ETAS INCA-MIP V7.5

User Guide

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INCA-MIP V7.5 I User Guide R02 EN I 06.2024

Contents

1 Introduction

1.1 Intended Use

INCA and INCA add-ons are developed and approved for automotive applications and procedures as described in the user documentation for INCA and INCA add-ons.

The INCA-MIP add-on (INCA MATLAB® Integration Package) is an application programming interface that controls INCA's functionality from within MATLAB®.

INCA and the INCA add-ons are intended to be used in industrial labs and in test vehicles.

ETAS GmbH cannot be made liable for damage that is caused by incorrect use and not adhering to the safety information.

1.2 Target Group

This software product and this user guide address qualified personnel working in the fields of automotive ECU development and calibration, as well as system administrators and users with administrator privileges who install, maintain, or uninstall software. Specialized knowledge in the areas of measurement and ECU technology is required.

To use the INCA-MIP API, you should be familiar with both INCA and MATLAB®. You should also be familiar with using scripts in MATLAB®.

1.3 Classification of Safety Messages

Safety messages warn of dangers that can lead to personal injury or damage to property:

DANGER

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

WARNING

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

CAUTION

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

NOTICE

NOTICE indicates a situation that, if not avoided, could result in damage to property.

1.4 Safety Information

Observe the following safety information when working with INCA and INCA add-ons:

WARNING

Risk of unexpected vehicle behavior

Calibration activities influence the behavior of the ECU and the systems that are connected to the ECU.

This can lead to unexpected vehicle behavior, such as engine shutdown as well as breaking, accelerating, or swerving of the vehicle.

Only perform calibration activities if you are trained in using the product and can assess the possible reactions of the connected systems.

WARNING

Risk of unexpected vehicle behavior

Sending messages via bus systems, such as CAN, LIN, FlexRay, or Ethernet, influences the behavior of the systems connected to it.

This can lead to unexpected vehicle behavior, such as engine shutdown as well as breaking, accelerating, or swerving of the vehicle.

Only perform the sending of messages via a bus system if you have sufficient knowledge in using the respective bus system and can assess the possible reactions of the connected systems.

Adhere to the instructions in the ETAS Safety Advice and the safety information given in the online help and user guides. Open the ETAS Safety Advice in the INCA help menu **? > Safety Advice**.

1.5 Data Protection

If the product contains functions that process personal data, legal requirements of data protection and data privacy laws shall be complied with by the customer. As the data controller, the customer usually designs subsequent processing. Therefore, he must check, if the protective measures are sufficient.

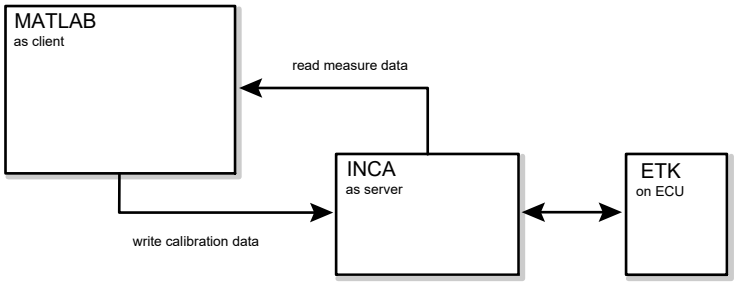
1.6 Data and Information Security

To securely handle data in the context of this product, see the INCA Help section “Data and Information Security”.

2 About INCA-MIP

The INCA-MIP Add-On (INCA MATLAB® Integration Package) is an application programming interface that controls INCA's functionality from within MATLAB®. Within this context, MATLAB® acts as a client accessing INCA's resources, which in this case is the server.

The following chart illustrates a typical application for the INCA-MIP API, using INCA to address an ETK.



The following overview outlines the INCA functionality that can be accessed from within MATLAB®.

Memory Page Management

Switching back and forth between memory pages and downloading memory pages to the control unit are supported.

Calibrating

All the calibration variables for an INCA experiment can be modified. The values can be read and updated for each element and for the associated break point distributions, where applicable.

Measuring

All measurement variables from an INCA experiment can be read. In addition, measurements can be started and stopped from within MATLAB®. All performance data that are available in INCA can also be accessed from MATLAB®. The performance data throughput at the INCA-MIP interface has been optimized.

Since INCA generates measurement and calibration variables as doubles, conversion formulas for reprocessing in MATLAB® are not required.

The INCA API functions described in this document are invoked from MATLAB® scripts (so-called M files), which can be used to define the entire control flow for INCA experiments.

The following chapters describe the underlying architecture for the INCA-MIP API and the available API functions as well as the installation procedures. MATLAB® or INCA operation falls outside the scope of this manual.

2.1 INCA Definitions

The API description uses certain technical terms that experienced INCA users should be familiar with. Below is a brief definition of these terms.

Calibration Variable

A calibration variable is an element that can be read and modified. Calibration variables can be scalars, vectors, matrices, curves and maps. The associated break point distributions can also be read and modified.

Data record

A record consists of a time stamp and all the measurement values in a signal group for a single acquisition. The measurement data for a signal group consists of several records that are generated throughout the entire measurement process.

Device

A measuring device used for capturing measurement variables within a certain measurement grid. Some measuring devices also support calibration for corresponding variables. For example, SMB devices can be used for measurements only, while the ETK is suitable both for measurements and calibrations.

Measure Data

All the records captured in one measurement for individual measure rasters.

Measurement Raster

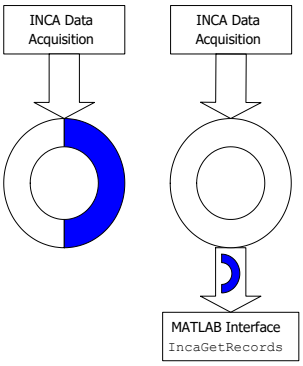
Acquisition rate (measuring frequency) used for measuring one or more signals in a signal group.

It is possible to combine two or more rasters in a so-called multi-raster. This is done by simply combining the raster names by means of a '+' character, e.g. `'10ms+100ms'`. When using such a multi-raster, a new virtual raster is created. Each signal can only be measured in exactly one raster or multi-raster.

Ring Buffer

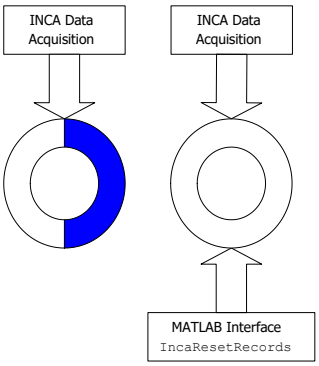
To ensure a reliable transfer of measurement data from INCA to MATLAB®, a dedicated ring buffer is used for each measurement raster (signal group). During an INCA online visualization or recording the acquired measurement data is automatically saved in the ring buffer.

The command `IncaGetRecords` can be used to read the time stamps and data from the ring buffer into MATLAB®:



The ring buffer is limited to 1 MByte per signal and can hold up to approximately 8 seconds of measurement data depending on the measurement rate. After this time old measurement data will get overwritten. To avoid losing data `IncaGetRecords` periodically has to be executed. Typically this will be done about once each second.

With the command `IncaResetRecords` the time stamps and data in the ring buffer for all measurement rasters can be cleared. All data already saved in the ring buffer will get lost:



Signal

A signal is an element whose value is measured in INCA. Each signal is characterized by its data type (Boolean, integer, float), length (1, 2, 4 or 8 bytes) and conversion formula. The conversion from the physical measure value on the implementation level is specified in the conversion formula.

Signal Group

A signal group consists of several individual signals. It is characterized by its measurement raster, which is the same for all signals in the signal group. Each signal group has a unique name.

3 Installation

INCA-MIP is a functional extension of INCA.

MATLAB® uses dynamically linked function calls, so-called MEX files, to communicate with other applications. The INCA-MIP API consists of a collection of MEX files that are copied into the associated sub-directories of your MATLAB® program directory during installation.

INCA-MIP is packaged in two versions. The INCA-MIP Base API set is readily available after the installation. In order to use the INCA-MIP Extended API set a software license key is required. A list of APIs and the respective API set can be found in "API Functions" on page 16.

3.1 System Requirements

To use the INCA-MIP add-on, INCA must be installed on your computer. For further information on INCA system requirements, refer to the INCA Installation Guide.

If you would like to develop MATLAB® scripts yourself for accessing INCA, you also need a full MATLAB® license.

INCA-MIP for INCA V7.5 requires the following program releases:

- INCA V7.5 SPx

  Note

  INCA V7.5 is required for the installation of this INCA-MIP version.

  Make sure that the INCA release number of the INCA installation is compatible with the release number of the INCA-MIP add-on package.

  After installation you can use this INCA-MIP version to work with any INCA V7.x version "Open INCA" on page 25.

- MATLAB® 64 bit version 2016a or higher (for MATLAB® integrated installation)

For further information on supported MATLAB® releases, contact your INCA support.

3.2 Installing

Before installing the add-on it is necessary to determine the type of installation. The following types are possible:

- **MATLAB® integrated installation**
  Select this option if you use one MATLAB® version for developing MATLAB® scripts.

- **Installation into ETASData**
  Select this option if you would just like to run compiled MATLAB® scripts or if you would like to use INCA-MIP with different MATLAB® versions on your PC. For a more detailed description see below.

