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programmable signal processor

TCS
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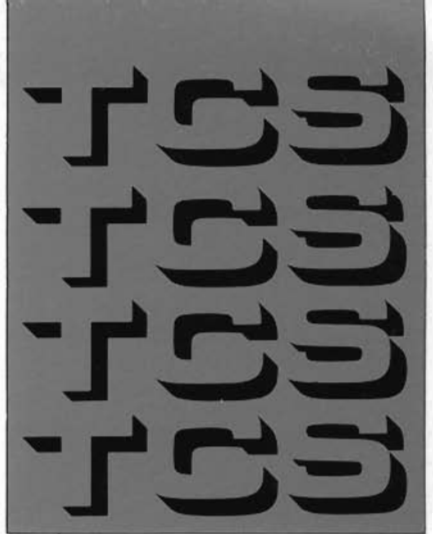TCS

system
6000
6433

product specification

Programmable signal processor: Features

* All Hardware facilities of the 6432 Signal Processor.
* 32 input/ouput channels in 4 blocks of 8.

* 32 Internal ('pseudo') channels in 4 blocks of 8 for Operator Setpoints and Derived Values.

* 16 internal timers.
* 64 internal variables.
* Analogue Computation.
* Logic/Sequencing.

Description

The 6433 Programmable Signal Processor is based on the hardware of the 32 channel 6432 Signal Processor. The latter is primarily intended for analogue and digital data acquisition and display but includes the ability to set alarms on selected inputs and link these to specified digital outputs.

The 6433 features a software enhancement which allows both arithmetic and boolean computation by means of a stack-oriented interpretive programming language based on a subset of FORTH. This includes various enhancements to provide floating point arithmetic and 16 internal timers. The language is highly compact, and statements are entered in "Reverse-Polish" notation.

The unit is intended for arithmetic computation, special control functions, logical manipulation and simple ramp generation and sequencing applications. Timing functions are carried out to a precision of 2mSecs under control of a real time clock.

Input/output capability is the same as for the 6432 (i.e. 4 blocks of 8 channels where blocks may be analogue or digital inputs or outputs) but in addition there are 4 blocks of 8 pseudo channels which may be used for internal derived values. These are accessible from the front panel and via the handheld

programming terminal socket or serial link in the same way as the real input/output channels, and would typically be used to display status, the results of calculations, and to set internal constants.

User memory is 8K RAM and 8K EEPROM. Programs are developed in RAM by using an RS232 teletype compatible device such as a VDU plugged into the front panel programming socket. A program developed in RAM can be "fixed" into EEPROM from the programming device. The program is, however, always run from RAM and this allows programs to be loaded into RAM, edited and then debugged before the original program is replaced.

Alphanumeric Display of Channel Address and Identity, or Tag name, or Related Parameters

Discrete LEDs for Indicating Analogue Alarm Status and Digital I/O States

Channel and Display Control Buttons

Prime Variable Display

Raise and Lower Control Buttons

Socket for Configuration Programming Terminals.

Operator displays and controls

Operator displays

Digital Readout
(for analogue input or output variables) 4-digit, orange LED display with sign and decimal point.

Status Display
2 rows of 8 red LEDs programmed to indicate for each channel:
(i) HI/LO alarm status for analogue inputs.
(ii) HI/LO logic level for digital inputs or outputs.
LEDs flash for alarm or logic state changes until acknowledged.

Identity/Diagnostic Display
Row of 8 red 17-segment alphanumeric LEDs displaying 64 character ASCII to indicate:
(i) Block and channel numbers/tag names.
(ii) Instrument diagnostic messages.

Operator controls

Display Mode Selection
1 non-illuminated push-button with alternate action, Inspect (INS) selects primary or secondary display modes.

Channel Selection
1 illuminated push-button, Channel Select (CHN) with integral green LED.
(i) Selects display channel via Raise/Lower buttons in primary mode (LED off).
(ii) Selects command parameter on alphanumeric display via Raise/Lower buttons in secondary mode (LED on).

