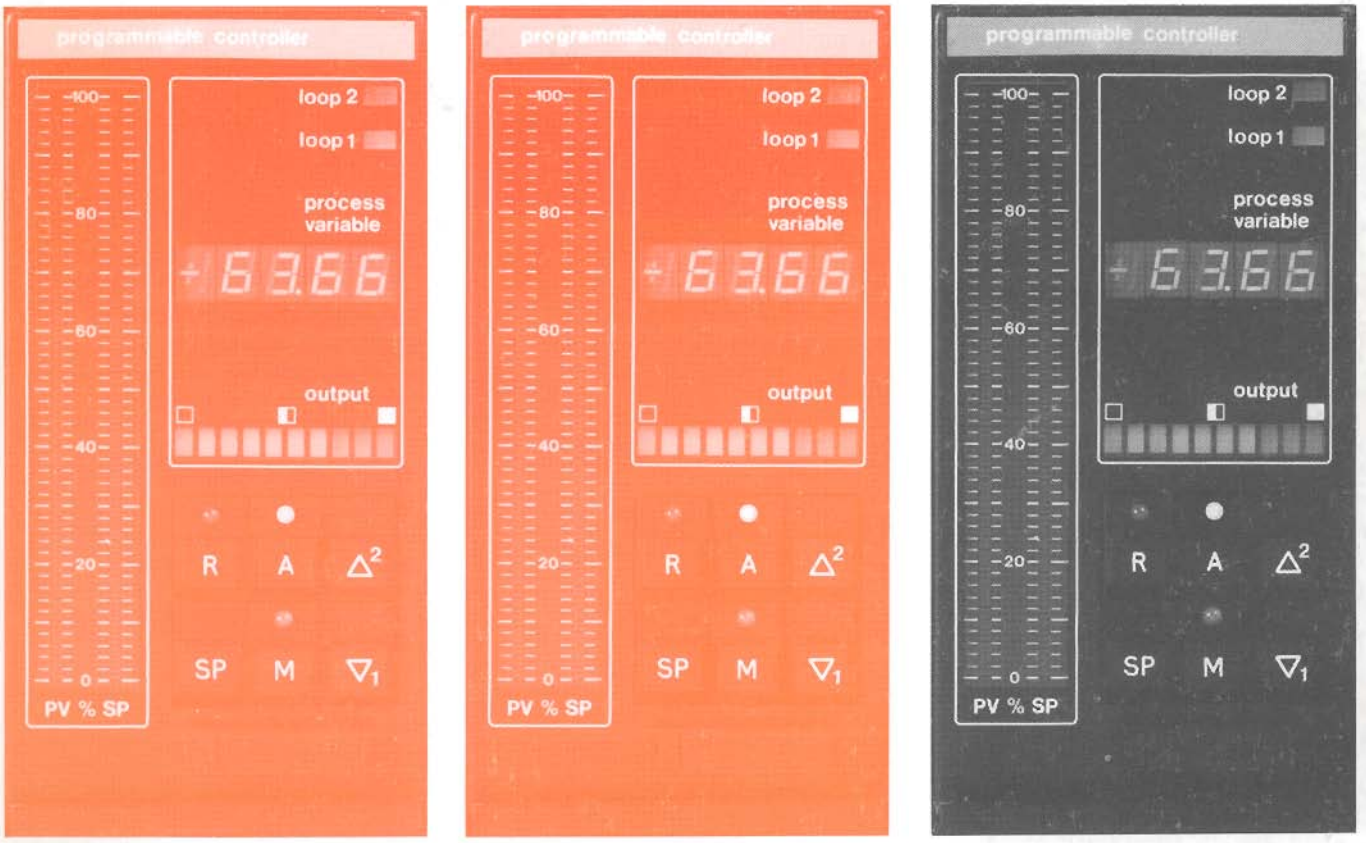
programmable advanced controller

system 6000

6366



product specification

Programmable Advanced Controller: Features

- **Extensive library of pre-configured Applications Programs including, Single Loop, Cascade Pair, Ratio Pair, Feed-Forward Control.**
- **Simple Edit Facility for Pre-set Applications Programs.**
- **Storage for 30 Applications Programs plus up to 20 User Programs.**
- Programmable Maths Logic and Sequence Functions – Totalisation and Time Delays.
- 2 PID Blocks, 64 Variables, 16 Timers plus Program Flow Structure.
- PID Terms Scheduling – Total Flexibility on Control Strategy.
- **Compatible with existing 6350/ 6360 Controllers and System 6000.**
- **All Controllers are Identical and Interchangeable.**
- **Powerful Diagnostics.**
- **No Options.**

Description

The 6366 Programmable Advanced Controller combines the flexibility of Microprocessor technology with the integrity associated with conventional stand-alone instruments.

