



## PKUS Family

UP-TO-DATE SOLUTIONS FOR RELAY-PROTECTION CHANNELS

# PKUS FAMILY

## FOR RELAY-PROTECTION CHANNELS

### About company

**UNITEL ENGINEERING LLC** is a Russian company founded by experts in the area of utility telecommunications in 2009. The main company's goal is to design and produce robust equipment for mission-critical infrastructures. Today **UNITEL ENGINEERING LLC** is one of the leading equipment manufacturers providing reliable and secure complex solutions for transmission and distribution of electrical power.

All **UNITEL ENGINEERING LLC** products, services and support are certified in accordance with ISO 9001 assuring customers of our quality commitment. Innovative product design, manufacturing excellence and customer response keep **UNITEL ENGINEERING LLC** on top of the industry.

### PKUS Family

Robust utility communications enable protection systems to clear a line fault within the shortest possible time or to isolate primary equipment directly affected by the fault while maintaining the reliable transmission and distribution of electrical power. The company's latest innovative product, **PKUS Family**, provides fast, highly reliable and secure relay-protection channels for both command based and differential protection applications over dedicated optical fibers, communication networks and power lines.

### PKUS Family consists of

Digital Teleprotection Equipment

- **PKUS SKO** – protection command transmission via dedicated optical fibers and communication networks

Power Line Carrier (PLC) Equipment

- **PKUS PLC** – protection command transmission over power lines

Converters for interfacing protection equipment with IEEE C37.94 or optical E1 ports to communication networks using electrical E1

- **PKUS E01** – single-channel converter of optical C37.94 or optical E1 to electrical E1
- **PKUS E02** – two double-channel independent converters of optical C37.94 or optical E1 to electrical E1 with cross-connect functionality

### New approach to teleprotection systems

Using **PKUS Family** equipment allows to implement the innovative unified solution named “**PLC / telecom networks / dedicated optical fibers / radio links media**” for teleprotection systems. “**PLC / telecom networks / dedicated optical fibers / radio links media**” is a technically and economically effective solution providing customers to save their investments in teleprotection systems upon growth of the telecom infrastructure.



# KEY FEATURES OF PKUS FAMILY

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**PKUS Family** complies with or exceeds the requirements of EMC Directive 2004/108/EC and Low-Voltage Directive 2006/95/EC.

## **PKUS Family features:**

- Compact design
- Advanced technology, digital signal processing
- In-operation testing
- User configurable
- Simple operations
- Optical ports with SFP transceivers (MM or SM; 850 nm, 1310 nm, 1550 nm, CWDM/DWDM); up to 2 km 850 nm MM Fiber; up to 40 km 1310 nm SM Fiber; up to 240 km 1550 nm Fiber
- Integrated nonvolatile and not editable event recorder for command/alarm/ manipulation with 1 ms time stamps, COMTRADE file format support
- Real Time Clock with an optional IRIG-B synchronization
- Diagnostic LEDs for Status and Alarms indication
- Link and Hardware Alarm contacts
- Two-wire RS-485/IEC 60870-5-101 for SCADA (IEC 60870-5-104 or SNMP using an optional external protocol converter by **UNITEL ENGINEERING LLC**)
- High EMC immunity
- Windows® compatible User Interface Program **PKUSConverter** for **PKUS Family**
  - Configuration (on-line and off-line downloadable files)
  - Testing and Commissioning
  - Status and Alarm Monitoring

## **PKUS Teleprotection Equipment applications:**

- Protection of HV single-circuit and double-circuit overhead and cable power lines (blocking, permissive and direct tripping commands)
- Protection of HV overhead and cable power lines
  - Distance protection
  - Directional comparison protection
  - High impedance earth fault protection
  - Protection of multi-terminal power lines with single or multiple T-offs
- Transformer and shunt reactor protection (direct tripping commands)
- Breaker failure protection (direct tripping commands)
- Generator shutdown (direct tripping commands)
- Emergency control (direct tripping commands)
- Whenever the fast, reliable and secure transmission of commands is required

## **PKUS Interface Converters applications:**

- Interfacing teleprotection equipment and line differential protection relay to telecom networks
  - Interfacing teleprotection equipment and line differential protection relay to dedicated optical fibers
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# PKUS TELEPROTECTION EQUIPMENT