To install INCA-MIP

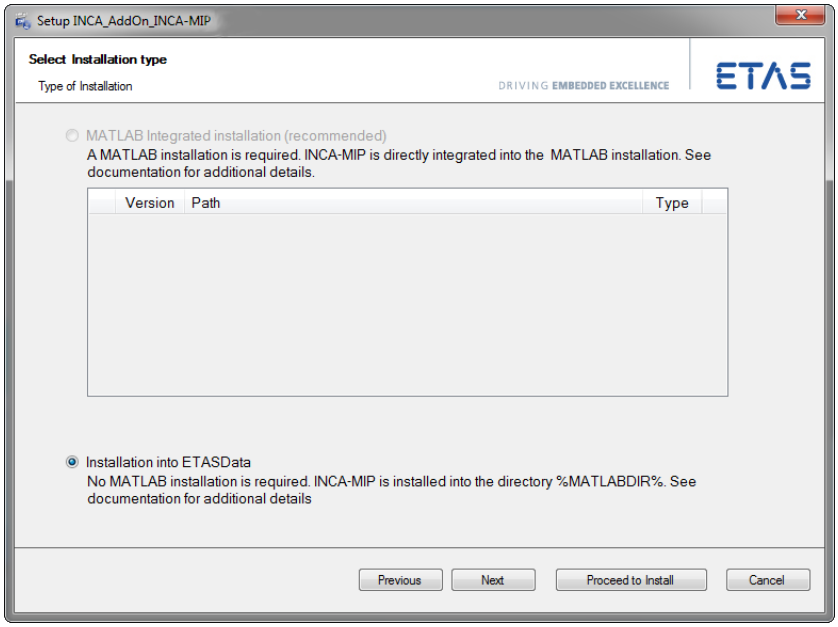
Make sure that INCA is installed on your computer and that the release number of the INCA installation is compatible with the release number of the INCA-MIP add-on package.

If you would like to develop your own MATLAB® scripts for accessing INCA, make sure that MATLAB® is installed on your computer and that the release number of the MATLAB® installation is compatible with the release number of the INCA-MIP add-on package.

1. Close all active programs.
2. Depending on your company-specific regulations, the installation files are provided on a network drive or on a DVD.

   By using the DVD, the installation routine starts automatically. If this is not the case, execute the `Autostart.exe` file on the DVD manually, click Installation, and select the INCA-MIP installation.

   If you install the program from a network drive, execute the `setup.exe` file.
3. Follow the instructions in the installation routine to install INCA-MIP on your computer.
4. In the installation routine, you are asked to indicate the desired type of installation:



5. If you like to develop MATLAB® scripts with exactly one MATLAB® version installed on your PC select the option **MATLAB® integrated installation**.

or

Select the option **Installation into ETASData** if one of the following cases applies:

- You want to use INCA-MIP with different MATLAB® versions.

  In this case you must add the INCA-MIP subdirectory to the MATLAB® toolbox directory of each MATLAB® installation on your PC before you can use INCA-MIP commands. See your MATLAB® user documentation on how to add directories to the MATLAB® path.
- You only want to run readily available MATLAB® stand-alone executables created with MATLAB®.

> **Note**
>
> You need the installation into ETASData if you use executable files that contain MATLAB® commands for controlling INCA. In this case you do not need a MATLAB® license. The executable files have to be provided by developers with a MATLAB® installation (see "Creation and Distribution of Stand-alone Executable Files using the MATLAB® Compiler" on page 71).

6. Continue with the installation routine.

To license INCA-MIP

Should you plan to use the extended set of API functions, a software license file will be required.

For further information on licensing, refer to "Licensing" on the next page.

3.3 Updating the Cache for MATLAB® Toolbox Directories

After installing the INCA-MIP API, you should first update the cache for the MATLAB® toolbox directories, in case this cache is enabled during your MATLAB® installation. This is true for MATLAB® V6 and higher if you are using the default settings; the cache was disabled in earlier releases. The cache needs to be updated so that the files used in INCA-MIP API are registered in MATLAB®.

See your MATLAB® user documentation to update the cache for the MATLAB® toolbox directories.

3.4 Disabling the Cache for MATLAB® Toolbox Directories

When working with the INCA-MIP API, it is recommended that you disable caching for the MATLAB® toolbox directories. Otherwise, malfunctions may occur because either the INCA-MIP API or individual, newly added script files may not be found.

As an alternative to disabling the caching, you can force the cache to update as described above while the cache is enabled. However, to avoid any faulty operation, it is recommended that you disable the cache while working with the INCA-MIP API.

See your MATLAB® user documentation for enabling or disabling the cache for the MATLAB® toolbox directories.

3.5 Licensing

A valid license is required to use the software. You can obtain a license in one of the following ways:

- from your tool coordinator
- via the self-service portal on the ETAS website at www.etas.com/support/licensing
- via the ETAS License Manager

To activate the license, you must enter the Activation ID that you received from ETAS during the ordering process.

For more information about ETAS license management, see the ETAS License Management FAQ or the ETAS License Manager help.

To open the ETAS License Manager help

The ETAS License Manager is available on your computer after the installation of any ETAS software.

1. From the Windows Start menu, select **E** > **ETAS** > **ETAS License Manager**.

   The ETAS License Manager opens.
2. Click in the ETAS License Manager window and press F1.

   The ETAS License Manager help opens.

Remote usage of INCA

It is not allowed to use an INCA workstation license (MACHINE-BASED LICENSE) through internet or network applications, for example, Microsoft Remote Desktop, other terminal or device services. This does not apply for the operation of INCA over test bench protocols (ASAP 3, MCD-3 MC, iLinkRT).

The usage of a USER-NAMED or FLOATING license allows to access INCA via Microsoft Remote Desktop as long as it is ensured that only one user uses one license at the same time.

4 API Functions

INCA-MIP provides a number of API functions for automating INCA processes. Some functions are available in the INCA-MIP Base package, others can be used only if you have purchased the INCA-MIP Extended package.

> **Note**
>
> Commands which are available only through INCA-MIP Extended are protected by a software license key. Should you use an Extended API function without a valid software license, MATLAB® script execution will throw an exception.
> As a development guideline we recommend that prior to using INCA-MIP Extended commands, you verify the validity of the license by means of the `IncaIsLicenseValid` command.

The following table lists all INCA-MIP API functions which are available in the add-on for INCA V7.5. It indicates

- whether the function is also available in the INCA-MIP Base package or only in the INCA-MIP Extended package;
- whether the function is used for initialization, measuring, calibrating, memory page management or whether it is a more general function;
- where in this document you can find more information about the corresponding function.

Function	Base[a]	Ext.[b]	Category	Refer to
IncaAddCalibrationElement	x	x	Calibration	on page 55
IncaAddMeasureElement	x	x	Measuring	on page 34
IncaBrowseCalibrationElements		x	Calibration	on page 54
IncaBrowseItemsInFolder		x	Initialization	on page 28
IncaBrowseMeasureElements		x	Measuring	on page 33
IncaClose		x	Initialization	on page 26
IncaCopyPageFromTo	x	x	MemoryPage-Manager	on page 67
IncaDatabaseImport		x	Initialization	on page 27
IncaDownloadDifferences	x	x	MemoryPage-Manager	on page 68
IncaDownloadPage	x	x	MemoryPage-Manager	on page 67

Function	Base[a]	Ext.[b]	Category	Refer to
IncaExecuteManualTrigger		x	Measuring	on page 53
IncaGetCalibrationValue	x	x	Calibration	on page 56
IncaGetCurrentPage		x	MemoryPage-Manager	on page 66
IncaGetDatasetsForDevice		x	Calibration	on page 63
IncaGetDeviceProperties		x	Initialization	on page 32
IncaGetDevices		x	Initialization	on page 31
IncaGetHardwareStatus		x	Measuring	on page 49
IncaGetInstalledAddOnInfo	x	x	General	on page 24
IncaGetInstalledProductInfo	x	x	General	on page 23
IncaGetMeasureRatesForDevice		x	Measuring	on page 34
IncaGetProperties		x	General	on page 25
IncaGetRecordingMode		x	Measuring	on page 41
IncaGetRecordingProperties		x	Measuring	on page 37
IncaGetRecordingState		x	Measuring	on page 53
IncaGetRecords	x	x	Measuring	on page 46
IncaGetRecordStruct		x	Measuring	on page 53
IncaGetVersion	x	x	General	on page 24
IncaGroupDevices		x	Calibration	on page 64
IncaIsLicenseValid		x	General	on page 23
IncaMessageIds	x	x	General	on page 20
IncaIsPageWriteProtected	x	x	Memory-PageManager	on page 66
IncaOpen	x	x	Initialization	on page 25
IncaOpenDatabase	x	x	Initialization	on page 26
IncaOpenExperiment	x	x	Initialization	on page 30
IncaResetExperiment	x	x	Initialization	on page 31
IncaResetRecords	x	x	Measuring	on page 49
IncaSetCalibrationMode		x	Calibration	on page 63
IncaSetCalibrationValue	x	x	Calibration	on page 59

Function	Base[a]	Ext.[b]	Category	Refer to
IncaSetDatasetInDevice		x	Calibration	on page 62
IncaSetMeasureReadMode	x	x	Measuring	on page 45
IncaSetProjectAndDatasetInDevice		x	Initialization	on page 29
IncaSetRecordingMode		x	Measuring	on page 42
IncaSetRecordingProperties		x	Measuring	on page 39
IncaSetTrigger		x	Measuring	on page 50
IncaShowMessages	x	x	General	on page 22
IncaStartMeasurement	x	x	Measuring	on page 36
IncaStartRecording	x	x	Measuring	on page 43
IncaStopMeasurement	x	x	Measuring	on page 37
IncaStopRecording	x	x	Measuring	on page 44
IncaSwitchPage	x	x	MemoryPage-Manager	on page 65
IncaUploadPages		x	MemoryPage-Manager	on page 68
IncaWriteToFile		x	Calibration	on page 65

a Function is supported in INCA-MIP Base Package

b Function is supported in INCA-MIP Extended Package

In this manual, the function descriptions are ordered according to their application area:

- "General Functions" on page 20
- "Initialization" on page 25
- "Measuring and Recording" on page 33
- "Calibrating" on page 54
- "Memory Page Manager" on page 65

Moreover, a number of sample files are provided. These are described under "Getting to know the INCA-MIP API through Sample Files" on the next page.

