Honeywell

DPR 180/DPR 250

MATH OPTION MANUAL

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1. CONFIGURATION

1.1 Description of a math function

1.1.1 Overview

This manual explains how to install and configure the math option.

A math function is characterized by:

- A set of constant coefficients
- A set of variables
- A set of processing conditions
- Unit and Tag Name to identify the function result.

The result = A mathematical function with configured conditions, coefficients, variables.

NOTE: If one of the above parameters is not correctly configured, the result of the selected math function will be incorrect.

1.1.2 Processing conditions (START and RESET)

- The **START** condition defines when the math computation must start. When the start condition becomes true, the math function computes continuously. When the start condition becomes false, the math function keeps the latest computed result. (If a result was never computed, the result will stay at the default value).
- The **RESET** condition defines when the math computation will reset. As long as the reset condition is true, the computed result will stay at the default value which is specific to each math function.

NOTE: When a periodic math function is reset, at the end of the configured time period, the result is printed on the chart and reset, and the math computation starts again. Hence, each time a periodic math function is reset (RESET in RUN mode or elapsed time) the function result is printed.
For more information, see section 3.2.2 "Printing a math result when a periodic function is reset".

START status	RESET status	RESULT
True	True	Default value
False	True	Default value
True	False	Continuously computed result
False	False	Latest result

1.1.3 Configuration data

The math function conditions can be one of the following:

START true:

- Continuously — Always computes, never stops.
- Digital input *i* closed — Computes as long as the contact of digital input *i* is closed.
- Alarm *i* on — Computes as long as the alarm *i* is on.

Note: START condition is false if:	- Alarm *i* off - Digital input *i* opened

RESET true:

- No reset — Never resets via a digital input.
- Digital input *i* opened — Keeps reset value as long as digital input *i* is opened.
- Alarm *i* off — Keeps reset value as long as the alarm *i* is off.

Note: RESET condition is false if:	- Alarm *i* on - Digital input *i* closed

1.1.4 Constant coefficients

Constant coefficients are fixed values which are entered during the configuration of the math function by the operator.

The math function may include up to 4 coefficients (A, B, C, D). These coefficients are represented in a math function by $COEF_A$, $COEF_B$, $COEF_C$ and $COEF_D$. Each coefficient is a numeric value with range limits from [-9999999 to 99999999] (maximum configurable characters is 8 including a negative sign and decimal point).

1.1.5 Variables

The math function may include up to 4 variables (A, B, C, D). These variables are represented in a formula by VAR_A, VAR_B, VAR_C and VAR_D.

The variables which are selected must be one of the following:

- Analog input
- Communication input
- Math input (which may be the result of another math function).

1.2 Available Functions

NOTE: If a mathematical function is not required, select "NO FUNCTION". The recorder will not display or print the result.

The following functions are available:

- Special (See note below)
- Addition
- Basic Math 1
- Basic Math 2
- Square Root
- Sterilization
- Group sum
- Totalization
- Gas or Steam Mass Flow
- Liquid Mass Flow
- Gas or Steam Flow Totalization
- Energy Consumption
- Group Average
- Simple Periodic Average
- Elapsed Time
- Lap Time
- Cumulative Time
- Count Down
- Periodic Pulse
- Translog
- Running Group Average
- Relative Humidity
- Vacuum 10^x
- Group Min.
- Group Max.
- Group Max. - Min.
- Sigma A
- Carbon Potential
- Alarms & Digital Inputs Counter

NOTE: This function is reserved for special mathematical applications and can only be obtained by contacting the factory, or your local sales office.

1.3 Parameter Configuration

1.3.1 Overview

1.3.1.1 List of Parameters

The parameters below are used in the configuration of the MATH sub-matrix:

1. FUNCTION (mathematical formula)
2. COEF A
3. COEF B
4. COEF C
5. COEF D
6. VARIABLE A
7. VARIABLE B
8. VARIABLE C
9. VARIABLE D
10. START/STOP
11. RESET
12. FORMAT
13. ENG UNIT
14. TAG NAME

1.3.1.2 Classification explanation

The operation of the recorder when entering or changing parameters is detailed below:

◆	The configuration of parameters **will not stop data acquisition. The math function result will not be reset.**
◆◆	The configuration of parameters **will stop data acquisition. The math function result will be reset.**
♣	To modify a parameter, **PASSWORD 1** is required.
♣♣	To modify a parameter, **PASSWORD 2** is required.

1.3.2 Description

Sub-matrix	*Parameter*	*Classification*
MATH	**FUNCTION**	◆◆♣♣
Definition:	Selection of a function (MATHEMATICAL FORMULA)	
How to modify it:	Select a new function	
Possible values:	See available functions	

Sub-matrix	*Parameter*	*Classification*
MATH	**COEF A**	◆◆♣♣
Definition:	First coefficient of a function	
How to modify it:	Enter a numeric value [-9999999 ... 99999999]	
Possible values:	Up to 8 digits including a negative sign and decimal point	

Sub-matrix	*Parameter*	*Classification*
MATH	**COEF B**	◆◆♣♣
Definition:	Second coefficient of a function	
How to modify it:	Enter a numeric value [-9999999 ... 99999999]	
Possible values:	Up to 8 digits including a negative sign and decimal point	

Sub-matrix	*Parameter*	*Classification*
MATH	**COEF C**	◆◆♣♣
Definition:	Third coefficient of a function	
How to modify it:	Enter a numeric value [-9999999 ... 99999999]	
Possible values:	Up to 8 digits including a negative sign and decimal point	

Sub-matrix	*Parameter*	*Classification*
MATH	**COEF D**	◆◆♣♣
Definition:	Fourth coefficient of a function	
How to modify it:	Enter a numeric value [-9999999 ... 99999999]	
Possible values:	Up to 8 digits including a negative sign and decimal point	

Sub-matrix	*Parameter*	*Classification*
MATH	**VARIAB A**	◆◆♣♣
Definition:	First variable of a function	
How to modify it:	Select a new variable	
Possible values:	ANALOG # COMM # MATH #	

Sub-matrix	*Parameter*	*Classification*
MATH	**VARIAB B**	◆◆♣♣
Definition:	Second variable of a function	
How to modify it:	Select a new variable	
Possible values:	ANALOG # COMM # MATH #	

Sub-matrix	*Parameter*	*Classification*
MATH	**VARIAB C**	◆◆♣♣
Definition:	Third variable of a function	
How to modify it:	Select a new variable	
Possible values:	ANALOG # COMM # MATH #	

Sub-matrix	*Parameter*	*Classification*
MATH	**VARIAB D**	◆◆♣♣
Definition:	Fourth variable of a function	
How to modify it:	Select a new variable	
Possible values:	ANALOG # COMM # MATH #	

Sub-matrix	*Parameter*	*Classification*
MATH	**START**	◆◆♣♣
Definition:	Start condition of math computation	
How to modify it:	Select a new input	
Possible values:	CONTINUOUSLY DI CLOSED# AL ON #	
NOTE:	Stop conditions are the following: DI OPENED# AL OFF #	

Sub-matrix	*Parameter*	*Classification*
MATH	**RESET**	◆◆♣♣
Definition:	Reset condition of math computation	
How to modify it:	Select a new input	
Possible values:	NO RESET DI OPENED AL OFF #	

Sub-matrix	*Parameter*	*Classification*
MATH	**FORMAT**	◆♣
Definition:	Selection of a format	
How to modify it:	Select a new format	
Possible values:	AUTOMATIC XXXXXXXX XXXXXX.X XXXXX.XX XXXX.XXX EXPONENT	

Sub-matrix	*Parameter*	*Classification*
MATH	**ENG UNIT**	◆♣
Definition:	Math result Eng. unit	
How to modify it:	Enter a text	
Possible values:	Max 5 alphanumerical characters e.g. • Deg F • Deg C • PSI • BAR • µA • mm/h	

Sub-matrix	*Parameter*	*Classification*
MATH	**TAG NAME**	◆♣
Definition:	Math result name	
How to modify it:	Enter a text	
Possible values:	8 alphanumerical characters max.	

