

# Agilent 4285A

## Precision LCR Meter

Data Sheet

### Specifications

The complete Agilent Technologies 4285A specifications are listed below. These specifications are the performance standards or limits against which the instrument is tested. When shipped from the factory, the 4285A meets the specifications listed in this section. The specification test procedures are covered in *Agilent 4285A Maintenance Manual* (Agilent Part Number 04285-90030).

### Measurement Functions

#### Measurement parameters

- |Z| = Absolute value of impedance
- |Y| = Absolute value of admittance
- L = Inductance
- C = Capacitance
- R = Resistance
- G = Conductance
- D = Dissipation factor
- Q = Quality factor
- R<sub>s</sub> = Equivalent series resistance
- R<sub>p</sub> = Parallel resistance
- X = Reactance
- B = Susceptance
- θ = Phase angle

#### Combinations of measurement parameters

| Z ,  Y           | L, C                                      | R | G |
|------------------|---|---|---|
| θ (deg), θ (rad) | D, Q, R <sub>s</sub> , R <sub>p</sub> , G | X | B |

### Mathematical functions

The deviation and the percent of deviation of measurement values from a programmable reference value.

### Equivalent measurement circuit

Parallel and series

### Ranging

Auto and manual (hold/up/down)

### Trigger

Internal, external, BUS (GPIB), and manual

### Delay time

Programmable delay from the trigger command to the start of the measurement, 0 to 60.000 s in 1 ms steps.

### Measurement terminals

Four-terminal pair

### Test cable length

0 m, 1 m, and 2 m selectable

### Integration time

Short, medium, and long selectable (refer to *Supplemental Performance Characteristics*, page 14, for the measurement time)

### Averaging

1 to 256, programmable



Agilent Technologies

## Test Signal

### Frequency

75 kHz to 30 MHz, 100 Hz solution

### Frequency accuracy

±0.01%

### Signal modes

**Normal**—Program selected voltage or current at the measurement terminals when they are opened or shorted, respectively

**Constant**—Maintains selected voltage or current at the device under test (DUT) independent of changes in the device's impedance.

### Signal level

The following test signal level accuracy is specified for an ambient temperature range of 23 °C ± 5 °C and the test cable length is 0 m.

|                | Mode                  | Range   | Setting accuracy                                      |
|----------------|-----------------------|---|---|
| <b>Voltage</b> | Normal                | 5 m V <sub>rms</sub> to 2 V <sub>rms</sub>    | ±{(8 + 0.4 f <sub>m</sub> )% + 1 m V <sub>rms</sub> } |
|                | Constant <sup>1</sup> | 10 mV <sub>rms</sub> to 1 V <sub>rms</sub>    | ±{(6 + 0.2 f <sub>m</sub> )% + 1 m V <sub>rms</sub> } |
| <b>Current</b> | Normal                | 200 μA <sub>rms</sub> to 20 mA <sub>rms</sub> | ±{(8 + 1 f <sub>m</sub> )% + 40 μA <sub>rms</sub> }   |
|                | Constant <sup>1</sup> | 100 μA <sub>rms</sub> to 20 mA <sub>rms</sub> | ±{(6 + 0.2 f <sub>m</sub> )% + 40 μA <sub>rms</sub> } |

1. When the ALC function is set to ON

For the temperature range of 0 °C to 55 °C, multiply the temperature induced setting error listed in Figure 1-5 to the test signal setting accuracy. When test cable length is 1 m or 2 m, add the following error due to test cable length.

$$0.2 \times f_m \times L [\%]$$

where:

$f_m$  = Test frequency [MHz]

$L$  = Test cable length [m]

## Output impedance

The following output impedance is specified for the test cable length of 0 m:

$$(25 + 0.5 f_m) \Omega \pm \left(10 + \frac{2}{3} f_m\right) \%$$

where:

$f_m$  = Test frequency [MHz]

## Test signal level monitor

The following test signal level monitor accuracy is specified for an ambient temperature range of 23 °C ± 5 °C and the test cable length is 0 m.

| Mode           | Range   | Monitor accuracy   |
|----------------|---|--|
| <b>Voltage</b> | 0.01 mV <sub>rms</sub> – 2.000 V <sub>rms</sub>   | $\pm \left\{ S_{mon} \frac{4 + 0.2 f_m}{100} + \frac{S_{set}}{500} \right\} [V]$ |
| <b>Current</b> | 0.001 μA <sub>rms</sub> – 20.00 mA <sub>rms</sub> |  |

For the temperature range of 0 °C to 55 °C, multiply the temperature induced setting error listed in Figure 1-5. When test cable length is 1 m or 2 m, add the following error due to test cable length.

$$S_{mon} \times 0.2 \times f_m \times L [V]$$

where:

$f_m$  = Test frequency [MHz]

$L$  = Test cable length [m]

$S_{mon}$  = Readout value of test signal level

$S_{set}$  = Setting value of test signal level

For example,

|                        |                       |
|------------------------|-----------------------|
| Test frequency:        | 1 MHz                 |
| Test signal level:     | 1 V <sub>rms</sub>    |
| Monitor readout value: | 500 mV <sub>rms</sub> |
| Cable length:          | 1 m                   |
| Ambient temperature:   | 25 °C                 |

Then, voltage level monitor accuracy  $V_{ma}$  is

$$\begin{aligned}\Delta V_{ma} &= 0.5 \times \frac{4 + 0.2 \times 1}{100} + \frac{1 \times 0.2}{100} + 0.5 \times \frac{0.2}{100} \times 1 \times 1 \\ &= 0.024 \text{ [V]} \\ V_{ma} &= \frac{0.024}{0.5} \\ &\approx 4.8 \text{ [%]}\end{aligned}$$

## Display Range

| Parameter | Range                                  |
|-----------|--|
| Z , R, X  | 0.00001 $\Omega$ to 99.9999 M $\Omega$ |
| Y , G, B  | 0.00001 $\mu$ S to 99.9999 S           |
| C         | 0.00001 pF to 999.999 $\mu$ F          |
| L         | 0.001 nH to 99.9999 H                  |
| D         | 0.000001 to 9.99999                    |
| Q         | 0.01 to 99999.9                        |
| $\theta$  | -180.000° to 180.000°                  |
| $\Delta$  | -999.999% to 999.999%                  |

