multicomp PRO

MP700641 Universal Counter

Introduction

MP700641 Universal Counter introduces high reliability and large scale integrated circuit and FPGA, the 16-bit high speed microcontroller is used for functions control, measurement timing control, data processing and results display. Also uses reciprocal counting techniques to improve the measurement accuracy. It has the measurement function of frequency, period, time interval, pulse width, duty cycle, totalize, phase difference, also with the measurement computing function such as multiple average, maximum, minimum, standard deviation, Allan Variance, a single relative deviation. Machine clock frequency is 400MHz. Measurements can automatically measure the internal gate, by an external signal trigger control measure. Instrument can automatically detect the external frequency standard 5MHz or 10MHz. The instrument performance is stable, fully functional, wide measuring range, high sensitivity, high precision, small size, beautiful appearance, easy to use and reliable.

Packing List

MP700641 Universal Counter	1 unit
BNC Testing Cable	1 piece
3-core Power Cable	1 piece
CD (User's Guide)	1 piece

Options

GPIB interface	1
200M~6.5GHz channel option	1

Content

Chapter 1 Main Characteristics

- High accuracy, the display resolution is 10 digits /s.
- Single measurement is available and single resolution can reach 2.5ns.
- The frequency measurement of CHA can reach to 200MHz.
- The maximum frequency's measurement can reach to 6.5GHz
- 16-bit microcontroller is used and the speed of data processing is fast.
- Large scale integrated circuit and FPGA and high reliability.
- With the functions of limit and mathematics for frequency measurement
- With the statistics functions of average, maximum, minimum, PPM, standard deviation and Allan Variance for frequency measurement
- Standard interfaces are USB and RS232, GPIB.
- High-stability crystal oscillator.
- Easy to read VFD display, small size and simple operation.

Chapter 2 Quick Reference Guide

The Quick Reference Guide is designed for experienced users of the MP700641 Universal Counter. It is intended to be used as a tool to trigger your memory. If you are using the MP700641 for the first time, we recommend that you read Chapter 4 carefully.

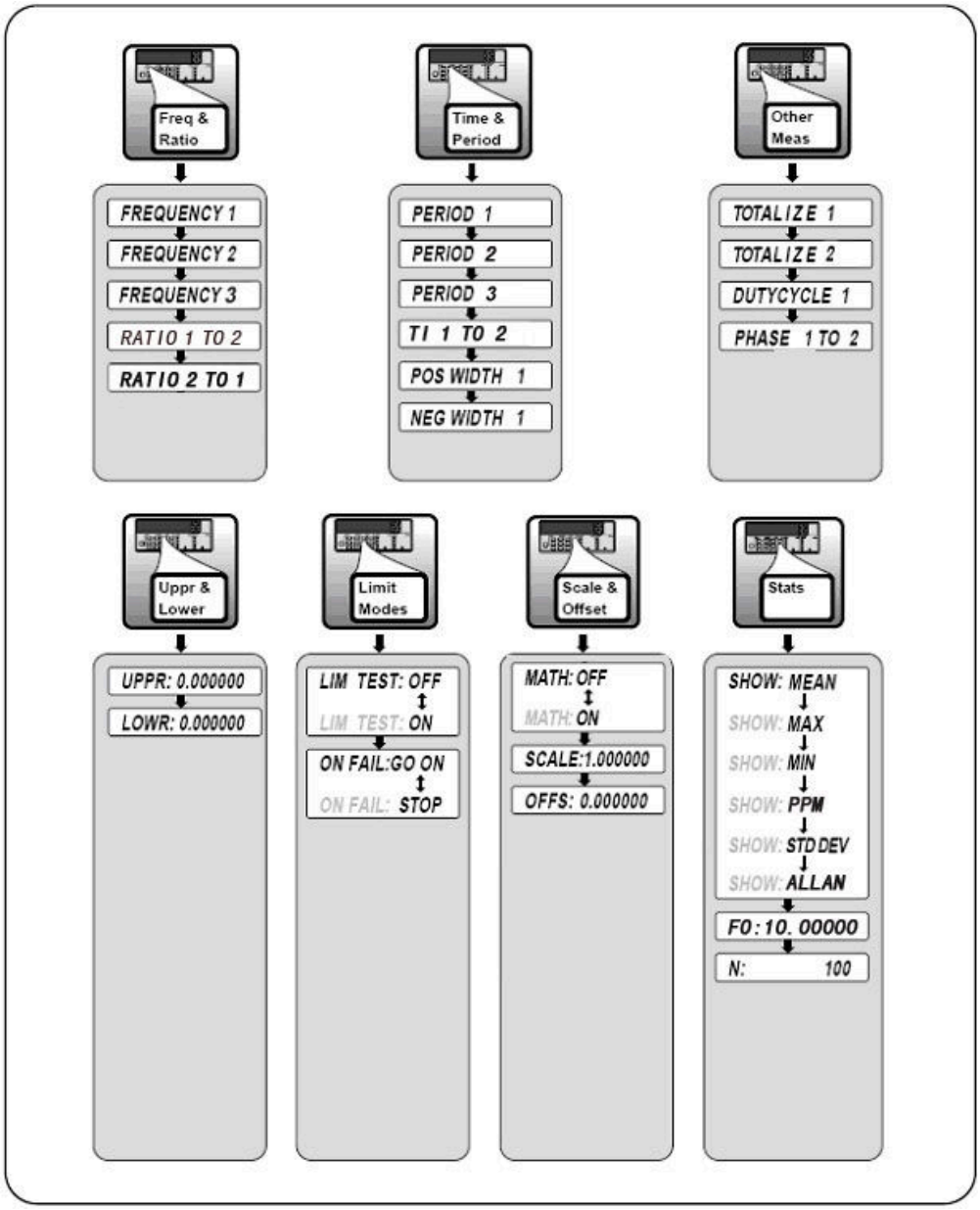
The Quick Reference Guide follows next page, and consists of the following items,

Menu Trees which may be removed from the guide for external use

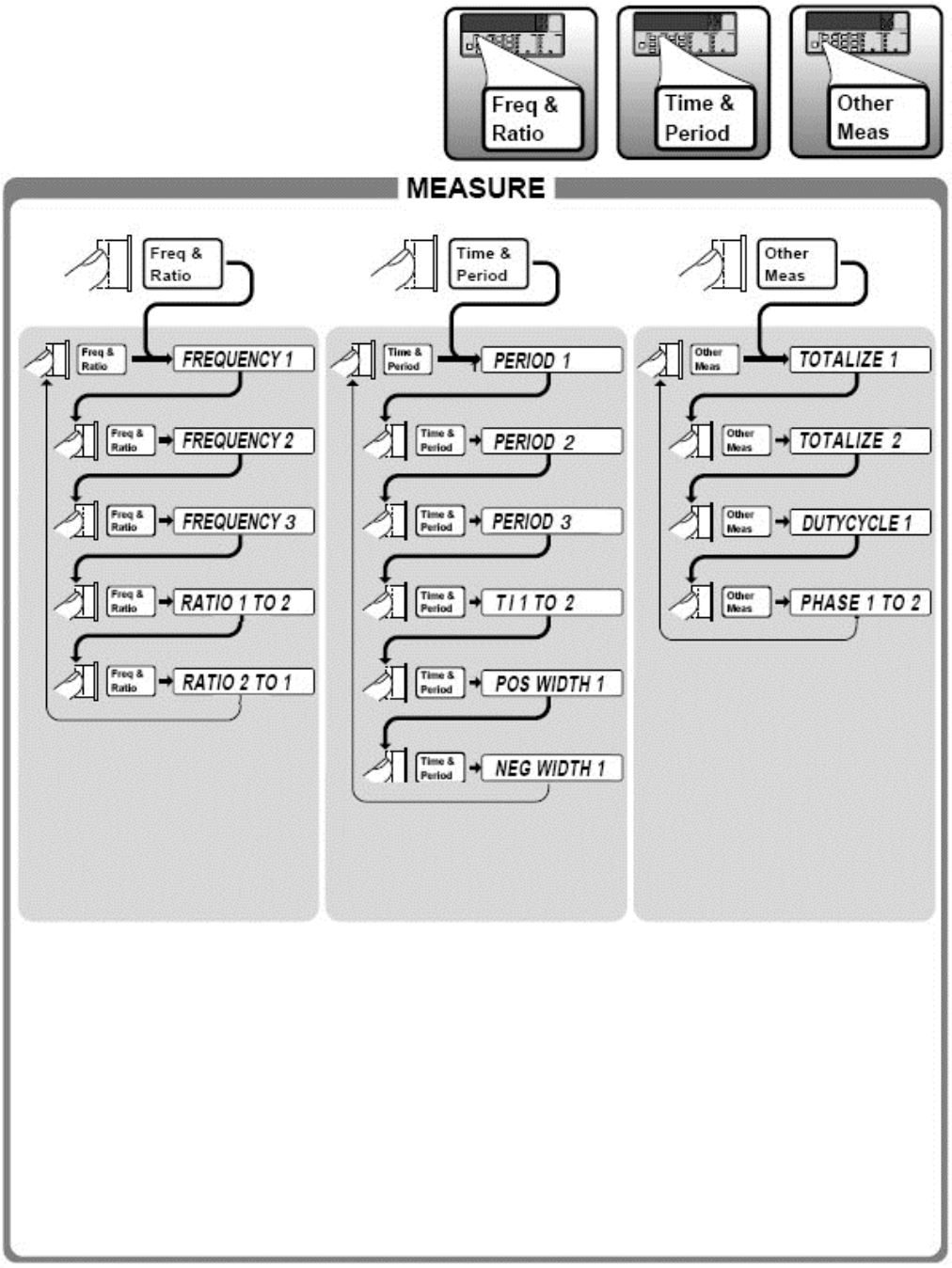
Menu Roadmaps which illustrate via key-press sequences how to navigate through the menus under the menu keys. Key-press sequences are provided for the following menu keys:

