ihr LDC

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LIN Driver and Configuration Tool

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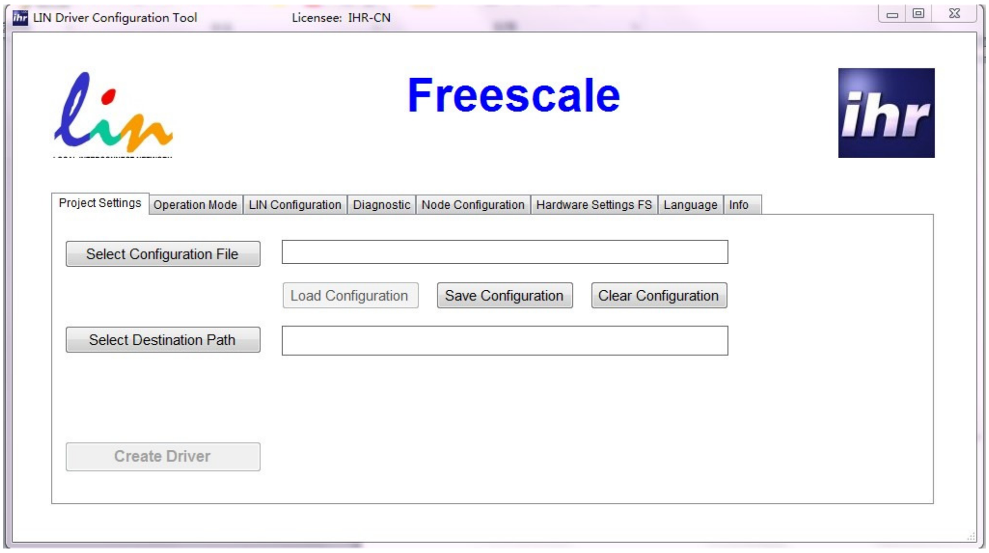

User Guide

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1 LDC – LIN Driver and Configuration Tool

1.1 Preface

ihr GmbH is an associated member to the LIN consortium since the beginning and member of the LIN testing workgroup since 2003. ***ihr*** GmbH is a well known supplier for premium LIN emulators and LIN measurement equipment. Since 2004 ***ihr*** GmbH performs conformance tests as an accredited test house. We have seen a lot of LIN applications and we know the always repeating customer demands related to the LIN topic.
Since ***ihr*** has a long and strong relationship over many years with microcontroller manufacturers, the idea arose for the LIN Driver and Configuration Tool (LDC-Tool) for microcontrollers.

1.2 Purpose of the LDC-Tool

Without special LIN expertise, designers can easily add a LIN interface to their applications using microcontrollers (MCUs). The LIN configuration tool supports LIN specifications 1.3, 2.0 and 2.1. In the version 2.0.0 the tool supports LIN 1.3 and LIN 2.x (also J2602) slave and master applications for many microcontroller families.

The configuration tool simply needs basic information such as:

- The MCU derivate
- The LIN Description File (LDF)
- The node to be implemented (as per LDF)
- Some controller hardware dependant settings

Additionally, designers can select optional services as per LIN specifications separate for each node. Experienced users can change hardware-specific settings. The tool then generates C Code for the embedded project. The configuration can be stored for later usage. The generated driver files are integrated into project workspace, and the code generated supports the specified compliant LIN API.

Therefore, the software designers can concentrate on the applications and rely on the LIN conform driver under the terms stated in the ihr EULA (see document reference no. 5).

1.3 Code generation

The code generated by the LDC is compliant to the MISRA standard C2004. It fulfils all required rules except:

- Rule 1.1: „All code shall conform to ISO 9899:1990“
  All the compilers used for embedded designs support microcontroller specific language extensions, which are to be used by the hardware related driver code.

- Rule 6.4: „Bit fields shall only be defined to be of type unsigned int or signed int“
  This rule does not apply to small microcontrollers. For saving resources, especially on 8 bit microcontrollers, we make use of byte variables of type „char“ or „unsigned char“ for bit fields.

- Rule 18.4 „Unions shall not be used“
  A communication driver has to handle buffers for data reception and sending. Protocol data units stored in that buffers are self describing data structures. So the data type of a PDU stored in a buffer must be detected on runtime. We use unions as overlay on the buffers, to access the data. This is a state of the art programming technique for communication drivers and protocol stacks.

2 Installation

2.1 Host System Requirements

To install and run the program the host system need to fulfil the following requirements:

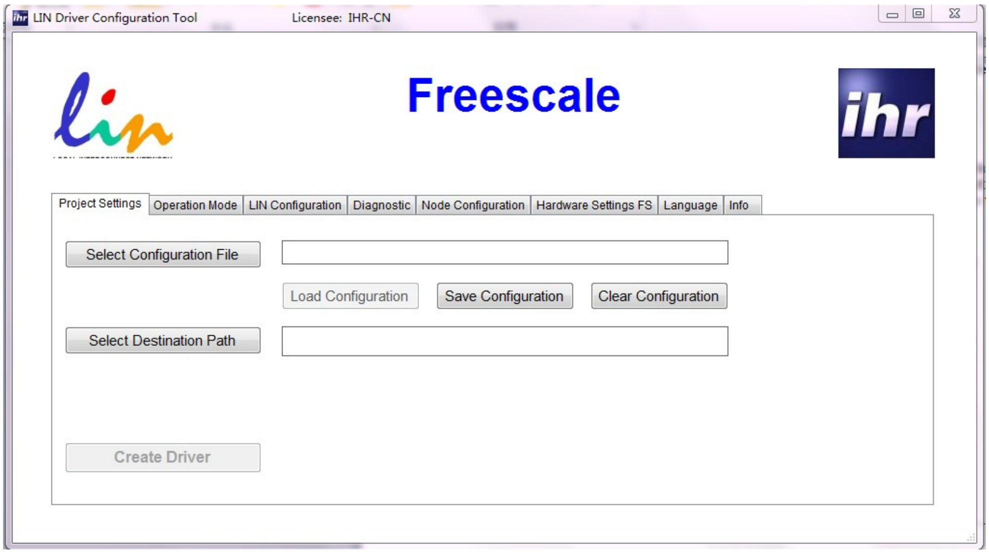
- PC-compatible system
- Microsoft® Windows 2000, XP, Vista, 7 (32Bit)
- Microsoft® Framework 3.5 or higher.

