

HF Series

High Frequency Current Shunts

User manual



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Terms in the manual

These terms may appear in this manual:

 **WARNING.** Warning statements identify conditions or practices that could result in injury or loss of life.

 **CAUTION.** Caution statements identify conditions or practices that could result in damage to this product or other property.

 **INFORMATION.** Information statements identify instructions or commands that may save time or provide extra functionality.

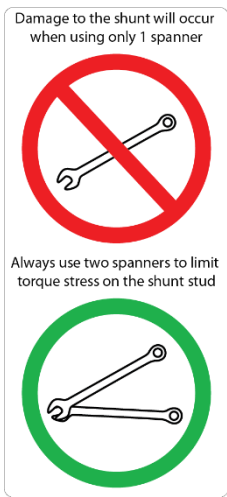
Terms on the product

These terms may appear on the product:

- **DANGER** indicates an injury hazard immediately accessible as you read the marking.
- **WARNING** indicates an injury hazard not immediately accessible as you read the marking.
- **CAUTION** indicates a hazard to property including the product.

Symbols on the product

 When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which must be taken to avoid them.



When this symbol is marked on a product, failure to observe the instructions shown for the lower green “2 spanner symbol” **WILL** damage the shunt.

Description

This manual covers the following, **HF 1A/3/6/10A/20/100/200/500** current shunts.

The HF series current shunts are reliable and accurate current sensing devices designed to maintain a known impedance value over a wide frequency range.

Utilising an innovative circuit design unique to N4L, the HF series does not exhibit the change in total impedance or the phase error that is commonly associated with conventional resistive shunt designs.

While the design incorporates quite a large number of components, it is a passive device and does not require external power. All shunts are tested during manufacture to confirm that they are within their specified tolerance and are then potted to improve heat dissipation and increase mechanical strength.

The design will withstand overcurrent up to the specified crest factor and provided that they are operated within their specified rms current range, the impedance will remain within the specified tolerance with no need for calibration.

Important safety Information

This manual contains important information that must be followed to ensure the safety of all operatives and both this instrument and any accessories attached.

General Safety Information

Use the product only as detailed in this manual. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

For correct and safe operation of this instrument, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only it is designed to comply with BSEN 61010-1 (Safety requirements for electrical equipment for measurement, control, and laboratory use)

Ensure that the supply voltage agrees with the rating of the instrument printed on the back panel before connecting to any instrumentation or DUT.

The cover(s) should not be removed to attempt repair, maintenance, or adjustment, as this instrument contains no user serviceable parts. All repairs, maintenance or adjustment should only be carried out by Newtons4th Ltd or our official distributor.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent.

To avoid fire or personal injury

Connect and disconnect properly. Do not connect or disconnect probes or test leads while they are connected to a voltage source. Use only insulated voltage probes, test leads, and accessories supplied with the product, or indicated by Newtons4th Ltd. to be suitable for the product.

Observe all terminal ratings. To avoid fire or shock hazard, observe all rating and markings on the instrument. Consult the specifications in this user manual for further ratings information before making connections to the product. Do not exceed the Measurement Category (CAT) rating and voltage or current rating of the lowest rated individual component of a product, probe, or accessory. Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate with suspected failures. If you suspect that there is damage to this instrument, have it inspected by Newtons4th Ltd or our official distributor. Do not use the instrument if it is damaged or operates incorrectly. If in doubt about safety of the instrument, turn it off and disconnect it. Clearly mark the instrument to prevent its further operation. Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged.

Do not operate in wet/damp conditions. Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry. Remove the input signals before you clean the product, only use a dry cloth for cleaning. Do not use chemicals or cleaning products on this instrument.

Provide a safe working environment. Always place the instrument in a location convenient for viewing and operating the switches.

Specific HF Shunt safety instructions

The HF series shunts are designed for use in a high voltage, high current environment by suitably trained personnel - **observe the following precautions:**

Ensure that all power is off when making connections to the HF shunt.



