



Newtons4th Ltd

ADI40

Start up Guide



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IMPORTANT SAFETY INSTRUCTIONS

This equipment is designed to comply with BSEN 61010-1 (Safety requirements for electrical equipment for measurement, control, and laboratory use) – observe the following precautions:

- Ensure that the supply voltage agrees with the rating of the instrument printed on the back panel **before** connecting the mains cord to the supply.
- This appliance **must** be earthed. Ensure that the instrument is powered from a properly grounded supply.
- High voltages can be generated if current flow to inductive components is interrupted. Turn off the output before connecting or disconnecting any component.



- Keep the ventilation holes on the underneath and sides free from obstruction.
- Do not operate or store under conditions where condensation may occur or where conducting debris may enter the case.
- 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.

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.

DECLARATION OF CONFORMITY

Manufacturer: Newtons4th Ltd.
Address: 1 Bede Island Road
Leicester
LE2 7EA
UK

We declare that the product:

Description: Analogue<>Digital Interface
Product name: ADI40

Conforms to the requirements of Council Directives:

2014/30/EU relating to electromagnetic compatibility:
EN 61326-1:2013

2014/35/EU relating to the safety of laboratory
equipment:
EN 61010-2-30:2010

January 2021

Jigar Patel
(Senior Engineer Newtons4th Ltd.)

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. Please have as much relevant information to hand as possible.

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 ADI40 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 or software.

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

It is recommended that the ADI40 should be re-calibrated annually.

ABOUT THIS MANUAL

The Analogue<>Digital Interface from Newtons4th Ltd (ADI40) is a precision interface for use with the PPA35 and PPA45/55 range of power analysers.

This manual is concerned specifically with the ADI40 and its use to measure and output DC voltages – a working knowledge is assumed of the PPA instrument that it is used with.

A detailed description of the PPA3500, PPA4500 & PPA5500 Power Analysers may be found in the appropriate user manual.

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1 ADI40 – an overview

The ADI40 Analogue<>Digital Interface unit is a powerful multi-channel measurement system for use in conjunction with the PPA3500, PPA4500 and PPA5500 Power Analysers. It offers a seamless interface between the Power Analyser, Analogue Signals and Software.

The unit can also interface with chart recorders via 20 DC output channels, which may be mapped to any of the internally computed/logged measurements made by the PPA. These outputs can produce DC voltages within the range of +/-10V at 5mV intervals and have an output impedance of 10 ohms.

Each unit has 20 input channels with the number of each input type varying according to ADI40 variant, as shown in the table below.

Model	+/- 10Vdc inputs	Thermocouple inputs
ADI40	16	4
ADI40-8	12	8
ADI40-12	8	12
ADI40-16	4	16

The inputs are differential with a range of +/-10VDC and can be driven up to 20VDC without causing irreversible damage to the internal circuitry. Each input's impedance to ground is $1M\Omega$.

The thermocouple inputs are differential with a range of +/-20mV. The correct compensation can be applied for both type J and K. An internal temperature sensor provides cold junction compensation to within +/-0.4degC.

2 Getting started

The ADI40 is supplied with appropriate leads and accessories for use with the PPA3500, PPA4500 and PPA5500 Precision Power Analysers from Newtons4th Ltd. The ADI40 calibration can be performed with any PPA35/45/55 and can then be used with any other unit without recalibration – see the later chapter on calibration.

2.1 Unpacking

Remove the instrument and accessories from the packaging and check them against the supplied packing list. Please contact your N4L office or local sales distributor should any items found to be missing or damaged during transportation.

Please retain the original packaging to ensure easy and safe return of the equipment for calibration etc.

If rack mounting brackets have been fitted to the equipment, please remove them before packaging the equipment for return. This reduces the risk of damage to the equipment during transportation.

There may also be a number of optional accessories if these have been ordered with the unit.

Having verified that the entire above list of contents is present, it would be wise to verify that your ADI40 operates correctly and has not been damaged in transit.

2.2 Initial setup

Site the ADI40 under the instrument that it will be used with. Connect the ribbon cable from the extension port on the back of the ADI40 to the extension port on the rear of the PPA.

