The Synchronization Experts.

SETUP GUIDE

IMS-FDM182

Hot-Plug Module

November 24, 2023

Meinberg Funkuhren GmbH & Co. KG

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1 Imprint

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2 Change Log

Version	Date	Revision Notes
1.0	5/22/2023	Initial version
1.01	6/13/2023	Minor layout adjustments, added information on Vorne FDM string
1.1	10.07.2023	Information added on new revision of IMS-FDM182 with RS-422 support

3 Introduction

The IMS-FDM182 is used to measure the grid frequency of an input AC voltage for grids with a nominal frequency of 50 Hz or 60 Hz. It also serves to monitor frequency deviations and maintains a "power line time" on this basis. This time of day is kept in relation to the accurate reference time maintained by the IMS system to enable a 'drift' value to be calculated that provides a representation of how the frequency of the input AC voltage deviates over time.

How It Works

The host reference clock of the IMS system provides a serial time string and a pulse-per-second signal. These signals are critical to the accuracy of the measurements and provide the basis for the accurate **reference time**. When the FDM module is (re)started, the **power line time** is also synchronized with the reference time, so that the time deviation is also zero at this point.

The **reference time** from this point continues to be synchronized on the basis of the signals from the reference clock, while the **power line time** is maintained solely on the basis of the mains frequency. For example, if the IMS-FDM182 is configured to expect a 50 Hz grid frequency, for example, one second of the power line time is equivalent to 50 oscillations of the input voltage.

If the power line frequency drops to 49.5 Hz for exactly one second, one second will pass in the power time line while 1010 milliseconds have passed in the reference time; one second in the reference time scale remains exactly 1000 milliseconds. This results in a drift of +10 milliseconds. If the same frequency deviation persists for another second, the drift increases to +20 milliseconds. This drift (time deviation) therefore provides a direct measure of frequency instability over time.

Compatibility

The IMS-FDM182 is an IMS module that is compatible with all of the current systems in the IMS LANTIME family:

IMS System	M500	M1000	M1000S	M2000S	M3000	M3000S	M4000
Compatible	✓	✓ *	✓ *	✓	✓	✓	✓

* Please note that the IMS-FDM182 cannot be installed in the MRI slot of an IMS LANTIME M1000 or M1000S due to the physical dimensions of the electrical insulation plate.

The module can be installed in any IO, MRI, or ESI slot of your IMS LANTIME system:

IMS Slot	PWR	CLK	CPU	MRI	ESI	I/O
Compatible	✗	✗	✗	✓	✓	✓

To eliminate any risk of compatibility problems, your IMS system should have at least **LANTIME OS Version 7.06** installed.

Manual Revisions

Meinberg products are subject to ongoing development even after their market release, with new features and enhancements added on a regular basis via firmware and software updates. Meinberg also revises its product manuals to account for these feature updates.

This version of the manual has been prepared based on the feature set provided by **Firmware Version 1.45** of your IMS-FDM182 as well as **LANTIME OS Version 7.08**. When using a LANTIME system or IMS module with different versions, there may be noticeable differences, for example in the presentation and availability of options in the Web Interface as shown in Chapter **10** ("**Configuration and Setup via Web Interface**").

Further Reading

This brief Setup Guide only provides the information required to quickly set up your module in your IMS system with a minimum of problems. We recommend also carefully studying the following manuals alongside this Setup Guide for the use of your IMS-FDM182:

Meinberg Manuals (all systems)	**http://www.mbg.link/doc-en**
LANTIME OS Version 7 Firmware Manual	**http://www.mbg.link/doce-fw-ltos**

The LANTIME OS firmware manual in particular provides a detailed description of all configuration and status monitoring options available for your Meinberg product.

4 Important Safety Information

The safety information provided in this chapter as well as specific safety warnings provided at relevant points in this manual must be observed during every installation and operation procedure of the device, as well as its removal from service.

Any safety warnings affixed to the product itself must also be observed.

Any failure to observe this safety information, these safety warnings, and other safety-critical operating instructions in the product documentation, or any other improper usage of the product may result in unpredictable behavior from the product, and may result in injury or death.

Depending on your specific device configuration and installed options, some safety information may not be applicable to your device.

Meinberg accepts no responsibility for injury or death arising from a failure to observe the safety information, warnings, and safety-critical instructions provided in the product documentation.

It is the responsibility of the operator to ensure that the product is safely and properly used.

Should you require additional assistance or advice on safety-related matters for your product, Meinberg's Technical Support team will be happy to assist you at any time. Simply send a mail to **techsupport@meinberg.de**.

4.1 Appropriate Usage

The device must only be used appropriately in accordance with the specifications of the product documentation! Appropriate usage is defined exclusively by this manual as well as any other relevant documentation provided directly by Meinberg.

Appropriate usage includes in particular compliance with specified limits! The device's operating parameters must never exceed or fall below these limits!

4.2 Product Documentation

The information in this manual is intended for readers with an appropriate degree of safety awareness.

The following are deemed to possess such an appropriate degree of safety awareness:

- **skilled persons** with a familiarity with relevant national safety standards and regulations,
- **instructed persons** having received suitable instruction from a skilled person on relevant national safety standards and regulations

Read the product manual carefully and completely before you set the product up for use.

If any of the safety information in the product documentation is unclear for you, do **not** continue with the set-up or operation of the device!

Safety standards and regulations change on a regular basis and Meinberg updates the corresponding safety information and warnings to reflect these changes. It is therefore recommended to regularly visit the Meinberg website at **https://www.meinbergglobal.com** or the Meinberg Customer Portal at **https://meinberg.support** to download up-to-date manuals.

Please keep all product documentation, including this manual, in a safe place in a digital or printed format to ensure that it is always easily accessible.

Meinberg's Technical Support team is also always available at **techsupport@meinberg.de** if you require additional assistance or advice on safety aspects of your system.

4.3 Electrical Safety

The IMS LANTIME system in which the module is installed is operated at a hazardous voltage. Please refer to the specific safety information contained within the manual of your IMS system for more information.

When removing a hot-pluggable power supply module, the power supply cable must first be disconnected from the module before the module itself is removed.

Never open a power supply module—hazardous voltages may still reside within the module even after it is disconnected from the power source. If a power supply module is defective, it can be sent to Meinberg for repair.

The installation, set-up, and operation of an IMS system must be performed by suitably qualified personnel.

Failure to observe these safety instructions can result in severe injury.

4.4 Battery Safety

The CR2032 lithium battery on the clock module has a service life of at least 10 years.

Should it be necessary to replace the battery, please note the following:

- The battery may only be replaced by the same type or a comparable type recommended by the manufacturer.
- The battery may only be replaced by the manufacturer or authorized personnel.
- The battery must not be exposed to air pressure levels outside of the limits specified by the manufacturer.

Improper handling of the battery may result in the battery exploding or in leakages of flammable or corrosive liquids or gases.

- Never short-circuit the battery!
- Never attempt to recharge the battery!
- Never throw the battery in a fire or dispose of it in an oven!
- Never dispose of the battery in a mechanical shredder!

5 Important Product Information

5.1 CE Marking

This product bears the CE mark as is required to introduce the product into the EU Single Market.

The use of this mark is a declaration that the product is compliant with all requirements of the EU directives effective and applicable as at the time of manufacture of the product.

5.2 Ensuring the Optimum Operation of Your Device

- Ensure that ventilation slots are not obscured or blocked by dust, or else heat may build up inside the device. While the system is designed to shut down safely and automatically in the event of temperature limits being exceeded, the risk of malfunctions and product damage following overheating cannot be entirely eliminated.
- The device is only deemed to be appropriately used and EMC limits (electromagnetic compatibility) are only deemed to be complied with while the device housing is fully assembled in order to ensure that requirements pertaining to cooling, fire safety, electrical shielding and (electro)magnetic shielding are upheld.

5.3 Maintenance and Modifications

Important!

Before performing any maintenance work on or authorized modification to your Meinberg system, we recommend making a backup of any stored configuration data (e.g., to a USB flash drive from the Web Interface).

5.3.1 Replacing the Battery

Your FDM module is fitted with a lithium battery (type CR2032). This battery has a life of at least ten years. However, if FDM-specific configuration data is lost after disconnection of the external power supply, the voltage of the battery may have dropped below 3 V, and the battery needs to be replaced as a result.

In this case you should not replace the battery on your own. Please contact the Meinberg Technical Support team, who will provide you with precise guidance on how to perform the replacement.

5.4 Prevention of ESD Damage

An **ESDS** device (electrostatic discharge-sensitive device) is any device at risk of damage or malfunction due to electrostatic discharge (ESD) and thus requires special measures to prevent such damage or malfunction. Systems and modules with ESDS devices usually bear this symbol.

Precautionary measures should be taken to protect ESDS components from damage and malfunction.

- Before removing or installing a module, ground your body first (for example, by touching a grounded object) before touching ESDS modules.
- Ensure that you wear a grounding strap on your wrist when handling such ESDS components. This strap must in turn be attached to an uncoated, non-conductive metal part of the system.
- Use only tools and equipment that are free of static electricity.
- Ensure that your clothing is suitable for the handling of ESDS components. In particular, do not wear garments that are susceptible to electrostatic discharges (wool, polyester). Ensure that your shoes enable a low-resistance path for electrostatic charges to dissipate to the ground.
- Only touch or hold ESDS components by the edges. Never touch any pins or conductors on the ESDS components.
- When removing or installing ESDS components, avoid coming into contact with persons who are not grounded. Such contact may compromise your connection with the grounding conductor and thus also compromise the ESDS component's protection from any static charges you may be carrying.
- Always store ESDS components in ESD-proof ("antistatic") bags. These bags must not be damaged in any way. ESD-proof bags that are crumpled or have holes cannot provide effective protection against electrostatic discharges. ESD-proof bags must have a sufficient electrical resistance and must not be made of conductive metals if the ESDS component has a lithium battery fitted on it.

