Return Format

The query returns FAIL or PASS.

Example

```
:MASK:OUTPut:EVENt PASS /*Sets the output event to PASS.*/
:MASK:OUTPut:EVENt? /*The query returns PASS.*/
```

3.15.13 :MASK:OUTPut:TIME

Syntax

:MASK:OUTPut:TIME <*time*>

:MASK:OUTPut:TIME?

Description

Sets or queries the output pulse time.

Parameter

Name	Type	Range	Default
<time>	Real	100 ns to 10 ms	1 µs

Remarks

N/A

Return Format

The query returns the pulse time in scientific notation.

Example

```
:MASK:OUTPut:TIME 0.000003 /*Sets the pulse time to 3 µs.*/
:MASK:OUTPut:TIME? /*The query returns 3.000000E-6.*/
```

3.16 :MATH<n> Commands

:MATH<n> commands are used to set various math operation function of the waveform between channels.

This series oscilloscopes can realize multiple math operations between waveforms of different channels, including arithmetic operation, function operation, FFT operation, logic operation, and digital filter.

Operator

Arithmetic Operation

The arithmetic operations supported by this oscilloscope include A+B, A-B, A×B, and A÷B.

- **A+B** adds the waveform voltage values of signal source A and B point by point and displays the results.

- **A-B** subtracts the waveform voltage values of signal source B from that of source A point by point and displays the results.

- **A×B** multiplies the waveform voltage values of signal source A and B point by point and displays the results.

- **A÷B** divides the waveform voltage values of signal source A by that of source B point by point and displays the results. It can be used to analyze the Multiple relation of the two channels waveforms. When the voltage of signal source B is 0 V, the division result is treated as 0.

Function Operation

The available function operation types of this oscilloscope include Intg, Diff, Sqrt, Lg (Base 10 Exponential), Ln, Exp, Abs, and AX+B.

- **Intg:** calculates the integral of the selected source. For example, you can use integral to measure the area under a waveform or the pulse energy.

- **Diff:** calculates the discrete time derivative of the selected source. For example, you can use differentiate to measure the instantaneous slope of a waveform.

- **Sqrt:** calculates the square roots of the selected source point by point and displays the results.

- **Lg (Base 10 Exponential):** calculates the base 10 exponential of the selected source point by point and displays the results.

- **Ln:** calculates the natural logarithm (Ln) of the selected source point by point and displays the results.

- **Exp:** calculates the exponential of the selected source point by point and displays the results.

- **Abs:** calculates the absolute value of the selected source and displays the results.

- **AX+B:** applies a linear function to the selected source, and displays the results.

FFT Operation

FFT (Fast Fourier Transform) is used to transform time-domain signals to frequency-domain components (frequency spectrum). This oscilloscope provides FFT operation function which enables you to observe the time-domain waveform and spectrum of the signal at the same time. FFT operation can facilitate the following works:

• Measure harmonic components and distortion in the system;

• Display the characteristics of the noise in DC power;

• Analyze vibration.

Table 3.161 Window Function

Window Function	Characteristics	Waveforms Applicable to the Window Function
Rectangular	Best frequency resolution Poorest amplitude resolution Similar to the situation when no window is applied	Transient or short pulse, the signal levels before and after the multiplication are basically the same Sine waveforms with the same amplitudes and rather similar frequencies Wide band random noise with relatively slow change of waveform spectrum
Blackman-Harris	Best amplitude resolution Poorest frequency resolution	Single frequency signal, searching for higher order harmonics
Hanning	Better frequency resolution and poorer amplitude resolution compared with Rectangular	Sine, periodic, and narrow band random noise
Hamming	A little bit better frequency resolution than Hanning	Transient or short pulse, the signal levels before and after the multiplication are rather different
Flattop	Measure the signals accurately	Measure the signal that has no accurate reference and requires an accurate measurement
Triangle	Better frequency resolution	Measure the narrow band signal and that has strong noise interference

Spectral leakage can be considerably minimized when a window function is used. The oscilloscope provides 6 FFT window functions which have different characteristics and are applicable to measure different waveforms, as shown in the table below. You need

to select the window function according to the characteristics of the waveform to be measured.

Logic Operation

The logic operations supported by this oscilloscope include A&&B, A||B, A^B, and !A. The results of logic operation of one binary bit are shown in the table below:

Table 3.162 Logic Operation Results

A	B	A&&B	A||B	A^B	!A
0	0	0	0	0	1
0	1	0	1	1	1
1	0	0	1	1	0
1	1	1	1	0	0

Digital Filter

The digital filters supported by this oscilloscope include: low-pass filter, high-pass filter, band-pass filter, and band-stop filter.

- **LowPass** only allows the signals whose frequencies are lower than the current upper limit frequency to pass.

- **HighPass** only allows the signals whose frequencies are higher than the current lower limit frequency to pass.

- **BandPass** only allows the signals whose frequencies are higher than the current lower limit frequency and lower than the current upper limit frequency to pass.

