PACTLAN & COMMUNICATIONS ACCESSORIES INSTALLATION INSTRUCTIONS

Copyright © 2003-2006, PRI Ltd.   9600-3007-2 Issue D

Information contained within this document is subject to change without notice and does not represent a commitment on the part of PRI Ltd or its agents. E&OE.

IMPORTANT SAFETY INFORMATION

Care must be exercised during the installation of PACTLAN and associated equipment due to the presence of mains voltages.

Local best practice and regulatory stipulations must always be observed.

Installation should only be performed by suitably trained personnel. Various points under the terminal cover operate at hazardous voltages.

Removing the cover with power applied exposes potentially hazardous voltages.

After installation access to the connectors and conductors must be prevented by fitting the cover supplied, ensuring that it is secured in position with the screws provided.

PACTLAN distribution units must be electrically earthed. The electrical supply should be taken from a point fused at 3 A via 3-core (two conductor and earth) cable rated at 230 V 3 A minimum.

An external two pole switch or circuit breaker must be mounted adjacent to the unit.

Replace fuses only with correctly rated items. The correct rating is shown adjacent to each fuse.

Use or installation other than in accordance with this document may result in safety hazards.

CE MARKING DECLARATION OF CONFORMITY
PACTLAN mains-powered units meet standard BS EN 610336:1997, and therefore conform to EU Directive 89/336/EEC 'EMC Directive' as amended by 92/31/EEC and 93/68/EEC.

SECTION A: BACKGROUND

PACTLAN is a networking system that allows a number of CALMU devices (meters or dataloggers) to be connected to a single point, such as a modem or a PC COM port, for data collection. PACTLAN networks can extend over large distances and can encompass large numbers of CALMU devices.

The simplest PACTLAN networks may only involve two adjacent meters connected in a 'daisy chain' to a single modem by means of a double-headed lead. A complex PACTLAN network can include several mains-powered distribution units connected together, each having a number of metering devices connected to it.

Interrogation software such as Principal or EASEii from PRI can be used to individually address devices connected to a PACTLAN network, as can software from a number of third-party vendors.

On a typical PACTLAN network the computer or modem is connected to a PACTLAN distribution unit which is wired to a number of Netboxes connected in series, each of which is in turn connected to an individual meter or datalogger.

Each PACTLAN distribution unit has two network ports. The maximum cable length which may be connected to a network port is nominally 400 m, although site conditions (particularly electrical noise) may affect this. The number of Netboxes that can be used with each port depends on the nature of the connection to the meter. The standard (PACT) Netbox uses an optical connection to the meter; up to 16 Netboxes can be connected in series to a network port. The alternative (D Port) Netbox is for connection to a suitable meter through a 9-pin or 25-pin D Port; a maximum of ten D Port Netboxes can be used on one network port. Mixtures of the two types of Netbox are permissible; for this purpose, the loading of a D Port Netbox is equivalent to two PACT Netboxes. Therefore eight PACT and four D Port units may be used on one network port. The load imposed by a PACTLAN distribution unit connected to a network port may be ignored when calculating the maximum permissible number of Netboxes. In most applications PACTLAN units can be connected in up to seven 'layers', but this may be adversely affected by site conditions.

Ideally, the network cable should be 'daisy-chained' from one netbox to the next to ease commissioning and associated fault-finding. However, where a daisy-chained configuration would result in significantly increased cable length, it is better to branch off from the main linear run. Branches may be taken from any Netbox provided no IDC 'fork' contains more than two conductors.

SECTION B: INSTALLING THE MAINS POWERED DISTRIBUTION UNIT

Mounting

PACTLAN distribution units are designed for wall mounting using the four holes in the base plate. The 'footprint' of the unit is 212 by 150 mm; the height is 62 mm. Four fixing holes are provided in the base plate, arranged in the corners of a 190 by 80 mm rectangle centered vertically and horizontally in the base of the unit. Appropriate fastenings must be used, the exact nature of which will be determined by the type of wall to which the unit is to be fitted. For typical brick or masonry constructions a screw of 30 mm length should be adequate. The holes in the base plate will accept screws up to 6 mm diameter.

Care must be taken when siting PACTLAN units to ensure adequate access for cables on all sides, and for fitting or removal of the cover. It is recommended that the unit is fixed to the wall before any electrical connections are made. With the cover removed hold the unit up against the wall to which it is be mounted. The required holes can then be marked out, using the holes in the base plate as a guide. Place the unit to one side while drilling the holes to protect it from dust ingress. The unit can then be mounted to the wall.

Wiring

Cables should be mechanically secured at the point of entry to the unit, using tie-wraps through the holes in the main PCB so that the terminals are not disturbed in the event of accidental mechanical stress.

When the unit is mounted securely, connect the mains supply to the terminal block marked 'TB1'. PACTLAN units must only be connected to 220/230 V 50 Hz or, 110/120 V 50/60 Hz supplies, according to model. The appropriate voltage is clearly marked on the top cover and also on the top of the power supply module inside the unit.

Electrical installation must be carried out in accordance with the current edition of IEE wiring regulations.

It is recommended that PACTLAN units are powered from a separate fixed switched outlet rather than from a 3-pin socket outlet, and that the supply is clearly marked to ensure that it is not accidentally switched off. Test for earth continuity before applying power.

The mains cable must be protected against accidental damage and chafing where it enters the equipment enclosure.

SECTION C: INSTALLING NETBOXES AND CABLING

Metering devices (meters or dataloggers) are connected to a PACTLAN network using Netboxes. Each Netbox comprises a standard telecom 6-core junction box and an adapter lead terminated in a PACT port or D Port (9-pin or 25-pin) for connection to a meter or datalogger. Each Netbox can accommodate up to three sets of connections:

1)   'In' from the upstream connection (PACTLAN distribution unit for first Netbox in the chain)

2)   'Meter' via the adapter lead (PACT or D Port)

3)   'Out' to the next connection downstream (not used on last Netbox in the chain)

Standard CW1308 unshielded 6-core telecom cable is used for the connections between Netboxes. Five cores of the 6-core cable are used for connections to D Ports; only four are needed for networks consisting entirely of PACT port connections.

Each Netbox has two rows of connections, each with six insulation displacement (IDC) terminals. The connections on each strip of six are linked to those with the same numbers on the other strip.

Each terminal can accommodate two conductor cores. Conductors must only be inserted using the correct tool; connections made by forcing conductors into the terminals with a slotted screwdriver are not reliable.

Cable ties should be used to protect the terminations from strain.

