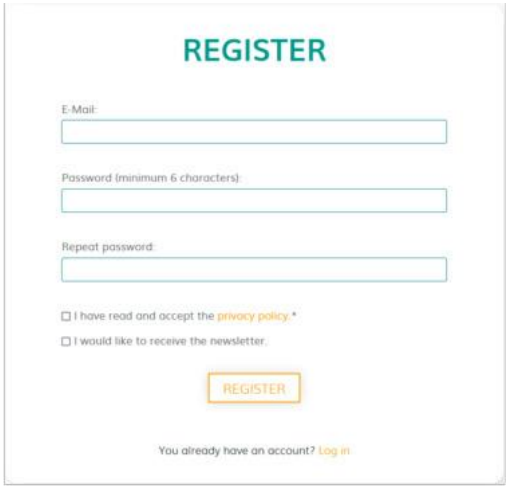
4.1.2 Downloads

The latest version of our software , fimrware and documents can be found in the download area on our website *www.lipowsky.de* .

Advice
The **LINWorks** archive contains not only the **LINWorks** software but also the manuals, datasheets, application notes and examples. Only the device firmware packages are not included. The firmware is available as separate package.

Documents such as the data sheets or introductions to LIN bus communication are freely available for download. For all other documents and our LINWokrs software you have to log in. If you do not have a customer account yet you can register on our website. After your account has been activated by us you will receive an e-mail and then you have full access to our download offer.





4.1.3 Installation

The LINWorks suite is delivered with a handy setup application. If you already have installed an older version you can simply install the newer versions. The setup application will take care of overwriting the required files. Simply follow these steps:

- Start the "Setup.exe".
- Select the components you want to install.
- Follow the instructions.

Warning
Please stop all running LINWorks applications and disconnect all Baby-LIN devices before starting the setup.

Version incompatibility
If you have used the SessionConf and SimpleMenu with version V1.x.x, the new version will be installed parallel to the old ones. Therefor you have to use the new shortcuts to start the new versions.

4.1.4 Check version

If you want to check the current version of the Baby-LIN-RM-III firmware or a LINWorks component the following table shows you how it is done:

Component	How to check the version
Baby-LIN-RM-III firmnware	Start the SimpleMenu and connect to the Baby-LIN-RM-III . Now the firmware version is visible in the device list.
LINWorks: • LDFEdit • SessionConf • SimpleMenu • LogViewer	Select the menu option "Help"/"About"/"Info". The info dialog will show the software version.
Baby-LIN-DLL	Call BLC_getVersionString(). The version is returned as string.
Baby-LIN-DLL .NET Wrapper	Call GetWrapperVersion(). The version is returned as string.

Advice
If you need support please always tell us the firmware and software versions you are using.

4.2 Support information

In case of any questions you can get technical support by email or phone. We can use TeamViewer to give you direct support and help on your own PC. This way we are able to sort out problems fast and direct. We have sample code and application notes available, which will help you to make your job.

Lipowsky Industrie-Elektronik GmbH realized many successful LIN and CAN related projects and therefor we can draw upon many years of experience in these fields. We also provide turn key solutions for specific applications like EOL (End of Line) testers or programming stations.

Lipowsky Industrie-Elektronik GmbH designs, produces and applies the Baby-LIN products, so you can always expect qualified and fast support.

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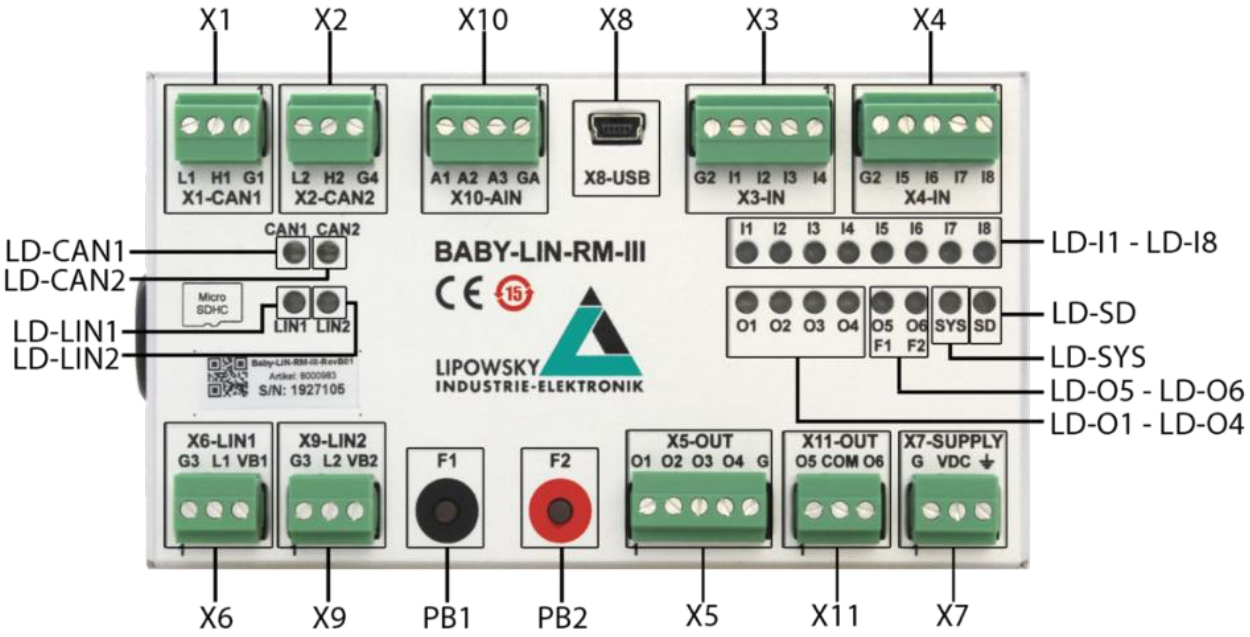
5 Hardware

5.1 Overview

The following images show you what features the Baby-LIN-RM-III has to offer. The following features will be shown:

Abbreviation	Description
X	Connectors to access the different interfaces.
LD	LEDs that symbol certain states.
PB	Push buttons that trigger programmable user-defined actions.
SD	A microSDHC card slot.



Abbreviation	Type	Description
X1	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	CAN-Bus 1 connector.
X2	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	CAN-Bus 2 connector.
X3	Socket for MC 1,5/ 5-ST-3,81 and MCVR 1,5/5-ST-3,81	Digital input 1 connector: Digital inputs 1-4.
X4	Socket for MC 1,5/ 5-ST-3,81 and MCVR 1,5/5-ST-3,81	Digital input 2 connector: Digital inputs 5-8.
X5	Socket for MC 1,5/ 5-ST-3,81 and MCVR 1,5/ 5-ST-3,81	Digital output 1 connector: Digital outputs 1-4.
X6	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/ 3-ST-3,81	LIN-Bus 1 connector.
X7	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	Logic power supply connector.
X8	USB 2.0 type B-Mini	PC connector.
X9	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	LIN-Bus 2 connector.
X10	Socket for MC 1,5/ 4-ST-3,81 and MCVR 1,5/4-ST-3,81	Analog input connector: Analog inputs 1-3.
X11	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	Digital output 2 connector: Digital outputs 5-6.
LD-SYS	Red/green multi colored LED	Device state indicator. Device error indicator. Firmware update indicator.
LD-SD	Red/green multi colored LED	Right now the LD-SD has no implemented functionality. **Advice** Future firmware versions may use this LED as microSDHC card slot indicator.
LD-LIN1	Red/green multi colored LED	LIN-Bus 1 voltage indicator. LIN-Bus 1 communication error.
LD-LIN2	Red/green multi colored LED	LIN-Bus 2 voltage indicator. LIN-Bus 2 communication error.
LD-CAN1	Red/green multi colored LED	CAN-Bus 1 state indicator. CAN-Bus 1 communication error.
LD-CAN2	Red/green multi colored LED	CAN-Bus 2 state indicator. CAN-Bus 2 communication error.
LD-I1-LD-I8	Green LED	Each LED signals the state of one digital input.
LD-O1 - LDO4	Green LED	Each LED signals the state of one digital output.
LD-O5 LD-F1	Green LED	LED signals the state of digital output 5. A freely programmable LED.
LD-O6 LD-F2	Green LED	LED signals the state of digital output 6. A freely programmable LED.
PB1	Black push button	A push button that triggers programmable user-defined actions.
PB2	Red push button	A push button that triggers programmable user-defined actions.
SD1	microSDHC card slot	Right now the microSDHC card slot has no implemented functionality. **Advice** Future firmware versions may use this microSDHC card slot for logging purposes.

5.2 Connectors

5.2.1 X1 - CAN-Bus 1 connector

The first CAN-Bus interface is available via a MCVR 1,5/ 3-ST-3,81 connector. This CAN-Bus interface supports:

- CAN-HS: CAN High-Speed interface according to ISO-11898.(1)
- CAN-FD: CAN Flexible Data-Rate interface according to ISO-11898-1:2015.(2)

(1) Requires activation code 8000810 - Option BL-HARP CAN-1-HS.
(2) Requires activation code 8000991 - Option BL-HARP CAN-1-FD.
Check the Baby-LIN-RM-III Datasheet for more information.

Pin	Signal	Description
X1-1	G1	CAN 1 Ground
X1-2	H1	CAN 1 High
X1-3	L1	CAN 1 Low

Advice
The CAN-Bus interface is galvanically isolated from the logic supply, the other communication interfaces and the digital I/Os.

Advice
A terminating resistor can be switched active for the CAN interface and must not be connected externally. The size of the terminating resistor is 120 Ω.

5.2.2 X2 - CAN-Bus 2 connector

The second CAN-Bus interface is available via a MC 1,5/ 3-ST-3,81 connector. This CAN-Bus interface supports:

- CAN-HS: CAN High-Speed interface according to ISO-11898.(1)
- CAN-FD: CAN Flexible Data-Rate interface according to ISO-11898-1:2015.(2)
- CAN-LS: Fault tolerant CAN Low-Speed interface according to ISO-11519.(3)

(1) Requires activation code 8000990 - Option BL-HARP CAN-2-HS.
(2) Requires activation code 8000992 - Option BL-HARP CAN-2-FD.
(3) Requires activation code 8000820 - Option BL-HARP CAN-2-LS.
Check the Baby-LIN-RM-III Datasheet for more information.

Pin	Signal	Description
X2-1	G4	CAN 2 Ground
X2-2	H2	CAN 2 High
X2-3	L2	CAN 2 Low

Advice
The CAN-Bus interface is galvanically isolated from the logic supply, the other communication interfaces and the digital I/Os.

Advice
A terminating resistor can be switched active for the CAN interface and must not be connected externally. The size of the terminating resistor is 120 Ω.

5.2.3 X3 and X4 - Digital input connector

The digital inputs are available via MCVR 1,5/ 5-ST-3,81 connectors. The inputs I7 and I8 are high speed inputs and can be used to process PWM signals.

Pin	Signal	Description
X3-1	I4	Digital input 4
X3-2	I3	Digital input 3
X3-3	I2	Digital input 2
X3-4	I1	Digital input 1
X3.5	G2	Digital input ground

Pin	Signal	Description
X4-1	I8	Digital input 8 (high speed)
X4-2	I7	Digital input 7 (high speed)
X4-3	I6	Digital input 6
X4-4	I5	Digital input 5
X4-5	G2	Digital input ground

Advice
The digital inputs are galvanically isolated from the logic supply and the communication interfaces.

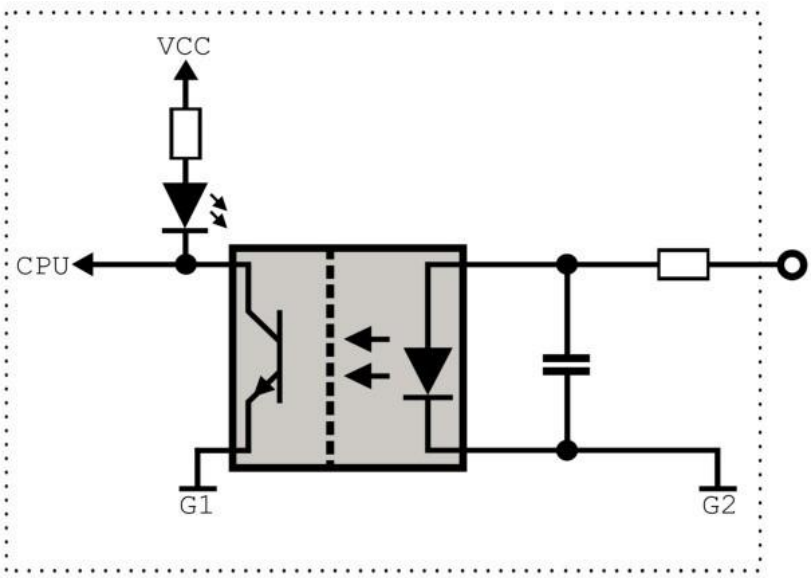
Warning
Both sets of digital inputs (X3 and X4) share the same ground and therefor have the same potential (G2).

Attention
Do not use higher voltages than 44 VDC.

To switch the digital inputs to high, a positive DC voltage is required between the digital input (I1 ... I8) and G2.

Equivalent circuit of the digital inputs of the Baby-LIN-RM-III:

Pins: X3, X4



Inputs I1 - I4, pins: X3-1, X3-2, X3-3, X3-4

Electrical characteristics	Value	Unit
Maximum voltage for low level	1	V
Minimum voltage for high level	8.5	V
Typical current at 24V	8.5	mA
Maximum current	18	mA
Maximum voltage	44	V

Inputs I5 - I8, pins: X4-1, X4-2, X4-3, X4-4

Electrical characteristics	Value	Unit
Maximum voltage for low level	1	V
Minimum voltage for high level	8.5	V
Typical current at 24V	8.5	mA
Maximum current	18	mA
Maximum voltage	44	V

5.2.4 X5 - Digital output connector

The digital outputs are available via a MCVR 1,5/ 5-ST-3,81 connector.

