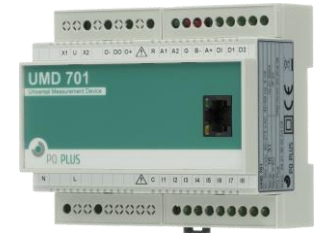
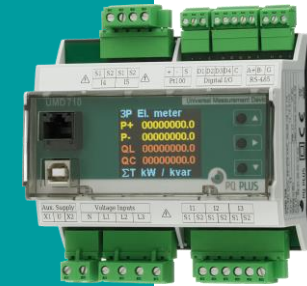
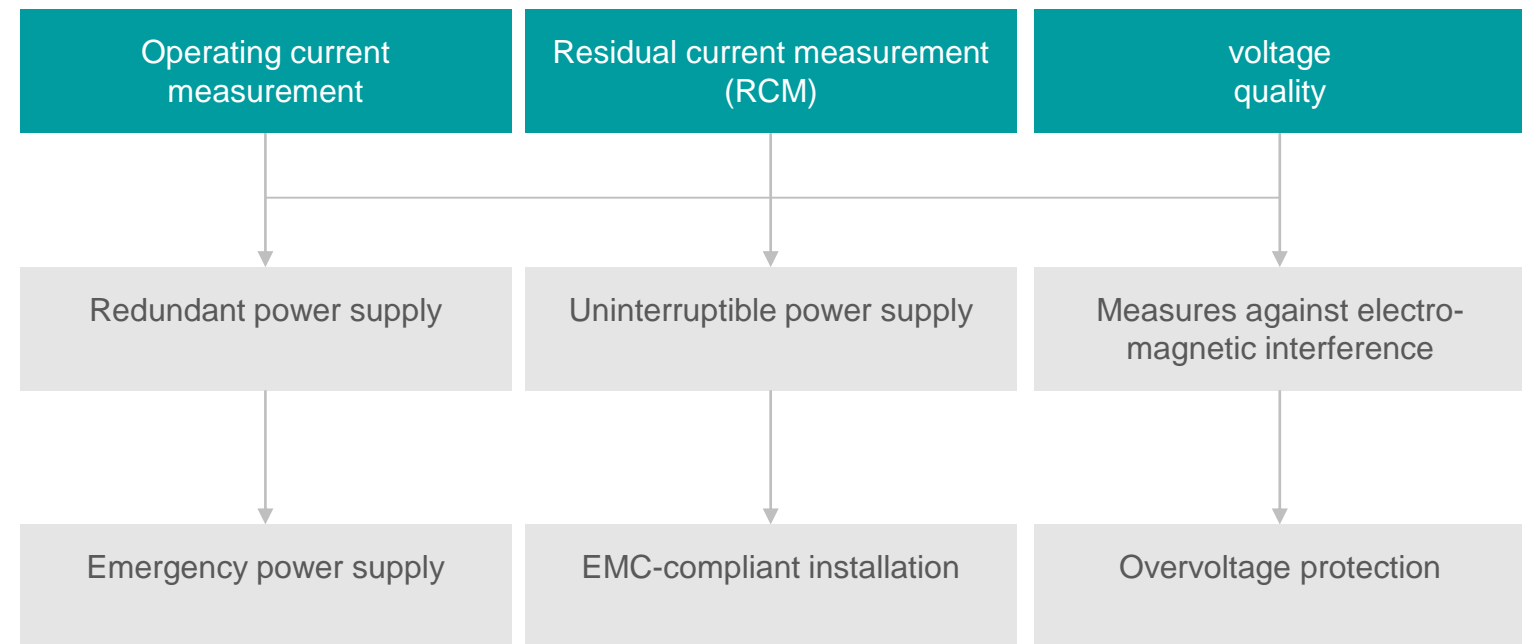


Energy meters are tools of maintenance

Detection and monitoring of overcurrents, leakage currents, voltage quality, operating hours and consumption peaks with alarm center.



Elements of the safe power supply



Requirements

1. Security
2. Maximum availability
3. Trouble-free
4. Economic efficiency
5. Verifiability

Standards

What standards and guidelines are there?

- **ArbschG**
- **DGUV**
- **EN 50600**
- **EnWG**
- **VdS-Grundschatz**
- **EN 61000-2-4**
- **KRITIS**
- **TRBS**
- **BetrSichV**
- **BSI-Grundschatz**

Problems

Modern consumers

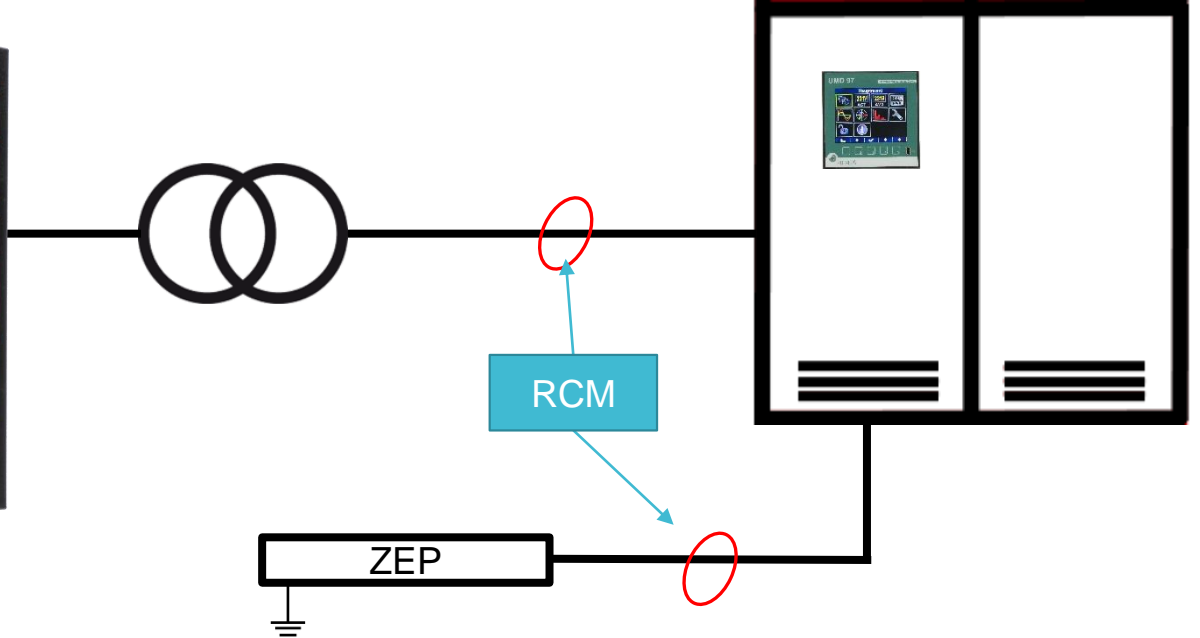
- Switching power supplies
- Frequency converter
- Inverter
- Lighting technology (LED)
- Elevators
- MRT



Targets

1. Ensure availability
2. Continuous monitoring
3. Measurement concept
4. Early detection
5. Histories
6. Compliance with standards
7. Avoid shutdowns
8. Ensuring periodic testing

