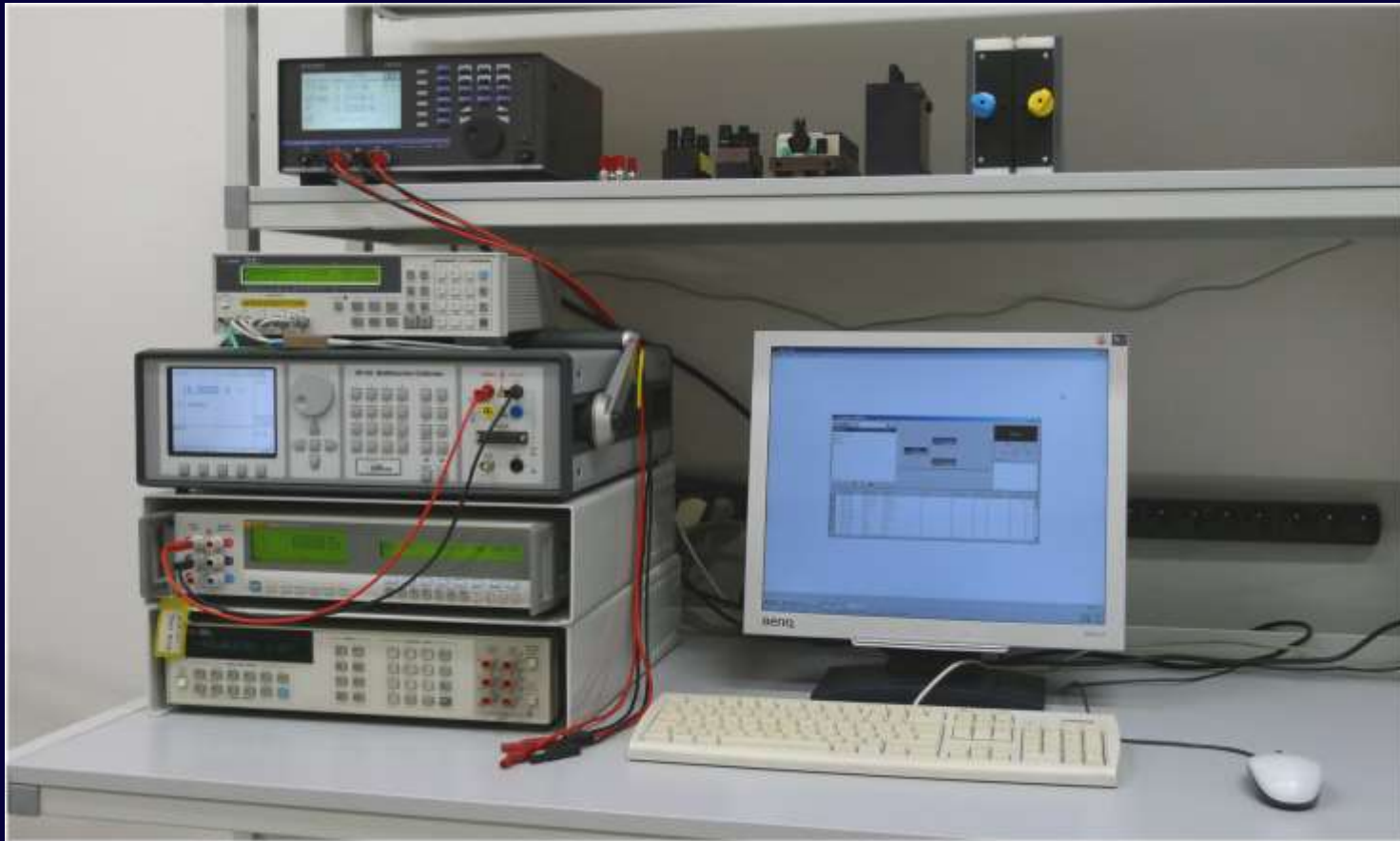


Computer - controlled calibration

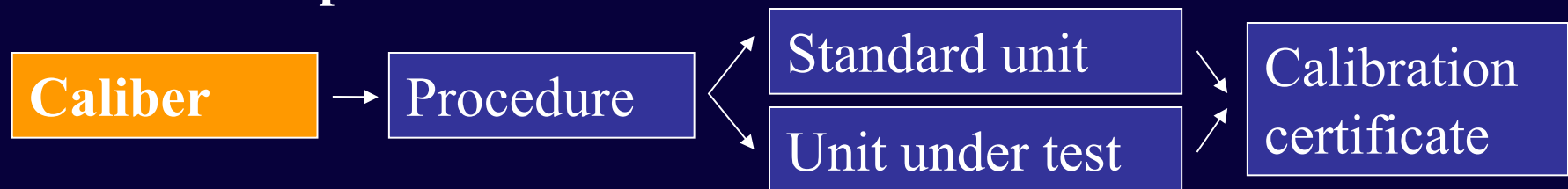


WinQBase and Caliber

WinQbase database software



Caliber computer controlled calibration



Both programs can work independent or together.

Caliber

Automatic calibration of instruments

Procedure "c:\program files (x86)\meatest\caliber\data\m3800.pro**"

Procedure
M3800 * | * | * | * | * | * | * | * | * | *
Version 1.00

Camera

Readings

Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty	Symbol
VDC-2W	200 mV	20.0 mV	20.1 mV	100 uV	50	201 uV	61 uV	ok
VDC-2W	200 mV	180.0 mV	180.5 mV	500 uV	50	1003 uV	69 uV	ok
VDC-2W	200 mV	-180.0 mV	-181.0 mV	-1000 uV	-100	1005 uV	69 uV	?
VDC-2W	2 V	0.200 V	0.201 V	1.00 mV	50	2.01 mV	0.58 mV	ok
VDC-2W	2 V	1.800 V	1.813 V	13.00 mV	129	10.07 mV	0.59 mV	*
VDC-2W	2 V	-1.800 V	-1.812 V	-12.00 mV	-119	10.06 mV	0.59 mV	*
VDC-2W	20 V	2.00 V	2.01 V	10.0 mV	50	20.1 mV	5.8 mV	ok
VDC-2W	20 V	10.00 V	10.07 V	70.0 mV	116	60.4 mV	5.8 mV	*
VDC-2W	20 V	18.00 V	18.10 V	100.0 mV	100	100.5 mV	5.8 mV	?
VDC-2W	20 V	-2.00 V	-2.01 V	-10.0 mV	-50	20.1 mV	5.8 mV	ok
VDC-2W	20 V	-18 V						

Caliber – basic features

Supported types of calibration

- **Fully automated**
 - all instruments (standard units SU and unit under test UUT) are connected to PC
- **Semi automated**
 - only some instruments are controlled via PC
- **Manual**
 - all instruments are controlled manually

Caliber – Modules

- Procedure Window
 - Creating calibration procedures, calibrating UUT
- Instrument Card Window
 - Adding new or modifying devices
- User Functions Window
 - Adding new functions for calibration
- Wizard Rules Window
 - Creating/Editing rules for automatic procedure generation

Caliber - Procedure window

- Main part of Caliber software, designed for:
 - Calibration of UUT
 - Easy editing and testing calibration procedures
- Procedure contains description of:
 - **Functions**
 - **Ranges**
 - **Points (Values)**
 - **Names of used instruments**

Caliber Procedure – Basic Description

Procedure "c:\data\vfpprogs9\caliber\m3800.pro"

