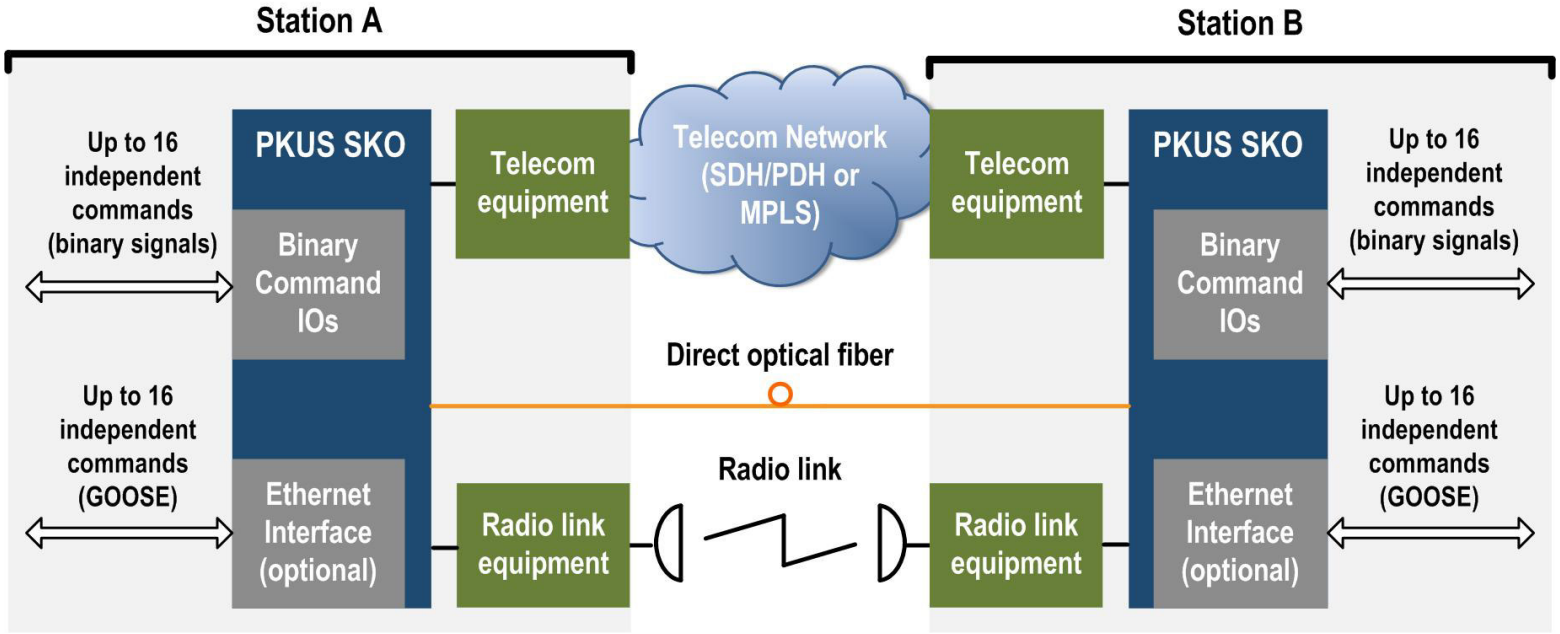
PKUS SKO TELEPROTECTION EQUIPMENT

EDITION SEPTEMBER, 2020

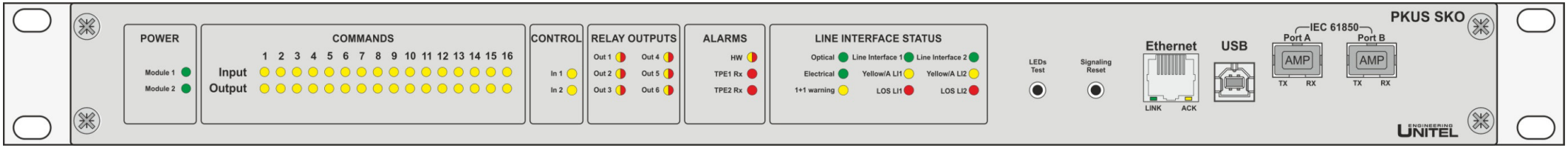
PKUS SKO DIGITAL TELEPROTECTION EQUIPMENT

- **PKUS SKO** – TELEPROTECTION COMMAND TRANSMISSION VIA DIRECT OPTICAL FIBERS, TELECOM NETWORKS (SDH/PDH OR MPLS) AND RADIO LINKS

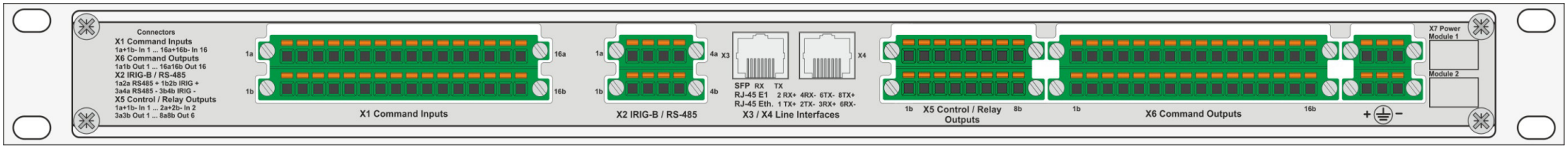


- **PKUS SKO** COMPLIES TO OR EXCEEDS THE REQUIREMENTS OF **IEC 60834-1** 'TELEPROTECTION EQUIPMENT OF POWER SYSTEMS - PERFORMANCE AND TESTING – PART 1: COMMAND SYSTEMS"
- **PKUS SKO** COMPLIES TO **2014/30/EU (EMC)**, **2014/35/EU (LVD)** AND **2015/863 (ROHS)** DIRECTIVES

KEY FEATURES OF THE PKUS SKO (1)



FRONT VIEW

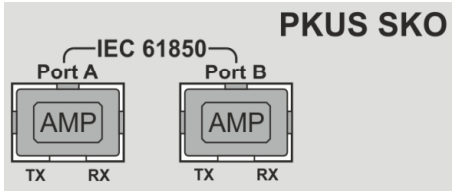


REAR VIEW

- Up to 16 independent teleprotection commands
- 16 binary command inputs, 16 binary commands outputs, 6 alarm and signaling relay contacts
- Line interfaces (on request):
  - two electrical **E1**: 2 Mbps, **RJ-45**
  - two optical interfaces: **C37.94** or **direct optical fiber**, **LC** connectors
  - one electrical **E1**: 2 Mbps, **RJ-45** and one optical interface: **C37.94** or **direct optical fiber**, **LC** connectors
  - two electrical **Ethernet** 100 Mbps, **RJ-45**

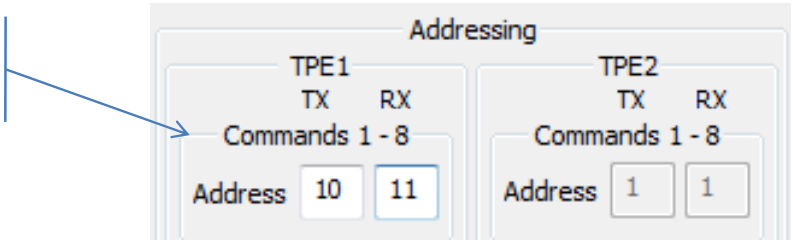
KEY FEATURES OF THE PKUS SKO (2)

- User configurable data rate for teleprotection command transmission:
  - min. 64 kbps to transmit up to 8 commands, or 128 kbps to transmit up to 16 commands via **E1** or **C37.94**
  - max. 1984 kbps via **E1**, or 768 kbps via **C37.94**
- Command transmission time:
  - 4.5 ms at 64 kbps
  - 2.9 ms at 512 kbps
- Dependability of 10^{-4} under BER=10^{-6}
- Security of 10^{-40} in worst case
- Optional **IEC 61850** communication interface: **GOOSE** and **MMS** according to **IEC 61850-8-1**
- Main and redundant power supplies: 48 VDC, or 110 / 125 VDC, or 220 VDC / 230 VAC (on request)
- Nominal binary input voltage: 48 VDC, or 110 / 125 VDC, or 220 VDC (set by jumpers)
- Configurable pick-up time (0…20 ms, step of 1 ms) to avoid unwanted command transmission in case of impulse interference at the binary command inputs, for example lightning discharges



