

394 MODEL



Annotating Circular Recorder Specification Sheet


Ideal for

- Boilers
- Water and waste water

Features

- Single chart view of selected recording period
- Controller and programmer
- Chart annotation
- Electronic data archiving
- Modbus communications
- Universal input channels

The 394 is a clear step forward in circular trending technology. The optional MODBUS RTU protocol ensures compatibility with standard SCADA software and other industrial instrumentation. Four colour printing together with annotation produces a clear and easy to read chart including printed text of channel values, time, date, scales and totaliser values. The unit is fully configurable from the front panel or via the optional PC card reader. Up to two PID controllers can be added enabling the 394 to control as well as record the process. A host of software and hardware options allows the 394 to exactly fit the requirements of your application.

Available features	 394
Display	Digital
Channels	6
Relays	Up to 18
Annotation	Standard
Chart diameter	10"
Retransmission	Up to 4
Modbus communications	Modbus RTU slave, EIA485
Memory card	PCMCIA Type I (SRAM)
Math	16 channels
PC Configuration	Configuration Editor
Transmitter power supply	Up to 6 channels
PID Control	Up to 2

Input technology

Use of the very latest in Application Specific Integrated Circuit (ASIC) and Surface Mount technologies, gives the 394 input circuitry high accuracy and stability. Inputs are fully universal accepting signals from thermocouples, resistance thermometers, potentiometers and digital sources, as well as linear dc voltage and current sources.

Annotation

The use of a multi-point printhead provides the 394 with the ability to print text on the chart including channel values, time, date, scales and totaliser values.

Display

The 394 display consists of a 20-character vacuum fluorescent display and alarm indicators.

Control

Two independent controllers can be case mounted to provide PID control of related process variables.

Configuration

The recorder is fully configurable from the front panel using push-button keys to follow a series of text prompts at the display. Access to most functions can be password protected as a part of the configuration process.

The recorder can also be configured from a PC based package, allowing the user to set up the configuration off-site for later downloading to the recorder.

PC-Card Storage

Using the computer industry standard type 1 SRAM PC-card, the recorder's configuration can be stored for transfer to another recorder or to a PC for manipulation using the PC configuration tool. Process data can also be stored on the PC-card in a format readable by standard spreadsheet packages, or, alternatively in a compressed format that can be used with the Eurotherm Review Software, a Windows based package for viewing and printing charts.

Maths, Timers, Counters and Totalisers

These options provide the recorder with integrating and counting facilities, and the ability to carry out calculations ranging from simple arithmetic functions (e.g. subtracting one channel's value from another) to complex application specific functions such as Mass Flow calculations.

MODBUS Communications

The communications option uses the MODBUS RTU protocol to ensure compatibility with standard SCADA software and other types of industrial equipment such as PLCs (the 394 acts as a slave device). The EIA485 specification allows multiple instruments on a single communications link.

Relay Outputs

Up to 18 relay outputs can be fitted, driven by any internal recorder event such as channel alarm, totaliser overflow, totaliser output etc.

Analogue Outputs

Up to four of the input or maths channels can be output as a linearised current or voltage signal.

Transmitter Power Supply

Up to six current loops can be powered by a built-in 25 Volt dc power supply unit which is suitable for most loops.

SPECIFICATION

Recorder

Board types and hardware options

Standard: Universal input / control board
Options: Changeover relay output board
Analogue output board
Communications board
Transmitter Power Supply
PID controller
PC Card

Environmental performance

Temperature limits Operation: 0 to 50°C (options can reduce maximum temp.)
Storage: -20 to +70°C

Humidity limits

(non-condensing): 10 to 90%

Protection: Standard: NEMA3 (IP54)

Waterproof: NEMA4 (IP65)

Shock: BS EN60873 and BS EN61010

Vibration (BS EN60873): 1g peak at 60 Hz to 150Hz

Altitude (max.): <2000 metres

Electromagnetic compatibility (EMC)

Emissions: BS EN50081-2

Immunity: BS EN50082-2

Electrical safety (BS EN61010)

Installation cat. II; Pollution degree 2

Physical

Bezel size: 360mm H x 380mm (When viewed from the front, offset 5mm right with respect to cutout centreline).

