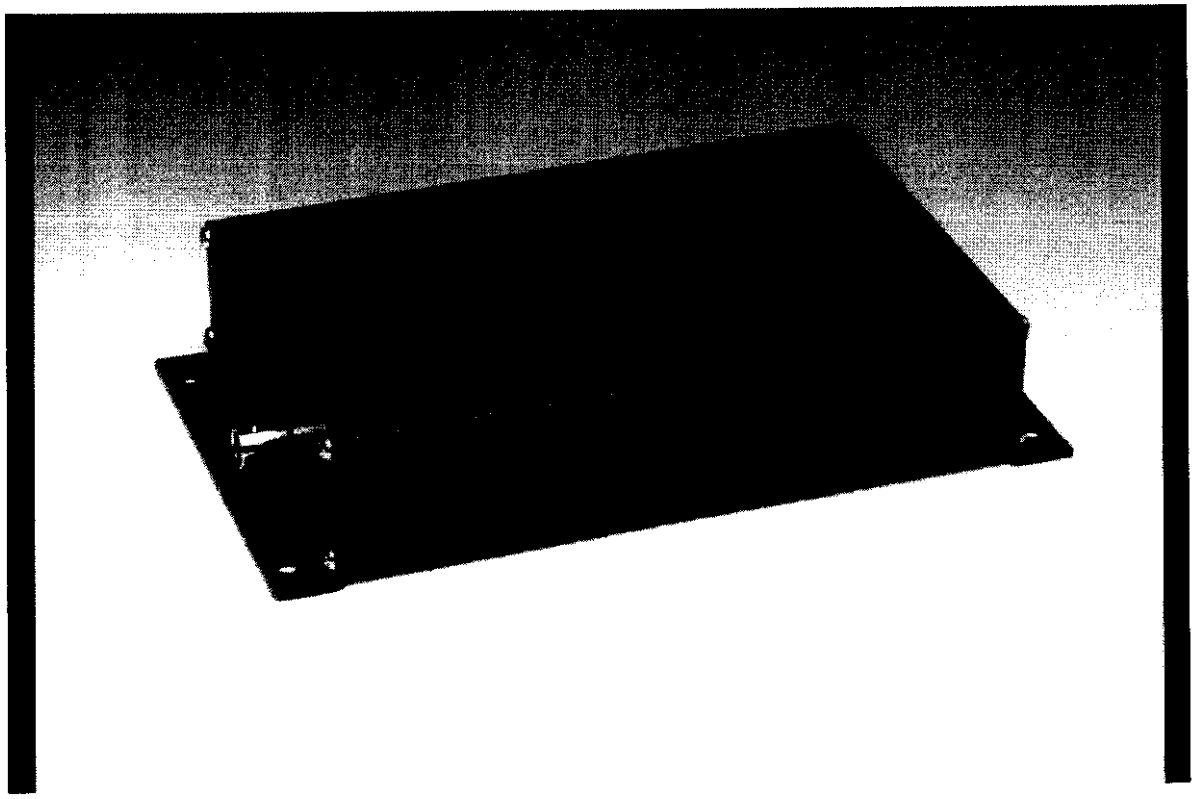
PackNet-2

System Description

PACKST



Contents

1 Introduction

1.1 Terminology

Below, abbreviations and terms which will occur in the document

Term	Meaning
• Repeater	Radio which can act as repeater
• PACKST	Software for PackNet-2 transparent radio system
• bps	Transmission speed (Bits Per Second)

1.2 History

Issued by: Björn Ljungkvist

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Approved by

Revision	Date	Updated by	Change
01	1998-05-08	Björn Ljungkvist	First revision

1.3 Technical data

- Product: PackNet-2
- Hardware: PCB REV 4
- Software: PACKST 1.0

2 General

2.1 Structure

PackNet-2 with PACKST software is the RADIUS system for packet switched transparent data transmission with repeater function in polled systems.

The system may contain one master, one repeater/slave, up to 254 slaves and up to 254 slaves via repeaters. However, in practise the limit is a total of 254 slaves if the bit error rate test is to be addressed correctly.
The software is the same for all radio units in a system. Please note that the repeater also simultaneously functions as an ordinary slave.
All addressing must be handled by connected control system since all units receive the master's transmission. No slave, however, receives transmission from any other slave.

The radio system is half duplex, which means that only one slave unit can transmit at any one time. PACKST is completely packet switched, meaning all data transmitted and received is buffered in each respective radio. At present, the data transfer rate at radio level is 1200 bps, whilst terminal speed to a connected system is optional between 600 and 9600 bps with or without parity. The terminal speed should be set as high as possible to speed up the system.
The maximum message length in the system is 240 characters.

