User’s manual

IM DX1K-S2E
Ed-01

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1. Foreword

Thank you for purchasing the DX1000(N)/DX2000 DXAdvanced.
This user's manual describes the functions listed below. For a description of other standard functions, see the DX1000(N) or DX2000 User's Manual (IM04L41B01-01E or IM04L42B01-01E) and the Communication Interface User's Manual (IM04L41B01-17E).

- LOG input function
- Simulation function

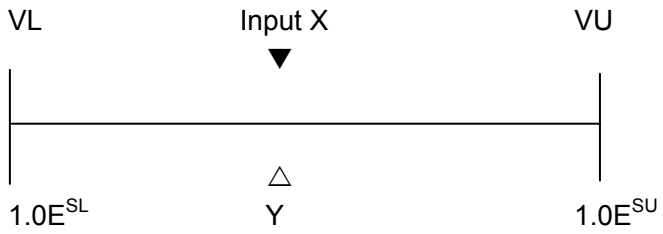
Note)
The Configurator on the accompanying software application DAQSTANDARD for DXAdvanced does not support the setup items of these TOKUCHU functions.
Note that proper settings will not be applied or the setup file will not be loaded, even if you attempt to load the setup file created using the DX1000(N) or DX2000 with this special specifications.

2. LOG Input Specifications

2.1. Converting the LOG Input (Relationship between the Input Voltage and Digital Display)

- Trend display (logarithmic scale): Displays the input voltage on a logarithmic scale.
- Digital display: Displays the result obtained by converting the input voltage using the equation below.
  - The relationship between the input voltage of special LOG range and digital display value is shown below.

Input voltage	X		
Lower limit of display span	VL	Upper limit of display span	VU
Scale lower limit	SL	Scale upper limit	SU



Digital display value $Y = 10^{(SU-SL)*(X-VL)/(VU-VL)+SL}$

2.2. LOG Input Mode

- This mode allows you to measure the DC voltage input (DCV: 20 mV, 60 mV, 200 mV, 2 V, 6 V, 20 V, and 50 V), convert to logarithmic scale, and display the data.
- Selectable span range: Same range as the DC voltage input
  - Span Lower must be less than Span Upper.
- Selectable scale range: 1.0E-15 to 1.0E+15 (15 decades maximum)
  - Scale Lower must be less than Scale Upper.
- Select two or three digits for the mantissa.
- You can set the unit.

2.2.1. Setting the LOG Input

1. Press **MENU** (switch to the setting mode).
2. Select **Meas channel** > **Range, Alarm**.
3. Select the channels in **First-CH** and **Last-CH**.
4. Set **Mode** to Log.
5. Set the measurement range, the span, and the exponents of the scale lower and upper limits.

LOG Input Setup Screen Example (DX1000(N) Example)

