4015A
Operation Manual

S/N：9004015A01 REV：A

Material Contents Declaration

(材料含量宣称**)**

(Part Name) 零件名称	Hazardous Substance (有毒有害物质或元素)					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr6+)	多溴 联苯 (PBB)	多溴 二苯醚 (PBDE)
PCBA (印刷电路装配件)	X	O	X	O	O	O
Electrical part not on PCBA's 未在PCBA上的电子零件	X	O	X	O	O	O
Metal parts 金属零件	O	O	O	X	O	O
Plastic parts 塑料零件	O	O	O	O	X	X
Wiring 电线	X	O	O	O	O	O
Package 封装	X	O	O	O	O	O

对销售之日的所售产品,本表显示, PRODIGIT 供应链的电子信息产品可能包含这些物质。注意:在所售产品中可能会也可能不会含有所有所列的部件。This table shows where these substances may be found in the supply chain of Prodigit electronic information products, as of the date of sale of the enclosed product. Note that some of the component types listed above may or may not be a part of the enclosed product. ○：表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T 11363-2006 标准规定的限量要求以下。○：Indicates that the concentration of the hazardous substance in all homogeneous materials in the parts is below the relevant threshold of the SJ/T 113632006 standard. ×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T 11363-2006 标准规定的限量要求。×： Indicates that the concentration of the hazardous substance of at least one of all homogeneous materials in the parts is above the relevant threshold of the SJ/T 11363-2006 standard.

Note(注释):

1.Prodigit has not fully transitioned to lead-free solder assembly at this moment；However, most of the components used are RoHS compliant.
 (此刻，Prodigit 并非完全过渡到无铅焊料组装；但是大部份的元器件一至于RoHS的规定。)

2. The product is labeled with an environment-friendly usage period in years.
 The marked period is assumed under the operating environment specified in the product specifications.
 (产品标注了环境友好的使用期限制(年)。所标注的环境使用期限假定是在此产品定义的使用环境之下。)

Example of a marking for a 10 year period:
(例如此标制环境使用期限为10年)

SAFETY SUMMARY

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 violates safety standards of design, manufacture, and intended use of the instrument. PRODIGIT assumes no liability for the *customer's failure to comply with these requirements.*

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category I, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 80% and at altitudes of up to 2000 meters. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the ac power supply mains through a three conductor power cable, with the third wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired

Fuses or short circuited fuse holder. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

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

DO NOT SERVICE OR ADJUST ALONE.

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

DO NOT EXCEED INPUT RATINGS.

This instrument may be equipped with a line filter to reduce electromagnetic interference and must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0 mA peak.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a PRODIGIT ELECTRONICS Sales and Service Office for service and repair to ensure that safety features are maintained. *Instruments which appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.*

SAFETY SYMBOLS

$\overline{\underline{}}$ ---   **Direct current (DC)**

     Alternating current (AC)

     Both   direct   and   alternating

3∼   **Three-phase alternating current**

     Protective earth (ground)

     On (Supply)

     Off (Supply)

     Fuse

     Caution ! Refer to this manual before using the meter.

     Caution, risk of electric shock

CAT IV – Is for measurements performed at the source of the low-voltage installation.

CAT III – Is for measurements performed in the building installation.

CAT II – Is for measurements performed on circuits directly connected to the low-voltage installation.

CAT I – Is for measurements performed on circuits not directly connected to Mains.

4015A AC/DC Digitizing Power Meter
Table of Contents

Chapter 1 Introduction

1-1. General Description

- 4015A Digital Power Meter is designed to measure the power line parameters of AC / DC and DC / DC power supply. It is suitable for AC / DC Adapter, Charger, Quick Charger, LED Driver and DC / DC Converter. It is also suitable for uninterruptible power supply UPS, Regulators AVR, Inverter, batteries, AC / DC power supply / components ... and other applications.

- 4015A digital power meter has three input source selection switch internally, according to the test needs to program that one of as input of the power meter.

- Each channel of 4015A digital power meter has a 200Apeak power MOSFET switch parallel relay switch as the output switch, it can adjustable output on / off and AC any angle, used to test the Inrush current and Hold up time.

- 4015A digital power meter contains 1 ~ 4 channels digital power meters, each power meter has a group of high-speed 16-Bits A / D Converter, sampling the voltage and current signals respectively. After the conversion, the data is calculated by a high-speed DSP processor. After calculation is completed, the data is transmitted to the host processor and read the relevant information through the RS-232 interface.

- The 4015A has a built-in 4-channel stand alone AC Source / AVR selector switch and output a 200Apeak, 0 ~ 360º ON / OFF high-speed switch that turns on the power to be tested one by one and accurately measures Inrush currents up to 200Apeak.
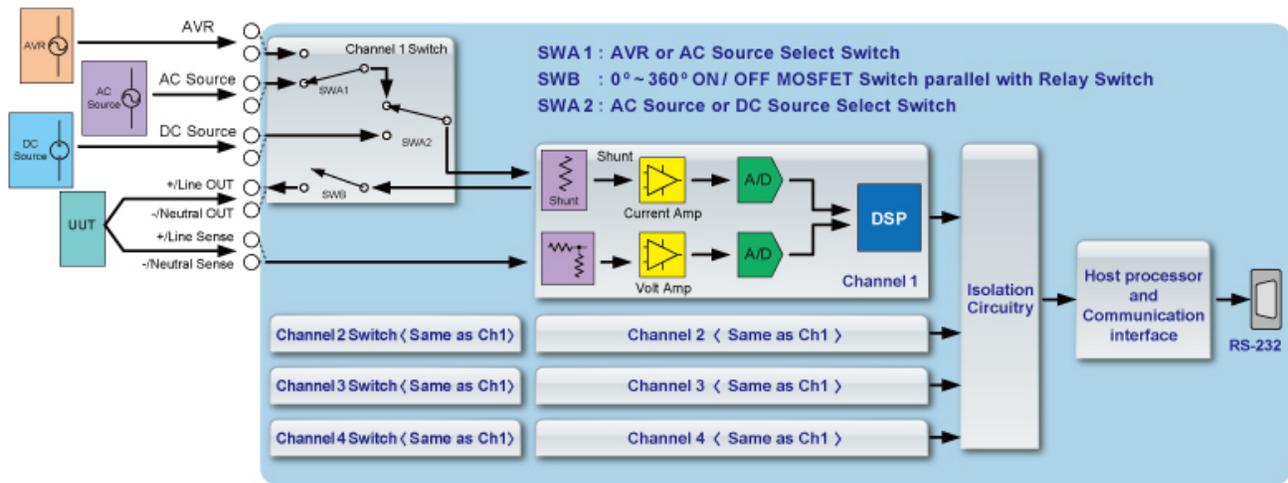

4015A Structure diagram

- 4015A digital power meter can be used with Prodigit 6010 ATE for Charger / Adapter and LED driver where current harmonics measurement is required. It can use with 5302A 270VA AC Source or 5310 1KVA AC Source and 5303 3KVA AVR for AC voltage, current, power parameters measurement that measured with the DC Load and then further measure the test unit's efficiency and get the related information.

- For AC / DC power supplies with output power within 30W, needs 4 units to be tested simultaneously, only one 5302A or 5310 AC Source is needed, if the output power> 30W but less than 60W, you can choose 2 units 5302A or 1 unit 5310 1KVA AC Source. 6010 ATE architecture is very flexible, it can use one 4015A 4 Channel Power Meter with 1 unit AC Source to test 4 units

test unit power supply, and allow to use 2 units AC power supply or 4 units AC power supply, as shown below ...
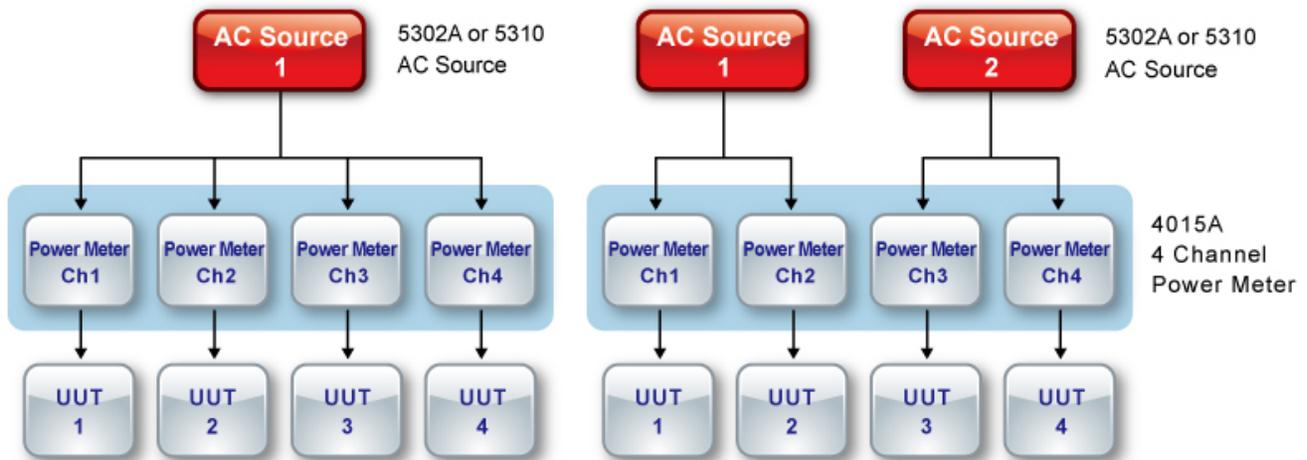
6010 ATE with 1 units AC Source and
1 units 4015A Power Meter