Procedure
 m3800
 Version: 1.00
 Author: Meatest
 E-mail: meatest@meatest.cz

Status window

Instrument scheme

```

  M140  M3800
  COM1  2  Camera  1
  
```

Information line

User prompt window

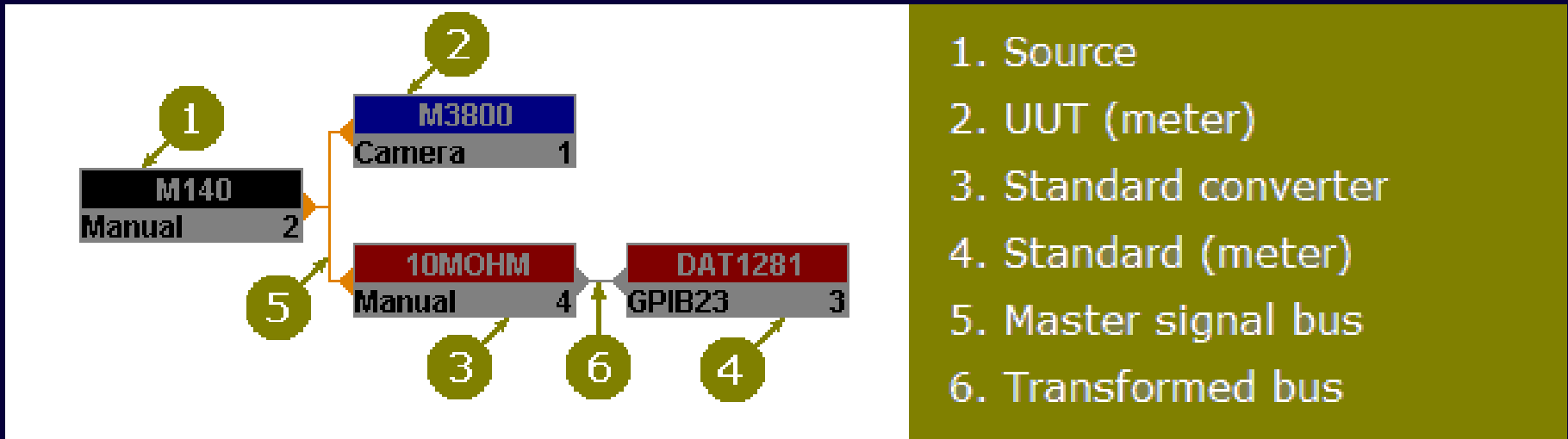
Camera

Readings

Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty	Symbol
VDC-2W	200 mV	20 mV						
VDC-2W	200 mV	-20 mV						
VDC-2W	200 mV	-180 mV						
VDC-2W	2 V	0.2 V						
VDC-2W	2 V	1.8 V						
VDC-2W	2 V	-1.8 V						
VDC-2W	20 V	2 V						
VDC-2W	20 V	10 V						
VDC-2W	20 V	18 V						

Test report

Caliber – Instrument scheme



Key features

- Visible name of used instrument card
- Color identification of instrument position
- Information about interface setting and unique number

Calibration of meter

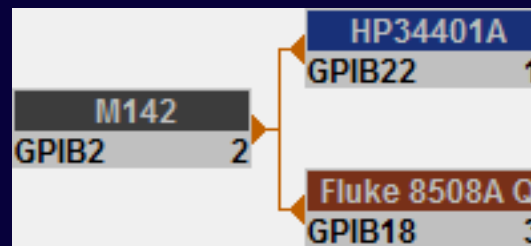
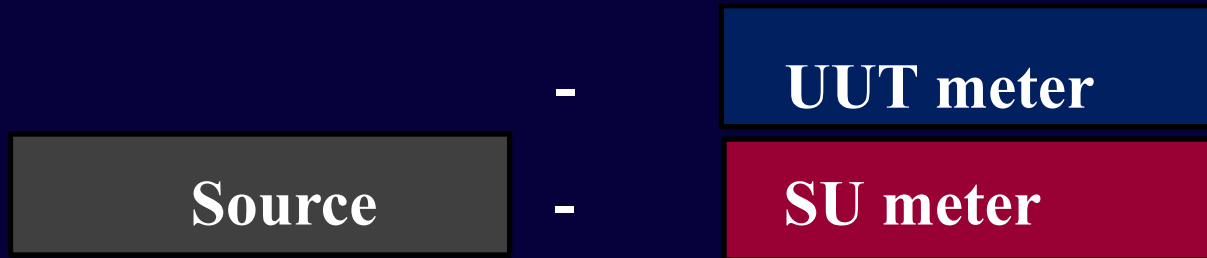
SU + source

-

UUT meter



Calibration of meter



Calibration of transducer

SU source

-

UUT converter

-

SU meter



Calibration of power source

UUT source

-

SU meter



Calibration of power source using additional convertor



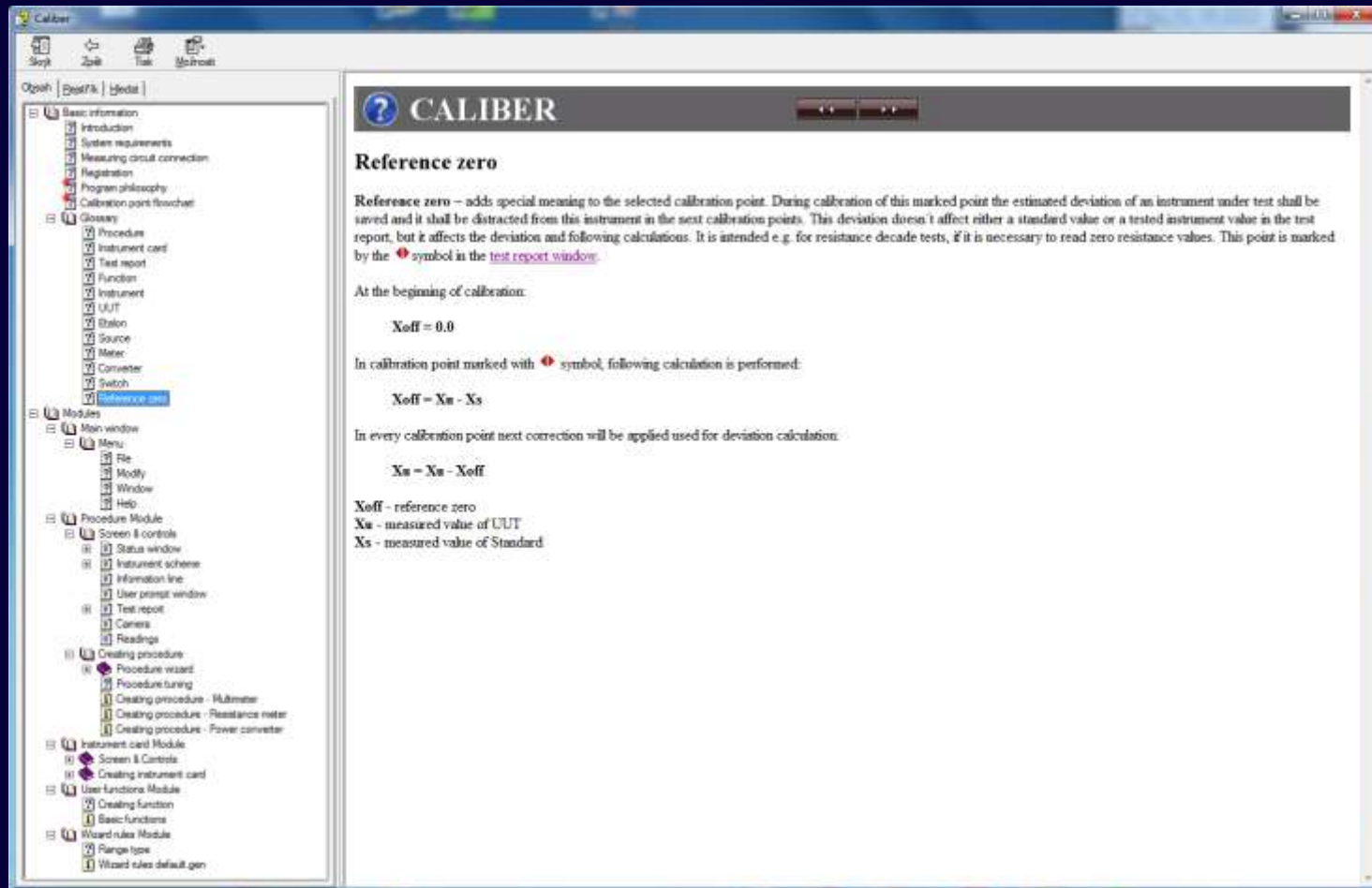
Calibration of power source

under specific Load



Caliber – Help File

Help file is opened on specific topic that depends on actual cursor position after pressing F1 key.



