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# MSC-1015 Multi Signal Calibrator
# User manual

**(Version 3.0)**

**January 2016**

**This manual should be read carefully**

**before using**

**Multi Signal Calibrator MSC-1015**

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## 2. MSC-1015 In Brief

Multi Signal Calibrator MSC-1015 is an easy to use, battery powered instrument, suitable for simulation of various kinds of sensor and transmitter outputs. Selecting different operating modes is done through a menu system shown on the calibrator's LCD screen. Navigation through the menu and submenu systems is done by push buttons located on the front panel of the instrument. Calibrator is powered from four, internal mounted, rechargeable Ni-MH batteries, charged by external Charger 9V DC supplied with this instrument. Calibrator also has a LEMO® (ODU®) USB 2.0 Connector for setting the calibrator output parameters using PC Software. An interface cable is also supplied.

It is suitable for inspecting/calibrating measurement lines according to the ISO 10816 standards. It is especially designed for inspecting/calibrating Condition Monitoring Systems (CMS) and Vibration Monitoring Systems (VMS) that can be connected to the SCADA/DCS Systems. Technical specifications are given below.

**Inputs / Outputs**

- mV - Sinusoidal AC Voltage Output (Single Ended)
- IEPE - Integrated Electronic Piezoelectric (ICP®) Output
- pC - Charge Output (Single Ended and Differential Output)
- 4-20 mA - DC Current Output (2 Wires Loop Powered)
- TTL - Digital Output for Speed/Flow (TTL Level)
- OSO® - Optical Speed Output
- BOV – Bias Output Voltage Input

| | |
|---|---|
| Frequency Range | 1Hz to 10 kHz, accuracy better then ±0.5% |
| Amplitude | Adjustable, from 10 mV to 10V AC RMS |
| Distortion | ≤1%, from 10Hz to 10kHz, 10mV to 10V |

**Transfer Characteristics**

| | |
|---|---|
| Amplitude Accuracy | ±1% of settings on any range |
| Frequency Stability | ±1% of settings on any range |
| Harmonic Distortion | ≤1% ,from 10Hz to 10kHz |

**Enviromental Characteristics**

| | |
|---|---|
| Temperature | |
| Operating from | -10°C to +65°C |
| Storage from | -18°C to +65°C |
| Humidity | 95% R.H. maximum |

**Power**

| | |
|---|---|
| Battery | 4 x AA rechargable Ni-MH Accus (supplied with calibrator) |
| Autonomy | More than 5 hours when fully charged |

**Physical Characteristics**

| | |
|---|---|
| Dimensions | 208 mm x 100 mm x 40 mm |
| Weight | 0.5 kg typical |
| Case | ABS molded plastic |
| Connection | mV , IEPE, BOV, 4-20mA and TTL – BNC Connectors<br>pC (single ended and differential) – Microdot Connectors<br>USB 2.0 – LEMO® (ODU®) Connector |
| Front Panel Controls | Keyboard with five sealed keys (Up↑, Down ↓, Enter **E**, Back ⮌ and ON/OFF button) |
| Front Panel Display | 64 Characters (4 Lines x 16 Characters) Alphanumeric Dot Matrix LCD with Backlight |

## 3. Map And Legend

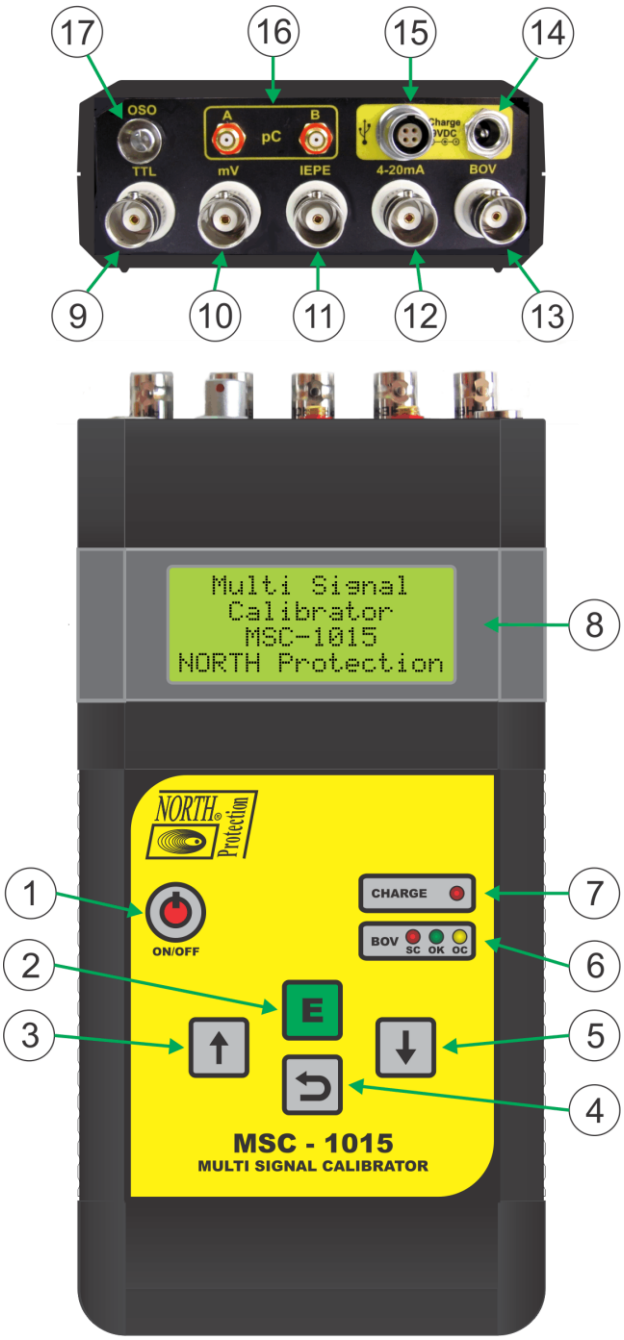



*Figure 1 MSC-1015 Legend*

### LEGEND

1 - Power button, ON/OFF switch

2 - ENTER button, used for entering and confirmation in menu

3 - UP arrow, used for navigation through menu

4 - BACK button, used for exiting menu

5 - DOWN arrow, used for navigation throught menu

6 - BOV test semaphore

7 - Charging LED

8 - LCD display

9 - BNC connector for TTL output

10 - BNC connector for mV output

11 - BNC connector for IEPE output

12 - BNC connector for mA output

13 - BNC connector for BOV testing

14 - Charging connector for external charger

15 - LEMO connector for USB connection

16 - MicroDot connectors for Charge output

17 - OSO optical speed output

## 4. Starting to Use MSC-1015

IMPORTANT NOTICE

Before using Multi Signal Calibrator MSC-1015, delivered NiMH Accu Batteries should be properly inserted in the batteries compartment (*See Figure 2*). *Inserting batteries with incorrect polarity may damage the unit!* Turn MSC-1015 to its backside. Batteries compartment cover is marked by two wide arrows. Carefully slide down the cover in the arrow direction labeled OPEN. Please insert a battery with proper polarity as it is shown at the bottom of the batteries compartment. After inserting the batteries, gently close the batteries compartment with its cover, moving it to the arrow direction labeled CLOSE.

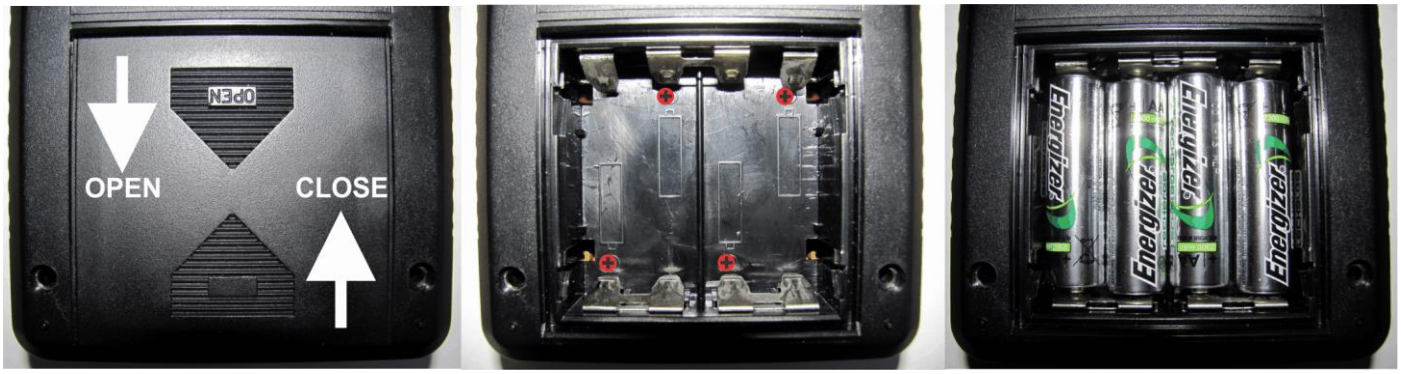



*Figure 2 Inserting NiMH Batteries*

Pressing briefly ON/OFF Push Button located at the top left of the front panel (*Figure 1*) will switch the device ON, whereas pressing the ON/OFF Push Button long will switch the device OFF. After switching the device ON, the next message will appear on LCD (*See Figure 3*):

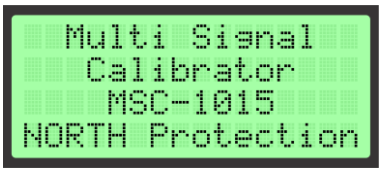



*Figure 3 First Screen*

Selection of the operating modes is done using the keyboard located on the front panel. The keyboard consists of five keys and four LEDs for visual indication of different measuring states. The CHARGE LED is lit when the device is connected to the external Charger of 9V DC.

Four keys in the middle of the keyboard are used for navigating through Menu system and for choosing a desired function of the device. The keys signed with arrows Up (▲) and Down (▼) are used for moving through the menu system, as well as for changing output parameters. ENTER (**E)** is used for confirming the chosen function, for entering/exiting the desired operating mode and for running/stopping the selected function of the instrument.

## 5. Main Menu

The Main Menu consists of ten Items and each of them represents a function for itself. The Items, as it appears in the Main Menu, are as follows: U[mV], Q[pC], IEPE, SPEED, BOV, FLOW, CURRENT, TRANSMITTER, VELOMITOR and SETTINGS. This User Manual describes in details the use of each Operating Mode to produce an adequate output. Navigation through the Menu system is done by keys Up (▲) and Down (▼)**,** whereas choosing of the function is done by pressing Enter (**E**).The back key is signed with sign(⮌).

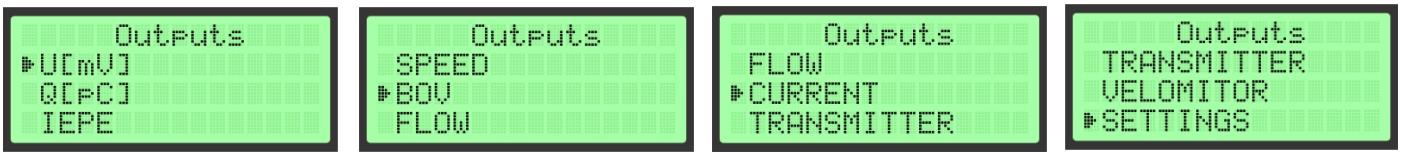



*Figure 4 Main Menu Items*

### 5.1 Menu Item U [mV]

By using this Operating Mode it is possible to set adequate voltage and frequency values for a sinusoidal output signal. After choosing the U[mV] Mode (*See Figure 5*), and before it is possible to set the output voltage and frequency, a message (*See Figure 6*) will appear on the screen warning the user that the mV Output (mV BNC connector) must be used for the desired output (*See Figure 7*).

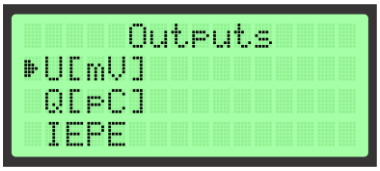



*Figure 5 Mode U[mV]*


*Figure 6 Warning Message*


*Figure 7 mV Output Selection*

After this message, the next sub-menu (*See Figure 8*) will appear on the LCD screen.