The powerful Micro-computer within the 6366 contains an extensive library of Applications Programs any of which may be selected and run These programs provide most single and dual PID loop configurations such as Single Loop (6360), Cascade Pair, Ratio Pair, Feed-forward Control, Split Range Inputs and Outputs, Adaptive Gain, etc

The Applications Programs are selected by name from the hand-held terminal. They each have an associated set of characterisation parameters such as ranges, alarms, PID constants, and input linearisation routines, etc. that may also be set from the hand-held terminal

The Applications Programs are complete in that they define the overall function of the instrument including the assignment of inputs, outputs, displays, and operator controls.

Modifications to the Applications Programs are possible either by re-assigning functions by changing the configuration parameters from the hand-held terminal, or for more complex changes, editing using a simple high level language. (The programming is the same as the 6433 Programmable Signal Processor)

A second library of User Programs which may comprise either edited Applications Programs or completely new user configurations can store up to 20 alternative functions. (Depending on the individual program length) These may also be called from the hand-held terminal.

All 6366 instruments are physically identical and interchangeable Within the limits of 30 Applications Programs plus 20 User Programs, a single instrument type may be used for all plant control functions and be supported by a single spare unit.

Programmable parameters include:- 2 PID blocks with Feed-Forward Capability, 2 Set-point Blocks, 2 Ratio Blocks, 2 Manual Control Blocks, 2 Display Sets, 2 Alarm Blocks, 2 Filter Blocks, 2 sets of Constants plus 64 Intermediate Variables, 16 Timers, Delays and Totalisation.

Supervision and monitoring of the 6366 is made particularly simple by the provision of a Communications Interface This allows an intelligent device to monitor or up-date any of the configuration parameters of a network of System 6000 instruments via an RS422 serial bus using a standard ANSI protocol.

The solid state technology provides high levels of reliability while the diagnostic procedures built into each instrument further improve integrity and facilitate fault-finding.

Operator Displays and Controls

Operator Displays

Loop Select Indicators
2 yellow rectangular LEDs indicating PID loop 1 and 2.

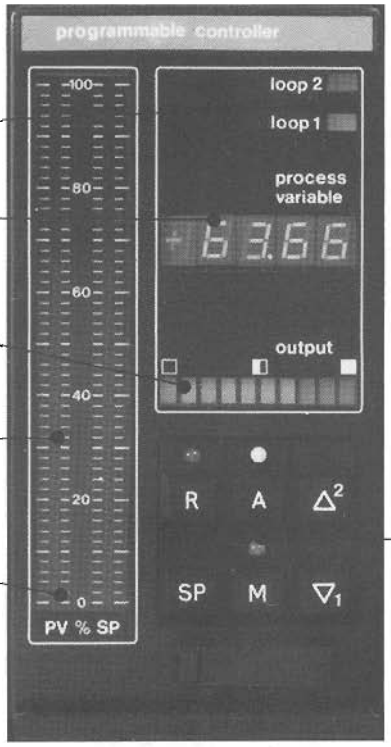
Digital Readout
4-digit, orange LED display with sign and decimal point assignable to any variables.

Output Display
Horizontal yellow LED bargraph with 10 segments to indicate 0-100% of the selected output.

Vertical Bargraph
Two 101 segment bargraphs labelled PV (process variable) and SP (set point) assignable to any variables.

Power-on Indication
Lowest segment of both bargraphs illuminated.

Alarm Indication
High or low alarms may be set to flash the bargraphs and/or set digital outputs.



Operator controls

The Operator Controls are dedicated to each of the PID loops as follows. In addition to the standard functions the Operator Controls may be used for other special purposes within the User Programs.

