MCS

Multichannel Current Source

User Manual

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Dear New Customer,

We would like to welcome you in the community of DM Technology device users. We are very happy you decided to purchase our ultra-low *Multichannel current source.* The source is a unique device, offering great performance and parameters inaccessible to other equipment available at the marker. We would like to assure you that we will do our best to meet your expectations.

Dear Valuable Existing Customer of DM Technologies,

We would like to express our extreme pride and happiness of your decision to continue your relationship with our company. We believe this decision is an indication of your satisfaction with our products and positive relationship with us. We would like to assure you that we will do our best to meet your expectations and continue your positive assessment of our company.

Right from the beginning of our company, our main goal has been to provide our Customers with reliable and easy-to-use device helping them in their research. Precisely designed and constructed systems, carefully investigated in long and demanding tests offer performance and capability inaccessible at the market. With precision or temporal resolution available to our devices, we can be used in most demanding applications.

Despite our efforts, there might be aspects of operation of our devices which would require further explanation or in your opinion the devices could benefit from some additional futures. In such a case, we would like to ask you to contact us. We will provide you with quick and competent help through our service staff and product managers.

You can contact us in the following ways:

Internet: At our website www.dmtechnologies.eu please do find Support section where you can find answers to frequently asked questions and a service contact form.
Email: info@dmtechnologies.eu
Phone: +48 609 413 923

As our aim is to improve our products, we greatly appreciate all customer feedback. We would like to encourage you to contact us with any positive remarks, regarding our product, but also with any suggestions regarding potential its improvements. We truly believe that with your help we manage to further develop our products to meet your ever-increasing demands.

We would like you to thank you for your choice.

Sincerely yours,

Dr. Szymon Pustelny

CEO of DM-Technologies

Table of Content

SAFETY INSTRUCTIONS AND WARNINGS

!!! WARNING !!!
Dangerous voltages, capable of causing injury are present in this instrument. Use caution whenever housing of the device is removed.

Before operating our Multichannel current source (MCS) please read carefully the manual. Operation of the device according to the instructions and safety guidelines will prevent personal injury and damage of the device.

The following safety instructions must be followed at any times.

The MCS system must be supplied using **power supply** generating a 12-V stabilized voltage. The optimum, low noise supply is delivered with the device.

Never operate the device without the box.

Any service and adjustment may only be performed by trained personnel.

Do not perform any unauthorized modifications to the device. Any unauthorized modifications of the device will cause termination of the warranty.

The instrument must not be operated in hazardous environment. In particular:
     (1) **Do not use the device in wet or humid environment.**
     (2) **Do not use the device in atmosphere containing explosive or corrosive gasses.**

Provide proper cooling of the device.

SPECIFICATION AND PERFORMANCE

Crucial features

- Independent 8 channels
- Bipolar source referenced to ground
- Two operation ranges: ±4 mA, ±40 mA
- Common ground – channels can be connected in parallel (current summation)
- High resolution: 1.25 µA, 0.125 µA
- Ultra-low noise: 10 pA/Hz$^{1/2}$ @ 1 kHz (4 mA range)
- Low thermal drifts
- Good stability with wide range of inductive loads
- Independent and computer-control operation

Specifications

Output		
Number of channels	8	
Current range	±4 mA	±40 mA
Current resolution	0.125 µA	1.25 µA
Output resistance	50 MΩ	
Output capacitance	100 nF	
Low thermal drifts	<5 ppm/°C	
Compliance range	±10 V	

Remote interface	
Interface type	USB

General	
Dimensions (L x W x H)	23 cm x 14 cm x 5 cm
Weight	850 g (without the power supply)
Operating temperature	15-60°C
Warranty	One year parts and labor on defects in materials and workmanship

1. GETTING STARTED

1.1. HOW TO US THIS MANUAL

There are two ways of using this manual. The Customers who want to gain a detailed knowledge about the current source should continue reading this part learning many information about the device, including step-by-step procedures verifying basic performance of the device. Alternatively, the Customers who are eager to use the device should start reading Section 2, where operation of the device is described.

1.2. IN THE BOX

The box contains following elements:
- Multichannel current source
- Power supply with a European-standard power cord
- 2-m micro-USB connection cable
- Device manual

1.3. OVERVIEW

Figure 1 shows the front and back of the current source with labels marking different elements.

Figure 1. Multichannel current source front (top) and back (bottom) panels.

① **LCD Screen**
On-screen display used for user interfacing.

