

This instrument should be adjusted by a qualified engineer at a qualified facility with sufficient precision. The adjustment feature of this instrument can be used to adjust the D/A output and voltage/current measurement. The adjustment values are retained even when the instrument is initialized, but they may be reset if the instrument is adjusted at a YOKOGAWA factory. If you need to adjust the instrument more than that is possible with the adjustment feature or if you want calibration and adjustment to be performed at a YOKOGAWA factory, contact your nearest YOKOGAWA dealer.

## Applicable Conditions

The following options are installed in the MT300.

- D/A output adjustment: /DA option
- Voltage/current measurement adjustment: /DM option

## Equipment Used

- Digital multimeter 3458A (Keysight) or equivalent
- Standard DC voltage/current source GS200 (YOKOGAWA) or equivalent
- Standard resistor (100Ω) 2792A06 (YOKOGAWA) or equivalent

Each piece of equipment must be calibrated and with sufficient precision.

## Adjustment Procedure and Conditions

- Ambient temperature  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ; humidity 35%RH to 75%RH; at least 30 minute warm-up
- Supply voltage fluctuation tolerance: 90 VAC to 132 VAC or 180 VAC to 264 VAC  
Power frequency fluctuation tolerance: 47 Hz to 63 Hz
- Use the default settings for settings that are not specified.

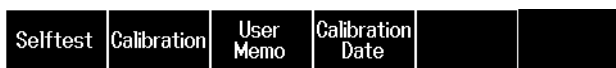
## Procedure

### Switching to Adjustment Mode

1. Press **MENU**. The top menu appears.
2. Press the **Utility** soft key, the **Next** soft key, and then the **Next** soft key. The following menu appears.
3. Press the **Maintenance** soft key. The Maintenance menu appears.



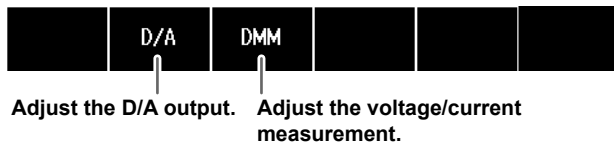
4. Press the **Calibration** soft key. A password input screen appears.



5. Use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to enter the password "1111."



6. Press **ENTER**. The adjustment menu appears.  
The features that can be adjusted on this instrument appear.



## Adjusting the D/A Output

1. Connect this instrument to a digital multimeter.  
For the wiring method and instrument setup, see “Explanation.”
2. Press the **D/A** soft key. Either 2 V or 5 V is output, and the D/A output adjustment menu appears.



3. Press the **Range** soft key to select the 2 V range.



4. Press the **Zero** soft key. The zero point (0 V) is output, and the input screen appears.



5. When the digital multimeter display stabilizes, use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to input the value displayed on the digital multimeter.



6. Press **ENTER**. The zero point adjustment value is set.
7. Press the **PlusFull** soft key. The full-scale positive value (+2 V) is output, and the input screen appears.



8. When the digital multimeter display stabilizes, use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to input the value displayed on the digital multimeter.



9. Press **ENTER**. The full-scale positive adjustment value is set.

10. Press the **MinusFull** soft key. The full-scale negative value (-2 V) is output, and the input screen appears.



11. When the digital multimeter display stabilizes, use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to input the value displayed on the digital multimeter.



12. Press **ENTER**. The full-scale negative adjustment value is set.

13. Press the **Range** soft key to select the 5 V range.



14. Repeat steps 4 to 12, set the adjustment values (zero point, full-scale positive and negative values) of the 5 V range.

15. Press the **OK** soft key. The adjustment values of the 2 V and 5 V ranges are saved, and the screen returns with adjustment menu.



## Adjusting the Voltage/Current Measurement

1. Press the **DMM** soft key. The voltage/current measurement adjustment menu appears.



### Note

If the warning code "59: The measured value is out of range" appears when you set an adjustment value, the value may be exceeding the adjustment range. Use the: `CALibrate:DMM:INITialize` command to initialize the voltage/current measurement adjustment values. When you initialize the adjustment values, they are returned to their factory default conditions. Adjust the voltage/current measurement again.

## Adjusting the Voltage Measurement

2. Press the **Range** soft key to select the 5 V range.



**Measurement value**  
When you enter adjustment values, they are reflected in the measurement value.

3. Connect this instrument, digital multimeter, and standard DC voltage current source. For the wiring method and instrument setup, see "Explanation."

4. Press the **PlusFull** soft key.



5. On the standard DC voltage current source, output +5 V.

6. When the digital multimeter display stabilizes, use the **arrow** (▲, ▼, ◀, and ▶) keys to input the value displayed on the digital multimeter.