– Freq & Ratio
– Time & Period
– Other Meas
– Gate & ExtArm
– Uppr & Lower
– Limit Modes
– Scale & Offset
– Stats
– Level/Trigger

MP700641 Universal Counter



MP700641 Universal Counter



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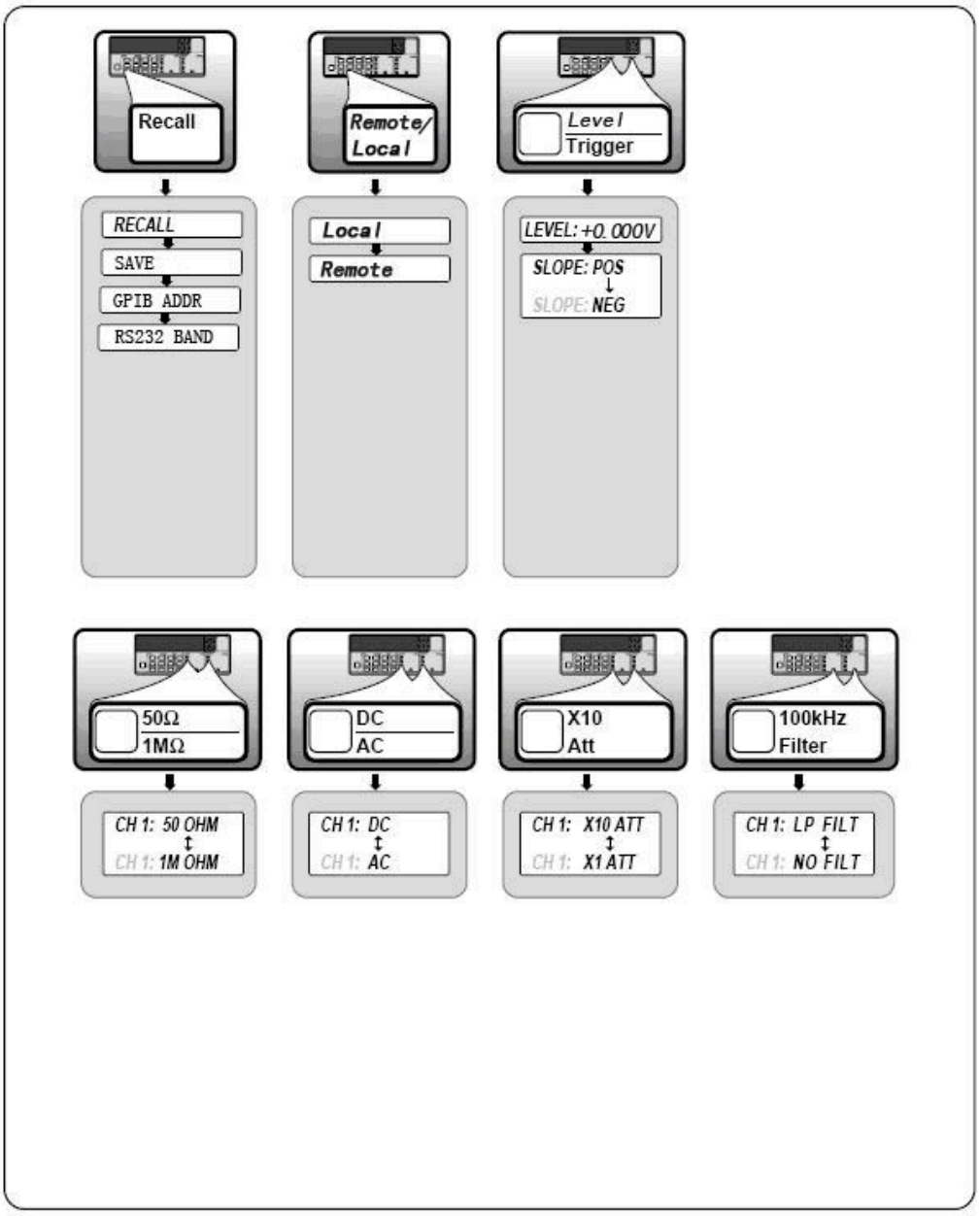

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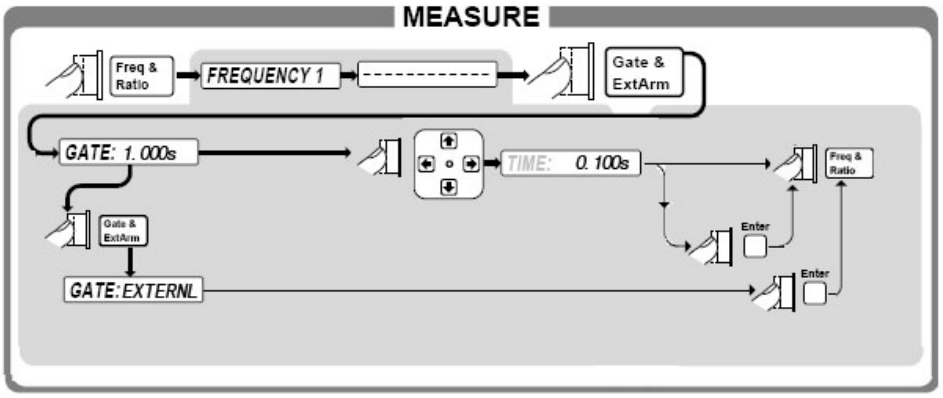

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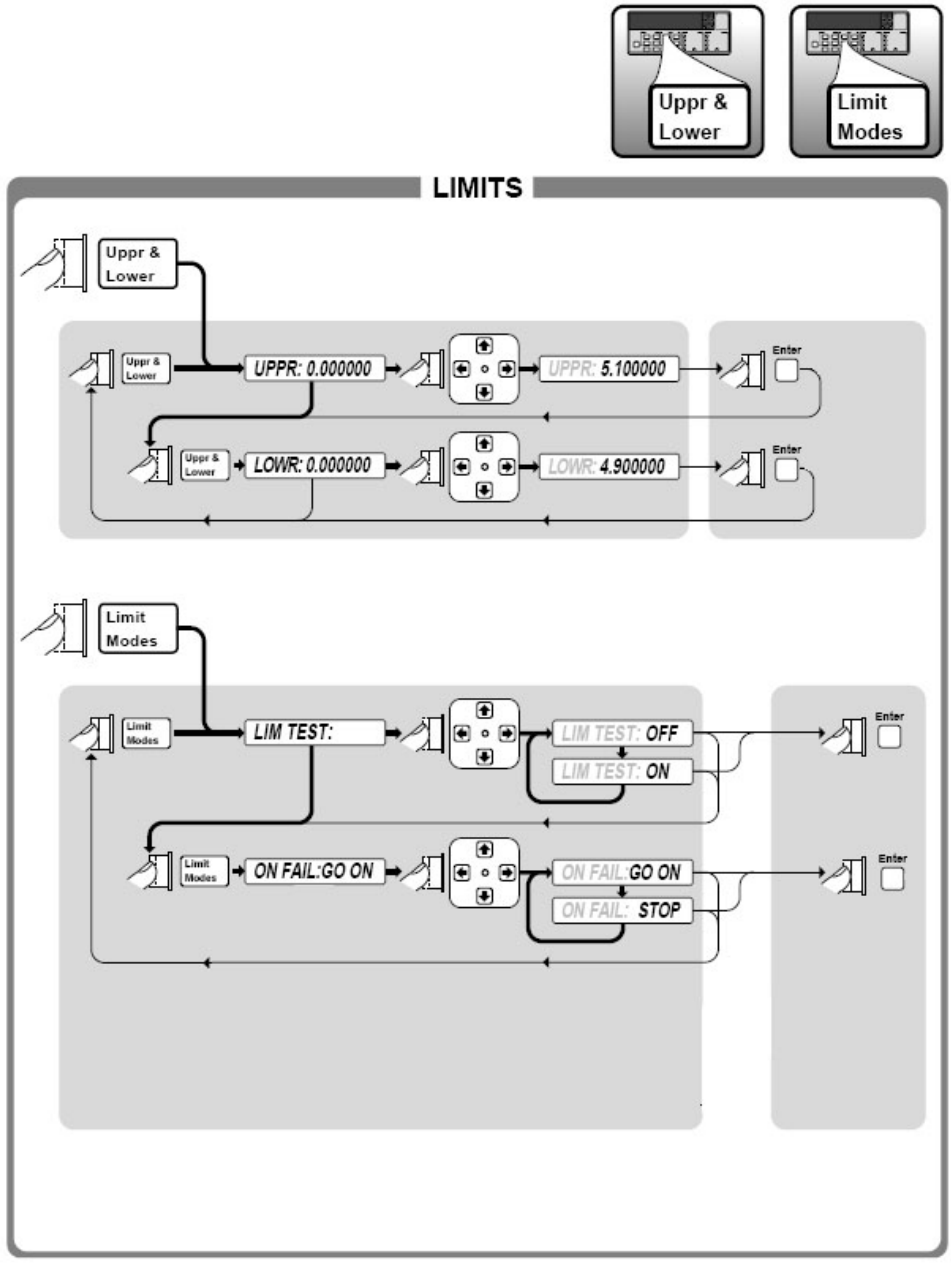