- **BandStop** only allows the signals whose frequencies are lower than the current lower limit frequency or higher than the current upper limit frequency to pass.

3.16.1   :MATH<n>:DISPlay

Syntax

:MATH<*n*>**:DISPlay** <*bool*>

:MATH<*n*>**:DISPlay?**

Description

Enables or disables the math operation function; or queries the on/off status of the math operation function.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<bool>	Bool	{{1|ON}|{0|OFF}}	0|OFF

Remarks

N/A

Return Format

The query returns 1 or 0.

Example

```
:MATH1:DISPlay ON     /*Enables the math operation of Math1.*/
:MATH1:DISPlay?       /*The query returns 1.*/
```

3.16.2 :MATH<n>:OPERator

Syntax

:MATH<*n*>:OPERator <*opt*>

:MATH<*n*>:OPERator?

Description

Sets or queries the operator of math operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<opt>	Discrete	{ADD|SUBTract|MULTiply|DIVision|AND|OR|XOR|NOT|FFT|INTG|DIFF|SQRT|LG|LN|EXP|ABS|LPASs|HPASs|BPASs|BSTop|AXB}	ADD

Remarks

Supported operators include A+B (ADD), A-B (SUBTract), A×B (MULTiply), A÷B (DIVision), A&&B (AND), A||B (OR), A^B (XOR), !A (NOT), FFT, Intg (INTG), Diff (DIFF), Sqrt (SQRT), Lg (Base 10 Exponential) (LG), Ln (LN), Exp (EXP), Abs (ABS), LowPass (LPASs), LighPass (HPASs), BandPass (BPASs), BandStop (BSTop), and AX+B (AXB). For details, refer to *Operator*.

Return Format

The query returns ADD, SUBT, MULT, DIV, AND, OR, XOR, NOT, FFT, INTG, DIFF, SQRT, LG, LN, EXP, ABS, LPAS, HPAS, BPAS, BST, or AXB.

Example

```
:MATH1:OPERator INTG /*Sets the math operator of Math1 to
Integrate.*/
:MATH1:OPERator? /*The query returns INTG.*/
```

3.16.3   :MATH<n>:SOURce1

Syntax

:MATH<*n*>:SOURce1 <*source*>

:MATH<*n*>:SOURce1?

Description

Sets or queries the source or Source A of arithmetic operation/function operation/ filter operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<source>	Discrete	{CHANnel1|CHANnel2|CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10|MATH1|MATH2|MATH3}	CHANnel1

Remarks

• For arithmetic operation, this command is used to set Source A.

• For function operation and filter operation, only use this command to set the

source.

• When n=1, the range of the parameter <source> is {CHANnel1|CHANnel2|

CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10}.

When n=2, the range of the parameter <source> is {CHANnel1|CHANnel2|
CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10|
MATH1}.

When n=3, the range of the parameter <source> is {CHANnel1|CHANnel2| CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10| MATH1|MATH2}.

When n=4, the range of the parameter <source> is {CHANnel1|CHANnel2| CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10| MATH1|MATH2|MATH3}.

- For detailed operations, refer to the descriptions in *Operator*.

Return Format

The query returns MATH1, MATH2, MATH3, CHAN1, CHAN2, CHAN3, CHAN4, REF1, REF2, REF3, REF4, REF5, REF6, REF7, REF8, REF9, or REF10.

Example

```
:MATH1:SOURce1 CHANnel3   /*Sets Source A of the arithmetic
operation to CHANnel3.*/
:MATH1:SOURce1?           /*The query returns CHAN3.*/
```

3.16.4 :MATH<n>:SOURce2

Syntax

:MATH<*n*>:SOURce2 <*source*>

:MATH<*n*>:SOURce2?

Description

Sets or queries Source B of arithmetic operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<source>	Discrete	{CHANnel1|CHANnel2| CHANnel3|CHANnel4|REF1| REF2|REF3|REF4|REF5|REF6|REF7| REF8|REF9|REF10|MATH1| MATH2|MATH3}	CHANnel1

Remarks

This command is only available for arithmetic operation (containing two sources). For detailed operations, refer to the descriptions in *Operator*.

When n=1, the range of the parameter <source> is {CHANnel1|CHANnel2|CHANnel3| CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10}.

When n=2, the range of the parameter <source> is {CHANnel1|CHANnel2|CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10|MATH1}.

When n=3, the range of the parameter <source> is {CHANnel1|CHANnel2|CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10|MATH1|MATH2}.

When n=4, the range of the parameter <source> is {CHANnel1|CHANnel2|CHANnel3|CHANnel4|REF1|REF2|REF3|REF4|REF5|REF6|REF7|REF8|REF9|REF10|MATH1|MATH2|MATH3}.

Return Format

The query returns MATH1, MATH2, MATH3, CHAN1, CHAN2, CHAN3, CHAN4, REF1, REF2, REF3, REF4, REF5, REF6, REF7, REF8, REF9, or REF10.