Caliber – Procedure Wizard

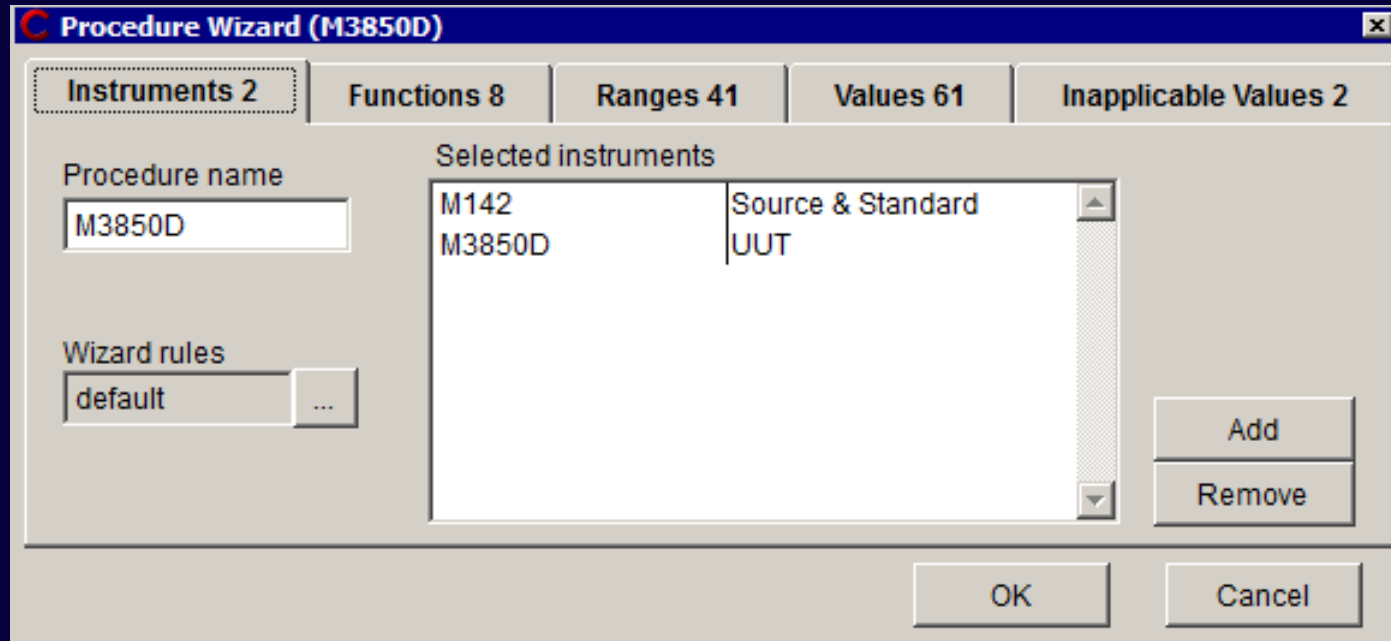
Generation of calibration procedure

Basic Steps:

- 1) Instruments selection, name, wizard rules
- 2) Functions selection
- 3) Ranges selection, type of ranges (density of cal. points)
- 4) Values selection, exact values of calibration points
- 5) Procedure checking, all values should be acceptable for all instruments
- 6) Procedure saving

Caliber – Procedure Wizard

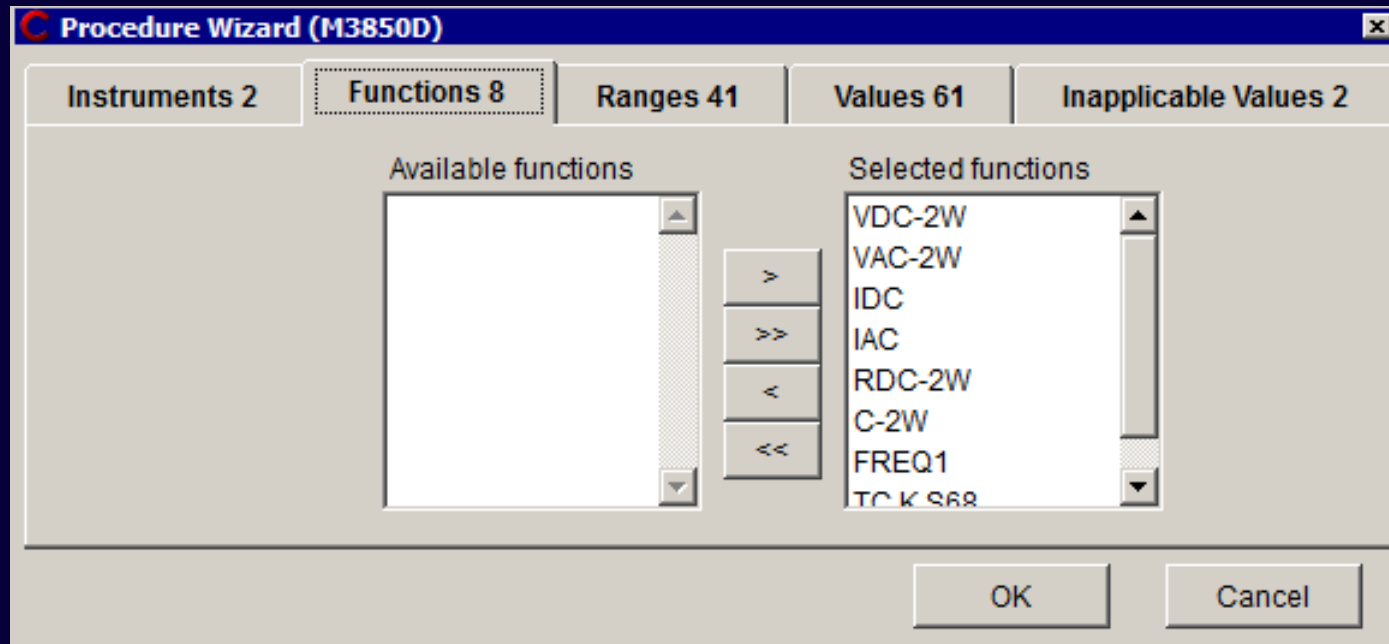
Step 1 - Instruments



- Write Procedure Name
- Choose Wizard Rules (Impact on number of calibration points)
- Add Instruments (UUT and SU)

