



# INCA-FLEXRAY V7.3

## User's Guide

## Copyright

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INCA-FLEXRAY R01 EN - 03.2020

## Content

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<b>1</b>	<b>Introduction</b> .....	<b>4</b>
1.1	Safety Notice .....	4
1.2	General Description .....	4
1.3	Definitions .....	6
1.4	About this Manual .....	6
<b>2</b>	<b>Installing INCA-FLEXRAY</b> .....	<b>8</b>
2.1	Package Contents .....	8
2.2	System Requirements .....	8
2.3	Installing INCA-FLEXRAY from CD-ROM .....	8
<b>3</b>	<b>Using the INCA-FLEXRAY Add-on in INCA</b> .....	<b>10</b>
3.1	Setting Up the Workspace .....	10
3.2	Configuring the FlexRay Hardware .....	11
3.2.1	Configuring the FlexRay Hardware for FlexRay Monitoring .....	12
3.2.2	Configuring the FlexRay Hardware for Measurement and Calibration via XCP on FlexRay .....	15
3.2.3	Selecting a Startup/Sync Controller in the Hardware Configuration Editor .....	17
3.3	Configuring the Experiment and Starting FlexRay Monitoring .....	18
<b>4</b>	<b>Tips and Tricks</b> .....	<b>20</b>
4.1	Selecting Variables by Frame, ECU or Signal Group .....	20
<b>5</b>	<b>Restrictions</b> .....	<b>22</b>
5.1	Some FIBEX Data Types Are Not Supported .....	22
5.2	Data with FlexRay PreambleIndicatorBit Set Is Discarded .....	22
5.3	FlexRay Network Temporarily Shuts Down on Hardware Initialization .....	22
5.4	FlexRay Bus Load Leads to PC Overload .....	23
5.5	ASAM MCD-3 (New)ASAM MCD 3 V2.00.02 (object-oriented model), dating from 04.04.2005 / ASAP3 .....	23
5.6	Flashing and Diagnosis over the XCP Interface Are Not Supported .....	23
<b>6</b>	<b>ETAS Contact Addresses</b> .....	<b>24</b>

# 1 Introduction

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The FlexRay bus system is a standardized communication system which is becoming increasingly important for automotive engineering projects, because limitations of the amount of data on the CAN bus can be overcome, and redundancies make it possible to use FlexRay in safety-critical use cases. Moreover the deterministic design ensures a reliable transmission of messages.

INCA supports measurement and calibration of ECUs in vehicles that are equipped with a FlexRay bus by monitoring signals on the FlexRay channels in their physical representation, as well as measurement and calibration via the XCP on FlexRay interface. The time stamps of the data samples are synchronized with all other data sources within INCA to enable causal analysis as well as error tracking within the investigated system.

While performing the ECU calibration via ETK, CAN, or XCP on FlexRay, the user can sample the signals on the FlexRay channels and store them together with all other data acquired by INCA in the measurement file for offline analysis. For the user's convenience, the integration of FlexRay monitoring keeps close to the well known and established CAN-Monitoring functionality in INCA.

The signals to be calibrated or monitored can be selected from all signals available in the connected cluster; the FlexRay monitoring signals are defined in the FIBEX file, the measurement and calibration variables are defined in the project describing files (\*.a2l).

INCA imports the FIBEX file to get information on the FlexRay cluster. In addition, INCA uses the information from FIBEX to configure the interface hardware.

## 1.1 Safety Notice

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### **WARNING**

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Calibration activities influence the behavior of the ECU and the systems controlled by the ECU. This may result in unexpected behavior of the vehicle and thus can lead to safety critical situations.

Only well trained personnel should be allowed to perform calibration activities.

