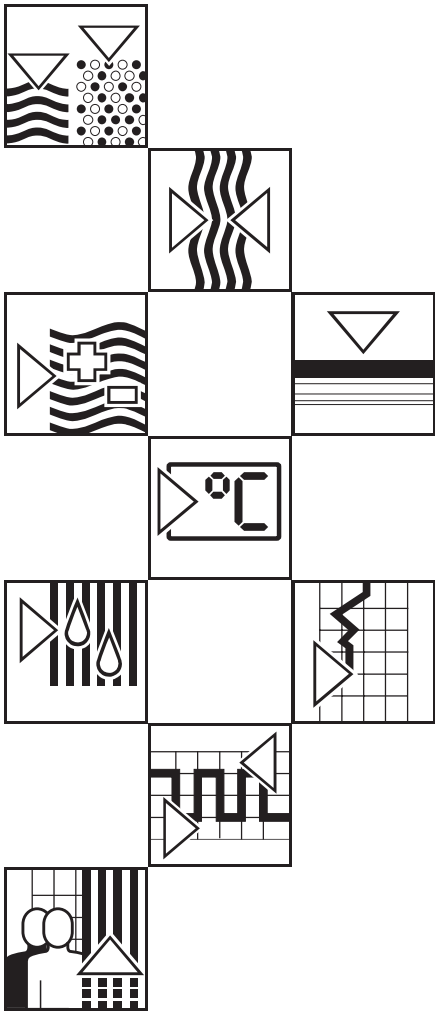
BA 085R/09/en/10.98
No.: 510 00394

Alphanumeric circular chart recorder *circu-log p*

Options



Endress+Hauser

OPTIONS MANUAL

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INSTALLATION CATEGORY AND POLLUTION DEGREE

This product has been designed to conform to BS EN61010 installation category II and pollution degree 2. These are defined as follows:

INSTALLATION CATEGORY II
The rated impulse voltage for equipment on voltages up to 230V ac supply voltage is 2500V. I.E. The equipment is supplied from the fixed installation (IEC664)

POLLUTION DEGREE 2
Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

NOTE

Questions concerning installation, performance or service should be directed to the company from which the instrument was purchased.

1 RELAY OUTPUTS

1.1 INTRODUCTION

The relay output option can have various numbers of relays. A relay board can have two, four or six relays. There can be one, two or three relay boards mounted within the recorder. Each relay has change-over contacts (i.e. common, normally closed and normally open). **In alarm or power off conditions, the common and normally closed contacts are closed.**

1.1.1 Configuration

Alarm types, thresholds etc. are set up as described in the Channel Configuration section of the Installation and Operation manual. Each relevant Process Variable can operate one or more relays using jobs.

JOBS

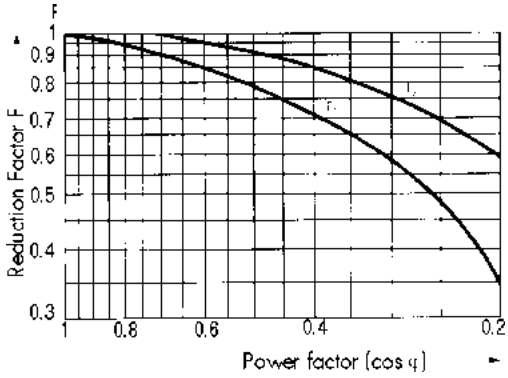
A single job 'Drive relay N of card N' (while active/inactive) is added to the job list shown in Section 4.1 of the installation and operation manual.

1.1.2 Relay specification

The relay specification for resistive loads is given below. Derate with reactive or inductive loads in accordance with figure 1.1.2, in which:

F1 = Actually measured on representative samples
F2 = Typical values (according to experience)
Contact life = Resistive contact life x Reduction factor.

Number of relays per board	*two, four or six*
Estimated life	*30,000,000 operations*
Maximum contact voltage	*250V ac*
Maximum contact current	*2 Amps*
Maximum switching power	*500VA or 60W*



Safety isolation (dc to 65Hz; BS EN61010) Installation category II, Pollution degree 2 (see page 2 for definitions).

Relay to relay:	*300v RMS or dc (double insulation)*
Relay to ground:	*300V RMS or dc (basic insulation)*

Figure 1.1.2 Derating curves

1.2 RELAY WIRING

The following diagrams show user terminations for the relay output board. Where other options are present, they are always mounted 'after' relay boards (i.e. relay boards always have the lowest option board numbers).

1.2.1 Six change-over (also called Form C or SPDT) relays board

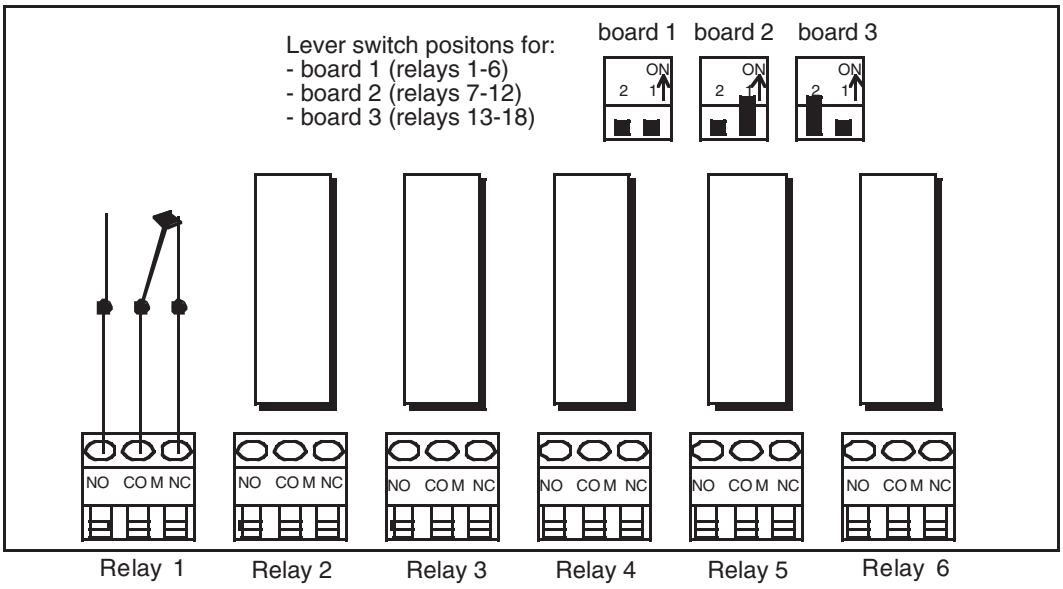


Figure 1.2.1 Change-over relay option wiring

2 ANALOG OUTPUT (RETRANSMISSION)

2.1 INTRODUCTION

The analog output option provides one card of 2 or 4 retransmissions of input or math channels, where a configurable proportion of a selected source channel's span is linearly mapped onto a configurable output range. The type of output (Volts or mA) and the output scaled, can be set up using the configuration pages described in 2.4, following.

2.2 SPECIFICATION

PRELIMINARY INFORMATION

Analog (retransmission) outputs

Output ranges (user configurable)

Voltage: *0 to 10 V (Source 6.5 mA max.)*

Current: *0 to 20mA (max. voltage 20V ,load resistance: 1kΩ)*

Update rate *1 Hz.*

Step response (10% to 90%) *250 msec maximum*

Linearity *0.04% of hardware range*

Performance

Performance in instrument at 20 deg. C		
Range	Accuracy	Temperature drift
0 to 10 V	0.1% of range	±0.12mV +0.022% of reading per deg. C
0 to 20 mA	0.1% of range	± 1 µA +0.03% of reading per deg. C
4 to 20 mA	0.1% of range	± 1 µA +0.03% of reading per deg. C

2.2 SPECIFICATION (cont.)

Safety isolation (dc to 65Hz; BS EN61010) *Installation categor y II; Pollution degr ee 2 (see page 2 for definitions)*
Channel to channel: *300V RMS or dc (double insulation)*
Channel to ground: *300V RMS or dc (basic insulation)*

2.3 WIRING

Either two or four outputs are present, depending on the installed option.