Caliber – Procedure Wizard

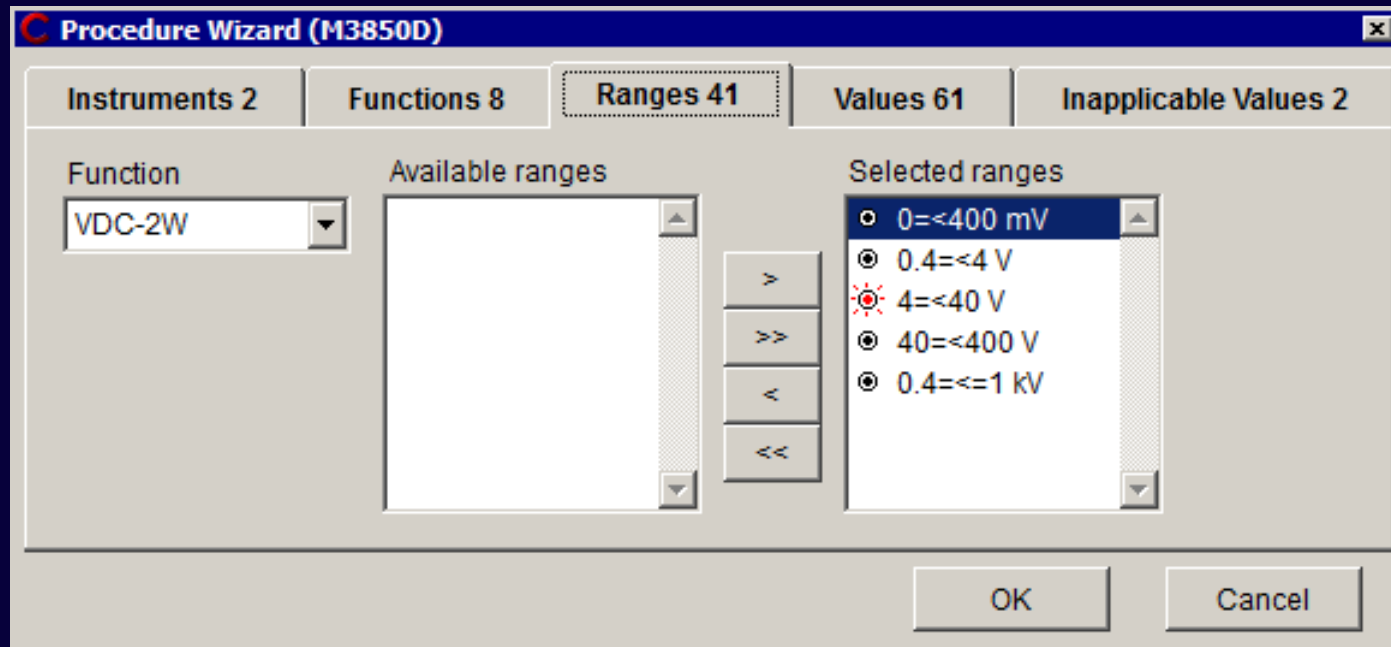
Step 2 - Functions



- Calibrated function (Default setting is select all supported function)
- Numbers after tabulator name gives actual information

Caliber – Procedure Wizard

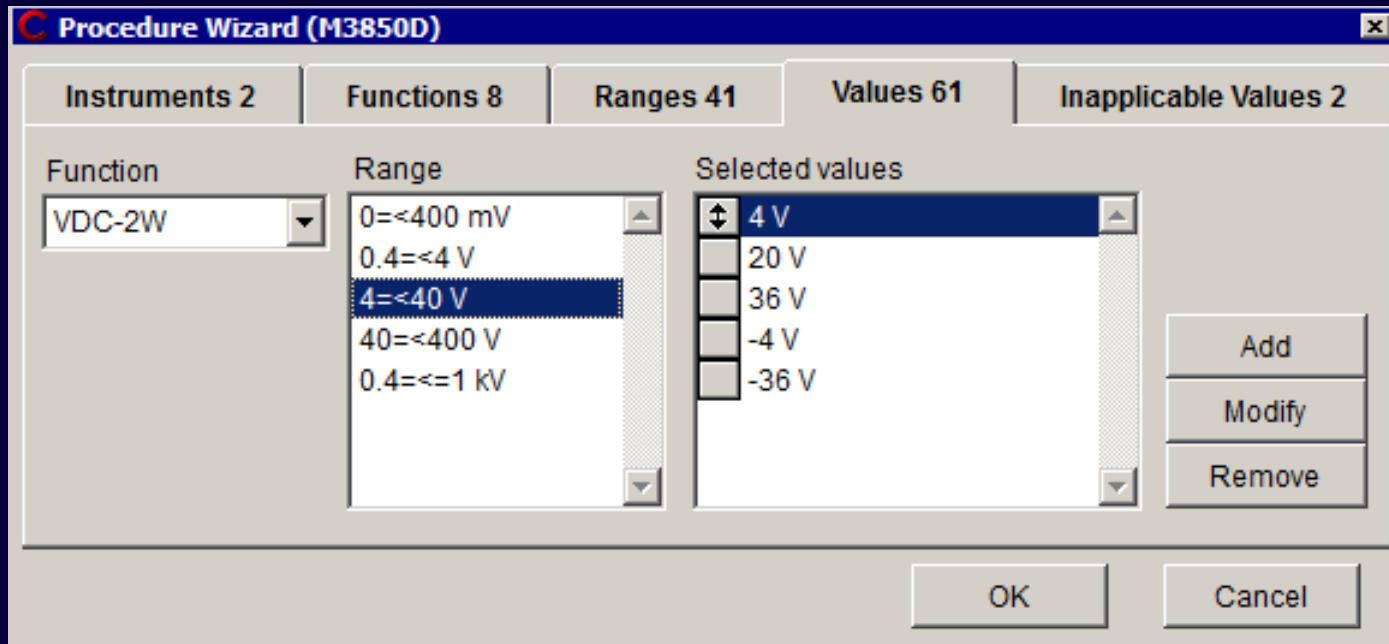
Step 3 - Ranges



- Selection of ranges used during calibration

Caliber – Procedure Wizard

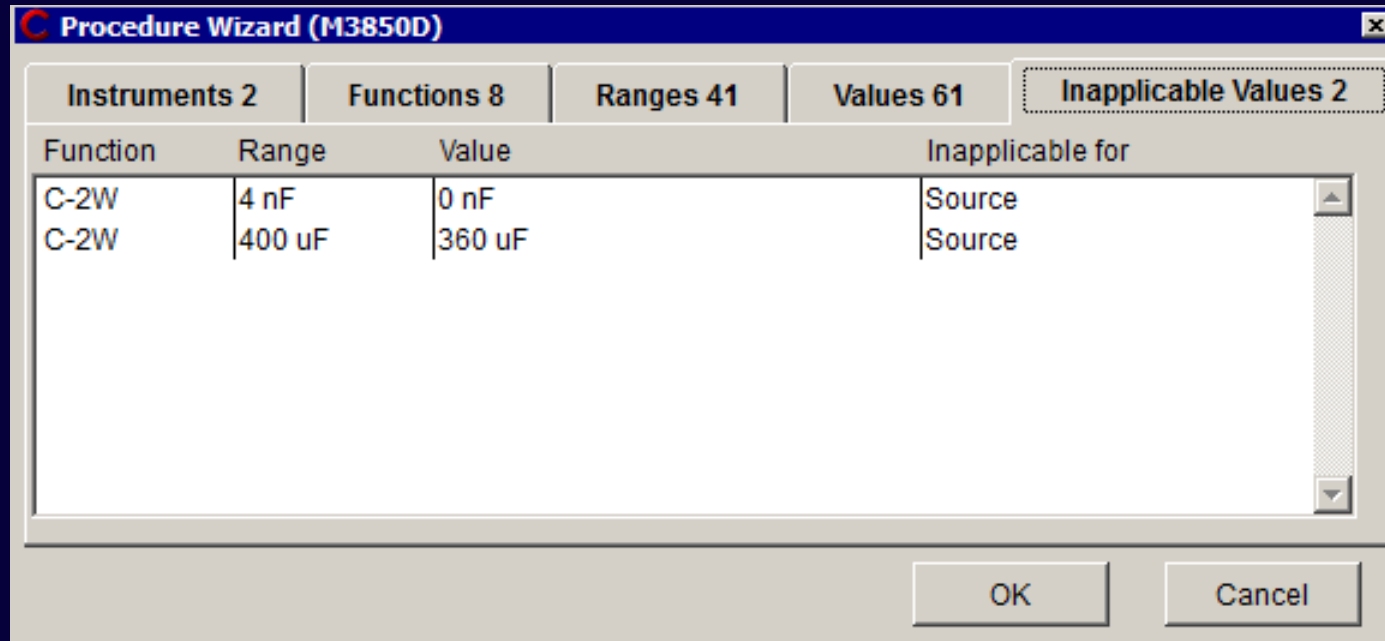
Step 4 - Values



- Adding, modifying or removing points
- Changing points position

Caliber – Procedure Wizard

Step 5 – Checking / Confirmation



- Note
 - Multifunction calibrator M-142
 - capacitance range: 0,7 nF to 100 uF

Caliber – Procedure Wizard

Step 6 - Saving new calibration procedure

Procedure "c:\program files (x86)\meatest\calibercz\data\m3850d.pro*"

