



DESIGNER'S HANDBOOK



MIB 8000 Multi-instrument



1. About the Designer's handbook	
1.1 Document information	3
1.1.1 Intended users of the Designer's handbook	3
1.1.2 Symbols for general notes	3
1.1.3 Symbols for hazard statements	3
1.2 Warnings and safety	4
1.3 Support information	5
1.4 Legal information	5
2. About the MIB	
2.1 Product overview	6
2.1.1 Application	6
2.1.2 Connection	6
2.1.3 Dimensions	7
2.2 Communication (only MIB 8000C)	7
2.3 Measurements	8
3. Measurements and functions	
3.1 Measured and calculated values	9
4. Wiring	
4.1 Input wiring	12
4.2 Auxiliary power supply wiring	12
4.3 Communication wiring (only MIB 8000C)	13
5. Operation	
5.1 MIB display and buttons	14
5.2 LCD display	15
5.3 Default password	16
6. Modbus	
6.1 How it works	17
6.2 Measuring principles	17
6.2.1 Voltage (U)	17
6.2.2 Current (I)	17
6.2.3 Power (P)	17
6.2.4 Reactive power (Q)	18
6.2.5 Apparent power (S)	18
6.2.6 Frequency (F)	18
6.2.7 Energy (Ep)	18
6.2.8 Reactive energy (Eq)	19
6.2.9 Apparent energy (Es)	19
6.2.10 Maximum demand	19
6.2.11 Total harmonic distortion (THD)	20
6.2.12 Three-phase unbalance factor	20
6.2.13 Maximum and minimum statistics	21
6.2.14 Running hour counter	21
6.3 Download Modbus tables	22
7. End-of-life	
7.1 Disposal of waste electrical and electronic equipment	23

1. About the Designer's handbook

1.1 Document information

1.1.1 Intended users of the Designer's handbook

This **Designer's Handbook** is mainly intended for the panel builder designer, and provides overall information about the MIB and functions. This document also provides information needed to operate or configure the MIB.

1.1.2 Symbols for general notes

NOTE This shows general information.



More information

This shows where you can find more information.



Example

This shows an example.



How to ...

This shows a link to a video for help and guidance.

1.1.3 Symbols for hazard statements



DANGER!



This shows dangerous situations.

If the guidelines are not followed, these situations will result in death, serious personal injury, and equipment damage or destruction.



WARNING



This shows potentially dangerous situations.

If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.



CAUTION



This shows low level risk situation.

If the guidelines are not followed, these situations could result in minor or moderate injury.

NOTICE



This shows an important notice

Make sure to read this information.

1.2 Warnings and safety

General safety guidelines



DANGER!

Incorrect use



Unjustified removal of protection devices, incorrect use, faulty installation or inappropriate operation could represent a serious risk to personnel and equipment.

All work relating to transportation, installation, commissioning and maintenance must be performed by experienced, qualified personnel (see IEC 364, CENELEC HD 384 or DIN VDE 0100, as well as national specifications for installation and accident prevention).

In these basic safety instructions, qualified personnel means persons competent to install, mount, commission and operate the product and possessing the relevant qualifications.

Safety guidelines during installation

The installation and cooling of equipment must comply with the specifications in the data sheet.

The MIB must be protected against excessive stress. In particular, there must be no damage to parts and/or modification of the clearance between components during transportation and handling.

Avoid touching any live parts.

Safety guidelines during electrical connection

When work is performed on MIBs which are powered up, national accident prevention specifications must be respected.

The electrical installation must comply with the relevant specifications (for example conductor cross-sections, protection via fused circuit-breaker, or/and connection of protective conductor).

Protective earth



DANGER!



Risk of electric shock

Failure to connect the earth/ground may result in electric shock.

The MIB must be connected to an approved earth/ground using the earth/ground terminal.

Electrostatic discharge

Protect the equipment terminals from electrostatic discharge when not installed in a grounded rack. Electrostatic discharge can damage the terminals.

1.3 Support information

Technical support

Technical documentation



Download free without registration any of the MIB technical documentation from the DEIF website:
<https://www.deif.com/documentation/mib/>

Service and support

DEIF is committed to being available to our customers and partners 24 hours a day, seven days a week, to guarantee the highest levels of service and support.

<https://www.deif.com/support>

Training

DEIF arranges **training courses** at DEIF offices worldwide.

<https://www.deif.com/training>

Additional service

DEIF offers **service** with design, commissioning, operating and optimisation.

<https://www.deif.com/support/local-office>

1.4 Legal information

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

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2. About the MIB

2.1 Product overview

2.1.1 Application

The MIB multi-instrument is a microprocessor-based measuring unit providing measurement of most electrical quantities on a 3-phase electric energy distribution network. The measurements are shown on the built-in display.