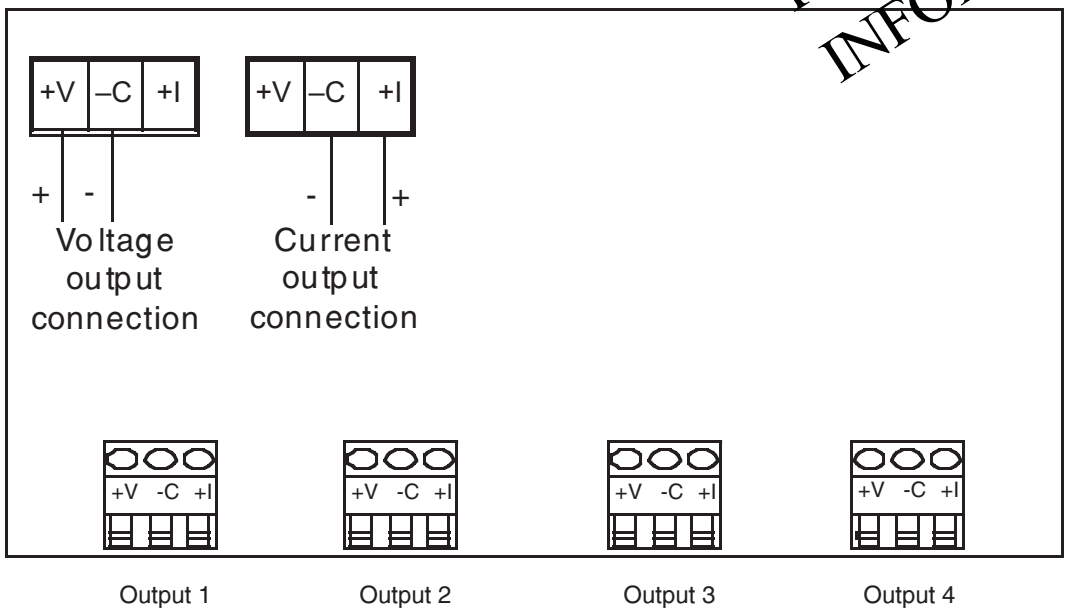


Figure 2.3 Retransmission option wiring

2.4 CONFIGURATION PAGES

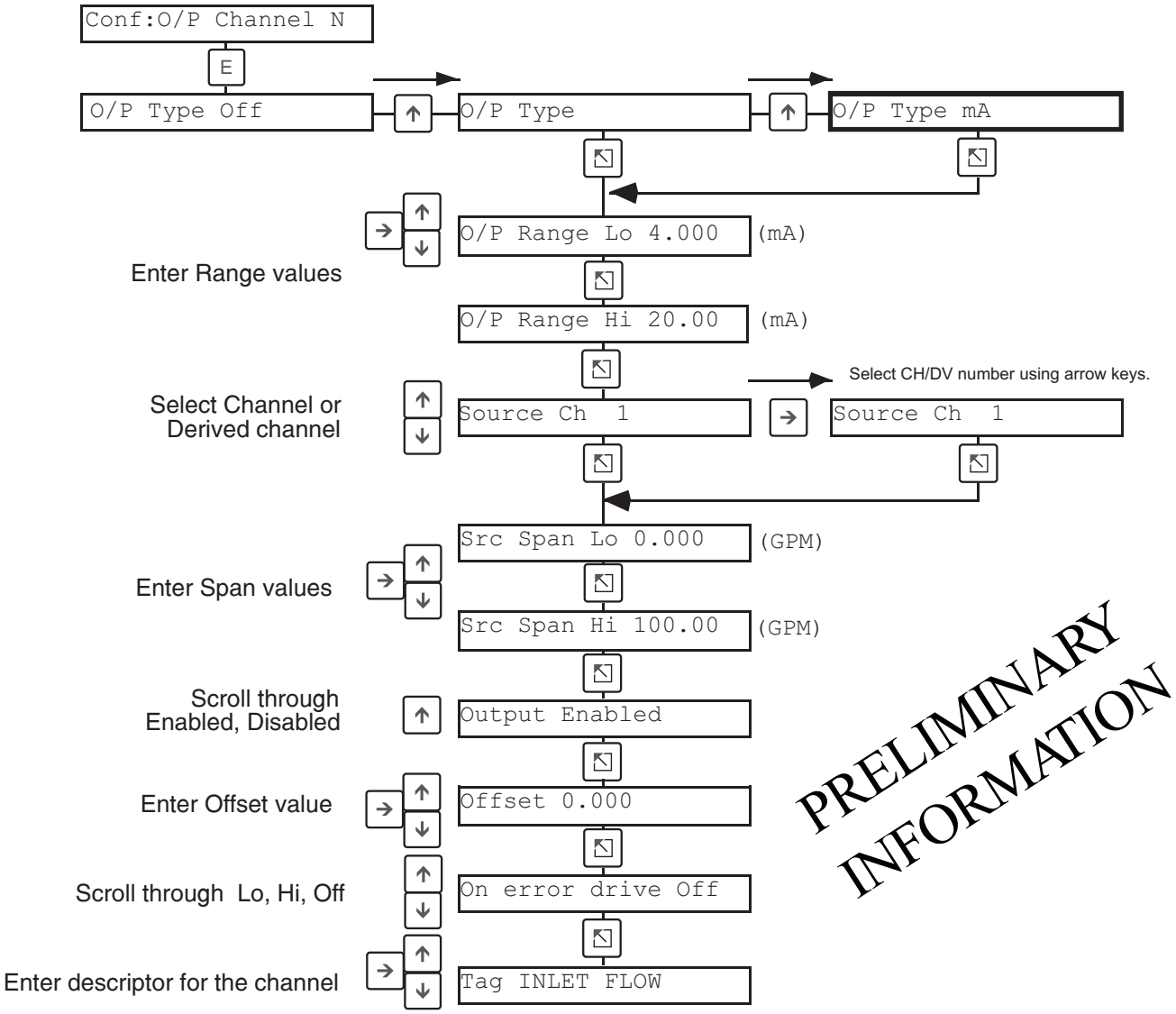


Figure 2.4 Retransmission configuration pages

Figure 2.4 shows the configuration pages for the analog output option.

O/P Type	Allows V or mA to be selected as the output type. When 'Off', the channel output goes to -250µA at I+ and – terminals and to approximately -4V across the V+ and – terminals
O/P Range Lo/Hi	Allows the setting of the voltage or current that is to appear at the output terminals when the source signal is at Span Lo/Hi (See below).
Source Ch	Allows 'Ch' (measuring channel) or 'DV' (derived channel) to be selected as input source type. When source type is as required, use the cursor key to move to the numeric field and use the arrow keys to scroll through the available channels or DVs.
Source Span Lo/Hi	Allows the setting of the high and low values of the source channel/DV which cause the high and low values (O/P Range Lo/Hi) of the retransmission output signal.
Output Enabled	Allows the output channel to be switched off, without its configuration being lost.
Offset	Allows a fixed value to be added to the value of the source channel/DV input to the retransmitter.
On error drive	Allows Off, high or low to be selected as an error output (e.g. if the input source is missing). 'Off' causes the output to be set to its Off state as defined in O/P type above. 'High' or 'low' cause the output to drive to approximately 15% above span or below 'zero' respectively.
Tag	Allows a 14-character descriptor to be applied to the selected channel.

2.5 OUTPUT ADJUST

This feature allows the retransmitted output signal to be adjusted to compensate for differences between the readings on the recorder and readings on the device connected to the retransmission output.
The adjustment can be applied or removed as required.

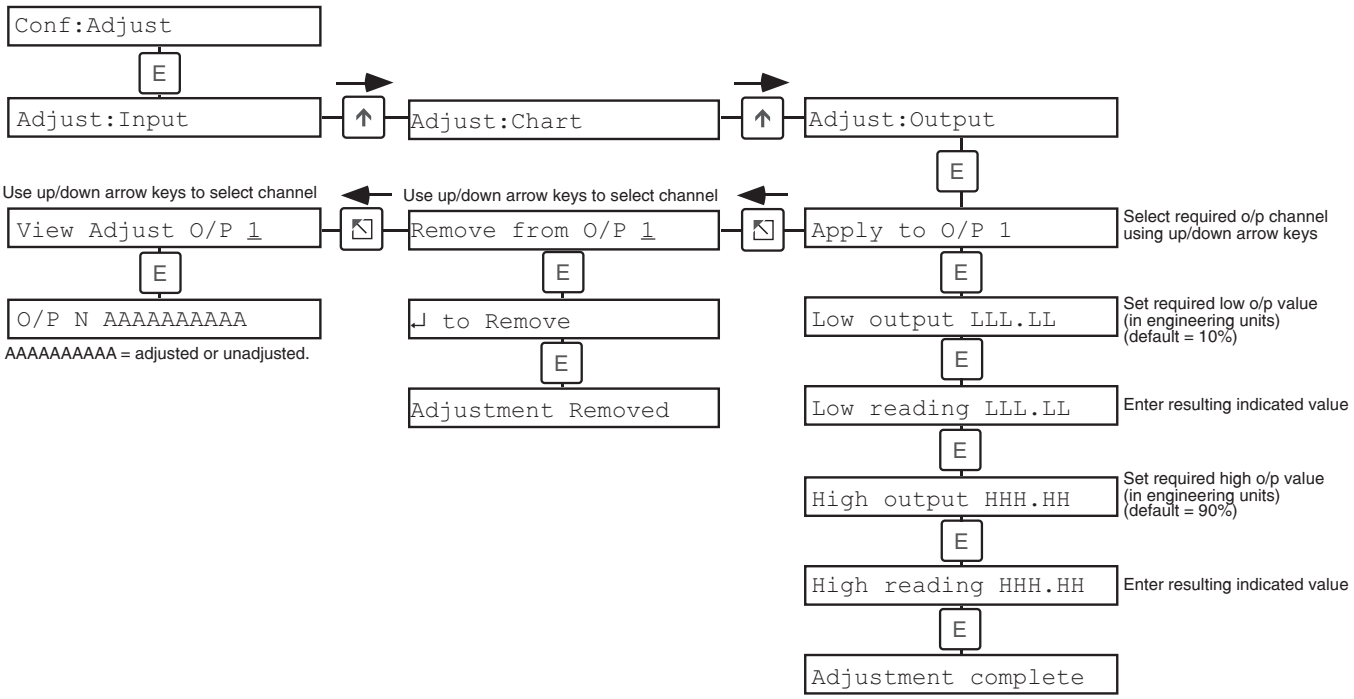
The technique used is:

1. The recorder outputs a known value (10%* of output span) at the analog output terminals.
2. The user takes the resulting value as indicated by the connected equipment and enters it into the recorder.
3. The recorder outputs a second value (90%* of output span).
4. The user takes the resulting value as indicated by the connected equipment and enters it into the recorder.

The recorder then calculates a linear gain and offset correction to be applied to the output.

*These are default values and can be adjusted by the user.

Figure 2.5 Output Adjust menu pages



'Remove' allows the adjustment to be removed from a selected channel.

'View' allows the user to determine whether any particular retransmission output is currently adjusted or not.

3 MATH PACK
(DERIVED CHANNELS)

3.1 INTRODUCTION

The math pack option provides 16 'derived' channels (DV1 to DV16), in addition to the measuring channels.

The option comes in three levels: level 1 which provides basic arithmetic functions, level 2 which provides advanced functions such as averaging, relative humidity calculations, mass flow etc. and level 3 which is a display format only . Scientific notation displays calculated values using a mantissa and an exponent of 10 (e.g. 1000 = **1.00** $^{+3}$). The functions for levels 1 & 2 are listed in table 3.1 below.

Table 3.1 Math functions

Level 1 functions	Level 2 functions (additional to level 1 functions)	
Off	Square root	DV group continuous maximum
Constant	Channel average	Third order polynomial
Copy	DV Group average	Relative humidity
Add	Rolling average	F value
Subtract	e^x	Linear mass flow
Multiply	$\log_n$	Square root mass flow
Divide	10^x	Zirconia probe
Modulus	$\log_{10}$	Switch
	Rate of change	High select
	Sample and hold	Low select
	Channel minimum	Stopwatch
	DV group latching minimum	Time stamp
	DV group continuous MinimumChannel maximum	O_2 Correction
	DV group latching maximum	Percentile

3.1.1 Groups

Derived channels can be added to the log and display groups described in the Group configuration section of the Installation and Operation manual. The operator can edit these groups to contain only those items which are to be logged or which are to appear at the display.

