Electrical network management

MV substation control unit

Merlin Gerin **Easergy** Range
T200 (P – P2 – I)

IEC 870-5-101 Communication

User's manual

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Modicon
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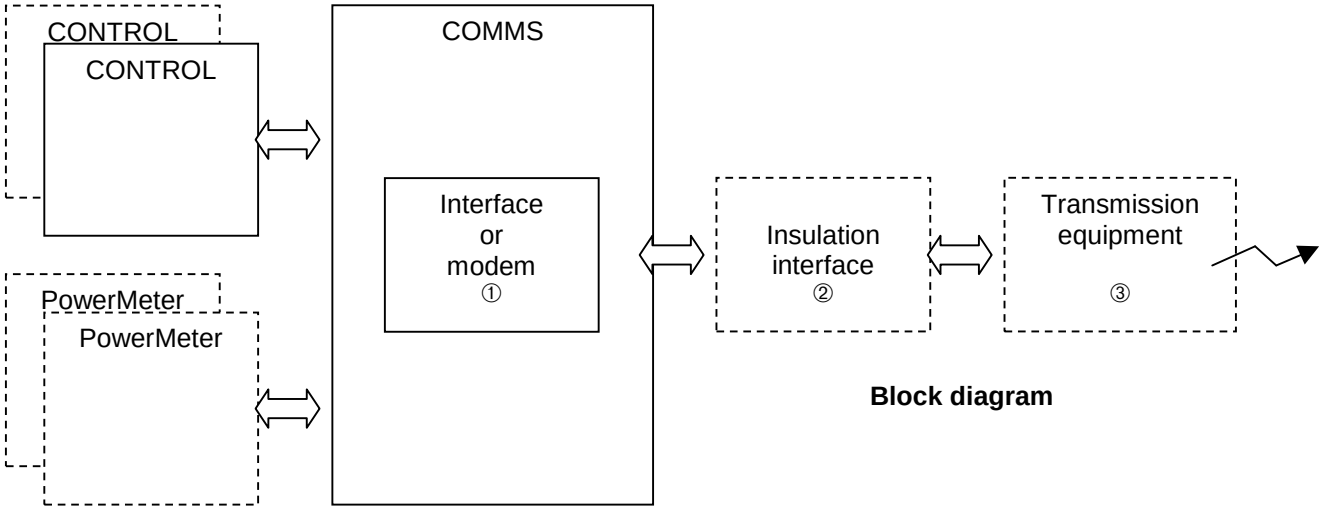
The T200 can communicate with a control centre by means of various transmission protocols and media.

It uses a communication module with an inbuilt interface or modem for this purpose. An insulation interface and (or) a device specifically designed for use with a transmission medium can also be used, if required.

The communication module (COMMS card) transmits the information received from the control module(s) (CONTROL card(s)) and possibly the PowerMeter(s) to the control centre. In the opposite direction, it sends the information received from the control centre (also known as the CC or SCADA) to the control module(s).



Block diagram

Examples:

- 1200 Baud FFSK modulation radio link
  ① 1200/2400 Baud FFSK radio modem
  ② not present
  ③ radio transmitter/receiver

- 9600 Baud optical fibre link
  ① RS232 interface
  ② RS232/RS485 converter for insulation purposes
  ③ RS485/optical fibre adapter

Most of the additional interfaces and associated equipment can be installed within the enclosure which supplies them, if required.

The transmission protocol ensures that none of the data transmitted to the SCADA is lost (or at least that the probability of loss of data is extremely low) and that no data is added.

The functions provided by the T200 depend on its equipment and on the services offered by the transmission protocol used.

The functions allowed by the IEC 870-5-101 protocol and supported by the T200 are as follows:

Commands

- Transmission of remote control commands to the MV switches,
- Transmission of the stored fault current indicator reset remote control command.
- Transmission of automatism enable/disable remote control commands (when automatism is used).

Indications

- Switch positions,
- Enable/disable position of automated commands (when automatism is present),
- "Locked" switch status,
- Phase and homopolar fault currents (A and possibly B),
- Voltage presence,
- Digital inputs,
- Local/remote operating mode,
- No immediate AC supply voltage present,
- No delayed AC supply voltage present,
- Charger fault,
- Battery fault,
- No switchgear supply present,
- Automatism operated (when present).

Measurements

- Phase currents,
- Voltages (optional),
- Measurements provided by PowerMeters (optional).

Main specifications

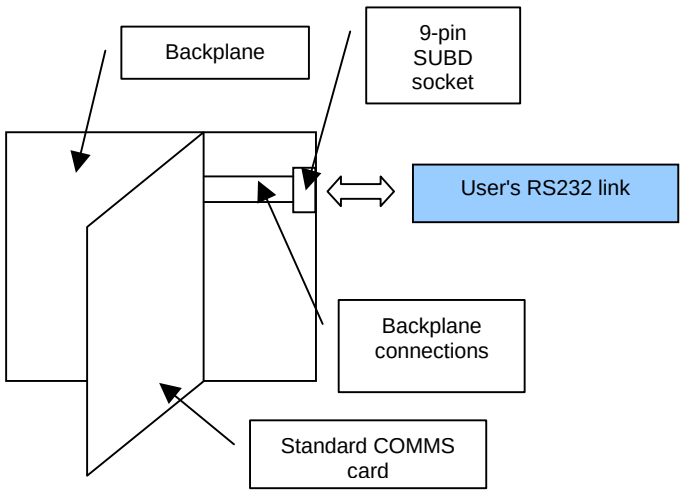
Type of transmission	Asynchronous serial
Protocol	To IEC 870-5-101
Frame structure	To IEC 870-5-1 format FT1.2
Data format	Characters: 1 start bit, 8 data bits, even parity, 1 stop bit[1]
Baud rate	200, 300, 600, 1200, 2400, 4800, 9600 Baud[2]

Hardware configurations

The T200 can use various transmission media. The transmission media and their associated equipment are described below.

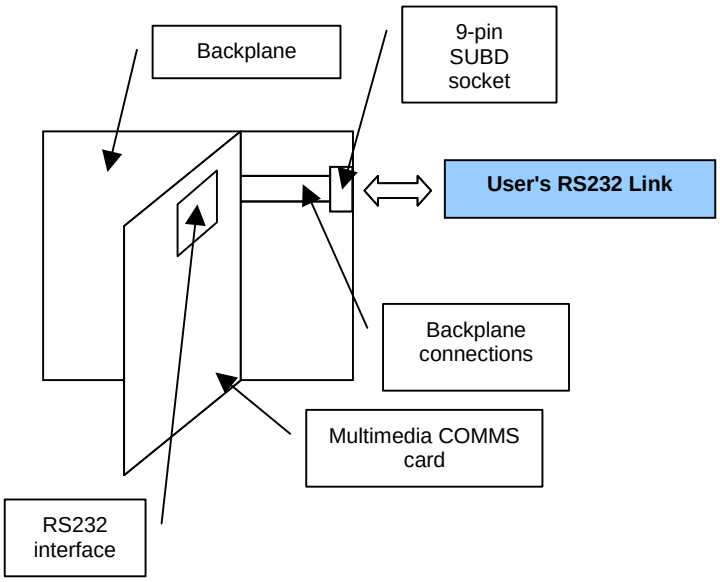
RS232 direct link

The RS232 link is the simplest type of link. It is generally used in a point-to-point configuration. This link is recommended for test purposes.



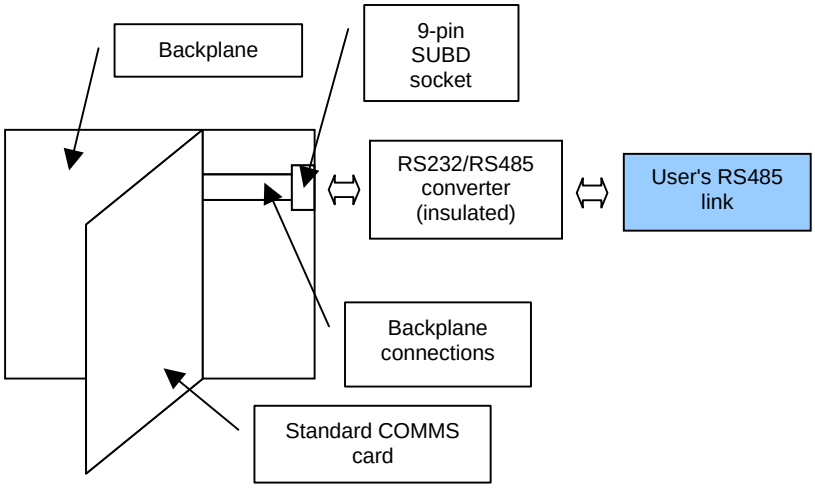
[1] Can also operate with no parity, or with odd or space parity (see the limitations described in the Secure transmission section).
[2] The speed depends on the medium used.

A multimedia COMMS card with an RS232 interface can be used instead of the standard COMMS card, as described below.

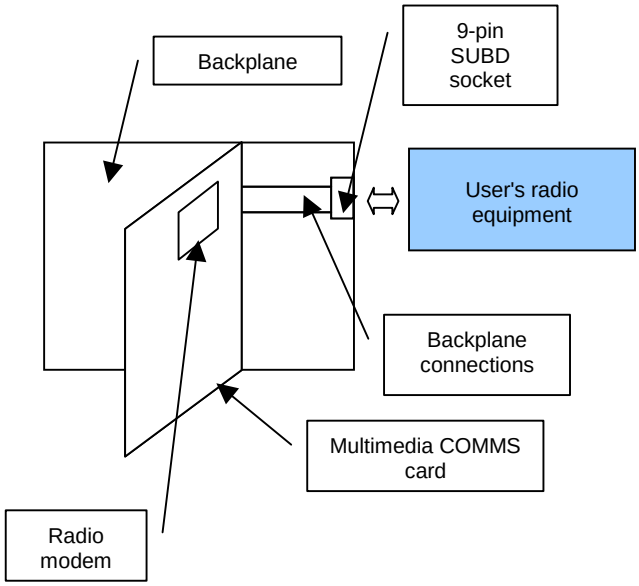


In the following examples, a standard COMMS card can always be replaced with a multimedia COMMS card with an RS232 interface.

RS485 direct link (with insulation)



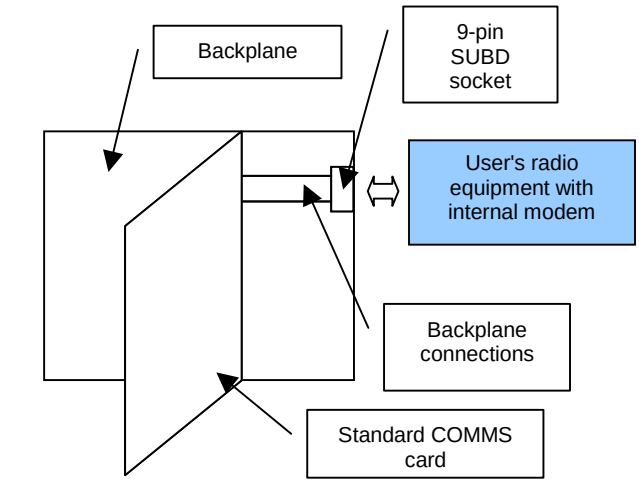
Radio (internal modem)



The following radio modems can be used:

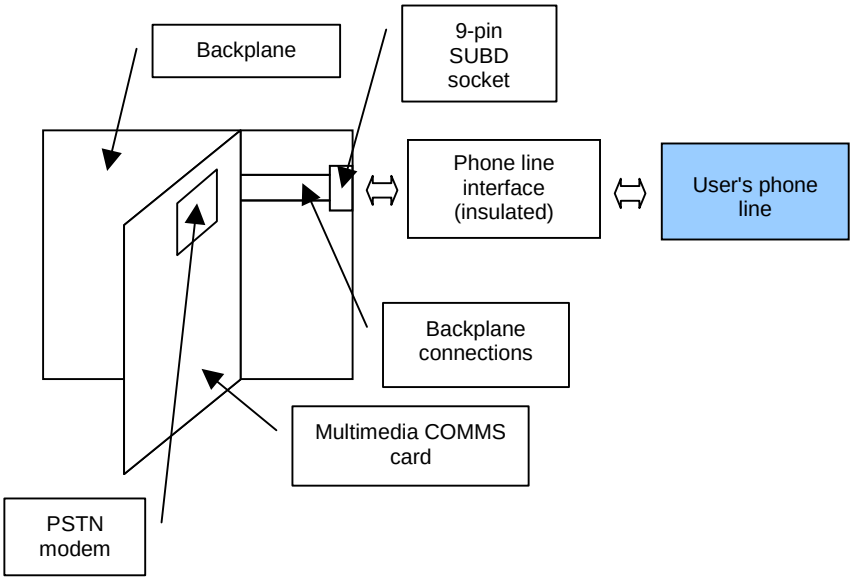
- 200 Baud FSK modulation modem,
- 600/1200 Baud FSK modulation modem,
- 1200/2400 Baud FFSK modulation modem.

Radio (external equipment with modem)



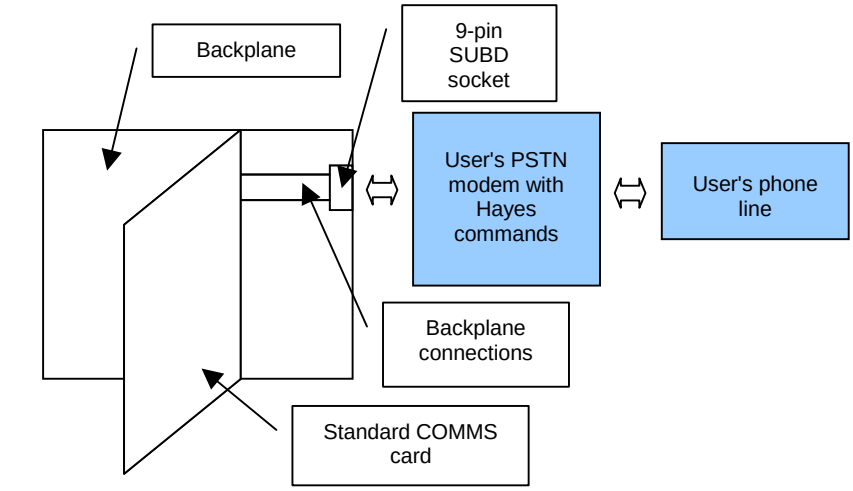
In this case, the radio equipment has an integrated modem.

Telephone (internal modem)



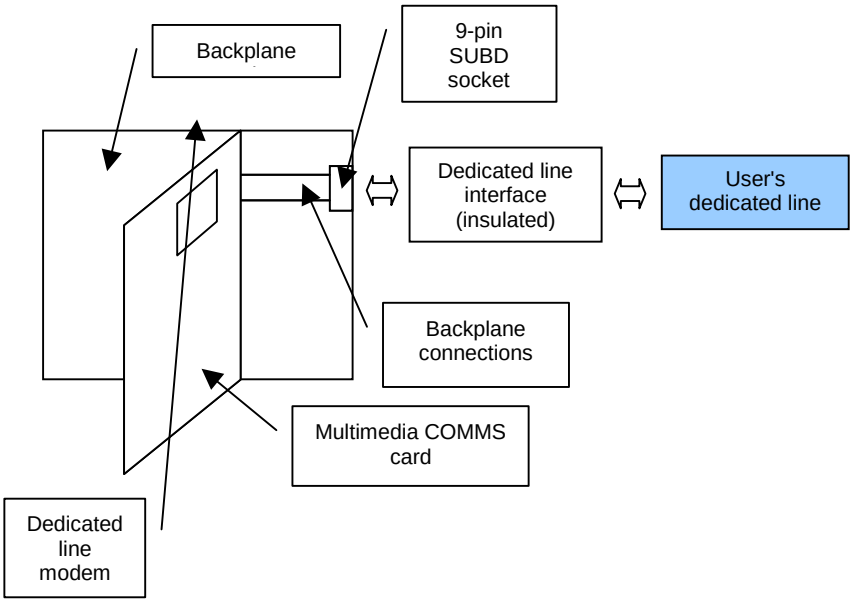
The telephone modem supports 600 and 1200 Baud (V22 recommendation).

Telephone (external modem with Hayes commands)



The telephone modem must be Hayes command compliant (AT commands).

