

FOX615/612

TEPI2 distance protection interface module.



01

01 TEPI2 distance protection interface module

Teleprotection is a critical application for any operational utility communications system, providing a safeguard against failure and damage

The performance of the protection relay directly depends on the ability of the communications network to quickly and reliably transmit information from one protection relay to another. Power grid availability can be increased by implementing high performance teleprotection solutions.

Integrated distance protection for guaranteed performance

The new TEPI2 teleprotection interface module provides four command inputs and outputs for distance protection relays, guaranteeing the extreme reliability and dependability requirements demanded by the application. Continuous monitoring of the data channel availability, hitless redundancy of the communication path, and cyclic loop test for delay measurement, make the TEPI2 interface the ideal solution for distance-protection signal transmission.

Specially designed for utilities

Combined with the TEPI2 interface the universal multiplexer FOX615 provides a specific solution for power utility applications. It enables the transmission of distance protection signals via packet-switched wide area networks (WANs) where compliance with demanding application requirements cannot be easily met. With the TEPI2 interface, FOX615 provides an outstanding, integrated solution based on ABB's experience in the area of protection applications. It provides long-term support of proven technologies and paves the way towards future-oriented, packet-switched solutions.

For accurate time-of-day information FOX615 fully supports IEEE 1588v2, enabling distribution of real

time information through a WAN. This makes local GPS installations unnecessary, while significantly enhancing the overall availability of the system. The TEPI2 and FOX615 solution fulfills all relevant teleprotection product standards, such as IEC 60834-1 as well as EMC standards IEEE 1613, EN 61000-6-3 and EN 61000-6-2.

TEPI2 key features

- Four command inputs and outputs for distance protection applications, guaranteeing the extreme reliability and dependability requirements defined in IEC 60834-1
- Teleprotection signal transmission through packet-switched WAN at unmatched speed
- Teleprotection ports are configurable for direct or permissive operation (speed- or security-optimized signal transmission)
- Hitless traffic protection in case of link failure, for highest availability of the communication channel
- IRIG-B outputs for real time information to end devices
- As integrated FOX615 solution TEPI2 is configured via FOXMAN-UN and FOXCST
- 12 binary signal inputs and 8 outputs for transmission of digital signals such as interlocking status or alarms
- External alarm acquisition, either as alarms of TEPI2 or as alarms in the network management system (FOXMAN-UN)
- Custom definition of up to six remote control functions which can be performed through FOXCST/FOXMAN-UN

TEPI2

Integrated teleprotection interface for distance protection applications with an unmatched speed.



02

02 FOX615: multiservice multiplexer with a modular platform

TEPI2 applications

Teleprotection signaling

TEPI2 provides four high-speed, high-power command inputs/outputs, and two programmable auxiliary relays for trip signal transmission compliant with the relevant teleprotection standard IEC 60834-1. The teleprotection signaling application is suitable for the following protection schemes:

- Permissive tripping
- Blocking / unblocking
- Duplicated main protection
- Direct-transfer tripping
- Teed line protection (normal or inverse)

The following key features for teleprotection are supported:

- Mapping trip signals into Ethernet frames for transport via packet-switched networks (PSN)
- 4 high-voltage command inputs, software configurable for trip voltage levels from 24 to 250 V DC
- 4 high-speed, high-power command outputs
- Secure and dependable command transmission, fully compliant with IEC 60834-1
- VLAN separation, and 8 bit channel addressing scheme, prevents wrong cross-connections
- Hitless traffic protection in case of link failure, for highest availability of the communication channel
- Continuous performance monitoring, and trip transmission time measurement for each command, including statistical analysis capability
- Non-volatile event recorder and trip counters
- Authentication of Ethernet packets to guarantee integrity of trip signals
- Possibility of logical operation of trip commands

- Input/output logic, flexible logical connection of commands to transmission channels
- Multiplication of command outputs as well as command prolongation or continuous command suppression are configurable

Teleprotection signaling performance

The TEPI2 module combines traditionally-known modes for speed and security. Sophisticated signal processing ensures security compliant values (as per IEC 60834-1) at the highest possible speed.