## 1.2 General Description

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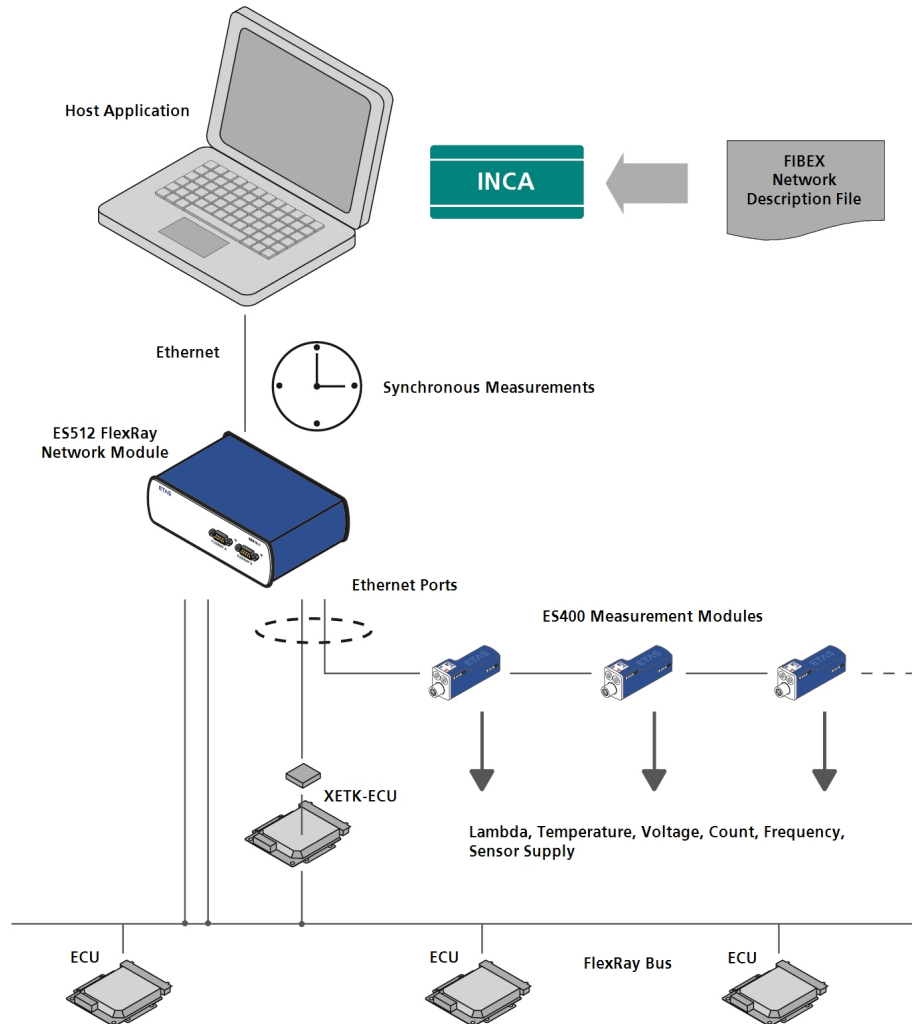
In typical FlexRay use cases, users often would like to carry out several tasks at the same time:

- Measuring and calibrating ECUs with ETK / CAN / XCP on FlexRay
- Monitoring the in-vehicle FlexRay Bus with synchronized time stamps
- Measuring signals and analyzing them later

In these tasks, the user would like to

- work with physical signals (temperature, voltage, ...)
- use files for the network description which are compliant to the FIBEX standard

INCA-FLEXRAY can fulfil all these requirements.



**Note**

The INCA-FLEXRAY add-on provides the FlexRay functionality. The support of FlexRay hardware in INCA is provided by means of the corresponding hardware add-ons for INCA. The hardware add-ons are delivered with the hardware modules and can be downloaded at the [ETAS Download Center](http://www.etas.com/en/download_center.php) ([http://www.etas.com/en/download\\_center.php](http://www.etas.com/en/download_center.php)).

## 1.3 Definitions

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### FlexRay

FlexRay is a scalable and fault tolerant communication system for high-speed and deterministic data exchange. FlexRay's time-division multiplexing facilitates the design of modular or safety-related distributed systems. Its high bandwidth of 10 MBaud on two channels helps to cope with the high network load caused by the increasing amount of innovative electronic systems in modern vehicles.

The communication system's specifications are released by the FlexRay consortium which is widely supported by vehicle manufacturers and suppliers worldwide.

### FIBEX

FIBEX (Field Bus Exchange) is an exchange format based on XML schema which is used for complete descriptions of the in-vehicle communication network. FIBEX is defined for various network types (CAN, LIN, MOST, FlexRay) and contains information about the bus architecture, signals, controller properties etc.

INCA uses FIBEX files to align tools and ECUs with the communication scheme given by the FlexRay cluster, i.e. the FIBEX file defines the signals which can be monitored via INCA in the connected cluster, and it contains data for the configuration of the interface hardware. The FIBEX file describes the whole FlexRay cluster; there is only one FIBEX file per cluster. If you are using the XCP on FlexRay interface, the definitions in the FIBEX file (description of the FlexRay cluster with the reserved frames for the XCP protocol) and the definitions in the A2L files of the ECUs that are part of the cluster (description of the available buffers for the XCP protocol of one ECU) must be consistent.

The FIBEX files have to be provided by the vehicle manufacturer.

The FIBEX file format is standardized by ASAM (Association for Standardisation of Automation- and Measuring Systems).

For further information please refer to the description of the FIBEX standard at <http://www.asam.net>.

### XCP

eXtended Calibration Protocol; XCP is a vendor- and interface-independent protocol for communication between calibration tools and control units. XCP was specified in the ASAM e.V.

