Aemulus

# DM482e

## User Manual

*Version 1.2, 10-2013*

## Table of Contents

## A. General Information

- Refer to the User Manual prepared by the manufacturer for proper usage of the instrument.
- If the product is used in a manner not specified, the protection provided by the instrument warranty may be impaired.
- Return the instrument to Aemulus for service and repair to ensure that safety features are maintained.

**WARNING**

**The WARNING heading explains hazards that might occur if an operating procedure, practice, or the like that, if not correctly performed or adhered to might result in personal injury or death. Always read the associated information very carefully and make sure the indicated information is met before performing the indicated procedure.**

**CAUTION**

**The CAUTION heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.**

## B. Identification and Discouragement of Hazardous Applications

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**CAUTION**

*Main Power*

- Ensure that the mains power is turned off before plugging or removing the PXI module into or from the chassis.
- Make sure the power cord is plugged properly to the chassis before applying power.
- The chassis that carries the instrument has to be plugged into a grounded (earthed) power outlet. By not doing so, it will defeat the power cord safety ground feature.
- Ensure that the power is removed from the product before connecting/disconnecting the cables to the product connectors.

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**WARNING**

*Instrument Cables / Connectors*

- Inspection of the connecting cable and test leads for possible wear, cracks, or breaks must be done before each use.
- Make sure the cables used for the product are rated to the specified voltage and current level.

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**WARNING**

*Instrument Output*

- Extreme caution is to be practiced when a shock hazard is present. Lethal voltage may be present on cable connector jacks.
- When power is applied to the circuit under test, do not touch the product and test cables or test leads.
- Do not touch the connector jacks or cables when the output of the product is turned on.

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**WARNING**

*Hot Surface*

- If the DM482e has been in use, it might exceed safe handling temperatures and cause burns. Allow some cooling time before removing the DM482e from the chassis.

**WARNING**

*Operating Temperature*

- The fan speed of the chassis that carries the instrument has to be in HIGH speed to allow proper heat ventilation.
- Make sure the product temperature is under 46˚C before operating the product.

## C. Identification of Authorized Personnel

| | |
|---|---|
| *End user* | Individual or group who is responsible for the use and maintenance of the product, as well as being responsible for ensuring that the product is operated within its specifications. Knowledge on electrical safety procedures and proper use of the product are prerequisite before operating the product. |
| *Maintenance personnel* | Individual or group who is responsible for performing routine procedures on the product to keep it operating properly. Any service should only be done by qualified service personnel. |
| *Service personnel* | Installation and service procedures may only be carried out by properly trained service personnel. Knowledge on working with live circuits, performing safe installations, and repairing the products are prerequisite for this individual or group. |

### 1.1 Product Start-up Configuration

Each product is carefully inspected before it leaves the factory. Upon receipt and before unpacking the product, please inspect the unit for any obvious damage that may occur during shipment. If any damage is found, notify the instrument manufacturer immediately.

Please verify that the following items are included in the original packing of this product. Contact the instrument manufacturer immediately if any of these items are found missing.

- Reference / Drivers CD-ROM

The product is designed to be used in an indoor environment, an area with low condensation and a temperature of between 23°C ± 10°C. Ensure that the area where the product is installed is free from the presence of any explosive or flammable fumes or gases.

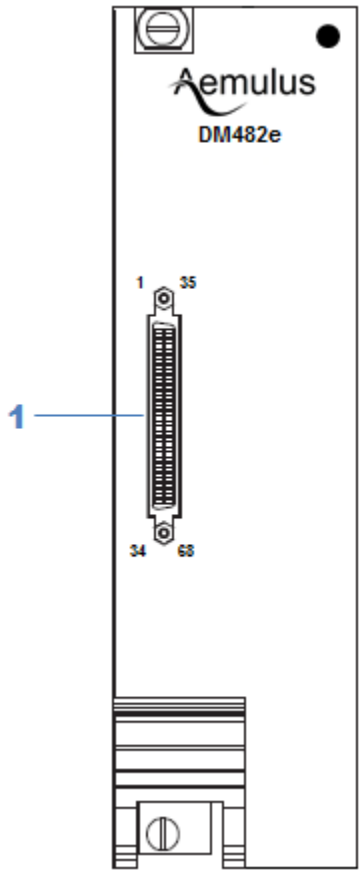
**CAUTION**

The product is shipped in materials that prevent static damage to the module. The module should only be removed from the packaging in an anti-static area ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not in use.

## 1.2 Product Software & Hardware Installation

Refer to installation guide.

### 2.1 Front Panel Connectors




1 OUTPUT (VHDCI, 68-Position, Receptacle)

Figure 1: DM482e Front Panel

| Pin | Signal Name (Primary) | Signal Name (MIPI) | Description |
|---|---|---|---|
| 1 | HV3 | | High Voltage Driver 3 |
| 2 | HV4 | | High Voltage Driver 4 |
| 3 | HV5 | | High Voltage Driver 5 |
| 4 | - | | - |
| 5 | - | | - |
| 6 | - | | - |
| 7 | PIN11_SH | | Pin 11 Sense-High |
| 8 | PIN10_PIN11_L | VIO3_GND | Pin 10-11 Low |
| 9 | PIN11_FH | VIO3 | Pin 11 Force-High |
| 10 | PIN8_PIN9_L | SCLK3_GND | Pin 8-9 Low |
| 11 | PIN9_FH | SCLK3 | Pin 9 Force-High |
| 12 | PIN9_SH | | Pin 9 Sense-High |
| 13 | PIN7_SH | | Pin 7 Sense-High |
| 14 | PIN6_PIN7_L | SDATA2_GND | Pin 6-7 Low |
| 15 | PIN7_FH | SDATA2 | Pin 7 Force-High |
| 16 | - | | - |
| 17 | - | | - |
| 18 | HV0 | | High Voltage Driver 0 |
| 19 | HV1 | | High Voltage Driver 1 |
| 20 | HV2 | | High Voltage Driver 2 |
| 21 | EXT_TRIGIN0 | | External Trigger Input 0 |
| 22 | GND | | Ground |
| 23 | EXT_TRIGOUT0 | | External Trigger Output 0 |
| 24 | GND | | Ground |
| 25 | PIN5_SH | | Pin 5 Sense-High |
| 26 | PIN4_PIN5_L | SDATA1_GND | Pin 4-5 Low |
| 27 | PIN5_FH | SDATA1 | Pin 5 Force-High |
| 28 | PIN2_PIN3_L | VIO1_GND | Pin 2-3 Low |
| 29 | PIN3_FH | VIO1 | Pin 3 Force-High |
| 30 | PIN3_SH | | Pin 3 Sense-High |
| 31 | PIN1_FH | SDATA0 | Pin 1 Force-High |
| 32 | PIN0_PIN1_L | SDATA0_GND | Pin 0-1 Low |
| 33 | PIN1_SH | | Pin 1 Sense-High |
| 34 | - | | - |