Panel cutout dimensions: 340.5mm H x 345mm W (both - 0 + 1 mm)

Depth behind bezel rear face: 150 mm

Weight: 7 kg (typical)

Panel mounting: +5 to -30 degrees from vertical (+ = top overhangs)

Printing system

Pen type: Four colour cartridge

Trace resolution Lateral: 0.2 mm
Time: 0.36mm at outer edge of chart

Default trace colours: See table 5

Printhead life Channel: 1.5 x 10⁶ dots black
1.0 x 10⁶ dots (other colours)

Update rate: 2 Hz (1 Hz for complex configurations)

Print rate (max): 1 pass every 5 seconds

Text characters per line: 39

Channel	Colour	Channel	Colour
1	blue	4	black
2	red	5	blue/red
3	green	6	green/black

Table 5 Trace colours

Paper transport

Type: Stepper motor

Chart type: Circular

Chart speeds Menu selectable: 12, 24, 48, 72 hours or 7 days/rev.

User enterable: 1 to 960 hours/rev

Power requirements

Line voltage Standard: 90 to 264V at 45 to 65 Hz.

Low voltage option: 20 to 53 V ac/dc
(ac frequency range: 45 to 400 Hz)

Power requirements (continued)

Power (Max):	< 100 VA (20VA typical)
Fuse type:	Not user servicable
Interrupt protection	Standard: 40 ms at 75% max. instrument load
	Enhanced: 120 ms at 75% max. instrument load

Options

Serial Communications

Type:	EIA 485 MODBUS® RTU
Isolation†:	Terminals to ground 100V RMS/dc (basic insulation)

Maths pack

Number of derived channels:	16
Level 1 functions:	Off, constant, add, subtract, multiply, divide, modulus.
Level 2 functions (additional to level 1):	See table 6

Channel average	DV group continuous min.	Sample and hold	Zirconia probe
Channel minimum	DV group latching max.	Square root	High select
Channel maximum	DV group continuous max.	3rd order polynomial	Low select
Rolling average	e_x	Fvalue	Switch
Rate of change	\log_n	Relative humidity	Stopwatch
DV group average	10_x	Linear mass flow	Time stamp
DV group latching min.	\log_{10}	Square root mass flow	O2 correction
			Percentile

Table 6 Level two maths functions

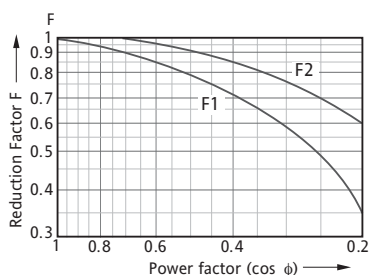
Customer linearisation tables

N° of tables available:	One
N° of point pairs :	32

Relay outputs

Maximum switching power*:	500VA or 60W
Maximum breaking current*:	2 Amps within above power ratings
Maximum contact voltage*:	250V within above power ratings
Isolation†	Contact to contact: 300V RMS or dc (double insulation)
	Contact to ground: 300V RMS or dc (basic insulation)

Estimated life with resistive loads*:



* With inductive loads, derate according to the graph, in which: contact life = resistive life x F1 or F2 where F1 = measured on representative examples and F2 = typical values according to experience.