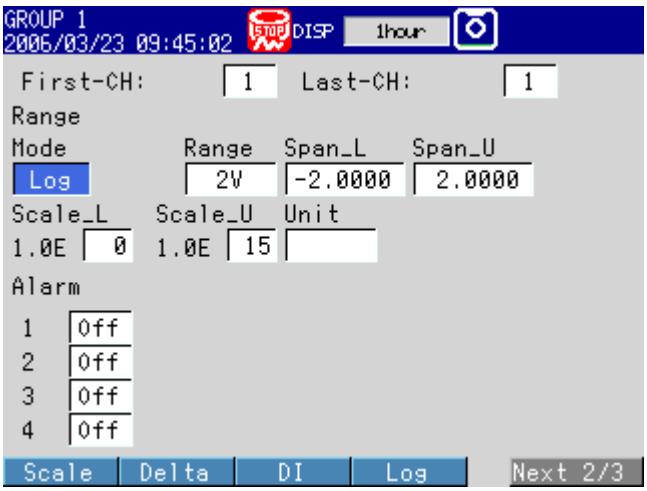


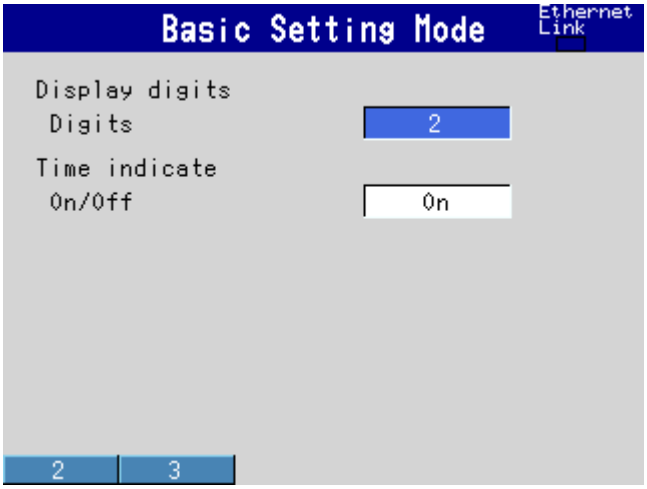
Table 2-1 Log Input Mode Settings

Setup Item	Selectable Items (Selectable Range)	Description
Range	Same as the DCV range	Sets the range.
Span Lower	Varies depending on the input type	Sets the span lower limit.
Span Upper	Varies depending on the input type	Sets the span upper limit. * Span Lower must be less than Span Upper.
Scale Lower	1.0E-15 to 1.0E+15	Sets the scale lower limit. 1.00E-15 to 1.00E+15 when the number of displayed mantissa digits is 3.
Scale Upper	1.0E-15 to 1.0E+15	Sets the scale upper limit. * 15 decades maximum. * Scale Lower must be less than Scale Upper. 1.00E-15 to 1.00E+15 when the number of displayed mantissa digits is 3.
Unit	Up to 6 characters	Sets the unit (alphanumeric characters).

2.2.2. Setting the Number of Displayed Mantissa Digits

1. Press **MENU** (switch to the setting mode).
2. Hold down **FUNC** for 3 s to switch to the basic setting mode.
3. Select **Environment** > **Digits, Time indicate**.
4. Set **Digits** to 2 or 3.

Setup Screen Example for the Number of Displayed Mantissa Digits (DX1000(N) Example)



2.3. Alarm

- Alarm types in LOG input mode
  - H, L, T, and t only.
- Set the alarm value using a voltage.
- Computing method of alarm values
  - Computing equation of the digital display value

    From $Y = 10^{(SU-SL)*(X-VL)/(VU-VL)+SL}$

    $\log Y = (SU-SL)*(X-VL)/(VU-VL)+SL$

    $X = (\log Y-SL)*(VU-VL)/(SU-SL)+VL$
  - For a computation example, see Table 2-2.
- Alarm hysteresis fixed to 0%.
  - The alarm hysteresis settings specified in the basic setting mode for the measurement channel are invalid.

Table 2-2 Computation Example of Alarm Values

Span Lower	Span Upper	Lower Limit of Exponent	Upper Limit of Exponent	Alarm Value	
				Equivalent Display	Voltage Equivalent
1	5	2	8	5.0E+6	4.133
1	5	2	8	1.0E+6	3.667

2.4. Computation Function (Option)

- When a channel set to LOG is used in a computation, error data is used as its measured value.

2.5. Report Function

- Report computation results in error if a channel set to LOG is assigned to a report channel.

2.6. Functions That Cannot Be Used

- Partial expanded display
  - Partial expanded display cannot be specified on a channel in LOG input mode.
- Difference computation between channels
  - There is no limitation on setting a channel in LOG input mode as a reference channel in a difference computation.
  - However, if such difference computation is executed, the measured result of the difference channel is error.
- Calibration correction function
  - Calibration correction cannot be specified on a channel in LOG input mode.