Table 1: I/O Pin-out (Pins 1-34)

| Pin | Signal Name (Primary) | Signal Name (MIPI) | Description |
|---|---|---|---|
| 35 | - | | - |
| 36 | - | | - |
| 37 | - | | - |
| 38 | - | | - |
| 39 | - | | - |
| 40 | - | | - |
| 41 | PIN10_SH | | Pin 10 Sense-High |
| 42 | PIN10_PIN11_L | SDATA3_GND | Pin 10-11 Low |
| 43 | PIN10_FH | SDATA3 | Pin 10 Force-High |
| 44 | PIN8_PIN9_L | VIO2_GND | Pin 8-9 Low |
| 45 | PIN8_FH | VIO2 | Pin 8 Force-High |
| 46 | PIN8_SH | | Pin 8 Sense-High |
| 47 | PIN6_SH | | Pin 6 Sense-High |
| 48 | PIN6_PIN7_L | SCLK2_GND | Pin 6-7 Low |
| 49 | PIN6_FH | SCLK2 | Pin 6 Force-High |
| 50 | GND | | Ground |
| 51 | EXT_TRIGOUT1 | | External Trigger Output 1 |
| 52 | GND | | Ground |
| 53 | EXT_TRIGIN1 | | External Trigger Input 1 |
| 54 | - | | - |
| 55 | - | | - |
| 56 | - | | - |
| 57 | - | | - |
| 58 | - | | - |
| 59 | PIN4_SH | | Pin 4 Sense-High |
| 60 | PIN4_PIN5_L | SCLK1_GND | Pin 4-5 Low |
| 61 | PIN4_FH | SCLK1 | Pin 4 Force-High |
| 62 | PIN2_PIN3_L | VIO0_GND | Pin 2-3 Low |
| 63 | PIN2_FH | VIO0 | Pin 2 Force-High |
| 64 | PIN2_SH | | Pin 2 Sense-High |
| 65 | PIN0_FH | SCLK0 | Pin 0 Force-High |
| 66 | PIN0_PIN1_L | SCLK0_GND | Pin 0-1 Low |
| 67 | PIN0_SH | | Pin 0 Sense-High |
| 68 | - | | - |

Table 2: I/O Pin-out (Pins 35-68)

| Signal Name | Description |
|---|---|
| HVx | High voltage driver capable of generating up to 13.5V. |
| PINx_FH | The I/O for a pin for all operating modes (PMU, VECTOR, DIO, CLOCK, INVERTED_CLOCK). Refer to programming manual for details. |
| PINx_SH | The remote sense line when operating in PMU mode. |
| PINx_PIN(x+1)_L | The ground reference level for a pin. 2 pins (PINx and PIN(x+1)) share the same reference level, and these 2 pins can be configured as a differential pins. |
| EXT_TRIGOUTx | External trigger output from the module. |
| EXT_TRIGINx | External trigger input to the module. |
| SCLKx | SCLK pin for MIPI. |
| SDATAx | SDATA pin for MIPI. |
| VIOx | VIO pin for MIPI. |
| SCLKx_GND<br>SDATAx_GND<br>VIOx_GND | GND pin for MIPI. User should short all the GND pins together. |

Table 3: Pin Function Description

## 2.2 Soft Front Panel

The soft front panel provides a graphical interface for operating the module. It is intended for testing and diagnosing, for demonstration and training, and for basic operation of the module. It represents most of the functions available in the instrument driver. It is not however a comprehensive application suitable for measurements; for this, remote programming the module.

