OPTIONS
[MATH FUNCTION]
[TOTALIZER]
[FLOW CORRECTION]
FOR RD200/RD2800 SERIES RECORDER

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- Pumps & Tubing
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Introduction

This manual is only for the optional specifications of 'Math function', 'Totalizer' and 'Flow correction' of RD200 /RD2800 series recorders. For the standard functions and other optional specifications, please refer the separate manuals.

1. Separate manuals

1) Standards
   - RD200 series (Multi-point type) M-4342/0606
   - RD2800 series (Multi-point type) M-4343/0606
   - RD200 series (Pen type) M-4341/0606
   - RD2800 series (Pen type) M-4344/0606

2) Option
   - Communications interface M-4344/0606

2. ‘Data communications input’ by keys

‘Data communications input’ can be programmed with keys when the ‘Math function’ (option) and ‘Communications interface’ (option) are combined. However, for the option of ‘Communications interface’, it is programmed through communications only.

[1] Math functions

The measured data of each channel can be computed and their results are displayed and printed. The alarm setpoints in the channel Nos. for computed results are programmed for the computed values.

1. Types of math functions

<table>
<thead>
<tr>
<th>TYPE</th>
<th>MATH EXPRESSION</th>
<th>SET VALUE *1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. non (no computation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. mUL</td>
<td>Ax + By + Cxy +D</td>
<td>• Channel No. for computed result</td>
</tr>
<tr>
<td>(Arithmetical</td>
<td>A, B, C, D : Constant</td>
<td>• Constant (A, B, C, D)</td>
</tr>
<tr>
<td>computation 1)</td>
<td>x, y : Measured values</td>
<td>• Channel No. for measured values (x, y)</td>
</tr>
<tr>
<td>3. dV *2</td>
<td>Ax / y + B</td>
<td>• Channel No. for computed result</td>
</tr>
<tr>
<td>(Arithmetical</td>
<td>A, B : Constant</td>
<td>• Constant (A, B)</td>
</tr>
<tr>
<td>computation 2)</td>
<td>x,y : Measured values</td>
<td>• Channel No. for measured values (x, y)</td>
</tr>
<tr>
<td>4. LoGE</td>
<td>LOG_aX</td>
<td>• Channel No. for measured value (x)</td>
</tr>
<tr>
<td>(Natural Logarithm)</td>
<td>x : Measured value</td>
<td>• (= Channel No. for computed result)</td>
</tr>
<tr>
<td>5. LoG10</td>
<td>LOG_{10}X</td>
<td>• Channel No. for measured value (x)</td>
</tr>
<tr>
<td>(Logarithm)</td>
<td>x : Measured value</td>
<td>• (= Channel No. for computed result)</td>
</tr>
<tr>
<td>6. PoWER</td>
<td>e^x</td>
<td>• Channel No. for measured value (x)</td>
</tr>
<tr>
<td>(Exponential)</td>
<td>x : Measured value</td>
<td>• (= Channel No. for computed result)</td>
</tr>
<tr>
<td>TYPE</td>
<td>MATH EXPRESSION</td>
<td>SET VALUE *1</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>7. root *3</td>
<td>( (S2-S2) \sqrt{\frac{R_{x}-R_{z}}{R_{x}+R_{z}}} + S2 )</td>
<td>-</td>
</tr>
<tr>
<td>(Square root)</td>
<td>( R_{x} ): Voltage value of measuring input</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>( R_{s} ): Maximum limit for range setting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>( R_{z} ): Minimum limit for range setting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>( S_{s} ): Maximum limit for scale setting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>( S_{z} ): Minimum limit for scale setting</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Channel No. for voltage value of measuring input ( R_{x} )</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(= Channel No. for computed result)</td>
<td>-</td>
</tr>
<tr>
<td>8. Humidity</td>
<td>Measured values of dry bulb ( x ) and wet bulb ( y ) and humidity is computed by the relative humidity table. ( x, y ): Measured values</td>
<td>-</td>
</tr>
<tr>
<td>(Humidity)</td>
<td>- Channel No. for computed result</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Channel No. for measured values ( x, y ).</td>
<td>-</td>
</tr>
<tr>
<td>9. Hi PEAk</td>
<td>Maximum value of measured values ( x ) during an interval</td>
<td>-</td>
</tr>
<tr>
<td>(Maximum value)</td>
<td>- Channel No. for computed result</td>
<td>-</td>
</tr>
<tr>
<td>10. Lo PEAk</td>
<td>Minimum value of measured values ( x ) during an interval</td>
<td>-</td>
</tr>
<tr>
<td>(Minimum value)</td>
<td>- Interval</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Starting time</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>- Channel No. for measured value ( x )</td>
<td>-</td>
</tr>
<tr>
<td>11. AVERAGE</td>
<td>Average value of measured values ( x ) during an interval</td>
<td>-</td>
</tr>
<tr>
<td>(Average value)</td>
<td>- Channel No. for measured value ( x )</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(= Channel No. for computed result)</td>
<td>-</td>
</tr>
<tr>
<td>12. Abs *5</td>
<td>(</td>
<td>x</td>
</tr>
<tr>
<td>(Absolute value)</td>
<td>- Channel No. for measured value ( x )</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(= Channel No. for computed result)</td>
<td>-</td>
</tr>
<tr>
<td>13. int *4</td>
<td>This is only applicable for the “Totalizer” (option). Refer to Section [2] for details.</td>
<td>-</td>
</tr>
<tr>
<td>(Totalizer)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>14. Comm in *5</td>
<td>Nil [Only displayed for the “communications interface” (option)]</td>
<td>-</td>
</tr>
<tr>
<td>(Data communications input)</td>
<td>- Channel for data communications input</td>
<td>-</td>
</tr>
<tr>
<td>15-21 *6</td>
<td>This is only applicable for the “Flow correction” (option). Refer to Section [3] for details.</td>
<td>-</td>
</tr>
</tbody>
</table>