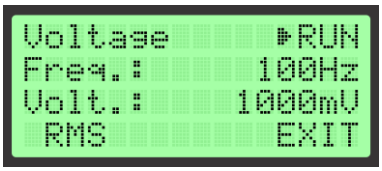



*Figure 8 Submenu Screen*

User can navigate through the offered options by Using Up (▲**)** and Down (▼). These options consist of several functions. If the user sets the cursor in the Frequency position (*See Figure 9*), after Enter pressing (**E**), Up-Down arrow will appear signaling the device has entered the mode for changing frequency value. By using Up (▲**)** and Down (▼) the user can increase or decrease the desired frequency value. Pressing long Up (▲**)** or Down (▼) will automatically increase or decrease frequency value. When the user sets an appropriate value for frequency, pressing Enter (**E**) will confirm it and return to Menu.

If the user sets the cursor to Voltage, after pressing Enter (**E**), Up-Down arrow will signal the device has entered the mode for changing Voltage value output (*See Figure 10*). Using Up (**▲**) and Down (**▼**) the user can increase and decrease voltage value. Pressing these keys long will automatically increase or decrease this value.

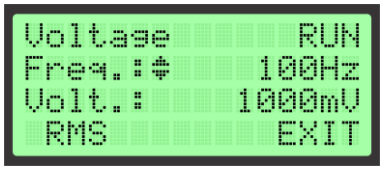



*Figure 9 Changing Frequency*

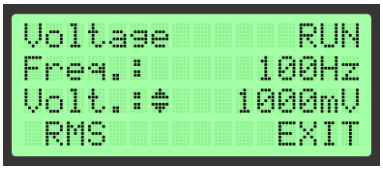



*Figure 10 Changing Voltage*

When the user sets an appropriate value for voltage, pressing Enter (**E**) will confirm it and return to the previous Menu.

By pressing Back (⮌) the user will also return to the previous Menu. By setting the cursor on the position RMS and by pressing Enter (**E)** the user can change the desired signal generating mode. User can change the mode depending on how the output voltage is to be displayed: RMS (Root Mean Square) value (*See Figure 11*), 0-P (Zero to Peak) value (*See Figure 12*) or P-P (Peak to Peak) value (*See Figure 13*).

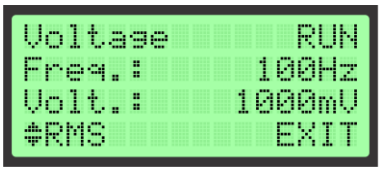



*Figure 11 Output as RMS Value*

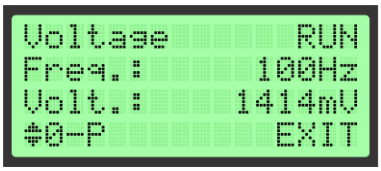



*Figure 12 Output as 0-P Value*

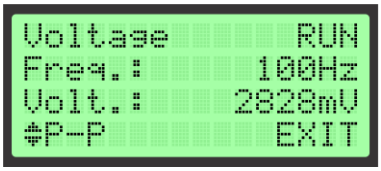



*Figure 13 Output as P-P Value*

By setting the cursor on **EXIT** and by pressing Enter (**E)** the user will return to the Main Menu**.** The same will happen by pressing Escape (⮌) at any position in this Menu.

If the user sets the cursor on **RUN** and presses Enter (**E)**, an adjusted sinusoidal voltage and frequency will appear on the mV output. The indication that the device is in **RUN** mode and that the output is generated is represented by a **STOP** sign (■) instead of **RUN** sign (▶). By pressing Enter (**E)** again, the calibrator stops generating the output voltage and the cursor switches back to **RUN** (▶). This can be also done by pressing Back (⮌) at any cursor position. The view of the screen while generating voltage on its output is given below (*See Figure 14*).

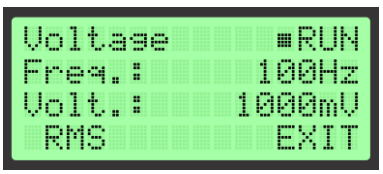



*Figure 14 Calibrator in RUN Mode*

Application Notes: Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.1, on Page 34

## 5.2 Menu Item Q [pC]

Generating Charge Output (pC) is suitable for vibration sensors simulation, giving charge as its output. When selecting this operating mode (*See Figure 15*), a message will appear on the LCD (*See Figure 16*) warning user to use an output(s) signed with **pC** (Microdot Connectors A,B) for the desired output. (*See Figure 17*).

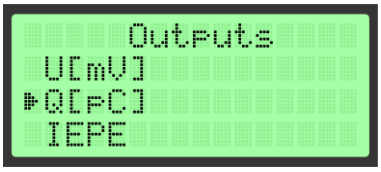



*Figure 15 Mode Q[pC]*


*Figure 16 Warning Message*


*Figure 17 pC Output Selection*

After this warning message, a sub-menu will appear on the screen (*See Figure 18*), allowing the user to change frequency and sensor sensitivity parameters. User can adjust the desired frequency value in the range from 1Hz to 1kHz (*See Figure 19*). For sensitivity value user can only choose between 50pC/g and 100pC/g (*See Figure 20*).

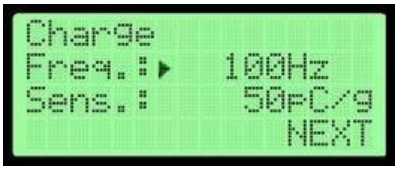



*Figure 18 Submenu Screen*

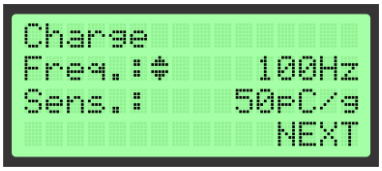



*Figure 19 Changing Frequency*

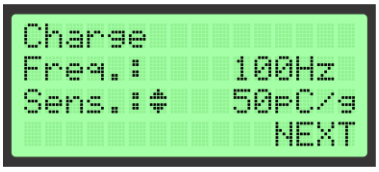



*Figure 20 Changing Sensitivity*

Up (🡅) and Down (🡇) keys are used for navigating through the menu system. By pressing Enter (**E),** the mode for changing values is entered. Instead of the Cursor sign (▶), the bolded Up-Down arrows appear on the screen, indicating that the selected values can be changed. In order to change values, please press Up (🡅) or Down (🡇). By pressing Enter (**E)**, the value the user has set is saved and the program returns to the previous menu. This can also be done by pressing Escape (⮌). The cursor shape then returns to its previous shape (▶), indicating the value is saved successfully. If the user moves the cursor to indicate NEXT Item and presses Enter (**E),** this will open the sub-menu for selecting a parameter which the user wants to simulate. By pressing Back (⮌) the user will return to the Main Menu.

This operating mode of MSC-1015 enables the device to simulate one of three vibration parameters – Velocity, Acceleration or Displacement. Using Up (🡅) and Down (🡇) and confirming by Enter (**E),** user can select which of these parameters he or she wants to simulate (*See Figure 21*).


*Figure 21 Selecting Parameter for Simulation*

If adjusted values exceed the range of the selected parameter, the following Error messages will appear on LCD, depending on the selected function (Displacement – *See Figure 22* or Velocity – *Figure 23*). Software will take a step back in order to enable the user to change frequency and sensitivity.

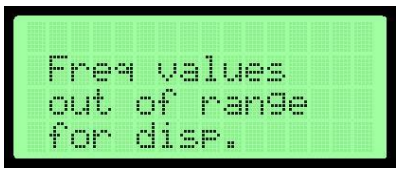



*Figure 22 Displacement Error*

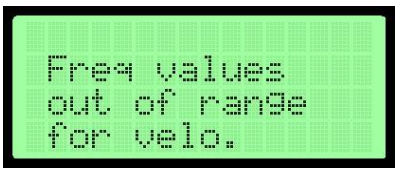



*Figure 23 Velocity Error*

If the values which the user has previously set fit into the range the calibrator can generate, one of the screens will appear depending on the user's previous choice, as it is shown below (Velocity – *See Figure 24*, Displacement – *Figure 25* and Acceleration – *Figure 26*). Each of them enables the user to set the final output value.

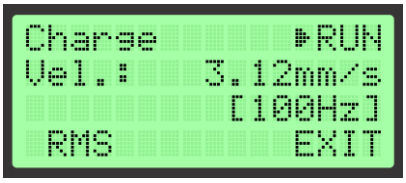



*Figure 24 Choice of Velocity*

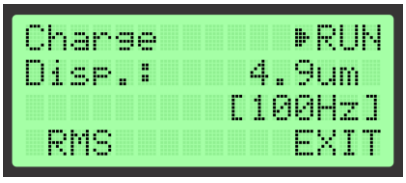



*Figure 25 Choice of Displacement*

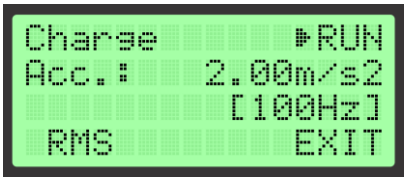



*Figure 26 Choice of Acceleration*

By using the keys Up (**▲),** Down (▼), Enter (**E**) and Back (⮌) the user can navigate through the offered options and change the output value for Vibration Velocity, Displacement or Acceleration in a similar way it has already been described. The output value can be displayed as RMS, P-P (Peak to Peak) or 0-P (Zero to Peak) value for Displacement, while for Velocity and Acceleration it can be displayed as RMS value or 0-P (Zero to Peak) value.

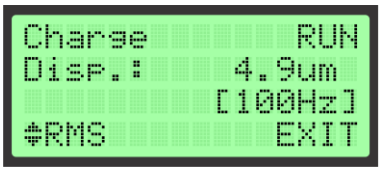



*Figure 27 Output as RMS Value*

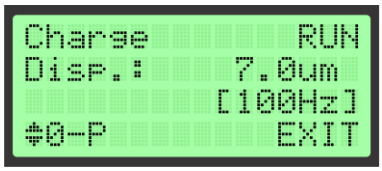



*Figure 28 Output as 0-P Value*

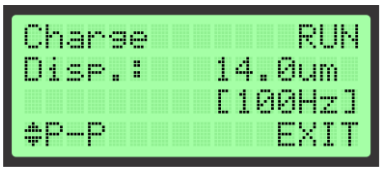
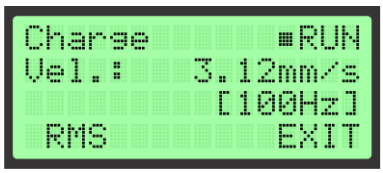
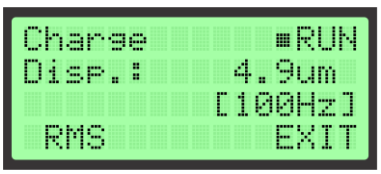



*Figure 29 Output as P-P Value*

When the user selects RUN from the Menu, by pressing Enter (**E**) the calibrator will start generating the output signal according to the adjusted parameters (*See Figure 30*). For Vibration Velocity, the output value is given in **mm/s** for Metric Units mode, ie. in **in/s** for Imperial Units mode (*See Chapter 5.10, Menu Item SETTINGS*). For Vibration Displacement, the output is given in **µm** for Metric Units mode, while in Imperial Units mode **mils** unit is used. For Vibration Acceleration, in Metric Units mode **m/s$^2$** unit will be used, while in Imperial Units mode **g** units will be used. On LCD there is also information in square brackets about the selected Frequency in the previous step.



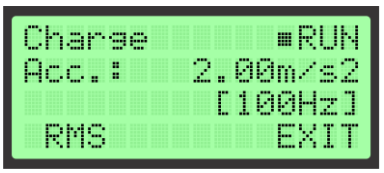




*Figure 30 Calibrator in RUN mode*

When the calibrator is started, the cursor will be changed from Run sign (▶) to Stop sign (■). By pressing Enter (**E)** again, generating of signal will be stopped and the cursor will regain its previous shape, Run sign (▶). Generating can be also stopped by pressing Back key (⮌). With this the mode for changing Velocity, Acceleration or Displacement parameters will be entered again, depending which type of measurement was previously selected, as it has been described before.