Parameter Value
1 illuminated push-button, Parameter Value (PAR) with integral green LED.
(i) Alters analogue or digital output levels via Raise/Lower buttons in primary mode (LED off).
(ii) Alters command parameter value via Raise/Lower buttons in secondary mode (LED on).

Function Selection
2 non-illuminated push-buttons:
Raise (▲) increments or scrolls forward,
Lower (▼) decrements or scrolls backward as described above, when (CHN) or (PAR) are depressed.

Alarm Acknowledge
1 illuminated push-button, Alarm (ALM) with integral red LED flashes whenever an analogue input alarm or digital state change alarm occurs, goes steady when acknowledged.

Note: Alphanumeric display indicates:
(i) Tag name with no buttons pressed.
(ii) Block and channel number (BC) if (ALM), (▲) or (▼) pressed.
(iii) BC in primary mode if (CHN) or (PAR) pressed.
(iv) Command parameter in secondary mode if (CHN) or (PAR) pressed.

Applications

Analogue Computation

Lead/Lag Combustion Control
Multifuel Combustion Control
Boiler Control
Advanced Control strategies   – Feedforward, Lead/Lag
                              – Dead Time
                              Compensation

Efficiency Monitoring
Complex Signal Compensation – Relative Humidity

Logic/Sequencing

Interlocks
Batch sequencing
Glass Furnace Reversal

Example
Lead/Lag Combustion Control Scheme:-

Single Fuel with Fuel/Air Cross Limiting

A combustion control scheme with cross limiting
between the fuel and the air is shown in the
accompanying diagram.