2.7. Number of Grids (Number of Divisions of the Scale Display)

- The number of grids can be set in the range of 4 to 12 or auto (same as the standard model).
- If the number of grids is set to auto on a target channel set to LOG range, the number of grids is equal to the number of decades. The display shows a LOG grid in this case.
- Channels set to LOG input mode is automatically set to LOG scale.

2.8. Communication Output and Binary Data Output Format

- The binary data is an A/D normalized value of the channel set to LOG.
  - Measured data output (FD command)
  - FIFO data output (FF command)

  (Example) If the input is 3.000 V measuring in the 6-V range, the binary data is 10000 (0x2710).
- If the measured result is -OVER, the value is set to 0x8001. If the measured result is +OVER, the value is set to 0x7FFF.

<note> Converting from binary data to LOG value

1. The binary data is output in A/D normalized value. The A/D normalized value is a scaled value taking the full span value of the range to be 20000. The full span value of the range is the maximum value that can be set in the range. It is 6 V in the 6-V range. For example, the A/D normalized values in the 6-V range are as follows: 6 V = 20000, -6 V = -20000, 1 V = 20000*1/6 = 3333.3.
2. The A/D normalized value is converted to voltage using the following equation.
   Voltage = (A/D normalized value)*(full span value of the range)/20000
3. The voltage is converted to a LOG value using the equation given in section 2.1, “Converting the LOG Input.”

2.9. Communication Output and ASCII Data Output Format

- Measured/computed data
  - ±DDDDD E±AA
    - ±DDDDD: Data mantissa (sign + 5 digits)
    - ±AA: Data exponent (sign + 2 digits)
      Value with the number of displayed mantissa digits corrected with respect to the exponent of the display data.
  - (Example) When the number of displayed mantissa digits is 3 and the measured result (display value) is 3.16E*02, the ASCII output is equal to +00316E+02.
- Handling of over data
  - When the measured result is -OVER: -99999E+99
  - When the measured result is +OVER: +99999E+99

2.10. Communication Commands

2.10.1. Setting the LOG Range

- Setting mode setting
- SR p1,p2,p3,p4,p5,p6,p7,p8,p9 <terminator>
  - p1: Channel number (001 to 048)
  - p2: Setting type (Log)
  - p3: Measurement range (20 mV, 60 mV, 200 mV, 2 V, 6 V, 20 V, or 50 V)
  - p4: Span lower limit
  - p5: Span upper limit p4 < p5
  - p6: Lower limit of exponent (-15 to 15)
  - p7: Upper limit of exponent (-15 to 15) p6 < p7 and (p7-p6) ≤ 15
  - p8: Decimal place (fixed to 0) * Decimal place of the exponent
  - p9: Unit (up to 6 characters)

2.10.2. Specifying the Number of Displayed Mantissa Digits

- Basic setting mode setting
- QA p1 <terminator>
  - p1: Number of displayed digits (2: 2 digits or 3: 3 digits)

2.11. Manual Sample Function

- Stored data when a channel set to LOG is assigned
  - The data is stored in the same format as with the digital value display (mantissa + exponent).
- Events that cause the manual sampled data to be divided
  - If the number of displayed mantissa digits of the LOG input range is changed, the data file is divided the next time manual sample is executed.

3. Accuracy and Display Resolution

3.1. Measurement and Display Accuracy (Digital Display)

- Computing method of the display value accuracy
  - Input voltage X
  - Lower limit of display span VL Upper limit of display span VU
  - Scale lower limit SL Scale upper limit SU
  - Digital display value Y

1) Converting equation for the input voltage (setting)
   - $Y = 10^{(SU-SL)*(X-VL)/(VU-VL)+SL}$
2) Measurement accuracy of input voltage X (uses the negative side due to the LOG characteristic)
   - X_{err} =X – (measurement accuracy of the voltage range)
3) Hardware error of the display value
   - $Y' = Y - Y_{err}$
   - The difference from the true value Y is hardware error Y' when display value Y_{err} corresponds to input voltage X_{err}.
4) Display accuracy of the mantissa
   - Display accuracy = Y'* 1.1 + 1 digit

