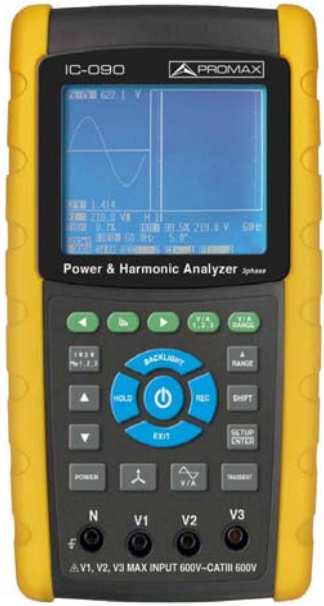
IC-090

3 PHASE POWER NETWORK ANALYSER
UP TO 3000 A



PROMAX

SAFETY NOTES

Read the user's manual before using the equipment, mainly " SAFETY RULES " paragraph.

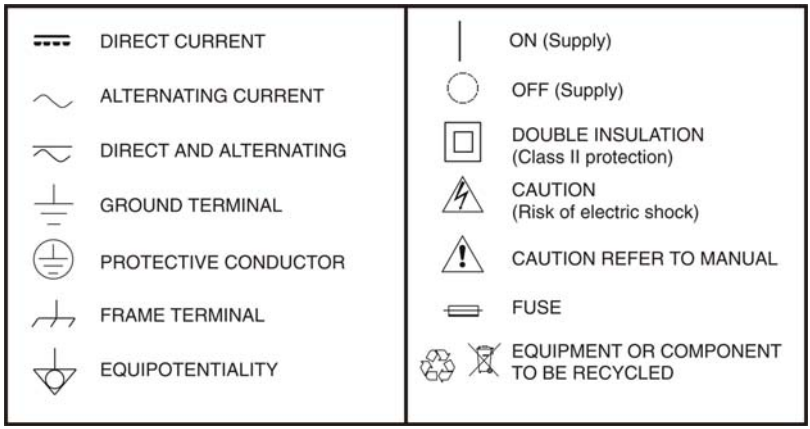
The symbol  **on the equipment means "SEE USER'S MANUAL". In this manual may also appear as a Caution or Warning symbol.**

Warning and Caution statements may appear in this manual to avoid injury hazard or damage to this product or other property.

ENVIROMENT CONDITIONS 

* **The safety could not be assured if the instructions for use are not closely followed.**
* **During the measurement, do not open the cabinet.**
* **Do not apply the overload voltage, current to the input terminal!**
* **Remove test leads before open the battery cover!**
* Observe all **specified ratings** both of supply and measurement.
* Remember that voltages higher than **60 V DC** or **30 V AC rms** are dangerous.
* Use only the accessories supplied to ensure safety.
* Keep accessories in good conditions.
* Operator is only autorised to change batteries.
* Installation Categories III 600V.
* Pollution Degree 2.
* Altitude up to 2000 meters.
* Indoor use.
* Relative humidity 80% max.
* Do not obstruct the ventilation system of the instrument.
* Use for the signal inputs/outputs, specially when working with high levels, appropriate low radiation cables.
* Follow the cleaning instructions described in the Maintenance paragraph.

* Symbols related with safety:



Descriptive Examples of Over-Voltage Categories

Cat I Low voltage installations isolated from the mains.

Cat II Portable domestic installations.

Cat III Fixed domestic installations.

Cat IV Industrial installations.

TABLE OF CONTENTS

3 PHASE POWER NETWORK ANALYSER UP TO 3000 A
IC-090

1 INTRODUCTION

Your purchase of this 3 phase power network analyser up to 3000 A marks a step forward for you into the field of precision measurement.

Although this power analyser is a complex and delicate instrument, its durable structure will allow many years of use if proper operating techniques are developed.

Please read the following instructions carefully and always keep this manual within easy reach.

2 FEATURES

- Analysis for 3 phase multi-power system, 1P/2W, 1P/3W, 3P/3W, 3P/4W.
- Voltage and the Current are the True RMS value.
- 3 current probes (CP-1201) are included, if change the current probes, the calibration procedures are not necessary.
- Current probe input signal/ranges with selection:

  Input signal (ACV): 200 mV / 300 mV / 500 mV / 1 V / 2 V / 3 V.

  Ranges (ACA): 20 A / 200 A / 2000 A (1200 A) / 30 A / 300 A / 3000 A / 60 A / 600 A / 6000 A.
- Meter can cooperate the universal current probes.
- Complete set with 4 PCs Test Leads, 4 PCs Alligator clips, 3 PCs Clamp Probe (CP 1201), AC to DC 9V adapter, 2G SD memory card and Carrying bag.

- Measurement:
  V (phase-to-phase), V (phase-to-ground)
  A (phase-to-ground)
  KW (True Power)/ KVA / KVAR / PF (phase)
  KW (True Power)/ KVA / KVAR / PF (system)
  KWH / KVAH / KVARH / PFH (system)
  Phase angle
- Harmonics display (1-50th order).
- Simultaneous display of Harmonics and Wave form.
- Display of Waveform with Peak Values.
- Analysis of Total Harmonic Distortion (THD).
- Graphic Phase diagram with 3-Phase system parameters.
- 3 phase Voltage or Current Unbalanced Ratio (VUR, AUR) and Unbalanced Factor.
- Calculated Unbalanced Current through Neutral Line (An).
- Capture Transient events (including Dip, Swell and Outage) with programmable threshold (%).
- Programmable CT ratio (1 to 600) and PT ratio (1 to 1000).
- ACV input impedance is 10 Mega ohms.
- Safety Standard: IEC 1010, CAT III 600V.
- Built-in clock and Calendar, real time data record with SD memory card , sampling time set from 2 to 7200 seconds. Just slot in the SD card into the computer, it can down load the all the measured value with the time information (year, month, data, hour, minute, second) to the Excel directly, then user can make the further data analysis by themselves.
- Powered by AA (UM-3) DC 1.5 V X 8 batteries (Alkaline type) or DC 9 V adapter.

3 DESCRIPTION

Front view

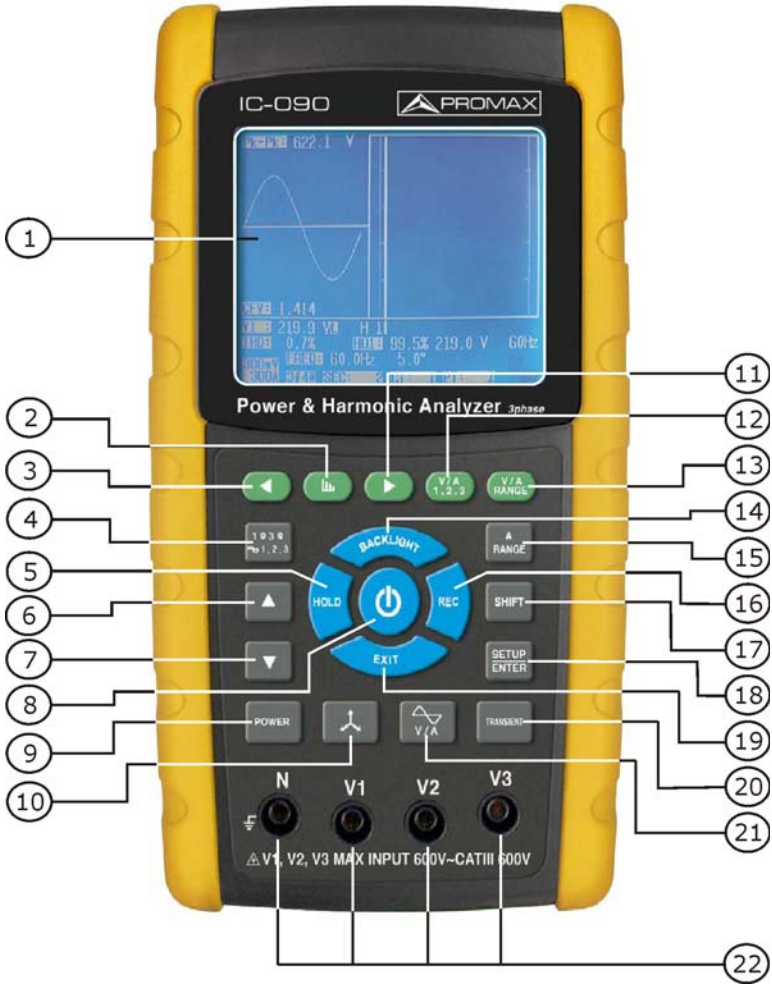


Figure 1. Front view.

1. Display.
2. Harmonic Key.
3. Harmonic Analysis Left Key.
4. 1Φ 3Φ (Phase/wire) key button.
5. Hold key button.
6. ▲ key button.
7. ▼ key button.
8. Power key button.
9. Power Measurement Key.
10. Phase Diagram Key.
11. Harmonic Analysis Right Key.
12. Harmonic Analysis V1,V2,V3, A1,A2,A3 Select Key.
13. Harmonic Function Voltage or Current Input Range.
14. Backlight key button.
15. A (current) range key button.
16. REC key button.
17. Shift key button.
18. Setup key button.
19. Exit key button.
20. Transient Key.
21. Waveform of Voltage and Current Key.
22. Voltage input terminals.

Top view

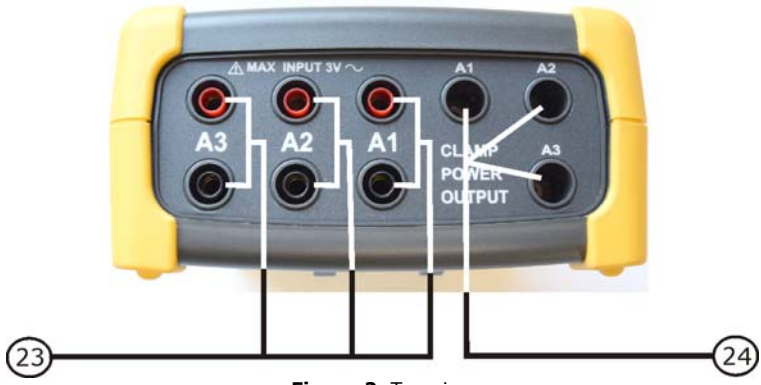


Figure 2. Top view

23 Waveform of Voltage and Current Key.

24 Voltage input terminals.

Side view and rear view

Figure 3. Side view and rear view

25 SD card socket.

26 RS232 socket.

27 RESET button.

28 DC 9 V power adapter socket.

29 Battery Cover/Battery compartment.

30 Stand.

Amperimetric clamp

Figure 4. Amperimetric clamp

31 Current Sense Jaw.

32 Trigger.

33 Current probe power plug.

34 Current probe signal plugs (red positive / black negative).

4 MEASURING PREPARATION

4.1 First screen

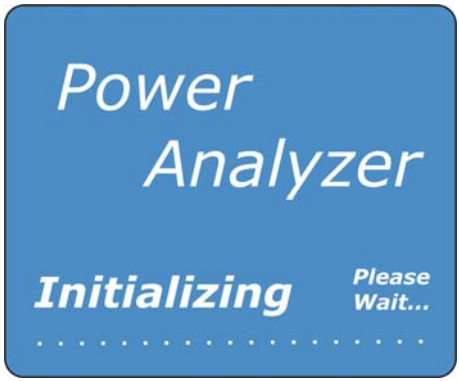


Figure 5.

4.2 Entry the measurement Screen

1 The bottom right display will show as "SD Check" along with blinking while inserting SD CARD then disappears after several seconds that indicates the data from SD CARD has been read completed.

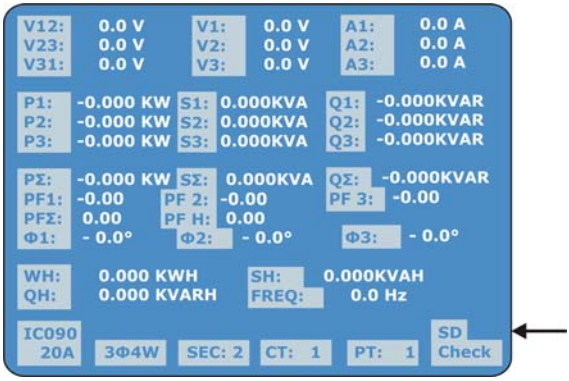


Figure 6.

2 The bottom right display will show as " NO DISK " along with blinking when SD CARD is not inserted (see figure).

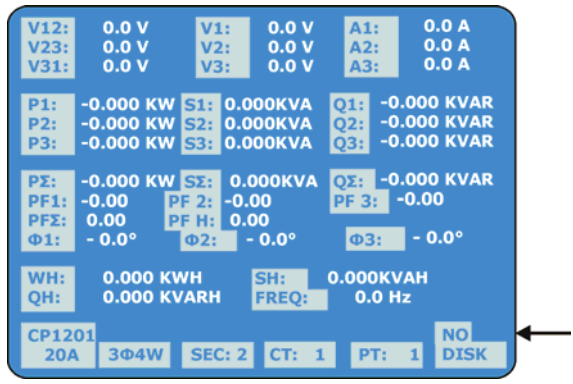


Figure 7.

4.3 Description of keyboard

1 **POWER KEY**:
Press the key to turn the instrument ON/OFF.

2 **1Φ 3Φ** (phase/wire) **KEY**:
Press the key to select (1P/2W, 1P/3W, 3P/3W, 3P/4W) measurement function mode.

3 **A** (curren) **RANGE KEY**:
Press the key to change the current range quickly.

4 **REC KEY**:
The data record key for SD CARD.

5 **HOLD KEY**:
Press the key to freeze the display reading.