KEY FEATURES OF THE PKUS SKO (3)

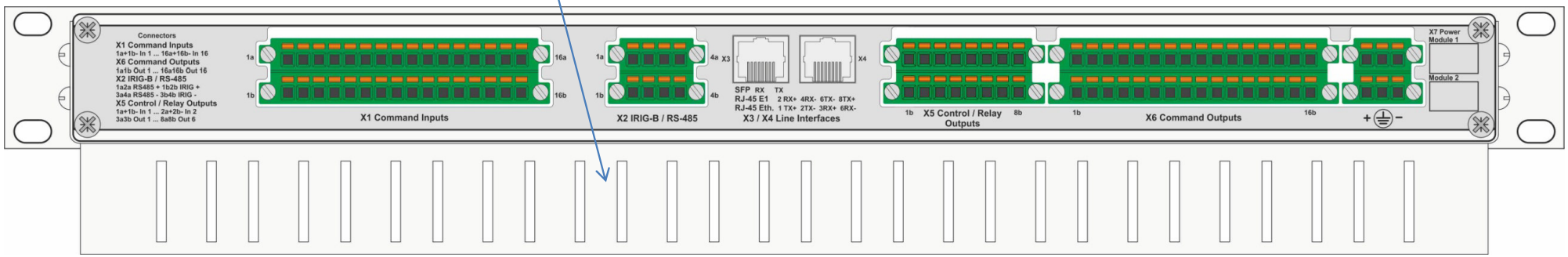
- **Point-to-point** and **point-to-multipoint** applications
- **Normal** and **Inverse T-operation** for a protection of power lines with T-offs
- **Seamless 1+1 path protection** (primary and secondary paths) with switchover time of 0 ms
- Cyclic (configurable) and Manual (activated via **HMISKO** software, or optional **IPM** display panel) Loop test
- Addressing facility preventing unwanted operation due to accidental channel crossovers in telecom network



- In-operation testing
- Optical ports with **SFP** transceivers (MM or SM; 850 nm, 1310 nm, 1550 nm, xWDM);
- Integrated non-volatile and not editable event recorder for command / alarm / manipulation with 1 ms time stamps
- Real Time Clock with optional **IRIG-B** or **SNTP** synchronization
- Diagnostic **LED**s for Status and Alarms indication, Link and Hardware Alarm contacts
- Two-wire **RS-485 / IEC 60870-5-101** and **Ethernet / IEC 60870-5-104** for **SCADA**, or **SNMPv3** for **NMS**

KEY FEATURES OF THE PKUS SKO (4)

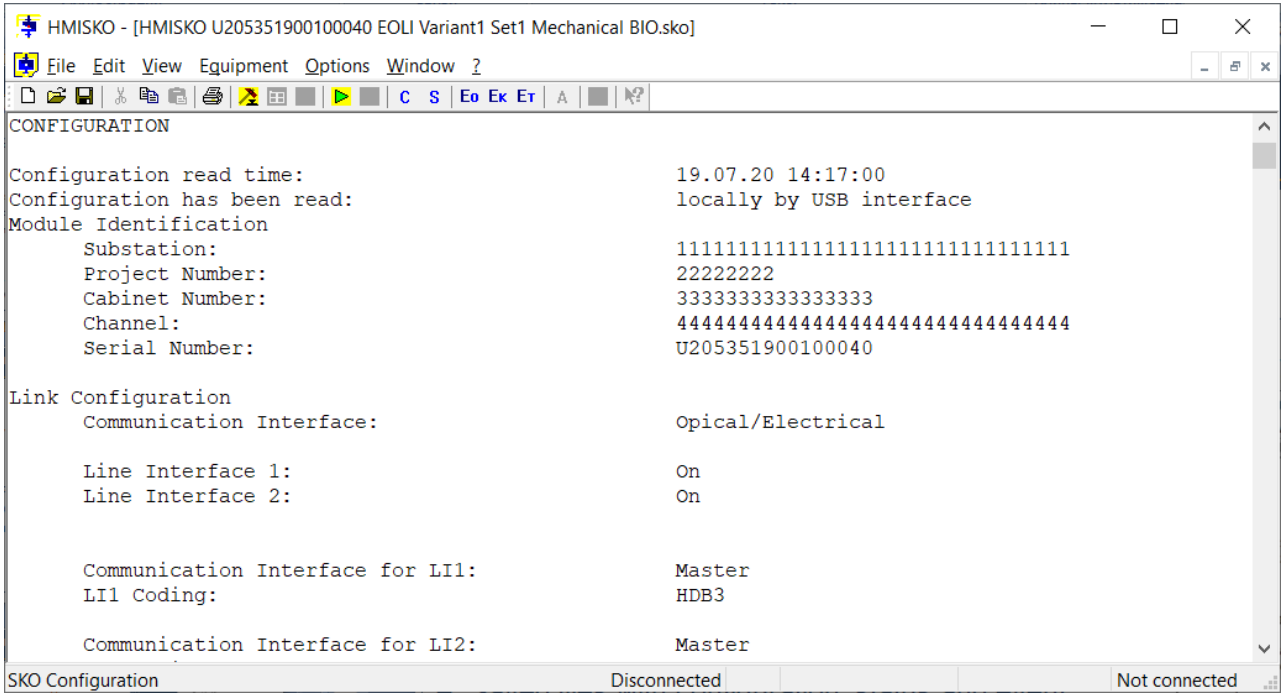
- **MTBF** – 125000 hours at 40^{0}C (according to **MIL-HDBK-217F**)
- Operational temperature range: -5 … +55^0 C
- 19-inch rack, 2 height units (2U) including 1U optional cable tray, overall depth of 365 mm
- Weight: 3 kg



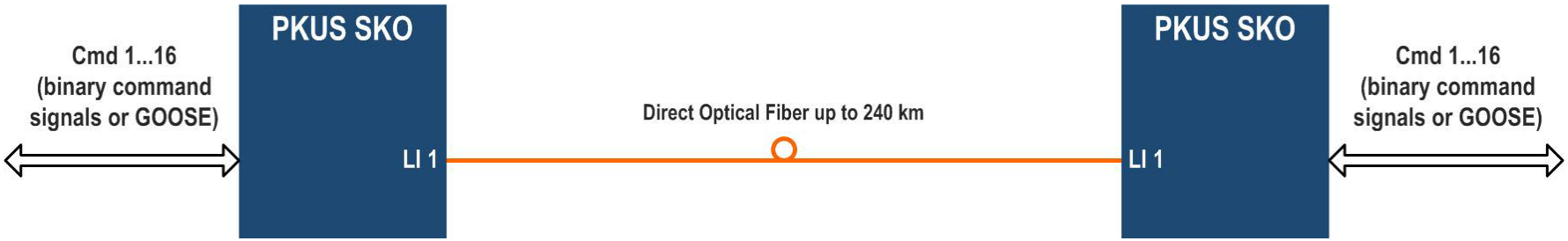
REAR VIEW WITH OPTIONAL 1U CABLE TRAY

HMISKO SOFTWARE

- Windows® compatible **HMISKO** software
  - Configuration (on-line and off-line modes)
  - Testing, Commissioning and Maintenance
- Saved files with configuration, status and event recorder data can be viewed
- **USB** port to connect **PC**
- **Ethernet** port can be utilized to remote access to multiple **PKUS SKO** in parallel via **LAN** or **WAN** (this functionality can be on/off via **HMISKO** when connected locally to the USB port)