This scheme requires the following TCS modules :-

6350   Single loop controller for fuel control

6350   Single loop controller for air control

6433   Programmable signal processor for analogue
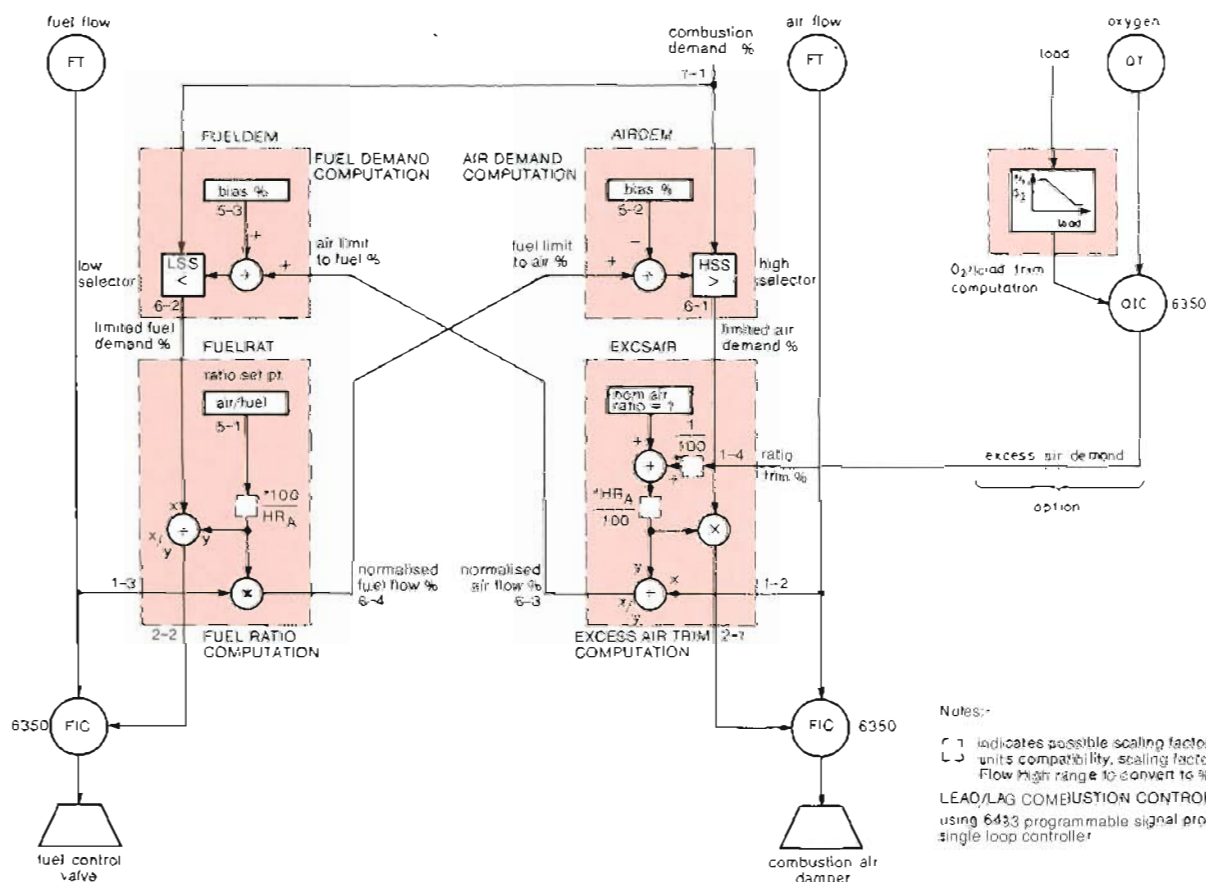   computation functions

The air and fuel controllers are standard 6350 single
loop microprocessor controllers connected to the field
transmitters and control valves. Any necessary
linearisation of the field transmitters (normally square
root) is carried out within the controller.

The use of two single loop controllers assures front-end
integrity and the standby capabilities of local automatic
and manual control. The 6433 programmable signal
processor provides computation associated with loop
interaction and provides the remote setpoints to the
controllers. Fail-safe operation in the event of failure of
the 6433 unit is achieved by wiring its watchdog to the
remote setpoint enable line of the controllers. If the
watchdog fails to a low condition then the controllers
continue in local (forced) auto mode at the last
calculated setpoint.

The combustion (i.e. heat) demand signal may come from
a temperature controller in the case of a furnace, or a
pressure controller in the case of a boiler application.
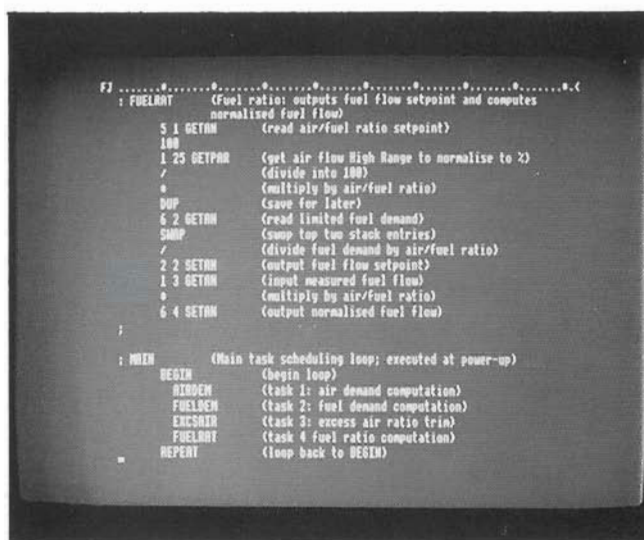
**Part of Application Program
– shows Fuel Ratio Computation and
Task Scheduler**

Communications

Every System 6000 microprocessor based instrument is fitted with an RS232 port and an RS422 port for serial data communications. The RS232 port is available via a front-panel socket and is used for the 8260 Hand-held programming terminal. The RS422 port is available on the module rear connector pins and is bussed onto the supervisory data link common to all modules. All parameters that can be monitored via the 8260 terminal can also be accessed and updated via the supervisory data link, apart from the channel number mnemonic CN. Each block is accessed by the supervisory computer calling up a different unit identifier number.