## Measurement Accuracy

The measurement accuracy includes stability, temperature coefficient, linearity, repeatability, and calibration interpolation error. The measurement accuracy is specified when all of the following conditions are satisfied:

- Warm-up time:  $\geq 30$  minutes
- Test cable length: 0 m, 1 m (Agilent 16048A), or 2 m (Agilent 16048D). For the 1 m or 2 m cable length operation (with Agilent 16048A/D), CABLE CORRECTION has been performed
- OPEN and SHORT corrections have been performed.
- The optimum measurement range is selected by matching the DUT's impedance to the effective measuring range shown in Figure 1-1 and Figure 1-2. (For example, if the DUT's impedance is 3 k $\Omega$  and oscillator level is less than or equal to 1 V, the optimum range is the 500  $\Omega$  range.)
- Measurement accuracy is specified at the following reference planes:
  - Test frequency  $\leq 1$  MHz  
At the UNKNOWN terminals on the Agilent 4285A front panel or at the end of the standard test leads (Agilent 16048A/D).
  - Test frequency  $\geq 1.001$  MHz  
At the 1-port terminal of the Agilent 16085B Terminal Adapter, which should be connected to the UNKNOWN terminals of the Agilent 4285A or to the end of the standard test leads (Agilent 16048A/D).

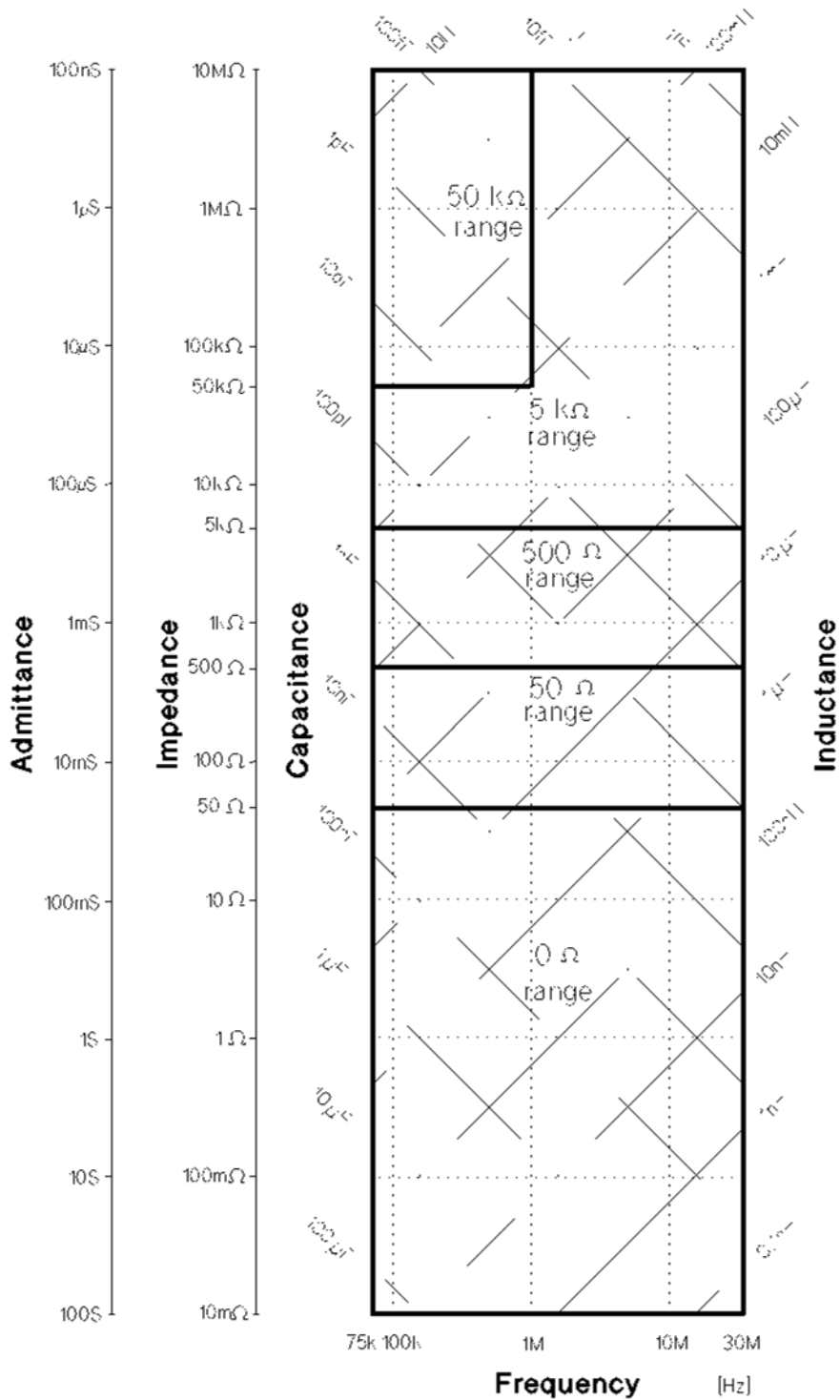


Figure 1-1. Effective measurement range (oscillator level  $\leq 1 V_{rms}$ )