5.5 Disposal

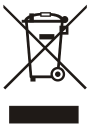
Disposal of Packaging Materials

The packaging materials that we use are fully recyclable:

Material	Used for	Disposal
Polystyrene	Packaging frame/filling material (e.g., polystyrene peanuts)	Recycling Depot
PE-LD (Low-density polyethylene)	Accessories packaging, bubble wrap	Recycling Depot
Cardboard	Shipping packaging, accessories packaging	Paper Recycling

For information on the proper disposal of packaging materials in your specific country, please inquire with your local waste disposal company or authority.

Disposal of the Device



This product falls under the labeling obligations of the Waste Electrical and Electronic Equipment Directive 2012/19/EU ("*WEEE Directive*") and thus bears this WEEE symbol. The presence of this symbol indicates that this electronic product may only be disposed of in accordance with the following provisions.

Important!

Do not dispose of the product or batteries via the household waste. Inquire with your local waste disposal company or authority on how to best dispose of the product or battery if necessary.

This product is considered to be a "**B2B**" product for the purposes of the WEEE Directive and is also classified as "**IT and Telecommunications Equipment**" in accordance with Annex I of the Directive.

It can be returned to Meinberg for disposal. In this case, the shipping costs are to be borne by the customer, while Meinberg will cover the costs for disposal. If you wish for Meinberg to handle disposal for you, please get in touch with us. Otherwise, please use the return and collection systems provided within your country to ensure that your device is disposed of in a compliant fashion to protect the environment and conserve valuable resources.

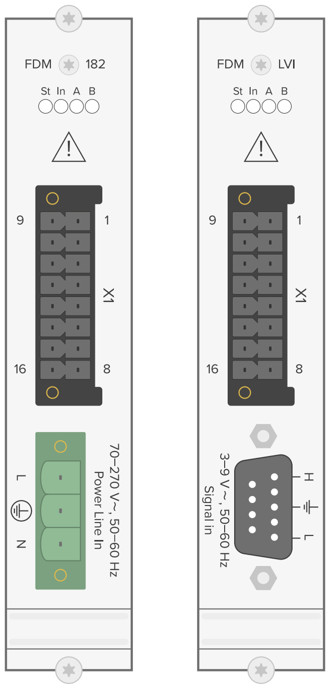
Disposal of Batteries

Please consult your local waste disposal regulations for information on the correct disposal of batteries as hazardous waste.

6 IMS-FDM182 Variants

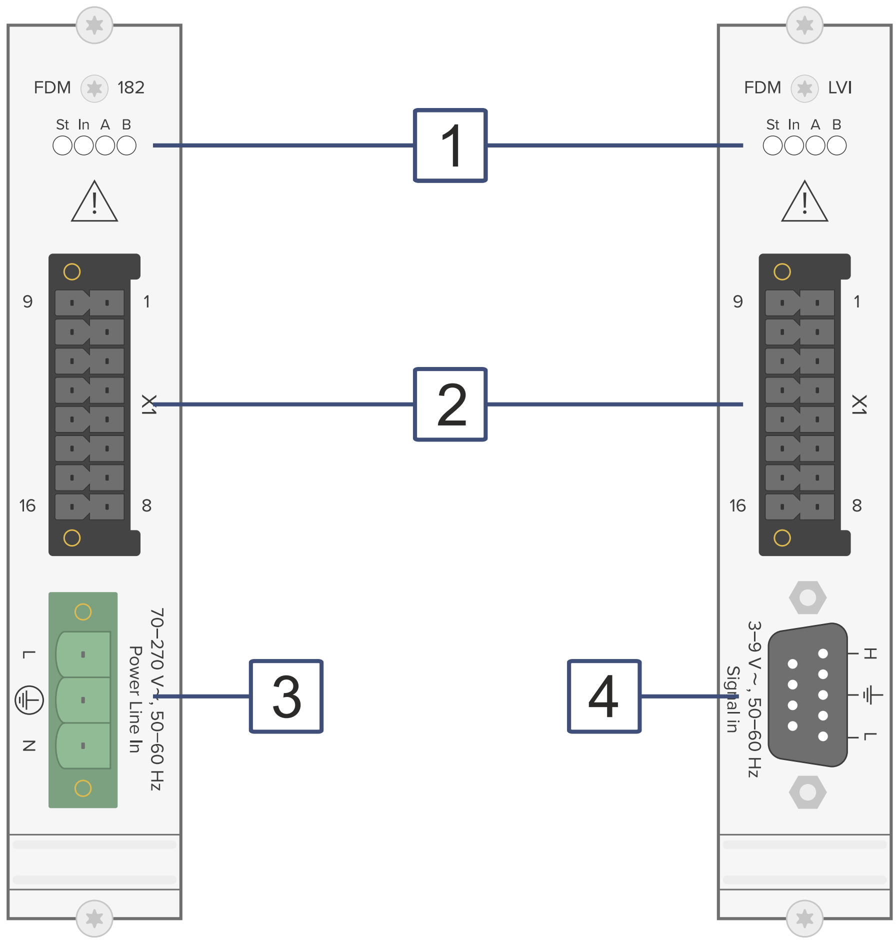
There are two models of the IMS-FDM182 that each vary in terms of the connectors and interfaces provided as follows:

Module	Form Factor	Connectors
IMS-FDM182 (Legacy)	4HP	1x 16-pin DFMC signal output "X1" (2x analog, 2x RS-232), 1x MSTB 3-pin AC voltage input 70–270 V, 50–60 Hz
IMS-FDM182 (Revised)	4HP	1x 16-pin DFMC signal output "X1" (2x analog, 2x RS-232, 1x RS-422), 1x MSTB 3-pin AC voltage input 70–270 V, 50–60 Hz
IMS-FDM182-LVI (Legacy)	4HP	1x 16-pin DFMC signal output "X1" (2x analog, 2x RS-232), 1x D-SUB 9 AC voltage input 3–9 V AC, 50–60 Hz
IMS-FDM182-LVI (Revised)	4HP	1x 16-pin DFMC signal output "X1" (2x analog, 2x RS-232, 1x RS-422), 1x D-SUB 9 AC voltage input 3–9 V AC, 50–60 Hz



Left: IMS-FDM182 4HP standard model with 3-pin MSTB voltage input
Right: IMS-FDM182-LVI (Low Voltage Input) 4HP special design with D-SUB 9 voltage input
Please note that there are currently no...

7 IMS-FDM182 Module Connectors and Indicators



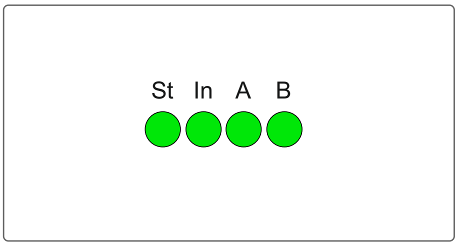
Information:

The numbering in the drawing above relates to the relevant subsection in this chapter.

7.1 Status LEDs

Status Indicators

"St" LED:	Status of IMS-FDM182 in operating system
"In" LED:	Status of synchronization against reference signal
"A" LED:	Frequency deviation status indicator
"B" LED:	Time deviation status indicator



"St" LED: System Status

Blue	IMS-FDM182 is initializing internally
Green	IMS-FDM182 has completed initialization

"In" LED: Reference Signal Status

Reports status after initialization by operating system

Green, not flashing	IMS-FDM182 is synchronized (accurate to $\leq$ 200 ns against reference)
Green, flashing	IMS-FDM182 is synchronized against reference signal
Yellow	IMS-FDM182 is not yet synchronized against the reference signal, but a signal has been found
Red	IMS-FDM182 cannot find a stable reference signal and therefore cannot be synchronized

"A" LED: Frequency Deviation Status

This LED indicates whether the frequency deviation has fallen below or exceeded the configured frequency deviation limits.

Green	The frequency deviation is currently within the configured limits
Yellow, flashing	No voltage detected at the voltage input
Red, not flashing	The frequency deviation of the last frequency reading fell below or exceeded a configured limit
Red, flashing	The frequency deviation of the last frequency reading fell below or exceeded a configured limit and there is no longer any voltage detected at the voltage input

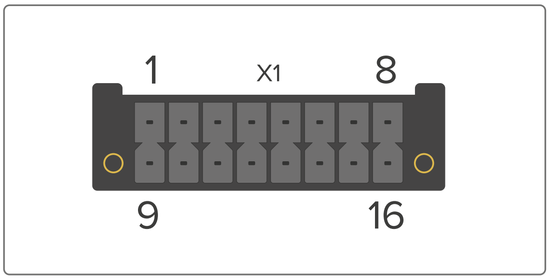
"B" LED: Time Deviation Status

This LED indicates whether the time deviation has fallen below or exceeded the configured time deviation limits.

Green	The time deviation is currently within the configured limits
Yellow, flashing	No voltage detected at the voltage input
Red, not flashing	The current time deviation is below or above a configured limit
Red, flashing	The current time deviation is below or above a configured limit and there is no longer any voltage detected at the voltage input

7.2 Signal Output X1

The 16-pin DFMC connector "X1" is used to output serial FDM strings and analog signals relating to frequency and power line time deviation in a variety of configurable formats.