They are implemented as open collectors and their output stages are protected against short circuits. They switch loads towards the ground of the logic supply (X7-1: G) and therefor are not galvanically isolated.

The maximum feasible load voltage is 32 VDC. The maximum load current is 1 ADC.

All outputs are able to generate PWM signals.

Pin	Signal	Description
X5-1	O1	Digital output 1
X5-2	O2	Digital output 2 (high speed)
X5-3	O3	Digital output 3
X5-4	O4	Digital output 4
X5-5	G	Digital output ground 1

Advice
The digital outputs are not galvanically isolated from the logic supply.

Advice
The digital outputs share the same ground as the logic supply and therefor have the same potential (G). It is highly recommended, that X5-5 is used for the digital outputs and not the ground of the logic supply.

Attention
Do not use higher voltages than 32 VDC.

Attention
Do not use higher currents than 2.5 ADC.

The digital outputs are implemented as protective open collector drivers. When an output is activated, the corresponding terminal (O1 ... O4) is switched to ground. This ground is connected with the ground of the logic supply (X7-1). Therefor the digital outputs are not galvanically isolated from the logic supply.

The wiring to a PLC depends on the topology applied by the relevant PLC inputs. If the PLC inputs can be activated by contact against ground, the output signals can be directly linked with the PLC.

Otherwise the use of a pull-up resistor is required to control the input of a PLC using a voltage level device. The schematic below shows such a wiring.

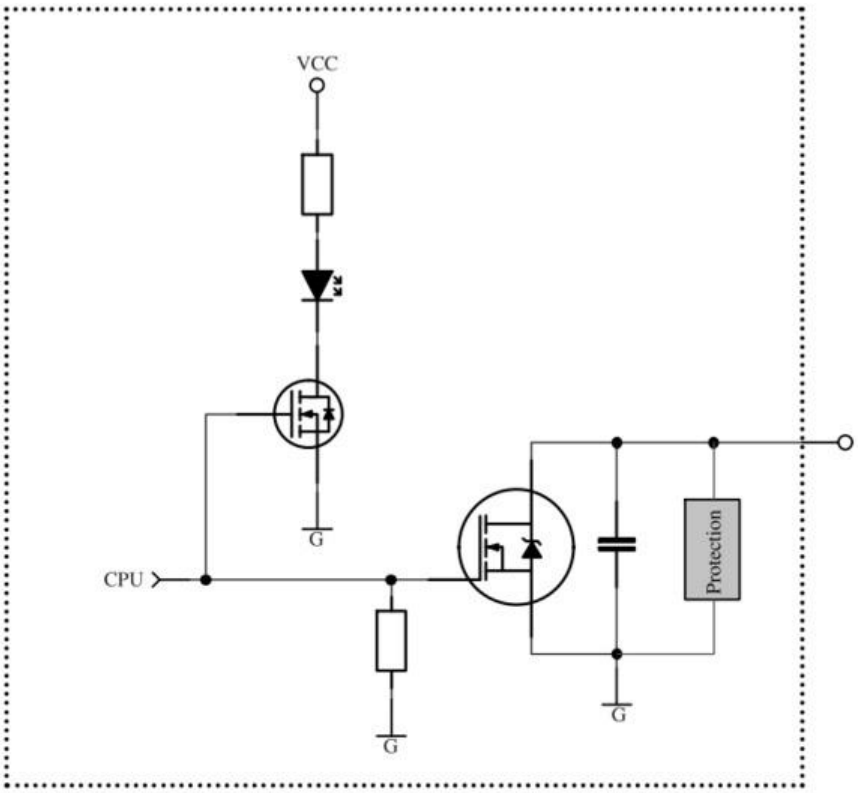
This then leads to an inverted logic, because an active output on the Baby-LIN-RM-III produces an inactive PLC input signal and an inactive output on the Baby-LIN-RM-III in turn leads to an active PLC input signal.

This inversion can be taken into account by the programming of the Baby-LIN-RM-III unit or the PLC control.

A small additional adapter is available from Lipowsky Industrie-Elektronik GmbH that allows the conversion of low-side signals into high-side signals. Check chapter **Baby-LIN-RM-III output adapter** and **Ordering information** for more information.

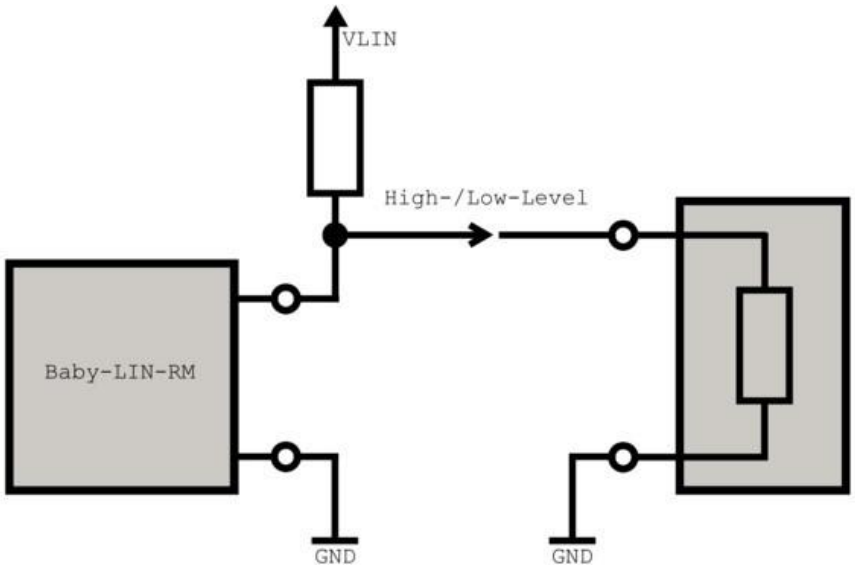
Equivalent circuit of the digital outputs of the Baby-LIN-RM-III:

Connector: X5



Electrical characteristics	Value	Unit
Maximum current for permanent low level	1	A
Maximum current	2.5	A
Maximum voltage	32	V

Connecting an input (e.g. a PLC input) to a digital output of the Baby-LIN-RM-III:



The calculation of the pull-up resistor value must meet two criteria:

- The voltage threshold for the digital input of your device must be exceeded.

  $$VThreshold < VLIN * (RIN/(Rin + RPullU p))$$

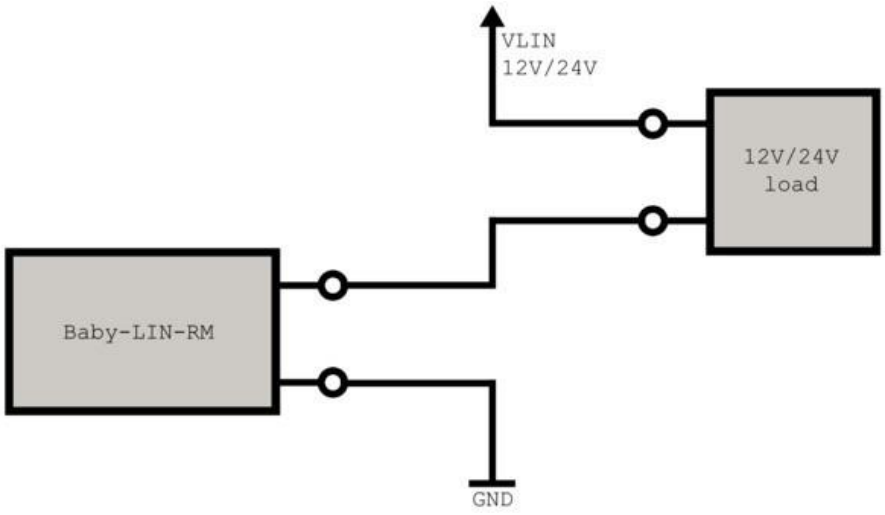
- The current through the digital output must be limited.

  $$RPullU p > VLIN/0.5A$$

Hence the pull-up resistor must meet the following inequation:

$$VLIN/0.5A < RPullU p < RIN * (VLIN/VThreshold - 1)$$

Connecting a load to a digital output of the Baby-LIN-RM-III:



If a load is connected, please make sure the maximum current through the output of the Baby-LIN-RM-III is lower than 1A.

5.2.5 X6 - LIN-1-Bus connector

The LIN-Bus interface is available via a MC 1,5/ 3-ST-3,81 connector.

The LIN interface of the Baby-LIN-RM-III can be operated between voltages of 8-26 VDC.

Pin	Signal	Description
X6-1	G3	LIN-Bus ground
X6-2	L1	LIN-1-Bus signal
X6-3	VB1	LIN-1-Bus power supply

CAUTION

Keep the LIN-Bus voltage within the following range: 8-26 VDC.

• Injury by damaged Baby-LIN-RM-III.

• The Baby-LIN-RM-III may get damaged.

CAUTION

Check LIN-Bus node specifications before using voltages above 18 VDC. If voltages in excess of 18 VDC are used as LIN-Bus supply voltage, it must be ensured that all connected nodes can cope with this voltage level. It is possible, that some nodes will function incorrectly in voltages exceeding 18 VDC, since the LIN specification states a maximum voltage of 18 VDC.

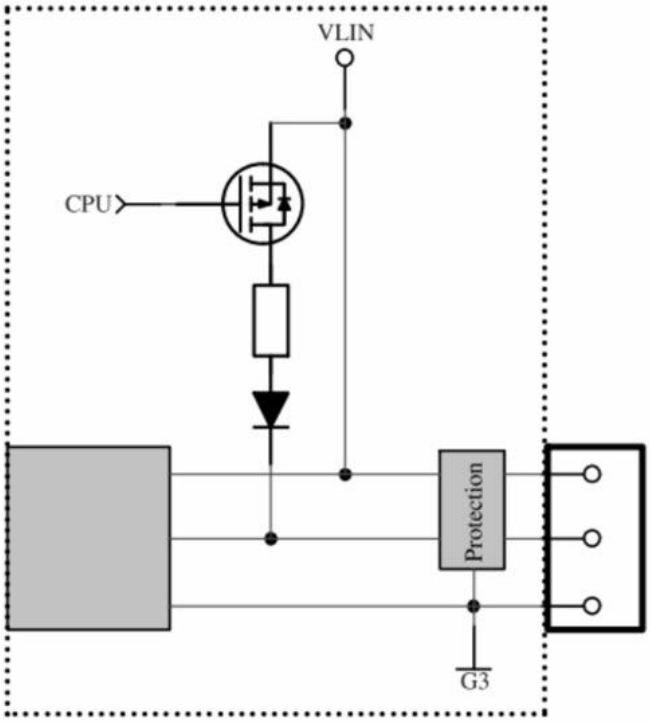
• Injury by damaged LIN-Bus nodes.

• LIN-Bus nodes may get damaged.

Advice
The LIN-Bus interface is galvanically isolated from the logic supply, the USB interface, the CAN interfaces and the digital I/Os, but not the other LIN-Bus interface.

Attention
The LIN-Bus supply must be provided by an external power supply and must not be interrupted during the LIN communication.

Equivalent circuit of the LIN-Bus interface:



Electrical characteristics	Value	Unit
Maximum operational voltage	26	V
Maximum LIN voltage	32	V
Maximum LIN current	680	mA
Maximum LIN supply voltage	51	V
Maximum LIN supply current	150	mA

Electrical characteristics	Voltage threshold for LIN detection	Voltage threshold for LIN transceiver
Minimum	7.5 V	7.5 V

The pull-up resistor of the LIN-Bus driver is switched to 30 kΩ, if the master node is emulated and to 1 kΩ, if only slave nodes are emulated.

5.2.6 X7 - Logic power supply connector

The logic supply interface is available via a MCVR 1,5/ 3-ST-3,81 connector.

The Baby-LIN-RM-III requires a supply voltage of 7-32 VDC.

Pin	Signal	Description
X7-1	G	Logic supply ground.
X7-2	VDC	Positive logic supply (7-32 VDC).
X7-3	⏚	Earth connection (Earth switch cabinet)

Advice
The logic supply interface is galvanically isolated from the communication interfaces and the digital inputs.

Attention
Do not operate the logic supply outside the voltage range of 7-32 VDC.

5.2.7 X8 - PC connector

This connector is a USB type B-Mini. It is used to connect the Baby-LIN-RM-III to a PC. To use this interface the Baby-LIN USB driver has to be installed on the PC.

Description
The connector uses the default pin assignment of USB type BMini.

Advice
The USB interface is galvanically isolated from all other connectors.

5.2.8 X9 - LIN-2-Bus connector

The LIN-Bus interface is available via a MC 1,5/ 3-ST-3,81 connector.

The LIN interface of the Baby-LIN-RM-III can be operated between voltages of 8-26 VDC.

Pin	Signal	Description
X9-1	G3	LIN-Bus ground
X9-2	L2	LIN-2-Bus signal
X9-3	VB2	LIN-2-Bus power supply

CAUTION

Keep the LIN-Bus voltage within the following range: 8-26 VDC.
• Injury by damaged Baby-LIN-RM-III.
• The Baby-LIN-RM-III may get damaged.

