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CX 1651



<i>Control of the calibrator</i>	106
Selection of function	106
Setting the value of output signal	106
Setting relative deviation	108
Change of value by factor of ten	109
Connection / disconnection of output terminals	109
Setting the frequency	110
Generation of calibrated voltage	111
Generation of calibrated current	113
Generation of non-harmonic shapes	114
Simulation of resistance and capacitance	115
Generation of electric power and energy	118
Generation of frequency	123
Simulation of temperature sensors	126
<i>Multimeter</i>	130
Basic menu	130
Function selection	131
Setting the measurement range	131
Units of measurement	132
Use of calculation formula	133
Setting function parameters	133
Start of measurement	134
Zero function	134
Simultaneous functions	136
<i>Tester</i>	138
Basic menu	138
Execution of test program	138
Programming the test	139
Setting the type of signals and the number of steps	140
Setting the numeric values of the test	140
Setting the relays	141
Setup menu	141
Error messages	145
Calibrator's maintenance	147
Performance Verification test	149
System control	157
IEEE-488 bus properties	157
RS232 bus properties	157

Command syntax	158
<i>Examples of use</i>	<i>163</i>
Calibration of measurement instruments	163
Multimeters.....	163
Counters and oscilloscopes	165
Measurement.....	166
Voltage, current and frequency	166
Measurement of resistance or temperature using resistance temperature sensors	167
Measurement of temperature using thermocouples.....	168
Strain gauge sensors for non-electrical values	168
Testing of regulation and measurement sets and evaluation units	170
Use of Opt. 140-41 cable adapter	170
Use of Option 40/60 cable adapter	171
Use of Option 70.....	171
Examples of tests	171
Testing	173
<i>Specification</i>	<i>173</i>
<i>Accessories.....</i>	<i>181</i>

Basic Information

CX 1651 Multifunction Calibrator is a multifunction calibrator-tester, to be used primarily as a standard for calibration laboratories. It can be used for calibration of any measuring instrument which measures voltage, current, resistance, capacitance and frequency. It generates fixed non-harmonic signals to allow calibration of measuring instruments using signals with non-zero harmonic distortion. Frequency, amplitude and duty cycle of output signal can be adjusted. CX 1651 Multifunction Calibrator is also suitable for basic calibration of oscilloscopes.

The calibrator includes a function which simulates resistance and thermocouple temperature sensors and a built-in multimeter, which can be used simultaneously. Transducers of various types, regulators and sensing units can be therefore checked without the need for additional measuring instruments. Programmable functions of the calibrator, when used as a tester, include programming of a 10-step testing procedure, which completes automatically and displays a PASS/FAIL information in the end. This feature is linked to an independent relay output, which allows the control of other equipment.

Basic features of the calibrator include: generation of calibrated DC and AC voltage in the range of 0 μ V to 1000 V, DC and AC current in the range of 0 μ A to 20 A (50 μ A to 1000 A when using a 50-turn coil). Maximum precision of the calibrator is 0.0035 % for DC voltage, 0.03 % for AC voltage, 0.013 % for DC current and 0.055 % for AC current. Maximum frequency range is 20 Hz to 50 kHz. The calibrator can generate periodic non-harmonic signal with defined duty cycle. This facilitates especially the checks of multimeters and their accuracy when measuring non-harmonic DC signals.

The calibrator can also simulate a resistance or capacitance. Resistance range is 0 Ω to 50 M Ω ; capacitance range is 1 nF to 50 μ F, the accuracy suits the calibration of common multimeters. Basic accuracy of resistance ranges is 0.03 %. Basic accuracy of capacitance ranges is 0.5 %. The resistance can be used with AC signals up to 300 Hz to 1 kHz, depending on set-up value.

Frequency ranges of the calibrator can generate a squarewave signal with definable and calibrated duty cycle and amplitude in the 1 mV to 10 V range and 0 to 10 kHz frequency range. Moreover, squarewave signal with very steep rising edge can be generated up to 20 MHz. Frequency ranges can be used to calibrate the corresponding frequency ranges of multimeters, as well as to calibrate the input sensitivity and time bases of oscilloscopes.

Powermeter mode can be used to calibrate DC and AC single phase powermeters and energy meters. Voltage range is up to 240 V and current range is up to 10 A, power factor range is -1 to +1 and the resolution is 1 % in the 40 Hz to 400 Hz frequency range. The voltage output can supply loads up to 30 mA, which allows the calibration of mechanical powermeters.

