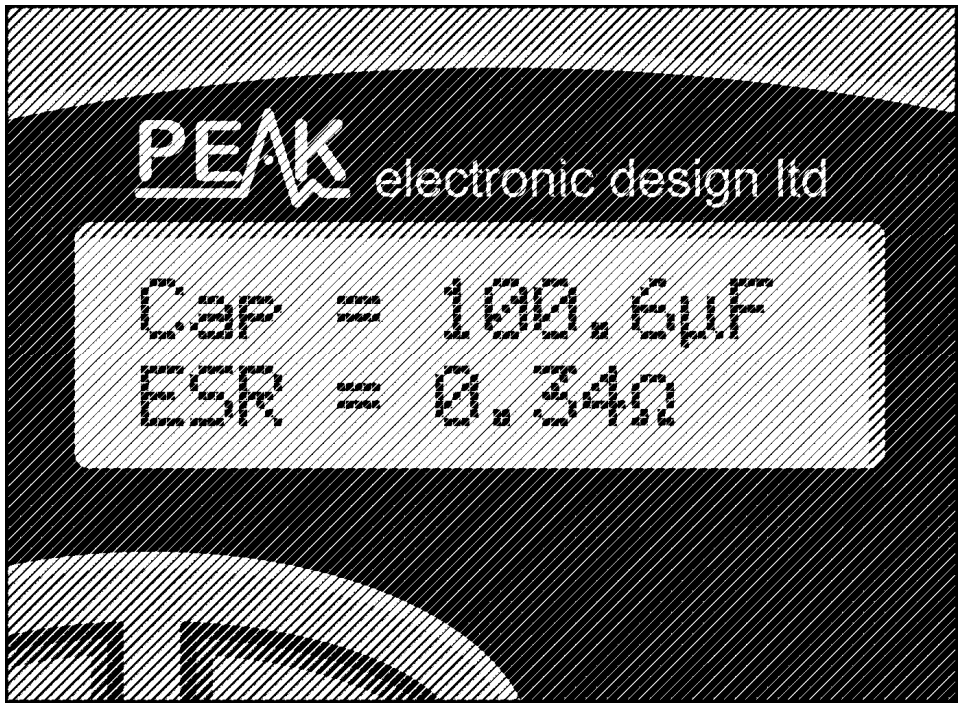
EN70G-14

Atlas ESR Gold

Equivalent Series Resistance and Capacitance Meter
(with high speed capacitance measurement)

Model ESR70G (Firmware: 6.0)



Designed and manufactured with pride in the UK

User Guide

UK CA CE

PEAK® electronic design ltd

Want to use it now?

We understand that you want to use your **ESR70** right now. The unit is ready to go and you should have little need to refer to this user guide, but please make sure that you do at least take a look at the very important notices on page 4!

Contents Page

This user guide has been written to accompany the **ESR70** meter with revision 6.0 firmware. Other revisions of firmware may differ in operation, features and specifications. The firmware version is displayed briefly upon power-up.

Introduction

The **Peak Atlas ESR70** is an advanced instrument designed specifically for the analysis of capacitor equivalent series resistance (in *or* out of circuit). Where possible, capacitance is also displayed.

Summary Features:

- ESR range of 0 to 40Ω with resolution as low as 0.01Ω.
- Integrated controlled discharge circuitry reduces the need for the user to manually discharge capacitors before test (see note).
- Use in or out of circuit for ESR and low-ohms resistance measurement.
- Audible alerts for quick user-feedback of ESR test status.
- Automatic analysis start when a component is detected.
- Automatic and manual power-off.

Gold Features:

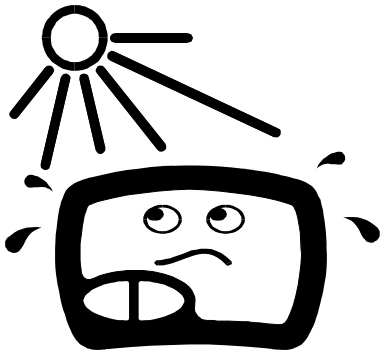
- Enhanced capacitance range of 0.3µF to 90,000µF.
- Capacitance over 125µF is now measured at 10x higher current (20mA instead of 2mA) for rapid measurement.
- New triple-slope measurement method reduces the influence of parallel resistance when measuring capacitance in-circuit.
- Improved in-circuit detection.
- Improved ESR measurement with less influence from lead inductance.
- Improved user-options system.