② **Control keys**
Control keys used to operate the device. The top and bottom key are used as up and down arrows switching between the channels. The middle key is the Enter key used to switch between multichannel display (General menu) and the single-channel display (Channel menu).

③ **Multiturn pressable knob**
The knob controls the current flowing through a selected/highlighted channel. The knob is speed sensitive offering larger changes for faster rotation and smaller changes for slower rotation.

④ **MicroUSB port**
The USB port is used for communication with the computer. Particularly remote control of the device and firmware upgrade can be performed using the port.

⑤ **Serial number sticker**
Number indicating a serial number of the device

⑥ **Banana ground jack**
The grounding jack is used to ground the devices and hence reduce the noise of the output current.

⑦ **Power socket**
The device accepts the stabilized 12-V (±1%) voltage.

⑧ **Output terminal**
This output terminal distributes current from the device. The channels are enumerated from right to left (from behind). The first pin in a pair is a signal channel, the second pin is the ground channel.

The green light-emitting diode situated next to MicroUSB port indicates the communication between the device and computer.

The red light-emitting diode situated next to the Control keys indicates overheating of the device (see Section 6.1). The blinking red diode indicates either the boot of the system or firmware upgrade

3. OPERATION OF THE DEVICE

3.1. INITIALIZATION

After powering up the device, a welcome screen with DM Technologies logo and current version of the device firmware is displayed. After 5 seconds, the initial screen disappears and the General menu is displayed.

During the initialization, the device can be introduced into the service mode (see Section 3.3). This can be achieved by double clicking any of the Control keys.
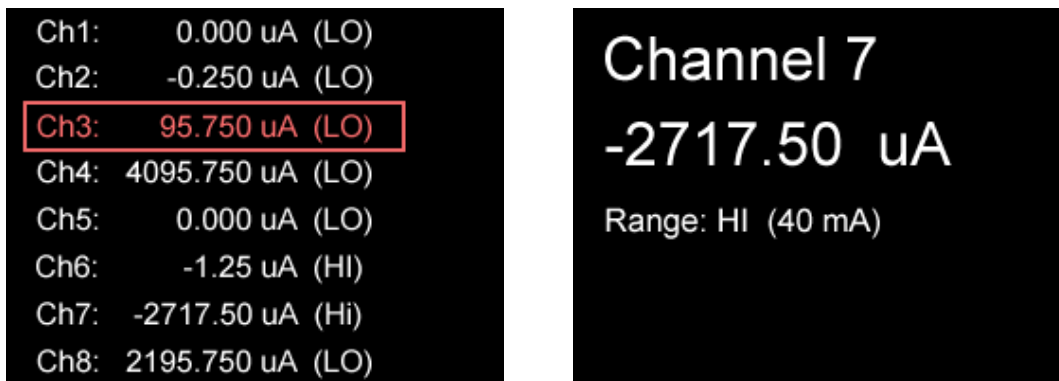

Figure 2. General menu (left) and Channel menu (right) of the device.

3.2. NORMAL OPERATION

There are two menus that can be displayed on the screen: General menu and Channel menu (Fig 2).

General menu

General menu (Fig 2 left) is the first menu displayed on the screen after initialization (Fig. 2)[1]. The menu displays settings of all channels along with the current range (LO – 4 mA range, LO – 4-mA range). After powering up the multichannel current source the settings correspond the last values set before switching off of the device.

Selection of channels occurs by using a top and bottom Control keys ②. The selected channel is highlighted with different color and frame. The setting of the channel can be changed by turning the Multiturn pressable knob ③. The system recognizes speed of the knob rotation and adjusts the change accordingly (faster rotation corresponds to faster speed).

Pressing Multiturn pressable knob ③ changes the set range. In case of switching between low and high ranges and value not accessible in the range, the system rounds the value to the closest value available in the range.

Pressing Multiturn pressable knob ③ for 1 s resets the current to zero.

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[1] Note that the composition of the menu (arrangement, type and color of fonts) can vary depending on a particular firmware (herein shown for ver. 2.6).

Channel menu

Channel menu (Fig. 2 right) can be called by pressing middle of Control keys ②. The channel displays the name of the channel, current set value, and current range. Change of the value is done by rotation of Multiturn pressable knob ③, which operates in the same manner as in General menu: speed-dependent rotation controls change of the current value, short pressing of the know changes the current range, and holding the pressed knob for 1s resets the current value to zero.

The top and bottom button of Control keys ② allows one to switch between the channels.

