

7110 / 7120

Single-Phase Power Meter

User Manual

Version: 1.01

Issued Date: Sep 2015

+ Safety Instructions

Pay careful attention to all safety instructions below when operating or maintaining the device. Disregarding these instructions and other warnings detailed in this manual constitutes a severe violation of the design, manufacture and operating safety standards of this device.

+ Maintenance Instructions

Operators must not remove the protective covers from the instruments. A qualified maintenance technician must perform all internal parts replacements or internal calibrations. Never replace any part while the power cord is plugged in. In special circumstances, dangerous voltages may still be present within the device after the power supply cord had been disconnected. Disconnect the power supply and take any necessary measures to discharge electricity before touching internal components to prevent injury.

+ Earthing the Instrument(s)

Earth all instrument power sources to minimize risks of electrical shock.

+ Never Perform Maintenance or Internal Calibration Work Alone

Never perform internal device maintenance or internal calibration work by yourself.

+ Never Replace Parts Yourself or Modify Device Functions or Structure

Never install surrogate parts onto the machine or undertake any device modifications yourself without the express permission of Microtest, as you may increase the levels of danger associated with the device or damage the device. Please return any malfunctioning instruments to Microtest for professional repairs guaranteeing the device's continued safety.

+ Product Warranty

Microtest provides a quality guarantee for this product for one year from the dispatch date of the product; however, warranty life may be different for special parts or different product specifications. Microtest will take responsibility for all maintenance and replacement of products found to have an actual defect during the life of the warranty (Microtest will determine the nature of the defect). Microtest guarantees that all software and hardware designated for use with

instruments can be used immediately upon installation. Microtest does not guarantee that instrument software and/or hardware will not disconnect or produce errors during operation.

+ Product Warranty Scope

The above guarantees and warranty do not apply if a customer has failed to use the product correctly, has modified or repaired the device or replaced parts without permission from Microtest, has misused the product, or has installed or repaired the product in an environment that does not meet the specified conditions.

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Declaration: Microtest Corporation reserves the rights to modify this manual without notification of any changes or modifications.

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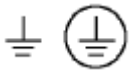
Chapter 1 Cautions

Do not use this instrument outside and avoid humid or dusty areas. Use of this instrument in an improper setting can increase the risk of electrical shock. Carefully read all safety instructions before using the device to prevent accidents due to misuse.

Section 1.1 Safety Labels

The following safety labels may appear in this user manual and on the device itself.

 Caution: Carefully read the user manual for detailed information.

 Earthing Required: Check that this terminal is earthed before operating the device to prevent electrical shocks due to leakage or contact with the housing.

CAUTION: Improper use of the device may result in instrument or testing object malfunctions.

WARNING: Improper use of the device may result in injury or death.

Section 1.2 Never modify the device or perform internal calibrations yourself.

Never install surrogate parts onto the machine or undertake any device modifications and internal calibrations yourself without the express permission of Microtest, as you may increase the levels of danger associated with the device or damage the device.

Section 1.3 Static Electricity

Keep items bearing static electricity away from the device to prevent damage.

Section 1.4 Earthing

A safe earthing terminal is located on the outer housing of the back panel of the device; check that this terminal is properly earthed to prevent contact with the housing and risk of electrical shock.

Section 1.5 Power Supply

You must use a power supply cable that meets local national specifications and an IEC320-compatible connector to connect the cable to the instrument. The user must check that the earth wire is properly earthed. If a fuse is included in the power supply plug it must be a 3.15A fuse compatible with relevant safety regulations. Always check before use to ensure A/C power supply and voltage values are between 100V-240V @ 50/60Hz.

Section 1.6 Warming-Up

The testing device can be used normally immediately after switching the power on, but will not meet accuracy specifications unless allowed to warm up for 30 minutes.

Section 1.7 Device Malfunctions

Return all malfunctioning instruments to the manufacturer for professional repair in order to ensure the accuracy and operational safety of the instrument.

Section 1.8 After Testing

Please turn the device off at the power source if it will not be used for a long period of time.

Section 1.9 Installation and Storage

The device may be operated normally in temperatures of 18-28°C with up to 80% RH. The device may not operate in conditions exceeding these limits. The device should be stored at -20°C~70°C with up to 80% RH. In order to ensure testing accuracy and safety, avoid installing the device anywhere it would be exposed to direct sunlight, extreme heat, extreme humidity, vibration frequencies, dust, or unstable power grids.

Section 1.10 Emergency Measures

Switch off the power supply and disconnect the power supply cable in the event of electrical shock, test item combustion and device combustion.

Chapter 2 Foreword

Section 2.1 Features

1. 0.1% Base Accuracy, Up to 160% AC Voltage Range, Current Crest Factor (cf) Settings of 3 or 9. CF3: Up to 215% AC Current Range; CF9: Up to 645% AC Current Range; CF3: Up to 344% Power Range; CF9: Up to 1,032% Power Range.
2. With Erp Lot6 2013 Standby and off-mode power loss Standby Power Consumption Gauge.
3. Continuous Sampling design; AC 50HZ/60HZ base sampling rate of 100KSPS/120KSPS; Standby Power Consumption Gauge Precision of up to 0.001W for compatible high/low frequency electronic products.
4. Measures: AC/DC voltage current, active power (W), variance (var), apparent power (VA), power factor (PF), VI angle (DEG), voltage current crest factor (CF), voltage and current frequencies (Hz), voltage peak-to-peak (VP-P), current peak-to-peak (IP-P), total harmonic distortion (THD), harmonic voltage/current analysis at any one of 50 stages, instantaneous current and more.
5. Double CPU Design for Faster Measurements.
6. Easy-to-use Operating Panel.
7. Fast Automatic Transmission - 1 range/0.02 sec @ 50Hz.
8. Current Measuring Circuit utilizes a highly reliable vehicle relay design and features a long service life.
9. Total harmonic/single-stage distortion can be measured at up to 50 stages.
10. Can connect high-amperage current transformers to measure large currents
11. Fast and Accurate Measurements.
12. Can connect standard RS232/GPIB cables (one at a time).
13. Suitable for both large and small power measurements and can measure 0.1W standby consumption with analysis precision of 0.001W.
14. High-capacity built-in memory capable of recording 1,000 units of measurement data for long-term power analysis over time.
15. Comes with voltage meter micro-consumption adjustments.

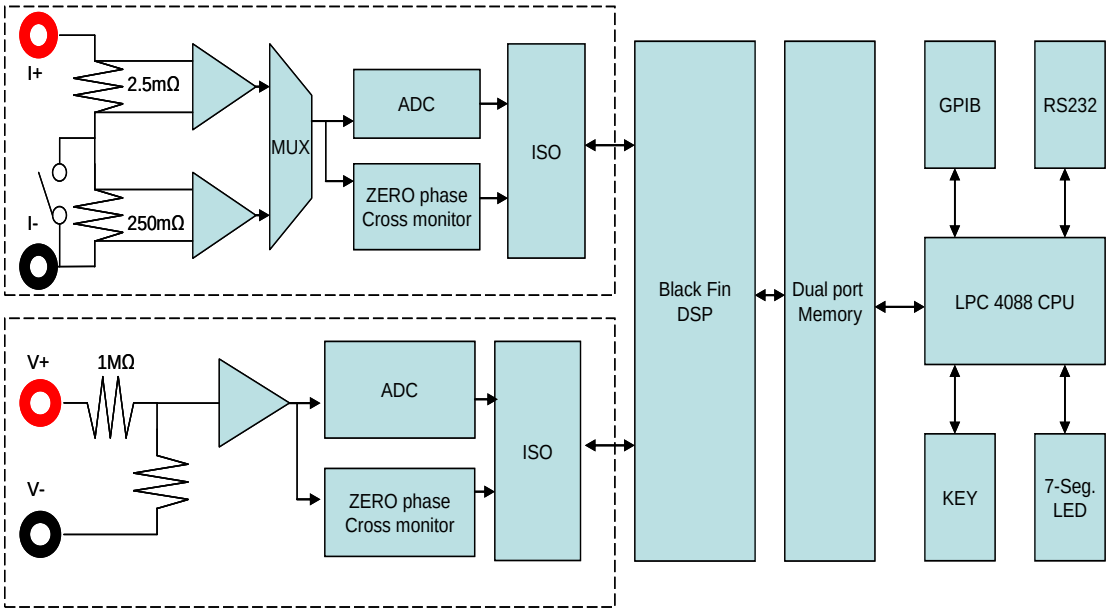
Section 2.2 Measuring Functions

Parameter Scope	Testing Scope
Vrms/Vdc	0.1V~800V
Irms/Idc	0.2mA~20A
W	0.01W~16KW
PF	0.0000~±1.0000
Deg	-180.00~+180.00
THD	0.01%~999.99%
Hz	15Hz~100kHz

Section 2.3 Function Flow-Chart

7120 Internal Flow Chart:

7120 Voltage channel input resistance is 1M ohm, voltage can be input directly for testing or measured with a standard attenuation sonde. Current measurement terminal uses 0.0025Ω and 0.25Ω precision shunts to directly measure currents between 0.0002A-20A, and an external CT can be used to measure larger currents. Measurement and sampling processes use independent digital signal processors and measurement results are saved in a dual-port memory before being transmitted to the LED 7-stage display panel by the CPU, integrated, and applied via the GPIB/RS-232 and ATE systems.

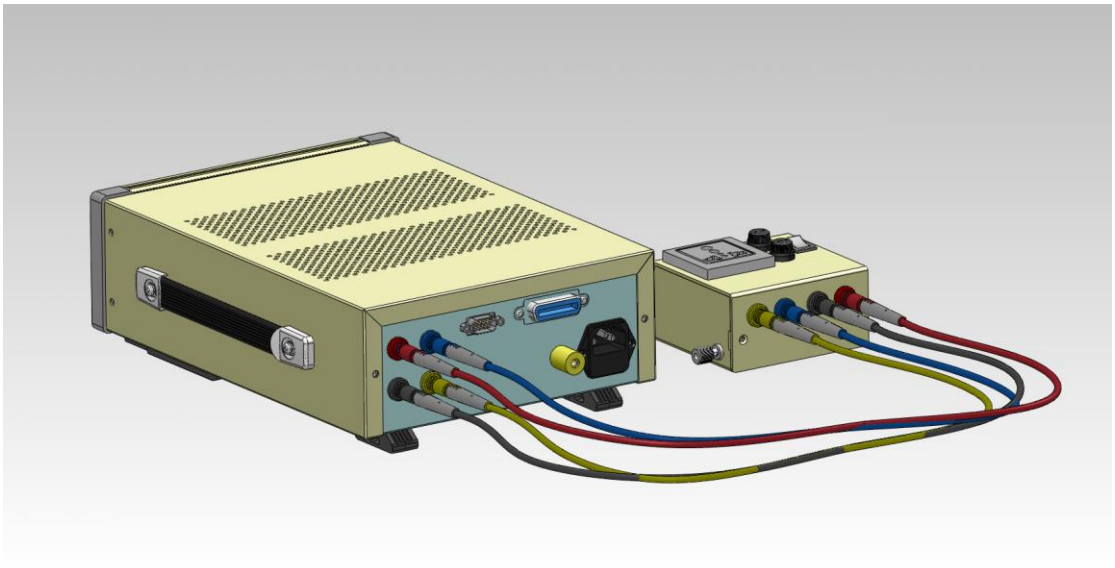


Chapter 3 Wiring

Section 3.1 Connecting to the Power Supply and Testing Items

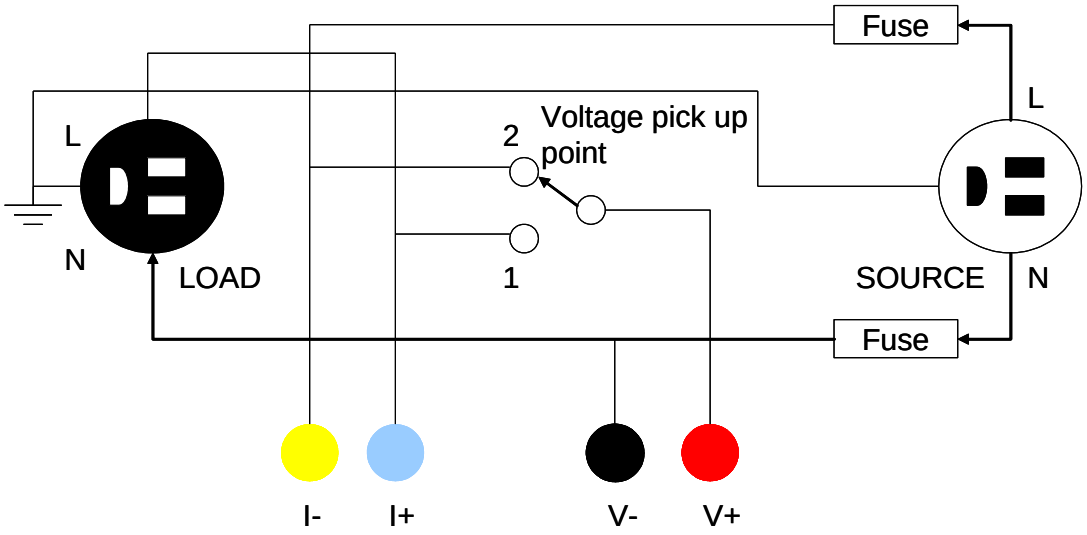
Match the colors on the terminals on the back panel to those of the terminals above the jigs on the F71201 Test Box to connect the wires and connect two AC power supply cables - 1 to the F71201, and one to the input port on the 7120 Power Supply.

Plug appearances in different countries may make it necessary to use a converter to connect the cable to the F71201 Text Box; please select an appropriate converter for your locale.



Section 3.2 F71201-Exclusive Jig Internal Measuring Wiring Schematic Diagram

Below is a schematic diagram of the internal wiring when using the F71201 Test Box. When the switch is set to 1 the voltage measurement point will be closer to the testing item to prevent overly low wattage measurements resulting from voltage drops across the wiring circuit under large currents. When the switch is set to 2 all power expended by the 7120 voltage input internal resistor 1M Ω is subtracted from the power rate closest to 0W; this setting is used only for measuring standby power. Determine whether to set the switch to 1 or 2 by looking at the rate of the current of the testing object.



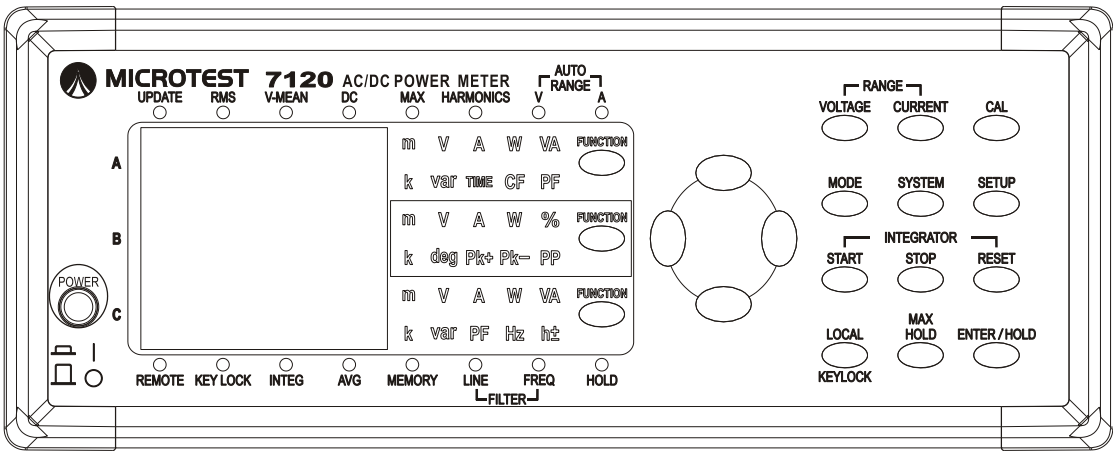
Caution:

Double check that the voltage and wiring at the current input terminals are correct before connecting to mains power to prevent power overload.

Chapter 4 Operating Settings

Section 4.1 Measurement Mode

Keys:



Steps:

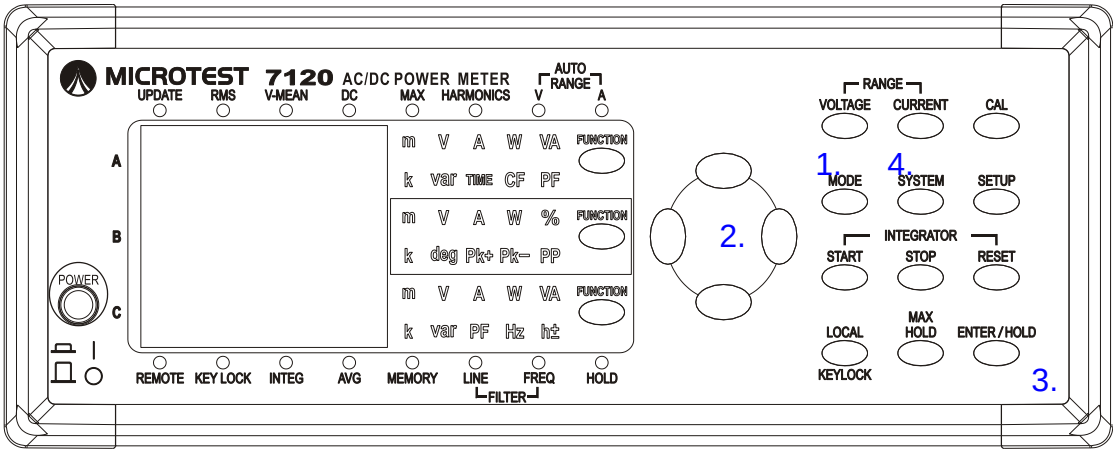
Press

Description:

Indicator	**Voltage**	**Current**
RMS	Measured true rms value	Measured true rms value
V-MEAN	Rectified mean value calibrated to the rms value	Measured true rms value
DC	Measured DC value obtained by averaging input signal	Measured DC value obtained by averaging input signal
Harmonic	Measured harmonic distortion	Measured harmonic distortion

Section 4.2 Measurement range

Keys:



Steps:

Set Voltage range

1. VOLTAGE 2. ↑↓ Select 10V/30V/100V/300V/600V/AUTO 3. ENTER/HOLD to complete voltage range selection.

Set Current Range

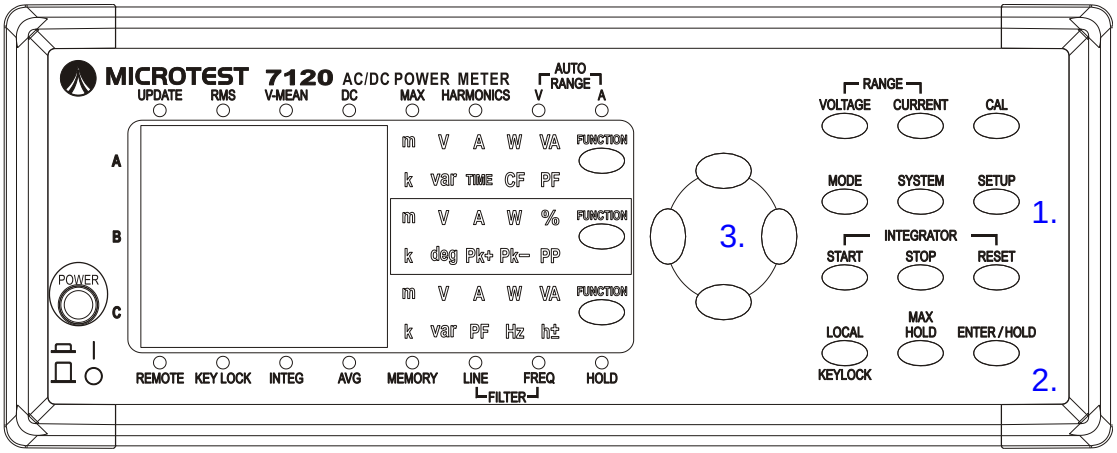
4. CURRENT 2. ↑↓ Select 0.01A/0.03A/0.1A/0.3A/1A/3A/10A/20A/AUTO then press 3. ENTER/HOLD to complete current range selection.