## 1.4 About this Manual

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This manual addresses qualified personnel working in the fields of automobile ECU development and calibration. Specialized knowledge in the areas of measurement and control unit technology is required. Moreover users need to be able to work with INCA and know the basic functionality.

The INCA-FLEXRAY manual consists of the following chapters:

- "Introduction" on page 4  
This chapter contains some general information on the INCA-FLEXRAY add-on and the underlying concepts.
- "Installing INCA-FLEXRAY" on page 8  
The installation chapter contains information on the scope of delivery, hardware and software requirements and describes the procedures used to install INCA-FLEXRAY.
- "Using the INCA-FLEXRAY Add-on in INCA" on page 10  
This chapter addresses users who are new to INCA-FLEXRAY. Practice-oriented examples in tutorial style show you how to use INCA-FLEXRAY.
- "Restrictions" on page 22  
This chapter provides information on restrictions within INCA-FLEXRAY.
- "Tips and Tricks" on page 20  
This chapter contains tips and tricks for the user.

## 2 **Installing INCA-FLEXRAY**

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This chapter is for all users who install the INCA-FLEXRAY add-on on a PC. It also contains information on hardware and software requirements and the preparation required for installation.

### 2.1 **Package Contents**

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The INCA-FLEXRAY add-on consists of the following items which have to be ordered separately:

- INCA-FLEXRAY software license
- CD ROM including
- Program files for the INCA-FLEXRAY add-on
- Manual in PDF format (Acrobat Reader)
- Product information in PDF format (Acrobat Reader)
- Demo Clip in avi format (Windows Media Player)

### 2.2 **System Requirements**

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INCA-FLEXRAY requires the following hardware and software:

- INCA Vx.y;  
Refer to the INCA Getting Started manual for the INCA system requirements.
- INCA-FLEXRAY hardware interface

### 2.3 **Installing INCA-FLEXRAY from CD-ROM**

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Please note that you must have administrator privileges to install the INCA-FLEXRAY add-on.

#### To install the INCA-FLEXRAY Add-on

1. Make sure that INCA is installed on your computer and that the release number of the INCA installation is compatible with the release number of the INCA-FLEXRAY add-on.
2. Close all active programs.
3. Insert the CD with the installation program into the CD-ROM drive of your computer.
4. If the installation CD does not start automatically, either execute the `autostart.exe` program on the CD to start the user interface of the CD or search for the `Inca_AddOn-FLEXRAY.exe` program on the CD and double-click it to start the installation routine manually.



5. Follow the instructions in the installation routine to install the INCA-FLEXRAY add-on on your computer.

## 3 Using the INCA-FLEXRAY Add-on in INCA

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This chapter gives an example of how INCA-FLEXRAY can be used in INCA. It describes a typical course of action for FlexRay monitoring as well as measurement and calibration via the XCP on FlexRay interface.

Before you can start monitoring the FlexRay bus via INCA, you have to prepare INCA for that task. Working with INCA-FLEXRAY comprises the following basic tasks:

- Setting up the workspace in the Database Manager
- Configuring the FlexRay hardware in the Hardware Configuration Editor
- Configuring the experiment and starting monitoring and calibrating in the Experiment Environment

The course of action resembles the usual procedure for preparing and carrying out measurement and calibration tasks. For the description of the FlexRay cluster, however, FIBEX files are used. These are handled in the same way as CANdb files.

The following sections describe the basic procedures applied when working with FlexRay from within INCA. In some cases there is more than one way of performing a task, e.g. FIBEX files can be added either in the Database Manager or in the Hardware Configuration Editor. The following description provides an example of one typical course of action.

### 3.1 Setting Up the Workspace

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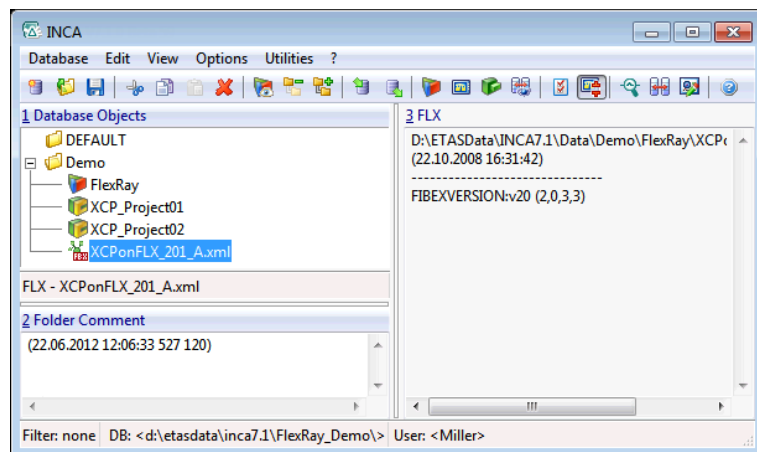
In the first step of preparing FlexRay monitoring, you create a new database and workspace and add a FIBEX file to the database.

