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## English

Revision B2.0

### FIRMWARE REVISIONS

This manual applies directly to instruments that have the firmware **Rev. B2.x**

#### Manual Print History

The print history shown below lists the printing dates of all Revisions and Addenda created for this manual. The Revision Level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between Revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new Revision is created, all Addenda associated with the previous Revision of the manual are incorporated into the new Revision of the manual. Each new Revision includes a revised copy of this print history page.

Revision A January, 2010

Revision B January, 2011

# [ AT2818/2816A/2816B/2817A/810A ]

LCR Meter  
User's Guide

## Safety Summary



Warning



Dangerous :

When you notice any of the unusual conditions listed below, immediately terminate operation and disconnect the power cable.

Please Contact Applent Instruments Incorporation sales representative for repair of the instrument. If you continue to operate without repairing the instrument, there is a potential fire or shock hazard for operators.

Instrument operates abnormally.

Instrument emits abnormal noise, smell, smoke, or a spark-like light during the operation.

Instrument generates high temperature or electrical shock during operation.

Power cable, plug, or receptacle on instrument is damaged.

Foreign substance or liquid has fallen into the instrument.

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific WARNINGS elsewhere in this manual may impair the protection provided by the equipment. In addition it violates safety standards of design, manufacture, and intended use of the instrument.

### Disclaimer

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Applent Instruments assumes no liability for the customer's failure to comply with these requirements.

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### Ground The Instrument

To avoid electric shock hazard, the instrument chassis and cabinet must be connected to a safety earth ground by the supplied power cable with earth blade.

### DO NOT Operate In An Explosive Atmosphere

Do not operate the instrument in the presence of inflammable gasses or fumes. Operation of any electrical instruments in such an environment constitutes a definite safety hazard.

### Keep Away From Live Circuits

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with the power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

### DO NOT Service Or Adjust Alone

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### DO NOT Substitute Parts Or Modify Instrument

Because of the danger of introducing additional hazards, do not install substitute parts or perform unauthorized modifications to the instrument. Return the instrument to an Applent Instruments Sales and Service Office for service and repair to ensure that safety features are maintained.

---

## CERTIFICATION, LIMITED WARRANTY, & LIMITATION OF LIABILITY

**Applent Instruments, Inc.** ( shortened form **Applent** ) certifies that this product met its published specifications at the time of shipment from the factory. Applent further certifies that its calibration measurements are traceable to the People's Republic of China National Institute of Standards and Technology, to the extent allowed by the Institution's calibration facility or by the calibration facilities of other International Standards Organization members.

This Applent instrument product is warranted against defects in material and workmanship for a period corresponding to the individual warranty periods of its component products. **The warranty period is 1 year and begins on the date of shipment.** During the warranty period, Applent will, at its option, either repair or replace products that prove to be defective. This warranty extends only to the original buyer or end-user customer of a Applent authorized reseller, and does not apply to fuses, disposable batteries or to any product which, in Applent's opinion, has been misused, altered, neglected or damaged by accident or abnormal conditions of operation or handling.

For warranty service or repair, this product must be returned to a service facility designated by Applent. The buyer shall prepay shipping charges to Applent and Applent shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Applent from another country.

Applent warrants that its software and firmware designated by Applent for use with an instrument will execute its programming instruction when properly installed on that instrument. Applent does not warrant that the operation of the instrument, or software, or firmware, will be uninterrupted or error free.

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside the environmental specifications for the product, or improper site preparation or maintenance.

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Applent Instruments, Inc.  
Changzhou,  
Jiangsu,  
China,  
Rev.A2 January, 2005  
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# 1. Unpacking and Preparation



This chapter describes how to set up and start the AT281x LCR Meter.

- Incoming Inspection
- Power Requirements
- Setting up the Fuse
- How to Remove the Handle
- Environmental Requirements
- Cleaning

## 1.1 Incoming Inspection

After you receive the instrument, carry out checks during unpacking according to the following procedure.



If the external face of the instrument (such as the cover, front/rear panel, VFD screen, power switch, and port connectors) appears to have been damaged during transport, do not turn on the power switch. Otherwise, you may get an electrical shock.

Make sure that the packing box or shock-absorbing material used to package the instrument has not been damaged.

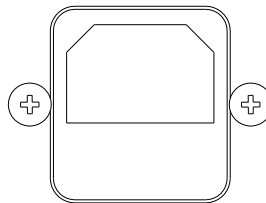
Referring to <Packing List> in the packing box, check that all packaged items supplied with the meter have been provided as per the specified optioned.

### NOTE

If an abnormality is detected, contact the company and transport the meter to your nearest Applent Instruments sales or service office. For inspection by the transport company, save the packing box, shock-absorbing material, and packaged items as you received them.

## 1.2 Setting up Fuse

Figure 1-1 Fuse Holder



~Line: 90VAC–115VAC  
20VA MAX  
Fuse: 250V 1A  
Slow Blow

Please use the following fuse type.

UL/CSA type, Slow-Blow, 5×20-mm miniature fuse, 1A, 250 V



When you need a fuse, contact your nearest Applent Instruments sales or service office. To verify and replace the fuse, remove the power cable and pull out the fuse holder.

---

**NOTE**

Two fuses are in Fuse Holder.

---

## 1.3 Environmental Requirements

Set up the AT281x where the following environmental requirements are satisfied.

### Operating Environments

Ensure that the operating environment meets the following requirements.

Temperature: 0°C to 55°C

Temperature range at calibration: 23°C±5°C (<1°C deviation from the temperature when performing calibration)

Humidity: 15% to 85% at wet bulb temperature ≤ 40°C (non-condensation)    Altitude: 0 to 2,000m

Vibration: Max. 0.5 G, 5 Hz to 500 Hz

## 1.4 Cleaning

To prevent electrical shock, disconnect the AT281x power cable from the receptacle before cleaning.

Use a dry cloth or a cloth slightly dipped in water to clean the casing.

Do not attempt to clean the AT281x internally.

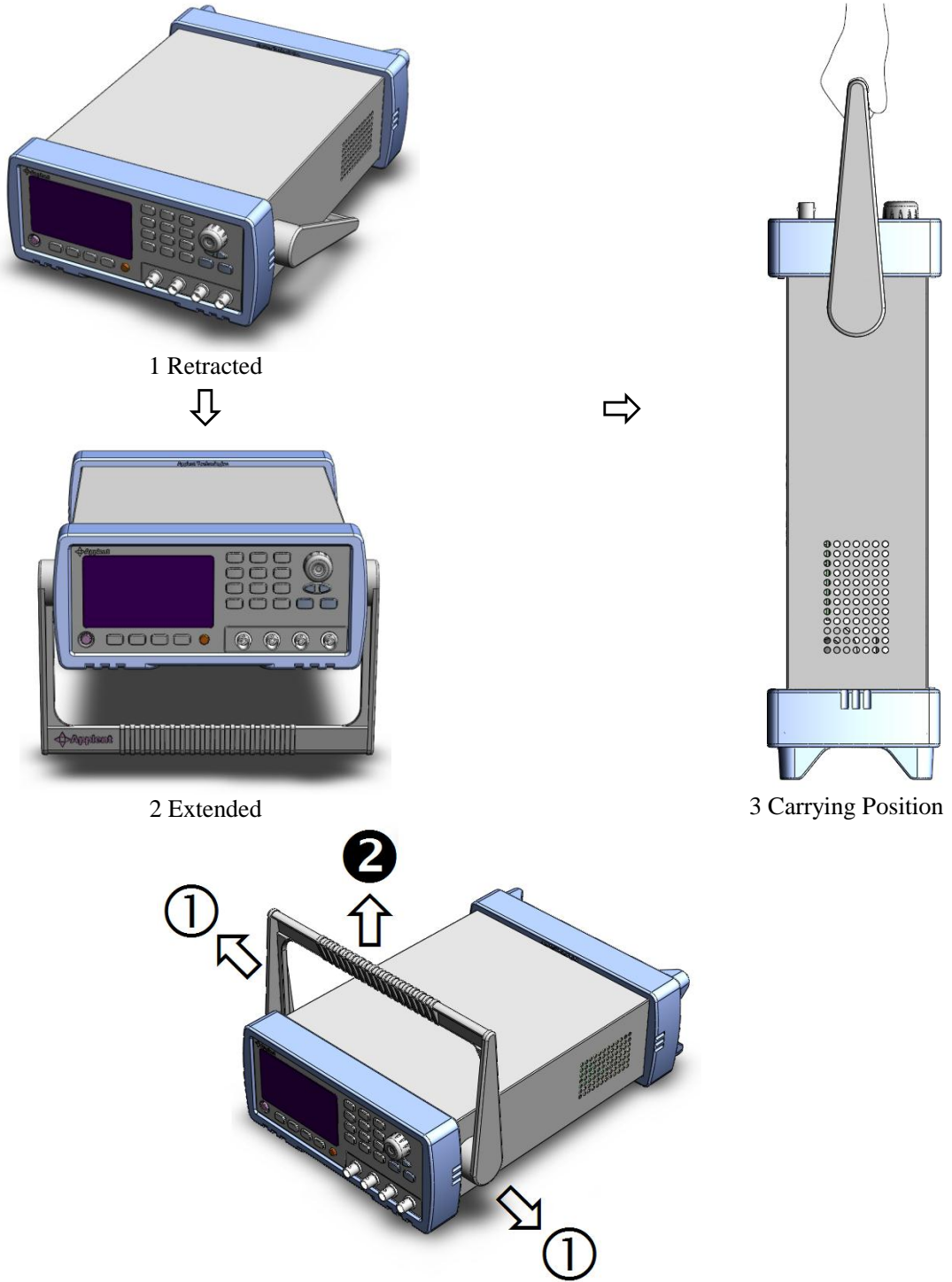


**WARNING:** Don't Use Organic Solvents (such as alcohol or gasoline) to clean the Instrument.

## 1.5 How to Remove the Handle

A handle kit is attached to the AT281x:

Figure 1-2 How to remove the handle



Remove Handle ( Lift the handle perpendicular to the unit while pulling it in the direction of 1.)

## 2. Overview



This chapter contains general information about AT281x .The information is organized as follows

- Introduction
- Main Specifications
- Feature overview

### 2.1 Introduction

Thank you for purchasing AT281x LCR meter.

The Applent AT281x is a general-purpose LCR meter for incoming inspection of components, quality control, and laboratory use.

The AT281x is used for evaluating LCR components, materials, and semiconductor devices over a wide range of frequencies (10 Hz to 300 kHz) and test signal levels (0.01Vrms to 2 Vrms).

With its built-in comparator, the AT281x can output comparison/decision results for sorting components into a maximum of ten bins. Furthermore, by using the handler interface, the AT281x can be easily combined with a component handler, and a system controller to fully automate component testing, sorting, and quality-control data processing.

The AT281x's list sweep function permits entry of up to 10 frequencies or test signal levels points to be automatically measured.

### 2.2 Main Specifications and Features

#### 2.2.1 Test Function

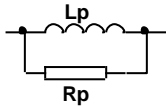
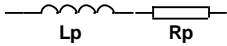
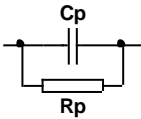
Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, G-B, Rs-Q, Z-θr, Z-θd.

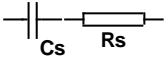
#### 2.2.2 Equivalent Circuit

Serial and Parallel

Table 2-1

Equivalent Circuit

Circuit	Dissipation Factor	Conversion	
L		$D=2\pi FLp/Rp=1/Q$	$Ls=Lp/(1+D^2)$ $Rs=RpD^2/(1+D^2)$
		$D=Rs/2\pi FLs=1/Q$	$Lp=(1+D^2)Ls$ $Rp=(1+D^2)Rs/D^2$
C		$D=1/2\pi FCpRp=1/Q$	$Cs=(1+D^2)Cp$ $Rs=RpD^2/(1+D^2)$

	$D=2\pi FCsRs=1/Q$	$Cp=Cs/(1+D^2)$ $Rp=Rs(1+D^2)/D^2$
---	--------------------	---------------------------------------

$Q=Xs/Rs$  ,  $D=Rs/Xs$  ,  $Xs=1/2\pi FCs=2\pi FLs$

**2.2.3 Ranging**

Auto, Hold and Nominal range. Total 9 Ranges.

About Nominal ranges: (Applent new definition) : The AT281x will automatically select the best range according to the nominal value.

**2.2.4 Measurement Speed**

Fast: 30 readers per second;  
 Medium 2: 10 readers per second;  
 Medium 1: 5 readers per second;  
 Slow: 1.5 readers per second.

Simultaneity, you can specify the averaging factor within the range of 1 to 256 in steps of 1 Averaging Factor to improve performance.

**2.2.5 Trigger Mode**

Include Internal, Manual, External and Bus Trigger.

**2.2.6 Basic Accuracy**

AT2818 0.05%  
 AT2816A 0.05%  
 AT2816B 0.1%  
 AT2817A 0.05%  
 AT2817 0.05%

**2.2.7 Measurement Range**

Table 2-2

Measurement Range

Parameter	Measurement Range
L	0.00001μH ~ 9999.99H
C	0.00001pF ~ 9999.99mF
R、X、Z	0.00001Ω ~ 99.9999MΩ
B、G	0.01nS ~ 999.999S
D	0.00001 ~ 9.99999
Q	0.00001 ~ 99999.9
θd	-179.999° ~ 179.999°
θr	-3.14159 ~ 3.14159

**2.3 Test Signal**

**2.3.1 Test Signal Frequency**

AT2818: 10Hz ~ 300kHz

AT2816A: 50Hz ~ 200kHz

AT2816B:

[37 Points]

50, 60, 80, 100, 120, 150, 200, 250, 300,400, 500, 600, 800,  
 1e3, 1.2e3, 1.5e3, 2e3, 2.5e3, 3e3, 4e3, 5e3, 6e3, 8e3,  
 10e3, 12e3, 15e3, 20e3, 25e3, 30e3, 40e3, 50e3, 60e3, 80e3,  
 100e3, 120e3, 150e3, 200e3

AT2817A :	[16 Points] 50, 60, 100, 120, 200, 400, 500, 1e3, 2e3, 4e3, 5e3, 10e3, 20e3, 40e3, 50e3, 100e3
AT2817 :	[10 Points] 50, 60, 100, 120, 1e3, 10e3, 20e3, 40e3, 50e3, 100e3

Frequency Accuracy: 0.02%

### 2.3.2 Test Signal Level

0.01V~2.00Vrms, 0.01V resolution.  
Test Signal Accuracy:  $\pm(10\%+10\text{mV})$

### 2.3.3 Output impedance

30 $\Omega$ , 50 $\Omega$  and 100 $\Omega$ ,  
Accuracy: 5%

## 2.4 Main Functions

### 2.4.1 Correction Function

OPEN/SHORT correction:  
Eliminates measurement errors due to stray parasitic impedance in the test fixtures.  
LOAD correction  
Improves measurement accuracy by using a calibrated device as a reference.

### 2.4.2 Comparator Function (Sorting)

**Bin sort**  
The primary parameter can be sorted into BIN1-BIN9, AUX, OUT and HI/IN/LO for each of the primary measurement parameters.  
The sequential mode or tolerance mode can be selected as the sorting mode.  
**Limit Setup**  
Absolute value, deviation value, and % deviation value can be used for setup.  
**BIN count [\*Not available in AT2817]**  
Countable from 0 to 999999

### 2.4.3 List Sweep

**Points**  
There is a maximum of 10 points.  
**Sweep parameter**  
Test frequency, test signal voltage.  
**Comparator function of list sweep**  
The comparator function enables you to set one pair of lower and upper limits for each measurement point.  
You can select from: Judge with the first sweep parameter/Judge with the second parameter/Not used for each pair of limits.

## 2.5 Measurement Assistance Functions

### 2.5.1 Files

Up to 10 setup conditions can be written to/read from the built-in non-volatile memory.

### 2.5.2 Key Lock

The front panel keys can be locked.

### 2.5.3 RS-232

Complies with SCPI.

## **2.6 Options**

### **2.6.1 USB host port [\*Option]**

Universal serial bus jack, type-A (4 contact positions, contact 1 is on your left); female; for connection to USB memory device only.

### **2.6.2 DC Bias Voltage**

0V/1.5V/2V.



### 3. Startup



This chapter describes names and functions of the front panel, rear panel, and screen display and provides the basic procedures for operating AT281x.

- Front panel summary
- Rear panel summary
- Power On/Off
- Connect to Device under Test

#### 3.1 Front panel

Figure 3-1 Front panel

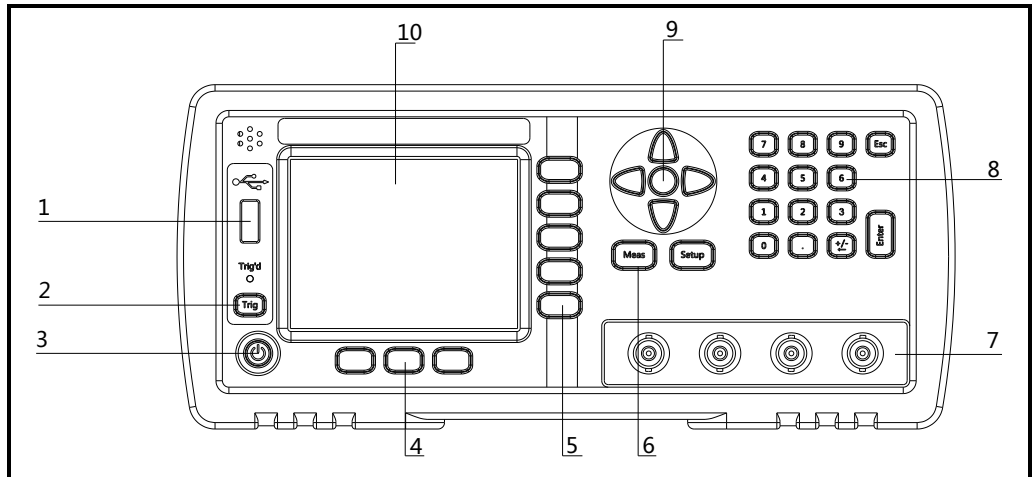


Table 3-1 Front panel description

No.	Description
1	USB Disk Port (USB-Host)
2	Trigger Key
3	Power Switch
4	System Key (Include File, System and Key Lock)
5	Soft Key
6	Menu key
7	UNKNOWN Terminal
8	Entry Key
9	Cursor Key
10	LCD Display

#### 3.2 Real Panel

Figure 3-2 Real Panel

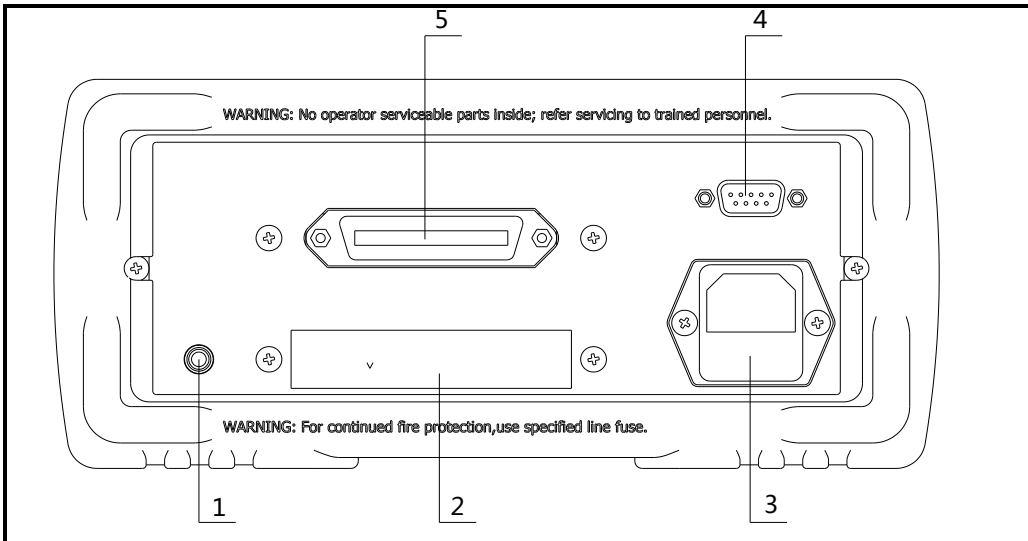


Table 3-2

Real panel description

No.	Description
1	Frame Terminal
2	Option Slot
3	Power Cable Receptacle(Outlet) (to LINE)
4	RS-232C Interface
5	Handler Interface

### 3.3 Power On/Off

#### 3.3.1 Power On

Press the power key at least 2 seconds. Release power key until the Trig'ed LED lit.

#### 3.3.2 Power Off

Press the power key at least 2 seconds. AT281x will shut down when you release the power key. No operation voltages are applied to the instruments.

### 3.4 Warm-up Time

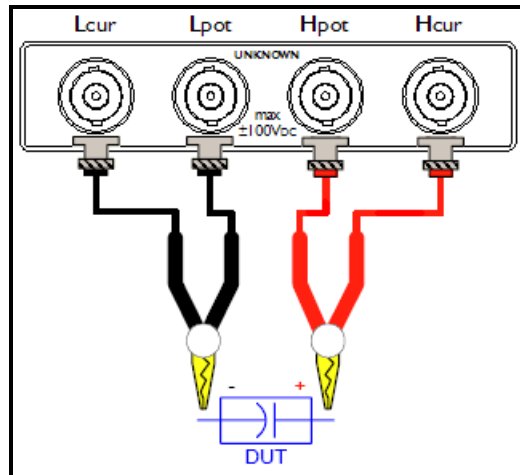
AT281x is ready to be used as soon as the power-up sequence has completed. However, to achieve the accuracy rating, warm up the instrument for 30 minutes.

### 3.5 Connect to Device under Test (DUT)

The AT281x uses a four terminal measurement configuration that provides easy, accurate and stable measurements and avoids mutual inductance, interference from measurement signals, noise and other factors inherent with other types of connections.

Figure 3-3

Connect to DUT



Do not apply DC voltage or current to the UNKNOWN terminals. Applying DC voltage or current may lead to device failure. Connect the measurement sample (DUT) to the test port (or the test fixture, cables, etc. connected to the test port) after the LCR meter has been completely discharged.

