Datasheet micromax-f

Precise measurement of the power supply mains frequency

1 General description

The frequency measurement device micromax-f determines the frequency of the supply voltage by measuring the time between zero crossings of the sinusoidal waveform. The time base is calibrated at regular intervals with a temperature compensated crystal, whereby a high accuracy is achieved.

The micromax-f uses a temperature-compensated quartz as its reference time source. The extended version, –fgps, additionally utilizes the timebase of GPS (Global Positioning System), based on multiple atomic clocks, as the reference time source and for timestamping data packets.

Measurement values are averaged over one second and are then available for further processing or output. The system includes a Modbus/TCP server, a web server to respond to measurement data queries (XML via HTTP), and a web client to actively send measurement data to a server (UDP). Devices with the 485 option can output data via a Modbus/RTU (RS485) server.

micromax-	f	fext	fgps	fgpsext	f485	f485ext	fext5V	fgpsext5V	f485ext5V
Accuracy 1 mHz	x	x	x	x	x	x	x	x	x
Resolution 0.1 mHz	x	x	x	x	x	x	x	x	x
Ethernet xml	x	x	x	x	x	x	x	x	x
Modbus/TCP (Ethernet)	x	x	x	x	x	x	x	x	x
Modbus/RTU with RS485					x	x			x
GNSS-Receiver			x	x				x	
Frequency measurement via									
supply voltage	x		x		x				
external input		x		x		x	x	x	x
Power supply									x
230V / 6 V AC transformer	x	x	x	x	x	x			
power supply for 5 V DC*							x	x	x

*) 5Va for supply with 9 - 36 V DC, 5Vb for 18 - 75 V DC and 5Vc for 85 - 264 V AC and 120 - 370 V DC

Table 1: *Characteristics of the model variants*

Option external measurement input (ext)

The standard device integrates the measurement input with the power supply, requiring only a single connection for both. The ext option (external measurement input) provides a separate input for measurements. This is advantageous for networks with a high harmonic content (e.g., caused by refrigeration units), as a less disturbed signal, e.g., from a medium-voltage measurement transformer, can then be used for measurement.

The measuring input can be supplied with voltages from 5 V to 15 V. The ext option includes a measuring transformer. This allows measuring signals with 50 V to 230 V to be reduced to the voltage level of the measuring input.

Option GPS (gps)

The measurement device processes the information provided by the included GNSS receiver (GPS, Glonass und Galileo). The pulse each second is used as the reference time source, and the date and time set the internal clock, ensuring that data packets use UTC timestamps.

To allow flexible placement of the device, it comes with an external, weatherproof GPS receiver, connected via a 5 m data cable.

Option Modbus/RTU over RS485 (485)

The device includes a Modbus/RTU server, enabling communication via RS485. This allows integration with systems like PLCs. If no Ethernet network is available or devices cannot be connected to the network, this option enables digital querying and forwarding of the measurement values.

Option power supply with 5V DC (5V)

The standard device is powered by the included 230 V/6 V transformer. For DC power supplies or alternative voltage levels (e.g., 110 V AC), the 5V option allows the device to be powered with a 5 V DC power adapter.

	Standard		GPS		RS485	
	6V AC	5V DC	6V AC	5V DC	6V AC	5V DC
Measurement input						
internal	-f		-fgps		-f485	
external	-fext	-fext5V	-fgpsext	-fgpsext5V	-f485ext	-f485ext5V

Table 2: *Compilation of options for the variants of the measuring device*

2 Content of delivery

The delivery should include:

- Measurement device micromax-f / -fgps / -f485
- 6 V AC Power Supply (220-240 V) or
  5 V DC power supply (option 5V)
- Network cable for ethernet
- Info sheet (MAC-address, serial number)
- Option gps: GPS/GNSS receiver
- Option ext: Measurement transformer and a 9-pin D-Sub cable for external measuring input