Application Notes: how to use this MSC-1015 function can be found in Chapter 10 - Item 10.2, on Page 34

## 5.3 IEPE Menu Item

This operating mode is suitable for simulation of different kinds of sensors which are powered by IEPE (ICP®) Power Supply (DC Constant Current Source 2...20mA, DC Voltage 18...30V). As a result, for using this output, IEPE power supply needs to be used. In this operating mode it is possible to set displacement, velocity or acceleration parameter. After starting the calibrator, this parameter will be converted to the sinusoidal AC output voltage, whose scale is based on the given values (displacement, velocity or acceleration), frequency and the sensor sensitivity in mV/g units. After selecting IEPE Menu Item and before the possibility to set any of the stated parameters (*See Figure 31*), a warning message will appear on LCD (*See Figures 32*) warning the user to use the IEPE output (*See Figures 33*).

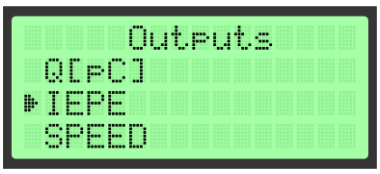



*Figure 31 Mode IEPE*


*Figure 32 Warning Message*


*Figure 33 IEPE Output Selection*

After choosing IEPE mode (*See Figure 34*), the next step is to set the desired frequency (*See Figure 35*) at which voltage which is proportional to displacement, velocity or acceleration value will be generated. Sensor Sensitivity Parameter can also be set to the next values: 50mV/g, 100mV/g, 500mV/g or 1000mV/g (*See Figure 36*).

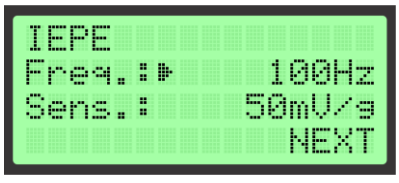



*Figure 34 Submenu Screen*

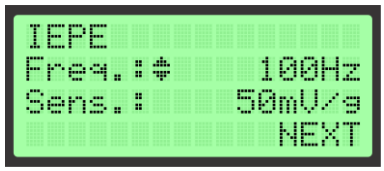



*Figure 35 Changing Frequency*

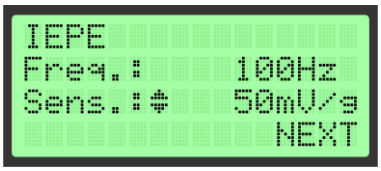



*Figure 36 Changing Sensitivity*

Navigation through submenus is done by Up (**🡅**) and Down (🡇) keys. By pressing Enter (**E**), the user selects values which he or she would like to change and the cursor shape is changed to bold Up-Down arrows, signaling that one has successfully entered into the mode for changing parameters. The selected parameters are changed by Up (**🡅**) and Down (🡇) keys. By pressing Enter (**E**), the user confirms the choice of the new value for the selected parameter and returns to the previous menu selection. This can also be done by pressing Back key (⮌).

After setting the cursor to point to the NEXT Item and by pressing Enter (**E**), the user enters the submenu system for selecting a parameter for simulation (See *Figure 37*). The user can select the following: Velocity, Displacement or Acceleration. By pressing Back key (⮌ ) one will return to the Main Menu.

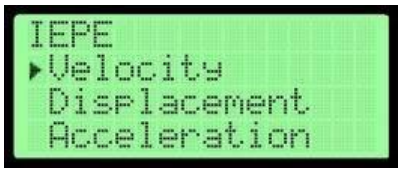



*Figure 37 Parameter selecting for simulation*

Using Up (**🡅**) and Down (**🡇**) keys, the user navigates through menu. By pressing Enter (**E**) will select the desired function.

If the adjusted frequency and sensitivity values for the selected function deviate from minimal or maximal output voltage value, an Error message will appear on LCD (*See Figures 38* and *39*).

If an Error has occurred, software returns to the option for setting frequency and sensitivity parameters again. This kind of Error may only occur if the selected function is Displacement or Velocity.

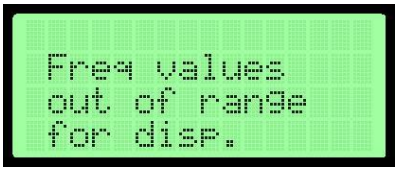



*Figure 38 Displacement Error*

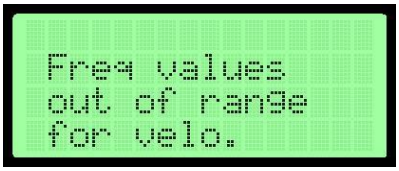



*Figure 39 Velocity Error*

If the adjusted values are adequate for the selected operating mode, the user can set the desired output values for Displacement, Velocity or Acceleration. The Displacement output value can be displayed as RMS value (*See Figure 40*), 0-P (Zero to Peak) Value (*See Figure 41*) or P-P (Peak to Peak) value (*See Figure 42*), while the Velocity and Acceleration output values can be displayed as RMS or 0-P (Zero to Peak) value.

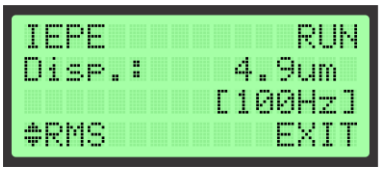



*Figure 40 Output as RMS Value*

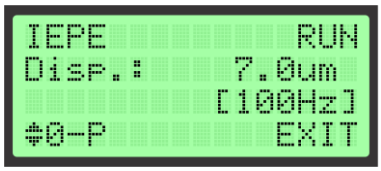



*Figure 41 Output as 0-P Value*

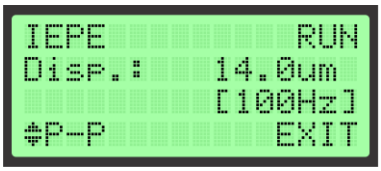



*Figure 42 Output as P-P Value*

Depending on the selected mode, one of the following screens will appear (*See Figures from 43 to 45*).

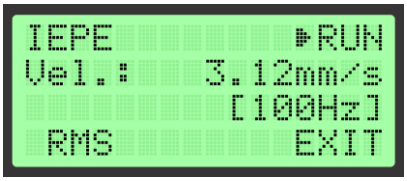



*Figure 43 Choice of Velocity*

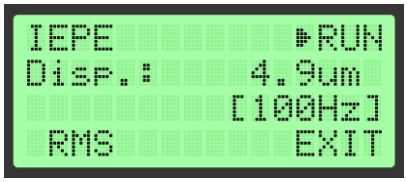



*Figure 44 Choice of Displacement*

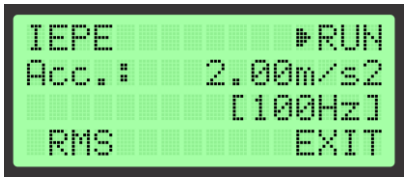



*Figure 45 Choice of Acceleration*

If the user selects Displacement function, the parameter can be changed into **µm** for Metrical Units, whereas in case of Imperial Units it can be changed into **mils**. Parameter for Velocity is given in **mm/s** in case Metrical Units System is set, whereas the **in/s** is used in case of Imperial Units System. For Acceleration, **m/s$^2$** is used as a Metrical unit, and **g** as an Imperial unit. Instructions how to change units in which the simulated parameter will be expressed is given in Chapter X.X

Each of these functions has several possibilities. If the user sets the cursor to point to **RUN** Item and presses Enter (**E),** this will start the simulation which is directly proportional to the given parameter for Displacement, Acceleration or Velocity (*See Figure 46*). While generating the output signal, the cursor shape will change into a Stop sign (■), informing the user the Simulator is active and the AC voltage is present on the selected Output connector.

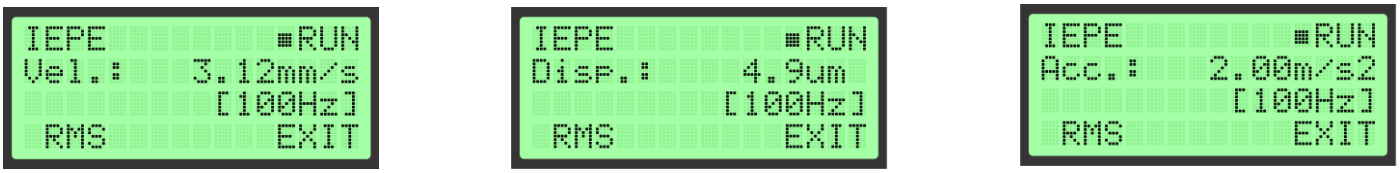



*Figure 46 Calibrator in RUN mode*

If any of these operating modes is activated, the cursor will change into Stop sign (■). By pressing again Enter (**E**), generating of the output signal will be stopped and the cursor will return to its previous shape (▶). User can also stop the signal generating by pressing Back key (⮌). When the cursor is set to point on the desired parameter and Enter (**E**) is pressed, this will activate the mode for changing parameters for Velocity, Acceleration or Displacement function, depending on which simulation mode is selected. Output parameters can be changed by using Up (**🡅**) and Down (**🡇**) keys. When the desired parameter is adjusted, by pressing Enter (**E)** one returns to the previous menu and the adjusted value becomes valid.

Application Notes: more details on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.3, on Page 35

## 5.4 Menu Item SPEED

Digital speed output is suitable for simulating speed sensors or transmitters which on its outputs generate a wave of rectangular pulses depending on the measured RPM value. The voltage level on this output is at the TTL level (+5V DC Pulse, 0V Pause) with the Duty Cycle of 50%. The **OSO**® output (**O**ptical **S**peed **O**utput) represents small Stroboscope which generates the adjusted RPM by flashing the OSO LED. In both cases the range is from 10 RPM to 60,000 RPM, resolution of 1 RPM.

When this function is selected (*See Figure 47*), a warning message appears on the LCD (*See Figure 48*) informing the user to use the TTL Output (*See Figure 49*).

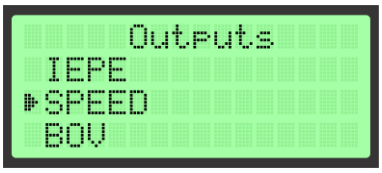



*Figure 47 SPEED Mode*

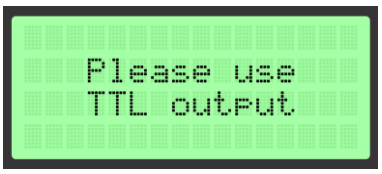



*Figure 48 Warning Message*


*Figure 49.TTL Output Selection*

After this message, the next submenu (*See Figure 50*) will appear on the LCD screen.

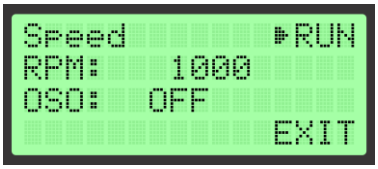



*Figure 50 Submenu Screen*

User can change the value for revolution per minute (RPM) (*See Figure 51*), as well as set the OSO® optical output ON or OFF (*See Figure 52*).

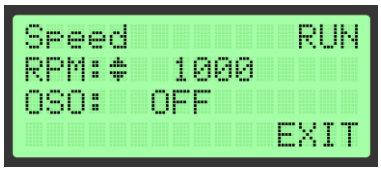



*Figure 51 Changing the RPM Value*

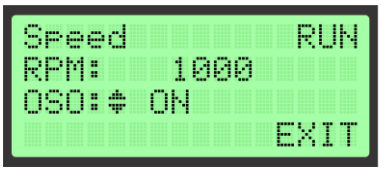



*Figure 52 Changing the OSO Status*

Using Up (**▲**) and Down (**▼**) keys, the user can navigate through this submenu. Pointing to the menu item and pressing Enter (**E**) will select the parameter which the user wants to change. Bringing the cursor to point to RUN and pressing Enter (**E**) will start generating the output signal based on the adjusted values.

If OSO® Output is ON, generating of light pulses will start together with generating the TTL Output. As in other operating modes, the Stop sign (■) near RUN menu item, indicates that the system is active and is generating square wave signal on the TTL Output, as well as OSO® Output if it is selected (*See Figure 53*).