The MIB is available in two versions:

- MIB 8000 (basic)
- MIB 8000C (with communication + optional I/O extension module)

True RMS values on all 3-phase network topologies are measured with/without neutral and with both balanced and unbalanced load. A large number of standard analogue instruments can be replaced by the MIB in all electrical measuring applications. The MIB contains all necessary measuring circuits and presents all values on a display with white backlight. The display has 4 digits resolution for all measurements. The backlight on-time is selectable. Operating the MIB is very easy. It is a flexible and logical measuring unit that enables the user to easily adapt the instrument to the individual application. Counter reset and change of settings can be password protected.

The optional I/O extension module (only for the MIB 8000C) extends the number of I/O possibilities. Digital input, pulse counter, pulse output, and SOE can be provided by the extension module.

2.1.2 Connection

The MIB can be used in almost all 3-phase network topologies with/without neutral and with both balanced and unbalanced load. The voltage and current input wiring modes are set separately in the parameter setting process.

The voltage wiring mode can be:

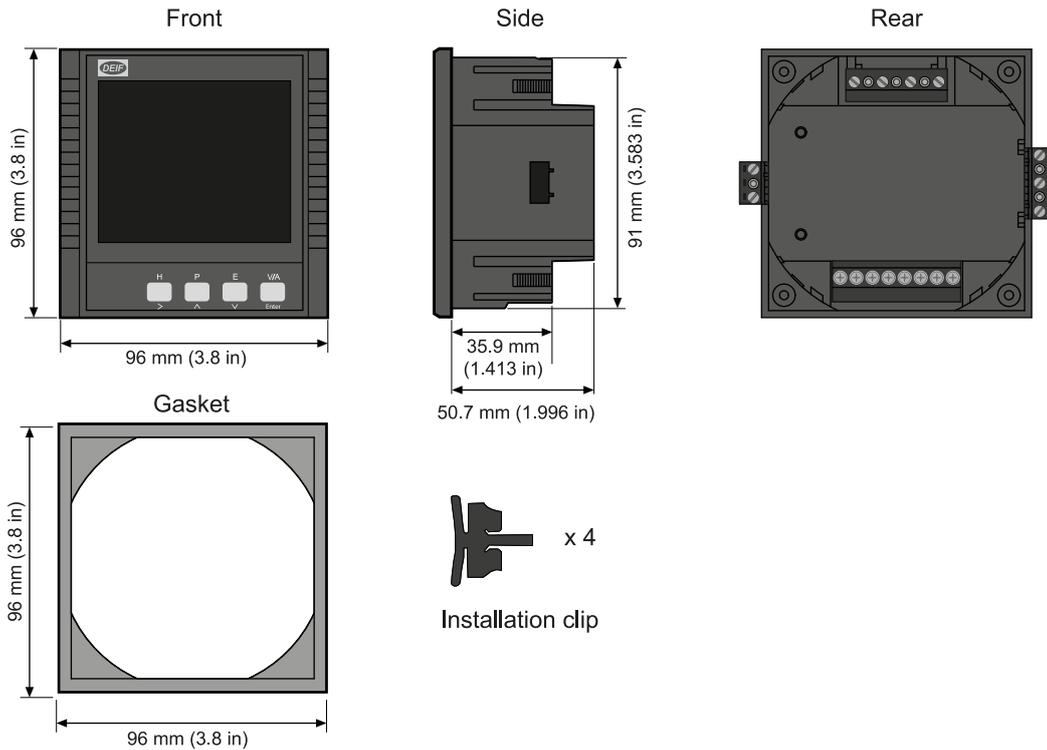
- 3LN 3-phase 4-line Y
- 2LN 3-phase 4-line Y with 2 VT
- 1LN 1-phase 2-line
- 2LL 3-phase 3-line open delta
- 3LL 3-phase 3-line direct connection

The current input wiring mode can be:

- 3CT Unbalance system
- 2CT Unbalance system without N
- 1CT Balance system

Any voltage mode can be grouped with any of the current modes. The MIB is supplied configured in 3-phase 4-wire unbalanced mode, that is to say, voltage wiring mode 3LN and current input mode 3CT (3W4).

2.1.3 Dimensions

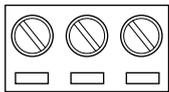


2.2 Communication (only MIB 8000C)

Suitable for SCADA systems, RS-485 serial output, and Modbus RTU protocol.

The communication port and protocol are RS-485 and Modbus RTU.

Communication



Comm Port		
A	B	S
14	15	16

The terminals are A, B and S (14, 15, 16).

- A is differential data signal +
- B is differential data signal
- S is connected to a shield of twisted pair cables

The unit can handle up to 32 devices on the RS-485 bus. The maximum connection length is 1000 m. Conductors A and B should be terminated with a 120 Ω (Ohm) terminating resistor at the end of the string. Use a baud rate of 9600 bps.

The MIB 8000C operates as server unit, and the client unit is normally a PC, PLC or a data collector of RTU. The communications port of the client unit must have RS-485 port.