Verify that the voltage ratings on the rear panels of the ADI40 and the instrument are appropriate for the supply, and then connect the mains cords to the inlets on the rear panels and the supply outlet.

Switch on the ADI40 and the instrument. The POWER led should illuminate and the AUX led will flash, indicating that the auxiliary cable is connected but communication has not yet been established.

Press the AUX key on the instrument, ensure that "master/slave" is disabled and then select "ADI40" from the "auxiliary device" menu. Press the HOME key twice for the change to take effect. The AUX led should stop flashing and the OUT and IN leds will begin to flash sequentially.

If the led's do not flash, then check that the extension port cable has not been damaged and has been correctly fitted between the instrument and the ADI40.

In the event of any problem with this procedure, please contact customer services at Newtons4th Ltd. or your local authorised representative: contact addresses and telephone numbers are given in the appendix at the back of this manual.

3 Using the ADI40

3.1 Basic Operation

Continuous measurements are made by the ADI40 inputs whenever it is connected to a PPA3500, PPA4500 or PPA5500 with the correct AUX menu setup. Measurement data can be accessed in the following ways:

- Using the ANALOG,channel? command to monitor the inputs in CommView2
- Assigning inputs to MULTIL,1-60 and reading back with MULTIL? or MULTIL,lines?, in CommView2
- Using the N4L PPALoG software to log and export measurement data.

The ADI40 inputs can be used with a wide variety of sensors and components such as Airflow rate sensors, pressure sensors and DC fans.

The ADI40 outputs are also updated whenever it is connected to a PPA3500, PPA4500 or PPA5500 with the correct AUX menu setup. Outputs can be accessed in the followings ways:

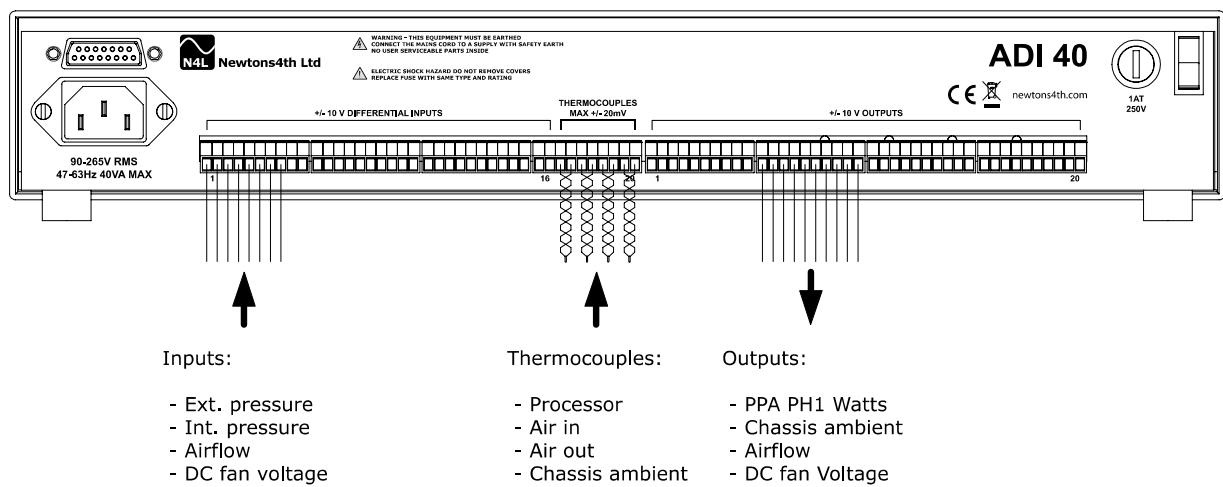
- Using the ANALOG,channel,value command to manually set the output voltage to a DC value between +/-10.
- Using the ADIMAP command to map a PPA parameter or ADI40 input back onto one of the outputs.

A detailed example of using the MULTIL and ADIMAP commands are given in section 3.2.

When not in use, it is recommended that short linking wires be screwed between each + and - thermocouple terminal pair. This eliminates noise pickup and allows the internal temperature of the ADI40 to be monitored.