Pin No.	Function	Pin No.	Function
Pin 1	A1 (Analog Output 1)	Pin 9	GND
Pin 2	A2 (Analog Output 2)	Pin 10	GND
Pin 3	GND	Pin 11	GND
Pin 4	Not connected	Pin 12	GND
Pin 5	Not connected	Pin 13	GND
Pin 6	GND	Pin 14	GND
Pin 7	COM 0 RxD (RS-232 Receive)	Pin 15	COM 1 RxD (RS-232 Receive)
Pin 8	COM 0 TxD (RS-232 Transmit)	Pin 16	COM 1 TxD (RS-232 Transmit)

Information:

Please refer to Chapter **9.3**, "**Data and Signal Cables**" for further information on supported data and signal cables and cable wiring.

7.2.1 Analog Outputs (A1 and A2)

Output Signal: Analog signal derived from internal DAC based on current time or frequency deviation (as configured by user)

Voltage Range: –2.5 to + 2.5 V (signal to ground)
(representing the lower and upper deviation limits as configured by the user)

DAC Signal Resolution: 16-bit (65536 increments)

Information:

Refer to Chapter **10.3**, "**Analog Outputs**" for more information on how to configure these outputs via the Web Interface.

7.2.2 RS-232 Interfaces (COM0 and COM1)

The RS-232 interfaces COM0 and COM1 are used to output FDM strings containing time & frequency deviation data and also to receive configuration information for the **FDM III User Format** string type.

Output Signal:	RS-232 serial string
Supported Baud Rates:	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
Supported Serial Framing:	7N2, 7E1, 7E2, 8N1, 8N2, 8E1, 7O2
String Output Modes:	On request (triggered by sending "?", ASCII code 3Fh, to RxD) Once every second (with optional alignment of final control character with second change) Once every minute
Connector Type:	D-Sub Female 9-Pin
Cable:	Data cable (Shielded) Connection to PC: (Interface) 1:1

Assignment:

FDM RS-232 / RS-422

Pin 2:	RxD
Pin 3:	TxD
Pin 5:	GND
Pin 8:	Tx -
Pin 9:	Tx +

COM0:

Pin 2:	RxD (receive)
Pin 3:	TxD (transmit)
Pin 5:	GND (ground)

Information:

When Fingrid or any of the FDM III string types is configured and "*On request '?' only*" is set, it is also possible to have a string output on request by sending "T" (ASCII code 54h) to RxD.

Not every FDM string type supports every string output mode.

Supported String Types:

Standard
Standard 2
Short
Areva (TTM1)
TPC (TTM2)
Computime
Fingrid
FDM III
FDM III User Format
SIE-TSF
FDM III XLi
Vorne

Information:

Refer to:

Chapter **10.2**, "**Serial Port**" for further information on how to configure these outputs via the Web Interface,

Chapter **11**, "**Configuration of FDM III User Format via Serial Interface**" for further information on how to configure the FDM III User Format string type via the serial interface,

Chapter **13.2**, "**String Formats**" for further information on the specific structure of each string format.

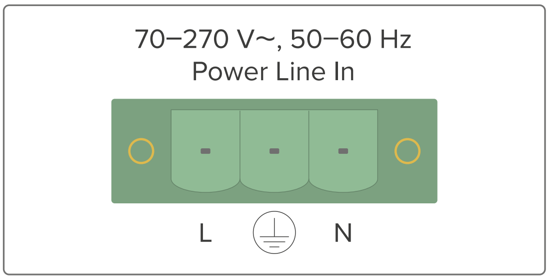
7.3 Voltage Input (Standard Model)

Connector Type: 3pin MSTB for input of of single-phase AC voltage

Input Voltage: 70 – 270 V AC

Input Frequency Range: 45 – 65 Hz

Nominal Input Frequencies: 50 Hz, 60 Hz



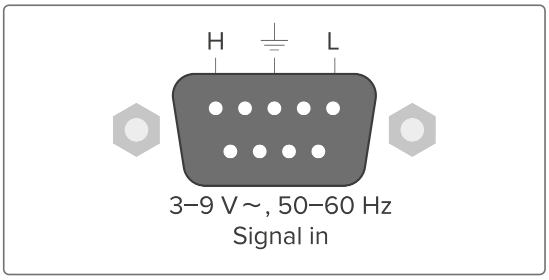
7.4 Voltage Input (Special LVI Model)

Connector Type: DSUB 9 for input of single-phase alternating current

Input Voltage: 3 – 9 V AC

Input Frequency Range: 45 – 65 Hz

Nominal Input Frequencies: 50 Hz, 60 Hz



8 Before You Start

8.1 Contents of Delivery

Unpack the IMS-FDM182 and all accessories carefully and check the contents of the delivery against the enclosed packing list to ensure that no parts are missing. If any of the listed items are missing, please contact our Sales Department at *sales@meinberg.de*.

Check that the product has not been damaged in transit. If the product is damaged or fails to operate upon installation, please contact Meinberg immediately. Only the recipient (the person or company receiving the system) may file claims or complaints against the forwarder for damage caused in transit.

Meinberg recommends that you keep the original packaging materials in case the product needs to be shipped or transported again at a later date.

9 System Installation

9.1 Important Information Regarding Hot-Pluggable IMS Modules

The following information should be strictly observed when replacing IMS modules during operation. Not all IMS modules are fully hot-pluggable. For example, it is naturally not possible to replace a power supply unit in a system without PSU redundancy without first having installed a second power supply unit while the system is in operation.

The following rules apply for the individual IMS slots:

PWR Slot:	"Hot-Swappable"	If you operate your system with only one power supply unit, a second power supply unit must be installed before removing or replacing it in order to keep your system operational.
I/O, ESI, and MRI Slots:	"Hot-Pluggable"	
CLK1, CLK2 Slots:	"Hot-Pluggable"	When a clock module is replaced or installed, it is important to rescan the reference clocks ("Rescan Refclocks") in the "System" menu of the Web Interface.
RSC/SPT Slots:	"Hot-Pluggable"	It will not be possible for your IMS system to switch between signal generators while the RSC/SPT is not installed.

CPU Slot:	"Not Hot-Pluggable"	Before the CPU is removed, the IMS system must be powered down. Please note that after powering on and rebooting the LANTIME Operating System, the configuration of some IMS modules may be reset to factory defaults!

Information:

The NTP service and access to the web interface will be unavailable while the CPU is not installed. Management and monitoring functions will also be disabled.

9.2 Installation and Removal of Hot-Pluggable IMS Modules

A Torx screwdriver is required (T8 x 60) to remove and install IMS modules.

Important!

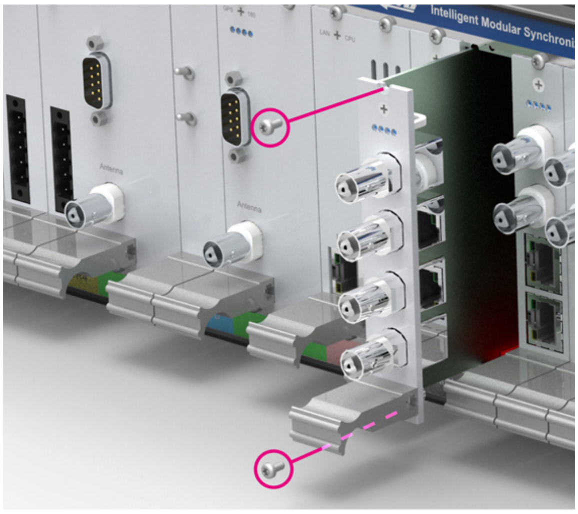
Heed the safety information in Chapter **4** of this manual!

Removing a Module

1. Remove the two marked Torx screws from the module faceplate.

2. Pull the module **carefully** out of the guide rail. Note that the module will be securely seated in the connector block inside the chassis—a certain amount of force must be applied to release the module. Once the module has been detached from the connector block on the system backplane, the module can be easily pulled out.

3. If the removed module is not to be replaced with another module, a suitable one-slot or two-slot 'placeholder' faceplate should be fitted using the two Torx screws in order to cover this space.



Locations of fixture screws in a 1U IMS system

Installing a Module

1. To replace a module, remove the installed module in accordance with the guide "**Removing a Module**" on the previous page. Otherwise, remove the two Torx screws from the cover plate of the unused slot. We recommend keeping the cover plate in a safe place for later use.

2. Insert the module correctly into the two guide rails of the system chassis. If the module cannot be inserted with minimal force, it is possible that the module is not properly seated in the guide rails. In this case, you should pull the module out and try again. **Do not use excessive force when pushing the module in!** Failure to heed this instruction may result in damage to the module and/or chassis.

3. Once the module has reached the connector block of the system backplane, a little more force will be required to insert the module into the connector block. Ensure that the module is locked securely into place and that the faceplate of the module is flush with that of the adjacent modules or cover plates.

4. Insert and tighten the two Torx screws with a **max. torque of 0.6 Nm**.

The installed module is now ready to be set up for use.

9.3 Data and Signal Cables

Data Communication Cable

The IMS-FDM182 module provides a DFMC connector labeled "**X1**", via which the current "power line time deviation" (offset of the "power line time" relative to the reference time) or "frequency deviation" (frequency measured at the power line input relative to the configured nominal value of 50 Hz or 60 Hz) values are output and which is also used by the module to receive some configuration data pertaining to signal formats.

A data and/or signal cable must be assembled specifically using the enclosed DFMC connector to enable your receiver to process the corresponding signals.

An RS-232 data cable for your IMS-FDM182 may typically be fitted with the enclosed DFMC connector at one end and a D-SUB 9 connector at the other. The corresponding RxD and TxD pins of the RS-232 DFMC output on your IMS-FDM182 module are respectively wired to pin 3 (TxD) and pin 2 (RxD) respectively of the D-SUB 9 connector, assuming compliance with the TIA-232-F standard.