2. FUNCTIONS

2.1 Addition

Definition:

This function adds 3 input channels i.e. Analog, math or communication inputs, each input can be weighted by a coefficient.

Formula:

$$Y = (COEF_A \times VAR_A) + (COEF_B \times VAR_B) + (COEF_C \times VAR_C) + COEF_D$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Only variables A, B and C are used in the mathematical function.
Note: Variable D is unused.

- Variable A, B, C = selected input channels.
- Coefficients A, B, C and D = weighting values.

Note:

- To obtain a fixed constant function
  configure all coefficients to 0 except $COEF_D$
- To obtain the function Y = Variable A
  put all coefficients to 0 except $COEF_A$ which must be set to 1

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.2 Basic Math 1

Definition:

This function contains a combination of multiplication and addition which can be applied to 3 input channels i.e. analog, math or communication inputs.
Each input can be weighted by a coefficient.

Formula:

$$Y = (COEF_A \times VAR_A + COEF_B \times VAR_B) \times (COEF_C \times VAR_C + COEF_D)$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

All the coefficients and Variables A, B and C are used in the mathematical function.
Note: Variable D is unused.

- Variables A, B, C = selected input channels.
- Coefficients A, B, C, D = weighting values.

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.3 Basic Math 2

Definition:

This function contains a combination of multiplication, addition and division, which can be applied to 3 input channels i.e. analog, math or communication inputs.
Each input can be weighted by a coefficient.

Formula:

$$Y = \frac{COEF_A \times VAR_A + COEF_B \times VAR_B}{COEF_C \times VAR_C + COEF_D}$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

All coefficients and Variables A, B and C are used in the mathematical function.
Note: Variable D is unused.

- Variables A, B, C = selected input channels
- Coefficients A, B, C and D = weighting values.

Error detection:

If $COEF_C$ = 0 and $COEF_D$ = 0, a configuration error will be detected (See error code 7e37 on page 45).
If $(COEF_C \times VAR_C + COEF_D) = 0$, a calculation error will be detected (See error code 5e37 on page 45).

Note:

The basic math 2 formula can be modified to create a percentage function. To obtain the function, configure Coefficient B and D to 0, Coefficient C to 1 and Coefficient A to 100.

$$Y = COEF_A \times \frac{VAR_A}{VAR_C}$$

VAR_A = specific value
VAR_C = total (you can use the math function group sum to do this total).

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.4 Square Root

Definition:

This function calculates the square root of an input channel VAR_A i.e. analog, math or communication inputs. The input channels can be weighted by a coefficient.

Formula:

$$Y = COEF_A \times \sqrt{VAR_A} + COEF_B$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Coefficients A, B and Variable A are used.
Note: Coefficient C, D and Variables B, C and D are unused.

- Variable A = selected input channel
- Coefficients A and B = weighting values.

Error detection:

If the input channel Variable A is less than 0, a calculation error will be detected (See error code 5e37 on page 45).

2.5 Sterilization

Definition:

This function calculates the time to sterilize food for example.
If the function is RESET the result will be printed, and the calculation will start again from zero.

Formula:

$$Y(t) = Y(t-1) + dt \times 10^{\frac{VAR_A - COEF_A}{COEF_B}}$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

VAR_A $COEF_A$ and $COEF_B$ are used in the mathematical function.

- dt = time interval in minutes (calculated by the recorder)
- *Y(t-1)* = previous calculation of sterilization time
- VAR_A = product temperature (in °F or °C)
- $COEF_A$ = temperature standard reference (usually 250° F or 121° C)
- $COEF_B$ = thermal resistance of the product (usually 18° F or 10°C)

Note:

Coefficients C and D and Variables B, C, D are unused.

Error detection:

If $COEF_B$ = 0, a configuration error will be detected (See error code 7e37 on page 45).

2.6 Group sum

Definition:

This function calculates the sum of a specified group of consecutive input channels i.e. analog, math or communication inputs, between VAR_A and VAR_B.

Formula:

$$Y = \mathrm{SUM}(VAR_A...VAR_B)$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Only VAR_A and VAR_B are used to configure the consecutive channel numbers.
Note: Coefficients A, B, C, D and Variables C, D are unused.

Error detection:

- If one of the consecutive channel between VAR_A and VAR_B is not configured, or there is a configuration error (See error code 8e37 on page 45).
- If the selected channels are not of the same type (VAR_A is an analog input and VAR_B is a math channel), (See error code 8e37 on page 45).

Note:

The function can be applied to a single input channel by configuring Variable A = Variable B.

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.7 Totalization

Definition:

This function integrates the volume from an input flow sensor using totalization.
At the end of the preconfigured time period the result will be printed.
The calculated value will reset to zero and the totalizer will start again.

Formula:

$$Y(t) = COEF_C \times \sum_{t=0}^{t=COEF_B} COEF_A \times VAR_A(t) \times dt$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]
Y(t) = result based on actual running time of the totalizer

Result Default value:

Y = 0

Parameters:

Coefficients A, B, C, D and Variable A are used in the mathematical function.
Note: Variables B, C, and D are unused.

- $COEF_D$ = engineering unit of the flow sensor,
  0 = second, 1 = minute, 2 = hour, 3 = day
  E.g.: for flow in m^3 / minute, configure $COEF_D$ to 1
- $COEF_B$ = time period in the time unit defined by $COEF_D$
  E.g.: If $COEF_D$ = 2 and $COEF_B$ = 1.25
  The running time of the totalizer will be 1h15mn.
  If $COEF_B$ = 0, the totalization period is infinite.
  Note: Coefficients A & C are weighting values.
  Variable A can be an analog, math or communication input.

Error detection:

- If $COEF_B$ is less than 0, a configuration error will be detected.(See error code 7e37 on page 45)
- If $COEF_D$ is not configured to 0, 1, 2 or 3, a configuration error will be detected.(See error code 7e37 on page 45).

Result printout:

Refer to Section 3 paragraph 3.2.2 "Printing a math result when a periodic function is reset".

2.8 Gas or Steam Mass Flow

Definition:

This function calculates the mass flow rate of gas or steam, based on changes in differential pressure, temperature and static pressure.

Formula:

$$Y = COEF_A \times \sqrt{\frac{VAR_A \times (VAR_B + COEF_B)}{VAR_C + COEF_C}}$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Coefficients A, B, C, and Variables A, B and C are used in the mathematical function.
Note: Coefficient D and Variable D are unused.
Variables A, B, C input channels can be analog, math or communication inputs.

	IS (metric)	English
$COEF_B$ = pressure reference	1	14.5
$COEF_C$ = temperature reference	273.2 DEG C	459.7 DEG F
VAR_A = differential pressure	BAR	P.S.I
VAR_B = gauge pressure	BAR	P.S.I
VAR_C = temperature	° C	° F

$COEF_A$ = K_0 (constant dependent on flow conditions).

Calculation of Coefficient A for steam flow application only

$$COEF_A = K_0 \times \sqrt{\frac{T_r}{V_r \times P_r}}$$

with T_r, V_r and P_r temperature, volume and pressure at the reference conditions

Error detection:

- If $(VAR_C + COEF_C) = 0$, a calculation error will be detected (See error code 5e37 on page 45).
- If $\frac{VAR_A \times (VAR_B + COEF_B)}{VAR_C + COEF_C} < 0$, a calculation error will be detected, (See error code 5e37 on page 45).

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.9 Liquid Mass Flow

Definition:

This function calculates the mass flow rate of a liquid via an input flow sensor i.e. analog, math or a communication input.

Formula:

$$Y = COEF_A \times \sqrt{COEF_B \times VAR_A} + COEF_C$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

$COEF_A$, $COEF_B$, $COEF_C$, VAR_A used.

- $COEF_A$ = flow constant
- $COEF_B$ = liquid density at flow temperature
- $COEF_C$ = weighting factor not normally required, default setting 0
- VAR_A = differential pressure

Error detection:

If $COEF_B \times VAR_A < 0$, a calculation error will be detected.
(See error code 5e37 on page 45).

