DH Instruments
A Fluke Company

MFC Switchbox™
User's Manual

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High pressure liquids and gases are potentially hazardous. Energy stored in these liquids and gases can be released unexpectedly and with extreme force. High pressure systems should be assembled and operated only by personnel who have been instructed in proper safety practices.

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Products described in this manual are manufactured under international patents and one or more of the following U.S. patents: 5,142,483, 5,257,640, 5,331,838, 5,445,035. Other U.S. and international patents pending.

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TABLE OF CONTENTS

TABLE OF CONTENTS I

TABLES III

FIGURES III

ABOUT THIS MANUAL IV

1. INTRODUCTION 1

1.1 PRODUCT OVERVIEW 1

1.2 LOCATION OF THE COMPONENTS 2

1.2.1 FRONT PANEL 2

1.2.2 REAR PANEL 2

1.3 1.3 SUBASSEMBLY DESCRIPTION 2

1.3.1 POWER SUPPLY 2

1.3.2 RELAY BOARD 2

1.3.3 FRONT PANEL ASSEMBLY 3

1.3.4 REAR PANEL ASSEMBLY 3

1.4 SPECIFICATIONS 3

1.4.1 GENERAL SPECIFICATIONS 3

1.4.2 MFC CONTROL FUNCTION SPECIFICATIONS 3

1.4.2.1 MOLBOX1 OR MFC-CB MFC PORT 3

1.4.2.2 MFC PORT 1 (DEVICE 1) 3

1.4.2.3 MFC / MFM PORT 2 - 5 (DEVICE 2 - DEVICE 5) 4

1.4.2.4 MFC SWITCHBOX CONTROL (DIGITAL CONTROL FROM MOLBOX OR MFC-CB) 4

2. INSTALLATION 5

2.1 UNPACKING AND INSPECTION 5

2.2 SITE REQUIREMENTS 5

2.3 INITIAL SETUP 5

2.3.1 POWER CONNECTION 5

2.3.2 CONNECTING THE MFC SWITCHBOX TO A MOLBOX1 5

2.3.3 CONNECTING THE MFC SWITCHBOX TO THE DEVICE TO BE CALIBRATED 5

3. OPERATION 7

3.1 OVERVIEW 7

3.2 GENERAL OPERATION 7

3.3 MFC PROFILES 8

3.4 UNITS OF MEASURE 8

4. REMOTE OPERATION 9

4.1 OVERVIEW 9

5. MAINTENANCE AND ADJUSTMENTS 11

5.1 OVERVIEW 11

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6. TROUBLESHOOTING 13

6.1 SYMPTOMS / CAUSES / SOLUTIONS 13

7. MENU TREE 15

7.1 OVERVIEW 15
7.2 MOLBOX1 OR MFC-CB MFC FUNCTION KEY 15
7.3 MOLBOX1 OR MFC-CB SETUP MENU 15

8. WARRANTY STATEMENT 17

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TABLES

Table 1. Troubleshooting Checklist 13
Table 2. DHI Authorized Service Providers 17

FIGURES

Figure 1. Front Panel 2
Figure 2. Rear Panel 2

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ABOUT THIS MANUAL

Manual Conventions



(CAUTION) is used in throughout the manual to identify user warnings and cautions.



(NOTE) is used throughout the manual to identify operating and applications advice and additional explanations.

[ ] indicates direct function keys (e.g., **[RANGE]**).
< > indicates PG7000 screen displays (e.g., **<1yes>**).

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1. INTRODUCTION

1.1 PRODUCT OVERVIEW

The MFC Switchbox™ can be used to connect a molbox1™ MFC control option or an MFC-CB™ control channel to up to five MFCs, or to one MFC and four MFMs. The rear panel of the MFC Switchbox connects to the molbox1 or MFC-CB via a circular 5-pin connector and a 25-pin DSUB connector. Cables are provided with the switchbox to facilitate these connections. A power cable is also provided. The MFC Switchbox contains its own power supply which allows it to maintain continuous power on all five devices under test (DUTs). The MFC Switchbox provides up to 55 watts of power. This allows it to provide 260 mA per MFC when fully loaded. MFCs typically require a maximum of 200 mA. Therefore, all five ports of the MFC Switchbox can be used simultaneously in most situations. Occasionally, when calibrating older, power hungry MFCs, it may only be feasible to connect four MFCs at a time.