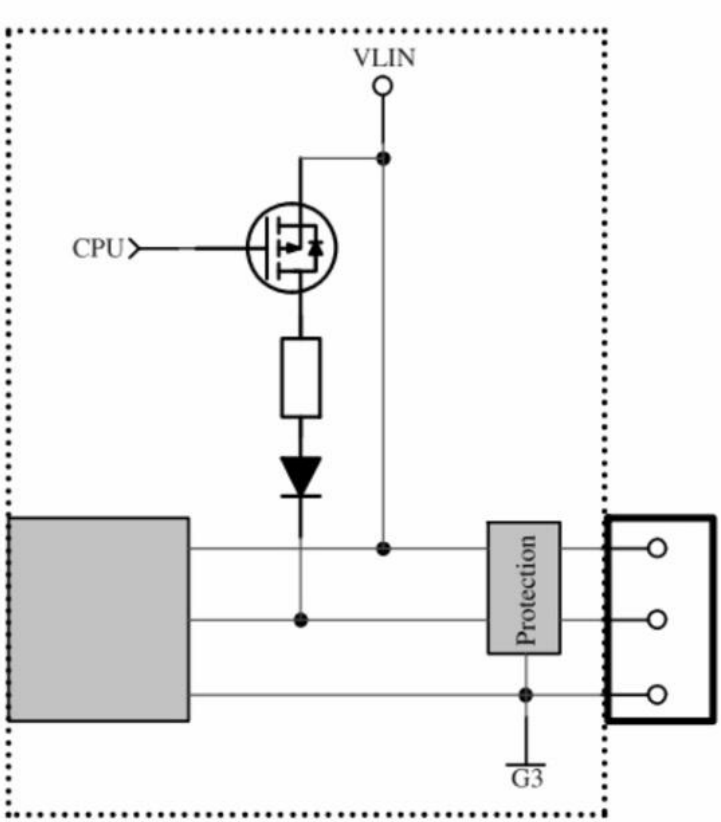
CAUTION

Check LIN-Bus node specifications before using voltages above 18 VDC. If voltages in excess of 18 VDC are used as LIN-Bus supply voltage, it must be ensured that all connected nodes can cope with this voltage level. It is possible, that some nodes will function incorrectly in voltages exceeding 18 VDC, since the LIN specification states a maximum voltage of 18 VDC.
• Injury by damaged LIN-Bus nodes.
• LIN-Bus nodes may get damaged.

Advice
The LIN-Bus interface is galvanically isolated from the logic supply, the USB interface, the CAN interfaces and the digital I/Os, but not the other LIN-Bus interface.

Attention
The LIN-Bus supply must be provided by an external power supply and must not be interrupted during the LIN communication.

Equivalent circuit of the LIN-Bus interface:



Electrical characteristics	Value	Unit
Maximum operational voltage	26	V
Maximum LIN voltage	32	V
Maximum LIN current	680	mA
Maximum LIN supply voltage	51	V
Maximum LIN supply current	150	mA

Electrical characteristics	Voltage threshold for LIN detection	Voltage threshold for LIN transceiver
Minimum	7.5 V	7.5 V

The pull-up resistor of the LIN-Bus driver is switched to 30 kΩ, if the master node is emulated and to 1 kΩ, if only slave nodes are emulated.

5.2.9 X10 - Analog input connector

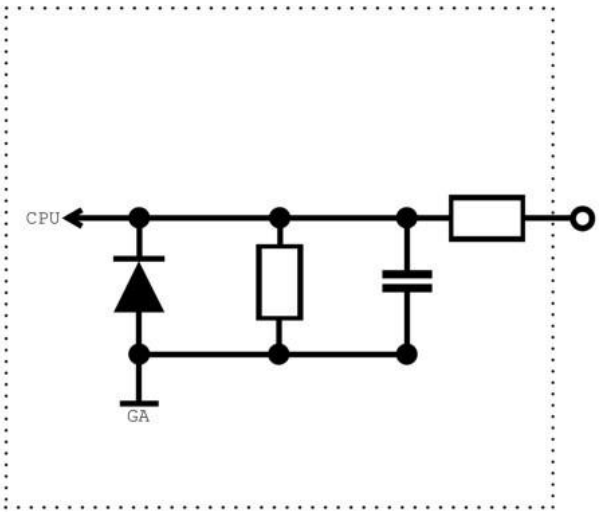
The digital inputs are available via MCVR 1,5/ 4-ST-3,81 connectors.

Pin	Signal	Description
X10-1	GA	Analog input ground
X10-2	A3	Analog input 3
X10-3	A2	Analog input 2
X10-4	A1	Analog input 1

Attention
Do not use higher voltages than 30 VDC.

Equivalent circuit of the analog inputs of the Baby-LIN-RM-III:

Pins: X10



Analog inputs A1 - A3, pins: X10-4, X10-3, X10-2, X10-1

Electrical characteristics	Value	Unit
Operational voltage range	0.5 - 24.5	V
Maximum current	900	µA
Maximum voltage	30	V

5.2.10 X11 - Digital output connector

The digital outputs are available via a MCVR 1,5/ 5-ST-3,81 connector.

They are implemented as bidirectional semiconductor and their output stages are protected against short circuits.

The maximum feasible load voltage is 51 VDC. The maximum load current is 450 mADC.

Pin	Signal	Description
X11-1	O5	Digital output 5
X11-2	COM	Common connector of digital output 5 and 6
X11-3	O6	Digital output 6

Attention
Do not use higher voltages than 51 VDC.

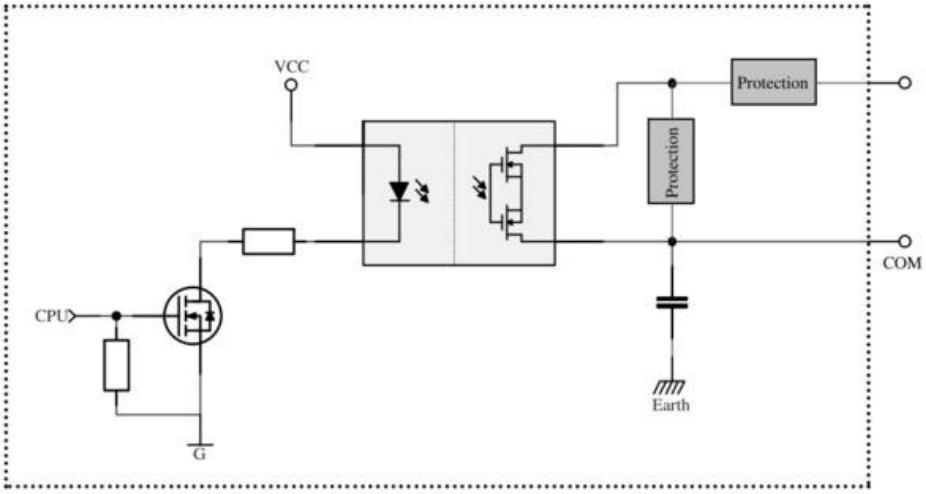
Attention
Do not use higher currents than 450 mADC.

The digital outputs are implemented as bidirectional semiconductor drivers. When an output is activated, the corresponding terminal (O5 ... O6) is switched to the COM terminal.

PLC inputs can be directly linked with the digital outputs.

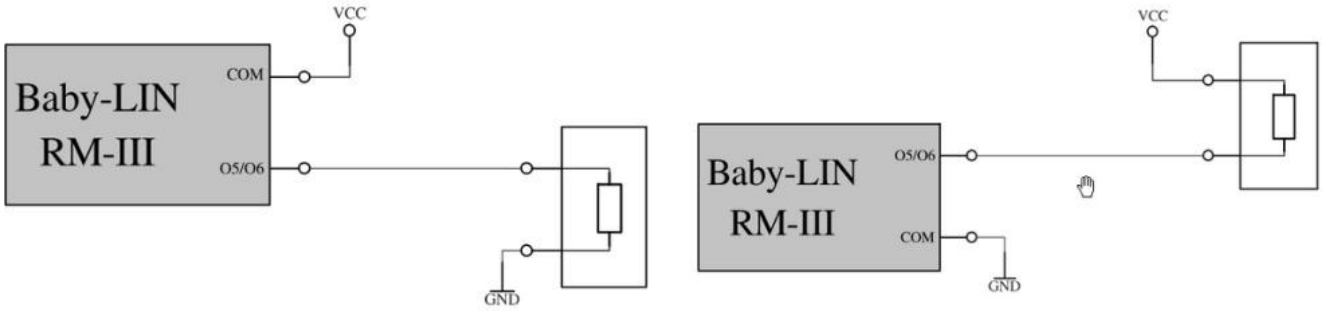
Equivalent circuit of the digital outputs of the Baby-LIN-RM-III:

Connector: X11



Electrical characteristics	Value	Unit
Maximum current for permanent low level	120	mA
Maximum current	450	µmA
Maximum voltage	51	V

Connecting an input (e.g. a PLC input) or a load to a digital output of the Baby-LIN-RM-III:



If a load is connected, please make sure the maximum current through the output of the Baby-LIN-RM-III is lower than 450 mA.

5.3 Power supply

- Power supply over connector: X7 - Logic power supply connector Supported power supply voltage: 7-32 VDC

The Baby-LIN-RM-III has a typical power consumption of 70 mA @ 24 VDC.

5.4 LEDs

5.4.1 LED boot behaviour

During the boot process the LEDs have a special behaviour. The Baby-LIN-RM-III progresses through three stages. The following table gives you an overview.

LEDs	Behavoiur		
	Stage 1	**Stage 2**	**Stage 3**
LD-SUPPLY	Flashing red	Flashing green	Off
LD-LIN			Flashing orange if the option "BLHARP SDFV3-LIN" was activated.
LD-CAN1			Flashing orange if the option "Option BLHARP SDFV3-CAN-HS" was activated.
LD-CAN2			Flashing orange if the option "Option BLHARP SDFV3-CAN-LS" was activated.
LD-F1	Off	On	Off
LD-F2			
LD-I1 - LD-I8	Depending on the input signal.		
LD-O1 - LD-O4	Undefined		

5.4.2 LD-SYS

This LED is a red/green multi colored LED. The following states are possible.

LED color	LED blink pattern	Condition
Green	Permanently on	The device has no error.
Red	Blinks once every 1.68 seconds.	The SDF within the persistent dataflash memory could not be loaded.
	Blinks 2 times every 2.06 seconds.	No SDF is stored within the persistent dataflash memory.
	Blinks 3 times every 2.44 seconds.	The SDF that should be loaded requires licenses that are not activated on the Baby-LIN-RM-III .

5.4.3 LD-SD

This LED is a red/green multi colored LED.

Version incompatitbility

This LED has no functionality right now. It is planned to use it in combination with the microSD-card reader.

5.4.4 LD-LIN1

This LED is a red/green multi colored LED. It shows the state of the LIN-1-Bus. The green part of the LED has the following behaviour:

LED blink pattern	Information
Blinks for 50 ms each second	No LIN-Bus voltage available.
Blinks for 500 ms each second	LIN-Bus voltage is available.

The red part of the LED has the following behaviour:

LED blink pattern	Information
Blinks once for 25 ms	An error has occurred. The error can have e.g. one of the following reasons: • Checksum error • Missing responses

5.4.5 LD-LIN2

This LED is a red/green multi colored LED. It shows the state of the LIN-2-Bus. The green part of the LED has the following behaviour:

LED blink pattern	Information
Blinks for 50 ms each second	No LIN-Bus voltage available.
Blinks for 500 ms each second	LIN-Bus voltage is available.

The red part of the LED has the following behaviour:

LED blink pattern	Information
Blinks once for 25 ms	An error has occurred. The error can have e.g. one of the following reasons: • Checksum error • Missing responses

5.4.6 LD-CAN1

This LED is a red/green multi colored LED. It shows the state of the CAN-1-Bus. The green part of the LED has no function right now. The red part of the LED has the following behaviour:

LED blink pattern	Information
Blinks once for 100 ms	An error has occurred on the CAN-Bus.

5.4.7 LD-CAN2

This LED is a red/green multi colored LED. It shows the state of the CAN-2-Bus. The green part of the LED has no function right now. The red part of the LED has the following behaviour:

LED blink pattern	Information
Blinks once for 100 ms	An error has occurred on the CAN-Bus.

5.4.8 LD-F1/O5, LD-F2/O6 - Button-LEDs

The green LED LD-F1/O5 and the LED LD-F2/O6 can be configured to operate in different modes. The first two modes use the following mapping:

LED	LED color	Button	Button color
LD-F1	green	PB1	black
LD-F2	green	PB2	red

The following modes can be configured:

Mode	Description
Push button state	The LED will signal the state of a push button: • The LED is on if the button is pressed. • The LED is off if the button is not pressed. **Advice** To enable this mode set the target-specific option "Buttons F1/F2 used as" to "Button". The target-specific options can be set using the following methods: • Selecting "Target configuration" of a connected device from the context menu in the SimpleMenu. • Set the target-specific option in the device section of a SDF-V3 in the SessionConf.
Switch button state	The LED will signal the state of a push button: • The LED is on if the button is pressed. • The LED is off if the button is not pressed. **Advice** To enable this mode set the target-specific option "Buttons F1/F2 used as" to "Button". The target-specific options can be set using the following methods: • Selecting "Target configuration" of a connected device from the context menu in the SimpleMenu. • Set the target-specific option in the device section of a SDF-V3 in the SessionConf.
Freely programmable	The LED will signal the value of a system variable: **LD-F1**: @@SYSDIGOUT5 **LD-F2**: @@SYSDIGOUT6

5.4.9 LD-I1-8 - Digital input LEDs

These 8 green LEDs signal the value of the digital input. The LED is on if the digital input signal is high.

5.4.10 LD-O1-4 - Digital output LEDs

These 4 green LEDs signal the value of the digital output. The LED is on if the digital output signal is high.

Warning
A high signal causes the digital output to switch through ground. The LED therefor shows the logic level and not the inverted state of the digital output.

Warning
The output driver can switch off, if the current through the output or the temperature is too high. In this case the LED does not represent the state of the output.

5.5 Push buttons

5.5.1 PB1, PB2 - Push button F1 and F2

This black push button PB1 and the red push button PB2 can be freely programmed and therefor used for userdefined actions, e.g. starting the bus communication.