### 2.2.1 General Functions

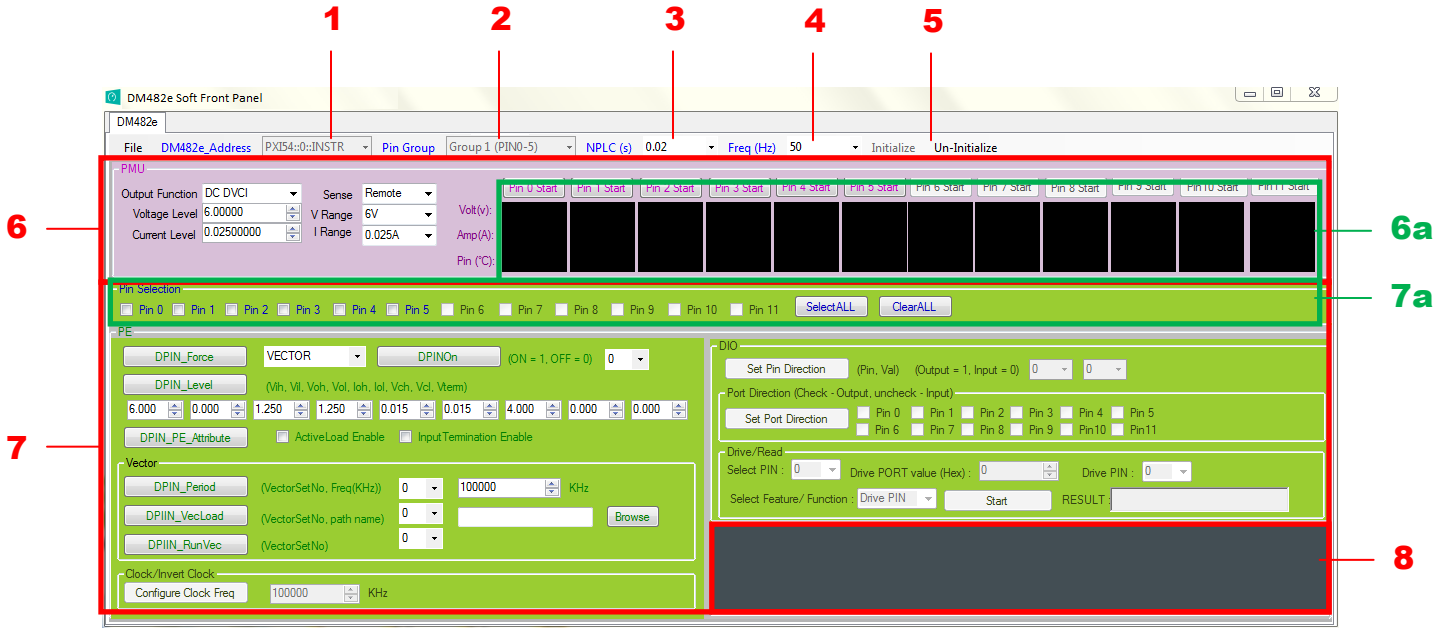



Figure 2: DM482e Soft Front Panel

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>1</td><td>Select the PXI address of the module. A list of addresses is shown for all detected modules in the chassis.</td></tr>
<tr><td>2</td><td>Select the pin group.</td></tr>
<tr><td>3</td><td>Set the number of power line cycle, in second.</td></tr>
<tr><td>4</td><td>Set the frequency of the power line (50Hz or 60Hz).</td></tr>
<tr><td>3</td><td>Initialize the selected module. This includes opening a session to communicate with the module, and then reset the module in its default state</td></tr>
<tr><td>5</td><td>Un-initialize the selected module. This includes closing the current communication session to the module.</td></tr>
<tr><td>6</td><td>Per Pin Parametric Measurement Unit (PPMU) function:<br><br>
<table>
<tr><td>a</td><td>Output Function</td><td>DC DVCI: Drive-Voltage Clamp-Current operation. Continuous mode.<br>DC DICV: Drive-Current Clamp-Voltage operation. Continuous mode.</td></tr>
<tr><td>b</td><td>Voltage Level</td><td>Voltage level</td></tr>
<tr><td>c</td><td>V Range</td><td>Range of the voltage level</td></tr>
<tr><td>d</td><td>Current Level</td><td>Current level (Current level setting is not required in DVCI mode. “I Range” will decide the compliance value)</td></tr>
<tr><td>e</td><td>I Range</td><td>Range of the current level</td></tr>
<tr><td>f</td><td>Sense</td><td>Select either Remote or Local sense connection</td></tr>
</table></td></tr>
<tr><td>6a</td><td>Click the “Start” button for the selected pin to execute PMU commands. The button will immediately turn to “Stop”. Press it to exit from PMU functions. Following results are shown for each pin:<br>a. Voltage (V)<br>b. Current (A)<br>c. On-board temperature</td></tr>
</table>

7

Pin Electronics (PE):

Generic Setting:

| | | |
|---|---|---|
| a | DPIN Force | Sets the operation mode:<br><br>Mode: VECTOR — Vector engine<br>DIO — General purpose I/O<br>CLOCK — Drive clock signal<br>INVERTED_CLOCK — Drive inverted clock signal. This is when 2 pins are selected as differential outputs |
| b | DPIN Level | Set the levels for each pin. |
| c | DPIN On | Turn on/off the selected pin. |
| d | DPIN PE Attribute | Enable/disable active load and input termination |

Vector:

| | | |
|---|---|---|
| a | DPIN Period | Specifies the timing set to be used, as well as its period setting |
| b | DPIN VecLoad | Load the specified vector set in the vector file to the module |
| c | DPIN RunVec | Run the specified vector set. |

Clock/Invert Clock:

| | | |
|---|---|---|
| a | Configure Clock Frequency | Configure the clock frequency when mode "CLOCK" or "INVERTED_CLOCK" is selected. |

DIO:

| | | |
|---|---|---|
| a | Set Pin Direction | Specifies the direction of the selected pin. |
| b | Set Port Direction | Specifies the direction of the selected pin group. |

<table>
<tr><td></td><td>c</td><td>Drive/Read<br><br><table><tr><td>Select Pin</td><td>Specifies the pin</td></tr><tr><td>Drive Pin Value</td><td>Specifies the logic level of the pin to be driven</td></tr><tr><td>Drive Port Value</td><td>Enter the port value (in HEX) if you want to drive to the whole pin group</td></tr><tr><td>Select Function</td><td>Select from a list of available DIO functions:<br>- Drive Pin<br>- Drive Port<br>- Read Pin<br>- Read Port</td></tr></table><br>Click the “Start” button for the selected pin to execute the command. The results for read functions for each pin will be displayed as either “H” (logic high), “L” (logic low) or “Z” (undefined).</td></tr>
<tr><td>8</td><td colspan="2">Display the actions taken in the background.</td></tr>
</table>

Table 4: Soft Front Panel Control

Quick steps to configure the module:

1. Select PXIe address of the targeted module from the drop-down list.
2. Select the targeted pin group. In this example, select "All Groups (PIN0-11)".
3. Press "Initialize".
4. The module is set to drive 1V and its current compliance is set to 25mA, in DVCI mode.
5. Press "Start" to execute the commands. The button will immediate to "Stop".
6. Both voltage and current are measured.
7. Press "Stop" to exit from PMU mode.
8. Press "Un-Initialize" to turn off the whole module.