Description:

The AUTO RANGE LED on the panel will light up when voltage or current range are set to AUTO. Press the voltage or current key to show which automatically selected voltage or current range is currently being used by the device on the C Display.

Section 4.3 Averaging

Keys:



Steps:

1.SETUP↑↓AVG→2.ENTER/HOLD→3.↑↓ON/OFF/FACT →2.ENTER/HOLD→ 3.↑↓LIN8/16/32/64/EP8/EP16/EP3/EP64 → 2.ENTER/HOLD

Description:
An exponential average (EP8~EP64) is calculated using the following formula:

$D = D_{n-1} + (M_n – D_{n-1})/K$

Where

D_n: the value at the n^{th} display;
D_{n-1}: the exponentially averaged value at the $n-1^{th}$ display;
M_n: the measurement value at the n^{th} display;
K: attenuation constant

A moving average is calculated using the following formula:

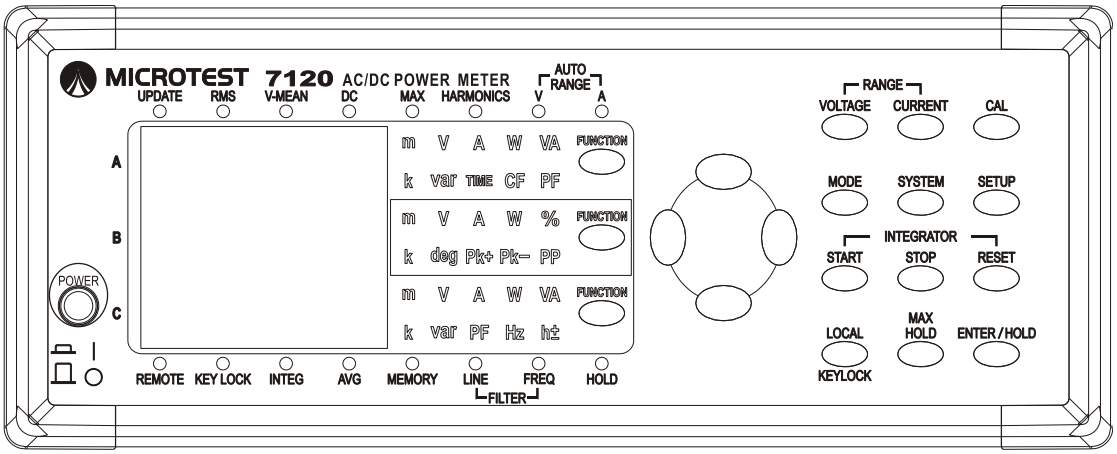
$D = (D_{m-1})+(D_{m-2})…(D_{m-64})/m$

Where

Dm-(1~64): the moving averaged value at the m-(1~64)th display;
m = 8, when setting LIN8
m = 16, when setting LIN16
m = 32, when setting LIN32
m = 64, when setting LIN64
m: sample number

Section 4.4 Update Rate

Keys:



Steps:

1. SETUP **2. ↑↓URATE** → **3. ENTER/HOLD** → **2.↑↓ 0.1/0.25/0.5/1/2/5** → **3.ENTER/HOLD**

Description:

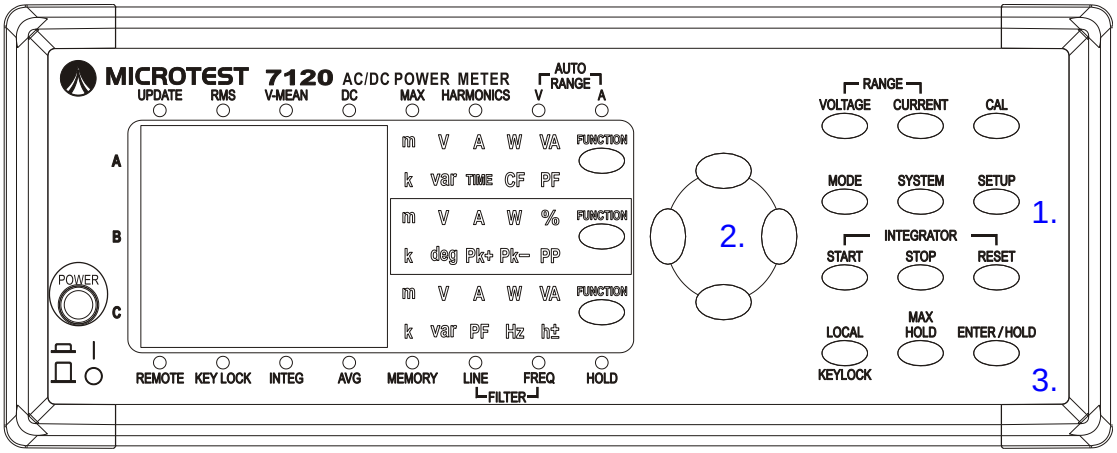
The update rate defines measurement update intervals: the longer the period set, the greater the number of sampling cycles, and the more stable the readings. Each testing item will have its own loading characteristics - slow down the update rate if the readings show great variation in order to obtain more stable readings. Sampling cycles for each URATE can be found below.

In Harmonics mode, the update rate can be between .025S~5S.

AC	0.1s	0.25s	0.5s	1s	2s	5s
50Hz Mains Power	5	10	25	50	100	250
60Hz Mains Power	6	12	30	60	120	300

Section 4.5 Synchronization

Keys:



Steps:

1. SETUP → 2.↓↑ Select SYNC → 3. Press ENTER/HOLD and use ↓↑ to select V/A/AUTO/OFF → 3. ENTER/HOLD

Description:

A: First use the current (with a frequency jitter of under 2%) as a synchronization source, then the voltage. If both are unstable, take a fixed sample at 200KSPS.

V: First use the voltage (with a frequency jitter of under 2%) as a synchronization source, then the current. If both are unstable, take a fixed sample at 200KSPS.

Auto: Automatically determine whether to use the voltage or the current as the synchronization source (voltage >1V / Current (only use if reading >3% of ranges). Automatic Synchronization Source Rules: Synchronize using voltage only when voltage is stable. Synchronize using current only when current is stable. Select the lower-frequency option if both current and voltage meet minimum signal conditions with a jitter of less than 2%. Use a fixed 200KSPS sample if neither the current nor voltage meets the required conditions. The current automatic synchronization locked source will be display beneath the Sync menu as V-Auto (voltage), A-Auto (current) or d-Auto (default fixed sample). Only RMS/MEAN/DC are supported in Auto mode; in Harmonic mode please set a stable and lower-frequency signal source as the base frequency.

Voltage >1V && Voltage Frequency Jitter < 2%

V-Sync	V-Auto

Current > 3% of range && Voltage Frequency Jitter < 2%

A-Sync	A-Auto

OFF: The **Sync OFF** option is only for capturing high-frequency surge currents. The 7120 takes fixed ~200KSPS samples and uses different update rates to calculate the samples. Reading stability has been reaching once the input signals match the frequencies given in the following table at the completion of the sampling cycle (pale blue cells); although the pink cell values also indicate a stable reading frequency, they are only given for reference purposes as their sampling cycle is just over half a cycle.

	Update Rate (Seconds)						
Freq.	0.1	0.25	0.5	1	2	5	10
15	1.5	3.75	7.5	15	30	75	150
16	1.6	4	8	16	32	80	160
17	1.7	4.25	8.5	17	34	85	170
18	1.8	4.5	9	18	36	90	180
19	1.9	4.75	9.5	19	38	95	190
20	2	5	10	20	40	100	200
21	2.1	5.25	10.5	21	42	105	210
22	2.2	5.5	11	22	44	110	220
23	2.3	5.75	11.5	23	46	115	230
24	2.4	6	12	24	48	120	240
25	2.5	6.25	12.5	25	50	125	250
26	2.6	6.5	13	26	52	130	260
27	2.7	6.75	13.5	27	54	135	270
28	2.8	7	14	28	56	140	280
29	2.9	7.25	14.5	29	58	145	290
30	3	7.5	15	30	60	150	300
31	3.1	7.75	15.5	31	62	155	310
32	3.2	8	16	32	64	160	320

33	3.3	8.25	16.5	33	66	165	330
34	3.4	8.5	17	34	68	170	340
35	3.5	8.75	17.5	35	70	175	350
36	3.6	9	18	36	72	180	360
37	3.7	9.25	18.5	37	74	185	370
38	3.8	9.5	19	38	76	190	380
39	3.9	9.75	19.5	39	78	195	390
40	4	10	20	40	80	200	400
41	4.1	10.25	20.5	41	82	205	410
42	4.2	10.5	21	42	84	210	420
43	4.3	10.75	21.5	43	86	215	430
44	4.4	11	22	44	88	220	440
45	4.5	11.25	22.5	45	90	225	450
46	4.6	11.5	23	46	92	230	460
47	4.7	11.75	23.5	47	94	235	470
48	4.8	12	24	48	96	240	480
49	4.9	12.25	24.5	49	98	245	490
50	5	12.5	25	50	100	250	500
51	5.1	12.75	25.5	51	102	255	510
52	5.2	13	26	52	104	260	520
53	5.3	13.25	26.5	53	106	265	530
54	5.4	13.5	27	54	108	270	540
55	5.5	13.75	27.5	55	110	275	550
56	5.6	14	28	56	112	280	560
57	5.7	14.25	28.5	57	114	285	570
58	5.8	14.5	29	58	116	290	580
59	5.9	14.75	29.5	59	118	295	590
60	6	15	30	60	120	300	600

Appropriate Synchronization Sources result in Stable Readings:

The 7120 can be operated in both ordinary power mode and as an independent ammeter, an ampere-hour meter or an independent voltmeter. The following table gives synchronization source settings for common input signals with a description of the synchronization rules of the 7120 in order to help the user select the most appropriate synchronization source to obtain a stable and accurate voltage/current/watt reading.

RMS / DC / MEAN Power Meter Mode					
Voltage	Current	Sync-V Priority Order (V-A-d)	Sync-A Priority Order (A-V-d)	Sync-Auto (Voltage over 1V, Current over Gear 3%)	Sync - OFF
		The below are actual operating mechanisms for internal synchronization sources.			
O(Stable)	X(No Freq or Unstable)	V	V	V-Auto	d(default) No synchronization source, use fixed sampling rate
O(Stable)	O(Stable)	V	A	Prioritize those with long periodic signals and jitter <2%.	
X(Unstable)	O(Stable)	A	A	A-Auto	
X(Unstable)	X(No Freq or Unstable)	d(default)	d(default)	d-Auto	

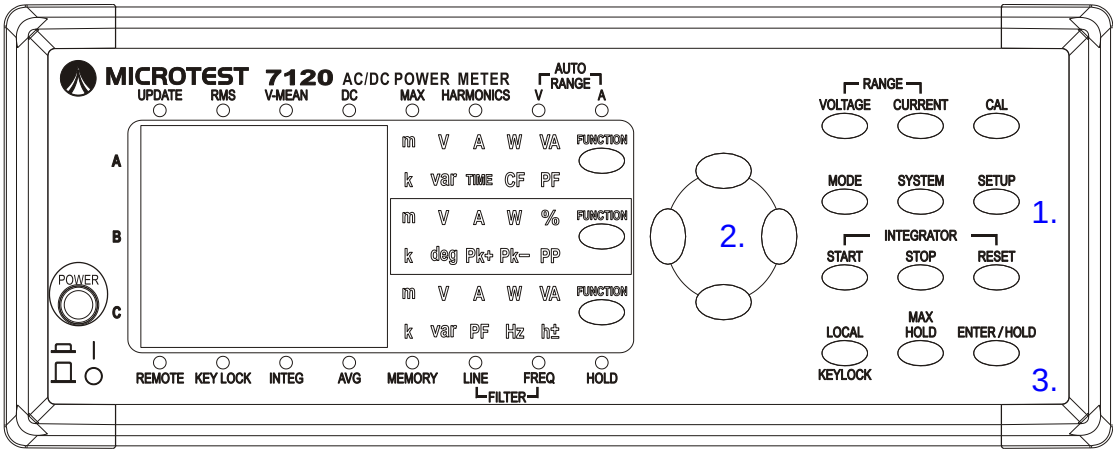
Harmonic Power Meter Mode					
Voltage	Current	Sync-V Selected Only V	Sync-V Selected Only V	Sync-Auto (Voltage over 1V, Current over Gear 3%)	Sync - OFF
		The below are actual operating mechanisms for internal synchronization sources.			
O(Stable)	X(No Freq or Unstable)	V	No Measurement	V-Auto	Setting does not exist
O(Stable)	O(Stable)	V	A	Prioritize those with long periodic signals and jitter <2%.	
X(Unstable)	O(Stable)	No Measurement	A	A-Auto	
X(Unstable)	X(No Freq or Unstable)	No Measurement	No Measurement	No Measurement	

RMS / DC / MEAN Ammeter Mode					
Voltage	Current	Sync-V Priority Order (V-A-d)	Sync-A Priority Order (A-V-d)	Sync-Auto (Current over Gear 3%)	Sync - OFF
		The below are actual operating mechanisms for internal synchronization sources.			
X(Idle Contact)	X(No Freq or Unstable)	d(default)	d(default)	d-Auto	d(default) No synchronization source, use fixed sampling rate
X(Idle Contact)	O(Stable)	A	A	Jitter must be less than 2% for A-Auto	

RMS / DC / MEAN Voltmeter Mode					
Voltage	Current	Sync-V Priority Order (V-A-d)	Sync-A Priority Order (A-V-d)	Sync-Auto (Voltage over 1V)	Sync - OFF
		The below are actual operating mechanisms for internal synchronization sources.			
O(Stable)	X(Idle Contact)	V	V	Jitter must be less than 2% for A-Auto	d(default) No synchronization source, use fixed sampling rate
X(Unstable)	X(Idle Contact)	d(default)	d(default)	d-Auto	

Section 4.6 Harmonic Operation Mode Selection

Keys:



Steps:

1. Press SETUP 2. Use ↑↓ to select THD and press ENTER/HOLD then use ↑↓ to select IEC or CSA

Description:

Below are the differences between IEC and CSA Total Harmonic Distortion Ratio Definitions. The 7120 supports calculations using both.

In case of iEC

$$\left[\sqrt{\sum_{k=2}^{n}(C_k)^2}\right] / C_1$$

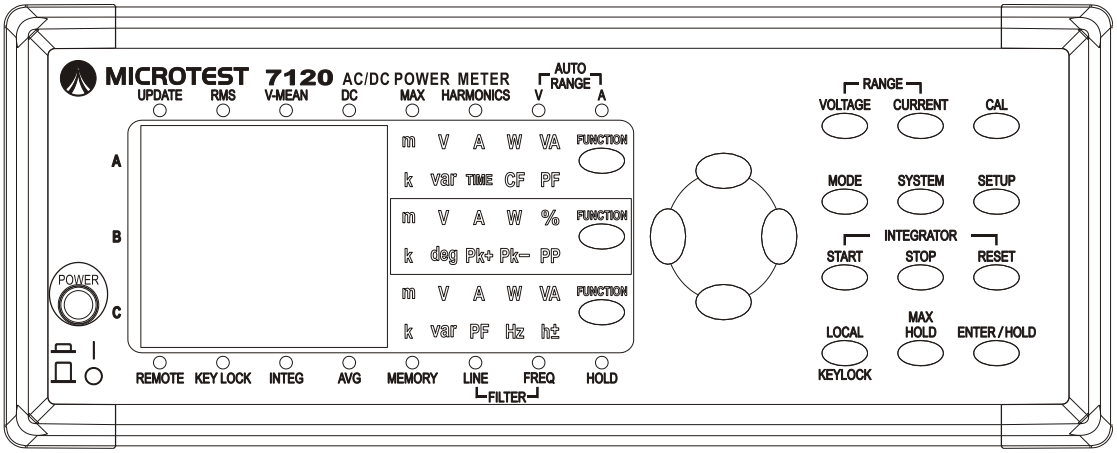
In case of CSA

$$\left[\sqrt{\sum_{k=2}^{n}(C_k)^2}\right] / \left[\sqrt{\sum_{k=1}^{n}(C_k)^2}\right]$$

- C1: Fundamental component (1st order)
- Ck: Fundamental or harmonic component
- k: Analysis order
- n: Maximum order. The maximum order depends on the fundamental frequency of the input set as the PLL source. Refer to Chapter 16 for more details.

Section 4.7 Start Line and Frequency Filter Function

Keys:



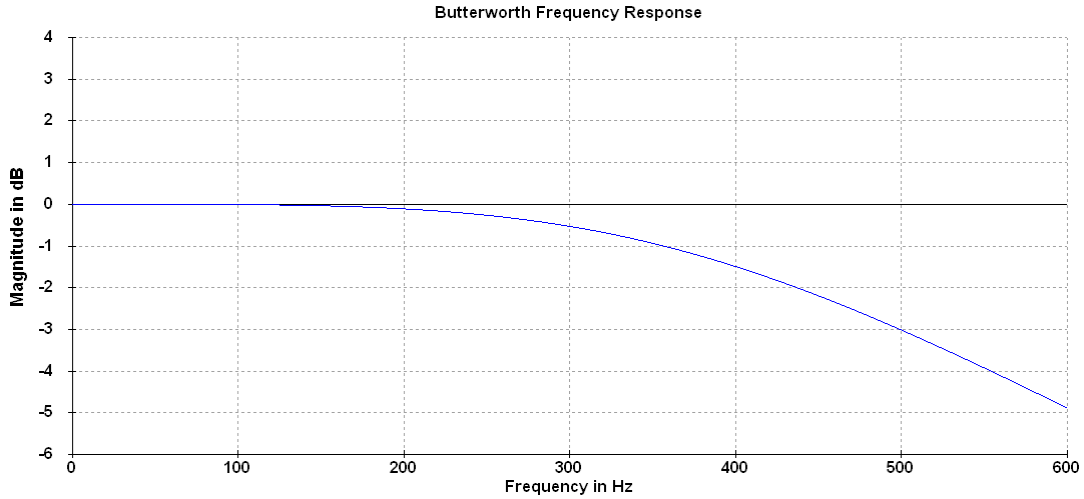
Steps:

Line Filter Start/Stop: Press SETUP and use ↑↓ to select L.FILTER, press ENTER/HOLD, select ON/OFF and press ENTER/HOLD

Frequency Filter Start/Stop: Press SETUP and use ↑↓ to select F.FILTER, press ENTER/HOLD, select ON/OFF and press ENTER/HOLD

Line Filter Description: Interference from background noise over 500Hz can be picked up easily and may affect low-frequency signal measuring precision when measuring small voltages (<0.1V) or small currents (1mA). Turn this function on to eliminate noise over 500Hz and increase precision. Use of this function is not recommended if the current frequency of the testing item is over 66Hz. The line filter coefficients for the 7120 were designed to eliminate high-frequency signals and allow the power meter to focus on measuring low-frequency continuous signals. The maximum input frequency allowed by the line filter is 16KHz.