Hand-held terminal link

Each System 6000 instrument can be set up using a plug-in 8260 Hand-held terminal. Every parameter is accessed by means of a simple 2 character command mnemonic and all data is entered directly in engineering units. This technique ensures the accuracy and security of parameter settings.

Specification

Transmission Standard
2-wire RS232/V24 ($\pm$12V)

Data Rate
300 baud

Character Length
10 bits made up of:
1 start + 7 data + 1 parity (even) + 1 stop
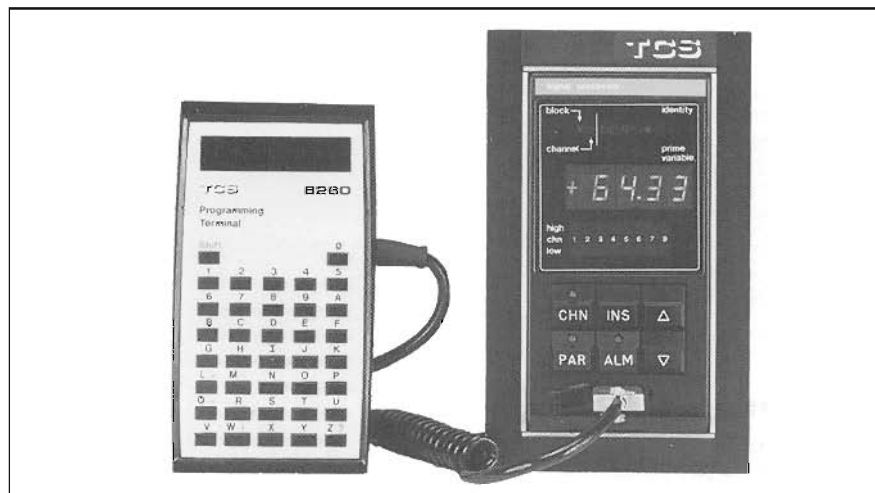
The photograph shows an 8260 terminal plugged into the front panel of a 6433 processor. A full list of the available command parameters is given in the 6433 Facts Card.

Multi-drop supervisory link

Every System 6000 instrument contains an RS422 communications port which enables it to send and receive command parameters over a simple four-wire link connected to other intelligent devices. The use of RS422 and the transmission of information in ASCII or Binary data format makes it particularly easy to communicate with the 6433 processor. To hook the 6433 into a distributed control system requires no modification to the instrument and no further expenditure on options. The four-wire link is simply connected up so that the 6433 becomes part of the distributed control system. The illustration shows how an array of 6433s can be directly connected to a supervisory computer which has an RS422 serial port. If the computer only has an RS232 serial port then an 8245 Communications Buffer Unit can be used to carry out the required RS232 to RS422 conversion as shown.
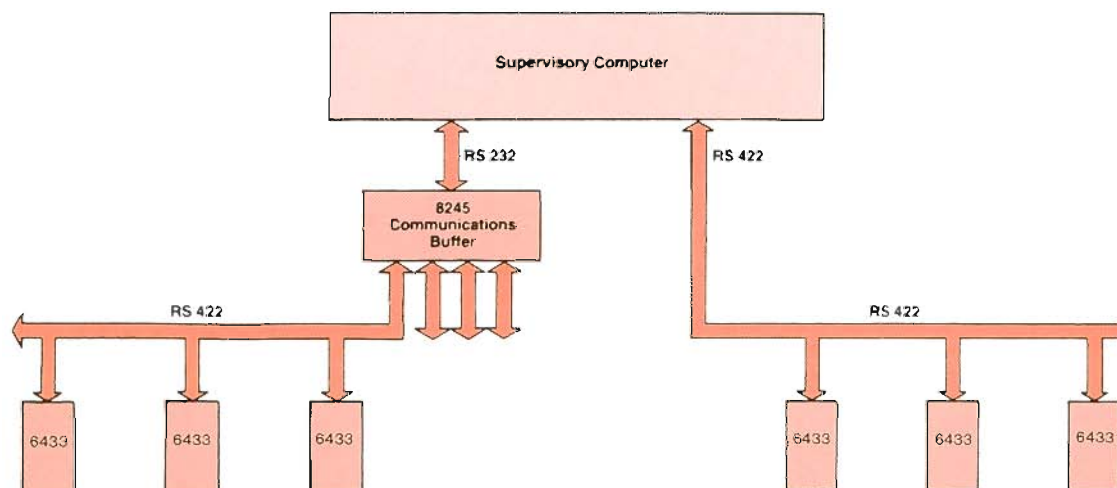
Specification