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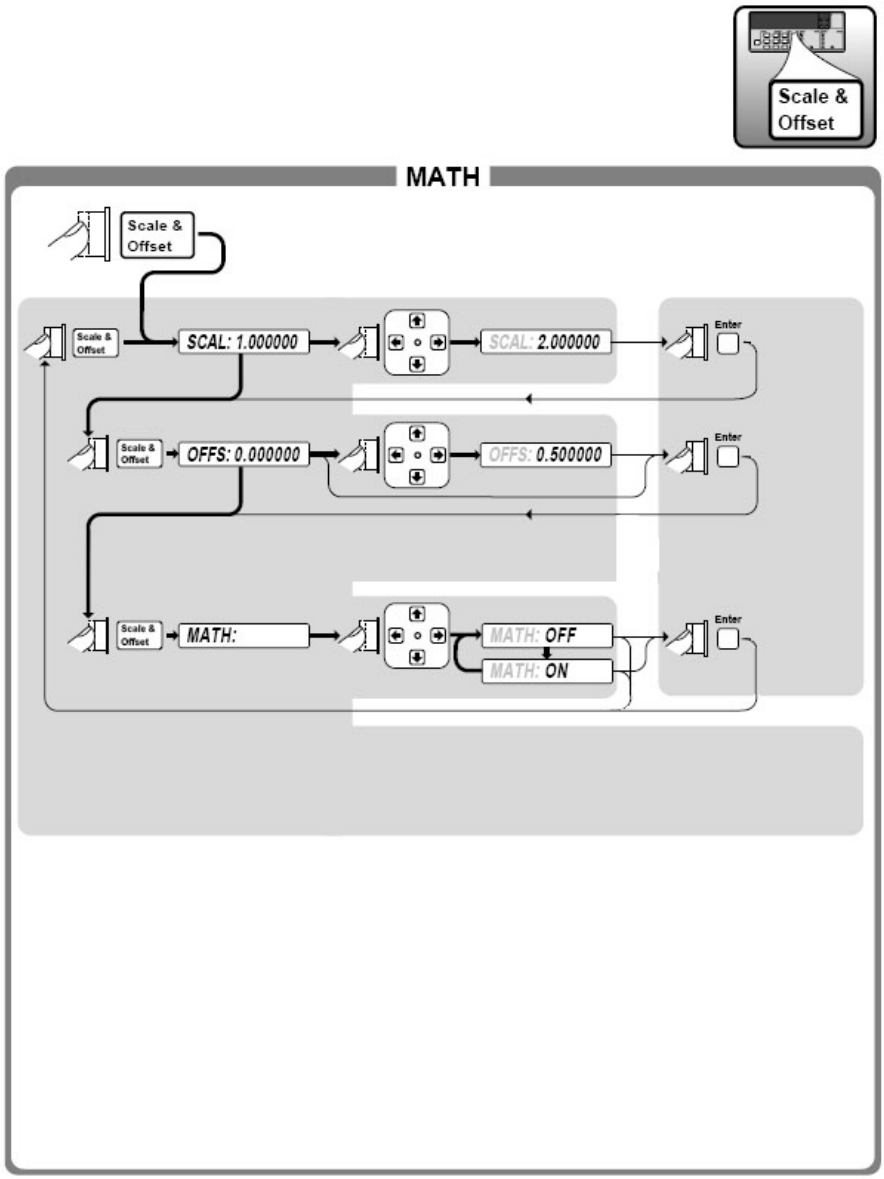
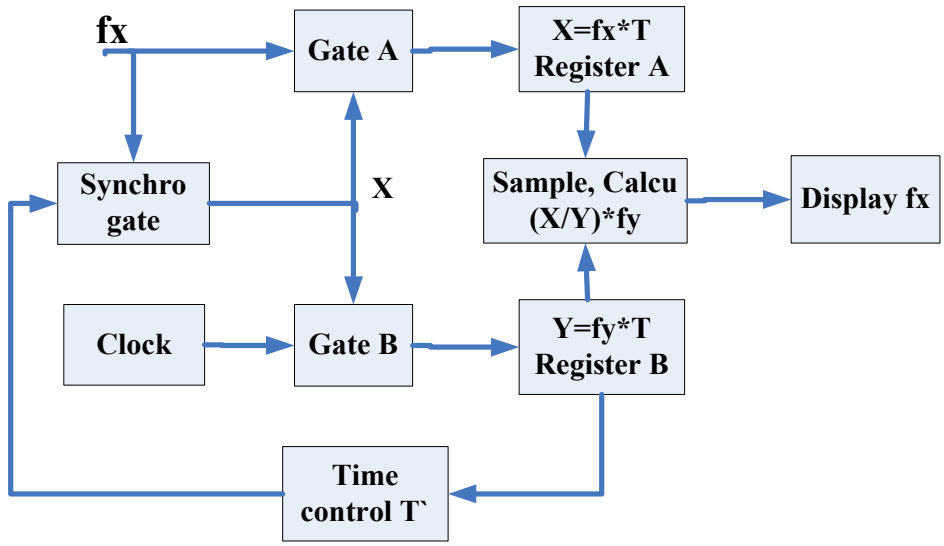


Chapter 3 Principle Summary

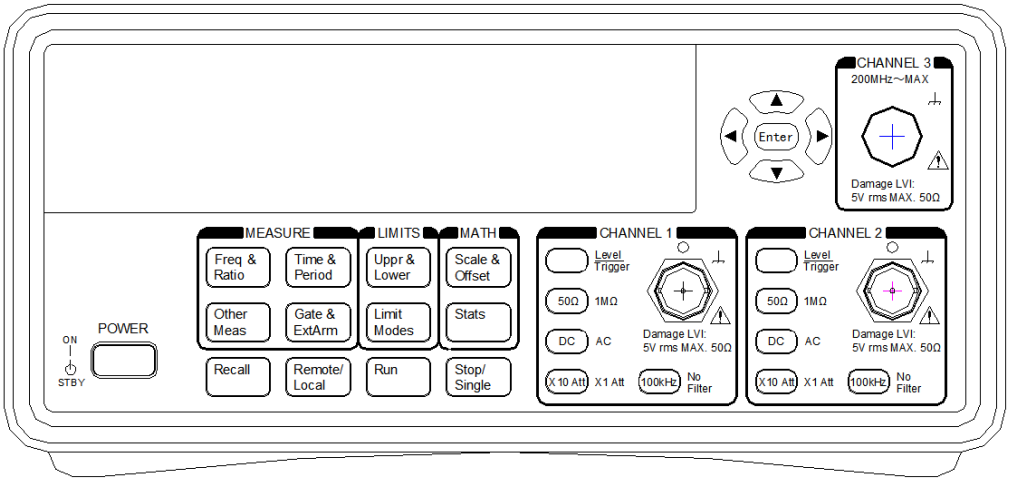
This instrument uses a microcontroller command of the whole system, all of the functions are pre-programmed to memory, so the user can get ideal test results as long as you operate following the instructions.

The machine adopts the inverse multi-cycle synchronous measurement method shown as above. To count sepeartely test signal f_x and clock pulse f_y with two registers within same gate time T, and storage down counted number $X = f_x * T$ and $Y = f_y * T$, and obtained $(X / Y) f_y = f_x$ by computing then displayed. Here, the gate time T determined by the time controller T ' but synchronous controlled by input signal. If you choose control time T' = 1s, when the first input signal open the gate, the register begin to counts for clock pulses. When up to the equivalent of 1s, the time controller outputs a signal to the synchronizer so as to make gate closed when the next input signal arrival, and then sent two register's values to computer processor to be calculated then display. As the synchronous control function (gate be synchronized with the input signal), there is no quantization error for X but Y do exist quantization error, Y has nothing to do with the measured signal fx, but be only related to the measurement time. The instrument's resolution is 8 bit / s or 9 bits/ 10s, 9 bits/s can be reached when using function of shield displaying bits. Block diagram is as follows



Chapter 4 Panel Introduction

4.1 Front Panel



4.1.1 Introduction of each interface, pressing-key and subarea

〖**POWER**〗 Power Swtich

【 **Freq&Ratio** 】 Key of frequency measurement and frequency ratio measurement, when in the state of this function, LED indicator under this key will be light on.

【**Time&Period**】 Function key of period, pulse width and time interval, the LED is the same as above.

【**Other Meas**】 Function key of totalize, duty circle and phase difference, and indicator light is the same as above.

【**Gate&ExtArm**】Selection key of internal gate and external trigger gate.

【**Upper&Lower**】To set upper limit and lower limit.

【**Limit Modes**】 To set limit modes, only limit mode is open the LED will light on.

【**Scale&Offset**】 To set value and function of scale and offset, only open this function the LED will be lighted on, the default of this function is OFF.

【**Stats**】 Statistics operation key, the LED will be light on when execute this function.

【**Recall**】Recall and Save key, and also can set the GPIB address and RS232 Baud rate，the LED will be light on when execute this function.

【**Remote/Local**】Key of Remote and Local, and the default state is Local, LED is off. While, the LED is on if Remote state is selected.

【**Run**】Run key, the indicator light will be on when the instruments be always on measurement state.

【**Stop/Single**】Key of Stop and Single, and LED will be light on and be red when execute this function.

【**Level/Trigger**】Function switch between trigger level and slope, and LED will be light on and be red when execute this function.

【**50Ω/1MΩ**】slection key between 50Ω or 1MΩ, light on means 50Ω and light off means 1MΩ, the default setting is 1MΩ.