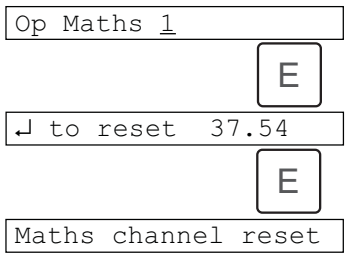
The Level 2 math pack option adds a further group, called the DV group, which can contain only derived and measuring channels (i.e. not totalizers or counters). The group can be used to assemble channels which are to be part of group averaging, group max/min, or group reset of averages, sample-and-hold, etc.

3.1.2 Jobs

The following jobs are added to the list given in the Installation and Operation Manual:
Reset channel NN
Reset all DVs
Switch to B on NN
Disable channel NN
Disable all DVs
Trigger Ch NN

3.1.3 Operator pages

If allowed by operator access (section 4.13 in the Installation and Operation manual), the operator can reset any of the resettable functions in level 2 from this menu. The reset page displays the current value of the channel to be reset.



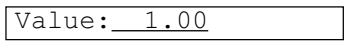
3.2 EQUATIONS

Note - Unless otherwise stated, a "channel" can be either an input channel or another derived calculation channel.

3.2.1 Level 1 equations

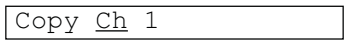
CONSTANT

Allows the entry of a constant to be used in other equations, values between -99999 and 999999.



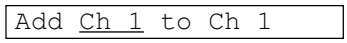
COPY

Can be used to duplicate input or derived channels when more than four alarms are required. Also useful to import totalizer or counter values so they can be traced on the chart and/or, so that they can be used in math calculations.



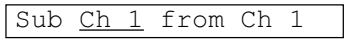
ADD

Allows one channel to be added to another.



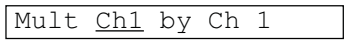
SUBTRACT

Allows one channel to be subtracted from another.



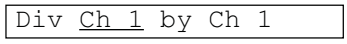
MULTIPLY

Allows one channel to be multiplied by another.



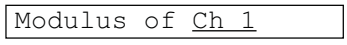
DIVIDE

Allows one channel to be divided by another.



MODULUS

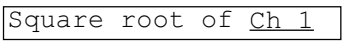
Takes the value of a channel, ignoring sign (i.e. always positive).



3.2.2 Level 2 equations

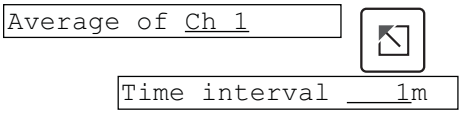
SQUARE ROOT

Takes the square root of the value of a channel. Produces a system error if signal value goes negative.



CHANNEL AVERAGE

Provides the average value of a channel over a configurable time interval, then repeats.



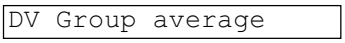
GROUP AVERAGE

Provides the current average value of all the channels in the DV group i.e.

(DVa + DVb + -------+ DVc)/R

where R is the total number of DVs in the group.

The function may be globally reset.

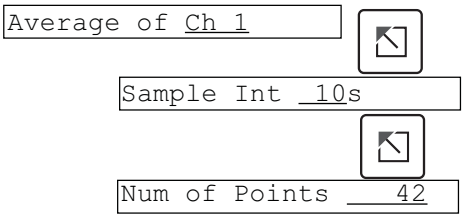


ROLLING AVERAGE

Takes the average value of a channel sampled a specified number of times (up to 9999) each at a specified time period in seconds.

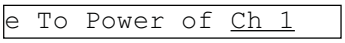
Example - a seven minute average can be 42 readings, taken every 10 seconds (42X10 = 420sec = 7min). The first reading is discarded when the 43rd one is taken and so on.

The function may be globally reset.



E TO THE POWER

Raises e to the power of the value of the specified channel. e ≈ 2.71828

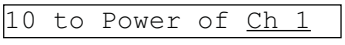


NATURAL LOG

Takes the Naperian log of the value of the specified input or derived channel.

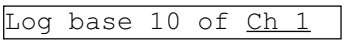
10 TO THE POWER

Raises 10 to the power of the value of the specified input or derived channel.



LOG BASE 10

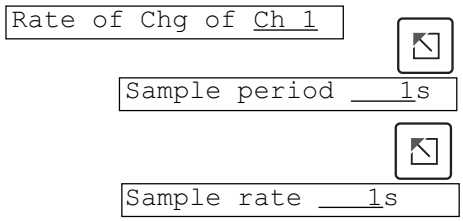
Takes base 10 log of the specified input or derived channel's value.



3.2.2 LEVEL 2 EQUATIONS (Cont.)

RATE OF CHANGE

Calculates the rate at which the selected channel's value changes over a specified time period, with a specified sample rate which will determine the number of measurements being taken during that time period.

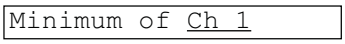


SAMPLE AND HOLD

When triggered, retains the current value of the specified channel's value, until reset.

CHANNEL MINIMUM

Saves the lowest value that the specified channel has reached since initiation or last reset.

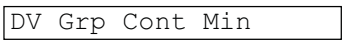


DV GROUP LATCH MIN

Outputs the lowest value reached by any channel in the DV group since initiation or last reset.

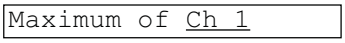
DV GROUP CONT MIN

Outputs the current value of whichever channel in the DV group has the lowest value.



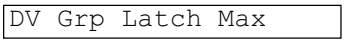
CHANNEL MAXIMUM

Outputs the highest value that the specified channel has reached since initiation or last reset.



DV GROUP LATCH MAX

Outputs the highest value reached by any channel in the DV group since initiation or last reset.



DV GROUP CONT MAX

Outputs the current value of whichever channel in the DV group has the highest value.

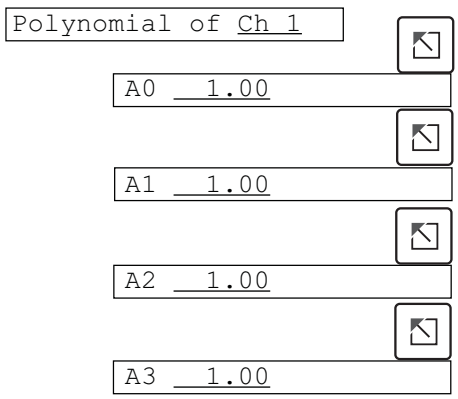
THIRD ORDER POLYNOMIAL

Provides a third order polynomial curve fit:

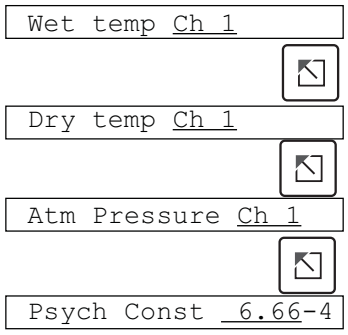
$$A0 + A1x + A2x^2 + A3x^3$$

where A0 to A3 are constants and x is the specified channel's value.

Constants less than 0.0001 or greater than 99999 require further configuration to execute, consult factory.



3.2.2 LEVEL 2 EQUATIONS (Cont.)

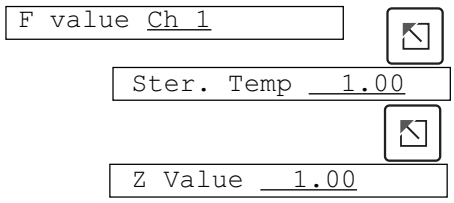


RELATIVE HUMIDITY

To determine the relative humidity percentage using wet and dry temperature readings in °F and atmospheric pressure inputs in bars. 1 bar = 14.7 psia.

The mantissa of the psychrometric constant times the pressure should equal 6.66 - e.g. a 0.9 bar times a 7.40 constant equals 6.66; (the exponent "-4" is fixed).

FVALUE



To calculate the equivalent time at Sterilizing Temperature (for temperatures below, at and above Sterilizing Temperature) both in dry (F_H) and steam (F_O) sterilizing environments, using the following equation:

$$Fval_t = Fval_{t-1} + T \times 10^{\frac{ma_t - target\ temp}{Z}}$$

Where $Fval_t$ = F value at time t (minutes)
$Fval_{t-1}$ = F value last iteration
T = Internal recorder iteration rate (minutes)
ma_t = Value of temperature measuring channel
Target temp = 121.1°C for F_O; 170°C for F_H
Z = Temperature interval representing a factor-of-10 reduction in killing efficiency
= 10°C for F_O; = 20°C for F_H

MASS FLOW LINEAR (see also Mass Flow Square Root)

Note: the overall accuracy of a flow measurement installation depends on a number of factors outside the control of the recorder manufacturer. For this reason, the manufacturer takes no responsibility for the accuracy of results obtained by using the mass flow equations implemented in the maths pack. **Independent verification is recommended before this recorder is used for custody transfer.**

The equation solved is: $$Qmt = \frac{K}{Rg \times Z} \times \frac{Flow_t \times AbsP_t}{Temp}$$

where: Qm_t = mass flow at time t, in the same flow units as '$Flow_t$'.
$Flow_t$ = measured value from the flow meter at time t
$AbsP_t$ = absolute pressure of the fluid at time t
Temp = absolute temperature of the fluid in Kelvins
K = scaling factor (see below)
Rg = specific gas constant in J/(kg-K) (see below)
Z = compressibility factor (see below)

For the recorder user, this becomes: $$\text{Mass flow} = \frac{md \times ma_t \times mb_t}{mc_t}$$

where: mat = the value, at time t, of the channel measuring the flow meter output
mbt = the value, at time t, of the channel measuring the absolute pressure of the fluid
mct = the value, at time t, of the channel measuring the fluid temperature in Kelvins

md = a constant, derived from the equation: $$Const = \frac{K}{Rg \times Z}$$

where: K = a scaling factor (see below)
Rg = specific gas constant in J/(kg-K) (see below)
Z = compressibility factor (see below)

3.2.2 LEVEL 2 EQUATIONS (Cont.)

SCALING FACTOR K

This is derived from the equation: $K = \frac{S}{ma_{max}}$

where: S = The full scale output from the flow meter

ma_{max} = the full scale input of the channel which is reading the flow meter output

SPECIFIC GAS CONST ANT (Rg)

The specific gas constant values are available from published tables.

