



Digital Power Meter
66201/66202
User's Manual



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Digital Power Meter 66201/66202 User's Manual



Version 2.2
March 2021

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CHROMA ATE INC.

88 Wenmao Rd., Guishan Dist., Taoyuan City 333001, Taiwan

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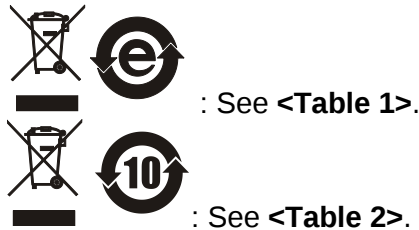
CHROMA ATE INC.

88 Wenmao Rd., Guishan Dist.,
Taoyuan City 333001, Taiwan
Tel: 886-3-327-9999
Fax: 886-3-327-8898
e-mail: info@chromaate.com

www.chromaate.com

Material Contents Declaration

The recycling label shown on the product indicates the Hazardous Substances contained in the product as the table listed below.



<Table 1>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr ⁶⁺	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	O	O	O	O	O	O
CHASSIS	O	O	O	O	O	O
ACCESSORY	O	O	O	O	O	O
PACKAGE	O	O	O	O	O	O

“O” indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

“X” indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

Remarks:

1. The CE marking on product is a declaration of product compliance with EU Directive 2011/65/EU and 2015/863/EU.
2. This product is complied with EU REACH regulation and no SVHC in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.



<Table 2>

Part Name	Hazardous Substances					
	Lead	Mercury	Cadmium	Hexavalent Chromium	Polybrominated Biphenyls/ Polybromodiphenyl Ethers	Selected Phthalates Group
	Pb	Hg	Cd	Cr ⁶⁺	PBB/PBDE	DEHP/BBP/DBP/DIBP
PCBA	×	○	○	○	○	○
CHASSIS	×	○	○	○	○	○
ACCESSORY	×	○	○	○	○	○
PACKAGE	○	○	○	○	○	○

“○” indicates that the level of the specified chemical substance is less than the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

“×” indicates that the level of the specified chemical substance exceeds the threshold level specified in the standards of SJ/T-11363-2006, EU Directive 2011/65/EU, and 2015/863/EU.

1. Chroma is not fully transitioned to lead-free solder assembly at this moment; however, most of the components used are RoHS compliant.
2. The environment-friendly usage period of the product is assumed under the operating environment specified in each product's specification.
3. This product is complied with EU REACH regulation and no SVHC in use.

Disposal

Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old appliances with new one, the retailer is legally obligated to take back your old appliances for disposal at least for free of charge.





Declaration of Conformity

For the following equipment :

Digital Power Meter

(Product Name/ Trade Name)

66201, 66202

(Model Designation)

CHROMA ATE INC.

(Manufacturer Name)

88 Wenmao Rd., Guishan Dist., Taoyuan City 333001, Taiwan

(Manufacturer Address)

Is herewith confirmed to comply with the requirements set out in the Council Directive on the Approximation of the Laws of the Member States relating to Electromagnetic Compatibility (2014/30/EU) and Low Voltage Directive (2014/35/EU). For the evaluation regarding the Directives, the following standards were applied :

EN 61326-1:2013

EN 55011:2009+A1:2010 Group I Class A, EN 61000-3-2:2014, EN 61000-3-3:2013,
IEC 61000-4-2 Edition 2.0 2008-12, IEC 61000-4-3 Edition 3.2 2010-04,
IEC 61000-4-4 Edition 3.0 2012-04, IEC 61000-4-5 Edition 2.0 2005-11,
IEC 61000-4-6 Edition 3.0 2008-10, IEC 61000-4-8 Edition 2.0 2009-09,
IEC 61000-4-11 Edition 2.0 2004-03

EN 61010-1:2010 and EN 61010-2-030:2010

The equipment describe above is in conformity with Directive 2011/65/EU and 2015/863/EU of the European Parliament and of the Council on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The following importer/manufacturer or authorized representative established within the EUT is responsible for this declaration :

CHROMA ATE INC.

(Company Name)

88 Wenmao Rd., Guishan Dist., Taoyuan City 333001, Taiwan

(Company Address)

Person responsible for this declaration:

Mr. Vincent Wu

(Name, Surname)

T&M BU Vice President

(Position/Title)

Taiwan

(Place)

2020.12.30

(Date)

Vincent Wu

(Legal Signature)

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 specific WARNINGS given elsewhere in this manual will violate safety standards of design, manufacture, and intended use of the instrument. *Chroma* assumes no liability for the customer's failure to comply with these requirements.



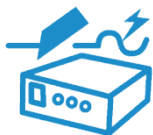
BEFORE APPLYING POWER

Verify that the power is set to match the rated input of this power supply.



PROTECTIVE GROUNDING

Make sure to connect the protective grounding to prevent an electric shock before turning on the power.



NECESSITY OF PROTECTIVE GROUNDING

Never cut off the internal or external protective grounding wire, or disconnect the wiring of protective grounding terminal. Doing so will cause a potential shock hazard that may bring injury to a person.



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 holders. 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. The instrument should be used in an environment of good ventilation.



DO NOT REMOVE THE COVER OF THE INSTRUMENT

Operating personnel must not remove the cover of the instrument. Component replacement and internal adjustment can be done only by qualified service personnel.

Safety Symbols

	DANGER – High voltage.
	Explanation: To avoid injury, death of personnel, or damage to the instrument, the operator must refer to an explanation in the instruction manual.
	High temperature: This symbol indicates the temperature is now higher than the acceptable range of human. Do not touch it to avoid any personal injury.
	Protective grounding terminal: To protect against electrical shock in case of a fault. This symbol indicates that the terminal must be connected to ground before operation of equipment.
	Functional grounding: To identify an earth (ground) terminal in cases where the protective ground is not explicitly stated. This symbol indicates the power connector does not provide grounding.
	Frame or chassis: To identify a frame or chassis terminal.
	Alternating Current (AC)
	Direct Current (DC) / Alternating Current (AC)
	Direct Current (DC)
	Push-on/Push-off power switch
	The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.
	The CAUTION sign denotes a hazard. It may result in personal injury or death if not noticed timely. It calls attention to procedures, practices and conditions.
	The Notice sign denotes important information in procedures, applications or the areas that require special attention. Be sure to read it carefully.

Revision History

The following lists the additions, deletions and modifications in this manual at each revision.

Date	Version	Revised Sections
Mar. 2007	1.0	Complete this manual.
Dec. 2007	1.1	Add “ <i>RATIO</i> ” function setting to the section of “ <i>Meas Function</i> .” Modify the GPIB Address in the section of “ <i>Definition of GPIB Address</i> .” Modify the section of “ <i>Instrument Commands</i> ” and add <i>RATIO</i> commands to it.
May 2008	1.2	Add CE Declaration of Conformity.
Nov. 2008	1.3	Add the following description: – “ <i>Examining Firmware Version</i> ” in the chapter of “ <i>Panel Description</i> .” – “ <i>DISP</i> ” & “ <i>HOLD</i> ” in the section of “ <i>Meas Function</i> ” in the chapter of “ <i>Operation</i> ” Modify the following contents – The chapter of “ <i>Specification</i> .” – “ <i>Standard Connection</i> ”, “ <i>Connecting with A662003 Fixture</i> ” and “ <i>Meas Function</i> ” in the chapter of “ <i>Operation</i> .” – “ <i>The Commands of the Power Meter</i> ” in the chapter of “ <i>Using Remote Control</i> .”
Apr. 2009	1.4	Change the specifications that are only applicable for the models after (including) the serial numbers listed below. 66201: 662010001300, 662011000540, 662012001130 66202: 662020001424, 662021000568, 662022001004
May 2009	1.5	Update the value of “ <i>Max. Spec.</i> ” and “ <i>Min. Spec.</i> ” for the test results in the appendix of “ <i>Specification Verification</i> .” Add the appendix of “ <i>Eliminating the Floating Current</i> .”
July 2010	1.6	Add “ <i>DC</i> ” function setting in the section of “ <i>Meas Function</i> ” in the chapter of “ <i>Operation</i> .” Modify the contents of “ <i>Instrument Commands</i> ” and add the <i>DC</i> Commands. Change the manual title to “ <i>Digital Power Meter 66201/66202 User’s Manual</i> .”
Jun. 2013	1.7	Replace the “ <i>CE Declaration of Conformity</i> ” with new version.
Oct. 2013	1.8	Modify the following: – “ <i>Standard Specifications</i> ” and “ <i>General Specifications</i> ” in the chapter of “ <i>Specification</i> ” – The panel figures in the chapter of “ <i>Panel Description</i> ” – Appendix of “ <i>Problem Solving</i> ”, “ <i>Specification Verification</i> ” and “ <i>Calibration Procedure</i> ”
Sep. 2014	1.9	Add <i>DC</i> Sepc.
Jul. 2016	2.0	Replace the “ <i>CE Declaration of Conformity</i> ” with new version. Modify the following sections: – “ <i>Special Measurement Parameters</i> ” and “ <i>Meas Function</i> ” in the chapter of “ <i>Operation</i> .” – “ <i>Instrument Commands</i> ” in the chapter of “ <i>Using Remote Control</i> .” Modify the following appendixes: – “ <i>Specification Verification</i> ”

		– “ <i>Calibration Procedure</i> ”
Apr. 2017	2.1	Update “ <i>Material Contents Declaration</i> ” and CE “ <i>Declaration of Conformity</i> ”.
Mar. 2021	2.2	Update address.

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1. Overview

1.1 Product Introduction

This Digital Power Meter manual covers the product models of 66201 and 66202.

66201/66202 is a digital power meter with voltage and current auto ranging function that can identify PASS / FAIL of UUT based on the inputted specification. Its front panel has 4 sets of 7-segment LCDs that can display AC voltage, current and the measurements of active power / power factor / apparent power / reactive power concurrently. The valid measurement ranges are 0 ~ 500 Vrms for AC voltage, 0 ~ 20Arms for AC current, 0 ~ 10KW for active power, 0 ~ 1.000 for power factor, 0 ~ 10KVA for apparent power and 0 ~ 10KVAR for reactive power.

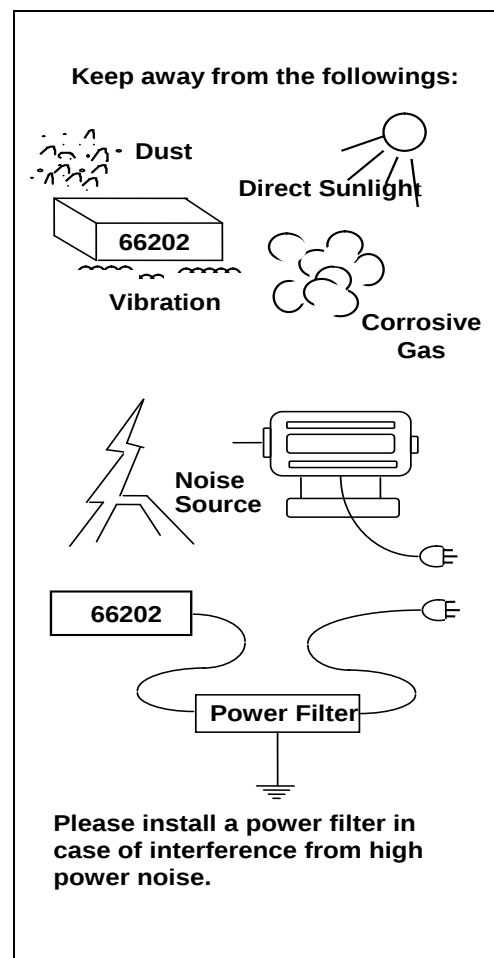
66201/66202 Digital Power Meters can also connect to PC via GPIB (IEEE standard 488-1978) and USB interfaces to perform measurements automatically when on line.

1.2 Inspection

Before shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the instrument is unpacked, inspect for any damage that may have occurred in transit. Save all packing materials in case the instrument has to be returned. If damage is found, please file claim with carrier immediately. Do not return the instrument to Chroma without prior approval.

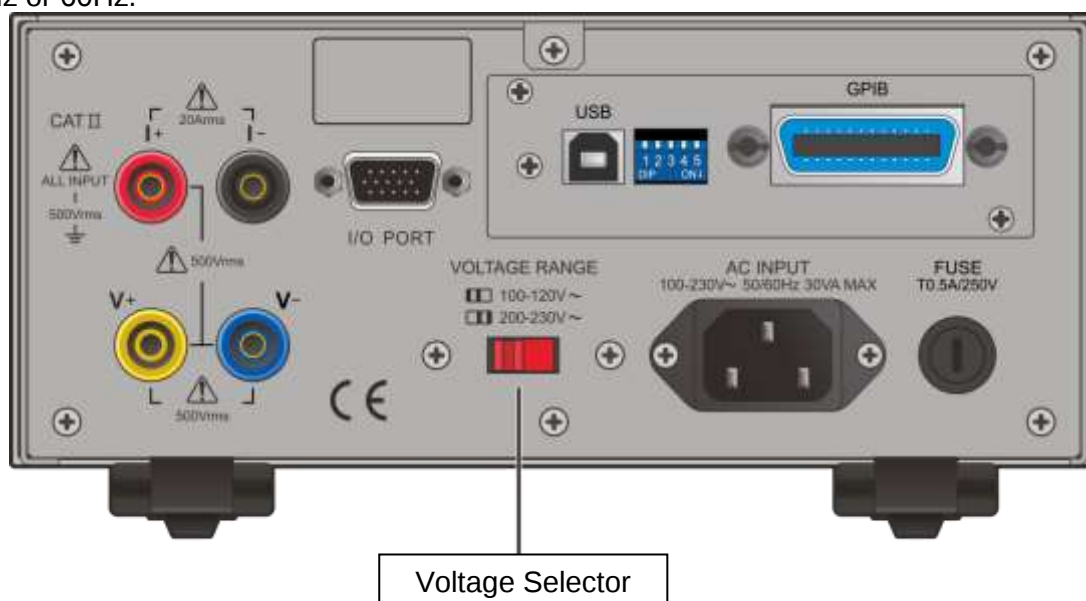
1.3 Ambient Environment

- (1) Do not use the meter in a dusty or vibrating location. Do not expose it to sunlight or corrosive gas. Be sure that the ambient temperature is $0^{\circ}\text{C} \sim +40^{\circ}\text{C}$ and the relative humidity is 20% ~ 80%.
- (2) The meter has been carefully designed to reduce the noise from the AC power source. However, it should be used in a noise-free or as low as possible environment. If noise is inevitable, please install a power filter.
- (3) The meter should be stored within the temperature range $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$. If the unit is not to be in use for a long time, please store it in the original or similar package and keep it from direct sunlight and humidity to ensure its accuracy when using again.



1.4 Power Line Connection

Before plugging in the power cord, make sure the power switch is off and the voltage selector on the rear panel meets the required voltage. Please use the power supply frequency of 50Hz or 60Hz.



1.5 Fuse

There is one fuse installed in the rear panel, please be aware of the following when replacing it:

- (1) First turn off the power and unplug the power cord before changing the fuse.
- (2) Since visual check cannot ensure the fuse to be used is appropriate, it is necessary to test its resistance to see if it is below 15Ω which is normal when checking.
- (3) When replacing the fuse, use finger or a flat screwdriver to press the fuse holder cover gently and turn it counterclockwise for 60 degree, the cover will be unlocked from the holder for 3mm.
- (4) Remove the over and replace the fuse with a new one (must be same as the original fuse.)
- (5) Press the cover down into the holder by a finger or a flat screwdriver and turn it clockwise for 60 degree to secure it.

	Specification	Note
Power Fuse	Slow blow 0.5A	Applicable for AC 190V ~ 250V

Table 1-1 Specification of Fuse



WARNING To prevent fire from occurring it is required to use the fuse of same type and same specification when replacing it.

1.6 Time for Warm-Up

All functions of this meter are active when it is powered on; however, to meet the accuracy listed in the specification it is suggested to warm-up for at least 60 minutes.

1.7 Cleaning

Ensure all cables and power cords are removed before cleaning the hardware. Use a dry cloth to clean the chassis. As the rear panel of power meter connects to the internal circuit board, to avoid damaging the hardware due to short circuit internally it is not allowed to wipe it with damp cloth.

2. Specification (18°C ~ 28°C, RH ≤ 75%)

2.1 Standard Specifications

Model	66201	66202
Channel	1 Channel	1 Channel
Parameters	Vrms, Vpk+, Vpk-, Irms, Ipk+, Ipk-, CFi,W, VA, VAR, PF,F	Vrms, Vpk+, Vpk-, THDv, Irms, Ipk+, Ipk-, Is, THDi, CFi,W, VA, VAR, PF,F, Energy,
AC Voltage (rms)		
Ranges	150V, 300V, 500V	
AC Current (rms)		
Ranges	(L Shunt) 0.01A, 0.1A, 0.4A, 2A	(L Shunt) 0.01A, 0.1A, 0.4A, 2A (H Shunt) 0.2A, 2A, 8A, 20A
Power		
Ranges	1.5W/... /1000W, 12 ranges	1.5W/.../10KW, 24 ranges
Crest Factor		
Voltage	150V, 300V, 500V, CF=1.6	
Current	(L Shunt) 0.01A, 0.1A, 0.4A, 2A, CF=4	(L Shunt) 0.01A, 0.1A, 0.4A, 2A, CF=4
		(H Shunt) 0.2A, 2A, 8A, CF=2; 20A, CF=4
Input Impedance		
Voltage	≥ 1MΩ	
Current	Approx. 50mΩ (L Shunt Range)	Approx. 50mΩ (L Shunt Range) Approx. 5mΩ (H Shunt Range)
Effective Input Range		
Voltage	10% – 100% for range	
Current	10% – 100% for range	
Accuracy		
Conditions	23°C±5°C, 75%RH. Sine wave, power factor=1. Warm-up time ≥ 60 minutes. Connect the power cord to a three-prong power outlet with proper grounding.	

66201 & 66202

Voltage / Harmonics Specifications (*Note)				
General Accuracy				Temperature Coefficient
Range	CF	DC,15Hz-1kHz	1kHz-10kHz	(ppm of reading + ppm of range) /°C
		% reading + % range	% reading + % range	
150	1.6	0.1+0.08	(0.1+0.05*kHz)+0.08	120+150
300		0.1+0.08	(0.1+0.05*kHz)+0.08	120+150
500		0.1+0.08	(0.1+0.05*kHz)+0.08	120+150

- Note**
1. The temperature coefficient accuracy is used for the situation when the ambient is beyond the accuracy-permitted temperature. This accuracy should be added into the voltage accuracy written above.
 2. The permitted frequency of voltage harmonics measurement is up to 6kHz.

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Current / Harmonics Specifications (*Notes)						
General Accuracy					Temperature Coefficient	
Shunt	Range	CF	DC,15Hz-1kHz	1kHz-10kHz	Without Cali	With Cali
			% reading + % range	% reading + % range	(ppm of reading + % of range) /°C	
L	0.01	4	0.1+0.25	(0.1+0.05*kHz)+0.25	150+0.20	150
	0.1		0.1+0.1	(0.1+0.05*kHz)+0.1	150+0.05	150
	0.4		0.1+0.1	(0.1+0.05*kHz)+0.1	120+0.05	150
	2		0.1+0.1	(0.1+0.05*kHz)+0.1	120+0.05	120
H	0.2	2	0.1+0.12	(0.1+0.05*kHz)+0.12	80+0.20	80
	2		0.1+0.1	(0.1+0.05*kHz)+0.1	80+0.05	80
	8		0.1+0.1	(0.1+0.05*kHz)+0.1	120+0.05	120
	20	4	0.1+0.1	(0.1+0.05*kHz)+0.1	120+0.05	120

- Note**
1. When measuring current, the voltage of 1/10 larger than the voltage range has to be inputted for frequency generation, voltage calculation and current measurement.
 2. The current accuracy is permitted in 23°C±1°C for 0.01A /0.2A (CF=2) and in 23°C±5°C for the other ranges.
 3. The temperature coefficient accuracy is used for the situation when the ambient is beyond the accuracy-permitted temperature. This accuracy should be added into the voltage accuracy and the current accuracy written above.
 4. The power meter should be in a thermally stable environment with power turned-on for at least 1 hour before performing auto-calibration (Cali).
 5. Add ±200 µA to the DC accuracy of current for L shunt range, and add ±2mA to the DC accuracy of current for H shunt range.
 6. The permitted frequency of current harmonics measurement is up to 6kHz.

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Active Power Specifications (*Note)						
Current Range			DC	47Hz~63Hz	15Hz-1kHz	1kHz-10kHz
Shunt	Range	CF	% reading+% range		% reading + % range	% reading + % range
L	0.01	4	0.15+0.3	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.33$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.33$
	0.1	4	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$
	0.4	4	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$
	2	4	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$
H	0.2	2	0.15+0.2	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.2$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.2$
	2	2	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$
	8	2	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$
	20	4	0.15+0.15	0.1+0.1	$(0.1+0.2/PF \times kHz)+0.18$	$(0.1+0.1 \times kHz+0.3/PF \times kHz)+0.18$

Note

1. The temperature coefficient is same as the temperature coefficient for voltage and current.
2. Add $\pm 200 \mu A$ (L current range) or $\pm 2mA$ (H current range) $\times$ voltage reading to the DC accuracy of power.

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Power Factor Specifications(*Notes)	
Ranges : 0.0000-1.0000	
$0.006+(0.003/PF) \times kHz$ (*Note 1)	
$0.027+(0.003/PF) \times kHz$ (*Note 2)	

Note

1. The PF spec is permitted only if neither voltage nor current falls to be less than 50% of the range rating.
2. The PF spec is permitted only if neither voltage nor current falls to be less than 10% of the range rating.

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Frequency Measurement	
Range	15Hz~10kHz
Accuracy	$\pm(0.06\%$ of reading value)
Frequency Source	voltage source
Condition	10% - 100% of the voltage range



Notice

The standard specifications described here are only applicable for the models after (including) the serial numbers listed below.

66201: 662010001300, 662011000540, 662012001130

66202: 662020001424, 662021000568, 662022001004

Over range & Protection display:

OVR Over Voltage Range (when the measured value exceeds "Range $\times$ CF")

OCR Over Current Range (when the measured value exceeds "Range $\times$ CF")

OCP Over Current Protection (when the measured value exceeds the following conditions)

- 4 Arms or 8 Apk (Low shunt range)
- 25A rms or 80 Apk (High shunt range)

2.2 General Specifications

Display Resolution	5 Digits
Display Update Rate	0.25sec/0.5sec/1sec/2sec
Power Supply	100V–120V/200V–230V, 50Hz/60Hz, 30 VA
Interface	USB or GPIB+USB
Operating Temperature	0°C - 40°C
Storage Temperature	-40°C - 85°C
Safety & EMC	CE (include EMC & LVD)
Dimension (W×H×D)	212 x 88 x 348.1 mm / 8.35 x 3.46 x 13.7 inch (excluding projections)
Weight	3.8 kg / 8.37 lbs

3. Panel Description

3.1 Front Panel

The front panel of 66201 and 66202 digital power meters with parts described from item (1) to (12) are shown in Figure 3-1 and Figure 3-2 below. For detail operation procedures, see Chapter 4 for more information.

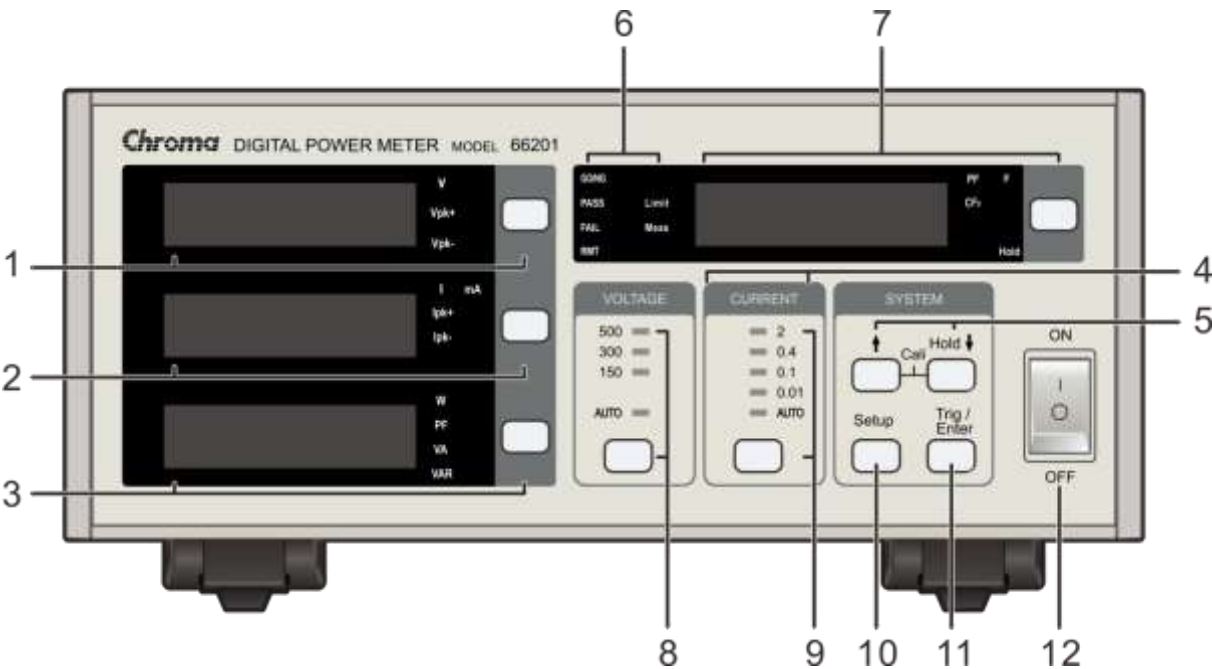


Figure 3-1 Front Panel of 66201 Digital Power Meter

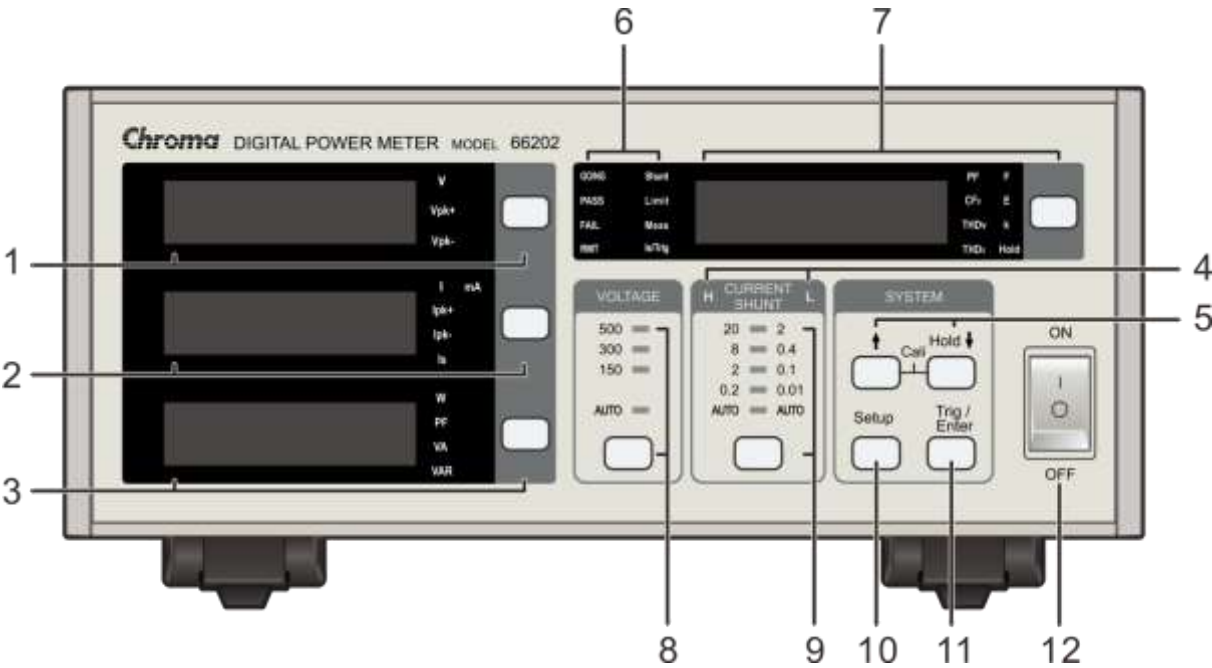


Figure 3-2 Front Panel of 66202 Digital Power Meter

- (1) **Voltage Measurement Display** : It is the voltage readout indicator that can switch to display V, Vpk+ and Vpk-. The mapping indicator will be on when selected.
- (2) **Current Measurement Display** : It is the current readout indicator that can switch to display I, Ipk+, Ipk- and Is (Inrush current). The mapping indicator will be on when selected. For instance, when the mA indicator is on it means the unit is mA. **(Note 3)**
- (3) **Power Measurement Display** : It is the power readout indicator that can switch to display W, PF, VA and VAR. The mapping indicator will be on when selected.
- (4) **Current Shunt Indicator** : It shows the state of Shunt module in use for current detection. **(Note 1)**
- (5) **↑↓ Arrow Keys** : The up and down arrow keys can be used to select the parameters when in Setup. Press these two keys concurrently will go to automatic calibration function.
- (6) **Function Setting Indicator** : It can switch to display Shunt, Limit, Meas and Is/Trig for setting. It will display the setting mode when in Setup or PASS/FAIL judgment when executing GO/NG. When the RMT LED is on, it indicates the system is under remote control. **(Note 5)**
- (7) **Special Measurement Display** : It can switch to display PF(Power Factor), CFi (Current Peak Factor), THDv (Voltage Total Harmonic Distortion), THDi (Current Total Harmonic Distortion), F (Frequency), E (Energy, J/W - hour), k (Energy unit: Thousand).The mapping indicator will be on when selected. When the k indicator is on, it means the energy test unit is KJ/ kilowatt-hour. **(Note 4)**
- (8) **Voltage Range Selection Key** : It is the selection key for AUTO and specified voltage range. The indicator above shows the selected range.
- (9) **Current Range Selection Key** : It is the selection key for AUTO and specified current range. The indicator above shows the selected range. **(Note 2)**
- (10) **Setup Key** : It is the function setup key that can select various functions for setting and the indicator above will show the selected item.
- (11) **Trig/Enter Function Key** : It is the confirmation key for various parameters when in Setup.
- (12) **Power Switch** : It is the power switch to turn the meter ON or OFF.

- Note**
- 1. 66201 Digital Power Meter is applicable for small current range measurement only, so there is no Current Shunt indicator.
 - 2. 66201 Digital Power Meter is applicable for small current range measurement only, so there is no high current range indicator.
 - 3. 66201 Digital Power Meter provides the measurements of I (current RMS), Ipk+ (positive peak current) and Ipk- (negative peak current) only.
 - 4. 66201 Digital Power Meter provides the parameters of PF (Power Factor), CFi (Crest Factor of Current) and F (Frequency).
 - 5. 66201 Digital Power Meter has Limit and Meas function for setting.

3.2 Rear Panel

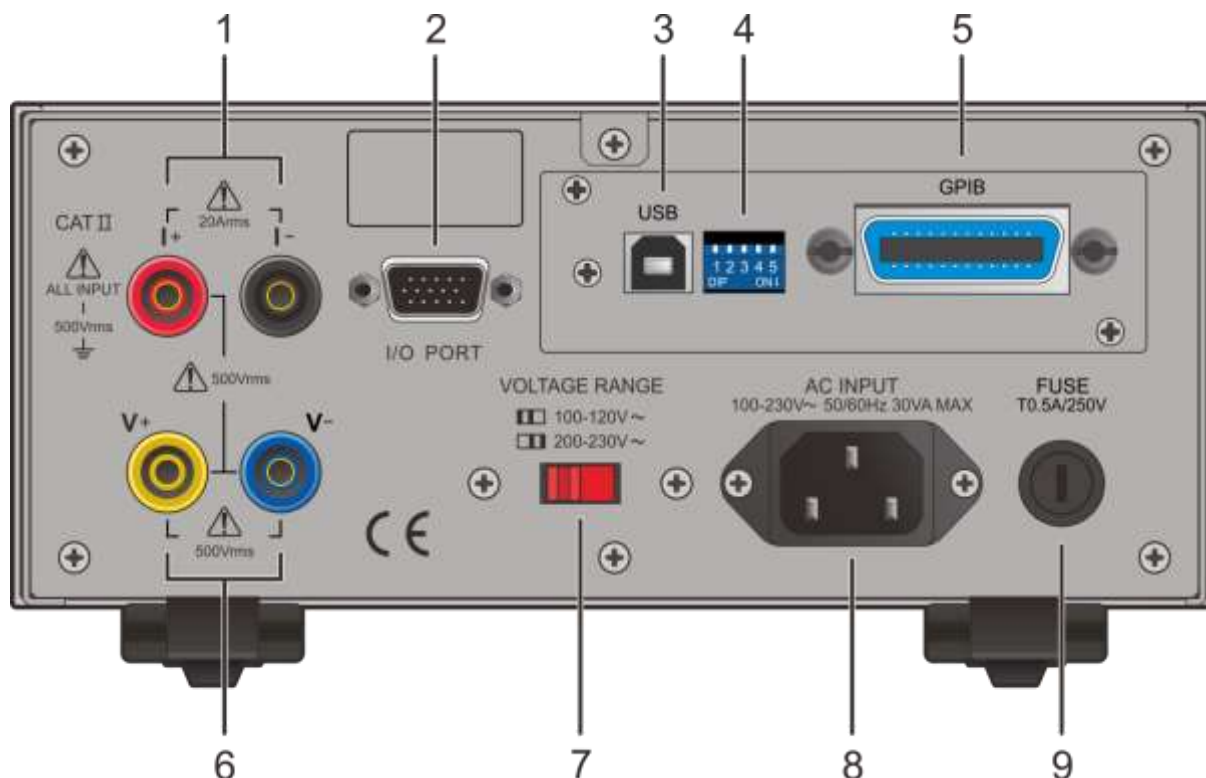


Figure 3-3 Rear Panel of 66201/66202 Digital Power Meter

The following explains the parts on the rear panel of 66201/66202 Digital Power Meter and their operation details.