- Computing example of the display value accuracy
  - Integration time 50 Hz
  - 2 V range Voltage span 0.0000 to 1.0000 V
  - LOG span -2 to 3

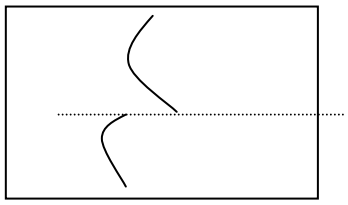
1) Determine the converting equation for the setting.
   - $Y = 10^{(SU-SL)*(X-VL)/(VU-VL)+SL}$
     $= 10^{(3-(-2))*(X-0)/(1-0)+(-2)}$
     $= 10^{(5X-2)}$
2) Determine the measurement error with respect to the input voltage.
   - Measurement accuracy of the 2 V range = ±(0.05% of rdg + 12 digits)
     = ±(0.0005*10000+12)
     = ±17 digits
   - Therefore, for an input voltage of 1 V, the value will fall within the range between 0.9983 V and 1.0017 V.
   - Since the computation is performed on the negative side with large error in the LOG characteristics, we obtain X_{err} = 0.9983 V.
3) Determine the hardware error of the display value.
   - Substitute X_{err}, the value determined in 2), into the equation of 1).
     $Y_{err} = 10^{(5*0.9983-2)}$
     $= 9.8 * 10^2$ (truncate values below the one-hundredths place)
   - Since the true value is $Y = 1.0 * 10^3$, the error is 2 digits.
   - Therefore, the hardware error of the display value is given by Y' = ±2 digits.
4) Display value accuracy of the mantissa
   - As a final error, we add the software error to the hardware error.
   - Software error = Hardware error * 1.1 + 1 digit
   - Display value accuracy = ±(2 digits * 1.1 + 1 digit)
     = ±(3.2 digits)
   - The fraction is rounded up. When the mantissa is 2 digits, the display accuracy is ±4 digits.

4. Simulation Function

4.1. Display Freeze Function

4.1.1. Specifications

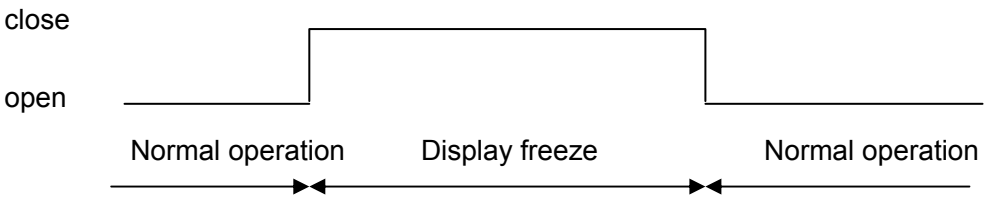
- A function used to stop the updating of the time, trend, digital values, and bar graph.
  - The display freeze function is controlled through the event action function or communication commands.
  - Alarm summary, message summary, and various log displays are also not updated if they are displayed.
- While the display is frozen, display data is also not updated.
- Key operation is possible while the display is frozen.
  - Display operations such as switching the display group are possible.
- When recovering from the display freeze condition to normal operation, the trend display is resumed from where it left off.
  - Screen image of the operation



- The time display can be enabled or disabled in the basic setting mode.
  - For details, see section 4.4, “Enabling/Disabling the Time Display.”

4.1.2. Event Action Function

- You can freeze or activate the display using the event action function.
  - The “Display Freeze/Activate” action can be specified only when the event is set to “Remote.”
- The “Display Freeze/Activate” action operates as a level action.
  - The display freeze action is executed when an open-to-close event (rising edge) is detected.
  - The display activate action (normal operation) is executed when a close-to-open event (falling edge) is detected.