3 Technical Specifications

Measurement device	
Case size	120 * 105 * 45 mm
(with DIN rail mounting)	120 * 117 * 45 mm
Weight	ca. 350 g
Operating temperature	-25 °C bis +85 °C
Storage temperature	-40 °C bis +85 °C
Case IP Code	IP30
GPS-receiver (only option GPS)	
Case size	61 * 61 * 19,5 mm
Weight	ca. 160 g
Cable Length	5 m
Operating temperature	-30 °C bis +80 °C
Storage temperature	-40 °C bis +90 °C
Case IP Code	IPX7 (waterproof IEC 60529)
Rail mount power supply	
Case size	54 * 90 * 63 mm
Power input	6 V AC (5V DC with option 5V)
Operating current	< 450 mA
Operating power	< 4,5 VA
Power supply standard	230 V AC
with option 5V	9 - 36 V DC / 18 - 75 V DC / 120 - 370 V DC / 85 - 264 V AC
Measurement Specifications	
Range	45 Hz bis 65 Hz
Resolution	0.1 mHz
Accuracy (1 second period)	+/- 1 mHz
Accuracy (<250 ms period)	+/- 5 mHz
Power on start-up time	< 4 s

Table 3: *Technical data*

4 Measurement Values

The following measurement values are provided:

Netzfrequenz (mains frequency): At the end of every second calculated average of the measurements over the period of a second. With the option gps the calculation is synchronous with the GPS time.

Netzfrequenz_100ms (150ms, 200ms, 1000ms): Moving average of the measurements of the last 100 ms (150 ms, 200 ms, 1000 ms). The value is calculated after each single measurement and thus represents the most recent result. The 100 ms value is considering a time interval of 10 cycles (average of 10 cycles, performed with a moving window).

Moving average is not suitable for calculating minute values due to the timing of ethernet transport

Phasenwinkel (phase angle): Angle of the current voltage vector relative to an imaginary machine which rotates at 50 Hz or 3000 revolutions per minute. The version -fgps provides calculation synchronous with the GPS time.
The correct name for this measured angle is Phasor. In discrepancy from this, the word phase angle or phase is used alternatively in this document due to compatibility with older versions.

5 Electrical Connections

The measurement device and included components are designed for DIN rail mounting. On the rail a width of at least 105 mm is required for the meter and the power supply.

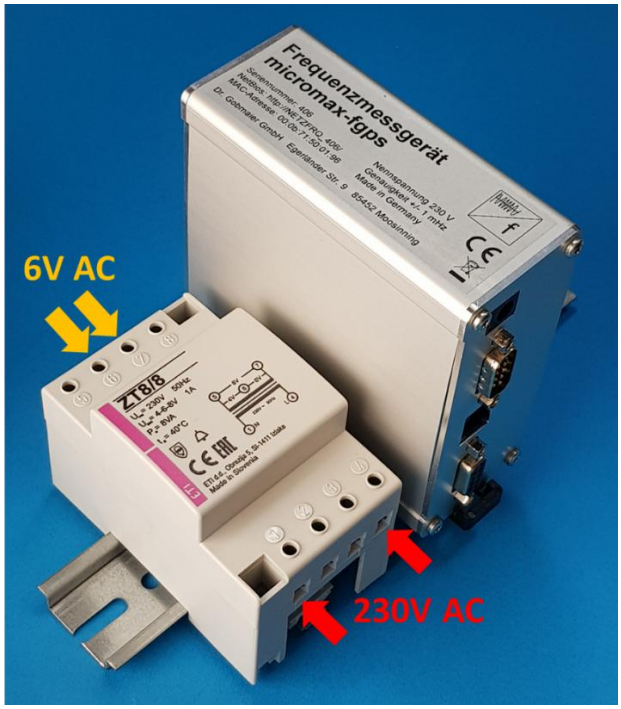


Figure 1: *Measuring device with DIN rail mounting, terminals marked*

Power supply for the measuring device: The included cable (black/red, 2 m in length) is connected to the measuring device via the barrel plug.