Fig. 1 Netbox Connections
to meter
to 'upstream' Netbox   to 'downstream' Netbox

---
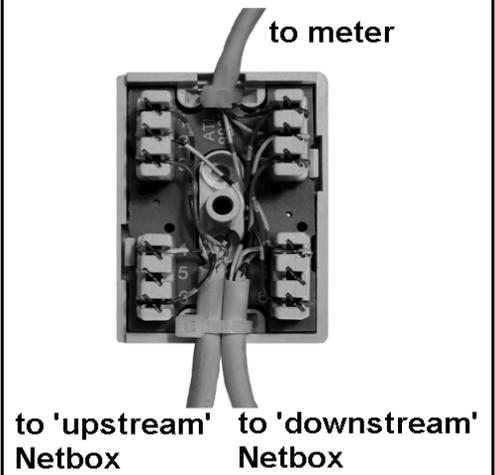
The PACTLAN network cable contains single-strand solid-core conductors and must not be repeatedly flexed. Care must be taken during installation to avoid excessive flexing of the cable. The minimum radius for bends in the cable is 10 mm.

Netboxes are supplied fitted with 2 m of cable terminated in either a PACT Port or a D Port for connection to a metering device. Cables can be cut to the required length and then reconnected to the terminals in the Netbox. Cables can be lengthened using a standard junction box to join sections together.

Table 1. PACTLAN Networking Components

PACTLAN Distribution Unit, 230 V		0200-0339/2	
PACTLAN Distribution Unit, 110 V		0200-0339/1	
PACT-Port Netbox with 2 m lead	One per meter. Can be used with any CALMU meter or datalogger	0800-0152/1	
9-pin D Port Netbox with 2 m lead	One per meter. Only for CALMU3+ meters fitted with a 9-pin D-Port	0800-0180/1	
25-pin D Port Netbox with 2 m lead	One per meter. Only for Premier meters	0800-0180/3	
IDC Termination Tool	More robust than the single-use tools supplied with telephone adapter kits	2100-0055	470-429
Telecom Junction Box	Not usually required; each Netbox contains one		252-986
6-Core Network Cable, 100 m reel	to BT spec. CW 1308	2701-0407	368-429
Modem/PC Lead, 1.5 m long	Supplied with PACTLAN unit	0800-0155	
Mini-modem line driver, female	Connects to PACTLAN unit D Port, or to PC COM port via an 'AT-FX' adapter	7800-0067	
Mini-modem line driver, male	As above. Connects to modem D Port.	7800-0068	
AT-FX adapter, 2 m long	For use with mini-modem and PC COM port		182-4043

Fig. 2 PACTLAN Unit Components
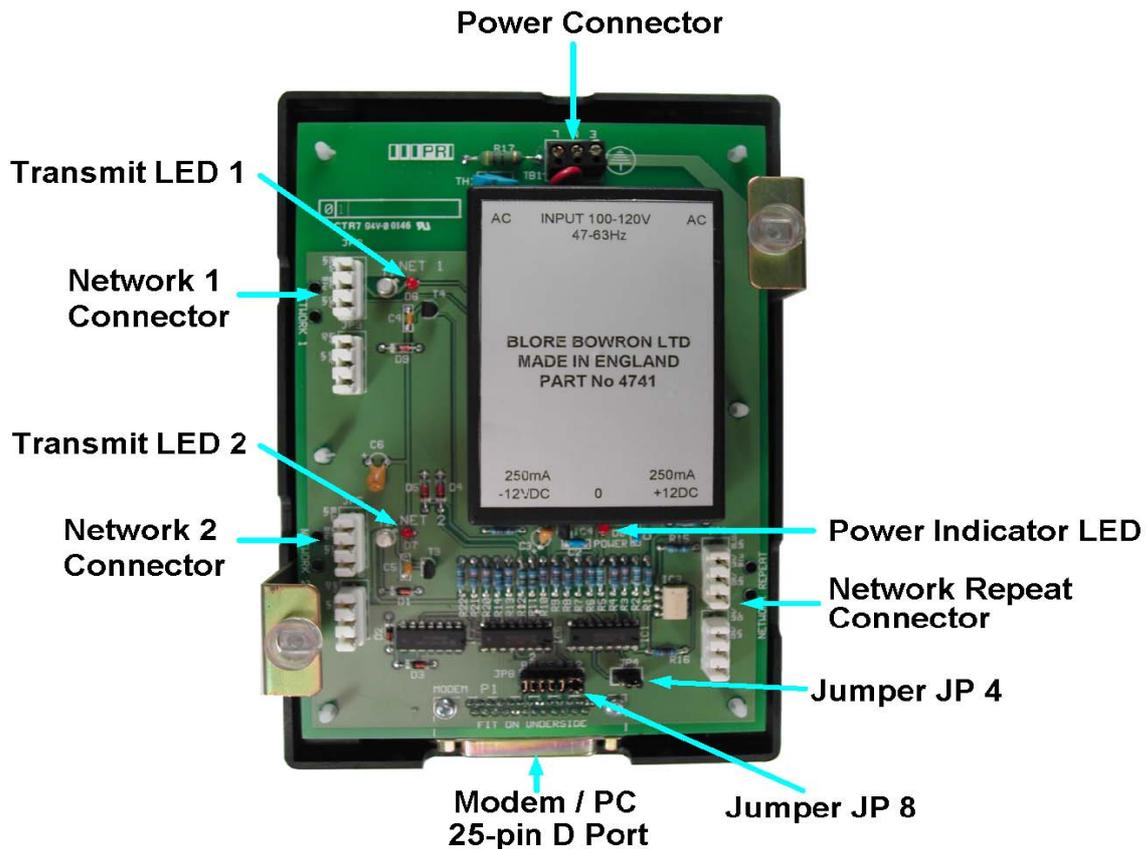
PACTLAN Unit Components

Power Connector
Standard connections for live, neutral and earth. PACTLAN units are supplied for use with either 230 V 50 Hz or 110 V, 50/60 Hz systems.

Power Indicator LED
This LED is continuously illuminated while power is applied to the unit.

Network 1 and 2 Connectors
Each PACTLAN unit houses two independent drive circuits. PACTLAN works by broadcasting simultaneously to all the metering devices connected on the network. Metering devices are addressed one at a time by unique serial number, so at any given moment all the devices are 'listening' but only the currently addressed one will be 'responding'.

Transmit LED 1 and 2
The LEDs are illuminated when the interrogating device is transmitting. Under normal operation both LEDs should flash simultaneously during interrogation.

Network Repeat Connector
This is used to 'daisy-chain' PACTLAN units. The last Netbox on the first PACTLAN unit is connected into the Network Repeat connector on the second PACTLAN unit, and so on.

Modem/PC 25-pin D Port
This is used to connect the interrogating device on the first PACTLAN unit in any network.

Jumper JP4
This is used to select input from either the Modem/PC port or the Network Repeat connector.

Jumper JP8
This is used to configure 'RS-232' options on the PC/Modem connector.

PACTLAN networks can be connected in a variety of ways. The examples in Figs. 3 to 6 show typical topographies. The basic priniciples can be extended to cover multiple distribution units installed at different points in a building. Interrogation can be performed remotely via PSTN modem or locally via a hard-wired connection to a PC.