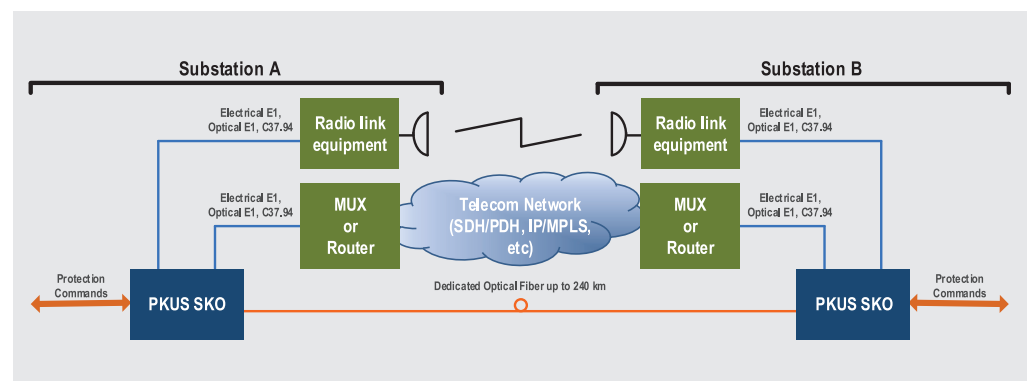
## PKUS DIGITAL TELEPROTECTION EQUIPMENT

**PKUS SKO** is the digital teleprotection equipment for command transmission via digital networks (transport and access multiplexers, IP/MPLS routers), radio links and dedicated optical fibers.

**PKUS SKO** equipment complies with or exceeds the requirements according to IEC 60834-1 "Teleprotection Equipment of Power Systems – Performance and Testing – Part 1: Command Systems"

### PKUS SKO features:

- Full duplex or simplex operating mode
- Processing up to 24 independent commands (transmission, receiving and transit)
- 16 inputs and outputs freely configurable to any command
- Up to 8 commands in 64 kbps (one time slot)
- User configurable data rate for command transmission (min. 64 kbps, max. 1984 kbps)
- Cyclic block code for command message
- Transmission time 6 ms at 64 kbps (Dependability 10-4 and Security 10-40 in worst case)
- Dual line interface: electrical E1 (HDB3, G.704), optical E1 (CMI, G.704), IEEE C37.94
- Point-to-point and point-to-multipoint applications via dedicated optical fibers and communication networks
- Up to 6 independent duplex directions (or up to 62 simplex directions) in point-to-multipoint applications via communication networks with DS0 cross-connect. Each command can be freely programmed to any direction by means of PKUSConverter
- Normal and Inverse T-operation for a protection of power lines with T-offs
- Seamless redundant 1+1 path (primary and secondary paths) protection with zero switchover time for point-to-point and point-to-multipoint applications
- Cyclic (configurable) and Manual (activated via **PKUSConverter**) Loop test for each direction in point-to-multipoint applications, primary path and, if used, secondary path
- Addressing facility preventing unwanted operation due to accidental channel crossovers in communication networks
- 19-inch rack, 2 height units (2U) including 1U cable tray
- Dual (redundant) 48 VDC power supply with passive load sharing (optional primary power supply 110 VAC, 110 VDC, 230 VAC, 220 VDC)



# PKUS TELEPROTECTION EQUIPMENT

## PKUS PLC TELEPROTECTION EQUIPMENT

HV power lines aren't only supposed to transmit electrical power, but also to carry high frequency signals. Special coupling devices are applied to connect a PLC terminal to HV power lines. The use of existing HV power lines for teleprotection (where time is crucial) is a good choice because this solution provides a direct link between substations. HV power lines are reliable and completely under control of the power utility. Furthermore, power lines represent an excellent communication media covering several hundred kilometers without a repeater. **PKUS PLC** equipment combined with **PKUS SKO** provides robust simplex or duplex transmission of protection commands over overhead and cable power lines of 35 – 750 kV.



