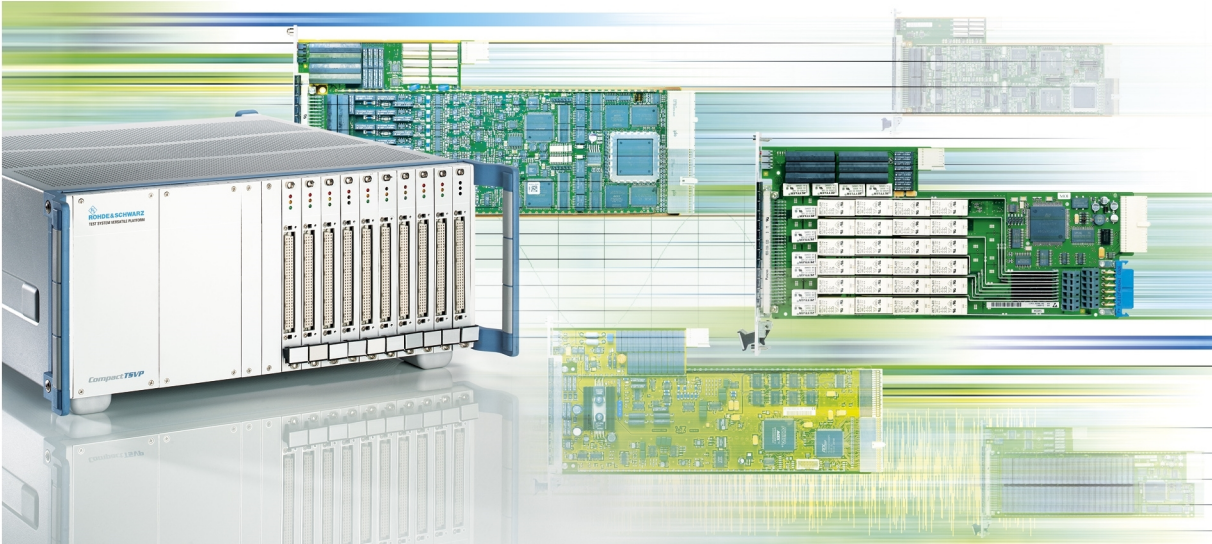


R&S[®]IC-Check

Generic Test Software Library

User Manual



1514511742

This Software Description is valid for the R&S GTSL-Software version 2.90 (and higher versions).

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Mühlhofstr. 15, 81671 München, Germany

Phone: +49 89 41 29 - 0

Fax: +49 89 41 29 12 164

Email: info@rohde-schwarz.com

Internet: www.rohde-schwarz.com

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1514.5117.42 | Version 03 | R&S®IC-Check

The following abbreviations are used throughout this manual: R&S®IC-Check is abbreviated as R&S IC-Check.

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1 General

1.1 Reference Documents

The Generic Test Software Library R&S IC-Check is part of the Generic Test Software Library R&S GTSL. For this reason, the following documentation is to be noted in addition to this software description:

- Software Description Generic Test Software Library R&S GTSL

The related test hardware is required for performing IC-Check tests. The test hardware is described in the following documentation:

- User Manual Test System Versatile Platform R&S CompactTSVP TS-PCA3
- User Manual Test System Versatile Platform R&S PowerTSVP TS-PWA3
- User Manual Analog Source and Measurement Module R&S TS-PSAM
- User Manual Matrix Module B R&S TS-PMB

1.2 Explanation of Symbols

Certain text passages in this software description are specially highlighted. The passages marked in this way have the following significance:



Highlights important details to which special attention must be paid and that make your work easier.

2 Software Installation



Generic Test Software Library R&S IC-Check is installed using the installation routine for the Generic Test Software Library R&S GTSL.

For a detailed description of the installation procedure for the Generic Test Software Library R&S GTSL please refer to chapter “Software Installation” of the document:

- Software Description Generic Test Software Library R&S GTSL

3 Functional Description

3.1 General

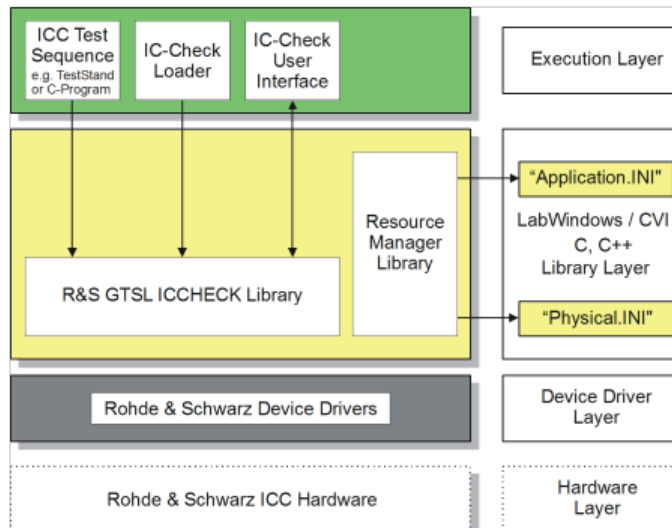


Figure 3-1: R&S IC-Check Layer Model

Using Generic Test Software Library R&S IC-Check it is possible to prepare and perform tests on pins of ICs or other mounted electronic circuit devices. The individual R&S IC-Check software components are arranged in layers exactly like R&S GTSL.

The bottom layer (device driver layer) of the R&S IC-Check contains the device drivers necessary for the test hardware used. The test hardware is accessed using these device drivers.

The middle layer (library layer) of the R&S IC-Check contains the R&S GTSL IC-Check library. The R&S IC-Check library provides the functions necessary for performing the IC-Check tests. In this layer further information is passed to the resource manager library via the two files `PHYSICAL.INI` and `APPLICATION.INI`. The various device drivers from the lowest level are called from this layer.

The top layer (execution layer) contains the test sequences for performing the IC-Check tests. The test sequences call functions from the R&S IC-Check test library in the middle layer. The function calls include, e.g.

- loading ICC programs,
- running ICC programs,
- debugging ICC programs and
- the generation of reports.

The calls for the individual functions from the R&S IC-Check test library can be made using a sequence editor (e.g. TestStand) or a dedicated C program.

The top layer (execution layer) also contains the R&S IC-Check Loader and the R&S IC-Check User Interface which is opened using a function call from the R&S IC-Check test library.



For further information on R&S GTSL see "Software Description Generic Test Software Library R&S GTSL"

R&S IC-Check includes the following parts and programs:

- R&S IC-Check test library
- R&S IC-Check Loader
- R&S IC-Check User interface

3.2 R&S IC-Check Test Library

The following section provides a short overview of the test functions available in the R&S IC-Check test library.



The individual test functions and their parameters are described in the online help for the R&S IC-Check test library. The help files (.HLP) are in the folder . . . \GTSL\BIN.



Starting with GTSL 3.30, no GTSL license is required.

3.2.1 General

Name of the dynamic link library (.DLL):	ICCHECK.DLL
Name of the help file (.HLP):	ICCHECK.HLP
License required	R&S TS-LBAS and R&S TS-LICC
Supported devices:	R&S TS-PMB Matrix Module R&S TS-PSAM Source and Measurement Module

The R&S IC-Check test library offers functions for the IC-Check test using the R&S IC-Check software and the R&S TS-PSAM and R&S TS-PMB modules.

The functions allow to

- load, run and debug ICC programs
- generate a report

3.2.2 Entries in PHYSICAL.INI

Section [device->...]

Keyword	Value	Description
Type	String	<i>Mandatory entry</i> pmb = R&S TS-PMB Matrix Module psam = R&S TS-PSAM Source and Measurement Module
ResourceDesc	String	<i>Mandatory entry</i> VISA resource descriptor in the form PXI[segment number]::[device number]:: [function]::INSTR CAN[board]::[controller]::[frame]::[slot]
DriverPrefix	String	<i>Mandatory entry</i> Prefix for the IVI driver functions, without underscore: R&S TS-PMB : rspmb R&S TS-PSAM : rpsam
DriverDLL	String	<i>Mandatory entry</i> File name of the driver DLL R&S TS-PMB : rspmb.dll R&S TS-PSAM : rpsam.dll
DriverOption	String	<i>Mandatory entry</i> Option string being passed to the device driver during the Driver_Init function. See the online help file for the appropriate device driver.

3.2.3 Entries in APPLICATION.INI

Section [bench->...]

Keyword	Value	Description
ICCDevice	String	<i>Mandatory entry</i> Refers to the device section of the R&S TS-PSAM
SwitchDevice<i>	String	<i>Mandatory entry</i> Refers to a section with switch devices in PHYSICAL.INI. <i> stands for a number from 1,2,3,...,n. The numbers must be assigned in ascending order without gaps. <i> may be omitted in the case it is 1.

Keyword	Value	Description
AppChannelTable	String	<i>Mandatory entry</i> Refers to a section with defined channel names in APPLICATION.INI.
Simulation	0 / 1	<i>Optional entry</i> Blocks the simulation of the entered devices (value = 0). Enables simulation of the entered devices (value = 1). Default = 0
Trace	0 / 1	<i>Optional entry</i> Blocks the tracing function of the library (value = 0). Enables the tracing function of the library (value = 1). Default = 0
ChannelTableCase Sensitive	0 / 1	<i>Optional entry</i> The channel names in the channel table are treated case-sensitive (value = 1) or case-insensitive (value = 0).

Section [io_channel->...]

Contains a list of user-specific channel names which are assigned to the physical device names and to the physical device channel names. The defined names apply only to the relevant application. For details about channel name syntax, refer to the manual "Software Description GTSL", chapter 8.3.4.

Keyword	Value	Description
<user-defined name>	String	Physical channel description in the combination <device name>!<device channel name>

3.2.4 Functions

Setup	ICCHECK_Setup
Cleanup	ICCHECK_Cleanup
Library Version	ICCHECK_Lib_Version
Program Control	
Load Program	ICCHECK_Load_Program
Run Program	ICCHECK_Run_Program
Debug Program	ICCHECK_Debug_Program
Report Generation	
Write Report to File	ICCHECK_Write_Report
Load Detailed Report	ICCHECK_Load_Detailed_Report

Get Detailed Report Entry Attribute Information	ICCHECK_Get_Detailed_Report_Entry
Get Attribute Int	ICCHECK_Get_Attribute_Int
Get Attribute Real	ICCHECK_Get_Attribute_Real
Get Attribute String	ICCHECK_Get_Attribute_String

3.3 R&S IC-Check Loader

Using the **R&S IC-Check Loader** the R&S IC-Check User Interface can be opened directly.



The operation of the R&S IC-Check Loader is described in [Chapter 7.2, "Starting the R&S IC-Check Loader"](#), on page 30.

3.4 R&S IC-Check User Interface

The R&S IC-Check User Interface for configuring and running an ICC program is started either using a function from the R&S IC-Check test library or using the R&S IC-Check Loader.