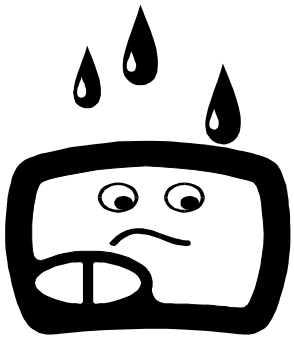
Note:
The discharge circuitry exists to ensure that a charged capacitor is less likely to damage the unit. For example, if the capacitor under test has a potential of a few tens of volts across it, the charge is removed automatically. It is the user's responsibility to ensure that any dangerously charged capacitors are safely discharged before connection to the unit.

Important Notices

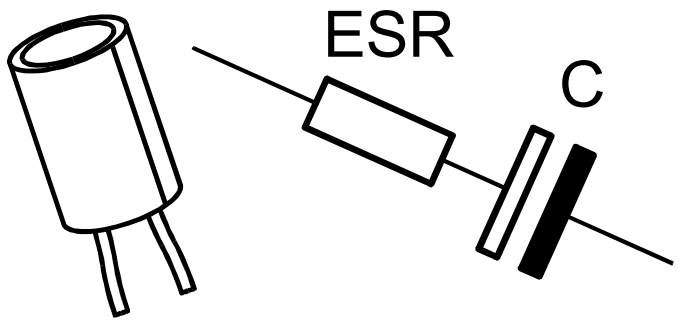
Please observe the following guidelines:

- This instrument must NEVER be connected to powered equipment/components.
- It is the user's responsibility to ensure that any dangerously charged capacitors are safely discharged before connection to the unit.
- To allow the self-protection mechanism to function, always ensure that the **ESR70** has completed any analysis before connecting the test probes to a component.
- Failure to comply with these warnings may result in personal injury, damage to the equipment under test, damage to the **ESR70** and invalidation of the manufacturer's warranty.
- Avoid rough treatment, hard knocks and extreme temperatures.
- This unit is not waterproof.





Notes on ESR



ESR (Equivalent Series Resistance), as its acronym implies, is the value of resistance that is effectively in series with an ideal capacitor.

No capacitor is ideal of course, the detailed equivalent circuit of a typical capacitor is very complex. For many electrolytic capacitors however, the most important parameters regarding the capacitor's performance are the capacitance and the ESR.

An increase in ESR (due to age, abuse or temperature cycling) can result in poor capacitor performance. The capacitor becomes less "ideal" and starts to dissipate more power, an ideal capacitor, of course, dissipates zero power.

Capacitor manufacturers typically quote the ESR of their products at 50-100kHz, which is similar to the test frequency used by the **ESR70.**

Sometimes, manufacturers quote ESR at 100Hz or 120Hz as the capacitors may be aimed at rectified mains power applications. ESR is generally not very frequency dependent however, so it can be reasonably considered equivalent to readings taken at 50-100kHz.

Note: The **ESR70** automatically ignores the reactance of the capacitor. So although a 1µF capacitor would have a reactance of about 3.2Ω at 50kHz, the displayed value of ESR should be the true ESR value (the real bit of resistance that is in series with the reactance).

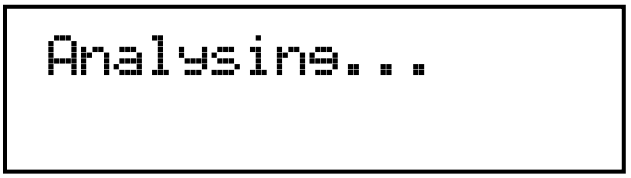
Analysing Capacitors

The **ESR70** is designed to analyse capacitor ESR in or out of circuit. The two test probes can be connected to the component any way around. Remember though that in-circuit testing can result in less accurate readings.

Important: To minimise risk of damage to the unit, make sure that the **ESR70** has completed any previous analysis before attaching the test probes to the capacitor. This ensures that the built-in protection circuit is ready for any charge that may be present on the capacitor.

The **ESR70** must first be switched on by briefly pressing the **on-test** button.