There are two ways of connecting the control system to the radio unit: either handshaking-free 2 wire (RxD, TxD and GND) or with full RTS/CTS handshaking.

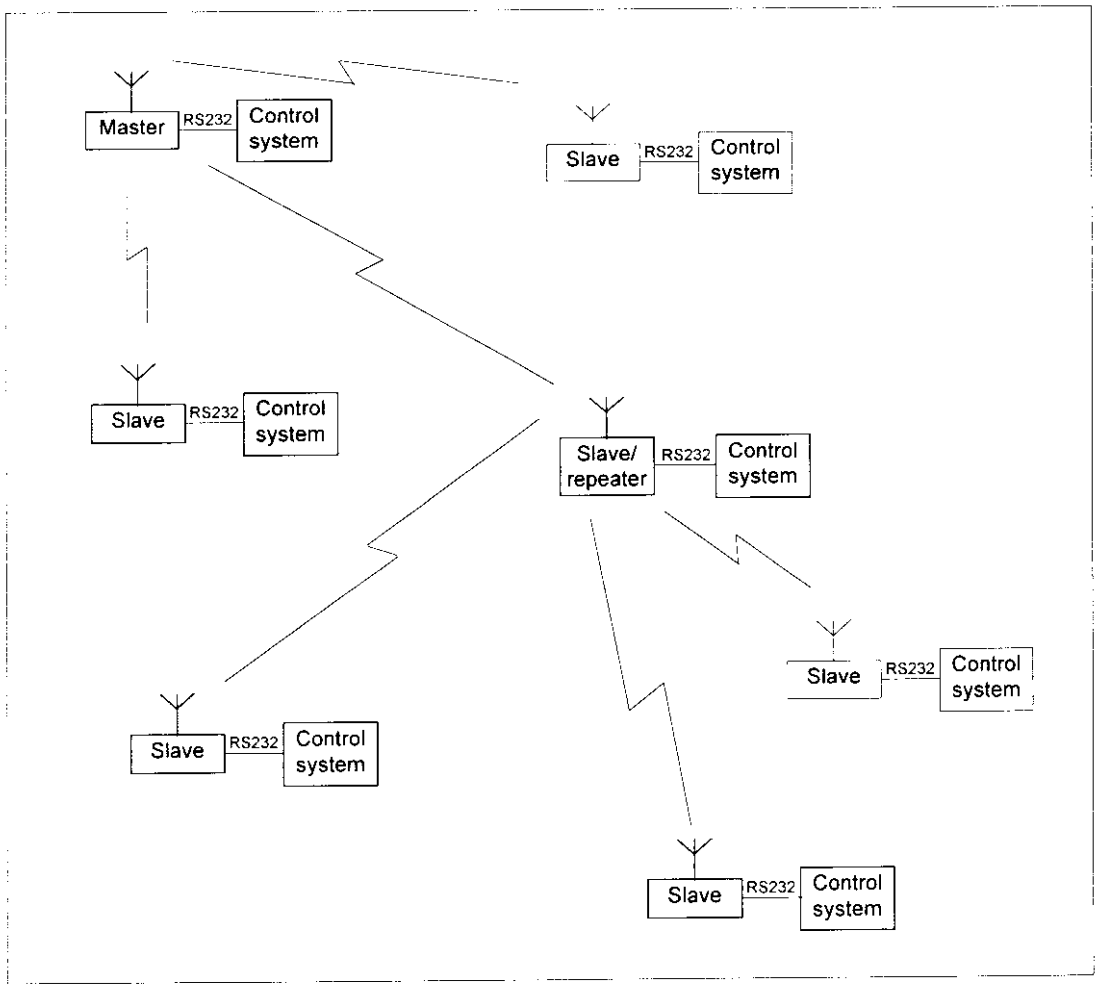

Figure 1. System structure

2.2 PackNet-2 indicators

PackNet-2 is equipped with three LED indicators:

- PWR (green) Supply voltage is present
- RD (yellow) The radio is receiving data (from another radio)
- TX (red) The radio is transmitting data (to another radio)

When PackNet-2 is being supplied via the back-up supply (BAT) all the indicators are switched off for reasons of current consumption.