6 **BACKLIGHT KEY**:
Press the key to switch LCD backlight to ON/OFF.

7 **SETUP KEY**:
Press the key to setup the function before measuring.

8 **EXIT KEY**:
Press the key to exit setting screen.

9 **SHIFT KEY**:
Press the key to set the different functions in setting screen.

10 **UP** (▲) **KEY**:
Press the key to move the cursor up in setting screen.

11 **DOWN** (▼) **KEY**:
Press the key to move the cursor down in setting screen.

12 Harmonic Analysis Left Key.

13 Harmonic Key.

14 Harmonic Analysis Right Key.

15 Harmonic Analysis **V1, V2, V3, A1, A2, A3** Select Key.

16 Harmonic Function Voltage or Current Input Range Select Key.

17 Power Measurement Key.

18 Phase Diagram Key.

19 Waveform of Voltage and Current Key.

20 Transient Key.

4.4 SETUP KEY description

4.4.1 Shift key

1 When the symbols "SETUP" and "SHIFT 1" are appeared on up right display (see figure) in the meantime, and then use the ▲ or ▼ to select the expect item.

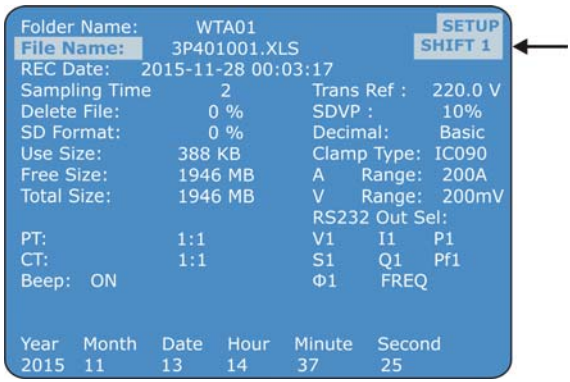


Figure 8.

2 When the symbols "SETUP" and "SHIFT 2" are appeared on up right display (see figure) in the meantime, and then use the ▲ or ▼ to select (1P/2W, 1P/3W, 3P/3W, 3P/4W) in File Name function.

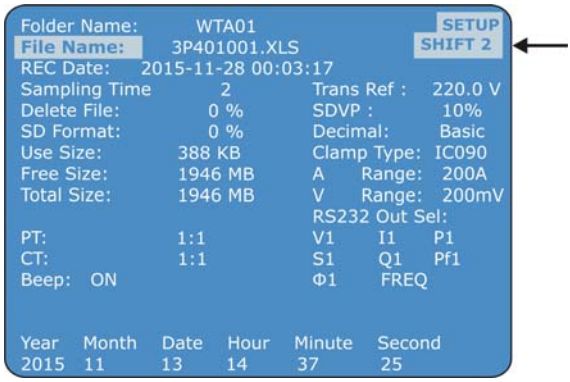


Figure 9.

4.4.2 The Setting Function menu

- **Folder Name**: Set the expect folder name for SD CARD, the range is between WTA01 and WTA10.
- **File Name**: Set the file name for SD CARD, It allows setting. 50 filenames in this function.
- **REC Date**: Show the recorded time of existing files (Year/Month/Date, Hour/Min./Sec.).
- **Sampling Time**: Set the sampling time from 2 to 7200 seconds.
- **Delete File** : To delete the existing data from SD CARD.
- **SD Format** : to Format SD CARD fast.
- **PT** : Set the potential transformer from 1 to 1000.
- **CT** : Set the current transformer from 1 to 600.
- **Beep** : Set to ON/OFF for buzzer.
- **Clamp Type** : Select the Clamp Type. The clamp supplied is CP-1201. For other types select "Other type".
- **RS232 out Sel.** : Set RS232 output function, maximum up to nine items can be selected to output. screen 1 screen 2.
- **Year** : Set the year.
- **Month** : Set the month.
- **Date:** Set the date.
- **Hour:** Set the hour.
- **Minute:** Set the minute.
- **Second:** Set the second.

4.5 Setting function description before measuring

Press **SETUP KEY** to enter setting function screen, the selected item will be displayed in highlight.

4.5.1 Folder Name

Set the folder name for SD

1. Folder Name range: WTA01 to WTA10.
2. Press ▲ or ▼ to select the expect folder number, the number consists of "01 to 10" (see figure).

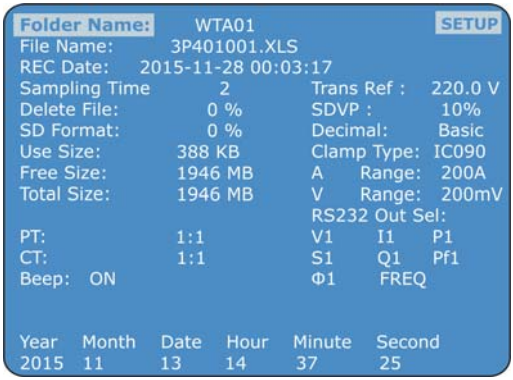


Figure 10.

3. Press ▲ or ▼ continuously at least two seconds can skip the numbers faster.
4. Press **SHIFT KEY** once, the symbol "SHIFT1" will appear on up right display, and then press ▼ to entry next setting function (see figure) (Folder Name → File Name).

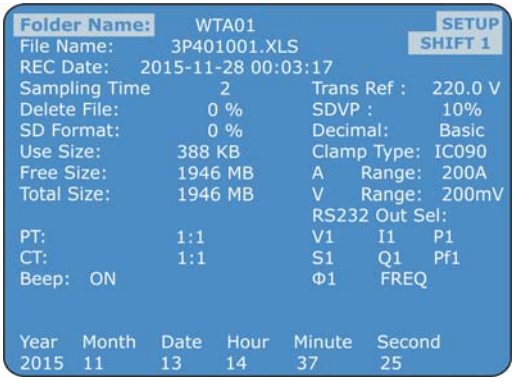


Figure 11.

4.5.2 File Name

Set the file name for SD

1 The screen will show "NO File" indicator in **REC** Date option when the selected file is new (see figure).

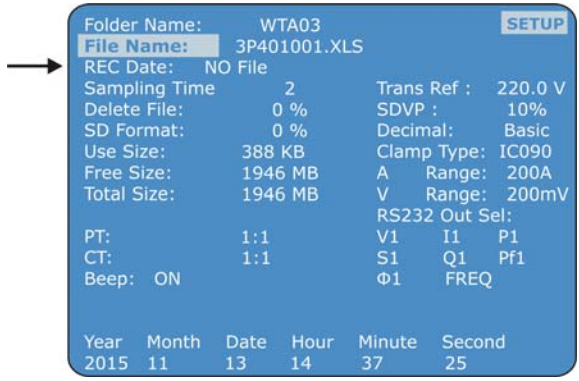


Figure 12.

2 The screen will show recording date and time in **REC** Date option when the selected file has been recorded (see figure).

3 **File Name description**: press ▲ or ▼ (see figure) to select expect file number from 001 to 050.

Remark:	When press ▲ or ▼ > 2 sec, the setting no. will change fast.

- **1P201001**: 1P2 means one phase by two wires.
- **1P301001**: 1P3 means one phase by three wires.
- **3P301001**: 3P3 means three phases by three wires.
- **3P401001**: 3P4 means three phases by four wires.
- **HAR01001**: HAR means harmonic measurement.
- **PHA01001**: PHA means phasor measurement.
- **TRA01001**: TRA means transient measurement.

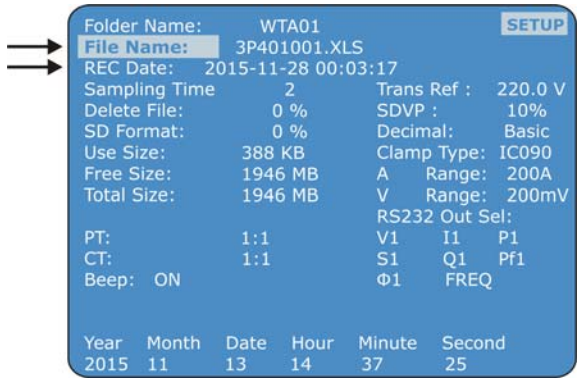


Figure 13.

Remark:	Above file description, 01 means folder number, 001 means file number.

4 The up right display will show "SHIFT1" symbol while pressing **SHIFT KEY** (see figure), and then press ▼ to enter next setting function (see next figure) (File Name → Sampling Time).

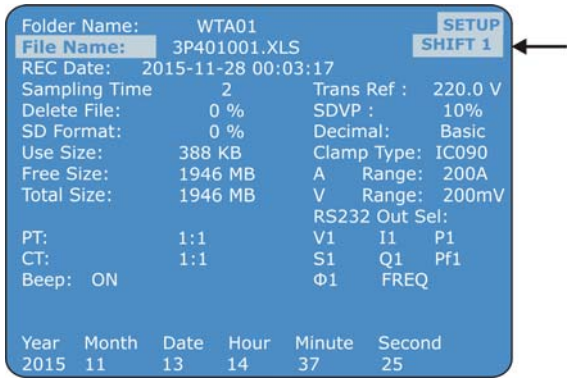


Figure 14.

5 The up right display will show "SHIFT2" symbol while pressing SHIFT KEY again (see figure), at this time press ▲ or ▼ to select 1P/2W (1P2), 1P/3W (1P3), 3P/3W (3P3) and 3P/4W (3P4) (see figure).

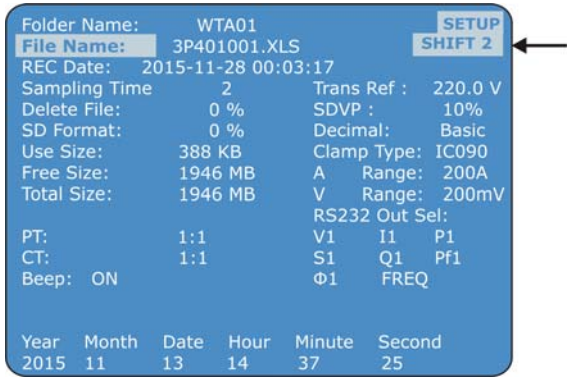


Figure 15.

6 One by one to press **SHIFT KEY** to select different functions circularly.

4.5.3 Sampling time

Set the data logger sampling time for SD

1 When press **SHIFT KEY** once, the symbol "**SHIFT1**" will disappear on up right display, at this time press ▲ or ▼ to adjust expect sampling time (see figure), adjusting numbers are from 2 to 7200 seconds.

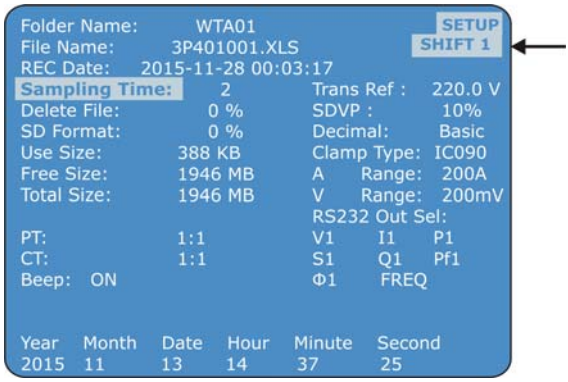


Figure 16.

Remark: When press ▲ or ▼ > 2 sec, the setting no. will change fast.

2 The up right display will show "**SHIFT1**" symbol while pressing **SHIFT KEY** again, and then press ▼ to enter next setting function (Sampling Time → Delete File).

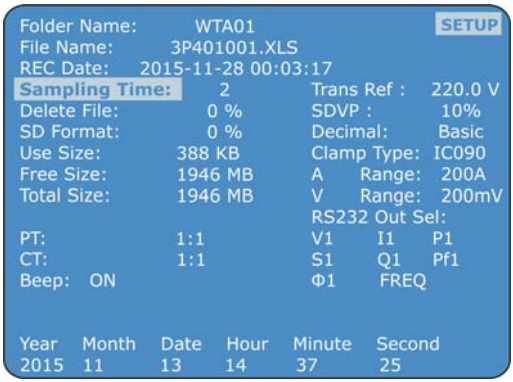


Figure 17.

4.5.4 Delete File

Delete the files for SD

1 The indicator "Y or N" will appear on right side display of the option while pressing SHIFT KEY continuously at least two seconds, and now press ▲ the display will show "Y" in highlight, press SETUP KEY again to confirm, the selected file (ex: 3P401001.XLS) will be erased then return to previous screen, or else press SETUP KEY in " N " option to return to previous screen.

2 Press ▼ to enter next setting function (Delete File → SD Format)

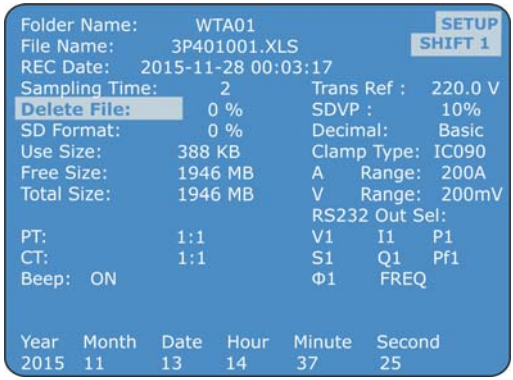


Figure 18.

