WaveGuide –
New transmission technology on the bay/station level
WaveGuide – New transmission technology on the bay/station level

WaveGuide:
Rectangular Waveguide –
a new communication solution for modern medium voltage switchgear

- Robust system
- Low attenuation
- High bandwidth
WaveGuide –
New transmission technology on the bay/station level

Air insulated medium voltage switchgear

- Type: UniGear ZS1
- Number of panels: 6
- Rated voltage: 12 kV
- Rated current: 1.250 A
- Rated short-circuit current: 25 kA
- Protection and control relay: REF542 plus
- Communication: IEC 61850
- Communication system: WaveGuide
- Connection to the control system: COM615 with Protocol IEC 60870-5-101
WaveGuide – New transmission technology on the bay/station level

WaveGuide in an UniGear ZS1 at LyondellBasell Industries

WaveGuide WGA631 and REF542 plus

WaveGuide WGA631 and COM615

Operator's station
WaveGuide –
New transmission technology on the bay/station level

Single core cable  CAT 7 cable (twisted pair)  Ethernet cable; preassembled

Retrospective
WaveGuide –
New transmission technology on the bay/station level

Coaxial cable

Optical fiber cable

Optical fiber cable; preassembled (LC Connector)

Retrospective
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State-of-the-art: Wireless LAN

Transmitter

Receiver
WaveGuide –
New transmission technology on the bay/station level

State-of-the-art: Wireless LAN – risks

Disturbances?
Privacy?
Security?
Interference?

Transmitter
Receiver

Attenuation = f (distance)
WaveGuide –
New transmission technology on the bay/station level

The solution

- Disturbances
- Privacy
- Security
- Interference
- Attenuation

Transmitter

Receiver
WaveGuide –
New transmission technology on the bay/station level

Rectangular WaveGuide

\[ a \]

\[ b \]
WaveGuide – New transmission technology on the bay/station level

WaveGuides in „everyday“ life:
- Wind instruments
  - Flutes, organ pipes, trumpets, …
- Microwave ovens
- Transmitters
- Glass fiber cables
- …
WaveGuide –
New transmission technology on the bay/station level

Rectangular WaveGuide
WaveGuide –
New transmission technology on the bay/station level

Rectangular WaveGuide

Attenuation = ~2dB / 1 km
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The future has begun:

- WaveGuides as a transmission medium in medium voltage switchgear
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New transmission technology on the bay/station level

Assembly situation in a ZS1 UniGear

WaveGuide access point WGA631

- Multi port version
  - 3 x Ethernet, 1 x WLAN
  - Aux. voltage: 110 … 220 V AC/DC
- Temperature range
  - Operating: -20° C to 55° C
  - Storage: -30° C to 70°C
- Humidity (non-condensing)
  - 5 % ~ 95 % typical

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Installation position
WaveGuide in a gas-insulated medium voltage panel – ZX2 doublefeeder panel
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New transmission technology on the bay/station level

Installation position
(detail view)
WaveGuide in a gas-insulated medium voltage panel – ZX2 double feeder panel
## WaveGuide – New transmission technology on the bay/station level

### Comparison: electrical – optical – radio signals

<table>
<thead>
<tr>
<th>Transmission media</th>
<th>System-availability</th>
<th>EMC</th>
<th>Thermal influences</th>
<th>Mechanical influences</th>
<th>Assembly work</th>
<th>Expandability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical connection (twisted pair CAT 5, RJ 45)</td>
<td>+</td>
<td>--</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Optical fibers (Multimode 2G 62.5/125 µm)</td>
<td>+</td>
<td>+</td>
<td>O</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>WaveGuide 631</td>
<td>++</td>
<td>+</td>
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</tr>
</tbody>
</table>

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View of the present

IEC 60870-5-101
IEC 60870-5-104

Station bus

Process bus

Copper cable
Coaxial cable
WaveGuide 631
Antenna

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View into the future

Station bus
Process bus

Coaxial cable
WaveGuide 631
Antenna

IEC 60870-5-104
IEC 61850-Future
WaveGuide –
New transmission technology on the bay/station level

WaveGuide – benefits

- Communication to IEC 61850
- Control and automation with the necessary safety
- Robust transmission technology by radio signals without electrical or optical links
- High system availability
- Closed system
- Small amount of installation work
- No time-consuming making up of cables
- Easily extendable
- No interference from outside:
  - EMC
  - Thermal
  - Mechanical
- Merging of process and station levels

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