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.10 Gas or Steam Flow Totalization

Definition:

This function integrates the volume of gas or steam flow using temperature and pressure compensation to calculate the totalized flow during a preconfigured time period. At the end of the preconfigured time period the result will be printed. The calculated value will rest to zero and the totalizer will start again.

Formula: The variables can be analog, math or communication inputs.

$$Y(t) = COEF_B \times \sum_{t=0}^{t=COEF_A} \left(\sqrt{\frac{VAR_A(t) \times (VAR_B(t) + P_r)}{VARc(t) + T_r}} \right) \times dt$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]
Y(t) = result based on actual running time of the totalizer.

Result Default value:

Y = 0

Parameters:

Variables A, B, C and coefficients A, B, C and D are used in the mathematical function.
Note: Variable D is unused.

- $COEF_C$ = engineering unit of flow sensor
  0 = second, 1 = minute, 2 = hour, 3 = day
  E.g.: for flow in m^3 / minute, configure $COEF_C$ to 1
- $COEF_A$ = time period in the time unit defined by $COEF_C$
  E.g.: If $COEF_C$ = 2, $COEF_B$ = 1.25
  The running time of the totalizer will be 1h15mn.
  If $COEF_A$ = 0, the totalization period is infinite.
- $COEF_D$ = selection of the Engineering unit. (0 = S.I.(metric), 1 = English)

	S.I. (metric)	English
$COEF_D$	0	1
P_r = pressure reference	1	14.5
T_r = temperature reference	273.2 DEG C	459.7 DEG F
VAR_A = differential pressure	BAR	P.S.I
VAR_B = gauge pressure	BAR	P.S.I
VAR_C = temperature	° C	° F

Error detection:

- If $COEF_A$ < 0, a configuration error will be detected. (See error code 7e37 on page 45).
- If $COEF_C$ is not configured to 0, 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).
- If $COEF_D$ is not configured to 0 or 1, a configuration error will be detected (See error code 7e37 on page 45).
- If $(VARc(t) + Tr)$ = 0, a calculation error will be detected. (See error code 7e37 on page 45).

- If $\frac{VAR_A(t) \times \left(VAR_B(t) + P_r\right)}{VAR_C(t) + T_r} < 0$, a calculation error will be detected. (See error code 7e37 on page 45).

Result printout:

Refer to section 3 Paragraph 3.2.2 "printing a math result when a periodic function is reset".

2.11 Energy consumption

Definition:

This function calculates continuously the energy consumption of a Flow input during a preconfigured time period.
At the end of the time period, the result will be printed. The result will reset to zero and the calculation will start again.

Formula: Variables can be analog, math or communication inputs

$$Y(t) = COEF_B \times \sum_{t=0}^{t=COEF_A} \left(VAR_A(t) - VAR_B(t)\right) \times VAR_C(t) \times dt$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]
Y(t) = Result based on actual running time of the totalizer.

Result Default value:

Y = 0

Parameters:

Coefficients A, B, C and Variables A, B, C are used in the mathematical function.
Note: Variable D and Coefficient D are unused.

- $COEF_C$ = engineering unit of the flow sensor
  0 = second, 1 = minute, 2 = hour, 3 = day
  Ex: for flow in m^3 / minute, configure $COEF_C$ to 1.
- $COEF_A$ = time period in the time unit defined by $COEF_C$
  Ex: If $COEF_C$ = 2, $COEF_B$ = 1.25
  The running time of the totalizer will be 1h15mn.
  If $COEF_A$ = 0, the totalization period is infinite.
- Coefficient B = Weighting Factor
- Variable A = inlet temperature
- Variable B = outlet temperature
- Variable C = Flow input

Error detection:

- If $COEF_A$ < 0, there is a configuration error (See error code 7e37 on page 45).
- If $COEF_C$ is different from 0, 1, 2 or 3, there is a configuration error, (See error code 7e37 on page 45).

Result printout:

Refer to section 3 Paragraph 3.2.2 "printing a math result when a periodic function is reset".

2.12 Group Average

Definition:

This function calculates the average value of a specified group of consecutive channels i.e. analog, math or communication inputs between VAR_A and VAR_B.

Formula:

$$Y = \frac{\mathrm{SUM}(VAR_A \ldots VAR_B)}{CHAN_B - CHAN_A + 1}$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Only VAR_A and VAR_B are used to configure the consecutive channel numbers.
Note: Coefficients A, B, C, D and Variables C, D are unused.

Error detection:

- If one of the consecutive channels between VAR_A and VAR_B is not configured, there is a configuration error.
  (See error code 8e37 on page 45).
- If the selected channels are not of the same type e.g.(VAR_A is an analog input and VAR_B is a math channel).
  (See error code 8e37 on page 45).

Note:

The function can be applied to a single channel by configuring
Variable A = Variable B

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.13 Simple Periodic Average

Definition:

This function calculates continuously the average value of a defined input channel during a preconfigured time period.
At the end of the preconfigured time period, the result will be printed.
The result will reset to zero and the calculation will start again.

Formula: Variable A can be an analog, math or communication input.

$$Y(t) = \sum_{t=0}^{t=COEF_B} \frac{VAR_A(t)}{dt}$$

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]
The result is the average value of the defined input channel VAR_A , since the start of the calculation.

Result Default value:

Y = 0

Parameters:

Coefficients A, B and Variable A are used in the mathematical function.
Note: Coefficients C, D and Variables B, C, D are unused.

- VAR_A = input to which the function is applied.
- $COEF_A$ = engineering unit
  1 = minute, 2 = hour, 3 = day.
- $COEF_B$ = time period in the time unit defined by $COEF_A$,
  If $COEF_B$ = 0, the periodic average time period is infinite.

Error detection:

- If $COEF_A$ is not configured to 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).
- If $COEF_B$ < 0, a configuration error will be detected.
  (See error code 7e37 on page 45).

Result printout:

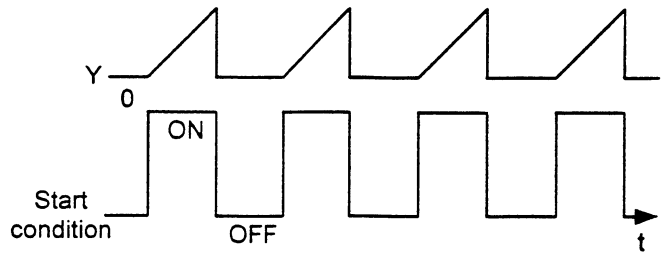
Refer to section 3 Paragraph 3.2.2 "printing a math result when a periodic function is reset".

2.14 Elapsed Time

Definition:

This function calculates the elapsed time for as long as the START condition is ON.

- If the START condition is OFF, the Elapsed time is equal to zero.
- If the RESET condition is ON, the Elapsed time is equal to zero.
- If the START condition is ON and the RESET condition is OFF, the timer counts.



Formula:

$$Y(t) = \text{ELAPSED TIME}(COEF_A)$$

Calculated Value Limits:

The result can be displayed in a decimal format [0... 99999999] or as an Exponent value [0 .. 1e37]

Result Default value:

Y (t) = 0

Parameters:

- Only Coefficient A is used.
  Note: Coefficients B, C, D and Variables A, B, C, D are unused.
- $COEF_A$ = engineering unit used for the result Y.
  0 = second, 1 = minute, 2 = hour, 3 = day.

Error detection:

If $COEF_A$ is not configured to 0, 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).

Note:

When the START condition is OFF, the result value will be reset to zero.