It can be configured to work as push or switch button. When used as switch button the LEDs LD-F1/O5 respectively LD-F2/O6 are used to show the current state.

Advice
To change this mode please set the target-specific option "Buttons F1/F2 used as" to "Button" or "Switch".
The target-specific options can be set using the following methods:

- Selecting "Target configuration" of a connected device from the context menu in the SimpleMenu.
- Set the target-specific option in the device section of a SDF-V3 in the SessionConf.

5.6 Hardware adaptations

5.6.1 Baby-LIN-RM-III output adapter

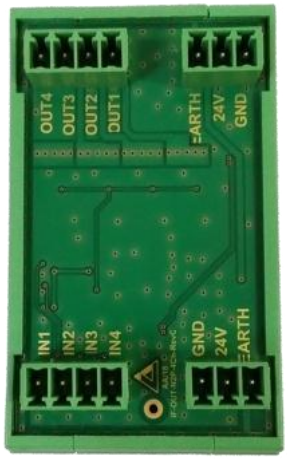
5.6.2 Introduction

The Baby-LIN-RM-III output adapter is an optional hardware item that converts the 4 open collector outputs of the Baby-LIN-RM-III into 4 high-side outputs.

The Baby-LIN-RM-III output adapter can be mounted on a top hat rail (TS 35) like the Baby-LIN-RM-III.

The power supply of the Baby-LIN-RM-III can be looped trough this adapter to prevent the requirement for an additional power supply connector.

Version incompatibility
The Baby-LIN-RM-III output adapter is compatible with both the Baby-LIN-RM as well as the Baby-LIN-RM-II.

Hardware revision C		Hardware revision B	
			

Version incompatibility
Only valid for the hardware revision B:
The power supply of the outputs can be configured to be connected to the power supply of the adapter using jumpers. This means the outputs do no longer require an individual power supply, but then they are no longer galvanically isolated.

The ordering information for the Baby-LIN-RM-III output adapter are:

Item number	Item	Description
8000960	IF-OUT-N2P-4Ch	Adapter to convert the 4 Low side Outputs (NPN) into high side outputs (PNP).

Scope of delivery:

- Baby-LIN-RM-III output adapter
- 2 3-pin plugs with screw connection (MCVR 1,5/ 3-ST-3,81)
- 2 4-pin plugs with screw connection (MCVR 1,5/ 4-ST-3,81)

5.6.3 Safety instructions

Please read this guide completely before you start the installation. Make sure you understood everything and have all the tools and materials required available.

The Baby-LIN-RM-III could be damaged.
• Please observe ESD measures before modifying the Baby-LIN-RM-III, opening the case and touching the circuit boards! Ideally you would use an ESD-pad and ESD-wristband.

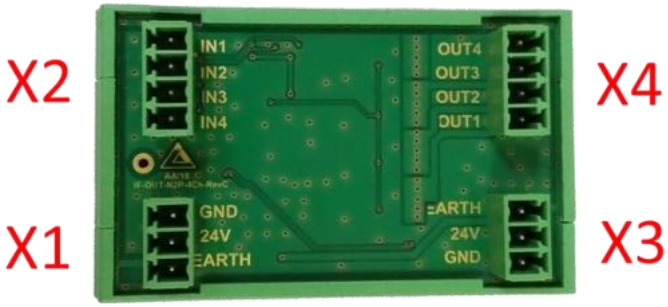
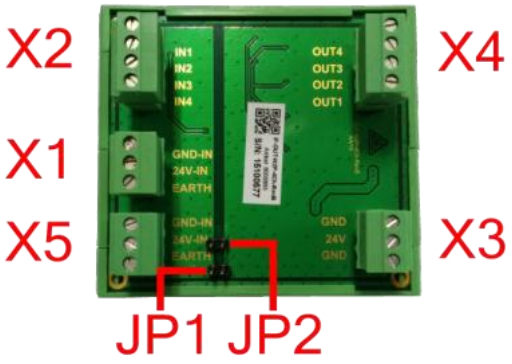
Advice
If you have any questions or need some guidance please contact us: "Support information"

5.6.4 Connectors

Version incompatitbility

The differences between hardware revision C and B are:

Property	Hardware revision C	Hardware revision B
Size [mm] (L x W x H):	45 x 77 x 23	68 x 77 x 23
Performance:	No distortion in PWM signals.	Distorted PWM signals.
Connectors:	4	5
Outputs galvanically separated:	No	Yes

Hardware revision C	Hardware revision B
	

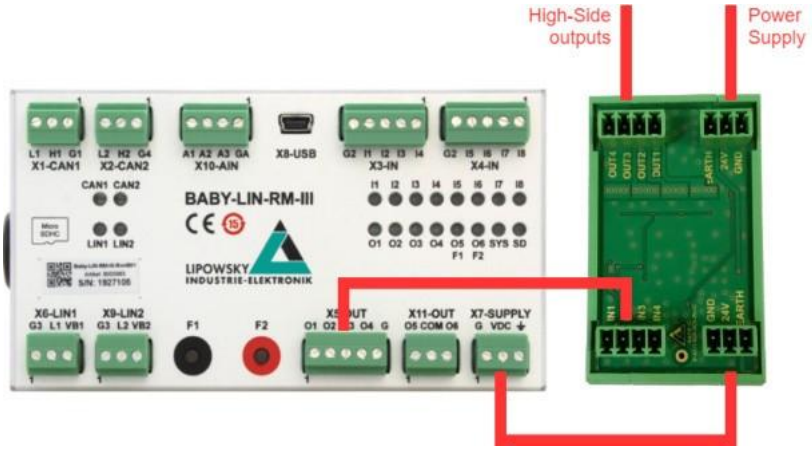
Connector	Type	Description for hardware revision C	Description for hardware revision B
X1	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/3-ST-3,81	Power supply connector for X2 inputs and X4 outputs. All pins are parallel connected with X3.	Power supply connector for X2 inputs. All pins are parallel connected with X5.
X2	Socket for MC 1,5/ 4-ST-3,81 and MCVR 1,5/4-ST-3,81	Inputs for the outputs of the Baby-LIN-RM-III.	Inputs for the outputs of the Baby-LIN-RM-III.
X3	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/4-ST-3,81	Power supply connector for X2 inputs and X4 outputs. All pins are parallel connected with X1.	Power supply connector for X4 outputs.
X4	Socket for MC 1,5/ 4-ST-3,81 and MCVR 1,5/4-ST-3,81	High-side outputs.	High-side outputs.
X5	Socket for MC 1,5/ 3-ST-3,81 and MCVR 1,5/4-ST-3,81	Not available.	Power supply connector for X2 inputs. All pins are parallel connected with X1.
JP1	Jumper	Not available.	Connects the ground of X1/X5 with the ground of X3.
JP2	Jumper	Not available.	Connects the 24V line of X1/X5 with the ground of X3.

5.6.5 Installation

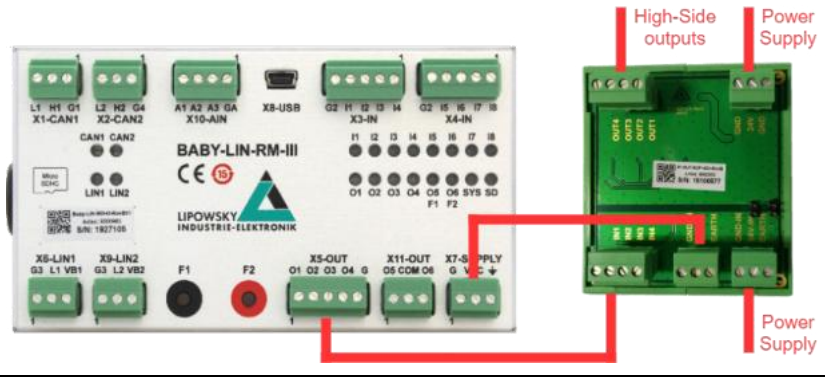
The installation of the Baby-LIN-RM-III output adapter only requires the following steps:

Hardware revision C	Hardware revision B
[Optional] Mount the Baby-LIN-RM-III output adapter on the top hat rail.	
Connect X2 with the output pins of X5 of the Baby-LIN-RM-III. Check chapter **X5 - Digital output connector** for more information.	
Connect X1 with X7 of the Baby-LIN-RM-III. Check chapter **X7 - Logic power supply connector** for more information.	
Connect the old power supply connector with X4.	Connect the old power supply connector with X5.
No separated power supply is required for the outputs.	Provide a power supply for the high side outputs. You have 2 possibilities to do that: • Connect a power supply connector to X3. The high side outputs are galvanically separated from the input side. • Set the jumper JP1 and JP2 to use the power supply of the input side.

Hardware revision B



Hardware revision C



6 Firmware

6.1 Introduction

The firmware is stored in the flash memory of the Baby-LIN-RM-III and can easily be programmed from a PC. The update process uses an ISP (In-system programming) operation and can be executed in the field.

As we are permanently working on product improvements, the firmware is updated periodically. These updates make new features available and solve problems, which have been discovered by our internal tests or have been reported by customers with earlier versions. All the firmware updates are done in a way, that the updated Baby-LIN-RM-III will continue to interwork with an already installed, older LINWorks installation. So updating the Baby-LIN firmware does not mean, that you necessarily have to update your LINWorks installation as well. Therefor it is highly recommended to always update your Baby-LIN-RM-III to the latest available firmware version.

6.2 Required software

Download archive	Description
BabyLinDriverSetup.exe	This setup contains the Baby-LIN driver. It is required to update the firmware.
FirmwarePackage-Baby-LIN-Devices.zip	This package contains the firmware for the Baby-LIN-RM-III as well as the update tool "blprog".

6.3 Update the firmware

To update the firmware of the Baby-LIN-RM-III you have to follow these steps:

- Install the drivers for the Baby-LIN-RM-III, if you have not already installed them.
- Connect the Baby-LIN-RM-III with your PC.
- Unpack the firmware archive.
- Start the "blprog.exe". A command prompt will be opened and guide you through the process.
- If you have other Baby-LIN products aside the Baby-LIN-RM-III connected with the PC, you will be asked which Baby-LIN product you want to update.
- Press the "y" key to confirm the correct firmware and start the flash process.
- Wait until the flashing finished.
- After the flashing has finished press the "Enter" key to exit the tool.

6.4 Stand-alone mode and autostart

6.4.1 Enable the stand-alone mode

The Baby-LIN-RM-III is able to operate stand-alone without a PC, PLC or operator. To enable this mode several requirements need to be met:

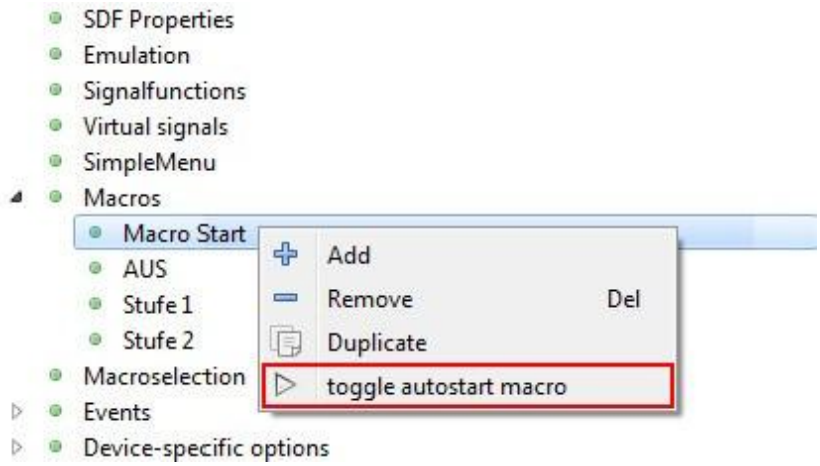
- You need a SDF with a macro that is marked as "autostart" macro.
- The SDF needs to be stored persistently on the Baby-LIN-RM-III.
- The device needs to be configured to automatically start the autostart macro of a persistently stored SDF when powered up.

6.4.2 Configure the autostart macro

You can mark a macro in a SDF as autostart macro. This means that this macro is started automatically when the SDF is loaded. Usually this macro will start the LIN-Bus communication and perform necessary initialisations.

To mark a macro as autostart macro the following steps are necessary.

- Open your SDF using the SessionConf.
- If this SDF does not already have a macro that you want to use as autostart macro please create one.
- Right click on the macro and select "toggle autostart macro". The macro will now have the "[autostart]" marker.



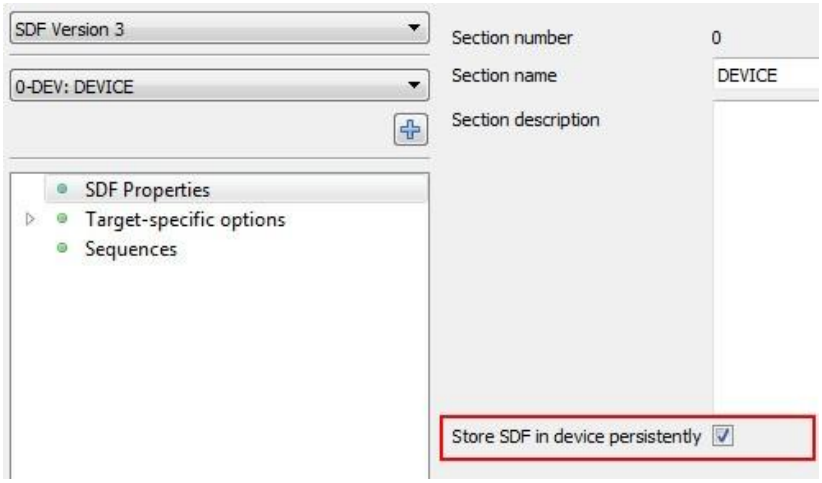
Advice
Please note that only one macro can be marked as autostart macro.

Tip
You probably want to start the LIN-Bus within the macro since it is not automatically started by loading the SDF.