# 4. [Meas] Key



This section includes the following information:

- MEAS DISPLAY page
- BIN No. page
- BIN COUNT page [Not available in AT2817]
- LIST SWEEP page [Not available in AT2817]

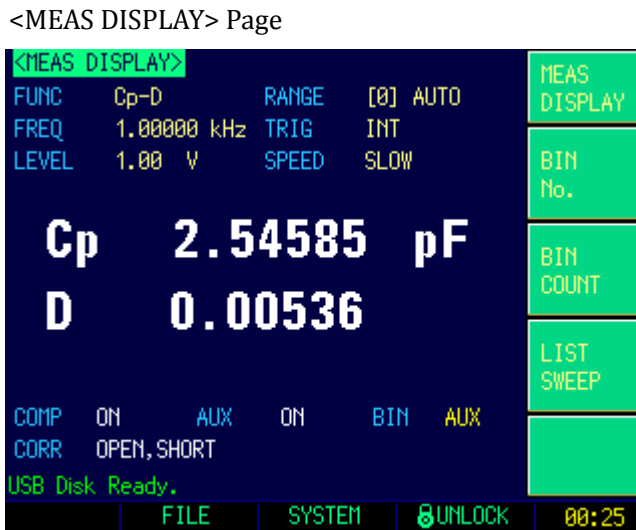
## 4.1 <MEAS DISPLAY> Page

When press the [Meas] key, the <MEAS DISPLAY> page appears.

The following measurement controls can be set.

- FUNC - Measurement Function
- RANGE - Impedance range
- FREQ - Test Frequency
- TRIG - Trigger Mode
- LEVEL - Test Signal Level
- SPEED - Meas Speed

Figure 4-1



### 4.1.1 Measurement Function [FUNC]

The AT281x simultaneously measures four components of the complex impedance (parameters) in a measurement cycle. These include primary parameter, secondary parameter and two monitor parameter.

**NOTE**

The monitor parameters can be set in <SETUP> page.  
The monitor parameters are initially set to OFF.

**Types of measurement parameters**

Table 4-1

The combinations of measurement parameters

Cs-Rs	Cs-D	Cp-Rp	Cp-D
Lp-Rp	Lp-Q	Ls-Rs	Ls-Q

R-Q	R-X	Z- $\theta_r$	Z- $\theta_d$
-----	-----	---------------	---------------

**Monitor parameters**

Table 4-2

## Monitor parameters

Z	D	Q	
$\theta_r$	$\theta_d$	R	X
G	B	Y	
Vac	Iac		
$\Delta$	$\Delta\%$		

## Measurement and Monitor parameter descriptions

Parameter	Description
Cs	Capacitance value measured using the series equivalent circuit model
Cp	Capacitance value measured using the parallel equivalent circuit model
Ls	Inductance value measured using the series equivalent circuit model
Lp	Inductance value measured using the parallel equivalent circuit model
Rs	Equivalent series resistance measured using the series equivalent circuit model (ESR)
Rp	Equivalent parallel resistance measured using the parallel equivalent circuit model
Z	Absolute value of impedance
Y	Absolute value of admittance
G	Conductance
B	Sustenance
R	Resistance (=Rs)
X	Reactance
D	Dissipation factor
Q	Quality factor(=1/D)
$\theta_r$	Phase radian
$\theta_d$	Phase angle
Vac	Test signal Voltage
Iac	Test signal Current
$\Delta$	Absolute deviation value
$\Delta\%$	Relative deviation value

**Procedure for setting the measurement function [FUNC]**

- Step 1. Press the [Meas] key
- Step 2. Press the <MEAS DISPLAY> soft key
- Step 3. Use the cursor key to select [FUNC] field
- Step 4. Use the soft keys to select measurement function.

**4.1.2 Impedance Range [RANGE]**

Table 4-3

Impedance range mode

Mode	Function overview	Advantage	Disadvantage
Auto range	AT281x sets the optimum impedance range for the impedance of the DUT	You don't need to select range.	The measurement time is longer due to the ranging time
Hold range	Measurement is performed with a fixed impedance range	No ranging time is required	You need to select a proper range depending on the value of the DUT.
Nominal Range	AT281x sets the optimum range depending on the nominal value.	You don't need to select range. No ranging time is required	Valid only in the sorting mode.

**Available impedance range**

The hold range has nine impedance ranges: 10Ω, 30Ω, 100Ω, 300Ω, 1kΩ, 3kΩ, 10kΩ, 30kΩ and 100kΩ.

The impedance range is selected according to the DUT's impedance even if the measurement parameter is capacitance or inductance.

Table 4-4

Effective measurement range for the impedance range when in HOLD state

Range No.	Impedance range	Effective measurement range
8	10Ω	0 - 10Ω
7	30Ω	10Ω -100Ω
6	100Ω	100Ω -316Ω
5	300Ω	316Ω-1kΩ
4	1kΩ	1kΩ-3.16kΩ
3	3kΩ	3.16kΩ-10kΩ
2	10kΩ	10kΩ-31.6kΩ
1	30kΩ	31.6kΩ-100kΩ (∞)
0	100kΩ	100kΩ-∞

Procedure for setting the impedance range [RANGE]

- Step 1. Press the [Meas] key
- Step 2. Use the cursor key to select [RANGE] field
- Step 3. Use the soft keys to select the impedance range mode or impedance range.

Soft key	Function
AUTO RANGE	
HOLD RANGE	
NORMINAL RANGE	
INCR +	Increments the impedance range in the HOLD mode
DECR -	Decrements the impedance range in the HOLD mode

**4.1.3 Test Frequency [FREQ]**

AT2818: 10Hz ~ 300kHz

Table 4-5 AT2818 Frequency range and test frequency point

Frequency range(F)	Resolution
$10.0000\text{Hz} \leq F \leq 99.9999\text{Hz}$	0.0001Hz
$100.0000\text{Hz} \leq F \leq 999.999\text{Hz}$	0.001Hz
$1.00000\text{kHz} \leq F \leq 9.99999\text{kHz}$	0.01Hz
$10.0000\text{kHz} \leq F \leq 99.9999\text{kHz}$	0.1Hz
$100.000\text{kHz} \leq F \leq 300.000\text{kHz}$	1Hz

AT2816A: 50Hz ~ 200kHz

Table 4-6 AT2816A Frequency range and test frequency point

Frequency range(F)	Resolution
$10.0000\text{Hz} \leq F \leq 99.9999\text{Hz}$	0.0001Hz
$100.0000\text{Hz} \leq F \leq 999.999\text{Hz}$	0.001Hz
$1.00000\text{kHz} \leq F \leq 9.99999\text{kHz}$	0.01Hz
$10.0000\text{kHz} \leq F \leq 99.9999\text{kHz}$	0.1Hz
$100.000\text{kHz} \leq F \leq 200.000\text{kHz}$	1Hz

AT2816B: [37 Points]

50, 60, 80, 100, 120, 150, 200, 250, 300, 400, 500, 600, 800,  
 1e3, 1.2e3, 1.5e3, 2e3, 2.5e3, 3e3, 4e3, 5e3, 6e3, 8e3,  
 10e3, 12e3, 15e3, 20e3, 25e3, 30e3, 40e3, 50e3, 60e3, 80e3,  
 100e3, 120e3, 150e3, 200e3

AT2817A : [16 Points]

50, 60, 100, 120, 200, 400, 500, 1e3, 2e3, 4e3, 5e3, 10e3, 20e3, 40e3, 50e3, 100e3

AT2817 : [10 Points]

50, 60, 100, 120, 1e3, 10e3, 20e3, 40e3, 50e3, 100e3

Frequency Accuracy: 0.02%

**Procedure for setting test frequency [FREQ]**

- Step 1. Press the [Meas] key
- Step 2. Use the cursor key to select [FREQ] field
- Step 3. Use the soft keys or numeric entry keys to enter the test frequency.

When data is entered with the numeric keys, the soft keys change to unit labels (Hz, kHz)

Soft key	Function
INCR ++	Refer to Table 4-7 AT2818's Test Frequency that can be set using INCR++/DECR-- and Table 4-8 AT2816X's Test Frequency that can be set using INCR++/DECR-- (*Note: not available in AT2817A and AT2817)
DECR --	
INCR +	Refer to Table 4-9, Table 4-10, Table 4-11 and Table 4-12
DECR -	

Table 4-7 AT2818's Test Frequency that can be set using INCR++/DECR--

INCR++/DECR--				
10Hz	50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz	40kHz	50kHz
100kHz	200kHz	250kHz	300kHz	

Table 4-8 AT2816X's Test Frequency that can be set using INCR++/DECR--

INCR++/DECR--				
50Hz	60Hz	100Hz	120Hz	
1kHz	10kHz	20kHz	40kHz	50kHz
100kHz	200kHz			

Table 4-9 AT2818's Test Frequency that can be set using INCR+/DECR-

INCR+/DECR- (Hz)									
10	12	15	20	25	30	40	50	60	80
100	120	150	200	250	300	400	500	600	800
1k	1.2k	1.5k	2k	2.5k	3k	4k	5k	6k	8k
10k	12k	15k	20k	25k	30k	40k	50k	60k	80k
100k	120k	150k	200k	250k	300k				

Table 4-10 AT2816X's Test Frequency that can be set using INCR+/DECR-

INCR+/DECR- (Hz)									
			50			60			80
100	120	150	200	250	300	400	500	600	800
1k	1.2k	1.5k	2k	2.5k	3k	4k	5k	6k	8k
10k	12k	15k	20k	25k	30k	40k	50k	60k	80k
100k		120k		150k		200k			

Table 4-11 AT2817A's Test Frequency that can be set using INCR+/DECR-

INCR+/DECR- (Hz)			
50Hz	60Hz	100Hz	120Hz
200Hz	400Hz	500Hz	1kHz
2kHz	4kHz	5kHz	10kHz
20kHz	40kHz	50kHz	100kHz

Table 4-12 AT2817's Test Frequency that can be set using INCR+/DECR-

INCR+/DECR- (Hz)			
50Hz	60Hz	100Hz	120Hz
1kHz	10kHz	20kHz	40kHz
50kHz	100kHz		

#### 4.1.4 Trigger Mode [TRIG]

AT281x supports four trigger modes: INT (internal), EXT (external), MAN (manual) and BUS (RS-232).

Trigger Mode	Description
INT	AT281x continuously repeats the measurement cycle.
MAN	AT281x performs one cycle of measurement each time you press the [Trig] key.
EXT	AT281x performs one cycle of measurement each time a rising pulse is input to the handler external trigger input pin on the rear panel.
BUS	AT281x performs one cycle of measurement each time it receives a trigger command sent via RS-232.

#### Procedure for choosing trigger mode [TRIG]

Step 1. Press the [Meas] key



- Step 2. Use the cursor key to select [TRIG] field
- Step 3. Use the soft keys to select desired trigger mode.

Soft key	Function
INT	Internal Trigger Mode
MAN	Manual Trigger Mode
EXT	External Trigger Mode
BUS	BUS Trigger Mode

#### 4.1.5 Test Signal Voltage Level [LEVEL]

The AT281x's test signal voltage level can be set as the effective value (RMS value) of a sine wave of the test frequency from the unit's internal oscillator.

The output impedance can be set to 30Ω, 50Ω or 100Ω.

##### Test signal level setting procedure

- Step 1. Press the [Meas] key
- Step 2. Use the cursor key to select [LEVEL] field
- Step 3. Use the soft keys or numeric entry keys to enter the test signal voltage level.

AT2816X, AT2818:

Soft key	Function						
INCR ++	Refer to AT2817: <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Soft key</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>0.1V</td> <td rowspan="3"></td> </tr> <tr> <td>0.3V</td> </tr> <tr> <td>1.0V</td> </tr> </tbody> </table> Table 4-13 Table 4-7 AT2818's Test Frequency that can be set using INCR++/DECR-- (*Note: These two items are not available in AT2817)	Soft key	Function	0.1V		0.3V	1.0V
Soft key		Function					
0.1V							
0.3V							
1.0V							
DECR --							
INCR +	Refer to Table 4-14						
DECR -	(*Note: These two items are not available in AT2817)						

AT2817:

Soft key	Function
0.1V	
0.3V	
1.0V	

Table 4-13

Test voltage Level that can be set with INCR++/DECR--

INCR++/DECR-- (V)						
0.01	0.10	0.30	0.50	1.00	1.50	2.00

Table 4-14

Test voltage Level that can be set with INCR+/DECR-

INCR+/INCR- (V)									
0.01	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
2.0									

#### 4.1.6 Measurement Speed [SPEED]

SLOW, MED 1, MED 2 and FAST can be selected for AT281x.

SLOW mode will result in more stable and accurate measurement result.

**Procedure for setting measurement speed mode**

- Step 1. Press the [Meas] key
- Step 2. Use the cursor key to select [SPEED] field
- Step 3. Use the soft keys to set measurement speed

Soft key	Function
SLOW	
MED 1	
MED 2	
FAST	

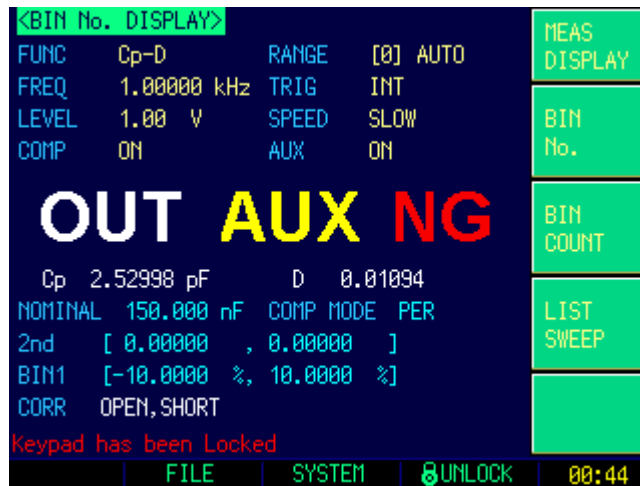
**4.2 <BIN No. DISPLAY> Page**

When press [Meas] key and [BIN No.] soft key, the <BIN No. DISPLAY> page appears.

The bin sorting results are displayed in larger characters while the measurement results are shown in normal characters.

Figure 4-2

<BIN No. DISPLAY> page



This page provides the following information:

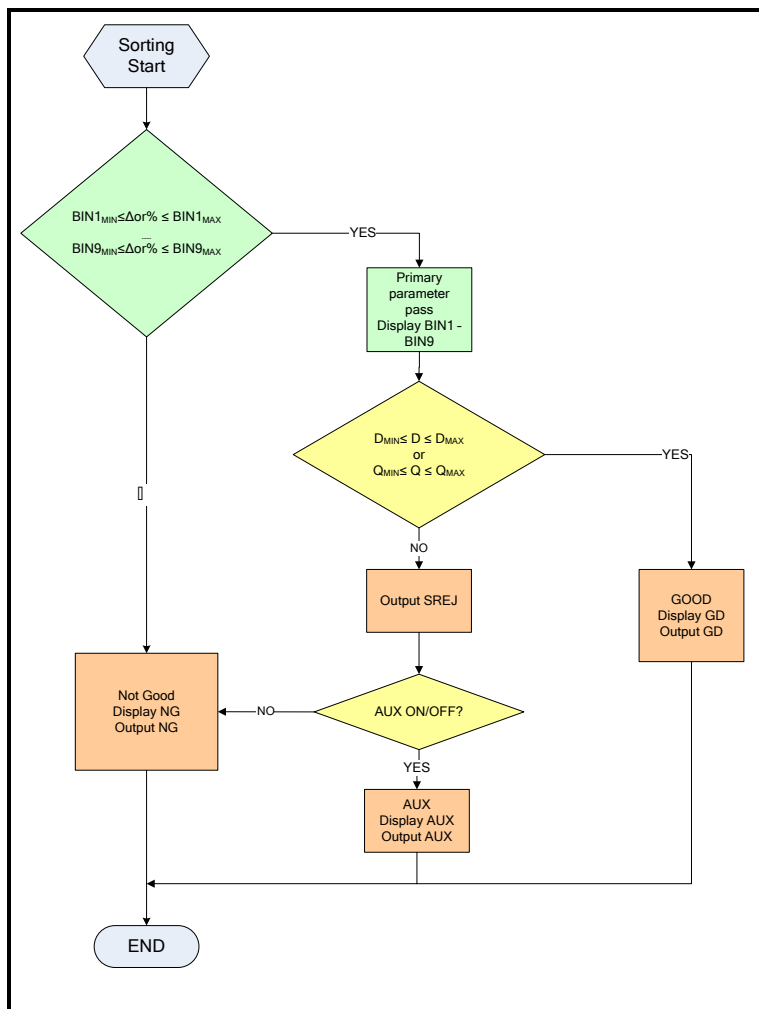
- FUNC, RANGE, FREQ, LEVEL, TRIG, LEVEL, SPEED: These conditions can be set from <MEAS DISPLAY> page.
- Comparator function ON/OFF [COMP]
- Auxiliary bin ON/OFF [AUX]

**4.2.1 Comparator Function ON/OFF**

AT281x's built-in comparator can sort devices into a maximum of 10 bins (BIN1 to BIN9 and OUT) using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits. A device which primary parameter is within limits, but secondary parameter is not, can be sorted into an auxiliary BIN (AUX).

Figure 4-3

Comparator Workflow



**Procedure for setting the comparator function [COMP]**

- Step 1. Press the [Meas] key
- Step 2. Press the <MEAS DISPLAY> soft key
- Step 3. Use the cursor key to select [COMP] field
- Step 4. Use the soft keys to turn on/off the comparator

Soft key	Function
ON	
OFF	

**4.2.2 Auxiliary Bin [AUX]**

After AUX turned on, DUTs that do not fall within the primary parameter limit values are sorted as OUT. In addition, DUTs that fall within the primary parameter limits but out of the secondary parameter limits are sorted into the auxiliary (AUX) bin.

**Procedure for turning ON/OFF the auxiliary bin [AUX]**

- Step 1. Press the [Meas] key
- Step 2. Press the <MEAS DISPLAY> soft key
- Step 3. Use the cursor key to select [AUX] field
- Step 4. Use the soft keys to turn on/off the auxiliary bin

Soft key	Function
ON	Turns ON the auxiliary bin

OFF	Turns OFF the auxiliary bin
-----	-----------------------------

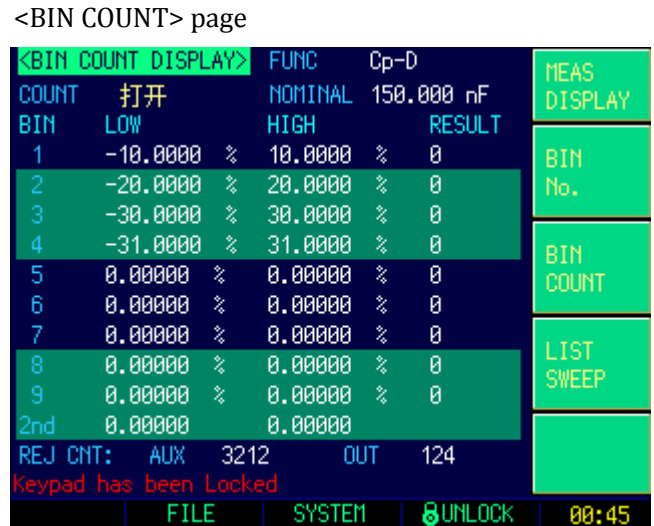
### 4.3 <BIN COUNT DISPLAY> page\*Not available in AT2817

When press the [Meas] key and [BIN COUNT] soft key, the <BIN COUNT DISPLAY > page appears.

This page provides the following information:

- Counter function [COUNT]

Figure 4-4



#### 4.3.1 Counter Function [COUNT]

The AT2818, AT2816X, AT2817A are capable of counting bins. The number of devices sorted into each bin is counted while unit sorts the devices into appropriate bins using the comparator function.

The maximum count is 999999, the counting operation stops and the overflow message “-----” appears when this value is reached.

**Set the Counter:**

- Step 1. Press the [Meas] key
- Step 2. Press the <MEAS DISPLAY> soft key
- Step 3. Use the cursor key to select [COUNT] field
- Step 4. Use the soft keys to set counter function

Soft key	Function
COUNT ON	
COUNT OFF	
-	
-	
RESET COUNT	The counter is reset when this key pressed.

### 4.4 <LIST SWEEP DISPLAY> Page\*Not available in AT2817

The <LIST SWEEP DISPLAY> will display when you press the [Meas] key and [LIST SWEEP] soft key.

Figure 4-5 <LIST SWEEP DISPLAY> page

<LIST SWEEP DISPLAY>						MEAS DISPLAY
TRIG	INT	RANGE		[6] AUTO		
No.	FREQ[Hz]	Cp	D	CMP		
1	1.00000 k	147.947 nF	0.00017	H		BIN No.
2	2.00000 k	148.359 nF	0.00022	H		
3	3.00000 k	148.359 nF	0.00019	H		BIN COUNT
4	4.00000 k	148.969 nF	0.00014	H		
5	5.00000 k	148.976 nF	0.00017	H		
6	6.00000 k	148.968 nF	0.00018	H		
*7	7.02247 k	148.964 nF	0.00021	H		LIST SWEEP
8	8.00000 k	148.969 nF	0.00012	H		
9	9.05797 k	148.966 nF	0.00014	H		
10	10.0000 k	148.964 nF	0.00015	H		

Keypad has been Locked

FILE SYSTEM UNLOCK 00:48

On the <LIST SWEEP DISPLAY> page, the sweep points are swept and the measurement results are compared to the limits. During a sweep, an asterisk mark (\*) will appear on the left side of the sweep point currently being measured.

This page provides the following information:

- Trigger mode [TRIG]
- Range mode [RANGE]

These conditions can be set from <MEAS DISPLAY> page and <SETUP> page.