Leased line (internal modem)

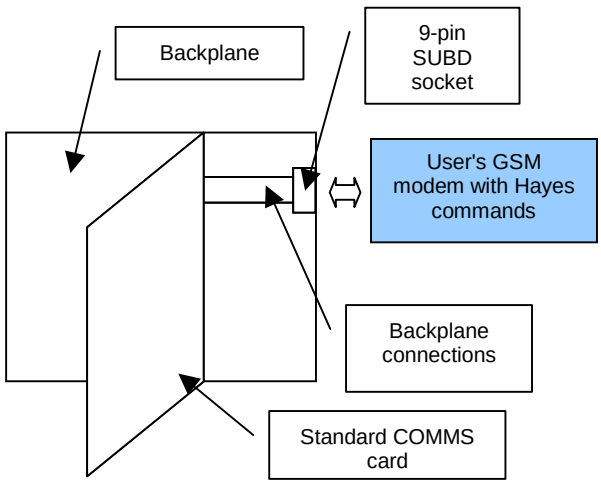


The leased lines supported use "radio" type modulation modems.

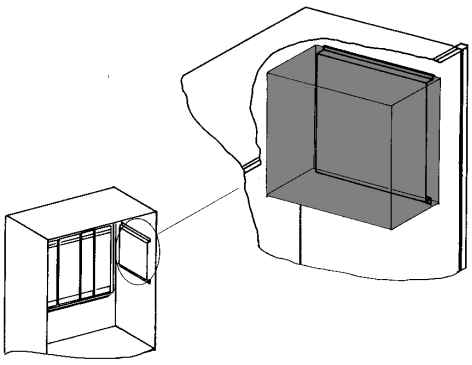
The following leased-line modems can be used:

- 200 Baud FSK modulation modem,
- 600/1200 Baud FSK modulation modem.

GSM (external modem with Hayes commands)

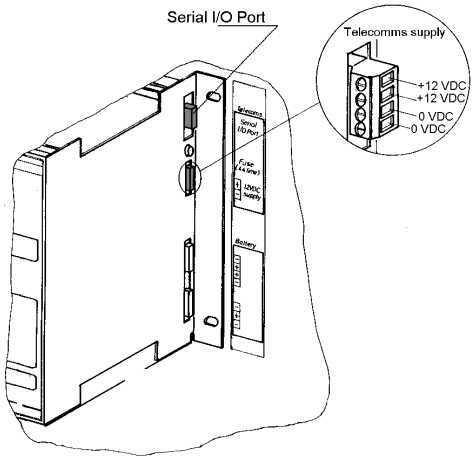


In this case, the GSM equipment has an integrated modem.



Transmission interface housing

The right-hand section of the equipment is designed to house a transmission interface (telephone modem with Hayes commands, RS485/optical fibre adapter, radio transmitter/receiver). A support structure mounted on sliding rails allows the interface to be mounted in several different ways.



Connection

Power supply

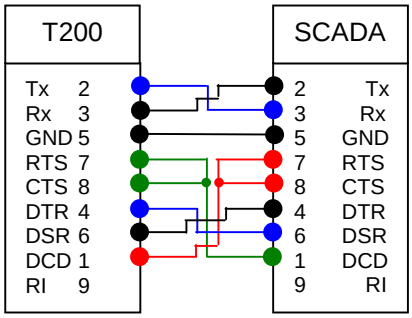
The interface can be connected to the "External 12 V supply" terminals.

- Available voltage:

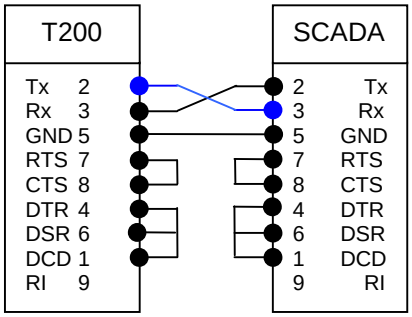
12 V DC (10.8 to 14.8 V DC)

- Available current:

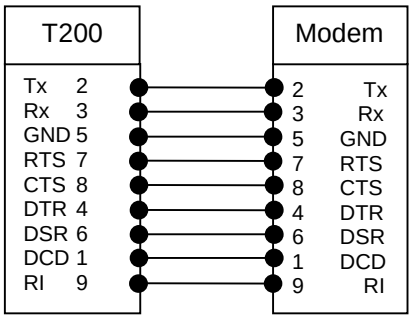
See the T200 documentation for further details. This output is protected by a 4 A time-lag fuse located on the right-hand side of the rack.



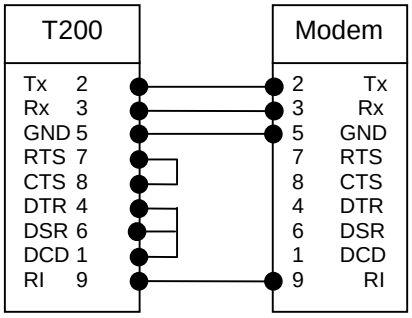
CTS, DCD, DSR support



No CTS, DCD, DSR support



CTS, DCD, DSR support



No CTS, DCD, DSR support

Transmission port

When an RS232 direct link, Radio (internal modem), Radio (external with modem), Phone line (external modem, Hayes command) or GSM (external modem, Hayes modem) is used, it is connected to the 9-pin SUB-D male connector located on the right-hand side of the rack.

- **RS232 direct link**

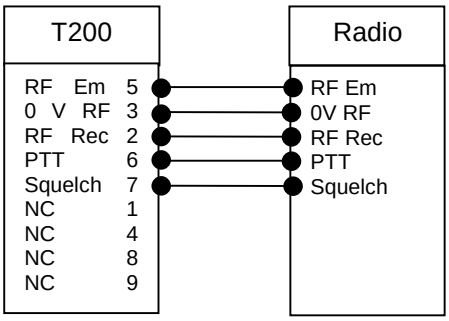
- DCD : Data Carrier Detect
- Rx : Receive
- Tx : Transmit
- DTR : Data Terminal Ready
- DSR : Data Set Ready
- RTS : Request To Send
- CTS : Clear To Send
- RI : Ring Indicator

The levels of these signals are equivalent to the RS232 levels.

- **Radio (external with modem), Phone line (external modem, Hayes commands), GSM (external modem, Hayes commands) links:**

- DCD : Data Carrier Detect
- Rx : Receive
- Tx : Transmit
- DTR : Data Terminal Ready
- DSR : Data Set Ready
- RTS : Request To Send
- CTS : Clear To Send
- RI : Ring Indicator

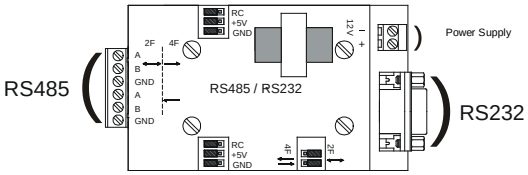
The levels of these signals are equivalent to the RS232 levels.



- **Radio (internal modem) link:**

□ N.C. : Not connected (unused).
□ RF Em : RF Emit
□ 0 V BF : RF GND.
□ RF Rec : BF Receive
□ PTT : Press To Talk
□ Sq : Squelch (radio busy)

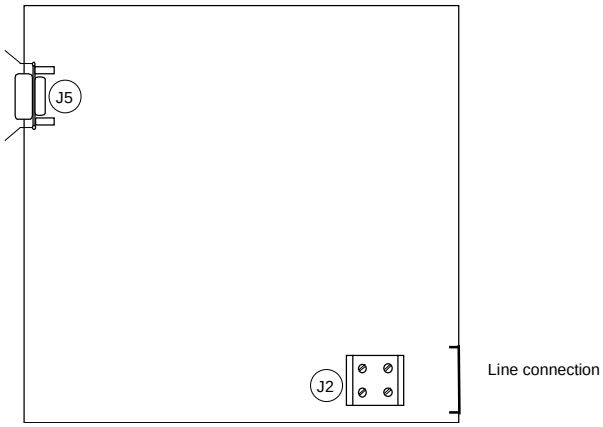
The levels of the Transmit and Squelch commands are 0 V, +12 V.



RS232/RS 485 Converter (insulated)

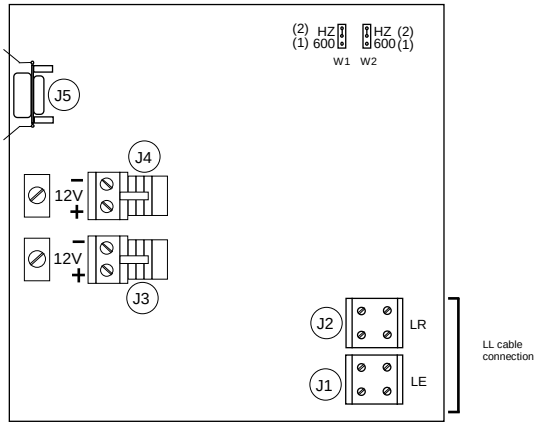
Connect the device on the RS485 side using 2 or 4 wires, according to the markings indicated.

Ensure that the transmission cable shields are connected. The shields must be earthed at one point in the line (preferably on the PC side of the remote control station).



PSTN interface (insulated)

Connect the line to connector J2.



Dedicated line interface (insulated)

Connect this interface using 2 or 4 wires.

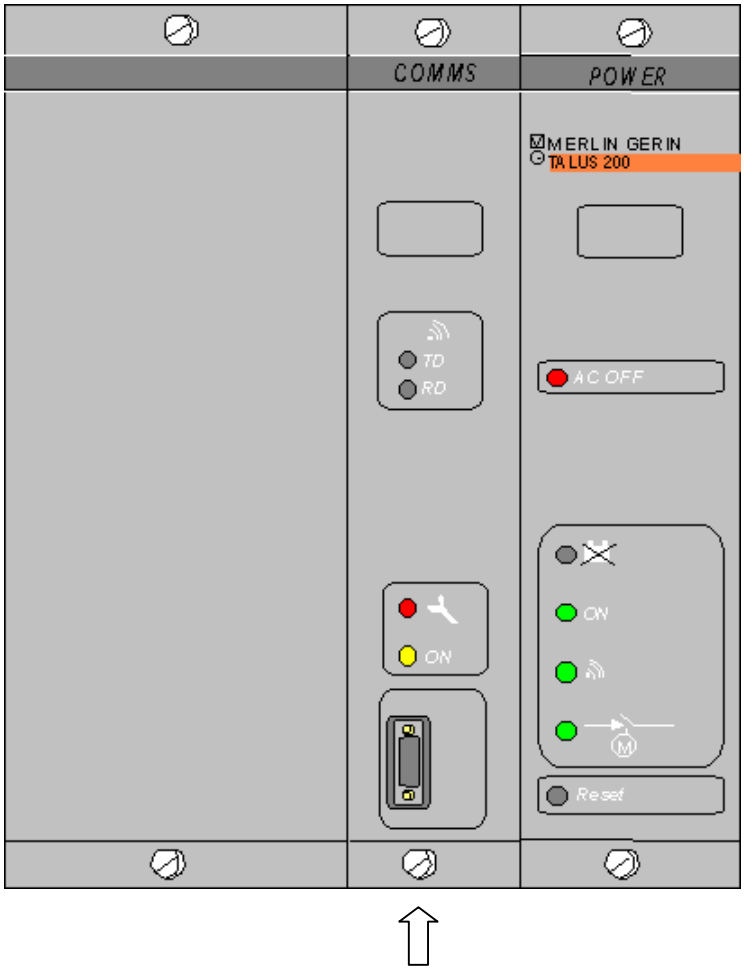
Select the appropriate impedance (600 Ω or High Z).

Ensure that the transmission cable shields are connected. The shields must be earthed at one point in the line (preferably on the PC side of the remote control station).

Communication module

Location

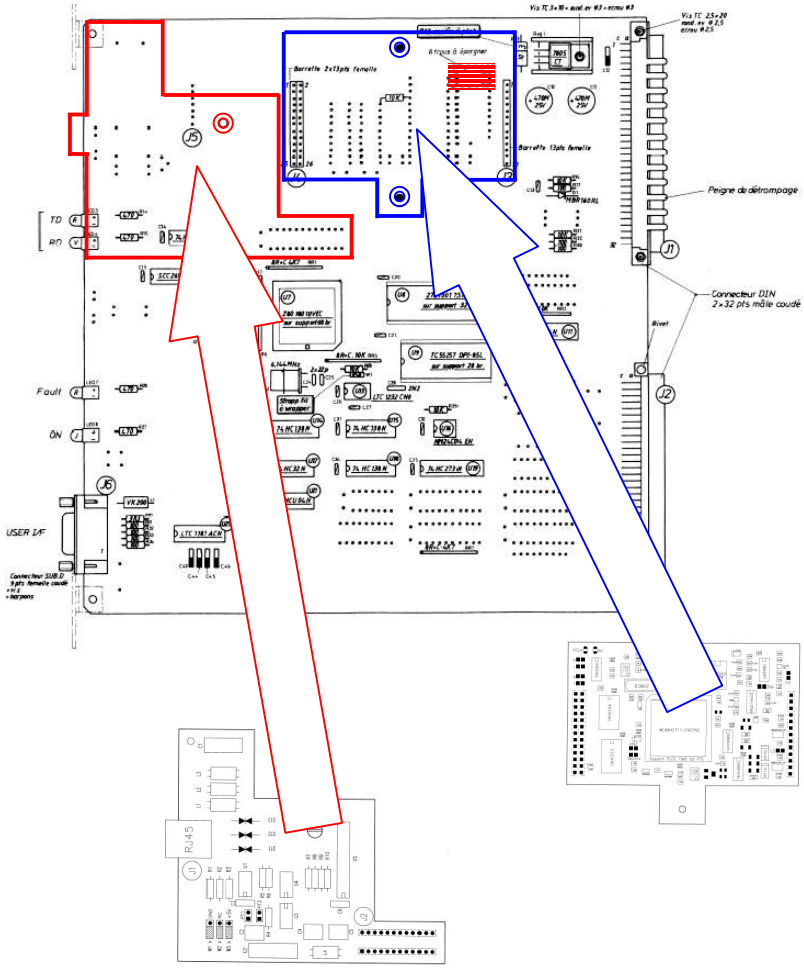
The COMMS module is installed in the T200 rack on the left of the power supply module.



Installing an interface or modem

The interface or modem (in the example below, an FSK radio modem) should be installed as outlined below in blue on the COMMS card (multimedia card). Ensure that the connectors are not offset. Attach the card using the screws supplied.

In the area outlined below in red, set straps ST1, ST2 and ST3, if required, according to the interface or modem concerned. These straps are not used for an RS232 interface. If an RS232 interface is installed, the straps are connected differently.



Installing an RS485 interface for a PM500 link

Replace the front panel with one that has a cutout for the RJ45 connector.
Install the interface on the COMMS card fitted with special connectors, as shown below in red. Ensure that the connectors are not offset. Attach the card using the screw supplied. For further information, see the "T200 I PowerMeter 500 Option User's Guide".