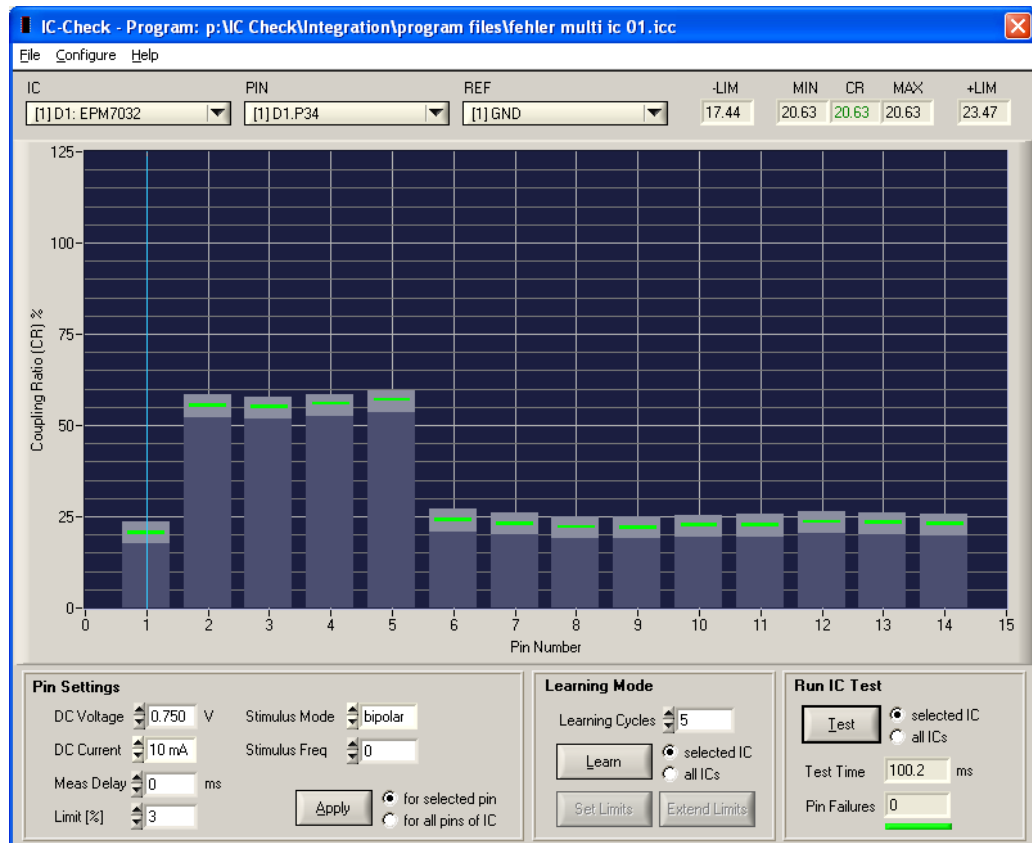


Figure 3-2: R&S IC-Check User Interface

R&S IC-Check User Interface provides functions for configuring test parameters, adjusting limit values (using the Learning Mode) and running an ICC program.



The individual functions of the R&S IC-Check User Interface are described in [Chapter 4, "R&S IC-Check User Interface"](#), on page 13.

3.5 Hardware for IC-Check Tests

To be able to perform an IC-Check test using R&S IC-Check the following test hardware must be available:

- Test System Versatile Platform R&S CompactTSVP TS-PCA3
- Test System Versatile Platform R&S PowerTSVP TS-PWA3 (alternative expansion)
- R&S TS-PSAM Source and Measurement Module
- R&S TS-PMB Matrix Module B

The individual components of test hardware are described in the related user manuals.

4 R&S IC-Check User Interface

4.1 General

The Generic Test Software Library R&S IC-Check runs under the Microsoft Windows operating systems.



To operate the Generic Test Software Library R&S IC-Check basic skills in the usage of the Microsoft Windows operating systems are required.

4.2 Main Screen

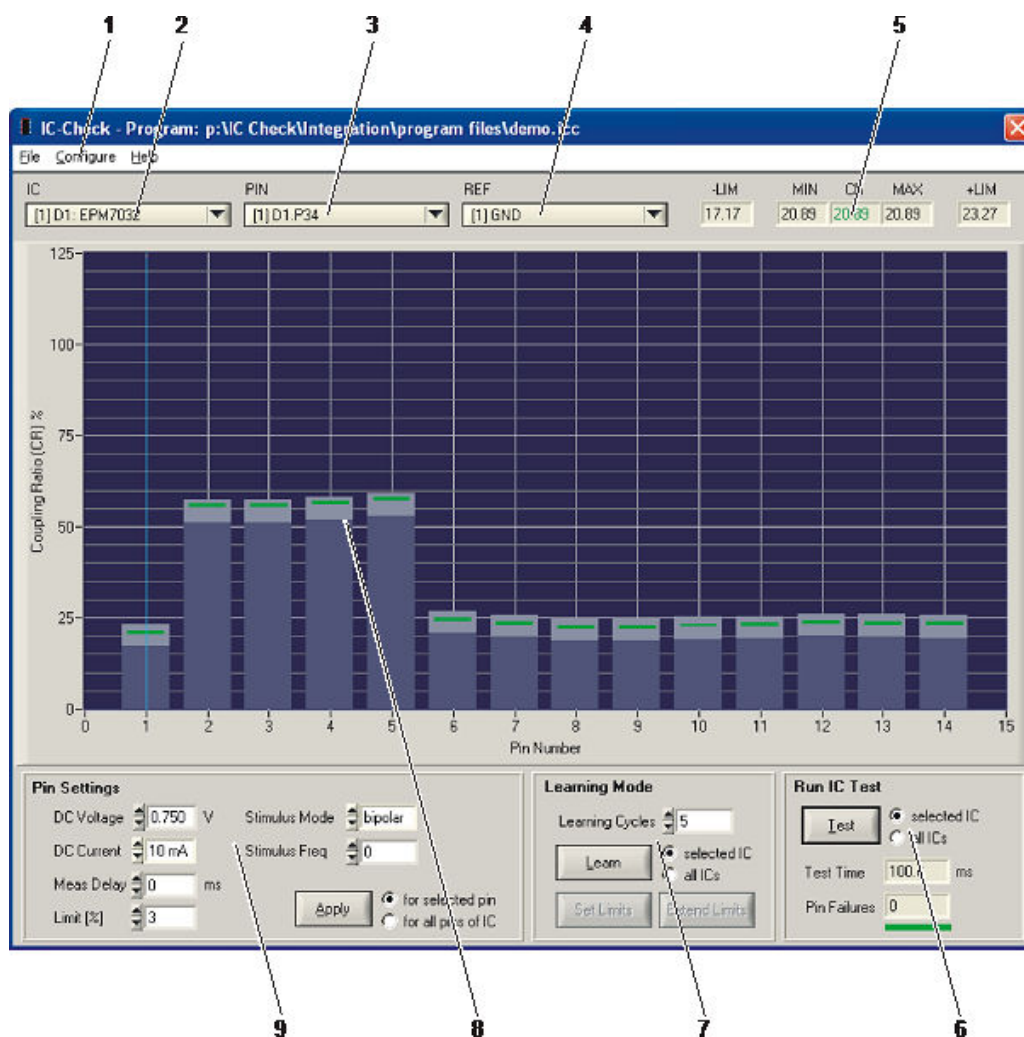


Figure 4-1: Main Screen

1	Menu bar	see section 4.3 and 4.4
2	IC Selection	see section 4.5.1
3	PIN Selection	see section 4.5.2
4	REF List	see section 4.5.3
5	PIN measurement results	see section 4.5.4
6	Run IC Test	see section 4.5.8
7	Learning Mode	see section 4.5.7
8	IC measurement result overview	see section 4.5.5
9	PIN settings	see section 4.5.6

4.3 Menu Structure

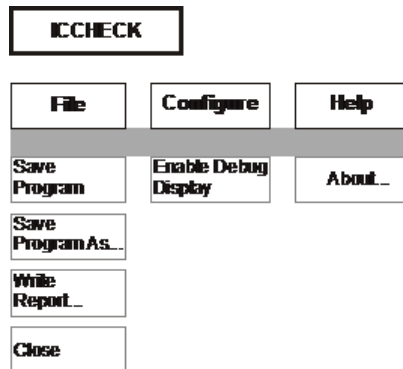


Figure 4-2: Menu structure

4.4 Menu Bar Functions

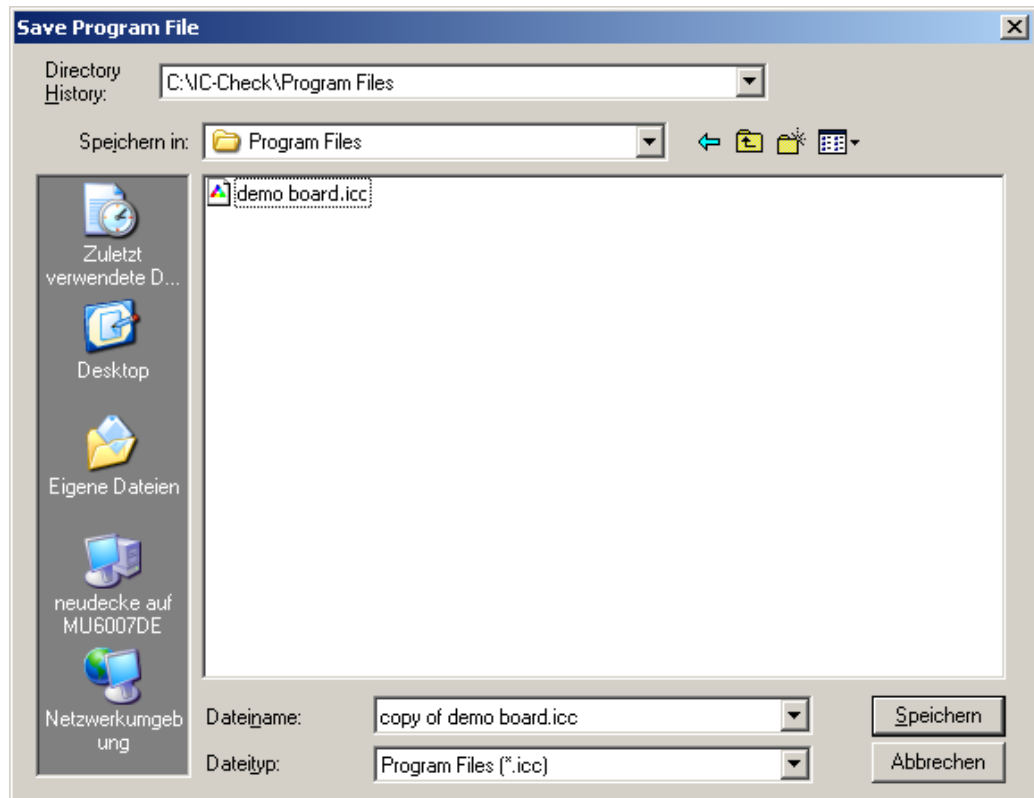
4.4.1 Main Menu <File>

4.4.1.1 Menu <Save Program>

All the changes made to the IC-Check program file currently loaded are saved.