2.2 Install the Tool

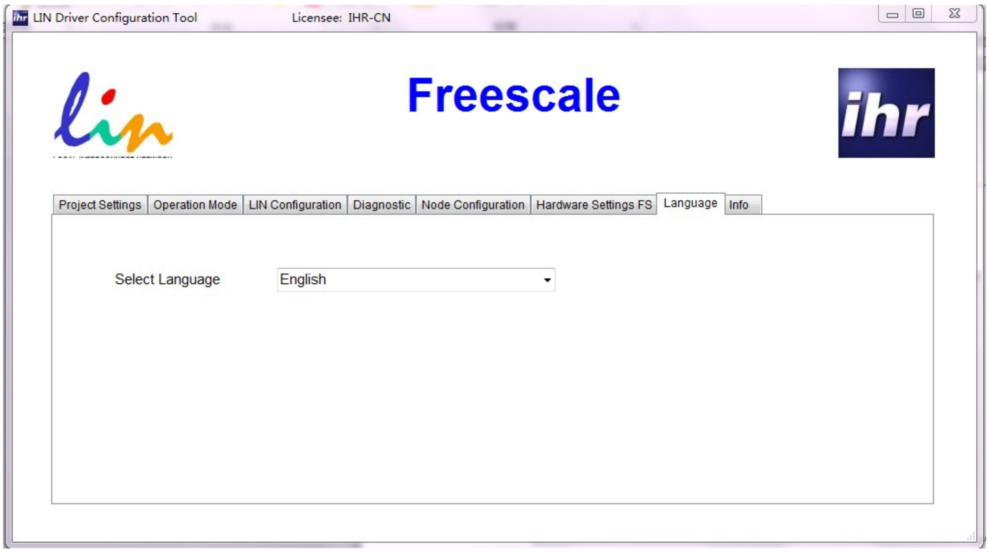
Copy the folder with the LDC-Tool to the preferred location on your hard drive (preferable: C:\Program Files\IHR GmbH\LDC_Tool). Please make sure that the “LDFapi3.dll” and the “IHRLicenseDLL.dll” is located in the same folder as the “LinDriverConfigurator.exe”. Also the language extension subdirectories must be copied to the target directory. To start the LDC-Tool please double click the “LinDriverConfigurator.exe” Icon. You may also create a shortcut or program icon on your desktop.

2.3 Setup the Tool

Before you start the program for the first time, login as a system administrator. Then start the LDC application explicit as a System Administrator. Click with the right mouse button on the program file and select the line “Execute as an administrator”. Then you will see the screen below:



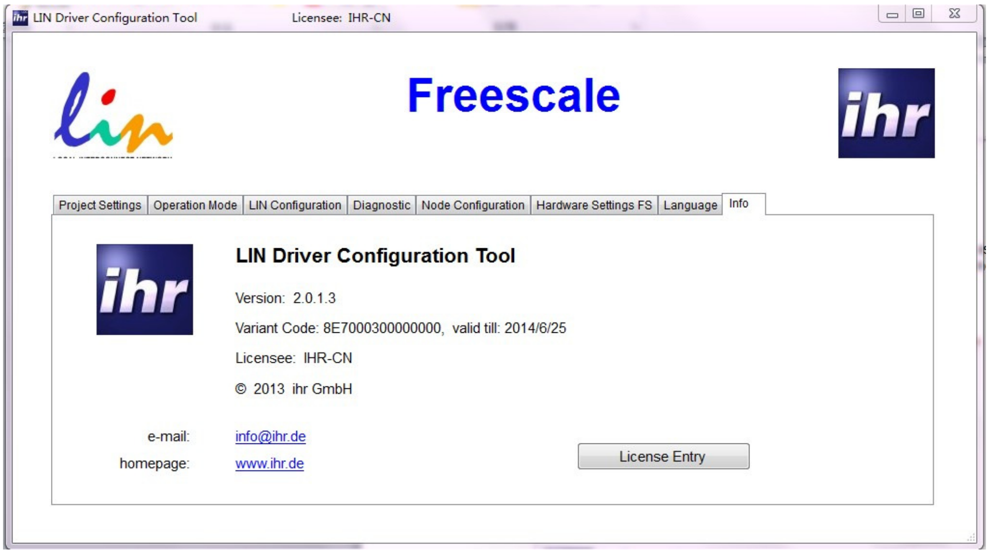
On the “Language” tab you may now select your preferred language.



Select Language English

2.4 Setup the License Code

You should be logged in as a system administrator. Start the application explicit as a system administrator. Click with the right mouse button on the program file and select the line “Execute as an administrator”. Then select the “Info” tab. You’ll see this screen.