*1: Setting of printing range is necessary for all math functions from 2 to 21.

*2: When the measured value \( y \) is 0, the value \( Ax \) becomes as bellow.

  - if \( Ax > 0 \) then OVER
  - if \( Ax = 0 \) then 0
  - if \( Ax < 0 \) then -OVER

*3: The math expression shown in the right side is applied when the measuring input voltage \( (R_x) \) is 1% or more of the setting range \( (R_s - R_z) \). When it is less than 1%, it becomes and is fixed to the minimum value of scale setting \( (S_z) \).

*4: Refer to Section 2 item 14 for the 'Totalizer' (option).

*5: When the ‘Math-function’ (option) and ‘Communications Interface’ (option) are combined, the data communications input can be set by keys.

*6: Only pen type.
2. Programming

2.1 Printing channel for computed result

1) Math functions of which computed results are only printed in the channels Nos. of measured value
   The computed result by the math functions of square root, natural logarithm, logarithm, absolute value, and
   exponential is only printed in the channel No. of measured value (x). Therefore the measured value (x), which
   these 5 math functions are applied to, cannot be printed.

2) Math functions of which computed results can be printed in any channels
   The computed result by other math functions than the above 5 kinds can be printed in any channels including
   the channel of measured value. However, if the channel of measured value is selected, the measured value
   cannot be printed.

2.2 Printing range

   The printing range of the channel for computed result is “Printing range” programmed by math function
   programming, not by range programming.

2.3 Decimal place for display and printing

   The decimal place is decided by “Printing range” programmed by math function programming. If the decimal
   place differs in the maximum and minimum values, the fewer decimal places is effective.

2.4 Computation of maximum, minimum and average values

1) Resetting of computation
   The computation is automatically reset after the programmed interval time. Accordingly maximum, minimum
   and average values in each interval time are computed.

2) Operation at power failure recovery
   1. If the power is recovered in the programmed interval time, the computation continues.
   2. If the power is not recovered in the programmed interval time, the computation is canceled and starts again
      from the recovery time.
   3. The judgment of power failure is within 24 hours. If the power failure continues longer than 24 hours, the
      computation is canceled irrespective the recovery time and starts again from the recovery time.

3) Starting time of computation
   The starting time is only valid for the first operation after its setting. The computation starts from the starting
   time.
3. Programming flow chart

3.1 Types of math function and their flow charts

The programming flow chart differs on the type of math function.