The front panel of the MFC Switchbox has five 25-pin DSUB connectors. These connectors are used to connect the switchbox to the various DUTs.

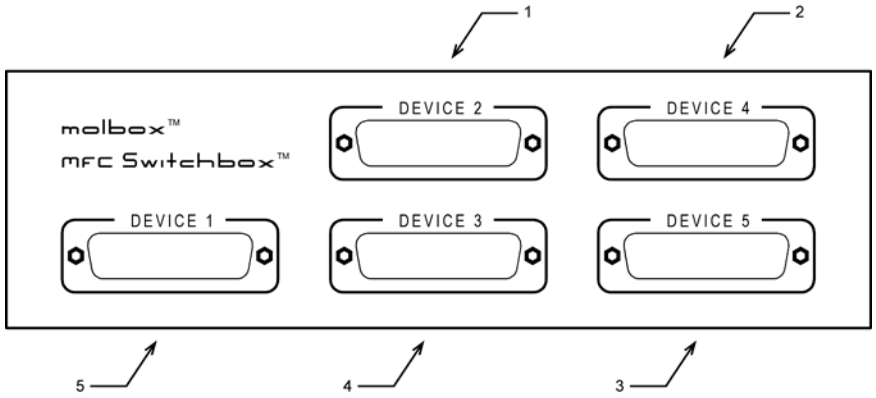


Current controlled MFCs can only be used on channel 1. When testing MFMs, an MFC can be used for controlling the flow in the test while taking the measurement data from the currently selected MFM. This controlling MFC must be a voltage based MFC.

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1.2 LOCATION OF THE COMPONENTS

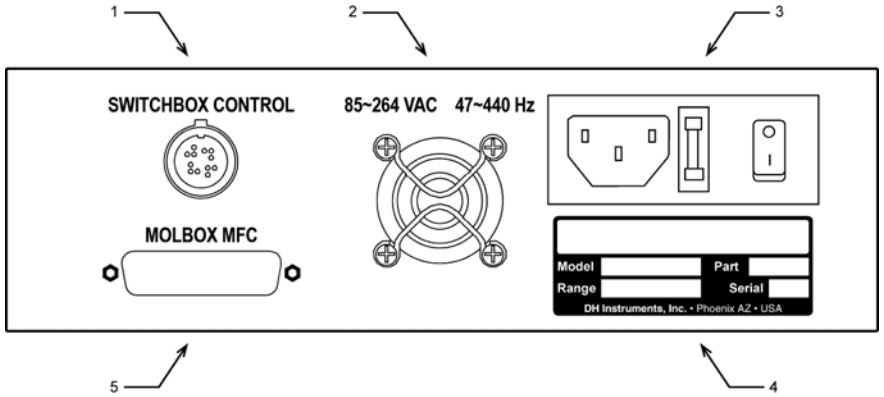
1.2.1 FRONT PANEL



1. Connection point for DUT 2
2. Connection point for DUT 4
3. Connection point for DUT 5
4. Connection point for DUT 3
5. Connection point for DUT 1

Figure 1. Front Panel

1.2.2 REAR PANEL



1. External Drivers Connection
2. Fan
3. Power Entry
4. Product Label
5. Electrical Connection

Figure 2. Rear Panel

1.3 1.3 SUBASSEMBLY DESCRIPTION

1.3.1 POWER SUPPLY

Powers the electronics inside the MFC Switchbox and provides continuous power to up to five connected DUTs. The switching power supply provides +5 volts at 0.5 amps and +15 volts at 4 amps. This 15 volt signal is converted via a DC-to-DC converter to -15 volts at 1.3 amps (leaving approximately 2 amps for the +15 volt signal). The enclosure is cooled by active air circulation using a fan on the rear panel.

1.3.2 RELAY BOARD

Provides the control and signal switching required to connect (one at a time) up to five DUTs to the molbox's single MFC port.

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1.3.3 FRONT PANEL ASSEMBLY

Provides connecting ports for up to five DUTs.

1.3.4 REAR PANEL ASSEMBLY

Supports power, signal communication with molbox1 or MFC-CB, control communication with molbox1 or MFC-CB and carries the cooling fan.