Analogue (retransmission) outputs

Output ranges (user configurable)	
	Voltage: 0 to 10V (Source 6.3mA max.)
	Current: 0 to 20mA (max. voltage drop = 18V)
Update rate:	1Hz
Step response 910% to 90%:	250msec
Linearity (maximum error):	0.02% of hardware range
Performance:	See table 7
Isolation†	Channel to channel: 300V RMS or dc (double insulation)
	Channel to ground: 300V RMS or dc (basic insulation)

Range		Error at 20 °C	Temperature coefficient (per °C)
0 to 10 V	Typical	5.7mV + 0.08% of output	100 μ V/°C + 50ppm/°C of output
	Max	11.7mV + 0.18% of output	300 μ V/°C + 70ppm/°C of output
0 to 20mA	Typical	15.3 μ A + 0.11% of output	0.2 μ A/°C + 50 ppm/°C of output
	Max	30.5 μ A + 0.21% of output	1 μ A/°C + 80 ppm/°C of output

Table 7 Analogue output performance

Transmitter Power Supply

Output voltage:	3 or 6 x 25Vdc (nom) outputs
Isolation†	Channel to channel: 100V RMS or dc (double insulation)
	Channel to ground: 100V RMS or dc (basic insulation)

Controllers

Number:	Up to 2
Type:	Eurotherm type 2216 PID temperature controllers

Input board

General

INSTALLATION CATEGORY II
The rated impulse voltage for equipment on nominal 230V mains is 2300V.
POLLUTION DEGREE 2
Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

Input types:	dc Volts, dc millivolts, dc milliamps (with shunt)
	Thermocouple, 2 / 3-wire RTD
	Contact closure (not channel 1) >500ms
Input type mix:	Freely configurable
Maximum number of inputs:	6
Input ranges:	-38 to +38mV; -150 to +150mV; -1V to +1V; -10 to +10mV

Termination:	Terminal block
Noise rejection (48 to 62Hz)	Common mode: >130dB (channel to channel and channel to ground)
	Series mode: 60dB

Maximum common mode voltage:	250 Volts continuous
Maximum series mode voltage:	45mV at lowest range; 12 Volts peak at highest range

Isolation (dc to 65Hz; BS EN1010):	Installation cat. II; pollution degree 2
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Channel-to-channel electronics:	300V RMS or dc (double insulation)
Channel-to-common electronics:	300V RMS or dc (double insulation)
Channel-to-ground:	300V RMS or dc (basic insulation)

Eielectric strength (BS EN61010): (1 minute type tests.)

Channel to channel:	2300 Vac
Channel to ground:	1350 Vac

Insulation resistance: >10 m Ω at 500 Vdc

Input resistance:	38mV, 150mV
	1V ranges: >10 M Ω ;
	10V range: 68.8k Ω

Over voltage protection (max): 42V RMS (between I and V-); 50V RMS (I and V+) or (V+ and V-)

Open circuit detection drive:	\pm 57 nA max.
Recognition time:	500 msec
Minimum break resistance:	10 M Ω

DC Input ranges

Stunt/Attenuator:	Internally mounted resistor modules
Additional error due to shunt:	0.1% of input

Additional error due to attenuator:	0.2% of input
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Leakage current (max)	38mV range: 1.7nA
	Other ranges: 8nA

Performance: See table 1

Range	Resolution	Error at 20 °C		Temperature coefficient (per °C)
± 38 mV	1.4 µV	Typical	0.035% input + 0.030% range	37 ppm input + 1.03 ppm range
		Max	0.085% input + 0.051% range	80 ppm input + 18.6 ppm range
± 150 mV	5.5 µV	Typical	0.035% input + 0.027% range	35 ppm input + 0.52 ppm range
		Max	0.084% input + 0.038% range	80 ppm input + 7.8 ppm range
± 1 V	37 µV	Typical	0.035% input + 0.024% range	35 ppm input + 0.16 ppm range
		Max	0.084% input + 0.029% range	80 ppm input + 1.6 ppm range
± 10 V	370 µV	Typical	0.076% input + 0.024% range	76 ppm input + 0.35 ppm range
		Max	0.275% input + 0.030% range	272 ppm input + 3.5 ppm range