Result printout:

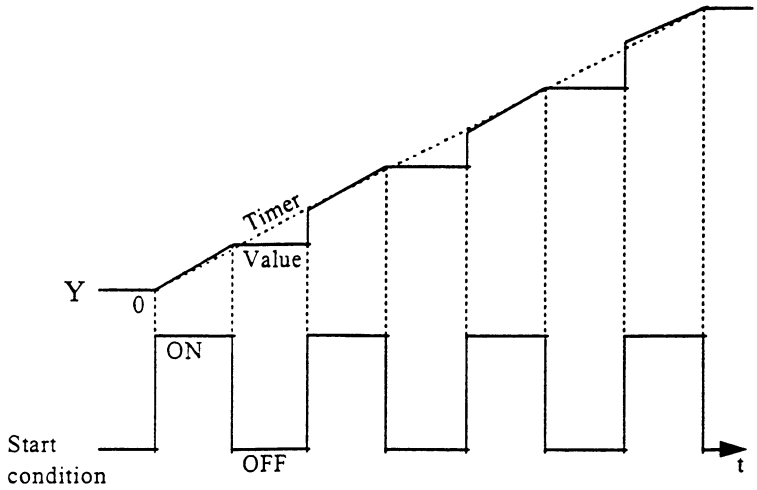
Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.15 Lap Time

Definition:

This function calculates the total which has elapsed since the start of the calculation.

- If the START condition is OFF, the elapsed time is held but the timer still continues to count.
- If the RESET condition is ON, the elapsed time is zero.
- If the START condition is ON and the RESET condition is OFF, the timer counts.



Formula:

$$Y(t) = \text{LAP TIME}(COEF_A)$$

Calculated Value Limits:

The result can be displayed in a decimal format [0... 99999999] or as an Exponent value [0 .. 1e37]

Result Default value:

Y (t) = 0

Parameters:

- Only Coefficient A is used.
  Note: Coefficients B, C, D and Variables A, B, C, D are unused.
- $COEF_A$ = engineering unit used for the result Y.
  0 = second, 1 = minute, 2 = hour, 3 = day.

Error detection:

If $COEF_A$ is not configured to 0, 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).

Result printout:

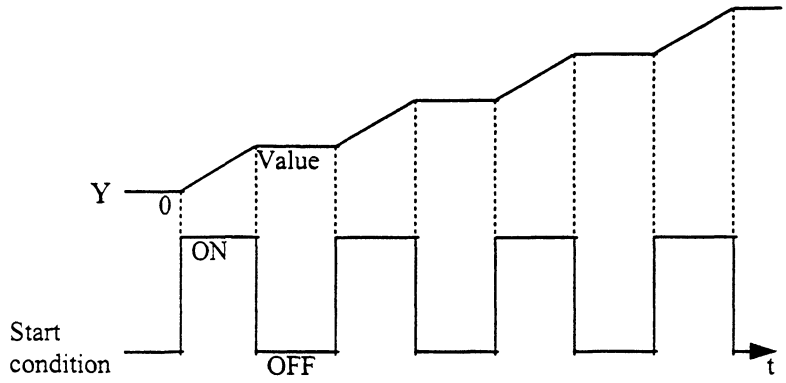
Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.16 Cumulative Time

Definition:

This function calculates the cumulative time only when the start condition is ON.

- If the START condition is OFF, the elapsed time is held and the timer stops counting.
- If the START condition is ON and the RESET condition is OFF, the timer counts.
- If the RESET condition is ON, the elapsed time is zero.



Formula:

$$Y(t) = \text{CUMULATIVE TIME}(COEF_A)$$

Calculated Value Limits:

The result can be displayed in a decimal format [0... 99999999] or as an Exponent value [0 .. 1e37]

Result Default value:

Y (t) = 0

Parameters:

- Only Coefficient A is used.
  Note: Coefficients B, C, D and Variables A, B, C, D are unused.
- $COEF_A$ = engineering unit used for the result Y.
  0 = second, 1 = minute, 2 = hour, 3 = day.

Error detection:

If $COEF_A$ is not configured to 0, 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).

Note:

This function is nearly identical to Lap time except that the timer stops counting when the start condition is OFF.

Result printout:

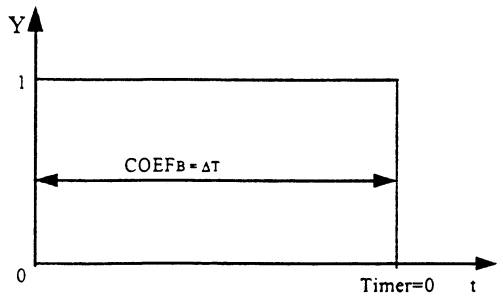
Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.17 Count Down

Definition:

This function decrements a timer.

- If the START condition is OFF, the time is held and the timer stops decrementing.
- If the START condition is ON and the RESET condition is OFF, the timer decrements.
- If the RESET condition is ON, the time is reset to the preconfigured time period equal to $COEF_B$.
- When the timer reaches 0, it stops decrementing.



Formula:

$$Y(t) = \text{COUNT DOWN}(COEF_A, COEF_B)$$

Calculated Value Limits:

0 or 1

Result Default value:

Y(t) = 1

Parameters:

Only Coefficients A and B are used.
Note: Coefficients C, D and Variables A, B, C, D are unused.

- $COEF_A$ = engineering unit used to configure $COEF_B$,
  0 = second, 1 = minute, 2 = hour, 3 = day
- $COEF_B$ = configured time interval to decrement.

Error detection:

- If $COEF_A$ is not configured to 0, 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).
- If $COEF_B \leq 0$, a configuration error will be detected. (See error code 7e37 on page 45).

Result printout:

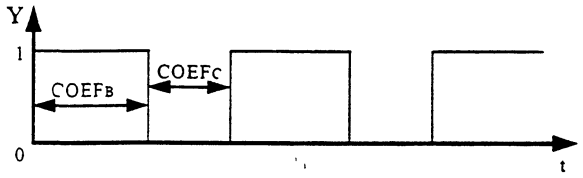
Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.18 Periodic Pulse

Definition:

This function decrements a dual timer.

- If the START condition is OFF, the Time is held and the Timer(s) stops decrementing.
- If the RESET condition is ON the timer is reset to the configured time interval equal to Coefficient B, the result will = 1.
- If the START condition is ON and the RESET condition is OFF, the timer(s) decrement.
- When the first time interval (Coefficient B) has elapsed the result switches from 1 to 0. The second time period (Coefficient C) then starts to decrease, when the time interval has elapsed the result switches from 0 to 1.
- The sequence will be repeated as long as the start condition is ON and the reset condition is OFF.
- The time intervals are configured by Coefficients A and B.



Formula:

$$Y(t) = \text{COUNT DOWN}(COEF_A, COEF_B, COEF_C)$$

Calculated Value Result:

0 or 1
When one of the configured time periods has elapsed the result will switch from 1 to 0 or from 0 to 1.

Result Default value:

Y(t) = 1

Parameters:

Only Coefficients A, B and C are used.
Note: Coefficient D and Variables A, B, C, D are unused.

- $COEF_A$ = engineering unit used to configure $COEF_B$ and $COEF_C$
  0 = second, 1 = minute, 2 = hour, 3 = day
- $COEF_B$ = time interval, the result will equal 1.
- $COEF_C$ = time interval, the result will equal 2.

Error detection:

- If $COEF_A$ is different from 0, 1, 2 or 3, there is a configuration error (See error code 7e37 on page 45).
- If $COEF_B \leq 0$ or $COEF_C \leq 0$, there is a configuration error (See error code 7e37 on page 45).

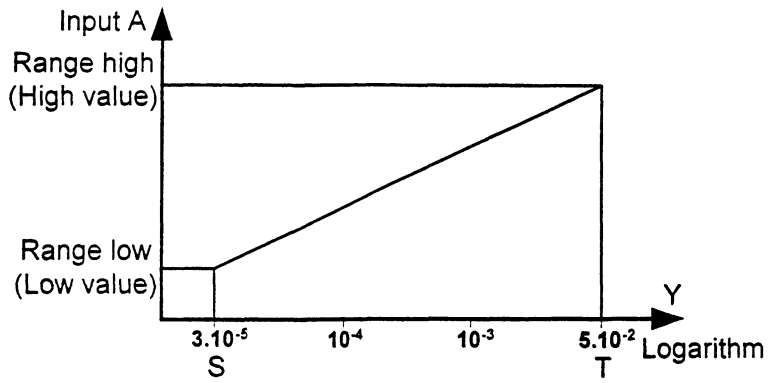
Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.19 Translog

Definition:

This function establishes a relationship between a linear analog input range (A) and a logarithmic scale (Y). See example below:



A typical application would be vacuum pressure measurement.

