

aDCLoad

2.4

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## Chapter 1

# Arduino Programmable Constant Current Power Resistance Load

This is all of the code, datasheets and design files for [my instructable](#)

- Arduino - It contains the Arduino code that we will be talking about here, within the dummy load folder. It also contains all of the 3rd party libraries I have used.
- Datasheets - It contains all of the datasheets for the major components used within the project.
- DesignSpark - I have used the opensource schematic and PCB design software for this project, its a fantastic free tool that has no limitations and I find it easier to use than Eagle - <http://www.rs-online.com/designspark/electronics/eng/page/designspark-pcb-home-page> The rev 1 folder contains all of my initial designs, please don't use this as there are 2 or 3 errors in the footprints plus I have completely revised the layout for rev 2, please only use these files. the gerber files are in there should you wish to have your own board done. See the next step for more information on this.
- LTSpice - This contains all of the LtSpice files from simulating the operation of the MOSFET.

Please checkout my instructable as it describes all of this code and the operation of the dummy load.



## Chapter 2

# ATmega32U4 fuses settings

Unlike the Arduino™ Leonardo board, the ATmega32U4 MCU used in this DC Load needs some special fuses settings.

The following command line defines them to the correct values:

```
avrdude -F -p atmega32u4 -C /etc/avrdude.conf -v -e -V -c usbasp -P usb -U lfuse:w:0xFF:m -U hfuse:w:0xD1:m  
-U efuse:w:0xCB:m -F lfuse:w:0xE1:m
```

You can also invoke the provided *Makefile*, as:

```
make fuses
```





## Chapter 3

# User interface overview





- The DC load control is done using a simple rotary encoder, which integrates a push button.
- When the DC Load displays the input value (left aligned values), a single encoder detents turns the DC Load's display in settings mode (right aligned values), without any setting value changes.
- There are two display modes, **input values** and **settings values**.

When you rotate the encoder, the DC Load switches automatically to **settings mode**.

You just need to rotate the encoder to define the desired value, accordingly to the focus : **Current** or **Power**.

- In both display modes, a double click changes the focus (delimited by '[' and ']' symbols) to the next value parameter, Current (**I**) or Power (**P**).
- A simple click changes the tuning step.

Next to the ']' delimiter symbol, an icon displays the tuning step multiplier, as following:







Multiplier	Glyph
x1	
x10	
x100	
x1000	

- By default, the DC Load displays **Input Voltage**, **Current load**, **Power dissipation** values and **heatsink temperature**.

**Note**

The Voltage is measured on the input connectors of the DC Load and may differs from the measured value out of the power supply source.

- After 3 seconds in settings mode, without any encoder action, the DC Load returns to the **input values** display mode.
- According to the actual status of the DC Load, some icons may be shown:

Feature	Glyph
Logging is running	
Encoder is locked	
USB remote controlled	
Over-Current alarm	
Over-Voltage alarm	
Over-Temperature alarm ( in place of "°C" )	

- To access to the options configuration, you need to press the button for more than 3 seconds. In this *window*, you can enable or disable the **backlight's auto-dimmer** and the **rotary encoder's auto-lock** features.  
A double click changes the option focus, a simple click changes the option enableity and a long press exits the options *window*.
- When **auto-lock** is turned on and triggered, a double click unlocks the rotary encoder (the key icon disappear).
- When **auto-dimmer** is turned on and triggered, any rotary encoder action will turn the backlight on, without any change to the defined settings.
- There are 3 differents kind of alarms:
  1. **OC** for over-current:  
When **Over-Current** is triggered, Current setting is defined to 0mA, **OC** icon is displayed.  
Over-Current alarm will be cleared once the encoder is used to set a new Current value.

2. **OV** for over-voltage:

When **Over-Voltage** is triggered, Current setting is defined to 0mA, **OV** icon is displayed.  
Encoder will have no action until the input voltage drops below to its maximum value (24V).

3. **OT** the over-temperature:

When **Over-Temperature** is triggered, Current setting is defined to 0mA, **OT** icon is displayed.  
Encoder will have no action until the internal temperature drops below to its maximum value (80 °C).

- The DC Load can be remotely controlled, see [Remote Commands](#)



## Chapter 4

# Remote Commands

See also [Logging data format](#)

### Note

Serial port configuration: **57600,8,N,1**

### Warning

Commands and arguments are **case sensitive**, **ALL** in **UPCASE**

## 4.1 Get Identification

- **:\*IDN?:**
  - Returns firmware informations

See [Return value](#)

## 4.2 Current setting getter

- **:ISET?:**
  - Returns current setting (in **mA**)

See [Return value](#).

## 4.3 Current setting setter

- **:ISET:*value***
  - Set current ***value*** (in **mA**)

See [Return value](#).

## 4.4 Calibration

- **:CAL:toggle**
  - Turns **ON** or **OFF** the logging feature.
- **:CAL:section:slope,offset**
  - **section** could be **V**, **C**, **D** or **VD**, standing for **V**oltage, **C**urrent, **D**AC and **V**oltage **D**rop.
  - **slope** and **offset** are floating point values, with US period decimal separator ('.'). These values could be calculated using the *LibreOffice's* spreadsheet file *aDCLoadCalibration.ods*.
- **:CAL:SAVE**
  - Backup calibration datas into EEPROM.

See [Return value](#)

See [Calibration Process](#)

## 4.5 DAC value setter (calibration purpose)

- **:DAC:value**
  - Set DAC value (from **0** to **4095**).

### Note

This command has no effect outside calibration mode

See [Calibration](#)

See [Calibration Process](#)

## 4.6 Current readed getter

- **:I?:**
  - Returns current readed from the load (in **mA**)

See [Return value](#).

## 4.7 Voltage readed getter

- **:U?:**
  - Returns voltage readed from the load (in **mV**)

See [Return value](#).

## 4.8 Logging enability

- **:LOG?:**
  - Printout if logging is **ON** or **OFF**.

See [Return value](#).

## 4.9 Logging enability

- **:LOG:toggle**
  - Turns **ON** or **OFF** the logging feature.

### Note

If **toggle** value is not specified, a single logging line is returned.

See [Return value](#).

## 4.10 Return value

### :value:status:

- Where:
  - **value** if any expected. **INVALID** on unknown command.
  - **status** could be **OK** on success or **ERR** on failure.





## Chapter 5

# Logging data format

See also [Remote Commands](#)

### Note

fields are comma separated

### 5.1 CSV logging format

*timestamp,voltage,current sets,current read,temperature\r\n*

- Where:
  - *timestamp* in hundred of milliseconds,
  - *voltage* in mV,
  - *current sets* in mA,
  - *current read* in mA,
  - *temperature* in Celcius degrees.



## Chapter 6

# Calibration Process

- **Prerequisites:**

- **Hardware:**

- \* Amp-meter,
    - \* Volt-meter,
    - \* Power supply (**0..24V, 8A**)

- **Software:**

- \* A serial terminal emulator (e.g. “*HyperTerminal*” or “*Tera Term*” on Windows, “*minicom*” or “*cute-com*” on Linux).
    - \* The calibration spreadsheet file **aDCLoadCalibration.ods**
    - \* A software able to open the calibration spreadsheet, like “*LibreOffice*”, “*OpenOffice*” and so on.  
The serial communication settings are: **57600, 8, N, 1**

- **Process Description:**

- **Step 1: Maximum Current**

Select “*Step 1*” tab in the calibration spreadsheet file.

Connect the amp-meter and the power supply to the DC load, for current measurements. Open your serial terminal emulator, connect the DC load, then type:

```
:DAC:4095
```

Write down the **mA** value readed on the amp-meter to the “**mA<sub>max</sub>**” column. Now, type:

```
:DAC:0
```

Edit the [aDCLoad.h](#) source file, browse down the file, looking for the following line:

```
static const float      CURRENT_MAXIMUM      = 7.845;    ///< Maximum value of  
load current (A)
```

If necessary, change the 7.845 value to the one you’ve got on your amp-meter (don’t forget to convert it from **mA** to **A**), then reflash the board with new code (using *Code::Blocks IDE* or the provided *Makefile*, running “*make burn*” command).

Remember, if you have to reflash the board, that could be only done using ICSP programming. There is no bootloader flashed on the MCU, due to flash space restriction.

Calibration step 1 is now done.

- **Step 2: Voltage**

Select “*Step 2*” tab in the calibration spreadsheet file.

Connect your power supply to the DC load, sets to **0V**. The DC Load should the sets to **0mA**. In the serial terminal emulator, type:

```
:CAL:ON
```

Set your power supply voltage output for each value in "**V<sub>set</sub>**" column, and write down the readed value in "**V<sub>read</sub>**" column.

Once you went through the whole array, the calibration string should be entered into the serial terminal emulator, like:

```
:CAL:V:x.xxx,y.yyy
```

Please note that the decimal separator **HAS TO BE** a period (('.')), as in US format.

Calibration step 2 is now done.

### – Step 3: Current

Select "*Step 3*" tab in the calibration spreadsheet file.

Connect the amp-meter and the power supply to the DC load, for current measurements. Sets the output voltage to **5V**.

Using the DAC command, try to adjust its value to match each value in the "**A Amp-Meter**" column, and write down the readed value, on the LCD or serial terminal emulator output, into the "**A LCD/Term.**" column.

You can change the values in the "**A Amp-Meter**" column to strictly match the ones you're reading on the amp-meter.

The DAC command syntax is :

```
:DAC:value
```

where value is an integer from 0 to 4095.

Once you went through the whole array, set DAC value to **0**:

```
:DAC:0
```

The calibration string should be entered into the serial terminal emulator, like:

```
:CAL:C:x.xxx,y.yyy
```

Please note that the decimal separator **HAS TO BE** a period (('.')), as in US format.

Calibration step 3 is now done.

### – Step 4: DAC

Select "*Step 4*" tab in the calibration spreadsheet file.

Connect the amp-meter and the power supply to the DC load, for current measurements. Sets the output voltage to **5V**.

Set the DAC value for each value in "**Steps**" column, and write down the readed value on the amp-meter into the "**mA<sub>read</sub>**" column.

The DAC command syntax is :

```
:DAC:value
```

where value is an integer from 0 to 4095.

Once you went through the whole array, set DAC value to **0**:

```
:DAC:0
```

The calibration string should be entered into the serial terminal emulator, like:

```
:CAL:D:x.xxx,y.yyy
```

Please note that the decimal separator **HAS TO BE** a period (('.')), as in US format.

Calibration step 4 is now done.

### – Step 5: Voltage Drop

Select "*Step 5*" tab in the calibration spreadsheet file.

Connect the amp-meter, the volt-meter and the power supply to the DC load, for current **AND** voltage measurements. Sets the output voltage to **5V** (the last entry in the array should be set around **12V**).

Using the DAC command, try to adjust its value to match each value in the "**mA**" column on the amp-meter, and write down the voltage readed value on the volt-meter into the "**mV meter**" column, and the readed value on the LCD and/or serial terminal emulator to the "**mV LCD/Term.**" column.