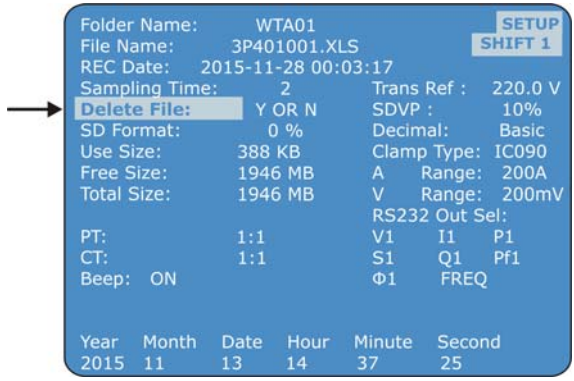


Figure 19.

4.5.5 SD Format

Formatting function for SD CARD

1 The indicator "Y or N" will appear on right side display of the option while pressing **SHIFT KEY** continuously at least two seconds, and press ▲ the display will show "Y" in highlight, press SETUP KEY again to confirm to format SD CARD then return to previous screen, or else press SETUP KEY in "N" option return to previous screen.

2 Press ▼ to enter next setting function (SD Format → PT).

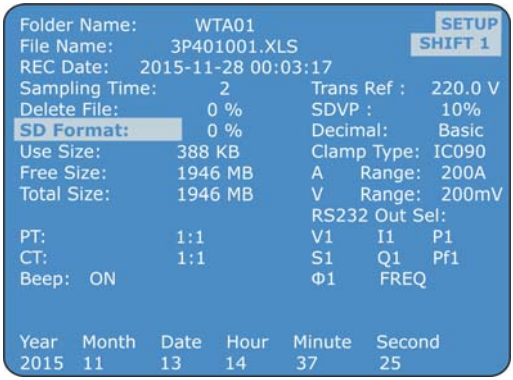


Figure 20.

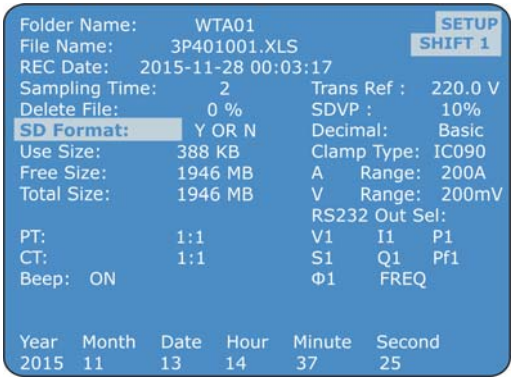


Figure 21.

4.5.6 PT: Potential transformer

Set the Potential Transformer

1 When press **SHIFT KEY** once, the symbol "SHIFT1" will disappear at this time press ▲ or ▼ can adjust to expect PT values (see figure), the adjusting numbers are from 1 to 1000.

Remark:	When press ▲ or ▼ > 2 sec, the setting no. will change fast.

2 Press **SHIFT KEY** once again will return to previous screen then press ▼ to enter next setting function (PT → CT).

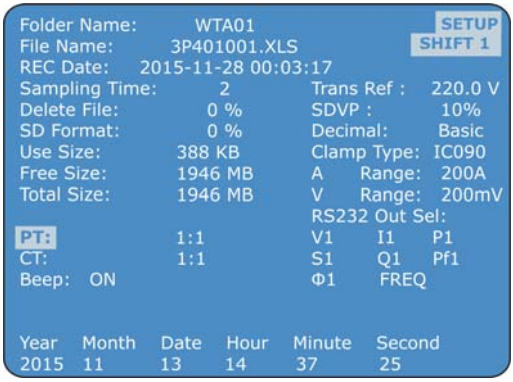


Figure 22.

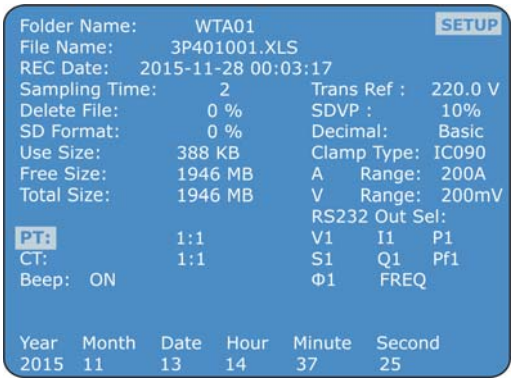


Figure 23.

4.5.7 CT: Current Transformer

Set the Current Transformer

1 When press **SHIFT KEY** once, the symbol "SHIFT1" will disappear at this time press ▲ or ▼ can adjust to expect CT values (see figure), the adjusting numbers are from 1 to 600.

Remark: When press ▲ or ▼ > 2 sec, the setting no. will change fast.

2 Press **SHIFT KEY** once again will return to previous screen then press ▼ to enter next setting function (CT → BEEP).

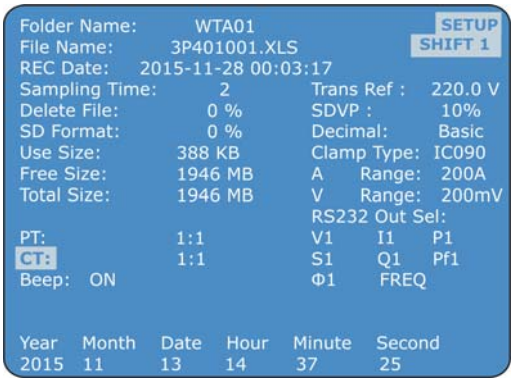


Figure 24.

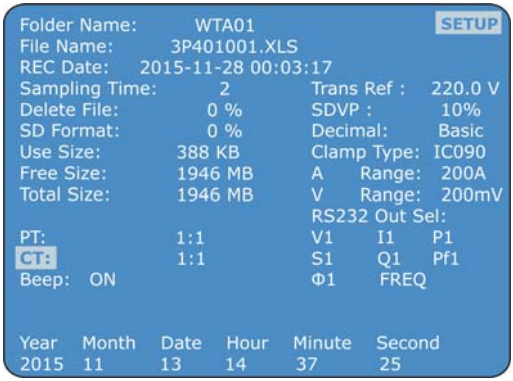


Figure 25.

4.5.8 Beep

Control the buzzer to ON/OFF

1. When press **SHIFT KEY** once the symbol "SHIFT1" will disappear as screen 2, at this time press ▲ or ▼ to control the buzzer to ON/OFF.

2. Press **SHIFT KEY** once again will return to previous screen then press ▼ to enter next setting function (BEEP → Trans Ref type)

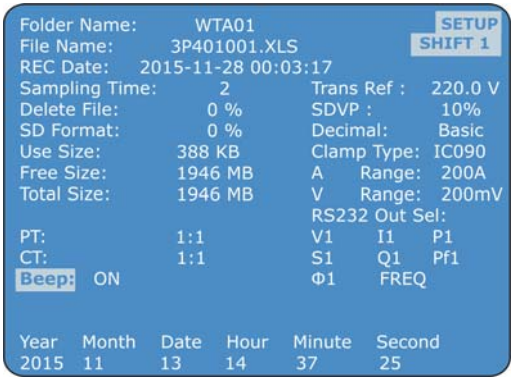


Figure 26.

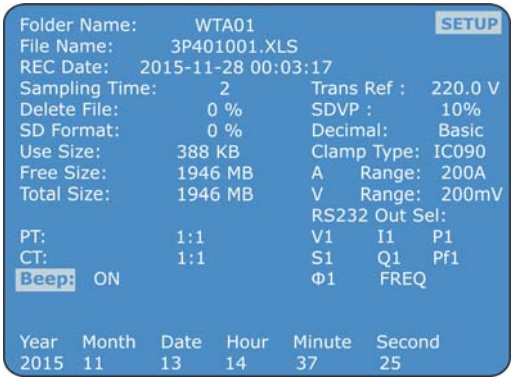


Figure 27.

4.5.9 Trans Ref

Nominal voltage for transient detection reference

1. When press **SHIFT KEY** once will disappear, at this time press ▲ or ▼ to adjust the voltage level to 50.0 V to 850.0 V.

2 Press **SHIFT KEY** once again will return to previous screen then press ▼ to enter next setting function (Trans Ref → SDVP).

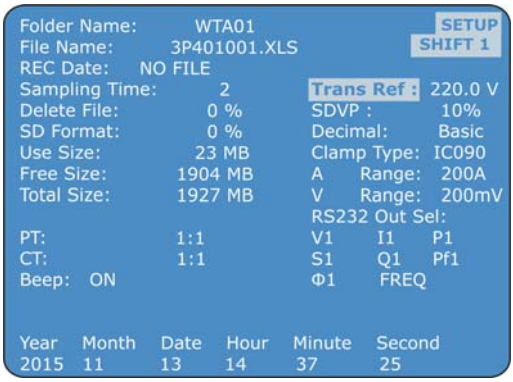


Figure 28.

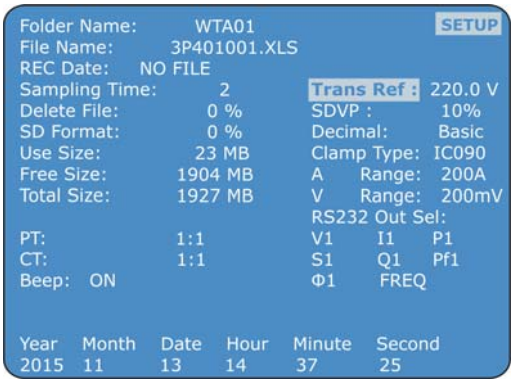


Figure 29.

4.5.10 SDVP

Set up upper and low limits % of transient voltage detection.

1 When press **SHIFT KEY** once will disappear (see figures), at this time press ▲ or ▼ to adjust the voltage % value to 1% to 100%.

2 Press **SHIFT KEY** once again will return to previous screen then press ▼ to enter next setting function (SDVP → Decimal).

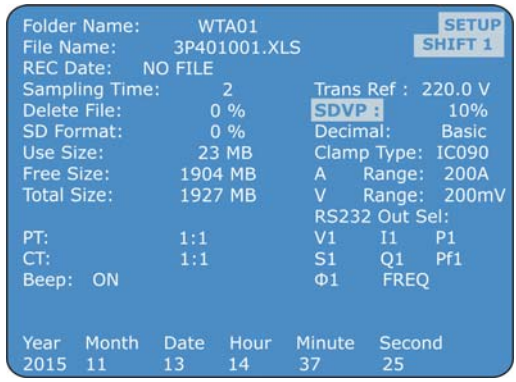


Figure 30.

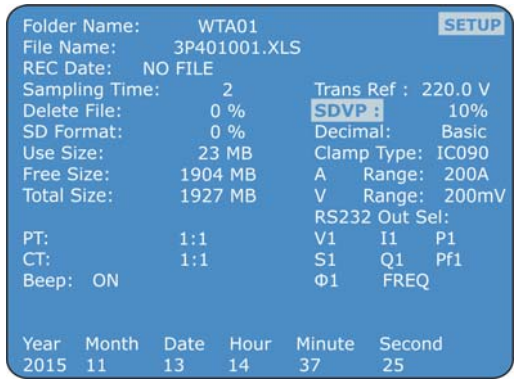


Figure 31.

4.5.11 Decimal Type

Set the Decimal type to Basic (.) or Euro (,)

The numerical data structure of SD card is default used the "." as the decimal, for example "20.6" "1000.53". But in certain countries (Europe ...) is used the "," as the decimal point, for example "20,6" "1000,53". Under such situation, it should change the Decimal character at first.

1. When press **SHIFT KEY** once the symbol "SHIFT1" will disappear (see figures), at this time press ▲ or ▼ to select the Decimal type to " Basic " or " Euro".

   - **Basic type**: The numerical data structure of SD card is default used the "." as the decimal, for example "20.6" "1000.53".
   - **Euro type**: The numerical data structure of SD card is default used the " , " as the decimal, for example "20,6" "1000,53".

2. Press SHIFT KEY once again will return to previous screen then press ▼ to enter next setting function (Decimal type → Clamp type).

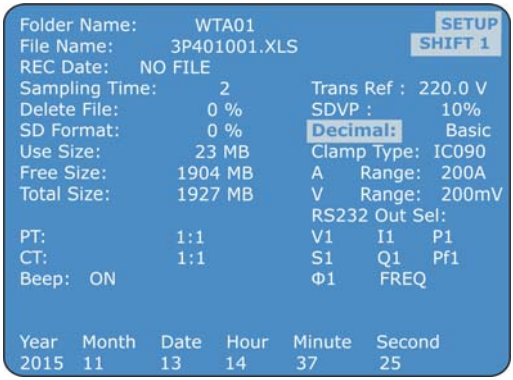


Figure 32.

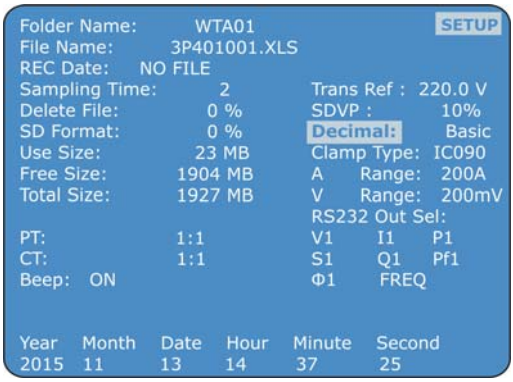


Figure 33.

4.5.12 Clamp Type

Set the clamp type to Lutron Clamp or other Clamp

1. When press SHIFT KEY once the symbol "SHIFT1" will be disappeared (see figures), at this time press ▲ or ▼ to select the clamp type. The clamp supplied is the CP1201. For another clamp select "Other".

2. When select the different Clamp type, the V range and the A range will show the corresponding value.

3 Press SHIFT KEY once again will return to previous screen then press ▼ to enter next setting function (Clamp Type → A range).