3.2 Example Application Overview

This example will demonstrate how the ADI40 can be used to monitor the performance of a desktop PC. Internal chassis pressure, external atmospheric pressure, airflow through the chassis and DC fan voltage are monitored with the +/-10V inputs. The thermocouple inputs are used to measure, main CPU temperature, air temperatures on and off the heat sink and chassis ambient temperature. An example of how this would be wired to the ADI is shown below. The PPA35/45/55 Phase 1 voltage and current inputs are connected to the PC mains inlet to monitor its power consumption.



3.3 Initial Setup

First, confirm that all sensor wires and thermocouples are of sufficient length to reach the DUT comfortably. If possible, avoid running thermocouples close to very noisy electrical equipment.

Unplug the terminal blocks to be used and secure sensors and thermocouples to their respective terminals, using a 2mm flathead screwdriver.

The ADI40 and PPA35/45/55 should now be set up as described in section 2.2. Once powered up, connect the terminal blocks back into the ADI40. The thermocouples being used must all be of either type J or K, a mixture of the two is not supported. The appropriate thermocouple type can be chosen in the AUX menu.

The outputs can then also be connected to a Chart Recorder, using appropriate gauge and length of wire. Disconnecting the terminal blocks before securing wires in place is advisable to ensure good contact is made.

3.4 Making Measurements

A PC running the N4L Commview2 or PPALoG software is required to observe and/or record measurements made by the ADI40. For this example, Commview2 will be used to observe all measurements made and output some of them to the Chart Recorder.

First, confirm that all inputs are reading within the expected range by using the ANALOG? command.

ANALOG,1?;ANALOG,2?;....

If the measurements confirm that the ADI40 has been connected correctly, the inputs can next be assigned to Multilog channels with the MULTIL command.

The MULTIL command is used to assign up to 60 data values or parameters to be read back in a single multi string reply. In this example we wish to read back the following:

- The various sensors and DC fan on ADI inputs 1 - 4
- The various PC temperatures on ADI inputs 17 - 20

If we assign these inputs using MULTIL, they can then be read back as a single multi string response using MULTIL?:

```
MULTIL, 0      (clear anything previously assigned)  
MULTIL, 1, 6, 1
```

The commands shown above clears any old Multilog setup and then assigns ADI input 1 (6,1) to MULTIL channel 1 (MULTIL,1,). The same is then done for the rest of the ADI inputs:

```
MULTIL,2,6,2; MULTIL,3,6,3;... MULTIL,8,6,20
```

Sending the MULTIL? command will now return a string containing the last set of readings made on channels 1-4 and 17-20. The changes in voltages and temperatures can now be monitored.

3.5 Mapping Data to the Outputs

To send some of this data back to the ADI40 outputs, the ADIMAP command is used. Any data value stored in one of

the MULTIL channels can be offset, scaled and then sent to an ADI40 output.

In this example, we want to map PPA PH1 Watts, chassis ambient temperature, airflow sensor output and DC fan voltage to the ADI40 outputs. Assuming the inputs are assigned to the same Multilog channels as given in the previous section, we can map the airflow sensor (input 3) to output 8 by sending:

```
ADIMAP,8 ,3 ,0 ,0.8
```

This assigns Multilog channel 3 to ADI output 8, with 0 offset and scaled by 0.8. As a further example, if PH1 Watts is assigned to Multilog,9 with:

```
MULTIL,9 ,1 ,2
```

Then Watts (multiplied by 0.5) can be mapped to output 6 with the command:

```
ADIMAP,6 ,9 ,0 ,0.5
```

Providing the ADI40 is correctly setup, the outputs selected will begin to map their assigned Multilog channel. The MULTIL? and ANALOG? commands can still be used after mapping inputs to outputs, without issue.

N4L Software is available as a free download from our website www.newtons4th.com (support section).

4 Communications Commands

ANALOG

ANALOG

Function: Interface with ADI40

Description: Write to individual ADI40 outputs

Format: ANALOG,*channel,value*

Arguments:

- Channel:
1-20
- Value:
-10.00 to +10.00

Reply: None

Example: ANALOG,5,-3.14

Notes: Up to 9 outputs can be written to with one CommView transfer, by separating each instance with a ";".

