



bushing/  
averaging controller



system  
6000  
**6352**



product  
specification

## 3-term bushing/averaging controller: Features

- High accuracy and reliability.
- No options.
- All controllers are identical.
- Single loop integrity.
- Built-in diagnostic routines.
- PID with setpoint depression and ramp.
- Averaging of two measured variables.
- Multiple output limits for cold bushing protection.
- Microprocessor technology and solid state displays.
- Remote monitoring and supervision via a simple serial link.
- Two-year warranty.
- Fully compatible with the TCS range of instrumentation.

## Description

The 6352 single loop process controller combines the flexibility of modern microprocessor technology with the integrity associated with conventional analogue instruments.

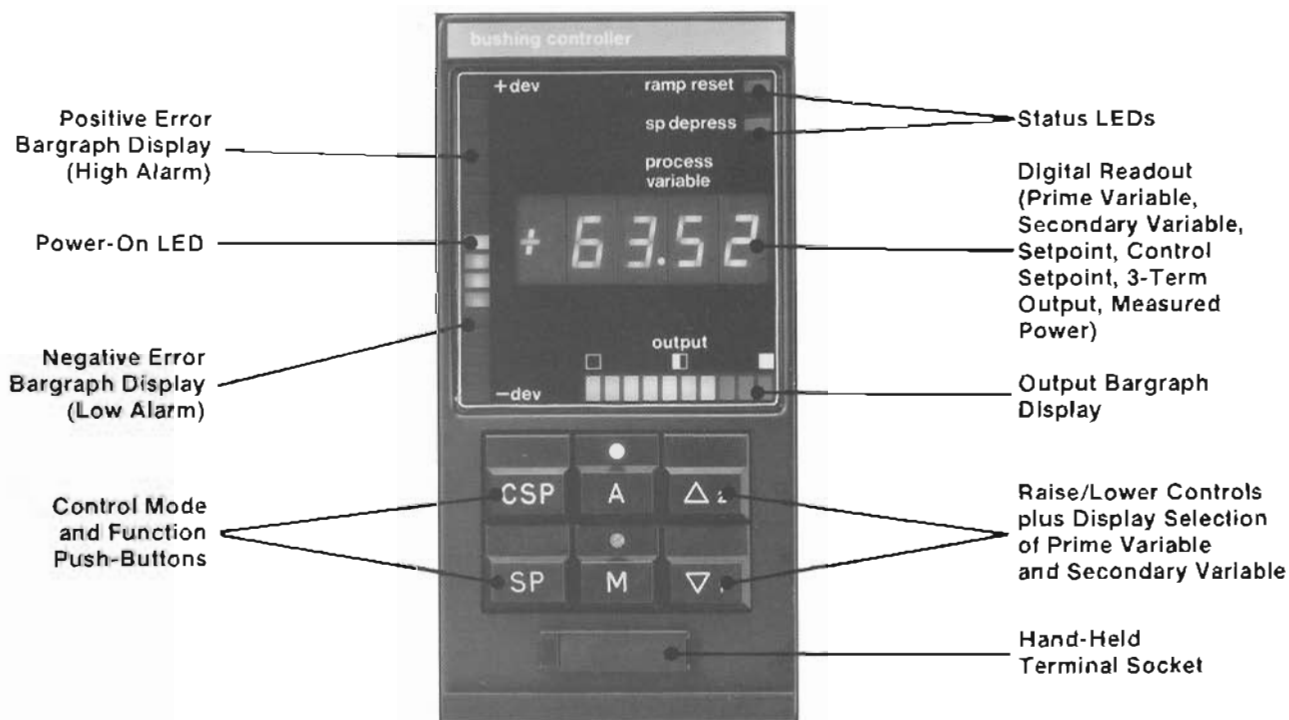
A microprocessor is incorporated in every 6352 enabling a user to characterise each device for the application using a simple plug in hand-held terminal. As the loop characteristics are defined by easily changed parameters, all 6352 controllers are identical and interchangeable. Use of the terminal ensures security of the settings which are retained indefinitely when the device is powered and for at least five years if unpowered.

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 6352 interfaces to 4-20mA signals from plant mounted equipment or 0-10V signals from System 6000 signal conditioners and output drivers.

