User's Guide

Rev.A1

AT186
Digital Multimeter

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Safety Summary

⚠ Warning ⚡ Dangerour :

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	The Applent Instruments assumes no liability for the customer's failure to comply with these requirements.
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 instrument in such an environment constitutes a definite safety hazard.
Keep away from live circuit	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.
Operations not included in the manual are forbidden	The protection measurements will be failure while beyond the scope.
⚠	Warning: TO AVOIDE INSTRUMENT DAMAGED, PLEASE DO NOT PUT DC VOLT OR CURRENT IN THE TESR TERMINAL MAKE SURE THE CAPACITOR IS DISCHARGED BEFORE TESTING

Safety Sign:

▣   Provide double insulation or reinforced insulation protection

Waste Electrical and Electronic Equipment (WEEE) order 2002/96/EC

     Do not leave in the trash can

CERTIFIACTION, LIMITED & 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 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.

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People's Republic of China
Jiangsu Province
Changzhou Applent Instruments Inc.
Oct. 2014
Rev.A1

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1.   Unpacking and Preparation

This chapter describes how to set up and start the AT186.

- 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 it out and check during unpacking according to the following procedures.

WARNING

If the external face of the instrument (such as the cover, front/rear panel, LCD 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   Power requirements and setting up Fuse

~Line: 220VAC, 50Hz/60Hz
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.

1.3   Environmental Requirements

Set up the AT186 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 AT186 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 AT186 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 AT186:

Figure 1-1   How to remove the handle

1 Retracted

2 Extended

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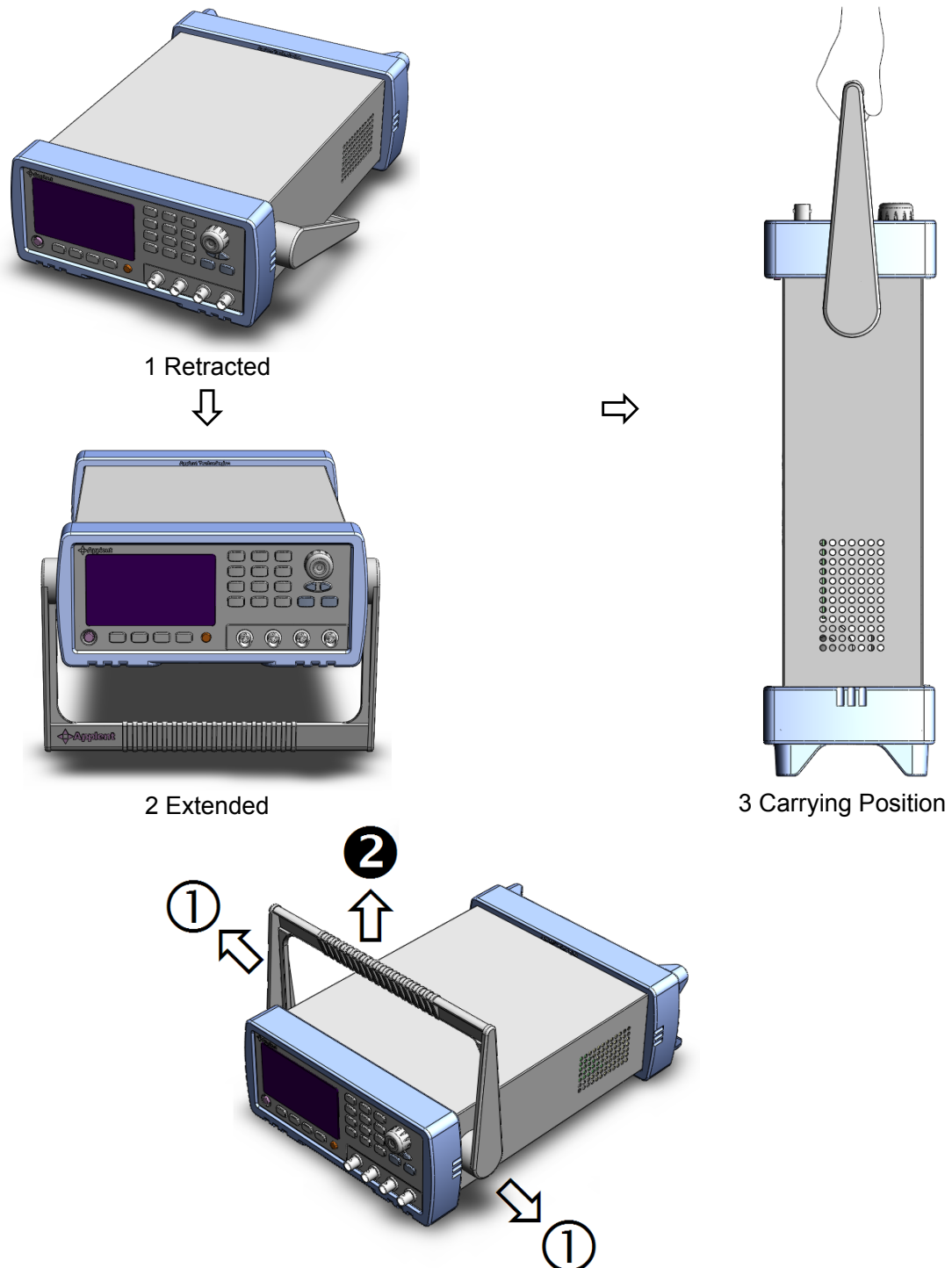
Remove Handle (*Lift the handle perpendicular to the unit while pulling it in the direction of 1.* ）

2.   Overview

This chapter provides the following information:
- Overview
- Main Specifications
- Main Function

2.1   Introduction

Thank you for purchasing AT186 Digital Multimeter

The AT186 Digital Multimeter, adopt high-powered ARM microprocessor control, TFT color LCD display. Digital Multimeter is a rapid, accurate voltage/current/resistance tester, concise design on the front panel enables you to quickly get the required measurement function, test parameters are in LCD display, the combination of a variety of functions for test bring users more convenience. Its inherent test platform and system features, meet user's measurement needs at present and in the future.

Instrument configures built-in RS232 interface, optional Applent USB232 and RS485 interface, through the standard computer software, comes with database function and Excel export function, which can realize data acquisition, analysis and printing, so as to complete efficient testing.

Instrument adopts enhanced PC remote control command, compatible with SCPI, which can efficiently complete remote control and data acquisition function.

2.2   Main Specifications

AT186 technical specification, including the basic technical indexes of the instrument and equipment testing allowed. These specifications are in instrument factory can achieve.

Reference：   See chapter 10 for complete technical specifications.