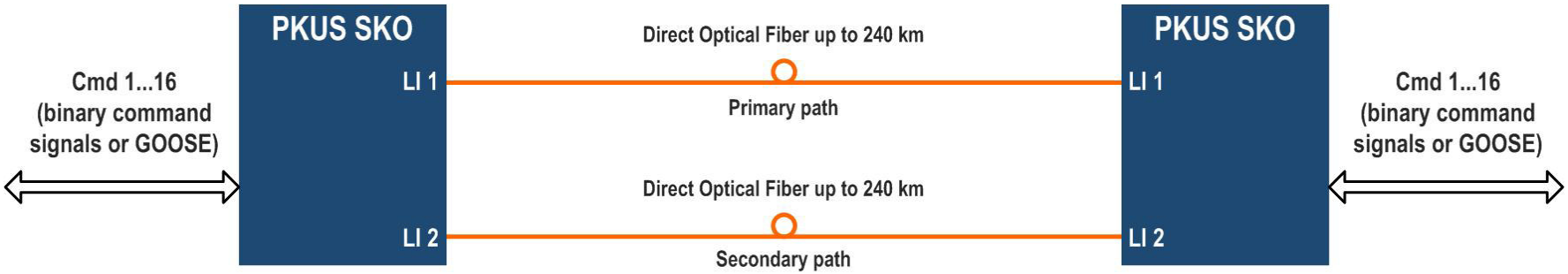


COMMAND TRANSMISSION VIA DIRECT OPTICAL FIBER



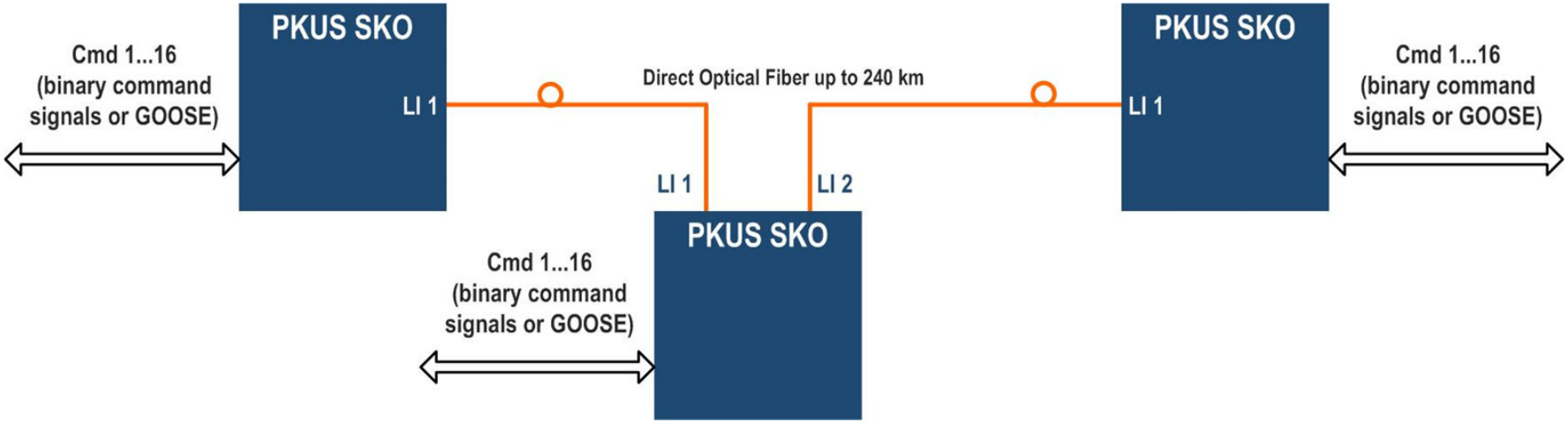
- Standard **SFP** transceiver for communication over direct optical fiber at 1310 or 1550 nm
- Other types of **SFP** modules, for example **DWDM**, are available on request
- 16 commands allow **PKUS SKO** to be used for protection of single-circuit and double-circuit power lines

COMMAND TRANSMISSION VIA DIRECT OPTICAL FIBER: PATH REDUNDANCY



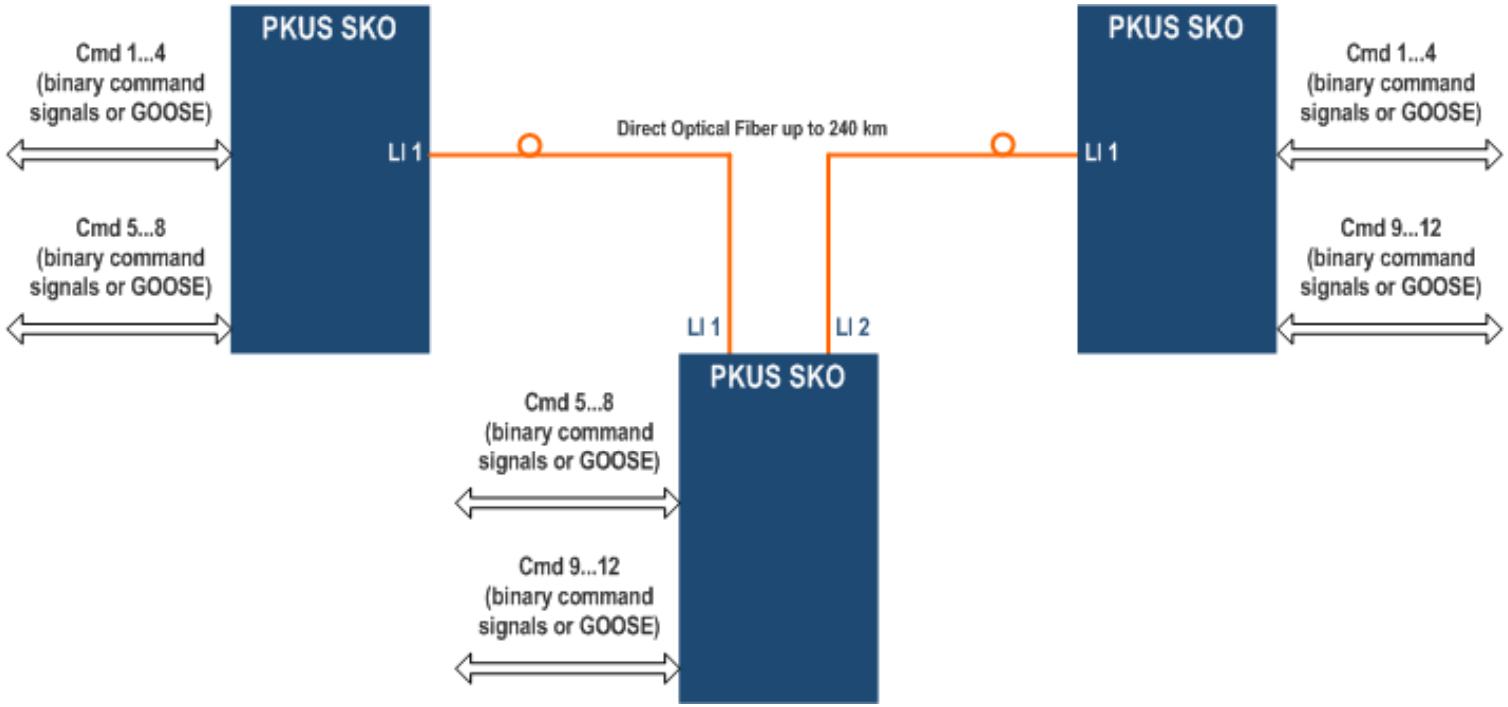
- 1+1 seamless path protection with zero switchover time
- This solution can be used for protection of single-circuit and double-circuit power lines