For convenience, the Rg values for a number of common gases are given in table 3.2

Gas	RG (J/kg-K)
Air	287.1
Ammonia	488.2
Carbon dioxide	188.9
Carbon monoxide	296.8
Ethylene	296.4
Hydrogen	4116.0
Methane	518.4
Nitrogen	296.8
Oxygen	259.8
Propane	188.5
Steam	461.4

Table 3.2 Common gas constants

COMPRESSIBILITY FACTOR (Z-FACTOR)

The compressibility factor is a density-related measure of how far a particular gas deviates from a 'perfect' gas under any set of temperature and pressure conditions, and is given by the equation:

$$Z = \frac{S}{T} \times \frac{1}{P}$$

Where: Z = Compressibility factor

P = Absolute pressure of the gas

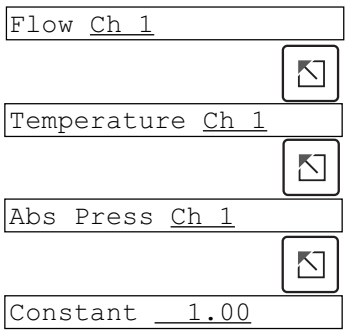
T = Absolute temperature of the gas

ρ = Gas density at pressure P and temperature T (from published tables)

Alternatively, the Z-factor can be established experimentally.

CONFIGURATION PAGES

Enter the flow rate, absolute temperature and the absolute pressure channels and the constant



3.2.2 LEVEL 2 EQUATIONS (Cont.)

MASS FLOW SQUARE ROOT (normally used for AGA 3 gas flow equation)

Note: the overall accuracy of a flow measurement installation depends on a number of factors outside the control of the recorder manufacturer. For this reason, the manufacturer takes no responsibility for the accuracy of results obtained by using the mass flow equations implemented in the maths pack.
Independent verification is recommended before this recorder is used for custody transfer.

The equation solved is: $Qmt = \sqrt{\frac{K}{Rg \times Z}} \times \sqrt{\frac{Flow_t \times AbsP_t}{Temp}}$

where: Qm_t = mass flow at time t, in the same flow units as 'Flow $_t$'.
$DeltaP_t$ = measured value of the differential pressure across the orifice plate at time t, in kPa.
$AbsP_t$ = absolute pressure of the fluid at time t
Temp = absolute temperature of the fluid in Kelvins
K = scaling factor (see below)
Rg = specific gas constant in J/(kg-K) (see below)
Z = compressibility factor (see below)

For the recorder user, this becomes: Mass flow = $\sqrt{\frac{md \times ma_t \times mb_t}{mc_t}}$

where: mat = the value, at time t, of the channel measuring the flow meter output
mbt = the value, at time t, of the channel measuring the absolute pressure of the fluid
mct = the value, at time t, of the channel measuring the fluid temperature in Kelvins

md = a constant, derived from the equation: $Const = \frac{K}{Rg \times Z}$

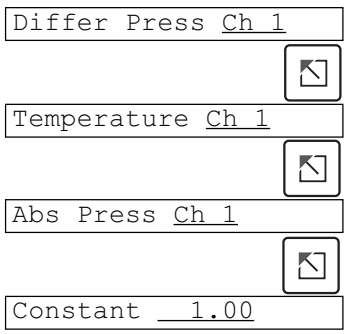
where: K = a scaling factor (see below)
Rg = specific gas constant in J/(kg-K) (see linear mass flow above)
Z = compressibility factor (see linear mass flow above)

SCALING FACTOR K
This is derived from the equation: $K = \frac{S}{\sqrt{ma_{max}}}$

where: S = The full scale output from the flow meter
ma_{max} = the full scale input of the channel which is reading the flow meter output

CONFIGURATION PAGES

Enter the differential pressure, absolute temperature and the absolute pressure channels and the constant



3.2.2 LEVEL 2 EQUATIONS (Cont.)

ZIRCONIA PROBES

A zirconia (oxygen) probe consists of two platinum electrodes bonded to a pellet or cylinder of zirconia. At elevated temperatures, such a probe develops an emf across it which is proportional to probe temperature and to the log of partial pressure of oxygen difference between its two ends.

OXYGEN CONCENTRATION MEASUREMENT

In order to measure oxygen concentrations, one end of the probe is inserted into the atmosphere to be measured, while the other is subjected to a reference atmosphere. For most applications, air provides a suitable reference (reference input = 20.95% for air).

The temperature of the probe is usually measured using a type K or a type R thermocouple. The temperature effect on the thermocouple is such that for successful operation with the recorder, the probe temperature must be greater than 973K (700°C).

The probe output obeys a law, described by the Nernst oxygen equation:

$$E_{(Volts)} = \frac{RT}{4F} \times \ln \frac{P_1}{P_2}, \text{ or, rewritten: } P_2 = \frac{P_1}{e^{\left(\frac{46.42\,E}{T}\right)}}$$

where, R = Universal Gas Constant, 8.3143×10^3 J/K/kMOL

F = Faraday Constant, 9.64867×10^4

P_2 = Partial pressure of oxygen in the sampled gas (%)

P_1 = Partial pressure of oxygen in the reference atmosphere (%) (20.95% for air)

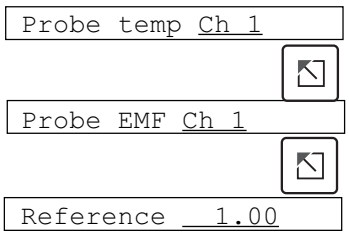
E = Electromotive force across the probe (the "E" in the rewritten equation is in **mV** from the sensor).

T = Probe temperature in Kelvins

In order to obtain a useful result, it is necessary to scale the inputs and outputs correctly. The channel measuring the probe voltage will normally need a scale of 0 to 100 mV. The temperature measuring channel will probably be scaled at 273 to 1800K, while the output scaling would typically be 0 to 5 % for boiler flues, and 0 to 20% in kilns.

CONFIGURATION PAGES

Enter channel numbers for Probe temperature, Probe emf and reference % measurements.



3.2.2 LEVEL 2 EQUATIONS (Cont.)

ZIRCONIA PROBES (Cont.)

OXYGEN POTENTIAL MEASUREMENT

The oxygen potential of an atmosphere is a measure of its ability to oxidise or reduce. For any element, a value of oxygen potential (free energy of formation) is known. Above this value, the material will oxidise, below it, no oxidation will occur.

Oxygen potential is given by the equation:

$$Op = 0.00457 \times T \times \log Op'$$

where, Op = Required oxygen potential (kilocalories)
T = Probe temperature (Kelvin)
Op′ = Partial pressure of oxygen in the reference atmosphere in atmospheres

It can be shown that, because oxygen potential of air is essentially constant over the range 870 to 1450 Kelvins, the probe output is proportional to the oxygen potential of an atmosphere according to:

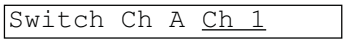
$$E = (10.84 \times T) + 40mV$$ between 870 to 1450 K.

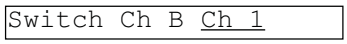
Thus it is possible to measure oxygen potential directly from a zirconia probe, using a standard input channel of the recorder, scaled in units of oxygen potential.

A typical input range would be 40 to 1124 mV, with a scale of 0 to -100 kilocalories. Such scaling would be appropriate over the temperature range 873 to 1473 K (600 to 1200 °C).

SWITCH

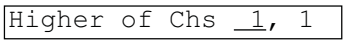
This function copies one of two channel values according to the state of its 'Select channel B for NN' job. I.E. if the relevant switch is active, copy the value of source channel B, else copy the value of source channel A.





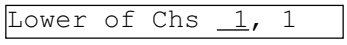
HIGH SELECT

This function has two channel inputs, and copies whichever has the higher value.



LOW SELECT

This function has two channel inputs, and copies whichever has the lower value.



STOPWATCH

The stopwatch starts counting as soon as the function is configured. The stopwatch can be held (disabled) by a maths pack 'job, (disable channel NN) and can also be reset to zero (Reset channel NN). The value is normally displayed as a number of 1/4 seconds, but if one of the date/time formats described in section 3.3 is selected, the value can be displayed in hours/minutes/seconds. When logged to the chart, it will appear in the specified format .

3.2.2 LEVEL 2 EQUATIONS (Cont.)

TIME STAMP

When triggered by a maths pack job (Trigger channel NN) becoming active, the time stamp reads the current time and date from the system clock and holds it. The time or the date can be displayed according to the configured value format.

Note: The display format selected affects only the value displayed, not the internal value of the channel. This internal value is a number of 1/4 seconds elapsed either since enabled (stopwatch) or since the 1st January 1988 (Time stamp). This allows time stamp functions to be processed in the maths pack. For example, two channels, each with a time stamp as its value can be subtracted from one another to give the time between the stamps, and this can be displayed as elapsed time if so configured in the Value Format page.

OXYGEN (O_2) CORRECTION

This function carries out O_2 correction of gas measurements for use in Continuous Emissions Monitoring (CEM) applications.

The equation calculated is:

$$Qmt = \frac{20.9\% - \text{Spec } O_2}{20.9\% - \text{Meas } O_2} \times \text{Meas. gas}$$

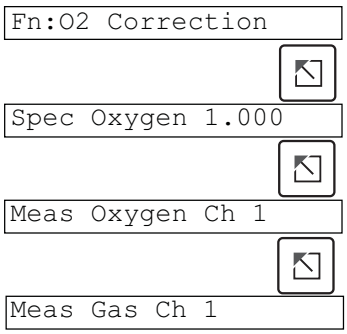
where,

Spec. O_2 = specified oxygen entered as a constant 5-digit value (prescribed for the particular process).
Meas. O_2 = measured oxygen, entered as a channel number (gas analyzer input)
Meas. gas = the measured gas, entered as a channel number (gas analyzer input)

NOTE - If the measured O_2% were to go below the specified O_2%, the above calculation will result in a compensated gas measurement that is **less than the actual measured gas value**. **This may not be allowed by some regulatory agencies.**

To prevent the calculated value from going lower than the measured value, add a "High Select" DV channel with inputs from the measured gas channel and the O_2 calculation above (Qmt). Since this DV selects the highest of its two input values, the actual measured gas channel value will be chosen when the Qmt calculation is lower. This High Select is now the compensated gas DV channel to be displayed, recorded, etc. rather than the above Qmt calculation.