- The requirement is to Display and record logarithmic values.
- The recorder must have a special pre-printed chart which is scaled with the required number of log divisions.
- The recorder must be configured not to print any chart range information.
  Refer to the Product Manual section 4 Configuration sub-matrix "CHART DOC" parameter "INFORMATION" to disable Chart Range printing.

Formula:

The low value (S) and the high value (T) must be entered for the logarithmic range.

$S = COEF_A \times 10^{COEF_B}$

$T = COEF_C \times 10^{COEF_D}$

Example: S = 3.10^{-5} with $COEF_A$ = 3 and $COEF_B$ = -5
T = 5.10^{-2} with $COEF_C$ = 5 and $COEF_D$ = -2

The recorder must be configured to record the Exponent
Refer to this manual, Section 1 Configuration sub-matrix "MATH" parameter "FORMAT".
The recorder will automatically select the configured Exponent range applied to the analog input.
Note: the recorder must be configured to record the mathematical result of the Translog.
Refer to the Product Manual Section 4 Configuration sub-matrix "CHART" parameter "TRACE".

Calculated Value Result:

The result will be displayed as an Exponent value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

All coefficients A, B, C, D and Variable A are used in the mathematical function.
Note: Variables B, C, D are unused.

- VAR_A = Selected analog input
- $COEF_A$ = low scale value (minimum value of S)
- $COEF_B$ = low scale exponent (exponent of S)
- $COEF_C$ = high scale value (maximum value of T)
- $COEF_D$ = high scale exponent (exponent of T)
- *HIGH VALUE* = high limit of analog input (see ANALOG INPUT matrix)
- *LOW VALUE* = low limit of analog input (see ANALOG INPUT matrix)

Error detection:

- If VAR_A is not an analog input, a configuration error will be detected. (See error code 8e37 on page 45).
- If the analog input *HIGH VALUE* = *LOW VALUE*, a configuration error will be detected. (See error code 8e37 on page 45).
- If $COEF_A \leq 0$ or $COEF_C \leq 0$, a configuration error will be detected. (See error code 7e37 on page 45).
- If the analog input value is not within the configured Low and High range values, a calculation overflow error will be detected. (See error code 1e38 on page 45).

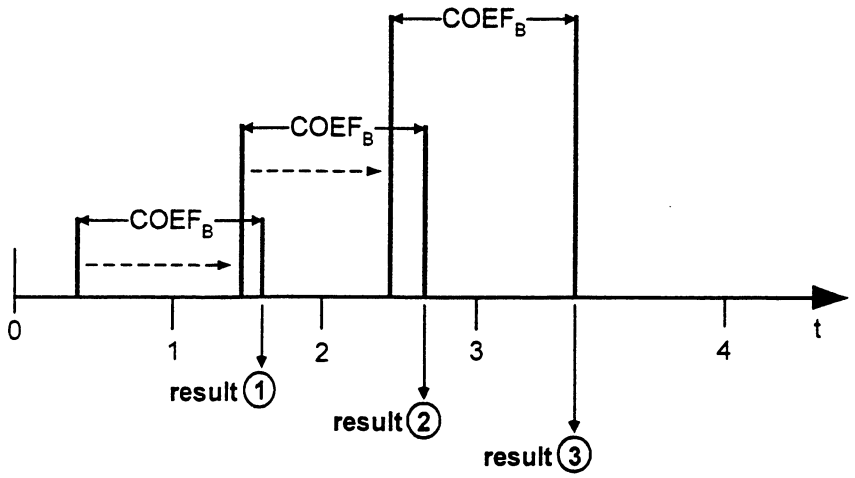
Note:

The logarithmic scale can be configured to have an inverse range if required.

2.20 Running Group Average

Definition:

This function calculates the running average of a specified group of consecutive input channels (analog, math or communication inputs), between VAR_A and VAR_B .
The sample time is configured by $COEF_A$ and $COEF_B$.
Example:



At the start of each new mathematical computation, the result will be the Average of the previous Average calculations i.e. a Continuous Running Average.

Calculated Value Result:

The result can be displayed in a decimal format [-9999999 ... 99999999] or as an Exponent Value [-1e38 .. 1e37]

Result Default value:

Y = 0

Parameters:

Only Coefficients A, B and Variables A, B are used in the mathematical function.
Note: Coefficients C, D and Variables C, D are unused.

- $COEF_A$ = Engineering unit of $COEF_B$.
  1 = minute, 2 = hour, 3 = day
- $COEF_B$ = time period in the time unit defined by $COEF_A$
- Variable A and B are used to configure the selected channel numbers.

Error detection:

- If one of the consecutive channels between VAR_A and VAR_B is not configured, there is a configuration error (See error code 8e37 on page 45).
- If the consecutive channels between VAR_A and VAR_B are not of the same type, (e.g VAR_A is an analog input and VAR_B is a math channel) a configuration error will be detected. (See error code 8e37 on page 45).
- If $COEF_A$ is not configured to 1, 2 or 3, a configuration error will be detected. (See error code 7e37 on page 45).
- If $COEF_B \leq 0$, a configuration error will be detected. (See error code 4e37 on page 45).

- The maximum number of "Running group average" calculations possible is 5, if this number is exceeded a configuration error will be detected. (See error code 4e37 on page 45).

Note:

This function can be applied to a single input channel by configuring Variable A = Variable B

Result printout:

Refer to section 3 Paragraph 3.2.1 "printing a math result".

2.21 Relative Humidity

Definition:

This function calculates the relative humidity from a difference of temperature between wet bulb and dry bulb sensors.

Formula:

$Y = W \times X$

$W = {}^{100}/_{P_{dry}}$

$K_a = VAR_A$ converted in °F

$K_b = VAR_B$ converted in °F

$X = P_{wet} - (K_b \times 0.001258 + 0.993)(K_a - K_b) \times COEF_B \times 0.000701$

Calculated Value Limits:

[0 .. 100].

Result Default value:

$Y = 0$

Parameters:

VAR_A, VAR_B, $COEF_A$, $COEF_B$ used.

- $COEF_A$ = 0 if in °F
  = 1 if in °C
- $COEF_B$ = atmospheric pressure in mmHg (usually 760 mmHg)
- VAR_A = dry bulb temperature in the unit defined by $COEF_A$, included in [0 .. 100°C] or [32 .. 212°F].
- VAR_B = wet bulb temperature in the unit defined by $COEF_A$, included in [0 .. 100°C] or [32 .. 212°F].
- P_{wet} and P_{drv} are automatically calculated by the recorder.

Error detection:

- If $COEF_A \notin \{0, 1\}$, there is a configuration error. (See error code 7e37 on page 45).
- If the values for VAR_A or VAR_B are not within the time period, there is a calculation error. (See error code 5e37 on page 45).

2.22 Vacuum 10^X

Definition:

This function calculates a power of 10.

Formula:

$$Y = COEF_A \times 10^{VAR_A}$$

Calculated Value Limits:

[0 .. 1e37]

Result Default value:

$Y = 0$

Parameters:

Only VAR_A and $COEF_A$ are used.

2.23 Group Min.

Definition:

This function calculates the lowest value of a specified group of consecutive channels between VAR_A and VAR_B.

Formula:

$$Y = \left(\mathrm{MIN}\left(VAR_A \ldots VAR_B\right)\right) \times COEF_A$$

Calculated Value Limits:

[-1e38 .. 1e37]

Result Default value:

$Y = 0$

Parameters:

$COEF_A$, VAR_A and VAR_B are used.
VAR_A and VAR_B are used to configure the consecutive channels numbers.

Example:

Take:	$VAR_A = \mathrm{MATH}_1$, $VAR_B = \mathrm{MATH}_4$, $COEF_A = 1$,
therefore:	$CHAN_A = 1$, $CHAN_B = 4$,
with:	$\mathrm{MATH}_1 = 45$, $\mathrm{MATH}_2 = 12$, $\mathrm{MATH}_3 = 4$, $\mathrm{MATH}_4 = 55$,
result:	$Y = 4$

Error detection:

- If one of the consecutive channels between VAR_A and VAR_B is not configured, there is a configuration error (See error code 8e37 on page 45).
- If the channels are not of the same type (VAR_A is an analog input and VAR_B is a math channel), there is a configuration error (See error code 8e37 on page 45).