COMMAND TRANSMISSION VIA DIRECT OPTICAL FIBER: T-OPERATION



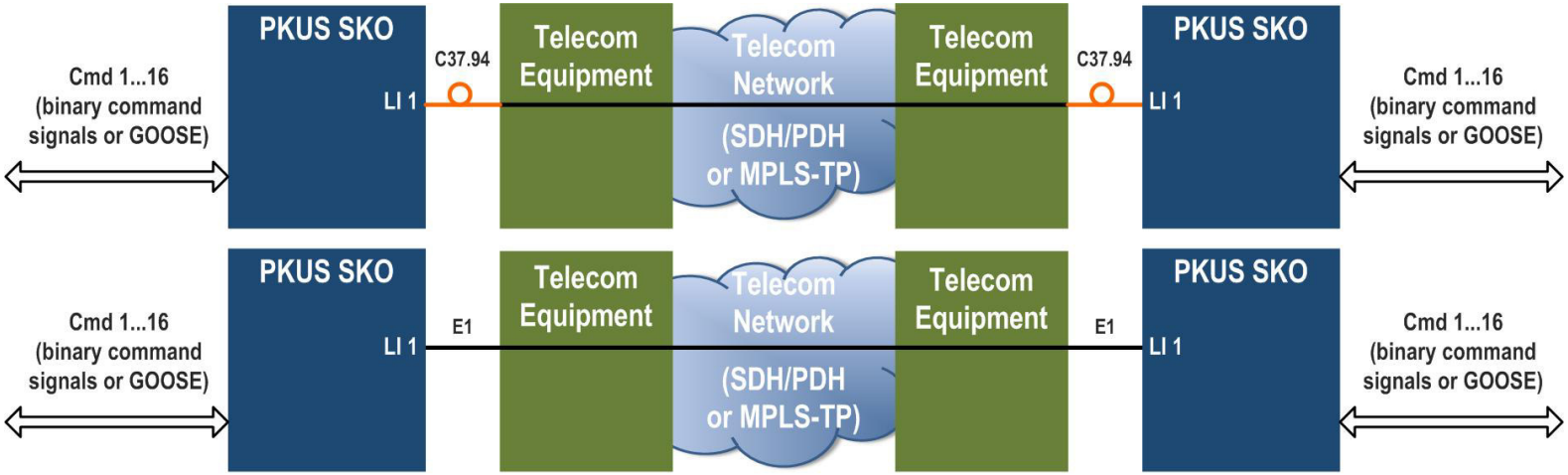
- **Two modes for each command** — normal T-operation or inverse T-operation
- **Normal T-operation** — a teleprotection command sent from any single station is received on all other stations
- **Inverse T-operation** — all opposite stations must simultaneously transmit a command to receive this command at any station
- Transit through-connection of commands in T-stations between two line interfaces of **PKUS SKO** provides minimum delay (less than 1 ms)
- The number of T-offs on single- and double-circuit power lines may be increased

COMMAND TRANSMISSION VIA DIRECT OPTICAL FIBER: POINT-TO-MULTIPOINT OPERATION



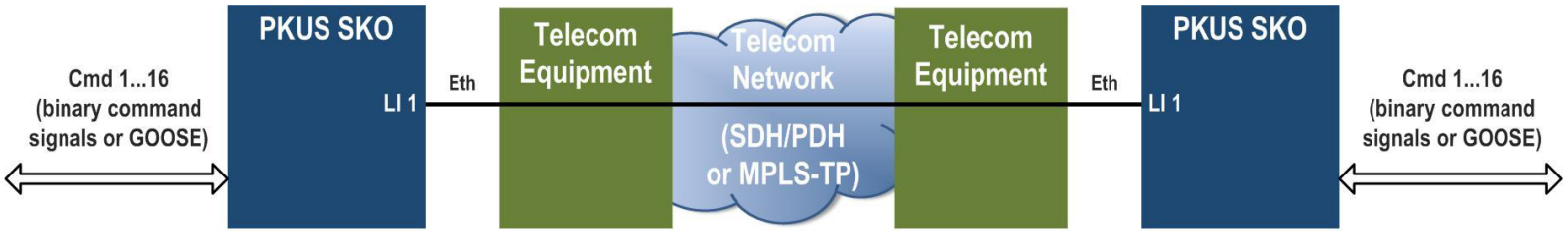
- **Cmd 1 … 4** are transmitted between outer stations, **Cmd 5 … 8** – between T-station and 1st outer station, **Cmd 9 … 12** – between T-station and 2nd outer station
- The number of T-offs may be increased

COMMAND TRANSMISSION VIA TELECOM NETWORK: C37.94 AND E1 INTERFACES



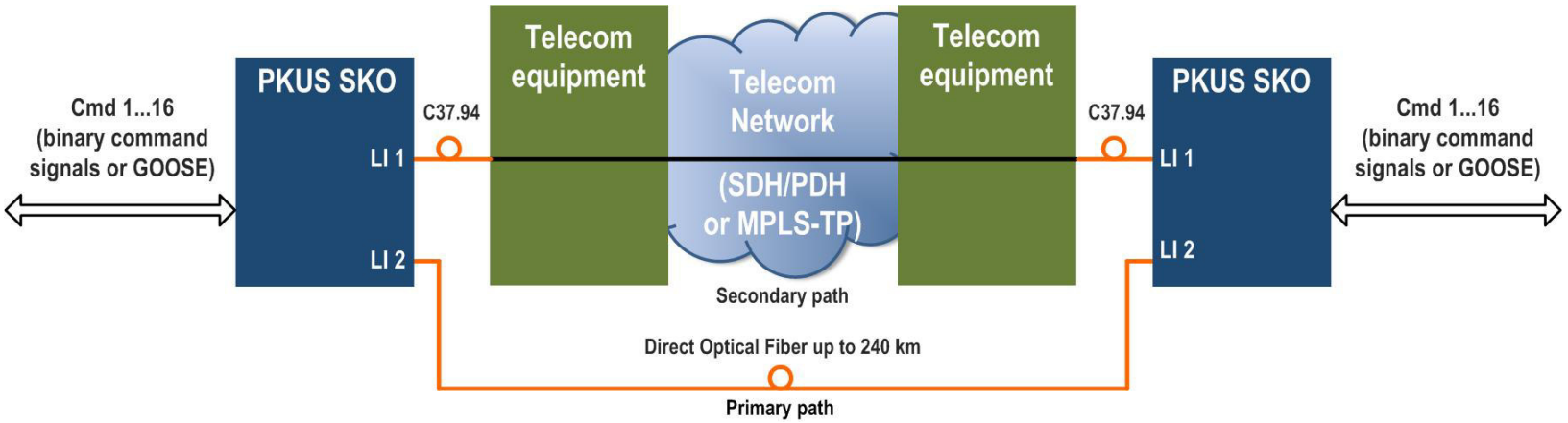
- Min. required data rate — 64 kbps for up to 8 commands (one time slot)
  128 kbps for up to 16 commands (two time slots)
  (increasing the data rate will reduce the command transmission time from 4.5 ms to min 2.9 ms excluding telecom network delay)
- This solution can be used for protection of single-circuit and double-circuit power lines
- 1+1 seamless path protection using static routes with zero switchover time is possible utilizing two line interfaces
- T-operation or point-to-multipoint operation can be implemented