EN 50160

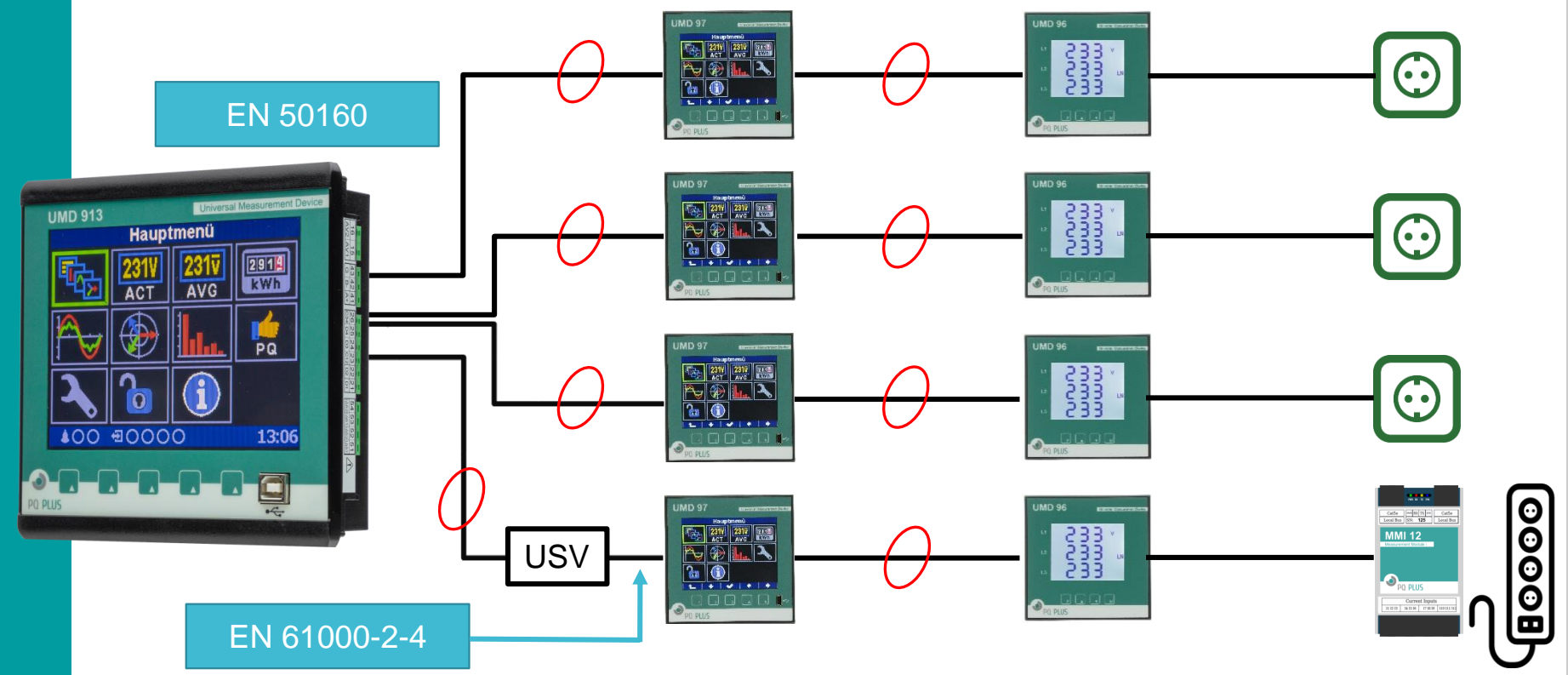


Granularity level 1

Primary / secondary care

Granularity level 2 / 3

Secondary distribution device

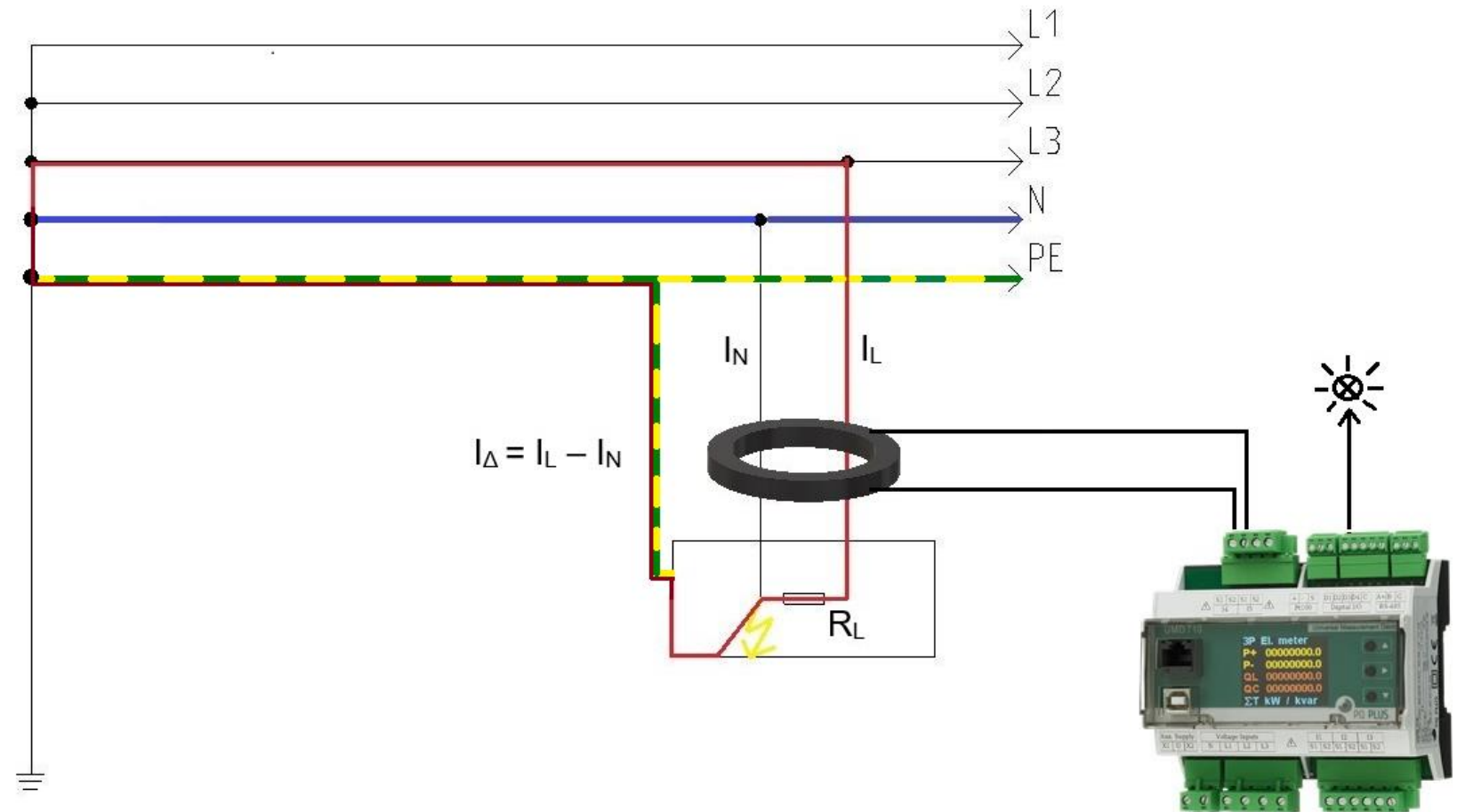


Granularity level 2

Granularity level 3

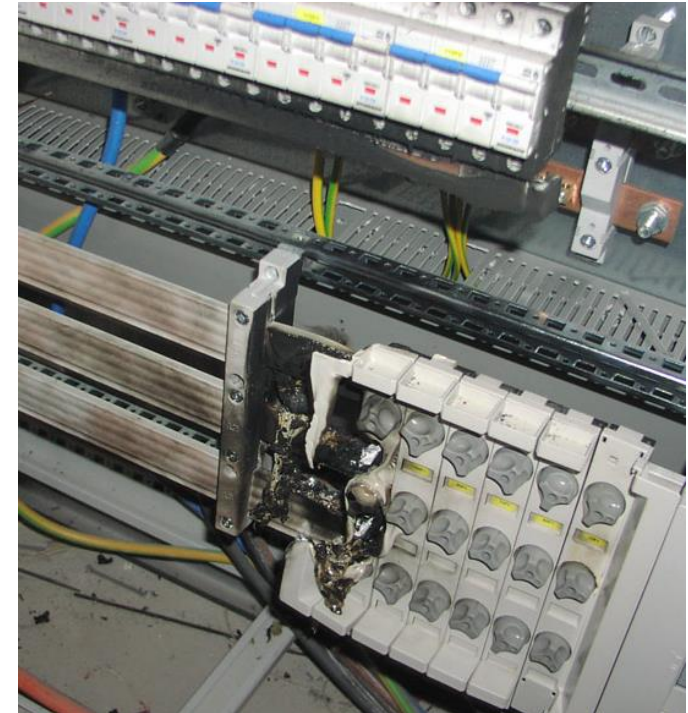
Principle RCM

"Differential current is the algebraic sum of the instantaneous values of the currents flowing at the same time in all active conductors (L, N) at a given point of a circuit in an electrical installation." (DIN VDE 0100-200)