LIN Driver Configuration Tool

Version: 2.0.1.3

Variant Code: 8E7000300000000, valid till: 2014/6/25

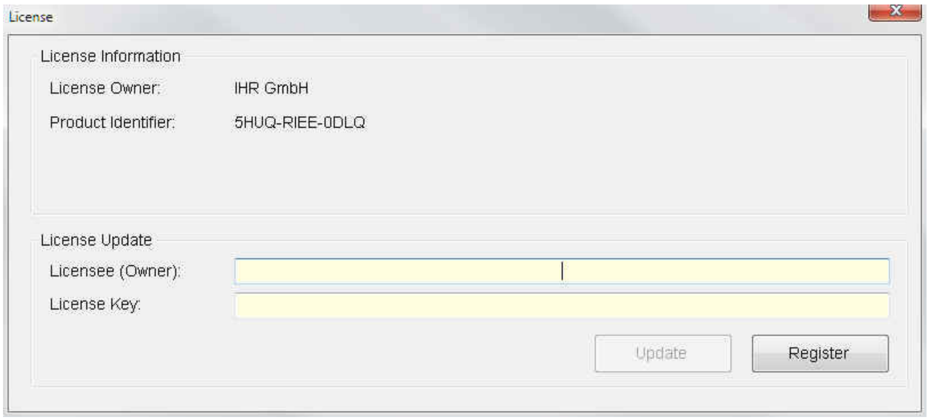
Licensee: IHR-CN

© 2013 ihr GmbH

e-mail: info@ihr.de

homepage: www.ihr.de

Click the “License Entry” Button. This license dialog window comes up:



License

License Information

License Owner: IHR GmbH

Product Identifier: 5HUQ-RIEE-0DLQ

License Update

Licensee (Owner):

License Key:

Now there are two choices:

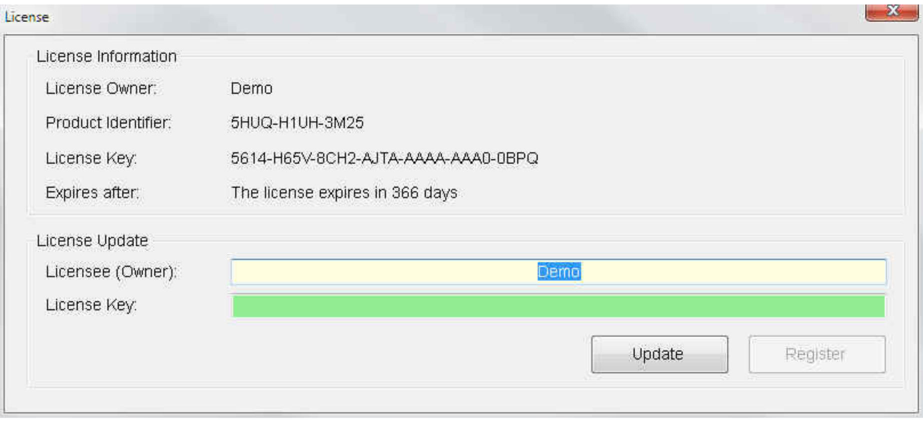
- Enter a evaluation license
- Get a unrestricted license

2.4.1 Enter Evaluation License

An evaluation license code is available on the ***ihr*** GmbH internet page for different microcontroller families. This license code normally is valid for one up to two years. All the features of the LDC tool are available but the LIN network is limited to a maximum of three LIN nodes. The license code looks like this

5614-55B2-078E-A9TA-AAAA-AAA0-0DO1

Take the actual evaluation license code and enter it into the lower input line, preferable by copy and paste. In the upper line for the name of the licensee enter the string “Demo”. Please take care of the letter cases. Then click on the “Register” button. Now you’ll see a screen like this.



License

License Information

License Owner: Demo

Product Identifier: 5HUQ-H1UH-3M25

License Key: 5614-H65V-8CH2-AJTA-AAAA-AAA0-0BPQ

Expires after: The license expires in 366 days

License Update

Licensee (Owner): Demo

License Key:

The license code is successful registered now and you may use the tool till expiration date. Before usage of the tool, exit the program and restart it again. Now it can be used without administrator rights. This procedure may be repeated as often as you need. You are also free, to change the microcontroller family without reinstallation of the LDC tool.

2.4.2 Get an unrestricted license

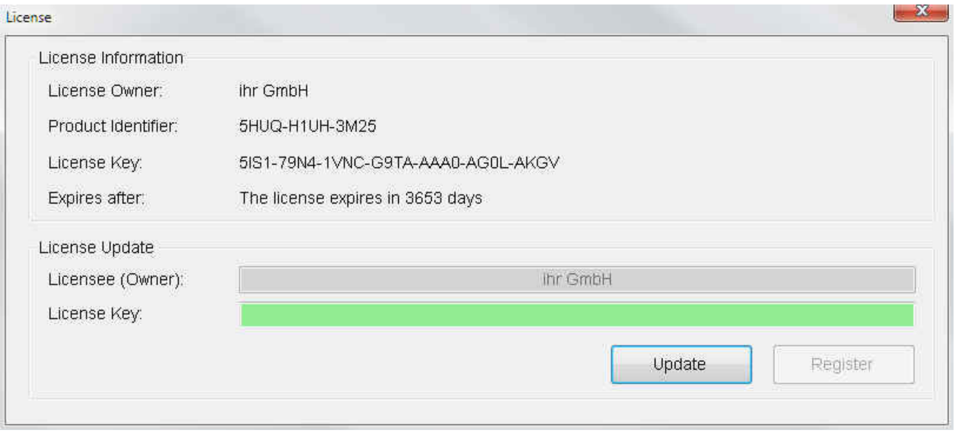
To get an unrestricted license, please send a order to ***ihr*** GmbH sales department. The order should contain all the options or capabilities of the LIN stack which you need for your application. Additional add the “Product Identifier” and your e-mail address on your order sheet. The product identifier is bound to the computer and can be found on the license dialog after first installation of the tool. It looks like this:

5HUQ-G7HR-CB4Q.

