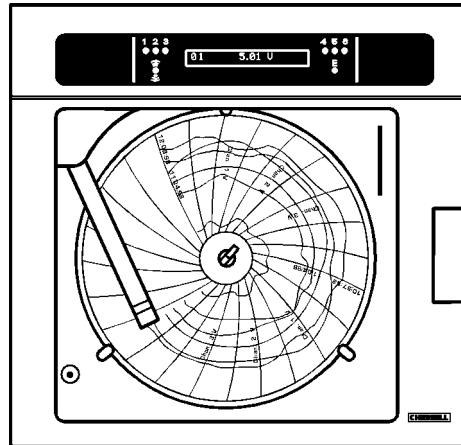- 1 to 6 Universal inputs
- Annotation as standard
- 1 or 2 independent
        case-mounted PID controllers
- Front panel or PC configuration
- PC Card storage
- Maths functions
- Totalisers, Counters and Timers
- MODBUS® Communications
- Up to 18 relay outputs
- Up to four analogue outputs

The 394 is a step forward in circular chart recording, tracing up to six signals by using printhead technology common to other successful Eurotherm Recorders Products.

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 contol 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 RS485 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.

TECHNICAL SPECIFICATION (Input board)

General

Input types	dc Volts, dc millivolts,
	dc milliamps (with shunt),
	Thermocouple,
	2 / 3-wire RTD
	Contact closure (not chan. 1) >500ms
Input type mix	Freely configurable.
Maximum number of inputs	6
Input ranges	-38 to + 38 mV;
	- 150 to +150 mV;
	-1V to + 1 V;
	-10 to + 10 V
Termination	Terminal block
Noise rejection (48 to 62 Hz)	Common mode: >130dB (channel to
	channel and channel to ground).
	Series mode: >60dB.
Maximum common mode voltage	250 Volts continuous
Maximum series mode voltage	45 mV at lowest range;
	12 Volts peak at highest range.
Isolation (dc to 65 Hz; BS EN61010)	Installation cat. II; Pollution degree 2
Channel - to - channel:	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)
Dielectric strength (BS EN61010)	(1 minute type tests.)
Channel to channel	2300 Vac
Channel to ground	1350 Vac
Insulation resistance	>10 MΩ at 500 V dc
Input resistance	38mV, 150 mV, 1 V ranges: >10 MΩ;
	10 V range: 68.8 kΩ
Over voltage protection (max)	42V RMS (between I and V-);
	50V RMS (I and V+) or (V+ and V-)
Open circuit detection drive	± 57 nA max.
Recognition time	500 msec
Minimum break resistance	10 MΩ

DC Input ranges

Shunt/Attenuator	Internally mounted resistor modules
Additional error due to shunt	0.1% of input
Additional error due to attenuator	0.2% of input
Leakage current (Max) 38mV range:	1.7nA
Other ranges:	8nA
Performance	See table 1

Range	Res-olution		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

Input board specification (Cont.)

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 mix of High and None or Low
	and None, but High and Low cannot be
	mixed.
Types and ranges	See table 2

T/C 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	DIN43700:1985 (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	Engelhard	0.02˚C

Table 2 Thermocouple types and ranges

Resistance inputs

Temperature scale	ITS90
Ranges (including lead resistance)	0 to 150Ω, 0 to 600 Ω, 0 to 6k Ω
Influence of lead resistance Error:	Negligible (3-wire connection)
Mismatch:	1 Ω/Ω
Wetting current	250 µA typical
Resolution and accuracy	See table 3
RTD types and ranges	See table 4

Range (Ω)	Res-olution		Error at 20 ˚C	Temperature coefficient (per ˚C)
0 to150	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

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 tempo-rary conductivity caused by condensation shall be expected.

TECHNICAL 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
		Case heater
		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:	1.5×10^6 dots black
		1.0×10^6 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 (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

TECHNICAL SPECIFICATION (Options)

Serial Communications

Type		RS 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 grp 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*		30,000,000 operations

* 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.
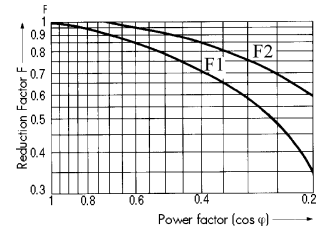
Analogue (retransmission) outputs

Output ranges (user configurable)		
	Voltage:	0 to 10 V (Source 6.3 mA max.)
	Current:	0 to 20mA (max. voltage drop =18V)
Update rate		1 Hz.
Step response (10% 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	100µV/˚C + 50ppm/˚C of output
	Max	11.7mV +0.18% of output	300µV/˚C + 70ppm/˚C of output
0 to 20mA	Typical	15.3µA + 0.11% of output	0.2 µA/˚C + 50 ppm/˚C of output
	Max	30.5µA + 0.21% of output	1 µA/˚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 isolation)

Controllers

Number	Up to 2
Type	Eurotherm type 2216 PID temperature controllers

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

Mechanical installation

Panel cutout
345.5mm Wide x
340.5mm High
both $^{+2}_{-0}$ mm

13.60 inches Wide x
13.41 inches High
both $^{+0.08}_{-0}$ in.

Bezel/door outline

x

y

Notes:
1 Bezel and panel cutout are offset from one another horizontally.
2 Min. inter-recorder distances:
   x = 72mm (2.95 in);
   y = 60mm (2.36 in).

22.5 mm   345 mm   12.5 mm

Top view

Door opens 100ß

Max. panel thickness = 25.4 mm

360 mm.

Front view

Lift latch to operate

Right side

340 mm

380 mm

148 mm

36 mm   2 mm

Electrical installation

Transmitter power supply N…2   Fuse
+ 4
+ 5
+ 6

Transmitter power supply N…1   Fuse
+ 1
+ 2
+ 3

'Micro' board

Input board

Option board 3
(Re-transmission connections shown)

Output 1   Output 2   Output 3   Output 4
+V -C +I   +V -C +I   +V -C +I   +V -C +I

Option board 2 (Comms connections shown)
TXA TXB CMN   RXA RXB FU

Option board 1 (Relay connections shown)
NO CO NC   NO CO NC   NO CO NC   NO CO NC   NO CO NC   NO CO NC
Relay 1   Relay 2   Relay 3   Relay 4   Relay 5   Relay 6

I V+ V-   I V+ V-   I V+ V-   I V+ V-   I V+ V-   I V+ V-
Chan 6   Chan 5   Chan 4   Chan 3   Chan 2   Chan 1

Cable clamp for mains lead

E L N
Connect supply voltage here

Input board signal wiring

| I | V+ | V- |
| + | | − |

DC V (-10V to +10V)
DC mV
Thermocouples

| I | V+ | V- |

Shunt assembly
| + | | − |

DC mA

Shunt assembly:
100 = LA249885UK10
250 = LA249885UK25

| I | V+ | V- |

Attenuator assembly
| + | | − |

DC V
(— 100V to +100V)

Attenuator assembly:
LA244180

| I | V+ | V- |

3-wire resistance thermometer

| I | V+ | V- |

2-wire resistance thermometer

| I | V+ | V- |

Potentiometer

| I | V+ | V- |

Closure must last > 500ms.

Contact closure (not channel 1)