- Event action functions that do not operate while the display is frozen
  - See Table 4-1.
  - If a level action such as Memory start/stop is executed due to a level event such as remote while the display is frozen, the DX operation may become mismatched with the event state.
    - Example) If Memory start/stop using remote is specified and the remote control input is switched from closed to open while the display is frozen, the memory stop operation is not executed. If display freeze is released in this condition, the remote control input terminal will be open even though the memory is in a start condition.

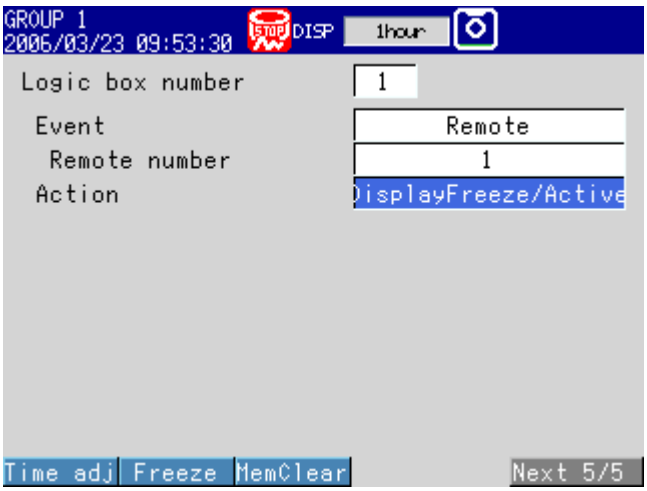
Table 4-1 Event Action Functions That Do Not Operate While the Display Is Frozen

Action	Note
Memory start/stop	Does not operate while the display is frozen. Operates after the display freeze is released.
Memory start	Does not operate while the display is frozen. Operates after the display freeze is released.
Memory stop	Does not operate while the display is frozen. Operates after the display freeze is released.
Event trigger	Does not operate while the display is frozen. Operates after the display freeze is released. However, the action does not operate if the event is set to timer or match timer.
Save display data	Does not operate while the display is frozen. Does not operate even after the display freeze is released.
Save event data	Does not operate while the display is frozen. Does not operate even after the display freeze is released.
Manual sample	Does not operate while the display is frozen. Does not operate even after the display freeze is released.

4.1.3. Setting the Display Freeze Function

1. Press **MENU** (switch to the setting mode).
2. Select **Timer, Event action** > **Event action**.
3. Set the **Logic box number**, **Event** (set to Remote), and **Remote number**.
4. In the **Action** box, press the **Freeze** soft key.

Setup Screen Example for the Display Freeze Function (DX1000(N) Example)



4.1.4. Operation While the Display is frozen

- If the DX is in a state in which it can switch to the basic setting mode, the DX can switch to the mode even while the display is frozen.
  - The display freeze function is released when switching back to the operation screen from the basic setting mode.
- If the power turns OFF and then back ON such as due to a power failure while the display is frozen (closed state) through remote control, the display freeze function is released even if there is no change in the remote state (remains at the closed state).
- The automatic display revert function does not operate.
  - The automatic revert timer is restarted when the display freeze function is released.

4.2. Memory and Trend Clear Function

4.2.1. Specifications

- A function used to clear the internal memory and the trend.
  - Clears the data area of the internal memory (data files that have been created are not cleared).
  - Can be executed while memory sample is in progress.
  - If you carry out the clear operation on the historical trend display, the display retains the condition before the operation.
  - If you execute memory and trend clear on a display other than the operation display, the screen automatically returns to the operation display.
- Methods for clearing the internal memory and trend display
  - Event action function
  - Communication command
    - For details, see section 4.3, “Communication Commands.”