The ***ihr*** GmbH sales department can create a license code for you only with this product identifier available. After the order is accepted by ***ihr*** GmbH, you’ll receive an e-mail with the license code. After you received the code, proceed in this way:

- Login as a system administrator.
- Then start the LDC application explicit as a System Administrator. Click with the right mouse button on the program file and select the line “Execute as an administrator”.
- Then select the “Info” tab and open the “License Entry” dialog window.
- Enter your user name in the upper line for licensee or owner. Take the user name as it is in the email, preferable by copy and past. If the user name is not identical, the license code will not work.
- Enter the license code in the lower line.

If it is the first license, press the register button. If you used already an evaluation license or the license code is an update for a previous installed license code, press the “Update” button. On successful registration of the license code you’ll see a screen like this:



License Owner: ihr GmbH

Product Identifier: 5HUQ-H1UH-3M25

License Key: 5IS1-79N4-1VNC-G9TA-AAA0-AG0L-AKGV

Expires after: The license expires in 3653 days

Licensee (Owner): ihr GmbH

License Key: 🟩

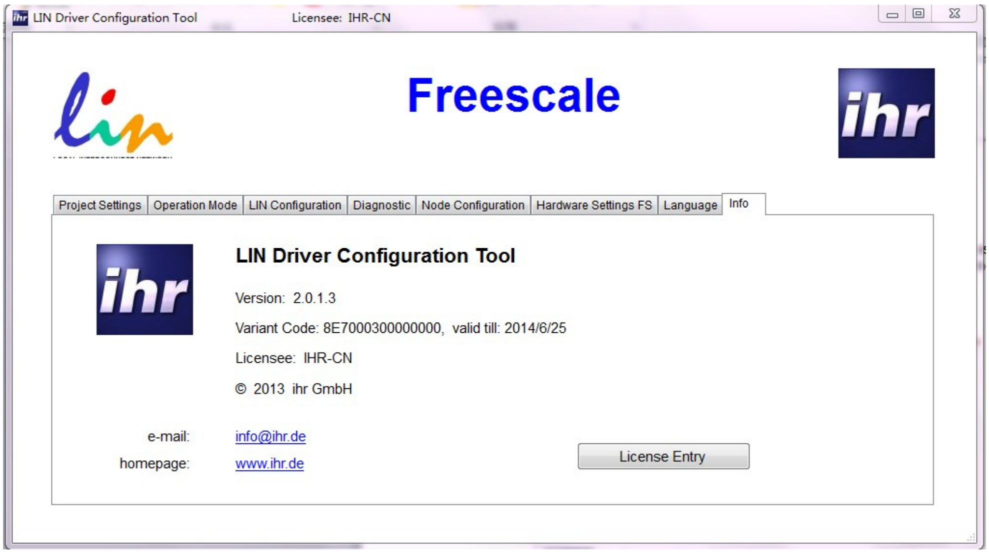
If the license registration fails, please check:

- Did you log in as an administrator?
- Did you start the program with administrator rights?
- Did you enter the user name correct (upper and lower case)?
- Is the license code correct?

Please be aware of:

- A license code is bound to one computer and can not be moved between different computers.
- A license code is granted to one licensee or user. The licensee can not be changed after first license code registration.
- If a license code is to be updated (except an evaluation license), an update must always have the same licensee registered.
- An update of the tool does not require a new license code registration.
- If you register a license code without administrator rights, the license will be valid only for this user, but not for all users of this computer!

If you exit the license dialog, you'll see a screen like this:



LIN Driver Configuration Tool

Version: 2.0.1.3

Variant Code: 8E7000300000000, valid till: 2014/6/25

Licensee: IHR-CN

© 2013 ihr GmbH

e-mail: info@ihr.de

homepage: www.ihr.de

The info tab shows all license and copyright related information about the LDC tool.

3 Using the LDC

3.1 The user interface

The LDC Tool offers a tabbed dialog with eight tabs. The tabs seven (Language) and eight (Info) are for administrative purpose and regular only used during setup phase.

The Tabs are:

1. Project settings
   Setting, saving and loading of project configuration files, setting of working directory
2. Operation Mode
   Application dependent run time parameter settings for the driver
3. LIN Configuration
   Administration of the related “LIN Description File”, Selection of LIN-Node
4. Diagnostic
   Settings for LIN diagnostic functionality
5. Node Configuration
   Individual settings of node operation and node specific parameters
6. Hardware settings
   Configuration of the hardware abstraction layer
7. Language
   Select your preferred language for the tool
8. Info
   Copyright and license information display