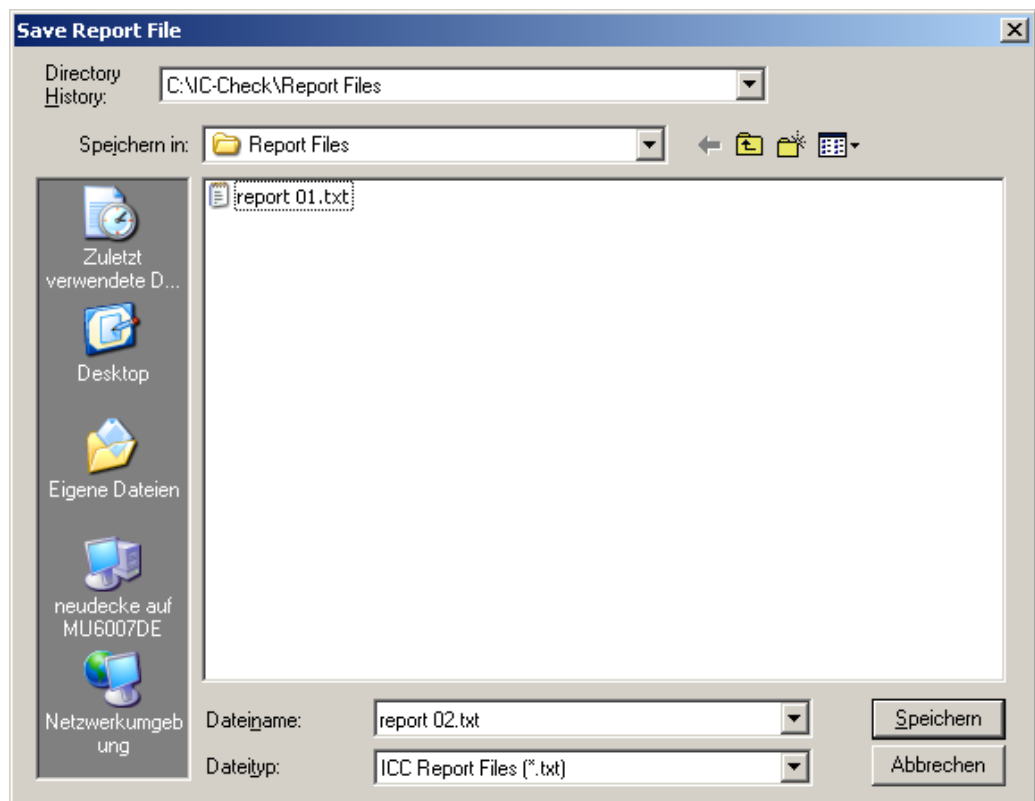
4.4.1.2 Menu <Save Program As...>

Here, the IC-Check program file currently loaded can be saved with a different name. All the changes made to the IC-Check program file currently loaded will also be saved.



4.4.1.3 Menu <Write Report...>

The topical measured values of the IC-Check program file currently loaded are written into a report file. The name of the report file can be selected via the Windows standard dialogue.



For a sample report file, please refer to chapter 9: Report Format.

4.4.1.4 Menu <Close>

The IC-Check user interface is closed.

4.4.2 Main Menu <Configure>

4.4.2.1 Menu <Enable Debug Display>

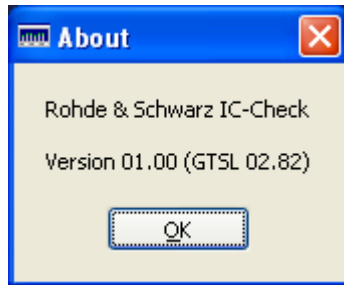
In this menu item, a marker can be set and removed again. When the marking has been set, the recorded measured values of the selected pin will be displayed in the form of a graphics after a measurement cycle.

For an example, please refer to [Chapter 6, "Test Methods"](#), on page 23.

4.4.3 Main Menu <Help>

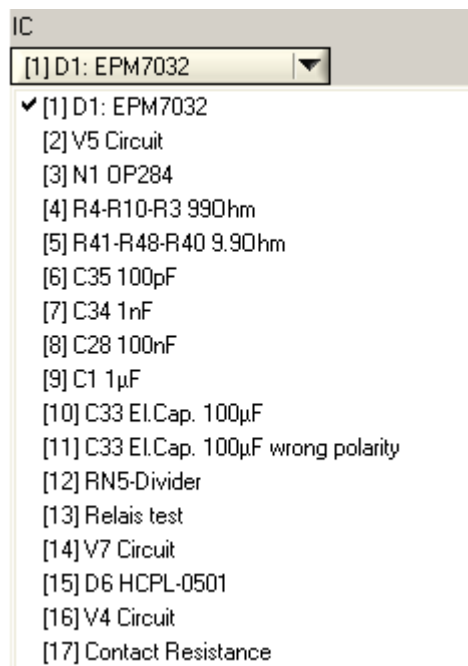
4.4.3.1 Menu <About...>

The version number of the R&S IC-Check library is displayed.



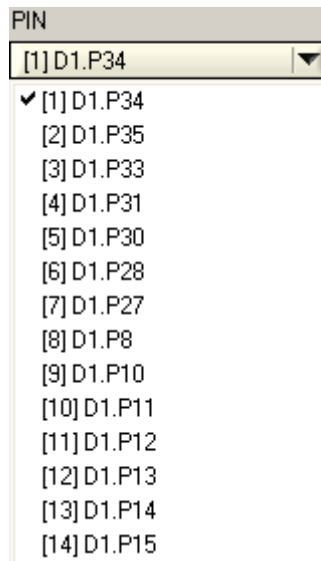
4.5 Control Elements

4.5.1 IC Selection



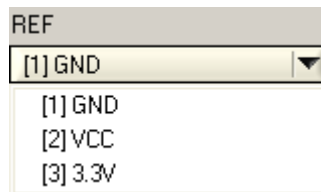
Selection of the IC to be tested. All the ICs defined in the IC-Check program file (.icc extension) currently loaded are listed.

4.5.2 PIN Selection



Selection of the pin, the configuration parameters and measured values of which are to be displayed on the user interface. The selected pin will also be selected in the graphical display of all the pins of the selected IC.

4.5.3 REF List



Display of all the reference pins defined for the selected IC. This list is intended as a display element only, it does not offer any options for selecting a reference pin. During a measurement sequence, all the reference pins are connected with each other.

4.5.4 PIN Measured Value Display

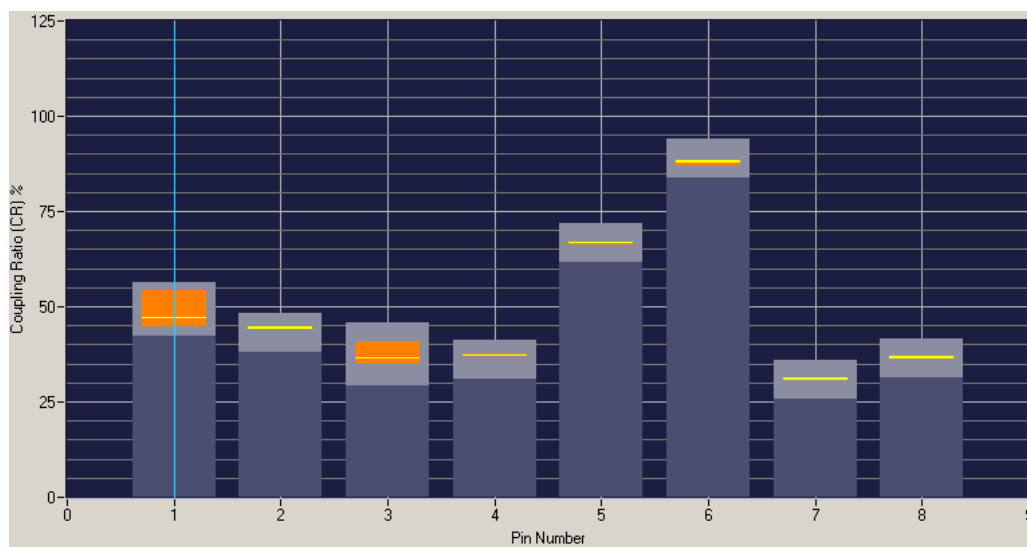
-LIM	MIN	CR	MAX	+LIM
17.17	20.95	20.96	20.98	23.27

These display fields display the CR measurement result and the configured limit values -LIM and +LIM of the currently selected pin. If several consecutive measurements are performed for one pin in learning mode, the lowest and highest value of the series of measurement will be displayed in the MIN and MAX fields. For more information on the learning mode, please refer to [Chapter 8, "R&S IC-Check Test Programs"](#), on page 34.

4.5.5 IC Measurement Result Overview Display

This graphics in the center of the user interface shows all the pins of the IC currently selected. The topical measured value and the configured limit values are displayed for each pin. In test mode, the indicator bar representing the topical measured value will be displayed in green as long as the measured value is within the permissible limits. Otherwise the indicator bar will be red.

In the learning mode, in which multiple measurements are performed for each pin, the entire range of the individual measured values will be displayed in orange. For more information on the learning mode, please refer to [Chapter 8.4.2, "Example: Determining the Limit Values via the Learning Mode"](#), on page 41.



4.5.6 Pin Settings

Pin Settings

DC Voltage V Stimulus Mode

DC Current mA Stimulus Freq = kHz

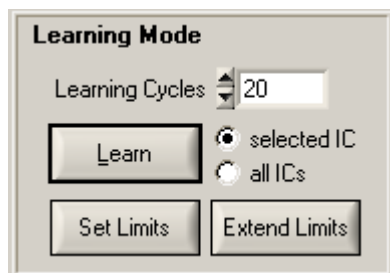
Meas Delay ms

Limit [%]

 for selected pin
 for all pins of IC

Display of the measurement configuration of the currently selected pin. The individual fields show the conditions on which the tests are performed for a pin. Changes in these fields will become effective after either the **Apply** button, the **Test** button or the **Learn** button has been clicked. It is possible to choose whether the current settings of all the fields are to be applied to the pin currently selected or to all the pins of the IC currently selected.

4.5.7 Learning Mode



In the learning mode, the configured measurements can be repeated automatically up to 100 times. For each pin, the range between the lowest and the highest of the determined measured values will be displayed in orange as the measurement result. The limit values to be set for each pin can then be adapted to this scatter range of the measurement values. There are two methods of doing so:

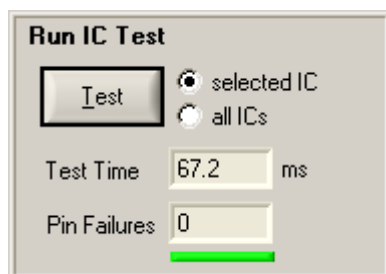
- Limits are set ("**Set Limits**" button)
The limits are set around the scatter range. The distance of the limits to the scatter range is defined for each pin in the "Limit" field of the "Pin Settings" area.
- Existing limits are extended ("**Extend Limits**" button)
Existing limits will be changed such that their distance to the scatter area is at least the value defined in the "Limit" field of the "Pin Settings" area. If the lower or upper limit defined up to that point is further away from the scatter area than this value, this limit value will not be changed.

The learning process can be performed for the IC currently selected or for all the ICs of the currently loaded IC-Check program file.

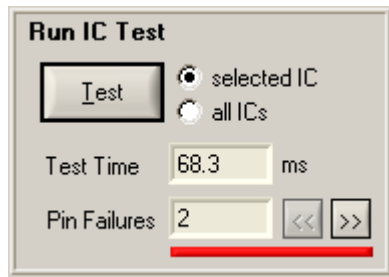
The learning mode procedure is described in detail in [Chapter 8.4.2, "Example: Determining the Limit Values via the Learning Mode"](#), on page 41.

4.5.8 Run IC Test

The test can be performed for the IC currently selected or for all the ICs of the currently loaded IC-Check program file. The required test time and the number of faults that occurred will be displayed.



Faults that occurred can be accessed via the arrow keys that will then be displayed.



5 License Management

The Generic Test Software Library R&S IC-Check is part of the Generic Test Software Library R&S GTSL.



Starting with GTSL 3.30, no GTSL license is required.

During the installation of the Generic Test Software Library R&S GTSL, all available test libraries and R&S IC-Check are copied to the system. You need the License Key File named `TS-LICC .lic` in order to access the functions from the R&S IC-Check test library. Refer to chapter “R&S GTSL license management” of the document “GTSL Software Description” for a detailed description of the R&S GTSL license management.