【**DC/AC**】selection key of DC or AC, the default setting is AC, and LED is off; when DC is selected, LED is on.

【**×10Att**】attenuation key, the default setting is unattenuation, and the LED is off; when attenuation is selected, the LED is on.

【**100kHz Filter**】filter key, the default setting is unfilter and LED is off; press this key again the filter is started and the LED is on.

【↑】【↓】【←】【→】 Arrow keys,

【**Enter**】enter key, every time you press this key the LED will on.

〖**MEASURE**〗Measurement function menu keys.

〖**LIMIT**〗Limit menu keys.

〖**MATH**〗Math menu keys.

〖**CHANNEL 1**〗input and state setting area of CH1, the LED above Q9 interface stands that whether the external signal is input.

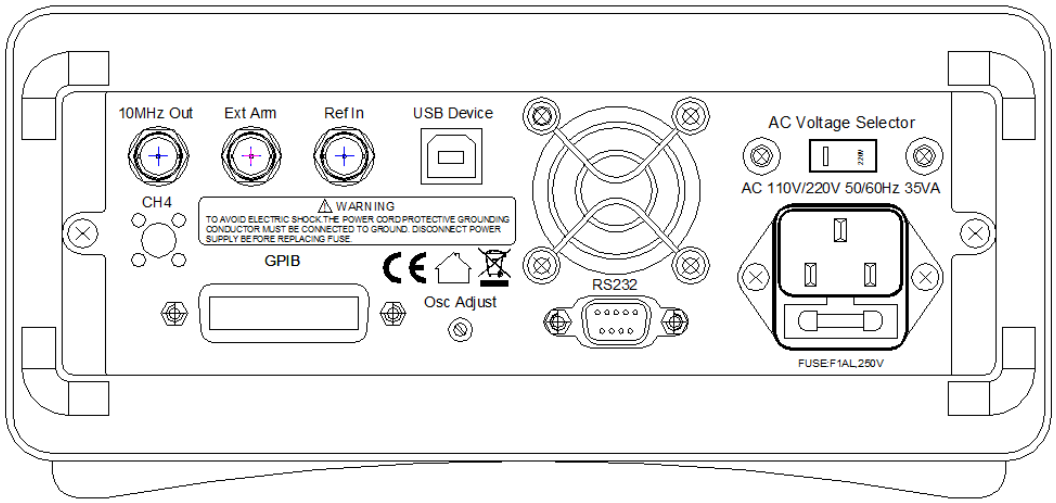
〖**CHANNEL 2**〗input and state setting area of CH2, the LED above Q9 interface stands that whether the external signal is input.

〖CHANNEL 3〗 signal input area of CH3.

4.1.2 Keys

Each function key is all transparaent key, green LED is under key. If one function is enabled or stopped, the corresponding LED will be turned on or off. The specific description will be in next chapter.

4.2 Rear Panel



Ref In External frequency standard input, 5MHz or 10MHz can be selected, switch automatically inside the instrument.

10MHz OUT Frequency standard output 10MHz.

Ext Arm External trigger input port.

USB Device USB Device interface

CH4 Output of adding option 26.5GHz

GPIB GPIB interface (Optional)

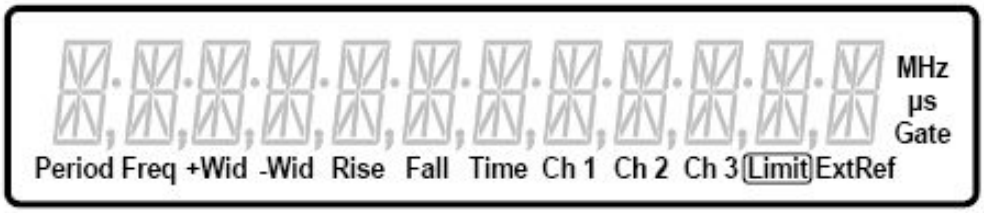
RS232 RS232 interface

Osc Adjust adjusting orifice of inner oscillator accuracy

AC Voltage Selsector AC 110V/220V switch

Outlet Power interface, with two 1A fuse, one for the spare

4.3 Display Indicator



Period Counter is set to measure Period

Freq Counter is set to measure Frequency

+Wid Counter is set to measure Positive Pulse Width

-Wid Counter is set to measure Negative Pulse Width

Rise Counter is set to measure Rise Time

Fall Counter is set to measure Fall Time

Time Counter is set to measure Time Interval

Ch 1 Counter's channel 1 is selected to measure an input signal.

Ch 2 Counter's channel 2 is selected to measure an input signal.

Ch 3 Counter's channel 3 is selected to measure an input signal.

Limit Counter is limit testing and the current measurement exceeds the user entered limits.

ExtRef Counter is set to use the signal connected at rear panel Ref In connector as the frequency standard signal

Hz The displayed data is in units of Hertz.

M The prefix for the units of the displayed data is mega (10^6).

µ The prefix for the units of the displayed data is micro (10^{-6}).

S The displayed data is in units of seconds.

Gate The gate is open. Before a measurement starts, this annunciator is OFF, indicating the gate is closed. During a measurement, the annunciator is ON, indicating the gate is open.

Chapter 5 Operating Instruction

5.1 Works before Measurement

5.1.1 Preparation before Measurement

Carefully check whether the power supply and voltage within the limit range of this counter, put the power cord into the power outlet in the rear panel of this counter. Make sure use a three-wire power cord and two-wire power cord is forbidden. Carefully check the power condition of the test system to ensure the earthing between systems is no problem, and make sure instrument housings and all exposed metal are grounded. Connected with other instruments, there is no potential difference between instruments.

5.1.2 Power on

After connecting power, internal crystal oscillator of the counter is already power on.

Press power switch in the front panel, the instrument enter into initialization state, all the indicators in the front panel are ON, then display screen is full-bright, display manufacturers brand and instrument model number, meanwhile, all the indicators in the front panel are OFF.

After initialization, the instrument will enter into measurement state of Frequency1. The default is the local state.

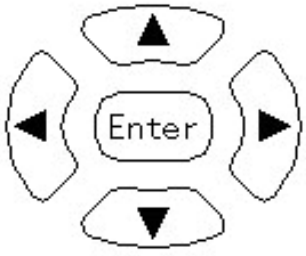
5.2 Operation Instruction

5.2.1 【Stop/Single】and 【Run】keys

In general, the Run key provides continuous Measurement, when it is pressed, its LED light is on. While the 【Stop/Single】 key allows you to stop the current measurement or make single-shot measurements. When switch from Run to Stop/Single, the display shows the last read value, and the red LED light under this key begin to light. At present, every time you press the Stop/Single key, the counter will read the value again and update the display. Meantime, the red indicator under Stop/Single key will light on once.

In the cumulative count function under 【Other Meas】, if in the Run state, the indicator of 【Other Meas】and 【Run】will be light at the same time, the display shows the totalize value. If press 【Stop/Single】key, the indicator of 【Run】will be off, while the indicator of 【Stop/Single】will be lit, showing the count value in last moment, then press again the 【Stop/ Single】key and cumulative count start again, the indicator blink once, press again the count will stop, display the last value and the red indicator light will be lit.

5.2.2 【Enter】、【↑】、【↓】、【←】、【→】key



Use the 【→】to move right to select adjustable digits or adjustable menu.

Use the 【←】to move left to select adjustable digits or adjustable menu.

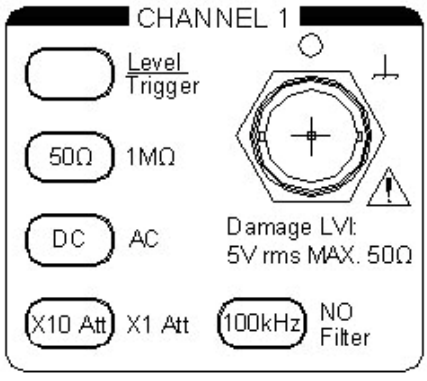
Use the 【↓】to decrement the selected digit of the displayed value.

Use the 【↑】to increment the selected digit of the displayed value. Also it can be used to select the adjustable menu in some function.

Use 【←】and【→】key to increase or decrease to display digits in Frequency and Period function. Press 【←】once can decrease one digits, at least 3 digits will be remain at last; press 【→】once can increase one digits, 12 digits at most can be displayed.

5.2.3 Setting key in Channel selection

1) 【Level/Trigger】key, press this key the indicator light on and the 'LEVEL:+0.000V' will be shown in the display, the value is adjustable. Then use the 【↑】【↓】【←】【→】key to adjust



the trigger level and press 【Enter】to confirm, and out of this function at present. Press this key again, the function is switched to polarity selection, 'SLOPE:POS' or 'SLOPE:NEG' will be shown in the display and the LED indicator will be on. Use 【↑】【↓】【←】【→】key to select in the Positive and Negative, finally press 【Enter】key to confirm.

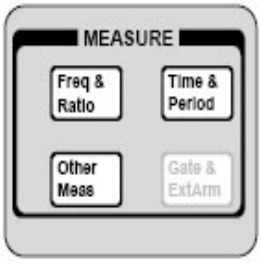
2) Use 【50Ω/1MΩ】key to select the chanel state to be 50Ω or 1MΩ, and the default setting is high impedance 1MΩ. Press this key fitst time and the indicator light on , the counter be in 50Ω, press this key again then switch to 1MΩ and the indicator light off.

3) Use the 【DC/AC】key to selec the AC or DC. The default setting is AC and the indicator is off. Press down this key, the state be switched to DC and indicator is light on.