Table 1 DC performance

Thermocouple data

Temperature scale: ITS 90
 Bias current (maximum): 1.7 nA
 Cold junction types: Off, internal, external, remote
 CJ error: 1°C max; instrument at 20°C
 CJ rejection ratio: 50:1 minimum
 Remote CJ: Via any user-defined channel
 Upscale / downscale drive: High. Low or None selectable for each thermocouple channel. Channels can be any max of high and none or Low and none, but High and low cannot be mixed.
 Types and ranges: See table 2

TC Type	Overall range (°C)	Standard	Max linearisation error
B	0 to +1820	IEC 584.1	0 to 400°C: 1.7°C 400 to 1820°C: 0.03°C
C	0 to +2300	Hoskins	0.12°C
D	0 to +2495	Hoskins	0.08°C
E	-270 to +1000	IEC 584.1	0.03°C
G2	0 to +2315	Hoskins	0.07°C
J	-210 to +1200	IEC 584.1	0.02°C
K	-270 to +1372	IEC 584.1	0.04°C
L	-200 to +900	DIN 43700:1985 (To IPTS68)	0.20°C
N	-270 to +1300	IEC 584.1	0.04°C
R	-50 to +1768	IEC 584.1	0.04°C
S	-50 to +1768	IEC 584.1	0.04°C
T	-270 to +400	IEC 584.1	0.02°C
U	-200 to +600	DIN 43710:1985	0.08°C
Ni/NiMo	0 to +1406	Ipsen	0.14°C
Platinel	0 to +1370	Ingelhard	0.02°C

Table 2 Thermocouple types and ranges

Resistance inputs

Temperature scale: ITS 90
 Ranges (including lead resistance): 0 to 150Ω, 0 to 600Ω, 0 to 6kΩ
 Influence of lead resistance
 Error: Negligible (3-wire connection)
 Mismatch: 1Ω/Ω
 Wetting current: 250µA typical
 Resolution and accuracy: See table 3
 RTD types and ranges: See table 4

Range (Ω)	Resolution	Error at 20 °C		Temperature coefficient (per °C)
0 to 150	5mΩ	Typical	0.030% input + 0.047% range	20 ppm input + 2.04 ppm range
		Max	0.045% input + 0.141% range	35 ppm input + 36.6 ppm range
0 to 600	22mΩ	Typical	0.030% input + 0.036% range	20 ppm input + 0.97 ppm range
		Max	0.045% input + 0.069% range	35 ppm input + 14.6 ppm range
0 to 6k	148mΩ	Typical	0.034% input + 0.026% range	20 ppm input + 0.19 ppm range
		Max	0.049% input + 0.032% range	35 ppm input + 1.9 ppm range

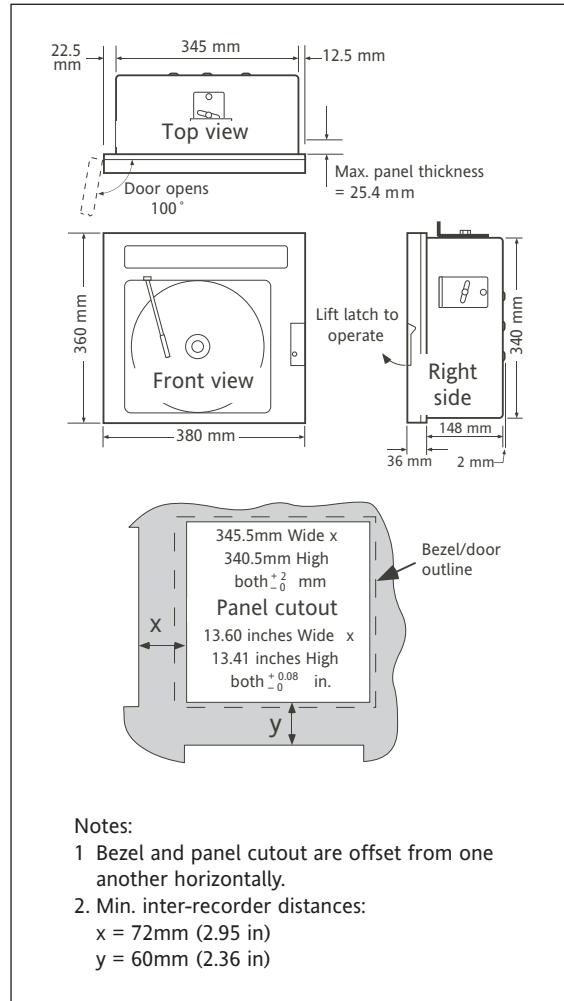
Table 3 Resistance ranges resolution and accuracy