A programmable setpoint depression and ramp actuated via digital inputs permits a temperature profile during production cycle. Two measurements are averaged or selected for highest/lowest before control action. 5 programmable output limits, limit output demand over different measurement ranges

Each controller has a suite of input linearisation routines. Custom linearisation may be provided at an additional cost. The 6352 generates a control output and 0-10V signals representing the linear process variable and the setpoint or deviation.

Supervision and monitoring of the 6352 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 6352s 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.



## Operator displays and controls

### Operator displays

#### Digital Readout

(for PV1, PV2, control 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 user selected 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

2 yellow rectangular LEDs to indicate ramp reset and setpoint depression 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 ( $\Delta$ ) increments the output when (M) is pressed, or increments the setpoint when (SP) is pressed. Lower ( $\nabla$ ) decrements the output when (M) is pressed, or decrements the setpoint when (SP) is pressed.

#### Display Selection

2 non-illuminated push-buttons: (SP) and (CSP) cause the digital readout to display the current setpoint or control setpoint while pressed.

**NOTE:** Pressing the (M) or (A) buttons causes the digital readout to display the current output level or measured power. Pressing  $\nabla$  or  $\Delta$  alone causes PV1 or PV2 to be displayed.

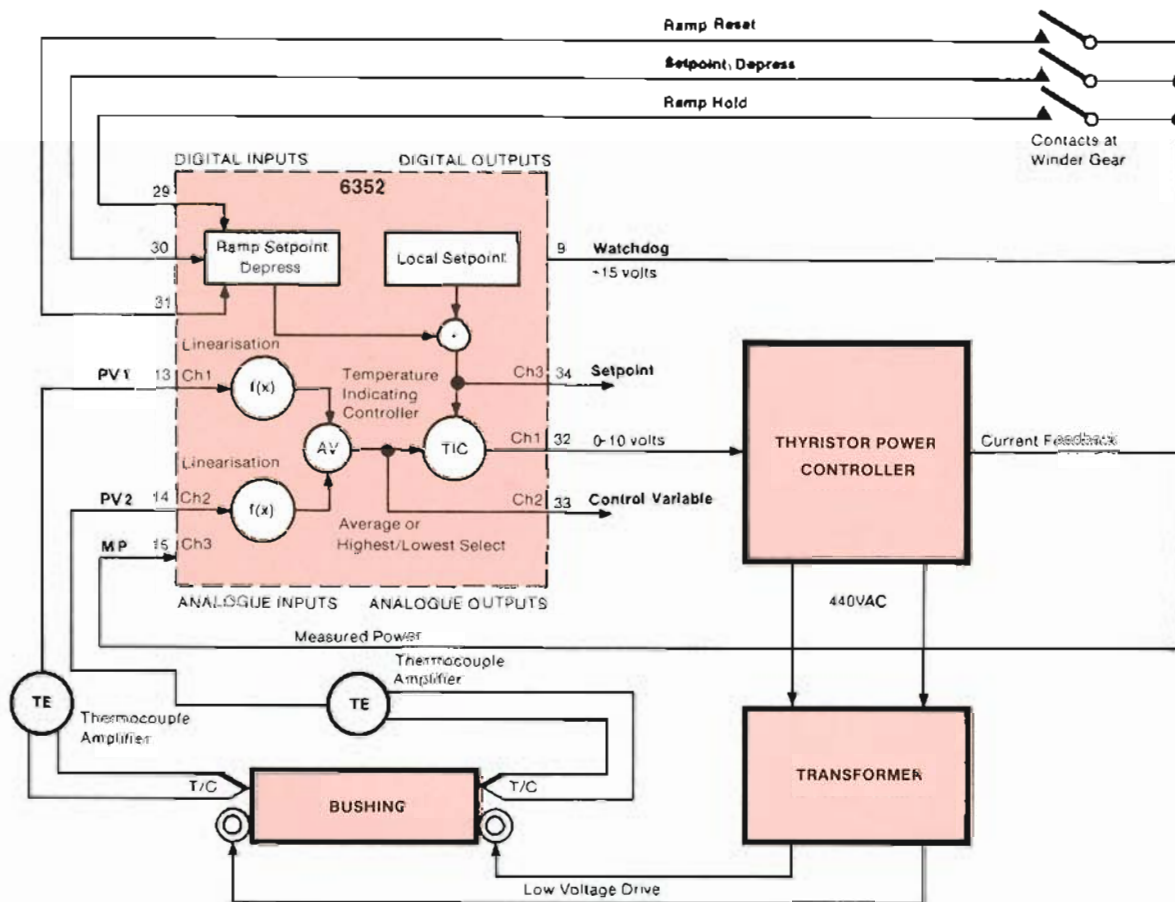
# Application

The features of the 6352 were developed primarily to meet the needs of the glass fibre bushing. The setpoint depression allows the bushing temperature to be reduced whilst the winder is not running. The setpoint ramp compensates for the