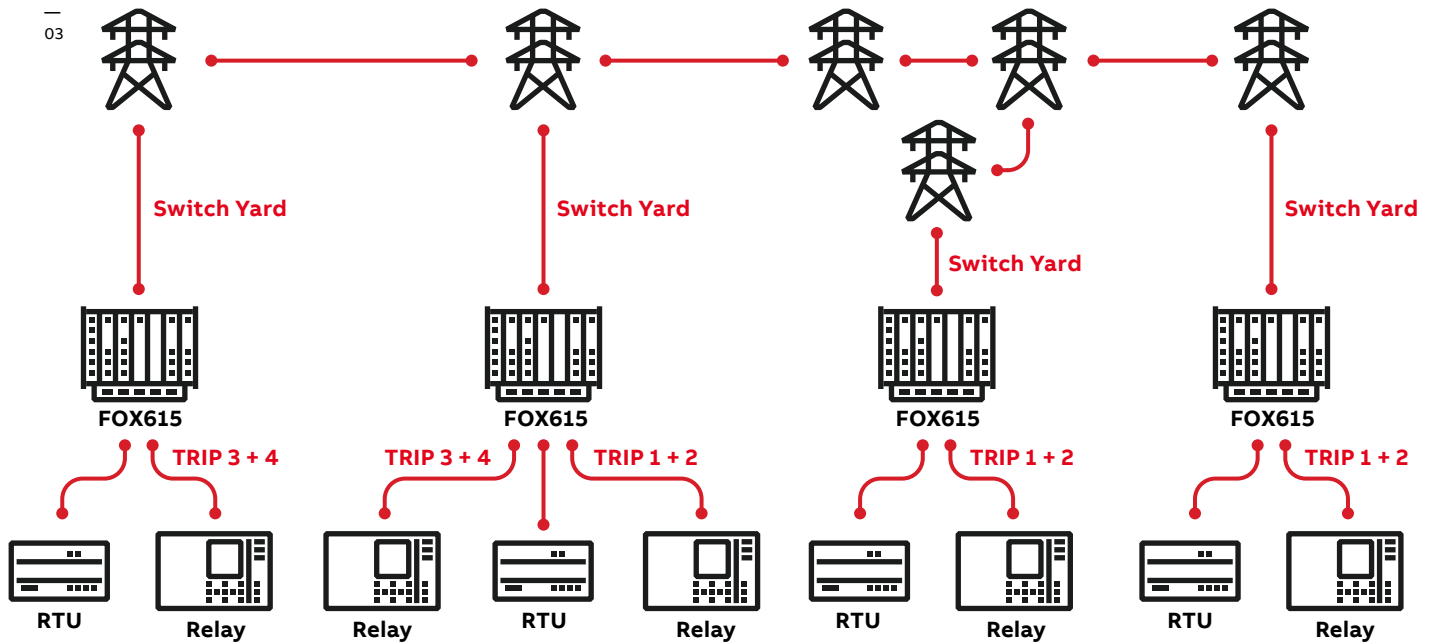
Operation mode 'Speed optimized'

Recommended for use with teleprotection schemes: Permissive tripping (blocking / unblocking)

	min.	typ.	max.
Trip immunity time	1.2 ms	1.25 ms	1.3 ms
Trip transmission time	1.6 ms	1.75 ms	1.9 ms
Propagation delay time	2.8 ms	3.0 ms	3.2 ms

Power line protection

TEPI2 provides 4 command inputs and outputs which can be sent in 1 or 2 directions. So it is possible to protect more than one power line (e.g. if only two commands are used per power line). The station in Fig 02 shows such a configuration: this station is connected in two different directions using two commands originating from the same TEPI2. The three TEPI2's are configured in a T configuration. Trip signal 1 and 2 are broadcast to the two opposite stations. Trip signal 3 and 4 are configured in a point-to-point connection with another TEPI2 module on the remote side. IRIG-B outputs can be used to provide real time information to end devices.



Binary signal Transmission

Transmission of up to 16 individual signals in two directions

- A maximum of 12 binary signal inputs and 8 binary signal outputs can be terminated locally
- Input logic and flexible connection of binary signals are configurable to transmission channels

The transmission of the following is supported:

- Control signals
- Status signals
- Metering pulses
- Other digital signals

The following features are supported:

- 4 optocoupler inputs for signal levels of 24 to 60 V DC
- 2 groups of 4 current inputs, for dry contacts
- 8 solid state outputs
- 4 relay outputs
- 1 galvanically insulated 24 V auxiliary supply
- Hitless redundancy

External alarm acquisition

With FOXCST or FOXMAN-UN, network management system alarms originating from external equipment will be directly displayed, either as alarms of TEPI2 or as alarms of foreign objects in FOXMAN-UN. Each TEPI2 can acquire up to 16 independent external equipment alarms. Combined with the binary signal transmission application, these alarms can additionally be propagated to further network element(s).