WARNING. The HF series are passive resistance shunts, and it is important to remember that they **do not provide isolation from the circuit to which they are connected.**

If the output BNC is connected to a ground point, line current will flow through the sense circuit causing irreparable damage to the shunt.

The sense output connector complies with 600V Cat II isolation rating and safe connection to a measurement device requires the use of a touch proof BNC cable with equivalent connectors to those used on the cable supplied with each shunt.

Connect the sense output only to an instrument with an isolated input rated for the voltage of the main current line.

Ensure adequate ventilation and airflow to prevent an excessive temperature rise of the shunt. If the shunt is used in an enclosed environment, then forced ventilation may be required.

Do not operate under conditions where condensation may occur.



CAUTION. There are no user serviceable parts inside the HF series shunts – **do not attempt to open the case**, refer service to the manufacturer or his appointed agent.

Note: Newtons4th Ltd. shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.

Environmental compliance

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling

Production of this equipment required the extraction and use of natural resources.

The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check with your local waste recycling facility.

Warranty

This product is guaranteed to be free from defects in materials and workmanship for a period of 36 months from the date of purchase.

In the unlikely event of any problem within this guarantee period, first contact Newtons4th Ltd. or your local representative, to give a description of the problem. If the problem cannot be resolved directly then you will be given an RMA number and asked to return the unit. The unit will be repaired or replaced at the sole discretion of Newtons4th Ltd.

This guarantee is limited to the cost of the HF Shunt itself and does not extend to any consequential damage or losses whatsoever including, but not limited to, any loss of earnings arising from a failure of the product.

In the event of any problem with the equipment outside of the guarantee period, Newtons4th Ltd. offers a full repair service – contact your local representative.

The HF Series shunts do not require any calibration.

Declaration of Conformity



Manufacturer: Newtons4th Ltd.

Address: 1 Bede Island Road
Leicester
LE2 7EA

We declare that the product:

Description: High Frequency Shunts

Models: HF 1A/3/6/10A/20/100/200/500

Conforms to the EEC Directives:

2014/30/EU relating to electromagnetic compatibility:

EN 61326-1:2013

EN 55022 class A

EN 61000-3-2:2014

EN 61000-3-3:2013

2014/35/EU relating to Low Voltage Directive:

EN 61010-2-030:2010

EN 61010-1:2010

January 2021

Jigar Patel

(Senior Engineer Newtons4th Ltd.)

Installing your HF shunt

Checking the shipped contents

Carefully unpack your HF Shunt and check the packing list that came with your instrument to verify that you have received all standard accessories and ordered items.



If any items are missing or damaged, please contact either Newtons4th Head Office or your local Distributor.

Visit <http://www.newtons4th.com> to find contact details of your nearest distributor.

It is highly advised to retain all the original protective packaging for re-use when you require to return the instrument for calibration or repair purposes to avoid transit damage.

Specification

Model	Nominal Resistance	Phase Error	Continuous Current	PPA typical* min Current
HF500	$0.2\text{m}\Omega \pm 0.1\%$	$0.1^\circ / \text{kHz}$	500A rms	0.5A rms
HF200	$0.5\text{m}\Omega \pm 0.1\%$	$0.1^\circ / \text{kHz}$	200A rms	0.2A rms
HF100	$1\text{m}\Omega \pm 0.1\%$	$0.05^\circ / \text{kHz}$	100A rms	0.1A rms
HF020	$10\text{m}\Omega \pm 0.1\%$	$0.01^\circ / \text{kHz}$	20A rms	10mA rms
HF006	$100\text{m}\Omega \pm 0.1\%$	$0.002^\circ / \text{kHz}$	6A rms	1mA rms
HF003	$470\text{m}\Omega \pm 0.1\%$	$0.001^\circ / \text{kHz}$	3A rms	200 μ A rms
HF01A	$1\Omega \pm 0.1\%$	$0.001^\circ / \text{kHz}$	1.5A rms	100 μ A rms
HF10A	$10\Omega \pm 0.1\%$	$0.001^\circ / \text{kHz}$	315mA rms	10 μ A rms