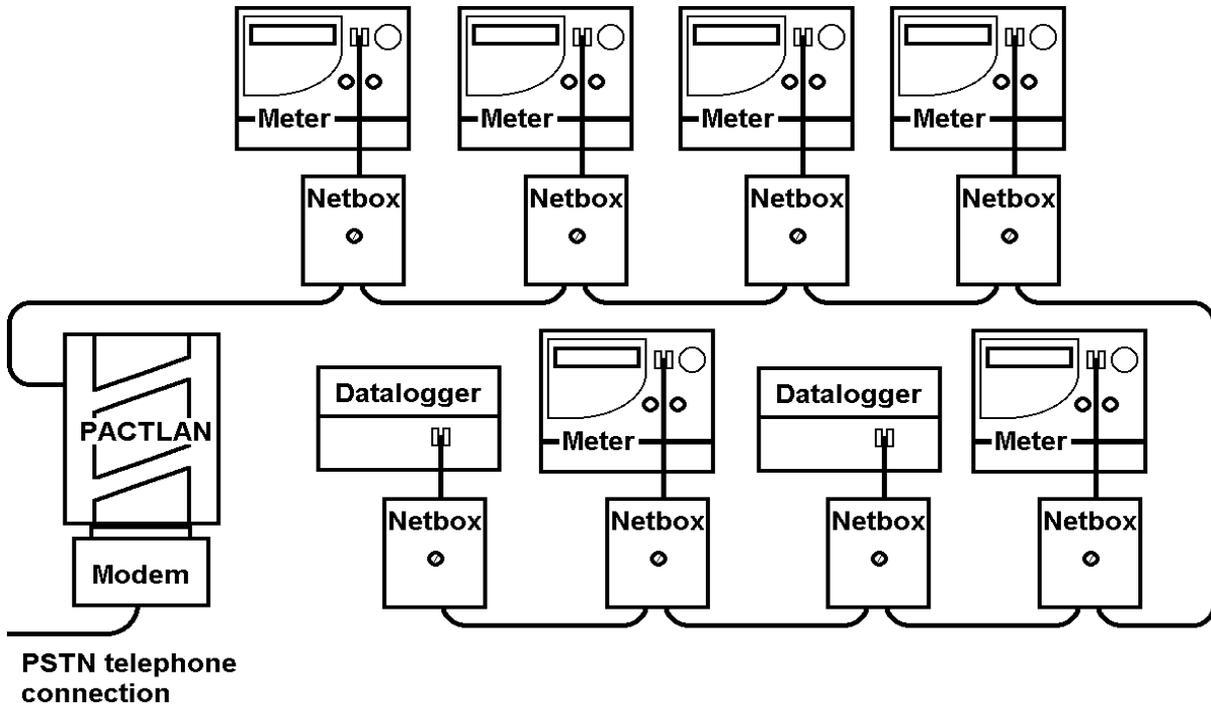### Fig. 3 Simple PACTLAN System with Single Distribution Unit