ANALOG?

ANALOG?

Function: Interface with ADI40

Description: Read from individual ADI40 inputs

Format: ANALOG,channel?

Arguments: Channel:
1-20

Reply: ASCII characters in scientific format:
1 - 16 in Volts
17- 20 in °C

Example: ANALOG,12?

Notes: Up to 9 inputs can be read back at once
with this command by separating each
instance with a ";".

MULTIL

MULTIL

Function: Selects data for multi string reply

Description: Selects data values across phases and functions that can be read in a single string.

Format: *MULTILOG,index,type,function*

Arguments:

index:	0	clear all
	1-60	select data 1-20
type:	1-3	phase 1-3
	4	sum
	5	neutral
	6	adi40
function:	1-60	assign to value

Reply: none

Example:

```
MULTIL,0
MULTIL,1,6,1
MULTIL,2,6,2
MULTIL,3,6,3
MULTIL?
```

3 data values returned for inputs 1 - 3

MULTIL?

MULTIL?

Function:	Reads multi string reply
Description:	Waits for data to be available then returns selected results.
Format:	MULTILOG?
Or:	MULTILOG, <i>lines</i> ?
Arguments:	Lines: Integer
Reply:	Up to 60 data values as selected by the MULTILOG command in a single reply string OR Up to 60 data values as selected by the MULTILOG command in a single reply string, replying " <i>lines</i> " times.
Example:	MULTIL,0 MULTIL,1,6,2 MULTIL,2,6,2 MULTIL,3,6,3 MULTIL? 3 data values returned MUTLIL,5? Replies 5 times, each containing 3 data values
Notes:	The MULTILOG, <i>lines</i> ? command will reply each time a new data point is available.

ADIMAP

ADIMAP

Function: Map multilog parameters to outputs

Description: Applies offset and scaling to a multilog value and maps value to chosen ADI output

Format: ADIMAP,output,multilog,offset,scale

Arguments:

- output: 1-20
- multilog: 1-64
- offset: Float
- scale: Float

Reply: None

Example:

- MULTIL,0
- MULTIL,2,1,1 (PH1 Frequency)
- ADIMAP,1,2,0.2,0.5

Output 1 = 0.5 * (PH1 frequency - 0.2)

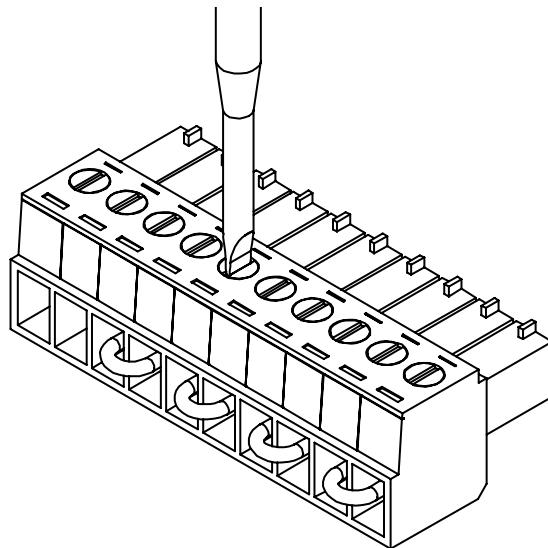
Notes: Offset is subtracted from multilog value, then scale is applied within the limits of +/- 10

5 Compensation

5.1 Thermocouples

The thermocouple inputs can be zeroed to remove small variations in measurements between channels. The following sequence is carried out during the production stage, but the user may wish to perform it again. To check the thermocouple inputs for drift; follow steps 1 to 3 below, use the ANALOG command to check all channels are reading the same room temperature and complete steps 4 to 6 if they vary by more than $+\text{-}0.2^{\circ}\text{C}$.

1. Set-up you're ADI40 as described in section 2.2.
2. Screw small shorting wires between the + and - terminals of each thermocouple channel, as shown below:



3. Plug the terminal block into the corresponding socket, ensuring it is fully locked in place.
4. In the AUX display, select 'manual zero' from the ADI adjustment menu.
5. With the cursor, highlight the 'press ENTER here to execute' text and press ENTER.
6. Verify that all thermocouple channels have been zeroed correctly.