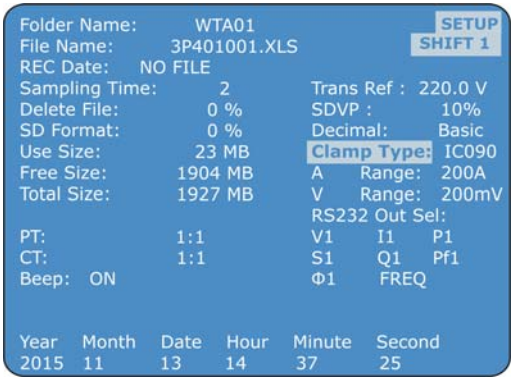


Figure 34.

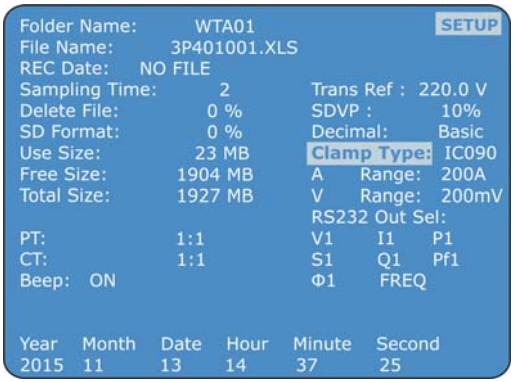


Figure 35.

4.5.13 A range Setting

Current range Setting

1 When press SHIFT KEY once the symbol " SHIFT1 " will be disappeared (see figures), at this time press ▲ or ▼ to select A range to 20 A to 2000 A, 30 A to 3000 A or 60 A to 6000 A.

- The setting value should accoding your Clamp type.
- The CP-1201 clamp can set 20 A, 200 A, 1200 A.
- The Other clamp can set 20 A, 200 A, 2000 A, 30 A, 300 A, 3000 A.60 A, 600 A, 6000 A.

Attention: The meter's A range (Current range) value should same as the Clamp's current selecting range value.

2 Press SHIFT KEY once again will return to previous screen then press ▼ to enter next setting function (A Range → V range).

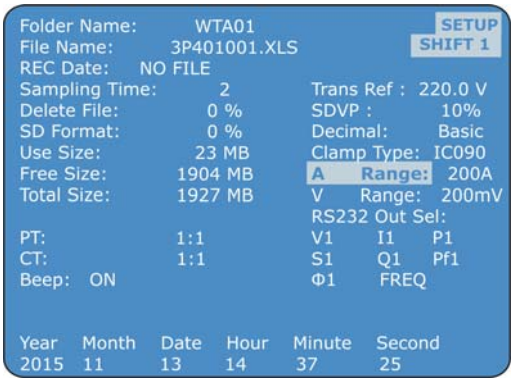


Figure 36.

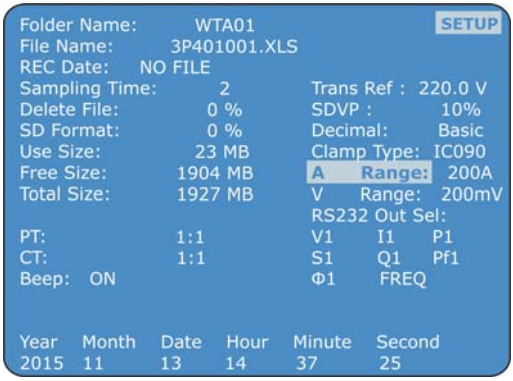


Figure 37.

4.5.14 V range Setting

Voltage range Setting

1 When press SHIFT KEY once the symbol "SHIFT1" will be disappeared (see figures), at this time press ▲ or ▼ to select V range to 200 mV, 300 mV, 500 mV, 1 V, 2 V, 3 V.

- The setting function only available for the Other clamp.
- The V range value of CP-1201 will default to 200 mV, it can not be adjusted.

2 Press SHIFT KEY once again will return to screen 1 then press ▼ to enter next setting function (A Range → RS232 OUT SEL).

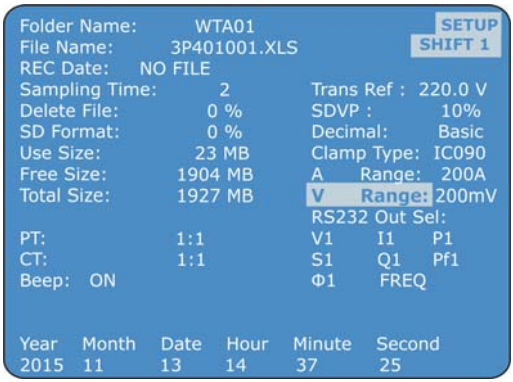


Figure 38.

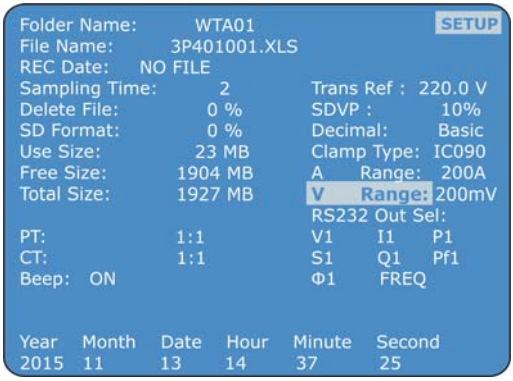


Figure 39.

4.5.15 RS232 Out Sel setting

1. When press SHIFT KEY continuously at least two seconds and now press ▲ or ▼ to select the item that intend to output, maximum up to nine items, when the cursor stops on the selected item and then press SETUP KEY again, the selected item will be displayed in highlight.
2. Press SHIFT KEY it can change the screen page from Screen 2 → Screen 5.
3. If the selected items are over nine, the low right display will show indicator "full".
4. After the selecting is completed, press SHIFT KEY continuously at least two seconds again will return to screen 1 and show all the selected items at the same time.
5. Press ▼ to enter next setting function (RS232 Out Sel → Year)

Figure 40.

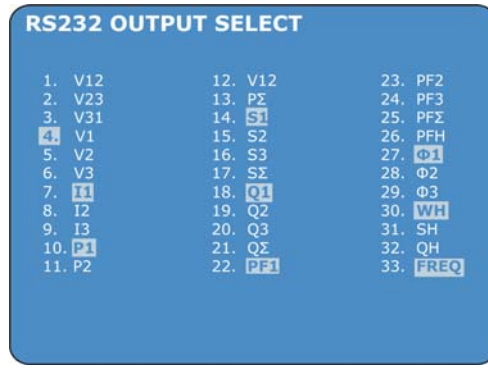


Figure 41.

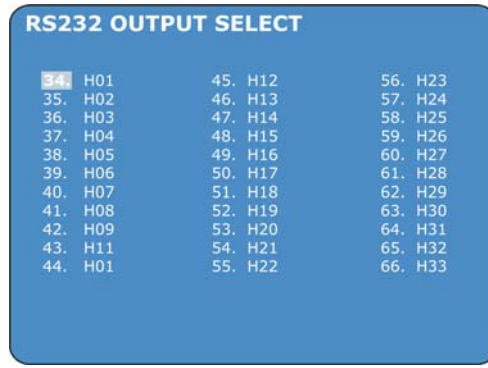


Figure 42.

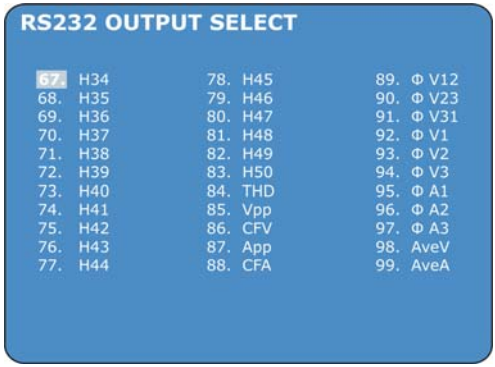


Figure 43.

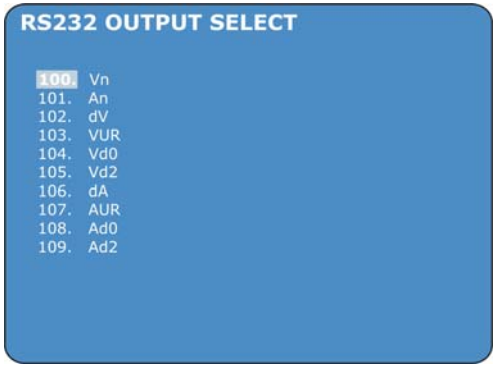


Figure 44.

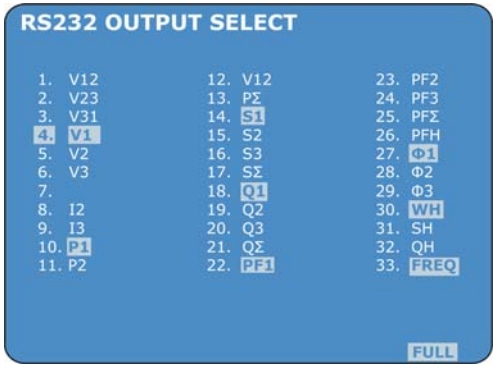


Figure 45.

4.5.16 Year/Month/Date/Hour/Minute/Second setting

1. When press SHIFT KEY once the symbol "SHIFT1" will disappear (see figures), at this time press ▲ or ▼ to adjust expect numbers, and press ▲ or ▼ continuously at least two seconds can skip the numbers faster.

2. When press SHIFT KEY once, the symbol "SHIFT1" will appear, at this time press to enter next setting function (Year → Month).

3. The settings about (Month → Date), (Date → Hour), (Hour → Minute), (Minute → Second) are same as above step A and step B.

4. In this setting function (Year → Minute), press ▲ or ▼ in addition to adjust the numbers, and the setting value will also be saved during the adjusting.

5. In the function of setting "second", press ▲ or ▼ to adjust numbers, at this point the number of second is at a standstill condition and then press setup key that will save setting value and also start counting function of "second".

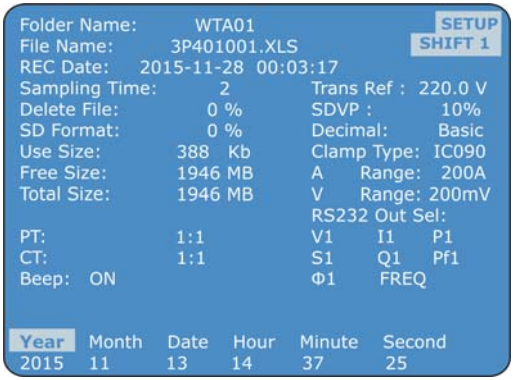


Figure 46.

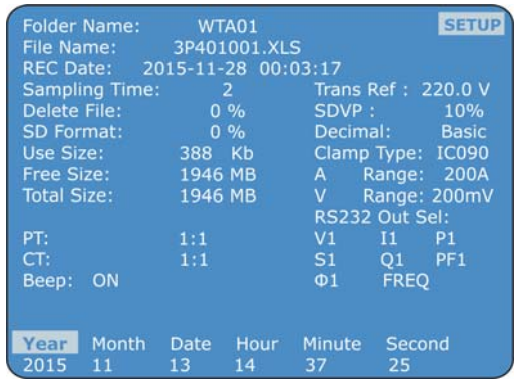


Figure 47.

4.5.17 Exit

When all settings are completed, press EXIT KEY to return measuring screen

4.5.18 SD Card

1. Use Size - To show the space data numbers that have been used.
2. Free Size - To show the data numbers of balance space.
3. Total Size - To show the data numbers of total space.
4. Typical SD CARD and SDHC both can be used with the instrument, except the SD CARD memory size is less than 32MB.

4.5.19 Reset

Press this key to reboot the instrument

5 MEASURING PROCEDURES

5.1 1Φ2W (one phase by two wires) measurement

1 Diagram

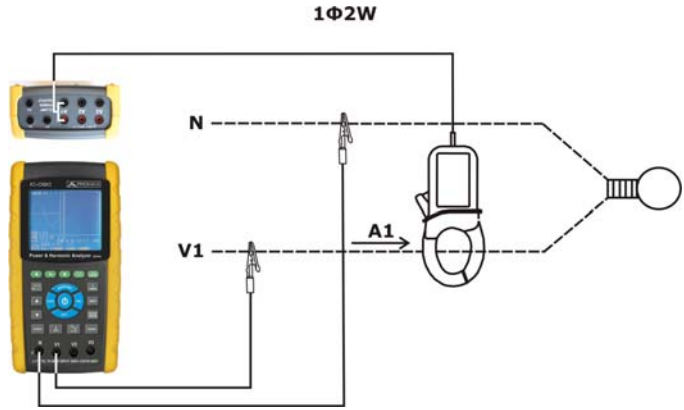


Figure 48.

2 Operation Instructions:

- Power on the instrument by pressing POWER KEY, and then press 1Φ 3Φ KEY to select the 1Φ 2W system, the selected name of system will be appeared on bottom left display (see figure).

Figure 49.

- Connect the line voltage L1, Vn (Neutral) to V1 and N terminals of the instrument.
- Place the conductor of CP-1201 (A1)to A1 as screen 1.
- Connect the output of clamp meter "CP-1201(A1)" to A1 terminal of the instrument.
- The related measuring factors will be appeared on display, about the instruction of factor please refer appendix 1.