1.4 SPECIFICATIONS

1.4.1 GENERAL SPECIFICATIONS

Power Requirements	85 to 264 VAC, 50/60 Hz, 55 VA maximum consumption
Weight	1.5 kg (3.25 lb)
Dimensions	22.5 cm W x 7.5 cm H x 20.0 D (8.85 in. x 2.95 in. x 7.87 in.)

1.4.2 MFC CONTROL FUNCTION SPECIFICATIONS

The MFC Switchbox works with any MFC that can be used with the molbox1 or MFC-CB. The switchbox provides the MFCs with continuous power, but the molbox1 or MFC-CB still provides all the control and measurement. For detailed specifications regarding MFC control please refer to specifications section of the molbox1 or MFC-CB Operation and Maintenance Manual.



Current based MFCs can only be used when connected to device 1 of the MFC Switchbox. It is not possible to switch between multiple current based MFCs.



The Valve Test Point signal is only available on device 1 of the MFC Switchbox.

1.4.2.1 MOLBOX1 OR MFC-CB MFC PORT

Connector One 25 Pin Female DSUB Metal Case Socket (Back Panel)

Signals (16)

+15 VDC	Setpoint Sense Common
-15 VDC	Valve Test
Power Supply Common	Valve Test Common
Setpoint Voltage (0 to 5 VDC)	Setpoint Current (4 to 20 mA Output)
Setpoint Common	MFC Measure (4 to 20 mA Input)
MFC Measure (0 to 5 VDC)	Case Ground (Earth Ground)
MFC Measure Common	RS485 TXRX+
Setpoint Sense (0 to 5 VDC)	RS485 TXRX-

1.4.2.2 MFC PORT 1 (DEVICE 1)

Connector One 25 Pin Female DSUB Metal Case Socket (Front Panel Device 1)

Signals (16)

+15 VDC	Setpoint Sense Common
-15 VDC	Valve Test
Power Supply Common	Valve Test Common
Setpoint Voltage (0 to 5 VDC)	Setpoint Current (4 to 20 mA Output)
Setpoint Common	MFC Measure (4 to 20 mA Input)
MFC Measure (0 to 5 VDC)	Case Ground (Earth Ground)
MFC Measure Common	RS485 TXRX+

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Setpoint Sense (0 to 5 VDC)	RS485 TXRX-

1.4.2.3 MFC / MFM PORT 2 - 5 (DEVICE 2 - DEVICE 5)

Connector Four 25 Pin Female DSUB Metal Case Socket (Front Panel)

Signals (16)

+15 VDC	Setpoint Sense Common
-15 VDC	MFC Measure (0 to 5 VDC)
Power Supply Common	MFC Measure Common
Setpoint Voltage (0 to 5 VDC)	Setpoint Sense (0 to 5 VDC)
Setpoint Common	Case Ground (Earth Ground)

1.4.2.4 MFC SWITCHBOX CONTROL (DIGITAL CONTROL FROM MOLBOX OR MFC-CB)

Connector One 5 Pin Female Socket (Back Panel)

Signals

Clock for Shift Register	Load Latch for Shift Register
Data Line for Shift Register	Ground

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2. INSTALLATION

2.1 UNPACKING AND INSPECTION

The MFC Switchbox is delivered in a corrugated box with foam end caps positioning it. It is enclosed in a heavy plastic bag. The accessories are in a separate plastic bag in the corrugated box. Remove the MFC Switchbox and accessories from the box. Retain the box and end caps for reuse. Remove the MFC Switchbox from its plastic bag. The MFC Switchbox is delivered with caps over the communications ports.

Check that all accessories are present. Accessories include:

- User's Manual
- Power Cord
- MFC Switchbox control cable
- molbox1/MFC-CB to MFC Switchbox MFC signal cable

2.2 SITE REQUIREMENTS

The MFC Switchbox can be placed on any flat, stable surface at a convenient height. It may be placed on top of or behind the molbox1 or MFC-CB without any risk of signal degradation.

2.3 INITIAL SETUP

2.3.1 POWER CONNECTION

Connect the MFC Switchbox to a power source using the power cable supplied. Power requirements are 85 to 264 VAC, 47 to 440 Hz, 55 VA maximum consumption.