If this process does not remove the offset or makes it worse, check thermocouples for damage or bad contact.

In the event of any problem with this procedure, please contact customer services at Newtons4th Ltd. or your local authorised representative: contact addresses and telephone numbers are given in the appendix at the back of this manual.

5.2 Standard Input Calibration

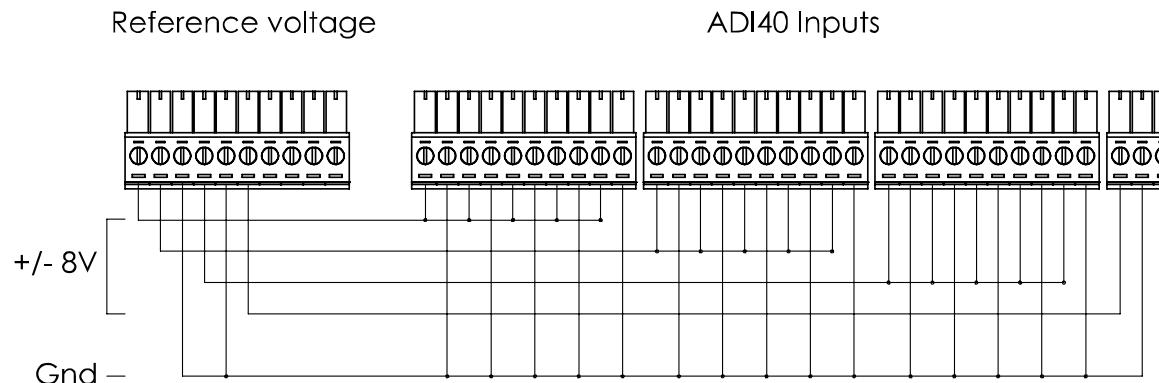
Calibrating the ADI40 inputs requires a PPA35/45/55 and a precision reference voltage of +8V and -8V. The ADI40 uses the reference voltage to produce a table of calibration factors, which are stored in internal flash memory. All inputs must be calibrated together at the same time.

The calibration instructions given here will use the ADI40 reference voltage calibration fixture available from Newtons4th Ltd, to demonstrate the process.

For further information about calibrating the ADI40 please contact customer services at Newtons4th Ltd. or your local authorised representative: contact addresses and telephone numbers are given in the appendix at the back of this manual.

5.3 Input Calibration Procedure

1. Set-up your ADI40 as described in section 2.2.
2. Wire all ADI40 inputs to the calibration reference voltage, as shown in the diagram below:



3. Verify the output is +8.000V, using a precision DMM (Digital Multimeter).
4. Select +8V in the ADI adjustment menu. With the cursor, highlight the 'press ENTER here to execute' text and press ENTER.
5. Verify that the IN and OUT leds begin to pulse sequentially at a faster rate, for about 2 seconds. If

the leds flash together, the calibration did not occur as one or more of the inputs were out of range.

6. Verify the output is -8.000V, using a precision DMM (Digital Multimeter).
7. Select -8V in the ADI adjustment menu. With the cursor, highlight the 'press ENTER here to execute' text and press ENTER.
8. Verify that the IN and OUT leds begin to pulse sequentially at a faster rate, for about 2 seconds. If the leds flash together, the calibration did not occur as one or more of the inputs were out of range.
9. Verify input calibration was successful by using CommView2 and the reference voltage.

In the event of any problem with this procedure, please contact customer services at Newtons4th Ltd. or your local authorised representative: contact addresses and telephone numbers are given in the appendix at the back of this manual.

6 Specification

All specifications are quoted for the ADI40 only.

