

2022 Sep

# M6013 V3 Capacitance Meter User Guide

## M6013 V3 电容值测试表 说明书



## **M6013 V3 User Guide V3.0**

### **Features:**

JINGYAN M6013 V3 Auto-ranging capacitance meter.

Using 128X64 dot matrix LCD, can display 5 digit reading, Large range of measuring 0.01pF to 47mF (47000uF) capacitance and new Fara (super capacitor) measurement range 47mF to 470F, which enough for DIY user to professional engineer usage.

M6013 have fast reading speed and high accuracy up to 1%.

Reading a 2200uF only take ~0.2s

### **\*PLEASE DISCHARGE THE CAPACITOR BEFORE TESTING**

Compare M6013 old V2 and new V3 Improvement:

- 1) Larger measuring range, V3 can read up to 470F super capacitor and measure super capacitor's ESR internal resistance, some super capacitor may have internal resistance up to 70ohm.
- 2) Tolerance estimation for 47nF to 47uF, and 47uF to 47mF, we can estimate the capacitor marking capacitance and provide a real time tolerance display.
- 3) Estimated ESR internal resistance displaying at 47uF to 47mF and 47mF to 470F range. Can have a rough estimation on the condition of the electrolytic capacitors
- 4) High voltage discharge notification, meter will try to discharge a capacitor if user doesn't discharge before testing. \*(WARNING! Strongly suggest user to discharge by suitable power resistor before testing, meter's discharge function is not 100% guarantee high energy stored inside capacitor will not damage the meter!)

**Specification:**

Range	Accuracy (After Zero, tested with 1nF, 1uF, 1000uF)	Refresh Time (Manual Mode) *Auto mode take 0 to 2s or more time depend on value Larger capacitance take more measuring time
0.01pF to 47.000nF	1%+2Digit (Reference to 1KHz Standard Capacitor)	~0.2s to 1s
47.00nF to 47.000uF	1%+1Digit (Reference to 1KHz Standard Capacitor)	~0.2s to 4s
47.00uF to 47.000mF	1 to 3%+1Digit (Reference to 100Hz Standard Capacitor)	~0.2s to 30s
(FARA) 47.00mF to 470.00F	3 to 12%+1Digit	~15s to 135s (need enough steady time for the dielectric material and terminal stable, longer testing time in this FARA range)

**\*Accuracy maybe affected by the test lead's length and distance of test leads. Especially testing pF small capacitance, shortest test lead is recommended, and be careful the surrounding EMI or RF noise may affect the pF reading. Human is also a conductor layer that affect pF reading**

- 1) Capacitance Accuracy: Up to 1% (detail on above table)
- 2) High Resolution: 5 digit
- 3) Measuring voltage: <0.8V
- 4) Clamping voltage: ~1.25V (open voltage)
- 5) Battery 2X AA 1.5V battery
- 6) External Power: 5V micro USB
- 7) Operating current 0.02A
- 8) Battery Life time: >80 Hours (Reference at range 1 measurement)

### **Operating Introduction:**

#### **1) POWER ON**

Press and hold the ON/ OFF circle orange button for 1 to 2 second to power on.  
Press and release the ON/ OFF button to shut down meter.

#### **2) AUTO/ MANUAL mode:**

i) Auto Range:

Press and release the RANGE button and at the first line of LCD will show "AUTO:"  
At auto mode meter will automatically select the best range to detect

ii) Manual Range:

Scroll the manual range from 47nF, 47uF, 47mF, 470F range by press and release the RANGE button

In LCD will show MANUAL at first LCD line and show at second line: 0-47NF, 47NF TO 47UF, 47UF TO 47MF and 47mF to 470F

**3) 1 Key Zero:**

OPEN circuit the test leads' terminal. Press and release the "ZERO" button, LCD shows "ZERO" and wait the zero disappear.

If you are using the meter array socket, you need to OPEN circuit to set zero too. This operation will take around 12s

**4) Socket:**

You can use the 8 pin socket to measure the capacitor



**5) Running Average:**

It will automatically start running average if the capacitance reading become stable and user can get more accuracy reading.