Simulation of temperature sensors is yet another feature which can be used to calibrate thermometers and heat sensing units. The calibrator allows the simulation of all common Pt and Ni resistance sensors and R, S, B, J, T, E, K, N type thermocouples. Compensation of cold junction of thermocouple is achieved by entering the respective temperature using the calibrator's keyboard. The accuracy of simulated temperature sensors depends on the value and type of sensor and ranges from 0.04 $^{\circ}$ C to 0.5 $^{\circ}$ C for resistance sensors and from 0.4 $^{\circ}$ C to 4.3 $^{\circ}$ C for thermocouples.

Internal multimeter with 20 mA, 20 mV, 200 mV and 10 V basic ranges and 0.01 % accuracy can be used to measure normalized signals coming from transducers, external thermocouples or resistance sensors or to measure pressure and force using strain gauge sensors.

The calibrator includes many other features which facilitate easy use. For example relative deviation from set value of the output, currently displayed uncertainty of the output signal, calibration and testing procedures etc. The concept of calibrator control and indication of its status is based on flat luminiscent display, which provides all necessary information. The calibrator is controlled by opening menus on the display and selection from menus. Frequently used functions are assigned direct-control keys. The calibrator comes with standard GPIB bus and RS-232 serial line, which allow the calibrator to be controlled from a PC.

The calibrator can easily fit within calibration systems featuring MBASE/WinQbase software support.

ATTENTION !
The calibrator generates life-threatening high voltage.

***The calibrator can only be used in line with this
Manual.***

Preparation for operation

Inspecting package contents, selecting the installation location

Basic package includes the following items:

- Multifunction calibrator
- Power cord
- Spare fuse T4L250/T, T8L250/T
- Operation manual.
- Test report
- Test cable 1000V/20 A 2 pcs
- Cable adapter Option 40
- Cable adapter Option 60
- Cable adapter Option 70
- RS 232 cable

The calibrator should be powered by 230/115 V – 50/60 Hz mains. It is a laboratory instrument whose parameters are guaranteed at 23 ± 2 °C. Before powering on the instruments, place it on a level surface. Do not cover the vents at the bottom side and the fan opening at the rear panel.

Power-on

- Before connecting the calibrator to the mains, check the position of the mains voltage selector located at the rear panel.
- Plug one end of the power cord into the connector located at the rear panel and connect the other end of the power cord into a wall outlet.
- Switch on the mains switch located at the rear panel. Flat display is lit.
- The calibrator performs internal hardware checks for 5 seconds.
- After the tests conclude, the calibrator resets to its reference state, i.e. the following parameters are set:

Function	DC voltage
Range	20 V
Set value	10 V
Output terminals	OFF

GPIB address of the calibrator is factory-preset to 2. This value is valid until the user changes it.

Note. The calibrator resets to its reference status in case of power switching off and reconnection.

Warm-up time

The calibrator works after it is switched on and the initial checks complete. Specified parameters are only guaranteed after the instrument warms up for 60 minutes. During this period, the instrument cannot be calibrated. The display shows “cannot access the calibration” message if calibration is attempted during this period.

Replacement of fuse

The calibrator includes a fuse located in the mains connector at the rear panel. Replace the fuse as follows:

- Switch off the calibrator
- Remove the end of power cord from the mains connector at the rear panel.
- Insert the blade of a flat screwdriver into the opening cut in the mains voltage selector and pull out the fuse holder.
- Remove the fuse and replace it with new fuse of the same rating.

Safety precautions

The instrument has been designed in Safety Class I according to EN 61010-1. The design reflects the requirements of A2 amendment of the standard.

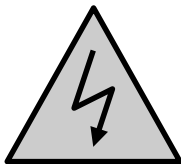
Safety is ensured by the design and by the use of specific component types.

The manufacturer is not liable for the damage caused by modification of the construction or replacement of parts with non-original ones.