6.4.3 Store a SDF persistently

It is possible to store a SDF persistently on the Baby-LIN-RM-III. Therefor a special option in the SDF must be configured:

- Start the SessionConf and load your SDF.
- In the left menu click on "SDF Properties".
- Check the "Store SDF in device persistently" option.



- Save your SDF and reload it to a device using the SimpleMenu.

Advice
The option "Store SDF in device persistently" can always be found in the "SDF Properties". It is independent from the SDF version (SDF v2, SDF v3) or type of section currently selected. This option is global for the whole SDF even though it can be found in every section.

6.4.4 Configure the device to automatically load a SDF and start a macro

The Baby-LIN-RM-III can be configured to automatically start a autostart macro. The Autostart can be triggered if the device is powered on or if the LIN-Bus is powered on. These target-specific options (also known as target configuration) are persistently stored on the Baby-LIN-RM-III.

There are 2 important options that affect the autostart feature:

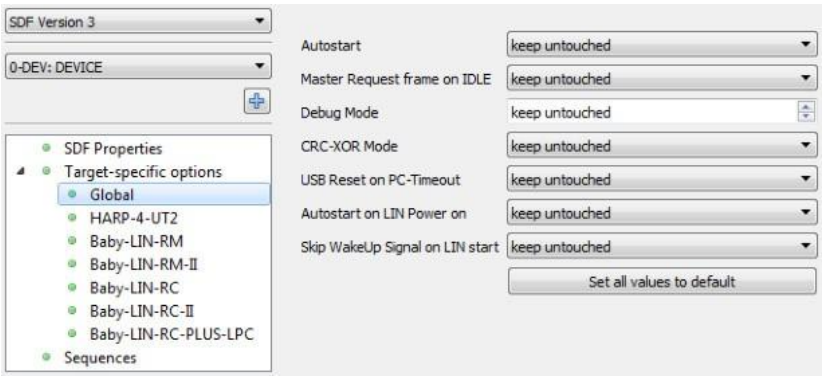
Target-specific option	Possible values	Description
Autostart	Off	No schedule or macro is started when the autostart is triggered.
	Schedule	The first schedule but not the autostart macro is started when the autostart is triggered.
	Schedule + Macro	The first schedule and the autostart macro are started when the autostart is triggered.
	Macro only	No schedule but the autostart macro is started when the autostart is triggered.
Autostart on LIN Power	Off	An autostart is triggered only when the device is powered on.
	On	An autostart is triggered each time the LIN-Bus is powered on.

Advice
If you want to start another but the first schedule simply select the macro only option and start another than the first schedule from that macro.

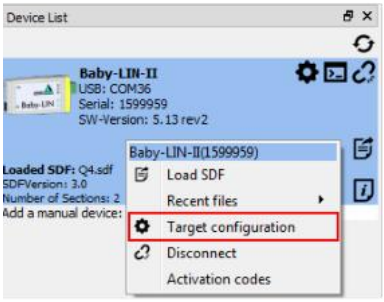
Tip
Triggering the autostart each time the LIN-Bus is powered on is especially helpful for applications in which the node connected to the LIN-Bus is changed periodically, e.g. EOL applications. In such a case, the simulation may be started automatically every time a new node is connected and the LIN-Bus voltage is turned on.

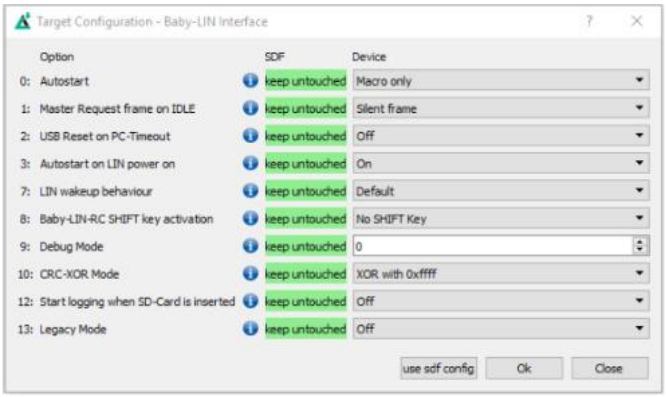
Warning
The option "Autostart on LIN Power on" is not required for the Baby-LIN-RM-III if the LIN voltage is also used as the logic supply.

SDF can store preset values for the target-specific options. These preset values can be found in the device section. These values overwrite the values in the device each time the SDF is uploaded. If a value is set to "keep untouched" the value in the device will not be changed.



The target-specific options can be set using the SimpleMenu. Right click on the connected device and click on "Target configuration". In the following dialog you can change the values in the device. For comparison reasons the preset values of the SDF are shown.





6.5 Logging

6.5.1 Introduction

The Baby-LIN-RM-III supports the logging of the frames on the LIN-Bus. The following possibilities to log the bus data are available:

- The bus data can be logged using the SimpleMenu if the Baby-LIN-RM-III is connected to a PC. The logging using the SimpleMenu is described here: Check chapter **"SimpleMenu"** for more information..
- The log data can be written to the microSD card without a PC, if the device supports the use of a microSD card

Version compatibility
This feature requires an up to date firmware. Check chapter **"Updates"** for more information.

6.5.2 Configure and activate the logging

The configuration of the logging feature depends on the mode the Baby-LIN-RM-III is using.

Configuration	SDFile with "@@SYSLOGCONTROL"	SDFile without "@@SYSLOGCONTROL"	Monitor mode
Mode description	A SDFile is loaded and the "@@SYSLOGCONTROL" system variable is used.	A SDFile is loaded and the "@@SYSLOGCONTROL" system variable is not used.	No SDFile is loaded.
		The target-specific option Start Logging when SD-Card is inserted must be set to On. Check chapter "List of options" for more information.	
Start the logging	Set the following system variable to 1: "@@SYSLOGCONTROL"	The logging starts as soon as a microSD card is recognized.	
Stop the logging and safely remove the microSD card	Set the following system variable to 0: "@@SYSLOGCONTROL" Then wait until the "LD3 - SD card LED" is off.	Supply the Baby-LIN-RM-III over the "X1 - PC connector". A connection to a PC is not required, only the supply must be ensured. Then remove the connector from the "X2 - LIN-Bus connector". Now wait for at least two seconds. After that time the logging has stopped and the micro SD card can be removed safely.	
Source channel of the log data	The LIN-Bus channel is the only source available.		
Format of the log data	The format will always be: "Binary format"		
Target of the log data	The target will always be: "Micro SD card"		
Resolution of the logged timestamps	The resolution of the logged timestamps is always in µs.		
Maximum log file size	Set the following system variable: "@@SYSLOGFILESIZE"	4096 MB	

The log files will be stored in the following path on the microSD card:

- Baby-LIN-RC-II\Loggs\

Attention
The microSD card may not be removed, while the "LD3 - SD card LED" is on. Please follow the above instructions for "Stop the logging and safely remove the microSD card".

6.5.3 Log data targets

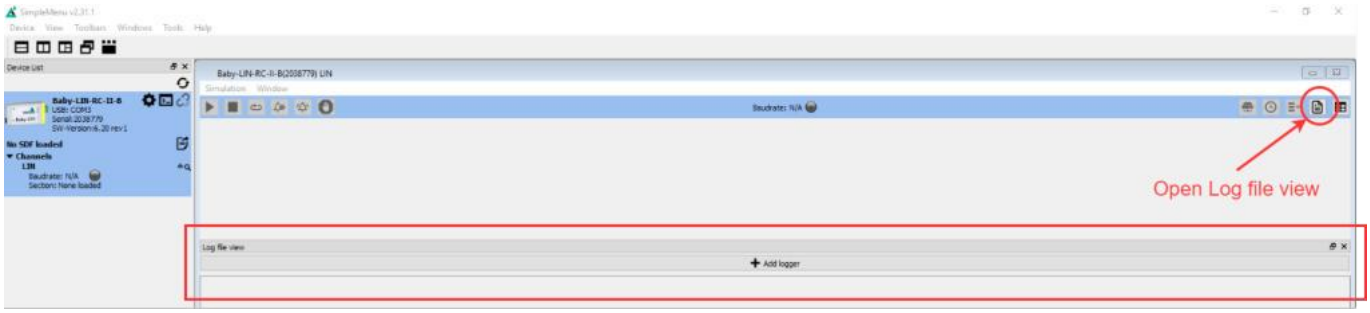
6.5.3.1 Overview

The Baby-LIN-RM-III can write log data to the following targets:

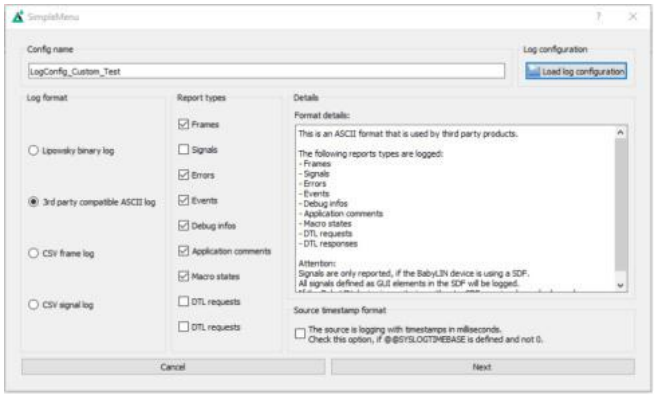
Target	Description
"SimpleMenu"	The logging data can be viewed and written into a file by using the "SimpleMenu".
"Micro SD card"	The logging data are stored as a file on the micro SD card.

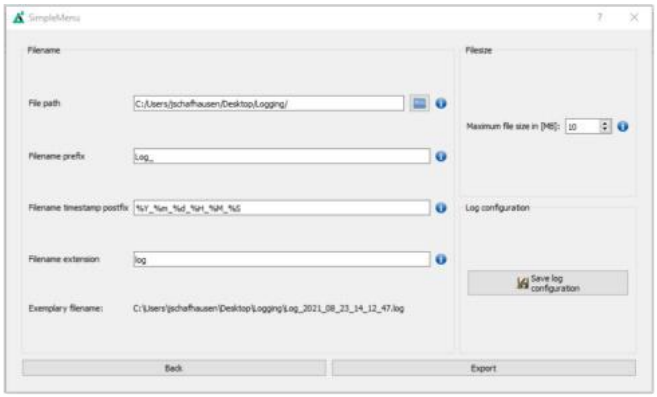
6.5.3.2 SimpleMenu

The SimpleMenu offers the possibility to record the complete bus communication of the Baby-LIN-Decvice and to save it locally in a file on the computer. To do this, open the integrated log viewer in the SimpleMenu.



After opening the Log file View, you can now add a logger. Adding the logger opens the Logging Configuration. Existing LOG configurations can be loaded or new ones can be created.





You can customise the logging of bus communication according to your requirements. You can select which data should be tracked and how this data should be saved in the next step.

6.5.3.3 Micro SD card

The log data are stored as a file on the micro SD card. The folder in which the log files are stored is "Product Name"\Loggs\. The filename will contain the date, time and channel the log file was started on. The microSD card has to be formatted as FAT16 or FAT32.

While the logging is active and log file is written, the LD3 - SD card LED will blink (Pattern: on for one second, off for 1 second).

Advice
The following microSD card types are supported:

Type	Explicit type description	Maximum size
microSD	SD (SDSC): Secure Digital Standard Capacity	2 GB
microSDHC	SDHC: Secure Digital High Capacity	32 GB

6.5.4 Log data formats

6.5.4.1 Format overview

The Baby-LIN-RM-III is writing log files in the following formats:

Target	Description	Frame size
Binary format	This is the default format of the current firmware of the Baby-LIN-RM-III . This format uses a proprietary binary data format to store the data. It is optimized for speed and a low file size. Files in this format can be converted into other formats using the "LogViewer".	24 Bytes
ASCII format	This format is a human readable ASCII format, that can be processed by some third party products.	88 Bytes
Debug format	This format is a human readable ASCII format, that is mainly used for debugging purposes. It does not contain any bus information.	

6.5.4.2 Binary format

This format uses a proprietary binary data format to store the log data. It is optimized for speed and a low file size. This file can be viewed, edited and converted into other formats using the "LogViewer".