<table>
<thead>
<tr>
<th>Type of math function</th>
<th>Item No. (Page)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MuL (Arithmetic computation 1)</td>
<td>3.3 (page 6)</td>
</tr>
<tr>
<td>diV (Arithmetic computation 2)</td>
<td>3.4 (page 8)</td>
</tr>
<tr>
<td>LoGE (Natural logarithm)</td>
<td>3.2 (page 5)</td>
</tr>
<tr>
<td>LoG10 (Logarithm)</td>
<td>3.2 (page 5)</td>
</tr>
<tr>
<td>PoWER (Exponential)</td>
<td>3.2 (page 5)</td>
</tr>
<tr>
<td>Root (Square root)</td>
<td>3.2 (page 5)</td>
</tr>
<tr>
<td>Humidity (Humidity)</td>
<td>3.6 (page 12)</td>
</tr>
<tr>
<td>Hi PEAk (Maximum value)</td>
<td>3.5 (page 10)</td>
</tr>
<tr>
<td>Lo PEAk (Minimum value)</td>
<td>3.5 (page 10)</td>
</tr>
<tr>
<td>AVErAGE (Average value)</td>
<td>3.5 (page 10)</td>
</tr>
<tr>
<td>AbS (Absolute value)</td>
<td>3.2 (page 5)</td>
</tr>
<tr>
<td>Comm in (Data communications port)</td>
<td>3.2 (page 5)</td>
</tr>
</tbody>
</table>
3.2 Square root, logarithm, exponential, absolute value and data communications input

(Ex.) To execute the square root computation for the measured value of Channel 2 and program the printing range to 0.0 to 100.0.

Ref. 1 → Checking of other channels
You can check the math function type of other channels. Press \( \sqrt[4]{ } \) or \( \sqrt[5]{ } \) to change channels.

Ref. 2 → Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3 → Math functions by this flow chart.
- This flow chart is applied to the following 3 math functions.
- When the communications interface is added, the data communications input can be set with keys.

\[
\begin{array}{|c|c|}
\hline
\text{LoGE} & \text{Natural logarithm} \\
\text{Log10} & \text{Logarithm} \\
\text{PoWEr} & \text{Exponential} \\
\text{AbS} & \text{Absolute value} \\
\text{Comin} & \text{Data communications input} \\
\hline
\end{array}
\]

Ref. 4 → Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 5 → Storing
Store "temporarily stored" parameters by pressing \( \text{SHIFT} \) and \( \text{SET} \) simultaneously. If not, the parameters programmed earlier remain.
3.3 Arithmetic computation 1

(Ex.) Ax + By + Cxy + D: To multiply the measured value 'x' of Channel 2 by 2 and print its result on Channel 2.
A = 2, B = C = D = 0, x = Channel 2, y = not used, Printing range = 0.0 to 100.0

--- Diagram Content ---

Ref. 1 Checking of other channels
You can check the math function type of other channels.
Press \( \downarrow \) or \( \uparrow \) to change channels.

Ref. 2 Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3 Math functions by this flow chart.
This flow chart is only applied to Arithmetic computation 1 (mUL).

Ref. 4 'x' and 'y' channels
1. Not-used channel
If the measured value of 'x' channel or 'y' channel is not used, make sure to program any channel number to the channel not used as a dummy input. (No programming of the channel not used will become an error.) Then program the appropriate constants to '0'.
2. For the initial programming, both 'x' and 'y' channels are blank.

Ref. 5 Constants of A, B, C and D
1. Not-used constants
For the not-used constant, program it to '0'.
2. Programming of constants
(1) 5 digits or less including a sign
(2) Down to three decimal places
Ex: \(0.0000\)
Ref. 6 Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 7 Storing
Store “temporarily stored” parameters by pressing [SHIFT] and [SET] simultaneously. If not, the parameters programmed earlier remain.
3.4 Arithmetic computation 2

(Ex.) Ax / y + B: To divide the measured value 'x' of Channel 2 by the measured value 'y' of Channel 1 and print its result on Channel 2
A = 1.0, B = 0, x = 2, y = 1, Printing range = 0.0 to 100.0

---

Ref. 1: Checking of other channels
You can check the math function type of other channels. Press \( \downarrow \) or \( \uparrow \) to change channels.

Ref. 2: Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3: Math functions by this flow chart.
This flow chart is only applied to Arithmetic computation 2 (dIV).