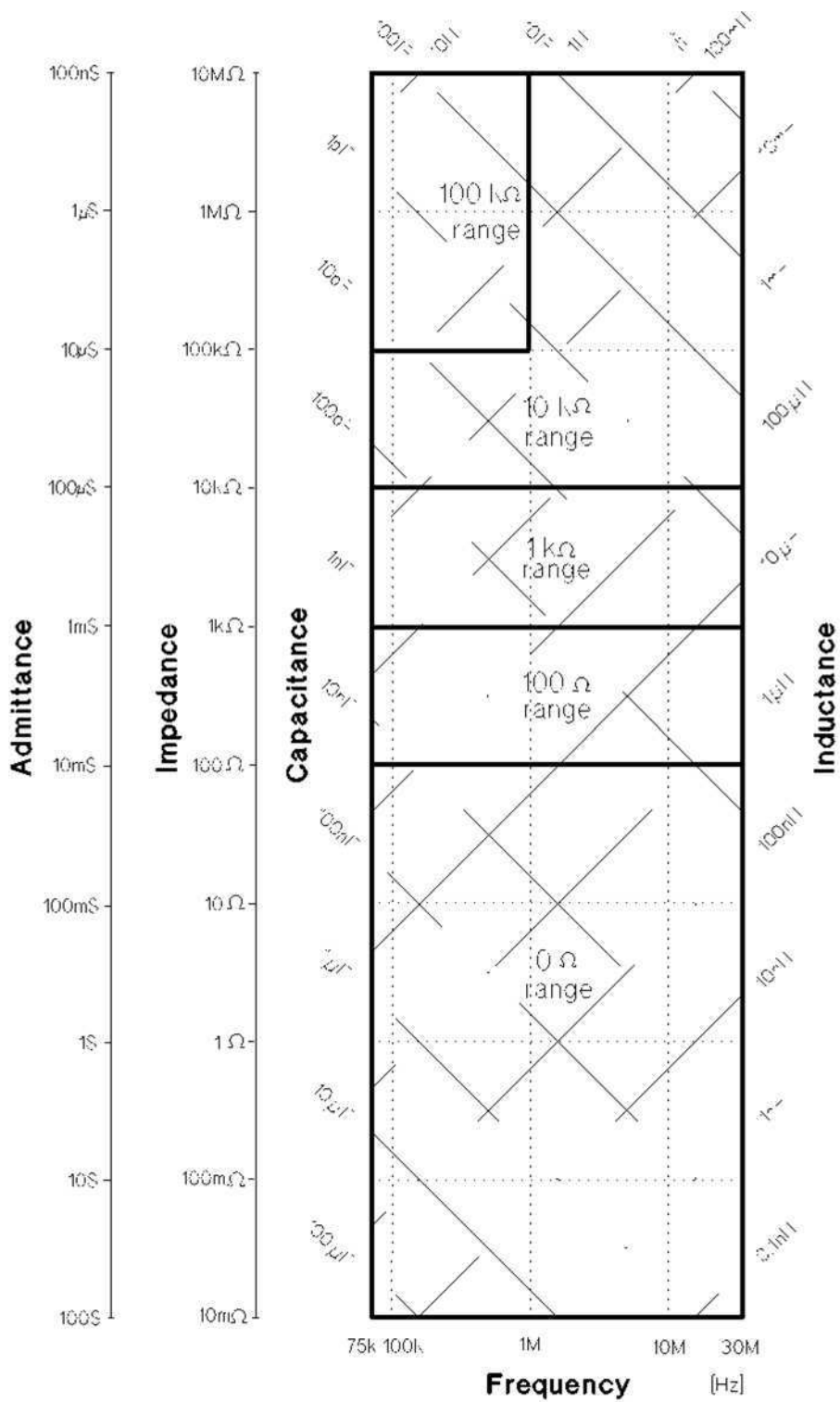


Figure 1-2. Effective measurement range (oscillator level > 1 V<sub>rms</sub>)

**|Z|, |Y|, L, C, R, X, G, and B accuracy**

|Z|, |Y|, L, C, R, X, G, and B accuracy  $A_e$  is given as

$$A_e = \pm(A_n + A_c) \times K_t [\%]$$

where:

$A_n$  = Basic accuracy equation given from the  $A_1$  to  $A_{16}$  shown in Table 1-1. The applicable frequency range and impedance range of equations  $A_1$  to  $A_{16}$  are shown in Figure 1-3 and Figure 1-4. (Refer to *Basic Accuracy Equations* on page 7.)

$A_c$  = Cable length factor (Refer to *Cable Length Factor* on page 10.)

$K_t$  = Temperature factor (Refer to *Temperature Factor* on page 10.)

L, C, X, and B accuracies apply when  $D_x$  (measured D value)  $\leq 0.1$ .

When  $D_x > 0.1$ , multiply  $A_e$  by  $\sqrt{1 + D_x^2}$  for L, C, X, and B accuracies.

R and G accuracies apply when  $Q_x$  (measured Q value)  $\leq 0.1$ .

When  $Q_x > 0.1$ , multiply  $A_e$  by  $\sqrt{1 + Q_x^2}$  for R and G accuracies. G accuracy given by the equation above applies to the G-B combination only.

**D accuracy**

D accuracy  $D_e$  is given as

$$D_e = \pm \frac{A_e}{100}$$

where:

$A_e$  = |Z|, |Y|, L, C, R, X, G, and B accuracy

D accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

When  $D_x > 0.1$ , multiply  $D_e$  by  $(1 + D_x)$ .

**Q accuracy**

Q accuracy  $Q_e$  is given as

$$Q_e = \pm \frac{Q_x \times D_e}{1 \mp Q_x \times D_e}$$

where:

$Q_x$  = Measured Q value

$D_e$  = D accuracy

Q accuracy applies when  $Q_x \times D_e < 1$ .

 **$\theta$  Accuracy**

$\theta$  accuracy  $\theta_e$  is given as

$$\theta_e = \pm \frac{180 \times A_e}{\pi \times 100} \text{ [deg]}$$

where:

$A_e$  = |Z|, |Y|, L, C, R, X, G, and B accuracy

**G Accuracy**

G accuracy  $G_e$  is given as

$$G_e = \pm B_x \times D_e \quad [S]$$

$$\left( B_x = 2 \pi f C_x = \frac{1}{2 \pi f L_x} \right)$$

where:

$B_x$  = Measured B value [S]

$C_x$  = Measured C value [F]

$L_x$  = Measured L value [H]

$D_e$  = D accuracy

$f$  = Test frequency [Hz]

G accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

G accuracy given by the equation above applies to the  $C_p$ -G and  $L_p$ -G combinations only.