The FIBEX file has to be provided by the vehicle manufacturer. It contains a description of the configuration of the measurement hardware as well as of the signals which are available through the FlexRay bus.

#### To set up the Workspace

1. First, create a new database. and therefore select **Database** → **New**.
2. In the "New Database" dialog, enter `FlexRay_Demo`.
3. Click **OK**.
4. Create a top folder in the database. Therefore, select **Edit** → **Add** → **Add top folder**.
5. Rename the new folder `Demo` and press <ENTER>.
6. Make sure the top folder you want to create the workspace in is selected. Here, select the `Demo` folder.
7. Select **Edit** → **Add** → **Workspace**.
8. Rename the new workspace `FlexRay` and press <ENTER>.

9. Then add a FIBEX file to the database. Select the top folder Demo.
10. Select **Edit** → **Add** → **FIBEX**.  
A dialog pops up where you can select the desired FIBEX file.
11. Select the FIBEX file and click **Open**.
12. Next, add the ECU project files to the database that are describing the ECUs used in your FlexRay cluster. Make sure the top folder Demo is selected.
13. Select **Edit** → **Add** → **ECU-Project (A2L)**.  
A dialog pops up where you can select the desired ECU project.
14. Select the A2L file and click **Open**.  
A dialog pops up where you can select the desired dataset for the project
15. Select the dataset file (hex file) and click **Open**.  
In the same way, add an ECU project and dataset for any other ECU that is part of the FlexRay cluster.



## 3.2 Configuring the FlexRay Hardware

After having set up the workspace, you must add the hardware to your configuration.

In the case of FlexRay monitoring or measurement and calibration via the XCP on FlexRay interface, you assign a FIBEX file to the hardware used. The FIBEX file contains hardware and signal related information such as formulas for automatic conversion to physical signal values, therefore making complex parameter entries obsolete. One FIBEX file describes the complete cluster.

For the XCP devices, you assign an ECU project file to the hardware used. The ECU project file describes the available buffers for the XCP protocol for an ECU. There must be one ECU project file for each ECU.

 **Note**

Make sure that the description in FIBEX and the description in the ECU project files are consistent. Otherwise the hardware cannot be successfully initialized.

The following sections describe the hardware configuration separately for FlexRay Monitoring and for measurement and calibration via XCP on FlexRay.

### 3.2.1 Configuring the FlexRay Hardware for FlexRay Monitoring

#### To add the FlexRay Hardware for FlexRay Monitoring

1. In the Database Manager, select the FlexRay workspace. Then click the **Configure Hardware** icon above the **Hardware** listbox to start the "Hardware Configuration Editor".
2. In the Hardware Configuration Editor, add the FlexRay hardware for FlexRay Monitoring and assign the FIBEX description. Therefore, select **Device** → **Insert**.

The "Add hardware device" dialog appears, showing a list of interfaces with available devices.

3. Expand the "ES512" folder by clicking on the **+** sign in front of it, then expand the "FLX" folder and select the entry **FLX Monitoring A**.

4. Click **OK**.

A dialog appears, where you can select the FIBEX file with the description of the FlexRay communication.

5. Select the FIBEX file.
6. Click **OK**.

In the following section you first get some more background information about configuring the FlexRay controller before continuing with the step by step instruction on "To configure and initialize the FlexRay hardware" on page 14.

One FlexRay bus consists of two physical channels: channel A and channel B. One FlexRay controller on a controller handles both channels A and B. The channels are not independent. All controllers connected to one net represent one 'cluster'.

INCA receives all frames on both FlexRay channels of all interfaces connected to INCA. It can monitor 1 to 4 FlexRay clusters in parallel (i.e. 1 to 8 FlexRay channels).

In the next step, after having selected the **FLX:1** controller in the **Hardware devices** list, you can select a controller for the configuration of the INCA-FLEXRAY hardware interface. The **Controller** drop down list contains all controllers that are defined in the FIBEX description file<sup>1</sup>.

Finally, you define which controller will be used for FlexRay startup.