The unit will start a component analysis when it detects that the open circuit probes have been applied to a component or when **on-test** button is re-pressed.



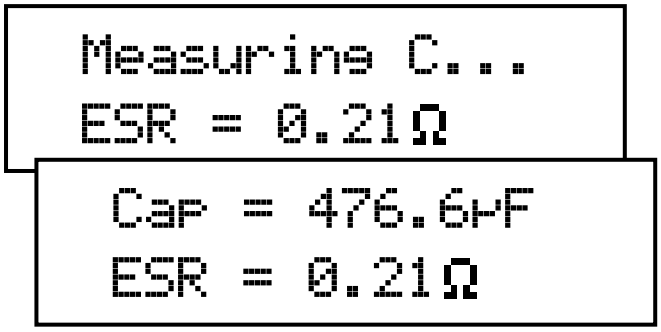
If the capacitor is charged (<50V), the **ESR70** will attempt to discharge the capacitor while showing the progress of the procedure:

If the **ESR70** cannot recognise the component connected to the test probes, or the capacitance is out of range, the following message may be displayed:

Analysing Capacitors continued…

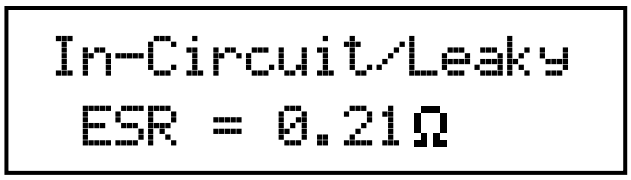
The ESR analysis typically takes around 2 seconds to complete, followed by up to around 3 seconds for the capacitance measurement (depending on the characteristics of the capacitor).

As soon as a valid ESR reading has been obtained, the ESR value is displayed while the instrument proceeds to measure the capacitance.

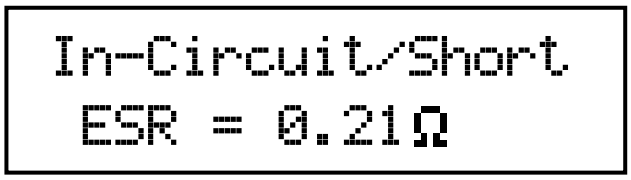


If the presence of external circuitry did not adversely affect the capacitance measurement, the capacitor value will be displayed.

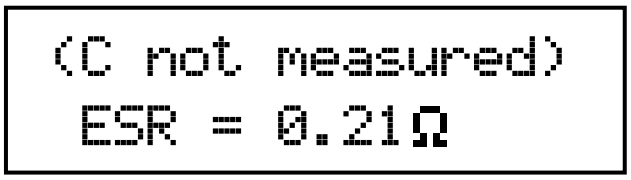
If the capacitance could not be accurately determined (perhaps it is in-circuit or a "leaky" capacitor), the display will only show the value of ESR measured.



If the instrument cannot detect any sensible capacitor behaviour, then it may display this:



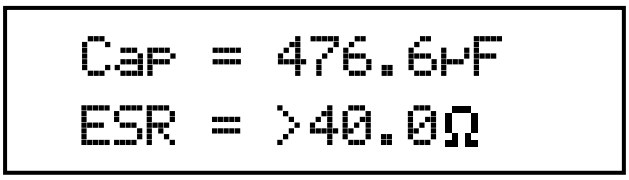
It is not necessary to wait for the capacitance measurement to complete if you are not interested in the capacitance value. If the probes are removed from the component under test before the capacitance measurement has completed, the display will confirm that the capacitance has not be measured.



It can be useful to disconnect the probes before the capacitance measurement has completed if you are wanting to simply check the ESR of multiple components in succession.

Analysing Capacitors continued…

If ESR exceeds the maximum that can be measured, the display may show:



or

The ESR measurement range is automatically determined during the analysis. Typically, the resolution for ESR measurement is as shown in the table below:

ESR Value	Automatically selected test current	Nominal measured resolution
0.00 Ω – 2.00 Ω	20mA	0.01 Ω
2.0 Ω – 20.0 Ω	2mA	0.1 Ω
20.0 Ω – 40.0 Ω	1mA	0.2 Ω

Although the measurement resolution is generally determined by the absolute value of the ESR (as shown in the above table), low capacitance values can result in a poorer ESR measurement resolution.