6010 ATE with 2 units AC Source and
1 units 4015A Power Meter
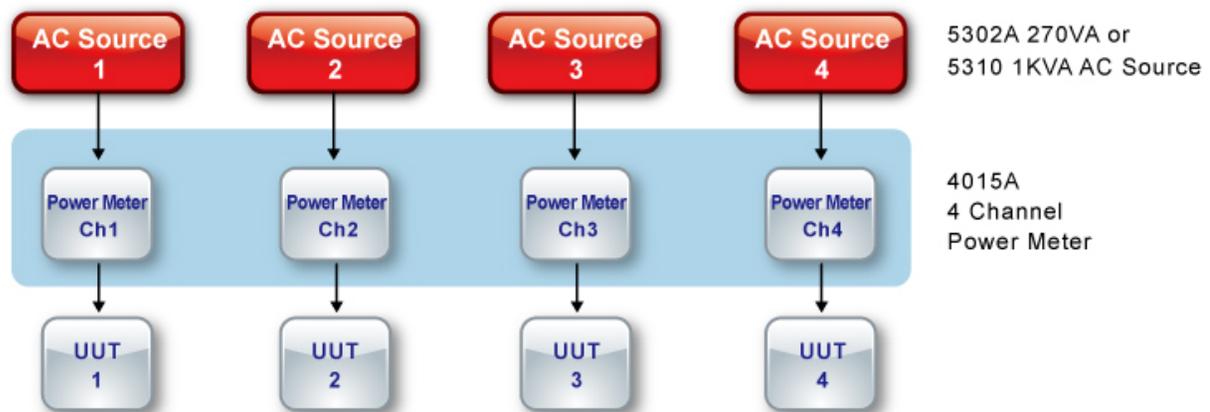
6010 ATE with 4 units AC Source and 1 units 4015A Power Meter

The 4015A digital power meter performs Inrush Current measurements can be implemented with 5302A/5310 ACSource and 5303 3KVA AVR. The 5303 3KVA AVR provides up to 200Apeak of instantaneous current, the 4015A digital power meter selects the input source to 5303 3KVA AVR when the Inrush Current test is in progress. The built-in output switch controls ON or OFF can be any voltage phase angle, then the Inrush Current can be measured by the 4015A Power Meter.
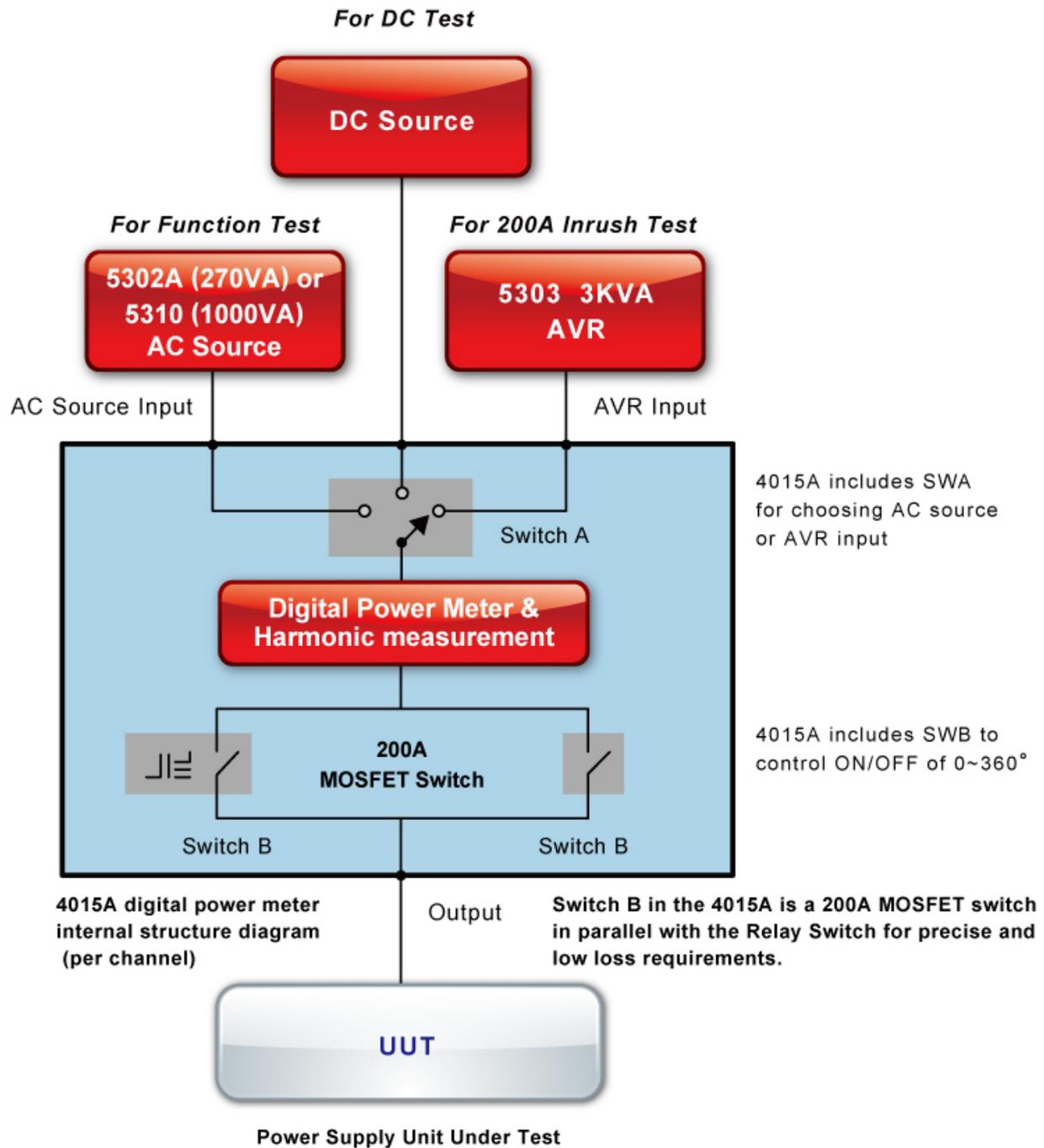
- ## 4015A digital power meter is the best Inrush Current test solution.

Inrush Current of Prodigit 6010 ATE adopts time distributed switch design, 5303 3KVA AVR Supply 230V / 264V / 277V, also can customized Inrush Current test power supply of other voltage value, can supply high current of 200Apeak.

The 4015A Power Meter has a built-in 4 channel time distributed Inrush Current high-speed switch capable of powering up four of the 99093 dual test fixture power supplies to be tested individually and accurately testing Inrush Current up to 200A.

Through the ingenious arrangement of the 5303 AVR and the 4015A Power Meter, the 6010 ATE can measure and accurately measure Inrush Current up to 200Apeak, and simultaneously test the Inrush Current for the four power supplies under test. The 6010 ATE requires only a typical ATE 25% AC power capacity compare to other ATE system, in addition to testing Inrush Current more accurate, but also save you the expensive, bulky, 400% more specifications AC power.

Specifically, it is sufficient to use one 5302A 270VA or 5310 1KVA power supply for an AC / DC power supply within 30W output (Note: The AC / DC power supply efficiency is 70%, the power factor PF is 0.7, so the 30W output AC / DC power supply its input power is about 60VA), the total AC input power of 4 units AC / DC power supplies is 240VA. When testing Inrush Current, the input of AC / DC power is switched by Switch A the output of 5303 3KVA AVR, and then 4 unit AC / DC power supply connect to each Channel of 4015A's Switch B, the Inrush Current test is one by one at different time division, so the 5303 AVR only needs to provide 200Apeak that can be provided without up to 800Apeak = 200Apeak x 4 instantaneous current (other ATE system), and finally the Inrush current test is completed, the 6010 ATE switches the input of the AC / DC power supply to the 5302A AC Source via Switch A. This is a significant optimization of the 6010 ATE for AC Source, therefore, the 6010 ATE does not require a particularly large AC power supply, but it still can accurately measure the Inrush's method.