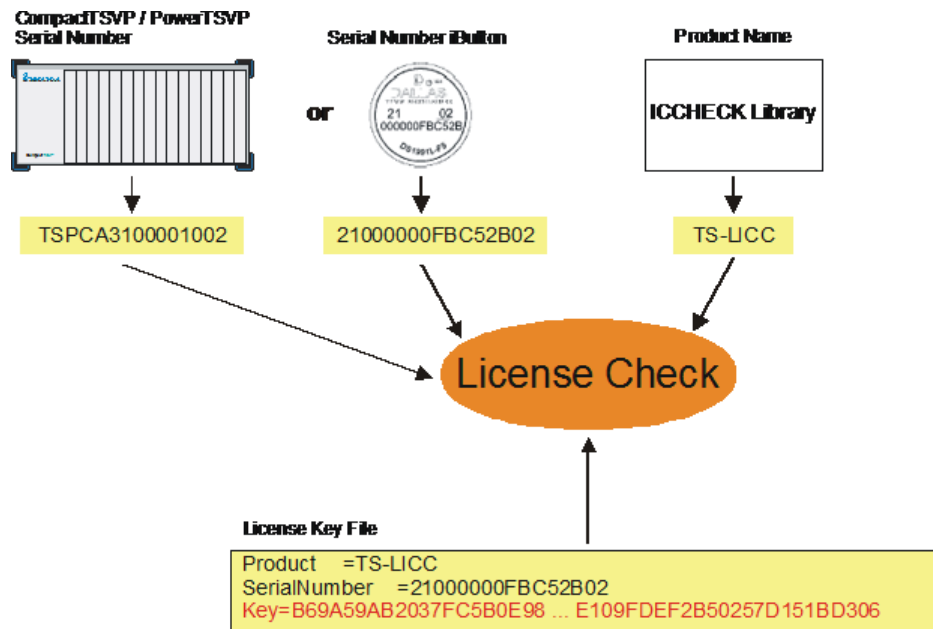


Figure 5-1: License checking

6 Test Methods

6.1 Test Setup

The following test equipment is used to perform the test:

- Bipolar DC source (square wave generator) with programmable analogue voltage, current limiting and switching frequency (R&S TS-PSAM).
- Fast ammeter with equidistant data recording (R&S TS-PSAM).
- Discharge circuit (R&S TS-PSAM).
- Flexible wiring matrix for test points and measuring systems (R&S TS-PMB).

6.2 Discharging the Reference Pins and Test Pins

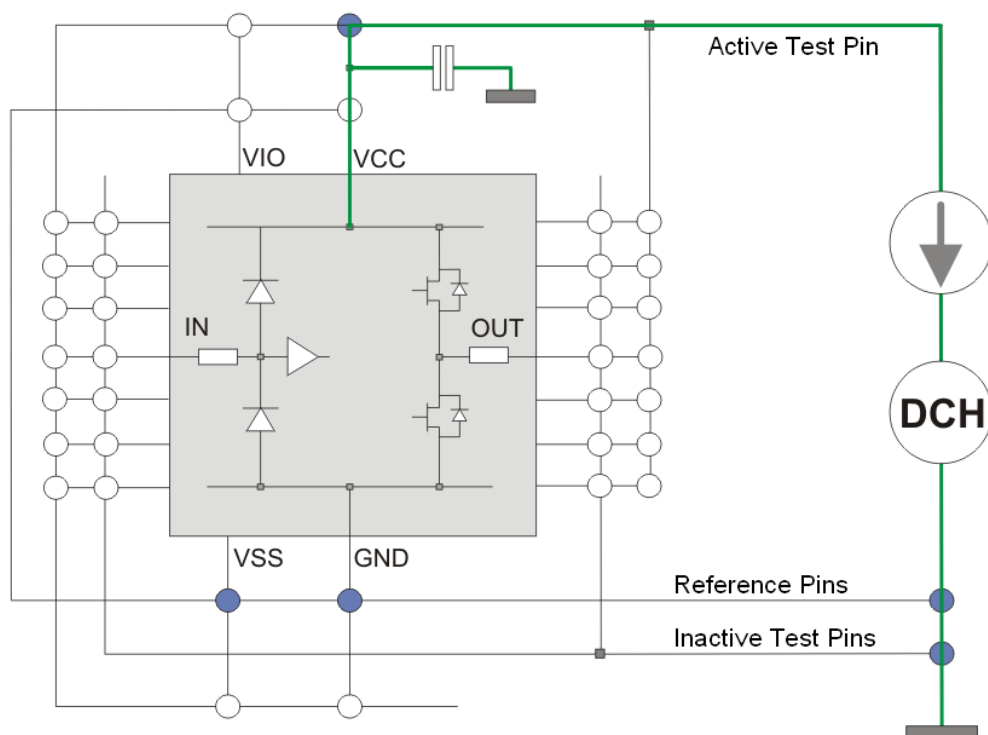


Figure 6-1: Discharging the reference pins and test pins

First, all the pins of the unit of a DUT (device under test) to be tested must be discharged so that faulty measurements due to charge reversal effects are prevented in the test later on (typically due to integrated or parasitic capacitors).

For this purpose, all the reference pins and test pins are discharged in a controlled via the ammeter and the discharge circuit (with current limiting) to the GND potential and connected to a common measuring line “Reference Pins” or “Inactive Test Pins”.

6.3 Checking Test Pins

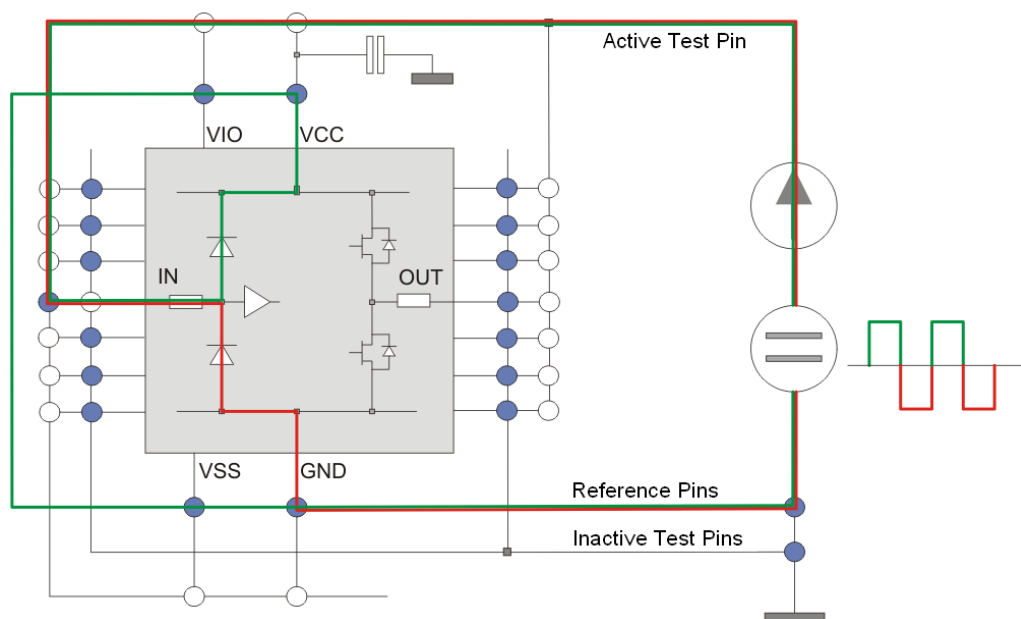


Figure 6-2: Checking test pins

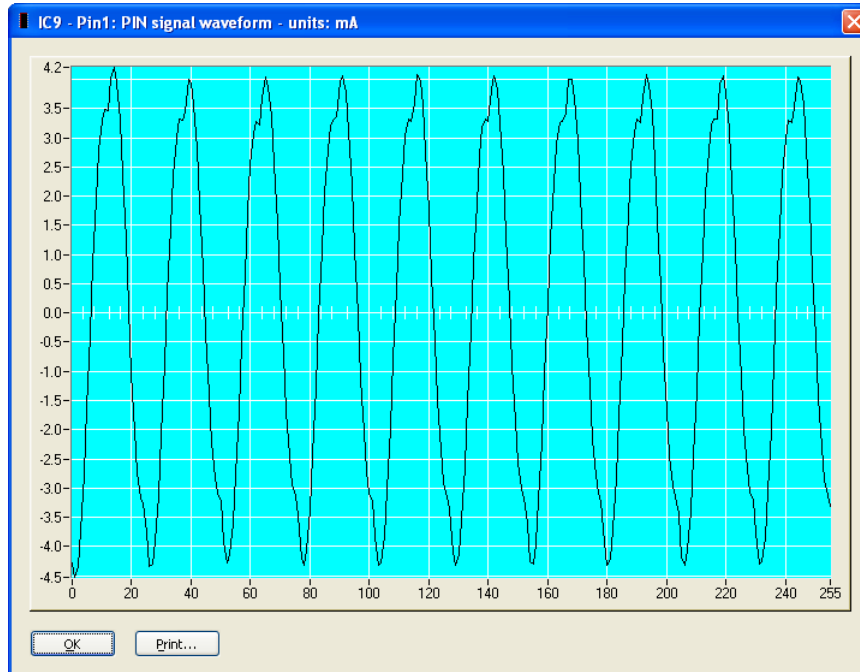
In the second phase, every single test pin is disconnected from the common measuring line “Inactive Test Pins” and connected to the measuring line “Active Test Pin”. Via the DC source connected in series with the ammeter, a DC voltage or a suitable square wave signal is connected to the test pin. The output voltage, current limiting and pulse frequency can be set individually for each test point. Isochronously with the activation of the DC source, the current flow will be recorded equidistantly with a sampling frequency of 200 kHz. 256 values will be recorded. Subsequently, the test pin is reconnected to the measuring line “Inactive Test Pins”.

Due to the bipolar characteristic of the DC source, multiple current paths can be measured in one measurement (refer to the example “red” and “green”).

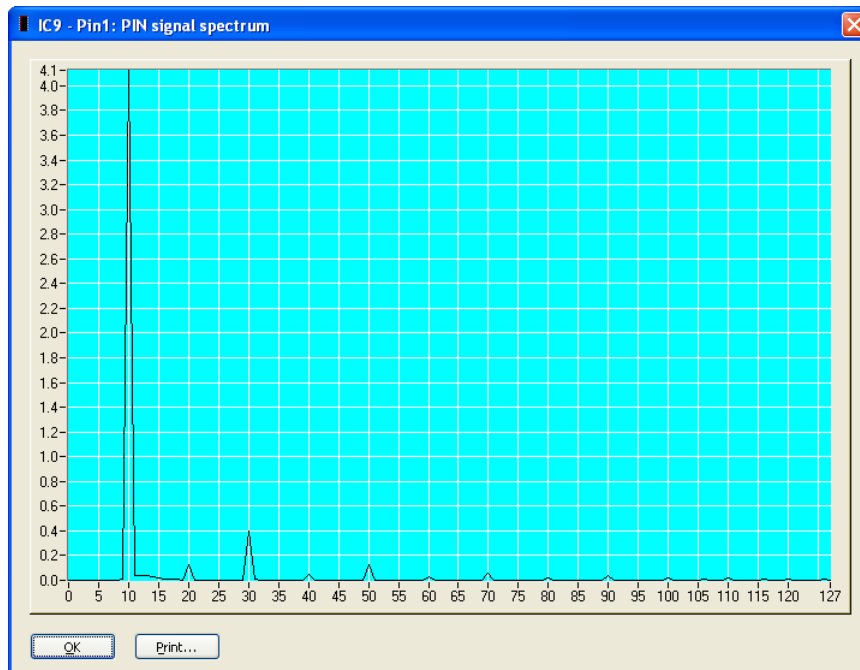
What is generally referred to as the “Coupling Ratio” is determined as the measurement result. It indicates the ratio of the current flow through a pin to the set current limiting of the stimulus source. If a DC voltage is used as the stimulus on the pin, the current flow through the pin is calculated as the average value of all the recorded measured values. If, however, a pulsed voltage (square wave voltage) is used as the stimulus following a Fast Fourier Transformation (FFT) of the recorded data, the amplitude of the basic oscillation is used as the dimension for the current flow through the pin. From the theory of the FFT a spectral resolution of sampling frequency divided by the number of recorded measured values, i.e. $200 \text{ kHz} / 256 = 781.25 \text{ Hz}$. When testing a

pin, the frequency of the applied stimulus voltage is always set to a multiple of this value (refer to the DCF setting parameters in [Chapter 8.2, "Keywords"](#), on page 35).