COMMAND TRANSMISSION VIA TELECOM NETWORK: ETHERNET INTERFACES



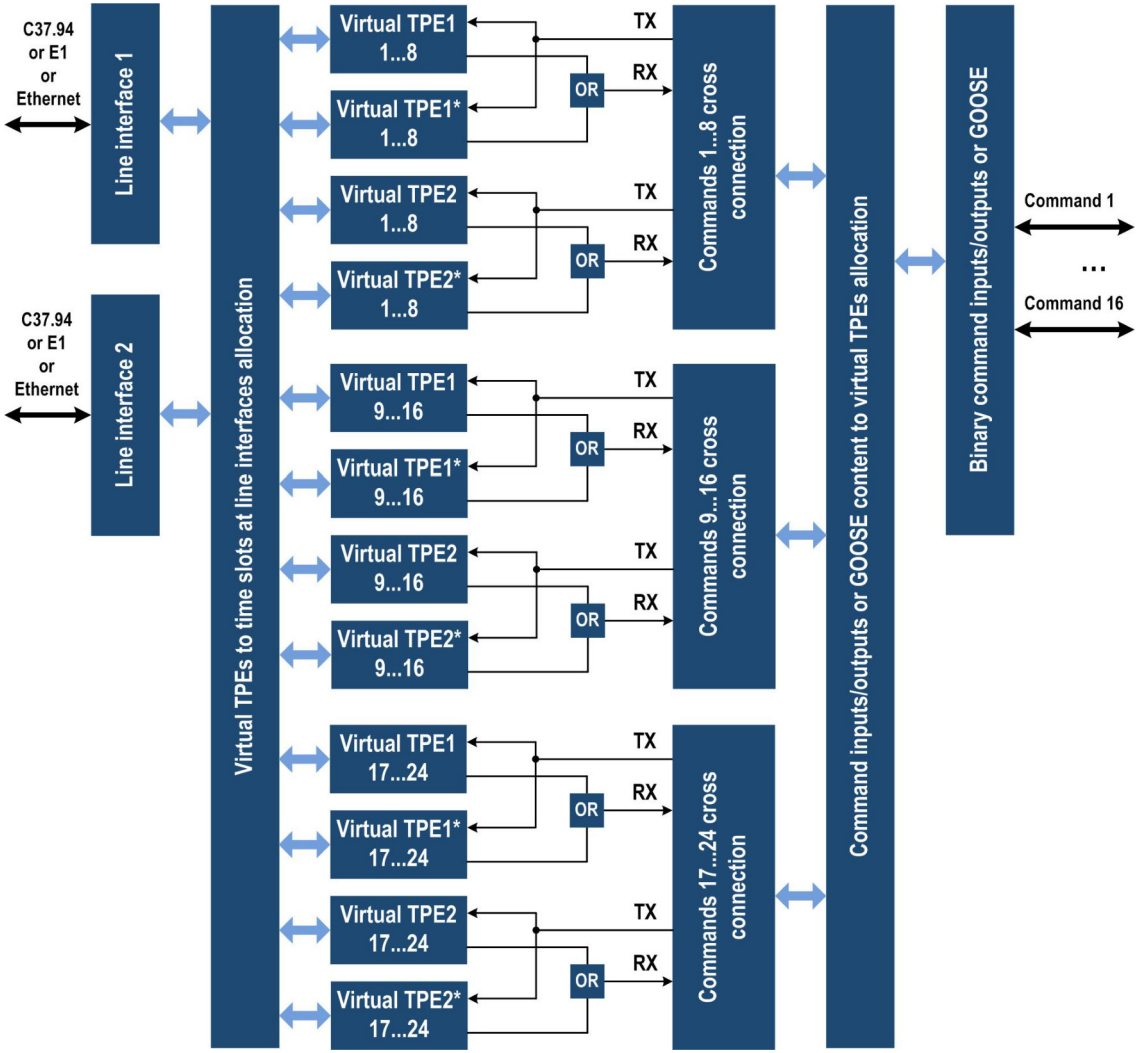
- Command transmission via **Ethernet** (**L2**) or **IP/Ethernet** (**L3**) links
- Min. required bandwidth 512 kbps for up to 8 commands
  1 Mbps for up to 16 commands
- This solution can be used for protection of single-circuit and double-circuit power lines
- 1+1 seamless path protection using static routes with zero switchover time is possible utilizing two line interfaces
- T-operation or point-to-multipoint operation can be implemented

COMMAND TRANSMISSION WITH MEDIA REDUNDANCY



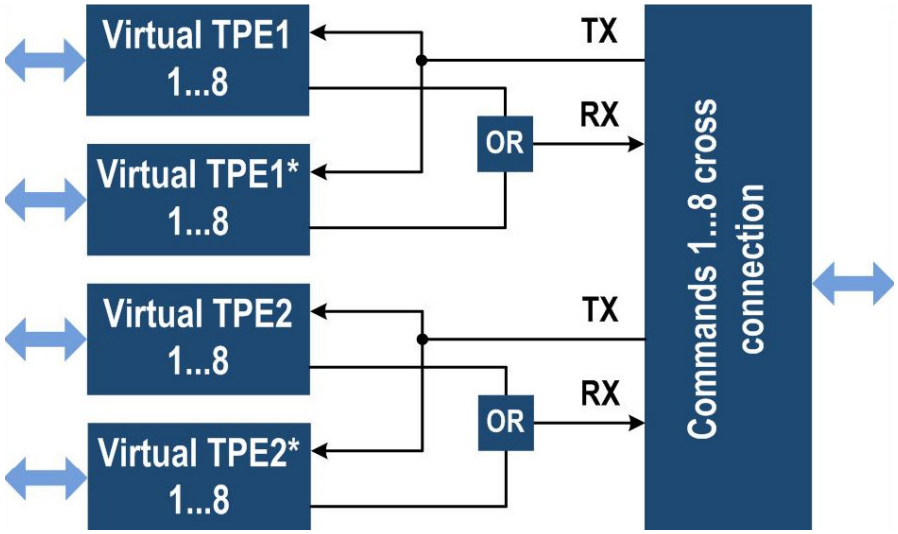
- 1+1 seamless media protection with zero switchover time (primary path – direct optical fiber, secondary path – telecom network)

VIRTUAL TPES IN PKUS SKO (1)



- Each of virtual **TPEs** can be freely allocated to one or more time slots in **E1** or **C37.94**
- In case of **Ethernet** line interface, each virtual **TPE** transmits and receives its own **UDP/IP** packets
- Each of inputs/outputs can be freely allocated to any **TPE**
- For simple application, for example for point-to-point transmission of up to 8 commands without 1+1 path protection, only one line interface and only **TPE1 1…8** can be used

VIRTUAL TPES IN PKUS SKO (2)



- **PKUS SKO contains the following virtual teleprotection units:**

  TPE1 1-8: transmission of command 1 … 8

  TPE1 9-16: transmission of command 9 … 16

  TPE1 17-24: transmission of command 17 … 24 (for commands transit)

  TPE2 1-8: transmission of command 1 … 8 in T or point-to-multipoint operating mode

  TPE2 9-16: transmission of command 9 … 16 in T or point-to-multipoint operating mode

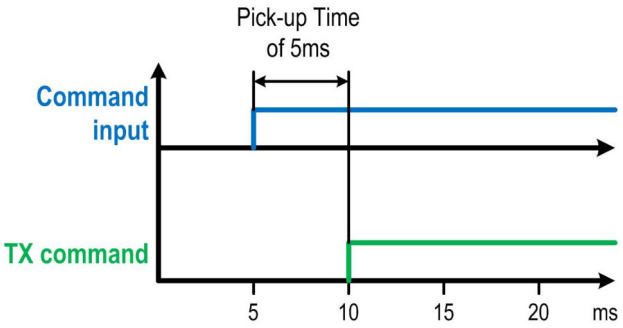
  TPE2 17-24: transmission of command 17 … 24 in T or point-to-multipoint operating mode

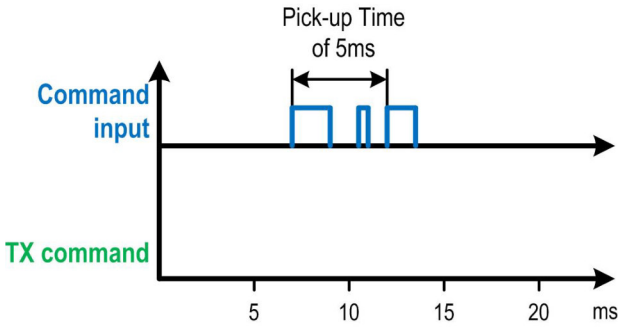
  TPE1* 1-8, TPE1* 9-16, TPE1* 17-24, TPE2* 1-8, TPE2* 9-16 and **TPE2* 17-24** for path/route protection mode