2.3 Construction

If the PackNet-2 radio is delivered in a cabinet together with a power supply unit, the construction is as shown below:

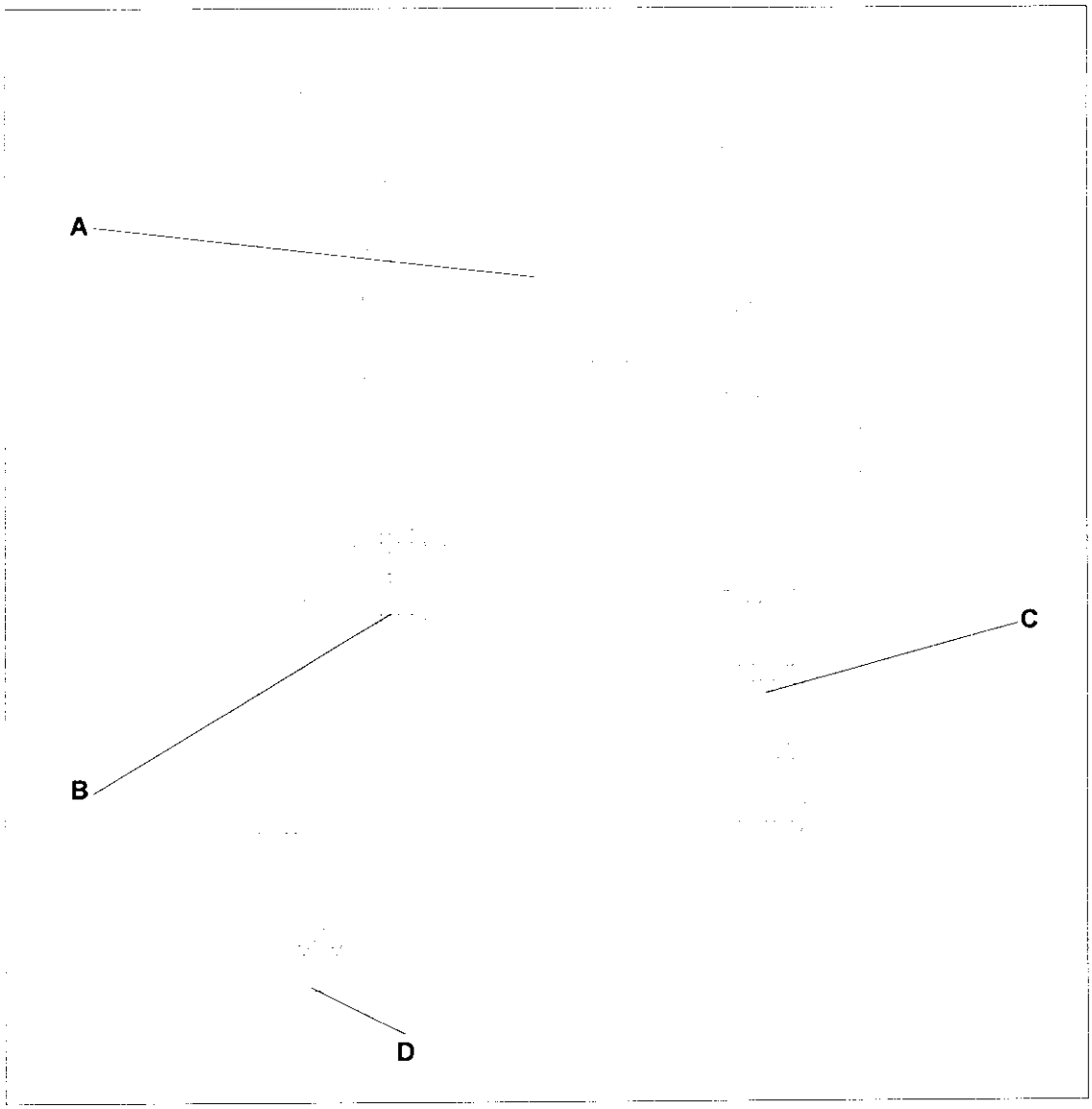

Figure 2. PackNet-2 cabinet

Designation	Object	Explanation
A	PackNet-2	Digital data radio
B	Block	Blocks for voltage connection
C	Voltage converter	Voltage converter XVACDC/12VDC
D	Coaxial connector N-female	Antenna jack for connection of antenna connector

3 Installation

3.1 General

The installation of radio systems places exceedingly heavy demands on design and material selection due to the fact that radio systems are more sensitive to interference and cause more interference than other types of apparatus. This is because a radio's two main functions are the ability to transmit powerful electromagnetic waves and to receive extremely weak ones.

The above means that a radio can be subjected to interference and also cause interference in unfavourable conditions. However it is possible to reduce the risk if the following advice is followed.

3.2 Installing the radio

PackNet-2 should be installed in such a way that it is as "free" as possible of other equipment. It should not be placed in the same box as other equipment or in the proximity of other sources of interference, such as frequency controls, thyristor controls, motors, relays or other kinds of equipment that can cause both low and high frequency radiation. Nor should PackNet-2 be installed near various kinds of sensitive sensors since these can be subjected to interference by carrier waves from the radio.