If measuring capacitors connected in parallel, the ESR reading will effectively be the value of all the ESRs in parallel, not just the ESR of the capacitor in contact with the probes.

The test current for the capacitance measurement is automatically determined and will be either 2mA or 20mA.
20mA is typically used if the capacitance is >125µF and if ESR<10Ω. This is to ensure that the capacitance measurement is high speed even for very large capacitances whilst also minimising the influence of leakage current that can be significant with large capacitances.
If 20mA has been used then a ✻ will appear next to the capacitance.

Typical ESR values:

	6.3V	10V	16V	25V	35V	50V	63V	100V	160V	250V	400V	630V
4.7µF	62.0Ω	54.0Ω	45.0Ω	40.0Ω	34.0Ω	28.0Ω	25.0Ω	23.0Ω	19.0Ω	16.0Ω	13.0Ω	11.0Ω
10µF	29.0Ω	25.0Ω	21.0Ω	19.0Ω	16.0Ω	13.0Ω	12.0Ω	11.0Ω	8.7Ω	7.4Ω	6.2Ω	5.2Ω
22µF	13.0Ω	11.0Ω	9.6Ω	8.4Ω	7.2Ω	6.0Ω	5.4Ω	4.8Ω	4.0Ω	3.4Ω	2.8Ω	2.4Ω
47µF	6.2Ω	5.4Ω	4.5Ω	4.0Ω	3.4Ω	2.8Ω	2.5Ω	2.3Ω	1.9Ω	1.6Ω	1.3Ω	1.1Ω
100µF	2.9Ω	2.5Ω	2.1Ω	1.9Ω	1.6Ω	1.3Ω	1.2Ω	1.1Ω	0.87Ω	0.74Ω	0.62Ω	0.52Ω
220µF	1.3Ω	1.1Ω	0.97Ω	0.84Ω	0.72Ω	0.60Ω	0.54Ω	0.48Ω	0.40Ω	0.34Ω	0.28Ω	0.24Ω
470µF	0.62Ω	0.54Ω	0.45Ω	0.40Ω	0.34Ω	0.28Ω	0.25Ω	0.23Ω	0.19Ω	0.16Ω	0.13Ω	0.11Ω
1000µF	0.29Ω	0.25Ω	0.21Ω	0.19Ω	0.16Ω	0.13Ω	0.12Ω	0.11Ω	0.09Ω	0.07Ω	0.06Ω	0.05Ω
2200µF	0.16Ω	0.14Ω	0.12Ω	0.11Ω	0.10Ω	0.09Ω	0.08Ω	0.07Ω	0.06Ω	0.06Ω	0.05Ω	0.04Ω
4700µF	0.09Ω	0.08Ω	0.07Ω	0.07Ω	0.06Ω	0.05Ω	0.05Ω	0.05Ω	0.04Ω	0.04Ω	0.04Ω	0.03Ω
10000µF	0.06Ω	0.05Ω	0.05Ω	0.05Ω	0.04Ω	0.04Ω	0.04Ω	0.04Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω
22000µF	0.04Ω	0.04Ω	0.04Ω	0.04Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω	0.03Ω

Table Rev3.

Remember, lower ESR is better. Many good capacitors will have ESR lower than shown above, that is good. ☺