For DC Test

DC Source

For Function Test

5302A (270VA) or 5310 (1000VA) AC Source

For 200A Inrush Test

5303 3KVA AVR

AC Source Input

AVR Input

Switch A

4015A includes SWA for choosing AC source or AVR input

Digital Power Meter & Harmonic measurement

200A MOSFET Switch

4015A includes SWB to control ON/OFF of 0~360°

Switch B

Switch B

4015A digital power meter internal structure diagram (per channel)

Output

Switch B in the 4015A is a 200A MOSFET switch in parallel with the Relay Switch for precise and low loss requirements.

UUT

Power Supply Unit Under Test

## 6010 ATE Inrush Current Test Report

```
Display Report Channel => 1                    ☐ System Auto detect Start key
STEP.1  : Inrush Current Test (230V50Hz Max Load)
 Vin  (V) = 230.0
 Fin (Hz) = 50.0
 Angle    = 90.0

 Io(A)
 -------
 1.00
InrushMax   InrushMin   Inrush+(A)   Inrush-(A)
---------   ---------   ----------   ----------
  100.0        0.0        55.84        0.00
=================================================================
```

1. 5303AVR
   AC voltage
   (Switch A 選擇 AVR Input)

2. Channel 1 inrush current

3. Channel 2 inrush current

4. Channel 3 inrush current

5. Channel 4 inrush current
   (Simulation)
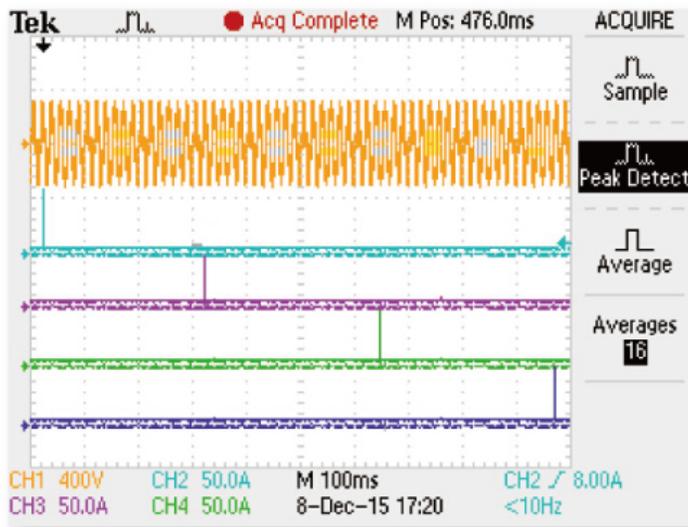
This is the waveform of 4 units UUT power supplies are divided into channels 1~channel 4 on the 6010 ATE to test the Inrush current one by one.

1. Ch1 Output
   AC voltage
   (Switch B OFF→ON 90度開機)

2. Channel 1 inrush current

3. Channel 2 inrush current

4. Channel 3 inrush current

5. Channel 4 inrush current
   (Simulation)
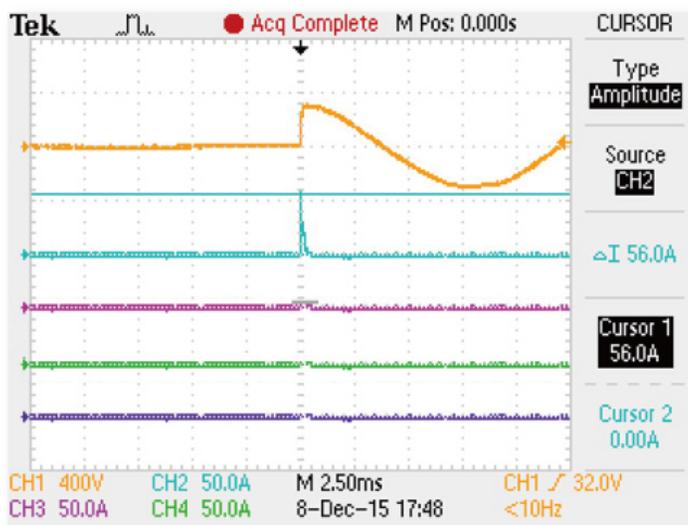


4015A power meter channel 1 :
The waveform of inrush current measured by Switch B when the power waveform is turned on at 90°
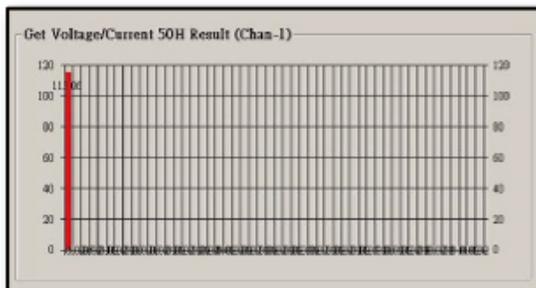
- ## THD measurements :

The 4015A Power Meter in the 6010 ATE has built-in 4 power meters that measure 4 sets of Inrush Current AC / DC and can simultaneously test 4 sets of AC / DC or DC / DC V / A / W / PF, V / A 50 order harmonics, 4015A voltage 6 ranges, can measure 500VAC or DC current 8 ranges plus Inrush 200A total 9 ranges, the power measurement from 0.3W ~ 10000W total 48 ranges, the minimum measured 0.01mW, 6010 ATE effectively supports Energy Star and Standby Power measurements.
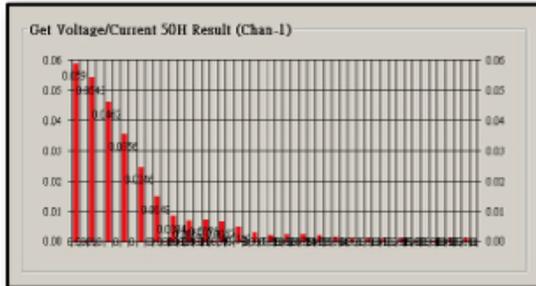
Charger current harmonic chart of 4015A
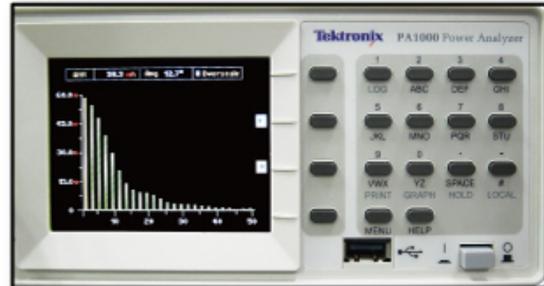
Charger current harmonic chart by PA1000 Power Analyzer

AC voltage harmonic chart of 4015A
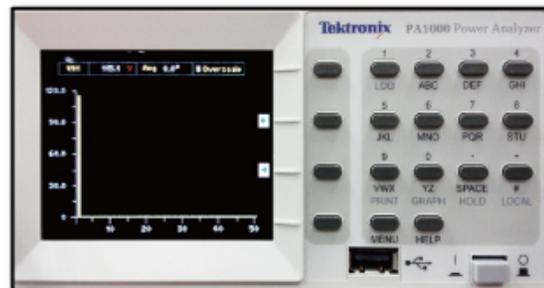
AC Voltage harmonic chart by PA1000 Power Analyzer

- ## Standby Power Measurements:

For AC / DC, DC / DC low power standby power measurement needs, 4015A Digital Power Meter Provides Energy Measurements solution to Measure Standby Power accurately using Integrated Power, Integrated Time, and Average Power Measurements Consumption.

1-2. Features

- Suitable for ATE: 500V 20A, 10000W AC/DC Digital Power Meter。

- Voltage Range：15 / 30 / 50 / 150 / 300 / 500Vrms

- Current Range：0.02 / 0.05 / 0.2 / 0.5 / 2 / 5 / 10 / 20Arms、200Apeak（for Inrush）

- 0.1% high accuracy

- Measure AC / DC voltage, AC / DC current, AC / DC power, AC power factor, AC frequency, Inrush current and V/A Harmonic parameters.

- Measure voltage / current harmonics up to 50th order, and total harmonic distortion .

- Frequency range DC、40~70Hz。

- Measuring module: 1 ~ 4CH, standard is 4 channels, option 1, 2, 3 Channel is available。

- The built-in internal low-pass filter (50KHz) can eliminate unnecessary high-frequency interference

- With AC, DC, AVR 3 sets of power input, through the control of choice of input power to achieve AC / DC or DC / DC test flexibility.

- With 0 ~ 360º 200Apeak output switch, can control the output on / off angle, you can accurately measure the Inrush current.