7. Press **ENTER**. The full-scale positive adjustment value is set.
8. Press the **MinusFull** soft key.



9. On the standard DC voltage current source, output -5 V.
10. When the digital multimeter display stabilizes, use the **arrow** (▲, ▼, ◀, and ▶) keys to input the value displayed on the digital multimeter.



11. Press **ENTER**. The full-scale negative adjustment value is set.

### Adjusting the Current Measurement

12. Press the **Range** soft key to select the +20 mA range.



13. Connect this instrument, digital multimeter, standard DC voltage current source, and standard resistor.  
For the wiring method and instrument setup, see "Explanation."

14. Press the **PlusFull** soft key.



15. On the standard DC voltage current source, output +20 mA.
16. When the value displayed on the digital multimeter stabilizes, divide the displayed value by the standard resistor value to calculate the current.
17. Use the **arrow** (▲, ▼, ◀, and ▶) keys to enter the calculated current.



18. Press **ENTER**. The full-scale positive adjustment value is set.
19. Press the **MinusFull** soft key.



20. On the standard DC voltage current source, output -20 mA.
21. When the value displayed on the digital multimeter stabilizes, divide the displayed value by the standard resistor value to calculate the current.

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22. Use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to enter the calculated current.



23. Press **ENTER**. The full-scale negative adjustment value is set.

### Saving the Adjustment Values

24. Press the **OK** soft key. The adjustment values of the 5 V and 20 mA ranges are saved, and the screen returns with adjustment menu.

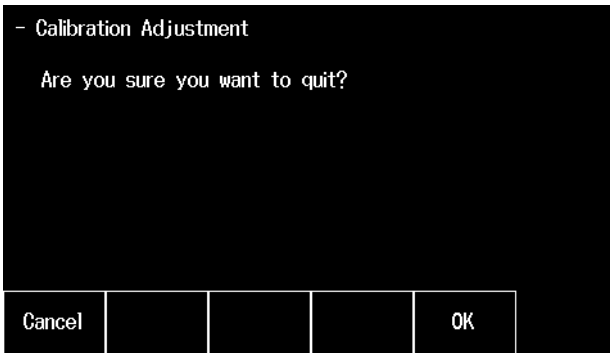


### Ending Adjustment Mode

1. On the adjustment menu, press **ESC**.



2. Press the **OK** soft key. The screen returns the top menu.



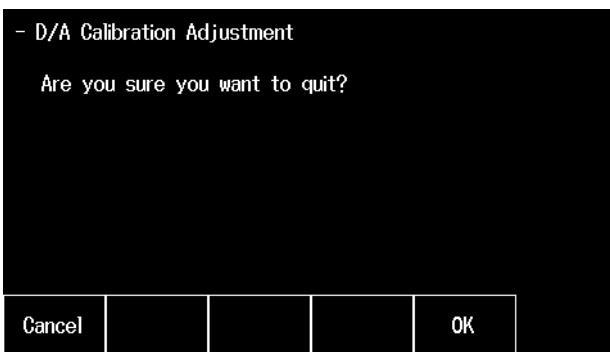
### Canceling the Adjustment Values

1. On the D/A output or voltage/current measurement adjustment menu, press **ESC**.

#### D/A output adjustment menu



2. Press the **OK** soft key. The adjustment values are discarded, and the screen returns to the adjustment menu.



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## Calibrating after Adjustment

After adjustment, be sure to calibrate the instrument. After calibration, enter the user calibration date.

### Entering the User Calibration Date

1. Press **MENU**. The top menu appears.
2. Press the **Utility** soft key, the **Next** soft key, and then the **Next** soft key. The following menu appears.
3. Press the **Maintenance** soft key. The Maintenance menu appears.

Language	Maintenance			Next 3/3	
English					

4. Press the **Calibration Date** soft key. The following menu appears.

Selftest	Calibration	User Memo	Calibration Date		
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5. If you calibrated the D/A output, press the **D/A Cal. Date** soft key. The following screen appears.

Pressure Cal. Date	DMM Cal. Date	D/A Cal. Date			
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6. Use the **arrow** (**▲**, **▼**, **◀**, and **▶**) keys to enter the date, and then press **ENTER**.

D/A Cal. Date	2019/11/07
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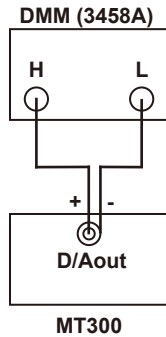
7. If you calibrated the voltage/current measurement (/DM option), in step 5 above, press the **DMM Cal. Date** soft key, and enter the calibration date.

