TELEPROTECTION SYSTEM

TYPE CTP-1

PRODUCT DESCRIPTION

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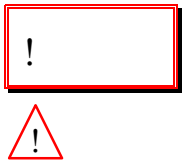
SAFETY SYMBOLS



WARNING OR CAUTION:

This symbol denotes a hazard. Do not follow the indicated procedure, operation or such like, it could mean a total or partial breakdown of the equipment or even injury to the personnel handling it.

NOTE:

Information or important aspects to take into account in a procedure, operation or such like.

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1 INTRODUCTION

1.1 GENERAL

The CTP-1 teleprotection system permits the two-way transmission of up to four teleprotection commands through a communication channel that can be analog or digital with electrical or optical interface.

The analog-channel line interface can operate using tones and can be used in any 4 kHz channel as, for example, Power-Line Carrier links over high-voltage lines, telephone cables, radio links, etc.

The digital-channel line interface can be electrical at 2 Mbit/s or 64 kbit/s according to Recommendation G.703 of the ITU-T, and at 64 kbit/s according to Recommendations V.11 and V.35 of the ITU-T. The optical interface works at a speed of 64 kbit/s.

The commands can be used for blocking, permissive and direct tripping teleprotection schemes, achieving in each case an optimal combination of security, dependability and transmission time, as well as in telesignalling systems.

CTP-1 terminals can be fully programmed from a standard web browser installed in a computer connected to the CTP-1 terminal via USB interface. The browser accesses a web server that stores all the necessaries HTML pages for the configuration of the system. The web server is installed in the management computer by means of the CD-ROM supplied with each terminal.

Once the web server is installed, it is not only possible to program all the operating parameters from the web browser, but also to supervise any CTP-1 terminal of a link and collect information relating to system state.

The CTP-1 terminals chronologically register all the alarms and events produced in a link. This chronological register of alarms and events of the CTP-1 terminals is carried out based on its internal real time clock, being able to synchronize it with the GPS system by means of an IRIG-B interface.

The elements necessary for external connection are included in the equipment itself. However, if one wishes the external connection to be carried out through a cabinet-mounting terminal block, it can be supplied upon request together with the necessary cables.

The CTP-1 terminals comply with Recommendation IEC 60834-1, which concerns teleprotection systems, and also with the standards ANSI C37.90.1 and ANSI C37.90.2.

1.2 TERMINAL MODELS

The CTP-1 terminal is configured at factory according to an specific parameters, these being: the line-interface type, the teleprotection command number, and the number of additional auxiliary outputs for signalling and/or alarm.

There are four different line-interface types: analog, digital at 64 kbit/s, digital at 2 Mbit/s and optical at 64 kbit/s. The modules required in each case are indicated in TABLE 1, and described in the following section. On the other hand, the connectors for external connections associated to each interface can be seen in FIGURE 6 to FIGURE 9, respectively.

TABLE 1 CTP-1 terminal models

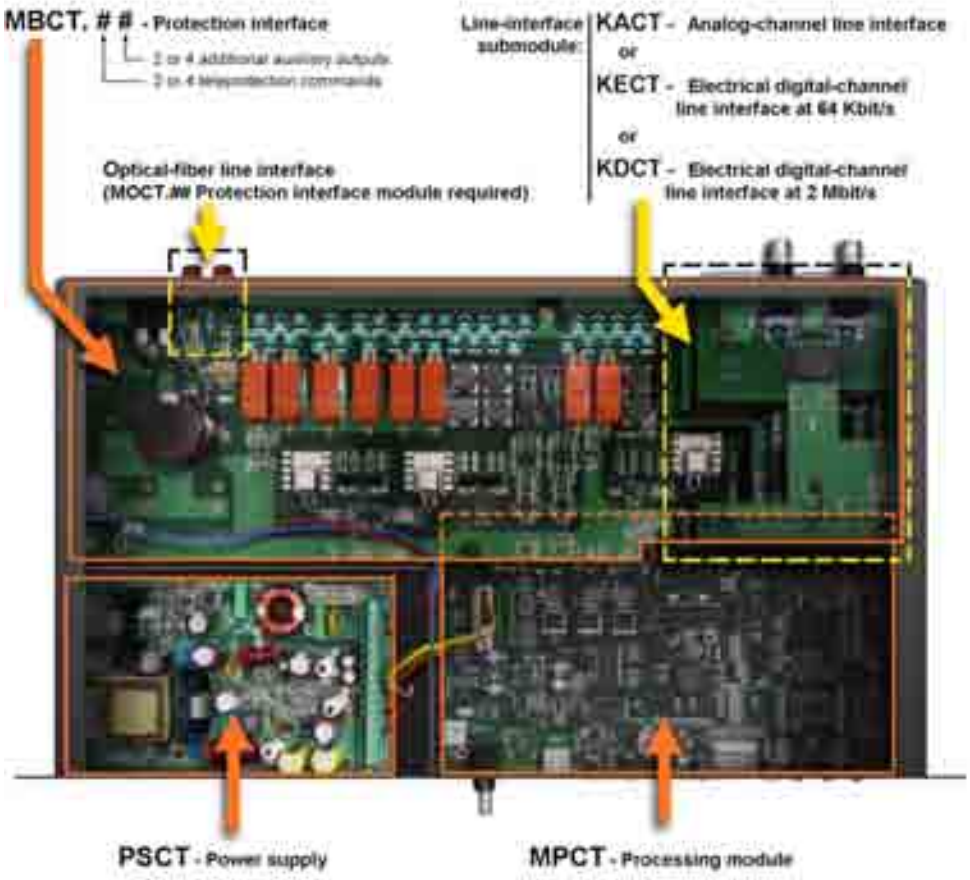
	Teleprotection commands	
	1 or 2	**3 or 4**
Analog interface	MBCT.2# + KACT	MBCT.44 + KACT
Electrical interface at 64 kbit/s	MBCT.2# + KECT	MBCT.44 + KECT
Electrical interface at 2 Mbit/s	MBCT.2# + KDCT	MBCT.44 + KDCT
Optical interface at 64 kbit/s	MOCT.2#	MOCT.44

1.3 MODULE DESCRIPTION

The CTP-1 is a small-sized terminal of 2 s.u. high where all the basic operating elements are contained in three main modules, these being: a power supply (PSCT), a processing unit (MPCT) and a protection interface (MBCT or MOCT).

The arrangement of the modules inside the shelf is shown in FIGURE 1.

FIGURE 1 CTP-1 module arrangement



The MBCT module incorporates the line-interface submodule. The KACT submodule is associated to the analog-channel line interface, the KECT submodule to the electrical digital-channel line interface at 64 kbit/s, and the KDCT submodule to the electrical digital-channel line interface at 2 Mbit/s. The optical interface at 64 kbit/s requires the MOCT type protection-interface module.

It is **NOT** possible to have an optical interface and a line-interface submodule at the same time.

PSCT.## POWER SUPPLY

This module contains the DC/DC converter that generates the internal power-supply voltages from the input voltage. The filter to suppress disturbance caused by fast transient bursts is located in the MBCT module.

The type of module depends on the nominal input voltage.

PSCT.00 Input voltage of 48 V_{DC}

The power supply is protected against polarity inversion.

MPCT.## PROCESSING MODULE

It contains the system programming circuits and manages the information specially associated to teleprotection, as well as the communication channel.
It includes the USB interface, a microcontroller, a Digital Signal Processor (DSP), and a decoder capable of processing, according to IRIG-B standard, signals coming from an external synchronization equipment.

The type of module depends on the communication channel type.

MPCT.00 Version for an analog-channel line interface (KACT submodule).

MPCT.01 Version for a digital-channel line interface at 64 kbit/s, electrical (KECT submodule) or optical (MOCT).

MPCT.02 Version for an electrical digital-channel line interface at 2 Mbit/s (KDCT submodule).

MBCT.## PROTECTION INTERFACE

It contains the power-supply filter to suppress disturbance caused by fast transient bursts.

It also contains the input and output circuits for up to four commands (commands A to D for an analog channel and commands 1 to 4 for a digital channel), made up of up to four optocoupled inputs (I1 to I4), up to four command outputs (O1 to O4), up to four basic auxiliary outputs for signalling and/or alarm, configurable by the user, and two or four additional auxiliary outputs for signalling and/or alarm, configurable by the user.

In this way, the type of module depends on the number of teleprotection commands and on the number of auxiliary outputs for signalling and/or alarms.

The following types are available:

MBCT.22 Two teleprotection commands, two basic auxiliary outputs (IPCT-1 connector) and two additional auxiliary outputs (IRCT-1 connector).

MBCT.24 Version upon request. Two teleprotection commands, two basic auxiliary outputs (IPCT-1 connector) and four additional auxiliary outputs (IRCT-1 connector).

MBCT.44 Four teleprotection commands, four basic auxiliary outputs (IPCT-1 & IPCT-2 connectors) and four additional auxiliary outputs (IRCT-1 connector).

Depending on the line-interface type, the MBCT module can house one of the following submodules:

KACT.00 Analog-line interface

The KACT submodule contains a power-boosting relay and an auxiliary relay for signalling or alarm, which can be configured by the user.

This submodule is able to transmit and receive up to four commands according to a specific logic, in the 0 to 4 kHz band, by means of 4 wire connections.

The MPCT module generates the guard and command tones and implements a bank of filters for the reception of commands.

KECT.00 Digital-line interface at 64 kbit/s

This submodule is prepared to work as an interface circuit at 64 kbit/s in accordance with Recommendation G.703 and at 64 kbit/s in accordance with Recommendations V.11 and V.35 of the ITU-T.

KDCT.00 Digital-line interface at 2 Mbit/s

This submodule is prepared to work as an interface circuit at 2 Mbit/s in accordance with Recommendation G.703 of the ITU-T with codirectional clock.

MOCT.## PROTECTION INTERFACE & OPTICAL-FIBER LINE INTERFACE
This module is used with a single-mode optical fiber.

As in the MBCT, the type of module depends on the number of teleprotection commands and on the number of auxiliary outputs.

The following types are available:

MOCT.22 Two teleprotection commands, two basic auxiliary outputs (IPCT-1 connector) and two additional auxiliary outputs (IRCT-1 connector).

MOCT.24 Version upon request. Two teleprotection commands, two basic auxiliary outputs (IPCT-1 connector) and four additional auxiliary outputs (IRCT-1 connector).

MOCT.44 Four teleprotection commands, four basic auxiliary outputs (IPCT-1 & IPCT-2 connectors) and four additional auxiliary outputs (IRCT-1 connector).

1.4 LOCAL MANAGEMENT SYSTEM BASED ON A WEB INTERFACE

The CTP-1 terminals of a link are managed from a web browser installed in a PC connected to one of the terminals via interface USB.

In order for the web browser to configure and supervise any of the parameters of the CTP-1 terminals of a link it is only necessary to install, in the same management PC, the web server containing all the web pages necessary for the management of the system. The web server is installed in the management PC by means of the CD-ROM supplied with every CTP-1 terminal. The CD-ROM also contains an off-line version of the web server for use in those cases where connection to the terminal is not possible. It allows the configuration of the terminal to be carried out in the computer, save it as a file and load it in the terminal when connection is possible.

The user can access the home web page of the Management System by entering the IP address ***(http://localhost:50900)*** of the CTP-1 web server installed in the management computer, once authorisation is gained by means of the user password, which comprises a user identification and a password.

By default, the system has two created user profiles, one basic and the other administrator, whose user identifications and passwords can be seen in TABLE 2. Each one has different management capacities, whilst the administrator user being able to modify and supervise any parameter of the terminal, the basic user can only retrieve or supervise the parameters of the terminal, and is unable to alter its operation at any time.

TABLE 2 Default user passwords of the system

	User identification	Password
Basic User	basic	basic
Administrator User	admin	admin

2 OPERATIONAL DESCRIPTION

This section describes the main aspects relating to the operation principles of the CTP-1 terminal, it explains the test mechanisms available in the terminal and, lastly, it explains how to carry out the time synchronization.

The operation principle of a CTP-1 terminal is based, on the one hand, on the communication with a protection terminal within the same substation and, on the other hand, on the communication with its collateral CTP-1 terminal, that is to say, the terminal at the other end of the link, to be able to transmit a command signal.

The communication between a CTP-1 terminal and its collateral can be carried out by means of a communication channel that can be analog or digital with electrical or optical interface.

2.1 COMMAND TRANSMISSION PROCEDURE

The user can assign the inputs to any of the possible commands to be transmitted (commands A to D for an analog channel and commands 1 to 4 for a digital channel) from the Management System. The nominal activation voltage of the inputs is configurable by means of jumpers. Should more than one input be assigned to the same command, the logic that must be fulfilled in order for the CTP-1 to transmit the command to the CTP-1 terminal at the other side of the link, must be programmed. This logic can be:

- All the inputs associated to the command active (logic AND).
- One of the inputs associated to the command active (logic OR).