USB/RS-485 or RS-232/RS-485 converter can be used to convert signal for PC.

Use shielded twisted pair of cable AWG22 (0.6 mm²).

The shield of the RS-485 cable must be connected to the ground at one end only

2.3 Measurements

Measurement	Description
Voltage	Actual voltage of each phase-phase and phase-neutral.
Current	Actual current of each phase and neutral current.
Active power (P)	Active power of each phase.
Reactive power (Q)	Reactive power of each phase.
Apparent power (S)	Total apparent power.
Demand	Demand of each phase current, active power and reactive power.
Power factor (PF)	Power factor of each phase and total power factor.
Min./max. :	Min./max. of demand, voltage, current and active/reactive power.
THD (up to 15th harmonics)	Voltage/current THD of each phase.
Energy	Import and export of energy, inductive and capacitive of reactive energy.
Alarm	Alarm can be related to any metering parameters.
Running hour	Meters the duration of the operation

3. Measurements and functions

3.1 Measured and calculated values

Almost all the electric parameters in power systems can be measured by the MIB. Some of the parameters which are special will be described in this part.

Reactive power (Q)

MIB adopts two definitions of reactive power:

1. Sinusoidal reactive power.

- The formula is as follows:
- $Q^2 + D^2 = S^2 - P^2$

2. Nonsinusoidal reactive power.

- The formula is as follows:

$$Q^1 = \sqrt{Q^2 + D^2}$$

Where: Q_D : Budeanu's distortion power

- Q : Budeanu's reactive power

Apparent power (S)

System total apparent power is measured and displayed.

Power factor (PF)

3-phase power factor and system total power factor are measured and displayed.

Frequency (F)

The frequency of L1 phase voltage input is measured as system frequency.

Energy (kWh)

Energy is time integral of power. The unit is kWh.

Import energy (imp)

"_"

Export energy (exp)

"+" is not shown in the display.

Reactive energy (kVArh)

Reactive energy is time integral of reactive power. The unit is kVArh.

Import energy (imp)

Capacitive energy.

Export energy (exp)

Inductive energy. Energy terms are based on the generator method.

Harmonic parameter : Total harmonic distortion

This factor is often used to express the power quality of the power system. The formula is as follows:

$$THD = \sqrt{\sum_{h=2}^{\infty} \left(\frac{U_h}{U_1} \right)^2} \times 100$$

In the formula, U_1 is RMS value of the voltage fundamental and U_h is RMS value of the voltage harmonic with order n.