- | | |
|---|---|
| (1) Current Measurement Input Terminal | : It is the positive/negative terminal input for current test point. |
| (2) Control Signal Input/Output Terminal | : See Appendix A for detail information. |
| (3) USB Interface Port | |
| (4) ADDRESS DIP Switch | : It is the DIP switch for setting GPIB interface address. |
| (5) GPIB Interface Port | |
| (6) Voltage Measurement Input Terminal | : It is the positive/negative terminal input for voltage test point. |
| (7) VOLTAGE Range Switch | : AC input voltage selector that can switch to 110V or 220V. |
| (8) AC LINE Inlet | : It is the power supply connection socket that is connected by power cord. |
| (9) Fuse Holder | : It is the fuse holder for power supply. |

3.3 Examining Firmware Version

1. Power on the 66201/66202 Digital Power Meter.
2. When the panel is in normal state, press **Setup** and **Enter** simultaneously. The screen shows:
The Model No. is 66202, FW version is 1.20 and FPGA program version is 1.00.

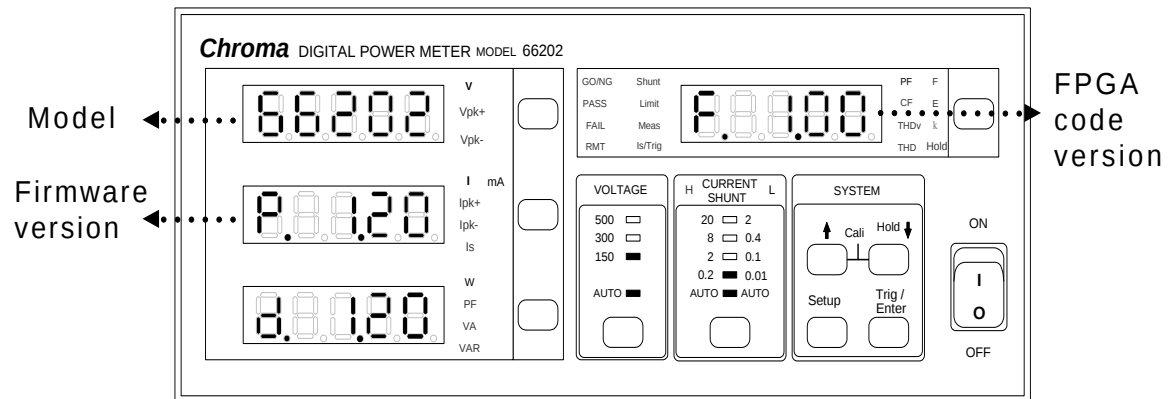


Figure 3-4 66202 Digital Power Meter Firmware Version Check

3. Press **Setup** to return to measurement screen when version is confirmed.

4. Operation

4.1 Preparation before Test

- (1) Before plugging in the power cord, make sure the power switch is off and the voltage selector on the rear panel meets the required voltage.
- (2) If there is a need to change the voltage, ensure the fuse used matches the voltage selected. See the section of *FUSE* for the fuse specification.

⚠ WARNING It is required to remove the power cord when replacing the fuse or changing the input voltage to avoid the hazard of electric shock.

4.2 Connecting Test Device

4.2.1 Standard Connection

66201/66202 Power Meter has two types of connection. Its measurement theory is shown in Figure 4-1 (a) and (b).

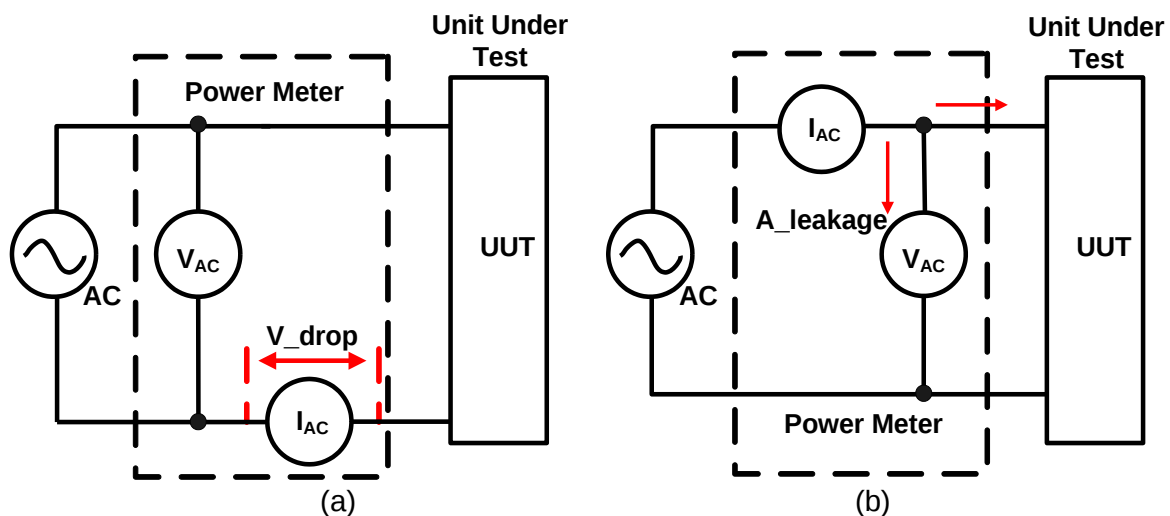


Figure 4-1 Measurement Theory for Power Meter Connection

The connection of Figure 4-1(a) is more accurate for current measurement; however, the voltage measurement may have small errors due to the voltage difference of current meter. It is applicable for the UUT with medium or small power. Its connection with 66201/66202 Power Meter is shown in Figure 4-2.

The connection of Figure 4-1(b) is more accurate for voltage measurement, but the current measurement will add the leakage current from voltage meter. It is applicable for the UUT with medium or larger power. Its connection with 66201/66202 Power Meter is shown in Figure 4-3.

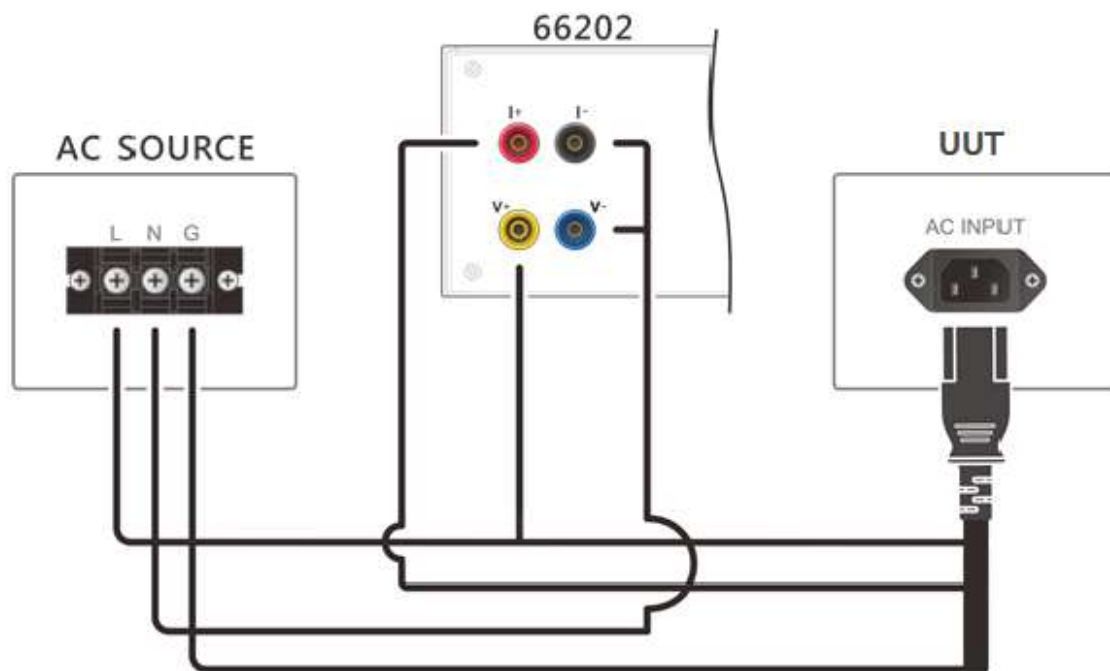


Figure 4-2 66201/66202 Power Connecting Diagram (for Figure 4-1(a))

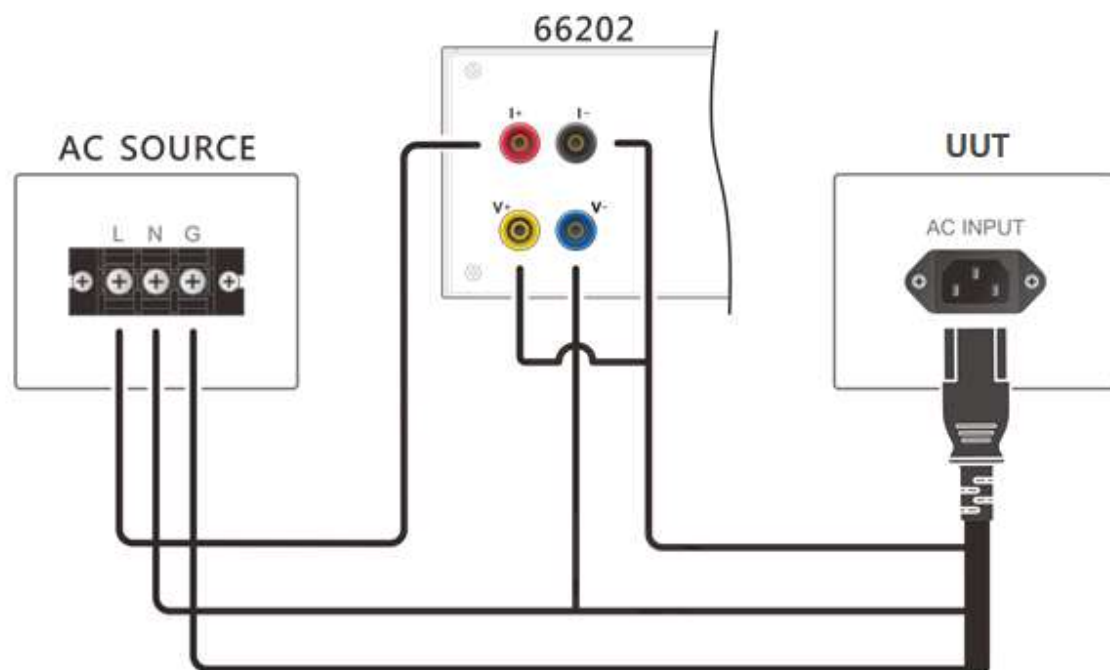


Figure 4-3 66201/66202 Power Meter Connecting Diagram (for Figure 4-1(b))

4.2.2 Connecting with A662003 Fixture

Figure 4-4 shows the connection of 66201/66202 Digital Power Meter and A662003 fixture. The connection of Figure 4-1(a) is applied by A662003 internally.

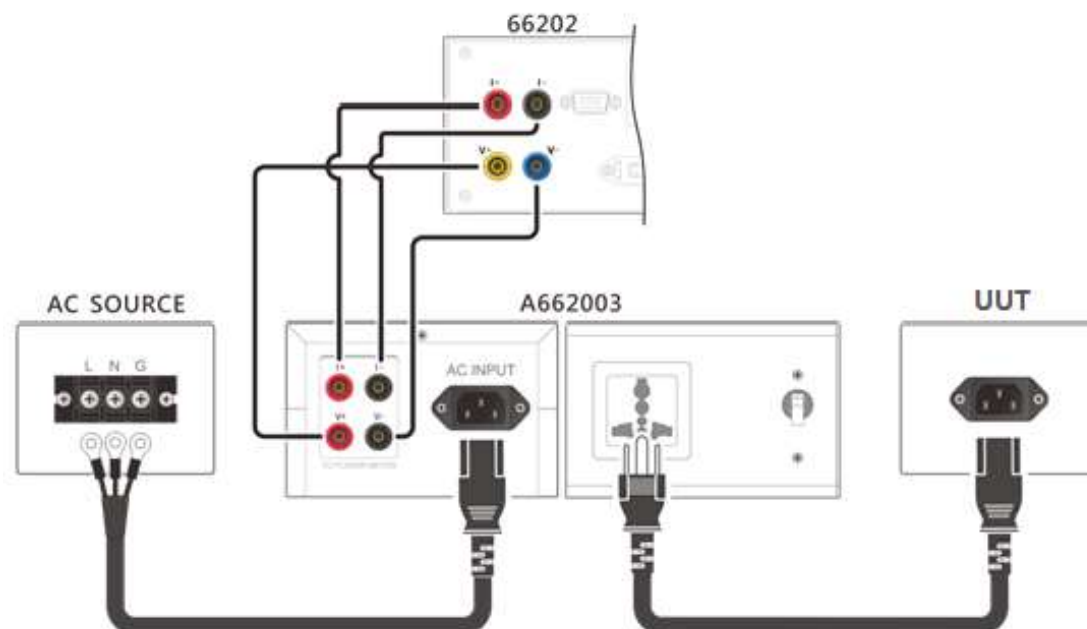


Figure 4-4 Connection of 66201/66202 Digital Power Meter and A662003 Fixture

⚠ WARNING

Be sure the connecting cable of voltage and current are in correct position as it may cause the internal circuit to burnout if connected mistakenly.

4.3 Test Function & Operation

When the Power Meter is powered on all LEDs on the front panel will be on for 3 seconds at the same time and users can check if they are acting normally. The Power Meter will set the panel display to its initial settings automatically where the voltage and current range are set to AUTO after 3 seconds.

Before powering off the 66201/66202 Power Meter, it will automatically save all parameter settings to internal flash (not including the voltage/current range selection), so that all settings will be resumed when power-on next time.

There are 4 display areas on the front panel of Power Meter. They are AC Voltage, AC Current, Power and Special Parameters readouts. Their functions and operation procedures are explained below.

4.3.1 AC Voltage Measurement

66201/66202 Power Meter is able to measure V (RMS of AC voltage), Vpk+ (positive peak voltage) and Vpk- (negative peak voltage) parameters. Not only the AC component, but also

the DC component will be measured. The displayed value is selected by the switch key aside with the LED shows the parameter. Figure 4-5 is the AC voltage display on 66201/66202 Power Meter and is refreshed every 0.5 second.

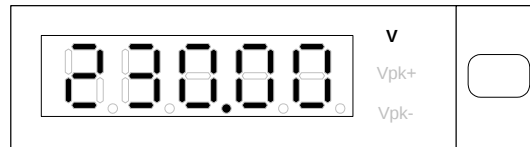


Figure 4-5 AC Voltage Display of 66201/66202 Power Meter

V (RMS of AC voltage)

V is calculated based on the following formula:

$$V = \sqrt{\frac{1}{T} \int_0^T v_i^2(t) dt}$$

Vpk+ (positive peak voltage), Vpk- (negative peak voltage)

Vpk+ and Vpk- are the maximum peak voltage got from the input signal within 2 cycles.

$$V_{PK+} = V_{\max+}$$

$$V_{PK-} = |V_{\max-}|$$

There are three voltage ranges 150, 300, 500 and AUTO for selection. Users can change it through the switch key under voltage range display manually. The key setting sequence is AUTO→150V→300V→500V→AUTO. When set to Auto (the initial setting) the Power Meter will detect the input voltage and switch to an appropriate range. The range switching mechanism is when the peak voltage of input voltage exceeds 1.6 times of present range it skips to the upper range; and if the peak voltage is under 80% of 1.6 times RMS of the lower range, it returns to the lower range. If the input voltage exceeds 1.6 times RMS of present range when switching the range manually, the display will appear Over Voltage Range (OVR) as Figure 4-6 shows.

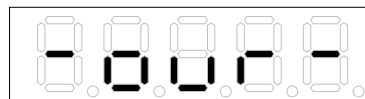


Figure 4-6 Over Voltage Range Warning

Once it is adjusted to appropriate range, the display will be cancelled and the measurement function will resume to normal.

Notice

Since the frequency cannot be detected when the voltage is pure DC, the 66201/66202 will measure the voltage and current using 60Hz for sampling and calculation.

4.3.2 AC Current Measurement

The 66201/66202 Power Meter is able to measure I (RMS of AC current), Ipk+ (positive peak current), Ipk- (negative peak current) and Is (Inrush current) 4 parameters. Not only the AC

component, but also the DC component will be measured. The required current parameter is selected by the switch key aside the display. Figure 4-7 and Figure 4-8 show the AC current readouts of 66201 and 66202 Power Meters.

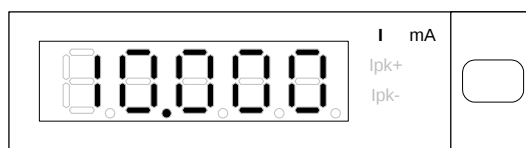


Figure 4-7 AC Current Readout of 66201 Power Meter

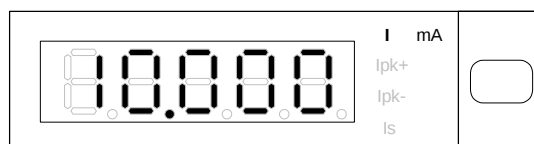


Figure 4-8 AC Current Readout of 66202 Power Meter

I (RMS of AC current)

I is calculated based on the following formula:

$$I = \sqrt{\frac{1}{T} \int_0^T I_i^2(t) dt}$$

Ipk+ (positive peak current), Ipk- (negative peak current)

Ipk+ and Ipk- are the maximum peak current got from the input signal within 2 cycles.

$$I_{PK+} = I_{\max+}$$

$$I_{PK-} = |I_{\max-}|$$

Is (Inrush current)

The Is selection in 66202 Power Meter is for users to measure the Inrush current when powering on the UUT. See 4.4.4 *Is/Trig Function (Inrush Current Test)* for detail settings.

For current measurement, the 66202 Power Meter has Low Shunt and High Shunt two modules. See 4.4.1 *Shunt Function* for setting Shunt module. For Low Shunt module there are 0.01A, 0.1A, 0.4A, 2A four current ranges and AUTO for selection; while High Shunt has 0.2A, 2A, 8A, 20A four current ranges and AUTO for selection. Users can change it through the switch key under current range display manually. The key setting sequence is:

Low Shunt Module: AUTO→0.01A→0.1A→0.4A→2A→AUTO
 High Shunt Module: AUTO→0.2A→2A→8A→20A→AUTO

When in Auto mode, the Power Meter will detect the input current and switch to an appropriate range. The range switching mechanism is to skip to upper one once the peak current exceeds the RMS times CF and when the peak current is under 30% of RMS times CF of lower one, it returns to lower range.

When in manual mode, if the input current exceeds the range of RMS times CF the display will appear Over Current Range (OCR) as Figure 4-9 shows:



Figure 4-9 Over Current Range Warning

Once it is adjusted to appropriate range, the display will be cancelled and the measurement function will resume to normal. If the measured current exceeds the maximum current, the current range will switch to 2A or 20A and an Over Current Protection message will appear as Figure 4-10 shows:



Figure 4-10 Over Current Protection Warning

At this time the current input of 66201/66202 Power Meter will use Relay to short-circuit the input to protect the measurement circuit. Once the error is fixed, press **Trig/Enter** to clear the error message and restore it to normal measurement state.

Notice

1. For instance when the current is 0.2A (RMS) but the peak current is 0.32A only, the current range stays in 0.1A without jumping to 0.4A as $0.32A < 0.1A \times 4$. This way the Power Meter can have better usability of measurement range that is to get better accuracy.
2. The maximum current range of 66201 is 2A. Since the current crest factor $CF=4$ enables the peak current to be measured up to 8A maximum, the current signals that $\leq \pm 8A$ can all be measured. However, taking the durability of internal shunt into consideration, the 66201 can only measure or endure up to 4A (RMS) within this current range. For 66202 Power Meter, the maximum current range of Hi Shunt module is 20A (RMS) so the maximum measurable or endurable current range is 20A (RMS).

WARNING

Once Over Current Range is occurred, the Meter will skip the range to 2A automatically to check if it exceeds the maximum current capacity. If not, it will switch back to the original range and show the message of Over Current Range. If yes, an Over Current Protection message will show up and users must adjust the current to fix it.

4.3.3 AC Power Measurement

The parameters for 66201/66202 Power Meter to perform AC power tests are W (Active Power), PF (Power Factor), VA (Apparent Power) and VAR (Reactive Power). Not only the AC component, but also the DC component will be measured. They are selected by the switch key aside the display as Figure 4-11 shows.

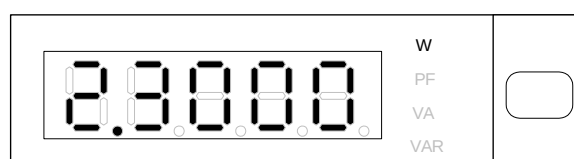


Figure 4-11 AC Power Display

The calculations of active power (W), power factor (PF), apparent power (VA) and reactive power (VAR) are based on the following formulas:

$$\text{Active Power (W)} = \frac{1}{T} \int_{t_0}^{t_0+T} (v_{(t)} \times i_{(t)}) dt$$

$$\text{Power Factor (PF)} = W / (V_{\text{rms}} \times I_{\text{rms}})$$

$$\text{Apparent Power (VA)} = V_{\text{rms}} \times I_{\text{rms}}$$

$$\text{Reactive Power (VAR)} = \sqrt{(VA)^2 - W^2}$$

Besides using average mode for power measurement display, the Power Meter can also use integration time mode, see 4.4.3 *Meas Function* for detail information.

4.3.4 Special Measurement Parameters

The 66201/66202 Power Meter has 6 special measurement parameters, which are PF (Power Factor), CF (Crest Factor), Harmonic, F (Frequency), E (Energy) and k (scientific notation). They are selected by the switch key aside the display. Figure 4-12 and Figure 4-13 show the display of special parameters for 66201 and 66202 Power Meters.

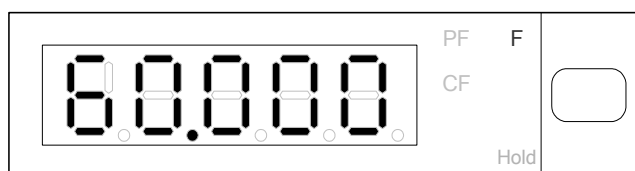


Figure 4-12 Special Parameters Display for 66201 Power Meter

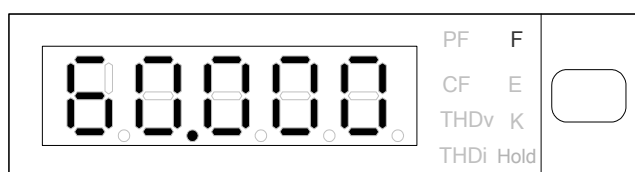


Figure 4-13 Special Parameters Display for 66202 Power Meter

PF (Power Factor)

$$PF = W / (V_{\text{rms}} \times I_{\text{rms}})$$

Notice

Power Factor is universally defined as the ratio of watts to volt-amps. Therefore, when power is negative, Power Factor is, by definition, negative. When power is positive, Power Factor is, by definition, positive.

CF (Crest Factor)

It is to measure the crest factor of input current by the following formula:

$$CF = \frac{I_{pk}}{I_{rms}}$$

Harmonic

The harmonic mode specifies the measurement window in number of cycles of the fundamental frequency. The window type is rectangular and the FFT data length is 4096. The sampling rate is synchronized to the fundamental frequency of voltage source.

The measurement signal values obtained in harmonic mode are only available by communication command. The harmonic mode functions as shown below.

Measurement Functions during Harmonic Measurement	Method of Determination, Equation			
	dc (when k=0)	1 (when k=1)	k (when k=2 to max)	Total
Voltage V() $[V]$	V(dc)=Vr(0)	$V(k) = \sqrt{V_r(k)^2 + V_j(k)^2}$		$V = \sqrt{\sum_{k=1}^{\max} V(k)^2}$
Current I() $[A]$	I(dc)=Ir(0)	$I(k) = \sqrt{I_r(k)^2 + I_j(k)^2}$		$I = \sqrt{\sum_{k=1}^{\max} I(k)^2}$
Active power P() $[W]$ or W() $[W]$	P(dc)= Vr(0) • Ir(0)	$P(k) = V_r(k) \cdot I_r(k) + V_j(k) \cdot I_j(k)$ or $P(k) = V(k) \cdot I(k) \cdot \cos \varphi(k)$		$P = \sum_{k=1}^{\max} P(k)$
Apparent power S() $[VA]$ or VA() $[VA]$	S(dc)=P(dc)	$S(k) = \sqrt{P(k)^2 + Q(k)^2}$		$S = \sqrt{P^2 + Q^2}$
Reactive power Q() $[var]$ or VAR() $[var]$	Q(dc)=0	$Q(k) = V_r(k) \cdot I_j(k) - V_j(k) \cdot I_r(k)$		$Q = \sum_{k=1}^{\max} Q(k)$
Power factor	$\frac{P(dc)}{S(dc)}$	$\frac{P(k)}{S(k)}$		$\frac{P}{S}$
Phase φ () $[^\circ]$	—	$\varphi(k) = \tan^{-1} \{ \frac{Q(k)}{P(k)} \}$		$\varphi = \tan^{-1} \{ \frac{Q}{P} \}$
Phase different with respect to V(1) Vdeg() $[^\circ]$	Vdeg(k) = Phase different of V(k) with respect to V(1)			
Phase different with respect to I(1) Ideg() $[^\circ]$	Ideg(k) = Phase different of I(k) with respect to I(1)			

Measurement Functions during Harmonic Measurement	Method of Determination, Equation
Voltage harmonic distortion factor Vhdf()[%]	$\frac{V(k)}{V(1)} \cdot 100$
Current harmonic distortion factor lhdf()[%]	$\frac{I(k)}{I(1)} \cdot 100$
Active power harmonic distortion factor Phdf()[%]	$\frac{P(k)}{P(1)} \cdot 100$
Total harmonic distortion of voltage Vthd[%] or THDV	$\frac{\sqrt{\sum_{k=2}^{\max} V(k)^2}}{V(1)} \cdot 100$ See 4.4.3 Meas Function for detailed description.
Total harmonic distortion of current lthd[%] or THDI	$\frac{\sqrt{\sum_{k=2}^{\max} I(k)^2}}{I(1)} \cdot 100$ See 4.4.3 Meas Function for detailed description.
Total harmonic distortion of power Pthd[%]	$\frac{\sum_{k=2}^{\max} P(k)}{P(1)} \cdot 100$

- Note**
1. Parameter k, r and j represent harmonic orders, real and virtual.
 2. Parameter V(k), Vr(k), Vj(k), I(k), Ir(k) and Ij(k) are all RMS.

F (Frequency)

The frequency measurement of 66201/66202 Power Meter is to measure the signal frequency of input voltage. It gets the average value of voltage signal after input within certain time unit. The measured voltage frequency is also the time base for measuring current.

When measuring AC voltage frequency the input signal voltage should be larger than the range for 10% or above. Since the frequency measurement is to detect the zero cross signal of input voltage, huge noise on the input signal will cause measurement error. The noise peak should not exceed the range for 5% or above.

E (Energy)

66202 Power Meter allows users to set the time for power measurement in two kinds of unit - W-hour and Joule. The calculation formula is:

$$E = \int_0^D (V_i \times I_i) dt$$

D: The measurement time set by users.

V_i : The temporal value of UUT's input voltage.

I_i : The temporal value of UUT's input current.

See 4.4.3 Meas Function for setting details.

k (scientific notation)

It indicates the value times a thousand.

4.4 Setting Main Functions

There are four main functions - 1. Shunt, 2. Limit, 3. Meas and 4. Is/Trig for setting. Users can use the buttons , , **Setup**, **Trig/Enter** to select the function and set the data.

Setup: It is the main function selection key. Users can use it to select the functions of 1. Shunt, 2. Limit, 3. Meas and 4. Is/Trig.

Trig/Enter: It is the confirmation and trigger key. Users can use this key to confirm and save the settings. In addition it can be used as a trigger of inrush current, energy and GO/NG selections.

, : They are the sub function and value selection keys. Users can use them to change the sub function under main function and set the required value.

Above listed the basic knowledge of the keys and detail descriptions and operations of main functions are explained below.

4.4.1 Shunt Function

66201/66202 Power Meter uses shunt resistance as the component for current sampling. There is AUTO, Hi and Lo current ranges for selection. 66201 Power Meter only provides Lo current range.

AUTO: The 66202 Power Meter selects the applicable Shunt automatically according to the measured current.

Hi: The maximum current range is 20Arms and the limit is 20Arms.

Lo: The maximum current range is 2Arms and the limit is 4Arms.

Follow the steps below to set the range:

1. Press **Setup** to select Shunt and the indicator of Shunt is on. Figure 4-14 shows the setting of Shunt.

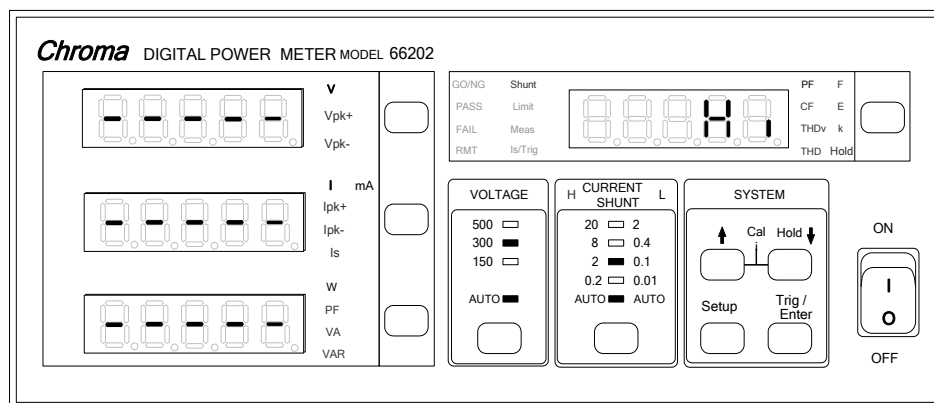


Figure 4-14 Setting Shunt

2. In special measurement display the default setting 'Hi' will blink. Use ,  key to select the required range.

3. Press **Trig/Enter** to save the setting and exit the function setting display.

Users can set appropriate current range via the steps described above.

Notice

1. When Shunt module is set to Auto, the current range has to set to Auto as well.
2. If the Shunt range is set to Lo, the maximum current can still measure up to 4A (RMS) only despite the current range is set to AUTO.