When the MPCT processing module detects, according to the programmed logic (AND, OR), that one or various teleprotection commands exist, it manages the information towards the line interface so that it can transmit the corresponding teleprotection signal.

Command transmission is signalled on the front plate by means of the corresponding Tx LED. Furthermore, the corresponding signalling relay is also activated if it has been programmed.

From the Management System, it is possible to slow down command transmission process by means of an additional timing, as well as program the duration of the transmission of each command.

Analog channel

When the line interface is for an analog channel, the MPCT module transmits the guard and command signals. In quiescent conditions the transmitter continuously transmits a guard signal, which is replaced by a command tone when a command needs to be sent.

The receiver has a maximum of eight filters for all the command frequencies so that, from one to three commands, can be transmitted and received independently or any combination of them. However, with four commands, as there are fifteen possible command combinations, it is necessary to establish a logic, which is indicated in TABLE 3, in order to determine the command tone that should be transmitted for each of the different input combinations. The logic can be programmed in three different ways named Mode 2+2, Mode 3+1 (1) and Mode 3+1 (2).

Mode 2+2 allows the simultaneous protection of two lines by means of two permissive trips (C and D) and two direct trips (A and B) which have priority over the permissive ones.

Mode 3+1 allows the simultaneous protection of the three phases of a line by means of three permissive trips (A, B and C) and a direct trip (D) which has priority. The difference between the two versions of the Mode 3+1 is in the command tone that is transmitted for each of the different input combinations associated to the permissive trips.

On the other hand, the CTP-1 terminal can be programmed to increase the output power above the nominal level during the transmission of a command signal, being the output maximum level of 0 dBm (including the power boosting). Each time a command signal is transmitted, the terminal signals the power-boosting situation by means of the contacts of a relay. Power-boosting, therefore, can be effected directly in the CTP-1 terminal, or the order can be delivered to the transmission equipment, by means of the CTP-1 power-boosting relay, for the transmission equipment to carry out the power-boosting facility. It must be taken into account that the output nominal level of the CTP-1 terminal should be equal to the input nominal level of the transmission equipment.

TABLE 3 Logic of the transmission tones for four commands

INPUT COMMANDS	MODE 2+2	MODE 3+1(1)	MODE 3+1(2)
A	f(A)	f(A)	f(A)
B	f(B)	f(B)	f(B)
C	f(C)	f(C)	f(C)
D	f(D)	f(D)	f(D)
A+B	f(A+B)	f(A+B)	f(D)
A+C	f(A)	f(A+C)	f(D)
A+D	f(A+D)	f(D)	f(D)
B+C	f(B+C)	f(B+C)	f(D)
B+D	f(B)	f(D)	f(D)
C+D	f(C+D)	f(D)	f(D)
A+B+C	f(A+B)	f(A+B+C)	f(D)
A+B+D	f(A+B)	f(D)	f(D)
A+C+D	f(A+D)	f(D)	f(D)
B+C+D	f(B+C)	f(D)	f(D)
A+B+C+D	f(A+B)	f(D)	f(D)

Digital channel

When the line interface is for a digital channel it generates a frame with the corresponding information at 64 kbit/s. One of the bytes of the frame contains the teleprotection information (byte COMMANDS).

Each one of the bits of the COMMANDS byte corresponds to a teleprotection command (commands 1 to 4) in such a way that the presence of the command is transmitted with the corresponding bit in state "1".

As well as the teleprotection information the said frame contains other information such as transmitter identification, internal communication-channel messages, and so on.

The CTP-1 terminal allows the communication through electric lines at 2 Mbit/s or 64 kbit/s according to Recommendation G.703 of the ITU-T and at 64 kbit/s according to Recommendations V.11 and V.35 of the ITU-T. It also allows the communication through optical fiber links at 64 kbit/s.

2.2 COMMAND RECEPTION PROCEDURE

The teleprotection signal is received in the line interface. Command reception is signalled on the front plate by means of the corresponding Rx LED.

When a command output relay (or relays) is activated, the corresponding signalling relay is also activated if it has been programmed.

The time during which the command output relay (or relays) should remain active can be specified from the Management System.

Analog channel

The signal coming from the line follows different paths depending on whether it is a guard signal or command signal. The guard signal is digitized, and the command signal is subjected to a non-linear process before being band-limited and digitized.

The digital signal processor (DSP) implements up to nine filters, which correspond to the guard tone and to the eight possible command tones. The central frequency and bandwidth of these filters are defined by the user when carrying out programming of the equipment.

With respect to the command-reception process, the disappearance of the guard tone initiates a temporary window during which the reception of a command signal is awaited. If the window time expires without a re-established guard signal or a command signal having been received, an internal blocking signalling is generated.

The internal blocking signalling blocks the outputs and generates the blocking alarm and the signal loss alarm. It also activates the relay programmed for receiver blocking alarm, except when there is an additional timing programmed for the relay. On the other hand, when the operating mode in reception named unblocking is configured for all the commands, the possibility of signalling the said function by means of a programmable relay exists. The unblocking signalling relay activates when the internal blocking signalling is generated, except when there is an activation delay programmed for the relay. The activation time of the unblocking relay can also be programmed by the user. When the said time has elapsed, the unblocking relay deactivates although the internal blocking signalling remains active.

Digital channel

In reception, the function of the line interface is to decode the frame received in line. Before carrying out the said process, it should be verified that the frame received is correct (length, error-detection code and fixed sequence). If it is detected that the value of the identification code does not coincide with that assigned to the terminal in reception, or the security identification code (SIC) received does not coincide with that expected, the optical indicator SYNCHRONISM lights up in amber on the front plate.

Each bit of the COMMANDS byte is stored in a shift register, which is given the name window. The length of the window is the number of teleprotection information bytes that must be analyzed to detect a command signal. The length of the register is variable and its value is determined from the Management System independently for each command.

The decision threshold is the number of teleprotection information bytes, with command signal, that must be received correctly within the length of the window for the command to be executed. As for the window, its value is determined from the Management System, independently for each command.

When the line module detects that the number of "1" bits contained in the window is the same as that of the prefixed number for the threshold, it manages the information towards the processing module so that it, as long as this situation is not due to a remote test starting locally or the terminal is blocked, can proceed to activate the corresponding output combination, that is to say, command output relay (or relays).

The command finishes when the number of "1" bits contained in the window is lower than the threshold and the number of "0" bits is greater. Should there be an equal quantity of "1" bits and "0" bits, the "1" bits have preference and the command therefore remains active.

In order to avoid the execution of a command being interrupted by transmission errors, incorrect messages are not taken into account. In this case, the shift register remains stable.

The quality of the received signal is established with regard to the bit error rate (BER) of the channel. The programming of the BER alarm is carried out by configuring the activation and deactivation thresholds (from $1x10^{-2}$ to $0.5x10^{-9}$ in 0.5 steps) from the Management System.

2.3 TELESIGNALLING

When the terminal is working in telesignalling mode, whenever the receiver detects the presence of a command signal and considers it to be valid, the corresponding command-output relay is activated. In telesignalling on the other hand, in order for a command to be accepted, it is not necessary for the guard signal to have been present, and should it exist, after it has disappeared there is no temporary window of command reception.

When a command signal is validated, as well as energizing the corresponding command-output relay, the same actions are carried out as in teleprotection mode, that is to say, reception of the command is stored in the chronological register of the teleprotection system, the associated command-reception LED illuminates, whilst the received-command counter (to be displayed from the Management System) is increased and, if programmed, the corresponding signalling relay is activated. However, end of command transmission and command reception is also stored in the chronological register of the teleprotection system, which is not the case in teleprotection mode.

Telesignalling calls for a determined configuration. In the terminal programmed for telesignalling, it must be specified that the activation time of each command-output relay be the same as that of command reception, and the terminal at the other end of the link must be programmed so that command transmission takes place while the command is present at the input. In telesignalling mode therefore, each command output is a true reflection of the state of the command inputs corresponding to the remote terminal.

It is possible to choose telesignalling although the other direction of the link is being used as teleprotection. However, in the direction programmed as telesignalling it is not possible to program other commands as teleprotection.

In telesignalling mode, whatever the reason for the blocking situation may be, the receiver is unblocked immediately when a signal is received, be it guard or command.

2.4 TEST DEVICES

In order to facilitate alignment and maintenance operations, as well as fault finding, the CTP-1 Management System allows different tests and loops to be carried out. These are described below.

> The Alignment help menu contains an option which allows the terminal to be blocked in order not to allow it to activate any output, when it receives a command. In this way, depending on the type of test or loop one wishes to carry out, it is first necessary to program a **blocking**.

2.4.1 Transmission of commands

From the *Alignment help* menu, it is possible to force the activation of the transmission of the desired command. The activation can be forced for a determined period or, if desired, permanently.

The equipment will indicate the transmitted commands by means of the corresponding LEDs.

From the *Monitoring* menu it is also possible to monitor the transmitted commands and consult the command transmission counters.

> Before carrying out a test of this type, the command transmission should be suitably treated in order to make sure that no undesired output activation takes place in the remote terminal or in the terminal itself if a loop has been established.

2.4.2 Input activation

From the *Alignment help* menu, it is possible to force the activation of the inputs and check whether the activation has initiated the transmission of the desired command.

The activation of the inputs can be forced for a determined period or, if desired, permanently. Once the activation is programmed, from the *Monitoring* menu, it is possible to verify whether the input activation has produced the transmission of the desired command.

From the *Monitoring* menu, it is also possible to monitor the state of the inputs and consult the counter of number of activations associated to each one of them.

Before carrying out a test of this type, the command transmission should be suitably treated in order to make sure that no undesired output activation takes place in the remote terminal or in the terminal itself if a loop has been established.

2.4.3 Local loop

The Alignment help menu of the CTP-1 Management System contains an option that allows a local loop to be programmed in the terminal, in such a way that the local transmitter remains connected to the local receiver.

The loop, therefore, allows the correct transmission and reception of the command to be verified, on a local level, and the correct operation of the output logic established for each command received. It must be borne in mind, however, that as the terminal is disconnected from the line, the loop will not function correctly in those cases where the clocks coming from the line terminal are required.

When the terminal is in loop, the optical indicator LOOP/TEST OK on the front plate lights up in amber.

The loop can be programmed for a pre-fixed duration, or can be established permanently until the programming to deactivate is not given. Once the loop is established, the activation of the inputs can be forced by means of the corresponding option of the Alignment help menu.

Before carrying out the loop, the command outputs of the terminal should be suitably treated in order to make sure that no undesired output activation take place.

2.4.4 Local test in analog line interface

The CTP-1 Management System contains an option that allows a local test to be carried out. This test can also be automatic when the specified time has elapsed.

The test consists of the transmitter sequentially sending the command tones programmed in the receiver to its own receiver without being interrupted by the sending of the guard signal to the collateral terminal. The receiver processes the received test tones in the same way that it does when receiving a command tone from the collateral terminal. If the receiver correctly identifies all the test signals, the test is correct.

The result of the test is shown by means of the optical indicator LOOP/ TEST OK on the front plate. When correct it lights up in green and when not, in red.

The terminal under test continuously supervises the reception of the guard signal from the other terminal and awaits the possible input of commands from its protection-side interface. This allows the test to be aborted and the transmission or reception of a real command to be attended to if necessary.

2.4.5 Local test in digital line interface

The CTP-1 Management System contains an option that allows a local test to be carried out. This test can also be automatic when the specified time has elapsed.

The test consists of sending a series of frames from the local terminal to the collateral terminal, with the fixed sequence modified, in which all the bits of the COMMANDS byte contain a command. The remote terminal must identify correctly all the commands and, if so, send a message indicating that the result of the remote test is correct to the local terminal by means of the service channel.

This test, therefore, allows the quality of the link to be verified periodically.

The result of the test is shown by means of the optical indicator LOOP/TEST OK on the front plate. When correct it lights up in green and when not, in red.

2.5 TIME SYNCHRONIZATION

The TPU-1 terminal chronologically registers all the alarms and events produced in the teleprotection link. In order to establish the date and time the alarms and/or events are produced, the CTP-1 terminal has a real time clock, which can be synchronized with the GPS system.

When time synchronization is established in the terminal, the CTP-1 refers its internal real time clock to the UTC[(1)] system, estimating in this way the UTC time by which it can calculate the UTC time (also known as GMT) in other zones of the world. In this case, the UTC time will always remain as a model of the internal clock of the terminal, even against any date and time programming carried out by the user.

[(1)] UTC is not really an abbreviation but a variant of universal time (*UT*) and the C of "coordinated" is added to show that it is another variant of UT.

The CTP-1 terminal can synchronize its real time clock with the time reference given by the GPS system. In order to do so, the time day, month and year must be programmed in the CTP-1 terminal and must then be connected to a GPS receiver that has a timing output, which must be an IRIG-B output. IRIG-B standard establishes the format of signals used to identify specific instants of time.