Application examples are given under "Application Examples" on page 69.

Note

The INCA-MIP Interface always operates on the global settings of the INCA User Options. For further information on INCA User Options please see the INCA Documentation.

4.1 Getting to know the INCA-MIP API through Sample Files

INCA-MIP comes with a group of examples. These sample files are automatically installed on your computer in addition to the MEX files. The sample files use several examples to demonstrate the use of the INCA-MIP API.

The examples include a number of M files that access the INCA-MIP API, as well as an INCA database where the elements used in the sample scripts have already been created.

The sample files are copied into the following directories during the installation (see "Installing" on page 12):

- For installation into MATLAB®:

  M files: `%MatlabDir%\toolbox\matlab\demos`

- For installation into ETASData:

  M files: `%EtasDataDir%\INCA-MIPx64`

  INCA demo database: `%EtasDataDir%\Database\db_matlabtest`

To use the sample files, you must first start INCA and open the sample database. No hardware is required.

The function of the M files is described below.

- `tOpen.m` – establishes a connection between INCA and MATLAB®. This function must be used at the start of each MATLAB® session before using any other function of the INCA-MIP API.
- `tDummy.m` – opens an empty INCA experiment using a hardware configuration with the VADI test device. The script creates several measurement variables in the INCA experiment.
- `tEtkDummy.m` – opens an empty INCA experiment using a hardware configuration with the ETK test device. This script creates several measurement and calibration variables in the INCA experiment. It also downloads the working and reference pages, reads the measurement and calibration variables, and modifies the values for individual calibration variables.
- `tGetRecords(aGroupName).m` – gathers the measured data for the `aGroupName` group for 20 seconds and then passes the data to MATLAB®. This function can be used both in connection with the VADI and ETK example (for “measure rasters,” see "INCA Definitions" on page 10.)
- `tPrintDB ({aFolder{, aFileId}}).m` – Writes the complete contents of the database beginning with directory `aFolder` to the file `aFileId`. If the function is executed without parameters, the complete database hierarchy is printed to the standard output.
- `tHWStatus.m` – Example for using the API function `IncaGetHardwareStatus`. MATLAB® attaches to an already opened experiment and chooses the first measurement element found in the first measurement

device found. It continues with a measurement of 5 minutes. If there is a warning or error during the measurement the measurement cycle gets aborted and restarted after a delay of 5 seconds.

4.2 General Functions

The following general API functions are available:

4.2.1 List INCA-MIP Interface Message IDs

INCA-MIP Interface commands may return with an error.

When using try/catch blocks, detailed error information can be returned.

Example

```
try,
      <command_1>
      ...
      <command_n>
   catch,
      [msgstr,msgid] = lasterr
      ...
   end
```

whereas:

`msgstr`	a descriptional string
`msgid`	the message id. The following message ids are available: – `INCA:ParameterError` – `INCA:ReturnParameterError` – `INCA:WrongParameterValue` – `INCA:WrongParameterType` – `INCA:NaN` – `INCA:ExecutionError` – `INCA:ResourceError` – `INCA:RasterFull` – `INCA:ObjectIsWriteProtected` – `INCA:CallSeqenceError` – `INCA:LicenseError` – `INCA:RecordingInProcess` – `INCA:NotInstalled` – `INCA:WrongVersion`

Hints for reaction on error ids:

`INCA:ParameterError`	Wrong number of input arguments (right hand side parameters)
`INCA:ReturnParameterError`	Wrong number of output arguments (left hand side parameters)
`INCA:WrongParameterValue`	Any of the values of the input arguments is out of its valid range or specification
`INCA:WrongParameterType`	Any of the input arguments has a wrong data type
`INCA:NaN`	Any of the parameters contains a 'not a number' value
`INCA:ExecutionError`	During the command execution an error occurred for some reason. Trying to execute functionality on the INCA user interface could give more information about the reason. Restarting INCA or a reboot could also help.
`INCA:ResourceError`	Unable to get operating system resources. Restarting INCA or a reboot could help.
`INCA:RasterFull`	The acquisition list is full for the requested measure raster when trying to add a measurement
`INCA:ObjectIsWriteProtected`	Unable to calibrate because of a write protected object
`INCA:CallSeqenceError`	Before executing the requested command other commands have to be executed first. E.g. `IncaOpenExperiment` is necessary before `IncaAddMeasureElement`.
`INCA:LicenseError`	To execute the command with the given parameters a license is needed

`INCA:RecordingInProcess`	It is not possible to execute the requested command (e.g. enable or disable signals for recording using `IncaSetRecordingMode`) because a recording is currently running.
`INCA:NotInstalled`	It is not possible to open the specified INCA version using the `IncaOpen` command because the corresponding INCA version is not installed.
`INCA:WrongVersion`	It is not possible to open the specified INCA version using the `IncaOpen` command because of one of the following reasons: – INCA is already started and an `IncaOpen` command is executed with a 'version' parameter different from the already opened INCA version – An `IncaOpen` command is executed from within INCA-MIP for INCA Vx.y with a 'version' parameter with major version != x.

4.2.2 Show Messages During Script Execution

Name	`IncaShowMessages`	
Description	Enables/disables the information display in the MATLAB® window during script execution	
Syntax	`IncaShowMessages(trueOrFalse)`	
Output Arguments	none	
Input Arguments	`trueOrFalse`	Numerical parameter whose value either equals or does not equal zero. If the parameter is zero, the information display is disabled, otherwise it is enabled (default).
Examples	`IncaShowMessages(0);` `IncaShowMessages;`	

4.2.3 Show Whether Valid INCA-MIP License exist (INCA-MIP Extended)

Name	`IncaIsLicenseValid`	
Description	Returns a status indicating whether a valid INCA-MIP license is available or not	
Syntax	`s = IncaIsLicenseValid`	
Output Arguments	`s`	License status: – `0`: no valid license – `1`: valid license
Input Arguments	none	
Examples	`status = IncaIsLicenseValid`	

4.2.4 Read Information on All Installed INCA Versions

Name	`IncaGetInstalledProductInfo`	
Description	Provides information on all installed INCA versions. This command can be executed before `IncaOpen`.	
Syntax	`info = IncaGetInstalledProductInfo`	
Output Arguments	`info`	Information on installed INCA versions as MATLAB® struct for each installation, consisting of the following entries:
	`info.name`	the product name
	`info.version`	the product version string
	`info.hotfixVersion`	the installed hotfix as string, or an empty string if no hotfix is installed
Input Arguments	none	
Examples	`i = IncaGetInstalledProductInfo;`	

4.2.5 Read Information on All Installed Product Add-ons

Name	IncaGetInstalledAddOnInfo	
Description	Provides information on all installed add-ons for a given product. This command can be executed before `IncaOpen`.	
Syntax	`info = IncaGetInstalledAddOnInfo(productName, productVersion)`	
Output Arguments	`info`	Information on installed add-ons as MATLAB® struct for each installation, consisting of the following entries:
	`info.name`	the name of the installed add-on
	`info.version`	the version string of the installed add-on
Input Arguments	`productName`	the name of the product
	`productVersion`	the product version as string. The whole version string is relevant.
Examples	`i = IncaGetInstalledAddOnInfo('INCA', 'V7.5.0');` `i = IncaGetInstalledAddOnInfo('INCA', 'V7.5.1 Build 100');`	

> **Note**
>
> Make sure that you use for the input arguments `productName` and `productVersion` exactly the name and version of a product as returned by `IncaGetInstalledProductInfo`.

4.2.6 Read INCA Version

Name	`IncaGetVersion`	
Description	Returns the INCA version	
Syntax	`IncaGetVersion`	
Output Arguments	`version`	the INCA version as a string
Input Arguments	none	
Examples	`IncaGetVersion;`	

4.2.7 Read INCA Properties (INCA-MIP Extended)

Name	`IncaGetProperties`	
Description	Reads properties of INCA	
Syntax	`p = IncaGetProperties`	
Output Arguments	`p`	Properties of INCA as MATLAB® struct, consisting of the following entries: – `p.databasePath` - Pathname of the open INCA database. If no INCA database is open an empty string is returned. – `p.dataPath` - Pathname of the INCA data directory. – `p.installationPath` - Pathname of the INCA installation directory. – `p.tempPath` - Pathname of the directory which is used by ETAS applications for temporary files.
Input Arguments	none	
Examples	`p = INCAGetProperties;`	

4.3 Initialization

All measurement and calibration operations in INCA will be performed within the context of an experiment. Before opening an experiment, a workspace with a valid hardware configuration must first be created and assigned.

To work with the INCA-MIP API, there must an empty experiment in the INCA database which is linked to a valid workspace and hardware configuration. The experiment can be opened from within MATLAB®.