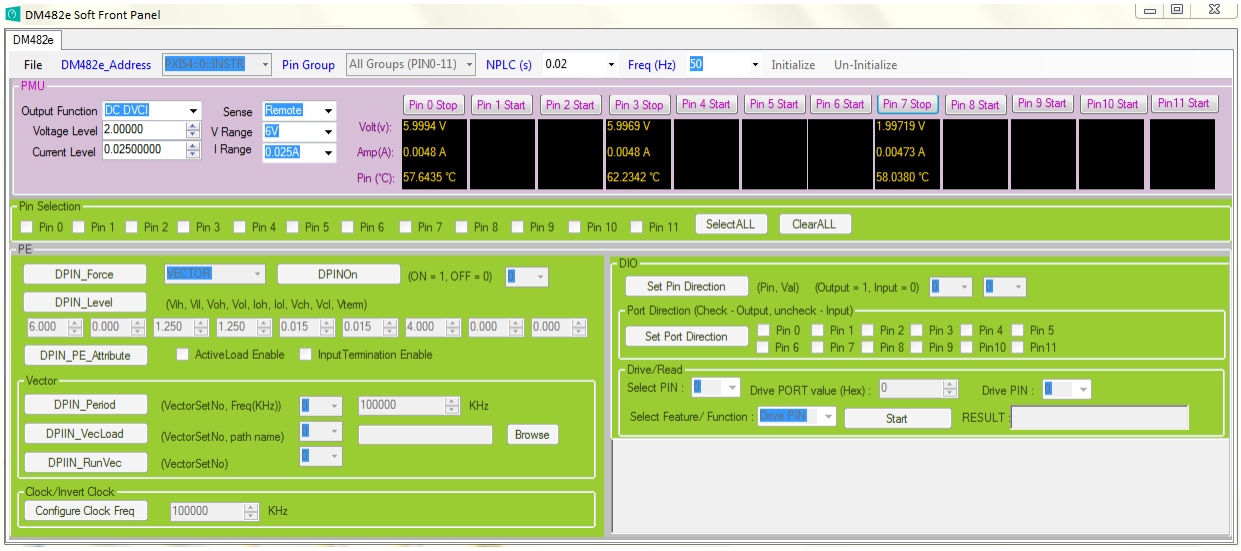



Figure 3: PMU Operation

### 2.2.2 MIPI Functions

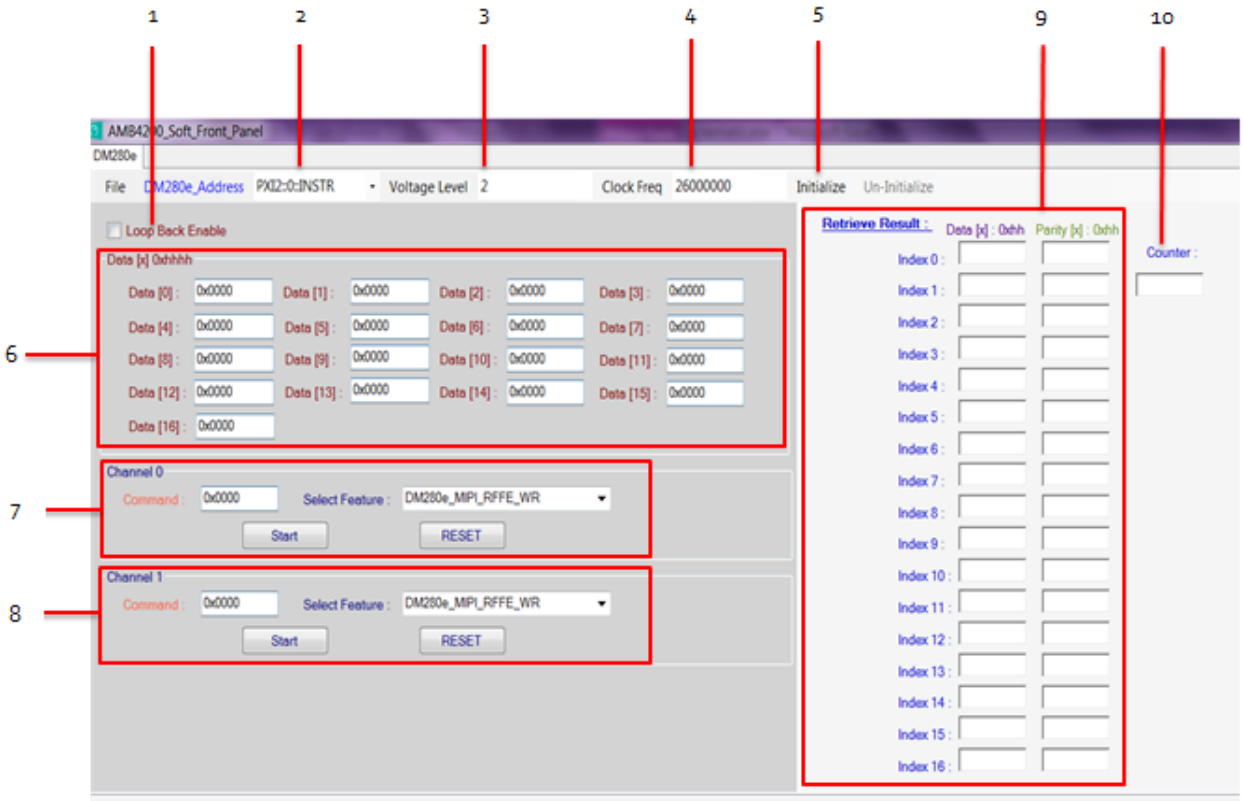



Figure 4: MIPI SFP

| Item | Description |
|---|---|
| 1 | Tick to enable loop-back[1] operation |
| 2 | Display the address of the module connected. A list of addresses is shown for all detected modules in the computer. |
| 3 | Set/ display the voltage supply of the module |
| 4 | Set/ display the frequency of the MIPI operation |
| 5 | Initialize or un-initialize the module |
| 6 | Data to be written into the module |

<table>
<tr><td>7</td><td>Channel 0 control panel:<br><br><table><tr><td>a</td><td>Start</td><td>Execute the operation</td></tr><tr><td>b</td><td>Command</td><td>The command to be sent to module for different MIPI operation</td></tr><tr><td>c</td><td>Select Feature</td><td>Select either DM482e_MIPI_RFFE_WR, DM482e_MIPI_RFFE_RD and DM482e_MIPI_RFFE_RETRIEVE</td></tr><tr><td>d</td><td>Reset</td><td>Reset all ports to input, drive logic low. Reset all internal registers</td></tr></table></td></tr>
<tr><td>8</td><td>Channel 1 control panel:<br><br><table><tr><td>a</td><td>Start</td><td>Execute the operation</td></tr><tr><td>b</td><td>Command</td><td>The command to be sent to module for different MIPI operation</td></tr><tr><td>c</td><td>Select Feature</td><td>Select either DM482e_MIPI_RFFE_WR, DM482e_MIPI_RFFE_RD and DM482e_MIPI_RFFE_RETRIEVE</td></tr><tr><td>d</td><td>Reset</td><td>Reset all ports to input, drive logic low. Reset all internal registers</td></tr></table></td></tr>
<tr><td>9</td><td>Display the data after read operation, together with its corresponding parity check bit.</td></tr>
<tr><td>10</td><td>Counter to display the number of data byte read</td></tr>
</table>

Table 5: MIPI Soft Front Panel Control

**Note:**

1. Loop-back – is an operation whereby the routing of signals or flows of items back to their originating devices or facilities without intentional processing or modification. This is used to test the transmission or transportation infrastructure.