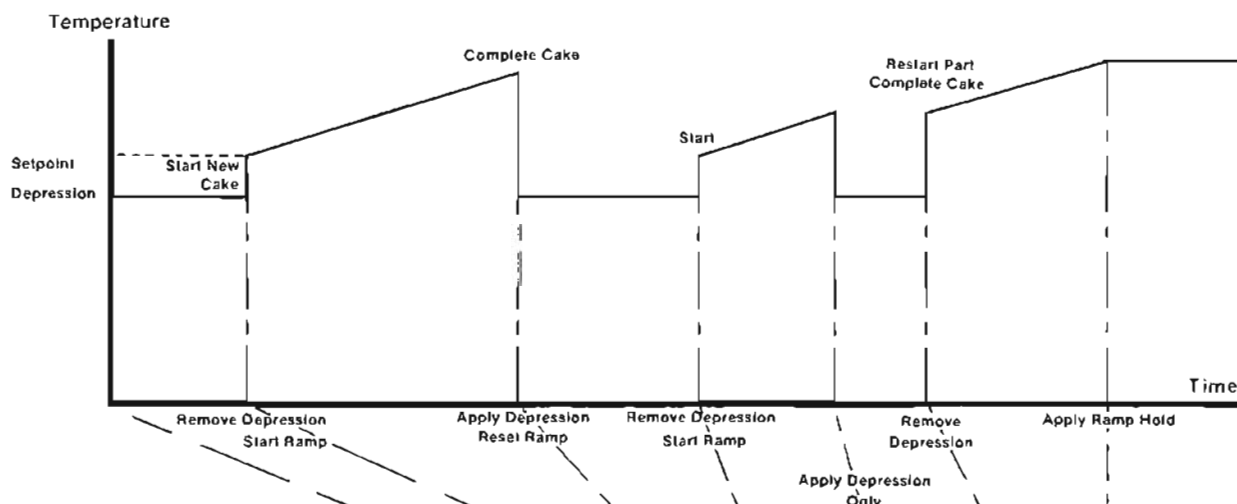
increase in fibre speed as the size of cake increases. The output limits provide protection to the bushing at low temperatures by limiting the current demand.

Each of these features may be selected individually or in any

combination, hence the 6352 has been applied to other processes and industries:  
i.e. Fermentation — Average control  
Furnace control — Ramp.



Typical Bushing Control System



|                       |             |      |      |      |      |      |      |          |
|-----------------------|-------------|------|------|------|------|------|------|----------|
| Ramp Hold             |             | +15V | +15V | +15V | +15V | +15V | +15V | 0V       |
| Set Depression Enable |             | 0V   | +15V | 0V   | +15V | 0V   | +15V | +15V     |
| Ramp Reset            |             | 0V   | +15V | 0V   | +15V | +15V | +15V | +15V     |
| Panel LED Indication  | Set Depress | ON   | OFF  | ON   | OFF  | ON   | OFF  | OFF      |
|                       | Ramp Reset  | ON   | OFF  | ON   | OFF  | OFF  | OFF  | FLASHING |