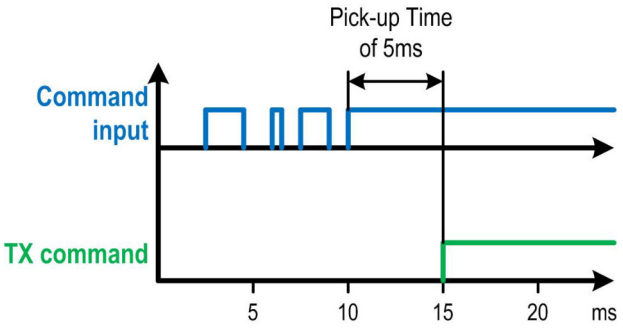
COMMAND INPUTS AND OUTPUTS

- **Binary command inputs**
  - **Nominal battery voltage** 48, 110/125, 220 VDC (set by jumpers)
  - **Reverse polarity protection** 400 VDC
  - **Input current** 20…25 mA at rated voltage
  - **Pick-up time** 0…20 ms (configurable via HMISKO software)
  - **Pick-up indication** LEDs for each input
- **Binary command outputs**
  - **Normally Open contact** electromechanical relay
  - **DC voltage** 5…250 VDC
  - **Contact ratings** 48 VDC/1.25 A, 110 VDC/0.55 A, 125 VDC/0.5 A, 220 VDC/0.27 A
  - **Pick-up indication** LEDs for each output

INPUT PICK-UP TIME



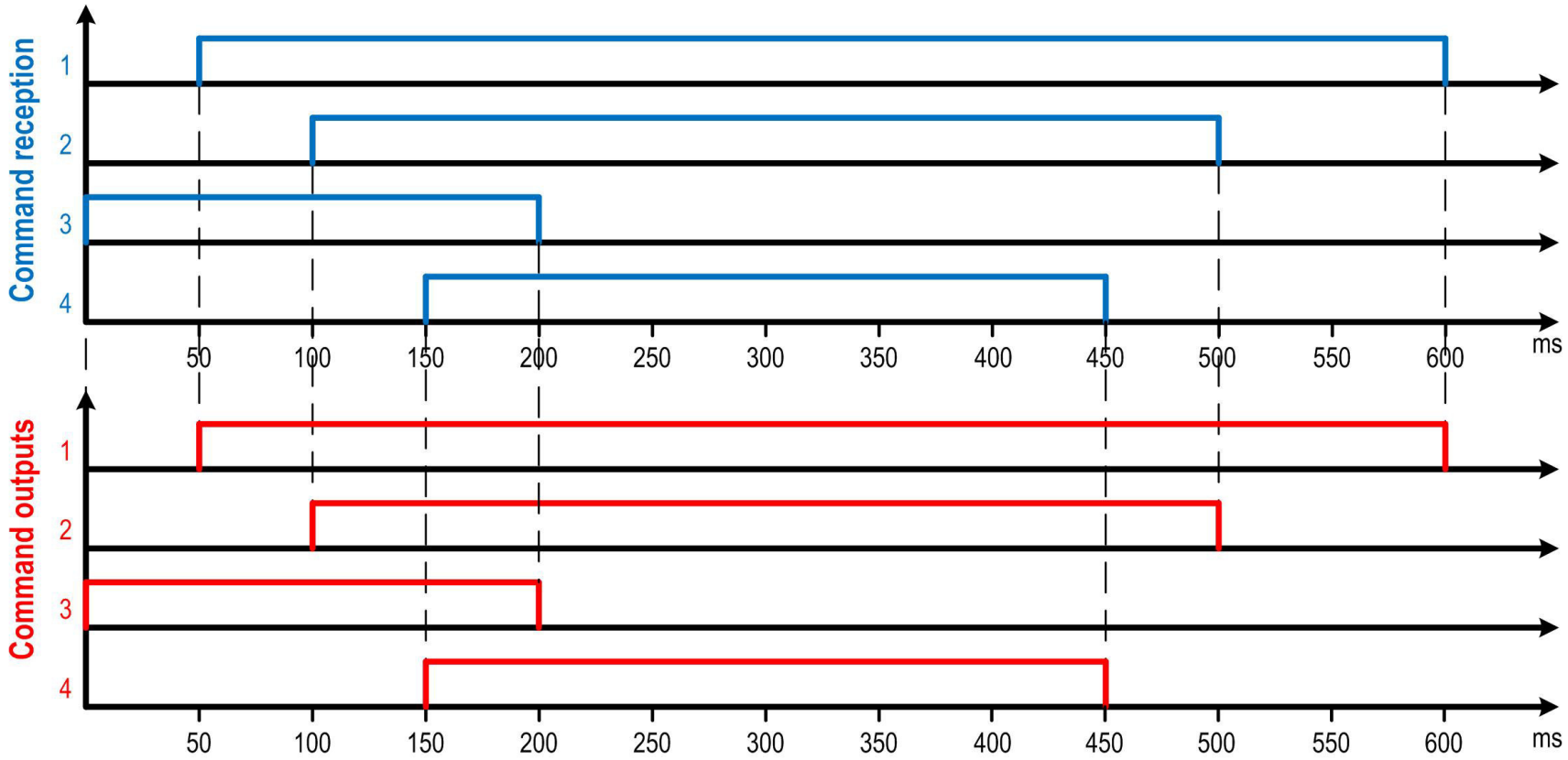




Pick-up time is used to avoid unwanted command transmission in the case of high-level impulse interference at the binary command inputs (lightning discharges and etc.)

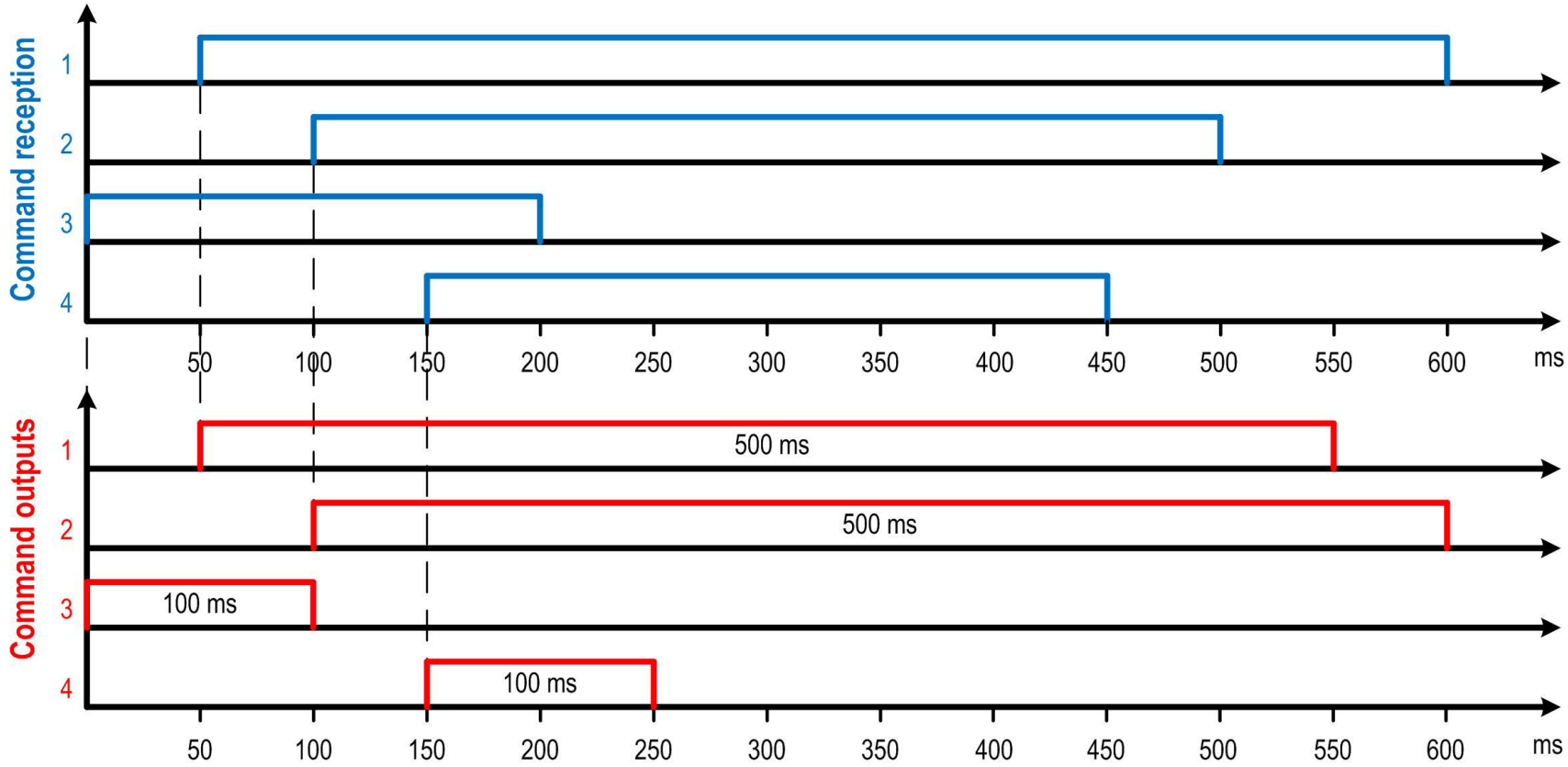
- Pick-up time can be individually configured for each binary command input (for example, 0 ms for permissive commands and 5 ms for direct trip commands)