The CTP-1 terminal is capable of processing standard IRIG-B 123 signals, in which the signal is modulated in amplitude at 1 kHz, and standard IRIG-B 003 signals, in which the signal is modulated by pulses.

3 MECHANICAL CHARACTERISTICS

The CTP-1 is a small-sized terminal where all the basic operating elements are contained in only three main modules that are integrated in a single 2 s.u. high shelf for mounting in a 19" rack.

FIGURE 2 shows the overall dimensions in mm of the shelf as well as the position of the fastening holes.

The shelf features two built-in endplate angles in order to secure the equipment to the frame of a cabinet or wall cabinet. These built-in endplate angles are located on each side of the shelf and are at the same level as the front panel.

> The shelf has various ventilation grids, one at the front, one at each side and three at the top.
> During installation it must be made sure that the ventilation grids are **NOT** obstructed in any way.

Should it be necessary to extract the shelf top cover, see *Appendix B*.

As can be seen in a detail in FIGURE 3, the 2 s.u. back panel possesses earth-connection screws that must be used to connect the earth of each cable.

FIGURE 2 Overall dimensions in mm of the CTP-1 terminal

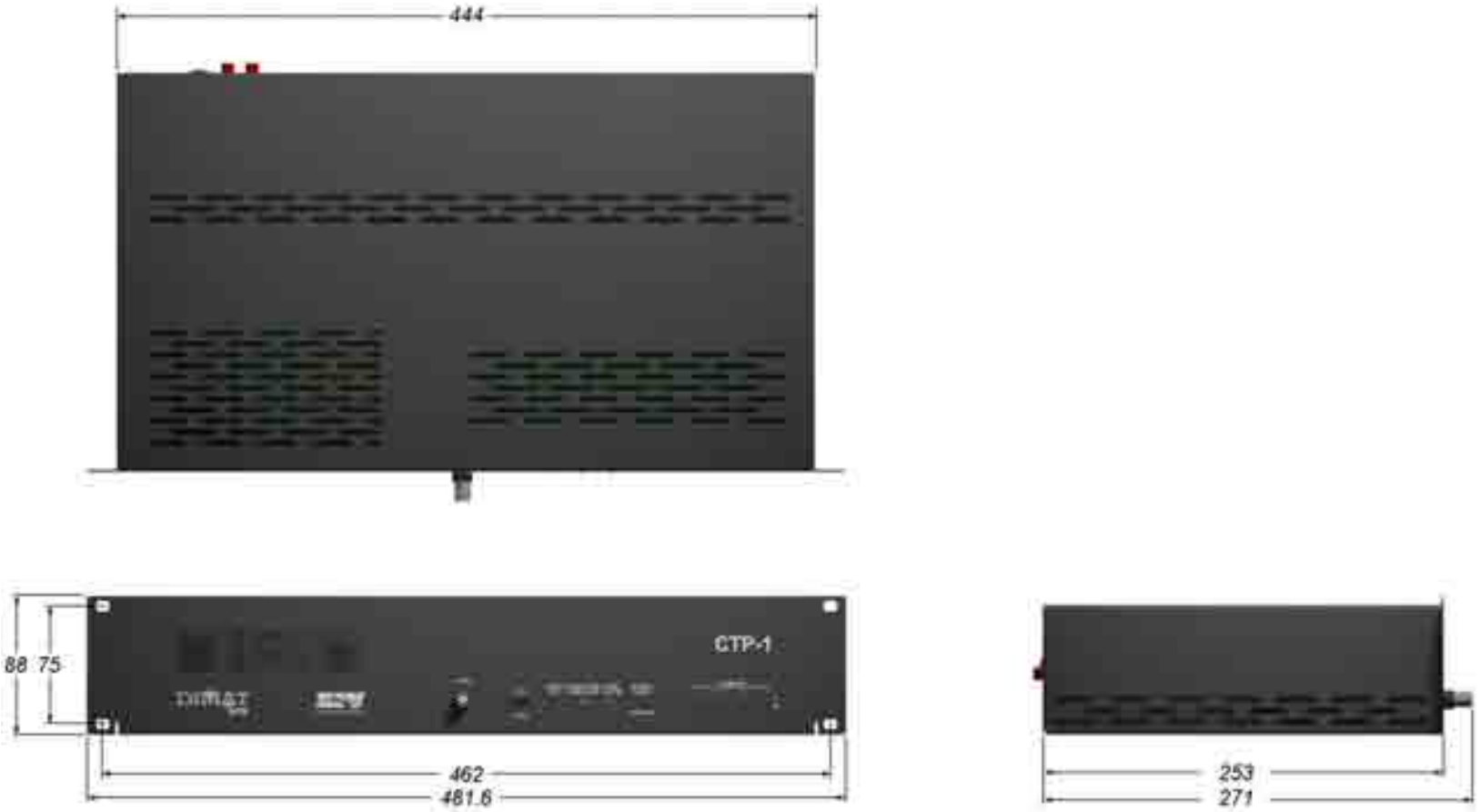
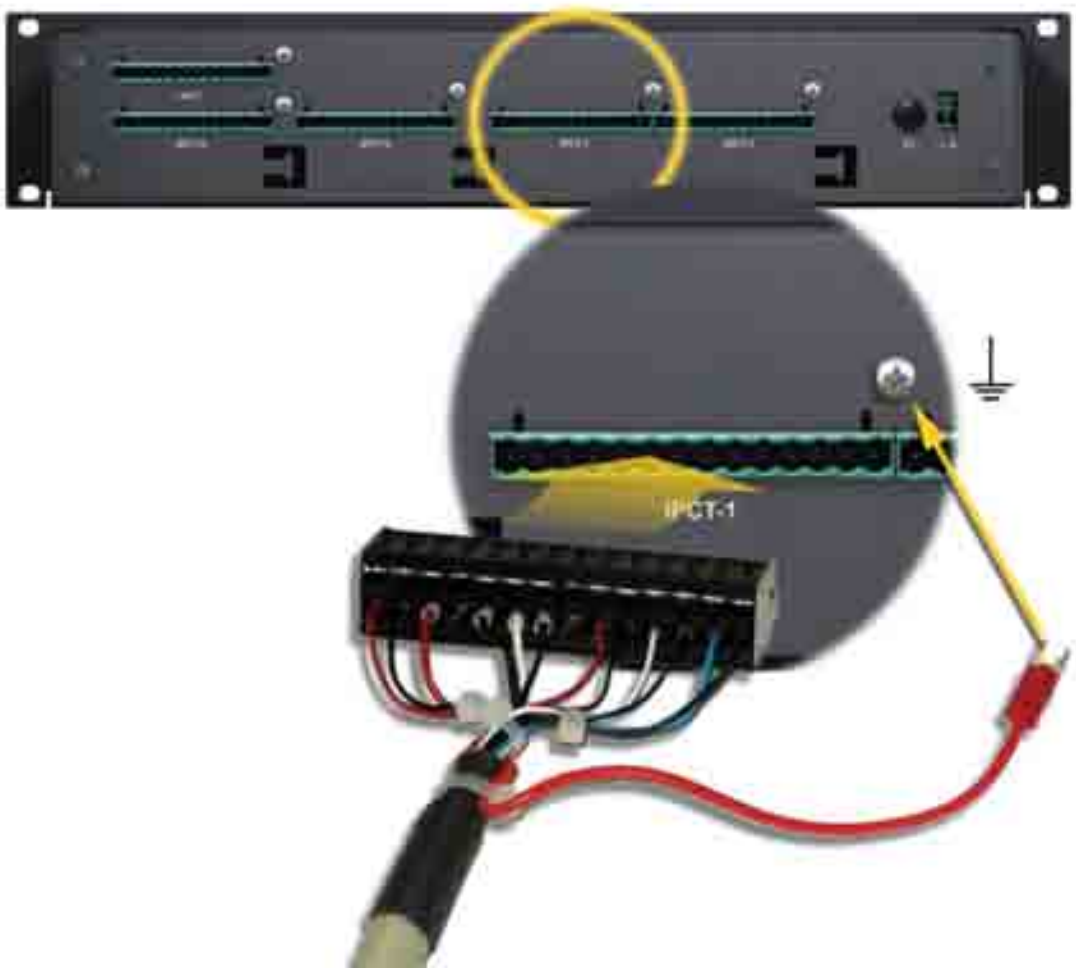


FIGURE 3 Detail of the earth-connection screws



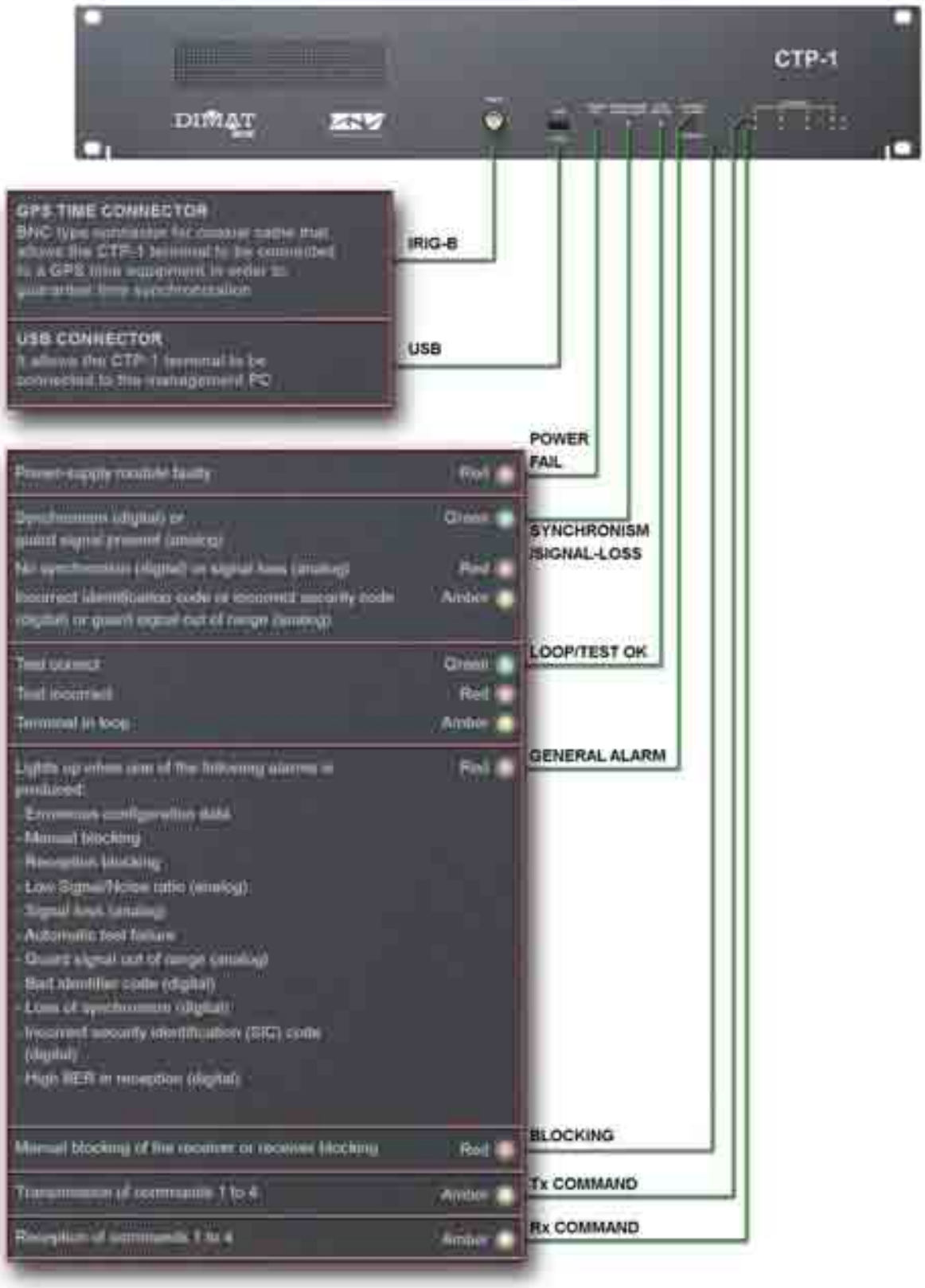
4 FRONT-PLATE ELEMENTS

The front plate of the CTP-1 terminal contains thirteen LEDs and two connectors, the function of which is detailed in FIGURE 4.

Optionally, the CTP-1 front plate can include transmitted and received command counters.

! ***Terminal reset*** is carried out from the corresponding option of the ***Management System***.

FIGURE 4 Function of the front-plate elements



5 INTERNAL SETTINGS

The CTP-1 internal settings are configured at factory according to user requirements. Should it be necessary to modify jumper configuration, it is first necessary to access the CTP-1 modules (see *Appendix B*).