Control Mode Selection
3 illuminated push-buttons:
Manual (M) with integral yellow LED.
Local Auto (A) with integral green LED.
Remote Auto or Ratio (R) with integral green LED.

Function Select
2 non-illuminated push-buttons:
Raise (△ 2) either selects PID loop 2 if operated alone, or increments the output when (M) is pressed, or increments the setpoint when (SP) is pressed.

Lower (▽ 1) either selects PID loop 1 or decrements output or setpoint as above.

Display Selection
1 non-illuminated push-button (SP) causes the digital readout to display the current setpoint while pressed.

Applications

- ★ Lead-lag Combustion Control
- ★ Reaction Vessel Control
- ★ Fluid Bed Dryer Control
- ★ Deadtime Control (Smith Predictor)
- ★ Forehearth Temperature Control
- ★ Adaptive Gain
- ★ Wellhead Choke Valve Control
- ★ Furnace/Kiln Profiling
- ★ Ph Control
- ★ Drum Level Control

The powerful combination of sophistication with flexibility means that the 6366 has found ready applications in the above process industries.

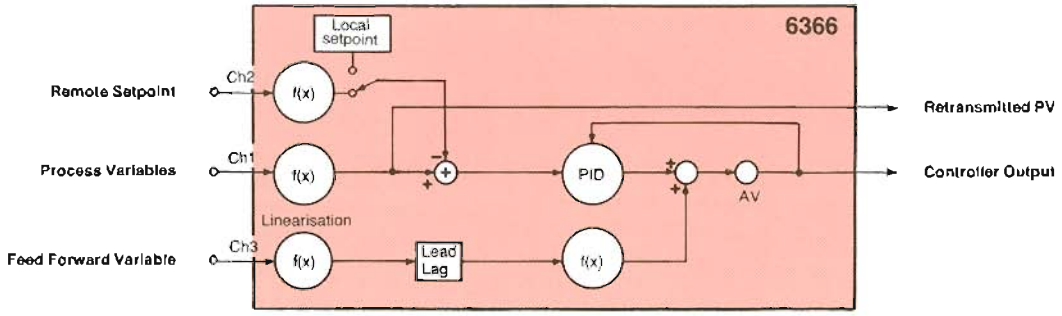
All system 6000 instruments use standard voltage and current levels for their analogue and digital interfaces. This means that the 6366 may be interconnected to other instruments within the range to form complex control configurations

However, the Function blocks already programmed in the 6366 Application library include all interconnection and interlocks within the instrument to perform single loop, cascade and ratio configurations as illustrated below.

Examples from the 6366 Extensive Applications Library

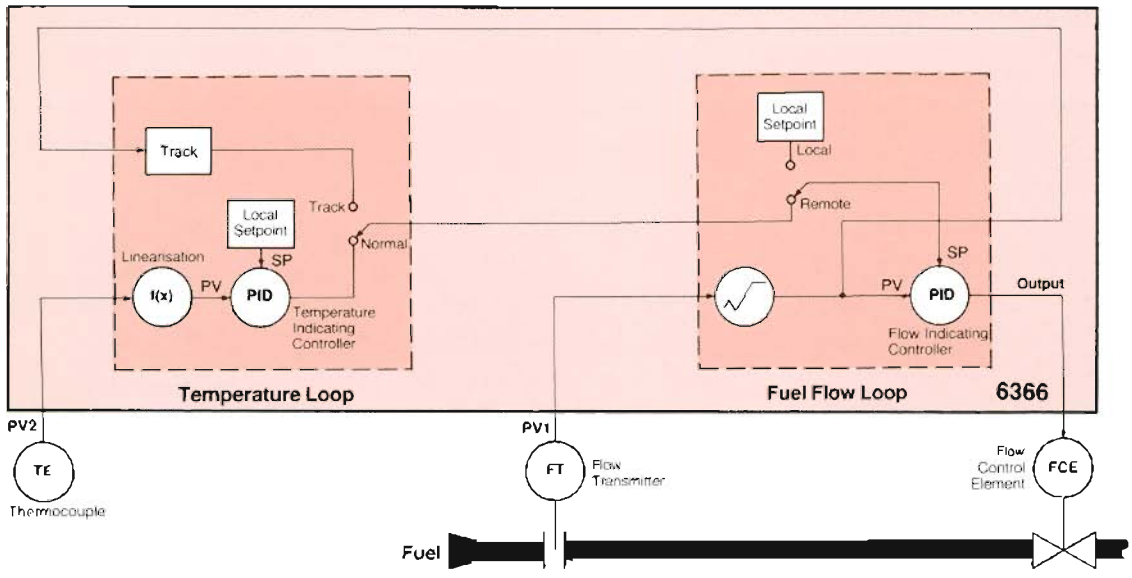
For a complete listing of all available TCS and user Applications consult the 6366 Applications Manual