Ref. 4: 'x' and 'y' channels
For the initial programming, both 'x' and 'y' channels are blank.

Ref. 5: Constants of A and B
1. Not-used constants
   For the not-used constant (B), program it to '0'.
2. Programming of constants
   (1) 5 digits or less including a sign
   (2) Down to three decimal places
   Ex.:\( \bullet \bullet \bullet \bullet \bullet \)
Ref. 6  Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 7  Storing
Store "temporarily stored" parameters by pressing [SHIFT] and [SET END] simultaneously. If not, the parameters programmed earlier remain.
3.5 Computation of maximum, minimum and average values

(Ex.: Maximum value) To print, on Channel 3, the maximum value in the measured value of Channel 2
A (Interval) = 30 min., B (Start time) = 08:00 am, Printing range = 0.0 to 100.0

Operation screen

[Checking of math function type]

Ref. 1: Checking of other channels
You can check the math function type of other channels.
Press 1 or 4 to change channels.

Display REC mode

Ref. 2: Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3: Math functions by this flow chart.
This flow chart is applied to the following 3 math functions.

<table>
<thead>
<tr>
<th>Math function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hi PEAK</td>
<td>Maximum value</td>
</tr>
<tr>
<td>Lo PEAK</td>
<td>Minimum value</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>Average value</td>
</tr>
</tbody>
</table>

Ref. 4: Measuring channel
For the initial programming, the measuring channel is blank.

Ref. 5: Programming range of interval
00:01 to 24:00

Ref. 6: Programming range of start time
00:00 to 23:59
Ref. 7 Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 8 Storing
Store "temporarily stored" parameters by pressing \texttt{SHIFT} and \texttt{SET} simultaneously. If not, the parameters programmed earlier remain.
3.6 Computation of temperature/humidity

(Ex.) To print the humidity on Channel 2
Dry bulb (Temperature) = Channel 1, Wet bulb (Temperature) = Channel 2, Printing range = 0.0 to 100.0

Operation screen

[Checking of math function type]

Recording Channel
Math function type
SET

[To be ready for programming]

[Programming printing channel]

[Selecting Humidity]

[Programming Dry bulb channel]

[Programming Wet bulb channel]

[To printing range programming]

Printing range (Min to Max)
Ref. 6  Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 7  Storing
Store "temporarily stored" parameters by pressing [shift] and [set] simultaneously. If not, the parameters programmed earlier remain.
[2] Totalizing

The measured data of each channel can be totalized and their results are displayed and printed. The alarm setpoints in the channel Nos. for totalized results is programmed for the totalized values.

1. Math expression for totalizing computation

\[
\text{INT}_n = \text{INT}_{n-1} + \frac{(\text{PV}_n + \text{PV}_{n-1}) \times (T_n - T_{n-1})}{2} \div \text{Tbase}
\]

- \(\text{INT}_n\) : Totalized value
- \(\text{INT}_{n-1}\) : Last totalized value
- \(\text{T}_n\) : Measured time at this time
- \(\text{T}_{n-1}\) : Measured time at last time
- \(\text{PV}_n\) : Measured value at this time
- \(\text{PV}_{n-1}\) : Measured value at last time
- \(\text{Tbase}\) : Time unit

*1: If the measured value exceeds the scale range, the minimum or maximum values of scale is taken as the measured value.

*2: This time unit is for the measured value. If the unit is in second, the value is 1. If it is in minute, the value is 60. If it is in hour, the value is 3600. The unit is selected from second, minute or hour.

(Ex.) m3/min—60, m3/h—3600

Note) Measuring interval \((T_n - T_{n-1})\)

- AL3000 Multi-point type (6-point input): approx. 5 seconds
- AH3000 Multi-point type (6-point input): approx. 5 seconds
- AH3000 Multi-point type (12-point input): approx. 10 seconds
- AH3000 Multi-point type (24-point input): approx. 20 seconds
- AL3000 pen type (1 to 4 point input): approx. 0.1 second
- AH3000 pen type (1 to 4 point input): approx. 0.1 second

2. Programming

2.1 Resetting of totalizing computation

1) Start and resetting of totalized value by remote contacts reset

When the optional remote contacts function is added, the totalizing computation can be started or the totalized value can be reset by the remote contacts signal.