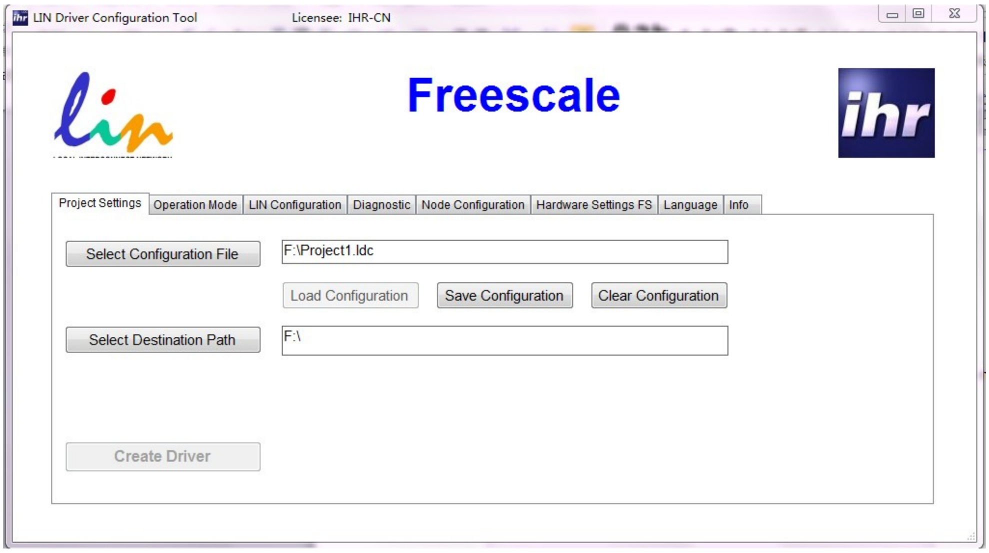
To configure a LIN driver straight forward, we recommend to select the tabs 1 to 6 and to fill in the forms strictly selecting the tabs from the left to the right side.

At the bottom in the first tab (project settings) there is a “Create Driver” button. At the beginning this button is not enabled. As soon as there is sufficient and consistent information available to create a functional driver, the button becomes enabled and changes color to green.

3.2 Tab “Project Settings”

On this screen you may:

- Select and load an existing LDC configuration file.
  A LDC configuration file has the suffix *.ldc
- Define a new LDC configuration file
- Load an existing configuration from a selected LDC configuration file
- Save a configuration into a LDC configuration file
- Clear a previous configuration
- Set path where LDC output should be stored.
  Normally this is your source code area for the LIN driver.



Licensee: IHR-CN

Select Configuration File: F:\Project1.ldc

Select Destination Path: F:\

3.2.1 Select Configuration File:

If you want to use an existing configuration file, click the “Select Configuration File” button and a windows file dialog is opened. Select the desired file and close the file selection dialog.

3.2.2 Load Configuration:

Now you can reload the selected file using the “Load Configuration” button and you can save modifications of the configuration into the selected file using the “Save Configuration” button. Configuration files have the suffix *.ldc. A selected file stays active as long as no other file is selected.

3.2.3 Save Configuration:

If you want to create a new configuration file, enter the filename and path into the field to the right of the “Select Configuration File” button and click the “Save Configuration” button.
A configuration may only be saved, when it is checked as a valid configuration. If the configuration is not consistent, the “Save Configuration” button is disabled, to prevent you from possibly overwriting a valid configuration by mistake.

3.2.4 Clear Configuration:

The “Clear Configuration” button erases all previous entered or loaded configuration data and creates a new empty configuration.

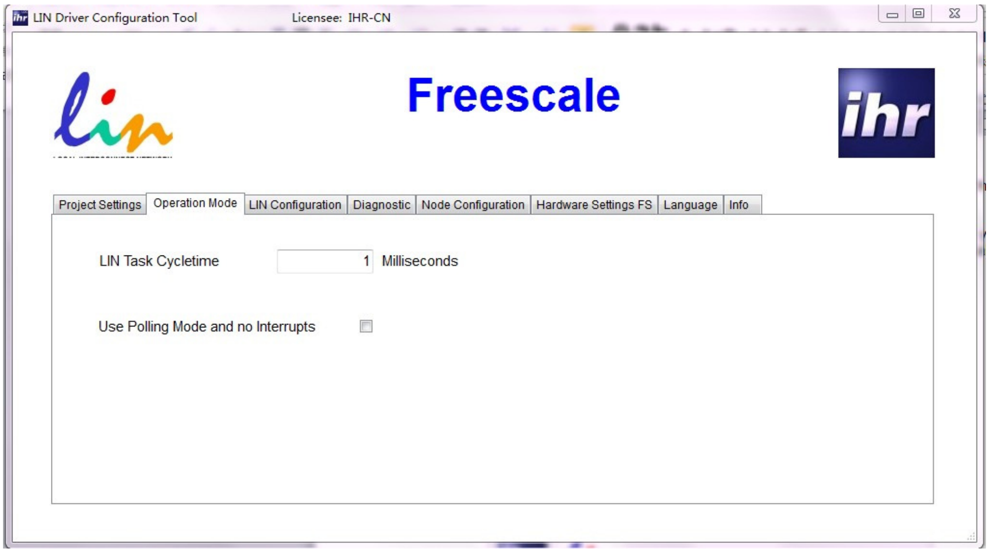
3.2.5 Select Destination Path:

To tell the LDC where the created code files are to be stored, select a working directory for your project by the “Select Destination Path” button. This opens a windows directory selection dialog to select the desired path or to create a new one.

3.3 Tab "Operation Mode"

This page configures how you integrate the LIN driver into your application. Currently there are two choices only:

- You have to give the time slice, how often the LIN task will be called by your application. Fill in the time period in milliseconds at which the “ld_task” will be called in your application. Typical values are between 1 to 5 milliseconds.
- You can select polling mode if you do not use interrupts.



LIN Task Cycletime 1 Milliseconds

Use Polling Mode and no Interrupts □

For details please refer to the LIN driver start up guide.

