flow controller

system 6000

6353

product specification

Flow controller: Features

- No options.
- Every unit operates with both Orifice Plates and Turbine meters.
- Compensates for; Pressure, Temperature, Density, Compressibility.
- Microprocessor technology.
- Displays; Mass flow, Temperature, Gauge pressure, Flow rate (turbine meter), Differential pressure (orifice plate), Output, setpoint and deviation, Alarm conditions.
- Input linearisation.
- Built-in diagnostic routines.
- Remote Raise Lower of setpoint.
- Pulse output for Integrator.
- Remote monitoring and supervision via a simple serial link.
- Field proven unit with a two-year warranty.
- Fully compatible with the TCS range of advanced Instrumentation.

Description

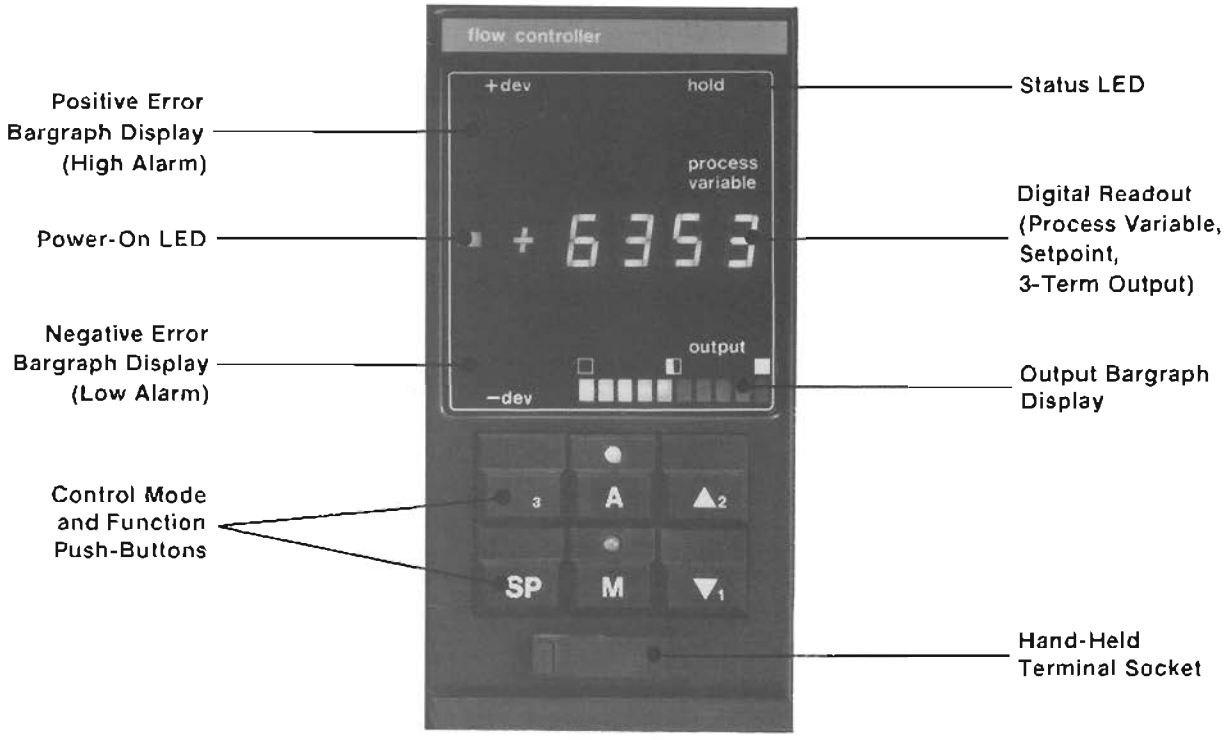
The 6353 Flow Controller utilises modern microprocessor technology to calculate and control the mass flow of liquids or gases using orifice plate or turbine meter inputs.

Each controller comes fully equipped with all the features described in this bulletin and is interchangeable with all other 6353 units. The controllers are characterised on site using a portable plug-in hand-held terminal, thus ensuring security of the settings which are retained in a battery supported memory.

Functionally the controller operates as a conventional analogue unit providing facilities to raise/lower the setpoint or output, via front panel push-buttons and to change control mode to Manual or Automatic The 6353 will interface to 4-20mA signals from plant mounted equipment or 0-10V signals from the System 6000 range of signal conditioners and output drivers.