Line Filter Rules: Voltage and current features are the same; Mainly specifications of 500Hz - 3dB shown on the Bode Plot below.



Line Filter Applications:

This function has two primary applications:

To filter and eliminate environmental noise when measuring low-frequency small currents e.g. when measuring A/C 60Hz 100μA, without the line filter the readings obtained are 0.000102A and 0.0001005A (nearly 100μA) with the line filter. This function can be used to measure extremely small static low-frequency power consumption in electrical products. This function will affect the V/A/W readings for items with greater power consumption and a frequency loading of over 66Hz, so please remember to switch it off.

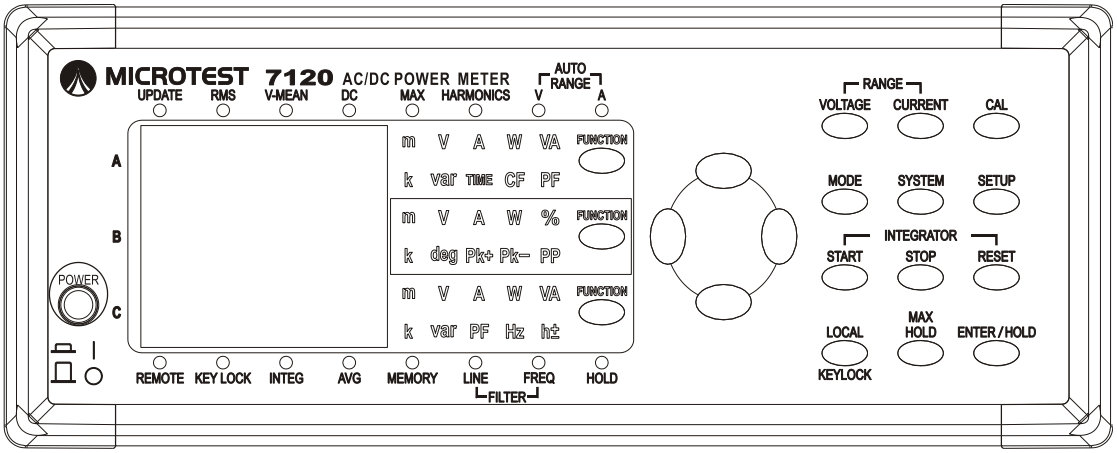
To filter and eliminate harmonics of over 500Hzwhen conducting harmonics analysis. It can only be used when analyzing harmonics under 500Hz (50Hz mains power in 10 stages); please remember to switch off the line filter function when analyzing harmonics over 500Hz.

Frequency Filter Description: When the signal to be measured has a base frequency of 50Hz/60Hz and a high-frequency component, turn the F-Filter on to filter out signals over 500Hz and only show those lower than 500Hz. This function only filters some frequencies and has no affected whatsoever on voltage/current/wattage.

The frequency filter must be switched off when the base frequency is greater than 490Hz to avoid affecting the bandwidth of the volt frequency counter and current frequency counter, making it impossible to measure the actual volt and current frequencies.

Section 4.8 Set Frequency CF Value

Keys:



Steps:

Press SETUP and use ↑↓ to select CF then press ENTER/HOLD. Select 3/9 and press ENTER/HOLD to switch between current CF3 / CF9

Description: Maximum CF3 crest current/RMS current ratio setting is 330%; set crest current/RMS current maximum ratio to 990% to eliminate time and precision spent switching small range when testing electrical items with high current crest factors to maintain the integrity of the current measurement.

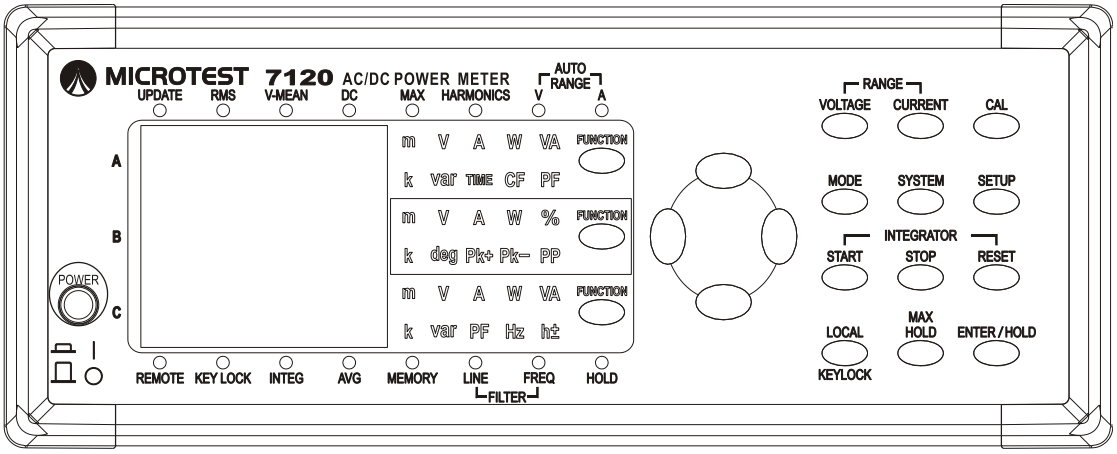
When settings range for CF3 current 0.3A (inc. 0.3A) or CF9 0.1A (inc. 0.1A) the current measurement uses a 0.25 ohm shunt. The hardware will force an automatic gear switch when the current exceeds 1.3A (AC) or 1.8A (DC) to protect the internal shunt from combustion, and when the device is switched off the internal default is to use the 0.0025 ohm circuit to protect the 0.25 ohm from accidental exertion and burn-out from large currents.

CF Definitions:

Crest current / RMS gear values all based of sine waves.

Section 4.9 Setting 4th Display Measurement Values

Keys:



Steps:

Press SETUP and use ↑↓ to select DISPL, press ENTER/HOLD and select ON/OFF/SET.

In SET press ENTER/HOLD and use ↑↓ to select Fun2, then press ENTER/HOLD and use ↑↓ to select display values to alternate.

In SET press ENTER/HOLD and use ↑↓ to select intvl, then press ENTER/HOLD and use ↑↓ to select from settings 1~30 for switching display interval time.

Description: This function allows the first display to alternately display two measurement values.

FUNC2: Select the second measurement value to display.

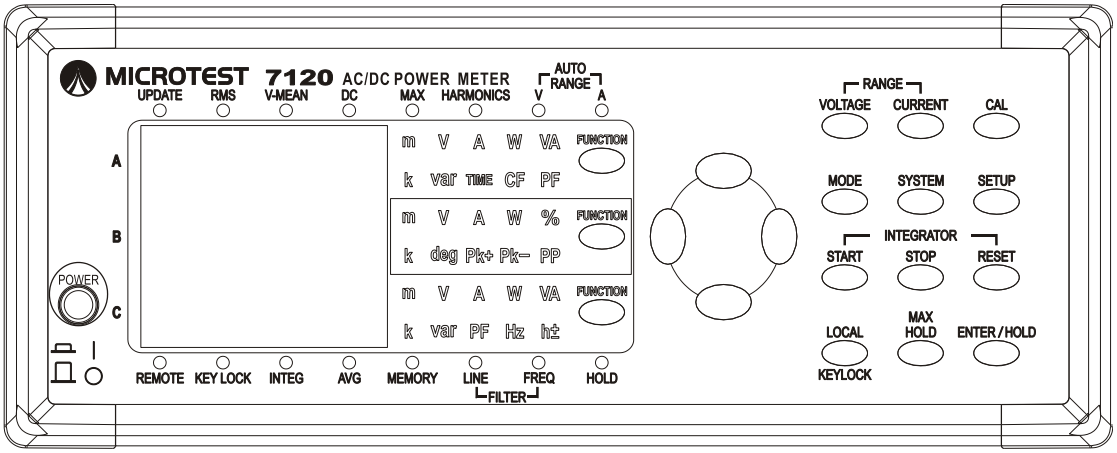
In RMS mode select either V, A, W, VA, VAR, Vcf, Acf or PF.

In HARM mode select either Order, V, A, W, or PF.

INTAL: Set the interval between the alternating displays - can choose between 1-30 seconds.

Section 4.10 Keyboard Lock

Keys:



Steps:

Set Keyboard Lock

Press KEY LOCK to immediately lock the keyboard.

Unlock Keyboard

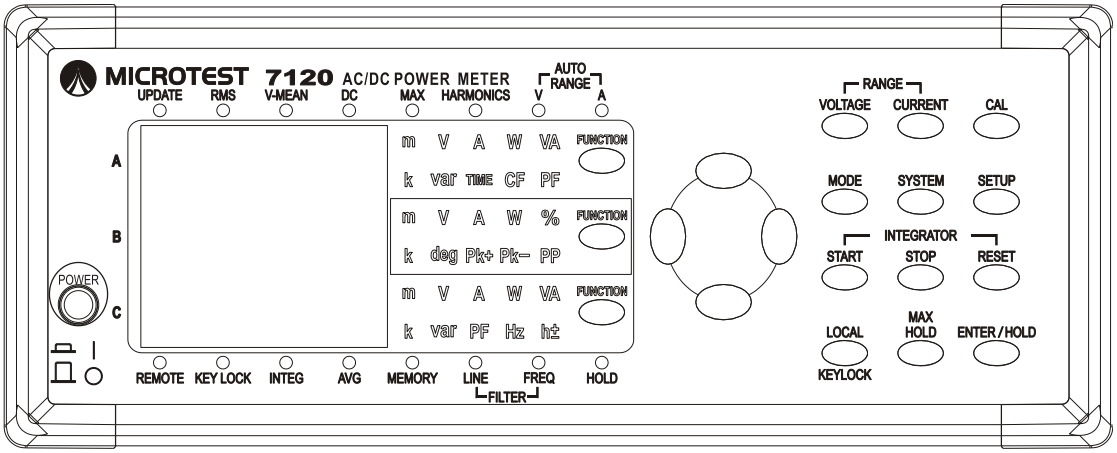
Press KEY LOCK again to immediately unlock the keyboard.

Description:

Locking the keyboard prevents all other keys from working, preventing erroneous setting adjustments. If a locked key is pressed Display A will flash a Lock message.

Section 4.11 Store/Load Panel Settings Configuration

Keys:



Steps:

Store and Delete

Press SYSTEM and use ↑↓ to select Store, then press ENTER/HOLD and use ← → to switch between the six storage slots, and then press ENTER/HOLD to save. The C Display will indicate a full slot with the letter F, press ↓ to delete the stored memory. The C display will show - to indicate an empty slot.

Load Settings

Press SYSTEM and use ↑↓ to select Recall, the use ← → to switch between the six storage slots. Press ENTER/HOLD to immediately read the panel settings.

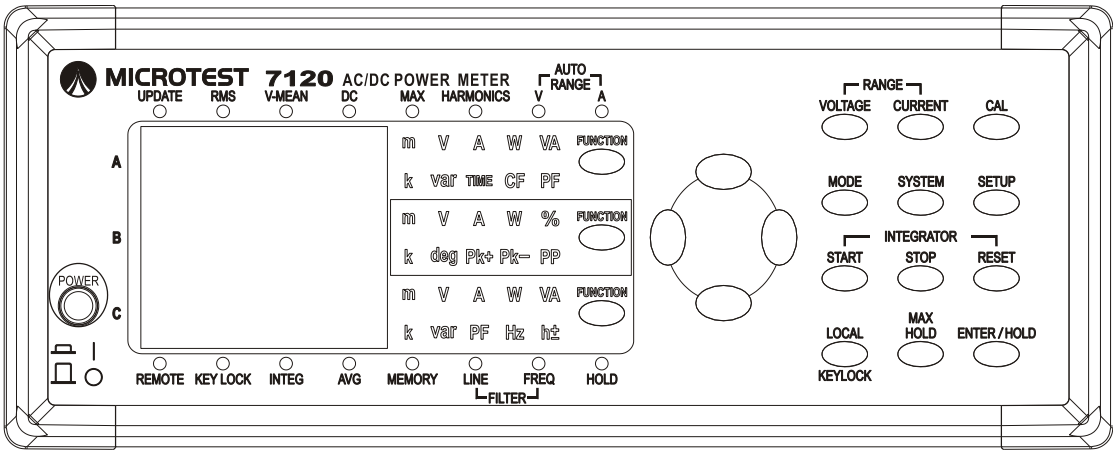
Description:

There are six storage slots to save panel settings. Current device settings can be saved. Used slots are indicated with an F on the display, and empty slots are indicated with a single line. Factory default settings leave all six slots empty.

STORE / RECALL: To save or load the current settings use the ← → to select a slot. FUNC A, B, and C will display the content of the currently selected file; press the down button to delete the file and the ENTER button to save the current settings in the slot/load the settings from the slot.

Section 4.12 Set GPIB Address

Keys:



Steps:

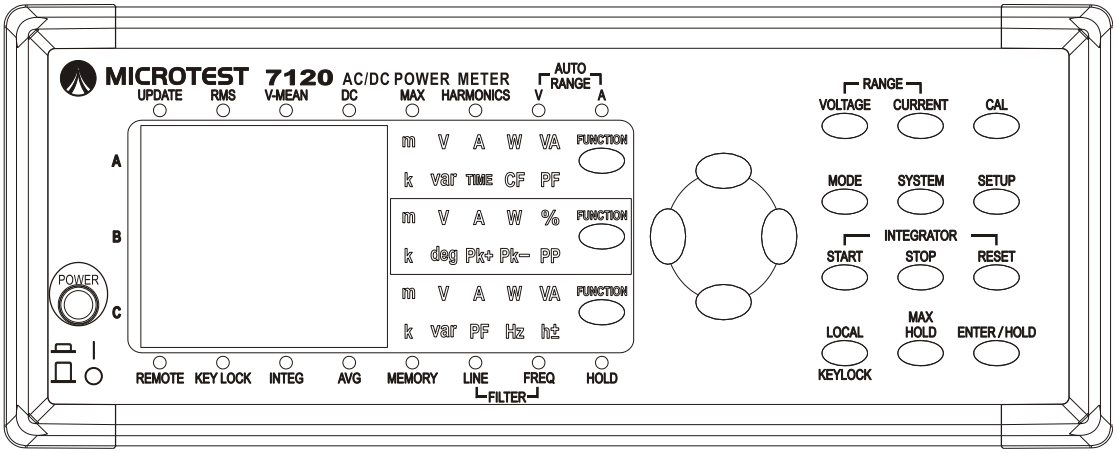
Press SYSTEM and use ↑↓ to select GPIB, then press ENTER/HOLD and use ↑↓ to toggle between GPIB Address 1~30, then press ENTER /HOLD to finish.

Description:

This function sets the GPIB address within a range of 1-30.

Section 4.13 Remote Control Mode

Keys:



Steps:

Setting a correct GPIB address or RS232 Baud rate will result in the Remote light being lit when a PC is successfully connected.

Exit Remote Control Mode

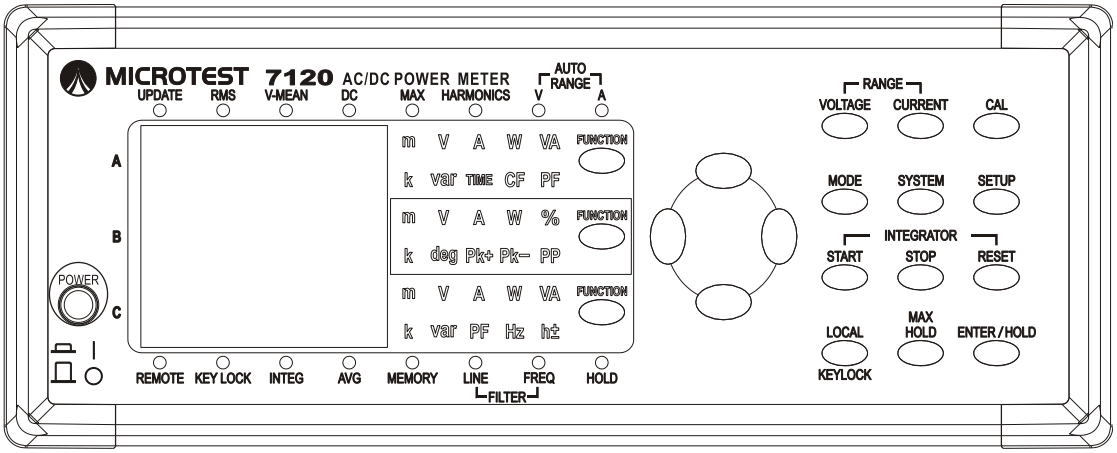
Press KEYLOCK to immediately exit remote control mode.

Description:

Users cannot use keys to control the device when the 7120 is being controlled remotely. Remote Control mode must be exited in order to manually control the device. The device will automatically enter this mode upon receipt of remote control commands.

Section 4.14 Set RS232 Baud rate and Final Character

Keys:



Steps:

Set Baud rate

Press SYSTEM and use ↑↓ to select RE-232, then press ENTER/HOLD and use ↑↓ to select b.rate. Press ENTER/HOLD and use ↑↓ to toggle between 9600 / 19200 / 38400 / 57600 /115200, then press ENTER/HOLD to complete 7120 Baud rate settings.

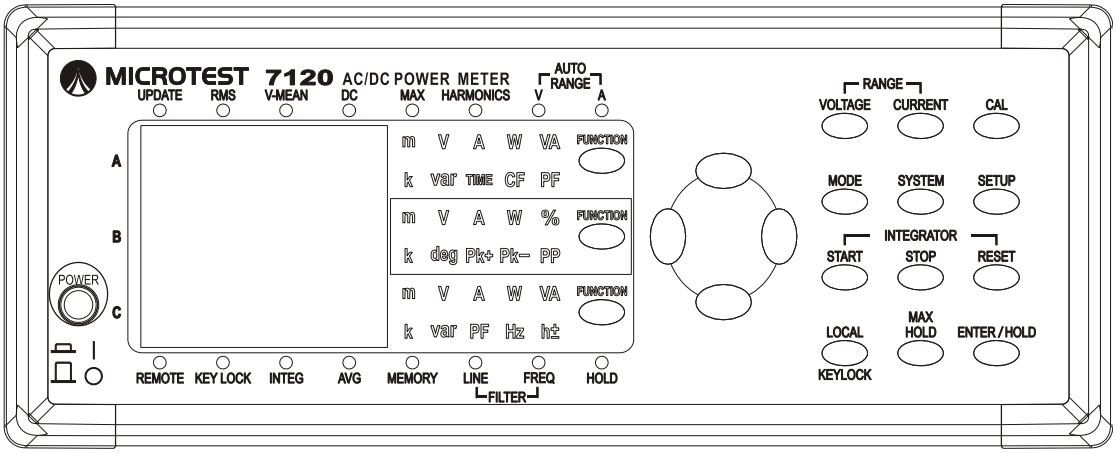
Press SYSTEM and use ↑↓ to select RE-232, then press ENTER/HOLD and use ↑↓ to select EoL 2. Press ENTER/HOLD and use ↑↓ to select Final Character CR(0xd) or LF(0xa).