1-3. Standard Accessories

1. 4015A Operation Manua.................................1 PC
2. Power Cord …………………………………....... 1 PC
3. RS232 Cable ………………………………...... .1 PC

1-4. Power Specifications

AC Input Rating	
Voltage range	100~230Vac±10%
Frequency range	47-63Hz
Fuse	T2A/250V(5×20 mm)
Dimension	440W × 398D × 88.9Hmm
Weight	10 kg

Table 1-1 Specifications

1-5. Specifications

MODEL	4015A		
No. of Input Channel	4		
ACV meter (Vrms)	15V / 0.001V 150V / 0.01V	30V / 0.001V 300V / 0.01V	50V / 0.001V 500V / 0.01V
Accuracy	± 0.1% of (Reading + Range)		
ACA meter (Arms)	20mA / 0.001mA 50mA / 0.001mA 200mA / 0.01mA	500mA / 0.01mA 2A / 0.1mA 5A / 0.1mA	10A / 1mA 20A / 1mA 200A peak / 0.01A
Accuracy	±0.1% of (Reading + Range) ±2% of (Reading + Range) for Inrush		
ACW meter	0.3W / 0.01mW 0.75W / 0.1mW 3W / 0.1mW 7.5W / 1mW 30W / 1mW 75W / 1mW 150W / 10mW 300W / 10mW	0.6W / 0.01mW 1.5W / 0.1mW 6W / 0.1mW 15W / 1mW 60W / 1mW 150W / 1mW 300W / 10mW 600W / 10mW	1W / 0.1mW 2.5W / 0.1mW 10W / 1mW 25W / 1mW 100W / 10mW 250W / 10mW 500W / 10mW 1000W / 0.1W
	3W / 0.1mW 7.5W / 1mW 30W / 1mW 75W / 10mW 300W / 10mW 750W / 10mW 1500W / 0.1W 3000W / 0.1W	6W / 0.1mW 15W / 1mW 60W / 1mW 150W / 10mW 600W / 10mW 1500W / 0.1W 3000W / 0.1W 6000W / 0.1W	10W / 1mW 25W / 1mW 100W / 10mW 250W / 10mW 1000W / 0.1W 2500W / 0.1W 5000W / 0.1W 10000W / 1W
Accuracy	± 0.1% of (Reading + Range)		
DCV meter	Same as ACV		
Accuracy	Same as ACV		
DCA meter	Same as ACA		
Accuracy	Same as ACA		
DCW meter	Same as ACW		
Accuracy	Same as ACW		
PF meter	± 0.001~1.000 / 0.001		
Accuracy	1% of (Reading + Range)		
Frequency meter	40~70 / 0.001		
Accuracy	± 0.1Hz		
V/A Harmonic	1~50 th / Same as ACV, ACA meter		
Accuracy	± 0.5% of (Reading + Range)		
V/A THD	0%~255% / 0.001%		
Accuracy	± 0.5% of (Reading + Range)		
Inrush Delay/Period	0~100ms		
Low Pass Filter(V & A)	50KHz		
Interface	GPIB		

Select Switch Current：20A Max.

ON/OFF Switch Current：20A Max.〈200Apeak Max.〉
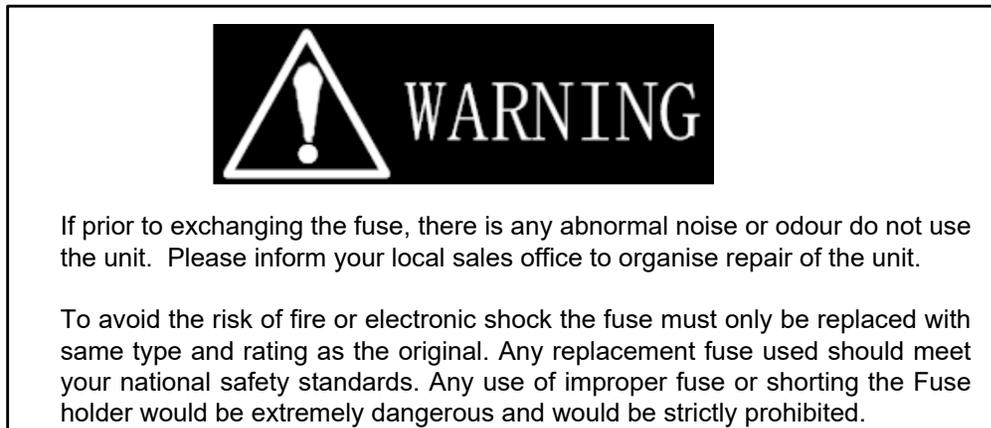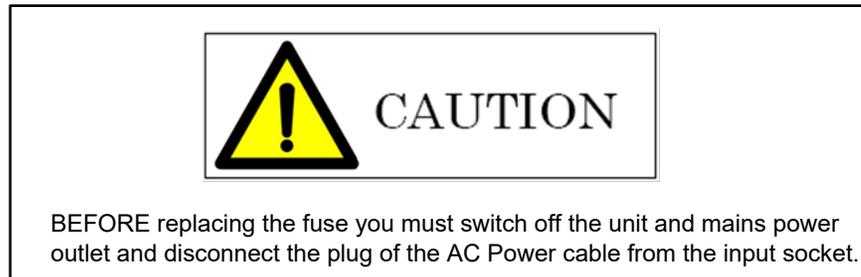
Inrush Current：200Apeak Max.

Chapter 2 Installation

2-1. Inspection

The 4015A digital power meter was carefully inspected before shipment. If instrument damage has occurred during transport, please inform Prodigit's sales and service office or representative.

2-2. Check line fuse

This product is fitted with a mains input fuse. If it needs to be replaced, please adhere to the following procedure.

CAUTION

BEFORE replacing the fuse you must switch off the unit and mains power outlet and disconnect the plug of the AC Power cable from the input socket.

WARNING

If prior to exchanging the fuse, there is any abnormal noise or odour do not use the unit. Please inform your local sales office to organise repair of the unit.

To avoid the risk of fire or electronic shock the fuse must only be replaced with same type and rating as the original. Any replacement fuse used should meet your national safety standards. Any use of improper fuse or shorting the Fuse holder would be extremely dangerous and would be strictly prohibited.

2-2.1   Check the rating of the mains input fuse. Replace only with the correct type and rating. The fuse type and rating is T1.0/250V (5*20mm).
2-2.2   The AC line fuse is located below the AC line recepitacle (see Fig 2-1). Use A small screwdriver to remove the fuse holder. Replace the failed fuse.
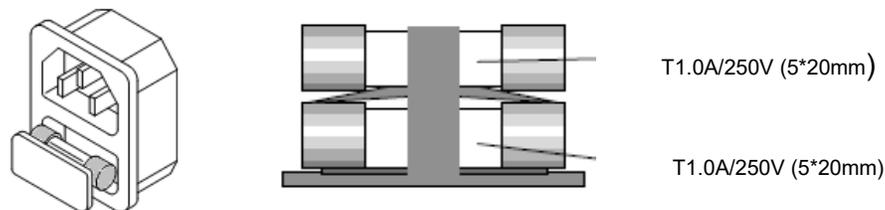2-2.3   Refit the fuse holder and connect the power cord.

T1.0A/250V (5*20mm)

T1.0A/250V (5*20mm)

Fig 2-1 FUSE RECEPTACLE

2-3. Grounding requirements

Shock Hazard

The unit is grounded via the AC Input. It must be ensured that the correct mains lead with earth pin is used. Correct grounding of your electrical system infrastructure according to national standards must also be observed.

2-4. Environmental reduirements

2.4.1 Indoor use.
2.4.2 Installation category I.
2.4.3 Pollution degree 2.
2.4.4 Altitude up to 2000 meter.
2.4.5 Relative humidity 80%.
2.4.6 Ambient temperature 0℃～40℃.
2.4.7 The ideal operating temperature is 25°C ± 5°C.

2-5. Repair and correct serving

If the instrument is damaged, please attach a tag to the instrument to identify the owner and indicated the require service or repairing. And inform the Prodigit sales and service office or representative.

2-6. Clean

Use a soft or slightly damp cloth to clean this product.

‧ BEFORE you clean the unit, switch the mains power off and disconnect the input lead.
‧ Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
‧ Please ensure that no liquid is allowed to penetrate this product。

2-7. RS232 interface function

4015A digital power meter has offered a RS-232(FEMALE) to connect the device on the rear panel of 4015A; this connection device connects the port with computer RS-232 to join by way of one of one.

2-8. GPIB BOX interface function

The GPIB BOX provides a RS232 male socket (MALE) connection device on the rear panel which connects to the RS232 port on the rear panel of the 4015A Power Meter one of one.
The front panel of the GPIB BOX provides a GPIB port which connects to the computer's GPIB port one of one.