Single Loop Control with Remote Setpoint and Feed Forward



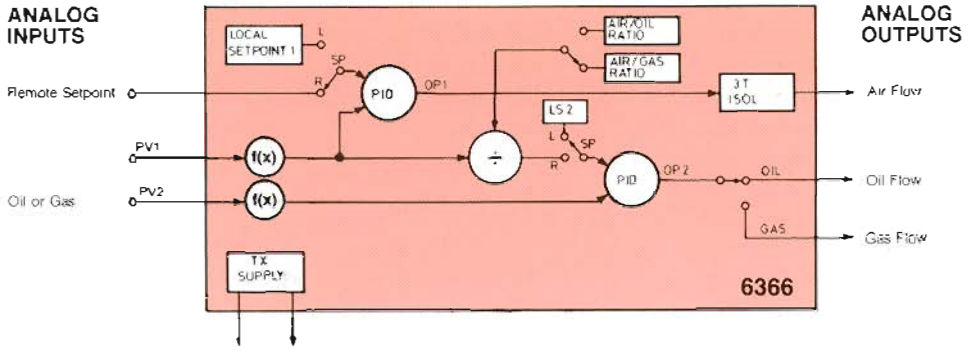
The example shows a single PID control loop with both internal and remote setpoints. The third channel is used for a feed forward variable that modifies the control output.

Cascade Control



The example shows a process temperature being controlled through a secondary fuel flow loop using one 6366 controller

Ratio Control



The fuel-air ratio control system illustrated demonstrates several features of the 6366.

The primary PID loop controls the Air flow from a demand from an external temperature controller. The secondary loop controls the fuel (Oil or Gas) as a Ratio of the Air.

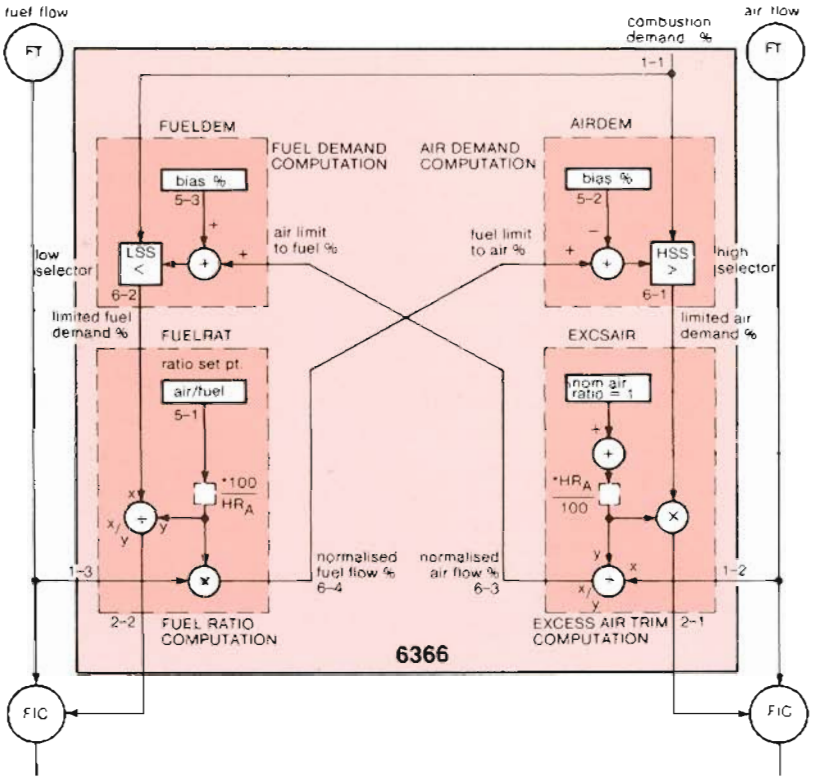
The Fuel (Oil or Gas) is selected by a digital input which also sets the correct ratio setting and if necessary the PID term.