Any ground pin on the DFMC connector can be connected to the corresponding ground pin of the opposite connector (pin 5 on a D-SUB 9 connector).

For other connectors typically used with RS-232 messaging (such as 8P8C "RJ-45" connectors or DSUB 25 connectors), please refer to your signal receiver's documentation. Information about RS-232 messaging with standardized connectors is also available widely online.

For more information about the serial interfaces COM0 and COM1, refer to Chapter **7.2.2**, "**RS-232 Interfaces (COM0 and COM1)**".

AC Voltage Input Cable (Standard Model)

Danger!

Assembly of AC Voltage Input Cable

Danger of death due to electrocution and fire!

An improperly assembled or defective AC voltage input cable can result in electric shock and represents a significant fire hazard.

- The cable may only be assembled by a qualified and competent electrician!
- It must be constructed with suitable materials and methods so that it remains safe to use while conducting voltages of up to 270 V.

Danger!

Proper Connection of AC Voltage Input Cable

Danger of death due to electrocution and fire!

An improperly connected AC voltage input cable can result in electric shock and represents a significant fire hazard.

- Always ensure that the AC voltage input cable is firmly inserted into the AC input voltage connector to ensure that all three pins (live, neutral, ground) make contact.
- Always tighten the lock screws to secure the connector and minimize the risk of accidental connector movements.

An AC voltage input cable must be assembled specifically using the enclosed MSTB 3-pin connector to enable your IMS-FDM182 module to receive the AC voltage.

Refer to **7.3**, "**Voltage Input (Standard Model)**" for information on pin layout.

AC Voltage Input Cable (Special LVI Model)

An AC voltage input cable must be assembled specifically using a D-SUB 9 female connector (not included) to enable your IMS-FDM182-LVI module to receive the AC voltage.

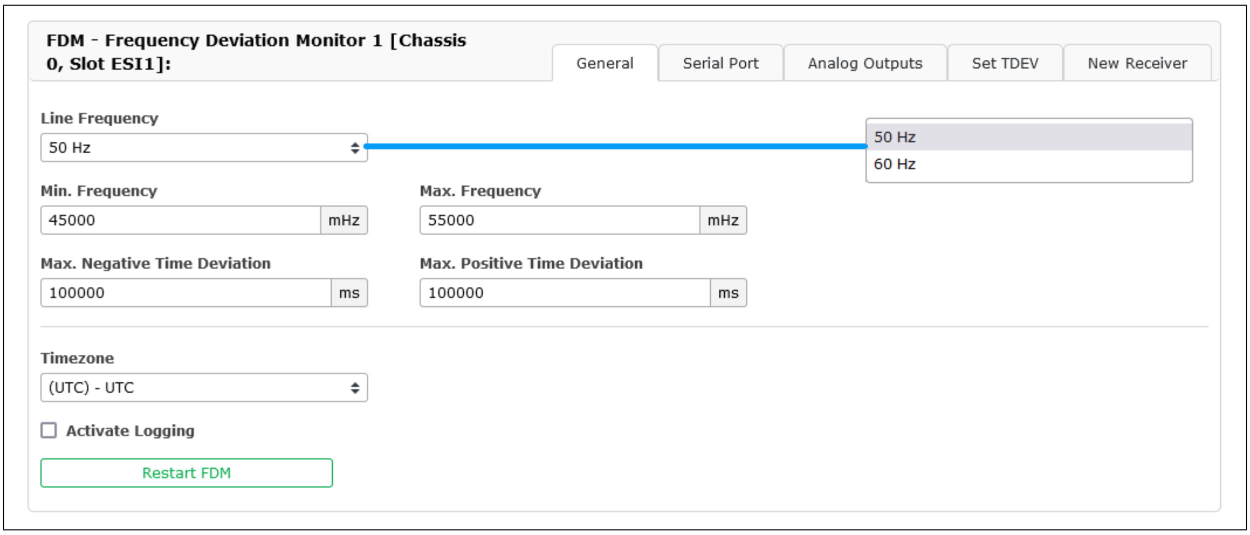
10 Configuration and Setup via Web Interface

This chapter describes the initial setup of a IMS-FDM182 using the Web Interface.

The IMS-FDM182 is configured by selecting the menu "**FDM**" → "**FDM Configuration**" in the Web Interface.

The configuration options addressed in this chapter represent a IMS-FDM182 with Firmware Version v1.45 running under LANTIME OS Version 7.08.

10.1 General



Line Frequency: The nominal frequency of the mains voltage passed into the voltage input port of the IMS-FDM182. This dictates how the power line time is synchronized to the incoming voltage; an incorrect configuration will cause the power line time to be incorrectly calculated and thus result in an improper drift calculation.

- *"50 Hz"*
- *"60 Hz"*

Min. Frequency: The lower frequency threshold in mHz at which:

- the minimum voltage of –2.5 V is output via each analog output configured to monitor frequency deviation
- "threshold exceeded" ("overflow") errors are displayed under the tab "**FDM State**"
- "threshold exceeded" ("overflow") errors are logged under "**Time-Related Messages**"

Max. Frequency: The upper frequency threshold in mHz at which:

- the maximum voltage of +2.5 V is output via each analog output configured to monitor frequency deviation
- "threshold exceeded" ("overflow") errors are displayed under the tab "**FDM State**"
- "threshold exceeded" ("overflow") errors are logged under "**Time-Related Messages**"

Min. Negative Time Deviation: The lower time deviation threshold in milliseconds at which:

- the maximum negative voltage of –2.5 V is output via each analog output if configured to monitor time deviation
- "threshold exceeded" ("overflow") errors are displayed under the tab "**FDM State**"
- "threshold exceeded" ("overflow") errors are logged under "**Time-Related Messages**"

Max. Positive Time Deviation: The upper time deviation threshold in milliseconds upon which:

- the maximum positive voltage of +2.5 V is output via each analog output configured to monitor time deviation
- "threshold exceeded" ("overflow") errors are displayed under the tab "**FDM State**"
- "threshold exceeded" ("overflow") errors are logged under "**Time-Related Messages**"

Timezone: The reference time is always passed to the FDM as UTC, regardless of the configuration of the host LANTIME system, and the power line time is maintained accordingly. This drop-down menu allows the reference time and the current power line time to be adjusted to a given FDM-specific timezone.

Important!

This only affects the data output of the FDM itself and does not change the timezone of the host reference time!

Activate Logging: If enabled, detailed statistics on measurements taken once a second will be logged under `/var/log/fdmstats_*.log`.

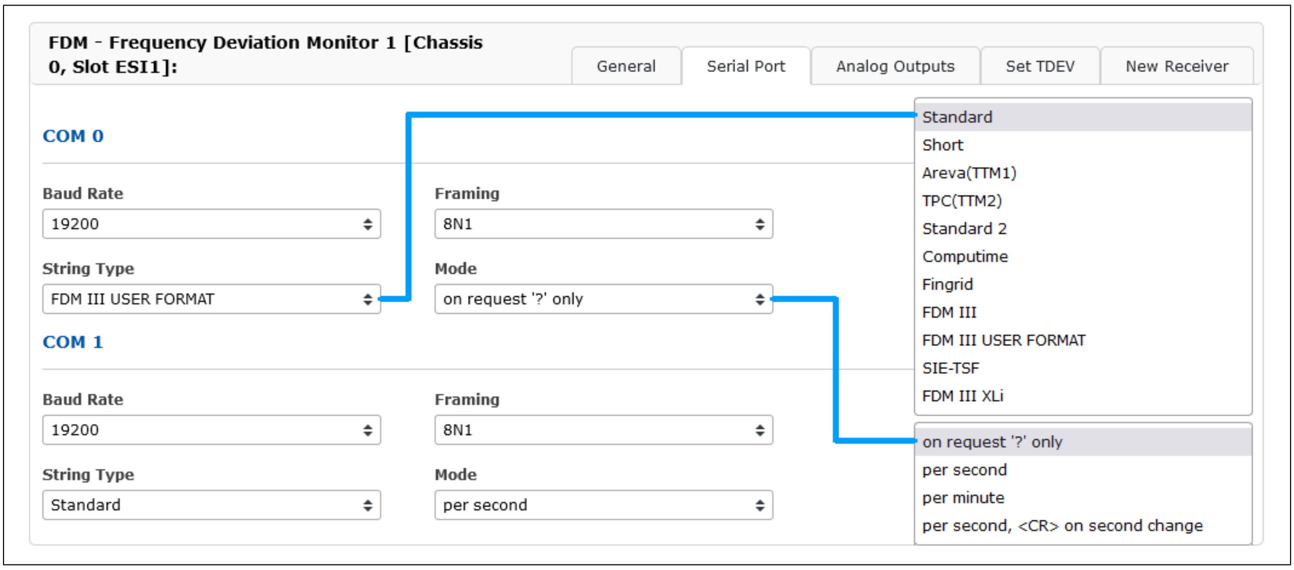
Restart FDM: Manually resets the FDM, resynchronizing it and realigning the power line time with the reference time.

Important!

The FDM possesses a dedicated on-board processor that allows it to continue monitoring the input frequency and outputting FDM strings for as long as it continues to receive power, even while host OS functions are temporarily unavailable (for system reboots, firmware updates, etc.)

The "**Restart FDM**" button serves to restart this dedicated processor and will therefore suspend FDM string and signal output for generally between 10 and 15 seconds. This button should therefore be used with care if you have downstream equipment recording the output stream from this FDM and are reliant on an uninterrupted data stream.

10.2 Serial Port



Information:

Serial port communication settings are defined individually for each port (COM0 and COM1).

