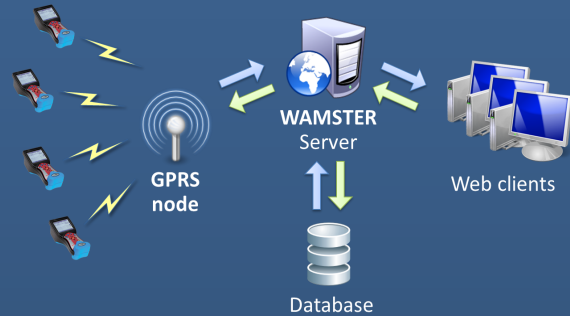# How does Wamster GPRS communication work?

Portable STER PMU device starts measuring synchrophasors as soon as it is powered on. During the GPRS initialization phase or during temporary GPRS link failure, phasor data is saved to local flash memory. Data transmission to the Wamster server begins after the connection is established.

As soon as the link has been established, server starts recollecting missing frames from the instrument's memory. Measured data is processed, stored in a database and available online through the web interface in near real-time fashion.



WAMSTER Server

GPRS node

Web clients

Database

If a drop in GPRS link quality is detected, server temporarily lowers the reporting speed and requests any missing phasor frames when appropriate. In case of a blackout, both the device and the modem remain operational and powered by the embedded backup battery.

If the modem is unable to connect to the network for any reason, device will continue saving data to its local flash memory at full synchronous speed, to be available for collection when the link is established again.

By default, synchrophasors are reported at a reporting speed of 10 frames per second. If a user defined event is detected, or upon a user request, synchrophasor data is recollected from instrument's memory at synchronous speed. For ethernet connections, synchrophasors are reported at synchronous speed by default.

When exporting through the web interface, frames can be optionally requested at higher resolutions, or exported from the database only.

## STUDIO ELEKTRONIKE RIJEKA

We are a company specialized in developing complete technical solutions, combining software, firmware and hardware development. Our key targets are integrated power quality and measurement solutions.

We are also specialized in various fields of electrical engineering, with focus on providing quick troubleshooting and solutions to specific and most complex power-related customer problems.

Our development team has years of experience in all phases of microcontroller development, programming dedicated Windows/Web applications for data gathering and analysis, as well as design and commissioning of various industrial automation systems.

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e-mail:   ster@ster.hr

# WAMSTER
## AD HOC PHASOR MEASUREMENT NETWORK

WAMSTER system integrates **portable, plug-and-play PMU devices** with a **reliable server solution** for gathering, storing and analyzing phasor data.



STER PMU is a small, handheld portable synchrophasor device.



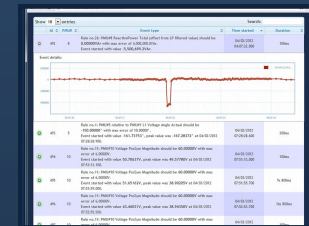Lightweight measurement accessories are included in a soft carrying bag.
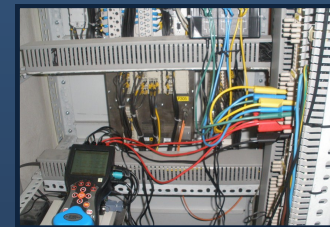


STER PMU fits in every cabinet.



Backlit LCD alleviates and simplifies measurement setup in all conditions.



Online user interface is used for status monitoring, data analysis, export and remote device setup.



User-defined triggering allows automatic capturing of events, data presentation and alarming.

↗ www.wamster.net

# STER PMU
### PORTABLE PHASOR MEASUREMENT UNIT

**Portable, handheld PMU devices**

Lightweight, handheld PMUs with rechargeable battery backup sufficient for 5h of autonomy during blackouts and 32 GB local removable SD flash memory for storing 4 months of synchronously reported data.

**GPRS/Ethernet IEEE C37.118 link**

STER PMU devices use a custom, optimized protocol for GPRS communication and a standard IEEE C37.118.2 protocol for integration with existing PDC systems.

**Synchrophasors in 15 minutes**

All the equipment necessary to start wide area monitoring with a STER PMU is included in a soft carrying bag: It takes only a couple of minutes to setup and connect the device. Synchrophasor data stream is then established automatically.

**Cloud data storage as a service**

Infrastructure and on-site deployment costs are significantly reduced with the cloud data storage service. Custom communication protocol extension ensures that no data is lost regardless of communication link quality.

**Web interface for remote data access**

Online web interface provides device status, near real-time measurements with magnitude and angle comparisons, historical data export and event-based triggering using any web enabled device, no plugins required.