Supervision and monitoring of the 6353 is made simple by the provision of a communications interface. This allows an intelligent device to monitor or update any of the control parameters of a network of 6353s via an RS422 serial bus using an ANSI protocol. The TCS 8245 Communications Buffer Unit enables RS232, TTL and fibre optic interfaces to be used

The solid state technology offers high reliability while the inbuilt diagnostics provide further integrity.



Operator displays and controls

Operator displays

Digital Readout
(for Process variable, setpoint, 3-term output and measured power indication) 4-digit, orange LED display with sign and decimal point.

Error Indication
Vertical red LED bargraphs with 8 segments for positive and negative error in 1% steps.

Alarm Indication
High or low alarms indicated by flashing positive or negative error bargraphs

Zero Error and Power-on Indication
Green LED in centre of error bargraph

3-Term Output or Measured Power Display
Horizontal yellow LED bargraph with 10 segments to indicate 0-100% output.

Status Indicators
Yellow rectangular LED to indicate HOLD status.

Operator controls

Control Mode Selection
2 illuminated push-buttons.
Manual (M) with integral yellow LED
Local Auto (A) with integral green LED

Function Selection
2 non-illuminated push-buttons. Raise (▲2) increments the outputs when (M) is pressed, or increments the setpoint when (SP) is pressed Lower (▼1) decrements the output when (M) is pressed, or decrements the setpoint when (SP) is pressed.

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

NOTE: Pressing the (▼1), (▲2) or (3) buttons causes the digital readout to display the current output level of the three process variables.

Applications

The powerful combination of sophistication with flexibility means that the 6353 Flow controller is applicable to any process whereby gas or liquid flow is to be controlled accurately within preset limits or to preset levels.

All System 6000 instruments use standard voltage and current levels for their analogue and digital interfaces. The 6353 Flow Controller has 3 input channels whose functions vary depending on the type of meter used. The illustration show two examples with the 6353 configured for Orifice Plate or Turbine Meter.

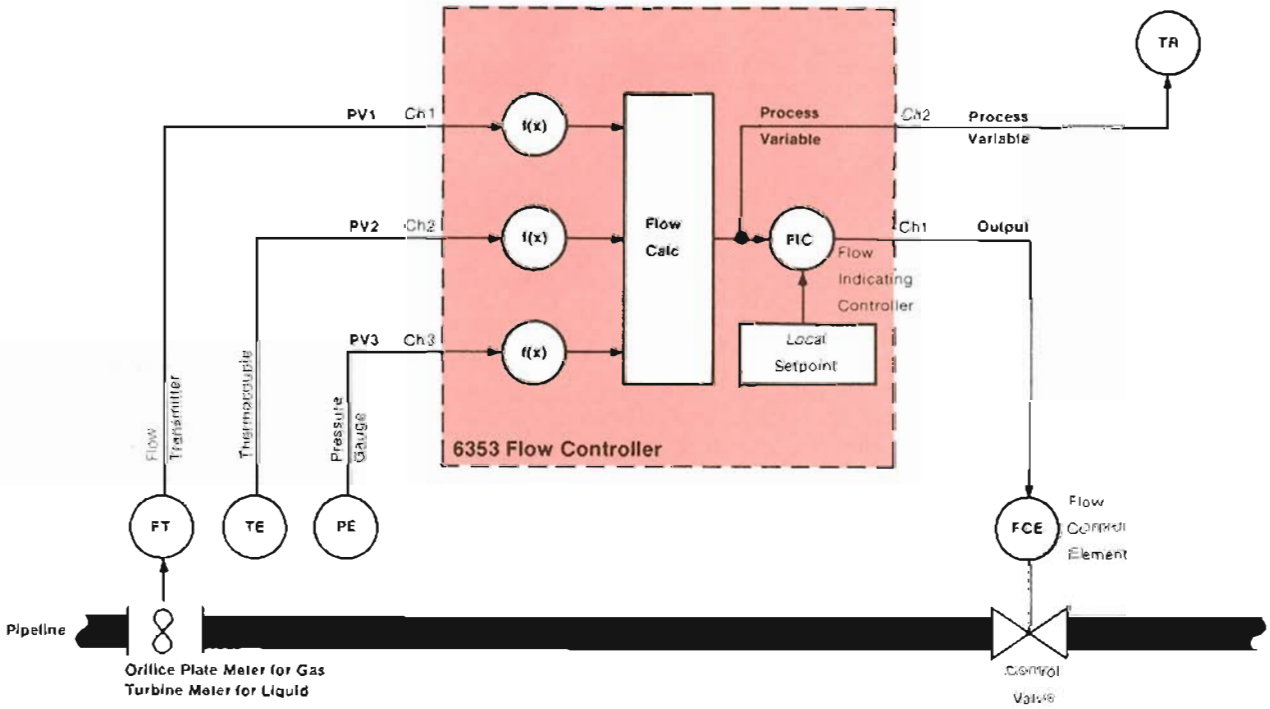
As well as monitoring flow rate, temperature and pressure the 6353 also needs the values of a number of constants in order to correctly compute the mass flow. These are entered via the hand-held terminal, which also gives ready access to the values by authorised personnel. All such constants are accessible over a supervisory link and can be written in remotely by another intelligent device.