3.4 Tab "LIN Configuration"

3.4.1 Select LDF

Selects the “LIN Description File” (LDF) file of the LIN network. Select the LDF file corresponding to the project. The internal LIN-parser checks the syntax of the LDF file. If the LDF parser detects errors in the LDF file, a corresponding error message is displayed. The LDF parser accepts LDF files as per Standard LIN 1.3, 2.0, 2.1, and J2602 dependent on your license capabilities.

3.4.2 Edit LDF

With "Edit LDF" the Windows editor opens the selected LDF file to view and modify the LDF file if modifications are required. The program will remind to reload the LDF file to overtake the modifications into the LDC database.

3.4.3 Reload LDF

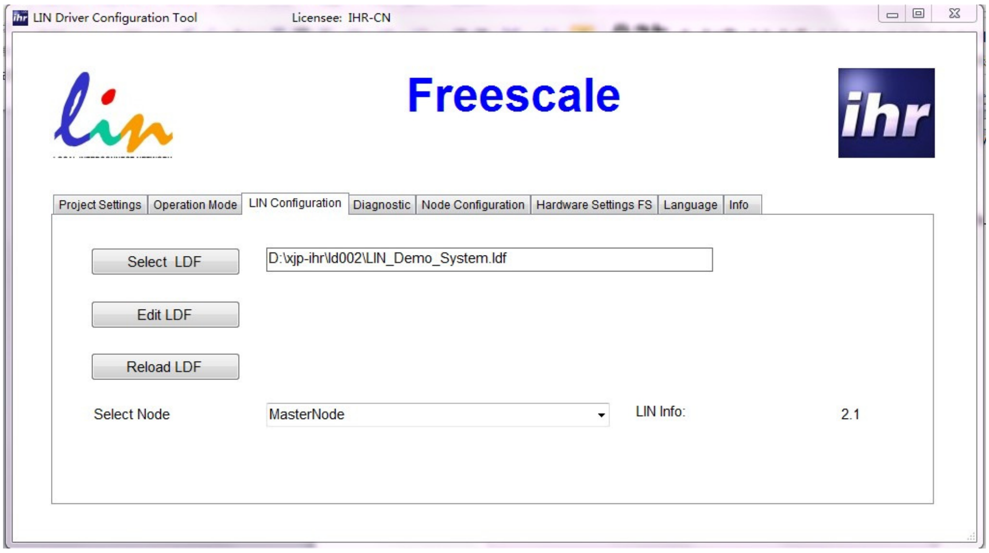
If the LDF file was modified, clicking this button reloads the file to overtake the modifications into the LDC database. If the LDF was modified outside the LDC-Tool the reminder to reload will not pop up.

3.4.4 Select Node

Select node chooses the node you want to design. Master nodes are only visible, if your license supports master nodes.

3.4.5 J2602 Option

This option depends on your license capabilities. If your node is not a standard LIN but a J2602 node, select this check box



D:\xjp-ihr\ld002\LIN_Demo_System.ldf

Select Node: MasterNode

LIN Info: 2.1

3.5 Tab "Diagnostics"

Diagnostic settings according to your LIN project.

3.5.1 LIN Standard Diagnostic

3.5.1.1 Cooked API

In the mode "Cooked API" the transport protocol layer is implemented in the LIN driver with a good flow control. The application exchanges the complete diagnostic messages to the drives. The driver handles the fragmentation and assembly of long messages (more than 5 data bytes). The buffers are available for application use during times without diagnostics.

3.5.1.2 Raw API

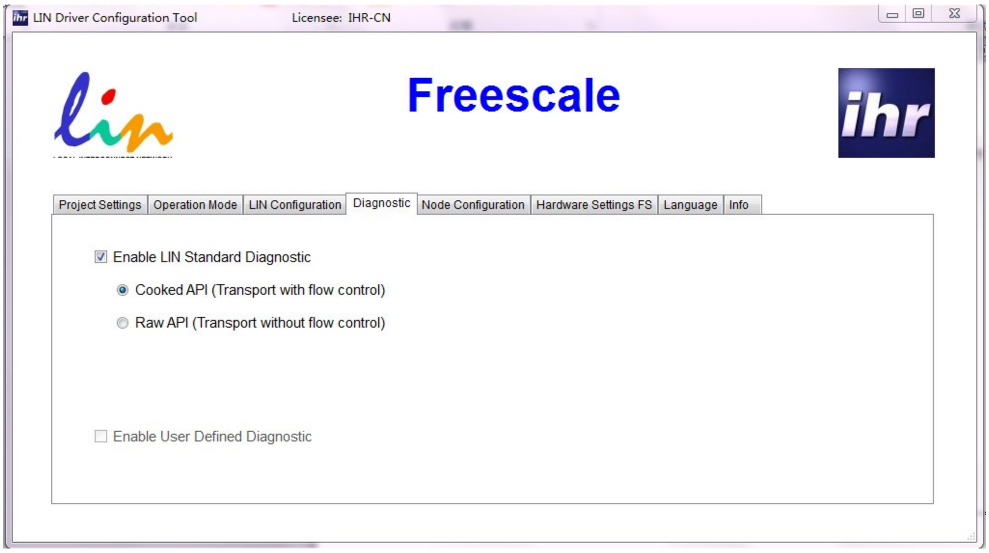
In the mode "Raw API" the driver exchanges whole frames, the transport protocol layer is also implemented in the LIN driver, but the flow control is not as good as with the Cooked API. The fragmentation of messages and formatting has to be done by the application itself. This if very useful if the first 2-4 bytes (depending on length of message) should not be reserved for the message overhead. The values "Receiver Queue Size" and Transmit Queue Size" need to be defined for memory resource allocation. The buffers are not available for application use.