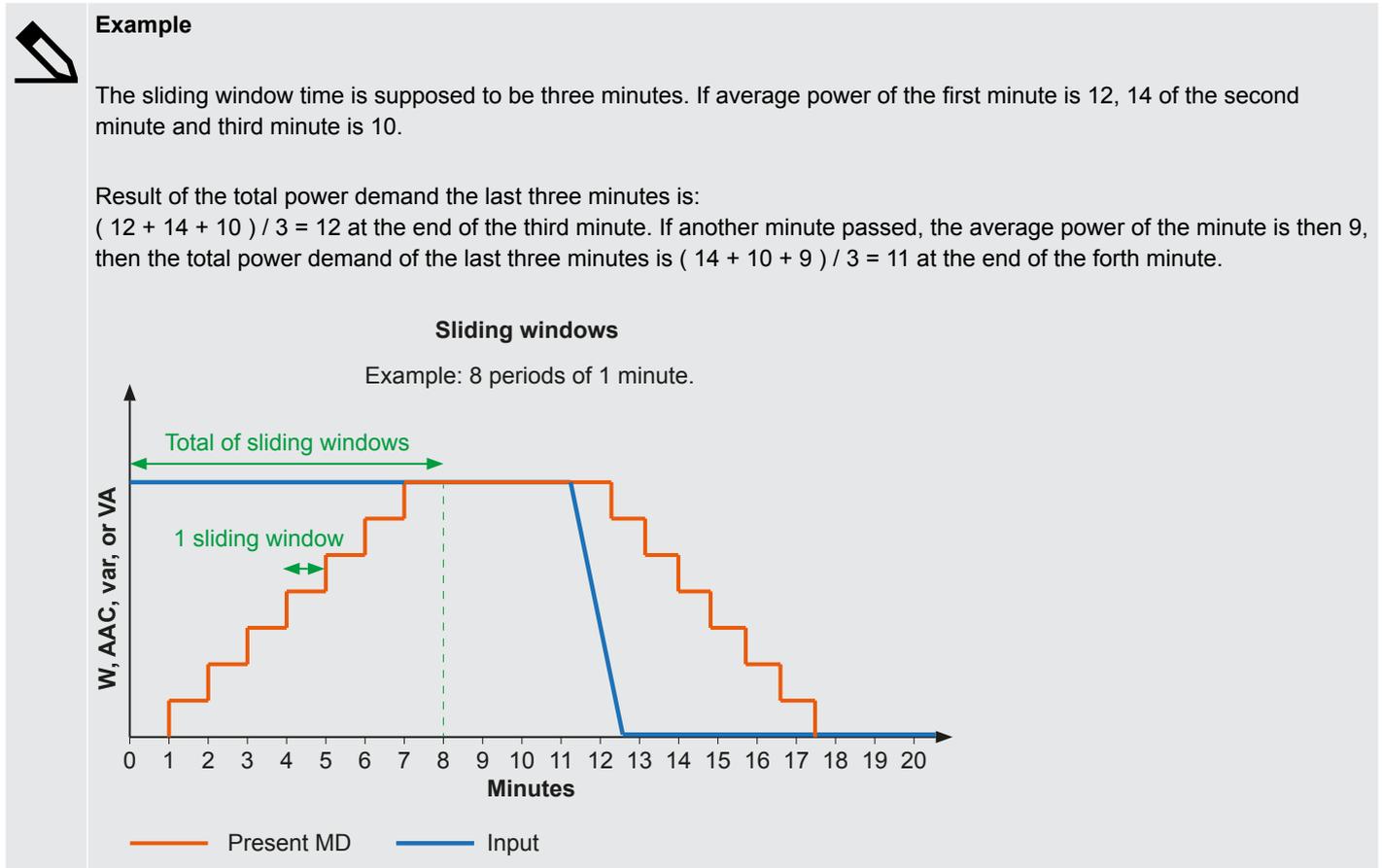
Harmonic parameter : Each harmonic rate

The percentage of each harmonic divided by fundamental.

$$HRU_h = \frac{U_h}{U_1} \times 100 \quad HRI_h = \frac{I_h}{I_1} \times 100$$

Demand

Demand of total power and reactive power of system, demand of 3-phase current. The demand statistics method in MIB is sliding windows. The total sliding windows time can be chosen from 1 to 30 minutes. Each window slides once per minute.



Unbalance factor

MIB can measure the unbalance factor of 3-phase voltage and current, using the method of sequence vector.

Max/Min: MIB can measure the max value of a system's total power, reactive power and apparent power and the max/min of the 3-phase voltage and current. The value of the measured data is stored in NV-RAM.

Alarm function

When the measured data value has reached the pre-set alarm limit and pre-set alarm time has expired, an alarm will be generated.

Digital output (only MIB 8000C with Extension module)

The digital output (DO) can be used to trigger a light or sound alarm indication. The following example describes how the over-limit alarming works.



Example : DO11+DO12 alarm output

Alarm occurs with current I1 goes over 1 A for a duration of more than 15 seconds.

1. Set the mode of DO11 as mode 1 (alarm output).
2. Set alarm time to 15 seconds, 1 digit represents 300 ms:
 - The value is: $15 \div 0.3 = 50$.
3. Alarm output item is I1, and value must be set to 7.
4. I1 must be higher than 1A, so the alarm function must be set to 1 (High alarm = 1).
5. Set alarm limit to 1A (use direct primary values).

Energy pulse output

The two digital outputs can be used as energy pulse outputs. The output energy can be selected among all kinds of active and reactive energy terms. Pulse rate and pulse width can be set to meet the requirements.

Pulse constant is the amount of kWh for each pulse.

Pulse width is the time that a pulse lasts.

When the accumulated energy reaches the pulse rate value, there will be a pulse on the digital output.

Related parameters:

Pulse energy output ranges from 0 to 4 corresponding to none, Ep_imp, Ep_exp, Eq_imp, Eq_exp.

Pulse rate ranges from 1 to 6000 (integer) with a unit of 0.1kWh (kVArh), apparently that is the resolving power of energy output.

Pulse width ranges from 1 to 50 (integer) with a unit of 20ms. The narrowest interval between two pulses is 20ms.

In practice the pulse width and the pulse ratio are selected according to system power. The relation of the two parameters should satisfy the following expression:

$$\text{Pulse rate} > [(\text{pulse width} + 1) \times P_{\max}] \div 18000$$

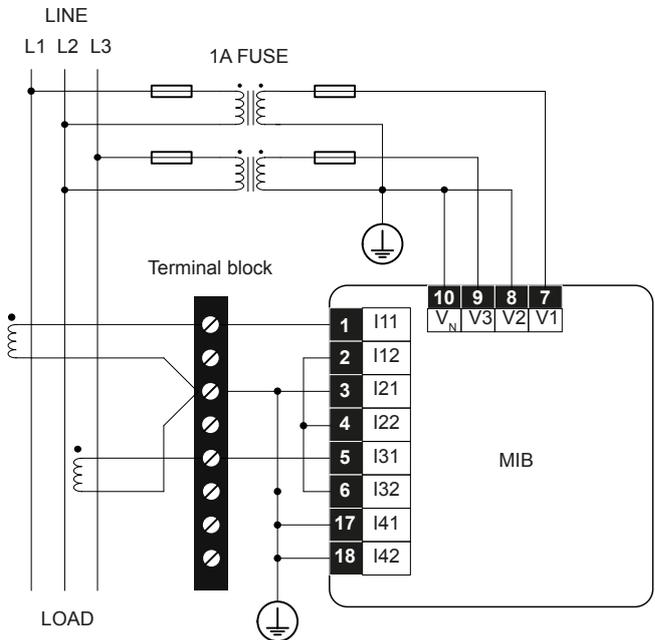
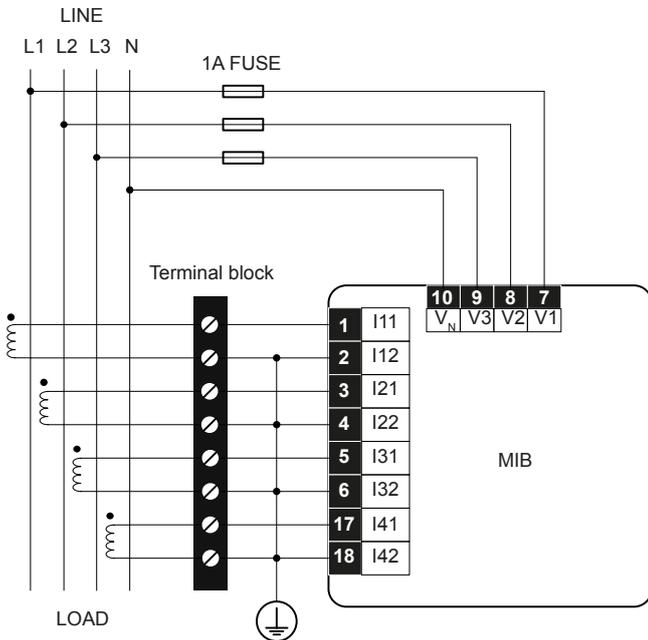
P_{\max} is the maximum power or reactive power.

The unit is kW or kVA. Recommended pulse rate is 3 to 5 times the right side value of the above expression.

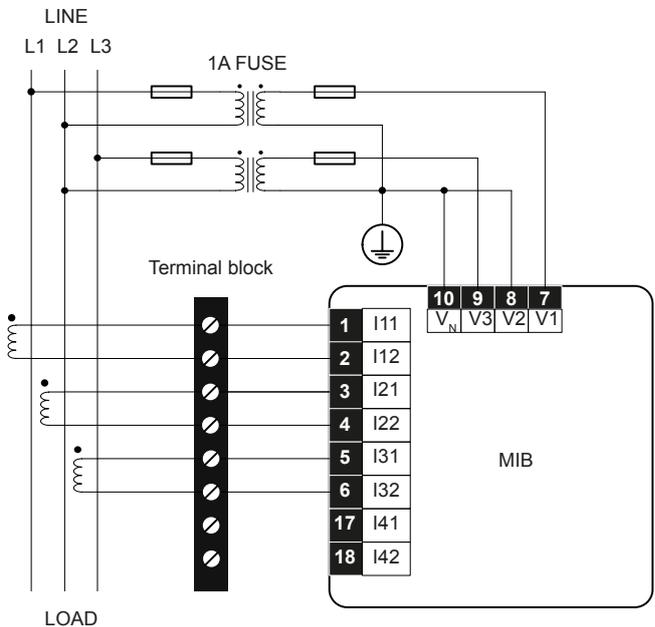
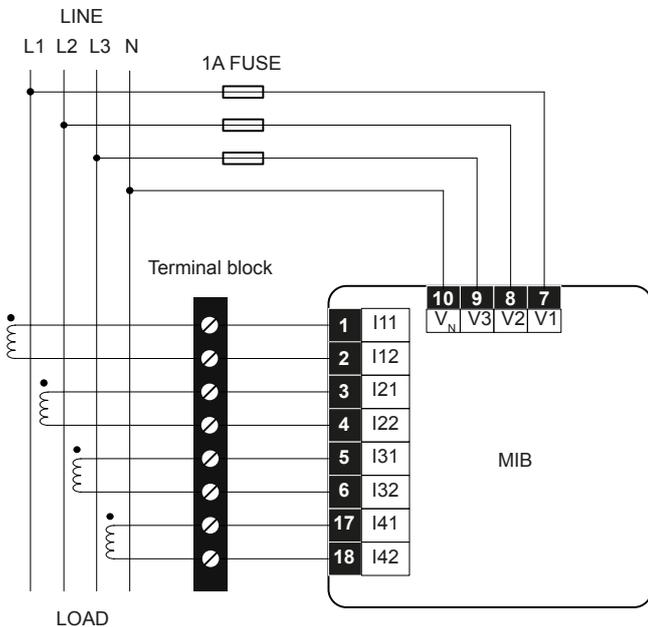
4. Wiring

4.1 Input wiring

Input configurations (5 Aac / 1 Aac):



Input configurations 333 mV / 100 mV (Rogowski coil) / 200 mA / 6.68 mA:



More information

See the **Installation instructions** for more information about installation, panel fitting, and connections.