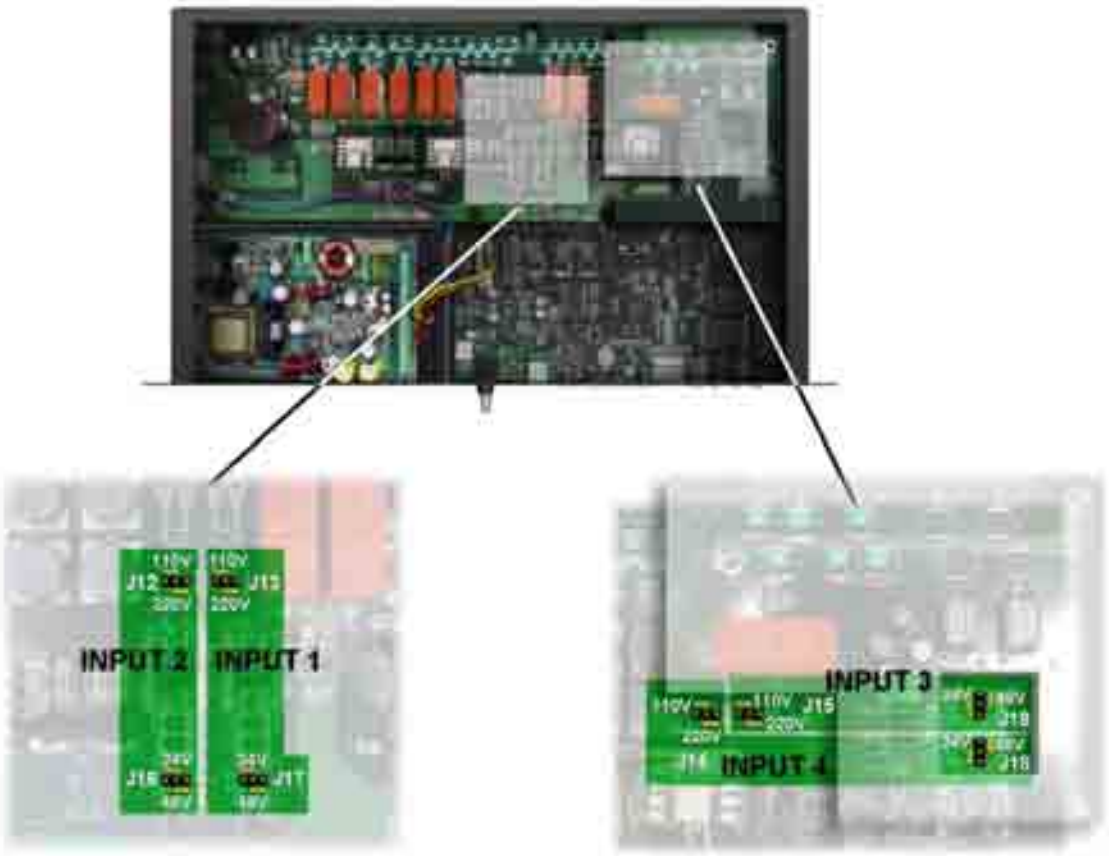
The activation of the command-input circuits (I1 to I4) can be established, by means of jumpers, for a nominal voltage of 24, 48, 110 or 220 V_{DC}.

Once the nominal voltage has been established, the minimum voltage that guarantees the input activation is 19 V_{DC} for 24 V_{DC}, 38 V_{DC} for 48 V_{DC}, 88 V_{DC} for 110 V_{DC} and 176 V_{DC} for 220 V_{DC}, and the maximum voltage that guarantees NO input activation is 14 V_{DC} for 24 V_{DC}, 29 V_{DC} for 48 V_{DC}, 66 V_{DC} for 110 V_{DC} and 132 V_{DC} for 220 V_{DC}.

FIGURE 5 shows the position of the input-activation nominal-voltage configuration jumpers in the MBCT module.

! Under **NO** circumstances must the maximum operating voltage be exceeded, being: 29 V_{DC} for 24 V_{DC}, 58 V_{DC} for 48 V_{DC}, 132 V_{DC} for 110 V_{DC} and 264 V_{DC} for 220 V_{DC}.

FIGURE 5 Input-activation nominal-voltage configuration jumpers of the MBCT module



6 EXTERNAL CONNECTIONS

The input and output of signals is carried out by means of the connectors located at the rear of the 2 s.u. shelf. If desired, the necessary cables can also be supplied on request.

The type and number of connectors depends on the CTP-1 terminal model. FIGURE 6 to FIGURE 9 show the four models available.

If one wishes the external connections to be carried out through a cabinet-mounting terminal block, it can be supplied on request, see Appendix A, together with the necessary cables.

The use of each of the connectors is detailed in FIGURE 10 to FIGURE 16.

> The use of the IPCT connectors depends on the number of teleprotection commands. For one or two commands, IPCT-1 connector is only used. From three or four commands, both connectors, IPCT-1 and IPCT-2, are used.
>
> The IRCT-1 connector is associated to the additional auxiliary relays, two or four. It must be born in mind that each IPCT connector has two basic auxiliary relays associated to it, and that the KACT submodule has one signalling relay associated to it.

The earth connection of each cable must be connected to the corresponding earth-connection screw, see FIGURE 3.

FIGURE 6 Terminal connectors for external connections when the line interface is analog

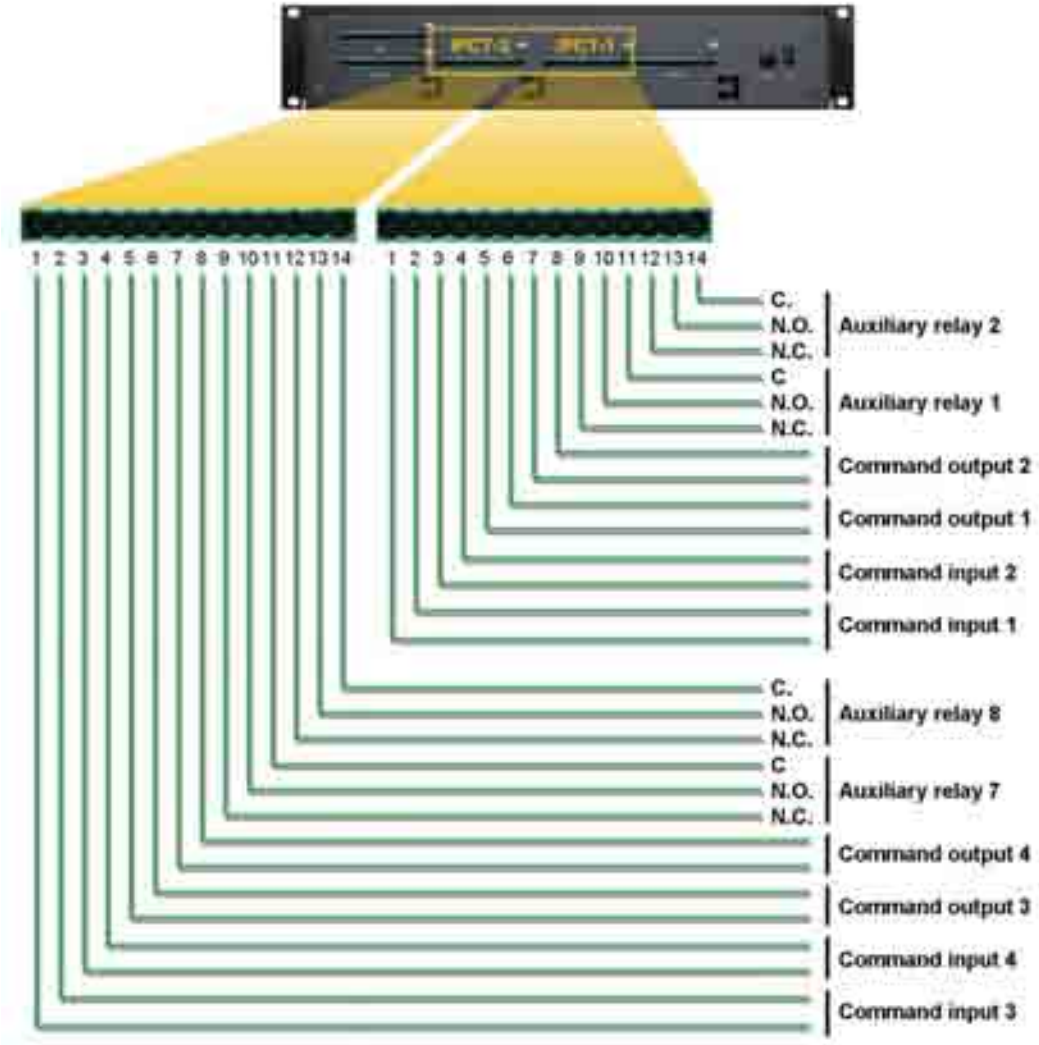
FIGURE 7 Terminal connectors for external connections when the line interface is digital at 64 kbit/s

FIGURE 8 Terminal connectors for external connections when the line interface is digital at 2 Mbit/s

FIGURE 9 Terminal connectors for external connections when the line interface is optical at 64 kbit/s

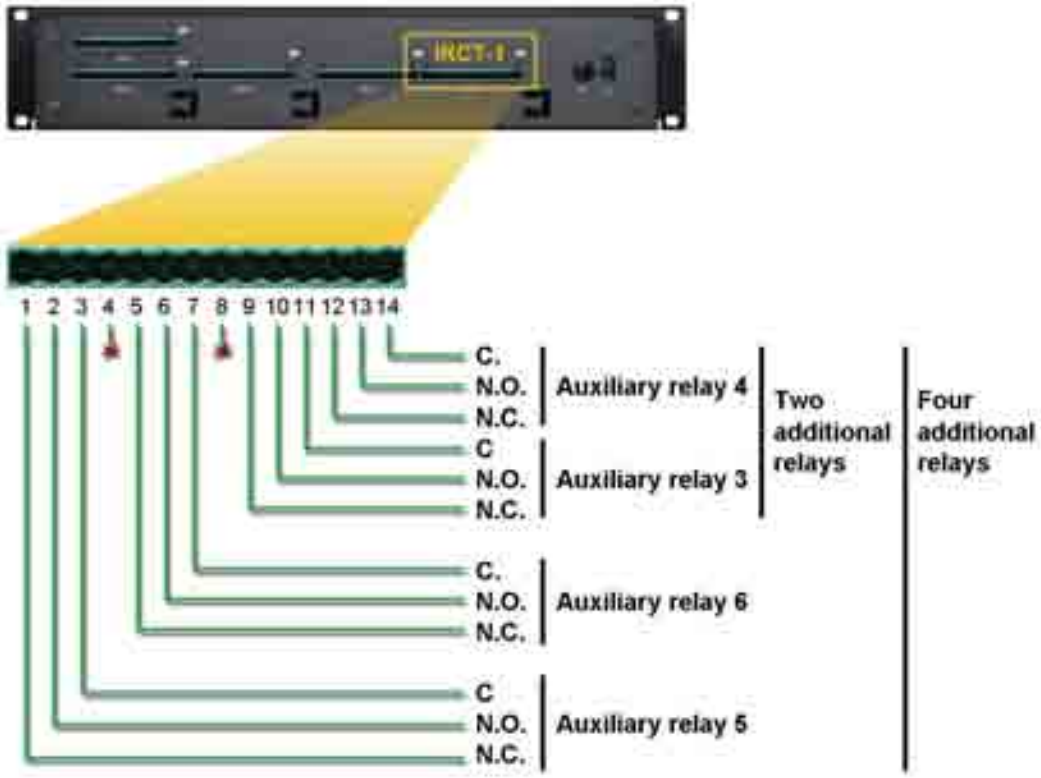
FIGURE 10 Power supply

FIGURE 11 Command input/output and basic auxiliary relays (IPCT-1 and IPCT-2 connectors)



In normal operation conditions the auxiliary relays are energized, that is to say, the N.O. and C contacts are short-circuited.

FIGURE 12 Additional auxiliary relays (IRCT-1 connector) (*)



(*) IRCT-2 connector is not used. It is for future use, and is intended for one or two additional auxiliary relays

In normal operation conditions the auxiliary relays are energized, that is to say, the N.O. and C contacts are short-circuited.