2.3.2 CONNECTING THE MFC SWITCHBOX TO A MOLBOX1

Connect the MFC Switchbox to a molbox1 or MFC-CB using the two cables provided in the accessory kit with this manual. Use the 25-pin male DSUB to 25-pin male DSUB cable to connect the molbox MFC port on the MFC Switchbox to the MFC port on the molbox1. If using the MFC Switchbox with an MFC-CB, connect to the desired MFC-CB channel (Device1 or Device2). Use the 5-pin male circular to 5-pin male circular cable to connect the SWITCHBOX CONTROL port on the MFC Switchbox to the MFC SWITCHBOX port on the molbox1 or MFC-CB.

2.3.3 CONNECTING THE MFC SWITCHBOX TO THE DEVICE TO BE CALIBRATED

Connect the MFC Switchbox to up to five DUTs using the appropriate MFC or MFM cables for the associated DUTs.



The MFC connected to Device 1 is used as the controller in MFM tests. Also Device 1 must be used for current based MFCs or when using the valve test point signal on an MFC.

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3. OPERATION

3.1 OVERVIEW

The MFC Switchbox in and of itself does not require any special setup or configuration. It just needs to be connected to the molbox1 or MFC-CB and DUTs as described above, plugged in and powered on by actuating the power switch on the MFC Switchbox rear panel.

3.2 GENERAL OPERATION

Before using the MFC Switchbox the MFC profiles for the connected DUTs must be defined in the molbox1 or MFC-CB. This is accomplished using the setup function to define the MFC profile. For details on the MFC profile definition, see the molbox1 or MFC-CB Operation and Maintenance Manual. In order to support MFM calibrations using the MFC Switchbox the device type is specified to the MFC profile. After entering the MFC range, you will be prompted to enter the device type. The device type for any voltage based profile can be either 'measure' or 'control'. If the profile indicates measure, then channel one will be used for control whenever the channel is selected that is associated with this profile. If the profile indicates control, then the selected channel will be used for both measurement and control.



When calibrating MFMs, the range of the MFC setup for channel 1 must be wide enough to cover the range of all the MFMs being calibrated on the other channels.

For details on configuring the MFC channels and profiles see the molbox1 or MFC-CB Operation and Maintenance Manual. Once the MFC channels have been configured using the setup menu, the MFC channel can be selected by pressing the MFC function key on the molbox1 or MFC-CB front panel.

When the MFC function key is first pressed the screen prompts the operator to select the MFC channel (**<0>** disables).

```
Select MFC Channel
(0 disables) : 0
```

The MFC Switchbox must be connected to the molbox1 or MFC-CB at the time of this selection, but does not have to be connected during the MFC setup described above. Entering **<1>**, **<2>**, **<3>**, **<4>** or **<5>** selects the corresponding channel on the MFC Switchbox and enables the MFC function. When not using the MFC Switchbox, select Channel #1 when activating the MFC function.

The operator is then prompted to select the MFC profile. The profile number that is associated with the selected channel is automatically displayed. This screen allows the operator to override the profile selection made during setup.

```
Select MFC Profile
(0 disables) : 0
```

The number refers to the profile number. When the profile number desired is entered a summary of the profile is displayed. When **[ENTER]** is pressed again, the display returns to the main run screen and the MFC function is active using the MFC profile selected. The MFC Switchbox must be connected to the molbox1 prior to pressing **[ENTER]** or the message that actually triggers the switching inside the MFC Switchbox will be missed. With molbox1, the text **<MFCn>** or **<MFMn>** (where n is the channel number and the type depends on the channel configuration) will be displayed in the bottom right hand corner of the main run screen. With MFC-CB, the text **<Dn,c>** (where n is the number of the active MFC-CB channel and c is the number of the active MFC Switchbox channel.

When the MFC function is active, pressing **[ENTER]** from the main run screen or an MFC run screen allows entry and execution of the MFC setpoint command.

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When the selected channel is associated with a 'measure' profile type, the control signal is sent to the device on channel 1. This setpoint must be set in voltage and will set flows according to the range specified in the profile for the device connected to channel 1. The measurements will be taken from the selected channel using the profile associated with the selected channel to define the flow value.

If the profile for channel 1 indicates a current based MFC, then attempting to select a channel with a 'measure' profile type will result in the error message <Voltage mode needed on channel 1 control>.

Pressing the [ð] arrow key any time the MFC control function is active causes an instant display of the current MFC profile summary allowing a quick check of the characteristics of the currently active MFC profile. Pressing [ESCAPE] returns from MFC profile screen to the last run screen.