Effects of differential currents

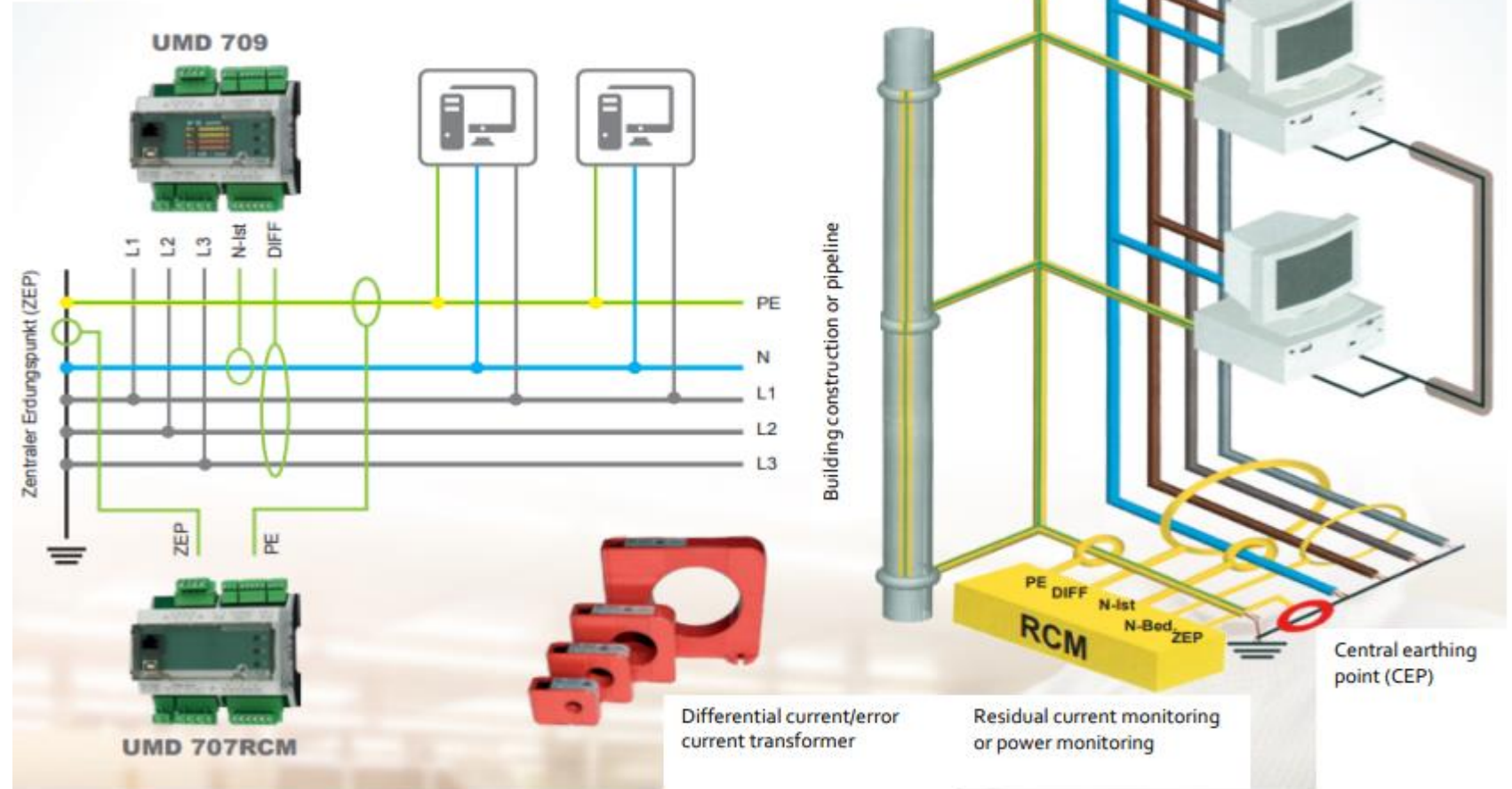
- Fire damage
- Electrical corrosion
- Unintentional interruptions of operation
- Malfunctions in equipment
- EDP crashes
- Interference with protective devices
- Interference with data transmissions
- Hum



Our solutions for residual current measurement

With our measuring instruments, we supply the tools for modern metrological equipment in power distribution at an interesting price/performance ratio. Transparency in the network and safeguard residual current monitoring at any time - with the UMD from PQ Plus.

Measure both the feed and all feeders continuously, as granularly as necessary. Alarm management and connection to telecontrol systems are a matter of course.

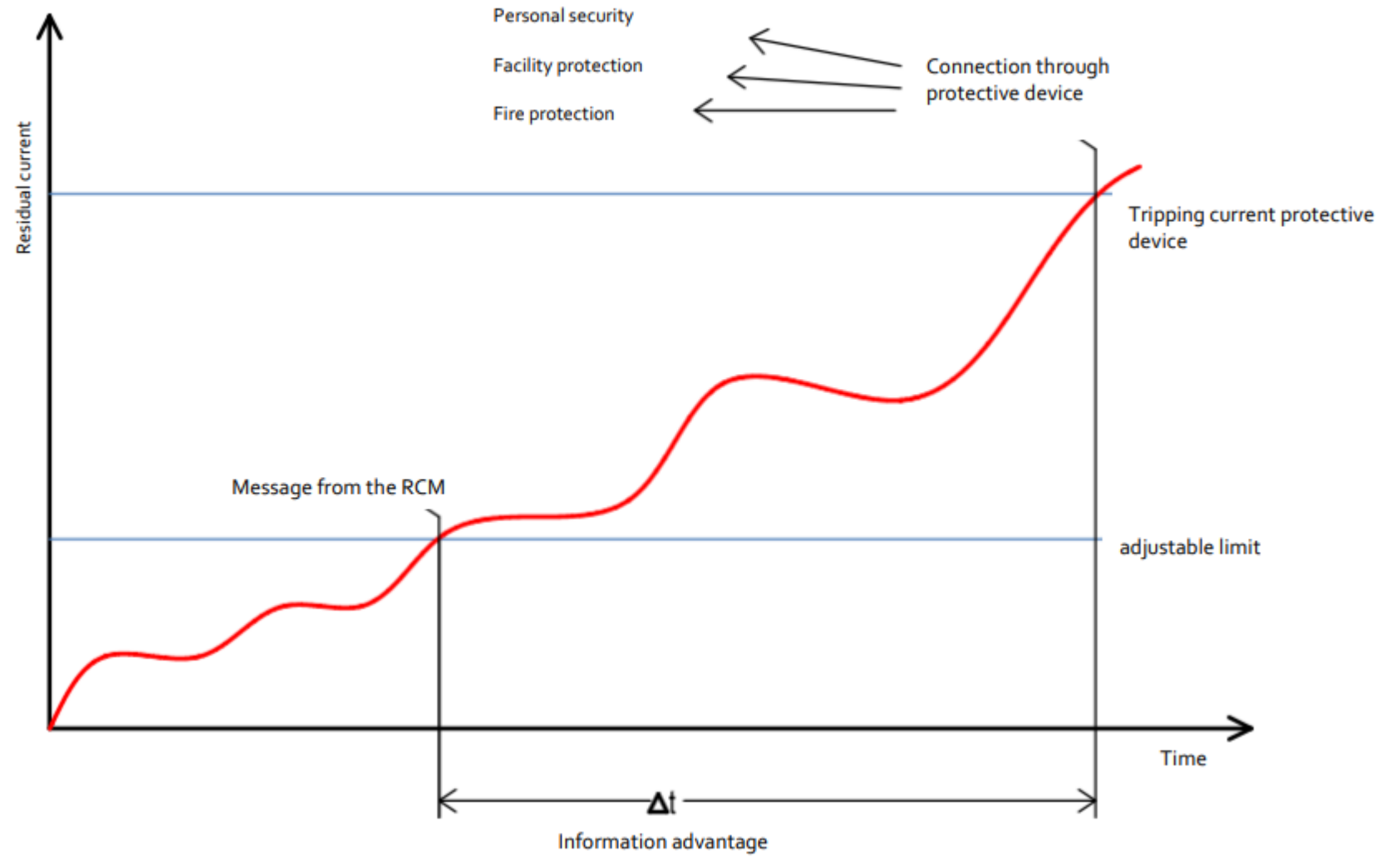


Yield

1. Cost savings
2. Efficiency
3. Resources
4. Personnel
5. Overview

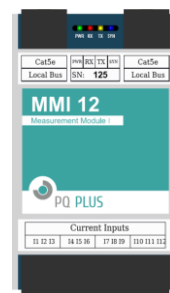
$$\blacktriangle \text{ Efficiency} = \frac{\blacktriangle \text{ Benefit}}{\blacktriangledown \text{ Effort}}$$