The above also applies to cabling (both signal and antenna cable) connected to the radio. The signal cables are to be shielded and routed "the shortest way" in cable ducts or suchlike. Cable surplus should not be tied up in bundles in the cable ducts.

PackNet-2 has an earth terminal on one of its sides. This should be connected to earth. It is to be noted that this ground connector is internally connected to the negative pole of the power supply connector.

Note! It is of vital importance that the negative pole of the power supply, the earth terminal and the antenna are connected to the same earth potential.

3.3 Power supply

The power supply unit in a radio system must be chosen with great care. There are special and high demands to obtain adequate function, especially regarding extremely low noise level and exact and fast line/load regulation.
The power supply unit should only dissipate low noise levels of both cabinet radiation and conducted interference to the radio. This should especially be observed when using switched mode power supply
The unit's regulation must not be interfered by the radio's carrier wave.

PackNet-2 consumes approximately 50mA in receiving mode. When transmitting, the consumption rises to approximately 1A in just a few milliseconds. The power supply unit must manage this rapid change of the output current without lowering the output voltage.
The power supply cables could with advantage be screened. The conductor area of each cable should, at least, be 1.5mm^2.

3.3.1 Recommended minimum demands:

Output voltage:	12.5VDC nom. (11.5-13.5)
Output current:	2A min. (power 30W min)
Rippel/noise:	30mV p-p max.
Line regulation:	1% max.
Load regulation:	1% max.
Temp spec	-25°C - +55°C

EMI/RFI protected with low RF/HF emissions.

3.4 Installation of antenna

Installation and choice of antenna, antenna cable, height etc. should be done according to the instructions for the system in question.
Antennas should always be mounted as far away as possible from interfering details (other antennas, tubes, stays, walls and roofs) to avoid reflections and interference.
All antennas within a system should be mounted with the same polarisation.
It is of vital importance that the antenna system is well grounded. The antenna holder should, for example, be grounded via a $4mm^2$ cable or thicker.

When installing the antenna cable, it is important to avoid mechanical damages. The cable must not be bent in sharp curves. Some sorts of cables (e.g. CellFlex) will be permanently damaged if the bend radius is below 0.5m.

The antenna connectors should be mounted according to the enclosed instructions. When these connectors are mounted or spliced, it is important no moisture or dirt penetrates the connector. Outdoor connectors should be winded with vulcanise tape all over the connector area.

3.5 Problems - fault correction

If the radio system does not work as required though it is installed according to this document as well as system specific documents, check:

- The power supply output voltage (measure the voltage both in receiving and transmitting mode).
- That the Standing wave ratio (SWR) is less than 1.5.
- That all ground connectors are correctly mounted.
- That there is no short-circuit in the antenna cable or its connectors. **Note!** The antenna could be DC grounded.
- That no interfering equipment is in close vicinity to the radio system.

4 Function

The system distinguishes between an "ordinary slave" and a slave via repeater. An "ordinary slave" can only receive data from, and send data to the master. A slave via repeater can only receive data from, and send data to the repeater.

4.1 General

When the master transmits a message it is received simultaneously by both the slaves and the repeater. Once the repeater has received the message it passes it on to the slaves via repeater. If, after that, a slave via repeater responds, its answer is transmitted firstly to the repeater which then transmits it to the master. If an "ordinary slave" responds, then its answer is transmitted straight to the master.

One of the limitations of a system that have a repeater as well as "ordinary slaves" and slaves via repeater is that, in order to avoid collisions, the "ordinary slaves" have to wait for the repeater to repeat any message before they can answer. This can however be avoided by switching repeater delay in the "ordinary slaves".
Repeater delay causes the slaves to automatically delay the output data to the connected control system so that collisions can never happen.