Remote control

Custom definition for up to six simple remote control functions, which can be performed through FOXCST or FOXMAN-UN enables using manually

switched, dedicated mechanical relays on the TEPI2 board for control of external devices. This application is often used in conjunction with the external-alarm acquisition and monitoring to acknowledge external equipment alarms, or to remotely control external devices such as emergency power generators.

TEPI2 architecture

The TEPI2 teleprotection interface is one of a wide range of interface modules that can be plugged into a FOX615/612 shelf.

Like all other FOX615 modules the TEPI2 module is:

- Powered from the FOX615/612 shelf
- Configured by FOXCST
- Supervised by FOXMAN Management system

Two front connectors provide access to the teleprotection and general purpose (binary) inputs and outputs. They are galvanically insulated, and provide highest Electromagnetic Compatibility (EMC) protection in harsh environments.

TEPI2 includes a highly accurate, non-volatile event recorder that can be synchronized to a GPS (Global Positioning System) using IRIG-B locally, or through the WAN via Precision Time Protocol (PTP). In addition, TEPI2 also provides IRIG-B outputs which enable highly accurate time-of-day information towards end devices, such as protection relays or fault recorders.

Feature	Rating or standard																
Teleprotection interface																	
Command inputs	4 (software configurable for input voltage)																
Nominal input voltage	24, 48, 60, 110, 125, 220, 250 V _{DC}																
Operation threshold (trip detection) ¹	<table> <tr> <td>Trip ON range:</td> <td>Trip OFF range:</td> </tr> <tr> <td>24 V_{DC}: typ. 14.8 V... 17.2 V</td> <td>24 V_{DC}: typ. 16.2 V... 13.9 V</td> </tr> <tr> <td>48 V_{DC}: typ. 32.7 V... 35.3 V</td> <td>48 V_{DC}: typ. 32.3 V... 29.7 V</td> </tr> <tr> <td>60 V_{DC}: typ. 41.6 V... 44.4 V</td> <td>60 V_{DC}: typ. 39.4 V... 36.6 V</td> </tr> <tr> <td>110 V_{DC}: typ. 78.2 V... 81.8 V</td> <td>110 V_{DC}: typ. 77.8 V... 74.2 V</td> </tr> <tr> <td>125 V_{DC}: typ. 89.1 V... 92.9 V</td> <td>125 V_{DC}: typ. 87.9 V... 84.1 V</td> </tr> <tr> <td>220 V_{DC}: typ. 159.4 V... 164.6 V</td> <td>220 V_{DC}: typ. 152.2 V... 147.5 V</td> </tr> <tr> <td>250 V_{DC}: typ. 181.2 V... 186.8 V</td> <td>250 V_{DC}: typ. 181.2 V... 167.3 V</td> </tr> </table>	Trip ON range:	Trip OFF range:	24 V _{DC} : typ. 14.8 V... 17.2 V	24 V _{DC} : typ. 16.2 V... 13.9 V	48 V _{DC} : typ. 32.7 V... 35.3 V	48 V _{DC} : typ. 32.3 V... 29.7 V	60 V _{DC} : typ. 41.6 V... 44.4 V	60 V _{DC} : typ. 39.4 V... 36.6 V	110 V _{DC} : typ. 78.2 V... 81.8 V	110 V _{DC} : typ. 77.8 V... 74.2 V	125 V _{DC} : typ. 89.1 V... 92.9 V	125 V _{DC} : typ. 87.9 V... 84.1 V	220 V _{DC} : typ. 159.4 V... 164.6 V	220 V _{DC} : typ. 152.2 V... 147.5 V	250 V _{DC} : typ. 181.2 V... 186.8 V	250 V _{DC} : typ. 181.2 V... 167.3 V
Trip ON range:	Trip OFF range:																
24 V _{DC} : typ. 14.8 V... 17.2 V	24 V _{DC} : typ. 16.2 V... 13.9 V																
48 V _{DC} : typ. 32.7 V... 35.3 V	48 V _{DC} : typ. 32.3 V... 29.7 V																
60 V _{DC} : typ. 41.6 V... 44.4 V	60 V _{DC} : typ. 39.4 V... 36.6 V																
110 V _{DC} : typ. 78.2 V... 81.8 V	110 V _{DC} : typ. 77.8 V... 74.2 V																
125 V _{DC} : typ. 89.1 V... 92.9 V	125 V _{DC} : typ. 87.9 V... 84.1 V																