CONFIGURATION PAGES

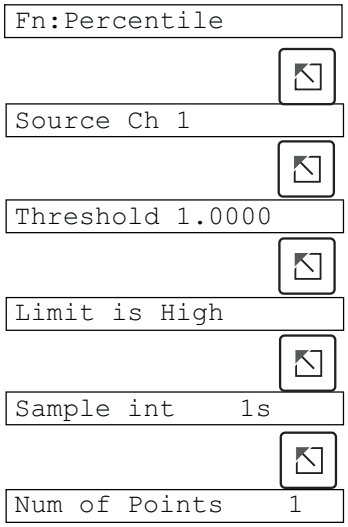


3.2.2 LEVEL 2 EQUATIONS (Cont.)

PERCENTILE

This function looks at a specifiable number of the most recent samples of a specified channel. It continuously calculates the percentage of these samples which are equal to or which lie within a specifiable limit. The limit can be a high limit or a low limit. (e.g. - the percentage of the last 20 samples that are equal to or less than 100°F).

Once the specified number of samples has been reached, the oldest sample is discarded and the percentage re-calculated with each new sample. The sample rate can also be specified.



Scroll through 'high' and 'low'

Use minimum number of points you can, to save memory space.

3.3 CONFIGURATION

Figure 3.3 is an overview of the maths pack configuration pages

The configuration technique for derived channels is similar to that described for measuring channels in the Installation and Operation manual. Input and derived channels share the following parameters:

Channel units	Five character user definable string	
Trace	On, off	
Line thickening*	On, off	
Color	Selectable from those available	
Span	A and B	
Tag	14-character tag	
Alarms	Type, threshold, jobs	
Value format	Level 1 & 2 Functions:	Five digits with configurable decimal point position.
	Level 3 Functions	Two digits (positive) or one digit (negative) plus the exponent (-9 to 9).

* Not graphics units

MATHS PACK UNIQUE PARAMETERS

GROUP RESET ENABLE

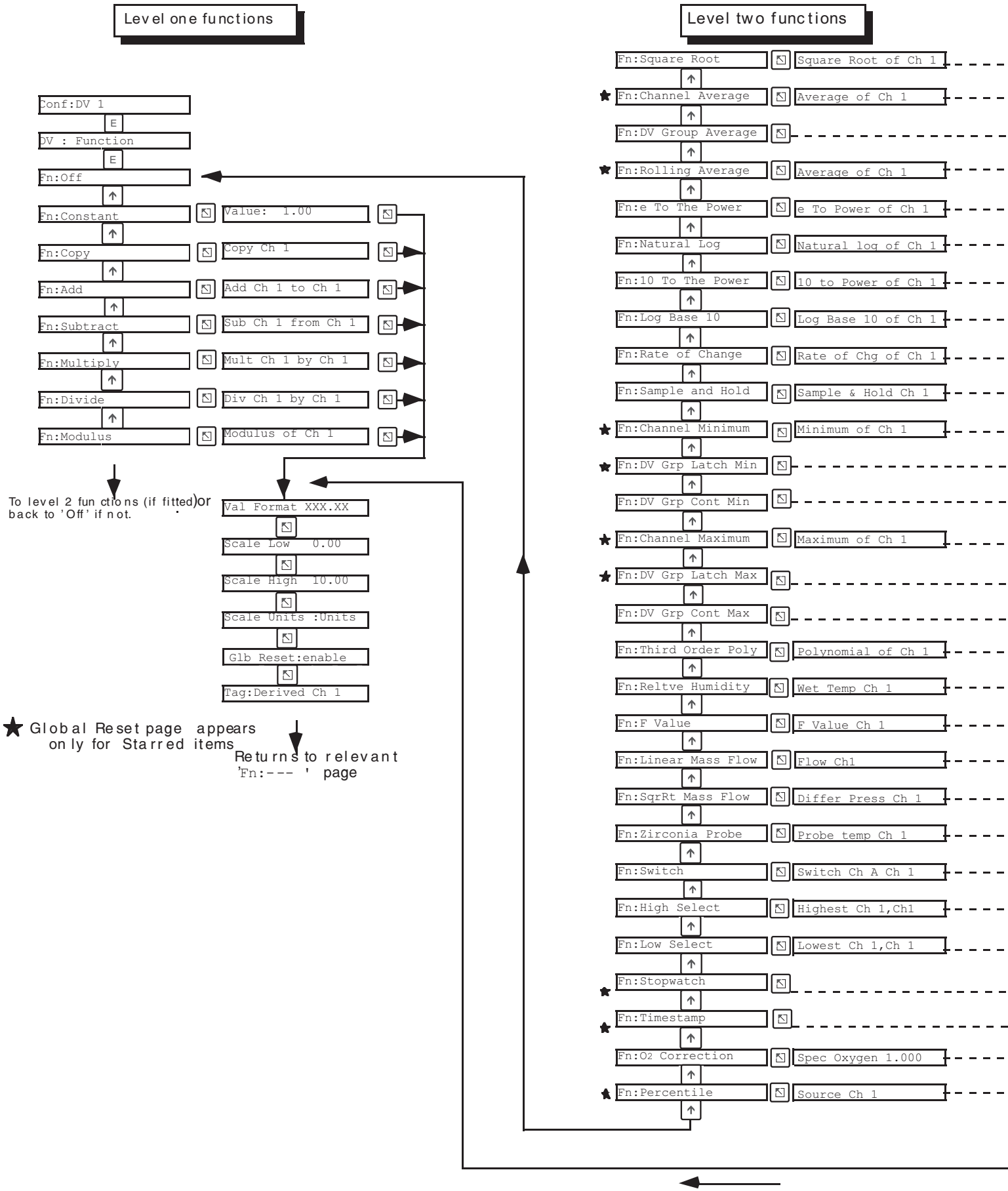
Allows resettable functions to be made susceptible to group reset.

LEVEL 2 VALUE FORMATS

Value format

Five digits with configurable decimal point position.
Time as HH:MM:SS (Time part of time stamp function, or elapsed time for the stopwatch).
Date as DD/MM/YY or MM/DD/YY (Date part of Time Stamp function). Date format is defined as a part of instrument configuration.
Elapsed time as HH:MM:SS. If the period is 100 hours or more, the format changes to HHHHH:MM.

Note: If a DV is configured with one of the above Date, Time or Elapsed formats, it will be displayed as -----, but will be logged on a separate line in the chosen format.


Level one functions
Level two functions
Conf:DV 1
E
DV : Function
E
Fn:Off
Fn:Constant
Value: 1.00
Fn:Copy
Copy Ch 1
Fn:Add
Add Ch 1 to Ch 1
Fn:Subtract
Sub Ch 1 from Ch 1
Fn:Multiply
Mult Ch 1 by Ch 1
Fn:Divide
Div Ch 1 by Ch 1
Fn:Modulus
Modulus of Ch 1
To level 2 functions (if fitted) or back to 'Off' if not.
Val Format XXX.XX
Scale Low 0.00
Scale High 10.00
Scale Units :Units
Glb Reset:enable
Tag:Derived Ch 1
★ Global Reset page appears only for Starred items
Returns to relevant 'Fn:--- ' page
Fn:Square Root
Square Root of Ch 1
★ Fn:Channel Average
Average of Ch 1
Fn:DV Group Average
★ Fn:Rolling Average
Average of Ch 1
Fn:e To The Power
e To Power of Ch 1
Fn:Natural Log
Natural log of Ch 1
Fn:10 To The Power
10 to Power of Ch 1
Fn:Log Base 10
Log Base 10 of Ch 1
Fn:Rate of Change
Rate of Chg of Ch 1
Fn:Sample and Hold
Sample & Hold Ch 1
★ Fn:Channel Minimum
Minimum of Ch 1
★ Fn:DV Grp Latch Min
Fn:DV Grp Cont Min
★ Fn:Channel Maximum
Maximum of Ch 1
★ Fn:DV Grp Latch Max
Fn:DV Grp Cont Max
Fn:Third Order Poly
Polynomial of Ch 1
Fn:Reltve Humidity
Wet Temp Ch 1
Fn:F Value
F Value Ch 1
Fn:Linear Mass Flow
Flow Ch1
Fn:SqrRt Mass Flow
Differ Press Ch 1
Fn:Zirconia Probe
Probe temp Ch 1
Fn:Switch
Switch Ch A Ch 1
Fn:High Select
Highest Ch 1,Ch1
Fn:Low Select
Lowest Ch 1,Ch 1
★ Fn:Stopwatch
★ Fn:Timestamp
Fn:O2 Correction
Spec Oxygen 1.000
★ Fn:Percentile
Source Ch 1