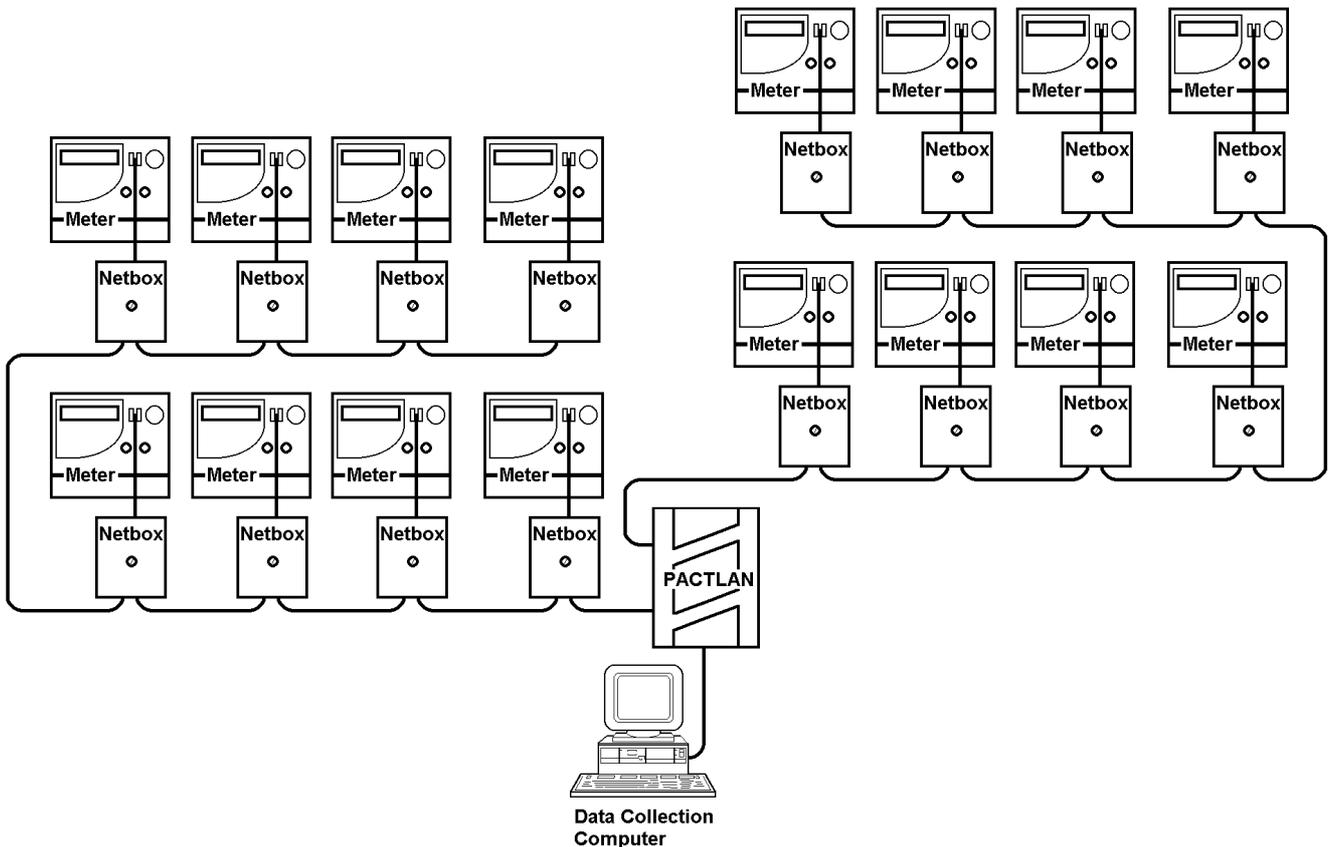

Fig. 4 Simple PACTLAN System Showing Both Networks Connected
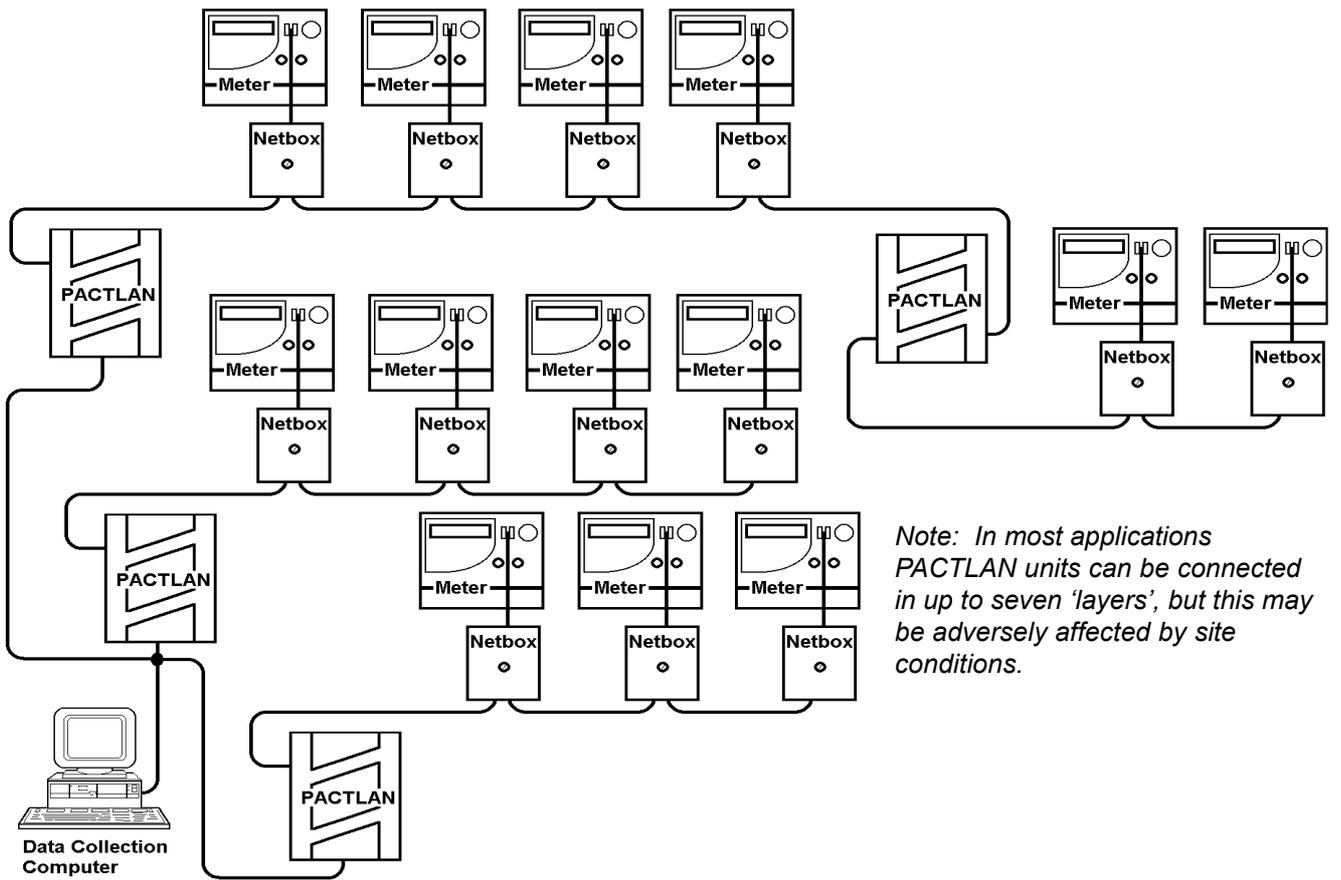
Fig. 5 Complex PACTLAN System with Multiple Branches

Note: In most applications PACTLAN units can be connected in up to seven 'layers', but this may be adversely affected by site conditions.

Fig. 6 Complex PACTLAN System with Multiple Units 'Daisy-Chained'

Note: In most applications PACTLAN units can be connected in up to seven 'layers', but this may be adversely affected by site conditions.

Fig. 7 Netbox Wiring

PACT Port

to PACT head

BLUE / white

WHITE / blue

ORANGE / white

WHITE / orange

GREEN / white

Network In   Network Out

D Port

ORANGE / white
RX to meter
Pin 2 (9-pin D Port)
Pin 3 (25-pin D Port)

WHITE / blue
TX from meter
Pin 3 (9-pin D Port)
Pin 2 (25-pin D Port)

WHITE / blue

ORANGE / white

WHITE / blue

ORANGE / white

WHITE / orange
Signal ground
Pin 5 (9-pin D Port)
Pin 7 (25-pin D Port)