FIGURE 13 Analog line-interface connector

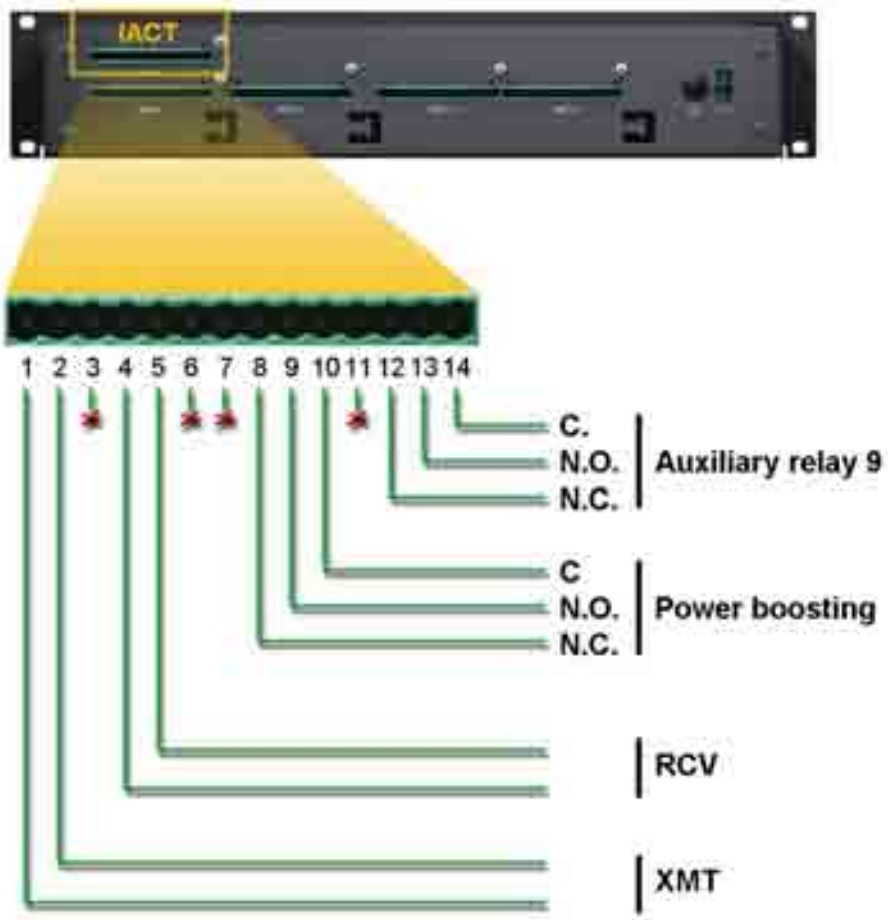
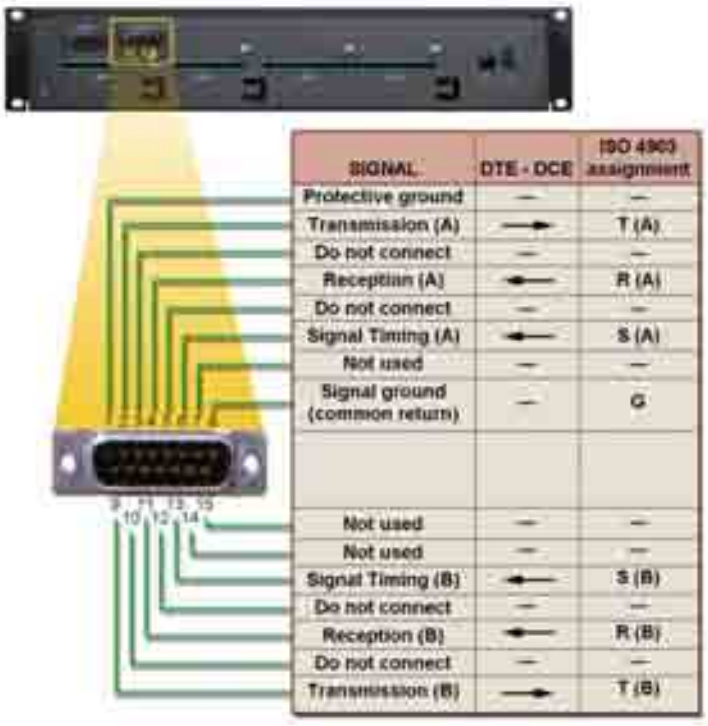
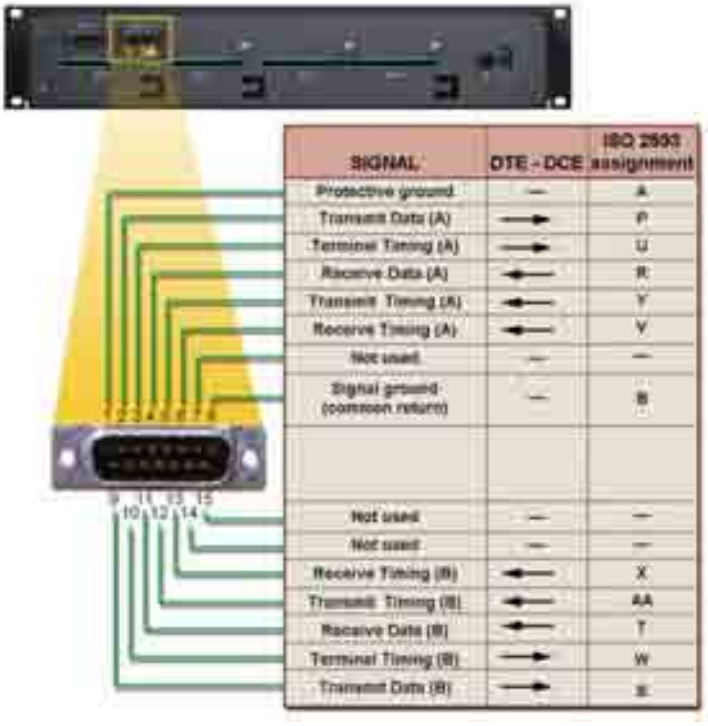


FIGURE 14 Electrical digital-line interface at 64 kbit/s connectors



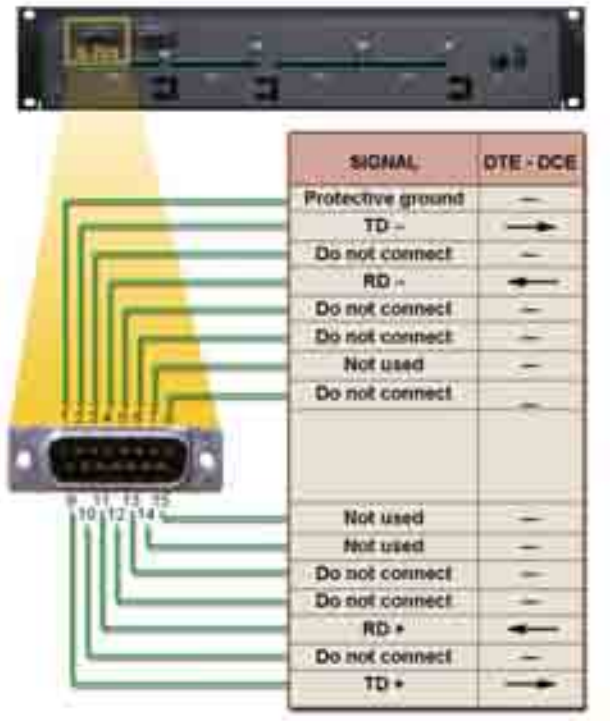
SIGNAL	DTE - DCE	ISO 4903 assignment
Protective ground	—	—
Transmission (A)	→	T (A)
Do not connect	—	—
Reception (A)	←	R (A)
Do not connect	—	—
Signal Timing (A)	←	S (A)
Not used	—	—
Signal ground (common return)	—	G
Not used	—	—
Not used	—	—
Signal Timing (B)	←	S (B)
Do not connect	—	—
Reception (B)	←	R (B)
Do not connect	—	—
Transmission (B)	→	T (B)

a) Assignation of pins for the V.11 interface



SIGNAL	DTE - DCE	ISO 2593 assignment
Protective ground	—	A
Transmit Data (A)	→	P
Terminal Timing (A)	→	U
Receive Data (A)	←	R
Transmit Timing (A)	←	Y
Receive Timing (A)	←	V
Not used	—	—
Signal ground (common return)	—	B
Not used	—	—
Not used	—	—
Receive Timing (B)	←	X
Transmit Timing (B)	←	AA
Receive Data (B)	←	T
Terminal Timing (B)	→	W
Transmit Data (B)	→	S

b) Assignation of pins for the V.35 interface



c) Assignation of pins for the codirectional G.703 interface

FIGURE 15 Electrical digital-line interface at 2 Mbit/s connectors

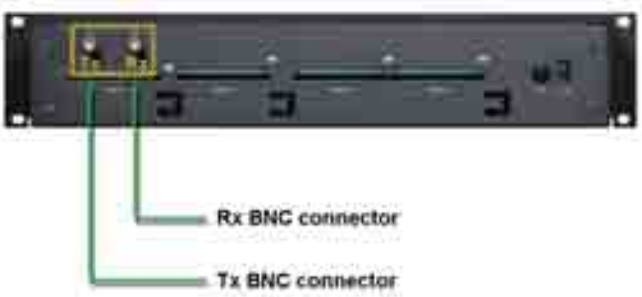
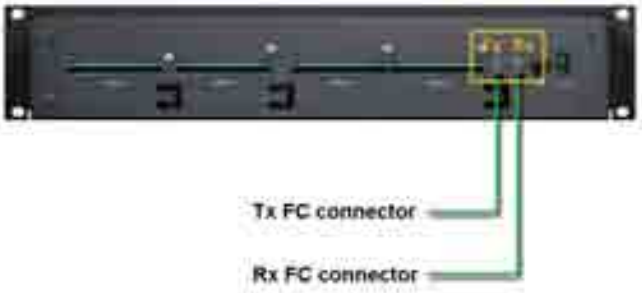


FIGURE 16 Optical interface at 64 kbit/s connectors



7 MAIN MANAGEMENT MENUS

The home web page of the CTP-1 Management System is as shown in FIGURE 17.

As can be seen, four main menus appear. The first menu, *Systems*, controls the flow of information entering and leaving the Management System, and allows the software and firmware of the terminal to be known and to be updated. The second, *Configuration*, allows all the operative parameters of the terminal to be configured and those of its collateral, that is to say, those of the terminal at the other side of the link. The third menu, *Monitoring,* allows supervision of the system to be carried out, whilst the fourth, *Alignment help*, contains guidelines on alignment and maintenance.

These menus are described in more detail in the following sections.

FIGURE 17 CTP-1 Management System home web page

7.1 SYSTEM MENU

This menu contains three options. The first gives access to the reading functions of the disk or terminal and writing functions to disk or in the terminal. The second allows the display of the terminal software versions. The third gives access to the option which allows the user passwords to be managed in order for the browser to access the web server.

7.2 CONFIGURATION MENU

This menu allows the parameters to adjust the operation of the CTP-1 terminal to specific teleprotection needs to be programmed.

The set of parameters to configure are:

- **Terminal identification.**
  In the CTP-1 terminals it is possible to program a numeric identification and a description of up to 50 characters.

- **Equipment definition.**
  Consists of specifying the CTP-1 terminal model, that is to say, line-interface type, number of teleprotection commands and number of auxiliary relays.

- **Transmit and receive level.**
  Consists of specifying, when the line interface is analog, the transmission and reception levels of the guard and command tones and, in the case of the command tones, the power-boosting condition level.

- **Input and output configuration.**
  On the one hand, it consists of establishing the input logic that allows the command transmission process to begin, the time during which the input conditions have to be fulfilled, and the duration of the command transmission to the CTP-1 at the other end of the link. The transmission can be permanent whilst the input condition is present, or the time can be prolonged, limited or of fixed duration.
  On the other hand, it consists of establishing the output logic for each command received, and the time during which the command output relay (or relays) should remain active. The time can be the same as that of the command reception, or be prolonged, limited, or of fixed duration.
  Finally, consists of specifying the interval of time, in hours, between local tests.

- **Teleprotection parameters.**

  The parameters to be specified are different depending on line-interface type. In this way, for example, in the case of the analog interface are the transmission and reception frequencies, the transmission time, and the activation and de-activation thresholds of the low signal-to-noise ratio alarm.

  In the case of the digital interface are the window length, decision threshold, identification codes and security identification codes and, for example, in the case of the G.703 interface, the data rate (64 kbit/s or 2 Mbit/s) and type of clock (internal or recovered).

- **Relays.**

  Consists of specifying the use of the basic and additional auxiliary relays and, if necessary, the use of the auxiliary relay of the analog-line interface (KACT submodule). The auxiliary relays can be programmed for command transmission signalling, command output signalling or alarm and, if be the case, unblocking.

  It is also possible to specify the time during which the programmed alarm conditions must be present in order to activate the corresponding auxiliary relay.

7.3 MONITORING MENU

The monitoring menu makes it possible to verify the operation of either of the two CTP-1 terminals in a link.

Data supplied by the monitoring system regarding each terminal are: Teleprotection state, Alarm signals and Chronological register. The data relative to Signal/Noise ratio also appear for the analog-line interface.

- **Teleprotection state**

  It is possible to monitor which command is being transmitted and which command is being received, and to monitor the counters of number of command transmissions and the counters of number of command receptions.

  It is also possible to monitor, on the one hand, what inputs have brought about the command transmission and the counters of number of input activations and, on the other hand, which outputs have been activated and the counters of number of output activations.

❖ **Alarm signals**

The alarms of the terminal that can be monitored from the Management System are the following:

- Erroneous configuration data.
- Device error.
- Manual blocking.
- Incoherent configuration of MBCT module.
- Reception blocking.
- Local test failure.
- Low Signal/Noise ratio (analog).
- Signal loss (analog).
- Low guard-signal level / Excess guard-signal level (analog).
- Loss of synchronism (digital).
- Incorrect security identification (SIC) code (digital).
- Bad identifier code (digital).
- High BER in reception (digital).