Description:

When connecting to a PC using RS232 ensure that Baud rate settings are correct and set data 8-bit to have a starting bit and a final character with LF as the final character.

Section 4.15 The SCALE Function

Keys:



Steps:

Set Scale Amplification Parameters

Press SETUP and ↑↓ select SCALE, press ENTER/HOLD and toggle to Data, then press ENTER/HOLD to enter Amplification Settings.

A Display shows P 1.000, use ←→ to select the digits and use ↑↓ to adjust the value by decimals. Press ENTER/HOLD once set to enter C Settings.

B Display shows C 1.000; follow instructions for A Display then press ENTER/HOLD once set to enter P Settings.

C Display shows F 1.000; follow instructions for B Display.

Set SCALE ON / OFF

Press SETUP and ↑↓ select SCALE, press ENTER/HOLD and toggle ON/OFF, then press ENTER/HOLD to finish settings.

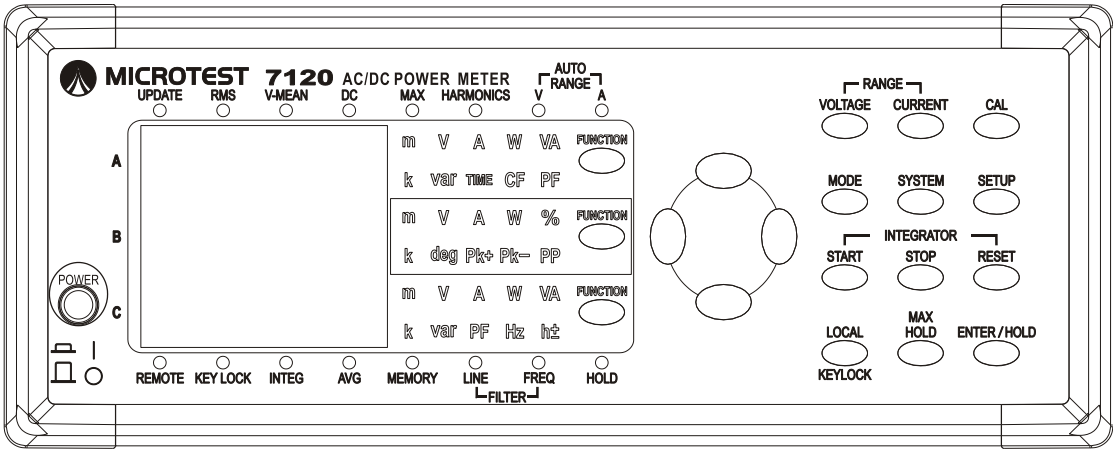
Description: This function is used with external potential transformers (P.T.), current transformers (C.T.) or shunts to convert numerical amplifications of measured voltage, current, power and other data. When this function is turned on all measured values will be amplified by the set amount and directly displayed on the screen.

Caution: When using P.T.s, C.T.s or shunts make sure that inputs into the 7120 voltage and current ports are within electrical specifications.

Measured Value	***Converted Result***
Voltage (V)	P (set scale value) * V
Current (A)	C (set scale value)* A
Active Power (W)	F (set scale value)* P * C * W
Variance (var)	F * P * C * var
Apparent Power (VA)	F * P * C * VA

Section 4.16 Use Power Integrator

Keys:



Steps:

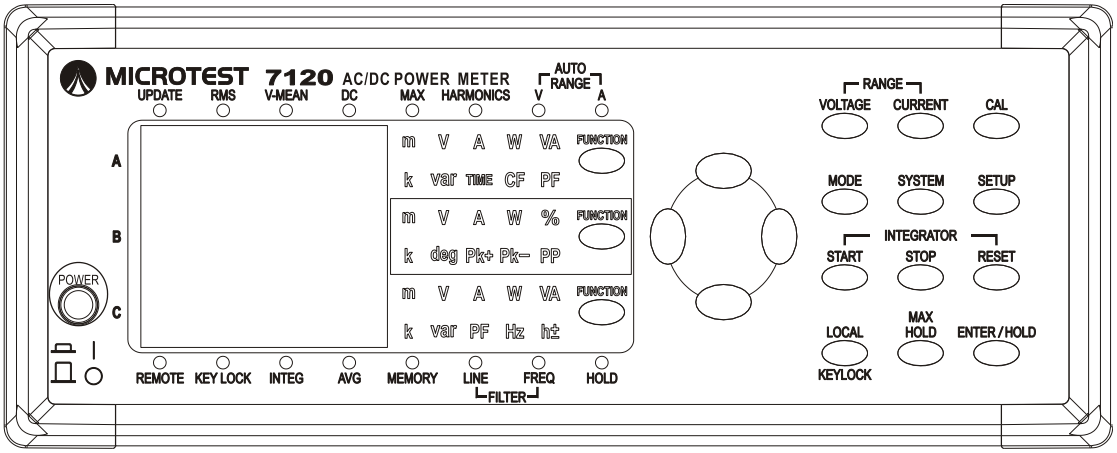
Press START to starting Integrator operation and use FUNCTION C to switch The display C to show W-H± or A-H± Reading.

Description:

This function is to calculate accumulated power use. Power and current consumption will begin to be counted until the user presses the STOP button. Counting time is set in 00.00.00 (HH.MM.SS). Pressing the Start Accumulating Power button when time parameters are greater than zero will turn this time into a countdown timer and settings will return to their original parameters once the countdown reaches zero. Pressing the Start Accumulating Power button when time parameters are zero will cause these parameters to count the length of accumulated time.

Section 4.17 Power Supply Frequency Parameters

Keys:



Steps:

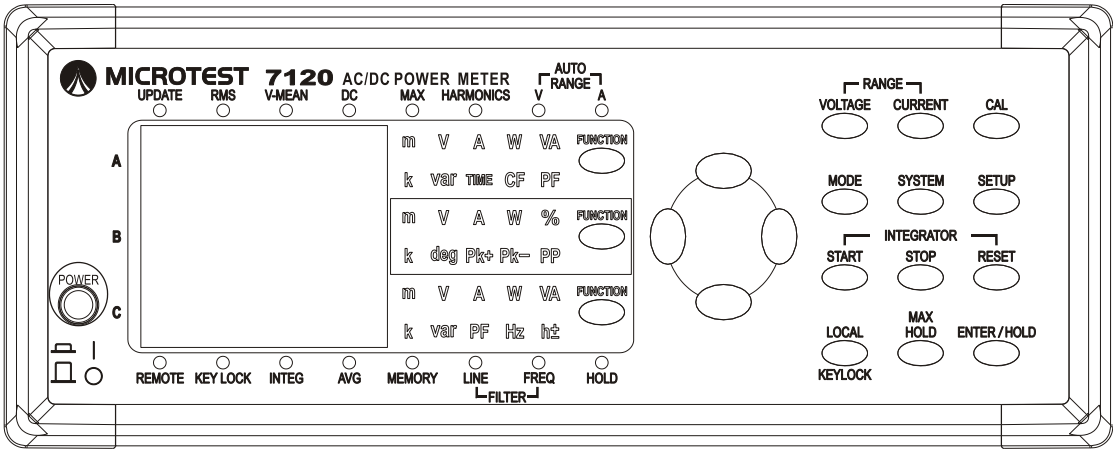
Press SYSTEM and use ↑↓ select ACLINE press ENTER to select 50Hz / 60 Hz press ENTER to complete setting.

Description:

This function can measure average values for AC power supply cycles in different regions (DC mode), increasing measurement value stability. Select between 50Hz and 60Hz; best results are obtained when the appropriate frequency is selected for your current power supply frequency.

Section 4.18 Calibrate to Zero

Keys:



Steps:

Press SYSTEM and use ↑↓ to select ZERO, then press ENTER/HOLD and use ↑↓ to select ON. Press ENTER/HOLD to start calibration to Zero.

Description:

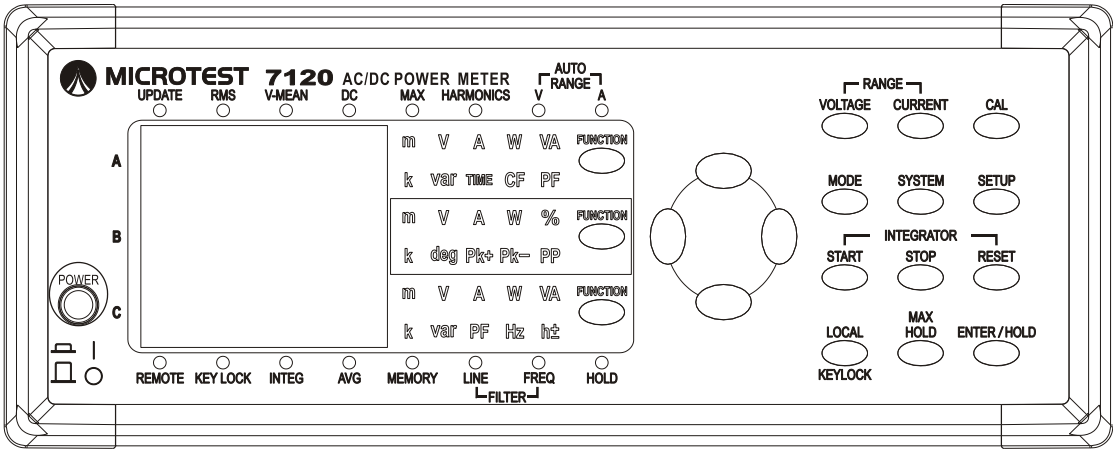
Zero calibration is carried out in the factory to ensure the precision of the device.

Devices are calibrated in the factory at 23°C ±1°C and RH 50%±10%. Users are advised to recalibrate the device to zero if the environment of use exceeds the factory environment by ±5°C in the interest of obtaining best results.

Before using this function, warm the machine up for 30 minutes and set voltage and current to Auto range. Remove all connections from the front and back panels and short terminals V+ and V- on the back panel before using this function. The device will automatically carry out a zero calibration once the command has been executed and the calibration will take approximately 10 seconds, after which the device will re-enter measurement mode.

Section 4.19 Software Version Look-up

Keys:



Steps:

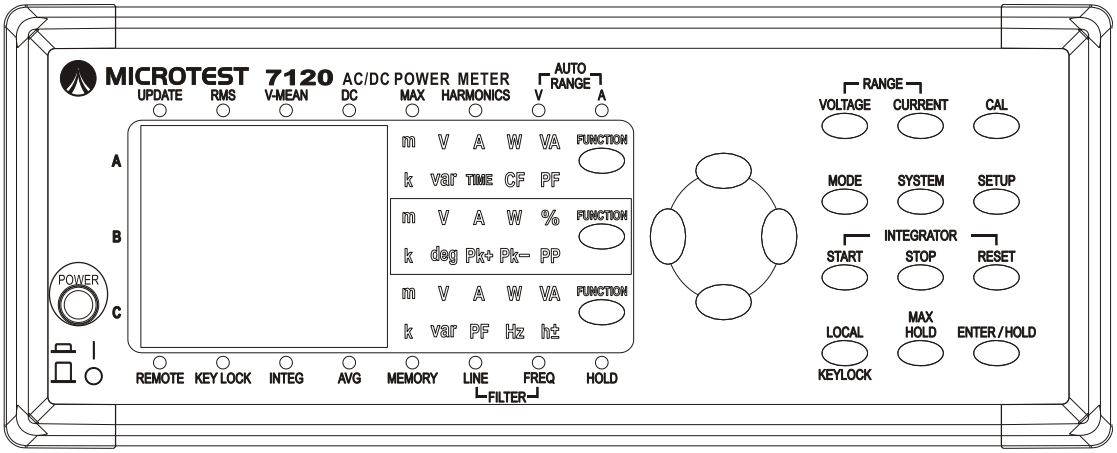
Press SYSTEM and use ↑↓ to select VER and check the Firmware version and date.

Description:

The Version screen displays the current version and date of the internal device program.

Section 4.20 Real time measure data storing

Keys:



Steps:

Save:

Open the SYSTEM menu and use ↑↓ to select MEMORY, then press RECORD and use ↑↓ to toggle to ON and begin data recording

Time Interval Settings (controls both play and recording intervals):

Open the SYSTEM menu and use ↑↓ to select MEMORY, then press RECORD and use ↑↓ to toggle to Intval. Press ENTER/HOLD and use ←→ to adjust the hours/minutes/seconds using the up/down arrows. Once the desired time has been set, press ENTER/HOLD to save your changes. If this time is set to 00:00:00 play and recording intervals will by synchronized to the Update rate.

Description:

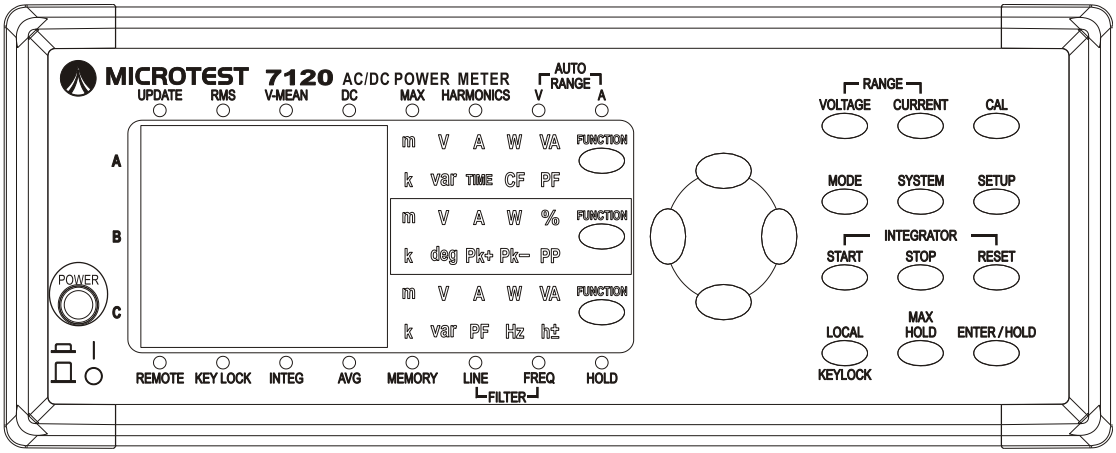
The 7120 Buind-in 1,000 space of flash memory for storing measurement data. Each unit of data records the AC/DC voltage, AC/DC current, voltage frequency, current frequency, power, voltage plus/minus peak values, current plus/minus peak values, voltage peak-to-peak, current peak-to-peak, power factor, voltage/current phase angle, voltage CF, current CF, apparent power, weakness, and total voltage harmonic distortion at the time of recording, and in harmonics mode also records 50 stages of voltage/current/wattage capacity and their distortion ratios.

This function is used in long-term power analyses. Range and detailed settings are recorded together with the recorded data and displayed together

during playback. No settings on the screen can be changed and the MEMORY light will flash during playback. The UPDATE light will stop flashing when playback concludes.

Section 4.21 Reso Settings

Keys:



Steps:

Press SYSTEM and use ↑↓ to select RESO, then press ENTER/HOLD and use ↑↓ to select HI/LO

Description:

This function can be used to switch between value decimals on the LED display. Detailed voltage and current display rules are outlined in the following two tables.

Current gear display rules for when RESO = LO, are given in the below table; add one decimal place when RESO = HI.				
	CF3		CF9	
	A	Unit	A	Unit
10mA	0.20-21.50	mA 2 decimal places	0.60-64.50	mA 2 decimal places
30mA	0.60-64.50	mA 2 decimal places	2.0-215.0	mA 1 decimal place
100mA	2.0-215.0	mA 1 decimal place	6.0-645.0	mA 1 decimal place
300mA	6.0-645.0	mA 1 decimal place	0.060-2.150	A 3 decimal places
1A	0.020-2.150	A 3 decimal places	0.060-6.450	A 3 decimal places
3A	0.060-6.450	A 3 decimal places	0.20-20.00	A 2 decimal places
10A	0.20-20.00	A 2 decimal places	0.40-20.00	A 2 decimal places
20A	0.40-20.00	A 2 decimal places	0.40-20.00	A 2 decimal places

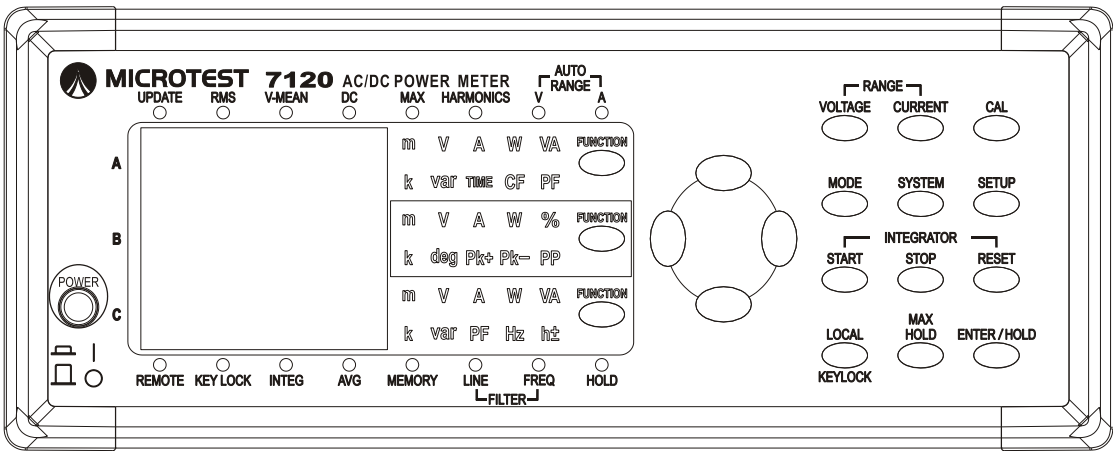
Voltage gear display rules for when RESO = LO, are given in the below table; add one decimal place when RESO = HI.		
	V	Unit
10V	0.10-16.00	V 2 decimal places
30V	0.30-48.00	V 2 decimal places
100V	1.0-160.0	V 1 decimal place
300V	3.0-480.0	V 1 decimal place
600V	6.0-800.0	V 1 decimal place

CF3 Wattage gear display rules for when RESO = LO, are given in the below table; add one decimal place when RESO = HI.					
	CF3				
	10V	30V	100V	300V	600V
10mA	000.0mW	0.000W	0.000W	00.00W	00.00W
30mA	0.000W	0.000W	00.00W	00.00W	00.00W
100mA	0.000W	00.00W	00.00W	000.0W	000.0W
300mA	00.00W	00.00W	000.0W	000.0W	000.0W
1A	00.00W	000.0W	000.0W	0.000KW	0.000KW
3A	000.0W	000.0W	0.000KW	0.000KW	0.000KW
10A	000.0W	0.000KW	0.000KW	0.00KW	00.00KW
20A	000.0W	0.000KW	0.000KW	0.00KW	00.00KW

CF9 Wattage gear display rules for when RESO = LO, are given in the below table; add one decimal place when RESO = HI.					
	CF9				
	10V	30V	100V	300V	600V
10mA	0.000W	0.000W	00.00W	00.00W	00.00W
30mA	0.000W	00.00W	00.00W	000.0W	000.0W
100mA	00.00W	00.00W	000.0W	000.0W	000.0W
300mA	00.00W	000.0W	000.0W	0.000KW	0.000KW
1A	000.0W	000.0W	0.000KW	0.000KW	0.000KW
3A	000.0W	0.000KW	0.000KW	00.00KW	00.00KW
10A	000.0W	0.000KW	0.000KW	00.00KW	00.00KW
20A	000.0W	0.000KW	0.000KW	00.00KW	00.00KW

Section 4.22 Gauge Head Power Consumption Deductions

Keys:



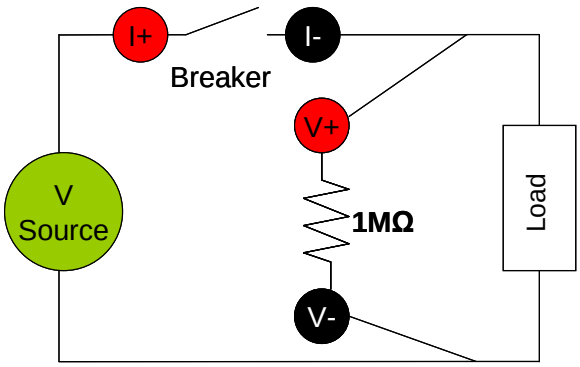
Steps:

In SYSTEM use ↑↓ to select M_CMP and then select ON or OFF

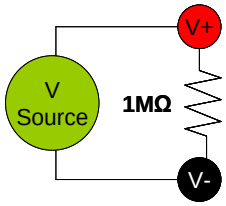
Description:

This function deducts internal micro-consumption from the voltmeter. E.G. 220V AC 60Hz with a F71201 Test Box using voltage set to I will measure a wattage of 0.048W (gauge head consumption). With MCP ON a deduction of $VRMS^2$ / 1M will be made for the voltmeter internal resister and the panel reading will show a consumption of almost 0W. When connected to an external Calibrator this function set M_CMP to OFF, as the voltage and current of the calibrator are independent. This function should also be off if the voltmeter is bridged in before the ammeter.