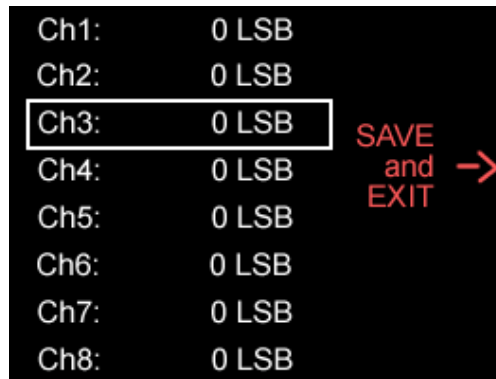Pressing the middle of Control keys ② returns to General menu.

Figure 3. Service-mode menu of the device.

3.3. SERVICE MODE

Doubling click of any of Control keys ② after powering up of the device introduces the MCS device into a service mode. The service mode enables calibrating of zero of each channel. To choose a specific channel top and bottom buttons of Control keys ②, in a way identical to that used for the normal-mode operation. After choosing of a specific channel, rotation of Multiturn pressable knob ③ modifies the current corresponding to 0-mA setting. The nonzero value of the current is a consequence of the manufacturing process of the electronic circuits used in Multichannel current source and drifts of the parameters while aging. This process is unavoidable but the MCS is shipped precalibrated (optimum zero values are set).

NOTE
All DM Technologies Multichannel Current Sources are delivered precalibrated.

Calibration procedure

In order to calibrate Multichannel current source please use the precise ampmeter with a sub-100-nA precision. To calibrate connect a specific channel to the input of the ampmeter and adjust the setting to achieve value closest to zero. The procedure should be repeated for all eight channels. After completion of the procedure, the new settings are save with middle of Control keys ②.

4. REMOTE INTERFACE

4.1. GENERAL SETTINGS

Multichannel current source can be controlled remotely. Communication with a computer occurs through a microUSB serial port.

<u>Microsoft Windows</u>

After connecting Multichannel current source with a computer, a new COM port should appear in Device manager. The communication settings are:

Baud rate: **115200**

Data bits: **8**

Parity: **None**

Stop bit: **1**

Row control: **Hardware**

4.2. COMMANDS

The subsequent list of comments controls Multichannel current source remotely

!idn	Identify Query identification string.
Example:	!idn DM Technologies, Multichannel Current Source, ver. 2.7, s/n 32019002

!set #CH;RANGE;VALUE	Sets current of a channel in specific range
	The device channel to be set is called by replacing #CH with a number from 1 to 8.
	There are two ranges: ±4 mA and ±40 mA called by replacing RANGE with 4mA or 40mA.
	Within each range the settings are chosen by choosing a number -4.960…4.960 (4-mA range) or -40.960…40.960 (40-mA range).
	NOTE!!! In case of choosing a value outside of the available range or between the available values, the current setting will be rounded to the closest available value.
Example:	!set 1;4mA;3.250 Sets Channel 1 to 3.250 µA in a 4-mA range.
	!set 3;40mA;-32225 Sets Channel 3 to -32.250 mA (the closest available value) in a 40-mA range.

!chk?	Query temperature of the sensors inside Multichannel current source.

Example:	!chk 1 Return the current value in Channel 1	
!tmp	Query temperature of the sensors inside Multichannel current source.	
Example:	!tmp Returns a string **#tmp;OK/HOT;TMPback;TMPfront** where OK/HOT indicates if temperature of the device is operational and TMPback and TMPfront indicates temperature (in Centigrade) of the Back and Front sensors, respectively.	

|	
!reset	Resets the device.
Example:	!reset Multichannel current source will be reset.

!help	Query a full list of commends controlling the device
Example:	!help Returns a string with all the comments along with their descriptions and examples.

4.3. LABVIEW VIS

There are several subVI prepared in LabView13 to control the device remotely.