Example of current flow measured on a pin stimulated with a square wave voltage:



The recorded current profile is subjected to an FFT.



You obtain a typical "digital fingerprint" of a test bin based on the basic frequency (refer to $f[10]$ kHz in the diagram) and of its multiple of the generated DC stimulus source square wave signal. Typically, the level of the basic frequency is the highest level. Due

to the bipolar characteristic of the DC source, the offset ($f[0]$ in the diagram) is also very concise and clearly different depending on the type of test pin or network (Input, Output, Diode, R, C,...). The amplitude values are converted to a fictitious coupling rate (CR= percentage of the set current limiting).

7 Running R&S IC-Check

The Generic Test Software Library R&S IC-Check can be executed in two ways:

- By opening a function from the R&S IC-Check test library.
- Using the R&S IC-Check Loader.

7.1 Calling R&S IC-Check Test Library Functions

7.1.1 Description

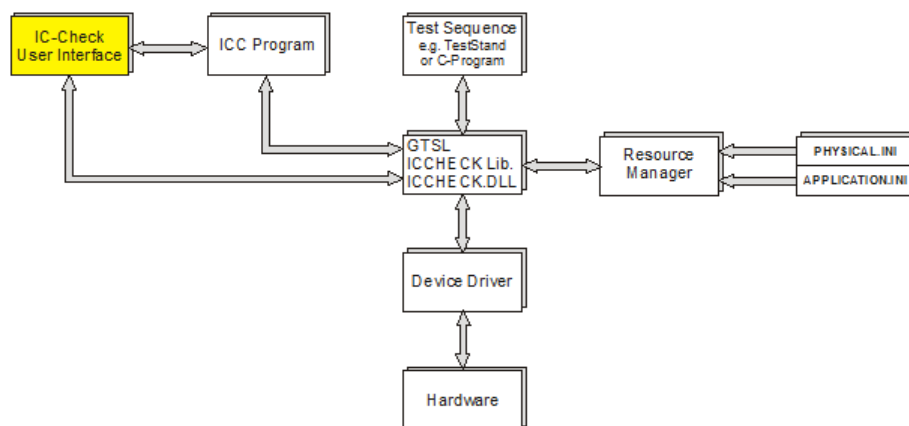


Figure 7-1: Running R&S IC-Check by calling R&S IC-Check library functions

R&S IC-Check test library functions are called from the test sequence (e.g. test sequence in TestStand or a dedicated C program). The test hardware available is managed using the resource manager with the aid of the configuration files (`PHYSICAL.INI` and `APPLICATION.INI`). The R&S IC-Check library opens the R&S IC-Check User Interface and the corresponding ICC program. The ICC program opened can now be configured in the R&S IC-Check User Interface. The ICC program can be executed on the test hardware directly from the R&S IC-Check User Interface. An ICC program can also be loaded and executed without opening the R&S IC-Check User Interface.

7.1.2 Example

In the following example, functions from the R&S IC-Check library are called from a C program. Among other aspects, the R&S IC-Check User Interface can be opened.

```
#include <cviauto.h>
#include <ansi_c.h>
#include <userint.h>
#include <cvirte.h>
```

```
#include "resmgr.h"
#include "iccheck.h"

// defines the drive and path for the example files
#define PATH "C:\\Program Files\\Rohde&Schwarz\\GTSL\\ICCHECK\\example\\"

int main (int argc, char *argv[])
{
    short errorOccurred = FALSE;
    long  errorCode;
    char  errorMessage[GTSL_ERROR_BUFFER_SIZE] = "";
    char  userMessage[1024];
    long  resourceId = -1;
    long  programId  = -1;
    long  numberOfICs;
    long  failCount;
    int   response = 0;

    // load the configuration files
    if ( ! errorOccurred )
    {
        RESMGR_Setup (0, PATH "example_physical.ini",
                     PATH "example1_application.ini",
                     &errorOccurred, &errorCode, errorMessage);
    }

    // load the ICCHECK library
    if ( ! errorOccurred )
    {
        ICCHECK_Setup (0, "bench->ICC",
                      &resourceId,
                      &errorOccurred, &errorCode, errorMessage);
    }

    // load the ICC program
    if ( ! errorOccurred )
    {
        ICCHECK_Load_Program (0, resourceId,
                              PATH "example1.icc",
                              &numberOfICs,
                              &errorOccurred, &errorCode, errorMessage);
    }

    do
    {
        // start the program
        if ( ! errorOccurred )
        {
```

Calling R&S IC-Check Test Library Functions

```

if ( 1 == ConfirmPopup ( "ICCHECK", "Start in configuration mode?" ) )
{
    // configure the program with IC-Check user interface
    ICCHECK_Debug_Program (0, resourceId,
                           0, // index of IC to test
                           &failCount,
                           &errorOccurred, &errorCode, errorMessage);
}
else
{
    // run the program without IC-Check user interface
    ICCHECK_Run_Program (0, resourceId,
                        0, // start index of ICs to test
                        0, // stop index of ICs to test
                        &failCount,
                        &errorOccurred, &errorCode, errorMessage);
}

// write the report to a text file
if ( ! errorOccurred )
{
    ICCHECK_Write_Report (0, resourceId,
                        "iccreport.txt",
                        0, // 0 = overwrite, 1 = append
                        &errorOccurred, &errorCode, errorMessage);
}

// ask the user to run the program again
if ( ! errorOccurred )
{
    sprintf ( userMessage, "%d tests failed\n\nTry again?", failCount );
    response = ConfirmPopup ("ICCHECK", userMessage );
}
else
{
    break;
}

} while (1 == response);
// error handling
if ( errorOccurred )
{
    sprintf ( userMessage, "Error Code %d:\n\n%s", errorCode, errorMessage );
    MessagePopup ( "ICCHECK", userMessage );
}

// release ICCHECK library
if ( resourceId >= 0 )
{

```

```

        ICCHECK_Cleanup (0, resourceId, &errorOccurred, &errorCode, errorMessage);
    }

    // close resource manager
    RESMGR_Cleanup (0, &errorOccurred, &errorCode, errorMessage);

    return 0;
}

```

7.2 Starting the R&S IC-Check Loader

7.2.1 Description

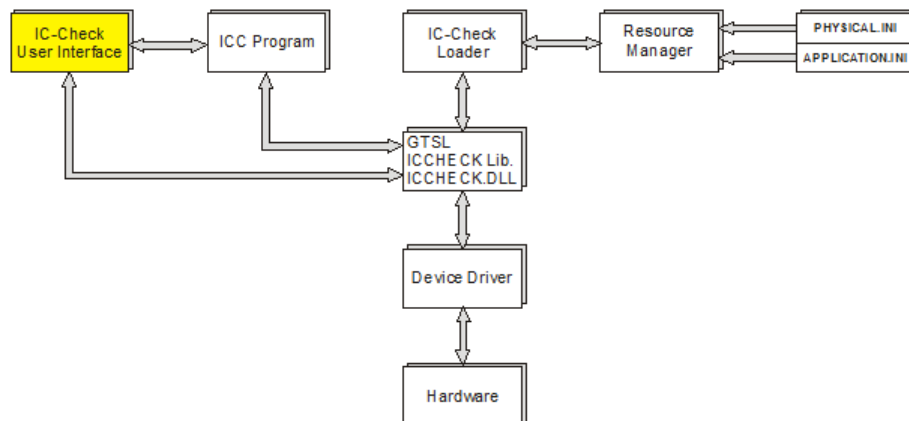


Figure 7-2: Running R&S IC-Check by starting R&S IC-Check Loader

The R&S IC-Check Loader initiates the function calls to the R&S IC-Check test library. In the R&S IC-Check Loader the names of the configuration files (`PHYSICAL.INI` and `APPLICATION.INI`) must be entered. Hardware management is performed using the resource manager. The R&S IC-Check Loader opens the R&S IC-Check User Interface and the selected ICC program. The ICC program can now be configured in the R&S IC-Check User Interface. The ICC program can be executed on the test hardware directly from the R&S IC-Check User Interface.

7.2.2 R&S IC-Check Loader, starting

To open the R&S IC-Check User Interface in the standalone mode, perform the following steps:

The following buttons work identically in all dialogs of the R&S IC-Check Loader:

1. Start the R&S IC-Check Loader using **Start->Programs->GTSL->IC-Check Loader**.



IC-Check Loader

	Opens the standard Windows dialog box for opening files. Select the appropriate files for the IC-Check.
	The previous dialog of the R&S IC-Check Loader appears.
	The next dialog of the R&S IC-Check Loader appears.
	Quits the R&S IC-Check Loader.

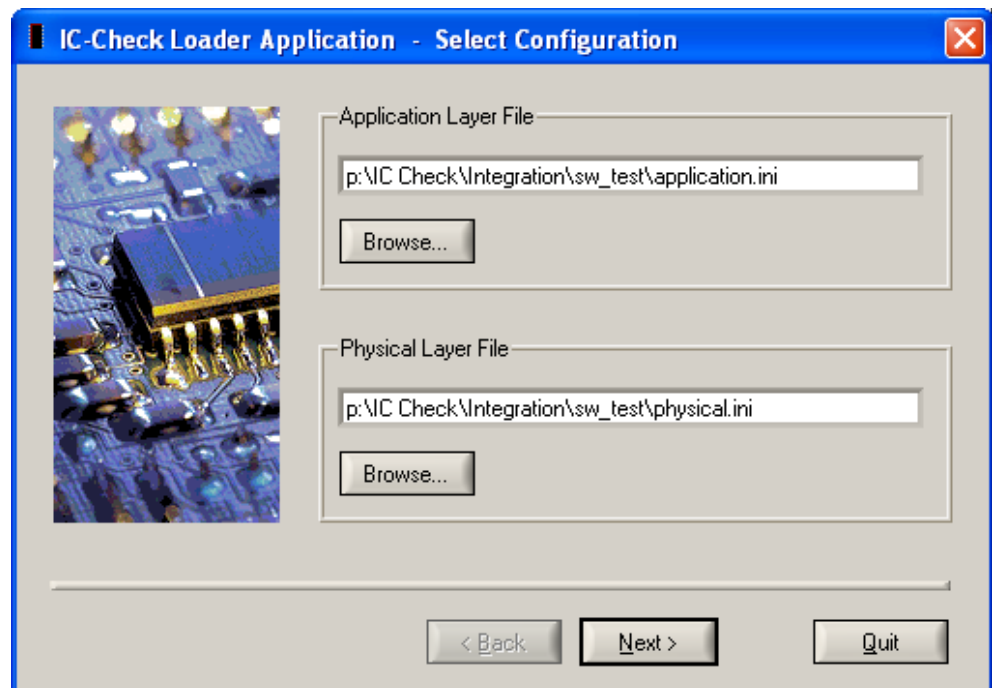


Figure 7-3: R&S IC-Check Loader Select Configuration

Note: If there is no valid license for the test libraries used, the R&S IC-Check User Interface is opened in the demo mode. The execution of the ICC program opened is simulated.