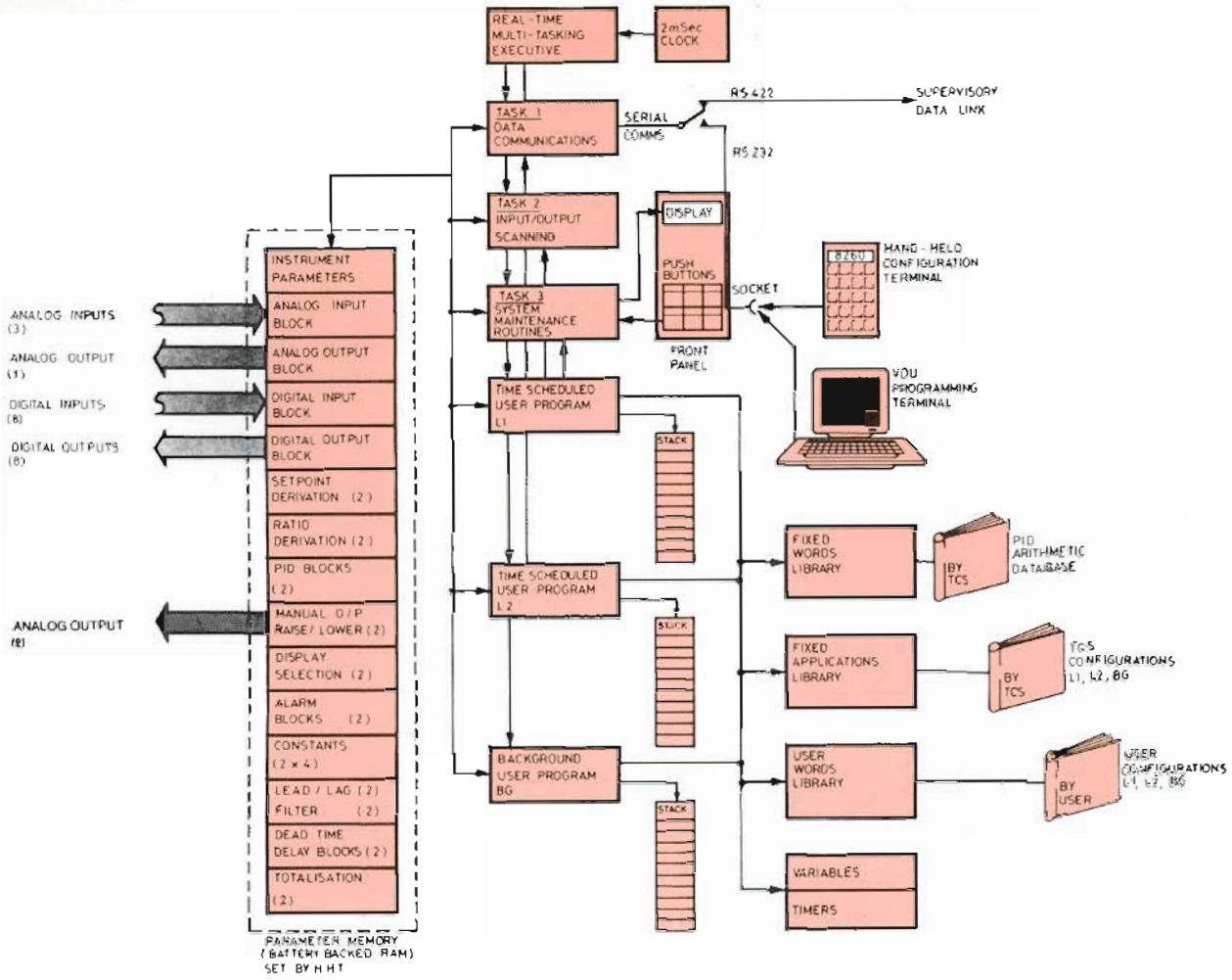
Example

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.