#### 4.4.1 Sweep Trigger Mode [TRIG]

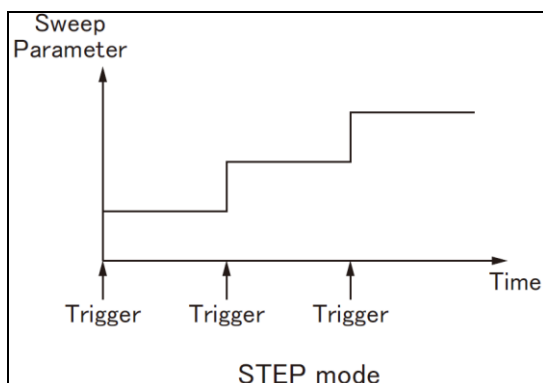
Figure 4-6

Sweep trigger mode

Trig Mode	Function
INT	Internal Trigger. All ten sweep points are swept continuous.
MAN	Manual Trigger. Each time the instrument is triggered by [Trig] key, the sweep points are swept one by one.
EXT	External Trigger. Each time the instrument is triggered by the handler trigger pin, the sweep points are swept one by one.
BUS	BUS Trigger. Each time the instrument is triggered by SCPI command, the sweep points are swept one by one.

Figure 4-7

Sweep Mode



## 5. [Setup] Key



This section includes the following information:

- MEAS SETUP page
- CORRECTION page
- LIMIT TABLE page
- LIST SETUP page [Not available in AT2817]

Every time or everywhere you can press the [Setup] key to open the <MEAS SETUP> page.

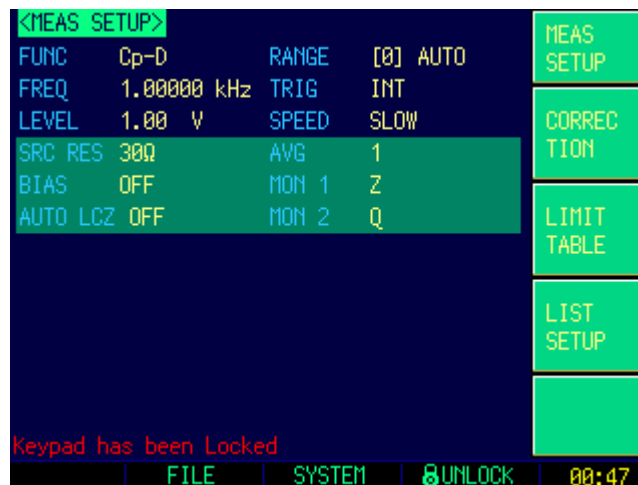
### 5.1 <MEAS SETUP> Page

#### NOTE

In <MEAS SETUP> page, the Instrument does not display test result and sorting result, but testing still in progress.

Figure 5-1

<MEAS SETUP> Page



In the <MEAS SETUP> Page, you can configure each of the following measurement controls with the cursor placed in the corresponding field.

- Measurement Function [FUNC] \*1
- Impedance range [RANGE] \*1
- Test Frequency [FREQ] \*1
- Trigger Mode [TRIG] \*1
- Test Signal Voltage Level [LEVEL] \*1
- Measurement Speed [SPEED] \*1
- Source Output Impedance [SRC RES]
- Averaging Factor [AVG]
- DC Bias Voltage [BIAS]
- Auto LCZ Function [AUTO LCZ]
- Monitor 1 and Monitor 2 Parameter Select [MON 1] [MON 2]

NOTE: \*1. This six setting can be set in <MEAS DISPLAY> page and <BIN No. DISPLAY> page.

Please refer Sector 4.1 <MEAS DISPLAY> Page to set.

### 5.1.1 Source Output Impedance [SRC RES]

The Source output impedance can be set to 30Ω, 50Ω or 100Ω.

If you use AT281x to test a lower inductor, please use 30Ω.

If you need to compare test results with Agilent 4284A, select 100Ω.

#### Procedure for setting source output impedance

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [SRC RES] field
- Step 3. Use the soft keys to set measurement speed

Soft key	Function
30Ω	
50Ω	
100Ω	

### 5.1.2 Averaging Factor [AVG]

The averaging feature allows you to obtain moving average values of successive measurement results.

You can specify the averaging factor from integer 1 to integer 256.

#### To set up the averaging factor

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [AVG] field
- Step 3. Use the soft keys or number keys to enter averaging factor.

Soft key	Function
INCR ++	Increments the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256.
INCR +	Increments the averaging factor in steps of 1.
DECR -	Decrements the averaging factor in steps of 1.
DECR --	Decrements the averaging factor in steps of 1, 2, 4, 8, 16, 32, 64, 128 and 256.

### 5.1.3 DC Bias Voltage Monitor {Option}

This setting is valid when DC bias voltage module is installed.

#### Procedure for setting DC bias voltage

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [BIAS] field
- Step 3. Use the soft keys to select DC bias voltage.

Soft key	Function
OFF	Turn off the DC bias voltage
2V	2V voltage is applied to the device under test.
1.5V	1.5V voltage is applied to the device under test.
EXTENAL INPUT	0~2V voltage is applied to the device under test.

### 5.1.4 Auto LCZ Function [AUTO LCZ]

Auto LCZ Function can help you to select a proper measurement parameter.

#### NOTE

Auto LCZ Function cannot judge complex components, please do not rely entirely on

this function to measure.

#### To set up the Auto LCZ Function

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [BIAS] field
- Step 3. Use the soft keys to turn on/off the Auto LCZ Function.

Soft key	Function
OFF	Turn off the Auto LCZ Function
ON	Turn on the Auto LCZ Function. When Auto LCZ Function is set to ON, "AUTO-LCZ" will display on [FUNC] field.

NOTE The Auto LCZ Function will be turned off after you set the measurement function.

### 5.1.5 Monitor 1 and Monitor 2 [MON 1][MON 2]

The AT281x can monitor the other two parameters.

NOTE: Additional monitoring parameters **do not** increase the instrument measurement time.  
Monitor parameter display in <MEAS DISPLAY> page only.

#### Procedure for setting monitor parameters (monitor 1 and monitor 2)

- Step 1. Press the [Setup] key
- Step 2. Use the cursor key to select [MON 1] or [MON 2] field
- Step 3. Use the soft keys to select DC bias voltage.

Soft key	Function
OFF	Turn off the monitor
Z	Absolute value of impedance
D	Dissipation factor
Q	Quality factor(=1/D)
$\theta_r$	Phase radian
$\theta_d$	Phase angle
R	Resistance (=Rs)
X	Reactance
G	Conductance
Y	Absolute value of admittance
Vac	Test signal Voltage
Iac	Test signal Current
$\Delta$	Absolute deviation value
$\Delta\%$	Relative deviation value

## 5.2 <CORRECTION> Page

When you press [Setup] key and [CORRECTION] soft key, the <CORRECTION> page appears.

In this page, the OPEN/SHORT/LOAD correction for correcting the stray admittance and residual



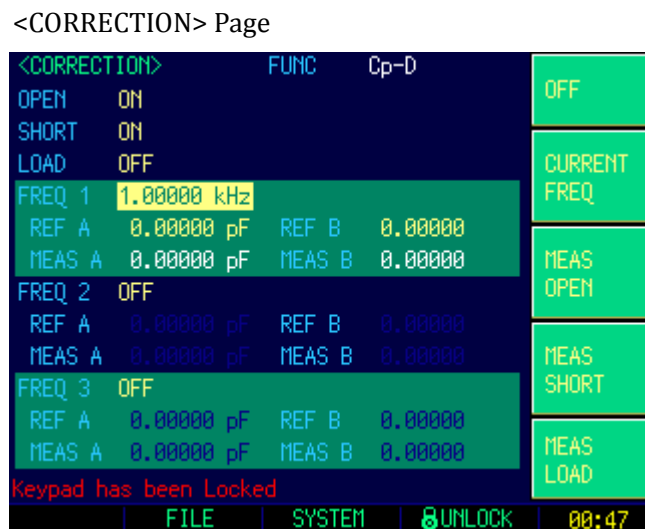
impedances can be performed.

The correction function has two kinds of correction methods. In one method the open and short correction can be performed at all of the frequency points using the interpolation method, and in the other method the open, short, and load correction can be performed at the frequency points you specify.

In <CORRECTION> page, you can configure each of the following controls with the cursor placed in the corresponding field.

- Open correction [OPEN]
- Short correction [SHORT]
- Load correction [LOAD]
- Frequency 1, 2, 3 for OPEN, SHORT, LOAD Correction [FREQ 1] [FREQ 2] [FREQ3]

Figure 5-2

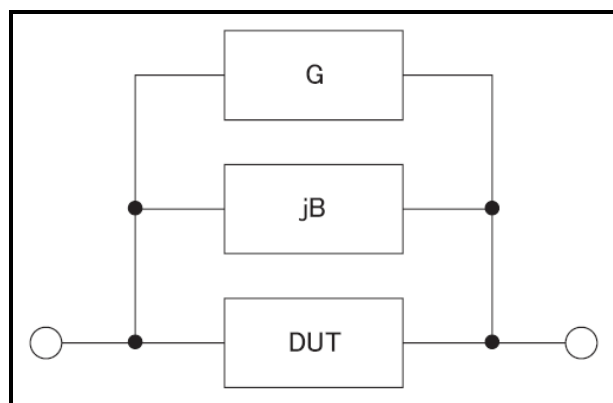


### 5.2.1 Open correction [OPEN]

The AT281x's OPEN correction capability cancels errors due to the stray admittance (G, B) in parallel with the device under test (Refer to Figure 5-3)

Figure 5-3

Stray Admittance



The OPEN correction data is taken at all preset frequency points, independent of the test frequency you set. Refer to Table 4-9, Table 4-10, Table 4-11 and Table 4-12. (Page 24)

#### To perform open correction

- Step 1. Press the [Setup] key
- Step 3. Press the [CORRECTION] soft key.

Step 3. Use the cursor key to select [OPEN] field

Soft key	Function
ON	Enables open correction.
OFF	Disables open correction.
MEAS OPEN	Starts open correction.

Step 4. Press [MEAS OPEN] soft key, a dialog message display “Connect the UNKNOWN terminal with no DUT”.

Step 5. Please Connect the UNKNOWN terminal and test fixture with no DUT connected.

Step 6. Press [OK] soft key. The AT281x measures open admittances (capacitance and conductance) at the all test frequency points.

During the measurement, an “OPEN measurement in progress” dialog message is shown on the display.

When the measurement has finished, a message “Correction finished” is displayed.

During the measurement, you can press [ABORT] soft key to abort open correction.

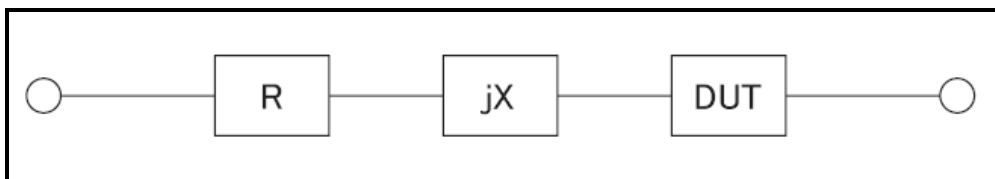
Step 7. Press the ON key to enable open correction in successive measurements.

### 5.2.2 Short Correction [SHORT]

The short correction feature of the AT281x compensates for any residual impedances (R,X) that may exist within the interval from the calibration plane, which is determined by the selected cable length, to the DUT connecting points (see Figure 5-4)

Figure 5-4

Residual Impedances



#### To perform short correction

Step 1. Press the [Setup] key

Step 3. Press the [CORRECTION] soft key.

Step 3. Use the cursor key to select [SHORT] field

Soft key	Function
ON	Enables short correction.
OFF	Disables short correction.
MEAS SHORT	Starts short correction.

Step 4. Press [MEAS SHORT] soft key, a dialog message display “Short-circuit the test terminals”.

Step 5. Connect the UNKNOWN terminal and the test fixture and short-circuit test terminals

Step 6. Press [OK] soft key. The AT281x measures short impedances (inductances and resistance) at the all test frequency points.

During the measurement, an “SHORT measurement in progress” dialog message is shown on the display.

When the measurement has finished, a message “Correction finished” is displayed.

During the measurement, you can press [ABORT] soft key to abort short correction.

Step 7. Press the ON key to enable short correction in successive measurements.

### 5.2.3 Frequency 1, 2, 3 Correction [FREQ 1] [FREQ 2] [FREQ3]

Correction based on specified frequency points involves performing open/short/load correction at user-specified frequency points. There are 3 frequency points you can specify.

In addition to the open/short correction features, AT281x provides a LOAD correction feature that allows you to carry out, at your specified frequency points, load correction using a transfer function determined based on the relationships between a particular standard's reference values (known values) and the standard's actual measurements. With load correction, you can compensate for errors that cannot be compensated using open/short correction.

#### To specify frequency points and perform open correction

- Step 1. Press the [Setup] key
- Step 3. Press the [CORRECTION] soft key.
- Step 3. Use the cursor key to select [FREQ 1], [FREQ 2] or [FREQ 3] field
- Step 4. Enter the frequency using the entry keys.

Soft key	Function
ON	Enable this point.
OFF	Disables this point.
CURRENT FREQ	Use current frequency
MEAS OPEN	Starts open correction.
MEAS SHORT	Starts short correction
MEAS LOAD	Starts load correction

- Step 4. Press [MEAS OPEN] soft key, a dialog message display "Connect the UNKNOWN terminal with no DUT".
- Step 5. Please Connect the UNKNOWN terminal and test fixture with no DUT connected.
- Step 6. Press [OK] soft key. The AT281x measures open admittances (capacitance and conductance) at this frequency point.  
During the measurement, an "OPEN measurement in progress" dialog message is shown on the display.  
When the measurement has finished, a message "Correction finished" is displayed.  
During the measurement, you can press [ABORT] soft key to abort open correction.

#### To specify frequency points and perform short correction

- Step 1. Press [MEAS SHORT] soft key, a dialog message display "Short-circuit the test terminals".
- Step 2. Connect the UNKNOWN terminal and the test fixture and short-circuit test terminals
- Step 3. Press [OK] soft key. The AT281x measures short impedances (inductances and resistance) at this frequency points.  
During the measurement, an "SHORT measurement in progress" dialog message is shown on the display.  
When the measurement has finished, a message "Correction finished" is displayed.  
During the measurement, you can press [ABORT] soft key to abort short correction.

#### To specify frequency points and perform load correction

- Step 1. Move the cursor into the REF A field
- Step 2. Enter the known value of the standard's primary parameter using entry keys.
- Step 3. Move the cursor into the REF B field, and enter the known value of the standard's secondary parameter.

- Step 4. Connect the standard to the UNKNOWN terminal.
- Step 5. Move the cursor into the FREQ # field

Soft key	Function
OFF	Disables this point.
CURRENT FREQ	Use current frequency
MEAS OPEN	Starts open correction.
MEAS SHORT	Starts short correction
MEAS LOAD	Starts load correction

- Step 6. Press [MEAS LOAD] soft key.
- During the measurement, an “LOAD measurement in progress” dialog message is shown on the display.
- When measurement has finished, the dialog disappears.

### 5.3 <LIMIT TABLE SETUP> Page

Press [Setup] key and press [LIMIT TABLE] soft key to open <LIMIT TABLE SETUP> page.

This page allows you to configure the AT281x's built-in comparator.

AT2818/AT2816X/AT2817A's built-in comparator can sort DUTs into a maximum 10 levels (BIN1 through BIN9 and OUT) using up to nine sets of primary parameter limits along with one set of secondary parameter limits.

AT2817A's built-in comparator can sort DUTs into a maximum 4 levels (BIN1 through BIN9 and OUT) using up to nine sets of primary parameter limits along with one set of secondary parameter limits.

In addition, DUTs that fall within the primary parameter limits but are out of the secondary parameter limits can be sorted into an auxiliary bin.

To take full advantage of the comparator, AT281x was equipped a handler interface for use in conjunction with the comparator. All 14 bins signal can output to yours PLC via the handler interface.

In the <LIMIT TABLE SETUP> page, you can configure each of the following controls with the cursor placed in the corresponding field.

- Comparator ON/OFF [COMP] \*1
- Auxiliary bin ON/OFF [AUX] \*1
- Nominal value [NOM]
- Primary parameter comparator limit mode [MODE]
- Beep feature [BEEP]\*2
- Primary parameter total bins [BINS]

NOTE:

\*1. This two setting also can be set in the <BIN NO. DISPLAY> page.

\*2. This setting also can be set in the <SYSTEM CONFIG> page.

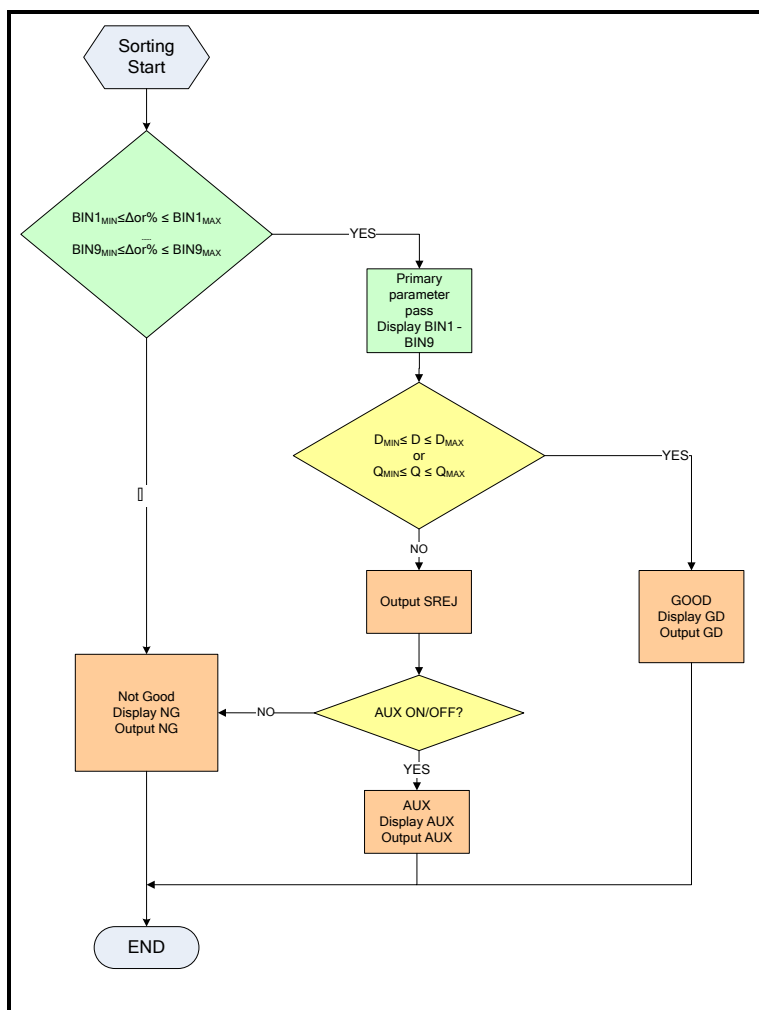
Figure 5-5 <LIMIT TABLE SETUP> Page

LIMIT TABLE SETUP				FUNC	Cp-D	MEAS SETUP
COMP	ON	NOM	150.000 nF	BEEP	OFF	CORRECTION
MODE	PER	AUX	ON	TONE	HIGH	
9-BINS	LOW		HIGH			LIMIT TABLE
1	-10.0000 %		10.0000 %			
2	-20.0000 %		20.0000 %			LIST SETUP
3	-30.0000 %		30.0000 %			
4	-31.0000 %		31.0000 %			
5	0.00000 %		0.00000 %			
6	0.00000 %		0.00000 %			
7	0.00000 %		0.00000 %			
8	0.00000 %		0.00000 %			
9	0.00000 %		0.00000 %			
2nd	0.00000		0.00000			
Keypad has been Locked						
FILE		SYSTEM		UNLOCK		00:49

### 5.3.1 Comparator Function ON/OFF

AT281x's built-in comparator can sort devices into a maximum of 10 bins (BIN1 to BIN9 and OUT) using a maximum of nine pairs of primary parameter limits and one pair of secondary parameter limits. A device which primary parameter is within limits, but secondary parameter is not, can be sorted into an auxiliary BIN (AUX).

Figure 5-6 Comparator Workflow



#### Procedure for setting the comparator function [COMP]

- Step 1. Press the [Setup] key

- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [COMP] field
- Step 4. Use the soft keys to turn on/off the comparator.

Soft key	Function
ON	
OFF	

### 5.3.2 Auxiliary Bin [AUX]

After AUX turned on, DUTs that do not fall within the primary parameter limit values are sorted as OUT. In addition, DUTs that fall within the primary parameter limits but are out of the secondary parameter limits are sorted into the auxiliary (AUX) bin.

#### Procedure for turning ON/OFF the auxiliary bin [AUX]

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [AUX] field
- Step 4. Use the soft keys to turn on/off the auxiliary bin

Soft key	Function
ON	Turns ON the auxiliary bin
OFF	Turns OFF the auxiliary bin

### 5.3.3 Primary Parameter Comparator limit mode [MODE]

You can specify the primary parameter limit values in one of the following 2 ways:

- Tolerance mode [%] [ $\Delta$ ]

In tolerance mode, the comparison limit values are based on the deviations from the specified nominal value, which can be specified in the [NOM] field. You configure the tolerance mode limit values as a deviation percentage (%) or absolute ( $\Delta$ ) parameter value.

- Sequential mode [SEQ]

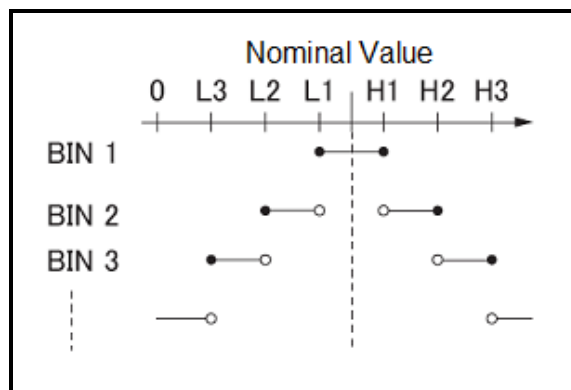
In sequential mode, the comparison limit values are based on the absolute value of the measurement. When you configure these limit values, you have to first define the minimum value and then the maximum value.

#### Tolerance mode

Tolerance mode includes deviation percentage (%) or absolute ( $\Delta$ ).