5.2 1Φ3W (one phase by three wires) measurement

1 Diagram

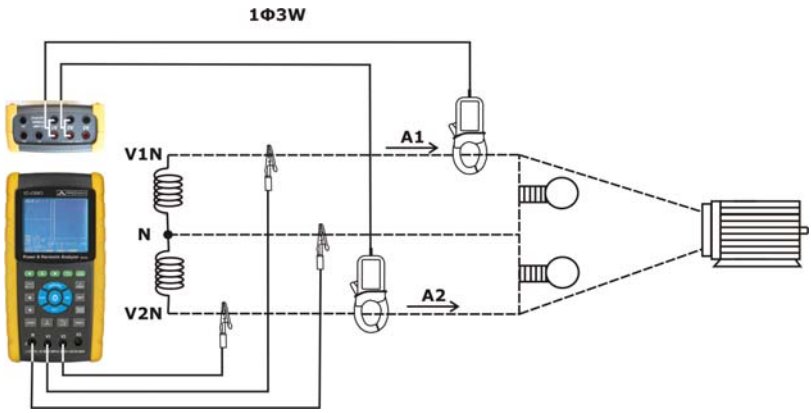


Figure 49.

2 Operation Instructions:

- Power on the instrument by pressing POWER KEY, and then press 1Φ 3Φ KEY to select the 1Φ 3W system, the selected name of system will be appeared on bottom left display (see figure).

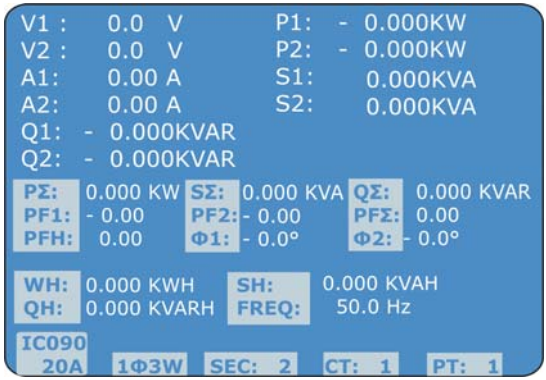


Figure 51.

- Connect the line voltage L1, L2 and Vn (Neutral) to V1, V2 and N terminals of the instrument.
- Place the conductor of CP-1201(A1), CP-1201(A2) hook to A1 and A2 (see figure).
- Connect the outputs of clamp meter CP-1201(A1), CP-1201(A2) to A1 and A2 terminals of the instrument.
- The related measuring factors will be appeared on display, about the instruction of factor please refer appendix 1.

5.3 3Φ3W (three phases by three wires) measurement

1 Diagram

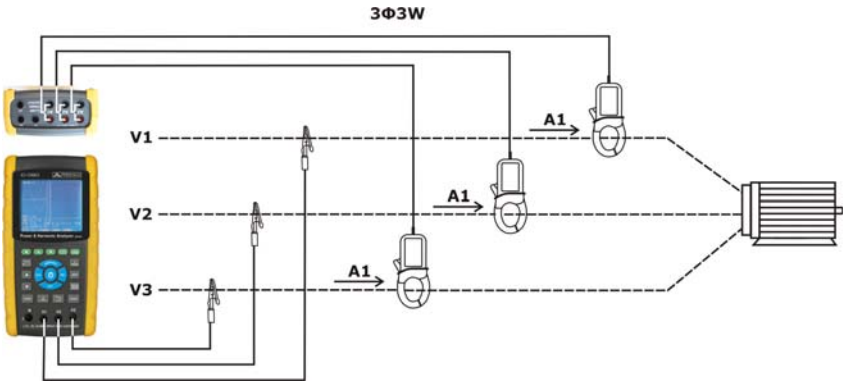


Figure 52.

2 Operation Instructions:

- Power on the instrument by pressing POWER KEY, and then press 1Φ 3Φ KEY to select the 3Φ 3W system, the selected name of system will be appeared on bottom left display (see figure).

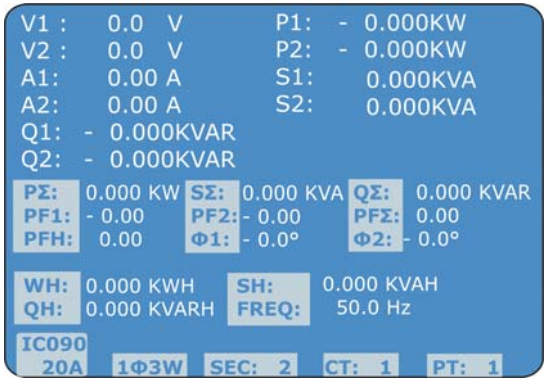


Figure 53.

- Connect the line voltage L1, L2 and L3 to V1, V2 and V3 terminals of the instrument.
- Place the conductor of CP-1201(A1), CP-1201(A2), CP-1201(A3) hook to A1, A2 ,A3 (see diagram).
- Connect the outputs of clamp meter CP-1201(A1), CP-1201(A2), CP-1201(A3) to A1, A2, A3 terminals of the instrument.
- The related measuring factors will be appeared on display, about the instruction of factor please refer appendix 1.

5.4 3Φ 4W (three phases by four wires) measurement

1 Diagram

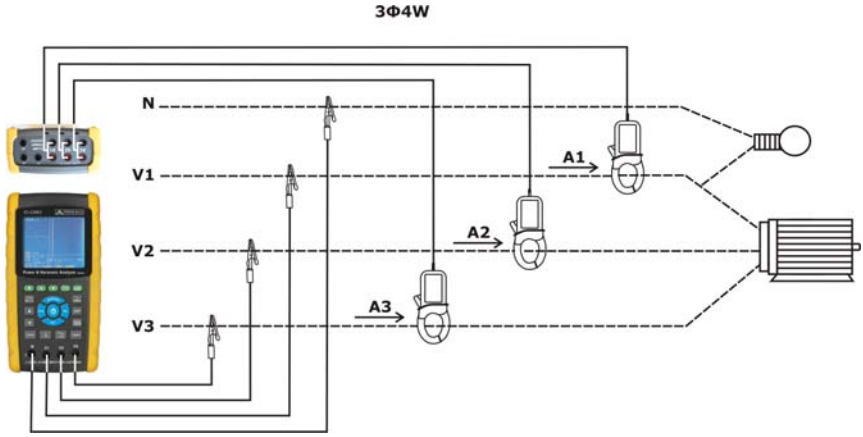


Figure 54.

2 Operation Instructions:

- Power on the instrument by pressing POWER KEY, and then press 1Φ 3Φ KEY to select the 3Φ 4W system, the selected name of system will be appeared on bottom left display (see figure).

Figure 55.

- Connect the line voltage L1, L2, L3 and Vn to V1, V2, V3 and N terminals of the instrument.

- Place the conductor of CP-1201(A1), CP-1201(A2), CP-1201(A3) hook to A1, A2, A3 (see diagram).

- Connect the outputs of clamp meter CP-1201(A1), CP-1201(A2), CP-1201(A3) to A1, A2, A3 terminals of the instrument.

- The related measuring factors will be appeared on display, about the instruction of factor please refer appendix 1

5.5 The CT and PT measurement

1 Diagram

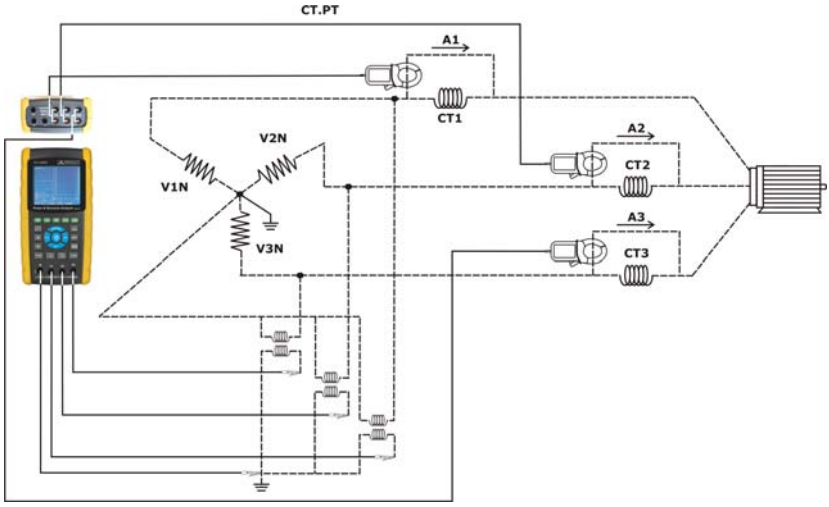


Figure 56.

2 Operation Instructions:

- Power on the instrument by pressing POWER KEY, and then press 1Φ 3Φ KEY to select the 3Φ 4W system, the selected name of system will be appeared on bottom left display (see figure).

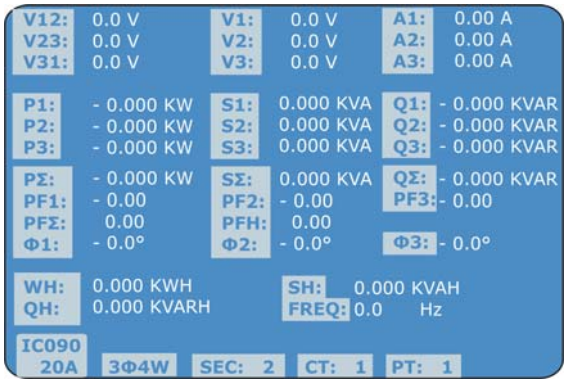


Figure 57.

- Connect the line voltage L1, L2, L3 and Vn to V1, V2, V3 and N terminals of the instrument.
- Place the conductor of CP-1201(A1), CP-1201(A2), CP-1201(A3) hook to A1, A2 , A3 (see figure).
- Connect the outputs of clamp meter CP-1201(A1), CP-1201(A2), CP-1201(A3) to A1, A2, A3 terminals of the instrument.
- The related measuring factors will be appeared on display, about the instruction of factor please refer appendix 1.

5.6 ZERO adjustment for Watt Hour

If reset the "Exit key button" continuously and > 6 seconds, the measurement value of "WH", "SH", "QH" will reset to Zero value.

5.7 Harmonic Function Measurement

1 Press "Harmonic Key" will enter measurement screen (see figure).

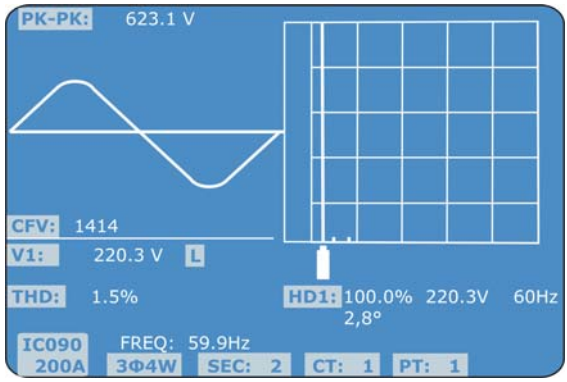


Figure 58.

2 Press "V/A 1. 2. 3 Key" will enter the next screen (see figure).

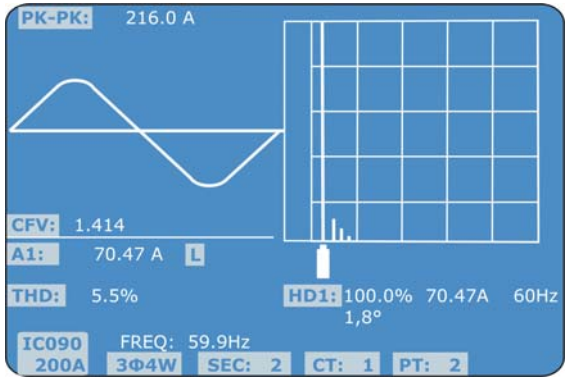


Figure 59.

3 If the wave show the distortion, Press "V/A range Key", switch to VH or AH to let the wave form not existing distortion (see figures).

4 Press "Left Key" or "Right Key" will show the voltage or current Nth harmonic value.

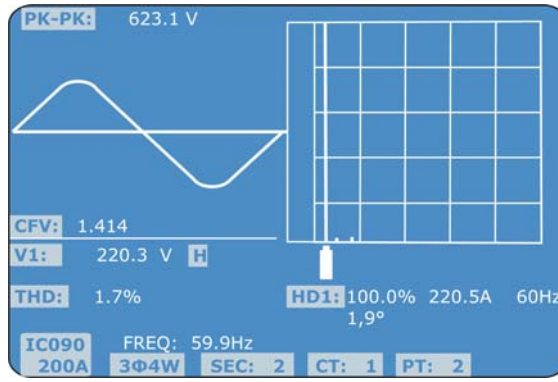


Figure 60.

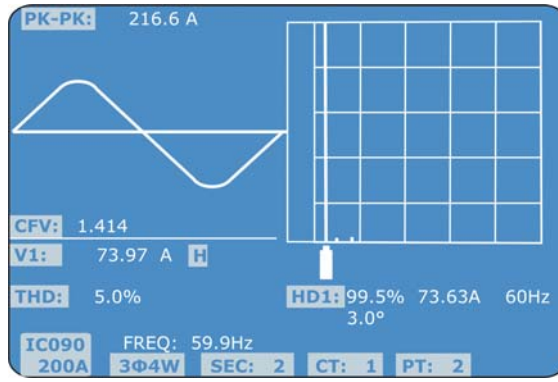


Figure 61.