4.4.2 Limit Function

Users can enable the Limit function and set the detection time, high/low limit of various parameters to assess the measured value. The parameters include V, Vpk+, Vpk-, I, Ipk+, Ipk-, Is, W, PF, VA, VAR, CFi, THDv, THDi, F and E etc. Users can set one or multiple of them. Here shows an example of the parameter setting of Vpk+:

1. Press **Setup** to select Limit and the indicator of Limit is on. Figure 4-15 shows the setting of Limit.

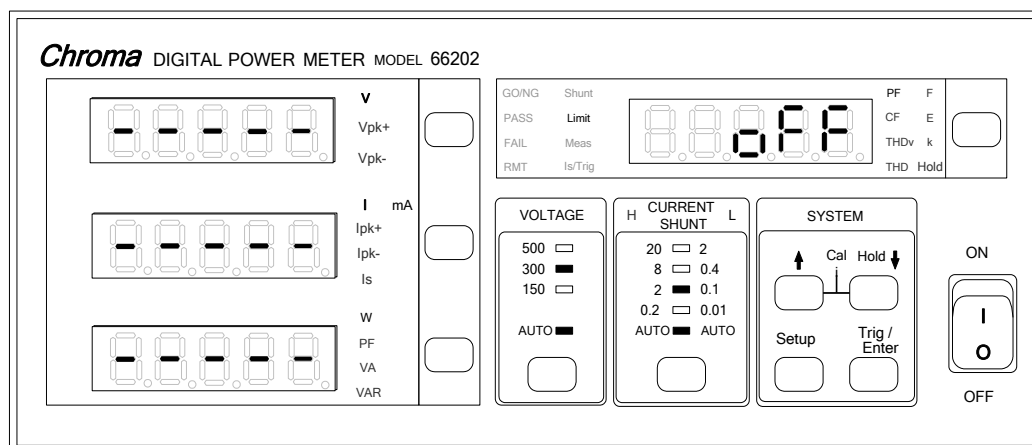


Figure 4-15 Setting Limit

2. In the special measurement display 'OFF' (default) starts to blink. Use ,  key to set it to ON and press **Trig/Enter** to save the setting and go to time setting for detection.
3. Use ,  key to select the time (second) required and press **Trig/Enter** to save the setting and turn to parameter selection.
4. Select Vpk+ parameter in the AC voltage display. When the 'V' LED starts blinking use ,  key to set it to Vpk+ and press **Trig/Enter** to save the setting and go to High/Low limit setting.
5. Now the display has a blinking 'H'. Press **Trig/Enter** will see the digits at right are blinking. Use ,  to set the high limit and press **Trig/Enter** to save the setting and go to Vpk+ LED.
6. Press **Trig/Enter** to enter the display again. Use ,  key to change the blinking 'H' to 'L' and press **Trig/Enter** will see the digits at right are blinking. Use ,  to set low limit and **Trig/Enter** to save the setting and go to Vpk+ LED. The setting is now done.
7. To set other special parameters, please repeat step 4-6.
8. Press **Setup** to exit the function setting display.

When the above settings are done, the GO/NG LED will be on. Press **Trig/Enter** to start measurement and specification assessment. If the parameters measured are within setting range in test time, the 66201/66202 Power Meter will beep twice when the test time is over and the **PASS** indicator will appear. On the contrary, the 66201/66202 Power Meter will show **FAIL** indicator and beep continuously if fail. The display will prompt the failed parameter automatically and the test data will keep on blinking.

When **PASS** is on, press **Trig/Enter** will activate the next specification assessment. When **FAIL** is on, it is necessary to press **Trig/Enter** to end the test for parameter reset or activate the next specification assessment.

Follow the step below to disable the measurement of Limit parameter:

1. Press **Setup** to select Limit and the indicator of Limit is on.
2. In the special measurement display 'ON' starts to blink. Use **↑**, **↓** to set to 'OFF' and press **Trig/Enter** to save the setting and exit the function setting.

GO/NG indicator will be off once it is disabled.



E (Energy), Is (Inrush current) and GO/NG three parameters of 66202 Power Meter need to be triggered by **Trig/Enter**. Once two are set, the triggering priority is E > Is > GO/NG.

4.4.3 Meas Function

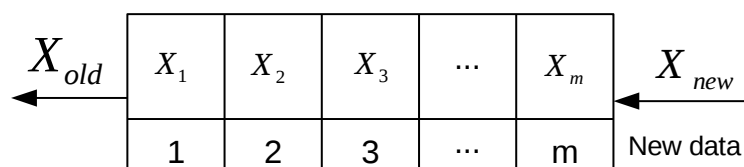
66201/66202 Power Meter has ten sub functions under Meas that are Meas, Ratio (66202 only), Energy (66202 only), THD (66202 only), R.RESP, DC, Hold, Disp, Filt and Power as explained below.

Meas:

66201/66202 Power Meter provides two ways to show the panel readouts, which are Avg (average) and Windo (window). The difference between two of them is the way of sampling as described beneath.

Avg

The parameter average is provided by 66201/66202 Power Meter to facilitate users reading the panel readouts. Figure 4-16 shows the calculation and update of average, where m is the average number set by user. Applying the concept of first in first out, the original X_1 will be excluded and $X_2 \rightarrow X_1$ so is $X_{new} \rightarrow X_m$ when updating the reading next time. The X_1 and $X_2 \dots X_m$ are the average sampling values and the method is to capture two complete voltage or current cycles with a certain interval (T) for sampling.



$$X_{avg} = \frac{X_1 + X_2 + X_3 + \dots + X_m}{m}$$

Figure 4-16 Calculation and Update of Average

Following are the steps to set the parameter:

1. Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-17 shows the setting of Meas.

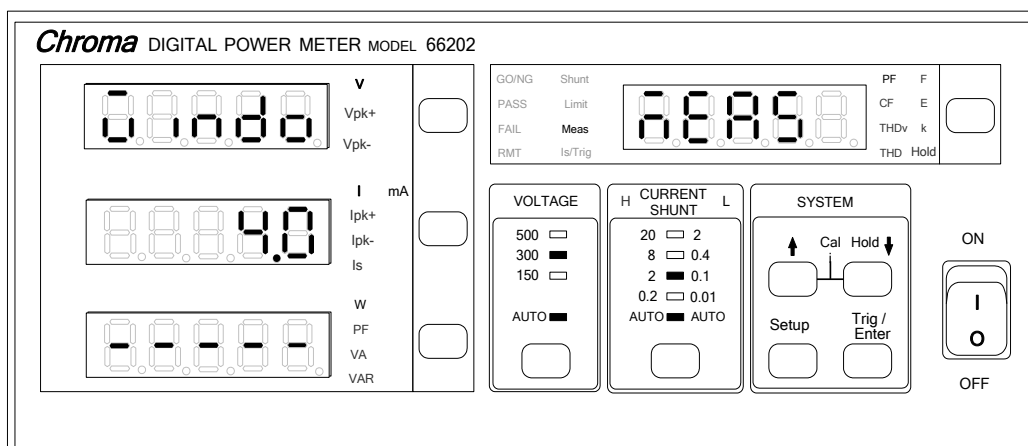


Figure 4-17 Setting Meas

2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select Meas and press **Trig/Enter** to save the setting and go to average and window selection display.
3. In AC voltage parameter display a blinking pattern will appear. Use **↑**, **↓** to select Avg and press **Trig/Enter** to save the setting and go to average number setting display as Figure 4-18 shows.

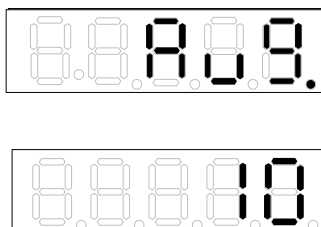


Figure 4-18 Setting Avg and the average number

4. Use **↑**, **↓** to select the required average number and press **Trig/Enter** to save the setting and exit the function setting display.

Once the average number is set, it will be saved in the internal flash memory of Power Meter and will not disappear even the power is off.

Windo

Movable window is another method 66201/66202 Power Meter provided to average the readings. The Power Meter adds up the measurements of all currents or current cycles within the window time set by user and then divides it by the total cycle numbers within that time frame. When the Power Meter read a new sample value, the oldest sample value in register in the window time will be excluded which means to keep the window time to a fixed value.

The window time range can be set by 66201/66202 Power Meter is 0.1 –10 seconds with every 0.1 second a unit.

Following are the steps to set the parameter:

1. Press **Setup** to select Meas and the indicator of Meas is on as Figure 4-17 shows.
2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select Meas and press **Trig/Enter** to save the setting and go to average and window selection display.
3. In AC voltage parameter display a blinking pattern will appear. Use **↑**, **↓** to select Windo and press **Trig/Enter** to save the setting and go to window second setting display as Figure 4-19 shows.

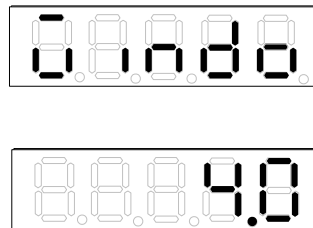


Figure 4-19 Setting Window and Window Time

4. Use **↑**, **↓** to set the required seconds and then press **Trig/Enter** to save the setting and exit the function setting display.

Notice

The UUT input source measured by Power Meter is a variable affected by the changes of power, load and other factors. The Power Meter panel display readouts will not change significantly if average is well utilized. However, please be noted that the more the average number the less UUT sudden change can be shown.

RATIO:

If the maximum current of UUT exceeds the maximum range of 66202 Digital Power Meter, CT (Current Transformer) is requirement for measurement. It also needs to set the RATIO function. For example: If the CT labeled 100A/1A, the RATIO needs to set to 100. The setting restriction is 0.1~9999.9.

Follow the steps below to set the parameter for RATIO:

1. Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-20 shows the setting of RATIO.

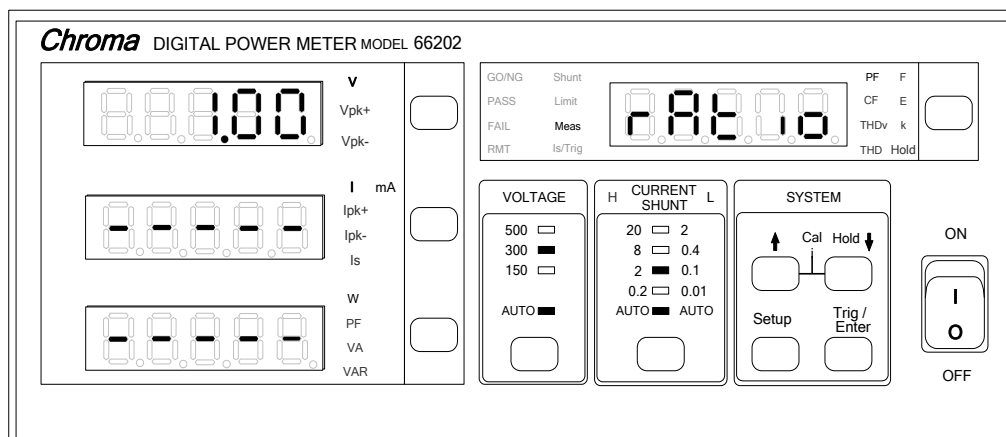


Figure 4-20 Setting RATIO

2. In the special measurement display a blinking pattern will appear. Use $\uparrow$, $\downarrow$ to select ratio and press **Trig/Enter** to save the setting then go to ratio (1.00) selection display.
3. Use $\uparrow$, $\downarrow$ to set the desired ratio and then press **Trig/Enter** to save the settings and exit the function setting display.

Notice

It is necessary to match the specification of measurement fixture such as CT when setting the RATIO; or the displayed current value will be incorrect. To input the current directly for test, it is necessary to set the RATIO to 1.00 to avoid calculation error.

WARNING

It should avoid opening the secondary coil when using CT as high voltage may be generated when the current goes through the secondary coil and cause hazard.

ENERG:

66202 Power Meter is able to measure the UUT's Energy within a certain time frame. Users can use **Trig/Enter** to decide when to start the measurement.

Following are the steps to set the parameter:

1. Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-21 shows the setting of Energy.

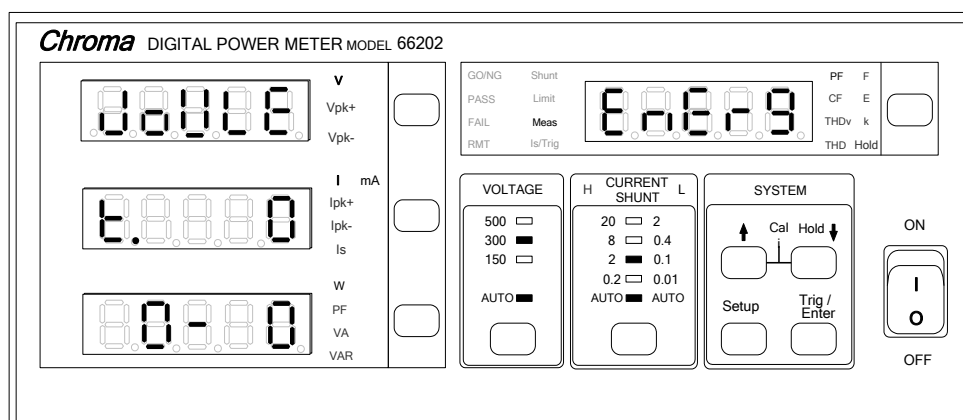
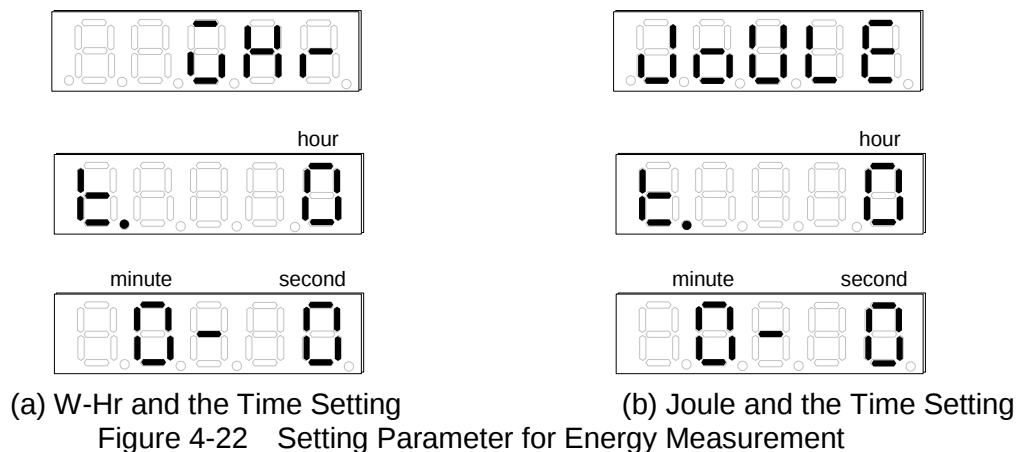


Figure 4-21 Setting Energy Parameters

2. In the special measurement display a blinking pattern will appear. Use $\uparrow$, $\downarrow$ to select ENERG and press **Trig/Enter** to save the setting and go to unit selection display.
3. Use $\uparrow$, $\downarrow$ to select W_hr or Joule and press **Trig/Enter** to save the setting and go to measurement time selection display as Figure 4-22 (a) and (b) show.



4. First, set the measurement time (hour) using $\uparrow$, $\downarrow$ to select 0~9999 and then press **Trig/Enter**.
 Next, set the measurement time (minute) using $\uparrow$, $\downarrow$ to select 0~59 and then press **Trig/Enter**.
 Last, set the measurement time (second) using $\uparrow$, $\downarrow$ to select 0~59 and then press **Trig/Enter** to save the setting and exit the function setting display.

Once the parameter is set, users can decide when to start calculating the UUT's energy. First, go to the special measurement display and switch to E (Energy) and press **Trig/Enter** to calculate the energy. The 'E' LED blinks one time indicates one second. It stops blinking when the measurement time is over and show the calculated data on the display.

Notice

E (Energy), Is (Inrush current) and GO/NG three parameters of 66202 Power Meter need to be triggered by **Trig/Enter** and their priority is E > Is > GO/NG.

THD:

Users are able to read the Total Harmonic Distortion (THD) of UUT's voltage and current from 66202 Power Meter. For the harmonic levels, 66202 Power Meter has a user-defined Order option that can set the harmonic up to 100 levels and a FULL option to select the entire 100 levels. In addition, the Cycle and SMOOT functions are explained below.

Cycle

The cycle mode specifies the measurement window in number of cycles of the fundamental frequency. The window type is rectangular and the FFT data length is 4096. The sampling rate is synchronized to the fundamental frequency of voltage source.

The cycle sets to 10(50Hz-system) or 12(60Hz-system) when measure fluctuating harmonic is preferred. The setting cycle range is 1 to 20. The upper limit of the measured order is decreased when cycle number is increased. The detail upper limit of the measured order is listed on the below table.

The larger cycle number is needed when the fundamental frequency is higher. The effective cycle setting is limited by the finite sample rate. The detail setting cycle information is showed to the below figure. Even if the setting cycle is invalid, the analysis mechanism still adjusts cycle number to be effective to keep the rectangular window type.

Sample rate, window width, and upper limit of measured order				
Fundamental Frequency (Hz)	Sample Rate (S/sec)	Measuring Window Width (cycle)	Upper Limit of the Measured Order	
			Filter on	Filter off
10 to 60	$(f \times 4096) / \text{cycle}$	See the figure of the effective setting cycle number	100	100
60 to 120			50	80
120 to 180			37	50
180 to 240			28	40
240 to 300			22	30
300 to 360			17	25
360 to 480			14	20
480 to 720			9	10
720 to 1200			5	5

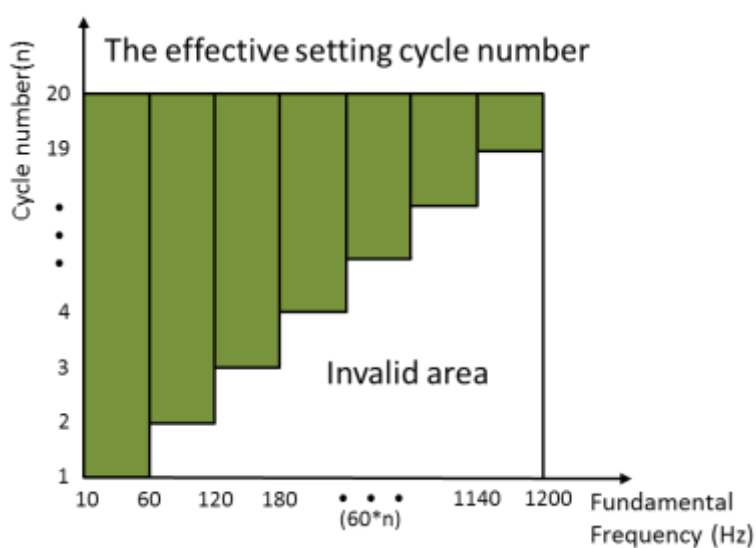


Figure 4-23 Effective Setting Cycle No. for Fundamental Frequency

Smooth

A smoothing is performed over the r.m.s. value of each harmonic order in each FFT measurement window by using a digital equivalent of a first-order low-pass filter with a time constant of 1.5 second. The smooth setting is ON or OFF. The smoothing filter sets to ON when measure fluctuating harmonic is preferred; the stable and average measured value will be obtained.

Follow the steps below to set the parameter for THD:

1. Press **Setup** to select Meas and the indicator of Meas is on as shown on Figure 4-24.

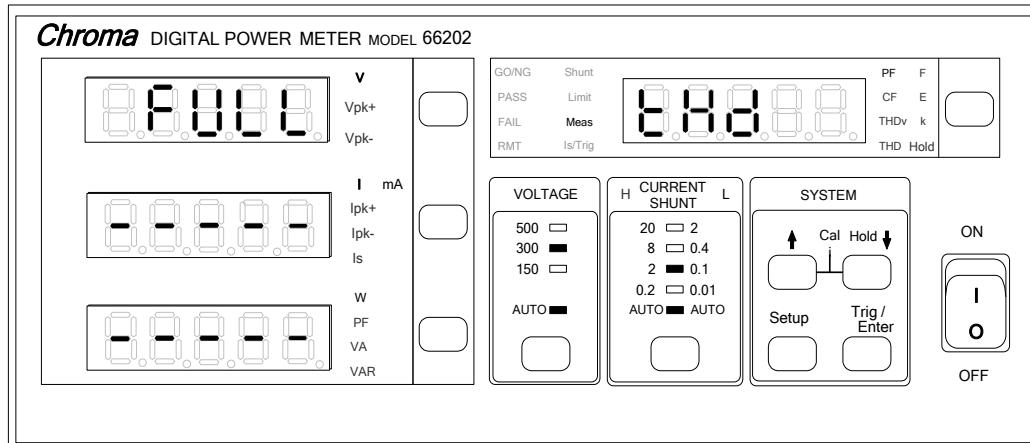


Figure 4-24 Setting THD Parameters

2. In the special measurement display a blinking pattern will appear. Use $\uparrow$, $\downarrow$ to select tHd and press **Trig/Enter** to save the setting and go to harmonic setting display.
3. A blinking pattern appears on the AC voltage display. Use $\uparrow$, $\downarrow$ to select one from Order, SMOOT, CYCLE and FULL and press **Trig/Enter** to save the settings and exit to window to set Order (2~100), SMOOT (ON/OFF) or CYCLE (1~20).
4. When the settings are done, press **Trig/Enter** to save the settings and return to the main screen.

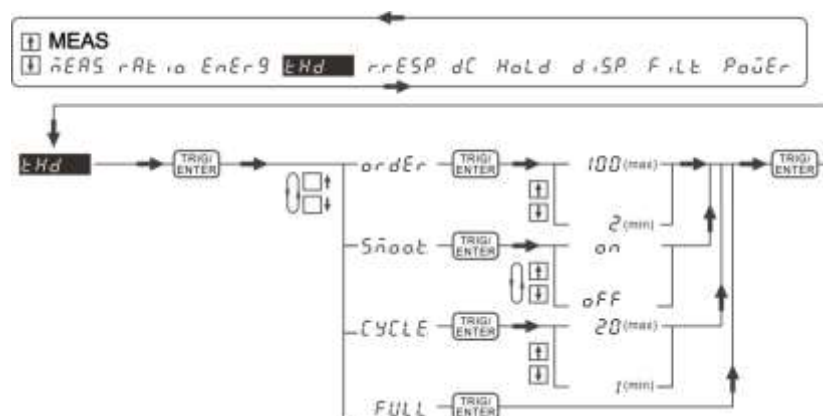


Figure 4-25 THD Parameters Setting Procedure

When the harmonic levels are set, it can go to other display window to select the desired current harmonic or voltage harmonic for observation.

Notice

1. The filter setting is used to eliminate high frequency components that are irrelevant to the harmonic measurement. For example, when measuring the input signal with a fundamental frequency of 50 Hz up to the 50th order, the frequency of the 50th order is 2.5 kHz. Thus, an approximated 6 kHz filter is used to eliminate high frequency components that are greater than or equal to approximately 6 kHz, which are irrelevant to the harmonic measurement.
2. The total harmonic level of voltage and current needs to be set concurrently. 66202 Power Meter does not provide individual setting function for voltage and current total harmonic.
3. The 66201/66202 power meter's Cycle and Smooth functions are only supported when the firmware version is ≥ 1.80 .

R.RESP:

The range down response time has two modes which are FAST response mode and SLOW response mode as described below.

FAST response mode

The range is down when all peak currents meet the range down condition within a short time (about 2 cycles of fundamental wave).

SLOW response mode

The range is down when all peak currents meet the range down condition within the time set in windo.

Notice

1. The R.RESP function is only valid during current measurement.
2. When the measured current is changing severely and causing the current range too sensitive to lose data, it is suggested to set R.RESP to SLOW.
3. The 66201/66202 power meter's R.RESP function is only supported when the firmware version is ≥ 1.80 .

Follow the steps below to set the parameter:

1. Press **Setup** to select Meas and the indicator is on.
2. In the special measurement display a blinking pattern will appear. Use $\uparrow$, $\downarrow$ to select r.rESP and press **Trig/Enter** to save the setting and go to R.RESP mode as shown in Figure 4-26.
3. A blinking pattern appears on the AC voltage display. Use $\uparrow$, $\downarrow$ to select FAST or SLOW and press **Trig/Enter** to save the settings and return to the main screen.

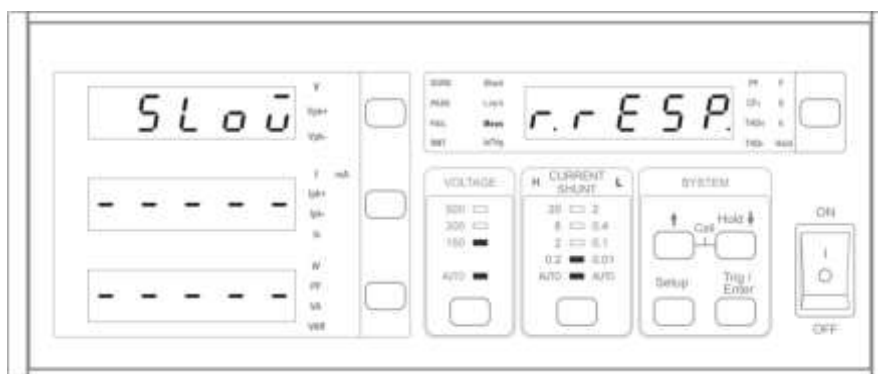


Figure 4-26 Setting R.RESP Parameters

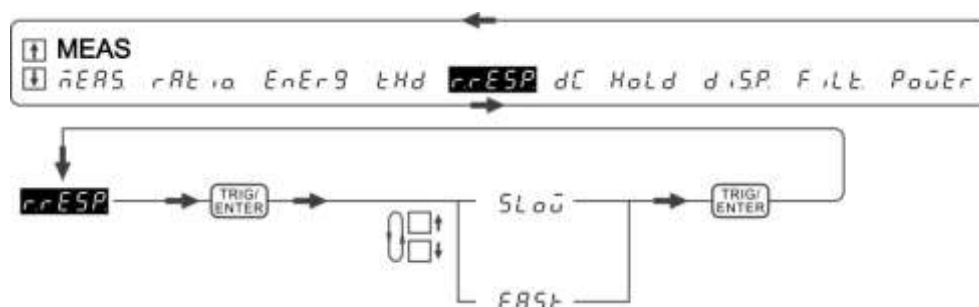


Figure 4-27 R.RESP Parameters Setting Procedure

DC:

The 66201/66202 Power Meter has equipped the function to measure the DC component signals.

Follow the steps below to set the parameters:

1. Press **Setup** to select Meas and the indicator of Meas is on.
2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select dC and the input signal will appear on the left for the measured voltage and current with DC component only (the AC component signals are filtered out) as Figure 4-28 shows.

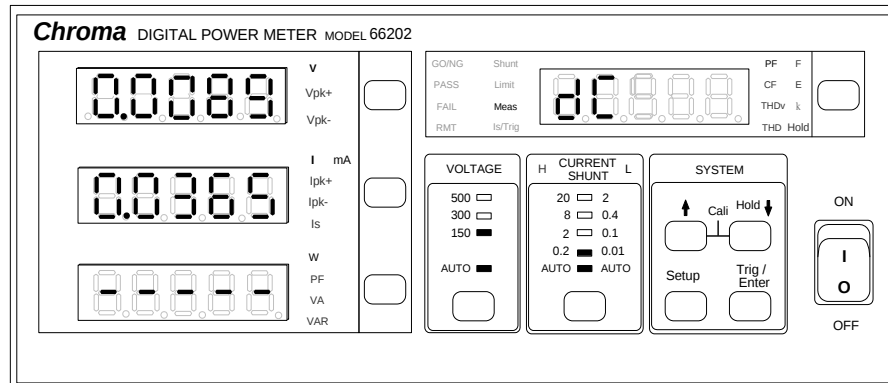


Figure 4-28 Setting dC Parameters

Notice

1. It is normal for the measured reading to fluctuate when there is no input signal. Please also note that the reading will vary under different range setting.
2. It is required that the measured AC+DC input signal's voltage magnitude be at least 1/10 of the voltage range implemented, as this is to ensure proper measurement operation of power meter. It is strongly suggested to set the Filter to ON when using this function.
3. When the voltage and current ranges are set to Auto. Both ranges will be determined automatically depending on the measured AC+DC signal. Therefore, when the AC portion of signal is much larger than the DC portion, the measurement error will be significant.
4. This function shows the readings of DC component and it is unable to select the voltage and current range manually in the selection screen. To select the range manually, quit this function and return to the measurement screen for setting.

HOLD:

66201/66202 Power Meter has 3 functions to hold the measurement display which are Stop, Max and Min.

Follow the steps below to set the parameter for HOLD:

1. Press **Setup** to select Meas and the indicator of Meas is on.
2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select HoLd and press **Trig/Enter** to save the setting and go to the function selection display.
3. Use **↑**, **↓** to select Stop, Max or Min as shown in Figure 4-29, Figure 4-30 and Figure

4-31. Press **Trig/Enter** to save the settings and go to the settings of Hold time (there is no time settings if Stop is selected.)

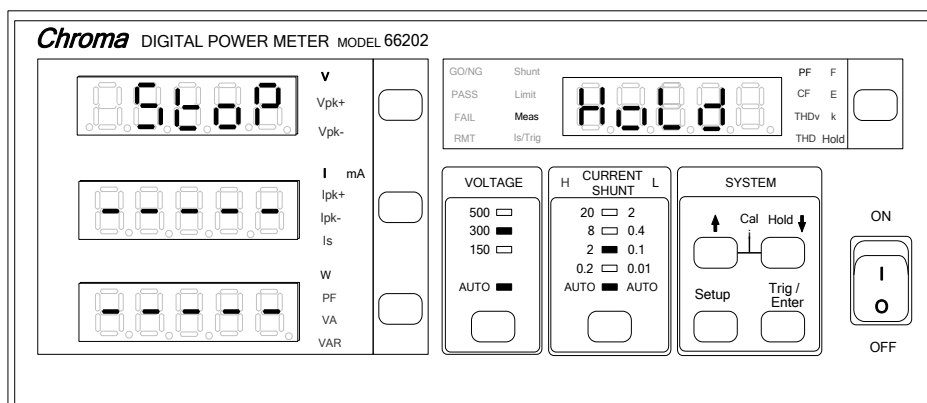


Figure 4-29 Setting Stop in HOLD

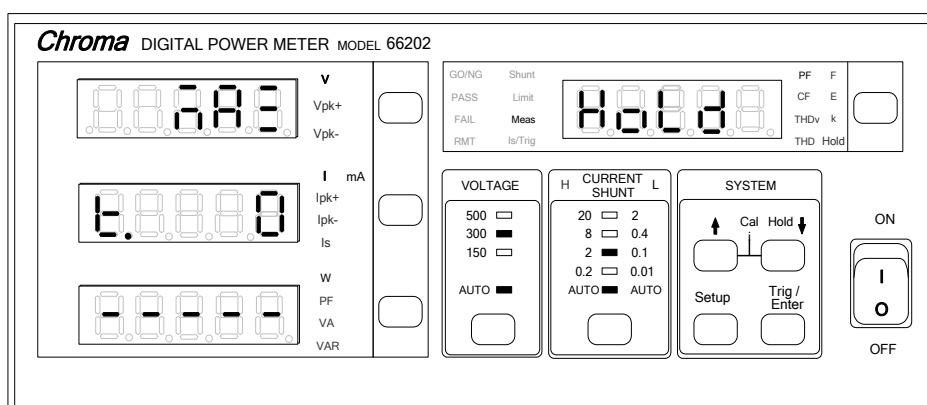


Figure 4-30 Setting Max in HOLD

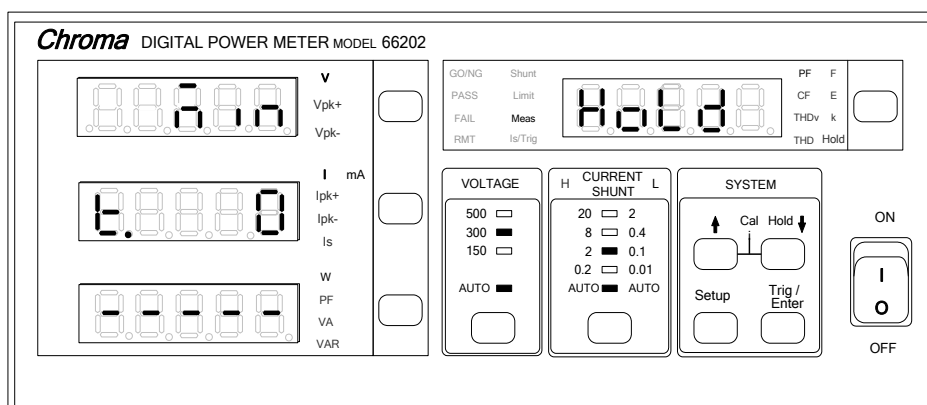


Figure 4-31 Setting Min in HOLD

4. Set the measurement time (second) using **↑**, **↓** to select 0~9999 and press **Trig/Enter** to return to measurement screen.
5. Press **HOLD** for activation and the HOLD indicator is blinking and keeps making short beep s.
6. When STOP is selected, press **HOLD** the display will be hold. Press any key in the SYSTEM area can release it and the HOLD indicator will be off.
7. When Max is selected and the time is set to 0 indicates there is no time limit. Press **HOLD** the panel will keep updating the measurement maximum. If the time is set to 10,

press **HOLD** the panel keeps blinking and updating the measurement maximum within 10 seconds. When the time is up, a long beep will sound to remind users the value panel displays is the measured maximum. Later the display is hold and keeps making short beeps. Press any key in the SYSTEM area can release it and the HOLD indicator will be off.

- Min function is to measure the minimum measurement within set time. Its setting and usages are the same as Max.

Notice

The HOLD function in 66201/66202 Power Meter is only supported when the firmware version is ≥ 1.20 . HOLD is a new function and since the display panel has old and new versions, the old version as Figure 4-32 shows has no HOLD indicator while the new version has it as shown in Figure 4-29. The HOLD is located at **↓** key.