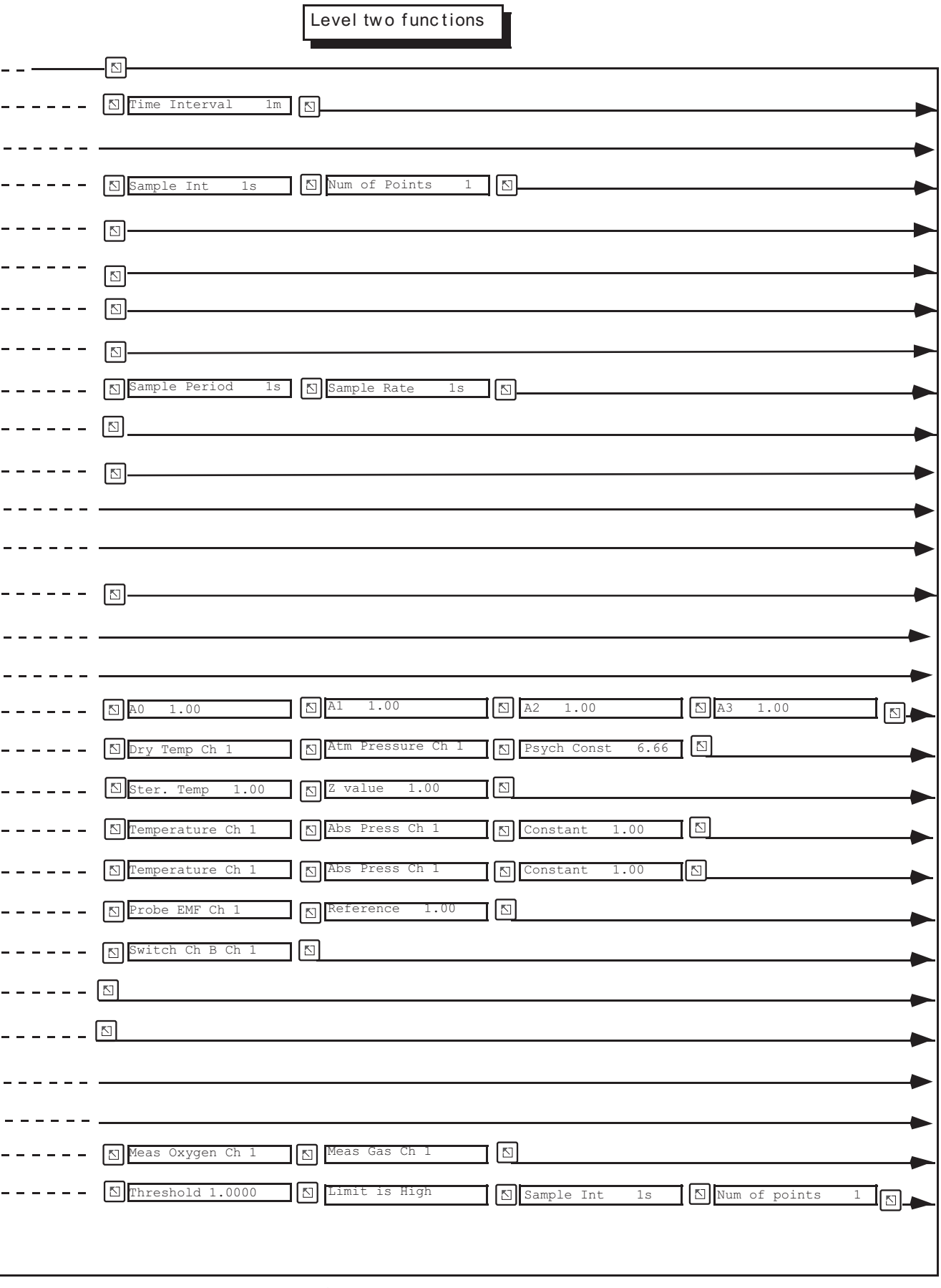


Figure 3.3 Maths pack configuration menu structure

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4 TOTALIZERS, COUNTERS AND TIMERS

4.1 INTRODUCTION

The Totalizer, Timer/Counter and Totalizer/Timer/Counter options supply up to six each of 9-digit (8-digit when decimal point used) totalizers, 8-digit counters and clock timers.

4.2 TOTALIZERS

4.2.1 Source types

Each totalizer can integrate a given input or derived channel's value providing this value is between the totalizer's configured low cut-off point and high cut-off point and within the channel's configured range.

4.2.2 Alarms

An alarm threshold can be set up for each totalizer, and each threshold can have up to two jobs associated with it. A 'limit' setting defines whether the job list is to be initiated when the totalizer value lies above (high) or below (low) the threshold value. Up to two jobs can be initiated by the alarm.

4.2.3 Display

The Display Group (described in the Installation and Operation Manual) is initially empty. With the TCT option, totalizers can be included in the display group with identifiers t1 to t6. It is up to the user to include totalizers in each group as required.

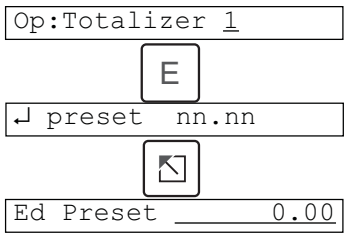
The value and units of each totalizer in the Display Group are displayed, in turn, in the 20-character text area. (The decimal point position is set up in the 'Value Format' configuration page.) Operation of the page key displays the totalizer tag and units instead.

4.2.4 Tracing on the chart (maths pack level 1 required)

To trace the value of a totalizer on the chart, it must be imported into a derived channel (using the 'Copy' function), and the derived channel then traced.

4.2.5 Operator pages

If operator access is allowed, the operator can preset individual totalizers, and can edit the preset value.



4.2.6 Totalizer configuration

Configuration is carried out using the normal techniques described in the Installation and Operation manual. Figure 4.2.6 below, shows the configuration pages.

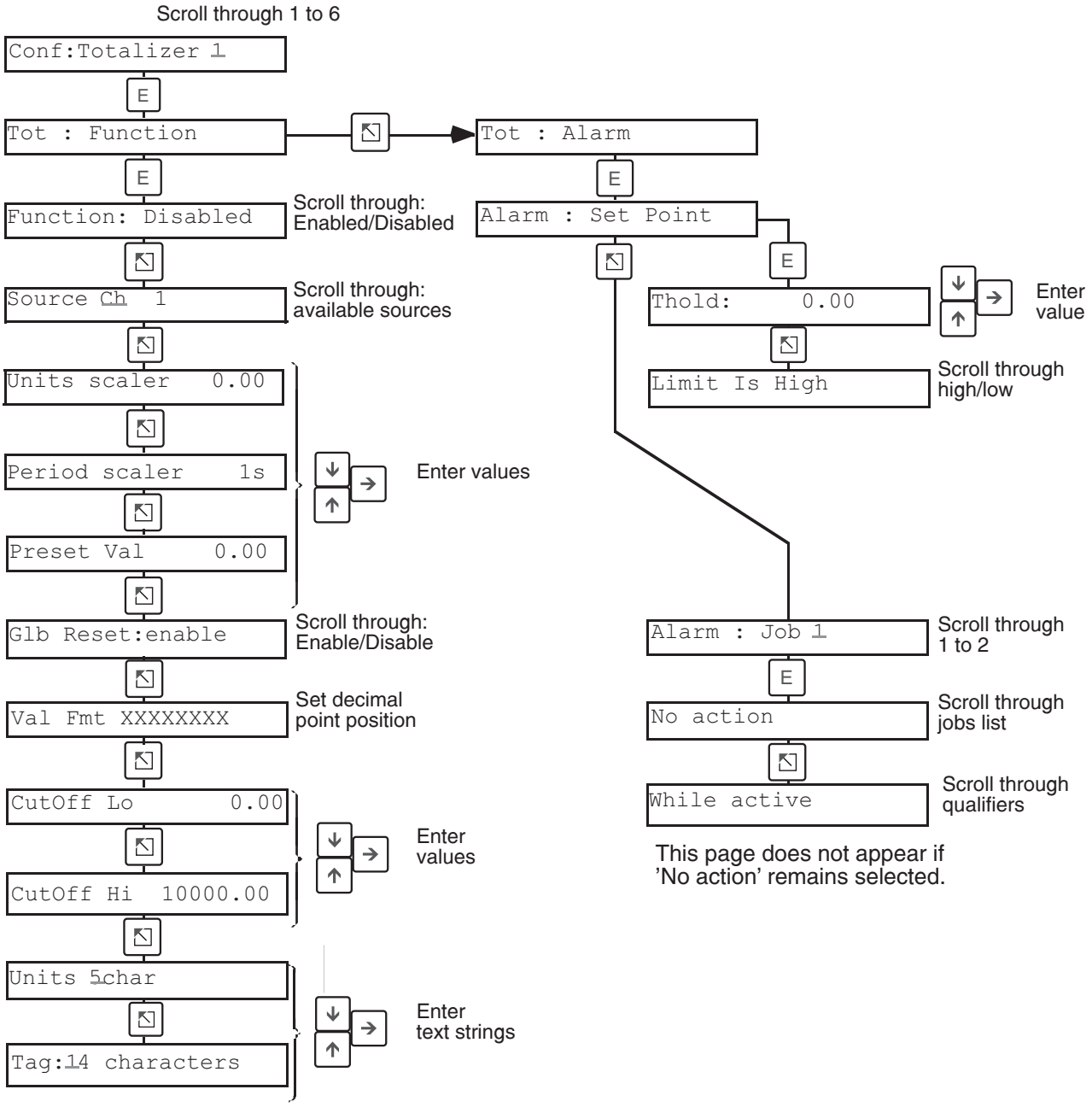


Figure 4.2.6 Totalizer configuration

4.2.6 TOT ALIZER CONFIGURA TION (Cont.)

Source — Allows input channels or derived channels to be selected as totalizer sources

Units scaler — Allows the counting to be scaled. For example, if the input to a storage tank is gallons/min and the totalizer value is to be gallons x 10^3 (i.e. one count for each thousand gallons), then the units scaler would be set to 1000. A units scaler greater than 1.0 causes the totalizer to run slower by the size of the scaler (counts divided by scaler). A units scaler less than 1.0 causes the totalizer to run faster.

Period scaler — The totalizer reads the source channel value every second. The period scaler defines the time value of the input units (/sec, /min, /hr, etc). **Except as (*) below, the period scaler is ALWAYS the number of seconds**. For example, if the input is in gallons/minute, then the period scaler would have to be the number of seconds in a minute (60). The larger the period scaler, the slower the totalizer counts.

Examples

Measured Value	Units Scaler	Period Scaler	Each Count Is
Pounds per Second	1.0000	1	1 Pound
Pounds per Second	1000.0	1	1000 Pounds
Standard Cubic Feet per Minute	1.0000	60	1 Cubic Foot
Gallons per Hour	1.0000	3600	1 Gallon
Gallons per Hour	100.00	3600	100 Gallons
Millions of Gallons per Day	10.000*	8640*	1 Million Gallons*
Millions of Gallons per Day	0.0100**	8640**	1000 Gallons**

* The period scaler would normally be 86,400 (the number of seconds in a day), but the entry for the period scaler only allows a maximum of 4 digits. This means that 86,400 cannot be entered directly . A 4-digit period scaler of 8640 is 10 times too small and makes the totalizer count 10 times too fast. However , also changing the units scaler to 10 makes the totalizer count 10 times slower and makes the millions in the totalizer correct (10 X 8640 = 86,400).

** Since it is unlikely that anyone would want each count on a totalizer to represent a million gallons, the units scaler can be reduced by a factor of 1000 resulting in a totalizer that counts in 1,000's of gallons (0.01 X 8640 = 86.400).

Preset value — Allows the entry of a nine-digit (eight digit when decimal point is used) number from which the totalizer will count. Totalizers can be set to their preset values, either individually or as a group, by job action or individually by the operator, if access permission is granted. See also 'Glb Preset Disable' immediately below. Preset to 0.000000 "resets" the totalizer.