Procedure: M3850D

Version: 1.00
Author:
E-mail:

M142 GPIB2 1 → M3850D Manual 2

Camera

Readings

	Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty	Symbol
↑	VDC-2W	400 mV	40 mV						▲
	VDC-2W	400 mV	360 mV						
	VDC-2W	400 mV	-360 mV						
	VDC-2W	4 V	0.4 V						
	VDC-2W	4 V	3.6 V						
	VDC-2W	4 V	-3.6 V						
	VDC-2W	40 V	4 V						
	VDC-2W	40 V	20 V						
	VDC-2W	40 V	36 V						▼

Practical Example

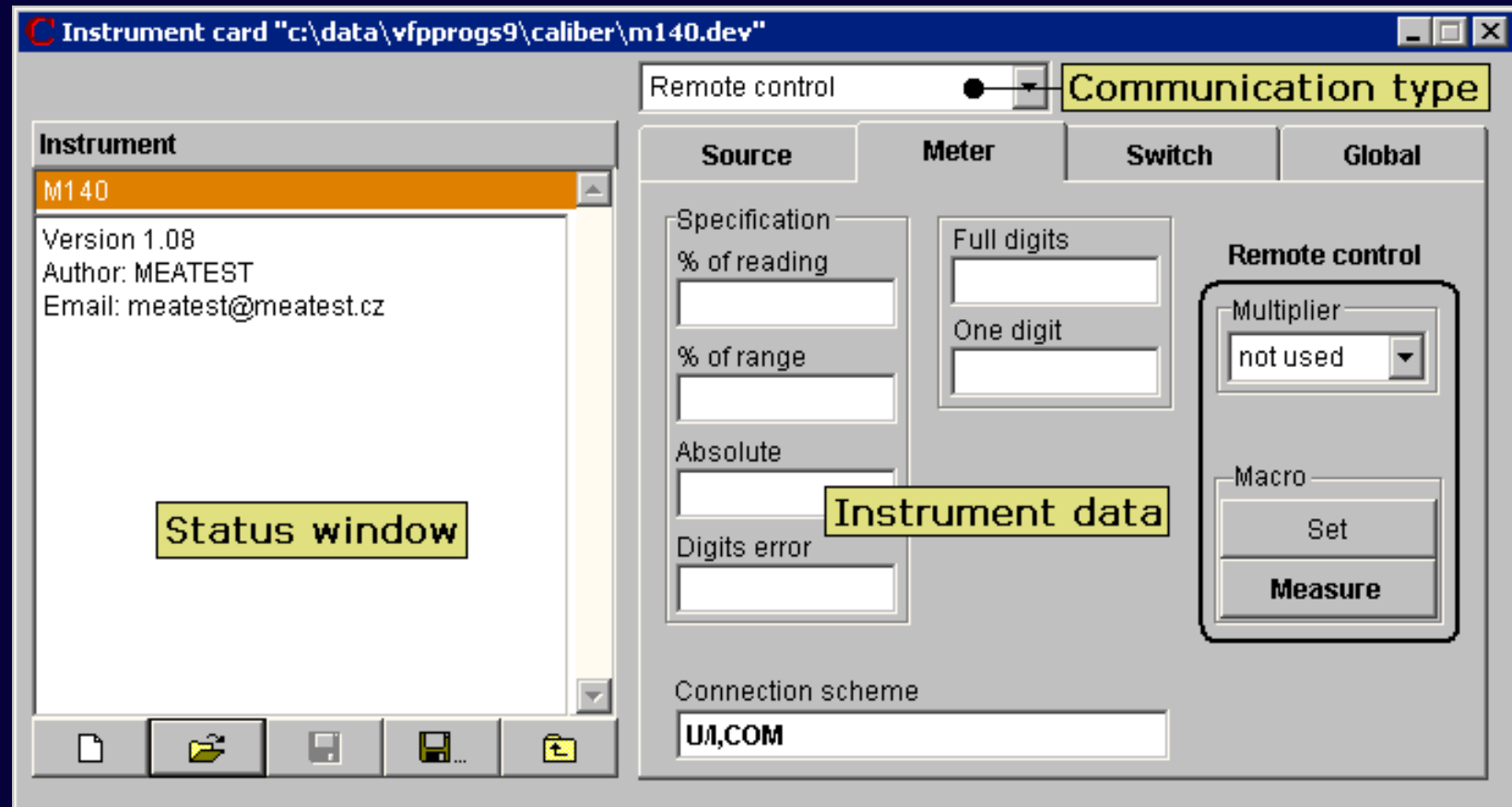
Creating new calibration procedure with
PROCEDURE WIZARD

Caliber - Instrument Card Window

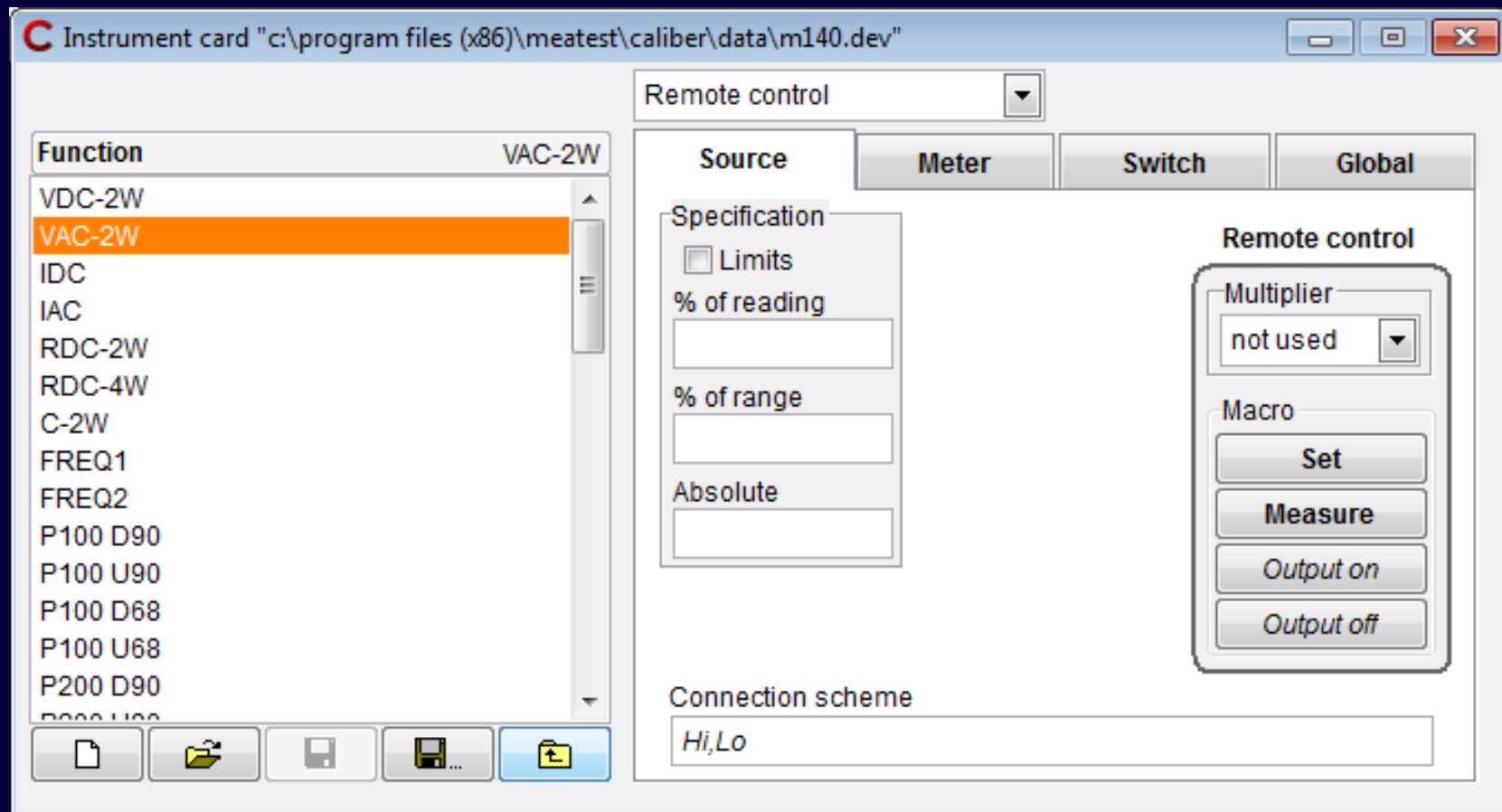
Tool for adding new instruments into the Caliber software.