4.2 Polling of slave via repeater

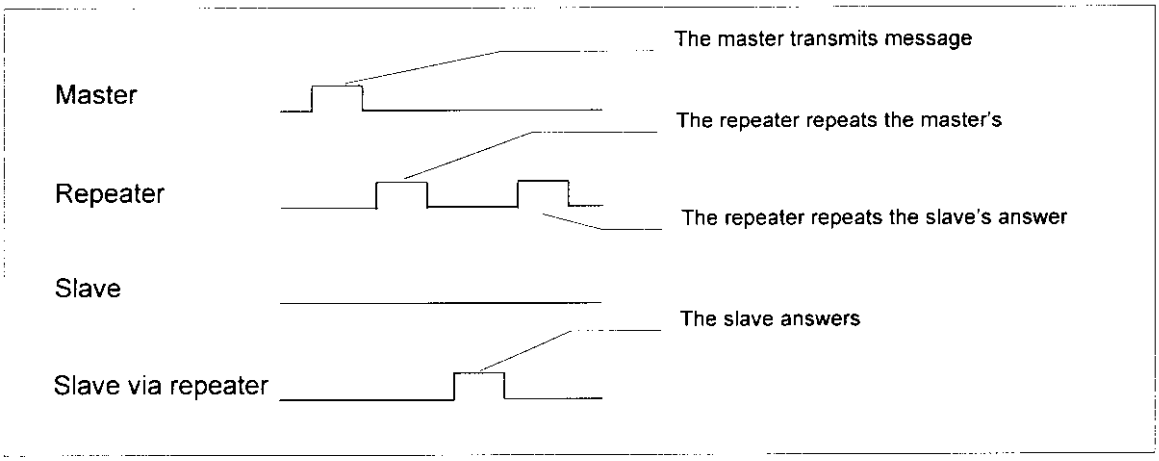

Figure 3. Polling slave via repeater

A slave via repeater can never collide with the repeater since it does not receive its message until the repeater has finished transmitting. This is also the case when an "ordinary slave" responds, provided that the repeater delay has been selected.

5 Programming - configuration

5.1 Preparations

5.1.1 Equipment

PackNet-2 and RTU 16-D are programmed from a personal computer, a hand-held terminal or the like. A special programming adapter (RADIUS Progint) is required for the programming. The Radius program, ProgTerm, is used for the programming. It is also possible to use other terminal programmes, such as, Procomm or the Windows standard terminal program, Hyper Terminal. If a different terminal program to ProgTerm is used then the format for serial communication is to be set at 1200 bps, 8 bits, 1 stop bit, no parity (1200-N-8-1).

5.1.2 Procedure

When programming PackNet-2 and RTU16-D it is important to follow the procedure below:

1. Make sure that the unit has voltage feed.
2. Start ProgTerm (or other terminal program on the PC)
3. Select serial port.
4. Connect the D-sub connector of the programming adapter to the PC.
5. Connect the modular connector of the programming adapter to the R-bus jack on the unit in question.

The unit is now ready for programming. This is carried out as described in Chapter 5.2.

5.2 Programming

When the steps mentioned in chapter 5.1 has been carried out, the main menu appears. From here, the required radio function, system identity and terminal speed is selected.

```
Program for PackNet-2 PACKST V1.0

Slave ID: 0F
9600 bps 8 bits even parity

0. Sys ID: 01
1. Master
2. Slave
3. Slave with repeater delay
4. Slave via repeater
5. Slave and repeater
6.  600 bps
7. 1200 bps
8. 2400 bps
9. 4800 bps
A. 9600 bps
B. 8 bits + no parity
C. 8 bits + even parity
D. 8 bits + odd parity
E. Use RTS: NO
F. Maximum distance between characters (ms): 0010
G. Test menu
```

The radio's current configuration is shown on the top of the main menu (in this example slave with the identity 0F). Below this, the current terminal speed and possible parity is shown.

5.2.1 Sys ID - System identity (menu option 0)

Here, the system identity is selected in a hexadecimal format. Identity 01-FE shall ensure that data cannot be interpreted by an adjacent system in the case of abnormal range conditions arising. The system identity must always be the same for all units within the same system.

5.2.2 Radio function (menu option 1-5)

Here, the required radio function is selected. If one of the "slave options" (option 2-5) is selected, a question concerning the slave identity appears. All slaves have to have an identity so the bit error rate test can be addressed correctly.
The slaves identities should be between 01 and FE.
Please note that "slave and repeater" is counted as "ordinary slave".
If the radio has been configured as a master, no identity is required.

5.2.3 Terminal speed (menu option 6-A)

Here, the required terminal speed is defined. Different terminal speeds can be freely used on different units in the system . The highest possible speed should be used to achieve optimal performance in the system

5.2.4 Parity configuration (menu option B-D)

Defines the required parity configuration.

5.2.5 Use RTS (menu option E)

Defines whether or not handshaking with RTS/CTS shall be used (Y/N). See chapter 7 below.

5.2.6 Maximum distance between characters (menu option F)

Here the maximum time interval between characters in the bit stream. This determines when a message can be sent when handshaking is not used. Possible values are 0000-9999 milliseconds. Value 0000 closes the function. See chapter 7 below.

5.2.7 Test menu (menu option G)

This option accesses a sub menu with built-in test functions. See Chapter 6 below.

6 Test menu

When option G is selected from the main menu the test menu appears. This is intended to help with the testing and evaluation of the quality of the radio system.

```
Test menu

0. Receiver test
1. Transmitter test
2. Bit error rate test
3. Channel: 1
```

6.1 Receiver test (menu option 0)

The receiver test is designed for laboratory tests and special instruments are required to perform it.