Example

```
:MATH1:SOURce2 CHANnel3   /*Sets Source B of the arithmetic
operation to CHANnel3.*/
:MATH1:SOURce2?           /*The query returns CHAN3.*/
```

3.16.5   :MATH<n>:LSOurce1

Syntax

:MATH<*n*>:LSOurce1 <*source*>

:MATH<*n*>:LSOurce1?

Description

Sets or queries Source A of the logic operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<source>	Discrete	{CHANnel1|CHANnel2|CHANnel3|CHANnel4|D0|D1|D2|D3|D4|D5|D6|D7|D8|D9|D10|D11|D12|D13|D14|D15}	CHANnel1

Remarks

The logic operations include A&&B, A||B, A^B, and !A.

D0-D15 are only available for the DHO900 series.

Return Format

The query returns D0, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, CHAN1, CHAN2, CHAN3, or CHAN4.

Example

```
:MATH1:LSOurce1 CHANnel3   /*Sets Source A of the logic operation
to CHANnel3.*/
:MATH1:LSOurce1?           /*The query returns CHAN3.*/
```

3.16.6   :MATH<n>:LSOurce2

Syntax

:MATH<*n*>**:LSOurce2** <*source*>

:MATH<*n*>**:LSOurce2?**

Description

Sets or queries Source B of the logic operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<source>	Discrete	{CHANnel1|CHANnel2|CHANnel3|CHANnel4|D0|D1|D2|D3|D4|D5|D6|D7|D8|D9|D10|D11|D12|D13|D14|D15}	CHANnel1

Remarks

•   The logic operations include A&&B, A||B, A^B, and !A.

•   This command is only available for the logic operation that contains two sources.

    It is used to set Source B.

•   D0-D15 are only available for the DHO900 series.

Return Format

The query returns D0, D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, CHAN1, CHAN2, CHAN3, or CHAN4.

Example

```
:MATH1:LSOurce2 CHANnel4   /*Sets Source B of the logic operation
to CHANnel4.*/
:MATH1:LSOurce2?           /*The query returns CHAN4.*/
```

3.16.7   :MATH<n>:SCALe

Syntax

:MATH<*n*>**:SCALe** <*scale*>

```
:MATH<n>:SCALe?
```

Description

Sets or queries the vertical scale of the operation results. The unit is related to the currently selected operator and the unit selected by the source.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<scale>	Real	Refer to *Remarks*	-

Remarks

- The setting range of the vertical scale is related to the currently selected operator and the scale of the source channel. For integration and differentiation operations, the actual range of <scale> is also related to the current horizontal time base.

- This command is invalid for logic operation and FFT operation.

Return Format

The query returns the vertical scale of the current operation results in scientific notation.

Example

```
:MATH1:SCALe 0.2   /*Sets the vertical scale to 200 mV.*/
:MATH1:SCALe?   /*The query returns 2.000000E-1.*/
```

3.16.8   :MATH<n>:OFFSet

Syntax

```
:MATH<n>:OFFSet <offset>
```

```
:MATH<n>:OFFSet?
```

Description

Sets or queries the vertical offset of the operation results. The unit is related to the currently selected operator and the unit selected by the source.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-

Name	Type	Range	Default
<offset>	Real	-1 GV to +1 GV	0.00 V

Remarks

This command is invalid for logic operation and FFT operation.

Return Format

The query returns the vertical offset of the current operation results in scientific notation.

Example

```
:MATH1:OFFSet 8    /*Sets the vertical offset to 8 V.*/
:MATH1:OFFSet?        /*The query returns 8.000000E0.*/
```

3.16.9　:MATH<n>:INVert

Syntax

:MATH<*n*>:INVert <*bool*>

:MATH<*n*>:INVert?

Description

Enables or disables the inverted display of the operation results; or queries the on/off status of the inverted display of the operation results.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<bool>	Bool	{{1|ON}|{0|OFF}}	0|OFF

Remarks

This command is invalid for FFT operation and logical operation.

Return Format

The query returns 1 or 0.

Example

```
:MATH1:INVert ON    /*Enables the inverted display.*/
:MATH1:INVert?        /*The query returns 1.*/
```

3.16.10 :MATH\<n>:RESet

Syntax

`:MATH<n>:RESet`

Description

After you send this command, the instrument will adjust the vertical scale of the operation results to an optimal value based on the currently selected operator and the horizontal time base of the source.

Parameter

N/A

Remarks

N/A

Return Format

N/A

Example

```
N/A
```

3.16.11 :MATH\<n>:GRID

Syntax

`:MATH<n>:GRID <grid>`

`:MATH<n>:GRID?`

Description

Sets or queries the grid type of the math operation display.

Parameter

Name	Type	Range	Default
\<grid>	Discrete	{FULL|HALF|NONE}	-

Remarks

- **FULL:** turns the background grid and coordinates on.

- **HALF:** turns the background grid off and turns the coordinate on.

