

**/MATH for
LR4100E, LR4200E Series
Recorders**

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CONTENTS

1.	OUTLINE	3
1.1	General	3
1.2	Computations Available	3
1.3	Computation Channel	3
1.4	Setpoint	3
2.	COMPUTATIONAL EXPRESSIONS	4
2.1	Addition, Subtraction, Multiplication, and Division	4
2.2	Square Root, Absolute Value, Common Logarithm and Exponential	4
2.3	Computation Channels and Constants	4
3.	LIMITATIONS AND ADDITIONAL INFORMATION	5
3.1	Numeric Data that can be used in an Expression	5
3.2	Error Handling	6
4.	SETTING ON THE DISPLAY PANEL	7
4.1	Setting Items	7
4.2	Sequential Setting	8
5.	INSTRUCTIONS	11

1. OUTLINE

1.1 General

This instruction manual describes " / MATH" functions included in the LR4100 / LR4200 Recorders. Read this manual carefully when using these functions.

1.2 Computations Available

Computations available for the measured data are as follows:

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

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 4 channels when a 4-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: 4 communication inputs available (C1 to C4)
- ⑤ Computational expression: 18 characters maximum.

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 ($\sqrt{\quad}$) 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 (measurement channel is used) 1 to 4
- Constants A to J (10)
- Communication inputs C1 to C4
(only when the communication option is installed)
The value entered digitally can be used through communication buses (GP-IB, RS-232C).
- In a computational expression, when the measurement computation results are used, the computation channel with the smaller number than that of the channel to which the computational expression is set must be used (not affected on the measured results).

3. LIMITATIONS AND ADDITIONAL INFORMATION

3.1 Numeric Data that can be used in an Expression

- Computation Channels (1 to 4)
 - * 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 computation result is used in the arithmetic expression, if a larger computational channel number is used, an error occurs. If a larger channel number is for measurement channel, it can be used for computational expression.
 - * Measurement channels (except its own channel) can be used in computational expression.

Computation Channel	Computation channels that can be used in computation expressions	Measurement channels that can be used in computational expressions.
1	None	2, 3 and 4
2	1	1, 3 and 4
3	1, 2	1, 2 and 4
4	1 to 3	1 to 3

- Constants (A to J)
- Communication inputs (C1 to C4)
(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]

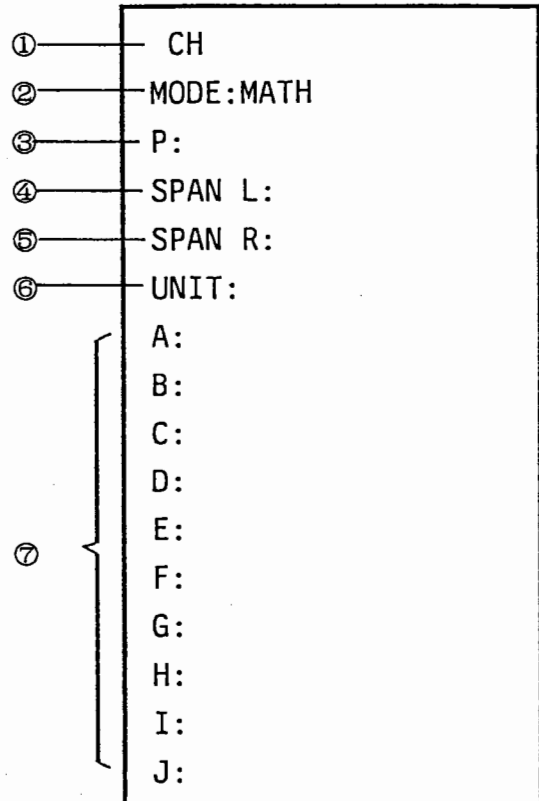
- If $X/0$, $(\sqrt{-X})$, $\text{LOG}(-X)$ are set
- If any channel whose MODE setting is OFF exists in an expression.
- If computation range is greater than $+ 10^{\pm 38}$ or if it is less than $- 10^{\pm 38}$ (however, 0 at UNDER FLOW)
- If the computation results, obtained from the channel with 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 C4 are used in the computational expression.

4. SETTING ON THE DISPLAY PANEL

Set computation between channels.