Standard: Connect the other end of the cable to terminals 6 and 7 of the power supply (6 V AC). To connect to a 230 V mains supply, connect terminals 1 (N) and 4 (L) to 230 V via a suitable fuse.

Option 5V: Connect the red cable on the power supply to +V and the black cable to −V. The power supply should then be connected to the appropriate voltage source as indicated on its label. It is crucial to observe the correct polarity.

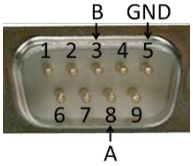
Option ext: The included D-Sub cable is connected to the measuring device. The free cable ends are then connected to the measurement transformer. One cable is connected to the 0V terminal, and the other cable is connected according to the corresponding table to the 8 V, 12 V, or 24 V output. For a measurement signal of 100 V, the 12 V output on the transformer is use.
The measurement transformer is then connected to the power source via the N and L terminals.

Voltage	
5 - 15 V	direct, no transformer
50 - 90 V	24 V tap
90 - 140 V	12 V tap
140 - 230 V	8 V tap

Option 485: A cable with a female 9-pin D-Sub connector with the following pin assignment is required:

Pin 3 → RS485 B, Pin 5 → GND, Pin 8 → RS485 A

The figure shows the pin assignment on the measuring device.



Important: Only the pins for A, B, and GND may be connected on the D-Sub connector. All other pins must remain unassigned. Pins 2 (RS232 Rx), 6 (GND), and 7 (+5 V) are internally connected to other components. To prevent malfunctions or damage, these pins must not be connected or used.

Measuring devices purchased before December 2022 required a male D-Sub connector with a different pin assignment: Pin 1 →GND, Pin 5 →B, Pin 9 →A

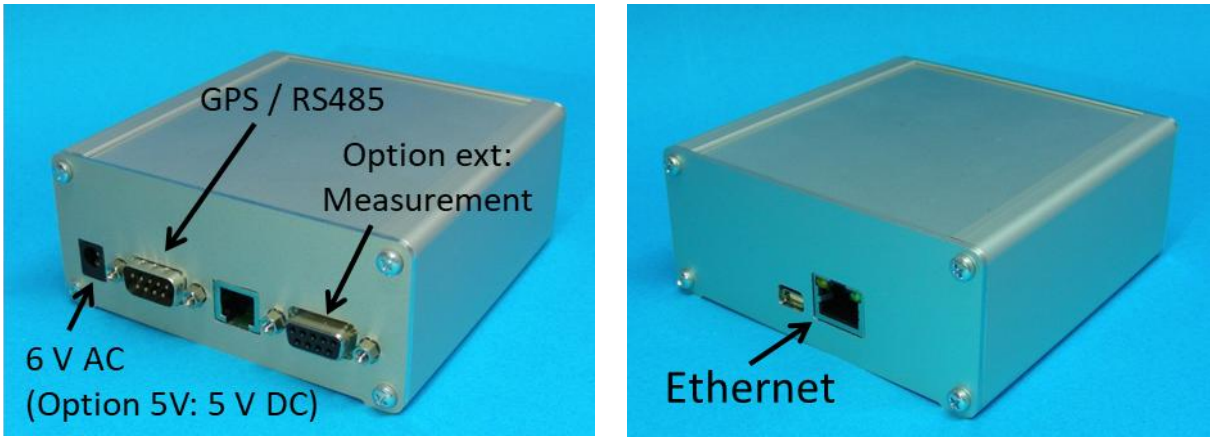


Figure 2: *The left image shows the front of the measuring device with the power supply connection and the port for the GPS receiver (option gps) or RS485 (option 485). The right image shows the rear of the device with the Ethernet interface.*