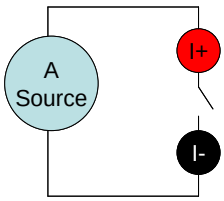
Fast Connection Measuring Wiring



Independent Voltmeter Wiring



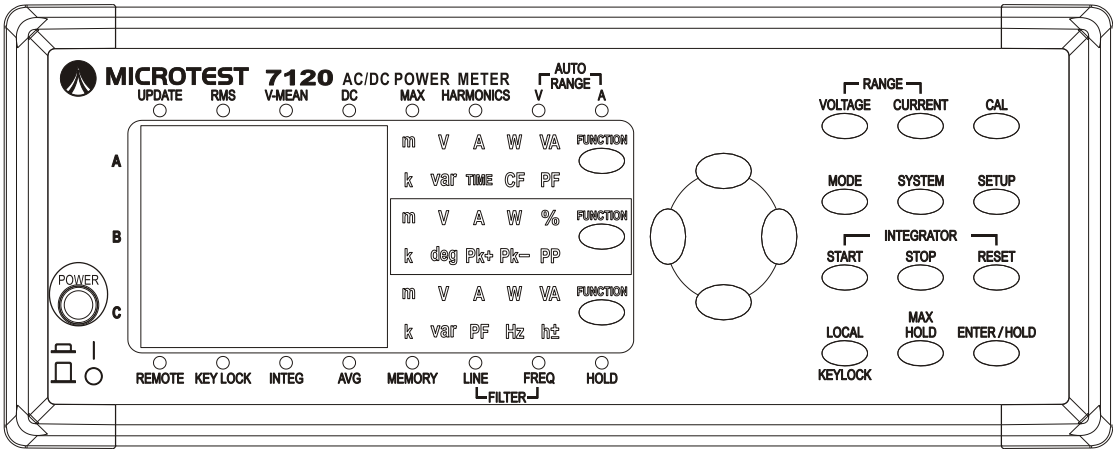
Independent Ammeter Wiring



Chapter 5 Display Measurement Values

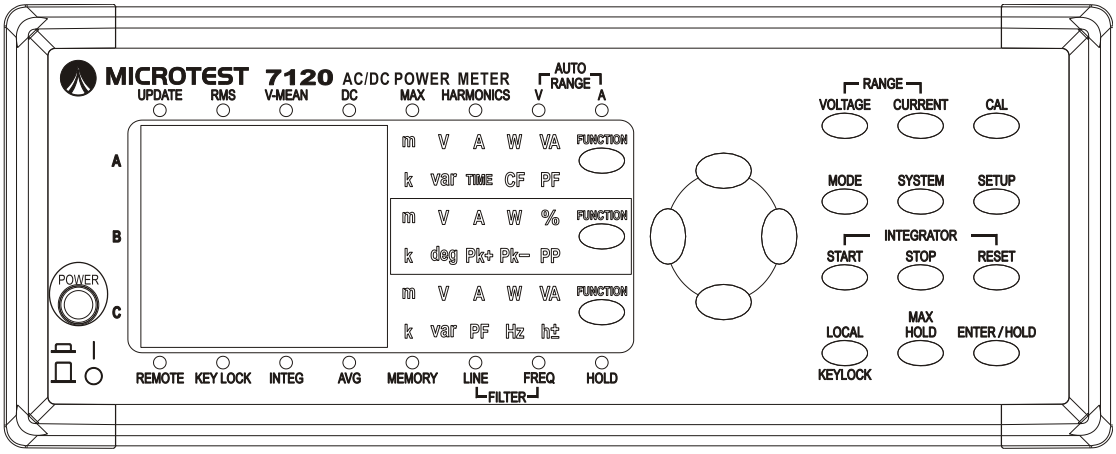
Section 5.1 Panel Description

Indicator LEDs are used in the panel description to indicate the current settings and measurement functions - e.g. Rms indicates that the device is currently set to measure RMS.



[1] Status Lights:

1. UPATE: indicates sampling (flash speed is the update rate).
2. RMS: Measure AC mode.
3. VOLT MEAN: Measure average voltage mode.
4. MAX HOLD: Maintain maximum value function.
5. HARMONICS: Measure harmonics mode.
6. V AUTO RANGE: Voltage range are automatically set.
7. A AUTO RANGE: Current range are automatically set.
8. REMOTE: Remote control mode
9. KEY LOCK: keyboard is locked.
10. INTEG: Power Accumulation Mode.
11. AVG: Set average value function activated.
12. MEMORY: Data recording/playback indicator light (flashes with UPDATE light when saving).
13. L-FILTER: Line filter function activated.
14. F-FILTER: Frequency filter function activated.
15. HOLD: Panel data update temporarily on hold.



[2]. POWER: Power Supply: Press I to switch on and O to switch off.

[3]. DISPLAY_A Measurement Value Display Area.

[4]. DISPLAY_A Measurement Item Display Area.

V: Displays voltage.

A: Displays amperage.

W: Displays wattage.

VA: Displays Apparent Power.

var: Displays Variance.

ET: Displays accumulated time.

V_CF: Displays voltage waveform factor.

A_CF: Displays current waveform factor.

PF: Displays power factor.

[5]. DISPLAY_B Measurement Value Display Area.

[6]. DISPLAY_B Measurement Item Display Area.

V: Displays voltage.

A: Displays amperage.

W: Displays wattage.

V_%: Displays voltage harmonic distortion (7-segment display t = 50 stage total harmonic distortion).

A_%: Displays current harmonic distortion (7- segment display t = 50 stage total harmonic distortion).

W_%: Displays Power/Harmonic Distortion

Deg: Displays phase angle.

V-Deg In Harmonics mode, displays 1-50 stages of voltage phase angles V-Deg Definition: First stage is phase difference between voltage and current, stages 2-50 are phase difference between stage one voltage and stage 2-50 voltage.

A-Deg In Harmonics mode, displays voltage phase angle A-Deg Definition: First stage is phase difference between voltage and current, stages 2-50 are phase difference between stage one current and stage 2-50 current.

V_PK^+: Displays voltage positive peak.

A_PK^+: Displays current positive peak.

V_PK^-: Displays voltage negative peak.

A_PK^-: Displays current negative peak.

V_PP: Displays voltage peak-to-peak.

A_PP: Displays current peak-to-peak.

[7]. DISPLAY_C Measurement Value Display Area.

[8]. DISPLAY_C Measurement Item Display Area.

V: Displays voltage.

A: Displays amperage.

W: Displays wattage.

VA: Displays Apparent Power.

var: Displays Variance.

PF: Displays power factor.

V_Hz: Displays voltage frequency.

A_H: Displays ampere/hour.

W_H: Displays wattage/hour.

VA_H: Displays Apparent Power/hour.

var_H: Displays variance/hour.

Vpk: Displays peak voltage. Display light V lights up, a P is shown at the left-most side of the display area.

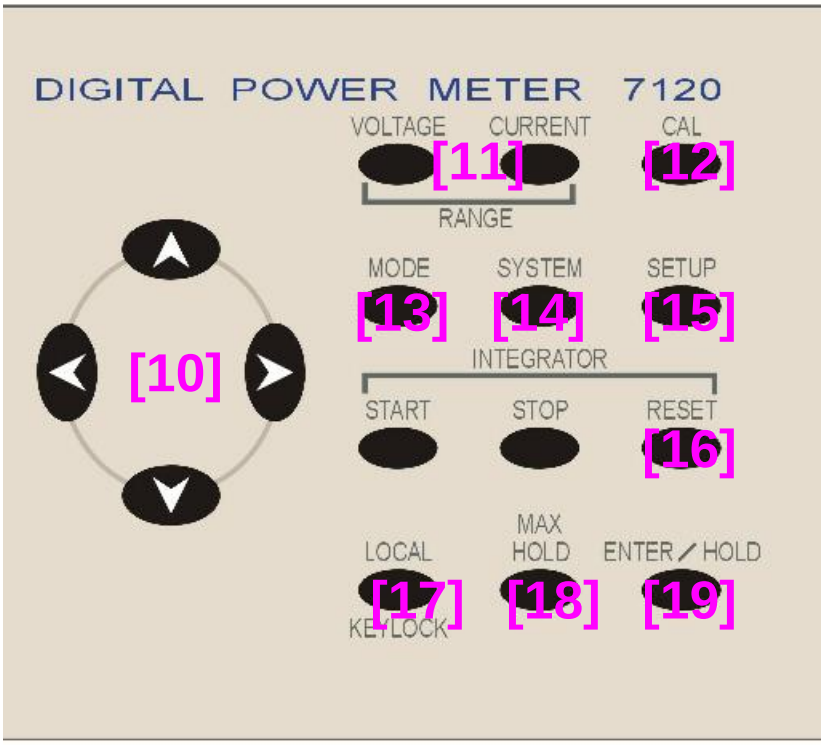
Apk: Displays current voltage. Display light A lights up, a P is shown at the left-most side of the display area.

[9]. Window Display Item Settings Key:

FuncA: Set DISPLAY_A display items.

FuncB: Set DISPLAY_B display items.

FuncC: Set DISPLAY_C display items.



[10]. Up, down, left, right settings operating key.

[11]. Gear settings shortcut key.

[12]. Calibrate keys.

[13]. Measurement mode selection key.

[14]. System function settings key.

[15]. Gear, average value, update rate settings key.

[16]. Accumulated settings key:

Start/Stop: Start or stop accumulation.

Reset: Press this button to clear all accumulated values (AH, WH, VAH, varH).

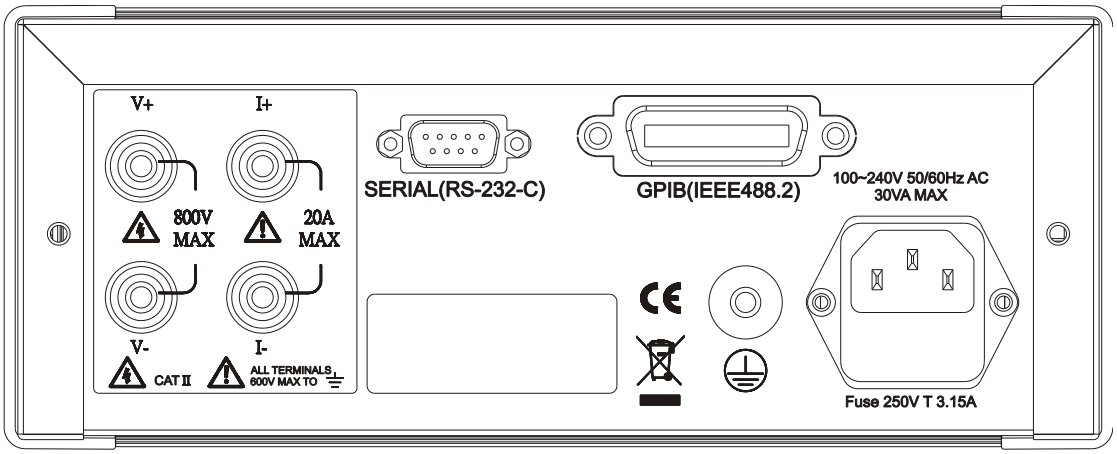
[17]. Unlock keyboard/remote control mode settings key.

[18]. MAX.HOLD mode shortcut key: Turn on this mode to only retain maximum values, press again to return to normal measuring mode.

[19]. Input/Hold Key: During settings mode this key is an input key; in measurement mode, this key retains data and pressing this key will hold all currently measured data and prevent updates from occurring. The window display settings key can also be pressed to switch between item values to display.

[20]. Device power supply socket.

[21]. Testing item object input.



[22]. GPIB Interface socket.

[23]. RS-232 interface socket.

Section 5.2 Measurement Items:

V: Displays voltage.

A: Displays amperage.

W: Displays wattage.

VA: Displays Apparent Power.

var: Displays Variance (inactive power).

TIME: Displays accumulated time.

Pk+: Displays positive peak.

Pk-: Displays negative peak.

PP: Displays peak-to-peak.

CF: Displays waveform factor.

PF: Displays power factor.

Hz: A-HZ and VHZ display function.

Deg: Displays phase angle.

h: Displays power/hour.

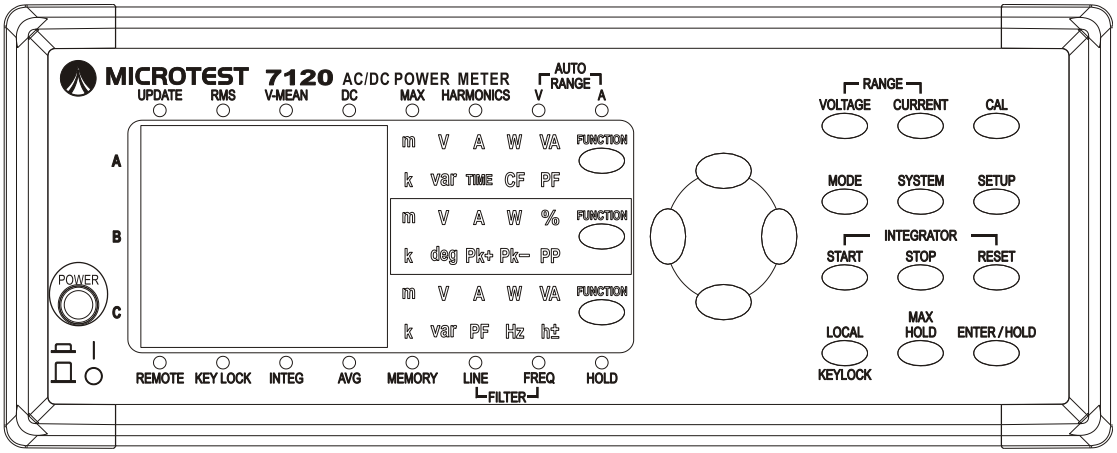
%: Displays total harmonic distortion (THD).

Vpk: Displays peak voltage.

Apk: Displays current voltage.

Section 5.3 Display A Measurement Display Area

Keys and Display Lights:



Description:

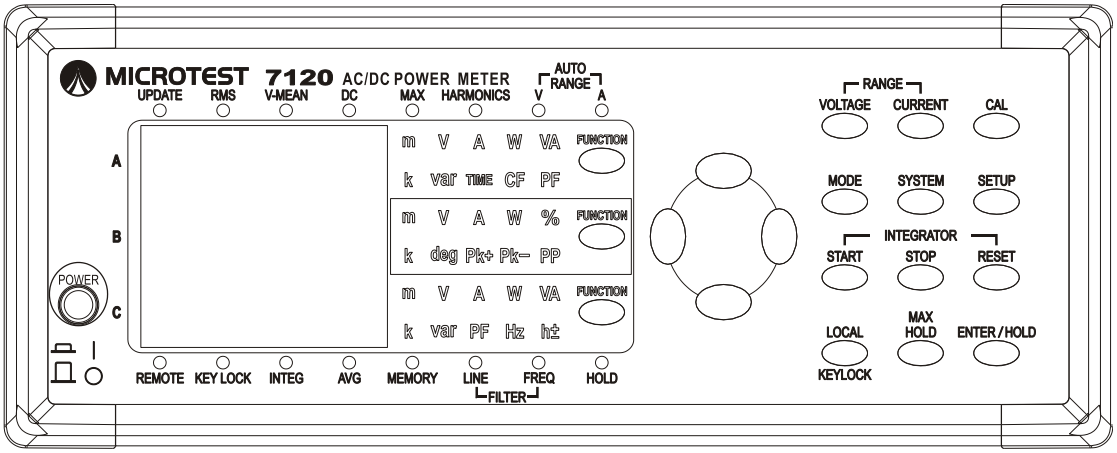
1. In Rms and Volt Mean modes press FunctionA key - the toggle order of functions in Window A is below.
   V → A → W → VA → var → TIME → V_CF → A_CF → PF → V (Default)

2. In Harmonic mode press FunctionA key - the toggle order of functions in Window A is below.
   V → A → W → or. Number (Default)

3. m & k are unit scientific notation lights; m = 10^{-3} and k = 10^{+3}.