*Figure 53 Calibrator in the RUN Mode with OSO® Output Enabled*

Pressing Enter (**E**) again will stop generating the TTL Output (and OSO® Output, if it was selected) and will return the device to the mode for changing parameters, which can be done again by using Up (**▲**), Down (**▼**) and Enter (**E**) keys.

| Application Notes: Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.4, on Page 36 |
|---|

## 5.5 Menu Item BOV

The purpose of this function is to determine fast the functionality status of the IEPE (ICP®) Sensor and its cabling by measuring the sensors BOV (**B**ias **O**utput **V**oltage) voltage. To perform this test, it is necessary to power the sensor under test by the IEPE Power Supply which is installed into MSC-1015 (24V DC at constant Current of 3mA). Performing the BOV test presents a fast way for identifying several types of malfunction of the IEPE (ICP®) Sensors. Depending on the measured BOV voltage, the user can determine the functionality state of the tested Sensor. There is also a visual indication of the satus of the Sensor under test (*See Figure 54*).


*Figure 54 Visual Indication of BOV Status*

After selecting the BOV function(*See Figure 55*), the warning message will appear on LCD (*See Figure 56*), informing the user to use the BOV labeled output (*See Figure 57*).

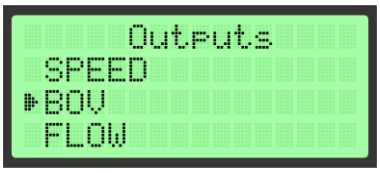



*Figure 55 Mode BOV*


*Figure 56 Warning Message*


*Figure 57 BOV Output Selection*

After this warning message, the next submenu will appear on the LCD (*See Figure 58*):

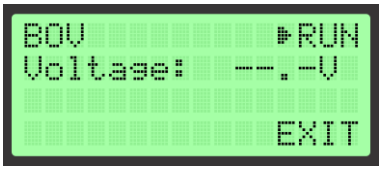



*Figure 58 Submenu Screen*

The user can navigate through this submenu by using Up (**▲**) and Down (**▼**). Pointing to the menu item and pressing Enter (**E**) the parameter the user wants to change will be selected. By bringing the cursor to point to the RUN Item and by pressing Enter (**E**) will start measuring BOV voltage of the connected IEPE Sensor and the Cursor shape will change from the Run sign (▶) to the Stop sign (■). After the measurement, which takes about 2 seconds, the Cursor will return to its previous shape (▶).

After the BOV Test is completed, the test results are displayed on LCD and are also indicated on BOV Test LEDs. Regarding the measured BOV voltage value, there are only three possible states of the tested IEPE sensor and its cabling: SHORT CIRCUIT, NORMAL and OPEN CIRCUIT.

If the measured BOV is below 7V DC, IEPE sensor (or cabling) is damaged (SHORT CIRCUIT).
(*See Figure 59)*


*Figure 59 BOV Test - SHORT CIRCUIT*

If the measured BOV is between 7V DC and 15V DC, the IEPE sensor (and cabling) is good (NORMAL).
(*See Figure 60)*


*Figure 60 BOV Test - NORMAL*

If the measured BOV is higher than 15V DC, the IEPE sensor (or cabling) is also damaged, or there is no IEPE sensor connected, or the IEPE sensor cabling is broken (OPEN CIRCUIT). (*See Figure 61)*


*Figure 61 BOV Test - OPEN CIRCUIT*

Setting the cursor to point to EXIT and pressing Enter **(E)** will return the user from this submenu to the Main menu. User can also do this by Back pressing (⮌).

| Application Notes Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.5, on Page 37 |
|---|

## 5.6 Menu Item FLOW

This MSC-1015 operating mode is suitable for simulating Flow Sensors and Flow Transmitters which on their outputs generate a wave of rectangular pulses depending on the measured Flow rate. Voltage level on this output is at the TTL level (+5V DC Pulse, 0V Pause) with the Duty Cycle of 50%.

When this mode is selected (*See Figure 62*), a warning message appears on LCD (*See Figure 63*) informing the user to use the TTL Output (*See Figure 64*).

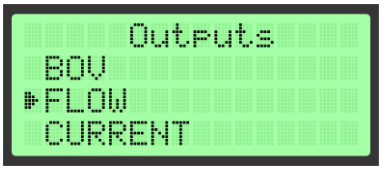



*Figure 62 Mode FLOW*


*Figure 63 Warning Message*


*Figure 64 TTL Output Selection*

After the warning message, the next submenu will appear on the LCD (*See Figure 65*):

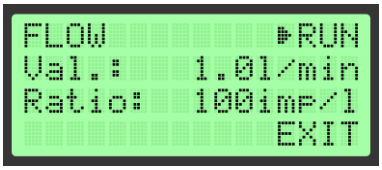



*Figure 65 Submenu Screen*

The user can navigate through this submenu by using Up (🡅) and Down (🡇). By pointing to the submenu item and by pressing Enter **(E)** the following parameter can be selected: Flow Rate value (*See Figure 66*) or Flow Ratio (*See Figure 67*).

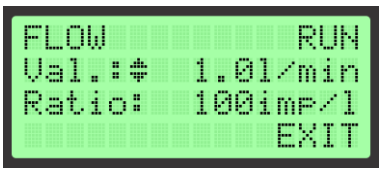



*Figure 66 Changing Flow Rate Value*

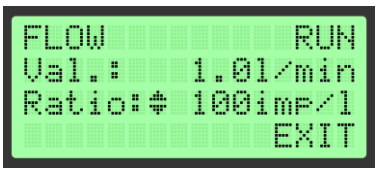



*Figure 67 Changing Flow Ratio*

For Metric Units Mode, Flow Rate Value is given in **l/min** (liters per minute), while Flow Ratio is given in **imp/l** (impulses per liter). For Imperial Units Mode, Flow Rate Value is given in **g/min** (gallons per minute) while Flow Ratio is given in **imp/g** (impulses per gallon) (*See Chapter 5.10, Menu Item SETTINGS*).

By bringing the cursor to point to the RUN Item and by pressing Enter (**E)** the simulation of Flow Sensor or Flow Transmitter based on the adjusted parameters will be started and the Cursor shape will change from the Run (▶) to the Stop sign (■). (*See Figure 68*)

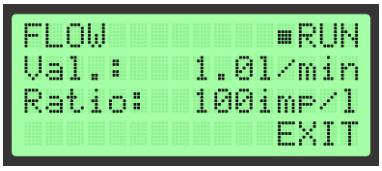



*Figure 68 Calibrator in RUN Mode*

By pressing Enter (**E**) again, the user will stop the simulation. By setting the cursor to point to the EXIT Item and by pressing Enter (**E)** the user will return from this submenu to the Main menu. This can also be done by pressing Back (⮌).

| Application Notes Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.6, on Page 38 |
|---|

## 5.7 CURRENT Menu Item

This MSC-1015 operating mode enables the user to generate the calibrated DC Current on its current output. The calibrated DC Current ranges from 4mA to 20mA. The current source inside the calibrator is Loop Powered, meaning that the external DC Power Supply is needed for proper operation, nominally voltage from 12V to 30V DC.

When this mode is selected (*See Figure 69*), a warning message appears on LCD (*See Figure 70*) informing the user to use the 4-20mA Output (*See Figure 71*).

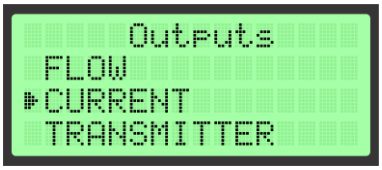



*Figure 69 Mode CURRENT*


*Figure 70 Warning Message*


*Figure 71 4-20mA Output Selection*

After the warning message, the next submenu will appear on LCD (*See Figure 72*):

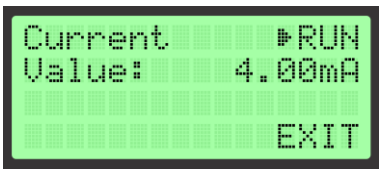



*Figure 72 Submenu Screen*

Using Up (**▲**) and Down (**▼**) user can navigate through this submenu. By pointing to the submenu item and pressing Enter (**E**) the user will select the parameter which he/she would like to change. Inside this submenu, user can adjust the calibrated DC current value (*See Figure 73*) and start or stop the calibrator. (*See Figure 74*)

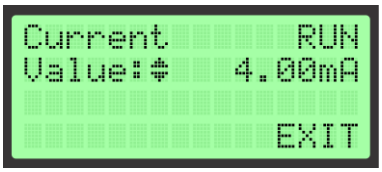



*Figure 73 Changing the Output Current Value*

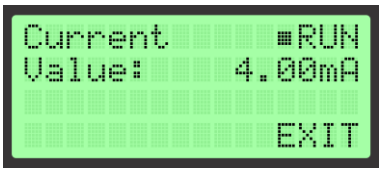



*Figure 74 Calibrator in RUN Mode*

By setting the cursor to point to RUN submenu item and by pressing Enter (**E**) the user will set off generation of calibrated output current. The cursor shape will change from Run (▶) to the Stop sign (■).By pressing Enter (**E**) again the output generation will be stopped and the cursor will revert to its previous shape, Run sign (▶). By setting the cursor to point to EXIT and by pressing Enter (**E**) the user will return from this submenu to the Main menu.

| Application Notes Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.7, on Page 39 |
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## 5.8 TRANSMITTER Menu Item

This MSC-1015 operating mode enables the user to simulate various types of sensors and transmitters which are Loop Powered and on their outputs generate the DC output current in the range from 4mA to 20mA. To operate properly, the internal current source inside the calibrator needs to be powered from the external DC Power Supply, nominally voltage from 12V to 30V DC.

When this mode is selected (*See Figure 75*), a warning message appears on LCD (*See Figure 76*) informing the user to use the 4-20mA Output (*See Figure 77*).

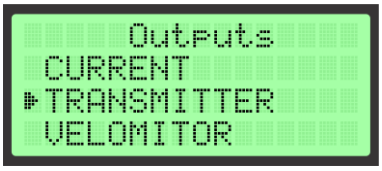


*Figure 75 TRANSMITTER Mode*


*Figure 76 Warning Message*


*Figure 77 4-20mA Output Selection*

After the warning message, the next submenu will appear on the LCD (*See Figure 78*):

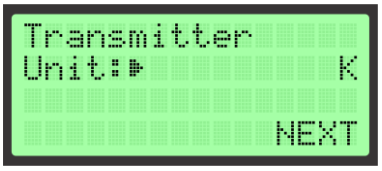


*Figure 78 Submenu Screen 1*

The user can navigate through this submenu by using Up (▲) and Down (▼). By pointing to the submenu item and by pressing Enter (E) the user will select parameters which he/she would like to adjust. Pressing Enter (E) will also confirm the adjusted value. Inside this submenu, the user can adjust measuring units of the simulated output parameter (*See Figure 79*).

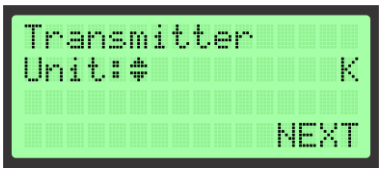


*Figure 79 Changing Output Measuring Unit*

Options for this submenu item are listed as follows: **K** (Kelvin Degrees for Temperature), **°F** (Fahrenheit Degrees for Temperature), **psi** (Pounds per Square Inch for Air Pressure), **lb** (Pound for Force), **$ft^3$/s** (Cubic Feet per Second for Flow Rate), **$ft^3$/min** (Cubic Feet per Minute for Flow Rate), **$ft^3$/h** (Cubic Feet per Hour for Flow Rate), **gal/s** ( Gallons per Second for Flow rate), **gal/min** ( Gallons per Minute for Flow Rate), **gal/h** ( Gallons per Hour for Flow Rate), **g** ( Gravity Unit for Acceleration), **in/s** (Inches per Second for Velocity), **ips** (Inches per Second for Velocity) and **mils** (1/1000 of Inch for Displacement)

After setting the cursor to point to NEXT and by pressing Enter (**E**) the user enters the new submenu system (See *Figure 80*) which allows adjusting of Maximal (Max.) (See *Figure 81*) and Minimal (Min.) (See *Figure 82*) Value of the previously selected Measuring Unit.