When the totalizing computation starts by the remote contacts reset, the totalized value is reset with each programmed interval, after the start.

For multi-point type, the EX4 terminal in remote contacts terminals EX1 to EX4 is used for the resetting of totalizing computation. The list printing is only executed by using this terminal when the totalizing computation is not required. For details, refer to the separate standard manual.

2) Resetting of totalized value by the programmed intervals

The totalized value is automatically reset after the programmed interval time from the start of the totalizing computation, and then restarts.

2.2 Overflow of totalized value

The maximum totalized value is limited to the maximum value of the printing range. When this totalized value exceeds its limitation, the value is reset to 0 and then the totalizing computation continues.
2.3 Operation at power failure recovery
1. If the power is recovered in the programmed interval time, the totalizing computation continues.
2. If the power is not recovered in the programmed interval time, the totalizing computation is canceled * and starts again from the recovery time.
3. The judgment of power failure is within 24 hours. If the power failure continues longer than 24 hours, the totalizing computation is canceled irrespective the recovery time and starts again from the recovery time.
   * The totalizing computation is canceled and reset.

2.4 Interval time
The programming range of the interval time is 00:01 to 24:00. If the interval time is not required (in case of resetting of the totalized value by the remote contacts reset), program it to 99:00.

2.5 Starting time of totalizing computation
The programming range of the starting time is 00:00 to 23:59. This starting time is only valid for the first operation after its setting. The totalizing computation starts from the starting time. If the starting time is not required (starting by the remote contacts signal), program it to 99:00.

2.6 Printing range
The printing range of the channel for totalized result is “Printing range” programmed by totalizing computation programming, not by range programming.

2.7 Decimal place for display and printing
The decimal place is decided by “Printing range” programmed by totalizing computation programming. If the decimal place differs in the maximum and minimum values, the fewer decimal places is effective.
3. Programming flow chart

(Ex.) To execute the totalizing computation for measured value of Channel 1 and print its result on Channel 2
Time unit = min, Totalizing interval = 1 hour, Start time = 08:00 am
Printing range for totalized value = 0 to 1000

[Checking of math function type]

[Recording Channel]

[Math function type]

[To be ready for programming]

[Programming printing channel]

[Selecting Totalization]

[Programming measuring channel]

[Programming time unit]

[Programming interval time]

[Programming starting time]

[To printing range programming]

Display and record format

Ref. 1 Checking of other channels
You can check the math function type of other channels. Press ▼ or ▲ to change channels.

Ref. 2 Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3 Math functions by this flow chart.
This flow chart is only applied to Totalizing computation (int). For the combined option with math functions, various items are displayed.

Ref. 4 Time unit
3 types of time unit (sec, min, and hour) for measured value, are available.
(Ex.) If m³/min is required, select min.

Ref. 5 Programming range of interval
00:01 to 24:00
If the interval time is not required, program it to 99:00.

Ref. 6 Programming range of start time
00:00 to 23:59
If the starting time is not required, program it to 99:00.
Ref. 7 Programming range of max. and min. values
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.

Ref. 8 Storing
Store "temporarily stored" parameters by pressing \textit{SHIFT} and \textit{SET} simultaneously. If not, the parameters programmed earlier remain.

1. Correction computation types and math expressions

1.1 Flow correction computation 1 (FLoW1):

Volume correction of gas (ideal gas)

\[ Q_n = Q_i \times \frac{T_n}{T_i} \times \frac{P_i}{P_n} \times \frac{Z_n}{Z_i} \]

A, B, C, D: Constants
E, F: Arbitrary channels
X: Measuring channel

Q_n : Corrected result
Q_i : Volumetric flow rate at measurement condition of flow meter
T_n : Reference temperature
T_i : Temperature of measured fluid at measurement condition
P_n : Reference pressure
P_i : Pressure of measured fluid at measurement condition
Z_n : Compression coefficient of measured fluid at reference temperature (T_n) and reference pressure (P_n).
Z_i : Compression coefficient of measured fluid at measurement condition

1.2 Flow correction computation 2 (FLoW2):

Volume correction of liquid (excluding petroleum)

\[ Q_n = Q_i \times (1 - A \cdot (E - B)) \times (1 + C \cdot (F - D)) \]

A, B, C, D: Constants
E, F: Arbitrary channels
X: Measuring channel

Q_n : Corrected result
Q_i : Volumetric flow rate at measurement condition of flow meter
T_n : Reference temperature
T_i : Temperature of measured fluid at measurement condition
P_n : Reference pressure
P_i : Pressure of measured fluid at measurement condition
\( \alpha \) : Cubic expansion coefficient of measured fluid
\( \beta \) : Compressibility of measured fluid.