5.8 Graphic Phasor Diagram

1. Press "Phase Diagram Key" will display the phasor diagram (see figure).

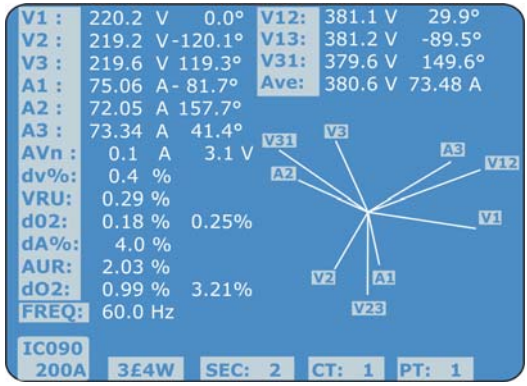


Figure 62.

2. Description of phasor diagram:

   - **V1, V2, V3**:
     Phase voltages in phasor format with respect to V1.
     A1, A2, A3:
     Line currents in phasor format with respect to A1.

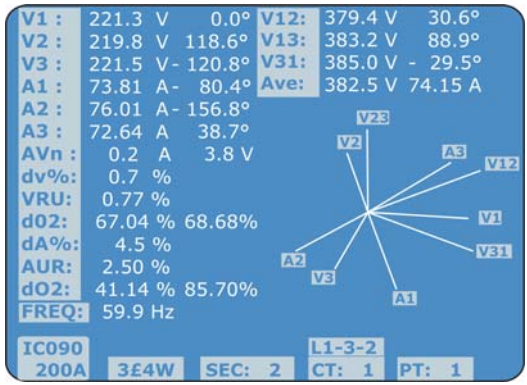


Figure 63.

- **AVE**:
  Average of the line voltages V12, V23 and V31 an the line current A1, A2 and A3.

- **AVn**:
  Calculated voltage and current of neutral with respect to ground.

- **dV%**:
  Historical maximum % value of (Max. (V1, V2, V3) - Min. (V1, V2, V3))/Min. (V1, V2, V3) * 100%.

- **VUR**:
  Voltage unbalance ratio.

- **do2 (do, d2)**:
  do - The first number is Zero Sequence Unbalance Ratio in % (d0) of voltage or current.
  d2 - The second number is the Negative Sequence Unbalance Ratio in % (d2) of voltage or current.

- **dA%**:
  Historical maximum % value of (Max. (A1, A2, A3) - Min. (A1, A2, A3))/Min. (A1, A2, A3) * 100%.

- **AUR**:
  Current unbalance ratio.

5.9 Voltage/Current Waveform

1 Press "Waveform Key" will enter to Voltage Waveform screen (see figure), then Press "1Φ /3Φ Key" once in sequence will switch the Voltage waveform from V1 to V2, V3.

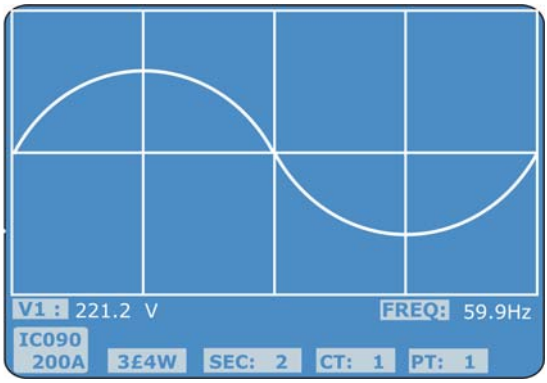


Figure 64.

2 Press "Waveform Key" once again will enter to Current Waveform screen (see figure), then "1Φ /3Φ Key" once in sequence will switch the Current waveform from A1 to A2, A3.

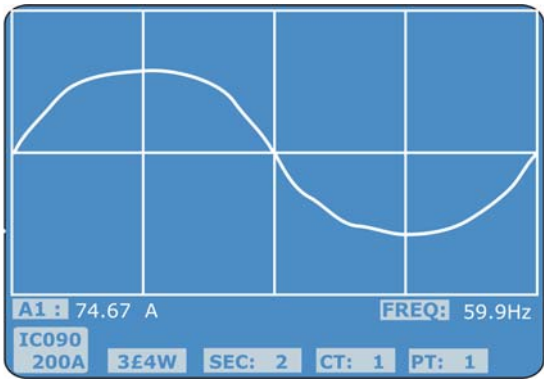


Figure 65.

3 Press "Waveform Key" once again will enter to Voltage/Current Waveform screen (see figure), then press "1Φ /3Φ Key" once in sequence will switch the Voltage/Current waveform from V1/A1 to V2/A2, V3/A3.

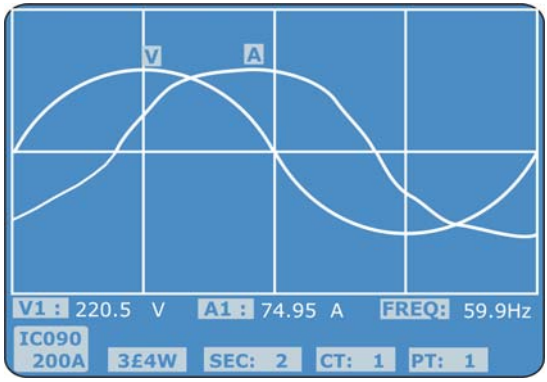


Figure 66.

5.10 Transient Capture (Dips, Swells, Outage)

1 If intend to make the Transient Capture measurement it should set the transient voltage level (high level, low level) at first , the setting procedures, please refere to chapter 5-5-9 and chapter 5-5-10.

2 Press "Transient Key" will enter to Transient Capture screen, insert the SD memory card then press the "REC Button" will make the measuremnt (see figure).

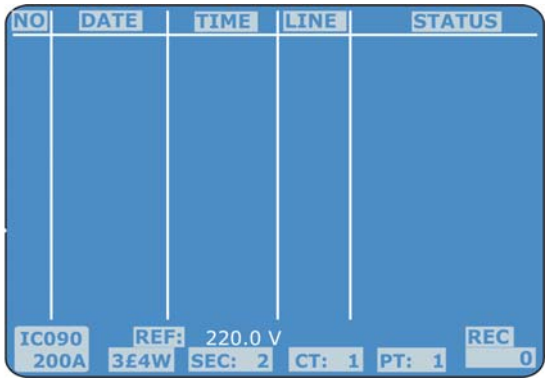


Figure 67.

3 Definition:

- **SWELL**:
  Vrms > (Vref + (Vref * SDVP%)).

- **DIP**
  Vrms < (Vref - (Vref * SDVP%)).

- **OUTAGE**
  Vrms < 30 V to 40 V.

- **Line item**:
  - V is the code show the all phase V1, V2, V3 ever happen the transient event.
  - V1, V2, V3 is the code that show each phase V1, V2, V3 ever happen the transient event (see figure).

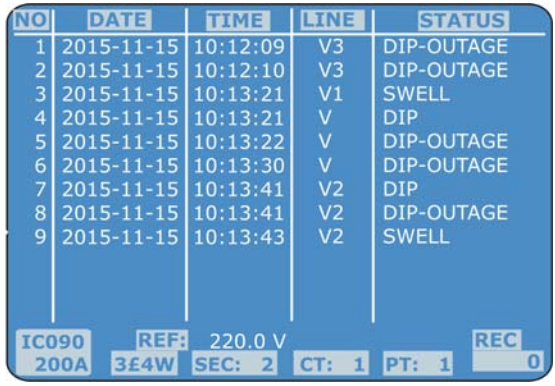


Figure 68.

4 Press the "REC Button" will exit the Transient Capture function (see figure).

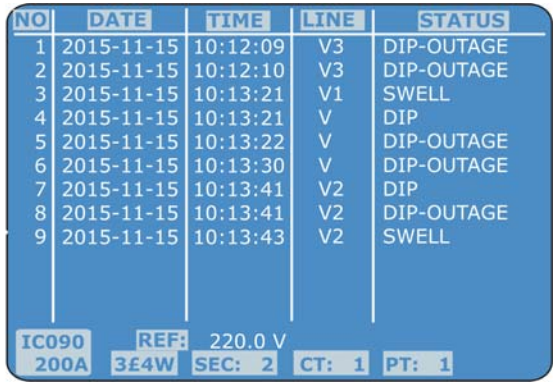


Figure 69.

5 One screen can show 13 transient events.
One file can record 99 transient events.
When the transient even more than 13 no, then press the "▼ Button" , "▲ Button" can show more transient events. If the transient events less than 13 no., "▼ Button", "▲ Button" are disable.

Remark:	When press "1Φ 3Φ Button" once in insequence, it can switch to the the transient measurement of different Wire connections such as 1P2W, 1P3W, 3P3W, 3P4W.

5.11 Data Logger function

1 Press REC KEY once to start the data record function.

- If the bottom right shows as "Change Card", it indicates the memory space is already full either or the SD CARD exist some wrong.
- If the SD CARD is normal, the data logger function will start to be executed.

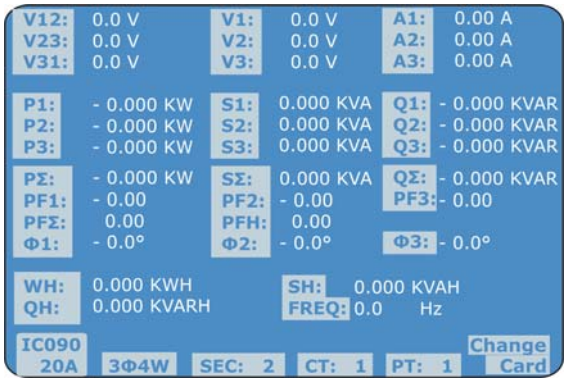


Figure 70.

2 The bottom right display will show the recorded data points.

- Each file can record up to 30,000 data points (see figure) when the record points exceed 30,000 points, system will create a new file automatically. (For example, WTA01001.XLS will be replaced by WTA01002.XLS)

Figure 71.

- While pressing REC KEY twice, the data logger function will stop to execute, the record points will disappear on bottom right display (see figure).

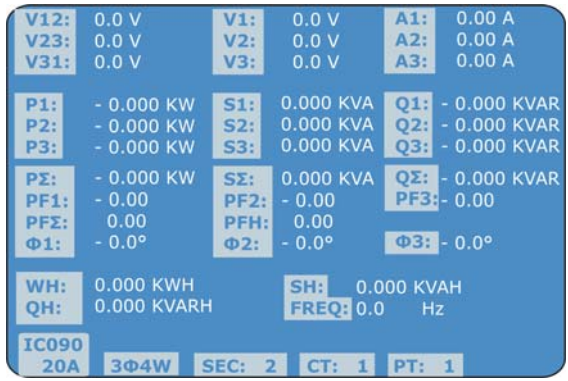


Figure 72.

5.12 Data HOLD Function

1 During the measurement, press HOLD KEY once, the bottom right display will show "HOLD symbol (see figure).

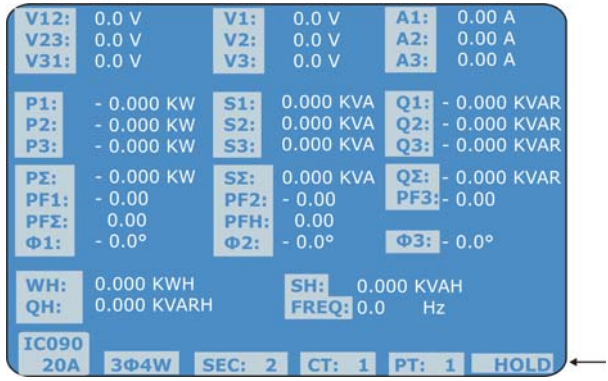


Figure 73.

2 Press the HOLD KEY twice will disable the Data HOLD function and the "HOLD" symbol will disappear in the meantime.

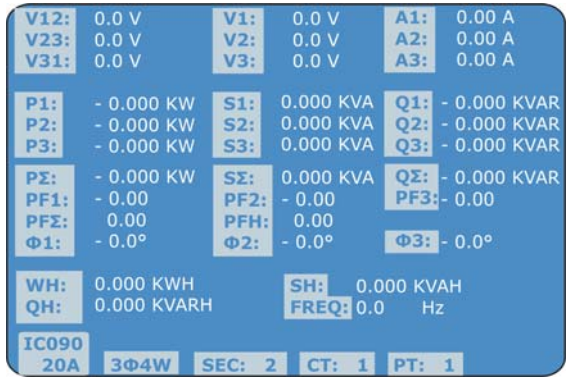


Figure 74.

5.13 Backlight Key

Control the backlight function of LCD to ON/OFF.

5.14 A Range (Current Range) KEY function

1. The A Range (Current Range) function key is used to change the current range quickly.

2. Press A RANGE KEY once will entry to screen (see figure).

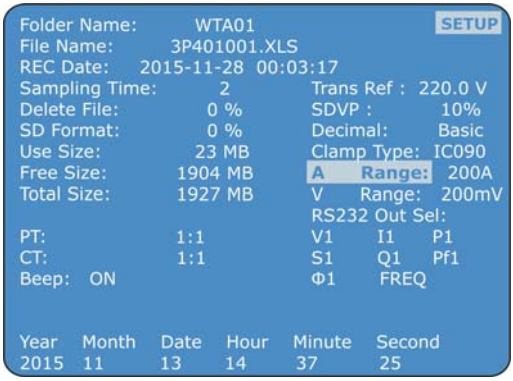


Figure 75.

3. The detail Current range Setting procedures, please reafer to section A range Setting (Current range Setting).

Remark:	The function of the "A Range (Current Range) key" is available for the Clamp Type, A Range, V Range setting only.

5.15 LowBat indicator

The LOWBAT screen: as show on lower right display of the following screen.

Figure 76.