- **NONE:** turns the background grid and coordinate off.

Return Format

The query returns FULL, HALF, or NONE.

Example

```
:MATH1:GRID NONE /*Turns the background grid and coordinates off.*/
:MATH1:GRID? /*The query returns NONE.*/
```

3.16.12 :MATH<n>:EXPand

Syntax

:MATH<*n*>:EXPand <*exp*>

:MATH<*n*>:EXPand?

Description

Sets or queries the vertical expansion type of math operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<exp>	Discrete	{GND|CENTer}	GND

Remarks

- **CENTer:** when the vertical scale is changed, the waveform will be expanded or compressed around the screen center.

- **GND:** when the vertical scale is changed, the waveform will be expanded or compressed around the signal ground level position.

Return Format

The query returns GND or CENTer.

Example

```
:MATH1:EXPand CENTer /*Sets the vertical expansion type of math
operation of CH1 to CENTer.*/
:MATH1:EXPand? /*The query returns CENTer.*/
```

3.16.13 :MATH<n>:WAVetype

Syntax

:MATH<*n*>:MATH<n>:WAVetype <*type*>

:MATH<*n*>:WAVetype?

Description

Sets or queries the waveform type of math operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<type>	Discrete	{MAIN|ZOOM}	MAIN

Remarks

- **MAIN:** indicates the main time base region.

- **ZOOM:** indicates the zoomed time base region.

  Only when the zoom function is enabled, can the Zoom waveform type be enabled. Zoom is not supported for the FFT operation.

Return Format

The query returns MAIN or ZOOM.

Example

```
:MATH1:WAVetype ZOOM  /*Sets the waveform type of math operation to
ZOOM.*/
:MATH1:WAVetype?  /*The query returns ZOOM.*/
```

3.16.14 :MATH<n>:FFT:SOURce

Syntax

:MATH<*n*>**:FFT:SOURce** <*source*>

:MATH<*n*>**:FFT:SOURce?**

Description

Sets or queries the channel source of FFT operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<source>	Discrete	{CHANnel1|CHANnel2|CHANnel3|CHANnel4}	CHANnel1

Remarks

N/A

Return Format

The query returns CHAN1, CHAN2, CHAN3, or CHAN4.

Example

```
:MATH1:FFT:SOURce CHANnel3    /*Sets the channel source of FFT
operation to CHANnel3.*/
:MATH1:FFT:SOURce?      /*The query returns CHAN3.*/
```

3.16.15   :MATH<n>:FFT:WINDow

Syntax

:MATH<*n*>:FFT:WINDow *<window>*

:MATH<*n*>:FFT:WINDow?

Description

Sets or queries the window function of FFT operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<window>	Discrete	{RECTangle|BLACkman|HANNing|HAMMing|FLATtop|TRIangle}	HANNing

Remarks

• Spectral leakage can be considerably minimized when a window function is used.

• Different window functions are applicable to measurements of different waveforms. You need to select the window function according to the different waveforms to be measured and their characteristics. For the characteristics of the window function and its applicable waveforms, refer to *Table 3.161 Window Function* .

Return Format

The query returns RECT, BLAC, HANN, HAMM, FLAT, or TRI.

Example

```
:MATH1:FFT:WINDow BLACkman    /*Sets the window function of FFT
operation to Blackman-Harris.*/
:MATH1:FFT:WINDow?          /*The query returns BLAC.*/
```

3.16.16 :MATH\<n\>:FFT:UNIT

Syntax

:MATH\<*n*\>**:FFT:UNIT** \<*unit*\>

:MATH\<*n*\>**:FFT:UNIT?**

Description

Sets or queries the vertical unit of FFT operation results.

Parameter

Name	Type	Range	Default
\<n\>	Discrete	{1|2|3|4}	-
\<unit\>	Discrete	{VRMS|DB}	DB

Remarks

N/A

Return Format

The query returns VRMS or DB.

Example

```
:MATH1:FFT:UNIT VRMS       /*Sets the vertical unit of FFT operation
results.*/
:MATH1:FFT:UNIT?            /*The query returns VRMS.*/
```

3.16.17 :MATH\<n\>:FFT:SCALe

Syntax

:MATH\<*n*\>**:FFT:SCALe** \<*scale*\>

:MATH\<*n*\>**:FFT:SCALe?**

Description

Sets or queries the vertical unit of FFT operation results.

Parameter

Name	Type	Range	Default
\<n\>	Discrete	{1|2|3|4}	-
\<scale\>	Real	Refer to *Remarks*	-

Remarks

- When the unit is set to dB, the range of <scale> is from 1 ndB to 5 GdB. The

  default value is 20 dB.

- When the unit is set to V_{rms}, the range of <scale> is from 1 nV_{rms} to 5 GV_{rms}. The

  default value is 10 V_{rms}.

You can run the *:MATH<n>:FFT:UNIT* command to configure or query the current unit.

Return Format

The query returns the current vertical scale in scientific notation.