Secure transmission

The IEC specifies that the parity of transmitted characters must be even and that the interval between 2 characters in transmitted messages must be less than 1 bit. Secure transmission depends on compliance with these two rules. However, some transmission equipment does not comply with such requirements. This is the case with certain telephone modems (characters with no parity) or new transmission media such as digital radios or GSM (packet data transmission in which "gaps" are created between the characters in a message).
Consequently, to enable it to operate with such equipment, the T200 can be configured to accept:

- **no-parity characters, or parity characters other than even (odd, space),**
- **messages with "gaps" between characters.**

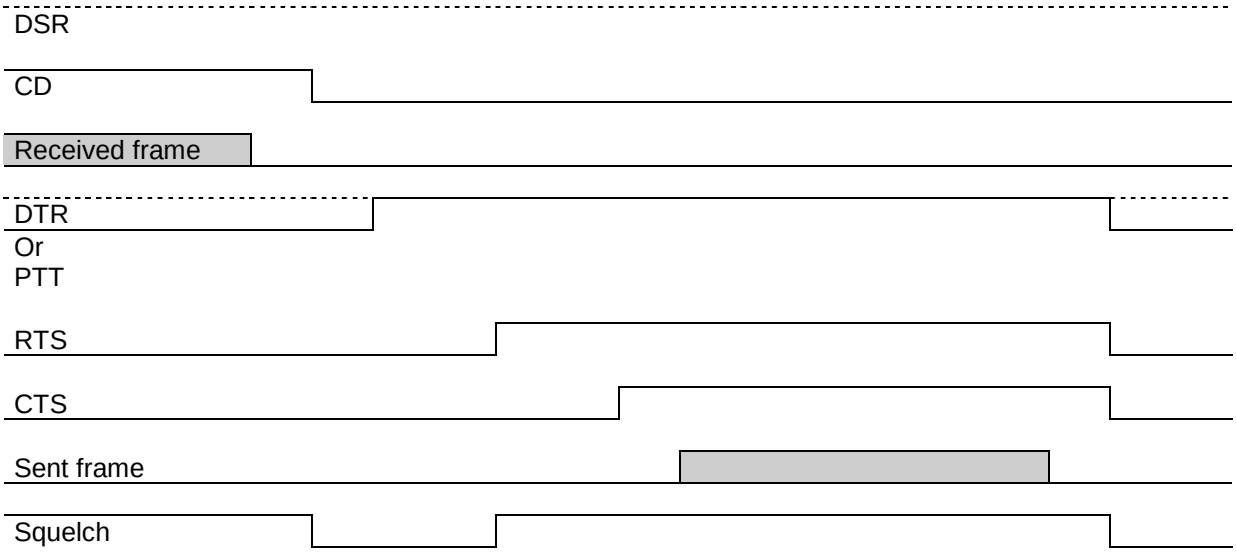
Such options should only be used under the following conditions:

- **the link between the T200 and the transmission equipment is as short as possible (for equipment within the enclosure) to prevent it being affected by interference.**
- **The transmission equipment itself ensures that all transmissions are secure.**

Transmission media not complying with the last two above-mentioned requirements should therefore not be used, unless the user takes responsibility for any defective or dangerous operations (loss of database, incorrect commands, etc.).
For example, a telephone modem that cannot handle the parity of the characters (online transmission, also with no parity) should not be used.
However, digital radio and GSM can generally be used, as they do not transmit messages as such online, but integrate them into secure transmission messages. The only risk of poor transmission is between the T200 and the equipment and there is practically no risk if such equipment is placed in the enclosure and the connection cabling is correctly installed. The only problem that may be encountered is a difficulty with resynchronisation at the beginning of a message when a transmission is disturbed (message interrupted and end of message lost).

Message transmission

The format of a transmitted message is as shown below:



The above signals may be used, depending on the medium.

- DSR (Data Set Ready): this signal may be issued (RS232 link) to inform the T200 that the control centre (or modem) is ready to transmit (or powered on).
- CD (Carrier Detect): this signal (when present) is used to confirm reception. It can also be used to indicate that the transmission network is busy.
- DTR (Data Terminal Ready) or Send command:
  DSR type operation: when the Control Centre is using DSR, DTR indicates that the T200 is ready to transmit (similar to DSR, but in the opposite direction).
  Send command type operation: the T200 uses this signal to switch a radio station to transmission mode when different transmission and carrier transmission commands are required.
- RTS (Request To Send): this signal controls carrier transmission.
- CTS (Clear To Send): when the T200 has issued a transmission request, the transmitter sometimes takes a certain amount of time to attain the power level required to send the messages. This is particularly the case with radio equipment. Hence, when the equipment is ready to transmit, it informs the T200 by increasing the CTS signal.
- Squelch: the equipment uses this signal in radio mode to inform the T200 that the radio link is busy.

Configurable signals and time delays

The T200 allows you to specify, if necessary, whether signals are to be used and if so, the various time delays between signals. The terms used by the configurator are listed below.

Signals

- Use of DSR:
  Confirms whether or not DSR is to be used.
- Use of CD:
  Confirms whether or not CD is to be used.
- Use of CTS:
  Confirms whether or not CTS is to be used.

Time delays

- Time delay before transmission:
  Minimum time delay between the time the last character of a message was received and the beginning of a transmission. It is only used in half-duplex mode. It avoids any signal overlap between receive and send, particularly carrier overlap in the case of radio. It can be also used when a modem requires a turnaround time. Less frequently, it can be used to release the SCADA from its send/receive tasks for a few moments.
- DTR – RTS time delay:
  Time delay to be observed between DTR and RTS. In radio mode (external equipment with modem), this generally corresponds to the time between PTT and carrier rise (the time required by the transmitter to reach the required power). If the command is unique to the radio equipment in question, this time should be set to 0.
- CTS time delay:
  When CTS is used after increasing RTS, the T200 waits for a certain specified time until CTS returns. This time is called the "CTS delay". If, after this period, CTS has not been confirmed, the T200 cancels the transmission.
- RTS (or CTS) time delay - message:
  Time delay between RTS (or CTS if this signal is used) and the start of message transmission. This time delay is typically used to define the stable carrier period required for it to be detected by the receiver.
  If required, when CTS is not available, the time needed to install the carrier can be added to resolve the problem caused by this signal being unavailable. Similarly, in the event of common PTT and RTS commands, the time required to power up the transmitter must be added.
- Message – RTS time delay:
  Minimum wait time, after sending a message, before RTS and DTR (or PTT) can be timed out. This time delay is specified by the receiver, using carrier detect to confirm reception.

Collisions in balanced mode

Description of the problem

Message collisions may occur in balanced mode. They are due to several transmitters being active at the same time (for example, several T200 transmitters, SCADA transmitter) in a multipoint transmission system. Such transmissions interfere with each other and the messages become incomprehensible, which may even block the system.
The longer and more numerous the transmission periods, the higher the probability of a collision. The probability of a collision therefore increases when a number of devices are in use, when a large amount of information is to be transmitted and when long frames and a low transmission speed are used.
In extreme cases, for example when a low-speed radio network is used with a very large number of high-capacity devices that may all call when a specific item of information is changed, it may be necessary to redesign the network, using, for example, several radio channels and distributing the devices amongst these different channels, or reverting to unbalanced mode management.

Proposed solution

The T200 recommends the use of a collision avoidance system as the best solution to this problem. This system requires a transmission to comply with the following rules:

- The T200 always indicates internally when the network is busy. For this purpose, it uses a network busy signal (carrier detection, squelch) and the internal transmission information.
- The T200 sends an immediate message acknowledgement to the Control Centre, if one is required.
- If a different type of message is to be sent, it checks whether the transmission system is free. When the system becomes free, it waits for a time period equal to:
  (Priority * Min. Random Delay) + Random Delay (value between Min. Random Delay and Max. Random Delay).
  "Priority", "Min. Random Delay" and "Max. Random Delay" will be configured.
  At the end of this period, the T200 checks that the network is free. Otherwise, it repeats the above operations.

- With some transmission systems, the network busy information supplied to the T200 is not always reliable. The signal from a carrier detector or squelch signal may be blocked. In fact, in radio mode, the detection settings configured when the equipment was commissioned may no longer be appropriate, depending on the propagation conditions (humidity, presence or absence of leaves on trees, and so on). According to the above explanation, if this signal is continuously present, the T200 can no longer transmit. "Max. Busy State Delay" will resolve this problem. This value is configurable. If the busy information time exceeds the time the T200 has to wait for the network to become available, the T200 assumes that the information is incorrect and that the network is free.

Configuration recommendations

- Collision avoidance system:
  This system should only be used when absolutely necessary, as it increases transmission times.
- Priority:
  Different priorities can be set for different T200s. This makes it possible to prioritise transmission from certain T200s as opposed to others.
  The lower the value set, the higher the priority of the T200.
  In general, different priorities are only defined if the information from some T200s is more urgent than that from other T200s. This is not usually the case. Maximum priority should then be assigned to all the T200s by setting the value to 0 (default value).
  Otherwise, set the top priority T200s to 0, the next highest priority T200s to 1, and so on, until the lowest priority group.
  If a large number of T200s do not need to be prioritised, they can be divided into different priority groups to make it easier to transfer information. However, as this "penalises" certain T200s as opposed to others, this procedure should only be used in extreme circumstances.
- Minimum random time interval:
  It is useful to set a low value to ensure a minimum wait time. However, this value must at least exceed a frame transmission time. As this time varies, transmission can be "ensured" by selecting the maximum frame transmission time, or greater "risks" can be taken, by selecting an average time. On-site experience will make it possible to set this value more accurately.

- Maximum random time interval:
  The greater the time interval, the greater the number of "transmission windows", which reduces the number of collisions during transfer. However, the greater the number of windows, the longer the probable wait time before transmission. It should therefore be set to a value equal to the minimum random time interval + the 2 to 4-window time interval, where the window time interval is the "average" or "maximum" frame transmission time (as per the above-mentioned criteria). Again, on-site experience will make it possible to set this parameter more accurately.

Notes:

- It is often useful to reduce the frame length when using the collision avoidance algorithm. In fact, this system is often used for radio transmission. Radio is however, a transmission medium that is frequently subject to interference. The longer the frame, the greater the risk of interference. The frame will have to be retransmitted in the event of interference. The greater the number of retransmissions, the greater the risk of collision. It is therefore preferable to restrict the length of the frames. It is obvious that more frames will be required to transmit the same amount of information, as the amount of information transmitted in each frame will be limited. However, in general, it is clear that limiting frames to an appropriate length increases the actual transfer rate (transmission rate of correctly received information). This length can be set in the configurator's "Interoperability (transmission)" screen.
- It is very important that the network busy information supplied to the T200 is reliable. In a difficult environment, the performance of the transmission equipment supplying correct information will be significantly higher.

General

The communication parameters are configured using the **T200 Configuration and diagnostic** software.

To do this, you will have to:

- Connect a PC to the communication module.
- With the PC running in DOS, insert the **T200 Configuration and diagnostic** floppy disc, type **A:MG,** then press **ENTER**.

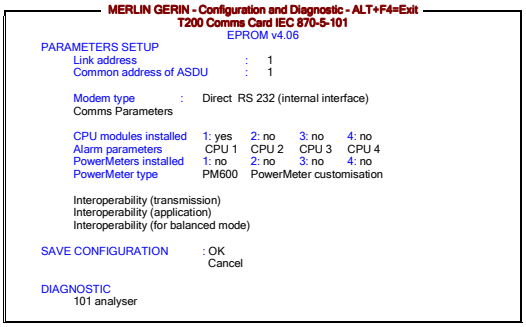
The main menu is displayed.

The **T200 User's Manual** describes how to use this software.

The default settings have been selected to meet most requirements. If you are not sure of the value to assign to a parameter, use the initial value. It will most probably be the correct one.

When an option has allowed you to declare that an element is not to be used, the items used to set the parameters associated with this element need not be entered.

Main menu



Link address:

- This is the "T200 number" to be used for the transmission. It can be any value between 0 and 65534. If the link address field is defined as a single octet, the highest number that can be used is 254.
- The default value is 1.

Common address of ASDU:

- This field is generally not used, but it must be present. The value often selected by the SCADAs is 0 or 1, or it is the same as the link address.
  However a value of 1 to 65534 can be used. If this field is defined as a single octet, the highest number that can be used is 254.
- The default value is 1.

Modem type:

- Many interfaces or modems are automatically detected by the T200. However, in some cases, various options can be selected.
  For example, the options available for a standard COMMS card are Direct RS232 (internal interface), Phone Line (external modem, Hayes commands), GSM (external modem, Hayes commands), Radio (external with modem), 1200/1400 Baud FFSK radio (internal modem).
- In the above example, the default option is Direct RS232 (internal interface)

Comms parameters:
Displays the menu used to set the communication parameters. This screen depends on the type of modem configured.

CPU modules installed:

- Declares the CPUs used (1 to 4) for the T200 I. Each CPU can be declared (yes) or not declared (no).
- By default, the configuration is "yes" for the 1st CPU and "no" for the others.

Note: some information is only available on CPU no. 1 (Local, etc.).

Alarm parameters CPU 1, CPU 2, CPU 3, CPU 4:
Displays the alarm elements configuration screen for the CPU in question.

PowerMeters installed:

- Declares the PowerMeters (1 to 4) used when this option is present. Enter "yes" to declare a PowerMeter, otherwise enter "no".
- By default, the configuration is "no" for all the PowerMeters.

PowerMeter type:

- Declares the model of the connected PowerMeter: PM600 or PM500.
- PM600 is selected by default.

PowerMeter customisation:
Displays the menu used to select the PowerMeter data to be transmitted.

Interoperability (transmission):
Calls the protocol-related transmission parameter configuration screen.

Interoperability (application):
Calls the application configuration menu for the protocol.

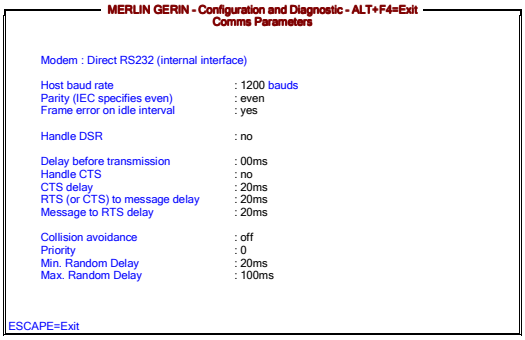
Interoperability (for balanced mode):
Displays the menu used to configure the transmission-specific elements in balanced mode.

Save configuration:
When the parameters have been selected, select "OK" to complete and save the configuration, then press "Enter". The "In progress…" text flashes and the COMMS card reboots with the new parameters.

When you do not want to keep the parameters you have selected since the last time the settings were confirmed, click on "Cancel" and press "Enter". The last parameters remain valid and they are displayed.
This procedure is recommended when you were in the middle of a configuration and left the configurator for a while, forgetting the values you had selected. It is better to start again from the beginning than to confirm incorrect parameters.

101 analyser:
Assists commissioning or maintenance. Displays the exchanges with the SCADA.

Communication parameters



Direct RS232 (internal interface)

Host baud rate:
- It can operate at 200, 300, 600, 1200, 2400, 4800 or 9600 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):
- Parity of the characters in send mode. Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:
- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Handle DTR:
- Select "yes" if the T200 is to supervise the link using DTR.
- The default value is "no".

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  The CC can generally support full-duplex transmission. Otherwise, it can normally receive data as soon as it has finished transmitting. 0 ms is therefore a suitable value.
- The default value is 0 ms.

Handle CTS:

- Select "yes" if you want the T200 to use CTS.
  There is usually no need to take CTS into account.
- The default value is "no".

CTS delay:

- Varies between 20 and 500 ms in increments of 10 ms.
  As high speeds are often used with RS232, a short time delay is sufficient.
- The default setting is 20 ms.

RTS (or CTS) to message delay:

- The possible values range from 0 to 500 ms.
  Sometimes, the message box is used to confirm that the characters have been received. Low values, such as 20 ms or even 0 ms, can be used with high speeds.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
  For the above-mentioned reasons, a very short time-interval is sufficient (20 ms, or 0 ms).
- The default value is 20 ms.

Collision avoidance:

- Simply select "off" to deactivate the collision avoidance system. Otherwise, select the signal to be used to detect the transmission busy state, "using CD" or "using Squelch". In this case, "using Squelch" refers to the signal connected to RI on the RS232 port.
- The default setting is "off".

As the RS232 links are point-to-point, "off" is therefore the appropriate setting. However, some adapters allow you to work with several T200s on the same link. In this case, the collision avoidance system can be enabled.

Priority:

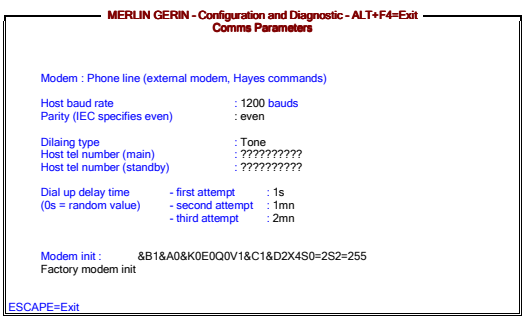
- The priority setting can vary between 0 and 10.
  In most cases, it is not necessary to set different priorities for the different RTUs, as the random time-interval is sufficient to minimise collisions.
- The default priority value is 0.

Min. Random Delay:

- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.



Phone Line (external modem, Hayes commands)

Host baud rate:

- It can operate at 200, 300, 600, 1200, 2400, 4800 or 9600 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):

- Parity of the characters in send mode. Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Dialling type:

- Select the type of dialling. You can select "Tone" (dial-tone multifrequency) or "Pulse" (pulse dialling).
- The default setting is "Tone".