- TFT display maximum 60,000 readers
- DC voltage measurement range: 1mV~1000V
- AC voltage measurement range: 1mV~750V
- DC current measurement range: 1uA~10A
- AC current measurement range: 1uA~10A
- Resistance measurement range: 0.001Ω~15MΩ
- 3 measuring speed: Fast, Medium, Slow

2.3   Main Functions

- 3.5 inches true color LCD
- Five basic testing capabilities:
  Voltage test, current test, resistance test, short-circuit test, diode test
- Interface
  Built-in RS232 interface, compatible with SCPI protocol, ASCII transmit, complete all functions
- Keypad Lock Function Setting

- Switch in English and Chinese
- Date and Time Setting
- Administrator and user accounts, password is available to administrator
- Remote Control
  Support MAX 115200bps baud rate, compatible with SCPI protocol, ASCII transmit

3. Startup

This chapter provides the following information:
- Front Panel
- Rear Panel
- Power up
- Connection to Device

3.1 Front Panel

3.1.1 Front panel description

Figure 3-1 Front Panel
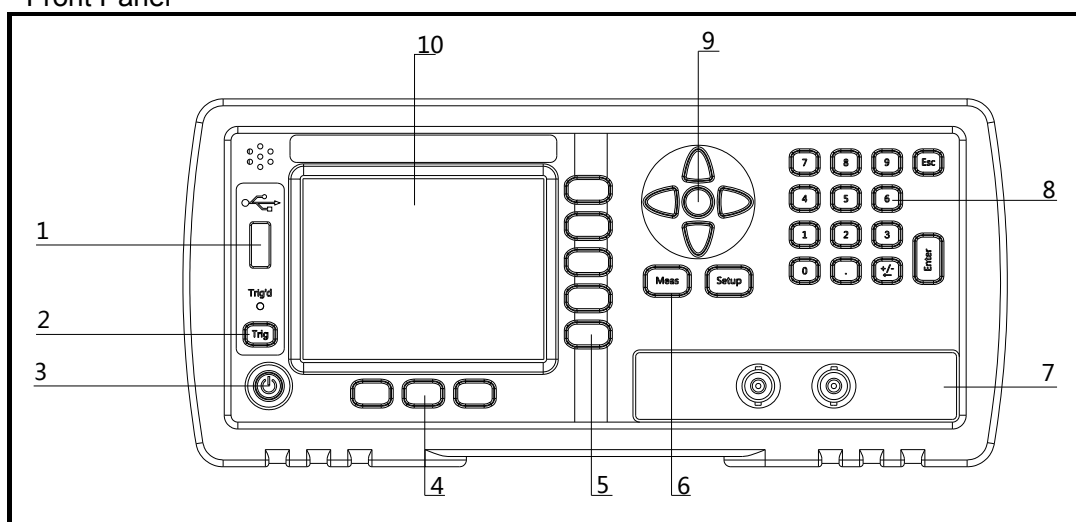
Table 3-1 Front panel description

No	Description
1	USB Disk Port
2	Manual Trigger Key and Trigger Indicator
3	Power Switch
4	System Key (Include system and key lock)
5	Function Key
6	Main function Key: Meas and Setup
7	Test Terminal
8	Numeric Key
9	Cursor Key
10	LCD Display

3.1.2 Rear Panel

Figure 3-2 Rear Panel
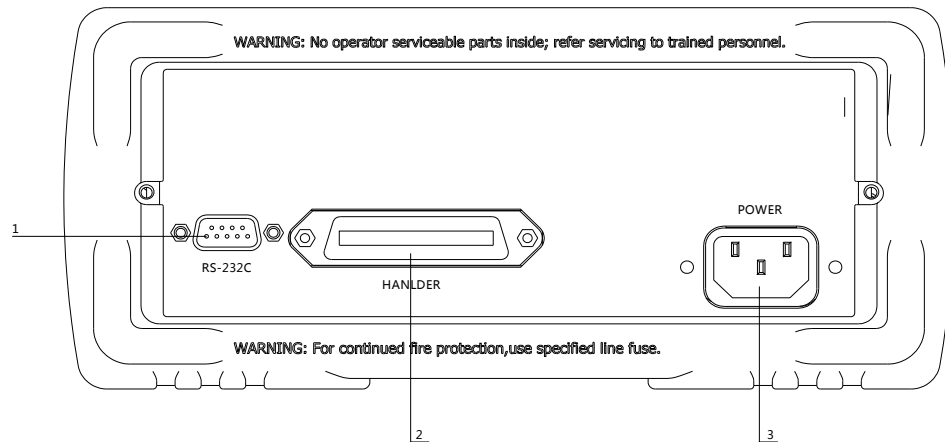
1. RS-232C interface
2. HANDLER interface
3. Power socket (exclude fuse, fuse is inide the instrument)

3.2　Power up

3.2.1　Power on/off

At left side of front panel, there is "+", it is power switch
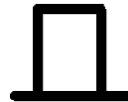
Power ON.　　　　　　　　　　　　Power OFF.

3.2.2　Safety information for high-tension line measurement

For safety's sake, if users need to measure voltage at high-tension line, please follow the notes as below:

When make measurement at high-tension line, please ensure to use wire and accessories that meet the requirements as below:

● Test wire and accessories must be completely insulated.
● Under state of AUTO test, users must use wires that can be connected to line, such as alligator, flat plug and so on.
● Don't use accessories that can narrow voltage space, because in this case, it will reduce protection function, and cause danger.

Warning：The voltage peak of COM terminal is 500V, when exceeding this range, it may cause electrical shock.

3.3　Connection method of VOLTAGE measurement

When instrument is under condition of factory settings, the operation procedures are as below:

1. Connect test leads to V and COM terminal.
2. On MEASURE DISPLAY page, select DC VOLTAGE or AC VOLTAGE function.
3. Select RANGE. After measurement function is started up, system default setting is AUTO RANGE. If users want to switch to MANUAL RANGE, on <Meas> page, choose a range that is corresponding to expected voltage.

If screen displays "-----", it means that it is outranged, in this case, please use soft

key to select a higher range, until it displays normal readings (or choose AUTO RANGE).

Note : Don't connect voltage that exceeds 1000V (peak-to-peak value) to instrument's input terminal, otherwise, it will cause damage to the instrument.

3.4　　　　Connection method of CURRENT measurement

When instrument is under condition of factory settings, the operation procedures are as below:
1.　Connect test leads to COM terminal and 600mA or 10A terminal
2.　On MEASURE DISPLAY page, select DC CURRENT or AC CURRENT function.
3.　Select RANGE. After measurement function is started up, system default setting is AUTO RANGE. If users want to switch to MANUAL RANGE, on <Meas> page, choose a range that is corresponding to expected current.
4.　If screen displays "-----", it means that it is outranged, in this case, please use soft key to select a higher range, until it displays normal readings (or choose AUTO RANGE).