The 6366 supports two time scheduled programs and a background program. These are selected using the hand-held terminal by setting their names into the parameters L1, L2 and BG in the general purpose parameters block.

L1, L2 and BG may be selected from either the:-

Fixed Applications Library

Users Program Library

or Completely new programs may be written and run.

The pre-set Applications Programs allow all tuning or technician set variables to be set using the hand- held terminal, i.e. PID, Alarms, Constants, etc.

Any existing Fixed Application or User Program may be selected and modified and re-stored in the User Library (assuming there is space).

Edits to existing programs or generation of new programs are carried out using simple, easily understandable statements.

The Fixed Word Library includes.-

An extensive list of
Arithmetic
Logical
Comparison
Tuning
and Totalisation functions
plus Get and Set variables

Common Control Functions are implemented as Fixed Words, i.e.

3 Term Control	PID
Manual Output Control	MSCONT
Ratio	RATIO
Remote Setpoint	REMOTE
Alarm Registers	ALARM
Digital Lead/Lag Filter	FILTER
Totalisation	TOTAL

Control Structures such as
DO ... .LOOP
IF ..... ENDIF
etc.

plus stack manipulators and systems utilities allow sophisticated real-time programs to be constructed.

Database
200 instrument parameters available via the hand-held terminal accessed at 2 levels
Level 1 – general instrument parameters
Level 2 – setpoint, ratio, input/output, PID alarm parameters, etc.

Data Format
32 bit floating point with optimisation for logical data, flags, etc.

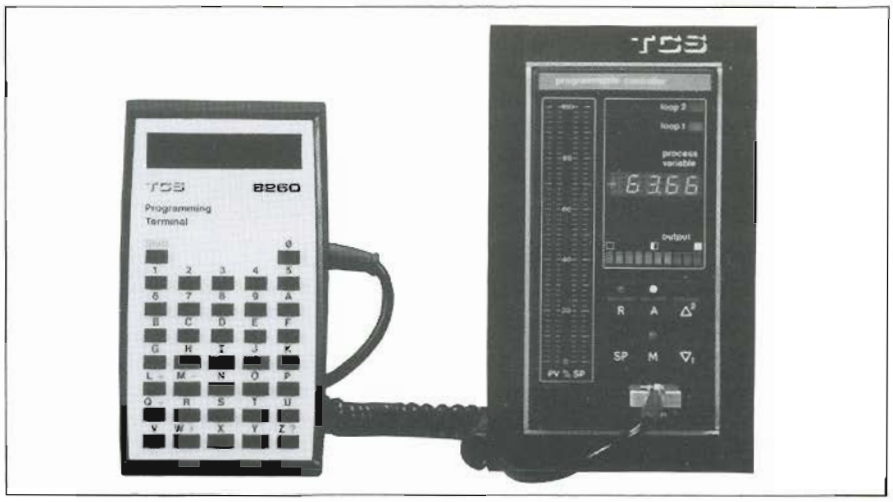
Timer precision: 1 bit corresponds to 2 milliseconds (Max. count about 7 weeks).

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 on to 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.

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

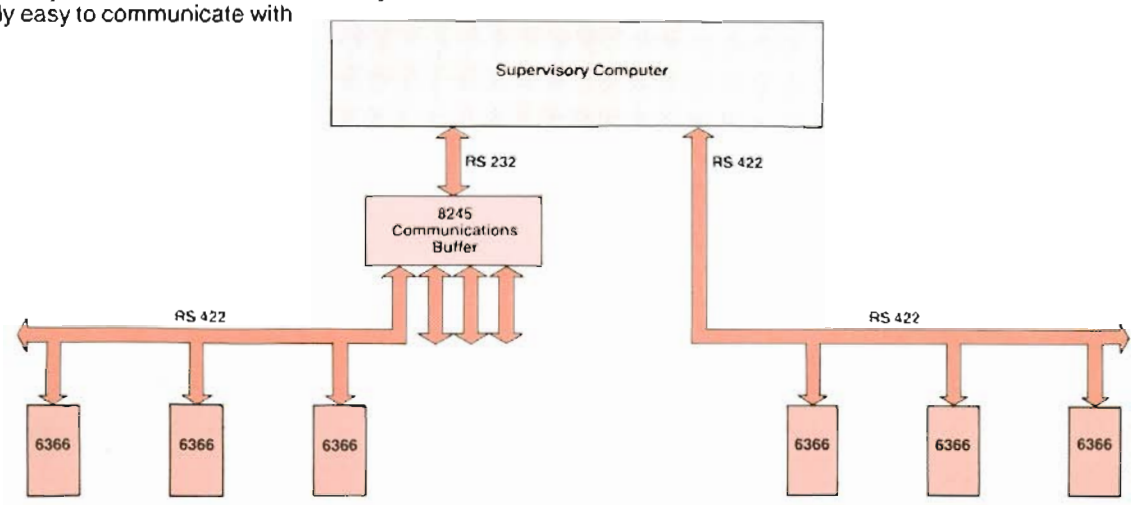
Transmission Standard
2-wire RS232/V24 (± 12V).