Baud Rate: The baud rate applied to serial communication with the device receiving the strings.
- *"1200"*
- *"2400"*
- *"4800"*
- *"9600"*
- *"19200"*
- *"38400"*
- *"57600"*
- *"115200"*

Framing: The framing applied to serial communication with the device receiving the strings.
- *"7N2"*
- *"7E1"*
- *"7E2"*
- *"8N1"*
- *"8N2"*
- *"8E1"*
- *"7O1"*

String Type: The format in whichstrings are output through the serial port.
- *"Standard"*
- *"Short"*
- *"Areva(TTM1)"*
- *"TPC(TTM2)"*
- *"Standard 2"*
- *"Computime"*
- *"Fingrid"*
- *"FDM III"*
- *"FDM III USER FORMAT"*
- *"SIE-TSF"*
- *"FDM III XLi"*
- *"Vorne"*

Information:

Refer to Chapter **13.2.1**, "**FDM String Formats (via Serial Output)**" for the precise specifications of each string format.

Mode: The frequency of string output, or the method by which time string output is triggered.
- *"On request '?' only"*
- *"Per second"*
- *"Per minute"*
- *"Per second, <CR> on second change"*

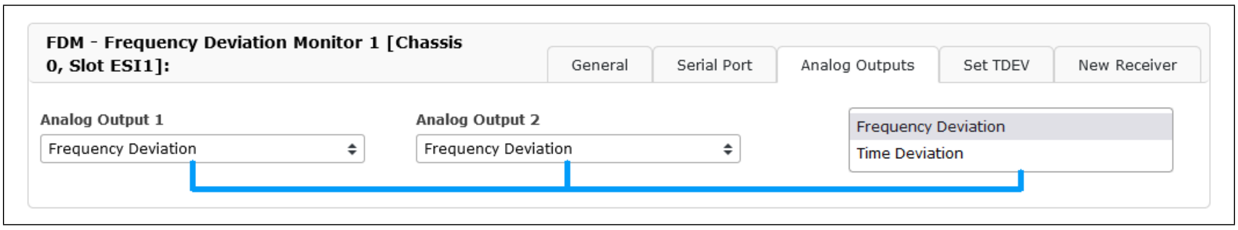
Selecting "*On request '?' only*" means that a string will only be output upon receipt of an "`?`" (ASCII code 3Fh) at the RxD pin of the corresponding COM port. Fingrid and FDM III string types also accept "`T`" (ASCII code 54h) as a string request.

Selecting "*Per second, <CR> on second change*" will result in a string being output once a second ahead of time, with the terminating control characters being output upon each change of second.

Information:

Not all string types support all transmission modes. Refer to Chapter **13.2**, "**String Formats**" for more information.

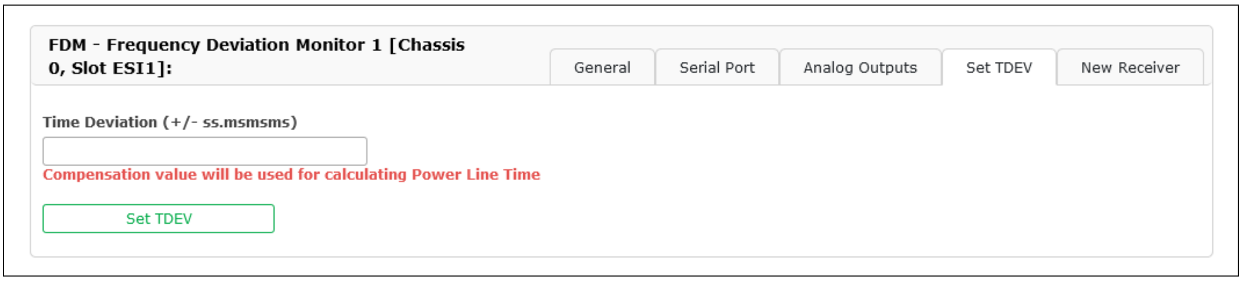
10.3 Analog Outputs



Analog Output 1: The value used to control the voltage output of the port **A1**.
- *"Frequency Deviation"*
- *"Time Deviation"*

Analog Output 2: The value used to control the voltage output of the port **A2**.
- *"Frequency Deviation"*
- *"Time Deviation"*

10.4 Set TDEV

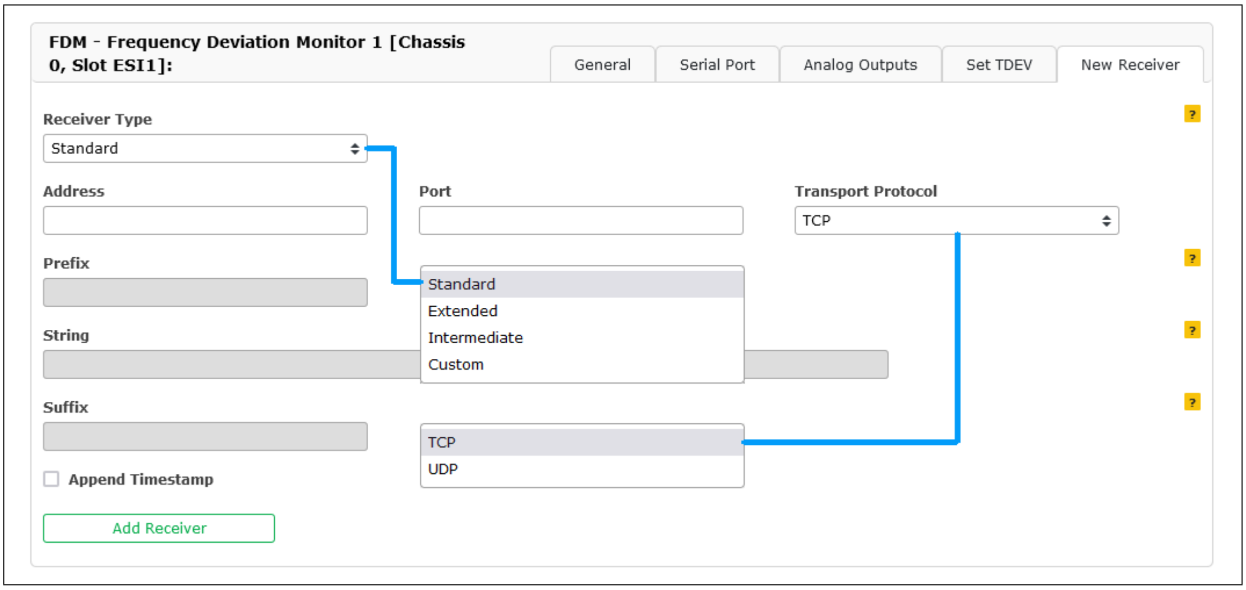


Time Deviation: The time deviation value is specified in seconds and fractions of seconds up to three decimal places (i.e., millisecond-level accuracy). It may be prefixed with a +/- sign to denote whether the power line time should run ahead or behind the reference time by this value upon its setting; the absence of a sign is taken to mean +.

Example: *+1.234* sets the power line time ahead of the reference time by 1234 milliseconds from the time it is set.

The time deviation can be reset to zero while the device is in operation by entering *0* and clicking on **Set TDEV**.

10.5 New Receiver



The **New Receiver** function can be used to transmit deviation value strings over IP networks via the TCP or UDP protocol instead of directly over a serial port.

Receiver Type: This specifies the string format transmitted to the receiver.
- *"Standard"*
- *"Extended"*
- *"Intermediate"*
- *"Custom"*

Information:

Refer to Chapter 13.2.2, "**FDM String Formats (via IP Network)**" for the precise specifications of each string format.

Address: The reachable IPv4 or IPv6 address of the receiver device.

Port: The network port on which the receiver device expects to receive the deviation value strings.

Transport Protocol: The transport protocol to be used for the transmission of the strings.
- *"TCP"*
- *"UDP"*

Prefix: Only applies to custom string formats. Specifies any prefix characters to be appended to the start of each string. Refer to "**Custom FDM String**" for more information.

String: Only applies to custom string formats. Specifies the data structure of the custom string. Refer to "**Custom FDM String**" for more information.

Suffix: Only applies to custom string formats. Specifies any suffix characters to be appended to the end of each string. Refer to "**Custom FDM String**" for more information.

Append Timestamp: Only applies to extended, intermediate, and custom string formats. If enabled, a timestamp will be appended to each string.

Important!

When adding a new receiver, please remember to click on the "**Add Receiver**" button. If you click on "**Save Settings**" before doing this, your new receiver configuration will not be saved!

Each receiver added will be listed under its own tab, where the receiver configuration can be reviewed and each receiver can be individually deleted as appropriate by clicking on the "**Delete Receiver**" button.

11 Configuration of FDM III User Format via Serial Interface

The FDM III User Format string type provides limited compatibility with the custom string functionality of the now-discontinued third-party XLi Time & Frequency System in order to enable custom FDM string structures to be defined. This allows equipment that was previously operated with the XLi system and is reliant on such custom strings to be operated with the FDM.

Please note that this compatibility is not comprehensive, nor is it is intended to be. Much of the XLi functionality is implemented in an entirely different manner by the FDM and this functionality only exists to allow continued integration of legacy receivers. This chapter specifies which string format configuration options the User Format interface provides.

While configuring the user format, it is recommended that the transmission mode be set to "*on request '?' only*" to ensure that terminal output remains manageable.

Syntax

The default FDM III User Format is as follows:

```
<SOH>068:12:17:55?T-1.537F+0.123SF+60.095ST12:17:53.463<CR><LF>
```

It is broadly identical to the FDM III format described in Chapter **13.2.1.8**, "**FDM III String**", but is prefixed with a leading Start of Header character (`<SOH>`, ASCII code 01h).