#### Tolerance mode

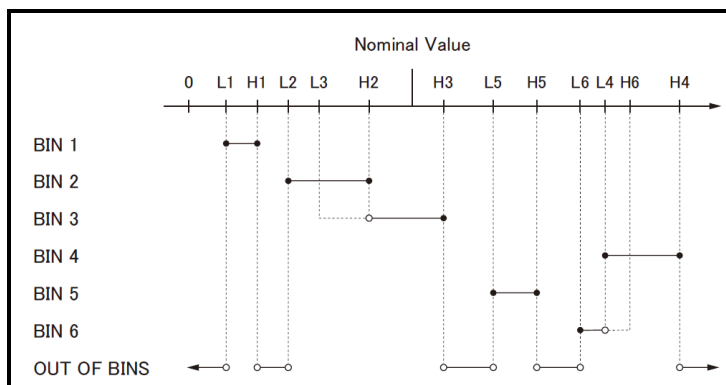
Figure 5-7



- Includes the point
- Excludes the point

Absolute value ( $\Delta$ ) = UNKNOWN value – nominal value  
 Deviation percentages (%) = Absolute value ( $\Delta$ ) / nominal value  $\times$  100%  
 Example of sorting in tolerance mode

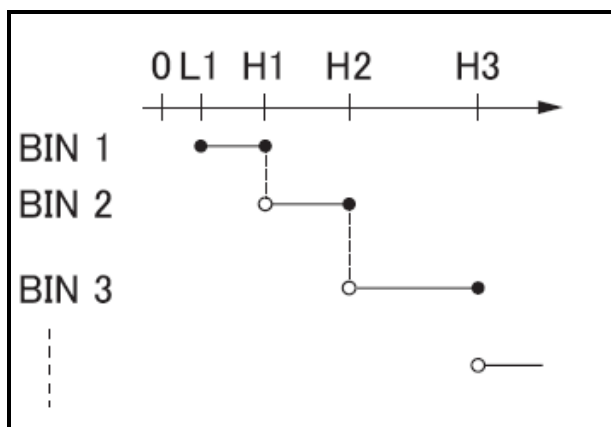
Figure 5-8



- Includes the point
- Excludes the point

**Sequential mode**  
 Sequential mode

Figure 5-9



- Includes the point
- Excludes the point

In Sequential mode, the comparison limit values are based on the absolute value of the measurement. The nominal value does not need to participate in operation.

**To set up the comparator limit mode**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [MODE] field
- Step 4. Use the soft keys to select comparator mode

Soft key	Function
ABS	Absolute parameter values
PER	Deviation percentages.
SEQ	Sequential mode.

**5.3.4 Nominal value for tolerance mode**

You must configure the nominal value when you use tolerance mode as the limit mode for the primary

parameter.

In sequential mode the nominal value does not affect sorting. In sequential mode you can configure nominal value or not.

**To enter the nominal value**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [NOM] field
- Step 4. Enter the nominal value using the entry keys. Use the soft key to select unit.

### 5.3.5 Beep feature

The beep feature behaves differently depending on which beep mode is in effect.

**To set up the beep feature**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [BEEP] field
- Step 4. Use the soft keys to set beep feature

Soft key	Function
OFF	
GD	Beep when the comparator sorting result is GD
NG	Beep when the comparator sorting result is NG

### 5.3.6 Beep Tone [TONE]

**To set up the beep tone**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [TONE] field
- Step 4. Use the soft keys to select beep tone.

Soft key	Function
HIGH	Buzzer sound high
LOW	Buzzer sound low

### 5.3.7 Total Number of Bins [#-BINS]

AT2817A, AT2816x and AT2818 specify nine bins (1-BINS to 9-BINS).

AT2817 specifies three bins (1-BINS to 3-BINS).

**To choose total number of the bins**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [#-BINS] field
- Step 4. Use the soft keys to select beep tone.

Soft key	Function
1-BINS	
2-BINS	
3-BINS	
4-BINS	*Not available in AT2817



5-BINS	*Not available in AT2817
6-BINS	*Not available in AT2817
7-BINS	*Not available in AT2817
8-BINS	*Not available in AT2817
9-BINS	*Not available in AT2817

### 5.3.8 Lower and Upper Limits

AT2817A, AT2816X and AT2818's built-in comparator can sort DUTs into a maximum 10 levels (Bin1 thru Bin9 and OUT) using up to nine sets of primary parameter limits alone with one set of secondary parameter limits. AT2817 is 4 levels (Bin1 thru Bin3 and OUT).

#### To enter the limit values for tolerance mode

- Step 1. Press the [Setup] key
- Step 2. Press the [LIMIT TABLE] soft key
- Step 3. Use the cursor key to select [BIN 1 LOW] field
- Step 4. Enter the limit value using the entry keys.  
When in the ABS and SEQ mode, please enter the unit using the soft keys.  
When in the PER mode, the unit is %.
- Step 5. Repeat Step 4 using the cursor keys until you have entered all limit values.
- Step 6. Use the cursor key to select [2nd LOW] field and enter the lower limit value for the secondary parameter.
- Step 7. Select [2nd HIGH] field to enter the upper limit value.

### 5.4 <LIST SWEEP SETUP> Page \*Not available in AT2817

Press the [Setup] key and press [LIST SETUP] soft key to open the <LIST SWEEP SETUP> page. The list sweep feature of AT2817A, AT2816X and AT2818 can perform automatic sweep measurement by sweeping the frequency, signal level through a maximum 10 sweep points.

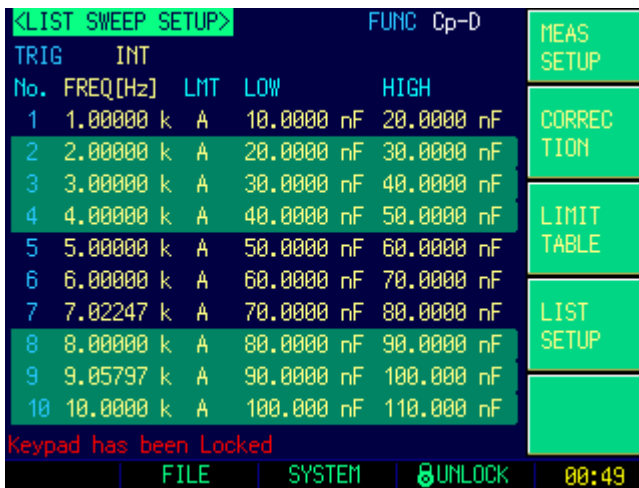
Before using list sweep feature, you have to configure the sweep list.

In the <LIST SWEEP SETUP> page, you can configure each of the following list sweep measurement controls with the cursor placed in the corresponding field.

- Sweep trigger mode [TRIG]
- Sweep parameter selection [FREQ[Hz], LEVEL[V]]
- Limit parameter selection [LMT]
- Lower and upper limits [LOW] [HIGH]

<LIST SWEEP SETUP> Page

Figure 5-10

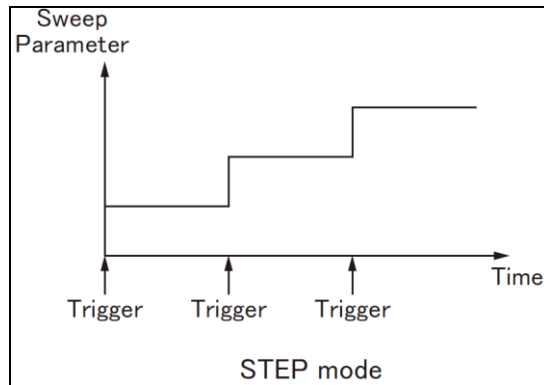


**5.4.1 Sweep Trigger Mode [TRIG]**

Figure 5-11 Sweep trigger mode

Trig Mode	Function
INT	Internal Trigger. All ten sweep points are swept continuous.
MAN	Manual Trigger. Each time the instrument is triggered by [Trig] key, the sweep points are swept one by one.
EXT	External Trigger. Each time the instrument is triggered by the handler trigger pin, the sweep points are swept one by one.
BUS	BUS Trigger. Each time the instrument is triggered by SCPI command, the sweep points are swept one by one.

Figure 5-12 Sweep Mode



**To choosing trigger mode [TRIG]**

You can also choose trigger mode in <MEAS DISPLAY> page, <BIN No. DISPLAY> page, <MEAS SETUP> page. (See Section 4.1.4, Page 24)

**5.4.2 List Sweep Parameters**

The sweep parameter used in list sweep measurement can be measurement frequency and signal level. Use the sweep point field to specify the list sweep measurement parameter.

**To specify the list sweep measurement parameter**

- Step 1. Press the [Setup] key
- Step 2. Press the [LIST SETUP] soft key
- Step 3. Use the cursor key to select **FREQ[Hz]** or **LEVEL[V]** field
- Step 4. Use the soft keys to select list sweep parameter.

Soft key	Function
FREQ[Hz]	Uses frequency as the list sweep parameter
LEVEL[V]	Uses voltage as the list sweep parameter

### 5.4.3 Sweep Point and Limit Modes

AT2817, AT2816X and AT2818's List sweep measurement feature supports up to 10 sweep points as well as measurement limit values. Each of sweep point can be turned on or off.

#### To configure the sweep points

- Step 1. Press the [Setup] key
- Step 2. Press the [LIST SETUP] soft key
- Step 3. Use the cursor key to select one of the sweep point field ( 1 thru 10)
- Step 4. Use soft keys to turn on/off current point.

Soft key	Function
ON	Turn on current point
OFF	Turn off current point

- Step 5. Enter the sweep point value (maybe the frequency value or signal level voltage value).  
When you enter the frequency value, the soft key labels change to unit label (Hz, kHz).  
When you enter the signal level voltage value, you don't need to enter unit.
- Step 6. Using the cursor keys, select the LMT field.
- Step 7. Configure the limit parameter by pressing the appropriate soft key

Soft key	Function
A	Uses the primary parameter as the limit parameter.
B	Uses the secondary parameter as the limit parameter.
-	Turns OFF the limit feature.

- Step 8. Using the cursor keys to select the LOW field
- Step 9. Enter the lower limit value
- Step 10. Using the cursor keys to select the HIGH field and enter the higher limit value.
- Step 11. Repeat Step 4 to Step 10.

## 6. System Configurations



This section includes the following information:

- SYSTEM INFO page
- SYSTEM CONFIG page
- SYSTEM SERVICE page

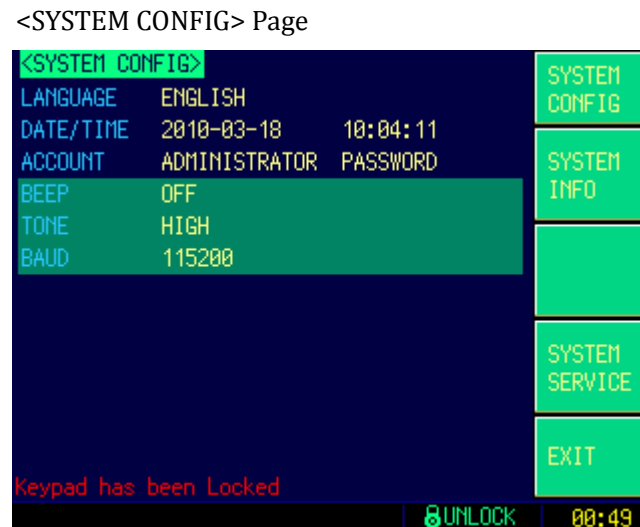
### 6.1 <SYSTEM CONFIG> Page

When press the [Meas] or [Setup] key followed by [SYSTEM] bottom soft key, the <SYSTEM CONFIG> page appears.

Following information can be configured in the <SYSTEM CONFIG> page.

- [LANGUAGE]
- System date and time configuration [DATE/TIME]
- Account settings [ACCOUNT]
- Beep setting [BEEP]
- Beep tone [TONE]
- RS-232 Baud rate setting [BAUD]

Figure 6-1



#### 6.1.1 System Language [LANGUAGE]

Two languages (ENGLISH and CHINESE) were supported by AT281x.

**To change languages**

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [LANGUAGE] field
- Step 4. Use the soft keys to select a language you understand.

Soft key	Function
中文	Chinese Language
ENGLISH	English Language

### 6.1.2 Setting the system date and time

AT281x features a built-in 24-hour color.

#### To change the date

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select date field
- Step 4. Use the soft keys to edit date

Soft key	Function
YEAR INCR+	Increases the year in steps of 1.
YEAR DECR-	Decreases the year in steps of 1.
MONTH INCR+	Increases the month in steps of 1.
DAY INCR+	Increases the day in steps of 1.
DAY DECR-	Decreases the day in steps of 1.

#### To change the time

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select time field
- Step 4. Use the soft keys to edit time

Soft key	Function
HOUR INCR+	Increases the hour in steps of 1.
HOUR DECR-	Decreases the hour in steps of 1.
MINUTE INCR+	Increases the minute in steps of 1.
MINUTE DECR-	Decreases the minute in steps of 1.
SECOND INCR+	Increases the second in steps of 1.
SECOND DECR-	Decreases the second in steps of 1.

### 6.1.3 Account Setting

The AT281x has two accounts, administrator and user.

Administrator: All functions can be configured by administrator except <SYSTEM SERVICE> page.

User: All functions can be configured by user except <SYSTEM SERVICE> page and <FILE> page.

#### To Change Account

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select date field
- Step 4. Use the soft keys to change account.

Soft key	Function
ADMIN	Administrator
USER	User

Switch user mode to administrator mode, you must input a correct password. The password can be s

#### To Change Administrator's Password

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [ADMIN] field.  
When the account field is [USER], you should change to [ADMIN].

Step 4. Use the soft keys to change password or delete password.

Soft key	Function
CHANGE PASSWORD	Input password(less than 9 numbers).
DELETE PASSWORD	The password will be removed.

NOTE: If you forget your password, please send an E-Mail to tech@applent.com.

### 6.1.4 Beep Feature

Beep Feature can also be set in <LIMIT TABLE SETUP>. (See Page 40, Sector 5.3.5)

#### To set up the beep feature

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [BEEP] field
- Step 4. Use the soft keys to set beep feature

Soft key	Function
OFF	Turn off the beep feature.
GD	Beep when the comparator sorting result is GD
NG	Beep when the comparator sorting result is NG

### 6.1.5 Beep Tone [TONE]

#### To set up the beep tone

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [TONE] field
- Step 4. Use the soft keys to select beep tone.

Soft key	Function
HIGH	Buzzer sound high
LOW	Buzzer sound low

### 6.1.6 RS-232 Baud Rate

Before you can control the AT281x by issuing RS-232 commands from built-in RS-232 controller connected via its DB-9 connector, you have to configure the RS-232 baud rate.

The AT281x's built-in RS-232 interface uses the SCPI language.

The configuration of RS-232

RS-232 configuration is as follows:

Data bits: 8-bit

Stop bits: 1-bit

Parity: none

#### To set up the baud rate

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [BAUD] field
- Step 4. Use the soft keys to select baud rate.

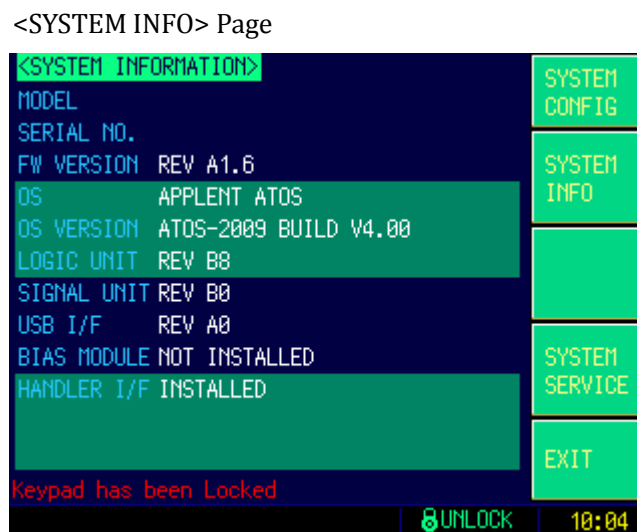
Soft key	Function
1200	
9600	
38400	
57600	
115200	Recommend, system default.

## 6.2 <SYSTEM INFO> Page

When press the [Meas] or [Setup] key followed by [SYSTEM] bottom soft key, and press [SYSTEM INFO] soft key, the <SYSTEM INFO> page appears.

There are no configurable options in the <SYSTEM INFO> page.

Figure 6-2



## 7. File Operation



This chapter provides information on the file operation of the AT281x.

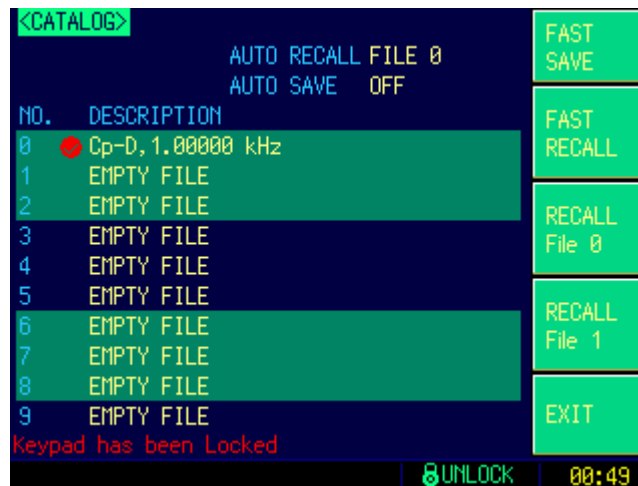
You can save up to 10 files into the internal non-volatile memory.

### 7.1 <CATALOG> Page

When press the [Meas] or [Setup] key followed by [FILE] bottom soft key, the <CATALOG> page appears.

Figure 7-1

<CATALOG> Page



The soft key labels change to shortcuts when the <CATALOG> page appears. These shortcut keys include:

- [FAST SAVE]: Fast save user data to current file.
- [FAST RECALL]: Fast recall data from current file.
- [RECALL FILE0]: Fast recall data from file0.
- [RECALL FILE1]: Fast recall data form file1.

In this page, you can configure each of the following controls with the cursor placed in the corresponding field.

- Recall a file at the instrument starts up [AUTO RECALL]
- Auto save file when the instrument shuts down [AUTO SAVE]

#### 7.1.1 Recall a File at Startup [AUTO RECALL]

You can recall file0 or current file at the instrument starts up.

**To select auto recall file**

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [FILE] bottom soft key.



- Step 3. Use the cursor key to select [AUTO RECALL] field
- Step 4. Use the soft keys to select.

Soft key	Function
LAST FILE	Last used file will be recalled at next startup.
FILE 0	File 0 will be recalled at next instrument startup.

### 7.1.2 Auto save data to last file [AUTO SAVE]

You can save the modified data into last used file when the instrument power key is pressed.

#### To turn on/off the AUTO SAVE function

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [FILE] bottom soft key.
- Step 3. Use the cursor key to select [AUTO SAVE] field
- Step 4. Use the soft keys to select.

Soft key	Function
ON	Auto save function will be enabled.
OFF	Turn off the auto save function.

### 7.1.3 File operation

#### To choose a file to operate

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [FILE] bottom soft key.
- Step 3. Use the cursor key to select a file (File name from 0 to 9)
- Step 4. Use the soft keys to operate.

Soft key	Function
SAVE	Save user configuration data into current selected file.
RECALL	Recall configuration data from current selected file.
ERASE	This file will be erased. The user configuration data will be reset to default at next startup.

## 8. Handler Interface



This chapter provides information of AT281x's built-in handler interface. Include:

- Pin Assignment
- Circuit Diagram
- Timing Chart

The AT281x's built-in handler interface outputs signals that indicate the end of a measurement cycle, the result of bin sorting by the comparator. In addition, the instrument accepts input of external trigger. You can use these signals to easily integrate the AT281x with a component handler or system controller. This means that you can fully automate such tasks as component inspection, component sorting, and processing of quality management data for higher manufacturing efficiency.

### 8.1 Pin Assignment

Figure 8-1

Pin Assignment

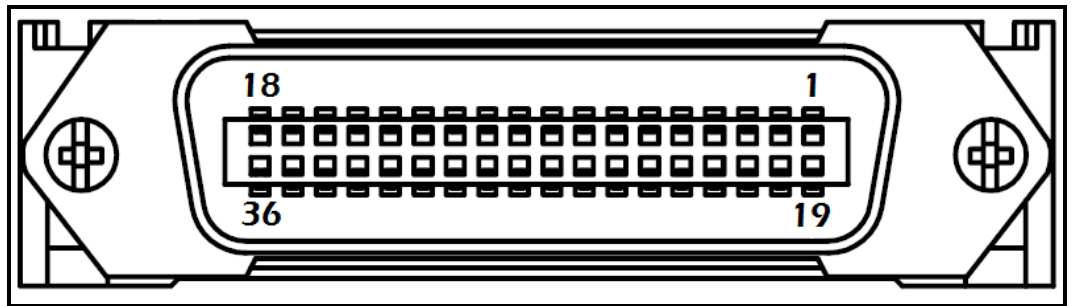


Table 8-1

Description of Handler Interface Signals

Pin	Signal	Direction	Overview
1	/BIN1	Output	The result of sorting. Open-collector based. If <b>EX-V2</b> signal was connected with EX-VCC, a built-in 5kΩ pull-up resistance used.
2	/BIN2	Output	
3	/BIN3	Output	
4	/BIN4	Output	
5	/BIN5	Output	
6	/BIN6	Output	
7	/BIN7	Output	
8	/BIN8	Output	
9	/BIN9	Output	
10	/OUT	Output	
11	/AUX	Output	
12	Trig-8V	Input	An external trigger signal for 8V EX-VCC. Connect to this pin when EX-VCC = 5~8V.
13	Trig-24V	Input	An external trigger signal for 24V EX-VCC. Connect to this pin when EX-VCC=8~24V
14	EX-V2	Power	External DC Voltage.
15			The power of built-in 5kΩ pull-up resistance of the output

			signals.
19	/PHI	Output	“Primary parameter beyond upper limit” signal. This signal is output when the primary parameter has exceeded the upper limit for bins 1 to 9.
20	/PLO	Output	“Primary parameter below lower limit” signal. This signal is output when the primary parameter is below the lower limit for bins 1 to 9.
21	/SREJ	Output	“Secondary parameter out of limits” signal. This signal is output when the secondary parameter is out of the limits.
27	EX-VCC	Power	External DC Voltage. Supplies voltage for DC isolation input signal (/TRIG8V, /TRIG24V)
28	EX-V1	Power	External DC Voltage. Supplies voltage for IDX and EOM signal pull-up resistance.
30	/IDX	Output	“End of analog measurement” signal. This signal is output when analog measurement is complete. This means that once the handler has received this signal, the next DUT can be connected to the UNKNOWN terminal. However, measurement data are not available until the /EOM signal is output.
31	/EOM	Output	“End of measurement cycle” signal. When this signal is output, the measurement data and sorting results are available.
32	EX-COM2	Power	Common signals for external DC current EX-V2.
33 34	EX-COM	Power	Common signal for external DC current EX-VCC
35 36	EX-COM1	Power	Common signals for external DC current EX-V1.