Chapter 3 Panel description and Dimensions

3-1. 4015A Front Panel
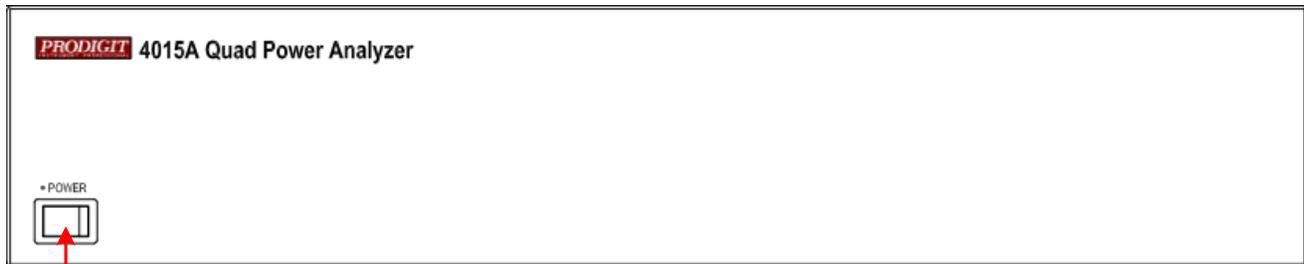
A. POWER：4015A Power Switch

3-2. 4015A Rear Panel
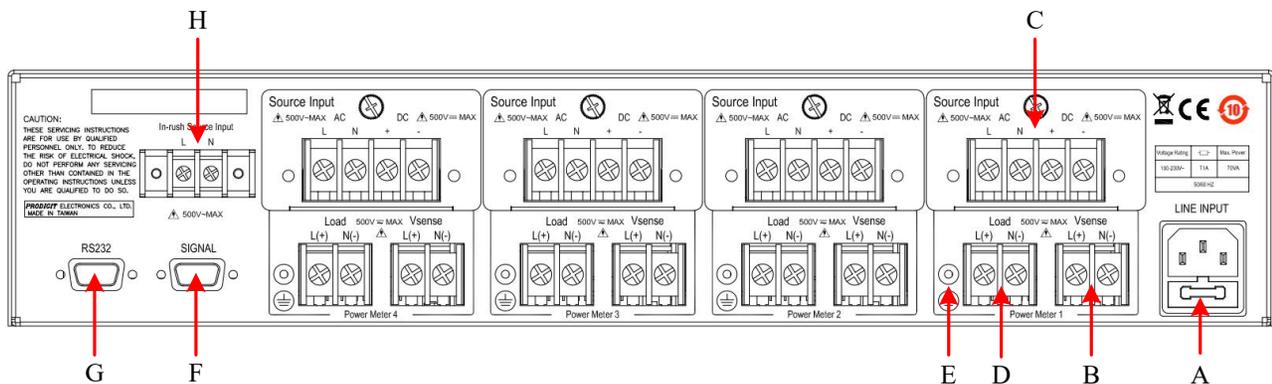
A. LINE INPUT：Line input receptacle.
B. Vsense：Vsense input terminal.
C. Source：AC/DC Power Source input terminal(Internal source input).
D. Load：Load terminal.
E. Source ground.
F. SYNC：Power ON/OFF synchronous signal Input) and ac on signal, the input signal waveform refer to Appendix 1.
G. RS-232 interface port. (Baud Rate 921600 bps)
H. AC Inrush Source Input(External source input)

3-3. 4015A Dimensions
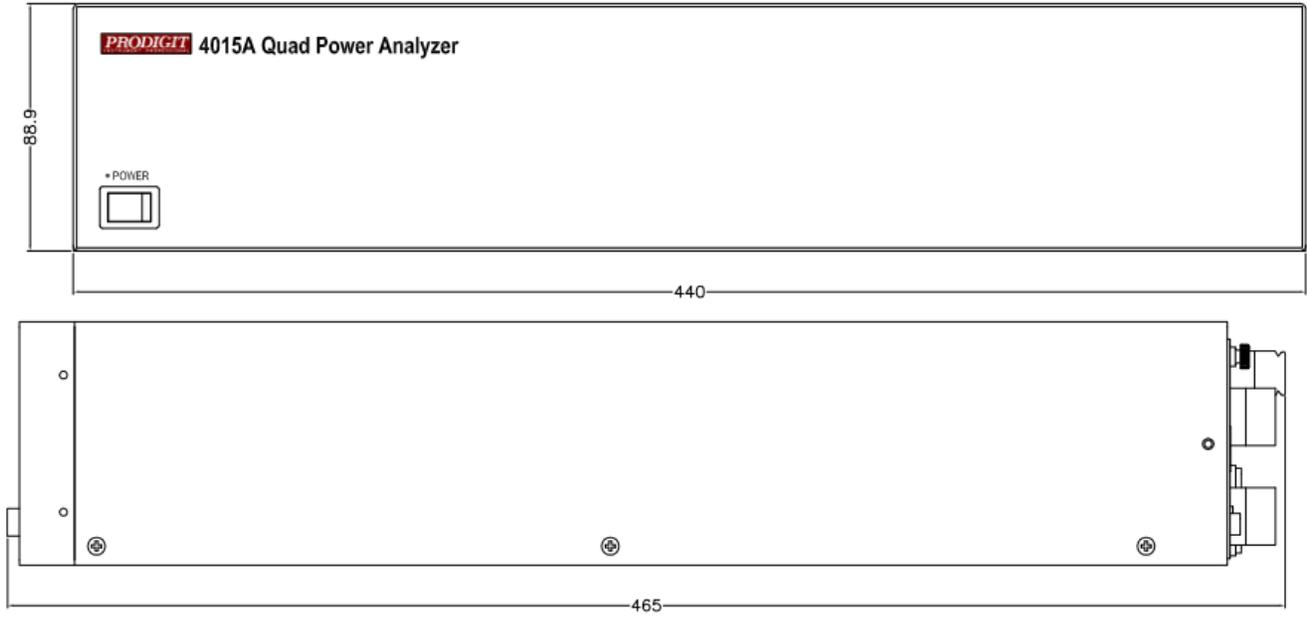
Chapter 4 Remote control programming operation

4-1.RS232 Setup

The RS232 interface of the 4015A is set up as follows.

Baud-rate   ：921600 bps
Parity   ：NO
Data bit   ：8 bit
Stop bit   ：1 bit
Handshaking ：Hardware (RTS/CTS)
Data Format ：Hex Format

The RS232 Interface connector of 4015A rear panel, RS232 is shown in Fig4-1.

Fig 4-1 PC RS232 Interface connection of rear panel

4-2. 4015A Programming Command List
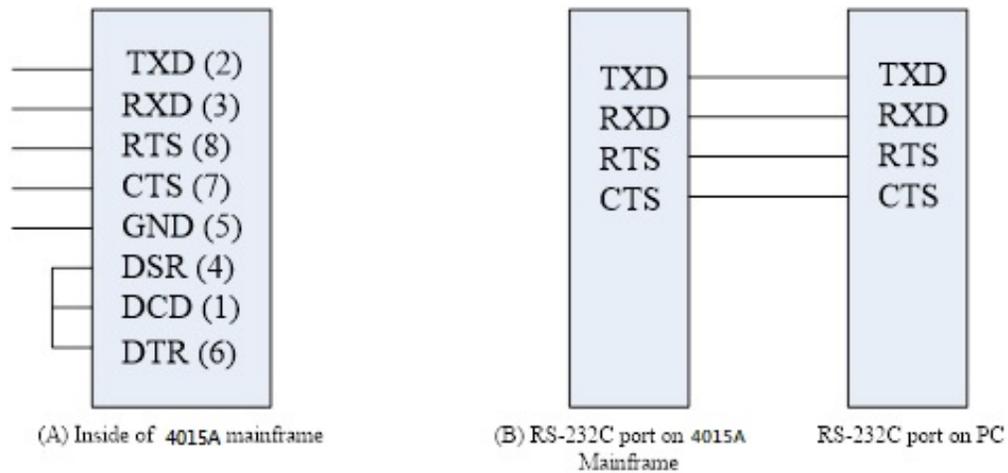
Functions	Descriptions	Syntax
Setting	Setting internal/external voltage synchronous (00=Internal, 01=External)	0x60 xx 0A
	Setting low pass filter 50KHz enable/disable (00=Disable, 01=Enable)	0x61 xx 0A
	Setting select CH1~CH4 digital power meter (01=CH1, 02=CH2, 04=CH3, 08=CH4, 0F=CH1~4)	0x62 xx 0A
	Setting AC/DC/Inrush measure mode (00=AC Mode, 01=DC Mode, 02=Inrush Mode)	0x80 xx 0A
	Setting Data Unlock/Lock (00=Unlock, 01=Lock)	0x81 xx 0A
	Setting V-Range (00=15V, 01=30V, 02=50V, 03=150V, 04=300V, 05=500V)	0x8E xx 0A
	Setting I-Range (00=0.02A, 01=0.05A, 02=0.2A, 03=0.5A, 04=2A, 05=5A, 06=10A, 07=20A, 08=200A)	0x8F xx 0A
	Setting AC trig rate = 2^N per cycle (00=Auto, 08~12, inital=00)	0x92 xx 0A
	Setting DC trig rate = 4096^N Hz (20~100, inital=60)	0x93 xx 0A
	Setting Inrush trig rate = 4096^N Hz (20~100, inital=100)	0x94 xx 0A
	Setting internal/external source input (00=Internal, 01=External)	0x95 xx 0A
	Setting output on/off (00=OFF, 01=ON)	0x96 xx 0A
	Setting output on degree (0~359)	0x97 xx xx 0A
	Setting output off degree (0~359)	0x98 xx xx 0A
	Setting trig enable/disable (00=Disable, 01=Enable)	0x9B xx 0A
	Setting trig level (0~±32768)	0x9D xx xx 0A
	Setting inrush measure start time after trig (0~65535 * 2.5us)	0x9E xx xx 0A
	Setting inrush measure start time after trig (0~65535 * 2.5us)	0x9F xx xx 0A
	Setting AC/DC input switch control (00=AC, 01=DC)	0xA0 xx 0A