Quick steps to configure the module:

1. Select PXIe address of the targeted module from the drop-down list.
2. Set the desired voltage level.
3. Set the desired frequency.
4. Press "Initialize".
5. Set desired operation from the feature in channel 0 or channel 1. For example, DM482e_MIPI_RFFE_WR.
6. Set the desired operation command, for example, 0x0202.
7. Set the data that should be written to the module at part (6). Refer to Figure 4.
8. Press "Start" to execute the command.
9. Press "Un-Initialize" to turn off the whole module.

**Note:**
Retrieve result and counter will be displayed after the operation of DM482e_MIPI_RFFE_RETRIEVE.

## 2.3 Remote Operation

Refer to programming manual.

## Section 3: Brief Technical Description

DM482e is a high speed digital waveform generator and analyzer, with integrated pin electronics (PE) and per pin parametric measurement unit (PPMU) functions.

### 3.1 Basic Operation

#### 3.1.1 Per Pin Parametric Measurement Unit (PPMU) Functions

Each DM482e pin can be configured can be set up to function as a voltage source/current monitor, current source/voltage monitor:

1. Source Current, Clamp Voltage (DICV)
    a. This configuration turns DM482e into high-impedance current source
    b. The voltage developed is limited by compliance setting
    c. If current is 0A, DM482e becomes a voltmeter

2. Source Voltage, Clamp Current (DVCI)
    a. This configuration turns DM482e into low-impedance voltage source
    b. Current flow is limited by compliance setting. Current compliance values are limited to the supported current range values. For example, if the available current ranges are 2uA, 20uA, 200uA, 2mA and 25mA, then the available compliance settings are 2uA, 20uA, 200uA, 2mA and 25mA.

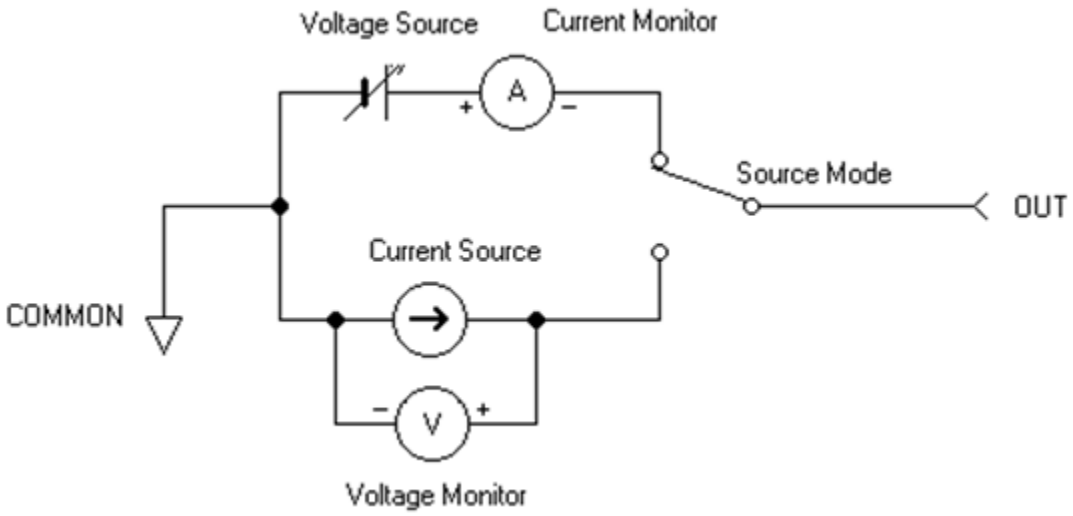



Figure 5: Typical Operation

To prevent over-voltage or over-current damage to the device-under-test (DUT), several levels of output protection, termed COMPLIANCE, is incorporated. Maximum specifiable compliance depends on the voltage or current range at which the pin is operating.
If a source pin reaches compliance during measurement, this indicates an error in the operation. Example:

1. DM482e is set to voltage source/current monitor mode; compliance of 2mA; output load is a 1kohm resistor.
2. If source voltage is 5V, the current that should flow through the resistor is 5V/1k=5mA.
3. Due to compliance of 2mA, the source channel turns into a constant current source of 2mA. This yields a voltage of 2V across the resistor.

The measurement result is the average value of all samples taken for $n^{th}$ number of power line cycle (PLC). For example, if the line frequency is set to 50Hz (period is 20ms), then 1 PLC equals to 20ms. The measured data is a resultant of averaged of raw samples captured by ADC on DM482e for 20ms.

**NOTE**

The NPLC setting of an instrument allows adjustment of the tradeoff between speed and accuracy. The greater the number of power line cycles, the greater noise rejection and better resolution the signal value will be.

### 3.1.2 Pin Electronics (PE) Functions

Apart from PMU, each DM482e pin can also perform the pin electronic functions of the driver, the comparator, and the active load (DCL), and DC levels for automated test equipment (ATE) applications. DM482e also contains high voltage drivers with capable of generating up to 13.5V on even-numbered pins (pins 0, 2, 4, 6, 8, and 10).