At input terminal, please don't use current and voltage that exceeds 1A and 250V, otherwise, the fuse will be burnout.

3.5　　　　Connection method of RESISTANCE mesurement

When instrument is under condition of factory settings, the operation procedures are as below:
1.　Connect test leads to Ω and COM terminal
2.　On MEASURE DISPLAY page, use soft key to select RESISTANCE measurement function.
3.　Select RANGE. After measurement function is started up, system default setting is AUTO RANGE. If users want to switch to MANUAL RANGE, on <Meas> page, choose a range that is corresponding to expected resistance.

3.6　　　　Connection method of Continuity Check measurement

When instrument is under condition of factory settings, the operation procedures are as below:
1.　Connect test leads to Ω and COM terminal.
2.　On MEASURE DISPLAY page, use soft key to select Continuity Check measurement function.

3.7　　　　Connection method of DIODE measurement

When instrument is under condition of factory settings, the operation procedures are as below:
1.　Connect test leads to V and COM terminal
2.　On MEASURE DISPLAY page, use soft key to select DIODE measurement function.
3.　Read readings on display screen.

4.   [Measure Display] Page

<MEASURE DISPLAY> page includes the following information:
- Related Settings for <Measure Display> Page's
- Data Log Function

4.1   < Measure Display > Page

Press [Meas] key, enter [Measure Display] page

<Measure Display> page is used for display measuring results and sorting results.
- Functions –Five basic measuring functions selection
- Range – Measuring range
- Speed – Measuring speed
- Beep – Comparator beep

Figure 4-1   <Measure Display> Page

■   AC Voltage Measurements Display:

■   DC Voltage Measurements Display:

■   DC Current μA Range Measurements Display:

■ DC Current mA Range Measurements Display:

■ DC Current 10A Range Measurements Display:

■ Resistance Measurements Display:
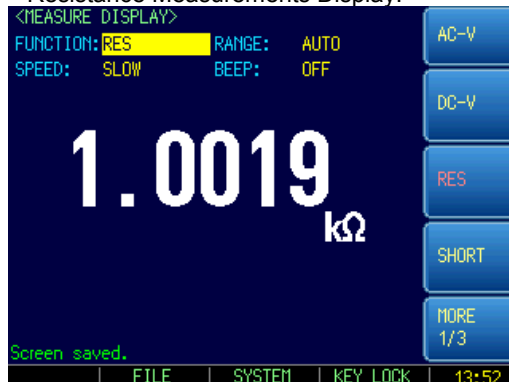
■ Diode Measurements Display:

4.1.1   Measurement Functions

The instrument supports five basic measurement functions: voltage, current, resistance, continuity check, and diode

Voltage measurement:

Voltage measurement range: 60mV ,600 mV ,6 V ,60 V ,600 V ,1000 V (750 VAC); AV voltage is RMS.
MAX AC voltage peak-to-peak value is 1000V

Current measurement:

Current measurement range: 600μA , 6000μA , 60 mA, 6000 mA , 6A, 10 A。

Resistance measurement:

Resistance measurement range: 60Ω , 600Ω ,6kΩ ,60kΩ ,600kΩ ,6MΩ ,15MΩ

Continuity Check measurement:

When using continuity check measurement function, buzzer will beep when instrument's reader is lower than 20Ω.

Diode measurement:

Can measure diode's pressure drop, when using diode measurement function, test current is 0.5mA, output voltage is 3.6V.

■   Steps to set up measurement modes

Step 1	Press [Meas] key to enter <MEASURE DISPLAY> page
Step 2	Use function key to select
	Soft Key	Function
	Voltage Measurement	Enter Voltage measurement mode
	Current Measurement	Enter Current measurement mode
	Resistance Measurement	Enter Resistance measurement mode
	Continuity Check	Enter Continuity Check mode
	Diode Measurement	Enter Diode measurement mode

4.2   Measuring [RANGE]

There are 2 options for RANGE selection:

Table 4-1   Measuring range introduction:

RANGE	Description	Advantage	Disadvantage
AUTO	Instrument will automatically select the best measuring range according to resistance value, range NO. will be set automatically in the RANGE field.	Users do not need to participate in selecting range	AUTO range need to forecast range, the test speed will be lower than manual range.
MANUAL	Instrument will use the range that is selected by users.	Test speed reaches the fastest.	Users need to participate in selecting range

■ Steps to set up the Range

Step 1	Press [Meas] key to enter < MEASURE DISPLAY > page
Step 2	Use soft key to select
	Soft Keys Function
	AUTO AUTO RANGE acquire the best measuring results
	MANUAL Manually choose measuring range
	UP Increased RANGE
	DOWN Decreased RANGE

4.3　　　Measuring [SPEED]

AT186 provides 3 options for speed (Slow, Medium and Fast), the lower the speed, the more accurate the measuring results are, the more stable it is.

  Slow: 1 time/second (1s)
  Medium: 5 times/second (200ms)

  Fast： 10 times/second (100ms)

■ Steps to set up Measuring Speed

Step 1	Press shortcut key [Meas] to enter < MEASURE DISPLAY > page
Step 2	Use cursor keys to select [SPEED] field
Step 3	Use soft keys to select
	Soft Key Function
	SLOW Set the sampling speed to slow
	MED Set the sampling speed to medium
	FAST Set the sampling speed to fast

4.4　　　Setting [BEEP]

Beep function is valid only when comparator function is turned on.
Beep setting allows GD beep, NG beep and turn off beep.

■ Steps to set up Beep feature

Step 1 Enter < MEASURE DISPLAY > page

Step 2 Use cursor keys to select 【BEEP】field

Step 3 Use soft keys to select

Soft Key	Function
OFF	Beep feature is turned off
DG beep	When sorting result is good (NG), buzzer will beep
NG beep	When sorting result is not good (NG), buzzer will beep.

5.   [Setup] Page

This chapter provides the information about all setup functions.

At any time, press shortcut key [Setup],   instrument will enter <**Setup**> page.

