

## Terminal and Protection Unit

### Introduction

The TPU 420 family is the product line of Terminal and Protection Units from Efacec, each version designed for a specific application, for different types of equipment. These products allow the client to choose the best solution for each situation from the versions available. The TPU 420 is easy to install and configure, completely programmable, allowing control and configuration as well as an integrated view of the alarms and other system information. These functions are also available using the WinProt, by Efacec.



### Distributed Automation

The complete integration of the TPU 420 in Substation Automation Systems allows the definition of control functions that take advantage of the connection to the Local Area Network (LAN). The fast communication mechanism available between the different TPU units allows the implementation of advanced automation, interlocking and other functions based on the interaction through the LAN. The TPU 420 automation is fully programmable, using the WinProt, by Efacec.



### Input and Output Modules

The TPU 420 provides a flexible Input/Output scheme. Each relay can have up to 3 I/O boards, with different configurations according to the project requirements. The main board has 9 binary inputs and 5 binary outputs completely configurable and isolated from each other. With 3 types of expansion boards (Type 1 with 9 inputs and 6 outputs, Type 2 with 16 inputs, Type 3 with 15 outputs), the TPU 420 may have up to 41 binary inputs, or 36 outputs.



### Engineering Remote Access

Through the use of a high speed LAN, the TPU 420 family can be fully integrated into the Efacec Protection, Command and Control Systems. Additionally, these units offer a variety of system and unit monitoring functions, including disturbance recorder, event logging and load diagram recording. The integration is assured by standard protocols such as IEC 60870-5-104 and IEC 61850. The time synchronization can be performed via SNTP, IRIG-B, or by communications protocols.

### Communication and Integration

The TPU 420 development has focused on the integration of advanced communications schemes, particularly the high speed LAN. Complex yet efficient schemes can be developed that increase system reliability, optimization and modularity. Traditional centralized implementations, based on standalone computers with separated automation and protection domains, have evolved to offer an extremely powerful distributed architecture.

# Specifications

Functions		TPU 5420			TPU C420		TPU B420	TPU TD420		TPU TC420		TPU L420	
	ANSI	I	C	S	C	S	F	I	R	S	D	R	S
<b>Protection Functions</b>													
Phase Overcurrent Protection HV	50/51	•	•	•	•	•	•	•	•	•	•	•	•
Phase Overcurrent Protection MV		•						•					
Earth Fault Overcurrent Protection HV	50N/51N	•	•	•	•	•	•	•	•	•	•	•	•
Earth Fault Overcurrent Protection MV		•						•					
Directional Phase Overcurrent Protection	67	•	•	•						•	•	•	
Directional Earth Fault Overcurrent Protection	67N	•	•	•						•	•	•	•
Resistive Earth Fault Protection	51N	•	•	•									
Phase and Zero Sequence Overvoltage Protection	59/59N			•	•	•	•			•			
Phase Undervoltage Protection	27			•		•	•			•			
Over and Underfrequency Protection	81			•		•	•						
Phase Balance Protection	46		•	•	•	•					•	•	
Overload Protection	49	•	•	•						•			
Transformer Differential Protection	87T							•	•				
Restricted Earth Fault Protection	87N								•	•			
Tank Overcurrent Protection	50/51G							•	•				
Capacitor Unbalance Protection	61N				•	•							
Distance Protection	21/21N										•	•	•
Distance Teleprotection Schemes	85/21										•	•	•
Remote Tripping											•	•	•
Echo and Weak End Infeed Logic	27WI												•
Power Swing Blocking / Out of Step Tripping	78												•
Earth Overcurrent Teleprotection Schemes	85/67N										•	•	•
Switch-on-to-Fault (SOTF)	50HS										•	•	•
<b>Monitoring</b>													
Circuit Breaker and Disconnecter Supervision		•	•	•	•	•	•	•	•	•	•	•	•
Tap Changer Supervision										•			
Transformer Protection Supervision								•	•	•			
Disturbance Recorder / Data-Logger / Measurements Load Diagram		•	•	•	•	•	•	•	•	•	•	•	•
Fuse Failure Supervision											•	•	•
Dead Line Supervision											•	•	•
Fault Locator		•	•	•							•	•	•