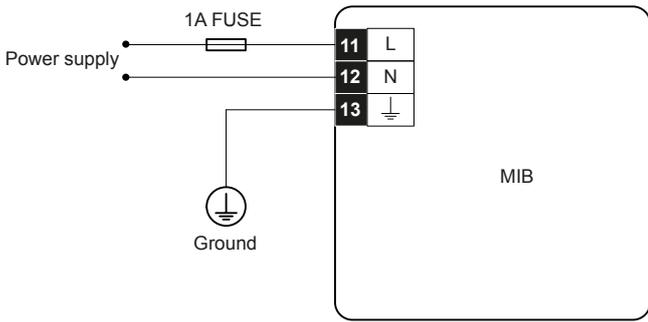
4.2 Auxiliary power supply wiring

The MIB is typically powered by the input configurations, but can also be powered by an auxiliary power supply.

MIB has 1 auxiliary power supply option for different applications (terminals 11, 12, and 13).

Universal (standard) :

100 to 415 Vac, 50 to 60 Hz, 100 to 300 Vdc

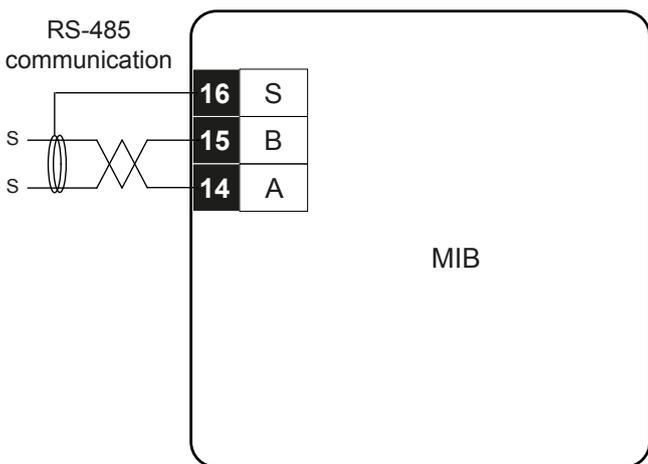


4.3 Communication wiring (only MIB 8000C)

MIB uses RS-485 serial communication and the Modbus-RTU protocol.

Communication terminals are A, B, and S (terminals 14, 15, 16).

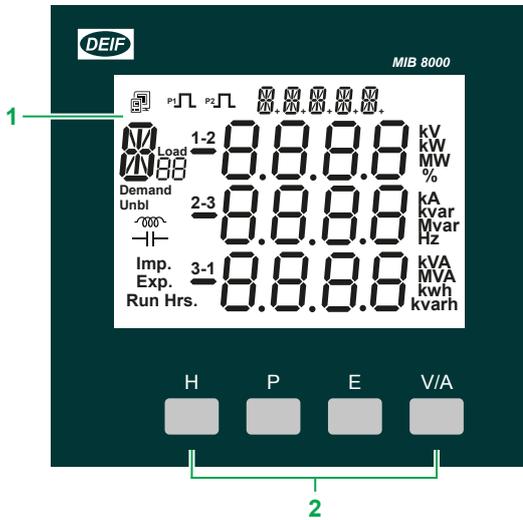
- A is differential signal +
- B is differential signal -
- S is connected to a shield of twisted pair cable.



5. Operation

5.1 MIB display and buttons

The MIB has a white backlight display used for all measured values and for configuration during the setup process.



No.	Name	Function
1	Display	Shows measured values and used for configuration modes. Display can operate in 3 modes: <ol style="list-style-type: none"> Display mode <ul style="list-style-type: none"> Shows measured values. System mode <ul style="list-style-type: none"> Configure the MIB settings. Statistic mode <ul style="list-style-type: none"> Shows recorded log values.
2	Push-buttons	Press buttons in display mode to change display: H = Power quality P = Power E = Energy V/A = Volt/Ampere Press combination of buttons to access other modes: Press H and V/A to enter System mode . Press H and E to enter Statistic mode .

System mode

Press **H** and **V/A** to enter **System mode**.

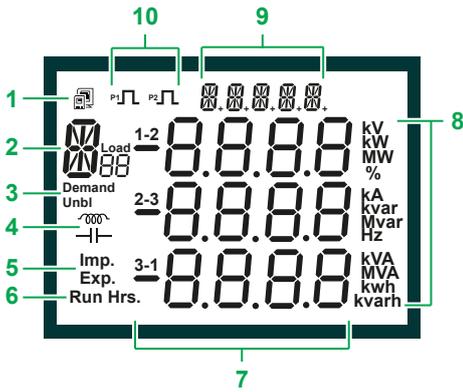
You can now view or configure settings:

- Press **H** to move the cursor one digit at a time.
- Press **P** to increase digit.
- Press **E** to decrease digit.
- Press **V/A** to accept setting and display next screen.