The DAC command syntax is :

---

```
:DAC:value
```

where value is an integer from 0 to 4095.

You can change the values in the “***mA***” column to strictly match the ones you’re reading on the amp-meter.

For the last row on the array, set the output voltage to around **12V**.

Once you went through the whole array, set DAC value to **0**:

```
:DAC:0
```

The calibration string should be entered into the serial terminal emulator, like:

```
:CAL:VD:x.xxx,y.yyy
```

Please note that the decimal separator **HAS TO BE** a period (‘.’), as in US format.

Calibration step 5 is now done.

#### – Last Step: Backup

Once the full calibration is done, you **HAVE** to save the values into the EEPROM, using the following command:

```
:CAL:SAVE
```

**Now, the calibration is done. You can use your DC load.**



## Chapter 7

# Hierarchical Index

### 7.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

aDCSettings::_eepromCalibrationValue_t . . . . .	25
aStepper . . . . .	56
aDCSettings . . . . .	35
aDCSettings::CalibrationData_t . . . . .	59
LiquidCrystal	
aLCD . . . . .	54
aDCDisplay . . . . .	25
aDCEngine . . . . .	29





## Chapter 8

# Class Index

### 8.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">aDCSettings::_eepromCalibrationValue_t</a>	Union to manipulate float/uint8_t [] calibration values . . . . .	25
<a href="#">aDCDisplay</a>	Class that handle LCD displaying . . . . .	25
<a href="#">aDCEngine</a>	Main class . . . . .	29
<a href="#">aDCSettings</a>	Class that handle settings . . . . .	35
<a href="#">aLCD</a>	LiquidDisplay extension class . . . . .	54
<a href="#">aStepper</a>	Class that handle increase/decrease step multiplier . . . . .	56
<a href="#">aDCSettings::CalibrationData_t</a>	Calibration values . . . . .	59



## Chapter 9

# File Index

### 9.1 File List

Here is a list of all files with brief descriptions:

aDCLoad.cpp	61
aDCLoad.h	66
CDC.cpp	78
HardwareSerial.cpp	78
HID.cpp	78
IPAddress.cpp	78
libraries.cpp	79
main.cpp	79
new.cpp	79
Print.cpp	79
sketch.cpp	79
Stream.cpp	80
Tone.cpp	80
USBCore.cpp	80
WInterrupts.c	80
wiring.c	80
wiring_analog.c	80
wiring_digital.c	80
wiring_pulse.c	80
wiring_shift.c	80
WMath.cpp	81
WString.cpp	81





- Constructor.*

  - [~aDCDisplay \(\)](#)
- Destructor.*

  - void [setup \(\)](#)

*Setup function. Should be called before any other member.*
- void [showBanner \(\)](#)

*Display small banner.*
- void [updateField \(aDCSettings::OperationMode\\_t, float, float, uint8\\_t, uint8\\_t\)](#)

*Update displayed field according to operation mode.*
- void [updateDisplay \(\)](#)

*Update LCD display management function.*
- void [pingBacklight \(\)](#)

*Reset backlight dimmer.*
- bool [isBacklightDimmed \(\)](#)

*Check if backlight is dimmed.*

## Private Member Functions

- void [\\_dimBacklight \(bool\)](#)

*Dim/undim backlight helper function.*
- void [\\_dimmingBacklight \(\)](#)

*Backlight dimming.*
- void [\\_wakeupBacklight \(\)](#)

*Backlight waker.*

## Private Attributes

- [aDCEngine \\* m\\_Parent](#)

*Pointer to [aDCEngine](#) parent.*
- bool [m\\_dimmed](#)

*Dimmed state storage.*
- unsigned long [m\\_dimmerTick](#)

*Dimmer timeout tick counter.*
- unsigned long [m\\_nextUpdate](#)

### 10.2.1 Detailed Description

Class that handle LCD displaying.

### 10.2.2 Constructor & Destructor Documentation

- 10.2.2.1 [aDCDisplay::aDCDisplay \( aDCEngine \\* parent, uint8\\_t rs, uint8\\_t enable, uint8\\_t d0, uint8\\_t d1, uint8\\_t d2, uint8\\_t d3, uint8\\_t d4, uint8\\_t d5, uint8\\_t d6, uint8\\_t d7, uint8\\_t cols, uint8\\_t rows \)](#)

Constructor.

Class to manage display output

## Parameters

<i>parent</i>	aDCEngine* : <b>Parent engine</b>
<i>rs</i>	uint8_t : <b>LCD RS pin</b>
<i>enable</i>	uint8_t : <b>LCD ENABLE pin</b>
<i>d0</i>	uint8_t : <b>LCD d0 pin</b>
<i>d1</i>	uint8_t : <b>LCD d1 pin</b>
<i>d2</i>	uint8_t : <b>LCD d2 pin</b>
<i>d3</i>	uint8_t : <b>LCD d3 pin</b>
<i>d4</i>	uint8_t : <b>LCD d4 pin</b>
<i>d5</i>	uint8_t : <b>LCD d5 pin</b>
<i>d6</i>	uint8_t : <b>LCD d6 pin</b>
<i>d7</i>	uint8_t : <b>LCD d7 pin</b>
<i>cols</i>	uint8_t : <b>LCD columns</b>
<i>rows</i>	uint8_t : <b>LCD rows</b>

## 10.2.2.2 aDCDisplay::~~aDCDisplay ( )

Destructor.

## 10.2.3 Member Function Documentation

10.2.3.1 void aDCDisplay::\_dimBacklight ( bool *up* ) [private]

Dim/undim backlight helper function.

## Parameters

<i>up</i>	bool : <b>dimmer direction</b>
-----------	--------------------------------

## Returns

void

## 10.2.3.2 void aDCDisplay::\_dimmingBacklight ( ) [private]

Backlight dimming.

## Returns

void

## 10.2.3.3 void aDCDisplay::\_wakeupBacklight ( ) [private]

Backlight waker.

## Returns

void

## 10.2.3.4 bool aDCDisplay::isBacklightDimmed ( )

Check if backlight is dimmed.

**Returns**

bool

**10.2.3.5 void aDCDisplay::pingBacklight ( )**

Reset backlight dimmer.

**Returns**

void

**10.2.3.6 void aDCDisplay::setup ( )**

Setup function. Should be called before any other member.

**Returns**

void

**10.2.3.7 void aDCDisplay::showBanner ( )**

Display small banner.

**Returns**

void

**10.2.3.8 void aDCDisplay::updateDisplay ( )**

Update LCD display management function.

Draw/Redraw on screen datas

**Returns**

void

**10.2.3.9 void aDCDisplay::updateField ( aDCSettings::OperationMode\_t *opMode*, float *vSet*, float *vRead*, uint8\_t *row*, uint8\_t *unit* )**

Update displayed field according to operation mode.

**Parameters**

<i>opMode</i>	OperationMode_t : <b>Operation mode</b>
<i>vSet</i>	float : <b>Settings value</b>
<i>vRead</i>	float : <b>Readed value</b>
<i>row</i>	uint8_t : <b>LCD row position</b>



<i>unit</i>	uint8_t : <b>Unit character</b>
-------------	---------------------------------

**Returns**

void

**10.2.4 Member Data Documentation****10.2.4.1 bool aDCDisplay::m\_dimmed** [private]

Dimmed state storage.

**10.2.4.2 unsigned long aDCDisplay::m\_dimmerTick** [private]

Dimmer timeout tick counter.

**10.2.4.3 unsigned long aDCDisplay::m\_nextUpdate** [private]**10.2.4.4 aDCEngine\* aDCDisplay::m\_Parent** [private]Pointer to [aDCEngine](#) parent.

The documentation for this class was generated from the following files:

- [aDCLoad.h](#)
- [aDCLoad.cpp](#)

**10.3 aDCEngine Class Reference**

Main class.

#include &lt;aDCLoad.h&gt;

Inherits [aDCDisplay](#).**Public Member Functions**

- [aDCEngine](#) (uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t=1)
- [~aDCEngine](#) ()  
*Destructor.*
- void [setup](#) (ISRCallback)  
*Setup function, should be called before any other member.*
- void [run](#) ()  
*Main loop function.*
- void [service](#) ()  
*Caller callback function that manages encoder clicking and so on.*

## Private Member Functions

- void [\\_handleButtonEvent](#) (ClickEncoder::Button)  
*Function that handles button clicking.*
- float [\\_getInputVoltage](#) ()  
*Function to read the input voltage and return a float number representation volts.*
- float [\\_getADC](#) (uint8\_t)  
*Function to read the ADC, accepts the channel to be read.*
- void [\\_setDAC](#) (uint16\_t, uint8\_t)  
*Function to set the DAC, Accepts the Value to be sent and the channel of the DAC to be used.*
- int16\_t [\\_getTemp](#) ()  
*Function that read temperature from ADC channels.*
- void [\\_updateFanSpeed](#) ()  
*Function to set the fan speed depending on the temperature sensors value.*
- float [\\_getMeasuredCurrent](#) ()  
*Function to measure the actual load current.*
- void [\\_updateLoadCurrent](#) ()  
*Function to calculate and set the required load current. Accepts the mode variable to determine if the constant current, resistance or power mode is to be used.*
- void [\\_adjustLoadCurrent](#) ()  
*Adjust current settings.*
- const [aDCSettings](#) \* [\\_getSettings](#) () const  
*Return a pointer to settings instantiated class.*
- void [\\_handleLoggingAndRemote](#) ()  
*Check and handle remote control and data logging.*

## Private Attributes

- [aDCSettings m\\_Data](#)  
*Settings object.*
- ClickEncoder \* [m\\_encoder](#)  
*Encoder object.*
- uint8\_t [m\\_RXbuffer](#) [RXBUFFER\_MAXLEN]  
*USB rx buffer.*
- uint8\_t [m\\_RXoffset](#)  
*USB rx buffer offset counter.*

## Static Private Attributes

- static const uint8\_t [RXBUFFER\\_MAXLEN](#) = 64

## Friends

- class [aDCDisplay](#)

## 10.3.1 Detailed Description

Main class.

### 10.3.2 Constructor & Destructor Documentation

10.3.2.1 aDCEngine::aDCEngine ( uint8\_t *rs*, uint8\_t *enable*, uint8\_t *d0*, uint8\_t *d1*, uint8\_t *d2*, uint8\_t *d3*, uint8\_t *d4*, uint8\_t *d5*, uint8\_t *d6*, uint8\_t *d7*, uint8\_t *cols*, uint8\_t *rows*, uint8\_t *enca*, uint8\_t *enclb*, uint8\_t *encpb*, uint8\_t *encsteps* = 1 )

Class to manage settings

## Parameters

<i>rs</i>	uint8_t : <b>LCD RS pin</b>
<i>enable</i>	uint8_t : <b>LCD ENABLE pin</b>
<i>d0</i>	uint8_t : <b>LCD d0 pin</b>
<i>d1</i>	uint8_t : <b>LCD d1 pin</b>
<i>d2</i>	uint8_t : <b>LCD d2 pin</b>
<i>d3</i>	uint8_t : <b>LCD d3 pin</b>
<i>d4</i>	uint8_t : <b>LCD d4 pin</b>
<i>d5</i>	uint8_t : <b>LCD d5 pin</b>
<i>d6</i>	uint8_t : <b>LCD d6 pin</b>
<i>d7</i>	uint8_t : <b>LCD d7 pin</b>
<i>cols</i>	uint8_t : <b>LCD Columns number</b>
<i>rows</i>	uint8_t : <b>LCD Rows number</b>
<i>enca</i>	uint8_t : <b>Encoder A pin</b>
<i>encb</i>	uint8_t : <b>Encoder B pin</b>
<i>encpb</i>	uint8_t : <b>Encoder push button pin</b>
<i>encsteps</i>	uint8_t : <b>Encoder steps per notch</b>

## 10.3.2.2 aDCEngine::~~aDCEngine ( )

Destructor.