## 2022 Sep

During running average it will show "AVG" at left bottom LCD or it will show raw data icon "RAW"

As a result, if you want to get higher accuracy reading, you can take the reading during AVG display.

This function will automatically on, once the raw data is noise.

### **6) Backlight:**

LCD backlight will on during power on

### **7) Auto Sleep:**

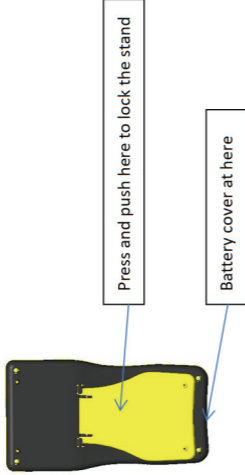
Around 1 hour for testing is not changed, it will shut down automatically to save power.

### **8) OVERFLOW or OL:**

Display overflow when the value is out of range, you can check that you are zero correctly.

### **9) PLASTIC STAND:**

If you don't use the stand, press and push the lock position:



#### 10) USB External power:

During using USB as power supply, be careful floating grounding issue. If the USB adaptor is floating ground, a noise will affect the pF reading with jumping. We will suggest using battery as power source during pF measurement, or you have a grounding on the negative of the testing terminal.

**\*PLEASE DISCHARGE THE CAPACITOR BEFORE TESTING**, you can use a power resistor around 10 ohm and short for 5 to 10s, better to take around 5 time constant time (Time= 5xRxC) to discharge. Meter has fast discharge function inside the meter to prevent high voltage, but it is not 100%, it is important to discharge the capacitor firstly, as it is a large surge current and voltage and may also damage the meter.

### Tolerance Estimation

Most of the electrolytic capacitor has +/-20% tolerance. For convenient we estimate the tolerance from common marking value standard.  
 Meter will estimate from standard: 1.0, 2.2, 3.3, 4.7, 6.8, like reading 1800uF, will be 2200uF tolerance is 100% $\times$  (1800uF-2200uF)/2200uF= -18.1%  
 Display at bottom of LCD: ECAP:-18.1% @2200.0uF

### FARA Capacitance Measurement

Measurement step of FARA Capacitor:

- 1) Wait for dielectric material steady and ion away from terminal, it will use 5s
- 2) Measure the capacitor's ESR
- 3) Charging the capacitor by a precision resistor with fixed voltage, after charging for 5 to 120s.
- 4) Wait for dielectric material steady and ion away from terminal, it will use 5s
- 5) Measure the capacitor increased voltage.
- 6) Calculate the capacitance of the fara capacitor.





Display on LCD: discharging... -> charging... -> calculating... -> one cycle update the capacitance.

Notice:

Fara Capacitor has different standard of measurement method from different manufacturer, some will need 5-minute steady time, or some will suggest having 30-minute steady time. Constant current, measure in charging or discharging step.

It will take too long time for user to test a Fara capacitor. As a result, we provide a faster FARA capacitance measurement, but the reading will be a **reference value for user only**.

(Some fara capacitor's specification has 30% variation drift from first measurement)

### **ESR Measurement**

We provide ESR reference value for user to estimate the condition of the capacitor. It will also include the long cable resistance, contact resistance.

The ESR value accuracy is only guarantee by design, and tolerance may over 10%. If the ESR is quite large, and you want a more accuracy ESR value measurement for verification again, you can choose MESR-100 in-circuit ESR meter.