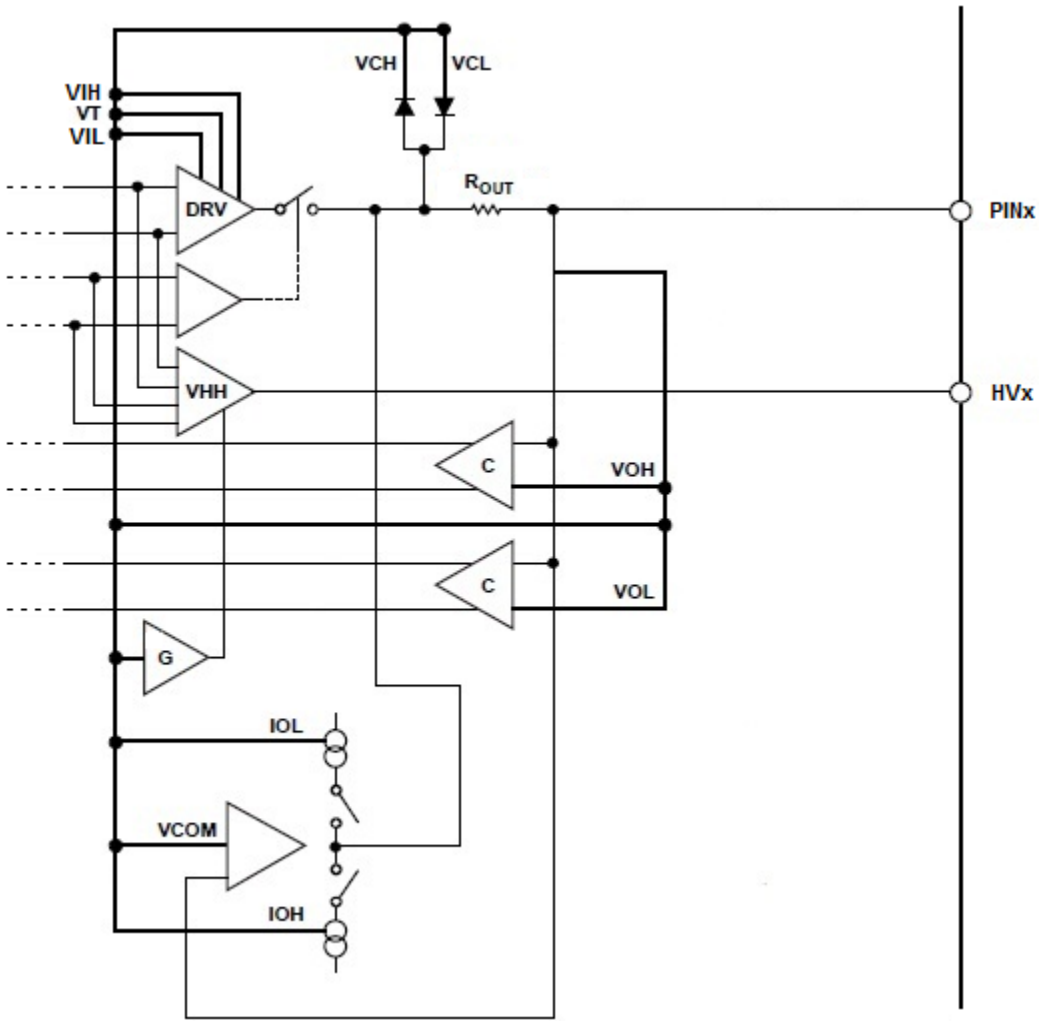



Figure 6: Pin Electronics (PE) Level Setting

Each pin consists of 9 level settings:

| Setting | Description |
|---|---|
| VIH | The output driver high voltage level from the pin. |
| VIL | The output driver low voltage level from the pin. |
| VOH | The input comparator high voltage level into the pin. |

| | |
|---|---|
| VOL | The input comparator low voltage level into the pin. |
| VT/VCOM | The termination voltage when input termination is enabled.<br>If input termination is disabled, driver is in high impedance. |
| IOH | The sink current when active load is enabled. |
| IOL | The source current when active load is enabled. |
| VCH | The reflection voltage clamp level for high range. |
| VCL | The reflection voltage clamp level for low range. |

Table 6: PE Level Setting

When differential comparator is enabled, odd pins (pins 1, 3, 5, 7, 9 and 11) will be disabled. The voltage difference between Pin 0 and Pin 1, for example, will be fed to the comparator of Pin 0 only.

Active load termination is a constant current source. If the external output voltage (e.g. from device-under-test) is more than VT, the pin will sink IOH current, otherwise, the pin will source IOL current.

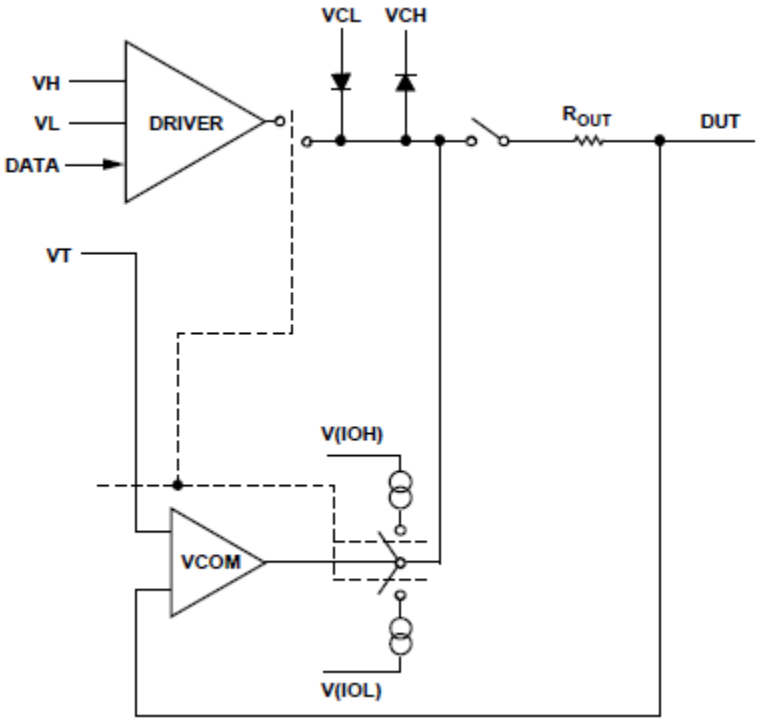



Figure 7: Active Load Block Diagram

### 3.1.3 Vector Engine Functions

DM482e allows user to generate or analyze user-defined patterns for each pin. Patterns are defined in a vector file (*.vec). Each vector file consists of one vector set only. Refer to specifications for the maximum number of supported vector set and timing set per DM482e.

If a pin is configured as an input-only or output-only pin, the data rate can achieve the maximum performance of DM482e. On the other hand, if a pin is configured as bi-directional pin, its maximum data rate is lower. Refer to specifications for details.

Figures below show the pattern format for dedicated pins and bi-directional pins.