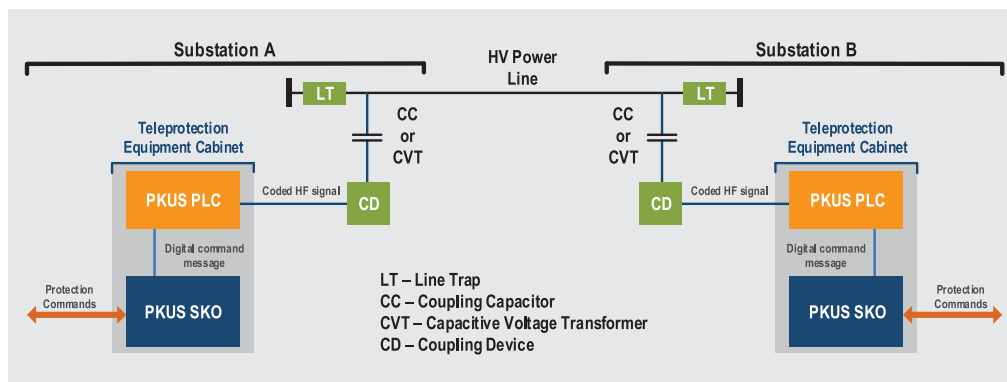
**PKUS PLC** equipment complies with or exceeds the requirements according to IEC 60834-1 "Teleprotection Equipment of Power Systems – Performance and Testing – Part 1: Command Systems" and IEC 60495 "Single Sideband Power-line Carrier Terminals"

### PKUS PLC key functionality:

- Conversion of digital command messages received from **PKUS SKO** equipment to coded high-frequency signals
- Transmission of coded HF signals over power line

### PKUS PLC features:

- Single-step frequency conversion and direct digital frequency synthesis (DDS)
- Extended frequency range – 24...1000 kHz
- Nominal bandwidth – 4 kHz (simplex mode), 4+4 kHz (duplex mode)
- Output power – 40 W
- Two electrical and two optical ports with SFP transceivers for interfacing to **PKUS SKO** and command transit using **PKUS SKO** command messages in a repeater station
  - **PKUS PLC ↔ PKUS PLC**
  - **PKUS PLC ↔ Telecom networks ↔ PKUS PLC/PKUS SKO**
  - **PKUS PLC ↔ Dedicated optical fibers ↔ PKUS PLC/PKUS SKO**
  - **PKUS PLC ↔ Radio links ↔ PKUS PLC/PKUS SKO**
- Commands can be individually mapped on any port
- Compact equipment: 19-inch rack, 3 height units (3U)



# PKUS INTERFACE CONVERTERS

## PKUS INTERFACE CONVERTERS

**PKUS E01** and **PKUS E02** are compatible with any relay protection equipment supporting C37.94.



### PKUS E01 features:

- Single channel converter
- Operating mode: Optical E1/Electrical E1 or C37.94/Electrical E1 (programmable in **PKUSConverter**)
- IEEE Standard Interface C37.94 Nx64 kbps (N=1...12)
- Compact case (198x115x50 mm), DIN-rail mounting
- Single 48 VDC power supply with two decoupled diode inputs (optional primary power supply 110 VAC, 110 VDC, 230 VAC, 220 VDC)

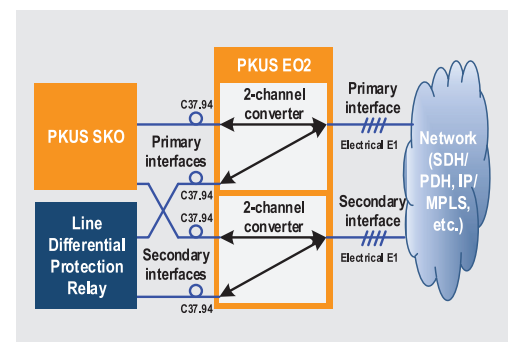
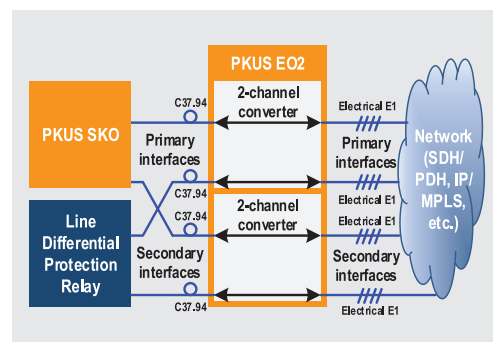