## 8.2 Power Rating

	Input/Output device	Logic	Electrical requirements
OUTPUT	Corrector out with pull-up resistance	Negative logic	35VDC 50mADC max
INPUT		Negative logic	50mADC max
EXT.DCV	DC voltage input		35VDC max

## 8.3 Electrical Characteristics

### 8.3.1 Input Signal:

Each input signal is connected to the LED (cathode side) of the photo-coupler. The LED

(anode side) is connected to the pull-up power supply voltage.

### 8.3.2 Output Signal:

Each output signal is outputted via an open collector by using a photo-coupler. The voltage of each output is obtained by connecting pull-up resistors, inside or outside of the AT281x.

### 8.3.3 Power supply

The power supply for the judgment output signal pull-up and that for the operation output signal pull-up and input signal drive can be set separately. You can select from +3.3V to +35V external power supply.

### 8.3.4 Schematic

Figure 8-2 Handler schematic

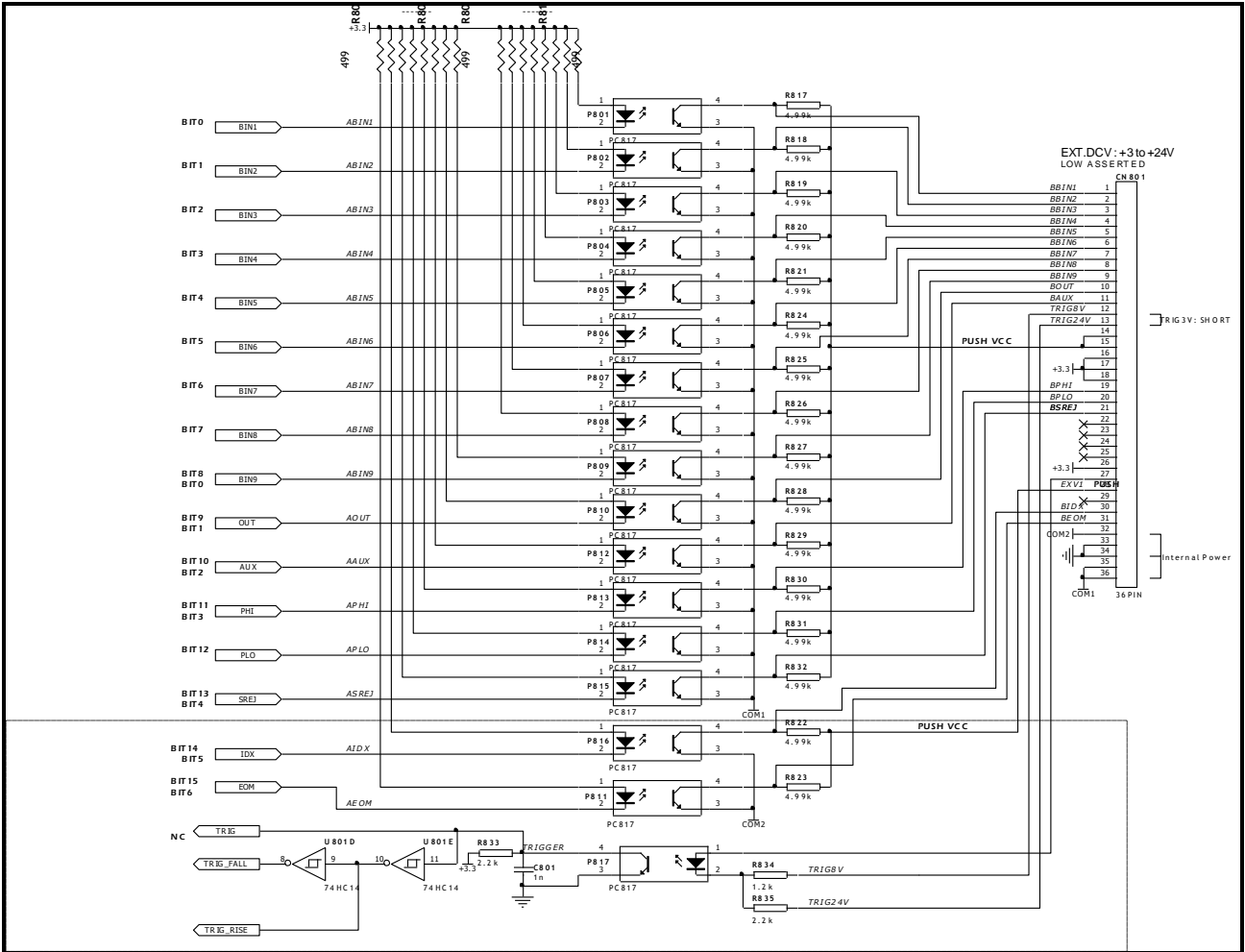


Figure 8-3 Typical Circuit Diagram of Handler Interface Input signals.

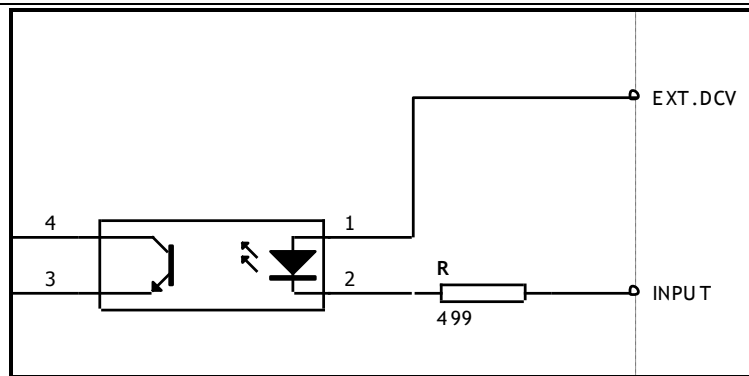
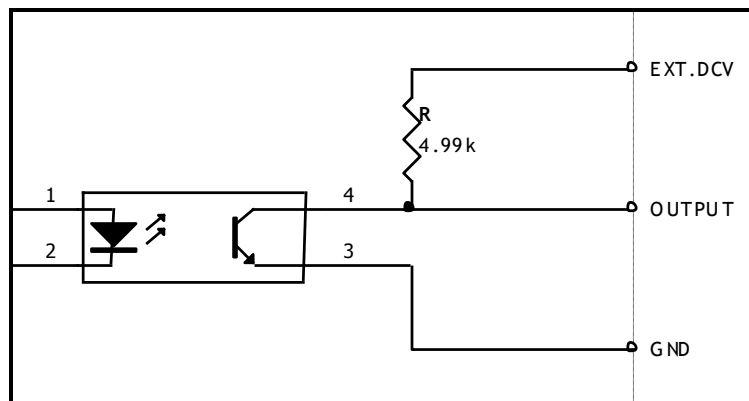


Figure 8-4 Typical Circuit Diagram of Handler Interface Output signals.



## 8.4 Timing Chart

Figure 8-5 Timing chart

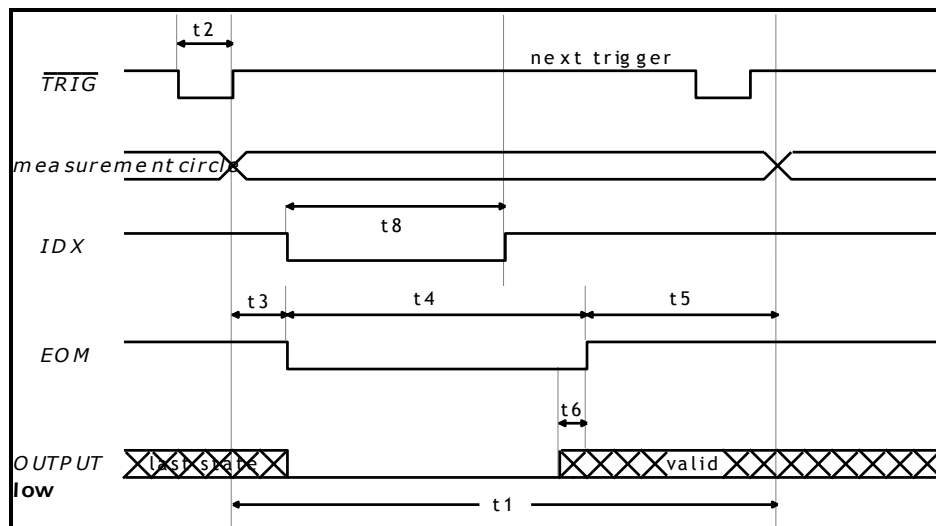


Table 8-2 Timing

	Description			Time		
				MIN	TYP	MAX
t1	One Measurement Circle	FAST	100Hz	-	180ms	-
			120Hz	-	160ms	-
			1kHz	-	67ms	-
			10kHz	-	67ms	-
			100kHz	-	67ms	-
		MED2	100Hz	-	260ms	-
			120Hz	-	225ms	-
			1kHz	-	235ms	-
			10kHz	-	235ms	-
		SLOW	100Hz	-	500ms	-
			120Hz	-	425ms	-
			1kHz	-	580ms	-
			10kHz	-	580ms	-
			100kHz	-	580ms	-
t2	Trigger pulse width			1ms	-	-
t3	Trigger delay time			-	25μs	
t4	AD Time (EOM)	FAST	100Hz	-	164ms	-
			120Hz		136ms	
			1kHz		48ms	
			10kHz		48ms	
			100kHz		48ms	
		MED2	100Hz	240ms	250ms	260ms
			120Hz		216ms	
			1kHz		232ms	
			10kHz	216ms	224ms	
			100kHz	216ms	224ms	
		SLOW	100Hz	460ms	480ms	-
			120Hz	400ms	420ms	-
			1kHz		560ms	-
			10kHz	540ms	560ms	-
100kHz	540ms		560ms	-		
t5	Print Result Time			8ms	-	8.8ms
t6	Handler out to EOM time			-	10μs	-

## 9. Examples



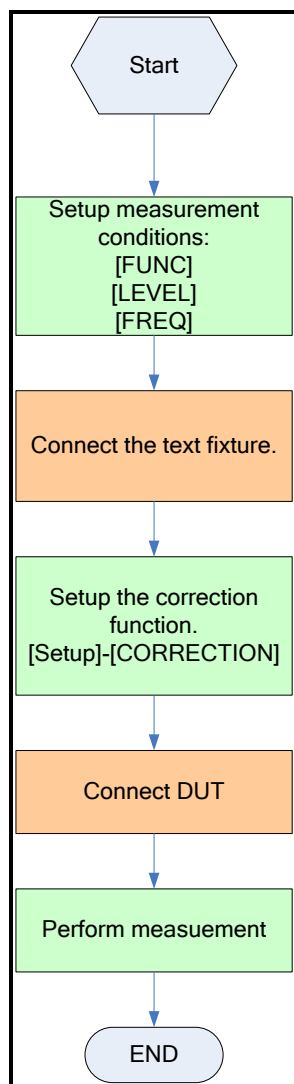
This chapter covers basic measurement procedures as well as basic L, C, and R measurement theory. It also offers various measurement hints. After the descriptions of basic measurement procedures, practical measurement examples are shown using AT281x.

### 9.1 Basic Measurement Procedure

The following flow chart shows the basic procedures used to measure the impedance of capacitors, inductors, resistors, and other components. Follow the procedures to perform impedance measurements while referring to the items noted to the right side of each step.

Figure 9-1

Basic Measurement Procedure



## 9.2 Example

This paragraph describes a practical example of measuring a ceramic capacitor.

The basic procedure flow to perform this measurement is the same as the Basic Measurement Procedure described previously. In this example, a ceramic capacitor is measured under the following conditions.

Sample (DUT) Ceramic capacitor

Measurement Conditions:

- Function: Cp-D
- Test Frequency: 100 kHz
- Test Signal Level: 1V

- Step 1. Turn the AT281x ON
- Step 2. Set up the measurement conditions by filling in the fields on the MEAS DISPLAY page.
  - Move to the FUNC field using the cursor keys and choose Cp-D.
  - Move to the FREQ field using the cursor keys and input 100 kHz
  - Move to the LEVEL field using the cursor keys and input 1 V
- Step 3. Connect the test fixture ATL607 to the AT281x.
- Step 4. To compensate for the test fixture ATL807, a user correction is required.  
Don't connect any DUT to ATL607 as shown like this:



1. Press [Setup] key and [CORRECTION] soft key.
2. Move to the OPEN field by using the cursor keys.
3. Press [MEAS OPEN] soft key and [OK] soft key.  
Wait until the message "Correction finished" displays.
4. Press [ON] soft key if OPEN field is OFF.
5. Move to the SHORT field by using the cursor keys.
6. Connect a shorting bar to the ATL607 as shown like this:





7. Press [MEAS SHORT] soft key and [OK] soft key. Wait until the message “Correction finished” displays.
8. Press [ON] soft key if SHORT field is OFF.

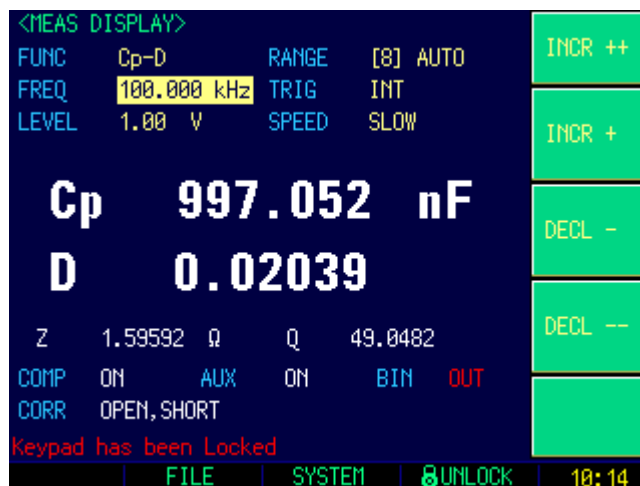
Step 5. Connect DUT to the test fixture as shown like this:



Step 6. Press the [Meas Setup] key. Measurements are performed continuously by the internal trigger, and the measured Cp and D values of the capacitors are displayed as shown like this:

Figure 9-2

Measurement results



# 10. Remote Control



This chapter provides the following information to remotely control the AT281x via the RS-232C or USB interface.

- About RS-232C
- About USB Interface
- Select Baud Rate.
- About SCPI

AT281x can use the RS-232 interface or USB interface to communicate with the computer to complete all the instrument functions.

## 10.1 About RS-232C

You can connect a controller (i.e. PC and PLC) to the RS-232 interface using Applent RS-232 DB-9 cable. The serial port uses the transmit (TXD), receive (RXD) and signal ground (GND) lines of the RS-232 standard. It does not use the hardware handshaking lines CTS and RTS.



NOTE:

JUST ONLY Use an Applent (not null modem) DB-9 cable.  
Cable length should not exceed 2m.

Figure 10-1

The RS-232 connector in the real panel

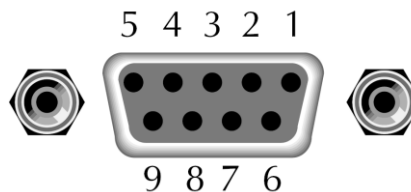


Table 10-1

RS-232 connector pinout

NAME	DB-25	DB-9	NOTE
DCD	8	1	Not Connection
RXD	3	2	Transmit data
TXD	2	3	Receive date
DTR	20	4	Not Connection
GND	7	5	Ground
DSR	6	6	Not Connection
RTS	4	7	Not Connection
CTS	5	8	Not Connection

- Make sure the controller you connect to AT281x also uses these settings.

The RS-232 interface transfers data using:

- 8 data bits,
- 1 stop bit,
- And no parity.

## 10.2 About USB-Serial Interface (Option)

The USB-Serial Interface allows you to connect AT281x to a USB port on you PC.



NOTE:

Please install the USB-Serial driver before using USB-Serial Interface.

## 10.3 To Select Baud Rate

Before you can control the AT281x by issuing RS-232 commands from built-in RS-232 controller connected via its DB-9 connector, you have to configure the RS-232 baud rate.

The AT281x's built-in RS-232 interface uses the SCPI language.

The configuration of RS-232

RS-232 configuration is as follows:

Data bits: 8-bit

Stop bits: 1-bit

Parity: none

**To set up the baud rate**

- Step 1. Press the [Meas] or [Setup] key
- Step 2. Press the [SYSTEM] bottom soft key.
- Step 3. Use the cursor key to select [BAUD] field
- Step 4. Use the soft keys to select baud rate.

Soft key	Function
1200	
9600	
38400	
57600	
115200	Recommend, system default.

## 10.4 About USB-Serial Interface

The USB-Serial Interface allows you to connect AT281X to a USB port on you PC. You can control AT281X by using USB port.

### 10.4.1 Installing USB-Serial drivers on Windows XP

You must install the USB-Serial driver before using USB-Serial interface.

1. Connect the USB-Serial Interface to a spare USB port on your PC.
2. Windows XP found New Hardware Wizard will launch.



Please Select “No, not this time” from the options available and then click “Next” to proceed with the installation.

3. Select “Install from a list or specific location (Advanced)” as shown followed figure and then click “Next”:



4. Select "Search for the best driver in these locations" and browse a location ("E:\FTDI driver" in figure below) by clicking the browse button. Once the file path has been selected, click next to proceed.



5. If Windows XP is configured to warn when unsigned (non-WHQL certified) drivers are about to be installed will be displayed unless installing a Microsoft WHQL certified driver. Click on "Continue Anyway" to continue with the installation. If Windows XP is configured to ignore file signature warnings, no message will appear.



6. This screen will be displayed as Windows XP copies the required driver files.



7. Completing the Found New Hardware Wizard.



Click "Finish" to complete the installation for the first port of the device.

8. The "Found New hardware Wizard will continue by installing the USB-Serial Converter driver for the second port of the device.

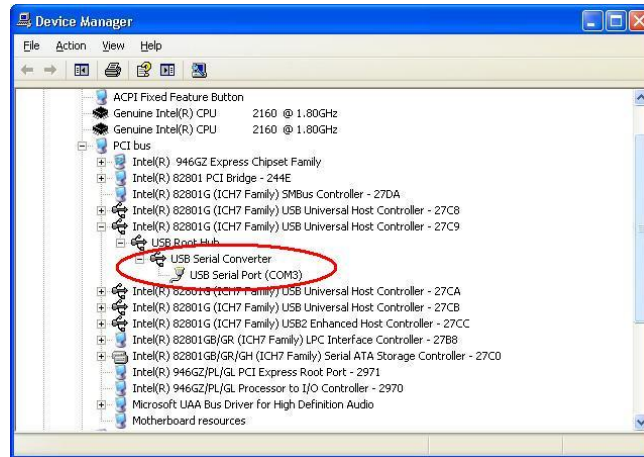
Repeat from step.2 to step.7 and finish the USB Serial Port installation.



9. Open the Device Manager (located in "Control Panel\System") then Select the "Hardware" tab and click "Device Manager") and select "View > Devices by connection", the device appears as a USB Serial Converter" with an additional COM port with the label "USB Serial Port".

USB Serial Port

Figure 10-2

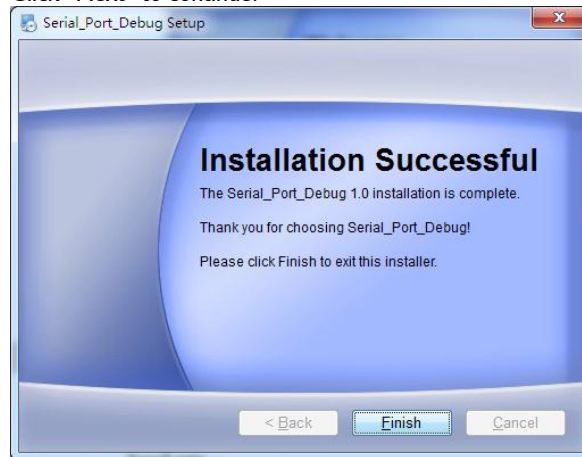


#### 10.4.2 Installing AT281X Serial\_Port\_Debug Software

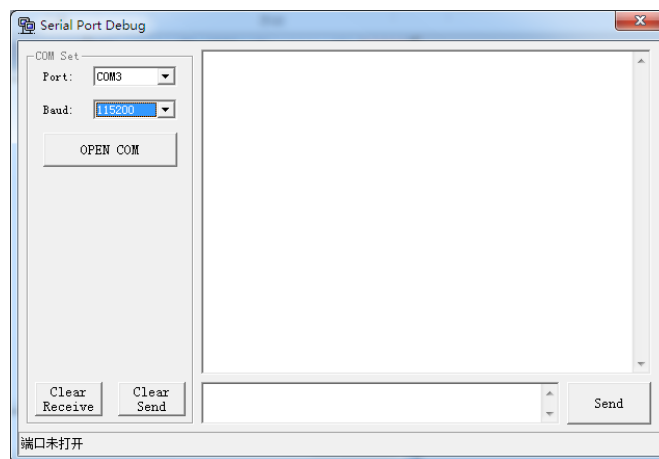
1. Run "AT281X Serial\_Port\_Debug\Setup.exe"



Click "Next" to continue.