<**Setup**> page can complete all settings concerned with the measurement, measuring results will not be displayed on this page, and the instrument is under waiting state. These settings are following parameters:
- Beep –Setting Buzzer
- Speed –Setting Sampling Speed
- Baud Rate – Setting Baud Rate
- Comparator – Setting Comparator

Figure 5-1   <Setup> Page
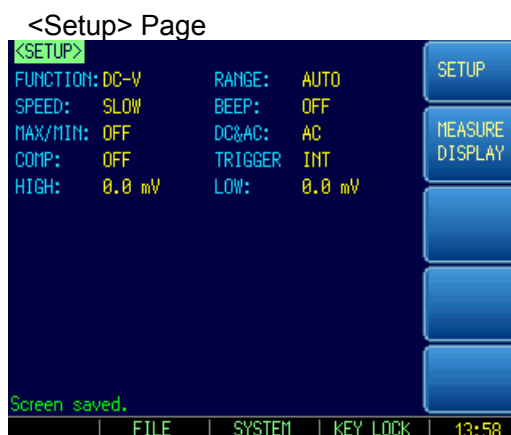
5.1   Setting【BEEP】

Under certain condition, instrument will beep.
When buzzer is turned off, instrument will not be affected under the following situations:
- There is error inside instrument.
- To instrument's continuity check measuring function.
- To keypad's sound.

Instrument buzzer's on-off state is saved in non-volatile memory, when power is off or instrument is reset, buzzer's state will not be changed.

■   Steps to set up Beep

Step 1	Press [Setup] shortcut key to enter < SETUP > page
Step 2	Use cursors key to select [BEEP] field
Step 3	Use soft keys to select
Soft Key	Function
OFF	Turn off the buzzer
ON	Turn on the buzzer

5.2   Setting Measuring【SPEED】

Measuring speed is integral time of setting A/D converter. Integral time will affect valid display digit and stability for reading.

In general, fast speed will increase reading's noise and decrease valid readings, slow speed can acquire the best serial common mode rejection; while medium speed can get balance point between test speed and noise.

■   Steps to set up Speed

Step 1	Press [Setup] shortcut key to enter < SETUP > page
Step 2	Use cursor keys to select [SPEED] field
Step 3	Use soft keys to select
	Soft Key	Function
	SLOW	Set the sampling speed to slow
	MED	Set the sampling speed to middle
	FAST	Set the sampling speed to fast

5.3   Setting Comparator

5.3.1   Setting【COMP】

To quick judge the accuracy of data in the course of measuring, users can complete this function comparator.

■   Steps to set up Comparator:

Step 1	Press [Setup] shortcut key to enter <SETUP> page
Step 2	Use cursor keys to select [COMP] field
Step 3	Use soft keys at sidebar to sep up comparator
	Soft Key	Function
	OFF	Turn off comparator function and comp icon disappeared
	ON	Turn on comparator function to ON and compicon appeared

5.3.2   Setting 【Lower Limit】 and【Upper Limit】

■   **Input limit value**

Step 1	Enter <COMP> page
Step 2	User cursor keys to select【Upper Limit】or【Lower Limit】field;
Step 3	Use numeric keys to input data
Step 4	Use soft keys to choose unit and then complete data input.

6.   System Configuration

This chapter will provide instrument's system configuration:
- <SYSTEM CONFIG> Page
- <SYSTEM INFORMATION> Page

At any time, just press 【Meas】or【Setup】 key,【SYSTEM】 key will appear at the very bottom.

6.1   System Configuration Page

On 【Meas】or【Setup】 page, press 【SYSTEM】to enter <System Configuration> page.

<**System Configuration**> Page includes the following settings:
- LANGUAGE
- Date/Time Setting
- Account Setting
- Beep Setting
- Baud Rate Setting

- Switch for Communication【Command Handshake】

- Communication【Result Sending】Way

All settings in System Configuration page will be automatically saved in the system, the settings will be automatically loaded when start up next time.

Figure 6-1   <System Configuration> Page

6.1.1   Changing System【LANGUAGE】

AT186 supports English and Chinese.

■   **Steps to changing Language**

Step 1   Enter <System Configuration> Page

Step 2   Use cursor keys to select【LANGUAGE】。

Step 3   Use soft keys to select language:

Soft key	Function
ENGLISH	English
CHINESE	Chinese

6.1.2   **Changing Date and Time**

AT186 features a built-in 24-hour clock.
- **To change Date:**
Step 1   Enter <System Configuration> Page
Step 2   Use cursor keys to select【DATE】field.
Step 3   Use soft keys to set up date:

Soft key	Function
YEAR INCR+	+1 year
YEAR DECR-	-1 year
MONTH INCR+	+1 month
MONTH DECR-	-1 month
DAY INCR+	+1 day
DAY DECR-	-1 day

- **To Changing Time:**
Step 1   Enter <System Configuration> Page
Step 2   Use cursor keys to select【TIME】field.
Step 3   Use soft keys to set up time:

Soft key	Function
HOUR INCR+	+1 Hour
HOUR DECR-	-1 Hour
MINUTE INCR+	+1 Minute
MINUTE DECR-	-1Minute
SECOND INCR+	+1Second
SECOND DECR-	-1 Second

6.1.3   **Setting Account**

AT186 provides two accounts:
Administrator and user
- Administrator: All functions can be configured by administrator except <SYSTEM SERVICE> page, and after delay 5 seconds, the parameters set by administrator will be saved in system storage device, these settings can be loaded by starting up next time.
- User: All functions can be configured by user except < SYSTEM SERVICE> page and <FILE> page, the data changed by user will be reverted to the data set by administrator when starting up next time.

- **To Change Account:**
Step 1   Enter <System Configuration> Page
Step 2   Use cursor keys to select【ACCOUNT】field.
Step 3   Use soft keys to change account:

Soft key	Function
ADMIN	Except < SYSTEM SERVICE > page，all functions are available to the administrator. Is forget password, please contact Applent sales department.
USER	Except [SYSTEM SERVICE] and [FILE] page, all functions can be operated by users. The set data is not allowed to be saved.

- **Administrator Password Setting:**
Step 1   Enter <System Configuration> Page
Step 2   Use cursor keys to select【ACCOUNT】field.
Step 3   Use soft keys to select:

Soft key	Function
CHANGE PASSWORD	Input 9 digits numeric password. Password include number and symbols.
DELETE	Administrator will not be protected by PASSWORD.

PASSWORD	

6.2   Setting【BAUD RATE】

Instrument has built-in RS-232 interface, after instrument senses there is signal conversion at RS-232 interface, it will immediately communicate with host according to the setting baud rate, and keypad is locked.

Before using RS-232C interface, please setup Baud Rate in correct way. If host computer and instrument's baud rate is different, it will be unable to communicate correctly.

Instrument's RS-232 interface uses SCPI language.

RS-232 configuration is as follows:

- Data bits: 8-bit
- Stop bits: 1-bit
- Parity bits: none
- Baud rate: configurable

■   **Setting Baud Rate:**

Step 1   Enter <System Configuration> Page

Step 2   Use cursor keys to select【BAUD】field;

Step 3   Use soft keys to select

Soft key	Function
1200	Choose this baud rate if you use the opto-isolated communication converter
9600	
38400	
57600	
115200	Choose this high-speed baud rate while communication with host PC

6.3   Handshake

Instrument supports RS232 command handshake.