This default format is set by passing the following string to the FDM in the same way that it would be passed to an XLi:

```
F27 B1 FS X,X,X,X,X
```

This definition declaration is structured as follows:

`F27`	"`F27`" references the interface "F27" on the XLi and is the standard and mandatory prefix for all configuration operations.
`B1`	"`B1`" on the XLi references the bay number in which the XLi was installed. For the purposes of the FDM, however, this can be any arbitrary number from B1–B99 and is only provided for compatibility with existing equipment. This guide will use B1 for the purposes of simplicity.
`FS`	"`FS`" would be interpreted as an instruction by an XLi to return or configure the string format.
`X,X,X,X,X`	"`X,X,X,X,X`" represents the five data fields that are output through the serial interface. These are, in order: reference time, time deviation, frequency deviation, measured frequency, and power line time.

To return the current format, pass the following to the serial interface:

```
F27 B1 FS
```

This will then return (assuming that the default format is unchanged):

```
F27 B1 FS X,X,X,X,X<CR><LF>
```

The basic structure of the format definition `X,X,X,X,X` must be maintained when passing a string format to the FDM. The `X` characters represent the individual data items in the order specified above.

As an example, let us assume that the following simple string format is passed:

```
F27 B1 FS X<CR><LF>
```

The FDM will acknowledge that the format has been accepted by returning the string:

```
<CR><LF>OK<CR><LF>
```

If nothing is returned, it is likely that there was an error.

The `X` in the format string represents the first item in the list of data items, which is the reference time. In this case, passing `T<CR><LF>` or `?<CR><LF>` to the serial interface to return the FDM III User Format data string will return (for example):

```
<SOH>040:15:10:08 <CR><LF>
```

Assuming the following string format is passed instead:

```
F27 B1 FS X,X,X<CR><LF>
```

This will assign the first three items in the list, namely reference time, time deviation, and frequency deviation:

```
<SOH>040:15:10:08 T-0.565F-0.004<CR><LF>
```

However, if you do not wish to include time deviation (as an example) in the string output, it can be excluded by removing the second `X` representing that data item, but leaving the commas in place to signify its absence:

```
F27 B1 FS X,,X<CR><LF>
```

This will return:

```
<SOH>040:15:10:08 F-0.004<CR><LF>
```

Therefore, if you wish to have only the frequency deviation and measured power line frequency included in the output string, you would pass:

```
F27 B1 FS ,,X,X<CR><LF>
```

This will return:

```
<SOH>F-0.022SF+49.978<CR><LF>
```

Simply passing `T<CR><LF>` (the XLi standard) or `?<CR><LF>` (the Meinberg standard) to the serial interface will output a single FDM string based on the current format configuration.

It is also possible to have the current time deviation of the FDM returned as a string by passing:

```
F27 B1 PS<CR><LF>
```

This will return (without `<SOH>`):

```
F27 B1 PS= -0.838<CR><LF>
```

The time deviation can be set or reset by passing a positive or negative value to up to three decimal places as follows (*60.001* in this case being an arbitrary example):

```
F27 B1 PS 60.001<CR><LF>
```

This has the same effect as the "**Set TDEV**" option in the Web Interface (see Chapter **10.4**). **Note:** The FDM must be synchronized ("**In**" LED must be green) for the TDEV value to be set.

12 Troubleshooting

Our Technical Support team will be pleased to help you with any problems that you may be having with your Meinberg IMS-FDM182. However, before you contact our Technical Support team, it is advisable to read this chapter through first to see if your problem might be more quickly resolved with one of the solutions below.

Problem	Possible Causes	Possible Solutions
The module is not detected by the base IMS unit.	The module may not have been properly inserted into the slot.	Ensure that the module is properly aligned with the guide rails inside the IMS unit; the module must lock securely into the socket at the back. The metal plate of the module should be perfectly flush with the metal plates of the other slots and the screws should be straight.
	Your IMS device's firmware may not be up to date.	Using the instructions in the chapter "**Firmware Updates**" in your IMS device manual, check whether the latest version of LANTIME OS is installed, and install the latest version if necessary.
The module cannot be inserted into the MRI slot of an M1000 or M1000S.	The IMS-FDM182 features an insulation plate that protects the IMS system and the user from the high voltages introduced via the AC input. The resultant increased dimensions of the module mean that it cannot be inserted into the MRI slot of an M1000 or M1000S.	**Please do not attempt to insert the module by force into the MRI slot, and never remove the insulation plate!** Instead, insert the module into the IO1, IO2, or ESI slot of your M1000 or M1000S system.
The "**In**" LED is red and there is no synchronization signal from the outputs.	Assuming that your IMS device has a reference clock, it may not be able to find the synchronization signal required to synchronize the IMS-VSG module.	Verify that your clock module is itself synchronized—further information is provided by the documentation for your clock module. Check your antenna and cables as appropriate. Refer to the main IMS manual for further information. If your IMS device has no reference clock, ensure that you set the operating mode to "*If warmed up only*" (see "**Configuration and Setup via Web Interface**") so that it uses only the oscillator in free-run mode for synchronization.

13 Technical Appendix

13.1 Technical Specifications

IMS Interface:	96-pin DIN 41612 Connector
Operating Voltage:	+5 V DC
Current Draw:	0.4 – 1 A
Temperature Range:	0 – 50 °C (32 – 122 °F)
Relative Humidity:	Max. 85 % at 30 °C (86 °F)

13.2 String Formats

This chapter documents the various FDM string formats supported by the RS-232 serial interface.

13.2.1 FDM String Formats (via Serial Output)

13.2.1.1 Standard FDM String

The Standard FDM String is a sequence of 62 ASCII characters containing the frequency *F*, the frequency deviation *FD*, the reference time *REF*, the power line time *PLT*, and the time deviation *TD*. Each field is separated by a space character (ASCII code 20h). The string is terminated with a Carriage Return (`<CR>`, ASCII code 0Dh) and Line Feed (`<LF>`, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

F:49.984 FD:*-00.016* REF:*15.03.30* PLT:*15.03.30.378* TD:*+00.378*<CR><LF>

The meaning of each value is described below:

F:*49.984*	The measured power line frequency, resolution: 1 mHz.
FD:*-00.016*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.
REF:*15.03.30*	The reference time from the upstream reference clock (hours:minutes:seconds)
PLT:*15.03.30.378*	The power line time, based on the mains frequency, (hours:minutes:seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!
TD:*+00.378*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms, maximum: +-99.999 s

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "<CR><LF>" are received at the start of each reference time second.

13.2.1.2 Standard 2 FDM String

The Standard 2 FDM string is identical to the Standard FDM string, but varies in the frequency of transmission, depending on the configured transmission mode.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second and at each 500 ms interval between each second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	Not supported.

13.2.1.3 Short FDM String

The Short FDM String is a sequence of 23 ASCII characters containing simplified information about the frequency deviation *FD* and time deviation *TD*, separated by a space character (ASCII code 20h). The string is terminated with a Carriage Return (CR, ASCII code 0Dh) and Line Feed (LF, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

FD:*-00.016*_TD:*+00.378*<CR><LF>

The meaning of each value is described below:

FD:*-00.016*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz, maximum: +-09.999 Hz
TD:*+00.378*	The time deviation of the power line time relative to the reference time, resolution: 1 ms, maximum: +-99.999 s

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "<CR><LF>" are received at the start of each reference time second.

13.2.1.4 Areva (TTM1) FDM String

The Areva FDM String is a sequence of 71 ASCII characters containing the frequency *020*, the frequency deviation *021*, the time deviation *022*, the power line time *023*, and the reference time *024* (preceded by the three-digit day of the year). Each of these items is separated by a Carriage Return (<CR>, ASCII code 0Dh) followed by a Line Feed (<LF>, ASCII code 0Ah).

Each of these fields is prefixed with a unique three-digit address (020–024).

The string as a whole is prefixed with the Start of Text character (<STX>, ASCII code 02h) and terminated with an End of Text character (<ETX>, ASCII code 03h).

The characters displayed in italics represent the measured values, while the other characters are unalterable elements of the string:

```
<STX>02049.984<CR><LF>
021-0.016<CR><LF>
022+00.378<CR><LF>
02315 03 30.378<CR><LF>
024068 15 03 30 <CR><LF>
<ETX>
```

The meaning of each value is described below:

020*49.984*	The measured power line frequency, resolution: 1 mHz.
021*-0.016*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.
022*+00.378*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms.
023*15_03_30.378*	The power line time, based on the mains frequency, (hours_minutes_seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!
024*068_15_03_30*	The reference time from the upstream reference clock, (day-of-year_hours_minutes_seconds). A space (ASCII code 20h) is appended to the time prior to the terminating <CR><LF>.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	Not supported.

13.2.1.5 TPC (TTM2) FDM String

The TPC FDM string is a sequence of 29 ASCII characters containing the reference time (with the three-digit day-of-year), the time deviation, and the frequency deviation *F*. The string starts with the Start of Header character (<SOH>, ASCII-Code 01h) and is terminated by the characters Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

`<SOH>`*`288:10:11:29?-00.03`*`F`*`+50.01`*`<CR><LF>`

The meaning of each value is described below:

288:10:11:29	The reference time from the upstream reference clock, (day-of-year:hours:minutes:seconds).
?	If the reference clock is not synchronized, this character will be ? (ASCII code 3Fh). If it is synchronized, a space will be output at this point (ASCII code 20h).
-00.03	The frequency deviation of the measured frequency relative to the nominal frequency, resolution: 1 mHz.
F*+50.01*	The measured power line frequency, resolution: 10 mHz.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	Not supported.