BLUE / white

GREEN / white
WHITE / orange
WHITE / orange
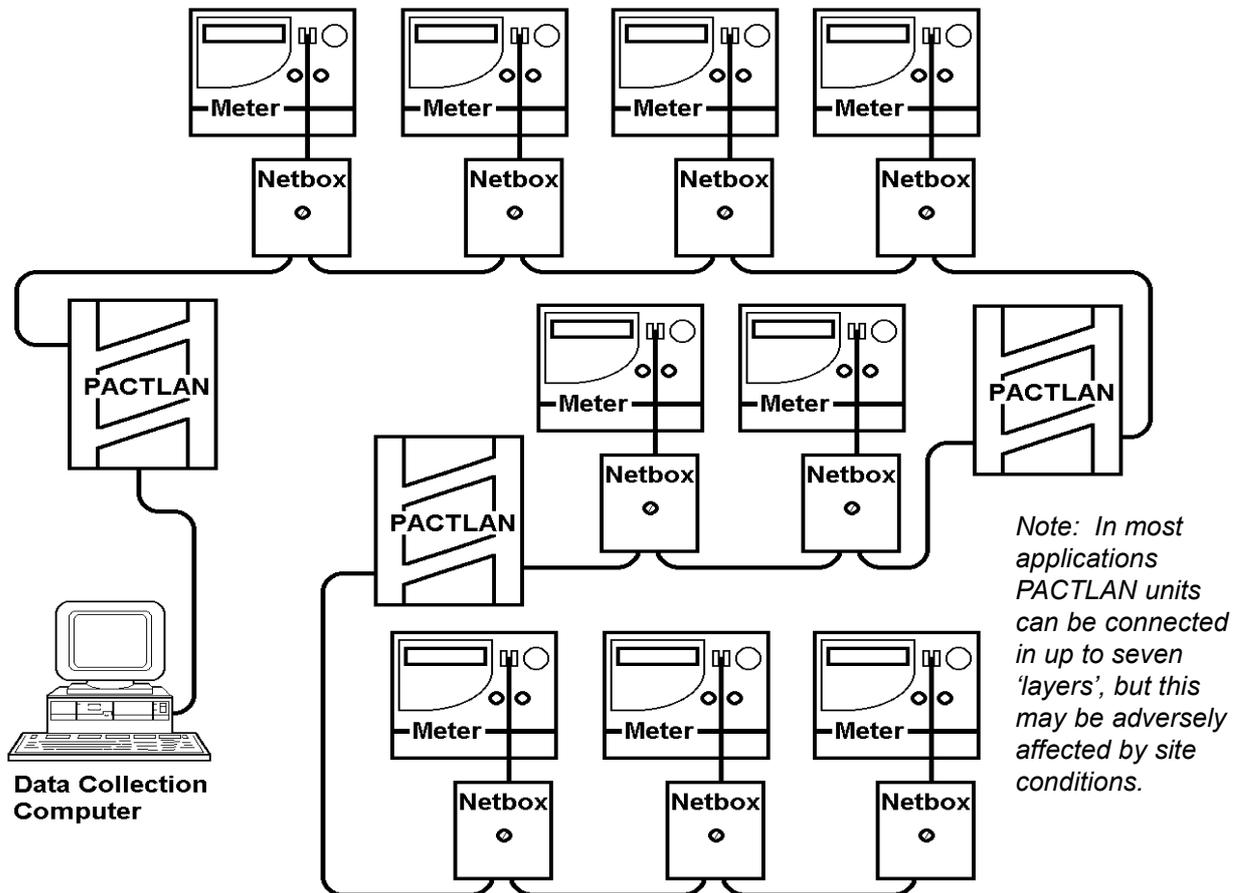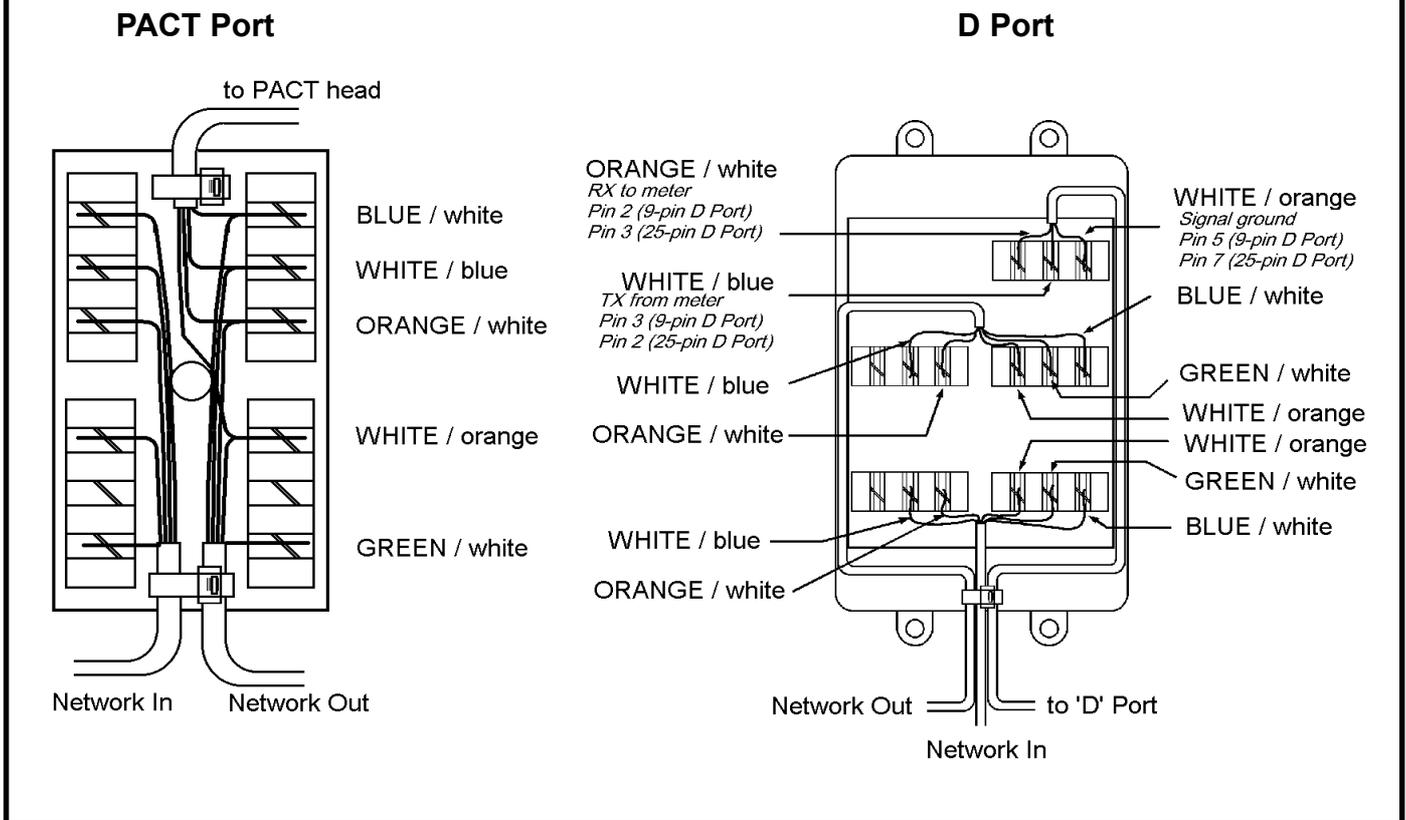GREEN / white
BLUE / white

Network Out ══ to 'D' Port
Network In

Notes:

1. PACTLAN cable is six-core unshielded CW1308 or similar, with maximum resistance 100 Ω per km.

2. Maximum length of the network can be affected by site-specific environmental conditions, but in general linear distances up to 400 m should work reliably.

3. 'Mini modem' type line drivers are recommended for installations with more than 10 m distance between the PC (or modem) and the first group of meters. Contact supplier for details.

4. Cable-ties should be used to secure cables.

5. Unused cores should be trimmed back to the outer insulation.

6. CAPITAL letters refer to the conductor insulation background colour, lower case letters refer to the trace colours.

7. Proper IDC tools must be used to insert cables, with no more than two conductors per terminal.

8. The terminal assignments can be varied, so long as all the conductors of a particular colour are connected to each other.

9. The GREEN / white connections are not required for PACT Port connections, but must be connected between Netboxes for systems requiring D Port connections.

10. Some 'legacy' PACTLAN systems using the PACT port have a 47 kΩ resistor fitted inside each Netbox. It is essential that the resistor is re-fitted correctly if the system is worked on. Contact supplier for details.

11. The maximum data rate supported by PACTLAN units is 4800 bd, but most systems operate at 1200 bd.

Each PACTLAN unit has two network ports which broadcast interrogation requests from an external device to all connected devices. Either or both network ports can be used, depending on the number of devices connected and the required topography.

A PACTLAN unit can receive interrogation requests either from a modem/PC connection on a 25-pin D Port, or as a 'repeat' connection from an upstream PACTLAN unit. In most applications PACTLAN units can be connected in up to seven 'layers', but this may be adversely affected by site conditions.

Jumper JP4 is used to select between the modem/PC connection and the network repeat connection. When set for 'Network Repeat' configuration JP8 is ignored and its settings are immaterial.