## 10.3.3 Member Function Documentation

## 10.3.3.1 void aDCEngine::\_adjustLoadCurrent ( ) [private]

Adjust current settings.

## Returns

void

10.3.3.2 float aDCEngine::\_getADC ( uint8\_t *channel* ) [private]

Function to read the ADC, accepts the channel to be read.

## Parameters

<i>channel</i>	uint8_t : <b>ADC channel</b>
----------------	------------------------------

## Returns

float : **readed value**

## 10.3.3.3 float aDCEngine::\_getInputVoltage ( ) [private]

Function to read the input voltage and return a float number representation volts.

## Returns

float : **readed input voltage**

#### 10.3.3.4 float aDCEngine::\_getMeasuredCurrent ( ) [private]

Function to measure the actual load current.

##### Returns

float : **readed current**

#### 10.3.3.5 const aDCSettings \* aDCEngine::\_getSettings ( ) const [private]

Return a pointer to settings instantiated class.

##### Returns

const aDCSettings\*

#### 10.3.3.6 int16\_t aDCEngine::\_getTemp ( ) [private]

Function that read temperature from ADC channels.

##### Returns

int16\_t : **temperature**

#### 10.3.3.7 void aDCEngine::\_handleButtonEvent ( ClickEncoder::Button *button* ) [private]

Function that handles button clicking.

##### Parameters

<i>button</i>	ClickEncoder::Button
---------------	----------------------

##### Returns

void

#### 10.3.3.8 void aDCEngine::\_handleLoggingAndRemote ( ) [private]

Check and handle remote control and data logging.

##### Returns

void

#### 10.3.3.9 void aDCEngine::\_setDAC ( uint16\_t *value*, uint8\_t *channel* ) [private]

Function to set the DAC, Accepts the Value to be sent and the channel of the DAC to be used.

##### Parameters

---

<i>value</i>	uint16_t : <b>value to send to DAC</b>
<i>channel</i>	uint8_t : <b>DAC channel</b>

**Returns**

void

**10.3.3.10 void aDCEngine::\_updateFanSpeed ( ) [private]**

Function to set the fan speed depending on the temperature sensors value.

**Returns**

void

**10.3.3.11 void aDCEngine::\_updateLoadCurrent ( ) [private]**

Function to calculate and set the required load current. Accepts the mode variable to determine if the constant current, resistance or power mode is to be used.

**Returns**

void

**10.3.3.12 void aDCEngine::run ( )**

Main loop function.

**Returns**

void

**10.3.3.13 void aDCEngine::service ( )**

Caller callback function that manages encoder clicking and so on.

**Returns**

void

**10.3.3.14 void aDCEngine::setup ( ISRCallback isr )**

Setup function, should be called before any other member.

**Parameters**

<i>isr</i>	ISRCallback : <b>pointer to callback function that may call <a href="#">service()</a></b>
------------	---

**Returns**

void

### 10.3.4 Friends And Related Function Documentation

10.3.4.1 `friend class aDCDisplay` [`friend`]

### 10.3.5 Member Data Documentation

10.3.5.1 `aDCSettings aDCEngine::m_Data` [`private`]

Settings object.

10.3.5.2 `ClickEncoder* aDCEngine::m_encoder` [`private`]

Encoder object.

10.3.5.3 `uint8_t aDCEngine::m_RXbuffer[RXBUFFER_MAXLEN]` [`private`]

USB rx buffer.

10.3.5.4 `uint8_t aDCEngine::m_RXoffset` [`private`]

USB rx buffer offset counter.

10.3.5.5 `const uint8_t aDCEngine::RXBUFFER_MAXLEN = 64` [`static`], [`private`]

The documentation for this class was generated from the following files:

- [aDCLoad.h](#)
- [aDCLoad.cpp](#)

## 10.4 aDCSettings Class Reference

Class that handle settings.

```
#include <aDCLoad.h>
```

Inherits [aStepper](#).

### Classes

- union [\\_eepromCalibrationValue\\_t](#)  
*Union to manipulate float/uint8\_t [] calibration values.*
- struct [CalibrationData\\_t](#)  
*Calibration values.*

### Public Types

- enum [OperationMode\\_t](#) { `OPERATION_MODE_READ`, `OPERATION_MODE_SET`, `OPERATION_MODE_UNKNOWN` }  
*Operation mode enumeration.*
- enum [SelectionMode\\_t](#) { `SELECTION_MODE_CURRENT`, `SELECTION_MODE_POWER`, `SELECTION_MODE_UNKNOWN` }

*Selection settings mode enumeration.*

- enum `DisplayMode_t` { `DISPLAY_MODE_VALUES`, `DISPLAY_MODE_SETUP`, `DISPLAY_MODE_UNKNOWN` }

*Display mode enumeration.*

- enum `SettingError_t` { `SETTING_ERROR_OVERSIZED`, `SETTING_ERROR_UNDERSIZED`, `SETTING_ERROR_VALID` }

*Setting error enumeration.*

- enum `CalibrationValues_t` { `CALIBRATION_VOLTAGE`, `CALIBRATION_READ_CURRENT`, `CALIBRATION_DAC_CURRENT`, `CALIBRATION_VOLTAGE_DROP`, `CALIBRATION_MAX` }

*Calibration offset enumeration.*

## Public Member Functions

- `aDCSettings ()`  
*Constructor.*
- `~aDCSettings ()`  
*Destructor.*
- `SettingError_t setVoltage (float)`  
*Voltage setter.*
- `float getVoltage ()`  
*Voltage getter.*
- `SettingError_t setCurrent (float, OperationMode_t)`  
*Current setter.*
- `float getCurrent (OperationMode_t)`  
*Current getter.*
- `SettingError_t setPower (float, OperationMode_t)`  
*Power setter.*
- `float getPower (OperationMode_t)`  
*Power getter.*
- `void updateValuesFromMode (float, SelectionMode_t)`  
*Update values setting (Current, Resistance, Power) according to selection mode. Sanity checking is also performed.*
- `void setTemperature (uint16_t)`  
*Temperature readed setter.*
- `uint16_t getTemperature ()`  
*Temperature readed getter.*
- `void setFanSpeed (uint16_t)`  
*Fan speed setter.*
- `uint16_t getFanSpeed ()`  
*Fan speed getter.*
- `void setCurrentDAC (uint16_t)`  
*Current DAC value setter.*
- `uint16_t getCurrentDAC ()`  
*Current DAC value getter.*
- `void setSelectionMode (SelectionMode_t, bool=false)`  
*Selection mode setter.*
- `SelectionMode_t getSelectionMode ()`  
*Selection mode getter.*
- `SelectionMode_t getPrevNextMode (SelectionMode_t=SELECTION_MODE_UNKNOWN, bool=true)`  
*Get the next selection mode, according to "origin", if any provided.*



- void [setDisplayMode](#) ([DisplayMode\\_t](#))  
*Display mode setter.*
- [DisplayMode\\_t](#) [getDisplayMode](#) ()  
*Display mode getter.*
- void [setEncoderPosition](#) ([int32\\_t](#))  
*Encoder position setter.*
- void [incEncoderPosition](#) ([int32\\_t](#)=1)  
*Increment stored encoder position by "p" (default = 1)*
- [int32\\_t](#) [getEncoderPosition](#) ()  
*Encoder position getter.*
- void [setOperationMode](#) ([OperationMode\\_t](#))  
*Operation mode setter.*
- [OperationMode\\_t](#) [getOperationMode](#) ()  
*Operation mode getter.*
- void [updateOperationMode](#) ()  
*Automatic timeouted toggle between OPERATION\_SET and OPERATION\_READ.*
- void [pingOperationMode](#) ()  
*Reset timeout while in OPERATION\_SET mode.*
- void [pingAutolock](#) ()  
*Reset autolock timeout.*
- bool [isAutolocked](#) ()  
*Check if autolock is enabled and performs.*
- void [setCalibrationMode](#) (bool=true)  
*Calibration mode enability setter.*
- bool [getCalibrationMode](#) ()  
*Calibration mode enability getter.*
- void [getCalibrationValues](#) ([CalibrationValues\\_t](#), [CalibrationData\\_t](#) &)  
*Calibration data getter, according to calsection argument.*
- void [setCalibrationValues](#) ([CalibrationValues\\_t](#), [CalibrationData\\_t](#))  
*Calibration data setter, according to calsection argument.*
- void [backupCalibration](#) ()  
*Backup calibration data into EEPROM.*
- void [restoreCalibration](#) ()  
*Restore calibration data from EEPROM.*
- void [enableAlarm](#) ([uint16\\_t](#) bit)  
*Turn alarm (OVP, OCP or OTP) on, sets output current to zero.*
- void [enableFeature](#) ([uint16\\_t](#), bool=true)  
*Helper function to manage bit-field features.*
- bool [isFeatureEnabled](#) ([uint16\\_t](#))  
*Check if FEATURE is enabled.*
- bool [isDataEnabled](#) ([uint16\\_t](#))  
*Get bit enability in m\_datas bit-field storage.*
- void [syncData](#) ([uint16\\_t](#))  
*Clear a bit in m\_datas bit-field storage.*

## Static Public Attributes

- static const uint16\_t [DATA\\_VOLTAGE](#) = 1  
*bit-field storage: Voltage readed*
- static const uint16\_t [DATA\\_CURRENT\\_SETS](#) = 1 << 1  
*bit-field storage: Current sets*
- static const uint16\_t [DATA\\_CURRENT\\_READ](#) = 1 << 2  
*bit-field storage: Current readed*
- static const uint16\_t [DATA\\_POWER\\_SETS](#) = 1 << 5  
*bit-field storage: Power sets*
- static const uint16\_t [DATA\\_POWER\\_READ](#) = 1 << 6  
*bit-field storage: Power readed*
- static const uint16\_t [DATA\\_TEMPERATURE](#) = 1 << 7  
*bit-field storage: Temperature readed*
- static const uint16\_t [DATA\\_SELECTION](#) = 1 << 8  
*bit-field storage: Selection mode sets*
- static const uint16\_t [DATA\\_DISPLAY](#) = 1 << 9  
*bit-field storage: Display mode sets*
- static const uint16\_t [DATA\\_ENCODER](#) = 1 << 10  
*bit-field storage: Encoder position sets*
- static const uint16\_t [DATA\\_OPERATION](#) = 1 << 11  
*bit-field storage: Operation mode sets*
- static const uint16\_t [DATA\\_IN\\_CALIBRATION](#) = 1 << 12  
*bit-field storage: In calibration mode*

