LD SERIES
Electronic DC Loads

80A-80V-400W or 16A-500V-400W

Constant current, resistance, power, voltage and conductance

Transient generator, variable slew rate, soft start

Current monitor output, analog remote control

USB, RS-232, GPIB and LAN interfaces
LD SERIES

Key Features

COMPACT ELECTRONIC DC LOADS
The LD series features electronic loads which are suitable for testing and characterising a wide variety of dc power sources. They can be used to investigate the behavior of many different types of power source such as PFCs, batteries and solar cells, as well as electronic power supply units. The wide voltage/current range, multiple operating modes and built-in transient generator give them versatility to offer test solutions from the design laboratory through to the component test area.

LD400 & LD400P

Key Features

- Variable drop-out voltage for battery testing
- 400 watts continuous dissipation at 28°C (de-rating to 360W at 40°C)
- Constant current, resistance, conductance, voltage (LD400 models only) and power modes
- High resolution and accuracy for level setting
- Current monitor output for waveform viewing
- Front and rear input terminals
- Built-in transient generator with variable slew
- High resolution backlit graphic LCD with soft key control
- Analog remote control of levels and TTL control of on/off and transient switching
- Full bus control via USB, RS232, GPIB and LXI compliant LAN interfaces *

* P models only

FEATURES SUMMARY

- Low minimum operating voltage of <1V at 40A
- Wide voltage and current range 0-80V & 0-80A
- 600 watts short term dissipation (up to 60 seconds)

LOW MINIMUM OPERATING VOLTAGE
The LD400 can operate at voltages below 500mV for currents up to 10 amps. At higher currents the fixed minimum resistance (typically better than 25mΩ) gradually raises the minimum operating voltage, but it remains below 1 volt up to 40 amps and below 2 volts up to 80 amps. This low operating voltage allows it to be used for many low voltage applications for which other electronic loads are unsuitable.

600 WATTS INTERMITTENT POWER
The LD400 can operate at power levels up to 600 watts for periods of up to 1 minute. Short term loading can be sufficient for many testing applications and significantly extends the usefulness of the LD400.

MODEL COMPARISON

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<th>Feature</th>
<th>LD400 &amp; LD400P</th>
<th>LDH400P</th>
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<td>Max Power range</td>
<td>400W (600W short term)</td>
<td>400W</td>
</tr>
<tr>
<td>Max Current</td>
<td>80A rear panel</td>
<td>16A</td>
</tr>
<tr>
<td></td>
<td>30A front panel</td>
<td></td>
</tr>
<tr>
<td>Operating range</td>
<td>0 - 80V</td>
<td>10 - 500V</td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>±300Vdc</td>
<td>CAT II (300V)</td>
</tr>
<tr>
<td>Operating modes</td>
<td>CC,CP,CR,CG,CV</td>
<td>CC,CP,CR,CG</td>
</tr>
</tbody>
</table>

PFC TEST EXAMPLE

CAT II (300V) RATING
The LDH400P load inputs are rated to CAT II (300V), this allows the direct testing of PFCs and mains connected power supplies to be simplified using the LDH400P by eliminating the need for an isolation transformer, saving bench space and cost.
**CONSTANT CURRENT MODE**
Used for load testing of normal voltage-source power supplies and for constant current discharge testing of batteries.
This mode provides rapid measurement of power source regulation (V/I characteristics).

**CONSTANT RESISTANCE MODE**
Simulates a standard resistive load by providing a current drain proportional to voltage. Settings are displayed in Ohms or milli-Ohms.
Unlike fixed resistors or rheostats, the load provides a precisely controllable resistance with high power dissipation and high temperature stability over a wide value range.

**CONSTANT POWER MODE**
Simulates a load whose power consumption is independent of the applied voltage.
This is true of many types of equipment that incorporate switch-mode regulators.
This mode may be particularly suitable for testing power sources of portable devices such as Lithium-ion batteries.

**CONSTANT VOLTAGE MODE** (LD400 MODELS ONLY)
Used for load testing of constant current power supplies. The unit operates as a high power shunt regulator.

**CONSTANT CONDUCTANCE MODE**
As well as showing settings in amps per volt, this mode provides better resolution when setting very low equivalent resistance values.

**TRANSIENT GENERATOR AND VARIABLE SLEW**
The LD series incorporates a full variable frequency, variable duty cycle transient generator.
Switching between the two preset levels can be done at any frequency between 0.01Hz and 10kHz. The transient generator can be used in all operating modes.
The rate of change between levels (slew rate) is controllable over a wide range.
Slew rate control applies to all changes of level including remote control and manual changes between level A and level B.
A slow-start function can be selected for situations where latching would otherwise occur at switch-on.