Note:

This function can be applied to a single input channel ($VAR_A = VAR_B$).

2.24 Group MAX.

Definition:

This function calculates the highest value of a specified group of consecutive channels between VAR_A and VAR_B.

Formula:

$$Y = \left(\mathrm{MAX}(VAR_A ... VAR_B)\right) \times COEF_A$$

Calculated Value Limits:

[-1e38 .. 1e37]

Result Default value:

$Y = 0$

Parameters:

$COEF_A$, VAR_A and VAR_B are used.
VAR_A and VAR_B are used to configure the consecutive channels numbers.

Example:

Take:	$VAR_A = \mathrm{MATH}_1$, $VAR_B = \mathrm{MATH}_4$, $COEF_A = 1$,
therefore:	$CHAN_A = 1$, $CHAN_B = 4$,
with:	$\mathrm{MATH}_1 = 45$, $\mathrm{MATH}_2 = 12$, $\mathrm{MATH}_3 = 4$, $\mathrm{MATH}_4 = 55$,
result:	$Y = 55$

Error detection:

- If one of the consecutive channels between VAR_A and VAR_B is not configured, there is a configuration error. (See error code 8e37 on page 45).
- If the channels are not of the same type (VAR_A is an analog input and VAR_B is a math channel), there is a configuration error. (See error code 8e37 on page 45).

Note:

This function can be applied to a single input channel ($VAR_A = VAR_B$).

2.25 Group MAX. - MIN.

Definition:

This function calculates the difference between the highest and the lowest value of a specified group of consecutive channels between VAR_A and VAR_B.

Formula:

$$Y = \left(\mathrm{MAX}(VAR_A \ldots VAR_B)\right) \times COEF_A - \left(\mathrm{MIN}(VAR_A \ldots VAR_B)\right) \times COEF_B$$

Calculated Value Limits:

[-1e38 .. 1e37].

Result Default value:

$Y = 0$

Parameters:

$COEF_A$, $COEF_B$, VAR_A and VAR_B are used.
VAR_A and VAR_B are used to configure the consecutive channels numbers.

Example:

Take:	$VAR_A = \mathrm{MATH}_1$, $VAR_B = \mathrm{MATH}_4$, $COEF_A = 1$, $COEF_B = 1$,
therefore:	$CHAN_A = 1$, $CHAN_B = 4$,
with:	$\mathrm{MATH}_1 = 45$, $\mathrm{MATH}_2 = 12$, $\mathrm{MATH}_3 = 4$, $\mathrm{MATH}_4 = 55$,
result:	$Y = 51$ (1×55-1×4)

Error detection:

- If one of the consecutive channels between VAR_A and VAR_B is not configured, there is a configuration error. (See error code 8e37 on page 45).
- If the channels are not of the same type (VAR_A is an analog input and VAR_B is a mathematical channel), there is a configuration error. (See error code 8e37 on page 45).

Note:

This function can be applied to only one input channel ($VAR_A = VAR_B$).

2.26 Sigma A

Definition:

This function continuously calculates the sigma A value for a vacuum application during a preconfigured time period. At the end of this period, the result will be printed, then reset to 0 and the totalization will start again.

Formula:

$$y(t) = 10^{COEF_B} \times \sum_{t=0}^{t=COEF_A} \left(\exp^{(-40000/T)} \right) \times dt$$

T is the VAR_A temperature expressed in Kelvin

Calculated Value Limits:

The result can be displayed in a decimal format [-9999999 ..... 99999999] or as an Exponent value [-1e38 .. 1e37].

Y(t) = partial calculation result.

Result default value:

Y(t) = 0

Parameters:

VAR_A, $COEF_A$, $COEF_B$, $COEF_C$ and $COEF_D$ are used.

- VAR_A is the temperature.
- $COEF_A$ = time period in the time unit defined by $COEF_C$
- $COEF_B$ coefficient of scale setting.
- $COEF_C$ time unit:
  0 = second, 1 = minute, 2 = hour, 3 = day
- $COEF_D$ expresses the VAR_A unit:
  0 = °C , 1 = °F.

Error detection:

- If $COEF_A$ < 0, a configuration error will be detected. (see error code 7e37 page 45).
- If $COEF_B$ <-38 or $COEF_B$ >37: a configuration error will be detected (see error code 7e37 on page 45).
- If $COEF_C$ is different from 0, 1, 2 or 3, a configuration error will be detected. (see error code 7e37 on page 45).
- If $COEF_D$ is different from 0 or 1, a configuration error will be detected. (see error code 7e37 on page 45).
- If *T* = 0, a configuration error will be generated (see error code 5e37 on page 45).

2.27 Carbon Potential

Definition:

This function calculates the carbon potential from:

- a carbon sensor,
- a Fahrenheit (or Celsius) degree temperature,
- a cracked carbon monoxide coefficient or a cracked carbon monoxide input sensor.

Five types of carbon are supported and you can make your selection with $COEF_B$.

Formula:

a - For Marathon, Corning, AACC and Barber Coleman types:

$$\%C = \frac{191.5 \times \left(10^{K}\right)}{1 + 50.5 \times \left(10^{K}\right)}$$

b - For FCC type:

$$\%C = 10^{K}$$

For both types: If $\%C > 0.85$ then

$$\%C = \%C + (\%C - 0.85) \times adjust$$

With:

- If $COEF_B$ = 1 (Marathon, Cambridge types),

$$K = \frac{Ec - 820.7}{0.05511 \times Tr} + \mathrm{LOG}(Pco) - 4.2143$$

and *adjust* = 0

- If $COEF_B$ = 2 (Corning type),

$$K = \left(\frac{Ec - 800.8}{0.05511 \times Tr} - 5.0113 + 0.86 \times \mathrm{LOG}(Pco)\right) \Big/ 1.21$$

and *adjust* = 0.24

- If $COEF_B$ = 3 (AACC type),

$$K = \frac{Ec - 799.38}{0.05511 \times Tr} + \mathrm{LOG}(Pco) - 4.39673$$

and *adjust* = 0.26

- If $COEF_B$ = 4 (Barber Coleman type),

$$K = \frac{Ec - 849.5}{0.05511 \times Tr} + \mathrm{LOG}(Pco) - 3.99332$$

and *adjust* = 0

- If $COEF_B$ = 5 (FCC type),

$$K = \frac{802.904 + 0.1601 \times Tr - Ec - \left(0.05512 \times Tr \times \mathrm{LOG}(5 \times Pco)\right)}{113.165 - 0.1249 \times Tr}$$

and *adjust* = 0

Result default value:

Y = 0

Parameters:

VAR_A, VAR_B, VAR_C, $COEF_A$, $COEF_B$, $COEF_C$ used.

- $COEF_A$ = 0 if in °F
  = 1 if in °C
- $COEF_B$ = carbon type
  1: Marathon, Cambridge
  2: Corning
  3: AACC
  4: Barber
  5: FCC
- $COEF_C$ = *Pco*: cracked carbon monoxide coefficient from 0.02 to 0.35.
  If $COEF_C$ = 0.0, *Pco* takes the VAR_C input result.
- VAR_B = *Ec*: carbon sensor output in mV (0 - 1250).
- VAR_A = Temperature used to calculate *Tr* in the unit defined by $COEF_A$, in the [1400 .. 2000 R] interval.
- VAR_C = *Pco*: cracked carbon monoxide value if $COEF_C$ = 0.0.
- *%C* = carbon potential.

Example:

Marathon sensor with thermocouple in °F

- $COEF_A$ = 0 (°F)
- $COEF_B$ = 1 (Marathon type)
- $COEF_C$ = 0.2 (*Pco*)
- VAR_A = 1500 °F
- VAR_B = 1098 mV
- VAR_C = not used in this example since $COEF_C$ is different from 0.

