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STATIC ELECTRICITY

High voltages (tens of kilo-volts) can be generated on the human skin through a number of mechanisms, such as friction between different materials (eg nylon and skin), and separation of similar materials (eg masking tape, nylon sheet). The gate-oxide region of all metal oxide semi-conductors (MOS) is extremely thin, and may be damaged by voltages as low as 60 Volts. Modern MOS devices have built-in clamp diodes which reduce the incidence of obvious static damage considerably. It is possible, however, even with such clamping diodes, to produce a small rupture in the oxide layer. This may not destroy the device immediately, but it may result in a gradual reduction in the performance of the device until, eventually, it fails.

For this reason, the following precautions should be taken when handling any circuit board in a 4500 rack:-

1. Personnel handling MOS devices, or circuit boards containing them, should wear anti-static materials such as cotton. Nylon clothing should be avoided.

2. All bench tops should be covered with conductive material (10^4 to 10^5 Ohms per square) maintained at the rack ground potential.

3. Circuit boards removed from any 4500 rack should be placed into a static-safe bag for storage.

4. Personnel handling MOS devices or boards containing them should wear a wrist strap connected (via a safety resistor) to the bench top, or if appropriate, to a suitable grounding point on the rack.

5 Leads of MOS devices removed from circuit should be shorted together using conductive foam or similar.

6 MOS devices should not be extracted from or inserted into circuit whilst the circuit board has power applied.

TERMINOLOGY

ANTI-STATIC

This term means that the material in question does not itself generate static electricity. Such materials do not afford protection against external electric fields.

STATIC SAFE

This means that the material in question a) does not generate static electricity, and b) any device enclosed in such material is safe from the effects of external electric fields.

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ASSOCIATED DOCUMENTS

Part Number	Title
HA237229	4001 INSTALLATION AND OPERATION MANUAL
HA237231	4001 SERIAL COMMUNICATIONS INSTRUCTION MANUAL
HA076568U100	TCS COMMUNICATIONS HANDBOOK
PI-MBUS-300	GOULD MODICON MODBUS PROTOCOL REFERENCE GUIDE
ESOMAN/3.21	EUROTHERM SUPERVISORY PACKAGE USER MANUAL
T457	GEM 80 SERIAL COMMUNICATIONS MANUAL

A fuller contents list appears at the beginning of each section.

LIST OF EFFECTIVE PAGES

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SECTION 1 OVERVIEW

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1.1 INTRODUCTION

This manual is intended to familiarise the 4500 user with all aspects of the installation, operation and configuration of the model 4500 data acquisition system.

1.2 MANUAL LAYOUT

The manual is arranged in the following sections:

Section 1 contains an introduction to the 4500 system, including a full specification.
Section 2 (installation) contains details of mechanical installation, and of mains (line) power connection and signal wiring.
Section 3 (operation) describes the day-to-day operation of the instrument.
Section 4 (configuration) gives details of the System, Channel and Alarm configuration
Section 5 (serial communications) describes the communications protocols available for use in communicating with a host computer.
Section 6 (options) contains information, specifications etc. on the various options available for use with the 4500 system.
Section 7 (reference) contains a number of tables which
a) cross reference the channel number with the circuit board slot;
b) allow the operator to keep track of channel allocations in a distributed recording system;
c) give a list of maths pack variables
d) give a list of reformatting selection criteria for systems fitted with the Archiving option
Annex A contains installation details for PC based software associated with the Terminal emulation and Archiving options.

1.3 THE 4500 SYSTEM

The 4500 is a powerful data acquisition and processing system, capable of handling up to 885 channels of input and output (I/O) data. I/O modules are housed in a master and up to 4 expansion units connected via a multi-drop serial link, with a maximum length of 1200 metres (4000 ft.).

1.3.1 INPUTS

Inputs can be dc voltage signals, thermocouples, dc mA, discrete inputs (5 to 250Vac or dc, or voltage free contact), or 2, 3 or 4-wire Pt100 resistance thermometers (RTDs). (Maximum number of RTD input channels is 354.) Thermocouple and RTD input channels can be user calibrated to take account of any small transducer inaccuracies.

1.3.2 OUTPUTS

Outputs can be analogue (dc voltage or current), discrete (Lo or Hi) or by means of relay closure.

1.3.3 ACQUISITION

The acquisition of data is carried out by scanning each input channel, and linearising, scaling and filtering as set up in the channel configuration. Each input or output variable can be allocated a unique descriptor and individual units string to enable the display to appear in the user's own terms.

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1.3.4 ALARMS

A powerful alarm scanning facility with a pool of up to 1000 set-points is supplied. If any of the set-points is exceeded, an alarm is triggered. Such an event is indicated on the operator display, and can be configured to set discrete outputs (DOs), to operate relay coils and/ or cause a 'report' to be printed. A DO or relay can be operated by many different channel set-points, and this feature can allow a major reduction in the number of relay output or DO boards required.

Three types of analogue (absolute, deviation and rate-of-change) and one type of digital set-point (on-off) are supplied. Providing that the system maximum is not exceeded, up to four set points (in any combination of types) may be defined for any input channel.

In addition to the normal alarm facility, a global alarm can be triggered by any set-point which has been so configured. The global alarm can be used to set either one or two DOs or relays as required. The global alarm is reset by acknowledging the alarm that caused it, or a discrete input (DI) may be configured as a global alarm acknowledgement.

1.3.5 MATHS PACK

A powerful mathematics package is available, as an option, to allow the derivation of expressions using up to 256 variables. The results of the calculations can be routed to input channels to be processed like any other type of input.

A full list of the mathematical functions available is given in the Options section of this manual, but the general areas included are as follows:-

1) Arithmetic (addition, subtraction, product, quotient, square etc.)
2) Calculus (totaliser, rate of change)
3) Logical (AND, OR, EXOR etc.)
4) Averaging of a channel or of a group of channels.
5) Continuous and latching maximum or minimum of a channel or of a group of channels.
6) Filter
7) Specialised functions (Mass flow, Nernst oxygen, F value (F_o) etc.)

1.3.6 OPERATOR INTERFACE

The system is operated from a rugged wall-, panel- or rack-mounting panel which includes a vacuum fluorescent display consisting of two lines of 40 characters, and a membrane panel with 23 tactile keys.

Configuration of the system can be carried out on-line from this operator panel, or off-line, using a VT100 compatible terminal or, if archival / retrieval to / from disc is required, an IBM® PC, PCAT or compatible. The use of a terminal or pc for configuration purposes provides the enhanced (form based) configuration techniques required for the larger system.

1.3.7 USER OUTPUTS

Information from the system's data base can be output in a number of forms:-

1) Data can be transferred to a host computer using Gould-Modicon, TCS binary or GEM 80 protocols, via an RS232-C or RS422 link.
2) Reports and alarm messages can be sent to a simple 80 column printer, again via a serial link.
3) Data can be re-directed to analogue outputs, allowing the output of scaled, linearised, filtered etc. data, (derived either directly from an input channel, or by means of maths pack operations) to analogue indicators.
4) Outputs can be directed to up to eight Model 4001 chart recorders which allow a permanent record of the output data to be made, with up to 30 channels being printed simultaneously by each recorder.
5) Channel and system configuration data can be archived to a mass storage medium. System configurations can subsequently be retrieved. A software package supplied with the option allows channel data to be reformatted in a suitable personal computer and used in graphics displays, spread-sheets etc.

1.4 SYSTEM SPECIFICATION

1.4.1 SINGLE BOARD COMPUTER

The single board computer (SBC) is mounted in a 'master' rack and uses a 68000 series microprocessor with an optional 68881 floating point co-processor for enhanced processing. Three levels of SBC software are available, each providing the same functionality, the three levels varying only in the number of channels, alarms etc. available and in speed of performance.

LEVEL 1	
I/O capability	Single 'master' unit giving a maximum of 165 channels.
Alarms	250, freely assignable with up tó four per channel.
Alarm messages	50 associated with any of the 250 channel alarms.
Maths pack (optional)	128 Single precision variables; 12 double precision variables.
Distributed recording (optional)	Total number of channels allocatable to all blocks: 165.
User defined linearisation	1 table applied to any or all channels
LEVEL 2	
I/O capability	One 'master' and up to four expansion units giving a maximum of 885 channels.
Alarms	1000, freely assignable, with up to four per channel.
Alarm messages	200, associated with any of the 1000 channel alarms.
Maths pack (optional)	256 Single precision variables; 32 double precision variables.,
Distributed recording (optional)	Total number of channels allocatable to all blocks: 480.
User defined linearisation	3 tables, each if which may be applied to any or all channels
LEVEL 3	
Specification as per level 2, but with floating point co-processor for enhanced mathematical and channel processing.	

1.4.2 INPUT-OUTPUT CAPABILITY

For both the master and expansion units below, the maximum number of input channels per slot is 15. Thus, with the maximum system of one master and four expansion units, the total number of input channels possible is 585 with all panel-mounting or bench units, or 885 with all 19" rack mounting units.

MASTER UNIT	
Panel-mounting or bench enclosure	7 slots
19" rack enclosure	11 slots
EXPANSION UNIT	
Panel-mounting or bench enclosure	8 slots
19" rack enclosure	12 slots

1.4.3 SERIAL COMMUNICATIONS

Two communications ports are available to the user, both configurable as either RS232C or as RS422A. Industry standard protocols GEM 80, TCS binary and Gould Modicon Modbus RTU are supported allowing the 4500 system to be used as a 'slave' I/O system to a host (supervisory) computer.

1.4.4 CONFIGURATION FACILITIES

Configuration can be carried out either from an operator panel (with multi-level password protection) or from a VT100 terminal using a screen-based form filling technique. A 'terminal emulation' software package available from the manufacturer, runs on an IBM® PC or equivalent, and emulates a VT100 terminal. This allows the storage and retrieval of a 4500 system configuration using standard PC discs.

1.5 INPUT-OUTPUT (I/O) BOARD SPECIFICATIONS

The following I/O boards are available for the 4500 system:

a) 6 channel dc input board (AH232128)
b) 15 channel isolated analogue input board. (AH239844)
d) 6 channel RTD input board. (AH234434)
e) 15 channel digital I/O board (AH239424)
f) 8 channel analogue output board (AH239307)
g) 4 or 8 channel relay output board (AH232123)

1.5.1 SIX CHANNEL DC INPUT BOARD

Six isolated measurements of dc Volts, dc mA, dc Amps, or thermocouple inputs, programmable in any mix. A dedicated analogue to digital (A to D) converter per channel allows digital multiplexing of data for reliable scanning.

		GENERAL SPECIFICATION
Number of inputs		Six maximum
Input types		Volts, mA, thermo-couple.
Input ranges	Voltage:	10mV to 10.24V (250V with attenuator) with 20% negative excursion.
	Current:	50mA max (100 ohms shunt).
	Thermocouples:	Full range including types B, E, J, K, N, R, S and T.
Mix of inputs		Any type to any input.
Linearisation		Thermocouple types B, E, J, K, N, R, S, T
Cold junction compensation		Internal or external.
Open circuit detection		Up-scale, down-scale or floating
		PERFORMANCE
Accuracy		IEC484 class 0.1 for ranges >160mV; class 0.25 for ranges ≤ 160mV.
Degredation in accuracy:		
when using standard attenuators		<128Vdc = 0.1%; ≥128Vdc = 1.1%
When using standard shunt resistors		0.1%
Additional voltage offset when using up- or down-scale sensor	fail detection:	± 20 µV
Zero offset		± 10 µV (doubles for every 10°C above 35°C)
Thermo-couple linearisation		± 0.3 °C (typical)
CJC error	Absolute:	± 0.5 °C ± 0.2°C between terminals.
	Rejection ratio:	25:1 minimum; 30:1 typical.
Noise rejection	Series:	>90 dB at 50 Hz.
	Common	>120 dB at 50 Hz.
Gain drift		50ppm (typical)
Conversion time per channel		< 0.5 secs (typical). For step input; 1 sec. to 5%; 2 secs. to 0.1 %; 2.5 secs to 0.01 % of reading.
		MAXIMUM RATINGS
Over/under range		5% of range.
Maximum input		100 Volts dc (250 Volts with attenuator).
Channel isolation		250 Volts RMS.

1.5.2 FIFTEEN CHANNEL ISOLATED ANALOGUE INPUT BOARD

Note...

This circuit board should be handled with care, since finger grease etc. can cause a degradation in the calibration accuracy.

This board is offered where a greater density of channels is required. A conventional reed-relay scanner is used with a dual slope analogue-to-digital converter to measure dc Volts. dc mA, or thermocouples. Each channel is fitted with an attenuator or shunt located, as a plug-in module, in the Signal Interface Module (SIM). Section 1.6 should be referred to for further details.

GENERAL SPECIFICATION		
Number of inputs		15 maximum
Input types		Volts, mA or thermocouple
Input ranges	Voltage:	10 mV to 10.24 Volts (200 Volts with attenuator) with up to 40% negative excursion.
	Current:	50 mA (100 ohm shunt)
	Thermocouples:	Full range including types B, E, J, K, N, R, S and T.
Mix of inputs		Any type to any input.
Linearisation		Thermocouple types B, E, J, K, N, R, S and T.
Cold junction compensation		Internal, external or remote.
PERFORMANCE		
Accuracy		IEC484 Class 0.25
Zero offset		± 40 µV
Thermocouple linearisation		± 0.4 °C typical
CJC error	Absolute:	± 0.5 °C ± 0.5°C between terminals.
	Rejection ratio:	25:1 minimum; 30:1 typical.
Noise rejection	Series:	>60 dB at 50 Hz.
	Common	>120 dB at 50 Hz.
Conversion time		All channels converted in 2 seconds.
MAXIMUM RATINGS		
Over/under range		5% of range.
Maximum input		63 Volts dc (200 Volts with attenuator).
Channel isolation		250 Volts RMS.

1.5.3 FIFTEEN CHANNEL NON-ISOLATED ANALOGUE INPUT BOARD

Not yet available

1.5.4 SIX CHANNEL RTD INPUT BOARD

Six isolated temperature measurements, using 2-, 3- or 4-wire RTDs are provided, programmable in any mix. Similar in design to the six-channel dc input board, the RTD input board possesses the same degree of integrity and noise immunity.

		GENERAL SPECIFICATION
Number of inputs		6 maximum.
Input types		2-, 3- or 4-wire Pt100 resistance thermometers.
Input range		-200 to +1000 °C.
Input mix		Any type to any input.
		PERFORMANCE
Accuracy range	>100 °C:	IEC484 class 0.1.
	<100 °C:	IEC class 0.25.
Linearity		±0.05%.
Lead resistance effects		
	3-wire:	0.02%/ohm typical; 0.04%/ohm maximum.
	4-wire:	0.03%/ohm typical; 0.06%/ohm maximum.
Current drive capability		0.6mA.
Noise rejection	series:	>90 dB at 50Hz.
	common:	>120 dB at 50 Hz.
		MAXIMUM RATINGS
Over-under range		5% of range.
Series mode voltage		-7 to -14 Volts.
Channel isolation		250 Volts RMS.

1.5.5 FIFTEEN CHANNEL DIGITAL I/O BOARD

This input-output board offers 15 discrete signal lines, each of which is configurable as either input or output, according to plug-in modules (see section 1.6) fitted to a daughter board within the Signal Interface Module (SIM). The following types of module are available: active dc input, active dc output, passive ac, passive dc input. The relevant figure in section two of this manual shows a typical configuration.

	GENERAL SPECIFICATION
Number of inputs/outputs	15 maximum.
I/O mix	Any type to any channel by SIM daughter board
Input type	Vac, Vdc or voltage free.
Input range	5 to 24 Volts dc or 50 to 100 Volts (peak) ac depending on plug-in module type.
Input isolation method	Opto-coupler.
Wetting voltage	Internally supplied.
Output type	Solid state switch.
Output source	24 Volts at 20 mA.
	MAXIMUM RATINGS
Channel isolation	250 Volts between blocks of 4-channels. (Channels 1 to 4, channels 5 to 8, channels 9 to 12, channels 13 to 15.)

Note...
There is no isolation amongst channels within the same block.

1.5.6 EIGHT CHANNEL ANALOGUE OUTPUT BOARD

This board provides transmission of measured and/or derived variables as a voltage or current driven signal. For current signals, the source can be internal (active) or external (passive). The selection of output type (Voltage, active current or passive current) is made for each channel by means of a link within the Signal Interface Module (SIM) associated with the board.

GENERAL SPECIFICATION	
Number of outputs	Eight maximum
Output types	0 to 10 Volts or 0 to 20 mA.
Current source	15 Volts dc internal or externally supplied.
PERFORMANCE	
Accuracy	0.1% of full scale.
Linearity	0.05% of full scale.
Temperature co-efficient	50 ppm/°C of zero and span (maximum).
Time response	1 second to within 0.1 % of full scale.
MAXIMUM RATINGS	
Over-under range	5% of full scale
Voltage output	20 mA source.
Current output	20 Volts dc (no load).
External current source	28 Volts dc.
Channel isolation	250 Volts RMS

1.5.7 RELAY OUTPUT BOARD

Four high power, or eight medium power relays are fitted within the Signal Interface Module (SIM) associated with this relay driver board. The relays can be used to switch external loads when an alarm state is detected, or as the result of an event from a discrete input.

When used as alarm outputs, the relays are held normally energised, so that in the event of a failure in the system supply, the relays de-energise to their alarm states (i.e. the relays fail safe).

When used as event outputs, the relays are energised for as long as the events are active.

GENERAL SPECIFICATION		
	4 CHANNEL	8 CHANNEL
Number of relays	Four	Eight
Contact format	Single form C	Single pole change-over
Estimated life (full load)	75,000 operations	10,000 operations.
MAXIMUM RATINGS		
Contact voltage	250 Volts ac	250 Volts ac.
Contact current (resistive) Make:	10 amps	8 amps.
Continuous:	8 amps	3 amps
Break:	8 amps	2 amps
Switchable power (resistive)	45 W or 2000 VA	60 W or 500 VA

1.6 PLUG-IN MODULE SPECIFICATION

1.6.1 15 CHANNEL ISOLATED ANALOGUE INPUT BOARD

The plug-in modules listed below (table 1.6.1) are available for the 15 channel isolated A/I board SIM, to provide input signal conditioning. Figure 1.6.1 shows the module circuit; figure 2.2.2d shows module installation.

Module part N°	Module type	Max. input	R1	R2
LA240988U100	Attenuator x1	10.24 Volts dc	Link (0 Ω)	Not fitted
LA240988U200	Attenuator x100	200 Volts dc	10 kΩ	990 kΩ
LA240988U300	Shunt 100 Ω	4 to 20 mA	Link (0 Ω)	100 Ω
LA240988U400	Shunt 250 Ω	4 to 20 mA	Link (0 Ω)	250 Ω

All resistors are 0.1%, 15ppm.

Table 1.6.1 15 channel isolated A/I SIM plug-in modules

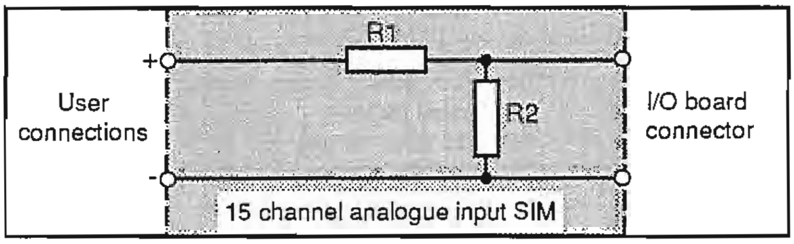


Figure 1.6.1 Isolated A/I board SIM plug-in board circuit schematic.

1.6.2 15 CHANNEL DIGITAL I/O BOARD

The plug-in modules listed below (table 1.6.2) are available for the 15 channel digital I/O board. Figures 1.6.2a to 1.6.2d show the module schematics for the available types. Figure 2.2.2b shows module installation.

Module part N°	Module type	Schematic	Comments
LA240397	Active dc input	Figure 1.6.2a	Used with 'volt-free' contacts.
LA240398U100	Passive dc input	Figure 1.6.2b	Input threshold voltage range: 5 to 24 Volts dc.
LA240398U200	Passive ac input	Figure 1.6.2c	Input threshold voltage range: 50 to 100 Volts peak.
LA240402	Active dc output	Figure 1.6.2d	Maximum output: 24 Volts at 20mA.

Table 1.6.2 15 Channel DIO SIM plug-in modules

1.6.2 (Cont.)

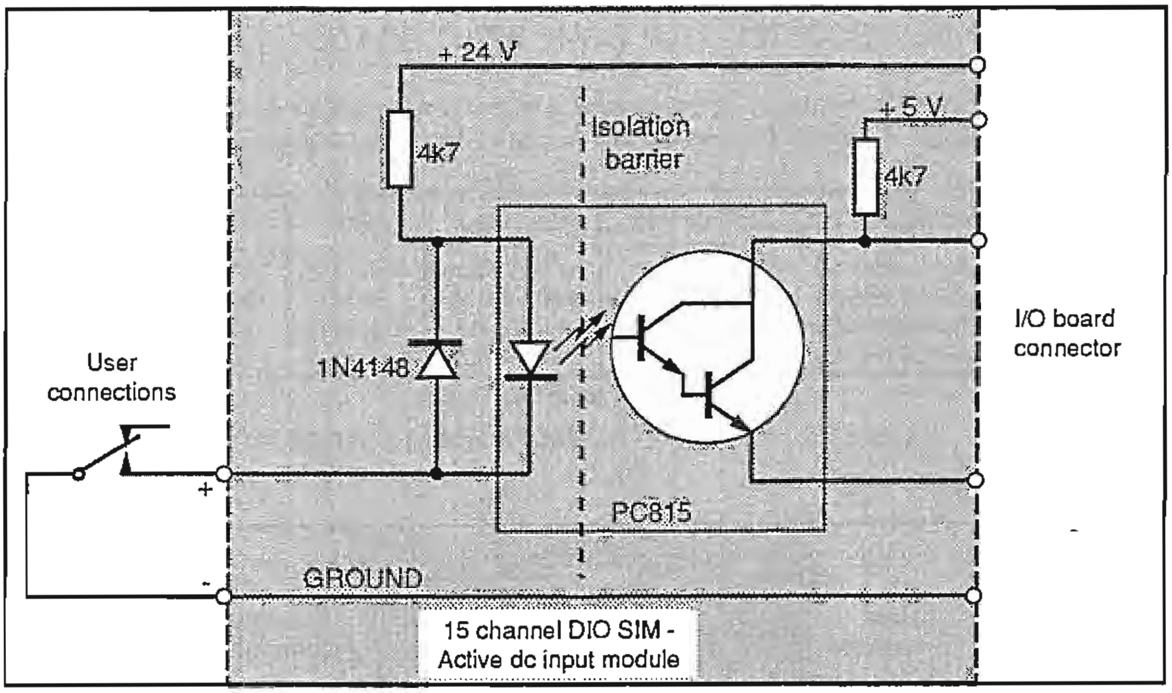


Figure 1.6.2a Active dc input module schematic

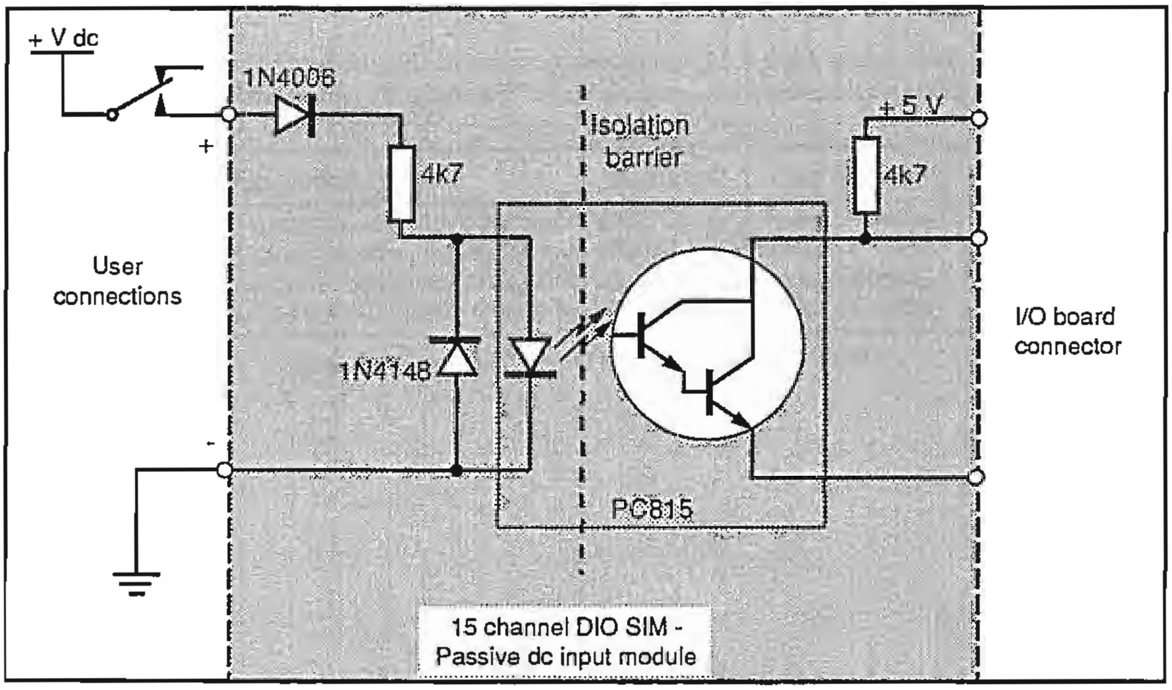


Figure 1.6.2b Passive dc input module schematic.

1.6.2 (Cont.)

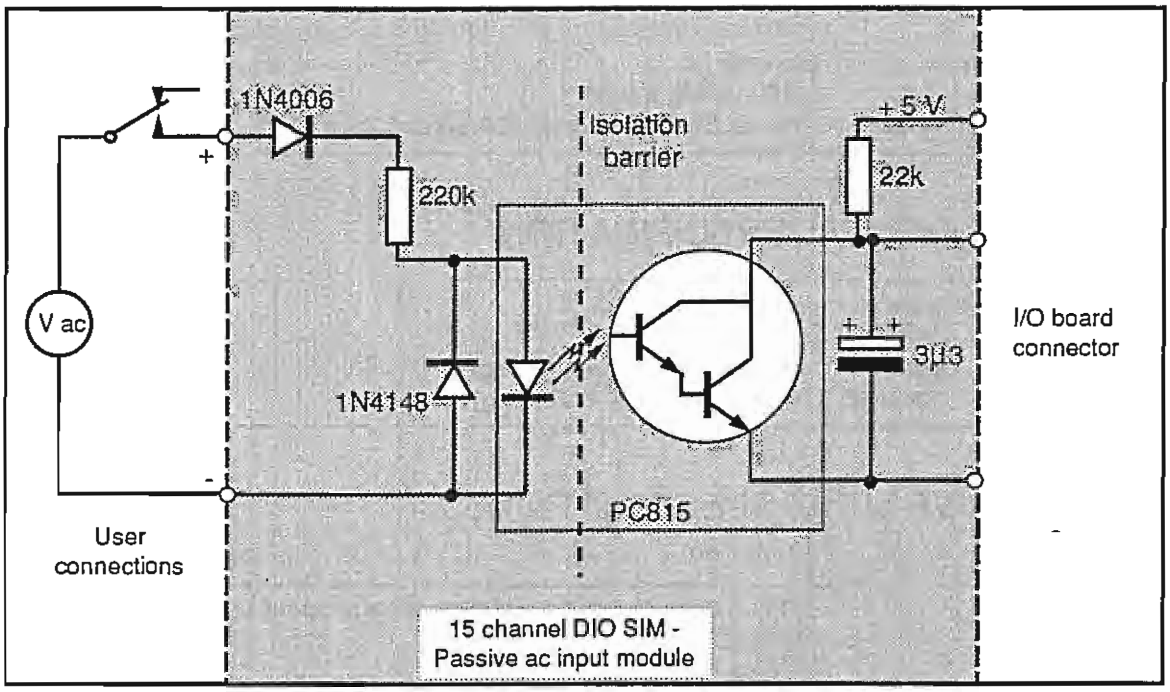


Figure 1.6.2c Passive ac input module schematic

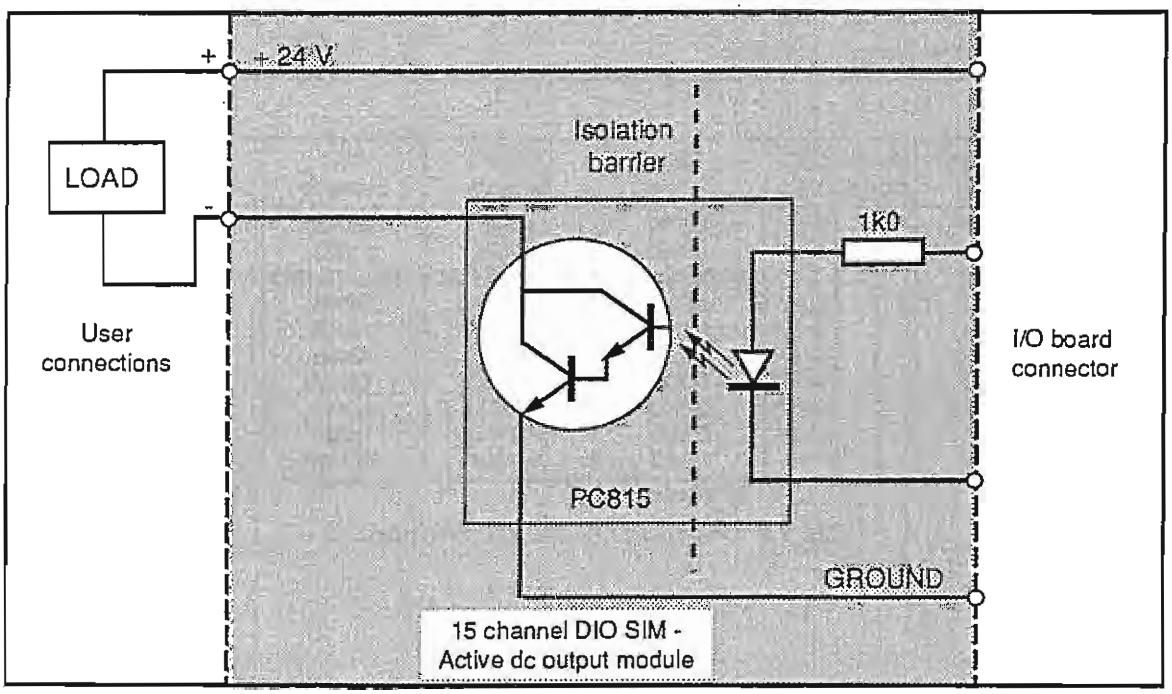


Figure 1.6.2d Active dc output module schematic.

1.7 POWER SUPPLY REQUIREMENTS

Line supply voltage	180 to 260 Volts ac, or 90 to 130 Volts ac (user selectable)
Line supply frequency	45 to 65 Hz.
Power consumption	<100 VA fully loaded.
Line supply interrupt protection	100 ms (minimum) supply interruption has no effect.

1.8 ENVIRONMENTAL SPECIFICATION

Temperature range	Operation:	0 to 40 °C
	Storage	-20 to +70 °C
Humidity range	Operation:	0 to 90% RH (Non-condensing)
	Storage:	5 to 95% RH (Non condensing)

1.9 DISC DRIVE (4510) SPECIFICATIONS

Line supply voltage	90 to 130 or 180 to 260 V ac as specified at time of order.
Line supply voltage	45 to 65 Hertz
Power consumption	<50 VA
Temperature range	10 to 45 °C (Storage-medium dependent)
Humidity range	20% to 80% Non-condensing (Storage medium dependent)
Disc type (see also table 1.9)	IBM® PC MSDOS compatible
Maximum number of files per disc	
5 $^1/_4$ inch DSHD (1.2 MB):	223 files
All other types:	111 files

Drive unit type	No of drives	Disc size	Disc format	Disc capacity	Unit capacity	No of serial ports
4510	1	5.25"	DSDD	360kB	360kB	1
4511	1	5.25"	DSHD	1.2MB	1.2MB	1
4512	1	3.5"	DSDD/DSHD*	720kB/1.44MB	720kB/1.44MB	1
4513	1	5.25"	DSDD	360kB	360kB	2
4514	1	5.25"	DSHD	1.2MB	1.2MB	2
4515	1	3.5"	DSDD	720kB	720kB	2
4516	2	5.25"	DSDD	360kB	720kB	2
4517	2	5.25"	DSHD	1.2MB	2.4MB	2
4518	2	3.5"	DSDD	720kB	1.4MB	2
4519	2	3.5"	DSHD	1.44MB	2.88MB	2

* Selectable

Table 1.9 Disc drive unit (4510) specifications

SECTION 2 INSTALLATION

LIST OF CONTENTS

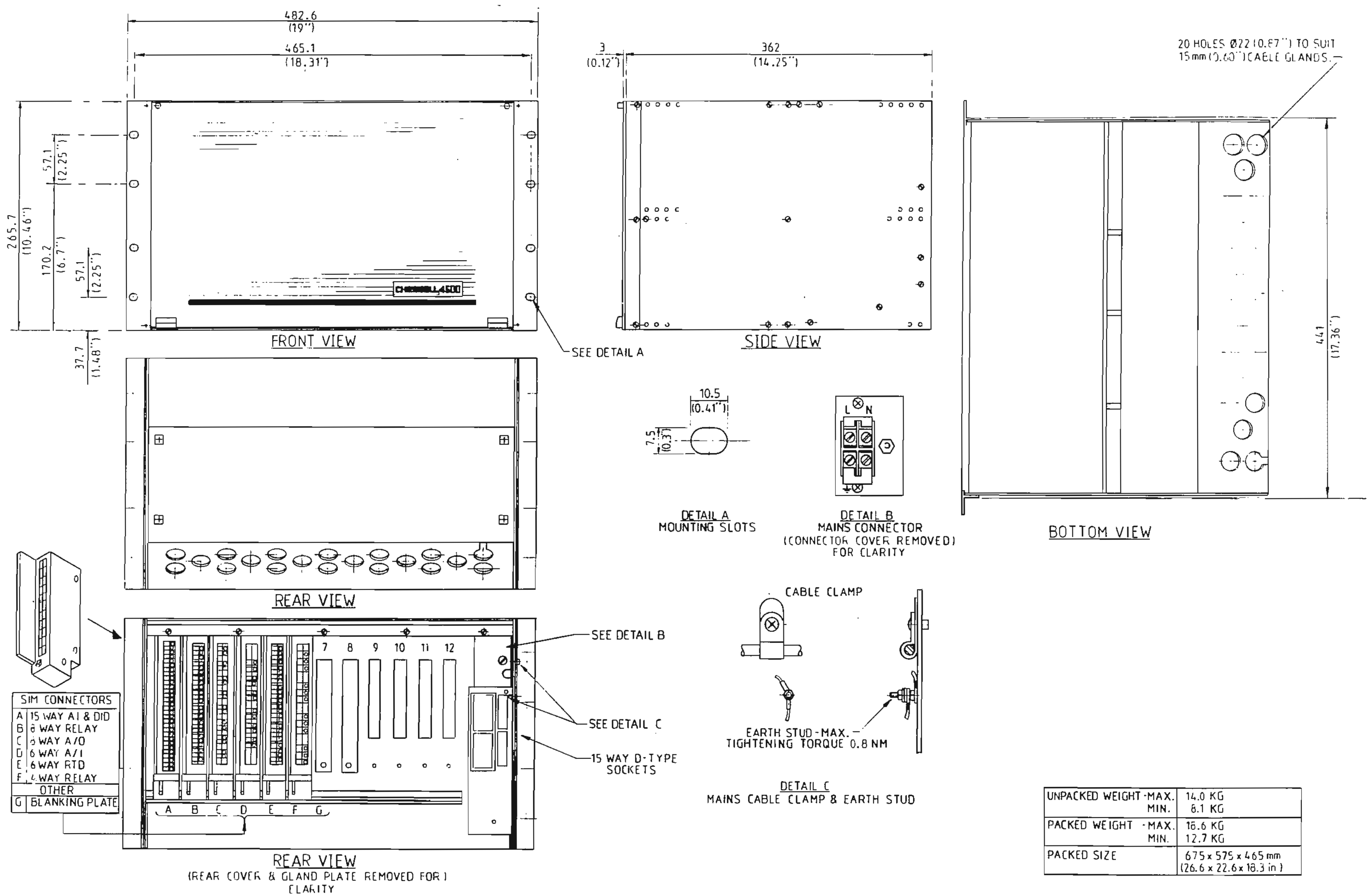
LIST OF FIGURES

SECTION 2 INSTALLATION

2.1 MECHANICAL INSTALLATION

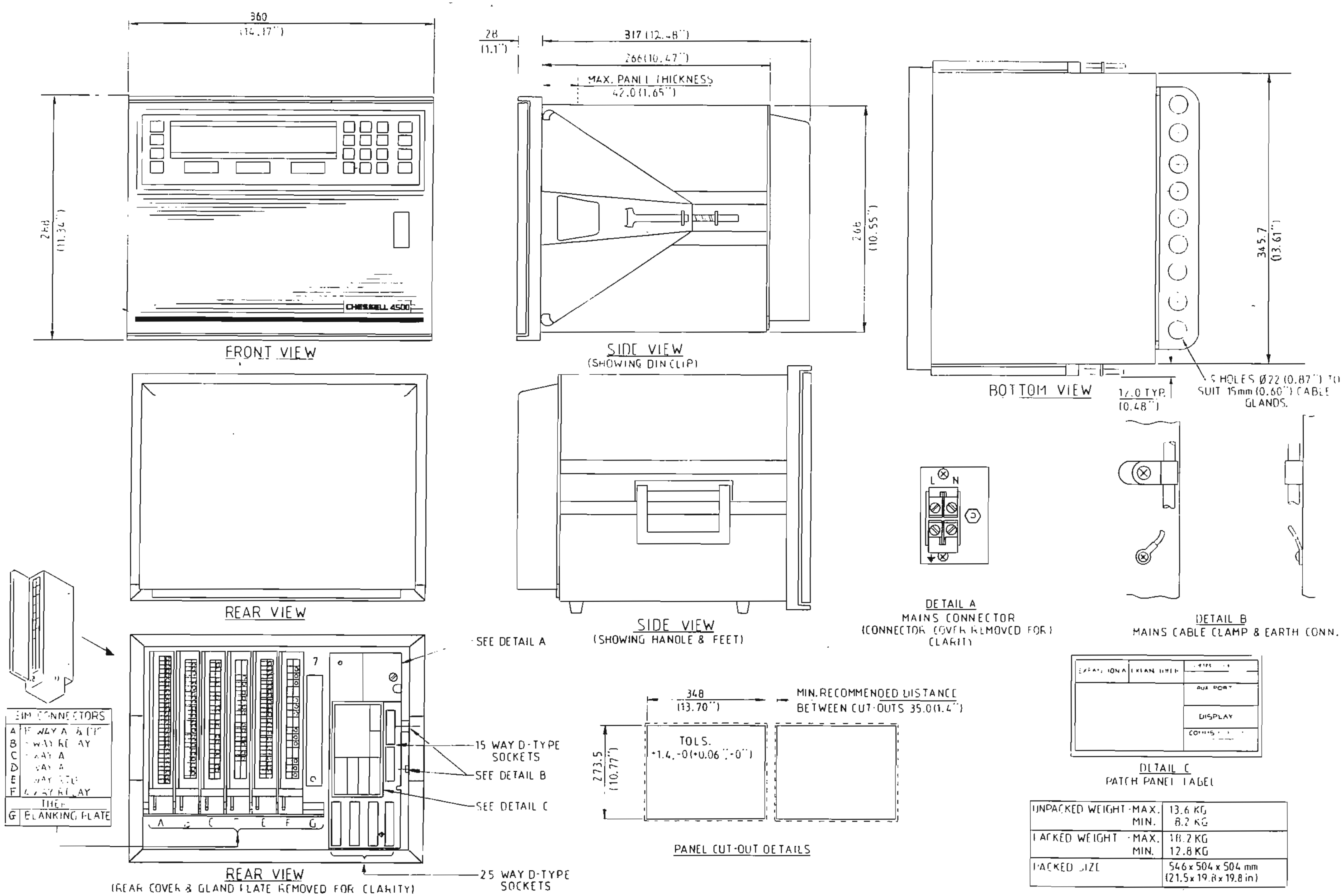
The major units of the 4500 system are intended for panel mounting, or for rack mounting in a 19 inch x 6U enclosure. Additionally, rack-mounted master units have a separate display/keyboard associated with them, which may be wall, rack or panel mounted, depending on the specification at time of order.

Full dimensional details are given in the mechanical installation drawing, figure 2.1.



UNPACKED WEIGHT - MAX.	14.0 KG
MIN.	8.1 KG
PACKED WEIGHT - MAX.	16.6 KG
MIN.	12.7 KG
PACKED SIZE	675 x 575 x 465 mm (26.6 x 22.6 x 18.3 in)

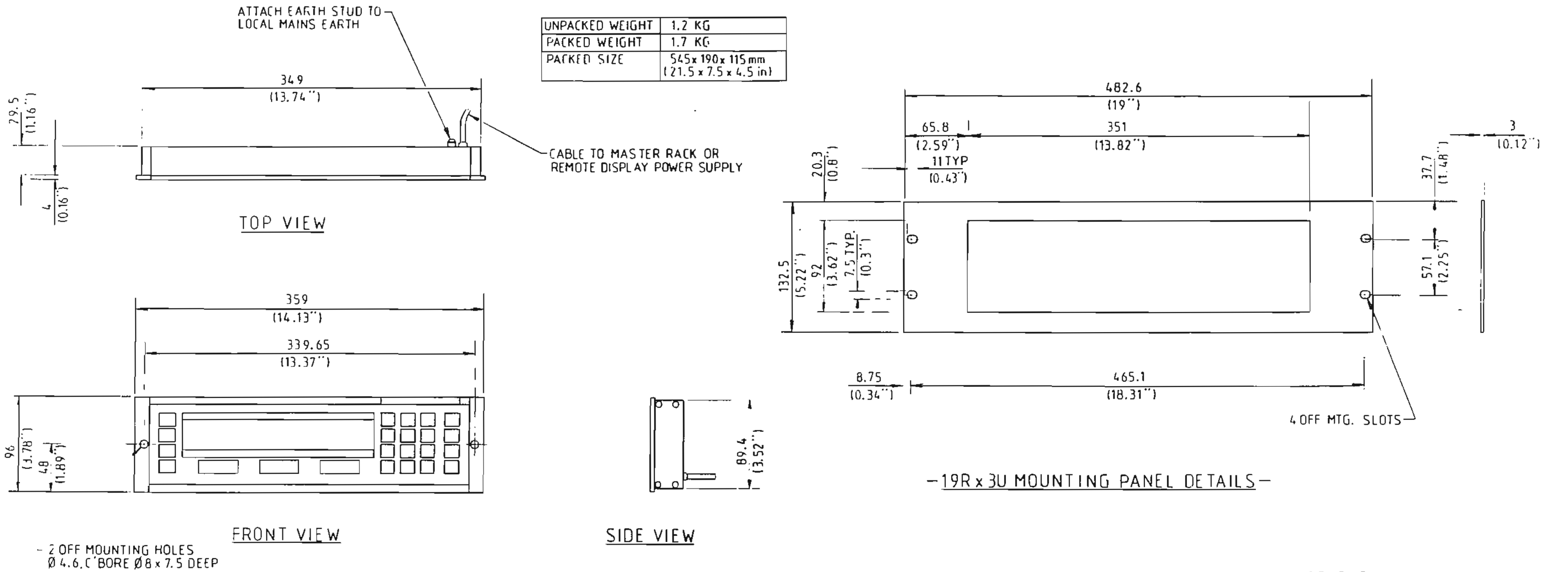
Figure 2.1a Rack-mounted unit mechanical installation



UNPACKED WEIGHT - MAX.		13.6 KG
MIN.		8.2 KG
PACKED WEIGHT - MAX.		18.2 KG
MIN.		12.8 KG
PACKED SIZE		546 x 504 x 504 mm (21.5 x 19.8 x 19.8 in)

Figure 2.1b Panel-mounted unit mechanical installation

UNPACKED WEIGHT	1.2 KG
PACKED WEIGHT	1.7 KG
PACKED SIZE	545x 190x 115mm (21.5 x 7.5 x 4.5 in)



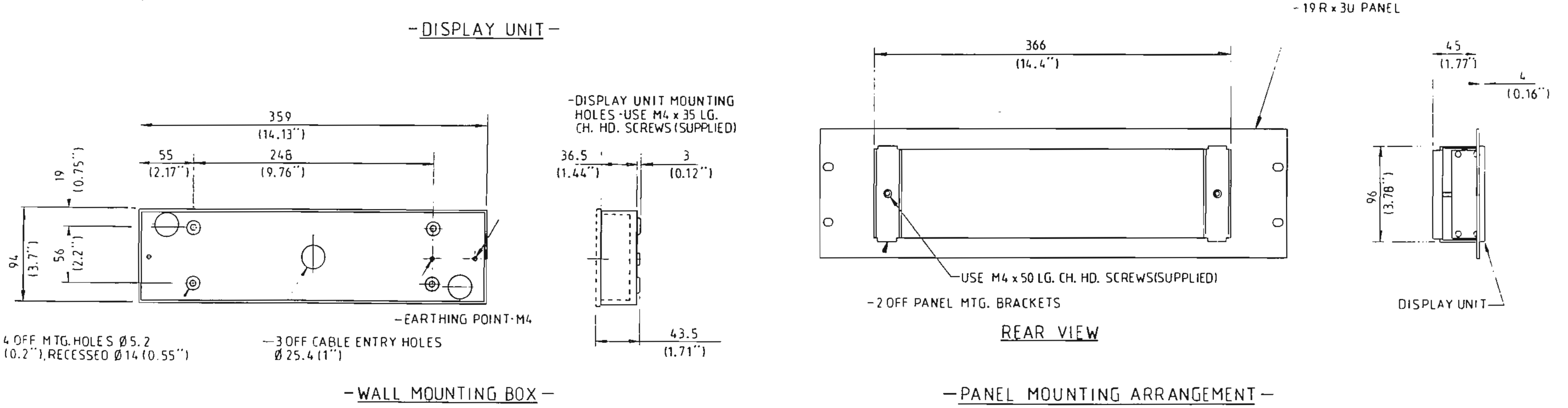


Figure 2.2.1c Display panel mounting

2.2 ELECTRICAL INSTALLATION

2.2.1 POWER WIRING

CAUTION

BEFORE ATTEMPTING TO CARRY OUT ANY SUPPLY CONNECTIONS, ENSURE THAT THE POWER SUPPLY UNIT IS SET UP TO THE CORRECT VOLTAGE RANGE. FAILURE TO ENSURE THIS, WILL CAUSE DAMAGE TO THE MASTER UNIT. SUCH DAMAGE LIES OUTSIDE THE MANUFACTURER'S WARRANTY.

SETTING THE INPUT VOLTAGE

The voltage selector switch is fitted on the front face of the power supply unit (PSU) accessible from the front of the instrument (ref figure 2.2.1a). The switch slider should be located such that its position matches the supply voltage.

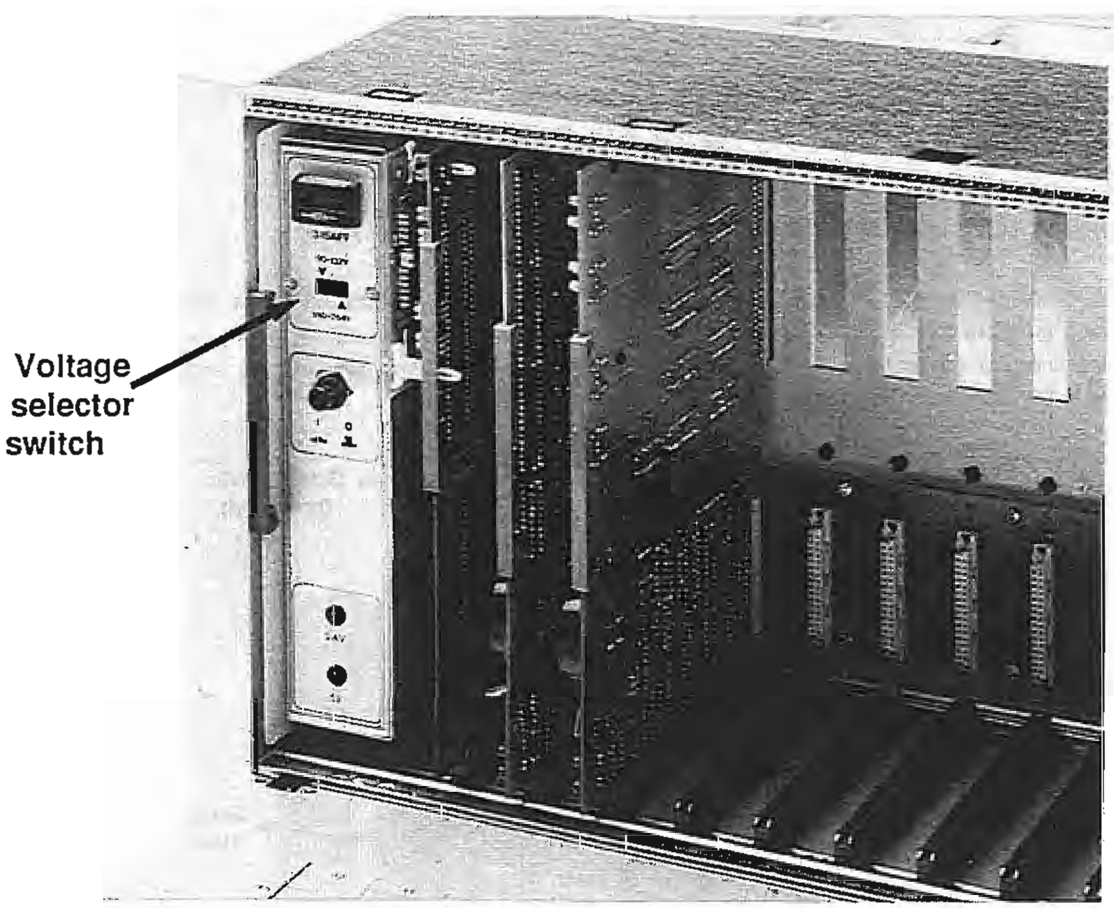


Figure 2.2.1a: Voltage selector switch location

2.2.1 (Cont.)

INPUT FUSES

The fuse holder is located immediately above the voltage selector switch, and the fuse is withdrawn (figure 2.2.1b) by compressing the horizontal sections of the plastic mounting between thumb and forefinger, and pulling the fuse out with its holder. The fuse type is 3.15 A F, available from the manufacturer under part number CH053151. It must be ensured that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short circuiting of fuse holders are prohibited.

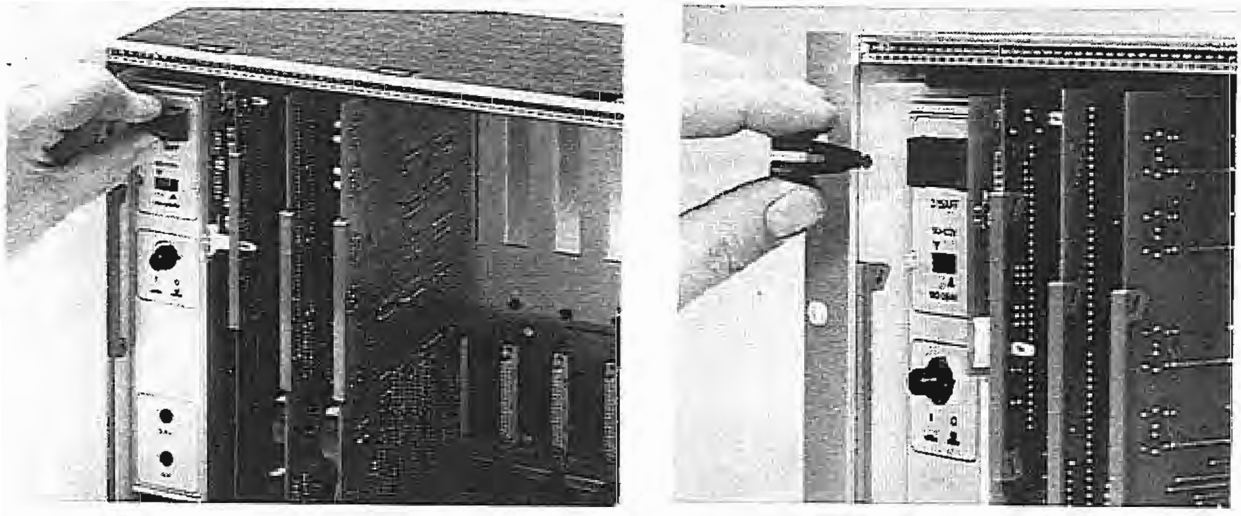


Figure 2.2.1b Safety fuse withdrawal

WIRING TO THE POWER SUPPLY UNIT

The mains (line) cable is terminated at a 4-way terminal block (located behind a removable safety cover) as shown in figure 2.2.1c. The cable should have a cross-sectional area of $1.5mm^2$, and should be terminated using crimp or solder tags. It should be ensured that the earth link between the terminal block and the earth stud in the side-wall is installed.

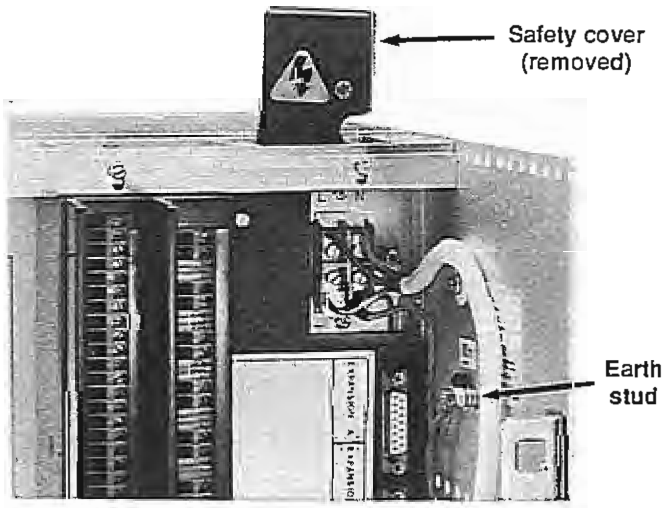


Figure 2.2.1c Power cable termination

REMOTE OPERATOR DISPLAY UNIT

The earthing stud at the rear of the unit ***MUST*** be connected to local mains earth.

2.2.2 INTERNAL SIGNAL INTERFACE MODULE CONNECTIONS

Each input/output (I/O) circuit board has an associated Signal Interface Module (SIM), located on a DIN rail, and accessible by removing the rear cover of the unit. Input/ output wiring to the circuit boards is terminated using terminal blocks in these SIMs. The pin-out for each SIM type is given below.

If the relevant inputs are specified at the time of order, then the SIM channels will already be set up. The re-wiring capability described below is for the case where changing requirements necessitate a change in the signal wiring **If these connections are to be made after the signal wiring has been completed, the warning below must first be read.**

WARNING
IT IS ESSENTIAL THAT ALL HAZARDOUS VOLTAGES CONNECTED TO THE SIMS ARE IDENTIFIED AND ISOLATED BEFORE ANY OF THE INTERNAL LINKS DESCRIBED BELOW ARE MADE. IF ANY DOUBT EXISTS, IT IS RECOMMENDED THAT AN APPROPRIATE METER IS USED TO CHECK ALL CHANNEL-TO-CHANNEL AND CHANNEL-TO-GROUND POTENTIALS APPEARING AT THE SIM TERMINALS.

SIM RE-WIRING

As may be be seen below, most of the SIMs can be configured to suit the input signal. For example, the Resistance thermometer SIM can be set up for two-, three- or four-wire devices; the Six channel analogue input board can be set up for dc current, dc voltages ≤ 10.24 Volts or dc voltages >10.24 Volts, and so on. The way in which this setting-up is achieved varies from SIM to SIM, and may consist simply in fitting a plug-in module, or it may involve the fitting of shunt resistors for example.

Figure 2.2.2 shows the internal connections to be made within the SIMs as follows:-

a) Figure 2.2.2a shows the connections to be made for 2-wire, 3-wire and 4-wire RTDs..
b) Figure 2.2.2b shows module location to define each of the 15 discrete channels as input or output in the 15-channel digital input/output (DIO) SIM.
c) Figure 2.2.2c shows the connections to be made within the 6-channel dc input board SIM to fit shunts and attenuators.
d) Figure 2.2.2d shows module location within the 15 channel isolated analogue input board SIM to fit shunts and attenuators.
e) Figure 2.2.2e shows the links to be fitted within the eight-channel analogue output board SIM to set the outputs to voltage or current outputs.

ACCESS TO THE INTERNAL LINKS AND SWITCHES

CAUTION
IN 19 INCH RACK UNITS, THE SIMS ARE RETAINED BY A LOCKING BAR SECURED AT THE TOP REAR OF THE RACK BY FOUR SCREWS. BEFORE ATTEMPTING TO REMOVE A SIM, THESE SCREWS SHOULD BE RELEASED AND THE BAR PUSHED UPWARDS. ONE OR MORE SCREWS SHOULD THEN BE GENTLY RE-TIGHTENED TO SECURE THE BAR IN ITS OPEN POSITION. ANY ATTEMPT TO RE-MOVE A SIM WITHOUT RELEASING THIS LOCKING BAR MIGHT RESULT IN DAMAGE TO THE SIM.

2.2.2 (Cont.)

ACCESS TO THE INTERNAL LINKS AND SWITCHES (Cont.)

The following procedure should be followed to remove the SIM to gain access to the links or modules.

a) Identify the first SIM to be modified
b) Read the **warning** above. For convenience, any wiring should be removed from the SIM, although it is possible to carry out the modification with signal wiring in place, **providing all hazardous potentials have been isolated.**
c) After ensuring that the locking bar is in its 'open' position, remove the SIM from the rack by depressing the retaining latch underneath the moulding, and, at the same time, lifting the latch bar and pulling the SIM firmly backwards out of the unit.
d) Remove the three screws retaining the SIM cover, remove the cover and the circuit board inside the SIM.
e) Locate each of the relevant channels from the silk screening on the circuit board.
f) Add or remove links/ modules to achieve the desired hardware configuration. The plug-in modules are changed, simply by pulling them out, and pushing the replacement in to the SIM circuit board.

CAUTION

THE PLUG-IN MODULES HAVE A RAISED DISC ON THEIR TOP SURFACE. THESE ALLOW THE MODULES TO BE ORIENTED CORRECTLY AS DETAILED IN THE SKETCHES ON THE FOLLOWING PAGES. FAILURE TO ORIENT THE MODULES CORRECTLY MAY RESULT IN DAMAGE TO THE I/O CIRCUITRY.

g) Re-fit the circuit board and the SIM cover, before re-installing the SIM and making the signal connections. When re-installing the SIM, ensure that the locating peg at the base of the SIM engages with the hole in the back panel and that the retaining catch is securely engaged. Once the SIM is installed, ensure that the associated I/O board is fully pushed home.
h) Slide the locking bar downwards to its 'closed' position, and fully tighten its securing screws.

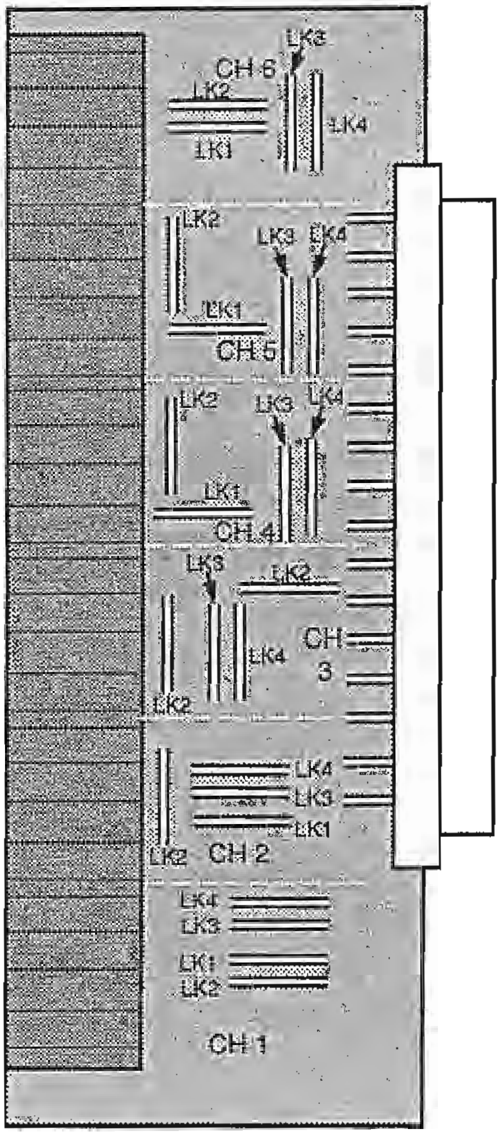
Notes..

1. Resistance thermometer inputs must not be left open circuit when power is applied to the system. Unused inputs must be shorted. Failure to ensure this will result in the channel's not reading.

2. When solder links are removed (RTD SIM only), the use of a 'solder sucker is recommended, to reduce the possibility of damage being caused to the circuit board tracking.

3. When setting the links within an 8-channel analogue output SIM for 'Voltage', the relevant section of the DIL switch located on the SIM board must also be moved to the 'ON' position (towards the circuit board) for each VOLTAGE channel. Thus if the links are set to 'VOLTAGE' for channels 1, 3, 7 and 8, then sections 1, 3, 7 and 8 of the DIL switch should be set to ON; the other sections to OFF. The switch section numbers are printed on the side of the switch, below the toggles.

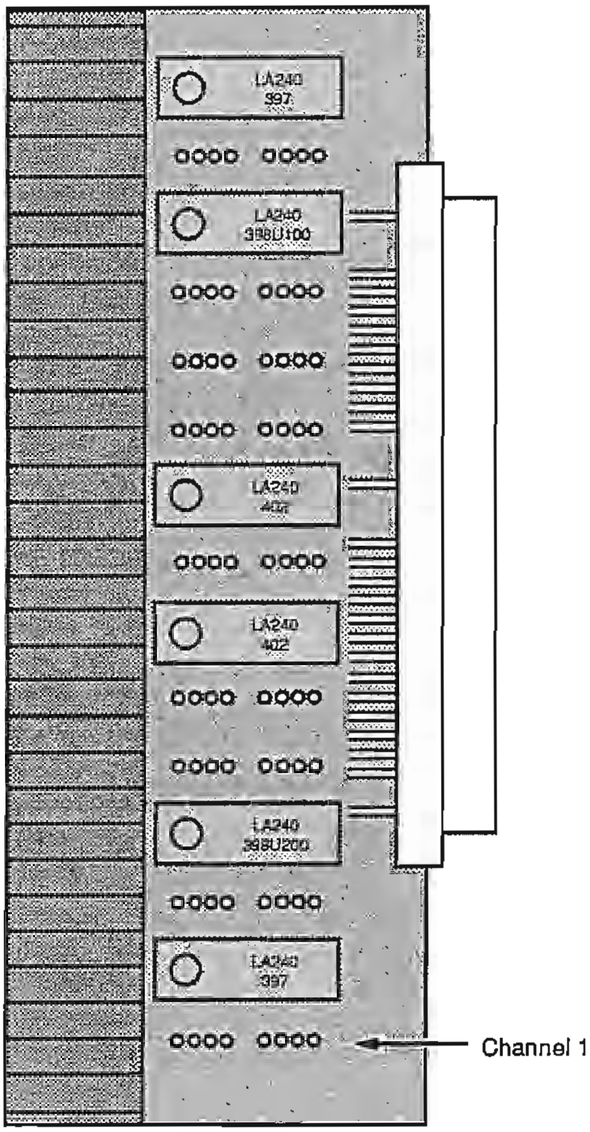
2.2.2 (Cont.)



RTD type	Link 1	Link 2	Link 3	Link 4
2-wire	Yes	Yes	No	Yes
3-wire	No	Yes	No	Yes
4-wire	Yes	No	Yes	No

Figure 2.2.2a 6-Channel RTD SIM internal links

2.2.2 (Cont.)



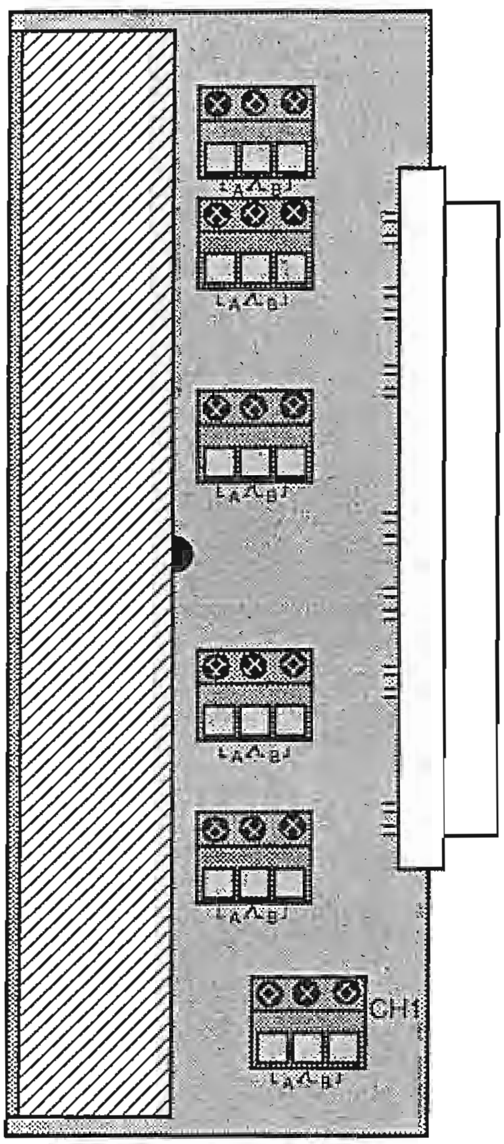
I/O MODULES	
Part No.	Module type
LA240397 LA240398U100 LA240398U200 LA240402	Active DC input Passive DC input Passive AC input Active DC output

Figure 2.2.2b 15 channel DIO SIM internal module (typical configuration).

CAUTION

MODULES MUST BE INSERTED SUCH THAT THE EMBOSSED DISC ON THE TOP SURFACE OF EACH MODULE IS ALIGNED WITH THE RELEVANT WHITE SPOT ON THE CIRCUIT BOARD

2.2.2 (Cont.)

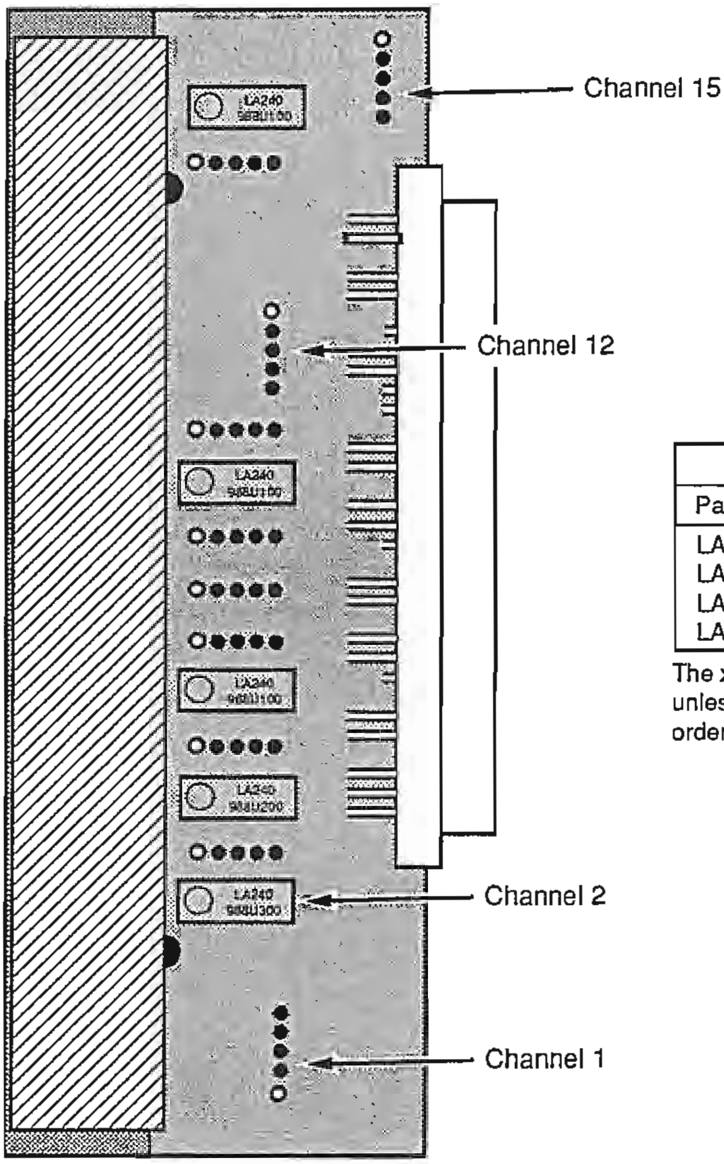


Input signal type	Link A	Link B
Thermocouples	Copper wire	Open circuit
DC Volts ≤ 10.24 V	Copper wire	Open circuit
DC Volts > 10.24 V.	990kΩ resistor *	10kΩ resistor *
DC Current	Copper wire	100Ω resistor *

* Resistors should be 0.1% tolerance with a temperature co-efficient of 15ppm/°C.

Figure 2.2.2c 6-channel dc input SIM internal links

2.2.2 (Cont.)



INPUT MODULES	
Part Number	Module type
LA240988U100	x1 attenuator
LA240988U200	x100 attenuator
LA240988U300	100Ω shunt
LA240988U400	250 Ω shunt

The x1 attenuator is fitted as standard, unless otherwise specified at time of order.

Figure 2.2.2d 15-channel analogue input SIM internal modules (typical configuration)

CAUTION

MODULES MUST BE INSERTED SUCH THAT THE EMBOSSED DISC ON THE TOP SURFACE OF EACH MODULE IS ALIGNED WITH THE RELEVANT WHITE SPOT ON THE BOARD.

2.2.2 (Cont.)

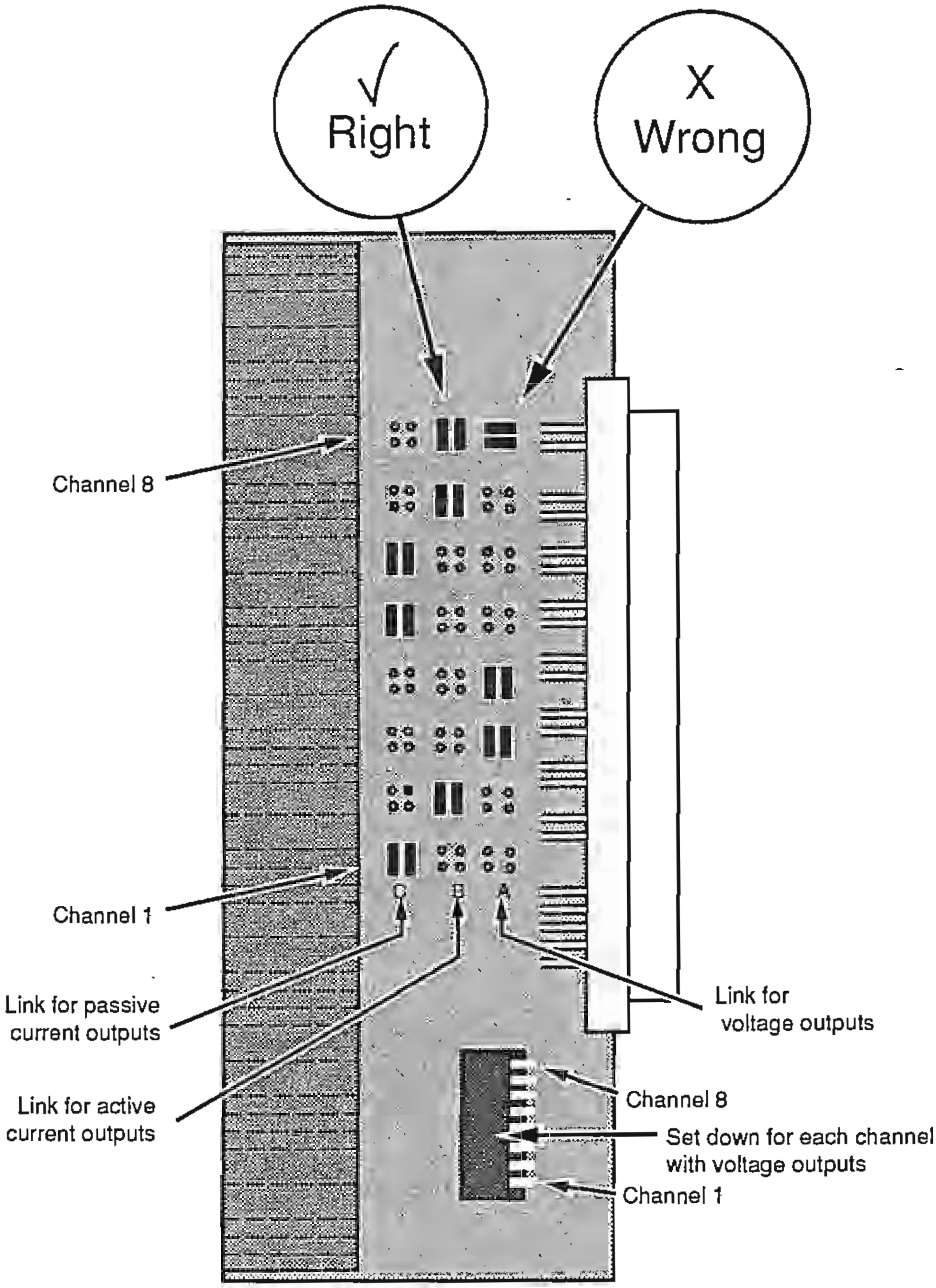


Figure 2.2.2e 8 channel analogue output SIM internal links

2.2.3 SIGNAL WIRING

Figure 2.2.3 shows the signal wiring to the SIMs associated with the various I/O boards available.

CAUTION

EACH TYPE OF I/O BOARD HAS A SPECIFIC TYPE OF SIM. FAILURE TO ENSURE THAT THE CORRECT SIM IS FITTED TO EACH I/O BOARD MAY RESULT IN DAMAGE TO THE I/O BOARD.

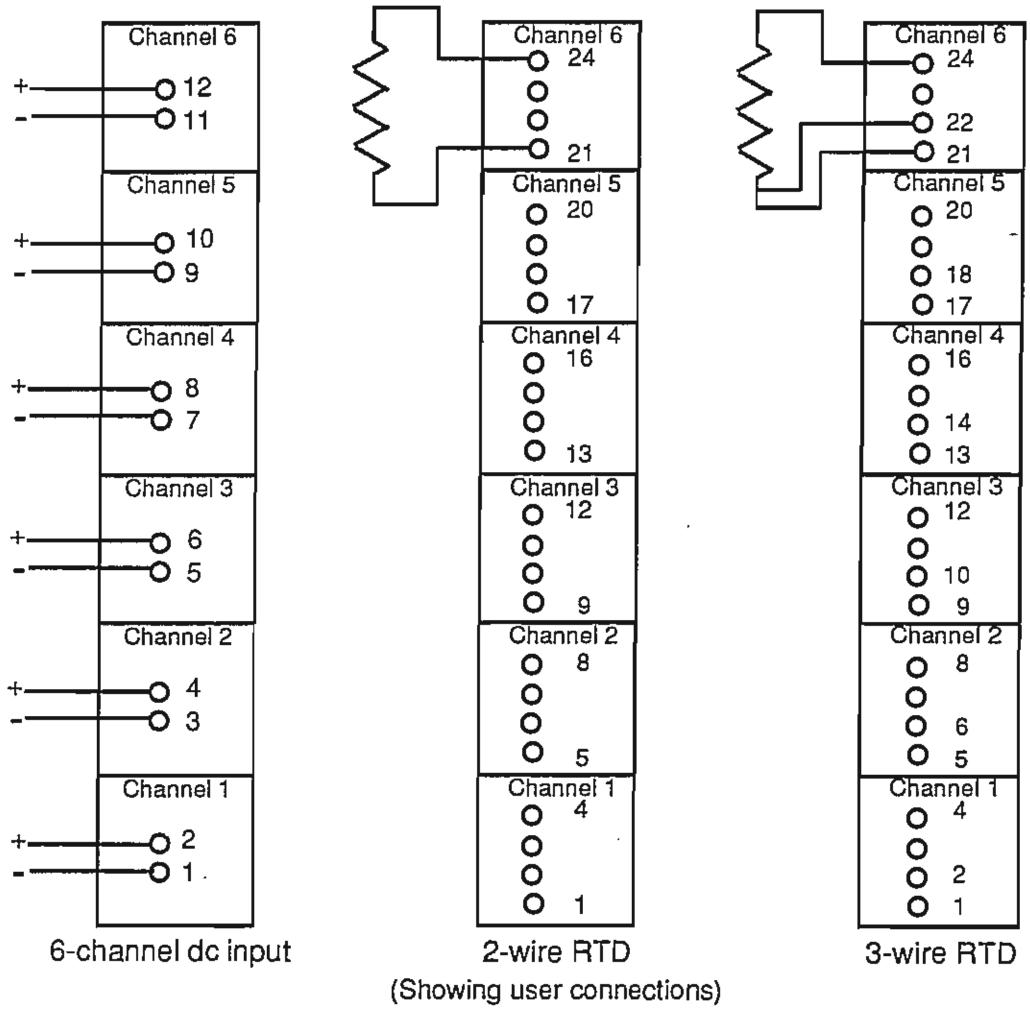


Figure 2.2.3 SIM wiring (sheet 1)

2.2.3 (Cont.)