Transmission Standard
4-wire RS422 (0–5V).

Line Impedance
120–240ohm twisted pair

Line Length
4000 ft max. (at 9600 baud)

Number of Units/Line
16

Data Rate
Selectable from 110, 300, 600, 1200, 2400, 3600, 4800 or 9600 baud

Character Length (ASCII/Binary)
10/11 bits – 300 to 9600 baud.
11/12 bits – 110 baud (2 stop)

Protocol

All microprocessor based instruments in the System 6000 range employ a standard ANSI protocol known as BI-SYNCH. The exact form of BI-SYNCH implemented within System 6000 corresponds with the American National Standard specification:

ANSI – X3.28 – 2.5 – A4 Revision 1976

TCS have implemented both an ASCII and Binary version of this protocol within each instrument.

The ASCII mode is simplest to use as all data is transmitted in ASCII characters. The Binary mode offers a 4 to 1 increase in transmission speed by compressing the data into a binary format, and also supports additional features like Multi-Parameter and Enquiry Polling.

Software Specification

Programming Language

Stack-oriented, FORTH-like language with enhancements for input/output, timing etc.

Program Memory

8K byte RAM
8K byte EEPROM

Database

19 instrument parameters
4 Tag parameters per channel
7 channel status parameters (analogue inputs)
6 channel status parameters (analogue outputs)
3 channel status parameters (digital inputs)
3 channel status parameters (digital outputs)
16 timers
64 variables

Data Format

32 bit floating point with optimisation for logical data, flags etc.
Timer resolution: 1 bit corresponds to 2 milliseconds (Max count about 7 weeks.)

Program Creation

```
:
;
MAIN
ERROR
```

Line Editor

```
BACKSPACE
TAB
DELETE
```

Operating Modes

|	
Command Mode	: DC1 (CTRL Q)
CMD ??	: Z
Scroll	: W
Enter +	: L
Enter −	. M
Programming Mode:	DLE (CTRL P)
Program Execution:	Word MAIN is executed at power up. Word ERROR is executed on trap to Run-time error.
Termination	: ESCAPE terminates program execution or Edit mode and resets error condition.

Programming Terminal Utilities

Load
- Initiate (to 6433) : STX (CTRL B)
- Terminate (to 6433) : ETX (CTRL C)

Save
- Initiate (to 6433) : ENQ (CTRL E)
- Terminate (from 6433)
                    : ETX (CTRL C)