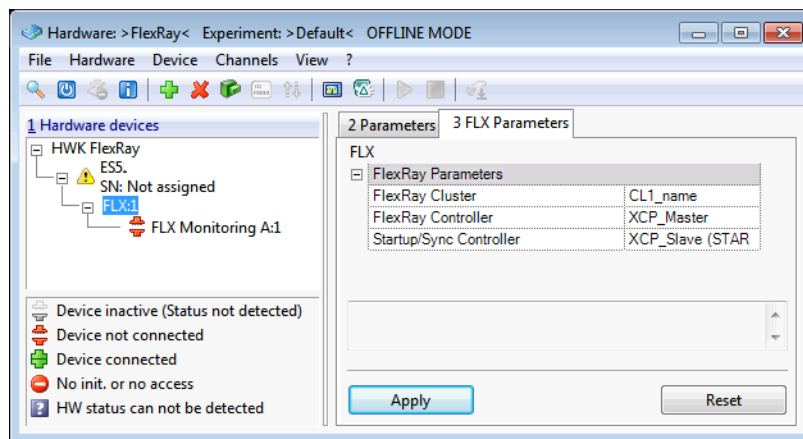
The FlexRay specification requires that for safety reasons, a FlexRay cluster must have at least three startup controllers. The FlexRay cluster still works with two startup controllers. The ES520 monitoring device also works in clusters where only one startup controller is present, because it is able to represent the second startup controller itself.

The number behind the string STARTUP describes the slot ID (KEY\_SLOT\_ID) in decimal representation that is used for sending the startup information. By selecting such a controller, you determine that INCA represents the second startup controller, which enables INCA to monitor communication on a FlexRay network in environments with only one physical startup controller.

The following figure shows an example of an INCA hardware configuration with a startup controller selected.

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1. FlexRay knows three different types of controllers: 1. Startup controllers: controllers that are used for startup of the FlexRay network. Startup controllers are listed in FIBEX and therefore also in INCA with the appendix "STARTUP nn", where nn represents the slot ID used for sending the startup information. Example for notation in FIBEX: `<flexray:STARTUP-SYNC>60</flexray:STARTUP-SYNC>`. 2. Sync controllers: controllers that are used for time synchronization of the controllers in the network. Sync controllers are listed in FIBEX and therefore also in INCA with the appendix "SYNC nn", where nn represents the slot ID used for sending the sync information. Startup controllers are always also sync controllers and can be used as such. Example for notation in FIBEX: `<flexray:SYNC>89</flexray:SYNC>`. 3. Integration controllers: all other controllers, which can be used to configure FlexRay monitoring. The names of integration controllers are not specifically indexed. Example for notation in FIBEX: `<flexray:NONE/>`



### Note

Certain devices, e.g. the ES595 FlexRay Network Module, support the ability to initiate two startups. If you are using such a device, an additional field is added in the Hardware Configuration Editor where you can select the second startup/sync controller.

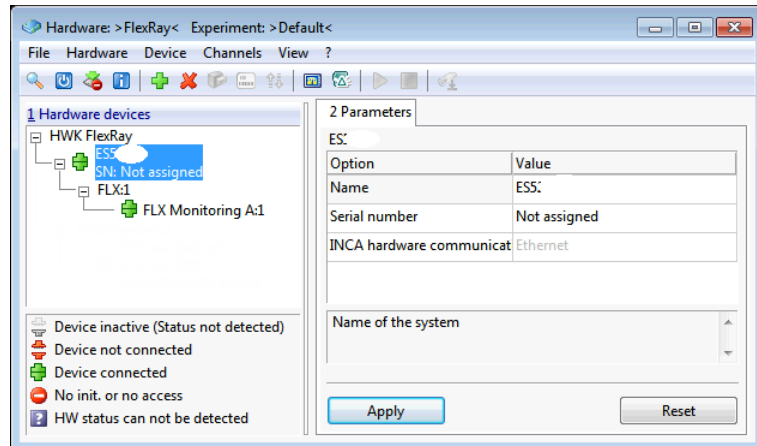
After having got this background information, you can now go on with selecting a controller and initializing the hardware:

#### To configure and initialize the FlexRay hardware

1. In the **Hardware devices** list, select the **FLX:1** controller.
2. In the **FLXParameters** list, click in the field on the right of the **FlexRay Cluster** field. Click it once again to open the list of available clusters.
3. Select the desired cluster.  
Please note that if the FIBEX file defines only one cluster, the list contains only one entry.
4. In the **FLXParameters** list, click in the field on the right of the **FlexRay controller** field. Click it once again to open the list of available controllers.
5. Select the controller you would like to use to configure the INCA-FLEXRAY hardware interface.
6. In the **FLXParameters** list, click in the field on the right of the **Startup/Sync controller** field. Click it once again to open the list of available controllers with startup functionality.
7. Select the controller you would like to use for FlexRay startup.
8. Select **Hardware** → **Initialize hardware**.

The "Connect Devices" dialog box opens where you can map physically connected devices to devices created in the Hardware Configuration Editor.