*Figure 80 Submenu Screen 2*

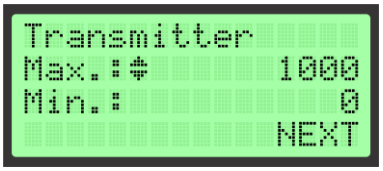


*Figure 81 Changing Maximal Value*

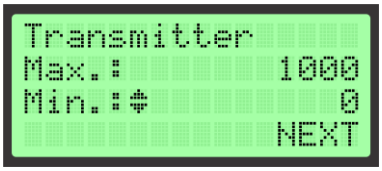


*Figure 82 Changing Minimal Value*

By using Up (▲) and Down (▼) the user can adjust the selected value for Max. and Min. (it can also be a negative value). Pressing Enter (E) will confirm the adjusted value. The program inside the calibrator will automatically span the output DC current to fulfill the condition for adjusted Min. value to be 4mA and for adjusted Max. value to be 20mA.

After setting the cursor to point to NEXT and by pressing Enter (**E**) the user will enter the final submenu system (See *Figure 83*).


*Figure 83 Submenu Screen 3*

The user navigates through this submenu system by using Up (▲) and Down (▼), which allows him/her to adjust the output value, ranging from the adjusted Min. value to the adjusted Max. value (See *Figure 84*). By pressing Enter (**E**) the adjusted value will be confirmed.

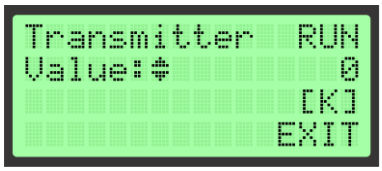


*Figure 84 Changing Value*

User can also Start or Stop generating of the output DC Current (See *Figure 85*). By pressing Enter (**E**) the user will Start simulation of Transmitter and the cursor shape will change from Run (▶) to Stop sign (■). By pressing Enter (E) again the output generation will be stopped and the cursor will revert to its previous shape, Run (▶). The adjusted Measuring Unit is displayed in the squared brackets.


*Figure 85 Calibrator in RUN Mode*

By setting the cursor to point to EXIT and by pressing Enter (**E)** the user will return to the Main menu. The same can be done by pressing Back (⮌).

| Application Notes Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.8 on Page 39 |
|---|

## 5.9 VELOMITOR Menu Item

This operating mode is suitable for simulation of different kinds of Velomitor Sensors, which produce the AC voltage output signal proportional to the measured vibration velocity value. These sensors can be of electro-dynamic or IEPE (ICP®) Type. After selecting this operating mode (See *Figure 86*), the user should select which type of Velomitor Output he/she would like to simulate (See *Figure 87* and *Figure 88*).

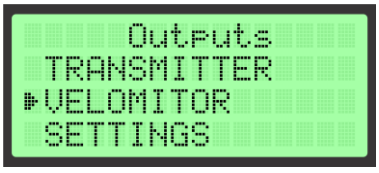


*Figure 86. VELOMITOR Mode*

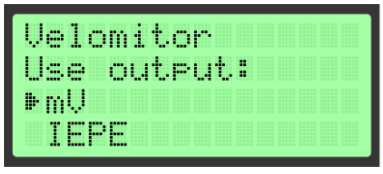


*Figure 87 Selecting Electrodynamic Velomitor Output*

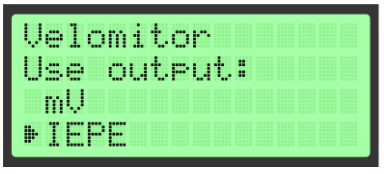


*Figure 88 Selecting IEPE Velomitor Output*

If the user selects the mV Option (Electro-dynamic Velomitor), the next warning message (See *Figure 89*) will appear on LCD.As Electrodynamic Velomitors directly produce the AC mV Output, mV Output needs to be used for their simulation. (See *Figure 90*).


*Figure 89 Warning Message*


*Figure 90 mV Output Selection*

Otherwise, if the user selects IEPE Option (IEPE (ICP®) Velomitor), the next warning message (See *Figure 91*) will appear on LCD. IEPE (ICP®) Velomitors need to be powered from external IEPE (ICP®) Power to produce

the correct AC voltage output (See *Figure 92*).

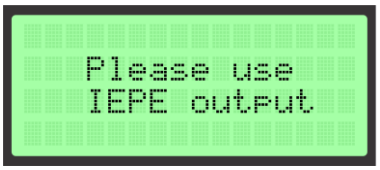


*Figure 91 Warning Message*


*Figure 92 IEPE Output Selection*

After this selection, the next submenu will appear on LCD (See *Figure 93*), allowing the user to adjust the Velomitor Sensitivity in the range from 2.0 to 500.0 mV/mm/s (See *Figure 94*).

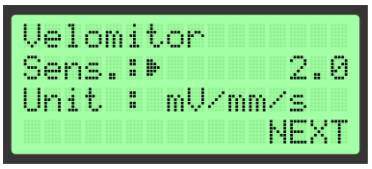


*Figure 93 Submenu Screen 1*

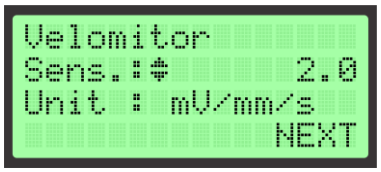


*Figure 94 Changing Velomitor Sensitivity*

User can navigate through this submenu by using Up (▲) and Down (▼) keys. By pointing to the submenu item and by pressing Enter (**E**) the user will select a parameter which he or she would like to change. The selection of the desired Velomitor sensitivity is confirmed by pressing Enter (**E**). Pointing to the Menu Item NEXT and pressing Enter (**E**) will bring the final submenu system (See *Figure 95*), which allows the user to set the desired Velomitors output value (See *Figure 96*) and frequency of the output signal (See *Figure 97*).

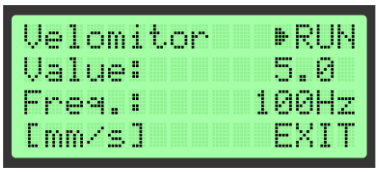


*Figure 95 Submenu Screen 2*

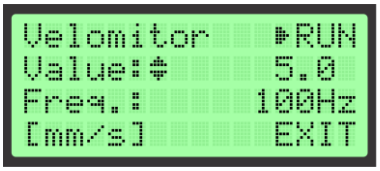


*Figure 96 Changing the Value*

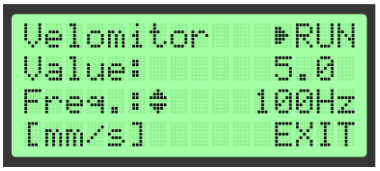


*Figure 97 Changing the Frequency*

The user can navigate through this submenu by using Up (**▲**) and Down (**▼**) By pointing to the submenu item and by pressing Enter (**E**) the user will select the parameter which he/she would like to change.

After the desired Velomitor parameter is adjusted, this selection is confirmed by pressing Enter (**E**). Pointing to RUN and pressing Enter (**E**) will start generating of the Velomitor Output (See *Figure 98*).

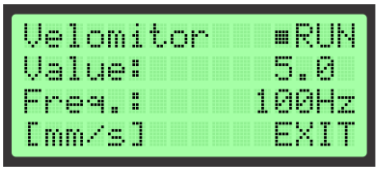


*Figure 98 Calibrator in RUN Mode*

The cursor shape will change from Run (▶) to Stop sign (■). By pressing Enter (**E**) again, the output generation will be stopped and the cursor will revert to its previous shape, Run (▶). The measuring unit is displayed in the squared brackets. By setting the cursor to point to EXIT and by pressing Enter (**E**) the user will return to the previous menu. This can also be done by pressing Back (⮌).

| Application Notes Instructions on how to use this MSC-1015 function can be found in Chapter 10 - Item 10.9 on Page 39 |
|---|

## 5.10 SETTINGS Menu Item

After selection of this Menu Item (See *Figure 99*), the next submenu will appear on the LCD (See *Figure 100*), allowing the user to select and set the Measurement Unit System and Language for LCD.

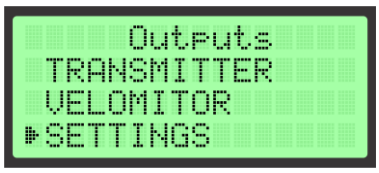


*Figure 99SETTINGS Mode*


*Figure 100 Submenu Screen*

Using Up (▲) and Down (▼) keys, the user can navigate through this submenu and move the cursor to point at the displayed item which could be edited. By pressing Enter (**E**) the user will enter the mode for adjusting the selected parameter. For Measuring Units System, the user can choose between IMPERIAL or METRIC (See *Figure 101*). The MSC-1015 will display the measuring units depending on this selection. This setting influences the next function of the device: Q[pC], IEPE and FLOW.

User can also set the Language for displaying the Menu Text and Messages (See *Figure 102*).

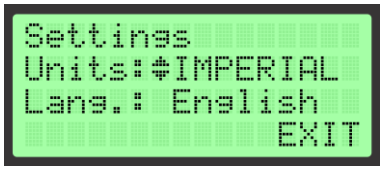


*Figure 101 Selecting Measuring Units System*

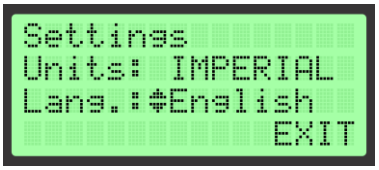


*Figure 102 Selecting Language*

After finishing the adjustment and pressing Enter (**E**), the selected values are saved in the internal memory and kept even when an MSC-1015 is switched Off and On again. If the user sets the cursor to point to EXIT and presses Enter (**E**), the system will return to the previous menu. The user can also do the same by pressing Back key (⮌).

## 6. PC Connection

IMPORTANT NOTICE

*The outer terminal of each BNC Output Connector, except the 4-20mA BNC Connector, is connected by the USB Interface Cable to the Personal Computer Case, which is usually grounded. In this operating mode, the user should take care to prevent the possibility of occurrence of Grounding Loops. (e.g. Battery operation of Notebook Computer, disconnecting PC or Notebook Computer from LAN, etc. )*

The MSC-1015 Outputs can also be controlled by using a Personal Computer (PC) or a Notebook through the USB 2.0 Interface. For this purpose, it is necessary to use the attached USB 2.0 Interface Cable (See *Figure 103*). User should connect the 4 pole LEMO (ODU) Cable Plug to the USB connector on the front panel of MSC-1015 (See *Figure 104*)

*Figure 103 USB2.0 Interface Cable*


*Figure 104 MSC-1015 USB Connector*

To connect this plug successfully to the MSC-1015 USB Connector, please observe that two RED Spots (Circled in Red Color, Red Spot • on the Plug and Red Spot • on the Connector) are in line during connection (See *Figure 105*). The other side of this interface cable should be connected to the PCs USB 2.0 Port (See *Figure 106*).

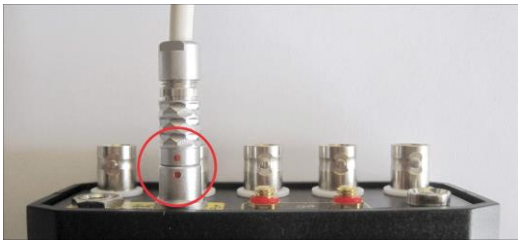

*Figure 105 Properly Connected USB Plug*


*Figure 106 USB Plug Connected to PCs USB Port*

When the connection is established, the confirmation message will appear on the LCD (*See Figure 107*).

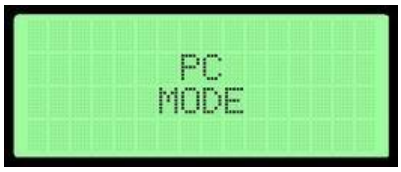


*Figure 107 PC Connection established*

Multi Signal Calibrator MSC-1015 is ready for use in the PC Mode. In this operating mode, the keyboard panel is disabled! For communication and setting up the output parameters the user may use the PC program MSC1015Control v5 or any other Serial Port Communication Program which supports the serial communication in binary mode!