Setting channel
MCS-SetCurrent.vi enables setting up a current in a specific channel within a given current range.
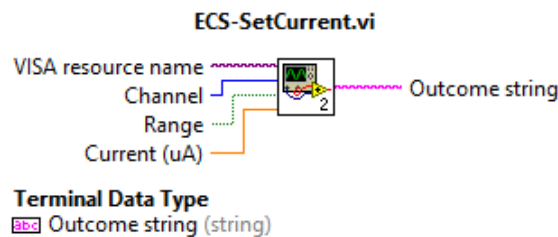
Terminals description:
VISA resource name specifies the resource name to be used.
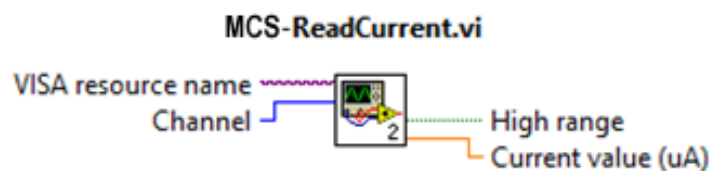**Channel** specifies the number of the channel to be used. The input takes unsigned integers between 1 and 8.
Range specifies the operation range of the current. The input takes boolean data where true corresponds to 4-mA range and false to 40-mA range.
Current (uA) specifies the current in microamps flowing through the channel. The input takes real numbers between -4000-4000 for the 40-mA range and -40000-40000 for the 4-mA range.
Outcome string returns the whole comment sent to the device to set it up.

Reading channel settings
MCS-ReadCurrent.vi retrieves information about settings of a specified channel.
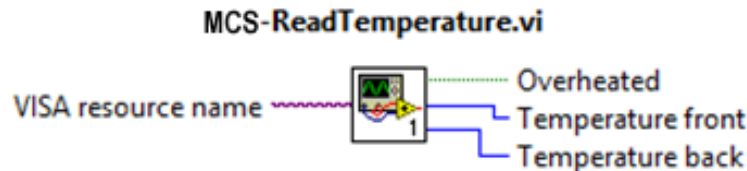
Terminal description:

VISA resource name specifies the resource name to be used.

Channel specifies the number of the channel to be used. The input takes unsigned integers between 1 and 8.

Reading temperature

MCS-ReadTemperature.vi retrieves information about internal temperature about the source.

Terminal description:

VISA resource name specifies the resource name to be used.

Temperature front returns the temperature measured with the sensor placed inside the MCS device in the front of the box. The temperature is returned as integer and is given in Centigrades.

Temperature back returns the temperature measured with the sensor placed inside the MCS device in the back of the box. The temperature is returned as integer and is given in Centigrade.

Overheated returns the boolean value which is True when the temperature measured with the sensors exceed 60°C.

Rebooting of the device

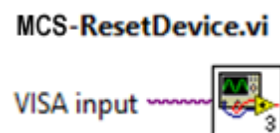MCS-Identification.vi queries an identification string of the MCS device.

Terminal description:

VISA resource name specifies the resource name to be used.

Identification string returns the string containing manufacturer name, Device name, firmware version, serial number.

Rebooting of the device

MCS-ResetDevice.vi sends a signal to the MCS device to reboot it.

Terminal description:

VISA resource name specifies the resource name to be used.

Exemplary program

MCS-Example.vi is an exemplar LabView program using all components described above. It enables setting all channels, measures channels' settings and temperature of the device. It can be also used to reset the device.

5. FIRMWARE UPGRADE

The device operates based on the firmware. The firmware controls various aspects of device operation and it may be upgraded using the provided bootloader application.