**HIGH RESOLUTION SETTING/MEASUREMENT**
The two operating levels for each operating mode are settable to high precision.
Levels are displayed using four digit meters which provide resolution down to 1mA, 1mV and 1mW.
The meters have an accuracy of 0.1% for voltage and 0.2% for current.

**CURRENT WAVEFORM MONITOR**
It is often important to be able to observe the load current waveform on an oscilloscope. The LD series provides a calibrated monitor output for this purpose as well as a sync output from the transient generator.
The LDH400P monitor output is ground (chassis) referenced and isolated from the load input, thus allowing it to be connected to a ground oscilloscope.

**SETTING MEMORIES**
Thirty non-volatile memories are provided which store all of the parameters of the load. This makes the LD series highly suitable for repetitive test use.

**ADJUSTABLE VOLTAGE DROPOUT**
Some power sources, such as rechargeable batteries, can be damaged if their output voltage falls below a certain level. The LD series provides automatic protection by incorporating fully variable voltage dropout. If the voltage applied to the load falls below a preset level, the load current is rapidly reduced to zero.

**MULTIPLE MODES OF OPERATION**

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*screens taken from LDH400P*
ANALOG REMOTE CONTROL

The LD series incorporates analog remote control for all modes of operation. When "external voltage" is selected the level becomes linearly proportional to the voltage applied to the remote control inputs on the rear panel.

A waveform can be used as the control voltage allowing complex load conditions to be simulated using, for example, an arbitrary waveform generator, such as the Aim-TTI TGF3000 series or a true arbitrary generator from the TGA series.

Alternatively, a logic signal can be used to switch between levels. When "external TTL" is selected, the level is switched between the two defined levels in response to an external logic signal.

COMPREHENSIVE BUS REMOTE CONTROL

To meet a wider variety of needs, the P models in the LD series add a comprehensive array of digital bus interfaces. USB, RS-232, GPIB and LAN with LXI support are all provided as standard. Each of the digital bus interfaces provides full control and read-back of settings and status. The interfaces are at ground potential and are opto-isolated from the terminals.

A standard RS-232/RS-423 interface is provided for use with legacy systems with a baud rate of 9600. The serial interface remains in common usage and is perfectly satisfactory for the control of load devices.

The GPIB interface is compliant with IEEE-488.1 and IEEE-488.2. GPIB remains a widely used interface for system applications. The interface subsets provided are:

SH1, AH1, T6, L4, SR1, RL2, PP1, DC1, DTO, C0, E2.

USB provides a simple and convenient means of connection to a PC and is particularly appropriate for small system use. A standard USB 2.0 driver is provided which operates as a virtual COM port and supports Windows 2000 and above including Win 8 and 10.

The LAN interface uses a standard 10/100 base-T Ethernet hardware connection with ICMP and TCP/IP Protocol for connection to a Local Area Network or direct connection to a single PC. This interface supports 1.4 LXI core 2011 and is highly appropriate for system use because of its scalable nature and low cost interconnection.

The LAN interface is LXI compliant. LXI (LAN eXtensions for Instrumentation) is the next-generation, LAN-based modular architecture standard for automated test systems managed by the LXI Consortium, and is expected to become the successor to GPIB in many systems. For more information on LXI go to: www.aimtti.com/go/lxi

LABVIEW & IVI DRIVER

An IVI driver for Windows is included with all P models in the LD series. This provides support for common high-level applications such as LabView®, LabWindows®, and KeysightVEE®.
MULTI INSTRUMENT CONTROL

Up to four instruments can be connected at one time, each one can be controlled by the instrument panel; settings and limits can be viewed and amended in the settings menu. Live and set data can be displayed for all channels on a multiple channel instrument, each one colour coded for ease of identification.

Compatible with Aim-TTi PSU and Loads: PL, QL, MX, CPX, TSX, QPX, and LD.

LOGGING TO TABLE AND GRAPH

Logging channels capture live data, they can be set to record values from any output on an active instrument at specified time intervals. Varying measurement intervals can be set alongside units and plot line colour. The results are plotted on one of the two available graphs and can also be viewed in a table. The graph provides advanced zooming and panning functions, allowing efficient data analysis. The data can be exported as a .TSV file.

TIMED SEQUENCE CONTROL

Each sequence is allocated to a specified channel on an instrument. Two different units can be added to each sequence, along with two events. A range of built in step options are available including: sine, triangle, ramp and step.