From reacting to acting



UMD measuring devices

- Door mounting
- Top-hat rail
- Sampling rate up to 28.8 kHz
- 128. harmonic
- RCM measurement
- Large data memory



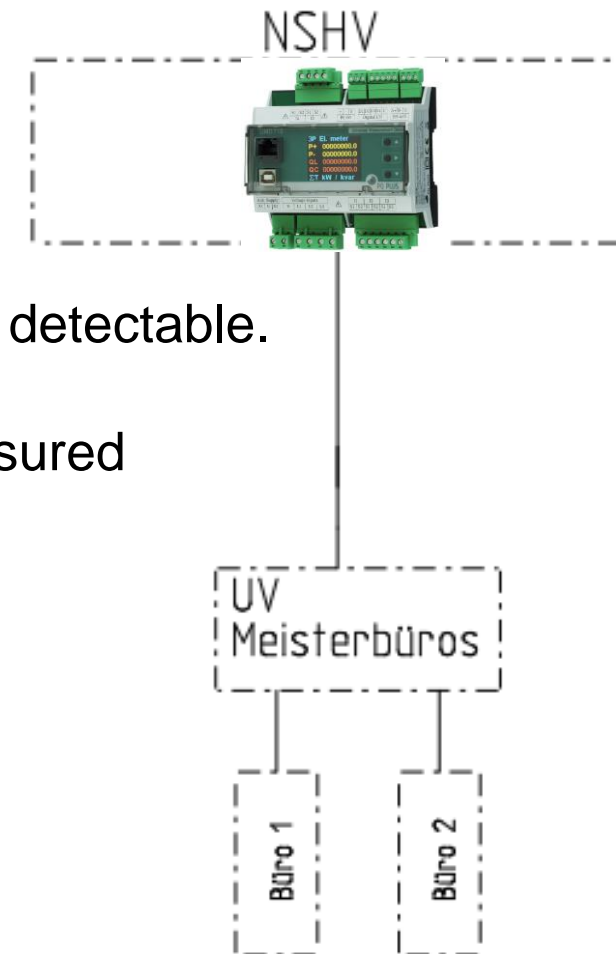
Residual current overview RCM devices

	RCM channels	Type A	Type B	Max. Residual current
UMD 98	2 (1)	x	x	28.000 mA
UMD 913G	2	x	x	28.000 mA
UMD 701RCM	8	x	-	3.000 mA
UMD 707RCM	5	x	-	28.000 mA
UMD 709	1	x	-	28.000 mA
UMD 710	1	x	-	28.000 mA

Example storey distributor AV/SV:

In order to increase fire protection fault currents up to 3000 mA should be detectable.

The actual fault current should be measured or estimated beforehand!



Goals are:

- Capture energy data
- Increase fire protection
- Analyze power quality

How high are leakage currents in the "normal state"?

Leakage currents are approx. 0.1 % - 0.5 % of the operating current.
They can be estimated or measured.

Example:

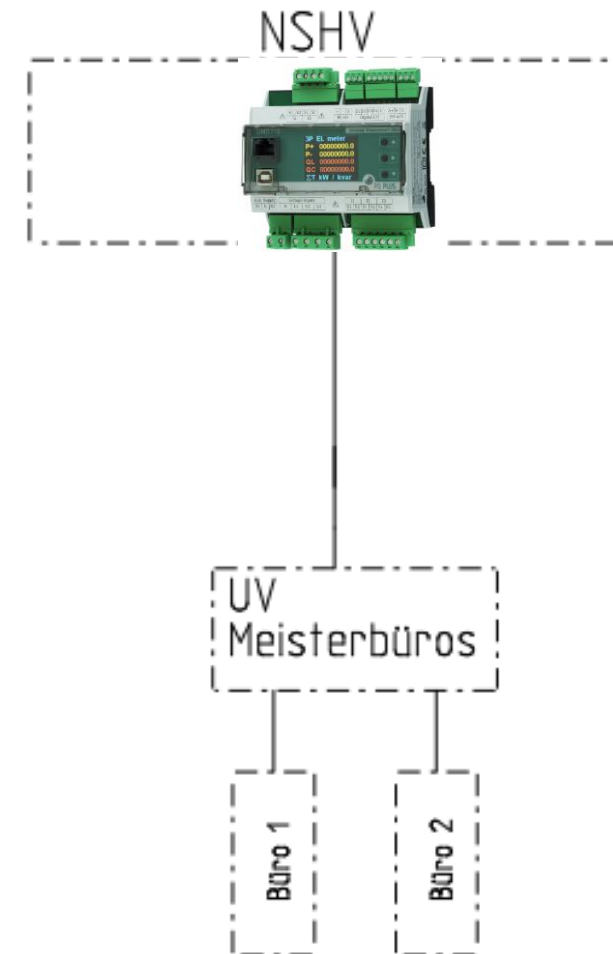
In the NSHV, the sub-distribution of the master offices is fused with 63 A.

Calculation:

$63 \text{ A} \times 0.1\% = 63 \text{ mA}$ leakage current.

Measurement:

120 mA

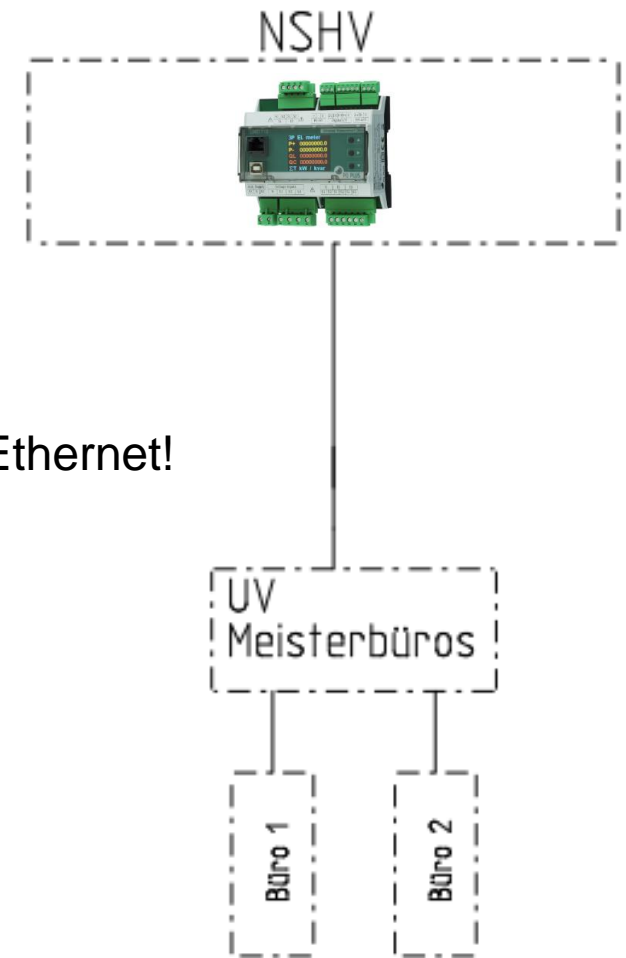


How high are leakage currents in the "normal state"?

Since the measured leakage current is 120 mA one measurement in the NSHV is sufficient.

Solution:

With the UMD 709/ 710, in addition to the leakage current as well as all common electrical and can be integrated into a control system via Ethernet! control system via Ethernet!



Measurement in the exits

Objectives:

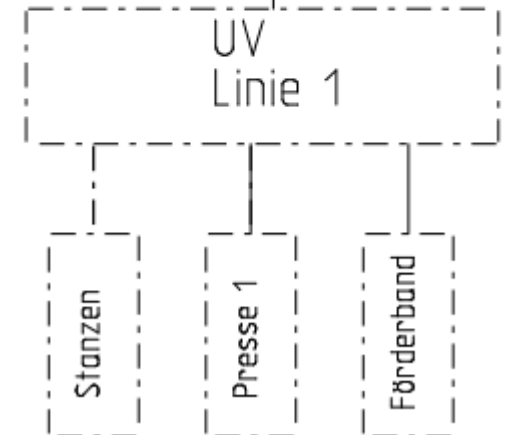
- Elimination of insulation resistance measurement
- Monitoring of voltage quality
- Recording of the total energy consumption.