• - Base feature | ◐ - Supports only one of the functions, in the base feature

Functions		TPU 5420	TPU C420	TPU B420	TPU TD420	TPU TC420	TPU L420						
Control Functions	ANSI	I	C	S	C	S	F	I	R	S	D	R	S
Auto Reclosing	79	•	•	•								•	•
Load Shedding and Restoration after Voltage Trip				•		•	•						
Load Shedding and Restoration after Frequency Trip				•		•	•						
Load Restoration after Voltage Trip (centralized)			•		•		•	•	•				
Load Restoration after Frequency Trip (centralized)			•		•		•	•	•				
Synchro-check	25			•								•	•
Capacitor Time Schedule					•	•							
Circuit Breaker Close Lock	86				•	•							
Transformer Circuit Breaker Close Lock	86T							•	•	•			
Automatic Voltage Control										•			
Circuit Breaker Failure	62BF	•	•	•	•	•	•	•	•	•	•	•	•
Trip Circuit Supervision	62	•	•	•	•	•	•	•	•	•	•	•	•
Logical Trip Lock	68	•	•	•			•	•	•	•			
Trip Transfer	43	•	•	•	•	•	•	•	•	•	•	•	•
Distributed Automation		•	•	•	•	•	•	•	•	•	•	•	•
Analogue Comparators		•	•	•	•	•	•	•	•	•	•	•	•
Programmable Logic		•	•	•	•	•	•	•	•	•	•	•	•
<b>Communications</b>													
Front Serial Port to interface with WinProt		•	•	•	•	•	•	•	•	•	•	•	•
Back Serial Ports (RS232, RS485 or Fiber Optic)		•	•	•	•	•	•	•	•	•	•	•	•
Redundant 100BASE-FX Port for SCADA integration and to interface with WebProt or Automation Studio		○	○	○	○	○	○	○	○	○	○	○	○
IEC 61850 Protocol		○	○	○	○	○	○	○	○	○	○	○	○
DNP 3.0 Protocol		○	○	○	○	○	○	○	○	○	○	○	○
IEC 60870-5-104 Protocol		○	○	○	○	○	○	○	○	○	○	○	○
LonWorks Protocol (redundant)		○	○	○	○	○	○	○	○	○	○	○	○
<b>Others</b>													
Height x Width x Depth (mm)		265 x 250 x 210											
Weight (kg)		8											

• - Base feature | ○ - Optional feature

# Technical Description

## Communication Protocols

The high level of integration of the TPU 420 in SCADA systems allows an easy and fast connection to substations concentrator units as well as upstream hierarchical control centres. The supported protocols include:

- IEC 61850, implemented over an Ethernet network
- IEC 60870-5-104, implemented over an Ethernet network (optional redundancy)
- LonWorks (bidirectional ring)
- DNP 3.0, based on serial connection (RS232, RS485 or fiber optic networks)

## Programmable Logic

The logic scheme is completely programmable according to the IEC 61131-3 standard, based on the traditional logic functions (AND, OR and NOT) and advanced gate types (timers, delays and pulses). This design allows the implementation of programmable delays, additional interlocking to the control functions and other complex logical expressions. The user may change all internal connections within the module and interconnect the individual modules, as well the descriptions associated to each logical gate, the gate type, timers, the initial status, etc.

## Human Machine Interface (HMI)

The TPU graphical display can show: panel mimic, settings and recording menus, as well as the equipment state, alarm descriptions, analogue measurements and static information. There are 8 programmable alarms on the graphical display that can be associated to logic variables, alarm type and description. With function keys it is possible to control directly devices, select through the mimic a specific device and manoeuvre it. This user-friendly HMI offers straightforward control through the most frequent system occurrences and the access to all the protection settings and records stored in the TPU.



Our products		
Equipment	Application	Example
TPU 5420	<ul style="list-style-type: none"> <li>• Protection and Control Unit for MV Feeders (aerial and underground cable)</li> <li>• Protection and Control Unit for Dispersed Generation</li> <li>• Backup Protection and Control Unit</li> </ul>	
TPU C420	<ul style="list-style-type: none"> <li>• Protection and Control Unit for Capacitor Banks</li> <li>• Unbalance Protection for double-eyed Capacitor Banks</li> <li>• Reactive Power Control and Time Scheduling Control</li> </ul>	
TPU B420	<ul style="list-style-type: none"> <li>• Busbar Protection and Control Unit</li> <li>• Load Shedding and Restoration by Frequency operation (5 protection zones)</li> <li>• Load Shedding and Restoration by Voltage operation (2 protection zones)</li> </ul>	
TPU TD420	<ul style="list-style-type: none"> <li>• Protection and Control Unit for two winding Transformers</li> <li>• Differential Protection</li> <li>• Restricted Earth Fault Protection</li> <li>• Overcurrent Protection functions for both HV and MV sides</li> </ul>	
TPU TC420	<ul style="list-style-type: none"> <li>• Protection and Control Unit for two winding Transformers</li> <li>• Automatic Voltage Control and Tap Changer Operation Supervision</li> <li>• Overcurrent Protection functions for one stage of the Transformer</li> <li>• Restricted Earth Fault Protection</li> </ul>	
TPU L420	<ul style="list-style-type: none"> <li>• Protection and Control Unit for HV lines</li> <li>• Distance Protection (5 protection zones)</li> <li>• Teleprotection Schemes for Distance and Earth Directional Protection</li> <li>• Auto Reclosing and Synchro-check (optional)</li> </ul>	



Automation Business Unit

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