Test Bridge software can be downloaded from: https://www.aimtti.com/support
### Maximum Input Ratings

<table>
<thead>
<tr>
<th>MODEL</th>
<th>LD400 &amp; LD400P</th>
<th>LDH400P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear panel</td>
<td>80A</td>
<td>16A</td>
</tr>
<tr>
<td>Front panel</td>
<td>30A</td>
<td></td>
</tr>
<tr>
<td><strong>Voltage:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear panel</td>
<td>80V</td>
<td>500V</td>
</tr>
<tr>
<td>Front panel</td>
<td>30A</td>
<td></td>
</tr>
</tbody>
</table>

**Power:**
- Continuous: 400W up to 28°C, 360W at 40°C, 400W up to 28°C, 360W at 40°C
- Short term: (1) 600W up to 28°C

**Minimum Operating Voltage:**
- <2V at 80A 10V 25mΩ 1Ω

**Minimum Effective Resistance:**
- <10mA <5mA (Including voltage sense circuit input resistance)

**Reverse Polarity:**
- 80A 16A (Diode will conduct)

**Isolation Voltage:**
- ±300Vdc CAT II (300V) (Either load input to chassis ground)

**Input Terminals:**
- Rear panel input: 5mm diameter wire or 8mm spades 80A 4mm plugs at 30A
- Front panel input: 4mm diameter wire, 6.5mm spades or 4mm plugs at 30A

**External Voltage Sense (LD400 & LD400P Only):**
- Connection: Terminal block on rear panel. Sense selection by slide switch.
- Input Impedance: 680kΩ each input to load negative
- Max. Sense Offset: 6V (allowance for backing-off supply for zero volt operation)

### Operating Modes

#### CC MODE
- **Range:**
  - Low: 0-8A
  - High: 0-80A
- **Accuracy:**
  - Low: ± 0.2% ± 30mA
  - High: ± 0.2% ± 30mA
- **Resolution:**
  - Low: 1mA
  - High: 10mA
- **Regulation:**
  - < 30mA for 90% load power change (Volts > 2V)
  - < 30mA for 90% load power change (Volts > 25V)
- **Temperature Coefficient:**
  - < (±0.02% ± 5 mA) per °C
  - < (±0.02% ± 5 mA) per °C
- **Slew Rate Range:**
  - Low: <2.5A per s to >250A per ms
  - High: <25A per s to >2500A per ms
- **Minimum Transition Time:**
  - (3) 50µs

#### CP MODE
- **Range:**
  - 0-400W (or 600W) 0-400W
- **Accuracy:**
  - ± 0.5% ± 2W ± 30mA (Volts > 25V)
- **Resolution:**
  - 100mV
  - 100mV
- **Regulation:**
  - < 2% over 5V to 75V source voltage change (using remote sense)
  - < 2% over 25V to 550V source voltage change
- **Temperature Coefficient:**
  - < (± 0.1% ± 5 mA) per °C

#### CR MODE
- **Range:**
  - Low: 0.04-10Ω
  - High: 2-400Ω
- **Accuracy:**
  - Low: ±0.5% ± 2 digits ± 30mA
  - High: ±0.5% ± 2 digits ± 30mA (Volts > 25V)
- **Resolution:**
  - Low: 0.01Ω
  - High: 0.1Ω
- **Regulation:**
  - < 2% for 90% load power change (Volts > 2V using remote sense)
  - < 2% for 90% load power change (Volts > 25V)
- **Temperature Coefficient:**
  - < (±0.04% ± 5 mA) per °C
  - < (±0.04% ± 5 mA) per °C
- **Slew Rate Range:**
  - Low: < 40W per s to >6000W per ms
  - High: 60W per s to 6000W per ms
- **Minimum Transition Time:**
  - (3) 150µs

#### CG MODE
- **Range:**
  - Low: 0.04-10Ω
  - High: 2-400Ω
- **Accuracy:**
  - Low: ±0.5% ± 2 digits ± 30mA
  - High: ±0.5% ± 2 digits ± 30mA (Volts > 25V)
- **Resolution:**
  - Low: 0.01Ω
  - High: 1Ω
- **Regulation:**
  - < 2% for 90% load power change (Volts > 2V using remote sense)
  - < 2% for 90% load power change (Volts > 25V)
- **Temperature Coefficient:**
  - < (±0.04% ± 5 mA) per °C
  - < (±0.04% ± 5 mA) per °C
- **Slew Rate Range:**
  - Low: < 1Ω per s to 100Ω per ms
  - High: 1Ω per ms to 100Ω per µs
- **Minimum Transition Time:**
  - (3) 150µs

#### CV MODE
- **Range:**
  - Low: < 0.01-1A/V
  - High: < 0.001-1 A/V
- **Accuracy:**
  - Low: ± 0.5% ± 2 digits ± 30mA
  - High: ± 0.5% ± 2 digits ± 30mA (Volts > 25V)
- **Resolution:**
  - Low: 1mA/V
  - High: 1mA/V
- **Regulation:**
  - < 2% for 90% load power change (Volts > 2V using remote sense)
  - < 2% for 90% load power change (Volts > 25V)
- **Temperature Coefficient:**
  - < (±0.04% ± 5mA) per °C
  - < (±0.04% ± 5mA) per °C
- **Slew Rate Range:**
  - Low: <0.1A/V per s to >10A/V per ms
  - High: <0.1A/V per s to >10A/V per ms
- **Minimum Transition Time:**
  - (3) 150µs