1.3 Flow correction computation 3 (FLoW3):

Volume correction of liquid (petroleum)

\[ Q_n = \frac{Q_i \cdot \exp (- \alpha \cdot \Delta t \cdot (1.0 + 0.8 \alpha \cdot \Delta t))}{(p_{15})^2} \times \frac{K_0}{\rho_{15}} \]

E, \alpha, P_{15}, K_0, K_1: Constants

Q_n : Corrected result
Q_i : Volumetric flow rate at measurement condition of flow meter
P_{15} : Density (15°C) [kg/m^3]
K_0, K_1 : Constants
\Delta t : Temperature difference [t = T_i - 15°C]
1.4 Flow correction computation 4 (FloW3):
Square root computation of flow correction 1

\[ \sqrt{A \cdot X \cdot (E+B) / C \cdot (F+D)} \]
A, B, C, D: Constants
E, F: Arbitrary channels
X: Measuring channel

1.5 Flow correction computation 5 (FloW5):
Temperature/pressure correction of differential pressure type flow meter (ideal gas)

\[ A \cdot X \cdot \sqrt{(B \cdot E+C)/(D \cdot F+273.15)} \]
A, B, C, D: Constants
E, F: Arbitrary channels
X: Measuring channel

(Basic formula)

\[ Q_d = Q_f \cdot \sqrt{\frac{P_f}{P_d}} \cdot \sqrt{\frac{T_d}{T_f}} \]

\[ Q_d : \text{Corrected result} \quad Q_f : \text{Flow rate at measurement condition.} \]
\[ P_d : \text{Reference pressure} \quad T_d : \text{Reference temperature} \]
\[ P_f : \text{Pressure of measured fluid at measurement condition} \]
\[ T_f : \text{Temperature of measured fluid at measurement condition} \]

1.6 Flow correction computation 6 (FloW6):
Temperature correction of differential pressure type flow meter (ideal gas)

\[ (A \cdot E+B / \sqrt{C \cdot F+D}) \]
A, B, C, D: Constants
E, F: Arbitrary channels

1.7 Flow correction computation 7 (FloW7):
Pressure correction of differential pressure type flow meter (ideal gas)

\[ (A \cdot E+B) \cdot \sqrt{C \cdot F+D} \]
A, B, C, D: Constants
E, F: Arbitrary channels
2. Programming

2.1 Printing range

The printing range of the channel for flow correction computed result is “Printing range” programmed by flow correction computation programming, not by range programming.

2.2 Decimal place for display and printing

The decimal place is decided by “Printing range” programmed by flow correction computation programming. If the decimal place differs in the maximum and minimum values, the fewer decimal places is effective.

2.3 Abnormal data

1. When the data of each channel is abnormal (over-range, under-range, burnout, without range programming) or a denominator becomes zero (0), the flow correction computed result is treated as under-range.

2. The flow rate input before correction is computed with the limitation at 0.
3. Programming flow chart

(Ex.) Flow correction 1: \(A \times X \times (E + B) / (C \times (F + D))\)
\[A = D = 273.15, \quad B = 0, \quad C = 1, \quad E = \text{Channel 3 (pressure input)}\]
\[F = \text{Channel 4 (temperature input)}, \quad X = \text{Channel 2 (flow input)}, \quad \text{Printing range} = 0.0 \text{ to } 100.0\]

---

Ref. 1 Checking of other channels
You can check the math function type of other channels. Press \(\downarrow\) or \(\uparrow\) to change channels.

Ref. 2 Channel digit
In AH3000 series multi-point type, a channel is programmed by two digits (06/12/24).