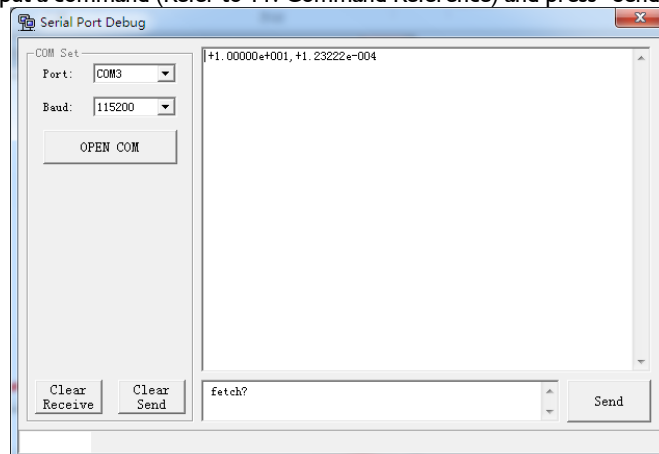
2. After finishing the Installation, Run "Serial\_Port\_Debug" on your desktop.



Please select Port that displayed in “Device Manager” (Refer to Figure 10-2 USB Serial Port) and select the same baud rate as AT281X’s <SYSTEM CONFIG> BAUD Item.



3. Press “OPEN COM” to Open USB-Serial connection.
4. Input a command (Refer to II. Command Reference) and press “Send”.



5. AT281X returns the query after received the command.



**NOTE:**

This “Serial\_Port\_Debug” application source code can be found in “AT281X\_Serial\_Port\_Debug” folder. You can open this project with Microsoft Visual Basic 6.0.

## 10.5 SCPI Language

Standard Commands for Programmable Instruments (SCPI) is fully supported by the RS-232 interfaces.



NOTE:  
AT281x ONLY supports the SCPI Language.

---



# 11. Command Reference



This chapter contains reference information on programming AT281x with the SCPI commands.

This chapter provides descriptions of all the AT281x's available RS-232 commands which correspond to Standard Commands for Programmable Instruments (SCPI) command sets, listed in functional subsystem order.

## 11.1 Terminator

**<NL>** : The EOI line is asserted by New Line or ASCII Line Feed character (decimal 10, Hex 0x0A , or ASCII '\n')

## 11.2 Notation Conventions and Definitions

The following conventions and definitions are used in this chapter to describe RS-232 operation.

**< >** Angular brackets enclose words or characters that are used to symbolize a program code parameter or an RS-232 command.

**[ ]** A square bracket indicates that the enclosed items are optional.

**\n** Command Terminator

## 11.3 Command Structure

The AT281x commands are divided into two types: Common commands and SCPI commands.

The common commands are defined in IEEE std. 488.2-1987, and these commands are common for all devices. The SCPI commands are used to control all of the AT281x's functions.

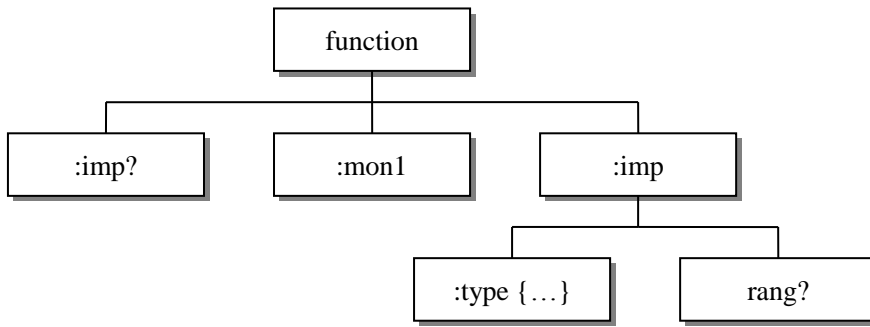
The SCPI commands are tree structured three levels deep. The highest level commands are called the subsystem commands in this manual. So the lower level commands are legal only when the subsystem commands have been selected.

A colon (:) is used to separate the higher level commands and the lower level commands.

Semicolon (;) A semicolon does not change the current path but separates two commands in the same message.

Figure 11-1

Command Tree Example



*Example:*

```

function:imp:type Cp-D
function Subsystem Command
  imp Level 2
    type Level 3
      Cp-D Parameter
  
```

- The basic rules of the command tree are as follows.
  - Letter case (upper and lower) is ignored.  
For example,  
**FUNCTION: IMPEDANCE = function:impedance**
  - Spaces ( \_ used to indicate a space) must not be placed before and/or after the colon (:).  
For example,  
 **func\_:\_imp** →  **func:imp**
  - The command can be completely spelled out or in abbreviated.(The rules for command abbreviation are described later in this section)  
For example,  
**function: impedance = func:imp**
  - The command header should be followed by a question mark (?) to generate a query for that command.  
For example,  
**function:imp?**
    - The semicolon (;) can be used as a separator to execute multiple commands on a single line. The multiple command rules are as follows.  
Commands at the same level and in the same subsystem command group can be separated by a semicolon (;) on a multiple command line.  
For example,  
**func:imp:type cp-d;rang 4**  
To restart commands from the highest level, a semicolon (;) must be used as the separator, and then a leading colon (:), which shows that the restarted command is a command at the top of the command tree, must follow.  
For example,  
**func:imp:range:auto on;:func:imp cp-d**
  - The common commands can restart only after a semicolon on a multiple command line.

For example,

**func:rang 8;\*IDN?;auto on**

• Command abbreviations:

Every command and character parameter has at least two forms, a short form and a long form. In some cases they will be the same. The short form is obtained using the following rules.

A) If the long form has four characters or less, the long form and short form are the same.

B) If the long form has more than 4 characters:

(a) If the 4th character is a vowel, the short form is the first 3 characters of the long form.

For example:

comparator	abbr. to	comp
current	abbr. to	curr
range	abbr. to	rang

(b) If the 4th character is not a vowel, the short form is the first 4 characters.

For example:

resistance	abbr. to	res
volume	abbr. to	vol

• If the long form mnemonic is defined as a phrase rather than a single word, then the long form mnemonic is the first character of the first word(s) followed by the entire last word. The above rules, when the long form mnemonic is a single word, are then applied to the resulting long form mnemonic to obtain the short form.

For example:

PercentTolerance	abbr. to	ptol
------------------	----------	------




---

The AT281x accepts the three forms of the same SCPI commands: all upper case, all lower case, and mixed upper and lower case.

---

## 11.4 Header and Parameters

The commands consist of a command header and parameters. (See the following.)

*For example*

<u>comp:nom</u>	<u>100.0e3</u>
Header	Parameter

- Headers can be of the long form or the short form. The long form allows easier understanding of the program code and the short form allows more efficient use of the computer.
- Parameters may be of two types as follows.
  - (A) Character Data and String Data Character data consists of ASCII characters. The abbreviation rules are the same as the rules for command headers.
  - (B) Numeric Data
    - (a) **NR1** integer: For example, 1,+123,-123
    - (b) **NR2** fix float: For example, 1.23,+1.23,-1.23

(c) **NR3** floating point: For example, 1.23e3, 5.67e-3, 123k, 1.23M, 2.34G, The available range for numeric data is 9.9E37. When numeric data is used as a parameter, the suffix multiplier mnemonics and suffix units (The suffix multiplier must be used with the suffix unit.) can be used for some commands as follows.

Table 11-1

## Multiplier Mnemonics

Definition	Mnemonic
1E18 (EXA)	EX
1E15 (PETA)	PE
1E12 (TERA)	T
1E9 (GIGA)	G
1E6 (MEGA)	MA
1E3 (KILO)	K
1E-3 (MILLI)	M
1E-6 (MICRO)	U
1E-9 (NANO)	N
1E-12 (PICO)	P
1E-15 (PEMTO)	F
1E-18 (ATTO)	A

## 11.5 Command Reference

All commands in this reference are fully explained and listed in the following functional command order.

- DISPlay Subsystem
- FUNCtion Subsystem
- FREQuency Subsystem
- VOLTage Subsystem
- APERTure Subsystem
- FETCh Subsystem
- COMParator Subsystem
- LIST Subsystem
- CORRection Subsystem
- TRIGger Subsystem
- BIAS Subsystem
- FILE Subsystem
- ERRor Subsystem

Common Command:

- \*TRG
- \*IDN?
- \*SAV
- \*RCL

The explanation of each subsystem command is patterned as follows.

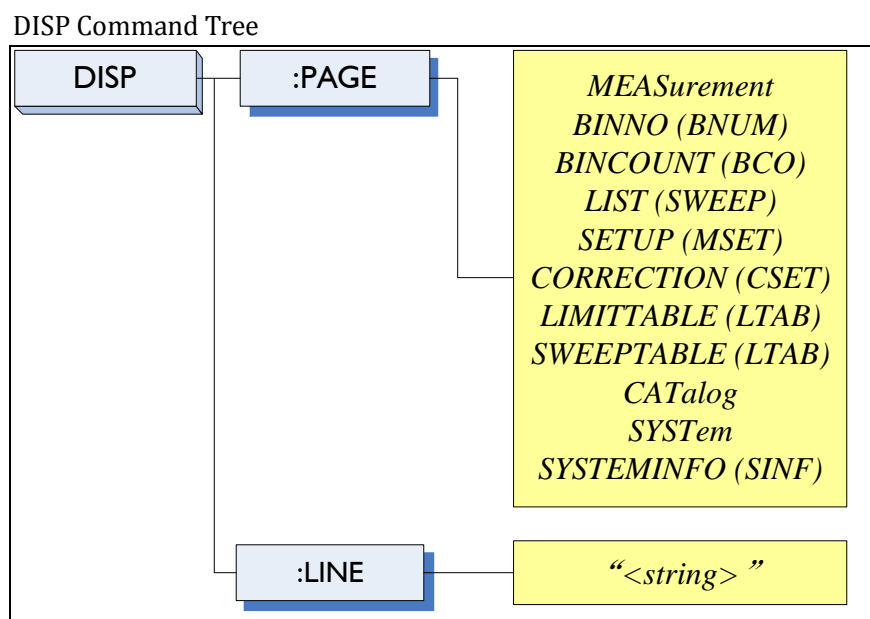
1. Subsystem command name
2. Command Tree (Subsystem command only)

3. Compound Command Name
4. Command Description
5. Command Syntax
6. Example Using the Above Command Syntax
7. Query Syntax
8. Query Response
9. Example Using the Above Query Syntax
10. Constraints

## 11.6 DISPlay Subsystem

The DISP Subsystem command group sets the display page.

Figure 11-2



### 11.6.1 DISP:PAGE

The :PAGE command sets the display page.

The :PAGE? Query returns the abbreviated page name currently displayed on the LCD screen.

<b>Command Syntax</b>	<b>DISP:PAGE &lt;page name&gt;</b>
<b>Parameter</b>	<p><b>Where, &lt;page name&gt; is:</b></p> <p>MEASurement [or MEAS] Sets display page to MEAS DISPLAY</p> <p>BINNO [or BNUM] Sets display page to BIN No. DISPLAY</p> <p>BINCOUNT [or BCO] Sets display page to BIN COUNT DISPLAY</p> <p>LIST [or SWEEP] Sets display page to LIST SWEEP DISPLAY</p> <p>SETUP [or MSET] Sets display page to MEAS SETUP</p> <p>CORRECTION [or CSET] Sets display page to CORRECTION</p> <p>LIMITTABLE [or LTAB] Sets display page to LIMIT TABLE SETUP</p> <p>SWEEPTABLE [or LTAB] Sets display page to LIST SWEEP SETUP</p> <p>CATalog [ or CAT] Sets display page to CATALOG</p> <p>SYSTem [or SYST] Sets display page to SYSTEM CONFIG</p> <p>SYSTEMINFO [or SINF] Sets display page to SYSTEM INFORMATION</p>
<b>Example</b>	<b>SEND&gt; DISP:PAGE SYST&lt;NL&gt; //Set to the SYSEMT CONFIG</b>
<b>Query Syntax</b>	<b>DISP:PAGE?</b>

<b>Query Response</b>	<code>&lt;page name&gt;&lt;NL&gt;</code>
<b>Example</b>	<code>SEND&gt; DISP:PAGE?&lt;NL&gt;</code> <code>RET&gt; SYST&lt;NL&gt;</code>

### 11.6.2 DISP:LINE

The :LINE command enters an arbitrary comment line of up to 30 ASCII characters in the comment field.

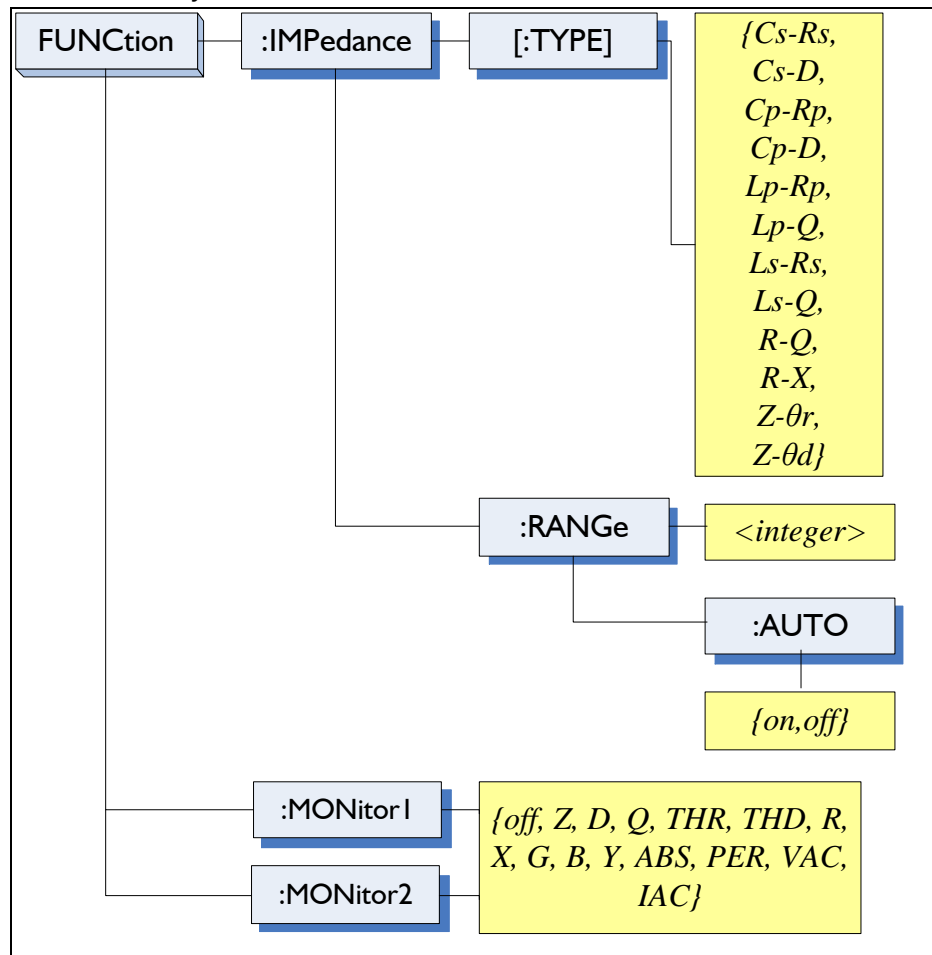
<b>Command Syntax</b>	<code>DISP:LINE "&lt;string&gt;"</code>
<b>Parameter</b>	Where, <string> is ASCII character string (30 ASCII characters)
<b>Example</b>	<code>SEND&gt; DISP:LINE "This is a comment."</code>

## 11.7 FUNCTION Subsystem

The FUNCtion subsystem command group sets the measurement function, the measurement range, monitors parameter control.

Figure 11-3

FUNCTION Subsystem Tree



### 11.7.1 FUNCTION[:IMPedance][:TYPE]

The :IMPedance command sets the measurement function.

<b>Command Syntax</b>	<code>FUNC[:IMPedance][:TYPE] &lt;function&gt;</code>
<b>Parameter</b>	Where, <function> is: <code>Cs-Rs, Cs-D, Cp-Rp, Cp-D,</code>

	Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, R-Q, R-X, Z- $\theta$ r, Z- $\theta$ d ( $\theta$ : ASCII Hex 0xE9)
Example	SEND> FUNC Cp-D<NL> //Set measurement function to Cp-D
Query Syntax	FUNC[:IMPedance][:TYPE]?
Query Response	<function>
Example	SEND> FUNC?<NL> RET> Cp-D<NL>

### 11.7.2 FUNCTION:IMPedance:RANGe

The FUNCtion:IMPedance:RANGe command sets the measurement range.

Command Syntax	FUNC:IMPedance:RANGe <0-8,MIN,MAX>
Parameter	Where, <0-8,MIN,MAX> is: 0-8, The range number MIN, =Range 0 MAX, =Range 8
Example	SEND> FUNC:IMP:RANG 2<NL> //Set measurement range to [2] 10k $\Omega$
Query Syntax	FUNC:IMPedance:RANGe?
Query Response	<0-8><NL>
Example	SEND> FUNC:IMP:RANG?<NL> RET> 0<NL>

### 11.7.3 FUNCTION:IMPedance:RANGe:AUTO

The FUNCtion:IMPedance:RANGe:AUTO command sets the auto range to ON or OFF

Command Syntax	FUNC:IMPedance:RANGe:AUTO {HOLD, AUTO, NOMinal}
Parameter	Where, {HOLD, AUTO, NOMinal} is: HOLD: Sets the auto range to off. AUTO: Sets the auto range to on. NOMinal: See Page 21 Section 4.1.2 Impedance Range [RANGE]
Example	SEND> FUNC:IMP:RANG:AUTO AUTO<NL> //Sets to auto range.
Query Syntax	FUNC:IMPedance:RANGe:AUTO?
Query Response	{HOLD,AUTO,NOM}
Example	SEND> FUNC:IMP:RANG:AUTO?<NL> RET> auto<NL>

### 11.7.4 FUNCTION:MONitor1 /2

The FUNCtion:MONitor1 and FUNCtion:MONitor2 commands set the two monitor parameter.

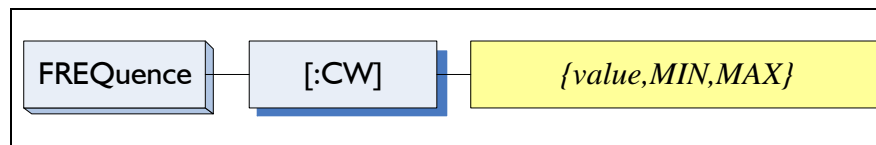
Command Syntax	FUNC:MONitor1 {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC} FUNC:MONitor2 {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC}
Parameter	Where, {off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC} Please refer to <a href="#">Page 32 Sector 5.1.5 Monitor 1 and Monitor 2 [MON 1][MON 2]</a> .

<b>Example</b>	<code>SEND&gt; FUNC:MON1 Z&lt;NL&gt;</code>
<b>Query Syntax</b>	<code>FUNC:MON1?</code> <code>FUNC:MON2?</code>
<b>Query Response</b>	<code>{off, Z, D, Q, THR, THD, R, X, G, B, Y, ABS, PER VAC, IAC}</code>
<b>Example</b>	<code>SEND&gt; FUNC:MON1?&lt;NL&gt;</code> <code>RET&gt; off&lt;NL&gt;</code>

## 11.8 FREQuency Subsystem

The FREQuency command sets the oscillator frequency. The FREQuency? Query returns the current test frequency setting.

Figure 11-4 FREQ Subsystem Command Tree

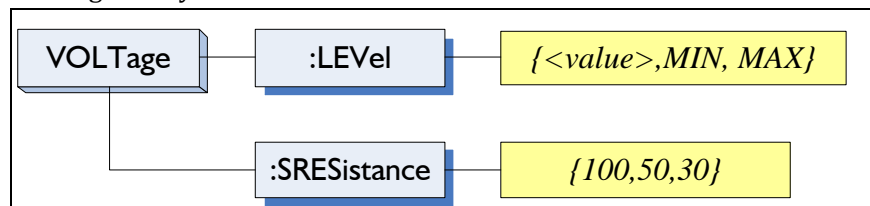


<b>Command Syntax</b>	<code>FREQ[:CW] {&lt;value&gt;,MIN,MAX}</code>
<b>Parameter</b>	<p><b>Where,</b></p> <p>&lt;value&gt; is the numeric data (NR1 integer, NR2 fix float or NR3 floating point).</p> <p>MIN Sets to the minimum value</p> <p>MAX Sets to the maximum value</p>
<b>Example</b>	<code>SEND&gt; FREQ 1K&lt;NL&gt; //Set to 1kHz, the Hz cannot be added.</code>
<b>Query Syntax</b>	<code>FREQ[:CW]?</code>
<b>Query Response</b>	<code>&lt;NR3&gt;&lt;NL&gt;</code> NR3 floating point
<b>Example</b>	<code>SEND&gt; FREQ?&lt;NL&gt;</code> <code>RET&gt; 1.000000E+03&lt;NL&gt;</code>
<b>Note</b>	<p>A suffix multiplier (k) can be used with this command. But the suffix unit Hz can't be used.</p> <p>This command CANNOT be used in LIST SWEEP DISPLAY page and CORRECTION page.</p>

## 11.9 VOLTage Subsystem

The VOLTage subsystem sets the oscillator's output voltage level and source output Impedance.

Figure 11-5 VOLTage Subsystem Command Tree



### 11.9.1 VOLTage:LEVel

The VOLTage:LEVel command sets the oscillator's output voltage level.



<b>Command Syntax</b>	<b>VOLTage:LEVel {&lt;value&gt;,MIN,MAX}</b>
<b>Parameter</b>	<b>Where,</b> <value> is the numeric data (NR1, NR2 or NR3). Please refer to Page 25 (Section 4.1.5) MIN Sets to the minimum value MAX Sets to the maximum value
<b>Example</b>	<b>SEND&gt; VOLT:LEVel 0.3&lt;NL&gt;</b> //Set to 0.3V,the unit V cannot be added.
<b>Query Syntax</b>	<b>VOLTage[:LEVel]?</b>
<b>Query Response</b>	<NR3> NR3 floating point
<b>Example</b>	<b>SEND&gt; VOLT?&lt;NL&gt;</b> <b>RET&gt; 1.000000e+00&lt;NL&gt;</b>
<b>Note</b>	The suffix unit V can't be used with this command. This command CANNOT be used in LIST SWEEP DISPLAY page and CORRECTION page.

### 11.9.2 VOLTage:SRESistance

The VOLTage:SRESistance command sets the source output Impedance.