Starting with GTSL 3.30, no GTSL license is required.

2. Use the dialog box **"Browse..."** button to select the appropriate Application Layer Configuration File for the IC-Check. The path and file name for the selected Application Layer Configuration File is displayed.
3. Use the dialog box **"Browse..."** button to select the appropriate Physical Layer Configuration File for the IC-Check. The path and file name for the Physical Layer Configuration File selected is displayed.
4. Using the **"Next"** button, the selected configuration files are loaded and the dialog for selecting a Bench and an ICC program appears.

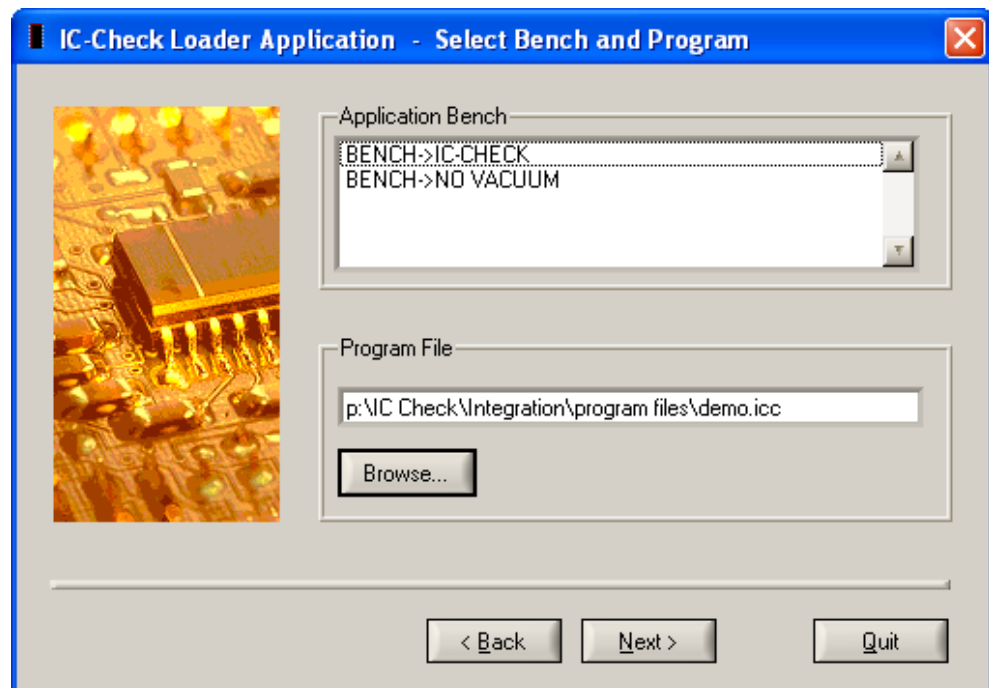


Figure 7-4: R&S IC-Check Bench and Program Configuration

5. Select the appropriate Application Layer Bench.
All benches in the Application Layer Configuration File are displayed in the list box.
6. Use the dialog box **"Browse..."** button to select the ICC program file to be loaded.
7. Use the **"Next"** button to load the selected bench and ICC program file.
8. Depending on the information read from the selected bench the following two options exist:
 - a) The R&S IC-Check User Interface is opened.

- b) The dialog box for the vacuum control is opened. If there is an entry for the vacuum library in the Application bench, the dialog box for the vacuum control is opened.

Example:

```
[bench->icc]
ICCDDevice = device->psam
VacuumControl1 = device->psys1
VacuumControl2 = device->psys2
SwitchDevice1 = device->pmb1
... etc.
```

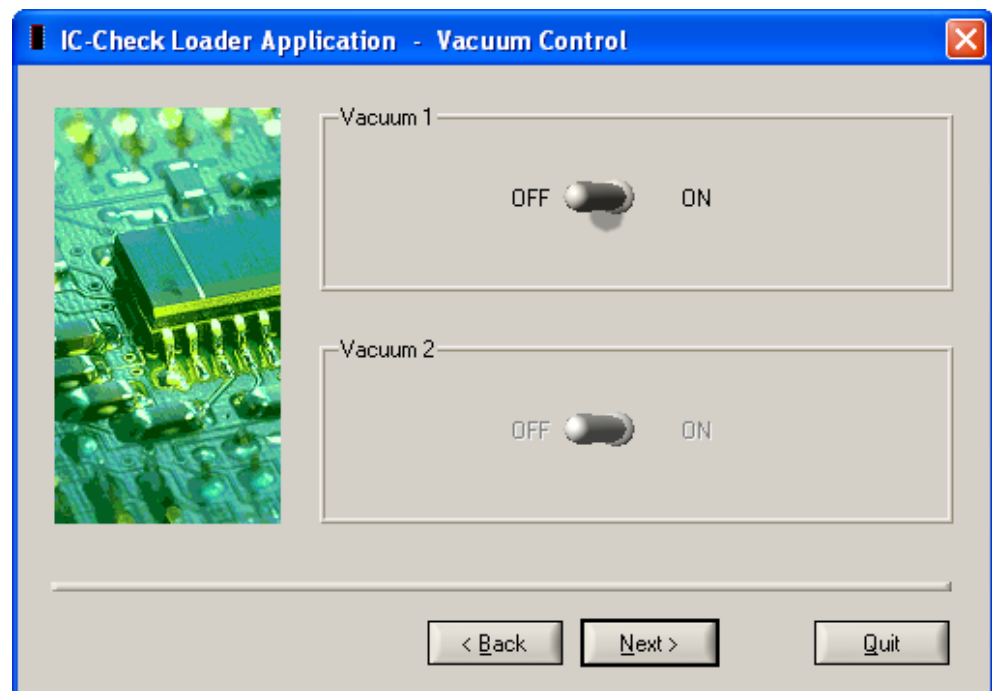


Figure 7-5: R&S IC-Check Loader Vacuum Control

9. Activate vacuum valves.
The vacuum control entries in the selected bench are represented by switch controls. A maximum of two entries can be supported. By selecting a switch control the corresponding vacuum valve can be activated.
10. Use the **"Next"** button to open the R&S IC-Check User Interface.

Once the R&S IC-Check User Interface has been quit, the opening dialog box (R&S IC-Check Loader Select bench and program File or RR&S IC-Check Loader Vacuum Control) is displayed again. Use the **"Quit"** button to exit the R&S IC-Check Loader.

8 R&S IC-Check Test Programs

8.1 Structure of an IC-Check Test File

An IC-Check program file is a test file with the extension `.icc`. It can be created or edited using any text editor. The logical structure of the ICC program file is made up of information blocks on ICs to be tested. Each information block begins with the name of the block in square brackets. All the subsequent lines begin with a keyword and either describe the measurement configuration to be applied to test the individual pins of the IC or the names of the pins and reference pins to be tested.

Example:

```
;
;
IC-Check Program File created on Fri May 08 13:13:36 2009
;

[IC1]
MSG = 'EPM7032'
DCV = 0.750
DCM = 1
DCC = 3
DCF = 0
DLY = 0
LIM = 3
REF = GND,
REF = VCC,
REF = 3.3V,
PIN = CTRQ0, MSG='D1.P34', LL=17.44, UL=23.47
PIN = CTRTC, MSG='D1.P35', LL=51.95, UL=58.29
PIN = CTRQ1, MSG='D1.P33', LL=51.74, UL=57.86
PIN = CTRQ2, MSG='D1.P31', LL=52.48, UL=58.57

[IC2]
MSG = 'V5 Cluster'
DCV = 2.000
DCM = 0
DCC = 2
DCF = 5
DLY = 0
LIM = 5
REF = GND,
REF = VCC,
PIN = INPUT, MSG='C17', DCV=0.100, DCM=1, DCF=30, DLY=1, LL=25.26, UL=51.46, LIM=13
PIN = TR1.B, MSG='BASISV5', DCV=0.900, DCF=0, LL=94.97, UL=104.99
PIN = TR1.C, MSG='COLLECTORV5', DCV=0.300, DCF=25, LL=78.37, UL=89.77
```

```
PIN = TR1.E, MSG='EMITTERV5', DCV=0.040, DCF=11, DLY=1, LL=17.37, UL=28.15
PIN = OUTPUT, MSG='C31', DCV=0.200, DCF=20, LL=76.64, UL=90.08
```

8.2 Keywords

The following keywords may be included in an ICC program file:

MSG	The name of the IC to be tested. The name entered here is also displayed on the user interface of the IC-Check as the name of the IC. If the optional keyword MSG is missing, the name of the information block will be used as the name for the IC (e.g. '[IC1]' in the above example).
DCV	Stimulus voltage for testing the pins of the IC in volt. Value range: 0.0 V bis 5.0 V. No specification results in a stimulus voltage of 1 V.
DCM	Operating mode of the R&S TS-PSAM DC voltage source DCS for generating the stimulus voltage. Value range: 1: DCS operates in the bipolar mode (possible as of R&S TS-PSAM modification index 3.0) 0: DCS operates in the unipolar mode. No specification results in the unipolar DCS mode. On one pin tested with a DC voltage, two measurements with different stimulus voltages are performed in the bipolar mode. First, the voltage +DCV is applied and then the voltage -DCV; in each case, the current is measured on the pin. If the DCS is operated in the unipolar mode, only one current measurement on the pin is performed with the stimulus voltage +DCV applied.
DCC	Selects the current limiting to be set on the R&S TS-PSAM DCS. Value range: 0: 10 µA 1: 100 µA 2: 1 mA 3: 10 mA. No specification results in a current limiting of 1 mA.
DCF	Selects the pulse frequency of the R&S TS-PSAM DCS stimulus voltage to be set. Value range: 0: the pin is tested with a DC stimulus voltage. 1 to 50: A pulsed stimulus voltage with a frequency of 200 kHz/256 * DCF is applied to the pin to be tested. No specification results in a DC stimulus voltage.

DLY	<p>Delay time in milliseconds between the application of a test voltage on a pin and the measurement of the current flow through the measuring unit MU of the R&S TS-PSAM.</p> <p>Value range: 0 ms to 100 ms.</p> <p>No specification results in a delay time of 0 seconds.</p> <p>Annotation: Even a DLY value of 0 ensures that all the relays involved in the measurement have switched reliably.</p>
LIM	<p>The value used in the learning mode of the IC-Check for the distance to be set between the most unfavourable of all the measured results recorded in the learning mode for one pin and the future limit value.</p> <p>Value range: 1 % to 25 %.</p> <p>No specification results in a default value of 10 %.</p>
REF	<p>Logical pin name defined in the "AppChannelTable" section of the <code>Application.ini</code> file. This pin is defined as the reference pin for all the measurements on other pins to be tested. The stimulus voltage is applied between this reference pin and the pin to be tested. Multiple reference pins per IC can be defined. During a measurement, all the reference pins are connected with each other.</p>
PIN	<p>Logical pin name defined in the "AppChannelTable" section of the <code>Application.ini</code> file. Here, the previously specified configuration codes can optionally be entered again separated by commas. These will then have a higher priority for this pin than the configuration settings specified for the entire IC. If a learning procedure was performed for an IC via the IC-Check user interface, i.e. if the limit values of the individual pins were automatically adapted to the measured values determined for the pins, the limit values for each pin will also be written when writing the ICC program file. The lower limit value is specified via the LL keyword, the upper limit value via the UL keyword.</p>

8.3 Required Entries

Each information block of an IC-Check program file must include at least one entry of a reference pin and one entry of a pin to be tested.