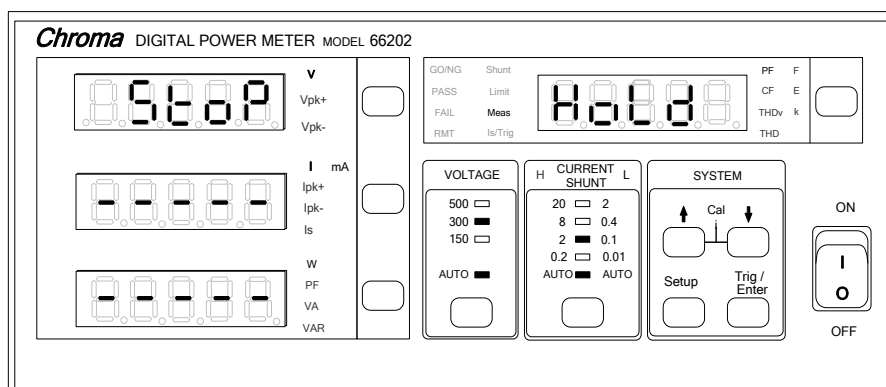


Figure 4-32 Old Setting Panel of Stop for HOLD

DISP:

66201/66202 Power Meter is able to adjust the measurement display speed. There are 0.25, 0.5, 1.0 and 2.0 (unit: second.) window times for setting.

Follow the steps below to set the parameter for DISP:

- Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-33 shows the initial setting screen.

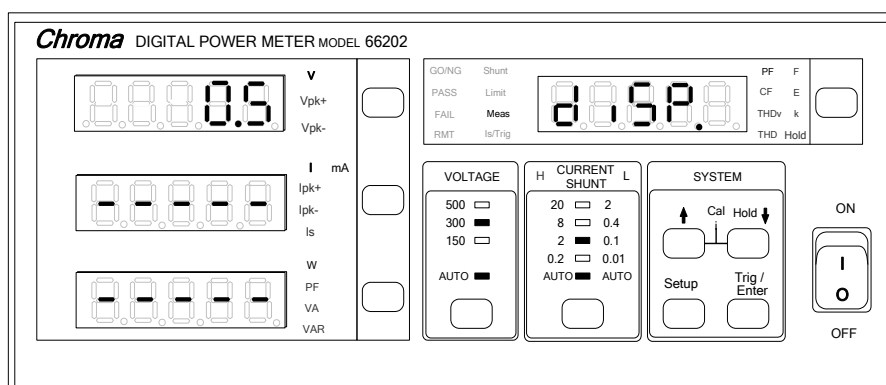


Figure 4-33 Setting DISP Option and Window Time

- In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select disp and press **Trig/Enter** to save the setting and go to the speed adjustment display.
- In the AC voltage parameter display a blinking pattern will appear. Use **↑**, **↓** to select the

display speed and press **Trig/Enter** to save the setting as well as exit the function setting screen.

FILT:

The 66201/66202 Power Meter has settings for digital filter. The bandwidth of digital filter is 6kHz and is able to filter out the high frequency component of input signal.

Follow the steps below to set the parameter for digital filter:

1. Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-34 shows the setting of Filter.

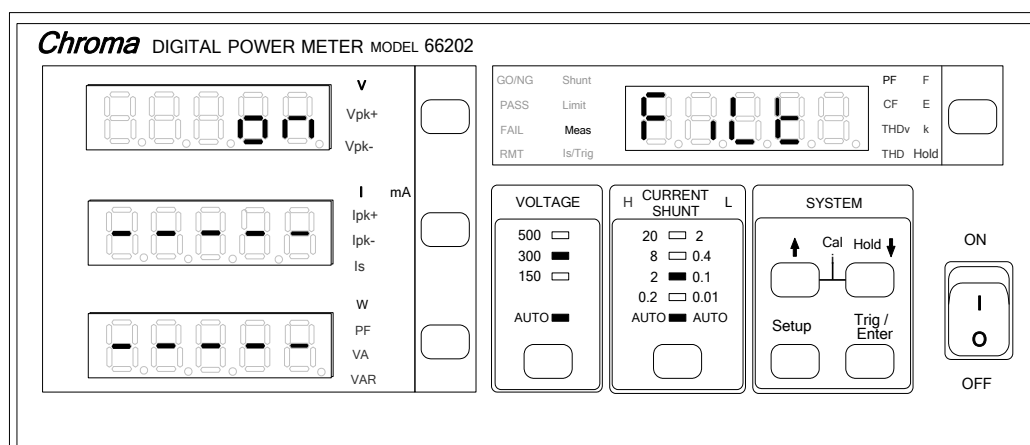


Figure 4-34 Setting Filter

2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select Filt and press **Trig/Enter** to save the setting and go to ON/OFF selection display.
3. Use **↑**, **↓** to select ON/OFF and then press **Trig/Enter** to save the setting and exit the function setting display.

Notice

1. The bandwidth of digital filter is adjusted by A/D sampling frequency which is varied with fundamental wave frequency. Therefore, the digital filter bandwidth is about 5 kHz~7 kHz when measuring the commercial frequency 45 Hz~65 Hz.
2. It is suggested to set the digital filter to OFF when performing Inrush current test.

POWER:

The 66202 Power Meter is able to use Accumulated Energy Approach Method (integration mode) to measure the UUT power, voltage and current RMS within fixed time frame continuously by integration mode.

Following the steps below to set the parameter:

1. Press **Setup** to select Meas and the indicator of Meas is on. Figure 4-35 shows the setting of Power.

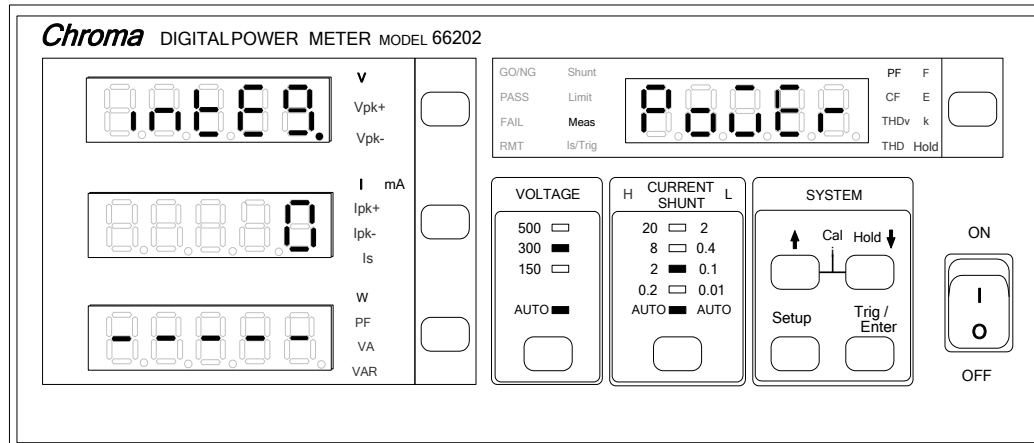


Figure 4-35 Setting Power

2. In the special measurement display a blinking pattern will appear. Use $\uparrow$, $\downarrow$ to select POWER and press **Trig/Enter** to save the setting and go to time setting display.
3. When INTEG appears it indicates Integration Mode is in use for calculation. Use $\uparrow$, $\downarrow$ to select the time (second) to be measured and press **Trig/Enter** to save the setting and exit the function setting display.

Once the parameter setting is done, users can see the voltage, current, V (voltage), I (current) and W (active power) indicators aside the AC Power display are blinking with one second per blink. The voltage, current and power readings also blink to indicate it is the measurement of the first time. When the time to be tested is due, the power meter will show a new reading and start to calculate next power automatically. To disable the Accumulated Energy Approach Method to calculate the power parameter, repeat setting parameter 1-3 and set the time to zero in step 3. The power calculation is then disabled.

When power measurement is set to perform in integration mode, it may cause power integration measurement error if changing the voltage, current range within integration time. A message of Range Change Error will appear on the display as Figure 4-36 shows:



Figure 4-36 Message of Range Change Error

When error message appears, press **Trig/Enter** to clear the error message and the system will redo the power integration measurement with the reset range. If **Trig/Enter** is not pressed to clear the error message, the system will clear it automatically when the integration time is due and redo power integration measurement with the rest range.

Notice

If users want to cancel integration mode for measuring Power, they can set the time to zero. The power meter will change by using Avg or Windo set on Meas.

WARNING

If over voltage or over current warning messages occurred when changing voltage or current range within integration time, please clear the over voltage or over current state.

4.4.4 Is/Trig Function (Inrush Current Test)

This function is only applicable to model 66202. When executing Inrush Current Test, users need to set the trigger level, time delayed and time for measurement. The trigger level unit is ampere (A), the time delayed unit is millisecond (ms) and the unit of time for measurement is also millisecond (ms). They are set by the following steps.

1. Press **Setup** to select Is/Trig and the indicator of Is/Trig is on. Figure 4-37 shows the setting of Is/Trig.

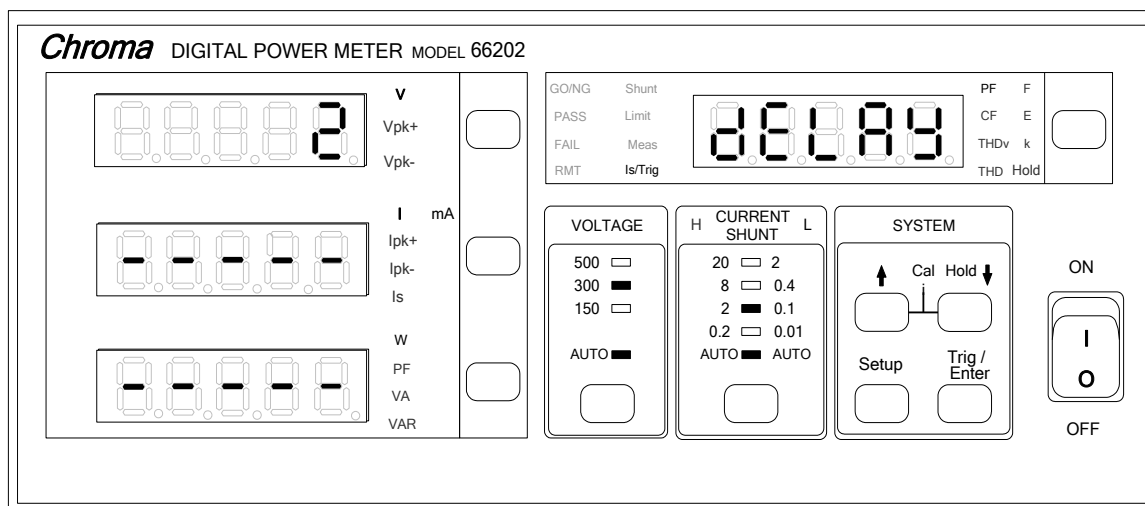


Figure 4-37 Setting Is/Trig

2. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select Level and press **Trig/Enter** to save the setting and go to trigger Level (ampere) selection display as shown in Figure 4-38.

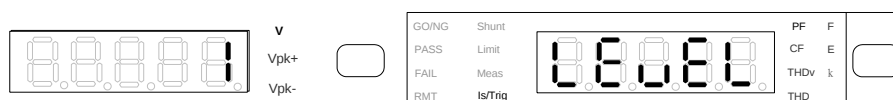


Figure 4-38 Setting LEVEL and Current

3. Use **↑**, **↓** to set the Level (ampere) and then press **Trig/Enter** to save the setting and go to the display of Step 2.
4. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select delay and press **Trig/Enter** to save the setting and go to Delay time (ms) selection display as shown in Figure 4-39.

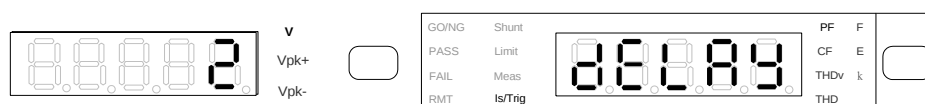


Figure 4-39 Setting DELAY and Time Length

5. Use **↑**, **↓** to set the time (second) and then press **Trig/Enter** to save the setting and go to the display of Step 2.
6. In the special measurement display a blinking pattern will appear. Use **↑**, **↓** to select time and press **Trig/Enter** to save the setting and go to measurement Time (ms) selection display as shown in Figure 4-40.

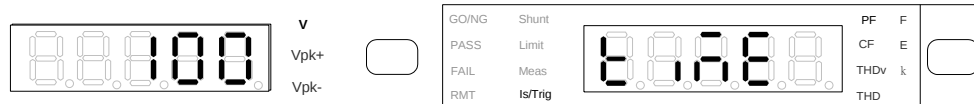


Figure 4-40 Setting TIME and Time Length

7. Use $\uparrow$, $\downarrow$ to set the time (second) and then press **Trig/Enter** to save the setting and go to the display of Step 2.
8. Press **Setup** to exit the function setting display.

Once the parameter is set, users can decide when to start the Inrush current measurement. First, go to the AC Power display and use switch key to change to Is and press **Trig/Enter**, the 66202 Power Meter starts to test the Inrush current. The display shows dash lines



at this moment and the Is LED blinks to indicate the system is in Inrush Current detecting mode. When the current exceeds the set trigger level, perform the measurement according to the time set to be delayed and measured and the show the detected maximum current in display.

Example 1:

Users can use the following setting to measure the Inrush current (1) in Figure 4-41.

Level: 1A
 Delay: 0 ms
 Time: 10 ms

From Figure 4-41 it can tell that the current exceeds the trigger current (1A) around 1.1ms and since the time delayed is 0 second, the 66202 Power Meter starts to measure the Inrush current and the maximum Inrush current can be measured is 12A approximately.

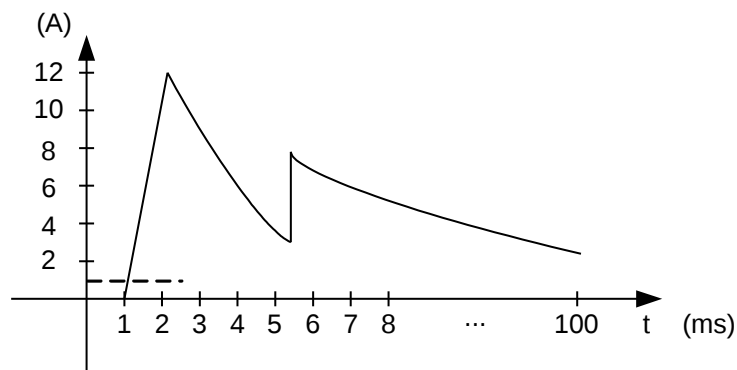


Figure 4-41 Measuring Inrush Current (1)

Example 2:

Users can use the following setting to measure the Inrush current (2) in Figure 4-42.

Level: 1A
 Delay: 3 ms
 Time: 10 ms

From Figure 4-42 it can tell that the current exceeds the trigger current (1A) around 1.1ms and after delayed for 3ms second, the 66202 Power Meter starts to measure the Inrush

current. From the current curve it can see that the maximum current has been exceeded so the maximum Inrush current can be measured is 8A approximately.

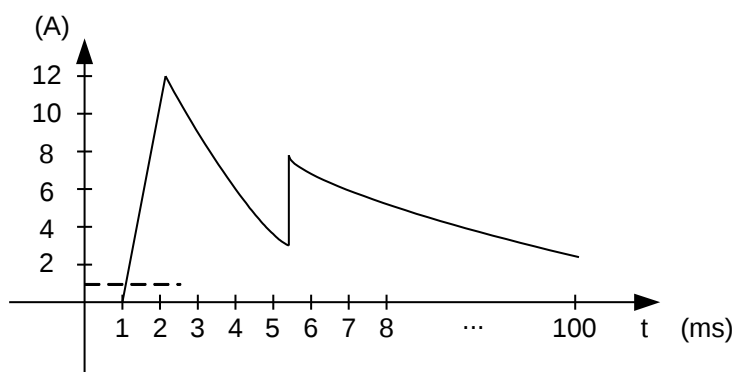


Figure 4-42 Measuring Inrush Current (2)

Notice

1. The fastest sampling rate of 66202 Power Meter is around $4 \mu\text{s}$ so if the maximum Inrush current occurs within $4 \mu\text{s}$, the 66202 Power Meter may miss the best measurement time.
2. Besides using current level to trigger for Inrush Current test, external trigger can also be used. The measurement starts when any of the trigger sources is triggered. See *Appendix A* for external trigger signal pin assignment.
3. The AUTO range cannot be fast enough when measuring Is. We suggest that the user fix the shunt selection and current range on High Shunt and 20A range.

4.5 Fan Detection

Since the maximum rating current of Model 66202 in 66201/66202 Digital Power Meters is 20A, to prevent the sample resistance of current measurement loop from accumulating too much heat due to excessive current that may cause the measurement error to increase, an extra fan is installed to reduce the temperature rise of sample resistance. 66202 Digital Power Meter will check if the fan is working as normal automatically under the conditions of 1. power on and 2. when setting the current range to 8A & 20A. Following explains the detection process.

(1) Power On

The 66202 Digital Power Meter executes fan detection automatically at power on. If the fan is not working normally, the voltage measurement window will display a warning message as Figure 4-43 shows and beeps continuously to inform users the fan is not working correctly. Users can press **Trig/Enter** to ignore the warning and perform low current range measurement.

(2) When Setting the Current Range to 8A, 20A

The 66202 Digital Power Meter will run fan detection as power on when setting the current range to 8A and 20A for execution. If the fan is not working normally before or during measurement, the voltage measurement window will display a warning message as Figure 4-43 shows and beeps continuously to inform users the fan is not working correctly. In this case, users cannot just press **Trig/Enter** to ignore it. It is suggested to send the 66202 Digital Power Meter back to Chroma for repair.

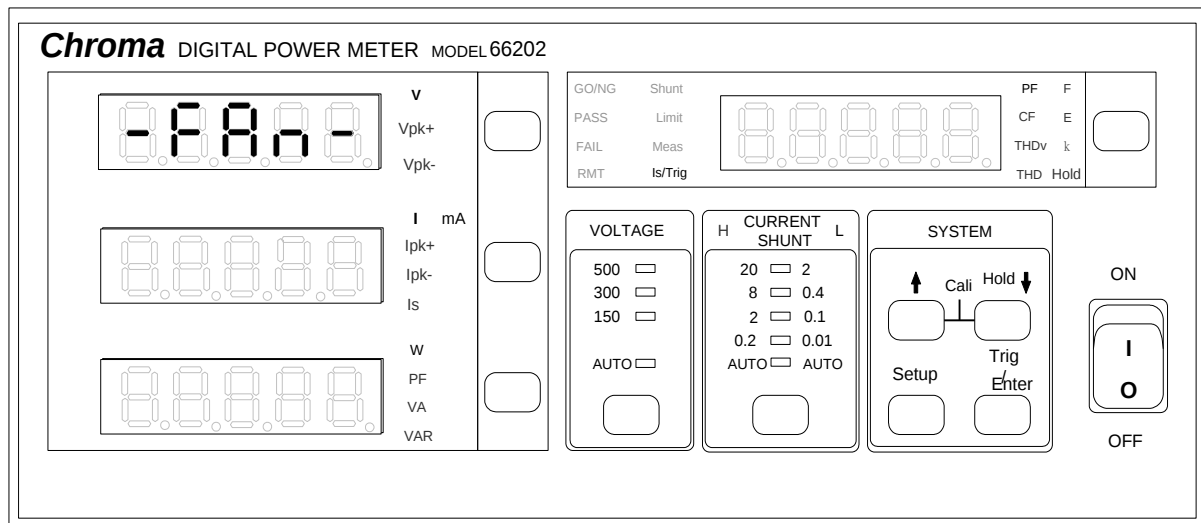


Figure 4-43 Warning Screen for Fan Failure

5. Using Remote Control

5.1 Overview

The 66201/66202 provides GPIB and USB two kinds of remote control interfaces and all functions of panel keys can be controlled by these two interfaces. The USB interface supports 2.0/USB 1.1, while the GPIB interface is complied with IEEE-488 standard.

5.2 USB Interface

Supported Hardware: USB 2.0 and USB 1.1
Supported Software: USBTMC class and USB488 subclass
Supported OS: Windows 98/2000/XP

Installing Driver Program:

The USB Interface of 66201/66202 supports USBTMC; therefore, if the PC's OS supports USBTMC (the PC has installed NI-VISA runtime 3.00 or above) there is no need to install other drivers in particular. The OS will search the standard USBTMC for installation automatically.

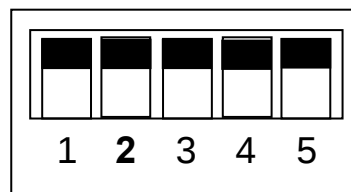
If the PC's OS does not support USBTMC, it is suggested to install NI-VISA runtime 3.00 or above first. The USBTMC driver will be in the OS once the NI-VISA runtime is installed. Power on the Digital Power Meter after connected it with the PC via USB cable and the PC can use the 66201/66202 SCPI commands through **NI-VISA** to communicate with the Digital Power Meter.

Related Documents:

- USB Test and Measurement Class (USBTMC) specification, Revision 1.0, <http://www.usb.org>
- USB Test and Measurement Class USB488 subclass specification, Revision 1.0, <http://www.usb.org>

5.3 Definition of GPIB Address

The DIP switch on the rear panel of 66201/66202 defines the GPIB address. The definition is binary (Bit0~Bit4) with Address 1 ~ Address 30 for setting as shown below.



DIP Switch	1	2	3	4	5
Address 1	1	0	0	0	0
Address 2	0	1	0	0	0
Address 3	1	1	0	0	0
Address 4	0	0	1	0	0
Address 5	1	0	1	0	0
Address 6	0	1	1	0	0
Address 7	1	1	1	0	0
Address 8	0	0	0	1	0
Address 9	1	0	0	1	0
Address 10	0	1	0	1	0
Address 11	1	1	0	1	0
Address 12	0	0	1	1	0
Address 13	1	0	1	1	0
Address 14	0	1	1	1	0
Address 15	1	1	1	1	0
Address 16	0	0	0	0	1
Address 17	1	0	0	0	1
Address 18	0	1	0	0	1
Address 19	1	1	0	0	1
Address 20	0	0	1	0	1
Address 21	1	0	1	0	1
Address 22	0	1	1	0	1
Address 23	1	1	1	0	1
Address 24	0	0	0	1	1
Address 25	1	0	0	1	1
Address 26	0	1	0	1	1
Address 27	1	1	0	1	1
Address 28	0	0	1	1	1
Address 29	1	0	1	1	1
Address 30	0	1	1	1	1

5.4 The GPIB Capability of the Power Meter

GPIB Capability	Response	Interface Functions
Talker/Listener	Commands and response messages can be sent and received over the GPIB bus. Status information can be read using a series poll.	AH1, SH1, T6, L4
Service Request	The Power Meter sets the SRQ line true if there is an enabled service request condition.	SR1
Remote/Local	The Power Meter powers up in local state. In local state, the front panel is operative, and the Power Meter responds to the commands from GPIB. In remote state, the RMT of indicator will be lighted up and all front panel keys except the "<SETUP>" key are disabled. Press "<SETUP>" key to return the Power Meter to local state.	RL1
Device Clear	The Power Meter responds to the Device Clear (DCL) and Selected Device Clear (SDC) interface commands. These cause the Power Meter to clear any activity that may prevent it from receiving and executing a new command. DCL and SDC do not change any programmed settings.	DCL, SDC

5.5 Introduction to Programming

All commands and response messages are transferred in form of ASCII codes. The response messages must be read completely before a new command is sent, otherwise the remaining response messages will be lost, and a query interrupt error will occur.

5.5.1 Conventions

Angle brackets < > Items in angle brackets are parameter abbreviations.

Vertical bar | Vertical bar separates alternative parameters.

Square brackets [] Items in square brackets are optional. For example, FETCh[:SCALar] means that :SCALar may be omitted.

Braces { } Braces indicate the parameters that may be repeated. The notation <A> {<, B>} means that parameter "A" must be entered while parameter "B" may be omitted or entered once or more times.

5.5.2 Data Formats

All data programmed to or returned from the Power meter are ASCII. The data can be numerical or character string.

Numerical Data Formats

Symbol	Description	Example
<NR1>	It is a digit with no decimal point. The decimal is assumed to be at the right of the least significant digit.	123 , 0123
<NR2>	It is a digit with a decimal point.	12.3 , .123

Character Data Format

The character strings returned by query command may take either of the following forms:

<CRD> Character Response Data : character string with maximum length of 12.
<SRD> String Response Data : character string.

Arbitrary Block Data Format

The arbitrary block data returned by query command may take either of the following forms:

<DLABRD> Definite Length Arbitrary Block Response Data:

The <DLABRD> is formatted as:

#<x><yy...y><byte1><byte2><byte3><byte4>...<byteN><RMT>

Where,

 <x> is the number of characters in <yy...y>.

 <yy...y> is the number of bytes to transfer.

For example, if <yy...y> = 01024, then <x> = 5 and <byte1><byte2><byte3>...<byte1024>

<ILABRD> Indefinite Length Arbitrary Block Response Data:

The <ILABRD> is formatted as:

#<0><byte1><byte2><byte3><byte4>...<byteN><RMT>

5.6 Basic Definition

5.6.1 Command Tree Table

The commands of the Power meter are based on a hierarchical structure, also known as a tree system. In order to obtain a particular command, the full path to that command must be specified. This path is represented in the table by placing the highest node in the farthest left position of the hierarchy. Lower nodes in the hierarchy are indented in the position to the right, below the parent node.

5.6.2 Program Headers

Program headers are key words that identify the command. They follow the syntax described in subsection 5.8 of IEEE 488.2. The Power meter accepts characters in both upper and lower case without distinguishing the difference. Program headers consist of two distinctive types, common command headers and instrument-controlled headers.

Common Command and Query Headers:

The syntax of common command and query headers is described in IEEE 488.2. It is used together with the IEEE 488.2-defined common commands and queries. The commands with a leading “*” are common commands.

Instrument-Controlled Headers:

Instrument-controlled headers are used for all other instrument commands. Each of them has a long form and a short form. The Power meter only accepts the exact short and long forms. A special notation will be taken to differentiate the short form header from the long one of the same header in this subsection. The short forms of the headers are shown in characters of upper case, whereas the rest of the headers are shown in those of lower case.

Long-Form : The word is spelled out completely to identify its function. For instance, CURRENT, VOLTAGE and MEASURE are long-form.

Short-Form : The word contains only the first three or four letters of the long-form. For instance, CURR, VOLT and MEAS are short-form.
In the section 5.8.2 Instrument Commands, the upper case is part of short-form. For instance, SYSTem : ERRor? can be wrote as SYST : ERR?

Program Header Separator (:):

If a command has more than one header, the user must separate them with a colon (example: FETC:CURR:RMS? or POW:INT 10). Data must be separated from program header by one space at least.

5.6.3 Program Message

Program message consists of a sequence of element of program message unit that is separated by program message unit separator elements of program message unit, and a program message terminator.

Program Message Unit:

Program message unit represents a single command, programming data, or query.

Example: FILT? or WIND ON

Program Message Unit Separator (;):

The separator (semicolon ;) separates the program message unit elements from one another in a program message.

Example: VOLT:RANG V300 ; CURR:RANG AUTO

Program Message Terminator (<PMT>):

A program message terminator represents the end of a program message. Three permitted terminators are:

- (1) <EOI> : end or identify.
- (2) <LF>(i.e.: NL, new line) : line feed which is a single ASCII-encoded byte 0A (10 decimals).
- (3) <LF><EOI> : line feed with EOI.

5.6.4 Response Message

Response message consists of a sequence one or more elements of response message unit that is separated by response message unit separator elements of response message unit, and a response message terminator.

Response Message Unit:

Response message unit consists of a sequence one or more elements of response data unit that is separated by response data unit separator elements of response data unit.

Example:

Query: FILT?	Response: ON
Query: VOLT:RANG?	Response: AUTO
Query: FILT?;;COMP:LIM:V?;;COMP?	Response: ON ; 220.0 , 50.0 ; OFF

Response Message Unit Separator (;):

The separator (semicolon ;) separates the response message unit elements from one another in a response message.

Example: ON ; AUTO ; 110.01

Response Data Unit:

Example: ON or AUTO or 110.01 or 220.0 or VPK+

Response Data Unit Separator:

The separator separates the response data unit elements from one another in a response message unit. Three permitted separators are:

When sets the SYSTem:TRANsmit:SEParator as 0 :

(1) (,) : Comma.

When sets the SYSTem:TRANsmit:SEParator as 1 :

(2) (;) : Semicolon.

Example:

If queries FETCH? than the response will be

<NR2>,<NR2>,<NR2>,<NR2>,<NR2>,<NR2>,<NR2>,<NR2>,... or
<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;...

If queries COMP:ITEM? than the response will be V , I , W , PF ,... or V ; I ; W ; PF ;...

Response Message Terminator (<RMT>):

A response message terminator represents the end of a response message. Three permitted terminators are:

When sets the SYSTem:TRANsmit:TERMinator as 0 :

(1) LF(i.e.: NL, new line) : line feed which is a single ASCII-encoded byte 0A (10 decimals).

(2) LF+EOI : line feed with end or identify (EOI).

When sets the SYSTem:TRANsmit:TERMinator as 1 :

(3) CR+LF : cursor return and line feed which are a single ASCII-encoded byte 0D (13 decimals) and a single ASCII-encoded byte 0A (10 decimals).

(4) CR+LF+EOI : cursor return and line feed with end or identify (EOI).

5.7 Traversal of the Command Tree

Multiple program message unit elements can be sent in a program message. The first command is always referred to the root node. Subsequent commands are referred to the same tree level as the previous command in a program message. A colon preceding a program message unit changes the header path to the root level.

Example:

TRIGger : STATE?

: TRIGger : STATE?

TRIGger : STATE? ; : VOLTage : RANGE V150

All colons are header separators.

Only the first colon is a specific root.

Only the second colon is a specific root.

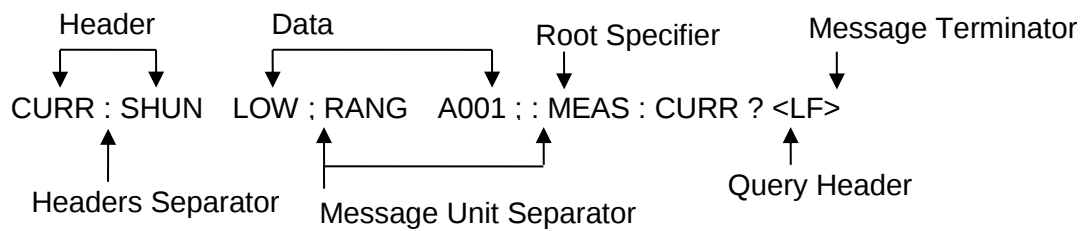


Figure 5-1 The Structure of Program Message

5.8 Power Meter Commands

5.8.1 Standard Commands

*CLS

66201 | 66202

Description: This command clears the status byte register and the event registers.

Setting Syntax: *CLS<PMT>

Setting Parameters: none

Query Syntax: none

Response Parameters: none

Example: none

*ESE

66201 | 66202

Description: This command sets the standard event status enable register.

This command programs the Standard Event register bits. If one or more of the enabled events of the Standard Event register is set, the ESB of Status Byte Register is set too.

Bit Configuration of Standard Event Status Enabled Register

Bit Position	7	6	5	4	3	2	1	0
Bit Name	PON	---	CME	EXE	---	QYE	---	---
CME = Command error			QYE = Query error					
EXE = Execution error			PON = Power-on					

Setting Syntax: *ESE<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 255

Query Syntax: *ESE?<PMT>

Response Parameters: <NR1>, 0 ~ 255

Header on: *ESE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

*ESR?

66201 | 66202

Description: This command reads out the contents of the standard event status register (SESR).

Setting Syntax: none

Setting Parameters: none

Query Syntax: *ESR?<PMT>

Response Parameters: <NR1>, 0 ~ 255

Header on: <NR1><RMT>

Header off: <NR1><RMT>

Example: none

***IDN?**

66201 | 66202

Description: This command queries manufacturer's name, model name, serial number and firmware version.

Setting Syntax: none

Setting Parameters: none

Query Syntax: *IDN?<PMT>

Response Parameters: <CRD>, Chroma ATE,66201,0,1.00

Header on: <CRD><RMT>

Header off: <CRD><RMT>

Example: none

***RST**

66201 | 66202

Description: This command performs device initial setting.

Setting Syntax: *RST<PMT>

Setting Parameters: none

Query Syntax: none

Response Parameters: none

Example: none

***SRE**

66201 | 66202

Description: This command sets the service request enable register (SRER).

Setting Syntax: *SRE<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 255

Query Syntax: *SRE?<PMT>

Response Parameters: <NR1>, 0 ~ 255

Header on: *SRE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

***STB?**

66201 | 66202

Description: This command queries the status byte register.