### R<sub>p</sub> accuracy

R<sub>p</sub> accuracy  $R_{pe}$  is given as

$$R_{pe} = \pm \frac{R_{px} \times D_e}{D_x \mp D_e} [\Omega]$$

where:

$R_{px}$  = Measured R<sub>p</sub> value [ $\Omega$ ]

$D_x$  = Measured D value

$D_e$  = D accuracy

R<sub>p</sub> accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

### R<sub>s</sub> accuracy

R<sub>s</sub> accuracy  $R_{se}$  is given as

$$R_{se} = \pm X_x \times D_e [\Omega]$$

$$\left( X_x = 2 \pi f L_x = \frac{1}{2 \pi f C_x} \right)$$

where:

$X_x$  = Measured X value [ $\Omega$ ]

$C_x$  = Measured C value [F]

$L_x$  = Measured L value [H]

$D_e$  = D accuracy

$f$  = Test frequency [Hz]

R<sub>s</sub> accuracy applies when  $D_x$  (measured D value)  $\leq 0.1$ .

### Basic accuracy equations

The basic accuracy  $A_n$  is calculated from the following procedure:

1. Determine  $A_n$  equation from Figure 1-3 or Figure 1-4. In both charts, boundary line belongs to the better accuracy area.

When the oscillator level is  $\leq 1 V_{rms}$ , determine  $A_n$  to be applied, value of  $K_i$  and value of  $K_{osc}$  from the Figure 1-3. If the determined  $K_{osc} \leq 1$ , then round up  $K_{osc}$  to 1.

When the oscillator level is  $> 1 V_{rms}$ , determine  $A_n$  to be applied and value of  $K_i$  from the Figure 1-4.

2. Calculate  $A_n$  from the formula to be applied. The n accuracy factor included in the  $A_n$  equation is shown in Table 1-2. Use  $K_i$  and  $K_{osc}$  factors determined in previous step.

**Table 1-1. A<sub>n</sub> equations**

|  |
|--|
| $A_1 = N_1\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{50}{ Z_m } [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.1\%] \cdot K_i \cdot K_{osc}$    |
| $A_2 = N_1\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{50} [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.05\%] \cdot K_i \cdot K_{osc}$   |
| $A_3 = N_1\% + \left(\frac{f_m}{5}\right)^2 \cdot 0.1\% + \frac{ Z_m }{500} [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.05\%] \cdot K_i \cdot K_{osc}$ |
| $A_4 = 0.3\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{500} [0.05\% + \left(\frac{f_m}{30}\right) \cdot 0.1\%] \cdot K_i \cdot K_{osc}$   |
| $A_5 = 0.18\% + \frac{ Z_m }{5k} \cdot 0.02\% \cdot K_i \cdot K_{osc}$   |
| $A_6 = 0.18\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{5k} [0.02\% + \left(\frac{f_m}{10}\right) \cdot 0.03\%] \cdot K_i \cdot K_{osc}$  |
| $A_7 = 0.5\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{5k} \cdot \left(\frac{f_m}{30}\right) \cdot 0.2\% \cdot K_i \cdot K_{osc}$         |
| $A_8 = 0.18\% + \frac{ Z_m }{50k} \cdot 0.03\% \cdot K_i \cdot K_{osc}$  |
| $A_9 = N_2\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{100}{ Z_m } [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.1\%] \cdot K_i$                 |
| $A_{10} = N_2\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{100} [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.05\%] \cdot K_i$             |
| $A_{11} = 0.18\% + \left(\frac{f_m}{5}\right)^2 \cdot 0.1\% + \frac{ Z_m }{1k} [0.02\% + \left(\frac{f_m}{30}\right) \cdot 0.05\%] \cdot K_i$            |
| $A_{12} = 0.3\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{1k} [0.05\% + \left(\frac{f_m}{30}\right) \cdot 0.1\%] \cdot K_i$               |
| $A_{13} = 0.18\% + \frac{ Z_m }{10k} \cdot 0.02\% \cdot K_i$   |
| $A_{14} = 0.18\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{10k} [0.02\% + \left(\frac{f_m}{10}\right) \cdot 0.03\%] \cdot K_i$            |
| $A_{15} = 0.5\% + \left(\frac{f_m}{30}\right)^2 \cdot 3\% + \frac{ Z_m }{10k} \cdot \left(\frac{f_m}{30}\right) \cdot 0.2\% \cdot K_i$                   |
| $A_{16} = 0.18\% + \frac{ Z_m }{100k} \cdot 0.03\% \cdot K_i$  |

$|Z_m|$ : Absolute value of measured impedance in [ $\Omega$ ]

$f_m$ : Test frequency in [MHz]

### N accuracy factors

$N_1$  and  $N_2$  in the  $A_n$  equations have the following values:

**Table 1-2. N accuracy factors**

| Frequency(f)                 | $N_1$ | $N_2$ |
|------------------------------|-------|-------|
| 75 kHz $\leq f \leq$ 200 kHz | 0.15  | 0.15  |
| 200 kHz $< f \leq$ 3 MHz     | 0.08  | 0.15  |
| 3 MHz $< f \leq$ 5 MHz       | .15   | 0.38  |
| 5 MHz $< f \leq$ 30 MHz      | 0.30  | 0.38  |