Host tel number (main):

- Main telephone number used by the T200 to send alarms to the remote control station.
  Maximum 15 characters.
  The telephone number can generally contain the following dialling options (depending on the external modem used):
  comma: 2-second pause.
  / (slash): 125-millisecond pause.
  W: wait for a second tone before continuing to dial. This applies to a modem that has to dial a number to obtain an outside line.
  @: wait for the line to be silent for 5 s before dialling the rest of the number.
- Initialised at ????????? (no number)

Host tel number (standby):

- Secondary telephone number used by the T200 to send alarms to the remote control station when the main telephone number is not operational.
  Maximum 15 characters.
  The dialling options described for "Host tel number (main)" can be used.
- Initialised at ????????? (no number)

Dial up delay time:
The T200 alarm call procedure is as follows:
– the T200 waits for a certain specified time before making a first attempt to dial. This time delay may be necessary to ensure that the devices with alarms set for the same condition do not all call the CC simultaneously.
– if the first attempt fails, the T200 waits for a second specified time before trying again.
– if the second attempt fails, the T200 waits for a third specified time before making a final attempt to dial.
First attempt:
- Can be set to 0 - 1 minute in 1-second increments.
- Default value: 1 s.

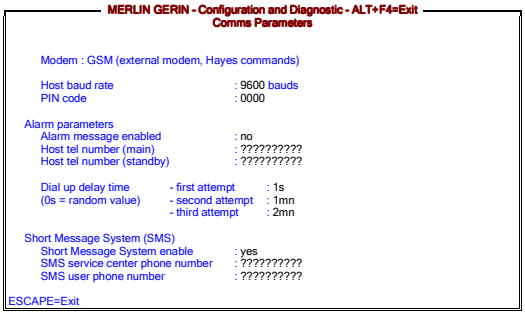
"0" sets a random time period of between 0 and 1 minute.
Second attempt:
- Can be set to 0 - 5 minutes in 1-minute increments.
- Default value: 1min.

"0" sets a random time period of between 1 and 5 minutes.
Third attempt:
- Can be set to 0 - 10 minutes in 1-minute increments.
- Default value: 2 min.

"0" sets a random time period of between 1 and 10 minutes.

Modem init:
- Hayes modem initialisation command.
  Maximum 40 characters.
  Note: DO NOT PLACE the AT command at the beginning of the initialisation command. The T200 will send it automatically to the modem before the configured string.
- The default string is:
  &B1&A0&K0E0Q0V1&C1&D2X4S0=2S2=255.
  Initialisation string commands:
  &B1: Fixed serial port bit rate (mandatory command). The modem communicates with the T200 at the speed set in the "Comms parameters" menu.
  E0: Echo deactivated.
  Q0: Displays the result codes (mandatory command).
  V1: Result code in words (mandatory command).
  &C1: Normal CD (DCD) signal processing.
  &D2: Normal CPD (DTR) signal processing.
  X4: Activates the X4 result code set.
  S0=2: Automatic reply after 2 rings (mandatory for the European standard).
  S2=255: Deactivates escape code +++ (mandatory command, as the transmission is in binary).

Factory modem init:
- Hayes modem default initialisation command.
  When this option is confirmed, a U.S. Robotics type initialisation command is assigned to the "Modem init" parameter (factory setting). This command is valid for most modems. The string is defined above.



GSM (external modem, Hayes commands)

Host baud rate:

- It can operate at 200, 300, 600, 1200, 2400, 4800 or 9600 Baud.
- The default value is 9600 Baud.

PIN code:

- The PIN code is configured in the SIM card.
- The default setting is 0000.

If this code is not identical to the one configured in the SIM card, the "GSM SIM card failure" error message appears in the "Equipment States" menu.
Caution: after three unsuccessful attempts, the SIM card is blocked. It must then be reactivated by another device (for example a mobile phone), as the T200 cannot be used to unblock a SIM card.
Refer to the unblocking procedure in the SIM card user guide.

Alarm parameters:
Alarm message enabled:

- Yes: the alarms detected by the T200 are transmitted to the remote control station.
  No: the alarms detected by the T200 are not transmitted to the remote control station.
- The default value is “no”.

Note: alarms can be sent individually to the remote control station and as a mini-message to another GSM device. In this case, the T200 first sends the mini-message and then the alarm to the remote control station.
Host tel number (main):

- Main telephone number used by the T200 to send alarms to the remote control station.
  Maximum 15 characters.
- Initialised at ????????? (no number)

Host tel number (standby):

- Secondary telephone number used by the T200 to send alarms to the remote control station when the main telephone number is not operational.
  Maximum 15 characters.
- Initialised at ????????? (no number)

Dial up delay time:
The T200 alarm call procedure is as follows:
– the T200 waits for a certain specified time before making a first attempt to dial. This time delay may be necessary to ensure that the devices with alarms set for the same condition do not all call the CC simultaneously.
– if the first attempt fails, the T200 waits for a second specified time before trying again.
– if the second attempt fails, the T200 waits for a third specified time before making a final attempt to dial.
First attempt:
- Can be set to 0 - 1 minute in 1-second increments.
- Default value: 1 s.

"0" sets a random time period of between 0 and 1 minute.
Second attempt:
- Can be set to 0 - 5 minutes in 1-minute increments.
- Default value: 1 min.

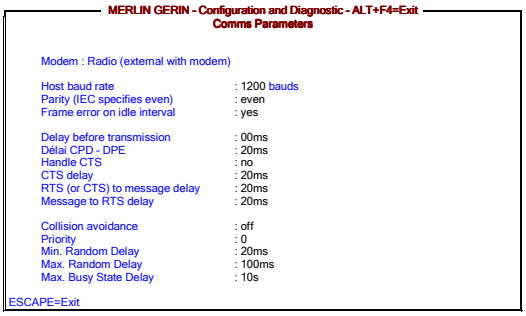
"0" sets a random time period of between 1 and 5 minutes.
Third attempt:
- Can be set to 0 - 10 minutes in 1-minute increments.
- Default value: 2 min.

"0" sets a random time period of between 1 and 10 minutes.

Short Message System (SMS):
SMS activated:
- Yes: the alarms detected by the T200 are sent as mini-messages to another GSM device (for example, a mobile phone).
  No**:** the alarms detected by the T200 are not sent as mini-messages.
  Note: alarms can be sent individually to the remote control station and as a mini-message to another GSM device. In this case, the T200 first sends the mini-message and then the alarm to the remote control station.
- The default value is "no".

SMS service center phone number:
- The mini-message server centre telephone number can be saved.
  Refer to the SIM card user guide for this number.
  Note: the number can be saved in its "international format". For example, for 06 89 00 40 00, you can directly enter +44 6 89 00 40 00 to allow this number to be used in France or abroad.
- The default setting is ?????????? (no number)

SMS user phone number:
- The telephone number of the GSM phone to which the mini-messages are to be sent can be saved.
  Note: the number can be saved in its "international format". For example, for 06 89 00 40 00, you can directly enter +44 6 89 00 40 00 to allow this number to be used in France or abroad.
- The default setting is ?????????? (no number)



Radio (external with modem)

Host baud rate:

- It can operate at 200, 300, 600, 1200, 2400, 4800 or 9600 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):

- Parity of the characters in send mode. Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  To avoid carrier overlap, if required, set this value equal to or greater than the carrier holdover after the last character of a message has been received.
- The default value is 0 ms.

DTR to RTS delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Handle CTS:

- Select "yes" if you want the T200 to use CTS.
  There is usually no need to take CTS into account.
- The default value is "no".

CTS delay:

- The value can vary between 20 and 500 ms in increments of 10 ms. It should be set according to the radio modem used.
- The default setting is 20 ms.

RTS (or CTS) to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Simply select "off" to deactivate the collision avoidance system. Otherwise, select the signal to be used to detect the transmission busy state, "using CD" or "using Squelch". Whenever possible, use Squelch, which is generally less sensitive to interference than carrier detection.
- The default setting is "off".

Priority:

- The priority setting can vary between 0 and 10.
  In most cases, it is not necessary to set different priorities for the different RTUs, as the random time-interval is sufficient to minimise collisions.
- The default priority value is 0.

Min. Random Delay:

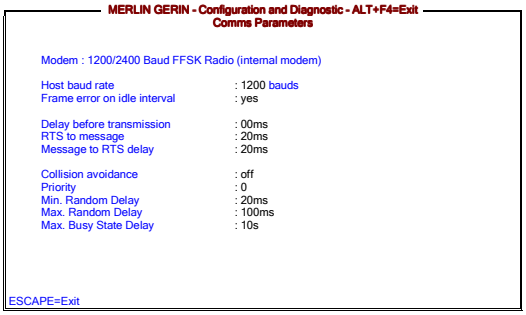
- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.

Max. Busy State Delay:

- Can be set from 1 s to 10 min.
  10 s is usually appropriate.
- The default value is 10 s.



1200/2400 Baud FFSK radio (internal modem)

Host baud rate:

- It can operate at 1200 or 2400 Baud.
- The default value is 1200 Baud.

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  To avoid carrier overlap, if required, set this value equal to or greater than the carrier holdover after the last character of a message has been received.
- The default value is 0 ms.

RTS to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Simply select "off" to deactivate the collision avoidance system. Otherwise, select the signal to be used to detect the transmission busy state, "using CD" or "using Squelch". Whenever possible, use Squelch, which is generally less sensitive to interference than carrier detection.
- The default setting is "off".

Priority:

- The priority setting can vary between 0 and 10.
  In most cases, it is not necessary to set different priorities for the different RTUs, as the random time-interval is sufficient to minimise collisions.
- The default priority value is 0.

Min. Random Delay:

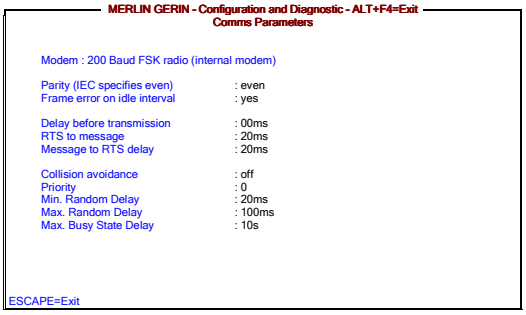
- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.

Max. Busy State Delay:

- Can be set from 1 s to 10 min. 10 s is usually appropriate.
- The default value is 10 s.



200 Baud FSK radio (internal modem)

Parity (IEC specifies even):

- Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  To avoid carrier overlap, if required, set this value equal to or greater than the carrier holdover after the last character of a message has been received.
- The default value is 0 ms.

RTS to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Select "off" to deactivate the collision avoidance system. Otherwise, select the signal to be used to detect the transmission busy state, "using CD" or "using Squelch". Whenever possible, use Squelch, which is generally less sensitive to interference than carrier detection.
- The default setting is "off".

Priority:

- The priority setting can vary between 0 and 10.
- The default priority value is 0.

Min. Random Delay:

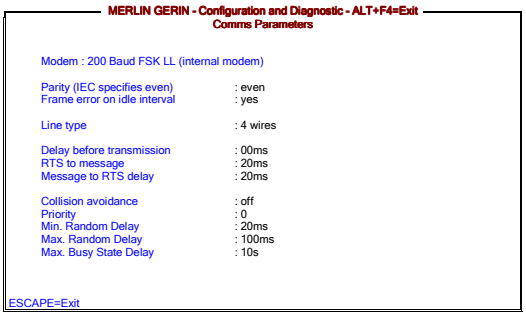
- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.

Max. Busy State Delay:

- Can be set from 1 s to 10 min.
  10 s is usually appropriate.
- The default value is 10 s.



200 Baud FSK LL (internal modem)

Parity (IEC specifies even):

- Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Line type:

- Select 2 wires or 4 wires.
- The default value is 4 wires.

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  Avoids carrier overlap.
- The default value is 0 ms.

RTS to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Select "off" to deactivate the collision avoidance system.
  Otherwise select "using CD".
- The default setting is "off".

Priority:

- The priority setting can vary between 0 and 10.
- The default priority value is 0.

Min. Random Delay:

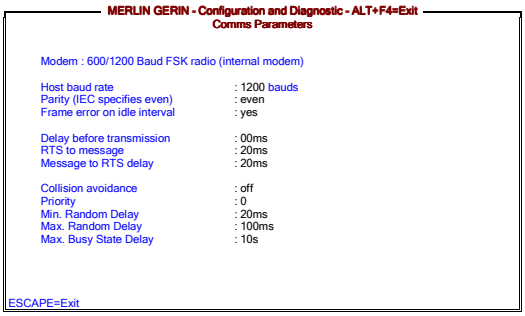
- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.

Max. Busy State Delay:

- Can be set from 1 s to 10 min.
  10 s is usually appropriate.
- The default value is 10 s.



600/1200 Baud FSK Radio (internal modem)

Host baud rate:

- It can operate at 600 or 1200 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):

- Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Delay before transmission:

- Can be set to between 0 and 2550 ms.
  To avoid carrier overlap, if required, set this value equal to or greater than the carrier holdover after the last character of a message has been received.
- The default value is 0 ms.

RTS to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Select "off" to deactivate the collision avoidance system. Otherwise, select the signal to be used to detect the transmission busy state, "using CD" or "using Squelch". Whenever possible, use Squelch, which is generally less sensitive to interference than carrier detection.
- The default setting is "off".

Priority:

- The priority setting can vary between 0 and 10.
- The default priority value is 0.

Min. Random Delay:

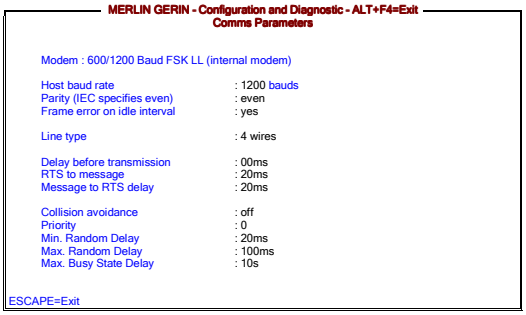
- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.

Max. Busy State Delay:

- Can be set from 1 s to 10 min.
  10 s is usually appropriate.
- The default value is 10 s.



600/1200 Baud FSK LL (internal modem)

Host baud rate:

- It can operate at 600 or 1200 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):

- Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Line type:

- Select 2 wires or 4 wires.
- The default value is 4 wires.

Delay before transmission:

- Can be set to between 0 and 2550 ms. Avoids carrier overlap.
- The default value is 0 ms.

RTS to message delay:

- The possible values range from 0 to 500 ms.
- The default value is 20 ms.

Message to RTS delay:

- This time interval can vary between 0 and 500 ms.
- The default value is 20 ms.

Collision avoidance:

- Select "off" to deactivate the collision avoidance system (point-to-point). Otherwise select "using CD".
- The default setting is "off".

Priority:

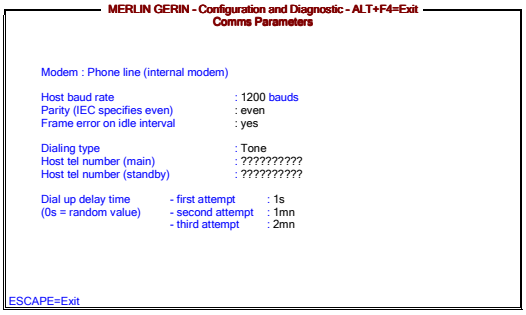
- The priority setting can vary between 0 and 10.
- The default priority value is 0.

Min. Random Delay:

- 20 to 500 ms.
- The default value is 20 ms.

Max. Random Delay:

- 20 ms to 5 s.
- The default value is 100 ms.



Phone line (internal modem)

Host baud rate:

- It can operate at 600 or 1200 Baud.
- The default value is 1200 Baud.

Parity (IEC specifies even):

- Parity of the characters in send mode. Select "none", "space", "even" or "odd".
  The IEC 870-5-101 protocol specifies even parity to ensure secure transmission.
- **The default setting is "even".**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Frame error on idle interval:

- The options available are "yes" or "no".
  The IEC standard specifies that if there is an interval of more than one bit between two characters, the message must be rejected.
- **"Yes" is selected by default.**

Do not change this setting unless absolutely necessary; if you do change it, you must ensure that certain rules are complied with (see Secure transmission).

Dialling type:

- Select the type of dialling. You can select "Tone" (dial-tone multifrequency) or "Pulse". (pulse dialling).
- The default setting is "Tone".