Example of minimum configuration

```
;
; IC-Check Program File
;
```

```
[IC1]
REF = GND,
PIN = CTRQ0
```

If this program file is loaded and saved again directly afterwards via the user interface of the IC-Check application, all the default configuration values will also be saved.

```

;
; IC-Check Program File created on Tue May 19 13:07:46 2009
;
```

```
[IC1]
MSG = ''
DCV = 1.000
DCM = 0
DCC = 2
DCF = 0
DLY = 0
LIM = 10
REF = GND, MSG=''
PIN = CTRQ0, MSG='', LL=40.00, UL=60.00
```

8.4 Configuration via the R&S IC-Check User Interface

To achieve optimum measurement results, each measurement on a pin of a component or an IC of the circuit to be tested must be configured via the setting parameters. What is generally referred to as the "coupling ratio" is determined as the measurement result. It indicates the ratio of the current flow through a pin to the set current limiting of the stimulus source (also refer to [Chapter 6, "Test Methods"](#), on page 23). Ideally, this "coupling ratio" is close to 50 %. A value close to 0 % points to a missing contact of the pin to its environment (faulty soldering), a value close to 100 % points to a short-circuit at this pin. With measurement results as close to 50 % as possible, you can achieve the largest sensitivity of discrimination for measurements performed one after the other on different test objects.

To achieve a measured value in the desired dimension, several settings can be changed on the R&S IC-Check user interface. The effect of the individual changes to setting parameters can be checked immediately through check measurements.

Notes on the setting parameters:

- DCF:
If measurements are to be performed on capacitance or inductance values, the stimulus source DCS of the R&S TS-PSAM is operated in pulsed mode. The pulse frequency that can be set via the DCF parameter depends on the size of the capacitance or inductance. The larger the value, the smaller the stimulus frequency must be chosen. If, however, the ohmic characteristics of the test pin is in the focus of interest, the effects caused by the reactance can be masked through a DC stimulus voltage. In this case, the DCF parameter will be assigned the value 0.

- **DCM:**
If the pin to be tested features free-wheeling diodes or diodes for reverse voltage protection that are not to be tested, the unipolar mode of the R&S TS-PSAM DCS stimulus source is most appropriate. If, however, the bipolar mode is used, the clamping effect of these diodes will be included in the measurement result so that the function of the diodes can be tested as well.
- **DCV and DCC:**
With the first tests of the measurement configuration on a pin, the stimulus voltage DCV should be set to a value larger than 0.6 V and the current limiting DCC to the medium current range, i.e. 1 mA. Subsequently, the two parameters are varied until an optimum measurement result (coupling ratio) is achieved. If a pin is tested with a pulsed stimulus source, the DCF parameter must also be varied accordingly.
- **DLY:**
If DC measurements for testing the ohmic characteristics are performed on pins that also feature capacitance or inductance values, a delay in milliseconds can be defined. This program lets this delay time elapse before performing a measurement to let transient effects on the test pin fade that could render the measurement instable. To detect any transient effects, the current flow measured on a selected pin can be represented in the form of a graphics on the IC-Check user interface. This function can be enabled via the menu item "Configure" > "Enable Debug Display".

8.4.1 Example: Determining the Optimum Settings

The pins of the following circuit are to be tested.

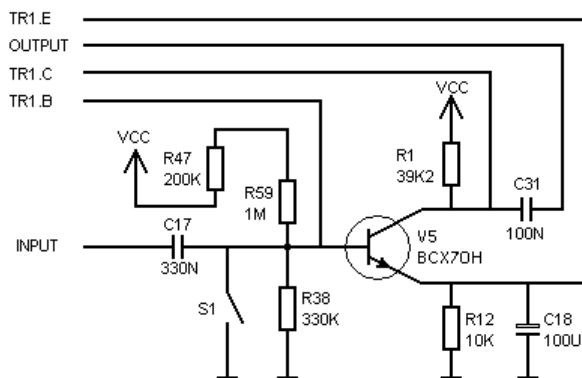


Figure 8-1: Example circuit

Minimum configuration that must be included in the corresponding information block of the IC-Check program file:

```

;
; IC-Check Program File
;

[IC_V5]

```

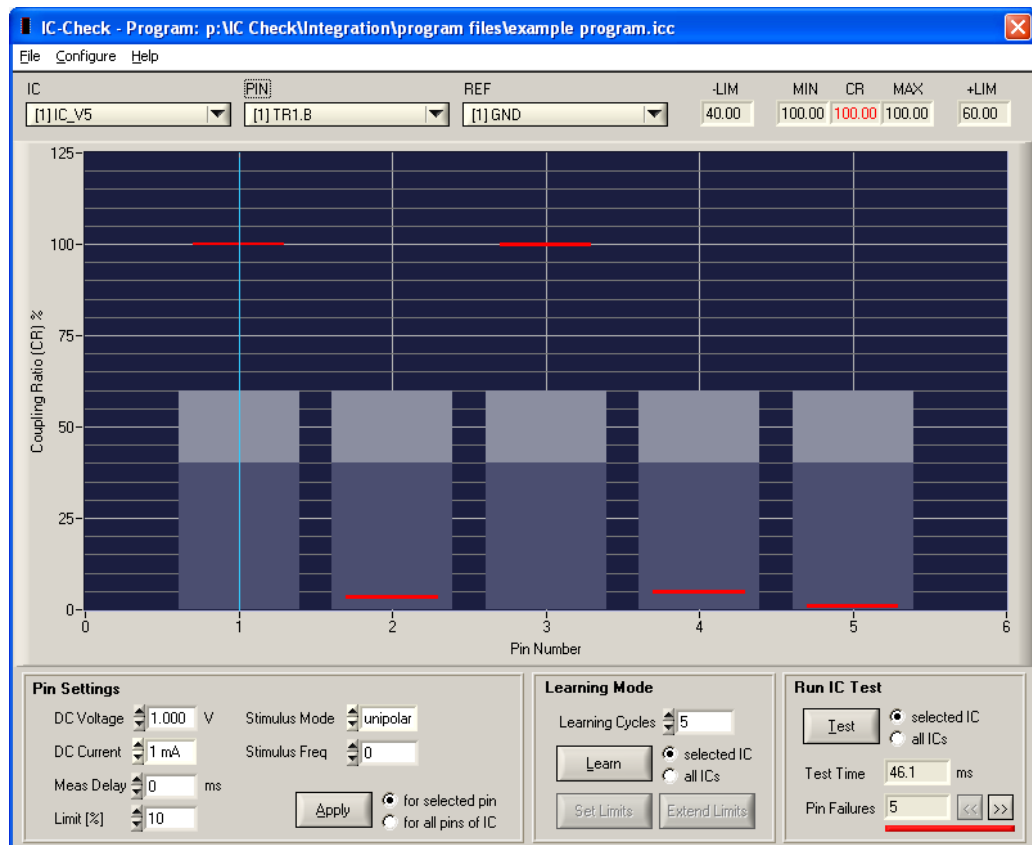
```

REF = GND
REF = VCC
PIN = TR1.B
PIN = TR1.C
PIN = TR1.E
PIN = INPUT
PIN = OUTPUT

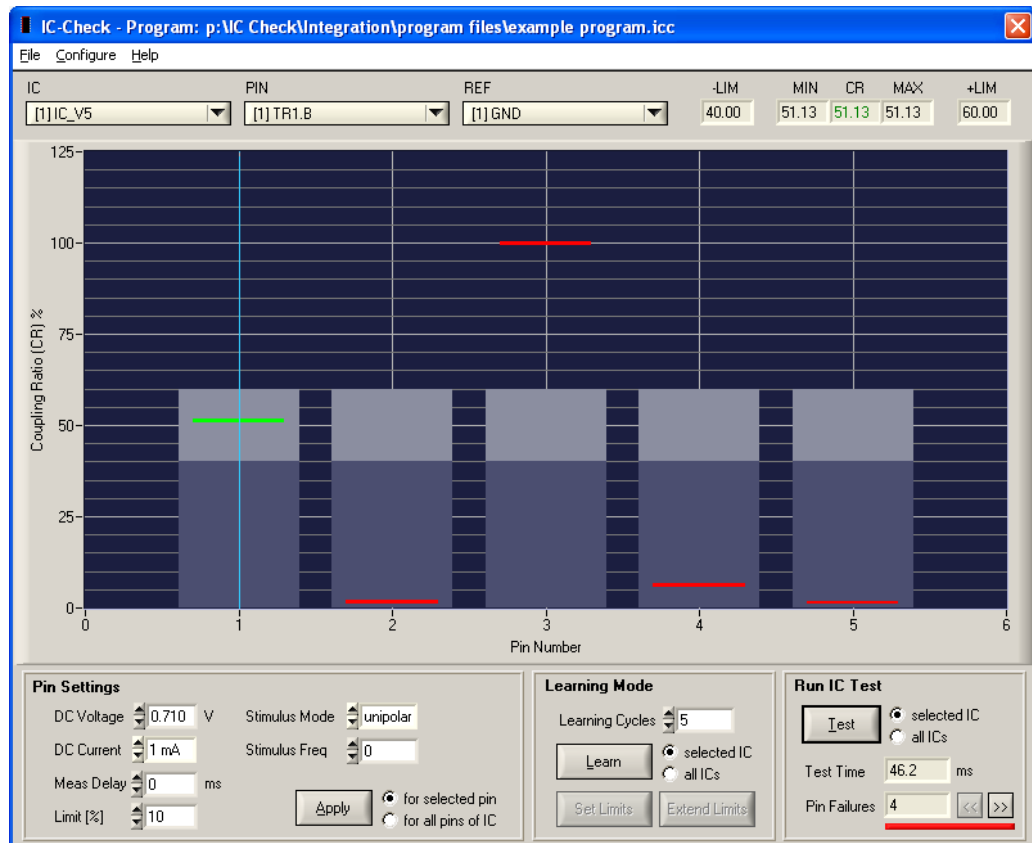
```

The channel names on the right-hand side of the assignments have already been defined in the `Application.ini` file in advance. They represent specific channels of the SwitchDevice also specified in the `Application.ini` file (R&S TS-PMB).