9. Assign the devices and click **OK**.



### 3.2.2 Configuring the FlexRay Hardware for Measurement and Calibration via XCP on FlexRay

You can now add XCP devices to the FlexRay cluster.

As you have already assigned the FIBEX description to the **FLX:1** controller in the **Hardware devices** list of the Hardware Configuration Editor, the description of the FlexRay cluster is already available, and you can skip this step in the configuration of the XCP on FlexRay interface. If, however, you start the hardware configuration with adding XCP devices to your Flexray cluster, you must also assign a FIBEX file to the FLX controller and configure the controller as described in "[Configuring the FlexRay Hardware for FlexRay Monitoring](#)" on [page 12](#).

To make it easier to configure the hardware, the controller that contains "XCP" in its name is automatically selected as the device controller.

#### To add the XCP devices to the FlexRay cluster

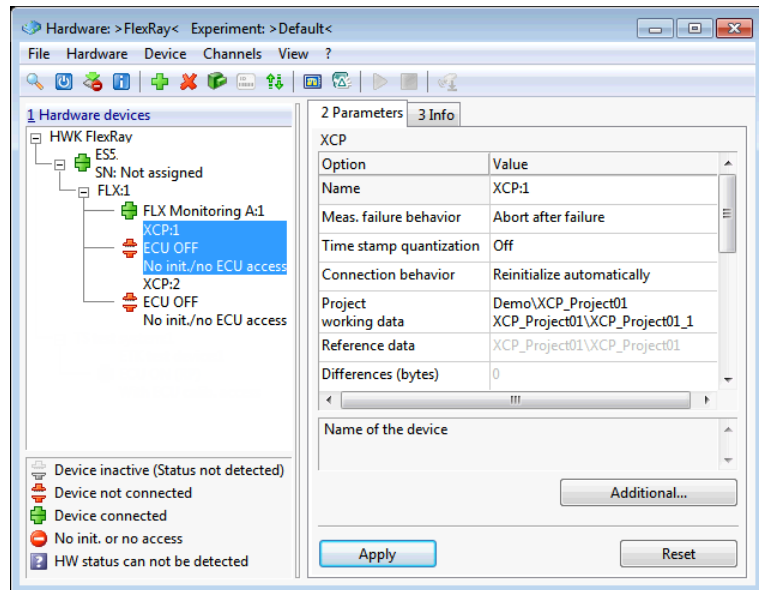
1. In the Hardware Configuration Editor, add the hardware for measurement and calibration via XCP on FlexRay and assign the ECU project descriptions. In the Hardware devices list, select the FlexRay controller **FLX:1**.
2. Select **Device** → **Insert**.  
The "Add hardware device" dialog appears. The "FLX" folder of the ES520 is already expanded.
3. Select the entry **XCP**.
4. Click **OK**.  
A dialog appears, where you can select the ECU project (A2L file) describing the ECU.
5. Select the A2L file in the **Projects** list box, then select the dataset in the **Datasets** list box.

6. Click **OK**.

In the same way, add an XCP device for any other ECU that is part of the FlexRay cluster.

**Note**

INCA supports up to 16 XCP on FlexRay devices.



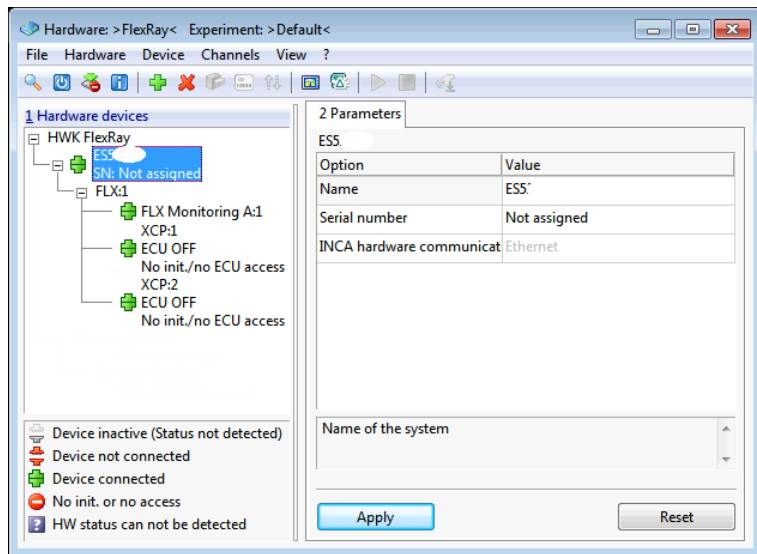
### To initialize the FlexRay hardware

1. Select **Hardware** → **Initialize hardware**.

The Connect Devices dialog box opens where you can map physically connected devices to devices created in the Hardware Configuration Editor.