The following API functions are available for initializing:

4.3.1 Open INCA

Name	`IncaOpen`
Description	Opens INCA and initialize the connection between MATLAB® and INCA.
Syntax	`IncaOpen` `IncaOpen( version )`

Output Arguments	none	
Input Arguments	`version`	INCA version to be opened (optional). Syntax: `<MajorVersion>.<MinorVersion>`. INCA-MIP for INCA x.y can only connect to INCA installations with the same major version x.
Examples	`IncaOpen;` `IncaOpen('7.3');`	

4.3.2 Close INCA (INCA-MIP Extended)

Name	`IncaClose`	
Description	Disconnects from INCA and optionally closes it after having successfully connected to INCA with `IncaOpen`.	
Syntax	`IncaClose` `IncaClose( isDisconnectOnly )`	
Output Arguments	none	
Input Arguments	`isDisconnectOnly`	Specifies if MATLAB® only disconnects from INCA or if it also closes INCA (optional). Possible values are: — `0`: Disconnect from INCA and close it (default). — `1`: Disconnect from INCA and leave it open.
Examples	`INCAClose;` `INCAClose(1);`	

4.3.3 Open a Database

Name	`IncaOpenDatabase`
Description	Opens the database in the specified directory
Syntax	`IncaOpenDatabase({pathName})`

Output Arguments	none	
Input Arguments	`pathName`	The directory in which the database to be opened is stored. If you do not specify a directory, the current database is opened.

Examples	`IncaOpenDatabase; % open current database`
	`IncaOpenDatabase`
	`('c:\etasdata\mydatabase');`	

4.3.4 Import a Database (INCA-MIP Extended)

Name	`IncaDatabaseImport`	
Description	Imports a database export file (*.exp) into INCA. Existing database items will always be overwritten.	

Syntax	`IncaDatabaseImport(path)`
	`name = IncaDatabaseImport(path)`
	`[name, type] = IncaDatabaseImport(path)`	

Output Arguments	`name`	Array of the full path names of all imported database items use `deblank()` when accessing an array element: `name2 = deblank(name(2,:))`

	`type`	Array of types of all imported database items Possible values are: – `Folder`: a database folder – `Experiment`: an Experiment Environment – `Workspace`: a Workspace – `Asap2Project`: an ASAP2 Project – `MeasurementCatalog`: an ASAP2 Measurement Catalog – `CanDB`: an ASAP2 CAN DB use `deblank()` when accessing an array element: `type2 = deblank(type(2,:))`
Input Arguments	`path`	The full path of the *.exp file to be imported
Examples	`names = IncaDatabaseImport('D:\ETASData\INCA7.5\export\Project0815.exp')`	

4.3.5 Read Database Items (INCA-MIP Extended)

Name	`IncaBrowseItemsInFolder`	
Description	Reads database items in the given database folder with a search pattern	
Syntax	`[name, type] = IncaBrowseItemsInFolder (pattern, folderName)`	
Output Arguments	`name`	List of names of the database items
	`type`	List of types of the database items: – `Folder`: Database folder – `Experiment`: Experiment – `Workspace`: Workspace – `Asap2Project`: ASAP2 Project

Input Arguments	`pattern`	Search pattern for database entries to look for. A '*' matches zero or any number of additional characters. A '#' matches exactly one character. All other characters have to match with the database items. There is no difference between lower and upper case.
	`folderName`	Database folder in which the database items are read. Folder hierarchies are separated by a '\'. An empty string is used for the upper most hierarchy level.
Examples	`[n,t]=IncaBrowseItemsInFolder('*', 'DEFAULT\MyProject');` `[name,type]=IncaBrowseItemsInFolder ('Prj*_##', '');`	

4.3.6 Assign Project and Dataset in Device (INCA-MIP Extended)

Name	`IncaSetProjectAndDatasetInDevice`	
Description	Assigns a project and dataset to a device in a given workspace. This can only be done if no experiment is currently opened.	
Syntax	`IncaSetProjectAndDatasetInDevice(workspace, device,project,dataset)`	
Output Arguments	none	
Input Arguments	`workspace`	database path of workspace
	`device`	name of device
	`project`	database path of project
	`dataset`	database path of dataset
Examples	`IncaSetProjectAndDatasetInDevice('DEFAULT\workspace','ETK:1','DEFAULT\Prj0815','Ds4711\Ds4711_3')`	

4.3.7 Open an Experiment

Name	`IncaOpenExperiment`	
Description	Opens the specified experiment (Experiment Environment). After an experiment has been opened, you can use the INCA-MIP API to add your measurement and calibration variables as desired.	

Syntax	`IncaOpenExperiment({closeAllViewsFlag})`
	or
	`IncaOpenExperiment(expFolderName, experimentName, workspaceFolderName, workspaceName {, closeAllViewsFlag})`	

Output Arguments	none	
Input Arguments	exp`FolderName`	directory in which the experiment is stored
	`experimentName`	name of the experiment
	workspace`FolderName`	directory in which the workspace is stored
	`workspaceName`	name of the workspace
	`closeAllViewsFlag`	Closes all measure and calibration windows in the selected experiment. Possible settings: – `1`: closes all windows (default) – `0`: leaves the windows unchanged.
Examples	`IncaOpenExperiment('ExpFolder', 'MyExperiment', 'WorkspaceFolder', 'MyWorkspace');`	

> **Note**
>
> If the experiment is already open when the function `IncaOpenExperiment` is called, the input arguments specifying the environment are optional.
>
> If the experiment is not yet open, you need to call `IncaOpenDatabase` before `IncaOpenExperiment`.

4.3.8 Reset an Experiment

Name	`IncaResetExperiment`
Description	Resets and closes the current experiment. You can use this function to remove all variables from an experiment. Removing individual variables is currently not supported.
Syntax	`IncaResetExperiment`
Output Arguments	none
Input Arguments	none
Examples	`IncaResetExperiment;`

> **Note**
>
> If the experiment has been opened manually and not by means of a MATLAB® command, `IncaResetExperiment` releases the experiment, but does not close the window. You need to execute `IncaOpenExperiment` before you can access the experiment once again.

4.3.9 Read Devices (INCA-MIP Extended)

Name	`IncaGetDevices`	
Description	Reads all devices in the experiment	
Syntax	`[name, type] = IncaGetDevices`	
Output Arguments	`name`	List of names of the devices
	`type`	List of device types: – `WorkbaseDevice`: Device with datasets – `MeasurementDevice`: Measurement device
Input Arguments	none	
Examples	[name,type]=IncaGetDevices;	

4.3.10 Read Device Properties (INCA-MIP Extended)

Name	`IncaGetDeviceProperties`	
Description	Reads properties of a device	
Syntax	`p = IncaGetDeviceProperties(deviceName)`	
Output Arguments	`p`	Device properties as MATLAB® struct, consisting of the following entries:
	`p.name`	device name
	`p.descriptionFile`	Pathname of the description file of the project assigned to the device. An empty string is returned if there is no project assigned to the device.
	`p.binaryFile`	Pathname of the binary file of the project assigned to the device. An empty string is returned if there is no project assigned to the device.
	`p.projectDBPath`	Pathname within the INCA database of the project assigned to the device. An empty string is returned if there is no project assigned to the device.
	`p.isWriteProtected`	– `0`: Device has no memory pages or current page is not write protected – `1`: Current page is write protected
	`p.isActive`	– `0`: Device is not connected or not active – `1`: Device is connected and active

	`p.isWorkbaseDevice`	– `0`: Device has no datasets – `1`: Device has datasets
Input Arguments	`deviceName`	name of the device
Examples	`p = IncaGetDeviceProperties('Device');`	

4.4 Measuring and Recording

A signal or measurement variable is always captured as part of a measure raster for that particular measuring device. Each measurement variable may appear in one measure raster only. To configure an experiment, first assign the measurement variables to the individual measure rasters.

> **Note**
>
> The names of elements, devices, signals, and measure rasters are case-sensitive.

4.4.1 Read Measurement Elements (INCA-MIP Extended)

Name	`IncaBrowseMeasureElements`	
Description	Gets measurement elements of the experiment with search pattern and optional device	
Syntax	`[name, type] = IncaBrowseMeasureElements (pattern, {deviceName})` `[name] = IncaBrowseMeasureElements(pattern, {deviceName})`	
Output Arguments	`name`	List of names of measurement elements
	`type`	List of types of the measurement elements: – `Scalar`: Scalar – `Array`: Vector – `Matrix`: Matrix

Input Arguments	`pattern`	Search pattern for the measurement elements to look for. A '*' matches zero or any number of additional characters. A '#' matches exactly one character. All other characters have to match with the measurement element. There is no difference between lower and upper case.
	deviceName	Name of the device
Examples	`[n,t]=IncaBrowseMeasureElements('ign*', 'Device');` `[name,type]=IncaBrowseMeasureElements ('*');`	

4.4.2 Read Measure Rasters (INCA-MIP Extended)

Name	`IncaGetMeasureRatesForDevice`	
Description	Gets all measure rasters of a device	
Syntax	`[name] = IncaGetMeasureRatesForDevice (deviceName)`	
Output Arguments	`name`	List of names of the measure rasters
Input Arguments	`deviceName`	Name of the device

Examples	`n=IncaGetMeasureRatesForDevice('Device');`
	
	`name=IncaGetMeasureRatesForDevice('Dev');`	

4.4.3 Add Measurement Variable to Experiment

Name	`IncaAddMeasureElement`
Description	Adds a measurement variable with or without given measure raster to an experiment.
Syntax	`IncaAddMeasureElement(deviceName, groupName, signalName {, displayMode})` `groupName = IncaAddMeasureElement( deviceName, [], signalName{, displayMode})`

Output Arguments	none	
Input Arguments	`deviceName`	name of the device
	`groupName`	name of the measure raster It is possible to use multiple rasters by simply combining raster names by means of a '+' character, e.g. '`10ms+100ms`'. When using such a multi-raster, a new virtual raster is created. Each signal can only be measured in exactly one raster or multi-raster. The group name may be [] (see note below).
	`signalName`	name of the measurement signal. For scalars, just the name is sufficient; for vectors and matrices, the index in the format `[n]` or `[n,m]` has to be appended to the name. The first element has the index of "zero."
	`displayMode`	display mode for the element: — `1`: measurement variable is displayed (default) — `0`: no display

Examples	`IncaAddMeasureElement('MyDevice', '10ms', 'Channel01', 0);`
	`IncaAddMeasureElement('ETK:1', '1.0ms', 'Matrix[2,1]');`
	`group = IncaAddMeasureElement('CalcDev', [], 'MyCalcSig1');`	

Note

If the measure raster is full, the measurement variable does not get added to the raster.