### PKUS E02 features:

- Fully independent 2-channel converters
- Operating mode: Optical E1/Electrical E1 or C37.94/Electrical E1 (separately programmable for each channel in **PKUSConverter**)
- IEEE Standard Interface C37.94 Nx64 kbps (N=1...12)
- DSO cross-connect functionality within each 2-channel converter
- 19-inch rack, 1 height unit (1U)
- Dual (redundant) 48 VDC power supply with passive load sharing (optional primary power supply 110 VAC, 110 VDC, 230 VAC, 220 VDC)

Interfacing **PKUS SKO** and Line Differential Protection Relay with C37.94 port to Telecom Network

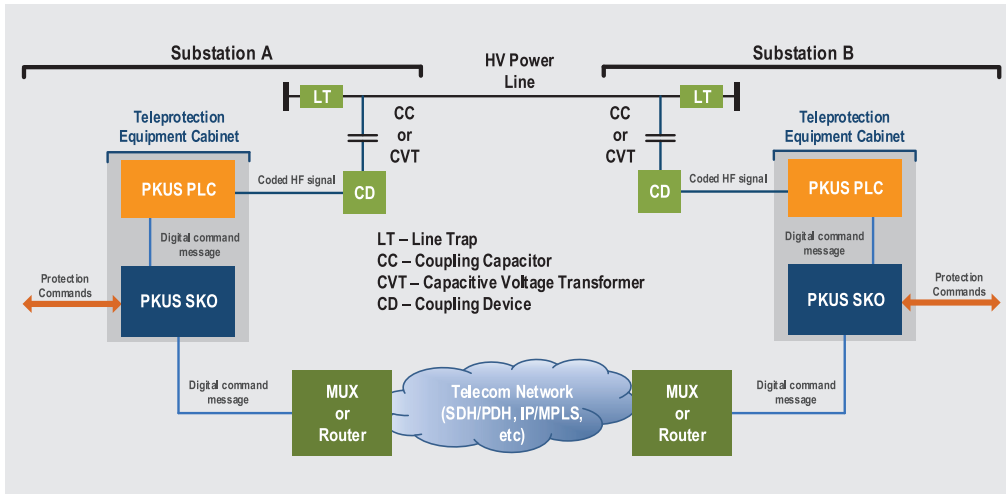
Interfacing **PKUS SKO** and Line Differential Protection Relay with C37.94 port to Telecom Network using cross-connect functionality



# APPLICATION EXAMPLES

## PATH PROTECTION OVER PLC LINK AND TELECOM NETWORK

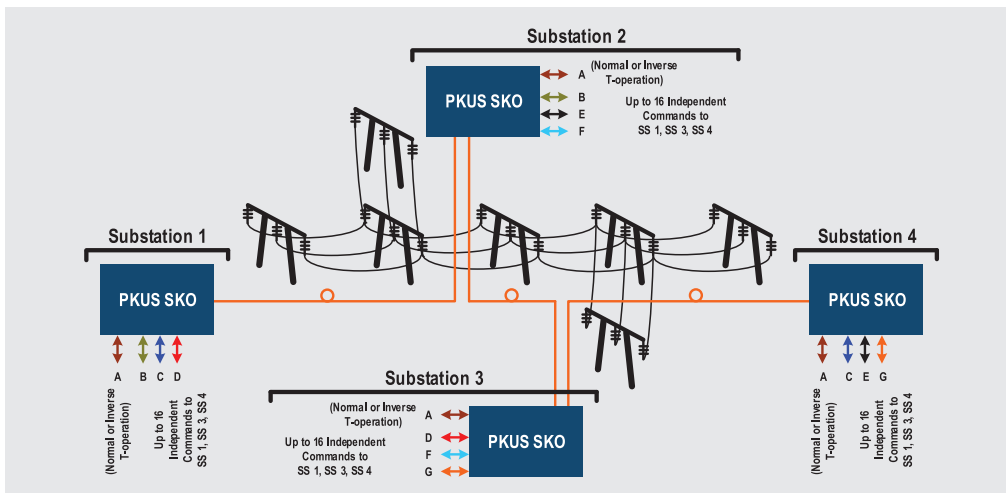
Commands are transmitted and received via overhead or cable power lines and communication networks (or dedicated optical fibers) in parallel.



Once a failure occurs to one path, the other remains operational for protection command transmission.

## T-OPERATION OVER DEDICATED OPTICAL FIBERS

T-operation shown below is a cost effective solution not requiring direct links between all substations.