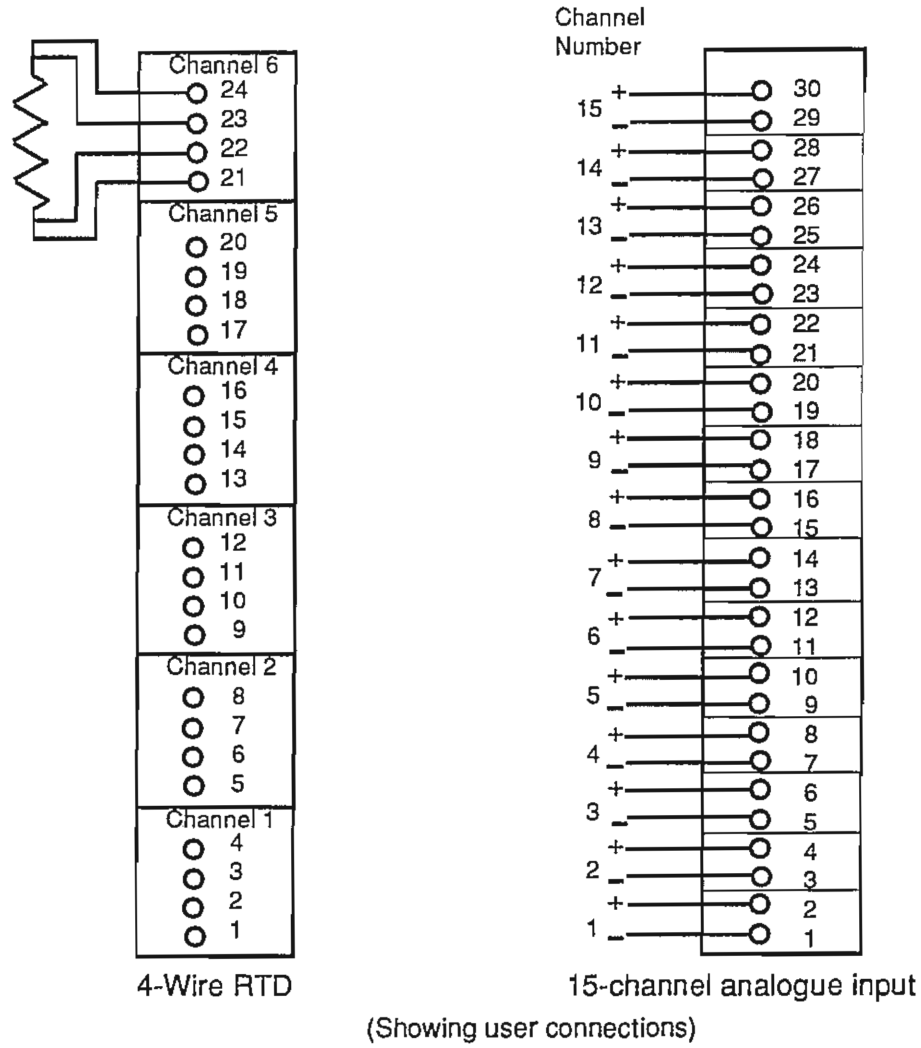


Figure 2.2.3 (cont.) SIM wiring (sheet 2)

2.2.3 (Cont.)

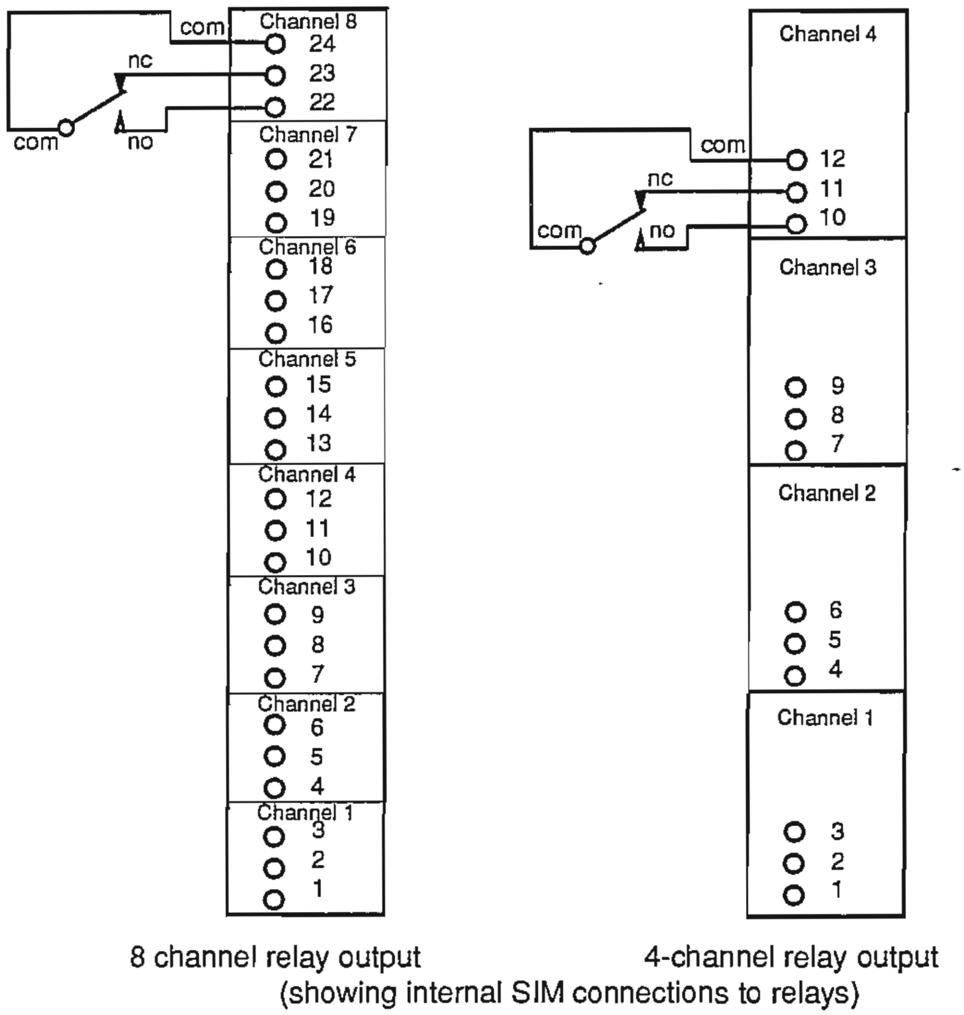
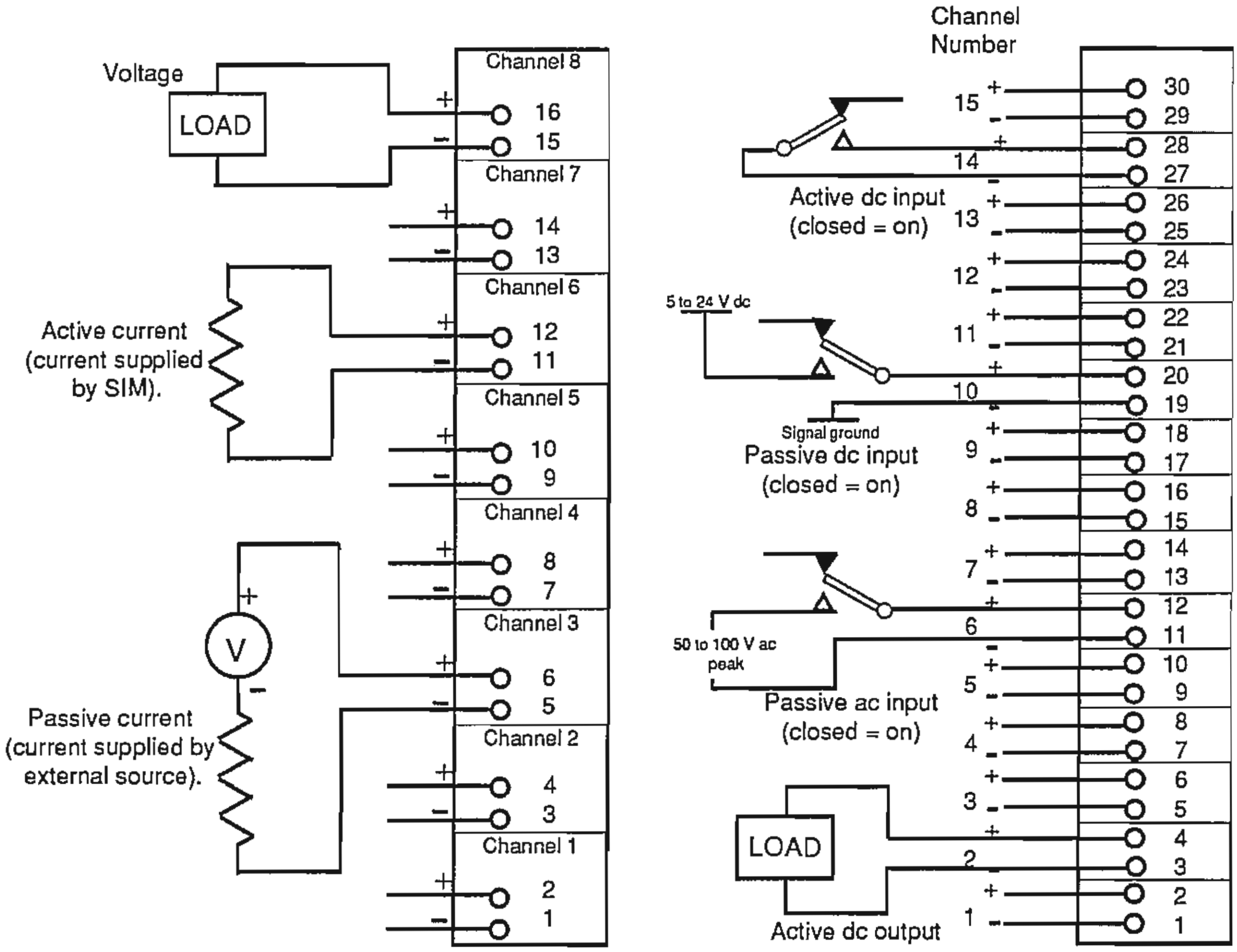


Figure 2.2.3 (cont.) SIM wiring (sheet 3)

Note...
In the above sketch (showing the internal SIM wiring to the relay contacts), the relays are drawn in their non energised state. This state is entered under the following conditions:

1 Supply power to the 4500 unit is removed, or unit is switched off.
2 The relay is allocated to an alarm which is active.
3 The relay is allocated to a Discrete Output (event) which is not active.

2.2.3 (Cont.)



8-channel analogue output

15 channel digital input-output

(Showing customer connections)

Figure 2.2.3 (cont.) SIM wiring (Sheet 4)

2.2.4 SERIAL LINK WIRING

All peripherals and expansion racks are connected to the master rack using a patch panel located at the back of the master unit. As can be seen from the diagram below, six ports are available for such connections

Communications between the various items is performed using either RS232-C or RS422-A as follows:-

Expansion A	Permanently configured as RS422. Used to communicate with one or more expansion units.
Expansion B	Permanently configured as RS422. Used to communicate with one or more expansion units.
Comms 1	User configurable. Used to communicate with a host computer, chart recorder etc.
Comms 2	User configurable. Used to communicate with a host computer, chart recorder etc.
Display	User configurable, but should always be configured as RS422. Used to communicate with the display/ control panel.
Aux port	User configurable. Used to communicate with a printer, personal computer, VDU etc.

The Comms 1, Comms 2 and Auxiliary ports are hardware configured as RS232 or RS422 by positioning links as detailed in figure 2.2.4a below.

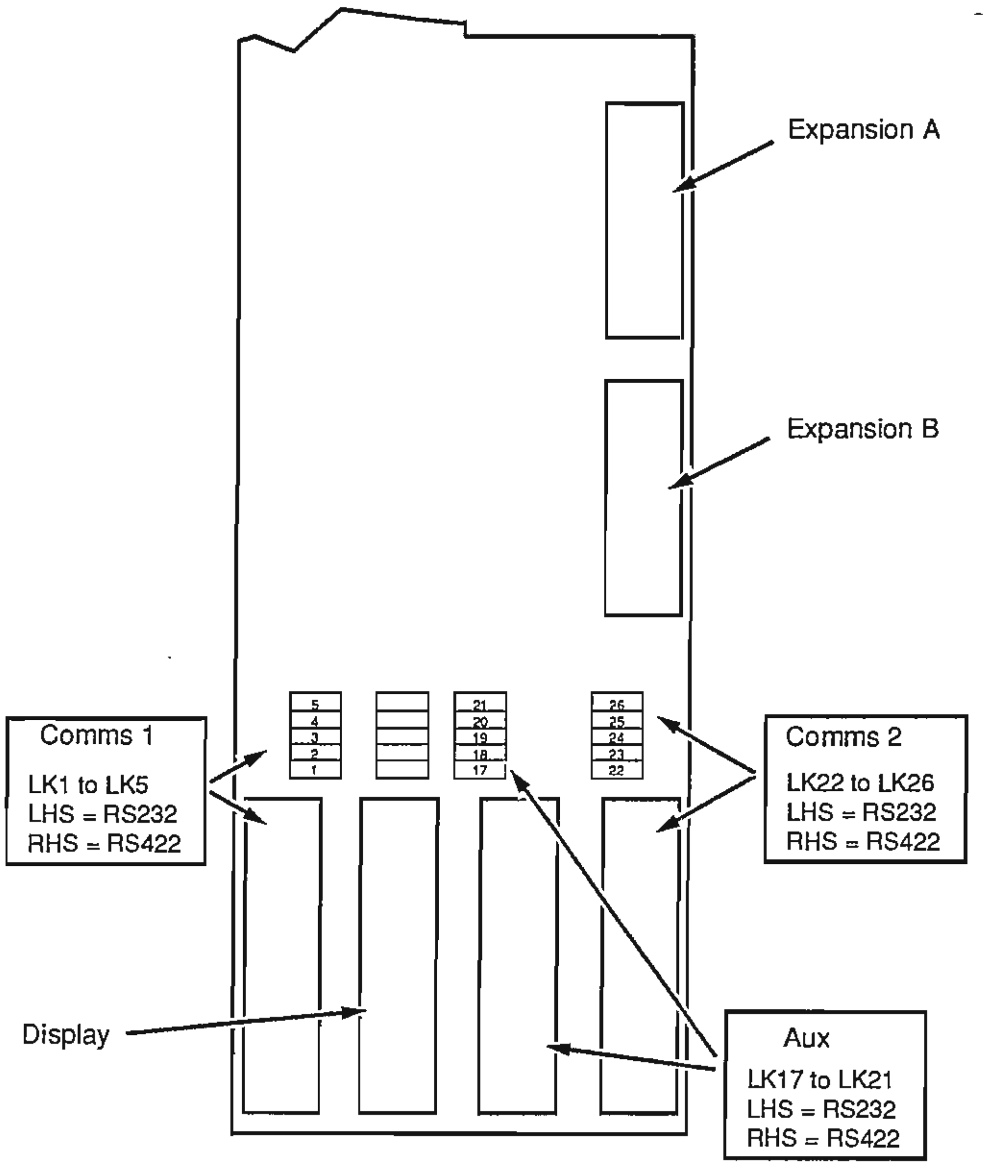


Figure 2.2.4a Master unit patch panel

2.2.4 (Cont.)

RS422 SIGNAL TERMINOLOGY

The terminology made use of in this document to describe the receive and transmit lines of the RS422 link is as given below. Suggested values for the pull-up and pull-down resistors mentioned, are to be found in the 'Termination and Biasing' section, below.

TxA, RxA. Signals 'idle' low and may need pull-down resistors for successful implementation of the link.
TxB, RxB. Signals 'idle' high and may need pull-up resistors for successful implementation of the link.

MASTER UNIT PORT DETAILS

EXPANSION A/ EXPANSION B

These two ports, wired in parallel, are used to connect expansion units to the master unit. Each expansion unit is fitted with a similar pair of connectors, allowing the various units to be connected in any combination (see examples below).

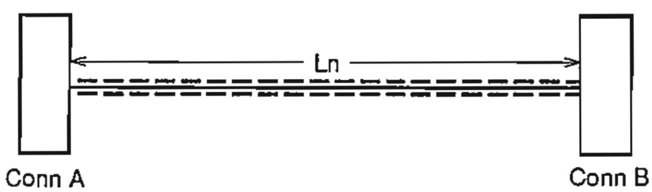
In order to avoid unwanted signal reflections interfering with true data, a termination module is required at each end of the cable (except where the master unit is at the end of the cable). Such termination modules are supplied as a part of the package, when a system incorporating one or more expansion units is ordered *.

Also supplied, with each expansion unit is a 1 metre (approx 3 ft.) length of cable, allowing immediate connection and operation of the link between the master unit and the expansion unit. If a cable of length greater than 1 metre is required, it must be made to the following specification:-

* Two modules are supplied with each system ordered which incorporates an expansion unit.

Port specification

Pin number		Signal description
Conn A	Conn B	Expansion I/F
1	1	Protective ground (screen)
2	2	TxB
3	3	TxA
4	4	RxB
5	5	RxA
6	6	5 V (for protocol translator)
7	7	Signal ground
8	8	Master reset - (MST RST B)
9	9	Master reset + (MST RST A)
10	10	Wake-up TxB (WUT B)
11	11	Wake-up TxA (WUT A)
12	12	Select 1(S1T B)
13	13	Select 1 (S1T A)
14	14	Select 2 TxB (S2T B
15	15	Select 2 TxA (S2T A)



2.2.4 (Cont.)

EXPANSION A/ EXPANSION B (Cont.)

Connecting cable extension

Connectors A and B: 15-way 'D' type plug with male jacking screws. Recommended parts:-

Part	Manufacturer	Part number
Plug	McMurdo	DE 15P
Plug	Amphenol	17DE15P
Shroud	McMurdo	MDL15S

or any equivalent shroud with male screw lock

Cable type is seven twisted pairs with overall screen. Recommended parts:-

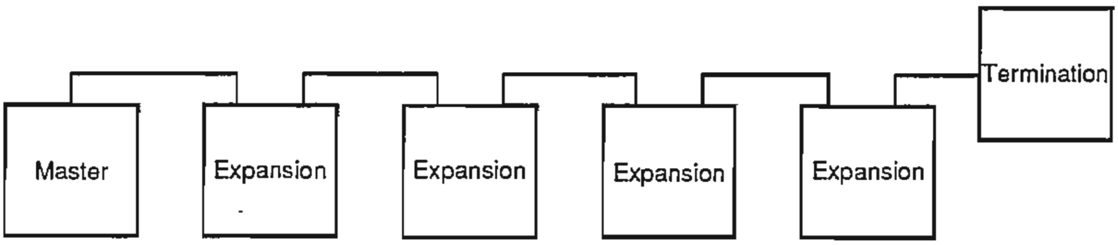
Manufacturer	Part Number
Belden	9507
BICC	H8138
STC	0S 7P24
UL	2464-7 pair

or any equivalent cable

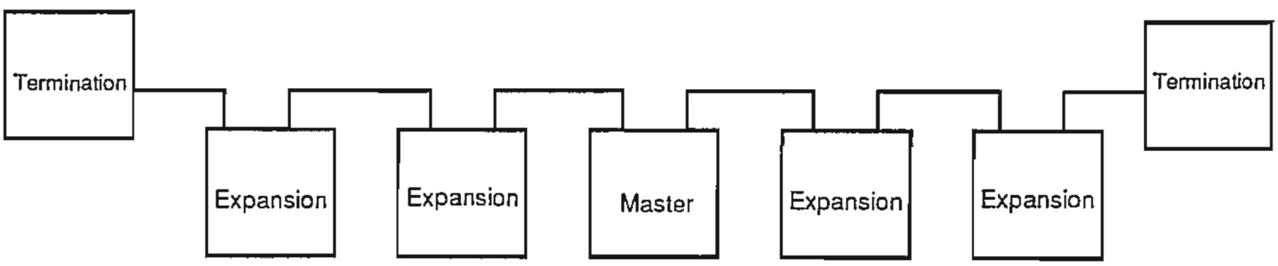
The total length of all connections between units may not exceed 1200 metres (3900 feet)

Connection examples

EXAMPLE 1



EXAMPLE 2



2.2.4 (Cont)

PORT DETAILS (Cont.)

COMMS 1, COMMS 2 Master unit

These two ports are available for general communications with host computers and peripherals. the two ports are configurable as either RS232 (host to single peripheral) or RS422 (host to multiple peripherals). Serial communications parameters (eg. Baud rate, protocol) are set up as a part of the unit communications configuration, as described in Section 4 of this manual.

Typical applications are:-

1. Distributed recording. Either (not both) of these ports can be used to communicate with up to eight 4001 recorders.
2. Host computer, running the Eurotherm Supervisory Package (ESP). The ESP running on an IBM® (or compatible) personal computer can interface with the 4500.
3. Off-line configuration. A 'dumb' terminal can be connected to Comms 1 (only) port, to allow the 4500 to be configured off-line. For further details, reference should be made to the Off-line Configuration Editor description in Section 4 of this manual.
4. Archiving. Either (not both) of these ports can be used to communicate with a mass storage unit.

Details of the cabling of these applications are given below.

PORT SPECIFICATION

The Comms 1 and Comms 2 connectors fitted to the master rack are 25-way 'D' type sockets, with female screw locks. The connections are as follows:-

Pin number		Signal description	
Comms 1	Comms 1	RS232	RS422
1	1	Protective ground (screen)	Protective ground (screen)
2	2	Tx	TxB
3	3	Rx	TxA
4	4	Not used	RxB
5	5	Not used	RxA
6	6	Not used	Not used
7	7	Signal ground	Signal ground
8 to 25	8 to 25	Not used	Not used

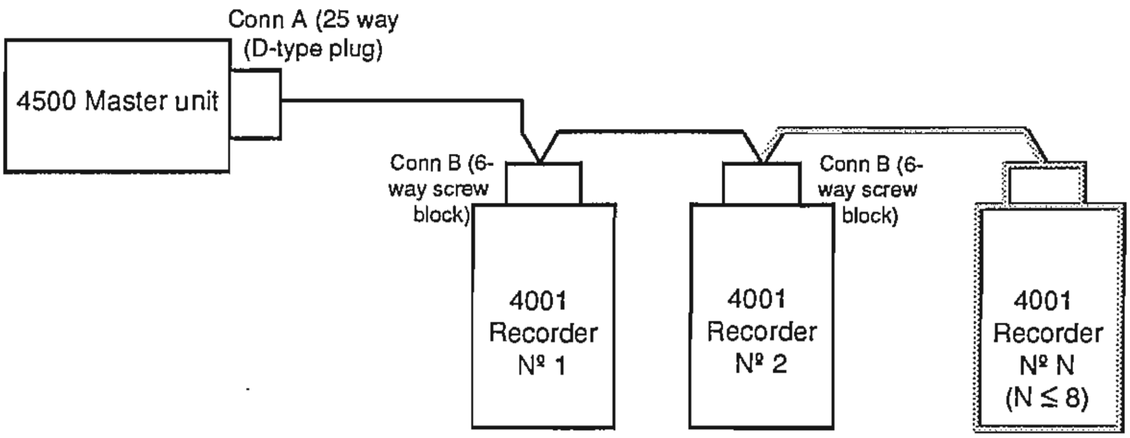
2.2.4 (Cont.)

COMMS1 AND COMMS 2 PORTS (Cont.)

CABLING EXAMPLES FOR 4500 TO 4001 COMMUNICATIONS

Conn A		Conn B
pin 1	Screen	pin 1
pin 2		pin 2
pin 3		pin 3
pin 7		pin 7

Example 1 RS232 connections



Conn A	Conn B	
pin 7	pin 2	(SIGNAL GND)
pin 2	pin 3	(RxB)
pin 3	pin 4	(RxA)
pin 4	pin 5	(TxB)
pin 5	pin 6	(TxA)

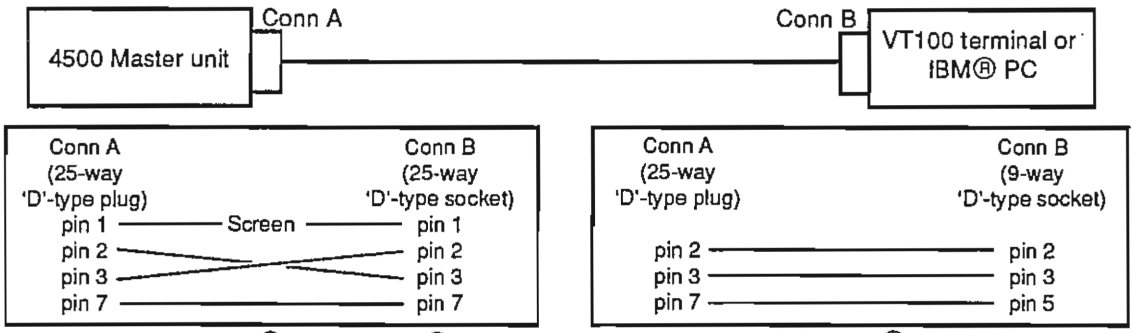
Example 2 RS422 connections

Note...

Conn B is a 6-way terminal block connector, plugged into an RS232 to RS422 converter module at the 4001 recorder.

2.2.4 COMMS 1 AND COMMS 2 PORTS (Cont.)

CABLING EXAMPLES FOR 4500 TO VT100 OR IBM® PC FOR OFF-LINE CONFIGURATION



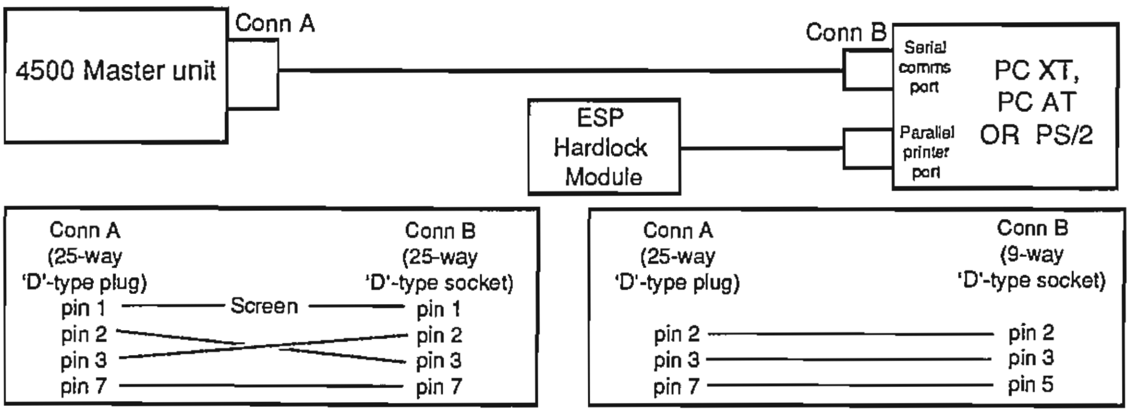
Cable for VT100, IBM® PC XT, IBM® PS/2

Cable for IBM® PC AT.

Note...

The off-line configuration editor can be accessed only via the COMMS 1 port at the 4500 Master unit.

CABLING EXAMPLES FOR 4500 TO ESP COMMUNICATIONS

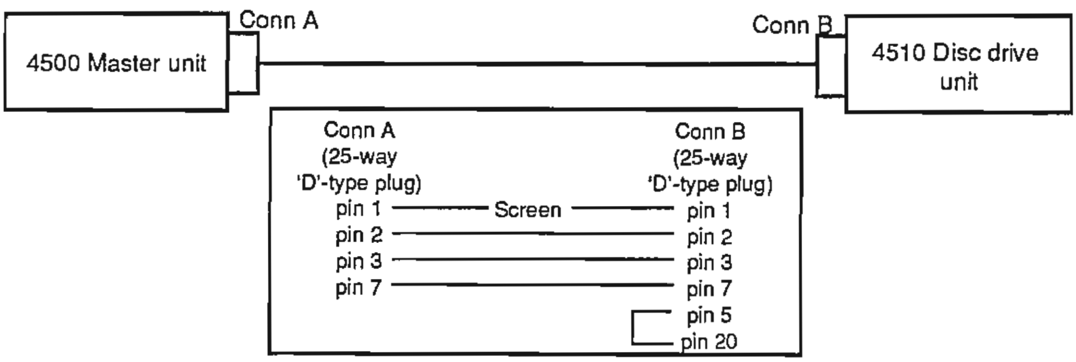


Cable for IBM® PC XT, IBM® PS/2

Cable for IBM® PC AT.

The ESP Hardlock Module (Dongle) is a software copy protection device, supplied as a part of the ESP. Serial communication with the 4500 is possible only when this device is fitted.

CABLING EXAMPLE FOR 4500 TO 4510 SERIES DISC DRIVE UNITS



Cable for 4510 disc drive unit

2.2.4 (Cont.)

DISPLAY PORT

This port is used to connect the display panel to the master unit, using the 1 metre (approx. 3 feet) flying lead supplied as an integral part of the display module. Should a longer run be required, an extension cable can be user-assembled to the following specification:

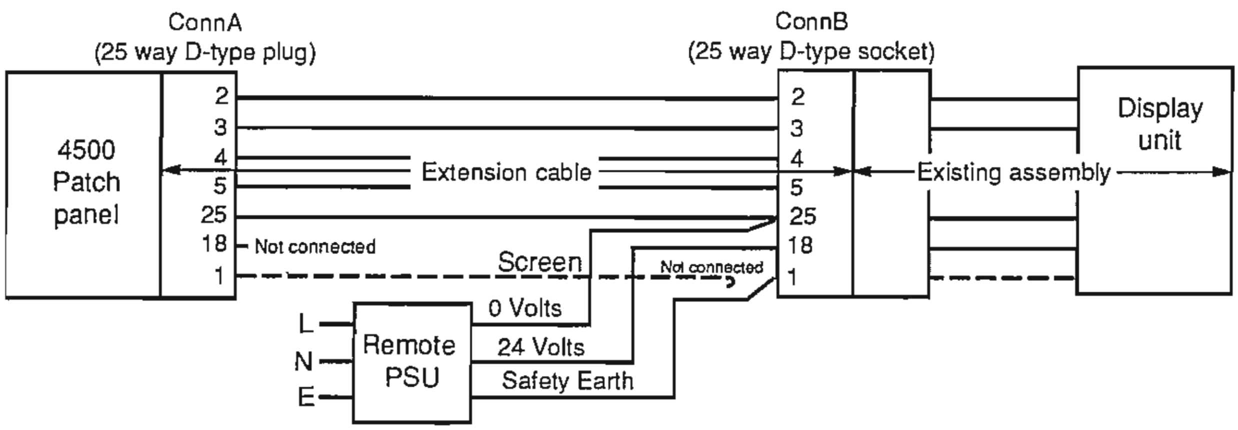
CONNECTOR PINOUTS

Pin Number		Description
ConnA	ConnB	RS422
1	1	Protective ground (screen)
2	2	TxB
3	3	TxA
4	4	RxB
5	5	RxA
18	18	24 Volt * display power
25	25	24 Volt display power return.

* 24V ± 10% line regulation, at 350mA max.

CONNECTING CABLE EXTENSION

The maximum cable length over which reliable operation can be guaranteed, is 1200 metres (3900 ft or approx 3/4 mile). It should be noted however, that if a cable run of greater than 30 metres (100 ft.) is required, then a separate power supply unit must be connected between pins 18 and 25 of the existing display cable as shown below. Pin 18 fron the patch panel end must not be connected to the external power supply.



The cable type is three twisted pairs with overall screen.

Manufacturer	Part Number
Belden	9503
BICC	H8136
STC	0S 3P24
UL	2464-3 pair

or equivalent cable

2.2.4 (Cont.)

DISPLAY PORT (Cont.)

CONNECTOR TYPES

CONN A: 25-way 'D' type plug with male jacking screws			CONN B: 25-way 'D' type socket with femal screw lock		
Part	Manufacturer	Part Number	Part	Manufacturer	Part Number
Plug	McMurdo	DB 25P	Socket	McMurdo	DB 25S
Plug	Amphenol	17DB25P	Socket	Amphenol	17DB25S
Shroud	McMurdo	MDL25S	Shroud	McMurdo	MD BP51025-3 with MD20418-2
Shroud	Amphenol	17D 4G 792 25	Shroud	Amphenol	17D 4G 793 25

or equivalent parts

AUXILIARY PORT

The AUX Port is used to communicate with a serial printer, terminal, or personal computer for displaying and / or logging of reports generated by the system. The port may be configured as either RS232 or RS422; the connections are as shown in the table below. The communications for this port are fixed as follows:

Baud rate	9,600
Stop bits	1
Parity	None

Note...

If the device connected to the port is not capable of accepting data at 9600 Baud, then XON/XOFF must be enabled at the device.

CONNECTOR PINOUTS

Pin Number Aux Port	Signal description RS232	RS422
1	Protective ground (screen)	Protective ground (screen)
2	Tx	TxB
3	Rx	TxA
4	Not used	RxB
5	Not used	RxA
6	Not used	Not used
7	Signal ground	Signal ground
8 to 25	Not used	Not used

GENERAL CABLE SPECIFICATION

For cables not specified above, the following types should be used:-

RS232: Two twisted pairs with overall screen

Manufacturer	Part Number
Belden	9502
BICC	H8072
STC	OS 2P24
UL	2464-2 pair

or equivalent cable

RS422 Three twisted pairs with overall screen

Manufacturer	Part number
	Belden 9503
	BICC H8136
STC	OS 3P24
UL	2464-3 Pair

or equivalent cable

2.2.4 (Cont.)

TERMINATION AND BIASING Communications termination and biassing

With an open-ended line, the end of the cable acts as a reflector, sending what can appear to be 'true' data signals back down the line. A receiver has no means of distinguishing between 'true' data and reflected data, with the result that the 'true' data is corrupted.

If the line is terminated with a resistor equal in value to the characteristic impedance of the cable (120 Ohms in this case) then the line appears to be of infinite length, so that no reflections occur. Unfortunately, such a value does not give the best signal to noise ratio, so a compromise value is chosen (220 Ohms) to give the best performance, both in reducing the amplitude of reflected signals, an in improving the general signal to noise ratio.

4500 SYSTEMS

The 4500 System Comms1, Comms2 and Aux ports are terminated as shown in the figure below. In a single point-to-point application, it may be necessary to terminate the 4500 with a 220 Ohm resistor. In multi-drop applications, only the final 4500 system in each transmission line must be terminated. To terminate more than one 4500 in such a way, may reduce the transmitted signal levels to an unacceptable degree.

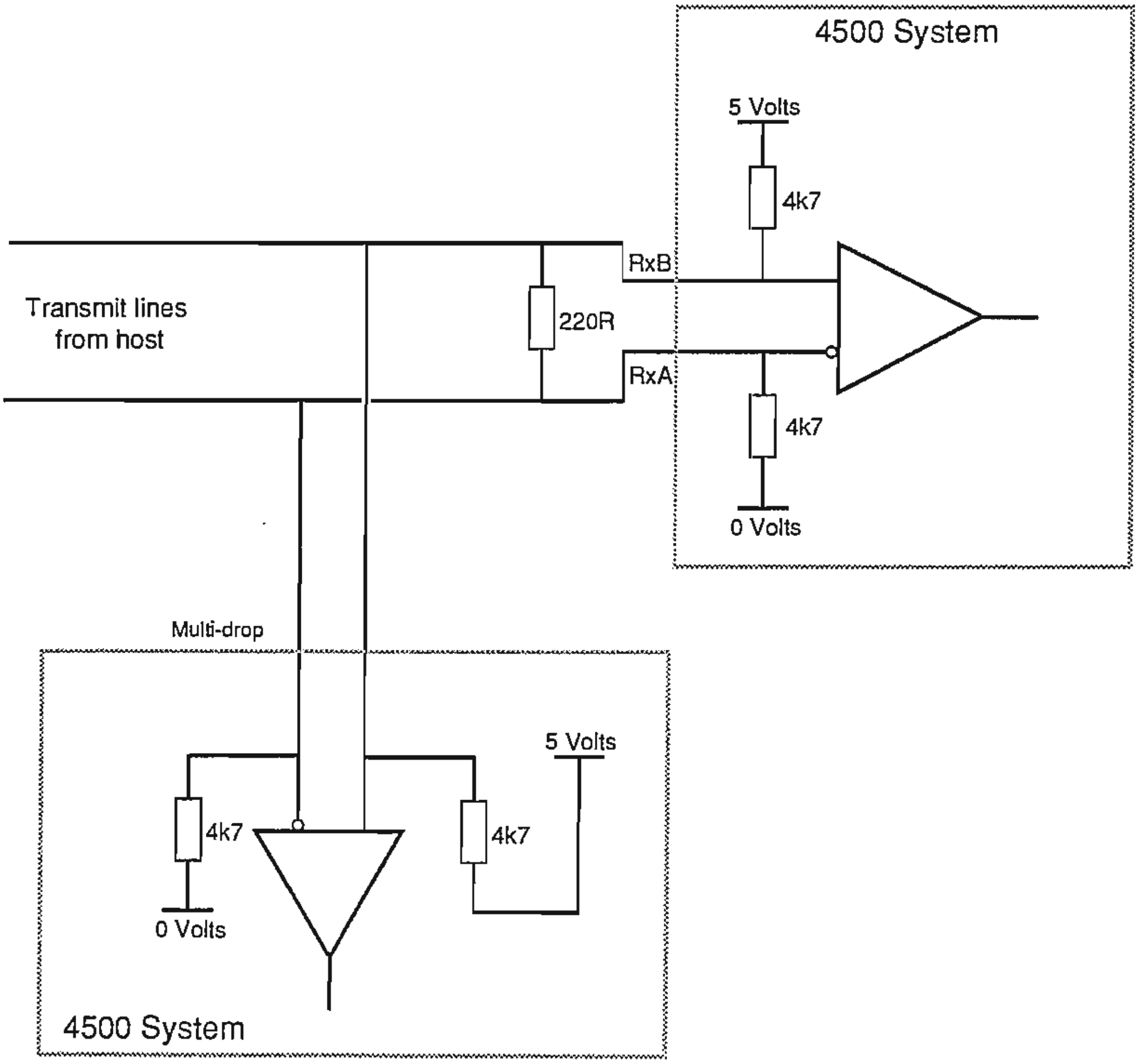


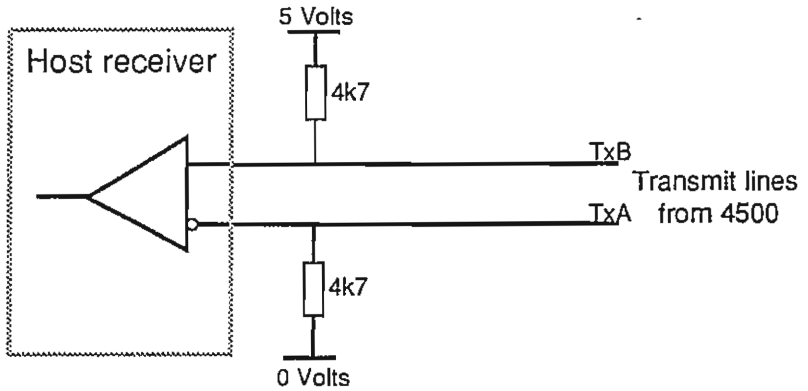
Figure 2.2.4b 4500 System termination and biasing

2.2.4 (Cont.)

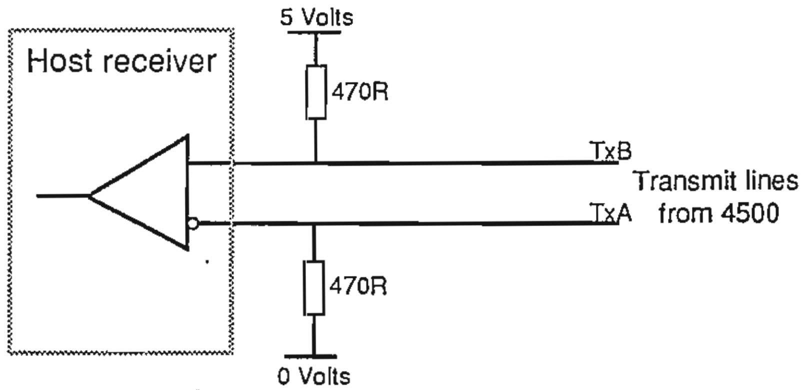
HOST COMPUTER

When not communicating, the 4500 transmit outputs go into a high impedance state, to allow multi-drop connection. This will cause a problem if the host computer is not fitted with biasing resistors to pull these essentially open circuit lines to their idle states as defined for the RS422 standard. If such is the case, external biasing resistors can be fitted as shown in figure 2.2.4c (a) below.

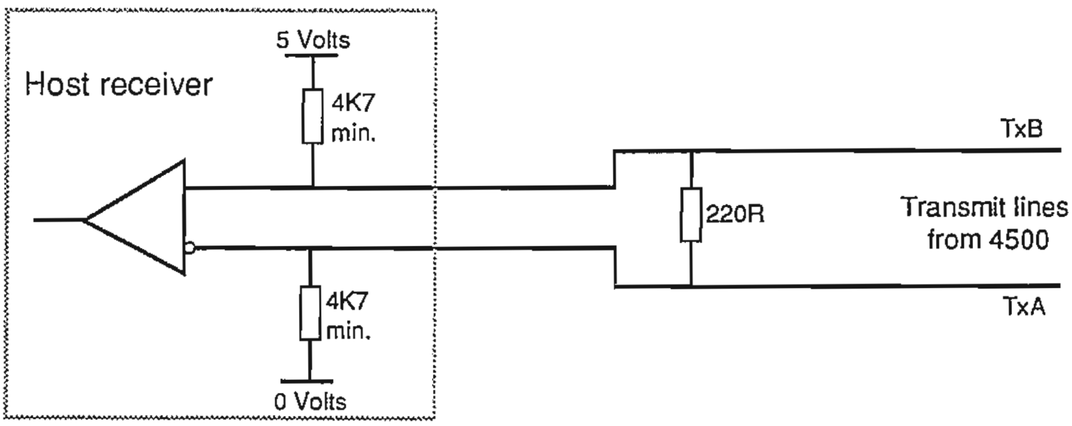
With long cable runs, it may also be necessary to terminate the transmission line. Figure 2.2.4c(b) shows how this may be achieved using external biasing resistors. Such a circuit is for use where the host receiver does not have its own internal biasing arrangements. Where the host does have its own internal biasing, the fitting of a 220 Ohm resistor across the receive inputs will terminate the line correctly (figure 2.2.4c(c)).



a) Host with external bias resistors



b) Host with external bias resistors providing termination



c) Host with internal bias resistors and external termination

Figure 2.2.4c Host computer termination and biasing

EXPANSION UNIT ADDRESSING

Any expansion racks associated with the system need an address setting in order that the master unit may communicate with them. Such addresses are set up using links on the expansion unit patch panels, as shown in figure 2.2.4d.

Note...
As supplied, any 4500 system which incorporates expansion units will have been set-up with the correct addresses for each expansion unit. Should the system be physically re-configured, it should be ensured that the address for each expansion unit is unique to the new system (e.g there is only one unit with link one fitted; only one unit with link two fitted and so on). Failure to ensure this will result in a failure in the communications between the master unit and any expansion racks with duplicate addresses.

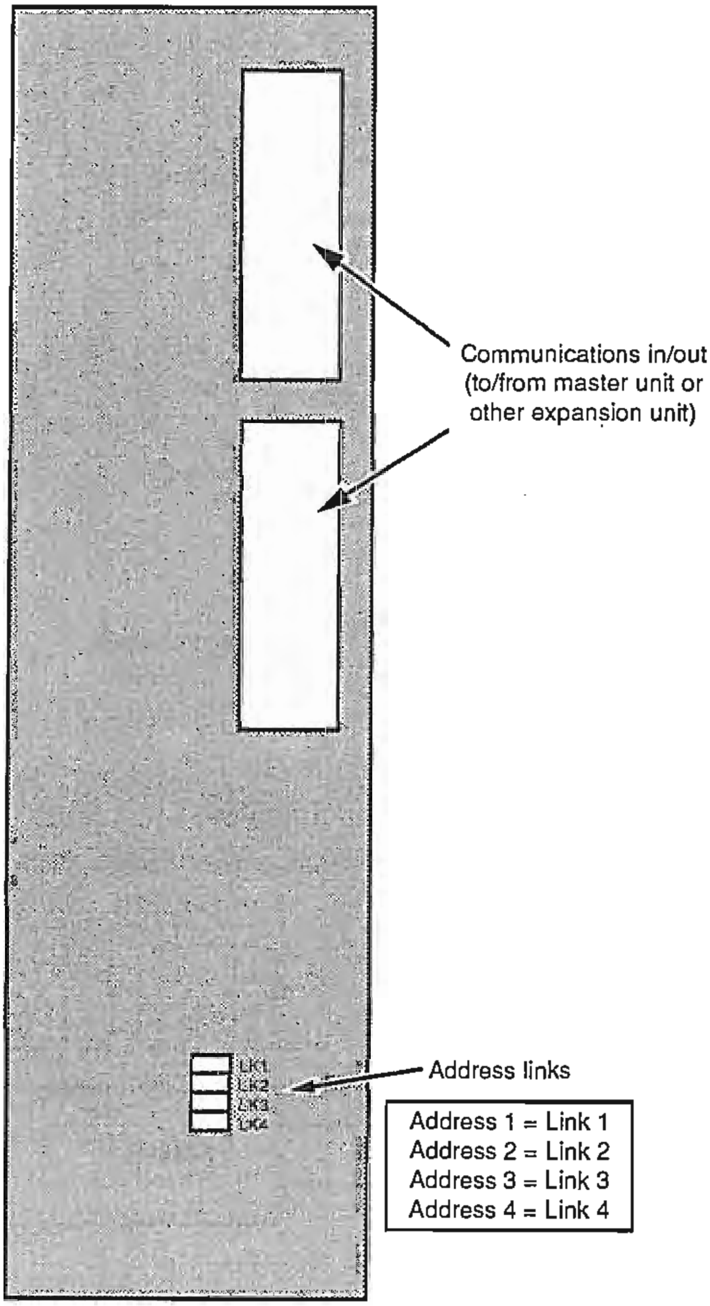


Figure 2.2.4d Expansion rack patch panel

2.2.5 FAIL-SAFE SETTINGS

Link positions are available on the analogue input boards which allow the inputs to be configured to drive the output signal to full scale or scale zero when the input is open circuit.

UP-SCALE SETTING: With up-scale setting, an over range reading (>RNG) will appear as the measured value if the sensor is open circuit.

DOWN-SCALE SETTING: With down-scale setting, an under range reading (<RNG) will appear as the measured value if the sensor is open circuit.

NO FAIL SAFE LINK SETTING: The indicated value will float.

6-CHANNEL DC INPUT BOARD

Each channel of the 6-channel dc input board can be set up to provide up-scale or down scale sensor fail detection when measuring thermo-couples, or dc input spans of less than 1.28 Volts. (Above 1.28 volts, the a zero reading results.) If specified at the time of order, these links will be factory set.

This setting up consists of the positioning of a link across one of three pairs of pins, for each channel as detailed in figure 2.2.5a.

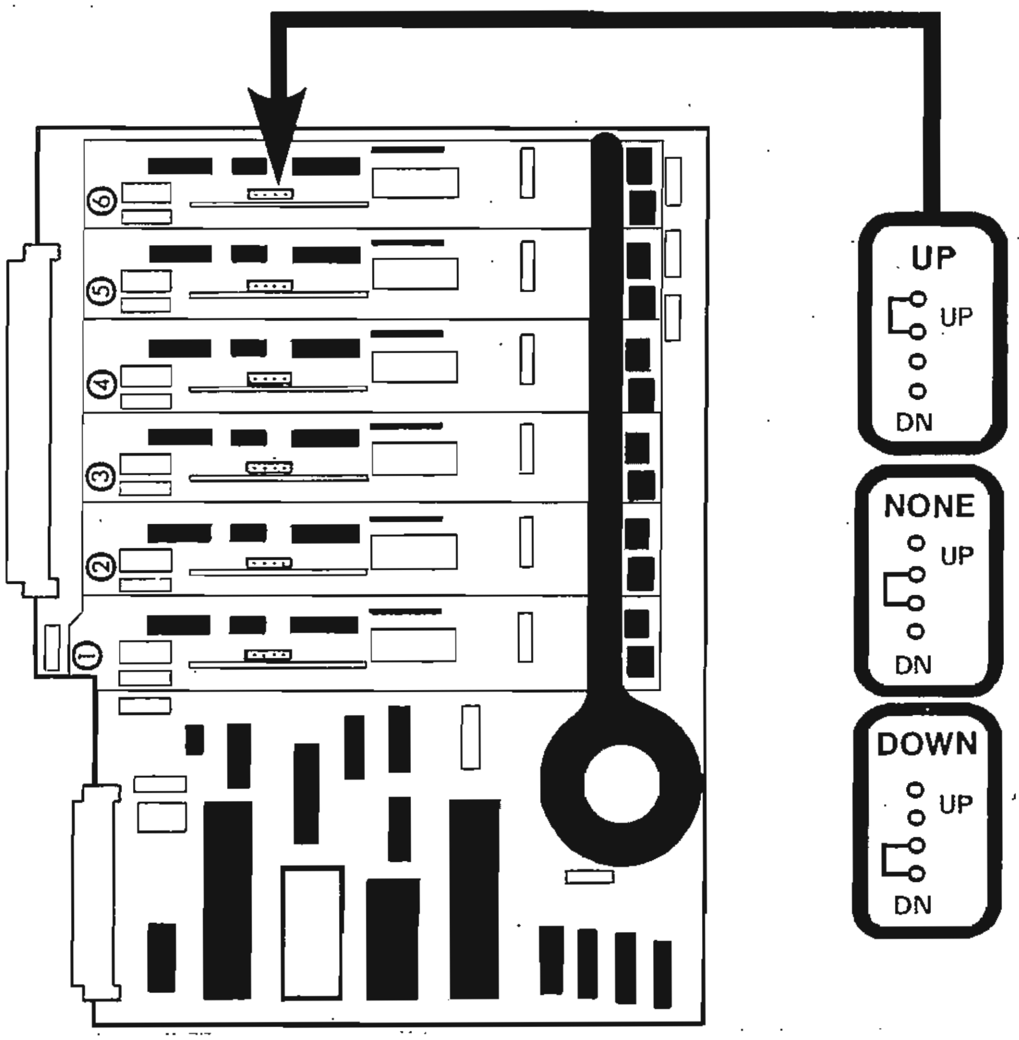


Figure 2.2.5a Fail-safe links for the 6-channel dc input board

2.2.5 (Cont.)

15-CHANNEL ANALOGUE INPUT BOARD

With the 15-channel analogue input board, all channels are set either to upscale, downscale or no fail safe. The necessary link is LK1, located as shown in figure 2.2.5b.

Location A results in down-scale protection. Location B results in no fail-safe protection. Location C results in up-scale protection

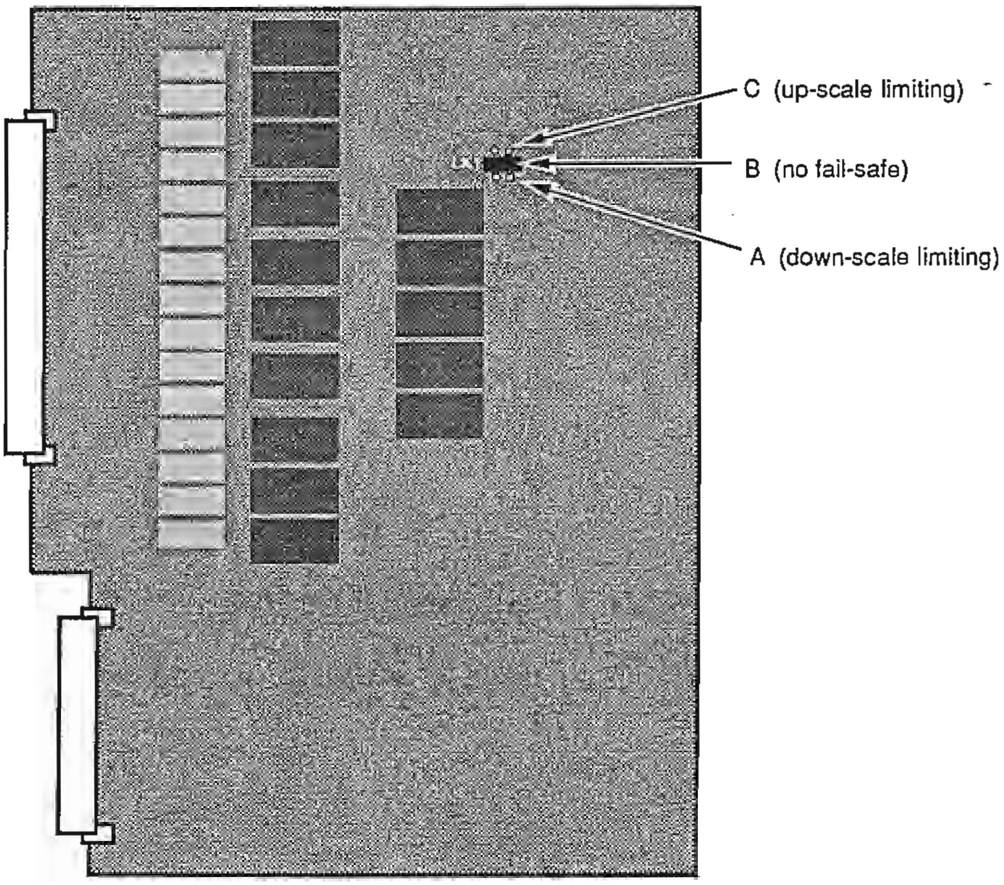


Figure 2.2.5b Fail-safe links for the 15-channel analogue input board.

2.2.6 I/O BOARD FUSE LINKS

Damage will be caused to the I/O boards if they are connected to an incompatible SIM type, or if the correct SIM type is used with incorrect plug-in modules. This damage consists in one of the two fuses loacted on the board being 'blown'.

The fuse locations are shown in the figures below, and are of the following types:

F1 2 Amp wire-ended Part number CH450023
F2 1 Amp wire-ended Part number CH450013

8 CHANNEL ANALOGUE OUTPUT AND 15 CHANNEL DIO BOARDS

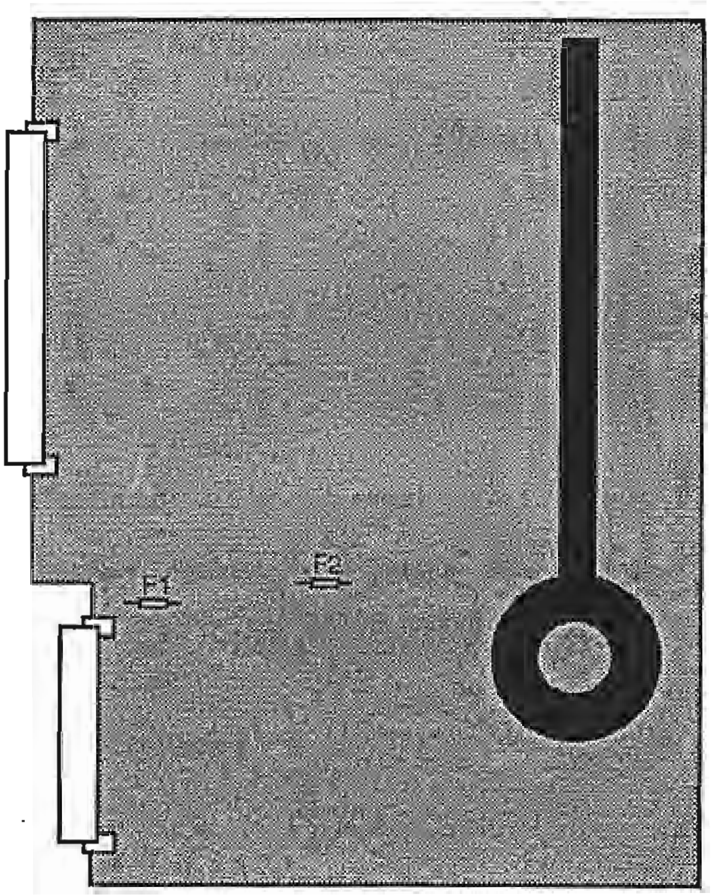


Figure 2.2.6a Fuse link locations for 8-channel analogue output and 15-channel DIO boards

2.2.6 (Cont.)

15 CHANNEL ANALOGUE INPUT

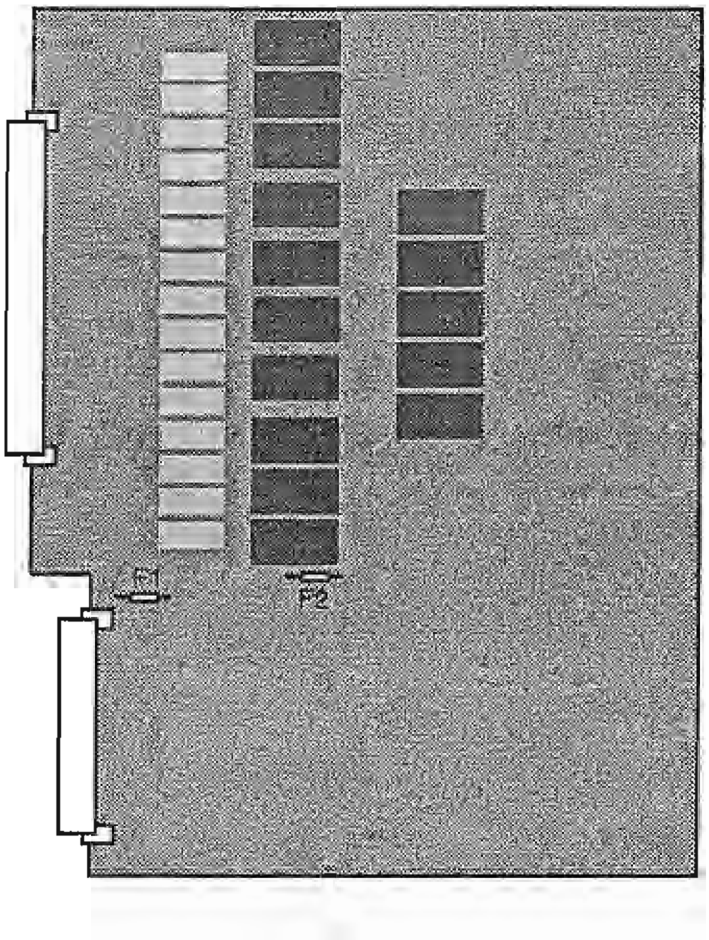


Figure 2.2.6b Fuse link locations for the 15-Channel analogue input board.

SECTION 3 OPERATION

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LIST OF TABLES

LIST OF FIGURES

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SECTION 3 OPERATION

3.1 INTRODUCTION

Section 3 describes the day-to-day operation of the 4500 system including such items as powering on, changing the display mode, acknowledging alarms and so on.

3.2 POWER UP AND INITIALISATION

Each 4500 master and expansion unit is fitted with a power supply unit (PSU) which has an on-off switch located on its front panel.

Note...

Where systems include expansion units, it is important to switch the expansion units on before switching the master unit on. If this is not done, the master rack will attempt to initialise circuit boards in the expansion racks before they have been powered-up, with resultant alarm/error messages.

During initialisation, the display below appears.

```
     CHESSELL 4500 SYSTEM VN.N/LRRR
Initialising I/O Modules......
```

Where N.N/LRRR gives the following information:

N.N	Software version number (eg 2.2)
L	System software level (1, 2 or 3)
RRR	Options installed as shown in the table.

RRR	Archiving	Distributed Recording	Maths pack
000	No	No	No
001	No	No	Yes
002	No	Yes	No
003	No	Yes	Yes
004	Yes	No	No
005	Yes	No	Yes
006	Yes	Yes	No
007	Yes	Yes	Yes

After initialisation, the 2-channel summary page, described later, appears, held at the first two configured channels.

3.2.1 ERROR MESSAGES

INTERNAL ERRORS

If an internal error occurs which causes the system to restart, the above message is replaced with an error message, giving an error number. The system then attempts to initialise as normal, and the error is stored in the system alarm 'stack' for subsequent interrogation via the 'ack alarms' page described later (section 3.6)

'FATAL' ERRORS

If the data base configuration is inconsistent with the software, either through corruption or because an incorrect data pack has been fitted in the SBC, a 'fatal' error is said to occur. The initialisation message is replaced by an error message indicating the type of inconsistency. This message remains at the display until the ↵ key is operated, when initialisation takes place with the loss of any data that may be on the data pack. Under such conditions, the recorder does not scan, and remains off-line until a new configuration is entered.

3.3 OPERATOR INTERFACE

The operator interface (display / keyboard) depicted below, has the following types of displays: Operator action, Softkey menu, Summary pages (2 or 4 channel, measuring or derived) and Configuration. The configuration pages are fully described in Section 4 (measuring channels) and Section 6 (derived channels) if the maths pack option is installed.

Unless configuration is taking place (See section 4), the panel will normally display one of the channel, alarm or maths pack summary pages, (2- and 4-channel summary pages depicted below), as selected from the 'display' page menu described below. Operation of the clear (#) key (figure 3.3a) results in the calling of the first page (also depicted below) of the top level menu to the display (ref figure 3.3b). Operation of any softkey calls the 'display' page to the display.

2 channel display

```
35  V938.0 degC   Boiler temp 1      AB
36  Λ992.6 degC   Boiler temp 2
```

4 channel display

```
35  V938.0 degC  36  Λ992.6 degC     AB
38  Λ898.9 degC  40  ±901.3 degC
```

The interpretation of the above displays is given later in this document.

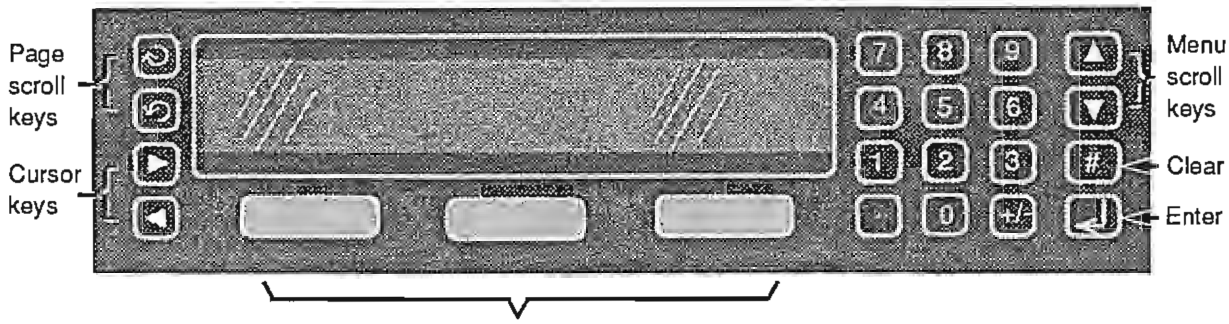

Figure 3.3a Display keyboard

3.4 TOP LEVEL SOFTKEY MENU PAGE 1

Top level menu (page 1)

```
Select operation:            More >    AB
  ♣List/Ack     Display       Logging
```

As described above, the operation of the clear key from a 2- or 4-channel summary display, calls the first page of the top level softkey menu to the display, as depicted above. Top level menu page 2 is accessed by operation of the → key. Page two contains configuration items which are described in Section 4 of this manual.

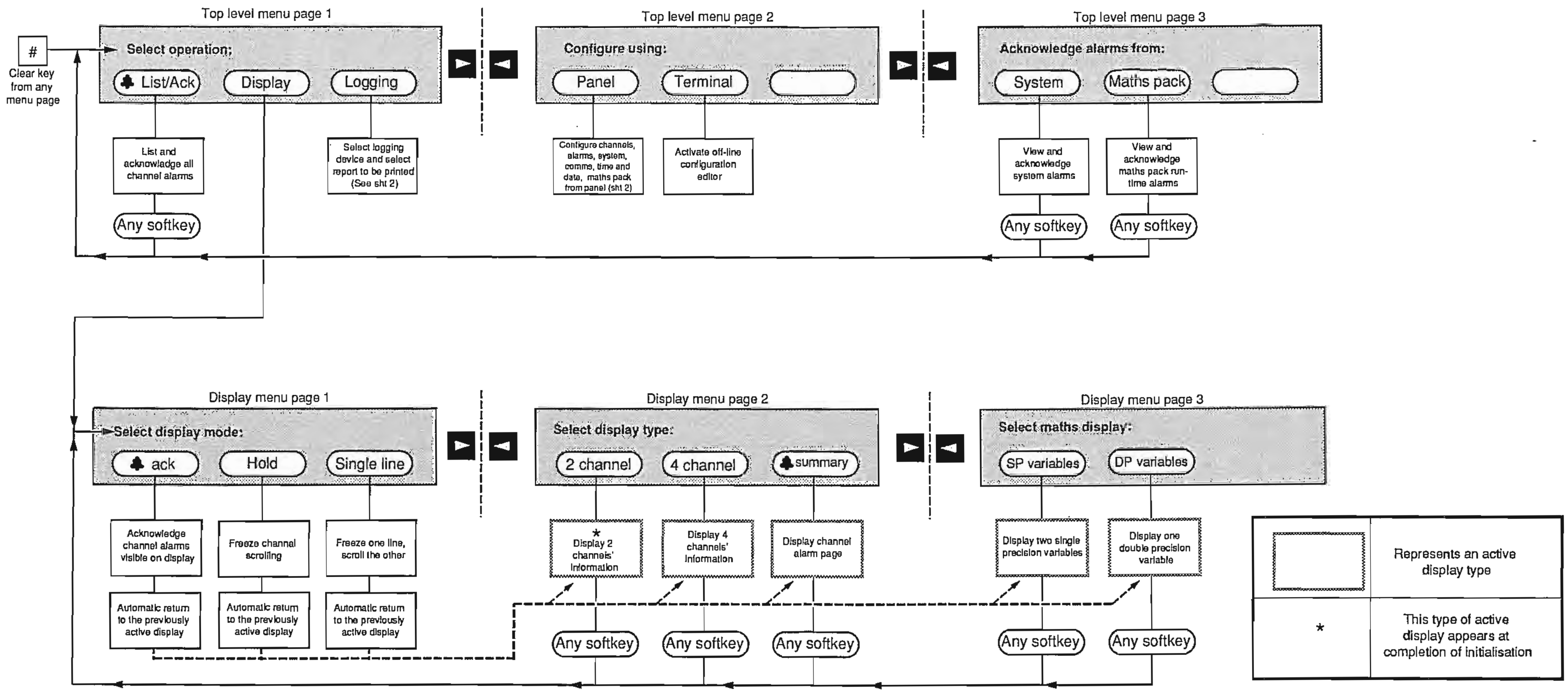

Figure 3.3b Menu Organisation (sheet 1 - top level and display)

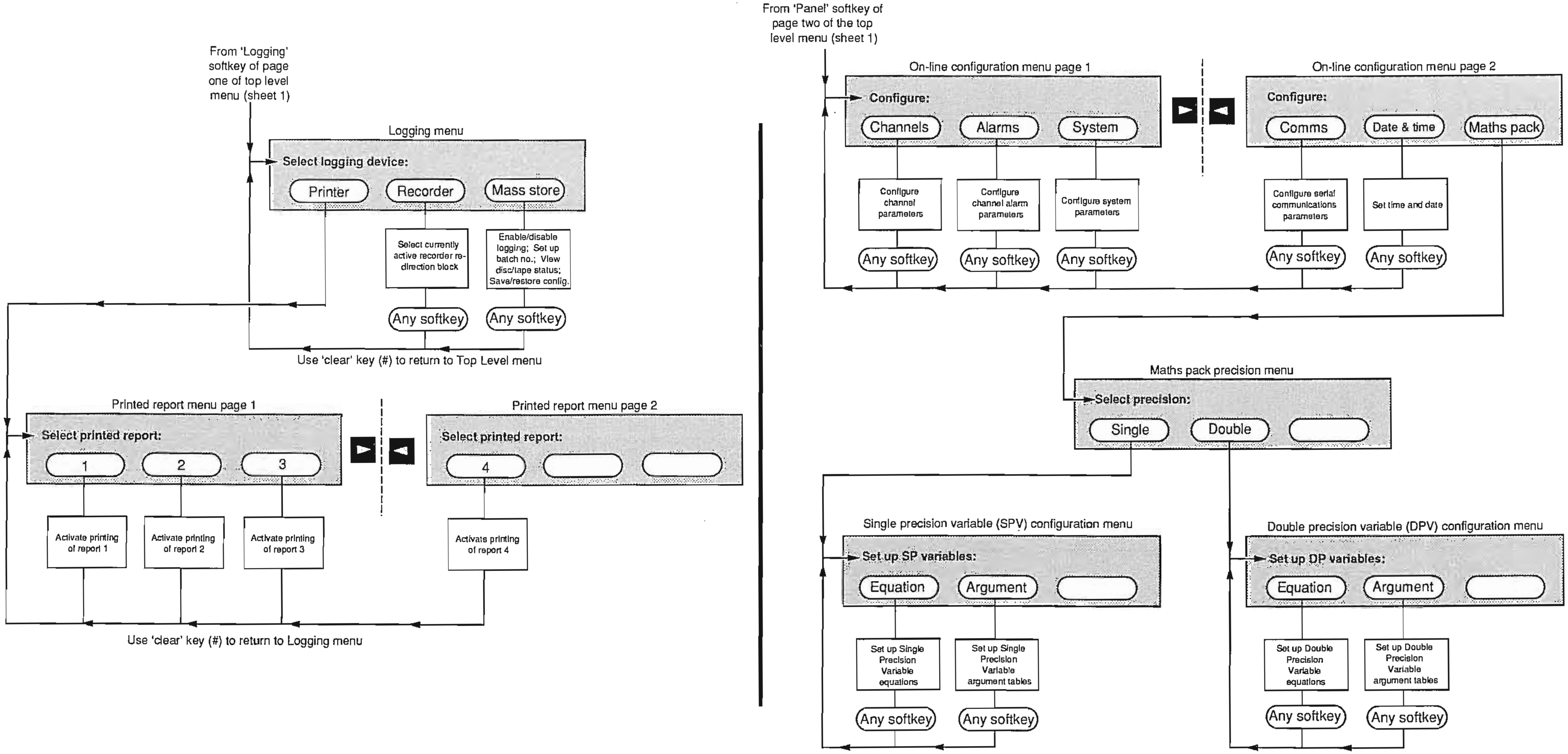

Figure 3.3b Menu organisation (sheet 2 - logging and configuration)

3.4.1 ♣LIST/ACK

Operation of the softkey immediately below this legend causes the 'Alarm list and acknowledge' operator action page to be displayed. The latest alarm in the system is brought to the display, and acknowledged at the same time.

```
163 ± 1000.Deg C Boiler 17          AB
29/02/88 10:59:59 Deviation alarm
```

As can be seen, the display contains the following information:-

1. Channel number (163 in the example above), measured value (1000), units and descriptor.
2. Alarm type (deviation in the above case)
3. Date and time of the alarm's occurrence and the alarm descriptor (see 'Time and date' in Section 4 for date format).
4. If a bell symbol in position B and the alarm descriptor field are flashing, then the alarm was previously unacknowledged.

Operation of the page scroll key causes any previous alarms to be displayed and acknowledged, one per keystroke. If, when acknowledged, the alarm condition is no longer valid, then the alarm is removed from the list. If the alarm is still valid, the alarm remains in the list, but the alarm descriptor field no longer flashes.

Operation of the # key moves to the top of the list; a further operation of this key causes a return to the top level menu.

3.4.2 'DISPLAY' MENU

PAGE 1 (SELECT DISPLAY MODE)

Operation of the softkey immediately below the DISPLAY legend causes the first page (Select display mode) of the display menu to appear:

```
Select Display Mode:        More >     AB
   ♣ ack          Hold      Single line
```

♣ ACK Operation of this softkey acknowledges any unacknowledged alarms associated with the channels displayed on the previously displayed summary page. An immediate return to the previously displayed summary page is made.

HOLD Operation of this softkey causes the channel numbers at the currently active 2- or 4-channel summary page to be 'frozen'. This is followed by an immediate return to the previously displayed summary page. Whilst the display is held, the channel numbers can be altered by moving the cursor to the required channel number and entering the new number. to release the display, a further operation of the HOLD softkey is required. See also 'Single line' below.

Notes...

1 Display hold affects only the channel numbers. The measured values, alarm status etc. of the displayed channel are still updated every second.
2. Analogue and discrete output levels can be set in hold mode. This is done by moving the cursor to under the value field and either scrolling the discrete output 'ON' or 'OFF', or setting an analogue value (in display units) using the numeric entry keys. This facility is available only if the access level is correct, and if the outputs have not previously been configured. In the latter case, the previous configuration takes precedence.

(Continued)

3.4.2 DISPLAY MENU (CONT.)

PAGE 1 (SELECT DISPLAY MODE) (Cont.)

SINGLE LINE

Similar to the operation of the HOLD softkey, operation of this key freezes only the top line or the bottom line of the display. The display then returns to the previously active summary page. Which of the two lines becomes frozen depends on the position of the cursor (top line or on the bottom line) when the 'single line' command is initiated.

DISPLAY MENU PAGE 2 (SELECT DISPLAY TYPE)

Operation of the → cursor key calls the second page of the display menu to allow selection of the next type of active summary display.

```
Select display type:     < More >     AB
  2 Channel      4 Channel      ♣Summary
```

Note...

If the maths pack option is fitted a right arrow appears to the right of the word 'More'. Operation of the right arrow cursor key brings the maths pack display mode selection menu to the display.

TWO CHANNEL

```
 35  V938.0 degC   Boiler temp 1        AB
 36  Λ992.6 degC   Boiler temp 2
```

Operation of the '2 channel' softkey selects two-channel display mode. The two channel display (depicted above) contains the information listed for two channels. The channels are displayed for approximately 8 seconds, before being replaced by the next pair of active channels (unless display hold is selected, when the two channels remain displayed until released). As can be seen from the example, the channel information displayed is:

1. Channel Number
2. Active alarm symbol
3. Measured value
4. Measured value units
5. Channel descriptor
6. System status indicators

Operation of any softkey causes a return to the Display menu.

3.4.2 DISPLAY MENU (Cont.)

ALARM INDICATORS

The alarm indicators show the latest alarm type to have become active, and flash until acknowledged. The symbols (up to two of which can be displayed at any one time) are depicted below, and the alarm types represented by these symbols are fully explained in the alarm configuration section later in this document.

⩓	Absolute high.	↓	Rate alarm negative going.
⩔	Absolute low.	↑	Rate alarm positive going.
±	Deviation.	H	Discrete high.
∧	Deviation high.	L	Discrete low.
∨	Deviation low.		

Notes..

1 If a displayed channel is in alarm, a double operation of the left-most softkey will acknowledge the alarm.

2 If an undisplayed alarm becomes active, then <#> followed by a single operation of the ♣ list/ack softkey will list and acknowledge the alarm.

???? as the measured value, indicates a communications alarm.
> RNG or < RNG as the measured value, indicates that the measured value lies outside the input range configured for the input.
-NE- as the measured value indicates that the channel is not enabled.
'empty' as the measured value, indicates that no I/O board is configured for the channel.
! preceding the measured value indicates that the value of a maths pack function has exceeded the maximum displayable value.

STATUS INDICATORS

System status indicators are used to provide assistance and warnings to the operator. They take the form of inverse characters (black on white) in the top right hand corner of the display, represented by the characters 'AB' in the example above. The indicators and their interpretations are as follows:

POSITION A

A This character indicates that a maths pack run-time error has occurred. The maths pack alarm acknowledge page can be used to view and acknowledge these errors.

E This character appears whenever an item of configuration has been changed, and the **ENTER** key has to be operated in order to save this in the unit's memory. It should be noted that it is not necessary to use this key after each item has been changed, but only after a complete page or channel or alarm configuration has been set up. Calling a new page, operating a softkey or changing channel number before entering the new data, will cause the new data to be lost.

H Reminds the operator that 'page hold' is in operation.

I This character indicates that a system fault has occurred. The 'SYSTEM ALARM ACKNOWLEDGE' display page can be used to acknowledge the alarm, and to indicate any alarms currently active.

S Reminds the operator that the display is in single line mode.

Note...

The indicators have priorities as follows (starting with the highest): I, A, E, H or S. (H and S cannot occur together)

3.4.2 DISPLAY MENU (Cont.)

STATUS INDICATORS (Cont.)

POSITION B
The character which can appear at position B is a bell symbol to warn of a channel alarm. If the symbol is flashing, the alarm to which it relates has not been acknowledged; if it is steady, then the alarm has been acknowledged.

4 CHANNEL

```
35  V938.0 degC  36  Λ992.6 degC     AB
38  Λ898.9 degC  40  ±901.3 degC
```

Operation of the '4 channel' softkey selects four-channel display mode. The four channel display contains the information listed for four channels. The channels are displayed for approximately 8 seconds, before being replaced by the next set of active channels (unless display hold is selected, when the channels remain displayed until released). As can be seen from the example, the channel information displayed is:

1. Channel Number
2. Active alarm symbol
3. Measured value
4. Measured value units
5. System status indicators

Operation of any softkey causes a return to the Display menu.

The active alarm symbols, status indicators and alarm acknowledgement techniques are as described for the 2-channel display.

♣ SUMMARY

Operation of this softkey calls the first (most recent) of the alarm 'history' pages to the display. The display shows the latest (up to) fifteen active alarms. Alarms occurring prior to this can be accessed, one page at a time, by operation of the page scroll key. The alarms are identified by channel and type symbol (see 2-channel display, above). Operation of any softkey causes a return to the Display menu.

The active alarm symbols, status indicators and alarm acknowledgement techniques are as described for the 2-channel display.

DISPLAY MENU PAGE 3 (SELECT MATHS DISPLAY)

This page is valid only when the maths pack option is fitted. A full description is to be found in Section 6 of this manual.

3.4.3 LOGGING SOFTKEY MENU

This menu appears when the 'Logging' softkey is operated in the top level menu.

```
Select Logging device:                   AB
  Printer       Recorder     Mass store
```

PRINTER

Selection of the 'Printer' softkey calls the first page of the PRINTER menu to the display:

```
Select Printed Report:     More >       AB
     1             2             3
```

Selection of 1, 2, 3 or (by using the ⟶ key) 4, causes that report to be printed. The report consists of various I/O channels and their current measured values as depicted below. The channels can be allocated to one or more reports as a part of each relevant channel's configuration. The start time and periodicity of each report are set up as a part of the system configuration. Refer to the Section 4 of this manual for full details.

Note...

As well as being printed on demand (via the above page), reports can be printed as alarm 'jobs' (set up in alarm configuration), or using a digital input channel as a trigger (set up in System configuration).

Operation of the <#> key causes a return to the top level menu.

A typical report is as follows:-

```
     R E P O R T     No.   1          14:36:52    THU  22-DEC-1988

001 Boiler Temp No.1      :        158.0 Deg C
002 Boiler Temp No2       :        158.0 Deg C
003 Drain Valve Temp 1    :        158.1 Deg C
006 Drain valve Temp 2    :        158.1 Deg C
```

RECORDER

There are eight 'blocks' to which 4500 series channels can be allocated, in order to re-direct them to input channels of up to eight 4000 series recorders. Selection of the RECORDER softkey allows selection of that block which is to be active. Section 6.2 of this manual gives full details of the Distributed Recording option.

```
Recorder redirection -                   AB
Select block: NNNNNN Active Block: MMM
```

NNNNNN	The current recorder redirection block, scrollable through 1 to 8 and REMOTE.
MMM	Indicates the block switched when REMOTE is selected. The active block field appears only when REMOTE is selected.

Operation of the <#> key, causes a return to the top level menu.