6.2 Transmitter test (menu option 1)

The transmitter test starts the transmitter (modulated with bit pattern) and can be used to measure the output and aerial adjustment. The transmitter transmits for a maximum of 30 seconds.

6.3 Bit error rate test (menu option 2)

This test helps to evaluate the data transfer quality between two units. The master can perform the bit error rate test on all slaves. Slaves can perform the test on the master and the other slaves. The identity of the unit under bit error rate test is selected from here.
The bit error rate test is described in chapter 8.

6.4 Channel (menu option 3)

Here, the particular radio channel that is to be used in a multi-channel system is selected. This should usually be 1.

7 Description of the PackNet-2 interface

7.1 General

All PackNet-2 units in the system are connected to peripheral equipment via the RS-232 interface. Data is transferred in half duplex mode at an optional speed between 600 and 9600 bps.
Two different methods can be used for serial communication using PackNet-2: Handshaking free or handshaking with RTS.

7.2 Handshaking with RTS not used

When handshaking with RTS is not used, the interruption in the bit stream from the peripheral system is used to determine when the message to the radio is finished.
The "maximum distance between characters"-time (see chapter 5.2.6) shall therefore be greater than the greatest possible character interval in the asynchronous transmission to the radio.
Normally the value of 5-30 (0005-0030) ms should suffice.

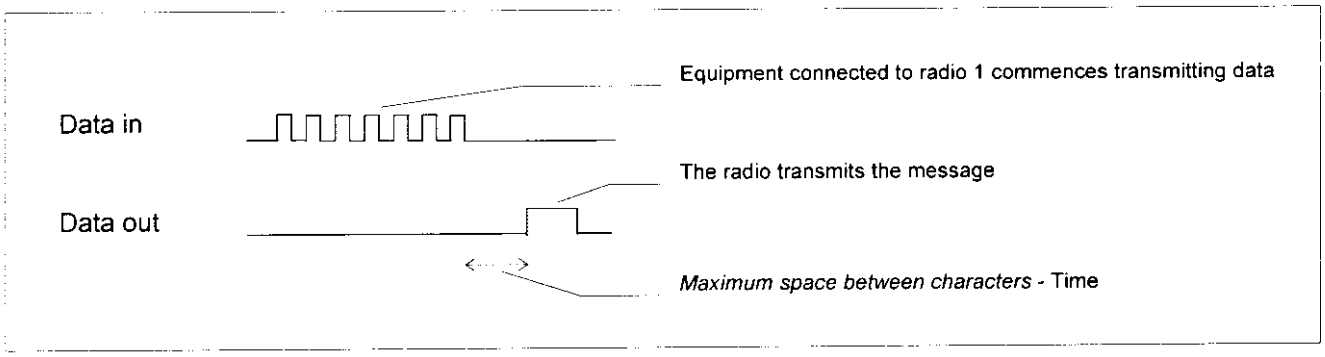

Figure 4. Handshaking with RTS not used

7.3 Handshaking with RTS used

When handshaking with RTS is used, the RTS' falling edge is utilised to determine when the message is finished.
The process is as follows: PackNet-2 always keeps CTS high as long as it is not busy. Connected equipment sets RTS high and sends data to the radio. When *all* data has been transmitted, the connected system shall release RTS and the radio then transmits the message.