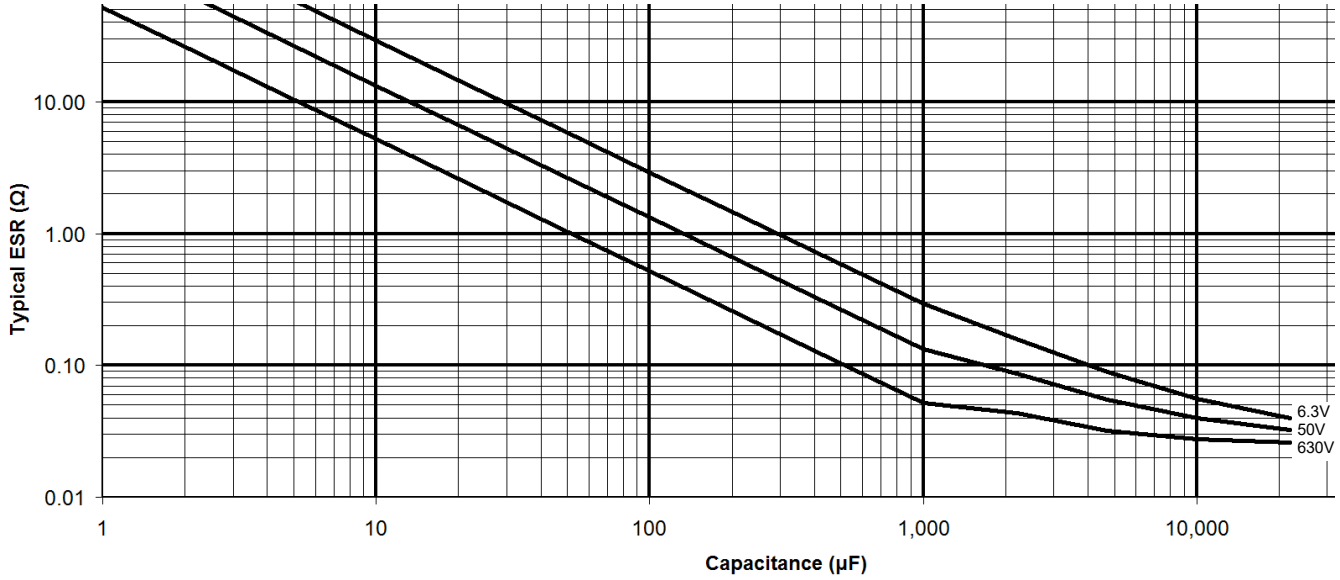
Values in this table are calculated from published dissipation factors for Panasonic® FR-Series capacitors from 4.7µF to 4700µF with voltage ratings of 6.3VDC to 100VDC. Other values extrapolated by curve-fitting.

Typical Values of ESR continued…

It is not possible to provide a definitive rule for values of ESR that are acceptable for all situations. **However, a table of typical ESR figures for a range of capacitance and voltage ratings is shown on the previous page.**

The expected value of ESR largely depends on the capacitance value and the voltage rating of the capacitor but also depends on temperature ratings and other factors. Some capacitors are manufactured to exhibit very low ESR values, whilst conventional low-cost parts are likely to exhibit higher values but may still be acceptable.

As a guide only, the following log-scaled graph shows "typical" values of ESR for a range of different capacitance and voltage ratings.



Please note that the figures shown on the previous page are only **typical** figures for standard grade electrolytics at room temperature, please verify readings against expected values for the particular type of capacitor you are testing.

For any particular capacitance and voltage rating, a lower ESR reading is generally better than a higher ESR reading. For good quality capacitors it is common for the ESR readings to be much lower than the figures shown in the previous table.

Sounds and Audible Alerts

The **ESR70** can produce audible tones to assist the user.

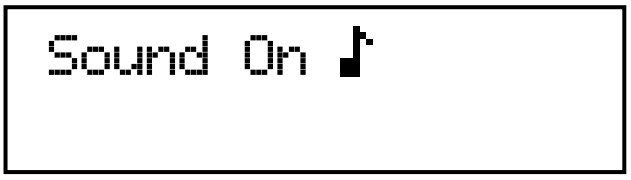
The various tones are summarised below:

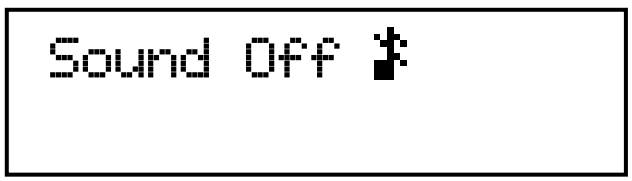
Condition / Operation	Sound Type
Start Analysis	Short Blip
End Analysis	Short Blip
Measured ESR > 40Ω	High-Low "Beep Barp"
Measured ESR < 5.0Ω	Single Bell "Ping"
Measured ESR < 1.0Ω	Double Bell "Ping-Ping"

You can switch audible alerts on or off by holding down the **on-test** button for about 4 seconds until the "Sound and probe options" is displayed.

Then you will be asked if you want to enable the sounds or not.