- **Temperature Coefficient:**
  - < (0.02% ± 1mV) per °C

- **Slew Rate Range:**
  - Low: 0.8V per s to >80V per ms
  - High: 8V per s to >800V per ms
- **Minimum Transition Time:**
  - (3) 150µs
## Meter Specifications

| Display Type | 256 x 112 pixel graphic LCD with white LED backlight. |

## Measured Values

| Volts & Amps | Measured values of current through and voltage across the load. |
| Watt & Ohms | Power and equivalent load resistance, calculated from Volts and Amps. |
| Voltage Accuracy | ± 0.1% ± 2 digits ± 0.1% ± 0.02% FS |
| Current Accuracy | ± 0.2% ± 3 digits ± 0.2% ± 0.04% FS |

## Current Monitor Output

| Output Terminals | 4mm safety sockets on front panel or terminal block on rear panel. |
| Output Impedance | 600Ω nominal, for >1MΩ load (e.g. oscilloscope) |
| Scaling | 50mV per Amp (4V full scale) 250mV per Amp (4V full scale). |
| Accuracy | ± 0.5% ± 5mV |

## Remote Control (P Models Only)

| Connection | Terminal block on rear panel. Lo terminal input grounded to chassis internally. |
| Input Impedance | 400kΩ each input to load negative. 10kΩ. Input protected against excess input voltages up to 50V. |

## Externally Analog Voltage Control

| Operating Mode | The applied voltage sets the operating level within the range. |
| Scaling | 4 Volts full scale. 4 Volts full scale (250mV per Amp). |
| Accuracy | ± 2% ± accuracy of range |
| Common Mode Rejection | Better than -66dB Better than -76dB |
### EXTERNAL LOGIC LEVEL (TTL) CONTROL

**Operating Mode:** The applied signal selects between Level A and Level B settings.

**Threshold:** +1.5V nominal. A logic high selects Level B.

### REMOTE DISABLE INPUT

**Connection:** Terminal block on rear panel. Input to the LED of an opto-isolator through 1kΩ resistor.

**Threshold:** Apply >+3V to disable the load input. Max. 12V.

### GENERAL

**AC Input:** 110V–120V or 220V–240V AC ±10%, 50/60Hz. Installation Category II

**Power Consumption:** 40VA max. Mains lead rating: 6A minimum.

**Operating Range:** +5°C to +40°C, 20% to 80% RH

**Storage Range:** –40°C to +70°C

**Environmental:** Indoor use at altitudes up to 2000m, Pollution Degree 2.

**Cooling:** Variable speed fan. Air exit at rear.

**Safety:** Complies with EN61010-1

**EMC:** Complies with EN61326

**Size:** 130mm H (3U) x 212mm W (½ rack) x 435mm D

**Weight:** 5.7 kg

**Option:** RM460 - 19-inch rack mount kit

### SPECIFICATION NOTES

LD400 & LD400P Accuracy specifications apply for 18°C – 28°C, at 50W load power (in normal 400W mode), after 30 minutes operation at the set conditions; regulation specifies variation at other powers. Setting accuracies apply with slew rate at the ‘Default’ setting.

LDH400P Accuracy specifications apply for 18°C – 28°C, using rear panel terminals, after 30 minutes operation at the set conditions. Setting accuracies apply with slew rate at the ‘Default’ setting.

1. In 600 Watt short-term operation mode the dynamic response is not specified, and both the slew rate and the transient oscillator frequency range are restricted. The slew rate limitation applies also to external voltage control. This mode is primarily intended for limited duration operation at a fixed level setting.

2. Slew Rate Ranges refer to the theoretical slope of the transition between two levels, regardless of whether that transition can be achieved when taking into account the level difference, the set transition duration, the minimum transition time, and the characteristics of the source.

3. Minimum Transition Time specification is an indication of the fastest available transition using a benign battery source and low inductance connections, with a minimum terminal voltage of 5V and a minimum current of 1A. The actual performance attainable with electronically regulated power supplies depends on the combination of source and load loop bandwidths and interconnection inductance.

4. Minimum Transition Time specification is an indication of the fastest available transition using a benign source and low inductance connections, with a minimum terminal voltage of 25V and a minimum current of 200mA. The actual performance attainable with electronically regulated power supplies depends on the combination of source and load loop bandwidths and interconnection inductance.

5. The common mode capability of the current monitor is to provide tolerance of voltage drops in the cables. The monitor negative must be connected at some point to the load negative circuit.

Thurlby Thandar Instruments Ltd. operates a policy of continuous development and reserves the right to alter specifications without prior notice.