Safety symbols used on the equipment



Warning, reference to the documentation



Warning - risk of electric shock

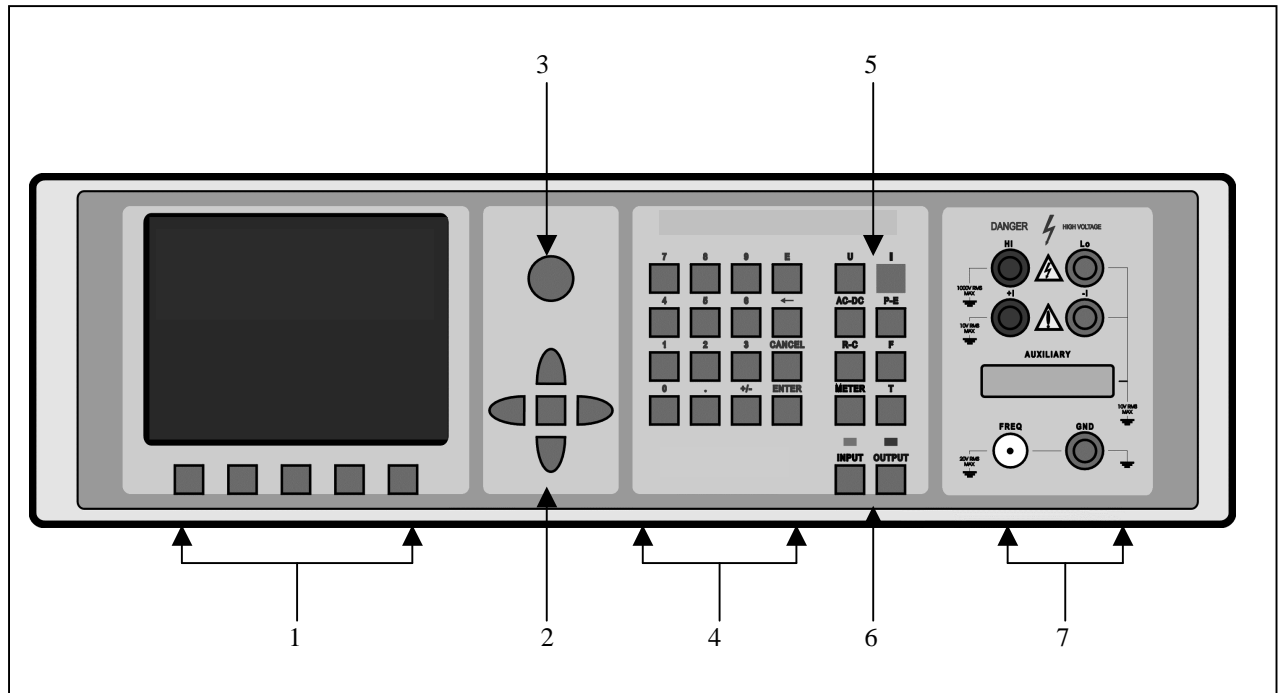


Danger - high voltage

Description of controls

Front panel

The front panel of the calibrator includes a flat luminiscent display, control buttons and output terminals. The following picture shows the control part of the front panel.



1 Display buttons

There are five buttons below the display, whose meaning changes depending on the contents of the display. These buttons usually call-up the MENU, allow range change, step, logging of values etc.

2 Cursor buttons

Using these buttons, the cursor can be controlled within allowed limits on the display. The keyboard includes two buttons (<, >) which allow the cursor to be set to the required position at the display. The cursor can be moved to the left or right. These buttons are usually used to step through the options and to move from one option to another or between the menu levels. Numeric values can be set in some control modes as well. In these cases, the buttons marked (\wedge , \vee) allow the user to increase or decrease the number at the cursor button.

The central button is used to confirm the selection (ENTER), or to SELECT from the menu.

3 Potentiometer

The potentiometer integrates several functions. By turning the knob to the left or right, the user can:

- step through the options
- enter numeric values

The function of the potentiometer can usually be performed by the cursor buttons. The central button is used to confirm the selection (ENTER).

4 *Numeric keyboard*

The keyboard allows the entry of numeric values on the display. The central button is used to confirm the selection (ENTER). CANCEL button can be used to cancel the entry.

5 *Function buttons*

Function buttons can be used to call-up the functions of the calibrator directly. The following buttons are provided:

<i>function</i>	<i>button</i>
DC voltage	U / DC
AC voltage	U / AC
DC current	I / DC
AC current	I / AC
resistance / capacitance	R – C
power / energy	P – E
frequency	F
internal multimeter	METER
simulation of temperature sensors	T

After the function mode is changed, the parameters of the respective function are restored. If the respective function was never used, the calibrator resets to its reference values. Reference values for individual functions are listed below.

<i>function</i>	<i>value</i>	<i>parameters</i>
DC voltage	10V	--
AC voltage	10 V	f = 1000 Hz
DC current	100 mA	--
AC current	100 mA	f = 1000 Hz
resistance	100 kΩ	
capacitance	1 μF	
power	100 W	f = 100 Hz ^{*1}
energy		
frequency	1000 Hz	U = 1 Vsym
multimeter	10 V	DC voltage
simulation of temperature sensors	100 °C	Pt 100/1.385, ITS90
cold junction temperature of TC sensors	23 °C	R

^{*1} U = 100 V, I = 1 A, PF(power factor) = 1 LA, active power is displayed in Watts

6 *Output / input terminals buttons*

OUTPUT button is used to connect the output signal of the calibrator to the output terminals. The connection is confirmed by red LED and a symbol at the display.