Example

```
:MATH1:FFT:SCALe 0.3     /*Sets the vertical scale of the FFT
operation results to 300 mdB.*/
:MATH1:FFT:SCALe?        /*The query returns 3.000000E-1.*/
```

3.16.18 :MATH<n>:FFT:OFFSet

Syntax

:MATH<*n*>:FFT:OFFSet <*offset*>

:MATH<*n*>:FFT:OFFSet?

Description

Sets or queries the vertical offset of FFT operation results.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<offset>	Real	Refer to *Remarks*	0 dB

Remarks

- When the unit is set to dB, the range of <offset> is from -1 GdB to 1 GdB. The

  default value is 0 dB.

- When the unit is set to V_{rms}, the range of <offset> is from -1 GV_{rms} to 1 GV_{rms},.

  The default value is 0 V_{rms}.

You can run the *:MATH<n>:FFT:UNIT* command to configure or query the current unit.

EN

Return Format

The query returns the current vertical offset in scientific notation.

Example

```
:MATH1:FFT:OFFSet 0.3      /*Sets the vertical offset of the FFT
operation results to 300 mdB.*/
:MATH1:FFT:OFFSet?          /*The query returns 3.000000E-1.*/
```

3.16.19   :MATH<n>:FFT:HSCale

Syntax

:MATH<*n*>:FFT:HSCale <*hsc*>

:MATH<*n*>:FFT:HSCale?

Description

Sets or queries the frequency range of FFT operation results. The default unit is Hz.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<hsc>	Real	10 Hz to 1 GHz	10 MHz

Remarks

You can reduce the frequency range to observe the details of the spectrum.

Modifying the frequency range of the FFT operation results will affect the value of the center frequency. You can run the *:MATH<n>:FFT:HCENter* command to query or modify the center frequency.

Return Format

The query returns the current frequency range in scientific notation.

Example

```
:MATH1:FFT:HSCale 500000    /*Sets the frequency range of the FFT
operation results to 500 kHz.*/
:MATH1:FFT:HSCale?          /*The query returns 5.000000E+5.*/
```

3.16.20   :MATH<n>:FFT:HCENter

Syntax

:MATH<*n*>:FFT:HCENter <*cent*>

:MATH<*n*>:FFT:HCENter?

Description

Sets or queries the center frequency of FFT operation results, that is, the frequency relative to the horizontal center of the screen.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<cent>	Real	5 Hz to 1 GHz	5 MHz

Remarks

Modifying the center frequency of the FFT operation results will affect the value of the frequency range. You can run the *:MATH<n>:FFT:HSCale* command to query or modify the frequency range.

Return Format

The query returns the current center frequency in scientific notation. The unit is Hz.

Example

```
:MATH1:FFT:HCENter 10000000     /*Sets the center frequency of the
FFT operation results to 10 MHz.*/
:MATH1:FFT:HCENter?          /*The query returns 1.000000E+7.*/
```

3.16.21   :MATH<n>:FFT:FREQuency:STARt

Syntax

:MATH<*n*>:FFT:FREQuency:STARt <*value*>

:MATH<*n*>:FFT:FREQuency:STARt?

Description

Sets or queries the start frequency of FFT operation results.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<value>	Real	0 Hz to (Stop Freq - 10 Hz)	0 Hz

Remarks

The range of the start frequency of FFT operation is related to the stop frequency. You can run the *:MATH<n>:FFT:FREQuency:END* command to query or configure the stop frequency.

Return Format

The query returns the start frequency of the operation results in scientific notation.
The unit is Hz.

Example

```
:MATH1:FFT:FREQuency:STARt 10000000    /*Sets the start frequency of
the FFT operation results to 10 MHz.*/
:MATH1:FFT:FREQuency:STARt?            /*The query returns 1.000000E
+7.*/
```

3.16.22 :MATH<n>:FFT:FREQuency:END

Syntax

:MATH<*n*>:FFT:FREQuency:END <*value*>

:MATH<*n*>:FFT:FREQuency:END?

Description

Sets or queries the stop frequency of FFT operation results.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<value>	Real	(Start Freq + 10 Hz) to 1 GHz	10 MHz

Remarks

The range of the stop frequency of FFT operation is related to the start frequency. You
can run the *:MATH<n>:FFT:FREQuency:STARt* command to query or configure the
start frequency.

Return Format

The query returns the stop frequency of the operation results in scientific notation.
The unit is Hz.

Example

```
:MATH1:FFT:FREQuency:END 10000000    /*Sets the stop frequency of
the FFT operation results to 10 MHz.*/
:MATH1:FFT:FREQuency:END?            /*The query returns 1.000000E
+7.*/
```

3.16.23 :MATH<n>:FFT:SEARch:ENABle

Syntax

:MATH<*n*>:FFT:SEARch:ENABle <*bool*>

EN

`:MATH<n>:FFT:SEARch:ENABle?`

Description

Enables or disables the FFT peak search; or queries the on/off status of the FFT peak search function.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<bool>	Bool	{{1|ON}|{0|OFF}}	0|OFF

Remarks

N/A

Return Format

The query returns 1 or 0.