> **Note**
>
> If the input argument `groupName` is [ ] (i.e. empty), the signal group will be determined in the following way:
> - If the signal is already part of the experiment, its existing signal group name is used.
> - If the signal is not part of the experiment, any available signal group is used arbitrarily. In the case of the Calculated device (CalcDev, used for calculated signals), or CAN Monitoring, the signal group that is defined for that signal is used.
>
> As the name of the signal group is needed for `IncaGetRecords`, `IncaGetRecordStruct` or `IncaGetRecordCount`, it is returned as optional left hand side parameter.
>
> **Examples:**
> ```
> groupName = IncaAddMeasureElement( 'CalcDev', [],
> 'MyCalcSig')
> groupName = IncaAddMeasureElement( 'CAN-Monitoring:1',
> [], 'nmot', 1)
> ```

> **Note**
>
> The total number of signals that can be added is device-specific as well as protocol-specific. The number of signals is limited by the amount of free buffer memory allocated by the Target Server Process. The total size of buffer memory depends on the used sample rate.
>
> **Example:**
> A signal with 0.1 ms sample rate requires > 3 Megabyte of data. Therefore the total number of signals that can be added is between 400 and 600 signals. Slower sample rates allow to add more signals.

4.4.4 Start Measurement

Name	`IncaStartMeasurement`
Description	Starts a measurement in INCA
Syntax	`IncaStartMeasurement`
Output Arguments	none
Input Arguments	none
Examples	`IncaStartMeasurement;`

4.4.5 Stop Measurement

Name	`IncaStopMeasurement`	
Description	Stops the current measurement and recording (if enabled) in INCA	
Syntax	`IncaStopMeasurement{(mdfFileName)}`	
Output Arguments	none	
Input Arguments	`mdfFileName`	name of the MDF file in which the recorded data are saved if recording is stopped together with the current measurement. Always specify the full access path to the file (e.g., `'c:\mydata\store1.dat'`).
Examples	`IncaStopMeasurement ('c:\mydata\store1.dat');`	

> **Note**
>
> To avoid data loss due to ongoing measurements, be sure to stop the current recording with the `IncaStopMeasurement(mdfFileName)` command if the data volume is high. Follow this up with the `IncaGetRecords` command to transfer the remaining data to MATLAB®.

4.4.6 Read Recording Properties (INCA-MIP Extended)

Name	`IncaGetRecordingProperties`	
Description	Reads the properties of the default recorder's primary output file and the file extension for the selected primary recording format.	
Syntax	`properties = IncaGetRecordingProperties`	
Output Arguments	`properties`	Recording properties as MATLAB® struct, consisting of the following entries:
	`properties.fileName`	the recording file name including the primary output file format
	`properties.directory`	the directory for the recording file

`properties.fileFormat`	the file format of the recording file; the following format strings are valid: – `ETASBinary` – `#DiademATF` – `ETASAscii` – `ETASGroupAscii` – `ETASMATLABMFILE` – `ETASGroupMatlabM` – `FamosRecord` – `ETASMDF` – `ETASMDF4`
`properties.autoIncrement`	Automatically increment the recording file name – `0`: don't auto increment – `1`: do auto increment
`properties.comment`	The comment in the recording file header. It must not exceed 1024 characters minus number of characters used for the default comment.
`properties.defaultComment`	The default comment in the recording file header generated by INCA
`properties.company`	The company in the recording file header
`properties.project`	The project in the recording file header
`properties.user`	The user in the recording file header

	`properties.vehicle`	The vehicle in the recording file header
Input Arguments	none	
Examples	`properties = IncaGetRecordingProperties;`	

4.4.7 Set Recording Properties (INCA-MIP Extended)

Name	`IncaSetRecordingProperties`	
Description	Sets properties for the next measurement data recording	
Syntax	`IncaSetRecordingProperties(properties)`	
Output Arguments	none	
Input Arguments	`properties`	recording properties as matlab struct containing any combination of the following field designators:
	`properties.fileName`	the recording file name
	`properties.directory`	the directory for the recording file
	`properties.fileFormat`	the file format of the recording file; the following format strings are valid: – `ETASBinary` – `#DiademATF` – `ETASAscii` – `ETASGroupAscii` – `ETASMATLABMFILE` – `ETASGroupMatlabM` – `FamosRecord` – `ETASMDF` – `ETASMDF4`

`properties.autoIncrement`	Automatically increment the recording file name – `0`: don't auto increment – `1`: do auto increment
`properties.comment`	the recording file header comment must contain max. 1024 characters minus the character count of the default comment
`properties.company`	the company in the recording file header company
`properties.project`	the project in the recording file header
`properties.user`	the user in the recording file header
`properties.vehicle`	the vehicle in the recording file header

Examples

```
properties.user = 'Michael';
properties.project = 'K70';
IncaSetRecordingProperties(properties);
```

> **Note**
>
> When setting the recording with `IncaSetRecordingProperties`, you should not finish a recording with `IncaStopRecording`. Instead `IncaSetTrigger` can be used. Any trigger condition can be used to stop the recording.
>
> **Example:**
>
> Stop recording after a constant duration:
>
> ```
> TIMEDURATION_SECONDS = 25;
> IncaSetTrigger('none', 'none', 'none', 'none',
> TIMEDURATION_SECONDS);
> IncaStartRecording;
> % Recording automatically stops after TIMEDURATION_
> SECONDS seconds
> ```
>
> Stop recording after a manual trigger condition:
>
> ```
> IncaSetTrigger('none', 'manual');
> IncaStartRecording;
> % Do anything until the stop trigger condition is met
> ...
> IncaExecuteManualTrigger('stop');
> ```

4.4.8 Read Recording Mode (INCA-MIP Extended)

Name	`IncaGetRecordingMode`
Description	Indicates whether a signal is recorded in the default recorder or not.
Syntax	`IncaGetRecordingMode(deviceName, signalName)`
Output Arguments	recording mode for the default recorder: – `0`: the signal is not recorded in the default recorder – `1`: the signal is recorded in the default recorder

Input Arguments	`deviceName`	name of the device
	`signalName`	name of the measurement signal. For scalars, just the name is sufficient; for vectors and matrices, the index in the format `[n]` or `[n,m]` has to be appended to the name. The first element has the index of "zero."

Examples

```
m = IncaGetRecordingMode('ETK:1', 'hfm');
mode = IncaGetRecordingMode('CalcDev',
'MyCalcSig1');
```

> **Note**
>
> Before using `IncaGetRecordingMode`, the signal has to be added with `IncaAddMeasureElement`.

4.4.9 Set Recording Mode (INCA-MIP Extended)

Name `IncaSetRecordingMode`

Description Enables or disables the recording of a signal in the default recorder. The recording can only be disabled for signals which are displayed in the INCA experiment. Before executing this command the signal has to be added to the experiment with `IncaAddMeasureSignal`.

Syntax

```
IncaSetRecordingMode(deviceName, signalName, recordingMode)
```

Output Arguments none

Input Arguments	`deviceName`	name of the device

	`signalName`	name of the measurement signal. For scalars, just the name is sufficient; for vectors and matrices, the index in the format `[n]` or `[n,m]` has to be appended to the name. The first element has the index of “zero.”
	`recordingMode`	recording mode for the default recorder: — `0`: the measurement variable is removed from the default recorder — `1`: the measurement signal is added to the default recorder
Examples	`IncaSetRecordingMode(’ETK:1’, ’hfm’, 1);` `IncaSetRecordingMode('CalcDev', 'MyCalcSig1', 0);`	

> **Note**
>
> Before using `IncaSetRecordingMode`, the signal has to be added with `IncaAddMeasureElement`.

4.4.10 Start Recording

Name	`IncaStartRecording`
Description	Starts recording in INCA. This function can be used after or instead of `IncaStartMeasurement`. After a measurement or recording has been started, the measured data are also available in MATLAB®.
Syntax	`IncaStartRecording`
Output Arguments	none
Input Arguments	none
Examples	`IncaStartRecording;`

4.4.11 Stop Recording

Name	`IncaStopRecording`	
Description	Stops the current recording in INCA. The measurement continues to run and must be stopped explicitely with `IncaStopMeasurement`. It is possible to toggle the recording on/off several times during a running measurement.	
Syntax	`IncaStopRecording(mdfFileName)`	
Output Arguments	none	
Input Arguments	`mdfFileName`	The name of the MDF file where the recorded data are saved. Always specify the complete access path to the file (e.g., `'c:\mydata\store1.dat'`).
Examples	`IncaStopRecording ('c:\mydata\store1.dat');`	

4.4.12 Set Data Reading Mode (Online/Offline Data)

Name	`IncaSetMeasureReadMode`	
Description	Determines from which source the measured data are transmitted to MATLAB®. The data are either first prepared in INCA and then transferred to MATLAB® (offline data), or they are read directly from the device buffer (online data). For some devices, such as the ES1303 card and the ES6xx series devices, there are no offline data available during the display of measure data. During the measure data display, it is recommended to use only online data. When recording measure data, both online and offline data can be used. In each case, the optimized transmission features produce special display characteristics of the results: online data may be incomplete at high loads, while offline data are always complete when measured data are recorded. However, offline data can only be transmitted with a certain time delay at high loads. It is recommended that you use only offline data while measured data are being recorded.	
Syntax	`IncaSetMeasureReadMode(measureReadMode)`	
Output Arguments	none	
Input Arguments	`measureReadMode`	numerical parameter whose value specifies the data source. Possible settings: – `1`: Offline data – `0`: Online data (default)
Examples	`IncaSetMeasureReadMode(0);`	

4.4.13 Read Measure Data

Name

`IncaGetRecords`

Description

Transfers measure data to MATLAB®. The measure data of each signal group is stored in a dedicated ring buffer which can hold data for up to 30 seconds of measuring time. The measure data is retrieved from MATLAB® in groups. You should therefore stop your script execution in MATLAB® after you have retrieved the measure data. The greater the amount of data being transferred at each time, the more efficient the data transfer is.