4) 【×10Att】is attenuation key. The default setting is ×1 attenuation state and the indicator is off. Press this key the state will be swith to ×10 attention and the indicator is ligh on.

5) 【100kHz Filter】is filter key. The default setting is non-filter and the indicator is off. Press this key and the state will be switch to 100kHz filter and the indicatot is on.

5.2.4【Freq&Ratio】,【Time&Period】,【Other Meas】



All measurement functions of this counter are included in the three keys. Use 【Freq&Ratio】to measure the Frequency and Frequency Ratio of CH1 and CH2. Use 【Time&Period】key to measure Period, pulse width(Postive or Negative) and time interval. And use 【Other Meas】key to measure Totalize, duty circle and phase difference.

For the detail function description of three keys, please see the below table,

【Freq&Ratio】	【Time&Period】	【Other Meas】
FREQUENCY 1	PERIOD 1	TOTALIZE 1
FREQUENCY 2	PERIOD 2	TOTALIZE 2
FREQUENCY 3	PERIOD 3	DUTYCYCLE 1
RATIO 1 TO 2	TI 1 TO 2	PHASE 1 TO 2
RATIO 2 TO 1	POS WIDTH 1	
	NEG WIDTH 1	

To sequence through the menus of the measurement function keys (Freq & Ratio, Time & Period, and Other Meas keys), you simply need to repeatedly press the appropriate MEASURE key to cycle through (and loop around) the menus under the key. Each press of a MEASURE key will advance the Counter to the next measurement function in the menu.

1) to Measure Frequency

a. Connect power source to Counter, and turn on Counter.

b. Connect an input signal to CH1.

To set up CH1's trigger level, signal polarity, coupling, impedance, and other triggering conditions to match the input signal you are trying to measure, which can be set by pressing key of 【100kHz Filter】, 【×10Att】, 【DC/AC】, 【50Ω/1MΩ】and【Level/Trigger】.

c. Press the 【Freq&Ratio】key until FREQUENCY 2 is displayed to measure the frequency of an input signal applied to CHANNEL 2. FREQUENCY 2 is momentarily displayed, the Freq and Ch2annunciators light, and the Counter is ready to measure frequency of a signal applied to CHANNEL 2 input.

2) To Measure Frequency Ratio

Press 【Freq&Ratio】 key until RATIO 1 TO 2 is displayed.

RATIO 1 TO 2 is momentarily displayed, the Freq, Ch1, and Ch2 annunciators light, and the Counter is ready to measure and display the frequency ratio of a signal applied to CHANNEL 1 in relation to a signal applied to CHANNEL 2 (Ch1/Ch2).

Note the result is not scaled by 100; it is not a percentage.

Note that the default setting of CH1 and CH2 is positive, gate time 1s and trigger level 0V, and the measure mode can be switch by function menu keys.

Note that RATIO 2 TO 1 is also available (Ch2/Ch1), and operation is same as CH1/CH2.

By pressing the Freq & Ratio key, the Counter will return to the Frequency 1 measurement mode; this demonstrates the loop around feature of the measurement function menu keys.

3) To Measure Period

Press 【Time&Period】 key until PERIOD 1 is displayed.

PERIOD 1 is momentarily displayed, the Period and Ch1 annunciators light in the screen, and the Counter is ready to measure the period of a signal applied to CH1.

Press the key again until PERIOD 2 is displayed and conter come into the measurement sate of CH2, the state and operation as same as CH1

4) To Mearsure Pulse Widht

Press 【Time&Period】 key until POS WIDTH 1 or NEG WIDTH 1 is displayed. POS WIDTH 1 or NEG WIDTH 1 is momentarily displayed, and the +WIDTH or -WIDTH, and Ch1 annunicators light. Note that the pulse width measurement automatically configures the Counter to perform positive or negative pulse width measurements through CHANNEL 1 input.

5) To Measure Time Interval

TI 1 TO 2 is momentarily displayed, the Time, Ch1, and Ch2 annunciators light, and the Counter is ready to measure the length of time between a start signal on CHANNEL 1 and a stop signal on CHANNEL 2. In the measurement process, use 【Level/Trigger】key to set the trigger slope of start or stop signal to be positive or negative.

6) Totalize 1

Press 【Other Meas】 key until TOTALIZE 1 is displayed.

TOTALIZE 1 is momentarily displayed, the Ch1 annunciator lights, and the Counter is in its totalize mode. The current totalize value is shown in the display and always in changing state.

The totalize measurement is cleared to zero and restart to totalize when the totalize function is first invoked, when the front-panel 【Run】 key is pressed, or when the 【Stop/Single】 key is pressed.

7) Totalize 2

Press 【Other Meas】 key until TOTALIZE 2 is displayed, TOTALIZE 2 is momentarily displayed, the Ch1 annunciator lights, and the Counter is in its totalize mode. The current totalize value of selected gate time will be displayed, which will be update based on different gate time.

The totalize measurement is cleared to zero and restart to totalize when the totalize function is first invoked, when the front-panel 【Run】 key is pressed, or when the 【Stop/Single】 key is pressed.

8) To Measure Duty Cycle

Press 【Other Meas】 key until DUTYCYCLE 1 is displayed. DUTYCYCLE 1 is momentarily displayed, the Ch1 annunciator lights. The dutycycle mode of operation is ready to measure a continuous waveform applied to CHANNEL 1 input. Then current duty cycle value will be shown in display and GATE flash once every time you measure gate. Results will range from 0 to 1.

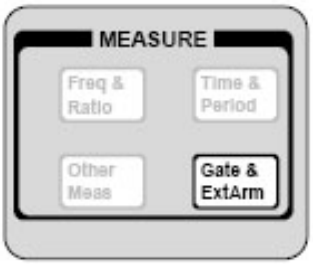
9) To Measure Phase Different Measurment

Press 【Other Meas】 key until PHASE 1 TO 2 is displayed. PHASE 1 TO 2 is momentarily displayed, the Ch1 and Ch2 annunicators light, and the Counter is ready to measure the phase of a signal applied to CHANNEL 1 input relative to a signal applied to CHANNEL 2 input. The phase difference is displayed in degrees. However, you may disable auto triggering, and change the trigger levels and slopes.

Use CHANNEL 2 as the reference. One period on CHANNEL 2 will define 360°. If CHANNEL 1 is leading CHANNEL 2 the pulse result is positive, otherwise

it will be negative.

5.2.5 【Gate&ExtArm】key

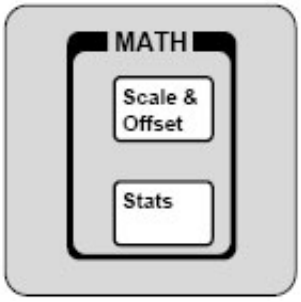


The MP00641 has two arming modes: Internal and External.

Press 【 Gate&ExtArm 】 key until GATE:1.000000s is displayed and the annunicators light. Use 【 ↑ 】, 【 ↓ 】, 【←】 and 【→】 to select gate setting, and use 【←】 or 【→】 to select the gate, use 【 ↑ 】 or 【 ↓ 】 to adjust the value of the gate. Every press of 【 ↑ 】 or 【 ↓ 】, gate value will increase or decrease one, and the adjustable range is 0.000001s-10000s. After selecting, press 【ENTER】 to confirm. Then the counter back to the previous measurement menu and continue measuring. When every measurement is completed, 'GATE' in the screen will flash one time.

Press 【Gate&ExtArm】 again until GATE:EXTERNL is displayed thus the annunicators light, and the EXTERNL is in flash state. When external arming mode is enabled, a signal must be connected to the Counter's rear-panel Ext Arm connector, then press 【ENTER】 key to confirm the current operation.

5.2.6 【Scale&Offset】 and 【Stats】 key



Note that Math and Limits are not available for Totalize. As shown in left diagram, the keys of 【Scale&Offset】 and 【Stats】 are included in MATH function area. The MATH function is disabled in the initial state and the annunicators of the two keys are OFF.

1) The function of 【Scale&Offset】 key

The Scale and Offset functions within the Math menu allow you to perform simple mathematical operations on the measurement result before it is displayed. Modification of the displayed measurement by these math

operations is represented by the following equation:

(Measurement × Scale) + Offset = Displayed Result

The math operations can be used, for example, to subtract systematic errors and so on.

The menu items of the Scale and Offset Math functions allow you to:

a. enter a desired multiplication factor for a measurement (SCAL:).

b. enter a desired addition or subtraction value for a measurement (OFFS:).

c. disable or enable the Math mode. The initial state is MATH:OFF. Make sure to turn the Math mode on if you want to make this function enable.

Example Procedure for Scale and Offset, see the below:

a. Connect a signal to channel 1, press 【Freq&Ratio】key to measure Frequency of CH1.

b. Press 【Scale&Offset】key and MATH:OFF is displayed, press any arrow key the MATH:ON is always displayed and the annunicators light.

c. Press 【Scale&Offset】again, and SCAL:1.000000 is displayed. The scale value doesn't need to be set in this example. If need, use arrow key to set SCAL value.

d. Then press 【Scale&Offset】again and OFFS:0.000000 is displayed. Because of systematic errors 1Hz, use arrow key to set offset value be 1Hz, and OFFS:-1.000000 is displayed.

e. Press 【ENTER】key to confirm the operation and the counter begin to mearsure, the displayed result is measured result multiply 1 then subtract 1(systematic error 1Hz)

Note: If you turned MATH off, no matter you set SCAL of OFFS, the MATH operation doesn't work. But if you set SCAL or OFFS then press 【ENTER】 and back to previous measure state, the MATH mode will be opened automatically and the annunicators of 【Scale&Offset】 light.