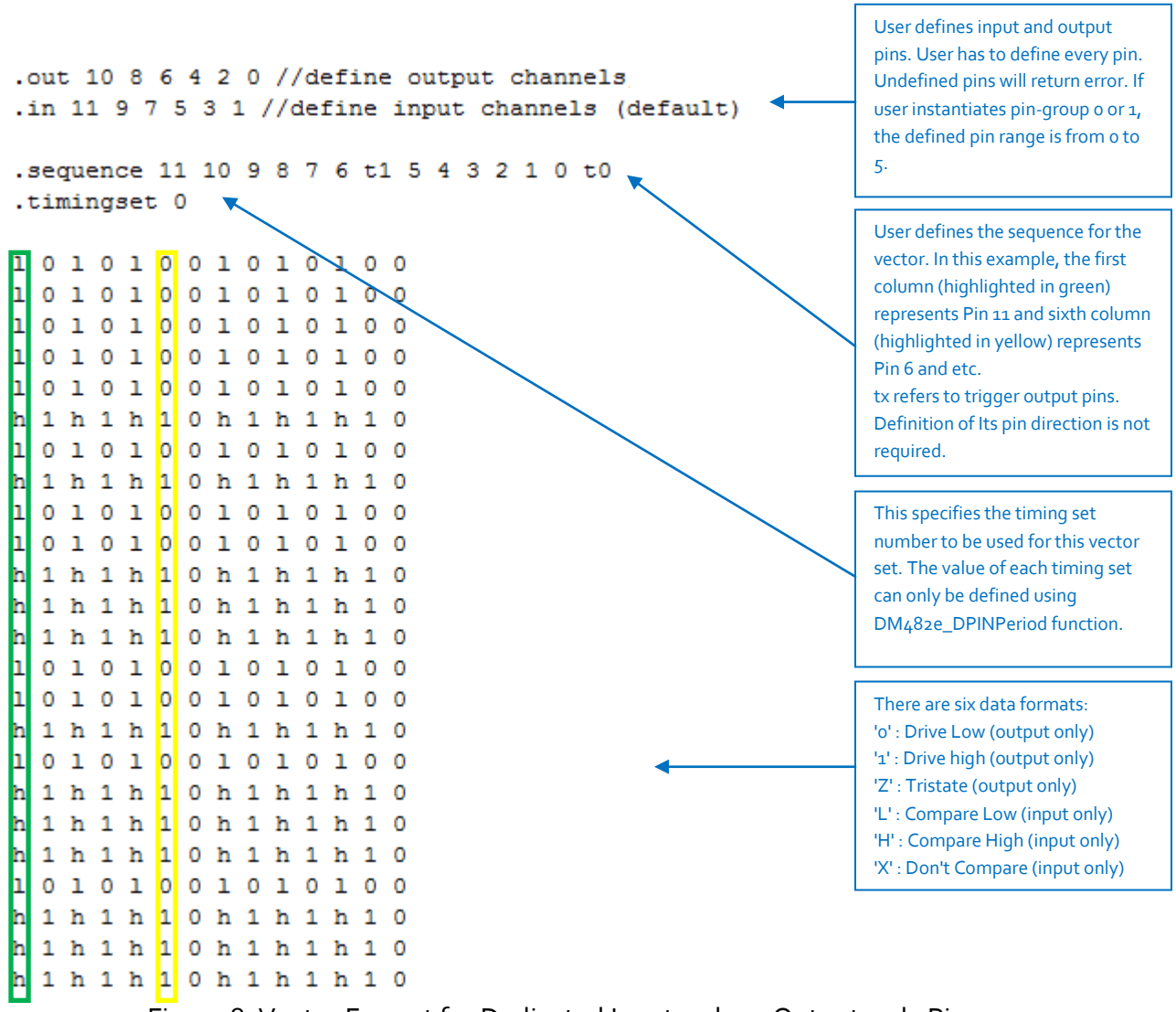



Figure 8: Vector Format for Dedicated Input-only or Output-only Pins

```
.sequence 11 10 9 8 7 6 t1 5 4 3 2 1 0 t0
.timingset 0

l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
h 1 h 1 h 1 0 h 1 h 1 h 1 0
l 0 l 0 l 0 0 l 0 l 0 l 0 0
```

The format is same as above except that user needs not define pin direction since it is bi-directional. Hence user can use all the six data formats for a pin.

Figure 9: Vector Format for Bi-directional Pins

### 3.1.4 Triggers

Figure below shows the triggering signals supported by DM482e. Only external trigger outputs are supported by vector engine.

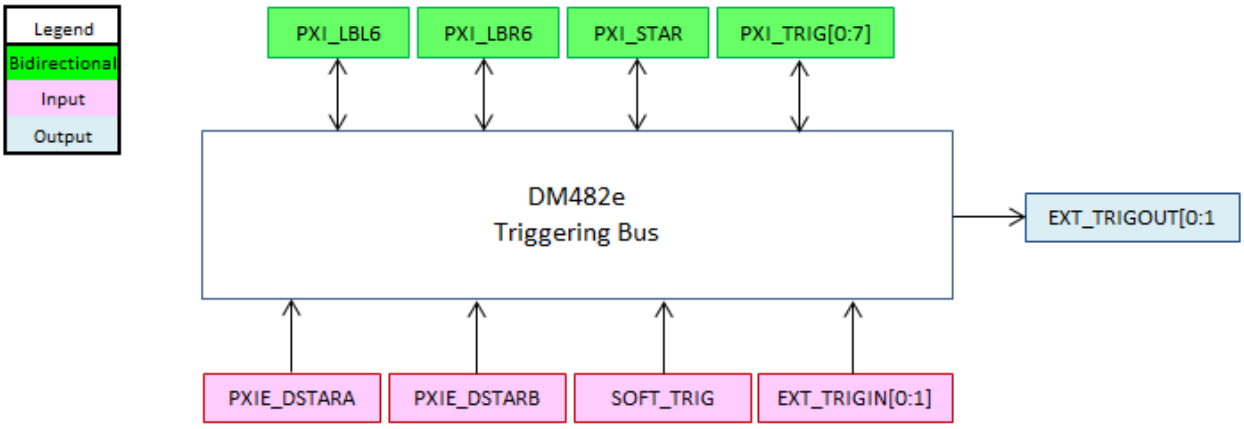



Figure 10: DM482e Trigger Bus

### 3.1.5 MIPI

DM482e contains MIPI controller to communicate with MIPI (Mobile Industry Processor Interface) RFFE (RF Front End) devices. It is capable of performing register o write, register write, extended register write, extended register write long, register read, extended register read as well as extended register read long operations. This feature avoids the hassle of constructing MIPI SCLK and SDATA using vectors or patterns.