Frequency Range: DC to 1MHz

Permitted Crest Factor: 10 (E.g., repetitive peak current for HF100 is 1000Apk)

Maximum peak current: Single peak current with $\leq 100\mu\text{s}$ duration is $2 \times \text{Apk}$
(E.g., single peak current for HF100 is $2000\text{Apk} \leq 100\mu\text{s}$)

Minimum current: Based on use with a PPA analyzer ext. input & $\text{CF} \leq 3$

Nominal inductance: $< 1\text{nH}$

Input connector HF01A/003/006/020: 4mm safety type
 HF100/200: M10 Bolt
 HF500: M16 Bolt and Lug

Output connector: Touch proof BNC

Note: LINE POTENTIAL DO NOT GROUND.

Protection rating of case: 600V Cat II,

HF100/HF200 supplied with protective boot for M10 bolt.

Fixing Bolt Guide

HF100 / 200

The HF100/200 Current Shunts are connected into a circuit via an M10 bolt, extreme care should be taken when making these connections as shown by the warning label on the side of each housing. See below.



The connection should be made using two 17mm spanners as shown below so that adequate torque can be applied to the fixing bolt without transferring excessive turning force to the connection stud.



HF500

Electrical

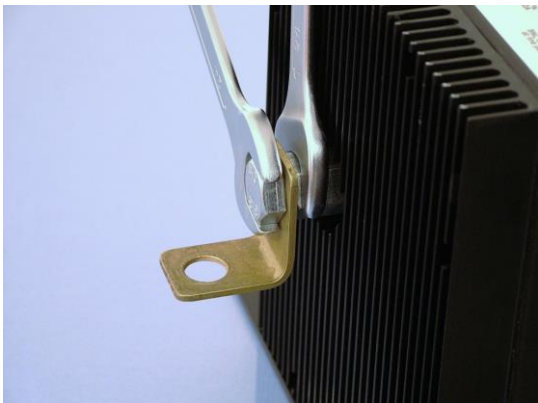
As the HF500 current shunt is fitted directly into a power circuit, it is essential that connection is made only while power is off and by suitably qualified personnel.

Mechanical

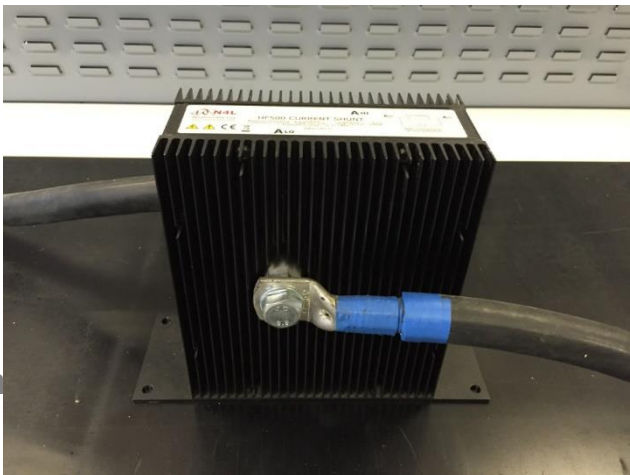
The HF500 current shunt is connected into a circuit via an M16 stud and bolt at each side of the shunt.

This connection technique allows heavy duty ring terminals to be connected directly the M16 stud or alternatively, to an 'L' bracket that is supplied along with an M16 bolt.

When tightening the M16 bolt, it is essential that two 24mm (15/16th Inch) spanners are used as shown below so that adequate torque can be applied to the bolt without transferring excessive turning force to the stud.