System	
Standard Inputs	
Basic Accuracy	0.1% Full Scale
Voltage Range	Bipolar +/- 10V
Maximum Input Voltage	+/- 30V
Maximum Common Mode Voltage	- 1V ~ +14V
Thermocouple Inputs	
Voltage Range	Bipolar +/- 20mV
Maximum Input Voltage	Bipolar +/- 50mV
Accuracy	+/- 1°C * ¹
All Inputs	
Input Impedance	1MΩ
Update Rate	10ms
Resolution	12 bit
Outputs	
No. Of Outputs (DC)	20
Voltage Range	Bipolar +/- 10V
Slew Rate	0.1V/µS
Maximum Source Current	50mA
Output Impedance	10Ω
Accuracy	0.1% Full Scale
Resolution	12 bit

*¹ Junction compensation ≤ 3°C across inputs subject to ambient stability

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General	
Operating Conditions	23 °C ± 5 °C Ambient Temperature (or air intake temperature when rack mounted), 20-90% Non-Condensing Relative Humidity.
Temperature coefficient	±0.01% per °C of reading at 5-18 °C and 28-40 °C
Connectors	40 x 3.5mm screw terminal
Power Requirements	universal input 90-265V rms, 47-63Hz 40VA max.
Size	H: 62.4mm, W: 395mm, L: 280 mm approx
Weight	2kg approx
Warranty	3 Years

Appendix A – Accessories

Calibration kit

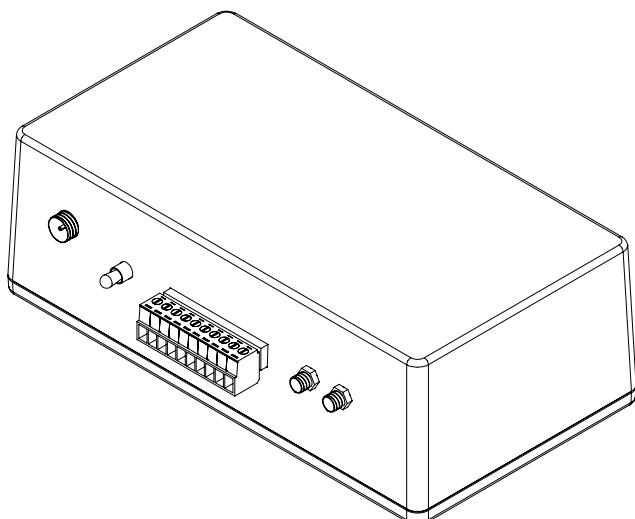
The ADI40 is calibrated with a voltage reference unit and a PPA35/45/55 Power Analyser. Calibration values are stored in the non-volatile FLASH memory of the instrument.

The calibration unit includes the necessary calibration cable assembly.

A 2.1mm DC power supply within the range of 9 – 18V is required to power the unit.

Part numbers

500-365 ADI40 calibration kit



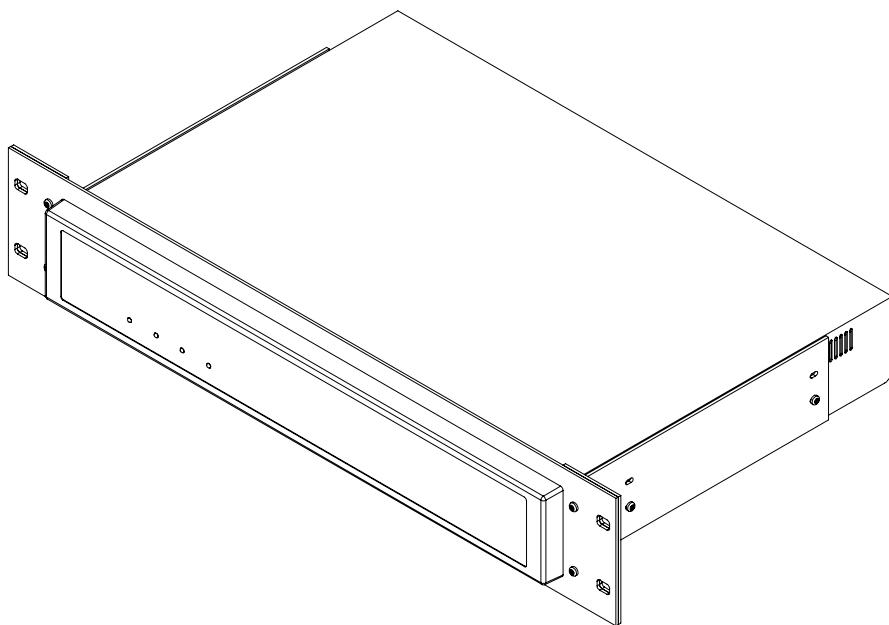
19" rack mounting kit

The ADI40 can be integrated into 19" rack systems using a 2U custom rack mounting kit.