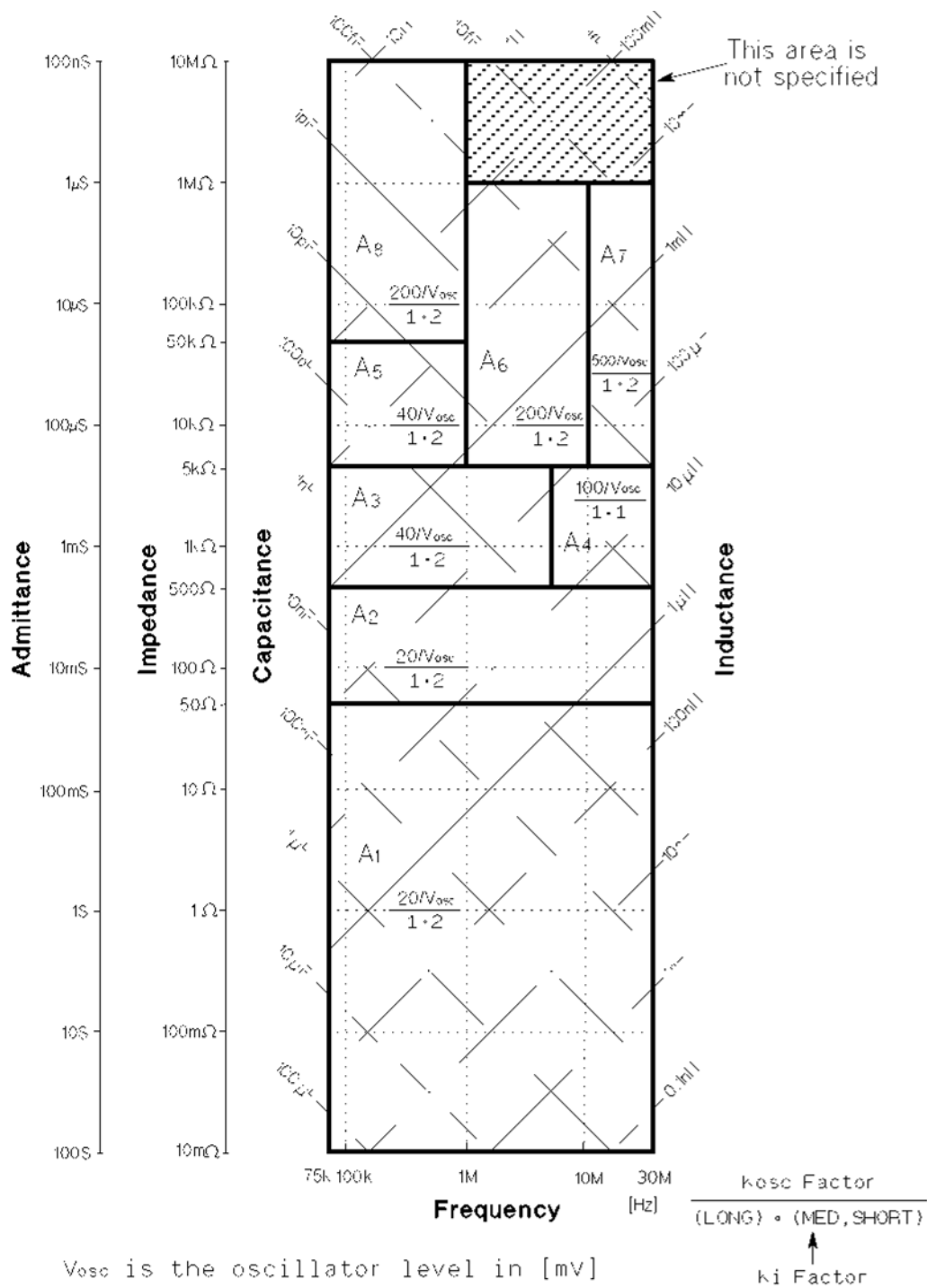
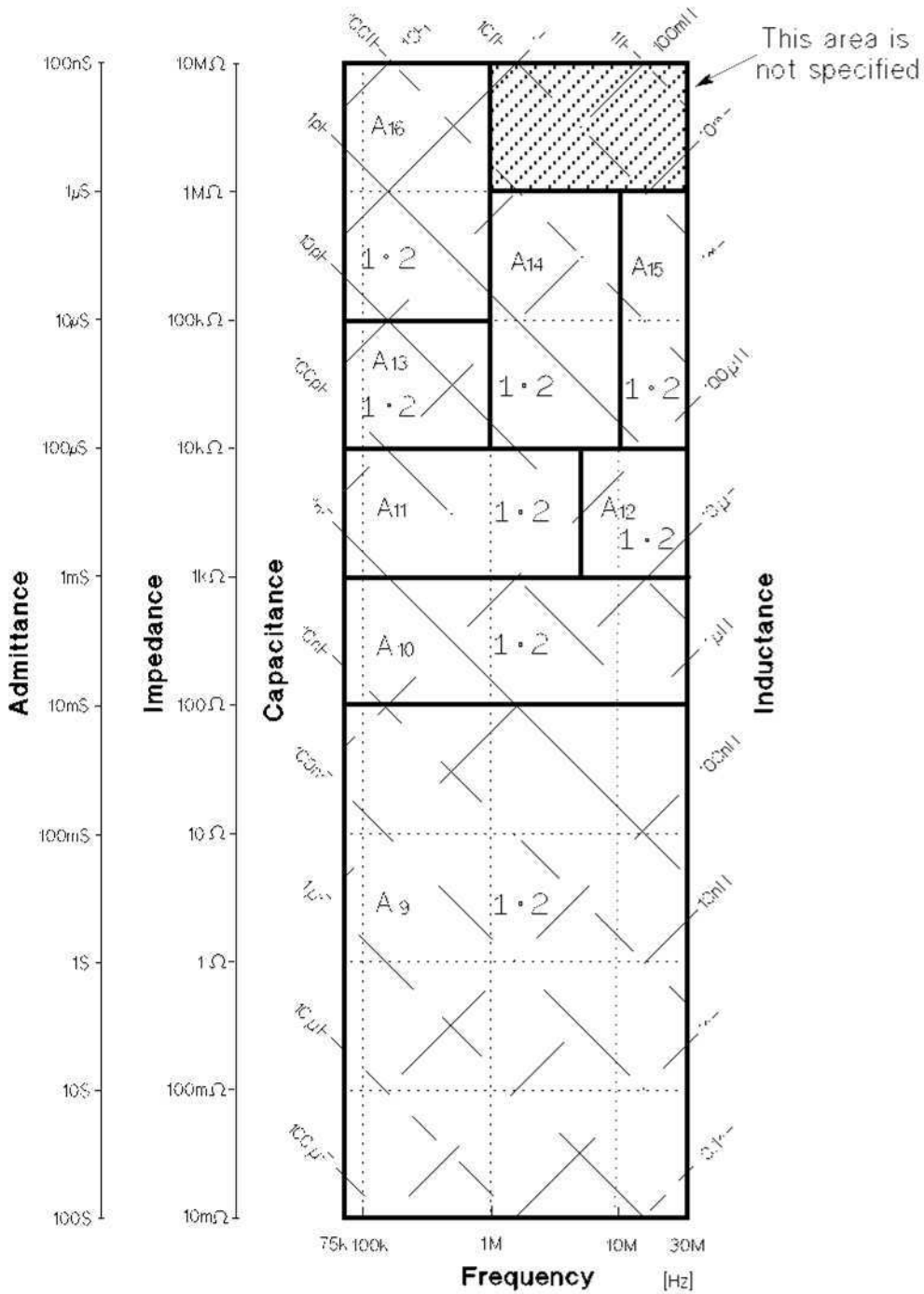