The following display appears if the RECORDER softkey is operated with the option not installed.

```
Option not installed                     AB
-Press a key to continue
```

3.4.3 LOGGING SOFTKEY MENU (Cont.)

MASS STORE

If the option is installed, the mass store menu item allows archiving and retrieving of data to and from mass storage media such as floppy discs, tapes etc. For full details, refer to section 6.4 of this manual.

PAGE 1

```
Logging -man:OFF ext: OFF Format NUM  AB
Batch Number: NNNNNNNN Auto inc: OFF
```

Logging	man:OFF	Disables log initiation by DIO channel.
	man:ON	DIO channel log initiation is enabled.
	ext:OFF	Remote DIO channel currently switched off (not configurable)
	ext:ON	Remote DIO channel currently active (not configurable)
Format	NUM, TEXT, DATE or TIME selectable as Batch number type.	
Batch Number	TEXT	Allows text entry of batch number
	NUM	Allows entry of numeric batch number
	DATE/TIME	Not configurable.
Auto inc	With NUM format only, batch number can be selected to increase by one each time a log is initiated.	

PAGE 2

```
Drive:0 Bytes Free: nnnnnnn Status:OK AB
Press ENTER for directory
```

Drive	0 (non configurable for single drives) or 1 (for dual drives only)
Bytes Free	Gives the available space on the disc in the selected drive.
Status	Gives status of the current operation. See section 6.4 for further details.

Operation of the ENTER key (whilst logging is not in progress) calls the first directory display page.

```
Drive:0 Bytes Free: nnnnnnn Status:OK AB
Batch100  Batch101  Batch102  Batch103
```

PAGE 3

```
Configuration File: FFFFFFFF.CFG      AB
  Select:          Save          Restore
```

Operation of the Save and Restore key will write or read (respectively) the file name which appears at the top line of the display to (from) the mass storage medium. This page is used only for configuration files.

Operation of the <#> key causes a return to the top level menu.

If the mass store facility is not installed the 'Option not installed' message (depicted above) appears when the softkey is operated.

3.5 TOP LEVEL MENU PAGE 2

This display page is called using the ⟶ key from Top Level Menu Page 1, and is used to select whether the system is to be configured on-line, by means of the Operator Interface (display/keyboard), or off-line, by means of a terminal. Full details of the configuration of the system are given in section 4 of this manual.

```
Configure using:          < More >     AB
    Panel        Terminal
```

Use of the ⟵ or ⟶ key calls Top Level Menu Page 1 or 3 respectively.

3.6 TOP LEVEL MENU PAGE 3

This (final) top level menu page is used to acknowledge System Alarms and / or Maths Pack Alarms. The display page is called using the → key from the Top Level Menu Page 2.

```
Ack. alarms from:          < More        AB
   System       Maths pack
```

SYSTEM

Operation of the softkey calls the System Alarm Acknowledge action page to the display. If there are no system alarms, then a message 'No more alarms' is displayed. If one or more system alarms is present then the oldest non-acknowledged alarm will be presented at the display.

```
Sys alarm type: ttt dd-mm-yy hh:mm:ss I
Nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
```

Where:

ttt	System alarm code (see table 3.6)
dd-mm-yy	Date of alarm
hh:mm:ss	Time of alarm
Nnn--nnn	Text describing the nature of the alarm (see table 3.6)

Operation of the page scroll key causes the system alarm history to be scrolled through, one per key-stroke.

Operation of the <ENTER> key whilst one of the alarms is displayed will cause that alarm to be acknowledged (if access level =3)

Operation of any softkey or the # key causes a return to the Top Level Menu Page 1.

If one or more system alarms keeps occurring, a note should be made of the alarm type number, and the local Service Engineer should be contacted.

MATHS PACK

Similar in operation to the System Alarm page described above, this page indicates that maths pack run-time errors have occurred, as described in Section 6 of this manual.

```
Maths err type: ttt dd-mm-yy hh:mm:ss A
Nnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnnn
```

Where:

ttt	Maths error code
dd-mm-yy	Date of alarm
hh:mm:ss	Time of alarm
Nnn--nnn	Text describing the nature of the error

3.6 (Cont.)

1.	SYSTEM ALARM MESSAGE OVERFLOW. Multiple system alarms have occurred and the message queue has over flowed.
2.	ENTIRE CONFIGURATION LOST. All configurable parameters have been lost and the system has been configured to a default state.
3.	4001 REDIRECTION LOST. The distributed recording redirection parameters have been lost. No data will be directed to 4001 recorders.
4.	CHANNEL NNN CONFIGURATION LOST. The channel parameters for channel NNN have been lost. The channel has been initialised to a default state.
5.	CHANNEL NNN ALARM CONFIGURATION LOST. The alarm parameters for channel NNN have been lost. No alarms are configured for channel NNN.
6.	SYSTEM CONFIGURATION LOST. The system configuration parameters have been lost, and the system has been initialised to a default state.
9.	MATHS PACK SPV ARGUMENT TABLE NNN LOST. The single precision argument table NNN associated with the maths pack has been lost and has been initialised empty.
10.	MATHS PACK DPV ARGUMENT TABLE NNN LOST. The double precision argument table NNN associated with the maths pack has been lost and has been initialised empty.
12.	MATHS PACK SPV NNN CONFIGURATION LOST. The Single precision variable argument parameters are lost and have been initialised to a default state.
13.	MATHS PACK DPV NNN CONFIGURATION LOST. The Double precision variable argument parameters are lost and have been initialised to a default state.
20.	YEAR LOST: RESET TO NNNN. The calendar year has been reset to NNNN
31.	BATTERY LOW. The single board computer (SBC) battery is approaching exhaustion and should be replaced. Failure to replace the battery will cause loss of real-time clock. Totalisers will be reset if power is removed.
35.	4001 COMMS ERROR RECORDER N, CHANNEL NN. Indicates that channel NN of recorder N cannot be communicated with. This error can appear only if the distributed recording option is fitted.
36.	4001 COMMS ERROR RECORDER N. This indicates that the 4500 system cannot communicate with any channel of recorder N. This error can appear only if the distributed recording option is fitted.
37	Reserved
38	Reserved
39	Reserved
40	451X DISC HAS LESS THAN 100K FREE. Less than 100kB of usable space left on disc.
41	451X DISC FULL
42	451X DISC DRIVE NOT READY
43	451X COMMUNICATION ALARM
44	451X FILE ALLOCATION EXCEEDED. Maximum number of files for the disc has been exceeded.
45	451X BATCH NUMBER ALREADY EXISTS. File will be saved to default file.
46	451X CONFIGURATION SAVE FAIL
47	451X CONFIGURATION RESTORE FAIL.
48	Reserved
49	Reserved
	Other error codes (50 to 89) are internal errors which appear only for the information of the manufacturer.

Table 3.6 System Alarm Code Interpretation

SECTION 4 CONFIGURATION

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LIST OF CONTENTS (CONTINUED)

(Cont.)

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SECTION 4 CONFIGURATION

4.1 INTRODUCTION

Configuration of the 4500 is carried out in a number of stages (e.g. System, Channel, Alarm etc.), either 'on-line' (using the display/keyboard depicted below) or 'off-line' (using an external terminal or computer). The configuration is held in an Electrically Erasable Programmable Read Only Memory (EEPROM) data-pack located on the Single Board Computer in the Master Unit.

4.1.1 ON-LINE CONFIGURATION

'On-line configuration' means that the system is programmed (using the keyboard / display unit depicted below), whilst it is still scanning and acquiring data. Care should be taken that invalid conditions do not arise as a result. Generally, on-line configuration is used to make minor modifications to the system set-up.

4.1.2 OFF-LINE CONFIGURATION

'Off-line configuration' means that configuration is carried out (using a separate terminal or personal computer), whilst the system is not scanning, and thus, not monitoring the plant. Off-line configuration is normally used to do the initial programming of the system, with any minor modifications being made on-line. If an IBM® PC (or compatible) is used, running the Terminal Emulation Package (available from the manufacturer), the final configuration can be stored on the computer's mass storage medium (disc), both for security, and for use in configuring other 4500 systems.

Off-line configuration is available only to operators with access level 3 password (see below).

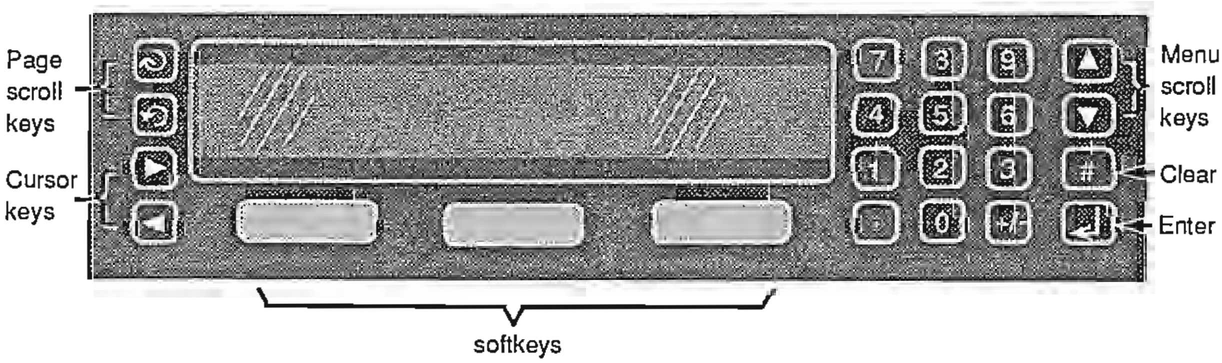


Figure 4.1a Display keyboard

4.2 ACCESS TO CONFIGURATION

4.2.1 LEVELS OF ACCESS

For reasons of security, three levels of access (1, 2 and 3) are built into the system. This allows operators with differing levels of responsibility to gain access to different sections of the configuration, by entering the appropriate password. Access level 3 is the highest level; level one is the lowest, accessible by any operator.

4.2.1 LEVELS OF ACCESS (Cont.)

PASSWORDS

The system powers-up in access level 1. In order to gain access to higher levels, a 'password' of up to 6 numeric characters has to be entered by the operator in the first of the System configuration pages (described below). Once access has been gained to level three, new passwords can be entered for level two and level three access, although it should be noted that operators with level three access have automatic access to level two without having to enter a separate password.

As shipped, 4500 systems have '123456' as a password for both level 2 and level 3 access. As stated above, new passwords can be entered for level two and level three access. Should these passwords be lost or forgotten, the manufacturer can provide a global password based on the system time and date which is valid for approximately one hour. This allows access to level three, where the current passwords can be determined and, if required, changed.

LEVEL 3

This is the highest level of access, allowing all configurable parameters to be accessed and changed at will.

The system configuration pages (described below) are accessible only at level 3. Once this access level is gained, the operator remains at level three until either he changes the access level, or until the system is powered off, and then on again.

Level 3 access allows the parameters listed in table 4.2.1 to be defined as being accessible either to operators with level two/three access only, or to all operators (i.e. level 1 access). Parameters not listed can be accessed only by level three operators.

1	Output variable
2	Alarm enable
3	Channel out limits
4	Channel descriptors
5	Alarm set-up
6	Alarm routing
7	Report and logging
8	Channel I/O set-up
9	Channel function
10	Channel display
11	Channel re-direction
12	Digital channel tags.

Table 4.2.1 Definable access level parameters

Note...

In order to use the off-line configuration editor it is first necessary to enter access level three.

LEVELS 1 AND 2

Those parameters which are to be available at levels 1 and 2 are defined as a part of the system configuration described below. Level three access allows a password to be set for level two. Additionally, level three access allows the parameters listed in table 4.2.1 to be assigned level one or level two access.

No password is required for level 1 access.

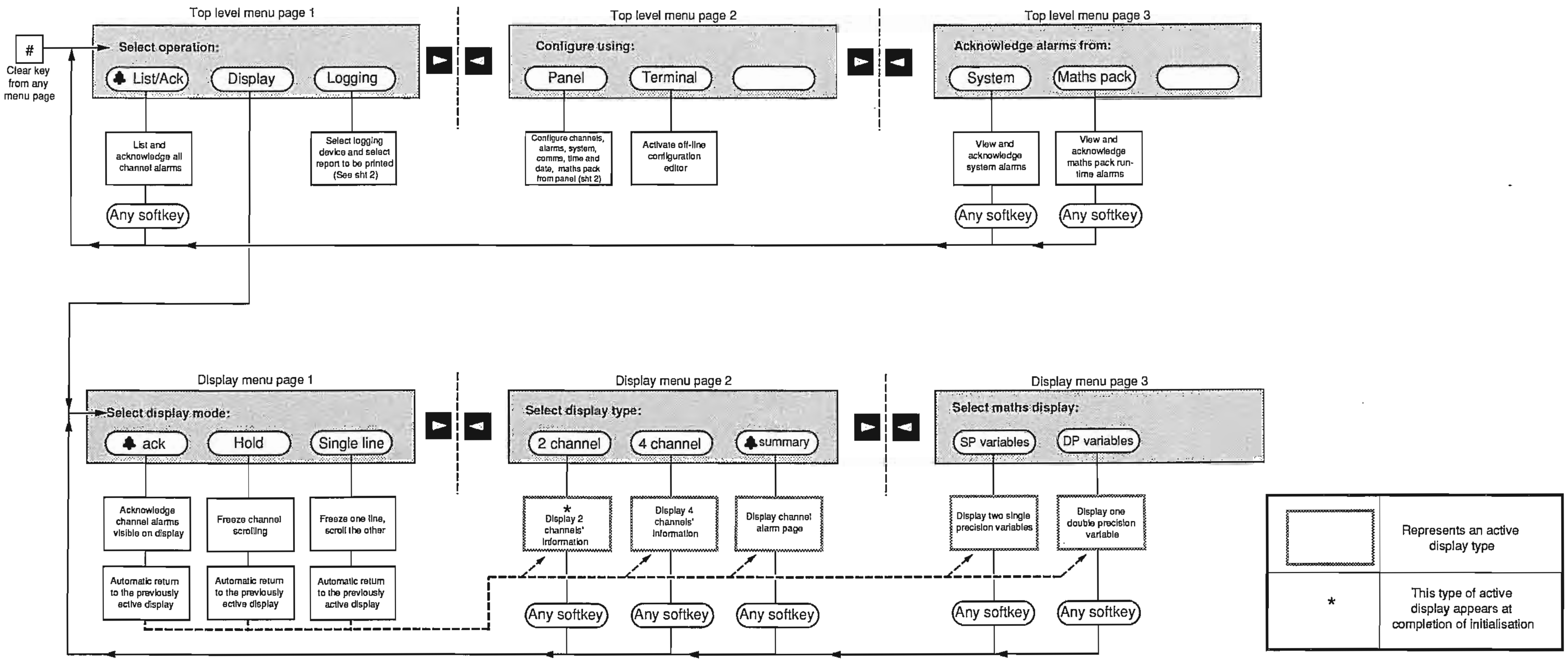


Figure 4.1b Menu organisation (Sheet 1 top level and display)

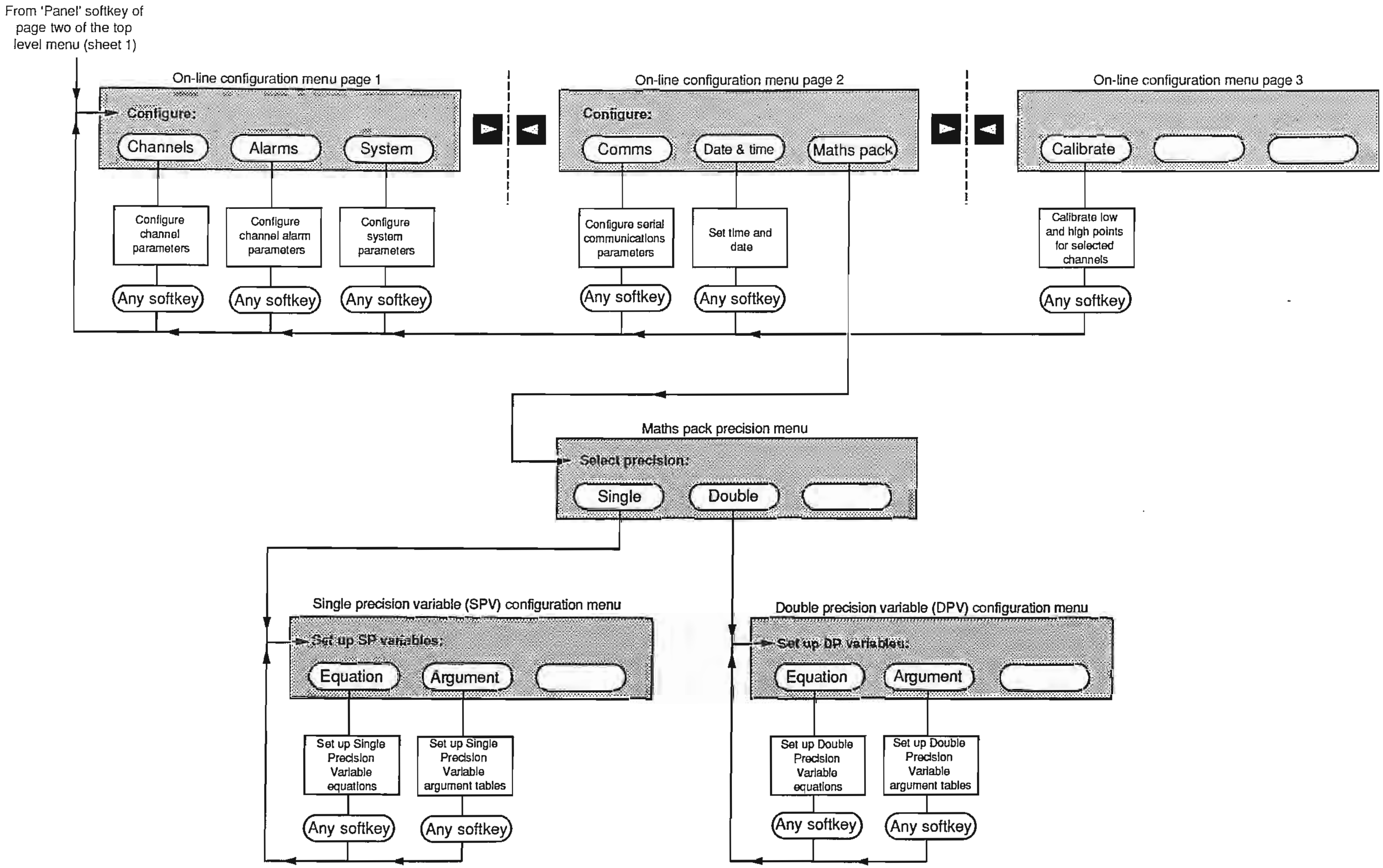


Figure 4.1b Menu organisation (Sheet 2 - logging and configuration)

4.2.2 DISPLAY/KEYBOARD SOFTKEY MENUS

The term softkey is used to describe a key which does not have a fixed function. The functions of the three softkeys (figure 4.1a) on the 4500 display/keyboard are defined by the legend appearing immediately above them in the display.

During normal operation a summary page is displayed, giving channel or alarm details according to the mode selected (ref. operation section above). Access to the configuration pages from the summary pages is by operation of the # key, which brings the first page of the top level softkey menu to the display. As shown, this contains the items: 'Alarm list/acknowledge', 'Display' and 'Logging'. These items are fully described in the Operation section above.

Top level menu (page 1)

```
Select operation:              More >     AB
  ♣List/Ack      Display         Logging
```

Operation of the → key causes the second page of the top level menu to be displayed. This page contains two softkey choices: Configure using Panel, and Configure using Terminal. For details of configuration using a terminal, refer to the Off-Line Configuration Editor section (below) of this manual.

Top level menu (page 2)

```
Configure using:             < More >     AB
    Panel        Terminal
```

As described in Section 3 above, a further operation of the → arrow calls Top Level Menu page 3 (System alarm and maths pack error page) to the display.

CONFIGURATION MENUS

As shown in fig 4.1b, operation of the 'Panel' softkey calls the first page of the configuration menu to the display. This offers the softkey choices: 'Channels', 'Alarms' and 'System'.

```
Configure:                     More >     AB
   Channels       Alarms         System
```

Operation of the → key causes the second page of the menu to be displayed. This page contains the softkey choices: 'Comm(unication)s', 'Date and time' and 'Maths pack' (If the maths pack softkey is operated when the option is not fitted, a message "not installed" is displayed.)

```
Configure:                     More >     AB
    Comms      Date & Time   Maths pack
```

Operation of the → key causes the third page of the menu to be displayed. This page contains the softkey choice: 'Calibrate'.

```
Configure:                  < More        AB
Calibrate
```

The selection of one of these configuration items, by operating its associated softkey, causes the first configuration page for that item to be called to the display. Each configuration page is described below, in the case of the Maths Pack, in Section 6.

4.3 ON-LINE CONFIGURATION

Once the first configuration page has been accessed, the cursor and menu scroll keys (figure 4.1a) are used to modify the configuration as required. Once the parameters have been updated, the **ENTER** key is operated to save the new configuration. A letter 'E' appears in the top right-hand corner of the display to remind the operator that it is necessary to operate the **ENTER** key before leaving the current configuration set-up if the new information is to be saved. (If the key is not operated the new items of configuration are lost.) Operation of the clear (#) key clears incorrect entries. Operation of the page scroll keys calls the next (or previous) page.

For channel and alarm pages, all pages associated with one channel can be updated before operation of the **ENTER** key. Other types of page require that the **ENTER** key be operated before the subsequent page is selected in order to save the data.

For all channel and alarm pages, the upper line of the display is arranged in a fixed format, showing the current, continuously-updated, measured value (with engineering units) of the associated channel, along with the relevant channel descriptor. Changes to the configuration of these items are reflected immediately in the top line of the display.

DATA ENTRY

A configurable parameter either requires a numeric value to be entered via the keyboard, or it has a number of fixed values, one of which has to be selected. In the latter case, the initial display will show the current value for the parameter. By placing the cursor below this value, each of the available fixed values can be called to the display, one after the other, using the menu scroll keys (fig. 4.1a). This process is called 'scrolling' and the available values for the parameter are called 'menu items'.

For example, the complete menu of Baud rate values is as follows: 75, 110, 134.5, 150, 300, 600, 1200, 2000, 2400, 4800, 1800, 9600, 19,200. Each of these items is displayed in turn when the relevant menu scroll key is operated. Thus, were the current rate 1200, and the required rate 9600, 1200 would appear when the display page was first called, and the down key would have to be operated five times to cause 9600 to appear. Operation of the **ENTER** key would then save 9600 as the new Baud rate.

TEXT ENTRY

When a text field is selected, the initial character of the string flashes. Use of the menu scroll key will allow this character to be selected from the available range depicted below. Once the correct letter, number or symbol is displayed, the next character in the string is selected by means of the ⟶ key, and the menu scrolled to bring the required character to the display. This process continues until the correct text string for the displayed units has been set up.

Should it be required to repeat a character (such as a blank space), then operation of the decimal point key at the next character position will cause the previous character to be repeated. This feature can be used to speed up the entry of some text strings, even if a character is not to be repeated. For example, if the text string being entered has the letters 'r' 's' next to one another, then, once the 'r' has been selected at its correct position in the text string, and the cursor subsequently placed at the 's' position, the decimal key could be used to bring 'r' to the display, and it would then need only one menu cursor keystroke to change this to an 's'.

Operation of the decimal point at the first character position will cause the last edited text string to be copied into the current text field. This feature is used, for example, where a large number of channels have the same engineering units.

The symbols below are available by use of the menu scroll key. The characters are shown in white on black as they appear on the display screen. The character immediately following the tilde (~) represents a blank space.

```
UVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRST
```

4.3 (Cont.)

OPERATION OF THE CLEAR (#) KEY

The # key operates in the following ways:

1. Once an entry field has been selected for edit, the # key can be used to clear the current value in that field.
2. If an incorrect entry has been made to a display field, operation of the # key restores the original value.
3. In any configuration display page in which the channel number appears, the operation of the # key will return the cursor to the channel number field from any other field on the page.
4. In any other case, operation of the # key results in a return to the top level menu

Note...

Under any circumstances, a maximum of four successive operations of the # key will cause a return to the top level menu.

The remainder of section 4 is made up of a list of configuration pages, the parameters which they hold, and the menus for each parameter.

4.3.1 SYSTEM CONFIGURATION

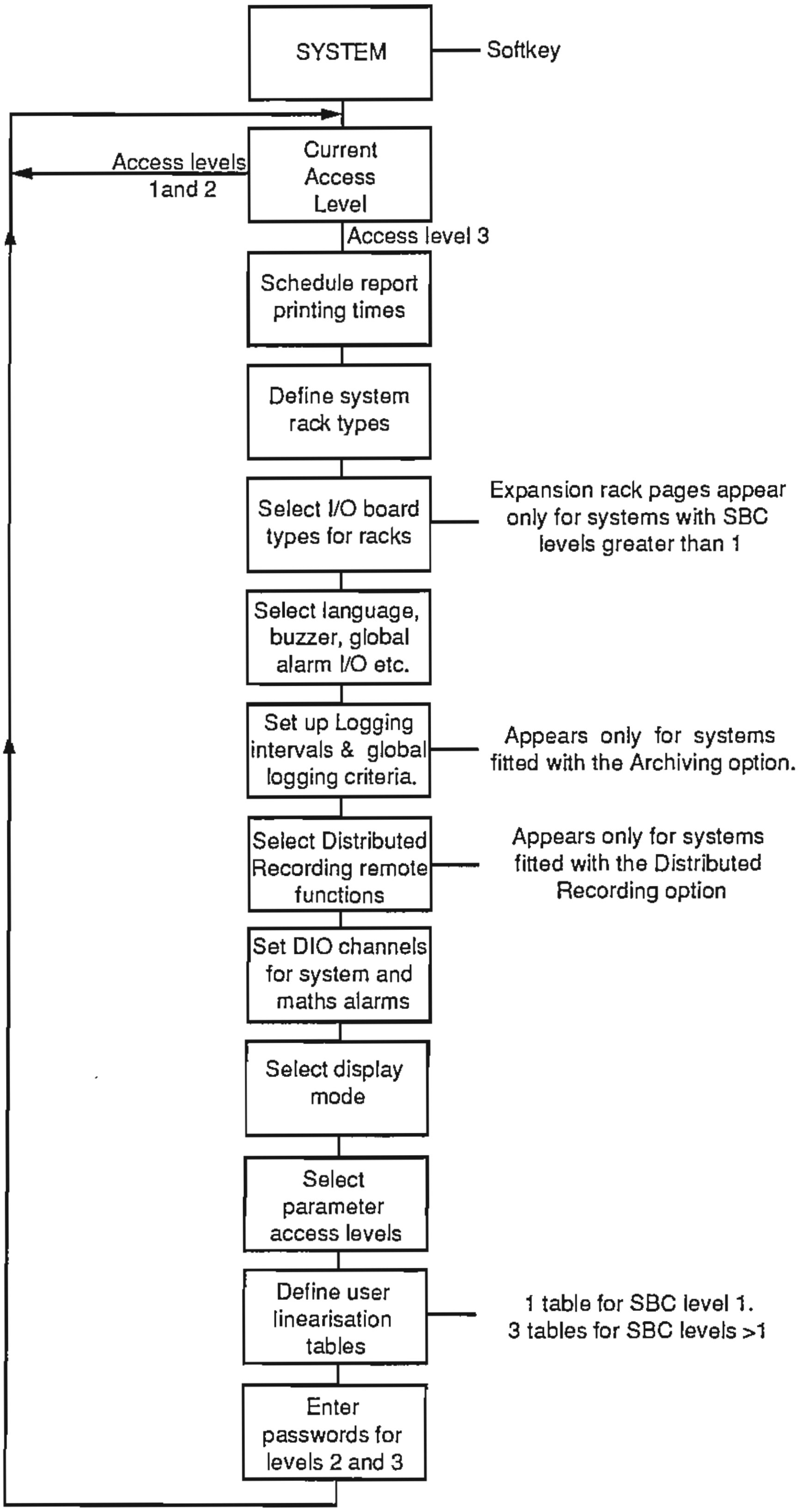


Figure 4.3.1 System configuration diagram

4.3.1 SYSTEM CONFIGURATION (Cont.)

The first system configuration page is the 'access level' page depicted below. Use of the menu scroll keys (up and down arrows) or the numeric keys allows the access level (1, 2 or 3) to be selected. Once the required level is displayed, the **ENTER** key is used to confirm the level.

If the level requested is lower than the current value, no password is required. If the level required is higher than that currently in force, a password is requested. When dispatched from the factory, the level three password is set to 123456. Entry of this number will allow access to the remainder of the system configuration pages, including that which enables new level 2 and 3 passwords to be entered.

```
Current access level  :  N
Required Access Level :  _
```

```
Current access level  :  N
Please enter password : ______
```

Note...

The remaining system configuration pages can be accessed only at level 3.

Entry of the correct password causes the display to return to the access level page, where the correct access level is now shown. Use of the page scroll down key calls the next system configuration page.

PRINT REPORT SCHEDULING PAGE

```
Schedule print report N   Trigger DDD
Start time: 0:00  Repeat period: 0:00
```

This page allows the scheduling of reports 1 to 4, and the entry of a digital input channel to act as a report generation trigger, (For a description of the report facility, reference should be made to section 3 of this document.)

Report Number:	Use menu scroll keys or numeric entry keys to enter a number from 1 to 4.
Trigger	Use numeric entry keys to enter a Digital input channel number for use for report initiation.
Start time:	Menu scroll or numeric keys are used to select the hours (0 to 23) and minutes (0 to 59) at which the selected report is to be printed the first time.[1]
Repeat period:	The repeat period is entered in the same way as the start time, and represents the time, in hours and minutes, between successive outputs of the selected reports.

Once the report number and times have been set up, the **ENTER** key must be used to save the new values. The next page is called by operating the page scroll down key.

[1] The start time is automatically updated to the next report print time each time a report is printed. The start time is incremented by the repeat period.

4.3.1 SYSTEM CONFIGURATION (Cont.)

RACK TYPE PAGE

This page is used to define the maximum number of I/O boards which can physically be fitted in the type of unit(s) supplied (i.e. 19 inch rack, portable, bench).

SBC level 1 page

```
Rack type (slots/rack)- master : NN   AB
```

NN — The number of I/O board slots available in the master rack. Scrollable choices are 7 (portable and bench-mounting units) and 11 (19 inch rack unit).

Note...

Changing the rack type to one with fewer slots, causes the loss of the data relating to the configuration of slots no longer available.

SBC levels >1 page

```
Rack type (slots/rack)- master : NN   AB
Expl: M  Exp2: M  Exp3: M  Exp4: M
```

NN — The number of I/O board slots available in the master rack. Scrollable choices are 7 (portable and bench-mounting units) and 11 (19 inch rack unit).

M — The number of I/O board slots available in each expansion rack. Scrollable choices are 8 (portable and bench-mounting units) and 12 (19 inch rack unit)

Note...

Changing the rack type to one with fewer slots, causes the loss of the data relating to the configuration of slots no longer available.

4.3.1 SYSTEM CONFIGURATION (Cont.)

MASTER RACK CONFIGURATION PAGE

Note...

If the display language is to be changed, it is recommended that this is done (see DISPLAY LANGUAGE, BUZZER AND GLOBAL ALARMS ACTION PAGE description below) before the master and expansion unit rack configuration is carried out.

```
Master rack slot configuration -      AB
Slot  1:15 CH ISOLATED ANALOG INPUT
```

This page is used to inform the system which type of I/O board is fitted in each slot of the master rack. Slot 1 is the right-most board location (viewed from the front of the rack); Slot 13 (the left-most, viewed from the front) is occupied by the power supply unit, and slot 12 by the single board computer (SBC) board.

CAUTION

THE HARDWARE CONFIGURATION IS USED TO DEFINE TO THE 4500 SYSTEM WHICH CARDS ARE FITTED IN THE MASTER RACK AND IN ANY EXPANSION RACKS FITTED. NO CHECKS ARE CARRIED OUT BY THE SYSTEM TO DETERMINE THAT THE CORRECT BOARD TYPES ARE PRESENT IN THE SPECIFIED SLOTS. BEFORE THE 4500 SYSTEM IS PLACED ON-LINE, IT MUST BE ENSURED THAT THE CORRECT BOARD TYPES ARE INSERTED IN THE RACKS' SLOTS, AND THAT ALL RELEVANT SIM LINKS HAVE BEEN FITTED OR REMOVED AS APPROPRIATE. FAILURE TO ENSURE THIS WILL RESULT IN DAMAGE BEING CAUSED TO THE 4500 OR TO THE EQUIPMENT TO WHICH IT IS CONNECTED, AS WELL AS GENERATING COMMUNICATIONS ALARMS FOR ANY ENABLED CHANNELS.

Slot: The menu scroll or numeric entry keys are used to select a slot for set up. For the master rack, slots 1 to 11 may be selected. As each slot is selected, the board type currently associated with the slot is displayed. (In the example above, slot 1 is fitted with a 15 channel isolated input board).

Board type: The allocation of a board type to a slot is done by using the menu scroll keys on the 'board type' field of the display. The menu items are:

Empty
6 channel isolated analogue input
6 channel RTD analogue input
15 channel isolated analogue input
15 channel non-isolated analogue input
8 channel analogue output
15 channel digital I/O
8 channel relay
4 channel relay
15 channel pseudo analogue input
15 channel pseudo analogue output
15 channel pseudo digital I/O board

Notes...

1. When changing the board allocation it must be ensured that the correct types of SIM are fitted at the rear of the rack and that the relevant internal connections have been made in the SIM (See section 2).
2. All empty slots must be set to 'Empty'.
3. The board-type legends appearing on the display are abbreviated, and thus may not be identical with the board types listed above.
4. Refer to the maths pack description in Section 6 of this manual for applications of pseudo I/O boards.

Once the slots have been set up, the **ENTER** key must be used to save the new values. The next page (called by operating the page scroll down key) is either the 'Expansion rack configuration' page (only with SBC levels >1) or the 'Display language, Buzzer and global alarms action page (if the SBC level =1).

4.3.1 SYSTEM CONFIGURATION (Cont.)

EXPANSION RACK CONFIGURATION PAGE

Note...

If the display language is to be changed, it is recommended that this is done (see DISPLAY LANGUAGE, BUZZER AND GLOBAL ALARMS ACTION PAGE description below) before the rack configuration is carried out.

```
Expansion rack:N slot configuration:
Slot  1:15 CH ISOLATED ANALOG INPUT
```

This page is used to set up the board allocation for any expansion racks associated with the system. The page does not appear if SBC level 1 is installed.

The setting up of the slots is carried out in the same way as described for the master rack, above, except that
a) the expansion rack number (N in the above example) has to be entered, and
b) the slot number range is 1 to 12, since there is no single-board computer in an expansion rack.

Once the slots have been set up, the **ENTER** key must be used to save the new values. The next page is called by operating the page scroll down key.

DISPLAY LANGUAGE, BUZZER AND GLOBAL ALARMS ACTION PAGE

This page is used to configure the following items:
a) The language in which the display pages appears.
b) Whether the keyboard aural cue (buzzer) used to confirm keystrokes, is on or off.
c) An input channel number to be used to acknowledge global alarms.
d) The actions to be taken in the event of a global alarm being triggered.

Note...

The change in display language takes place as soon as the **ENTER** key is operated. Some default text strings (associated with channel and alarm descriptors) are initialised only when the corresponding I/O board is configured in the rack configuration pages (described above). Thus, the string language changes only if the relevant I/O boards are removed from and then re-installed in the rack configuration (resulting in the loss of channel and alarm etc. configuration). For this reason it is recommended that the language change is implemented before the master and expansion rack slot configuration.

```
Lang:ENGLISH Beep:ON_ G♣ ack i/p:MMM  AB
G♣ outputs- latched:NNN unlatched:PPP
```

Lang	The language in which the display is to appear. Scrollable choices are ENGLISH, FRENCH, GERMAN and ITALIAN.
Beep	The menu scroll keys are used to toggle the buzzer ON or OFF.
MMM	The digital I/O channel to be used to acknowledge global alarms. A logic high at the input causes any global alarms to be acknowledged.
NNN	The channel number to become latched active when the global alarm is triggered. **This output remains active until cancelled by acknowledgement.** The channel number can be incremented or decremented using the menu scroll keys, or it can be entered by use of the numeric keys. The range of valid channel numbers is 1 to 885, depending on the system.
PPP	As above, but the output remains active only until the alarm(s) causing the global alarm, cease to be active.

The operation of global alarms is more fully described in the alarms configuration section, later in this document.

Once the configurable items on this display page have been set-up, the **ENTER** key must be used to save their new values. The next page is called by operating the page scroll down key.

4.3.1 SYSTEM CONFIGURATION (Cont.)

MASS STORAGE CONFIGURATION PAGE

This page is used to set logging intervals, and logging criteria for channels which are to be logged to a mass storage medium. For full details of the Archiving option, refer to Section 6.4 of this manual.

```
Logging Enable ch:nnn Alarm log: OFF  AB
Interval N: pp DAYS Desc:  ON Units:  ON
```

Logging Enable ch

A digital input or digital output channel is entered in this field. This channel is used to enable or to disable the logging of all channels that are configured to do so. If the facility is not required, then the default channel number of 000 is entered.

It should be noted that the 'Logging-man' parameter on Mass Storage Configuration page 1 (described below) can be used to override this DIO channel and disable logging. It should also be noted that the channel configuration page (below) allows a separate DIO channel to be defined to disable the logging of the relevant channel individually.

Alarm log

Scrollable between OFF and ON. When ON, channels which are configured to log under any one or more logging criteria, are also logged at alarm ON, alarm OFF and at alarm acknowledge, providing that logging is not inhibited either globally, or individually, and that the relevant channel log interval is not set to 'Disabled'. When Alarm log is set to OFF, channels are not logged as a result of an alarm becoming active, becoming inactive or being acknowledged.

Interval N

N is scrollable through 1 to 6, allowing up to six time periods to be defined for interval logging. The interval timer controlling this period is not reset by a change in value. For this reason, the remaining period of the previous value has to complete before the new value becomes operative. In order to force the new value to become active, logging should be turned off, then on again.

pp

pp can be scrolled, or entered numerically between 00 and 99. A time period of say, 1 $^1/_2$ hours, is easily set up by entering 90 in this field, and setting the following field to 'MINS'. Entering a value of zero in this field implies no time interval for this period, and this is displayed as OFF in the channel page scroll menu described below.

DAYS

Scrollable through SECS, MINS, HRS and DAYS.

Desc

Scrollable between ON and OFF Setting this field to ON, causes the channel or alarm descriptor, for the channel, to be logged whenever the channel or alarm is logged. Setting this field to OFF, disables the logging of the descriptor(s).

Units

Scrollable between OFF and ON. Setting this field to ON, causes the Engineering units descriptor string for the channel to be logged, whenever the channel is logged. Setting this field to OFF disables the logging of the units string

4.3.1 SYSTEM CONFIGURATION (Cont.)

DISTRIBUTED RECORDING REMOTE FUNCTION PAGE

This page is used to configure the remote functions (controlled by DIO inputs) of the distributed recording option. Section 6 outlines these functions in detail. this page appears only if the Distributed Recording option is fitted.

```
Block switching i/o-block:OFF ch:123  AB
Recorder print control:OFF  Fail o/p:OFF
```

Block switching i/o block

This item can be scrolled between 1 and 8 or to OFF. This allows a particular DIO channel (defined in the next field) to be associated with a particular block. Thus, when redirection is set to Remote, and the defined channel becomes active, the block associated with this DIO channel is switched to the recorder.

See Section 6.2.2 for full details of priorities etc.

ch:123

This is the DIO channel (123 in this example) which is to control the block defined in the previous field.

Recorder print control

Scrollable to ON or OFF. When OFF, the function is disabled. When ON, the recorder will stop recording if there is no active block switched to it. This can avoid unnecessary use of chart paper and print ribbon.

Fail o/p

Scrollable to ON or OFF. When OFF, the function is disabled. When on, if all the 4001 recorder(s) are configured appropriately, as described in section 6, one or more the 4001s will activate an alarm if the 4500 fails.

Notes...

1. This function requires that all 4001 recorders to be used are fitted with the maths pack option at either level 2 or 3.
2. DIO channels are active low.

SYSTEM / MATHS ALARM DIGITAL OUTPUT PAGE

This page allows digital output channels to be defined for:

1. Maths pack global alarm
2. System global alarm
3. Individual system alarms

```
Math♣:124 Sys - G♣:125 ♣No:006 Ch:126 AB
System configuration lost
```

Math♣:124

Allows an output channel (124 in the above example) to be defined for a global maths pack alarm. I.E. This channel is active when any maths pack alarm is active. The channel number can be entered using the numeric entry keys or by scrolling.

G♣:125

Allows an output channel (125 in the above example) to be defined for a global system alarm. I.E. This channel is active when any system alarm is active. The channel number can be entered using the numeric entry keys or by scrolling.

♣No:006

Allows the system alarms (006 in this case) to be scrolled through, so an output channel can be assigned to one or more of them (in the next field). Whilst scrolling this field, the bottom line of the display shows the relevant system alarm descriptor (see table 3.6), with any numeric values shown as zeros.

(Continued)

SYSTEM CONFIGURATION (Cont.)

SYSTEM / MATHS ALARM DIGITAL OUTPUT PAGE (Cont.)

Ch:126	Allows an output channel (126 in this example) to be defined for the system alarm selected in the previous field (006 in this example). The channel number can be entered using the numeric entry keys or by scrolling. The same channel number can be used for any number of system alarms.

Notes...
1. In any of the above channel entries, should the channel number not be associated with a digital or pseudo digital I/O board, then an error message will be displayed.
2. The above channels can be inputs if the associated board is a Pseudo I/O type.

Once all the required system alarm outputs have been set up, the **ENTER** key must be used to save the new mode. The next page is called by operating the page scroll down key.

DISPLAY MODE PAGE

```
Select mode of display operation -    AB
 SHOW ONLY ALTERABLE FIELDS
```

This page allows a level 3 operator to select whether:
a) Only those fields within channel and alarm pages that can be configured at a given access level, appear at that access level.
b) All fields are displayed at all access levels, although not all may be altered.

ONLY ALTERABLE	The menu scroll keys are used to toggle between: 'SHOW ONLY ALTERABLE FIELDS', and: 'SHOW ALL INFORMATION FIELDS'.

Once the required mode has been selected, the **ENTER** key must be used to save the new mode. The next page is called by operating the page scroll down key.

4.3.1 SYSTEM CONFIGURATION (Cont.)

PARAMETER ACCESS PAGE

```
Channel/alarm parameter access config AB
Field: OUTPUT VARIABLE FIELD   Level N
```

This page is used to define the minimum access levels required in order to change the parameters.

Field: This area of the display shows the parameter whose access level is to be defined. The menu scroll keys are used to scroll the items listed below onto the display. (Note...Some display legends might be abbreviated and in such cases, they will not match exactly the items in the list below.)

Output variable.	Prevents level 1 operator setting AO channel value in two- and four-channel displays.
Alarm enable	Locks 'alarm enable page' (alarm configuration).
Channel output limits	Locks 'analogue output limits' page (AO channel configuration).
Channel descriptor	Locks 'new descriptor' page (channel configuration).
Alarm set-up	Locks 'alarm setpoint' page (alarm configuration).
Alarm routing	Locks 'alarm output' page (alarm configuration).
Report	Locks 'report' page (channel configuration).
Channel I/O set-up	Locks 'input' page (channel configuration).
Channel function	Locks 'function' page (AI channel configuration)
Channel display	Locks 'filter and scale' page (AI channel configuration).
Channel re-direction	Locks 're-direction' pages (AI channel configuration).
Digital channel tag	Locks 'input' page (DIO channel configuration)

As each item is called to the display, the current access level (N in the example above) is displayed alongside it.

N: Used to define the access level for each of the above listed parameters. The menu scroll or numeric keys can be used to enter the required access level in the range 1 to 3.

Once the access levels been set up, the **ENTER** key must be used to save the new values. The next page is called by operating the page scroll down key.

4.3.1 SYSTEM CONFIGURATION (Cont.)

USER DEFINED LINEARISATION PAGE

This page allows the user to enter data into up to three linearisation tables which can then be used to condition the input signal of any channel. Such tables can be used to allow interface with non-standard thermocouples, and other sensors not included in the built-in linearisation tables.

In order for the cold junction compensation (CJC) to operate correctly, data points must be included in the range 0 to 60 degrees C. To obtain maximum CJC accuracy, points must be located at 0, 30 and 60 degrees C.

```
Linearisation Table: H Entry: NN of MMAB
XXXXX: xxxxxx UUU YYYYY: yyyyyy TTT
```

Configurable items:

H	The table number (1 for level 1 SBCs, 1, 2 or 3 for other levels).
NN	The number of the point to be entered. This is set to 1 upon entry to the page, and is incremented after the entry of each y co-ordinate (i.e the typing-in of the y value, followed by operation of the ↵ key) up to a maximum of 33 points.
MM	The total number of points in the table. Minimum = 2, maximum = 33.
XXXXX	A five character descriptor string for the x-axis. Text entry is as described previously.
xxxxxx	The x co-ordinate for this point of the table. 6 digits plus decimal point and sign. Operation of the ↵ key will move the cursor to the y co-ordinate field.
UUU	A three character units string for the x axis (used for clarity only). Text entry is as described previously.
YYYYY	A five character descriptor string for the y-axis. Text entry is as previously described.
yyyyyy	The y co-ordinate for this point of the table. 6 digits plus decimal point and sign.
TTT	A three character units string for the y axis (used for clarity only). Text entry is as described previously.

Notes...

1. When entering the table, care should be taken to ensure that only one 'y' entry is made for each 'x' co-ordinate. Once the table has been completed, it is recommended that the entire table is scrolled through to check the validity of its contents.
2. To avoid accidental table clearing, the table data can be overwritten only by the operator from the control panel.
3. It is not possible to 'invert' a signal using the input, scale and linearisation ranges (e.g. it is not possible to configure an input signal of 0 to 10 mV to have a scale of 100 to 0 %). In order to arrange this it is necessary to swap the positive and negative input terminations round and configure the input signal as -10 to 0 mV. It should be ensured that no 'grounding' problems will occur if this is done.
4. The table is sent to the I/O board as a table with 64 evenly spaced break-points. Although the user can enter whatever points he requires, 'zooming' several points onto one part of the curve will not necessarily result in higher resolution at that part of the curve when the 64-point table is generated.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.1 SYSTEM CONFIGURATION (Cont.)

ACCESS LEVEL PASSWORD PAGE

```
Enter password for Level 2 : ______    AB
Enter password for level 3 : ______
```

This page is used to create or change the passwords for levels 2 and/or 3 access. Each password must contain six numeric characters; any more or less will result in an error message appearing for a few seconds.

After entering each password, the display requests confirmation of the password, to ensure that no errors were made in the initial entry (for reasons of security, the password appears only as a line of stars when entered).

```
Please re-enter password :   ______
```

After the passwords have been entered successfully, the page scroll key can be operated to access any of the pages previously described. To leave system configuration, any of the softkeys may be operated to call the configuration softkey menu to the display, or the <#> key may be operated to return to the top level menu.

Should the password be re-entered incorrectly, an error message appears for a few seconds, after which the display returns to the 'Access level password' page.

```
Error -
Confirmation failed, no change
```

4.3.2 CHANNEL CONFIGURATION

Channel configuration is carried out in much the same way as is the system configuration, with the exception that the pages that appear may or may not be configurable, according to the access level of the operator. The top line of each page holds a fixed format displaying the current, continuously updated, measured value, units descriptor and channel descriptor or, where appropriate, channel tag, I/O designation and channel descriptor. Changes to the these fields are reflected in the top line immediately the **ENTER** key is operated.

The page descriptions which follow are grouped in the order 'analogue input', 'analogue output', 'digital I/O' and 'relay output'.

ANALOGUE INPUT BOARD

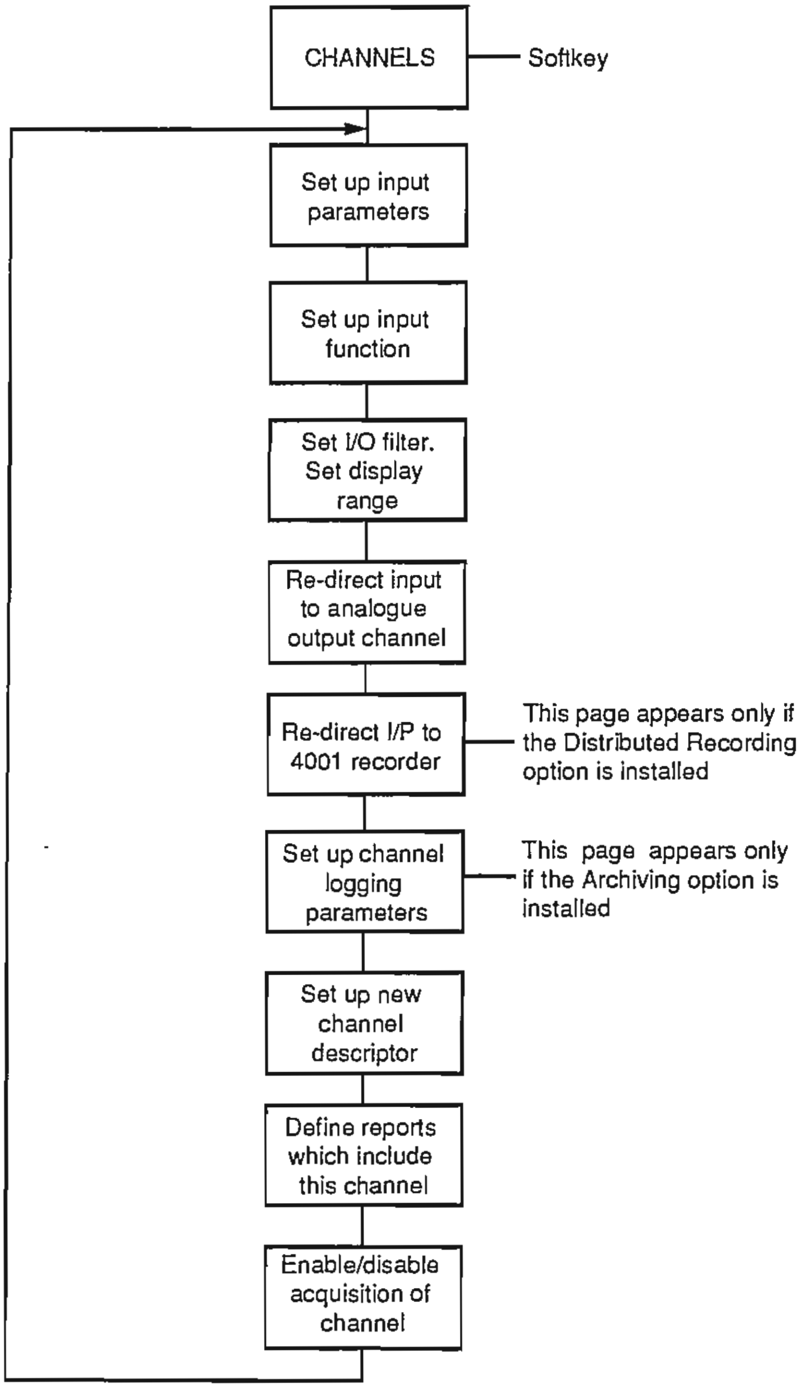


Figure 4.3.2a Access to channel configuration: analogue input.

4.3.2 CHANNEL CONFIGURATION (Cont.)

ANALOGUE INPUT PARAMETER PAGE

Milliamps input example

```
 78v^ 34.77 mm/Hr   RATE 1
i/p:mA  00.00 to  20.00   SHN :   100Ω
```

This page gives detailed information on the channel selected. The displayed items are as follows:

78:	Channel number. If this channel number is not the one required, the correct number can be entered via the numeric input keys, or can be scrolled-to using the menu scroll keys (V and Λ). The range of inputs depends on how many I/O boards are fitted in the master and any expansion racks.

Note...

The 4500 is so arranged that it assumes there are 15 channels per board slot. This means that slot 1 is always allocated channels 1 to 15, slot 2 channels 16 to 30 and so on. For example, for a 6-channel dc (analogue) input board in slot 1, only channels 1 to 6 are available for use. Channels 7 to 15 are not available, and appear as 'Channel empty'. For a cross reference between channel number and slot number refer to the Reference Section of this manual.

VΛ:	Currently active alarm symbols (flashing if not acknowledged). The interpretation of these symbols is given in the Alarm Configuration section later in this document.
34.77:	This is the measured value of the channel in the units which are displayed immediately to the right of it. This field flashes if the channel is in unacknowledged alarm.
mm/Hr:	The units in which the measured value is displayed. These units are set up in the CHANNEL RANGE page described below.
RATE 1:	The channel descriptor set up in the NEW DESCRIPTOR page described below.
i/p	Describes the type of board in the relevant slot, as set in the slot configuration part of the SYSTEM configuration.

Configurable items:

mA	This defines the units of the input signal. The menu selections available are: Volts, mA, T/C (thermocouple), RTD (resistance thermometer - 100 ohms), and mV.
00.00	This is the low range (zero) input to the channel. The input value is entered by using the numeric keys, and, providing it is not invalid for the channel function, can be in the range -9999 to +9999, with a maximum of 4 decimal places in the 5 character display field (eg. ' .0033')
20.00	This is the high range (full scale) input to the channel and is set up in the same way as the low range input.
SHN	Allows the value of any shunt resistor associated with the channel to be entered. Scrolling to CJC allows Cold Junction Compensation to be implemented when the input is used to measure a thermocouple temperature via a current loop transmitter.
100	The value of the attenuator or shunt resistor. The value may be entered in integer values using either the menu scroll or numeric keys. Minimum value = 0 (no attenuator or shunt).
Ω	The units of the shunt or attenuator resistor. Scrollable through Ω and kΩ.

If CJC is selected instead of SHN, the CJC type is requested instead of the shunt value:-

CJC field	INT	uses the relevant SIM's temperature sensors as a cold junction.
	EXT	is used when the thermocouple cold junction is maintained at a known temperature. This temperature is entered using the numeric keys. The CJC temperature units can be scrolled through °Celsius, °Fahrenheit °Rankine and Kelvins and can be the same as, or different from the thermocouple units, as required.
	REM	(15 channel AI board only) is used when a second channel is to be used to input the Cold Junction Temperature. The channel number can be entered via the numeric keypad, or it can be scrolled-to.
	OFF	No CJC compensation is required.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

Thermocouple input example

```
 78v^ 847.7 deg C   Boiler 1
i/p:T/C 500.0 to 2300.°C CJC REM   96
```

This page gives detailed information on the channel selected. The displayed items are as follows:

78: Channel number. If this channel number is not the one required, the correct number can be entered via the numeric input keys, or can be scrolled-to using the menu scroll keys (V and Λ). The range of inputs depends on how many I/O boards are fitted in the master and any expansion racks.

Note...

The 4500 is so arranged that it assumes there are 15 channels per board slot. This means that slot 1 is always allocated channels 1 to 15, slot 2 channels 16 to 30 and so on. For example, for a 6-channel dc (analogue) input board in slot 1, only channels 1 to 6 are available for use. Channels 7 to 15 are not available, and appear as 'Channel empty'. For a cross reference between channel number and slot number refer to the Reference Section of this manual.

VΛ: Currently active alarm symbols (flashing if not acknowledged). The interpretation of these symbols is given in the Alarm Configuration section later in this document.

847.7: This is the measured value of the channel in the units which are displayed immediately to the right of it. This field flashes if the channel is in unacknowledged alarm.

deg C: The units in which the measured value is displayed. These units are set up in the CHANNEL RANGE page described below.

Boiler 1: The channel descriptor or legend. This descriptor is set up in the NEW DESCRIPTOR page described below.

i/p Describes the type of board (Input or output) in the relevant slot, as set in the slot configuration part of the SYSTEM configuration.

Configurable items:

T/C This defines the units of the input signal. The menu selections available are: Volts, mA, T/C (thermo-couple), RTD (resistance thermometer - 100 ohms), and mV.

500.0 This is the low range (zero) input to the channel. The input value is entered by using the numeric keys, and, providing it is not invalid for the channel function, can be in the range -9999 to +9999, with a maximum of 4 decimal places in the 5 character display field (eg. ' .0033')

2300. This is the high range (full scale) input to the channel and is set up in the same way as the low range input.

°C The temperature units in which the thermocouple temperature is to be measured. Scrollable through ° Celsius, ° Fahrenheit ° Rankine and Kelvins.

REM 96 The Cold junction compensation can be scrolled through INTernal, EXTernal, REMote (as in the example above) or OFF.

- INT uses the relevant SIM's temperature sensors as a cold junction.
- EXT is used when the thermocouple cold junction is maintained at a known temperature. This temperature is entered using the numeric keys. The CJC temperature units can be scrolled through °Celsius, °Fahrenheit °Rankine and Kelvins and can be the same as, or different from the thermocouple units, as required.
- REM is used when a second channel is to be used to input the Cold Junction Temperature. The channel number can be entered via the numeric keypad, or it can be scrolled to.
- OFF No CJC compensation is required.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

Resistance thermometer input example

```
78v^ 347.7 deg C   Boiler 2
i/p:RTD 100.0 to 500.°C
```

This page gives detailed information on the channel selected. The displayed items are as follows:

78: Channel number. If this channel number is not the one required, the correct number can be entered via the numeric input keys, or can be scrolled-to using the menu scroll keys (V and Λ). The range of inputs depends on how many I/O boards are fitted in the master and any expansion racks.

Note...

The 4500 is so arranged that it assumes there are 15 channels per board slot. This means that slot 1 is always allocated channels 1 to 15, slot 2 channels 16 to 30 and so on. For example, for a 6-channel dc (analogue) input board in slot 1, only channels 1 to 6 are available for use. Channels 7 to 15 are not available, and appear as 'Channel empty'. For a cross reference between channel number and slot number refer to the Reference Section of this manual.

VΛ: Currently active alarm symbols (flashing if not acknowledged). The interpretation of these symbols is given in the Alarm Configuration section later in this document.

347.7: This is the measured value of the channel in the units which are displayed immediately to the right of it. This field flashes if the channel is in unacknowledged alarm.

deg C: The units in which the measured value is displayed. These units are set up in the CHANNEL RANGE page described below.

Boiler 2: The channel descriptor or legend. This descriptor is set up in the NEW DESCRIPTOR page described below.

i/p Describes the type of board (Input or output) in the relevant slot, as set in the slot configuration part of the SYSTEM configuration.

Configurable items:

RTD This defines the units of the input signal. The menu selections available are: Volts, mA, T/C (thermocouple), RTD (resistance thermometer - 100 ohms), and mV.

100.0 This is the low range (zero) input to the channel. The input value is entered by using the numeric keys, and, providing it is not invalid for the channel function, can be in the range -9999 to +9999, with a maximum of 4 decimal places in the 5 character display field (eg. ' .0033')

500. This is the high range (full scale) input to the channel and is set up in the same way as the low range input.

°C The temperature units in which the thermocouple temperature is to be measured. Scrollable through ° Celsius, ° Fahrenheit ° Rankine and Kelvins.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

Millivolts input example

```
 32v^ 820.9 deg C   Boiler 3
i/p:mV  00.00 to 10.00   CJC REM   94
```

This page gives detailed information on the channel selected. The displayed items are as follows:

32: Channel number. If this channel number is not the one required, the correct number can be entered via the numeric input keys, or can be scrolled-to using the menu scroll keys (v and ^). The range of inputs depends on how many I/O boards are fitted in the master and any expansion racks.

Note...
The 4500 is so arranged that it assumes there are 15 channels per board slot. This means that slot 1 is always allocated channels 1 to 15, slot 2 channels 16 to 30 and so on. For example, for a 6-channel dc (analogue) input board in slot 1, only channels 1 to 6 are available for use. Channels 7 to 15 are not available, and appear as 'Channel empty'. For a cross reference between channel number and slot number refer to the Reference Section of this manual.

v^: Currently active alarm symbols (flashing if not acknowledged). The interpretation of these symbols is given in the Alarm Configuration section later in this document.

820.9: This is the measured value of the channel in the units which are displayed immediately to the right of it. This field flashes if the channel is in unacknowledged alarm.

deg C: The units in which the measured value is displayed. These units are set up in the CHANNEL RANGE page described below.

Boiler 3: The channel descriptor or legend. This descriptor is set up in the NEW DESCRIPTOR page described below.

i/p Describes the type of board (Input or output) in the relevant slot, as set in the slot configuration part of the SYSTEM configuration.

Configurable items:

mV This defines the units of the input signal. The menu selections available are: Volts, mA, T/C (thermocouple), RTD (resistance thermometer - 100 ohms), and mV.

00.00 This is the low range (zero) input to the channel. The input value is entered by using the numeric keys, and, providing it is not invalid for the channel function, can be in the range -9999 to +9999, with a maximum of 4 decimal places in the 5 character display field (eg. ' .0033')

10.00 This is the high range (full scale) input to the channel and is set up in the same way as the low range input.

REM 94 The Cold junction compensation can be scrolled through INTernal, EXTernal, REMote (as in the example above) or OFF. When normally measuring voltages, the CJC is set to OFF. If the voltage being measured is a transmitted temperature value derived from a thermocouple, the cold junction has to be compensated-for by setting one of the following:

INT uses the relevant SIM's temperature sensors as a cold junction.

EXT is used when the thermocouple cold junction is maintained at a known temperature. This temperature is entered using the numeric keys. The CJC temperature units can be scrolled through °Celsius, °Fahrenheit °Rankine and Kelvins and can be the same as, or different from the thermocouple units, as required.

REM is used when a second channel (94 in this example) is to be used to input the Cold Junction Temperature. The channel number can be entered via the numeric keypad, or it can be scrolled-to.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

ANALOGUE INPUT PARAMETER PAGE (Cont.)

Voltage inputs

Voltage inputs are identical in set-up to mV inputs, except in that the CJC field is scrollable to ATTenuator, allowing the value of any attenuating module associated with the channel to be entered.

The field is scrollable between x 1 and x 100 indicating the level of attenuation required (x 1 = no attenuation). The attenuators themselves are located in the associated SIM either held in plug-in modules (15 channel AI board) or fitted at terminal blocks (6 channel dc input board)

Section 2.2.2 shows locations and part numbers for the various attenuators (and shunts) available from the manufacturer.

It is possible to use non-standard resistor values with the 6-channel input board. In such cases, x 1 must be selected at the display, and the input range selected as the maximum voltage range appearing at the input of the channel (i.e after attenuation).

Limitations on input range

The input range may not be less than $^1/_{16}$ of the minimum hardware range on the analogue I/O board. Selection of ranges less than this result in error displays ???? or <RNG depending on I/O type. The minimum hardware range for the 15-channel A/I board is 14mV; for the 6-channel dc input board, 12mV.

Thus when using, for example, a type K thermocouple, 14mV equates to approximately 343 degrees C. Thus the minimum range is 343/16 = 21 degrees C.

4.3.2 CHANNEL CONFIGURATION (Cont.)

ANALOGUE INPUT CHANNEL FUNCTION PAGE

```
NNN   DD.DD units channel descriptor
Funct: FFFFFFFFF Range: AA.AA to BB.BBCC
```

This page is applicable only to analogue input channels, and is used to define:

a) The type of linearisation to be applied to the channel.
b) The range over which the linearisation is to act.

Examples of setting up function ranges are given at the end of the 'Filter and Scale' page description.

Funct: FFFFFFFFF — The type of linearisation required, selected by menu scroll, from the following:

Off	Turns the channel off. Results in '-NE-' (not enabled) appearing as the measured value of the channel.
Linear	Applies no linearisation to the signal.
Pt100	Applies resistance thermometer linearisation to input signals from platinum resistance thermometers with the characteristics: -Resistance at 0°C = 100Ω; resistance at 100°C = 138.5Ω. Valid range limits: -205to1004°C
Type B	Pt6%Rh/ Pt30%Rh thermocouple. Valid range limits: -32 to +1821°C
Type E	Chromel/Constantan thermocouple. Valid range limits: -225 to 1002°C
Type J	Iron/Constantan thermocouple. Valid range limits: -210 to +1202°C
Type K	Chromel/Alumel thermocouple. Valid range limits: -223 to +1370°C
Type N	Nicrosil/Nisil. Valid range limits: -270 to 1300°C
Type R	Pt/ Pt13%Rh thermocouple. Valid range limits: -60 to +1770°C
Type S	Pt/ Pt10%Rh thermocouple. Valid range limits: -50 to +1770°C
Type T	Copper/Constantan thermocouple. Valid range limits: -264 to 401°C
Sq. root	Extracts square root of the input signal.
Square	Applies a squaring function to the input signal.
User 1	User defined linearisation table (SBC levels 1, 2 and 3). See the system configuration section above for more details.
User 2/3	User defined linearisation tables (SBC levels 2 and 3 only) See the system configuration section above for more details.

Range AA to BB — This defines the start and end points of the linearising characteristic and correspond to the zero and full scale values entered in the input page for the channel. The range is selected automatically when thermocouple input type is selected. See examples in the 'Filter and Display Range' page description below.

For linear, square and square-root functions, the range input defines the 'sub-set' of the input range over which the input will be linearised. This feature allows localised, more accurate linearisation to be achieved. The linearised equivalent range is mapped to the display range. For example:
Input range = 0 to 10 Volts; Function range = 0 to 2 Volts; Display range = 0 to 10; Function = square. An input of 1.5 Volts will result in a linearised value of 1.5 x 1.5 = 2.25. The function limits on input are 2 V, giving a range of 0 to 4. (2 x 2). Thus the value displayed will be 2.25 ÷ 4 x 10 = 5.625 display units. If the function is a user defined square, the linearised value is scaled to the function range before being mapped to the display range to give a value of 0.225.

CC — Temperature transducer units. Selected by menu scroll from °C, °F, °R or K. This field appears only if the input function is temperature related (i.e. not 'linear', 'square' etc.).

Note...

When using square root or square functions, the linearising table is applied over the full range. For this reason, gross errors will occur if the input zero and full scale values do not correspond exactly with the zero and full scale values output by the transducer. The 'Range' input limits this, so that greater resolution is obtained, but no linearisation is applied outside the limits.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

ANALOGUE INPUT FILTER/CHANGE AND DISPLAY RANGE PAGE

```
NNN  DD.DD Deg C  Temp 1
FILTER:SSSsec Range: AA.AA to BB.BBUnits
```

This page is applicable only to analogue inputs, and allows

a. a time constant to be entered for a low pass filter on the input signal, OR a specified change of measured value to be entered, effectively to control the rate at which slowly changing measured values are written to the data base. This function can be used, for example, to reduce the number of times a channel is logged, when its value is essentially stable.

b. a scaling to be applied to the input so that the displayed value is in different units from those of the input signal. (See examples at the end of this page description.)

FILTER — Scrollable between FILTER and CHANGE.

- FILTER — The following field (depicted as 'SSS' above) shows the low-pass filter time constant, entered either by use of the menu scroll or the numeric input keys. The range of inputs is 0 (no filter) to 255 seconds.
- CHANGE — The following field changes to a percentage value, alterable using the numeric keys. Allowable values are 0.0 to 9.9, and 10 to 99%

  This represents the percentage of **display range full scale** by which the measured value must change before it can be written to the data base.

  The initial measured value is that obtaining when the ENTER key is operated to enter this page of configuration.

  When the measured value changes by the stated value (% of display range full scale), this new measured value is written into the data base. This is used as a new baseline for the change value to be measured from, until the measured value has again changed by the stated value, when it will be written to the data base, and so on.

Range AA.AA to BB.BB — The required display low and high values, entered via the numeric entry keys. For example, a 0 to 10 Volt input range may be required to be displayed in % terms so that 5 V reads 50 %, 2 V reads 20 % and so on. In such a case the entries on this page would be '0' to '100' and the units (see following) would be set to '%'

Units — These are the displayed units. When this field is selected by means of one of the cursor keys, the initial character ('U' in the above example) will flash. Use of the menu scroll key will allow this character to be selected from the available range, as depicted below.* Once the correct letter, number or symbol is displayed, the next character is selected by means of the → key, and the menu scrolled to bring the required character to the display. This process continues until the correct text string for the displayed units has been set up.

Should it be required to repeat a character (such as a blank space), then operation of the decimal point key at the next character position will cause the previous character to be repeated.

This feature can be used to speed up the entry of some text strings, even if a character is not to be repeated. For example, if the text string being entered has the letters 'r' 's' next to one another, then, once the 'r' has been selected at its correct position in the text string, and the cursor subsequently placed at the 's' position, the decimal key could be used to bring 'r' to the display, and it would then need only one menu cursor keystroke to change this to an 's'.

* Operation of the decimal point key, whilst the flashing cursor is beneath the first character of the Units string, will cause the first five characters, of the last string entered, to be copied to the Units string. This string may originate from the current channel, or from any page which contains configurable strings.

4.3.2 CHANNEL CONFIGURATION (Cont.)

4500 CHARACTER SET

The following symbols are available by use of the menu scroll key:

```
UVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~ !"#$%
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRST
```

The characters are shown in white on black as they appear on the display screen. The character immediately following the tilde (~) represents a blank space.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

INPUT, FUNCTION AND SCALE EXAMPLES

1. It is required to display an input signal of 4 to 20 mA from a thermocouple transmitter. The thermocouple is type K, measuring a temperature range of 0 to 1000°C.

Enter the channel configuration pages, select the required channel and set up the parameters as shown below:

```
NNN   DDD D Deg C Channel descriptor
i/p   mA 4.000 to    20.00   SHN = 100Ω
```

```
NNN   DD.DD Deg C  Channel descriptor
Funct: TYPE K    Range:00.00 to 1000.°C
```

```
NNN   DD.DD Deg C  Channel descriptor
Filter  0sec Range: 00.00 to  1000.°C
```

2. It is required to display an input signal of 4 to 20 mA from a thermocouple transmitter. The 4 to 20 mA range represents a voltage range of 100 to 200°C, measured by a type J thermocouple. The signal is to be displayed as % efficiency, where the 4 to 20 mA range represents 0 to 100 % efficiency.

Enter the channel configuration, select the required channel and set up the parameters as shown below:

```
NNN   DDD.D %  Channel descriptor
i/p   mA 4.000 to  20.00    shn = 100Ω
```

```
NNN   DD.DD %  Channel descriptor
Funct. Type J    Range: 100.0 to  200.0°C
```

```
NNN   DD.DD %  Channel descriptor
Filter    0sec Range 00.00 to 100.0%
```

4.3.2 CHANNEL CONFIGURATION (Cont.)

REDIRECTION OUTPUT CHANNEL PAGE

```
NNN   DDD D Units Channel descriptor
Redirection output channel:CCC
```

This allows the scaled and linearised display value of an input channel to be directed to an output channel. Refer to the 'analogue output' section later in this document for more details.

Note...The output channel must be enabled before this page is configured.

CCC — The channel number to which the scaled and linearised value of the channel being configured is to be sent to be output. The output channel number must be an analogue output channel, (as set up in the slot configuration part of system configuration) otherwise an error message (Warning - Redirection error) will be displayed.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

REDIRECTION RECORDER CHANNEL PAGE

```
NNN   DDD.D Units  Channel descriptor
Recorder redirection- block:z id:y ch:xx
```

This allows the measured variable from an input channel to be directed to a model 4001 recorder if the recorder redirection option is fitted. For further details of this facility, reference should be made to the 'Distributed recording' description in section 6 of this manual.

z — This is the block number (scrollable through 1 to 8). Which of the blocks is currently active is selected as a part of the 'logging' top level menu selection. For further explanatory details refer to the 'Distributed recording' description in the Options section later in this document. The reference section of this manual includes forms (copies of) which may be filled-in, in order to keep a record of redirection destinations.

y — This is the group ID of the recorder (scrollable through 0 to 7) to which the 4500 channel is to be sent. Clearly, the correct address(es) must be set up at the recorder(s) (via the Serial Link 2 page) as described in the Installation and operating manual (HA237229) supplied with the recorder.

xx — This is the model 4001 channel number to which the 4500 channel is to be routed. The channel encoding is transparent to the user so it is not necessary to enter a logical unit number or channel address as is normally required when a host is communicating with a model 4001.

4.3.2 CHANNEL CONFIGURATION (Cont.)

MASS STORAGE CONFIGURATION PAGE

```
NNN DD.DD units channel descriptor     AB
Log interval : N:  Time        Enable:123
```

This page allows a log interval, and a control channel number to be set up for any channel which is to be logged. The page appears only when the Archiving option is installed. For further details of this facility, reference should be made to section 6.4 of this manual.

Log interval

Scrollable through DISABLED, ON CHANGE, ON EVENT, Time interval

DISABLED — The channel is not to be logged

ON CHANGE — For analogue or pseudo analogue input/output channels, the channel is logged if its value has changed. For DIO channels, the channel is logged whenever the channel changes state. The maximum rate at which channels can be logged is 1 Hz..

Further details may be found in the description of the 'Analogue Input Filter/Change and Display Range' page, above.

ON EVENT — This requires a DIO channel to be specified. The channel is logged each time this DIO channel changes state from 'false' to 'true'.

Time interval — The scrollable values (N) for this field are the six intervals set in the System configuration page described above. If no time period is allocated for a particular interval, then this interval is displayed as OFF.

Enable 123

Sroll or numeric entry of a DIO channel which must be active (High) for the channel to be logged. If the DIO channel is low, logging of this channel is disabled. If the channel is high, which should normally enable the logging of this channel, it can be overridden by global logging-inhibit function in the System Configuration page described above or in the Mass Storage Configuration page 1, described in section 6.4 below.

If a channel number of zero is entered, the channel is permanently enabled for logging except when globally inhibited.

4.3.2 CHANNEL CONFIGURATION (Cont.)

NEW DESCRIPTOR PAGE

```
NNN  DD.DD Units Current Descriptor   AB
New descriptor:  CURRENT DESCRIPTOR
```

This page allows new channel descriptors of up to 20 characters to be entered, using the menu scroll keys to select characters from the set depicted below.

CURRENT DESCRIPTOR

When this field is selected by means of one of the cursor keys, the initial character ('C' in the above example) will be flashing. Use of the menu scroll key will allow this character to be selected from the available range, as depicted below. Once the correct letter, number or symbol is displayed, the next character is selected by means of the → key, and the menu scrolled to bring the required character to the display. This process continues until the correct text string for the new descriptor has been set up.

Should it be required to repeat a character then operation of the decimal point key at the current character position will cause the previous character to be repeated.*

This feature can be used to speed up the entry of some text strings, even if a character is not to be repeated. For example, if the text string being entered has the letters 'r' 's' next to one another, then, once the 'r' has been selected at its correct position in the text string, and the cursor subsequently placed at the 's' position, the decimal key could be used to bring 'r' to the display, and it would then need only one menu cursor keystroke to change this to an 's'.

* Operation of the decimal point key whilst the flashing cursor is located below the first character of the descriptor string causes the first 20 characters, of the last string to be stored, to be copied to the descriptor field. This string may originate from the current channel, or from any page which contains configurable strings.