- Contains separate definition for: Source, Meter, Switch
- Card contains description of the instrument:
 - **Functions**
 - **Ranges**
 - **Accuracy, limits**
 - Description of output terminals
 - Remote control commands
 - User Notes

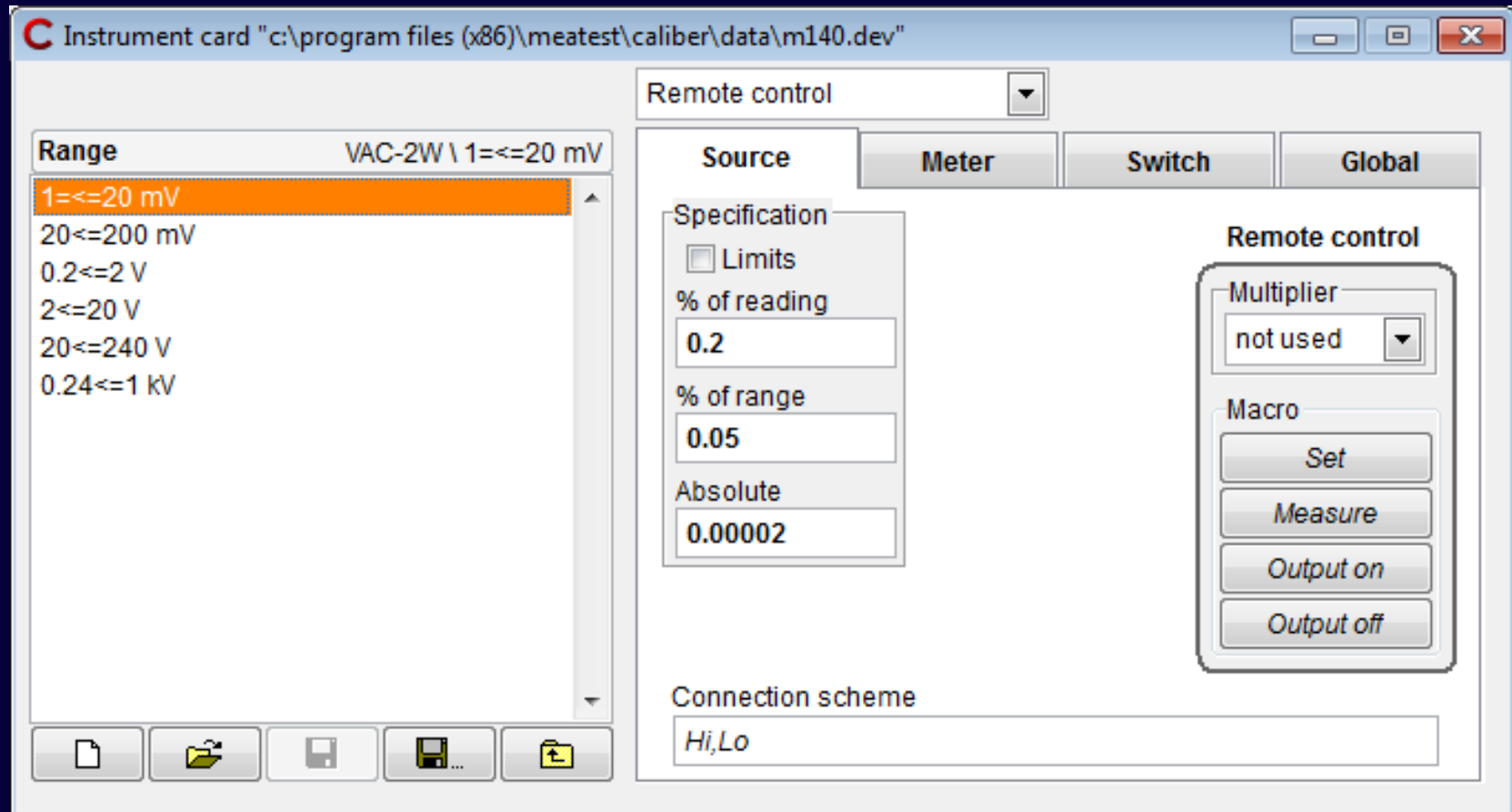
Caliber - Instrument Card - Description



Caliber - Instrument Card - Description



Caliber - Instrument Card - Specification



Practical Example

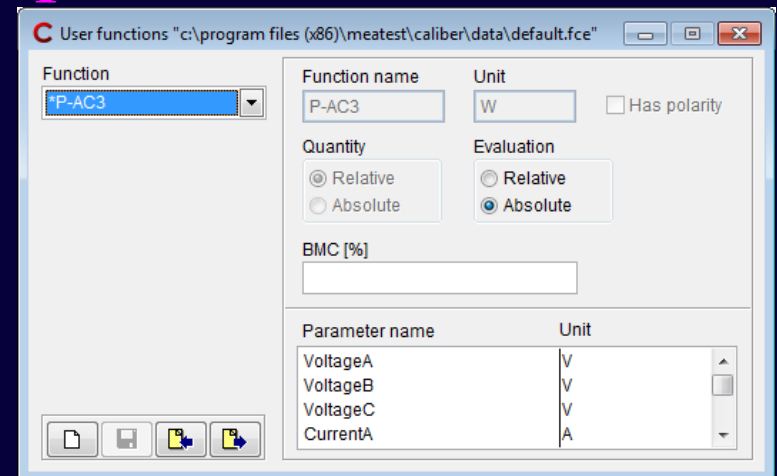
Creating/Changing instrument card with
INSTRUMENT CARDS

Caliber - User Functions Window

Tool for adding **new functions** into the Caliber software. For calibration should be used only functions defined in this window.