Ref. 3 Constants of A, B, C and D
1. Not-used constants
   For the not-used constant (B), program it to 0.
2. Programming of constants
   (1) 5 digits or less including a sign
   (2) Down to three decimal places
Ex. \(0.000.000\)
3. For FloW3, the constant D is not existed.
[Programming Constant D]  
ENTRY  Various keys  

Ref. 3  
Constant D  

[To printing range programming]  
ENTRY  

Printing range (Min to Max)  

Ref. 4  

[Programming printing range]  
Various keys  

Ref. 4  

ENTRY  

YES  Error message appears?  

Any key other than  
SHIFT  

NO  

Temporarily stored  

YES  Programming other channels?  

NO  

SHIFT + SET  

Stored  

Ref. 5  

Ref. 4  
Programming range of max. and min. values  
Program the values within 5 digits including a sign. The remaining digits on the right side should be kept blank. For the initial programming, all digits are blank.  

Ref. 5  
Storing  
Store "temporarily stored" parameters by pressing [SHIFT] and [SET] simultaneously. If not, the parameters programmed earlier remain.
[4] List printing

If the channels that math computation, totalizing computation or flow correction computation is programmed exist, a list of these computations is printed after the scale printing (including engineering unit and tag).

[Example of list print]

<table>
<thead>
<tr>
<th>CH</th>
<th>MATH</th>
<th>RECORD</th>
<th>PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MUL</td>
<td>0.0~100.0</td>
<td>E:1 F:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 2, B: 0, C: 0, D: 0</td>
</tr>
<tr>
<td>2</td>
<td>DIV</td>
<td>0.0~100.0</td>
<td>E:2 F:3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A:2, B:1.5</td>
</tr>
<tr>
<td>3</td>
<td>LOGE</td>
<td>0.00~100.0</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>LOG10</td>
<td>0.0~200.0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>POWER</td>
<td>0.0~50.0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>ROOT</td>
<td>0.0~100.0</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HUMID</td>
<td>0.0~100.0</td>
<td>E:1 F:2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 01:00, B: 08:00</td>
</tr>
<tr>
<td>3</td>
<td>H-PEAK</td>
<td>0~1000</td>
<td>E:3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 00:30, B: 12:00</td>
</tr>
<tr>
<td>4</td>
<td>L-PEAK</td>
<td>-100.0~100.0</td>
<td>E:4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 00:30, B: 12:00</td>
</tr>
<tr>
<td>5</td>
<td>AVE</td>
<td>0.00~100.0</td>
<td>E:5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 01:00, B: 06:30</td>
</tr>
<tr>
<td>6</td>
<td>ABS</td>
<td>0.00~100.00</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>INT</td>
<td>0.0~1000.0</td>
<td>E:1 F:M</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 00:30, B: 08:00</td>
</tr>
<tr>
<td>2</td>
<td>COMM</td>
<td>0.0~1000.0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FLOW1</td>
<td>0.0~100.0</td>
<td>E:2 F03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A: 273.15, B: 0, C: 1, D: 273.15</td>
</tr>
</tbody>
</table>

[Remark 1]
The above example is for RD200.
For RD2800, Arithmetic computation 1, Arithmetic computation 2, Maximum value computation, Minimum value computation, Average value computation and Totalizing computation are printed in a single line.

[Remark 2]
Parameters E and F
E is for x channel and F is for y channel.
For the totalizing computation, E is for a measuring channel and F is for a time unit.

[Remark 3]
The printing format for FLoW2 to FLoW7 is same as FLoW1.
For FLoW3, the constant D is not printed because it does not exist.
### Conversion table for temperature/humidity computation

(Annexed formula)

| 0° | 0.0 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | 2.8 | 3.0 | 3.5 | 4.0 | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 80 | 100 | 99  | 98  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 78 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 70 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 62 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 54 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 45 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 37 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 29 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |
| 21 | 100 | 99  | 97  | 96  | 95  | 94  | 93  | 92  | 91  | 89  | 88  | 87  | 86  | 85  | 84  | 83  | 81  | 78  | 76  | 73  | 71  | 69  | 67  | 65  | 61  | 57  | 54  | 51  | 48  | 45  | 43  | 40  | 37  | 35  | 33  | 31  | 29  | 27  | 25  | 23  | 21  | 19  | 17  | 15  |

Δθ: Temperature difference between dry bulb and wet bulb  
θw: Temperature of wet bulb (°C)