RTD Type	Overall range (°C)	Standard	Max linearisation error
Cu10	-20 to + 400	General Electric Co.	0.02 °C
JPT100	-220 to + 630	JIS C1604:1989	0.01 °C
Ni100	- 60 to + 250	DIN43760:1987	0.01 °C
Ni120	-50 to + 170	DIN43760:1987	0.01 °C
Pt100	-200 to + 850	IEC 751	0.01 °C
Pt100A	-200 to + 600	Eurotherm Recorders SA	0.09 °C
Pt1000	-200 to + 850	IEC 751	0.01 °C

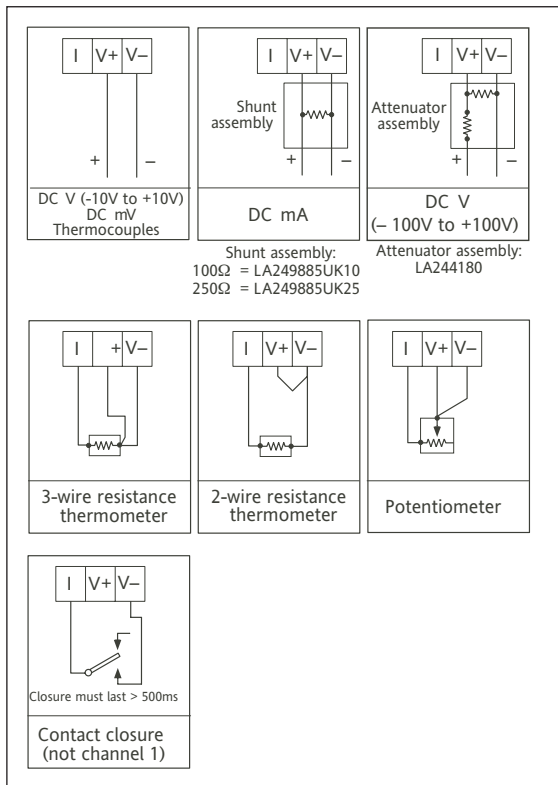
Table 4 RTD types, ranges and accuracies

† All isolation figures are: DC to 65Hz; BS EN61010 Installation category II; pollution degree 2

DIMENSIONS



INPUT BOARD SIGNAL WIRING



ORDER CODE

394	1 6	2	3	4	5	6	7	8	9 X	10	11	12
13 X	14	15	16	17	18 X	19	20	21	22 X	23	24 X	25
26 X	27 X	28 3	29 X	30 X	31 X	32 X	33	34	35 1	36 X	37	38
39 X	40 X	41	42 E									

Basic Product
394 Circular Recorder

1 No. of Channels
6 6 Channels

2 Operating Voltage
1 90-264V ac (50-60Hz)
2 24-48V ac/dc 45-400Hz

3 Input Channel 1 (note 1)
0 None (I/P card not fitted)
1 Universal V, mV, TC, RTD
2 10V to 100V dc (inc 100:1 att)
3 4 to 20mA (inc 250 ohm shunt)