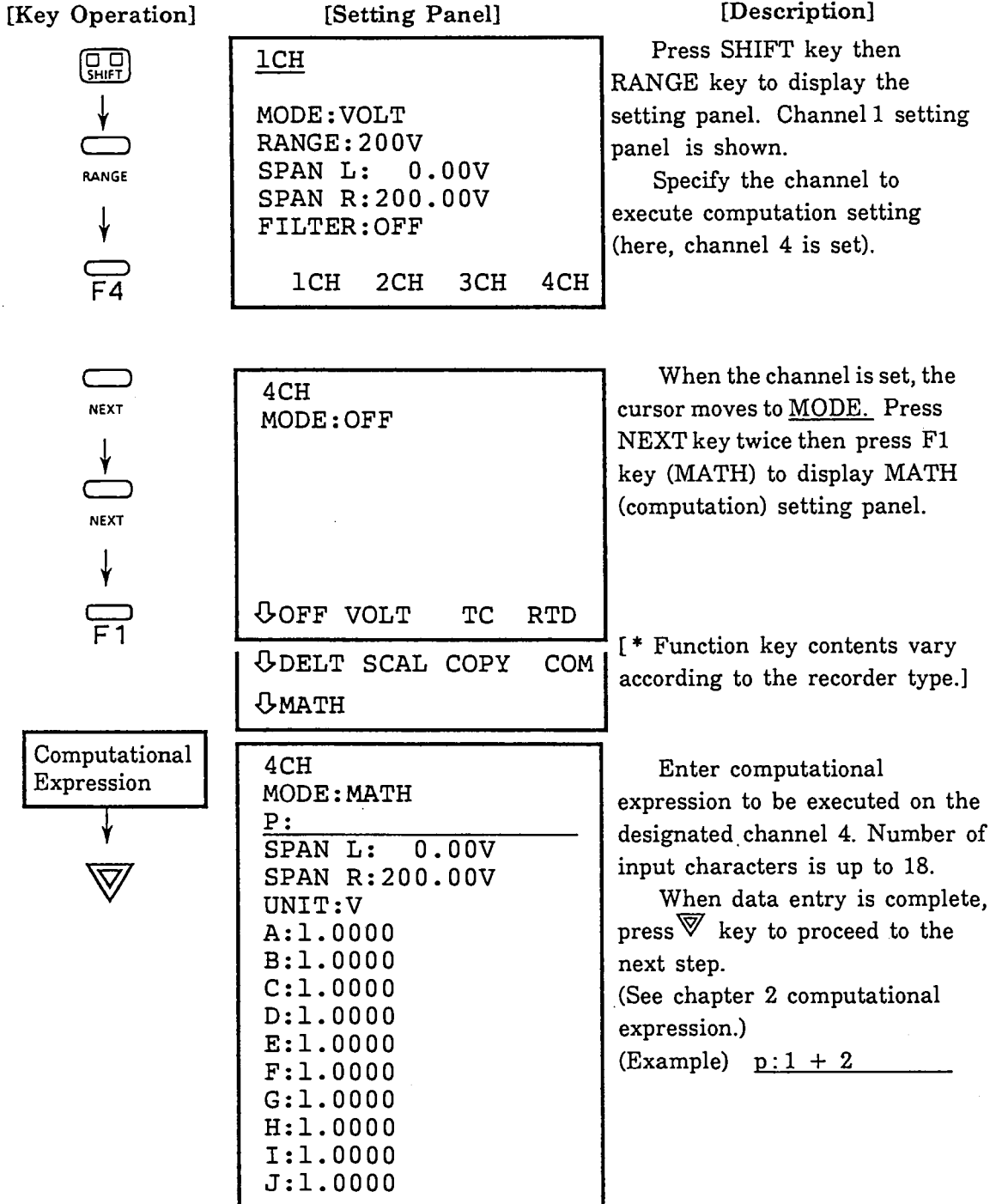
4.1 Setting Items

- 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

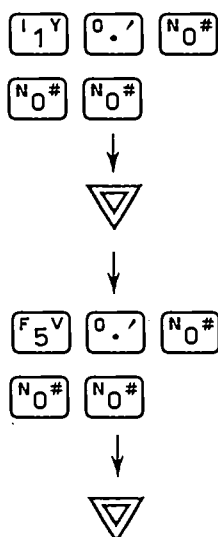
When power is turned on, the recorder performs a self-test. Upon completion of the self-test, proceed as follows.



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

Key entry sequence :   

[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: -22,000to+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

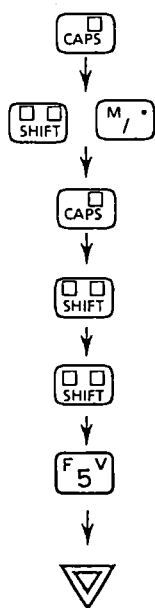
 results

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 substituted with figures A to J.

- Up to 18 characters can be entered.
- Effective number of digits is 5 and excess digits are discarded.
- Constant ranges

$\left\{ \begin{array}{l} +9.9999E+29 \sim +1.0000E-30 \\ 0 \\ -1.0000E-30 \sim -9.9999E+29 \end{array} \right.$

NOTE

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

The constants set in channel 3 MATH can be handled as being identical to those constants in channel 4 MATH.

If any constant in channel 4 is changed, the corresponding constant in channel 3 is also changed.

RANGE	1	2	3	4
MATH	Computational expression	Computational expression	Computational expression	Computational expression
Constant	Constants A to J			

5. INSTRUCTIONS

- The effective number of digits for each setting is limited and excess numbers are not permitted.
- The following input are permissible in computational expressions.

(Example) $1 + 2$

$(1 + 2) * A$

$(1 + 2 + 3) / B$

$1 * C + 2 / D$