The MIPI RFFE Specification defines an interface between RFFE-capable devices, with one master device and up to 15 slaves on a single RFFE bus. The RFFE Interface and bus structure is illustrated below.

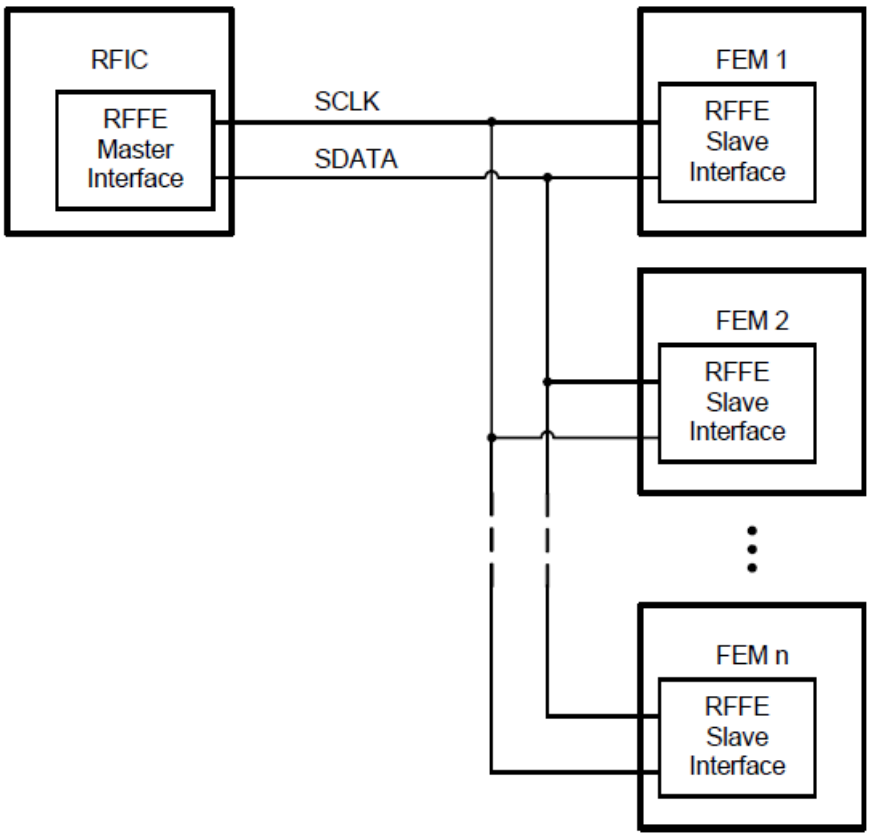



Figure 11: RFFE Interface and Bus Structure

MIPI uses two signal lines, a clock signal (SCLK) controlled by the master, a unidirectional/bidirectional data signal (SDATA), and an I/O supply/reference voltage (VIO). The choice of SDATA attribute is based on whether a slave device is write-only, or whether it supports read/write capability.

RFFE bus components are connected in parallel to the SCLK and SDATA lines of the bus. Line drivers always exist for both SCLK and SDATA in the master, whereas only slaves supporting read-back functionality need a line driver for SDATA. Each physical slave must have one SCLK input pin, one SDATA input or bidirectional pin, and a VIO pin to ensure signal compatibility between devices. Note that VIO can be supplied externally or it may be sourced from the master device.

## 3.2 Signal Connection

Depending on the mode of operation (PE or PMU), there are 3 leads per pin:

1. Force-High (FH)
2. Low (L)
3. Sense-High (SH)

For PMU mode, Force-High and Low signals are where voltage and current are generated during source or sink operation. Sense-High signals are high impedance paths. Connect these lines as close to the DUT terminal as possible for more accurate voltage source or measure operations. Presence of Sense lines at the DUT terminals is known as 4-wire, remote-sense, or Kelvin operation.

For PE mode, Sense-High lines do not play any role. Digital signals are travelling via Force-High and Low lines.

## Section 4: Maintenance

### 4.1 Cleaning

Before doing any cleaning to the product, switch off the chassis and disconnect it from main power supply.

You can wipe the front panel of the module using a soft cloth moistened in water, taking care not to wet the connectors. Do not use aerosol or liquid solvent cleaners.

You can use a handheld vacuum cleaner to remove any accumulated dust on the product, if necessary.

**CAUTION**

Be careful NOT to be in direct contact with any circuits on the product to prevent any damages. Contaminants such as oils and salts from the human skin can affect the performance of the product.

Comply with good ESD practice when handling the product during cleaning.

### 4.2 Calibration

Electronic components tend to drift over time. Environmental changes, operation stresses and aging increase the measurement uncertainty. Periodic calibration is required to ensure the accuracy of the instrument.

The recommended calibration interval for the product is 6 months.

### 4.3 Servicing

There are no user-serviceable parts in the product; if any attention is needed, return it to instrument manufacturer.

**NOTE**

Any repair that is not covered in this manual should only be performed by qualified Aemulus personnel.

## Section 5: Warranty

Aemulus warrants that the product delivered will be free from defects in material and workmanship for 1 year from the date of delivery order. This warranty does not cover the product if it is damaged in the process of being installed.

This warranty does not cover replacement of products damaged by abuse, accident, misuse, neglect, alteration, repair, improper installation or improper testing. If the product is found to be defective otherwise, Aemulus, at its option, will replace or repair the product at no charge. If you ship the product, you must assume the risk of damage or loss in transit. Aemulus may replace or repair the product with either a new or reconditioned unit, and the product returned becomes Aemulus property.

## Section 6: Revision History

| | | |
|---|---|---|
| 1.0 | DEC 2012 | INITIAL RELEASE |
| 1.1 | JUN 2013 | ADDED MIPI SPECIFICATION |
| 1.2 | OCT 2013 | ADDED OPERATING TEMPERATURE WARNING MESSAGE |

## Section 7: Contact Us

To obtain service, warranty or technical assistance, please contact Aemulus.

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Product specifications and descriptions in this document are subject to change without prior notice.