The display Of ESR is XXX.XX ohm, resolution is 0.01ohm

47mF Range: Max display ESR is 25ohm

470F Range: Max display ESR is 100ohm

**LCD Display at bottom: ESR: + 3. 10  $\Omega$**

**\*ESR is for user reference only.**

## M6013 V3 说明书

### 产品特点:

M6013 V3 自动量程切换电容容值切换表。使用 128X64 点阵 LCD 屏幕, 可以显示 5 位数字, 电容测试范围 0.01 pF 至 47mF (47000uF), h 和新法拉 (超级电容) 测量范围 47mF 至 470F 可以满足 DIY 用户和专业工程师的使用要求。

M6013 拥有高的测量速度和高精度(精度达到 1%)。测量 2200uF 的电容只需要花费约 0.2s。

### **\*请注意, 在测试电容前, 需要给电容进行放电!**

M6013 新版 V3 相较于旧版 V2 的改进:

- 1) 测量范围更大, V3 可以读取高达 470F 的超级电容器并测量超级电容器的 ESR 内阻, 一些超级电容器的内阻可能高达 70ohm。
- 2) 对于 47nF 至 47uF 和 47uF 至 47mF 公差估计功能, 我们可以估计电容器对应标称电容, 并提供实时公差显示。
- 3) 估计 ESR 内阻显示在 47uF 至 47mF 和 47mF 至 470F 范围内。可以粗略估计电解电容器的好坏状况
- 4) 高压放电通知, 若用户在测试前未放电, 仪表将尝试放电电容器\* (警告! 强烈建议用户在测试前使用合适的功率电阻器放电, 仪表的放电功能不能百分之百保证电容器内储存的高能量不会损坏仪表!)

## 规格:

量程范围	精度(归零后, 分别测试 1nF, 1uF, 1000uF)	刷新时间(手动控制模式) *自动模式会花费 0 到 2s 具体时间取决于电容的大小的电容会花费更多的测量时间
0.01pF 至 47.000nF	1%+2 位数 (参考 1KHz 标准电容器)	~0.2s 至 1s
47.00nF 至 47.000uF	1%+1 位数 (参考 1KHz 标准电容器)	~0.2s 至 4s
47.00uF 至 47.000mF	1 到 3%+1 位数 (参考 100Hz 标准电容器)	~0.2s 至 30s
47.00mF 至 470.00F	3 到 12%+1 位数 (大容量电容会有较大的误差)	~15s 至 135s (电介质材料需要足够的稳定时间, 法拉范围内的测试时间更长)

\*精度也可能受到测试线的长度和测试线之间距离影响。特别是测试 pF 级别的电容, 建议使用尽可能短的测试线, 还要注意周围的电磁干扰 (EMI) 和无线频率 (RF) 噪声, 这些都会影响 pF 级别的电容测试。人体也是影响 pF 读数的导体层。如使用外接电源, 注意接地良好。

- 1) 1 精度：高达 1%(具体细节如上表)
- 2) 分辨率：5 位数
- 3) 测量电压：<0.8V
- 4) 钳位电压：~1.25V (开路电压)
- 5) 电池：2X AA 1.5V 电池
- 6) 外部电源：5V 微型 USB (micro USB )
- 7) 工作电流：0.02A
- 8) 电池续航时间： >80 小时 (参考范围 1 测量)

## 操作指引：

### 1) 开机

长按 ON/ OFF 圆形橙色按键 1 至 2 秒就会开机。

单击 ON/ OFF 按键就会关闭电容表电源。

### 2) 自动模式/ 手动模式：

i) 自动切换量程：

单击 RANGE 按键，LCD 屏幕第一行会显示 “AUTO:”

在自动模式下电容表会自动选择最适宜的量程进行测试。

ii) 手动切换量程：

当按下 RANGE 按键电容表会循环切换 47nF, 47nF 和 470mF 这三个之间量程。

LCD 屏幕第一行会显示 MANUAL，LCD 屏幕第二行会显示：0-47NF，47NF-47UF，47UF-47MF 或 47MF-47OF。

### 3) 一键归零：

保证测试线两端没有接任何东西，保持开路状态。

按下“ZERO”按键，LCD 屏幕会显示“ZERO”然后等待直到 ZERO 消失。如果您使用的是阵列式插座，也需要保证期处于开路状态再归零。

### 4) 插座：

您可以使用 8 口插座来测试电容



### 5) 滑动平均：

当测量电容稳定后会自动启动滑动平均功能，可以让用户更加准确读取数值。

当开始运行滑动平均是 LCD 屏幕左下方会显示“AVG” 没有运行时会显示原始数据图标“RAW”