Bit configuration of Status Byte Register

Bit Position	7	6	5	4	3	2	1	0
Condition	---	MSS	ESB	MAV	QES	---	---	---

ESB = event status byte summary

QES = questionable status summary

MSS = master status summary

MAV = message available

Setting Syntax: none

Setting Parameters: none

Query Syntax: *STB?<PMT>

Response Parameters: <NR1>, 0 ~ 255

Header on: <NR1><RMT>

Header off: <NR1><RMT>

Example: none

***TST?**

66201 | 66202

Description: This command requests execution of, and queries the result of self-test.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** *TST?<PMT>**Response Parameters:** <NR1>, 0

Header on: <NR1><RMT>

Header off: <NR1><RMT>

Example: none***SAV**

66201 | 66202

Description: This command saves the value of setting.**Setting Syntax:** *SAV<PMT>**Setting Parameters:** none**Query Syntax:** none**Response Parameters:** none**Example:** none

5.8.2 Instrument Commands

SYSTEM Sub-system**SYSTem : ERRor?**

66201 | 66202

Description: This command queries the error string of the command parser.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** SYSTem:ERRor?<PMT>**Response Parameters:** <CRD> ,

0, "No Error"

1, "Data Format Error"

2, "Data Range Error"

3, "Command Error"

4, "Execution Error"

5, "Too many Errors"

Header on: :SYSTEM:ERROR<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**SYSTem : HEADER**

66201 | 66202

Description: This command turns response headers ON or OFF.**Setting Syntax:** SYSTem:HEADer<space><CRD><PMT>**Setting Parameters:** <CRD>, ON | OFF**Query Syntax:** SYSTem:HEADer?<PMT>**Response Parameters:** <CRD>, ON | OFF

Header on: :SYSTEM:HEADER<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

SYSTem : TRANsmit : SEParator

66201 | 66202

Description: This command sets the message unit separator for response messages.**Setting Syntax:** SYSTem:TRANsmit:SEParator<space><NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 1; 0 : Comma 1 : Semicolon**Query Syntax:** SYSTem:TRANsmit:SEParator?<PMT>**Response Parameters:** <NR1>, 0 ~ 1

Header on: :SYSTEM:TRANSMIT:SEPARATOR<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**SYSTem : TRANsmit : TERMinator**

66201 | 66202

Description: This command sets the data terminator for response messages.**Setting Syntax:** SYSTem:TRANsmit:TERMinator<space><NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 1; 0 : LF 1 : CR+LF**Query Syntax:** SYSTem:TRANsmit:TERMinator?<PMT>**Response Parameters:** <NR1>, 0 ~ 1

Header on: :SYSTEM:TRANSMIT:TERMINATOR<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**SYSTem : VERsion?**

66201 | 66202

Description: This query returns an <NR2> formatted numeric value corresponding to the SCPI version number for which the instrument complies.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** SYSTem:VERsion?<PMT>**Response Parameters:** <NR2>, 1991.1

Header on: :SYSTEM:VERSION<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none**SYSTem : LOCal**

66201 | 66202

Description: This command can only be used under control of USB. If SYST:LOC is programmed, the Power Meter will be set in the LOCAL state, and the front panel will work.**Setting Syntax:** SYSTem:LOCal<PMT>**Setting Parameters:** none**Query Syntax:** none**Response Parameters:** none**Example:** none**SYSTem : REMote**

66201 | 66202

Description: This command can only be used under control of USB. If SYST:REM is programmed, the Power Meter will be set in the REMOTE state, and the front panel will be disabled except the <SETUP>key pressed.**Setting Syntax:** SYSTem:REMote<PMT>**Setting Parameters:** none**Query Syntax:** none**Response Parameters:** none**Example:** none

STATUS Sub-system**STATus : OPERation [: EVENT]?**

66201 | 66202

Description: This command queries the Operation Status register.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** STATus:OPERation?<PMT>**Response Parameters:** <NR1>, 0

Header on: :STATUS:OPERATION:EVENT<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**STATus : OPERation : ENABLE**

66201 | 66202

Description: This command sets the Operation Status Enable register. The register is a mask which enables specific bits from the Operation Status register.**Setting Syntax:** STATus:OPERation:ENABLE<space><NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 255**Query Syntax:** STATus:OPERation:ENABLE?<PMT>**Response Parameters:** <NR1>, 0 ~ 255

Header on: :STATUS:OPERATION:ENABLE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**STATus : QUEStionable [: EVENT]?**

66201 | 66202

Description: This query returns the value of the Questionable Event register. The Event register is a read-only register which holds all events that are passed by the Questionable NTR and/or PTR filter. If QUES bit of the Service Request Enable register is set, and the Questionable Event register > 0, QUES bit of the Status Byte register is set too.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** STATus:QUEStionable?<PMT>**Response Parameters:** <NR1>, 0 ~ 65535

Header on: :STATUS:QUESTIONABLE:EVENT<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**STATus : QUEStionable : CONDition?**

66201 | 66202

Description: This query returns the value of the Questionable Condition register, which is a read-only register that holds the real-time questionable status of the Power Meter.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** STATus:QUEStionable:CONDition?<PMT>**Response Parameters:** <NR1>, 0 ~ 65535

Header on: :STATUS:QUESTIONABLE:CONDITION<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

STATus : QUESTionable : ENABLE

66201 | 66202

Description: This command sets or reads the value of the Questionable Enable register. The register is a mask which enables specific bits from the Questionable Event register to set the questionable summary (QUES) bit of the Status Byte register.

Setting Syntax: STATus:QUESTionable:ENABLE<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 65535

Query Syntax: STATus:QUESTionable:ENABLE?<PMT>

Response Parameters: <NR1>, 0 ~ 65535

Header on: :STATUS:QUESTIONABLE:ENABLE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

STATus : QUESTionable : NTRansition

66201 | 66202

Description: This command makes the values of the Questionable NTR register set or read. These registers serve as polarity filters between the Questionable Enable and Questionable Event registers, and result in the following actions:

- * When a bit of the Questionable NTR register is set at 1, a 1-to-0 transition of the corresponding bit in the Questionable Condition register will cause that bit in the Questionable Event register to be set.
- * When a bit of the Questionable PTR register is set at 1, a 0-to-1 transition of the corresponding bit in the Questionable Condition register will cause that bit in the Questionable Event register to be set.
- * If the two same bits in both NTR and PTR registers are set at 0, no transition of that bit in the Questionable Condition register can set the corresponding bit in the Questionable Event register.

Bit Configuration of Questionable Status Register

Bit Position	15	14~6	5	4	3	2	1	0
Condition	FAN	---	Energy RCE	Inrush RCE	Integrate RCE	OCP	OCR	OVR

OVR: Over voltage range.

OCR: Over current range.

OCP: Over current protection.

Integrate RCE: Range change error when integrate mode running.

Inrush RCE: Range change error when inrush mode running.

Energy RCE: Range change error when energy mode running.

FAN: Fan failure.

Setting Syntax: STATus:QUESTionable:NTRansition<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 65535

Query Syntax: STATus:QUESTionable:NTRansition?<PMT>

Response Parameters: <NR1>, 0 ~ 65535

Header on: :STATUS:QUESTIONABLE:NTRANSITION<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

STATus : QUEStionable : PTRansition

66201 | 66202

Description: This command makes the values of the Questionable PTR register set or read.
Please refer to the description of the previous command.

Setting Syntax: STATus:QUEStionable:PTRansition<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 65535

Query Syntax: STATus:QUEStionable:PTRansition?<PMT>

Response Parameters: <NR1>, 0 ~ 65535

Header on: :STATUS:QUESTIONABLE:PTRANSITION<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

STATus : PRESet

66201 | 66202

Description: This command sets the Enable, PTR, and NTR register of the status groups to their power-on value.

Setting Syntax: STATus:PRESet<PMT>

Setting Parameters: none

Query Syntax: none

Response Parameters: none

Example: none

FETCH & MEASURE Sub-system**FETCh?****MEASure?**

66201 | 66202

Description: This command lets the user get measurement data from the Power Meter. Two measurement commands are available: MEASure and FETCh. MEASure triggers the acquisition of new data before returning data. FETCh returns the previously acquired data from measurement buffer. The return could be -1, -2, -3 and <NR2>.

-1: The first time integrated calculation is not complete yet.

-2: RCE represents "range change error" when integration process is executing.

-3: Invalid data when OVR、OCR、OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax:

FETCh?<PMT>

FETCh?<space><CRD>,<CRD>,<CRD>,...<PMT>

MEASure?

MEASure?<space><CRD>,<CRD>,<CRD>,...<PMT>

Query Parameters: <CRD>,

66201: V, VPK+, VPK-, I, IPK+, IPK-, CFI, W, PF, VA, VAR, FREQ, VDC, IDC

66202: V, VPK+, VPK-, THDV, I, IPK+, IPK-, IS, CFI, THDI, W, PF, VA, VAR, ENEG, FREQ, VDC, IDC

Response Parameters: <NR2>

Example 1:

Query: FETCh?<PMT>

Response:

Header on:

66201: :FETCH<space>V<space><NR2>;VPK+<space><NR2>;VPK-<space><NR2>;I<space><NR2>;IPK+<space><NR2>;IPK-

```

        <space><NR2>;CFI<space><NR2>;W<space><NR2>;PF<space><NR2>
        ;VA<space><NR2>;VAR<space><NR2>;FREQ<space><NR2>;VDC<spa
        ce><NR2>;IDC<space><NR2><RMT>
66202: :FETCH<space>V<space><NR2>;VPK+<space><NR2>;VPK-
        <space><NR2>;THDV<space><NR2>;I<space><NR2>;IPK+<space><N
        R2>;IPK-
        <space><NR2>;IS<space><NR2>;CFI<space><NR2>;THDI<space><NR
        2>;W<space><NR2>;PF<space><NR2>;VA<space><NR2>;VAR<space>
        <NR2>;ENEG<space><NR2>;FREQ<space><NR2>;VDC<space><NR2>
        ;IDC<space><NR2><RMT>
Header off:
66201: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>
66202: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;
        <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>
Separator 0:
66201: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>
66201: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>
Separator 1:
66201: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>
66202: <NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR
        2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2>;<NR2><RMT>

```

Example 2:

Query: FETC?<space>V,I,W<PMT>

Response:

Header on: :FETCH<space>V<space><NR2>;I<space><NR2>;W<space><NR2><RMT>

Header off: <NR2>;<NR2>;<NR2><RMT>

Separator 0: <NR2>;<NR2>;<NR2><RMT>

Separator 1: <NR2>;<NR2>;<NR2><RMT>

FETCh [: SCALar] : CURRent : RMS?

MEASure [: SCALar] : CURRent : RMS?

66201 | 66202

Description: These queries return the r.m.s. current. The return could be -1, -2, -3 and <NR2>.

-1: The first time integrated calculation is not complete yet.

-2: RCE represents "range change error" when integration process is executing.

-3: Invalid data when OCR, OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:RMS?<PMT> , MEASure:CURRent:RMS?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRENT:RMS<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : DC?

MEASure [: SCALar] : CURRent : DC?

66201 | 66202

Description: These queries return the DC current. The return could be -3 or <NR2>.

-3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:DC?<PMT> , MEASure:CURRent:DC?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRENT:DC<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : PEAK+?

MEASure [: SCALar] : CURRent : PEAK+?

66201 | 66202

Description: These queries return the plus value of peak current. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:PEAK+?<PMT> , MEASure:CURRent:PEAK+?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRENT:PEAK+<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : PEAK-?**MEASure [: SCALar] : CURRent : PEAK-?**

66201 | 66202

Description: These queries return the minus value of peak current. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:PEAK-?<PMT> , MEASure:CURRent:PEAK-?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRent:PEAK-<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : INRush?**MEASure [: SCALar] : CURRent : INRush?**

66202

Description: These queries return the inrush current. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:INRush?<PMT> , MEASure:CURRent:INRush?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRent:INRUSH<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : CRESTfactor?**MEASure [: SCALar] : CURRent : CRESTfactor?**

66201 | 66202

Description: These queries return the crest factor of current. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:CRESTfactor?<PMT> ,
MEASure:CURRent:CRESTfactor? <PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRent:CRESTFACTOR<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : CURRent : THD?**MEASure [: SCALar] : CURRent : THD?**

66202

Description: These queries return the total harmonic distortion of current. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:THD?<PMT> , MEASure:CURRent:THD?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:CURRent:THD<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALAr] : CURRent : HARMonic : ARRay?

MEASure [: SCALAr] : CURRent : HARMonic : ARRay?

66202

Description: These queries return the amplitude of all the harmonic order. The return could be -3 or <NR2>. -3: Invalid data when OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:CURRent:HARMonic:ARRay?<space><CRD><PMT> ,
MEASure:CURRent:HARMonic:ARRay?<space><CRD><PMT>

Query Parameters: <CRD>, VALUE | PERCENT

Response Parameters: <NR2>

Header on: :FETCh:CURRent:HARMonic:ARRay<space><NR2>,
<NR2>,<NR2>,...up to 101 <RMT>

Header off: <NR2>,<NR2>,<NR2>,...up to 101 <RMT>

Separator 0: <NR2>,<NR2>,<NR2>,...up to 101 <RMT>

Separator 1: <NR2>;<NR2>;<NR2>;...up to 101 <RMT>

Example: none

FETCh [: SCALAr] : FREQuency?

MEASure [: SCALAr] : FREQuency?

66201 | 66202

Description: These queries return the frequency in Hertz.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:FREQuency?<PMT> , MEASure:FREQuency?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:FREQuency<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALAr] : POWer : REAL?

MEASure [: SCALAr] : POWer : REAL?

66201 | 66202

Description: These queries return the true power. The return could be -1, -2, -3 and <NR2>.

-1: The first time integrated calculation is not complete yet.

-2: RCE represents "range change error" when integration process is executing.

-3: Invalid data when OVR 、 OCR 、 OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:POWer:REAL?<PMT> , MEASure:POWer:REAL?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:POWer:REAL<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : POWer : APParent?**MEASure [: SCALar] : POWer : APParent?**

66201 | 66202

Description: These queries return the apparent power. The return could be -3 or <NR2>.
 -3: Invalid data when OVR 、OCR 、OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:POWer:APParent?<PMT> , MEASure:POWer:APParent?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:POWer:APPARENT<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : POWer : REACtive?**MEASure [: SCALar] : POWer : REACtive?**

66201 | 66202

Description: These queries return the reactive power. The return could be -3 or <NR2>.
 -3: Invalid data when OVR 、OCR 、OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:POWer:REACtive?<PMT> , MEASure:POWer:REACtive?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:POWer:REACTIVE<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : POWer : PFACTOR?**MEASure [: SCALar] : POWer : PFACTOR?**

66201 | 66202

Description: These queries return the power factor. The return could be -3 or <NR2>.
 -3: Invalid data when OVR, OCR, OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:POWer:PFACTOR?<PMT> , MEASure:POWer:PFACTOR?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:POWer:PFACTOR<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : POWer : ENERgy?**MEASure [: SCALar] : POWer : ENERgy?**

66202

Description: These queries return the energy in Joule when the ENER:MODE is JOULE or return the energy in watt hour when the ENER:MODE is WHR. The return could be -3 or <NR2>. -3: Invalid data when OVR 、OCR 、OCP occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:POWer:ENERgy?<PMT> , MEASure:POWer:ENERgy?<PMT>

Response Parameters: <NR2>

Header on: :FETCh:POWer:ENERGY<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : VOLTage : RMS?

MEASure [: SCALar] : VOLTage : RMS?

66201 | 66202

Description: These queries return the r.m.s. voltage. The return could be -1, -2, -3 and <NR2>.

- 1: The first time integrated calculation is not complete yet.
- 2: RCE represents "range change error" when integration process is executing.
- 3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:VOLTage:RMS?<PMT> , MEASure:VOLTage:RMS?<PMT>

Response Parameters: <NR2>

Header on: :FETCH:VOLTAGE:RMS<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : VOLTage : DC?

MEASure [: SCALar] : VOLTage : DC?

66201 | 66202

Description: These queries return the DC voltage. The return could be -3 or <NR2>.

- 3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:VOLTage:DC?<PMT> , MEASure:VOLTage:DC?<PMT>

Response Parameters: <NR2>

Header on: :FETCH:VOLTAGE:DC<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCh [: SCALar] : VOLTage : PEAK+?

MEASure [: SCALar] : VOLTage : PEAK+?

66201 | 66202

Description: These queries return the plus value of peak voltage. The return could be -3 or <NR2>. -3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCh:VOLTage:PEAK+?<PMT> , MEASure:VOLTage:PEAK+?<PMT>

Response Parameters: <NR2>

Header on: :FETCH:VOLTAGE:PEAK+<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCH [: SCALar] : VOLTage : PEAK-?**MEASure [: SCALar] : VOLTage : PEAK-?**

66201 | 66202

Description: These queries return the minus value of peak voltage. The return could be -3 or <NR2>. -3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCH:VOLTage:PEAK-?<PMT> , MEASure:VOLTage:PEAK-?<PMT>

Response Parameters: <NR2>

Header on: :FETCH:VOLTAGE:PEAK-<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCH [: SCALar] : VOLTage : THD?**MEASure [: SCALar] : VOLTage : THD?**

66202

Description: These queries return the total harmonic distortion of voltage. The return could be -3 or <NR2>. -3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCH:VOLTage:THD?<PMT> , MEASure:VOLTage:THD?<PMT>

Response Parameters: <NR2>

Header on: :FETCH:VOLTAGE:THD<space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

FETCH [: SCALar] : VOLTage : HARMonic : ARRay?**MEASure [: SCALar] : VOLTage : HARMonic : ARRay?**

66202

Description: These queries return the amplitude of all the harmonic order of voltage. The return could be -3 or <NR2>. -3: Invalid data when OVR occur.

Setting Syntax: none

Setting Parameters: none

Query Syntax: FETCH:VOLTage:HARMonic:ARRay?<space><CRD><PMT> ,
MEASure:VOLTage:HARMonic:ARRay?<space><CRD><PMT>

Query Parameters: <CRD>, VALUE | PERCENT

Response Parameters: <NR2>

Header on:

:FETCH:VOLTAGE:HARMONIC:ARRAY<space><NR2>,<NR2>,<NR2>,...up to 101 <RMT>

Header off: <NR2>,<NR2>,<NR2>,...up to 101 <RMT>

Separator 0: <NR2>,<NR2>,<NR2>,...up to 101 <RMT>

Separator 1: <NR2>;<NR2>;<NR2>;...up to 101 <RMT>

Example: none

FETCH [: SCALAr] : HARMonic : ARRay?**MEASure [: SCALAr] : HARMonic : ARRay?**

66202

Description: These queries return the total parameters of harmonic measurement.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** FETCH:HARMonic:ARRay?<PMT> ,**MEASure:** HARMonic:ARRay?<PMT>**Query Parameters:** none**Response Parameters:** <NR2> or NAN, NAN represents no measure value.

<Arg1>;<Arg2>;<Arg3>;<Arg4>;<Arg5>;<Arg6>;<Arg7>;<Arg8>;<Arg9>;<Arg10>;<Arg11>;<Arg12>;<Arg13><PMT>

<Arg1> : V,I,P,S,Q,PF, $\phi(1)$,Vthd,Ithd,Pthd

<Arg2> : V(k) , k = 0 ~ 100

<Arg3> : I(k) , k = 0 ~ 100

<Arg4> : P(k) , k = 0 ~ 100

<Arg5> : S(k) , k = 0 ~ 100

<Arg6> : Q(k) , k = 0 ~ 100

<Arg7> : PF(k) , k = 0 ~ 100

<Arg8> : Vdeg(k) , k = 0 ~ 100

<Arg9> : Ideg(k) , k = 0 ~ 100

<Arg10> : $\phi(k)$, k = 0 ~ 100

<Arg11> : Vhdf(k) , k = 0 ~ 100

<Arg12> : Ihdf(k) , k = 0 ~ 100

<Arg13> : Phdf(k) , k = 0 ~ 100

Header on:

:FETCH:HARMONIC:ARRAY<space><NR2>,...,<NR2>;<NR2>,...,<NR2>;<NR2>,...,<NR2><RMT>

Header off: <NR2>,...,<NR2>;<NR2>,...,<NR2>;<NR2>,...,<NR2><RMT>

Separator 0: <NR2>,...,<NR2>;<NR2>,...,<NR2>;<NR2>,...,<NR2><RMT>

Separator 1: <NR2>;...,<NR2>;<NR2>;...,<NR2>;<NR2>;...,<NR2><RMT>

Example: none**SOURCE Sub-system****[SOURce :] CURRent : SHUNt**

66202

Description: This command sets the current shunt of measure.**Setting Syntax:** CURRent:SHUNt<space><CRD><PMT>**Setting Parameters:** <CRD>, HIGH | LOW | AUTO**Query Syntax:** CURRent:SHUNt?<PMT>**Response Parameters:** <CRD>, HIGH | LOW | AUTO

Header on: :CURRENT:SHUNT<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[SOURCE :] CURRENT : RANGE

66201 | 66202

Description: This command sets the current range of measure.**Setting Syntax:** CURRENT:RANGE<space><CRD><PMT>**Setting Parameters:** <CRD>,

66201: AUTO | A2 | A04 | A01 | A001

66202: High shunt: AUTO | A20 | A8 | A2H | A02

Low shunt: AUTO | A2L | A04 | A01 | A001

Auto shunt: AUTO | A20 | A8 | A2H | A02 | A2L | A04 | A01 | A001

Query Syntax: CURRENT:RANGE?<PMT>**Response Parameters:** <CRD>,

66201: A2 | A04 | A01 | A001

66202: A20 | A8 | A2H | A02 | A2L | A04 | A01 | A001

Header on: :CURRENT:RANGE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] CURRENT : RATIo**

66202

Description: This command sets the CT ratio.**Setting Syntax:** CURRENT:RATIo<space><NR2><PMT>**Setting Parameters:** <NR2>, 1.0 ~ 9999.9 , resolution 0.1**Query Syntax:** CURRENT:RATIo?<PMT>**Response Parameters:** <NR2>, 1.0 ~ 9999.9

Header on: :CURRENT:RATIO <space><NR2><RMT>

Header off: <NR2><RMT>

Example: none**[SOURCE :] CURRENT : INRush : TRIGger : LEVel**

66202

Description: This command sets the level of trigger of inrush current in Ampere.**Setting Syntax:** CURRENT:INRush:TRIGger:LEVel<space><NR1><PMT>**Setting Parameters:** <NR1>, 0.1 ~ 10.0 , resolution 0.1**Query Syntax:** CURRENT:INRush:TRIGger:LEVel?<PMT>**Response Parameters:** <NR1>, 0.1 ~ 10.0

Header on: :CURRENT:INRUSH:TRIGGER:LEVEL<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**[SOURCE :] CURRENT : INRush : TRIGger : TIME**

66202

Description: This command sets the time of measure of inrush current in Millisecond.**Setting Syntax:** CURRENT:INRush:TRIGger:TIME<space><NR1><PMT>**Setting Parameters:** <NR1>, 1 ~ 9999**Query Syntax:** CURRENT:INRush:TRIGger:TIME?<PMT>**Response Parameters:** <NR1>, 1 ~ 9999

Header on: :CURRENT:INRUSH:TRIGGER:TIME<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

[SOURCE :] CURRENT : INRush : TRIGger : DELay

66202

Description: This command sets the delay of measure of inrush current in Millisecond.**Setting Syntax:** CURRENT:INRush:TRIGger:DELay<space><NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 9999**Query Syntax:** CURRENT:INRush:TRIGger:DELay?<PMT>**Response Parameters:** <NR1>, 0 ~ 9999

Header on: :CURRENT:INRUSH:TRIGGER:DELAY<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**[SOURCE :] VOLTage : RANGE**

66201 | 66202

Description: This command sets the voltage range of measure.**Setting Syntax:** VOLTage:RANGe<space><CRD><PMT>**Setting Parameters:** <CRD>, AUTO | V500 | V300 | V150**Query Syntax:** VOLTage:RANGe?<PMT>**Response Parameters:** <CRD>, V500 | V300 | V150

Header on: :VOLTAGE:RANGE <space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] MEASure : MODE**

66201 | 66202

Description: This command sets the mode of measure.**Setting Syntax:** MEASure:MODE<space><CRD><PMT>**Setting Parameters:** <CRD>, WINDOW | AVERAGE**Query Syntax:** MEASure:MODE?<PMT>**Response Parameters:** <CRD>, WINDOW | AVERAGE

Header on: :MEASURE:MODE <space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] MEASure : WINDow**

66201 | 66202

Description: This command sets the time of measure over which the window calculation is to be performed.**Setting Syntax:** MEASure:WINDow<space><NR2><PMT>**Setting Parameters:** <NR2>, 0.10 ~ 10.00 ,resolution 0.1**Query Syntax:** MEASure:WINDow?<PMT>**Response Parameters:** <NR2>, 0.10 ~ 10.00

Header on: :MEASURE:WINDOW <space><NR2><RMT>

Header off: <NR2><RMT>

Example: none

[SOURCE :] MEASure : WINDow : UPDate

66201 | 66202

Description: This command sets the update rate of measure over which the window calculation is to be performed.

FIXED: The fixed interval of window sliding.

WINDOW: The varied interval according to the setting of window time, that just affects the FETCH commands.

Setting Syntax: MEASure:WINDow:UPDate<space><CRD><PMT>

Setting Parameters: <CRD>, FIXED | WINDOW

Query Syntax: MEASure:WINDow:UPDate?<PMT>

Response Parameters: <CRD>, FIXED | WINDOW

Header on: :MEASURE:WINDOW:UPDATE <space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[SOURCE :] MEASure : AVERage

66201 | 66202

Description: This command sets the number of measurements over which the average calculation is to be performed.

Setting Syntax: MEASure:AVERage<space><NR1><PMT>

Setting Parameters: <NR1>, 1 ~ 512

Query Syntax: MEASure:AVERage?<PMT>

Response Parameters: <NR1>, 1 ~ 512

Header on: :MEASURE:AVERAGE <space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

[SOURCE :] POWer : INTegrate

66201 | 66202

Description: This command sets the time of integration in Second.

Setting Syntax: POWer:INTegrate<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 9999

Query Syntax: POWer:INTegrate?<PMT>

Response Parameters: <NR1>, 0 ~ 9999

Header on: :POWER:INTEGRATE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

[SOURCE :] FILTer

66201 | 66202

Description: This command is used to switch the low pass filter.

Setting Syntax: FILTer<space><CRD><PMT>

Setting Parameters: <CRD>, ON | OFF

Query Syntax: FILTer?<PMT>

Response Parameters: <CRD>, ON | OFF

Header on: :FILTER<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[SOURCE :] ENERGY : MODE

66202

Description: This command sets the mode of energy measure.**Setting Syntax:** ENERGY:MODE<space><CRD><PMT>**Setting Parameters:** <CRD>, JOULE | WHR**Query Syntax:** ENERGY:MODE?<PMT>**Response Parameters:** <CRD>, JOULE | WHR

Header on: :ENERGY:MODE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] ENERGY : TIME**

66202

Description: This command sets the time of energy measure in Second.**Setting Syntax:** ENERGY:TIME<space><NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 35999999**Query Syntax:** ENERGY:TIME?<PMT>**Response Parameters:** <NR1>, 0 ~ 35999999

Header on: :ENERGY:TIME<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**[SOURCE :] THD : MODE**

66202

Description: This command sets the mode of THD measure.**Setting Syntax:** THD:MODE<space><CRD><PMT>**Setting Parameters:** <CRD>, FULL | ORDER**Query Syntax:** THD:MODE?<PMT>**Response Parameters:** <CRD>, FULL | ORDER

Header on: :THD:MODE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] THD : ORDER**

66202

Description: This command sets the order of THD measure.**Setting Syntax:** THD:ORDER<space><NR1><PMT>**Setting Parameters:** <NR1>, 2 ~ 100**Query Syntax:** THD:ORDER?<PMT>**Response Parameters:** <NR1>, 2 ~ 100

Header on: :THD:ORDER<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none**[SOURCE :] THD : CYCLE**

66202

Description: This command sets the cycles of THD measure.**Setting Syntax:** THD:CYCLE<space><NR1><PMT>**Setting Parameters:** <NR1>, 1 ~ 20**Query Syntax:** THD:CYCLE?<PMT>**Response Parameters:** <NR1>, 1 ~ 20

Header on: :THD:CYCLE<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

[SOURCE :] THD : SMOothing

66202

Description: This command sets the state of smoothing filter.**Setting Syntax:** THD:SMOothing<space><CRD><PMT>**Setting Parameters:** <CRD>, OFF | ON**Query Syntax:** THD:SMOothing?<PMT>**Response Parameters:** <CRD>, OFF | ON

Header on: :THD:SMOOTHING<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] RANGE : RESPonse**

66201 | 66202

Description: This command sets the response of the current range switch.**Setting Syntax:** RANGE:RESPonse<space><CRD><PMT>**Setting Parameters:** <CRD>, FAST | SLOW**Query Syntax:** RANGE:RESPonse?<PMT>**Response Parameters:** <CRD>, FAST | SLOW

Header on: :RANGE:RESPONSE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] TRIGger**

66201 | 66202

Description: Three different modes, GONG, INRUSH and ENERGY, are triggered by this command.**Setting Syntax:** TRIGger<space><CRD><PMT>**Setting Parameters:** <CRD>, OFF | ON**Query Syntax:** TRIGger:STATe?<RMT>**Response Parameters:** <CRD>, STOP | FINISH | RUNNING

Header on: :TRIGGER:STATE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none**[SOURCE :] TRIGger : MODE**

66201 | 66202

Description: This command is used to select which mode will be triggered.**Setting Syntax:** TRIGger:MODE<space><CRD><PMT>**Setting Parameters:** <CRD>,

66201: NONE | GONG

66202: NONE | GONG | INRUSH | ENERGY

Query Syntax: TRIGger:MODE?<PMT>**Response Parameters:** <CRD>, NONE | GONG | INRUSH | ENERGY

Header on: :TRIGGER:MODE<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[SOURCE :] PROTection : CLear

66201 | 66202

Description: This command clears the protection message.

Setting Syntax: PROtection:CLEar<PMT>

Setting Parameters: none

Query Syntax: none

Response Parameters: none

Example: none

[SOURce :] WAVeform : CAPture?

66202

Description: This query performs the acquisition of new waveform once and returns the status of this action.

Setting Syntax: none

Setting Parameters: none

Query Syntax: WAVEform:CAPture?<PMT>

Response Parameters: <CRD>, OK | FAIL

Header on: :WAVEFORM:CAPTURE<space><CRD><RMT>

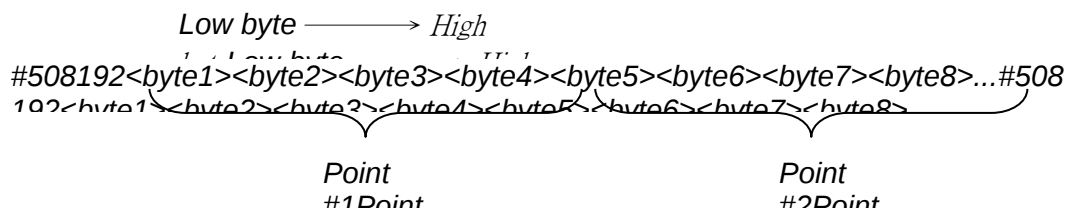
Header off: <CRD><RMT>

Example: none

[SOURce :] WAVeform : DATA?

66202

Description: This query returns voltage or current waveform data from the Power Meter in binary format. The waveform either voltage or current are consist of 2048 points in format of 32bits float point.



Setting Syntax: none

Setting Parameters: none

Query Syntax: WAVEform:DATA?<space><CRD><PMT>

Query Parameters: <CRD>, V | I

Response Parameters: <DLABRD>, #508192<byte1><byte2><byte3>...<byte8192>

Header on: :WAVEFORM:DATA<space><DLABRD><RMT>

Header off: <DLABRD><RMT>

Example: none

[SOURCE :] FORMat : WARNing

66201 | 66202

Description: This command sets the format of warning message.

Setting Syntax: FORMat:WARNing<space><CRD><PMT>

Setting Parameters: <CRD>, NUMBER | STRING

NUMBER message : -1, -2, -3, -4

STRING message : E1, E2, E3, E4

Query Syntax: FORMat:WARNing?<PMT>

Response Parameters: <CRD>, NUMBER | STRING

Header on: :FORMat:WARning<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

CALCULATE Sub-system**[CALCulate :] COMParator**

66201 | 66202

Description: Users can configure upper and lower boundary of measured items. 662xx will check measured items according to the boundaries. Once any item exceeds the boundaries, the item will be recorded. The command is used to turn on/off the comparison function.

Setting Syntax: COMParator<space><CRD><PMT>

Setting Parameters: <CRD>, ON | OFF

Query Syntax: COMParator?<PMT>

Response Parameters: <CRD>, ON | OFF

Header on: :COMPARATOR<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[CALCulate :] COMParator : TIME

66201 | 66202

Description: Programming "COMP:TIME" decides the dwelling time of comparison function. The unit of Setting Parameter is second.