Estimation or measurement of the differential current

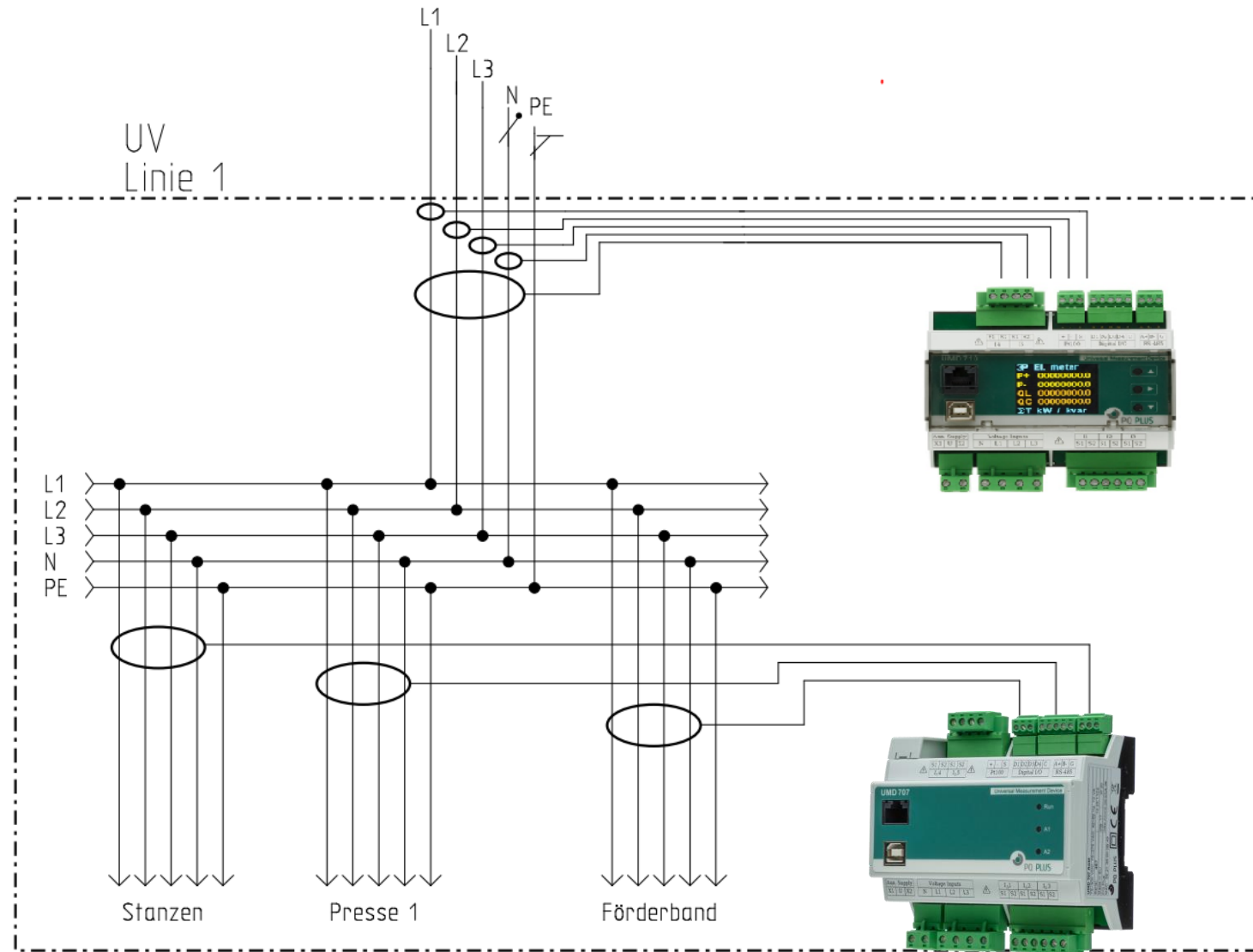
Sub-distribution line 1 is fused with 200 A.
at 0,1% the differential current may be
be max. 200mA

Fault currents should be detectable in final circuits up
be detectable. In addition, a measuring accuracy
of 5 mA is recommended.

In addition, the central grounding point should be
be monitored.



Sub-distribution connection diagram



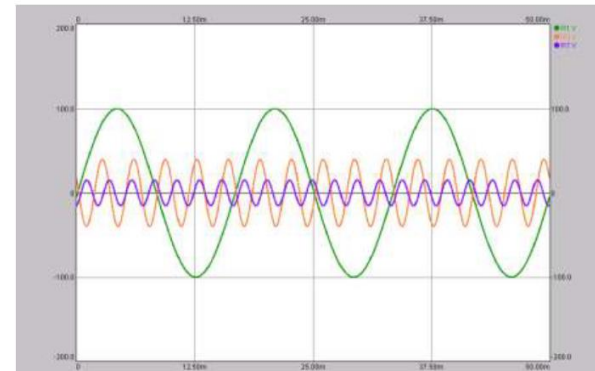
Harmonics

Harmonics voltage THD(U) and current THD(I) occur in many devices/systems.

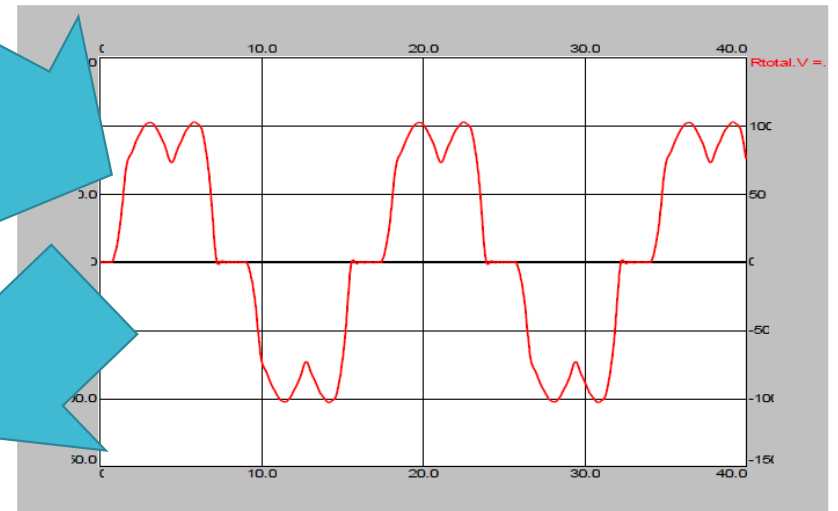
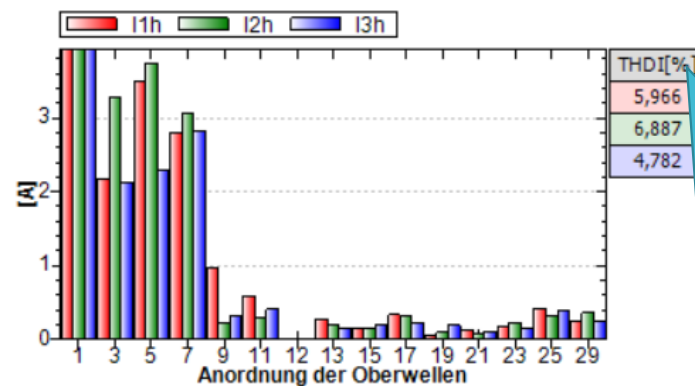
They can be subdivided into harmonic

They load the mains, fuses and transformers

Bestandteile einer nichtlinearen, periodischen Schwingung



- 1. Oberschwingung (Grundschiwingung)
- 5. Oberschwingung
- 7. Oberschwingung

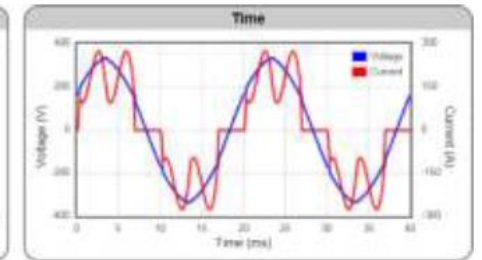
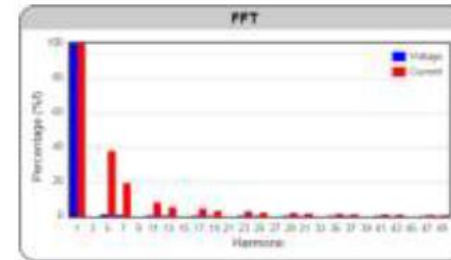


Causes harmonics

Causes of harmonics of different equipment in hospital environment:

- Refrigeration systems, MRI, ... (frequency converter)
- Electrical, controlled heat with phase control (thyristor controller)
- Switched-mode power supplies in PCs, computers, UPS systems, ...
- Solar and wind power plants with ... (inverter)

And many more ...