总而言之，如果您想得到较高精度的测试，当屏幕显示 AVG 时再读取数值。一旦原始数据充满噪声，这个功能就会启动。

**6) 屏幕背光:**

一旦开机 LCD 屏幕背光会处于一直开的状态。

**7) 自动关机:**

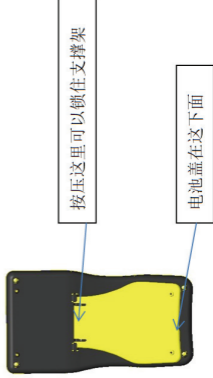
大约 8 到 10 小时没有测试，电表会自动关机以节约电量。

**8) 超量程或低于量程:**

当测试值超出量程时会显示 overflow，您可以检测一下归零是否正确。

**9) 塑料支撑架:**

如果不使用支撑架，按压锁的锁定位置:



## 10) USB 外部电源:

使用 USB 作为电源时, 请注意接地问题。如果公共接地不够好, 噪声将影响 pF 读数并伴有跳跃。我们建议在 pF 测量期间使用电池作为电源, 或者在测试端子的负极上接地。

**\*测试电容前请给电容放电。** 您可以使用一个 10 R 功率电阻大概 5 到 10s, 最好用大约 5 个时间常数 (时间=5xRxC) 来放电。电容表里面有保护防电设计预防高电压, 但不是 100%保护的。必须对电容进行放电, 否则一个强浪涌电流和电压会损坏电容表。

## 公差估算功能

大多数电解电容器的公差为+/-20%。为方便起见, 我们根据通用标记值标准估算公差。

根据标准: 1. 0、2. 2、3. 3、4. 7、6. 8, 如: 电容读数 1800uF, 仪表将估算为 2200uF。公差为  $100\% \times (1800\mu\text{F} - 2200\mu\text{F}) / 2200\mu\text{F} = -18.1\%$ 。

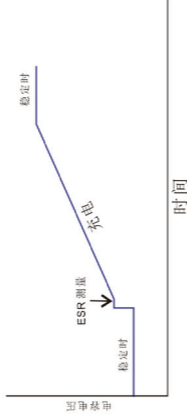
屏下方显示: **ECAP: -18.1% @2200.0uF**

## 法拉电容测量

### 法拉电容器测量步骤:

- 1) 等待电介质材料稳定, 等待离子远离端子, 需时 5s

- 2) 测量电容器的 ESR
- 3) 充电 5~120s 后, 用固定电压和精密电阻给电容器充电。
- 4) 等待电介质材料稳定, 等待离子远离端子, 需时 5s
- 5) 测量电容器增加的电压。
- 6) 计算法拉电容器的电容。



表显: discharging... -> charging... -> calculating... -> calculating... 完整循环后容值更新

### 注意事项:

法拉电容器有不同制造商的不同测量方法标准, 有些制造商建议 5 分钟的稳定时间, 有些建议有 30 分钟的稳定时间。或建议恒流, 或充电或放电步骤中测量容值, 方法不一。用户测试法拉电容器的时间太长。因此, 我们提供了更快的法拉电容测量, 但读数将仅供用户参考。

(一些制造商会标示法拉电容器的测量容值与第一次测量相比有 30% 的变化漂移)



## ESR 测量

我们提供 ESR 参考值，供用户估计电容器的状况。显示数值包括长电缆电阻、接触电阻。

ESR 值的准确性仅由设计保证，公差可能超过 10%。如果 ESR 相当大，如果您需要更精确的 ESR 值测量以再次验证，您可以选择 MESR-100 ESR 表。

ESR 显示为 XXX.XX 欧姆，分辨率为 0.01 欧姆。

47mF 范围：最大显示 ESR 为 25 欧姆。

470F 范围：最大显示 ESR 为 100 欧姆。

如表檢測出來 ESR 是 3.1 欧姆:

屏下方顯示: **ESR: + 3.10Ω**

**\*\* ESR 值的准确性仅由设计保证，公差可能超过 10%，只供参考用**