220 V _{DC} : typ. 159.4 V... 164.6 V	220 V _{DC} : typ. 152.2 V... 147.5 V																
250 V _{DC} : typ. 181.2 V... 186.8 V	250 V _{DC} : typ. 181.2 V... 167.3 V																
Command outputs	4 solid-state relay (power MOSFET); normally open																
Tripping command	250 V _{DC} : ≤ 2 A; duty cycle: ratio T _{on} /T _{off} ≤ 1/3; T _{on} ≤ 5 min																
Continuous command	250 V _{DC} : ≤ 1 A																
Auxiliary mechanical relay outputs	2 monostable electromechanical relay; 1 change-over contact																
Max. switching power	2'000 VA, 240 W																
Max. switching voltage	250 V _{DC}																
Max. switching current	≤ 2 A continuous current																
General purpose I/O interface																	
Voltage inputs	8 (no configuration required for voltage input)																
Nominal input voltage	24, 48, 60 V _{DC}																
Operation threshold ²	<table> <tr> <td>ON range:</td> <td>OFF range:</td> </tr> <tr> <td>+18 V ... +72 V_{DC}</td> <td>- 72 V ... + 9 V_{DC}</td> </tr> </table>	ON range:	OFF range:	+18 V ... +72 V _{DC}	- 72 V ... + 9 V _{DC}												
ON range:	OFF range:																
+18 V ... +72 V _{DC}	- 72 V ... + 9 V _{DC}																
Input current	2.5 mA ... 12.5 mA ≤ 1.5 mA																
Current loop inputs	2 galvanically isolated groups of 4																
Operation threshold	<table> <tr> <td>ON range:</td> <td>OFF range:</td> </tr> <tr> <td>≥ 3 mA</td> <td>≤ 1 mA</td> </tr> </table>	ON range:	OFF range:	≥ 3 mA	≤ 1 mA												
ON range:	OFF range:																
≥ 3 mA	≤ 1 mA																
Short-circuit current	5 mA ± 10%																
Voltage outputs	8 solid-state relay; normally open																
Nominal output switching voltage	24, 48, 60 V _{DC}																
Switching Current	≤ 0,5 A 100 ms max. (current inrush peak) ≤ 0.2 A continuous current																
Auxiliary mechanical relay outputs	4 monostable electromechanical relay with 1 change-over contact																
Max. switching power	62.5 VA, 60 W																
Max. switching voltage	125 V _{AC} or 220 V _{DC}																
Max. switching current	≤ 0.2 A continuous current																
Auxiliary power supply output	1																
Output voltage	24 VDC +5% / -20%																
Load current	≤ 40 mA continuous; short-circuit protected																
IRIG-B input	1 unmodulated (DC-level shift), complying IRIG 200-04-TT-45																
Supported serial time code formats	IRIG-B002 ³ (100pps, pulse with code, no carrier, BCD _{TOY}) IRIG-B006 (100pps, pulse with code, no carrier, BCD _{TOY} , BCD _{YEAR})																
IRIG-B output	4 electrical outputs IRIG-B002																
EMC standards	Generic: EN 61000-6-3, EN 61000-6-2; Specific: IEC 61000-4-2/3/4/5/6/8/16/18/29																
Product standards	IEC 60834-1, IEEE 1613																
Electrical safety	EN 60950-1																
Electrical isolation	IEC 60255-5																
MTBF	> 60 years																

¹ Threshold accuracy ±5%

² The input state is defined for the given ON and OFF voltage ranges only. The range between the ON and OFF value is not defined.

³ Time Code Format B: The 74-bit time code contains 30 bits of BCD time-of-year information in days, hours, minutes and seconds, 17 bits of SB seconds-of-day, 9 bits for year information and 18 bits for control functions.