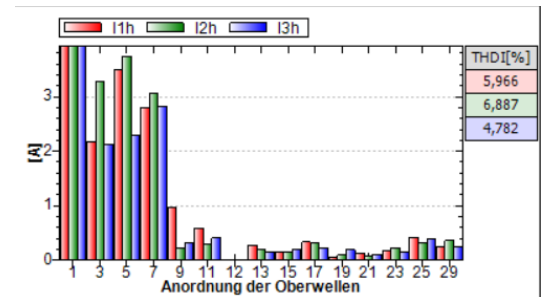


Today, harmonics are present in every power system (public and own transformer).

Effects of harmonics

Effect:

- Higher load on transformers and emergency generators -> Increased costs
- Heating of cables and lines -> Increase of fire risk
- High current on the N conductor (3 harmonics) -> Fire hazard
- Incorrect tripping of circuit breakers and fuses -> Operational failures
- Malfunctioning of devices and equipment -> Operational failures and possibly incorrect diagnoses

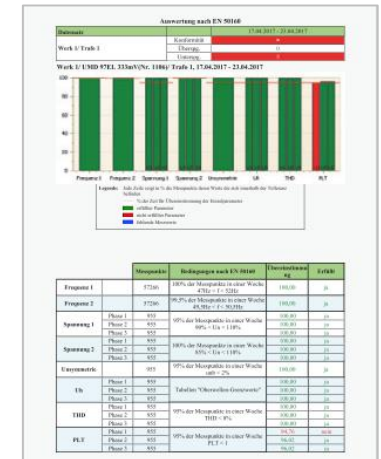


Harmonics reduce operational safety and increase maintenance and operating costs!

Standards in the field of harmonics

Important standards in the field of harmonics:

- Network operator EN50160
- Public network: EN61000-2-2, EN61000-3-2/12
- Non-public network EN61000-2-4 - hospital class 1 - max. 6% THD(U)
- Different standards in the field of power supply like AR4110



Most standards refer only to voltage harmonics not to current harmonics!

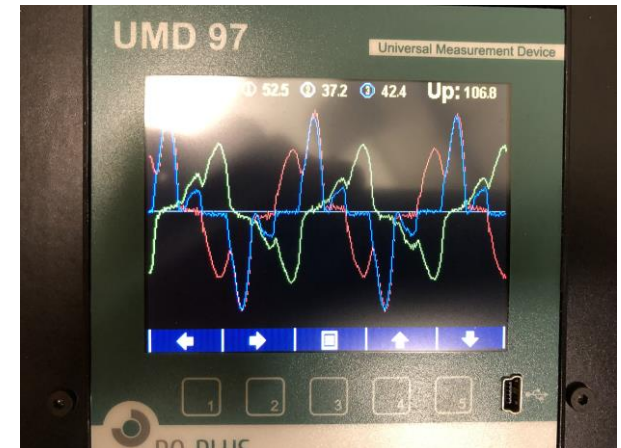
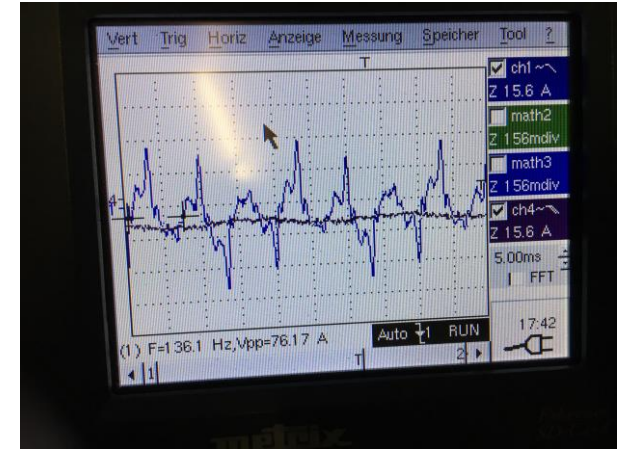
Measures against harmonics

Filtering measures against harmonics

- Passive filtering by choking:
 - > *reduction of current harmonics up to 5%*

- Active filtering: "counter-current" to pollution
 - > *reduction of current/voltage harmonics down to 0%.*

Also acts against EMC and Cos phi



Filtering measures should be taken for THD(U) values higher 6%, 8%, 10% (EN61000-2-4 - own transformer and/or THD(I) values in the network of 20% and higher.

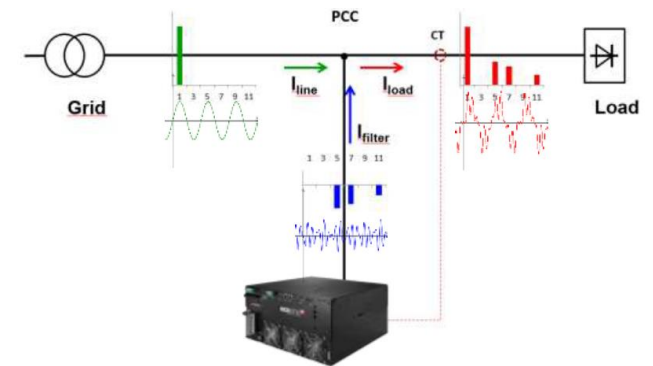
Measures against harmonics

Filter measures against harmonics

- Passive filtering by throttling:



- Active filtration: "counterflow" to pollution



Filter measures cost money but also bring money!
Important space requirement!

PQ S / PQ A:

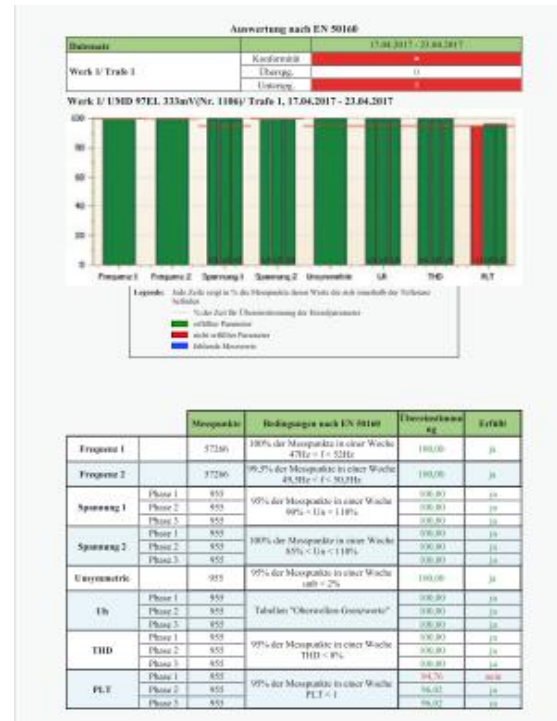
Acquisition and evaluation of measured values according to EN 50160 or EN 61000-2-2, EN 61000-2-4, EN 61000-2-12.Flicker,

Voltage dips and harmonics

Weekly evaluation in a PQ archive

Firmware modules

Voltage quality



PQ - Spannungseinbrüche

U < %	0.2	0.5	1	5	60s
90					
80					
70					
40					
5					
U > %	0.5	5	60s	löschen	
120	4			06.03.17	
110	1			17:54:39	