❖ **Chronological register**

The appearance and disappearance of the alarms is stored in a register together with the indication of the date, with day, month and year, and time, with minute, second and millisecond, they were produced.

Events related to the link service, such as transmission of command, reception of command, modification of programming, carrying out a lop, and so on are also introduced in the same register. The register has a maximum capacity of 900 alarms and events; when the limit is reached the events or alarms introduced at the beginning of the register are eliminated.

❖ **Signal/Noise ratio**

For an analog-line interface, the Monitoring menu displays the signal-to-noise ratio referred to a 4 kHz-band signal with the modulation percentage programmed in the guard tone. It also indicates whether an alarm for low signal-to-noise ratio or signal loss exists.

7.4 ALIGNMENT HELP MENU

The Alignment help menu is provided to facilitate commissioning operations and system maintenance. The menu allows the internal clock of the terminal to be set and contains the instructions for making the loops necessary to check the operation of the link, etc. It also contains the corresponding option to carry out the terminal reset.

Clocks and synchronism

The Alignment help menu has an option that shows the date and time of the internal real time clock of the terminal and the UTC time allowing, if desired, the date and time values of the internal clock of the terminal to be modified using the UTC clock as a reference.

> The date and time programming of the internal clock of the terminal does not remain when the terminal has an external timing synchronization programmed, via GPS.

Initializations

From the Alignment help menu it is possible to force a reset of the processing module as well as to put to zero the counters of number of command transmissions and receptions and the counters of number of input and output activations.

Arrangement of MBCT jumpers

The Alignment help menu contains an option to display which position the jumpers of the MBCT module should be in, according to the nominal voltage applied to the command input circuits.

Loops, blocking and tests

The Alignment help Menu contains an option which allows the terminal to be blocked for a certain period of time, or permanently, so that it cannot activate any output. It also contains the options that allow the local loop and the local test to be carried out.

Command transmission and input activation

The Alignment help menu contains the options necessary to force the activation of the transmission of the desired command, and to force the activation of the inputs in order to check whether the activation has initiated the transmission of the desired command.

8 TECHNICAL CHARACTERISTICS

8.1 GENERAL CHARACTERISTICS

Application	Transmission of teleprotection commands for electrical high-frequency line protection for the following schemes: - Blocking. - Direct tripping. - Permissive tripping. Telesignalling.
Communication channel	Analog or digital with electric or optic interface
Capacity	From 1 to 4 commands
Analog channel interface	By means of 4-wire connections, in the 0 to 4 kHz band, for operation using tones
Digital channel interface	E1/T1 (G.703). 64 kbit/s (G.703 codirectional, V35 or V.11). 64 kbit/s (single-mode 9/125 μm optical fiber, 1300 nm)
Test devices	- Command transmission (permanent or not). - Input activation (permanent or not). - Local loop (permanent or not). - Local test
Capacity of chronological register	900 alarms and events
Resolution of chronological register	1 ms

GPS time connector	
Connector type	BNC
Standard	IRIG-B 123 and IRIG-B 003

8.2 ANALOG LINE-INTERFACE CHARACTERISTICS

Operation using tones	- Able to transmit and receive up to three commands independently or in any combination. - Able to transmit and receive up to four commands according to the following logic: **Mode 2+2:** simultaneous protection of two lines by means of two permissive trips (C and D) and two direct trips (A and B). **Mode 3+1:** simultaneous protection of the three phases of a line by means of three permissive trips (A, B and C) and one direct trip (D)
Security and dependability	In accordance with IEC 60834-1 standard
AF output	
Nominal impedance	600 Ω
Return loss	>20 dB
Nominal level	Configurable from the Management System between -30 and 0 dBm
Power boosting	Configurable from the Management System between 0 and +6 dB. External signalling: By solid-state relay of 120 mA/250 V_{DC}. Non energized (contacts N.C. and C short-circuited) in normal operating conditions

AF input	
Nominal impedance	600 Ω
Return loss	>20 dB
Receiver sensitivity	Configurable from the Management System between -40 and 0 dBm
Guard and command frequencies	Within audio band and configurable from among those defined in Recs. R.35, R.37 and R.38 of the ITU-T and the frequencies: 3300 Hz, 3360 Hz, 3420 Hz, 3480 Hz, 3540 Hz, 3600 Hz, 3660 Hz, 3780 Hz and 3800 Hz
Nominal transmission time	Configurable among 7 ms, 15 ms and 25 ms
Internal channel	
Functions	Data transmission
Central frequency	Guard frequency
Modulation	By frequency-shift keying of ±15 Hz
Maximum rate	25 bit/s

8.3 DIGITAL-LINE INTERFACE CHARACTERISTICS

Communication protocol	HDLC (High-Level Data Link Control) with fixed sequence
Nominal transmission time	
At 2 Mbit/s (1 slot)	
Decision threshold = 1	Between 2.1 ms and 2.6 ms
Decision threshold = 5	Between 3.6 ms and 4.1 ms
Decision threshold = 15	Between 7.3 ms and 7.8 ms

At 64 kbit/s	
Decision threshold = 1	Between 1.56 ms and 2.45 ms
Decision threshold = 5	Between 5.10 ms and 5.99 ms
Decision threshold = 15	Between 13.94 ms and 14.04 ms
Security and dependability	In accordance with IEC 60834-1 standard
G.703 interface (2 Mbit/s)	
Transmission speed	2 Mbit/s (5 slots)
Internal-oscillator stability	± 50 ppm
Synchronism	Codirectional clock
Output impedance	75 Ω[(2)]
Input impedance	75 Ω[(3)]
Maximum line attenuation	6 dB at 1024 kHz
Type of connector	BNC[(3)]
Electrical characteristics and line coding	In accordance with Recommendation ITU-T G.703
Phase-fluctuation tolerance	In accordance with Recommendation ITU-T G.823
G.703 interface (64 kbit/s)	
Transmission speed	64 kbit/s
Internal-oscillator stability	± 50 ppm
Synchronism	Codirectional clock
Output impedance	120 Ω ± 5%, symmetric
Input impedance	120 Ω ± 5%, symmetric
Maximum line attenuation	6 dB at 128 kHz

(2) A balanced-to-unbalanced adapter is available upon request for connecting a balanced 120 Ω twisted pair interface to this unbalanced 75 Ω coaxial interface and vice versa.

Type of connector	SUB-D male 15-pin
Electrical characteristics and line coding	In accordance with Recommendation ITU-T G.703
Phase-fluctuation tolerance	In accordance with Recommendation ITU-T G.823
V.11 interface	
Transmission speed	64 kbit/s
Synchronism	Terminal equipment. Clock from the line terminal
Type of connector	SUB-D male 15-pin
Electrical characteristics	In accordance with Recommendation ITU-T V.11
V.35 interface	
Transmission speed	64 kbit/s
Internal-oscillator stability	± 50 ppm
Synchronism	Internal transmission clock or from the line terminal
Type of connector	SUB-D male 15-pin
Electrical characteristics	In accordance with appendix 2 of Recommendation ITU-T V.35
Optical-fiber interface	
Transmission speed	64 kbit/s
Internal-oscillator stability	± 50 ppm
Line coding	MANCHESTER
Maximum attenuation permissible	30 dB
Transmitter optical power minimum level	-5 dBm

Type of connector	FC female
Fiber type	Single mode (9/125 μm)
Wavelength	1300 nm (second window)

8.4 COMMAND INPUT AND OUTPUT

Command inputs	
Type	Optocoupled
Number of inputs per command	With IPCT-1 connector: 2 With IPCT-1 & IPCT-2 connectors: 4 (configurable up to two inputs per command).
Nominal operating voltage	24, 48, 110 and 220 V_{DC}
Minimum voltage that guarantees activation	-20% of the nominal voltage
Maximum voltage that guarantees NO activation	-40% of the nominal voltage
Maximum operating voltage	+20% of the nominal voltage
Polarity	Indistinct
Consumption	Constant 10 mA to the nominal voltage (in the whole range)
Activation minimum time	700 μs
Activation logic	By presence of voltage
Additional timing for command transmission	Configurable from the Management System between 2 and 30 ms with 1 ms steps
Timing possibilities	- Whilst the analog command input is activated. - Prolonged to 20÷2500 ms. Configurable in 10 ms steps. - Limited between 20÷2500 ms. Configurable in 10 ms steps. - Fixed duration of 20÷2500 ms. Configurable in 10 ms steps

Command outputs	
Type	Solid-state relay (semiconductor)
Number of outputs per command	With IPCT-1 connector: 2 With IPCT-1 & IPCT-2 connectors: 4 (configurable up to two outputs per command).
Contact	Normally open. Voltage free
Maximum connection power	900 W
Maximum current in connection	Permanent: 2 A 3 A for a max. of 20 s
Maximum connection voltage	300 V_{DC}
Residual voltage in connection	4 V
Leakage current	<300 μA
Switching time	<250 μs
Timing possibilities	- Whilst receiving command. - Prolonged to 20÷2500 ms. Configurable in 10 ms steps. - Limited between 20÷2500 ms. Configurable in 10 ms steps. - Fixed duration of 20÷2500 ms. Configurable in 10 ms steps

8.5 VISUAL INDICATIONS AND EXTERNAL SIGNALLING

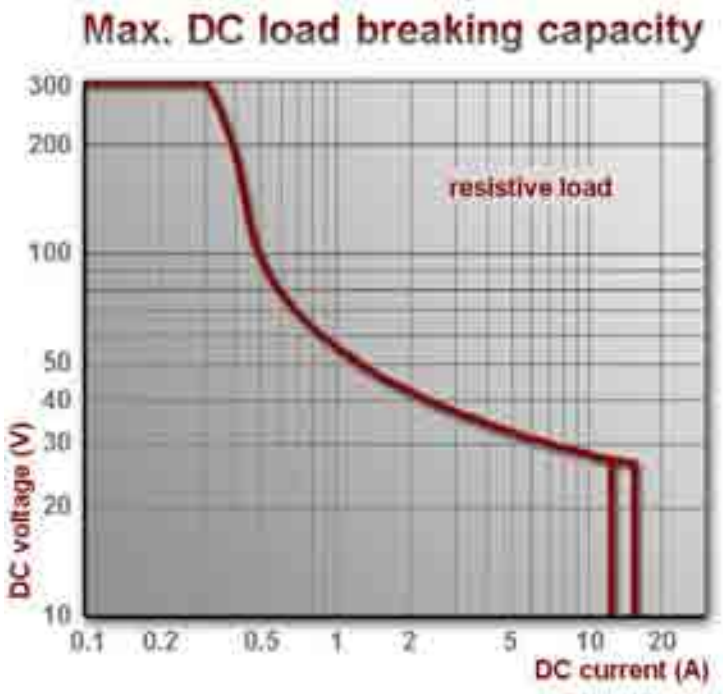
Front-plate indications	
Signalling	➢ Command transmission. ➢ Command reception. ➢ Guard signal present (analog). ➢ Synchronism (digital). ➢ Terminal in loop. ➢ Test correct.

Alarms	• Power-supply failure. • Signal loss (analog). • No synchronism (digital). • Guard signal out of range (analog) • Incorrect identification code or incorrect security code (digital) • Test incorrect. • Manual blocking. • Reception blocking • General alarm(3) An alarm or combination of alarms can be assigned to the auxiliary signalling relays from the Management System
Command transmission and reception counters	Monitored from the Management System. On demand, can be monitored on the front of the terminal
Input and output activation counters	Monitored from the Management System.
External signalling	
Type	By relay. Changeover contact. Maximum contact rating 1 A/250 V_{AC}, see FIGURE 18 for V_{DC}
Number of relays	- 2 relays per IPCT connector. - 1 relay per IACT connector. - 2 or 4 relays per IRCT-1 connector. Configurable for signalling of: command transmission, command output or alarm and, if be the case, unblocking
Closing/opening times including bounces	7/5 ms

(3) It lights up when one of the following alarms is produced: Erroneous configuration data, Device error, Manual blocking, Incoherent configuration of MBCT module, Reception blocking, Local test failure, Low Signal/Noise ratio (analog), Signal loss (analog), Automatic test failure (analog), Guard signal out of range (analog), Loss of synchronism (digital), Incorrect security identification (SIC) code (digital), Bad identifier code (digital), and high BER in reception (digital).

State in normal operation conditions	➢ Relays programmed for signalling of command transmission, command output and unblocking: Non energized (N.C. and C contacts short-circuited). ➢ Relays programmed for alarm signalling: Energized (N.O. and C contacts short-circuited).
Activation timing in case of alarm	Configurable from the Management System between 0 and 60 s
Alarm programmable conditions	- Device error. - Incoherent configuration of MBCT module. - Reception blocking. - Local test failure. - Low Signal/Noise ratio (analog). - Signal loss (analog). - Low guard-signal level / Excess guard-signal level (analog). - Loss of synchronism (digital). - Incorrect security identification (SIC) code (digital). - Bad identifier code (digital). - High BER in reception (digital).