RX COMMAND OUTPUT TYPE ‘AS IS’



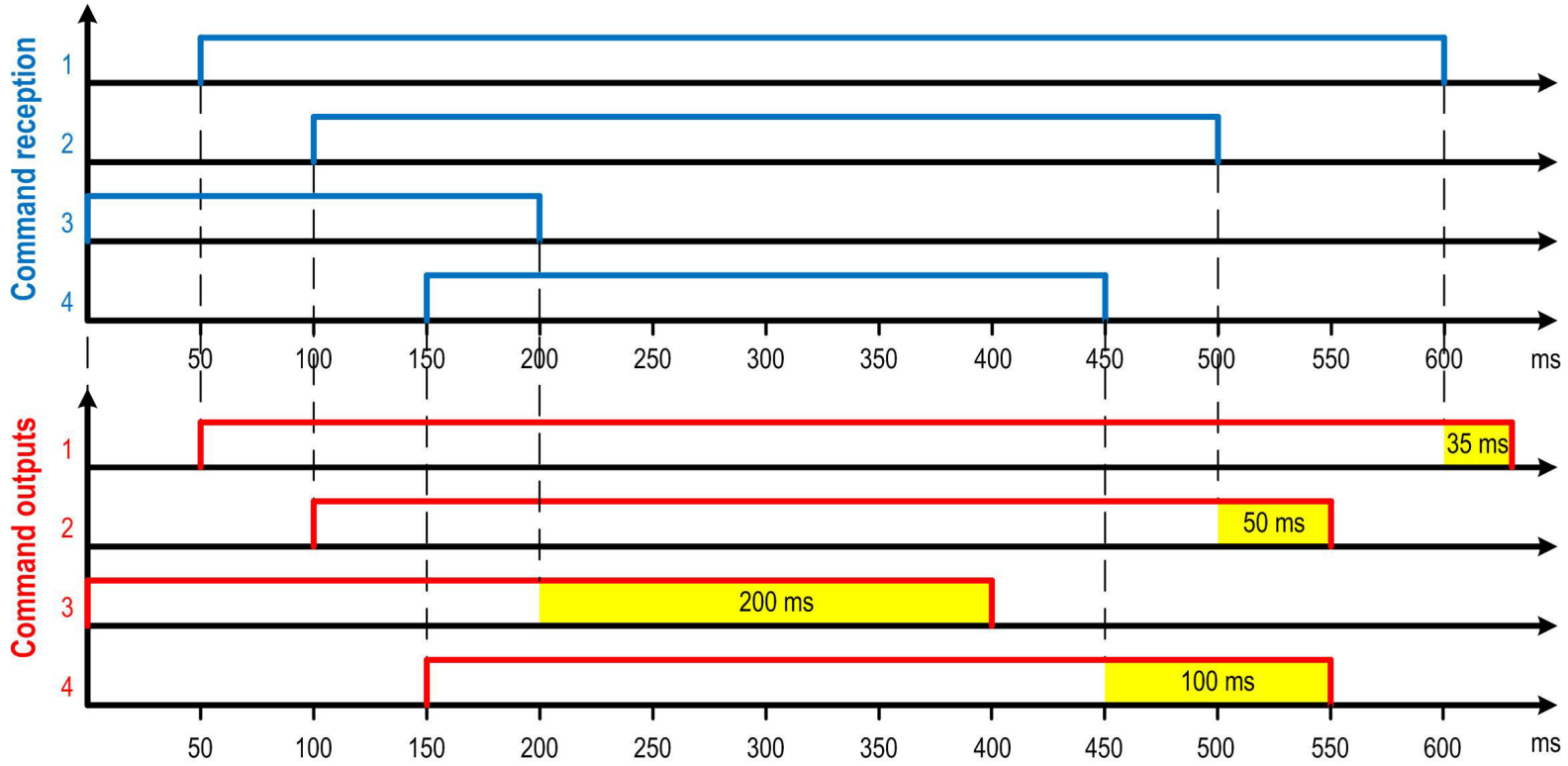
- The command duration at the output is the same like duration of the command in the communication link

RX COMMAND OUTPUT TYPE 'FIXED DURATION'



- The command duration at the output is equal to the preconfigured fixed time value and does not depend on the time during which the command is available in the communication link

RX COMMAND OUTPUT TYPE ‘PROLONGATION’



- The command duration at the output is equal to duration of the command in the communication link plus the preconfigured prolongation time
- Rx command output type can be individually configured for each command output

PKUS SKO non-volatile event recorders is not editable by user

- **Command event recorder** — transmitted and received commands
- **Manipulations event recorder** — start up / power down / user-reset / configuration download / set of date and time / reset counter
- **Alarm and warning event recorder** — alarms and warnings
- **Access log event recorder** — login, set password

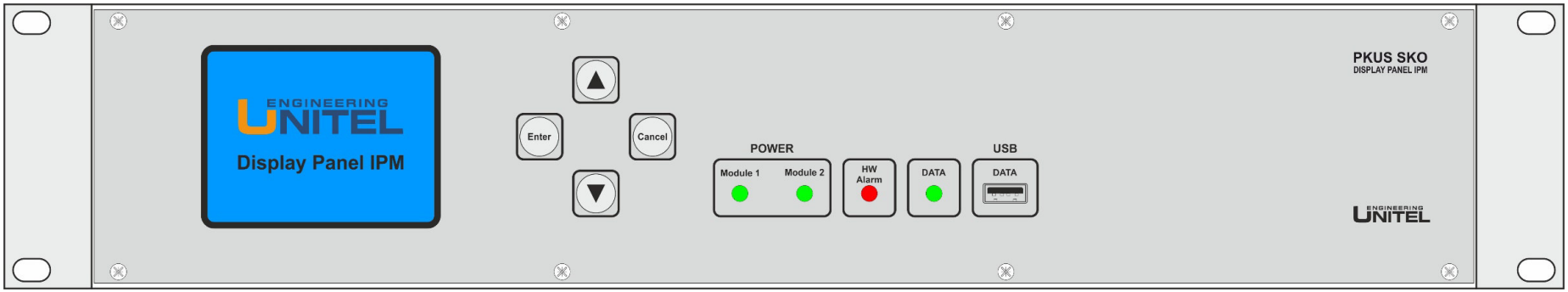
Number of recordable events before overwriting of the oldest event is 2000 in each of the event recorders mentioned above

- **Start time and end time with resolution** 1 ms

Real Time Clock (**RTC**) with optional **IRIG-B** or **SNMP** synchronization

It is possible to synchronize **RTC** on the one side of the link from **RTC** on the other side of the link (configurable via **HMISKO** software)