## Private Member Functions

- uint8\_t [\\_crc8](#) (const uint8\_t \*, uint8\_t)  
*CRC8 computation.*
- void [\\_eepromCalibrationRestore](#) (int16\_t, [CalibrationData\\_t](#) &)  
*Read data from EEPROM, used to restore calibration data.*
- void [\\_eepromCalibrationBackup](#) (int16\_t, [CalibrationData\\_t](#))  
*Save data to EEPROM, used to restore calibration data.*
- bool [\\_eepromCheckForMagicNumbers](#) ()  
*Check for EEPROM magic numbers.*
- void [\\_eepromWriteMagicNumbers](#) ()  
*Write magic numbers into EEPROM.*
- void [\\_eepromReset](#) ()  
*Reset all stored parameters into EEPROM.*
- void [\\_eepromRestore](#) ()  
*Restore value from EEPROM.*
- void [\\_enableData](#) (uint16\_t, bool)  
*Enable a bit in the m\_datas bit-field storage.*
- void [\\_enableDataCheck](#) (uint16\_t, bool)  
*Enable a bit in the m\_datas bit-field storage, checking for previous state.*
- template<typename T>  
[SettingError\\_t\\_setValue](#) ([OperationMode\\_t](#) mode, uint16\_t bit, T value, T &sets, T &read, float maximum)  
*Value setter.*

## Private Attributes

- float [m\\_readVoltage](#)  
*voltage storage*
- float [m\\_setsCurrent](#)
- float [m\\_readCurrent](#)  
*current storage*
- float [m\\_setsPower](#)
- float [m\\_readPower](#)  
*power storage*
- uint16\_t [m\\_readTemperature](#)  
*temperature storage*
- uint16\_t [m\\_fanSpeed](#)  
*fan speed storage*
- uint16\_t [m\\_currentDAC](#)  
*current DAC value*
- [OperationMode\\_t m\\_operationMode](#)  
*operation mode*
- [SelectionMode\\_t m\\_mode](#)  
*selection mode*
- int32\_t [m\\_encoderPos](#)  
*encoder position (yeah, 32bits, due to resistance max val (12000 \* 1000));*
- [DisplayMode\\_t m\\_dispMode](#)  
*display mode*
- unsigned long [m\\_lockTick](#)  
*tick count storage, for autolock feature*
- unsigned long [m\\_operationTick](#)  
*tick count storage, for SET/READ operation*
- uint16\_t [m\\_features](#)  
*boolean features storage*
- uint16\_t [m\\_datas](#)  
*boolean displays data storage*
- [CalibrationData\\_t m\\_calibrationValues](#) [CALIBRATION\_MAX]  
*Calibration datas, restored from EEPROM.*

### 10.4.1 Detailed Description

Class that handle settings.

### 10.4.2 Member Enumeration Documentation

#### 10.4.2.1 enum aDCSettings::CalibrationValues\_t

Calibration offset enumeration.

Used to get/set calibration values

Enumerator

- CALIBRATION\_VOLTAGE** Voltage calibration offset value.
- CALIBRATION\_READ\_CURRENT** Readed Current calibration offset value.
- CALIBRATION\_DAC\_CURRENT** DAC Current calibration offset value.
- CALIBRATION\_VOLTAGE\_DROP** Voltage drop calibration offset value.
- CALIBRATION\_MAX** Maximum offset in calibration array.

#### 10.4.2.2 enum aDCSettings::DisplayMode\_t

Display mode enumeration.

Enumerator

- DISPLAY\_MODE\_VALUES** Display read/set values mode.
- DISPLAY\_MODE\_SETUP** Display settings mode.
- DISPLAY\_MODE\_UNKNOWN** Display in undefined (internal)

#### 10.4.2.3 enum aDCSettings::OperationMode\_t

Operation mode enumeration.

Enumerator

- OPERATION\_MODE\_READ** Reading values.
- OPERATION\_MODE\_SET** Settings values.
- OPERATION\_MODE\_UNKNOWN** Unset (internal)

#### 10.4.2.4 enum aDCSettings::SelectionMode\_t

Selection settings mode enumeration.

Enumerator

- SELECTION\_MODE\_CURRENT** Current selected.
- SELECTION\_MODE\_POWER** Power selected.
- SELECTION\_MODE\_UNKNOWN** Nothing selected (internal)

#### 10.4.2.5 enum aDCSettings::SettingError\_t

Setting error enumeration.

Enumerator

- SETTING\_ERROR\_OVERSIZED** Setting value is oversized.
- SETTING\_ERROR\_UNDERSIZED** Setting value is undersized.
- SETTING\_ERROR\_VALID** Setting value is valid.

### 10.4.3 Constructor & Destructor Documentation

#### 10.4.3.1 aDCSettings::aDCSettings ( )

Constructor.

#### 10.4.3.2 aDCSettings::~~aDCSettings ( )

Destructor.

### 10.4.4 Member Function Documentation

10.4.4.1 `uint8_t aDCSettings::_crc8 ( const uint8_t* addr, uint8_t len )` [private]

CRC8 computation.

Code took from [http://www.pjrc.com/teensy/td\\_libs\\_OneWire.html](http://www.pjrc.com/teensy/td_libs_OneWire.html)

Parameters

<i>addr</i>	const uint8_t* : <b>Data source</b>
<i>len</i>	uint8_t : <b>Data source length</b>

Returns

uint8\_t : **CRC**

10.4.4.2 `void aDCSettings::_eepromCalibrationBackup ( int16_t addr, CalibrationData_t cal )` [private]

Save data to EEPROM, used to restore calibration data.

Parameters

<i>addr</i>	int16_t : <b>start address location</b>
<i>cal</i>	<a href="#">CalibrationData_t</a> & : <b>destination</b>

Returns

void

10.4.4.3 `void aDCSettings::_eepromCalibrationRestore ( int16_t addr, CalibrationData_t & cal )` [private]

Read data from EEPROM, used to restore calibration data.

Parameters

<i>addr</i>	int16_t : <b>start address location</b>
<i>cal</i>	<a href="#">CalibrationData_t</a> & : <b>destination</b>

Returns

void

10.4.4.4 `bool aDCSettings::_eepromCheckForMagicNumbers ( )` [private]

Check for EEPROM magic numbers.

Returns

bool

Used to check if some data has already been wrote in the EEPROM.

10.4.4.5 `void aDCSettings::_eepromReset ( )` [private]

Reset all stored parameters into EEPROM.

## Returns

void

## 10.4.4.6 void aDCSettings::\_eepromRestore ( ) [private]

Restore value from EEPROM.

## Returns

void

## 10.4.4.7 void aDCSettings::\_eepromWriteMagicNumbers ( ) [private]

Write magic numbers into EEPROM.

## Returns

void

10.4.4.8 void aDCSettings::\_enableData ( uint16\_t *bit*, bool *enable* ) [private]

Enable a bit in the m\_datas bit-field storage.

## Parameters

<i>bit</i>	uint16_t : <b>Bit to set</b>
<i>enable</i>	bool : <b>Bit enableity</b>

## Returns

void

10.4.4.9 void aDCSettings::\_enableDataCheck ( uint16\_t *bit*, bool *enable* ) [private]

Enable a bit in the m\_datas bit-field storage, checking for previous state.

If the bit is already sets to TRUE, we don't touch his state, [syncData\(\)](#) should be called for this.

## Parameters

<i>bit</i>	uint16_t : <b>Bit to set</b>
<i>enable</i>	bool : <b>Bit enableity</b>

## Returns

void

10.4.4.10 template<typename T> SettingError\_t aDCSettings::\_setValue ( OperationMode\_t *mode*, uint16\_t *bit*, T *value*, T & *sets*, T & *read*, float *maximum* ) [inline],[private]

Value setter.

## Parameters

<i>mode</i>	OperationMode_t : <b>Operation mode (SET/READ)</b>
<i>bit</i>	uint16_t : <b>DATA_* bit to set</b>
<i>value</i>	T : <b>value to store</b>
<i>sets</i>	T& : <b>destination variable for OPERATION_SET</b>
<i>read</i>	T& : <b>destination variable for OPERATION_READ</b>
<i>maximum</i>	float : <b>maximum value, used for boundaries checking</b>

## Returns

template<typename T> SettingError\_t : **validity result**

## 10.4.4.11 void aDCSettings::backupCalibration ( )

Backup calibration data into EEPROM.

## Returns

void

## 10.4.4.12 void aDCSettings::enableAlarm ( uint16\_t aBit )

Turn alarm (OVP, OCP or OTP) on, sets output current to zero.

## Parameters

<i>aBit</i>	uint16_t : <b>alarm bit to set</b>
-------------	------------------------------------

## Returns

void

## 10.4.4.13 void aDCSettings::enableFeature ( uint16\_t feature, bool enable = true )

Helper function to manage bit-field features.

## Parameters

<i>feature</i>	uint16_t : <b>FEATURE to enable/disable</b>
<i>enable</i>	bool : <b>FEATURE enableity (default = enable)</b>

## Returns

void

## 10.4.4.14 bool aDCSettings::getCalibrationMode ( )

Calibration mode enableity getter.

## Returns

bool : **enableity**

## 10.4.4.15 void aDCSettings::getCalibrationValues ( CalibrationValues\_t calsection, CalibrationData\_t &amp; data )

Calibration data getter, according to *calsection* argument.

## Parameters

<i>calsection</i>	CalibrationValues_t : <b>calibration parameter</b>
<i>data</i>	<a href="#">CalibrationData_t</a> & : <b>calibration data</b>

## Returns

void

10.4.4.16 float aDCSettings::getCurrent ( OperationMode\_t *mode* )

Current getter.

## Parameters

<i>mode</i>	OperationMode_t : <b>READ/SET mode storage access</b>
-------------	---

## Returns

float : **current**

10.4.4.17 uint16\_t aDCSettings::getCurrentDAC ( )

Current DAC value getter.

## Returns

uint16\_t : **current DAC value**

10.4.4.18 aDCSettings::DisplayMode\_t aDCSettings::getDisplayMode ( )

Display mode getter.

## Returns

DisplayMode\_t : **Display mode**

10.4.4.19 int32\_t aDCSettings::getEncoderPosition ( )

Encoder position getter.

## Returns

int32\_t : **encoder position**

10.4.4.20 uint16\_t aDCSettings::getFanSpeed ( )

Fan speed getter.

## Returns

uint16\_t : **DAC speed value**



#### 10.4.4.21 aDCSettings::OperationMode\_t aDCSettings::getOperationMode ( )

Operation mode getter.

Returns

OperationMode\_t : **operation mode**

#### 10.4.4.22 float aDCSettings::getPower ( OperationMode\_t mode )

Power getter.

