/ MATH for
Model 3701
LR8100E RECORDER

IM 3701 - 30E

IM 3701 - 30E
2nd Edition

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FD No. 10006 - N

1. OUTLINE

1.1 General

This instruction manual describes " / MATH" functions included in the LR series Recorder. Read this manual carefully when using these functions.

1.2 Computations Available

Computations available for the measured data are as follows:

- Arithmetic operation : Addition (+), subraction (−), multiplication (×), and division (÷).
- SQR : Extracts square root ($\sqrt{\ }$).
- ABS : Calculates the absolute value.
- LOG : Calculates the common logarithm. ($y = \log_{10} x$)
- Exp : Calculates the exponential function. ($y = e^n$)

1.3 Computation Channel

- Refer to Chapter 4 "Display Panel Setting" of this manual for detailed computation channel setting instructions.
- Use the measurement channel as a computation channels, (1 to 8 channels when an 8-pen recorder is used). For example, if channel 1 is declared as a computation channel, measurements cannot be taken using channel 1.
- For computation channel data, an alarm can be set or the data can be recorded as the measured data.

1.4 Setpoint

① Computation Range : Up to $\pm 10^{\pm 38}$. If the computation value exceeds the above range, overflowing occurs.

② Display and printout ranges:

+ 22000 to + .00001
0
− .00001 to − 22000
[exceeding + 22000, positive (+) overflow
exceeding − 22000, negative (−) overflow]

③ Constant : A constant must be set prior to use

- Up to 10 (A to J) constants can be used.
- Constant ranges:

+9.9999E+29 to + 1.0000E+30
0
−1.0000E−30 to −9.9999E+29

④ Communication inputs: 8 communication inputs available (C1 to C8)

2. COMPUTATIONAL EXPRESSIONS

2.1 Addition, Subtraction, Multiplication, and Division

- Addition (+) ····· Expression: 1+2
  (Sum of channel 1 and channel 2 measured values).
- Subtraction (−) ····· Expression : 1−2
  (obtains difference between channel 1 and channel 2 measured values)
- Multiplication (*) ····· Expression : 1 * A
  (A is constant. Assuming that A is set to 2, then two times the channel 1 measured value is obtained.)
- Division (/) ····· Expression : 1 / A
  (A is constant. Assume that A is set to 1, then one half the measured value on channel 1 is obtained.)

2.2 Square Root, Absolute Value, Common Logarithm and Exponential

- Square root ($\sqrt{\ }$) ····· Expression : SQR (1)
  Channel 1 measured value square root extraction
- Absolute value ····· Expression : ABS (1)
  (Calculates the absolute value of the channel 1 measured value.)
- Common logarithm ····· Expression : LOG (1)
  (Calculates channel 1 measured value logarithms)
- Exponential ····· Expression : EXP (1)
  (Calculates channel 1 measured value exponentials)

2.3 Computation Channels and Constants

- Measurement computation results (measurment channel is used) ····· 1 to 8
- Constants ····· A to J (10)
- Communication inputs ····· C1 to C8
  (only when the communication option is installed)
  The value entered digitally can be used through communication buses (GP-IB, RS-232C).
- When the computed result is used in the arithmetic expression, the computation channel, prior to the channel to which the computational expression is set, must be used (this is not necessary when measured results are used).

3. LIMITATIONS AND ADDITIONAL INFORMATION

3.1 Numeric Data that can be used in an Expression

- Computation Channels ····· (1 to 8)
  * If an attempt is made to use the measured value of a channel which is in the OFF MODE, an error occurs in the result.
  * When the result is used in the arithmetic expression, and if the computation channel prior to this channel is not used, an error ocurs. If the channel prior to this channel is not a computation channel but a measurement channel, it can be used for computationa expression. However if the measurement channel is altered to the computation channel, an error occurs in the computation result.