Defined function contains description of:

- **Name**
- **Unit**
- **Quantity (type of function)**
- **Evaluation style**
- **BMC (Best Measurement Capability)**
or CMC (Calibration and Measurement Capability)
- **Additional parameters (optional)**



Caliber - Evaluation

Calibration uncertainty

Method of calculation meets requirements of **EA-4/02**

Basic calculation formula:

$$U = k_u \times u_c$$

k_u extension coefficient

u_c [%] combined standard uncertainty

$$u_c = \sqrt{(u_a^2 + u_b^2 + u_{ud}^2 + u_{ua}^2 + u_{sd}^2 + u_{sa}^2 + u_{sb}^2 + u_{td}^2 + u_{ta}^2 + u_{tb}^2 + u_{cb}^2)}$$

Caliber - evaluation

Calibration uncertainty

$$\mathbf{u}_c = \sqrt{(\mathbf{u}_a^2 + \mathbf{u}_b^2 + \mathbf{u}_{ud}^2 + \mathbf{u}_{ua}^2 + \mathbf{u}_{sd}^2 + \mathbf{u}_{sa}^2 + \mathbf{u}_{sb}^2 + \mathbf{u}_{td}^2 + \mathbf{u}_{ta}^2 + \mathbf{u}_{tb}^2 + \mathbf{u}_{cb}^2)}$$

- \mathbf{u}_a general uncertainty of type A
- \mathbf{u}_b general uncertainty of type B
- \mathbf{u}_{ud} uncertainty due to the limited resolution of UUT
- \mathbf{u}_{ua} uncertainty type A - repeated measurements UUT
- \mathbf{u}_{sd} uncertainty due to the limited resolution of SU
- \mathbf{u}_{sa} uncertainty type A - repeated readings SU
- \mathbf{u}_{sb} uncertainty due to the uncertainty of SU
- \mathbf{u}_{td} uncertainty due to the limited resolution of auxiliary SU (transmitter)
- \mathbf{u}_{ta} uncertainty type A - repeated readings auxiliary SU (transmitter)
- \mathbf{u}_{tb} uncertainty due to the uncertainty of auxiliary SU (transmitter)
- \mathbf{u}_{cb} uncertainty due to the accuracy of converter (if used)

Caliber - Example 1

Multimeter M3800 calibration

The screenshot displays the Meatest software interface for calibrating a multimeter. The window title is "Procedura "c:\program files\meatest\caliber\data\m3800.pro".

Hodnota table:

	*										*
xM3800											
VDC-2W											
2 V											
0.2 V											
1.8 V											
-1.8 V											

Diagram showing the calibration setup:

- M140 (Manuální) 2 is connected to M3800 (Manuální) 1.
- Etalon & Zdroj: M140: Funkce: VDC-2W, Rozsah: 200 mV, Hodnota: 200 mV.
- UUT: M3800: Funkce: VDC-2W, Rozsah: 2 V, Hodnota: 0.2 V.

Kamera control panel:

- Buttons for camera control (up, down, left, right, zoom).
- Label: Odměry.

Main data table:

	Funkce	Rozsah	Etalon	UUT	Odchylka	%spec	Povoleno	Nejistota	Symbol
	VDC-2W	2 V	0.2 V						
	VDC-2W	2 V	1.8 V						
	VDC-2W	2 V	-1.8 V						

Caliber - Example 1

Calibration uncertainty

$$\mathbf{u}_c = \sqrt{(\mathbf{u}_a^2 + \mathbf{u}_b^2 + \mathbf{u}_{ud}^2 + \mathbf{u}_{ua}^2 + \mathbf{u}_{sd}^2 + \mathbf{u}_{sa}^2 + \mathbf{u}_{sb}^2 + \mathbf{u}_{td}^2 + \mathbf{u}_{ta}^2 + \mathbf{u}_{tb}^2 + \mathbf{u}_{cb}^2)}$$

$$\mathbf{u}_c = \sqrt{(\mathbf{u}_{ud}^2 + \mathbf{u}_{ua}^2 + \mathbf{u}_{sb}^2)}$$

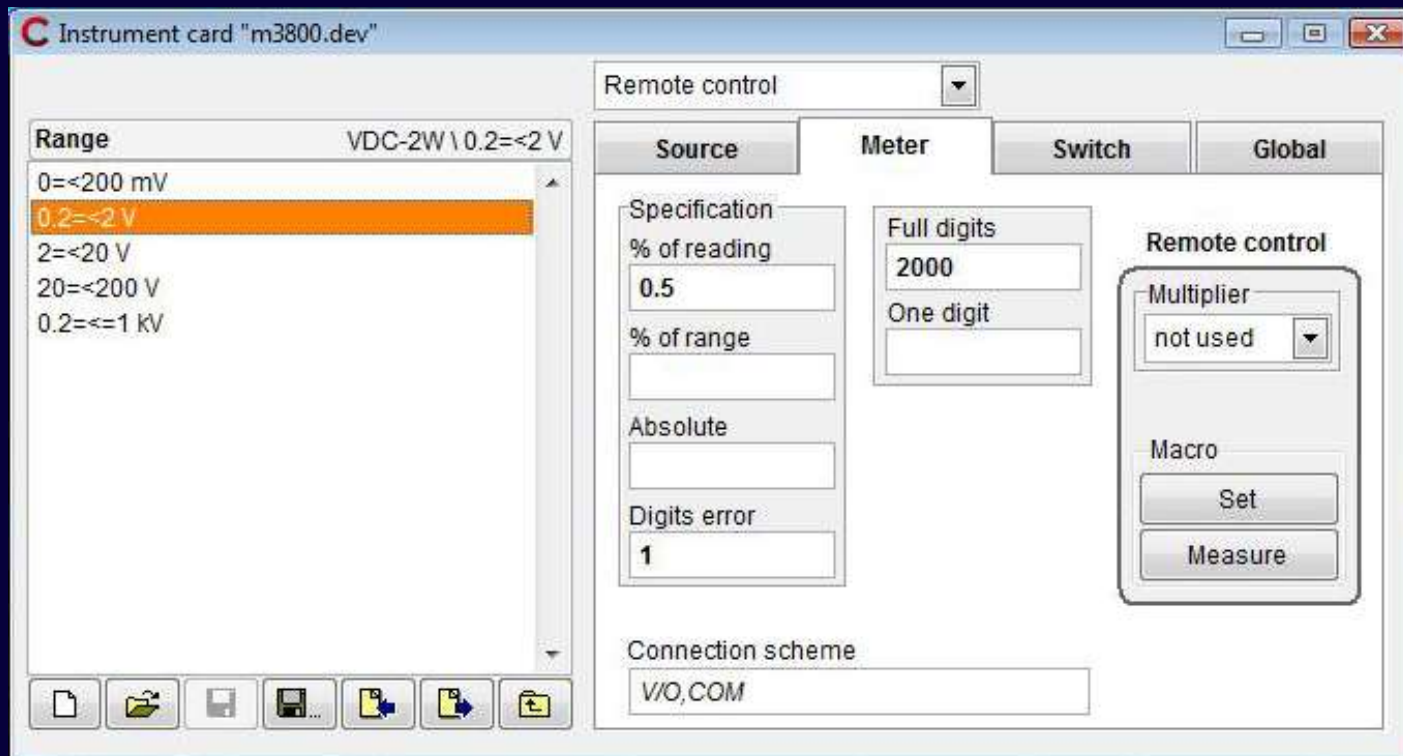
- \mathbf{u}_{ud} uncertainty due to the limited resolution of UUT
 - calculated from parameters written in instrument card
- \mathbf{u}_{ua} uncertainty type A - repeated measurements UUT
 - calculated from repeated measurements
- \mathbf{u}_{sb} uncertainty due to the uncertainty of SU
 - calculated from parameters written in instrument card

Caliber – Example 1

U_{ud} uncertainty due to the limited resolution of UUT

$$u_{ud} [\text{mV}] = 0.29 * \text{Dig}_u = 0.29 * 2000 \text{mV} / 2000 \text{dig} = 0.29 \text{mV}$$