Example

```
:MATH1:FFT:SEARch:ENABle ON      /*Enables the FFT peak search.*/
:MATH1:FFT:SEARch:ENABle?          /*The query returns 1.*/
```

3.16.24   :MATH<n>:FFT:SEARch:NUM

Syntax

`:MATH<n>:FFT:SEARch:NUM <num>`

`:MATH<n>:FFT:SEARch:NUM?`

Description

Sets or queries the maximum number of the FFT peak search.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<num>	Integer	1 to 15	5

Remarks

N/A

Return Format

The query returns an integer ranging from 1 to 15.

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Example

```
:MATH1:FFT:SEARch:NUM 10          /*Sets the maximum number of the
FFT peak search to 10.*/
:MATH1:FFT:SEARch:NUM?            /*The query returns 10.*/
```

3.16.25 :MATH<n>:FFT:SEARch:THReshold

Syntax

:MATH<*n*>:FFT:SEARch:THReshold <*thres*>

:MATH<*n*>:FFT:SEARch:THReshold?

Description

Sets or queries the threshold of the FFT peak search.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<thres>	Real	Related to the vertical scale and vertical offset of FFT operation	5.5 dB

Remarks

N/A

Return Format

The query returns the threshold in scientific notation.

Example

```
:MATH1:FFT:SEARch:THReshold 0.5         /*Sets the threshold of the
FFT peak search to 500 mdB.*/
:MATH1:FFT:SEARch:THReshold?            /*The query returns
5.000000E-1.*/
```

3.16.26 :MATH<n>:FFT:SEARch:EXCursion

Syntax

:MATH<*n*>:FFT:SEARch:EXCursion <*excur*>

:MATH<*n*>:FFT:SEARch:EXCursion?

Description

Sets or queries the excursion of the FFT peak search.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<excur>	Real	0 to (8 x VerticalScale)	1.8 dB

Remarks

VerticalScale indicates the vertical scale of FFT.

Return Format

The query returns the excursion in scientific notation.

Example

```
:MATH1:FFT:SEARch:EXCursion 0.5          /*Sets the excursion of the
FFT peak search to 500 mdB.*/
:MATH1:FFT:SEARch:EXCursion?             /*The query returns
5.000000E-1.*/
```

3.16.27   :MATH<n>:FFT:SEARch:ORDer

Syntax

:MATH<*n*>:FFT:SEARch:ORDer <*order*>

:MATH<*n*>:FFT:SEARch:ORDer?

Description

Sets or queries the sequence of the FFT peak search results.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<order>	Discrete	{AMPorder|FREQorder}	AMPorder

Remarks

N/A

Return Format

The query returns AMP or FREQ.

Example

```
:MATH1:FFT:SEARch:ORDer AMPorder  /*Sets the sequence of the FFT
peak search results to AMPorder.*/
:MATH1:FFT:SEARch:ORDer?          /*The query returns AMP.*/
```

3.16.28 :MATH<n>:FFT:SEARch:RES?

Syntax

:MATH<*n*>:FFT:SEARch:RES?

Description

Queries the peak search results table.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-

Remarks

N/A

Return Format

The query returns the peak search results table in strings.

Example

```
:MATH1:FFT:SEARch:RES?    /*The query returns the peak search
results table in strings.*/
1,2.50000MHz,-24.98dBV
2,3.50000MHz,-27.84dBV
3,4.50000MHz,-30.04dBV
4,5.50125MHz,-31.5dBV
5,6.50125MHz,-32.34dBV
```

3.16.29 :MATH<n>:FILTer:TYPE

Syntax

:MATH<*n*>:FILTer:TYPE <*type*>

:MATH<*n*>:FILTer:TYPE?

Description

Sets or queries the filter type.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<type>	Discrete	{LPASs|HPASs|BPASs|BSTop}	LPASs

Remarks

The oscilloscope provides 4 practical filters (Low Pass Filter, High Pass Filter, Band Pass Filter, and Band Stop Filter), which can filter the specified frequencies in the signal by setting the bandwidth. You can use the *:MATH<n>:FFT:SOURce* command to set or query the channel source of the filter.

- **LPASs:** indicates low pass filter, which only allows the signals whose frequencies are smaller than the current cut-off frequency to pass.

- **HPASs:** indicates high pass filter, which only allows the signals whose frequencies are greater than the current cut-off frequency to pass.

- **BPASs:** indicates band pass filter, which only allows the signals whose frequencies are greater than the current cut-off frequency 1 and smaller than the current cut-off frequency 2 to pass.

  Note: The cut-off frequency 1 must be smaller than the cut-off frequency 2.

- **BSTop:** indicates band stop filter, which only allows the signals whose frequencies are smaller than the current cut-off frequency 1 or greater than the current cut-off frequency 2 to pass.