6.5.4.3 ASCII format

This format is a human readable ASCII format. It consists of a header, the logged frame data and comments. It can be processed by many third party products. The ASCII format has the following structure:

```
date Fri May 12 13:38:13 2017
base hex timestamps absolute
internal events logged
// version HARP-4 V.1.43 Build1
 2.788508 Li           11 Tx 1 00                      checksum = ff         CSM = classic
 2.788508 Li           11 Tx 1 00                      checksum = ff         CSM = classic
 3.288498 Li           12 Rx 8 43 a1 16 d0 a7 53 29 00 checksum = 10         CSM = classic
 3.538493 Li           13 Rx 0                         NodeResponseMissing
 3.788488 Li           11 Tx 1 01                      checksum = fe         CSM = classic
 4.288531 Li           12 Rx 8 4d a6 19 d3 a9 54 2a 00 checksum = f6         CSM = classic
 4.538525 Li           13 Rx 0                          NodeResponseMissing
 4.788519 Li           11 Tx 1 02                      checksum = fd         CSM = classic
 5.288509 Li           12 Rx 8 56 ab 1d d5 ab 55 2a 00 checksum = df         CSM = classic
 5.538504 Li           13 Rx 0                          NodeResponseMissing
 5.788499 Li           11 Tx 1 03                      checksum = fc         CSM = classic
 6.288489 Li           12 Rx 8 60 b0 20 d8 ad 56 2b 00 checksum = c6         CSM = classic
 6.538536 Li           13 Rx 0                          NodeResponseMissing
 6.788531 Li           11 Tx 1 04                      checksum = fb         CSM = classic
 7.288521 Li           12 Rx 8 6a b5 23 da af 57 2b 00 checksum = af
 7.538515 Li           13 Rx 0                          NodeResponseMissing
 7.788510 Li           11 Tx 1 05                      checksum = fa         CSM = classic
 8.288500 Li           12 Rx 8 74 ba 27 dd b1 58 2c 00 checksum = 95         CSM = classic
 8.538495 Li           13 Rx 0                          NodeResponseMissing
 8.788490 Li           11 Tx 1 06                      checksum = f9         CSM = classic
 9.288532 Li           12 Rx 8 7e bf 2a df b3 59 2c 00 checksum = 7e         CSM = classic
 9.538527 Li           13 Rx 0                          NodeResponseMissing
 9.788522 Li           11 Tx 1 07                      checksum = f8         CSM = classic
 10.288511 Li          12 Rx 8 88 c4 2d e2 b5 5a 2d 00 checksum = 65         CSM = classic
 10.538506 Li          13 Rx 0                          NodeResponseMissing
 10.788501 Li          11 Tx 1 08                      checksum = f7         CSM = classic
```

The frame line components are explained using the first frame:

TarComponentget	Description
2.788508	This is a timestamp. It represents the seconds since the Baby-LIN-RM-III was powered on.
Li	A bus identifier
11	The ID of the frame
Tx	The direction of the frame
1	The lenght of the frame
00	All data bytes of the frame
checksum = ff	The checksum of the frame.
CSM = classic	The checkszum type used by the frame

7 Workflow

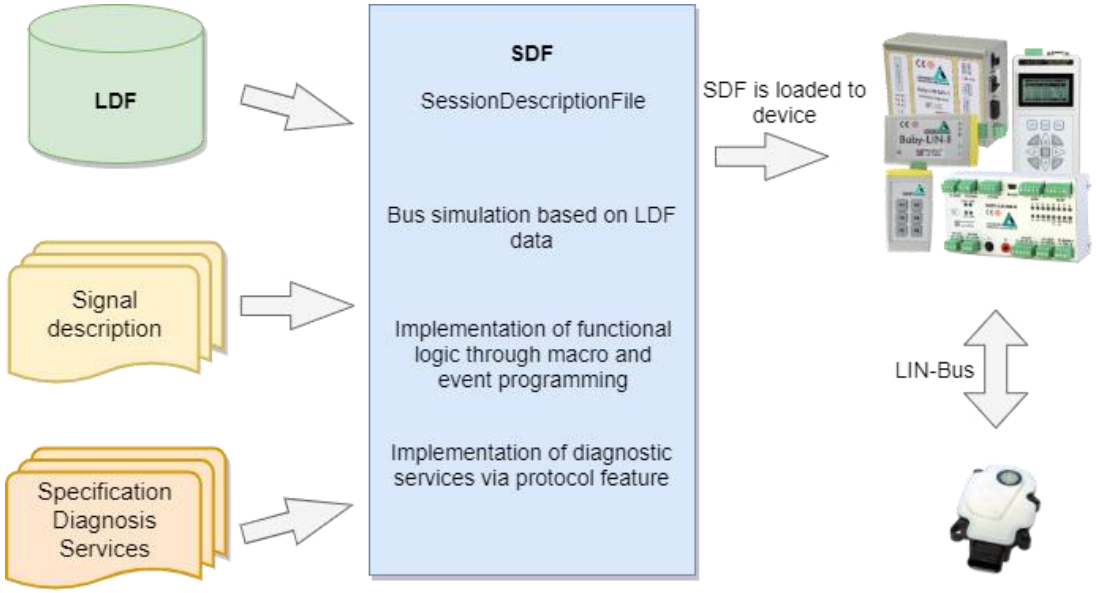
In this chapter we will show you how the workflow looks like in a typical LIN use case. For this purpose, we will introduce the following components to you:

- LDF
- Signal description
- Specification Diagnosis Services

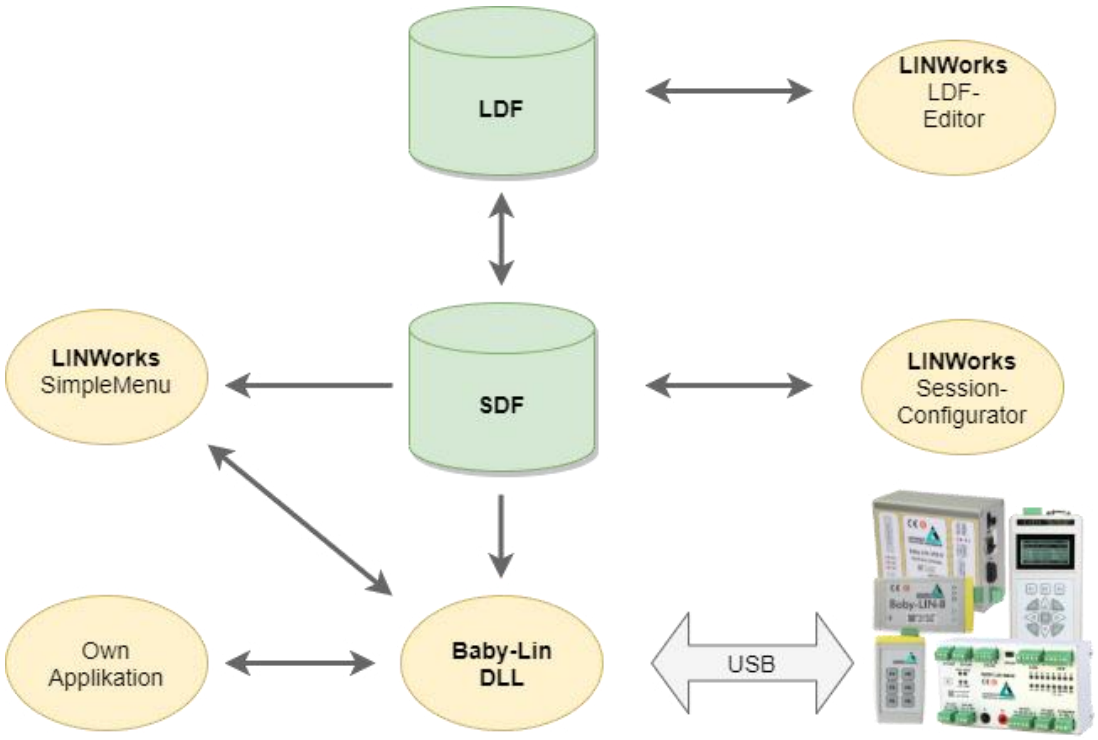
From this information, the SessionDescriptionFile (SDF) can be created. The SDF is the linchpin in LINWorks-based applications.

7.1 Overview

The following graphic shows the typical workflow of a LIN-based application with our Baby-LIN-Device.



This diagram shows how the individual LINWorks software applications are linked to each other.



7.2 Getting started

7.2.1 Introduction

This getting started guide will show you how to create your Lin application using the information from the LDF and the signal descriptions. In the following, you will learn how to create an LDF and integrate it into the SDF. Furthermore, the Unifeid Diagnostic Services will be introduced. After you have successfully created the SDF, the Baby-LIN-RM-III can be operated in standalone mode, LIN bus data can be logged, or macros can be defined for autostart.

Advice
This guide assumes you are using a Microsoft Windows operating system.

7.2.2 Installation

Before you can start using the Baby-LIN-RM-III you have to install several components of the LINWorks software.

If you have not already downloaded the LINWorks software, please download it now from our customer portal: *portal.lipowsky.de*

Advice
Check chapter "Downloads" for more information.

The following components are required for this getting started guide:

- Baby-LIN driver
- SessionConf
- SimpleMenu
- LDFEdit

7.3 LDF

LDF (LinDescriptionFile) has been developed by the LIN Consortium, in which various parties such as car manufacturers, suppliers and tool suppliers were involved. This means that the LDF specification is not dependent on a single manufacturer and can be used universally.The Format and syntax of the LDF are described in the LIN specification.

Each LIN bus has its own LDF, which collects all the properties of this specific bus in one document. This includes which nodes are present on the bus, which frames are defined and according to which scheme they are to be emulated.

7.3.1 LDF Example

The following example shows the LDF of a windscreen wiper motor.

LDF header

```
LIN_description_file ;
LIN_language_version = "1.3" ;
LIN_speed = 19.200 kbps ;
```

Node section

```
Nodes {
Master:MasterECU,1.0000 ms,0.1000 ms ;
Slaves:Slave1Motor,Slave2Sensor;
}
```

```
{ MessageCounter:8,0x00,MasterECU,Slave1Motor,Slave2Sensor;

Ignition:1,0x0,MasterECU,Slave1Motor,Slave2Sensor;
WiperSpeed:3,0x0,MasterECU,Slave1Motor;
Temperature:8,0xFF,MasterECU,Slave1Motor,Slave2Sensor;
WiperActive:1,0x0,Slave1Motor,MasterECU;
ParkPosition:1,0x0,Slave1Motor,MasterECU;
CycleCounter:16,0x00,Slave1Motor,MasterECU;
StatusSensor:8,0x00,Slave2Sensor,MasterECU;
ValueSensor:8,0x00,Slave2Sensor,MasterECU;
}
```

Frame section

```
Frames {
MasterCmd:0x10,MasterECU,4{MessageCounter,0;
Ignition,8; WiperSpeed,9; Temperature,16; }
MotorFrame:0x20,Slave1Motor,4{ WiperActive,0;
ParkPosition,1; CycleCounter,16; }
SensorFrame:0x30,Slave2Sensor,2StatusSensor,0; ValueSensor,8;
}
```

Schedule table

```
Schedule_tables {
Table1 { MasterCmd delay 20.0000 ms ;
MotorFrame delay 20.0000 ms ;
SensorFrame delay 20.0000 ms ;}
}
```

Signal section

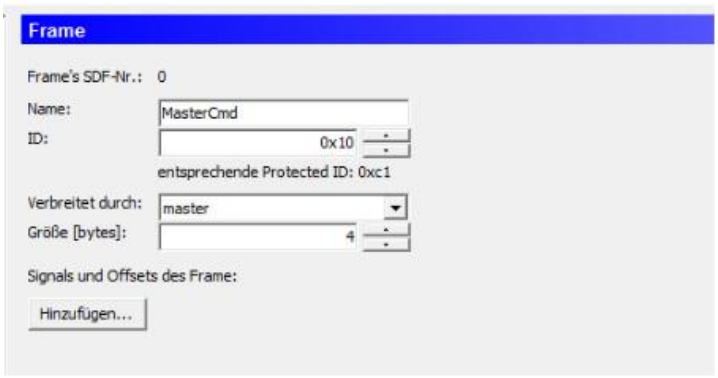
Signal encoding section

```
Signals
Signal_encoding_types {
EncodingSpeed { logical_value,0x00,"Off" ;
logical_value,0x01,"Speed1" ;
logical_value,0x02,"Speed2" ;
logical_value,0x03,"Interval" ;}
EncodingTemp { physical_value,0,253,0.8,- 35,"degrees C" ;
logical_value,0xFE,"Signal not supported" ;
logical_value,0xFF,"Signal not available" ;}
}

Signal_representation
{ EncodingSpeed:WiperSpee
d;
EncodingTemp:Temperature;
}
```

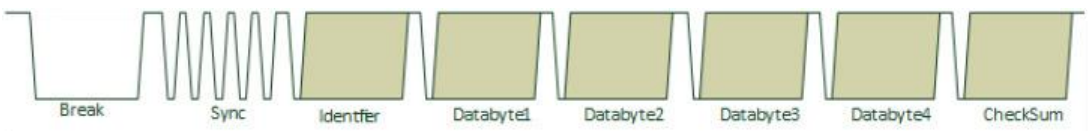
7.3.2 LIN application frames

With the information from an LDF, you can assign all frames that appear on the bus to your publisher using the PID. You can also interpret the data regarding the signals it contains.




```
Frames{
   MasterCmd:0x10,MasterECU,4 {
        MessageCounter,0;
        Ignition,8;
        WiperSpeed,9;
        Temperature,16; }
        }
```

The frame is structured as shown in the following graphic. The frame defined in the LDF is recognised with the identifier with ID = 0x10 and the signals can be mapped from the 4 databytes.



7.3.2.1 Protected LIN identifier

The Frame Id is 8 Bit in size, where by the upper 2 bits are used as parity bits. So only 6 bits remains to represent the effective frame identifier. This

makes a range of 64 different frame id's.

Paritybit P1 (ID.7)	Paritybit P0 (ID.6)	Identifier Bits ID.5 - ID.0
ID.1^ID.3^ID.4^ID.5	!(ID.0^ID.1^ID.2^ID.4)	0…63

Id dec	Id hex	PID	Id dec	Id Hex	PID	Id dec	Id hex	PID	Id dec	Id hex	PID
0	0x00	0x80	16	0x10	0x50	32	0x20	0x20	48	0x30	0xF0
1	0x01	0xc1	17	0x11	0x11	33	0x21	0x61	49	0x31	0xB1
2	0x02	0x42	18	0x12	0x92	34	0x22	0xE2	50	0x32	0x32
3	0x03	0x03	19	0x13	0xD3	35	0x23	0xA3	51	0x33	0x73
4	0x04	0xc4	20	0x14	0x14	36	0x24	0x64	52	0x34	0xB4
5	0x05	0x85	21	0x15	0x55	37	0x25	0x25	53	0x35	0xF5
6	0x06	0x06	22	0x16	0xD6	38	0x26	0xA6	54	0x36	0x76
7	0x07	0x47	23	0x17	0x97	39	0x27	0xE7	55	0x37	0x37
8	0x08	0x08	24	0x18	0xD8	40	0x28	0xA8	56	0x38	0x78
9	0x09	0x49	25	0x19	0x99	41	0x29	0xE9	57	0x39	0x39
10	0x0A	0xCA	26	0x1A	0x1A	42	0x2A	0x6A	58	0x3A	0xBA
11	0x0B	0x8B	27	0x1B	0x5B	43	0x2B	0x2B	59	0x3B	0xFB
12	0x0C	0x4C	28	0x1C	0x9C	44	0x2C	0xEC	60	0x3C	0x3C
13	0x0D	0x0D	29	0x1D	0xDD	45	0x2D	0xAD	61	0x3D	0x7D
14	0x0E	0x8E	30	0x1E	0x5E	46	0x2E	0x2E	62	0x3E	0xFE
15	0x0F	0xCF	31	0x1F	0x1F	47	0x2F	0x6F	63	0x3F	0xBF

Advice
Note that the following IDs are reserved for protocol extensions and diagnostic and configuration data:
• 60 (0x3C) and 61 (0x3D) are used to carry diagnostic and configuration data.
• 62 (0x3E) and 63 (0x3F) are reserved for future protocol enhancements.