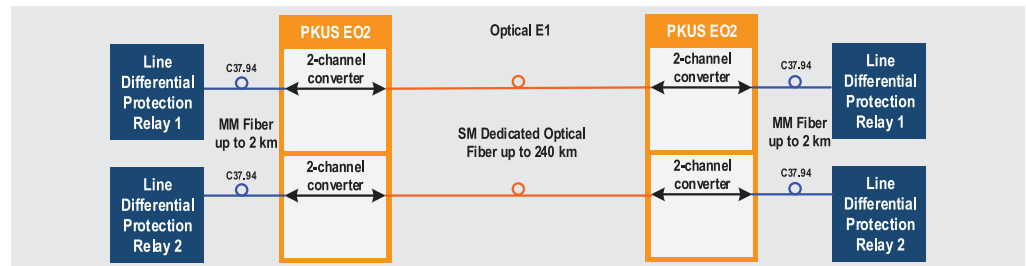
PKUS SKO transit time of a command in power line T-offs is less than 1 ms.

Furthermore, the **PKUS Family** equipment implements T-operation via PLC links, telecom network, radio links or their combination including dedicated optical fibers (an example of unified “**PLC / telecom networks / dedicated optical fibers / radio links media**”). The unified media utilizes an existing telecom infrastructure for teleprotection applications in a more flexible way.

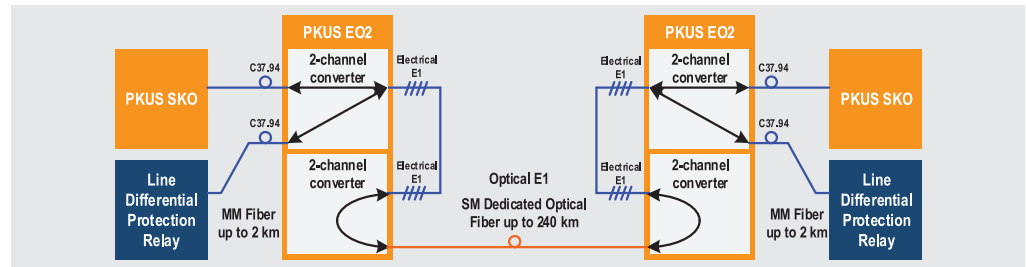
# APPLICATION EXAMPLES

## INTERFACING PROTECTION EQUIPMENT WITH C37.94 TO SINGLE MODE OPTICAL FIBER

The C37.94 standard limits a distance between protection and telecom equipment up to 2 km over multimode optical fibers. An example of interfacing two Line Differential Protection Relays with C37.94 port to two dedicated single mode optical fibers up to 240 km is shown below.

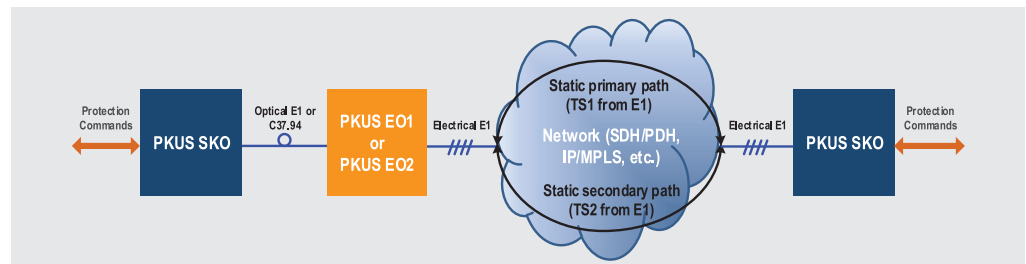


Interfacing **PKUS SKO** and Line Differential Protection Relay with C37.94 ports to one dedicated single mode optical fiber allows to use existing fiber infrastructure more effectively.



## PATH PROTECTION VIA STATIC ROUTES IN TELECOM NETWORKS USING DSO CROSS CONNECTION

As shown below, a single interface is required to connect **PKUS SKO** to a telecom network (with DSO cross connection) supporting a seamless path protection for command transmission. The cost of command transmission equipment and fibers for this solution is the same as in case of a not seamless path protection within a telecom network.



Innovative PKUS Family makes transmission and distribution of electrical power more safe, more reliable and more economical.