FIGURE 18 DC voltage/DC current



8.6 ELECTROMAGNETIC COMPATIBILITY

Standards	Complies with IEC 60834-1, IEC 61000-6-2, ANSI C37.90.1 and ANSI C37.90.2

8.7 OPERATING AND STORAGE CONDITIONS

Temperature and humidity	From –5 °C to +45 °C and relative humidity not greater than 95%, in accordance with IEC 721-3-3 class 3K5 (climatogram 3K5)
Power supply	
Nominal input voltage	48 V_{DC} ±20% by means of DC/DC converter.
Operating range	From 36 to 72 V_{DC}
Power supply interruptions	Level 1 of IEC 60870-2-1

Protection against overvoltages	Electronic PTC
Consumption	15 W
Storage conditions	In accordance with IEC 721-3-1, class 1K5

8.8 MECHANICAL CHARACTERISTICS

Dimensions	19" (482 mm) wide and 2 s.u. high (88 mm). Depth of 271 mm
Weight	5 kg
Connections	By means of connectors at the back of the terminal. If desired, the necessary cables can also be supplied on demand
Optional cabinet-mounting terminal block	
Power-supply terminals	Terminals that do not have disconnect devices and that are suitable for flexible conductors of up to 4 mm^2 of section or rigid conductors of up to 6 mm^2 of section.
The rest of the terminals	Terminals that have disconnect devices and that are suitable for flexible conductors of up to 2.5 mm^2 of section or rigid conductors of up to 4 mm^2 of section.

8.9 CHARACTERISTICS OF THE MANAGEMENT COMPUTER

Type	Compatible personal computer (PC)
Model	Pentium III 350 MHz processor or higher
RAM memory	512 MBytes
Graphic adapter	1 Mbyte SVGA

Communication	USB port (flat connector at each cable end)
Additional hardware	CD-ROM unit and a mouse
Operating system	Microsoft Windows 2000 or Microsoft Windows XP
Web browser	Microsoft Internet Explorer v 5.5 or higher
JAVA virtual machine (Sun Microsystems)	Version 1.6 or higher

APPENDIX A

OPTIONAL CABINET-MOUNTING TERMINAL BLOCK

A.1 OPTIONAL CABINET- MOUNTING TERMINAL BLOCK

For external connection, the CTP-1 teleprotection terminal can be supplied, on demand, with a cabinet-mounting terminal block, together with the necessary cables.

The optional cabinet-mounting terminal block is made up of various terminal blocks mounted on a metal plate, forming a compact unit. This plate is fixed by means of non-slip nuts to the vertical guide rails located inside the back wall of the cabinet.

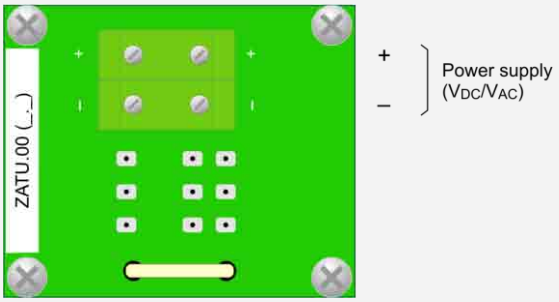
The general dimensions of the optional cabinet-mounting terminal block can be seen in FIGURE 22.

The type of terminal block associated to each back-panel connector is indicated in the next sections. Examples of different compositions are shown at the end of the Appendix.

The optical-fiber line interface do not have a terminal block associated. Connections are carried out directly in the connectors at the rear of the shelf (see FIGURE 16).

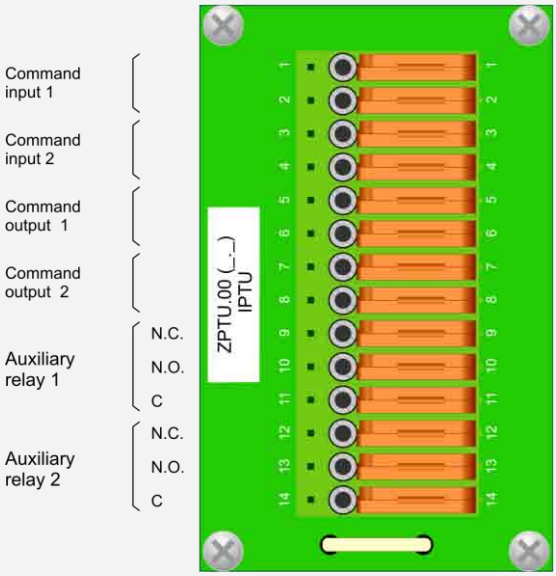
The earth connection of each cable must be connected to the corresponding earth-connection screw, see FIGURE 3.

A.2 TYPE OF TERMINAL BLOCKS

ZATU.00 terminal block The ZATU.00 terminal block is associated to the back-panel power-supply connector. The two terminals associated to the power supply do not have disconnect devices and are suitable for 0.2 to 4 mm^2 flexible conductors and for 0.2 to 6 mm^2 rigid conductors.	

ZPTU.00 terminal block

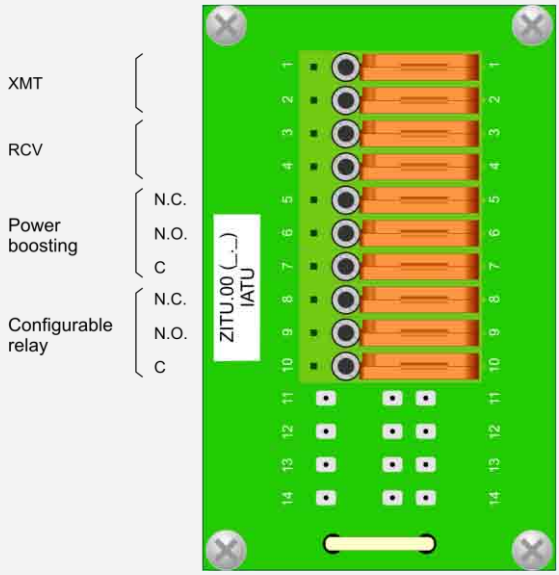
The ZPTU.00 terminal block is associated to the back-panel IPCT connector. This block contains fourteen terminals, which have disconnect devices and suitable for up to 2.5 mm2 flexible conductors and up to 4 mm2 rigid conductors.



ZDTU.00 terminal block

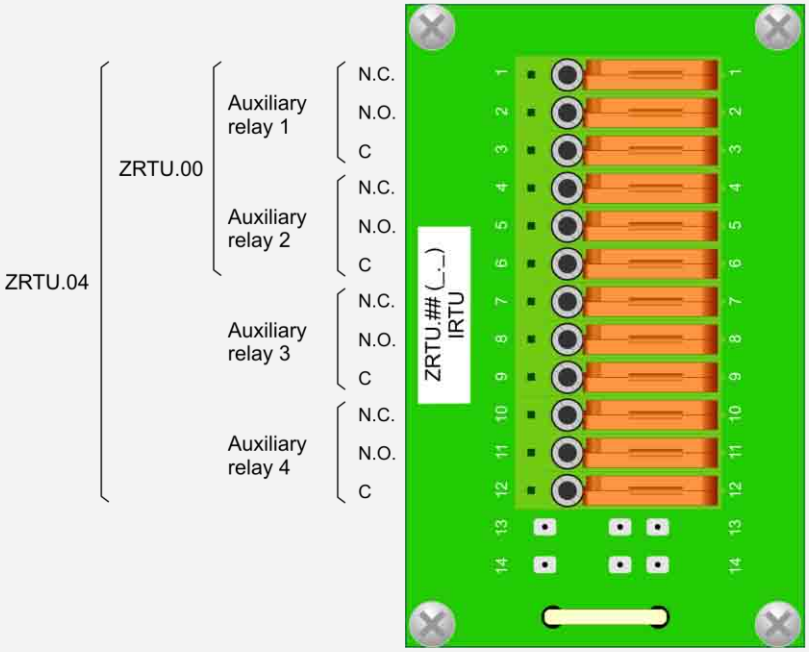
The ZDTU.00 terminal block is associated to the 2 Mbit/s back-panel connectors. As can be seen in the figure, this terminal block is made up of two BNC[4] type connectors identified as Tx and Rx.

[4] A balanced-to-unbalanced adapter is available upon request for connecting a balanced 120 Ω twisted pair interface to this unbalanced 75 Ω coaxial interface and vice versa.

ZETU.00 terminal block The ZETU.00 terminal block is associated to the back-panel G.703 and V.35/V.11 connectors. As can be seen in the figure, this block is made up of a 15 pin SUB-D type connector. The use of the connector for the V.11, V.35 and G.703 co-directional interfaces is identical to that indicated in FIGURE 14a) to FIGURE 14c), respectively.	
ZITU.00 terminal block The ZITU.00 terminal block is associated to the back-panel IACT connector. This block is made up of ten terminals, which have disconnect devices and suitable for up to 2.5 mm^2 flexible conductors and up to 4 mm^2 rigid conductors.	

ZRTU.## terminal block

The ZRTU.## terminal block is associated to the back-panel IRCT-1 connector. The ZRTU.00 block is made up of six terminals, whilst the ZRTU.04 block is made up of twelve. The terminals have disconnect devices and suitable for up to 2.5 mm^2 flexible conductors and up to 4 mm^2 rigid conductors.



A.3 EXAMPLES OF DIFFERENT COMPOSITIONS

FIGURE 19 Cabinet-mounting terminal block for a digital channel and four commands

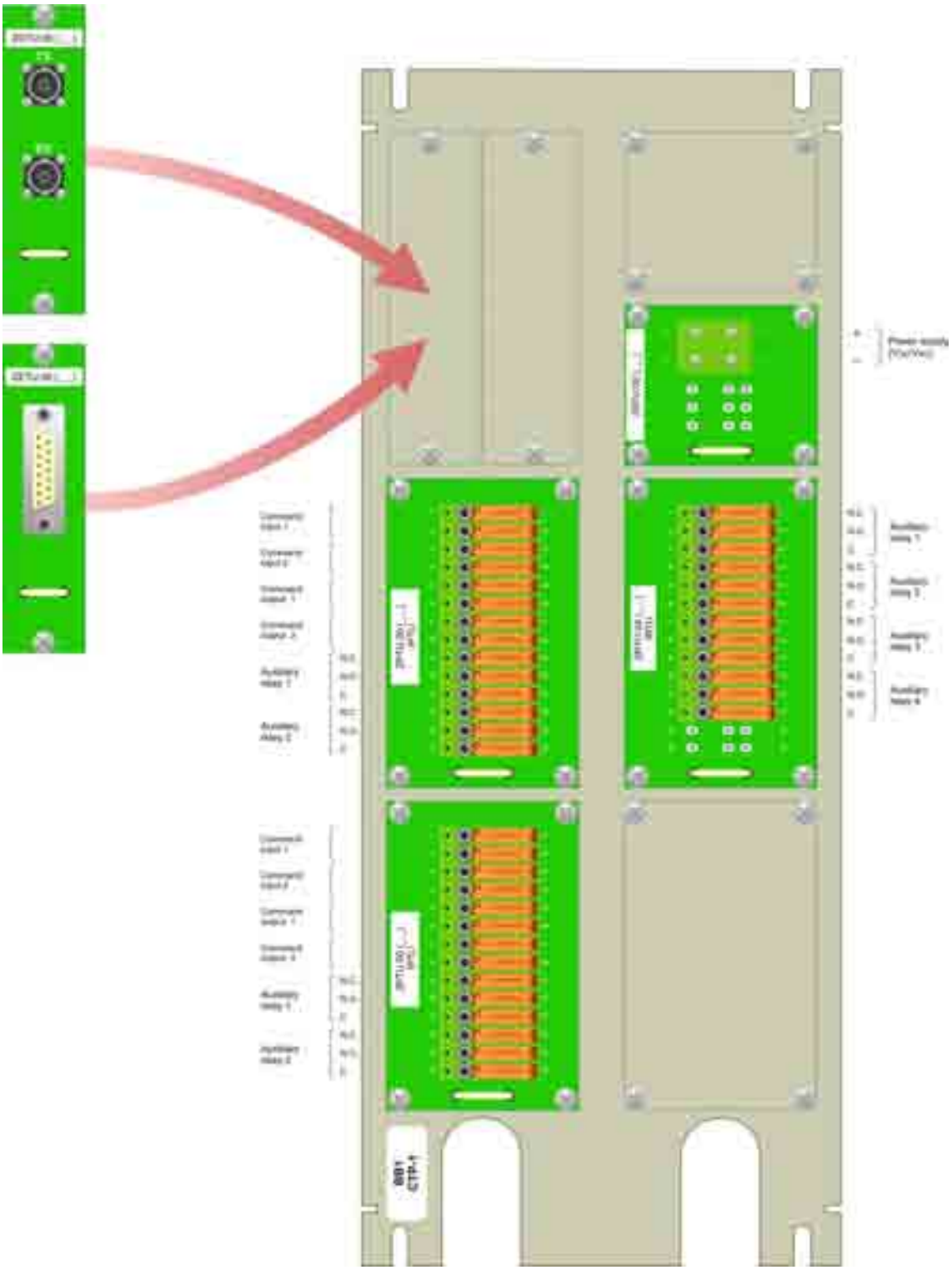


FIGURE 20 Cabinet-mounting terminal block for an analog channel and four commands