This function transmits a specified number of records for the specified measure raster.

For further information on the ring buffer see the corresponding entry in the "INCA Definitions" on page 10.

Syntax

```
[time, data {,state}] = IncaGetRecords
(deviceName, groupName, maxRecords
{{,latest{, exact}})
```

Output Arguments

`time`	A vector containing the time stamps of the transferred records. This variable contains a maximum number of `m` values, whereas `m <= maxRecords`.
`data`	A 2-dimensional matrix containing the data values for each measure variable in the order in which it was added to the experiment by `IncaAddMeasureElement`. In this matrix, the dimension m reflects the number of transferred records, whereas n indicates the number of measure rasters.
state	Optional return parameter: — 0: Success. Records received — 1: Acquisition not running. No records received — 2: Not enough records. No records received. This can only be returned if exact = 1

Input Arguments

`deviceName`	Name of the device

`groupName`	Name of the measure raster It is possible to use multiple rasters by simply combining raster names by means of a '+' character, e.g. '`10ms+100ms`'. When using such a multi-raster, a new virtual raster is created. Each signal can only be measured in exactly one raster or multi-raster.
`maxRecords`	(Maximum) number of records to be received. See also parameter `exact`. The number you enter here is the dimension `m` for the time or data variable above. If this dimension reaches the value of `maxRecords`, not all existing records are read so that the ring buffer may overflow.
latest	Defines if the oldest or latest n records will be received
exact	It defines to receive records also if n < maxRecords are available in the ring buffer, or if the ring buffer should be unchanged.

Examples

```
[t, d] = IncaGetRecords('ETK:1', '100ms',
500);
data = [data; d];
time = [time; t];
[t, d, s] = IncaGetRecords('ETK:1',
'100ms', 25, 1, 1);
```

For a larger context using this piece of code please see "Example 2" on page 69.

Note

The raster used in `IncaGetRecords` directly corresponds to the raster used in `IncaAddMeasureElement`, i.e. you have to use the same raster or multi-raster.

Example:

```
IncaAddMeasureElement('ETK test device:1','RASTER_
A+RASTER_B', 'N')
IncaAddMeasureElement('ETK test device:1','RASTER_
A+RASTER_B', 'n')
[t,d]= IncaGetRecords('ETK test device:1','RASTER_
A+RASTER_B',15)
```

To check the raster assignment of signals, you can use the command `IncaGetRecordStruct`.

Example:

```
l=IncaGetRecordStruct('ETK test device:1', 'RASTER_
A+RASTER_B')
```

Note

The following parameter combinations execute as follows:

- `latest = 0, exact = 0: (default)`
  Returns the oldest up to `maxRecords` records from the ring buffer. Any newer records remain unchanged.
- `latest = 1, exact = 0:`
  Returns the latest up to `maxRecords` records from the ring buffer. Any older records intentionally are rejected.
- `latest = 0, exact = 1:`
  Returns the oldest `maxRecords` records from the ring buffer. Any newer records remain unchanged. If only n < `maxRecords` records are availabe in the ring buffer, nothing is received.
- `latest = 1, exact = 1:`
  Returns the latest `maxRecords` records from the ring buffer. Any older records are rejected intentionally. If only n < `maxRecords` records are availabe in the ring buffer, nothing is received.

4.4.14 Reset Ring Buffer

Name	`IncaResetRecords`
Description	Resets the ring buffer for all signal groups. This function can even be used during a running measurement to reset all ring buffers. They are reset automatically when starting a measurement or recording; it is not necessary to issue this command explicitely. For further information on the ring buffer see the corresponding entry in the "INCA Definitions" on page 10.
Syntax	`IncaResetRecords`
Output Arguments	none
Input Arguments	none
Examples	`IncaResetRecords;`

4.4.15 Read Hardware Status (INCA-MIP Extended)

Name	`IncaGetHardwareStatus`
Description	Gets the current Hardware Status during a measurement or recording
Syntax	`[status, message] = IncaGetHardwareStatus`
Output Arguments	`status` current Hardware Status – `0`: Status ok – `1`: Warning – `2`: Error

	`message`	If `status` returns `1` or `2`, `message` returns a text describing the warning or error. If `status` returns `1` or `2`, the measurement or recording has to be finished before `IncaGetHardwareStatus` can be called once again. See also example script `tHWStatus.m` in "Getting to know the INCA-MIP API through Sample Files" on page 19
Input Arguments	none	
Examples	`[s, m] = IncaGetHardwareStatus;`	

4.4.16 Set Trigger (INCA-MIP Extended)

Name	`IncaSetTrigger`	
Description	Sets the trigger condition before starting a measurement or recording with `IncaStartMeasurement` or `IncaStartRecording`	
Syntax	`IncaSetTrigger(startTrigger{, stopTrigger {, preTriggerTime{, postTriggerTime{, duration}}}})`	
Output Arguments	none	
Input Arguments	`startTrigger`	Start trigger condition. – `manual` for a manual start trigger – `none` if no trigger is to be used
	`stopTrigger`	Stop trigger condition. – `manual` for a manual stop trigger – `none` if no trigger is to be used (default)
	`preTriggerTime`	The pre trigger time in seconds – `none` if unspecified (default)

`postTriggerTime`	The post trigger time in seconds – `none` if unspecified (default)
`duration`	Duration of measurement or recording in seconds – `none` if unspecified (default); in this case the duration is infinite.

Examples

```
IncaSetTrigger('nmot\ETK:1 > 2000',
'none', 2.0, 3.0)
IncaSetTrigger('none', 'none', 'none',
'none', 360)
```

The following table lists all combinations of input parameters that are supported (other combinations lead to an exception).

Combinations of Input Parameters

Trigger Functionality	startTrigger	stopTrigger	preTriggerTime	postTriggerTime	duration
Recording with time duration	'none'	'none'	'none'	'none'	value
Recording with manual start trigger, pre-trigger time and manual stop trigger condition	'manual'	'manual'	value	'none'	'none'
Recording with manual start trigger, pre- and post-trigger time	'manual'	'none'	value	value	'none'
Recording with manual start trigger, pre-trigger time and stop trigger condition	'manual'	value	value	'none'	'none'
Recording with manual stop trigger condition	'none'	'manual'	'none'	'none'	'none'
Recording with start trigger condition and recording duration	value	'none'	'none'	'none'	value
Recording with start trigger condition and manual stop trigger	value	'manual'	'none'	'none'	'none'
Recording with start trigger condition, pre-trigger time and manual stop trigger	value	'manual'	value	'none'	'none'
Recording with start trigger condition, pre- and post-trigger time	value	'none'	value	value	'none'
Recording with start trigger condition, pre-trigger time and stop trigger condition	value	value	value	'none'	'none'

4.4.17 Execute Manual Trigger (INCA-MIP Extended)

Name	`IncaExecuteManualTrigger`	
Description	Executes a manual start or stop trigger. This only has an effect if a `IncaSetTrigger` command has been set before with the `startTrigger` or `stopTrigger` parameter set to `manual` .	
Syntax	`IncaExecuteManualTrigger(type)`	
Output Arguments	none	
Input Arguments	`type`	Trigger type – `start` for executing a manual start trigger – `stop` for executing a manual stop trigger
Examples	`IncaExecuteManualTrigger('start')`	

4.4.18 Read Recording State (INCA-MIP Extended)

Name	`IncaGetRecordingState`	
Description	Gets the current recording status.	
Syntax	`result = IncaGetRecordingState`	
Output Arguments	result	recording status – `0`: switched off – `1`: waiting for trigger or recording in progress
Input Arguments	none	
Examples	`s = IncaGetRecordingState`	

4.4.19 Read List of Measurement Variables (INCA-MIP Extended)

Name	`IncaGetRecordStruct`
Description	Gets list of measurement variables which have been assigned for measurement or recording. The list returns the measurement names in the same order as they have been assigned with `IncaAddMeasureElement`.
Syntax	`list = IncaGetRecordStruct(device,groupName)`

Output Arguments	none	
Input Arguments	`device`	name of device
	`groupName`	name of measure raster It is possible to use multiple rasters by simply combining raster names by means of a '+' character, e.g. '`10ms+100ms`'.
Examples	`l = IncaGetRecordStruct('ETK:1', '10ms');` `list = IncaGetRecordStruct('device1', 'Syncro');`	

4.5 Calibrating

Calibrations can be performed with scalars, characteristic curves and maps, including the associated break point distributions. In each experiment, it is possible to define any number of calibration variables.

> **Note**
>
> Note that the names of calibration variables are case-sensitive.