13.2.1.6 Computime Extended FDM String

The Computime Extended FDM String consists of a sequence of 42 ASCII characters containing the reference time (with date and day of the week), the time deviation `D` and the frequency `F`. The string is terminated with a Carriage Return (`<CR>`, ASCII code 0Dh) and Line Feed (`<LF>`, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

`T:`*`10:03:09:02:15:03:30`*`D:`*`+000.378F:49.984`*`<CR><LF>`

The meaning of each value is described below:

`T:`*`10:03:09:02`*`:`	The date from the upstream reference clock, (year:month:day:day-of-the-week / Monday = 01, Sunday = 07)
`15:03:30`	The reference time from the upstream reference clock, (hours:minutes:seconds)
`D:`*`+000.378`*	The time deviation between reference time and power line time, signed (+/-), resolution: 1 ms, maximum: +-99.999 s (always with a leading 0!)
`F`*`49.984`*	The measured power line frequency, resolution: 1 mHz.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "`<CR><LF>`" are received at the start of each reference time second.

13.2.1.7 Fingrid FDM String

The Fingrid FDM String is a sequence of 34 ASCII characters containing the reference time, the time deviation *T*, and the frequency deviation *F*. The string is terminated with a Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

079:08:13:55.000 T*+6.780*F*+0.012*<CR><LF>

The meaning of each value is described below:

079:08:13:55.000	The reference time from the upstream reference clock, (day-of-year:hours:minutes:seconds:milliseconds).
T*+6.780*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms.
F*+0.012*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) or "T" (ASCII code 54h) at RxD.
Per second, <CR> on second change	Not supported.

13.2.1.8 FDM III String

The FDM III String is a sequence of 52 ASCII characters containing the reference time (with three-digit day-of-year), the time deviation *T*, the frequency deviation *F*, the measured power line frequency *SF*, and the power line time *ST*. The string is terminated with a Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

*068:12:17:55?*T*-1.537*F*+0.123*SF*+60.095*ST*12:17:53.463*<CR><LF>

The meaning of each value is described below:

068:12:17:55	The reference time from the upstream reference clock, (day-of-year:hours:minutes:seconds).
?	If the reference clock is not synchronized, this character will be ? (ASCII code 3Fh). If it is synchronized, a space will be output at this point (ASCII code 20h).
T*-01.537*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms.
F*+0.123*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.
SF*+60.095*	The measured power line frequency, resolution: 1 mHz.
ST*12:17:53.463*	The power line time, based on the mains frequency, (hours:minutes:seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) or "T" (ASCII code 54h) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "<CR><LF>" are received at the start of each reference time second.

13.2.1.9 FDM III XLi String

The FDM III XLi String is a sequence of 52 or 56 ASCII characters (depending on transmission mode, see below) containing the reference time (with three-digit day-of-year), the time deviation *T*, the frequency deviation *F*, the measured power line frequency *SF*, and the power line time *ST*. The string is terminated with a Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah).

It differs from the standard FDM III string in that it features an additional leading zero in the time deviation field *T* while the frequency field *F* is unsigned here.

If the transmission mode is set to *per second*, *per minute*, or *per second <CR> on second change*, the string will be as follows:

*068:12:17:55?*T*-01.537*F*+0.123*SF*60.095*ST*12:17:53.463*<CR><LF>

If the transmission mode is set to *on request '?' only*, the string will include the reference time with millisecond precision as follows:

*068:12:17:55.000?*T*-01.537*F*+0.123*SF*60.095*ST*12:17:53.463*<CR><LF>

The characters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

The meaning of each value is described below:

068:12:17:55	The reference time from the upstream reference clock, (day-of-year:hours:minutes:seconds). If the transmission mode is set to *on request '?' only*, the format of this field will be (day-of-year:hours:minutes:seconds.milliseconds).
?	If the reference clock is not synchronized, this character will be ? (ASCII code 3Fh). If it is synchronized, a space will be output at this point (ASCII code 20h).
T*-01.537*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms.
F*+0.123*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.
SF*+60.095*	The measured power line frequency, resolution: 1 mHz.
ST*12:17:53.463*	The power line time, based on the mains frequency, (hours:minutes:seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) or "T" (ASCII code 54h) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "<CR><LF>" are received at the start of each reference time second. The reference time is output with millisecond precision instead of second precision in this case.

13.2.1.10 SIE-TSF-FDM String

The SIE-TSF String is a sequence of 32 ASCII characters containing the reference time *R*, the time deviation *D*, and the measured power line frequency *F*. Each field is terminated by a Line Feed (`<LF>`, ASCII code 0Ah) followed by a Carriage Return (`<CR>`, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

`R:`*`13:11:19`*`<LF><CR>D:`*`+000.575`*`<LF><CR>F:`*`49.981`*`<LF><CR>`

The meaning of each value is described below:

`R:`*`13:11:19`*	The reference time from the upstream reference clock, (day-of-year:hours:minutes:seconds).
`D:`*`+000.575`*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms.
`F:`*`+0.123`*	The measured power line frequency, resolution: 1 mHz.

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating characters "`<CR><LF>`" are received at the start of each are received at the start of each reference time second.

Information:

The SIE-TSF string uses the sequence `<LF><CR>` as a terminating sequence for each of the fields instead of the standard `<CR><LF>`.

However, if *per second, <CR> on second change* is configured with this string type, the string as a whole (after the *F* field) is terminated by the conventional termination sequence `<CR><LF>`, such that the first two fields are still terminated with `<LF><CR>`, but the last field is terminated with `<CR><LF>`. As a result, the complete string in this case would be as follows (as an example):

`R:13:11:19<LF><CR>D:+000.575<LF><CR>F:49.981<CR><LF>`

13.2.1.11 Vorne Display String

The Vorne Display String is a sequence of 90 ASCII characters containing the reference time, the frequency deviation, the time deviation (in two different formats), the power line time, and the power line frequency. Each field is terminated by a Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah), and the string as a whole is terminated by a Bell character (<BEL>, ASCII code 07h).

The Vorne Protocol is employed by a proprietary phasor measurement unit, and the implementation in the FDM is therefore aimed at enabling the continued use of existing receivers. Please note, however, that the FDM is not a full phasor measurement unit, and while the phase and magnitude fields are preserved in the time string to maintain compatibility, these fields in the string as provided by the FDM will always be set to zero.

The Vorne Protocol also includes an "out-of-lock" field that specifies how long the reference clock has been isolated from the upstream reference source. This is also not used by the FDM; if your Meinberg system loses lock with its reference source and falls back to holdover, the FDM will suspend string output; the "out-of-lock" field will remain at 0 even after this time, even if the reference clock is set to simulation mode.

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

1100<CR><LF>44*101103*<CR><LF>22*+00016*<CR><LF>33*+015*<CR><LF>34+ *0156*<CR><LF>
66*101103*<CR><LF>77*50016*<CR><LF>8800000<CR><LF>8900000<CR><LF>55*164*<CR><LF><BEL>

The meaning of each value is described below:

1100

A notional "out-of-lock" time that would specify how long the clock had been disengaged from its reference source on original devices. This is always 11 (the field code) followed by 00 (the placeholder time) on a Meinberg system.

15:03:30

The reference time from the upstream reference clock, (HoursMinutesSeconds)

22*+00016*

The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz. The first two digits are the integer value, the last three digits represent the three decimal places.

33+ *015*

The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 10 ms. The first two digits are the integer value, the last three digits represent the three decimal places. If the deviation exceeds a value of +*9.99* or is less than -*9.99*, this overflow this overflow will be represented by the last two decimal places being represented by spaces (i.e., +9.<SP><SP><CR><LF>).

Please note that no rounding is performed, i.e., a value of +089 may represent any value between +*0.890* or +*0.899*.

34+ *0156*

The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms. This is represented as a six-digit value; the first three digits after the sign are the integer value, the last three digits represent the three decimal places. Any leading zeroes in the integer segment will be substituted with spaces (i.e., 34+1500<CR><LF> represents 1 second and 500 milliseconds.

If the deviation exceeds a value of +*999.999* or is less than -*999.999*, this overflow will be represented by all numerical characters being substituted with spaces (i.e., +<SP><SP><SP><SP><SP><SP><CR><LF>). The direction of the overflow will remain indicated by the +/- sign.

66*101103*

The power line time, based on the mains frequency, (HoursMinutesSeconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!

77*50016*	The measured power line frequency, resolution of 1 mHz. The first two digits are the integer value, the last three digits represent the three decimal places.
88*00000*	A notional phase value for the power line waveform that would specify the phase of the AC wave at the time of measurement. This is always `88` (the field code) followed by `00000` (the placeholder value) on a Meinberg system.
89*00000*	A notional magnitude value for the power line waveform that would specify the the AC wave at the time of measurement. This is always `89` (the field code) followed by `00000` (the placeholder value) on a Meinberg system.
55*164*	The day-of-year value from the upstream reference clock (1– 366).

Transmission Mode Behavior

Per second	The transmission of the string is initiated at the start of each reference time second.
Per minute	The transmission of the string is initiated at the start of each reference time minute.
On request '?' only	The transmission of the string is triggered by receipt of the character "?" (ASCII code 3Fh) at RxD.
Per second, <CR> on second change	The transmission of the string is initiated in advance of a new reference time second so that the terminating character `<BEL>` is received at the start of each reference time second.

13.2.2 FDM String Formats (via IP Network)

13.2.2.1 Standard FDM String

The Standard FDM String is a sequence of 62 ASCII characters containing the frequency *F*, the frequency deviation *FD*, the reference time *REF*, the power line time *PLT*, and the time deviation *TD*. Each field is separated by a space character (ASCII code 20h).