After command handshake is turned on, all commands sent to the instrument by host will return to the host in original state, later will return data.

After command handshake is turned off, the command sent to the instrument by host will be handled.

■   **Steps to Set up Command Handshake:**

Step 1   Enter <System Configuration> Page

Step 2   Use cursor keys to select【COMMAND HANDSHAKE】field;

Step 3   Use soft keys to select

Soft key	Function
OFF	Do not use command handshake. There is no special requirement, Please set command handshake as OFF.
ON	

6.4   Result Sending

Instrument supports function of automatically sending data to the host. Every time completing testing, data will be automatically sent to the host, don't need host to send FETCH？ Command.

■   **Steps to Set up【Result Sending】:**

Step 1   Enter <System Configuration> Page

Step 2   Use cursor keys to select【RESULT SENDING】field;

Step 3   Use soft keys to select

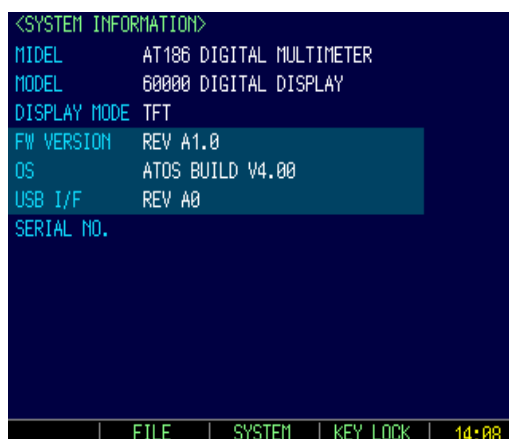| Soft key	Function
FETCH	Use command FETCH ? to acquire all measuring data
AUTO	Every time completing testing, data will be automatically sent to the host

6.5   <SYSTEM INFORMATION> Page

Press【Meas】or【Setup】, choose【SYSTEM】 key at very bottom of taskbar, enter

<System Configuration> page, press soft keys to select【SYSTEM INFO】.

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

Figure 6-2   <System Information> Page

7.   Remote Control

This chapter provides the following information:
- About RS-232
- RS-232 Connection
- Select Baud Rate
- Protocol

Instrument adopts RS-232 interface (standard configuration) to communicate with PC, and complete all instrument functions.by standard SCPI command, users can program various kinds of fitting acquisition system.

7.1   RS-232C

RS-232 is currently widely used serial communications standard, is also called asynchronous serial communications standard, it is applied to realize communication of PC and PC、 PC and peripheral. RS is the English abbreviation for "Recommended Standard" (recommended standard), 232 is standard number, this standard is officially announced by EIA in 1969.

Most configuration of serial port is not based on RS-232 standard: each port use 25-core or 9- core connector (now all PC use 9-core connector). The most common RS-232 signal is as below:

Table 7-1   Common RS-232 signal

Signal	Mark	25-core connector Pin No	9-core connector Pin No
Request To Send	RTS	4	7
Clear To Send	CTS	5	8
Data Set Ready	DSR	6	6
Data Carrier Detect	DCD	8	1
Data Terminal Ready	DTR	20	4
Transmit Data	TXD	2	3
Receive Data	RXD	3	2
Ground	GND	7	5
Request To Send	RTS	4	7

In addition, there is MAX subset for RS232, it is convenient to connect 3-wire, and widely used by industrial control, and instrument also adopts this connection method.

Table 7-2   RS-232 Standard minimum subset

Signal	Mark	9-core connector Pin No
Transmit Data	TXD	2
Receive Data	RXD	3
Ground	GND	5

7.1.1   RS232C Connection

RS-232 serial interface can be connected to serial interface of controller (such as PC or PLC) by DB-9 cable.
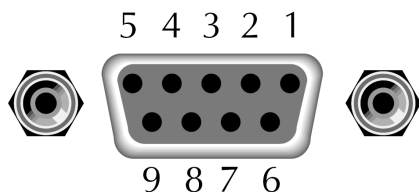
⚠ **Tip: instrument cannot use null modem cable.**
Users can make it or buy 9-core cable from Applent Instruments.
If users make 3-core cable, should pay attention to:

•If using PC's built-in DB9 port, probably users need to short circuit 4-6、7-8 on PC port's DB-9 connector (pin)

Figure 7-1   RS-232 connector on rear panel

In order to avoid electrical shock, please disconnect power when insert and pull the connector.

■   Instrument's default communications settings:

Transmission mode: includes full duplex asynchronous communication of start bits and stop bits

Data bits: 8-bit
Stop bits: 1-bit
Parity bits: None

7.2   Handshake Protocol

Due to instrument use RS-232 standard minimum subset, rather than handware handshake signal, so instrument adopts software handshake to reduce phenomenon of possible data loss or data error during communication.

Instrument can start using software handshake, high-level language software engineer should strictly do it according to the following handshake protocol to program communication software:

● Instrument terminator only accepts ASCII format, command response also returns ASCII code.

● **Command string that sent by host must be ended with NL ('\n') mark, instrument terminator will begin performing command string only after it receives end mark.**

● Instrument can set command handshake: instrument will return an identification code to the host after it receives command and finishes processing.

Remark:

if host is unable to receive the data returned by instrument, users can try to resolve the problem by the following methods:

1 . Software handshake is turned off, please refer to <SYSTEM CONFIG> page and turn it on.

2 . Serial port connection fault, please check cable connection.

3 . The format of high-level language program communication at computer end is error, please try to check whether serial port number and communication format is correct, and check whether Baud Rate is the same as that of instrument's setting.

4 . If instrument is parsing the previous command, host will be unable to receive response from instrument, please try later.

<If problem still cannot be solved, please contact our technical engineer.>

7.3   SCPI Language

SCPI-Standard Commands for Programmable Instruments is a common command that Applent adopts and it is used to test instrument. SCPI is also called TMSL-Test and Measurement System Language, which is developed by Agilent Technologies according to IEEE488.2, so far it is widely used by equipment manufacturers.

Instrument built-in terminator is responsible for parsing user's various command formats. Because terminator is on the basis of SCPI protocol, but it is not fully consistent with SCPI, please read "SCPI command" chapter before using instrument.

8.   SCPI Command Reference

This chapter includes the following contents:
- Terminator
- Command Syntax
- Query Syntax
- Query Response
- Command Reference

This chapter provides instrument's all available SCPI commands sets, it can control instrument all function by these SCPI commands.