Error Reporting

Hardware Specification

See 6432 Data Sheet

BASIC 6432 FACILITIES
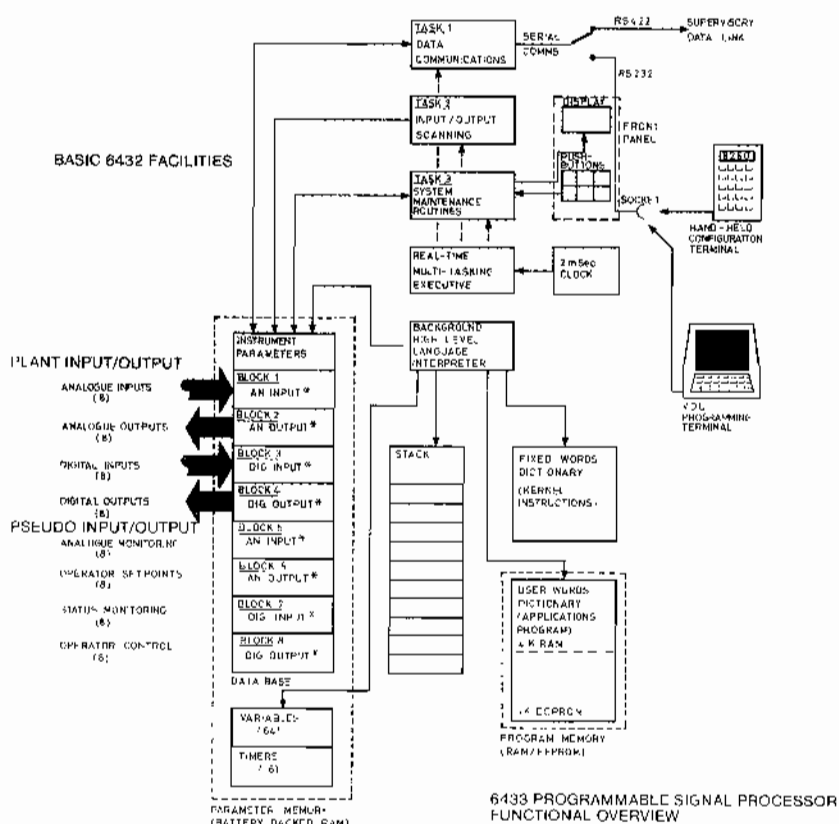
PLANT INPUT/OUTPUT

SOFTWARE ENHANCEMENTS WITHIN 6433

*NOTE: ANALOGUE AND DIGITAL INPUT/OUTPUT CARDS ARE SHOWN IN A TYPICAL CONFIGURATION. ANY COMBINATION MAY BE SPECIFIED

6433 PROGRAMMABLE SIGNAL PROCESSOR FUNCTIONAL OVERVIEW

Fixed Words Dictionary

Arithmetic
+
−
*
/
ABS
MAX
MIN
MINUS
SQR
SQRT
SIN
COS
ATAN
ATAN 2
E
EXP
LN
PI
INT

Logical
AND
OR
XOR
NOT

Comparison
>
<
=
0 >
0 <
0 =

Display Control
GETBCN
SETBCN
TAG."

Input/Output
GETAN
SETAN
GETDIG
SETDIG
GETPAR
SETPAR

Global Variable
GETVAR
SETVAR
DIFVAR
SUMVAR

Local Variable
GETARG
SETARG
GETRES
SETRES

Timer
GETTIM
SETTIM
+TIM

Terminal Input/Output
KEY
NUMBER
EMIT
."
.
SPACE
CR
LF
BS
NL

Stack Manipulation
DROP
DUP
OVER
ROT
SWAP
ARG
RES

Control Structures
DO ... LOOP
I
LEAVE
DO ... +LOOP
BEGIN ... REPEAT
BEGIN ... UNTIL
IF ... ELSE ... ENDIF
CASE ... ENDCASE
OF ... ENDOF
ELSOF ... ENDOF

System Utilities
WINDOW
FWORDS
UWORDS
ULIST
FORGET
INSERT
NEW
STORE
RECALL
CLEAN
TRA-ON
TRA-OFF

Programming Terminal

Applications Programmes may be entered using any RS232 teletype-compatible VDU plugged into the front panel socket of the 6433. This allows statement entry, editing and listing in Programme mode as well as the parameter configuration facilities normally available in Command (Handheld Terminal) mode.

More extensive facilities are provided by the 8261 Programming Terminal based on the Epson PX8. This allows off-line creation, documentation and disc/tape storage of applications programmes using a word processing package. Programmes may be block down-loaded to the 6433.

Datalink Specification

Transmission Standard Character Length
As for Hand-held Terminal.