4.5.1 Read Calibration Elements (INCA-MIP Extended)

Name	`IncaBrowseCalibrationElements`	
Description	Gets calibration elements of the experiment with search pattern and optional device.	
Syntax	`[name, type] = IncaBrowseCalibrationElements (pattern, {deviceName})` `name = IncaBrowseCalibrationElements (pattern, {deviceName})`	
Output Arguments	`name`	List of names of calibration elements

	`type`	List of types of the calibration elements: – `Distribution`: Axis distribution – `OneDTable`: Curve – `TwoDTable`: Map – `Scalar`: Scalar – `Array`: Vector – `Matrix`: Matrix
Input Arguments	`pattern`	Search pattern for the calibration elements to look for. A '*' matches zero or any number of additional characters. A '#' matches exactly one character. All other characters have to match with the calibration element. There is no difference between lower and upper case.
	deviceName	Name of the device
Examples	`[n,t]=IncaBrowseCalibrationElements ('MAP*', 'Device');` `[name,type]= IncaBrowseCalibrationElements('*');`	

4.5.2 Add Calibration Element

Name	`IncaAddCalibrationElement`	
Description	Adds a calibration variable to the current experiment. Calibrations can be performed with scalars, characteristic curves and maps including the associated axis point distributions. In each experiment it is possible to define any number of calibration variables. Also axis point distributions and group axis point distributions are supported with this command.	
Syntax	`IncaAddCalibrationElement(deviceName, calibrationName {, displayMode})`	
Output Arguments	none	
Input Arguments	`deviceName`	name of the device

	`calibrationName`	name of the calibration element
	`displayMode`	display mode for the element: – `2`: the calibration variable is displayed and constantly updated (default) – `1`: it is displayed but not updated – `0`: no display Selecting `1` (display only) may considerably improve the performance at high data volumes.

Examples

```
IncaAddCalibrationElement('anEtk',
'Scalar');
IncaAddCalibrationElement('anEtk',
'Curve');
IncaAddCalibrationElement('anEtk',
'Map');
```

> **Note**
>
> For group axes no interpolation of the dependent curves and maps is executed.

4.5.3 Read Calibration Value

Name `IncaGetCalibrationValue`

Description Reads the current value of a calibration variable or the associated break point distribution

Syntax

```
value = IncaGetCalibrationValue
(deviceName, calibrationName {, start,
size} {, valueType})
```

Output Arguments	`value`	the current value of the calibration variable; it must match the data types specified below: – Scalars: a (1,1) matrix – Curves: an (x,1) matrix – Maps: an (x,y) matrix – Break point distributions: an (x,1)-matrix

Input Arguments	`deviceName`	name of the device
	`calibrationName`	the name of the calibration element

	`start`	Startindex. Supported datatypes:
		– For curves and break point distributions a startindex `x` has to be specified.
		`x >= 1`
		– For maps a startindex `[x,y]` has to be specified.
		`x,y >= 1`

`size`	Number of values to read. Supported datatypes:
	— For curves and break point distributions a count `n` has to be specified.
	`n >= 1`
	— For maps a count `[n,m]` has to be specified.
	`n,m >= 1`

`valueType`	selection of the output argument (string). The function either returns the value of the calibration variable (default) or the X- and Y-break point distribution. Possible settings: — `v`: value — `x`: x break point (curves and maps — `y`: y break point (maps)

Examples

```
aValue = IncaGetCalibrationValue('anEtk',
'Scalar');
aCurve = IncaGetCalibrationValue('anEtk',
'Curve');
aMap = IncaGetCalibrationValue('anEtk',
'Map');
xMap = IncaGetCalibrationValue('anEtk',
'Map', 'x');
yMap = IncaGetCalibrationValue('anEtk',
'Map', 'y');
aCurveRange = IncaGetCalibrationValue
('anEtk', 'Curve', 2, 3);
aMapRange = IncaGetCalibrationValue
('anEtk', 'Map', [2,3], [3,4]);
xMapRange = IncaGetCalibrationValue
('anEtk', 'Map', 2, 3, 'x');
```

4.5.4 Change Calibration Value

Name `IncaSetCalibrationValue`

Description Assigns a value to a calibration variable or associated break point

Syntax

```
IncaSetCalibrationValue( deviceName, calibrationName, value )
IncaSetCalibrationValue( deviceName, calibrationName, value, valueType )
IncaSetCalibrationValue( deviceName, calibrationName, value, start )
IncaSetCalibrationValue( deviceName, calibrationName, value, start, valueType )
result = IncaSetCalibrationValue( deviceName, calibrationName, value )
result = IncaSetCalibrationValue( deviceName, calibrationName, value, valueType )
result = IncaSetCalibrationValue( deviceName, calibrationName, value, start )
result = IncaSetCalibrationValue( deviceName, calibrationName, value, start, valueType )
```

Output Arguments	`result`	result of calibration (optional, only in case of failures) If no result bit is set, then the calibration value has been successfully modified. This is also the case if one of the bits 5 to 8 is set, which provide additional information. If, however, one of the bits 0 to 4 is set, then the calibration has failed. — Bit 0 set: calibration not done — Bit 1 set: lower weak bound violated — Bit 2 set: upper weak bound violated — Bit 3 set: lower hard bound violated — Bit 4 set: upper hard bound violated — Bit 5 set: limited to lower weak bound — Bit 6 set: limited to upper weak bound — Bit 7 set: limited to lower hard bound — Bit 8 set: limited to upper hard bound There may be different causes for a calibration not to be executed. For instance, depending on the active calibration mode, any of the bounds would have been violated. In this case more detailed information is returned by bit 1 to 4. Another cause might be that the calibration element or active page is write protected or a x- or y-distribution would be violating the monotony. In all

		these cases only bit 0 is set.
Input Arguments	`deviceName`	name of the device
	`calibrationName`	name of the calibration element
	`value`	value of the calibration element. Acceptable data types: – Scalars: a (1, 1) matrix – Curves: an (x, 1) matrix – Maps: an (x, y) matrix – x and y break point distributions: an (x, 1) matrix

`start`	Start index. Supported datatypes:
	– For curves and break point distributions a startindex `x` has to be specified.
	`x >= 1`
	For maps a startindex `[x,y]` has to be specified.
	`x,y >= 1`

`valueType`	Selection of value (string). The function modifies either the value of the calibration variable (default) or the X/Y break point distribution. Possible settings: – `v`: value (default) – `x`: x break point (curves and maps) – `y`: y break point (maps)

Examples

```
IncaSetCalibrationValue('anEtk',
'Scalar', aValue);
IncaSetCalibrationValue('anEtk', 'Curve',
aCurve);
IncaSetCalibrationValue('anEtk', 'Map',
aMap);
IncaSetCalibrationValue('anEtk', 'Map',
xMap, 'x');
IncaSetCalibrationValue('anEtk', 'Map',
yMap, 'y');
IncaSetCalibrationValue('anEtk', 'Curve',
aCurveRange, 2);
IncaSetCalibrationValue('anEtk', 'Map',
aMapRange,[2,3]);
IncaSetCalibrationValue('anEtk', 'Map',
xMapRange, 2, 'x');
```

4.5.5 Assign Dataset to Device (INCA-MIP Extended)

Name	`IncaSetDatasetInDevice`
Description	Assigns a dataset to a device in an open experiment
Syntax	`IncaSetDatasetInDevice(device,dataset)`
Output Arguments	none

Input Arguments	`device`	name of device
	`dataset`	database path of dataset
Examples	`IncaSetDatasetInDevice ('ETK:1','Ds4711\Ds4711_3')`	

4.5.6 List Datasets of a Device (INCA-MIP Extended)

Name	`IncaGetDatasetsForDevice`	
Description	Gets a list of all dataset names for a given device	
Syntax	`name = IncaGetDatasetsForDevice(device)` `[name, properties] = IncaGetDatasetsForDevice(device)`	
Output Arguments	`name`	A string list with the full path of all datasets found
	`properties`	A string list of the dataset properties Possible values are: — '' (empty string): A dataset with read-write access — `r` : A dataset with read-only access — `m` : A master dataset with read-write access — `mr`: A master dataset with read-only access
Input Arguments	`device`	name of device
Examples	`l = IncaGetDatasetsForDevice('ETK:1')`	

4.5.7 Set Calibration Mode (INCA-MIP Extended)

Name	`IncaSetCalibrationMode`
Description	Sets the global calibration mode valid for all subsequent calibrations done with `IncaSetCalibrationValue`. The mode remains valid even after closing and reopening an experiment. When starting the MATLAB® Interface the default mode for both lower and upper limits is `rejectWeakBoundViolation`.
Syntax	`IncaSetCalibrationMode(lowerLimitMode, upperLimitMode)`

Output Arguments	none	
Input Arguments	`lowerLimitMode`	The new Calibration Mode for lower limits
	`upperLimitMode`	The new Calibration Mode for upper limits: — `rejectWeakBoundViolation`: reject complete calibration if weak bound would be violated at least once (default) — `limitToWeakBound`: If min. or max. weak bound limit would be violated use min. or max. weak bound value instead — `rejectHardBoundViolation`: Ignore weak bounds. Reject complete calibration if hard bound would be violated at least once — `limitToHardBound`: Ignore weak bounds. If min. or max. hard bound limit would be violated use min. or max. hard bound value instead
Examples	`IncaSetCalibrationMode ('rejectHardBoundViolation', 'limitToHardBound')`	

4.5.8 Group Devices (INCA-MIP Extended)

Name	`IncaGroupDevices`	
Description	Activates or deactivates Device Grouping	
Syntax	`IncaGroupDevices(onOff)`	
Output Arguments	none	
Input Arguments	`onOff`	— `0`: Deactivate device grouping — `1`: Activate device grouping
Examples	`IncaGroupDevices(1)`	

4.5.9 Write DCM File (INCA-MIP Extended)

Name	`IncaWriteToFile`	
Description	Writes a DCM file within an open experiment	
Syntax	`IncaWriteToFile(format,file,device, calibs{,options})`	
Output Arguments	none	
Input Arguments	`format`	File format identifier: – `'DCM'`: DCM format
	`file`	Full path of file to be written to
	`device`	Device whose calibration elements will be written
	`calibs`	List of calibration elements to write (as cell array)
	`options`	Options used for writing in specified format

Examples	`calibs = {'A0_KW', 'BRABEVI_KL', 'KFZW_GKF'};`
	`IncaWriteToFile('DCM','C:\DCMOut1.dcm', 'device1', calibs);`
	`IncaWriteToFile('DCM','C:\DCMOut2.dcm', 'ETK:1','A0_KW');`	

4.6 Memory Page Manager

All previously described API functions are effective for a device's currently active page. In principle, calibration access is possible only from the working page. However, it might occur that write access to the ETK's working page is blocked because the checksums of the working pages in the INCA database and in the ETK do not match.