Data Rate
300 baud

Character Length
10 bits made up of:
1 start + 7 data + 1 parity (even) + 1 stop.

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 6366 Controller. To hook the 6366 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 6366 becomes part of the distributed control system. The illustration shows how an array of 6366's can be directly connected to a supervisory computer which has an RS422 serial port. If the computer only has a 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
120–240 Ω 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

Control Characteristics

Input Filter (3 blocks)
First order digital filter on analogue inputs selectable in the range 0 04 to 60.0 secs.

Setpoint (2 blocks)
Range, Limits, Rate
– low, high –9999 to +9999

Ratio (2 blocks)
Process variable and setpoint range –9999 to +9999.

Alarms (2 blocks)
Low, high, rate –9999 to +9999 with user selectable hysteresis plus alarms on each setpoint block with hysteresis of ½% of setpoint span.

PID Algorithm Sampling Period (2 blocks)
100ms to 0.6 secs set by program

Proportional Band Range (2 blocks)
0 to 999.9%

Integral Time Constant Range (2 blocks)
0.04 to 99 99 sec. or 0.01 to 99.99 mins
0 = off.

Derivative Time Constant Range (2 blocks)
0.04 to 99.99 sec. or 0.01 to 99.99 mins.
0 = off.

Feedforward Action (2)
Lead/lag range.

Delay Blocks (2)
100ms to 2.7 hrs 80 segments.

Totalisation (2 blocks)
Range 0 to 9999

Auto-Manual Station Output Range (2 blocks)
–0 to 99.99% = 0–10V or 4–20mA (Ch1).
Limits – high, low, rate 0 to 99.99%
Polarity – inverse output mode switch selectable.
Raise/lower rate in manual –0 to 99 99% in 10 secs. with accelerating action

Display Blocks (2)
Assignment of all front panel displays.

Constants
8 off 4 digit constants plus 2 off 8 bit status words available via comms link.

Input/Output Signals

Analogue inputs

Number of Channels
3 direct non-isolated inputs or 3 conditioned non-isolated inputs.

Input Signal Levels
Direct inputs are 0-10V range, conditioned inputs are 1-5V or 4-20mA range with external sense resistors.

Resolution
12 bit binary ADC (.025%) hardware applied to inputs. 15 bit binary representation obtained after digital input filtering and signal averaging giving resolution of 1 digit in ± 9999.

Accuracy
± 1 LSB max. over 0-50°C range for hardware.
± 1 digit of reading for 0-4000 range,
± 2 digits of reading for 0-8000 range,
± 3 digits of reading for 0-9999 range, after input filtering.

Sampling Rate
ADC samples 1 channel every 12ms, i.e. any one channel is sampled once every 36ms.

Input Impedance
IM5 pull-down to –5V on channel 1.
IM pull-down to 0V on channels 2 and 3.

Input Signal Processing
Linear (normal or inverse).
Normalised square root.
Type J, K, T, S, R, E, B thermocouples.
Platinum resistance thermometers.
5 user specified linearisation functions

Analogue outputs

Number of Channels
3 direct non-isolated outputs plus 1 isolated output.

Output Signal Levels
Direct outputs are 0-10V range.
Isolated output is 4-20mA (channel 1 only).

Output Circuit Type
Medium-term analogue sample-and-hold circuits preceded by DAC.

Output Resolution
12 bit binary (.025%) giving minimum analogue voltage steps of 2.5mV.