Figure 4 shows BootApp application, which is the program used for upgrading the MSC firmware.
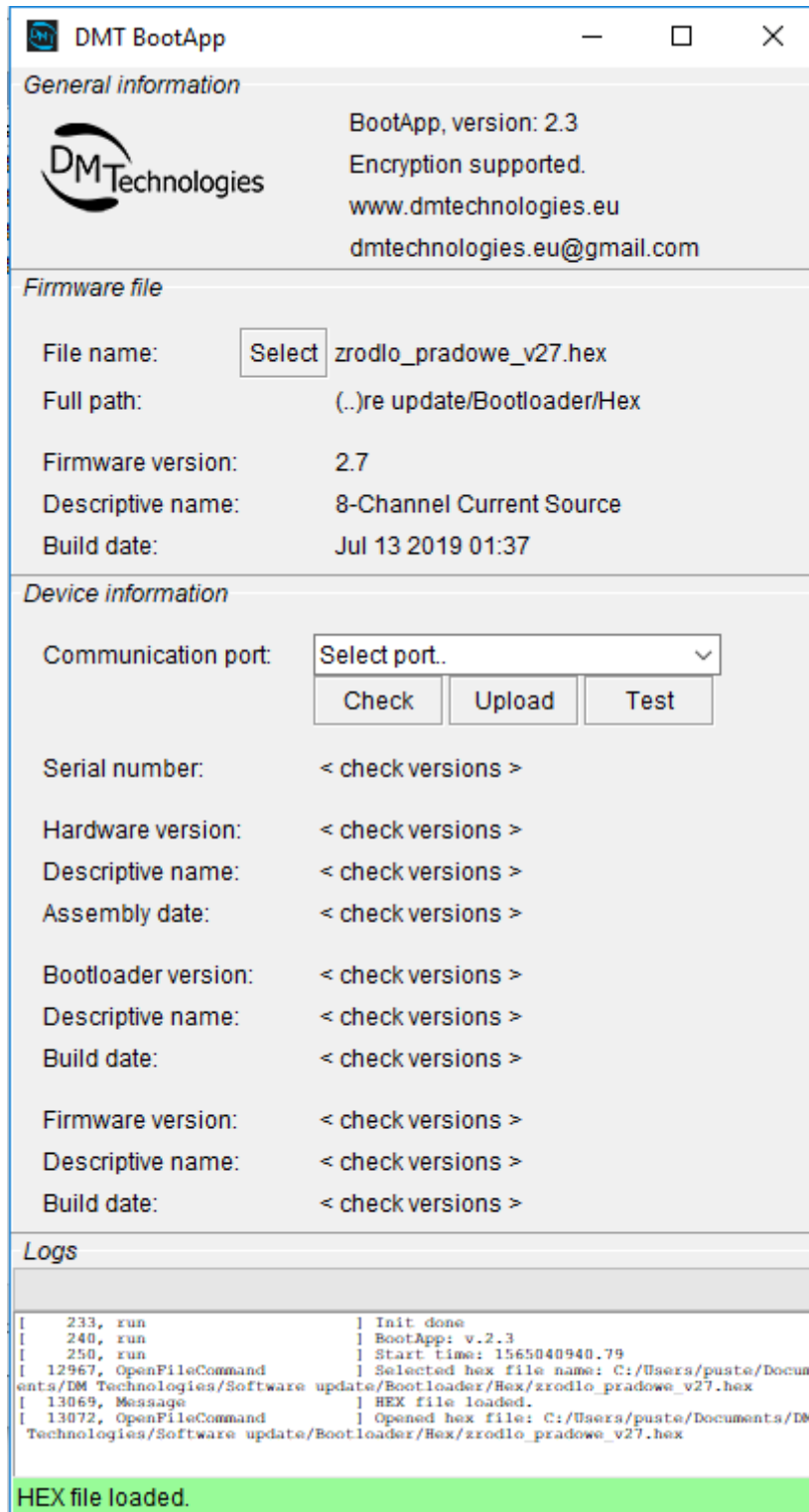

Figure 4. Application used for upgrading the device firmware.

The topmost **General information box** contains information about BootApp, its current version, as well as information about the manufacturer and its address.

The **Firmware box** contains information about the firmware file. To select the firmware file click **Select** bottom and then choose the hex file from its location. After choosing a hex file with the firmware update, information about the firmware name, version, and build date along with the file name and firmware source folder are displayed.

The **Device information** box contains information about the device and current version of firmware. To obtain this information one needs to identify the COM port the device is connected to and then clicking the **Check** bottom. After clicking the **Test** box BootApp verifies the communication with the computer. If the firmware file is selected, clicking the **Upload** bottom initiates the procedure of firmware transfer. Such update takes up to 1 minute, during which the connection between computer cannot be interrupted or none of the devices should not be powered down. Failure to follow these recommendations may lead to corruption of the firmware and malfunction of the device. However, it should not lead to complete failure of the device and successive uninterrupted upgrade of the software should resume its full operation.

The bottommost **Logs** window shows all the logs regarding the firmware upgrade. The same logs are also stored in a file saved locally at the computer.

6. TROUBLESHOOTING

6.1. OVERHEATING

<div style="border:1px solid red">

!!! WARNING !!!

In order to avoid destruction of Multichannel current source, when the temperature inside the device box exceeds 60°C, the system automatically switches of all channels until temperature inside the device drops below 50°C and operation with last settings is resumed.

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In an unlikely case of temperature inside the box of the Multichannel current source exceeding 60°C, a red LED in a front of the device (next to the Control keys ②) is switched on and all the currents are switched off. This is done until the temperature of the device is reduced below 50°C until the operation with last settings is resumed. It was verified with independent test if the free access of the air is ensured the device overheating even with a full load at all channels.

!!! To avoid problems with overheating provide good ventilation of Multichannel current source !!!