8.1   Terminator

Host can send a string of command to instrument, instrument terminator will begin parsing after it captures end mark (\n) or after input buffer overflows.

For example: Legal command string:
AAA:BBB CCC;DDD EEE;:FFF

Instrument terminator is responsible for parsing and performing all commands, before programming, users must know about parsing rules.

8.1.1   Terminator Rules

1. Terminator only parses and responds ASCII code's data.
2. **Command string must be ended with NL (' \n' ASCII 0x0A) mark, terminator will begin performing command string only after it receives end mark or after** buffer overflows**.**
3. If command handshake is turned on, every time terminator receives one string, it will promptly return this string to the host, only when host receives this returned string, can it continues sending the next string.
4. After terminator parses error, it will promptly stop parsing, and the current command is canceled.
5. When terminator parses the query command, it will terminate parsing this command string, the latter command string will be ignored.
6. When parsing command string, terminator is case insensitive.
7. Terminator supports command abbreviated form, please refer to the latter chapter regarding abbreviation norms.

8.1.2   Notation Conventions and Definitions

This chapter employs some marks, these marks are not a part of command tree; they are only for better understanding of command string.

<>   The character in <> means this command's parameter
[ ]   The character in [] means optional command
{}   When there includes several parameter items in {}, means that users can only choose one item from it.
( )   The abbreviated form of parameter is put in ().
**Capital letters**   Abbreviated form of command.命令的缩写形式。

8.1.3   Command Structure

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.

SCPI use （:）to separate high level commands and low level commands.

Figure 8-1   Command Tree Example
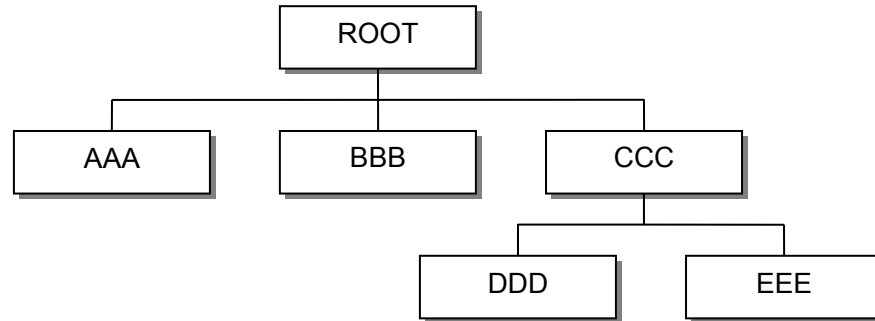
Example   ROOT:CCC:DDD ppp
                         ROOT   Subsystem Command
                              CCC   Level 2
                                   DDD   Level 2
                                        ppp   Parameter

8.2   Header and Parameters

A command tree consists of header and parameters, it uses a space (ASCII: 20H) to separate in the middle

Example   AAA:BBB 1.234
                           Header   [Parameter]

8.2.1   Header

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.

8.2.2   Parameter

■   Single command word, no parameter
    Example: AAA:BBB
■   Parameter can be character string form, the abbreviation rules are the same as the rules for command.

    Example：AAA:BBB 1.23
■   Parameter can be numeric form.

    · *<integer>*   integer 123 , +123 ,   -123

    · *<float>*   floating number

    1. <fixfloat>：fixed point floating number: 1.23 , -1.23

    2. <Sciloat>：scientific notation floating number: 1.23E+4 , +1.23e-4

    3. <mpfloat>: multiplier expressed by floating number:1.23k , 1.23M , 1.23u

Table   8-1   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

Multiplier is Case Insensitive, its writing style is different from standard name.

8.2.3   Separator

Instrument terminator only accepts allowed separators, terminator will occur "Invalid separator" error if beyond this separator, and these separators include:

;   semicolon, used for separate two commands.
     Example: AAA:BBB 100.0 ; CCC:DDD

:   colon, used for separate command tree, or restart command tree.
     Example: AAA : BBB : CCC 123.4; : DDD : EEE 567.8

?   question mark, used for query.
     Example: AAA ?

□   space, used for separate parameters.

     Example : AAA:BBB□1.234

8.3   Command Reference

All commands in this reference are listed in the following functional command order, the following is all subsystem

- DISPlay   Display SUBSYSTEM
- FUNCtion   Function SUBSYSTEM
- SYSTem   System SUBSYSTEM
- TRIGger   Trigger SUBSYSTEM
- FETCh?   Acquire Result SUBSYSTEM
- ERRor   Error Information SUBSYSTEM

Common Commands:
- IDN?   Instrument Information Query SUBSYSTEM
- TRG   Trigger and Acquire Data
- SAV   Save all Set Parameters to Internal Disk

8.4   DISPlay SUBSYSTEM

DISPlay SUBSYSTEMcan be used for switching different display page or display a string of text at cue.

Figure 8-2   DISPlay Subsystem Tree

DISPlay	**:PAGE**	**{MEASurement, SETUp,SYSTem,SYSTEMINFO(SINF)}**
	:LINE	**<string>**

8.4.1   DISPlay:PAGE

DISP:PAGE is used for switching to a certain page.

Command Syntax: **DISPlay:PAGE <Page Name>**

Parameter： <Page Name> includes:

MEASurement   MEASURE DISPLAY PAGE
SETUp   SETUP PAGE
SYSTem   SYSTEM CONFIGURATION PAGE

	SYSTEMINFO(SINF)	SYSTEM INFORMATION PAGE

Example: SEND> **disp**:**page setup**_{*<NL>*}   //switch to SETUP page

Query Syntax: **DISP:PAGE?**

Query Response: **<Page Name> abbreviation**
meas
setu
syst
sinf

Example: SEND> **disp:page?**   *<NL>*
RET> **meas**_{*<NL>*}

8.4.2   DISP:LINE

DISP:LINE is used for display a string of text at botton. The MAX display is 30 characters.

Command Syntax: **DISPlay:LINE <*string*>**
Parameter: **<string> MAX 30 characters**
Example: SEND> **DISP:LINE "This is a Comment."** *<NL>*

8.5   FUNCtion SUBSYSTEM

Figure 8-3   FUNCtion Subsystem Tree

FUNCtion	:MODEL	{AC-V,DC-V,Res,Short,Diode,AC-uA,DC-uA, AC-mA,DC-mA,AC-10A,DC-10A}
	:RATE	{SLOW,MED,FAST, ULTRA}

8.5.1   FUNCtion:MODEL

FUNC:RANG is used for setting current measuring mode

Command Syntax: **FUNCtion:MODEL {<Measuring model> }**
Parameter: **{AC-V,DC-V,Res,Short,Diode,AC-uA,DC-uA,**
AC-mA,DC-mA,AC-10A,DC-10A}
Example: SEND> **FUNC:MODEL AC-V**_{*<NL>*}   //switch to AC measuring mode
Query Syntax: **FUNC:MODEL?**
Query Response: **Measuring model**
Example: SEND> **FUNC: MODEL?** *<NL>*
RET> **DC-V**_{*<NL>*}

8.5.2   FUNCtion:RATE

FUNC:RATE is used for setting measuring speed.