Figure 1-3. Accuracy equations,  $K_1$  factor, and  $K_{osc}$  factor (test signal level  $\leq 1 V_{rms}$ )





$|K_f$  Factor : (LONG) \* (MED,SHORT)

Figure 1-4. Accuracy equations and K<sub>f</sub> factor (test signal level > 1 V<sub>rms</sub>)

### Cable length factor

Add the following cable length factor  $A_c$  to the measurement accuracy when the cable length is set to 1 m (for 16048A) or 2 m (for 16048D) in *CABLE* field, after performing the cable correction and the OPEN/SHORT correction. When the cable length is 0 m,  $A_c$  is 0 percent.

$$A_c = \frac{f_m}{15} + A_{co} [\%]$$

$A_{co}$  is the additional error when the impedance range is above 5 k $\Omega$ .

$$A_{co} = \frac{|Z_m| \cdot f_m \cdot K_t}{1000} [\%]$$

where:

- $f_m$  = Test frequency in [MHz]
- $Z_m$  = Absolute value of measured impedance in [k $\Omega$ ]
- $K_t$  = Test cable length in [m]

### Temperature factor

Multiply the sum of the basic accuracy and the cable length factor by the following temperature induced error  $K_t$ , when the temperature range is 0 °C to 55 °C. The boundary belongs to the smaller multiplier.

| Temperature (°C) | 0 | 8  | 18 | 28 | 38 | 48 | 55 |
|------------------|---|----|----|----|----|----|----|
| $K_t$            | \ | \3 | \2 | >1 | /2 | /3 | >4 |

Figure 1-5. Temperature factor  $K_t$

### Measurement Accuracy Calculation Example

#### Example of $L_s$ -Q accuracy calculation

Measurement conditions

|                                   |                    |
|-----------------------------------|--------------------|
| Measured inductance $L_x$ of DUT: | 220 nH             |
| Measured Q value of DUT:          | 30                 |
| Test signal level:                | 1 V <sub>rms</sub> |
| Test frequency $f_m$ :            | 25.2 MHz           |
| Integration time:                 | LONG               |
| Cable length:                     | 0 m                |
| Operating temperature:            | 28 °C              |

### Determine inductance measurement accuracy $A_e$

1. From  $|Z|$ ,  $|Y|$ ,  $L$ ,  $C$ ,  $R$ ,  $X$ ,  $G$ , and  $B$  Accuracy (see page 6), measurement accuracy  $A_e$  is determined as below:

$$A_e = \pm(A_n + A_c) \times K_t$$

2. First of all, to determine the measurement accuracy  $A_e$ , calculate the impedance value from the DUT's inductance value. So the measurement impedance  $Z_m$  is:

$$Z_m = 2 \pi f_m L_x \\ \approx 35 [\Omega]$$

where:

- $f_m$  = Test frequency [Hz]
- $L_x$  = Measured inductance value of the DUT [H]

3. Choose an accuracy chart from Figure 1-3 and Figure 1-4. The oscillator level is 1 V<sub>rms</sub>, then Figure 1-3 is chosen for this measurement.

4. Find the frequency point of  $f_m$  (25.2 MHz) along the X axis in Figure 1-3. Both axes are in log format. Interpolation may be required.

5. Find the impedance point of  $Z_m$  (35  $\Omega$ ) along the Y axis in Figure 1-3 determined in step 2. Both axes are in log format. Interpolation may be required.

6. Mark the intersection of above two steps and determine the basic accuracy equation  $A_n$ , integration factor  $K_i$ , and oscillator level factor  $K_{osc}$ .

From:

|                         |                    |
|-------------------------|--------------------|
| Test frequency $f_m$ :  | 25.2 MHz           |
| DUT's impedance $Z_m$ : | 35 $\Omega$        |
| Integration time:       | LONG               |
| Test signal level:      | 1 V <sub>rms</sub> |

Then,  $A_n = A_l$ ,  $K_i = 1$ , and  $K_{osc} = 1$  (rounded from 0.02).

7. From Table 1-1, the actual accuracy equation to be applied is determined as  $A_I$ .

Then,

$$A_I = N_I \% + \left(\frac{f}{30}\right)^2 \cdot 3\% + \frac{50}{|Z_m|} [0.02\% + \left(\frac{f}{30}\right) \cdot 0.1\%] \cdot K_i \cdot K_{osc}$$

8. Determine  $N_I$  from Table 1-2.

From frequency = 25.2 MHz, then,  $N_I = 0.3$ .