The default Serial Communication Parameters are: **9600** Bauds**, No** Parity**, 8** Data bits**, 1** Stop bit**.**

*NOTICE: The user is not able to change these Communication Parameters!*

The Communication Protocol Frame format is $\boxed{: b_1\ b_2\ b_3\ b_4\ b_5\ b_6\ b_7\ b_8 \#}$ The frame consists of two special characters, '**:**' and '**#**' , plus eight bytes that carry the information. Every Communication Frame starts with a special character '**:**' and ends with second special character '**#**'. In the middle of the Communication Frame, there are eight bytes which carry information for setting the MSC-1015 Outputs. The first three bytes ($b_1\ b_2\ b_3$) carry information about the output voltage value (byte $b_1$ is Most Significant!); another three bytes ($b_4\ b_5\ b_6$) carry information about the output frequency value (byte $b_4$ is Most Significant!); the seventh byte $b_7$ carries information about Starting or Stopping the generation of output signal, while the eighth byte $b_8$ carries information regarding the chosen output function of MSC-1015.

The desired output voltage must be multiplied by 100 and parsing to the three bytes array ($b_1\ b_2\ b_3$). Using this method, the user can obtain two decimal places of precision for the desired output voltage value. The desired output frequency value must also be multiplied by 100 before parsing it to the three bytes array ($b_4\ b_5\ b_6$). Using this method, two decimal places of precision will be obtained for the desired output frequency value.

**Explanation of Communication Protocol Frame Bytes**

- **$b_1$** – Most significant Byte of the output Voltage value (24 bit to 17 bit of voltage value )
- **$b_2$** – 2nd Byte of the output Voltage value (16 bit to 9 bit of voltage value )
- **$b_3$** – Least significant Byte of the output Voltage value (8 bit to 1 bit of voltage value )
- **$b_4$** – Most significant Byte of the output Frequency value (24 bit to 17 bit of frequency value )
- **$b_5$** – 2nd Byte of the output Frequency value (16 bit to 9 bit of frequency value )
- **$b_6$** – Least significant Byte of the output Frequency value (8 bit to 1 bit of frequency value )
- **$b_7$** – Start/Stop byte (If the user wants to Start the output generation, this byte should be set to binary value 1 or otherwise to binary value 0 )
- **$b_8$** – Output Function Byte (BINARY VALUE not ASCII !)

  Functions: mV- binary value **0,** Battery Voltage - binary value **1,** OSO On - binary value **2,** OSO Off - binary value **3,** Ping – binary value **4,** IEPE – binary value **5,** pC – binary value **6,** TTL – binary value **7,** Current – binary value **8**

*The Calculation Example*

Desired output voltage value: 10,000.00 mV (10.00 V)

This value should be multiplied by 100.

10,000.00 x 100 = 1,000,000

This value should be parsed into three bytes. This can easily be done by using the following procedure:

1. To calculate the MSB (Most Significant Byte) divide 1,000,000 by 65,536

   1,000,000 / 65,536 = 15.2587

   For MSB the integer value of the result should be used.

   MSB = **15**

2. To calculate the Voltage 2nd Byte, first multiply 65,536 by the value of MSB.

   65,536 x 15 = 983,040

   Subtract this value from 1,000,000

   1,000,000 – 983,040 = 16,960

   Divide the result by 256

   16960 / 256 = 66.25

For 2nd Byte the integer value of the result should be used.

2nd Byte = **66**

3. To calculate the LSB (Least Significant Byte), first multiply 256 by the value of 2nd Byte.

   256 x 66 = 16,896

   Subtract this value from 16,960

   16,960 – 16,896 = 64

   LSB = **64**

4. Checking the calculations:

   ( 65,536 x **15** ) + ( 256 x **66** ) + **64** = 1,000,000

   Converting to the output voltage value:

   1,000,000 / 100 = 10,000.00 mV

   *The calculation for the MSB, 2nd Byte and the LSB is correct!*

Following this procedure, the user can calculate the MSB, 2nd Byte and the LSB of any output Voltage value in the range from 10.00 $mV_{RMS}$ to 10,000.00 $mV_{RMS}$ (10.00 $V_{RMS}$), the MSB, 2nd Byte and the LSB of any output Frequency value in the range from 1.00 Hz to 10,000.00 Hz (10.00 kHz) and the MSB, 2nd Byte and the LSB of any output DC Current value in the range from 4.00 mA to 20.00 mA.

***MSC-1015 cannot generate the output voltage higher than 10,000.00 $mV_{RMS}$ (10.00 $V_{RMS}$) and the output frequency higher than 10,000.00 Hz (10.00 kHz)!***

**Communication Protocol**

After each command sent to MSC-1015, the communication program will receive an appropriate answer from a calibrator.

Examples of certain Functions:

a) For voltage output generation without IEPE, the user should use the Function **0.**

   ***Function numbers are binary values, not the ASCII values!***

   The command is***: $v_1v_2v_3f_1f_2f_3$ss0#***

   ***$v_1$, $v_2$*** and ***$v_3$*** are three bytes that carry information about the desired output voltage value, ***$f_1$, $f_2$*** and ***$f_3$*** are three bytes that carry information about the desired output frequency value, ***ss*** byte (Start/Stop byte) may be binary value **1** to Start or binary value **0** to Stop the generation of the output at the mV Output.

If MSC-1015 receives parameters without errors and the values for output voltage and frequency are in the allowed ranges (10.00 $mV_{RMS}$ to 10,000.00 m $V_{RMS}$; 1.00 Hz to 10,000.00 Hz), it will send the confirmation ***:OK#***

If any of the output values is out of the allowed range, MSC-1015 will send***:E0#*** as an error message.

b) To get the information about Battery voltage, the user should use Function **1**
The command is***: 00000001#***

The answer from MSC-1015 consists of 4 bytes, ***:$b_1b_2$#***
Battery voltage can be calculated as:

$$U_{bat} = ( b_1 * 256 + b_2 ) / 100$$

c) To enable the OSO® (Optical Speed Output), the user should use Function **2**
The command is***: 00000002#***

The answer from device will be***: O1#***

d) To disable the OSO® (Optical Speed Output), the user should use Function **3**
The command is***: 00000003#***

The answer from device will be***: 00#***

e) For Ping testing, the user should use Function **4**
The command is***: 00000004#***

If there is an MSC-1015 connected, the user will receive an answer***: !!#***

This function is very useful if there are many communications ports on the PC and the user would like to find the one on which the MSC-1015 is connected.

f) For the IEPE voltage mode generation, the user should use Function **5**
The command is***: $v_1v_2v_3f_1f_2f_3$ss5#***

***$v_1$***, ***$v_2$*** and ***$v_3$*** are three bytes that carry information about the desired output voltage value, ***$f_1$***, ***$f_2$*** and ***$f_3$*** are three bytes that carry information about the desired output frequency value,
***ss*** byte (Start/Stop byte) may be binary value **1** to Start or binary value **0** to Stop the generation of the output at the IEPE output.

If MSC-1015 receives parameters without errors and the output voltage and frequency values are within the allowed ranges (10.00 $mV_{RMS}$ to 6,000.00 $mV_{RMS}$ ; 1.00 Hz to 10,000.00 Hz), it will send the confirmation **: *OK#***

If any of the output values is out of the allowed ranges, MSC-1015 will send the following message***: E0#***

***This function enables accurate generation of the output voltage up to 6 $V_{RMS}$ !***

g) For the Charge Output generation (pC), the user should use Function **6**
The command is***: $p_1p_2p_3f_1f_2f_3$ss6#***

***$p_1$, $p_2$*** and ***$p_3$*** are three bytes that carry information about the desired output Charge value (pC), ***$f_1$, $f_2$*** and ***$f_3$*** are three bytes that carry information about the desired output frequency value,
***ss*** byte (Start/Stop byte) may be binary value **1** to Start or binary value **0** to Stop the generation of the output at the pC output.

If MSC-1015 receives the parameters without errors, and the output voltage and frequency values are within the allowed ranges from 10.00 pC to 10,000.00 pC ; from 1.00 Hz to 10,000.00 Hz, it will send the confirmation ***:OK#***

If any of the output values is out of the allowed range, the MSC-1015 will send the following message***: E0#***

h) For the TTL Output generation, the user should use Function **7**

The command is***: 000$f_1f_2f_3$ss7#***

***$f_1$, $f_2$*** and ***$f_3$*** are three bytes that carry information about desired output frequency value,
***ss*** byte (Start/Stop byte) may be binary value **1** to Start or binary value **0** to Stop the output generation at the TTL output.

If MSC-1015 receives the parameters without errors and the output frequency value is within the allowed range (1.00 Hz to 10,000.00 Hz), it will send the confirmation**: *OK#***

If the output frequency value exceeds the allowed range, the MSC-1015 will send the following message***: E0#***

i) For the 4-20 mA Current Output generation, the user should use Function **8**

The command is***: $c_1c_2c_3$000ss8#***

***$c_1$, $c_2$*** and ***$c_3$*** are three bytes that carry information about desired output DC Current value, ***ss*** byte (Start/Stop byte) may be binary value **1** to Start or binary value **0** to Stop the output generation at the 4-20 mA output.

If MSC-1015 receives the parameters without errors and the output current value is within the allowed range from 4.00 mA to 20.00 mA, it will send the confirmation**: *OK#***

If the output current value exceeds the allowed range, MSC-1015 will send the following message***: E0#***

In each command, the first and the last bytes, '**:**' and '**#**', are given as the ASCII Codes. Since this is the Binary Protocol, the user should use ASCII values from the ASCII Table. The ASCII value of '**:**' character is 58 dec. or 3A hex., while the ASCII Code of the '**#**' character is 35 dec. or 23 hex. Except these two bytes, all other values are binary values, not the ASCII! Please note, when communication program receives an answer from the MSC-1015, the received bytes are coded and displayed as the ASCII values, but for further calculations the user should convert them and use their binary values!

**Caution**

Using described protocol to make custom applications is highly recommended for the ADVANCED USERS ONLY! The improper use of this protocol can damage MSC-1015. Higher rates of the output voltage can also damage user's equipment (especially in the IEPE Mode).

***NORTH Protection Ltd DOES NOT ACCEPT any responsibility for damages of user's test equipment caused by improper use of this option.***

For the safest use of the MSC-1015 Calibrator, the user should obtain the manufacturer PC Application, which can be downloaded from the official NORTH Protection Ltd Web Site: **www.north-protection.com**

## 7. Charging the Accu Bateries

When the installed Accu Batteries get Low, the user will get the warning message on LCD (*See Figure.108*)


*Figure 108 The Empty Battery Warning Screen*

About 10 seconds after displaying this message on LCD, MSC-1015 Calibrator will be automatically switched Off, to prevent the generation of output signals which are outside of the specified accuracy.

When this occurs, it is necessary to connect the external charger (*See Figure.109*) to the Charge Connector (*See Figure.110*)


*Figure 109 Charging Adapter 9$V_{DC}$*


*Figure 110 MSC-1015 Charging Connector*

This connector is used for connecting the external regulated power supply of 9 $V_{DC.}$ When the Charger is connected, the Charge LED is lit (*See Figure.111*).


*Figure 111 Charging LED*

***During the charging process, DO NOT used the device to generate any of the output signals because the output signals will not be within specified accuracy ranges!***

The charging time to obtain the fully charged Accu batteries depends on the capacity of the batteries. It may take up to 16 hours. The embedded charger electronics will automatically stop the charging process after the batteries are fully charged.

## 8. Accessories

For proper and adequate use of MSC-1015 Calibrator and also in order to obtain the stated output characteristics, it is necessary to use only the Accessories which are originally supplied with the device, in its Carrying Case.

The included accessories are:

a) Charging Adapter, output voltage $9V_{DC}$, 500 mA (*See Figure.112*)

Purpose: For Charging the installed Accu Batteries, when they get Low (or Empty)


*Figure 112 Charging Adapter*

b) USB 2.0 Interface Cable, LEMO to USB 2.0 Type A Connector (*See Figure.113*)

Purpose: For controlling MSC-10l5 Functions using a Personal Computer (PC) or a Notebook via USB 2.0 Interface.