Command Syntax: **FUNCtion:RATE {SLOW,MED,FAST}**
Example: SEND> **FUNC:RATE FAST**_{*<NL>*}   //Set as FAST measuring speed.
Query Syntax: **FUNC:RATE?**
Query Response: **{SLOW,MED,FAST}**

8.6   COMParator SUBSYSTEM

Use COMParator SUBSYSTEM's comparator parameters, it will be saved system for starting up use.
COMP SUBSYSTEM is used for set up comparator parameters.

Figure 8-4   COMParator Subsystem Tree

COMParator	:BEEP	{OFF,GD,NG}	
	:STATE	{OFF,ON}	
	:TOLerance	Limit	<LOWER,UPPER>

8.6.1   COMParator:BEEP

COMP:BEEP is used for enabling beep function.

Command Syntax:	**COMParator:BEEP {OFF,GD,NG}**
Example:	SEND**> COMP:BEEP GD*<NL>*** //GD BEEP
Query Syntax:	**COMP:BEEP?**
Query Response:	**{OFF,GD,NG}**

8.6.2 **COMParator:STATE**

COMP:STATE is used for setting turning on/off comparator.

Command Syntax:	**COMParator:STATE < OFF , ON >**
Example:	SEND**> COMP:STATE ON*<NL>*** //Set to turn on comparator
Query Syntax:	**COMP:STATE?**
Query Response:	**<OFF>**
Example:	SEND**> COMP: STATE? *<NL>***
	RET**> ON*<NL>*** //Comparator is turned off

8.6.3 **COMParator:TOLerance: LMT**

COMP:TOLerance: LMT is used for setting upper limit and lower limit

Command Syntax:	**COMParator:TOLerance:LMT <float Lower Limit>,<float Upper Limit>**
Example:	SEND**> COMP:TOL: LMT -10,+10**
	//If under voltage measuring mode, Lower Limit is -10V, Upper Limit is 10V.
Query Syntax:	**COMP:TOL: LMT?**
Query Response:	**<float>,<float>**
Example:	SEND**> COMP:TOL: LMT?*<NL>***
	RET**> -10.0000,+10.0000*<NL>*** //-10,+10

8.7 TRIGger SUBSYSTEM

Figure 8-5   TRIGger Subsystem Tree

TRIGger	**[:IMMediate]**	
	:SOURce	**{INT,MAN,BUS}**
TRG		

TRIGger is used for setting trigger source and generate a trigger.

8.7.1 **TRIGger[:IMMediate]**

TRIG[:IMM] when trigger sourceis set as BUS, it will generate a trigger, but it will not return measuring data by trigger.

Command Syntax:	**TRIGger[IMMediate]**
Example:	SEND**> TRIG*<NL>*** //will stop after instrument tests a time.

8.7.2 **TRIGger:SOURce**

TRIG:SOUR is used for setting trigger source.

Command Syntax:	**TRIGger:SOURce {INT,MAN,BUS}**
Example:	SEND**> TRIG:SOUR BUS*<NL>*** //Set as BUS trigger mode
Query Syntax:	**TRIG:SOUR?**
Query Response:	**<INT,MAN,BUS>**

8.8 FETCh? SUBSYSTEM

FETCh? Is used for acquiring measuring data. Before using this command, users need to set 【Result Sending】 filed as 【FETCH】 on <System Configuration> page.

FETCh ? Command will return measuring data.

Query Syntax:	**FETCh?**
Query Response:	**{<float>}**
Example:	SEND**> FETC? *<NL>***

RET**> 0.001mVDC** *<NL>* //Return to measuring model as DC, measured value is 0.001mV.

8.9 SYSTem SUBSYSTEM

SYSTem SUBSYSTEM is used for setting parameters that are related to system.

SYSTem data set by SUBSYSTEM will not be saved in the internal of instrument.子

Figure 8-6 SYSTem Subsystem Tree

SYSTem	:LANGuage	{ENGLISH,CHINESE,EN,CN}
	:SENDmode	{FETCH,AUTO}

8.9.1 SYSTem:LANGuage

Instrument language setting

Command Syntax:	**SYSTem:LANGuage {ENGLISH,CHINESE,EN,CN}**
Example:	SEND**> SYST:LANG EN***<NL>* //Set as English display.
Query Syntax:	**SYST:LANG?**
Query Response:	**{ENGLISH,CHINESE}**

8.9.2 SYSTem:SENDmode

SYST:SEND is used for setting data sending mode: AUTO or FETCH command.

Command Syntax:	**SYSTem:SENDmode {FETCH,AUTO}**
Example:	SEND**> SYST:SEND AUTO** //Set as AUTO sending
Query Syntax:	**SYST:SEND?**
Query Response:	**{FETCH,AUTO}**

8.10 IDN? SUBSYSTEM

IDN? SUBSYSTEM is used for returning instrument's version

Command Syntax:	**IDN?**
Query Response:	**<MODEL>,<Revision>,<SN>,< Manufacturer>**
Example:	SEND**> IDN?** *<NL>*
	RET> **AT86,REV A1.4,0000000,Applent Instruments***<NL>*

9.   Specification

This chapter provides the following information:
- Technical Specifications
- General Specifications
- Dimensions

9.1   Technical Specifications

The Data is Achieved under the Following Conditions:

Temperature: 23℃±5℃

Humidity: ≤65% R.H.
Zero value adjustment: perform zero clearing before measuring
Warm-up Time: > 60 minutes

Calibration Time：12 months

■ **DC Voltage Specifications**

Range	Resolution	MAX Reading	Accuracy
60.000mV	10uV	65.000mV	±0.2%rdg. ±25dgt
600.00mV	10uV	650.00mV	±0.02%rdg. ±5dgt
6.0000V	100uV	6.5000V	±0.02%rdg. ±2dgt
60.000V	1mV	65.000V	±0.02%rdg. ±2dgt
600.00V	10mV	650.00V	±0.02%rdg. ±2dgt
1000.0V	100mV	1000.0V	±0.02%rdg. ±2dgt