After the program file has been loaded and the R&S IC-Check user interface has been called (also refer to [Chapter 7, "Running R&S IC-Check"](#), on page 27), the following screen will be displayed:

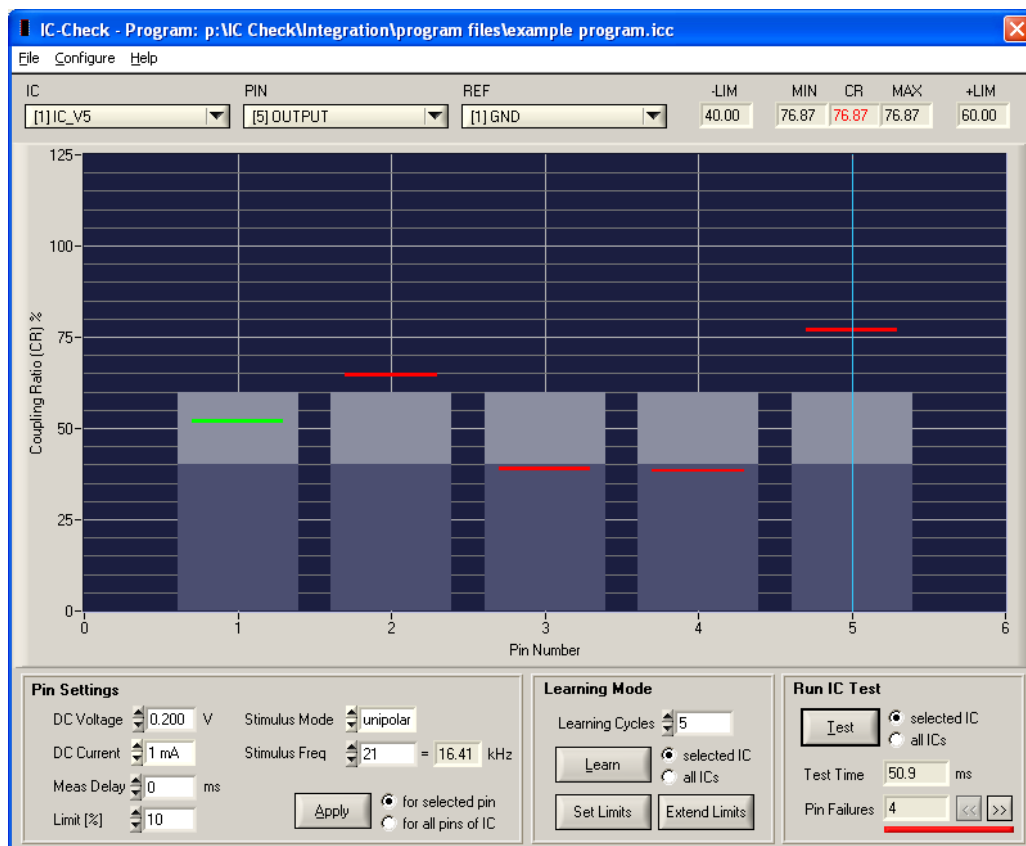


The default values set for all five pins to be tested do not yet yield useful results. Now the measurement parameters must be adapted for each pin such that the measured coupling ratio is as close to 50 % as possible. For pin 1, the basic pin of the transistor called TR1.B, the stimulus voltage is reduced to achieve a lower current flow and thus a lower "coupling ratio".



A stimulus voltage of 0.71 on pin 1 results in a current flow of approx. 0.5 mA and thus to a measured value for the coupling ratio of approx. 50 %.

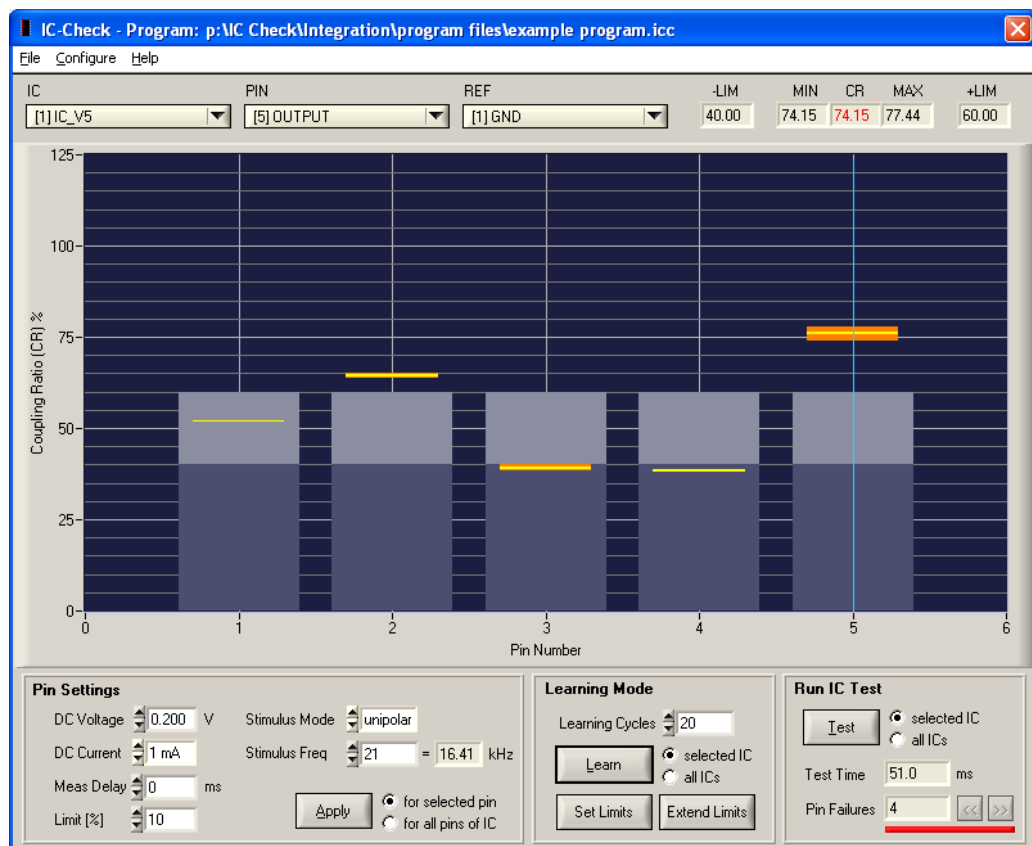
The measurement parameters for the other pins are now gradually set until all the measurement results are in the desired range.



The next step is to set the limit values for each pin. The learning mode described in [Chapter 8.4.2, "Example: Determining the Limit Values via the Learning Mode"](#), on page 41 is used for this purpose.

8.4.2 Example: Determining the Limit Values via the Learning Mode

In the learning mode of the R&S IC-Check user interface, measurements can be performed on one IC or on all the ICs in a loop defined in the program file. In this case, all the measurement results obtained will be evaluated and the variation of the measurement results for each pin will be shown in the form of a graphics. This information serves for determining the permissible limit values for the "coupling ratio" of each pin. In the present example, the measurements on the defined IC V5 will be repeated 20 times.

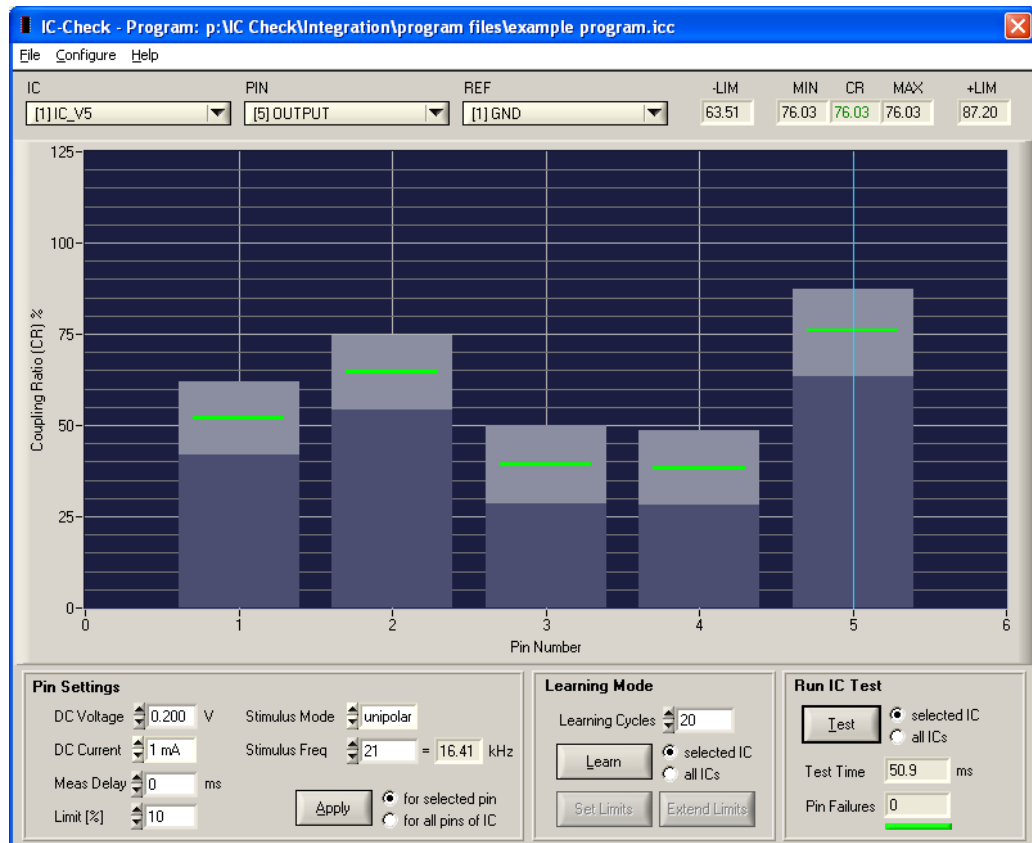


The permissible limit values must be adapted to the range of variation of the measurement results for the individual pins. There are two methods of doing so:

- **Setting of the limit values**
The limits are set around the spreading range. The distance of the limits to the spreading range is defined for each pin in the "Limit" field of the "Pin Settings" parameter area.
- **Expansion of the existing limit values**
Existing limits will be changed such that their distance to the spreading range is at least the value defined in the Limit field of the Pin Settings area. If the lower or upper limit defined up to that point is further away from the spreading range than this value, this limit value will not be changed.

The limit values are set in the present example. Now, the following measurements are all within the defined limits. The characteristics have now been "learned" for the tested circuit. Now it is possible to test other modules in the production and check whether they are within the limits of the reference module.

Configuration via the R&S IC-Check User Interface



For pins, the spreading range of which is very small, the limit range can be set to values lower than the ten percent set in the present example.

Via the "File" > "Save Program" or "File" > "Save Program As" menu items the topical settings can be saved in a program file. The corresponding information block in the program file will then look as follows:

```

;
; IC-Check Program File created on Tue May 19 17:34:29 2009
;

[IC_V5]
MSG = ''
DCV = 1.000
DCM = 0
DCC = 2
DCF = 0
DLY = 0
LIM = 10
REF = GND, MSG=''
REF = VCC, MSG=''
PIN = TR1.B, MSG='', DCV=0.710, LL=41.99, UL=62.12
PIN = TR1.C, MSG='', DCV=0.300, DCF=30, LL=54.09, UL=74.76
PIN = TR1.E, MSG='', DCV=0.060, DCF=10, DLY=1, LL=28.57, UL=50.04

```

Configuration via the R&S IC-Check User Interface

```
PIN = INPUT, MSG='', DCV=0.100, DCM=1, DCF=30, DLY=1, LL=28.20, UL=48.50  
PIN = OUTPUT, MSG='', DCV=0.200, DCF=21, LL=63.51, UL=87.20
```

9 Report Format

For each test step, i.e. for each tested pin, a report entry is created. This consists of the following entries:

1. Header

The following entries are listed in the header:

- IC name and number of IC in order of appearance in the program file (also appears in the IC-Check user interface)
- Pin name and number of pin in order of appearance in the program file IC section (also appears in the IC-Check user interface)
- Status of measurement: Passed or Failed

2. Measured result

The measured result consists of the measured value (Coupling Ratio) in percent as well as the lower and upper limit in square brackets.

Example:

```
;
; IC-Check Report created on Wed May 20 14:25:25 2009
;

IC [1]: 'IC_V5' Pin [1]: 'TR1.B' Passed
CR = 52.147 % [41.990 ... 62.120]

IC [1]: 'IC_V5' Pin [2]: 'TR1.C' Passed
CR = 64.702 % [54.090 ... 74.760]

IC [1]: 'IC_V5' Pin [3]: 'TR1.E' Passed
CR = 39.619 % [28.570 ... 50.040]

IC [1]: 'IC_V5' Pin [4]: 'INPUT' Passed
CR = 38.371 % [28.200 ... 48.500]

IC [1]: 'IC_V5' Pin [5]: 'OUTPUT' Passed
CR = 75.875 % [63.510 ... 87.200]
```