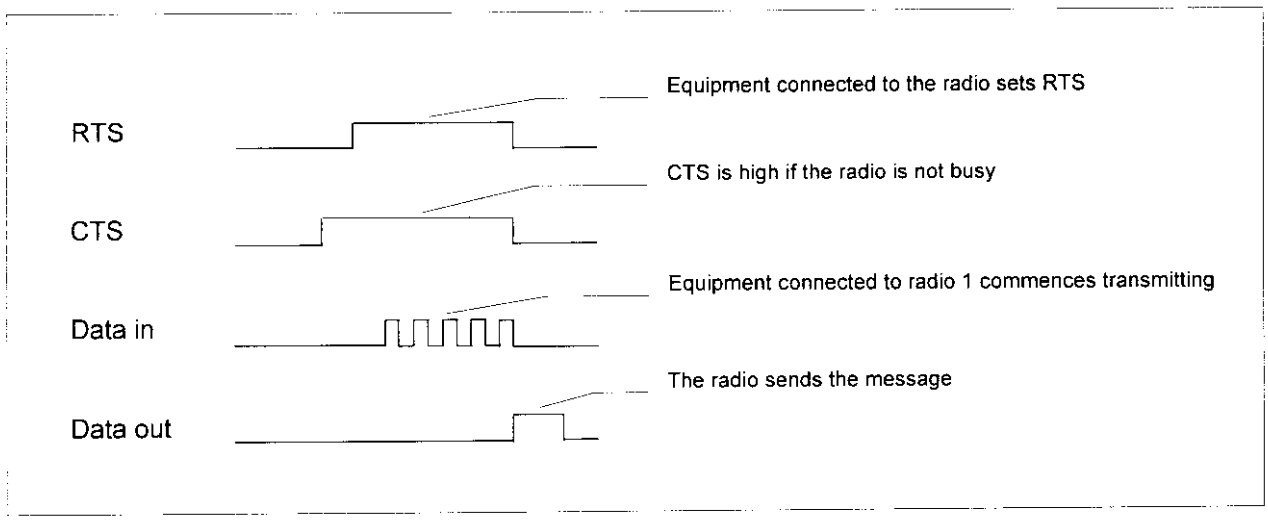

Figure 5. Handshaking with RTS used

8 Bit error rate test

This function tests the transmission quality directly (i.e. without repeaters) between two radio units. A command is sent to the corresponding unit which replies by sending back a bit stream with 'U' (55H).
A 'U' is written on the screen for each correctly received character. Incorrectly received characters are indicated with space. This provides an on screen graphic presentation of data transfer quality. The function should be used together with the automatically controlled attenuator, *Att-4*, which is serially connected via the R-bus. The attenuator attenuates the signal, transmitted by the corresponding unit, in four stages. A total of 4000 (1000+1000+1000+1000) characters is transmitted.
When the test has been completed the result is presented as below:

```
Bit error rate test

UUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUUU
UUUUUUUUUUUUUU UUUUUUUUUUUUUUUUUU  UUUUUUUUUUUUUUUUUUUUUUUUUUUUUU
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Attenuation level 0 0000 errors
Attenuation level 1 0010 errors
Attenuation level 2 0093 errors
Attenuation level 3 0219 errors
```