2. Assign the devices and click **OK**.



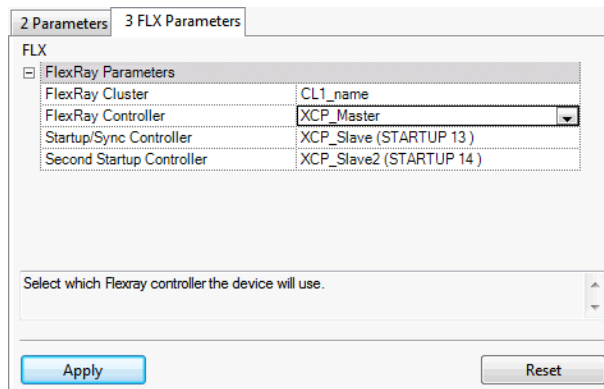


You have now finished hardware configuration and can close the Hardware Configuration Editor. The FlexRay interface will join the FlexRay communication as soon as the other participants in the cluster are present.

### 3.2.3 Selecting a Startup/Sync Controller in the Hardware Configuration Editor

To select a startup/sync controller

1. If a FIBEX file is assigned to the workspace, on the **3 FLX Parameters** tab select the **FlexRay Controller**.



Select the controller which you want to use as startup/sync controller with the communication controller. You can select any available controller with startup/sync functionality.

It is only necessary to select a startup/sync controller when INCA is used in networks that do not contain at least two startup/sync controllers.

Some hardware devices, e.g. the ES595 FlexRay Network Module, have two startup controllers. If you are using such a hardware device, you can finally select a second startup/sync controller (optional).

### 3.3 Configuring the Experiment and Starting FlexRay Monitoring

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In the Experiment Environment you can select all signals for monitoring which are defined in the FlexRay part of the FIBEX file.

#### To configure the Experiment

1. In the Database Manager, select the FlexRay workspace.
2. Click the **Start Experiment** icon above the **Experiment** listbox to open an experiment in the Experiment Environment.
3. Select and configure the variables you would like to add to the experiment. In the **Experiment** window, select **Variables** → **Variable Selection**.

The "Variable Selection" dialog opens.

4. In the list **Sources**, select the device **FLX Monitoring A:1**.

The variables list now shows all variables in alphabetical order that belong to this device. It might happen that you do not see the variables that you expect or that there are no variables displayed at all; in this case please verify that there is no filter being used. If required, you can deactivate all filters by clicking on the **Clear all filters**  icon in the toolbar.

If you are interested only in variables for individual functions, you can expand the tree in the **Sources** list by clicking on the + sign left of the device and select only the desired functions. The variables list only displays the variables of the selected functions. Depending on the definition in the FIBEX file, signals might also be grouped by frame, ECU or signal groups (see "[Selecting Variables by Frame, ECU or Signal Group](#)" on page 20). Summarizing these explanations, you can select variables in one of the following ways:

- You click on the FlexRay device and select the desired signals from a complete list of signals for that device.
- You expand the tree structure of the FlexRay device by clicking on the + sign in front of it, click on a function and select the desired variables from a list of signals associated with that function. For both devices and functions, the same icon representing a devices hierarchy is used in the tree view of the **Sources** list.
- You expand the tree structure of the FlexRay device by clicking on the + sign in front of it, further expand one of the groups for frames, ECUs or signal groups and click on the desired items. Afterwards you can select the desired variables from a subset containing signals associated with the selected frames, ECUs or signal groups. Groups are represented by the following icon in the tree view of the

**Sources** list:

5. In the variables list, select all variables you would like to monitor.  
Please note that further information is displayed in the information pane of the dialog as soon as you select a variable
6. In the list **Sources**, select one of the XCP device that you have added to your workspace.
7. In the variables list, select all variables you would like to measure or calibrate.
8. Click **OK** to add the selected variables to the Experiment window.
9. Select **Experiment** → **Save**.  
The Save as dialog appears.
10. In the list **Database Objects** select the Demo folder to add the experiment to the folder.
11. Then enter the name `Monitoring_Exp` in the list **Item name** and click **OK**.

**To start Monitoring / Measuring**

1. Click <F11> to start visualization without recording.
- or*
- Click <F12> to start recording.

**To start Calibrating**

1. Make sure that the Working Page is activated.
2. Perform your calibration tasks as usual.

For detailed information on how to perform calibration tasks please see the INCA tutorial.

## 4 Tips and Tricks

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This section provides some help information for tasks which might be difficult to understand or can be optimized by means of little tips and tricks.