Table 4-1 Setting command list

Query	Query project number	0x22 0A
	Query firmware version	0x23 0A

Table 4-2 Query command list

Measurement	Query voltage RMS value (Vrms)	0x00 0A
	Query ± voltage PEAK value (Vpeak)	0x01 0A
	Query Vrms maximum and minimum	0x02 0A
	Query current RMS value (Irms)	0x03 0A
	Query ± current PEAK value (Ipeak)	0x04 0A
	Query Irms maximum and minimum	0x05 0A
	Query active power (watt)	0x06 0A
	Query max/min active power (watt)	0x07 0A
	Query apparent power (VA)	0x08 0A
	Query reactive power (VAR)	0x09 0A
	Query power factor (P.F.)	0x0A 0A
	Query voltage peak factor (VCF)	0x0B 0A
	Query current peak factor (ICF)	0x0C 0A
	Query freauency	0x0D 0A
	Query voltage 50th harmonic (VH)	0x0E 0A
	Query current 50th harmonic (IH)	0x0F 0A
	Query voltage total harmonic distortion referred to the RMS value (VTHDR)	0x10 0A
	Query voltage total harmonic distortion referred to the fundamental component (VTHDF)	0x11 0A
	Query current total harmonic distortion referred to the RMS value (ITHDR)	0x12 0A
	Query current total harmonic distortion referred to the fundamental component (ITHDF)	0x13 0A
	Query inrush voltage value	0x17 0A
	Query inrush current value	0x18 0A

Table 4-3 Measurement command list

4-3. Remote Command Feedback Data Descriptions

1. Setting command feedback data format：
    Setting command 0x60~0xA0.
    Feedback 2 bytes data format, at last byte is the 0x0A.

ACK	END
0x06	0x0A

2. Query command feedback data format：
    Query command 0x22~0x23.
    Feedback 3 bytes data format, at last byte is the 0x0A.

Data1	Data2	END
0x00~0xFF	0x00~0xFF	0x0A

3. Measurement command feedback data format：
    Measurement command 0x00~0x18.
    Feedback 14~406 bytes data format, at last byte is the 0x0A.
    First 2 bytes is the range flag and status flag.

Range	Status	CH1 Data	,	CH2 Data	,	CH3 Data	,	CH4 Data	END
1Byte	1Byte	N Byte	0x2C	N Byte	0x2C	N Byte	0x2C	N Byte	0x0A

    Range Flag

B7	B6	B5	B4	B3	B2	B1	B0
Mode	V Level	V Range		Inrush	I Level	I Range	
0=AC 1=DC	0=Low 1=High	00=15V/150V 01=30V/300V 10=50V/500V		0=I Range 1=200A	0=Low 1=High	00=0.02A/0.05A 01=0.2A/0.5A 10=2A/5A 11=10A/20A	

    Status Flag

B7	B6	B5	B4	B3	B2	B1	B0
FILTER	SYNC	OVER	ERROR	Negative Value			
0=Off 1=On	0=INT 1=EXT	1=Over	1=Error	1=CH4 is Negative	1=CH3 is Negative	1=CH2 is Negative	1=CH1 is Negative

4. Error command feedback data format：
    Feedback 2 bytes data format, at last byte is the 0x0A

NAK	END
0x15	0x0A

    Feedback 10 bytes data format, at last byte is the 0x0A

Range	Status	CH1 NAK	,	CH2 NAK	,	CH3 NAK	,	CH4 NAK	END
1Byte	1Byte	0x15	0x2C	0x06	0x2C	0x15	0x2C	0x15	0x0A

4-4.Remote Command Descriptions

4-4-1 Setting Command

0x60
Syntax： 0x60 xx 0A
Purpose：Setting internal/external synchronous
Description：1) Setting internal synchronous：0x60 00 0A
2) Setting external synchronous：0x60 01 0A
Feedback 2 bytes data format：0x06 0A

0x61
Syntax： 0x61 xx 0A
Purpose：Setting low pass filter（50KHz）enable/disable
Description：1) Low pass Filter（50KHz）disable：0x61 00 0A
2) Low pass Filter（50KHz）enable：0x61 01 0A
Feedback 2 bytes data format：0x06 0A

0x62
Syntax： 0x62 xx 0A
Purpose：Setting select CH1~CH4 digital power meter
Description：

Commamd	Data								END
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
0x62	---	---	---	---	CH4	CH3	CH2	CH1	0x0A

1) Only use CH1 digital power meter：0x62 01 0A
2) Only use CH2 digital power meter：0x62 02 0A
3) Only use CH3 digital power meter：0x62 04 0A
4) Only use CH4 digital power meter：0x62 08 0A
5) Use CH1~2 digital power meter：0x62 03 0A
6) Use CH3~4 digital power meter：0x62 0C 0A
7) Use CH1~4 digital power meter：0x62 0F 0A
Feedback 2 bytes data format：0x06 0A

0x80
Syntax： 0x80 xx 0A
Purpose：Setting AC/DC/Inrush mode。
Description：1) Setting AC mode：0x80 00 0A
2) Setting DC mode：0x80 01 0A
3) Setting Inrush mode：0x80 02 0A
Feedback 2 bytes data format：0x06 0A

0x81
Syntax： **0x81 xx 0A**
Purpose：Setting Data Unlock/Lock
Description：1) Data Unlock：0x81 00 0A
2) Data Lock：0x81 01 0A
Feedback 2 bytes data format：0x06 0A

0x8E
Syntax： 0x8E xx 0A
Purpose：Setting V-Range
Description：1) Low V-Range 0.000 ~ 15.000V：0x8E 00 0A
              2) Low V-Range 15.000 ~ 30.000V：0x8E 01 0A
              3) Low V-Range 30.000 ~ 50.000V：0x8E 02 0A
              4) High V-Range 50.00 ~ 150.00V：0x8E 03 0A
              5) High V-Range 150.00 ~ 300.00V：0x8E 04 0A
              6) High V-Range 300.00 ~ 500.00V：0x8E 05 0A
Feedback 2 bytes data format：0x06 0A

0x8F
Syntax： 0x8F xx 0A
Purpose：Setting I-Range
Description：1) Setting I-Range 20.000mA：0x8F 00 0A
              2) Setting I-Range 50.000mA：0x8F 01 0A
              3) Setting I-Range 200.00mA：0x8F 02 0A
              4) Setting I-Range 500.00mA：0x8F 03 0A
              5) Setting I-Range 2.0000A：0x8F 04 0A
              6) Setting I-Range 5.0000A：0x8F 05 0A
              7) Setting I-Range 10.000A：0x8F 06 0A
              8) Setting I-Range 20.000A：0x8F 07 0A
              9) Setting I-Range 200.00A：0x8F 08 0A
Feedback 2 bytes data format：0x06 0A

0x92
Syntax： 0x92 xx 0A
Purpose：Setting AC trig rate = 2^N per cycle (N = 0(Auto), 8~12)
Description：1) N=0(initial)：0x92 00 0A
Feedback 2 bytes data format：0x06 0A

0x93
Syntax： 0x93 xx 0A
Purpose：Setting DC trig rate = 4096^N Hz (N = 20~100)
Description：1) N=60(initial)：0x93 3C 0A
Feedback 2 bytes data format：0x06 0A