Result: *%C* = 0.7 % (Carbon Potential)

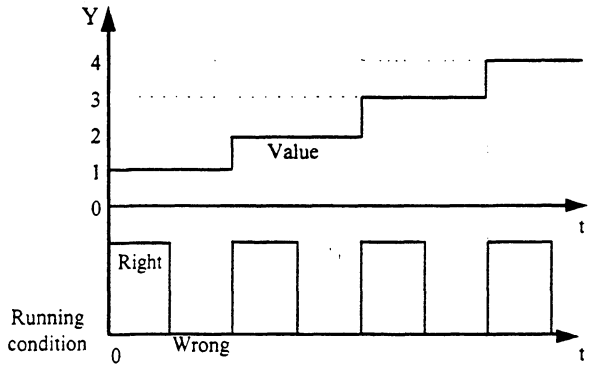
Error detection:

- If $COEF_A \notin \{0, 1\}$, there is a configuration error (see error code 7e37 on page 45).
- If $COEF_B \notin \{1, 2, 3, 4, 5\}$, there is a configuration error (see error code 7e37 on page 45).
- If $COEF_C \notin [0.02 \ldots 0.35]$ and $COEF_C \neq 0$, there is a configuration error (see error code 7e37 on page 45).
- If $VAR_B \notin [0 \ldots 1250]$, there is a calculation error (see error code 5e37 on page 45).
- If $VAR_C \notin [0.02 \ldots 0.35]$, there is a calculation error (see error code 5e37 on page 45).

2.28 Alarms & Digital Inputs Counter

Definition:

This function totalizes the high state changes of the RUNNING condition during a preconfigured time period in $COEF_B$. Each time the RUNNING condition switches from wrong to right, the function result increases by 1. This allows to count how many times an alarm has been triggered for example.
At the end of the time period, the result is printed, reinitialized to its default value and the totalization starts again during the same time period.



Calculated Value Limits:

[0 .. 2e9].
Y(t) = totalization result since the beginning of the time period.

Result default value:

Y = 0

Parameters:

$COEF_A$ and $COEF_B$ are used.

- $COEF_A$ = unit of time used by $COEF_B$,
  1 = minute, 2 = hour, 3 = day.
- $COEF_B$ = totalization period,
  if $COEF_B$ = 0, the totalization period is infinite.

Errors detection:

- If $COEF_A \notin \{1, 2, 3\}$, there is a configuration error (see error code 7e37 on page 45).
- If $COEF_B < 0$, there is a configuration error (see error code 7e37 on page 45).

Note:

This mathematical function can miss running condition state changes if these are too close. The on time for the Alarm or Digital Input must be on at least 5 seconds in order to be detected.

3. RESULT FORMAT

3.1 Introduction

Mathematical results are floating-point numbers between the Exponent values [-1e38 .. 1e37].
The recorder can also indicate the results in a decimal format [- 9999999 ..... 99999999].

If the value exceeds 1e37 an error will be detected.
Refer to Section 4 "Troubleshooting guide" to understand the meaning of the error code and the corrective action required.

Each mathematical result can be displayed and printed in an 8 digit format if required.
Refer to Section 1 Parameter "FORMAT" in the "MATH " sub-matrix configuration.

NOTE: The mathematical results can also be displayed in a 5 digit format, and recorded as a TREND trace. Refer to the recorder product manual Section 4 Configuration sub-matrix "CHART" parameter "FORMAT".

NOTE: The results will only be indicated in a 5 digit format, if the recorder is configured to display "TRACE & TAG" or "2 PVS TRACE".
Refer to the recorder product manual Section 4 Configuration Sub-matrix "MMI" parameter "DISPLAY HI & LO".
The results will only be indicated in an 8 digit format, if the recorder is configured to display the "MATH RESULTS."

The results will only be printed in an 8 digit format, when the recorder prints a snap shot of the math results.

3.2 Printing math results

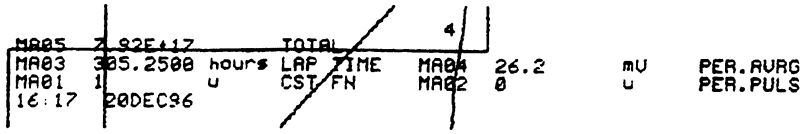
3.2.1 Printing a math result table

The printing of the mathematical results table can be triggered:

- When the recorder is selected to print a "SNAP SHOT MATH" in RUN mode (on blank paper).
  Refer to the recorder product manual Section 3 Paragraph 3.5.2 Printer action.
- When an Analog alarm or a Digital event is configured to " PRINT MATH LOG" (on top of traces).
  Refer to the recorder product manual Section 4 Sub-matrix "ALARM" or "DIGITAL" parameter "ACTION".
- Periodically if "SNAP SHOT MATH" (on top of trend traces) is selected.
  Refer to the recorder product manual Section 4 sub-matrix "CHART DOC" parameter "INFORMATION".

NOTE: Only the configured math channels will be printed.

Print format:



3.2.2 Printing a math result when a periodic function is reset

The math functions below will automatically print the result of a calculation at the end of the pre-configured time period.

The function result will reset to zero, and the computation starts again.
Hence each time a periodic function is reset, i.e. RESET in RUN mode or RESET due to the preconfigured time period, the function result will be printed.

List of periodic functions:

- Totalization
- Gas or Steam Flow Totalization
- Energy Consumption
- Simple Periodic Average
- Alarms & digital inputs counter

Print format when a function is reset:

MA16	1490849	flow	ENERGY C	16:24	13	JAN 97
MAIO	7313067	flow	ENERGY10	16:24	13	JAN 97
MA13	4348338	flow	ENERGY C	16:23	13	JAN 97

4. TROUBLESHOOTING GUIDE

4.1 Overview

There are only two errors types:

- **CONFIGURATION ERRORS** (error codes 9e37, 8e37, 7e37 and 4e37)

The above error codes are detected **AFTER** a configuration change. They cannot be detected when starting modification.

If the errors are detected the following actions will be implemented:

➔ The math function which is incorrectly configured will not operate, only the error code will be displayed.

➔ The math function which is incorrectly configured will not be recorded as a trend trace.

➔ The math function which is incorrectly configured will not operate any Alarms assigned to it, the Alarms will automatically be set to OFF.

- **COMPUTING ERRORS** (error codes 6e37, 5e37, 1e38)
  These errors are detected **DURING** the normal operation of a math Function.

Note: If the function is not used i.e. the selected math function is configured NO FUNCTION, the RESULT will not be displayed or recorded.

4.2 Explanations

	ERROR CODE # (OUTPUT)	CONDITIONS
CONFIGURATION ERRORS	9e37	Incorrect configuration for the START or RESET condition of a math function: • the ALARM type is configured " NONE", or • the configured digital input does not exist.
	8e37	One of the selected math function variables has an incorrectly configured input. • the selected Analog input does not exist or is configured NO ENTRY, or • a Math result is being used as input variable but is configured NO FUNCTION or the math input is incorrectly configured (configuration error) or • the communication card is not present.
	7e37	The value of one of the coefficients used in the formula is incorrect. (Ex.: $COEF_C$ = 0 and $COEF_D$ = 0 in the BASIC MATH 2 function)
	4e37	The maximum number of Running Group Average functions has been exceeded.
COMPUTING ERRORS	6e37	The value of one of the configured variables is incorrect. • The math function used for a variable input has computed an error result, i.e. the result is an overflow value. • The analog input is in burnout (See note below).
	5e37	One of the variables has a value which creates a computing error in the formula i.e. a negative value is applied to a square root function, or a value is being divided by zero.
	1e38	The result is an overflow value.

Note: The Burnout configuration for certain input sensors cannot be changed i.e. fixed (FIX LOW, FIX HIGH). The failure of the sensor types listed below cannot be detected.

RTD/OHMS, mA: See BURNOUT parameter in ANALOG sub-matrix (in the Product Manual).