The string is sent out once a second, at the beginning of each reference time second and is terminated by a Carriage Return (`<CR>`, ASCII code 0Dh) and Line Feed (`<LF>`, ASCII code 0Ah).

The standard string over IP is identical to the standard string over serial.

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

```
F:49.984 FD:-00.016 REF:15:03:30 PLT:15:03:30.378 TD:+00.378<CR><LF>
```

The meaning of each value is described below:

`F:`*49.984*	The measured power line frequency, resolution: 1 mHz.
`FD:`*-00.016*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), resolution: 1 mHz.
`REF:`*15:03:30*	The reference time from the upstream reference clock (hours:minutes:seconds)
`PLT:`*15:03:30.378*	The power line time, based on the mains frequency, (hours:minutes:seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!
`TD:`*+00.378*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms, maximum: +-99.999 s

13.2.2.2 Extended FDM String

The Extended FDM String is similar to the Standard FDM String, but begins with nine prior interim deviation measurements taken at exact 100 ms intervals, followed by the final 'conclusive' measurement with the frequency deviation, reference time, power line time, time deviation, and a sequential ID number for the complete string.

The string is sent out once a second, at the beginning of each reference time second, and is terminated by a Carriage Return (`<CR>`, ASCII code 0Dh) and Line Feed (`<LF>`, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

```
F:50.006 F:50.004 F:50.013 F:50.012 F:50.010 F:50.010 F:50.006 F:50.012
F:50.020 F:50.013 FD:+00.013 REF:15:19:10 PLT:15:19:10.071 TD:+00.071
SEQ:0000000004<CR><LF>
```

The meaning of each value is described below:

F:*50.013*	The nine interim and one final power line frequency measurements, resolution: 1 mHz.
FD:*+00.013*	The frequency deviation of the measured frequency relative to the nominal frequency, signed (+/-), maximum: +-09.999 Hz
REF:*15:19:10*	The reference time from the upstream reference clock (hours:minutes:seconds)
PLT:*15:19:10.071*	The power line time, based on the mains frequency, (hours:minutes:seconds.milliseconds) Time jumps such as changes between daylight saving and standard time or leap seconds are **not** applied to power line time!
TD:*+00.071*	The time deviation of the power line time relative to the reference time, signed (+/-), resolution: 1 ms, maximum: +-99.999 s
SEQ:*0000000004*	A sequentially assigned ten-digit ID number for each string.

13.2.2.3 Intermediate FDM String

The Intermediate FDM String format is used to send individual strings with power line frequency measurements taken and sent every 100 ms.

Each string is terminated by a Carriage Return (<CR>, ASCII code 0Dh) and Line Feed (<LF>, ASCII code 0Ah).

The letters displayed in italics below represent the measured values, while the other characters are unalterable elements of the string:

```
M1:49.997 SEQ:0000000054<CR><LF>
M2:49.996 SEQ:0000000055<CR><LF>
M3:50.000 SEQ:0000000056<CR><LF>
M4:49.999 SEQ:0000000057<CR><LF>
M5:49.996 SEQ:0000000058<CR><LF>
M6:49.996 SEQ:0000000059<CR><LF>
M7:49.997 SEQ:0000000060<CR><LF>
M8:49.995 SEQ:0000000061<CR><LF>
M9:49.996 SEQ:0000000062<CR><LF>
M9:49.996 SEQ:0000000063<CR><LF>
```

The meaning of each value is described below:

`SEQ:`*1*	A sequentially assigned single-digit ID for each frequency measurement within a second. The final two strings in a second both have the ID "M9", but have unique SEQ IDs (see below).
49.997	The measured frequency in Hz, resolution: 1 mHz, maximum: +-09.999 Hz
`SEQ:`*0000000054*	A unique, sequentially assigned ten-digit ID for each frequency measurement since the last restart of the FDM.

13.2.2.4 Custom FDM String

The Custom FDM String is used to define a custom string format, comprising a fixed prefix, the string itself containing a selection of possible variables, and a fixed suffix.

This string is sent once per second.

Prefix

The prefix can be used for example to provide control characters or other header data that the receiver is expecting to receive as an announcement of a string. ASCII characters can be specified with `\x`*[hex]*, where *[hex]* represents the hexadecimal ASCII code. This is required for certain control characters, for example:

`\x01`	SOH (Start of Header)
`\x02`	STX (Start of Text)
`\x0D`	CR (Carriage Return)
`\x0A`	LF (Line Feed)

String

The string supports any arbitrary text (including ASCII control codes as specified above under **Prefix**) as well as a number of variables that return data from the FDM:

`%PLFRQ`	The current power line frequency. Example output: `50.002`
`%FRQDEV`	The current signed frequency deviation. Example output: `+0.002`
`%REFTIME`	The current reference time. Example output: `15:17:23`
`%POWERLNTIME`	The current power line time. Example output: `15:17:24`
`%PLTDEV`	The current deviation of the power line time relative to the reference time in seconds and fractional seconds up to three decimal places. Example output: `+01.002`
`%IDX`	An interim measurement index. This value relates to multiple interim frequency measurements taken within the one-second period. Example output: `1`
`%IMMFRQ`*[Index]*	An interim frequency measurement, whereby *[Index]* is substituted by an index value 1–9, e.g. `%IMMFRQ1`. Example output: `50.002`
`%SEQID`	The sequential ID number for each individual frequency measurement (including for each interim measurement performed during the space of a second). Example output: `0000000001`
`%SYSTIME`	The current system time. Example output: `15:17:23`
`%SYNCSTATE`	The current synchronization status of the reference clock of the host IMS

	LANTIME system. If *unsynchronized*, this will return a space (ASCII code 20h). If *synchronized*, this will return an asterisk "*" (ASCII code 2Ah).
`%SYNCTEXT`	The current synchronization status of the reference clock of the host IMS LANTIME system. If *unsynchronized*, this will return `NO`. If *synchronized*, this will return `OK`.
`%TIMESTAMP`	Returns a current timestamp containing date and time with millisecond accuracy. Example output: `2023-01-27 12:19:11.042`
`%TIMESTRING`	Returns a time string used to set the time of a frequency output display. Example output:`S12:19:11;27.01.23S`

Sequential Output of Multiple Strings

It is possible to configure the string output to cycle through multiple strings; this may be done, for example, to cycle the output on an LED display with a limited character number of characters. Each string to be displayed is separated by a comma in the "**String**" field. For example:

```
POWER LINE FREQ: %PLFRQ Hz,FREQ DEVIATION: %FRQDEV Hz,REFERENCE TIME:
%REFTIME ,POWER LINE TIME: %POWERLNTIME
```

will output (the values here are arbitrary)

```
POWER LINE FREQ: 50.002 Hz
```

then, one second later,

```
FREQ DEVIATION: +00.002 Hz
```

then, one second later,

```
REFERENCE TIME: 15:17:23
```

then, one second later,

```
POWER LINE TIME: 15:17:23.012
```

A delay between string changes can also be introduced by appending `@XX` to the end of any string in the sequence, where `XX` is a value in seconds. Therefore:

```
POWER LINE FREQ: %PLFRQ Hz@10,FREQ DEVIATION: %FRQDEV Hz@2,REFERENCE TIME:
%REFTIME @2,POWER LINE TIME: %POWERLNTIME@2
```

will ensure that the string output only changes every two seconds, with the exception of the power line frequency, which is output for ten seconds.

Suffix

Much like the prefix, the suffix can be used to provide control characters or other string termination data that the receiver is expecting to receive to terminate a string. ASCII characters can be specified in the same way with `\x`*[hex]*.

14 Your Opinion Matters to Us

This user manual is intended to assist you in the preparation, use, and care of your Meinberg product, and provides important information for configuration and status monitoring.

Be a part of the ongoing improvement of the information contained in this manual. Please contact our Technical Support team if you have any suggestions for improvements or technical questions that are relevant to the manual.

Meinberg – Technical Support

Phone: +49 (0) 5281 – 9309- 888
Email: techsupport@meinberg.de

15 RoHS Conformity

Conformity with EU Directive 2011/65/EU (RoHS)

We hereby declare that this product is compliant with the European Union Directive 2011/65/EU and its delegated directive 2015/863/EU "Restrictions of Hazardous Substances in Electrical and Electronic Equipment" and that no impermissible substances are present in our products pursuant to these Directives.

We warrant that our electrical and electronic products sold in the EU do not contain lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs), bis(2-ethylhexyl)phthalat (DEHP), benzyl butyl phthalate (BBP), dibutyl phthalate (DBP), or diisobutyl phthalate (DIBP) above the legal limits.

16 List of Abbreviations

CLK	Clock
CPU	Central Processing Unit
CR	Carriage Return (Zeilenumbruch)
DAC	Digital-Analog Converter
DC	Direct Current
D-Sub/DSUB	D-Subminiature
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ESDS	Electrostatic Discharge Sensitivity/Sensitive
ESI	External Synchronization Input
ETX	End of Text
GND	Ground
HP	Horizontal Pitch
IMS	Intelligent Modular Synchronization
I/O	Input/Output
LF	Line Feed
LTOS	LANTIME Operating System
LVI	Low-Voltage Input
MRI	Multi-Reference Input
PWR	Power
RSC	Redundant Switch Control
RTC	Real-Time Clock
SOH	Start of Header
STX	Start of Text
TCP	Transmission Control Protocol
TDEV	Time Deviation
TTL	Transistor-Transistor Logic

UDP User Datagram Protocol

USB Universal Serial Bus

WEEE Waste of Electrical and Electronic Equipment