Pressing the relevant button will be confirmed with one of the following messages:



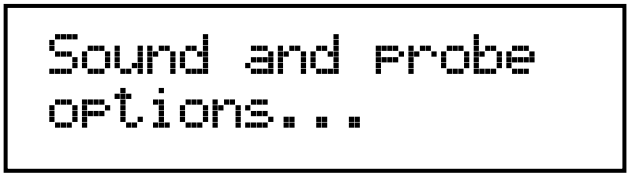


You will then be asked if you wish to perform a probe compensation procedure, see next page. (You can press "no" or simply wait a few seconds if you do not need to perform a probe compensation).

Probe Compensation

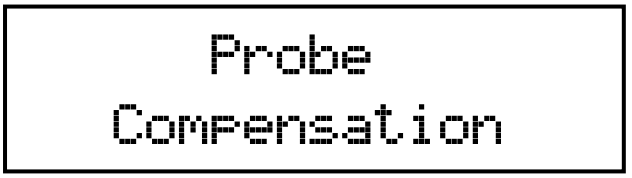
To ensure good repeatable readings, particularly for low values of ESR, it may be necessary to perform a simple Probe Compensation procedure.

Press and hold down the **on-test** button for about 4 seconds until the following message is displayed:



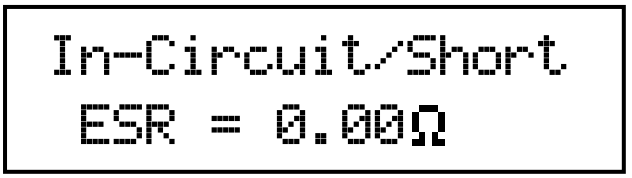
You'll first be asked if you want to enable sound or not. Select your desired option and continue. Then you will be asked if you want to perform a probe compensation procedure.

When you select "YES", the unit will confirm that you have selected the probe compensation mode.



You will then be asked to short the probes together (by interlocking the jaws of each croc clip). Then press the **on-test** button.

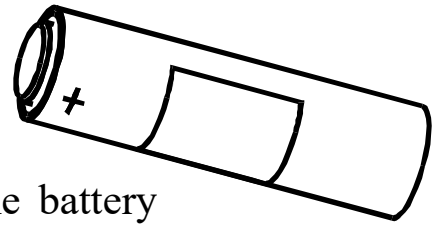
After a short delay, the display will confirm that the procedure is complete and it will then perform a self-test of the ESR (which should be very close to 0.00Ω).



If the following message is displayed then the probes may not have been correctly shorted during the above proecedure. **This message may also be displayed if any of the probe connections are faulty.**

It is useful to test the integrity of the probe compensation by measuring fixed resistors of 1Ω and 10Ω to verify the correct ESR reading respectively.

Care of your ESR70



The **ESR70** should provide many years of service if used in accordance with this user guide. Care should be taken not to expose your unit to excessive heat, shock or moisture. Additionally, the battery should be replaced at least every 12 months to reduce the risk of leak damage.

If a low battery warning message appears, replacement of the battery is essential.

Immediate replacement of the battery is EXTREMELY IMPORTANT as the built-in protection mechanism may not function correctly if the battery condition is poor and therefore render your unit susceptible to damage from even low energy charged capacitors.

The **ESR70** will not operate if a low battery condition is encountered.

New batteries can be purchased from many retailers and directly from Peak Electronic Design Ltd or an authorised agent.

Battery type: AAA cell (Alkaline, NiMh or Lithium-Iron-Disulphide).

Battery access: To replace the battery, place the unit face down on a clean smooth surface and unscrew the three screws to remove the rear panel. Remove the old battery and insert a new one, take care to observe the correct polarity. Carefully replace the rear panel and ensure that you do not pinch the test leads. Do not over-tighten the screws.