Setting Syntax: COMParator:TIME<space><NR1><PMT>

Setting Parameters: <NR1>, 0 ~ 9999

Query Syntax: COMParator:TIME?<PMT>

Response Parameters: <NR1>, 0 ~ 9999

Header on: :COMPARATOR:TIME<space><NR1><RMT>

Header off: <NR1><RMT>

Example: none

[CALCulate :] COMParator : RESult?

66201 | 66202

Description: This query command returns the result of comparison. The return value is PASS/FAIL/NONE.

Setting Syntax: none

Setting Parameters: none

Query Syntax: COMParator:RESult?<PMT>

Response Parameters: <CRD>, NONE | PASS | FAIL

Header on: :COMPARATOR:RESULT<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

[CALCulate :] COMParator : FAIL?

66201 | 66202

Description: This query command returns the measured items which are out of programmed boundaries. The return strings of measured item are listed in **Response Parameters**.

Setting Syntax: none

Setting Parameters: none

Query Syntax: COMParator:FAIL?<PMT>

Response Parameters: <CRD>, NONE, V, VPK+, VPK-, THDV, I, IPK+, IPK-, IS, CFI, THDI, W, PF, VA, VAR, ENeg, FREQ

Header on: :COMPARATOR:FAIL<space><CRD>,<CRD>,...<RMT>

Header off: <CRD>,<CRD>,...<RMT>

Separator 0: <CRD>,<CRD>,...<RMT>

Separator 1: <CRD>;<CRD>;...<RMT>

Example: none

[CALCulate :] COMParator : ITEM

66201 | 66202

Description: This command is used to select measured items as comparison items in GONG mode.

Setting Syntax: COMParator:ITEM<space><CRD>,<CRD>,<CRD>,...<PMT>

Setting Parameters: <CRD>,

66201: V, VPK+, VPK-, I, IPK+, IPK-, CFI, W, PF, VA, VAR, FREQ

66202: V, VPK+, VPK-, THDV, I, IPK+, IPK-, IS, CFI, THDI, W, PF, VA, VAR, ENEG, FREQ

Query Syntax: COMParator:ITEM?<PMT>

Response Parameters: <CRD>, NONE, V, VPK+, VPK-, THDV, I, IPK+, IPK-, IS, CFI, THDI, W, PF, VA, VAR, ENEG, FREQ

Header on: :COMPARATOR:ITEM<space><CRD>,<CRD>,...<RMT>

Header off: <CRD>,<CRD>,...<RMT>

Separator 0: <CRD>,<CRD>,...<RMT>

Separator 1: <CRD>;<CRD>;...<RMT>

Example: none

[CALCulate :] COMParator : LIMit : V

66201 | 66202

Description: This command sets upper and lower boundaries of voltage (r.m.s) in GONG mode.

Setting Syntax: COMParator:LIMit:V<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.0 ~ 999.9

Query Syntax: COMParator:LIMit:V?<PMT>

Response Parameters: <NR2>, 0.0 ~ 999.9

Header on: :COMPARATOR:LIMIT:V<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : VPK+

66201 | 66202

Description: This command sets upper and lower boundaries of positive peak voltage in GONG mode.

Setting Syntax: COMParator:LIMit:VPK+<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.0 ~ 999.9

Query Syntax: COMParator:LIMit:VPK+?<PMT>

Response Parameters: <NR2>, 0.0 ~ 999.9

Header on: :COMPARATOR:LIMIT:VPK+<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : VPK-

66201 | 66202

Description: This command sets upper and lower boundaries of negative peak voltage in GONG mode.

Setting Syntax: COMParator:LIMit:VPK-<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.0 ~ 999.9

Query Syntax: COMParator:LIMit:VPK-?<PMT>

Response Parameters: <NR2>, 0.0 ~ 999.9

Header on: :COMPARATOR:LIMIT:VPK-<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : THDV

66202

Description: This command sets upper and lower boundaries of total harmonic distortion of voltage in GONG mode.

Setting Syntax: COMParator:LIMit:THDV<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.00 ~ 99.99

Query Syntax: COMParator:LIMit:THDV?<PMT>

Response Parameters: <NR2>, 0.00 ~ 99.99

Header on: :COMPARATOR:LIMIT:THDV<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : I

66201 | 66202

Description: This command sets upper and lower boundaries of current (r.m.s.) in GONG mode.

Setting Syntax: COMParator:LIMit:I<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.000 ~ 99.99

Query Syntax: COMParator:LIMit:I?<PMT>

Response Parameters: <NR2>, 0.000 ~ 99.99

Header on: :COMPARATOR:LIMIT:I<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : IPK+

66201 | 66202

Description: This command sets upper and lower boundaries of positive peak current in GONG mode.

Setting Syntax: COMParator:LIMit:IPK+<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.000 ~ 99.99

Query Syntax: COMParator:LIMit:IPK+?<PMT>

Response Parameters: <NR2>, 0.000 ~ 99.99

Header on: :COMPARATOR:LIMIT:IPK+<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : IPK-

66201 | 66202

Description: This command sets upper and lower boundaries of negative peak current in GONG mode.

Setting Syntax: COMParator:LIMit:IPK-<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.000 ~ 99.99

Query Syntax: COMParator:LIMit:IPK-?<PMT>

Response Parameters: <NR2>, 0.000 ~ 99.99

Header on: :COMPARATOR:LIMIT:IPK-<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : IS

66202

Description: This command sets upper and lower boundaries of inrush current in GONG mode.

Setting Syntax: COMParator:LIMit:IS<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.000 ~ 99.99

Query Syntax: COMParator:LIMit:IS?<PMT>

Response Parameters: <NR2>, 0.000 ~ 99.99

Header on: :COMPARATOR:LIMIT:IS<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : CFI

66201 | 66202

Description: This command sets upper and lower boundaries of current crest factor in GONG mode.

Setting Syntax: COMParator:LIMit:CFI<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.00 ~ 99.99

Query Syntax: COMParator:LIMit:CFI?<PMT>

Response Parameters: <NR2>, 0.00 ~ 99.99

Header on: :COMPARATOR:LIMIT:CFI<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : THDI

66202

Description: This command sets upper and lower boundaries of total harmonic distortion of current in GONG mode.

Setting Syntax: COMParator:LIMit:THDI<space><NR2>,<NR2><PMT>

Setting Parameters: <NR2>, 0.00 ~ 99.99

Query Syntax: COMParator:LIMit:THDI?<PMT>

Response Parameters: <NR2>, 0.00 ~ 99.99

Header on: :COMPARATOR:LIMIT:THDI<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : W

66201 | 66202

Description: This command sets upper and lower boundaries of power in GONG mode.**Setting Syntax:** COMParator:LIMit:W<space><NR2>,<NR2><PMT>**Setting Parameters:** <NR2>, 0.00 ~ 9999.0**Query Syntax:** COMParator:LIMit:W?<PMT>**Response Parameters:** <NR2>, 0.00 ~ 9999.0

Header on: :COMPARATOR:LIMIT:W<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none**[CALCulate :] COMParator : LIMit : PF**

66201 | 66202

Description: This command sets upper and lower boundaries of power factor in GONG mode.**Setting Syntax:** COMParator:LIMit:PF<space><NR2>,<NR2><PMT>**Setting Parameters:** <NR2>, 0.000 ~ 9.999**Query Syntax:** COMParator:LIMit:PF?<PMT>**Response Parameters:** <NR2>, 0.000 ~ 9.999

Header on: :COMPARATOR:LIMIT:PF<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none**[CALCulate :] COMParator : LIMit : VA**

66201 | 66202

Description: This command sets upper and lower boundaries of apparent power in GONG mode.**Setting Syntax:** COMParator:LIMit:VA<space><NR2>,<NR2><PMT>**Setting Parameters:** <NR2>, 0.00 ~ 9999.0**Query Syntax:** COMParator:LIMit:VA?<PMT>**Response Parameters:** <NR2>, 0.00 ~ 9999.0

Header on: :COMPARATOR:LIMIT:VA<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none**[CALCulate :] COMParator : LIMit : VAR**

66201 | 66202

Description: This command sets upper and lower boundaries of reactive power in GONG mode.**Setting Syntax:** COMParator:LIMit:VAR<space><NR2>,<NR2><PMT>**Setting Parameters:** <NR2>, 0.00 ~ 9999.0**Query Syntax:** COMParator:LIMit:VAR?<PMT>**Response Parameters:** <NR2>, 0.00 ~ 9999.0

Header on: :COMPARATOR:LIMIT:VAR<space><NR2>,<NR2><RMT>

Header off: <NR2>,<NR2><RMT>

Separator 0: <NR2>,<NR2><RMT>

Separator 1: <NR2>;<NR2><RMT>

Example: none

[CALCulate :] COMParator : LIMit : FREQ

66201 | 66202

Description: This command sets upper and lower boundaries of frequency in GONG mode.**Setting Syntax:** COMParator:LIMit:FREQ<space><NR1>,<NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 9999**Query Syntax:** COMParator:LIMit:FREQ?<PMT>**Response Parameters:** <NR1>, 0 ~ 9999

Header on: :COMPARATOR:LIMIT:FREQ<space><NR1>,<NR1><RMT>

Header off: <NR1>,<NR1><RMT>

Separator 0: <NR1>,<NR1><RMT>

Separator 1: <NR1>;<NR1><RMT>

Example: none**[CALCulate :] COMParator : LIMit : ENEG**

66202

Description: This command sets upper and lower boundaries of energy in GONG mode.**Setting Syntax:** COMParator:LIMit:ENEG<space><NR1>,<NR1><PMT>**Setting Parameters:** <NR1>, 0 ~ 9999**Query Syntax:** COMParator:LIMit:ENEG?<PMT>**Response Parameters:** <NR1>, 0 ~ 9999

Header on: :COMPARATOR:LIMIT:ENEG<space><NR1>,<NR1><RMT>

Header off: <NR1>,<NR1><RMT>

Separator 0: <NR1>,<NR1><RMT>

Separator 1: <NR1>;<NR1><RMT>

Example: none**CALIBRATION Sub-system****CALibration : AUTO?**

66201 | 66202

Description: The command is used to force 662xx to re-calibrate the offset of current. If ambient temperature variation is too much, user may program this command to improve the accuracy.**Setting Syntax:** none**Setting Parameters:** none**Query Syntax:** CALibration:AUTO?<PMT>**Response Parameters:** <CRD>, OK | FAIL

Header on: :CALIBRATION:AUTO<space><CRD><RMT>

Header off: <CRD><RMT>

Example: none

Appendix A Using Control Signal Input/Output Terminal

The rear panel of 66201/66202 has a 15-pin D_type terminal for external trigger signal and external Pass/Fail display. The table below lists the pin definition:

Pin	Definition	Pin	Definition	Pin	Definition
1	+5V	6	GND	11	Fail -
2	Is Trigger	7	Reserve_TTL3	12	Fail +
3	Reserve_TTL1	8	Limit Trigger	13	Reserve_TTL5
4	GND	9	GND	14	Pass -
5	Reserve_TTL2	10	Reserve_TTL4	15	Pass +

Limit Trigger Connection

Figure A-1 shows the connection of Limit Trigger. The 66201/66202 Power Meter defines the Limit Trigger as falling edge trigger. Ground the 8th pin can trigger it. The trigger is same as pressing **Trig/Enter** on the front panel.

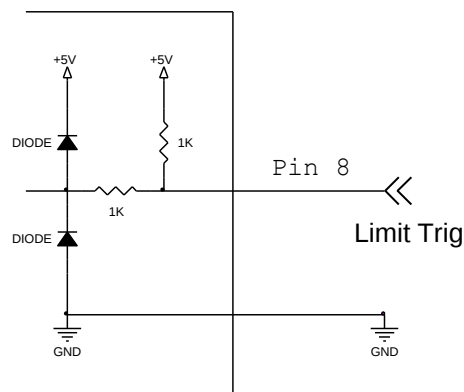


Figure A-1 Connection of Limit Trigger

Is Trigger Connection (66202 only)

Figure A-2 shows the connection of Is Trigger. 66202 Power Meter defines the Is Trigger as falling edge trigger.

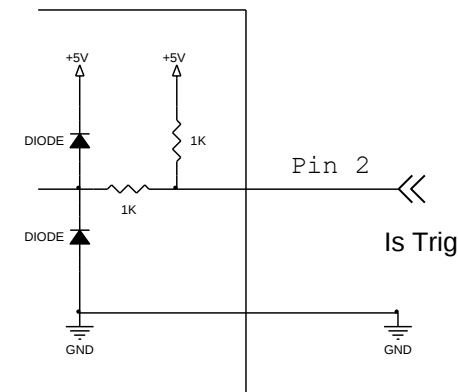


Figure A-2 Connection of Limit Trigger

Users can use external TTL signal to replace the **Trig/Enter** function on the front panel. First, set the Is/Trig function following the steps 1~8 described in section 4.4.4 *Is/Trig Function*. Next, set the AC current display to Is. Last ground the pin 2 can trigger it for inrush current test. Every trigger is same as pressing the **Trig/Enter** key on the front panel.

Reserve TTL1-Reserve TTL3 Connection

Figure A-3 shows the connection of Reserve TTL1-Reserve TTL3. 66201/66202 Power Meter keeps the Reserve TTL1 -Reserve TTL3 for receiving TTL signal.

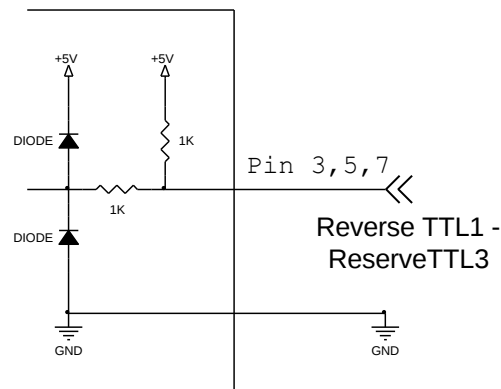


Figure A-3 Connection of Reserve TTL1-Reserve TTL3

Reserve TTL4-Reserve TTL5 Connection

Figure A-4 shows the connection of Reserve TTL4-Reserve TTL5. 66201/66202 Power Meter keeps the ReserveTTL4 -Reserve TTL5 for outputting TTL signal.

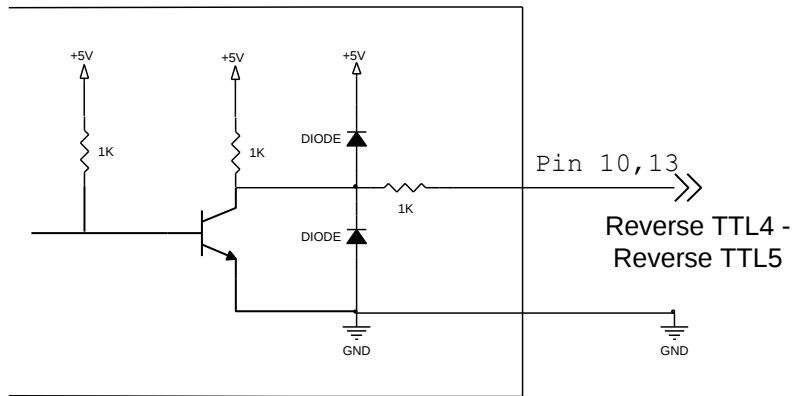


Figure A-4 Connection of Reserve TTL4-Reserve TTL5

Pass + / Pass – Connection

Figure A-5 shows the connection of Pass + / Pass –. Pass + / Pass – output is the two terminals of a one-gate Relay as shown above. When running GO/NG if the test result is Pass the Relay will short-circuit. The Relay specification is 200VDC/0.5A Max.

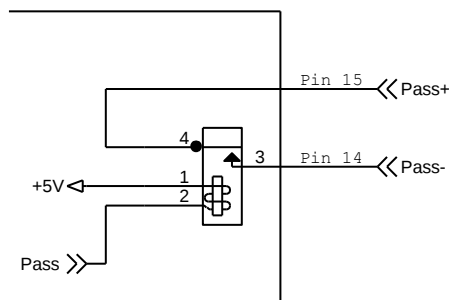


Figure A-5 Connection of Pass + / Pass –

Fail + / Fail – Connection

Figure A-6 shows the connection of Fail + / Fail –. Fail + / Fail – output is the two terminals of a one-gate Relay as shown above. When running GO/NG if the test result is Fail the Relay will short-circuit. The Relay specification is 200VDC/0.5A Max.

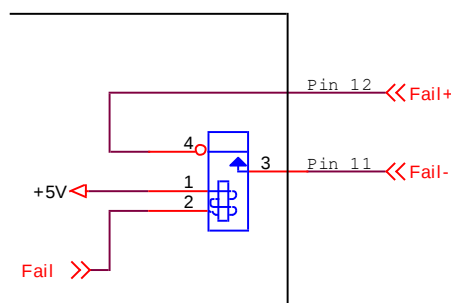
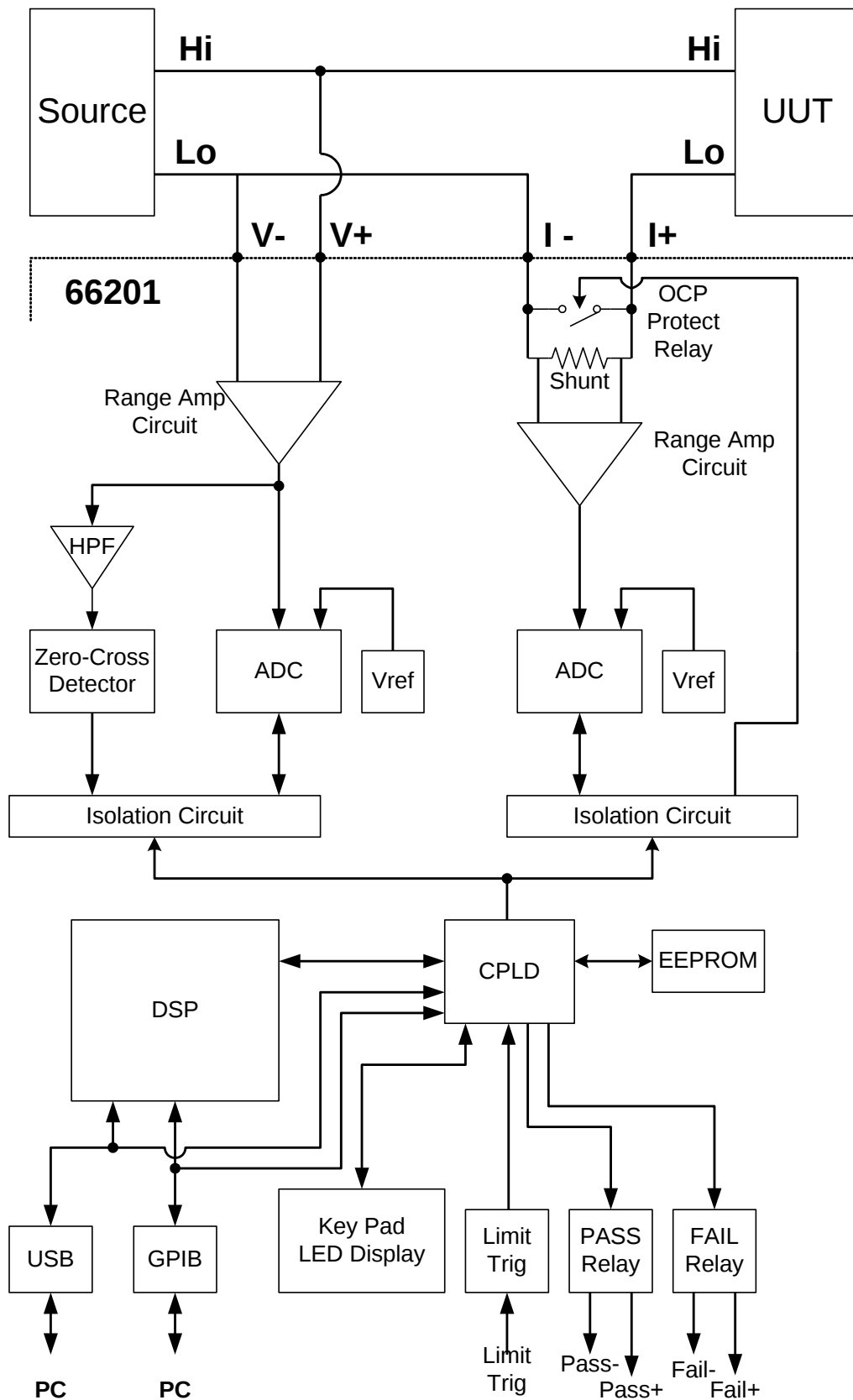


Figure A-6 Connection of Fail + / Fail –

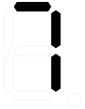
Appendix B Circuit Diagram



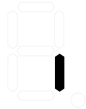
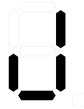
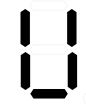
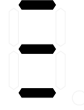
Appendix C Mapping Table for Displayed Letters

The following table shows the numbers and alphabets displayed by the 7-segment display of 66201/66202 Digital Power Meter.

Numbers:

0	1	2	3	4	5	6
						
7	8	9	—			
						

Alphabets:

A, a	B, b	C, c	D, d	E, e	F, f	G, g
						
H, h	I, i	J, j	K, k	L, l	M, m	N, n
						
O, o	P, p	Q, q	R, r	S, s	T, t	U, u
						
V, v	W, w	X, x	Y, y	Z, z		
						

Appendix D Problem Solving

This chapter introduces the error messages displayed by 66201/66202 Digital Power Meter and how to troubleshoot the problems. If any unlisted error appears or the procedure described here is unable to fix the problem, please contact the local Sales Distributor or Service Center of Chroma directly.

Error Message Code

The following error messages may appear on the LCD:

Protection on Display	Full Name	Description
Err.01 	SDRAM checked error	The system hardware SDRAM error, contact Sales Distributor for service matter.
Err.02 	Program code error	The system F/W program error, contact Sales Distributor for service matter.
-OVR- 	Over Voltage Range	The input voltage exceeds the range when switching it manually. The error message will disappear when the range is adjusted to an appropriate one and return to normal measurement function. This message could also appear when the internal fuse is blowout.
-OCR- 	Over Current Range	The input current exceeds the range when switching it manually. The error message will disappear when the range is adjusted to an appropriate one and return to normal measurement function.
-OCP- 	Over Current Protection	The input current exceeds the measurement range of 66201/66202 Power Meter. Ensure the system measurement current is in normal state. This message could also appear when the internal fuse is blowout. Prolonged or frequent use of over current may blowout the fuse on the inner current loop and cause the current unable to be measured.
-RCE- 	Range Change Error	When the power measurement is set to run in time integrated mode, switch voltage or current range within integrated time may cause the power integration measurement error.

Troubleshooting

Problem	Troubleshooting Procedure
Unable to turn on Power Meter	1. Make sure the power cord is connected securely. 2. Make sure the voltage selector on the rear panel matches the input power. 3. Make sure the fuse is not damaged.
Measured data error	1. Make sure the measurement wires are connected correctly. 2. Make sure the humidity condition of test environment is within the specification. 3. Follow the steps listed in <i>Appendix E Specification Verification</i> to ensure the product measurement is within specification. 4. If the current measurement keeps display 0 (zero) after the current is inputted, it could be the fuse on the inner current loop is blowout. Please contact Chroma's dealer for services.
Unable to do remote control	1. Make sure the remote control address setting is correct. 2. Make sure applicable wires are used for connection.

Appendix E Specification Verification

This chapter describes the procedure of specification verification for verifying the functions of 66201/66202 Digital Power Meter. This test procedure is applicable for validating the instruments of newly purchased and repaired as well as for periodic calibration. The measurement items provided by 66201/66202 Power Meter are based on the 66201 Power Meter with additional current range test items that are marked by (66202 only) in the table below.

Only qualified professional personnel can perform the specification verification. The person should have professional knowledge of power measurement and is familiar with the test devices used in this chapter to avoid causing electric shock or other injury during execution.

 **CAUTION** : Do not perform the procedures described in this chapter except qualified personnel to avoid electric shock.

Hardware Requirements

The test devices required are:

Test Equipment	Specification	Suggested Model
Voltage Source	0~500Vrms output	Fluke 5500A or 5520A
Current Source	0~20Arms output	Fluke 5500A or 5520A (The rated output current of Fluke 5500A is 11A.)
Test Wire	Withstand voltage 600Vrms Withstand current 20Arms	

 **Notice** : The wiring of 5500A is the same as 5520A except for 20A range. The following uses 5500A as the example.

Configuring Test Wires

Connect the Fluke 5500A voltage output Hi/Lo to the 66201/66202 Power Meter's rear panel V+/V- and the Fluke 5500A current output to the 66201/66202 Power Meter's rear panel I+/I- with test wires as Figure E-1 shows.

Once the instruments are configured, power on the Fluke 5500A and 66201.

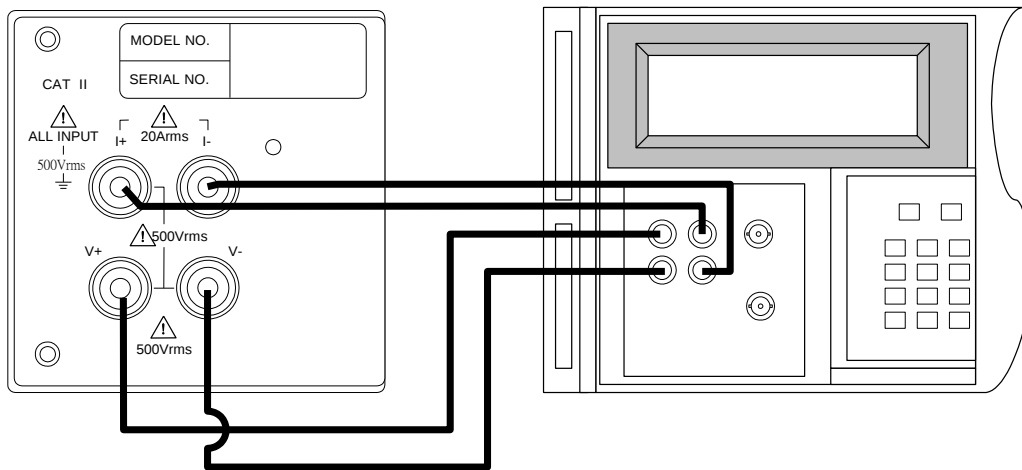


Figure E-1

⚠ WARNING Be sure the voltage and current wire position are connected correctly. It could burn out the instrument internal circuit if mistake.

Voltage Measurement Specification Verification

Steps:

1. Set the voltage range of 66201/66202 Power Meter to 500Vrms, the voltage measurement display is set to V (AC voltage RMS).
2. Follow the test table to set the high voltage output of Fluke 5500A.
3. Press **OPR** to set the Fluke 5500A to begin output.
4. Log the voltage RMS showed on the 66201/66202 Power Meter voltage measurement display panel.
5. Follow the test table to set the low voltage output of Fluke 5500A.
6. Repeat step 3 and 4 to log the 66201/66202 Power Meter panel readings.
7. Set the Fluke 5500A output to Standby and follow the test table to switch the 66201/66202 Power Meter voltage range.
8. Repeat step 2 to 7 and measure the voltage of remaining ranges.
9. Once the test is completed, set the Fluke 5500A output to Standby.

⚠ WARNING Make sure the Fluke 5500A output is OFF when switching the voltage range to avoid any measurement error. Do not touch the test wire when performing Fluke 5500A output test to prevent electric shock. Once the test is done, make sure the Fluke 5500A output is OFF before changing the wire configuration to avoid electric shock.

The test result of each voltage range for 66201/66202 Power Meter:

66201/66202 500V Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Voltage 500Vrms 60Hz	Vrms	500.9		499.1
Low Voltage 50Vrms 60Hz	Vrms	50.45		49.55
High Voltage 500Vrms 10K Hz	Vrms	503.4		496.6

66201/66202 300V Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Voltage 300Vrms 60Hz	Vrms	300.55		299.45
Low Voltage 30Vrms 60Hz	Vrms	30.27		29.73
High Voltage 300Vrms 10K Hz	Vrms	302.04		297.96

66201/66202 150V Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Voltage 150Vrms 60Hz	Vrms	150.27		149.73
Low Voltage 15Vrms 60Hz	Vrms	15.14		14.86
High Voltage 150Vrms 10K Hz	Vrms	151.02		148.98

Current Measurement Specification Verification

Steps:

1. Set the voltage range of 66201/66202 Power Meter to 150Vrms and current range to 2A, the current measurement display is set to I (AC current RMS).
2. Follow the test table to set the voltage, high current output of Fluke 5500A.

3. Press **OPR** to set the Fluke 5500A to begin output.
4. Log the current RMS showed on the 66201/66202 Power Meter current measurement display panel.
5. Follow the test table to set the voltage, low current output of Fluke 5500A.
6. Repeat step 3 and 4 to log the 66201/66202 Power Meter panel readings.
7. Set the Fluke 5500A output to Standby and follow the test table to switch the 66201/66202 Power Meter current range.
8. Repeat step 2 to 7 and measure the current of remaining ranges.
9. Once the test is completed, set the Fluke 5500A output to Standby.

⚠ WARNING

Make sure the Fluke 5500A output is OFF when switching the current range to avoid any measurement error. Do not touch the test wire when performing Fluke 5500A output test to prevent electric shock. Once the test is done, make sure the Fluke 5500A output is OFF before changing the wire configuration to avoid electric shock.

The test result of each current range for 66201/66202 Power Meter:

66201/66202 2A Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Current 100V/ 2Arms 60Hz	I _{rms}	2.004		1.996
Low Current 100V/ 0.2Arms 60Hz	I _{rms}	0.2022		0.1978
High Current 100V/ 0.2Arms 10K Hz	I _{rms}	0.2032		0.1968

66201/66202 0.4A Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Current 100V/ 0.4Arms 60Hz	I _{rms}	0.4008		0.3992
Low Current 100V/ 0.04Arms 60Hz	I _{rms}	0.04044		0.03956
High Current 100V/ 0.04Arms 10K Hz	I _{rms}	0.04064		0.03936

66201/66202 0.1A Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Current 100V/ 0.1Arms 60Hz	I _{rms}	0.1002		0.0998
Low Current	I _{rms}	0.01011		0.00989

100V/ 0.01Arms 60Hz				
High Current 100V/ 0.01Arms 10K Hz	Irms	0.01016		0.00984

66201/66202 0.01A Range				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
High Current 100V/ 0.01Arms 60Hz	Irms	0.010035		0.009965
Low Current 100V/ 0.001Arms 60Hz	Irms	0.001026		0.000974
High Current 100V/ 0.001Arms 10K Hz	Irms	0.001031		0.000969

20A Range (66202 Only)				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
100V/ 10Arms 60Hz	Irms	10.03		9.97
100V/ 2Arms 60Hz	Irms	2.022		1.978
100V/ 2Arms 400Hz	Irms	2.0224		1.9776

8A Range (66202 Only)				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
100V/ 8Arms 60Hz	Irms	8.016		7.984
100V/ 0.8Arms 60Hz	Irms	0.8088		0.7912
100V/ 0.8Arms 400Hz	Irms	0.8090		0.7910

2A Range (66202 Only)				
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
100V/ 2Arms 60Hz	Irms	2.004		1.996
100V/ 0.2Arms 60Hz	Irms	0.2022		0.1978
100V/ 0.2Arms 400Hz	Irms	0.2023		0.1977

0.2A Range (66202 Only)				
Fluke 5500 Output	Parameter	Max. Spec.	Measured	Min. Spec.

			Result	
100V/ 0.2Arms 60Hz	Irms	0.20044		0.19956
100V/ 0.02Arms 60Hz	Irms	0.02026		0.01974
100V/ 0.02Arms 400Hz	Irms	0.02027		0.01973

Voltage Frequency Measurement Specification Verification

Steps:

1. Set the voltage range of 66201/66202 Power Meter to 150Vrms and current range to 2A, special measurement display is set to F (frequency).
2. Follow the test table to set the voltage, frequency output of Fluke 5500A.
3. Press **OPR** to set the Fluke 5500A to begin output.
4. Log the voltage frequency showed on the 66201/66202 Power Meter special measurement display panel.
5. Follow the test table to set the voltage, frequency output of Fluke 5500A.
6. Repeat step 3 and 4 to log the 66201/66202 Power Meter panel readings.
7. Once the test is completed, set the Fluke 5500A output to Standby.

The test result of frequency measurement for 66201/66202 Power Meter:

Fluke 5500 Output	Max. Spec.	Measured Result	Min. Spec.
150V/ 60Hz	60.012		59.988
150 V/ 10KHz	10002		9998
40V/50Hz	50.01		49.99
40V/15Hz	14.996		15.005

Power Measurement Specification Verification

The test tables of verification are divided into 66202 and 66201 Power Meters that cannot be mixed for use. The digital filter must set to OFF when using 66202 Power Meter during measuring at 400Hz.