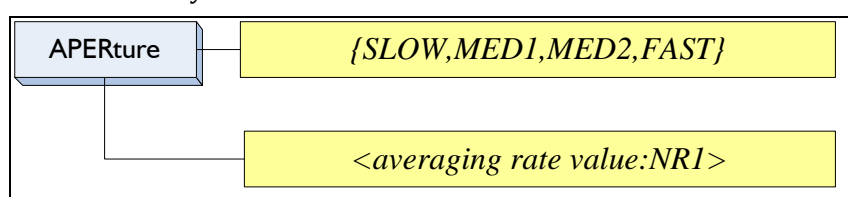
<b>Command Syntax</b>	<b>VOLTage:SRESistance {30,50,100}</b>
<b>Parameter</b>	<b>{30,50,100}</b> <b>Where,</b> 30 Sets the output impedance to 30Ω 50 Sets the output impedance to 50Ω 100 Sets the output impedance to 100Ω
<b>Example</b>	<b>SEND&gt; VOLT:SRES 30&lt;NL&gt;</b> //Set to 30Ω, the unit Ω cannot be added.
<b>Query Syntax</b>	<b>VOLTage:SRES?</b>
<b>Query Response</b>	<NR1> NR1 integer
<b>Example</b>	<b>SEND&gt; VOLT:SRES?&lt;NL&gt;</b> <b>RET&gt; 30&lt;NL&gt;</b>
<b>Note</b>	The suffix unit Ω can't be used with this command. This command CANNOT be used in LIST SWEEP DISPLAY page and CORRECTION page.

## 11.10 APERTure Subsystem

The APERTure subsystem command sets the integration time of the ADC and the averaging rate.

Figure 11-6

APERTure Subsystem Command Tree



<b>Command Syntax</b>	<b>APERTure {SLOW,MED1,MED2,FAST}</b> <b>APERTure &lt;value&gt;</b>
<b>Parameter</b>	Where,

	SLOW	Set test speed to slow
	MED1	Set test speed to medium (level 1)
	MED2	Set test speed to medium (level 2)
	FAST	Set test speed to fast
	<value>	NR1(0 to 256): Averaging rate (0=OFF=1)
<b>Example</b>	<b>SEND&gt; APER FAST&lt;NL&gt;</b> <b>SEND&gt; APER 10&lt;NL&gt;</b>	

### 11.10.1 APERTure:RATE?

The **APERTure:RATE?** query returns the current integration time.

<b>Query Syntax</b>	<b>APER:RATE?</b>
<b>Query Response</b>	SLOW
<b>Example</b>	<b>SEND&gt; APER:RATE?&lt;NL&gt;</b> <b>RET&gt; slow&lt;NL&gt;</b>

### 11.10.2 APERTure:AVG?

The **APERTure:AVG?** query returns the averaging rate settings.

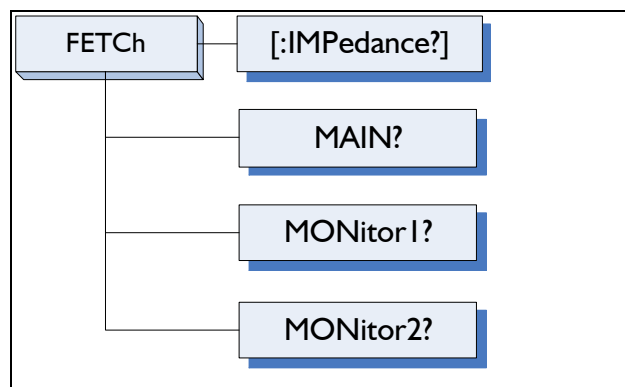
<b>Query Syntax</b>	<b>APER:AVG?</b>
<b>Query Response</b>	<NR1> Integer (0 to 256)
<b>Example</b>	<b>SEND&gt; APER:AVG?&lt;NL&gt;</b> <b>RET&gt; 0&lt;NL&gt;</b>

## 11.11 FETCh Subsystem

The **FETCh** subsystem command group is a sensor-only command which retrieves the measurement data taken by measurement(s) initiated by a trigger, and places the data into the output buffer.

Figure 11-7

FETCh Subsystem Command Tree



### 11.11.1 FETCh[:IMPedance]?

The **FETCh[:IMPedance]?** query sets the latest measurement data of the primary , secondary parameters and comparator result into the output buffer.

<b>Query Syntax</b>	<b>FETCh [ : IMPedance ] ?</b>
<b>Query Response</b>	<NR3:primary value>,<NR3:secondary value>,<comparator result>
<b>Example</b>	<b>SEND&gt; FETC?&lt;NL&gt;</b>

```
RET> +2.617886e-11,+5.454426e-01,AUX <NL>
      Primary ,Secondary ,Comparator result
```

### 11.11.2 FETCh:MAIN?

The FETCh:MAIN? query sets the latest measurement data of the primary and secondary parameters

Query Syntax	FETCh:MAIN?
Query Response	<NR3:primary value>,<NR3:secondary value>
Example	<pre>SEND&gt; FETC:MAIN?&lt;NL&gt; RET&gt; +2.021009e-11,+1.644222e-01&lt;NL&gt;       Primary ,Secondary</pre>

### 11.11.3 FETCh:MONitor1? /2?

The FETCh:MONitor1? and FETCh:MONitor2 set the latest measurement data of the monitor1 and monitor2 parameters into the output buffer.

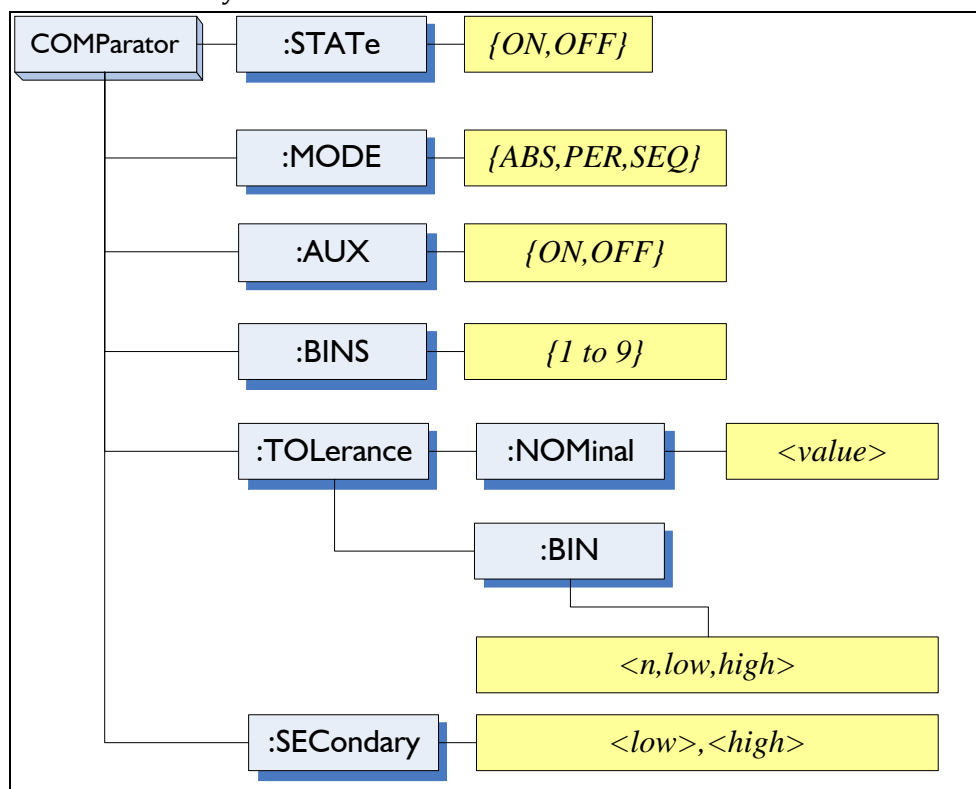
Query Syntax	FETCh:MONitor1? and FETCh:MONitor2?
Query Response	<NR3: monitor1/2 value>
Example	<pre>SEND&gt; FETC:MON1?&lt;NL&gt; RET&gt; +3.886517e+05&lt;NL&gt; RET&gt; +0.000000e+00&lt;NL&gt; //0: The monitor 1 is OFF</pre>

## 11.12 COMParator Subsystem

The COMParator subsystem command group sets the comparator function, including its ON/OFF setting, limit mode, and limit values.

Figure 11-8

COMParator Subsystem Command Tree



**11.12.1 COMParator:STATe**

The COMParator:STATe command sets the comparator function to ON or OFF.

<b>Command Syntax</b>	<b>COMParator:STATe {ON,OFF,1,0}</b>
<b>Parameter</b>	<b>Where,</b> ON or 1      Sets the comparator to ON OFF or 0     Sets the comparator to OFF
<b>Example</b>	<b>SEND&gt; COMP:STAT OFF&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:STATe?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	<b>SEND&gt; COMP:STAT?&lt;NL&gt;</b> <b>RET&gt; on&lt;NL&gt;</b>

**11.12.2 COMParator:MODE**

The :COMParator:MODE command sets the limit mode of the comparator function.

<b>Command Syntax</b>	<b>COMParator:MODE {ABS,PER,SEQ}</b>
<b>Parameter</b>	<b>Where, {ABS,PER,SEQ} is:</b> ABS      Absolute tolerance mode PER      Percent tolerance mode SEQ      Sequential mode
<b>Example</b>	<b>SEND&gt; COMP:MODE PER&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:MODE?</b>
<b>Query Response</b>	<b>{abs,per,seq}</b>
<b>Example</b>	<b>SEND&gt; COMP:MODE?&lt;NL&gt;</b> <b>RET&gt; abs&lt;NL&gt;</b>

**11.12.3 COMParator:AUX**

The COMParator:AUX command sets the auxiliary BIN counting function of the comparator to ON or OFF.

<b>Command Syntax</b>	<b>COMParator:AUX {ON,OFF,1,0}</b>
<b>Parameter</b>	<b>Where, {ON,OFF,1,0} is:</b> ON or 1      Set the AUX BIN to ON OFF or 0     Set the AUX BIN to OFF
<b>Example</b>	<b>SEND&gt; COMP:AUX OFF&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:AUX?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	<b>SEND&gt; COMP:AUX?&lt;NL&gt;</b> <b>RET&gt; on&lt;NL&gt;</b>

**11.12.4 COMParator:BINS**

The COMParator:BINS command sets the total number of bins.

<b>Command Syntax</b>	<b>COMParator:BINS &lt;value&gt;</b>
<b>Parameter</b>	<b>Where, {value} is:</b> NR1 (1 to 9)
<b>Example</b>	<b>SEND&gt; COMP:BINS 3&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:BINS?</b>
<b>Query Response</b>	<b>&lt;NR1&gt; (1 to 9)</b>

<b>Example</b>	<b>SEND&gt; COMP:BINS?&lt;NL&gt;</b> <b>RET&gt; 3&lt;NL&gt;</b>
----------------	--

### 11.12.5 COMParator:TOLerance:NOMinal

The COMParator:TOLerance:NOMinal command sets the nominal value for the tolerance mode of the comparator function.

<b>Command Syntax</b>	<b>COMParator:TOLerance:NOMinal &lt;value&gt;</b>
<b>Parameter</b>	<b>Where, &lt;value&gt; is:</b> NR1, NR2 or NR3 A suffix multiplier can be used with this command. But the suffix unit F/Ω/H can't be used.
<b>Example</b>	<b>SEND&gt; COMP:TOL:NOM 100N&lt;NL&gt;</b> <b>SEND&gt; COMP:TOL:NOM 1E-6&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:TOLerance:NOMinal?</b>
<b>Query Response</b>	<b>&lt;NR3&gt;</b>
<b>Example</b>	<b>SEND&gt; COMP:TOL:NOM?&lt;NL&gt;</b> <b>RET&gt; 1.000000e-06&lt;NL&gt;</b>

### 11.12.6 COMParator:TOLerance:BIN

The COMParator:TOLerance:BIN command sets the low/high limit values of each BIN for the comparator function tolerance mode.

<b>Command Syntax</b>	<b>COMParator:TOLerance:BIN &lt;n&gt;,&lt;low limit&gt;,&lt;high limit&gt;</b>
<b>Parameter</b>	<b>Where, &lt;n&gt;,&lt;low limit&gt;,&lt;high limit&gt; is:</b> n NR1 (1 to 9): Bin number low limit NR1,NR2 or NR3: low limit value high limit NR1,NR2 or NR3: high limit value
<b>Example</b>	<b>SEND&gt; COMP:TOL:BIN 1,100P,200P&lt;NL&gt;</b> <b>SEND&gt; COMP:TOL:BIN 2,200E-6,300E-6&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:TOLerance:BIN? &lt;n&gt;</b>
<b>Parameter</b>	<b>Where, &lt;n&gt; is:</b> NR1 (1 to 9): Bin number
<b>Query Response</b>	<b>&lt;NR3:low limit&gt;,&lt;NR3:high limit&gt;</b>
<b>Example</b>	<b>SEND&gt; COMP:TOL:BIN? 2&lt;NL&gt;</b> <b>RET&gt; 1.000000e-06,2.000000E-6&lt;NL&gt;</b>

### 11.12.7 COMParator:SLIM

The COMParator:SLIM or COMParator:secondary command sets the LOW/HIGH limit values for the secondary parameter.

<b>Command Syntax</b>	<b>COMParator:SLIM &lt;low value&gt;,&lt;high value&gt;</b> <b>COMParator:secondary &lt;low value&gt;,&lt;high value&gt;</b>
<b>Parameter</b>	<b>Where, &lt;low value&gt;,&lt;high value&gt; is:</b> <low value> NR1,NR2 or NR3: low limit value <high value> NR1,NR2 or NR3: high limit value A suffix multiplier can be used with this command.
<b>Example</b>	<b>SEND&gt; COMP:SLIM 0.0001,0.0010&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>COMParator:SLIM?</b>

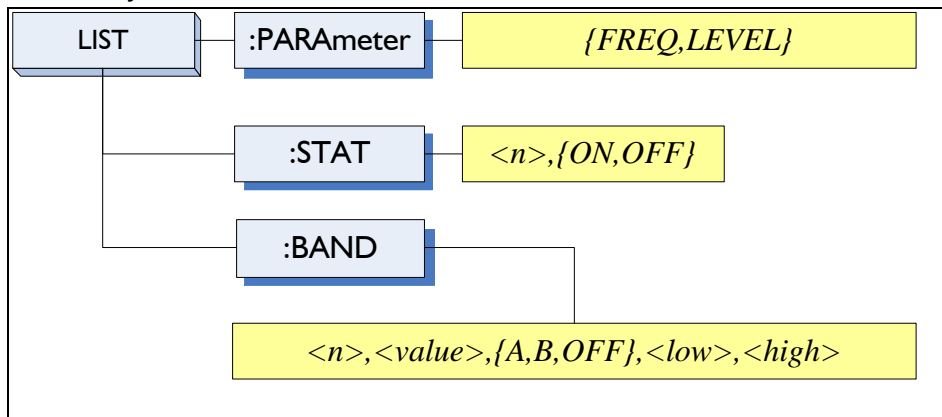
	COMParator:secondary?
Query Response	<NR3:low limit>,<NR3:high limit>
Example	SEND> COMP:SLIM?<NL> RET> 1.000000e-04,1.000000e-03<NL>

### 11.13 LIST Subsystem \*Not available in AT2817

The LIST or SWEEP Subsystem command group sets the List Sweep measurement function, including the sweep point setting and limit values for the limit function.

Figure 11-9

LIST Subsystem Command Tree



#### 11.13.1 LIST:PARAMeter

The LIST:PARAMeter command sets the list sweep parameter.

Command Syntax	LIST:PARAMeter {FREQ,LEVEL}
Parameter	Where, {FREQ,LEVEL} is: FREQ                Sets the sweep parameter to frequency LEVEL               Sets the sweep parameter to voltage level
Example	SEND> LIST:PARA LEVEL<NL>
Query Syntax	LIST:PARAMeter?
Query Response	{FREQ,LEVEL}
Example	SEND> LIST:PARA?<NL> RET> FREQ<NL>

#### 11.13.2 LIST:STAT

The LIST:STAT command turns on/off the specified sweep point.

Command Syntax	LIST:STAT <n>,{ON,OFF,1,0}
Parameter	Where,<n> is: n                    NR1(1 to 10): List sweep point ON or 1            Set this point to ON OFF or 0           Set this point to OFF
Example	SEND> LIST:STAT 1,ON<NL>
Query Syntax	LIST:STAT? <n>
Parameter	Where,<n> is: n                    NR1(1 to 10): List sweep point
Query Response	{on,off}

<b>Example</b>	<b>SEND&gt; LIST:STAT? 1&lt;NL&gt;</b> <b>RET&gt; on&lt;NL&gt;</b>
----------------	---

### 11.13.3 LIST:BAND

The LIST:BAND command sets the List Sweep point value, limit mode and low/high limit values.

<b>Command Syntax</b>	<b>LIST:BAND &lt;n&gt;,&lt;point value&gt;,{A,B,OFF},&lt;low&gt;,&lt;high&gt;</b>
<b>Parameter</b>	<p><b>Where, &lt;n&gt;,&lt;point value&gt;,{A,B,OFF},&lt;low&gt;,&lt;high&gt; is:</b></p> <p>n NR1(1 to 10): List sweep point</p> <p>&lt;point value&gt; sweep point value (frequency value or signal level voltage value)</p> <p>A, Uses the primary parameter as the limit parameter.</p> <p>B, Uses the secondary parameter as the limit parameter.</p> <p>OFF Turn off the List Sweep's comparator function</p> <p>&lt;low&gt; NR1,NR2 or NR3: low limit value</p> <p>&lt;high&gt; NR1,NR2 or NR3: high limit value</p> <p>Note: The suffix multipliers can be used with this command. But the suffix units CANNOT be added.</p>
<b>Example</b>	<b>SEND&gt; LIST:BAND 1,1k,A,1n,2n&lt;NL&gt;</b> <b>SEND&gt; LIST:BAND 2,10k,A,1E-9,2E-9&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>LIST:BAND? &lt;n&gt;</b>
<b>Parameter</b>	<p><b>Where, &lt;n&gt; is:</b></p> <p>n NR1(1 to 10): List sweep point</p>
<b>Query Response</b>	<b>{on,off},&lt;point value&gt;,{A,B,-},&lt;NR3:low&gt;,&lt;NR4:high&gt;</b>
<b>Example</b>	<b>SEND&gt; LIST:BAND? 1&lt;NL&gt;</b> <b>RET&gt; on,1.00000e+03,A,1.000000E-9,2.000000E-9&lt;NL&gt;</b>

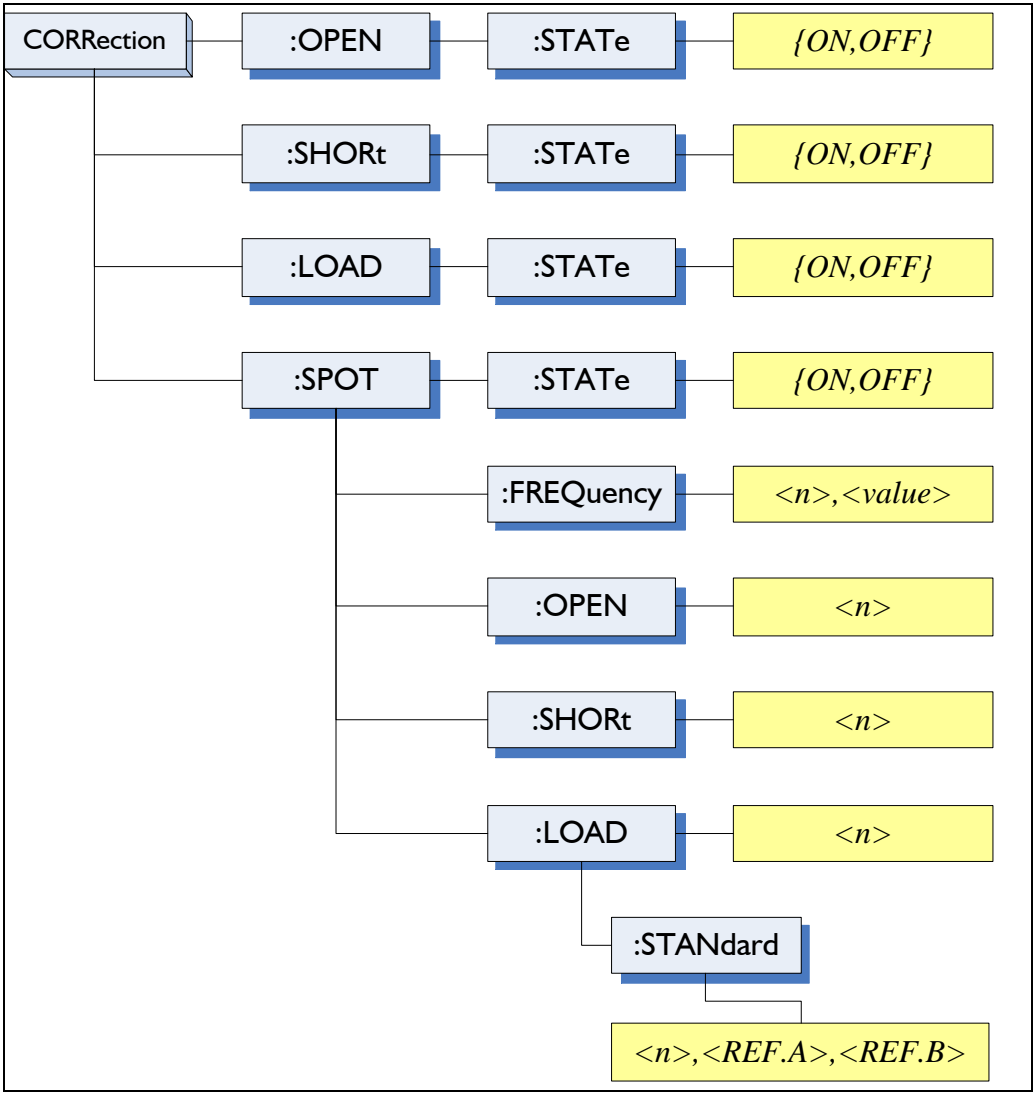
## 11.14 CORRection Subsystem

The CORRection subsystem command group sets the correction function, including the OPEN, SHORT and LOAD correction settings.