7.3.3 LIN Scheduling

The order in which the frames are sent to the LIN bus is defined in a so-called Schedule Table. One or more Schedule Table(s) are defined in each LDF.

Each table entry describes a frame by its LDF name and a delay time, which is the time that is made available to the frame on the bus.

A Schedule Table is always selected as active and is executed by the master.The master places the corresponding frame headers on the bus and the publisher assigned to this frame places the corresponding data section + checksum on the bus.

Only the master can switch the Schedule Table. Thus the master application determines which frames appear on the bus in which time sequence.

7.3.4 LIN Diagnostic frames

Diagnostic frames are a pair of MasterRequest (0x3c) and SlaveResponse (0x3D) frames. Used to send information that is not described in the LDF.

0x3C MasterRequest:
Request Data define the node and the requested action.

0x3D SlaveResponse:
Data generated by the addressed slave; content depends on request

The Master Request and Slave Response have special properties:

- They are always 8 bytes long and always use the Classic Checksum.
- No static mapping of frame data to signals; frame(s) are containers for transporting generic data.
- Request and response data can consist of more than 8 data bytes.

The MasterRequest - SlaveResponse mechanism can be used to transmit a wide variety of data because it is a universal transport mechanism. A main application is the diagnosis and End of Line (EOL) configuration of nodes.

In the field there is a whole range of different protocols, depending on the vehicle and ECU manufacturer:

- A lot of proprietary diagnostics or EOL protocols
- DTL based protocols (Diagnostic Transport Layer)
- Keyword 2000 Protocol (ISO 14230 -1 to 4)
- UDS (Unified Diagnostic Services) (ISO 14229-1:2013)

Advice
A more detailed explanation of all the possibilities of using Unified Diagnosis Services can be found in the chapter "Diagnostic Modes".

7.4 Session Description File (SDF)

7.4.1 How to create a LIN application

1. Requirement

A LIN node (slave) and a suitable LDF file are available. An application is to be implemented in which a simulated LIN master allows the node to be operated in a certain way.

2. Requirement

However, the information in the LDF is usually not sufficient. The LDF describes the access and interpretation of the signals, but the LDF does not describe the functional logic behind these signals. Therefore you need an additional signal description which describes the functional logic of the signals.

3. Requirement

If the task also requires diagnostic communication, a specification of the diagnostic services supported by the nodes is also required. In the LDF, only the frames with the respective data bytes are defined, but not their meaning.

These requirements can then be defined and edited together in a Session Description file (SDF).

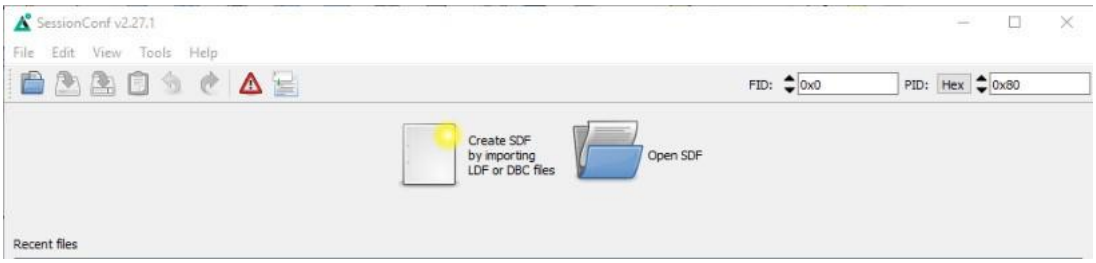
7.4.2 Introduction

The Session Description file (SDF) contains the bus simulation based on the LDF data. The logic of the individual frames and signals can be programmed by macros and events. In addition to the LDF LIN schedule, further diagnostic services can be implemented in the SDF via protocols.

This makes the SDF the central working point of all LINWorks applications.

7.4.3 Create a SDF

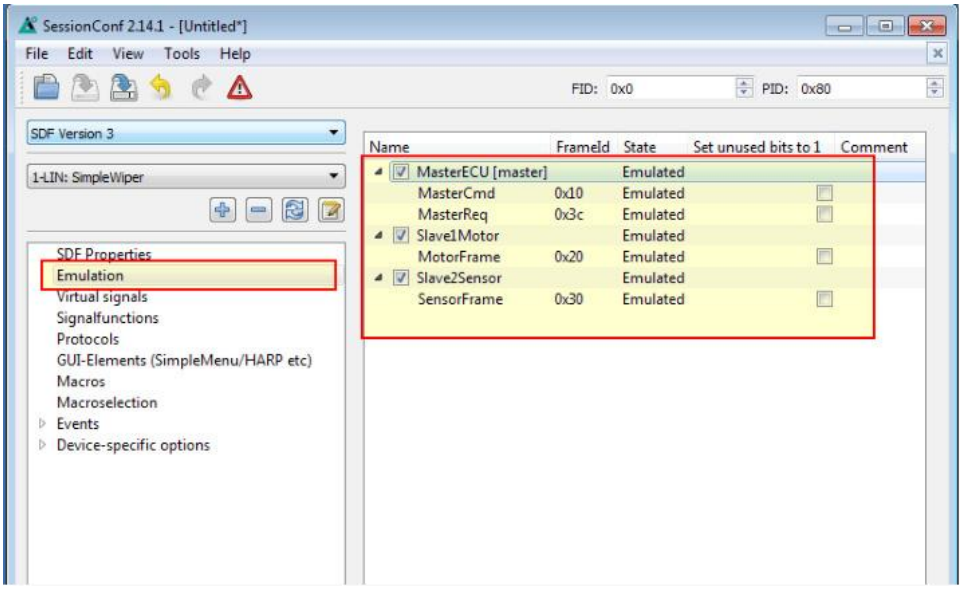
The SessionConf software application is used to create and edit the SDF. For this purpose, an existing LDF is imported.



7.4.4 Common Setup

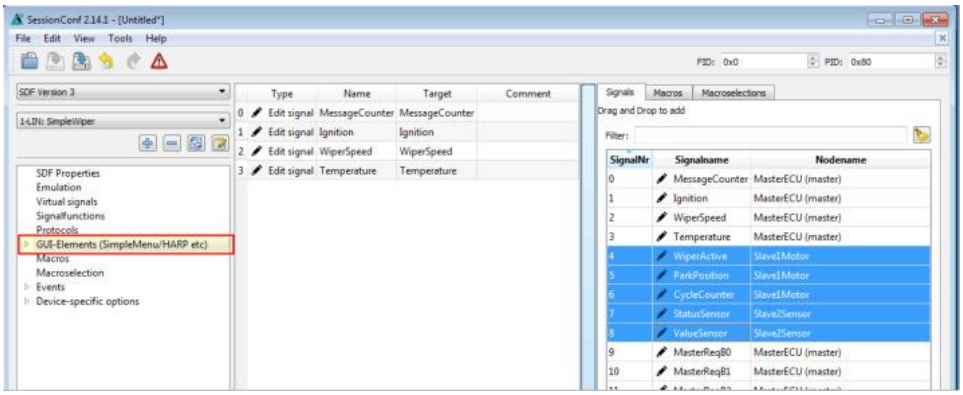
7.4.4.1 Emulation

Select Emulation in the navigation menu on the left. Here you can select which nodes you want to be simulated by the Baby-LIN-RM-III. If you only want to monitor the LIN-Bus, select nothing.



7.4.4.2 GUI-Elements

Select GUI-Elements in the navigation menu on the left. Here you can add signals you want to monitor.



Advice
There are other ways to monitor frames and signals, but this is a good and configurable starting point.

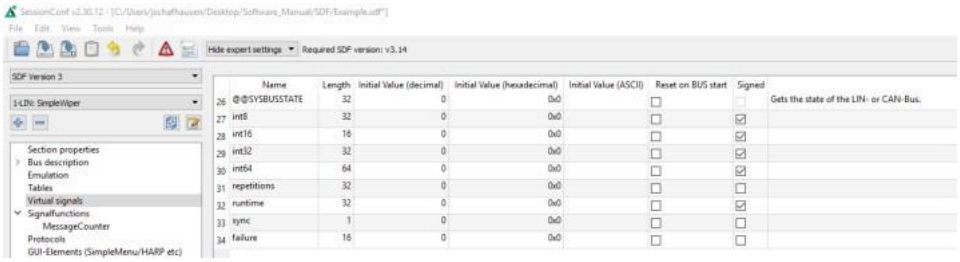
7.4.4.3 Virtual signals

Virtual signals can store values just like bus signals, but they do not appear on the bus. They can be used for many different tasks like:

- Temporary values, like counters
- Store constants
- Operands and results from calculations
- etc.

The size of a virtual signal can be set to 1...64 bits. important for use in the protocol feature.

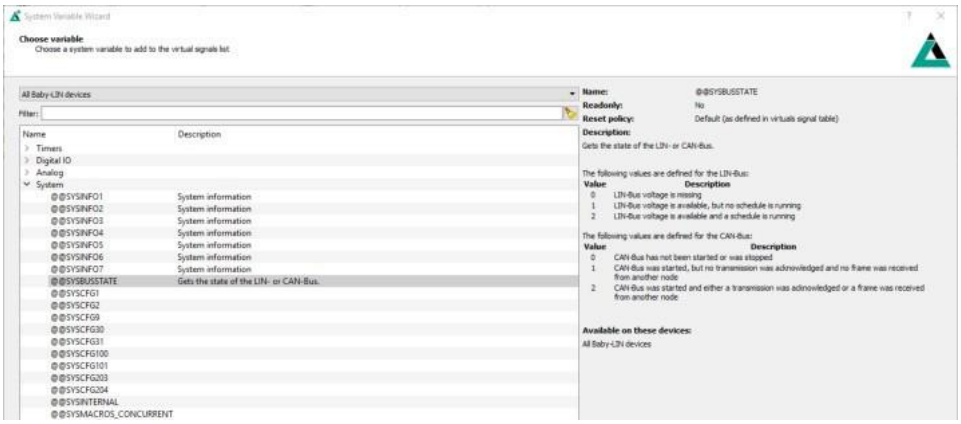
Each signal has a default value that is set when the SDF is loaded.



7.4.4.4 System signals

System signals are virtual signals with reserved names. When a system signal is applied, a virtual signal is created at the same time and linked to a specific behaviour.

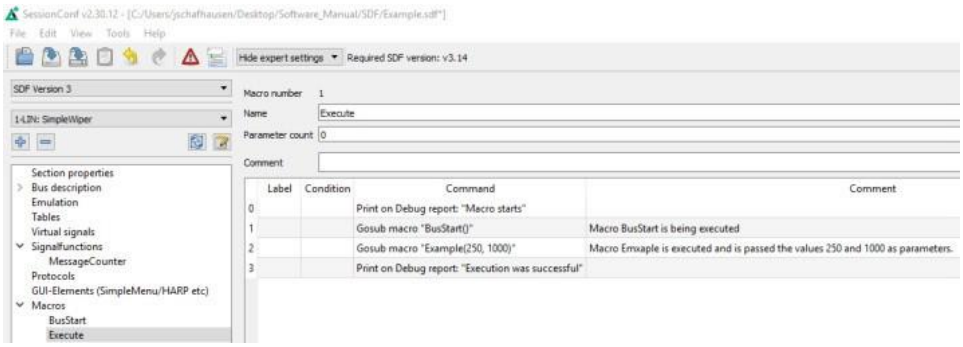
In this way, you can access timer, input and output resources and system information.



Advice
For more information and a list of all available system signals, please check the chapter "System variables".

7.4.4.5 Macros

Macros are used to combine multiple operations into a sequence. Macros can be started by events or, can also be called from other macros in the sense of a Goto or Gosub. The DLL API calls a macro with the macro_execute command.



All Macro Commands can use signals from the LDF and signals from the Virtual Signal section like the system signals.

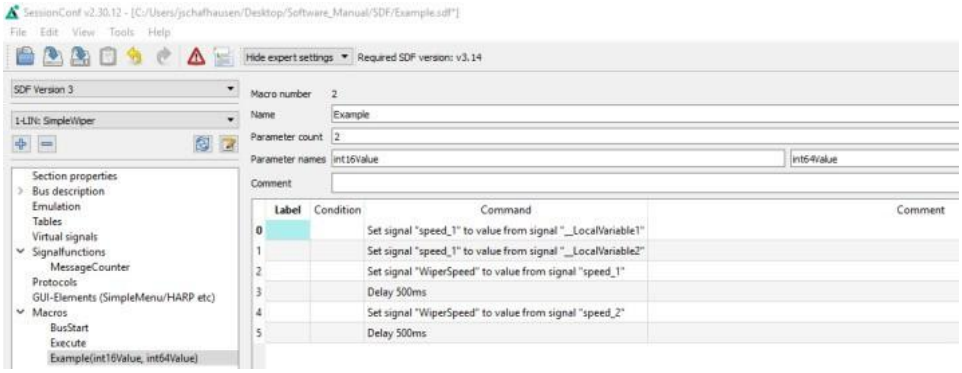
Another important function of the macros is to control the bus. The bus can be started and stopped via macro. Furthermore, the schedule can be selected and the status of the bus can be checked with the help of the system signals.