Parameters

<i>mode</i>	OperationMode_t : <b>READ/SET mode storage access</b>
-------------	---

Returns

float : **power**

#### 10.4.4.23 aDCSettings::SelectionMode\_t aDCSettings::getPrevNextMode ( aDCSettings::SelectionMode\_t origin = SELECTION\_MODE\_UNKNOWN, bool next = true )

Get the next selection mode, according to "origin", if any provided.

Parameters

<i>origin</i>	SelectionMode_t : <b>origin starter selection mode</b>
<i>next</i>	bool : <b>Next or Previous mode</b>

Returns

SelectionMode\_t : **next selection mode**

#### 10.4.4.24 aDCSettings::SelectionMode\_t aDCSettings::getSelectionMode ( )

Selection mode getter.

Returns

SelectionMode\_t : **current selection mode**

#### 10.4.4.25 uint16\_t aDCSettings::getTemperature ( )

Temperature readed getter.

Returns

uint16\_t : **temperature**

#### 10.4.4.26 float aDCSettings::getVoltage ( )

Voltage getter.

Returns

float : **voltage**

#### 10.4.4.27 void aDCSettings::incEncoderPosition ( int32\_t *v* = 1 )

Increment stored encoder position by "p" (default = 1)

##### Parameters

<i>v</i>	int32_t : <b>increment value, 1 by default</b>
----------	--

##### Returns

void

#### 10.4.4.28 bool aDCSettings::isAutolocked ( )

Check if autolock is enabled and performs.

##### Returns

bool

#### 10.4.4.29 bool aDCSettings::isDataEnabled ( uint16\_t *bit* )

Get bit enability in m\_datas bit-field storage.

##### Parameters

<i>bit</i>	uint16_t : <b>Bit to check</b>
------------	--------------------------------

##### Returns

bool

#### 10.4.4.30 bool aDCSettings::isFeatureEnabled ( uint16\_t *feature* )

Check if FEATURE is enabled.

##### Parameters

<i>feature</i>	uint16_t : <b>FEATURE to check against</b>
----------------	--

##### Returns

bool

#### 10.4.4.31 void aDCSettings::pingAutolock ( )

Reset autolock timeout.

##### Returns

void

## 10.4.4.32 void aDCSettings::pingOperationMode ( )

Reset timeout while in OPERATION\_SET mode.

Returns

void

## 10.4.4.33 void aDCSettings::restoreCalibration ( )

Restore calibration data from EEPROM.

Returns

void

10.4.4.34 void aDCSettings::setCalibrationMode ( bool *enable* = true )

Calibration mode enable setter.

Parameters

<i>enable</i>	bool : <b>enable</b>
---------------	----------------------

Returns

void

10.4.4.35 void aDCSettings::setCalibrationValues ( CalibrationValues\_t *calsection*, CalibrationData\_t *data* )

Calibration data setter, according to *calsection* argument.

Parameters

<i>calsection</i>	CalibrationValues_t : <b>calibration parameter</b>
<i>data</i>	<a href="#">CalibrationData_t</a> & : <b>calibration data</b>

Returns

void

10.4.4.36 aDCSettings::SettingError\_t aDCSettings::setCurrent ( float *v*, OperationMode\_t *mode* )

Current setter.

Parameters

<i>v</i>	float : <b>current</b>
<i>mode</i>	OperationMode_t : <b>READ/SET mode storage access</b>

Returns

[aDCSettings::SettingError\\_t](#)

10.4.4.37 void aDCSettings::setCurrentDAC ( uint16\_t *dac* )

Current DAC value setter.

## Parameters

<i>dac</i>	uint16_t : <b>current DAC value</b>
------------	-------------------------------------

## Returns

void

10.4.4.38 void aDCSettings::setDisplayMode ( DisplayMode\_t *d* )

Display mode setter.

## Parameters

<i>d</i>	DisplayMode_t : <b>display mode</b>
----------	-------------------------------------

## Returns

void

10.4.4.39 void aDCSettings::setEncoderPosition ( int32\_t *v* )

Encoder position setter.

## Parameters

<i>v</i>	int32_t : <b>encoder position</b>
----------	-----------------------------------

## Returns

void

10.4.4.40 void aDCSettings::setFanSpeed ( uint16\_t *v* )

Fan speed setter.

## Parameters

<i>v</i>	uint16_t : <b>DAC speed value</b>
----------	-----------------------------------

## Returns

void

10.4.4.41 void aDCSettings::setOperationMode ( OperationMode\_t *m* )

Operation mode setter.

## Parameters

<i>m</i>	OperationMode_t : <b>new operation mode</b>
----------	---

## Returns

void

10.4.4.42 aDCSettings::SettingError\_t aDCSettings::setPower ( float *v*, OperationMode\_t *mode* )

Power setter.

## Parameters

<i>v</i>	float : <b>power</b>
<i>mode</i>	OperationMode_t : <b>READ/SET mode storage access</b>

## Returns

[aDCSettings::SettingError\\_t](#)

10.4.4.43 void aDCSettings::setSelectionMode ( SelectionMode\_t *m*, bool *force* = false )

Selection mode setter.

## Parameters

<i>m</i>	SelectionMode_t : <b>new selection mode</b>
<i>force</i>	bool : <b>force the bit setting in m_datas to be set (default : false)</b>

## Returns

void

10.4.4.44 void aDCSettings::setTemperature ( uint16\_t *v* )

Temperature readed setter.

## Parameters

<i>v</i>	uint16_t : <b>temperature</b>
----------	-------------------------------

## Returns

void

10.4.4.45 aDCSettings::SettingError\_t aDCSettings::setVoltage ( float *v* )

Voltage setter.

## Parameters

<i>v</i>	float : <b>voltage</b>
----------	------------------------

## Returns

[aDCSettings::SettingError\\_t](#)

10.4.4.46 void aDCSettings::syncData ( uint16\_t *bit* )

Clear a bit in m\_datas bit-field storage.

## Parameters

---

<i>bit</i>	uint16_t
------------	----------

**Returns**

void

**10.4.4.47 void aDCSettings::updateOperationMode ( )**

Automatic timeouted toggle between OPERATION\_SET and OPERATION\_READ.

**Returns**

void

**10.4.4.48 void aDCSettings::updateValuesFromMode ( float *v*, SelectionMode\_t *mode* )**

Update values setting (Current, Resistance, Power) according to selection mode. Sanity checking is also performed.

**Parameters**

<i>v</i>	float : <b>updated value</b>
<i>mode</i>	SelectionMode_t : <b>selection mode (CURRENT, RESISTANCE, POWER)</b>

**Returns**

void

**10.4.5 Member Data Documentation****10.4.5.1 const uint16\_t aDCSettings::DATA\_CURRENT\_READ = 1 << 2 [static]**

bit-field storage: Current readed

**10.4.5.2 const uint16\_t aDCSettings::DATA\_CURRENT\_SETS = 1 << 1 [static]**

bit-field storage: Current sets

**10.4.5.3 const uint16\_t aDCSettings::DATA\_DISPLAY = 1 << 9 [static]**

bit-field storage: Display mode sets

**10.4.5.4 const uint16\_t aDCSettings::DATA\_ENCODER = 1 << 10 [static]**

bit-field storage: Encoder position sets

**10.4.5.5 const uint16\_t aDCSettings::DATA\_IN\_CALIBRATION = 1 << 12 [static]**

bit-field storage: In calibration mode

**10.4.5.6 const uint16\_t aDCSettings::DATA\_OPERATION = 1 << 11 [static]**

bit-field storage: Operation mode sets

10.4.5.7 `const uint16_t aDCSettings::DATA_POWER_READ = 1 << 6` `[static]`

bit-field storage: Power readed

10.4.5.8 `const uint16_t aDCSettings::DATA_POWER_SETS = 1 << 5` `[static]`

bit-field storage: Power sets

10.4.5.9 `const uint16_t aDCSettings::DATA_SELECTION = 1 << 8` `[static]`

bit-field storage: Selection mode sets

10.4.5.10 `const uint16_t aDCSettings::DATA_TEMPERATURE = 1 << 7` `[static]`

bit-field storage: Temperature readed

10.4.5.11 `const uint16_t aDCSettings::DATA_VOLTAGE = 1` `[static]`

bit-field storage: Voltage readed

10.4.5.12 `CalibrationData_t aDCSettings::m_calibrationValues[CALIBRATION_MAX]` `[private]`

Calibration datas, restored from EEPROM.

10.4.5.13 `uint16_t aDCSettings::m_currentDAC` `[private]`

current DAC value

10.4.5.14 `uint16_t aDCSettings::m_datas` `[private]`

boolean displays data storage

10.4.5.15 `DisplayMode_t aDCSettings::m_dispMode` `[private]`

display mode

See Also

`DisplayMode`

10.4.5.16 `int32_t aDCSettings::m_encoderPos` `[private]`

encoder position (yeah, 32bits, due to resistance max val (12000 \* 1000);

10.4.5.17 `uint16_t aDCSettings::m_fanSpeed` `[private]`

fan speed storage



10.4.5.18 `uint16_t aDCSettings::m_features` [private]

boolean features storage

10.4.5.19 `unsigned long aDCSettings::m_lockTick` [private]

tick count storage, for autolock feature

10.4.5.20 `SelectionMode_t aDCSettings::m_mode` [private]

selection mode

See Also

`SelectionMode`

10.4.5.21 `OperationMode_t aDCSettings::m_operationMode` [private]

operation mode

See Also

`OperationMode`

10.4.5.22 `unsigned long aDCSettings::m_operationTick` [private]

tick count storage, for SET/READ operation

10.4.5.23 `float aDCSettings::m_readCurrent` [private]

current storage

10.4.5.24 `float aDCSettings::m_readPower` [private]

power storage

10.4.5.25 `uint16_t aDCSettings::m_readTemperature` [private]

temperature storage

10.4.5.26 `float aDCSettings::m_readVoltage` [private]

voltage storage

10.4.5.27 `float aDCSettings::m_setsCurrent` [private]

10.4.5.28 `float aDCSettings::m_setsPower` [private]

The documentation for this class was generated from the following files:

- [aDCLoad.h](#)
- [aDCLoad.cpp](#)

## 10.5 aLCD Class Reference

LiquidDisplay extension class.

```
#include <aDCLoad.h>
```

Inherits LiquidCrystal.

Inherited by [aDCDisplay](#).

### Public Member Functions

- [aLCD](#) (uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t, uint8\_t)  
*Constructor.*
- [~aLCD](#) ()  
*Destructor.*
- void [begin](#) (uint8\_t, uint8\_t)  
*Initialize LCD screen size.*
- void [setCursor](#) (uint8\_t, uint8\_t)  
*Set cursor position.*
- void [printCenter](#) (const char \*)  
*Print centered string to current row.*
- void [printCenter](#) (const \_\_FlashStringHelper \*)  
*Print centered string to current row.*
- void [clearValue](#) (uint8\_t, int=0)  
*Clear displayed value, from given row, stopping at value end field - destMinus.*

### Private Attributes

- uint8\_t [m\\_cols](#)
- uint8\_t [m\\_rows](#)  
*LCD sizes.*
- uint8\_t [m\\_curCol](#)
- uint8\_t [m\\_curRow](#)  
*Current cursor position.*

#### 10.5.1 Detailed Description

LiquidDisplay extension class.