Steps:

1. Set the voltage range of 66201/66202 Power Meter to 500Vrms and current range to 2A, power measurement display is set to W (active power) and special measurement display is set to PF (power factor).
2. Follow the test table to set the voltage, current and PF output of Fluke 5500A.
3. Press **OPR** to set the Fluke 5500A to begin output.
4. Log the active power, PF readings showed on the 66201/66202 Power Meter's power measurement and special measurement display.
5. Follow the test table to set the voltage, current and PF output of Fluke 5500A.
6. Repeat step 4 and 5 to log the 66201/66202 Power Meter panel readings.
7. Set the Fluke 5500A output to Standby and follow the test table to switch the voltage and current range.
8. Repeat step 2 to 7 and measure the voltage, current and PF of remaining ranges.
9. Once the test is completed, set the Fluke 5500A output to Standby.

The test result of power measurement for 66201 Power Meter:

66201 Range		Voltage: 500V Range		Current: 2A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
500Vrms 2Arms 60Hz PF = 1	W	1002		998
	PF	1.000		0.9938
66201 Range		Voltage: 300V Range		Current: 0.4A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
300Vrms 0.4Arms 60Hz PF = 1	W	120.24		119.76
	PF	1.000		0.9938

66201 Range		Voltage: 150V Range		Current: 0.1A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
150Vrms 0.1Arms 60Hz PF = 1	W	15.03		14.97
	PF	1.000		0.9938
66201 Range		Voltage: 300V Range		Current: 0.01A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
220Vrms 0.01Arms 60Hz PF = 1	W	2.2052		2.1948
	PF	1.000		0.9938

The test result of power measurement for 66202 Power Meter:

66202 Range		Voltage: 500V Range		Current: 20A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
500Vrms 10Arms 60Hz PF = 1	W	5015		4985
	PF	1.000		0.9938
66202 Range		Voltage: 150V Range		Current: 0.2A Range
Fluke 5500 Output	Parameter	Max. Spec.	Measured Result	Min. Spec.
150Vrms 0.2Arms 400Hz PF = 1	W	30.114		29.886
	PF	1.000		0.9938

Appendix F Calibration Procedure

This chapter provides the basic adjustment information for 66201 Digital Power Meter. This procedure can be used to verify the operation of instrument during its periodic specification verification or after troubleshooting or being repaired to ensure its functionality and performance.

Only qualified professional personnel can perform the specification verification. The person should have professional knowledge of power measurement and is familiar with the test devices used in this chapter to avoid causing electric shock or other injury during execution.

 **CAUTION** : Do not perform the procedures described in this chapter except qualified personnel to avoid electric shock.

Hardware Requirements

The test devices required are:

Test Equipment	Specification	Suggested Model
Voltage Source	0~500Vrms output	Fluke 5500A or 5520A
Current Source	0~20Arms output	Fluke 5500A or 5520A (The rated output current of Fluke 5500A is 11A.)
Short Circuit Wire	Withstand voltage 600Vrms Withstand current 20Arms Twin banana plugs	
Test Wire	Withstand voltage 600Vrms Withstand current 20Arms	

 **Notice** : The wiring of 5500A is the same as 5520A except for 20A range. The following uses 5500A as the example.

Configuring Test Wires

Connect the Fluke 5500A voltage output Hi/Lo to the 66201/66202 Power Meter's rear panel V+/V- and the Fluke 5500A current output to the 66201/66202 Power Meter's rear panel I+/I- with test wires as Figure F-1 shows.

Once the instruments are configured, power on the Fluke 5500A and 66201/66202 Power Meter.

 **WARNING** : Be sure the voltage and current wire position are connected correctly. It could burn out the instrument internal circuit if mistake.

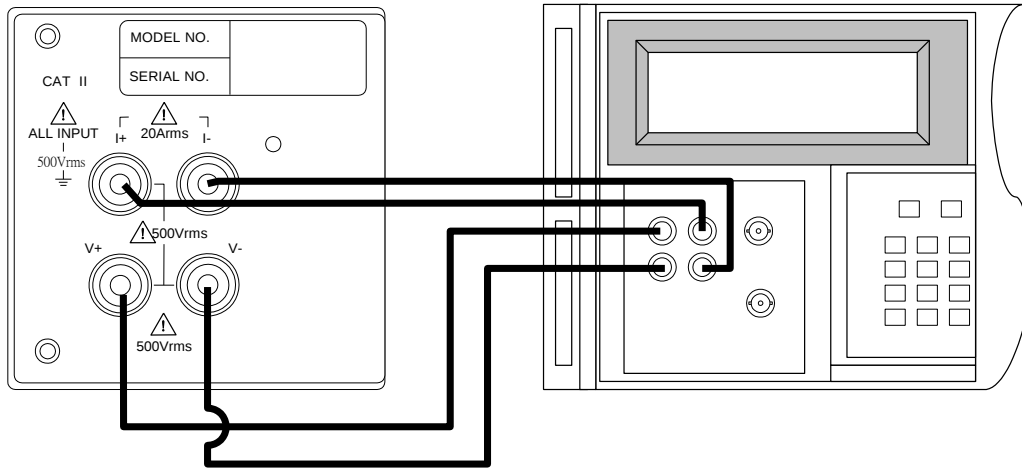


Figure F-1

The front panels of 66201 and 66202 Power Meters are slightly different and are introduced in section 3.1. For convenient use, here lists the front panels of 66201 and 66202 Power Meters again as Figure F-2 and F-3 show. The dash lines circled out in the following figures are related to current calibration. 66202 Power Meter has additional high range current functions.

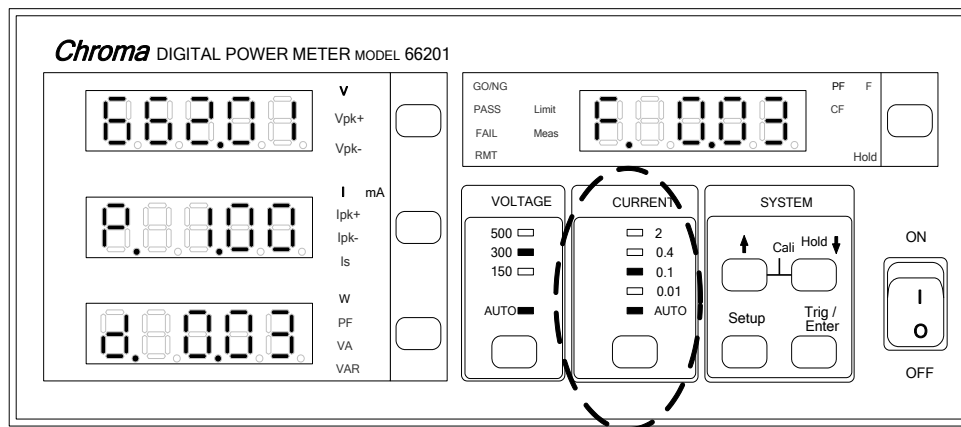


Figure F-2 Front Panel of 66201 Power Meter

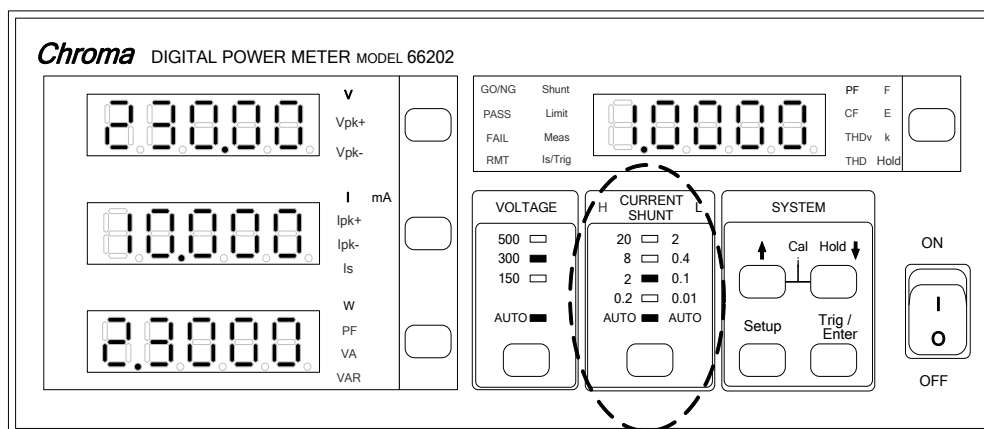
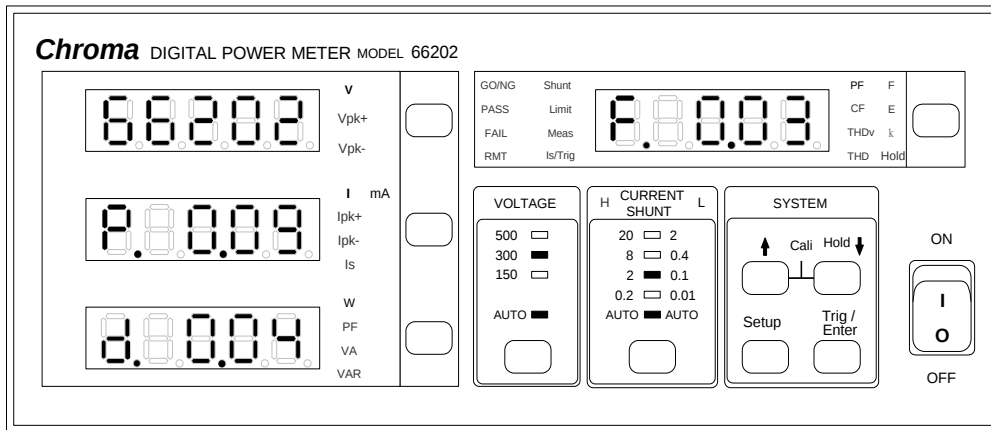


Figure F-3 Front Panel of 66202 Power Meter

Entering Calibration:

1. Power on the 66201.
2. Press **Setup**, **Enter** concurrently when the panel is in normal measurement state. The screen appears as below:



The screen shows P: 66201 F/W version
F: 66201 FPGA version

3. Press **↑**, **↓** at the same time to enter into Calibration mode as shown below:



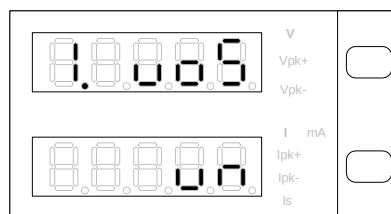
Use **↑**, **↓** to select the screen display to YES (the YES screen blinks) and press **Enter** to enter into Calibration procedure.

To return to measurement mode without running calibration, press **↑**, **↓** to select no when YES is blinking, then press **Trig/Enter** to confirm will return to measurement mode.

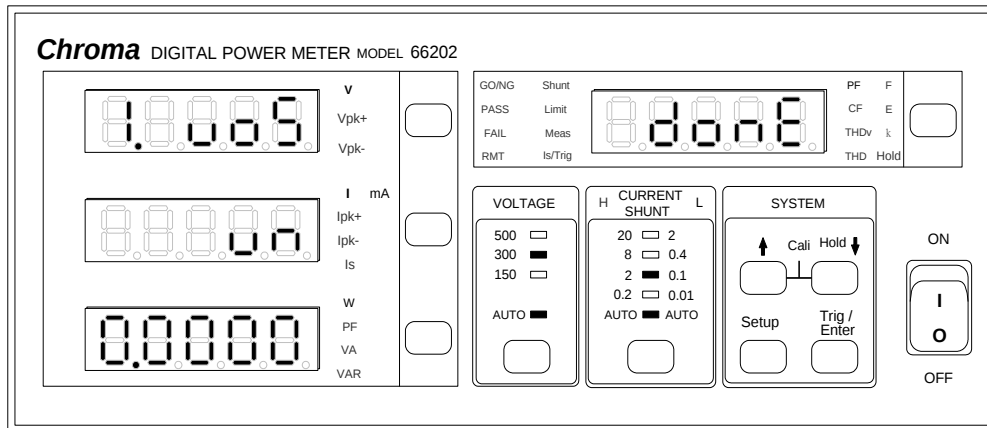
Calibration Procedure:

1. Offset and Noise Calibration for Voltage Measurement:

- (1) Short-circuit the V+ and V- on 66202 rear panel (use short circuit cable) and the screen will blink as below:



- (2) Press **Trig/Enter** the W measurement window shows the uncalculated measurement and run V offset and V noise Calibration. (During process the voltage range LED 150, 300 and 500 will be on accordingly.) Once the calibration is done, the W measurement window will show the calibrated value (as shown below in example figures), and the measurement window will show the message "done". The meter will beep concurrently.

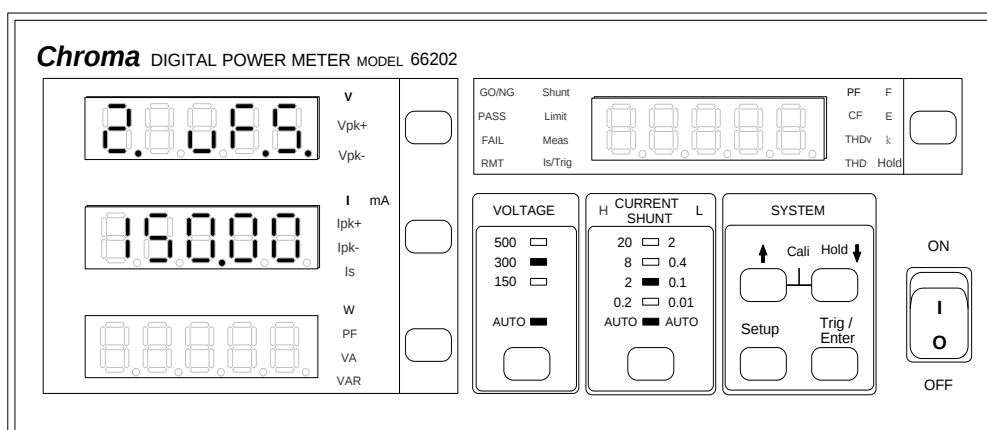


- (3) When finished, remove the short circuit wire and press **Trig/Enter** to go to next procedure.

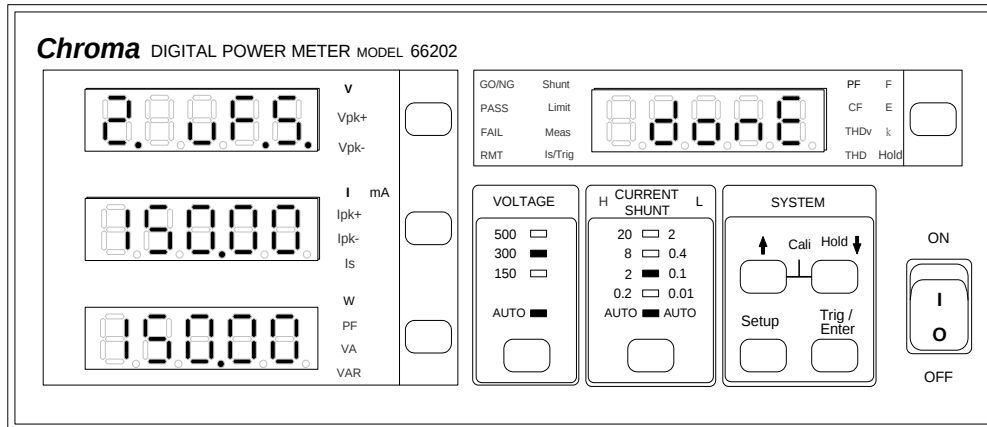
2. Full Scale Calibration for Voltage Measurement Range:

a. 150V Range Calibration:

- (1) Connect the V+ and V- output of Fluke 5500A to the V+ and V- on 66202 rear panel respectively. Then the screen will show as below (the V measurement window blinks):



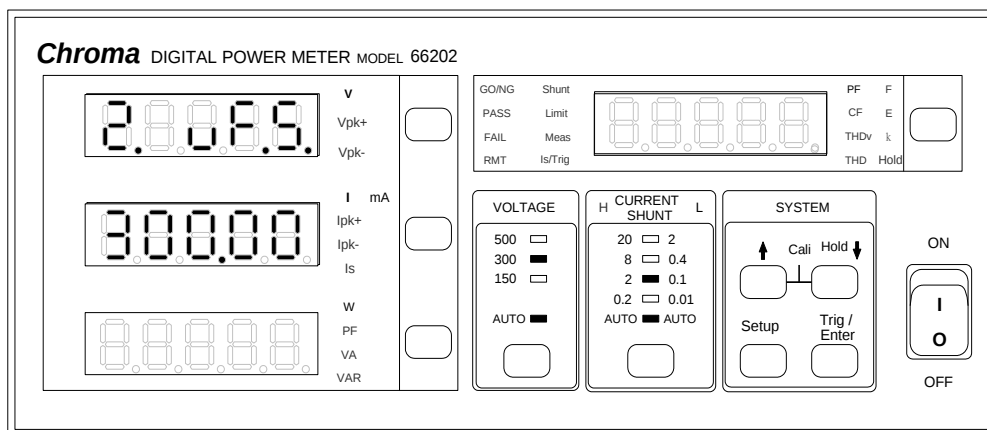
- (2) Press **Trig/Enter** the 150.00 in I measurement window will blink. Set the Fluke 5500A output to 150V/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 150.00 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



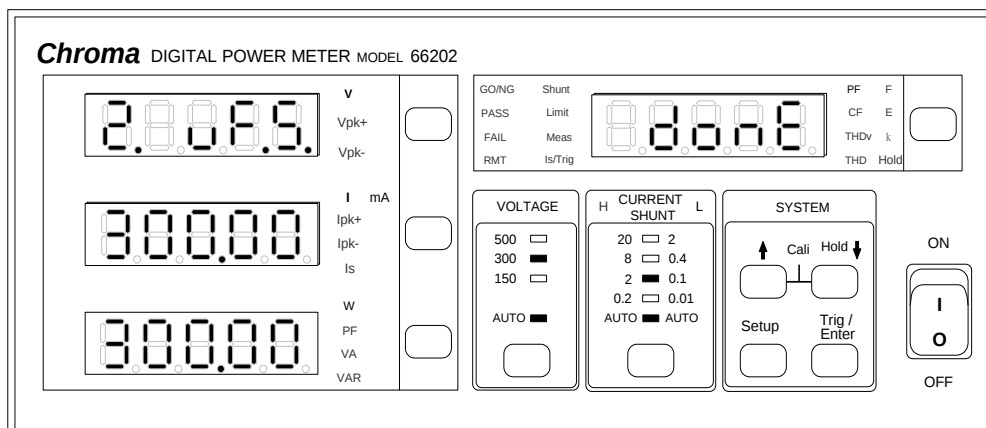
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to next range (300.00V) for calibration.

b. 300V Range Calibration:

- (1) The calibration screen of 300V Range is shown as below (V measurement window blinks):



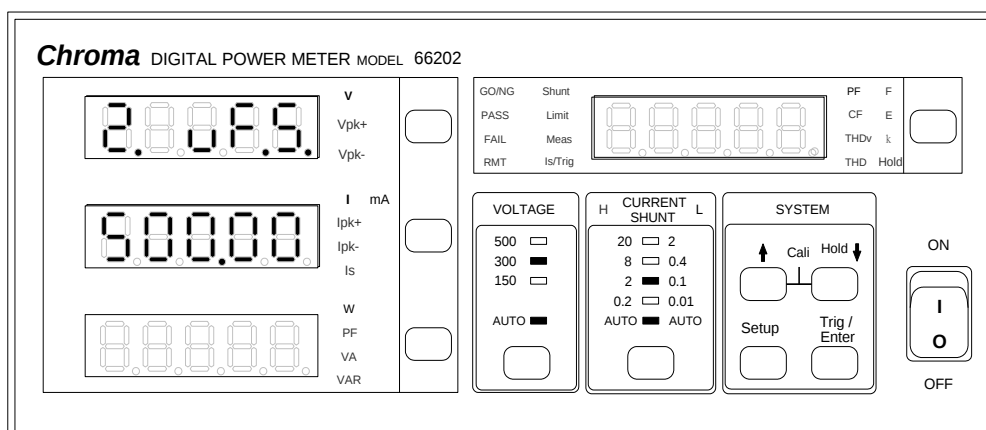
- (2) Press **Trig/Enter** the 300.00 in I measurement window blinks. Set the Fluke 5500A output to 300V/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 300.00 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



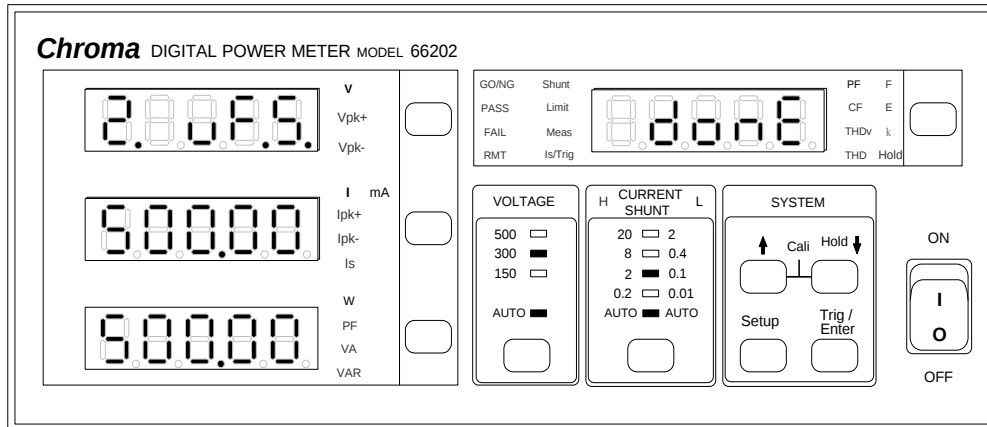
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to next range (500.00V) for calibration.

c. 500V Range Calibration:

- (1) The calibration screen of 500V Range is shown as below (V measurement window blinks):



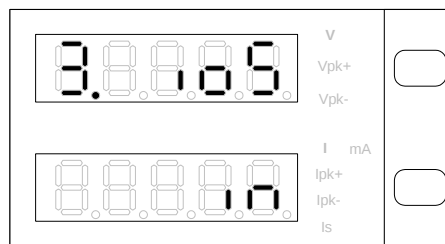
- (2) Press **Trig/Enter** the 500.00 in I measurement window blinks. Set the Fluke 5500A output to 500V/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 500.00 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



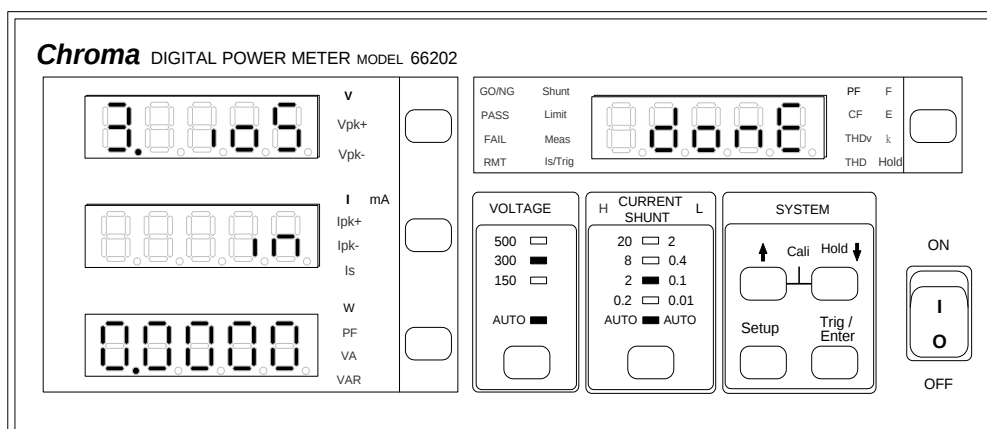
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to voltage measurement for offset and noise calibration.

3. Offset and Noise Calibration for Current Measurement:

- (1) Short-circuit the I+ and I- on 66202 rear panel (using short circuit wire). The screen blinks as shown below:



- (2) Press **Trig/Enter** the W measurement window shows the uncalculated measurement and run I offset and I noise Calibration. (During process the current range LED 0.01, 0.1, 0.4 and 2 will be on accordingly.) Once the calibration is done, the W measurement window will show the calibrated value (as shown below in example figures), and the measurement window will show the message "done". The meter will beep concurrently.



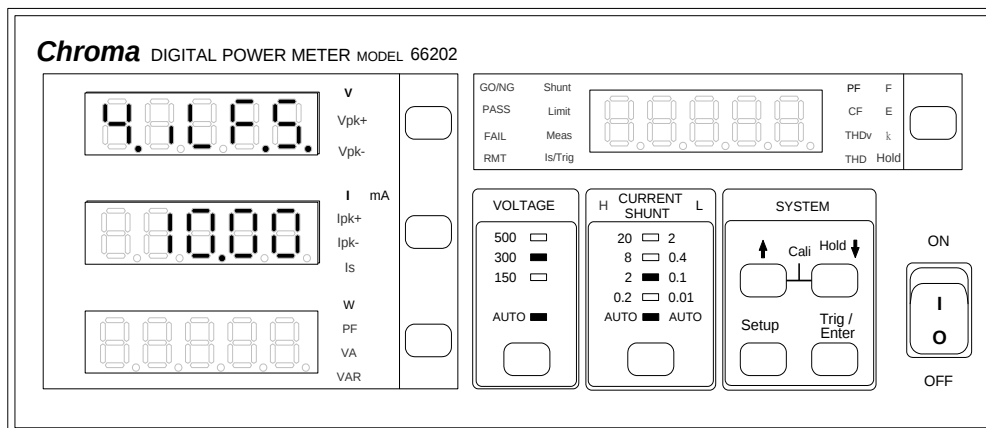
- (3) When finished, remove the short circuit wire and press **Trig/Enter** to go to next procedure.

4. Full Scale Calibration for Current Measurement Range:

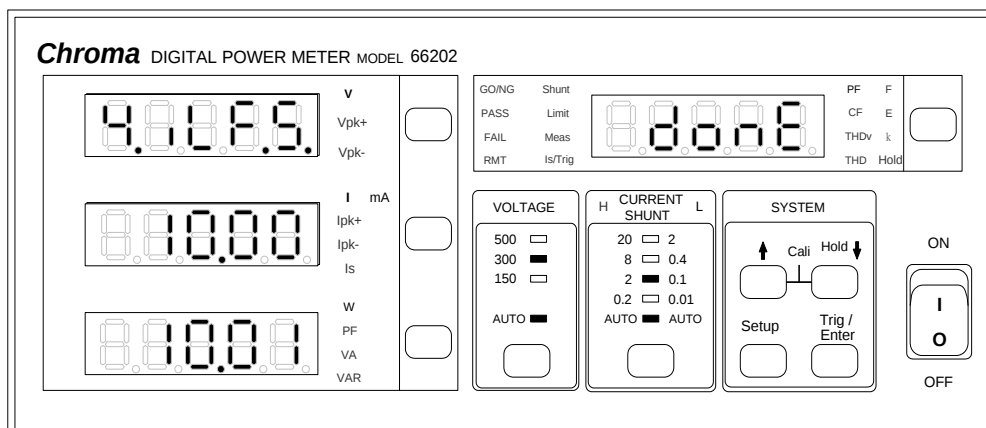
Low Current Shunt:

a. 0.01 Range Calibration:

- (1) Connect the I+ and I- output of Fluke 5500A to the I+ and I- on 66202 rear panel respectively. Then the screen will show as below (the V measurement window blinks):



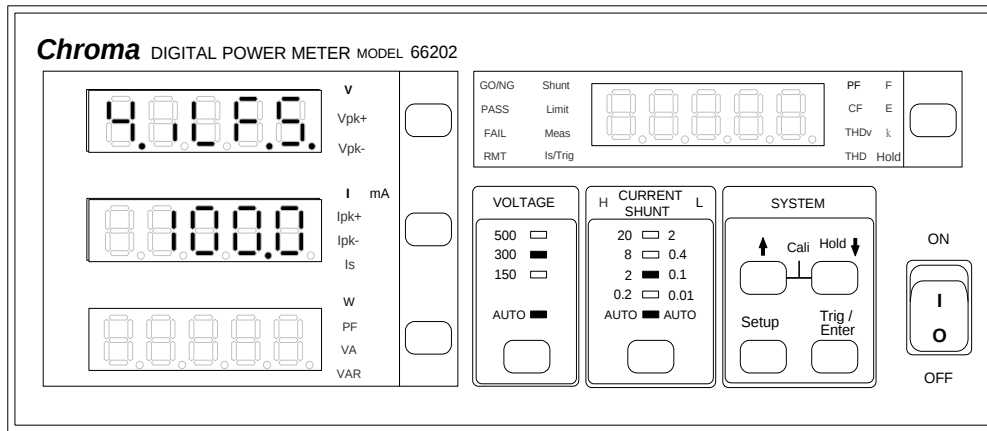
- (2) Press **Trig/Enter** the 10.00 in I measurement window blinks. Set the Fluke 5500A output to 150V/10mA/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 10.01 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



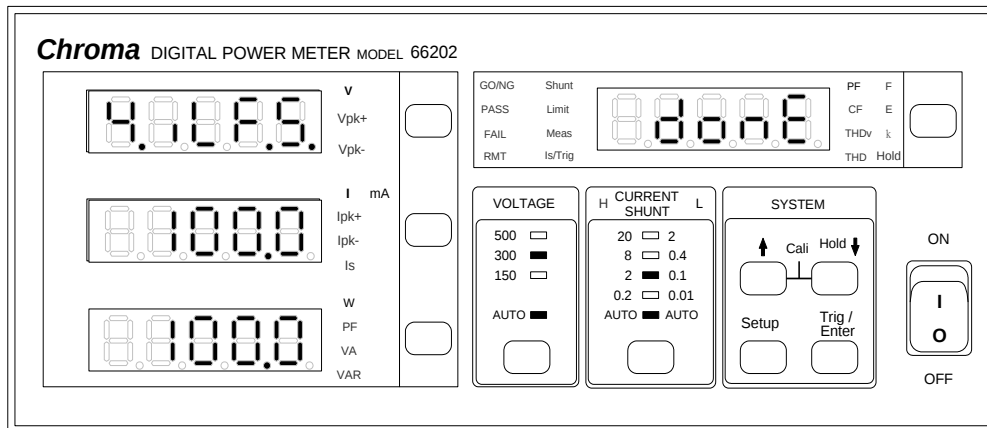
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to next range (0.1A) for calibration.

b. 0.1A Range Calibration:

- (1) The calibration screen of 0.1A Range is shown as below (V measurement window blinks):



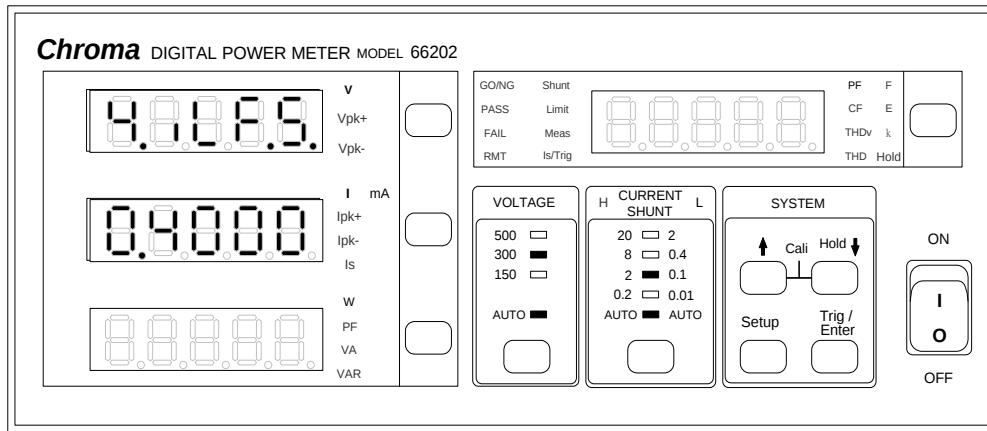
- (2) Press **Trig/Enter** the 100.00 in I measurement window blinks. Set the Fluke 5500A output to 150V/100mA/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 100.0 (this is the reference) and the PF window will show the message “done”. The meter will beep concurrently.