METER button can be used to connect the input terminals to the internal multimeter. The connection is confirmed by green LED.

7 *Output / input terminals*

Output signal of the calibrator is connected to the output terminals. Current ranges are connected to **+I / -I** terminals, frequency output is connected to **FREQ** terminal. All other functions (voltage, resistance, capacitance) are connected to **Hi / Lo** terminals.

GND terminal is connected to the chassis of the calibrator. It is connected to the ground terminal of the mains plug. Using the SETUP MENU of the calibrator, the output terminals of the calibrator can be grounded as well. Grounding is done internally by connecting Lo and GND terminals using a relay. This circuit design is suitable for most calibrations, when the object (multimeter) being calibrated is floating.

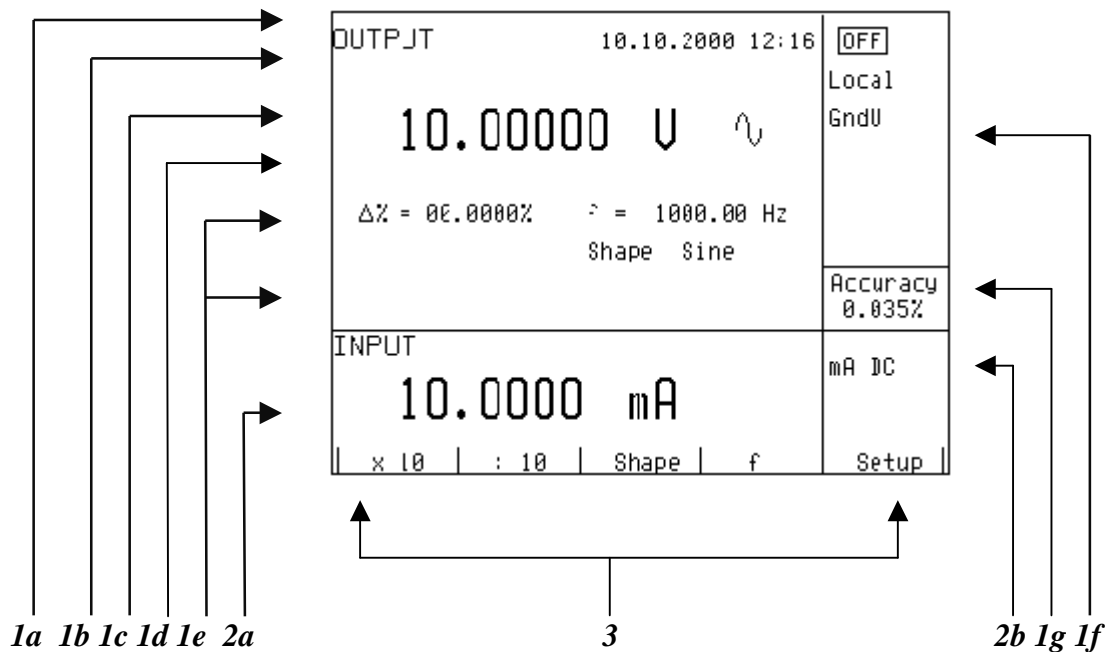
AUXILIARY connector creates input of internal multimeter. It includes a limited range of output signals of the calibrator as well. The layout of individual pins and their meanings are listed in the following table.

Auxiliary connector can be used with one of cable adapters Opt. 40, 60, 70, Opt. 140-41. Calibrator can recognize which type of adapter is connected and displays the information on front panel display.

<i>pin</i>	<i>label</i>	<i>signal</i>	<i>limitation</i>
1	L	common terminal of multimeter input	
2	INP	input terminal of multimeter for voltage/current ranges	U _{max.} =25 V _{pp} , I _{max.} =25 mA
3	-U	low output terminal for DC voltage range	
4	+U	high output terminal for DC voltage range	U _{max.} =20 V _{ss}
5	-I	low output terminal for DC current range	
6	+I	high output terminal for DC current range	I _{max.} =25 mA
7	NG1	sort function output, contact 1 of relay	U _{max.} =50V _{pp} , I _{max.} =100 mA
8	NG2	sort function output, contact 2 of relay	U _{max.} =50V _{pp} , I _{max.} =100 mA
9	PTLI	resistance temperature sensor input terminal Li	U _{max.} = 10V _{pp} . R<2 kΩ
10	PTHI	resistance temperature sensor input terminal Hi	U _{max.} = 10V _{pp} . R<2 kΩ
11	PTLU	resistance temperature sensor input terminal Lu input terminal L on ranges 20, 200, 2000 mV	U _{max.} = 10V _{pp} . R<2 kΩ
12	PTHU	resistance temperature sensor input terminal Hu input terminal H on ranges 20, 200, 2000 mV	U _{max.} = 10V _{pp} . R<2 kΩ
13	TEST1	identification terminal of actually used adapter	
14	TEST2	identification terminal of actually used adapter	
15	NC	not used	
16	NC	not used	
17	0	identification terminal of actually used adapter	
18	0	identification terminal of actually used adapter	
19	NC	not used	
20	SIMLI	RC simulator output, current terminal Lie	U _{max.} = 10V _{pp} , I _{max.} =40mA
21	SIMHI	RC simulator output, current terminal Hi	U _{max.} = 10V _{pp} , I _{max.} =40mA
22	SIMLU	RC simulator output, voltage terminal Hi	U _{max.} = 10V _{pp} , I _{max.} =40mA
23	SIMHU	RC simulator output, voltage terminal Hu	U _{max.} = 10V _{pp} , I _{max.} =40mA
24	NC	not used	
25	NC	not used	