Glb Reset — Allows each totalizer to be configured to be susceptible to global reset (Enable) or not (Disable).

Val format — Allows the decimal point position to be specified using the up and/or down arrow keys.

Cut Off Lo(Hi) — Allows cut-off values to be entered, below (above) which the totalizing function will be disabled.

Units — Allows a 5-character text string to be entered to describe the totalizer units.

Tag — Allows a 14-character descriptive text string to be entered.

ALARM PAGES

Threshold — Allows a value to be entered to act as an alarm trigger.

Limit — Defines whether the alarm triggers when the totalizer value is ≥ the threshold (absolute high alarm) (limit = high) or ≤ the threshold (absolute low alarm) (limit = low)

Jobs — The following jobs are added to the scroll list given in Section 4.1.5 of the Installation and Operation manual:
Preset Tot N
Preset all Tots
Disable all Tots

4.3 TOTALIZER COUNTER OUTPUT

The totalizer counter output option provides a pulse output to an assigned relay which is scaled to the count on the associated totalizer. There are two entries for this feature (see figure 4.2.6).

O/P (output)factor: divide the totalizer value, e.g. a factor of 100 outputs a pulse every 100 totalizer counts. A factor of 0.00 disables the output.

Pulse Relay "n" of card "n":

4.4 COUNTERS

4.4.1 Introduction

The counter options supply six, eight-digit counters which are controlled from other recorder functions through job lists. The following jobs are added to the list given in section 4.1.5 of the Installation and Operation Manual. They can all be triggered when the source goes active, goes inactive or on alarm acknowledgment, as configured:

1. Increment Counter N
2. Decrement Counter N
3. Preset counter N
4. Preset all counters
5. Disable all counters

Each counter can be configured with a threshold value to enable it to trigger up to two jobs itself. A 'limit' input allows a job list to be initiated either when the counter value ≥ the threshold (limit high) or when it is ≤ the threshold (limit low).

4.4.2 Tracing on the chart (maths pack level 1 required)

To trace the value of a counter on the chart, it must be imported into a derived channel (using the 'Copy' function), and the derived channel then traced.

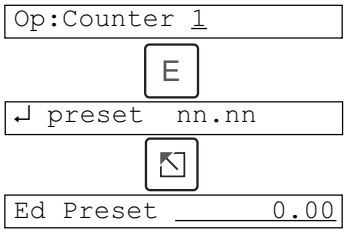
4.4.3 Display

The Display Group (described in the Installation and Operation Manual) is initially empty. With the TC or TCT option, counters can be included in the display group with identifiers Co1 to Co6. It is up to the user to include counters in the group as required.

The value and units of each counter in the Display Group are displayed, in turn, in the 20-character text area. (The decimal point position is set up in the 'Value Format' configuration page). Operation of the page key displays the counter tag and units instead.

4.4.3 Operator pages

If operator access is allowed, the operator can preset individual counters, and can edit the preset value. Initiation of preset can also be carried out by job action on individual channels or on all channels simultaneously.



4.4.4 Configuration

Configuration is carried out using the normal techniques described in the Installation and Operation manual. Figure 4.3.4, shows the configuration pages.

Preset	Eight digit value of preset, entered using the up and down arrows. The preset value is loaded into the counter by job or by operator action.
Units	Allows a 5-character units string to be entered using the up/down arrows and cursor key.
Glb preset	Allows each counter to be defined as being susceptible to global reset (enable) or not (disable).
Tag	Allows a 14-character descriptive tag to be entered for each counter.

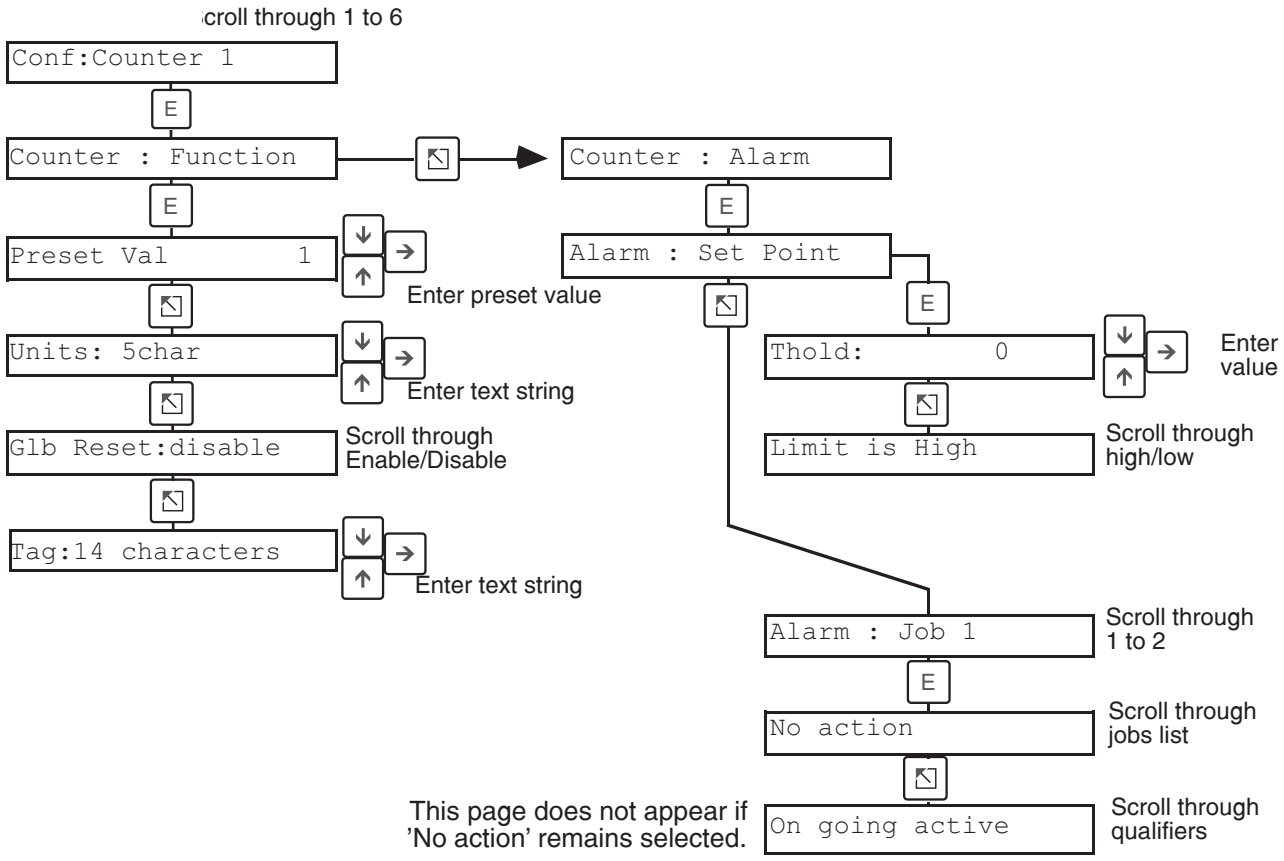


Figure 4.3.4 Counter configuration

ALARM PAGES

Threshold	Allows a value to be entered to act as an alarm trigger.
Limit	Defines whether the alarm triggers when the counter value is ≥ the threshold (absolute high alarm) (limit = high) or ≤ the threshold (absolute low alarm) (limit = low)

4.5 TIMERS

4.5.1 Introduction

The timer options supply six timers, each of which can be configured to start at a specific time and date relative to the real-time clock in the recorder. Once initiated, the timer will run for a configurable time period (duration) and repeat at a configurable rate. Alternatively, the timer can be initiated by a job, and it will then repeat at the configured repetition rate. Once initiated, the timer will re-start every repeat period until it is disabled.

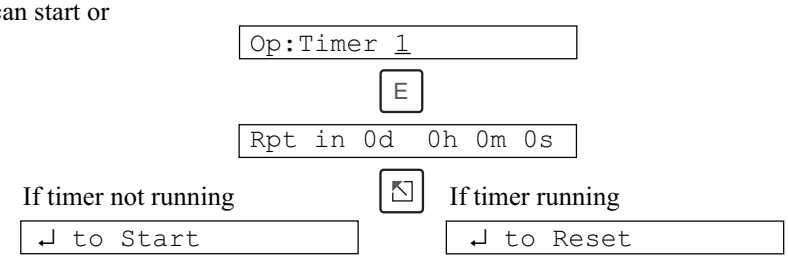
Each timer can have up to two jobs associated with it, and continuous jobs (e.g. chart speed change) remain active for the full time of the timer duration period. "One shot" jobs (e.g. resetting a totalizer) can be defined to occur as the timer is "going active" or "going inactive".

The timer options add the following jobs to the list given in the Installation and Operation Manual:

Start specified timer - resets and starts timer
Reset specified timer - resets but does not start timer