3.5.2 User defined Diagnostic

Diagnosis services are to be implemented by the application as needed. This is useful, when the application use its own transport protocol layer or to reduce memory use in case of low level diagnostics. Complete flow control and transport layer have to be implemented in the application.

3.5.2.1 Mandatory Services

The standard mandatory LIN diagnosis services and only these will be implemented by the LIN stack (Read by ID – identifier 0 and depending on LIN 2.0 / 2.1 the assign frame ID or assign frame ID range service).



☑ Enable LIN Standard Diagnostic

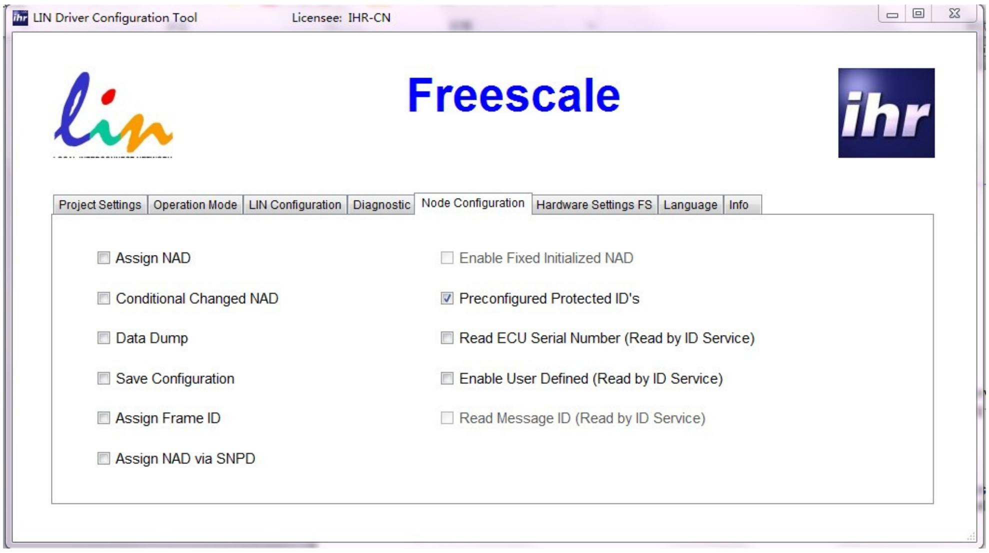
● Cooked API (Transport with flow control)

○ Raw API (Transport without flow control)

☐ Enable User Defined Diagnostic

3.6 Tab "Node Configuration"

Enables or disables some functionalities of the driver assigned to the specific node.



□ Assign NAD
□ Conditional Changed NAD
□ Data Dump
□ Save Configuration
□ Assign Frame ID
□ Assign NAD via SNPD
□ Enable Fixed Initialized NAD
☑ Preconfigured Protected ID's
□ Read ECU Serial Number (Read by ID Service)
□ Enable User Defined (Read by ID Service)
□ Read Message ID (Read by ID Service)

3.6.1 Assign NAD

This will enable the service “Assign NAD” (specified in the LIN specification 2.x). The service will be handled by the driver stack without intervention from the application. But saving the NAD in the NVM is still in the responsibility of the application.

3.6.2 Fixed Initialized NAD

This will set the initial NAD (as specified in LIN 2.1) to a value defined in the LDC regardless of the setting in the LDF. If the value is not set by the tool the value defined by the LDF will be taken. This can also be set for LIN 2.0.

3.6.3 Conditional Changed NAD

This will enable the service Conditional Assign NAD (specified in the LIN Specification 2.x). The service will be handled by the driver stack without intervention from the application. Saving the NAD in the NVM is still in the duty of the application.

3.6.4 Preconfigured Protected IDs

This will set the PIDs to the values defined in the LDF. If this option is unchecked, the PIDs will be set to zero and the node will not respond to any frame header. An initial configuration sequence has to be executed after first startup. There are several approaches to accomplish this. for example a configuration via LIN (assign frame ID / assign frame ID range are mandatory services for LIN 2.0 / 2.1).

3.6.5 Data Dump

This option enables the service Data Dump (specified in the LIN Specification 2.x). The driver stack will provide a declaration for a call-back function to treat the data received. The function has to be implemented by the application.

3.6.6 Read ECU Serial Number

This option enables the Read by ID service with identifier 1. The driver stack will provide a declaration for a call-back function to support the driver with the correct data. The function has to be implemented by the application.

3.6.7 Save Configuration

This option enables the service Save Configuration (specified in the LIN Specification 2.1). The status word will indicate a received request with the appropriate flag. It is in the responsibility to save the configuration.

3.6.8 Enable User Defined

This option enables the Read by ID services for identifiers 32-63 (specified in the LIN Specification 2.x). The driver stack will provide a declaration for a call-back function to supply the correct response for the received identifier. Please be aware that LIN 2.0 specification does not provide the possibility of a negative response when this feature is activated!

3.6.9 Assign Frame ID

This option enables the Assign Frame ID services (specified in LIN specification 2.0). On LIN 2.1 networks this option should be selected only for master nodes to ensure that compatibility with 2.0 slave nodes is given. For 2.0 nodes this service is mandatory and will be automatically generated. On LIN 2.1 slave nodes this function will not work correctly because the message identifiers needed for this service are not given.

3.6.10 Read Message ID

This option enables the Read by ID service for identifiers 16-31 (specified in LIN specification 2.0).