Functional inputs and outputs present at the connector can be best utilized using supplied cable adapters.

LCD display shows all information provided by the calibrator, e.g. set parameters of the signal, error messages, setup information. The display is divided to several information sections.

8 *Display*

The display is divided to three horizontal sections:

4. *OUTPUT section*

This section displays the set-up values of generated signals and the data related to the calibrator status. The section includes the following types of data:

a) *Information line*

- designation of display section: OUTPUT
- error messages. The messages appear when an attempt is made to set up an invalid state of the calibrator, if analogue circuits of the calibrator are overloaded or if a communication error occurs when the calibrator is controlled using GPIB bus.
- real date and time, if its display is set-up in the setup menu.

b) *Auxiliary data*

This line displays the total value of output signal if a non-zero relative deviation is set.

c) *Main data*

This line displays the main data of the output signal and the unit of measurement (using double size signs). The line also includes two symbols (▼▲) to define the actual position of the cursor during adjustment of the value. <, > buttons can be used to move the cursor and ^, v buttons to change the value. (The value can be also changed using the potentiometer).

d) *Monitoring line*

This line displays the numbers entered using the numeric keyboard when the main data are set using the numeric keyboard. The information allows the entered information to be checked.

e) *Minor data*

There are two lines displaying the minor data of the output signal, especially:

- set relative deviation from main set value in %
- frequency (for DC voltage, current, power, energy functions)
- set value of current, voltage or power factor (phase) for power, energy functions

- value of R0 resistance and the type of resistance temperature sensor
- cold junction temperature of TC sensors and the selected type of TC sensor
- value of amplitude and shape type for frequency function

f) *Information section*

The information section located in the right part of the display displays additional information related to the selected function:

- symbol of connected or disconnected output terminals.

At the same time, a LED located above the OUTPUT button is lit.

- information about remote/local control of the calibrator. If the calibrator is controlled remotely, REM is displayed. If the calibrator is controlled locally using the keyboard, LOCAL is displayed.
- information about the use of 50-turn coil (COIL x50) at the current output of the calibrator, if this feature is turned on using the SETUP menu.
- information about the type of connected cable adapter, if used
- information about the grounding method of output terminals: GND I, GND U as set up using the setup menu.

g) *Information about the uncertainty of the output signal*

This section displays the maximum error of the main value of the output signal. The value is calculated using the main specification listed in the User's Manual and it is displayed in %.

5. **INPUT section**

This section displays the values measured by the multimeter. The section includes following data:

a) *Main value of measured signal*

This line displays the measured value and the unit of measurement. If the input signals exceed the permitted range, OVERFLOW is displayed.

b) *Designation of selected function of the multimeter*

Symbolic display of selected function of the multimeter: V DC, mA DC, mV DC, R 4W, Freq, T TC, T RTD, SGS, ACAL.

6. **Display buttons section**

This line displays the symbolic descriptions which define the meaning of four related display buttons. The respective meanings are as follows:

<i>symbol</i>	<i>button function</i>	<i>note</i>
x 10	increase set value 10 x	
: 10	decrease set value 10 x	
Shape	selection of signal shape	only for U, I, F functions
+/-	reversed polarity of output voltage and current	only for DC U, DC I functions
EXIT	move up one level	only for F, P-E functions
Calib.	enter the calibration menu	
SETUP	enter the setup menu	
TC type	selection of thermocouple sensor type	only for T function
RTD type	selection of resistance temperature sensor type	only for T function
f	enter the frequency of the signal	only for U, I function
MODE	select the unit of measurement	only for AC P-E function

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