Fig. 8 Configuration of Jumper JP4 for Input Selection
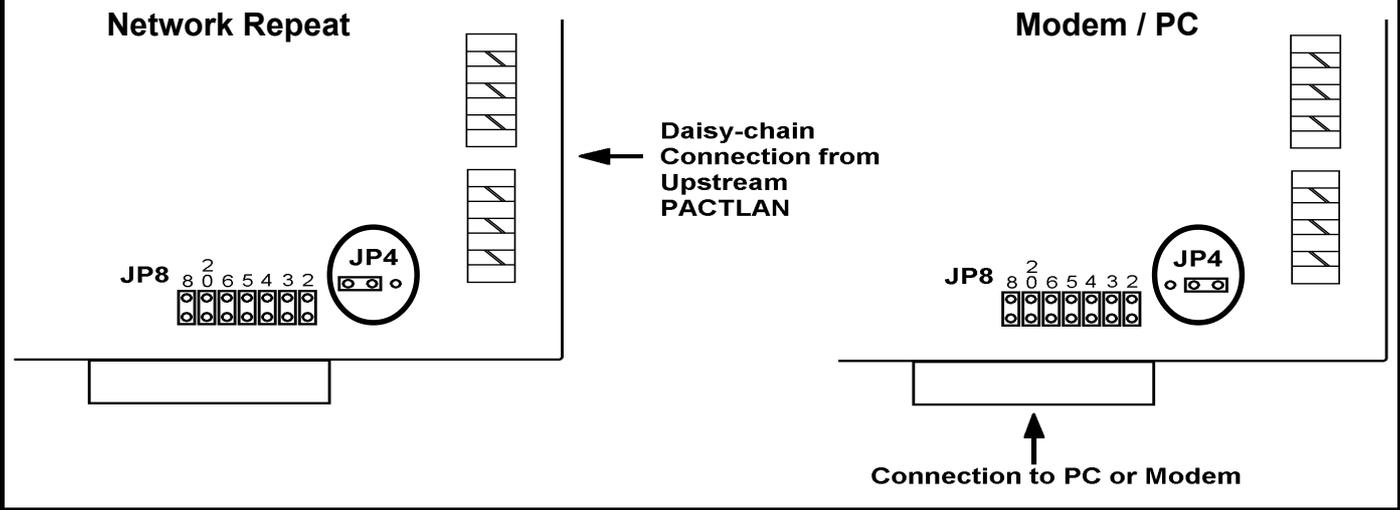
PACTLAN units are normally supplied with a lead (part number 0800-0155) for connection to an external PC or modem.   One end of the lead has a 25-way female D-connector (for the PACTLAN unit) while the other end has both a 25-way male D-connector (for a modem) and a 9-way female D-connector (for a PC COM port). Jumper JP8 must be configured correctly. For connection to a PC or a modem using the supplied lead (0800-0155), links 2 and 3 on jumper JP8 should be orientated 'horizontally' to effect a '2-3 swap'. For operation with modems remove link 8 (DCD - Data Carrier Detect) to ensure that the ring signal is detected correctly. The remaining jumpers are normally left in place, orientated in their default 'vertical' orientation.

Fig. 9 Connection to Modem or PC COM Port Using 0800-0155 Lead
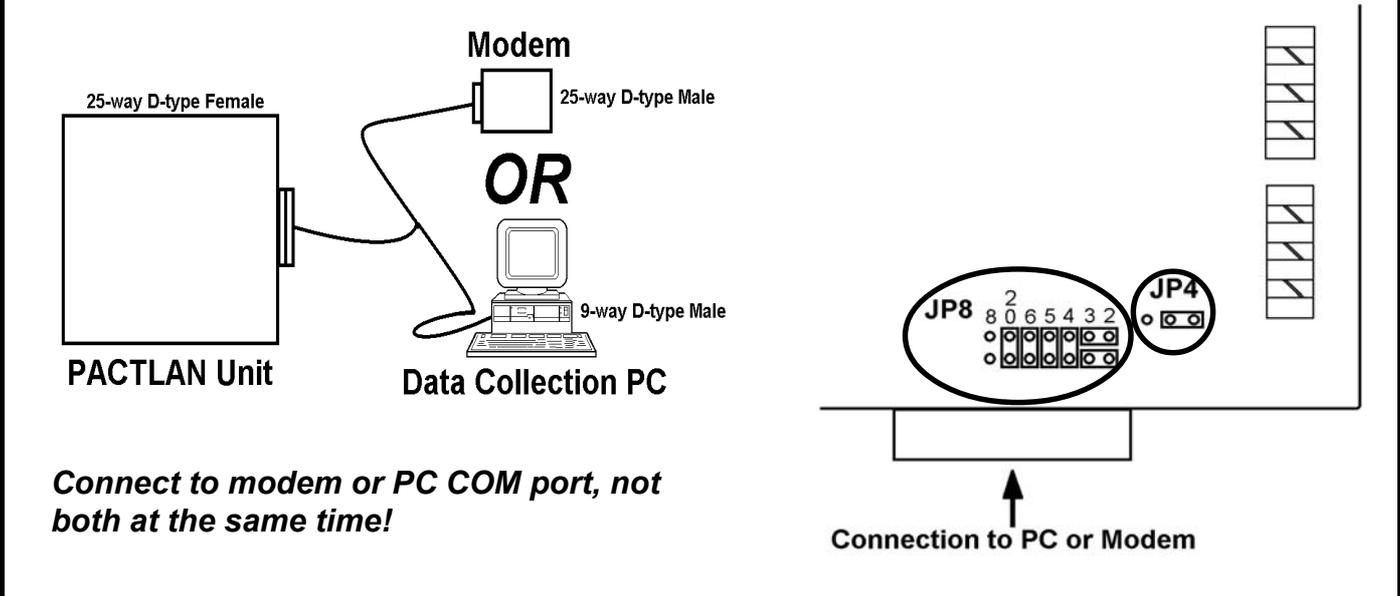
SECTION H: PACTLAN COMMISSIONING

It is essential that all metering devices are connected correctly to the PACTLAN system. It is possible to incorrectly configure a connection to a particular device without affecting any others. Therefore the only certain method for checking connections is to test each one in turn. PACTLAN works by broadcasting messages to all connected metering devices, which are enabled in turn by unique serial number. Functions are provided within EASEii and Principal software from PRI for testing and commissioning PACTLAN networks.

The process is to address each metering device in turn by its unique serial number and check that communication occurs without errors. As PRI software is 'fault-tolerant' to some degree it is important to check at the commissioning stage that there no errors 'in the background', otherwise operational efficiency may be compromised.

For systems using EASEii it is recommended that the DDE server is set up to 'Show Errors' to enable a check to be made on line quality; there should not normally be any errors for locally connected systems, but some errors due to poor external line quality may be unavoidable on modem-connected systems.