Data Rate
Selectable from 110, 300, 600, 1200, 2400, 3600, 4800 or 9600.

Ordering information

All units are ordered in the format:
6433 / A / B / C / D
Where A, B, C, & D are the input/output block types to be fitted into the I/O slots 1, 2, 3 & 4 respectively.

The input/output block types available are shown in the adjacent table.

NOTE: Slots with no I/O cards fitted must be specified with an X.
Example:- **6433 /0/0/24/X**
Configuration is:-
Slots 1 and 2 – 8 channel analogue inputs.
Slot 3 – 8 channel digital output.
Slot 4 – no card fitted.

| Order Code	I/O card type
0	8 channel analogue input
8	8 channel analogue output
16	8 channel digital input
24	8 channel digital output
X	no card fitted

Mechanical details

All System 6000 microprocessor based instruments are supplied in 72mm wide metal housings fitted with front-panel fascias and catch handles for module retention. These may be used with a wide variety of rack and panel mounting hardware as illustrated in the examples below.

7000 series racks

Up to six 6433 signal processors may be fitted in to a 7000 series 19 inch rack as shown. Interconnections between instruments are made by wire wrapping while external connections may be brought out to screw terminal blocks fitted to the hinge down rear door. The 7000 series rack is also available with a panel mounting option, and a 10 inch half rack version for mounting up to three 6433s can also be supplied.
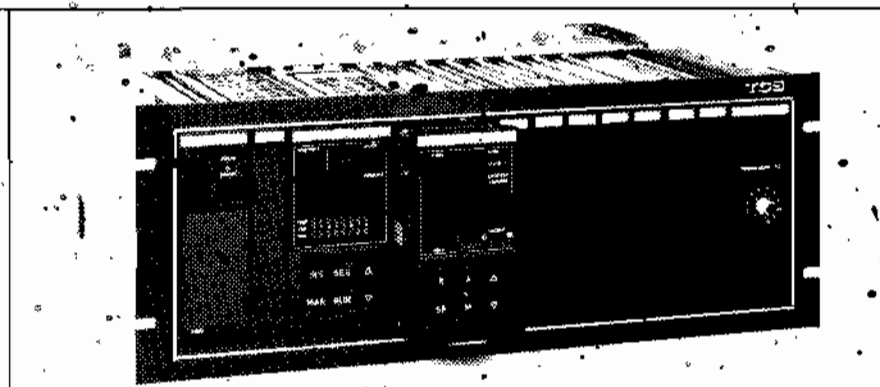
7900 powered sleeves

The powered sleeve allows a 6433 to be mounted with a mains power unit. This is incorporated in the associated 7433 Rear Termination Assembly which gives access to all module connections via screw terminals. The 7900 assembly is available in single, 3 way or 6 way versions for mounting in panels from 1.5mm to 6.5mm thick. A 6 way 19 inch rack mounting version can also be supplied.
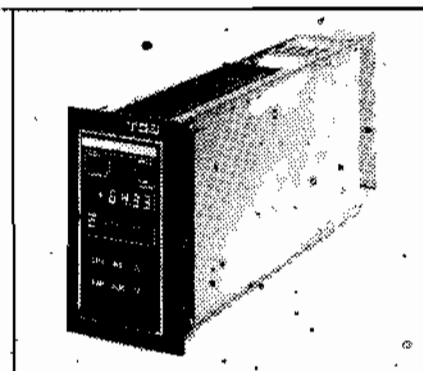
Overall dimensions in mm of housing illustrated:

	7000 rack	7900 sleeve
width:	482	105
height:	177	177
depth:	380	423

Panel cut-out dimensions in mm:

	7000 rack	7900 sleeve
width:	448.2	88.2
height:	166.3	166 3

Details

For further details refer to:
6433
32 channel signal processor technical manual

6433
Facts Card
7433
Signal processor rear termination assembly.

7900
Single or multi-way sleeve assembly for microprocessor based instrumentation.