Statistic mode

Statistic mode shows the recorded log values.

5.2 LCD display



No.	Name	Symbol	Function
1	Communication		Shows communication is active. (Only for MIB 8000C)
2	Item label		U: Voltage I: Current P: Active power q: Reactive power PF: Power factor For harmonic rate, the little 8 segment displays harmonic value.
3	3-phase unbalance	Unbl	Shows unbalance label.
4	Load nature		Capacitive load.
			Inductive load.
5	Energy label	Imp.	Consumption energy.
		Exp.	Generating energy.
6	Time label	Run Hr:	Shows the running time in hours.
7	Values	¹⁻² 8.8.8.8 ²⁻³ 8.8.8.8 ³⁻¹ 8.8.8.8	Shows 3 lines of metering data.
8	Unit	-	Voltage: K, kV Current: kA, A Power: kW, MW Reactive power: kvar, Mvar Apparent power: kVA, MVA Frequency: Hz Energy: kWh Reactive power: kvarh Percentage: %
9	Status display		Meter: Metering status Max: Maximum value Min: Minimum value THD: Display THD Har: Harmonic data
10	Energy pulse output		Shows pulse P1 output.
			Shows pulse P2 output.

5.3 Default password

The parameter setting mode is protected by a four digit password each time.

The default password is **0000**.



6. Modbus

6.1 How it works

The MIB is based on a digital processing platform. All current and voltage input signals are digitally sampled and all values are calculated from these sampled signals. The MIB can also measure total harmonic distortion of voltage and current.

6.2 Measuring principles

6.2.1 Voltage (U)

The MIB calculates the true RMS value of the 3 phase-neutral voltages (V1, V2, V3) and the 3 phase-phase voltages (V12, V23, V32) using this equation:

$$U_{RMS} = \sqrt{\frac{\sum_{n=1}^N u_n^2}{N}}$$

where N = number of sampled values/period, and u_n = sampled value. The MIB uses N = 64 for the calculations.

You can see all voltage values on the display. You can also view the values remotely using RS485 communication and MIBLink, the utility software for MIB.

If you use Modbus to collect the voltage data you need to use this equation to calculate the values:

$$U = Rx \times \frac{PT1}{PT2} / 10$$

where Rx = register value, and PT1 and PT2 = voltage transformer data.

6.2.2 Current (I)

The MIB calculates the true RMS value of the three phase currents with this equation:

$$I_{RMS} = \sqrt{\frac{\sum_{n=1}^N i_n^2}{N}}$$

where N = number of sampled values/period and i_n = sampled value. The MIB uses N = 64 for the calculations.

You can see the current values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the current data, you need to use this equation to calculate the values:

$$I = Rx \times \frac{CT1}{CT2} / 1000$$

where Rx = register value, and CT1 and CT2 = current transformer data.

6.2.3 Power (P)

The MIB calculates the three-phase power and the total power of the system. You can see all the power values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the power data, you need to use this equation to calculate the power values:

$$P = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

6.2.4 Reactive power (Q)

The MIB calculates the three-phase reactive power and the total reactive power of the system. You can see all the reactive power values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the reactive power data, you need to use this equation to calculate the reactive power values:

$$Q = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

6.2.5 Apparent power (S)

The MIB calculates the three-phase apparent power and the total apparent power of the system. You can see all the values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the apparent power data, you need to use this equation to calculate the values:

$$S = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

6.2.6 Frequency (F)

The frequency of phase 1, which is the voltage input, is measured as system frequency. You can see all the frequency values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the frequency data, you need to use this equation to calculate the values:

$$F = \frac{Rx}{100}$$

where Rx = register value.

6.2.7 Energy (Ep)

The energy is the time integral of power, and the unit is kWh. Import of energy is equal to the consumption of energy, and is therefore positive. Export of energy is equal to the generation of energy, and is therefore negative.

You can see the energy counters on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the energy data, you need to use this equation to calculate the values:

$$Ep = \frac{Rx}{10}$$

where Rx = register value.

6.2.8 Reactive energy (Eq)

The reactive energy is the time integral of reactive power, and the unit is kVAh. Import of reactive energy is equal to inductive reactive energy, and is positive. Export of reactive energy is equal to capacitive reactive energy and is negative.

You can see the reactive energy counters on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the reactive energy data, you need to use this equation to calculate the values:

$$Eq = \frac{Rx}{10}$$

where Rx = register value.

6.2.9 Apparent energy (Es)

The apparent energy is the time integral of apparent power, and the unit is kVAh. You can see the apparent energy counter on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the apparent energy data, you need to use this equation to calculate the apparent energy values:

$$Es = \frac{Rx}{10}$$

where Rx = register value.