9. Then,

$$A_n = 0.3\% + \left(\frac{25.2}{30}\right)^2 \cdot 3\% + \frac{50}{|35|} [0.02\% + \left(\frac{25.2}{30}\right) \cdot 0.1\%] \cdot 1 \cdot 1 \\ \approx 2.6 \text{ [%]}$$

10. Cable length is 0 m, then  $A_c = 0$ .

11. Operating temperature is 28 °C, then  $K_t = 1$  (from Figure 1-5).

12. Therefore, inductance measurement accuracy  $A_e$  is:

$$A_e = \pm(A_n + A_c) \times K_t \\ = \pm(2.6 + 0) \times 1 \\ = \pm 2.6 \text{ [%]}$$

#### Determine Q measurement accuracy $Q_e$

1. From *Q Accuracy* (see page 6), Q measurement accuracy  $Q_e$  is determined as below:

$$Q_e = \pm \frac{Q_x^2 \times D_e}{1 \mp Q_x \times D_e}$$

2. Determine D accuracy  $D_e$  for calculating  $Q_e$ . From the previous step *Determine inductance measurement accuracy  $A_e$*  (see page 10),  $A_e$  is 2.6 [%], then:

$$D_e = \pm \frac{A_e}{100} \\ = \pm 0.026$$

3. Therefore  $Q_e$  is:

$$Q_e = \pm \frac{Q_x^2 \times D_e}{1 \mp Q_x \times D_e}$$

$$Q_e = \pm \frac{30^2 \times 0.026}{1 \mp 30 \times 0.026}$$

$$\approx +106/-13$$

## Correction Functions

### Zero open

Eliminates measurement errors due to parasitic stray admittance (C, G) of the test fixture.

### Zero short

Eliminates measurement errors due to parasitic residual impedances (L, R) of the test fixture.

### Load

Improves the measurement accuracy by using a device whose value is accurately known (a working standard) as a reference.

## List Sweep

A maximum of ten frequencies or test signal levels can be programmed. Single or sequential tests can be performed. When Option 4285A-001 is installed, DC bias voltages can also be programmed.

## Comparator Function

Ten-bin sorting for the primary measurement parameter, and IN/OUT decision output for the secondary measurement parameter.

### Sorting modes

**Sequential mode.** Sorting into unnested bins with absolute upper and lower limits.

**Tolerance mode.** Sorting into nested bins with absolute or percent limits.

### Bin count

0 to 999999

### List sweep comparator

HIGH/IN/LOW decision output for each point in the list sweep table.

## Other Functions

### Store/Load

Ten instrument control settings, including comparator limits and list sweep programs, can be stored and loaded into and from the internal non-volatile memory. Ten additional settings can also be stored and loaded from each memory card.

### GPIB

All control settings, measured values, comparator limits, and list sweep program can be controlled or monitored. Uses ASCII and 64-bit binary data format. GPIB buffer memory can store measured values for a maximum of 128 measurements and output packed data over the GPIB bus. Complies with IEEE-488.1 and 488.2. The programming language is Test and Measurement Systems Language (TMSL).

### GPIB interface functions

SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, C0, E1

### Self test

Softkey controllable. Provides a means to confirm proper operation.

## Option 4285A-001 (Internal DC Bias)

Adds the variable DC bias voltage function.

### DC bias level

The following DC bias level accuracy is specified for an ambient temperature range of  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ . Multiply the temperature induced setting error,  $K_t$  listed in Figure 1-5 for the temperature range of  $0\text{ }^{\circ}\text{C}$  to  $55\text{ }^{\circ}\text{C}$ .

| Voltage range                          | Resolution | Setting accuracy                               |
|--|------------|--|
| $\pm(0.000\text{ to }4.000)\text{ V}$  | 1 mV       | $\pm(0.1\% \text{ of setting} + 1\text{ mV})$  |
| $\pm(4.002\text{ to }8.000)\text{ V}$  | 2 mV       | $\pm(0.1\% \text{ of setting} + 2\text{ mV})$  |
| $\pm(8.005\text{ to }20.000)\text{ V}$ | 5 mV       | $\pm(0.1\% \text{ of setting} + 5\text{ mV})$  |
| $\pm(20.01\text{ to }40.00)\text{ V}$  | 10 mV      | $\pm(0.1\% \text{ of setting} + 10\text{ mV})$ |

A maximum DC bias current of 100 mA can be applied to the DUT.

### DC bias monitor terminal

DC bias voltage or current can be monitored at the rear panel BNC connector.

The following monitor accuracies are applied when the digital volt meter whose input impedance is  $\geq 10\text{ M}\Omega$  is used.

- DC bias voltage monitor  
DC bias voltage across the DUT  $\times 1$

Output impedance: 11 k $\Omega$   
Monitor accuracy:  $\pm(0.2\% \text{ of reading} + 2 + 0.8 \times I_{\text{dut}})\text{ mV}$

where:

$I_{\text{dut}}$  is current flowing through the DUT in [mA].

- DC bias current monitor  
DC bias current through the DUT  $\times 10\text{ }\Omega$  (1 V at 100 mA)

Output impedance: 10 k $\Omega$   
Monitor accuracy:  $\pm(1\% \text{ of reading} + 0.3)\text{ mA}$

## Other Options

**Option 4285A-700:** No DC bias

**Option 4285A-002:** Accessory Control Interface  
Allows the 4285A to control the Agilent 42841A bias current source or the Agilent 42851A precision Q adapter.

The voltage ratio measurement accuracy, when the 4285A is used with the 42851A precision Q adapter, is described in the 42851A's operation manual.

**Option 4285A-201:** Handler interface

**Option 4285A-202:** Handler interface

**Option 4285A-301:** Scanner interface

**Option 4285A-710:** Blank panel

**Option 4285A-907:** Front handle kit

**Option 4285A-908:** Rack mount kit

**Option 4285A-909:** Rack flange and handle kit

**Option 4285A-915:** Add service manual

**Option 4285A-ABA:** Add English manual

**Option 4285A-ABD:** Add German manual

**Option 4285A-ABJ:** Add Japanese manual

## Furnished Accessories

|                           |   |
|---------------------------|---|
| Power cord                | Depends on the country where the 4285A is being used          |
| 100 $\Omega$ resistor box | Agilent P/N 04285-61001                                       |
| BNC female-female Adapter | Agilent P/N 1250-0080 (4 ea.)                                 |
| Fuse                      | Only for Option 4285A-201<br>Agilent P/N 2110-0046<br>(2 ea.) |