4500 CHARACTER SET

The following symbols are available by use of the menu scroll key:

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_‘abcdefghijklmno
pqrstuvwxyz{|}~█!"#$%&’()*+,-./0123456789:;<=>?@
```

The characters are shown in white on black as they appear on the display screen. The character immediately following the tilde (~) represents a blank space.

After setting the new descriptor, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

REPORT PAGE

```
NNN   DDD.D Units Channel descriptor
Report A: YYY
```

This page allows the channel to be included in a report to be sent to the printer (at the time and repetition frequency set up in the instrument configuration pages).

A — The menu scroll or numeric input keys are used to enter a report number between 1 and 4 inclusive.

YYY — The menu scroll keys are used to toggle this field between 'ON' and 'OFF'. When selected 'ON', the channel is included in the report; when selected 'OFF' the channel is omitted.

REPORT FACILITY. This facility allows the measured values of one or more channels to be sent to a printer. Reports can be printed on demand (part of the ACTION softkey menu), as a result of an alarm becoming active , or at a set start time, and at a set repetition frequency. Four reports can be chosen, with different times and rates, and each channel can be included in any report.

For example it is possible to set up report 1 to start at 1200 hrs and repeat every 2 hours (see system configuration) and then to allocate channels 1, 31, 63 to 90 etc. to report 1. A second report can be set up to start at 1300 hrs, and repeat every 2 hours, with channels 2, 32, 91 to 130 allocated to it.

Clearly, care must be taken to ensure that the repeat interval of any report is greater than the time taken to print the report. Further details of the report facility are to be found in Section 3 of this document.

ACQUISITION INHIBIT/CALIBRATION DISABLE PAGE

```
NNN   DDD D Units Channel descriptor
Acquisition:YYY Calibration:NNN
```

This page allows the channel's data acquisition to be turned off, and any user entered calibration to be ignored. Data acquisition 'Off' allows a standard analogue input channel to be used as a 'pseudo' channel as described in the Maths pack section of this manual. Calibration 'On/Off' allows a user entered calibration for the channel to be used ('On') or ignored ('Off').

YYY — This field may be scrolled to ON or OFF, enabling and disabling acquisition respectively.

NNN — This field may be scrolled ON or OFF, enabling or disabling user calibration respectively. Calibration must be switched OFF if channel range parameters are subsequently to be changed.

After this page has been configured and the **ENTER** key pressed, operation of the page scroll down key will bring the first of the channel configuration pages back to the display. To exit the channel configuration pages, one of the softkeys is operated to call the configuration softkey menu (described above), or the <#> operated to return to the top level menu.

4.3.2 CHANNEL CONFIGURATION (Cont.)

ANALOGUE OUTPUT BOARD.

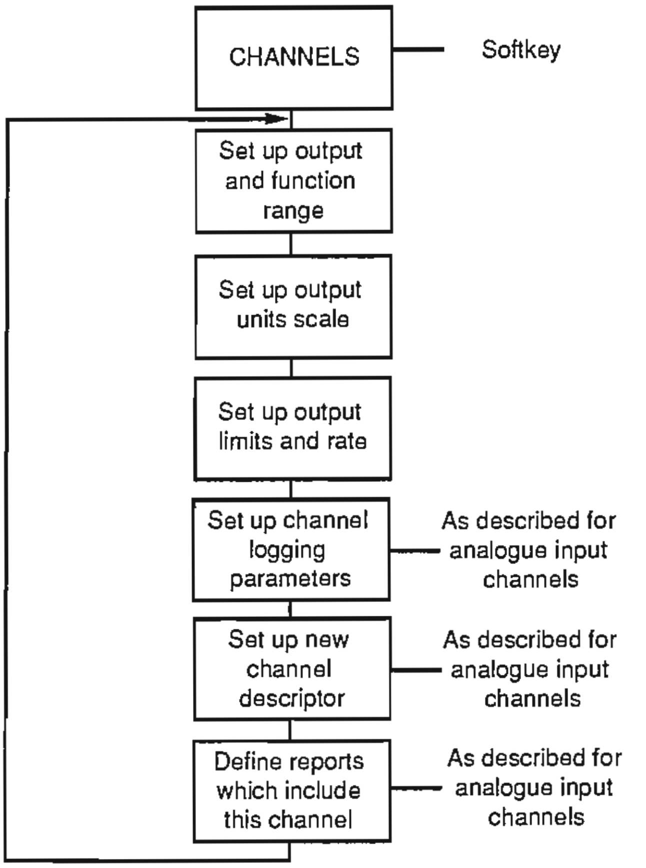


Figure 4.3.2b Access to channel configuration: analogue output

ANALOGUE OUTPUT PARAMETER PAGE

```
NNN   DD.DD Units   Channel descriptor
o/p: LL.LL to HH.HH  V Function:OFF
```

This page is used to configure the output from an analogue output channel, the input to which is a redirected channel, as defined in the redirection channel display page described above.

NNN	Output channel number.
LL.LL	Output low range value. This is the voltage or current to be output at scale zero input from the relevant input channel.
HH.HH	Output high range value. This is the voltage or current to be output at full scale input from the relevant input channel.
V	Output units. Scrollable between Volts and mA.
OFF	This is the function to be applied to the input from the input channel. The scrollable functions are: Off, Square, square root, linear.

CAUTION

THE LINKS AND SWITCHES IN THE SIM MUST BE SET UP FOR VOLTAGE OR FOR mA OUTPUTS AS APPROPRIATE. FAILURE TO ENSURE THIS WILL RESULT IN ERRONEOUS OUTPUT VALUES, AND MIGHT LEAD TO DAMAGE BEING CAUSED TO THE LOAD, OR TO THE INTERNAL OUTPUT CIRCUITRY OF THE 4500.

4.3.2 CHANNEL CONFIGURATION (Cont.)

OUTPUT UNITS PAGE

```
NNN   DD.DD Units   Channel descriptor
Scale :  LL.LL to  HH.HH Units
```

This page is used to define the output scale in user's units. For example, an output range of 0 to 10 Volts may represent a temperature range of 500 to 700 degrees Celsius.

LL.LL	The output signal 'zero' value entered by means of the numeric keys. This value corresponds to the 'zero' of the display range of the redirected input.
HH.HH	The output signal full scale value entered by means of the numeric input keys. This value corresponds to full scale of the display range of the redirected input.
Units	This is the output units field. When this field is selected by means of one of the cursor keys, the initial character ('U' in the above example) will flash. Use of the menu scroll key will allow this character to be selected from the available range, as depicted below. Once the correct letter, number or symbol is displayed, the next character is selected by means of the → key, and the menu scrolled to bring the required character to the display. This process continues until the correct text string for the displayed units has been set up. Should it be required to repeat a character (such as a blank space), then operation of the decimal point key at the next character position will cause the previous character to be repeated.* This feature can be used to speed up the entry of some text strings, even if a character is not to be repeated. For example, if the text string being entered has the letters 'r' 's' next to one another, then, once the 'r' has been selected at its correct position in the text string, and the cursor subsequently placed at the 's' position, the decimal key could be used to bring 'r' to the display, and it would then need only one menu cursor keystroke to change this to an 's'.

* Operation of the decimal point key whilst the flashing cursor is located below the first character of the Units string causes the first five characters, of the last string to be stored, to be copied to the Units field. This string may originate from the current channel, or from any page which contains configurable strings.

4500 CHARACTER SET

The following symbols are available by use of the menu scroll key:

```
UVWXYZ[\]^_‘abcdefghijklmnopqrstuvwxyz{|}~ !"#$%
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRST
```

The characters are shown in white on black as they appear on the display screen. The character immediately following the tilde (~) represents a blank space.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

4.3.2 CHANNEL CONFIGURATION (Cont.)

OUTPUT LIMITS PAGE

```
NNN   DD.DD Units  Channel descriptor
Limits: LL.LL to  HH.HH      rate: RR.RR
```

This page is used to limit the maximum output range and maximum rate-of-change with time of the analogue output board. This feature is used to protect external equipment against excessive accelerations or amplitude swings.

LL.LL	The low value (in display units) that must not be 'exceeded' by the output.
HH.HH	The high value (in display units) that must not be exceeded by the output.
RR.RR	The maximum allowable positive or negative rate of change (in display units per second) for the output. This entry is intended to prevent damage being caused to the load due to excessive changes in output level.

Operation of the page scroll key will call the 'new descriptor' page to the display. This and the subsequent pages are identical in format and operation, with the equivalent pages for analogue input channels described above.

Once all the pages have been configured and the <ENTER> key operated, the page down key can be used to re-call the first channel configuration page to the display. Alternatively, any softkey can be operated to return to the configuration select menu, or the <#> key can be operated to call the top level menu.

4.3.2 CHANNEL CONFIGURATION (Cont.)

DIGITAL I/O AND RELAY OUTPUT BOARDS

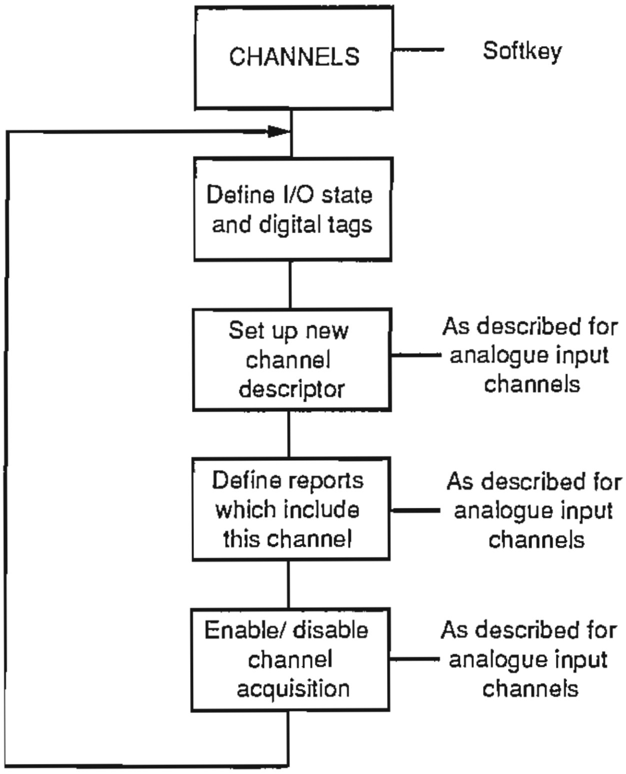


Figure 4.3.2c Access to channel configuration: Digital I/O and Relay O/P

4.3.2 CHANNEL CONFIGURATION (Cont.)

DIGITAL I/O AND RELAY OUTPUT CHANNEL TAG PAGE

```
NNN  TTTTTT  RRR Channel Descriptor   AB
Ch:    SSS  Hi tag: TTTTTT Lo tag: UUUUUU
```

This page allows tags (signal names for example) to be allocated to the on and off states of the digital input and output channels.

NNN	Channel number
TTTTTT	When the input or output is high, this field contains the text string TTTTTT (High tag). When the input or output is low, the field contains the string UUUUUU (Low tag).
RRR	This states whether the channel is set up as an input (i/p) or as an output (o/p). (This is set up in the bottom line of this display page.)
SSS	This field allows the I/O for the channel to be selected as input (i/p), output (o/p) or OFF. When OFF, the tag field reads '-NE-'.

CAUTION

IT IS ESSENTIAL THAT THE PLUG-IN MODULE IN THE DIO SIM IS OF THE CORRECT TYPE FOR THE INPUT OR OUTPUT SELECTED. FAILURE TO ENSURE THIS WILL RESULT IN DAMAGE TO THE FUSE LINKS ON THE INPUT - OUTPUT BOARD.

TTTTTT	A six-character, user defined string entered in the Hi tag field. This string is displayed at the top line of the display if the input (output) is high. For definitions of 'high' and 'low' reference should be made to the specification for the 15-channel DIGITAL I/O board in section 1.3 of this document.
UUUUUU	A six-character, user defined string entered in the Lo tag field. This string is displayed at the top line of the display if the input (output) is high. For definitions of 'high' and 'low' reference should be made to the specification for the 15-channel DIGITAL I/O board in section 1.3 of this document.

Note...

Text is entered using the technique described elsewhere in this section (e.g. in the output units page description above).

Operation of the page scroll key will call the 'new descriptor' page to the display. This and the subsequent pages are identical to the equivalent pages described in the analogue input section above.

After all the pages have been configured and the **ENTER** key pressed, operation of the page scroll down key will bring the first of the channel configuration pages back to the display. To exit the channel configuration pages, one of the softkeys is operated to call the configuration softkey menu (described above), or the <#> key may be operated to return to the top level menu.

4.3.2 CHANNEL CONFIGURATION (Cont.)

PSEUDO ANALOGUE INPUT BOARD

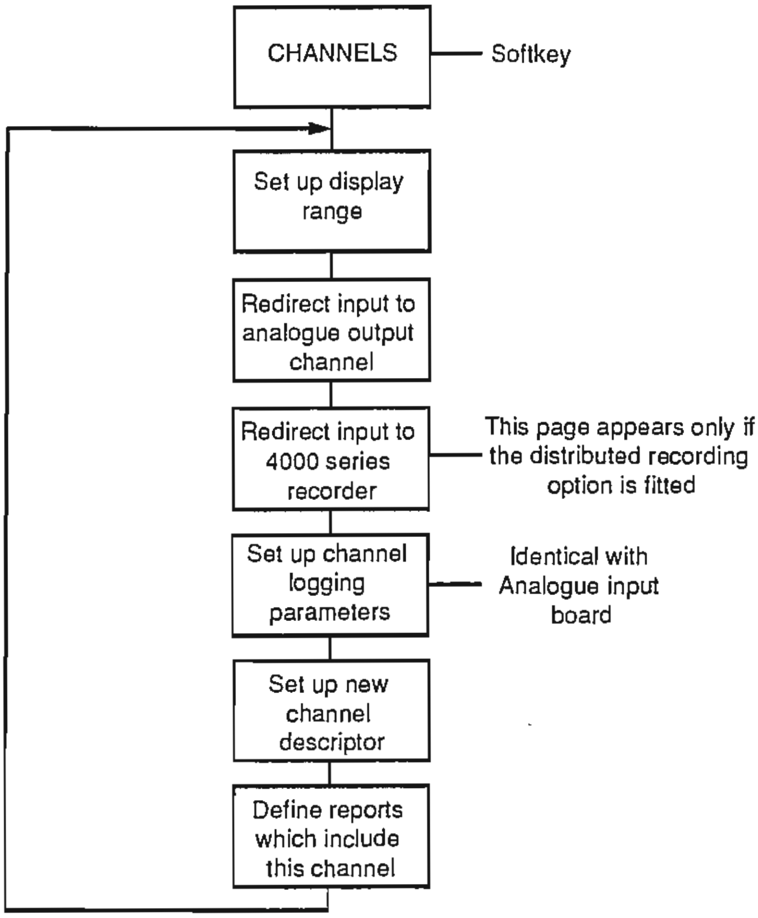


Figure 4.3.2d Access to channel configuration: pseudo analogue input

Note...

The use of the pseudo input and output board pages described below, is fully described in the maths pack description in Section 6 of this manual.

DISPLAY RANGE PAGE

```
NNN  PP.PPUnits Channel descriptor     AB
Range: DD.DD to EE.EE Units Change: 00. %
```

This page is used to set up the display range, and units to be set-up

Range DD.DD to EE.EE	As for standard analogue input board described above.
Units	As for standard analogue input boards described above.
Change	As for standard analogue input boards, described above

The remaining four pseudo analogue input board pages are identical with the equivalent standard analogue input board pages described above.

4.3.2 CHANNEL CONFIGURATION (Cont.)

PSEUDO ANALOGUE OUTPUT BOARDS

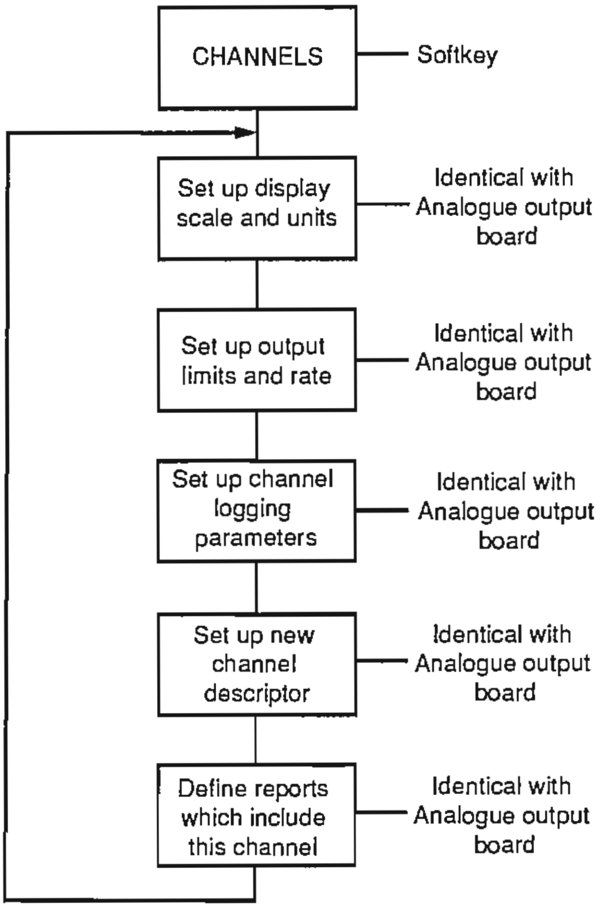


Figure 4.3.2e Access to configuration pages: pseudo analogue output

PSEUDO ANALOGUE OUTPUT PAGES

As can be seen from the figure above, the four display pages (Display and scale units, output limits and rates, new channel descriptor, report page) are identical with the equivalent pages associated with the standard analogue output board described earlier in this section.

4.3.2 CHANNEL CONFIGURATION (Cont.)

PSEUDO DIGITAL I/O BOARD

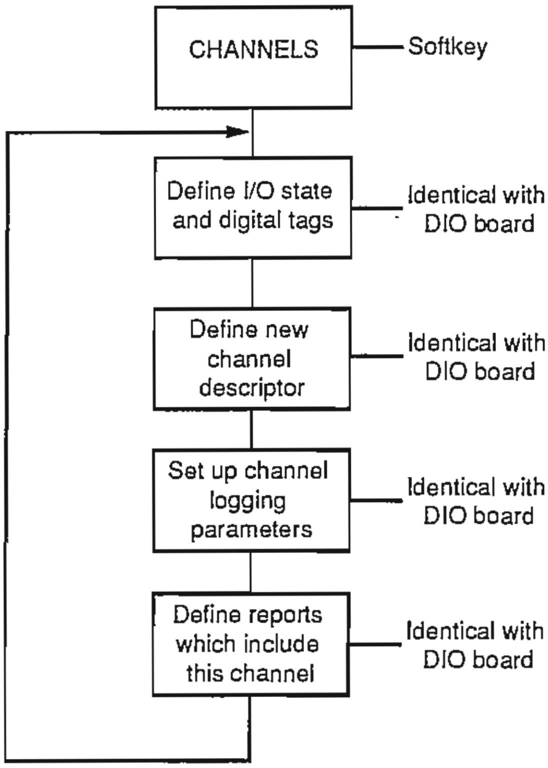


Figure 4.3.2f Access to channel configuration: Pseudo digital I/O

PSEUDO DIGITAL I/O PAGES

As can be seen from the figure above, the display pages are identical with the equivalent pages associated with the standard DIO board described earlier in this section. The logging parameters page appears only if the archiving option is installed.

4.3.3 COMMUNICATIONS CONFIGURATION

The communications configuration pages allow the user configurable serial link ports (1 and 2) to be set up according to the requirements of the system. The protocols available are described in the Communications section of this document.

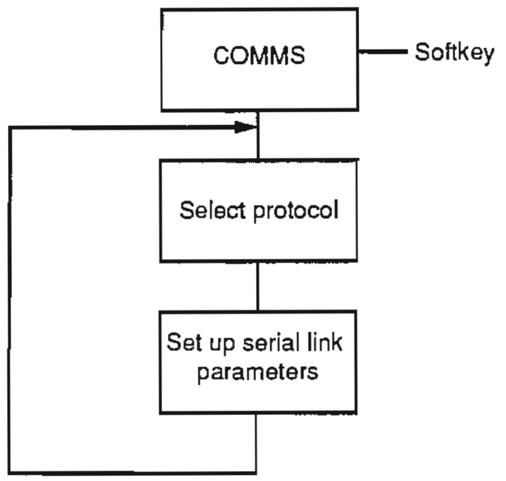


Figure 4.3.3 Access to communications configuration

SERIAL LINK PROTOCOL PAGE

```
Comms port N Protocol: PPPPPPPPPPPPPP AB
Unit id:UUUUU
```

This page is used to select a communications protocol, and to define a unit address for the 4500 system, for use by external devices where appropriate. The configurable items are as follows:

N	Port number to be configured. Scrollable through 1 and 2.
PPPPPPPPPPPP	The menu scroll keys are used to scroll through: TCS BINARY, Gould Modicon 'MODBUS RTU', GEM 80, 4001 ASCII (if the Distributed Recording option is installed), 451X DISK (if the Archiving option is fitted) and NOT ENABLED.When MODBUS RTU, TCS BINARY or GEM 80 is selected, an additional field ('Unit ID', 'Address', 'Tributary address' respectively) appears on the bottom line of the display.
UUUUU	Menu scroll or numeric entry keys are used to enter a unit address in the range 0 to 255. This is the address which a host computer will use to communicate with the 4500 system. If the Distributed Recording and / or Archiving option is installed this field does not appear, since the 4500 is acting as the host.

If TCS binary protocol is selected, the bottom line of the display changes:

```
Comms port N Protocol: TCS BINARY     AB
Address UUUUU ENQ POLL: PARTIAL
```

PARTIAL	The enquiry poll field is scrollable between FULL and PARTIAL. Full gives a full implementation of the enquiry poll, whilst Partial gives a partial implementation for higher speed. See Section 5 for further details.

4.3.3 COMMUNICATIONS CONFIGURATION (Cont.)

SERIAL LINK PROTOCOL PAGE (Cont.)

If GEM 80 protocol is selected, the bottom line of the display changes:

```
Comms port N Protocol: GEM 80        AB
Tributary address: NN
```

Tributary address	This is the address (0 to 14 inclusive) which the GEM 80 system will use to address the 4500. See section 5 for further details.

After setting the configurable items, and operating the **ENTER** key to save the new data, the next display page is called by use of the page scroll down key.

SERIAL LINK SETTINGS PAGE

```
Comms port N:  BBBB Baud xon/xoff OFF AB
P bits S stop bit  par EEEE  rts/cts OFF
```

This page is used to set up the transmission rate, data structure and 'handshake' items. The configurable items are as follows:-

N	This is the port being configured. Scrollable through 1 and 2.
BBBB	This field sets up the transmission rate in Baud. Scrollable values are: 75, 110, 134.5, 150, 300, 600, 1200, 2000, 2400, 4800, 1800, 9600, 19,200.
P	This field allows the number of data bits in the data word to be set up. Scrollable between 7 and 8.
S	This field allows the number of stop bits to be set up. Scrollable between 1 and 2.
EEEE	This field allows the parity to be set to ODD, EVEN or NONE.

Notes...

1. The XON-XOFF and CTS-RTS hardware handshakes are set OFF and are not configurable items.
2. The transmission line type (RS232 or RS422) is selected by means of hardware links on the master unit patch panel circuit board. Full details are to be found in Section 2 of this manual.
3. The auxiliary port is not configurable but has fixed parameters as described in the 'Serial Link Wiring' part of Section 2 of this manual.
4. With TCS Binary or GEM 80 selected, only Baud Rate is configurable. All other parameters are fixed as: 8 data bits, 1 stop bit, parity: even (TCS) or none (GEM 80)
5. With 451X DISK selected, only Baud Rate is configurable. All other parameters are fixed as: 7 data and 1 stop bit, with even parity.

After setting the configurable items, and operating the **ENTER** key to save the new data, the first display page can be re-called by use of the page scroll down key. Alternatively, the operation of any softkey causes a return to the configuration menu, or operation of <#> causes a return to the top level menu.

4.3.4 ALARM CONFIGURATION

Alarms are set up, channel-by-channel. Each channel can have up to four alarms associated with it of any mix of types as described below. Once the relevant alarm set-points have been entered, the actions which are to be initiated when the alarm becomes active are configured in the 'alarm job' page.

Notes...

1. Alarm relay coils in the relay output SIMs are energised ***EXCEPT*** when the alarms controlling them are active. (This is to ensure that fail-safe conditions apply should there be a failure in the line power supply to the system, a relay failure, system dc PSU failure etc..). If the output is viewed on the display panel, the channel will be true when the alarm is off (and vice versa). See the 'Output SIM Wiring' part of Section 2 for further details.
2. When discrete outputs (DOs) on the 15 channel DIO board are being used as alarm outputs, each output is 'low' when the alarm is active, and 'high' when the alarm is not active.

ALARM MESSAGES

Unless otherwise configured, each alarm is initialised with a default descriptor, describing the type of alarm. Examples of such descriptors are:- Absolute high alarm, Absolute low alarm, Deviation alarm, Increase rate alarm, Low digital alarm and so on.

The user can enter a new message, to replace the default, within the following constraints:

1 Level 1 software: maximum of 50 messages of which 11 are used for the defaults.
2 Level 2 and 3 software: maximum of 200 messages of which 11 are used for the defaults.
3 Once a configurable message has been allocated to an alarm, that alarm has to be removed to release its message for reconfiguration to another alarm.

More than one alarm can share the same message, by copying from the channel which originally defined it. When configuring on-line, this copying can be carried out using the text entry techniques described previously (eg 'TEXT ENTRY' in Section 4.3 - System Configuration). With off-line configuration, the 'copy channel' function must be used to copy the entire configuration of the channel.

GLOBAL ALARMS

The 4500 system provides a global alarm facility , the alarm being triggered either by a channel alarm configured to do so, or as a result of any communications alarm (internal to the 4500 system and not configurable) becoming active.

Two discrete outputs are associated with the global alarm system. One (latched) remains active until the alarm which is triggering the global alarm is acknowledged; the other (unlatched) remains active until the alarm condition is no longer active irrespective of whether or not the alarm has been acknowledged. These outputs are defined as a part of the SYSTEM configuration described previously.

A discrete input can also be configured to act as a universal alarm acknowledgement. A logic high at this input acknowledges all active alarms (whether or not they are configured to trigger the global alarm.)

4.3.4 ALARM CONFIGURATION (Cont.)

ALARM TYPES

ABSOLUTE ALARMS.

Absolute alarm set-points are said to be either 'high' or 'low', according to whether the alarm is to become active when the signal exceeds the set-point in a positive or negative direction respectively. For example, if an alarm is to become active if an input voltage falls below 5 volts, then the set-point should be defined as being 'low'. If another alarm is to become active if the voltage rises above say, 5.25 Volts, then its set-point should be defined as 'high'. A hysteresis value can be set to prevent alarms toggling on and off when the measured value hovers about the set-point.

Notes...

1. The setpoints must both lie between the scale zero and full scale values for the appropriate channel.
2. Hysteresis is defined as a percentage of the full scale value, and is configurable between 0 and 10% in steps of 0.1%. A high alarm will become non-active when its value falls below (setpoint - hysteresis value); a low alarm will become non-active when its value rises above (setpoint + hysteresis value).
3. The above hold true only when the input signal and the scale have the same polarity. The setpoint polarities are related to the input signal, not the scale. Thus, in the case where the scale value decreases for an increasing input signal, the alarm polarities are reversed.

DEVIATION ALARMS.

Deviation alarms need to have either:

a) a reference value and a deviation value defined. If the channel's measured value goes outside the band 'reference value ± deviation value' then the alarm is triggered (see note 3 below). For example, it may be required that an alarm becomes active if a voltage falls below 4.75 Volts or if it rises above 5.25 Volts. In such a case, a reference voltage of 5 would be used with a deviation value of 0.25 Volts. Again, a hysteresis value can be set.

b) a reference channel and a deviation value defined. If the value of the channel being configured differs from the reference channel value by more than the deviation value, the alarm becomes active (see note 3 below).

Notes...

1. The range within which the deviation alarm operates must lie within the scale zero and full scale values.
2. Hysteresis is defined as a percentage of the full scale value, and is configurable between 0 and 10% in steps of 0.1%. The alarm becomes active when its value falls outside the range (reference value ± deviation). Such an alarm becomes non-active again when its value lies within the range:
   Reference point - deviation + hysteresis < value < reference point + deviation - hysteresis.
3. It is possible to set deviation alarms to trigger:
   a) only when the channel value is greater than the reference + deviation value;
   b) only when the channel value is less than the reference - deviation value;
   c) whenever the channel value lies outside the range 'reference value ± deviation value'.

4.3.4 ALARM TYPES (Cont.)

RATE-OF-CHANGE ALARMS

Rate-of-change alarms become active if the measured value changes at a rate greater than the defined maximum for the channel. The inputs required are

i) A number of units (eg 10 m^3).
ii) A time period which is the minimum time over which the entered quantity may be allowed to change before triggering the alarm (eg. 60 minutes).
iii) A direction (rising or falling).
iv) An averaging period. This is the time period over which the average of the rate-of change readings is taken (eg. 1 second).

Notes...
1. Selectable time periods are: 1, 10, 30 seconds, 1 10, 30 minutes, 1 hour.
2. Selectable averaging periods are: 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9 seconds

Example: A flow rate is to be regulated, so that any increase does not exceed 100 cubic metres per hour. Should this rate of increase be exceeded, the channel alarm is to be triggered

i) Measuring quantity = 100
ii) Units = cubic metres
iii) Time period =1 hour (60 x 60 seconds)
iv) Direction = rising
v) Averaging period =5 seconds.

Each second, the average rate of change is calculated for the preceding 5-second period. If this value exceeds $\frac{100}{60 \times 60}$ the alarm triggers.

DIGITAL ALARMS.

Digital alarms become active whenever a discrete input goes high or low, (according to configuration).

ALARM INDICATORS

The following alarm indicators are used in the system's display to denote the alarm types described above:

$\hat{\hat{}}$ Absolute high
$\check{\check{}}$ Absolute low
± Deviation (bi-polar)
∧ Deviation (positive excursions only)
∨ Deviation (negative excursions only)
↑ Rate alarm positive going
↓ Rate alarm negative going.
H Discrete high
L Discrete low

4.3.4 ALARM CONFIGURATION (Cont.)

PRINTER ALARM MESSAGES

If a printer is fitted, then a message will be printed every time an alarm becomes active, and every time an alarm becomes non-active. The messages take the form shown below.

```
14:38:12 22-DEC   1-Boiler Temp No1      in     HI ABS AL  SP= 50.00
14:38:44 22-DEC   1-Boiler Temp No1      out of HI ABS AL  SP= 50.00
14:39:13 22-DEC   1-Boiler Temp No1      in     Communication alarm
14:40:06 22-DEC   1-Boiler Temp No1      out of Communication alarm
14:52:59 22-DEC  32-Discrete input No 2  in     ALARM ON
15:01:03 22-DEC   1-Boiler Temp No1      in     HI DEV AL  SP= 18.00 Dev:=.1000
15:04:39 22-DEC   3-Drain valve temp 1   in     HI RATE AL SP= .1000/1 SEC
```

Channel descriptors

4.3.4 ALARM CONFIGURATION (Cont.)

ACCESS TO ALARM CONFIGURATION

The following figure shows the arrangement of the alarm configuration pages.

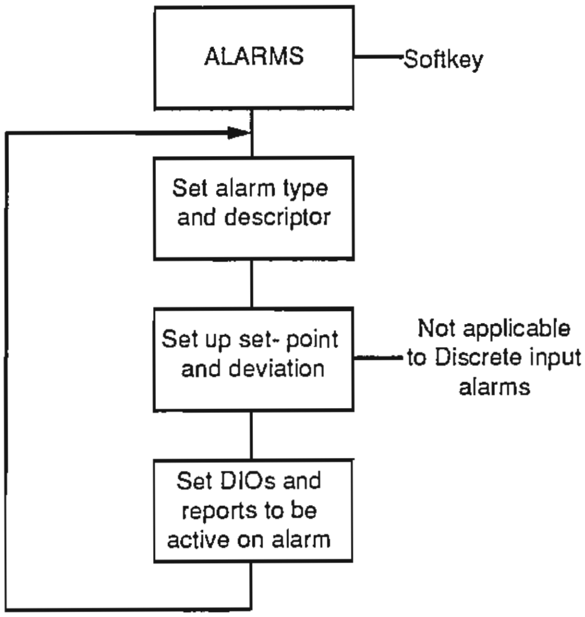


Figure 4.3.4 Access to alarm configuration

For each channel accessed, if no alarms have yet been set up, the display page will be as follows:

```
NNN   DDD.D Units Channel descriptor  AB
      No alarms configured
```

Operation of one of the cursor keys will move the cursor to the left-most position on the lower display line. Operation of the menu scroll keys will now allow the first alarm type for this channel to be selected (using the **ENTER** key when the appropriate symbol appears at the cursor position). To set up the second alarm type for the channel, the cursor keys are used to move the cursor one character position to the right, and the selection process repeated. If required, the third and fourth alarm types for the channel are set up in a similar way.

Note...

The alarm symbols can be selected only from alarm page 1 for whichever type of alarm is being configured.

With absolute high and low alarms selected as alarms 1 and 2, the page will look similar to the figure below. The alarm symbols on the top display line appear only when the alarms are active.

4.3.4 ALARM CONFIGURATION (Cont.)

ABSOLUTE ALARM PAGE 1 (ENABLE)

```
NNN  ⇑⇓DDD.D Units Channel descriptor  AB
 ⇑⇓   @ ON   G♣:OFF aaaaaaaaaaaaaaaaaaaa
```

This page allows a channel alarm descriptor to be entered, and allows each of the alarms associated with the channel to be individually enabled or disabled, (switched on or off) and to be set up to trigger or not to trigger a global alarm as required.

⇑⇓	Alarm types associated with the channel (maximum 4 per channel).
@	Indicates which of the four alarms is currently selected for configuration.
ON	Allows the alarm to be enabled (scrolled to 'ON') or disabled (scrolled to 'OFF').
OFF	Allows the alarm to trigger (scrolled to 'ON') or not to trigger (scrolled to 'OFF') the global alarm described in the system configuration section (above) of this document.
aaa........aaa	A 20 character alarm descriptor, entered using the text entry technique described elsewhere in this document (eg in the output units page description above).

After all the configurable items required have been set up, the next display page is called using the page scroll key.

ABSOLUTE ALARM PAGE 2 (SETPOINTS)

```
NNN  ⇑⇓DDD.D Units Channel descriptor  AB
 ⇑⇓    @  Set point :  DD.DD   Hys:  NN%
```

@	The alarm type currently being configured.
DD.DD	The threshold value. Should the channel value exceed the threshold value in the appropriate sense, the alarm becomes active.
N.N	The hysteresis value in % of full scale. (More fully described in the 'alarm types' section above.)

ABSOLUTE ALARM PAGE 3 (ALARM JOBS)

```
NNN  ⇑⇓DDD.D Units Channel Descriptor AB
 ⇑⇓   @  op1:PPP op2:RRR  Report N : OFF
```

This page allows the operator to define the actions to be taken when an alarm becomes active.

@	The alarm currently being configured.
PPP	DO or relay channel number to be activated on alarm.
RRR	Additional DO or relay channel number to be activated on alarm.
N	Select report 1 to 4 by scrolling or by numeric entry.
OFF	Scrollable 'OFF' to disable or 'ON' to enable report printing on alarm.

4.3.4 ALARM CONFIGURATION (Cont.)

DEVIATION ALARM PAGE 1 (ENABLE)

```
NNN V∧ DD.DD Units Channel Descriptor AB
±V∧  @ YYY  G♣:NNN aaaaaaaaaaaaaaaaaaaa
```

This page allows a channel alarm descriptor to be entered, and allows each of the alarms associated with the channel to be individually enabled or disabled, (switched on or off) and to be set up to trigger or not to trigger a global alarm as required.

±V∧	Alarm types associated with the channel.
@	Indicates which of the four alarm is currently selected for set-up.
YYY	Allows the alarm to be enabled (scrolled to 'ON') or disabled (scrolled to 'OFF').
NNN	Allows the alarm to trigger (scrolled to 'ON') or not to trigger (scrolled to 'OFF') the global alarm, described in the system configuration section (above) of this document.
aaa........aaa	A 20 character alarm descriptor, entered using the text entry technique described elsewhere in this document (eg in the output units page description above).

DEVIATION ALARM PAGE 2 (SETPOINTS)

```
NNN V∧ DD.DD Units Channel Descriptor AB
±V∧  @Ref:VAL RR.RR Dev: DD.DD Hys: H.H%
```

```
NNN V∧ DD.DD Units Channel descriptor AB
±V∧  @Ref:CH  NNN   Dev: DD.DD Hys: H.H%
```

@	The alarm type currently being configured.
REF VAL/REF CH	This field allows a choice of references to be made: 1) When scrolled to 'VAL', the deviation value is relative to a fixed (reference) value. Should the measured value of the channel move outside the band defined by RR.RR ± DD.DD (reference value ± deviation), then the alarm will become active, as described in the 'alarm types' section above. 2) When scrolled to 'CH', the deviation value operates on the difference between the measured value of the channel being configured and the measured value of the reference channel. Should the difference between the values of these channels exceed the deviation value, the alarm will become active, as described in the 'alarm types' section above.
RR.RR	The reference value.
NNN	The reference channel number.
DD.DD	The deviation value.
H.H	The hysteresis value in % of full scale. (More fully described in the 'alarm types' section above.)

4.3.4 ALARM CONFIGURATION (Cont.)

DEVIATION ALARM PAGE 3 (ALARM JOBS)

```
NNN V^ DD.DD Units Channel descriptor AB
±V^  @  op1:PPP op2:RRR  Report N : YYY
```

This page allows the user to define the actions to be taken when an alarm becomes active.

@	The alarm currently being configured.
PPP	DO or relay channel number to be activated on alarm.
RRR	Additional DO or relay channel number to be activated on alarm.
N	Select report 1 to 4 by scrolling or by numeric entry.
YYY	Scrollable 'OFF' to disable or 'ON' to enable report printing on alarm.

4.3.4 ALARM CONFIGURATION (Cont.)

RATE-OF-CHANGE ALARM PAGE 1 (ENABLE)

```
NNN ↑↓ DD.DD Units Channel descriptor AB
↑↓    @ PPP G♣:RRR aaaaaaaaaaaaaaaaaaaa
```

This page allows a channel alarm descriptor to be entered, and allows each of the rate-of-change alarms associated with the channel to be individually enabled or disabled, (switched on or off) and to be set up to trigger or not to trigger a global alarm as required.

↑↓	Rate-of-change types associated with the channel.
@	Indicates which of the four alarms is currently selected for configuration.
PPP	Allows the alarm to be enabled (scrolled to 'ON') or disabled (scrolled to 'OFF').
RRR	Allows the alarm to trigger (scrolled to 'ON') or not to trigger (scrolled to 'OFF') the global alarm, described in the system configuration section (above) of this document.
aaa........aaa	A 20 character alarm descriptor, entered using the text entry technique described elsewhere in this document (eg in the output units page description above).

RATE-OF-CHANGE ALARM PAGE 2 (RATES)

```
NNN ↑↓ DD.DD Units Channel Descriptor AB
↑↓    @Val: VV.VV Period:PP SECS Avrg: As
```

@	The alarm type currently being configured.
VV.VV	Rate value. This is the average amount of change (in display units) which is not to be exceeded in the time period to be defined in the next field.
PP	The period over which the rate value (VV.VV) is not to be exceeded. This period is scrollable to the following values: 1, 10 or 30 seconds, 1, 10 or 30 minutes, or 1 hour.
A	The time constant of the 'walking window' averager. The time constant is scrollable to the following values: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 seconds.

RATE-OF-CHANGE ALARM PAGE 3 (ALARM JOBS)

```
NNN ↑↓ DD.DD Units Channel descriptor AB
↑↓    @  op1:PPP op2:RRR  Report N : YYY
```

This page allows the operator to define the actions to be taken when an alarm becomes active.

@	The alarm type currently being configured.
PPP	DO or relay channel number to be activated on alarm.
RRR	Additional DO or relay channel number to be activated on alarm.
N	Select report 1 to 4 by scrolling or by numeric entry.
YYY	Scrollable 'OFF' to disable or 'ON' to enable report printing on alarm.

4.3.4 ALARM CONFIGURATION (Cont.)

DIGITAL ALARM PAGE 1 (ENABLE)

```
NNN H  Hitag i/p Channel descriptor   AB
H    @ NNN G♣:YYY  aaaaaaaaaaaaaaaaaaaa
```

This page allows a channel alarm descriptor to be entered, and allows one digital alarm associated with the channel to be individually enabled or disabled, (switched on or off) and to be set up to trigger or not to trigger a global alarm as required.

H	Input alarm types associated with the channel. H is selected if the channel is to go into alarm state when the input is positive going. L is selected if the channel is to go into alarm when the input is negative going.
@	Indicates which of the alarm types is currently selected for set-up.
NNN	Allows the alarm to be enabled (scrolled to 'ON') or disabled (scrolled to 'OFF').
YYY	Allows the alarm to trigger (scrolled to 'ON') or not to trigger (scrolled to 'OFF') the global alarm, described in the system configuration section (above) of this document.
aaa........aaa	A 20 character alarm descriptor, entered using the text entry technique described elsewhere in this document (eg in the output units page description above).

DIGITAL ALARM PAGE 2 (ALARM JOBS)

```
NNN H Hitag i/p Channel descriptor   AB
H   @  op1:MMM op2:PPP  Report N : YYY
```

This page allows the operator to define the actions to be taken when an alarm becomes active.

@	The alarm currently being configured.
MMM	DO or relay channel number to be activated on alarm.
PPP	Additional DO or relay channel number to be activated on alarm.
N	Select report 1 to 4 by scrolling or by numeric entry.
YYY	Scrollable 'OFF' to disable or 'ON' to enable report printing on alarm.

Once configuration is complete, operation of the page scroll key will re-call the first alarm set-up page. Alternatively, operation of any softkey causes a return to the configuration menu, or operation of the <#> key causes a return to the top level menu.

4.3.5 DATE AND TIME CONFIGURATION

Date and time configuration are carried out by operating the 'Date & time' softkey in the 'Configure:' menu.. The operation of this softkey causes the display to show what the system believes to be the current date and time as depicted in the figure below:

```
HH:MM:ss  day  DD MMM YYYY       AB
```

Note...

It is necessary for the operator to be in level three access before the time and/or date can be changed.

If no further key strokes are made, the time continues to increment, and the display returns to the top level menu after about 10 seconds. As soon as any attempt is made to update any of the fields, the seconds field stops incrementing.

At entry, the cursor is located under the hours (HH) field. If it is required that this field be changed, then the numeric entry or menu scroll keys can be used to set the new hours. If not, the cursor keys are used to locate the cursor under the required field.

An identical technique is used to set minutes, day number, Month and Year. Once all the changes have been made, the **ENTER** key is operated to save the new set-up. This operation resets the seconds display to zero, re-starts the seconds display incrementing, and sets the day name to the correct day for the entered date.

The display returns to the top level menu after about 10 seconds, or if the <#> is operated.

If an incorrect date or time entry is attempted, an error message appears for about 5 seconds, before the display returns to the date and time display, waiting for a valid entry.

Once the time and date have been configured, the operation of any softkey will cause a return to the configuration menu. Alternatively, a return to the top level menu can be made by the operation of the <#> key.

4.3.6 MATHS PACK CONFIGURATION

Section 6 details in full, the configuration of the maths pack functions. If this softkey is selected but the maths pack option is not installed, the following display page appears:

```
Option not installed
 - Press a key to continue
```

Operation of any of the keys will cause a return to the next higher menu level.

4.3.7 CHANNEL CALIBRATION

This feature allows small inaccuracies in one or more input channels' transducers to be accounted for. The procedure is as follows for a temperature transducer. The procedure is similar for other input types.

1. Select a channel or group of channels for calibration
2. For the selected channel(s), place the transducer(s) in an environment where the temperature is known, and which is at or near the low end of the temperature range which is to be measured.
3. Enter the known temperature.
4. Operate the ENTER key to calibrate the low point, for each channel in turn.
5. Place the transducer(s) in an environment where the temperature is known, and which is at or near the high end of the temperature range which is to be measured.
6. Enter the known temperature.
7. Operate the ENTER key to calibrate the high point, for each channel in turn.
8. Quit calibration facility

Each channel's calibration can be enabled and disabled using the 'Acquisition inhibit/Calibration disable' page described in section 4.3.2.

CALIBRATION ACCESS

The calibration pages are accessed from the on-line top level configuration menu, as shown in figure 4.1b.

CONFIGURATION PAGES

CHANNEL SELECTION

```
Enter channel range to calibrate
Start channel:NNN End channel:PPP
```

This page allows one or more channels to be selected for calibration. If say NNN is entered as 23, and PPP as 50, then all analogue input channels within this range will be selected. Channels other than analogue inputs are skipped, as are channels with square or square-root linearising functions.

LOW END CALIBRATION

```
Set sensor(s) to their low value
Enter required display value:VVVVVV
```

This page allows a value to be entered for the low calibration point. This is the value that should be displayed when the transducer is at its known low calibration point.

ENSURE STABLE READING

```
Check channel reading has stabilised
ch no:NNN value VVVVVV(Enter = calibrate)
```

Once the reading has stabilised, the **ENTER** key is operated to tell the 4500 to calibrate at this point. Where more than one channel is being calibrated to the same low value, the channel number will change to the next relevant channel and wait for an **ENTER** before continuing to the next channel. Once all the selected channels have been low-end calibrated, the display changes to the 'High end calibration' page as follows:

4.3.7 CHANNEL CALIBRATION (Cont.)

HIGH END CALIBRATION

```
Set sensor(s) to their high value
Enter required display value:VVVVVV
```

This page allows a value to be entered for the high calibration point. This is the value that should be displayed when the transducer is at its known high calibration point.

ENSURE STABLE READING

```
Check channel reading has stabilised
ch no:NNN value VVVVVV(Enter = calibrate)
```

Once the reading has stabilised, the **ENTER** key is operated to tell the 4500 to calibrate at this point. Where more than one channel is being calibrated to the same high value, the channel number will change to the next relevant channel and wait for an **ENTER** before continuing to the next channel. Once all the selected channels have been high-end calibrated, the display changes to the 'Calibration complete' page as follows:

CALIBRATION COMPLETE

```
Calibration complete.  Press enter to
continue calibrating, #or softkey to exit
```

This page is displayed when the 4500 has finished calibrating the selected group of channels. **ENTER** causes a return to the first of the calibration pages to allow the operator to select further channels for calibration. Operation of either the # key or any of the softkeys calls the 'Calibration exit' page.

CALIBRATION EXIT

```
Do you wish to exit the calibration
facility ? YYY
```

This page allows the operator to quit calibration (Scroll YYY to Yes) or to continue calibration (Scroll YYY to No).

4.4 OFF-LINE CONFIGURATION EDITOR

WARNING
DURING OFF-LINE CONFIGURATION, THE 4500 SYSTEM IS EFFECTIVELY SWITCHED OFF AS FAR AS THE MONITORING OF INPUT SIGNALS IS CONCERNED. FURTHER, ALL ALARM RELAYS WILL ASSUME THEIR ACTIVE STATE. FOR THESE REASONS, BEFORE OFF-LINE CONFIGURATION IS SELECTED, THE OPERATOR SHOULD ENSURE THAT NO RISK OF DAMAGE TO PERSONNEL OR EQUIPMENT WILL RESULT FROM SWITCHING THE SYSTEM OFF-LINE.

This option allows rapid, off-line configuration of a 4500 system, using a VT100 or compatible terminal connected to Comms Port 1 of the 4500 master unit. Once 'terminal configuration' has been selected, all acquisition and processing of data is disabled until, once the configuration is complete, the 4500 is re-initialised and then re-started.

The parameters available for off line configuration are the same as those described for on-line configuration (Section 4.3 above), except for the Time and Date which are available for on-line configuration only.

Section 4.4.14 of this manual describes a Terminal Emulation software package available from the manufacturer under part numbers RD242844 (5.25" disc) and RD242844 (3.25" disc). This package, which must be running before off-line configuration is selected, allows an IBM® PC or compatible computer to emulate a VT100 terminal, and supplies the facility to save and recall 4500 configurations to/from bulk storage media.

4.4.1 TERMINAL COMMUNICATIONS

The terminal to be used must be connected to the Comms Port 1 at the rear of the 4500 master unit, and have its communications parameters set as listed below. If the Terminal Emulation software package is in use, then the package sets-up all the necessary parameters itself.

Baud rate	9600
Nº. of data bits	8
Nº. of stop bits	1
Parity	None

4.4.2 OPERATION

ENTRY

Note...
For entry using the terminal emulation software, refer to sub-section 4.4.14.

In order to access the main configuration menu, the following procedure should be used:-

1. At the operator panel of the 4500, select access level three, then enter page 2 of the top level menu and select (configure using:) Terminal. The display responds with the following message:

```
4500 Offline Configurator      AB
  Press ENTER to continue
```

Operation of any key other than ↵ will cause a return to the level 1 softkey menu. Operation of the ↵ key calls the following display:

```
CHESSELL 4500 SYSTEM VN.N/LRRR   AB
Offline configuration in progress
```

4.4.2 OPERATION (Cont.)

ENTRY (Cont.)

2. Connect the terminal to the Comms 1 Port.
3. Switch the terminal on and operate <RETURN> to bring the main configuration menu to the screen.

```
                MAIN CONFIGURATION MENU

          1 -- RETURN TO ON-LINE
          2 -- RACK HARDWARE
          3 -- CHANNEL AND ALARM
          4 -- SYSTEM
          5 -- COMMUNICATIONS
          6 -- REPORTS
          7 -- RECORDER REDIRECTION
          8 -- MATHS PACK
          9 -- USER LINEARISATION TABLES
          10-- ACCESS
          11-- PRINT ENTIRE CONFIGURATION
          12-- SAVE ON DISC
          13-- RECALL OR INITIALISE
```

Each of these menu items is described fully later in this section.

EXIT

In order to return to on-line operation, a return is made to the main configuration menu (above) by operating the <CONTROL> and <E> keys together. Once the main menu is displayed, operation of <1> followed by <RETURN> causes the message

```
Are you sure (Y/N)
```

to appear on the screen. Operation of <Y> (or <Ctrl><E>) causes the 4500 system to re-start as if it were powering-up.

CONFIGURATION PRINTING

Selection of item 11 of the main configuration menu causes the entire 4500 configuration to be queued for printing by a serial printer connected to the 4500 AUX port at the rear of the master unit.

As an alternative, it is possible to print out pages of the configuration separately, by operating the <CTRL> and <W> keys simultaneously whilst the required page is displayed on the screen. <CTRL> <A> aborts printing, <CTRL> <P> causes the printing to pause and <CTRL> <B> re-starts printing after a print pause.

It should be noted that operation of the <CTRL> <W> keys whilst any channel or alarm page is on display causes the configuration of all channels to be printed, not just those currently on the displayed page.

For further details, refer to Section 4.4.13

4.4.3 CONFIGURATION TECHNIQUE

The area of configuration to be carried out is selected from the main configuration menu by typing the required menu item number and operating the <RETURN> key. This will result in a sub-menu or a configuration page appearing on the screen. Sub-menu items are also selected by typing the item number followed by <RETURN>.

In order to edit any of the fields on a configuration page, the cursor (arrow) keys are used to highlight the relevant field. The <RETURN>* key is then used to scroll through the available alternatives in the field, or the keyboard is used to enter the required string. Once the edit of any particular field is complete, the cursor keys are used to go on to the next item to be edited.

Note...

When editing text fields, the <Tab> and <DEL> keys can be used to move the text cursor forwards and backwards respectively, within the field. In both cases, the text remains unchanged (i.e. these keys do not edit the text, they just allow the cursor to be moved).

At any time, the previous menu can be returned-to by operation of the <CTRL> and <E> keys simultaneously. Where this does not return to the main configuration menu, then item one of the displayed menu items will be 'return to menu'. Typing <1> <RETURN>, or a further operation of <CTRL><E> will cause a return to the main configuration menu.

An area of each display page is dedicated to the display of 'control' characters which are applicable to that page.

* <DEL> or <BACKSPACE> keys can be used to reverse the direction of scroll.

CHANNEL BLOCKS

The channel and alarm configuration is displayed in groups of 15 channels. Further channels can be brought to the display either by means of the up (↑) and down (↓) cursor keys, or by defining a 'block' of channels to be displayed, by using <CTRL> <F>. If the selected block is empty, the closest non-empty block is displayed; if the selected block number exceeds the highest block number which contains channels, the request is ignored.

Note...

Each block contains 15 channels, so in order to bring, for example, channel 139 to the display, a block number of 10 would be entered to display channels 136 to 150. (Table 7.2 is a cross-reference table which defines block numbers for all possible 4500 system channels).

Operation of <CTRL> <F> keys causes the cursor to jump from the current channel field to a separate 'page number' field. Operation of the → and ← arrow keys allows the cursor to be moved between the 'BLOCK' and 'PAGE NUMBER' fields, allowing a block or page number to be entered using either the numeric keys or the ↑ and ↓ keys. To return the cursor to the new configuration page, the <CTRL> <F> keys are operated again.

CHANNEL PAGES

The total number of parameters which have to be set up for a channel far exceed the ability of the system to display them across one screen. For this reason the configuration is divided into a number of 'pages'. Each of these pages contains the channel numbers and their descriptors for up to one block of 15 channels. Once all the configurable items have been set up in page one, further parameters for the channel(s) in question are accessed by operating the right arrow cursor key from the final field on the page. This process continues until all the configurable parameters for the channel(s) in question have been set up. Individual configuration pages can be accessed using <CTRL><F> as described above.

CHANNEL COPYING

It is sometimes convenient to copy the configuration of one channel to one or more other channels. To do this, it is first necessary to 'mark' or 'tag' the channel to be copied (source channel) and then to select the channel to which the data is to be copied (destination channel).

With the source channel highlighted, <CTRL> <T> tags the channel, then if the cursor is moved to highlight the destination channel, <CTRL> <C> copies the channel's data, including alarms.

4.4.4 RACK HARDWARE CONFIGURATION

This area is entered by operating the <2> key followed by <RETURN> from the main configuration menu. Upon selection the master configuration page (typical example depicted below) appears at the terminal screen for editing. Repeated operation of the <RETURN> key with the 'MASTER' field highlighted calls similar pages to the screen for expansion units 1 (also depicted below), 2, 3 and 4 if these are fitted.

Note...

Alterable fields are shown undelined for clarity in these examples. This underlining does not appear on the screen.

CAUTION

THE HARDWARE CONFIGURATION IS USED TO DEFINE TO THE 4500 SYSTEM WHICH CARDS ARE FITTED IN THE MASTER RACK AND IN ANY EXPANSION RACKS FITTED. NO CHECKS ARE CARRIED OUT BY THE SYSTEM TO DETERMINE THAT THE CORRECT BOARD TYPES ARE PRESENT IN THE SPECIFIED SLOTS. BEFORE THE 4500 SYSTEM IS PLACED ON-LINE, IT MUST BE ENSURED THAT THE CORRECT BOARD TYPES ARE INSERTED IN THE RACKS' SLOTS, AND THAT ALL RELEVANT SIM LINKS HAVE BEEN FITTED OR REMOVED AS APPROPRIATE. FAILURE TO ENSURE THIS WILL RESULT IN DAMAGE BEING CAUSED TO THE 4500 OR TO THE EQUIPMENT TO WHICH IT IS CONNECTED, AS WELL AS GENERATING COMMUNICATIONS ALARMS FOR ANY ENABLED CHANNELS.

```
|---------------------------------------------------------------------------|
| RACK : MASTER                                              ENABLED        |
|---------------------------------------------------------------------------|
|SLOT| I/O  | CHANNEL |  I/O MODULE DESCRIPTOR                              |
| NO.| TYPE |  RANGE  |                                                     |
|---------------------------------------------------------------------------|
   1   00      1 -   6  6 CH ISOLATED ANALOG INPUT
   2   02     16 -  21  6 CH RTD ANALOG INPUT
   3   09     31 -  45 15 CH ISOLATED ANALOG INPUT
   4   03     46 -  60 15 CH NON ISOLATED ANALOG INPUT
   5   04     61 -  68  8 CH ANALOG OUTPUT
   6   07     76 -  90 15 CH DIGITAL I/O
   7   06     91 -  98  8 CH RELAY OUTPUT
   8   05    106 - 109  4 CH RELAY OUTPUT
   9   30    121 - 135 15 CH PSEUDO ANALOG INPUT
  10   31    136 - 150 15 CH PSEUDO ANALOG OUTPUT
  11   32    151 - 165 15 CH PSEUDO DIGITAL I/O
```

```
|---------------------------------------------------------------------------|
| RACK : EXPANSION 1                                         ENABLED        |
|---------------------------------------------------------------------------|
|SLOT| CARD | CHANNEL |  I/O MODULE DESCRIPTOR                              |
| NO.| TYPE |  RANGE  |                                                     |
|---------------------------------------------------------------------------|
   1   02    166 - 171  6 CH RTD ANALOG INPUT
   2   09    181 - 195 15 CH ISOLATED ANALOG INPUT
   3   03    196 - 210 15 CH NON ISOLATED ANALOG INPUT
   4   04    211 - 218  8 CH ANALOG OUTPUT
   5   07    226 - 240 15 CH DIGITAL I/O
   6   06    241 - 248  8 CH RELAY OUTPUT
   7   05    256 - 259  4 CH RELAY OUTPUT
   8   30    271 - 285 15 CH PSEUDO ANALOG INPUT
   9   31    286 - 300 15 CH PSEUDO ANALOG OUTPUT
  10   32    301 - 315 15 CH PSEUDO DIGITAL I/O
  11   --          -     EMPTY
  12   00    331 - 336  6 CH ISOLATED ANALOGUE INPUT
```

4.4.4 (Cont.)

RACK HARDWARE CONFIGURATION (Cont.)

ALTERABLE FIELDS

MASTER	This field allows the master rack or any of the expansion racks (if fitted) to be selected for edit. The cursor (arrow) keys are used to highlight the field, and once the field is highlighted, the return key is operated as many times as is necessary to scroll the required rack (ie EXPANSION 1, EXPANSION 2 etc.) to the field.
ENABLED	This field allows the master or the selected rack to be enabled or disabled, by operating the return key whilst the field is highlighted. When disabled, no communications exist between the single board computer and the I/O boards in the displayed rack. Thus, although the channels will be configured as selected (allowing configuration of slots which are not currently filled), the measured values of all disabled channels will be displayed as -NE-
00, 02, etc	This is the 'card type' field which allows the type of card in each rack slot to be defined. With the required slot's field highlighted, the return key is operated to scroll through all the available card types (shown in the example above). Specifications for all these card types appear in section 1 of this document.

4.4.5 CHANNEL AND ALARM CONFIGURATION

When item 3 is selected from the main configuration menu, the channel configuration menu appears:-

```
              CHANNEL CONFIGURATION

            1 -- RETURN TO MENU
            2 -- ANALOG INPUT
            3 -- ANALOG OUTPUT
            4 -- DIGITAL I/O
            5 -- PSEUDO ANALOG INPUT
            6 -- PSEUDO ANALOG OUTPUT
            7 -- PSEUDO DIGITAL I/O
```

ANALOGUE INPUT PAGE 1

Selection of item 2 (type <2><RETURN>) causes page 1 of the analogue input configuration to appear for the first 15 analogue input channels. As shown below, this screen display contains the (underlined) configuration fields:

1) Channel descriptor
2) Input type
3) Input hardware low range ('zero')
4) Input hardware high range ('span')
5) Input engineering units
6) CJC location and external values and units as appropriate
7) Attenuator/shunt value

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	INPUT TYPE	INPUT H/W LO RANGE	INPUT H/W HI RANGE	I/P ENG UNIT	CJC LOC	CJC CHN/ VAL	ENG UNIT	SHUNT/ ATTEN. OHM/K
1	Boiler pressure	00	V	0.000	100.0	V	OFF			X100
2	Boiler temp 2	00	mA	4.000	20.00	mA	INT			100
3	Boiler temp 3	00	T/C	-100.0	800.0	F	EXT	440.0	R	
4	Boiler temp 4	00	T/C	50.00	200.0	C	REM	192		
5	Boiler temp 5	00	T/C	600.0	1000.	R	EXT	273.0	K	
6	Boiler temp 6	00	T/C	300.0	500.0	K	EXT	32.00	F	
16	Outlet temp 1	02	T/C	100.0	350.0	F	EXT	00.00	C	
17	Outlet temp 2	02	T/C	50.00	200.0	C	OFF			
18	Outlet temp 3	02	T/C	600.0	900.0	R	OFF			
19	Outlet temp 4	02	RTD	320.0	470.0	K	OFF			
20	Valve posn 1	02	mV	00.00	100.0	mV	OFF			
21	Rotn rate 6	02	mA	00.00	10.00	mA	OFF			2K
22	Flow rate 1	09	V	00.00	10.00	V	OFF			X1
23	Flow rate 2	09	V	00.00	10.00	V	OFF			X1
24	Flow rate 3	09	V	00.00	10.00	V	OFF			X1

The configurable fields are as described in the 'On-line configuration' section of this document. The notes below may, however, be helpful.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE INPUT PAGE 1 (Cont.)

Channel descriptor	The descriptor for the channel may be typed in using the qwerty keyboard associated with the terminal. These descriptors appear on other configuration pages as well, but they cannot be edited on any page but this. The <TAB> and <DEL> keys can be used to move the text cursor through the text field as described in section 4.4.3 above.
CJC location	Scrollable choices are: OFF, INT, EXT, REM. INT The cold junction temperature is sensed in the analogue board SIM. EXT The temperature of an external cold junction used as a reference for thermocouple inputs. Entered using the terminal keyboard. REM Available for use with 15-channel boards only, the temperature reference is another channel the number of which is entered in this field, using the terminal keyboard.
ATT/SHUNT	The value of the attenuator (voltage inputs) or shunt (current inputs) fitted across the relevant terminals in the channel SIM. Shunt values can be specified in Ω or in kΩ, according to whether the field after the value is scrolled to blank or to 'k'.

To access page two, the → key is operated from the ATT/SHUNT field.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE INPUT PAGE 2

Page two is accessed by operating the —> cursor key from the shunt/attenuator field in page 1. The page (depicted below) retains the channel ID and Channel descriptor fields for reference purposes (ie the channel descriptors are not available for edit other than in page 1) and holds the following configuration fields:-

1) Filter time constant in seconds or Change value as % of full scale.
2) Linearisation function type.
3) Linearisation low range ('zero').
4) Linearisation high range ('span').
5) Linearisation engineering units.
6) Enable / disable data acquisition.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	FILTER / CHANGE	FUNCTION	LINEARIZATION LOW RANGE	HIGH RANGE	ENG UNIT	ACQ
1	Boiler pressure	00	1 s	LINEAR	00.00	100.0		OFF
2	Boiler temp 2	00	2 s	LINEAR	04.00	20.00		ON
3	Boiler temp 3	00	3 s	TYPE K	-100.0	800.0	F	ON
4	Boiler temp 4	00	4 s	TYPE J	50.00	200.0	C	ON
5	Boiler temp 5	00	5 s	USER 1	600.0	1000.	R	ON
6	Boiler temp 6	00	6 s	TYPE T	300.0	500.0	K	ON
16	Outlet temp 1	02	7 s	TYPE S	100.0	350.0	F	ON
17	Outlet temp 2	02	8 s	TYPE R	50.00	200.0	C	ON
18	Outlet temp 3	02	255 s	TYPE E	600.0	900.0	R	ON
19	Outlet temp 4	02	2 %	PT100	320.0	470.0	K	ON
20	Valve posn 1	02	4.5 %	LINEAR	00.00	100.0	%	ON
21	Rotn rate 6	02	9.9 %	OFF	00.00	10.00		ON
22	Flow rate 1	09	10 %	SQR ROOT	00.00	10.00		ON
23	Flow rate 2	09	0 s	SQR ROOT	00.00	10.00		ON
24	Flow rate 3	09	0 s	SQR ROOT	00.00	10.00		ON

The configurable (underlined) fields are as described in the 'On-line configuration' section of this document.

To access page three the —> key is operated from the ACQ field.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE INPUT PAGE 3

Page three is accessed by operating the ⟶ cursor key from the ACQ field of page two. The page (depicted below) retains the channel ID and Channel descriptor fields for reference purposes (ie the channel descriptors are not available for edit other than in page 1) and holds the following configuration fields:-

1) Display low range ('zero')
2) Display high range ('span')
3) Display engineering units
4) Redirection channel number
5) Data logging interval for Mass Storage
6) Log enable channel for Mass Storage

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	DISPLAY LOW SCALE	DISPLAY HIGH SCALE	DISPLAY ENG UNITS	REDIRECT TO CHAN NO.	DATA LOGGING INTERVAL	LOG ENBLE
1	Boiler pressure	00	00.00	1000.	PSI	None	1: 2 D	166
2	Boiler temp 2	00	00.00	200.0	DEG C	None	DISABLED	None
3	Boiler temp 3	00	00.00	1000.	DEG F	None	CHANGE	167
4	Boiler temp 4	00	00.00	200.0	DEG C	None	EVNT:123	168
5	Boiler temp 5	00	00.00	1000.	DEG R	None	DISABLED	None
6	Boiler temp 6	00	300.0	500.0	K	None	DISABLED	None
16	Outlet temp 1	02	100.0	350.0	DEG F	122	DISABLED	None
17	Outlet temp 2	02	50.00	200.0	DEG C	123	DISABLED	None
18	Outlet temp 3	02	500.0	1000.	DEG R	124	DISABLED	None
19	Outlet temp 4	02	300.0	500.0	K	125	DISABLED	None
20	Valve posn 1	02	00.00	100.0	%	126	DISABLED	None
21	Rotn rate 6	02	00.00	100.0	%	127	DISABLED	None
22	Flow rate 1	09	00.00	1000.	l/hr	128	DISABLED	None
23	Flow rate 2	09	00.00	1000.	l/hr	129	DISABLED	None
24	Flow rate 3	09	00.00	1000.	l/hr	None	DISABLED	None

The configurable fields are as described in the 'On-line configuration' section of this document

To access page four the ⟶ key is operated from the LOG ENBLE field.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE INPUT PAGE 4

Page four is accessed by using the ⟶ cursor key from the log enable field. The page (depicted below) retains the channel ID and Channel descriptor fields for reference purposes (ie the descriptor is not available for edit other than in page 1) and holds the following configurable fields for the first alarm setpoint for the channels.

1) Alarm type
2) Setpoint value or reference channel if required for deviation alarm.
3) Deviation value for deviation alarm
4) Period value for rate alarm
5) Hysteresis value
6) Alarm enable
7) Global alarm enable
8) First alarm output channel number

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	ALARM TYPE	VAL/CH SET PNT	PERIOD VALUE	T/CON HYST %	EN. ALARM	TRIP GLOBAL ALARM	O/P CH 1
1	Boiler pressure	00	NONE						
2	Boiler temp 2	00	ABSH	850.0		01.00	YES	YES	1
3	Boiler temp 3	00	ABSL	100.0		01.00	NO	YES	2
4	Boiler temp 4	00	DEV	150.0	75.00	9.500	YES	NO	3
5	Boiler temp 5	00	DEVH	900.0	00.00	01.00	YES	NO	4
6	Boiler temp 6	00	DEVL	380.0	00.00	01.50	NO	NO	5
16	Outlet temp 1	02	RATEH	20.00	1 SEC	0	NO	YES	99
17	Outlet temp 2	02	RATEL	2.000	1 SEC	0	YES	NO	None
18	Outlet temp 3	02	NONE						
19	Outlet temp 4	02	NONE						
20	Valve posn 1	02	NONE						
21	Rotn rate 6	02	NONE						
22	Flow rate 1	09	NONE						
23	Flow rate 2	09	NONE						
24	Flow rate 3	09	NONE						

The configurable fields are as described in the 'On-line configuration' section of this document.

To access page five the ⟶ key is operated from the O/P CH 1 field.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE INPUT PAGE 5

Page five is accessed by using the → cursor key from the O/P CH 1 field on page 4. The page (depicted below) retains the channel ID and Channel descriptor fields for reference purposes (ie the descriptor is not available for edit other than in page 1) and holds the following configurable fields for the first alarm setpoint for the channels.

1) Second alarm output channel number
2) Alarm message
3) Enabling of report printing on alarm.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	O/P CH 2	ALARM MESSAGE	PRINT REPORT YES / NO 1	2	3	4
1	Boiler pressure	00						
2	Boiler temp 2	00	139	TEMP 2 TOO HIGH	YES	NO	YES	NO
3	Boiler temp 3	00	140	TEMP 3 TOO LOW	NO	YES	NO	YES
4	Boiler temp 4	00	141	TEMP 4 OUT OF RANGE	YES	YES	YES	YES
5	Boiler temp 5	00	142	TEMP 5 TOO HIGH	NO	NO	NO	NO
6	Boiler temp 6	00	143	TEMP 6 TOO LOW	YES	NO	NO	NO
16	Outlet temp 1	02	NONE	OUTLET 1 RISING FAST	NO	YES	NO	NO
17	Outlet temp 2	02	NONE	OUTLET 2 FALLING FAST	NO	NO	YES	NO
18	Outlet temp 3	02	NONE					
19	Outlet temp 4	02	NONE					
20	Valve posn 1	02	NONE					
21	Rotn rate 6	02	NONE					
22	Flow rate 1	09	NONE					
23	Flow rate 2	09	NONE					
24	Flow rate 3	09	NONE					

The configurable fields are as described in the 'On-line Configuration' section of this document.

This page, completes the channel and alarm 1 configuration for the channels displayed. The configuration of alarms 2, 3 and 4 for these channels is carried out in the same way as for alarm 1, and this configuration takes place in pages 6 to 11. To access page six the → key is operated from the PRINT REPORT field.

Once all the required alarm setpoints have been set up, <CTRL><E> is used to return to the channel configuration menu.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE OUTPUT PAGE 1

When 3 is selected from the channel configuration menu, the first analogue output configuration page appears at the terminal for the first 15 output channels found. This page (depicted below) allows the output type and range to be set up.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	OUTPUT TYPE	OUTPUT H/W LO RANGE	OUTPUT H/W HI RANGE
61	HP Turbine 1 speed	04	mA	04.00	20.00
62	Turbine 1 flow 1	04	V	00.00	10.00
63	Turbine 1 flow 2	04	V	00.00	10.00
64	Turbine 1 flow 3	04	V	00.00	10.00
65	Turbine 1 flow 4	04	V	00.00	10.00
66	HP Turbine 2 speed	04	mA	04.00	20.00
67	HP Turbine 3 speed	04	mA	04.00	20.00
68	Turbine 2 flow 1	04	V	00.00	10.00
211	Turbine 2 flow 2	04	V	00.00	10.00
212	Turbine 2 flow 3	04	V	00.00	10.00
213	Turbine 2 flow 4	04	V	00.00	10.00
214	Turbine 3 flow 1	04	V	00.00	10.00
215	Turbine 3 flow 2	04	V	00.00	10.00
216	Turbine 3 flow 3	04	V	00.00	10.00
217	Turbine 3 flow 4	04	V	00.00	10.00

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access output page 2, the —> key is operated from the OUTPUT H/W HI RANGE field.

ANALOGUE OUTPUT PAGE 2

The second analogue output page (depicted below) allows the configuration of output function and of the output high and low limits.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	FUNCTION	LOW LIMIT	HIGH LIMIT
61	HP Turbine 1 speed	04	LINEAR	04.00	20.00
62	Turbine 1 flow 1	04	LINEAR	00.00	10.00
63	Turbine 1 flow 2	04	SQR ROOT	00.00	10.00
64	Turbine 1 flow 3	04	LINEAR	00.00	10.00
65	Turbine 1 flow 4	04	LINEAR	00.00	10.00
66	HP Turbine 2 speed	04	LINEAR	04.00	20.00
67	HP Turbine 3 speed	04	LINEAR	04.00	20.00
68	Turbine 2 flow 1	04	LINEAR	00.00	10.00
211	Turbine 2 flow 2	04	SQR ROOT	00.00	10.00
212	Turbine 2 flow 3	04	LINEAR	00.00	12.00
213	Turbine 2 flow 4	04	LINEAR	00.00	12.00
214	Turbine 3 flow 1	04	LINEAR	00.00	12.00
215	Turbine 3 flow 2	04	SQR ROOT	00.00	10.00
216	Turbine 3 flow 3	04	LINEAR	00.00	12.00
217	Turbine 3 flow 3	04	LINEAR	00.00	12.00

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access output page 3, the —> key is operated from the HIGH LIMIT field.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

ANALOGUE OUTPUT PAGE 3

The third analogue output page (depicted below) allows the configuration of display high and low scale, rate limit and engineering units. If the Mass Storage option is installed, the Data Logging interval and Log enable/disable channel can be configured.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	DISPLAY LOW SCALE	DISPLAY HIGH SCALE	RATE LIMIT	ENG UNITS	DATA LOGGING INTERVAL	LOG ENBLE
61	HP Turbine 1 speed	04	00.00	100.0	20.00	r/sec	1: 2 D	166
62	Turbine 1 flow 1	04	00.00	1000.	30.00	l/hr	DISABLED	None
63	Turbine 1 flow 2	04	00.00	1000.	30.00	l/hr	CHANGE	167
64	Turbine 1 flow 3	04	00.00	1000.	30.00	l/hr	EVNT:123	168
65	Turbine 1 flow 4	04	00.00	1000.	00.00	l/hr	DISABLED	None
66	HP Turbine 2 speed	04	00.00	100.0	20.00	r/sec	DISABLED	None
67	HP Turbine 3 speed	04	00.00	100.0	20.00	r/sec	DISABLED	None
68	Turbine 2 flow 1	04	00.00	1000.	00.00	l/hr	DISABLED	None
211	Turbine 2 flow 2	04	00.00	1000.	00.00	l/hr	DISABLED	None
212	Turbine 2 flow 3	04	00.00	1000.	00.00	l/hr	DISABLED	None
213	Turbine 2 flow 4	04	00.00	1000.	00.00	l/hr	DISABLED	None
214	Turbine 3 flow 1	04	00.00	1000.	00.00	l/hr	DISABLED	None
215	Turbine 3 flow 2	04	00.00	1000.	00.00	l/hr	DISABLED	None
216	Turbine 3 flow 3	04	00.00	1000.	00.00	l/hr	DISABLED	None
217	Turbine 3 flow 4	04	00.00	1000.	00.00	l/hr	DISABLED	None

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

Once all the analogue output channels have been configured <CTRL><E> is used to return to the channel configuration menu.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

DIGITAL INPUT/OUTPUT PAGE 1

Selection of item 4 of the channel configuration menu calls digital I/O page 1 to the screen. This page (depicted below) allows each channel associated with DIO boards to be configured as either input or output, and further allows the high state and low state messages and the acquisition of data to be enabled or disabled for each relevant channel as required. If the Mass Storage option is installed, then the Data Logging interval and Log enable/disable channel can be configured.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	TYPE: DIGIN DIGOUT	MESSAGE ON	MESSAGE OFF	ACQ	DATA LOGGING INTERVAL	LOG ENBLE
76	Valve 1 open	07	DIGOUT	P1 on	P1off		1: 2 D	166
77	Valve 2 open	07	DIGOUT	On	Off		DISABLED	None
78	Valve 3 open	07	DIGOUT	On	Off		CHANGE	167
79	Valve 4 open	07	DIGOUT	On	Off		EVNT:123	168
80	Valve 5 open	07	DIGOUT	On	Off		DISABLED	None
81	Valve 6 open	07	DIGOUT	On	Off		DISABLED	None
82	Valve 101 closed	07	DIGOUT	On	Off		DISABLED	None
83	Valve 103 closed	07	DIGOUT	On	Off		DISABLED	None
84	Sodium flow	07	DIGIN	On	On	ON	DISABLED	None
85	Primary cooling OK	07	DIGIN	On	On	ON	DISABLED	None
86	Primary coolant hot	07	DIGIN	On	On	ON	DISABLED	None
87	Valve 203 opened	07	DIGIN	On	On	ON	DISABLED	None
88	Valve 204 opened	07	DIGIN	Off	Off	ON	DISABLED	None
89	Valve 207 opened	07	DIGIN	Off	Off	ON	DISABLED	None
90	Reactor shut down	07	DIGIN	Off	On	ON	DISABLED	None

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access digital input/output page 2, the → key is operated from the LOG ENABLE field.

Note...

The ACQuisition field is always blank for digital outputs, as the channel acquisition cannot be turned off for such channels.

4.4.5 CHANNELS AND ALARM CONFIGURATION (Cont.)

DIGITAL INPUT/OUTPUT PAGE 2

The second digital I/O page (depicted below) allows the listed items of configuration to be carried out for each channel associated with DIO boards.

a) Alarm type
b) Alarm enable
c) Global alarm linkage
d) Output alarm 1 channel number.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	ALARM TYPE	EN. ALARM	TRIP GLOBAL ALARM	O/P CH 1
76	Valve 1 open	07				
77	Valve 2 open	07				
78	Valve 3 open	07				
79	Valve 4 open	07				
80	Valve 5 open	07				
81	Valve 6 open	07				
82	Valve 101 closed	07				
83	Valve 103 closed	07				
84	Sodium flow	07	ON	NO	NO	884
85	Primary cooling OK	07	ON	YES	YES	6
86	Primary coolant hot	07	ON	NO	YES	7
87	Valve 203 opened	07	OFF	NO	NO	8
88	Valve 204 opened	07	ON	YES	YES	9
89	Valve 207 opened	07	OFF	YES	YES	None
90	Reactor shut down	07	NONE			

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access digital input/output page 3, the --> key is operated from the O/P CH 1 field.

Note...

The alarm parameter fields for digital output channels are always blank because alarms cannot be set for this type of channel.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

DIGITAL INPUT/OUTPUT PAGE 3

The third digital I/O page (depicted below) allows the listed items of configuration to be carried out for each DIO board channel.

a) Output alarm 2 channel number entry.
b) Typing-in of the alarm messages.
c) Report enabling.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	O/P CH 2	ALARM MESSAGE	REPORT FORMAT ON / OFF 1	2	3	4
76	Valve 1 open	07						
77	Valve 2 open	07						
78	Valve 3 open	07						
79	Valve 4 open	07						
80	Valve 5 open	07						
81	Valve 6 open	07						
82	Valve 101 closed	07						
83	Valve 103 closed	07						
84	Sodium flow	07	346	Na flow low	NO	NO	NO	NO
85	Primary cooling OK	07	347	Primary temp OK	NO	NO	NO	NO
86	Primary coolant hot	07	348	Coolant temp warning	NO	NO	NO	NO
87	Valve 203 opened	07	349	Emergency coolant 1	NO	NO	NO	NO
88	Valve 204 opened	07	350	Emergency coolant 2	NO	NO	NO	NO
89	Valve 207 opened	07	351	Emergency coolant 3	NO	NO	NO	NO
90	Reactor shut down	07						

The configurable fields (underlined) are as described in the 'On-lie configuration' section of this document.

Once all the required DIO channels have been configured, <CTRL><E> is used to return to the channel configuration menu.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

PSEUDO INPUT - OUTPUT BOARDS

Pseudo input-output boards are generally used only with the Maths pack option. The relevant part of the Options Section of this manual should be referred to for a detailed description of Pseudo board usage.

Pseudo analogue input board Page 1

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	DISPLAY LOW SCALE	DISPLAY HIGH SCALE	DISPLAY ENG UNITS	REDR TO CHAN	CHANGE %	DATA LOGGING INTERVAL	LOG ENBLE
121	Ps/analog input	30	00.00	99.99	1/hr	1	2.5	1: 2 D	166
122	Ps/analog input	30	00.00	99.99	1/hr	None	10.0	DISABLED	None
123	Ps/analog input	30	00.00	99.99	1/hr	None		CHANGE	167
124	Ps/analog input	30	00.00	99.99	1/hr	None		EVNT:123	168
125	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
126	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
127	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
128	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
129	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
130	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
131	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
132	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
133	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
134	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None
135	Ps/analog input	30	00.00	99.99	1/hr	None		DISABLED	None

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access the alarm configuration for this type of input, the → key is operated at the LOG ENBLE field. This alarm configuration, held on pseudo analogue input board pages 2 to 9, is identical to that described previously, for pages 4 to 11 of the normal analogue input boards.

Once all the required pseudo analogue input channels have been configured, <CTRL><E> is used to return to the channel configuration menu.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

Pseudo analogue output board Page 1

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	LOW LIMIT	HIGH LIMIT
136	Ps/Analog Output 1	31	00.00	99.99
137	Ps/Analog Output 2	31	00.00	99.99
138	Ps/Analog Output 3	31	00.00	99.99
139	Ps/Analog Output 4	31	00.00	99.99
140	Ps/Analog Output 5	31	00.00	99.99
141	Ps/Analog Output 6	31	00.00	99.99
142	Ps/Analog Output 7	31	00.00	99.99
143	Ps/Analog Output 8	31	00.00	99.99
144	Ps/Analog Output 9	31	00.00	99.99
145	Ps/Analog Output 10	31	00.00	99.99
146	Ps/Analog Output 11	31	00.00	99.99
147	Ps/Analog Output 12	31	00.00	99.99
148	Ps/Analog Output 13	31	00.00	99.99
149	Ps/Analog Output 14	31	00.00	99.99
150	Ps/Analog Output 15	31	00.00	99.99

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access output page 2, the → key is operated from the HIGH LIMIT field.

Pseudo analogue output board Page 2

The second analogue output page (depicted below) allows the configuration of display high and low scale values, rate limit and engineering units. If the Mass Storage option is installed, the Data Logging interval and Log enable/disable channel can be configured.

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	DISPLAY LOW SCALE	DISPLAY HIGH SCALE	RATE LIMIT	ENG UNITS	DATA LOGGING INTERVAL	LOG ENBLE
136	Ps/Analog Output 1	31	00.00	99.99	45.00	1/hr	1: 2 D	166
137	Ps/Analog Output 2	31	00.00	99.99	45.00	1/hr	DISABLED	None
138	Ps/Analog Output 3	31	00.00	99.99	45.00	1/hr	CHANGE	167
139	Ps/Analog Output 4	31	00.00	99.99	45.00	1/hr	EVNT:123	168
140	Ps/Analog Output 5	31	00.00	99.99	45.00	1/hr	DISABLED	None
141	Ps/Analog Output 6	31	00.00	99.99	45.00	1/hr	DISABLED	None
142	Ps/Analog Output 7	31	00.00	99.99	45.00	1/hr	DISABLED	None
134	Ps/Analog Output 8	31	00.00	99.99	45.00	1/hr	DISABLED	None
144	Ps/Analog Output 9	31	00.00	99.99	45.00	1/hr	DISABLED	None
145	Ps/Analog Output 10	31	00.00	99.99	45.00	1/hr	DISABLED	None
146	Ps/Analog Output 11	31	00.00	99.99	45.00	1/hr	DISABLED	None
147	Ps/Analog Output 12	31	00.00	99.99	45.00	1/hr	DISABLED	None
148	Ps/Analog Output 13	31	00.00	99.99	45.00	1/hr	DISABLED	None
149	Ps/Analog Output 14	31	00.00	99.99	45.00	1/hr	DISABLED	None
150	Ps/Analog Output 15	31	00.00	99.99	45.00	1/hr	DISABLED	None

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

Once all the pseudo analogue output channels have been configured <CTRL><E> is used to return to the channel configuration menu.

4.4.5 CHANNEL AND ALARM CONFIGURATION (Cont.)

PSEUDO INPUT-OUTPUT BOARDS (Cont.)

Pseudo digital I/O board Page

CHAN ID.	CHANNEL DESCRIPTOR	CARD TYPE	TYPE: DIGIN DIGOUT	MESSAGE ON	MESSAGE OFF	DATA LOGGING INTERVAL	LOG ENBLE
151	Ps/digital Output 1	32	DIGOUT	On	Off	1: 2 D	166
152	Ps/digital Output 2	32	DIGOUT	On	Off	DISABLED	None
153	Ps/digital Output 3	32	DIGOUT	On	Off	CHANGE	167
154	Ps/digital Output 4	32	DIGOUT	On	Off	EVNT:123	168
155	Ps/digital Output 5	32	DIGOUT	On	Off	DISABLED	None
156	Ps/digital Output 6	32	DIGOUT	On	Off	DISABLED	None
157	Ps/digital Output 7	32	DIGOUT	On	Off	DISABLED	None
158	Ps/digital Output 8	32	DIGOUT	On	Off	DISABLED	None
159	Ps/digital Input 1	32	DIGIN	Off	On	DISABLED	None
160	Ps/digital Input 2	32	DIGIN	Off	On	DISABLED	None
161	Ps/digital Input 3	32	DIGIN	Off	On	DISABLED	None
162	Ps/digital Input 4	32	DIGIN	Off	On	DISABLED	None
163	Ps/digital Input 5	32	DIGIN	Off	On	DISABLED	None
164	Ps/digital Input 6	32	DIGIN	Off	On	DISABLED	None
165	Ps/digital Input 7	32	DIGIN	Off	On	DISABLED	None

The configurable fields (underlined) are as described in the 'On-line configuration' section of this document.

To access pseudo digital input/output page 2, the → key is operated from the LOG ENABLE field. Pages 2 and 3 are identical with normal digital I/O pages 2 and 3, described above.

Once all the pseudo DIO channels have been configured <CTRL><E> is used to return to the channel configuration menu.

4.4.6 SYSTEM CONFIGURATION

Selection of menu item 4 of the main configuration menu calls the system configuration menu to the screen:

```
1 -- RETURN TO MAIN MENU
2 -- SYSTEM CONFIGURATION
3 -- SYSTEM ALARM CHANNELS
```

Selection of menu item 2 calls the system configuration page (depicted below) to the screen

```
                          SYSTEM CONFIGURATION PAGE


LANGUAGE : ENGLISH                        DATA LOGGING:
                                               INHIBIT I/P CH : NNN
RACK TYPE (No. of Slots/Rack):                 TIME INTERVAL 1 :  1 MINS
               MASTER       : 11               TIME INTERVAL 2 : 10 MINS
               EXPANSION 1 : 12                TIME INTERVAL 3 :  1 HRS
               EXPANSION 2 : 12                TIME INTERVAL 4 :  0 SECS
               EXPANSION 3 : 12                TIME INTERVAL 5 :  0 SECS
               EXPANSION 4 : 12                TIME INTERVAL 6 :  0 SECS
                                               LOG ON  ALARM   :  OFF
GLOBAL ALARM INPUTS/OUTPUTS :                  LOG DESCRIPTOR  :  OFF
               REMOTE ACK.I/P CH : RRR         LOG UNITS       :  OFF
               LATCHED O/P CH    : LLL         BATCH NUMBERING:
               UNLATCHED O/P CH  : UUU              FORMAT     :  TEXT
                                                    AUTO INC   :  OFF
                                                    INITIAL No.:  123456


KEYBOARD BEEP : ON
```

The configurable (underlined) items on the left side of this display are as described in the ' on-line configuration' section of this document. The DATA LOGGING parameters on the right hand side of the screen appear only if the Archiving option is installed. Section 6.4 should be referred to for details.

Once the system configuration has been carried out, operation of the <CTRL><E> keys causes a return to the system configuration menu.

Note...

If the language is changed, all menus, headers , field descriptors etc. will change immediately to the selected language.

Selection of menu item 3 of the system configuration menu calls the first system alarm output channel page (depicted overleaf) to the screen.

4.4.6 SYSTEM CONFIGURATION (Cont)

```
                  SYSTEM ALARM DIO CHANNEL CONFIGURATION

PAGE:1

No. ALARM DESCRIPTOR                           CH. CHANNEL DESCRIPTOR
    Global Maths Alarm                         124 Maths alarm
    Global System Alarm                        125 System alarm
```

The configurable (underlined) items are as described in the 'on-line system configuration' section of this manual (Section 4.3.1).

Operation of <CTRL> <E> causes a return to the System configuration menu. Selection of page 2 etc at the top of the screen calls the 2nd etc page which allows the selection of individual DIO channels for each System alarm, with 16 alarms appearing on each page. Page 2 is depicted below, further pages are similar.