0-10V Output Accuracy
± 1 LSB max over 0 to 50°C range.

Isolated Output Accuracy
± 0.5% of full scale.

Sample and Hold
DAC updates 1 channel every 12ms. i.e. any one channel is refreshed once every 36ms

Output Drift Rate Under Watchdog Failure Conditions
½mV/sec maximum (equivalent to 1% of full scale in 3 minutes)

Output Drive Capability
± 5mA for direct voltage outputs.

Isolation Voltage
± 50V minimum with respect to system ground.

Digital inputs

Number of Inputs
8 external non-isolated inputs

Input Voltage Levels
15V = logic one.
0V = logic zero.

Input Impedance
100k Ω pull-down to 0V (gives 150μ A logic one current).

Digital outputs

Number of Outputs
8 external non-isolated outputs plus Watchdog.

Output Voltage Levels
15V = logic one.
0V = logic zero.

Output Drive Capability
2k2 open-collector pull-up to +15V supply, maximum logic zero sink current = 16mA.

Programming details

Applications Programs may be entered using any RS232 teletype-compatible VDU plugged into the front panel socket of the 6366. This allows statement entry, editing and listing in Program mode as well as the parameter configuration facilities normally available in Command (Hand-held Terminal) mode.

More extensive facilities are provided by an Intelligent Programming Terminal based on the BBC Micro. This allows off-line creation, documentation and disc storage of applications programs using a word processing package Programs may be block down-loaded to the 6366.

Datalink Specification

Transmission Standard Character Length

As for Hand-held Terminal.

Data Rate

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

Power supplies

Input Voltage

(May be unsmoothed, full-wave rectified AC).
20-30V DC recommended operating range.
19-35V DC absolute maximum input limits.

Input Current

600mA without hand-held terminal.
700mA with hand-held terminal.

Input Fuse Rating

2A.

Power Failure Detect Threshold

When input voltage falls below 16.5 ± 0.5V.

Remote Transmitter Supply

26V ± 1.5V at 4mA output.
30V ± 0.5V at 20mA output.
± 50V minimum isolation with respect to system ground

Memory Standby Battery

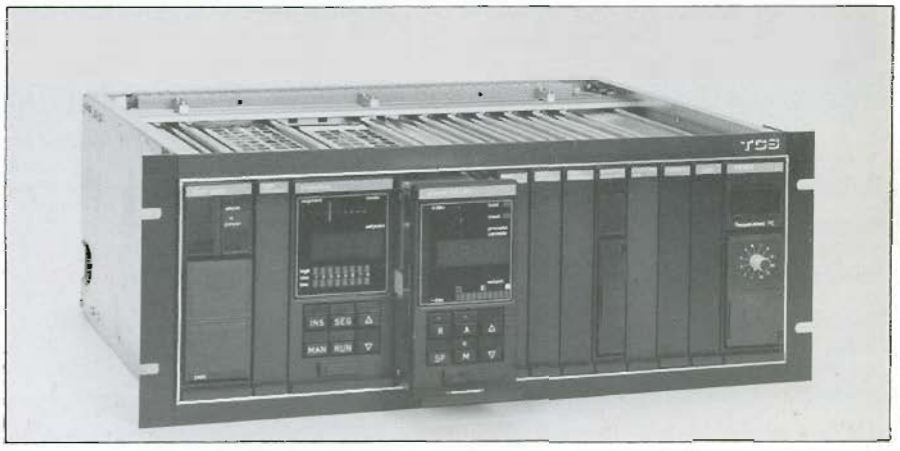
3.0V Lithium type.
160mAh rating.
8-10 year shelf life.
5 year life minimum on continuous standby.

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 6366 controllers may be fitted into a 7000 series 19 inch rack as shown. Interconnections between instruments are made by wire wrapping while external connections may be brought out to 2 rows of 64 way 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 6366s can also be supplied.



7900 powered sleeves

The 7900 powered sleeve allows a 6366 to be mounted with a mains power unit. This is incorporated in the associated 7366 Rear Termination Assembly which is also fitted with alarm relays and 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 housings 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:

6366 Single loop microprocessor based controller technical manual.

6366 Facts Card.

7366 Programmable Advanced Controller rear termination assembly.

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

TCS
Advanced Instrumentation

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