## Accessories Available

### Test fixture/test leads

|                 |   |
|-----------------|---|
| 16034E          | Test fixture for SMD or chip type DUT, $f \leq 40$ MHz              |
| 16047A          | Test fixture for axial or radial DUT, $f \leq 13$ MHz               |
| 16047C          | Test fixture for axial or radial DUT, $f \leq 40$ MHz               |
| 16047D          | Test fixture for axial or radial DUT, $f \leq 40$ MHz               |
| 16048A          | Test leads, length 1 m (BNC connector)                              |
| 16048D          | Test leads, length 2 m (BNC connector)                              |
| 16065A          | External voltage bias fixture                                       |
| 16334A          | Tweezer-type test fixture for SMD or chip type DUT, $f \leq 15$ MHz |
| 16451B          | Dielectric test fixture   |
| 42842C          | Bias current test fixture   |
| P/N 42851-61100 | SMD test fixture<br>(Option 42842C-201)                             |

### DC bias source

|        |                     |
|--------|---------------------|
| 42841A | Bias current source |
|--------|---------------------|

### Memory card

|                 |                         |
|-----------------|-------------------------|
| P/N 04278-89001 | Memory card, 1 ea.      |
| 16470A          | Memory card set, 10 ea. |

### GPIB interconnection cables

|        |                   |
|--------|-------------------|
| 10833A | GPIB cable, 1 m   |
| 10833B | GPIB cable, 2 m   |
| 10833C | GPIB cable, 4 m   |
| 10833D | GPIB cable, 0.5 m |

### Handler interface connector for mating with Option 4285A-201

P/N 1251-0084 AMPHENOL 36-pin connector

### Scanner interface connector for mating with Option 4285A-301

P/N 1251-0142 AMPHENOL 14-pin connector

## Power Requirements

### Line voltage

100, 120, 220 Vac  $\pm 10\%$ , 240 Vac  $+5\% -10\%$

### Line frequency

47 to 66 Hz

### Power consumption

200 VA max.

## Operating Environment

### Temperature

0 °C to 55 °C

### Humidity

$\leq 95\%$  R.H. at 40 °C

## Dimensions

426 (W) by 177 (H) by 498 (D) (mm)

## Weight

Approximately 16 kg (35.3 lb., standard)

## Display

LCD dot-matrix display

### Capable of displaying

Measured values  
Control settings  
Comparator limits and decisions  
List sweep tables  
Self test message and annunciations

### Number of display digits

6-digits, maximum display count 999999

## Supplemental Performance Characteristics

The Agilent 4285A supplemental performance characteristics are listed below. These supplemental performance characteristics are not specifications, but are typical characteristics included as supplemental information for the operator.

### Stability

When the following conditions are satisfied,

Integration time: LONG  
 Operating temperature: Constant operating temperature of 23 °C ± 5 °C

| Parameter        | ≤ 1 MHz      | 30 MHz       |
|------------------|--------------|--------------|
| Z ,  Y , L, C, R | < 0.01%/day  | < 0.05%/day  |
| D                | < 0.0001/day | < 0.0005/day |

### Temperature coefficient

When the following conditions are satisfied,

Integration time: LONG  
 Test signal voltage: ≥ 20 mV<sub>rms</sub>  
 Operating temperature: 23 °C ± 5 °C

| Parameter        | ≤ 1 MHz       | 30 MHz       |
|------------------|---------------|--------------|
| Z ,  Y , L, C, R | < 0.004%/°C   | < 0.05%/°C   |
| D                | < 0.00004%/°C | < 0.0005%/°C |

### Settling time

**Frequency (f<sub>m</sub>)**  
 < 50 msec.

**Test signal level**  
 < 100 msec.

**Measurement range**  
 < 50 msec./range shift

### Input protection

Internal circuit protection, when a charged capacitor is connected to the UNKNOWN terminals.

The maximum capacitor voltage is:

$$V_{max} = \sqrt{\frac{1}{C}} [V]$$

where:

$V_{max} = \leq 200$  V  
 $C$  = Capacitance value in Farads

### Measurement time

Typical measurement times from the trigger to the output of EOM at the Handler Interface. (EOM: End of Measurement)

| Integration time | Measurement time |
|------------------|------------------|
| SHORT            | 30 ms            |
| MEDIUM           | 65 ms            |
| LONG             | 200 ms           |

In the following condition an additional measurement time, approx. 300 ms, is added to the measurement time.

Test signal voltage: 0.51 V – 2 V<sub>rms</sub>  
 Measurement range: 0 Ω Range  
 Test signal current: ≥ 22 mA

### Display time

Display time for each display format is given as:

*MEAS DISPLAY* page            Approx. 8 ms  
*BIN No. DISPLAY* page        Approx. 5 ms  
*BIN COUNT DISPLAY* page    Approx. 0.5 ms

### GPIB data output time

Internal GPIB data, processing time from EOM output to measurement data output on GPIB lines (excluding display time):

- Approx. 10 ms

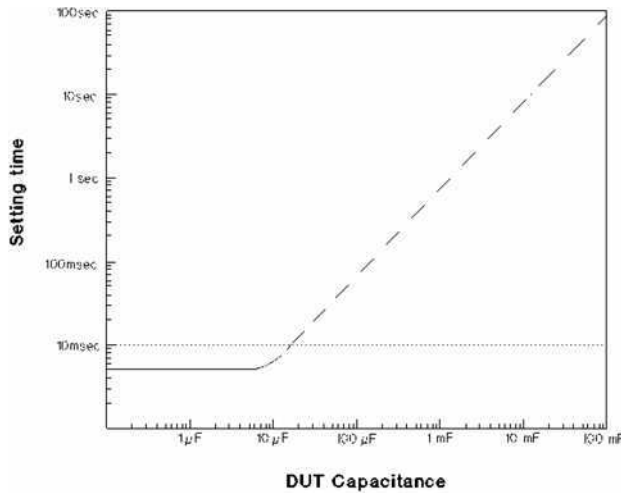
**Option 4285A-001 (internal DC bias)**

Maximum DC bias current when the normal measurement can be performed is 100 mA.

**DC bias settling time**

When DC bias is set to ON, add 5 ms to the measurement time. This settling time does not include the DUT charge time.

Sum of DC bias settling time plus DUT (capacitor) charge time is shown in the following figure.



**Figure 1-6. Sum of the DC bias settling time and DUT (capacitor) charge time**

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