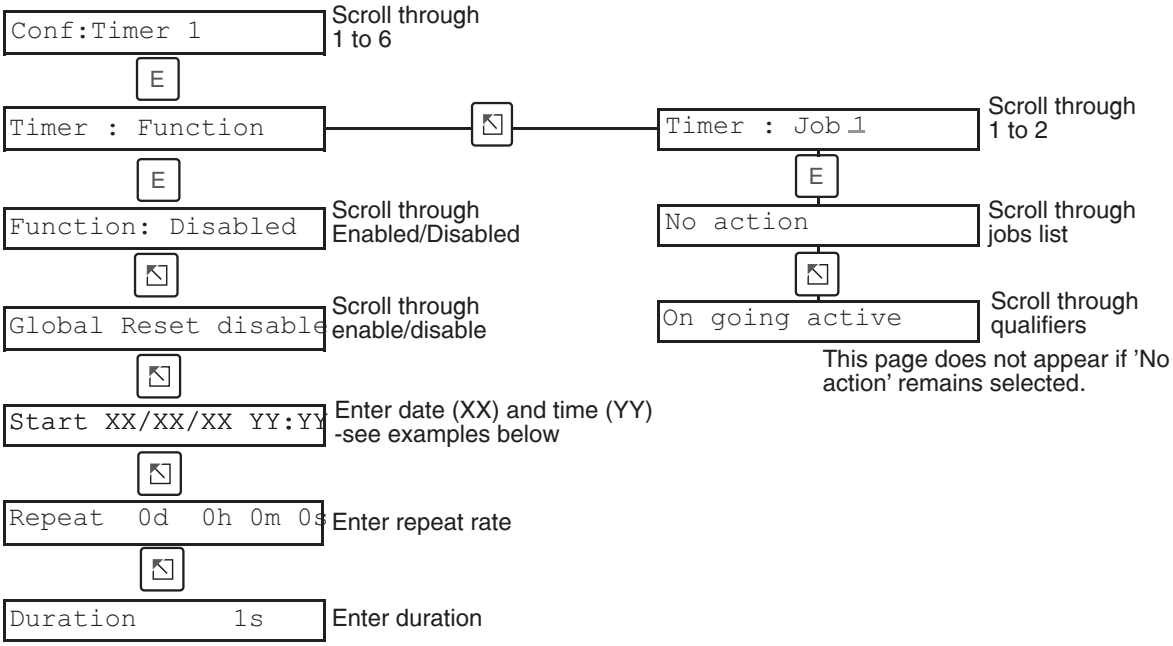
4.5.2 Operator pages

If access permission is granted, the operator can start or reset a timer



4.5.3 Configuration

Figure 4.4.3 T imer configuration pages



4.5.3 TIMER CONFIGURATION (Cont.)

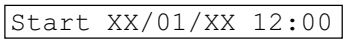
Function	Allows the timer to be switched on or off
Global reset	Allows each timer to be configured to be susceptible to global reset (enable) or not (disable)
Start	Allows a date and time to be entered for the timer to start. If an entry is left as XX, the timer will operate at the next smallest time unit. If all entries are left as XX, the timer can be started only by job or by operator action
Repeat	Allows a repeat period to be entered. If entries are left as zeros, the timer does not repeat.
Duration	Allows a duration period to be entered for the timer

JOBS PAGES

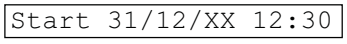
Allows up to two jobs to be entered for the timer to trigger.

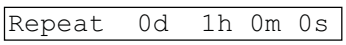
4.5.4 Timer examples

1. To start a timer at mid-day on the 1st of each month:



2. To start a timer every hour, on the 1/2 hour, starting at 12:30 on 31st December:





5 TRANSMITTER POWER SUPPLY OPTION

5.1 INTRODUCTION

This option supplies one or two sets of three isolated 25 Volt outputs. Each output is intended to supply power to a remote transmitter in order to run a 0 to 20 mA or a 4 to 20 mA current loop.

Physically, each unit consists of a circuit board and associated channel input shunt assemblies located on the inside back wall of the case (see Installation and Operation manual Fig 1.2.2). Electrically, the circuit boards contain a transformer with multiple isolated secondary windings used to drive three simple regulators via individual rectifing/ filtering circuits. Outputs from the regulators are wired to terminal blocks for user connection.

Note: that although the recorder can operate on a line voltage of 90 to 264 Vac, the transmitter power supply must be set for the level of voltage connected. See the link identifications shown in Figure 9.1.

Figure 9.1 shows an overall view of a transmitter power supply option with inputs for three channels.

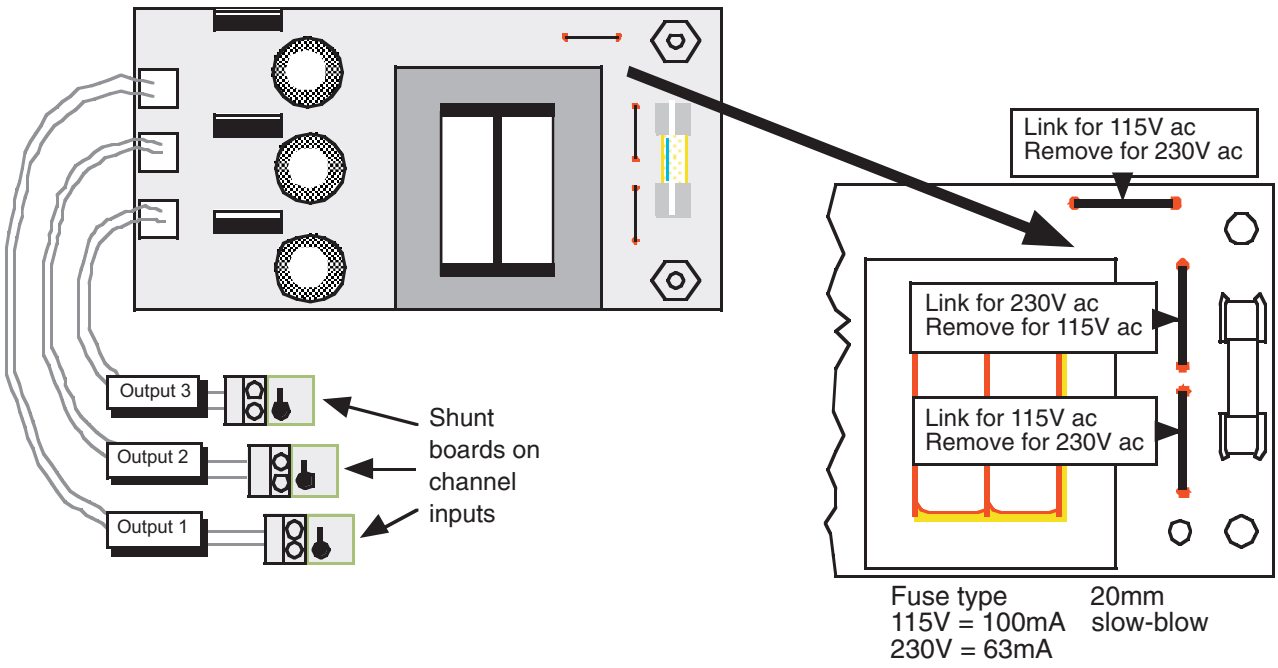


Figure 5.1 Transmitter power supply

5.1.1 Fuses

The required fuse value depends on the supply voltage, as shown in table 9.1.1 below. The fuse type is 20mm slow-blow, and one is located under a insulating cover on each circuit board as shown in figure 9.1 above.

5.1.2 Safety isolation specification

Safety isolation (dc to 65Hz; BS EN61010)	*Installation categor y II; Pollution degree 2 (see page 2 for definitions)*
Channel to channel:	*100V RMS or dc (double insulation)*
Channel to ground:	*300V RMS or dc (basic insulation)*

5.2 SIGNAL WIRING

The transmitter outputs are connected at a terminal block as shown below. Connection between the shunt board and the power supply are made at manufacture.

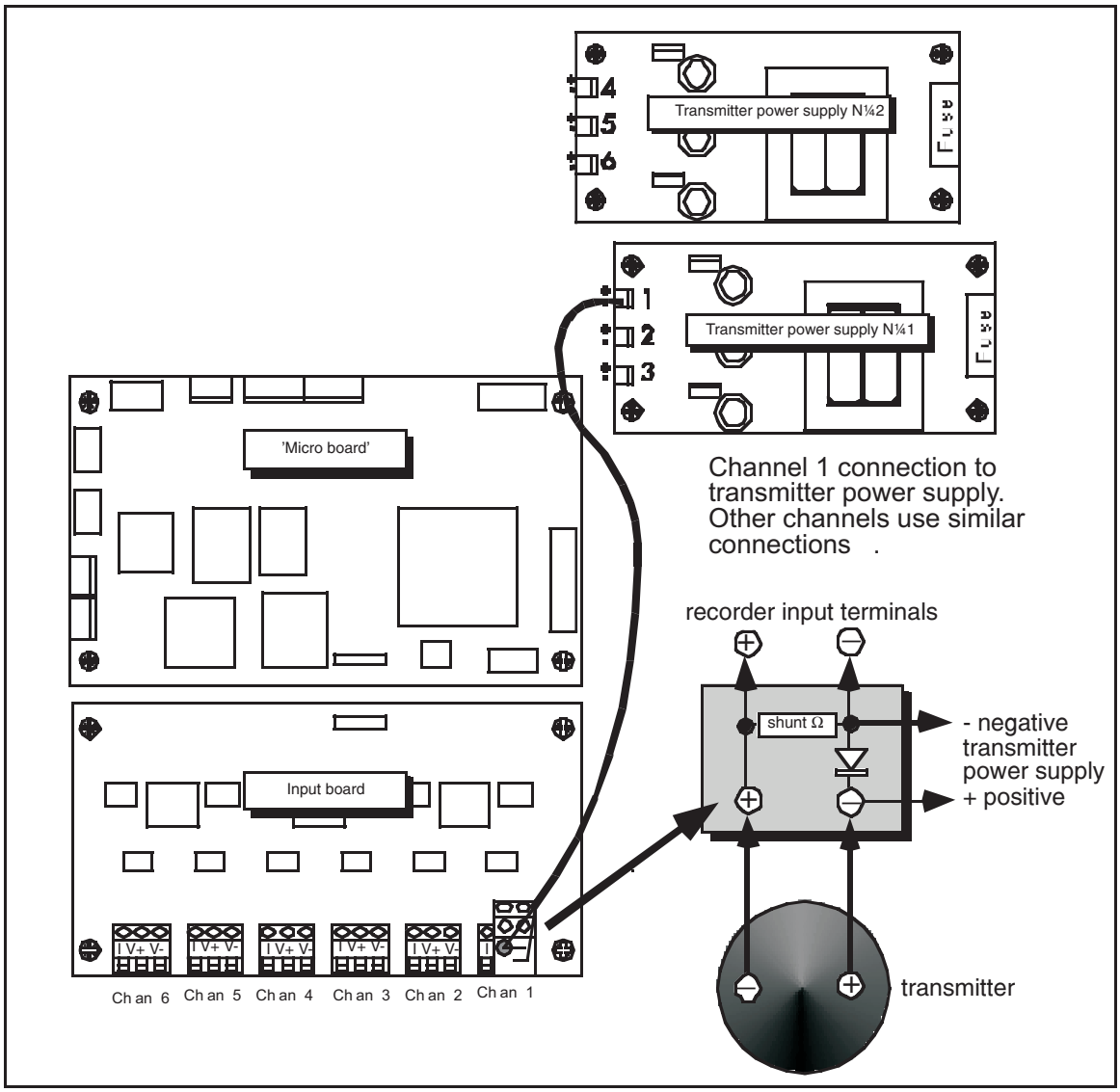


Figure 5.2 Transmitter power supply signal wiring

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