

# Atlas ESR

*Capacitance and Equivalent Series Resistance Meter*

*Model ESR60 (Enhanced)*



## User Guide

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In the interests of development, information in this guide is subject to change without notice - E&OE



**PEAK**  
electronic design ltd

## **Want to use it now?**

We understand that you want to use your *Atlas ESR* 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 notices on page 4!

<b>Contents</b>	<b>Page</b>
-----------------	-------------

Introduction .....	3
Safety Considerations .....	4
Notes on ESR.....	5
Analysing capacitors.....	6-7
Typical values of ESR .....	8
Probe Compensation.....	9
Care of your Atlas <i>ESR</i> .....	10
Appendix A – Troubleshooting .....	11
Appendix B – Technical Specifications.....	12
Appendix C – Warranty Information.....	13
Appendix D – Disposal Information.....	14

## Introduction

The *Atlas ESR* is an advanced instrument designed specifically for the analysis of capacitor equivalent series resistance (in *or* out of circuit). In addition it will, where possible, display the capacitance of the device under test.

### Summary Features:

- ESR measurement range 0 to 20 $\Omega$ .
- ESR resolution as low as 0.01 $\Omega$
- Capacitance range 1 $\mu$ F...22mF (22,000 $\mu$ F).
- Can be used for low-ohms resistance checking too.
- Built-in protection circuitry means risk of damage to the unit due to residual charge is greatly reduced.
- Integrated controlled discharge circuitry reduces the need for the user to manually discharge capacitors before test.\*
- Use in or out of circuit for ESR measurement.
- Automatic and manual power-off.

#### \* 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.

## **Safety Considerations**

### **WARNING:**

**This instrument must NEVER be connected to powered equipment/components.**

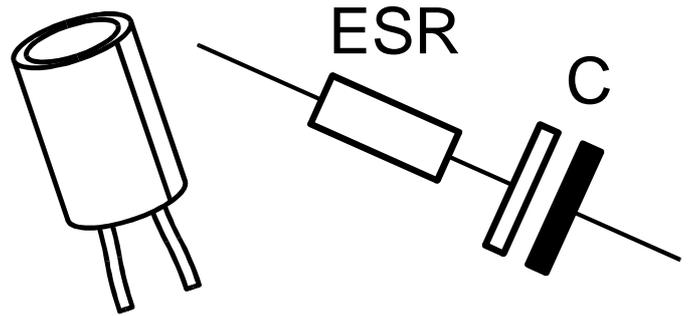
**It is the user's responsibility to ensure that any dangerously charged capacitors are safely discharged before connection to the unit.**

**To allow the self-protection mechanism to function, always ensure that the *Atlas ESR* 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 *Atlas ESR* and invalidation of the manufacturer's warranty.**

## 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 is 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 100kHz, which is the same test frequency used by the *Atlas ESR*.

## Analysing Capacitors

The *Peak Atlas ESR* 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 *Atlas ESR* 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 *Atlas ESR* will start component analysis when the **on-test** button is pressed.

Measuring  
Capacitance. . .

The analysis typically takes under 10 seconds to complete, depending on the characteristics of the capacitor.

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

Discharging. . .  
Capacitor V= 23V

If the *Atlas ESR* cannot recognise the component connected to the test probes, or the capacitance is out of range, one the following messages may be displayed:

Open circuit or  
Low capacitance.

Capacitor value  
too high

## Analysing Capacitors continued...

Once a valid ESR reading has been obtained, the results are displayed.

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

Cap = 476.6µF  
ESR = 0.21Ω

If the capacitance could not be determined, the display will only show the value of ESR measured.

\* In Circuit \*  
ESR = 0.21Ω

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

Cap = 476.6µF  
ESR = >20.0Ω

or

\* In Circuit \*  
ESR = >20.0Ω

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	Displayed Resolution
0.00 Ω – 2.00 Ω	20mA	0.01 Ω
2.0 Ω – 20.0 Ω	2mA	0.1 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.

## Typical Values of ESR

It is not possible to provide a definitive rule for values of ESR that are acceptable for all situations.

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 still be acceptable.

As a rough guide only, the following table shows “typical” values of ESR for a range of different capacitance and voltage ratings.