4 Input Channel 2 (note 1)

5 Input Channel 3 (note 1)

6 Input Channel 4 (note 1)

7 Input Channel 5 (note 1)

8 Input Channel 6 (note 1)

9 Fixed Digit

10 O/P Changeover Relays (note 2)
0 None
6 Six (one card)
B Twelve (two cards)
E Eighteen (three cards)

11 Controller One (note 3)

12 Controller Two (note 3)
0 None
1 2216 relay (R1/XX)
2 2216 triac (T1/XX)
3 2216 mA (D3/XX)
4 2216 relay/triac (R1/R1)
5 2216 relay/triac (R1/T1)
6 2216 triac/triac (T1/R1)
7 2216 triac/triac (T1/T1)
8 2216 mA/triac (D3/R1)
9 2216 mA/triac (D3/T1)

14 Case Style
0 IP54 Panel mounting
1 IP54 Pipe mounting
2 IP65 Panel mounting
3 IP65 Pipe mounting
4 IP65 Panel mount + stainless steel
5 IP65 Pipe mount + stainless steel

15 Door Lock
0 None
1 Door lock

16 Transducer Power Supply
0 None
1 3 chs, 120V ac supply
2 3 chs, 240V ac supply
6 6 chs, 120V ac supply
7 6 chs, 240V ac supply

17 Totalisers, Timers & Counters (note 4)
0 None
2 Two totalisers
4 Four totalisers
6 Six totalisers
C Six timers & six counters
T Six totalisers, timers & counters

19 Customer Curve
0 None
1 32 point pairs

20 Derived (Maths) Channels
0 Maths pack not fitted
1 Basic maths pack fitted
2 Advanced maths pack fitted
3 Adv maths pack & exp disp

21 Analogue Retransmission (note 2)
0 None
4 4 channel O/P (1 card)

23 Digital Communications (note 2)
0 None
1 Modbus RTU

25 Window Material
0 Glass
1 Acrylic

26 Fixed Digit

27 Fixed Digit

28 Certifications
3 CE-European standards

29 Fixed Digit

30 Fixed Digit

31 Fixed Digit

32 Fixed Digit

33 PC Card Driver
0 None
A ASCII logging
C Config save & restore
P Packed data logging

34 Memory Card
0 None
3 2 Mb PC card
5 6 Mb PC card

35 Custom Message
1 20 messages (20 Character)

36 Fixed Digit

37 Customer Logo (Door Label)
01 Eurotherm English

38 Additional Information
0 None
3 Customer inspection
4 Calibration Cert 1 Ch
5 Calibration Cert 2 Chs
6 Calibration Cert 3 Chs
7 Calibration Cert 4 Chs
8 Calibration Cert 6 Chs