As well as retransmitting the calculated flow for recording purposes, the 6353 is equipped with a flow integration/pulse output which can be used to drive a counter for external display of integrated flow.

If it is necessary to compensate for density, a density probe can be connected to input channel 3

Where associated input or output signal conditioning is required, the appropriate units from the TCS range of plug-in modules can be easily packaged with the 6353. Auxiliary modules are also available to provide extra digital or analogue bargraph displays of variables and the Chessell range of chart recorders are plug-compatible with the TCS module system.

Flow measurement and control – Gas/Liquid



Flow calculations

Computed variable :

$$PV = 1K \times 2K \times \left\{ \begin{matrix} 1V \\ \text{or} \\ \sqrt{1V} \end{matrix} \right\} \times \left\{ \begin{matrix} DCT \\ \text{or} \\ \sqrt{DCT} \end{matrix} \right\}$$

Density Correction Term :

$$DCT = \left(\frac{PF + PA}{PO}\right) \times \left(\frac{TO}{TF + TA}\right) \times \frac{1}{SG} \cdot \frac{XO}{ZF}$$

Compressibility factor of 0°C < TF < 40°C and PF < 70 bar:

$ZF = 1 + b(PF + PA) + c(PF + PA)^2$

$b = [3K + (4K \times TF) + (5K \times TF^2)] \times 10^{-5}$

$c = [6K + (7K \times TF) + (8K \times TF^2)] \times 10^{-8}$

S2 No. 1 is used to enable the square root on 1V

S2 No. 2 is used to enable the square root on the DCT

measured variables.

PV1 (Channel 1) = 1V = Primary Input Variable

PV2 (Channel 2) = TF = Temperature

PV3 (Channel 3) = PF = Static Pressure

presettable constants:

PA = Offset to absolute pressure

PO = Reference pressure (absolute)

TA = Offset to absolute temperature

TO = Reference temperature (absolute)

SG = Relative density (specific gravity)

XO = Base compressibility (a value of 0 disables the compressibility factor)

1K, 2K, 3K, 4K, 5K, 6K, 7K, 8K = Scaling factors

e.g. Turbine Meter (S2 No. 1 and No. 2 OFF)

Computed variable : $PV = 1K \times 2K \times 1V \times \left(\frac{PF + PA}{PO}\right) \times \left(\frac{TO}{TF + TA}\right) \times \frac{1}{SG} \times \frac{XO}{ZF}$

Orifice Plate Meter (S2 No. 1 and No. 2 ON)

Computed variable : $PV = 1K \times 2K \times \sqrt{1V} \times \sqrt{\left(\frac{PF + PA}{PO}\right) \times \left(\frac{TO}{TF + TA}\right) \times \frac{1}{SG} \times \frac{XO}{ZF}}$

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

Hand-held terminal

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)

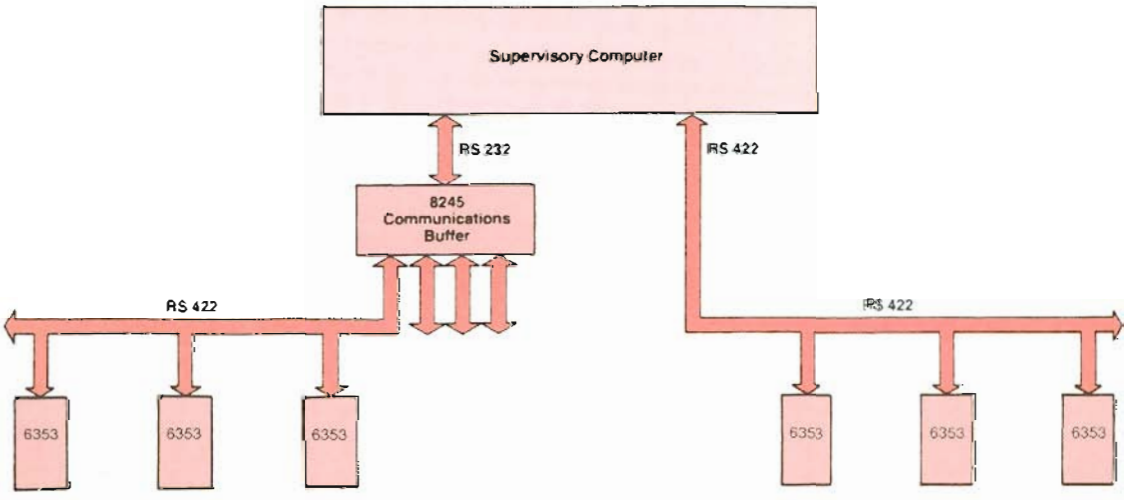
Data Rate
300 baud.