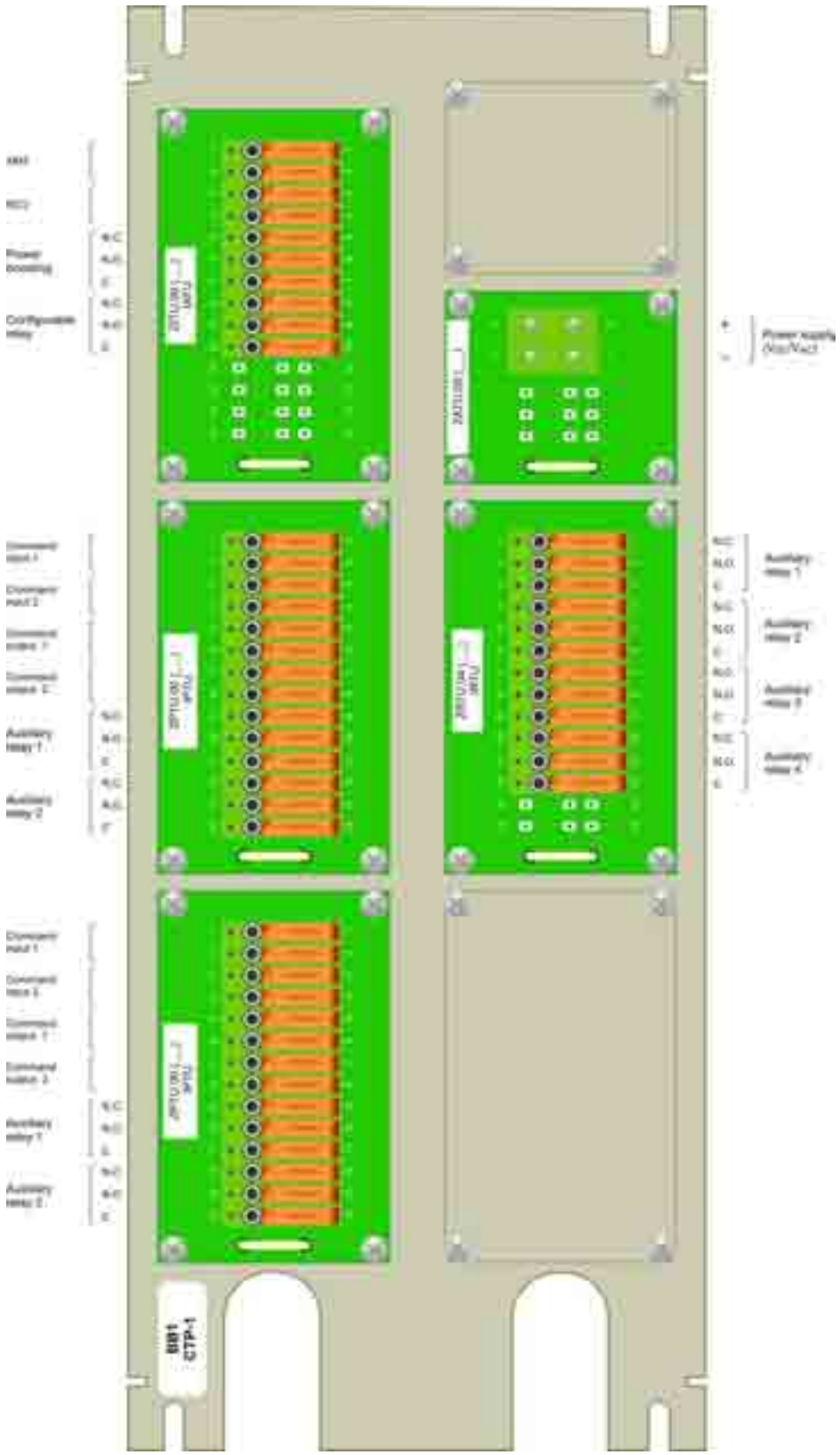


FIGURE 21 Cabinet-mounting terminal block for an analog channel and two commands

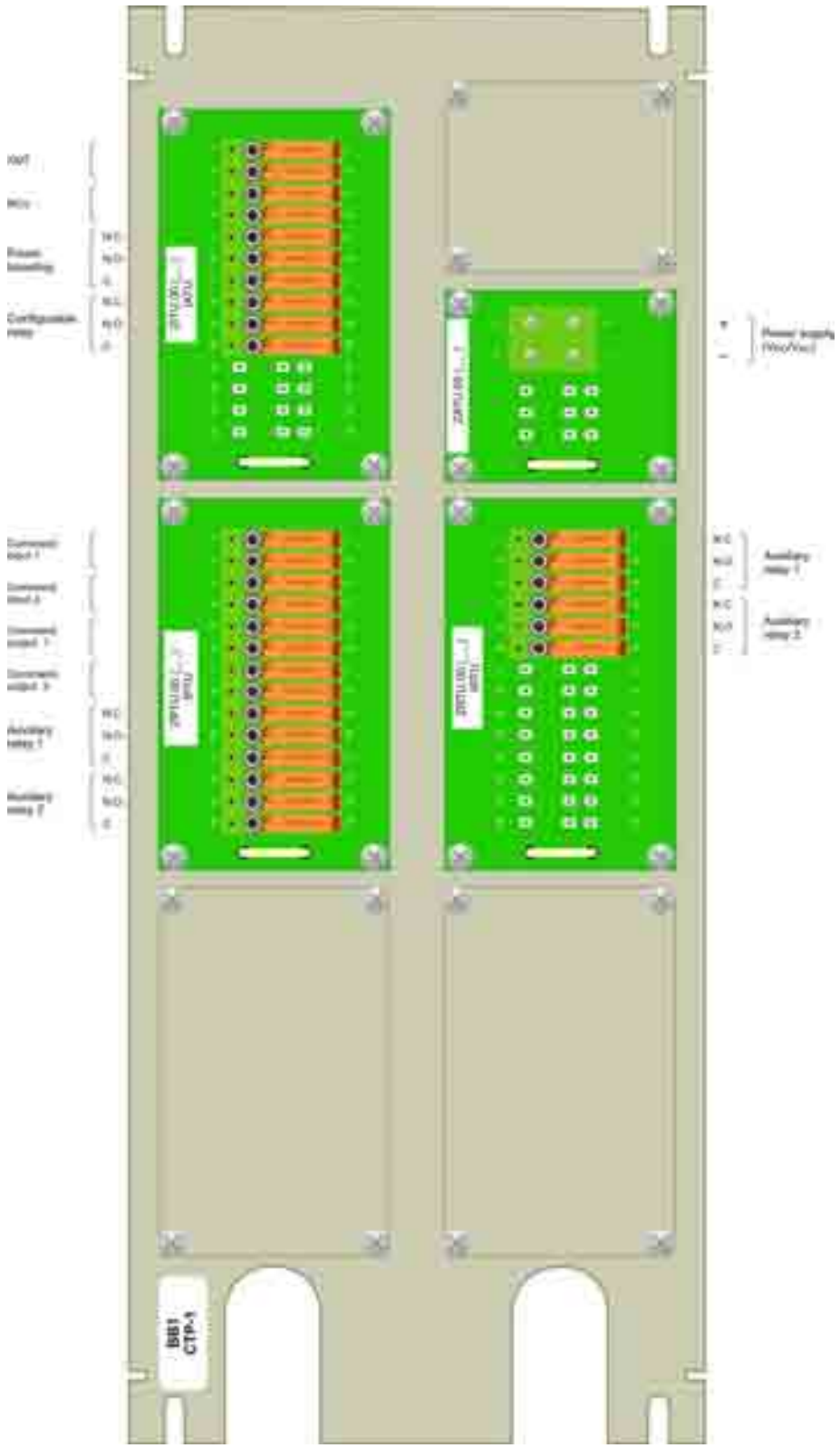
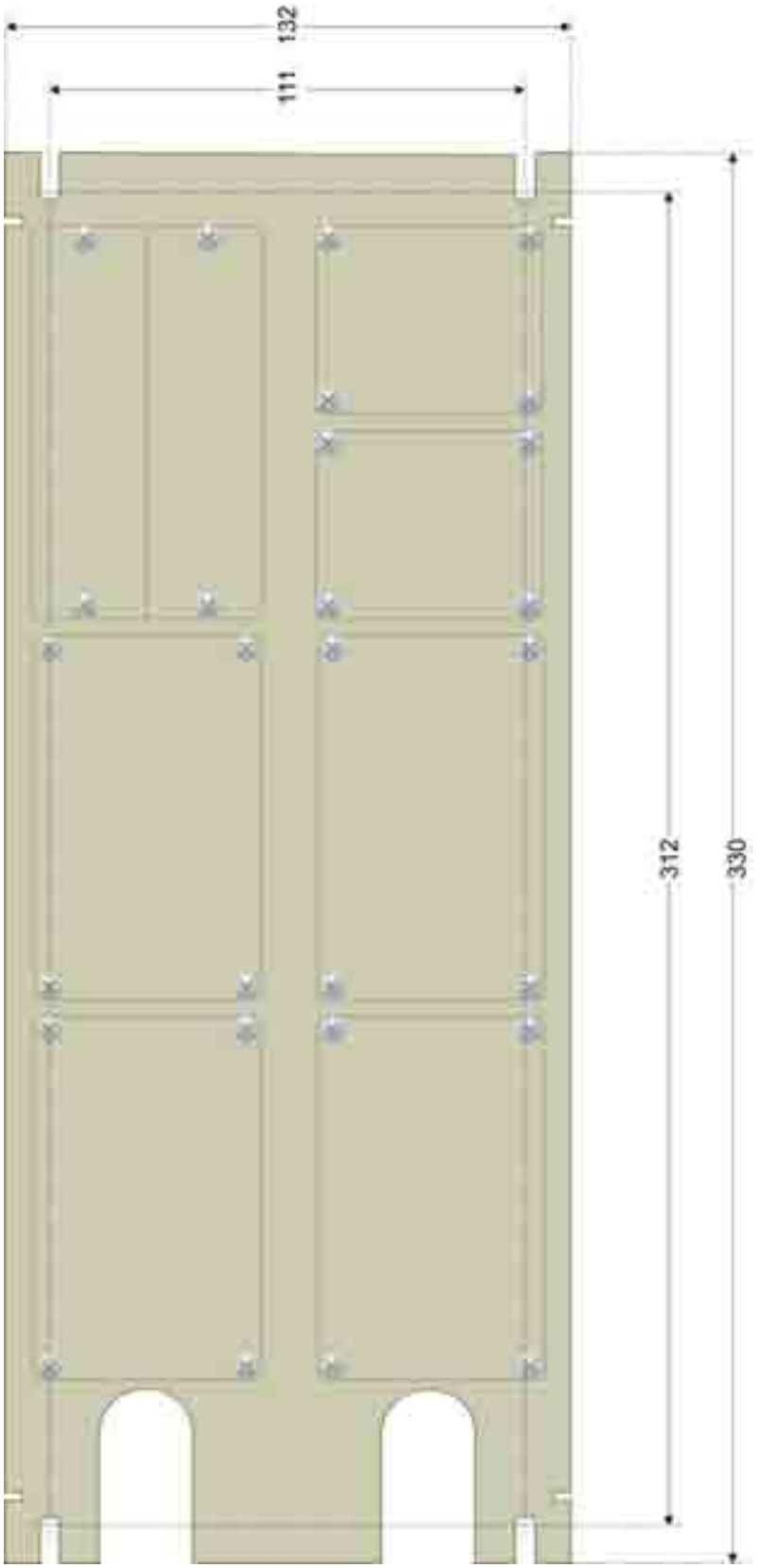


FIGURE 22 General dimensions of the optional cabinet-mounting terminal block



APPENDIX B

PROCEDURE FOR ACCESSING THE MODULES

To access the CTP-1 modules, the top cover must be extracted. The extraction process is shown in FIGURE 23. The procedure for extracting the KACT submodule, if be necessary to make jumper accessing easier, is detailed in FIGURE 24.

> ! A module must **NOT** be replaced whilst the terminal power-supply is connected. Disconnect the main power-supply switch at the rear of the 2 s.u. shelf before doing so.

FIGURE 23 How to extract the top cover

1- Locate and extract the screws
2- Lift the top cover

FIGURE 24 Procedure for extracting the KACT submodule if be the case