6.2.10 Maximum demand

You can view the demand values of power, reactive power, and apparent power on the MIB. The MIB uses the method of sliding window statistics to calculate the demand values. In this method, a window of specified length, moves over the data, sample by sample, and the statistic is computed for the data in the window. You can set the length of the window sliding time to be between 1 to 30 minutes. The window slides one minute each time. The MIB always calculates the average demand every minute. If the time is set to 3 minutes, then the MIB uses the remaining 3 minutes to calculate the average demand.

You can see the demand values on the display. You can also view the values remotely using RS485 or MIBLink, the MIB utility software.

If you use Modbus to collect the demand data, you need to use these equations to calculate the demand values:

Power (P)

$$Dmd_P = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

Reactive power (Q)

$$Dmd_Q = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

Apparent power (S)

$$Dmd_S = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

Current, I1

$$Max_Dmd_of_I1 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

Current, I2

$$Max_Dmd_of_I2 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

Current, I3

$$Max_Dmd_of_I3 = Rx \times \frac{PT1}{PT2} \times \frac{CT1}{CT2}$$

where Rx = register value, CT1 and CT2 = current transformer data, and PT1 and PT2 = voltage transformer data.

6.2.11 Total harmonic distortion (THD)

The MIB calculates the total harmonic distortion (THD) for these values:

- The three-phase current
- The average current
- The three phase-neutral voltages*
- The average phase-neutral voltage*

NOTE * If the voltage input is 2LL, the MIB calculates the TDH for the three phase-phase voltages.

The THD is expressed as a percentage of harmonics due to the fundamental frequency. The MIB uses a true RMS measurement technique to calculate the values with harmonics present up to 31st harmonics.

You can see the THD values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the THD data, you need to use this equation to calculate the THD values:

$$THD = \frac{Rx}{1000 \times 100\%}$$

where Rx = register value.

6.2.12 Three-phase unbalance factor

The MIB can measure the three-phase voltage unbalance factor and the three-phase current unbalance factor. The factor is expressed in percentage, and is calculated using these equations:

$$\text{Voltage unbalance factor} = \frac{\text{Max difference value of the three voltages}}{\text{Average value of the three voltages}}$$

$$\text{Current unbalance factor} = \frac{\text{Max difference value of the three currents}}{\text{Average value of the three currents}}$$

You can see the unbalance factors on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the unbalance factor data, you need to use these equations to calculate the values:

$$U_unbl = \left(\frac{Rx}{1000}\right) \times 100\%$$

where Rx = register value.

$$I_unbl = \left(\frac{Rx}{1000}\right) \times 100\%$$

where Rx = register value.

6.2.13 Maximum and minimum statistics

The MIB stores the maximum and minimum value of this data:

- The three phase-neutral voltages
- The three phase-phase voltages
- The three phase currents
- The power
- The reactive power
- The apparent power
- The power factor
- The frequency
- The system total power demand
- The system total reactive power demand
- The system total apparent power demand

You can see the statistics values on the display. You can also view the values remotely using RS485 communication and MIBLink, the MIB utility software.

The MIB stores the data in a non-volatile RAM. You can reset the statistics data from the display and using RS485 communication.

6.2.14 Running hour counter

The MIB has a running hour counter that shows the number of hours the MIB has been connected to the auxiliary supply. You can see the counter on the display. You can also view the counter remotely using RS485 communication and MIBLink, the MIB utility software.

If you use Modbus to collect the data, you need to use this equation to calculate the running hour (RH) values:

$$RH = \frac{Rx}{10} \text{ [h]}$$

where Rx = register value.

6.3 Download Modbus tables

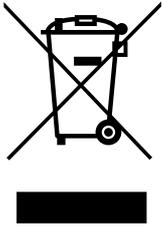
To download the Modbus tables, follow these steps:

1. Go to www.deif.com/documentation/mib/
2. Go to the **Reference** section, and select **Communication**.
3. Select the Modbus tables to start the download.

7. End-of-life

7.1 Disposal of waste electrical and electronic equipment

WEEE symbol



All products that are marked with the crossed-out wheeled bin (the WEEE symbol) are electrical and electronic equipment (EEE). EEE contains materials, components and substances that can be dangerous and harmful to people's health and to the environment. Waste electrical and electronic equipment (WEEE) must therefore be disposed of properly. In Europe, the disposal of WEEE is governed by the WEEE directive issued by the European Parliament. DEIF complies with this directive.

You must not dispose of WEEE as unsorted municipal waste. Instead, WEEE must be collected separately, to minimise the load on the environment, and to improve the opportunities to recycle, reuse and/or recover the WEEE. In Europe, local governments are responsible for facilities to receive WEEE. If you need more information on how to dispose of DEIF WEEE, please contact DEIF.