Host tel number (main):

- Main telephone number used by the T200 to send alarms to the remote control station.
  Maximum 15 characters.
  Initialised at ????????? (no number)

Host tel number (standby):

- Secondary telephone number used by the T200 to send alarms to the remote control station when the main telephone number is not operational.
  Maximum 15 characters.
  Initialised at ????????? (no number)

Dial up delay time:
The T200 alarm call procedure is as follows:
– the T200 waits for a certain specified time before making a first attempt to dial. This time delay may be necessary to ensure that the devices with alarms set for the same condition do not all call the CC simultaneously.
– if the first attempt fails, the T200 waits for a second specified time before trying again.
– if the second attempt fails, the T200 waits for a third specified time before making a final attempt to dial.
First attempt:

- It can be set to 0 - 1 minute in 1-second increments.
- Default value: 1 s.

"0" sets a random time period of between 0 and 1 minute.
Second attempt:

- Can be set to 0 - 5 minutes in 1-minute increments.
- Default value: 1 min.

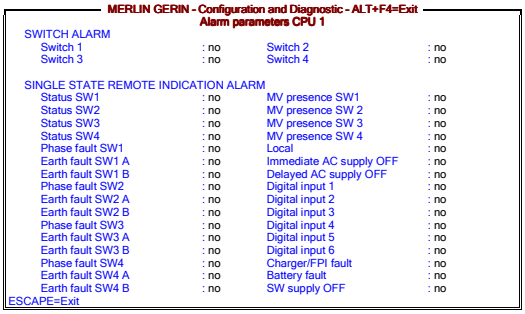
"0" sets a random time period of between 1 and 5 minutes.
Third attempt:

- Can be set to 0 - 10 minutes in 1-minute increments.
- Default value: 2 min.

"0" sets a random time period of between 1 and 10 minutes.

Alarm information

In balanced mode, the T200 can act as the calling party when information is changed. In telephone and GSM modes, to limit the number of calls and thus the cost of communications, or to restrict traffic, it is possible to select the information that will allow a call to be initiated. This can be done via the following screens.


MERLIN GERIN - Configuration and Diagnostic - ALT+F4=Exit
Alarm parameters CPU 1

SWITCH ALARM

Switch 1	: no	Switch 2	: no
Switch 3	: no	Switch 4	: no

SINGLE STATE REMOTE INDICATION ALARM

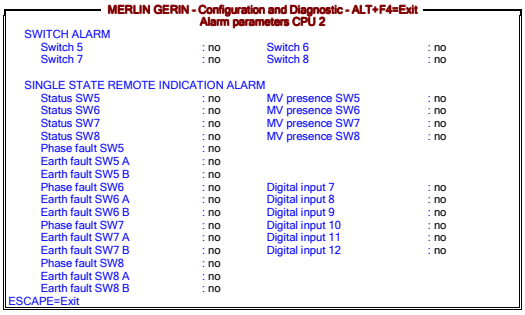
Status SW1	: no	MV presence SW1	: no
Status SW2	: no	MV presence SW 2	: no
Status SW3	: no	MV presence SW 3	: no
Status SW4	: no	MV presence SW 4	: no
Phase fault SW1	: no	Local	: no
Earth fault SW1 A	: no	Immediate AC supply OFF	: no
Earth fault SW1 B	: no	Delayed AC supply OFF	: no
Phase fault SW2	: no	Digital input 1	: no
Earth fault SW2 A	: no	Digital input 2	: no
Earth fault SW2 B	: no	Digital input 3	: no
Phase fault SW3	: no	Digital input 4	: no
Earth fault SW3 A	: no	Digital input 5	: no
Earth fault SW3 B	: no	Digital input 6	: no
Phase fault SW4	: no	Charger/FPI fault	: no
Earth fault SW4 A	: no	Battery fault	: no
Earth fault SW4 B	: no	SW supply OFF	: no

ESCAPE=Exit

CPU 1

Switch 1
to
SW supply OFF:

- Select "yes" or "no" according to whether or not you want the call to be authorised.
- The default setting for each option is "no".


MERLIN GERIN - Configuration and Diagnostic - ALT+F4=Exit
Alarm parameters CPU 2

SWITCH ALARM

Switch 5	: no	Switch 6	: no
Switch 7	: no	Switch 8	: no

SINGLE STATE REMOTE INDICATION ALARM

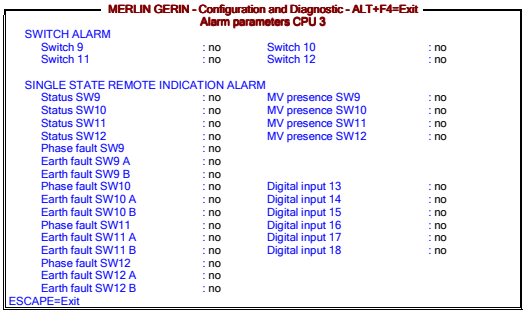
Status SW5	: no	MV presence SW5	: no
Status SW6	: no	MV presence SW6	: no
Status SW7	: no	MV presence SW7	: no
Status SW8	: no	MV presence SW8	: no
Phase fault SW5	: no		
Earth fault SW5 A	: no		
Earth fault SW5 B	: no		
Phase fault SW6	: no	Digital input 7	: no
Earth fault SW6 A	: no	Digital input 8	: no
Earth fault SW6 B	: no	Digital input 9	: no
Phase fault SW7	: no	Digital input 10	: no
Earth fault SW7 A	: no	Digital input 11	: no
Earth fault SW7 B	: no	Digital input 12	: no
Phase fault SW8	: no		
Earth fault SW8 A	: no		
Earth fault SW8 B	: no		

ESCAPE=Exit

CPU 2

Switch 5
to
Digital input 12:

- Select "yes" or "no" according to whether or not you want the call to be authorised.
- The default setting for each option is "no".


MERLIN GERIN - Configuration and Diagnostic - ALT+F4=Exit
Alarm parameters CPU 3

SWITCH ALARM

Switch 9	: no	Switch 10	: no
Switch 11	: no	Switch 12	: no

SINGLE STATE REMOTE INDICATION ALARM

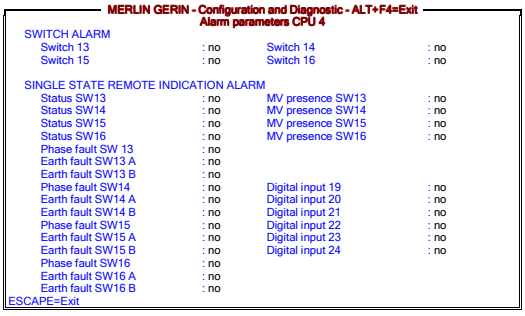
Status SW9	: no	MV presence SW9	: no
Status SW10	: no	MV presence SW10	: no
Status SW11	: no	MV presence SW11	: no
Status SW12	: no	MV presence SW12	: no
Phase fault SW9	: no		
Earth fault SW9 A	: no		
Earth fault SW9 B	: no		
Phase fault SW10	: no	Digital input 13	: no
Earth fault SW10 A	: no	Digital input 14	: no
Earth fault SW10 B	: no	Digital input 15	: no
Phase fault SW11	: no	Digital input 16	: no
Earth fault SW11 A	: no	Digital input 17	: no
Earth fault SW11 B	: no	Digital input 18	: no
Phase fault SW12	: no		
Earth fault SW12 A	: no		
Earth fault SW12 B	: no		

ESCAPE=Exit

CPU 3

Switch 9
to
Digital input 18:

- Select "yes" or "no" according to whether or not you want the call to be authorised.
- The default setting for each option is "no".


MERLIN GERIN - Configuration and Diagnostic - ALT+F4=Exit
Alarm parameters CPU 4

SWITCH ALARM

Switch 13	: no	Switch 14	: no
Switch 15	: no	Switch 16	: no

SINGLE STATE REMOTE INDICATION ALARM

Status SW13	: no	MV presence SW13	: no
Status SW14	: no	MV presence SW14	: no
Status SW15	: no	MV presence SW15	: no
Status SW16	: no	MV presence SW16	: no
Phase fault SW 13	: no		
Earth fault SW13 A	: no		
Earth fault SW13 B	: no		
Phase fault SW14	: no	Digital input 19	: no
Earth fault SW14 A	: no	Digital input 20	: no
Earth fault SW14 B	: no	Digital input 21	: no
Phase fault SW15	: no	Digital input 22	: no
Earth fault SW15 A	: no	Digital input 23	: no
Earth fault SW15 B	: no	Digital input 24	: no
Phase fault SW16	: no		
Earth fault SW16 A	: no		
Earth fault SW16 B	: no		

ESCAPE=Exit

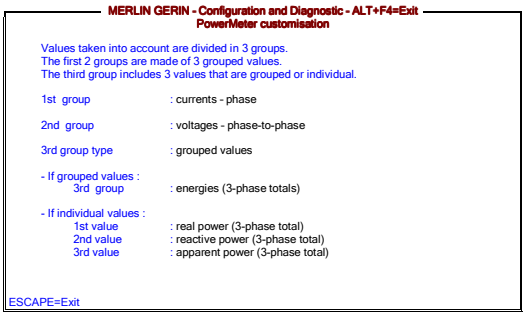
CPU 4

Switch 13
to
Digital input 24:

- Select "yes" or "no" according to whether or not you want the call to be authorised.
- The default setting for each option is "no".

PowerMeter customisation

The type of PowerMeter must first be selected in the main menu, as this affects the items displayed.
The menu is used to select the information the PowerMeters can be asked to supply at the end of a transmission.
This information is divided into 3 groups. The first two groups are made up of three grouped values (for example, 3 instantaneous currents, phase, etc.). The third group consists of three grouped values (for example, 3 power factors, phase) or individual values (for example neutral current, frequency and total active power).



PM600

1st group,
2nd group,
3rd group:
The third group is only used if "grouped values" is selected for the type of group:

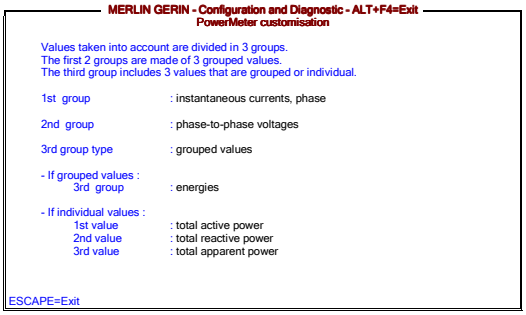
- The options available are "currents – phase", "currents unbalances – phase", "voltages – phase to phase", "voltages - phase-to-neutral", "true power factors – phase", "real powers – phase", "reactive powers – phase", "apparent powers – phase", "energies (3-phase total)".
- The default settings are "currents – phase" for the first set, "voltages – phase to phase" for the second and "energies (3-phase total)" for the third.

3rd group type:

- This is where you declare whether the third group is to consist of "grouped values" or "individual values".
- The default setting is "grouped values".

1st value,
2nd value,
3rd value:
These three options are only used if "individual values" is selected for the type of third group.

- Select from "frequency", "current unbalance - worst", "true power factor (3-phase total)", "real power (3-phase total)", "reactive power (3-phase total)", "apparent power (3-phase total)", "apparent energy (3-phase total)", "real energy (3-phase total)", "reactive energy (3-phase total)", "current – calculated neutral", "THD/thd A voltage", "max. current unbalance - worst", "max. true power factor - total", "max. real power - total", "max. reactive power - total", "max. apparent power - total", "max. THD/thd voltage - phase A".
- The default settings are real power (3-phase total)" for the first group, "reactive power (3-phase total)" for the second and "apparent power (3-phase total)" for the third.



PM500

1st group,
2nd group,
3rd group:
The third group is only used if "grouped values" is selected for the type of group:

- The options available are "instantaneous currents, phase", "maximum demand currents, phase", "phase-to-phase voltages", "phase-to-neutral voltages", "power factors, phase", "active powers, phase", "reactive powers, phase", "apparent powers, phase", "energies"
- The default settings are "instantaneous currents, phase" for the first group, "phase-to-phase voltages" for the second and "energies" for the third.

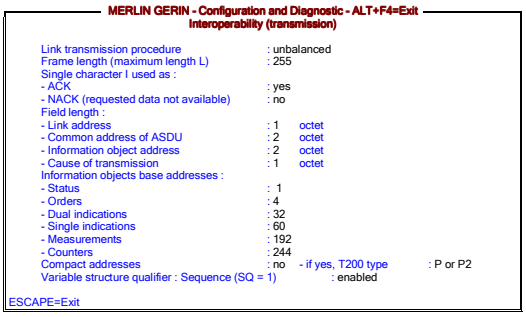
3rd group type:

- This is where you declare whether the third group is to consist of "grouped values" or "individual values".
- The default setting is "grouped values".

1st value,
2nd value,
3rd value:
These three values are only used if "individual values" is selected for the type of third group.

- Select from "frequency", "demand current in neutral", "total power factor", "total active power", "total reactive power", "total apparent power", "apparent energy", "active energy", "reactive energy", "neutral current", "THD phase 1 to neutral", "total demand active power", "max. demand cur. in the neutral", "max. demand active power", "max. demand reactive power", "max. demand apparent power", "current THD in the neutral".
- The default setting is "total active power" for the first option, "total reactive power" for the second and "total apparent power" for the third.

To find the correct definition of the terms used above, see the respective PM600 and PM500 PowerMeter manuals.



Interoperability (transmission)

Link transmission procedure:

- As specified in IEC 870-5-101. Balanced (Master-master) or unbalanced (master-slave).
- The default setting is "unbalanced".

Frame length (maximum length L):

- As specified in IEC 870-5-101. The values range from 11 to 255. Select a value less than 255 if shorter frames are required (see the note on frame length - also applies to unbalanced mode - in the Notes in the section entitled Collisions in balanced mode).
- The default value is 255 octets.

Single character I used as ACK:

- Select "yes" if you want to use the single character I (E5) as an ACK, otherwise a fixed-length frame is used.
  In radio mode, "no" is recommended, as the character I (E5) is easily generated by noise.
- The default setting is "yes".

Single character I used as NACK (requested data not available):

- Select "yes" if you want to use the single character I (E5) as a NACK (requested data not available), otherwise a fixed-length frame is used.
  In radio mode, "no" is recommended, as the character I (E5) is easily generated by noise.
- The default setting is "no".

Link address:

- Defines the length of the link address field (1 or 2 octets).
- The default value is 1.

Common address of ASDU:

- Defines the length of the ASDU common address field (1 or 2 octets).
- The default value is 2.

Information object address:

- Defines the length of the object information address field (1, 2 or 3 octets).
- The default value is 2.

Cause of transmission:

- Defines the length of the cause of transmission field (1 or 2 octets).
- The default value is 1.

These four parameters must be the same on the Control Centre side as on the RTU side.

Information object base addresses:
The value of the information object addresses is the object type base address + relative address. The relative addresses are given in the tables in the Information object addresses section. The base addresses can be defined by configuration. The following rules must be complied with:

- An object cannot have a null address.
- The addresses obtained must be less than the maximum possible value (255 for a 1-octet field, 65535 for a 2-octet field, 16777215 for a 3-octet field).
- The addresses must be unique (no overlap between the address areas of different types - except in the case of commands)

Status:

- The values can range from 0 to 255.
- The default value is 1.

Orders:

- The values can range from 0 to 255.
- The default value is 4.

Dual indications:

- The values can range from 0 to 255.
- The default value is 32.

Single indications:

- The values can range from 0 to 255.
- The default value is 60.

Measurements:

- The values can range from 0 to 255.
- The default value is 192.

Counters:

- The values can range from 0 to 255.
- The default value is 244.

Compact addresses:

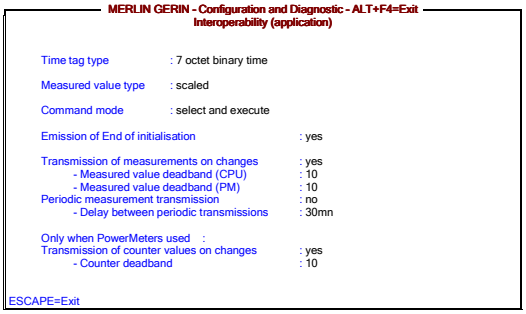
- Select "yes" or "no" according to whether or not you want to use a specific type of addressing called "compact", which limits the amount of addressing space and the amount of information transferred.
- The default setting is "no".