#### 10.5.2 Constructor & Destructor Documentation

- 10.5.2.1 [aLCD::aLCD](#) ( uint8\_t *rs*, uint8\_t *enable*, uint8\_t *d0*, uint8\_t *d1*, uint8\_t *d2*, uint8\_t *d3*, uint8\_t *d4*, uint8\_t *d5*, uint8\_t *d6*, uint8\_t *d7*, uint8\_t *cols*, uint8\_t *rows* )

Constructor.

LiquidDisplay extension

Parameters

---

<i>rs</i>	uint8_t : <b>LCD RS pin</b>
<i>enable</i>	uint8_t : <b>LCD ENABLE pin</b>
<i>d0</i>	uint8_t : <b>LCD d0 pin</b>
<i>d1</i>	uint8_t : <b>LCD d1 pin</b>
<i>d2</i>	uint8_t : <b>LCD d2 pin</b>
<i>d3</i>	uint8_t : <b>LCD d3 pin</b>
<i>d4</i>	uint8_t : <b>LCD d4 pin</b>
<i>d5</i>	uint8_t : <b>LCD d5 pin</b>
<i>d6</i>	uint8_t : <b>LCD d6 pin</b>
<i>d7</i>	uint8_t : <b>LCD d7 pin</b>
<i>cols</i>	uint8_t : <b>LCD columns number</b>
<i>rows</i>	uint8_t : <b>LCD rows number</b>

### 10.5.2.2 aLCD::~~aLCD ( )

Destructor.

## 10.5.3 Member Function Documentation

### 10.5.3.1 void aLCD::begin ( uint8\_t cols, uint8\_t lines )

Initialize LCD screen size.

Parameters

<i>cols</i>	uint8_t : <b>Columns</b>
<i>lines</i>	uint8_t : <b>Rows</b>

Returns

void

### 10.5.3.2 void aLCD::clearValue ( uint8\_t row, int destMinus = 0 )

Clear displayed value, from given row, stopping at value end field - destMinus.

Parameters

<i>row</i>	uint8_t : <b>field row</b>
<i>destMinus</i>	int : <b>minus end field position (default = 0)</b>

Returns

void

### 10.5.3.3 void aLCD::printCenter ( const char \* str )

Print centered string to current row.

Parameters

<i>str</i>	const char* : <b>String to display</b>
------------	--

Returns

void

10.5.3.4 void aLCD::printCenter ( const \_\_FlashStringHelper \* *ifsh* )

Print centered string to current row.

Parameters

<i>ifsh</i>	const __FlashStringHelper* : <b>string to display</b>
-------------	---

Returns

void

10.5.3.5 void aLCD::setCursor ( uint8\_t *col*, uint8\_t *row* )

Set cursor position.

Parameters

<i>col</i>	uint8_t : <b>Column</b>
<i>row</i>	uint8_t : <b>Row</b>

Returns

void

## 10.5.4 Member Data Documentation

10.5.4.1 uint8\_t aLCD::m\_cols [private]

10.5.4.2 uint8\_t aLCD::m\_curCol [private]

10.5.4.3 uint8\_t aLCD::m\_curRow [private]

Current cursor position.

10.5.4.4 uint8\_t aLCD::m\_rows [private]

LCD sizes.

The documentation for this class was generated from the following files:

- [aDCLoad.h](#)
- [aDCLoad.cpp](#)

## 10.6 aStepper Class Reference

Class that handle increase/decrease step multiplier.

#include <aDCLoad.h>

Inherited by [aDCSettings](#).

## Public Member Functions

- [aStepper](#) ()  
*Constructor.*
- [~aStepper](#) ()  
*Destructor.*
- void [increment](#) ()  
*Increment value, check for boundaries.*
- uint8\_t [getValue](#) ()  
*Value getter.*
- void [reset](#) ()  
*Reset value.*
- int16\_t [getMult](#) ()  
*Value getter, according to multiple.*
- int16\_t [getValueFromMode](#) (uint8\_t)  
*Get value according to selection mode.*
- bool [isSynced](#) ()  
*Synchronize value.*
- void [sync](#) ()  
*Check if value is synchronized.*

## Private Member Functions

- int16\_t [\\_pow](#) (int, int)  
*Small implementation of pow() math function.*

## Private Attributes

- uint8\_t [m\\_inc](#)
- uint8\_t [m\\_incPrev](#)  
*Stepper counters.*

## Static Private Attributes

- static const uint8\_t [MAX\\_VALUE](#) = 3

### 10.6.1 Detailed Description

Class that handle increase/decrease step multiplier.

Classes declarations

### 10.6.2 Constructor & Destructor Documentation

#### 10.6.2.1 [aStepper::aStepper](#) ( )

Constructor.

#### 10.6.2.2 [aStepper::~~aStepper](#) ( )

Destructor.

### 10.6.3 Member Function Documentation

#### 10.6.3.1 `int16_t aStepper::_pow ( int base, int exp )` `[inline]`, `[private]`

Small implementation of `pow()` math function.

Parameters

<i>base</i>	int : <b>base radix</b>
<i>exp</i>	int : <b>exponent value</b>

Returns

`int16_t` : **result**

#### 10.6.3.2 `int16_t aStepper::getMult ( )`

Value getter, according to multiple.

Returns

`int16_t`

#### 10.6.3.3 `uint8_t aStepper::getValue ( )`

Value getter.

Returns

`uint8_t`

#### 10.6.3.4 `int16_t aStepper::getValueFromMode ( uint8_t mode )`

Get value according to selection mode.

Parameters

<i>mode</i>	<code>uint16_t</code> : <b>Selection mode (will be typecasted to <a href="#">aDCSettings::SelectionMode_t</a>)</b>
-------------	--

Returns

`int16_t`

#### 10.6.3.5 `void aStepper::increment ( )`

Increment value, check for boundaries.

Returns

`void`

#### 10.6.3.6 bool aStepper::isSynced ( )

Synchronize value.

Returns

bool

#### 10.6.3.7 void aStepper::reset ( )

Reset value.

Returns

void

#### 10.6.3.8 void aStepper::sync ( )

Check if value is synchronized.

Returns

void

### 10.6.4 Member Data Documentation

#### 10.6.4.1 uint8\_t aStepper::m\_inc [private]

#### 10.6.4.2 uint8\_t aStepper::m\_incPrev [private]

Stepper counters.

#### 10.6.4.3 const uint8\_t aStepper::MAX\_VALUE = 3 [static],[private]

The documentation for this class was generated from the following files:

- [aDCLoad.h](#)
- [aDCLoad.cpp](#)

## 10.7 aDCSettings::CalibrationData\_t Struct Reference

Calibration values.

```
#include <aDCLoad.h>
```

### Public Attributes

- float [slope](#)  
*Slope value.*
- float [offset](#)  
*Offset value.*

### 10.7.1 Detailed Description

Calibration values.

Contains Slope and Offset float values

### 10.7.2 Member Data Documentation

#### 10.7.2.1 float aDCSettings::CalibrationData\_t::offset

Offset value.

#### 10.7.2.2 float aDCSettings::CalibrationData\_t::slope

Slope value.

The documentation for this struct was generated from the following file:

- [aDCLoad.h](#)



# Chapter 11

## File Documentation

### 11.1 aDCLoad.cpp File Reference

```
#include <Arduino.h>
#include <avr/pgmspace.h>
#include <LiquidCrystal.h>
#include <SPI.h>
#include <EEPROM.h>
#include <ClickEncoder.h>
#include <TimerOne.h>
#include "aDCLoad.h"
```

#### Functions

- void [serialPrint](#) (unsigned long n, int base)  
*Serial printing.*
- void [serialWrite](#) (char c)  
*Serial printing.*
- void [serialPrint](#) (const char str[])  
*Serial printing.*
- void [serialPrint](#) (char c)  
*Serial printing.*
- void [serialPrint](#) (int n, int16\_t base=DEC)  
*Serial printing.*
- void [serialFlush](#) ()  
*Flush serial buffer (TX)*
- void [serialPrintln](#) ()  
*Serial printing.*
- void [serialPrint](#) (double n, int digits)  
*Serial printing.*
- void [serialPrintln](#) (double n, int digits)  
*Serial printing.*
- void [serialPrintln](#) (char c)  
*Serial printing.*
- int16\_t [serialAvailable](#) ()  
*Get the number of bytes (characters) available for reading from the serial port.*
- uint8\_t [serialRead](#) ()  
*Reads incoming serial data.*

- `int8_t getNumericalLength` (float n, uint8\_t len=3)  
*Get float string length, according to decimal man length.*
- `float floatRounding` (float f)  
*Float number rounding, extensively used.*

### 11.1.1 Detailed Description

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#### Warning

### BIG FAT WARNING

Should be compiled with **"-Os"** flag.

Bootloader **couldn't** be flashed, **ISP programming ONLY**

-- use *Code::Blocks* or the included *Makefile* to compile --

#### Author

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 Lee Wiggins [lee@wigweb.com.au](mailto:lee@wigweb.com.au)

### 11.1.2 Function Documentation

#### 11.1.2.1 float floatRounding ( float f )

Float number rounding, extensively used.

Float rounding functionWe just get rid of +4 decimal values

#### Parameters

<i>f</i>	float : <b>Float to rounding</b>
----------	----------------------------------

#### Returns

float : **rounded value**

#### 11.1.2.2 `int8_t getNumericalLength ( float n, uint8_t len = 3 )`

Get float string length, according to decimal man length.

Our float to string format function

## Parameters

<i>n</i>	float : <b>Float number to analyse</b>
<i>len</i>	uint8_t : <b>decimal max length (3 as default)</b>

## Returns

int8\_t : **numeric value length**

## 11.1.2.3 int16\_t serialAvailable ( )

Get the number of bytes (characters) available for reading from the serial port.

## Returns

int16\_t

## 11.1.2.4 void serialFlush ( )

Flush serial buffer (TX)

## Returns

void

11.1.2.5 void serialPrint ( unsigned long *n*, int *base* = DEC )

Serial printing.

Implement our serial print function to save ~300ko

## Parameters

<i>n</i>	unsigned long
<i>base</i>	int

## Returns

void

11.1.2.6 void serialPrint ( const char *str*[] )

Serial printing.

## Parameters

<i>str</i>	char[]
------------	--------

## Returns

void

11.1.2.7 void serialPrint ( char *c* )

Serial printing.

## Parameters

<i>c</i>	char
----------	------

## Returns

void

11.1.2.8 void serialPrint ( int *n*, int16\_t *base* = DEC )

Serial printing.

## Parameters

<i>n</i>	int
<i>base</i>	int16_t

## Returns

void

11.1.2.9 void serialPrint ( double *n*, int *digits* )

Serial printing.