**NOTE:** The CORRection subsystem CANNOT work in <LIST SWEEP DISPLAY> page.

Figure 11-10

CORRection Subsystem Command Tree



**11.14.1 CORRection:OPEN**

The CORRection:OPEN command execute all presetted OPEN correction data measurement points. (Refer to Page 24 Table 4-9, Table 4-10, Table 4-11 and Table 4-12)

<b>Command Syntax</b>	<b>CORRection:OPEN</b>
<b>Example</b>	<b>SEND&gt; CORRection:OPEN&lt;NL&gt;</b>

**11.14.1.1 CORRection:OPEN:STATe**

The CORRection:OPEN:STATe command sets the OPEN correction function to ON or OFF.

<b>Command Syntax</b>	<b>CORRection:OPEN:STATe {ON,OFF,1,0}</b>
<b>Parameter</b>	Where, {ON,OFF,1,0} is: ON, 1                    When the function is ON OFF,0                    When the function is OFF
<b>Example</b>	<b>SEND&gt; CORR:OPEN:STATe ON&lt;NL&gt;</b> <b>RET&gt; open&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>CORRection:OPEN:STATe?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	<b>SEND&gt; CORR:OPEN:STATe?&lt;NL&gt;</b> <b>RET&gt; on&lt;NL&gt;</b>



**11.14.2 CORRection:SHORT**

The CORRection:SHORT command execute all presetted SHORT correction data measurement points.  
(Refer to Page 24 Table 4-9, Table 4-10, Table 4-11 and Table 4-12)

<b>Command Syntax</b>	<b>CORRection:SHORT</b>
<b>Example</b>	SEND> CORRection:SHOR<NL> RET> short<NL>

**11.14.2.1 CORRection:SHORT:STATe**

The CORRection:SHORT:STATe command sets the SHORT correction function to ON or OFF.

<b>Command Syntax</b>	<b>CORRection:SHORT:STATe {ON,OFF,1,0}</b>
<b>Parameter</b>	<b>Where, {ON,OFF,1,0} is:</b> ON,1                      When the function is ON OFF,0                     When the function is OFF
<b>Example</b>	SEND> CORR:SHOR:STATe ON<NL>
<b>Query Syntax</b>	<b>CORRection:SHOR:STATe?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	SEND> CORR:SHOR:STATe?<NL> RET> on<NL>

**11.14.3 CORRection:LOAD:STATe**

The CORRection:LOAD:STATe command sets the LOAD correction function to ON or OFF.

<b>Command Syntax</b>	<b>CORRection:LOAD:STATe {ON,OFF,1,0}</b>
<b>Parameter</b>	<b>Where, {ON,OFF,1,0} is:</b> ON,1                      When the function is ON OFF,0                     When the function is OFF
<b>Example</b>	SEND> CORR:LOAD:STATe ON<NL>
<b>Query Syntax</b>	<b>CORRection:LOAD:STATe?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	SEND> CORR:LOAD:STATe?<NL> RET> on<NL>

**11.14.4 CORRection:SPOT:STAT**

The CORRection:SPOT:STATe command sets the LOAD correction function to ON or OFF.

<b>Command Syntax</b>	<b>CORRection:LOAD:STATe {ON,OFF,1,0}</b>
<b>Parameter</b>	<b>Where, {ON,OFF,1,0} is:</b> ON,1                      When the function is ON OFF,0                     When the function is OFF
<b>Example</b>	SEND> CORR:LOAD:STATe ON<NL>
<b>Query Syntax</b>	<b>CORRection:LOAD:STATe?</b>
<b>Query Response</b>	<b>{on,off}</b>
<b>Example</b>	SEND> CORR:LOAD:STATe?<NL> RET> on<NL>

**11.14.5 CORRection:SPOT:FREQuency**

The CORRection:SPOT:FREQuency command sets the frequency points (FREQ1, FREQ2 or FREQ3) for the specified frequency point correction.

<b>Command Syntax</b>	<b>CORREction:SPOT:FREQuency &lt;n&gt;,&lt;value&gt;</b>
<b>Parameter</b>	Where, <n>,<value> is: n NR1(1,2 or 3):Spot number value NR1,NR2 or NR3:Frequencny value. A suffix multiplier can be used with this command. But the unit “Hz” cannot be added.
<b>Example</b>	SEND> CORR:SPOT:FREQ 1,1k<NL> SEND> CORR:SPOT:FREQ 2,10k<NL>
<b>Query Syntax</b>	<b>CORREction:SPOT:FREQuency? &lt;n&gt;</b>
<b>Parameter</b>	Where, <n> is: n NR1(1,2 or 3):Spot number
<b>Query Response</b>	<NR3>
<b>Example</b>	SEND> CORR:SPOT:FREQ? 1<NL> RET> 1.000000e+03<NL>

**11.14.6 CORREction:SPOT:OPEN**

This command executes the OPEN correction data measure for the specified frequency (FREQ1, FREQ2 or FREQ3) correction.

<b>Command Syntax</b>	<b>CORREction:SPOT:OPEN &lt;spot number:1 to 3&gt;</b>
<b>Example</b>	SEND> CORR:SPOT:OPEN 1<NL>

**11.14.7 CORREction:SPOT:SHORT**

This command executes the SHORT correction data measure for the specified frequency (FREQ1, FREQ2 or FREQ3) correction.

<b>Command Syntax</b>	<b>CORREction:SPOT:SHORT &lt;spot number:1 to 3&gt;</b>
<b>Example</b>	SEND> CORR:SPOT:SHOR 1<NL>

**11.14.8 CORREction:SPOT:LOAD**

This command executes the LOAD correction data measure for the specified frequency (FREQ1, FREQ2 or FREQ3) correction.

<b>Command Syntax</b>	<b>CORREction:SPOT:LOAD &lt;spot number:1 to 3&gt;</b>
<b>Example</b>	SEND> CORR:SPOT:LOAD 1<NL>

**11.14.8.1 CORREction:SPOT:LOAD:STANDARD**

This command sets the reference values of the standard at the specified frequency point(FREQ1,FREQ2 or FREQ3).

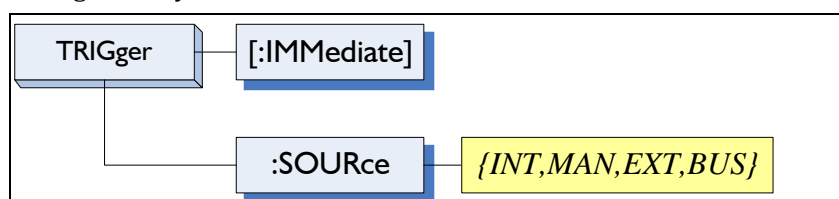
<b>Command Syntax</b>	<b>CORREction:SPOT:LOAD:STANDARD &lt;n&gt;,&lt;REF.A&gt;,&lt;REF.B&gt;</b>
<b>Parameter</b>	Where, <n>,<REF.A>,<REF.B> is: n NR1(1,2 or 3):Spot number REF.A NR1,NR2 or NR3:Primary parameter's reference value of the standard. REF.B NR1,NR2 or NR3:Secondary parameter's reference value of the standard. A suffix multiplier can be used with this command.
<b>Example</b>	SEND> CORR:SPOT:LOAD:STAN 1,100.5,0.0004<NL>
<b>Query Syntax</b>	<b>CORREction:SPOT:LOAD:STANDARD? &lt;n&gt;</b>
<b>Parameter</b>	Where, <n> is: n NR1(1,2 or 3):Spot number
<b>Query Response</b>	<NR3:REF.A value>,<NR3:REF.B value>

```
Example SEND> CORR:SPOT:LOAD:STAN? 1<NL>
RET> 1.005000E+00,4.000000E-04<NL>
```

## 11.15 TRIGger Subsystem

The TRIGger subsystem command group is used to enable a measurement or a sweep measurement, and to set the trigger mode.

Figure 11-11 TRIGger Subsystem Command Tree



### 11.15.1 TRIGger[:IMMEDIATE]

The TRIGger:IMMEDIATE command causes the trigger to execute a measurement or a sweep measurement, regardless of the trigger state.

Refer to [Page 14 Sector 2.2.5 Trigger Mode](#).

<b>Command Syntax</b>	<b>TRIGger[:IMMEDIATE]</b>
<b>Example</b>	<b>SEND&gt; TRIG&lt;NL&gt;</b>
<b>Note</b>	<b>This command can be ONLY used in BUS trigger mode.</b>

### 11.15.2 TRIGger:SOURce

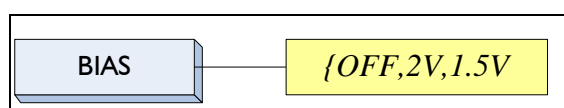
The TRIGger:SOURce command sets the trigger mode.

<b>Command Syntax</b>	<b>TRIGger:SOURce {INT,MAN,EXT,BUS}</b>
<b>Parameter</b>	Where, {INT,MAN,EXT,BUS} is INT Internal Trigger Mode MAN Manual Trigger Mode EXT External Trigger Mode BUS BUS Trigger Mode
<b>Example</b>	<b>SEND&gt; TRIG:SOUR BUS&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>TRIGger:SOURce?</b>
<b>Query Response</b>	<b>{INT,MAN,EXT,BUS}</b>
<b>Example</b>	<b>SEND&gt; TRIG:SOUR? 1&lt;NL&gt;</b> <b>RET&gt; INT&lt;NL&gt;</b>

## 11.16 BIAS Subsystem

The BIAS subsystem command group sets the DC BIAS switch to ON or OFF, and sets the DC bias voltage value.

Figure 11-12 BIAS Subsystem Command Tree



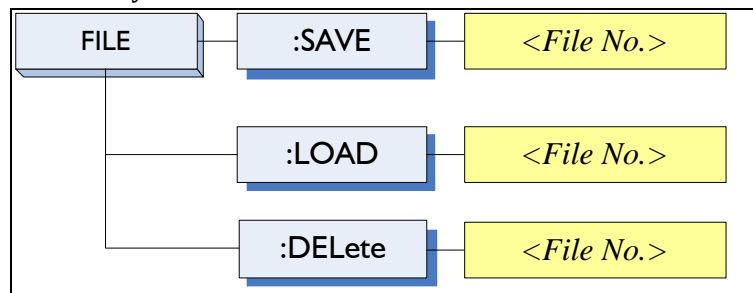
<b>Command Syntax</b>	<b>BIAS {OFF, 2V, 1.5V, EXT}</b>
<b>Example</b>	<b>SEND&gt; BIAS OFF&lt;NL&gt;</b>
<b>Query Syntax</b>	<b>BIAS?</b>
<b>Query Response</b>	<b>{OFF, 2V, 1.5V, EXTENALINPUT}</b>
<b>Example</b>	<b>SEND&gt; BIAS?&lt;NL&gt;</b> <b>RET&gt; OFF&lt;NL&gt;</b>

## 11.17 FILE Subsystem

The FILE subsystem command group executes the file operation.

Figure 11-13

FILE Subsystem Command Tree



### 11.17.1 FILE?

The FILE? query returns the file number used by system.

<b>Query Syntax</b>	<b>FILE?</b>
<b>Query Response</b>	<b>&lt;NR1 (0 TO 9) :File number&gt;</b>
<b>Example</b>	<b>SEND&gt; FILE?&lt;NL&gt;</b> <b>RET&gt; 0&lt;NL&gt;</b>

### 11.17.2 FILE:SAVE

The FILE:SAVE command saves all user settings into current used file.

<b>Command Syntax</b>	<b>FILE:SAVE</b>
<b>Example</b>	<b>SEND&gt; FILE:SAVE&lt;NL&gt;</b>

The FILE:SAVE <n> command saves all user settings into specified file.

<b>Command Syntax</b>	<b>FILE:SAVE &lt;File No.&gt;</b>
<b>Parameter</b>	<b>Where, &lt;File No.&gt; is:</b> NR1 (0 to 9)
<b>Example</b>	<b>SEND&gt; FILE:SAVE 0&lt;NL&gt;</b>

### 11.17.3 FILE:LOAD

The FILE:LOAD command recalls all user settings from current used file.

<b>Command Syntax</b>	<b>FILE:LOAD</b>
<b>Example</b>	<b>SEND&gt; FILE:LOAD&lt;NL&gt;</b>

The FILE:LOAD <n> command recalls all user settings from specified file.

<b>Command Syntax</b>	<b>FILE:LOAD &lt;File No.&gt;</b>
<b>Parameter</b>	Where, <File No.> is: NR1 (0 to 9)
<b>Example</b>	<b>SEND&gt; FILE:LOAD 0&lt;NL&gt;</b>

#### 11.17.4 FILE:DELeTe

<b>Command Syntax</b>	<b>FILE:DELeTe &lt;File No.&gt;</b>
<b>Parameter</b>	Where, <File No.> is: NR1 (0 to 9)
<b>Example</b>	<b>SEND&gt; FILE:DELeTe&lt;NL&gt;</b>

### 11.18 ERROr Subsystem

The ERROr subsystem retrieves last error information.

<b>Query Syntax</b>	<b>ERRor?</b>
<b>Query Response</b>	<b>Error string</b>
<b>Example</b>	<b>SEND&gt; ERR?&lt;NL&gt;</b> <b>RET&gt; no error.&lt;NL&gt;</b>

### 11.19 Common Commands

#### 11.19.1 \*IDN?

The \*IDN? query returns the instrument ID.

<b>Query Syntax</b>	<b>IDN? Or *IDN?</b>
<b>Query Response</b>	<b>&lt;manufacturer&gt;,&lt;model&gt;,&lt;serial no.&gt;,&lt;fireware&gt;</b>

#### 11.19.2 \*TRG

The \*TRG command (trigger command) performs the same function as the Group Execute Trigger command.

<b>Command Syntax</b>	<b>*TRG</b>
<b>Query Response</b>	<b>&lt;primary value&gt;,&lt;secondary value&gt;,&lt;comparator result&gt;</b>
<b>Example</b>	<b>SEND&gt; *TRG</b> <b>RET&gt; +5.566785e-11,+7.253470e-01,OUT</b>
<b>Note</b>	This command can be used in BUS trigger mode. *TRG = TRIG;:FETC?

#### 11.19.3 \*SAV

\*SAV = FILE:SAVE

The \*SAV command saves all user settings into current used file.

<b>Command Syntax</b>	<b>*SAV</b>
<b>Example</b>	<b>SEND&gt; *SAV&lt;NL&gt;</b>

**11.19.4 \*RCL**

\*RCL = FILE:LOAD

The \*RCL command recalls all user settings from current used file.

<b>Command Syntax</b>	<b>*RCL</b>
<b>Example</b>	<b>SEND&gt; *RCL&lt;NL&gt;</b>

# 12. Specification



This chapter describes the specifications and supplemental performance characteristics of the AT281x :

- Specifications
- Dimension

Accuracy is defined as meeting all of the following conditions.

Temperature:  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$

Humidity:  $\leq 65\%$  R.H.

Zeroing: Open and Short Correction

Warm up time is 30 min or more.

Rate: Slow

A 1-year calibration cycle

Test frequency accuracy: 0.02%

Test signal level: 10%

Basic Accuracy:

AT2818/AT2816A/AT2817A/AT2817 : 0.05%

AT2816B : 0.1%

## 12.1 General Specification

Display : True color TFT-LCD, Size: 3.5"

Test Function: Cs-Rs, Cs-D, Cp-Rp, Cp-D, Lp-Rp, Lp-Q, Ls-Rs, Ls-Q, G-B, Rs-Q, Z-0r, Z-0d.

AT2818: 10Hz ~ 300kHz

Frequency range(F)	Resolution
$10.0000\text{Hz} \leq F \leq 99.9999\text{Hz}$	0.0001Hz
$100.0000\text{Hz} \leq F \leq 999.999\text{Hz}$	0.001Hz
$1.00000\text{kHz} \leq F \leq 9.99999\text{kHz}$	0.01Hz
$10.0000\text{kHz} \leq F \leq 99.9999\text{kHz}$	0.1Hz
$100.000\text{kHz} \leq F \leq 300.000\text{kHz}$	1Hz

AT2816A: 50Hz ~ 200kHz

Frequency range(F)	Resolution
$10.0000\text{Hz} \leq F \leq 99.9999\text{Hz}$	0.0001Hz
$100.0000\text{Hz} \leq F \leq 999.999\text{Hz}$	0.001Hz
$1.00000\text{kHz} \leq F \leq 9.99999\text{kHz}$	0.01Hz
$10.0000\text{kHz} \leq F \leq 99.9999\text{kHz}$	0.1Hz
$100.000\text{kHz} \leq F \leq 200.000\text{kHz}$	1Hz

- AT2816B: [37 Points]  
 50, 60, 80, 100, 120, 150, 200, 250, 300,400, 500, 600, 800,  
 1e3, 1.2e3, 1.5e3, 2e3, 2.5e3, 3e3, 4e3, 5e3, 6e3, 8e3,  
 10e3, 12e3, 15e3, 20e3, 25e3, 30e3, 40e3, 50e3, 60e3, 80e3,  
 100e3, 120e3, 150e3, 200e3
- AT2817A : [16 Points]  
 50, 60, 100, 120, 200, 400, 500, 1e3, 2e3, 4e3, 5e3, 10e3, 20e3, 40e3, 50e3, 100e3
- AT2817 : [10 Points]  
 50, 60, 100, 120, 1e3, 10e3, 20e3, 40e3, 50e3, 100e3

## Measurement Range

Parameter	Measurement Range
L	0.00001 $\mu$ H ~ 9999.99H
C	0.00001pF ~ 9999.99mF
R、 X、 Z	0.00001 $\Omega$ ~ 99.9999M $\Omega$
B、 G	0.01nS ~ 999.999S
D	0.00001 ~ 9.99999
Q	0.00001 ~ 99999.9
$\theta_d$	-179.999 $^\circ$ ~ 179.999 $^\circ$
$\theta_r$	-3.14159 ~ 3.14159

- Measurement Speed: 30 times/s, 10 times/s, 6 times/s, 3times/s  
 Output impedance: 30 $\Omega$ , 50 $\Omega$  and 100 $\Omega$ ,  
 Ranging: Auto, Hold and Nominal range. Total 9 Ranges.  
 Equivalent Circuit: Serial and Parallel  
 Correction Function: OPEN/SHORT/LOAD  
 Files: built-in 10 files  
 Beep Feature: OFF/GD/NG and HIGH/LOW tone.  
 Trigger Mode: Internal, Manual, External and Bus Trigger.  
 Built-in Interface: Handler interface and RS232 interface.  
 Programming language: SCPI

**Environment:**

- Temperature and humidity range: 15 $^\circ$ C~35 $^\circ$ C, 80% RH or less  
 Storage temperature and humidity range: 10 $^\circ$ C~40 $^\circ$ C,10~90% RH  
 Power Supply: AC 95V-260V, 48.5Hz-62.5Hz  
 Fuse: 3A Slow-Blow  
 Maximum rated power: 30VA

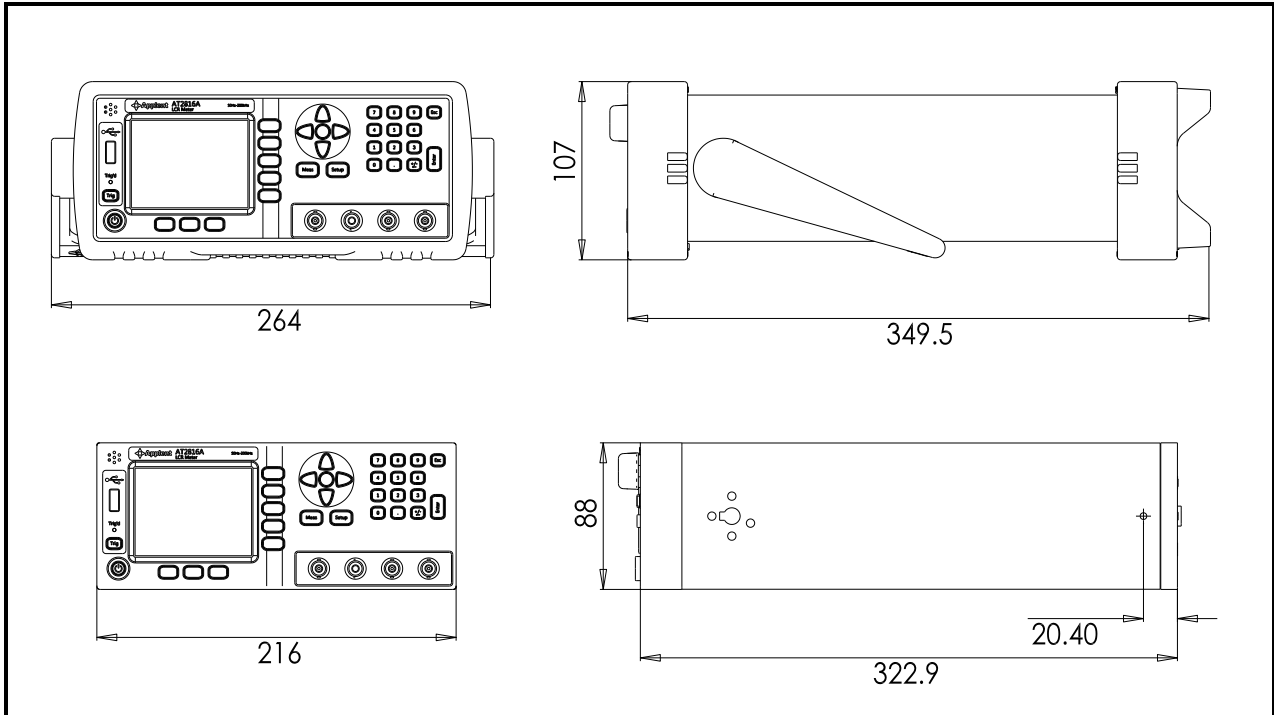


Weight:

3.5kg, net

## 12.2 Dimensions

Figure 12-1 Dimensions



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-AT281x/AT810A User's Guide-  
English

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