*Figure 113 USB 2.0 Interface Cable*

c) BNC to BNC Adapter Cable (*See Figure.114*)

Purpose: For connecting MSC-1015 Calibrator to DUT (Device Under Test)

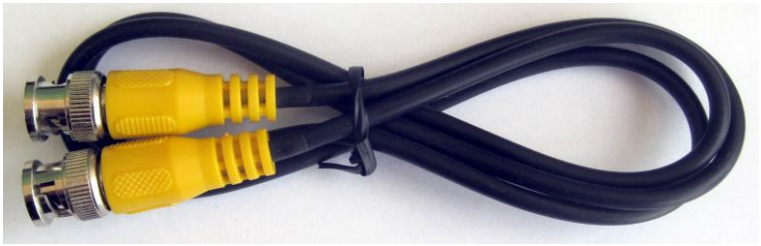

*Figure 114 BNC to BNC Adapter Cable*

d) BNC to Banana Plugs Adapter Cable with Crocodile Crimps (*See Figure.115*)

Purpose: For connecting MSC-1015 Calibrator to DUT (Device Under Test)

*Figure 115 BNC to Banana Plugs Adapter Cable with Crocodile Crimps*

## 9. Device Dimensions

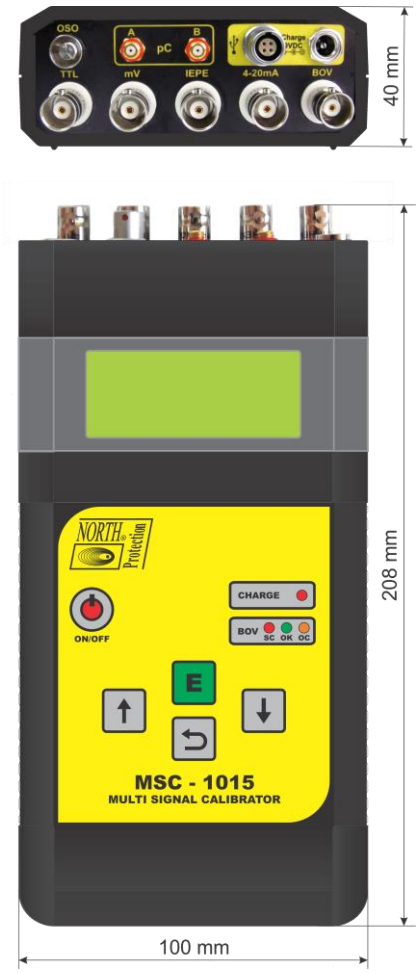


*Figure 116 Device dimensions in millimeters*

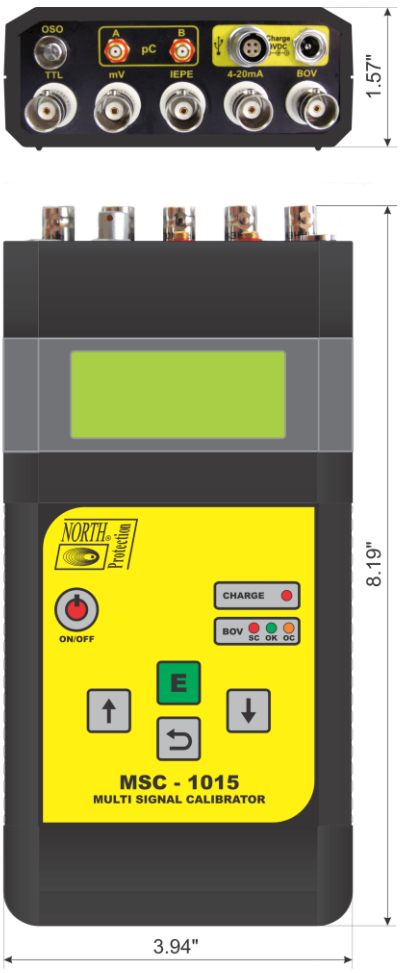


*Figure 117 Device dimensions in inches*

## 10. Application Notes

### 10.1 Using mV Output

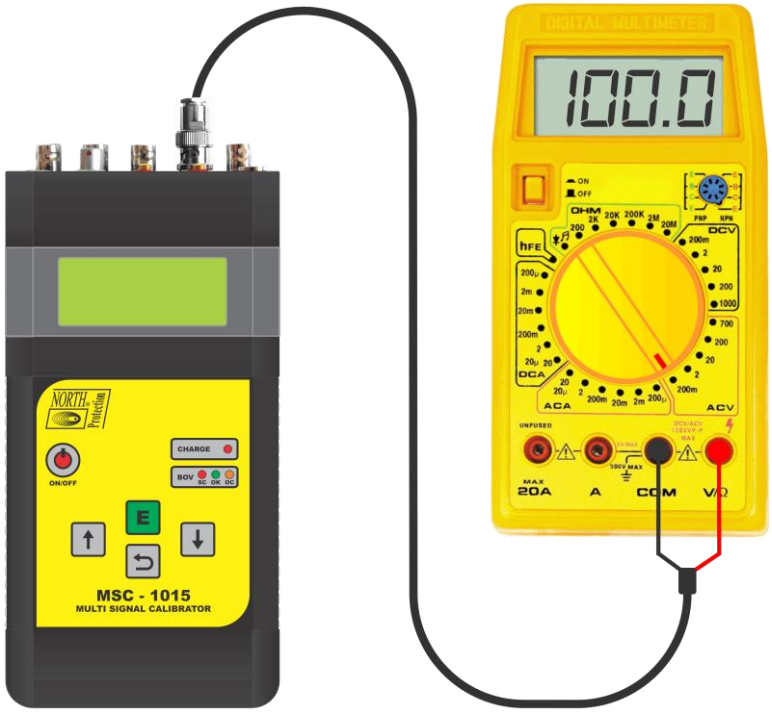


*Figure 118 Testing Digital Multi Meter*

### 10.2 Using pC Output


*Figure 119 Testing Charge Amplifier*

## 10.3 Using IEPE Output


*Figure 120 Testing Vibration Meter*

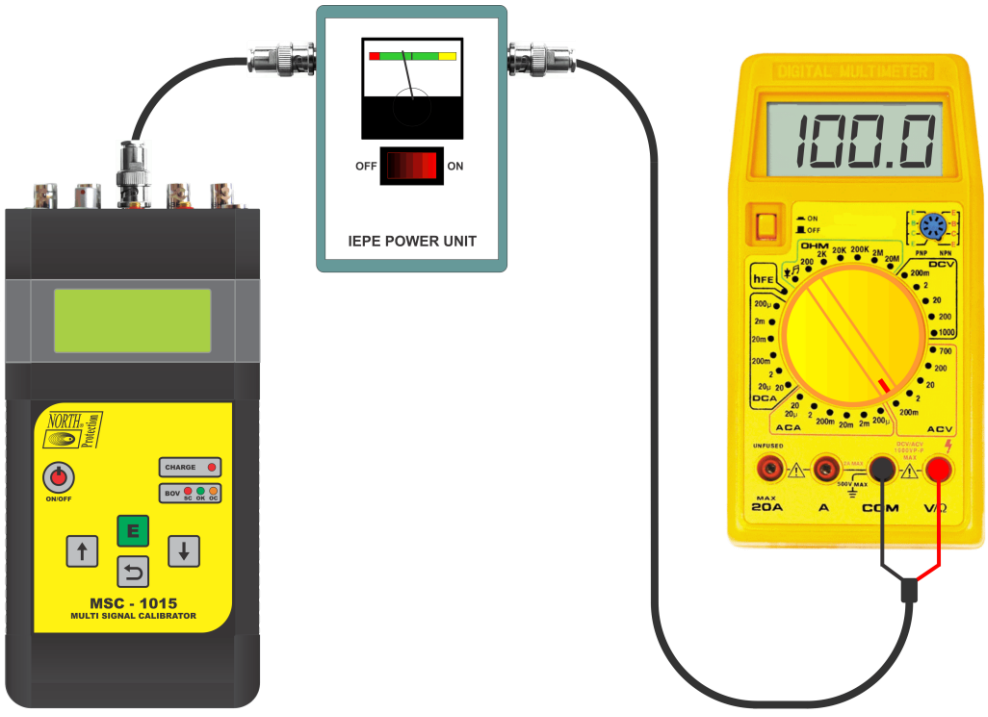


*Figure 121 Testing IEPE Power Supply*

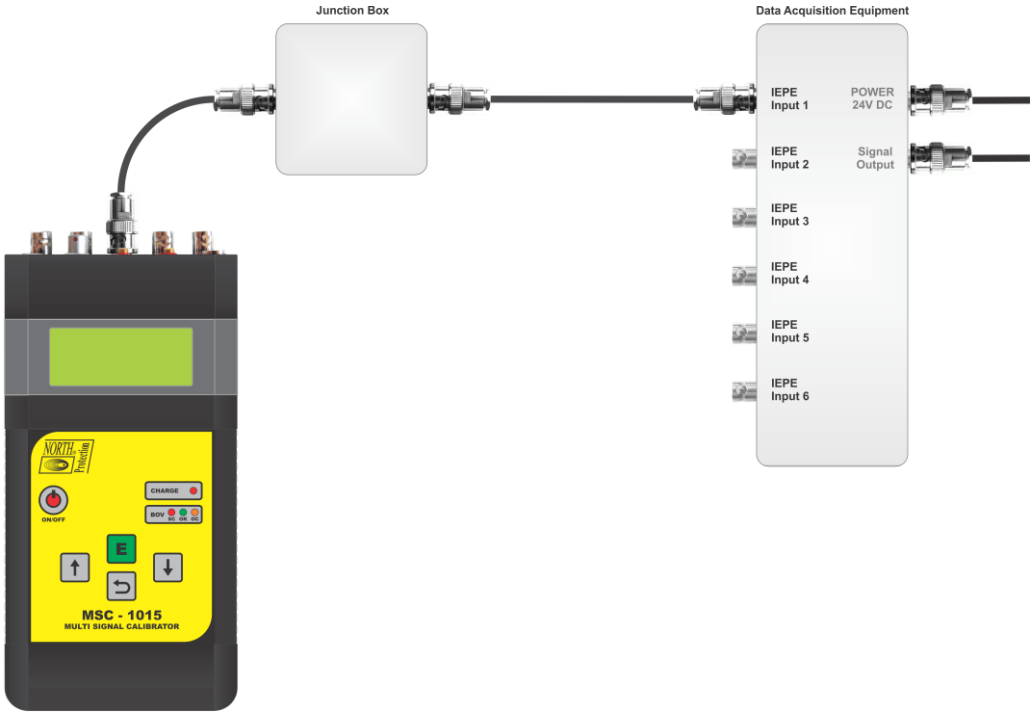


*Figure 122 Testing Acquisition Unit including Cables and Junction Box*