If yes, T200 type:

- When "compact" addressing is selected, you must specify the type of T200, as this type of addressing varies according to the T200 used. See Information object addresses.
- The default value is "P or P2".

Variable structure qualifier: Sequence (SQ = 1):

- When "enabled" is selected, the T200 tries to shorten the frames when the same types of objects are to be sent in a message.
  Detailed explanation: when SQ = 1 is enabled, the ASDUs, with the same TID and COT are coded, when possible, as a sequence of information elements in an information object (SQ = 1), or as a sequence of information objects (SQ = 0) (for further details, see the M_SP_NA_1 coding in IEC 870-5-101, subclause 7.3.1.1). As some PCs do not understand messages in which SQ = 1, this option can be disabled.
- The default option is "enabled".



Interoperability (application)

Time tag type:

- This option is used to send spontaneous status changes without a time tag or with a time tag using binary time on 3 or 7 octets (CP24Time2a or CP56Time2a).
  For example, a single point change can be transmitted in the format ASDU M_SP_NA_1, M_SP_TA_1 or M_SP_TB_1, according to the option selected.
  Note: binary time on 2 octets is not used.
- The default option is "7-octet binary time". Binary time on 3 octets consists only of minutes and milliseconds, whereas 7-octet binary time gives the year, month, day (of month), hours, minutes and milliseconds.

Measured value type:

- "Normalized" or "scaled" can be selected.
- The default setting is "scaled".

Command mode:

- There are two options: "Direct" and "Select and execute". Choose "Select and execute" if you want the RTU to operate in Select Before Execute mode.
  Note that this option increases the number of messages between the PC and the RTU.
- The default setting is "Select and execute".

Emission of End of initialisation:

- Select "no" if you do not want the T200 to send an "End of initialisation" (M_EI_NA_1) message after startup (when the SCADA does not support this information).
- The default setting is "yes".

Transmission of measurements on changes:

- Measurements can be transmitted or inhibited subsequent to changes by selecting "yes" or “no".
- The default setting is "yes".

Measured value deadband (CPU):

- In the case of measurements obtained from the CPU cards, this value is the difference required between the last value transmitted and the current value for an M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1 or M_ME_TE_1 string to be generated (depending on the option configured) where COT = spontaneous. It can vary between 1 and 10,000.
- The default value is 10.

Measured value deadband (PM):

- In the case of measurements obtained from PowerMeters (when the option is installed), this value is the difference required between the last value transmitted and the current value for an M_ME_NA_1, M_ME_TA_1, M_ME_TD_1, M_ME_NB_1, M_ME_TB_1 or M_ME_TE_1 string to be generated (depending on the option configured) where COT = spontaneous. It can vary between 1 and 10,000.
- The default value is 10.

Periodic measurement transmission:

- Measurements can be transmitted periodically or their transmission can be inhibited by selecting "yes" or no" respectively.
- The default setting is "no".

Delay between periodic transmissions:

- This time interval is the time between two consecutive measurement transmissions. It can vary between 1 s and 4 h.
- The default value is 30 minutes.

Only when PowerMeters used:

Transmission of counter values on changes:

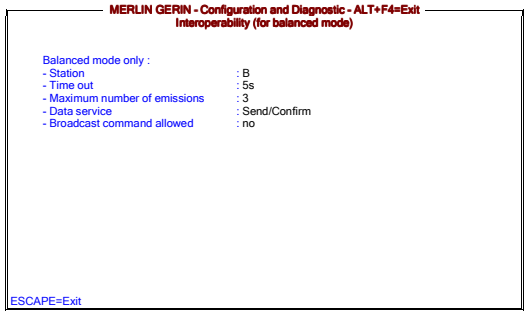
- Counter values can be transmitted or inhibited subsequent to changes by selecting "yes" or no" respectively.
- The default setting is "yes".

Counter deadband:

This option is only used when the optional PowerMeters are installed.

- This value is the difference required between the last value transmitted and the current value for an M_IT_NA_1, M_IT_TA_1 or M_IT_TB_1 string to be generated (depending on the option configured) where COT = spontaneous. It can vary between 1 and 10,000.
- The default value is 10.

Interoperability (for balanced mode)



Balanced mode only:

The balanced mode requires additional information:

Station:

- As specified in IEC 870-5-101. RTUs are usually type B stations, but it may be necessary to declare them as type A.
- The default setting is B.

Time out:

- As specified in IEC 870-5-101. It can vary between 1 and 60 s.
- The default value is 5 s.

Maximum number of emissions:

- As specified in IEC 870-5-101. It includes the first transmission and the repetitions. It can vary between 1 and 10.
- The default value is 3.

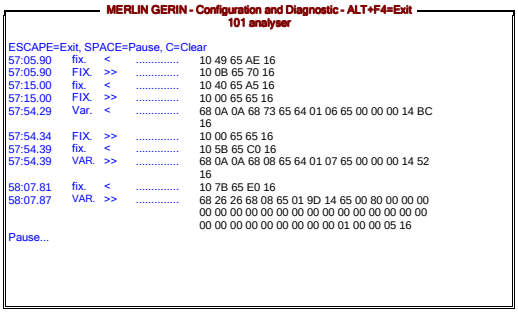
Data service:

- As specified in IEC 870-5-101. Send/Confirm or Send/No Reply.
- The default setting is "Send/Confirm".

Broadcast command allowed:

- Normally, the broadcast command cannot be used in balanced mode. However, when the collision avoidance algorithm is enabled, the broadcast command can be used to reduce the number of messages exchanged. Select "yes" to use this additional option.
- The default setting is "no".

101 analyser



This analyser shows the different frames recognised, together with additional information such as the message transmission direction (SCADA -> T200 or T200 -> SCADA), the type of frame (single character, fixed or variable length), possibly the error detected (character framing error, overflow, time-out, incorrect checksum, incorrect length, incorrect control character). In the event of multiple errors, the first error is indicated.

Furthermore, two types of analysis can be selected: a full analysis or an analysis of only the correct frames, by pressing the "T" key to switch from one type to another. The first is very useful for detecting frame recognition problems, such as the presence of noise-generated characters, the presence of spaces between characters within a frame, the non-reception of characters at the end of a frame, etc. The second is mostly used in normal operating mode for noise-sensitive media (mainly radio) and when problems detected by the full analysis have been eliminated. It prevents the screen from being saturated with all the characters generated by the noise. Problems such as the non-execution of a command can be monitored by following the exchanges "seen" by the T200. The full analysis is recommended for environments that are not noisy (direct RS232 link, telephone, leased line), as it displays everything that is "seen" by the T200.

Class 1/class 2

The protocol defines two object transmission classes. All objects are class 1, except the periodically transmitted measurements, which are class 2.

Measurements/counters

The deadband method is used to transmit measurements or counter values subsequent to changes when the new value differs from the previous transmitted value by more than "n". "n" is settings dependent.
Notes:

- The measurement or counter value is transmitted when the status changes from valid to invalid, or conversely (the difference in the values is not then taken into account).
- The deadband method operates as follows. Let us assume that you have defined a deadband of 50 and wish to measure a phase current of 100 A. If the line is open, the current will be reduced to 0 A. It will pass through the intermediary values between 100 and 0 A. If the T200 detects an intermediate value of 40 A, it will send it to the Control Centre (100 – 40 > 50). However, when the T200 detects a value of 0 A, it does not send it to the Control Centre (40 - 0 < 50). The CC will therefore receive a current of 40 A when the line is open. To reduce the risk of such a phenomenon occurring, the deadband value can be reduced, or the deadband transmission can be continued as a periodic transmission (initiated by the Control Centre or the UTD).

Remote control commands

When the T200 detects a problem while executing a command, the cause of the problem can be indicated by using QU in the private range as follows:
<16>: = Order fault (the switch is already in the required position)
<17>: = Serious fault (invalid command, command already in progress, hardware problem)
<18>: = External fault (the position of the switch has not changed)
<19>: = Local fault (the local/remote switch is set to local)
<20>: = Unknown fault
In the event of a fault, a COT with the P/N bit set to negative confirmation is generated.

Status

The "Status" octet provides general information.
When this object is read, the T200 responds with a 32-bit string (M_BO_NA_1).
The meaning of the bits is as follows:

8	7	6	5	4	3	2	1
0	x	0	0	0	0	0	0

Clock not synchronised

7 - Clock not synchronised: set to 1 when the clock has not been synchronised by the PC.

16	15	14	13	12	11	10	9
x	0	0	0	0	0	0	0

Overflow

16 – Overflow: in the event of an overflow (in other words, when the queue where the information objects to be transmitted are stored is full and there is a new object to be stored), the current time is memorised. No further information objects can be stored until the queue becomes half empty. Two "status" information objects are then generated, the first with the overflow bit set to 1 and the time stored, the second with the overflow bit set to 0 and the current time. The queue is then ready to accept new information objects.

24	23	22	21	20	19	18	17
0	0	0	0	0	0	0	0
32	31	30	29	28	27	26	25
0	0	0	0	0	0	0	0

8.1 *Network configuration*
(network-specific parameter)

- ■ Point-to-point
- ■ Multiple point-to-point
- ■ Multipoint-party line
- ☐ Multipoint-star

8.2 *Physical layer*
(network-specific parameter)

Transmission speed (control direction)

Unbalanced interchange circuit V.24/V.28 Standard	Unbalanced interchange circuit V.24/V.28 Recommended if > 1200 bit/s	Balanced interchange circuit X.24/X.27	
☐ 100 bit/s	■ 2,400 bit/s	☐ 2,400 bit/s	☐ 56,000 bit/s
■ 200 bit/s	■ 4,800 bit/s	☐ 4,800 bit/s	☐ 64,000 bit/s
■ 300 bit/s	■ 9,600 bit/s	☐ 9,600 bit/s	
■ 600 bit/s		☐ 19,200 bit/s	
■ 1,200 bit/s			

Transmission speed (monitor direction)

Unbalanced interchange circuit V.24/V.28 Standard	Unbalanced interchange circuit V.24/V.28 Recommended if > 1200 bit/s	Balanced interchange circuit X.24/X.27	
☐ 100 bit/s	■ 2,400 bit/s	☐ 2,400 bit/s	☐ 56,000 bit/s
■ 200 bit/s	■ 4,800 bit/s	☐ 4,800 bit/s	☐ 64,000 bit/s
■ 300 bit/s	■ 9,600 bit/s	☐ 9,600 bit/s	
■ 600 bit/s		☐ 19,200 bit/s	
■ 1,200 bit/s			

Transmission speed must be the same in the control and monitor directions.

8.3 *Link layer*
(network-specific parameter)

Frame format FT1.2, single character 1 and the fixed timeout interval are used exclusively in this companion standard.

Link transmission procedure

- ■ Balanced transmission
- ■ Unbalanced transmission

Address field of the link

- ☐ Not present (balanced transmission only)
- ■ One octet
- ■ Two octets
- ☐ Structured
- ■ Unstructured

Frame length

255 Maximum length L (number of octets)

8.4 *Application layer*

Transmission mode for application data

Mode 1 (Least significant octet first), as defined in clause 4.10 of IEC 870-5-4, is used exclusively in this companion standard.

Common address of ASDU
(system-specific parameter)

■ One octet ■ Two octets

Information object address
(system-specific parameter)

■ One octet ☐ structured
■ Two octets ■ unstructured
■ Three octets

Cause of transmission
(system-specific parameter)

■ One octet ■ Two octets (with originator address)

Selection of standard ASDUs
Process information in monitor direction
(station-specific parameter)

■	<1>	:= Single-point information	M_SP_NA_1
■	<2>	:= Single-point information with time tag	M_SP_TA_1
■	<3>	:= Double-point information	M_DP_NA_1
■	<4>	:= Double-point information with time tag	M_DP_TA_1
☐	<5>	:= Step position information	M_ST_NA_1
☐	<6>	:= Step position information with time tag	M_ST_TA_1
■	<7>	:= 32-bit string	M_BO_NA_1
■	<8>	:= 32-bit string with time tag	M_BO_TA_1
■	<9>	:= Measured value, normalised value	M_ME_NA_1
■	<10>	:= Measured value, normalised value with time tag	M_ME_TA_1
■	<11>	:= Measured value, scaled value	M_ME_NB_1
■	<12>	:= Measured value, scaled value with time tag	M_ME_TB_1
☐	<13>	:= Measured value, short floating point value	M_ME_NC_1
☐	<14>	:= Measured value, short floating point value with time tag	M_ME_TC_1
■	<15>	:= Integrated totals	M_IT_NA_1
■	<16>	:= Integrated totals with time tag	M_IT_TA_1
☐	<17>	:= Protection equipment event with time tag	M_EP_TA_1
☐	<18>	:= Packed start protection equipment events with time tag	M_EP_TB_1
☐	<19>	:= Packed output circuit information of protection equipment with time tag	M_EP_TC_1
☐	<20>	:= Packed single-point information with status change detection	M_PS_NA_1
☐	<21>	:= Measured value, normalised value without quality descriptor	M_ME_ND_1

Extension

■	<30> := Single-point information with time tag CP56Time2a	M_SP_TB_1
■	<31> := Double-point information with time tag CP56Time2a	M_DP_TB_1
☐	<32> := Step position information with time tag CP56Time2a	M_ST_TB_1
■	<33> := 32-bit string with time tag CP56Time2a	M_BO_TB_1
■	<34> := Measured value, normalised value with time tag CP56Time2a	M_ME_TD_1
■	<35> := Measured value, scaled value with time tag CP56Time2a	M_ME_TE_1
☐	<36> := Measured value, short floating point value with time tag CP56Time2a	M_ME_TF_1
■	<37> := Integrated totals with time tag CP56Time2a	M_IT_TB_1
☐	<38> := Protection equipment event with time tag CP56Time2a	M_EP_TD_1
☐	<39> := Packed start events of protection equipment with time tag CP56Time2a	M_EP_TE_1
☐	<40> := Packed output circuit information of protection equipment with time tag CP56Time2a	M_EP_TF_1

Process information in control direction
(station-specific parameter)

☐	<45> := Single command	C_SC_NA_1
■	<46> := Double command	C_DC_NA_1
☐	<47> := Regulating step command	C_RC_NA_1
☐	<48> := Set point command, normalised value	C_SE_NA_1
☐	<49> := Set point command, scaled value	C_SE_NB_1
☐	<50> := Set point command, short floating point value	C_SE_NC_1
☐	<51> := 32-bit string	C_BO_NA_1

System information in monitor direction
(station-specific parameter)

■	<70> := End of initialisation	M_EI_NA_1

System information in control direction
(station-specific parameter)

■	<100> := Interrogation command	C_IC_NA_1
■	<101> := Counter interrogation command	C_CI_NA_1
■	<102> := Read command	C_RD_NA_1
■	<103> := Clock synchronisation command	C_CS_NA_1
☐	<104> := Test command	C_TS_NB_1
■	<105> := Reset process command	C_RP_NC_1
■	<106> := Delay acquisition command	C_CD_NA_1

Parameter in control direction
(station-specific parameter)

☐<110> := Parameter of measured value, normalised value	P_ME_NA_1
☐<111> := Parameter of measured value, scaled value	P_ME_NB_1
☐<112> := Parameter of measured value, short floating point value	P_ME_NC_1
☐<113> := Parameter activation	P_AC_NA_1

File transfer
(station-specific parameter)

☐<120> := File ready	F_FR_NA_1
☐<121> := Section ready	F_SR_NA_1
☐<122> := Call directory, select file, call file, call section	F_SC_NA_1
☐<123> := Last section, last segment	F_LS_NA_1
☐<124> := Ack file, ack section	F_AF_NA_1
☐<125> := Segment	F_SG_NA_1
☐<126> := Directory	F_DR_TA_1

8.5 *Basic application functions*

Station initialisation
(station-specific parameter)

■ Remote initialisation

General interrogation
(system- or station-specific parameter)

■ global

☐ group 1	☐ group 7	☐ group 13
☐ group 2	☐ group 8	☐ group 14
☐ group 3	☐ group 9	☐ group 15
☐ group 4	☐ group 10	☐ group 16
☐ group 5	☐ group 11	
☐ group 6	☐ group 12	

Addresses must be defined by group

Clock synchronisation
(station-specific parameter)

■ Clock synchronisation

Clock synchronisation
(station-specific parameter)

■ Clock synchronisation

Transmission command
(object-specific parameter)

■ Direct command
☐ Direct set-point transmission command
■ Select and execute command
☐ Select and execute a set-point transmission command
☐ C_SE_ACTTERM used
■ No additional definition
☐ Short pulse (duration set by a satellite station system parameter)
☐ Long pulse (duration set by a satellite station system parameter)
☐ Continuous output

Transmission of integrated totals
(station or object-specific parameter)

■ Counter request
☐ Counter freezes without reset
☐ Counter freezes with reset
☐ Counter reset
■ General counter request
☐ Group 1 counter request
☐ Group 2 counter request
☐ Group 3 counter request
☐ Group 4 counter request

Addresses must be defined by group

Parameter loading
(object-specific parameter)

☐ Threshold value
☐ Smoothing factor
☐ Low measured value transmission limit
☐ High measured value transmission limit

Activation parameter
(object-specific parameter)

☐ Addressed object cyclic or periodic transmission activation/deactivation

File transfer
(station-specific parameter)

☐ File transfer in the monitoring direction
☐ File transfer in the control direction

Review: information object address = object type base address + object type relative address (see Information object base addresses in the section entitled Interoperability (transmission).