```
                  SYSTEM ALARM DIO CHANNEL CONFIGURATION

PAGE:2

No. ALARM DESCRIPTOR                           CH. CHANNEL DESCRIPTOR
 1  System alarm buffer overflow               None
 2  Entire configuration lost                  None
 3  4001 redirection lost                      None
 4  Channel   0 configuration lost             None
 5  Channel   0 alarm(s) configuration lost    None
 6  System configuration lost                  126 System conf. gone
 7  Maths pack SPV user function   0 lost      None
 8  Maths pack DPV user function   0 lost      None
 9  Maths pack SPV argument table 000 lost     None
10  Maths pack DPV argument table 000 lost     None
12  Maths pack SPV 000 configuration lost      None
13  Maths pack DPV 000 configuration lost      None
20  Year lost - reset to    0                  None
31  Battery low                                None
35  4001 Comms error recorder 0,  channel 00   None
36  4001 Comms error recorder 0                None
```

Once all the required channel numbers have been set up, a further page can be selected at the top of the screen, or <CTRL> <E> causes a return to the system configuration menu. Selection of item 1 of this menu causes a return to the main configuration menu.

4.4.7 COMMUNICATIONS CONFIGURATION

Selection of menu item 5 of the main configuration menu calls the communications configuration page (depicted below) to the screen.

```
                    COMMUNICATIONS CONFIGURATION PAGE


COMMS PORT 1 :                                 COMMS PORT 2 :


BAUD RATE :          9600                      BAUD RATE :          110
DATA BITS :          8                         DATA BITS :          7
STOP BIT(S) :        1                         STOP BIT(S) :        2
PARITY :             EVEN                      PARITY :             NONE
DRIVE PROTOCOL :     TCS BINARY                DRIVE PROTOCOL :     MODBUS RTU
ADDRESS/UNIT ID:        0                      ADDRESS/UNIT ID:        2
ENQ POLL:            PARTIAL*
```

* Enquiry poll field appears only with TCS BINARY selected as protocol.

The configurable (underlined) items in this display are fully described in the 'On-line configuration' section of this document. Once the communications configuration has been carried out, operation of the <CTRL><E> keys causes a return to the main configuration menu.

4.4.8 REPORT CONFIGURATION

Selection of menu item 6 brings the report configuration page (depicted below) to the screen. This page allows reports to be scheduled for time of start and periodicity, and allows channels to be allocated to the four available reports (described more fully in the configuration section of this manual).

```
|----------------------------------------------------------------------------|
|    REPORT 1                      | __ Start time       |hh. 12    |mm. 30   |
|----------------------------------| __ Report period    |hh. 01    |mm. 30   |
| LIST OF CHANNELS TO BE REPORTED  | __ Insert one       |cn.       |         |
| CHANNEL |                        | __ Insert sequence  |st.   12  |end 16   |
|   ID    |   CHANNEL DESCRIPTOR   | __ Delete one       |cn.       |         |
|----------------------------------| __ Delete sequence  |st.       |end      |
|    1    | Boiler pressure        | __ List of channels |          |         |
|    2    | Boiler temp 2          | __ Trigger report   |cn. 159   |         |
|    5    | Boiler temp 5          |-------------------------------------------
|   16    | Outlet temp 1          |    | CHANNEL |                      |
|         |                        |    |   ID    |  CHANNEL DESCRIPTOR  |
|         |                        |    ---------------------------------
|         |                        |    |    1    | Boiler pressure      |
|         |                        |    |    2    | Boiler temp 2        |
|         |                        |    |    5    | Boiler temp 5        |
|         |                        |    |   16    | Outlet temp 1        |
|         |                        |    |   20    | Valve posn  1        |
|         |                        |    |   33    | Analog output 3      |
|         |                        |    |  130    | ps/analog input      |
|         |                        |    |  181    | Fo autoclave 1       |
|----------------------------------|    |  182    | Fo autoclave 2       |
                                        |  183    | Fo autoclave 3       |
                                        |--------------------------------|
```

List of channels window

CONFIGURABLE ITEMS:

Report number. This is entered as a number between 1 and 4 as follows:

a) Operate the <CTRL> and <R> keys together.
b) Operate the <RETURN> key to scroll through reports 1 to 4

Channel allocation menu items (top right hand section of the screen):

To gain access to the menu, the → cursor key is operated. The ↑ and ↓ cursor keys are used to move up and down the menu. Once the required menu item is highlighted data can be typed in using the keyboard. This data is entered when the next left or right cursor movement is made, to move to another field.

Start time — Report printing start time in hours and minutes (12:30 in the example above).

Report period — The period between report printing start times ($1^1/_2$ hours in the example above). If the report is not to be repeated, the period fields are left blank.

Insert one — In order to add a channel to the currently displayed report's list, the item 'Insert one' is highlighted by cursor action, and the required channel's number is typed-in followed by the operation of the right arrow cursor key. Operation of the left arrow cursor key will move the cursor to the report window, where the list of channels allocated to the report can be viewed by scrolling through using the ↑ and ↓ keys.

(Continued)

4.4.8 REPORT CONFIGURATION (Cont.)

Insert sequence

In order to add a number of contiguous channels to the currently displayed report's list, the item 'Insert sequence' is highlighted by cursor action and the right arrow key operated. The number of the first channel in the sequence is then typed in, followed by the number of the final channel in the sequence. Finally, operation of the ⟶ or ⟵ arrow key enters the sequence of channels into the report list.

Delete one

In order to delete a channel from the currently displayed report's list, the item 'Delete one' is highlighted by cursor action and the right arrow key operated. The required channel's number is then typed in followed by operation of the ⟶ or ⟵ arrow key.

Delete sequence

In order to delete a number of contiguous channels from the currently displayed report's list, the item 'Delete sequence' is highlighted using the cursor and the number of the first channel in the sequence is then typed in, followed by operation of the ⟶ key. The number of the final channel in the sequence is then typed in, followed by operation of the ⟶ or ⟵ key to cause the removal of the sequence of channels from the report list.

List of channels

Operation of the <RETURN> key whilst this item is highlighted, causes a list of all configured channels to be displayed in a separate 'window' on the screen. The ↑ and ↓ keys are used to scroll the cursor through the list, to help the operator to decide which channels to include in the report. To return to editing operations, the ⟵ key is operated.

Trigger report

Allows a digital input channel to be defined for use as a report initiator.

4.4.9 RECORDER REDIRECTION

Selection of this item (if the distributed recording option is fitted) calls the Recorder Redirection menu to the screen. Off-line configuration for the distributed recording option is fully described in Section 6 (Options) of this manual.

If the menu item is selected and the option is not fitted, a message 'Option not installed' appears on the screen.

4.4.10 MATHS PACK

Selection of this item (if the maths pack option is fitted) calls the 'Precision' sub-menu to the screen. Off-line configuration for the maths pack option is fully described in Section 6 (Options) of this manual.

If the menu item is selected and the option is not fitted, a message 'Option not installed' appears on the screen.

4.4.11 USER LINEARISATION TABLES

Selection of this item allows the entry, via the page depicted below, of up to three special linearisation tables, to be used as alternatives to the factory supplied thermocouple, RTD etc. linearisations.

```
                         USER LINEARISATION TABLES

LINEARISATION TABLE :  1                   MAX NO. OF ENTRIES : 33

X-AXIS DESC.:     X    UNITS :  V        Y-AXIS DESC.:     Y     UNITS : dgC

Entry   X-Axis   Y-Axis    Entry   X-Axis   Y-Axis    Entry   X-Axis   Y-Axis

  1    01.0000  01.0000     12    00.0000  00.0000     23    00.0000  00.0000
  2    01.5000  03.4750     13    00.0000  00.0000     24    00.0000  00.0000
  3    02.0000  08.0000     14    00.0000  00.0000     25    00.0000  00.0000
  4    02.5000  15.6250     15    00.0000  00.0000     26    00.0000  00.0000
  5    03.0000  27.0000     16    00.0000  00.0000     27    00.0000  00.0000
  6    03.5000  42.8750     17    00.0000  00.0000     28    00.0000  00.0000
  7    04.0000  64.0000     18    00.0000  00.0000     29    00.0000  00.0000
  8    04.5000  91.1250     19    00.0000  00.0000     30    00.0000  00.0000
  9    05.0000  125.000     20    00.0000  00.0000     31    00.0000  00.0000
 10    00.0000  00.0000     21    00.0000  00.0000     32    00.0000  00.0000
 11    00.0000  00.0000     22    00.0000  00.0000     33    00.0000  00.0000
```

Each of the up to 33 points of each table has two values associated with it. One of these (x-axis) represents an input value; the other (y-axis) is the required output resulting from this input. For example, if a cube function ($y = x^3$) were required, then input (x) values of, say, 1.0, 1.5 and 2.0 would have output (y) values entered for them of 1.0000, 3.475 and 8.000 respectively.

To clear an existing table, the <CTRL> <Z> keys should be operated together to return all values to zero.

The configurable (underlined) items appearing on the page are as described in the 'On-line configuration' section of this manual.

Once all the points have been entered, operation of the <CTRL> <E> keys causes a return to the main configuration menu.

4.4.12 ACCESS

Selection of this menu item allows the operator to view and alter if necessary the level 2 and 3 passwords, and to re-define access levels for the parameters listed on the page depicted below.

```
                    ACCESS CONFIGURATION PAGE

PASSWORDS :  LEVEL  2   123456                 LEVEL 3   123456

MODE OF DISPLAY :        SHOW ONLY ALTERABLE FIELDS

SET CHANNEL/ALARMS PARAMETER FIELD ACCESS LEVELS :

   OUTPUT VARIABLE FIELD                     ACCESS LEVEL   1
   ALARM ENABLE FIELD                        ACCESS LEVEL   1
   CH O/P LIMITS FIELDS                      ACCESS LEVEL   1
   CH DESCRIPTOR FIELDS                      ACCESS LEVEL   1
   ALARM SETUP FIELDS                        ACCESS LEVEL   1
   ALARM ROUTING FIELDS                      ACCESS LEVEL   1
   REPORT/LOGGING FIELDS                     ACCESS LEVEL   1
   CH I/O SETUP FIELDS                       ACCESS LEVEL   1
   CH FUNCTION FIELDS                        ACCESS LEVEL   1
   CH DISPLAY FIELDS                         ACCESS LEVEL   1
   CH REDIRECTION FIELDS                     ACCESS LEVEL   1
   DIGITAL CH TAG FIELDS                     ACCESS LEVEL   1
```

The configurable (underlined) items appearing on the page are as described in the 'On-line configuration' section of this manual.

The access level fields are scrolled using the <RETURN> key.

Once all the points have been entered, operation of the <CTRL> <E> keys causes a return to the main configuration menu.

4.4.13 PRINT ENTIRE CONFIGURATION

The 4500 configuration can be printed at a standard line printer using a serial communications link attached to the AUX port at the rear of the master unit rack.

Section 2 of this manual details how to set this port up mechanically, whilst the electronic set-up should be carried out as a part of COMMS configuration as follows:

Baud rate	9600
Start bits	1
Data bits	8
Stop bits	1
Parity	None

Note...

The printer must be connected and be on-line before printing is started, otherwise data will be lost.

Selection of this menu item causes the display page depicted below to appear:

4.4.13 PRINT ENTIRE CONFIGURATION (Cont.)

```
                    PRINTER SET \ RESET SEQUENCE


        +---------------------------------------------------------+
        |                                                         |
SET     |                                                         |
        |                                                         |
        +---------------------------------------------------------+



        +---------------------------------------------------------+
        |                                                         |
RESET   |                                                         |
        |                                                         |
        +---------------------------------------------------------+



PRINTER FORMATTED FOR     80 COLUMNS
```

SET	This allows a sequence of characters to be typed in as a printer SET sequence, as described in the line printer's handbook. Control characters must be typed in as their ASCII code preceded by a back slash (\) (\027 is the Escape character for example). Once the correct SET characters have been typed-in, they are sent to the printer by operation of the <CTRL> <U> keys.
RESET	This allows a sequence of characters to be typed in as a printer RESET sequence, as described in the line printer's handbook. Control characters must be typed in as their ASCII code preceded by a back slash (\). Once the correct RESET characters have been typed-in, they are sent to the printer after every print.
PRINTER FORMATTED FOR	This field allows the number of characters to be printed across the page to be selected as either 80 or 132, by operation of the <RETURN> key, once the ↓ key has been operated from the RESET field. Normally, 80 column mode is used, but for channel/alarm pages, 132 column mode is more useful.

Once the SET and RESET sequences and the print format mode have been entered, operation of the <CTRL> <W> keys causes the print-out to commence. During printing, the following control characters can be used:

<CTRL> <A>	Aborts printing as soon as the printer buffer is empty.
<CTRL> <P>	Causes printing to pause (until <CTRL> <B> keys are operated) as soon as the printer buffer is empty.
<CTRL> <B>	Re-starts printing after print pause (<CTRL> <P>).

Once the 4500 system has stopped transmitting data to the printer, operation of the <CTRL> <E> keys causes a return to the Main Configuration Menu.

4.4.14 SAVE / RECALL FACILITIES

Selection of items 12 or 13 of the main configuration menu calls the SAVE ON DISC or the RECALL OR INITIALISE facility. If an IBM® PC or compatible computer running the 4500 system terminal emulation software, has been connected instead of the VT100 terminal, this facility allows the 4500 configuration to be stored on and recalled from disc

The installation of the terminal emulation software is described in Annex A of this document.

ENTRY TO THE SYSTEM

The terminal emulation software must be invoked on the PC before the 4500 is switched into off-line configuration mode. The software is invoked by typing, at the PC keyboard, 'te4500<RETURN>' from the root directory of the relevant drive. The computer will then initialise itself, and the following display will appear.

```
              4500 Terminal Emulator - V1.1
                Chessell Ltd (c)  1989



        (Select 'Terminal' softkey on 4500 display)
```

The 4500 off-line configuration editor can now be entered by operating the 'Terminal' softkey from the top level menu (as suggested in the display above), and configuration of the 4500 system can be carried out as described above for the VT100 terminal.

Notes...

1. The terminal emulation software incorporates a proprietary software package called Procomm plus. This software produces a status line at the bottom of monochrome monitors. This status is irrelevant to the 4500 user, and may thus be ignored.
2. Procomm Plus uses 'hot keys' to display menus associated with the software communications. These menus are irrelevant to the 4500 user, but if such a key is accidentally used, operation of the <ESC> key will remove the menu, in some case leaving some unwanted text on the screen. This can be removed either by re-calling the main configuration menu (<CTRL> <E>) or by selecting a sub-menu item, according to the current type of display.

4.4.14 SAVE RECALL FACILITIES (Cont.)

SAVE ON DISC

Once configuration is complete, the main menu should be returned to and item 12 (Save on disc) selected. The screen is cleared and the following message displayed:-

`Enter Destination Drive letter`

Operation of the <CTRL> <E> keys with this display present causes a return to the Main Configuration Menu. Otherwise, the required drive letter (normally a, b or c) should be typed, followed by <RETURN>. This will result in a request for the filename in which the configuration is to be stored:-

`Enter Save Filename (without .ext)`

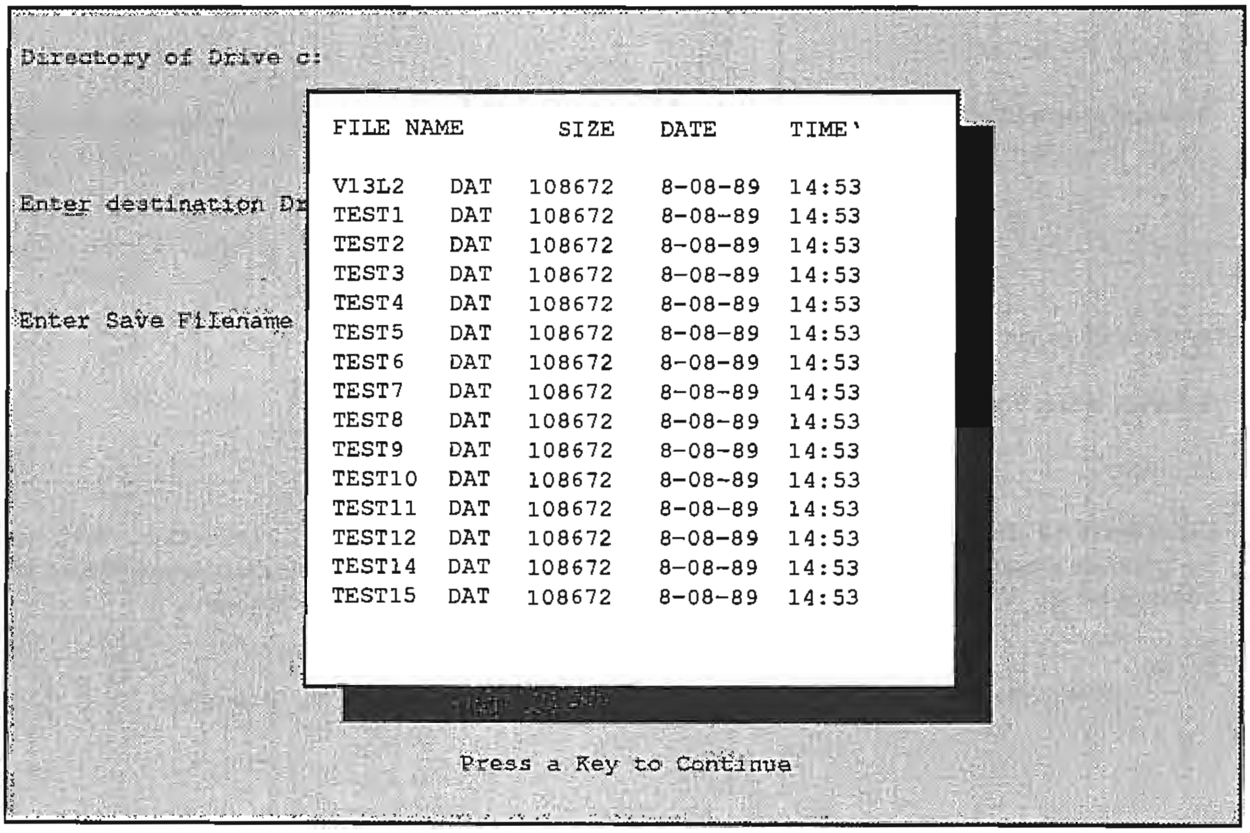
Operation of the <RETURN> key without a file name being entered causes a return to the 'Enter destination drive letter' display, allowing the operator to exit to the main menu. Otherwise, the filename (up to eight characters) should be entered without any extension, followed by <RETURN>. The program will then save the file (with the extension .dat). Should the file already exist on the disc, the following message will be displayed:-

`File already exists - overwrite ? (Y/N)`

<Y> will save the file to the existing file, destroying the original contents. <N> will cause a return to the 'Enter destination drive letter' display.

Note...

Operation of the <?> key followed by <RETURN> in either the 'Enter destination drive letter' or the 'Enter save filename' display, causes a list of files contained in the selected or default destination drive, respectively, to be displayed (example depicted below). Operation of any key causes further file names to be displayed, or returns the operator to the file name or destination drive display according to where the file list was called from.



FILE NAME		SIZE	DATE	TIME
V13L2	DAT	108672	8-08-89	14:53
TEST1	DAT	108672	8-08-89	14:53
TEST2	DAT	108672	8-08-89	14:53
TEST3	DAT	108672	8-08-89	14:53
TEST4	DAT	108672	8-08-89	14:53
TEST5	DAT	108672	8-08-89	14:53
TEST6	DAT	108672	8-08-89	14:53
TEST7	DAT	108672	8-08-89	14:53
TEST8	DAT	108672	8-08-89	14:53
TEST9	DAT	108672	8-08-89	14:53
TEST10	DAT	108672	8-08-89	14:53
TEST11	DAT	108672	8-08-89	14:53
TEST12	DAT	108672	8-08-89	14:53
TEST14	DAT	108672	8-08-89	14:53
TEST15	DAT	108672	8-08-89	14:53

4.4.14 SAVE ON DISC (Cont.)

Once the save data transfer is under way, a 'window' appears on the screen, showing the progress of the transfer.

```
Enter Destination Drive Letter:  c              PROTOCOL: XMODEM
                                               FILE NAME: cfg01.dat
                                               FILE SIZE:
                                             BLOCK CHECK: CRC
Enter Save Filename (without .ext): cfg01   TOTAL BLOCKS:
                                           TRANSFER TIME:
                                             TRANSMITTED:
File already exists - overwrite ? (Y/N)       BYTE COUNT: 4736
                                             BLOCK COUNT: 37
                                             ERROR COUNT: 0
                                            LAST MESSAGE:
                                                PROGRESS

                                           [ ESC to abort transfer ]
```

Note...

Underlined characters represent operator responses.

As can be seen from the above display, operation of <ESC> will cause the transfer to be stopped. Control is returned to the main configuration menu.

RECALL OR INITIALISE

Selection of item 13 at the main configuration menu will result in the following menu to appearing at the display:-

```
1 -- Return to menu
2 -- Load configuration
3 -- New configuration
```

NEW CONFIGURATION

Selection of item 3 will cause the following message to appear:-

```
Erase configuration - are you sure (y/n)
```

Operation of the <N> key causes a return to the Main Configuration Menu. Operation of the <Y> key will cause the complete erasure of the user-entered configuration, leaving the system with its default values, with no I/O channels set up. Once erasure is complete, control is returned to the Main Configuration Menu.

Note...

Depending on the amount of data to be erased, the process will take some time to complete.

4.4.14 SAVE/RECALL FACILITIES (Cont.)

LOAD CONFIGURATION

Selection of item 2 initiates the 'load configuration' process, first clearing the screen, then displaying the message:-

`Enter Source Drive Letter:`

Once the correct source drive letter has been entered, the program will ask for a file name (without extension), as in the 'storing on disc' procedure. If the file name is incorrect, the display returns to the

`Enter Source Drive Letter:` message.

Once the correct file name has been entered, the file transfer begins, and a 'progress' window appears on the screen, as shown below. On completion of the data transfer, control is returned to the main configuration menu.

Note...
Use of the <CTRL> <E> and <?> keys is as described for 'Save on disc' above.

```
Enter Destination Drive Letter:  c              PROTOCOL: XMODEM
                                               FILE NAME: cfg01.dat
                                               FILE SIZE: 10240
                                             BLOCK CHECK: CRC
Enter Save Filename (without .ext): cfg01   TOTAL BLOCKS: 80
                                           TRANSFER TIME: 00:27
                                          TRANSMITTED: 25%
                                              BYTE COUNT: 2560
                                             BLOCK COUNT: 20
                                             ERROR COUNT: 0
                                            LAST MESSAGE:
                                                PROGRESS

                                            [ ESC to abort transfer ]
```

Note...
Underlined characters represent operator responses.

As can be seen from the above display, operation of <ESC> will cause the transfer to be stopped. The screen is cleared, and the message:-

`Press ENTER to continue`

appears. Operation of the <ENTER> key causes the following messages to be displayed:-

```
Transfer failed
Re-initialising configuration
```

During this initialisation, whatever part of the configuration that got downloaded before the abort, is erased. If the abort takes place before transfer starts, the 'Transfer failed' message appears as above, but followed by:-

`No action taken.`

In either case, control is returned to the Main Configuration Menu.

4.4.14 SAVE / RECALL FACILITIES (Cont.)

ERROR DISPLAY

Should an attempt be made to save or recall data to/from disc, without a suitable PC connected and running the appropriate software, the screen of whichever terminal is connected instead will display the following messages:-

```
Sorry,  function not available on this terminal.

Ctrl-E  To return to MENU.
```

In order to carry out the function, it is necessary to exit the off-line configuration facility, connect an appropriate PC fitted with the correct software, and then re-enter off-line configuration, as described above.

4.4.15 RETURN TO ON-LINE OPERATIONS

Operation of the <CONTROL> and <E> keys together from any configuration page returns the editor to the main configuration editor menu. Selection of item 1 (RETURN TO ON-LINE) will cause the following message to appear:-

```
Are you sure (Y/N)
```

Operation of the <N> key results in no action being taken, except to return control to the Main Configuration Menu. Operation of the <Y> key restarts the 4500 system as for a normal power-up. If the terminal emulation software is running, this will exit and return control to MS-DOS.

SECTION 5
SERIAL COMMUNICATIONS

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SECTION 5 SERIAL COMMUNICATIONS

5.1 INTRODUCTION

This section describes the implementation of a serial communications link between a host (supervisory) computer, and a 4500 master unit. Two host communications ports are available, and it is possible to use both at the same time.

This introductory sub-section includes brief descriptions of the RS232 and RS422 standards. Later sub-sections contain details of a) the communications protocols which are currently supported, and b) the byte structures for the transmitted data.

Full details of the electrical installation of a communications link, including pin-outs, cable and connector types, and biasing and termination requirements are to be found in Section 2 of this manual.

5.2 COMMUNICATIONS STANDARDS

Two internationally agreed standards for electrical interconnection are supported, viz: RS232C and RS422. Full details of these standards are beyond the scope of this document, but may be found in the relevant specifications published by Electronic Industries Association, Washington D.C.

5.2.1 RS232C

The RS232 interface is used to wire the host computer to a single instrument, using a relatively short length of cable. The maximum usable distance varies according to a number of parameters including data transmission rate (baud rate), the electro-magnetic environment through which it passes, etc.

5.2.2 RS422

An RS422 data link allows a number of instruments to be wired in parallel to common receive and transmit buses. All the output drivers go into a high impedance state (essentially open-circuit) when not transmitting i.e. outputs are tri-stated.

The maximum number of 4500 systems that can be connected to such a serial link is protocol dependent, as described later.

The maximum length of cable which can be used without 'repeaters' is 1200 metres, (4000 feet).

5 3 TCS BINARY PROTOCOL

The TCS binary protocol (ANSI - X3.28 - 2.5 - A4) defines the control codes, data sequencing and so on required for the successful interchange of information amongst units, using a serial data link. The 4500 system supports a second (operator selectable) protocol (Gould Modicon (MODBUS RTU)) described in a later section.

5.3.1 INTRODUCTION

The 4500 system emulates the TCS 6432 Signal processor as far as communications are concerned.

The BINARY protocol consists of exchanges of control and data bytes which are packaged with 'start', 'stop' and 'parity' bits to form an 11 or 12 bit word, according to set-up. Control bytes (EOT, STX, ETX, ETB, ENQ, ACK, NAK) have their control bit (MSB) set to logic zero. All other bytes have their control bit set to logic 1.

In order for the host to communicate with a 4500, 2 modes of operation are specified: POLLING and SELECTION.

POLLING - used to read data from the instrument into the supervisory computer.

SELECTION - used to write data from the supervisory computer into the instrument.

Each mode is implemented as three procedures :-

a) Establish connection
b) Message transfer
c) Terminate connection

Before describing these procedures in detail, it is necessary to explain the addressing parameters used to define a particular channel in a particular unit.

INSTRUMENT NUMBER (INO)

The instrument number (or address byte) provides the host with the ability to address a particular circuit board slot within a 4500 system. 128 separate addresses are available in an 8-bit byte as follows:-

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1 Data byte	X	X	X	X INO	X	X	X

The base address for each 4500 system is set up as a part of the communications configuration (serial link protocol page). This addresses channels 1 to 8 in slot one of the system. As shown in the table below, each group of 7 or 8 channels is addressed by adding an offset to this basic address. (Within these groups of channels, each individual channel is accessed by means of a parameter number (PNO), discussed below.)

Thus, in a system consisting of three 19 inch racks (11 slots in the master unit, 12 slots in the expansion racks) the address offsets for the first slots are 0 (master), 22 (expansion rack Nº.1), and 46 (expansion rack Nº.2).

Note...

Only enabled I/O slots respond to commands addressed to them. Thus several 4500 systems can be multi-dropped onto a single serial link, by distributing enabled I/O slots appropriately throughout the systems.

5.3.1 TCS BINARY PROTOCOL (Cont.)

4500 channel Nº	INO	4500 channel Nº	INO
1 to 8	Address + 0	459 to 465	Address + 61
9 to 15	Address + 1	466 to 473	Address + 62
16 to 23	Address + 2	474 to 480	Address + 63
24 to 30	Address + 3	481 to 488	Address + 64
31 to 38	Address + 4	489 to 495	Address + 65
39 to 45	Address + 5	496 to 503	Address + 66
46 to 53	Address + 6	504 to 510	Address + 67
54 to 60	Address + 7	511 to 518	Address + 68
61 to 68	Address + 8	519 to 525	Address + 69
69 to 75	Address + 9	526 to 533	Address + 70
76 to 83	Address + 10	534 to 540	Address + 71
84 to 90	Address + 11	541 to 548	Address + 72
91 to 98	Address + 12	549 to 555	Address + 73
99 to 105	Address + 13	556 to 563	Address + 74
106 to 113	Address + 14	564 to 570	Address + 75
114 to 120	Address + 15	571 to 578	Address + 76
121 to 128	Address + 16	579 to 585	Address + 77
129 to 135	Address + 17	586 to 593	Address + 78
136 to 143	Address + 18	594 to 600	Address + 79
144 to 150	Address + 19	601 to 608	Address + 80
151 to 158	Address + 20	609 to 615	Address + 81
159 to 165	Address + 21	616 to 623	Address + 82
166 to 173	Address + 22	624 to 630	Address + 83
174 to 180	Address + 23	631 to 638	Address + 84
181 to 188	Address + 24	639 to 645	Address + 85
189 to 195	Address + 25	646 to 653	Address + 86
196 to 203	Address + 26	654 to 660	Address + 87
204 to 210	Address + 27	661 to 668	Address + 88
211 to 218	Address + 28	669 to 675	Address + 89
219 to 225	Address + 29	676 to 683	Address + 90
226 to 233	Address + 30	684 to 690	Address + 91
234 to 240	Address + 31	691 to 698	Address + 92
241 to 248	Address + 32	699 to 705	Address + 93
249 to 255	Address + 33	706 to 713	Address + 94
256 to 263	Address + 34	714 to 720	Address + 95
264 to 270	Address + 35	721 to 728	Address + 96
271 to 278	Address + 36	729 to 735	Address + 97
279 to 285	Address + 37	736 to 743	Address + 98
286 to 293	Address + 38	744 to 750	Address + 99
294 to 300	Address + 39	751 to 758	Address + 100
301 to 308	Address + 40	759 to 765	Address + 101
309 to 315	Address + 41	766 to 773	Address + 102
316 to 323	Address + 42	774 to 780	Address + 103
324 to 330	Address + 43	781 to 788	Address + 104
331 to 338	Address + 44	789 to 795	Address + 105
339 to 345	Address + 45	796 to 803	Address + 106
346 to 353	Address + 46	804 to 810	Address + 107
354 to 360	Address + 47	811 to 818	Address + 108
361 to 368	Address + 48	819 to 825	Address + 109
369 to 375	Address + 49	826 to 833	Address + 110
376 to 383	Address + 50	834 to 840	Address + 111
384 to 390	Address + 51	841 to 848	Address + 112
391 to 398	Address + 52	849 to 855	Address + 113
399 to 405	Address + 53	856 to 863	Address + 114
406 to 413	Address + 54	864 to 870	Address + 115
414 to 420	Address + 55	871 to 878	Address + 116
421 to 428	Address + 56	879 to 885	Address + 117
429 to 435	Address + 57		
436 to 443	Address + 58		
444 to 450	Address + 59		
451 to 458	Address + 60		

Table 5.3.1a Channel number address offsets

5.3.1 TCS BINARY PROTOCOL (Cont).

PARAMETER NUMBER (PNO)

The parameter number contains details of the parameter to be accessed, as well as the channel number within the group defined by the instrument number (INO), described above. The accessible parameters vary according to the circuit board type in the slot being addressed, as shown in the tables below.

Data is transmitted in one of two formats (explained later in this section) viz: hexadecimal ('H' in the tables below) and twos-complement binary decimal (D in the tables below). An asterisk denotes that the parameter is available for 'enquiry poll', also described below.

CHECKSUM

Two checksum characters are used in the TCS binary protocol, as follows:

CONNECTION CHECK CONTROL (CCC)

This value is the result of computing the individual binary sums (without carry) of each of the seven bits of transmitted characters between EOT at the start of the 'establish connection' procedure and the start of the 'message transfer' procedure.

BLOCK CHECK CONTROL (BCC)

This value is the result of computing the individual binary sums (without carry) of each of the seven bits of the message transfer procedure transmitted characters between STX and ETX or ETB, including ETX (ETB) but not STX.

5.3.1 TCS BINARY PROTOCOL (Cont.)

PNO	Parameter	Format	Comments
0	Instrument ID	H	Always returns '432A'
1	Board type in this slot	H	Always returns '0800' for analogue input board.
2	Historic alarms	H	Always returns '0'
3 to 15	Not used		
16	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
17	High range *	D	First channel's display high range (3 characters).
18	Low range *	D	First channel's display low range (3 characters).
19	High alarm *	D	First channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
20	Low alarm *	D	First channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
21	Value * †	D	First channel's measured value in engineering units (3 characters)
22	Not used		
23	Not used		
24	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
25	High range *	D	Second channel's display high range (3 characters).
26	Low range *	D	Second channel's display low range (3 characters).
27	High alarm *	D	Second channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
28	Low alarm *	D	Second channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
29	Value * †	D	Second channel's measured value in engineering units (3 characters)
30	Not used		
31	Not used		
32	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
33	High range *	D	Third channel's display high range (3 characters).
34	Low range *	D	Third channel's display low range (3 characters).
35	High alarm *	D	Third channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
36	Low alarm *	D	Third channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
37	Value * †	D	Third channel's measured value in engineering units (3 characters)
38	Not used		
39	Not used		
40	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
41	High range *	D	Fourth channel's display high range (3 characters).
42	Low range *	D	Fourth channel's display low range (3 characters).
43	High alarm *	D	Fourth channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
44	Low alarm *	D	Fourth channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
45	Value * †	D	Fourth channel's measured value in engineering units (3 characters)
46	Not used		
47	Not used		
48	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
49	High range *	D	Fifth channel's display high range (3 characters).
50	Low range *	D	Fifth channel's display low range (3 characters).
51	High alarm *	D	Fifth channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
52	Low alarm *	D	Fifth channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
53	Value * †	D	Fifth channel's measured value in engineering units (3 characters)
54	Not used		
55	Not used		
56	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
57	High range *	D	Sixth channel's display high range (3 characters).
58	Low range *	D	Sixth channel's display low range (3 characters).
59	High alarm *	D	Sixth channel's high setpoints for alarms 1 and 2 (absolute elarms only) (3 characters).
60	Low alarm *	D	Sixth channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
61	Value * †	D	Sixth channel's measured value in engineering units (3 characters)
62	Not used		
63	Not used		
64	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
65	High range *	D	Seventh channel's display high range (3 characters).
66	Low range *	D	Seventh channel's display low range (3 characters).
67	High alarm *	D	Seventh channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
68	Low alarm *	D	Seventh channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
69	Value * †	D	Seventh channel's measured value in engineering units (3 characters)
70	Not used		
71	Not used		
72	Channel status * †	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
73	High range *	D	Eighth channel's display high range (3 characters).
74	Low range *	D	Eighth channel's display low range (3 characters).
75	High alarm *	D	Eighth channel's high setpoints for alarms 1 and 2 (absolute alarms only) (3 characters).
76	Low alarm *	D	Eighth channel's low setpoints for alarms 1 and 2 (absolute alarms only) (3 characters)
77	Value * †	D	Eighth channel's measured value in engineering units (3 characters)
78	Not used		
79	Not used		
80 to 111	Not used		

Note...

Any attempt to access channel eight of a group containing only seven channels will result in the return of all zeros.

* Available for enquiry poll if FULL is selected in communications configuration.

† Available for enquiry poll if PARTIAL is selected in communications configuration.

Table 5.3.1b PNOs for Analogue input boards

5.3.1 TCS BINARY PROTOCOL (Cont.)

PNO	Parameter	Format	Comments
0	Instrument ID	H	Always returns '432A'
1	Board type in this slot	H	Always returns '0808' for analogue output board.
2	Historic alarms	H	Always returns '0'
3 to 15	Not used		
16	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
17	High range *	D	First channel's display high range (3 characters).
18	Low range *	D	First channel's display low range (3 characters).
19	Output value *	D	First channel's output value in engineering units (3 characters).
20	High limit *	D	First channel's high output limit (3 characters).
21	Low limit *	D	First channel's low output limit (3 characters)
22	Not used		
23	Not used		
24	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
25	High range *	D	Second channel's display high range (3 characters).
26	Low range *	D	Second channel's display low range (3 characters).
27	Output value *	D	Second channel's output value in engineering units (3 characters).
28	High limit *	D	Second channel's high output limit (3 characters).
29	Low limit *	D	Second channel's low output limit (3 characters)
30	Not used		
31	Not used		
32	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
33	High range *	D	Third channel's display high range (3 characters).
34	Low range *	D	Third channel's display low range (3 characters).
35	Output value *	D	Third channel's output value in engineering units (3 characters).
36	High limit *	D	Third channel's high output limit (3 characters).
37	Low limit *	D	Third channel's low output limit (3 characters)
38	Not used		
39	Not used		
40	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
41	High range *	D	Fourth channel's display high range (3 characters).
42	Low range *	D	Fourth channel's display low range (3 characters).
43	Output value *	D	Fourth channel's output value in engineering units (3 characters).
44	High limit *	D	Fourth channel's high output limit (3 characters).
45	Low limit *	D	Fourth channel's low output limit (3 characters)
46	Not used		
47	Not used		
48	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
49	High range *	D	Fifth channel's display high range (3 characters).
50	Low range *	D	Fifth channel's display low range (3 characters).
51	Output value *	D	Fifth channel's output value in engineering units (3 characters).
52	High limit *	D	Fifth channel's high output limit (3 characters).
53	Low limit *	D	Fifth channel's low output limit (3 characters)
54	Not used		
55	Not used		
56	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
57	High range *	D	Sixth channel's display high range (3 characters).
58	Low range *	D	Sixth channel's display low range (3 characters).
59	Output value *	D	Sixth channel's output value in engineering units (3 characters).
60	High limit *	D	Sixth channel's high output limit (3 characters).
61	Low limit *	D	Sixth channel's low output limit (3 characters)
62	Not used		
63	Not used		
64	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
65	High range *	D	Seventh channel's display high range (3 characters).
66	Low range *	D	Seventh channel's display low range (3 characters).
67	Output value *	D	Seventh channel's output value in engineering units (3 characters).
68	High limit *	D	Seventh channel's high output limit (3 characters).
69	Low limit *	D	Seventh channel's low output limit (3 characters)
70	Not used		
71	Not used		
72	Channel status *	H	Gives decimal point position (bits 12 to 15), checksum failure status (bit 3), out of range (bit 2)
73	High range *	D	Eighth channel's display high range (3 characters).
74	Low range *	D	Eighth channel's display low range (3 characters).
75	Output value *	D	Eighth channel's output value in engineering units (3 characters).
76	High limit *	D	Eighth channel's high output limit (3 characters).
77	Low limit *	D	Eighth channel's low output limit (3 characters)
78	Not used		
79	Not used		
80 to 111	Not used		

Note...

Any attempt to access channel eight of a group containing only seven channels will result in the return of all zeros.

* Available for enquiry poll (full or partial).

Table 5.3.1c PNOs for Analogue output boards

5.3.1 TCS BINARY PROTOCOL (Cont.)

PNO	Parameter	Format	Comments
0	Instrument ID	H	Always returns '432A'
1	Board type in this slot	H	Always returns '0810' for digital input board.
2	Historic alarms	H	Always returns '0'
3 to 15	Not used		
16	Channel status *	H	Indicates checksum status (bit 3 set for a failure in any channel).
17	Not used		
18	Discrete input states *	H	Bitwise word, giving input status on 8 channels
19 to 111	Not used		

Note...

Any attempt to access channel eight of a group containing only seven channels will result in the return of all zeros.

* Available for enquiry poll (full or partial).

Table 5.3.1d PNOs for Digital input boards

PNO	Parameter	Format	Comments
0	Instrument ID	H	Always returns '432A'
1	Board type in this slot	H	Always returns '0818' for digital output board.
2	Historic alarms	H	Always returns '0'
3 to 15	Not used		
16	Channel status *	H	Indicates checksum status (bit 3 set for a failure in any channel).
17	Not used		
18	Discrete input states *	H	Bitwise word, giving output status on 8 channels
19 to 111	Not used		

Note...

Any attempt to access channel eight of a group containing only seven channels will result in the return of all zeros.

* Available for enquiry poll (full or partial).

Table 5.3.1e PNOs for Digital output boards

5.3.2 READING DATA FROM A LOGICAL UNIT (POLLING)

Three types of polling are described below: the single parameter poll, the multiple parameter poll and the enquiry poll. The procedures are similar to one another, so only the single parameter poll is fully described, the unique properties of the other two types being identified in separate sub-sections.

SINGLE PARAMETER POLL

Data is requested by the supervisory computer using the polling sequence illustrated in figure 5.3.2a. The figure shows the sequence divided into 3 procedures:-

a) Establish connection
b) Message transfer
c) Terminate connection

ESTABLISH CONNECTION PROCEDURE

Initially, the supervisory computer has master status, and begins the establish connection procedure by transmitting a polling message:-

EOT INO PNO CCC ENQ

This message identifies a logical unit using the group and unit numbers described above.

NOTE...

The spaces between characters have been entered in this example only for the sake of clarity. Such spaces must not be entered when transmitting messages.

EOT
The control character EOT resets the data link to all associated instruments. This causes each instrument to examine the next 4 characters to see if they address one of its channels.

INO
This is the instrument number described above.

PNO
This is the parameter number described above.

CCC
This is the Connection Check Control character described above

ENQ
The polling message is terminated by the ENQ control character.

5.3.2 SINGLE PARAMETER POLL (Cont.)

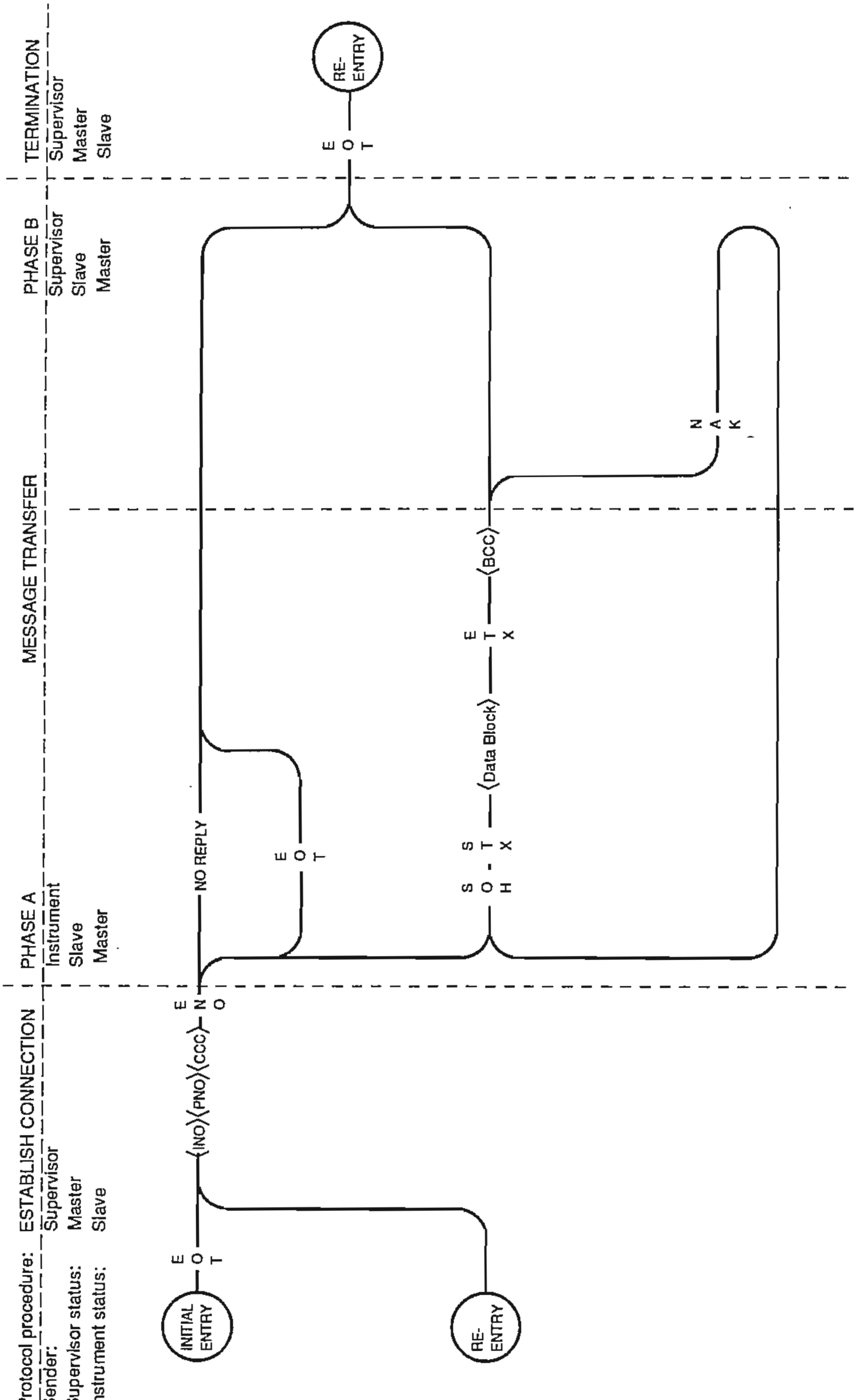


Figure 5.3.2a Single parameter polling sequence

5.3.2 SINGLE PARAMETER POLL (Cont.)

MESSAGE TRANSFER PROCEDURE

After the supervisory computer has transmitted the ENQ character, the protocol enters the Message Transfer procedure. Figure 5.3.2a shows that this procedure takes place in 2 phases:-

a) Phase A - instrument is the sender
b) Phase B - supervisory computer is the sender

Phase A

1. POLLING COMPLETE RESPONSE. Once the 4500 has recognised the instrument and parameter numbers, it assumes master status, and transmits the following message.

SOH STX PNO D1 D2 D3 ETX BCC

NOTE... The spaces between characters have been entered in this example only for the sake of clarity. Such spaces are not part of the transmitted message.

SOH STX prefixes the message being sent to the computer.

PNO is the parameter number discussed above.

D1 to D3 are the data bytes in which the value of the parameter is held. Data byte structure is described in a later section.

ETX terminates the message so that the computer is made aware that the next character is the block check control (BCC).

BCC is generated from the previous 5 bytes (PNO, D1, D2, D3, ETX).

2. POLLING INCOMPLETE RESPONSE. If the instrument recognises the instrument number and agrees with the CCC character, but finds that the parameter number is invalid, it terminates its master status by transmitting an EOT character.

3. NO RESPONSE. If the instrument number is not recognised, or if there is some error in, for example, parity or baud rate setting, or if there is a fault in the data link or instrument hardware or if the CCC character is not compatible with the transmitted data, no (valid) response will be made to the host computer. In such a case, the host will time-out and retaining master status, enter the 'termination' procedure described below.

Phase B

1. POLLING COMPLETE RESPONSE. Following a polling complete response, the protocol enters phase B, where the host computer becomes the sender.

If the host responds with NAK (negative acknowledge) the instrument re-transmits the value of the last parameter polled. The NAK response is made either if an error occurred in the last message, or if the host computer wishes to monitor one particular channel continuously. Once the host has read all the required data, it enters the termination procedure.

2. POLLING INCOMPLETE RESPONSE. Following a polling incomplete response, the protocol enters phase B. In this case, the host must enter the termination procedure prior to further polling or selection.

3. FOLLOWING NO RESPONSE. The host computer should time out, retain master status, and enter the termination procedure.

5.3.2 SINGLE PARAMETER POLL (Cont.)

TERMINATION PROCEDURE

The termination procedure is entered under the following circumstances:-

a. The host computer wishes to stop polling a particular logical unit or parameter.
b No response is received from a polled logical unit.
c. The polled logical unit responds with an EOT.

The computer assumes master status and transmits an EOT to re-set the data link. It then starts a new polling sequence, performs a selection sequence (described later) or idles until a further parameter is to be accessed.

MULTIPLE PARAMETER POLL (Figure 5.3.2b)

The multiple parameter poll is identical to the single parameter poll (described in the previous sub-section) with the following exceptions:

ESTABLISH CONNECTION PROCEDURE

An extra parameter (count number) is transmitted as a part of the establish connection procedure:

EOT INO PNO $\underline{\underline{\text{CNO}}}$ CCC ENQ

This seven-bit count number allows to up to 127 parameters (starting at PNO) to be accessed in response to a single polling request. A CNO of 1 means that only the PNO parameter would be polled. A CNO of 3 means that PNO and the two subsequent parameters would be polled.

POLLING COMPLETE RESPONSE (CNO ≤ 8)

Once the 4500 has recognised the instrument, parameter and count numbers, and has agreed the connection check control character (CCC) it assumes master status and transmits the following message:

```
STX PNO[1] D1 D2 D3
    PNO[2] D1 D2 D3
    PNO[3] D1 D2 D3
    ↓
    PNO[x] D1 D2 D3
    ↓
    PNO[N] D1 D2 D3 ETX BCC
```

Where PNO[1] is the PNO of the establish connection procedure, and [N] is equal to the count number (CNO) of the establish connection procedure. (In the above example, it is assumed that the CNO is greater than three.) In phase B of the message, the host transmits a NAK or enters the termination procedure as for the single parameter poll described above. If CNO is > 8, then more than one group of 8 data blocks has to be transmitted, as described in the following sub-section.

5.3.2 MULTIPLE PARAMETER POLL (Cont.)

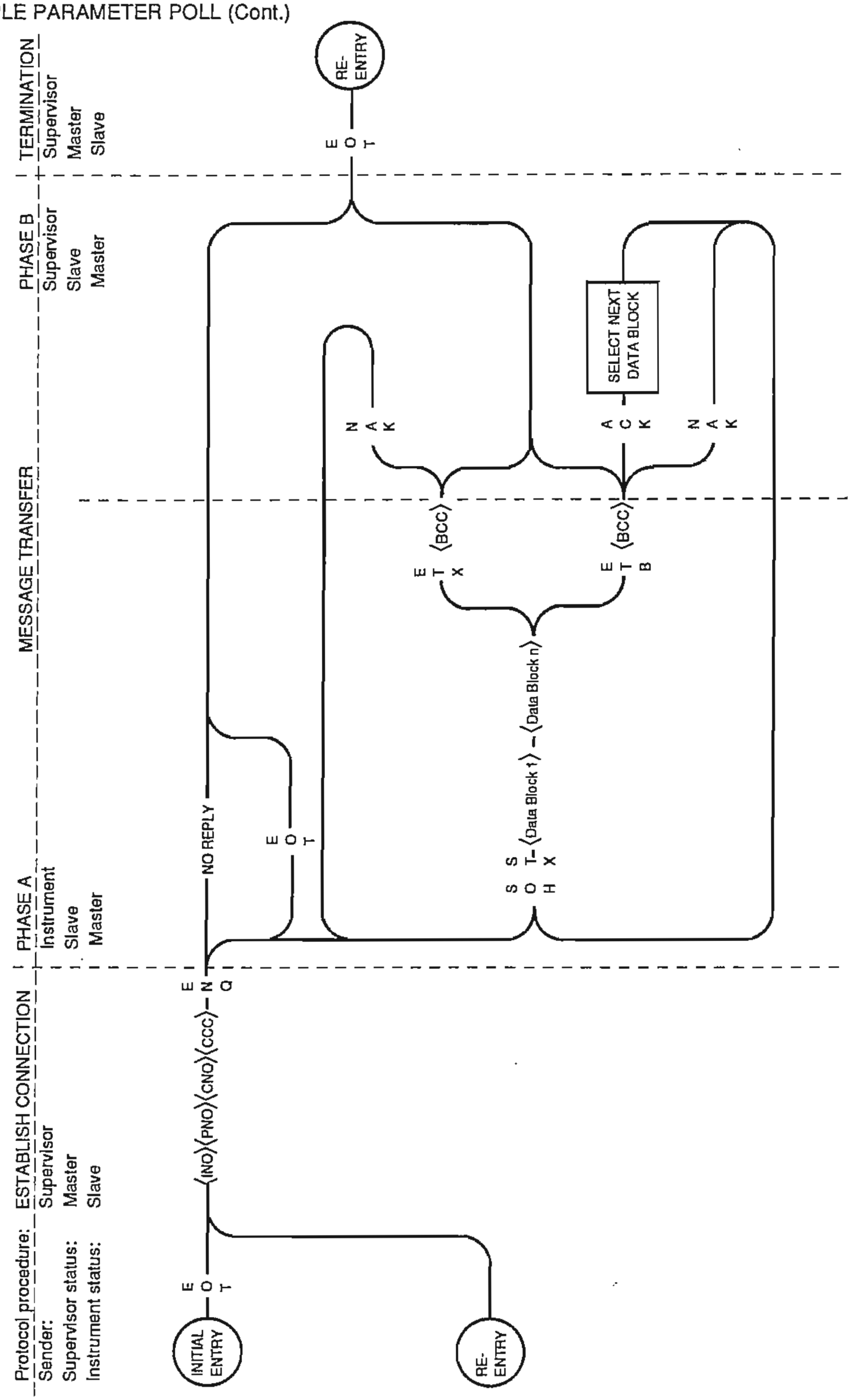


Figure 5.3.2b Multiple parameter polling sequence

5.3.2 MULTIPLE PARAMETER POLL (Cont.)

POLLING COMPLETE RESPONSE (CNO > 8)

Once the 4500 has recognised the instrument, parameter and count numbers, and has agreed the connection check control character (CCC), it assumes master status and transmits the following messages:

```
STX PNO[1] D1 D2 D3
    PNO[2] D1 D2 D3
    PNO[3] D1 D2 D3
    ↓
    PNO[x] D1 D2 D3
    ↓
    PNO[8] D1 D2 D3 ETB BCC
```

Should the host wish to re-poll this block, it sends a NAK. Alternatively, the host may leave the multiple parameter poll by entering the termination procedure, described above (for the single parameter poll). If the next set of blocks is to be transmitted, the host responds with an ACK.

```
STX PNO[9] D1 D2 D3
    PNO[10] D1 D2 D3
    PNO[11] D1 D2 D3
    ↓
    PNO[x] D1 D2 D3
    ↓
    PNO[16] D1 D2 D3 ETB BCC
```

If 8 < CNO < 17, then the above message is replaced by a polling complete message similar to that immediately above, but with ETX replacing the ETB, and the final PNO number = to CNO.

In a similar way, for CNOs > 16, all the data blocks are transmitted in groups of eight, followed by an ETB (End of text block) message, until all the required data blocks have been sent, when an ETX character is sent to indicate the end of transmission. (I.E. The final message is a polling complete message.)

ENQUIRY POLL

This facility allows a polling sequence to read only that data which has changed since the last poll, causing a significant reduction in communications traffic in most applications.

The enquiry poll is identical to the multiple parameter poll (described above) with the following exceptions:

ESTABLISH CONNECTION PROCEDURE

The establish connection procedure does not contain a parameter number (PNO) or count number (CNO)

EOT INO CCC ENQ

5.3.2 ENQUIRY POLL (Cont.)

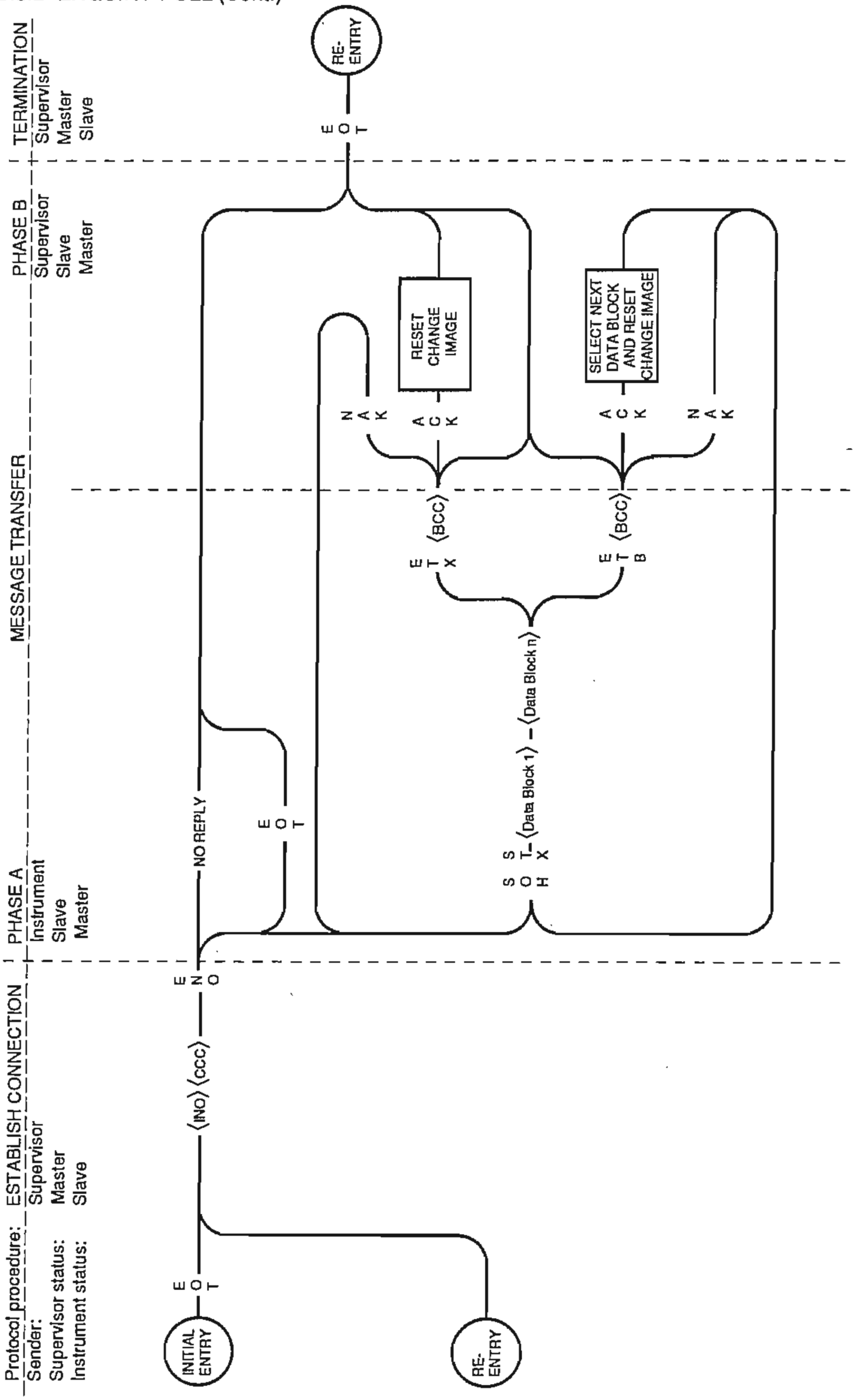


Figure 5.3.2c Enquiry polling sequence

Figure 5.3.2c Enquiry polling sequence

5.3.2 ENQUIRY POLL (Cont.)

POLLING INCOMPLETE MESSAGE

Once the 4500 has recognised the INO and checked the CCC for validity, if the number of changed parameters is eight or less, the message below is transmitted. If the number of parameters is more than eight, a number of 'polling incomplete' messages (described below) are transmitted before this polling complete message.

```
STX PNO[1] D1 D2 D3
    PNO[2] D1 D2 D3
    ↓
    PNO[X] D1 D2 D3
    ↓
    PNO[N] D1 D2 D3 ETX BCC
```

Where PNO[X] is the parameter number of the xth changed parameter, and N is the parameter number of the final changed parameter.

POLLING INCOMPLETE MESSAGE

As with the multiple parameter polling, if the number of parameters which have changed is greater than eight, then one or more polling incomplete messages are sent. For blocks 1 to 8, the following message would be sent:

```
STX PNO[1] D1 D2 D3
    PNO[2] D1 D2 D3
    PNO[3] D1 D2 D3
    PNO[4] D1 D2 D3
    PNO[5] D1 D2 D3
    PNO[6] D1 D2 D3
    PNO[7] D1 D2 D3
    PNO[8] D1 D2 D3 ETB BCC
```

The next message would contain PNOs [9[to [16] and so on until the remaining number of blocks is eight or less, when a 'polling complete' message is sent, as described above.

Note...

These PNOs are 'change data' only.

NO CHANGE DATA

If none of the parameters has changed value since the previous poll, then the system responds by transmitting an EOT.

PHASE B

The host responds with an ACK for each successfully transmitted data block. The 4500 system can then re-set the 'change' bits which are used to indicate which parameters have to be transferred.

Notes...

1. It is only the host computer's sending of an ACK which initiates the change bit re-set. The 4500 system will ignore all other characters (except EOT) sent to it, once it has started transmitting. If EOT is sent, without a preceding ACK, then the last successfully transmitted block will be re-transmitted next time round, because the change bits have not been reset.
2. All change bits are reset at power-up to ensure that all parameters are sent at the first enquiry poll.

5.3.3 WRITING DATA TO A LOGICAL UNIT (SELECTION)

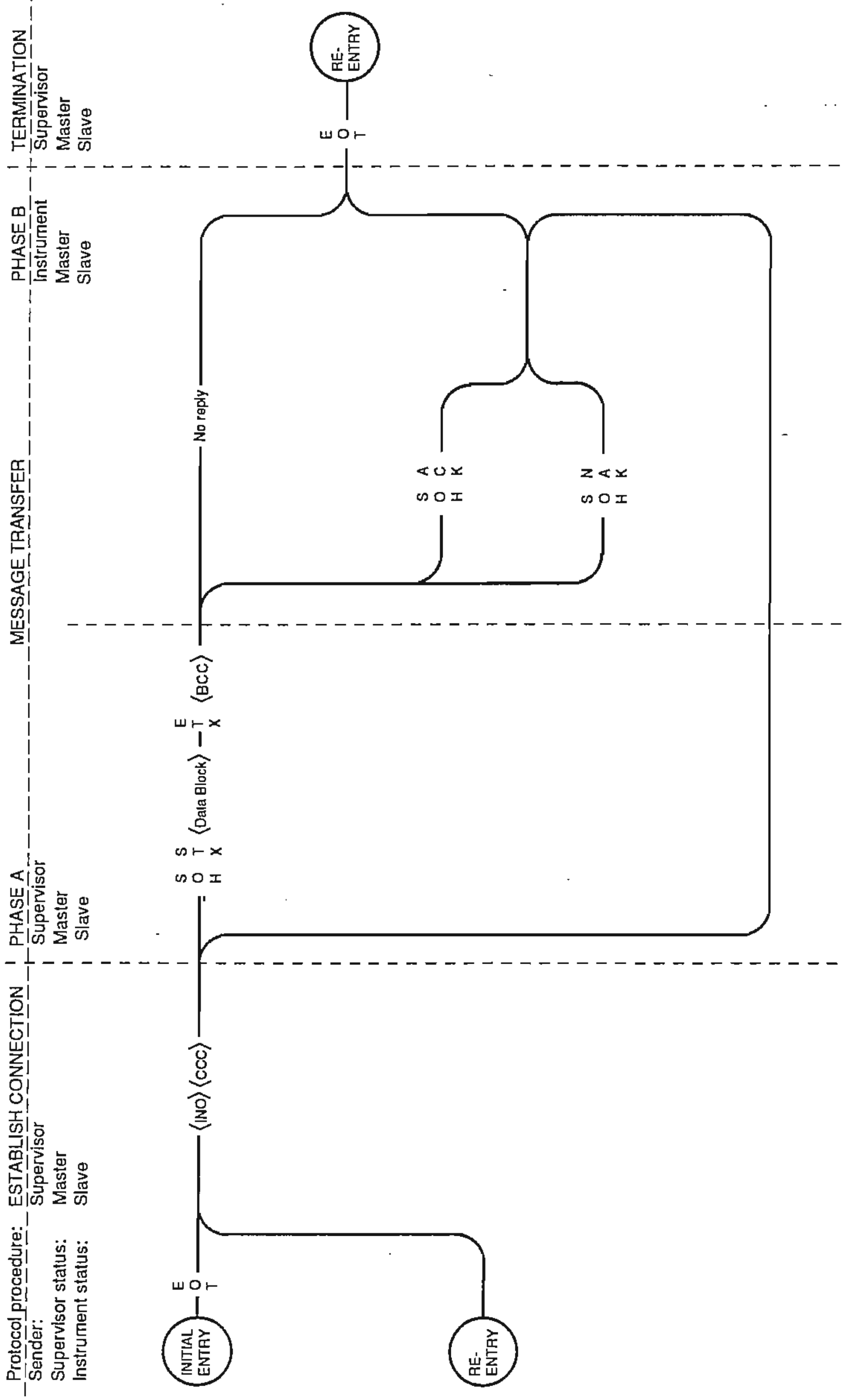


Figure 5.3.3 Selection sequence for writing to a 4500 system

5.3.3 WRITING DATA TO A LOGICAL UNIT (SELECTION)

Data is written to a logical unit using the selection sequence shown in figure 5.3.3 The figure shows the sequence to be divided into 3 procedures:-

a. Establish connection
b. Message transfer
c. Terminate connection

ESTABLISH CONNECTION PROCEDURE

The supervisory computer retains master status throughout the selection sequence. The sequence is started by the transmission of the following:

EOT INO CCC

Each of these characters is defined in previous sections.

NOTE... The spaces between characters have been entered in this example only for the sake of clarity. Such spaces must not be entered when transmitting messages.

Once the instrument number (INO) recognised, and the CCC successfully checked, the sequence enters the message transfer procedure.

MESSAGE TRANSFER PROCEDURE

Figure 5.3.3 shows that this procedure is split into two phases:-

a. Phase A - host is the sender
b. Phase B - instrument is the sender

PHASE A

After the establish connection procedure, this phase is entered directly, and the addressed logical unit reads the second part of the selection message:-

SOH STX PNO D1 D2 D3 ETX BCC

NOTE... The spaces between characters have been entered in this example only for the sake of clarity. Such spaces must not be entered when transmitting messages.

As soon as the addressed unit receives the message, it performs the following tasks:-

a) It calculates the BCC from PNO to ETX inclusive, and verifies that it corresponds with the BCC sent from the computer. If no error is found:-

b) It verifies that the PNO is valid. If it is,

c) It verifies that D1 D2 AND D3 contain valid data. If so:-

e) It updates the selected parameter with the new value.

5.3.3 MESSAGE TRANSFER PROCEDURE (Cont.)

PHASE B

If the parameter is updated successfully and the validity checks are correct, the 4500 responds with an acknowledge (ACK) indicating that the message was accepted as being correct, and that the selection has been performed. At this stage, the host may enter the termination procedure, or transmit a further message to the same channel group.

Negative acknowledge

If any of the errors listed below is detected, a negative acknowledge (NAK) character is transmitted. Upon receipt of this, the supervisor computer may enter the termination procedure outlined below, or it may remain in the message transfer procedure and transmit the same, or a different message.

A NAK is returned if any of the following is true:-
1. The parameter number (PNO) is invalid, or refers to a read-only parameter.
2. Any of the data characters is invalid.
3. The BCC does not agree with the transmitted value.

After transmitting an ACK or NAK, the 4500 ignores all characters except STX or EOT.

No response

If any of the errors listed below is detected, the 4500 will make no response to the selection message. The host computer should time-out and enter the termination procedure.

No response is made if any of the following is true:-
1. The instrument number (INO) is not recognised.
2. An error (eg. parity) found in any of the characters up to STX inclusive.
3. Baud rate incorrectly set.
4. Noise on, or failure in the communications link.
5. 4500 in off-line configuration mode, and thus not communicating.

TERMINATION PROCEDURE

The termination procedure is entered under the following circumstances:-

1) The host computer has completed the selection process for that particular logical unit.
2) No response is received to a selection message.

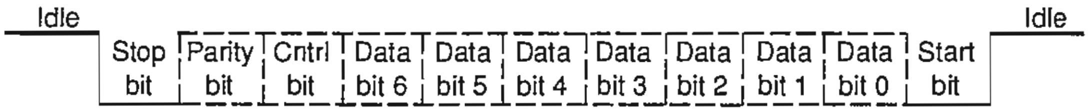
The host retains master status, and transmits an EOT character. and then either starts a new selection or polling sequence, or it enters an idle state until a further parameter is to be accessed.

5.3.4 DATA BYTE FORMATTING

Data is transferred between host computer and 4500 system as a stream of control and data bytes as discussed above. This section describes how the data bytes are assembled.

DATA PACKING

Figure 5.3.4a shows the structure of a typical data byte, set up with 1 start bit, 7 data bits, 1 control bit, 1 parity bit (even), and 1 stop bit.



1 start bit, 7 data bits, 1 control bit, 1 parity bit, 1 stop bit

Figure 5.3.4a Data byte structure

In the non-transmitting state, the transmission line is held at logic 1 (MARK or OFF). As soon as the host computer or instrument is ready to transmit a character, it drives the line low to a logic 0 (SPACE or ON) state for one bit period. This is called the START bit and it is used to state that a stream of data is on its way so that the receiver can synchronise with the data stream. The binary code for the character being transmitted is then sent starting with the least significant bit (bit 0). Following this are the parity bit and the stop bit which sets the line high again.

The various codes associated with all the characters used in the protocol are as follows:

Control character	Decimal value	Hex value	Binary code
SOH	1	1	0 000 0001
STX	2	2	0 000 0010
ETX	3	3	0 000 0011
EOT	4	4	0 000 0100
ENQ	5	5	0 000 0101
ACK	6	6	0 000 0110
NAK	21	15	0 001 0101
ETB	23	17	0 001 0111

Control bit

Bit 0

Table 5.3.4a Control character binary codes

The most significant bit of the binary code is set to zero for control characters, and set to 1 for data characters.

5.3.4 DATA BYTE FORMATTING (Cont.)

DATA FORMATS

Each accessible parameter has one of two formats allocated to it. Only the specified format may be used for any particular parameter, and these formats must be established in the host's data base. The format for each parameter is given in the PNO tables above.

DECIMAL FORMAT.

Parameters are transmitted as three data bytes, D1 to D3 as shown in figure 5.3.4b. Bit 7 of each of these data bytes is set to logic 1 to indicate that the characters are data characters and not control characters (bits 7 set to logic 0). Bits 2 to 6 of D1 contain information relating to the position of the decimal point as shown in the table below. The remaining 16 bits (bits 0 to 6 of data byte 3, bits 0 to 6 of data byte 2 and bits 0 and 1 of data byte 1 are a 'twos complement' binary equivalent of the decimal value. (See example below.)

Data byte	D1			D2		D3	
Bit number	7	6 5 4 3 2	1 0	7	6 5 4 3 2 1 0	7	6 5 4 3 2 1 0
Data	1	Parameter Format	Bits 15, 14	1	Bits 13 to 7	1	Bits 6 to 0

16-bit data field (2s complement).

Figure 5.3.4b Data byte packing

When writing to the 4500 system, the decimal point may be positioned in any one of five positions and, leading and trailing zeros may be entered as desired. For example, .3000 is as acceptable as 000.3.

Format number		Decimal point position
Decimal	Bit 6 5 4 3 2	
0	0 0 0 0 0	NNNN.
1	0 0 0 0 1	NNN.N
2	0 0 0 1 0	NN.NN
3	0 0 0 1 1	N.NNN
4	0 0 1 0 0	.NNNN

Table 5.3.4b Decimal point format number

5.3.4 DECIMAL FORMAT (Cont.)

EXAMPLE.

Disregarding start, stop and parity bits, the contents of the data bytes D1 to D3 are as follows for a decimal value of -23.45

The decimal point is positioned according to bits 2 to 6 of D1 as shown in the table above. From this table, bits 6 to 2 are 0 (bit 6) 0 0 1 0 (bit 2). From the data packing diagram (figure 5.3.4b) above, bit 7 is set to 1 because the data bytes contain a value rather than a command code (bit 7 set to 0).

In order to determine the remaining bits, the value 2345 has to be converted to binary, and because it is a negative value, the twos complement of this number is taken (invert and add binary 1).

A full discussion of the conversion of decimal to binary values is beyond this document. For the purposes of this example, the value 2345 is equal to 1 x 2048 (2^{11} - bit 11) + 1 x 256 (2^8 - bit 8) + 1 x 32 (2^5 - bit 5) + 1 x 8 (2^3 - bit 3) + 1 x 1 (2^0 - bit 0), so written out as a 16-bit word, 2345_{10}= 0000 1001 0010 1001_2. To take the twos complement of this (i.e. to make it a negative number) each bit is inverted and binary 1 is added to it, as shown below. It should be noted, that bit 15 (MSB) is used only as a sign bit; i.e. it is set to 0 for positive numbers and to 1 for negative numbers.

Positive binary number	=	0000 1001 0010 1001
Complement of the positive binary number	=	1111 0110 1101 0110
Add binary 1 to produce		1111 0110 1101 0111
Ensure the most significant bit (bit 15) is 1	=	1111 0110 1101 0111

Sub-divide the number into two 7-bit and one 2-bit sections:

= 11 1101101 1010111

Pack this data into the data bytes D1 to D3 as follows (note the most significant bit of each data byte =1 to show that the byte contains data and not a control code).

Data byte 1	=	1 0 0 0 1 0 1 1
Data byte 2	=	1 1 1 0 1 1 0 1
Data byte 3	=	1 1 0 1 0 1 1 1

HEXADECIMAL FORMAT

Hex format parameters are held in the recorder as 16-bit words. The data is packed into the three data bytes as follows: D1 contains the parameter code 00000 and bits 14 and 15 of the hex word. D2 and D3 hold bits 13 to 7, and 6 to 0 respectively. (See fig 5.3.4b above).

EXAMPLE

The hex. value 080F will be packed as follows:

D1	D2	D3
100000<u>00</u>	1 <u>010000</u>	1 <u>001111</u>

Where the underlined areas are the hex value, distributed amongst the 3 data bytes.

5.4 GOULD MODICON MODBUS PROTOCOL

The 4500 acts as a slave Modbus device the unit address being set up as a part of the 4500 Communications configuration (ref section 4) when the Modbus RTU protocol is selected.

Only a limited number of function codes have been implemented (ref Modbus protocol manual) and these are listed in table 5.4 below.

5.4.1 ADDRESSING

The base address specified (ref table 5.4) is the address at which channel one may be accessed. **It should be noted that the addressing starts at zero, whilst the channel numbers start at 1.**

Example 1. To read a digital input at channel 23, the required address passed with the function 01 message is 22.

Example 2 To read the low limit of an analogue output at channel 145, the required address passed with function message 03 is 2144

If an alarm is set for an analogue input channel, the associated alarm parameters can be read, again by using message 03. The interpretation of the alarm parameters (A1 to A4, SP1 to SP4) in table 5.4 are as follows:

ALARM TYPE	PARAMETER	DEFINITION
Absolute	A1 to A4	Set point values
Absolute	SP1 to SP4	Not used
Deviation	A1 to A4	Deviation value
Deviation	SP1 to SP4	Set point value
Rate	A1 to A4	Rate value
Rate	SP1 to SP4	Period value in secs.

Thus, to read the set point of alarm two on channel 566, the address passed with the 03 message would be 5565.

Note...

The read-alarm values do not imply that an alarm is set, since any request to read a non-existant setpoint value will result in the value 0000 being returned. This should not be interpreted as a setpoint value of zero.

5.4.2 READING ANALOGUE INPUTS

The values read are in the hex range 0000 to 7FFF. To obtain the scaled relative value, the following calculation has to be carried out:

$$Scaled\ value = \left(\frac{High\ range - low\ range}{7FFF} \times Analogue\ input\right) + low\ range$$

where the analogue input is in hex.

5.4 MODBUS RTU (Cont.)

CODE	FUNCTION	4500 ACTION	CHANNEL BASE ADDRESS (DECIMAL)
01	Read coil status	Read digital output channel	0
02	Read input status	Read digital input status	0
		Read alarm 1 status	1000
		Read alarm 2 status	2000
		Read alarm 3 status	3000
		Read alarm 4 status	4000
		Read out-of-range status	5000
		Read Comms error status	6000
03	Read holding registers	1) Analogue output value	0
		2) Analogue output high limit	1000
		3) Analogue output low limit	2000
		4) Analogue input A1	0
		5) Analogue input A2	1000
		6) Analogue input A3	2000
		7) Analogue input A4	3000
		8) Analogue input SP1	4000
		9) Analogue input SP2	5000
		10) Analogue input SP3	6000
		11) Analogue input SP4	7000
04	Read input registers	Reads analogue input channel value	0
05	Force single coil	Sets a digital output channel	0
06	Preset single register	For analogue input channels, alarm conditions can be set; for analogue output channels, the output value and the high and low limits can be set. Base addresses as for code 03.	
08	Loopback test	Diagnostic code 0. Echoes message as sent.	
15	Force multiple coils	Sets the digital outputs in each channel as specified by the address range.	0
16	Preset multiple registers	Sets the analogue output for each channel as specified by the address range.	0

EXCEPTION RESPONSES

CODE	FUNCTION	4500 ACTION	CHANNEL BASE ADDRESS (DECIMAL)
02	Illegal data address	Illegal channel address referenced	0
03	Illegal data value	Data illegal or out of range	0

Table 5.4 Modbus implementation

5.4 MODBUS RTU (Cont.)

5.4.3 CONFIGURATION READ / WRITE

Four function codes, 65 to 68 (hex 41 to 44), are available for accessing system (65 and 66) and channel (67 and 68) configuration.

FUNCTION CODE 65 - READ SYSTEM CONFIGURATION

Function code 65 (hex 41) allows a host to read the system configuration by sending the following message:

Instrument ID (1 byte); 65 (decimal); 0000; 0001; CRC (2 bytes)

The response from the 4500 will be:

Instrument ID (1 byte); 65 (decimal); Byte count (1 byte); Data (see below); CRC (2 bytes)

The data sent will be as follows:

Byte Nº(s)	Nº of Bytes	Byte content
1	1	Number of slots (7 or 11) in master rack
2 to 5	4	Number of slots in expansion racks 1 (byte 2) to 4 (byte 5)
6	1	Reserved
7 to 65	59	Board type fitted in master rack slot 1 (byte 7) to expansion rack four - slot 12 (byte 65) as defined below. Note that all 59 bytes must have a value associated with them.
66	1	Reserved.
67 to 68	2	Latched global alarm channel number
69 to 70	2	Non-latched global alarm channel number
71 to 72	2	Global alarm acknowledge channel number
73 to 74	2	Year (e.g. 1991). If 0 sent during write, year retains previous value until 1st January.
75	1	Month number (1 to 12). If 0 sent during write, month retains value until end of month.
76	1	Day number (1 to 31), If 0 sent during write, day number retains value until midnight.
77	1	Hour number (0 to 23). If 0 sent during write, hour retains value until normal change.
78	1	Minutes (0 to 59). If 0 sent during write, minutes retain value until normal change.
79	1	Seconds (0 to 59). If zero sent during write, seconds retain value until normal change.
80	1	Reserved.

Table 5.4.3a System configuration data byte definition

SLOT DEFINITION

The 4500 system assumes all units to be rack mounting units, having 11 I/O slots in the master unit, and 12 in the expansion units, giving a maximum number of slots of 59. Where panel or bench mounting units are used, having 7 slots in the master unit, and 8 in the expansion units, the missing slots are still counted, and must be defined as being empty. No matter what kind of units are in use, the first slot in expansion unit one is slot 12, the first slot in expansion unit two is 24, in expansion unit 3: 36 and in expansion unit 4: 48.

Where an expansion unit is not used, all its slots must be defined as empty for this function to work.

Note...
The 4500 carries out no error checking on the configuration data sent to it. The user must ensure that only valid data is sent, as invalid data can cause the system to malfunction. Reserved bytes can take any value.

5.4.3 MODBUS RTU FUNCTION CODE 65 (Cont.)

BOARD TYPE CODES

The codes to be fitted into bytes 7 to 65 are as follows:

Board type	Code
Six channel dc input	0
Six channel RTD input	1
15 channel isolated analogue input	2
15 channel non-isolated analogue input	3
Eight channel analogue output	4
15 channel digital I/O	5
Four channel relay output	6
Eight channel analogue output	7
15 channel pseudo analogue input	8
15 channel pseudo analogue output	9
15 channel pseudo digital I/O	10
Empty	11

Table 5.4.3b Board type codes

FUNCTION CODE 66 - WRITE SYSTEM CONFIGURATION

Code 66 (Hex 42) is used to write a system configuration to the 4500. The message sent is as follows

Instrument ID (1 byte); 66; 0000; Data (see below); CRC (2 bytes).

The response from the 4500 will be as follows:

Instrument ID (1 byte); 66; 0000; CRC (2 bytes)

The data to be sent is as described for function 65 above.

FUNCTION CODE 67 - READ CHANNEL CONFIGURATION

Code 67 (Hex 43) allows a host to read channel configuration from the 4500 by sending the following message:

Instrument ID (1 byte); 67; (channel number -1) (2 bytes); 0001; CRC (2 bytes)

The response from the 4500 will be:

Instrument ID (1 byte); 67; Byte count (1 byte); Data (see below); CRC (2 bytes)

The channel data sent depends on the type of board being addressed, as depicted in the tables below for analogue input, analogue output and digital input-output boards.

FUNCTION CODE 68 - WRITE CHANNEL CONFIGURATION

Code 68 (Hex 44) allows a host to send a channel configuration to the 4500, using the following message:

Instrument ID (1 byte); 68, (channel number-1) (2 bytes); Data (see below); CRC (2 bytes)

The response from the 4500 system will be:

Instrument ID (1 byte); 68, (channel number -1) (2 bytes); CRC (2 bytes)

The channel data sent depends on the type of board being addressed, as depicted in the tables below for analogue input, analogue output and digital input-output boards.

MODBUS RTU CHANNEL CONFIGURATION (Cont.)

Byte Number(s)	Number of bytes	Byte content
1	1	Input type 0 = Thermocouple 1 = RTD 2 = mV 3 = V 4 = mA
2	1	Input units 0 = °C 1 = °F 2 = R 3 = K
3	1	External CJ units 0 = °C 1 = °F 2 = R 3 = K
4	1	mA-input shunt units 0 = kΩ 1 = Ω
5 to 10	6	Input range low limit (ASCII), with optional decimal point / sign. Spaces must be filled
11 to 16	6	Input range high limit (ASCII), with optional decimal point / sign. Spaces must be filled
17, 18	2	Attenuator value (Voltage inputs) or shunt resistance value in byte 4 units (mA inputs). Attenuator values (decimal): 0 = times 1 10 = times 100
19	1	CJ type 0 = Off 2 = External 1 = Internal 3 = Remote
20	1	Filter/change selection 0 = Filter 1= Change
21, 22	2	For remote CJ (byte 19), the channel number, or for external CJ, the external CJ temperature entered as a number between -32767 and +32767, representing -999 to + 999 units as defined in byte 3.
23, 24	2	Filter time (0 to 255 seconds) or 10 times change percentage (eg 95 = 9.5% change)
25 to 30	6	Linearisation range low value (ASCII), with optional decimal point/sign. Spaces must be filled
31 to 36	6	Linearisation range high value (ASCII), with optional decimal point / sign. Spaces must be filled.
37 to 42		Display range low value (ASCII), with optional decimal point / sign. Spaces must be filled.
43 to 48	6	Display range high value (ASCII), with optional decimal point / sign. Spaces must be filled.
49, 50	2	Redirection channel number
51	1	Acquisition 0 = On 1 = Off
52	1	Linearisation function 0 = Off 1 = Linear 2 = Square root 3 = Square 4 = Type J 5 = Type K 6 = Type T 7 = Type S 8 = Type R 9 = Type E 10 = Type B 11 = Type N 12 = Pt100 13 = User 1 14 = User 2 15 = User 3
53 to 72	20	Channel descriptor string (ASCII).
73 to 77	5	Channel units string (ASCII).
78	1	Reserved (value immaterial).
79 to 108	30	Alarm 1 configuration (see table 5.4.3f).
109 to 138	30	Alarm 2 configuration (see table 5.4.3f).
139 to 168	30	Alarm 3 configuration (see table 5.4.3f).
169 to 198	30	Alarm 4 configuration (see table 5.4.3f).

Table 5.4.3c Analogue input channel data byte definition

5.4.3 MODBUS CHANNEL CONFIGURATION (Cont.)

Byte Number(s)	Number of bytes	Byte content
1	1	Output type 0 = Volts 1 = mA
2	1	Linearisation function 0 = Off 2 = Square root 1 = Linear 3 = Square
3 to 8	6	Output range low value (ASCII), with optional decimal point / sign. Spaces must be filled.
9 to 14	6	Output range high value (ASCII), with optional decimal point / sign. Spaces must be filled.
15 to 20	6	Scale range low value (ASCII), with optional decimal point / sign. Spaces must be filled.
21 to 26	6	Scale range high value (ASCII), with optional decimal point / sign. Spaces must be filled.
27 to 32	6	Low limit (ASCII), with optional decimal point / sign. Spaces must be filled.
33 to 38	6	High limit (ASCII), with optional decimal point / sign. Spaces must be filled.
39, 40	2	Output rate limit. A value in the range -32767 to +32767 representing a value between -9999 and 9999 display units.
41 to 60	20	Channel descriptor string (ASCII).
61 to 65	5	Channel units string (ASCII).
66 to 198	133	Reserved (value immaterial).

Table 5.4.3d Analogue output channel data byte definition

Byte Number(s)	Number of bytes	Byte content
1	1	Channel type 0 = Off 2 = input 1 = not used 3 = output
2	1	Acquisition 0 = On 1 = Off
3 to 8	6	High tag string (ASCII).
9 to 14	6	Low tag string (ASCII).
15 to 34	20	Channel descriptor string.
35 to 64	30	Alarm configuration (see table 5.4.3f).
65 to 198	134	Reserved (value immaterial).

Table 5.4.3e Digital input/output channel data byte definition

Byte Number(s)	Number of bytes	Byte content
1	1	Alarm type * 0 = no alarm 1 = absolute high 2 = absolute low 3 = deviation +/- 4 = deviation +'ve 5 = deviation -'ve 6 = rate-of-change +'ve 7 = rate-of-change -'ve 8 = digital high 9 = digital low
2	1	Enable / disable 0 = Alarm enabled 1 = Alarm disabled
3	1	Global alarm link 0 = link on 1 = link off
4	1	Hysteresis x 10 (decimal): Enter 10 x required hysteresis value. (e.g. 55 = 5.5% hysteresis)
5 to 26	22	Alarm message string (ASCII).
27 to 28	2	Output 1 channel number.
29 to 30	134	Output 2 channel number.
* If 0 is selected as alarm type, the content of subsequent bytes is immaterial.		

Table 5.4.3f Alarm configuration data byte definition

5.5 LINKING ESP TO THE 4500

This sub-section describes the interfacing of a Model 4500 with an IBM® PC (or compatible) which is running the Eurotherm Supervisory Package (ESP) software. It is assumed that the user is familiar with the ESP operation Manual.

PROTOCOLS

As described earlier in Section 5, the 4500 system supports two binary protocols, TCS binary and the Gould modicon Modbus RTU either of which can be used with ESP. The major advantage of using TCS binary is its compatibility with other Eurotherm Ltd. products. The major advantages of the Modbus RTU are a higher throughput when reading blocks of data, and simpler addressing.

HARDWARE CONNECTION

The 4500 is connected to one of the Serial communications ports of the PC. For ESP software versions 3.1 or higher, a 'Hardlock' module (supplied with the software package) must be connected to the parallel printer port of the PC. This module (dongle) is a software copy protection device and must be fitted in order for the software to run successfully. If a printer is to be used, this is plugged into the Hardlock module such that the module is connected between the printer and the PC; the Hardlock module has no effect on the operation of the printer.

Full 4500-to-PC connection details are given in Section 2 of this manual.

5.5.1 TCS BINARY

4500 CONFIGURATION

The 4500 system emulates the TCS 6432 signal processor. Each 4500 slot represents two 6432 eight-channel blocks. The second block has only seven channels since 4500 slots have a maximum of 15 channels.

The 4500 TCS Binary handler decides its response to DIO according to the type of I/O located in channels 1 and 9 in each slot. For this reason, it is necessary to set each digital I/O half-slot (channels 1 to 8 or channels 9 to 15) to either all inputs or to all outputs.

Note...

> If the DIO configuration is changed, then the TCS Binary protocol must be re-enabled by selecting 'NOT ENABLED' then 'TCS BINARY' in the Serial Link Protocol display page described below.

As detailed in Section 4.3.3 of this manual, the 4500 communications parameters are set up using two display pages: the Serial Link Protocol page and the Serial Link Settings page.

```
Comms port 1 Protocol: TCS BINARY     AB
Address  : 0
```

The Serial Link Protocol page depicted above, is used to select TCS Binary as the communications protocol, and to define a base address for the 4500 system. Valid addresses for use with TCS Binary are 0, 4, 8, 16, 20 etc. up to 124.

After selecting the required communications port protocol type and base address, the **ENTER** key is operated to save the new data, and the Serial Link Settings page is called by use of the page scroll down key.

5.5.1 ESP WITH TCS BINARY (Cont.)

4500 CONFIGURATION (Cont.)

```
Comms port 1:  9600 Baud xon/xoff OFF AB
8 bits 1 stop bit  par EVEN  rts/cts OFF
```

The Serial Link Settings page depicted above, is used to select a Baud rate. All other TCS Binary parameters are set by the system and are not user selectable.

ESP CONFIGURATION

ESP configuration is carried out using the 'cfg' facility. This is entered from the DOS prompt whilst the user is in the ESP directory by typing: cfg<ENTER>. The PLC interface settings should then be set up to match the 4500 settings described above..

```
PLC Interface                                                Ports
VPI  Port  PLC  Baud Parity Data Stop R/W    Write  Outside Port Addr
No.  No.   Type Rate        Bits Bits Enable Enable Blocks
 1    1    ET   9600    E   8    1    +      +      +       1.   03F8
 2    0            0        0    0                          2.   02F8
 3    0            0        0    0                          3.

                                  etc.
```

Where 'ET' indicates TCS Binary.

Note...

It should be ensured (when the ESP software package is installed), that the file 'VPIET.COM' is resident in the ESP directory.

SETTING UP GATES

The address format used to define the source of data for a gate is 'NNPPP' for analogue gates and 'NNPPPB' for digital gates.

NN is the address (in hex) of the 4500 half slot containing the required source channel. As can be seen from table 5.5.1a below, if this channel number is 117, and the 4500 base address (set up in the 4500 Communications configuration) is 0, then the half block address is '0F'. Were the base address to be 20 (14 hex), then the half slot address for channel 117 would be hex 23 (0F + 14). PPP is a parameter number, described below.

B, for digital gates defines the channel required, and has the following values:

Half slot channel number	Value of B
1	F
2	E
3	D
4	C
5	B
6	A
7	9
8*	8

* Any attempt to access channel eight of a seven-channel half-slot will result in 0s being returned.

5.5.1 ESP WITH TCS BINARY (Cont.)

MASTER UNIT			EXPANSION UNIT 2			EXPANSION UNIT 4		
4500 Slot	Channel range	Half slot address (hex)	4500 Slot	Channel range	Half slot address (hex)	4500 Slot	Channel range	Half slot address (hex)
1	1 to 8	Base + 0	1	346 to 353	Base + 2E	1	706 to 713	Base + 5E
1	9 to 15	Base + 1	1	354 to 360	Base + 2F	1	714 to 720	Base + 5F
2	16 to 23	Base + 2	2	361 to 368	Base + 30	2	721 to 728	Base + 60
2	24 to 30	Base + 3	2	369 to 375	Base + 31	2	729 to 735	Base + 61
3	31 to 38	Base + 4	3	376 to 383	Base + 32	3	736 to 743	Base + 62
3	39 to 45	Base + 5	3	384 to 390	Base + 33	3	744 to 750	Base + 63
4	46 to 53	Base + 6	4	391 to 398	Base + 34	4	751 to 758	Base + 64
4	54 to 60	Base + 7	4	399 to 405	Base + 35	4	759 to 765	Base + 65
5	61 to 68	Base + 8	5	406 to 413	Base + 36	5	766 to 773	Base + 66
5	69 to 75	Base + 9	5	414 to 420	Base + 37	5	774 to 780	Base + 67
6	76 to 83	Base + A	6	421 to 428	Base + 38	6	781 to 788	Base + 68
6	84 to 90	Base + B	6	429 to 435	Base + 39	6	789 to 795	Base + 69
7	91 to 98	Base + C	7	436 to 443	Base + 3A	7	796 to 803	Base + 6A
7	99 to 105	Base + D	7	444 to 450	Base + 3B	7	804 to 810	Base + 6B
8	106 to 113	Base + E	8	451 to 458	Base + 3C	8	811 to 818	Base + 6C
8	114 to 120	Base + F	8	459 to 465	Base + 3D	8	819 to 825	Base + 6D
9	121 to 128	Base + 10	9	466 to 473	Base + 3E	9	826 to 833	Base + 6E
9	129 to 135	Base + 11	9	474 to 480	Base + 3F	9	834 to 840	Base + 6F
10	136 to 143	Base + 12	10	481 to 488	Base + 40	10	841 to 848	Base + 70
10	144 to 150	Base + 13	10	489 to 495	Base + 41	10	849 to 855	Base + 71
11	151 to 158	Base + 14	11	496 to 503	Base + 42	11	856 to 863	Base + 72
11	159 to 165	Base + 15	11	504 to 510	Base + 43	11	864 to 870	Base + 73
			12	511 to 518	Base + 44	12	871 to 878	Base + 74
			12	519 to 525	Base + 45	12	879 to 885	Base + 75

EXPANSION UNIT 1			EXPANSION UNIT 3		
4500 Slot	Channel range	Half slot address (hex)	4500 Slot	Channel range	Half slot address (hex)
1	166 to 173	Base + 16	1	526 to 533	Base + 46
1	174 to 180	Base + 17	1	534 to 540	Base + 47
2	181 to 188	Base + 18	2	541 to 548	Base + 48
2	189 to 195	Base + 19	2	549 to 555	Base + 49
3	196 to 203	Base + 1A	3	556 to 563	Base + 4A
3	204 to 210	Base + 1B	3	564 to 570	Base + 4B
4	211 to 218	Base + 1C	4	571 to 578	Base + 4C
4	219 to 225	Base + 1D	4	579 to 585	Base + 4D
5	226 to 233	Base + 1E	5	586 to 593	Base + 4E
5	234 to 240	Base + 1F	5	594 to 600	Base + 4F
6	241 to 248	Base + 20	6	601 to 608	Base + 50
6	249 to 255	Base + 21	6	609 to 615	Base + 51
7	256 to 263	Base + 22	7	616 to 623	Base + 52
7	264 to 270	Base + 23	7	624 to 630	Base + 53
8	271 to 278	Base + 24	8	631 to 638	Base + 54
8	279 to 285	Base + 25	8	639 to 645	Base + 55
9	286 to 293	Base + 26	9	646 to 653	Base + 56
9	294 to 300	Base + 27	9	654 to 660	Base + 57
10	301 to 308	Base + 28	10	661 to 668	Base + 58
10	309 to 315	Base + 29	10	669 to 675	Base + 59
11	316 to 323	Base + 2A	11	676 to 683	Base + 5A
11	324 to 330	Base + 2B	11	684 to 690	Base + 5B
12	331 to 338	Base + 2C	12	691 to 698	Base + 5C
12	339 to 345	Base + 2D	12	699 to 705	Base + 5D

Table 5.5.1a Half slot addresses

5.5.1 ESP WITH TCS BINARY (Cont.)

PARAMETER NUMBER

Apart from a number of non-channel functions, the parameters which can be accessed depend on the type of I/O board associated with the channel in question. The following tables give details of accessible parameters.

GENERAL PARAMETER NUMBERS

Table 5.5.1b gives a list of those parameters and their numbers (PPP) which are related to the 4500 system itself, rather than to a specific channel:

Mnemonic	PPP	Description
II	000	Instrument ident. Always returns 4321
S1	001	Board type. Returns 0800 for analogue input, 0808 for analogue output, 0810 for digital input or 0818 for digital output.
A1	002	Historical alarms. Returns 0
S2	003	Always returns 081F (board not fitted).
A2	004	Always returns 0.
S3	005	Always returns 081F (board not fitted).
A3	006	Always returns 0.
S4	007	Always returns 081F (board not fitted).
A4	008	Always returns 0.
SW	009	Always returns 0.
MD	010	Always returns 0.

Table 5.5.1b General parameter numbers

DIGITAL INPUT - OUTPUT PARAMETERS

As described above, the DIO channel number within the half slot has to be stated at the end of the address string. Because the channel number is defined, there is only one parameter number per DIO mnemonic, viz:-

Mnemonic	PPP	Description
ST	016	Bit 3 is set for a checksum failure.
DS	018	Bitwise word giving input status for 8 channels.

Table 5.5.1c DIO parameter numbers

ANALOGUE INPUT/OUTPUT PARAMETERS

Table 5.5.1d shows the parameter numbers for all accessible parameters for analogue channels within a half slot address. It should be noted that some of the parameter numbers have different interpretations according to whether the relevant channel is an analogue input or an analogue output.

Notes...
1. The status mnemonic (ST) returns bit 3 set if there is a checksum failure associated with the channel.
2. Bits 12 to 15 of ST indicate the decimal point position.

5.5.1 ESP WITH TCS BINARY (Cont.)

Channel Nº	PPP	Analogue input description	Analogue output description
1	016	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	017	HR: Accesses low display range.	HR: As analogue input
	018	LR: Accesses high display range.	LR: As analogue input
	019	HA: Absolute high alarm setpoint	OP: Output value of channel
	020	LA: Absolute low alarm setpoint	HO: High output limit
	021	PV: Measured value in eng. units	LO: Low output limit
2	024	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	025	HR: Accesses low display range.	HR: As analogue input
	026	LR: Accesses high display range.	LR: As analogue input
	027	HA: Absolute high alarm setpoint	OP: Output value of channel
	028	LA: Absolute low alarm setpoint	HO: High output limit
	029	PV: Measured value in eng. units	LO: Low output limit
3	032	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	033	HR: Accesses low display range.	HR: As analogue input
	034	LR: Accesses high display range.	LR: As analogue input
	035	HA: Absolute high alarm setpoint	OP: Output value of channel
	036	LA: Absolute low alarm setpoint	HO: High output limit
	037	PV: Measured value in eng. units	LO: Low output limit
4	040	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	041	HR: Accesses low display range.	HR: As analogue input
	042	LR: Accesses high display range.	LR: As analogue input
	043	HA: Absolute high alarm setpoint	OP: Output value of channel
	044	LA: Absolute low alarm setpoint	HO: High output limit
	045	PV: Measured value in eng. units	LO: Low output limit
5	048	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	049	HR: Accesses low display range.	HR: As analogue input
	050	LR: Accesses high display range.	LR: As analogue input
	051	HA: Absolute high alarm setpoint	OP: Output value of channel
	052	LA: Absolute low alarm setpoint	HO: High output limit
	053	PV: Measured value in eng. units	LO: Low output limit
6	056	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	057	HR: Accesses low display range.	HR: As analogue input
	058	LR: Accesses high display range.	LR: As analogue input
	059	HA: Absolute high alarm setpoint	OP: Output value of channel
	060	LA: Absolute low alarm setpoint	HO: High output limit
	061	PV: Measured value in eng. units	LO: Low output limit
7	064	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	065	HR: Accesses low display range.	HR: As analogue input
	066	LR: Accesses high display range.	LR: As analogue input
	067	HA: Absolute high alarm setpoint	OP: Output value of channel
	068	LA: Absolute low alarm setpoint	HO: High output limit
	069	PV: Measured value in eng. units	LO: Low output limit
8	072	ST: Channel status. Bit 3 = checksum fail staus; Bits 12 to 15 indicate decimal position	ST: As analogue input
	073	HR: Accesses low display range.	HR: As analogue input
	074	LR: Accesses high display range.	LR: As analogue input
	075	HA: Absolute high alarm setpoint	OP: Output value of channel
	076	LA: Absolute low alarm setpoint	HO: High output limit
	077	PV: Measured value in eng. units	LO: Low output limit

Table 5.5.1d Parameter numbers for analogue input and analogue output channels

5.5.1 ESP WITH TCS BINARY (Cont.)

NUMBER FORMATS

The ESP software reads data from the 4500 in integer format (i.e without any decimal places.) The actual integer value transmitted by the 4500 depends on not only the (rounded) value itself, but also on the position of the decimal point in the 'scale maximum range' set up in the channel configuration. This means that the transmitted data needs to be scaled (converted to the correct value) by dividing it by some power of ten. As can be seen from the simple examples below, this process leads to some loss in resolution due to the rounding process.

4500 maximum scaling range	ESP gate conversion scaling
XXXX	divide by 1
XXX.X	divide by 10
XX.XX	divide by 100
X.XXX	divide by 1,000
.XXXX	divide by 10,000.

Examples
1. With a scale maximum of say, 1000, a value of 9.856 will be transmitted as 10, giving a scaled result of 10
2. With a scale maximum of 100.0 a value of 9.856 will be transmitted as 99, giving a scaled result of 9.9
3. With a scale maximum of 10.00 a value of 9.856 will be transmitted as 986, giving a scaled result of 9.86

Thus, the closer the measured value is to the scale maximum, the more accurate the conversion.

Once the range maximum value is known, the scaling factor can be set up in the 'conversion' area of the relevant gate definition display. For example, both the conversion factors depicted below cause a divide-by-ten scaling.

```
Conversion:
1.  Measured =      0. Eng. =     0.
2.  Measured = 10,000. Eng. = 1,000.
```

```
Conversion:
1.  Measured =       0. Eng. =     0.
2.  Measured =      10. Eng. =     1.
```

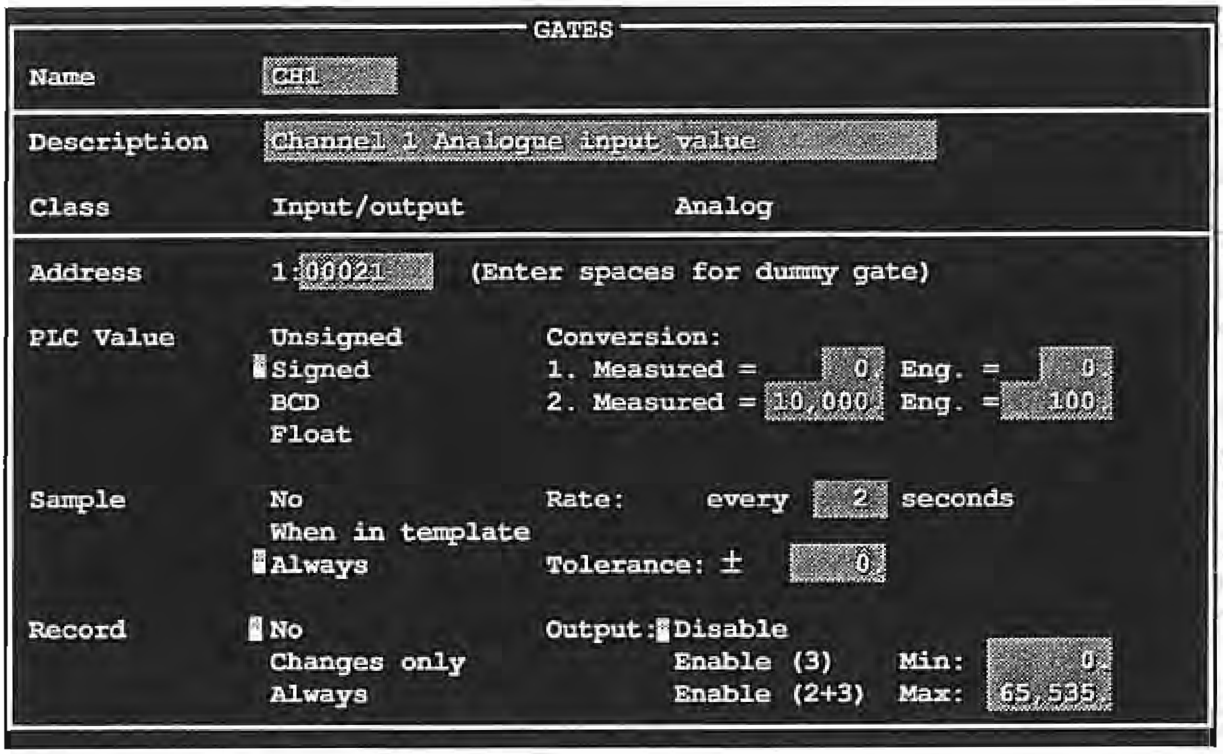
TCS BINARY SAMPLE ESP PAGES

The next few pages depict the setting up of 4 channels, as listed below, from the 'Gates' option in the ESP 'Engineering menu'.

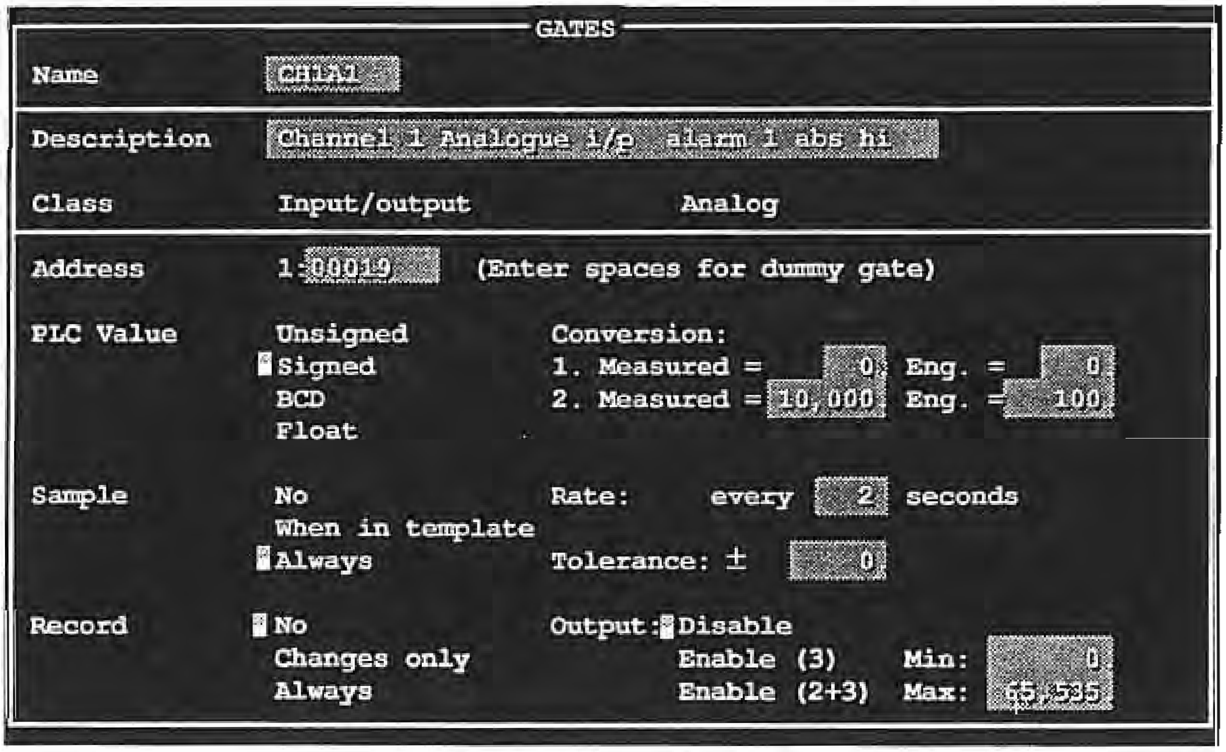
Channel 1: analogue input with one absolute high alarm and one absolute low alarm.
Channel 16: analogue output with high and low limits
Channel 31: digital input
Channel 41: digital output

In each case, the scale range is assumed to be 0 to 99.99.

5.5.1 ESP WITH TCS BINARY (Cont.)



Analogue input gate (measured value)



Analogue input gate (high absolute alarm)

5.5.1 ESP WITH TCS BINARY (Cont.)

```
                                  GATES
Name          CH1A2

Description   Channel 1 Analogue i/p  alarm 2 abs lo

Class         Input/output              Analog

Address       1:00020     (Enter spaces for dummy gate)

PLC Value     Unsigned          Conversion:
             ▮Signed            1. Measured =       0  Eng. =     0
              BCD               2. Measured = 10,000  Eng. =   100
              Float

Sample        No                Rate:     every   2  seconds
              When in template
             ▮Always            Tolerance: ±      0

Record       ▮No                Output:▮Disable
              Changes only              Enable (3)     Min:      0
              Always                    Enable (2+3)   Max: 65,535
```

Analogue input gate (low absolute alarm)

```
                                  GATES
Name          CH16

Description   Channel 16 Analogue output value

Class         Input/output              Analog

Address       1:02019     (Enter spaces for dummy gate)

PLC Value     Unsigned          Conversion:
             ▮Signed            1. Measured =       0  Eng. =     0
              BCD               2. Measured = 10,000  Eng. =   100
              Float

Sample        No                Rate:     every   2  seconds
              When in template
             ▮Always            Tolerance: ±      0

Record       ▮No                Output: Disable
              Changes only              Enable (3)     Min:      0
              Always                   ▮Enable (2+3)   Max: 65,535
```

Analogue output gate (value)

5.5.1 ESP WITH TCS BINARY (Cont.)

```
                              GATES
Name            CH16H
Description     Channel 16 Analogue o/p high limit value
Class           Input/output              Analog
Address         1:02020   (Enter spaces for dummy gate)
PLC Value       Unsigned          Conversion:
               ▓Signed            1. Measured =      0. Eng. =     0.
                BCD               2. Measured = 10,000. Eng. =   100.
                Float
Sample          No                Rate:     every    2  seconds
                When in template
               ▓Always            Tolerance: ±      0.
Record         ▓No                Output:▓Disable
                Changes only             Enable (3)    Min:       0.
                Always                   Enable (2+3)  Max:  65,535.
```

Analogue output gate (high limit)

```
                              GATES
Name            CH16L
Description     Channel 16 Analogue o/p low limit value
Class           Input/output              Analog
Address         1:02021   (Enter spaces for dummy gate)
PLC Value       Unsigned          Conversion:
               ▓Signed            1. Measured =      0. Eng. =     0.
                BCD               2. Measured = 10,000. Eng. =   100.
                Float
Sample          No                Rate:     every    2  seconds
                When in template
               ▓Always            Tolerance: ±      0.
Record         ▓No                Output:▓Disable
                Changes only             Enable (3)    Min:       0.
                Always                   Enable (2+3)  Max:  65,535.
```

Analogue output gate (low limit)

5.5.1 ESP WITH TCS BINARY (Cont.)

```
                                   GATES
Name          CH31

Description   Channel 31 Digital input state

Class         Input/output                 Digital

Address       1:04018F    (Enter spaces for dummy gate)

Sample        No             Rate:     every   2  seconds
              When in template
              Always         Filter:           0  seconds

Record        No             Output: Disable
              Changes only           Enable (3)     Min:       0
              Always                 Enable (2+3)   Max:  65,535
```

Digital input gate

```
                                   GATES
Name          CH41

Description   Channel 41 Digital output state

Class         Input/output                 Digital

Address       1:05018D    (Enter spaces for dummy gate)

Sample        No             Rate:     every   2  seconds
              When in template
              Always         Filter:           0  seconds

Record        No             Output: Disable
              Changes only           Enable (3)     Min:       0
              Always                 Enable (2+3)   Max:  65,535
```

Digital output gate

5.5.2 GOULD MODICON MODBUS RTU

4500 CONFIGURATION

As detailed in Section 4.3.3 of this manual, the 4500 communications parameters are set up using two display pages: the Serial Link Protocol page and the Serial Link Settings page.

```
Comms port 1 Protocol: MODBUS RTU     AB
Unit ID : 1
```

The Serial Link Protocol page depicted above, is used to select MODBUS RTU as the communications protocol, and to define a Unit ID for the 4500 system. This ID must lie in the range 1 to 255.

After selecting the required communications port protocol type and unit ID, the **ENTER** key is operated to save the new data, and the Serial Link Settings page is called by use of the page scroll down key.

```
Comms port 1:  9600 Baud xon/xoff OFF AB
8 bits 1 stop bit  par NONE  rts/cts OFF
```

The Serial Link Settings page depicted above, is used to select Baud rate, the number of data bits, the number of stop bits and the parity setting. The hardware handshake fields (xon/xoff and rts/cts) are set to 'OFF' and are not accessible to the operator.

ESP CONFIGURATION

ESP configuration is carried out using the 'cfg' facility. This is entered from the DOS prompt whilst the user is in the ESP directory by typing: cfg<ENTER>. The PLC interface settings should then be set up to match the 4500 settings described above..

PLC Interface											Ports
VPI No.	Port No.	PLC Type	Baud Rate	Parity	Data Bits	Stop Bits	R/W Enable	Write Enable	Outside Blocks	Port	Addr
1	1	MR	9600	N	8	1	+	+	+	1.	03F8
2	0		0		0	0				2.	02F8
3	0		0		0	0				3.	

etc.

Where 'MR' indicates MODBUS RTU.

Note...

When the ESP software is installed, it should be ensured that the file VPIMR.COM is resident, and that if the file 'VPIMR.INT' is installed in the ESP directory, it contains the ASCII text: BUS=M,D.

SETTING UP GATES

The address format used to define the source of data for a gate is: NNCAAAA.

NN The Unit ID as set up in the Serial link protocol page depicted above, entered in hexadecimal.
C Data type code as given in table 5.5.2 below.
AAAA Address of the channel to be read. For data type code 0 to 3, this is zero, followed by the channel number in decimal. For type code 4, the decimal channel number is preceded by a character in the range 0 to 7 as shown in table 5.5.2 below.

5.5.2 ESP WITH MODBUS RTU (Cont.)

C AAAA	Description
0 0XXX	Digital output channel status
1 0XXX	Digital input channel status
3 0XXX	Analogue input channel measured value
4 0XXX	Analogue output channel value
4 1XXX	Analogue output high limit
4 2XXX	Analogue output low limit
4 0XXX	Analogue input A1 (note 2)
4 1XXX	Analogue input A2 (note 2)
4 2XXX	Analogue input A3 (note 2)
4 3XXX	Analogue input A4 (note 2)
4 4XXX	Analogue input SP1 (note 3)
4 5XXX	Analogue input SP2 (note 3)
4 6XXX	Analogue input SP3 (note 3)
4 7XXX	Analogue input SP4 (note 3)

Table 5.5.2 Channel addressing for ESP

Notes...
1. XXX represents the decimal channel number
2. A1 to A4 are set point values for absolute alarms, reference values for deviation alarms or rate values for rate-of-change alarms. If a deviation value is referenced to another channel rather than to a constant value, the value of the reference channel can be read, but not written to.
3. SP1 to SP4 are deviation values for deviation alarms or period values (in seconds) for rate-of-change alarms. They are not used with absolute alarms.

NUMBER FORMAT

Analogue values are transfered as integer numbers between 0 (low scale) and 32767 (full scale). Thus, for a scale 0 to 100 units, a measured value of 50 units would be transfered as 16381.

GOULD MODICON MODBUS RTU SAMPLE ESP PAGES

The next few pages depict the setting up of 4 channels, as listed below, from the 'Gates' option in the ESP 'Engineering menu'.

Channel 1: analogue input with one absolute high alarm and one absolute low alarm.
Channel 16: analogue output with high and low limits
Channel 31: digital input
Channel 41: digital output

In each case, the scale range is assumed to be 0 to 99.99.

5.5.2 ESP WITH MODBUS RTU (Cont.)

```
                              GATES
Name           CH1

Description    Channel 1 Analogue input value

Class          Input/output               Analog

Address        1:0130001   (Enter spaces for dummy gate)

PLC Value      Unsigned            Conversion:
               Signed              1. Measured =      0. Eng. =      0.
               BCD                 2. Measured = 32,767. Eng. = 99.99.
               Float

Sample         No                  Rate:     every    2  seconds
               When in template
               Always              Tolerance: ±       0.

Record         No                  Output :Disable
               Changes only                Enable (3)    Min:      0.
               Always                      Enable (2+3)  Max: 65,535.
```

Analogue input gate (measured value)

```
                              GATES
Name           CH1A1

Description    Channel 1 Analogue i/p  alarm 1 abs hi

Class          Input/output               Analog

Address        1:0140001   (Enter spaces for dummy gate)

PLC Value      Unsigned            Conversion:
               Signed              1. Measured =      0. Eng. =      0.
               BCD                 2. Measured = 32,767. Eng. = 99.99.
               Float

Sample         No                  Rate:     every    2  seconds
               When in template
               Always              Tolerance: ±       0.

Record         No                  Output :Disable
               Changes only                Enable (3)    Min:      0.
               Always                      Enable (2+3)  Max: 65,535.
```

Analogue input gate (high absolute alarm)

5.5.2ESP WITH MODBUS RTU (Cont.)

```
                                GATES
Name          CH1A2

Description   Channel 1 Analogue i/p  alarm 2 abs low

Class         Input/output           Analog

Address       1:0141001   (Enter spaces for dummy gate)

PLC Value     Unsigned          Conversion:
             █Signed            1. Measured =      0  Eng. =     0.
              BCD               2. Measured = 32,767  Eng. = 99.99
              Float

Sample        No                Rate:     every    2  seconds
              When in template
             █Always            Tolerance: ±       0

Record       █No                Output:█Disable
              Changes only             Enable (3)    Min:       0.
              Always                   Enable (2+3)  Max:  65,535.
```

Analogue input gate (low absolute alarm).

```
                                GATES
Name          CH16

Description   Channel 16 Analogue output value

Class         Input/output           Analog

Address       1:0140016   (Enter spaces for dummy gate)

PLC Value     Unsigned          Conversion:
             █Signed            1. Measured =      0  Eng. =     0.
              BCD               2. Measured = 32,767  Eng. = 99.99
              Float

Sample        No                Rate:     every    2  seconds
              When in template
             █Always            Tolerance: ±       0

Record       █No                Output:█Disable
              Changes only             Enable (3)    Min:       0.
              Always                   Enable (2+3)  Max:  65,535.
```

Analogue output gate (value).

5.5.2 ESP WITH MODBUS RTU (Cont.)

```
                              GATES
Name          CH16H

Description   Channel 16 Analogue o/p high limit value
Class         Input/output             Analog

Address       1:0141016   (Enter spaces for dummy gate)
PLC Value     Unsigned          Conversion:
             ▮Signed            1. Measured =      0. Eng. =     0.
              BCD               2. Measured = 32,767. Eng. = 99.99.
              Float

Sample        No                Rate:      every   2  seconds
              When in template
             ▮Always            Tolerance: ±       0.

Record       ▮No                Output:▮Disable
              Changes only             Enable (3)    Min:      0.
              Always                   Enable (2+3)  Max: 65,535.
```

Analogue output gate (high limit)

```
                              GATES
Name          CH16L

Description   Channel 16 Analogue o/p low limit value
Class         Input/output             Analog

Address       1:0142016   (Enter spaces for dummy gate)
PLC Value     Unsigned          Conversion:
             ▮Signed            1. Measured =      0. Eng. =     0.
              BCD               2. Measured = 32,767. Eng. = 99.99.
              Float

Sample        No                Rate:      every   2  seconds
              When in template
             ▮Always            Tolerance: ±       0.

Record       ▮No                Output:▮Disable
              Changes only             Enable (3)    Min:      0.
              Always                   Enable (2+3)  Max: 65,535.
```

Analogue output gate (low limit)

5.5.2 ESP WITH MODBUS RTU (Cont.)

```
                              GATES
Name            CH31
Description     Channel 31 Digital input state
Class           Input/output              Digital
Address         1:0110031   (Enter spaces for dummy gate)
Sample          No               Rate:     every    2  seconds
                When in template
                Always           Filter:            0  seconds
Record          No               Output: Disable
                Changes only             Enable (3)    Min:      0
                Always                   Enable (2+3)  Max: 65,535
```

Digital input gate

```
                              GATES
Name            CH41
Description     Channel 41 Digital output state
Class           Input/output              Digital
Address         1:0100041   (Enter spaces for dummy gate)
Sample          No               Rate:     every    2  seconds
                When in template
                Always           Filter:            0  seconds
Record          No               Output: Disable
                Changes only             Enable (3)    Min:      0
                Always                   Enable (2+3)  Max: 65,535
```

Digital output gate

5.5.2 MODBUS RTU (Cont.)

BLOCK READS

The MODBUS protocol allows ESP to read channel values etc. in blocks, rather than singly. Because there is only one set of access instructions per block, this results in a reduction in the time taken to access each channel, with a resulting increase in through-put.

BLOCK CONSTRAINTS

The following constraints must be considered when setting up blocks.

1. Channels which do not exist are 'invalid' and a value of zero is returned for them. Such channels may be channel numbers greater than 165 (level 1 SBC) or 885 (level 2 or 3 SBC), or may be channels 7 to 15, for example, of a 6-channel dc input module.
2. Channels within a block must all be of the same type. The type is defined during block configuration, as described below.
3. The maximum number of channels in a block is 125.

BLOCK CONFIGURATION

Blocks are configured in page two of the ESP 'set-up' option. The address field in this page defines the number of the first channel in the block, and its I/O type.

The following 'page' depicts two blocks:

```
                                        SET-UP
Logger read-blocks in VPI no.:  1
    Address   Length  Sample (sec)
1.  0130001     125       1
2.  0140166     125       1


                                         etc.
```

This example shows two blocks, each of 125 channels. Block 1 contains 125 analogue input channel values starting at channel 1 (channels 1 to 125). Block 2 contains 125 analogue output channel values, starting at channel 166 (channels 166 to 290).

Each channel in a block must be of the same type as that defined in the address field for that block, the address being in the form NNCAAAA as described above, for a single channel.

5.6 GEM 80 PROTOCOL

5.6.1 INTRODUCTION

The 4500 acts as a slave or tributary within a GEM 80 system. It is not within the scope of this manual fully to describe such a system, so where necessary, it is recommended that reference be made to the GEM 80 Serial Communications Manual.

The J/K message, read/write block, read/write single and the Controller Facilities messages are supported, allowing the GEM 80 protocol to read and write channel values, read alarm status and to check out-of-range and internal communications status.

Standard GEM 80 serial ports are either current loop or an interface similar to RS422. In either case, a converter (available from GEC) must be used to convert to RS232C (for communicating with a single 4500) or RS422 (for communicating with one to 14 models 4500).

5.6.2 CHANNEL ADDRESSING

Channel addresses, for reading or writing process variable values are the same as the channel numbers; e.g. to address channel 132, a channel address of 132 is used.

Addresses for reading alarm status, are (channel number + 1000); e.g. to read alarm status of channel 132, an address of 1132 is used.

5.6.3 DATA FORMATS

ANALOGUE INPUT / OUTPUT VALUES

Channel values are represented in a 16-bit integer format ranging between 0 (low scale) and 32767 (high scale). For example, for an input scaled between 500 and 1000, a value of 500 would be 0, a value of 750 would be 16384 and a value of 1000 would be 32767.

DIGITAL INPUT / OUTPUT VALUES

When reading, a value of 0 states that the input is low, a value of 1 means that it is high. When writing, 0 sets the channel low, whilst any non-zero value sets the channel high.

ALARM STATUS

The alarm status for the addressed channel is returned as a 16-bit word, as below, where bit set = alarm active.

bit 0 = alarm 1
bit 1 = alarm 2
bit 2 = alarm 3
bit 3 = alarm 4
bit 4 = channel out of range (1 = true)
bit 5 = Communications failure between 4500 SBC and interface for the channel.
bits 6 to 15 are not used.

5.6.4 GEM 80 MESSAGE FORMATS

The following messages are shown with their control characters, CRCs etc. removed.

CONTROLLER FACILITIES (CF) MESSAGE

The GEM 80 controller sends the message `CF`

where CF is the 'Controller Facilities' mnemonic.

The 4500 response is: `.B.S..`

where B means 'Caters for block messages' and S means '4500 is a slave I/O processor'. The full stops (from left to right) mean that:

a) The 4500 does not cater for on-line program changes.
b) General edit mode is not available.
c) Off-line data storage is not included.
d) EPROM user memory is not included.

WRITE DATA TO TABLE (WG) MESSAGE

The GEM 80 controller sends the message `WGaaaa@dddd`

Where WG is the 'write data to table G' mnemonic
aaaa is the channel address
dddd is the ASCII hex data to be written to the channel.

READ DATA FROM TABLE (RG) MESSAGE

The GEM 80 controller sends the message `RGaaaa`

Where RG is the 'read data from table G' mnemonic
aaaa is the channel address.

The 4500 responds with the message `dddd`

Where dddd is the current process value for the addressed channel.

J/K TABLE INTERCHANGE (KJ) MESSAGE

The user places his base channel address in the first K register of his GEM 80 controller. The number (N) of channels to be read from (max. 32) or written-to (max. 30) is then placed in the next K register. If data is to be written to channels, then this data is loaded into the next N K-registers.

The GEM 80 must be set up to transmit the correct number of registers. If this is not done, it will assume that all K-registers are to be transmitted.

5.6.4 GEM 80 MESSAGE FORMATS (Cont.)

J/K TABLE INTERCHANGE (KJ) MESSAGE (Cont.)

WRITING DATA TO THE 4500

The GEM 80 controller sends the message `KJlmnopqpqpq...pq`

Where KJ is the JK interchange mnemonic
l is the least significant byte of the base channel address
m is the most significant byte of the base channel address
n is the least significant byte of the number of channels (max. 30) to be acted upon.
o is the most significant byte of the number of channels (max. 30) to be acted upon.
pqpqpq etc. are the least significant (p) and most significant (q) bytes of the data to be written to each of the channels to be acted upon, in turn, starting with the base channel.

READING FROM THE 4500

The GEM 80 controller sends the message `KJlmno`

Where KJ is the JK interchange mnemonic
l is the least significant byte of the base channel address
m is the most significant byte of the base channel address
n is the least significant byte of the number of channels (max 32) to be acted upon.
o is the most significant byte of the number of channels (max 32) to be acted upon.

The 4500 responds with `pqpqpq...pq`

Where pqpqpq etc. are the least significant (p) and most significant (q) bytes of the data read from each of the channels in turn, starting with the base channel.

WRITE BLOCK (XG) MESSAGE

The GEM 80 controller sends the message `XGlmnpqpqpq....pq`

Where XG is the 'Write block to table G' mnemonic
l is the least significant byte of the start channel address
m is the most significant byte of the start channel address
n is the number of channels (max. 32) to be acted upon.
pqpqpq etc. are the least significant (p) and most significant (q) bytes of the data to be written to each of the channels in turn, starting with the start channel.

READ BLOCK (SG) MESSAGE

The GEM 80 controller sends the message `SGlmn`

Where SG is the 'Read block from table G' mnemonic
l is the least significant byte of the start channel address
m is the most significant byte of the start channel address
n is the number of channels (max 32) to be acted upon.

The 4500 responds with `pqpqpq...pq`

Where pqpqpq etc. are the least significant (p) and most significant (q) bytes of the data read from each of the channels in turn, starting with the start channel.

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SECTION 6 OPTIONS

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(Continued)

LIST OF CONTENTS (CONT.)

LIST OF CONTENTS (Cont.)

LIST OF FIGURES

LIST OF TABLES

SECTION 6 OPTIONS

This section describes the various options available for the 4500 system.

6.1 MATHS PACK

The inclusion of the maths pack software to the 4500 system, gives a comprehensive facility for the manipulation of measured values and of variables derived by the maths pack itself. The mathematical facilities available are divided into two types: those capable of being implemented in both single and double precision, and those which can be implemented only at single precision.

The number of mathematical operations that can be carried out depends on (amongst other things) the level of the installed software. Level one software allows up to 128 single precision variables (SPVs), 12 double precision variables (DPVs) and 128 argument tables to be utilised. Levels two and three allow the use of up to 256 SPVs, 32 DPVs and 256 argument tables. The terms 'Single precision', 'Double precision' and 'Argument table' are defined below.

Applications involving large numbers of variables normally require level three software which includes a floating point co-processor to allow most maths pack configurations to be processed at the maximum update rate (once per second). The update rate of a level two system can fall to once every three to four seconds in extreme cases.

6.1.1 PRINCIPLES OF OPERATION

SINGLE PRECISION FUNCTIONS

All the maths pack functions listed below operate in single precision. This means that the operation of the functions, their display etc. are limited to six digits. The functions, which are configured using the 'equation' pages, are fully described later in this section.

Arithmetic (Addition, Subtraction, Division, Multiplication), Absolute value, Negate, Integer, Square root, Square, trigonometric (Arctangent ($\tan^{-1}$), cosine, sine), log, e^x, logical (OR, AND, XOR, AND, NOT), comparator (>, =, <), Rate-of-change, Low pass filter, Group average, Running channel average, Moving channel average, Latching and continuous maximum, Latching and continuous minimum, Totalisation, Set channel.

In addition to these basic arithmetic/logic functions, a number of specialised equations are solved, as follows: Zirconia Oxygen probe (Nernst Oxygen equation), Mass flow.

DOUBLE PRECISION FUNCTIONS

The following functions operate in double precision: Addition, Subtraction, Multiplication, Division, Totalisation, F_{value} and Set channel These functions, which are configured using the 'equation' pages, are fully described later in this section.

Double precision mode is used in totalising and accumulating operations which handle large numbers. For this reason the double precision background display differs from other such displays in that up to 15 characters are used, with floating decimal point, for the measured value. (See 'variables displays' section below.)

Double precision variables cannot be directly routed to channels. If the value is to be output, the dpv value must used as an argument in an spv function which can then be routed (with associated loss of precision) to a channel.

6.1.1 PRINCIPLES OF OPERATION (Cont.)

ARGUMENT TABLES AND EQUATION PAGES

If for example, the measured values of two channels are to be summed, then the function (addition in this case) is said to operate on the *ARGUMENTS:* 'measured value of the first channel' and 'measured value of the second channel'. The arguments available in the 4500 maths pack are: constant, channel number, other derived variable, null (no operation).

The values (channel number, variable number etc.) associated with the arguments for a particular function are entered into a user selected table of values called an argument table.

EXAMPLE:

It is required to calculate the result of adding 25 to 4 times the current value of channel 32, and then to route this result to channel 16 (i.e.Ch16 = 25 +(4 x ch 32)) For the purposes of this example, SPVs 12 and13, and argument tables 3 and 4 will be used, as follows:

SPV12 = 4 MUL ch 32 (4 and channel 32 are arguments (table 3) to the **MUL**tiply function)
SPV13 = SPV12 ADD 25 (SPV12 and 25 are arguments (table 4) to the **ADD**ition function)

As shown in the displays depicted below, the first step is to set constant '4' and channel number '32' into argument table 3. Constant '25' and SPV12 are then set into argument table 4.

SPV12 is now configured to multiply together the contents of argument table 3. SPV 13 is configured to add together the contents of argument table 4 and to route the result to channel 16.

```
Spv arg table:   3
ELEMENT:  0     CONST     4
```

```
Spv arg table:   3
ELEMENT:  1     CH       32
```

```
Spv arg table:   4
ELEMENT:  0     SPV      12
```

```
Spv arg table:   4
ELEMENT:  1     CONST    25
```

```
Spv 12  RUN  Fn:  MUL   arg table:  3 AB
NOT ROUTED
```

```
Spv 13  RUN  Fn:  ADD   arg table:  4 AB
ROUTED TO CH: 16  Chan 16  descriptor
```

Note...

For many functions, it is essential that the entries are made in the correct sequence. Even simple functions such as Divide and Subtract will give erroneous results if the correct sequence is not followed. The order of entry for each function is given in the function descriptions later in this section.

6.1.1 PRINCIPLES OF OPERATION (Cont.)

PSEUDO CHANNELS

In order to allow the variables derived in the maths pack to be treated as conventional channel values, the concept of pseudo channels has been devised. When setting-up the master and expansion unit slot allocations, three types of pseudo board are available in the scroll menu: 15 channel pseudo analogue input, 15 channel pseudo analogue output, 15 channel pseudo digital input. These boards do not physically exist, but when allocated, any derived channel routed to a pseudo channel behaves as though it is a normal I/O channel as far as the rest of the system is concerned.

In order to reduce the number of channels used, only genuine results should be routed

Notes...

1. Although the pseudo channel boards do not physically exist, it should be noted that any slot to which such a board is allocated, cannot be used for any other type of board.
2. Pseudo channels can also be used with the Maths Pack Option disabled or not fitted. This allows operator and/or host computer access to alarm status

BOOLEAN AND LOGIC FUNCTIONS

These functions (examples: OR, AND, Equals) produce 'logic' results (true or false) which are represented by values of 1.000 (true) or 0.000 (false) by both single and double precision variables. These values can be cascaded to further logic functions, routed to digital channels, or used in other maths pack functions.

EXAMPLE:

SPV 3 is to be used as a 'constant' input value to another equation. The value of this constant is to be 100 if the value of SPV 1 is greater than 23 units, or 0 if the value of SPV 1 is less than or equal to 23. In other words:

If SPV 1 > 23, then SPV 3 = 100:
If SPV 1 ≤ 23, SPV = 0

Such a decisiion would be configured as follows:

```
Spv arg table:   2
ELEMENT:  0      SPV   1
```

```
Spv arg table:   2
ELEMENT:  1      CONST    23.0
```

```
Spv arg table:   3
ELEMENT:  0      SPV        2
```

```
Spv arg table:   3
ELEMENT:  1      CONST   100
```

```
Spv  2  RUN  Fn:   GT   arg table:  2 AB
NOT ROUTED
```

```
Spv  3  RUN  Fn:  MUL   arg table:  3 AB
NOT ROUTED
```

Where the first equation page sets SPV2 to 1.000 (if SPV1 is more than 23), or to 0 (if it is not). The second equation page multiplies the result by 100, so that SPV 3 is (100 x 1.0000) = 100, or (100 x 0.000) = 0.000 according as SPV1 is greater than 23 or not, respectively.

6.1.1 PRINCIPLES OF OPERATION (Cont.)

DISPLAY AND OUTPUT

Any maths pack variable value can be routed to any input or output channel (including pseudo channels). In this way, maths pack results can be treated as though they are normal measured values i.e. they can be:-

1 Viewed at the operator panel
2. Output as a part of a printed report
3. Output via an analogue or a digital channel
4 Transmitted for printing on a chart recorder
5 Accessed by a host computer.

VARIABLE UPDATE

The maths pack variables are updated (normally once per second), in ascending number order, from SPV1 to SPV_{max} followed by DPV1 to DPV $_{max}$ (see fig 6.6.1 below). For this reason, if the results of one mathematical function are to be used as an input to a second function, thought must be given to the order in which entries are made.

In the example above, the operation on the channel value (SPV12) is carried out before adding the constant (SPV13). Were SPV12 not available, and SPV 15 say, had to be used, then the addition would act on four times the **previous** value of channel 32, since the **current** value of the channel will not be multiplied by 4 (SPV15) until after SPV 13 has been calculated.

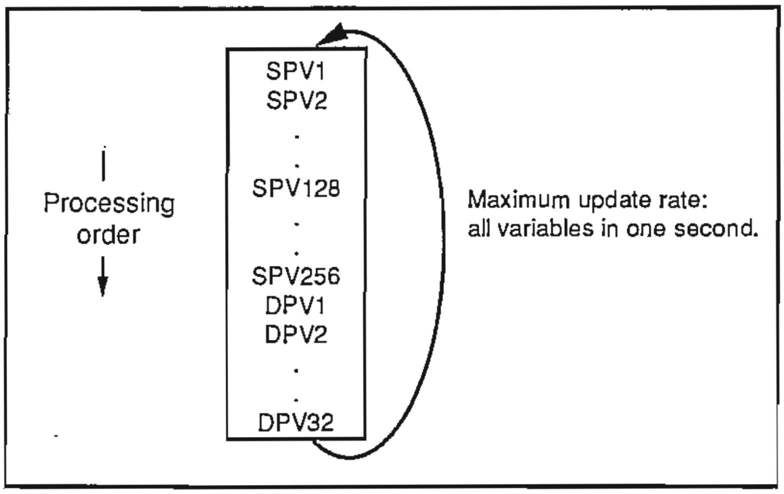


Figure 6.1.1 Processing order

As described above, the output channels can be viewed at the operator panel by selecting either 'Single precision' or 'double precision' in the 'Display' menu page. This facility is used for de-bugging, for seeing a double precision variable value and, in the case of a double precision value, for the reset of totalisation and F_{value} functions.

6.1.2 VARIABLES DISPLAYS

As shown in figure 6.1.3, the 'Display' menu includes a 'Select maths display' section if the maths pack option is fitted. The display of single or double precision variables is selected from this menu. Once selected, the display becomes the currently active display for the system.

SINGLE PRECISION VARIABLES

```
Spv NNN    DDDDDDD   running
Spv NNN    00.0000   in error
```

This display is similar to the normal channel display except that the channel descriptor is replaced with an SPV status description. Display hold and single SPV displays operate as for channels.

Spv NNN	The spv whose value is shown. As with channel displays, the spv numbers displayed, scroll after a period of 10 seconds, unless display hold is in operation.
DDDDDD	The current value of the spv. (Reads 00.0000 if the spv has been stopped by a configuration error.
running / in error	This field is a status field for the spv. Indicates whether the spv is running, stopped or if a configuration error has been made in, for example, the entry of argument table elements.

DOUBLE PRECISION VARIABLES

```
Dpv NNN     DDDDDDDDDDDDDDD   Units
Variable  descriptor   running    Reset
```

The double precision display holds one variable which scrolls every 10 seconds unless display hold is selected.

Dpv NNN	The currently displayed dpv number
DDDDDDDDDDDDDDDD	The 15 character (+ decimal point) value associated with the currently displayed dpv.
Units	The engineering units string for the displayed value. This (five character) string is entered when configuring the dpv function (described below).
Variable descriptor	The 'tag' for the dpv. Equivalent to a channel descriptor, this 20-character string is entered when configuring the dpv function (described below).
Reset	With the cursor in this field, the dpv can be manually reset by operating the ↵ key.

6.1.3 CONFIGURATION

The parameters listed below are set up (for both single and double precision variables) from 'equation' pages at the operator panel or configuration editor. These parameters are explained later in this section.

Run / Stopped status.
Function type.
Routing of the result to a channel.
The relevant argument table .

By identifying the arguments as a table, the operator can apply several functions to the same arguments without re-entering them.

ACCESS TO CONFIGURATION

As may be seen in figure 6.1.3 the maths pack configuration pages are accessed from page 2 of the on-line configuration menu, accessed itself from the 'Configure via panel' display page menu.

The first item allows the selection of either single or double precision variables for configuration. The configuring of the actual variables is carried out in the 'equation' pages, whilst the configuration of the argument tables takes place in the 'argument' pages.

SINGLE PRECISION VARIABLES (SPVs)

On selecting single precision equations for configuration, a display page of the following type appears:

```
Spv 123 RUN  Fn:  ADD   arg table:  1 AB
ROUTED TO CH: 115 Chan 115 descriptor
```

Spv 123 The single precision variable assigned to this task. Numeric entry or scroll input, 1 to 128 (256).

RUN Scrollable between 'RUN' and 'STOP'. Allows the function to be disabled.

ADD The function selected for this variable. Scroll order is:

Add (ADD)	Log (LOG)	Continuous maximum (CONMAX)
Subtract (SUB)	Exponent (EXP)	Continuous minimum (CONMIN)
Multiply (MUL)	OR	Latching maximum (LTCMAX)
Divide (DIV)	Exclusive OR (XOR)	Latching minimum (LTCMIN)
Absolute (ABS)	AND	Rate of change (RATECH)
Negate (NEG)	NOT	Filter (FILTER)
Integer (INT)	Greater than (GT)	Mass flow square root (MFSQRT)
Square root (SQRT)	Less than (LT)	Mass flow linear (MFLIN)
Square (SQUARE)	Equals (EQUAL)	Zirconia probe (ZIRCON)
Sine (SIN)	Running average (R AVE)	Totalise (TOTAL)
Cosine (COS)	Moving average (M AVE)	Set channel (SETCH)
Arctangent (ARCTAN)	Group average (G AVE)	

Additionally, 'NULL' is available to freeze the SPV.

(Continued)

6.1.3 SINGLE PRECISION VARIABLES (Cont.)

arg table: 1	Selects the table which is to hold the arguments for this particular equation. Numeric entry or scrollable value between 0 and 127 (255). Argument tables are not exclusive to one equation; thus if for example, Table 013 contains the measured values of channels 103 and 206, then these two channels' values can be summed by one function (ADD) and used to set a Discrete Output (DO) if the value of channel 103 exceeds the value of channel 206 by a second function (GT) both using Table 13.
ROUTED TO CH 115:	This implies that a 'Pseudo' input or output board (described below), an analogue output board, or an Analogue input board (with acquisition disabled) has been configured in slot 8 of the master rack. Once routed to this channel, the variable can be treated, in all respects, as a measured value, and can be used, for example, to trigger alarms etc. Scrollable to 'NOT ROUTED'.
Chan 115 descriptor	The channel descriptor of the channel 'routed-to'.

DOUBLE PRECISION VARIABLES (DPVs)

On selecting double precision variables for configuration, the following display page appears:;

```
Dpv NNN RUN  Fn:  ADD   arg table:  A AB
Tag:xxxxxxxxxxxxxxxxxxxx    unit:yyyyy
```

Dpv 12	The double precision variable assigned to this task. Numeric entry or scroll input, 1 to 12 (or 32).
RUN	Scrollable between 'RUN' and 'STOP'. Allows the function to be disabled.
ADD	The function selected for this variable. The scroll order is:

Add (ADD)	Totalise (TOTAL)
Subtract (SUB)	F_{value} (F VAL)
Multiply (MUL)	Set channel (SETCH)
Divide (DIV)	

Additionally, 'NULL' is available to freeze the variable.

arg table A	Selects the double precision table which is to hold the arguments for this particular equation. Numeric entry or scrollable value between 1 and 12 or 32. As with single precision tables, these tables are not exclusive to one equation.
Tag:	A descriptor for the variable can be entered, as described for normal channels.
unit:	A units string for the variable can be entered as for normal channels.

Note...

In order to make use of the double precision variable, the DPV number can be referenced in a single precision argument table. This results in its value being truncated, allowing it to be used in other single precision equations, to trigger alarms and so on. The variable can be re-routed, if necessary, using the SETCH variable described later in this section.

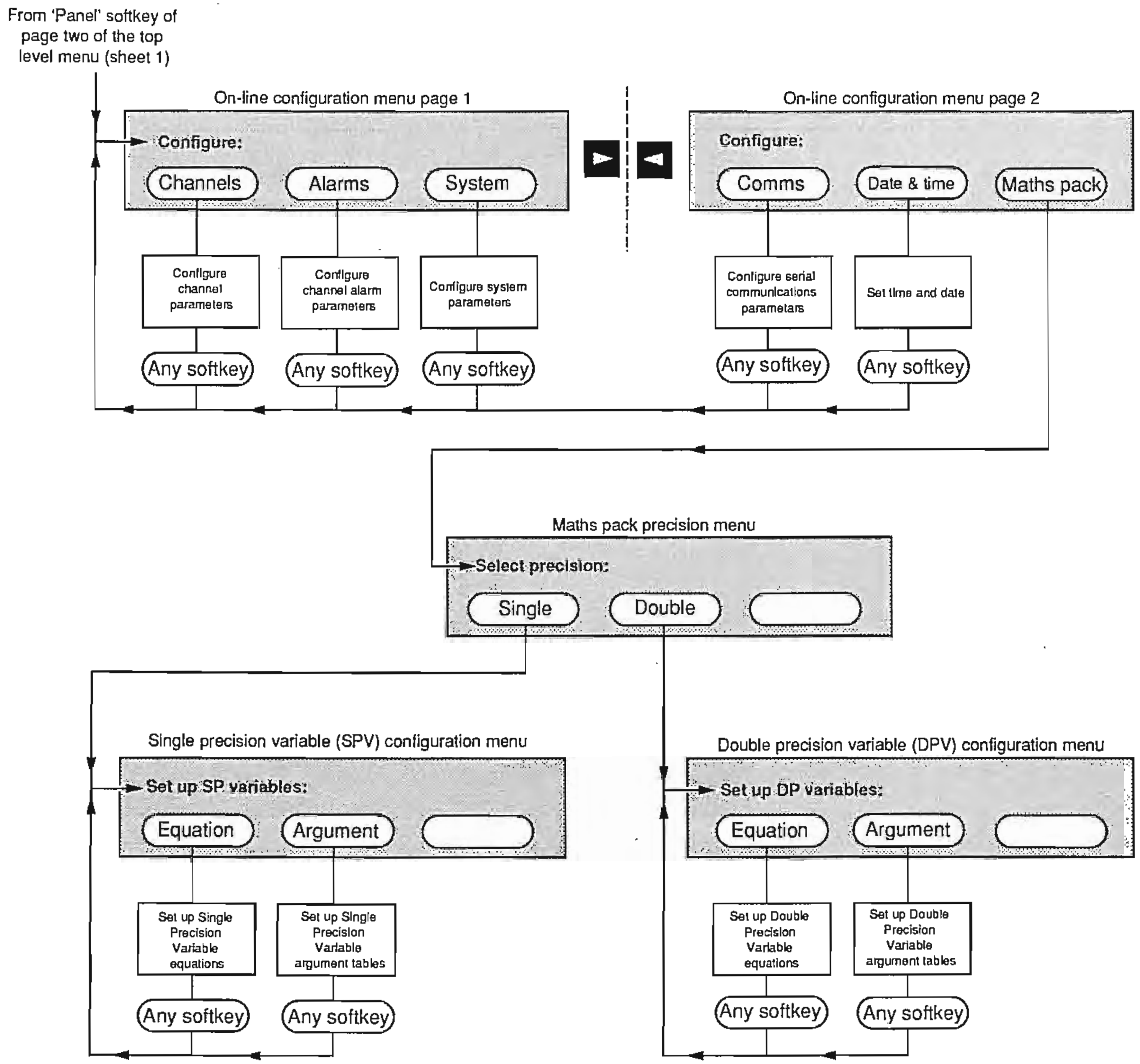


Figure 6.1.3 Access to Maths pack configuration

6.1.3 MATHS PACK ON-LINE CONFIGURATION (Cont.)

SINGLE PRECISION ARGUMENT TABLES

```
Spv arg table: nnn cccccccccccccccc
ELEMENT:xxx      TYPE      yyyyyy
```

Spv arg table: nnn	This is the number of the table being configured. Numeric entry or scroll input.
ccccccc--cc	The descriptor of a channel or of a double precision variable if either is selected in the 'Type' field below.
ELEMENT: XXX	XXX represents the element number currently being configured (see example below). Scroll or numeric input. If there are no elements configured in the table, 'EMPTY' is displayed in place of 'ELEMENT'. The EMPTY field is scrolled to ELEMENT in order to start entering values. In order to clear the argument table, the ELEMENT field is scrolled to EMPTY and the enter key operated.-
TYPE	This field allows the argument related to this element number to be selected from a menu of the following scroll items: 1. CONST. This allows a numerical entry (YYYYYY) to be made, to be used as a constant value in the equation which is to be solved. 2. CH. This allows the instantaneous value of a measuring or pseudo channel to be used as one input to an equation. Numeric entry of channel number The channel descriptor appears at the top line of the display. 3. SPV This allows the instantaneous value of a single precision variable to be used as an input to an equation. Numeric entry of variable number. 4. DPV This allows the instantaneous value of a double precision variable to be used as an input to an equation. The DPV number is entered using the numeric entry keys and the variable's descriptor appears at the top line of the display. The value is truncated to single precision. 5. NULL Causes no operation to take place. This is used to 'clear' unwanted elements from the table.
YYYYYY	The field where the numeric values for constant, channel or SPV or DPV are input.

<u>Example</u>

It is required to locate in SPV101 the difference between the value of channel 31 (boiler 1 temp) and the value of channel 113 (boiler 2 temp). The required display entries are as follows:

```
Spv arg table:   1 boiler 1 temp
ELEMENT:  0     CH        31
```

```
Spv arg table:   1 boiler 2 temp
ELEMENT:  1     CH        113
```

```
Spv 103 RUN  Fn:  SUB   arg table:  1 AB
NOT ROUTED
```

The value of SPV101 now contains the difference between the two measured values required and can be used if required as an input to a further maths function or as an output.

6.1.3 MATHS PACK ON-LINE CONFIGURATION (Cont.)

DOUBLE PRECISION ARGUMENT TABLES