PQ - EN 50160 Woche

	Mo	Di	Mi	Do	Fr	Sa	So
03.04.	✓	✓	✓	✓	✓	✓	✓
27.03.	✓	✓	✓	✓	✓	✓	✓
20.03.					✓	✓	✓

PQ Hauptarchiv (alle abgespeicherten Reihen)

entspre...	Woche	f	1	2	3	U	Uns...	THD	Oberwellen	Flicker Pt			
kein	06.04.2016	100	99,8	99,8	99,8	100	100	100	100	100	94,0	94,0	94,0
ja	11.04.2016	100	100	100	100	100	100	100	100	100	100	100	100
ja	18.04.2016	100	100	100	100	100	100	100	100	100	97,1	97,1	97,1
ja	25.04.2016	100	100	100	100	100	100	100	100	100	100	100	100
ja	02.05.2016	100	100	99,9	100	99,9	100	100	100	100	100	100	98,8
ja	09.05.2016	100	100	100	100	100	100	100	100	100	100	100	98,2
ja	17.05.2016	100	100	100	100	100	100	100	100	100	100	97,7	96,2

Spannungsereignisse (alle abgespeicherten Reihen)

pannung [%]	10ms <= t < 200ms	200ms <= t < 500ms	500ms <= t < 1s	1s <= t < 5s	5s <= t < 60s	None
u <= 120	4	0	0	0	0	0
120 < u <= 110	0	0	0	0	0	0
90 < u <= 80	2	0	0	0	0	0
80 < u <= 70	1	0	0	0	0	0
70 < u <= 40	Letzte Ereignisse: 0 Samstag, 21. Mai 2016 20:21:08					
40 < u <= 25	0	1	0	1	2	0
5 > u	0	0	0	0	0	0

Firmware modules

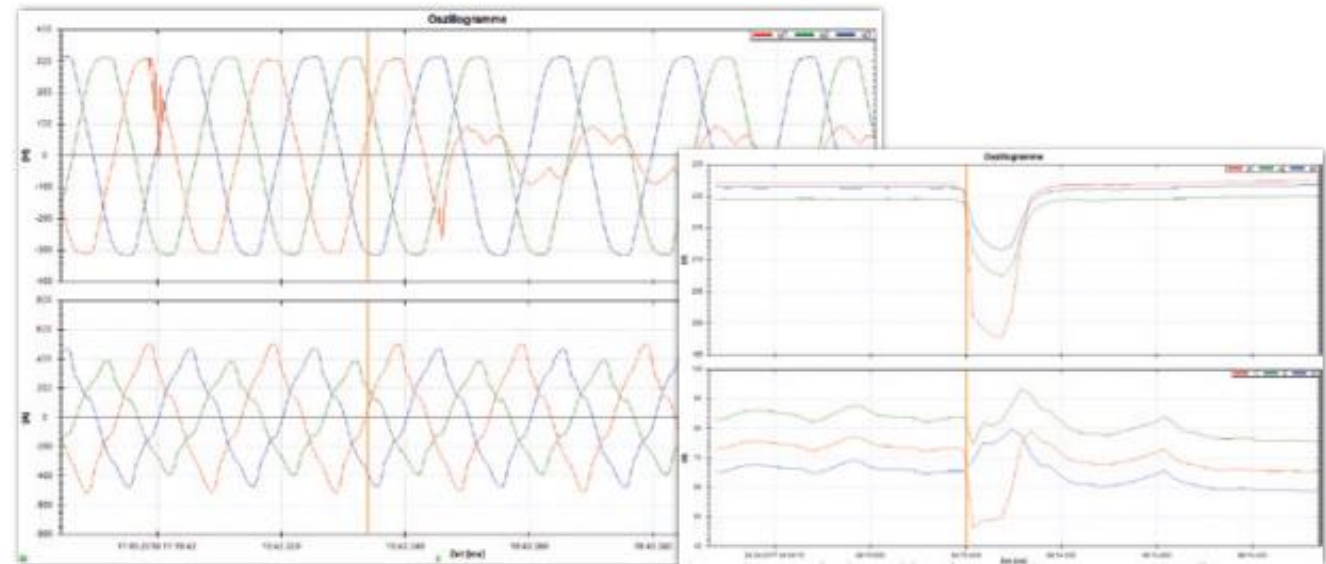
GO (General Oszillogramm)

PQ S / PQ A:

Detection and precise recording of various signal distortions and transient events

Records oscillograms of voltages and currents in memory at high resolution with extended details (up to 288 samples per period) and trigger options

Stored data is processed in ENVIS or provided in .xls or .csv files for processing in any software.



Communication

- Modbus TCP
- Modbus RTU
- SNMP
- SQL database
- M-Bus



Alarms

- Message from device
- Message from the system
- E-mail
- Warning signals
- Collective message



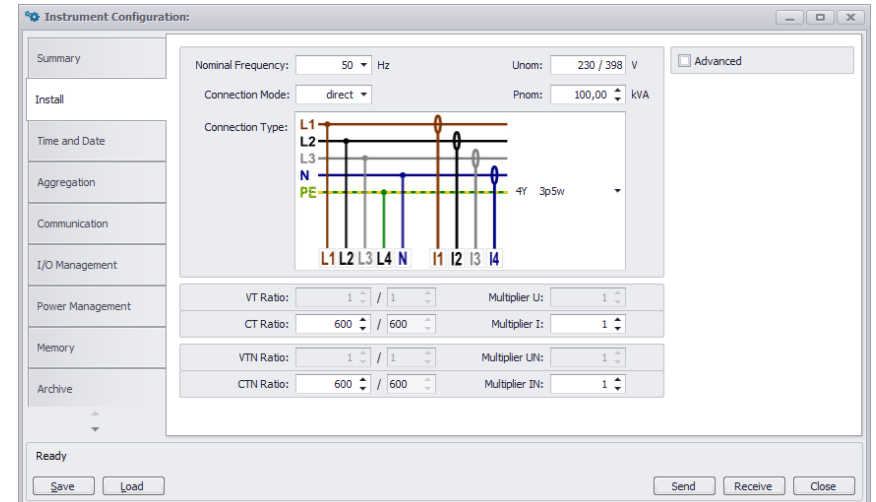
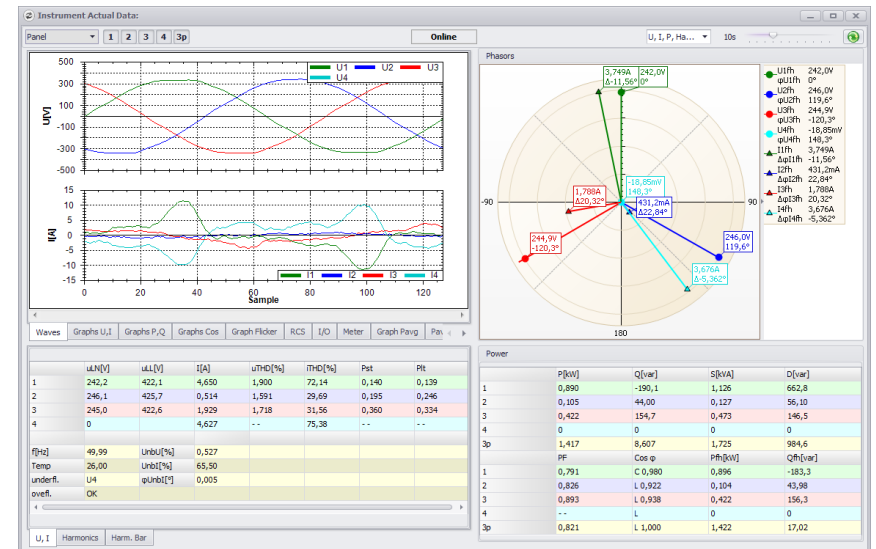
<input type="checkbox"/> ON	Ircm1 +	=>	EMAIL +
<input type="checkbox"/> ON	Ircm2 +	=>	EMAIL +