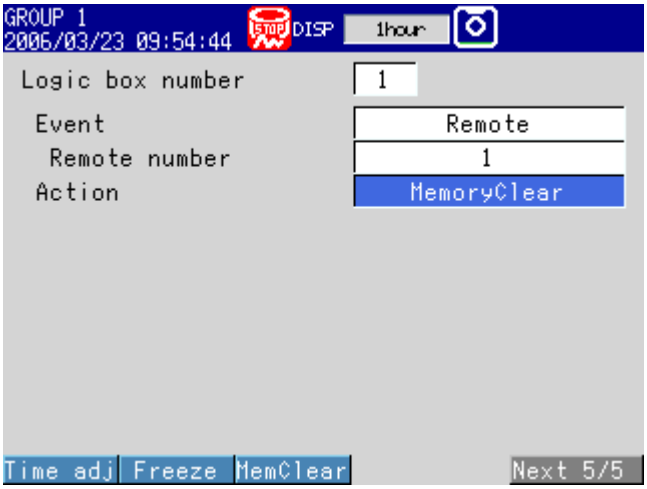
4.2.2. Event Action Function

- You can use the event action function to clear the internal memory and trend display.
  - The “Clear the internal memory and trend display” action can be specified only when the event is set to “Remote.”
- The “Clear the internal memory and trend display” action is executed only when an open-to-close event (rising edge) is detected.

4.2.3. Setting the Memory and Trend Clear Function

1. Press **MENU** (switch to the setting mode).
2. Select **Timer, Event action** > **Event action**.
3. Set the **Logic box number**, **Event** (set to Remote), and **Remote number**.
4. In the **Action** box, press the **MemClear** soft key.

Setup Screen Example for the Memory and Trend Clear Function (DX1000(N) Example)



4.3. Communication Commands

- The same command is used to control the display freeze function and memory and trend clear function.
- QB p1 <terminator>
  - p1: Switch the screen operation and clear the memory (0 to 2)
    - 0: Normal operation
    - 1: Freeze the display
    - 2: Clear the internal memory and trend display

4.4. Enabling/Disabling the Time Display

4.4.1. Specifications

- A function used to disable the time display on the operation display.
- Displays on which the time display is disabled
  - See Table 4-2 Displays on Which the Time Display Is Enabled/Disabled and the Description.

Table 4-2 Displays on Which the Time Display Is Enabled/Disabled and the Description

Display Name		Description
Status display	Time display	Time
Trend display	Grid time display	Grid time
	Message display	Written time
Circular display	Grid time display	Grid time
	Message display	Written time
Historical trend display	Grid time display	Grid time
	Message display	Written time
	Alarm summary	Alarm time
	Message summary	Written time
	Memory information	Start time and stop time
		Batch comment time
	Cursor time display	Cursor time
Summary display	Memory summary	Start/Stop time
		Manual sample data time
		Report data time
	Message summary	Alarm time
	Alarm summary	Written time
	Report data display	Start time
		Timeout time
Log display	Login log	Time
	Error log	Time
	Communication log	Time
	FTP log	Time
	WEB log	Time
	E-mail log	Time
	SNTP log	Time
	DHCP log	Time
	MODBUS log	Time

4.4.2. Enabling/Disabling the Time Display

1. Press **MENU** (switch to the setting mode).
2. Hold down **FUNC** for 3 s to switch to the basic setting mode.
3. Select **Environment** > **Digits, Time indicate**.
4. Set **Time indicate on/off** to On or Off.

Setup Screen Example for Enabling/Disabling the Time Display (DX1000(N) Example)