0x94
Syntax： 0x94 xx 0A
Purpose：Setting Inrush trig rate = 4096^N Hz (N = 20~100)
Description：1) N=100(initial)：0x94 64 0A
Feedback 2 bytes data format：0x06 0A

0x95
Syntax： 0x95 xx 0A
Purpose：Setting internal/external source input
Description：1) Setting internal source input：0x95 00 0A
　　　　　　2) Setting external source input：0x95 01 0A
Feedback 2 bytes data format：0x06 0A

0x96
Syntax： 0x96 xx 0A
Purpose：Setting output on/off
Description：1) Setting output off：0x96 00 0A
　　　　　　2) Setting output on：0x96 01 0A
Feedback 2 bytes data format：0x06 0A

0x97
Syntax： 0x97 xx xx 0A
Purpose：Setting output on degree (0~359)
Description：1) Setting voltage output to turn on at 0°：0x97 00 00 0A
　　　　　　2) Setting voltage output to turn on at 90°：0x97 00 5A 0A
Feedback 2 bytes data format：0x06 0A

0x98
Syntax： 0x98 xx xx 0A
Purpose：Setting output off degree (0~359)
Description：1) Setting voltage output to turn off at 0°：0x98 00 00 0A
　　　　　　2) Setting voltage output to turn off at 90°：0x98 00 5A 0A
Feedback 2 bytes data format：0x06 0A

0x9B
Syntax： 0x9B xx 0A
Purpose：Setting inrush trig enable/disable
Description：1) Setting inrush trig disable：0x9B 00 0A
　　　　　　2) Setting inrush trig enable：0x9B 01 0A
Feedback 2 bytes data format：0x06 0A

0x9D
Syntax： 0x9D xx xx 0A
Purpose：Setting inrush trig level (0~±32767)
Description：1) Setting inrush trig level at +32767：0x9D 0F FF 0A
　　　　　　2) Setting inrush trig level at -32767：0x9D 8F FF 0A
Feedback 2 bytes data format：0x06 0A

0x9E
Syntax： 0x9E xx xx 0A
Purpose：Setting inrush measure start time after trig (0~65535 * 2.5uS)
Description：1) Setting inrush measure start time 10uS：0x9E 00 04 0A
Feedback 2 bytes data format：0x06 0A

0x9F

Syntax： 0x9F xx xx 0A

Purpose：Setting inrush measure stop time (0~65535 * 2.5uS)

Description：1) Setting inrush measure stop time 100mS：0x9F 9C 40 0A

Feedback 2 bytes data format：0x06 0A

0xA0

Syntax： 0xA0 xx 0A

Purpose：Setting AC/DC input switch control

Description：1) Setting AC input：0xA0 00 0A

            2) Setting DC input：0xA0 01 0A

Feedback 2 bytes data format：0x06 0A

4-4-2 Query Command

0x22

Syntax： 0x22 0A

Purpose：Query project number

Description：Query project number：0x22 0A

Feedback 3 bytes data format：0x0F AD 0A

0x23

Syntax： 0x23 0A

Purpose：Query firmware version

Description：Query firmware version：0x23 0A

Feedback 3 bytes data format：0xXX XX 0A

4-4-3 Measurement Command

0x00
Syntax： 0x00 0A
Purpose：Query voltage RMS value (Vrms)
Description：CH1~CH4 AC 100.00V (V-Range 300V/I-Range 20A)
Feedback 14 bytes data format：0x57 00 27 10 2C 27 10 2C 27 10 2C 27 10 0A

0x01
Syntax： 0x01 0A
Purpose：Query ± voltage PEAK value (Vpeak)
Description：CH1~CH4 AC ±141.40 Vpeak (V-Range 300V/I-Range 20A)
Feedback 30 bytes data format：0x57 00 00 37 3C 00 37 3C 00 37 3C 00 37 3C 2C
00 37 3C 00 37 3C 2C 00 37 3C 00 37 3C 0A

0x02
Syntax： 0x02 0A
Purpose：Query Vrms maximum and minimum
Description：CH1~CH4 AC141.40 Vmax, 100.00 Vmin (V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 37 3C 27 10 2C 37 3C 27 10 2C 37 3C 27 10
2C 37 3C 27 10 0A

0x03
Syntax： 0x03 0A
Purpose：Query current RMS value (Irms)
Description：CH1~CH4 AC 10.000A (V-Range 300V/I-Range 20A)
Feedback 14 bytes data format：0x57 00 27 10 2C 27 10 2C 27 10 2C 27 10 0A

0x04
Syntax： 0x04 0A
Purpose：Query ± current PEAK value (Ipeak)
Description：CH1~CH4 AC ±14.140 Apeak (V-Range 300V/I-Range 20A)
Feedback 30 bytes data format：0x57 00 00 37 3C 00 37 3C 2C 00 37 3C 00 37 3C 2C
00 37 3C 00 37 3C 2C 00 37 3C 00 37 3C 0A

0x05
Syntax： 0x05 0A
Purpose：Query Irms maximum and minimum
Description：CH1~CH4 14.140 Amax, 10.000 Amin (V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 37 3C 27 10 2C 37 3C 27 10 2C 37 3C 27 10
2C 37 3C 27 10 0A

0x06
Syntax： 0x06 0A
Purpose：Query active power (watt)
Description：CH1~CH4 AC 2000.00000W (V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 0B EB C2 00 2C 0B EB C2 00 2C 0B EB C2
00 2C 0B EB C2 00 0A

0x07
Syntax： 0x07 0A
Purpose：Query max/min active power (watt)
Description：CH1~CH4 AC 2000.00000 Wmax, 0.10000 Wmin (V-Range 300V/I-Range 20A)
Feedback 38 bytes data format：0x57 00 0B EB C2 00 00 00 27 10 2C 0B EB C2 00 00 00 27 10 2C 0B EB C2 00 00 00 27 10 2C 0B EB C2 00 00 00 27 10 0A

0x08
Syntax： 0x08 0A
Purpose：Query apparent power (VA)
Description：CH1~CH4 AC 2000.00000VA (V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 0B EB C2 00 2C 0B EB C2 00 2C 0B EB C2 00 2C 0B EB C2 00 0A

0x09
Syntax： 0x09 0A
Purpose：Query reactive power (VAR)
Description：CH1~CH4 AC 2000.00000VAR (V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 0B EB C2 00 2C 0B EB C2 00 2C 0B EB C2 00 2C 0B EB C2 00 0A

0x0A
Syntax： 0x0A 0A
Purpose：Query power factor (P.F.)
Description：CH1~CH4 PF (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x0B
Syntax： 0x0B 0A
Purpose：Query voltage peak factor (VCF)
Description：CH1~CH4 VCF (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x0C
Syntax： 0x0C 0A
Purpose：Query current peak factor (ICF)
Description：CH1~CH4 ICF (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x0D
Syntax： 0x0D 0A
Purpose：Query frequency
Description：CH1~CH4 frequency ((V-Range 300V/I-Range 20A)
Feedback 22 bytes data format：0x57 00 xx xx xx xx 2C xx xx xx xx 2C xx xx xx xx 2C xx xx xx xx 0A

0x0E
Syntax： 0x0E 0A
Purpose：Query voltage 50th harmonic (VH)
Description：CH1~CH4 50th harmonic (V-Range 300V/I-Range 20A)
Feedback 406 bytes data format：0x57 00 xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 0A

0x0F
Syntax： 0x0F 0A
Purpose：Query current 50th harmonic (IH)
Description：CH1~CH4 50th harmonic (V-Range 300V/I-Range 20A)
Feedback 406 bytes data format：0x57 00 xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 2C xx xx(1st) xx xx(2nd) xx xx (3rd) ~ xx xx(50th) 0A

0x10
Syntax： 0x10 0A
Purpose：Query voltage total harmonic distortion referred to the RMS value (VTHDR)
Description：CH1~CH4 VTHDR (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x11
Syntax： 0x11 0A
Purpose：Query voltage total harmonic distortion referred to the fundamental component (VTHDF)
Description：CH1~CH4 VTHDF (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x12
Syntax： 0x12 0A
Purpose：Query current total harmonic distortion referred to the RMS value (ITHDR)
Description：CH1~CH4 ITHDR (V-Range 300V/I-Range 20A)
Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x13

Syntax： 0x13 0A

Purpose：Query current total harmonic distortion referred to the fundamental component (ITHDF)

Description：CH1~CH4 ITHDF (V-Range 300V/I-Range 20A)

Feedback 18 bytes data format：0x57 00 xx xx xx 2C xx xx xx 2C xx xx xx 2C xx xx xx 0A

0x17

Syntax： 0x17 0A

Purpose：Query inrush voltage value

Description：CH1~CH4 AC 141.40 Vpeak+/100.00 Vpeak- (V-Range 300V/I-Range 20A)