Computation Channel	Computation channel that can be used in arithmetic channel expressions
1	None
2	1
3	1, 2
4	1 to 3
5	1 to 4
6	1 to 5
7	1 to 6
8	1 to 7

- Constants ····· (A to J)
- Communication inputs ····· (C1 to C8)
  (When the communication option is installed)

3.2 Error Handling

While computations are being executed and if a computational error occurs, + OVER (01 – OVER if specified) is displayed.
Place the recorder in SET UP mode and set MATH error UP (+ OVER) or DOWN (– OVER). The initial setting is UP.
[Errors occur if any of the following conditions is satisfied]

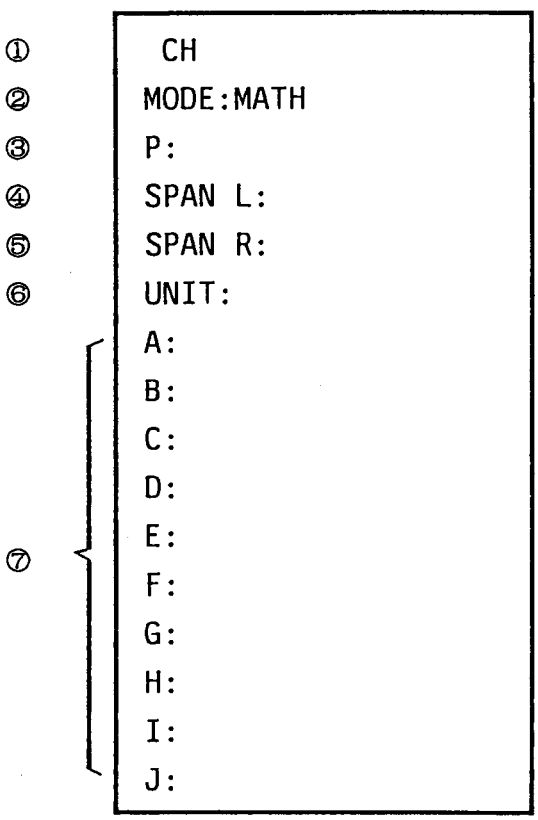
- If X/0, ($\sqrt{-X}$), LOG(–X) are set
- If any channel whose MODE setting is OFF exists in an expression.
- If computation range is greater than + $10^{\pm 38}$ or if it is less than – $10^{\pm 38}$ (however, 0 at UNDER FLOW)
- If the computation results, obtained from the channel with a greater number than the channel which is set, is used with the computational expression.
- For the model without a COM (communication) card (RS - 232C or GP -IB) card, communication input values C1 to C8 are used in the computational expression.

4. SETTING ON THE DISPLAY PANEL

Set computation between channels.

4.1 Setting Items

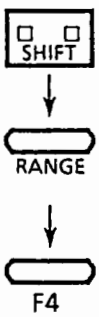
① Channel to execute computation
② Mode
③ Computational expression
④ Span left
⑤ Span right
⑥ Unit
⑦ Constants (A to J) 10



4.2 Sequential Setting

When power is turned on, the recorder performs a self-test. Upon completion of the self-test, proceed as follows.

[Key operation] [Setting panel] [Description]




```
1CH
MODE:VOLT
RANGE:200V
SPAN L:  0.00V
SPAN R:200.00V
FILTER:OFF

⇩ 1CH  2CH  3CH  4CH
⇩ 5CH  6CH  7CH  8CH
```

Press SHIFT key then RANGE key to display the setting panel. Channel 1 setting panel is shown.

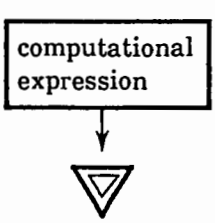
Specify the channel to execute computation setting (here, channel 4 is set).


```
4CH
MODE:OFF

⇩ OFF VOLT   TC   RTD
⇩DELT SCAL COPY  COM
⇩MATH
```

When the channel is set, the cursor moves to MODE. Press NEXT key twice then press F1 key (MATH) to display MATH (computation) setting panel.

[* Function key contents vary according to the recorder type.]




```
4CH
MODE:MATH
P:
SPAN L:  0.00V
SPAN R:200.00V
UNIT:V
A:1.0000
B:1.0000
C:1.0000
D:1.0000
E:1.0000
F:1.0000
G:1.0000
H:1.0000
I:1.0000
J:1.0000
```

Enter computational expression to be executed on the designated channel 4. Number of input characters is eight.