Appendix A - Troubleshooting

Problem	Cause / Possible Solution
ESR value when probes are shorted is not close to 0Ω	Perform a probe compensation.
Display shows `Removing trace charge`	This message is displayed if the **ESR70** has detected that the attached capacitor may be exhibiting "Soakage" or "Dielectric Absorption", this is quite normal. The instrument then ensures that the capacitor is very well discharged and helps to prevent voltage developing across the capacitor after the normal discharge procedure has completed.
Display shows `Auto discharge taking too long!`	The unit attempts to remove charge from the capacitor using a controlled discharge procedure. If this takes longer than 60 seconds then the discharge process will be aborted. It is recommended that you safely discharge the capacitor manually and try analysis again.
Display shows `Warning! V=132V Safely discharge`	If the voltage across the capacitor is greater than 50V then the **ESR70** will not attempt to discharge the capacitor, please safely discharge the capacitor manually.
Display shows `Self Test Fail Code 2`	It is possible that a hardware failure has occurred, please contact Peak Electronic Design Limited for assistance.
Display shows `In-Circuit/Leaky` even though it is a new capacitor and out-of-circuit.	The **ESR70** will display "In-Circuit/Leaky" if the charge curve is non-linear by more than 10%. Some capacitors (even new ones) can exhibit a non-linear charge characteristic and means that the capacitance cannot be reliably measured. "Exercising" the capacitor can help, so try to measure it again a few times.

Appendix B - Technical Specifications

All values are at 20°C unless otherwise specified.

Parameter	Min	Typ	Max	Note
Peak test current into S/C		±20mA	±23mA	
Peak test voltage, full scale ESR		±40mV	±46mV	
Peak test voltage across O/C			±5.5V	
Capacitance measurement range	0.3µF		90,000µF	1
Capacitance accuracy		±4% ±0.2µF		2
Capacitance test current	1.7mA	2.0mA	2.3mA	3
	17mA	20mA	23mA	4
Capacitance measurement ΔV		±500mV		5
ESR measurement range	0Ω		40Ω	
ESR resolution for ESR < 2Ω	0.01Ω		0.02Ω	
ESR resolution for ESR > 2Ω	0.1Ω		0.2Ω	
ESR accuracy for ESR < 2Ω		±2% ±0.02Ω		
ESR accuracy for ESR > 2Ω		±2% ±0.2Ω		
ESR test current	±0.8mA		±23mA	
ESR test frequency	48kHz	50kHz	104kHz	5
Abuse voltage (for C < 10µF)			±275V	6
Abuse voltage (for C > 10µF)			±50V	6
Auto-Discharge voltage limit			±50V	6
Auto-Discharge RMS power		1.5W		
Battery type		AAA Alkaline, NiMh or Lithium-Iron-Disulphide		
Battery life		Typically ~1500 operations		7
Inactivity power-down period		60 seconds		
Dimensions (excluding leads)		103 x 70 x 20 mm		
Operating temperature range	15°C		35°C	8

Notes

1. The UK convention of the decimal point "." is used in most of our products. This must not be confused with the comma thousands separator ",".
2. Capacitance accuracy quoted for capacitance between 10µF and 10,000µF.
3. Capacitance test current of 2mA if C < ~125µF or ESR > ~10Ω.
4. Capacitance test current of 20mA if C > ~125µF and ESR < ~10Ω.
5. Subject to revision.
6. Maximum abuse voltage rated limitation of internal protection electronics. Probes, leads and unit are not certified for high voltage use.
7. Based on <1 minute per operation.
8. Also subject to acceptable LCD visibility.

Appendix C – Statutory Information

Peak Satisfaction Warranty

If for any reason you are not completely satisfied with the **ESR70,** within 14 days of purchase, you may return the unit to your distributor. You will receive a refund covering the full purchase price if the unit is returned in perfect condition.

Statutory Warranty

The statutory warranty is valid for 24 months from date of purchase. This warranty covers the cost of repair or replacement due to defects in materials and/or manufacturing faults.

The warranty does not cover malfunction or defects caused by:

a) Operation outside the scope of the user guide.
b) Unauthorised access or modification of the unit (except for battery replacement).
c) Accidental physical damage or abuse.
d) Normal wear and tear.

The customer's statutory rights are not affected by any of the above.
All claims must be accompanied by a proof of purchase.

WEEE (Waste of Electrical and Electronic Equipment), Recycling of Electrical and Electronic Products

It is not permissible to simply throw away electrical and electronic equipment. Instead, these products must enter the recycling process. Each country has implemented the WEEE regulations into national law in slightly different ways. Please follow your national law when you want to dispose of any electrical or electronic products. **More details can be obtained from your national WEEE recycling agency.**