Feedback 22 bytes data format：0x57 00 37 3C 27 10 2C 37 3C 27 10 2C 37 3C 27 10 2C 37 3C 27 10 0A
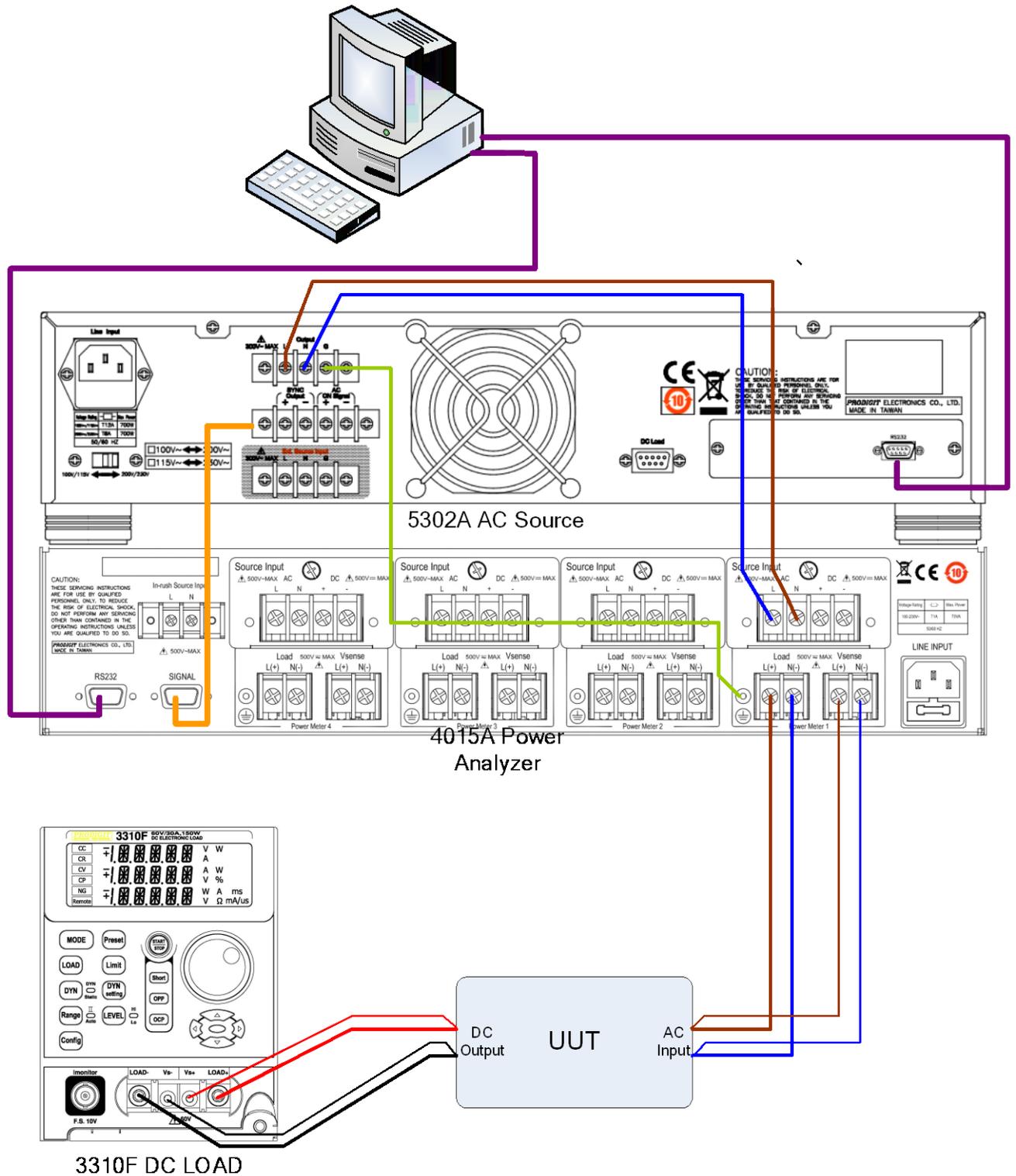
0x18

Syntax： 0x18 0A

Purpose：Query inrush current value

Description：CH1~CH4 AC10.000 Apeak+/5.000 Apeak- (V-Range 300V/I-Range 20A)

Feedback 22 bytes data format：0x57 00 27 10 13 88 2C 27 10 13 88 2C 27 10 13 88 2C 27 10 13 88 0A

Chapter 5 Applications

5-1. Measurement device connection

5-2. INRUSH current mode setting procedure

1. Setting Source AC Switch Control
        0xA0 00 0A

2. Setting Source Ext Input
        0x95 01 0A

3. Setting Inrush Relay (Setting Inrush Range 200A)
        0x8F 08 0A

4. Setting Output ON Degree (Setting 90 Degree)
        0x97 00 5A 0A

5. Setting Inrush Trig Level (Setting 30%)
        0x9D 26 66 0A

6. Setting Inrush Start Time (Setting 0.03ms)
        0x9E 00 0C 0A

7. Setting Inrush Measure Time (Setting 100ms)
        0x9F 9C 40 0A

8. Setting Inrush Mode
        0x80 02 0A

9. Setting Trig Enable)
        0x9B 01 0A

10. Setting Power ON (measure Inrush start)
        0x96 01 0A

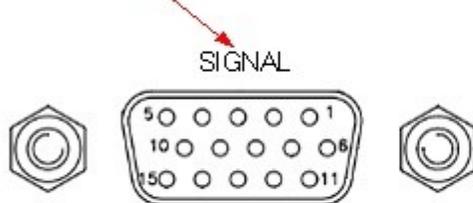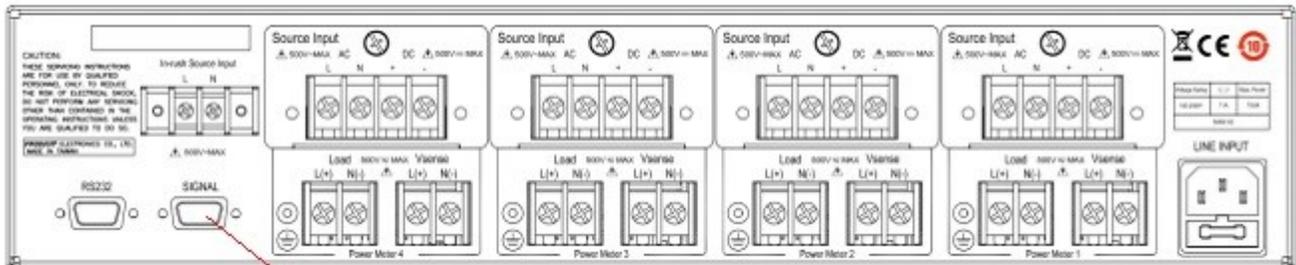   Wait 200ms

11. Read Inrush Voltage Value
   0x17 0A

12. Read Inrush Current Value
        0x18 0A

13. Setting Inrush Test off (measure Inrush stop)
        0x9B 00 0A

14. Setting Power OFF
        0x96 00 0A

Appendix 1 SYNC D-SUB HD 15P descriptions

SIGNAL

4015 SIGNAL D-SUB HD 15PIN

PIN 01   CH1 External SYNC(-) Input
PIN 02   CH2 External SYNC(-) Input
PIN 03   CH3 External SYNC(-) Input
PIN 04   CH4 External SYNC(-) Input
PIN 05   AC Start Signal PWR(+) Output
PIN 06   CH1 External SYNC PWR(+) Input
PIN 07   CH2 External SYNC PWR(+) Input
PIN 08   CH3 External SYNC PWR(+) Input
PIN 09   CH4 External SYNC PWR(+) Input
PIN 10   AC Start Signal PWR(+) Output
PIN 11   CH1 AC Start Signal(-) Output
PIN 12   CH2 AC Start Signal(-) Output
PIN 13   CH3 AC Start Signal(-) Output
PIN 14   CH4 AC Start Signal(-) Output
PIN 15   AC Start Signal PWR(+) Output

SIGNAL Waveform

AC OFF à ON	
5302A AC ON Signal	
4015 AC Start Signal Output	
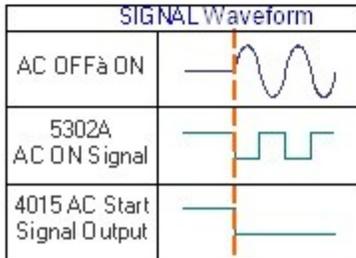
Please connect **PIN 01~04 to 5302A AC ON Signal(-)**
PIN 06~09 to 5302A AC ON Signal(+)
PIN 11~14 to 4032 Source ON(-)
PIN 5,10,15 to 4032 Source ON(+)