When data entry is complete, press ▽ key to proceed to the next step.

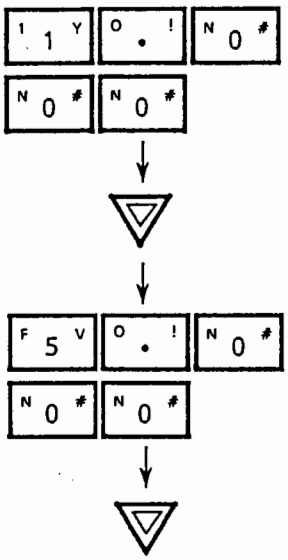
(See chapter 2 computational expression.)

(Example) p:1 + 2

(Example) Set the sum of channel 1 and channel 2 computational expression = 1 + 2

Key entry sequence : [I 1 Y] [D + T] [J 2 Z]

(Key operation)



(Setting panel)

```
4CH

MODE:MATH
P:1+2
SPAN L:1.000V
SPAN R:5.000V
UNIT:V
A:1.0000
B:1.0000
C:1.0000
D:1.0000
E:1.0000
F:1.0000
G:1.0000
H:1.0000
I:1.0000
J:1.0000
    ←    →  del
```

(Description)

Enter required span left value via the progra key pad.

Then press ▽ key to proceed to the span right value. Proceed as above.

Span range : −22.000~+22.000 Effective number of digits : 5

* If the decimal point positions of the span left and span right values differ, adjust the number of decimal points to coincide with the smallest value.

Entry of

```
L:0.01
R:1.0
```

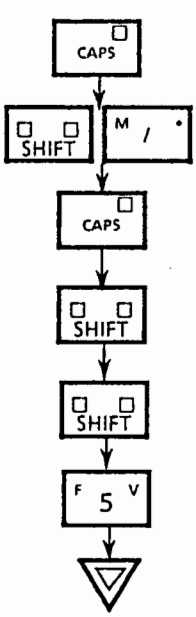
results

```
L:0.0
R:1.0
```

So, to enable the value to two places of decimals

enter

```
L:0.01
R:1.00
```




```
4CH
MODE:MATH
P:1+2
SPAN L:1.000mV
SPAN R:5.000mV
UNIT:mV
A:1.0000
B:1.0000
C:1.0000
D:1.0000
E:1.0000
F:1.0000
G:1.0000
H:1.0000
I:1.0000
J:1.0000
⇩    ←    →   del
⇩    Ω    μ    %    &
```

Note that for the MATH, the output waveform may depend upon the number of decimal points.
As the decimal point increases, the resolution of the output waveform also increases.
Set the span left and span right UNIT. Up to 6 characters can be entered (enter in mV)
[Ω, % can be entered using function keys.]

(Key operation)

Setting numeric value

press ▽ key to more down

(Setting panel)

```
4CH
MODE:MATH
P:1+2
SPAN L:1.000mV
SPAN R:5.000mV
UNIT:mV
A:1.0000
B:1.0000
C:1.0000
D:1.0000
E:1.0000
F:1.0000
G:1.0000
H:1.0000
I:1.0000
J:1.0000
```

(Description)

Set constants

When MATH is utilized, constants cannot be used unless the numeric values, to be used as constants, are substitued with figures A to J.

- Up to 12 characters can be entered.
- Effective number of digits is 5 and excess digits are discarded.
- Constant ranges

+9.9999E+29~+1.0000E−30
0
−1.0000E−30~−9.9999+29

NOTE

The constants A to J that can be set in each MATH function are common to all channels.

The constants set in channel 4 MATH can be handled as being identical to those constants in channel 5 MATH.

If any channel 5 constants are changed, the corresponding constant in channel 4 is also changed.

RANGE	1	2	3	4	5	6	7	8
MATH	computational expression	computational expression	computational expression	computational expression	computational expression	computational expression	computational expression	computational expression
Constant	Constant A~J							

5. INSTRUCTIONS

- The effecitve number of digits for each setting is limited and excess numbers are not permitted.
- The following iput are permissable in computational expressions.
  (Example) 1 + 2
  (1 + 2) * A
  (1 + 2 + 3)/B
  1*C + 2/D