  Note: The cut-off frequency 1 must be smaller than the cut-off frequency 2.

Return Format

The query returns LPAS, HPAS, BPAS, or BST.

Example

```
:MATH1:FILTer:TYPE LPASs    /*Sets the filter type to Low Pass
Filter.*/
:MATH1:FILTer:TYPE?         /*The query returns LPAS.*/
```

3.16.30 :MATH<n>:FILTer:W1

Syntax

:MATH<*n*>:FILTer:W1 <*freq1*>

:MATH<*n*>:FILTer:W1?

Description

Sets or queries the cut-off frequency of Low Pass Filter/High Pass Filter; or the cut-off frequency 1 of Band Pass Filter/Band Stop Filter. The default unit is Hz.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<freq1>	Real	Refer to *Remarks*	Refer to *Remarks*

Remarks

- When the filter type is set to LPASs (Low Pass Filter) or HPASs (High Pass Filter), you need to set one cut-off frequency. At this time, the range of <freq1> is from (0.005 x screen sample rate) to (0.1 x screen sample rate), at a step of (0.005 x screen sample rate); wherein, screen sample rate = 100/horizontal time base.

- When the filter type is set to BPASs (Band Pass Filter) or BSTop (Band Stop Filter), you need to set two cut-off frequencies. Note: The cut-off frequency 1 must be smaller than the cut-off frequency 2. Run this command to set the cut-off frequency 1, and run the *:MATH<n>:FILTer:W2* command to set the cut-off frequency 2. At this time, the range of <freq1> is from (0.005 x screen sample rate) to (0.095 x screen sample rate), at a step of (0.005 x screen sample rate); wherein, screen sample rate = 100/horizontal time base.

- The default value of <freq1> is related to the filter type.

    - When the filter type is set to LPASs (Low Pass Filter), BPASs (Band Pass Filter), or BSTop (Band Stop Filter), the default value is 0.005 x screen sample rate.

    - When the filter type is set to HPASs (High Pass Filter), the default value is 0.1 x screen sample rate.

- You can use *:MATH<n>:FILTer:TYPE* to set or query the filter type.

Return Format

The query returns the current cut-off frequency or cut-off frequency 1 in scientific notation.

Example

```
:MATH1:FILTer:W1 1000000        /*Sets the cut-off frequency of Low
Pass Filter to 1 MHz.*/
:MATH1:FILTer:W1?               /*The query returns 1.000000E+6.*/
```

3.16.31   :MATH<n>:FILTer:W2

Syntax

:MATH<*n*>:FILTer:W2 <*freq2*>

:MATH<*n*>:FILTer:W2?

Description

Sets or queries the cut-off frequency 2 of Band Pass Filter/Band Stop Filter. The default unit is Hz.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<freq2>	Real	Refer to *Remarks*	0.1 x screen sample rate

Remarks

When the filter type is set to BPASs (Band Pass Filter) or BSTop (Band Stop Filter), you need to set two cut-off frequencies. Note: The cut-off frequency 2 must be smaller than the cut-off frequency 1. Run the *:MATH<n>:FILTer:W1* command to set the cut-off frequency 1, and run this command to set the cut-off frequency 2. At this time, the range of <freq2> is from (0.01 x screen sample rate) to (0.1 x screen sample rate), at a step of (0.005 x screen sample rate); wherein, screen sample rate = 100/horizontal time base.

Return Format

The query returns the current cut-off frequency 2 in scientific notation.

Example

```
:MATH1:FILTer:W2 1500000        /*Sets the cut-off frequency 2 of
Band Pass Filter to 1.5 Mhz.*/
:MATH1:FILTer:W2?               /*The query returns 1.500000E+6.*/
```

3.16.32   :MATH<n>:SENSitivity

Syntax

:MATH<*n*>:SENSitivity <*sens*>

:MATH<*n*>:SENSitivity?

Description

Sets or queries the sensitivity of the logic operation. The default unit is div.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<sens>	Real	100 mdiv to 1 div	300 mdiv

Remarks

N/A

Return Format

The query returns the sensitivity of the logic operation in scientific notation.

Example

```
:MATH1:SENSitivity 0.2    /*Sets the sensitivity of the logic
operation to 0.2 div.*/
:MATH1:SENSitivity?     /*The query returns 2.000000E-1.*/
```

3.16.33 :MATH<n>:DISTance

Syntax

:MATH<*n*>:DISTance <*dist*>

:MATH<*n*>:DISTance?

Description

Sets or queries the smoothing window width of differential operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<dist>	Integer	1 to 1,000	-

Remarks

N/A

Return Format

The query returns an integer ranging from 1 to 1,000.

Example

```
:MATH1:DISTance 20    /*Sets the smoothing window width of
differential operation to 20.*/
:MATH1:DISTance?      /*The query returns 20.*/
```

3.16.34 :MATH<n>:THReshold1

Syntax

:MATH<*n*>:THReshold1 <*thre*>

:MATH<*n*>:THReshold1?