While the 'L' bracket permits additional connection options when space is limited, it is always preferable to make direct connections where possible because increased contact points will inevitably increase the total contact resistance and therefore also the operating temperature. The ideal connection will be with suitably sized connectors directly to the M16 bolt as shown on the next page:



HF500 Thermal Characteristics



The nominal resistance of HF series shunts is within 0.1% of the specified value as defined in the product brochure.

For HF100, 200 and 500 models, compliance with this specification is confirmed by voltage ratio calibration against a reference shunt. The current value at which calibration is carried out is appropriate for validation of the manufacturing process, from which compliance to the shunt specification over its complete operating range is assured by design.

Given the high current rating of an HF500 shunt and the associated increase in operating temperature at full working current, consideration of a thermal characteristic should also be taken into account when considering absolute accuracy under varying load conditions.

Thermal Characteristic.

The HF500 shunt incorporates five circuit boards, each carrying up to 100Arms continuous current. These boards are immersed in potting compound that provides mechanical strength, electrical isolation and thermal conduction.

Optimum shunt performance is achieved when the HF500 heatsink fins have reached full working temperature and can then maintain the shunt temperature within design tolerance.

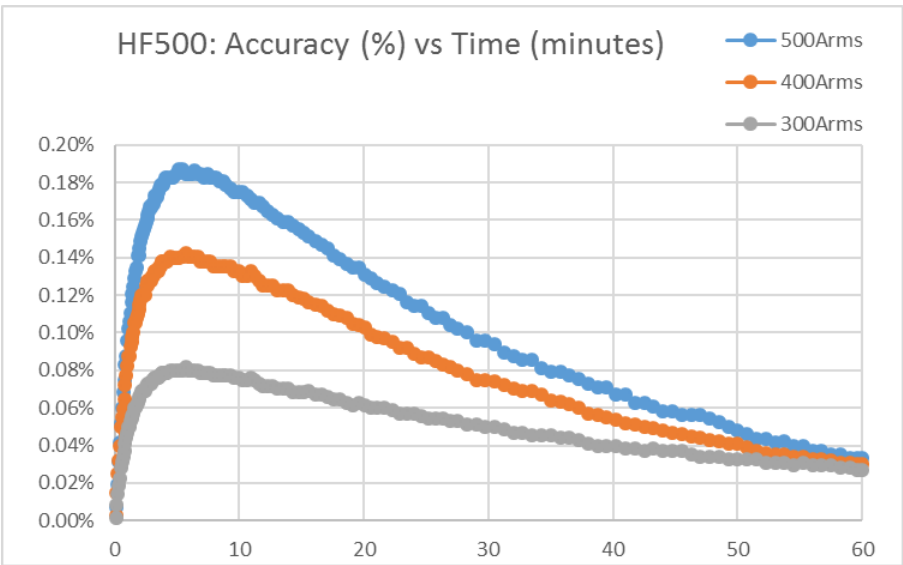
In the time period before working temperature is achieved, increased error will apply when continuous current above 300Arms is applied.

Here we illustrate an error profile with 300, 400 and 500Arms continuous current for 1 hour from an ambient temperature start.

400A continuous current reaches 0.1% accuracy within 20 minutes and remains within 0.15% during this time.

500A continuous current reaches 0.1% accuracy within 30 minutes and remains within 0.2% during this time.

This profile applies equally to DC current, AC current or the equivalent RMS current of a varying duty cycle load.



Summary

The nominal accuracy of HF500 shunts remains within 0.1% up to 300Arms with no warmup time and also at current up to the full rated value after a warm up time as defined here.

During a warmup and stabilisation period, the nominal thermal characteristic is as follows:

Error	300Arms	400Arms	500Arms	Note: This data assumes an ambient temperature between 5-30°C and unobstructed convection cooling of the shunt
in	0.00%	0.00%	0.00%	
mean	0.05%	0.09%	0.10%	
max	0.08%	0.14%	0.19%	