PKUS SKO DISPLAY PANEL IPM



FRONT VIEW

REAR VIEW

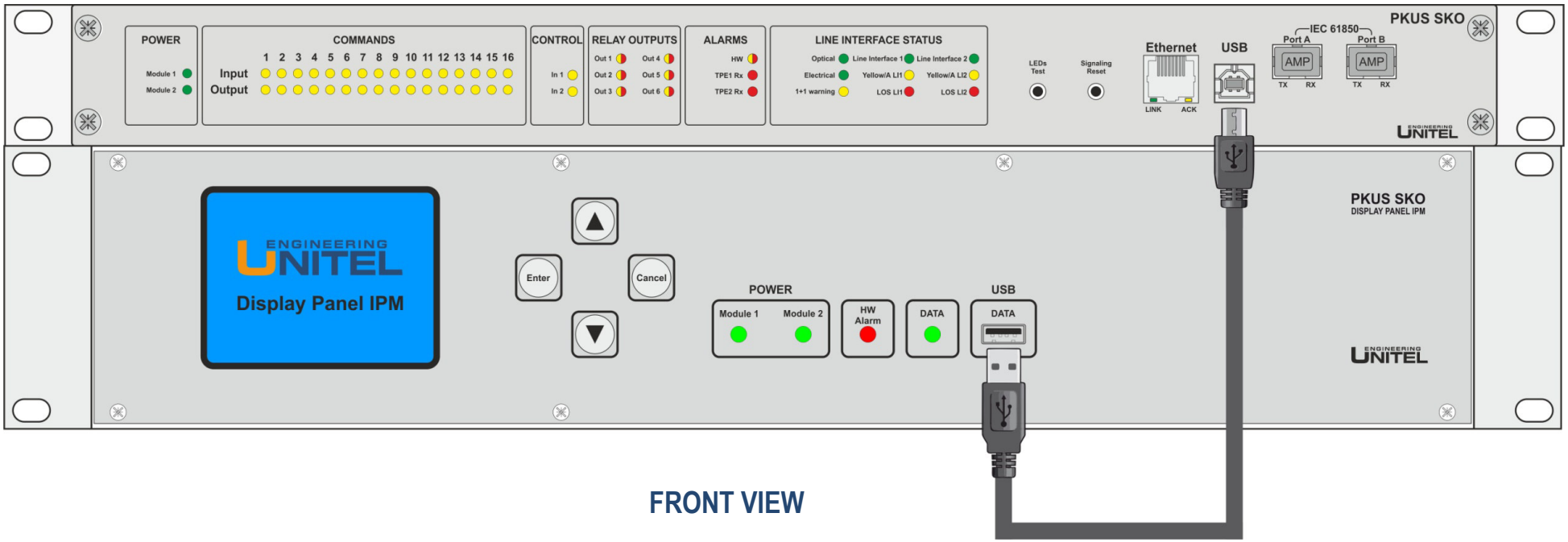
- Optional external panel for displaying counters, status and event recorders of the **PKUS SKO** (without usage of **PC**)
- Color **TFT** display and four navigation buttons

KEY FEATURES OF THE PKUS SKO DISPLAY PANEL IPM

PKUS SKO Display Panel IPM designed to display the following parameters of PKUS SKO

- **Counters**
  - Number of binary command inputs and outputs triggering
  - Number of **GOOSE** received and **GOOSE** published
  - Number of transmitted and received commands over link, including transit commands in T-operation and point-to-multipoint mode
  - Number of control inputs triggering and relay outputs triggering
- **Current status**
  - Existing link and hardware alarms and warnings
  - States of binary command inputs and outputs
  - States of **GOOSE** content
  - States of command transmission and command receiving over communication link
  - States of control inputs and relay outputs
- **Event recorders**
  - Command recorder
  - Alarm and warning recorder
  - Manipulation recorder
- **Loop test time**

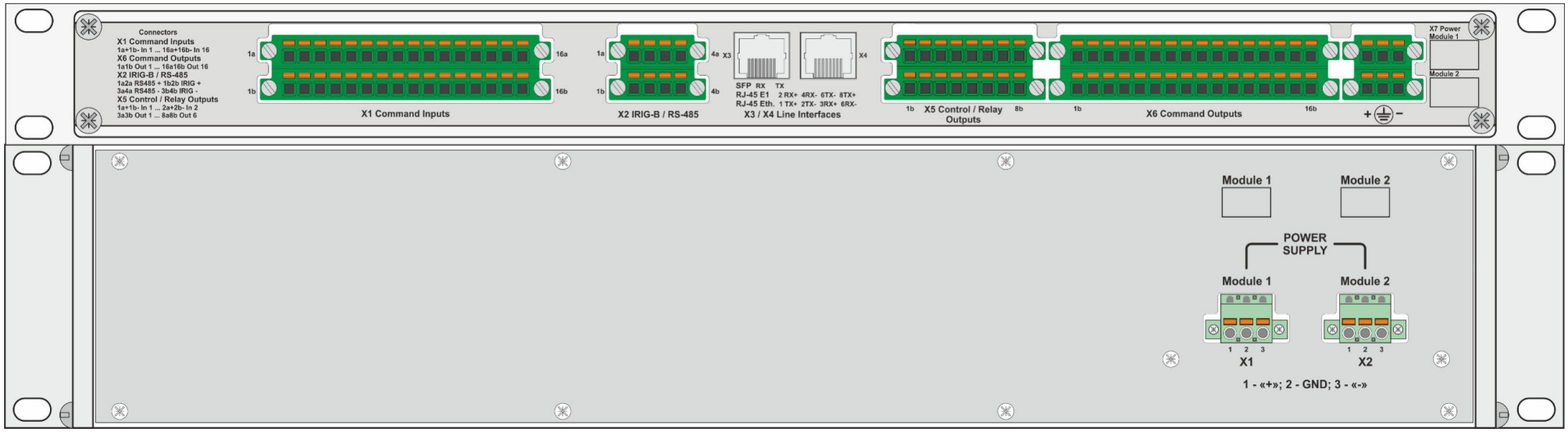
PKUS SKO DISPLAY PANEL IPM: CONNECTION



FRONT VIEW

- Display Panel **IPM** does not require configuration
- External connection to front of **PKUS SKO** via **USB** printer cable (type A male – type B male)

PKUS SKO DISPLAY PANEL IPM: CONNECTION



REAR VIEW

- Connector X1: First power supply 48 VDC, or 110/125 VDC, or 220 VDC / 230 VAC (on request)
- Connector X2: Second power supply 48 VDC, or 110/125 VDC, or 220 VDC / 230 VAC (on request)

PKUS SKO ADVANTAGES

- Compact design
- Provides transmission and receiving of up to 16 independent commands
- Flexible configuration for many various applications
- Complies to or exceeds the functional and **EMC** requirements of **IEC 60834-1** 'Teleprotection equipment of power systems - performance and testing – Part 1: Command systems'
- Point-to-multipoint operation mode
- Seamless 1+1 path protection with zero switchover time

UTK8 TELEPROTECTION COMMAND TESTER

- **UTK8** is the specialized teleprotection command tester that allows you to inspect the parameters of command transmission via binary inputs and outputs during
  - Factory Acceptance Tests
  - Commissioning
  - Maintenance
- **UTK8** performs the functions of protection relays connected to the teleprotection equipment (replaces them) and in accordance to specified test procedure sends and receives commands
- Simultaneously testing of up to 8 commands
- 0.1 ms accuracy for measurement of command transmission time
- Small overall dimensions and weight: 220x140x40 mm and 0.8 kg
- Both, standalone operation and operation under control of the **UTK8** software installed on **PC**
- Ability to create, store and load up to 16 test configuration profile

WE ARE GLAD TO BE THE RELIABLE PARTNER FOR SERVING YOUR TASKS

THANK YOU FOR YOUR ATTENTION!

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