2)【Stats】key

All the statistical computation function under this key is not applicable to Totalize function.

a. Press 【Stats】key until SHOW:MEAN is displayed, the annunciators of Freq and CH1 light.

b. Use the arrow key to select the required function, such as MEAN, MAX, MIN, PPM, STD DEV and ALLAN.

Averaged value MEAN: after 'N' Measurement

$$\text{MEAN}=\frac{1}{N}\sum_{i=1}^{N}Fi$$

Maximum value MAX: after 'N'Measurement

MAX= the maximum value during 'N' measurement.

Minimum value MIN:

MIN= the minimum value during 'N' measurement.

Singal relative deviation measurement （PPM ACCURACY）:

$$\text{PPM}=\frac{Fi-Fo}{Fo}\times 10^{6}$$

Standard deviation measurement (STD DEVIATION):

$$\text{STD DEV}=\sqrt{\frac{N\sum_{i=1}^{N}Fi^{2}-(\sum_{i=1}^{N}Fi)^{2}}{N(N-1)}}$$

Allan Variance Measurement（ALLAN VARIANCE）:

$$\text{ALLAN}=\sqrt{\frac{\sum_{i=1}^{N-1}(F_{i+1}-F_{i})^{2}}{2(N-1)}}$$

'N' in above formular is sample number, F_0 is pre-setting frequency, F_i is measured frequency.

Press any arrow key until SHOW:MAX is display if you want use MAX function.

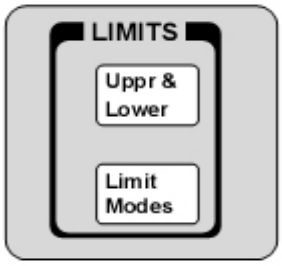
c. Press 【ENTER】key to confirm the current operation, the annunciators

flash once and the counter is ready to measure and DOING STATS is displayed. The default sample number N is 100 and trigger gate time is 1s. The maxmum value is displayed after 'N' measurement. If you want to restat to select the computing function, press 【ENTER】key again then ao back to function menu.

d. Press 【Stats】again until F_0:10.000000 is displayed, the anunciators of unit M is light. F_0 is pre-setting frequency which is applied to PPM ACCURACY. Press arrow key to adjust the pre-seting frequency. Use 【↑】and【↓】key to increase or decrease the current value and the step value is 1. Use 【←】and【→】key to shift the digits left or right. Press 【ENTER】key to confirm, otherwise, it isn't a valid operation.

e. Press 【**Stats**】key again unitl N:100 is displayed. N is sample number, and it's minmum number is 2 and maxmum number is 10000. In current menu, use 【↑】and【↓】key to increase or decrease the current value and the step value is 1. Use 【←】and【→】key to shift the digits left or right. Press 【ENTER】key to confirm, otherwise, it isn't a valid operation.

5.2.7 【Uppr&Lower】and【Limit Modes】key



Note: Math and Limis menus are not available for Totalize and
Voltage Peaks measurements.

The menu items under the Limits keys allow you to:

1) select the desired upper and lower measurement limits (UPPR:, LOWR:).
2) disable or enable Limit Testing (LIM TEST: OFF or ON)—Note that the Limit Testing is automatically enabled when you set the upper and lower limits.
3) set the Counter's run mode when a measurement exceeds the user-entered limits: continue taking measurements or stop making measurements

(ONFAIL: GO ON ON FAIL: STOP).

For example: to measure a signal frequency whether within the setting limits, suppose the frequency of the signal is 10MHz. Now start the operation:

a. Connect input signals to channels 1 of the Counter, the anunciators light.
b. Press 【Freq&Ratio】key and set CH1 frequency until FREQUENCY 1 is displayed, the counter is ready to measure and the current frequency value is displayed.
c. Press 【Uppr&Lower】key until UPPR:********* is displayed.
d. Set upper frequency by arrow keys, and set the frequency value to be 11.000000MHz.

   Note: make sure to press 【ENTER】key to confirm after setting upper limits.
e. Press 【Uppr&Lower】key until LOWER:********* is displayed.
f. Set lower limits frequency to be 9.000000MHz by using arrow keys and make sure to press 【ENTER】key to confirm after setting.
g. Press 【Limit Modes】key until LIM TEST:ON is displayed and press 【ENTER】to confirm.

   Note that the Limit Testing is automatically enabled when you set the upper and lower limits. But to gurantee no problem, please turn on the limits function again after setting upper and lower limits.
h. Press 【Limit Modes】key again until ON FAIL:GO ON is displayed. Adjust ON FAIL: STOP by using any arrow key. Press 【ENTER】key to confirm.
i. Press 【Freq&Ratio】key or 【Run】key and the counter is ready to measure. If the measurement result exceeds the user-entered limits, the annunciators of LIMIT will light.

5.2.8 【Recall】and【Remote/Local】key

5.2.8.1 Under 【Recall】composite key, the following functions are included: RECALL, SAVE, UNSAVE, GPIB interface address and RS232 Baud rate, CH1 system voltage, CH2 system voltage, buzzer switch and software version.

a. Save and Recall

RECALL/SAVE/UNSAVE are three function menus under Save/Recall. 16 kinds status, from 0 to 15, can be recalled. Only status with location number is saved in SAVE menu that can be recalled under RECALL function. 0 in RECALL is the default status, which can't be used in SAVE and UNSAVE.

Memory location 1-15 could be set in SAVE menu. Use the direction key to select the save location and press 【ENTER】key, the current setting is saved.

Recall the corresponding memory location number, the instrument will enter into that status directly. If the location number wasn't saved, it won't be displayed in RECALL and UNSAVE menu. And memory location number can be repeatly edited, and instrument will operate according to the final save. When power on instrument, it will use the last save or recall status before last powering off .

UNSAVE menu can erase the saved status. Only the saved location can be erased. Select the save location by direction key and press 【ENTER】key to confirm erase operation.

b. GPIB address and Baud Rate set

GPIB address can be set from 0~30, and default is 15. Press【Recall】continuously until 'GPIB:15' is displayed in the screen. 1 or 5 in 15 flashing means they can be adjusted. Press 【←】and【→】key to change the adjustable location, and each press 【↑】and【↓】key to increase or decrease 1, at last press 【ENTER】key to confirm the operation.

Default baud rate is 9600, and others are the fixed allocation, including eight data bits, one stop bit, no check bit. Baud rate includes 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Change the baud rate by pressing 【←】

【→】【↑】and【↓】key, at last press 【ENTER】key to confirm the operation.

c. CH1 and CH2 system voltage

Press【Recall】continuously until 'SYSTEM: x.xxxV' is displayed in the screen. When CH1 is synchronously displayed, it means CH1 system voltage, CH2 displayed means CH2 system voltage. Press 【←】【→】【↑】【↓】key and 【ENTER】key to adjust the voltage and setting. The system voltage is special for the calibrator, pls don't randomly change them in using.

d. Buzzer

Press【Recall】continuously until 'BUZZER: ON' or 'BUZZER: OFF' is displayed in the screen. 'ON' or 'OFF' flashing means it can be adjusted by direction keys and press【ENTER】key to confirm it. Select'BUZZER: ON' to switch on the buzzer, and every pressing will be with sound. Select 'BUZZER: OFF' to switch off the buzzer, and every pressing will be without sound.

e. Software version

Press【Recall】continuously until 'V5-XX.XX.XX' is displayed in the screen. For example, 'V5-19.02.18' means the instrument's software version, which can be only checked and not be changed.

5.2.8.2 【Remote/Local】key

The initial state of the counter is local, the annunciator of 【Remote/Local】is OFF. Press 【Remote/Local】key until REMOTE or LOCAL is displayed. If 'REMOTE' is displayed and the annunciator light,the counte is in remote state. except of 【Remote/Local】key, other keys are disable and only remote operation are enable. Press 【Remote/Local】key again until LOCAL is displayed and the annunciators is OFF. At present the counter is in LOCAL state and can be operated by local key.

Chapter 6 Remote Instruction

6.1 Summary

The programmer commands for the counter are written by referring to SCPI standards. And interface of USB Device, RS232 and GPIB are support for this counter but GPIB is optional, users should enquiry if they are required. The programmer commands are based on ASCII code, the datas that counter return to computer are also ASCII code, through the remote interface to programmer control the instruments.

6.2 Connection and setting of interface

The RS232 interface of this instrument is universal serial one with 9-pin socket. Using a standard RS232 connection cable can connect the computer and counters. Make sure to power off when connecting. Press 【Recall】key to set the paremeters （Baud rate）of RS232interface. If the communation between computer and counter is unavailable, pay attention to the Baud rate setting and check whether they are in line. Change baud rate if necessary.

Use IEEE488 cable to connect the computer and counter and make sure to power off before connecting. The address setting of GPIB interface through pressing 【Recall】key.

The USB Device interface is in the rear panel of the counter, use a piece of standard USB cable to connect the computer and counter. The initial state is LOCAL when powering on. Once enter into REMOTE state, the other keys in front panel except of 【 Remote/Local 】 key are disable. Press 【Remote/Local】key in remote state the counter will enter into LOCAL state manually.