**Customization on request**

Additional features and protocol can be implemented according to customers requests. Since the application is web-based, all updates to the interface are visible immediately.

# STERPMU
PORTABLE PHASOR MEASUREMENT UNIT

## Technical specification

### AC Voltage inputs

| | |
|---|---|
| No.of inputs | $U_1$, $U_2$, $U_3$, $U_{Earth}$ |
| Input range | 150/300/1000V |
| Resolution | 10/100mV |
| Basic accuracy | 0.2% of reading |
| Sampling rate | 64 samp./period, synchronized |

### AC Current inputs

| | |
|---|---|
| No.of inputs | $I_1$, $I_2$, $I_3$, $I_{Earth}$ |
| Input range | Voltage coded ...A/1V, ...A/0.1V |
| Current measuring range | 0.5-6000 A (depending on clamps) |
| Basic accuracy | 0.25% of reading |
| Sampling rate | 64 samp./period, synchronized |

### Device characteristics

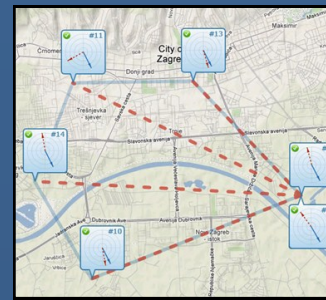| | |
|---|---|
| Comm. ports | RS232, USB, TCP/IP with GPRS/UMTS or Ethernet adapter |
| Display | 320x200 graphic LCD with backlight |
| Memory | Internal 8 MB (77 min at 60fps) |
| | microSD card (4 months at 60fps) |
| Voltage supply | 110/230VAC |
| Battery backup | 6 x 1.2V NiMH, size AA rechargeable (5 h of autonomy) |
| Category | 1000 V / CAT III; 600 V / CAT IV |
| Protection class | double insulation |
| W x H x D | 115 x 90 x 220 mm |
| Weight | 0.65 kg |

## Example of an ad-hoc WAM system
# Zagreb 110kV loop

↗ installed in Sep 2011 (ongoing)

↗ part of the **SIPS Project** for Croatian TSO conducted by Faculty of Engineering Rijeka

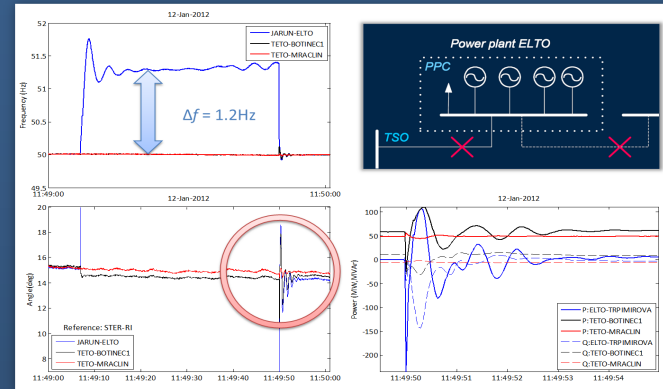↗ goals: **dynamic model tuning, baselining and troubleshooting**



6 STER PMU devices installed at critical points in the loop

# Event triggering

↗ comprehensive processing rules for automatic **event triggering**: thresholds for instantaneous values, relative values, rate of change, offset from low-pass, etc.

↗ **event analysis and data export** through the web interface

↗ **e-mail** notifications and alarm reporting



Triggers are configured on various quantities. Events are easily analyzed using the web interface



Geographical locations of Zagreb devices



TE-TO Zagreb, during installation



Wamster data used for detecting and troubleshooting various system conditions

# IEEE C37.118 protocol

↗ for STER PMU devices connected to a compatible PDC device

↗ provided **serial-to-ethernet adapter** simplifies deployment scenarios

# Wamster GPRS protocol

↗ Wamster system utilizes a **custom GPRS optimized** communication protocol

↗ protocol allows dynamic reporting speed adjustments, historical frame requests at different frame rates, enhanced diagnostics and full remote device control

# Remote device access

↗ For troubleshooting and remote configuration, devices can be accessed and controlled **remotely** through the web interface

## STER PMU accessories


**Current transformer 5A / 1V**


**Current clamp 1000/100/5A / 1V**


**Current clamp 1000A/1V**


**Mini current clamp 100A / 1V**


**Mini current clamp 5A / 1V**


**3-phase flexible current clamps 3000/300/30A / 1V**


**GPRS /UMTS modem**


**Serial to Ethernet converter**