40 Fixed Digit

41 Chart Supplied with Instrument (Note 5)

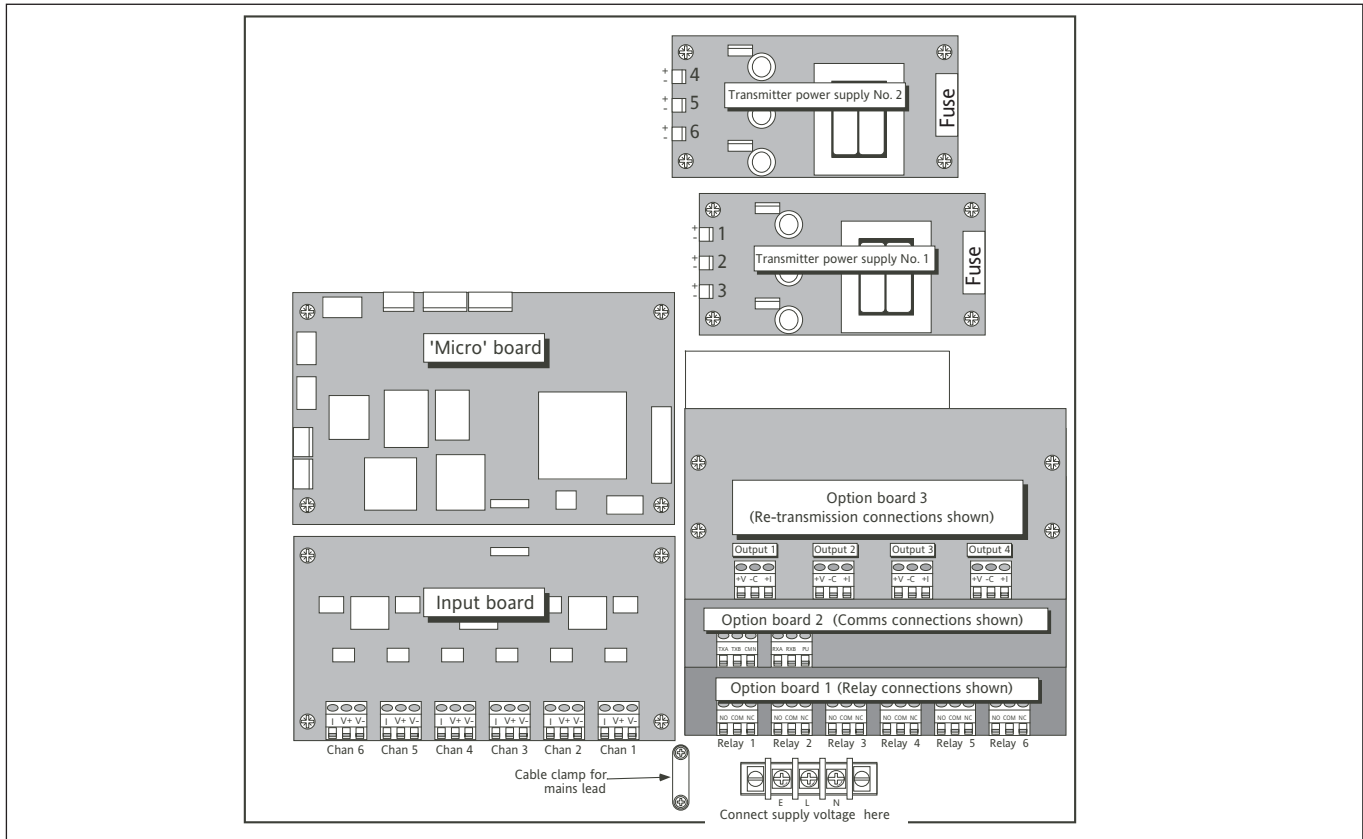
SV0394U050	7 Day, 50 Div
SV0394U060	7 Day, 60 Div
SV0394U070	7 Day, 70 Div
SV0394U080	7 Day, 80 Div
SV0394U090	7 Day, 90 Div
SV0394U100	7 Day, 100 Div
TW0394U050	24 Hour, 50 Div
TW0394U060	24 Hour, 60 Div
TW0394U070	24 Hour, 70 Div
TW0394U080	24 Hour, 80 Div
TW0394U090	24 Hour, 90 Div
TW0394U100	24 Hour, 100 Div

42 Installation Operation Manual
E English

Notes:

- Inputs MUST be selected in order (e.g. you cannot specify inputs 1 and 3 and enter '0' for input 2). Any universal input can be configured for TC, RTD, mV dc and V dc directly. Inputs are specified as 4-20mA are universal inputs with a 250ohm shunt resistor provided. Inputs specified as 5V to 100 V dc are universal inputs fitted with a 1M ohm voltage divider. Channel 1 CANNOT be configured to respond to a contact closure.
- There are THREE option card positions. A relay card takes one position, communications card takes one position, controllers use one position.
- PID control with 85-264V ac power supply and 1 or 2 outputs as selected requires 1 option slot.
- Totalisers (integrators) are user assignable to any input or derived (math) channel.
- One pack of 100 charts is included as standard. Other charts WITH AND WITHOUT RANGE PRINTING are available, consult the factory for further information.

ELECTRICAL INSTALLATION



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394 Specification Sheet



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