6 Commissioning

- The device is connected to the mains power using the included power supply unit. The measuring device then starts up automatically.
- For option ext, the measurement reading remains at 0 Hz until the measurement transformer receives the measurement signal.
- Option gps: Place the GPS/GNSS receiver near a window (to ensure GPS reception) and connect it to the measuring device. The cable can be extended by a 5 m extension if necessary.
  Note: If the GPS receiver has been switched off for several days or has been moved a considerable distance, a cold start can take up to 5 minutes.
- Connect the network cable to the LAN. The network must have a DHCP server that assigns an IP address to the device. Proper functioning of power and network connections is indicated by the yellow LED on the Ethernet port. Ongoing communication over the network is indicated by the green LED on the Ethernet port.
- The system announces its hostname on the network via NetBIOS, allowing direct access in a browser (e.g., http://NETZFRQ_152/ for a device with serial number 152). Devices with a two-digit serial number may be reachable, for instance, via http://NETZFREQUENZ_15/.
- If the network does not support this service, the device's IP address can be found using its MAC address (see the supplied information sheet). This can be done, for example, with the free "*Angry IP Scanner*" tool or directly in the Windows Command Prompt (cmd.exe) using the command "arp –a".

To simplify commissioning, a factory preconfiguration is possible, so that parameters such as a fixed IP address or RS485 bitrate are already set. In that case, only the physical connections have to be made.

7 Interfaces

The measurement device automatically connects to the network (Ethernet) through the built-in DHCP client. For the transfer of data multiple paths are provided:

- Retrieval of the data from the website of the embedded webserver
- Active transmission of measurement data to a server via UDP
- Retrieving a xml file from the embedded webserver
- Retrieval of the frequency trend (seconds values) from the embedded webserver
- Retrieving the moving average from the embedded webserver
- Modbus/TCP Server (slave), Modbus/RTU (option 485)

Retrieval of the data from the website of the integrated webserver

The embedded webserver provides a web site on which the actual measurements are available, updated every second. On this site, the IP address for sending UDP data packets and the system time can be set.

Example: Calling http://netzfrq_490/ returns the following website:

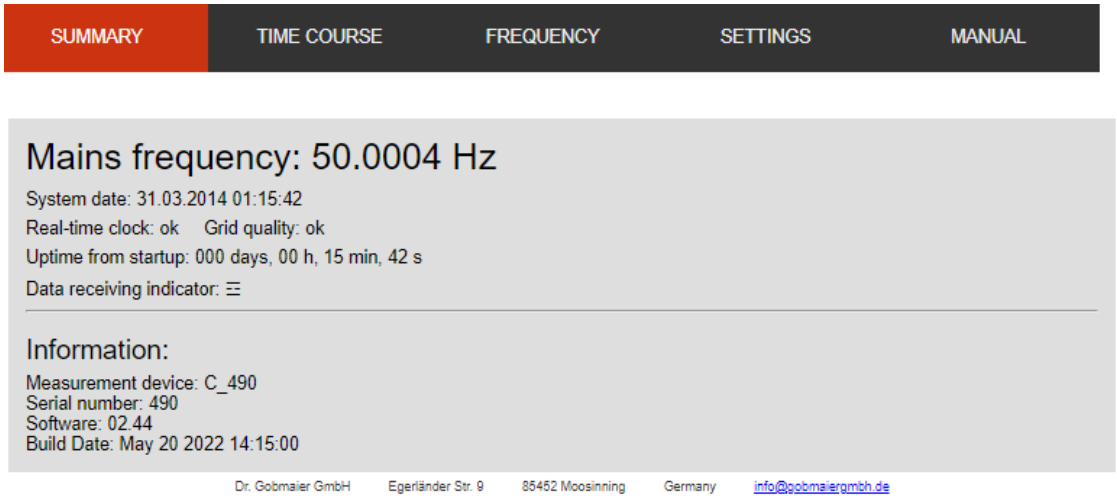


Figure 3: *Summary page of the integrated webserver*

The time course of the frequency can be displayed for different periods (5 minutes to 24 hours).