5. SUPPLEMENTARY NOTES AND BACKUP FEATURE

5.1 About the MATH option

To activate the MATH option:

A math code must be entered into the recorder to unlock the MATH option.
Refer to the product manual Section 4 Configuration Sub-matrix "MISCEL" parameter "OPTIONS".

The code is dependent on the serial number of the recorder and on the required options.

Note: The various options will only need to be activated, if the recorder did not have them enabled at the time of ordering.

5.2 Backup for timers and math results

After changing the configuration of a math function, only the result of the modified function will be reset.
Any other math functions, e.g. timers etc. will be restored with the original values before the configuration was modified.

In the event of power failure, the math results will automatically be saved in battery backed memory.

In the event of the Clock battery failing, the "BACKUP" parameter in the "MISCELLANEOUS" sub-matrix will need to be done to automatically save the results before the battery is replaced.

Refer to the recorder product manual Section 8 ("SERVICE" main matrix).

The only math results which are not saved will be "Running Group Average".

To restore the math results after replacing the battery the "RESTORE" parameter in the "MISCELLANEOUS" sub-matrix will need to be done.

Refer to the recorder product manual Section 8 ("SERVICE" main matrix).

5.3 List of actions which cause a math function to reinitialize.

- The RESET condition is TRUE.
- A RESET action was activated by the operator using RESET facility in RUN mode.
- When a periodic math function reaches the end of its preconfigured time period (for example, the Energy Consumption function).
- The math function configuration is changed. (Except for FORMAT, ENG UNIT and TAG NAME parameters).
- A Firmware upgrade is executed.

5.4 Combining math functions

The mathematical calculations are performed in a sequential order for example MA01 would be calculated before MA02. This should be observed when combining mathematical functions to avoid any possible calculation errors due to the result being delayed.
For example:

- If MA01 result is used as a variable input for MA02, there would be no calculation delay.
- If MA02 result is used as a variable input for MA01 there would be a calculation delay. i.e. MA01 is using the previous result of MA02.

6. PROMPTS TRANSLATION

EN	FR	GE	IT	SP
OPTIONS	OPTIONS	OPTIONEN	OPZIONI	OPCIONES
MATH	MATHEMATIQUE	MATHEMATIK	MATEM	MATEMATICO
MATH	MATH	MATH PAKET	FUNZ MATEM	PAQ MATEMAT
NO PACKAGE	PAS D'OPTION	PAKET	FUNZIONI	PAQUETE
FUNCTIONS				
NO FUNCTION	SANS MATH	KEIN FUNKT	NO FUNZIONE	NO FUNCION
SPECIAL	SPECIALE	SPEZIAL	SPECIALE	ESPECIAL
ADDITION	ADDITION	ADDITION	SOMMA	SUMA
BASIC MATH 1	FONCT BASE1	GRUNDMATH 1	MATEM 1 BASE	MAT BASICO 1
BASIC MATH 2	FONCT BASE2	GRUNDMATH 2	MATEM 2 BASE	MAT BASICO 2
SQUARE ROOT	RACINE CARRE	RADIZIEREN	RADICE QUADR	RAIZ CUADRAD
FO STERILIZA	FO STERILISA	FO STERILISA	FO STERILIZ	ESTERILIZ FO
GROUP SUM	GROUPE SOMME	GRUPPE SUMME	SOMMA GRUPPO	SUMA GRUPO
TOTALIZATION	TOTALISATION	TOTALISATION	TOTALIZZAZ	TOTALIZACION
GAS MAS FLOW	DEB.MAS. GAZ	GAS MAS FLU	PORTATA GAS	CAUD MAS GAS
LIQ MAS FLOW	DEB.MAS. LIQ	FLÜS MAS FLU	PORTATA LIQ	CAUD MAS LIQ
STEAM FLOW	DEBIT VAPEUR	DAMPF DURCHF	PORTATA VAP	CAUD VAPOR
ENERGY CONSP	CONSOM ENERG	ENERGIEVERBR	CONSUMO ENER	ENER CONSP
GRP AVERAGE	MOYENNE GRP	GRP MITTELW	MEDIA GRUPPO	PROMD GRUPO
SIMPLE AVRG	MOYENNE	PERIOD MITTL	MEDIA	PROMEDIO SIM
ELAPSED TIME	TEMPS ECOULE	ABGELAU ZEIT	TEMPO TRASC	TIEMP TRANSC
LAP TIME	TEMPS INTERM	RESTZEIT	TEMPO MANC	PORC TIEMP
CUMUL TIME	TEMPS CUMULE	KUMUL ZEIT	TEMPO ACCUM	TIEMP ACUMUL
COUNT DOWN	COMPT REBOUR	ABW ZÄHLEN	CONTEGGIO	CUENT ATRAS
PERIOD PULSE	IMPULSIONS	PERIOD PULS	PERIODO IMP	PULSO PERIOD
TRANSLOG	TRANSLOG	LINTRANSLOG	TRANSLOG	TRANSLOG
RUNNING AVRG	MOY GLISSANT	PERGRP MITTL	MEDIA ATTIVA	EJEC PROMED
SIGMA A	SIGMA A	SIGMA A	SIGMA A	SIGMA A
REL HUMIDITY	HUMIDITE REL	REL FEUCHTE	UMIDITA REL	HUMEDAD REL
GROUP MIN	MINIMUM GRP	GRUPPE MIN	MIN GRUPPO	MIN GRUPO
GROUP MAX	MAXIMUM GRP	GRUPPE MAX	MAX GRUPPO	MAX GRUPO
GROUP MAX-MIN	MAX MIN GRP	GRP MAX/MIN	MAX/MIN GRUP	GRP MAX/MIN
% CARBON	% CARBON	% KOHLENST	% CARBONIO	% CARBON
ALARM COUNT	ALARM COMPTE	ALARM Z HLEN	ALLARME CONT	CONT ALARMA
VACUUM 10	VIDE EXP 10	VAKKUUM 10	VUOTO 10	VACIO 10
SUB-MATRICES				
FUNCTION	FONCTION	FUNKTION	FUNZIONE	FUNCION
COEF A	COEF A	KOEFF A	COEF A	COEF A
COEF B	COEF B	KOEFF B	COEF B	COEF B
COEF C	COEF C	KOEFF C	COEF C	COEF C
COEF D	COEF D	KOEFF D	COEF D	COEF D
VARIAB A	VARIAB A	VARIAB A	VARIAB A	VARIAB A
VARIAB B	VARIAB B	VARIAB B	VARIAB B	VARIAB B
VARIAB C	VARIAB C	VARIAB C	VARIAB C	VARIAB C
VARIAB D	VARIAB D	VARIAB D	VARIAB D	VARIAB D
START	DEMARRAGE	START	PARTENZA	EMPEZAR
RESET	RAZ	RÜCKSETZ	RESET	REINCIAR
FORMAT	DECIMAL	FORMAT	FORMATO	FORMATO
ENG UNIT	UNITE VOIE	TECHN EINH	UNITA ING	UNID ING
TAG NAME	NOM VOIE	KA BEZEICHN	TARGHETTA	NOMBRE IDNT

POSSIBLE VALUES

ANALOG #i	ANALOG N°i	ANALOG NRi	ANALOG N	ANALOG #i
COMM #i	COMM N°i	KOMM NRi	COM N	COM #i
MATH #i	MATH N°i	MATH NRi	MATE N	MAT #i
CONTINUOUSLY	CONTINU	DAUERND	CONTINUO	CONTINUAMENT
DI CLOSED#	LO FER N°	BI SCHL NR	LO CHIUSO	ED CERRA #
DI OPENED#	LO OUV N°	BI OFFN NR	LO APERTO	ED ABIERT#
AL ON #	AL ON N°	AL EIN NR	ALL ON N	AL ACTIV #
AL OFF #	AL OFF N°	AL AUS NR	ALL OFF N	AL DESAC #
NO RESET	PAS RAZ	KEIN RÜCKSET	NO RESET	NO REINCIO
AUTOMATIC	AUTOMATIC	AUTOMATIK	AUTOMATICO	AUTOMATIC
EXPONENT	EXPONENTIEL	EXPONENT	ESPONENZ	EXPONENT

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