6.3 Introduction of Programmer commands

6.3.1 SCPI commands structure

There are two commands types for this counter: GPIB common commands and SCPI commands (Standard Commands for Programmable Instruments). GPIB

common commands are definited with IEEE488.2-1987 standards and be applied to all instruments, but this counter isn't support all the common commands. SCPI command, with tree structure, has three levels at most, and top one is called subsystem command. Only select the subsystem command, the sub-level under this command can be effective. Use a colon to separate high-level command and low-level commands

6.3.2 SCPI commands syntax

1) Command keywords and parameter

There are two types for common commands and SCPI commands: parameter and without parameter. Here are some examples:

*RST	without parameter
:FORMat<name>	with parameter (name)
:IMMediate	without parameter

There is at lease one space between keywords and parameter.

Some command words are put in [ ]:, which means these commands are optional, and which can be omissed in programming. For example:

:RANGe[:UPPer] <n>

[:UPPer] means :UUPer is optional and can be selected not to use. This is to say, this command can be sent by the following two ways:

:RANGe <n> or :RANGe:UPPer <n>

Angular bracket < > indicates this option is a parameter value, which will not be included in programming. For example: :HOLD:STATe <b>

<b> means here is a Boolean parameter. If you want to turn on HOLD function, commands with On or 1 must be sent, see below:

:HOLD:STATe ON or :HOLD:STATe 1

Parameter type: here are some common parameters types:

<b> Boolean: enable or disable some operation function by using this parameter. 0（OFF）means to turn off this operation and 1 （ON）means to turn on the operation. For example:

:INPut1:FILTer ON turn on filter function of CH1

<name> Name parameter: select one parameter in the listed parameter, for example:

<name> = MOVing

REPeat

:RESistance:AVERage:TCONtrol MOVing

<NRf> Numeric Representation format: this represents an integer （4）, real (42.4) or float number (4.24E3). For example:

:EVENt1:LEVel:ABSolute 4.24

<n> Numeric value: This parameter value represents the NRf number or name of these parameters are as follows: DEFault，MINimum，MAXimum.

2) Rules for commands keyword

Use the following rules to determine any SCPI command abbreviations.

If the length of keywords is less than or equal to four characters, there is no abbreviations. For example:

:AUTO = :AUTO

The rules is applied to keywords exceeds four characters.

If the forth character of key words is one of v,o,w,e and l, remove it and following words. For example:

:immediate = :imm

Special rules: The following abbreviations of this command only use the first two characters of the keyword:

:Tcouple = :tc

If the forth character in the keyword is a consonant, then remain it and remove tge following charanters. For example,

:format = :form

If this command contains the query sign (?) Or a non-selected numbers in the command keyword, it must be included in abbreviations. For example:

: Delay? =: Del?

Keywords or signs included in square brackets ([ ]) are optional, which can't be included in the programing code.

3) Basic rules of command structure

Ignore block letters or lowercase.

For example，FUNC:IMP CPD = func:imp cpd = Func:Imp CpD

Space (_ stands for space) can't be put in the back of colon.

Command for instrument is either can be used in abbreviation format or be used in full format. (block letters must be used in abbreviation format)

Add a interrogation "?" in the end of commands, you can query the current value for this command.

4) Multi-command rules

Use semicolon (;) to separate the multi commands in the same level.

Semicolon (;) as a separator, followed by a colon (:), means re-start to command from the top level of the command tree.

As long as using a semicolon (;) to separate the common commands and SCPI commands, they can be used in the same command.

4) Command path rules

Each new program must begin from the root command, unless the root command is optional (for example: [SENSe]). If the root command is optional, make the next level of command as root command.

The colon (:) in the beginning of the program is optional, you can select do not use it. For example:

: INITiate [: IMMediate] = INITiate [: IMMediate]

When theprogram detects a colon (:), the program pointer moves to the next command level.

When the program detects a colon (:) followed by a semicolon (;), it will return to the root command level.

The procedure pointer can only move down to lower level but can not move up upper level, so when the implementation of a high-level command, you need to start from the root command.

6.3.3 Programmable command format

Programmable command is the commands that computer send to counter and be based on ASCII characters. The end command is 0AH (LF or hex ten). Note: a period of time should be retained for counter to respond after computer sending a piece of command then you can let the computer send the second command.

6.4 Programmer commands

Here will introduce the remote commands the counter will use in detail and other requirements:

1. To set/enquiry trigger level

[:SENSe]:EVENt[1|2]:LEVel[:ABSolute] <numeric_value>[V]

[:SENSe]:EVENt[1|2]:LEVel[:ABSolute]?

<numeric_value> in this command means it should be a real value , and setting range is - 5V<=numeric_value<=+5V, set the step value to be 0.005V, and there is no space between last value and unit.

2. To set/enquiry trigger slope

[:SENSe]:EVENt[1|2]:SLOPe POSitive | NEGative

[:SENSe]:EVENt[1|2]:SLOPe?

3. To set/enquiry input impedance

:INPut[1|2]:IMPedance <numeric_value> [OHM]

:INPut[1|2]:IMPedance?

4. :INPut[1|2]:COUPling AC|DC

:INPut[1|2]:COUPling?

5. To set/enquiry attenuation ×1

:INPut[1|2]:ATTenuation 1

:INPut[1|2]:ATTenuation?

6. To set/enquiry attenuation×10

:INPut[1|2]:ATTenuation 10

:INPut[1|2]:ATTenuation?

7. Filter switch/status enquiry

:INPut[1|2]:FILTer ON | OFF

:INPut[1|2]:FILTer?

8. To set/enquiry Baud rate

:SYSTem:COMMunicate:SERial:TRANsmit:BAUD <numeric_value>

:SYSTem:COMMunicate:SERial:TRANsmit:BAUD?

9. To set/enquiry GPIB address

:SYSTem:COMMunicate:GPIB:TRANsmit:ADDRess <numeric_value>

:SYSTem:COMMunicate:GPIB:TRANsmit:ADDRess?

10. Stop or Single/enquiry

:INITiate:CONTinuous OFF

:INITiate:CONTinuous?

11. Run at full speed/enquiry

:INITiate:CONTinuous ON

:INITiate:CONTinuous?

12. Begin to measure

:INITiate[:IMMediate]

13. To mearsure frequency

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]FREQuency [1 | 2 | 3]"

14. To measure frequency ratio

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]FREQuency:RATio [1,2 | 2,1]"

15. Totalize

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]TOTalize [1|2]"

16. To measure phase difference

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]PHASe [1,2]"

17. To measure duty cycle

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]DCYCle [1]"

18. To measure time interval

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]TINTerval [1,2]"

19. To measure period

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]PERiod [1,2]"

20. To measure positive pulse-width

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]PWIDth [1]"

21.To measure negative pulse-width

[:SENSe]:FUNCtion[:ON] "[:][XNONe:]NWIDth [1]"

22.External gate trigger/enquiry

[:SENSe]: ARM:SOURce EXTernal

[:SENSe]: ARM:SOURce?

23.To set/enquiry gate time

[:SENSe]:ARM:TIMer <numeric_value> [S]

[:SENSe]:ARM:TIMer?

24.To set/enquiry start signal's trigger slope in time interval

[:SENSe]:TINTerval:ARM:STARt:SLOPe POSitive | NEGative

[:SENSe]:TINTerval:ARM:STARt:SLOPe?

25.To set/enquiry stop signal's trigger slope in time interval

[:SENSe]:TINTerval:ARM:STOP:SLOPe POSitive | NEGative

[:SENSe]:TINTerval:ARM:STOP:SLOPe?

26.To set/enquiry upper limit

:CALCulate2:LIMit:UPPer[:DATA] <numeric_value> [HZ | S | DEG

:CALCulate2:LIMit:UPPer[:DATA]?

27.To set/enquiry lower limit

:CALCulate2:LIMit:LOWer[:DATA] <numeric_value> [HZ | S | DEG]

:CALCulate2:LIMit:LOWer[:DATA]?

28.To set/enquiry Limit state ON/OFF

:CALCulate2:LIMit:STATe OFF | ON

:CALCulate2:LIMit:STATe?

29.To set/enquiry ON FAIL:GO ON

:INITiate:AUTO OFF

:INITiate:AUTO?

30.To set/enquiry ON FAIL:STOP

:INITiate:AUTO ON

:INITiate:AUTO?

31.To select/enquiry Statistics computation

:CALCulate3:AVERage:TYPE MAXimum | MINimum |SDEViation | MEAN |ALLan|PPM

:CALCulate3:AVERage:TYPE?

32.To set/enquiry N value

:CALCulate3:AVERage:COUNt <numeric_value>

:CALCulate3:AVERage:COUNt?

The range of <numeric_value> should be in 2 to 100000, a space should be added between the setting number and unit.

33.To set/enquiry SCALE

:TRACe[:DATA] SCALE <numeric_value>

:TRACe[:DATA] SCALE?

34.To set/enquiry OFFSET

:TRACe[:DATA] OFFSET <numeric_value>

:TRACe[:DATA] OFFSET?

35.Math function ON/OFF/enquiry

:CALCulate:MATH:STATe OFF | ON

:CALCulate:MATH:STATe?

36.To set/enquiry F0

:CALCulate3:AVERage:F0 <numeric_value>

:CALCulate3:AVERage:F0?

37.To readout the current value

FETC?

38. Reset

*RST

39. To get the model and version of the counter

*IDN?

'SUIN, SS7200A' will return if the counter receive this command.

40.Enquiry current measuring function

[:SENSe]:FUNCtion[:ON]?

41.Read frequency value: it is also available in measuring period.

:FETCh[:FREQuency]?

42.Read period value: it is also available in measuring frequency.

:FETCh[:PERiod]?

43.Read frequency ratio value

:FETCh[:FREQ:RAT]?

44.Read phase difference value

:FETCh[:PHASe]?

45.Read duty cycle value

:FETCh[:DCYCle]?