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

The photograph shows an 8260 terminal plugged into the front panel of a 6353 controller. A full list of the available command parameters is given in the 6353 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 6353 controller. To hook the 6353 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 6353 becomes part of the distributed control system. The illustration shows how an array of 6353s 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
120-240 ohm 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

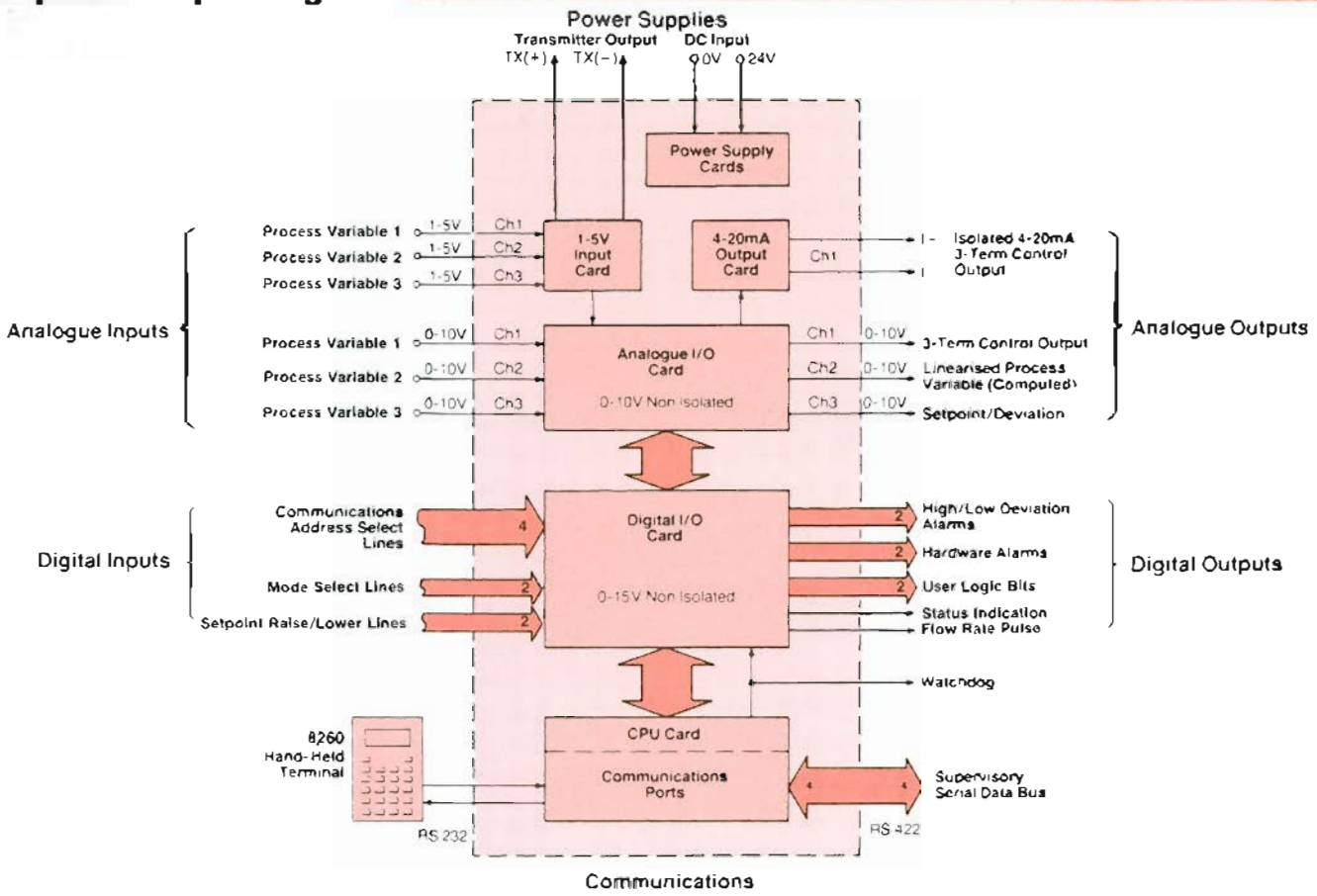
All microprocessor based instruments in the System 6000 range employ a standard ANSI protocol known as BI-SYNCH. The exact form of BI-SYNCH implemented within System 6000 corresponds with the American National Standard specification:

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.