## Parameters

<i>n</i>	double
<i>digits</i>	int

## Returns

void

11.1.2.10 void serialPrintln ( )

Serial printing.

## Returns

void

11.1.2.11 void serialPrintln ( double *n*, int *digits* )

Serial printing.

## Parameters

<i>n</i>	double
<i>digits</i>	int

## Returns

void

11.1.2.12 void serialPrintln ( char *c* )

Serial printing.

**Parameters**

<code>c</code>	<code>char</code>
----------------	-------------------

**Returns**

`void`

**11.1.2.13 `uint8_t serialRead ( )`**

Reads incoming serial data.

**Returns**

`uint8_t`

**11.1.2.14 `void serialWrite ( char c )`**

Serial printing.

**Parameters**

<code>c</code>	<code>char</code>
----------------	-------------------

**Returns**

`void`

**11.2 aDCLoad.h File Reference**

```
#include <float.h>
#include <LiquidCrystal.h>
#include <ClickEncoder.h>
#include <EEPROM.h>
```

**Classes**

- class [aStepper](#)  
*Class that handle increase/decrease step multiplier.*
- class [aDCSettings](#)  
*Class that handle settings.*
- struct [aDCSettings::CalibrationData\\_t](#)  
*Calibration values.*
- union [aDCSettings::\\_eepromCalibrationValue\\_t](#)  
*Union to manipulate float/uint8\_t [] calibration values.*
- class [aLCD](#)  
*LiquidDisplay extension class.*
- class [aDCDisplay](#)  
*Class that handle LCD displaying.*
- class [aDCEngine](#)  
*Main class.*

## Macros

- `#define MAX_POWER 1`  
*Define this if you want 192W support (otherwise 50W)*

## Typedefs

- `typedef void(* ISRCallback )()`  
*Function prototype for ISR callback.*

## Variables

- `static const uint8_t ADC_CHIPSELECT_PIN = 8`  
*set pin 8 as the chip select for the ADC:*
- `static const uint8_t ADC_INPUTVOLTAGE_CHAN = 0`  
*set the ADC channel that reads the input voltage.*
- `static const uint8_t ADC_MEASUREDCURRENT_CHAN = 1`  
*set the ADC channel that reads the input current by measuring the voltage on the input side of the sense resistors.*
- `static const uint8_t ADC_TEMPSENSE1_CHAN = 2`  
*set the ADC channel that reads the temperature sensor 1 under the heatsink.*
- `static const uint8_t ADC_TEMPSENSE2_CHAN = 3`  
*set the ADC channel that reads the temperature sensor 2 under the heatsink.*
- `static const uint8_t DAC_CHIPSELECT_PIN = 9`  
*set pin 9 as the chip select for the DAC:*
- `static const uint8_t DAC_CURRENT_CHAN = 0`  
*set The DAC channel that sets the constant current.*
- `static const uint8_t DAC_FAN_CHAN = 1`  
*set The DAC channel that sets the fan speed.*
- `static const uint8_t LCD_RS_PIN = 10`  
*LCD RS pin.*
- `static const uint8_t LCD_ENABLE_PIN = 12`  
*LCD ENABLE pin.*
- `static const uint8_t LCD_D0_PIN = A0`  
*LCD d0 pin.*
- `static const uint8_t LCD_D1_PIN = A1`  
*LCD d1 pin.*
- `static const uint8_t LCD_D2_PIN = A2`  
*LCD d3 pin.*
- `static const uint8_t LCD_D3_PIN = A3`  
*LCD d2 pin.*
- `static const uint8_t LCD_D4_PIN = 4`  
*LCD d4 pin.*
- `static const uint8_t LCD_D5_PIN = 13`  
*LCD d5 pin.*
- `static const uint8_t LCD_D6_PIN = 6`  
*LCD d6 pin.*
- `static const uint8_t LCD_D7_PIN = 5`  
*LCD d7 pin.*
- `static const uint8_t LCD_COLS_NUM = 20`  
*LCD columns size.*

- static const uint8\_t `LCD_ROWS_NUM` = 4  
*LCD rows size.*
- static const uint8\_t `ENCODER_A_PIN` = 3  
*Encoder Channel A pin, INT 0.*
- static const uint8\_t `ENCODER_B_PIN` = 2  
*Encoder Channel B pin, INT 1.*
- static const uint8\_t `ENCODER_PB_PIN` = 0  
*Encoder push button pin, INT 2.*
- static const uint8\_t `ENCODER_STEPS_PER_NOTCH` = 4  
*Depending on the type of your encoder, you can define use the constructors parameter `stepsPerNotch` an set it to either 1, 2 or 4 steps per notch, with 1 being the default.*
- static const uint8\_t `LED_BACKLIGHT_PIN` = 11  
*LCD backlight pin.*
- static const uint8\_t `OFFSET_UNIT` = 1  
*Unit column LCD offset.*
- static const uint8\_t `OFFSET_VALUE` = 4  
*Value column LCD offset.*
- static const uint8\_t `OFFSET_TEMP` = 12  
*Temperature column LCD offset.*
- static const uint8\_t `OFFSET_MARKER_LEFT` = 0  
*Column LCD offset for left marker '['.*
- static const uint8\_t `OFFSET_MARKER_RIGHT` = 14  
*Column LCD offset for right marker ']'.*
- static const uint8\_t `OFFSET_SETUP_MARKER_LEFT` = 1  
*Column LCD offset for left marker '[' in setup mode.*
- static const uint8\_t `OFFSET_SETUP_MARKER_RIGHT` = 18  
*Column LCD offset for right marker ']' in setup mode.*
- static const uint8\_t `LOGGING_ICON_X_COORD` = 17  
*Logging icon LCD X coord.*
- static const uint8\_t `LOGGING_ICON_Y_COORD` = 3  
*Logging icon LCD Y coord.*
- static const uint8\_t `USB_ICON_X_COORD` = 18  
*USB icon LCD X coord.*
- static const uint8\_t `USB_ICON_Y_COORD` = 3  
*USB icon LCD Y coord.*
- static const uint8\_t `LOCK_ICON_X_COORD` = 19  
*LOCK icon LCD X coord.*
- static const uint8\_t `LOCK_ICON_Y_COORD` = 3  
*LOCK icon LCD Y coord.*
- static const uint8\_t `ALARM_OV_X_COORD` = 18  
*Over-voltage 'OV' text LCD X coord.*
- static const uint8\_t `ALARM_OV_Y_COORD` = 1  
*Over-voltage 'OV' text LCD Y coord.*
- static const uint8\_t `ALARM_OC_X_COORD` = 18  
*Over-current 'OC' text LCD X coord.*
- static const uint8\_t `ALARM_OC_Y_COORD` = 2  
*Over-current 'OC' text LCD Y coord.*
- static const uint8\_t `ALARM_OT_X_COORD` = 18  
*Over-temperature 'OT' text LCD X coord.*
- static const uint8\_t `ALARM_OT_Y_COORD` = 2  
*Over-temperature 'OT' text LCD Y coord.*



- static const unsigned long AUTOLOCK\_TIMEOUT = 60000  
*Autolock timeout value (60 seconds)*
- static const unsigned long OPERATION\_SET\_TIMEOUT = 3000  
*Automatic toggle settings->reading timeout (3 seconds)*
- static const unsigned long BACKLIGHT\_TIMEOUT = 600000  
*Backlight dimmer timeout (10 minutes)*
- static const unsigned long LOGGING\_RATE = 100  
*CSV data-logging rate (ms)*
- static const unsigned long DISPLAY\_UPDATE\_RATE = 200  
*Display update rate (ms)*
- static const float VOLTAGE\_MAXIMUM = 24.000  
*Maximum handled voltage (V)*
- static const float CURRENT\_MAXIMUM = 7.845  
*Maximum value of load current (A)*
- static const float POWER\_MAXIMUM = VOLTAGE\_MAXIMUM \* CURRENT\_MAXIMUM  
*Maximum power dissipated (W)*
- static const uint16\_t TEMPERATURE\_MAXIMUM = 80  
*Over-temperature threshold.*
- static const int8\_t SOFTWARE\_VERSION\_MAJOR = 2  
*Software major version.*
- static const int8\_t SOFTWARE\_VERSION\_MINOR = 4  
*Software minor version.*
- static const uint16\_t FEATURE\_LOGGING = 1  
*Bitfield logging feature.*
- static const uint16\_t FEATURE\_LOGGING\_VISIBLE = 1 << 1  
*Bitfield logging icon feature.*
- static const uint16\_t FEATURE\_USB = 1 << 2  
*Bitfield USB feature.*
- static const uint16\_t FEATURE\_USB\_VISIBLE = 1 << 3  
*Bitfield USB icon feature.*
- static const uint16\_t FEATURE\_LOCKED = 1 << 4  
*Bitfield locking feature.*
- static const uint16\_t FEATURE\_LOCKED\_VISIBLE = 1 << 5  
*Bitfield locking icon feature.*
- static const uint16\_t FEATURE\_AUTOLOCK = 1 << 6  
*Bitfield auto-lock setting feature.*
- static const uint16\_t FEATURE\_AUTOLOCK\_VISIBLE = 1 << 7  
*Bitfield auto-lock setting icon feature.*
- static const uint16\_t FEATURE\_AUTODIM = 1 << 8  
*Bitfield auto-dimmer setting feature.*
- static const uint16\_t FEATURE\_AUTODIM\_VISIBLE = 1 << 9  
*Bitfield auto-dimmer setting icon feature.*
- static const uint16\_t FEATURE\_OVP = 1 << 10  
*Bitfield over-voltage protection feature.*
- static const uint16\_t FEATURE\_OVP\_VISIBLE = 1 << 11  
*Bitfield over-voltage protection icon feature.*
- static const uint16\_t FEATURE\_OCP = 1 << 12  
*Bitfield over-current protection feature.*
- static const uint16\_t FEATURE\_OCP\_VISIBLE = 1 << 13  
*Bitfield over-current protection icon feature.*
- static const uint16\_t FEATURE\_OTP = 1 << 14