Section 5.4 Display B Measurement Display Area

Keys and Display Lights:



Description:

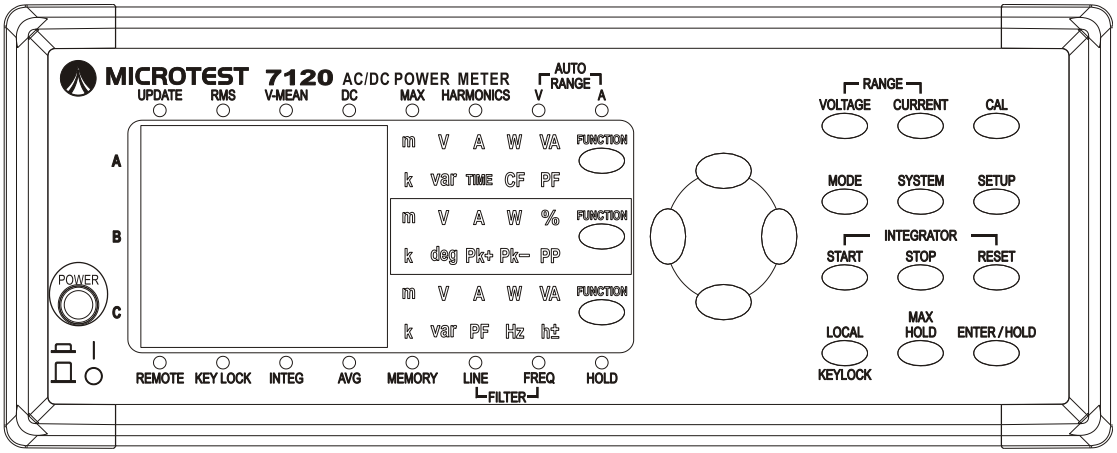
1. In Rms, Volt Mean and DC modes press FunctionB key - the toggle order of functions in Window B is below.
   A → W → Deg → V_Pk+ → A_Pk- → V_Pk+ → A_Pk-→ V_PP →A_PP → V → A(Default)

2. In Harmonic mode press FunctionB key - the toggle order of functions in Window B is below.
   V-t (default)% → A-t% → W% → V-deg → A-deg → V→ A →W → V-t (default)%,
   t = total mode, in this mode pressing the left and right keys allows you to toggle between total mode (t) and single-stage mode.

3. m & k are unit scientific notation lights; m = 10^{-3} and k = 10^{+3}.

Section 5.5 Display C Measurement Display Area

Keys and Display Lights:



Description:

1. In Rms, Volt Mean and DC modes press FuncC key - the toggle order of functions in Window C is below.
   W → VA → var → PF → Hz → A_H → W_H → VA_H → var_H →Vpk→Apk →V →A →W (Default)

2. In Harmonic mode press FuncC key - the toggle order of functions in Window C is below.
   VHz → AHz →V → A → W →VHz (Default)

3. m & k are unit scientific notation lights; m = 10 -3 and k = 10 +3.

Note:

Vpk: Displays peak voltage. Display light V lights up, a P is shown at the left-most side of the display area.

Apk: Displays peak voltage. Display light A lights up, a P is shown at the left-most side of the display area.

Chapter 6 Electrical Features Specifications

Basic measurement mode specifications	
Measurement Foundation	Obtain a stable base frequency (less than 1% variation) from voltage or current (non-variable) and begin taking measurements.
Frequency Range	15HZ ~ 100KHz
Data Length	dual 4096x16 RAM for voltage & current
ADC Data Format	16 bits
Sampling Rate	Max 200KSPS/Basic 100KSPS/120KSPS (50Hz/60Hz)
Operation Precision	IEEE-754 32bits
Frequency Filter	500HZ cut off, 25MHZ digital chip filter
Line Filter	500Hz -3db, Butterworth digital filter
Filter Sampling Method	Voltage/Current 25MHZ base frequency digital dynamic counter chip
Phase Leader Detection	Based off the current, analog/digital mixed sensing (margin of error within 5 degrees)

Zero Level Specifications (CF3)					
Voltage			Current		
	AC(Noise)	DC(Offset)		AC(Noise)	DC(Offset)
10V	<0.045V	±0.01V	0.01A	<0.00005A	±0.00003A
30V	<0.045V	±0.03V	0.03A	<0.00007	±0.00003A
100V	<0.1V	±0.1V	0.1A	<0.0002A	±0.00004A
300V	<0.3V	±0.3V	0.3A	<0.0002A	±0.0003A
600V	<0.6V	±0.6V	1A	<0.008A	±0.003A
			3A	<0.008A	±0.005A
			10A	<0.02A	±0.01A
			20A	<0.02A	±0.02A

Accessory Specification Conditions:

a. Environmental temperature variance 30 minutes after switching the device on is within 5 degrees of 23°C.
b. Voltage offset to short circuit V+ V- with a 5cm short wire.
c. Current offset obtained with I+ I- idle contact.
d. AC Voltage/AC Current obtained with L-Filter on.

CAT II level specifications (50H, 60Hz)					
	Voltage (Red)	Voltage (Black)	Current (Red)	Current (Black)	Case – Earthed
Voltage (Red)	---	800V RMS	600V RMS	600V RMS	600V RMS
Voltage (Black)	800V RMS	---	600V RMS	600V RMS	600V RMS
Current (Red)	600V RMS	600V RMS	---		600V RMS
Current (Black)	600V RMS	600V RMS		---	600V RMS
Case - Earthed	600V RMS	600V RMS	600V RMS	600V RMS	---

Environment of Use Requirements:

- Electrical Item Specifications Scope of Warranty Temperature Within Scope: 23±5°C
- Humidity: 30 to 75%RH.
- Power Factor: 1
- Input signal: sine wave
- With scaling off
- Only use indoors after a 30 minute warm-up
- New devices un-package must be zero calibration before initial use.
- Calibration with a Fluke 5522A guarantees precision for 6 months.

Voltage (V)	
Ranges (Auto or Manual) (5 ranges)	
10V, 30V, 100V, 300V, 600V	
Operating Principle	True RMS or mean value rectification
Frequency Range	DC and 15Hz to 100KHz
AC Accuracy (23°C±5°C Environmental)	
15 Hz≦f<45 Hz	±(0.1% of reading + 0.4% of range)
45 Hz≦f≦66 Hz	±(0.1% of reading + 0.1 % of range)
66 Hz<f≦1 kHz	±(0.1% of reading + 0.2 % of range)
1 kHz<f≦10 kHz	±(0.07*f % of reading + 0.3 % of range) f Unit K
10 kHz<f≦100 kHz	±(0.5 % of reading + 0.5 % of range) ±[{0.04×(f–10)}% of reading]
Accessory Margin of Error Tolerance Conditions	
Line Filter Tolerance:	Frequencies between 45 to 66 Hz: Add 0.2% of reading. Frequencies less than 45 Hz: Add 0.5% of reading
Temperature Tolerance Effect:	Add ±0.03% of reading/°C in the range 5 to 18°C or 28°C to 40°C
Margin of Error within 12 Months:	Add ±(0.5% of reading)
DC Accuracy (23°C±5°C Environmental)	
10V	{±0.2% reading ± 0.2% of range}
30V	{±0.2% reading ± 0.2% of range}
100V	{±0.2% reading ± 0.2% of range}
300V	{±0.2% reading ± 0.2% of range}
600V	{±0.2% reading ± 0.2% of range}
Maximum Input	800V RMS/1000Vpk
Input impedance	1M ohm on all ranges

Current (A)	
Ranges (Auto or Manual) (8 ranges)	0.01A, 0.03A, 0.1A, 0.3A, 1A, 3A, 10A, 20A
Operating Principle	True RMS or mean value rectification
Frequency Range	DC and 15Hz to 100KHz
AC Accuracy (23°C±5°C Environmental)	
15 Hz≦f<45 Hz	±(0.1% of reading + 0.4% of range)
45 Hz≦f≦66 Hz	±(0.1% of reading + 0.1 % of range)
66 Hz<f≦1 kHz	±(0.1% of reading + 0.2 % of range)
1 kHz<f≦10 kHz	±((0.07 × f)% of reading + 0.3 % of range)
10 kHz<f≦100 kHz	±(0.5 % of reading + 0.5% of range) ±[{0.04×(f–10)}% of reading]
AC Accessory Margin of Error Tolerance Conditions	
Line Filter Tolerance:	Frequencies between 45 to 66 Hz: Add ± 0.2% of reading. Frequencies less than 45 Hz: Add ± 0.5% of reading
CF 9 Margin of Error	Add ± 0.3% of range
Temperature Effects (AC)	Add ±0.03% of reading/°C in the range 5 to 18°C or 28°C to 40°C
DC Accuracy (23°C±5°C Environmental)	
0.01A	±{(0.2)% of reading + 0.5 % of range}
0.03A	±{(0.2)% of reading + 0.5 % of range}
0.1A	±{(0.2)% of reading + 0.5 % of range}
0.3A	±{(0.2)% of reading + 0.5 % of range}
1.0A	±{(0.2)% of reading + 0.5 % of range}
3A	±{(0.2)% of reading + 0.5 % of range}
10A	±{(0.2)% of reading + 0.5 % of range}
20A	±{(0.2)% of reading + 0.5 % of range}
Input impedance	0.0025 ohm For 1A ~ 20A Range(CF3) 0.25 ohm For 0.01A~0.3A(CF3) +10m ohm(wire) on all ranges
DC Accessory Margin of Error Tolerance Conditions	
Error within 12 Months:	Add ±(0.5% of reading)
* Caution: While measuring keep the device in a well-ventilated area. For best results never use in a closed environment.	

<table>
<tr><th colspan="2">Power (W)</th></tr>
<tr><td colspan="2">AC power ranges (Auto or Manual)(40 ranges) range up to 16KW
Max Power (W) value determined by max voltage gear.</td></tr>
<tr><td colspan="2">AC Accuracy</td></tr>
<tr><td colspan="2">15 Hz≦f<45 Hz ±(0.3% of reading + 0.2% of range)
45 Hz≦f≦66 Hz ±(0.1% of reading + 0.1 % of range)
66 Hz<f≦1 kHz ±(0.2% of reading + 0.2 % of range)
1 kHz<f≦10 kHz ±(0.4% of reading + 0.3 % of range)± [{0.06×(f)}% of reading]
10 kHz<f≦100 kHz ±(0.5 % of reading + 0.5 % of range)±[{0.09×(f–10)}% of reading]</td></tr>
<tr><td colspan="2">Environmental Temperature (23°C±5°C)</td></tr>
<tr><td colspan="2">DC ±0.2% reading ± 0.5% of range</td></tr>
<tr><td colspan="2">Accessory Margin of Error Tolerance Conditions</td></tr>
<tr><td>Line Filter Margin of Error (AC)</td><td>Frequencies between 45 to 66 Hz: Add 0.3% of reading.
Frequencies less than 45 to 66 Hz: outside of range, add 1% of reading</td></tr>
<tr><td>CF9 Margin of Error (DC)</td><td>Add range tolerance * 3</td></tr>
<tr><td colspan="2">Phase Margin of Error may affect power precision.</td></tr>
<tr><td colspan="2">When power factor (PF) = 0, Watt margin of error range is:
Situation 1: for 45 Hz<f<66 Hz. Add ± 1.0% of VA
Situation 2: for 45 Hz>f or f >66 Hz.
Add ±{(3.5 + 0.5 × f)% of VA} for up to 100 kHz as reference data.
The unit for frequency f is kHz.
When Power Factor 0 < PF ≦ Margin of Error Range.
When 0<PF≦1 (θ: phase angle of the voltage and current)
for 45 Hz≦f≦66 Hz. Add ± power reading *{tan(θ)*(0.5)}%
for f < 45 Hz, f >66 Hz. Add ± power reading *{ tan θ* (0.5×f+0.2) }%</td></tr>
<tr><td>Margin of Error within 12 Months:</td><td>Add ±(0.5% of reading)</td></tr>
</table>

DC power ranges (Auto or Manual)(40 ranges) Range 0.001W to 16KW Max Power (W) value determined by max voltage gear.				
Voltage Gear	Current Gear	CF3 Range	CF9 Range	Resolution
10V	0.01~20A	0W~200W	0W~200W	0.001W
30V	0.01~20A	0W~600W	0W~600W	0.001W
100V	0.01~20A	0W~2000W	0W~2000W	0.001W/1W(K)
300V	0.01~20A	0W~6000W	0W~6000W	0.001W/1W(K)
600V	0.01~20A	0W~12KW	0W~12KW	0.01W/1W(K)

Power range with CF 3 setting								
Voltage Range	0.01A	0.03A	0.1A	0.3A	1A	3A	10A	20A
10V	0.1W	0.3W	1W	3W	10W	30W	100W	200W
30V	0.3W	0.9W	3W	9W	30W	90W	300W	600W
100V	1W	3W	10W	30W	100W	300W	1KW	2KW
300V	3W	9W	30W	90W	300W	900W	3KW	6KW
600V	6W	18W	60W	180W	600W	1.8KW	6KW	12KW

Power range with CF 9 setting								
Voltage Range	0.01A	0.03A	0.1A	0.3A	1A	3A	10A	20A
10V	0.3W	1W	3W	10W	30W	100W	200W	200W
30V	0.9W	3W	9W	30W	90W	300W	600W	600W
100V	3W	10W	30W	100W	300W	1KW	2KW	2KW
300V	9W	30W	90W	300W	900W	3KW	6KW	6KW
600V	18W	60W	180W	600W	1.8KW	6KW	12KW	12KW

Total Harmonic Distortion (THD)	
Frequency Range, Fundamental (Automatic Tuned)	40Hz ~ 440Hz
Measuring Input	Voltage or Current

Frequency (Hz)	
Operating Principle	Digital frequency detector
Accuracy (23°C±5°C Environmental)	±0.5% reading
Measuring Input	Voltage or Current

Peak Voltage (Vpkp, Vpkn, Vpp)	
Ranges (Auto or Manual) (5 Range)	10V(16V), 30V(48V), 100V(160V), 300V(480V), 600V(800V)
Frequency Range	15Hz to 100kHz
Accuracy (23°C±5°C Environmental)	±3% reading ±3% range ±(0.01*F kHz)%

Peak Current(Ipkp, Ipkn, Ipp)	
Ranges (Auto or Manual) (8 Range)	0.01A(0.0215), 0.03A(0.0645), 0.1A(0.215), 0.3A(0.645), 1A(2.15A), 3A(6.45A), 10A(21.5A), 20A(50A peak)
Frequency Range	15Hz to 100kHz
Accuracy (23°C±5°C Environmental)	±3% reading ±3% range ±(0.2*F kHz)%

Crest Factor (CF)	
Computation	Peak/RMS
Current input	CF3(1~3.0) / CF 9.0(1~9)
Voltage Input	CF 2.2 (1~2.2)

Inrush Current	
Ranges (Manual) (8 Range)	60mApk to 66 Apk (20A)
Accuracy (23°C±5°C Environmental)	±5% of selected range

Power Factor (PF)	
Ranges	0.0000 to ±1.0000
Computation	W / (VA)
Accuracy (23°C±5°C Environmental)	

Phase Angle (DEG)	
Ranges	0.00 to ±180.00
Computation	DEG = ACOS(PF) with lead/lag detection.

Apparent Power (VA)	
Ranges	V A Range
Computation	VrmsXArms
Accuracy (23°C±5°C Environmental)	When power factor (PF) = 0(VA: apparent power) • Add ±0.2% of VA for 45 Hz<f<66 Hz. • Add ±{(0.2 + 0.2×f)% of VA} for up to 100 kHz as reference data. The unit for frequency f is kHz.

Reactive Power (var)	
Ranges	V A Range
Computation	$\sqrt{((VXA)^2 - W^2)}$
Accuracy (23°C±5°C Environmental)	VA accuracy * PF accuracy

Frequency Precision & Frequency Sensitivity	
	Frequency Range
Range	15HZ ~ 100KHZ
Accuracy	Precision 0.5% of reading (standard sin wave signal requires 30%)
Sensitivity	Conditions: 1. Voltage signal must be 30% of voltage gear 2. Current signal must be 30% of current gear
Description	Precision is maintained by the sine wave. Different testing items have different current gear settings and have different reference frequencies for measuring e.g. variable/high-frequency/oscillating/loading

Minimum Measuring Signal Frequency Range at Different Update Rates	
Update Time (sec)	Frequency Range
0.1	25HZ ~ 100KHZ
0.25	10HZ ~ 100KHZ
0.5	5HZ ~ 100KHZ
1	2.5HZ ~ 100KHZ
2	1.5HZ ~ 100KHZ
5	0.5HZ ~ 100KHZ
Description: Measuring range is 15Hz-100KH (update time set to 0.25s); at 0.1 seconds, precision of any values measured below the measuring range cannot be guaranteed.	

DC Gear Measurement Specifications					
	MIN	MAX		MIN CF3 / 9	MAX CF3 / 9
10V	1%	210%	0.01A	2% / 6%	260% / 780%
30V	1%	210%	0.03A	2% / 6%	260% / 780%
100V	1%	210%	0.1A	2% / 6%	260% / 780%
300V	1%	210%	0.3A	2% / 6%	260% / 780%
600V	1%	133%	1A	2% / 6%	260% / 780%
			3A	2% / 6%	260% / 666%
			10A	2% / 6%	200%
			20A	2% / 6%	100%
Accessory Specification Conditions:					

AC Gear Measurement Specifications					
	MIN	MAX		MIN CF3 / 9	MAX CF3 / 9
10V	1%	160%	0.01A	2% / 6%	215% / 645%
30V	1%	160%	0.03A	2% / 6%	215% / 645%
100V	1%	160%	0.1A	2% / 6%	215% / 645%
300V	1%	160%	0.3A	2% / 6%	215% / 645%
600V	1%	130%	1A	2% / 6%	215% / 645%
			3A	2% / 6%	215% / 645%
			10A	2% / 6%	200%
			20A	2% / 6%	100%

Accessory Specification Conditions:

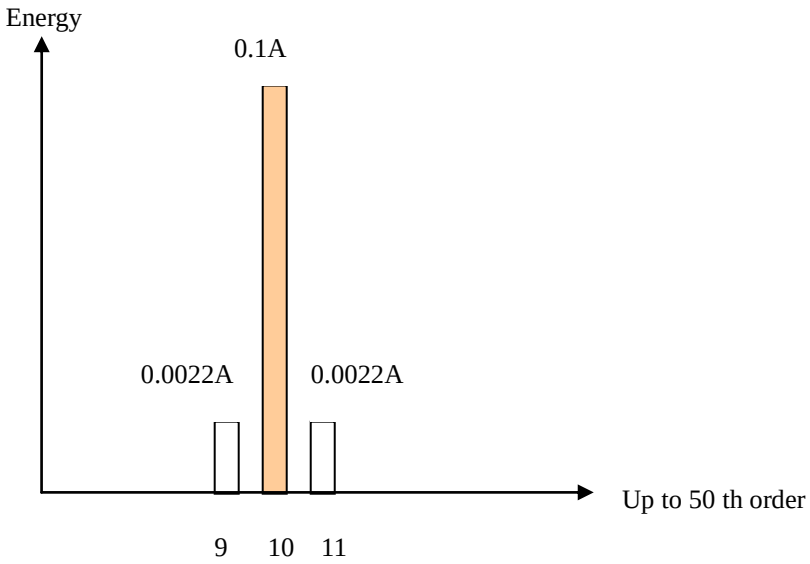
a. The above AC Current Measurement Verifications used a Fluke 5522A calibrator. Once current output reached 70% of the equipment 2.99999A gear power rating maximum current a low-frequency adjuster LCOMP function was used to adjust output to contain some high-frequency noise.
b. All AC voltage range and current range were tested and verified with standard SIN waves.