## 10.4 Using SPEED Output

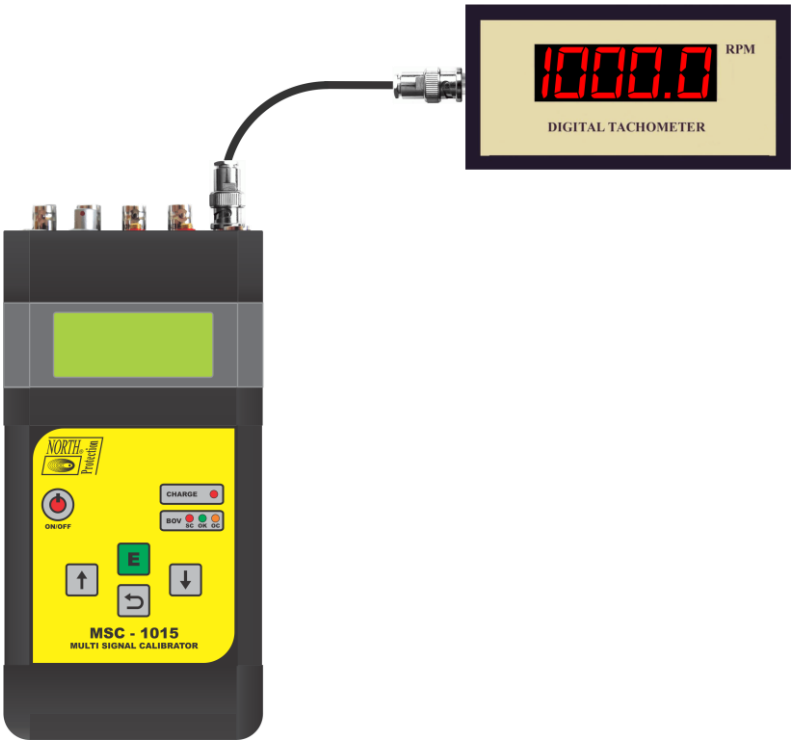


*Figure 123 Testing RPM Meter*


*Figure 124 Testing Frequency Counter*

## 10.5 Using BOV Input


*Figure 125 Testing IEPE Sensor*


*Figure 126 Testing IEPE Sensor including Cables and Junction Box*

## 10.6 Using FLOW Output

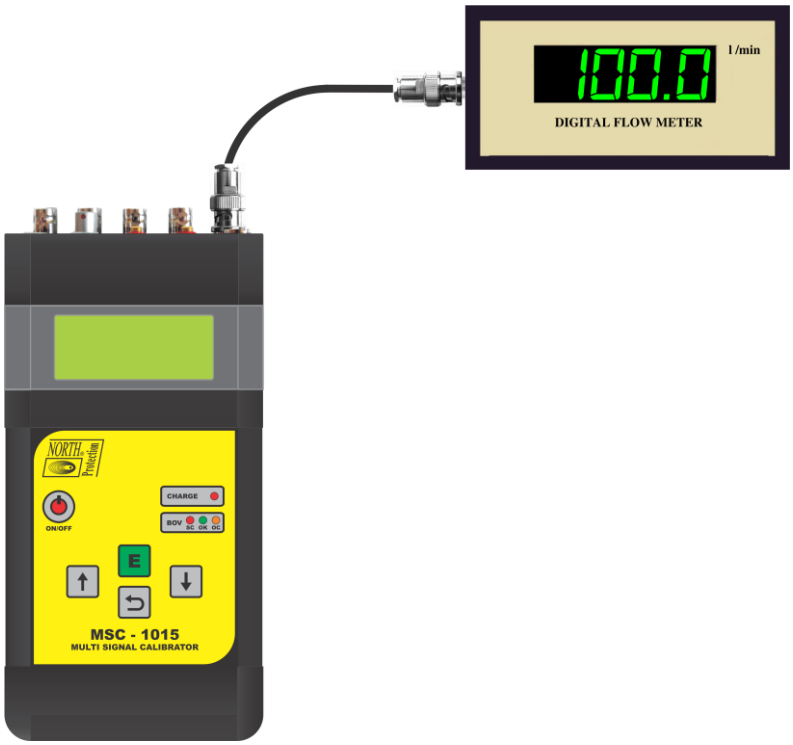


*Figure 127 Testing Digital Flow Meter*

## 10.7 Using CURRENT Output

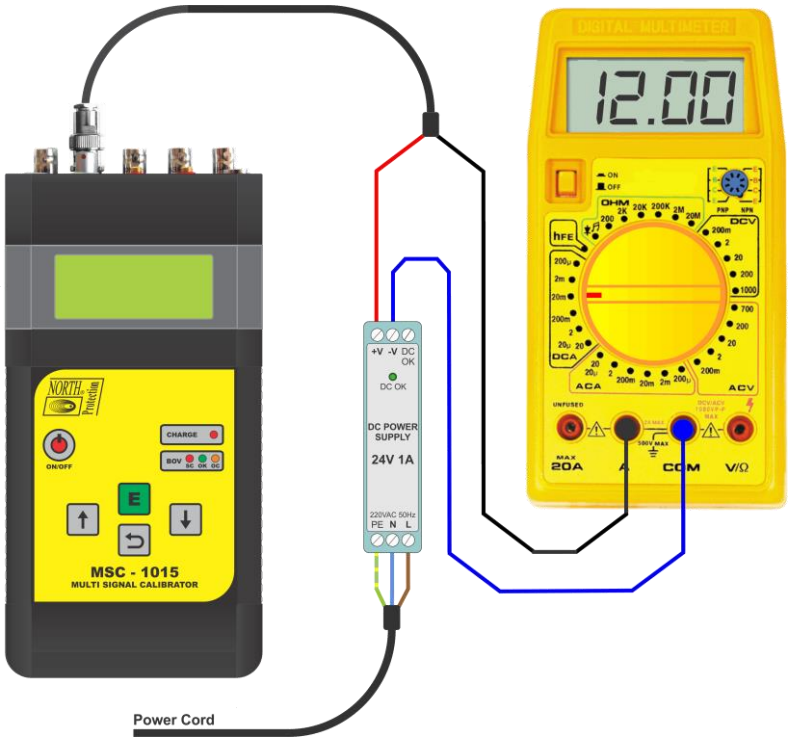


*Figure 128 Testing Digital Multi Meter DC mA Range*

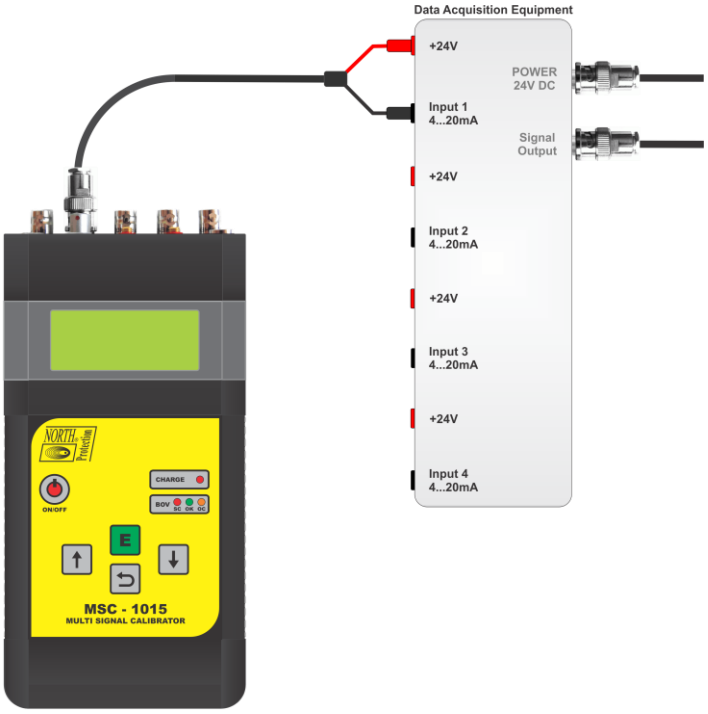


*Figure 129 Testing Data Acquisition Unit Current Inputs*

*(4...20mA DC, 2 Wires, Loop Powered)*

## 10.8 Using TRANSMITTER Output

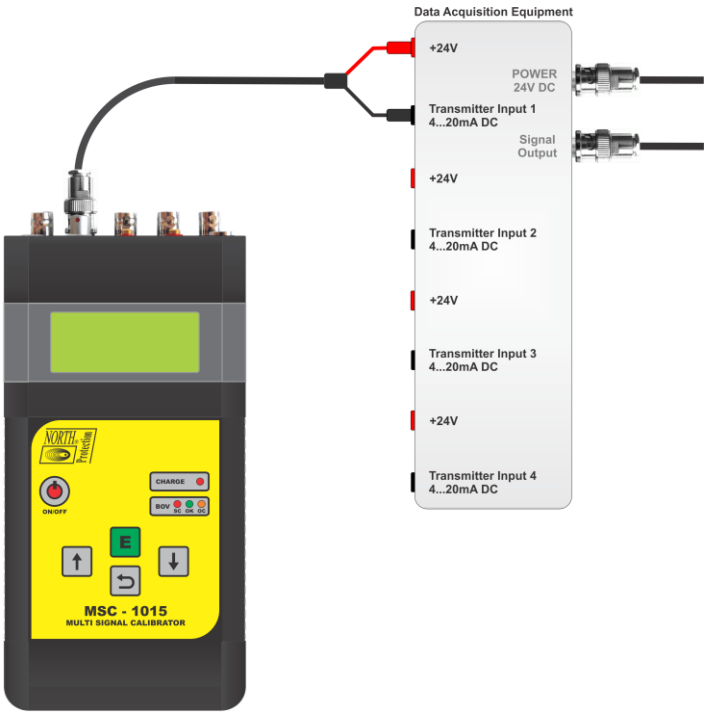


*Figure 130 Testing Acquisition Unit Transmitter Inputs*

*(4...20mA DC, 2 Wires, Loop Powered)*

## 10.9 Using VELOMITOR Output

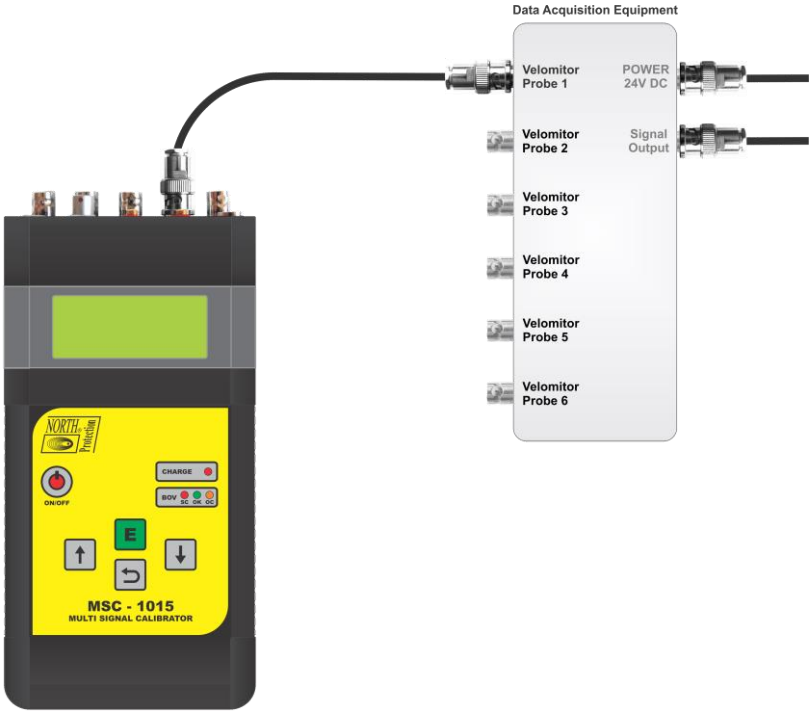


*Figure 131 Testing Acquisition Unit AC Voltage Velomitor Inputs*

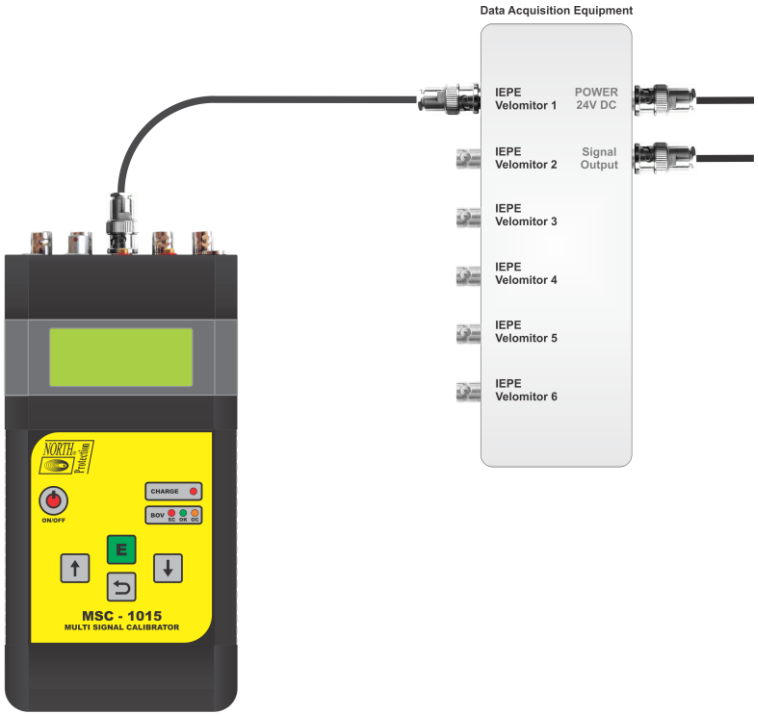


*Figure 132 Testing  Acquisition Unit IEPE Velomitor Inputs*

## 11. Notes

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