5.16 Appendix 1

- **V12, V23, V31**: Line Voltage.
- **V1, V2, V3**: Phase Voltage.
- **A1, A2, A3**: Line Current.
- **P1, P2, P3**: True Power of each phase. (W).
- **S1, S2, S3**: Apparent Power of each phase. (VA).
- **Q1, Q2, Q3**: Reactive Power of each phase (VAR).
- **PΣ**: Total True Power (W).
- **SΣ**: Total Apparent Power (VA).
- **QΣ**: Total Reactive Power (VAR).
- **PF1, PF2, PF3**: Power Factor of each phase.
- **PFΣ**: Total Power Factor.
- **PFH**: Long Term Average Power Factor (WH/SH).
- **Φ 1, Φ 2, Φ 3**: Phase Angle of each phase.

- **WH**: Watt Hour.
- **SH**: Apparent Power Hour.
- **QH**: Reactive Power Hour.
- **1Φ 2W**: One phase by two wires.
- **1Φ 3W**: One phase by three wires.
- **3Φ 3W**: Three phases by three wires.
- **3Φ 4W**: Three phases by four wires.
- **SEC**: The sampling time of data logger.
- **CT**: Current transformer.
- **PT**: Potential transformer.

6 RS232 PC SERIAL OUTPUT

The instrument is provided an 3.5 mm dia. phone socket for RS232 computer interface socket.

The connector output is a 16 digits data stream which can be utilized to the user's specific application.

A RS232 lead with the following connection will be required to link the instrument with the PC serial input.

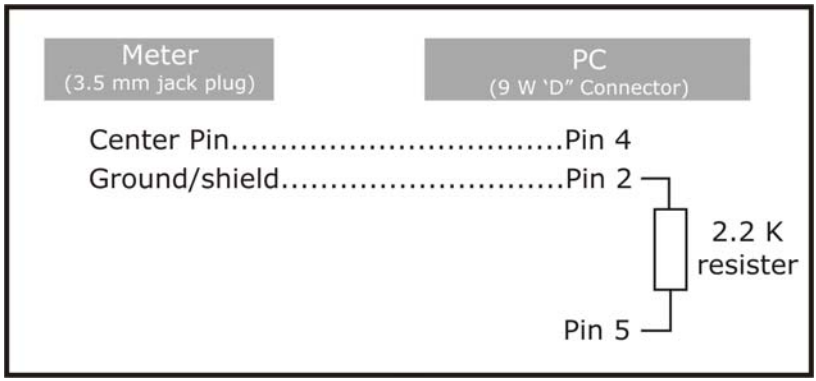


Figure 77.

The 16 digits data stream will be displayed in the following format:

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0

Each digit indicate the following status:

D15	Start Word		
D14	4		
D13	1		
D12 & D11	Annunciator for Display		
	03=%	B9=MACA	D0=MW/Hr
	31=HZ	C0=MW	D1=GW/Hr
	32=DEGREE	C1=GW	D2=TW/Hr
	48=K WATT	C2=TW	D3=KVA/Hr
	50=ACV	C3=MVA	D4=MVA/Hr
	52=ACA	C4=GVA	D5=GVA/Hr
	64=KVA	C5=TVA	D6=TVA/Hr
	65=KW/HR	C6=KVAR	D7=KVAR/Hr
	B6=KACV	C7=MVAR	D8=MVAR/Hr
	B7=MACV	C8=GVAR	D9=GVAR/Hr
	B8=KACA	C9=TVAR	E0=TVAR/Hr
D10	Polarity 0 = Positive 1 = Negative		
D9	Decimal Point (DP), position from right to the left 0 = No DP, 1 = 1 DP, 2 = 2 DP, 3 = 3 DP		
D8 to D1	Display reading, D1 = LSD, D8 = MSD For example: If the display reading is 1234, then D8 to D1 is: 00001234		
D0	End Word		

RS232 setting

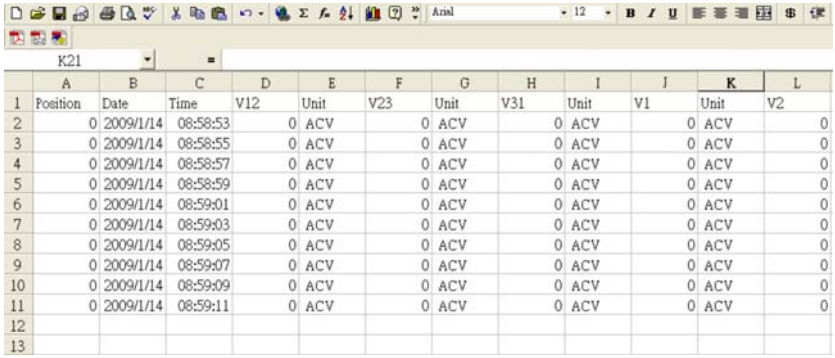
Baud rate	9600
Parity	No parity
Data bit no.	8 Data bits
Stop bit	1 Stop bit

7 DOWNLOAD THE SAVING DATA FROM THE SD CARD TO THE COMPUTER (EXCEL SOFTWARE)

1. After execute the Data Logger function, take away the SD card out from the " SD card socket ".

2. Plug in the SD card into the Computer's SD card slot (if your computer build in this installation) or insert the SD card into the "SD card adapter". then connect the "SD card adapter" into the computer.

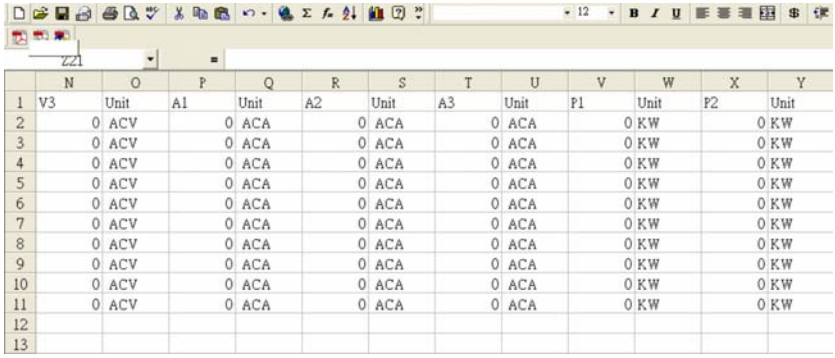
3. Power ON the computer and run the " EXCEL software ". Down load the saving data file (for example the file name : 3P401001.XLS, 1P201001.XLS, 1P301001.XLS, 3P301001.XLS...) from the SD card to the computer. The saving data will present into the EXCEL software screen (for example as following EXCEL data screens) , then user can use those EXCEL data to make the further Data or Graphic analysis usefully.



K21 =

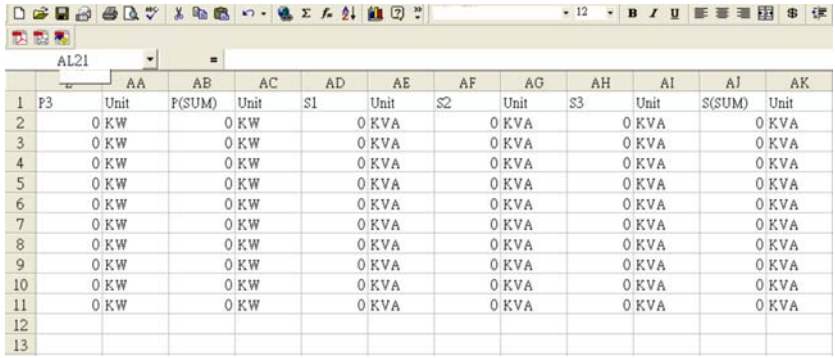
	A	B	C	D	E	F	G	H	I	J	K	L
1	Position	Date	Time	V12	Unit	V23	Unit	V31	Unit	V1	Unit	V2
2	0	2009/1/14	08:58:53	0	ACV	0	ACV	0	ACV	0	ACV	0
3	0	2009/1/14	08:58:55	0	ACV	0	ACV	0	ACV	0	ACV	0
4	0	2009/1/14	08:58:57	0	ACV	0	ACV	0	ACV	0	ACV	0
5	0	2009/1/14	08:58:59	0	ACV	0	ACV	0	ACV	0	ACV	0
6	0	2009/1/14	08:59:01	0	ACV	0	ACV	0	ACV	0	ACV	0
7	0	2009/1/14	08:59:03	0	ACV	0	ACV	0	ACV	0	ACV	0
8	0	2009/1/14	08:59:05	0	ACV	0	ACV	0	ACV	0	ACV	0
9	0	2009/1/14	08:59:07	0	ACV	0	ACV	0	ACV	0	ACV	0
10	0	2009/1/14	08:59:09	0	ACV	0	ACV	0	ACV	0	ACV	0
11	0	2009/1/14	08:59:11	0	ACV	0	ACV	0	ACV	0	ACV	0
12												
13												

Figure 78.



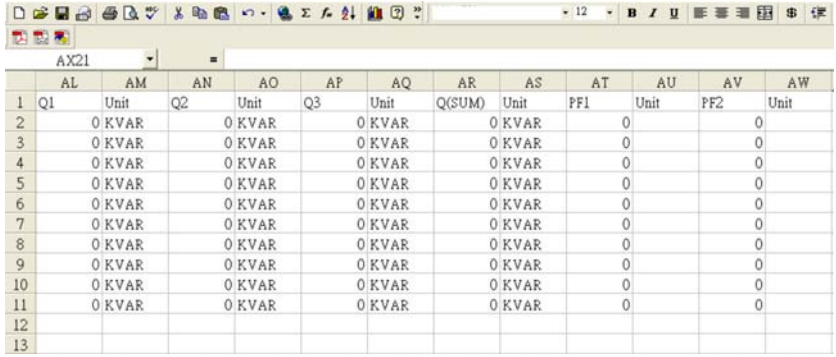
	N	O	P	Q	R	S	T	U	V	W	X	Y
1	V3	Unit	A1	Unit	A2	Unit	A3	Unit	P1	Unit	P2	Unit
2	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
3	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
4	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
5	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
6	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
7	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
8	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
9	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
10	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
11	0	ACV	0	ACA	0	ACA	0	ACA	0	KW	0	KW
12												
13												

Figure 79.



	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK
1	P3	Unit	P(SUM)	Unit	S1	Unit	S2	Unit	S3	Unit	S(SUM)	Unit
2	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
3	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
4	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
5	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
6	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
7	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
8	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
9	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
10	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
11	0	KW	0	KW	0	KVA	0	KVA	0	KVA	0	KVA
12												
13												

Figure 80.



	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW
1	Q1	Unit	Q2	Unit	Q3	Unit	Q(SUM)	Unit	PF1	Unit	PF2	Unit
2	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
3	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
4	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
5	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
6	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
7	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
8	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
9	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
10	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
11	0	KVAR	0	KVAR	0	KVAR	0	KVAR	0		0	
12												
13												

Figure 81.

BJ21

	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI
1	PF3	Unit	PF(SUM)	Unit	PFH	Unit	PHASE1	Unit	PHASE2	Unit	PHASE3	Unit
2	0		0		0		0	Degree	0	Degree	0	Degree
3	0		0		0		0	Degree	0	Degree	0	Degree
4	0		0		0		0	Degree	0	Degree	0	Degree
5	0		0		0		0	Degree	0	Degree	0	Degree
6	0		0		0		0	Degree	0	Degree	0	Degree
7	0		0		0		0	Degree	0	Degree	0	Degree
8	0		0		0		0	Degree	0	Degree	0	Degree
9	0		0		0		0	Degree	0	Degree	0	Degree
10	0		0		0		0	Degree	0	Degree	0	Degree
11	0		0		0		0	Degree	0	Degree	0	Degree
12												
13												

Figure 82.

BV13

	BJ	BK	BL	BM	BN	BO	BP	BQ	BR	BS	BT	BU
1	WH	Unit	SH	Unit	QH	Unit	FREQ	Unit				
2	0	KWH	0	KVAH	0	KVARH	0	Hz				
3	0	KWH	0	KVAH	0	KVARH	0	Hz				
4	0	KWH	0	KVAH	0	KVARH	0	Hz				
5	0	KWH	0	KVAH	0	KVARH	0	Hz				
6	0	KWH	0	KVAH	0	KVARH	0	Hz				
7	0	KWH	0	KVAH	0	KVARH	0	Hz				
8	0	KWH	0	KVAH	0	KVARH	0	Hz				
9	0	KWH	0	KVAH	0	KVARH	0	Hz				
10	0	KWH	0	KVAH	0	KVARH	0	Hz				
11	0	KWH	0	KVAH	0	KVARH	0	Hz				
12												
13												

Figure 83.

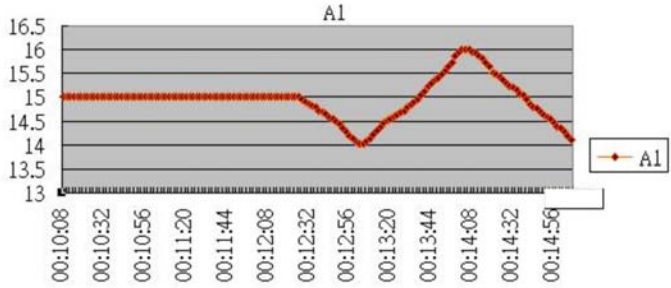


Figure 84.

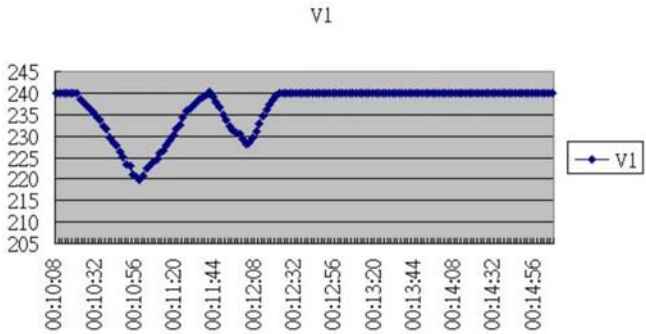


Figure 85.