For systems using Principal software it is best to run checks in 'terminal mode' to observe errors. Each meter should be addressed in turn, using the PACTLAN module, then a series of terminal messages (such as 'uK' for total energy register) should be sent to the meter. There should be no replies from the network other than a single response to each request sent to the meter. Note that the PACTLAN addressing function is time-limited. The default state is for all connected devices to reply to any interrogation message; this ensures that direct connection to a single meter will always function. For multiple-meter installations PACTLAN addressing works by disabling responses from all meters except the one currently selected by its unique serial number. All the metering devices continuously monitor all interrogation messages but only the currently selected one will respond. After a time-out period of 20-25 seconds the disabled meters 'wake up'; it is therefore necessary to start sending messages to the selected meter within 20 seconds of enabling it within the PACTLAN module.

For networks involving a modem it is recommended that all the connections to metering devices are checked locally before connecting the modem.

Note: Each metering device has a unique serial number printed on a label on its cover. The last eight characters of the serial number are used to select the meter when connected to a PACTLAN network. All the channels on a multi-channel meter are accessed using the meter serial number. Dataloggers have a number of discrete channels each addressed by a unique number based on the physical number. For example, an eight-channel datalogger with physical serial number PD101234 would have channels PD101234 up to PD171234.

SECTION I: FAULT-FINDING

Warning: Mains voltages are present inside the PACTLAN distribution unit and terminals are accessible when the cover is removed. Do not touch any components inside the unit while power is applied.

The causes of a communications failure generally fall into the following categories:

Power failure:	This can apply to a modem, a PACTLAN distribution unit or a metering device
Incorrect serial number:	These are case-sensitive, i.e. 'PD001000' not 'pd001000'
Incorrect telephone number:	Where appropriate check the 'dial out' code for external telephone line and the STD code as well as the remote modem contact number.
Broken or detached lead:	Check the connection between the Netbox and the metering device.
Broken cable:	Check the condition of the cabling between Netboxes
Poor Netbox connection:	Check the IDC terminations in the Netbox.

A systematic approach is recommended when tracing faults on a PACTLAN system. It is best to break the system down into small blocks to isolate faults one at a time. Setting jumper JP4 to 'Modem/PC' isolates upstream units on networks with more than one PACTLAN distribution unit.
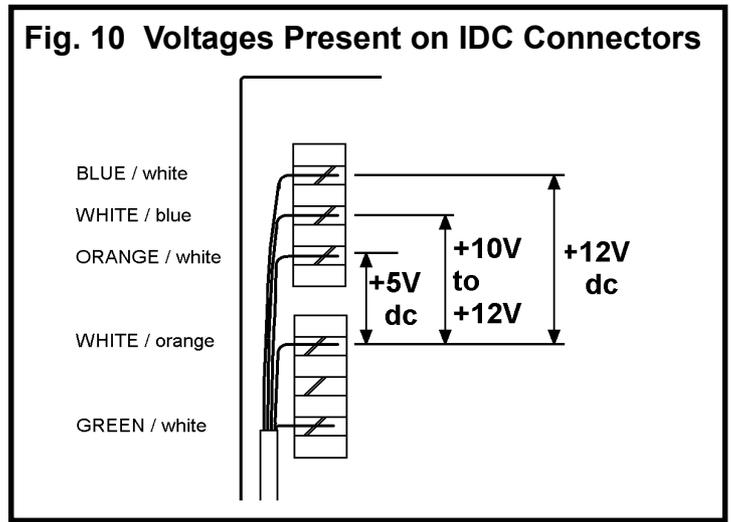
Start with the fundamental connections at the first PACTLAN unit. Check the connections from the input device (PC COM port or modem).

For systems with a modem check that the telephone lines at both ends are functioning, and check the telephone number for the PACTLAN unit, the dial-out code, and the STD code. Try dialling the number to which the PACTLAN unit is connected with a handset; the modem should respond with a 'dual-tone' handshaking signal. (See Section J for details on checking telephone line serviceability.)

Check the cabling between the PC or modem and the first PACTLAN distribution unit. Check the setting of jumpers JP4 and JP8.

Check the voltages present on the IDC connectors for network 1 and network 2, either at the first Netbox or inside the PACTLAN unit.

Warning: Mains voltages are present inside the PACTLAN distribution unit and terminals are accessible when the cover is removed. Do not touch any components inside the unit while power is applied.

Fig. 10 Voltages Present on IDC Connectors

BLUE / white
WHITE / blue
ORANGE / white
WHITE / orange
GREEN / white

+5V dc
+10V to +12V
+12V dc

It may be necessary to islolate Netboxes in turn to locate wiring faults. This can be done by temporarily disconnecting either the 'Network Out' lead or the lead to the meter.

By a logical process of elimination it is always possible to isolate the location and nature of any wiring faults.

The 'transmit' LEDs indicate whether messages are being received from the interrogating device. The two networks are independent, so it is possible for only one LED to flash if there is a fault on one network.

SECTION J: TELEPHONE LINE TEST PROCEDURE

Equipment Required

1. B.T. line cord with line plug
2. Two-way connector block
3. Two-way telephone adapter
4. Digital multimeter (covering ranges 0 - 100 V DC, 0 - 100 mA DC)

Method

a. Connect the two-way connector block to the bared end of the BT line cord, connecting cores 2 & 5, (red and white in most cases).

b. Remove any equipment connected to the BT phone socket and insert the two-way telephone adapter.

c. Insert the cord plug into the two-way adapter.

d. Measure the nominal **voltage** at the test block. It should be in the range **47 to 53 V DC.**

e. Measure **line current** drive capability at the test block. It should be **>25 mA** (typically 40 mA)

> **DO NOT TEST FOR LONGER THAN 10 SECONDS CONTINUOUSLY**

f. Insert modem or phone into the second socket of the two way adapter.

g. Take the telephone or modem "**off-hook".**

h. Measure the nominal **voltage** at the test block   It should be in the range **8.0 to 9.0 V DC.**

i. Measure **line current** drive capability at the test block. It should be **>25 mA** (typically 40 mA)

> **DO NOT TEST FOR LONGER THAN 10 SECONDS CONTINUOUSLY**

j. Place modem or phone back "**on-hook".**

All PRI metering devices can be interrogated remotely over PSTN when connected to a suitable modem.

Terminology: The interrogating PC (running EASEii or Principal for example) is referred to as the 'Instation'. The remote end to which the metering device is connected is called the 'Outstation'.

Modems used for metering are very different from those used in typical desk-top activities such as Internet 'surfing'; data-rates are very much lower, and data-compression and error-correction are not normally appropriate. While it is possible to use a desk-top modem at the Outstation it is not recommended for long-term use. Outstation modems are specifically designed for unattended operation, are more resilient than desk-top units, and always power-up with the correct settings for metering applications.

Modems are either mains-powered or take their power from device to which they are connected (such modems can only drive one metering device whereas mains-powered modems can be connected over a short distance to up to four metering devices using a special lead). Networks with more than four metering devices, or covering larger distances than a few metres, require a mains-powered PACTLAN unit.