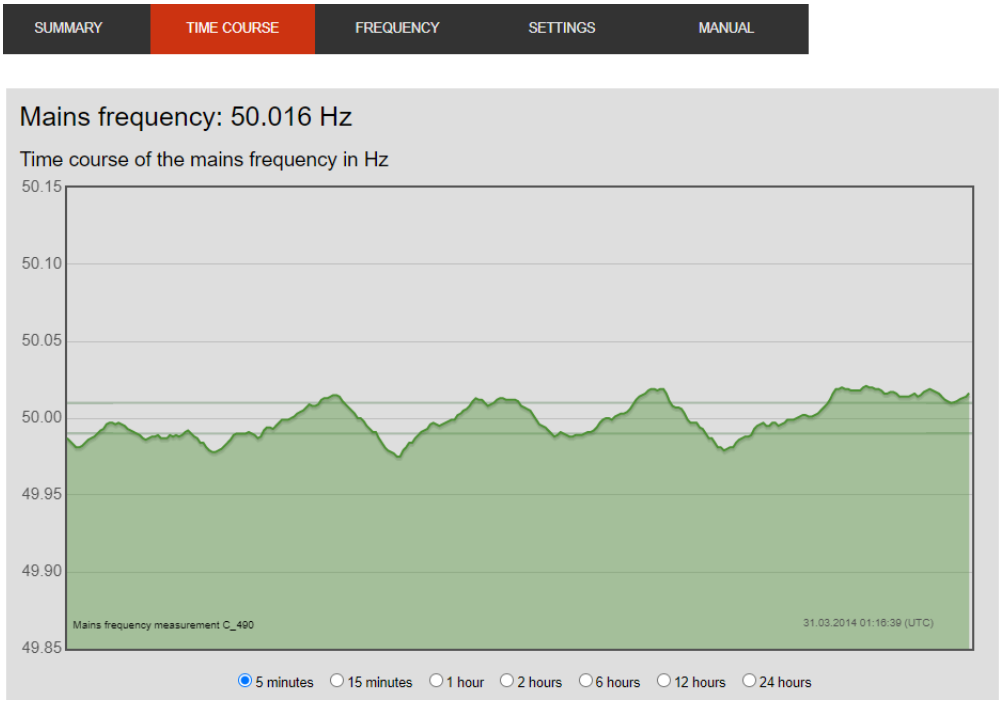


Figure 4: *Time course of the frequency*

The menu item " FREQUENCY" leads to a simple representation of the frequency.

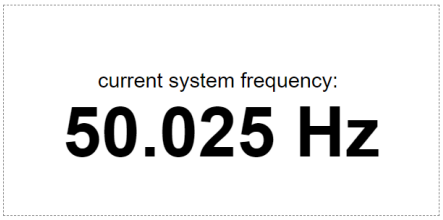


Figure 5: *Display of the current network frequency*

Static IP address or dynamic IP address with DHCP
The meter has a DHCP client which automatically gets an IP address assigned in many networks (by a DHCP server). In this case, the field for the static IP address must contain the entry 0.0.0.0. Should the device get a static IP, then the address can be set in this input field. After pressing the button, „Set IP Measurement device" the meter is restarted with the new IP.

Caution: If an incorrect IP is specified, the device may be unreachable from your network. Please contact the manufacturer for resetting.

Active transmission of measurement data to a server via UDP
The integrated UDP client sends UDP packets to max. two pre-programmed IP addresses. The IP address can be set on the integrated web server. For UDP the device needs a dynamic IP via DHCP.

Mode Second values repeated each 500 ms: The second values of the mains frequency and the phasor of the last second change are sent with the time stamp. As UDP packets can be lost on the network they are repeated each 500 ms.

Example: Setting the field „Target IP-Address for UDP transmission" will result in sending UDP packets to the IP each second (frequency 50.0273 Hz, Date/Time 14.05.2014 08:46:04, device number C_490):

f=50.0273&n=C_490 &z=14.05.2014 08:46:04

Mode Second and 100 ms mean values repeated each 100 ms: In addition to the data just described, the moving 100 ms mean value, the last measured phasor and the internal millisecond time are transmitted. The packets are sent every 100 ms.