The following API functions can be used for memory page management.

4.6.1 Activate Memory Page

Name	`IncaSwitchPage`
Description	Activates the specified memory page.
Syntax	`IncaSwitchPage(deviceName, pageName)`
Output Arguments	none

Input Arguments	`deviceName`	name of the device
	`pageName`	name of the page: – `wp`: working page – `rp`: reference page
Examples	`IncaSwitchPage('MyDevice', 'wp');` `IncaSwitchPage('Dev', 'rp');`	

4.6.2 Get Current Page (INCA-MIP Extended)

Name	`IncaGetCurrentPage`	
Description	Gets the currently active memory page	
Syntax	`pageName = IncaGetCurrentPage(deviceName)`	
Output Arguments	`pageName`	name of the active memory page: – `wp`: working page – `rp`: reference page
Input Arguments	`deviceName`	Name of the device
Examples	`p = IncaGetCurrentPage('MyDevice');`	

4.6.3 Check Write-Protection

Name	`IncaIsPageWriteProtected`	
Description	Checks whether the specified memory page is write-protected	
Syntax	`isRW = IncaIsPageWriteProtected (deviceName, pageName)`	
Output Arguments	`isRw`	– `0`: page is not write-protected – `not 0`: page is write-protected
Input Arguments	`deviceName`	name of the device
	`pageName`	name of the page: – `wp`: working page – `rp` : reference page
Examples	`isETK1RW = IncaIsPageWriteProtected ('ETK:1', 'wp');` `isETK2RW = IncaIsPageWriteProtected ('ETK:2', 'rp');`	

4.6.4 Download Memory Page

Name	`IncaDownloadPage`	
Description	Downloads the specified memory page to the control unit	
Syntax	`IncaDownloadPage(deviceName, pageName)`	
Output Arguments	none	
Input Arguments	`deviceName`	name of the device
	`pageName`	name of the page to download — `wp`: working page — `rp`: reference page
Examples	`IncaDownloadPage('ETK:1', 'wp');` `IncaDownloadPage('ETK:1', 'rp');`	

4.6.5 Copy Memory Page

Name	`IncaCopyPageFromTo`	
Description	Copies the specified memory page. Currently, it is only possible to copy from the reference page to the working page; other combinations of sources and targets are not supported.	
Syntax	`IncaCopyPageFromTo( deviceName, sourcePageName, destinationPageName)`	
Output Arguments	none	
Input Arguments	`deviceName`	name of the device
	`sourcePageName`	name of the page to be copied: — `wp`: working page — `rp`: reference page
	`destinationPageName`	name of the page to copy to: — `wp`: working page — `rp`: reference page
Examples	`IncaCopyPageFromTo('ETK:1', 'rp', 'wp');`	

4.6.6 Download Differences

Name	`IncaDownloadDifferences`	
Description	Loads the differences between the working page and reference page into the control unit. As with the corresponding menu option, this is only updated if the working page and reference page in the target unit match the reference page in INCA.	
Syntax	`IncaDownloadDifferences( deviceName )`	
Output Arguments	none	
Input Arguments	`deviceName`	name of the device
Examples	`IncaDownloadDifferences('ETK:1');`	

4.6.7 Upload Pages (INCA-MIP Extended)

Name	`IncaUploadPages`	
Description	Uploads reference and working page to newly created datasets. The new datasets are automatically assigned to the device.	
Syntax	`IncaUploadPages(device{,referencePage, workingPage})`	
Output Arguments	none	
Input Arguments	`device`	name of device
	`referencePage`	Dataset name for uploaded reference page. If not specified, INCA uses a default name
	`workingPage`	Dataset name for uploaded working page. If not specified, INCA uses a default name
Examples	`IncaUploadPages('ETK:1');` `IncaUploadPages('ETK:1', 'ref_1', 'work_1');`	

4.7 Application Examples

Example 1

```
% Check if working page is write-protected and
% download the page if it is write-protected
if(IncaIsPageWriteProtected ('anEtk', 'wp'))
 IncaDownloadPage('anEtk', 'wp');
end
% Switch to the working page
IncaSwitchPage( 'anEtk', 'wp');
```

Example 2

In the following example, the functions described above are used to read measured values from the device `MyDevice` and measure raster `10ms`. To execute this example, you must first open an experiment in INCA that includes an assigned device named `MyDevice`.

```
% Measure the following signals
IncaAddMeasureElement( 'MyDevice', '10ms', 'Chan1' );
IncaAddMeasureElement( 'MyDevice', '10ms', 'Chan2' );
IncaAddMeasureElement( 'MyDevice', '10ms', 'Chan3' );
IncaAddMeasureElement( 'MyDevice', '10ms', 'Chan4' );
% Now measure
data = [];
time = [];
IncaShowMessages(0);
IncaSetMeasureReadMode(0)
IncaStartMeasurement;
deltaT = 0;
% Measure for 20 seconds
while( deltaT < 20 )
      % Pause for 0.1 seconds to have more than one
      % record -- saves processor time.
      pause(0.1)
      % Get up to 500 records for group 10ms
      [ t, d ]=IncaGetRecords( 'MyDevice', '10ms', 500
);
      % Append t and d to time and data
      data = [data; d];
      time = [time; t];
      if( length(time) )
```

```
            % Calculate time measured
            deltaT = time( length(time)) - time(1);
        end
    end
    IncaStopMeasurement;
    IncaShowMessages(1);
    % Plot the results
    plot(time, data);
```

This example uses only one measure raster. However, you can use several groups and request the data for each group independent of MATLAB®.

5 Creation and Distribution of Stand-alone Executable Files using the MATLAB® Compiler

With INCA-MIP, you can create and compile m-files containing MATLAB® API functions including INCA-MIP functions. The resulting stand-alone files can be executed also in environments without a MATLAB® installation.

Creating stand-alone executable files requires a MATLAB® installation. The resulting executable, together with copies of some MATLAB® and ETAS DLLs, can be used without a MATLAB® installation on the target system.

Furthermore, MATLAB® runtime libraries may be needed for running compiled executables on the target system.

See your MATLAB® user documentation under Distributing Stand-Alone Applications for information on how to install and use the MATLAB® runtime libraries.

5.1 Compilation of m-Files

To compile m-Files using the MATLAB® compiler:

1. Copy all `Inca*.dll` and `Inca.*.mexw64` files into the current working directory.

   Depending on the folder you selected during installation, you find the DLL and MEXW64 files in that folder.

   EXAMPLE

   `<drive:\>Program Files\MATLAB\Ryyyy\bin\win64`

   `<drive:\>ETASData\INCAx.y\INCA-MIPx64`

   Make sure that the MATLAB® compiler and the INCA-MIP paths are added to the Windows Environmental Variable.

   To set the environmental variables, see the Windows user documentation for Advanced System Settings.

   Execute the following command:

   ```
   mcc -m <m-file-script> -a incaRci2Matlab.dll
   ```

   EXAMPLE

   With the following command a stand-alone executable file is created from the file `testCase2.m`:

   ```
   mcc -m testCase2 -a incaRci2x64Matlab.dll
   ```

   Result is the file `testCase2.exe`.

The MATLAB® compiler creates a container with all MEX function DLLs and dependent DLLs which are needed to execute the compiled MATLAB® script. All Inca *.dll files that are used by the script as well as the `incaRci2x64Matlab.dll` have to be part of this container. INCA MEX function DLLs have the extension `*.mexw64`.

When the compiled script is executed, the DLLs do not need to be present on the system.

See your MATLAB® user documentation under the keyword *MATLAB® Compiler* or `mcc` for needed versions and corresponding settings of the MATLAB® compiler.

> **Note**
>
> INCA can be controlled by only one MATLAB® session at a time. Trying to control INCA simultaneously from different instances of MATLAB® or stand-alone executables will be aborted with an error message.

> **Note**
>
> With MATLAB® R2016a or higher the INCA MEX function DLLs have the extension `*.mexw64`.

5.2 Distribution of Stand-alone Executable Files

Executing stand-alone executable files that were compiled using the MATLAB® compiler only require the executable itself. A MATLAB® installation or copies of MATLAB® libraries are not required.

To distribute stand-alone executable files compiled with the MATLAB® compiler

- Copy the stand-alone executable files to the target system.

Afterwards you can execute them; no further steps are required.

6 Contact Information

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:

www.etas.com/hotlines

ETAS offers trainings for its products:

www.etas.com/academy

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