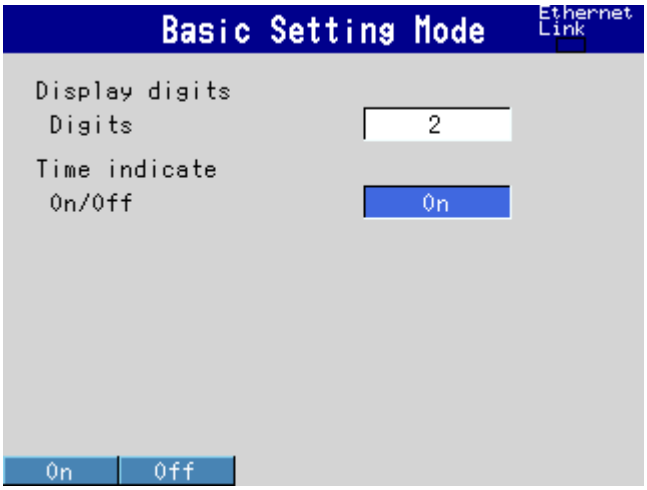


Table 4-3 Setting the Time Display

Setup Item	Selectable Items (Selectable Range)	Description
Time display	On/Off	Enables/disables the time display. Off: Disable On: Enable

4.4.3. Communication Commands

- QC p1 <terminator>
  - p1: Enables/disables the time display (On/Off).
    - On: Enable
    - Off: Disable

4.5. Special Current Value Mark Function

4.5.1. Specifications

- A function used to display the channel using two digits for the current value mark (see Fig. 4-1, “Current Value Mark”) that is displayed in the scale display position on the trend/historical trend display.
  - For the channel display, see Table 4-4.
  - If you set the display to two digits, you will not be able to distinguish between measurement, computation, and external input channels. In addition, the external input channels will overlap.

Fig. 4-1 Current Value Mark

Table 4-4 Channel Display of the Current Value Mark

Channel Type	Channel Display of the Current Value Mark	
	Three Digits (Standard)	Two Digits (Special Setting)
Measurement channel	1 to 48	1 to 48
Computation channel	101 to 160	1 to 60
External input channel	201 to 299	1 to 99
	300 to 399	0 to 99
	400 to 440	0 to 40

4.5.2. Setting the Channel Display of the Current Value Mark

1. Press **MENU** (switch to the setting mode).
2. Hold down **FUNC** for 3 s to switch to the basic setting mode.
3. Select **Environment** > **AUX.**
4. Set item **1** under **AUX** to On (two digits, special setting) or Off (three digits, standard setting).

Setup Screen Example for the Channel Display of the Current Value Mark (DX1000(N) Example)

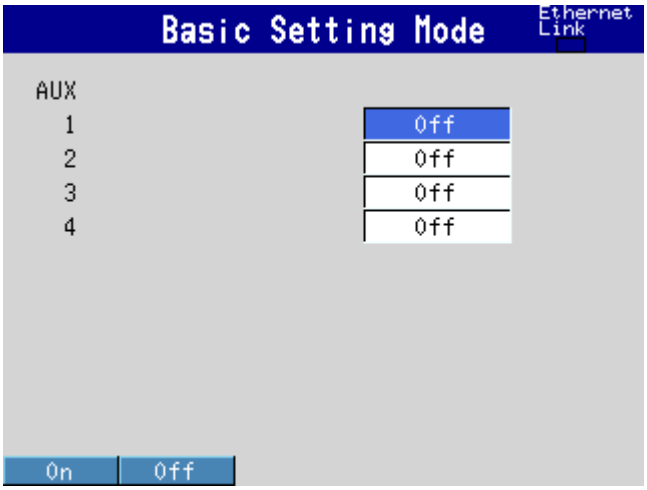


Table 4-5 Setting the Channel Display of the Current Value Mark

AUX Setting	Selectable Items (Selectable Range)	Description
1	On/Off	Channel display of the current value mark Off: Three digits (standard setting) On: Two digits (Special setting)
2	On/Off	Not used
3	On/Off	Not used
4	On/Off	Not used

4.5.3. Communication Commands

- WU p1,p2,p3,p4,p5 <terminator>
  - p1: Setup type (AUX)
  - p2: Channel display of the current value mark (On: two digits, Off: three digits)
  - p3: Not used (On/Off)
  - p4: Not used (On/Off)
  - p5: Not used (On/Off)