```
Dpv arg table:nnn
ELEMENT:NNN TYPE   YYYYYYYYYYYYYYYY
```

Dpv arg table: nnn	This is the number of the table being configured. Numeric entry or scroll input.
ELEMENT: NNN	NNN represents the element number currently being configured. Scroll or numeric input. If there are no elements configured in the table, 'EMPTY' is displayed in place of 'ELEMENT'. The EMPTY field is scrolled to ELEMENT in order to start entering values. In order to clear the argument table, the ELEMENT field is scrolled to EMPTY and the enter key operated.
TYPE	This field allows the argument related to this element number to be selected from a menu of the following scroll items: 1. CONST. This allows a numerical entry to be made, to be used as a constant value in the equation which is to be solved. 2. CH. This allows the instantaneous value of a measuring or pseudo channel to be used as one input to an equation. Numeric entry of channel number. The channel descriptor appears at the top line of the display. 3. SPV This allows the instantaneous value of a single precision variable to be used as an input to an equation. Numeric entry of variable number. 4. DPV This allows the instantaneous value of a double precision variable to be used as an input to an equation. The DPV number is entered using the numeric entry keys and the variable's descriptor appears at the top line of the display. The value is truncated to single precision. 5. NULL Causes no operation to take place. This is used to 'clear' unwanted elements form the table.
YYYYYYYYYYYYYYYY	If CONST is selected as the dpv type, this field shows its current value and allows this value to be modified by numeric entry from the keyboard. If CH, SPV or DPV is selected, then this field shows the channel or variable number currently selected for input.

6.1.4 MATHS FUNCTIONS

ADD

The Add function computes the sum of elements zero and one of the relevant element table. This function is available in both single and double precision modes.

Argument table equation: Variable value = Element 0 + Element 1

SUBTRACT (SUB)

The subtract function subtracts element one of the relevant argument table from element zero of the table. Care should be taken to ensure that the elements are entered in the right order, or erroneous results will occur. This function is available in both single and double precision modes

Argument table equation: Variable value = Element 0 - Element 1

MULTIPLY (MUL)

The multiply function multiplies elements zero and one of the relevant element table. This function is available in both single and double precision modes.

Argument table equation: Variable value = Element 0 x Element 1

DIVIDE (DIV)

The divide function divides element zero by element one of the relevant argument table. Care should be taken to ensure that the elements are entered in the correct order, or erroneous results will occur. This function is available in both single and double precision modes.

Argument table equation: Variable value = Element 0 / Element 1

ABSOLUTE (ABS)

This function 'strips' the negative sign from its input (element 0) thus converting a negative value to a positive value (without changing a positive value to a negative one). I. E. The function takes only the magnitude of the input value, and ignores its sign. This function is available only on single precision mode.

Argument table equation: Variable value = ABS (Element 0)

NEGATE (NEG)

The negate function inverts the sign of the input (element 0). Thus an input value of -12.32 will become +12.32 and vice-versa. This function is available only in single precision mode.

Argument table equation: Variable value = NEG (Element 0)

6.1.4 MATHS FUNCTIONS (Cont.)

INTEGER (INT)

This function 'strips' all decimal places from the input (element 0). Thus, an input value of -12.32 will become -12. It should be noted that this function is not a 'rounding' function, so an input of -12.99 will also become -12. This function is available only in single precision mode.

Argument table equation: Variable value = INT (Element 0)

SQUARE ROOT (SQRT)

This function (available only in single precision mode) takes the square root of the input value.

Argument table equation: Variable value = $\sqrt{}$ (Element 0)

SQUARE

This function (available only in single precision mode) squares the input value.

Argument table equation: Variable value = $(\text{Element } 0)^2$

SINE (SIN)

This function (available only on single precision) takes the sine of the input value **expressed in radians.** (To convert degrees to radians, multiply by π and divide by 180.)

Argument table equation: Variable value = sin (Element 0)

COSINE (COS)

This function (available only on single precision) takes the cosine of the input value **expressed in radians.** (To convert degrees to radians, multiply by π and divide by 180.)

Argument table equation: Variable value = cos (Element 0)

ARCTANGENT (ARCTAN)

This function (available only in single precision) produces an angular value in radians, from a tangent input. (To convert degrees to radians, multiply by π and divide by 180.)

Argument table equation: Variable value = $\tan^{-1}$ (Element 0)

LOG

This function (available only in single precision mode) takes the natural logarithm (base e) of the input value.

Argument table equation: Variable value = $\log_e$ (Element 0)

6.1.4 MATHS FUNCTIONS (Cont.)

EXPONENT(EXP)

This function (available only in single precision mode) takes the exponent of the input value.

Argument table equation: Variable value = Exp (Element 0)

Note...

For all the following Boolean (Logic) functions, the SPV result is 0.00 for logic 0 (low), and 1.00 for logic 1 (high). These values can be directly related to digital I/O channels.

OR

This function (available only in single precision mode) produces the logical OR of two discrete inputs, to give a result as shown in the table below. This result becomes the value of the SPV.

Element 0	Element 1	Result
Low	Low	Low
Low	High	High
High	Low	High
High	High	High.

Thus, it can be seen that if either (or both) of the input elements is 'high' then the resultant value is also 'high'.

Argument table equation: Variable value = Element 0 OR Element 1

EXCLUSIVE OR (XOR)

This function (available only in single precision mode) produces the logical exclusive OR of two discrete inputs to give a result as shown in the table below. This result becomes the value of the SPV.

Element 0	Element 1	Result
Low	Low	Low
Low	High	High
High	Low	High
High	High	Low.

Thus, it can be seen that if either (but not both) of the input elements is 'high' then the resultant value is also 'high'.

Argument table equation: Variable value = Element 0 XOR Element 1

AND

This function (available only in single precision mode) produces the logical AND of two discrete inputs, to give a result as shown in the table below. This result becomes the value of the SPV.

Element 1	Element 2	Result
Low	Low	Low
Low	High	Low
High	Low	Low
High	High	High.

Thus, it can be seen that only when both of the input elements are 'high' is the resultant value is also 'high'.

Argument table equation: Variable value = Element 0 AND Element 1

6.1.4 MATHS FUNCTIONS (Cont.)

NOT

This function (available only in single precision mode) inverts the status of a discrete signal. Thus to get the inverse of the logical OR, XOR and AND functions described above, the SPV output obtained from the relevant function is applied as an input to a further SPV the function of which is NOT.

Argument table equation: Variable value = NOT (Element 0)

GREATER THAN (GT)

This function (available only in single precision mode), causes the value of an SPV to be set to logical 'high' (=1.0) if the measured value of element zero of the relevant argument table is greater than the value of element one. Otherwise the measured value is 0.0. Care must be taken to ensure that that the two measuring inputs are entered in the correct order in the table.

Argument table equation: Variable value is high if Element 0 > Element 1

LESS THAN (LT)

This function (available only in single precision mode), causes the value of an SPV to be set to logical 'high' (=1.0) if the measured value of element zero of the relevant argument table is less than the value of element one. Otherwise the measured value is 0.0. Care must be taken to ensure that the two measuring inputs are entered in the correct order in the table.

Argument table equation: Variable value is high if Element 0 < Element 1

EQUALS (EQUAL)

This function (available only in single precision mode), causes the value of an SPV to be set to logical 'high' (=1.0) if the measured values of elements zero and one of the relevant argument table are equal. Otherwise the measured value is 0.0.

Argument table equation: Variable value is high if Element 0 = Element 1

RUNNING AVERAGE (R AVE)

This function (available only in single precision mode), gives the 'average to date' of a channel or variable over a selected number of readings. When this number of readings is complete, the channel or variable value is updated to its then current reading, and the process repeats.

$$A'_t = \frac{(A'_{t-1} \times N) + ma_t}{N+1}$$

Where:

A'_t = The average value of the channel or variable

ma_t = The current value of the channel or variable

A'_{t-1} = The average value last iteration

N = A constant, defining the number of samples over which the average is to be taken. With N = 0, the average is continuous, and resets only after the maximum number of samples has been taken. Typically, this will take place every six months or so.

The required argument table elements are:

0. A constant giving the required number of samples.
1 Reset input (0 = no reset; 1 = reset) entered as a channel number or as a constant.
2. The input channel or variable number which is to be averaged.

Argument table equation:-

$$Variable\ value = \frac{(Last\ value \times Element\ 0) + Element\ 2}{1 + Element\ 0}$$

6.1.4 MATHS FUNCTIONS (Cont.)

MOVING AVERAGE (M AVE)

This function (available only in single precision mode), gives the average value of a channel or variable over the last 16 samples, according to the equation below. The required time between samples is entered as a constant in element 0 of the argument table.

$$A'_t = \frac{\sum_{t=1}^{t=16} m\,a_t}{16}$$

Where: A'_t = The average value of the channel or variable.

ma_t = The current value of the channel or variable.

The required elements are:

0. The time period in seconds between samples.
1. Reset channel (as for running average)
2. The input channel or SPV number which is to be averaged.

Note...

The output of this function will not be accurate until the first 16T seconds after switch on. After this, the value is updated once every T seconds.

GROUP AVERAGE (G AVE)

This function (available only in single precision mode), is used to calculate the arithmetic mean of a number of **consecutive** input channels. It is necessary to route non-consecutive channels or variables to consecutive Pseudo input channels using an Spv or a Dpv, with Function set to SETCH. See example below.

The equation used is:

$$A_t = (m(a)_t + m(b)_t + \text{------} + m(n\text{-}1)_t + m(n)_t) \div R$$

Where:

A_t = The mean value of channels a to n at time t.

$m(a)_t$ = Input value of the first channel of the group at time t.

$m(b)_t$ = Input value of the second channel of the group at time t.

$m(n)_t$ = Input value of the final channel of the group at time t.

R = The number of channels in the group

The required argument table elements are:

0 The total number of channels in the group (last channel number - first channel number +1), entered as a CONST.

1 The channel number of the first channel. This channel number is entered as a CONST in the argument table.

6.1.4 MATHS FUNCTIONS (Cont.)

GROUP AVERAGE (Cont.)

EXAMPLE OF USE

It is required to take a group average of channels 13, 178 and 358.

The following are assumed for the purposes of this example:

a) Slot nº 2 in expansion rack nº 1 is empty and can be configured as a 15-channel pseudo analogue input board (channels 181 to 195 inc.).
b) The SPVs and argument tables used are available (i.e. they are not used for any other maths function).

Procedure

1. In the system configuration, set up slot 2 in expansion rack 1 as a pseudo analogue input board.
2. In the maths pack configuration, select 'Spv arguments'.
3. In element 0 of argument table 0, enter Ch 13
4. In element 1 of argument table 0, enter CONST 181.0
5. In element 0 of argument table 2, enter Ch 178
6. In element 1 of argument table 2, enter CONST 182.0
7 In element 0 of argument table 5, enter Ch 358
8 In element 1 of argument table 5, enter CONST 183.0
9. In element 0 of argument table 3, enter CONST 3 (Nº of channels in the group)
   In element 1 of argument table 3, enter CONST 181 (The number of the first channel to be averaged)

10. Return to the 'set up SP variables' display menu by pressing any softkey, and select 'Equations'.

11. Set up Spv 3 as follows:
    a) RUN / STOP = RUN
    b) Argument table Nº = 0
    c) Function = SETCH

12. Set up Spv 14 as follows:
    a) RUN/STOP = RUN
    b) Argument table Nº = 2
    c) Function = SETCH

13. Set up Spv 9 as follows:
    a) RUN / STOP = RUN
    b) Argument table Nº = 5
    c) Function = SETCH

14. Set up Spv 12 as follows:
    a) RUN / STOP = RUN
    b) Argument table Nº = 3
    c) Function = G AVE
    d) Routed to channel 184
    e) Channel descriptor = 'Gp Ave 13, 178, 358'

Channel 184 now contains the group average of channels 13, 178 and 358

6.1.4 MATHS FUNCTIONS (Cont.)

CONTINUOUS MAXIMUM (CONMAX)

This function (available only in single precision mode), is used to monitor the current maximum value of any of a group of consecutive channels. Reference should be made , if necessary, to the group average description (above) if the relevant channels are non-consecutive.

The equation used is:

$$M_t = MAX(ma_t, mb_t, - - - mn_t)$$

Where:

M_t = Maximum value within the specified group.
ma_t = input value of first input of the group at time t.
mb_t = input value of second input of the group at time t
mn_t = input value of the final input of the group at time t.

The required argument table elements are:

0 The number of consecutive channels in the group (last channel number - first channel number +1), entered as a CONST.

1 The channel number of the first channel. This channel number is entered as a CONST in the argument table.

CONTINUOUS MINIMUM (CONMIN)

This function (available only in single precision mode), is used to monitor the current minimum value of any of a group of consecutive channels. Reference should be made, if necessary, to the group average description (above) if the relevant channels are non-consecutive.

The equation used is:

$$M_t = MIN(ma_t, mb_t, - - - mn_t)$$

Where:

M_t = Minimum value within the specified group.
ma_t = input value of first input of the group at time t.
mb_t = input value of second input of the group at time t
mn_t = input value of the final input of the group at time t.

The required argument table elements are:

0 The number of consecutive channels in the group (last channel number - first channel number +1), entered as a CONST.

1 The channel number of the first channel. This channel number is entered as a CONST in the argument table.

6.1.4 MATHS FUNCTIONS (Cont.)

LATCHING MAXIMUM (LTCMAX)

This function (available only in single precision mode), is used to monitor, and hold at the maximum value that any one of a group of consecutive channels reaches, over the time period between power up and reset, or between re-sets. If the function is required for a single channel only, then the 'number of channels in the group' should be set to one. Reference should be made, if necessary, to the group average description (above) if the relevant channels are non-consecutive.

The equation used is:

$$M_t = MAX(ma_t, mb_t, - - - mn_t, M_{t-1})$$

Where:

M_t = Maximum value reached within the specified group.
M_{t-1} = Maximum value reached last time.
ma_t = input value of first input of the group at time t.
mb_t = input value of second input of the group at time t
mn_t = input value of the final input of the group at time t.

The required elements are:

0. The number of consecutive channels in the group (last channel number - first channel number +1).
1 Reset input (0 = no reset; 1 = reset) entered as a channel number or as a constant.
2. The channel number of the first channel. This channel number is entered as a CONST in the argument table.

LATCHING MINIMUM (LTC MIN)

This function is used to monitor and hold at the minimum value that any one of a group of consecutive channels reaches over the time period between power up and reset, or between re-sets. If the function is required for a single channel only, then the 'number of channels in the group' should be set to one.

Reference should be made, if necessary, to the group average description (above) if the relevant channels are non-consecutive.

The equation used is:

$$M_t = MIN(ma_t, mb_t, - - - mn_t, M_{t-1})$$

Where:

M_t = Minimum value reached within the specified group.
M_{t-1} = Minimum value reached last time.
ma_t = input value of first input of the group at time t.
mb_t = input value of second input of the group at time t
mn_t = input value of the final input of the group at time t.

The required argument table elements are:

0 The number of consecutive channels in the group (last channel number - first channel number +1), entered as a CONST.
1 Reset input (0 = no reset; 1 = reset) entered as a channel number or as a constant.
2. The channel number of the first channel. This channel number is entered as a CONST in the argument table.

6.1.4 MATHS FUNCTIONS (Cont.)

RATE-OF-CHANGE (RATECH)

This function is used to calculate the rate of change with time (d /dt) of a channel or variable. The equation is:

$$R = (m\,a_t - m\,a_{(t-Ta)}) \times \frac{Rb}{Ta}$$

Where:

R = The calculated rate-of-change
T_a = Sample rate (seconds)
R_b = Rate multiplier
ma_t = Input value at time t
$ma_{(t-Ta)}$ = Input value at the previous sample period

The required argument table elements are:

0. Sample rate (time between calculations) in seconds
1. Rate multiplier. This is a multiplier to give the result in rate per minute, rate per hour etc. For example if the rate required is 'per hour', the Rate input is 3600. If the rate required is 'per minute', the Rate input is 60. I.E. the Rate input is the number of seconds in the required rate of change period.
2. Channel or variable number containing the value, the rate-of-change of which is to be determined.

EXAMPLES

A process is expected to cause a change in temperature at a maximum rate of 100 °C per hour upto a maximum temperature of 1000°C. The following examples show how the inputs may be set-up to give the result in different formats. For the purposes of these examples the temperature being monitored is at channel 18, and the resultant rate-of-change is to be held in SPV 03.

Example 1: To give the rate of change in °C per hour, updated once per minute.

Input channel number = 18
Input channel scale = 0 to 1000

Spv 003 maths function = Rate-of-change
Element table called = 002
Element table 002 contents:
Element 0 = 60 - (Sample rate = 1 minute)
Element 1 = 3600- (3600 seconds = 1 hour)
Element 2 = channel 18

Example 2: To give the rate of change in °C per minute, updated every 10 seconds

Input channel number = 18
Input channel scale = 0 to 1000

Spv 003 Maths function = Rate-of-change
Element table called = 002
Element table 002 contents:
Element 0 = 10 - (Sample rate = 10 seconds)
Element 1 = 60 - (60 seconds = 1 minute)
Element 2 = 18

6.1.4 MATHS FUNCTIONS (Cont.)

FILTER

This function (available only in single precision mode), is used to produce a low-pass filtered version of a specified input channel, using the following equation:

$$F_t = (1-\tfrac{1}{T}) \times F_{(t-1)} + \frac{m\,a_t}{T}$$

Where:

F_t = Filter output at time t
$F_{(t-1)}$ = Filter output the previous iteration
ma_t = Input value at time t
T = Time constant of the filter in seconds

The required argument table elements are;

0. The time constant of the filter in seconds.
1. The number of the input channel or variable to be filtered.

Note...

The output of this function is set to zero at power on and at channel configuration

SQUARE ROOT MASS FLOW (MFSQRT)

This function (available only in single precision mode) calculates the mass flow of a fluid in kg per second from the differential pressure developed across an orifice plate, using the following equation:

$$Q\,m_t = \frac{K \times \sqrt{\Delta P \times AbsP}}{\sqrt{(Temp + 273.15) \times Rg \times Z}}$$

Where:

Qm_t = The mass flow in kg per second
K = An output scaling factor. This is determined from an assumed value of Qm at a known ΔP, AbsP and temperature, and is chosen to give an output in the range: low scale to high scale.
ΔP = The differential pressure across the orifice plate in kPa. (Element 3)
AbsP = The absolute pressure at up-stream tapping, in kPa(A). (Element 2)
Temp = The temperature of the fluid at the up-stream tapping in degrees Celsius. (Element 1)
Rg = The specific gas constant in Joules per Kelvin-kilogramme (J/K-kg)
Z = Compressability factor

The required argument table elements are:

0. A constant (= K^2 /(Rg $\times$ Z) entered using the numeric entry keys.
1. The number of the channel measuring the upstream temperature in degrees C.
2. The number of the channel measuring AbsP in kPa(A).
3. The number of the channel measuring ΔP in kPa.

More details of mass flow calculations are given in the 'Special Functions' sub-section at the end of the maths pack description.

6.1.4 MATHS FUNCTIONS (Cont.)

LINEAR MASS FLOW (MFLIN)

This function (available only in single precision mode) calculates the mass flow of a fluid in kg. per second from a linear signal generated for example, by a turbine meter. The equation solved by the function is as follows:

$$Qm_t = \frac{K \times Flow_t \times AbsP_t}{(Temp + 273.15) \times Rg \times Z}$$

Where:

Qm_t = The mass flow in kg per second

K = An output scaling factor. This is determined from an assumed value of Qm at a known flow, AbsP and temperature, and is chosen to give an output in the range: low scale to high sale.

$Flow_t$ = The measured value from the transducer at time t. (Element 3)

$AbsP_t$ = The absolute pressure at up-stream tapping, in kPa(A). (Element 2)

Temp = The temperature of the fluid at the up-stream tapping in degrees Celsius. (Element 1)

Rg = The specific gas constant in Joules per Kelvin-kilogramme (J/K-kg)

Z = Compressability factor

The required argument table elements are:

0. A constant (= K /(Rg × Z) entered using the numeric entry keys.
1. The number of the channel measuring the upstream temperature in degrees C.
2. The number of the channel measuring AbsP in kPa(A).
3. The number of the channel measuring flow rate.

More details of mass flow calculations are given in the 'Special Functions' sub-section at the end of the maths pack description.

ZIRCONIA PROBE (ZIRCON)

This function calculates the partial pressure of Oxygen at the test electrode of a zirconia Oxygen probe, using the Nernst Oxygen equation:

$$Pt = Pr \times 10^{\frac{Ea_t}{0.0496(T + 273.15)}}$$

Where:

P_t = The calculated Oxygen partial pressure (in percent) at time t.

P_r = The partial Oxygen pressure at the reference electrode in percent

Ea_t = The potential difference between electrodes at time t, in mV.

Tb_t = The temperature of the probe in °C at time t.

The required argument table elements are:

0. The (constant) partial pressure (P_r) of Oxygen at the reference electrode.
1. The number of the input channel measuring the probe temperature (Tb_t) in °C.
2. The number of the input channel measuring the probe emf (Ea_t) in mV.

Note...

For further details, refer to the 'special functions' sub-section at the end of this maths pack description.

6.1.4 MATHS FUNCTIONS (Cont.)

Fvalue (F VAL)

This function (available only in double precision mode), calculates a value for f_o (in minutes) for a specified input channel using the following equation:

$$Fo_t = Fo_{(t-1)} + T \times 10^{\frac{ma_t - S}{Z}}$$

Where:

Fo_t = The F value (in minutes) at time t.
$Fo_{(t-1)}$ = F value last time.
T = Sampling period in minutes (set internally to 1/60).
ma_t = Input temperature value at time t.
S = Sterilising temperature.
Z = 'Z' value

The required argument table elements are:

0 Reset input channel number (1 = reset), entered as a channel number.
1 Sterilising temperature (CONST).
2 Z value (CONST).
3 Input channel number, entered as a channel number (not as a CONST).

Notes...

1. The input channel, the sterilising temperature and the Z value must all have the same temperature units.
2. The output of the function is set to zero at power on and at channel configuration.
3. Reset input is by discrete input (DIO board required) or via the DPV display reset function.
4. For further details, refer to the 'special functions' sub- section at the end of this maths pack description.

TOTALISATION (TOTAL)

This function (available in single and in double precision mode), is used to totalise a given input. The totalisation equation solved is:

$$tot_t = tot_{(t-1)} + \frac{ma_t}{R}$$

Where:

tot_t = totalised value at time t.
$tot_{(t-1)}$ = totalised value the previous time.
ma_t = input value to be totalised.
R = the totaliser rate in seconds.

The required elements are:

0. Enable input (1 = totalise), entered as a channel number or as a constant.
1. Reset input (1 = reset), entered as a channel number. (Reset is initiated via a discrete input (DIO), via the DPV reset function or by entering a constant)
2. Rate in seconds, entered, as a CONST, using the numeric entry keys.
3. The number of the channel, variable or constant, the value of which is to be totalised.

Note...

The enable input can, if required, be generated by a GT (greater than) function operating on the input channel's value. By this means, a minimum 'cut-off' value can be implemented.

6.1.4 MATHS FUNCTIONS (Cont.)

TOTALISATION (Cont.)

EXAMPLE OF USE

A common application is to use this function to totalise flow or power, usually over a period of one hour (Rate = 3600). The following example shows how the system may be set-up to achieve this.

Example 1

It is required to totalise an average flow rate of of 2500 cubic metres per hour, in a situation where the maximum possible flow rate is 5000 cubic metres per hour. For the purposes of this example, channel 11 is the channel measuring the flow rate, and DPV12 is to contain the derived quantity, using the totalise function calling argument table 012.

Dpv 12 maths function = Totalise
Argument table 014 contents:
Element 0 = SPV 10* - - - - - - - - - - - - - - - - - (Cut-off rate = 50 cubic metres/hour.*)
Element 1 = Reset input (1 = reset) (CONST = 0 for manual reset.)
Element 2 = 3600 - - - - - - - - - - - - - - - - - - - (1 hour = 3600 seconds)
Element 3 = Ch 11

*SPV10 operation

SPV function = GT (greater than)
Argument table 10 contents:
Element 0 = Ch 11
Element 1 = CONST 50

SET CHANNEL (SETCH)

This function (available in both single- and double precision modes), is used to set a value into the specified channel. This value may be a constant (CONST), maths pack variable, or another channel.

The SETCH function can be used, for example, to redirect a number of analogue or digital channels to consecutive pseudo channels for group averaging etc.

Argument table equation:-

element 1 = element 0

Where element 1 is entered as a CONST representing the channel number to be 'SET'.

6.1.5 MATHS PACK ERROR MESSAGES

Any maths pack errors are indicated only when the associated variable is active (set to RUN). If an alarm occurs it causes an error number to appear at the display panel for approximately three seconds, and the error is stored in the maths pack alarm buffer. Additionally an inverse A appears at the top right of the display to warn the operator that an alarm has occurred. Maths pack alarms are identical in operation with system alarms as described in section 3 of this manual.

The possible maths pack alarms are as follows :-

ERROR NUMBER	INTERPRETATION
01	CONSTANT CODE NOT IMPLEMENTED
02	VARIABLE CODE NOT IMPLEMENTED
03	POINT INDEX NOT ALLOWED
04	POINT TYPE NOT IMPLEMENTED
05	ARGUEMENT TYPE NOT IMPLEMENTED
06	OPERAND STACK OVERFLOW
07	OPERAND STACK UNDERFLOW
08	PARAMETER STACK OVERFLOW
09	PARAMETER STACK UNDERFLOW
10	CANNOT USE NULL ARGUMENT
11	CANNOT USE DISABLED ACQUIRED POINT
12	CANNOT SET ACQUIRED INPUT CHANNEL
13	OPERATOR STACK OVERFLOW
14	CONDITION STACK OVERFLOW
15	OPERATOR TYPE NOT IMPLEMENTED
16	SUBROUTINE STACK OVERFLOW
17	IMM. OPERATOR NOT IMPLEMENTED
18	IMMEDIATE OPERATOR NOT IMPLEMENTED
19	SUB. OPERATOR PRIORITY NOT IMPLEMENTED
20	SUBROUTINE OPERATOR NOT IMPLEMENTED
21	IMM. OPERATOR PRIORITY NOT ENABLED
22	IMM. OPERATOR INDEX NOT ENABLED
23	SUB. OPERATOR PRIORITY NOT ENABLED
24	SUB. OPERATOR INDEX NOT ENABLED
25	IMM. FUNC. OPERATOR INDEX NOT ENABLED
26	FORMULA NEEDS MORE INTERNAL REGISTERS
27	USER SUBROUTINE NOT YET CONFIGURED
28	CANNOT DIVIDE BY ZERO
29	CANNOT TAKE SQUARE ROOT OF NEGATIVE NUMBER
30	CANNOT TAKE LOGARITHM OF NEGATIVE NUMBER
31	RUNNING AVERAGE NOT COHERENT
32	NO CHANNEL
33	NO CHANNEL
34	NO CHANNEL
35	NO CHANNEL
36	NO CHANNEL
37	MATHS ERROR STACK OVERFLOW

6.1.6 SPECIAL FUNCTIONS

ZIRCONIA PROBES

INTRODUCTION

The Zirconia Oxygen probe consists of two platinum electrodes bonded to a pellet or a cylinder of zirconia. At elevated temperatures, such a probe develops an emf (Voltage) across it, proportional to the temperature of the probe and to the logarithm of Oxygen partial pressure difference between its two ends. Figure 6.1.6a shows the relationship between the percentage of Oxygen in an atmosphere and the probe output in mV for a number of temperatures.

OXYGEN CONCENTRATION MEASUREMENT

In order to measure Oxygen concentrations, one end of the probe is inserted into the atmosphere to be measured whilst the other end is subjected to a known (reference) atmosphere. For most applications, air provides a suitable reference. (Reference input = 20.95% for air.)

The temperature of the probe is measured, normally, by a type K or a type R thermocouple. The-temperature effects on the impedance of the zirconia pellet are such that, for successful operation with a 4500 system, the probe needs to be at a temperature in excess of 700°C.

The output from the probe obeys a law described by the Nernst Oxygen equation:

$$E = 0.0496\,(T + 273.15\,)\,log\,\frac{Pt}{Pr}$$

or. re-written:

$$Pt = Pr \times 10^{\frac{E}{0.0496(T + 273.15)}}$$

Where:

E = the electromotive force (mV).
T = the temperature of the probe in °C
Pt = the calculated partial pressure of Oxygen in the sampled gas.
Pr = the partial pressure of Oxygen at the reference electrode (20.95% for air).

This latter equation is solved by the 4500 system to give a result in percentage Oxygen.

In order to obtain a useful result, it is necessary to scale the inputs and any output channel correctly. The channel measuring the probe output voltage is normally scaled at 0 to 100 mV. The temperature measuring channel is normally scaled at 0 to 1500°C, and the output scaling is typically 0 to 5% for boiler flues, or 0 to 20% in kilns.

6.1.6 SPECIAL FUNCTIONS (Cont.)

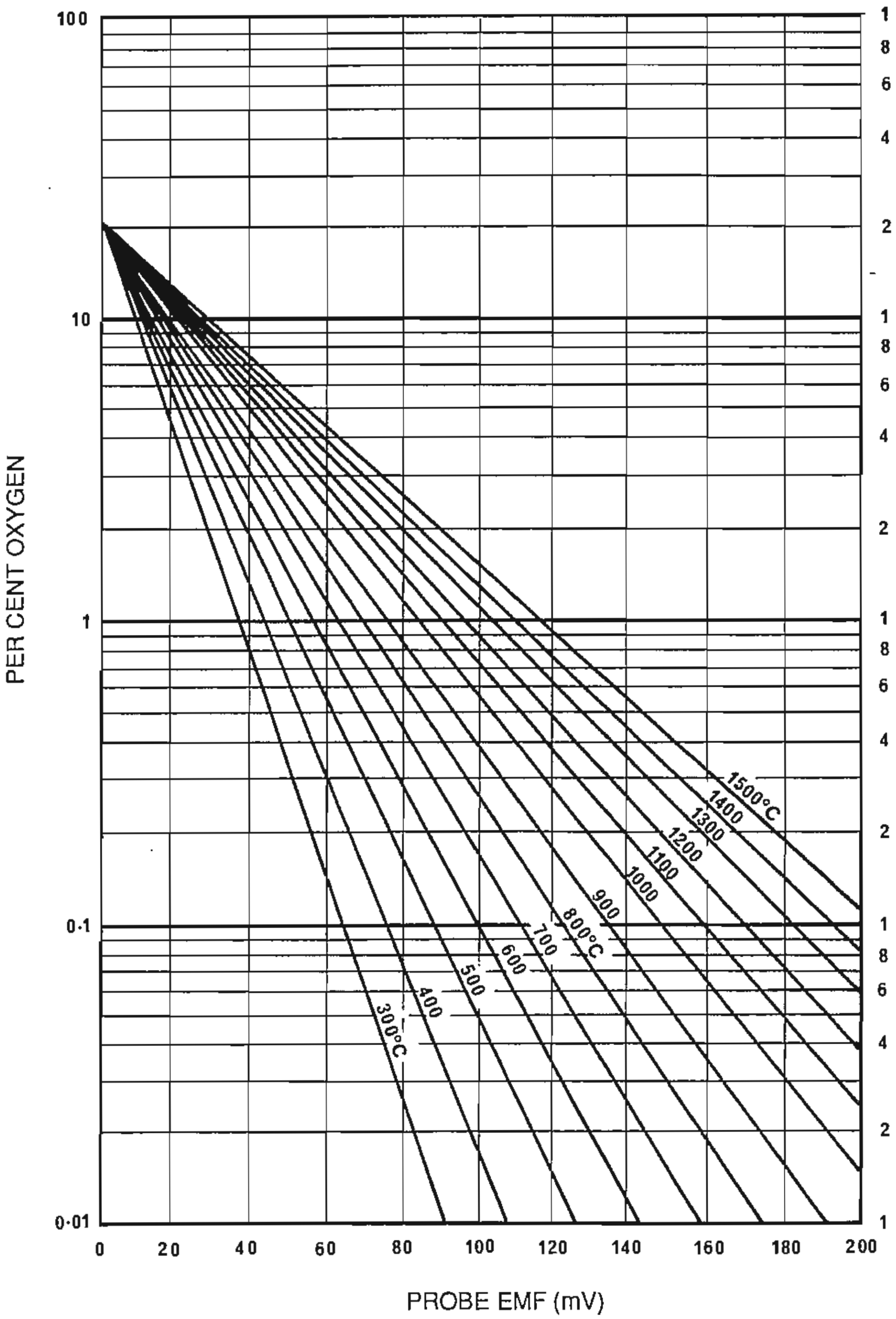


Figure 6.1.6a Oxygen concentration versus probe output

6.1.6 SPECIAL FUNCTIONS (Cont.)

OXYGEN POTENTIAL MEASUREMENT

The oxygen potential of an atmosphere is a measure of its oxidising / reducing capability. For any element, a value of Oxygen potential (free energy of formation) is known. Above this value, the element will oxidise, below it, no oxidation will occur. Figure 6.1.6b is a free energy diagram for a number of oxidising processes.

An 'Oxygen potential' cell may be considered as measuring the difference in Oxygen potential between a reference atmosphere and an oxidising / reducing atmosphere.

The oxygen potential is given by the equation:

$$O_p = 0.03157T \times \log O_p2$$

Where;

O_p = Oxygen potential in kilo calories
T = Probe temperature in Kelvins
O_p2 = Partial pressure of Oxygen in the reference atmosphere (in atmospheres).

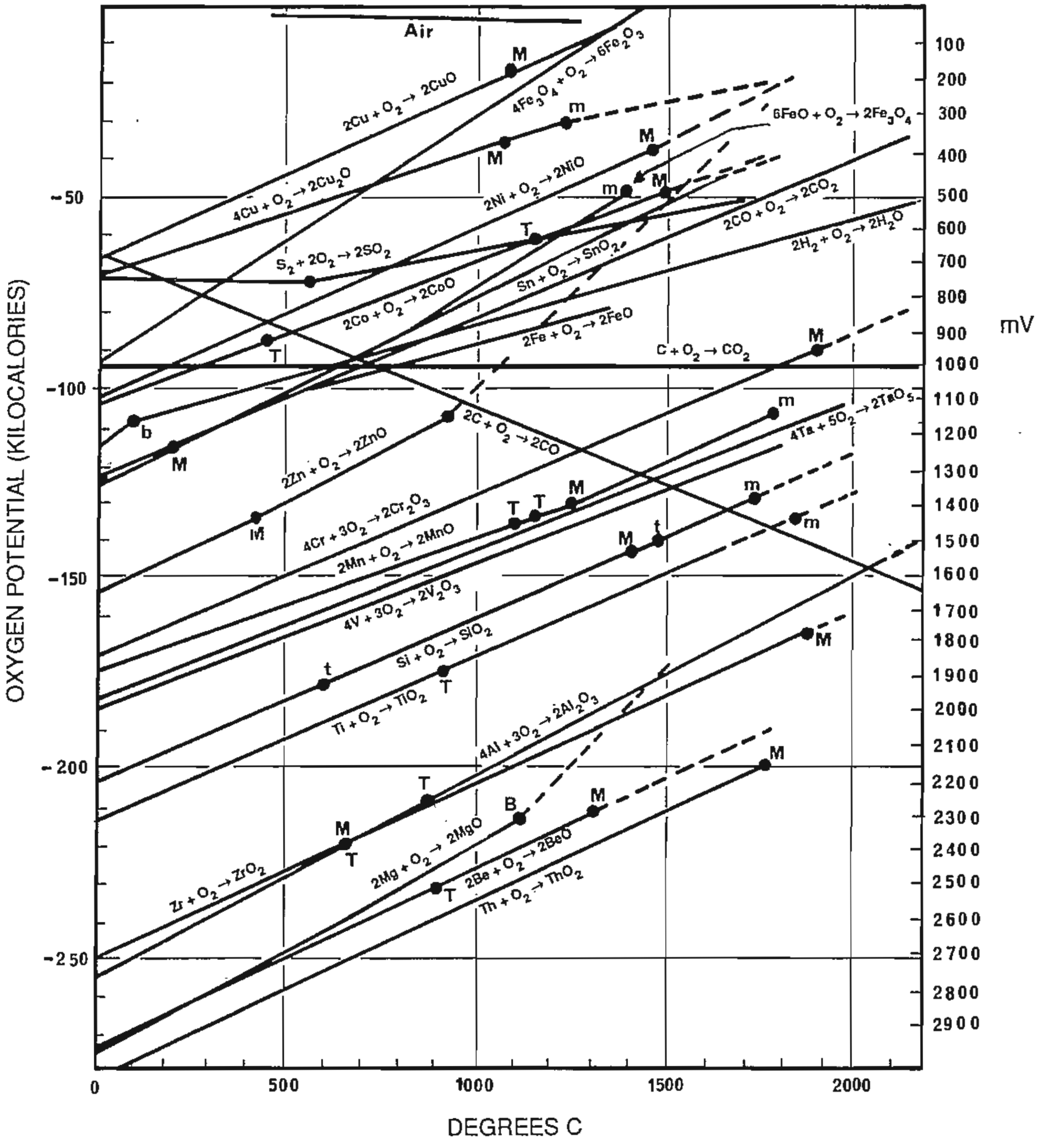
It can be shown that, because the Oxygen potential of air is essentially constant over the temperature range 600 to 1200°C, the probe output is proportional to the Oxygen potential of the atmosphere according to the equation:

$$E = 10.84O_p + 40 \text{ mV}$$

between 600 and 1200°C. It is thus possible to measure Oxygen potential directly from a zirconia probe, using a standard measuring channel of the 4500 system, scaled in units of Oxygen potential.

A typical input range is 40 to 1124mV, with a scale of 0 to -100 kilocalories. Such scaling is appropriate over the temperature range 600 to 1200°C.

6.1.6 SPECIAL FUNCTIONS (Cont.)



Change of state	Element	Oxide
Melting point	M	m
Boiling point	B	b
Sublimation point	S	s
Transition point	T	t

Figure 6.1.6b Free energy diagram

6.1.6 SPECIAL FUNCTIONS (Cont.)

Fvalue CALCULATIONS

INTRODUCTION

The calculation of Fvalues is important wherever sterilisation of medical or food products etc. is carried out. The Fvalue (in minutes) gives an equivalent time-at-sterilising temperature for temperatures below, at, and above sterilising temperature, both in dry sterilising (Fh) and in steam sterilising (Fo) environments.

In other words, F values give 'killing credits' for the time during the sterilising cycle that the load spends in approaching and in exceeding the target temperature. The values thus represent an equivalent time spent at the actual target temperature.

4500 IMPLEMENTATION

The Fvalue calculation carried out in the 4500 maths pack solves the general equation:

$$F_{val(t)} = F_{val(t-1)} + \frac{10^{\frac{temp(t) - target\ temp}{Z}}}{60}$$

Where:

$F_{val(t)}$ = Current total in minutes
$F_{val(t-1)}$ = total 1 second earlier
temp(t) = current measured temperature.
target temp = 121.1°C (F_o) or 170°C (F_h)
Z = temperature interval representing a factor-of-10 reduction in killing efficiency.
(Z=10°C for F_o; 20°C for F_h)

APPLICATION NOTES

A typical steriliser will have up to 12 measuring points within the load to be sterilised to ensure that loads containing materials with different thermal inertias will be thoroughly sterilised. To ensure accuracy, the temperature sensors must be calibrated.

Before an actual steam sterilising process starts, the chamber normally undergoes a purging cycle alternately being evacuated and flooded with steam. During this period, it is normal that local temperatures exceed the normal sterilising temperatures by a considerable margin.

Note...
It must be ensured that the input channels for the temperature are scaled such that these purge temperatures do not exceed the scale. If they do, the inputs to the F_o equations will go invalid with resulting errors in the result. Input scaling must be configured to exceed the target temperature by at least 15%.

If each of the temperature inputs is used to calculate an individual Fvalue, then each of these values can be used as an input to a continuous minimum function, with a high alarm set at the required Fvalue. This alarm can then be used to sound an audible warning, or it can be interlocked with the autoclave control system to signify the end of a sterilisation cycle.

6.1.6 SPECIAL FUNCTIONS (Cont.)

MASS FLOW CALCULATIONS

INTRODUCTION

The measurement of fluid flow is an extensive subject, beyond the scope of this document which is solely concerned with the implementation of the 4500 math pack mass flow equations.

Note...
The overall accuracy of a flow measurement installation depends on a number of factors outside the control of the 4500 system manufacturer. For this reason, the manufacturer takes no responsibility for the accuracy of the results from the mass flow equations. It is not recommended that the 4500 be used for custody transfer.

Possible sources of error are:

a) Meter type, size and age.
b) Pipe-work size, surface condition and layout.
c) Transmitter calibration accuracy.
d) True fluid composition compared with design data
e) Turn down ratio

TRANSDUCER APPLICATION

Square root equation

The square root mass flow equation is suitable for use when the output from the differential pressure transducer is proportional to the square root of the flow rate AND to the square root of the fluid density. Suitable transducers, (when used with a differential pressure transmitter with an output which is linearly proportional to the differential pressure) are listed below:

a) Orifice plates.
b) Venturies
c) Dall tubes
d) Pitot systems
e) Annubars

Linear equation

The linear equation is for use with transducers which have outputs that are linearly proportional to flow rate AND linearly proportional to density. Such transducers include turbine and vortex shedding flow meters.

OTHER TRANSDUCER TYPES

Other types of transducer (e.g. Gilflow meters) where the differential pressure is **linearly** proportional to flow rate, but proportional to the **square root** of density are not suitable for use with the mass flow equations implemented in the 4500 maths pack.

6.1.6 MASS FLOW CALCULATIONS (Cont.)

SQUARE ROOT EQUATION

As described earlier, the equation solved by the square root mass flow function is as follows:

$$Qm_t = \frac{K \times \sqrt{\Delta P \times AbsP}}{\sqrt{(Temp + 273.15) \times Rg \times Z}}$$

Where:
- Qm_t = The mass flow in kg per second
- K = An output scaling factor. This is determined from an assumed value of Qm at a known ΔP, AbsP and temperature, and is chosen to give an output in the range: low scale to high sale.
- ΔP = The differential pressure across the orifice plate in kPa. (Element 1)
- AbsP = The absolute pressure at up-stream tapping, in kPa(A). (Element 2)
- Temp = The temperature of the fluid at the up-stream tapping in degrees Celsius. (Element 3)
- R_g = The specific gas constant in Joules per Kelvin-kilogramme (J/K-kg)
- Z = Compressability factor

The required elements are:

0. A constant (= $K^2 /(R_g \times Z)$ entered using the numeric entry keys.
1. The number of the channel measuring the upstream temperature in degrees C.
2. The number of the channel measuring AbsP in kPa(A).
3. The number of the channel measuring ΔP in kPa.

Elements one, two and three are straight forward. Element 0 requires a scaling factor (K), the specific gas constant for the gas of interest (R_g) and the compressibility factor for the fluid (Z) to be known. These three items are found as follows:

Scaling factor

The scaling factor is derived from the equation:

$$K = \frac{S}{\sqrt{D_p}}$$

where:
- S = The full scale output from the flow meter
- D_p = The full scale input of the input measuring channel of the 4500

Specific gas constant (R_g)

Specific gas constants are available from published tables. For convenience, the R_g values for a number of common gases are given in table 6.1.6.

GAS	R_g (J/kg-K)
Air	287.1
Ammonia	488.2
Carbon dioxide	188.9
Carbon Monoxide	296.8
Ethylene	296.4
Hydrogen	4116.0
Methane	518.4
Nitrogen	296.8
Oxygen	259.8
Propane	188.5
Steam	461.4

Table 6.1.6 Gas constants for common gases

6.1.6 SPECIAL FUNCTIONS (Cont.)

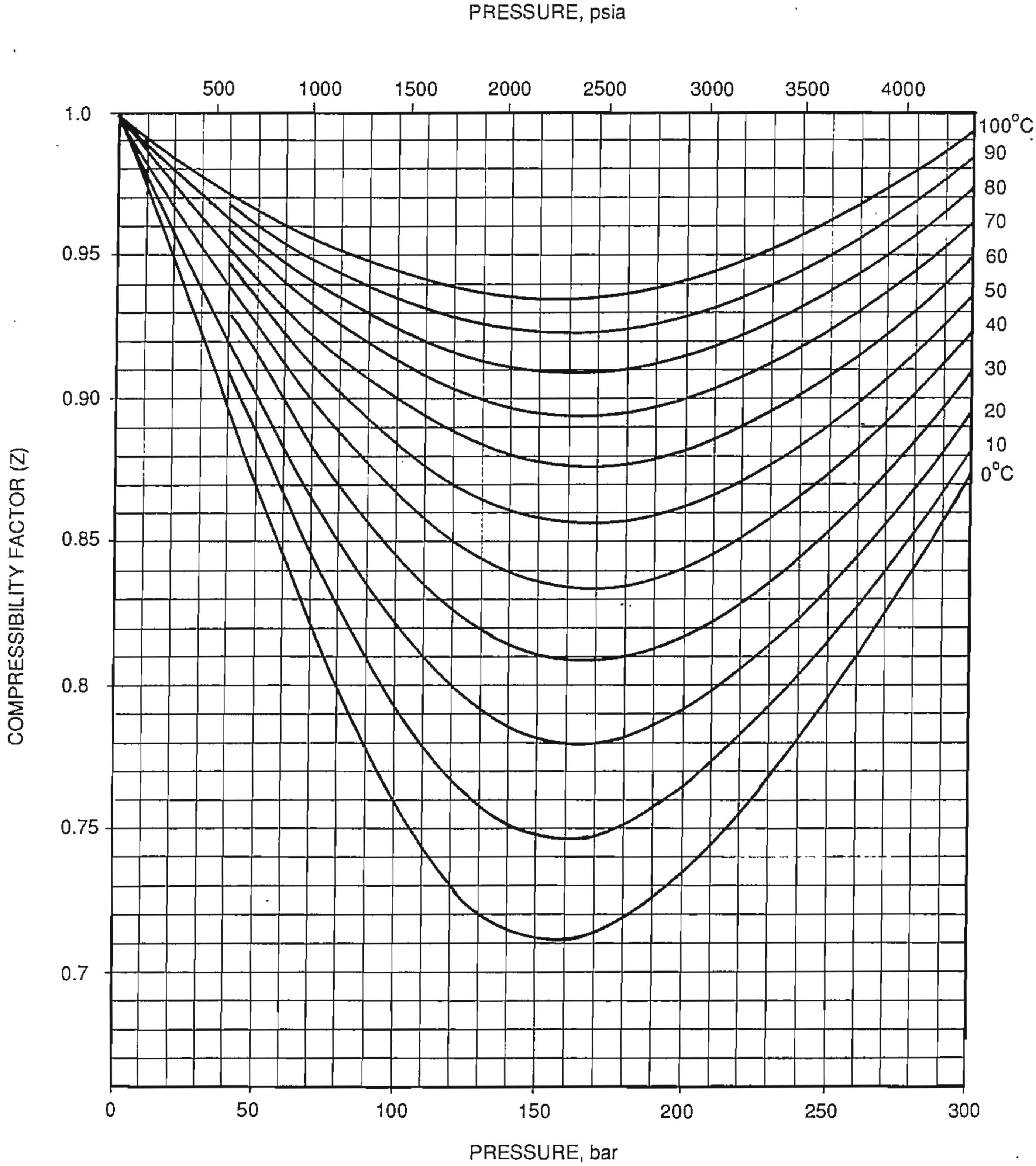


Figure 6.1.6c Typical Z-value graph

6.1.6 SPECIAL FUNCTIONS (Cont.)

SQUARE ROOT (Cont.)

Compressability factor (Z)

The compressability factor of a gas is a measure of how far a particular gas deviates from a perfect gas under any given set of pressure and temperature conditions. The z-value is related to the temperature, pressure and density of the gas by the following equation:

$$Z = \frac{P}{T} \times \frac{1}{r}$$

Where

Z = Compressibility factor
P = Absolute pressure
T = Absolute temperature
r = The gas density at that temperature and pressure (obtainable from published tables).

Alternatively, the z-value can be determined experimentally.

Figure 6.1.6c shows a typical z-value graph.

INPUT RANGE CALCULATIONS

Pressure inputs

Differential pressure (ΔP)

Since the maths pack calculation performs the square root function, the input range of the ΔP input measuring channel must be set to LINEAR. The scaling should be in appropriate zero-based pressure units. (For example, the design differential-pressure stated on the orifice calibration certificate may be used only after having been converted to SI units.)

Note...
If it is not required that the differential pressure be displayed in engineering units, a scale of 0 to 100 may be chosen in oreder to simplify the calculation of the constant.

Upstream pressure (AbsP)

This pressure input must be absolute, and must be measured in kPa. If the pressure transducer is a gauge pressure device, an offset is required to account for atmospheric pressure (mean sea level pressure = 101.35 kPa) at the relevant altitude (-10.5 kPa/km or -3.2kPa/1000ft.). This offset is incorporated by scaling the input channel with equal zero and span offsets (see the following example).

Example. To determine the channel scaling for a site located 200 metres (1/5 km.) AMSL. The pressure transducer range is 4 to 20 mA for a range of 0 to 2000 kPa(G). (Mean sea-level pressure assumed).

Offset = Atmospheric pressure - altitude effects
= 101.35 - 1/5(10.5) kPa(A)
= 101.35-2.1 kPa(A)
= 99.25kPa(A)

Input range = 4 to 20 mA LINEAR

Channel scaling = 99.25 to 2099.25 kPa(A)

Note...
kPa(A) shows that the measurement is in absolute units; kPa(G) shows that the measurement is in gauge units.

6.1.6 SPECIAL FUNCTIONS (Cont.)

INPUT RANGE CALCULATIONS (Cont.)

Temperature input

The temperature input to mass flow equations must be in degrees Celsius, since 273.15 is added to the temperature by the maths pack. If the displayed temperature is required in Fahrenheit, then two SPVs can be used, first to subtract 32, and then to divide by 1.8. The resulting Celsius temperature can then be routed to a pseudo analogue input channel for use by the mass flow (or any other similar function) equations.

LINEAR EQUATION

The linear mass flow equation solved by the 4500 maths pack is as follows:

$$Qm_t = \frac{K \times Flow_t \times AbsP_t}{(Temp + 273.15) \times Rg \times Z}$$

Where:

- Qm_t = The mass flow in kg per second
- K = An output scaling factor. This is determined from an assumed value of Qm at a known flow, AbsP and temperature, and is chosen to give an output in the range: low scale to high sale.
- $Flow_t$ = The measured value from the transducer at time t. (Element 1)
- $AbsP_t$ = The absolute pressure at up-stream tapping, in kPa(A). (Element 2)
- Temp = The temperature of the fluid at the up-stream tapping in degrees Celsius. (Element 3)
- Rg = The specific gas constant in Joules per Kelvin-kilogramme (J/K-kg)
- Z = Compressability factor

The required elements are:

0. A constant (= K /(Rg × Z) entered using the numeric entry keys.
1. The number of the channel measuring the upstream temperature in degrees C.
2. The number of the channel measuring AbsP in kPa(A).
3. The number of the channel measuring flow rate.

The determination of the K, R_g and Z is as explained above for the square root equation. It should be noted, however, that the constant term (Element 0) is proportional to K for the linear equation, whereas it is proportional to K^2 for the square root case.

See the input range calculations above for details of AbsP and T measurement.

6.1.7 OFF-LINE MATHS PACK CONFIGURATION

Access to off-line configuration of the maths pack is by selection of item 8 of the main configuration menu described in the 'Off-line configuration' section of this manual (Section 4.4).

```
MAIN CONFIGURATION MENU

1 -- RETURN TO ON-LINE
2 -- RACK HARDWARE
3 -- CHANNEL AND ALARM
4 -- SYSTEM
5 -- COMMUNICATIONS
6 -- REPORTS
7 -- RECORDER REDIRECTION
8 -- MATHS PACK
9 -- USER LINEARISATION TABLES
10-- ACCESS
11-- PRINT ENTIRE CONFIGURATION
12-- SAVE ON DISC
13-- RECALL OR INITIALISE
```

Selection of item 8 brings the 'precision' page to the screen:

```
MATHS PRECISION

1 -- RETURN TO MENU
2 -- SINGLE
3 -- DOUBLE
```

Selection of item 2 or 3 from this menu calls the 'setup variables' page to the screen:-

```
SETUP VARIABLES

1 -- RETURN TO MENU
2 -- EQUATION
3 -- ARGUMENTS
```

Operation of item 2 calls the single or double precision equations page to the screen. The page depicted below is for single precision variables; the double precision page is similar.

6.1.7 OFF-LINE CONFIGURATION (Cont.)

The off-line configuration technique for maths pack parameters is identical with that for the off-line configuration of normal channel, system, communications etc. parameters described in section 4 of this manual.

SAMPLE EQUATIONS PAGE

SPV NUMBER	STOP/ RUN	FUNCT TYPE	ROUTE TO CH	ROUTED CHANNEL DESCRIPTOR	ARG TABLE
1	RUN	ADD	1	Ps/analog output	0
2	RUN	SUB	None		0
3	RUN	DIV	None		0
4	RUN	MUL	None		0
5	RUN	R AVE	2	Ps/analog output	0
6	RUN	G AVE	3	Ps/analog output	0
7	RUN	LTCMAX	4	Ps/analog output	0
8	RUN	LTCMIN	5	Ps/analog output	0
9	STOP	ADD	None		0
10	STOP	ADD	None		0
11	STOP	ADD	None		0
12	RUN	MUL	None		3
13	RUN	ADD	16	Chan 16 descriptor	4
14	STOP	ADD	None		0
15	STOP	ADD	None		0

Notes...

1. Configurable (underlined) items are as described for on-line configuration.
2. The 'routed channel descriptor' is that which is set up during channel configuration. The field is not configurable from this equations page.
3. When the cursor is in the 'ARG TABLE' field operation of <CTRL> <O> keys causes the associated argument table configuration page (example depicted below) to appear.

SAMPLE ARGUMENT TABLE PAGE

This page is entered either from the 'SETUP VARIABLES' menu (item 3) or by operation of the <CTRL> <O> keys from the 'ARG TABLE' field of the 'equations' page described above. (if entry is made by <CTRL> <O>, then exit also has to be made using <CTRL> <O>, causing a return to the equations page.

Upon entry to the argument table page, the cursor is located in an SP ARG TABLE field. Use of <↑> and <↓> keys allows the argument table number to be incremented or decremented.

If the argument table is to be updated, the <CTRL> <T> keys are operated to allow updating. Once the table has been edited, a further operation of the <CTRL> <T> keys causes the changes to be saved.

If required, <CTRL> <N> can be used to cancel all changes made to a table since the previous <CTRL><T> operation.

If required, <CTRL><D> can be used to clear all elements of the table.

6.1.7 OFF-LINE CONFIGURATION (Cont.)

SAMPLE ARGUMENT TABLE PAGE (Cont.)

```
+-----------------------+-----------------------+-----------------------+
|SP ARG TABLE 0         |SP ARG TABLE   1       |SP ARG TABLE    2      |
+---+------+------------+---+------+------------+---+------+------------+
|EL |      | VARIABLE / |EL |      | VARIABLE / |EL |      | VARIABLE / |
|No.| TYPE |CHANNEL No. |No.| TYPE |CHANNEL No. |No.| TYPE |CHANNEL No. |
+---+------+------------+---+------+------------+---+------+------------+
| 0  CHN        31      | 0  CONST   2.00000    | 0  CONST   2.00000    |
| 1  CONST   5.00000    | 1   CHN       31      | 1  CHN       46       |
|                       |                       | 2  CONST   31.0000    |
|                       |                       |                       |
|                       |                       |                       |
|                       |                       |                       |
                       Etc.
```

Note...

Configurable (underlined) items are as described for on-line configuration.

6.2 DISTRIBUTED RECORDING OPTION

6.2.1 INTRODUCTION

This facility allows the operator to cause 4500 series analogue channels to be output to one or more Model 4001 recorders which have the communications option fitted. If more than one recorder is used, the communications link must be RS422. For one recorder only, the link may be either RS232 or RS422 according to the transmission cable length and the environment in which the system is to operate.

The communications link to the recorder(s) is made using either COMMS 1 or COMMS 2 port at the rear of the master rack. See the 'Installation' section of this manual for connection details.

Selection of recorder re-direction is accomplished in the communications configuration pages (described previously in this document) by selecting '4001 ASCII' menu item. In such a case, the 'Unit ID' field will not be available for edit.

6.2.2 RE-DIRECTION BLOCKS

A re-direction block allows up to 30 × N channels to be recorded, where N is the number of 4001 recorders available on a communications link, providing that the system maximum of 480 channels (165 for SBC level 1) is not exceeded. For example, channels 1 to 15 may be allocated to block 1; channels 1 to 8, 16 to 30 and123 to block 2; channels 4 to 15, 17 to 23, 125 to 128 to block 3 and so on (fig 6.2.2). Each re-directed channel has a specified channel in a specified recorder to which it is sent. See the 'Redirection recorder channel' page description below.

There are eight blocks available for use, but only one can be 'active' at any one time. The active block is normally selected from the block switch page (called to the display by softkey operation from the 'Logging' menu described in the Operation section of this manual), but in REMOTE mode, blocks can be switched by Discrete inputs, as shown in the 'Remote function' page described below.

```
Recorder redirection                      AB
Select block: NNNNNN  Active block: MMM
```

Where:

NNNNNN is the current recorder redirection block, scrollable through OFF, 1, 2, 3, 4, 5, 6, 7, 8 and REMOTE.

MMM is actual block switched when in remote mode. The active block field appears only when REMOTE has been selected.

6.2.2 DISTRIBUTED RECORDING (Cont.)

REMOTE FUNCTION PAGE

This page appears as a part of the system configuration menu (described in section 4.3.1) when the distributed recording option is fitted, and when REMOTE has been selected in the recorder redirection channel page (described below)

```
Block switching i/o block:OFF ch:123   AB
Recorder print control:OFF  Fail o/p: OFF
```

Block switching i/o block This item can be scrolled through 1 to 8 or OFF, and represents the block which is to become active when the DIO channel defined in the next display field becomes active (low). When more than one relevant channel is active, low block numbers have priority over high block numbers and OFF, OFF having the lowest priority of all.

When only one relevant DIO channel is active, then the block remains switched to the recorder, even when the DIO channel subsequently becomes inactive. The block will remain switched until another DIO channel becomes active. Selecting a block to OFF, and grounding its DIO channel such that it is permanently active, ensures that this 'OFF block' is switched to the recorder as soon as all other relevant DIO channels become inactive. Note that OFF is suggested here, because all other values will have priority. Any permanently active block will have the same effect, but levels below that which is permanently active, will never be switched.

ch:123 This is the DIO channel (123 in this example) which is to control the switching of the block defined in the previous field.

Recorder print control Srollable to ON or OFF. When OFF, the function is disabled. When ON, the recorder will stop whenever there is no active block connected to it. This feature can be used to avoid unneccesary use of chart paper and print ribbon.

Fail o/p Scrollable to ON or OFF. When OFF, the function is disabled. When on, if the recorders are appropriately configured, one or more of the 4001s will go into alarm if there is a failure in the 4500 system. See section 6.2.3 for further details.

6.2.2 REDIRECTION BLOCKS (Cont.)

REDIRECTION RECORDER CHANNEL PAGE

To allocate a channel to a block, the 'channel redirection' page is used (part of the channel configuration described in the 'Configuration' Section of this manual).

```
NNN   DDD.D Units  Channel descriptor
Recorder redirection- block:z id:y ch:xx
```

This allows the measured variable from an input channel to be directed to a model 4001 recorder if the recorder redirection option is fitted. In order for communications to take place, the recorder must be fitted with either RS232C (one recorder only) or RS422A (up to 8 recorders) communications software and hardware.

z This is the block number (scrollable through 1 to 8). As an example, block one might re-direct 4500 channel 231 to channel 16 of recorder 1, block two might re-direct 4500 channel 231 to channel 8 of recorder address 1, whilst block three re-directs channel 231 to channel 16 of recorder address 3. The currently active block is set up at the 'block switch' menu described in the operation section of this manual. The maximum number of channels which may be allocated to any one block is 240, providing that the system maximum of 480 (165 with level 1 SBC) is not exceeded. The reference section of this manual includes forms (copies of) which may be filled-in, in order to keep a record of redirection destinations.

y This is the group ID of the recorder (scrollable through 0 to 7) to which the 4500 channel is to be sent. Clearly, the correct address(es) must be set up at the recorder(s) (via the Serial Link 2 page) as described in the Installation and operating manual (HA237229) supplied with the recorder.

xx This is the model 4001 channel number to which the 4500 channel is to be sent. The channel encoding is transparent to the user so it is not necessary to enter a logical unit number or channel address as is normally required when a host is communicating with a model 4001.

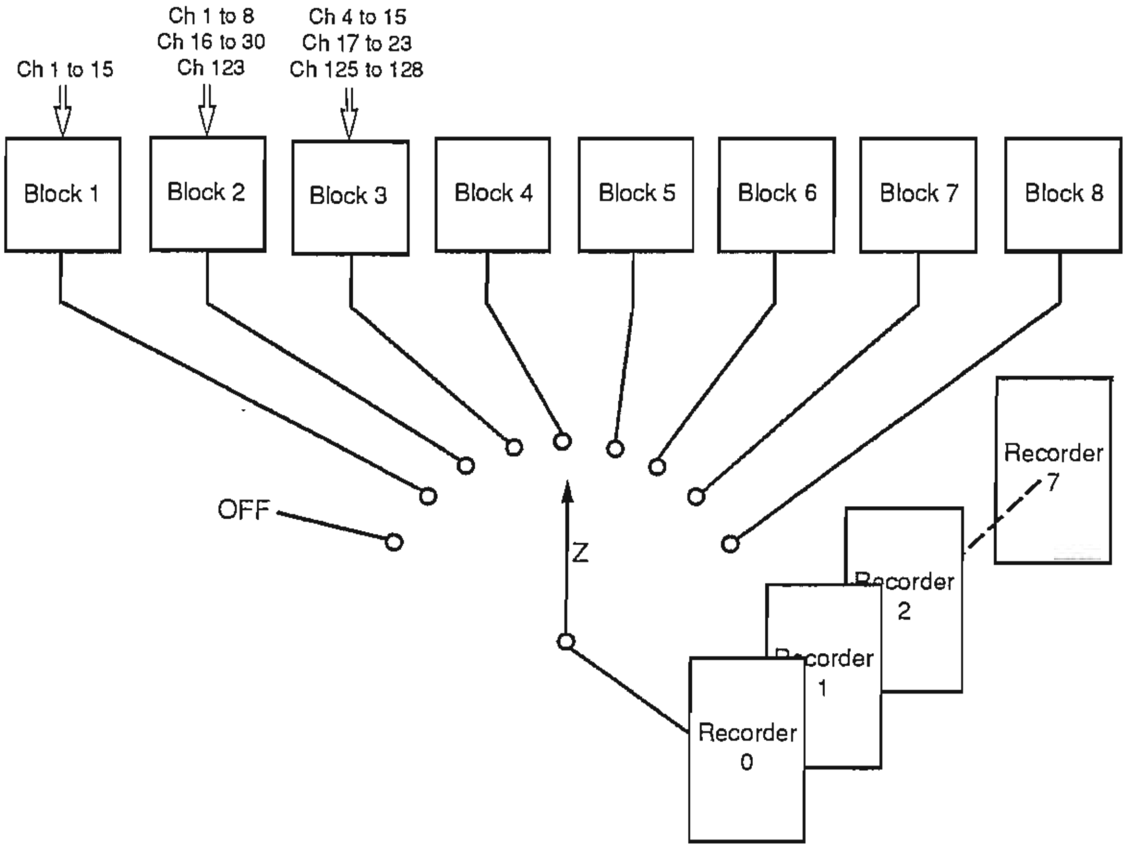


Figure 6.2.2 Recorder redirection

Note...

A 4500 channel can be allocated once only in any one or more block(s). The maximum block size is 240, allowing 30 channels to be allocated to each of eight recorders.

6.2.3 INTERFACE BETWEEN 4001 RECORDERS AND 4500 SYSTEMS

A number of items of configuration need to be set up at the recorder to allow blocks of channels to be transmitted successfully from a 4500 system. The configuration of the recorder is outside the scope of this document, but in the following description, the user is referred to the relevant sections of the 4001 Installation and Operation Manual (HA237229 - supplied with the recorder) as necessary.

Note...

Parameters configured at the 4001 recorder should be changed only when redirection is selected to OFF. Failure to observe this might result in parts of the 4001 recorder configuration being lost when blocks are changed.

COMMUNICATIONS PARAMETERS

The communications parameters of the recorder are set-up via Serial Link Pages 1 and 2, described in Section 6 of the recorder manual.

The serial link parameters should be set up to the following values:-

Stop bits	1
Data bits	8
Parity	None
Mode	ASCII
Handshake	Off
Group ID	As appropriate to the channel

The 4500 system Baud rate is set to 9600 at initialisation. This may be re-set if required as long as the value set at the 4500 system matches that set at the recorder.

ASCII CONTROL CODES

When using the ASCII protocol, certain characters are used as control codes, and may therefore not be used as characters within a text string. These characters are shown in table 6.2.3 below.

Character	Definition	Hex code
"	Start of text (STX)	22
#	End of text (ETX)	23
$	End of transmission (EOT)	24
%	Enquiry (ENQ)	25
&	Acknowledge (ACK)	26
(	Negative acknowledge (NAK)	28

Table 6.2.3 ASCII control characters

SLOT CONFIGURATION

For a 4001 input board to receive signals from the 4500 system, the relevant slot configuration for the board must be set to 'EXI/P'.

Refer to the 'Slot Configuration Page Display' description in Section 6 of the recorder Installation and Operation Manual for further details.

6.2.3 INTERFACE BETWEEN 4001 ECORDERS AND 4500 SYSTEMS (Cont.)

CHANNEL CONFIGURATION

For each redirected channel, the following hold true for the duration of the redirection. Once the redirection function is terminated, the channel function is set to OFF and all other parameters are left as previously configured.

1. The recorder channel scale is set to the same zero and span values as the redirected channel's scale.
2. The recorder channel function is set to EXT.
3. The recorder channel engineering units string number is set to 13, which is normally blank.
4. The recorder channel descriptor is over-written with a text string consisting of the 4500 channel number (123 in the example below), the first 8 characters of the 4500 channel descriptor (Boiler 1 in this case) and the 4500 channel units string (Deg C).

```
123 Boiler 1 Deg C
```

The rest of the channel configuration (eg zoning the trace) is the responsibility of the user, but it should be noted that the changing of parameters should take place only when the 4500 redirection is set to off. Otherwise some of the configuration may be lost, when blocks are changed.

RECORDER MESSAGES

When the recorder is in print modes 2 or 3, a number of status messages are printed on the chart in black. In multiple recorder applications, the messages are printed on the charts of only those recorders which are having data re-directed to them.

1. `***** 4500 Trending on - block N`

   This message indicates that an active block has been enabled at the 4500, and data is now being directed to the recorder.

2. `***** 4500 Trending off`

   This message indicates that the active block number has been changed such that 4500 data is no longer being sent to the recorder.

3. `***** 4500 Redirection data changed`

   This message indicates that the channel allocation to the currently active block has been changed (ie channels have been added to or deleted from the active block).

4. `***** CH NNN Configuration changed`

   This message appears if the configuration of any of the 4500 channels in the currently active block is changed.

5. `***** 4500 System Failure-Trending restarted`

   This message appears on all recorders if the 4500 system fails, and automatically re-initialises itself. It indicates that the redirected channels have not been updated during the initialisation period. The recorder continues to trace the last data received.

6.2.3 INTERFACE BETWEEN 4001 ECORDERS AND 4500 SYSTEMS (Cont.)

4500/4001 WATCHDOG

Note...

Correct use of this function requires that all the 4001 recorders connected to the 4500 system are fitted with maths pack software at level 2 or 3.

If this system is activated, by using the 'Distributed recording remote functions' page, described in section 6.2.2, the the 4500 sends a signal which is alternates every 6 seconds, between +1 unit and -1 unit, to channel 30 of every recorder which appears in the redirection blocks.

This alternating signal has an average value of zero over a period of 12 seconds, but if the 4500 fails, the output will remain at either -1 or +1, so the average will tend to -1 or +1 respectively. Thus, by setting an alarm to check the average value of channel 30, a failure in the 4500 can be easily detected, and appropriate action can be taken.

Each 4001 should be configured as follows:-
Channel 30: Scale -1 to +1, Function type: External
Channel 60: Scale -1 to +1, Function: Average; channel 30; interval 0.2 minutes.
Alarm type: deviation; reference 0.0; deviation 0.5; hysteresis 0.0%.

6.2.4 OFF-LINE CONFIGURATION OF REDIRECTION BLOCKS

The relevant part of Section 4 of this document describes the operation of the off-line configuration facility of the 4500 system. Once the main configuration menu appears, selection of item 7 will call the following menu:

```
   RECORDER REDIRECTION
1 -- RETURN TO MENU
2 -- CONFIGURE REDIRECTION TABLES
3 -- CONFIGURE REMOTE CONTROL
```

REDIRECTION TABLE PAGE

Selection of item 2 from the above menu calls the redirection table display, depicted below. The display page shows channels 1 to 30 of recorder 1, with any 4500 channels which are redirected to them in a particular block. The block number can be changed from the keyboard, so that, the redirected channels for each recorder for each block, can be observed. The page also allows the block and/or table to be cleared.

```
        RECORDER REDIRECTION TABLE - CONFIGURATION PAGE
                       BLOCK: B                    RECORDER ID: R
   CLEAR THIS BLOCK (Y/N): N     CLEAR ENTIRE TABLE (Y/N): N
|------------------------------------------------------------------|
| REC CH  | 4500 CH  | REC CH  | 4500 CH  | REC CH  | 4500 CH  |
|------------------------------------------------------------------|
|    1    |   001    |   11    |   000    |   21    |   000    |
|    2    |   002    |   12    |   000    |   22    |   000    |
|    3    |   003    |   13    |   000    |   23    |   000    |
|    4    |   004    |   14    |   000    |   24    |   248    |
|    5    |   004    |   15    |   000    |   25    |   000    |
|    6    |   006    |   16    |   231    |   26    |   000    |
|    7    |   007    |   17    |   000    |   27    |   000    |
|    8    |   166    |   18    |   000    |   28    |   000    |
|    9    |   188    |   19    |   000    |   29    |   000    |
|   10    |   000    |   20    |   000    |   30    |   000    |
|------------------------------------------------------------------|
```

For configurable items see over.

6.2.4 OFF-LINE CONFIGURATION OF REDIRECTION BLOCKS (Cont.)

CONFIGURABLE ITEMS:

Block: B	B is the currently displayed block, selectable between 1 and 8. The 4500 channels which are redirected to the 30 channels of the recorder in question are shown for whichever block number is selected. In the example above, showing the 30 channels of recorder 'R' it can be seen that for block 'B', 4500 channel 231 is redirected to 4001 channel 16. In another block, channel 16 of recorder 1 might have 4500 channel 23 (say) redirected to it.
Recorder ID: R	R is the currently displayed recorder, selectable between 0 and 7. The 30 channels associated with this particular recorder are listed along with any 4500 channels redirected to them for this particular block number.
Clear this block	Selection of 'Y' causes the block currently selected to be cleared, not just for the recorder displayed, but for all recorders.
Clear entire table	Selection of 'Y' causes all blocks to be cleared for all recorders.

The bottom part of the screen contains a status area where configuration error messages are displayed, and, below this, a 'help' area with <Ctrl><E> (return to menu) and <CTRL><W> (print configuration page) messages.

REMOTE CONTROL PAGE

Selection of item 3 of the above menu causes the following page to appear:-

```
RECORDER REDIRECTION - REMOTE CONTROL CONFIGURATION PAGE

         SWITCH ALL BLOCKS OFF : 526
         SWITCH BLOCK 1        : 527
         SWITCH BLOCK 2        : 528
         SWITCH BLOCK 3        : 529
         SWITCH BLOCK 4        : 530
         SWITCH BLOCK 5        : 531
         SWITCH BLOCK 6        : 532
         SWITCH BLOCK 7        : 533
         SWITCH BLOCK 8        : 534