<table>
<tr><th colspan="5">Harmonics Analysis Function Specification</th></tr>
<tr><td>Analysis Foundation</td><td colspan="4">Obtain a stable base frequency (less than 1% variation) from voltage or current (non-variable) and begin analysis.</td></tr>
<tr><td>Frequency Range</td><td colspan="4">45Hz ~ 440Hz</td></tr>
<tr><td>FFT Data Length</td><td colspan="4">1024</td></tr>
<tr><td>FFT Data Format</td><td colspan="4">32 bits</td></tr>
<tr><td>Measurement Items:</td><td colspan="4">1-50 Total Harmonics Distortion, 1-50 Stage Voltage/Current V[n], A[n],
1-50 Stage Voltage/Current Distortion Ratio V[n%], A[n%]
1-50 Stage Wattage W[n]
1-50 Wattage Distortion Ratio W[n%]
1-50 Stage Voltage and Current Angle DEG[n]
Vrms, Irms, Watt, PF</td></tr>
<tr><td>Window function</td><td colspan="4">Rectangular</td></tr>
<tr><td rowspan="5">Sampling Specifications and Analysis Stages</td><td>Base Frequency</td><td>Sample rate</td><td>FFT Data Base Frequency Intervals</td><td>MAX. Order</td></tr>
<tr><td>45≦ F＜70</td><td>Base Frequency*512</td><td>2</td><td>50</td></tr>
<tr><td>70≦ F＜130</td><td>Base Frequency*512</td><td>2</td><td>50</td></tr>
<tr><td>130≦ F＜250</td><td>Base Frequency*512</td><td>2</td><td>50</td></tr>
<tr><td>250≦ F＜440</td><td>Base Frequency*512</td><td>2</td><td>30</td></tr>
<tr><td></td><td colspan="4">Add ±0.2% of range to normal measurement. However, for n th order component input, <u>add (n th order reading)*(10/n+1) %</u> to (n-1) order and (n+1) order.

Example: 10V@60Hz 0.1A@600Hz sin wave, 10th order current display 0.1A, current values for adjacent stages calculated thus:</td></tr>
</table>

<table>
<tr><td>Accuracy</td><td colspan="3">9th order Maximum Tolerance 0.1A * (10/10+1))% = 0.0018A~0.0022A

11th order Maximum Tolerance 0.1A * (10/10+1)% = 0.0018A~0.0022A


</td></tr>
<tr><td rowspan="5">Harmonic Analysis with Line filter specifications</td><td>Base Frequency</td><td>-3dB Frequency</td><td>Deadline Frequency Stages (Degredation ~0.707)</td></tr>
<tr><td>50Hz</td><td>~500HZ</td><td>10^{TH}</td></tr>
<tr><td>60Hz</td><td>~500HZ</td><td>~8^{TH}</td></tr>
<tr><td>100Hz</td><td>~500HZ</td><td>5^{TH}</td></tr>
<tr><td>250Hz</td><td>~500HZ</td><td>2^{TH}</td></tr>
<tr><td>A/D Conversion Rate</td><td colspan="3">23040 SPS (45Hz) ~ 225280SPS (440Hz)</td></tr>
<tr><td>A/D Precision</td><td colspan="3">16Bits</td></tr>
<tr><td>FFT Conversion Precision</td><td colspan="3">32Bits</td></tr>
<tr><td>Panel Update Rate</td><td colspan="3">0.25s / 0.5s / 1s / 2s / 5s</td></tr>
</table>

Common mode voltage Specifications	
Testing Method	V+, V- Input Terminal Short Circuit, I+,I- open circuit, Apply AC voltage between CASE & V+ and test.
Voltage Specifications	< Voltage * F * 0.3 /1000 F = KHz Unit For example 600V 10KHz: 600V *10 *0.3 /1000 = 1.8V
Current Specifications	< Voltage * F * 0.01 / 1000000 F = KHz Unit For example 600V 10KHz 600V *10 *0.01 /1000000 = 0.00006A

Voltage & Current channel cross talk Specifications	
Current Testing Method	V+, V- Input Voltage, I+,I- Idle Contact
Voltage Effects on Current Specifications	<0.0005% * F of Voltage/100 **F = KHz Unit**
Voltage Testing Method	I+, I- Input Current, V+,V- use 5cm wire short circuit
Current Effects on Voltage Specifications	<0.0005% * F * Current **F = KHz unit**

Storage Temperature	-10°C ~ 60°C
Operating Temperature	23°C ~ ±5°C
Operating Humidity	30% ~ 75%

Chapter 7 GPIB Instruction Sets

Section 7.1 Serial Communications Specifications

Electrical characteristics	RS232
Connection	Point-to-point
Communications	Full-duplex
Synchronization	Start-stop system
Baud rate	19200/38400/57600/115200 (can change settings)
Start bit	1 bit
Data length	8 bits
Parity	No parity
Stop bit	1 bit

Section 7.2 Symbols

Symbol	Description	Example
< >	Defined value	DISP<X>, <X>=1 to 3
{ }	One of the options in {} is selected	MODE{RMS | VME | DC | HARM}
|	Exclusive OR	
[ ]	Abbreviated	[:CONF]:VOLT:AUTO = :VOLT:AUTO

Section 7.3 Commands

Command **Description**

COMMunicateG roup

:COMMunicate:LOCKout Sets/cancels local lockout.

:COMMunicate:REMote Sets remote/local condition.

CONFigure Group

:CONFigure? Queries all settings related to the measurement conditions.

[:CONFigure]:AVERaging? Queries all settings related to the averaging function.

[:CONFigure]:AVERaging[:STATe] Sets/queries averaging ON/OFF.
[:CONFigure]:AVERaging:TYPE Sets/queries averaging type and coefficient.
[:CONFigure]:CURRent? Queries all settings related to the current range.
[:CONFigure]:CURRent:AUTO Sets/queries the current auto range ON/OFF.
[:CONFigure]:CURRent:RANGe Sets/queries the current range.
[:CONFigure]:FILTer Sets/queries the frequency filter ON/OFF.
[:CONFigure]:LFILter Sets/queries the line filter ON/OFF.
[:CONFigure]:MHOLd[:STATe] Sets/queries the MAX hold ON/OFF.
[:CONFigure]:MODE Sets/queries the measurement mode.
[:CONFigure]:SCALing? Queries all settings related to the scaling function.
[:CONFigure]:SCALing:{PT|CT|SFACtor}?
Queries all settings related to scaling constants for {voltage|current|power}.
[:CONFigure]:SCALing:{PT|CT|SFACtor}[:ALL]
Sets the scaling constants for all elements of {voltage|current|power}.
[:CONFigure]:SCALing:{PT|CT|SFACtor}:ELEMent1
Sets the scaling values for each element of {voltage|current|power}.
[:CONFigure]:SCALing[:STATe] Sets/queries the scaling function ON/OFF.
[:CONFigure]:SYNChronize Sets/queries the measurement synchronization source.
[:CONFigure]:VOLTage? Queries all settings related to the voltage range.
[:CONFigure]:VOLTage:AUTO Sets/queries the voltage auto range ON/OFF.
[:CONFigure]:VOLTage:RANGe Sets/queries the voltage range.

DISPlay Group

:DISPlay<x>? Queries all the display settings.
:DISPlay<x>:ELEMent Sets/queries the element to be displayed.
:DISPlay<x>:FUNCtion Sets/queries the function to be displayed.
:DISPlay<x>:MODE Sets/queries the contents of the display.
:DISPlay<x>:RESolution Sets/queries the number of display digits.

HARMonics Group

:HARMonics? Queries all settings related to harmonic measurement.
:HARMonics:DISPlay? Queries all settings related to the display in case of harmonic measurement.
:HARMonics:DISPlay:ORDer Sets/queries the order of the harmonic component to be shown on display B.
:HARMonics:ELEMent Sets/queries the element for harmonic measurement.
:HARMonics[:STATe] Sets/queries the harmonic measurement mode ON/OFF.
:HARMonics:SYNChronize Sets/queries the input to be used as PLL source.
:HARMonics:THD Sets/queries the computation method for harmonic

distortion.

INTEGrate Group

:INTEGrate? Queries all settings related to integration.

:INTEGrate:MODE Sets/queries the integration mode.

:INTEGrate:RESet Resets the integration values.

:INTEGrate:STARt Starts integration.

:INTEGrate:STOP Stops integration.

:INTEGrate:TIMer Sets/queries the integration timer.

MATH Group

:MATH? Queries all settings related to the computing function.

:MATH:CFACtor Sets/queries the computing equation of the crest factor.

MEASure Group

:MEASure? Queries all settings related to measurement/computation data.

:MEASure:HARMonics? Queries all settings related to harmonic measurement data.

:MEASure:HARMonics:ITEM? Queries all settings related to the output items of harmonic measurement data.

:MEASure:HARMonics:ITEM:PRESet Sets the ON/OFF pattern for all communication outputs of the harmonic measurement function.

:MEASure:HARMonics:ITEM:{SYNChronize|<harmonic measurement function>}

Sets/queries the communication output item of harmonic measurement ON/OFF.

:MEASure:HARMonics:VALue? Queries harmonic measurement data set by commands other than “MEASure:HARMonics:ITEM” (ASCII format).

:MEASure:NORMal? Queries all settings related to normal measured/computed data.

:MEASure[:NORMal]:ITEM? Queries all settings related to the output items of normal measured/computed data.

:MEASure[:NORMal]:ITEM:PRESet Sets the ON/OFF pattern for all communication outputs of the normal measurement function.

:MEASure[:NORMal]:ITEM:{TIME|MATH} Sets/queries the ON/OFF state of the communication output of {integration time|MATH}.

:MEASure[:NORMal]:ITEM:<normal measurement function>?

Queries communication output settings of the normal measurement function.

:MEASure[:NORMal]:ITEM:<normal measurement function>:ELEMent1

Sets/queries the communication output items concerning each element ON/OFF.

:MEASure[:NORMal]:VALue? Queries normal measured/computed data set by commands other than“MEASure[:NORMal]:ITEM” (ASCII format).

RECall Group

:RECall? Queries all settings related to recalling data.

:RECall:INTerval Sets/queries the recalling interval.

:RECall:PANel Retrieves the setup parameters file.

:RECall[:STATe] Sets/queries recalling ON/OFF.

SAMPle Group

:SAMPle? Queries all settings related to sampling.

:SAMPle:HOLD Sets/queries to hold the output of data (display, communication).

:SAMPle:RATE Sets the display update rate or queries the current setting.

STATus Group

:STATus:ERRor? Queries the occurred error code and message.

STORe Group

:STORe? Queries all settings related to storing data.

:STORe:INTerval Sets/queries the interval for storing data.

:STORe:PANel Saves the setup parameters to a file.

:STORe[:STATe] Sets/queries the store function ON/OFF.

Common Command Group

*CAL? Executes zero-level compensation and queries the results.

*CLS Clears the standard event register, extended event register and error queue.

*ESE Sets/queries the value of the standard event enable register.

*ESR? Sets/queries the value of the standard event register and clears it.

*IDN? Queries the instrument model.

*OPC This command is not supported by this instrument.

*OPC? This command is not supported by this instrument, and is always “1”.

*OPT? Queries installed options.

*PSC Sets/queries whether or not to clear some registers at power ON.

*RST Initializes the setup parameters.

*SRE Sets/queries the value of the service request enable register.

*STB? Queries the value of the status byte register.

*TRG Executes the same operation as the TRIG(SHIFT+HOLD) key.

*TST? Executes a self-test and queries the results.

*WAI This command is not supported by this instrument.

Communicate group:

COMMunicate:LOCKout

Function Sets local lockout ON or OFF.
Syntax COMMunicate:LOCKout {<Boolean>}
Example COMMUNICATE:LOCKout ON

COMMunicate:REMote
Function Sets remote (ON) or local mode (OFF).
Syntax COMMunicate:REMote {<Boolean>}
Example COMMUNICATE:REMOTE ON

Configure group:
CONFigure?
Function Queries all the settings related to the measurement conditions.
Syntax CONFigure?
Example CONFIGURE? ->:MODE DC;:VOLT:RANG 1.000000E+01;:AUTO 1;:CURR:RANG 1.000000E-02;:AUTO 0;:FILT 0;:LFIL 0;:SCAL 0;:SCAL:PT:ELEM1
1.000000E+00;:SCAL:CT:ELEM1 1.000000E+00;:SCAL:SFAC:ELEM1 1.000000E+00;:AVER 0;:AVER:TYPE EXP8;:SYNC V;:MHOL 0

[CONFigure]:AVERaging?
Function Queries all the setting values related to the averaging function.
Syntax [CONFigure]:AVERaging?
Example [CONFIGURE]:AVERAGING? -> :AVER 0;AVER:TYPE EXP8

[CONFigure]:AVERaging[:STATe]
Function Sets averaging ON/OFF, or queries the current status.
Syntax [CONFigure]:AVERaging[:STATe] {<Boolean>}
[CONFigure]:AVERaging:STATe?
Example [CONFIGURE]:AVERAGING:STATE OFF
[CONFIGURE]:AVERAGING:STATE?-> :AVER 0

[CONFigure]:AVERaging:TYPE
Function Sets the averaging type and coefficient, queries the current setting.
Syntax [CONFigure]:AVERaging:TYPE {(LIN|EXP),<NRf>}
[CONFigure]:AVERaging:TYPE?
{<NRf>}=8, 16, 32, 64 (averaging coefficient)
Example [CONFIGURE]:AVERAGING:TYPE LIN,8
[CONFIGURE]:AVERAGING:TYPE?->:AVER:TYPE LIN8

[CONFigure]:CURRent?
Function Queries all setting values relating to the current range (external sensor range)
Syntax [CONFigure]:CURRent?
Example [CONFIGURE]:CURRENT? ->:CURR:RANG 1.000000E-02;AUTO 0

[CONFigure]:CURRent:AUTO
Function Sets the current auto range ON/OFF, or queries the current setting.
Syntax [CONFigure]:CURRent:AUTO {<Boolean>}
[CONFigure]:CURRent:AUTO?
Example [CONFIGURE]:CURRENT:AUTO ON
[CONFIGURE]:CURRENT:AUTO?
->:CURR:AUTO 0

[CONFigure]:CURRent:RANGe
Function Sets the current range, queries the current setting.
Syntax [CONFigure]:CURRent:RANGe {<current>}
[CONFigure]:CURRent:RANGe?
<current> =5mA to 20A
(0.005|0.01,0.02|0.03,0.05|0.1,0.2|0.3,0.5|1,2|3,5|10,20A)
Example Setting of current range/query
[CONFIGURE]:CURRENT:RANGE 20A
[CONFIGURE]:CURRENT:RANGE?-> :CURR:RANG 2.000000E+01

[CONFigure]:FILTer
Function Sets the frequency filter ON/OFF, queries the current setting.
Syntax [CONFigure]:FILTer {<Boolean>}
[CONFigure]:FILTer?
Example [CONFIGURE]:FILTER OFF
[CONFIGURE]:FILTER? ->:FILT 0

[CONFigure]:LFILter
Function Sets the line filter ON/OFF queries the current setting.
Syntax [CONFigure]:LFILter {<Boolean>}
[CONFigure]:LFILter?
Example [CONFIGURE]:LFILTER OFF
[CONFIGURE]:LFILTER?-> :LFIL 0

[CONFigure]:MHOLd[:STATe]
Function Sets the MAX hold ON/OFF, queries the current setting.
Syntax [CONFigure]:MHold[:STATe] {<Boolean>}
[CONFigure]:MHold[:STATe]?
Example [CONFIGURE]:MHOLD:STATE OFF
[CONFIGURE]:MHOLD:STATE? ->:MHOL 0

[CONFigure]:MODE
Function Sets the measurement mode of current and voltage, queries the current setting.
Syntax [CONFigure]:MODE {RMS|VMEan|DC|HARMonics}
[CONFigure]:MODE?
Example [CONFIGURE]:MODE RMS
[CONFIGURE]:MODE? -> :MODE RMS

[CONFigure]:SCALing?
Function Queries all settings relating to the scaling function.
Syntax [CONFigure]:SCALing?
Example [CONFIGURE]:SCALING? -> :SCAL 0;:SCAL:PT:ELEM1 1.000000E+00;:SCAL:CT:ELEM1 1.000000E+00;:SCAL:SFAC:ELEM1 1.000000E+00

[CONFigure]:SCALing:{PT|CT|SFACtor}[{:ALL|ELEM1}]
Function Sets the scaling constants for element1 of{voltage|current|power} at once. queries the current setting.
Syntax [CONFigure]:SCALing:{PT|CT|SFACtor}[{:ALL|ELEM1}] {<NRf>}
{<NRf>}=0.001 to 9999
Example [CONFIGURE]:SCALING:PT:ALL 1.000
[CONFIGURE]:SCALING:PT:ALL?-> :SCAL:PT:ELEM1 1.000000E+00
Description The setting values are rounded as follows.
Less than 1.000 : Three digits after the decimal point are valid.
1.000 to 9999 : The first five digits are valid.

[CONFigure]:SCALing[:STATe]
Function Sets scaling ON/OFF, queries the current setting.
Syntax [CONFigure]:SCALing[:STATe] {<Boolean>}
[CONFigure]:SCALing:STATe?

Example [CONFIGURE]:SCALING:STATE OFF
[CONFIGURE]:SCALING:STATE?-> :SCAL 0

[CONFigure]:SYNChronize?
Function Sets the measurement synchronization source/queries the current setting.
Syntax [CONFigure]:SYNChronize {VOLTage|CURRent|AUTO|OFF}
[CONFigure]:SYNChronize?
Example [CONFIGURE]:SYNCHRONIZE VOLTAGE?
[CONFIGURE]:SYNCHRONIZE? ->:SYNC V

[CONFigure]:VOLTage?
Function Queries all settings relating to voltage range.
Syntax [CONFigure]:VOLTage?
Example [CONFIGURE]:VOLTAGE? -> :VOLT:RANG 1.000000E+01;AUTO 1

[CONFigure]:VOLTage:AUTO
Function Sets the voltage auto range ON/OFF, queries the current setting.
Syntax [CONFigure]:VOLTage:AUTO {<Boolean>}
[CONFigure]:VOLTage:AUTO?
Example [CONFigure]:VOLTage:AUTO ON
[CONFIGURE]:VOLTAGE:AUTO?-> :VOLT:AUTO 1

[CONFigure]:VOLTage:RANGe
Function Sets the voltage range/queries the current setting.
Syntax [CONFigure]:VOLTage:RANGe {<voltage>}
[CONFigure]:VOLTage:RANGe?
<voltage>=10V to 600V (10, 15|30,60|100,150|300, 600V)
Example [CONFIGURE]:VOLTAGE:RANGE 600V
[CONFIGURE]:VOLTAGE:RANGE?-> :VOLT:RANG 6.000000E+02

[CONFigure]:ACLINE
Function Sets the ACLINE /queries the current setting.
Syntax [CONFigure]:ACLINE {<acline>}
[CONFigure]:VOLTage:RANGe?
< acline >= (50HZ,60HZ)
Example [CONFIGURE]:ACLINE 60HZ
[CONFIGURE]:ACLINE?-> :ACLINE 60Hz

[CONFigure]: CFACtor

Function Sets the CFACtor /queries the current setting.
Syntax [CONFigure]:CFACtor {<cfac>},{<elem>}
[CONFigure]:CFACtor?
< cfac >= (3,9)
<elem>=(1)
Example [CONFIGURE]:CFACtor 3,1
[CONFIGURE]:CFACtor?-> :MATH:CFAC 3,1

[CONFigure]: MCMP

Function Sets the MCMP/queries the current setting.
Syntax [CONFigure]:MCMP {<Boolean>}
[CONFigure]:MCMP?
Example [CONFIGURE]:MCMP OFF
[CONFIGURE]:MCMP?-> :MCMP 0

DISPlay<x>?