## Explanation

### Wiring Method and Instrument Configuration

#### Adjusting the D/A Output

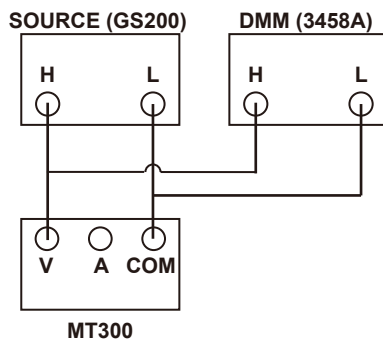
- Connect this instrument's D/A output terminal to the 3458A digital multimeter's voltage input terminal.



- Set the 3458A measurement range to 10 VDC range and the integration time to 50NPLC.

#### Adjusting the Voltage Measurement

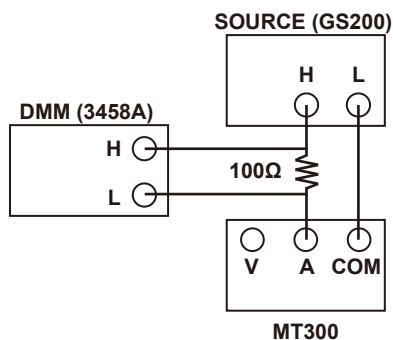
- Connect this instrument's voltage input terminal, the 3458A digital multimeter's voltage input terminal, and the GS200 standard DC voltage current source's output terminal.



- Set the 3458A measurement range to 10 VDC range and the integration time to 50NPLC.

#### Adjusting the Current Measurement

- Connect this instrument's current input terminal, the 3458A digital multimeter's voltage input terminal, the GS200 standard DC voltage current source's output terminal, and the 2792A06 standard resistor.



- Set the 3458A measurement range to 10 VDC range and the integration time to 50NPLC.

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## List of Commands

Command	Function	Page
<b>CALibrate Group</b>		
:CALibrate:DA:ADJust:MFULL	Sets the full-scale negative adjustment value of the D/A output.	9
:CALibrate:DA:ADJust:PFULL	Sets the full-scale positive adjustment value of the D/A output.	9
:CALibrate:DA:ADJust:ZERO	Sets the zero point adjustment value of D/A output.	9
:CALibrate:DA:DATE?	Queries the date when the adjustment value of D/A output was written.	9
:CALibrate:DA:INITialize	Initializes the adjustment value of D/A output.	9
:CALibrate:DA:POINT	Sets or queries the adjustment point of the D/A output range to be adjusted.	10
:CALibrate:DA:RANGe	Sets or queries the D/A output range to be adjusted.	10
:CALibrate:DA:WRITe	Writes the adjustment value of D/A output.	10
:CALibrate:DMM:ADJust:MFULL	Sets the full-scale negative adjustment value of the voltage/current measurement.	10
:CALibrate:DMM:ADJust:PFULL	Sets the full-scale positive adjustment value of the voltage/current measurement.	10
:CALibrate:DMM:DATE?	Queries the date when the adjustment value of voltage/current measurement was written.	11
:CALibrate:DMM:INITialize	Initializes the adjustment value of voltage/current measurement.	11
:CALibrate:DMM:MEASure?	Queries the measured voltage/current.	11
:CALibrate:DMM:POINT	Sets or queries the adjustment point of the measurement range of the voltage/current measurement to be adjusted.	11
:CALibrate:DMM:RANGe	Sets or queries the measurement range of the voltage/current measurement to be adjusted.	11
:CALibrate:DMM:WRITe	Writes the adjustment value of voltage/current measurement.	11
:CALibrate:FUNction	Sets or queries the adjustment target (voltage/current measurement, D/A output).	12
:CALibrate:PASSword	Enters the password for switching to adjustment mode.	12



## CALibrate Group

### **:CALibrate:DA:ADJust:MFULL**

**Function** Sets the full-scale negative adjustment value of the D/A output.

**Syntax** :CALibrate:DA:ADJust:MFULL <Voltage>  
<Voltage> =  
5 V range  
-4.00000 (V) to -6.00000 (V) (0.00001 V setting resolution)  
2 V range  
-1.60000 (V) to -2.40000 (V) (0.00001 V setting resolution)

**Example** :CALIBRATE:DA:ADJUST:MFULL -5.00000V

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur.
- Use the :CALibrate:DA:POINT command to set the adjustment point to MFULL. If the adjustment point is not MFULL, a "221: Setting conflict" error will occur.