Description

Sets or queries threshold level of Analog Channel 1 in the logic operation. The default unit is V.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<thre>	Real	(-4 × VerticalScale - VerticalOffset) to (4 × VerticalScale - VerticalOffset)	0 V

Remarks

- This command is only available for the logic operations A&&B, A||B, A^B, and !A.

- VerticalScale indicates the vertical scale of Analog Channel 1. VerticalOffset

  indicates the vertical offset of Analog Channel 1. The step value is

  VerticalScale/10.

Return Format

The query returns the threshold level of of Analog Channel 1 in scientific notation.

Example

```
:MATH1:THReshold1 0.8   /*Sets the threshold level of Analog
Channel 1 in logic operation to 800 mV.*/
:MATH1:THReshold1?      /*The query returns 8.000000E-1.*/
```

3.16.35　:MATH<n>:THReshold2

Syntax

`:MATH<n>:THReshold2 <thre>`

`:MATH<n>:THReshold2?`

Description

Sets or queries threshold level of Analog Channel 2 in the logic operation. The default unit is V.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<thre>	Real	(-4 × VerticalScale - VerticalOffset) to (4 × VerticalScale - VerticalOffset)	0 V

Remarks

- This command is only available for the logic operations A&&B, A\|\|B, A^B, and !A.

- VerticalScale indicates the vertical scale of Analog Channel 2. VerticalOffset indicates the vertical offset of Analog Channel 2. The step value is VerticalScale/10.

Return Format

The query returns the threshold level of of Analog Channel 2 in scientific notation.

Example

```
:MATH1:THReshold2 0.8   /*Sets the threshold level of Analog
Channel 2 in logic operation to 800 mV.*/
:MATH1:THReshold2?      /*The query returns 8.000000E-1.*/
```

3.16.36　:MATH<n>:THReshold3

Syntax

`:MATH<n>:THReshold3 <thre>`

`:MATH<n>:THReshold3?`

Description

Sets or queries threshold level of Analog Channel 3 in the logic operation. The default unit is V.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<thre>	Real	(-4 × VerticalScale - VerticalOffset) to (4 × VerticalScale - VerticalOffset)	0 V

Remarks

• This command is only available for the logic operations A&&B, A\|\|B, A^B, and !A.

• VerticalScale indicates the vertical scale of Analog Channel 3. VerticalOffset indicates the vertical offset of Analog Channel 3. The step value is VerticalScale/10.

Return Format

The query returns the threshold level of of Analog Channel 3 in scientific notation.

Example

```
:MATH1:THReshold3 0.8    /*Sets the threshold level of Analog
Channel 3 in logic operation to 800 mV.*/
:MATH1:THReshold3?       /*The query returns 8.000000E-1.*/
```

3.16.37 :MATH<n>:THReshold4

Syntax

:MATH<*n*>:THReshold4 <*thre*>

:MATH<*n*>:THReshold4?

Description

Sets or queries threshold level of Analog Channel 4 in the logic operation. The default unit is V.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<thre>	Real	(-4 × VerticalScale - VerticalOffset) to (4 × VerticalScale - VerticalOffset)	0 V

Remarks

- This command is only available for the logic operations A&&B, A||B, A^B, and !A.

- VerticalScale indicates the vertical scale of Analog Channel 4. VerticalOffset indicates the vertical offset of Analog Channel 4. The step value is VerticalScale/10.

Return Format

The query returns the threshold level of of Analog Channel 4 in scientific notation.

Example

```
:MATH1:THReshold4 0.8    /*Sets the threshold level of Analog
Channel 4 in logic operation to 800 mV.*/
:MATH1:THReshold4?       /*The query returns 8.000000E-1.*/
```

3.16.38 :MATH<n>:WINDow:TITLe?

Syntax

`:MATH<n>:WINDow:TITLe?`

Description

Queries the title of the specified math operation window.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-

Remarks

N/A

Return Format

The query returns the title of the specified math operation window in strings.

Example

```
:MATH1:WINDow:TITLe? /*The query returns Math1 CH1*CH1 Scale:0U
Sa:2GSa/s.*/
```

3.16.39 :MATH<n>:LABel:SHOW

Syntax

:MATH<*n*>:LABel:SHOW <*bool*>

:MATH<*n*>:LABel:SHOW?

Description

Sets or queries whether to display the waveform label of the specified operation.

Parameter

Name	Type	Range	Default
<n>	Discrete	{1|2|3|4}	-
<bool>	Bool	{{1|ON}|{0|OFF}}	-

Remarks

N/A

Return Format

The query returns 1 or 0.

Example

```
:MATH1:LABel:ENABle ON          /*Enables the display of the
label.*/
:MATH1:LABel:ENABle?            /*The query returns 1.*/
```

3.17 :MEASure Commands

:MEASure commands are used to set and query the parameters related to measurements.

This oscilloscope allows you to set the measurement source, enable or disable the all measurement function, the statistical function, and etc.