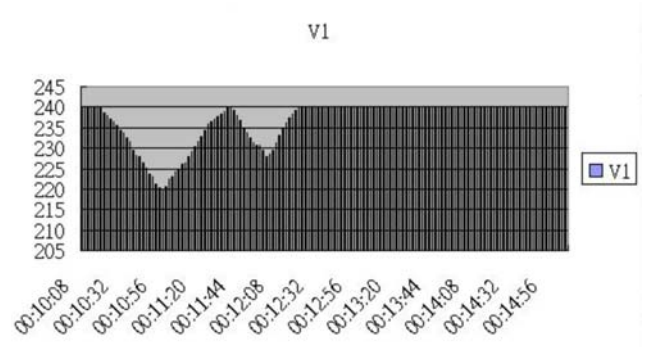


Figure 86.

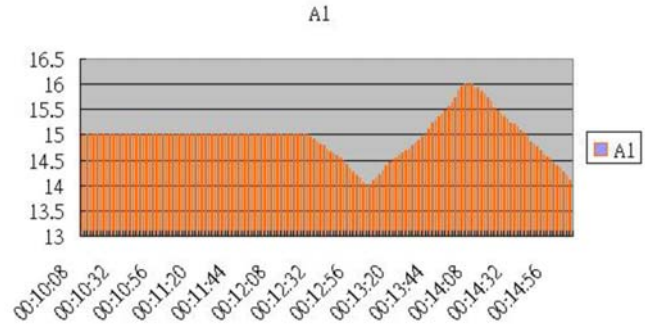


Figure 87.

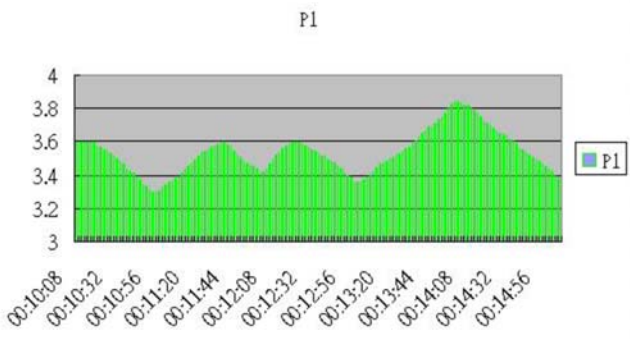

P1
4
3.8
3.6
3.4
3.2
3
P1
00:10:08
00:10:32
00:10:56
00:11:20
00:11:44
00:12:08
00:12:32
00:12:56
00:13:20
00:13:44
00:14:08
00:14:32
00:14:56

Figure 88.

8 SPECIFICATIONS

8.1 General Specifications

Circuit	Custom one-chip of microprocessor LSI circuit.	
Display	LCD Size: 81.4 X 61 mm (3.2 X 2.4 inch).	
	Dot Matrix LCD (320 X 240 pixels) with back light.	
Measurement	V (phase-to-phase).	
	V (phase-to-ground).	
	A (phase-to-ground).	
	KW / KVA / KVAR / PF (phase) KW / KVA / KVAR / PF (system) KWH / KVAH / KVARH / PFH (system)	
	Power factor	
	Phase angle	
	Frequency	
	Harmonics display.	
Wire connections	1P/2W, 1P/3W, 3P/3W, 3P/4W.	
Voltage ranges	10 ACV to 600 ACV, auto range.	
Current probe input signal and range	Current probe input signal voltage (ACV): 200 mV / 300 mV / 500 mV / 1 V / 2 V / 3 V.	
	Current probe input current range (ACA): 20 A / 200 A / 2000 A (1200 A) / 30 A / 300 A / 3000 A 60 A / 600 A / 6000 A.	
	Meter can cooperate the universal current probe.	
Safety standard	IEC1010 CAT III 600 V.	
ACV input impedance	10 Mega ohms.	
Range select	ACV Auto range.	
	ACA Manual range.	
Clamp frequency response	40 Hz to 1 KHz.	
Spec. tested frequency	45 to 65 Hz.	
Over load protection	ACV	720 ACV rms.
	ACA	1300 ACA with clamp probe. ■ For the Clamp ,CP-1201
Over Indicator	■ LCD display show "OL". ■ The data save into the SD card will show "9999" or "999" (overleap the decimal point).	

Under Indicator	■ LCD display show "UR". ■ The data save into the SD card will show "9999" or "999" (overleap the decimal point).
Data Hold	Freeze the display reading.
Data Record	SD Card Record.
Sampling Time	Approx. 1 second.
Power ON/OFF	Manual OFF by push button.
Real time data logger	Real time data logger, saved the data into SD memory card and down load the all the measured value with the time information (year/month/data/hour/minute/second) down load to the Excel.
	Sampling time for data logger: 2 seconds to 7200 seconds, the during of setting step are 2 seconds.
	Data error no.: ≤ 0.1% no. of total saved data typically.
Data Output **USB/RS232** *** Computer interface**	■ Connect the USB cable will get the USB plug. ■ Connect the RS232 cable will get the RS232 plug.
Operating Temperature	0 to 50 °C.
Operating Humidity	Less than 80% R.H.
Power Supply	■ DC 1.5V, AA (UM-3) Battery X 8 PCs (Alkaline or heavy-duty battery) ■ AC to DC 9V power adapter.
Power Consumption	■ Meter : 270 DCmA. ■ Clamp : 22 DCmA.
Clamp max. conductor Size	50 mm (2.0 inch) Dia. For the Clamp ,CP-1201
Weight	Meter: 1010 g (includes batteries) Clamp (includded cable): 500 g
Dimension	Meter: 225 X 125 X 64 mm (8.86 X 4.92 X 2.52 inch)
	Clamp: 210 X 64 X 33 mm (8.3 X 2.5 X 1.3 inch)
	Clamp Jaw: 86 mm (3.4 inch)- outside

Accessories Included	Instruction manual	1 PC
	Test Leads (TL88-4AT)	1 Set (4 PCs)
	Alligator clips (TL88-4AC)	1 Set (4 PCs)
	Clamp Probe (CP-1201)	3 PCs
	AC to DC 9V adapter	1 PC
	SD card (2 G)	1 PC
	Carrying bag	1 PC

NOTE: Equipment specifications are set in these environmental operating conditions. Operation outside these specifications are also possible. Please check with us if you have specific requirements.

RECOMMENDATIONS FOR PACKING

It is recommended to keep all the packing material permanently in case you need to return the equipment to the Technical Assistance Service.

8.2 Electrical Specifications (23± 5 ºC)

ACV

Range	Resolution	Accuracy
10.0 V to 600.0 V * Phase to neutral line	0.1 V	± (0.5%+0.5 V)
10.0 V to 600.0 V * Phase to phase		

ACA

Range	Resolution	Accuracy	
20 A	0.001 A, < 10 A 0.01 A, ≥ 10 A	Meter + CP-1201	± (1 % + 0.1 A)
		Meter only	± (0.5 % + 0.02 A)
200A	0.01 A, < 100 A 0.1 A, ≥ 100 A	Meter + CP-1201	± (1 %+0.5 A)
		Meter only	± (0.5 %+0.2 A)
1200A	0.1 A, < 1000 A 1 A, ≥ 1000 A	Meter + CP-1201	± (1 %+5 A)
		Meter only	± (0.5 %+2 A)

Remark: When the Active power value (P1 to P3) and Apparent power value (S1 to S3) show "-" indicator, it means the current probe is under the reverse direction that compare with the real measuring current.

POWER FACTOR

Range	Resolution	Accuracy
0.00 to 1.00	0.01	± 0.04

Remark: * PFH: Long term power factor.
* PFΣ:
For 3Φ 4W, 3Φ 3W, 1Φ 3W: PFΣ = PΣ /SΣ
For 1Φ 2W: PF1 = P1/S1

Φ (Phase angle)

Range	Resolution	Accuracy
-180° to 180°	0.1°	± 1° * *ACOS (PF)*

Frequency

Range	Resolution	Accuracy
45 to 65 Hz	0.1 Hz	0.1 Hz

Active (Real) Power

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KW	*0.001/0.01/0.1 KW	± (1.2 %+0.008 KW)
10.00 to 99.99 KW	*0.01/0.1 KW	± (1.2 %+0.08 KW)
100.0 to 999.9 KW	0.1 KW	± (1.2 %+0.8 KW)
1.000 to 9.999 MW	0.001 MW	± (1.2 %+0.008 MW)

* The resolution is changed according the different ACA range.

Apparent Power

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KVA	*0.001/0.01/0.1 KVA	± (1.2 %+0.008 KVA)
10.00 to 99.99 KVA	*0.01/0.1 KVA	± (1.2 %+0.08 KVA)
100.0 to 999.9 KVA	0.1 KVA	± (1.2 %+0.8 KVA)
1.000 to 9.999 MVA	0.001 MVA	± (1.2 %+0.008 MVA)

* The resolution is changed according the different ACA range.

Reactive Power

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KVAR	*0.001/0.01/0.1 KVAR	± (1.2 %+0.008 KVAR)
10.00 to 99.99 KVAR	*0.01/0.1 KVAR	± (1.2 %+0.08 KVAR)
100.0 to 999.9 KVAR	0.1 KVAR	± (1.2 %+0.8 KVAR)
1.000 to 9.999 MVAR	0.001 MVAR	± (1.2 %+0.008 MVAR)

* The resolution is changed according the different ACA range.

Remark: When the Reactive power value (Q1 to Q3) show " - " indicator, it means the " current phase " lag than the " voltage phase ", the load character is induction.

When the Reactive power value (Q1 to Q3) do not show " - " indicator, it means the " current phase " lead than the " voltage phase ", the load character is capacitance.

Watt Hour (Active Power Hour): WH

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KWH	0.001 KWH	± (2 %+0.008 KWH)
10.00 to 99.99 KWH	0.01 KWH	± (2 %+0.08 KWH)
100.0 to 999.9 KWH	0.1 KWH	± (2 %+0.8 KWH)
1.000 to 9.999 MWH	0.001 MWH	± (2 %+0.008 MWH)

VA Hour (Apparent Power Hour): SH

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KVAH	0.001 KVAH	± (2 %+0.008 KVAH)
10.00 to 99.99 KVAH	0.01 KVAH	± (2 %+0.08 KVAH)
100.0 to 999.9 KVAH	0.1 KVAH	± (2 %+0.8 KVAH)
1.000 to 9.999 MVAH	0.001 MVAH	± (2 %+0.008 MVAH)

VAR Hour (Reactive Power Hour): QH

IC-090 + CP1201

Range	Resolution	System Accuracy
0.000 to 9.999 KVARH	0.001 KVARH	± (2%+0.008 KVARH)
10.00 to 99.99 KVARH	0.01 KVARH	± (2%+0.08 KVARH)
100.0 to 999.9 KVARH	0.1 KVARH	± (2%+0.8 KVARH)
1.000 to 9.999 MVARH	0.001 MVARH	± (2%+0.008 MVARH)

Harmonics of AC voltage in Magnitude

* Fundamental frequency 50 Hz, 60 Hz

IC-090 + CP1201

Range	Resolution	System Accuracy
1 to 20th	0.1 V	± (2 % + 0.5 V)
21 to 30th		± (4 % + 0.5 V)
31 to 50th		reference

Harmonics of AC voltage in Percentage

* Fundamental frequency 50 Hz, 60 Hz

IC-090 + CP1201

Range	Resolution	System Accuracy
1 to 20th	0.1 %	± (2 % + 0.5 V)
21 to 30th		± (4 % + 0.5 V)
31 to 50th		reference

Harmonics of AC current in Magnitude

* Fundamental frequency 50 Hz, 60 Hz

IC-090 + CP1201

Range	Resolution	System Accuracy
1 to 20th	0.001 A to 1 A	± (2 % + 0.5 A)
21 to 30th		± (4 % + 0.5 A)
31 to 50th		reference

Harmonics of AC current in Percentage

* Fundamental frequency 50 Hz, 60 Hz

IC-090 + CP1201

Range	Resolution	System Accuracy
1 to 20th	0.001 %	± (2 % + 0.5 d)
21 to 30th		± (4 % + 0.5 d)
31 to 50th		reference

Peak value of ACV or ACA

IC-090 + CP1201

Range	Resolution	System Accuracy
ACV (Peak to Peak)	0.1 V to 1 V	± (5 % + 30 d)
ACA (Peak to Peak)	0.001 A to 1 A	

Crest Factor of ACV or ACA

IC-090 + CP1201

Range	Resolution	System Accuracy
1.000 - 9.999	0.001	± (5 % + 0.3)

Total Harmonic Distortion

IC-090 + CP1201

Range	Resolution	System Accuracy
0 to 20 %	0.1 %	± (2 % + 5 d)
20.1 to 100 %		± (6 % + 10 d)

9 MAINTENANCE

Caution: **Remove test leads before opening the battery cover or housing case!**

9.1 Cleaning

Caution: **Cleaning - Only use the dry cloth to clean the plastic case!**

9.2 Replacement of batteries

1. When Display show the "LOWBAT" indicator, it should change the batteries.
2. Open the "Battery Cover" away from the instrument and remove the battery.
3. Replace with batteries (DC 1.5 V, AA battery X 8 PCs) and reinstate the cover.

   * **When install the batteries, should make attention the battery polarity.**

4. Make sure the battery cover is secured after changing the batteries.

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