Example: Packet at the millisecond 600 with moving 100 ms average of 50.0128 mHz and a phasor of 221.6°:

f=50.0273&n=C_490&z=14.01.2020 08:46:04 …
&p=062.9 &d=009&zx=0600&fx=50.0128&px=221.6

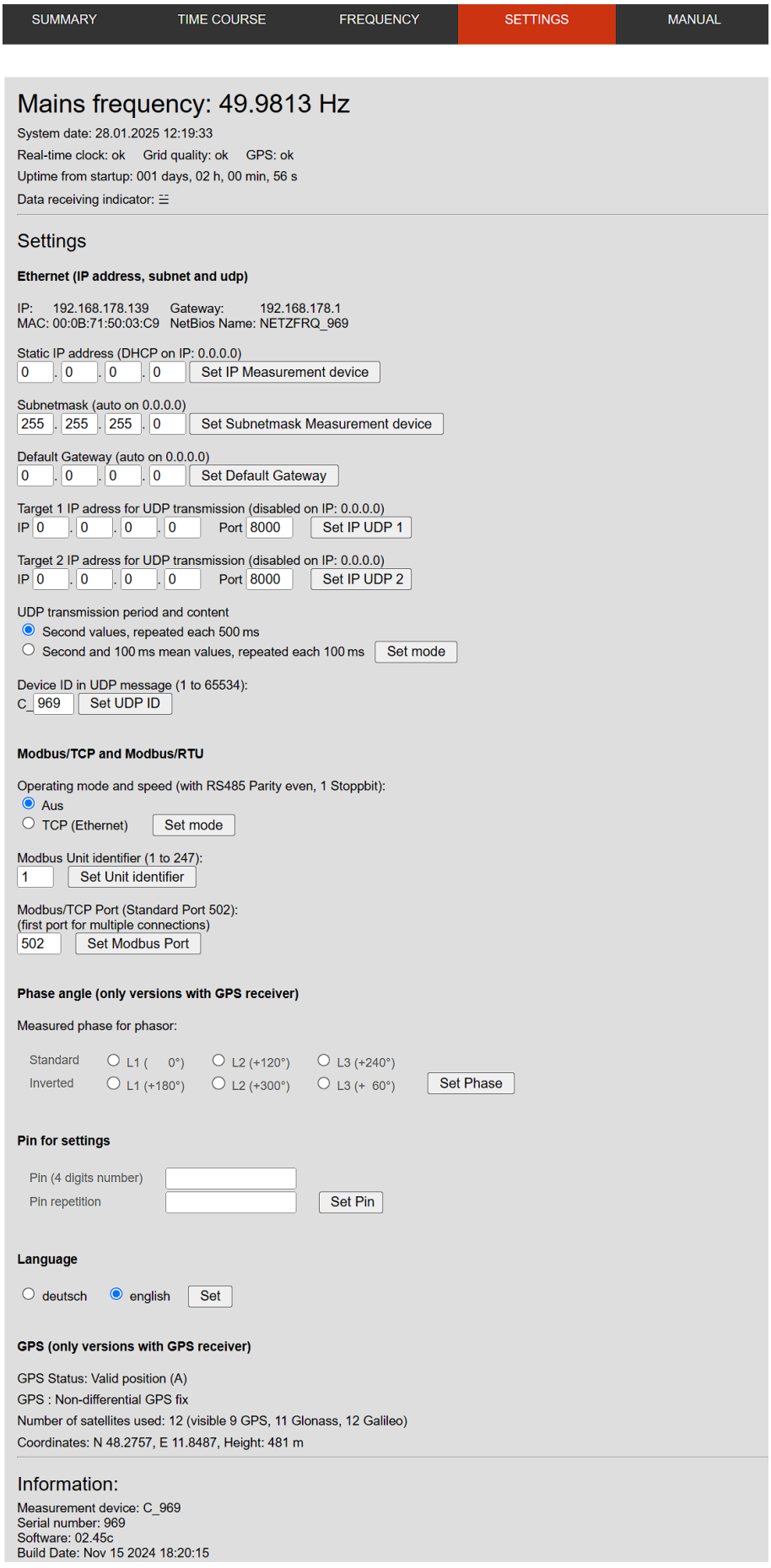


Figure 6: *Settings of the device*

Retrieving the xml file from the embedded webserver
Each second a xml file with the current measurement data is generated. This file can be downloaded with a server that calls via http cyclically the file "frequenz.xml".