Function Queries all the display settings.
Syntax DISPlay<x>?
<x>= 1 to 3
1:Display A
2:Display B
3:Display C
Example DISPlay1? -> :DISP:MODE VAL;FUNC V;ELEM 1;RES HIGH

DISPlay<x>:ELEMent

Function Sets the element to be displayed/queries the current setting.
Syntax DISPlay<x>:ELEMent {<NRf>|SIGMa}
DISPlay<x>:ELEMent?
<x>= 1 to 3
1:Display A
2:Display B
3:Display C
{<NRf>}=1
Example DISPLAY1:ELEMENT 1
DISPLAY1:ELEMENT? -> :DISP:ELEM 1

DISPlay<x>:FUNCtion

Function Sets the function to be displayed/queries the
current setting.
Syntax DISPlay<x>:FUNCtion {<display function>}
DISPlay<x>:FUNCtion?
<x>= 1 to 3
1:Display A
2:Display B
3:Display C
In case of normal measurement:
<display function>=
{V|A|W|VA|VAR|PF|DEGRee|VHZ|AHZ|WH|WHP|WHM|AH|AHP|AHM
|MATH|VPK|APK|TIME}
In case of harmonic measurement:
<display function>={V|A|W|PF|VHZ|AHZ|VTHD|ATHD|VCON|ACON|WCON
|VDEG|ADEG|ORDer}
Example DISPLAY1:FUNCTION V
DISPLAY1:FUNCTION? -> :DISP:FUNC A

DISPlay<x>:MODE

Function Sets the contents of the display/queries the current setting.
Syntax DISPlay<x>:MODE {VALue|RANGe }
DISPlay<x>:MODE?
<x>= 1 to 3
1:Display A
2:Display B
3:Display C
VALue: displays measurement data
RANGe: displays the present range of voltage and current
Example DISPLAY1:MODE VALUE
DISPLAY1:MODE? -> :DISP:MODE VAL
Description <x> will be ignored. The contents of all the displays A to C will be received

DISPlay<x>:RESolution

Function Sets the number of displayed digits/queries the current setting.
Syntax DISPlay<x>:RESolution {HIGH|Low}
DISPlay<x>:RESolution?

<x>= 1 to 3
1:Display A
2:Display B
3:Display C
Example DISPLAY1:RESOLUTION LOW
DISPLAY1:RESOLUTION? -> :DISP:RES LOW
Description <x> will be ignored. The contents of all the displays A to C will be received.

DISPlay:INTerval
Function Sets the INTerval ON/OFF, queries the current setting.
Syntax DISPlay: INTerval {<Boolean>}
DISPlay: INTerval?
Example DISPLAY: INTerval OFF
DISPLAY: INTerval? -> :DISP:INT 0;FUNC V;TIM 1

DISPlay:INTerval:FUNCtion
Function Sets the function to be displayed/queries the current setting.
Syntax DISPlay:INTerval:FUNCtion {<display function>}
DISPlay:INTerval:FUNCtion?
In case of RMS&VMEAN Mode:
<display function>={V|A|W|VA|VAR| VCF|ACF|PF}
In case of DC Mode:
<display function>={V|A|W }
In case of HARMONIC Mode:
<display function>={ORDER|V|A|W |PF}
Example DISPLAY:INTerval:FUNCTION V
DISPLAY1:INTerval:FUNCTION? -> :DISP:INT:FUNC V

DISPlay:INTerval:STATe
Function Sets the INTerval ON/OFF, queries the current setting.
Syntax DISPlay:INTerval:STATe {<Boolean>}
DISPlay:INTerval:STATe?
Example DISPLAY:INTerval:STATe OFF
DISPLAY:INTerval:STATe? -> :DISP:INT 0

DISPlay:INTerval:TIMer
Function Sets the INTerval TIMer, queries the current setting.

Syntax DISPlay:INTerval:TIMer {<NRf> }
DISPlay:INTerval:TIMer?
<NRf>=1 to 30
Example DISPLAY:INTerval:TIMer 1
DISPLAY:INTerval:TIMer? -> :DISP:INT:TIM 1

DISPlay:INTENsity
Function Sets the INTENsity, queries the current setting.
Syntax DISPlay:INTENsity {<NRf> }
DISPlay:INTerval:INTENsity?
<NRf>=0 to 5
Example DISPlay:INTENsity 3
DISPlay:INTENsity? -> :DISP:INTEN 3

HARMonics?
Function Queries all settings relating to harmonic measurement.
Syntax HARMonics?
Example HARMONICS? -> :HARM 0;HARM:ELEM 1;SYNC V,1;THD IEC;DISP:ORD 1

HARMonics:DISPlay?
Function Queries all settings concerning the display in case of harmonic measurement.
Syntax HARMonics:DISPlay?
Example HARMONICS:DISPLAY?
HARMONICS:DISPLAY? -> :HARM:DISP:ORD 1

HARMonics:DISPlay:ORDer
Function Sets the order of the harmonic component to be shown on display A, queries the current setting.
Syntax HARMonics:DISPlay:ORDer {<NRf>}
HARMonics:DISPlay:ORDer?
{<NRf>}=1 to 50
Example HARMONICS:DISPLAY:ORDER 1
HARMONICS:DISPLAY:ORDER?-> :HARM:DISP:ORD 1

HARMonics:ELEMent
Function Sets the element for harmonic measurement/queries the current

setting.
Syntax HARMonics:ELEMent {<NRf>}
HARMonics:ELEMent?
{<NRf>}=1
Example HARMONICS:ELEMENT 1
HARMONICS:ELEMENT?-> :HARM:ELEM 1

HARMonics[:STATe]
Function Sets the harmonic measurement mode ON/OFF, queries the current setting.
Syntax HARMonics[:STATe] {<Boolean>}
HARMonics[:STATe]?
Example HARMONICS:STATE ON
HARMONICS:STATE? -> :HARM 1

HARMonics:SYNChronize
Function Sets the fundamental frequency for PLL synchronization (PLL source)/queries the current setting.
Syntax HARMonics:SYNChronize {(V|A|AUTO),(ELEMent<1>)}
HARMonics:SYNChronize?
Example HARMONICS:SYNCHRONIZE V,1
HARMONICS:SYNCHRONIZE?-> :HARM:SYNC V,1

HARMonics:THD
Function Sets the computation method for harmonic distortion (THD) for harmonic measurement/queries the current setting.
Syntax HARMonics:THD {IEC|CSA}
HARMonics:THD?
Example HARMONICS:THD IEC
HARMONICS:THD? -> :HARM:THD IEC

INTEGrate?
Function Queries all settings relating to integration.
Syntax INTEGrate?
Example INTEGRATE? -> :INTEG:MODE NORM;TIM 00,00,00

INTEGrate:MODE
Function Sets the integration mode/queries the current setting.

Syntax INTEGrate:MODE {NORMal|CONTinuous}
INTEGrate:MODE?
Example INTEGRATE:MODE NORMAL
INTEGRATE:MODE?-> :INTEG:MODE NORM

INTEGrate:RESet
Function Resets the integrated values.
Syntax INTEGrate:RESet
Example INTEGRATE:RESET

INTEGrate:STARt
Function Starts integration.
Syntax INTEGrate:STARt
Example INTEGRATE:START

INTEGrate:STOP
Function Stops integration.
Syntax INTEGrate:STOP
Example INTEGRATE:STOP

INTEGrate:TIMer
Function Sets the integration timer/queries the current setting.
Syntax INTEGrate:TIMer {<NRf>,<NRf>,<NRf>}
{<NRf>,<NRf>,<NRf>}=0,0,0 to99,59,59
Example INTEGRATE:TIMER 10,0,0
INTEGRATE:TIMER? -> :INTEG:TIM 10,00,00

MATH?
Function Queries all settings related to the computing function.
Syntax MATH?
Example MATH? -> :MATH:CFAC 9,1

MATH:CFACtor
Function Sets the CFACtor /queries the current setting.
Syntax MATH:CFACtor {<cfac>},{<elem>}
MATH:CFACtor?
< cfac >= (3,9)
<elem>=(1)

Example MATH:CFACtor 3,1
MATH:CFACtor?-> :MATH:CFAC 3,1

MEASure?
Function Queries all the settings related to measurement/computation data.
Syntax MEASure?
Example MEASURE? -> :MEAS:ITEM:V:ELEM1 1;:MEAS:ITEM:A:ELEM1 1;:MEAS:ITEM:W:ELEM1 1;:MEAS:ITEM:VA:ELEM1 0;:MEAS:ITEM:VAR:ELEM1 0;:MEAS:ITEM:PF:ELEM1 0;:MEAS:ITEM

MEASure:HARMonics?
Function Queries all settings related to harmonic measurement data.
Syntax MEASure:HARMonics?
Example MEASURE:HARMONICS?-> :MEAS:HARM:ITEM:SYNC 1;VTHD 1;V 1;VCON 1;ATHD 1;A 1;ACON 1;PF 1;W 1;WCON 1;VDEG 1;ADEG 1

MEASure:HARMonics:ITEM?
Function Queries all settings related to the communication output items of harmonic measurement data.
Syntax MEASure:HARMonics:ITEM?
Example MEASURE:HARMONICS:ITEM? -> (Same result as for MEASure:HARMonics?)

MEASure:HARMonics:ITEM:PRESet
Function Sets the ON/OFF pattern for all communication outputs of the harmonic measurement function.
Syntax MEASure:HARMonics:ITEM:PRESet {VPATtern|APATtern|WPATtern|DPATtern|ALL|CLEar}
Example MEASURE:HARMONICS:ITEM:PRESET VPATTERN
Description The following six patterns can be selected.
VPATtern:SYNChronize/VTHD/V/VCON -> ON, others ->OFF
APATtern:SYNChronize/ATHD/A/ACON -> ON, others ->OFF
WPATtern:SYNChronize/PF/W/WCON -> ON, others ->OFF
DPATtern:SYNChronize/VDEG/ADEG -> ON, others ->OFF
ALL: all items -> ON
CLEar: all items -> OFF

MEASure:HARMonics:ITEM:{ SYNChronize| <harmonicmeasurement

function>}

Function Sets the communication output item of harmonic measurement ON/OFF, queries the current setting.

Syntax MEASure:HARMonics:ITEM:{ SYNChronize|<harmonic measurement function>} {<Boolean>}

SYNChronize=PLL source

<harmonic measurement function>

={VTHD|V|VCON|ATHD|A|ACON|PF|W|WCON|VDEG|ADEG}

Example MEASURE:HARMONICS:ITEM:VTHD ON

MEASURE:HARMONICS:ITEM:VTHD?-> :MEAS:HARM:ITEM:VTHD 1

Description The selection SYNChronize is for outputting the frequency of the PLL source.

You can query the PLL source input by the command HARMonics:SYNChronize?

MEASure:HARMonics:VALue?

Function Queries harmonic measurement data set by commands other than ”MEASure:HARMonics:ITEM” (ASCII format).

Syntax MEASure:HARMonics:VALue?

Example MEASURE:HARMONICS:VALUE? -> 3.362256E+02,9.336657E-04,9.999695E+01,1.852538E+02,.....

MEASure:NORMal?

Function Queries all settings related to normal measured/computed data.

Syntax MEASure:NORMal?

Example MEASURE:NORMAL? -> :MEAS:ITEM:V:ELEM1 1;:MEAS:ITEM:A:ELEM1 1;:MEAS:ITEM:W:ELEM1 1;:MEAS:ITEM:VA:ELEM1 0;:MEAS:ITEM:VAR:ELEM1 0;:MEAS:ITEM:PF:ELEM1 0;:MEAS:ITEM:DEGR:ELEM1 0;:MEAS:ITEM:VHZ:ELEM1 0;:MEAS:ITEM:AHZ:ELEM1 0;:MEAS:ITEM:WH:ELEM1 0;:MEAS:ITEM:AH:ELEM1 0;:MEAS:ITEM:VPK:ELEM1 0;:MEAS:ITEM:APK:ELEM1 0;:MEAS:ITEM:TIME:ELEM1 0

MEASure[:NORMal]:ITEM?

Function Queries all settings related to the communication output items of normal measured/computed data.

Syntax MEASure[:NORMal]:ITEM?

Example MEASURE:NORMAL:ITEM? -> (Results are
the same as for MEASure:NORMal?)

MEASure[:NORMal]:ITEM:PRESet
Function Sets the ON/OFF pattern for all communication outputs of the normal measurement function.
Syntax MEASure[:NORMal]:ITEM:PRESet {NORMal|INTEGrate|CLEar}
Example MEASURE:NORMAL:ITEM:PRESET NORMAL
Description The following three patterns can be selected.
NORMal: V/A/W -> ON, others -> OFF
INTEGrate: W/WH/AH/TIME -> ON, others ->OFF
CLEar: all items -> OFF

MEASure[:NORMal]:ITEM:{TIME|MATH}
Function Sets the communication output of elapsed integration time ON/OFF, queries about the current setting.
Syntax MEASure[:NORMal]:ITEM:TIME {<Boolean>}
MEASure[:NORMal]:ITEM:TIME ?
Example MEASURE:NORMAL:ITEM:TIME OFF
MEASURE:NORMAL:ITEM:TIME?-> :MEAS:ITEM:TIME 0

MEASure[:NORMal]:ITEM:<normal measurement function>:ELEMent1
Function Sets the communication output concerning element1 ON/OFF, queries the current setting.
Syntax MEASure[:NORMal]:ITEM:<normal measurement function>:ELEMent1 {<Boolean>}
<normal measurement function>
={V|A|W|VA|VAR|PF|DEGRee|VHZ|AHZ|WH|WHP|WHM|AH|AHP|AHM|VPK|APK}
MEASure[:NORMal]:ITEM:<normal measurement function>:ELEMent1?
Example MEASURE:NORMAL:ITEM:V:ELEMENT1 ON
MEASURE:NORMAL:ITEM:V:ELEMENT1?-> :MEAS:ITEM:V:ELEM1 1

MEASure[:NORMal]:VALue?
Function Queries normal measured/computed data set by commands other than
“MEASure[:NORMal]:ITEM” (ASCII format).
Syntax MEASure[:NORMal]:VALue?

Example MEASURE:NORMAL:VALUE?
-> 1.624902E-01,1.737977E-02,1.343538E-03,1.624902E-01,10,00,00,...

Common Command Group

***CAL?**
Function Execute zero-level compensation and queries the result.
Syntax *CAL?
Example *CAL? -> 0
Description “0” is returned when the zero-level compensation completes properly. Otherwise,“1” is returned.

***CLS**
Function Clears the standard event register, extended event register and error queue.
Syntax *CLS
Example *CLS
Description • The output will also be cleared if a *CLS command is appended after the program message terminator.

***ESE**
Function Sets the value for the standard event enable register, or queries the current setting.
Syntax *ESE {<NRf>}
*ESE?
{<NRf>}=0 to 255
Example *ESE 15
*ESE? -> 15

***ESR?**
Function Queries the value of the standard event register and clears it at the same time.
Syntax *ESR?
Example *ESR? -> 32
Description • Each bit is expressed as a decimal number.
• It is possible to ascertain the type of event which has occurred, while SRQ is occuring.

***IDN?**

Function Queries the instrument model.
Syntax *IDN?
Example *IDN? -> MICROTEST, PM7120
Description A reply consists of the following information:<Model>,<Type>

***OPC**

Function When *OPC is sent, this command sets bit 0 (the OPC bit) of the standard event register to “1”.
This command is not supported by this instrument.
Syntax *OPC

***OPC?**

Function When *OPC? is sent, “1” in (ASCII code) will be returned.
This command is not supported by this instrument.
Syntax *OPC?

***OPT?**

Function Queries installed options.
Syntax *OPT?
Example *OPT? -> HARM,GPIB
Description • “NONE” will be attached to the reply if no options are installed.

***PSC**

Function Selects whether or not to clear the following registers when turning ON the power, or queries the current setting. The registers are the standard event enable register, the extended event enable register and the transition filter. However, they cannot be cleared if the parameter is “0.”
Syntax *PSC {<NRf>}
*PSC?
{<NRf>}=0(no clearance), other than 0(clearance)
Example *PSC 1
*PSC? -> 1
This command is not supported by this instrument.

***RST**

Function Resets (initializes) the present settings.
Syntax *RST

Example *RST
Description initialize settings.

***SRE**

Function Sets the value of the service request enable register, or queries the current setting.
Syntax *SRE {<NRf>}
*SRE?
{<NRf>}=0 to 255
Example *SRE 245
*SRE? -> 181
Description • Each bit is expressed as a decimal number.

***STB?**

Function Queries the value of the status byte register.
Syntax *STB?
Example *STB? -> 4
Description • Each bit is expressed as a decimal number.

***TRG**

Function Executes the same operation as the TRIG (SHIFT+HOLD) key on the front panel.
Syntax *TRG
Description Executes the same operation as when using the
multi line message GET.

***TST?**

Function Executes a self-test and queries the result. All internal memory boards are tested.
Syntax *TST?
Example *TST? -> 0
Description “0” will be returned when the result are satisfactory. If an abnormality is detected, “1”will be returned.
This command is not supported by this instrument.

***WAI**

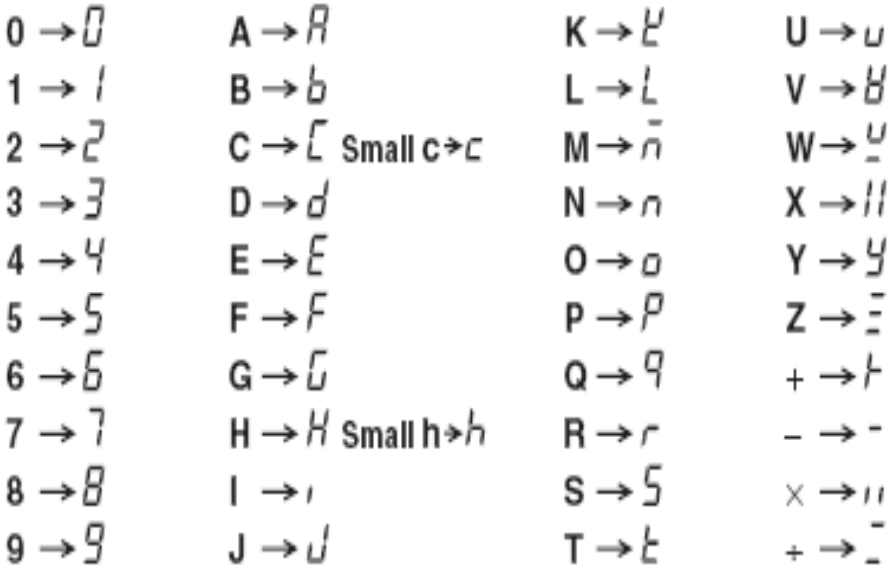
Function Waits for the command following *WAI until execution of the designated overlap command has been completed.

Syntax *WAI

This command is not supported by this instrument.

Appendix

Character Chart



Version

V1.0 2015/07/07 Initial Release

V1.01 2015/9/7 Frequencry accuracy & common mode specification change.