         RECORDER PRINT CONTROL: OFF
         FAILURE OUTPUT        : OFF
```

As can be seen, the above menu allows channels (526 to 534 in this example) to be defined to control the remote switching of redirection blocks. Further, the recorder print control and watchdog (failure output) functions can be set on or off as required.

The bottom part of the screen contains a 'help' area with <Ctrl><E> (return to menu) and <Ctrl><W> (print this page messages.

6.3 PROTOCOL TRANSLATOR OPTION

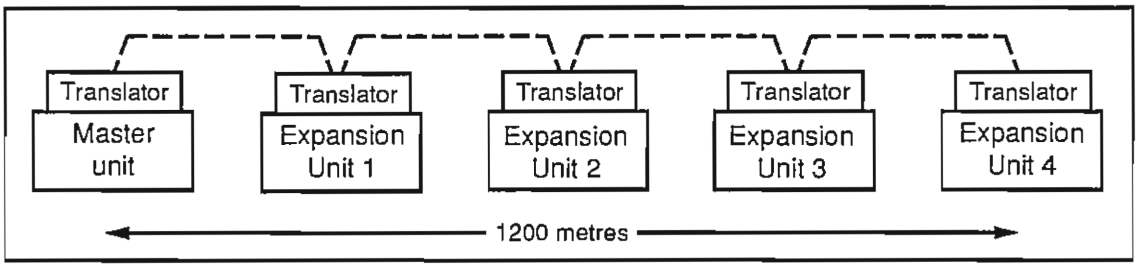
6.3.1 INTRODUCTION

The protocol translator option can be used in two modes: 'normal' and 'repeater'. In both modes, it translates the 14-wire communication amongst master and expansion racks to 4-wire communications, thus reducing cable costs in applications with large distances between adjacent racks.

Two slightly different versions of the option are available, one for use with 4500 master units; the other with expansion units. Each translator has two ports, labelled 'IN' and 'OUT'. Both ports of the master unit translator can be configured either as 4-wire or 14-wire. Expansion unit translator IN ports can be configured to accept either 4 or 14 wire communications; OUT ports are not configurable, being permanently set to 4-wire.

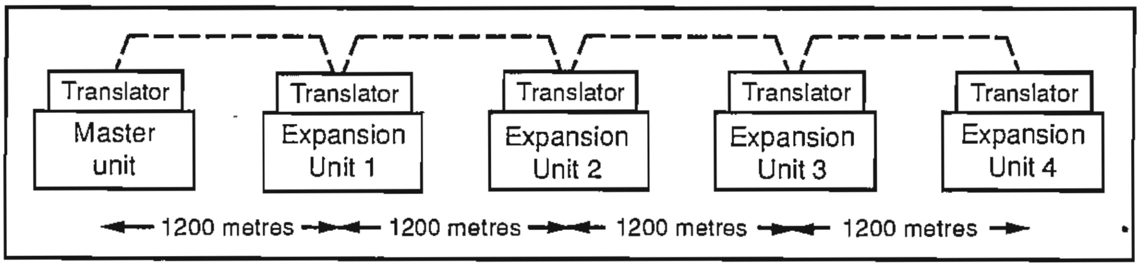
NORMAL MODE

As described above, the translator reduces the normal 14-wire communications to 4-wires.



REPEATER MODE

The translator unit re-constitutes weak signals. In repeater mode, this allows each inter-rack distance to be increased to 1200 metres (approx 3/4 mile). Without the translator, 1200 metres is the maximum length between the master unit and the farthest expansion unit.



In repeater mode, it is necessary that the 4500 master unit be at one end of the communications link, and that expansion rack addresses increase along the chain, each translator unit being set up to have the same address as that of the expansion unit to which it is attached. The setting of the translator unit address is described in the 'Translator installation' section below. The setting of expansion unit addresses is described in the 'Installation' section of this manual (Section 2).

Note...

In repeater mode, it is essential that all translator units be powered up if the link is to operate successfully.

6.3.2 TRANSLATOR INSTALLATION

It is recommended that the installation of the unit is carried out in the following order:

1. Parameter set-up (by switches and links on the circuit board located within the case).
2. Mechanical fixing
3. Cabling.

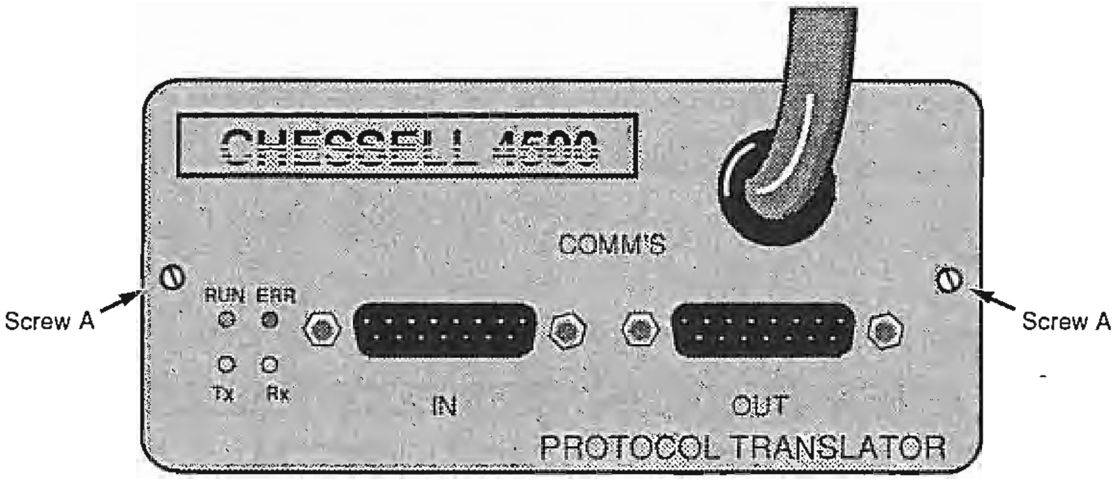


Figure 6.3.2a Protocol translator front panel

PARAMETER SET-UP

The purpose of this setting up procedure is to set the 14 to 4 wire translation on or off, to set the relevant expansion unit addresses, and to select 'normal' or 'repeater' mode.

1. Remove the circuit board from the case, by removing the two securing screws ('A' in fig 6.3.2a) and pulling the front panel gently forwards.

CAUTION

THE WIRE TERMINATIONS TO THE CIRCUIT BOARD ARE CLOSE TO ONE EDGE OF THE BOARD. CARE MUST BE TAKEN NOT TO DETACH ANY OF THESE WIRES FROM THEIR TERMINAL BLOCK LOCATIONS.

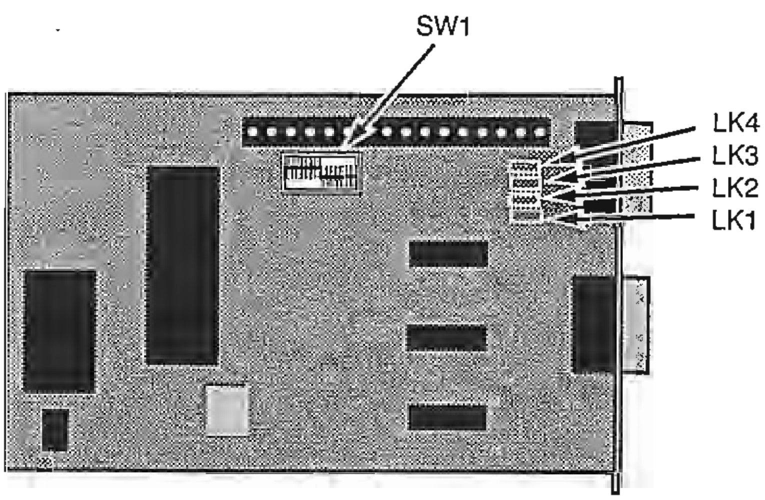


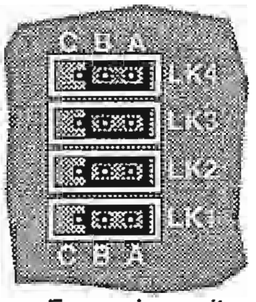
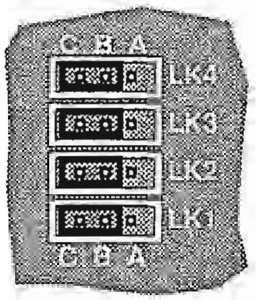
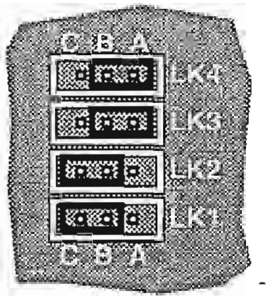
Figure 6.3.2b Switch and link locations

6.3.2 TRANSLATOR INSTALLATION (Cont.)

PARAMETER SET-UP (Cont.)Protocol translator

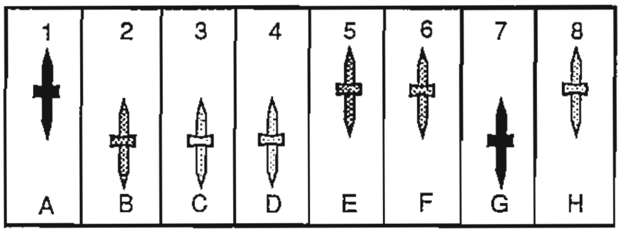
LK1 TO LK4

Links 1 to 4 are used to select 'Normal' or 'Repeat' Mode of operation for the expansion unit translator units. The links must be set as shown below for the master unit.

 Expansion unit Normal (Non-repeater) mode	 Expansion unit Repeater mode	 Master unit

SWITCH 1 (MASTER UNIT)

The table below shows the SW1 positions for setting the IN and OUT port protocols for the master unit translator. The master unit uses only elements 6 and 8 of SW1. The ↑in the table indicates that the switch slider is moved towards the numeral (1 to 8); the ↓ indicates that the slider is moved towards the 'letter' (A to H).



Protocol required	Switch settings (X = don't care) 1	2	3	4	5	6	7	8
Both ports 14-wire protocol	X	X	X	X	X	↑	X	↑
Both ports 14-wire protocol	X	X	X	X	X	↑	X	↓
Both ports 4-wire protocol	X	X	X	X	X	↓	X	↑
IN port: 14-wire; OUT port: 4-wire	X	X	X	X	X	↓	X	↓

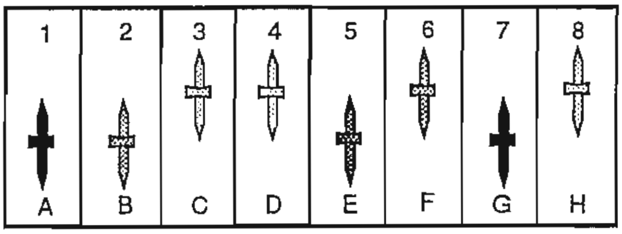
Master unit SW1 settings

6.3.2 TRANSLATOR INSTALLATION (Cont.)

SWITCH 1 (EXPANSION UNIT)

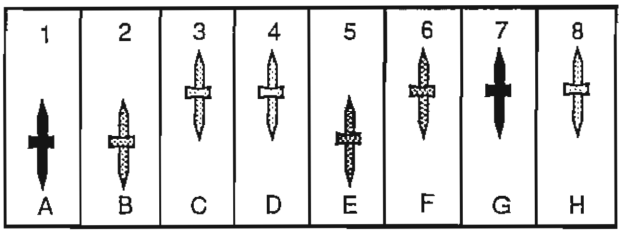
The tables below show the SW1 positions for selecting expansion unit translator addresses (elements 3 and 4) and whether or not the input port on the translator is to receive 4-wire or 14-wire protocol. The output port always supplies translated data, so only expansion unit one translator will need to be set to 14-wire input, and then, only if the master unit translator OUT port is set to 14-wire protocol.

14-wire protocol is available at the IN port, only in repeat mode.



Expansion unit address	Switch settings (X = don't care) 1	2	3	4	5	6	7	8
Address 1	X	X	↑	↑	X	X	X	X
Address 2	X	X	↑	↓	X	X	X	X
Address 3	X	X	↓	↑	X	X	X	X
Address 4	X	X	↓	↓	X	X	X	X

Expansion unit SW1 settings: Addresses



	Switch settings (X = don't care) 1	2	3	4	5	6	7	8
IN port 4-wire translated	X	X	X	X	X	X	↑	X
IN port 14-wire un-translated	X	X	X	X	X	X	↓	X

Expansion unit SW1 settings: IN port translation

MECHANICAL INSTALLATION

The unit is supplied with the following fixing accessories:-

1. Brackets for fixing the unit to a wall or panel.
2. A mounting plate suitable for a standard 19 inch rack
3. Rubber feet (to be fitted over the tapped holes in the case brackets when the unit is to be free standing).

Figure 6.3.2, below, shows the fixing hole centres for wall or panel mounting.

6.3.2 TRANSLATOR INSTALLATION (Cont.)

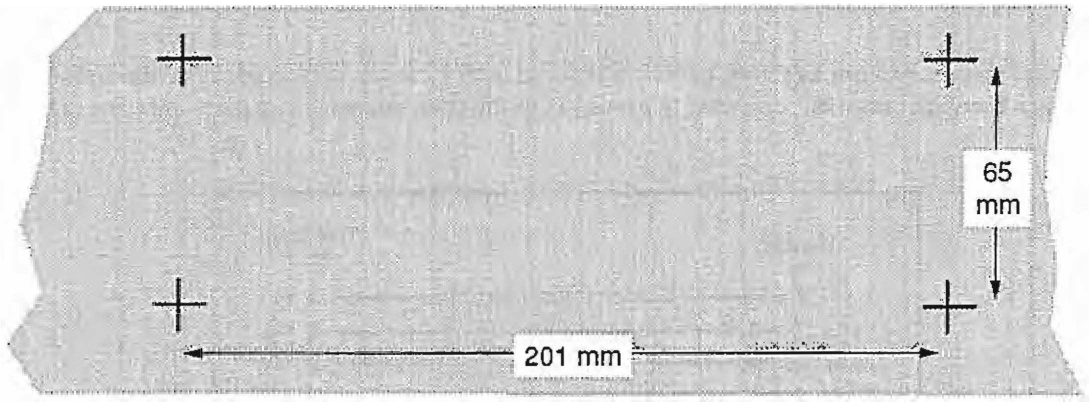


Figure 6.3.2 Panel mounting fixing centres

ELECTRICAL CONNECTION

The protocol translator is supplied with a one metre long flying lead for connection to either of the two 15-way D-type sockets at the patch panel at the rear of the relevant master or expansion rack. A suitable 15-way connector plug with jacking screws is also supplied with the unit, for use when making the connections between translators.

CONNECTOR TYPE

Should spare connectors be required, the following are suitable types:

McMurdo DE15P plug
Amphenol 17DE15P plug
OSSI connectors Ltd. DPKK15 Shroud.

CABLE TYPE

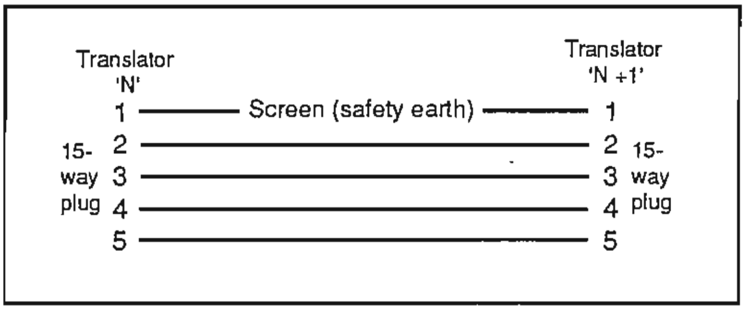
A cable with two twisted pairs and a screen is required for connection between translators. Some recommended cable types are as follows:

Belden 9502
BICC H8072
STC OS 2P24
UL 2624 - 2 pair

6.3.2 TRANSLATOR INSTALLATION (Cont.)

CONNECTIONS

The electrical connections are as shown below. If required, pins 7 can be connected to provide a signal ground. Pin 1 of each connector must be connected to pin one of all the other connectors (e.g. by using the cable screen drain wire).



6.3.3 TRANSLATOR OPERATION

The operation of the translator is transparent to the user. The interpretation of the information given by the four LEDs on the front panel (fig 6.3.2a above) may however be of use:

RUN Green LED. A steady flashing (approximately 4 Hz) indicates that the micro-processor within the translator is operating correctly. Irregular flashing, or a continuous on or off state indicates that there is a 'hardware' fault.

ERR Red LED. Indicates a communications error. The LED flashes once for each framing error detected.

Tx Amber LED. For the master rack translator, this LED flashes at the end of a message. At an expansion rack, the LED flashes once, whenever a message for its associated rack is received.

Rx Amber LED. For the master unit translator, this LED flashes at the start of a message. At an expansion rack, the LED flashes once, whenever a message is received, no matter which expansion unit the message is addressed to. This LED therefore flashes more frequently than the Tx LED, depending on the system configuration.

6.4 ARCHIVING OPTION

The Archiving option allows the operator to log channel values and system alarms to a mass storage medium according to a number of configurable criteria, such as 'log on alarm', 'log on change', 'log every time period' and so on. A software facility (Reformater), supplied with the option, can be used to convert logged data into a 'spreadsheet' format suitable for use with most personal computers.

Entire configurations can also be saved, for copying to other systems, or for security against configuration loss.

FILE HANDLING

FILE NAMES

File names can be entered using the Batch Number field in the first of the Mass storage display pages (described below). The file name can be entered as a text string or as a numerical string (with auto increment if required). Alternatively, the system time or date can be selected for use as a file name. All such filenames are saved with a '.CAF' extension.

Entire system configurations can be saved for copying to other systems, or for security against configuration loss. Configuration file names are entered as text strings in the third of the Mass Store display pages described below. Configuration files are saved with a '.CFG' extension.

OPERATION

At log initiation, all channel data for all the relevant time intervals is logged. Subsequently, timed data is logged as the appropriate time intervals expire. Other types of data (alarm, event, change) are logged when their appropriate trigger occurs.

All simultaneous alarm-triggered data is logged as a single block. Similarly, all simultaneous event-triggered data will be logged as a single block.

With disc-drive units, the file to which data is transferred will close after 30 seconds of inactivity, if a further interval of 30 seconds or more is predicted from the configured time intervals. This helps to minimise the risk of losing data whilst changing discs or tapes. Each time a log interval is due, the file is re-opened, and the new data is appended to the old data. If the file cannot be found (i.e. the disc has been changed) then a new file is opened.

On dual disc-drive units, the drive switches automatically when the current disc is full. This results in an arbitrary file boundary which must be overcome by using, for example, DOS 'copy' before the data is reformatted. If the disc in the second drive is full, or missing, the system disables logging and generates a system alarm. Logging must be re-enabled form the operator display once an appropriate disc has been inserted into the second drive.

A system alarm is generated as the disc or tape approaches being full. On dual disc-drive units, this will clear automatically on a successful drive switch.

6.4.1 DISC DRIVE SYSTEMS

INTRODUCTION

Note...

'4510' is used as a general term for the disc drive units listed below.

The table below shows the different disc drive systems which can be chosen for various requirements. All these systems are fully compatible with the 4500 system, and provide a comprehensive data archiving system. The drive units provide between 360 kB and 2.88 MB of storage through single or dual drives, using either 5.25 or 3.5 inch discs. The maximum number of files per disc is 111 except for units using 5.25 inch DSHD (1.2MB) drives, in which case the maximum number of files is 223.

The disc drive units are compatible with IBM® PC MS-DOS, enabling archived data to be analysed by industry-standard software packages such as spreadsheets and data bases.

Part Number *	Model Nº	Format	Nº of ports
LA245100Ux00	4510	Single 5.25 inch; 360 kB	1
LA245101Ux00	4511	Single 5.25 inch; 1.2 MB	1
LA245102Ux00	4512	Single 3.5 inch; 720kB/1.44MB	1
LA245103Ux00	4513	Single 5.25 inch; 360 kB	2
LA245104Ux00	4514	Single 5.25 inch; 1.2 MB	2
LA245105Ux00	4515	Single 3.5 inch; 720 kB	2
LA245106Ux00	4516	Dual 5.25 inch; 360 kB	2
LA245107Ux00	4517	Dual 5.25 inch; 1.2 MB	2
LA245108Ux00	4518	Dual 3.5 inch; 720 kB	2
LA245099Ux00	4519	Dual 3.5 inch; 1.44 MB	2
* x = 1 for 110 Volt; = 2 for 240 Volt supply			

Table 6.4.1 Alternative disc drive systems

Note...

The second Serial Port on models 4513 to 4519 allows a second device (e.g. a host computer) to gain access to the archived data, remotely, by MODEM if required. This second port may not be used whilst the 4500 is logging to the disc drive. Details of the protocol for the port are available from the manufacturer on request.

DISC HANDLING

Modern discs are quite robust, but it is important for long-term security of data that certain rules are adhered to when handling and storing them.

1. Finger contact with the disc surface must be avoided. For this reason, and also to keep the disc as clean as possible, it is recommended that $5^1/_4$ discs are kept in their envelopes whenever possible. The sliding 'shutter' on $3^1/_2$ inch discs should be kept closed for the same reasons.
2. When labelling $5^1/_4$ discs, the label should ideally be written-on before it is attached to the disc. If the label is already on the disc, then a soft-tipped marker must be used, to avoid damage to the disc.
3. Discs must not be bent or folded.
4. Discs must be kept away from strong magnetic and electric fields.
5. Discs must be maintained at a temperature within the range specified by the disc manufacturer.
6 Discs must be inserted correctly (see figure 6.4.1a below).

6.4.1 DISC DRIVE SYSTEMS (Cont.)

DISC SIZES

The following discs are suitable for use. Higher density discs cannot be read in lower density drives.

1. $5^{1}/_{4}$ inch double sided, double density, 360 kB formatted, 48tpi.
2. $5^{1}/_{4}$ inch double sided, high density, 1.2 MB formatted, 96tpi.
3. $3^{1}/_{2}$ inch double sided, double density, 720 kB formatted, 135 tpi
4. $3^{1}/_{2}$ inch double sided, high density, 1.44 MB formatted, 135 tpi

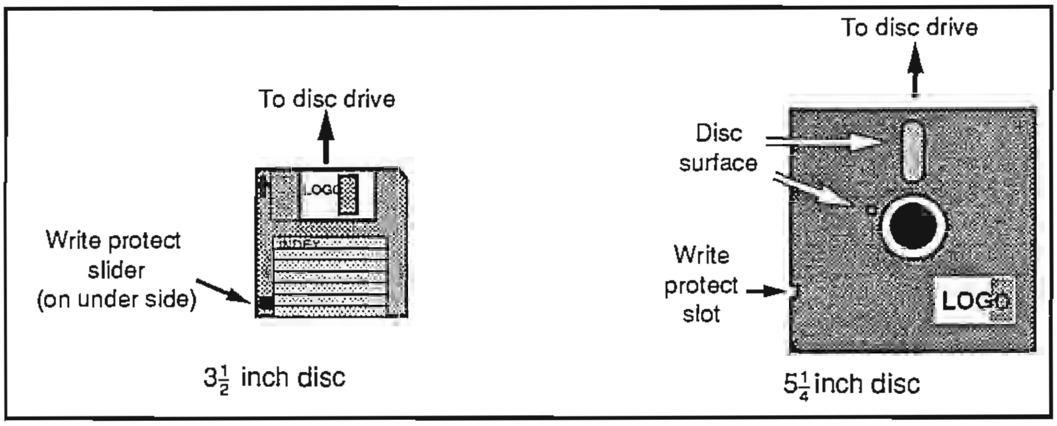


Figure 6.4.1a Disc orientation relative to disc drive

WRITE PROTECTION

Write protection is available on both types of disc (see figure 6.4.1a). It is recommended that if disc copying is to be carried out, the source disc is write protected before copying is started. With $5^{1}/_{4}$ inch discs, the write protect slot has to be covered by an opaque, self-adhesive label, usually supplied with the discs. $3^{1}/_{4}$ discs have a movable plastic slide with two positions: write enable, write protect.

CHANGING DISCS

If a disc is removed whilst a file is still being written-to, the entire contents of that file might be lost. In order to ensure that this does not happen, the logging facility should be disabled. If this is not done, then it is 'safe' to change discs only when the STOP/STBY indicator is illuminated (files closed). It must be remembered, however, that logging can re-start at any time.

If a log is initiated to a drive with no disc inserted, a system alarm is generated and logging is automatically disabled.

DISC FORMATTING

Before a disc can successfully be used, it must be appropriately formatted. Formatting a disc will remove all data stored on it, so it should be ensured that the disc is new or that any data held on it is no longer required. To format, the disc is inserted into the disc drive unit and the STBY and WRITE keys (or STOP and RECORD keys, according to the type of unit) operated together for a minimum of five seconds. Alternatively, the disc can be formatted using an appropriate PC drive.

6.4.1 DISC DRIVE UNITS (Cont.)

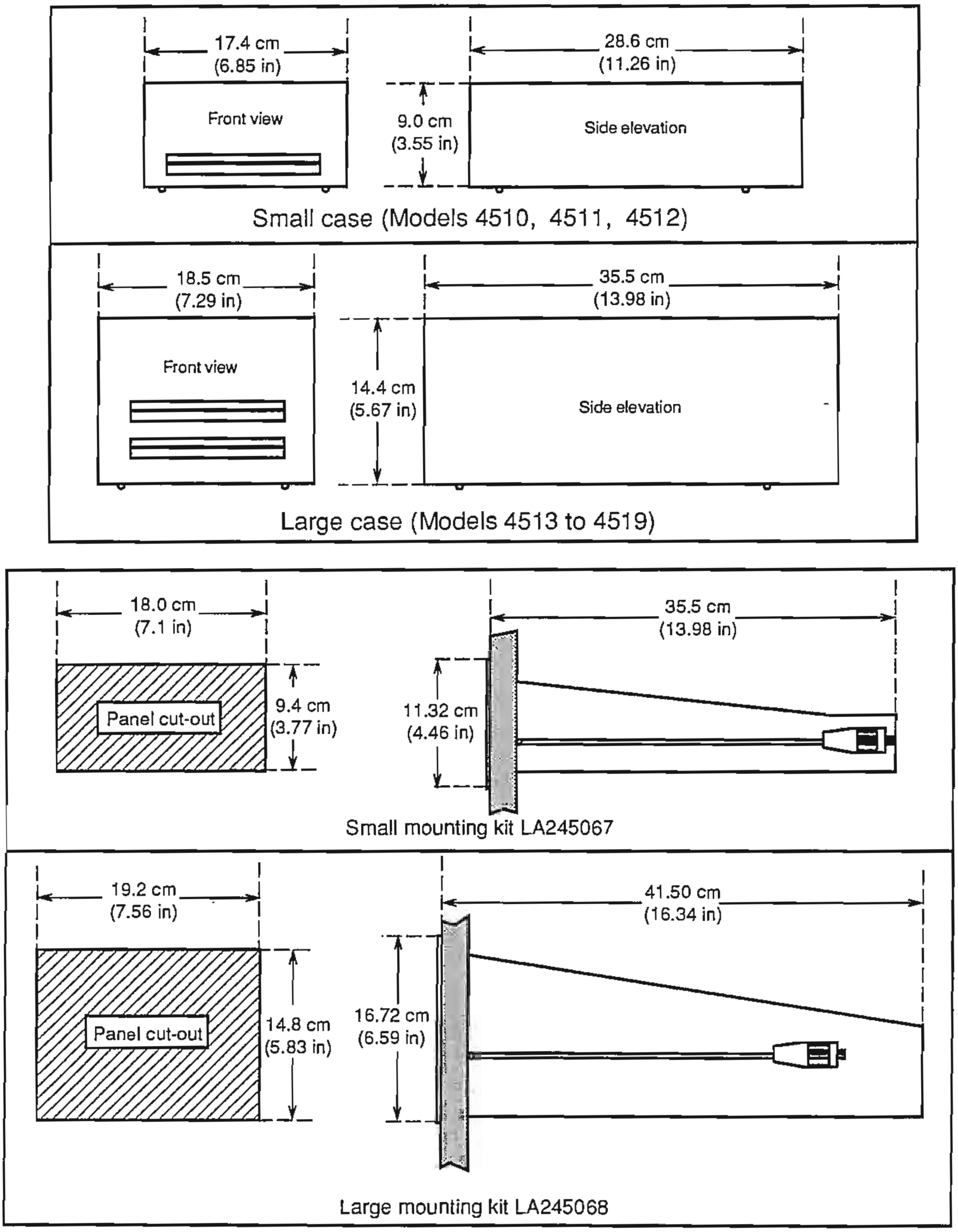


Figure 6.4.1b Disc drive unit mechanical installation: dimensions

6.4.1 DISC DRIVE UNITS (Cont)

INSTALLATION

MECHANICAL

The disc drive units come in two sizes, both of which can be free-standing, or with the use of a bezel kit, can be panel mounted. Figure 6.4.1b above gives details of the unit dimensions. If the mounting bezel kit is to be used, the disc drive unit is secured to the bezel using clamps similar to but shorter than those used to secure the bezel to the panel.

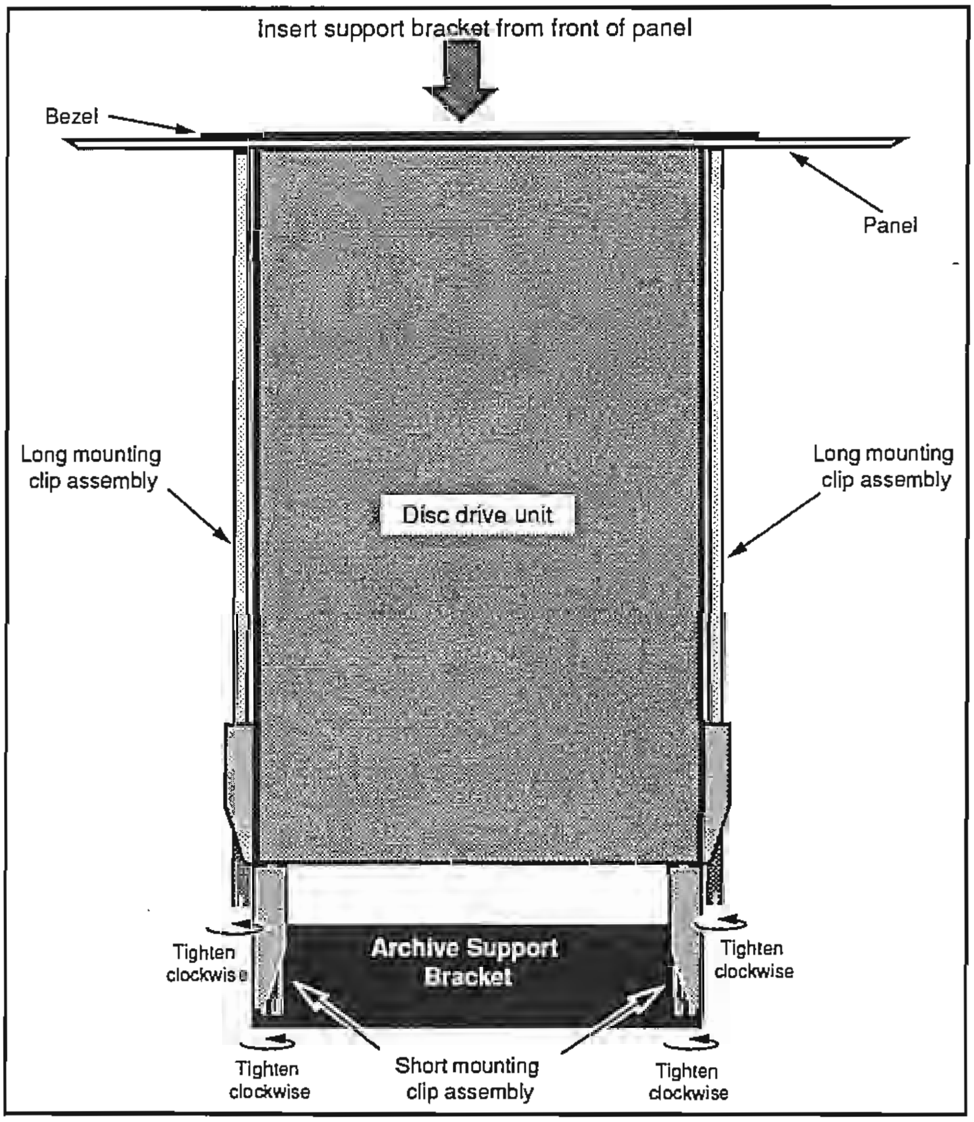


Figure 6.4.1c Disc drive unit mechanical installation: bezel mounting

ELECTRICAL

Supply voltage (Mains) for Models 4513 to 4519, is applied at a standard three-pin IEC plug mounted at the rear of the disc drive unit. Models 4510, 4511 and 4512 have a 'flying' mains lead emerging from the rear panel.

The serial link between the disc drive and the 4500 unit is by means of a 25-way D-type connector at the rear of the unit. A suitable cable is supplied with the option, and is described in Section 2 of this manual. Spare cables are available from the manufacturer under part number DN244728.

The setting up of the communications parameters is described later, in the configuration section.

6.4.1 DISC DRIVE UNITS (Cont.)

CONTROLS

The disc drive units have a number of front panel controls and indicators which are largely redundant as far as the 4500 system is concerned. The following brief desription of the functions of these controls is included for the sake of completeness. It should be noted that the control legends on Models 4510 to 4512 are 'STOP', 'RECORD', and 'PLAY', whilst the legends on Models 4513 to 4519 are 'STBY', 'WRITE' and 'READ' respectively.

STOP (STBY) — Operation of this switch causes the current mode (read or write, but not format) to be exited. If operated during standby, then any error condition will be reset.

RECORD (WRITE) — Operation of the RECORD/WRITE switch causes an autofile to be opened, and data to be written to that file from the serial interface.

PLAY (READ) — Operating this switch causes the next file to be read from the disc, and sent to the serial interface.

ERROR LED — Indicates that there has been a read, write or communications error.

DISC FULL LED — Flashing indicates that the disc is nearly full. If illuminated steadily, this indicates that the disc is full.

SET-UP SWITCHES

The DIL switches shown in the figures below are set at the factory and should not be changed, with the possible exception of Segment 8 on Single port units. This switch controls the data density for 3.5 inch discs. For high density, this segment should be ON (down); for low density the segment should be OFF.

The DIL switch segments should be operated only with power removed from the disc drive unit.

Single port units (Models 4510, 4511, 4512)

Single port units have one DIL switch set up as shown in the figure 6.4.1d below.

Segment	Definition	Factory setting
1	Baud rate	Off
2	Baud rate	On
3	Baud rate	On
4	Parity enable	Off
5	Even parity	On
6	ASCII data type	Off
7	Transparency	Off
8	Disc density	Off

Baud rate set to 9600: see Baud rate table

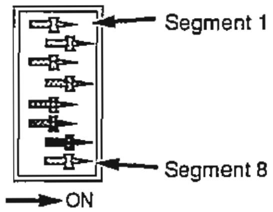
Baud rate	Segment 1	Segment 2	Segment 3
110	OFF	OFF	OFF
150	ON	OFF	OFF
300	OFF	ON	OFF
1200	ON	ON	OFF
2400	OFF	OFF	ON
4800	ON	OFF	ON
9600	**OFF**	**ON**	**ON**
19200	ON	ON	ON

Figure 6.4.1d Single port DIL switch settings

6.4.1 DISC DRIVE UNITS (Cont.)

Dual port units (Models 4513 to 4519)

Dual port units (those fitted with a 'MODEM' port) have four DIL switches set up as shown in figure 6.4.1e below. Note that the Terminal Baud rate is set to 9600, as for the single port units shown in fig 6.4.1d above.



Segment	Definition	Factory setting
1	Baud rate (terminal)	Off
2	Baud rate (terminal)	On
3	Baud rate (terminal)	On
4	Baud rate (Modem)	Off
5	Baud rate (Modem)	Off
6	Baud rate (Modem)	Off
7	Disable CRC	Off
8	Spare	Off

Switch 1

Segment	Definition	Factory setting
1	Read code (Ctrl A)	On
2	80 char / CR	Off
3	Line Modes	Off
4	CR delay	Off
5	Parity inhibit	Off
6	Even parity	On
7	Stop bits (Modem)	Off
8	Stop bits (Terminal)	Off

Switch 2

Segment	Definition	Factory setting
1	Front panel disable	Off
2	Continuous	On
3	On / Off line pwr-up	On
4	Power fail recovery	On
5	Spare	Off
6	Input handshake	On
7	Soft handshake	On
8	Output handshake	On

Switch 3

Segment	Definition	Factory setting
1	Duplex	Off
2	Monitor	Off
3	ASCII / binary	Off
4	Auto answer monitor	Off
5	Auto answer	Off
6	Transparency sense	Off
7	Modem transparency	Off
8	Terminal transparency	Off

Switch 4

Figure 6.4.1e Dual port DIL switch settings

SYSTEM ALARMS

The following alarm types can be generated by the disc drive system. Alarms specified as being 'non-latching' are cleared as soon as the alarm cause has been rectified (i.e. there is no need for the operator to acknowledge or clear such alarms).

Type 40	451X Disc has fewer than 100kBytes left.
Type 41	451X Disc full. Non latching alarm.
Type 42	451X Disc drive not ready. Non latching alarm.
Type 43	451X Communication alarm.
Type 44	451X File allocation exceeded. Non latching alarm.
Type 45	451X Batch number already exists. Non latching alarm.
Type 46	451X Configuration save fail. Non latching alarm.
Type 47	451X Configuration restore fail.

6.4.2 TAPE DRIVE UNITS

This section is to be issued later.

6.4.3 ARCHIVING ON-LINE CONFIGURATION

INTRODUCTION

The on-line configuration takes place on three Mass Storage display pages, an extra System Configuration page, an extra Channel Configuration page, and the Communications Configuration page. The new pages are described fully later in this section; in brief, the contents of each page is as follows.

MASS STORAGE PAGE 1

1. Log enable / disable
2. Batch number set-up (This batch number is used as the file name when storing data)

MASS STORAGE PAGE 2

The disc directory (contents) and disc status can be viewed.

MASS STORAGE PAGE 3

Allows Save or Restore functions to be selected for configuration files.

SYSTEM CONFIGURATION PAGE

This follows the 'Display language, Buzzer and Global alarms action' page described in Section 4.3.1. On this page, up to six, separate Logging time intervals can be entered, and a DIO channel selected for a global remote logging inhibit function.

CHANNEL CONFIGURATION PAGE

This page allows a logging criterion to be set up for the channel being configured. The page also allows a DIO channel to be selected to act as an enable / disable switch for the channel.

COMMUNICATIONS CONFIGURATION PAGE

If the Archiving option is installed, a further Protocol (451X DISK) appears as a part of the scroll menu. With this protocol selected, only the Baud rate is configurable, all other communications parameters being fixed.

ACCESS TO CONFIGURATION

As shown in figure 6.4.3 the Mass storage pages are accessed via the Logging menu, accessed itself from the 'Logging' soft key of the top level menu. The System, Channel and Communications pages are accessed as described in the relevant parts of Section 4.

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

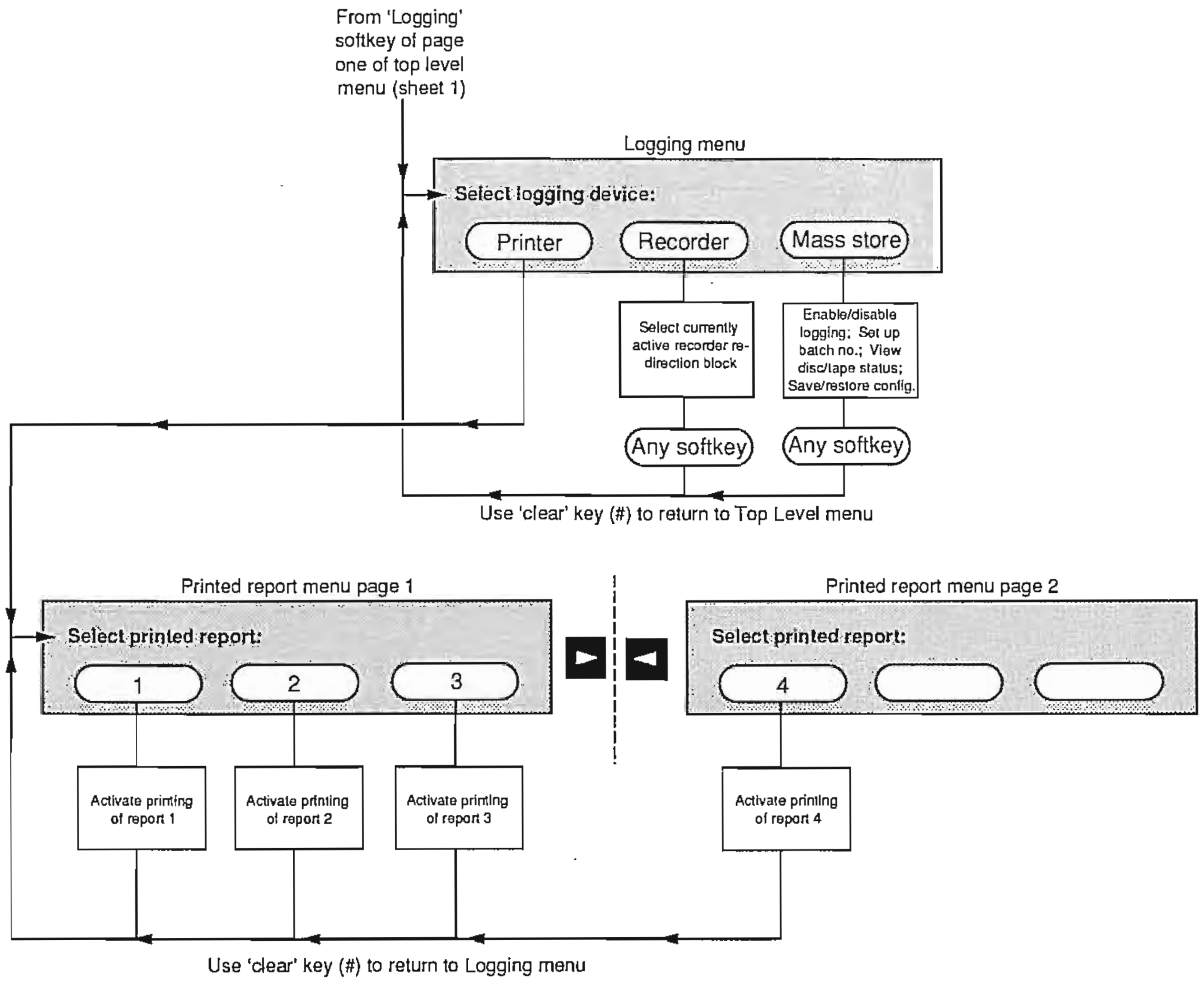


Figure 6.4.3 Access to archiving configuration

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

CONFIGURATION PAGES

SYSTEM CONFIGURATION MASS STORAGE PAGE

```
Logging Enable ch:nnn Alarm log: OFF  AB
Interval N: pp DAYS Desc:  ON Units:  ON
```

Logging Enable ch	A digital input or digital output channel is entered in this field. This channel is used to enable or to disable the logging of all channels that are configured to do so. If the facility is not required, then the default channel number of 000 is entered It should be noted that the 'Logging-man' parameter on Mass Storage Configuration page 1 (described below) can be used to override this DIO channel and disable logging. It should also be noted that the channel configuration page (below) allows a separate DIO channel to be defined to disable the logging of the relevant channel individually.
Alarm log	Scrollable between OFF and ON. When ON, channels which are configured to log under any one or more logging criteria, are also logged at alarm ON, alarm OFF and at alarm acknowledge, providing that logging is not inhibited either globally, or individually, and that the relevant channel log interval is not set to 'Disabled'. When Alarm log is set to OFF, channels are not logged as a result of an alarm becoming active, becoming inactive or being acknowledged.
Interval N	N is scrollable through 1 to 6, allowing up to six time periods to be defined for interval logging. The interval timer controlling this period is not reset by a change in value. For this reason, the remaining period of the previous value has to complete before the new value becomes operative. In order to force the new value to become active, logging should be turned off, then on again.
pp	pp can be scrolled, or entered numerically between 00 and 99. A time period of say, 1 $^1/_2$ hours, is easily set up by entering 90 in this field, and setting the following field to 'MINS'. Entering a value of zero in this field implies no time interval for this period, and this is displayed as OFF in the channel page scroll menu described below.
DAYS	Scrollable through SECS, MINS, HRS and DAYS.
Desc	Scrollable between ON and OFF. Setting this field to ON, causes the alarm or channel descriptor, for the channel, to be logged whenever the channel or alarm is logged. Setting this field to OFF disables the logging of the alarm descriptor(s).
Units	Scrollable between ON and OFF. Setting this field to ON, causes the Engineering units descriptor string for the channel to be logged whenever the channel is logged. Setting this field to OFF disables the logging of the units string

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

CHANNEL CONFIGURATION MASS STORAGE PAGE

```
NNN DD.DD units channel descriptor    AB
Log interval : N: Time        Enable:123
```

This page allows a log interval, and a control channel number to be set up for any channel which is to be logged to disc.

Log interval

Scrollable through DISABLED ON CHANGE, ON EVENT, Time interval

- DISABLED — The channel is not to be logged
- ON CHANGE — For analogue or pseudo analogue input/output channels, the channel is logged if its value has changed. For DIO channels, the channel is logged whenever the channel changes state. The maximum rate at which channels can be logged is 1 Hz..

  Further details may be found in the description of the 'Analogue Input Filter/Change and Display Range' page described in section 4.3.2 of this manual.
- ON EVENT — This requires a DIO channel to be specified. The channel is logged when this DIO channel changes state from 'false' to 'true'.
- Time interval — The scrollable values (N) for this field are the six intervals set in the System configuration page described above. If no time period is allocated for a particular interval, then this interval is displayed as OFF.

Enable 123

Sroll or numeric entry of a DIO channel which must be active (High) for the channel to be logged. If the DIO channel is low, the logging of this channel is disabled. If the channel is high, which should normally enable the logging of this channel, it can be overridden by the global logging-inhibit function in the System Configuration page described above or in the Mass Storage Configuration page 1, described below.

If a DIO channel number of zero is entered, the channel is permanently enabled for logging except when globally inhibited.

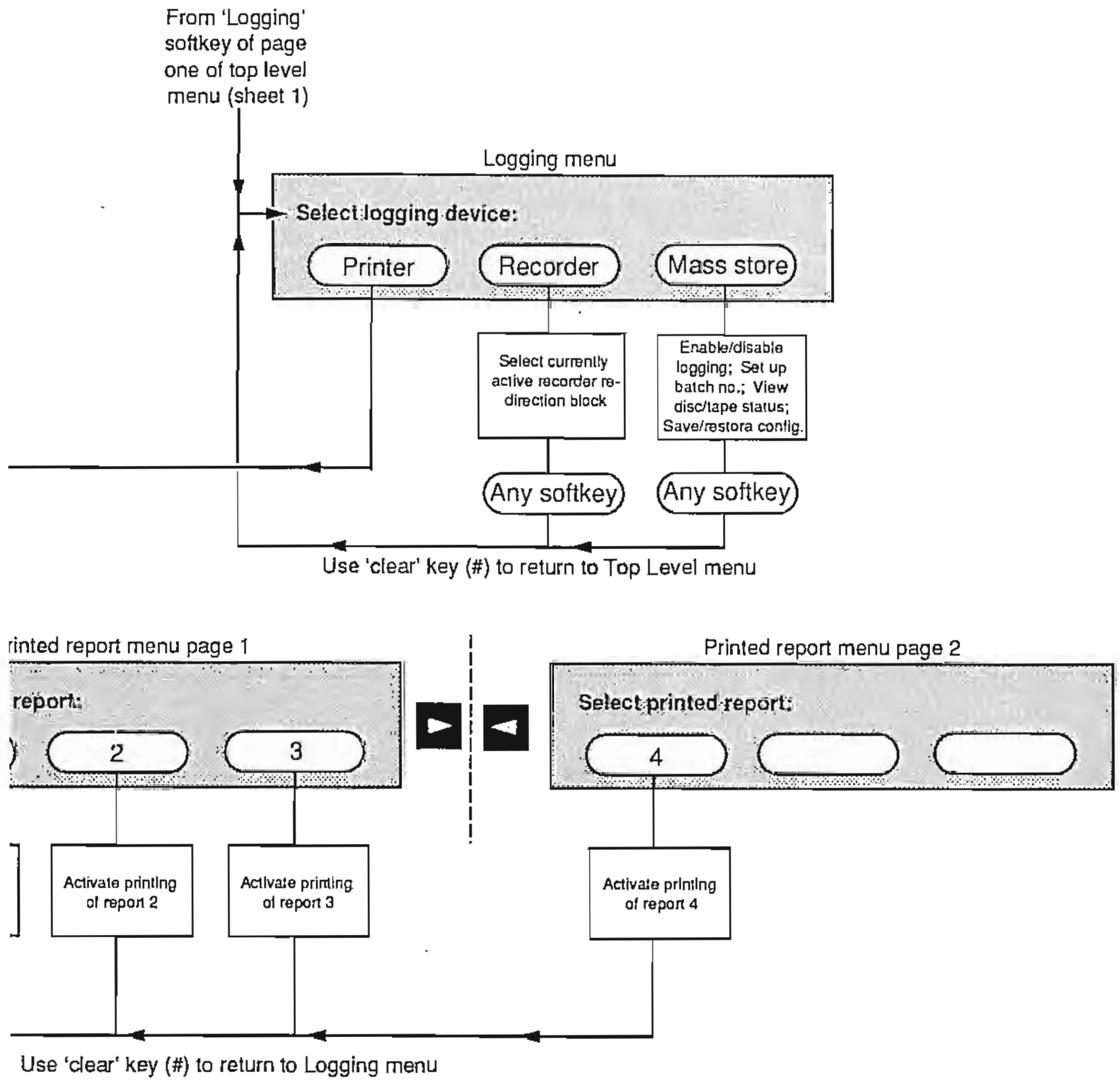


Figure 6.4.3 Access to archiving configuration

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

CONFIGURATION PAGES

SYSTEM CONFIGURATION MASS STORAGE PAGE

```
Logging Enable ch:nnn Alarm log: OFF  AB
Interval N: pp DAYS Desc:  ON Units:  ON
```

Logging Enable ch	A digital input or digital output channel is entered in this field. This channel is used to enable or to disable the logging of all channels that are configured to do so. If the facility is not required, then the default channel number of 000 is entered It should be noted that the 'Logging-man' parameter on Mass Storage Configuration page 1 (described below) can be used to override this DIO channel and disable logging. It should also be noted that the channel configuration page (below) allows a separate DIO channel to be defined to disable the logging of the relevant channel individually.
Alarm log	Scrollable between OFF and ON. When ON, channels which are configured to log under any one or more logging criteria, are also logged at alarm ON, alarm OFF and at alarm acknowledge, providing that logging is not inhibited either globally, or individually, and that the relevant channel log interval is not set to 'Disabled'. When Alarm log is set to OFF, channels are not logged as a result of an alarm becoming active, becoming inactive or being acknowledged.
Interval N	N is scrollable through 1 to 6, allowing up to six time periods to be defined for interval logging. The interval timer controlling this period is not reset by a change in value. For this reason, the remaining period of the previous value has to complete before the new value becomes operative. In order to force the new value to become active, logging should be turned off, then on again.
pp	pp can be scrolled, or entered numerically between 00 and 99. A time period of say, 1 $^1/_2$ hours, is easily set up by entering 90 in this field, and setting the following field to 'MINS'. Entering a value of zero in this field implies no time interval for this period, and this is displayed as OFF in the channel page scroll menu described below.
DAYS	Scrollable through SECS, MINS, HRS and DAYS.
Desc	Scrollable between ON and OFF. Setting this field to ON, causes the alarm or channel descriptor, for the channel, to be logged whenever the channel or alarm is logged. Setting this field to OFF disables the logging of the alarm descriptor(s).
Units	Scrollable between ON and OFF. Setting this field to ON, causes the Engineering units descriptor string for the channel to be logged whenever the channel is logged. Setting this field to OFF disables the logging of the units string

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

CHANNEL CONFIGURATION MASS STORAGE PAGE

```
NNN DD.DD units channel descriptor    AB
Log interval : N: Time        Enable:123
```

This page allows a log interval, and a control channel number to be set up for any channel which is to be logged to disc.

Log interval

Scrollable through DISABLED ON CHANGE, ON EVENT, Time interval

DISABLED — The channel is not to be logged

ON CHANGE — For analogue or pseudo analogue input/output channels, the channel is logged if its value has changed. For DIO channels, the channel is logged whenever the channel changes state. The maximum rate at which channels can be logged is 1 Hz..

Further details may be found in the description of the 'Analogue Input Filter/Change and Display Range' page described in section 4.3.2 of this manual.

ON EVENT — This requires a DIO channel to be specified. The channel is logged when this DIO channel changes state from 'false' to 'true'.

Time interval — The scrollable values (N) for this field are the six intervals set in the System configuration page described above. If no time period is allocated for a particular interval, then this interval is displayed as OFF.

Enable 123

Sroll or numeric entry of a DIO channel which must be active (High) for the channel to be logged. If the DIO channel is low, the logging of this channel is disabled. If the channel is high, which should normally enable the logging of this channel, it can be overridden by the global logging-inhibit function in the System Configuration page described above or in the Mass Storage Configuration page 1, described below.

If a DIO channel number of zero is entered, the channel is permanently enabled for logging except when globally inhibited.

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

MASS STORAGE PAGE 1

```
Logging -man:OFF ext:OFF Format:NUM   AB
Batch Number: NNNNNNNN Auto inc: OFF
```

Logging - man: Scrollable between OFF and ON. If selected OFF, logging is disabled, no matter what the state of the DIO channel selected in the system configuration page described above. If selected ON, then the global inhibiting of logging is under the control of the above mentioned DIO.

Logging ext: This non-alterable field shows the status of the DIO used for global inhibit. If no DIO has been selected , this field always shows 'ON'.

Format Scrollable through TEXT, NUM, DATE, TIME. This field allows the format of the Batch Number to be selected.

- TEXT In this format, the batch number (described below) can be entered as an alpha-numeric string.
- NUM In this format the batch number can be entered only as a numeric string. The AUTO INC field on the bottom line of this display page can be used to add 1 to the batch number each time logging is initiated. Should the maximum number of files be used up in this way, a system alarm is initiated, and this is removed only by changing disc.
- DATE In this format, the batch number (non-alterable) is the system date, at the time the log is initiated. Should the date change during logging, logging stops, the initial file is closed and a further file, with the new date as file name, is opened. Logging then continues.
- TIME In this format, the batch number (non-alterable) is the system time at the time the log is initiated. The batch number increments with time whilst logging is off.

Batch Number The batch number is used as a file name when logging data. As described above, the batch number can be in one of four formats. In TEXT and NUM formats, operator access to the batch number is inhibited whilst logging is actually in progress. In DATE and TIME formats, batch number changes are made automatically, using the system time and date. If, whilst in DATE format, the date should change whilst logging is in progress, the initial file is closed, and a new one opened complete with file header. If this results in a file name which already exists, data will be appended to this existing file.

Auto inc This field appears only when NUM is selected as Batch Number format. The field is scrollable between ON and OFF. When ON, the batch number is increased by 1, each time logging is initiated. If this results in a file name which already exists then a message (depicted below) is displayed, System alarm 45 is generated, and the file is saved in a default file, named DEFAULT.CAF. Data continues to be appended to this file until an 'unused' batch number is defined.

Error display:

```
Batch number already exists on disc - AB
```

Notes...

1. The batch number is formatted as Dddmmyy, where dd is the day number, mm is the month number, and yy is the least significant two digits of the year number.
2. The batch number is formatted as Thhmmss, where hh represents the hours, mm the minutes and ss the seconds.

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

MASS STORAGE PAGE 2

```
Drive:N Bytes Free: nnnnnnn Status OK AB
Press ENTER for directory
```

Drive — For dual disc drive units, this field is scrollable between 0 and 1, whilst logging is not taking place. The field is always '0' for single drive units.

Bytes Free — This field indicates the unused bytes remaining on the disc. The value is continuously updated.

Status — This field can contain one of the following unalterable codes:

OK	No errors detected
DF	Disc is full
WP	Disc is write protected
NR	Disc drive not ready. Display of the directory will not appear until the disc drive is ready.
??	Communication Error. Display of the directory will not appear until the communications error has been cleared.
RD	Disc read active
WR	Write disc active
RE	Disc read error
WE	Disc write error
CE	Command error
CP	Disc copy mode active.

Operation of the ENTER key results in names of the first four files held on the disc to appear. In order to read all files on the disc, repeated operation the ⟶ key causes a further group of four file names to replace the current group until all have been displayed. Operation of the ⟵ key reverses the direction of scroll.

```
Drive:N Bytes Free: nnnnnnn Status OK AB
Batch100  Batch101  Batch102  Batch103
```

Note...

If logging is taking place, the Mass Storage Page 2 is replaced by the message below:

Error message:

```
Drive:N Bytes Free: nnnnnnn Status OK AB
Directory not available
```

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

MASS STORAGE PAGE 3

The softkeys are used to control the archiving (Save) and retrieving (Restore) of configuration files to the disc or tape.

```
Configuration File: CONFIG.CFG          AB
Edit name:          Save         Restore
```

On entry to the page, the default filename CONFIG is displayed. Operation of the ENTER key causes a directory search for any other configuration files (.CFG extension). The first to be found is displayed, and any further configuration file names can be brought to the display using the menu scroll (↓ and ↑) keys.

In order to select a particular file name, operation of the 'Edit Name' sets the 'Configuration File' field into text entry mode.

Configuration File	On entry, this field displays the default file name CONFIG.CFG. Operation of the ENTER key, followed by the scroll up and down keys allows the complete list of configuration files to be accessed. Operation of the 'Edit Name' softkey sets the field to text entry mode to allow a new file name to be entered.
Save	Operation of this softkey will cause the entire configuration of the system to be written to disc or tape. Once the write process is complete, the system checks that the transfer of data has been carried out without error. During the time the configuration is being saved, the system goes into off-line mode, and all data acquisition etc. is suspended until the write is complete, and the error checking is satisfactory.
Restore	Operation of this softkey causes the data held in the specified configuration file on the disc or tape to be read to the system EEPROM. Once the read process is complete the system checks that the transfer of data has been carried out without error. During the read process the system goes into off-line mode, and all data acquisition is suspended until the read is complete and the error checking is satisfactory. Once this is done, the system restarts as though at power-on.

SAVE ERRORS

If an error is found in the written data, for whatever reason, an error message will appear at the display, and a system alarm will be generated. This alarm will be cleared at the next successful transfer, or if it is cleared manually. Any corrupt data files are deleted from the disc or tape. The displayed error messages are as follows:

1.

```
Not enough room on disk                 AB
File size will be NNNNNN bytes
```

NNNNNN Predicted size of file.

The above message is displayed if there is insufficient free space on the storage medium for the file being saved.

2.

```
File name already exists                AB
```

Shows that an attempt has been made to save to a file that already exists.

6.4.3 ARCHIVING ON-LINE CONFIGURATION (Cont.)

MASS STORAGE PAGE 3 ERROR MESSAGES (Cont.)

3.

```
Disk communication alarm                    AB
```

The above message appears is a failure in the communications link between the 4500 and a 4510 disc drive unit has occurred.

4.

```
Configuration Save Failed - Aborting...
```

The above message appears if the configuration save fails.

5.

```
File Erasure Failed - Aborting...
```

The above message appears if the corrupt (partial) data file resulting from a failed configuration save cannot be erased.

RESTORE ERRORS

If an error is found in the retrieved data, the EEPROM is set to its default state and a system alarm is generated. The system is then re-started as though from power-on. The following message appears at re-start:

```
Configuration Restore Failed
```

PAUSE MESSAGE

Occasionally, it will take some time for the 4500 to access the storage medium. At such times, the following message is displayed to indicate that the 4500 is busy:

```
Working - Please wait a moment
```

6.4.4 ARCHIVING OFF-LINE CONFIGURATION

The off-line configuration parameters are identical with the on-line parameters. For this reason, the following treatment deals only with the relevant screen pages. For details of the parameters themselves, reference should be made to the on-line configuration section above.

SYSTEM CONFIGURATION

Selection of menu item 4 of the main configuration menu calls the system configuration page (depicted below) to the screen.

```
                    SYSTEM CONFIGURATION


LANGUAGE : ENGLISH                        DATA LOGGING:
                                               INHIBIT I/P CH : NNN
RACK TYPE (No. of Slots/Rack):                 TIME INTERVAL 1 :  1 MINS
               MASTER       : 11               TIME INTERVAL 2 : 10 MINS
               EXPANSION 1 : 12                TIME INTERVAL 3 :  1 HRS
               EXPANSION 2 : 12                TIME INTERVAL 4 :  0 SECS
               EXPANSION 3 : 12                TIME INTERVAL 5 :  0 SECS
               EXPANSION 4 : 12                TIME INTERVAL 6 :  0 SECS
                                               LOG ON  ALARM   :  OFF
GLOBAL ALARM INPUTS/OUTPUTS :                  LOG DESCRIPTOR  :  OFF
               REMOTE ACK.I/P CH : RRR         LOG UNITS       :  OFF
               LATCHED O/P CH    : LLL         BATCH NUMBERING:
               UNLATCHED O/P CH  : UUU              FORMAT     :  TEXT
                                                    AUTO INC   :  OFF
                                                    INITIAL No.:  123456


KEYBOARD BEEP : ON
```

The configurable (underlined) items on the left side of this display are as described in the ' on-line configuration' section (Section 4.3) of this document. The DATA LOGGING parameters on the right hand side of the screen appear only if the Archiving option is installed and are described in the on-line configuration section above.

Once the system configuration has been carried out, operation of the <CTRL><E> keys causes a return to the main configuration menu.

Note...

If the language is changed, all menus, headers , field descriptors etc. will change immediately to the selected language.

CHANNEL CONFIGURATION

The off-line channel configuration applies to all channel types, and is carried out using two extra fields 'Data Logging Interval' and 'Log enable'. The page depicted below (analgue input page 3) is typical. For similar pages for other types of I/O channel, section 4.4.5 of this manual should be referred to.

6.4.4 ARCHIVING OFF-LINE CONFIGURATION (Cont.)

COMMUNICATIONS CONFIGURATION.

The off-line page changes only in that the '451X DISK' protocol is available. When this protocol is selected, the only alterable parameter is the Baud rate, normally set to 9,600 for mass storage. Refer to Section 4.4.7 for further details.

ANALOGUE INPUT PAGE 3

Page three is accessed by operating the → cursor key from the ACQ field of page two. The page (depicted below) retains the channel ID and Channel descriptor fields for reference purposes (ie the channel descriptors are not available for edit other than in page 1, and holds the following configuration fields:-

1) Display low scale ('zero')
2) Display high scale ('span')
3) Display engineering units
4) Redirection channel number
5) Data logging interval for Mass Storage
6) Log enable channel for Mass Storage

CHAN ID.	CHANNEL DESCRIPTOR	I/O TYPE	DISPLAY LOW SCALE	DISPLAY HIGH SCALE	DISPLAY ENG UNITS	REDIRECT TO CHAN NO.	DATA LOGGING INTERVAL	LOG ENBLE
1	Boiler pressure	00	00.00	1000.	PSI	None	1: 123 D	123
2	Boiler temp 2	00	00.00	200.0	DEG C	None	DISABLED	None
3	Boiler temp 3	00	00.00	1000.	DEG F	None	CHANGE	43
4	Boiler temp 4	00	00.00	200.0	DEG C	None	EVNT:123	123
5	Boiler temp 5	00	00.00	1000.	DEG R	None	DISABLED	None
6	Boiler temp 6	00	300.0	500.0	K	None	DISABLED	None
16	Outlet temp 1	02	100.0	350.0	DEG F	122	DISABLED	None
17	Outlet temp 2	02	50.00	200.0	DEG C	123	DISABLED	None
18	Outlet temp 3	02	500.0	1000.	DEG R	124	DISABLED	None
19	Outlet temp 4	02	300.0	500.0	K	125	DISABLED	None
20	Valve posn 1	02	00.00	100.0	%	126	DISABLED	None
21	Rotn rate 6	02	00.00	100.0	%	127	DISABLED	None
22	Flow rate 1	09	00.00	1000.	l/hr	128	DISABLED	None
23	Flow rate 2	09	00.00	1000.	l/hr	129	DISABLED	None
24	Flow rate 3	09	00.00	1000.	l/hr	None	DISABLED	None

The configurable fields are as described in the 'On-line configuration' section of this document

6.4.5 REFORMAT FACILITY

This software facility, running under MS-DOS on an IBM® PC or compatible, is available for those who have saved data to disc, and who wish to display the results in a different format. The facility converts the 4500 system data format into one that can be imported into a personal computer with a spread-sheet facility which allows the logged data to be manipulated according to the user's requirements.

Since each pc is different, and can have one of many different software packages to act upon the data, the description which follows covers only the actions necessary to reformat the data, no attempt being made to explain how this data is used within the pc. It is assumed that the user is familiar with DOS and with the pc spreadsheet software.

Once the Reformatter software is installed (see Annex A) the 4500 disc containing the required data should be inserted into the disc drive of the computer. If it is required to list the file names held on the disc, `DIR a:<RETURN>` can be typed at the computer keyboard, where 'a' is the name of the drive on which the 4500 disc is held. This will result in a directory of all the files held on the disc to be displayed.

The data file can be reformatted direct form the command line as described later, or by using the menu pages described below.

REFORMATTING FROM MENU PAGES

INPUT FILENAME PAGE

In order to initiate the reformatting process, the following should be typed: `reform<RETURN>`. This results in the first reformatting page (depicted below) being displayed on the screen.

```
                    CHESSELL ARCHIVE FILE REFORMATTER VN.N




Specify input file : DEFAULT.CAF





                              ESC TO EXIT                HH:MM:SS
```

The name (max. 79 characters) of the required file should now be typed-in (with or without the `.CAF` extension) at the computer keyboard, followed by operation of the ENTER key. This calls the selection criteria page as depicted below.

6.4.5 REFORMAT FACILITY (Cont.)

SELECTION CRITERIA PAGE

This page allows the data which is to be reformatted to be 'filtered' from the rest of the file contents by block, time period, channel number etc., or by a combination of such criteria.

```
                    CHESSELL ARCHIVE FILE REFORMATTER VN.N

                           SELECTION CRITERIA

 (F1)   Select block sources   : 1 2 3 4 5 6 7 8 9 0
 (F2)   Select period          : All
 (F3)   Select channel number  : All
 (F4)   Select channel type    : I T C S D R O A
 (F5)   Output as              : d t c y v h a u s
 (F6)   Output file            : DEFAULT.OUT


                           PRESS F7 TO REFORMAT

                             ESC TO RETURN               HH:MM:SS
```

This screen shows the currently selected filtering criteria. When entered from the input filename page, all the criteria are at their default values as depicted above. The function keys are used to select further pages which allow the selection criteria to be edited.

Once all the selection criteria have been set up (as described below) operation of <F7> starts the reformatting process.

MODIFY BLOCK SOURCE PAGE

In order to select specific block sources, the <F1> key is operated from the 'selection criteria' page to call the 'Modify block source' page to the screen. Operation of the required function key toggles the associated block source on /off (see table 6.4.5 below for block source information). In the example below, blocks 2, 5 and 8 have been deselected.

```
                    CHESSELL ARCHIVE FILE FORMATTER VN.N

                           MODIFY BLOCK SOURCE

                          (F1)   Source 1 : YES
                          (F2)   Source 2 : NO
                          (F3)   Source 3 : YES
                          (F4)   Source 4 : YES
                          (F5)   Source 5 : NO
                          (F6)   Source 6 : YES
                          (F7)   Source 7 : YES
                          (F8)   Source 8 : NO
                          (F9)   Source 9 : YES
                          (F10)  Source 0 : YES


                             ESC TO RETURN               HH:MM:SS
```

Once all the sources have been configured, operation of the <ESC> key causes a return to the 'Selection Criteria' page.

6.4.5 REFORMAT FACILITY (Cont.)

BLOCK SOURCES

As shown in table 6.4.5 below, block sources can be:

a. Any of the six intervals set up in the Mass Storage page of the system configuration.
b. All channels that have changed value by more than the amount set in the channels' configurations.
c. All channels which have changed their alarm status.
d. All channels set to log on event.
e. Instrument or maths pack alarm.

Code	Source
1	Time interval 1
2	Time interval 2
3	Time interval 3
4	Time interval 4
5	Time interval 5
6	Time interval 6
7	Change
8	Channel alarm
9	Event
0	Instrument or maths pack alarm

Table 6.4.5 Block sources

MODIFY PERIOD PAGE

Operation of <F2> in the 'Selection Criteria' page calls the 'Modify Period' page depicted below. In the example below, the 'Select on period' criterion has been toggled to YES (by operation of <F1>). This allows the user to specify a start time/date and an end time/date, between which the other selection criteria will operate.

```
                CHESSELL ARCHIVE FILE REFORMATTER VN.N

                          MODIFY PERIOD

                (F1)  Select on period : YES
                (F2)  From time        : HH:MM
                (F3)  From date        : DD/MM/YYYY
                (F4)  To time          : HH:MM
                (F5)  To date          : DD/MM/YYYY


                          ESC TO RETURN              HH:MM:SS
```

<F1> Toggles the 'period' criterion on/off. If selected YES, then if no 'From Date' is entered, all data from 1900 up to the 'To Date' will be included in the selection. If no 'To Date' is entered, the current system date is used instead. If selected NO, then date and time are ignored as selection criteria.

<F2> Clears the existing 'From time' field, and allows a new value to be entered using the computer keyboard. The colon (:) is entered automatically.

<F3> Clears the existing 'From date' field, and allows a new date to be entered using the computer keyboard. The slash (/) delimiters are entered automatically.

Operation of <F4> and <F5> keys is similar, but for the 'To time' and 'To date' fields.

Operation of <ESC> causes a return to the 'Selection Criteria' page.

Notes...

1. When American date format is selected during software installation (Annex A), the day and month positions are swapped (ie. from DD/MM/YYYY(UK) to MM/DD/YYYY (USA))
2. Operation of any of <F2> to <F5> will force the 'Select on period' criterion to YES.

6.4.5 REFORMAT FACILITY (Cont.)

MODIFY CHANNELS PAGE

Operation of <F3> in the 'Selection Criteria' page calls the 'Modify channel number' page depicted below. This allows a single channel, or a group of contiguous channels to chosen for manipulation.

```
                 CHESSELL ARCHIVE FILE REFORMATTER VN.N

                        MODIFY CHANNEL NUMBER

                  (F1)   Select on number : YES
                  (F2)   From number      : NNN
                  (F3)   To number        : MMM





                          ESC TO RETURN                  HH:MM:SS
```

Operation of <F1> allows the Select on number to be toggled on/off. When off (NO), then all channels are included in the selection process. When on (YES) <F2> and <F3> are used to enter the range of channels to be included.

Operation of <F2> causes the 'From number' field to clear, allowing entry of the number of the first channel in the group. If no entry is made, then the 'From number' will default to the lowest in the file.

Operation of the <F3> key causes the 'To number' field to clear, allowing entry of the number of the last channel in the group. If only one channel is to be included, then this 'To' number must be the same as the 'From' number. If no entry is made, then the 'To number' will default to the highest in the file.

Notes...
1. The 'To number' must be greater than or equal to the 'From number'.
2. Operation of either <F2> or <F3> forces the 'Select on number' criterion to YES

Operation of <ESC> causes a return to the 'Selection criteria' page.

6.4.5 REFORMAT PAGES (Cont.)

MODIFY CHANNEL TYPE PAGE

Operation of <F4> in the 'Selection criteria' page calls the 'Modify Channel Type' page depicted below. The page allows the selection of data from one or more a particular types of channel to be made, so that the selection can be made just for relay output channels for example.

```
                CHESSELL ARCHIVE FILE REFORMATTER VN.N

                       MODIFY CHANNEL TYPE

                (F1)  Analogue input        (I) : YES
                (F2)  Totaliser             (T) : NO
                (F3)  Counter               (C) : NO
                (F4)  Descriptor String     (S) : YES
                (F5)  Digital input         (D) : NO
                (F6)  Digital output        (R) : YES
                (F7)  Analogue output       (O) : YES
                (F8)  Instrument alarm      (A) : NO



                          ESC TO RETURN                HH:MM:SS
```

Operation of keys <F1> to <F8> allows the selection of the types of channel to be included in the output file as follows:

F1 Includes all analogue input channel data
F2 Totaliser - not currently available
F3 Counter - not currently available
F4 Text strings are to be included
F5 Includes all digital inputs
F6 Includes all digital outputs
F7 Includes all analogue output channel data
F8 Includes System alarm data.

Operation of the <ESC> key causes a return to the 'Selection criteria' page.

This page is deliberately left blank.

SECTION 7 REFERENCE

This section contains tabular data to allow quick reference to be made to configuration and operation data. The tables are as follows:

1. Re-direction block channel allocations (to be filled in by the operator as required).
2. Channel to rack slot cross-listing.
3. Maths pack argument table entries.
4. Archiving option selection criteria

4001 ID 0		4001 ID 1		4001 ID 2		4001 ID 3	
4001 Channel	4500 Channel	4001 Channel	4500 Channel	4001 Channel	4500 Channel	4001 Channel	4500 Channel
01		01		01		01	
02		02		02		02	
03		03		03		03	
04		04		04		04	
05		05		05		05	
06		06		06		06	
07		07		07		07	
08		08		08		08	
09		09		09		09	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	
17		17		17		17	
18		18		18		18	
19		19		19		19	
20		20		20		20	
21		21		21		21	
22		22		22		22	
23		23		23		23	
24		24		24		24	
25		25		25		25	
26		26		26		26	
27		27		27		27	
28		28		28		28	
29		29		29		29	
30		30		30		30	

Table 7.1 Re-direction block channel allocations
Sheet 1: ID 0 to ID 3

4001 ID 4		4001 ID 5		4001 ID 6		4001 ID 7	
4001 Channel	4500 Channel	4001 Channel	4500 Channel	4001 Channel	4500 Channel	4001 Channel	4500 Channel
01		01		01		01	
02		02		02		02	
03		03		03		03	
04		04		04		04	
05		05		05		05	
06		06		06		06	
07		07		07		07	
08		08		08		08	
09		09		09		09	
10		10		10		10	
11		11		11		11	
12		12		12		12	
13		13		13		13	
14		14		14		14	
15		15		15		15	
16		16		16		16	
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21		21		21		21	
22		22		22		22	
23		23		23		23	
24		24		24		24	
25		25		25		25	
26		26		26		26	
27		27		27		27	
28		28		28		28	
29		29		29		29	
30		30		30		30	

Table 7.1 Re-direction block channel allocations
Sheet 2: ID 4 to ID 7

Channel Numbers	Channel Location		Block Nº	Channel Numbers	Channel Location		Block Nº
	Rack	Slot			Rack	Slot	
1 to 15	Master	1	1	526 to 540	Expansion 3	1	36
16 to 30	Master	2	2	541 to 555	Expansion 3	2	37
31 to 45	Master	3	3	556 to 570	Expansion 3	3	38
46 to 60	Master	4	4	571 to 585	Expansion 3	4	39
61 to 75	Master	5	5	586 to 600	Expansion 3	5	40
76 to 90	Master	6	6	601 to 615	Expansion 3	6	41
91 to 105	Master	7	7	616 to 630	Expansion 3	7	42
106 to 120	Master	8	8	631 to 645	Expansion 3	8	43
121 to 135	Master	9	9	646 to 660	Expansion 3	9	44
136 to 150	Master	10	10	661 to 675	Expansion 3	10	45
151 to 165	Master	11	11	676 to 690	Expansion 3	11	46
SBC	Master	12	N/A	691 to 705	Expansion 3	12	47
166 to 180	Expansion 1	1	12	706 to 720	Expansion 4	1	48
181 to 195	Expansion 1	2	13	721 to 735	Expansion 4	2	49
196 to 210	Expansion 1	3	14	736 to 750	Expansion 4	3	50
211 to 225	Expansion 1	4	15	751 to 765	Expansion 4	4	51
226 to 240	Expansion 1	5	16	766 to 780	Expansion 4	5	52
241 to 255	Expansion 1	6	17	781 to 795	Expansion 4	6	53
256 to 270	Expansion 1	7	18	796 to 810	Expansion 4	7	54
271 to 285	Expansion 1	8	19	811 to 825	Expansion 4	8	55
286 to 300	Expansion 1	9	20	826 to 840	Expansion 4	9	56
301 to 315	Expansion 1	10	21	841 to 855	Expansion 4	10	57
316 to 330	Expansion 1	11	22	856 to 870	Expansion 4	11	58
331 to 345	Expansion 1	12	23	871 to 885	Expansion 4	12	59
346 to 360	Expansion 2	1	24				
361 to 375	Expansion 2	2	25				
376 to 390	Expansion 2	3	26				
391 to 405	Expansion 2	4	27				
406 to 420	Expansion 2	5	28				
421 to 435	Expansion 2	6	29				
436 to 450	Expansion 2	7	30				
451 to 465	Expansion 2	8	31				
466 to 480	Expansion 2	9	32				
481 to 495	Expansion 2	10	33				
496 to 510	Expansion 2	11	34				
511 to 525	Expansion 2	12	35				

Table 7.2 Channel to rack-slot cross listing

7.3 MATHS PACK ARGUMENT TABLE ENTRIES

FUNCTION	EQUATION
Add	Element 0 + Element 1
Subtract	Element 0 - Element 1
Multiply	Element 0 x Element 1
Divide	Element 0 ÷ Element 1
Absolute	ABS (Element 0)
Negate	NEG (Element 0)
Integer	INT (Element 0)
Square root	√ (Element 0)
Square	$(\text{Element } 0)^2$
SINE	SINE (Element 0 in radians)
COSINE	COSINE (Element 0 in radians)
ARCTANGENT	TAN^{-1} (Element 0) (Result in radians)
Log	Log_e (Element 0)
Exponent	$e^{(\text{Element } 0)}$
OR	Element 0 OR Element 1
Exclusive OR	Element 0 XOR Element 1
AND	Element 0 AND Element 1
NOT	NOT Element 0
GT	Result 'high' if Element 0 > Element 1
LT	Result 'high' if Element 0 < Element 1
=	Result 'high' if Element 0 = Element 1
The remaining maths functions do not have simple argument table equations. Please see the descriptions in Section 6 for full details.	

Table 7.3 Maths pack argument table entries

7.4 ARCHIVING OPTION TABLES

Code	Source
1	Time interval 1
2	Time interval 2
3	Time interval 3
4	Time interval 4
5	Time interval 5
6	Time interval 6
7	Change
8	Channel alarm
9	Event
0	Instrument or maths pack alarm

Table 7.4a Archiving option block sources

Channel type	Identifier
Analogue input	I
Totaliser *	T
Counter *	C
Descriptor string	S
Digital input/output	D
Relay	R
Analogue output	O
Instrument alarm	A

* Not currently available

Table 7.4b Archiving option
Channel type identifiers

Output record	Identifier
Date	D
Time	T
Number	C
Type	Y
Value	V
Health	H
Alarm status	A
Units	U
Descriptor	S

Table 7.4c Archiving option
Output record type identifiers

ANNEX A

PC SOFTWARE INSTALLATION

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LIST OF FIGURES

ANNEX A PC SOFTWARE INSTALLATION

A1 TERMINAL EMULATION SOFTWARE

A1.1 INTRODUCTION

This section describes the installation of terminal emulation software in an IBM PC or compatible computer, for the purposes of storing and re-calling system configurations to and from for example, floppy discs. Two versions of the software packaging are available from the 4500 System manufacturer, viz: $5^1/_4$ inch and $3^1/_2$ inch floppy disc(ette)s.

The software package can be installed on most personal computers which run PC/MS-DOS (version 3.0 or greater). Because of the complexity of the software contained in the terminal emulation package, it is recommended that 'terminate and stay resident' (TSR) type software is avoided, in particular if it has a communications capability associated with it.

HARDWARE REQUIREMENTS

1. A minimum of 512 kBytes of RAM is required, (640 kB preferred.)
2. Two disc drives, either both floppy-disc drives, or one floppy and one hard-disc drive.
3. An RS232-C Serial Communication link configured either as COM1 or COM 2.

A1.2 INSTALLATION PROCEDURE

The following instructions assume a working knowledge of the DOS system. If such is not the case, then reference to the relevant section of the manual supplied with the computer, should be made as required.

1. Use the 'diskcopy' facility supplied with DOS to make a copy of the terminal emulation software. Store the master disc in a safe place, and use the master copy as a work disc. The disc type required is Double-sided, Double-Density for either size of disc.

Note...

The master disc is write protected. The master copy disc must not be write protected, or it will not work correctly.

2. If the software is to be installed on a PC with twin floppy disc drives, a second disc should now be formatted with the DOS format command, using the /s (system) switch. (If the /s switch is not used, the software will fail to operate correctly when installed).

   If a hard disc is to be used, this formatting is not required, provided that the hard disc installation itself is complete.

3. The master copy disc should now be placed into disc drive 'a:' and for twin floppy disc drive PCs, the DOS formatted disc should be placed into drive 'b:'.

4. The PC should be logged into drive a: (Type 'a:<RETURN>'), and the operator should enter the root directory of drive 'a' (Type 'cd<SPACE>\<RETURN>').

(Continued)

A1.2 TERMINAL EMULATION INSTALLATION (Cont.)

5. Installation of the software will now start after the following command is typed in:-

   i4500<SPACE>*s*:<SPACE>*d*:<SPACE>*n*<RETURN>

   Where s is the drive holding the copy disc; d is the drive on which the software is to be installed; n is the communications port (COM 1 or COM 2) of the PC to be used.

Note...
The drive letters and communications port number must be in lower case letters (i.e. not capitals).

If this is a first-time installation, then the software installation continues until it is complete. If the installation has been done before, the following message appears:

```
*** WARNING **** 4500 Directory already exists on drive n:
OK to Overwrite (Y/N) ?
```

If 'N' is entered, the new installation will be aborted. If 'Y' is entered, the installation will continue, over-writing the previous **installation** files. Any previously existing **configuration** files will remain untouched.

A1.3 OPERATION

The DOS 'dir' command should be used to see if there is a file called 'config.sys' in the root directory of the boot disc (either the hard disc or the floppy disc in drive a:).

If such a file exists, it should be modified to include the following:-

```
FILES=20
BUFFERS=40
```

unless it already contains values greater than these.

If the file does not exist, then it is necessary to create it, using either the text editing facility of the PC, or the 'config.new' file on the master copy disc. In the latter case, the 'config.new' file should be copied to the boot disc, and renamed config.sys.

Once the 'config.sys' file is in a suitable state, the computer should be re-booted, and the package can then be entered by typing:-

'te4500<RETURN>'

This will result in the off-line configuration editing facilities associated with the 4500 system becoming available at the PC. For full details of the operation of these facilities, refer to Section 4 of this Manual.

Note...
Should an error message appear, after an attempt to run the software, which indicates that the program has run out of 'environment space', the environment space can be increased to 3000 Bytes by adding the line below to the 'config.sys' file using a text editor. The PC will then have to be re-booted before a further attempt at running the software is attempted.

```
SHELL=COMMAND.COM /E:3000 /P
```

A1.4 SUPERVISORY SOFTWARE PACKAGE (ESP)

Users of the ESP, have a file called 'menu.dat' provided with the installed software. If this file is copied to the current ESP directory, then the terminal emulation program can be accessed directly from the ESP main engineering menu, if the ESP communications link is connected to the COMMS 1 port at the rear of the 4500 master unit.

When using this configuration, parity should be set to 'NONE' at both the 4500 and the ESP.

A1.5 DIRECTORY STRUCTURE

The terminal emulator software package uses a standard communications package called 'Procomm Plus'. This is installed, together with Procomm Plus script files in the directory '4500'. The figure below shows the directory tree structure as installed.

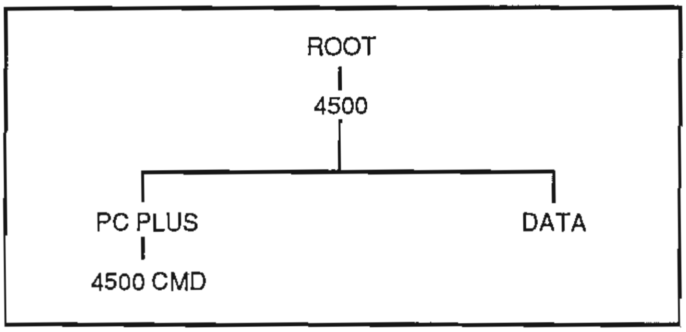

Figure A1.5 Directory structure

Configuration files are stored to and recalled from the DATA directory. If the DATA directory does not exist (ie. the data is held on a disc which does not contain the terminal emulation software), then the configuration data is saved to the currently logged directory. As long as this is done consistently, the software will recall the file from its correct location

A2 ARCHIVE FILE REFORMATTER SOFTWARE INSTALLATION

A2.1 INTRODUCTION

This section describes the installation of archive reformatting software in an IBM® PC or compatible computer, for the purposes of formatting 4500 channel data into a form suitable for use with PC spreadsheet programmes.

The software package can be installed on most personal computers which run PC/MS-DOS (version 2.0 or greater). If reconfiguration is to take place, using the menu pages (see section 6.4.5)then the standard screen driver ANSI.SYS must be configured in the system.

HARDWARE REQUIREMENTS

1. A minimum of 256 kBytes of RAM is required.
2. Two disc drives, either both floppy-disc drives, or one floppy and one hard-disc drive.

A2.2 INSTALLATION PROCEDURE

The following instructions assume a working knowledge of the DOS system. If such is not the case, then reference to the relevant section of the manual supplied with the computer, should be made as required.

1. Use the 'diskcopy' facility supplied with DOS to make a copy of the archive reformatting software. Store the master disc in a safe place, and use the master copy as a work disc.

Note...

The master disc is write protected. The master copy disc must not be write protected, or it will not work correctly.

2. If the software is to be installed on a PC with twin floppy disc drives, a second disc should now be formatted with the DOS format command. If a hard disc is to be used, this formatting is not required, provided that the hard disc installation itself is complete.

3. The master copy disc should now be placed into disc drive 'a:' and for twin floppy disc drive PCs, the DOS formatted disc should be placed into drive 'b:'.

4. The PC should be logged into drive a: (Type 'a:<RETURN>'), and the operator should enter the root directory of drive 'a' (Type 'cd<SPACE>\<RETURN>').

5. Installation of the software will start after the following command is typed in:-

```
ireform<SPACE>s:<SPACE>d:<SPACE>n<SPACE>b<RETURN>
```

Where s is the drive holding the copy disc; d is the drive on which the software is to be installed. n is the language to be used (e = English, f = French, d = German, i = Italian) and b is the date format (a = American (month before day); e = European (day before month)). All letters must be in lower case (i.e. not capitals).

A2.2 INSTALLATION procedure (Cont.)

If this is a first-time installation, then the software installation continues on the disc in drive 'd' until it is complete, generating status messages as follows:

```
****Generating directory structure on drive %N

Date format selected is DD/MM/YY
Installing....... Please wait
Installing....... Please wait
Installation of reform software complete
```

If the installation has been done before, the following message appears:

```
**** ERROR **** REFORM directory already exists on drive %d
                OK to Overwrite (Y/N) ?
```

If 'N' is entered, the new installation will be aborted. If 'Y' is entered, the installation will continue, over-writing the previous **installation** files. Any previously existing **configuration** files will remain untouched.

The DOS 'dir' command should be used to ensure that a file called 'reform.exe' exists in the reform directory of the disc on which the software was installed.

OTHER ERROR MESSAGES

Other error messages which can appear at installation are as follows:

```
**** ERROR **** remove or rename %d:REFORM.TMP then run IREFORM again

**** ERROR **** unable to write to drive %d
       *** Aborting Installation ***
```

Note...

REFORM.TMP is a temporary file created to test if the disc is write protected. If the file already exists, the installation will abort rather than overwrite an existing file.

```
**** ERROR ****  You must select key E(e),F(f),D(d), I(i)
                      Installation aborting
```

The user has attempted to give an invalid language character during installation. The software must be re-installed using a valid entry.

INDEX

A

Index (Cont.)

A (Cont.)

Index (Cont.)

A (Cont.)

Index (Cont.)

B

C

Index (Cont.)

C (Cont.)

Index (Cont.)

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E

Index (Cont.)

F

G

H

I

Index (Cont.)

I (Cont.)

Index (Cont.)

J

K

L

M

Index (Cont.)

M (Cont.)

Index (Cont.)

M (Cont.)

Index (Cont.)

M (Cont.)

Index (Cont.)

P (Cont.)

Q

R

Index (Cont.)

R (Cont.)

S

Index (Cont.)

S (Cont.)

T

Index (Cont.)

T (Cont.)

U

V

W

X

Y

Z