Example: Access the http://netzfrq_298/frequenz.xml to get a xml-file with the content:

```
<response>
   <frequenz>50.0273</frequenz>
   <phase>163</phase>
   <datumzeit_utc>14.05.2014 08:46:04</datumzeit_utc>
   <controller>C_298</controller>
</response>
```

Retrieval of the frequency trend (second values) from the embedded webserver
The meter provides an xml file (frequenz_export.xml) which includes an adjustable number of measurements. With the parameter „d" up to 3,600 second values can be queried. The last value is the current measured value. To simplify further processing, the values are transferred in mHz and separated by semicolons.

Example: Access http://netzfrq_298/frequenz_export.xml?d=5 to get a xml file with the measured values of the last 5 seconds:

```
<result>
   <data>50019;50019;50020;50020;50020;</data>
</result>
```

Retrieving the moving average from the embedded webserver
The measurement device continuously calculates a moving average over the last 100 ms, 150 ms, 200 ms and 1000 ms. These values can be retrieved via the file "frequenz_ms.xml". The frequency measurement <frequency> is synchronized to the second change, the moving averages shows the current average of the last measurements (e.g. <frequenz_100ms> shows the average of the last 100 ms period).

The phase angle <phase> indicates the phasor at the last second change, the value <phasen20ms> indicates the phasor of the last zero crossing.

Example: Access http://netzfrq_298/frequenz_ms.xml to get a xml-file with the content:

```
<response>
    <frequenz>49.9667</frequenz>
    <phase>163</phase>
    <frequenz1000ms>49.9664</frequenz1000ms>
    <frequenz100ms>49.9643</frequenz100ms>
    <frequenz150ms>49.9646</frequenz150ms>
    <frequenz200ms>49.9646</frequenz200ms>
    <phase20ms>159</phase20ms>
    <datumzeit_utc>31.03.2014 00:08:07</datumzeit_utc>
    <zeit_ms>560</zeit_ms>
 <controller>C_298</controller>
</response>
```

Modbus/TCP Server (slave)

The measuring device has an integrated Modbus/TCP server (slave), which delivers the requested register values upon request from a Modbus client (master). The Modbus/TCP server can serve up to 3 clients (with a manufacturer-side configuration allowing a maximum of 12).

The system does not support multi-port capability. This means only one connection per port is possible at a time when using Modbus/TCP. In order to retrieve measurement data from multiple master devices, you must use ports starting from 502 in ascending order (for example, the first device uses port 502, the second device port 503, the third device port 504, and so on). The unit identifier is not used in Modbus/TCP because the device is uniquely addressed via its IP address.

Modbus/RTU Server (slave) via RS485 (option 485)

With option 485, you can query measurement values using the Modbus/RTU protocol over RS485. 2W-MODBUS is used, which is a serial transmission method based on two differentially driven lines (A/B). This setup allows multiple participants and is robust against interference.

Parameters: 19,200 bps / 9,600 bps, even parity, 1 stop bit

The unit identifier (unitID) is used with Modbus/RTU to identify the target device and must match the device's value when making a request.

Modbus Registers (Modbus/TCP and Modbus/RTU)

Modbus data transmission can be enabled in the device settings. Only holding registers (function code 3 or addresses starting at 0x40000) are supported. The contents of the registers are shown in the following table.