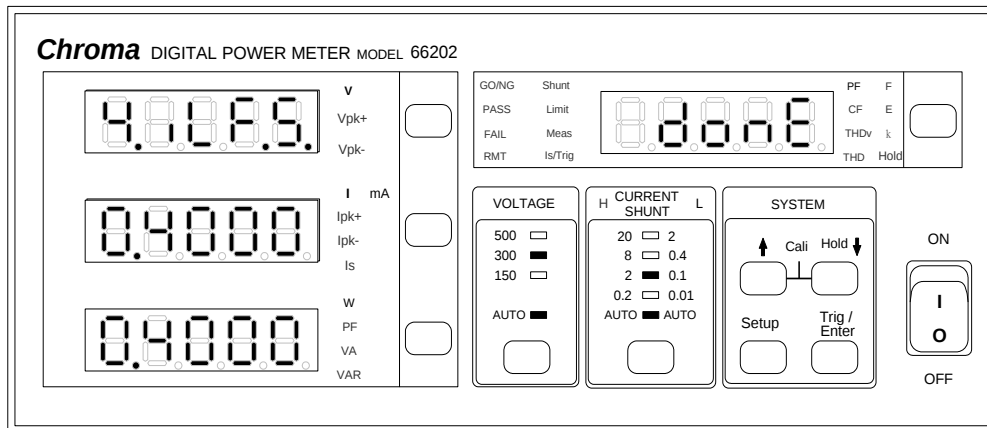
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to next range (0.4A) for calibration.

c. 0.4A Range Calibration:

- (1) The calibration screen of 0.4A Range is shown as below (V measurement window blinks):



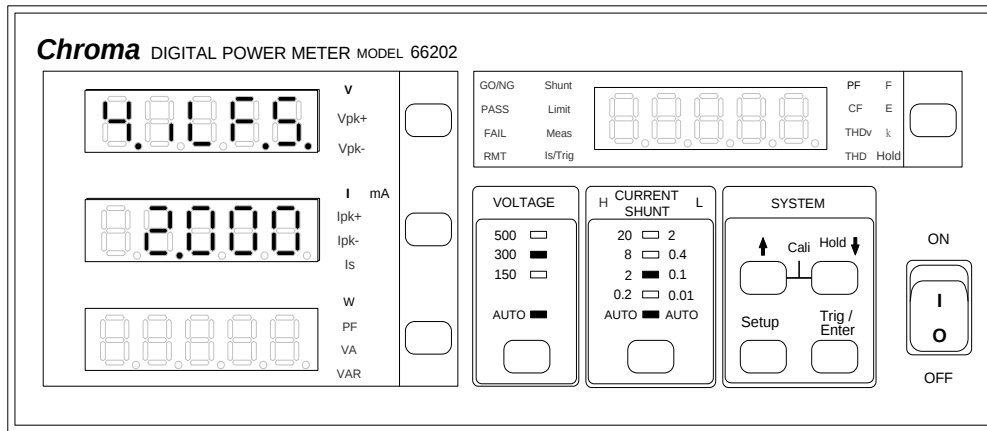
- (2) Press **Trig/Enter** the 0.4000 in I measurement window blinks. Set the Fluke 5500A output to 150V/0.4A/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 0.4000 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



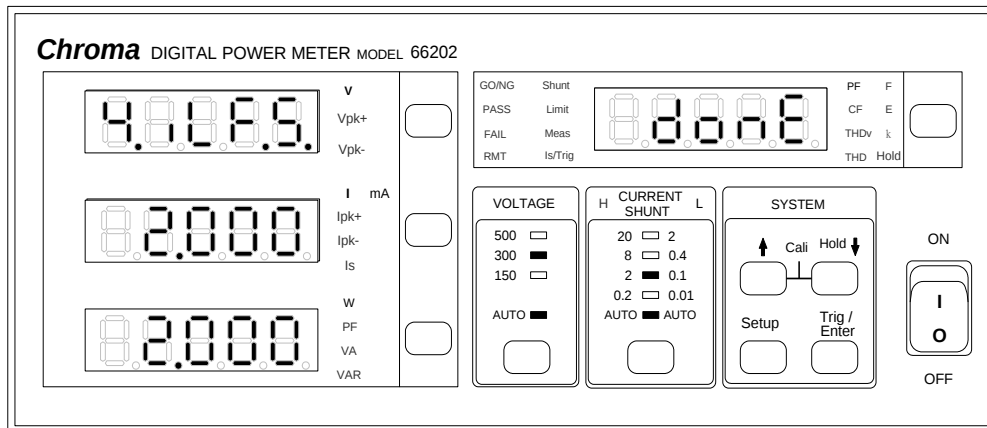
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to next range (2A) for calibration.

d. **2A Range Calibration:**

- (1) The calibration screen of 2A Range is shown as below (V measurement window blinks):



- (2) Press **Trig/Enter** the 2.000 in I measurement window blinks. Set the Fluke 5500A output to 150V/2A/60Hz and then press **OPR** to begin output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 2.000 (this is the reference) and the PF window will show the message “done”. The meter will beep concurrently.

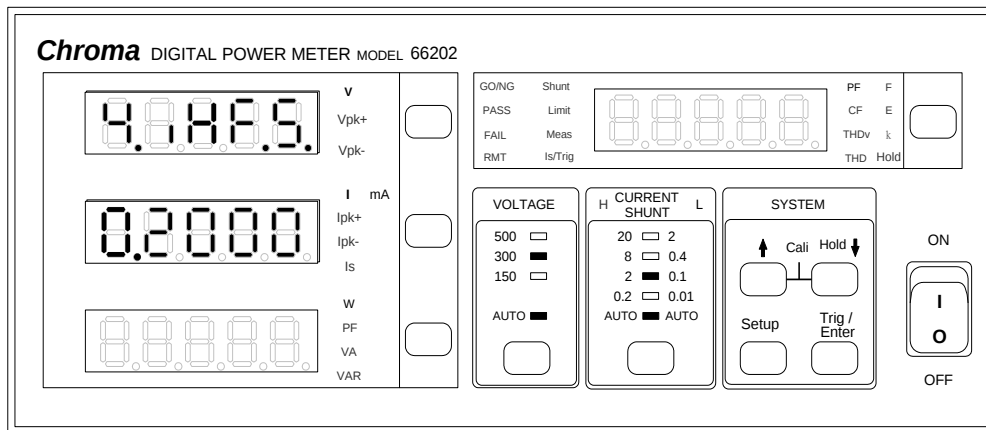


- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to the screen for storing calibrated data.

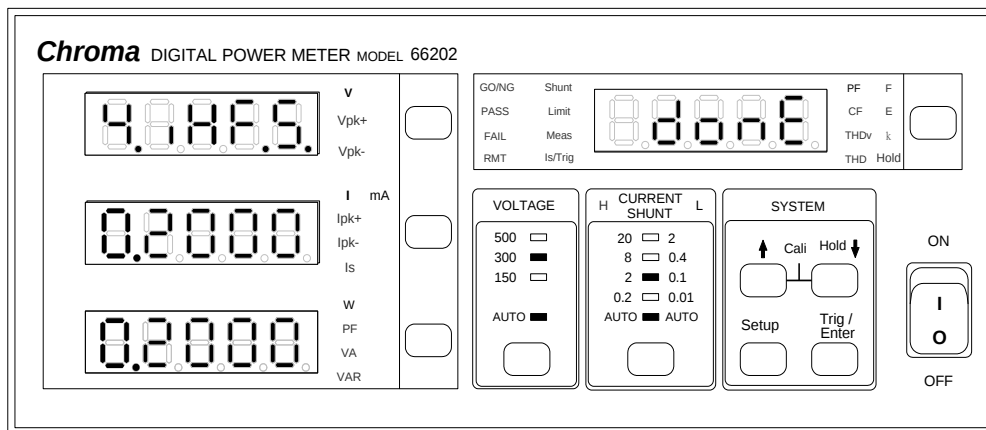
High Current Shunt:

e. 0.2A Range Calibration:

- (1) The calibration screen of 0.2A Range is shown as below (V measurement window blinks):



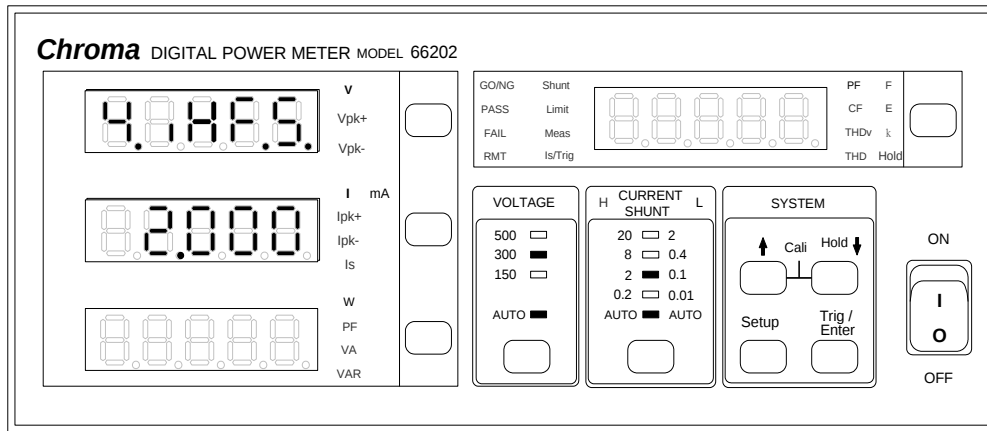
- (2) Press **Trig/Enter** the 0.2000 in I measurement window blinks. Set the Fluke 5500A output to 150V/0.2A/60Hz and then begin to output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 0.2000 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



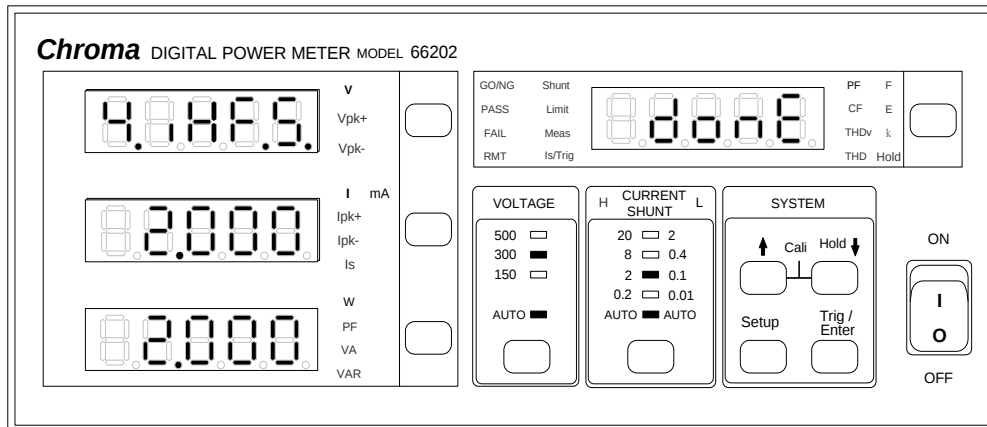
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to the screen for storing calibrated data.

f. 2A Range Calibration:

- (1) The calibration screen of 2A Range is shown as below (V measurement window blinks):



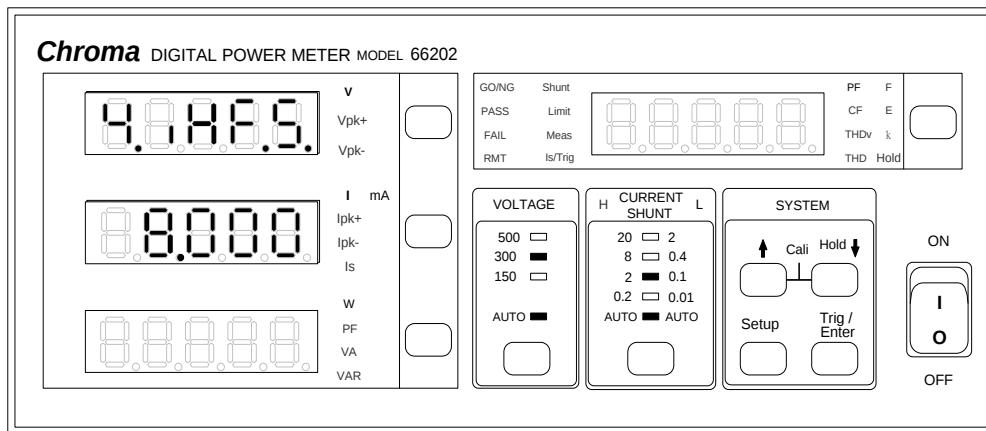
- (2) Press **Trig/Enter** the 2.000 in I measurement window blinks. Set the Fluke 5500A output to 150V/2A/60Hz and then begin to output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 2.000 (this is the reference) and the PF window will show the message “done”. The meter will beep concurrently.



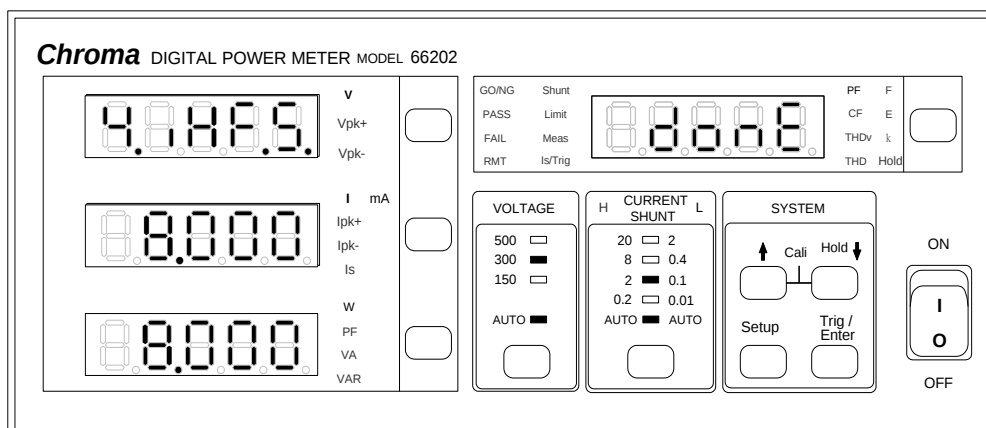
- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to the screen for storing calibrated data.

g. 8A Range Calibration:

- (1) The calibration screen of 8A Range is shown as below (V measurement window blinks):



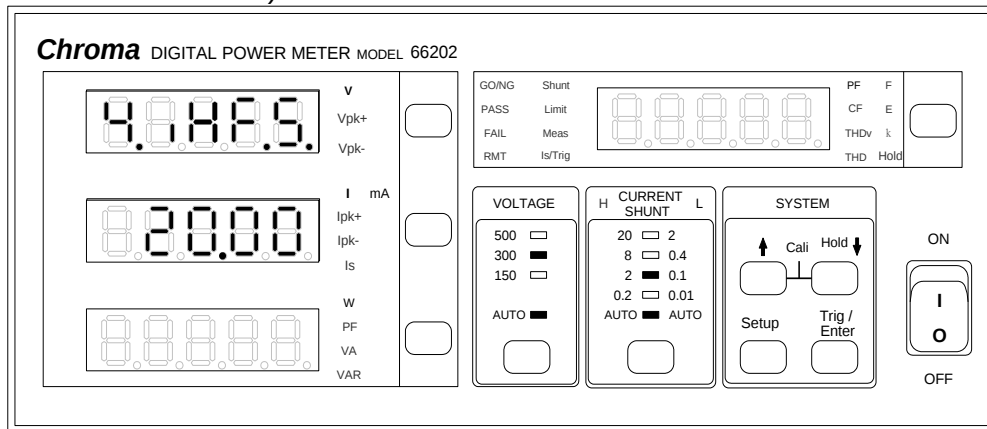
- (2) Press **Trig/Enter** the 8.000 in I measurement window blinks. Set the Fluke 5500A output to 150V/8A/60Hz and then begin to output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5500A.)
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 8.000 (this is the reference) and the PF window will show the message "done". The meter will beep concurrently.



- (4) Set the Fluke 5500A output to OFF and press **Trig/Enter** to go to the screen for storing calibrated data.

h. 20A Range Calibration:

- (1) The calibration screen of 20A Range is shown as below (V measurement window blinks):

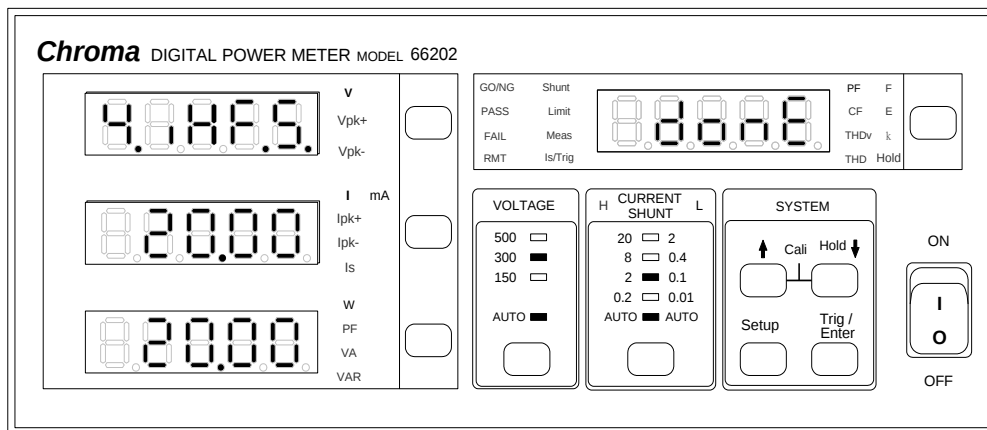


- (2) Press **Trig/Enter** the 20.000 in I measurement window blinks. Set the Fluke 5520A output to 150V/20A/60Hz and then begin to output. (To use other voltage for calibration, use **↑**, **↓** to adjust the value in I measurement window and set the voltage in Fluke 5520A.)



The maximum output of 5500A is about 11A, so please adjust the value to 10A if using 5500A for calibration. The 5500A current output is 10A.

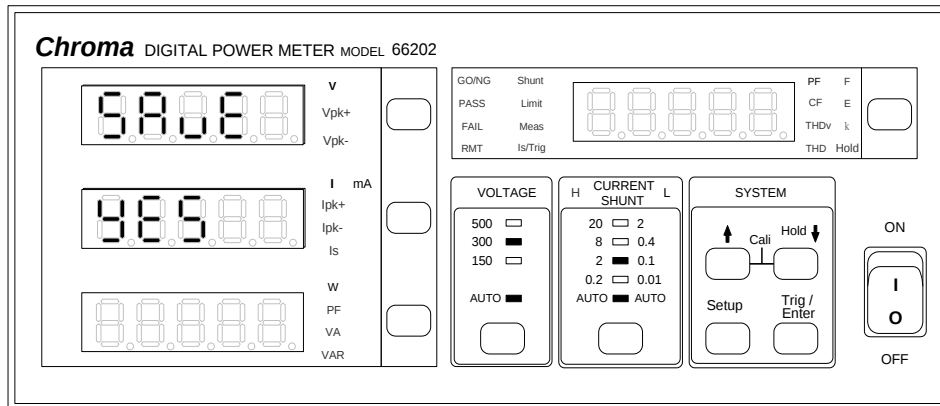
- (3) Press **Trig/Enter** the W measurement window will show the calibrated value 20.000 (this is the reference) and the PF window will show the message “done”. The meter will beep concurrently.



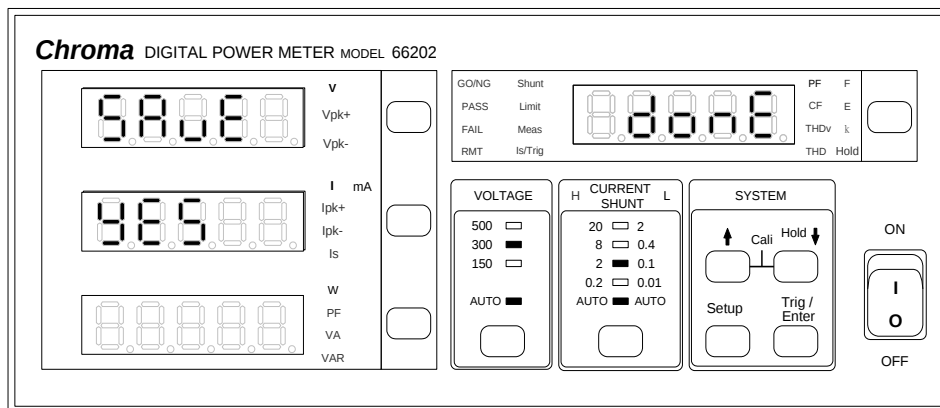
- (4) Set the Fluke 5520A output to OFF and press **Trig/Enter** to go to the screen for storing calibrated data.

5. Storing Calibrated Data:

- (1) Once the calibration is done, users can choose if saving the calibrated data. The screen of 66201 shows as below:

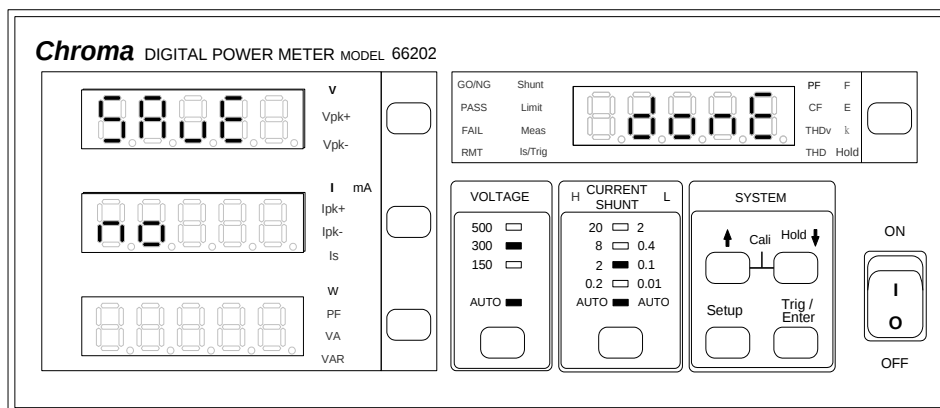


- (2) Press **Trig/Enter** the YES in V measurement window will blink. To save the data, press **Trig/Enter** again to save the calibrated data. It shows as below when done.



Press **Trig/Enter** again will skip the calibration mode and back to the normal measurement mode.

- (3) If there is no need to save the calibrated data, use **↑**, **↓** to change YES to no after pressed **Trig/Enter** in screen (1). Press **Trig/Enter** again when the setting is done and the screen shows:



Press **Trig/Enter** again will skip the calibration mode and back to normal measurement mode.

Appendix G Eliminating Floating Current

This appendix provides the information of eliminating the offset current in current range for the 66201/66202 Digital Power Meter. When the power meter is operated stand-alone, offset current may occur due to the factors of significant room temperature change, aging parts or not calibrated for a long time that affect the accuracy of current measurement. This adjustment procedure can be used to validate the operation and ensure its performance.

To execute the procedures in this appendix, first ensure the 66201/66202 is powered on and not connecting with any current cables. Conduct the elimination when the 66201/66202 current measurement window appears the measured current (could be several mA or less.)

Notice

1. Do not execute the procedures described in this appendix for verification to avoid any incorrect current measurement unless they are conducted by qualified personnel.
2. The power meter should be in a thermally stable environment with power turned-on for at least 30 minutes before performing auto-calibration (Cali).

Test Wire Configuration

First remove the current cable connected to the rear panel of the 66201/66202 Power Meter as Figure G-1 shows. When done, setup the 66201/66202 Power Meter and turn it on.

WARNING

It is necessary to remove the current cable exactly. Protection may occur on the Power Meter and make it unable to use if the current cable is not removed.

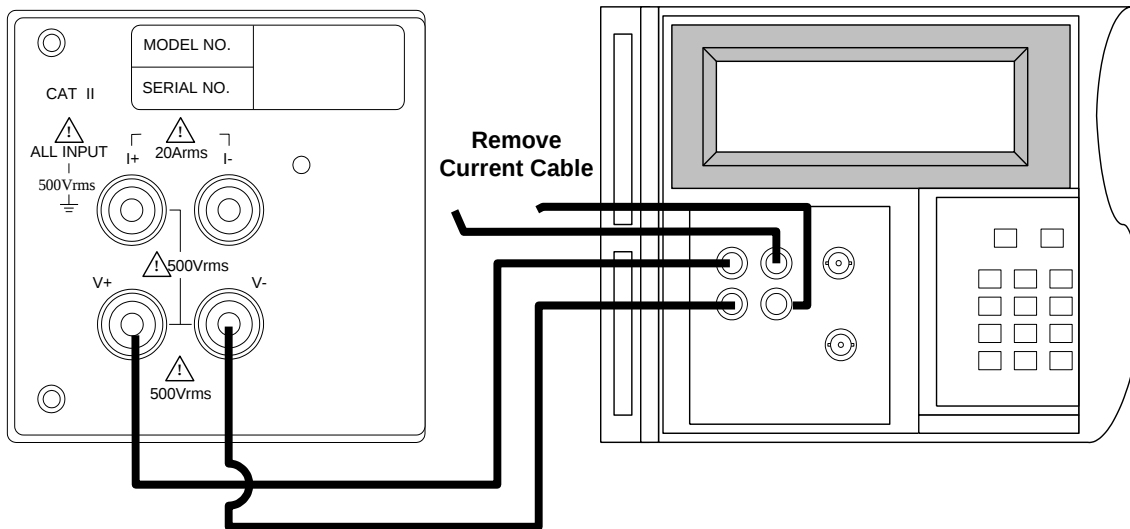
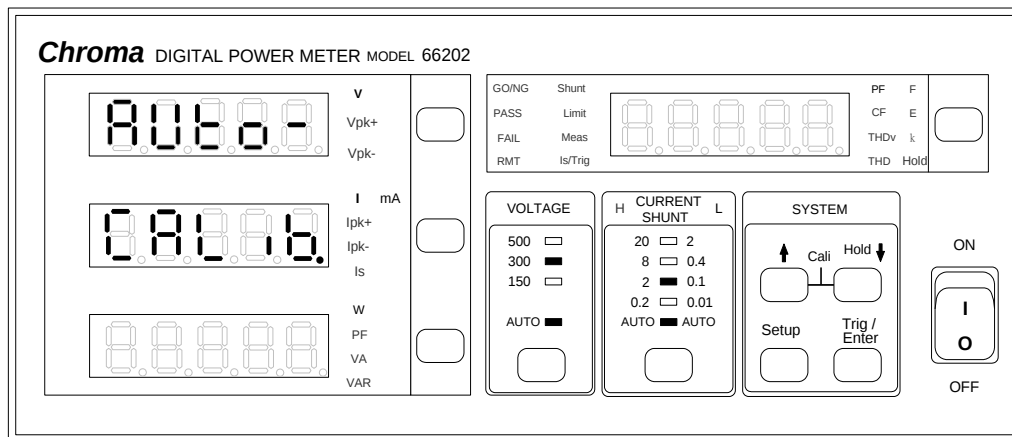


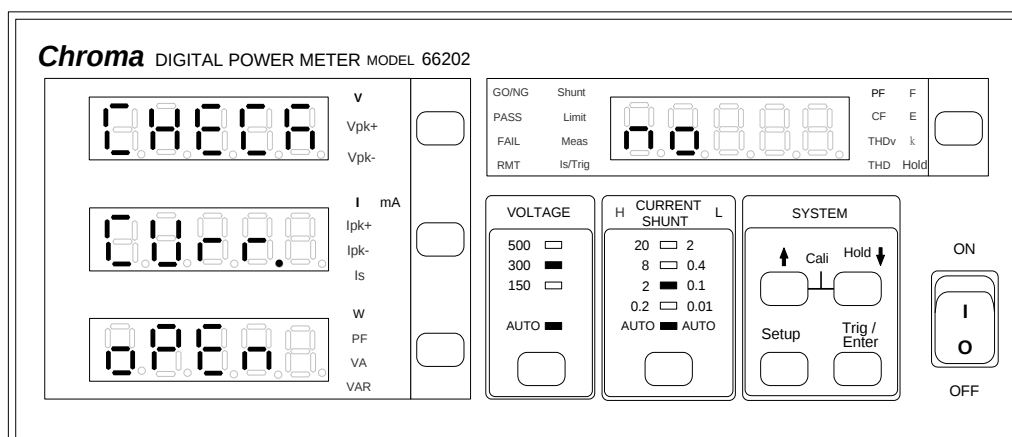
Figure G-1

Elimination Procedure:

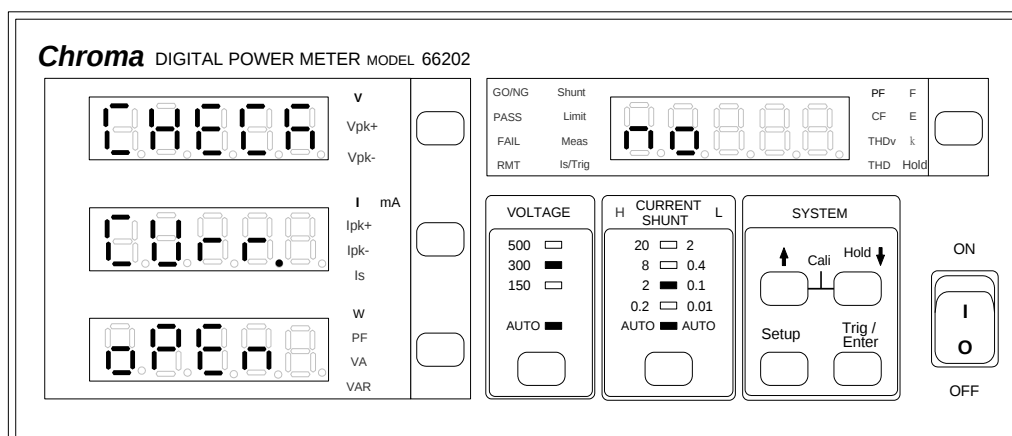
1. Turn on the Power Meter.
2. When the panel is in normal measurement mode, press  and  simultaneously, the screen will show as below:



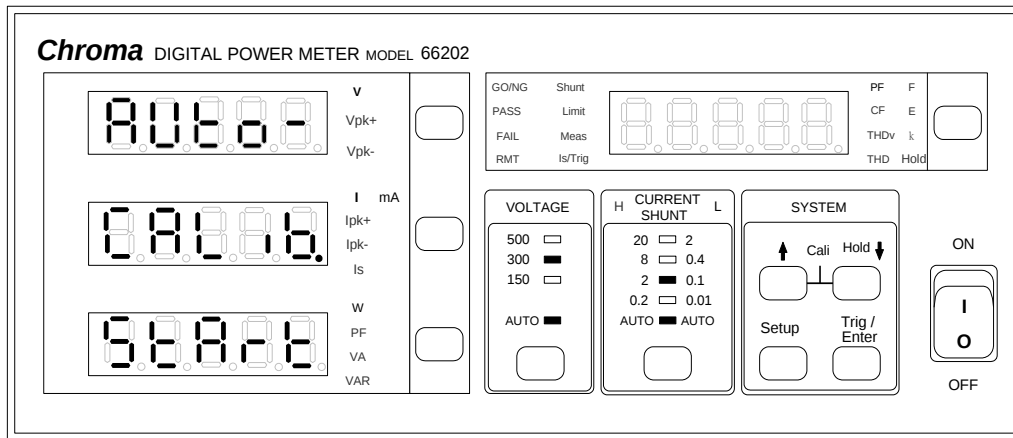
3. Press **Enter** to enter into the screen for current cable removal confirmation screen as the figure shown below.



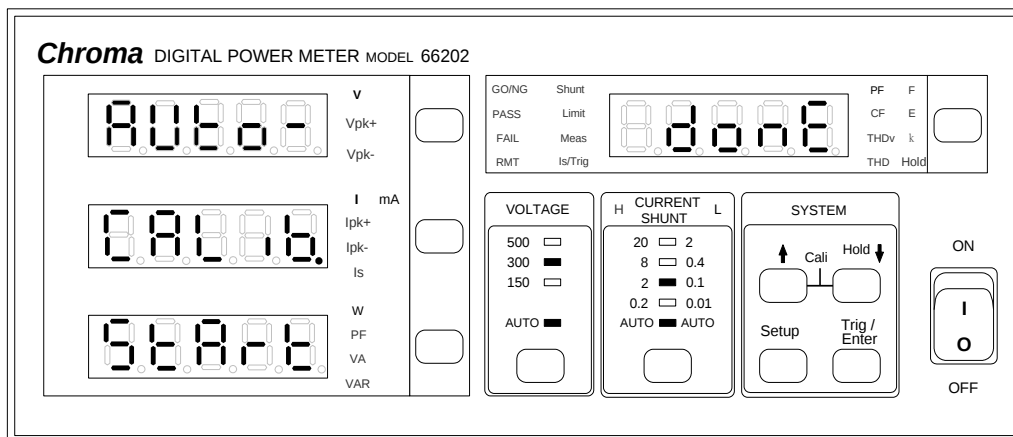
4. Ensure the cable is removed and press  or  to select "Yes" or "no". It goes to Current Offset calibration if selecting "Yes" and exits when selecting "no" as shown below.



- A current offset screen will appear for start confirmation when entered as the figure shown below.



- Press **Enter** to start eliminating the measured floating current in the current range. At this time the current range LED will appear from the lowest range to the highest range in sequence and it will show the figure below when done.



Press **Trig/Enter** again to return to the normal measurement mode.



CHROMA ATE INC.

info@chromaate.com

www.chromaate.com