### **:CALibrate:DA:ADJust:PFULL**

**Function** Sets the full-scale positive adjustment value of the D/A output.

**Syntax** :CALibrate:DA:ADJust:PFULL <Voltage>  
<Voltage> =  
5 V range  
4.00000 (V) to 6.00000 (V) (0.00001 V setting resolution)  
2 V range  
1.60000 (V) to 2.40000 (V) (0.00001 V setting resolution)

**Example** :CALIBRATE:DA:ADJUST:PFULL 5.00000V

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur.
- Use the :CALibrate:DA:POINT command to set the adjustment point to PFULL. If the adjustment point is not PFULL, a "221: Setting conflict" error will occur.

### **:CALibrate:DA:ADJust:ZERO**

**Function** Sets the zero point adjustment value of D/A output.

**Syntax** :CALibrate:DA:ADJust:ZERO <Voltage>  
<Voltage> =  
5 V range  
-0.50000 (V) to 0.50000 (V) (0.00001 V setting resolution)  
2 V range  
-0.20000 (V) to 0.20000 (V) (0.00001 V setting resolution)

**Example** :CALIBRATE:DA:ADJUST:ZERO 0.10000V

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur.
- Use the :CALibrate:DA:POINT command to set the adjustment point to ZERO. If the adjustment point is not ZERO, a "221: Setting conflict" error will occur.

### **:CALibrate:DA:DATE?**

**Function** Queries the date when the adjustment value of D/A output was written.

**Syntax** :CALibrate:DA:DATE?

**Example** :CALIBRATE:DA:DATE?  
-> :CALIBRATE:DA:DATE "2019/09/12"

**Description** On models without the /DA option, a "241: Hardware missing" error will occur.

### **:CALibrate:DA:INITialize**

**Function** Initializes the adjustment value of D/A output.

**Syntax** :CALibrate:DA:INITialize

**Example** :CALIBRATE:DA:INITIALIZE

**Description**

- Initializes the adjustment value of D/A output. On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur.

### **:CALibrate:DA:POINT**

**Function** Sets or queries the adjustment point of the D/A output range to be adjusted.

**Syntax** :CALibrate:DA:POINT {PFULL|MFULL|ZERO}  
CALibrate:DA:POINT?  
PFULL: Full-scale positive value  
MFULL: Full-scale negative value  
ZERO: Zero point

**Example** :CALIBRATE:DA:POINT PFULL  
:CALIBRATE:DA:POINT?  
-> :CALIBRATE:DA:POINT PFULL

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur. A query returns the current value.

### **:CALibrate:DA:RANGE**

**Function** Sets or queries the D/A output range to be adjusted.

**Syntax** :CALibrate:DA:RANGE <Voltage>  
:CALibrate:DA:RANGE?  
<Voltage> = 2, 5 (V)

**Example** :CALIBRATE:DA:RANGE 5V  
:CALIBRATE:DA:RANGE?  
-> :CALIBRATE:DA:RANGE 5.0E+00

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur. A query returns the current value.

### **:CALibrate:DA:WRITE**

**Function** Writes the adjustment value of D/A output.

**Syntax** :CALibrate:DA:WRITE

**Example** :CALIBRATE:DA:WRITE

**Description**

- On models without the /DA option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DA. If the adjustment target is not DA, a "221: Setting conflict" error will occur.
- When executed, the adjustment target is set to NONE.

### **:CALibrate:DMM:ADJust:MFULL**

**Function** Sets the full-scale negative adjustment value of the voltage/current measurement.

**Syntax** :CALibrate:DMM:ADJust:MFULL <NRf>  
<NRf> =  
5 V range  
-4.00000 (V) to -6.00000 (V) (0.00001 V setting resolution)  
20 mA range  
-16.0000 (mA) to -24.0000 (mA) (0.00001 mA setting resolution)

**Example** :CALIBRATE:DMM:ADJUST:MFULL -5.00000

**Description**

- On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur.
- Use the :CALibrate:DMM:POINT command to set the adjustment point to MFULL. If the adjustment point is not MFULL, a "221: Setting conflict" error will occur.

### **:CALibrate:DMM:ADJust:PFULL**

**Function** Sets the full-scale positive adjustment value of the voltage/current measurement.

**Syntax** :CALibrate:DMM:ADJust:PFULL <NRf>  
<NRf> =  
5 V range  
4.00000 (V) to 6.00000 (V) (0.00001 V setting resolution)  
20 mA range  
16.0000 (mA) to 24.0000 (mA) (0.00001 mA setting resolution)

**Example** :CALIBRATE:DMM:ADJUST:PFULL 5.00000

**Description**

- On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur.
- Use the :CALibrate:DMM:POINT command to set the adjustment point to PFULL. If the adjustment point is not PFULL, a "221: Setting conflict" error will occur.