Example: the default address of the "local" SP is 82 (52h):
60 (3Ch) (single-point information default base address) + 22 (16h) (relative address given below) = 82 (52h)

T200 P - Standard addressing

General information (monitor direction)	BSI				
Description	Name	Relative address		Default address	
Status	Status	0	00h	1	01h

Base

Double Command (control direction)	DCO				
Description	Name	Relative address		Default address	
DC 1	Switch	0	00h	4	04h
DC 2	Spare	1	01h	5	05h
DC 3	Spare	2	02h	6	06h
DC 4	Enable/disable automatism	3	03h	7	07h

DC 18	Fault current indicator reset [3]	17	11h	21	15h

DC 21	Spare	20	14h	24	18h

Double-Point information (monitor direction)	DIQ				
Description	Name	Relative address		Default address	
DP 1	Switch	0	00h	32	20h
DP 2	Spare	1	01h	33	21h
DP 3	Spare	2	02h	34	22h
DP 4	Enable/disable automatism	3	03h	35	23h

DP 18	Fault current indicator reset [4]	17	11h	49	31h

DP 21	Spare	20	14h	52	34h

[3] Accepts only "ON" commands.
[4] Always read as "OFF".

Base

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault	0	00h	60	3Ch
SP 2	Homopolar fault	1	01h	61	3Dh
SP 3	Spare	2	02h	62	3Eh
SP 4	Spare	3	03h	63	3Fh
SP 5	Spare	4	04h	64	40h
SP 6	Spare	5	05h	65	41h
SP 7	Spare	6	06h	66	42h
SP 8	Spare	7	07h	67	43h
SP 9	Locked status	8	08h	68	44h
SP 10	Spare	9	09h	69	45h
SP 11	Spare	10	0Ah	70	46h
SP 12	Spare	11	0Bh	71	47h
SP 13	Spare	12	0Ch	72	48h
SP 14	Spare	13	0Dh	73	49h
SP 15	Spare	14	0Eh	74	4Ah
SP 16	Spare	15	0Fh	75	4Bh
SP 17	Digital input 1	16	10h	76	4Ch
SP 18	Digital input 2	17	11h	77	4Dh
SP 19	Digital input 3	18	12h	78	4Eh
SP 20	Spare	19	13h	79	4Fh
SP 21	Spare	20	14h	80	50h
SP 22	Spare	21	15h	81	51h
SP 23	Local	22	16h	82	52h
SP 24	No immediate AC supply present	23	17h	83	53h
SP 25	Spare	24	18h	84	54h
SP 26	Charger/FPI fault	25	19h	85	55h
SP 27	Battery fault	26	1Ah	86	56h
SP 28	No switchgear supply present	27	1Bh	87	57h
SP 29	No delayed AC supply present	28	1Ch	88	58h
SP 30	Automatism operated	29	1Dh	89	59h
SP 31	Spare	30	1Eh	90	5Ah
SP 32	Spare	31	1Fh	91	5Bh

MEasured value (monitor direction)	NVA / SVA				
Description	Name	Relative address		Default address	
ME 1	Phase current	0	00h	192	C0h
ME 2	Voltage measurement	1	01h	193	C1h
ME 3	Spare	2	02h	194	C2h
ME 4	Spare	3	03h	195	C3h

T200 P2 - Standard addressing

Base

General information (monitor direction)	BSI				
Description	Name	Relative address		Default address	
Status	Status	0	00h	1	01h

Double Command (control direction)	DCO				
Description	Name	Relative address		Default address	
DC 1	SW1	0	00h	4	04h
DC 2	SW2	1	01h	5	05h
DC 3	Spare	2	02h	6	06h
DC 4	Enable/disable automatism	3	03h	7	07h
DC 18	Fault current indicator reset [5]	17	11h	21	15h
DC 21	Spare	20	14h	24	18h

Double-Point information (monitor direction)	DIQ				
Description	Name	Relative address		Default address	
DP 1	SW1	0	00h	32	20h
DP 2	SW2	1	01h	33	21h
DP 3	Spare	2	02h	34	22h
DP 4	Enable/disable automatism	3	03h	35	23h
DP 18	Fault current indicator reset [6]	17	11h	49	31h
DP 21	Spare	20	14h	52	34h

[5] Accepts only "ON" commands.
[6] Always read as "OFF".

Base

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault channel 1	0	00h	60	3Ch
SP 2	Homopolar fault channel 1	1	01h	61	3Dh
SP 3	Phase fault channel 2	2	02h	62	3Eh
SP 4	Homopolar fault channel 2	3	03h	63	3Fh
SP 5	Spare	4	04h	64	40h
SP 6	Spare	5	05h	65	41h
SP 7	Spare	6	06h	66	42h
SP 8	Spare	7	07h	67	43h
SP 9	Locked status SW1	8	08h	68	44h
SP 10	Locked status SW2	9	09h	69	45h
SP 11	Spare	10	0Ah	70	46h
SP 12	Spare	11	0Bh	71	47h
SP 13	Spare	12	0Ch	72	48h
SP 14	Spare	13	0Dh	73	49h
SP 15	Spare	14	0Eh	74	4Ah
SP 16	Spare	15	0Fh	75	4Bh
SP 17	Digital input 1	16	10h	76	4Ch
SP 18	Digital input 2	17	11h	77	4Dh
SP 19	Door open	18	12h	78	4Eh
SP 20	MV present channel 2	19	13h	79	4Fh
SP 21	Spare	20	14h	80	50h
SP 22	Spare	21	15h	81	51h
SP 23	Local	22	16h	82	52h
SP 24	No immediate AC supply present	23	17h	83	53h
SP 25	Spare	24	18h	84	54h
SP 26	Charger fault	25	19h	85	55h
SP 27	Battery fault	26	1Ah	86	56h
SP 28	No switchgear supply present	27	1Bh	87	57h
SP 29	No delayed AC supply present	28	1Ch	88	58h
SP 30	Automatism operated	29	1Dh	89	59h
SP 31	Spare	30	1Eh	90	5Ah
SP 32	Spare	31	1Fh	91	5Bh

MEasured value (monitor direction)	NVA / SVA				
Description	Name	Relative address		Default address	
ME 1	Phase current, channel 1	0	00h	192	C0h
ME 2	Phase current, channel 2	1	01h	193	C1h
ME 3	Voltage measurement 1	2	02h	194	C2h
ME 4	Voltage measurement 2	3	03h	195	C3h

T200 I - Standard addressing

Base
Expansion

General information (monitor direction)	BSI				
Description	Name	Relative address		Default address	
Status	Status	0	00h	1	01h

Double Command (control direction)	DCO				
Description	Name	Relative address		Default address	
DC 1	SW1	0	00h	4	04h
DC 2	SW2	1	01h	5	05h
DC 3	SW3	2	02h	6	06h
DC 4	SW4	3	03h	7	07h
DC 5	SW5	4	04h	8	08h
DC 6	SW6	5	05h	9	09h
DC 7	SW7	6	06h	10	0Ah
DC 8	SW8	7	07h	11	0Bh
DC 9	SW9	8	08h	12	0Ch
DC 10	SW10	9	09h	13	0Dh
DC 11	SW11	10	0Ah	14	0Eh
DC 12	SW12	11	0Bh	15	0Fh
DC 13	SW13	12	0Ch	16	10h
DC 14	SW14	13	0Dh	17	11h
DC 15	SW15	14	0Eh	18	12h
DC 16	SW16	15	0Fh	19	13h

DC 18	Fault current indicator reset [7]	17	11h	21	15h

DC 21	Enable/disable automatism Group 1 (channels 1-4)	20	14h	24	18h
DC 22	Enable/disable automatism Group 2 (channels 5-8)	21	15h	24	19h
DC 23	Enable/disable automatism Group 3 (channels 9-12)	22	16h	24	1Ah
DC 24	Enable/disable automatism Group 4 (channels 13-16)	23	17h	24	1Bh

[7] Accepts only "ON" commands.

Base
Expansion

Double-Point information (monitor direction)	DIQ				
Description	Name	Relative address		Default address	
DP 1	SW1	0	00h	32	20h
DP 2	SW2	1	01h	33	21h
DP 3	SW3	2	02h	34	22h
DP 4	SW4	3	03h	35	23h
DP 5	SW5	4	04h	36	24h
DP 6	SW6	5	05h	37	25h
DP 7	SW7	6	06h	38	26h
DP 8	SW8	7	07h	39	27h
DP 9	SW9	8	08h	40	28h
DP 10	SW10	9	09h	41	29h
DP 11	SW11	10	0Ah	42	2Ah
DP 12	SW12	11	0Bh	43	2Bh
DP 13	SW13	12	0Ch	44	2Ch
DP 14	SW14	13	0Dh	45	2Dh
DP 15	SW15	14	0Eh	46	2Eh
DP 16	SW16	15	0Fh	47	2Fh

DP 18	Fault current indicator reset [8]	17	11h	49	31h

DP 21	Enable/disable automatism Group 1 (channels 1-4)	20	14h	52	34h
DP 22	Enable/disable automatism Group 2 (channels 5-8)	21	15h	53	35h
DP 23	Enable/disable automatism Group 3 (channels 9-12)	22	16h	54	36h
DP 24	Enable/disable automatism Group 4 (channels 13-16)	23	17h	55	37h

[8] Always read as "OFF".

Base

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault, channel 1	0	00h	60	3Ch
SP 2	Homopolar fault A, channel 1	1	01h	61	3Dh
SP 3	Phase fault, channel 2	2	02h	62	3Eh
SP 4	Homopolar fault A, channel 2	3	03h	63	3Fh
SP 5	Phase fault, channel 3	4	04h	64	40h
SP 6	Homopolar fault A, channel 3	5	05h	65	41h
SP 7	Phase fault, channel 4	6	06h	66	42h
SP 8	Homopolar fault A, channel 4	7	07h	67	43h
SP 9	Locked status SW1	8	08h	68	44h
SP 10	Locked status SW2	9	09h	69	45h
SP 11	Locked status SW3	10	0Ah	70	46h
SP 12	Locked status SW4	11	0Bh	71	47h
SP 13	Homopolar fault B, channel 1	12	0Ch	72	48h
SP 14	Homopolar fault B, channel 2	13	0Dh	73	49h
SP 15	Homopolar fault B, channel 3	14	0Eh	74	4Ah
SP 16	Homopolar fault B, channel 4	15	0Fh	75	4Bh
SP 17	Digital input 1	16	10h	76	4Ch
SP 18	Digital input 2	17	11h	77	4Dh
SP 19	MV present channel 1	18	12h	78	4Eh
SP 20	MV present channel 2	19	13h	79	4Fh
SP 21	MV present channel 3	20	14h	80	50h
SP 22	MV present channel 4	21	15h	81	51h
SP 23	Local	22	16h	82	52h
SP 24	No immediate AC supply present	23	17h	83	53h
SP 25	Digital input 3	24	18h	84	54h
SP 26	Charger/FPI fault	25	19h	85	55h
SP 27	Battery fault	26	1Ah	86	56h
SP 28	No switchgear supply present	27	1Bh	87	57h
SP 29	No delayed AC supply present	28	1Ch	88	58h
SP 30	Digital input 4	29	1Dh	89	59h
SP 31	Digital input 5	30	1Eh	90	5Ah
SP 32	Digital input 6	31	1Fh	91	5Bh

Expansion

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 33	Phase fault, channel 5	32	20h	92	5Ch
SP 34	Homopolar fault A, channel 5	33	21h	93	5Dh
SP 35	Phase fault, channel 6	34	22h	94	5Eh
SP 36	Homopolar fault A, channel 6	35	23h	95	5Fh
SP 37	Phase fault, channel 7	36	24h	96	60h
SP 38	Homopolar fault A, channel 7	37	25h	97	61h
SP 39	Phase fault, channel 8	38	26h	98	62h
SP 40	Homopolar fault A, channel 8	39	27h	99	63h
SP 41	Locked status SW5	40	28h	100	64h
SP 42	Locked status SW6	41	29h	101	65h
SP 43	Locked status SW7	42	2Ah	102	66h
SP 44	Locked status SW8	43	2Bh	103	67h
SP 45	Homopolar fault B, channel 5	44	2Ch	104	68h
SP 46	Homopolar fault B, channel 6	45	2Dh	105	69h
SP 47	Homopolar fault B, channel 7	46	2Eh	106	6Ah
SP 48	Homopolar fault B, channel 8	47	2Fh	107	6Bh
SP 49	Digital input 7	48	30h	108	6Ch
SP 50	Digital input 8	49	31h	109	6Dh
SP 51	MV present channel 5	50	32h	110	6Eh
SP 52	MV present channel 6	51	33h	111	6Fh
SP 53	MV present channel 7	52	34h	112	70h
SP 54	MV present channel 8	53	35h	113	71h
SP 55	Spare	54	36h	114	72h
SP 56	Spare	55	37h	115	73h
SP 57	Digital input 9	56	38h	116	74h
SP 58	Spare	57	39h	117	75h
SP 59	Spare	58	3Ah	118	76h
SP 60	Spare	59	3Bh	119	77h
SP 61	Spare	60	3Ch	120	78h
SP 62	Digital input 10	61	3Dh	121	79h
SP 63	Digital input 11	62	3Eh	122	7Ah
SP 64	Digital input 12	63	3Fh	123	7Bh

Expansion

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 65	Phase fault, channel 9	64	40h	124	7Ch
SP 66	Homopolar fault A, channel 9	65	41h	125	7Dh
SP 67	Phase fault, channel 10	66	42h	126	7Eh
SP 68	Homopolar fault A, channel 10	67	43h	127	7Fh
SP 69	Phase fault, channel 11	68	44h	128	80h
SP 70	Homopolar fault A, channel 11	69	45h	129	81h
SP 71	Phase fault, channel 12	70	46h	130	82h
SP 72	Homopolar fault A, channel 12	71	47h	131	83h
SP 73	Locked status SW9	72	48h	132	84h
SP 74	Locked status SW10	73	49h	133	85h
SP 75	Locked status SW11	74	4Ah	134	86h
SP 76	Locked status SW12	75	4Bh	135	87h
SP 77	Homopolar fault B, channel 9	76	4Ch	136	88h
SP 78	Homopolar fault B, channel 10	77	4Dh	137	89h
SP 79	Homopolar fault B, channel 11	78	4Eh	138	8Ah
SP 80	Homopolar fault B, channel 12	79	4Fh	139	8Bh
SP 81	Digital input 13	80	50h	140	8Ch
SP 82	Digital input 14	81	51h	141	8Dh
SP 83	MV present channel 9	82	52h	142	8Eh
SP 84	MV present channel 10	83	53h	143	8Fh
SP 85	MV present channel 11	84	54h	144	90h
SP 86	MV present channel 12	85	55h	145	91h
SP 87	Spare	86	56h	146	92h
SP 88	Spare	87	57h	147	93h
SP 89	Digital input 15	88	58h	148	94h
SP 90	Spare	89	59h	149	95h
SP 91	Spare	90	5Ah	150	96h
SP 92	Spare	91	5Bh	151	97h
SP 93	Spare	92	5Ch	152	98h
SP 94	Digital input 16	93	5Dh	153	99h
SP 95	Digital input 17	94	5Eh	154	9Ah
SP 96	Digital input 18	95	5Fh	155	9Bh