PRI modems can be connected to any Encore, Elite, CALMU3, CALMU3+, Sprint, Sprint XP or Premier meter or any PRI datalogger. The information that can be retrieved varies between models, but can include energy registers or half-hourly load survey data. All PRI meters can be interrogated for instantaneous electrical parameters such as voltage, current, power, power factor and so on.

Sprint XP meters can be fitted with a 'CoP5' XP module with integrated modem for simple connection to PSTN via a single cable; no external power supply is required. Premier meters can be equipped with a modem under the terminal cover, powered by the meter.

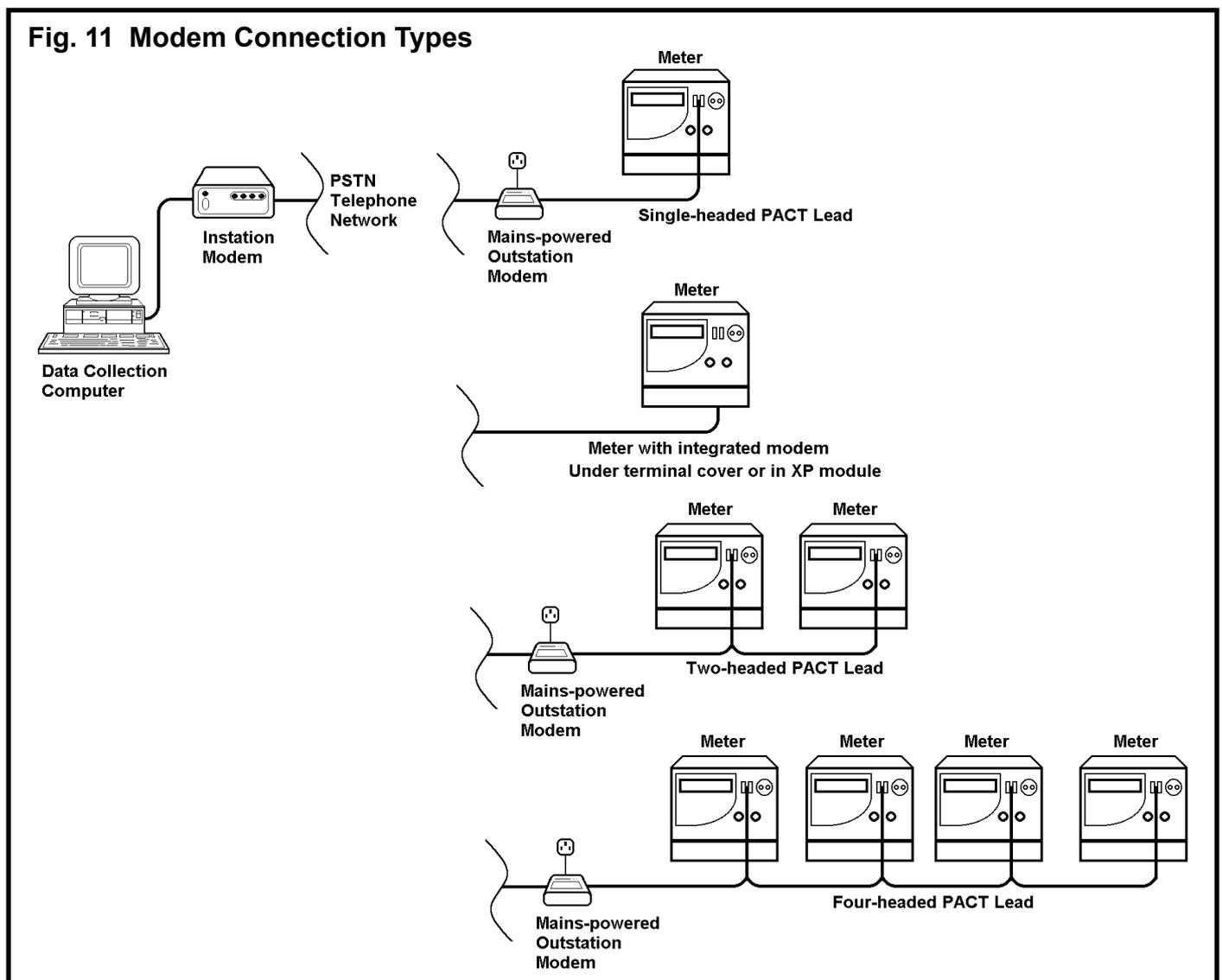Different leads are available for connection between metering devices and modems, see Table 2.

Fig. 11 Modem Connection Types

Table 2. Outstation Modems and Associated Leads

General purpose mains-powered modem	0200-0378/1	Connects to any PRI metering device via any of the leads below.
230 V ac power supply for modem	0200-0346	Supplied with modem
Step-up transformer, 110/230 V ac	0200-0347	For use with power supply for mains-powered modem.
Meter-powered modem	0200-0394	For use with Premier. Connects to D Port under terminal cover.
PACT to modem lead	0800-0004/1	Connects mains-powered modem to one meter.
Two-headed PACT to modem lead	0800-0174/2	Connects mains-powered modem to two meters.
Four-headed PACT to modem lead	0800-0174/4	Connects mains-powered modem to four meters.

Note: PRI Outstation modems are supplied with a fixed configuration and do not require any setting up before use or after a power-outage. This is not the case with Instation modems, or with desk-top modems in general.

SECTION L: INSTATION MODEMS

PRI recommend the following desk-top modems for Instation use with EASEii or Principal software:

1.   Hayes Accura 33.6 Message Modem
2.   Hayes Accura 56k Fax/Voice Modem
3.   Diamond Supra Express 56e Pro Modem

In general any modem that supports V22 and has a fully 'Hayes AT'-compatible command set can be used, but some models may require specialist knowledge for configuration.

Internal modems and 'software' modems are not recommended. External modems are easier to configure, and usually have indicator LEDs that can aid diagnosis. EASEii software can operate with any port in the range COM1 to COM4, but Principal software can only address COM1 or COM2.   PCMCIA-card modems are often set up by default for operation on COM5 or COM6, but can sometimes be reconfigured.

The default data format for use with PRI metering devices is '8N1' (8 data bits, 1 stop bit, no parity) at 1200 bd. Specialist applications involving GSM modems often use higher baud rates and require metering devices configured accordingly.

Most applications involving PSTN modems require an initialisation string to be sent to the modem before dialling the remote connection. PRI software includes 'generic' default initialisation strings that may need to be modified for specific modems.

For systems using the CALMU DDE server (such as EASEii) the following general settings are recommended:

Reply Timeout:	45 seconds
Inactivity Timeout:	5 seconds
Number of Retries:	2
Dial Timeout Period:	45 seconds

Pre-dial String: T (for tone-dialling). The access number for an external line ('9' for most PABXs) can also be entered here, in the format 'T9,'

Initialisation String:

Generic 'Hayes' modem: ATE0V0X0Q0&D2S37=5N0

Diamond Supra Express 56e: ATBEVM1QX0CLS=0MS=1