Address	Data	Format
0x00 01	Measured value of the mains frequency (second value)	unsigned int 16 bit
0x00 02	State of the device	unsigned int 16 bit
0x00 03	Day	unsigned int 16 bit
0x00 04	Month	unsigned int 16 bit
0x00 05	Year	unsigned int 16 bit
0x00 06	Hour (UTC)	unsigned int 16 bit
0x00 07	Minute	unsigned int 16 bit
0x00 08	Second	unsigned int 16 bit
0x00 09	ProgrammNo.	unsigned int 16 bit
0x00 0A	VersionsNo.	unsigned int 16 bit
0x00 0B	Phasor of last second change	unsigned int 16 bit
0x00 0C	spare	unsigned int 16 bit
0x00 0D	Millisecond cpu time	unsigned int 16 bit
0x00 0E	Mains frequency (floating mean value over 1000 ms)	unsigned int 16 bit
0x00 0F	Mains frequency (floating mean value over 200 ms)	unsigned int 16 bit
0x00 10	Mains frequency (floating mean value over 150 ms)	unsigned int 16 bit
0x00 11	Mains frequency (floating mean value over 100 ms)	unsigned int 16 bit
0x00 12	spare	unsigned int 16 bit
0x00 13	Phasor of last measurement	unsigned int 16 bit

Table 4: *Register of Modbus (Modbus/TCP & Modbus/RTU)*

The status of the device is bit-coded:

Bit 0: Time base correction successful. After switching on, it takes up to 3 minutes for the correction to be carried out.
Status 0: Lower accuracy than +/- 1mHz possible
Status 1: Accuracy better than +/- 1 mHz

Bit 1: power quality
Status 0: Due to interference (e.g. during switching processes in the network) less than 45 zero crossings could be used for the measurement
Status 1: More than 45 zero crossings could be evaluated. At good power quality 50 zero crossings per second can be evaluated.

Bit 2: GPS reception ok (with micromax-fgps)
Status 0: No GPS device connected or poor GPS reception
Status 1: GPS ok

8 Information

- Indoor use only.
- Use only the supplied accessories (e.g. power supply, GPS receiver).
- Do not use the meter on mains with higher voltage or frequencies as specified.
- Do not use the device if it appears damaged, incomplete, or not properly closed.
- Only use the factory supplied power adapter.
- Repairs and checks must be performed by accredited experts.
- If there is doubt about the proper function of the device, the frequency-value of the integrated web interface can be compared with the value shown under www.netzfrequenzmessung.de. For a detailed review the values of a 10-minute period can be logged and sent to the manufacturer, so we can compare it to its reference measurement.
- The accuracy can decrease with time due to aging of electronic components. Therefore, it is recommended that the unit is checked every four years. For this the submission of a recorded 10-minute period to the manufacturer is sufficient to possibly identify deviations.

The CE mark confirms the compliance with European Directives, notably the Low Voltage Directive and the EMC Directive.

The crossed out dustbin means that the product must be supplied in the European Union in accordance with the WEEE Directive 2012/19/EG a separate e-waste recycling. The product may not be treated as household waste.

9 Kontakt

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EG-Konformitätserklärung

micma
micro maximal electronic

Allgemein

Hiermit erklären wir, dass die nachstehend bezeichnete Maschine in Ihrer Konzeption und Bauart sowie der von uns in Verkehr gebrachten Ausführung der grundlegenden Sicherheits- und Gesundheitsanforderungen der EG-Richtlinie 2006/42/EG entspricht. Bei einer mit uns nicht abgestimmten Änderung des Messgerätes verliert die Erklärung ihre Gültigkeit.

Hersteller/Bevollmächtigter:

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Glonner Straße 19
85667 Oberpframmern
Tel: 08093 / 905940

Beschreibung der Maschine:

Funktion:	Messgerät für Netzfrequenzmessung micromax-f
Typ/Model:	Netzfrequenzmessung
Seriennummer:	
Baujahr:	2016

Es wird die Übereinstimmung mit weiteren, ebenfalls für das Produkt geltenden Richtlinien/Bestimmungen erklärt:

Niederspannungsrichtlinie 2014/35/EU

den Bestimmungen der oben gekennzeichneten Richtlinien – einschließlich deren zum Zeitpunkt der Erklärung geltenden Änderungen – entspricht.

Angaben zur Person des Unterzeichners:

Siegfried Zeller, Geschäftsführer

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