### 4.1 Selecting Variables by Frame, ECU or Signal Group

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When you determine which variables are to be used in the INCA Experiment Environment for measurement and calibration tasks, you usually first select a device or a function of that device and then select the desired variables from a plain list in the "Variable Selection" dialog.

In case of CAN Monitoring devices, the variables are also grouped by CAN frames so that you can either select the variables from a list of all variables or from a sub-list of variables belonging only to the selected CAN frame.

According to the same principle, the variables of a FlexRay device can be grouped by one of the following categories:

- Grouping by frames:

When you select a frame in the **Sources** list, the variables list shows all signals located in the selected frame.



#### Note

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Depending on the description in the FIBEX file, the same signal can occur in different frames.

- Grouping by ECUs:

When you select an ECU in the **Sources** list, the variables list shows all TX-signals of the selected ECU (i.e. signals that are sent by the ECU).

- Grouping by signal groups<sup>1</sup>:

When you select a signal group in the **Sources** list, the variables list shows all signals that are part of the selected signal group.



#### Note

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Only those groupings are available in the "Variable Selection" dialog that are defined in the FIBEX file provided by the vehicle manufacturer. If the FIBEX file does not contain any of these groups, the FlexRay device does not contain any branches for groups in the **Sources** tree structure, and the variables belonging to the FlexRay device can only be selected from a plain list.

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<sup>1</sup>. In this context the term "signal group" refers to the signal groups as specified in the FIBEX file in the <requirements> section. FIBEX specifies that all signals of a signal group must be located in one frame.

In the "Variable Selection Dialog", each group is depicted by the following icon:



## 5 Restrictions

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This product has been manufactured with the utmost care for quality, usability and completeness in terms of users' expectations.

Nevertheless there are constraints that need to be considered when using this product.

### 5.1 Some FIBEX Data Types Are Not Supported

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INCA supports all signal data types usually used. This includes data types of up to 32 bit and float 64 data types.

Some minor data types are not supported in INCA and therefore removed from the imported FIBEX file:

- Signals with data types longer than 32 bit (A\_UINT64, A\_INT64)
- Signals with the data type A\_UNICODE2STRING
- Signals with the data type A\_BYTEFIELD
- Signals with the data type A\_BITFIELD
- Signals with the data type OTHER

The .log files for the FIBEX import report any removal of data types from the FIBEX file.

### 5.2 Data with FlexRay PreambleIndicatorBit Set Is Discarded

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The FlexRay specification defines a preamble indicator bit for NetworkManagement and special filtering applications.

INCA-FLEXRAY discards the data of FlexRay frames where the preamble indicator bit is set:

- The NetworkManagement information is neither captured nor used.
- Message filtering in the dynamic segment is not applied.
- The log file `A1b_FlexRayMon.log` logs events where data was discarded.

### 5.3 FlexRay Network Temporarily Shuts Down on Hardware Initialization

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The add-On INCA-FLEXRAY is able to represent one startup/sync controller in a FlexRay network.

In cases where only two startup/sync controllers are present in the connected cluster a re-initialization of the measurement hardware will result in a temporary shutdown of the FlexRay network.

## 5.4 **FlexRay Bus Load Leads to PC Overload**

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FlexRay delivers a high amount of data to measurement systems.

Multiple FlexRay channels with high bus load may lead to an overload situation for the PC.

The following setup is recommended to avoid overload situations:

- 3 GHz PC in idle mode (no further task or measurement)

## 5.5 **ASAM MCD-3 (New)<sup>1</sup> / ASAP3**

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When using the remote control functionality (ASAM-MCD3 MCD or ASAP3) you need to select "FRAME AVAILABLE" from the available rasters to monitor FlexRay signals.

## 5.6 **Flashing and Diagnosis over the XCP Interface Are Not Supported**

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The XCP on FlexRay interface only supports measurement and calibration use cases; flash programming and diagnosis are not supported. If you need to flash code and/or data to the ECU, you can use other flash ports according to your system configuration.

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<sup>1</sup>. ASAM MCD 3 V2.00.02 (object-oriented model), dating from 04.04.2005

## 6 ETAS Contact Addresses

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### ETAS Headquarter

ETAS GmbH

Borsigstraße 24

Phone: +49 711 3423-0

70469 Stuttgart

FAX: +49 711 3423-2106

Germany

Internet: [www.etas.com](http://www.etas.com)

### ETAS Subsidiaries and Technical Support

For details of your local sales office as well as your local technical support team and product hotlines, take a look at the ETAS website:

ETAS subsidiaries

Internet: [www.etas.com/en/contact.php](http://www.etas.com/en/contact.php)

ETAS technical support:

Internet: [www.etas.com/en/hotlines.php](http://www.etas.com/en/hotlines.php)