Input/Output signals



Analogue inputs

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

Channel Functions
Channel 1 = PV1 (Flow/Diff. Press.).
Channel 2 = PV 2 (Temperature).
Channel 3 = PV 3 (Pressure/Density).

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
150k ohm pull-down to -5V on channel 1.
100k ohm 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.
User specified linearisation functions.

Analogue outputs

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

Channel Functions
Channel 1 = 3-Term control output
Channel 2 = Computed process variable output.
Channel 3 = Setpoint output or amplified deviation (error).

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 0-50 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

Inputs Functions
4 communications unit address select lines.
2 mode select lines.
2 remote setpoint raise/lower lines.

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

Input Impedance
100k ohm pull-down to 0V (gives 150μA logic one current.

Digital outputs

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

Output Functions
2 deviation alarms.
2 hardware alarms.
1 status indicator.
1 flow totalisation pulse.
2 user logic bits

Flow Totalisation Pulse Output Scaling Factor
Varies pulse rate for correct scaling of internal and external totalisation counters.
Range 0.1 to 999.9 (4 pulses per second max.).

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.

3-term control characteristics

Algorithm Sampling Period
36ms to 1.56s dependant upon integral and derivative times.

Setpoint
Range — low, high -9999 to +9999
Limits — low, high -9999 to +9999

Alarm Limits (on deviation)
Low, high 0 to 9999 with hysterisis of ½% of setpoint span.

Input Filter Range (all inputs)
0 to 99.99 sec (first order).

Control Output
0 to 99 99% = 0-10V or 4-20mA (Ch1)
Limits — low, high — 0 to 99.99%.
Polarity — inverse output mode switch selectable.
Raise/lower rate in manual — 0 to 99.99% in 10 sec with accelerating action.

Proportional Band Range
0 to 999.9%.

Integral Time Constant Range
0 04 to 99.99 sec. or 0.01 to 99.99 min.
0 = off.

Derivative Time Constant Range
0.04 to 99 99 sec or 0.01 to 99 99 min
0 = off.

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
550mA without hand-held terminal.
650mA 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.

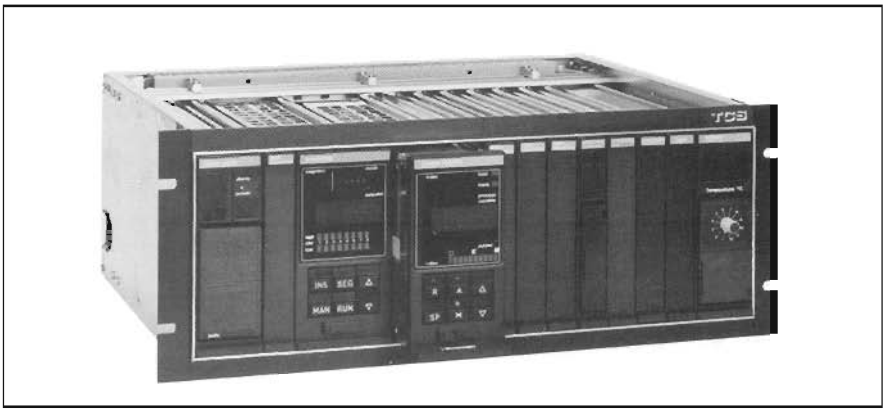
Memory Standby Battery
3 5V Lithium type.
500mAh rating.
8-10 year shelf life.
5 year life minimum on continuous standby.

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 6353 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 6353s can also be supplied.



7900 powered sleeves

The powered sleeve allows a 6353 to be mounted with a mains power unit. This is incorporated in the associated 7353 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:

6353 Single loop microprocessor based Flow controller technical manual.

6353 Facts Card.

7353 Flow Controller rear termination assembly

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

TCS
Advanced Instrumentation

Turnbull Control Systems Limited
Broadwater Trading Estate
Worthing, Sussex, BN14 8NW
Telephone: Worthing (0903) 205277 Telex: 87437

HA075413U001
Issue 2/1 Oct 1983