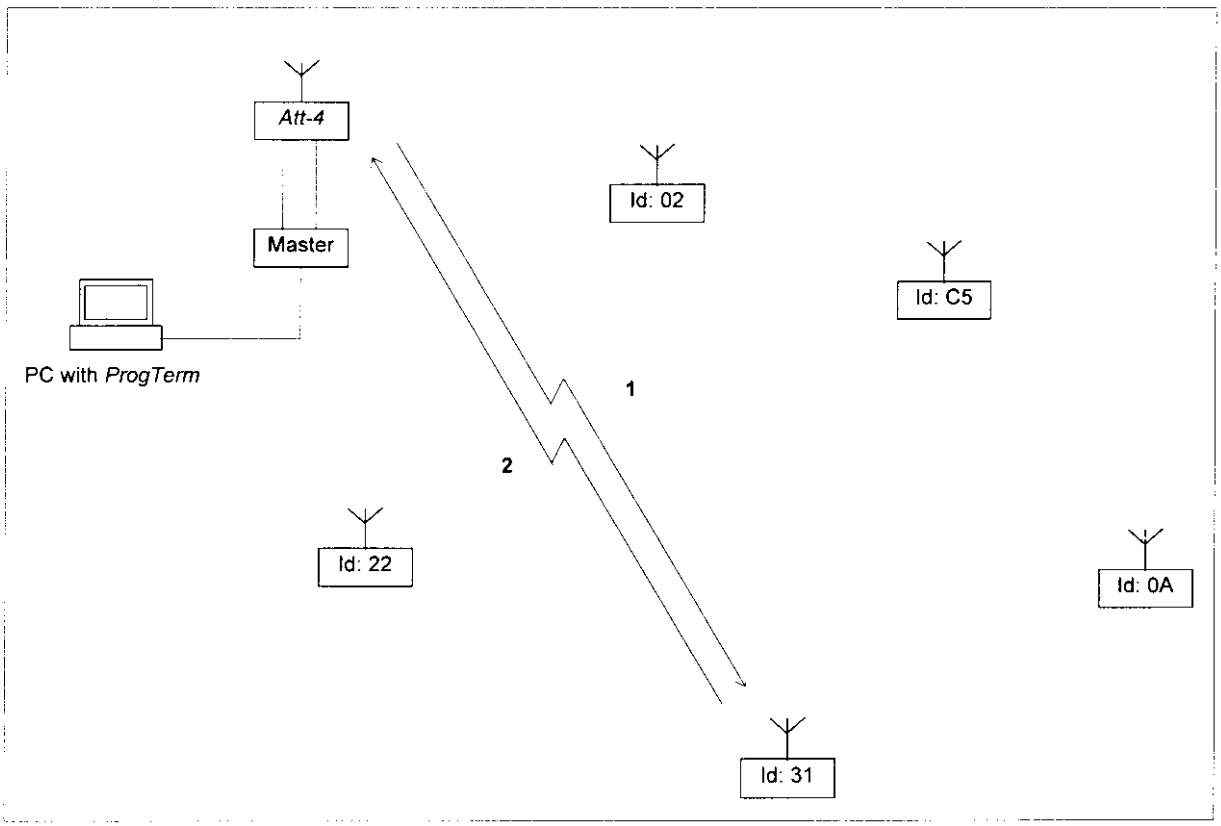
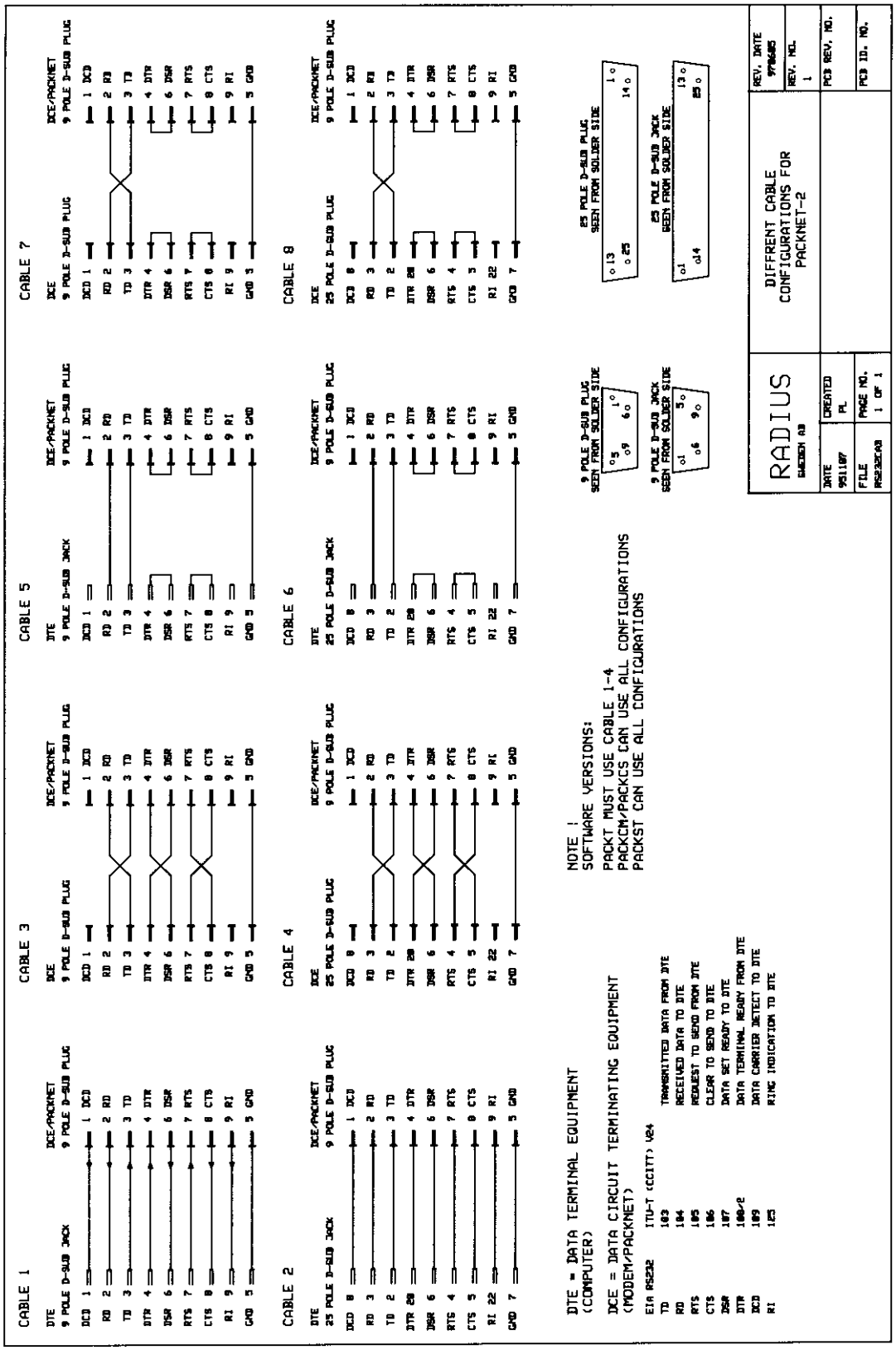


Figure 6 Bit error rate test

9 Drawings

9.1 Serial cable configuration



9.2 Packet switched transparent signalling