Typical Temperature Profiles Available

# 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

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



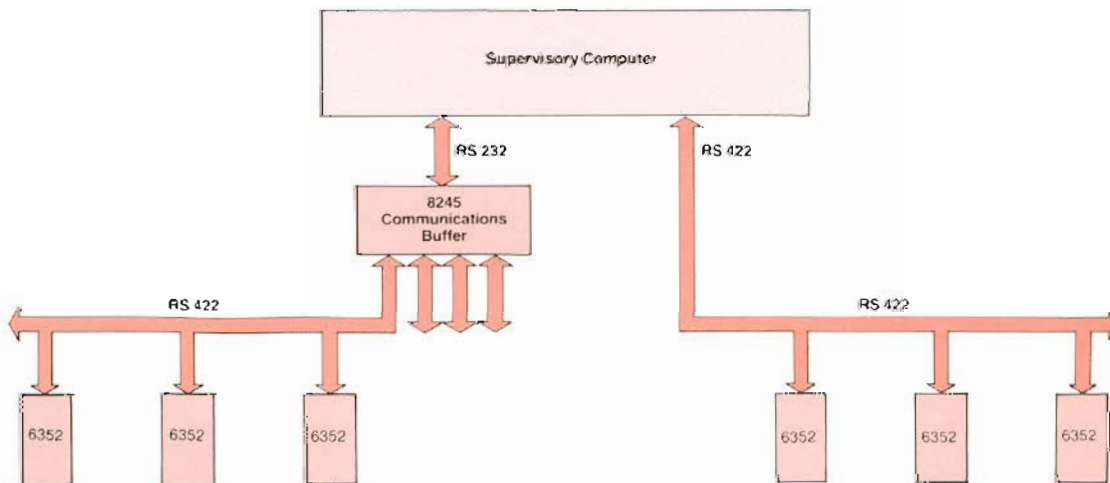
The photograph shows an 8260 terminal plugged into the front panel of a 6352 controller. A full list of the available command parameters is given in the 6352 Facts Card.

## 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 6352 controller. To hook the 6352 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 6352 becomes part of the distributed control system. The illustration

shows how an array of 6352s 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 96000 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

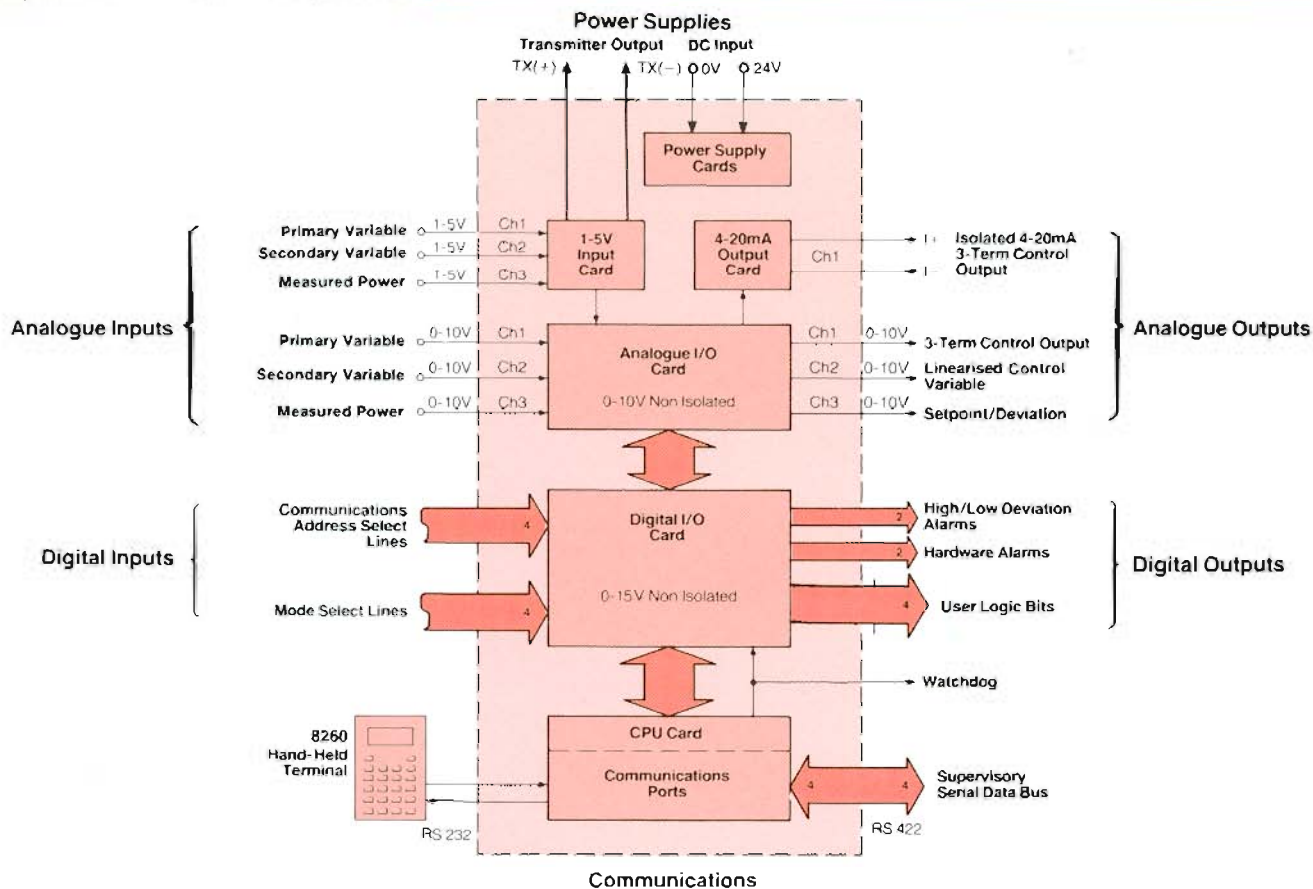
All microprocessor based instruments in the System 6000 range employ a standard ANSI protocol known as BI-SYNCH. The exact form of BI-SYNCH implemented within System 6000 corresponds with the American National Standard specification:

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=Primary Variable input  
 Channel 2=Secondary Variable input.  
 Channel 3=Measured Power or trim input.

### 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 (.250%) hardware applied to inputs.  
 15 bit binary representation obtained after digital input filtering and signal averaging giving resolution of 1 digit in  $\pm 9999$ .

### Accuracy

$\pm 1$  LSB max. over 0-50°C range for hardware  
 $\pm 1$  digit of reading for 0-4000 range,  
 $\pm 2$  digits of reading for 0-8000 range,  
 $\pm 3$  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

1M $\Omega$  pull-down to -5V on channel 1.  
 1M $\Omega$  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 = Control 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

$\pm 1$  LSB max. over 0-50°C range.

### Isolated Output Accuracy

$\pm 0.5\%$  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  
 $\frac{1}{2}$ mV/sec maximum (equivalent to 1% of full scale in 3 minutes).

### Output Drive Capability

$\pm 5$ mA for direct voltage outputs.

### Isolation Voltage

$\pm 50$ V minimum with respect to system ground

## Digital inputs

### Number of Inputs

8 external non-isolated inputs.

### Inputs Functions

4 communications unit address select lines.  
 4 mode select lines.

### Input Voltage Levels

15V = logic one.  
 0V = logic zero.

### Input Impedance

100k $\Omega$  pull-down to 0V (gives 150 $\mu$ A logic one current).

## Digital outputs

### Number of Outputs

8 external non-isolated outputs plus watchdog.

### Output Functions

2 deviation alarms.  
 2 hardware alarms.  
 4 user logic bits.

### Output Voltage Levels

15V = logic one.  
 0V = logic zero.

### Output Drive Capability

2k $\Omega$  open-collector pull-up to +15V supply, maximum logic zero sink current = 16mA.

## 3-term control characteristics

### Algorithm Sampling Period

36ms to 0.16mins dependent upon integral and derivative times.

### Setpoint

Range — low, high, —9999 to +9999.  
Limits — low, high, —9999 to +9999.

### Setpoint Depression

Range as per Setpoint.

### Ramp

Range 0.000 to 9.999/sec. or min.

### Output Limits

Range 00.00 to 99.99%,  
0-15%, 15-30%, 30-50%, 50-75%,  
75-100% PV span.

### Alarm Limits (on deviation)

low, high, 0 to 9999 with hysteresis of  
 $\frac{1}{2}\%$  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 Fuse Rating

2A.

### Input Current

550mA without hand-held terminal.

650mA with hand-held terminal.

### Power Failure Detect Threshold

When input voltage falls below 16.5  
 $\pm 0.5V$ .

### Remote Transmitter Supply

26V  $\pm 1.5V$  at 4mA output

30V  $\pm 0.5V$  at 20mA output.

$\pm 50V$  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 6352 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 6352s can also  
be supplied.



## 7900 powered sleeves

The powered sleeve allows a 6352 to  
be mounted with a mains power  
unit. This is incorporated in the  
associated 7352 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:

6352 Single loop microprocessor  
based controller technical manual.

6352 Facts Card.

7352 Process Controller rear  
termination assembly.

7900 Single or multi-way sleeve

assembly for microprocessor based  
instrumentation.



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