■ **AC Voltage Specifications**

Range	Frequency	Resolution	MAX Reading	Accuracy
60.000mV	45-65Hz	10uV	65.000mV	±0.4%rdg. ±40dgt
600.00mV	45-65Hz	10uV	650.00mV	±0.4%rdg. ±40dgt
6.0000V	45-65Hz	100uV	6.5000V	±0.2%rdg. ±25dgt
60.000V	45-65Hz	1mV	65.000V	±0.2%rdg. ±25dgt
600.00V	45-65Hz	10mV	650.00V	±0.2%rdg. ±25dgt
750.0V	45-65Hz	100mV	800.0V	±0.2%rdg. ±25dgt

■ **DC Current Specifications**

Range	Shunt	Resolution	MAX Reading	Accuracy
600.00uA	101Ω	0.01uA	650.00uA	±0.05%rdg. ±25dgt
6000.0uA	101Ω	0.1uA	6500.0uA	±0.05%rdg. ±5dgt
60.000mA	1Ω	1uA	65.000mA	±0.05%rdg. ±25dgt
600.00mA	1Ω	10uA	650.00mA	±0.15%rdg. ±5dgt
6.0000A	10mΩ	100uA	6.5000A	±0.2%rdg. ±25dgt
10.000A	10mΩ	1mA	10.000A	±0.2%rdg. ±25dgt

■ AC Current Specifications:

Range	Frequency	Shunt	Resolution	MAX Reading	Accuracy
600.00uA	45-65Hz	101Ω	0.01uA	650.00uA	±0.6%rdg. ± 25dgt
6000.0uA	45-65Hz	101Ω	0.1uA	6500.0uA	±0.6%rdg. ±5dgt
60.000mA	45-65Hz	1Ω	1uA	65.000mA	±0.6%rdg. ±25dgt
600.00mA	45-65Hz	1Ω	10uA	650.00mA	±0.6%rdg. ±5dgt
6.0000A	45-65Hz	10mΩ	100uA	6.5000A	±0.6%rdg. ±25dgt
10.000A	45-65Hz	10mΩ	1mA	10.000A	±0.6%rdg. ±25dgt

■ Resistance Specificat

Range	Test Current	Resolution	MAX Reading	Accuracy
60.000Ω	920uA	1mΩ	65.000Ω	±0.3%rdg. ±25dgt
600.00Ω	920uA	10mΩ	650.00Ω	±0.03%rdg. ±10dgt
6.0000kΩ	92uA	100mΩ	6.5000kΩ	±0.03%rdg. ±2dgt
60.000kΩ	9.2uA	1Ω	65.000kΩ	±0.03%rdg. ±2dgt
600.00kΩ	917nA	10Ω	650.00kΩ	±0.03%rdg. ±2dgt
6.0000MΩ	917nA	100Ω	6.5000MΩ	±0.15%rdg. ±20dgt
15.000MΩ	917nA	1kΩ	15.000MΩ	±1.5%rdg. ±20dgt

■ Diode Specifications:

Range	Test Current	Resolution	MAX Reading	Accuracy
3.600V	1.2mA	100uV	3.600V	±0.1%rdg. ±5dgt

9.2 General Specifications

Screen :   TFT-LCD true color display, screen size 3.5 inches
Beep: OFF, DG, NG
Interface: RS232 interface
Programming Language: SCPI
Other: Keypad lock

9.3 Environmental Requirement

Environment :   Spec.:   Temperature 18°C~28°C   Humidity ≤ 65% RH
                     Operating: Temperature 10°C~40°C   Humidity 10~80% RH

Storage: Temperature 0℃~50℃   Humidity 10~90% RH

Power Supply: 110VAC/220VAC（1±10%）
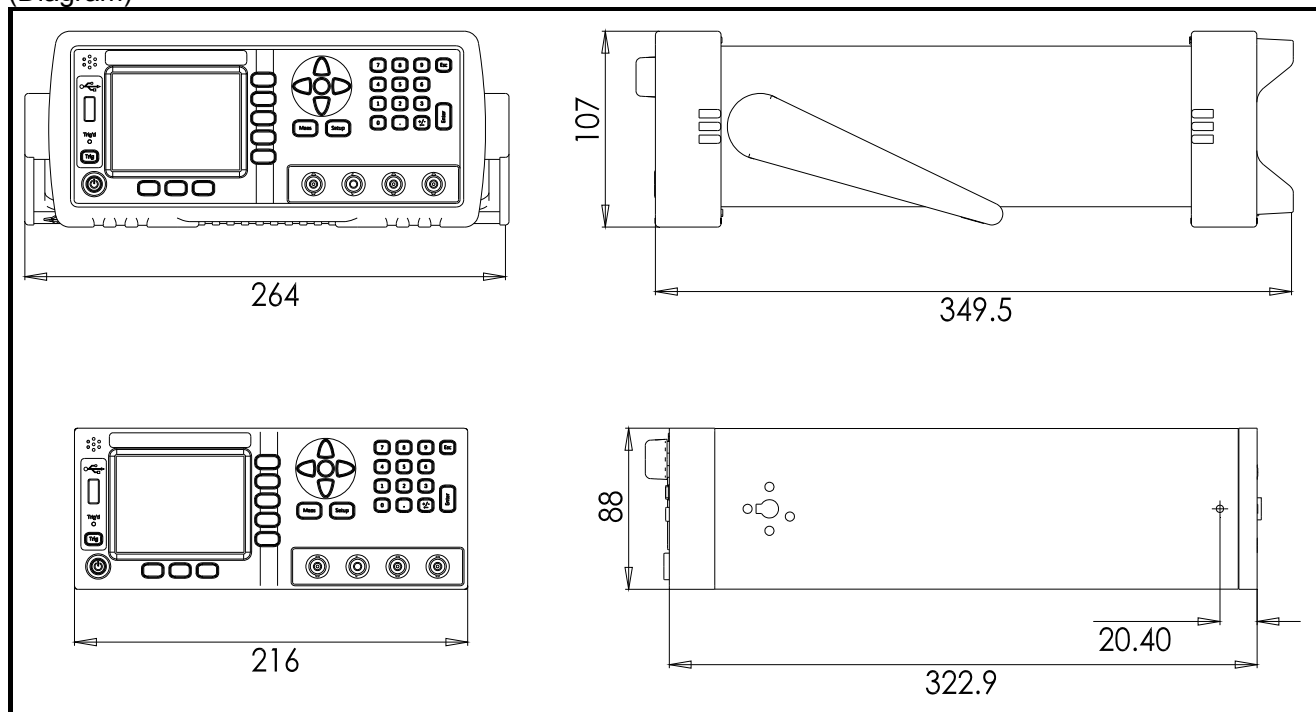Fuse: 250V 1A Slow-Blow
Power: <20VA
Weight: About 3.5 KGS

9.4   Dimensions

(Diagram)