3.3 MFC PROFILES

MFC profiles are used by molbox1 or MFC-CB to configure the MFC function. MFC profiles define the analog signal range of the MFC or MFM and the relationship between the analog signal range and the flow range of the MFC or MFM. This information allows molbox1 or MFC-CB to operate with the correct signal for the selected MFC and to convert the MFC or MFM analog signals to the corresponding flow or % FS values, when desired.

MFC profiles are set up using **[SETUP]**, **<1MFC>**. MFC profiles are stored by molbox1 and MFC-CB under profile numbers. This is the same number that will be used to select the MFC profile when the MFC function is activated using the MFC function key. Up to 26 MFC profiles can be defined and stored.

MFC profiles are designed to allow the user to set up the profiles of the MFCs that are typically used with so that they can be conveniently recalled from a lookup table when needed.

MFC profiles #1 and #2 are default profiles for working with the MFC function directly in analog units without an MFC flow range or units. Profile #1 is 0 to 5 V, Profile #2 is 4 to 20 mA. When the MFC function is active with Profile #1 or #2 selected, the MFC units of measure will always be V or mA. The UNIT function selects the molbox1 flow measurement unit.

3.4 UNITS OF MEASURE

When using the MFC Switchbox with molbox1

When the MFC function is active, the molbox1 flow units of measure will always be the units of measure specified in the active MFC profile.

When the MFC function is active, the **[UNIT]** function key is for selection of the units of measure for the MFC setpoint and output. The choices available are **<V>** or **<mA>** (depending on the active MFC profile's analog range), % FS or flow. The % FS selection will cause MFC setpoint and output to be displayed in % FS of the MFC which molbox1 will calculate using the definition of analog range and flow range contained in the MFC profile. The **<3flow>** selection will cause MFC setpoint and output to be displayed in the flow units of the MFC using the definition of analog range, flow range and flow units contained in the MFC profile.

When using the MFC Switchbox with MFC-CB

Units of measure are set using **[UNIT]**. If MFC profile #1 or #2 is active, the only units available are V, mA or % FS. If an MFC profile that specifies a flow range (any profile >#2) is selected, the display unit of measure may be a flow unit. See the MFC-CB Operation and Maintenance Manual for additional information.

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4. REMOTE OPERATION

4.1 OVERVIEW

The MFC Switchbox is completely controlled by the molbox1 or MFC-CB to which it is connected. When the molbox1/MFC-CB is properly configured the control of the MFC Switchbox is completely transparent to the user. The MFC Switchbox cannot distinguish a remotely controlled molbox1/MFC-CB from a manually controlled one. For details of remote operation of the molbox1 or MFC-CB see that product's Operation and Maintenance Manual. The following remote commands for those products command pertain directly to the use of the MFC Switchbox:

MFCCH	
Purpose	Read or set the MFC channel and output mode (voltage or current).
Syntax	"MFCCH=*channel, mode*" "MFCCH"
Defaults	"MFCCH=1, v"
Arguments	channel: The optional MFC Switchbox channel. 0 disables the MFC interface. 1 enables the optional MFC interface. 1 to 5 selects the MFC channel to use for optional MFC Switchbox. mode: The MFC mode. 'v' Voltage control and measure mode. The selected channel will be used for voltage setting and measuring. 'mA' Current loop control and measure mode. The selected channel will be used for current loop setting and measuring. ' ' If this argument is not given, then the molbox will use the selected channel to measure the voltage, and will always use channel 1 to set the voltage. This is used to measure voltage MFM's that are connected to channels 2..5 with an MFC controlling on channel 1.
Remarks	The MFC control output can be volts or current. An MFC Switchbox can be connected to the output to switch between multiple devices.
Example	Command: "MFCCH=1, mA" Enables MFC for current Reply: "1, mA" Command: "MFCCH=3, V" Enables MFC on switchbox channel 3 for volts Reply: "3, V" Command: "MFCCH=0" Disables MFC interface (0 is used on molbox1 only) Reply: "0, V"
Errors	ERR# 6: Channel or mode arguments invalid ERR# 23: The MFC option is not installed (molbox1 only) ERR# 23: Channel greater than 1 and MFC Switchbox accessory is not installed
See Also	This command in molbox1 or MFC-CB Operation and Maintenance Manual.