### **:CALibrate:DMM:DATE?**

Function Queries the date when the adjustment value of voltage/current measurement was written.

Syntax :CALibrate:DMM:DATE?

Example :CALIBRATE:DMM:DATE?  
-> :CALIBRATE:DMM:DATE "2019/09/12"

Description On models without the /DM option, a "241: Hardware missing" error will occur.

### **:CALibrate:DMM:INITialize**

Function Initializes the adjustment value of voltage/current measurement.

Syntax :CALibrate:DMM:INITialize

Example :CALIBRATE:DMM:INITIALIZE

Description

- Initializes the adjustment value of voltage/current measurement. On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur.

### **:CALibrate:DMM:MEASure?**

Function Queries the measured voltage/current.

Syntax :CALibrate:DMM:MEASure?

Example :CALIBRATE:DMM:MEASURE?  
-> :CALIBRATE:DMM:MEASURE 5.0000E+00

Description

- On models without the /DM option, a "241: Hardware missing" error will occur.
- If the value is +OverRange or +Overflow, 9.90E+37 is returned. If the value is -OverRange or -Overflow, -9.90E+37 is returned. If DMM is not selected with the :CALibrate:FUNCTION command, 9.91E+37 is returned.

### **:CALibrate:DMM:POINT**

Function Sets or queries the adjustment point of the measurement range of the voltage/current measurement to be adjusted.

Syntax :CALibrate:DMM:POINT {PFULL|MFULL}  
:CALibrate:DMM:POINT?  
PFULL: Full-scale positive value  
MFULL: Full-scale negative value

Example :CALIBRATE:DMM:POINT PFULL  
:CALIBRATE:DMM:POINT?  
-> :CALIBRATE:DMM:POINT PFULL

Description

- On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur. A query returns the current value.

### **:CALibrate:DMM:RANGE**

Function Sets or queries the measurement range of the voltage/current measurement to be adjusted.

Syntax :CALibrate:DMM:RANGE {VOLTage,  
<Voltage>|CURRent,<Current>}  
:CALibrate:DMM:RANGE?  
<Voltage> = 5 (V)  
<Current> = 20 (mA)

Example :CALIBRATE:DMM:RANGE VOLTAGE, 5V  
:CALIBRATE:DMM:RANGE?

• 5 V range

-> :CALIBRATE:DMM:RANGE VOLTAGE,  
5.000E+00

• 20 mA range

-> :CALIBRATE:DMM:RANGE CURRENT,  
20.0E-03

Description

- On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur. A query returns the current value.

### **:CALibrate:DMM:WRITE**

Function Writes the adjustment value of voltage/current measurement.

Syntax :CALibrate:DMM:WRITE

Example :CALIBRATE:DMM:WRITE

Description

- On models without the /DM option, a "241: Hardware missing" error will occur.
- Use the :CALibrate:FUNCTION command in advance to set the adjustment target to DMM. If the adjustment target is not DMM, a "221: Setting conflict" error will occur.
- When executed, the adjustment target is set to NONE.

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### **:CALibrate:FUNCTION**

- Function** Sets or queries the adjustment target (voltage/current measurement, D/A output).
- Syntax** :CALibrate:FUNCTION {DMM|DA|NONE}  
:CALibrate:FUNCTION?  
DMM: Voltage/current measurement  
DA: D/A output  
NONE: Not selected
- Example** :CALIBRATE:FUNCTION DMM  
:CALIBRATE:FUNCTION?  
-> :CALIBRATE:FUNCTION DMM
- Description**
- If you change the adjustment target before executing the :CALibrate:DMM:WRITE or :CALibrate:DA:WRITE command, the adjustment values that you have set will return to their original values. Be sure to write the adjustment values using the appropriate command before changing the adjustment target.
  - On models without the /DM option, sending a :CALibrate:FUNCTION DMM command will cause a "141: Invalid character data" error.
  - On models without the /DA option, sending a :CALibrate:FUNCTION DA command will cause a "141: Invalid character data" error.

### **:CALibrate:PASSWORD**

- Function** Enters the password for switching to adjustment mode.
- Syntax** :CALibrate:PASSWORD {<String>}  
<String>: Password
- Example** :CALIBRATE:PASSWORD "1111"
- Description** You must enter a password to use the commands in the CALibrate group.  
Enter a character string for the password.  
To exit from adjustment mode, enter an empty string (two consecutive double quotation marks).