3.6.11 Assign NAD via SNPD

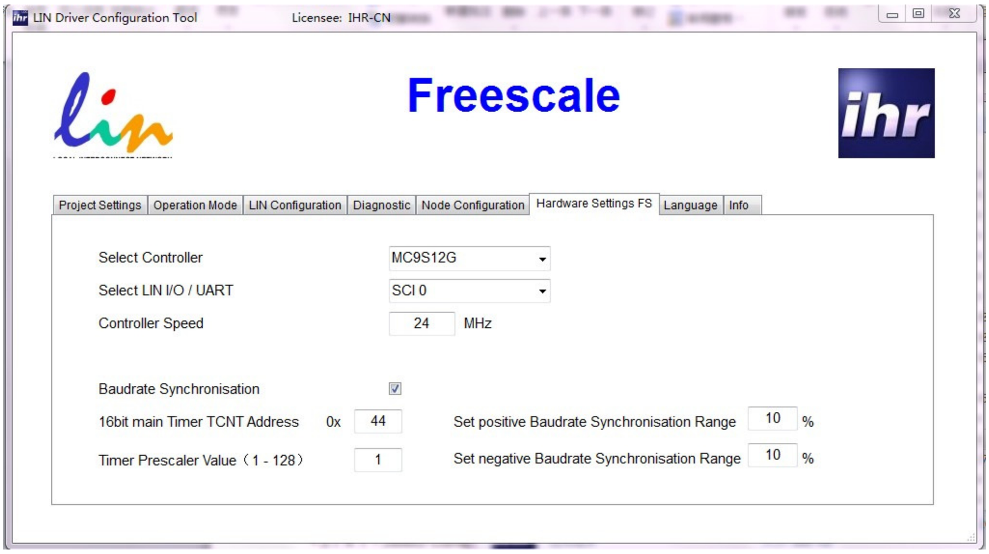
This option enables the Assign NAD via SNPD service. The driver stack will provide a callback function to the application to handle the requested service (start, stop, and configuration messages). This is not part of the standard driver but a separate add-on.

3.7 Tab "Hardware Settings"

This tab page depends on the microcontroller manufacturer supported by your license or, if your LDC is licensed for more than one microcontroller supplier, of the supplier selected on the “Project Settings” tab.

Ihr GmbH is permanently extending the number of supported microcontrollers. For details of hardware specific settings please refer to your microcontroller handbook. This chapter shows some samples of hardware setting pages, just to explain how settings should be done.

3.7.1 The Hardware Page



Select Controller MC9S12G

Select LIN I/O / UART SCI 0

Controller Speed 24 MHz

Baudrate Synchronisation ☑

16bit main Timer TCNT Address 0x 44

Timer Prescaler Value（1 - 128） 1

Set positive Baudrate Synchronisation Range 10 %

Set negative Baudrate Synchronisation Range 10 %

3.7.1.1 Select Controller

Select the controller family. The drop down box will show all microcontroller families from Freescale which are supported by the driver.

3.7.1.2 Select LIN IO/UART

Select the SCI serial number. This will be used to select corresponding SCI register.

3.7.1.3 Controller Speed

Enter the clock rate on which the controller is running. This will be used to calculate the baudrate register value. A higher MCU speed leads to a more accurate synchronized baudrate.

3.7.1.4 Baudrate Synchronisation

Choose to enable the baudrate synchronisation setting.

3.7.1.5 16bit Free Timer Counter Address

The 16-bit main timer of the Timer Module is a free running up counter. This will be used to calculate the synchronized baudrate value.

3.7.1.6 Timer Prescaler Value (1-128)

The value is the prescaler of the Timer Module. It is based on the user’s application, but should be within 1-128. A small prescaler leads to a more accurate synchronized baudrate.

3.7.1.7 Set positive Baudrate Register Range

Positive offset value. Define the max positive synchronize range.

3.7.1.8 Set negative Baudrate Register Range

Negative offset value. Define the max negative synchronize range.

4 LIN Conformance

The LIN driver is pre-tested:

- This means the driver has been tested embedded into a test application.
- A conformance report always states the tested components, only! Usually the report indicates the HW and SW release, so the report is valid for the certified configuration only!
- The application can have an influence on the operation of the LIN stack. Therefore each integration of the LIN driver has to be tested inside of its application.
- Some adjustments in the driver configuration can effect the LIN communication e.g. controller specific settings

5 Glossary

API = Application Programming Interface
ASIC = Application Specific Integrated Circuit
DUT = Device under Test
ECU = Electronic Control Unit
ETF = Event Triggered Frame
ID = Identifier (6 Bit without Parity Bits)
LIN = Local Interconnect Network
LDF = LIN Description File
NAD = Node Address
NVM = Non volatile Memory
NCF = Node Capability File
OTP = On time Programmable
PCI = Protocol Control Information
PID = Protected Identifier (6 Bits identifier + 2 Parity Bits)
SBC = System Basis Chip
SCI = Serial Communication Interface
SOC = System on Chip
UART = Universal Asynchronous Receiver/Transmitter

6 Document References

No.	Document/Description	Comment	Rev./ Date
1	ReleaseNote LDC-Tool.pdf	Updated for each LDC-Tool release containing the most recent changes as well as change history	2.x.x.x
2	LIN Specification 1.3		1.3
3	LIN Specification 2.0		2.0
4	LIN Specification 2.1		2.1
5	ihr_EULA_vx.x.pdf	current version is part of this delivery	

7 Change History

Status	Date	by	Remark
created	2013.07.11	JX	Initial draft
updated	2013.07.15	BR	Format update
reviewed			
released			

LDC - LIN Driver and Configuration Tool

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