$$u_{ud} [\%] = 0.29 \text{mV} * 100\% / 200 \text{mV} = 0.145\%$$



Caliber – Example 1

U_{ua} repeated measurement of UUT

$$u_{ua} [\text{mV}] = \sqrt{((\sum(a_j - Xu)^2)/(j*(j-1)))} = 0\text{mV}$$

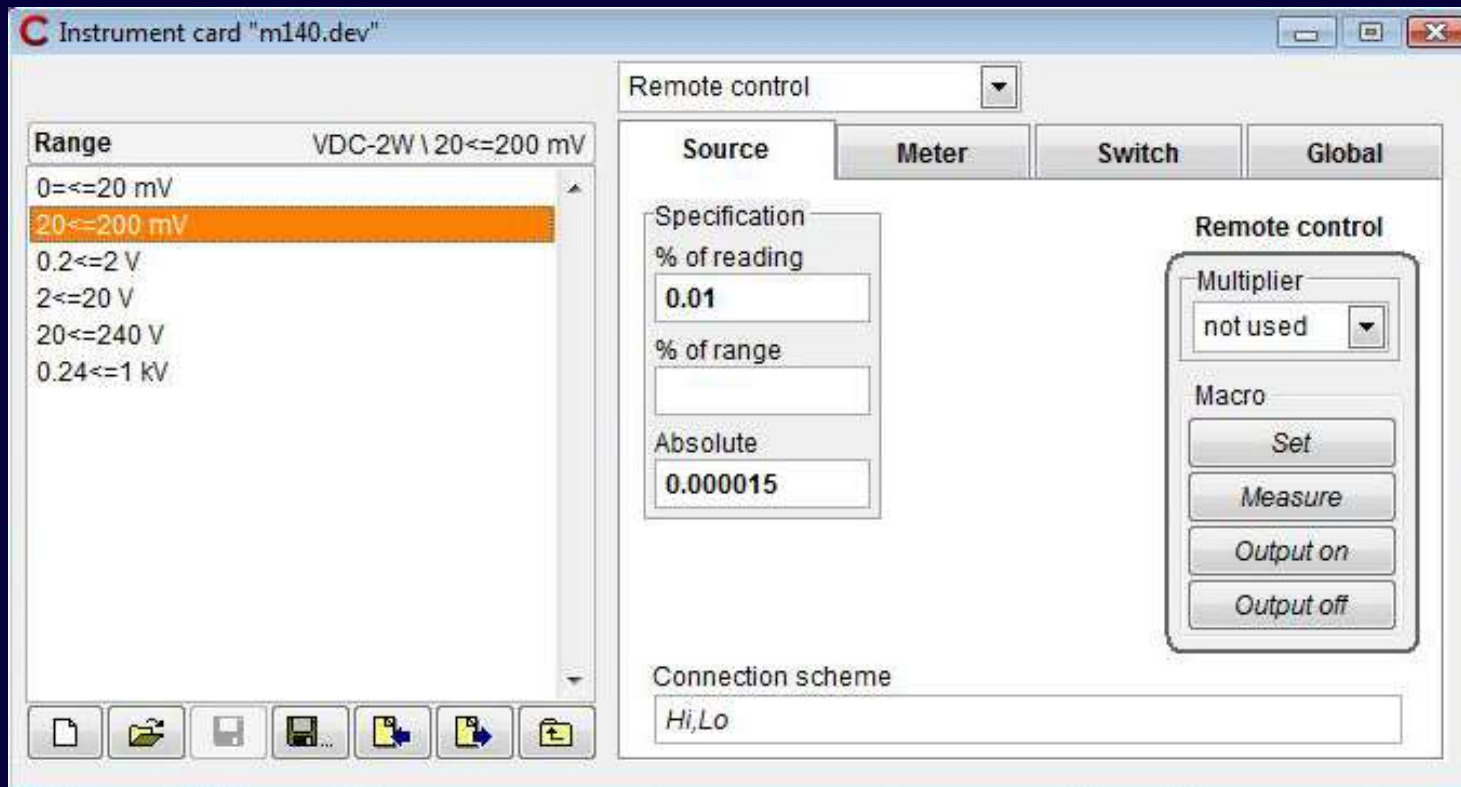
$$u_{ua} [\%] = 0\text{mV} * 100\% / 200\text{mV} = 0\%$$



Caliber – Example 1

U_{sb} uncertainty due to the uncertainty of SU

$$u_{sb} [\text{mV}] = D_{\text{max}_s} / \sqrt{3}$$
$$= (200\text{mV} * 0.01\% / 100\% + 0.015\text{mV}) / \sqrt{3} = 0.02021 \text{ mV}$$



Caliber – Example 1

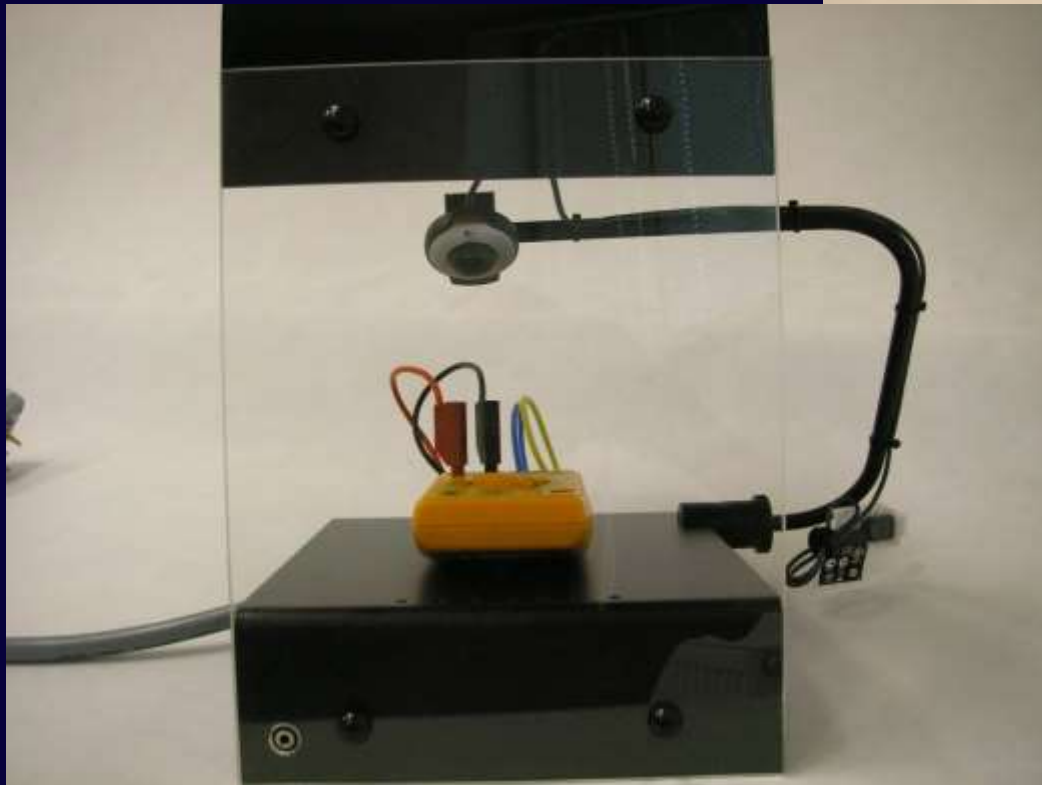
$$u_c = \sqrt{(u_{ud}^2 + u_{ua}^2 + u_{sb}^2)} = \sqrt{(0.29^2 + 0^2 + 0.02021^2)} = 0.2907 \text{ mV}$$

$$U = k_u * u_c = 2 * 0.2907 = 0.58 \text{ mV (rounded)}$$

The screenshot shows the Meatest software interface for a procedure named "xm3800". The interface includes a control panel on the left with a "Value" column and a grid of buttons. The central area displays a diagram of two manual meters, M140 and M3800, connected by a cable. On the right, there is a "Camera" section with a black display and navigation buttons, and a "Readings" section with a large empty box. At the bottom, a table lists the function settings and a results table.

Function	Range	Standard	UUT	Deviation	%spec	Allowed	Uncertainty	Symbol
VDC-2W	2 V	0.200 V	0.200 V	-0.00 mV	0	2.00 mV	0.58 mV	ok
VDC-2W	2 V	1.8 V						
VDC-2W	2 V	-1.8 V						

CamOcr - Camera Module



CamOcr - Camera Module

Purpose

Scanning of non-system multimeter's display. Recognizing of displayed number.

Advantages

There is **no need to enter values manually** – less human work.
Simple repeated **measuring with fixed sampling rate** and calculation of calibration uncertainties.

System requirements

OS Windows 2000 or higher, USB port

CamOcr - Camera Module - Example



Measuring of 20 mV on Multimeter M3800

Thank you for your attention

Company web sites: www.meatest.com