Expansion

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 97	Phase fault, channel 13	96	60h	156	9Ch
SP 98	Homopolar fault A, channel 13	97	61h	157	9Dh
SP 99	Phase fault, channel 14	98	62h	158	9Eh
SP 100	Homopolar fault A, channel 14	99	63h	159	9Fh
SP 101	Phase fault, channel 15	100	64h	160	A0h
SP 102	Homopolar fault A, channel 15	101	65h	161	A1h
SP 103	Phase fault, channel 16	102	66h	162	A2h
SP 104	Homopolar fault A, channel 16	103	67h	163	A3h
SP 105	Locked status SW13	104	68h	164	A4h
SP 106	Locked status SW14	105	69h	165	A5h
SP 107	Locked status SW15	106	6Ah	166	A6h
SP 108	Locked status SW16	107	6Bh	167	A7h
SP 109	Homopolar fault B, channel 13	108	6Ch	168	A8h
SP 110	Homopolar fault B, channel 14	109	6Dh	169	A9h
SP 111	Homopolar fault B, channel 15	110	6Eh	170	AAh
SP 112	Homopolar fault B, channel 16	111	6Fh	171	ABh
SP 113	Digital input 19	112	70h	172	ACh
SP 114	Digital input 20	113	71h	173	ADh
SP 115	MV present channel 13	114	72h	174	AEh
SP 116	MV present channel 14	115	73h	175	AFh
SP 117	MV present channel 15	116	74h	176	B0h
SP 118	MV present channel 16	117	75h	177	B1h
SP 119	Spare	118	76h	178	B2h
SP 120	Spare	119	77h	179	B3h
SP 121	Digital input 21	120	78h	180	B4h
SP 122	Spare	121	79h	181	B5h
SP 123	Spare	122	7Ah	182	B6h
SP 124	Spare	123	7Bh	183	B7h
SP 125	Spare	124	7Ch	184	B8h
SP 126	Digital input 22	125	7Dh	185	B9h
SP 127	Digital input 23	126	7Eh	186	BAh
SP 128	Digital input 24	127	7Fh	187	BBh

Base
Expansion
PowerMeter Option

MEasured value (monitor direction)	NVA / SVA				
Description	Name	Relative address		Default address	
ME 1	Phase current, channel 1	0	00h	192	C0h
ME 2	Phase current, channel 2	1	01h	193	C1h
ME 3	Phase current, channel 3	2	02h	194	C2h
ME 4	Phase current, channel 4	3	03h	195	C3h
ME 5	Phase current, channel 5	4	04h	196	C4h
ME 6	Phase current, channel 6	5	05h	197	C5h
ME 7	Phase current, channel 7	6	06h	198	C6h
ME 8	Phase current, channel 8	7	07h	199	C7h
ME 9	Phase current, channel 9	8	08h	200	C8h
ME 10	Phase current, channel 10	9	09h	201	C9h
ME 11	Phase current, channel 11	10	0Ah	202	CAh
ME 12	Phase current, channel 12	11	0Bh	203	CBh
ME 13	Phase current, channel 13	12	0Ch	204	CCh
ME 14	Phase current, channel 14	13	0Dh	205	CDh
ME 15	Phase current, channel 15	14	0Eh	206	CEh
ME 16	Phase current, channel 16	15	0Fh	207	CFh
ME 17	PM1 Group 1 Element 1	16	10h	208	D0h
ME 18	PM1 Group 1 Element 2	17	11h	209	D1h
ME 19	PM1 Group 1 Element 3	18	12h	210	D2h
ME 20	PM1 Group 2 Element 1	19	13h	211	D3h
ME 21	PM1 Group 2 Element 2	20	14h	212	D4h
ME 22	PM1 Group 2 Element 3	21	15h	213	D5h
ME 23	PM2 Group 1 Element 1	22	16h	214	D6h
ME 24	PM2 Group 1 Element 2	23	17h	215	D7h
ME 25	PM2 Group 1 Element 3	24	18h	216	D8h
ME 26	PM2 Group 2 Element 1	25	19h	217	D9h
ME 27	PM2 Group 2 Element 2	26	1Ah	218	DAh
ME 28	PM2 Group 2 Element 3	27	1Bh	219	DBh
ME 29	PM3 Group 1 Element 1	28	1Ch	220	DCh
ME 30	PM3 Group 1 Element 2	29	1Dh	221	DDh
ME 31	PM3 Group 1 Element 3	30	1Eh	222	DEh
ME 32	PM3 Group 2 Element 1	31	1Fh	223	DFh
ME 33	PM3 Group 2 Element 2	32	20h	224	E0h
ME 34	PM3 Group 2 Element 3	33	21h	225	E1h
ME 35	PM4 Group 1 Element 1	34	22h	226	E2h
ME 36	PM4 Group 1 Element 2	35	23h	227	E3h
ME 37	PM4 Group 1 Element 3	36	24h	228	E4h
ME 38	PM4 Group 2 Element 1	37	25h	229	E5h
ME 39	PM4 Group 2 Element 2	38	26h	230	E6h
ME 40	PM4 Group 2 Element 3	39	27h	231	E7h
ME 41	PM1 Group 3 Element 1	40	28h	232	E8h
ME 42	PM1 Group 3 Element 2	41	29h	233	E9h
ME 43	PM1 Group 3 Element 3	42	2Ah	234	EAh
ME 44	PM2 Group 3 Element 1	43	2Bh	235	EBh
ME 45	PM2 Group 3 Element 2	44	2Ch	236	ECh
ME 46	PM2 Group 3 Element 3	45	2Dh	237	EDh
ME 47	PM3 Group 3 Element 1	46	2Eh	238	EEh
ME 48	PM3 Group 3 Element 2	47	2Fh	239	EFh
ME 49	PM3 Group 3 Element 3	48	30h	240	F0h
ME 50	PM4 Group 3 Element 1	49	31h	241	F1h
ME 51	PM4 Group 3 Element 2	50	32h	242	F2h
ME 52	PM4 Group 3 Element 3	51	33h	243	F3h

PowerMeter Option

Integrated Total (monitor direction)	BCR				
Description	Name	Relative address		Default address	
IT 1	PM1 Group n Element 1	0	00h		h
IT 2	PM1 Group n Element 2	1	01h		h
IT 3	PM2 Group n Element 1	2	02h		h
IT 4	PM2 Group n Element 2	3	03h		h
IT 5	PM3 Group n Element 1	4	04h		h
IT 6	PM3 Group n Element 2	5	05h		h
IT 7	PM4 Group n Element 1	6	06h		h
IT 8	PM4 Group n Element 2	7	07h		h
IT 9	PM1 Group n Element 3	8	08h		h
IT 10	PM2 Group n Element 3	9	09h		h
IT 11	PM3 Group n Element 3	10	0Ah		h
IT 12	PM4 Group n Element 3	11	0Bh		h

n ranges from 1 to 3 and is the number of the group used to upload the energies.

Caution: do not use multiple groups for energies.

When the energies are part of a grouped set, they are in the following order:
Element 1: Active energy
Element 2: Reactive energy
Element 3: Apparent energy

T200 P - Compact addressing

In compact addressing, the number of single points is limited to 26. They have different addresses from those used for standard addressing.

Base

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault	0	00h	60	3Ch
SP 2	Homopolar fault	1	01h	61	3Dh
SP 3	Spare	2	02h	62	3Eh
SP 4	Spare	3	03h	63	3Fh
SP 5	Spare	4	04h	64	40h
SP 6	Spare	5	05h	65	41h
SP 7	Spare	6	06h	66	42h
SP 8	Spare	7	07h	67	43h
SP 9	Locked status	8	08h	68	44h
SP 10	Spare	9	09h	69	45h
SP 11	Spare	10	0Ah	70	46h
SP 12	Spare	11	0Bh	71	47h
SP 13	Digital input 1	12	0Ch	72	48h
SP 14	Digital input 2	13	0Dh	73	49h
SP 15	Digital input 3	14	0Eh	74	4Ah
SP 16	Spare	15	0Fh	75	4Bh
SP 17	Spare	16	10h	76	4Ch
SP 18	Spare	17	11h	77	4Dh
SP 19	Spare	18	12h	78	4Eh
SP 20	Automatism operated	19	13h	79	4Fh
SP 21	Local	20	14h	80	50h
SP 22	No immediate AC supply present	21	15h	81	51h
SP 23	No delayed AC supply present	22	16h	82	52h
SP 24	Charger/FPI fault	23	17h	83	53h
SP 25	Battery fault	24	18h	84	54h
SP 26	No switchgear supply present	25	19h	85	55h

Base

T200 P2 - Compact addressing

In compact addressing, the number of single points is limited to 26. They have different addresses from those used for standard addressing.

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault, channel 1	0	00h	60	3Ch
SP 2	Homopolar fault channel 1	1	01h	61	3Dh
SP 3	Phase fault, channel 2	2	02h	62	3Eh
SP 4	Homopolar fault channel 2	3	03h	63	3Fh
SP 5	Spare	4	04h	64	40h
SP 6	Spare	5	05h	65	41h
SP 7	Spare	6	06h	66	42h
SP 8	Spare	7	07h	67	43h
SP 9	Locked status channel 1	8	08h	68	44h
SP 10	Locked status channel 2	9	09h	69	45h
SP 11	Spare	10	0Ah	70	46h
SP 12	Spare	11	0Bh	71	47h
SP 13	Digital input 1	12	0Ch	72	48h
SP 14	Digital input 2	13	0Dh	73	49h
SP 15	Door open	14	0Eh	74	4Ah
SP 16	MV present channel 2	15	0Fh	75	4Bh
SP 17	Spare	16	10h	76	4Ch
SP 18	Spare	17	11h	77	4Dh
SP 19	Spare	18	12h	78	4Eh
SP 20	Automatism operated	19	13h	79	4Fh
SP 21	Local	20	14h	80	50h
SP 22	No immediate AC supply present	21	15h	81	51h
SP 23	No delayed AC supply present	22	16h	82	52h
SP 24	Charger fault	23	17h	83	53h
SP 25	Battery fault	24	18h	84	54h
SP 26	No switchgear supply present	25	19h	85	55h

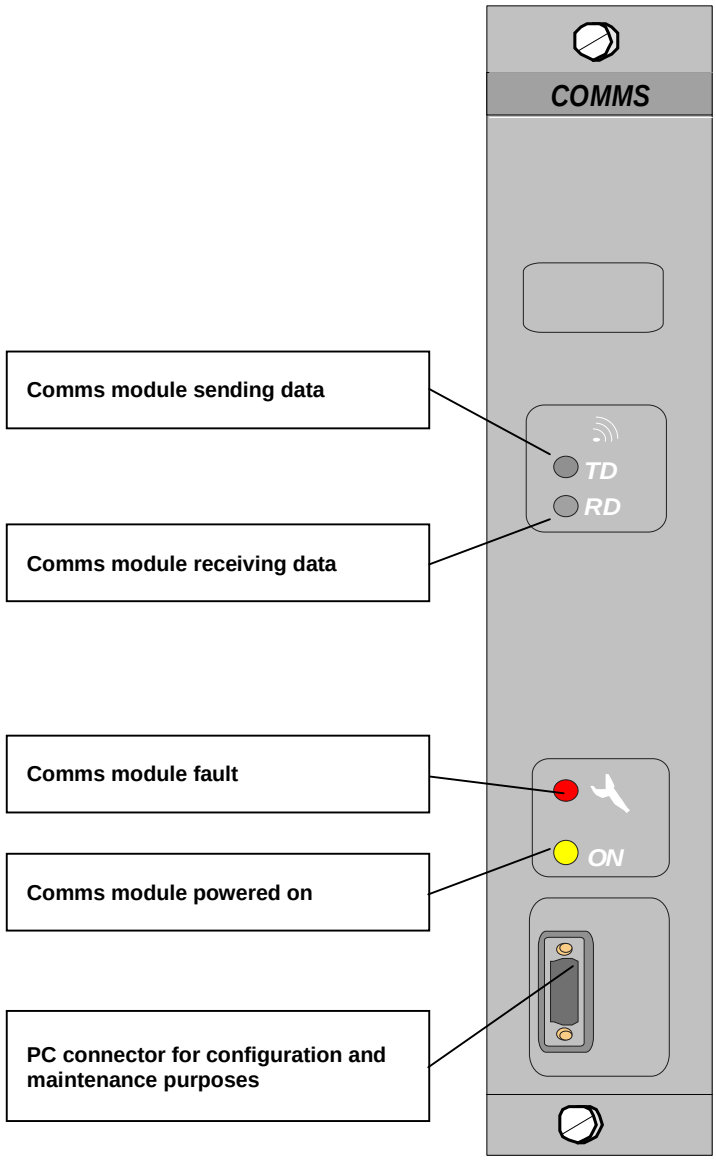
Base

T200 I (4 channels max.) - Compact addressing

In compact addressing, the number of single points is limited to 26. They have different addresses from those used for standard addressing.

Single-Point information (monitor direction)	SIQ				
Description	Name	Relative address		Default address	
SP 1	Phase fault, channel 1	0	00h	60	3Ch
SP 2	Homopolar fault channel 1	1	01h	61	3Dh
SP 3	Phase fault, channel 2	2	02h	62	3Eh
SP 4	Homopolar fault channel 2	3	03h	63	3Fh
SP 5	Phase fault, channel 3	4	04h	64	40h
SP 6	Homopolar fault channel 3	5	05h	65	41h
SP 7	Phase fault, channel 4	6	06h	66	42h
SP 8	Homopolar fault channel 4	7	07h	67	43h
SP 9	Locked status channel 1	8	08h	68	44h
SP 10	Locked status channel 2	9	09h	69	45h
SP 11	Locked status channel 3	10	0Ah	70	46h
SP 12	Locked status channel 4	11	0Bh	71	47h
SP 13	Digital input 1	12	0Ch	72	48h
SP 14	Digital input 2	13	0Dh	73	49h
SP 15	Digital input 3	14	0Eh	74	4Ah
SP 16	Digital input 4	15	0Fh	75	4Bh
SP 17	MV present channel 1	16	10h	76	4Ch
SP 18	MV present channel 2	17	11h	77	4Dh
SP 19	MV present channel 3	18	12h	78	4Eh
SP 20	MV present channel 4	19	13h	79	4Fh
SP 21	Local	20	14h	80	50h
SP 22	No immediate AC supply present	21	15h	81	51h
SP 23	No delayed AC supply present	22	16h	82	52h
SP 24	Charger/FPI fault	23	17h	83	53h
SP 25	Battery fault	24	18h	84	54h
SP 26	No switchgear supply present	25	19h	85	55h

Front panel indications



Normal operation

During normal operation, the Comms module display is as follows:

The RD and TD transmission LEDs are on when T200 is receiving or sending data.

- The ON LED is lit up.
- The Fault LED is OFF.

Diagnostics using the front panel indicator lamps and timestamped events

The T200 records and dates events to assist diagnostics. The events are saved in the CPU module.

The timestamped events can be read locally from a PC running the "**T200 Configuration and diagnostic**" software.

- Connect the PC to the CPU module.
- When the PC is powered on and running DOS, insert the "**T200 Configuration and diagnostic**" floppy disc in the drive, type **A:MG** (not case-sensitive) and press **ENTER**. The main menu is displayed.

For further information on using the configuration software package, refer to the T200 user's manual.

Event	Probable cause	Solution
The COMMS module "ON" LED is OFF.	The equipment is not powered on.	Switch on the equipment.
	The power supply fuse if supply is blown.	Replace the Power supply module fuse: 5 x 20 mm, 0.8 A semi time-lag fuse
	Comms module fault.	Replace the COMMS card.
The "Fault" LED on the Comms module is ON.	The configuration is lost.	Connect a PC running the "**T200 Configuration and diagnostic**" software. If "Configuration lost" is flashing on the screen, check or correct the configuration. If the problem persists after you have confirmed the configuration, replace the Comms module.
The "Fault" LED is flashing on the Comms module.	The Comms module software is defective.	Press the "General RESET" button on the Power supply module. If the LED does not go off after a few seconds, replace the Comms module.
The "Fault" LED on the "Control" module is ON and a MODBUS Comms failure event has occurred.	COMMS card fault.	Replace the Comms module.

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