46.Read time interval value

:FETCh[:TINTerval]?

47.Read positive pulse width value

:FETCh[:PWIDth]?

48.Read negtive pulse width value

:FETCh[:NWIDth]?

6.5 Introduction of programmer commands

The initial state of the counter is local state, but it will enter into the remote state when sending commands to the counter by using remote interface. The baud rate of RS232 in initial state is 9600, and the remote address of GPIB is 15, which can modified by using the keys in front panel or programmer commands. In the process to remote control the counter, the counter will automatically execute the commands if it's correct, but if the sending command is wrong, the counter won't execute it. One point to say, the data sending to counter or from counter are all ending with 0X0A. If the data sending to counter don't have this ending mark, counter will judge it wrong and not execute it.

Concerning to the unit of commands, they are all the international standard units, if you input other units the counter won't recognize. If using a piece of remote commands including unit, the unit can be input or ignored.

If input commands including datas, there are two ways to input, for example, 10000 is equivalent to 1e4, 0.00234 is equivalent to 2.34e-3.

Chapter 7 Specification

7.1 Working Environment

Temperature: 0 ~ +40℃

Realtive Humility: 20~90%

7.2 Input Characteristic

7.2.1CHA & CHB

Frequency range:	when DC coupling 0.001Hz ～ 200 MHz
	when AC coupling 1MHz~200 MHz （50Ω）
	when AC coupling 30Hz~200 MHz（1MΩ）
Dynamic Range:	50mVrms~1.0Vrms (Sine)
	150mV$_{P-P}$~4.5V$_{P-P}$ (Pulse)
Input impedance:	1MΩ//35pF or 50Ω
Coupling mode:	AC or DC
Trigger Mode:	rise edge or fall edge
Input attenuation:	×1 or ×10
Low-pass Filter:	Ending frequency is around 100 kHz
Trigger level:	-5.000V~+5.000V (mini step: 5mV)
Damage Level:	
	50Ω 5Vrms
0 ~ 3.5kHz	1MΩ 350Vdc + ac pk
3.5kHz ~100kHz	1MΩ 350Vdc + ac pk，when linearity fall to 5Vrms
> 100kHz	1MΩ 5Vrms

7.2.2 CHC

1) Option1

Frequency range:	100MHz~3GHz
Dynamic Range:	-27dBm~+19dBm (Sine) (Frequency: 100MHz~2.6GHz)
	-15dBm~+19dBm (Sine) (Frequency: 2.6GHz~3GHz)
Input impedance:	50Ω
Coupling mode:	AC

2) Option2

Frequency range: 100MHz~3GHz

Dynamic Range: -27dBm~+19dBm Sine

Input impedance: 50Ω

Coupling mode: AC

3) Option3

Frequency range: 200MHz ~ 6.5GHz

Input sensitivity: ≤-15dBm

Max. input power: +13dBm

Damage: +20dBm

4) Option4

Frequency range: 6.5GHz ~ 12.4GHz

Input sensitivity: ≤-15dBm (Typical Value)

Max. input power: +10dBm (typical: +13dBm)

Damage: +25dBm

5) Option5

Frequency range: 6.5GHz ~ 16GHz

Input sensitivity: ≤-15dBm (Typical Value)

Max. input power: +10dBm (typical: +13dBm)

Damage: +25dBm

6) Option6

Frequency range: 200MHz ~ 20GHz

Input sensitivity: 200MHz～350MHz ≤-10dBm (Typical Value)

350MHz～18GHz ≤-15dBm(Typical Value)

18GHz～20GHz ≤-10dBm(Typical Value)

Max. input power: +10dBm

Damage: +25dBm

7) Option7

Frequency range: 10GHz~26.5GHz
Dynamic range: -20dBm~+10dBm (10GHz~20GHz) *
-15dBm~+10dBm (20GHz~24GHz) *
-10dBm~+10dBm (24GHz~26.5GHz) *
Damage Level: +20dBm

* Standard provided accessory should be connected externally when input signal is greater than 0dBm.

7.2.3 External-gate input

Signal input range: TTL level

Pulse width: ≥50ns

External-gate signal: Positive pulse

7.3 Time Base

7.3.1 Internal crystal oscillator

Nominal frequency: 10MHz

	Common crystal oscillator	High stability crystal oscillator
Factory accuracy	Better than 5×10^{-8}	Better than 5×10^{-8}
Aging rate per day	1×10^{-8}/day	5×10^{-10}/day
Aging rate per year	5×10^{-7}/year	5×10^{-8}/year

Note: When the counter is connected to the power supply, even if not press ON/OFF key on the front panel, oscillator already works and fan also begins to work to make the time base preheated and go to the stable work status. On the other hand, the oscillator in this counter has voltage controlling function. Oscillator's accuracy can be adjusted by this function through the adjusting port in the rear panel.

7.3.2 Time base input

Frequency: 5MHz or 10MHz

Amplitude: ≥1V_{P-P}

7.3.3 Time base output

Frequency: 10MHz Sine

Amplitude: ≥1V_{P-P}

7.4 Measurement index

7.4.1 Frequency measurement

CHA range: 0.001Hz~200MHz

CHB range: 0.001Hz~200MHz

CHC range: with reference of 8.2.2

Least significant digits（LSD）:

$$\frac{1 \times 10^{-8} \times Freq}{gate\ \ time}$$

Measurement error:

$$\pm LSD \pm system\ error \pm trigger\ error \pm time\ base\ \ error \times tested\ \ frequency$$

Trigger error:

$$\frac{(15mV + 0.5\% \times setting\ trigger\ level) \times 2 + noise\ amplitude}{Input\ signal\ slew\ rate\ at\ trigger\ \ po\,\text{int}} \times \frac{Freq}{gate\ time}$$

System error:

$$\frac{1 \times 10^{-7} \times Freq}{gate\ \ time}$$

7.4.2 Period measurement

CHA range: 5ns~1000s

CHB range: 5ns~1000s

CHC range: with reference of 8.2.2, period is reciprocal of frequency.

Least significant digits（LSD）:

$$\frac{1 \times 10^{-8}\ s \times Period}{gate\ \ time}$$

Measurement error:

$$\pm LSD \pm system\ error \pm trigger\ error \pm time\ base\ \ error \times period$$

Trigger error:

$$\frac{(15mV + 0.5\% \times setting\ trigger\ level) \times 2 + noise\ amplitude}{Input\ signal\ slew\ rate\ at\ trigger\ \ po\,\text{int}} \times \frac{Freq}{gate\ time}$$

System error:

$$\frac{1 \times 10^{-7}\ s \times Period}{gate\ \ time}$$

7.4.3 Time interval measurement

Input signal through CHA、CHB

Measurement range: 10ns~10000s

Least significant digits: 2.5ns

Trigger signal: internal trigger automatically or external trigger

Measurement error:

$$\pm LSD \pm trigger\ error \pm time\ base\ error \times time\ \text{int}erval \pm system\ error$$

System error: ± 5ns

7.4.4 Frequency ratio measurement

Least significant digits（LSD）:

$$\text{CHA / CHB: } \frac{1}{Fre\ of\ CHB \times gate\ time}$$

7.4.5 Pulse width measurement

CHA inputting, includes positive pulse width measurement and negative pulse width measurement.

Measurement range: 30ns~1000s

Least significant digits: 2.5ns

Trigger signal: internal trigger automatically or external trigger

Measurement error:

$$\pm LSD \pm trigger\ error \pm time\ base\ error \times time\ \text{int}erval \pm system\ error$$

System error: ± 4ns

7.4.6 Duty circle measurement

CHA input

Requirement: only meet the conditions of pulse width ≥ 10ns, period<10000s,

Duty circle measurement range 1~99%

7.4.7 Totalize measurement

Measurement range: $0\sim 1\times 10^{13}$

Measurement accuracy: $\pm$ one counting

Gate time: automatic or manual

7.4.8 Phase-difference measurement

Input the signal through CHA、CHB

Measurement range: 1 ~ +359°

Gate time: automatic or external gate

Measurement error of phase difference:

$< \pm(3\ ns \times Freq. \times 360 + 0.05)°$

Measurement resolution of phase difference:

$(2.5ns \times Freq. \times 360 + 0.1)°$

7.4.9 Upper/lower limit operation

Display mode: the indicator light 'Limit'will on if the result beyond the upper/lower limit, but it will off if the result in the upper/lower limit.

7.4.10 Statistics operation (frequency measurement)

Statistics function: repeatedly average, maximal value, minimum value, single relative deviation（PPM）, standard deviation, Allan variance

Display: repeatedly average, standard deviation, Allen variance LSD= single/N

LSD of single relative deviation =single×106/F0, the unit is PPM, LSD of other function will remain.

Sampling time: 2~1000000

7.5 General Characteristics

7.5.1 Remote programmable interface

USB Device, RS-232 and GPIB(optional)

7.5.2 Power conditions

Voltage:	AC220V (1±10%)	AC110V (1±10%)
Frequency:	50Hz (1±5%)	60Hz (1±5%)
Power:	<35VA	<35VA

7.5.3 Dimensions: 375×105×235(mm)3

7.5.4 Weight: 3.7kg

INFORMATION ON WASTE DISPOSAL FOR CONSUMERS OF ELECTRICAL & ELECTRONIC EQUIPMENT.

When this product has reached the end of its life it must be treated as Waste Electrical & Electronic Equipment (WEEE). Any WEEE marked products must not be mixed with general household waste, but kept separate for the treatment, recovery and recycling of the materials used. Contact your local authority for details of recycling schemes in your area.

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