	10V	16V	25V	35V	63V	160V	250V
4.7 $\mu$ F	>20 $\Omega$	>20 $\Omega$	>20 $\Omega$	>20 $\Omega$	19.0 $\Omega$	16.0 $\Omega$	13.0 $\Omega$
10 $\mu$ F	20.0 $\Omega$	16.0 $\Omega$	14.0 $\Omega$	11.0 $\Omega$	9.3 $\Omega$	7.7 $\Omega$	6.3 $\Omega$
22 $\mu$ F	9.0 $\Omega$	7.5 $\Omega$	6.2 $\Omega$	5.1 $\Omega$	4.2 $\Omega$	3.5 $\Omega$	2.9 $\Omega$
47 $\mu$ F	4.2 $\Omega$	3.5 $\Omega$	2.9 $\Omega$	2.4 $\Omega$	2.0 $\Omega$	1.60 $\Omega$	1.40 $\Omega$
100 $\mu$ F	2.0 $\Omega$	1.60 $\Omega$	1.40 $\Omega$	1.10 $\Omega$	0.93 $\Omega$	0.77 $\Omega$	0.63 $\Omega$
220 $\mu$ F	0.90 $\Omega$	0.75 $\Omega$	0.62 $\Omega$	0.51 $\Omega$	0.42 $\Omega$	0.35 $\Omega$	0.29 $\Omega$
470 $\mu$ F	0.42 $\Omega$	0.35 $\Omega$	0.29 $\Omega$	0.24 $\Omega$	0.20 $\Omega$	0.16 $\Omega$	0.13 $\Omega$
1000 $\mu$ F	0.20 $\Omega$	0.16 $\Omega$	0.14 $\Omega$	0.11 $\Omega$	0.09 $\Omega$	0.08 $\Omega$	0.06 $\Omega$
2,200 $\mu$ F	0.09 $\Omega$	0.07 $\Omega$	0.06 $\Omega$	0.05 $\Omega$	0.04 $\Omega$	0.03 $\Omega$	0.03 $\Omega$
4,700 $\mu$ F	0.04 $\Omega$	0.03 $\Omega$	0.03 $\Omega$	0.02 $\Omega$	0.02 $\Omega$	0.02 $\Omega$	0.01 $\Omega$
10,000 $\mu$ F	0.02 $\Omega$	0.02 $\Omega$	0.01 $\Omega$				

Please note that the above figures 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.

## Probe Compensation

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

1. Ensure the unit is switched off.

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

Probe  
Compensati on

3. The unit will then ask you to short the probes together (by interlocking the jaws of each croc clip). Then press the **on-test** button.

Short probes  
and press TEST.

4. After a short delay the display will confirm that the procedure is complete and then switch off.

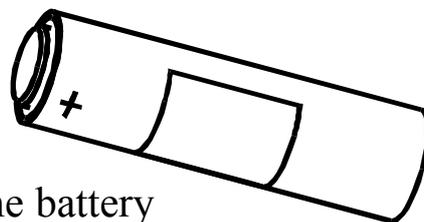
OK

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

Compensati on  
Fai l . Try agai n.

## Care of your Atlas *ESR*

The *Peak Atlas ESR* 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.



**\*\* Warning \*\***  
**Low Battery** 

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 *Atlas ESR* will not continue to 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 types:** Suitable battery types include 23A, V23A, GP23A, MN21 or a good quality 12V alkaline equivalent as used in many test instruments and automotive remote key fobs.

**Battery access:** To replace the battery, unscrew the three screws to remove the rear panel. Remove the old battery and insert a new one, taking care to observe the correct polarity. Carefully replace the rear panel, do not over-tighten the screws.

**Peak Safe Battery Disposal Scheme:** Please return your old analyser battery to Peak Electronic Design Ltd for safe and environmentally responsible disposal.

## Appendix A - Troubleshooting

Problem	Cause / Possible Solution
ESR value when probes are shorted is not close to $0\Omega$	Perform a probe compensation.
Seems to be stuck “Measuring capacitance”	It is possible that one (or more) of the 4-wire probe connections has become broken. Check all connections.
Display shows Removing trace charge	This message is displayed if the <i>Atlas ESR</i> 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 recommend 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 <i>Atlas ESR</i> 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.

## Appendix B - Technical Specifications

All values are at 25°C unless otherwise specified.

Parameter	Min	Typ	Max	Note
Peak test current into S/C		±20mA	±25mA	
Peak test voltage across O/C		±2.5V	±3.0V	
Capacitance measurement range	1µF		22,000µF	
Capacitance accuracy	±4% ±0.2µF			
ESR measurement range	0Ω		20Ω	2
ESR resolution for ESR < 2Ω	0.01Ω		0.02Ω	
ESR resolution for ESR > 2Ω	0.1Ω		0.2Ω	
ESR accuracy for ESR < 2Ω	±1.5% ±0.02Ω			
ESR accuracy for ESR > 2Ω	±1.5% ±0.2Ω			
Abuse voltage (for C < 10µF)			±275V	3
Abuse voltage (for C > 10µF)			±50V	3
Auto-Discharge voltage limit			±50V	
Battery type	MN21/GP23A 12V Alkaline			2
Battery voltage range	8.5V	12V		
Battery voltage warning threshold		8.5V		
Inactivity power-down period	30 seconds			
Dimensions (excluding test leads)	103 x 70 x 20 mm			
Operating temperature range	10°C		40°C	1

### Notes

1. Subject to acceptable LCD visibility.
2. Subject to revision.
3. Maximum abuse voltage rated limitation of internal protection electronics. Probes, leads and unit are not certified for high voltage use.

## Appendix C - Warranty Information

### Peak Satisfaction Guarantee

If for any reason you are not completely satisfied with the *Peak Atlas ESR* 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.

### Peak Warranty

The warranty is valid for 12 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.

The customer's statutory rights are not affected by any of the above.

All claims must be accompanied by a proof of purchase.

## Appendix D - Disposal Information



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

#### **United Kingdom**

In 2006 the European Union introduced regulations (WEEE) for the collection and recycling of all waste electrical and electronic equipment. It is no longer permissible to simply throw away electrical and electronic equipment. Instead, these products must enter the recycling process.

Each individual EU member state 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.**

If in doubt, you may send your Peak Product to us for safe and environmentally responsible disposal.

At Peak Electronic Design Ltd we are committed to continual product development and improvement. The specifications of our products are therefore subject to change without notice.

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