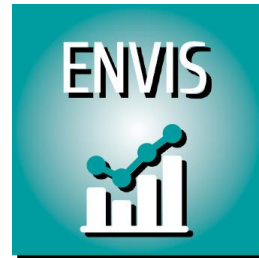


ENVIS – Applications

ENVIS.Daq

- Configuration
- Live data
- Memory





ENVIS – Applications ENVIS

- Visualization
- Evaluation
- Compare

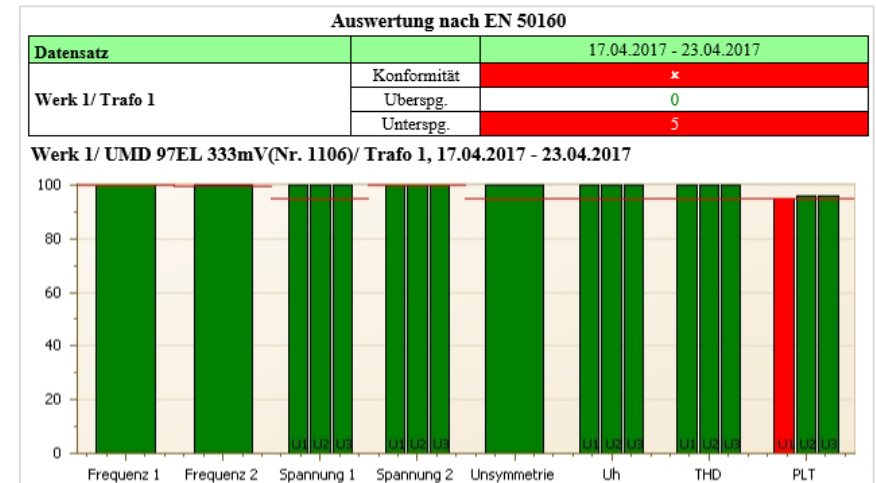
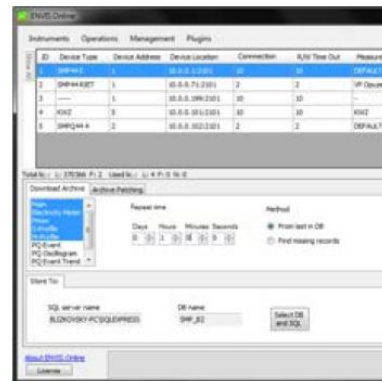




ENVIS – Applications

ENVIS.Online

- Automation
- Alerting
- Reporting



	Messbeispiele	Erfüllung der Bedingung aus EN 50160	Konformitätsgrad	übereinstimmen
Frequenz 1	21544	100% of Beispiele in einem Woche 47Hz < f < 52Hz	100,00	ja
Frequenz 2	21544	99,5% of Beispiele in einem Woche 49,5Hz < f < 50,5Hz	100,00	ja
Spannung 1	Phase 1	95% of Beispiele in einem Woche 90% < Un < 110%	100,00	ja
	Phase 2		100,00	ja
	Phase 3		100,00	ja
Spannung 2	Phase 1	100% of Beispiele in einem Woche 85% < Un < 110%	100,00	ja
	Phase 2		100,00	ja
	Phase 3		100,00	ja
Unsymmetrie	361	95% of Beispiele in einem Woche unb < 2%	100,00	ja
Oberwellenspannung	Phase 1	Tabellen 'Individual harmonic limits'	100,00	ja
	Phase 2		100,00	ja
	Phase 3		100,00	ja
THD	Phase 1	95% of Beispiele in einem Woche THD < 8%	100,00	ja
	Phase 2		100,00	ja
	Phase 3		100,00	ja
PLT	Phase 1	95% of Beispiele in einem Woche PLT < 1	90,30	kein
	Phase 2		90,30	kein
	Phase 3		90,30	kein

ENVIS – Applications

ENVIS Web

- Eligible for 50001
- Update service
- Manufacturer-independent
- User management
- Data import/export
- Modbus / M-Bus
- KPI's



ENVIS – Applications

ENVIS Web

- Alarm management
- Reporting
- Sankey diagram
- Load profile analysis
- E-mail dispatch
- Consumption and cost overview
- Manual data collection



Mobile measurement MMD 97

- Mobile measuring case
- Rogowski coils
- IP 65
- < 2 kg
- EN 50160
- 512 MB memory



References

UKSH – Kiel-Lübeck

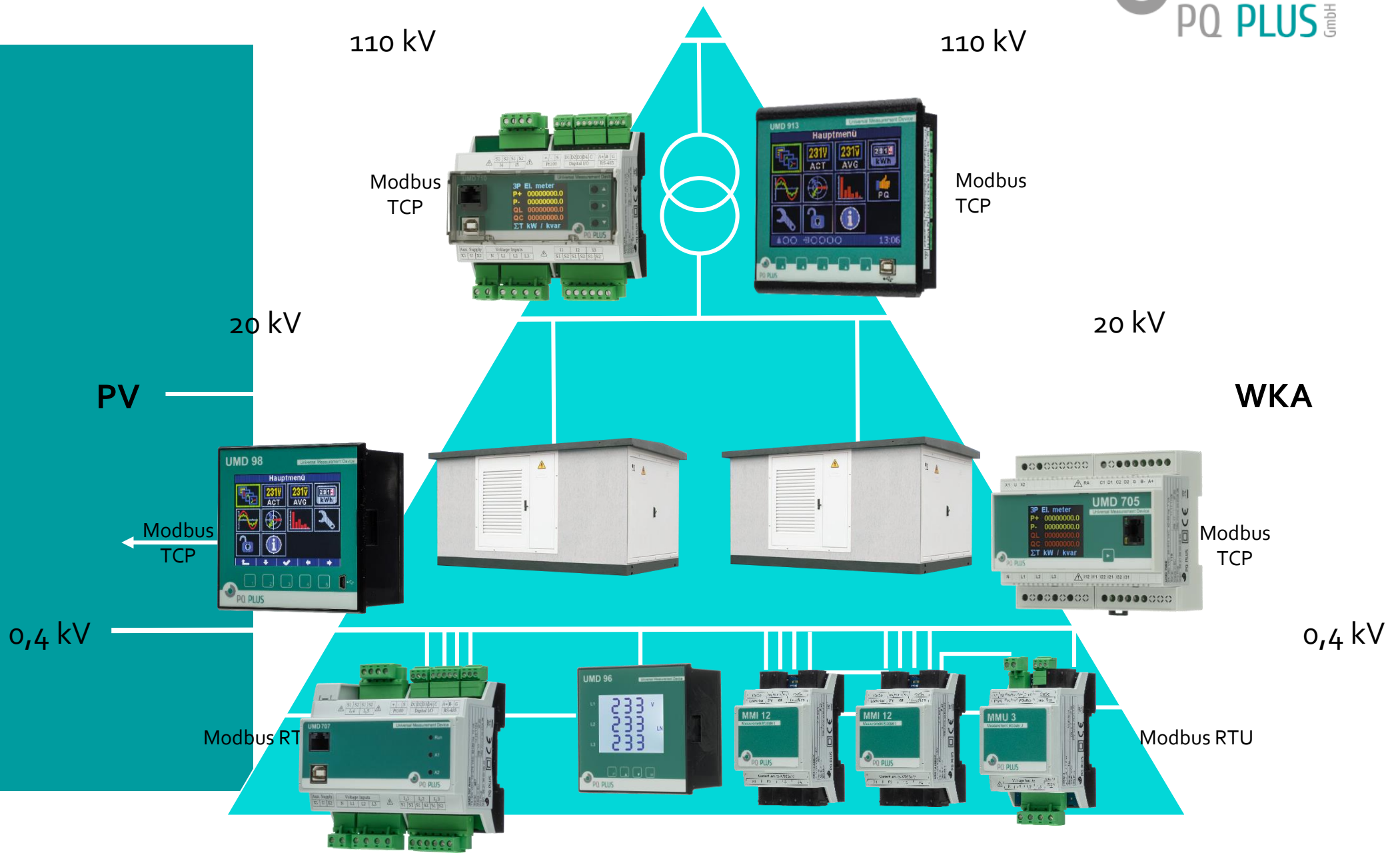


References

UKSH – Kiel-Lübeck



Topology



Excursus: Measuring energy

Different measurement concepts:

- **Energy metering "management"**
no calibration/declaration of conformity of the electricity meter and the transformers required
- **Single calibrated measurement (billing):**
Electricity meter with MID and transformer according to declaration of conformity/calibrated (class 0.5 or better) Replacement obligation 8 years+.
- **Measurement according to the Energy Collection Act (third party quantities):**
RLM meter (15 minute load profile measurement) - transducer according to declaration of conformity/calibrated Replacement obligation 8 years+.

It is essential to consult with the auditor in advance:
-> cf. presentation by ENOPLAN

QUESTIONS?

Thank you for your attention