The kit consists of one front panel, two universal brackets and eight black M3 x 10mm pan head bolts.

Part numbers

515-253 ADI40 19" rack mounting kit



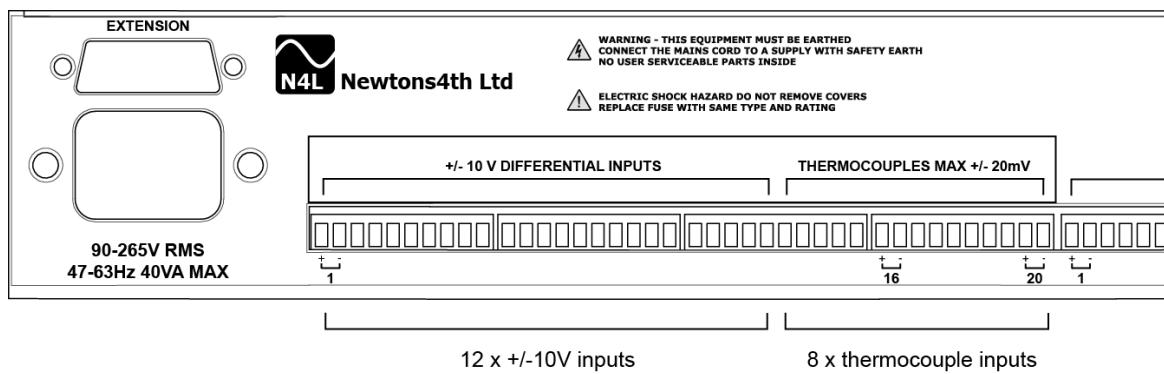
Appendix B – ADI40 variant information

There are currently 4 ADI40 variants available: the standard 4 thermocouples, 8 thermocouples, 12 thermocouples and 16 thermocouples.

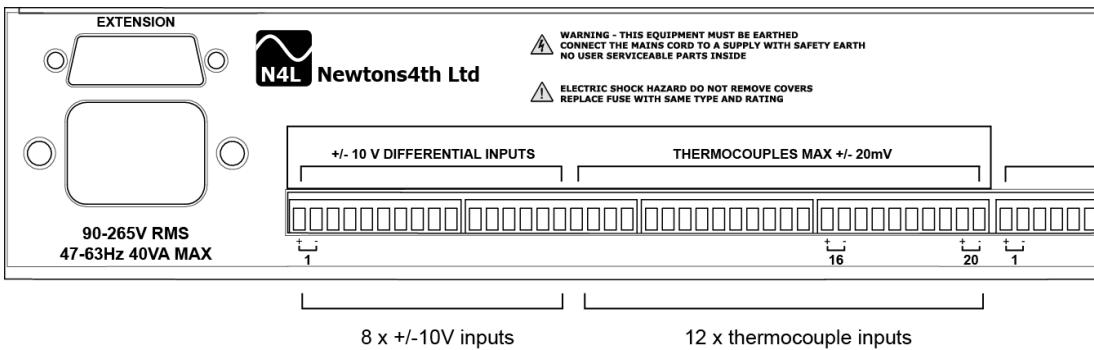
If you do not have the standard unit, there will be an additional **ADI40-8** , **ADI40-12** or **ADI40-16** model overlay located under the power switch on the rear of the unit.

Examples of the ADI40-8 and ADI40-12 inputs types are given below:

ADI40 – 8



ADI40 – 12



Appendix C – Contact details

Please direct all queries or comments regarding the ADI40 instrument or manual to:

Newton4th Ltd.
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Leicester
LE2 7EA
United Kingdom

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office@newtons4th.com

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At Newtons4th Ltd. we have a policy of continuous product improvement and are always keen to hear comments, whether favourable or unfavourable, from users of our products.