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5. MAINTENANCE AND ADJUSTMENTS

5.1 OVERVIEW

There are no user maintainable parts or systems in the MFC Switchbox.

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6. TROUBLESHOOTING

6.1 SYMPTOMS / CAUSES / SOLUTIONS

Table 1. Troubleshooting Checklist

SYMPTOM	PROBABLE CAUSE	SOLUTION
MFC doesn't appear to be responding when the MFC Switchbox is used.	MFC control cable not connected between the switchbox and the MFC, or it is incorrectly connected.	Check the MFC Cable connections.
MFC doesn't appear to be responding when the MFC Switchbox is used.	The MFC Switchbox is not correctly connected to the molbox1.	Check the connections.
MFC doesn't appear to be responding when the MFC Switchbox is used.	The MFC Switchbox power is not on.	Power on the MFC Switchbox.
MFC connected to molbox1 doesn't appear to be responding.	MFC option not implemented.	Check to see if this option was ordered and installed.
MFC connected to molbox1 doesn't appear to be responding.	MFC control function not active.	Activate MFC control function.
MFC connected to molbox1 or MFC-CB doesn't appear to be responding correctly.	MFC control cable not connected or incorrectly connected.	Check MFC cable connection and MFC cable configuration.
MFC value and/or molbox1 flow values appear incorrect.	MFC profile does not correspond to MFC in use.	Check MFC profile and select correct one.
MFC value and/or molbox1 flow values appear incorrect.	Incorrect or inadvertent use of K factor and/or gas selection.	Check K factor and gas selection and correct if necessary.

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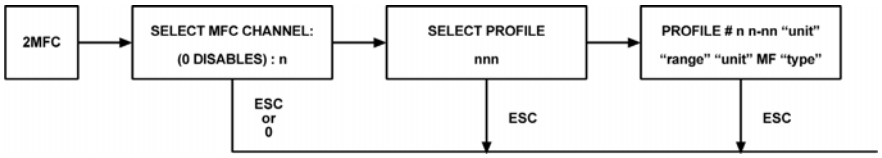
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7. MENU TREE