Advice
For more information or if you want to implement an autostart macro, please read the chapter "Configuring an autostart macro".

Each macro always provides 13 local signals:

`_LocalVariable1, _LocalVariable2, ..., _LocalVarable10, _Failure, _ResultLastMacroCommand, _Return`

The last 3 provide a mechanism to return values to a callcontext `_Return, _Failure`) or to check the result of a previous macro command. The signals `_LocalVariableX` can be used e.g. as temporary variables in a macro.



A macro can receive up to 10 parameters when called. In the macro definition, you can give these parameters names, which are then displayed on the left in the menu tree in brackets after the macro name. The parameters end up in the signals `_LocalVariable1...10` of the called. If no parameters or less than 10 parameters are are passed, the remaining `_LocalVariableX` signals receive the value 0.

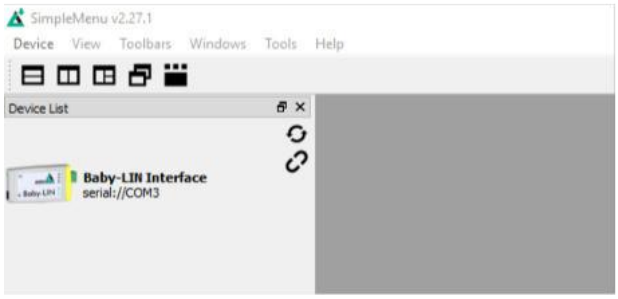
7.4.4.6 Embbeded SDF

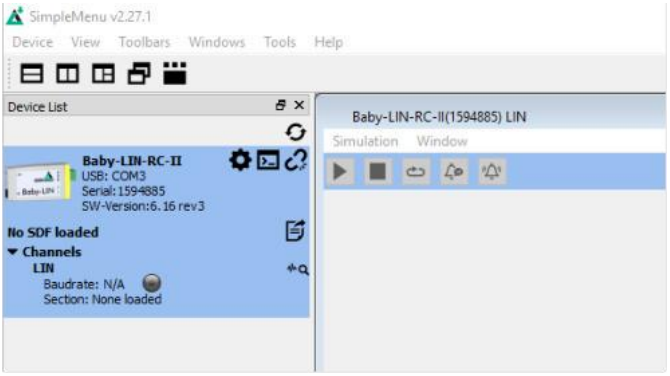
You can download the sample SDFs in the download area on our website under the following link.

Link: *https://www.lipowsky.de/downloads/*

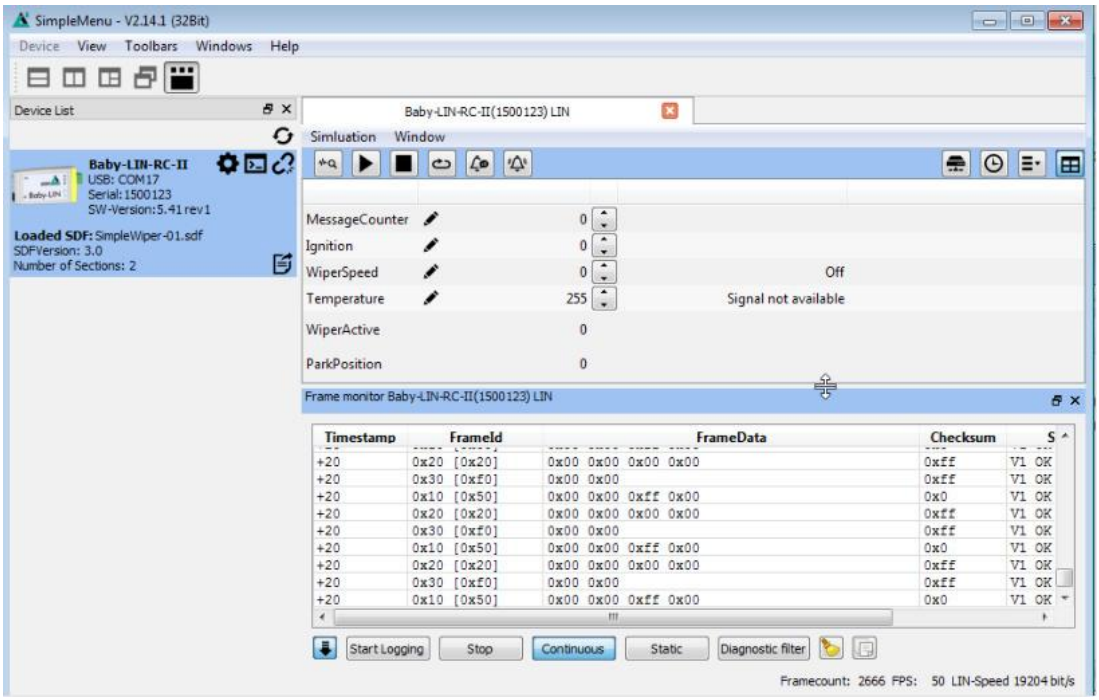
7.4.5 Start the bus communication

Start the SimpleMenu. You should be able to find your Baby-LIN-RM-III in the device list on the left. Click the connect button and then load the SDF you created earlier.





Now you can see the variables you added to monitor. To start the simulation/monitoring click on the start button.



Now you will see the changes of these signals.

Tip
The Baby-LIN-RM-III features a lot more features and possibilities and can be used for a wide selection of applications. Keep on reading this manual to learn more about the Baby-LIN-RM-III .

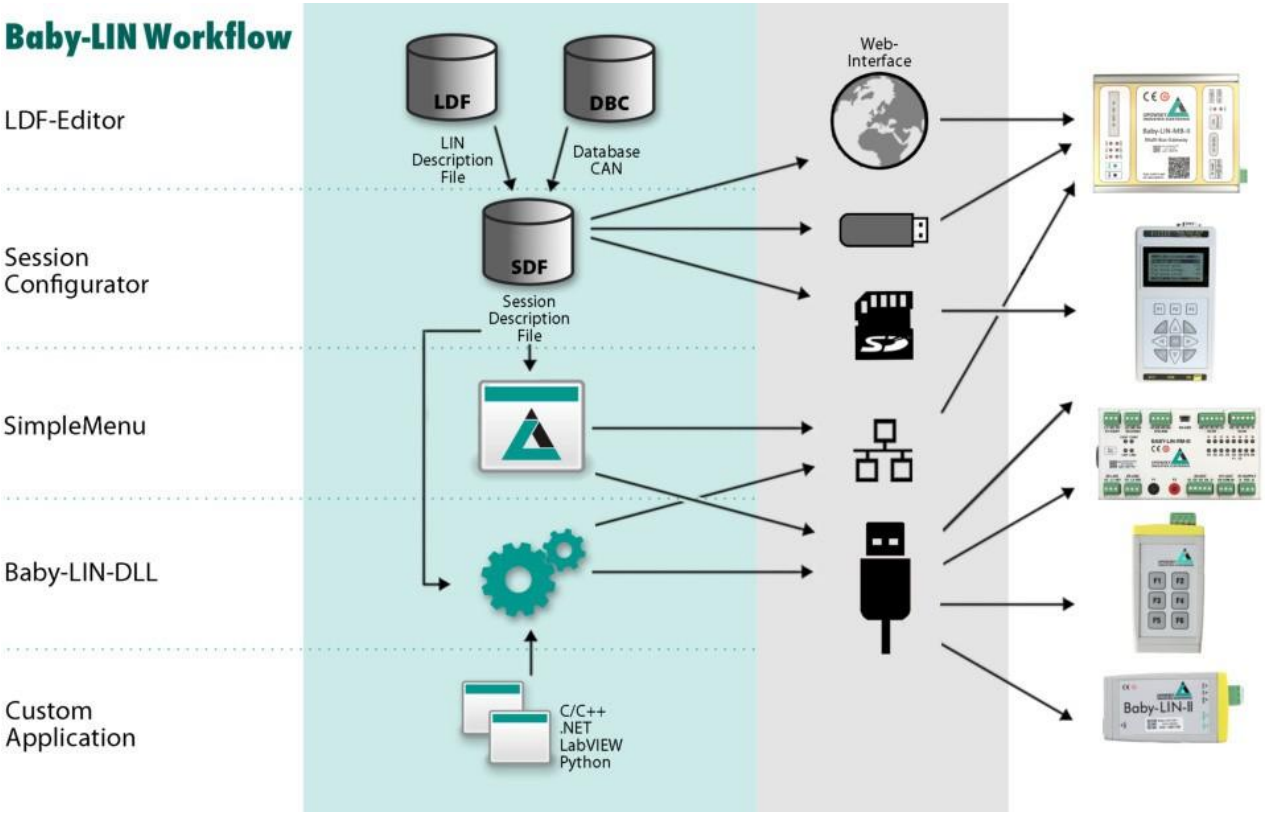
8 LINWorks Software - Overview

The LINWorks is a collection of software to operate the Baby-LIN-RM-III.The complete LINWorks software package is available for download on our website. There you will also find the LINWorks Software Manual, which gives a detailed overview of the individual program and how to work with and create Session Description Files.

You can download both from the following link: *https://www.lipowsky.de/downloads/*

Component	Archive subfolder	Description
Datasheets User manuals Application notes	Documentation	The datasheets show a quick overview about a Baby-LIN product and its features. The user manuals contain the main documentation. The application notes contain some older information, that have not been added to the user manuals yet.
Baby-LIN driver		The **Baby-LIN driver** is necessary to connect a Baby-LIN-RM-III to a windows PC via USB. The Baby-LIN-RM-III will be available as **virtual COM port**.
LDFEdit	LINWokrs	The **LDFEdit** allows the inspection, creation and edit of a LDFile (LIN Description File).
SessionConf	LINWokrs	The **SessionConf** allows the inspection, creation and edit of a SDFile (Session Description File) and features a file import for LDFiles (for LIN-Bus simulation). It defines everything needed for a complete simulation of each available bus, e.g. which nodes on each bus are available and which nodes should be simulated by the Baby- LIN-RC-II. Moreover it allows defining an application logic. This programming ability is available for each device out of the box.
SimpleMenu	LINWokrs	The **SimpleMenu** is used to establish a connection to the Baby-LIN-RM-III and upload SDFiles, change the device target configuration, control the bus and monitor the frames and signals on the bus. Even without a LDFile/ SDFile the bus can be monitored and the frames can be logged.
LogViewer	LINWorks	The **LogViewer** can show and convert the log files of the Baby-LIN-RM-III as well as the SimpleMenu.
Baby-LIN-DLL	Development	The **Baby-LIN-DLL** allows customers to create their own application and use all features of the Baby-LIN-RM-III like controlling and monitoring the LIN-Bus interfaces. The **Baby-LIN-DLL** is a native **C/C++** DLL. It is available for **Windows**, **Linux** and **RaspberryPi**. Wrapper for **.NET**, **Python**, **VB6** and **LabView** are available. Of course we provide examples for all supported languages.
Serial writer	Tools	The **serial writer** is used to change the **serial number**, that is stored within the persistent memory of a Baby-LIN-RM-III . This serial number influences the allocation of the **virtual COM port** number, the Baby-LIN-RM-III is available under.
BLProg	Tools	The **BLProg** is used to update the **firmware** of a Baby- LIN-RC-II. If you download a firmware package from our customer portal (*portal.lipowsky.de*) a current version of the **BLProg** will always be included.

The following graphic shows how you can use our LINWorks software in connection with our the Baby-LIN-Devices.


Baby-LIN Workflow
LDF-Editor
Session Configurator
SimpleMenu
Baby-LIN-DLL
Custom Application
LDF
DBC
LIN Description File
Database CAN
SDF
Session Description File
Web-Interface
C/C++
.NET
LabVIEW
Python
Baby-LIN-II

9 Migration information

9.1 Migration from Baby-LIN-RM-III to Baby-LIN-RM-II

All Baby-LIN products of the second generation were designed to be compatible with the first generation. Due to hardware and software changes, the compatibility may be affected in certain areas.

If you have used a Baby-LIN-RM-II in your environments and applications and now want to replace it with a Baby-LIN-RM-III, the following chapters give you an overview of the topics, you have to consider.

Version incompatibility
Each of the following chapters may decrease the compatibility depending on your application and the way, you use the Baby-LIN-RM-III. Therefor you should check all these chapters very carefully.

9.2 Performance

The Baby-LIN products of the second generation are in common more powerful.

The faster and more powerful CPU executes operations faster and therefor allows more operations in the same time interval. The higher memory allows to download bigger SDFiles into the Baby-LIN-RM-III.

The SDF-V3 format allows to use new powerful features within the SDFile.

	Baby-LIN-RM-III	Baby-LIN-RM-II
CPU	ARM Cortex-M7, 300 MHz	ARM Cortex-M4, 168 MHz
Memory	32 MB RAM	4 MB RAM
SDF-Version	SDF-V2	SDF-V3

9.3 LIN-Bus transceiver

Version incompatibility
If you want to replace a Baby-LIN-RM-II with a Baby-LIN-RM-III you should check the following chapter, since this issue reduce the compatibility depending on your application and the way, you use the Baby-LIN-RM-III.

The used LIN-Bus transceiver has changed. The following table shows you, what properties have changed:

Feature	Baby-LIN-RM-II	Baby-LIN-RM-III
LIN-Bus transceiver	Si9241A	MC33662
Maximum LIN-Bus baud rate	200 kBaud	125 kBaud
Minimum LIN-Bus voltage	3,8 V	6,9 V
	We recommend a minimum LIN-Bus voltage of 8 V.	
Maximum LIN-Bus voltage	36 V	26 V