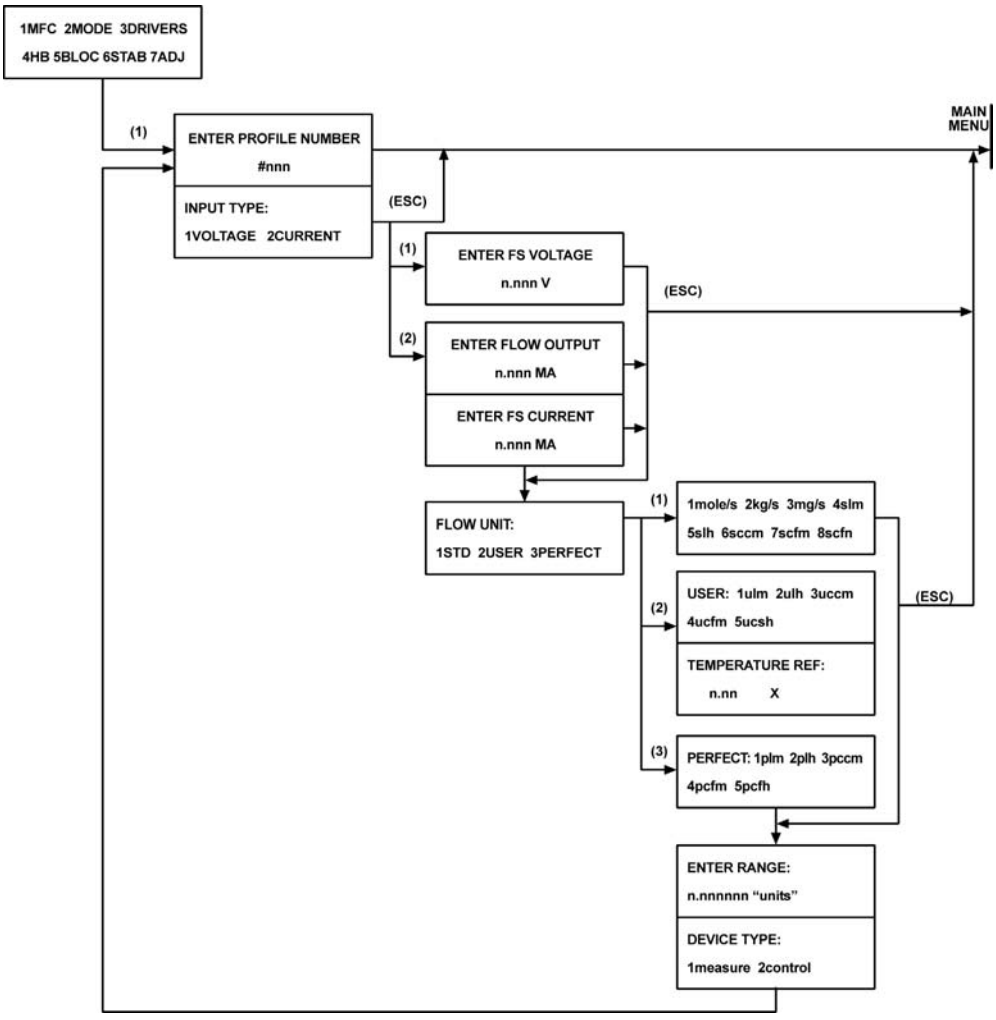
7.1 OVERVIEW

The following is the portion of the molbox1 or MFC-CB internal menu that pertains to use of the MFC Switchbox.

7.2 MOLBOX1 OR MFC-CB MFC FUNCTION KEY



7.3 MOLBOX1 OR MFC-CB SETUP MENU



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8. WARRANTY STATEMENT

Except to the extent limited or otherwise provided herein, **DH Instruments, a Fluke Company** (**DHI**) warrants for one year from purchase, each new product sold by it or one of its authorized distributors, only against defects in workmanship and/or materials under normal service and use. Products which have been changed or altered in any manner from their original design, or which are improperly or defectively installed, serviced or used are not covered by this warranty.

DHI and any of its authorized service providers' obligations with respect to this warranty are limited to the repair or replacement of defective products after their inspection and verification of such defects. All products to be considered for repair or replacement are to be returned to **DHI**, or its authorized service provider, freight prepaid, after receiving authorization from **DHI** or its authorized service provider. The buyer assumes all liability vis-à-vis third parties in respect of its acts or omissions involving use of the products. In no event shall **DHI** be liable to purchaser for any unforeseeable or indirect damage, it being expressly stated that, for the purpose of this warranty, such indirect damage includes, but is not limited to, loss of production, profits, revenue, or goodwill, even if **DHI** has been advised of the possibility thereof, and regardless of whether such products are used individually or as components in other products.

Items returned to **DHI** under warranty claim but determined to not have a defect covered under warranty or to not have a defect at all are subject to an evaluation and shipping charge as well as applicable repair and/or calibration costs.

The provisions of this warranty and limitation may not be modified in any respect except in writing signed by a duly authorized officer of **DHI**.

The above warranty and the obligations and liability of **DHI** and its authorized service providers exclude any other warranties or liabilities of any kind.

Table 2. DHI Authorized Service Providers

DH INSTRUMENTS, A FLUKE COMPANY AUTHORIZED SERVICE PROVIDERS			
COMPANY	**ADDRESS**	**TELEPHONE, FAX & EMAIL**	**NORMAL SUPPORT REGION**
DH Instruments, a Fluke Company	4765 East Beautiful Lane Phoenix AZ 85044-5318 USA	Tel 602.431.9100 Fax 602.431.9559 cal.repair@dhinstruments.com	Worldwide
Minerva Meettechniek B.V.	Chrysantstraat 1 3812 WX Amersfoort the NETHERLANDS	Tel (+31) 33.46.22.000 Fax (+31) 33.46.22.218 info@minervaipm.com	European Union
Nippon CalService, Inc.	2-9-1 Sengen, Tsukuba-Shi Ibaraki Prefecture 305 JAPAN	Tel 0298-55-8778 Fax 0298-55-8700 n-calservice@ohtegiken.co.jp	Japan/Asia
DH Products Technical Service Division	National Institute of Metrology Heat Division Pressure & Vacuum Lab NO. 18, Bei San Huan Donglu Beijing 100013 PR CHINA	Tel 010-64291994 ext 5 Tel 010-64218637 ext 5 Fax 010-64218703 cxcen@mx.cei.gov.cn	Peoples Republic of China

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