- *Bitfield over-temperature protection feature.*  
static const uint16\_t **FEATURE\_OTP\_VISIBLE** = 1 << 15
- *Bitfield over-temperature protection icon feature.*  
static const uint8\_t **GLYPH\_X1** = 0
- *Offset of \*1 icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_X10** = 1
- *Offset of \*10 icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_X100** = 2
- *Offset of \*100 icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_X1000** = 3
- *Offset of \*1000 icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_USB** = 4
- *Offset of USB icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_LOCK** = 5
- *Offset of LOCK icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_CHECKBOX\_UNTICKED** = 6
- *Offset of unticked checkbox icon in LCD HD44780 controller memory.*  
static const uint8\_t **GLYPH\_CHECKBOX\_TICKED** = 7
- *Offset of ticked checkbox icon in LCD HD44780 controller memory.*  
static const int16\_t **EEPROM\_ADDR\_MAGIC** = 0
- *EEPROM start offset to magic numbers (0xDEAD)*  
static const int16\_t **EEPROM\_ADDR\_AUTODIM** = 4
- *EEPROM start offset for autodimming setting.*  
static const int16\_t **EEPROM\_ADDR\_AUTOLOCK** = 5
- *EEPROM start offset for autolocking setting.*  
static const int16\_t **EEPROM\_CALIBRATION\_SIZE** = (sizeof(float) \* 2) + sizeof(uint8\_t)
- static const int16\_t **EEPROM\_ADDR\_CALIBRATION\_VOLTAGE** = **EEPROM\_ADDR\_AUTOLOCK** + 1
- *EEPROM start offset for voltage calibration values.*  
static const int16\_t **EEPROM\_ADDR\_CALIBRATION\_READ\_CURRENT** = **EEPROM\_ADDR\_CALIBRATION\_VOLTAGE** + **EEPROM\_CALIBRATION\_SIZE**
- *EEPROM start offset for current calibration values.*  
static const int16\_t **EEPROM\_ADDR\_CALIBRATION\_DAC\_CURRENT** = **EEPROM\_ADDR\_CALIBRATION\_READ\_CURRENT** + **EEPROM\_CALIBRATION\_SIZE**
- *EEPROM start offset for DAC calibration values.*  
static const int16\_t **EEPROM\_ADDR\_CALIBRATION\_VOLTAGE\_DROP** = **EEPROM\_ADDR\_CALIBRATION\_DAC\_CURRENT** + **EEPROM\_CALIBRATION\_SIZE**
- *EEPROM start offset for DAC calibration values.*

## 11.2.1 Detailed Description

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Lee Wiggins [lee@wigweb.com.au](mailto:lee@wigweb.com.au)

**11.2.2 Macro Definition Documentation****11.2.2.1 #define MAX\_POWER 1**

Define this if you want 192W support (otherwise 50W)

**11.2.3 Typedef Documentation****11.2.3.1 typedef void(\* ISRCallback)()**

Function prototype for ISR callback.

**11.2.4 Variable Documentation****11.2.4.1 const uint8\_t ADC\_CHIPSELECT\_PIN = 8 [static]**

set pin 8 as the chip select for the ADC:

**11.2.4.2 const uint8\_t ADC\_INPUTVOLTAGE\_CHAN = 0 [static]**

set the ADC channel that reads the input voltage.

**11.2.4.3 const uint8\_t ADC\_MEASUREDCURRENT\_CHAN = 1 [static]**

set the ADC channel that reads the input current by measuring the voltage on the input side of the sense resistors.

**11.2.4.4 const uint8\_t ADC\_TEMPSENSE1\_CHAN = 2 [static]**

set the ADC channel that reads the temperature sensor 1 under the heatsink.

**11.2.4.5 const uint8\_t ADC\_TEMPSENSE2\_CHAN = 3 [static]**

set the ADC channel that reads the temperature sensor 2 under the heatsink.

**11.2.4.6 const uint8\_t ALARM\_OC\_X\_COORD = 18 [static]**

Over-current 'OC' text LCD X coord.

**11.2.4.7 const uint8\_t ALARM\_OC\_Y\_COORD = 2 [static]**

Over-current 'OC' text LCD Y coord.

**11.2.4.8 const uint8\_t ALARM\_OT\_X\_COORD = 18 [static]**

Over-temperature 'OT' text LCD X coord.

**11.2.4.9** `const uint8_t ALARM_OT_Y_COORD = 2` `[static]`

Over-temperature 'OT' text LCD Y coord.

**11.2.4.10** `const uint8_t ALARM_OV_X_COORD = 18` `[static]`

Over-voltage 'OV' text LCD X coord.

**11.2.4.11** `const uint8_t ALARM_OV_Y_COORD = 1` `[static]`

Over-voltage 'OV' text LCD Y coord.

**11.2.4.12** `const unsigned long AUTOLOCK_TIMEOUT = 60000` `[static]`

Autolock timeout value (60 seconds)

**11.2.4.13** `const unsigned long BACKLIGHT_TIMEOUT = 600000` `[static]`

Backlight dimmer timeout (10 minutes)

**11.2.4.14** `const float CURRENT_MAXIMUM = 7.845` `[static]`

Maximum value of load current (A)

**11.2.4.15** `const uint8_t DAC_CHIPSELECT_PIN = 9` `[static]`

set pin 9 as the chip select for the DAC:

**11.2.4.16** `const uint8_t DAC_CURRENT_CHAN = 0` `[static]`

set The DAC channel that sets the constant current.

**11.2.4.17** `const uint8_t DAC_FAN_CHAN = 1` `[static]`

set The DAC channel that sets the fan speed.

**11.2.4.18** `const unsigned long DISPLAY_UPDATE_RATE = 200` `[static]`

Display update rate (ms)

**11.2.4.19** `const int16_t EEPROM_ADDR_AUTODIM = 4` `[static]`

EEPROM start offset for autodimming setting.

**11.2.4.20** `const int16_t EEPROM_ADDR_AUTOLOCK = 5` `[static]`

EEPROM start offset for autolocking setting.

11.2.4.21 `const int16_t EEPROM_ADDR_CALIBRATION_DAC_CURRENT = EEPROM_ADDR_CALIBRATION_READ_CURRENT + EEPROM_CALIBRATION_SIZE` [static]

EEPROM start offset for DAC calibration values.

11.2.4.22 `const int16_t EEPROM_ADDR_CALIBRATION_READ_CURRENT = EEPROM_ADDR_CALIBRATION_VOLTAGE + EEPROM_CALIBRATION_SIZE` [static]

EEPROM start offset for current calibration values.

11.2.4.23 `const int16_t EEPROM_ADDR_CALIBRATION_VOLTAGE = EEPROM_ADDR_AUTOLOCK + 1` [static]

EEPROM start offset for voltage calibration values.

11.2.4.24 `const int16_t EEPROM_ADDR_CALIBRATION_VOLTAGE_DROP = EEPROM_ADDR_CALIBRATION_DAC_CURRENT + EEPROM_CALIBRATION_SIZE` [static]

EEPROM start offset for DAC calibration values.

11.2.4.25 `const int16_t EEPROM_ADDR_MAGIC = 0` [static]

EEPROM start offset to magic numbers (0xDEAD)

11.2.4.26 `const int16_t EEPROM_CALIBRATION_SIZE = (sizeof(float) * 2) + sizeof(uint8_t)` [static]

11.2.4.27 `const uint8_t ENCODER_A_PIN = 3` [static]

Encoder Channel A pin, INT 0.

11.2.4.28 `const uint8_t ENCODER_B_PIN = 2` [static]

Encoder Channel B pin, INT 1.

11.2.4.29 `const uint8_t ENCODER_PB_PIN = 0` [static]

Encoder push button pin, INT 2.

11.2.4.30 `const uint8_t ENCODER_STEPS_PER_NOTCH = 4` [static]

Depending on the type of your encoder, you can define use the constructors parameter `stepsPerNotch` an set it to either 1, 2 or 4 steps per notch, with 1 being the default.

11.2.4.31 `const uint16_t FEATURE_AUTODIM = 1 << 8` [static]

Bitfield auto-dimmer setting feature.

11.2.4.32 `const uint16_t FEATURE_AUTODIM_VISIBLE = 1 << 9` [static]

Bitfield auto-dimmer setting icon feature.

11.2.4.33 `const uint16_t FEATURE_AUTOLOCK = 1 << 6` [static]

Bitfield auto-lock setting feature.

11.2.4.34 `const uint16_t FEATURE_AUTOLOCK_VISIBLE = 1 << 7` [static]

Bitfield auto-lock setting icon feature.

11.2.4.35 `const uint16_t FEATURE_LOCKED = 1 << 4` [static]

Bitfield locking feature.

11.2.4.36 `const uint16_t FEATURE_LOCKED_VISIBLE = 1 << 5` [static]

Bitfield locking icon feature.

11.2.4.37 `const uint16_t FEATURE_LOGGING = 1` [static]

Bitfield logging feature.

11.2.4.38 `const uint16_t FEATURE_LOGGING_VISIBLE = 1 << 1` [static]

Bitfield logging icon feature.

11.2.4.39 `const uint16_t FEATURE_OCP = 1 << 12` [static]

Bitfield over-current protection feature.

11.2.4.40 `const uint16_t FEATURE_OCP_VISIBLE = 1 << 13` [static]

Bitfield over-current protection icon feature.

11.2.4.41 `const uint16_t FEATURE_OTP = 1 << 14` [static]

Bitfield over-temperature protection feature.

11.2.4.42 `const uint16_t FEATURE_OTP_VISIBLE = 1 << 15` [static]

Bitfield over-temperature protection icon feature.

11.2.4.43 `const uint16_t FEATURE_OVP = 1 << 10` [static]

Bitfield over-voltage protection feature.

11.2.4.44 `const uint16_t FEATURE_OVP_VISIBLE = 1 << 11` [static]

Bitfield over-voltage protection icon feature.

11.2.4.45 `const uint16_t FEATURE_USB = 1 << 2` `[static]`

Bitfield USB feature.

11.2.4.46 `const uint16_t FEATURE_USB_VISIBLE = 1 << 3` `[static]`

Bitfield USB icon feature.

11.2.4.47 `const uint8_t GLYPH_CHECKBOX_TICKED = 7` `[static]`

Offset of ticked checkbox icon in LCD HD44780 controller memory.

11.2.4.48 `const uint8_t GLYPH_CHECKBOX_UNTICKED = 6` `[static]`

Offset of unticked checkbox icon in LCD HD44780 controller memory.

11.2.4.49 `const uint8_t GLYPH_LOCK = 5` `[static]`

Offset of LOCK icon in LCD HD44780 controller memory.

11.2.4.50 `const uint8_t GLYPH_USB = 4` `[static]`

Offset of USB icon in LCD HD44780 controller memory.

11.2.4.51 `const uint8_t GLYPH_X1 = 0` `[static]`

Offset of \*1 icon in LCD HD44780 controller memory.

11.2.4.52 `const uint8_t GLYPH_X10 = 1` `[static]`

Offset of \*10 icon in LCD HD44780 controller memory.

11.2.4.53 `const uint8_t GLYPH_X100 = 2` `[static]`

Offset of \*100 icon in LCD HD44780 controller memory.

11.2.4.54 `const uint8_t GLYPH_X1000 = 3` `[static]`

Offset of \*1000 icon in LCD HD44780 controller memory.

11.2.4.55 `const uint8_t LCD_COLS_NUM = 20` `[static]`

LCD columns size.

11.2.4.56 `const uint8_t LCD_D0_PIN = A0` `[static]`

LCD d0 pin.

11.2.4.57 `const uint8_t LCD_D1_PIN = A1` `[static]`

LCD d1 pin.

11.2.4.58 `const uint8_t LCD_D2_PIN = A2` `[static]`

LCD d3 pin.

11.2.4.59 `const uint8_t LCD_D3_PIN = A3` `[static]`

LCD d2 pin.

11.2.4.60 `const uint8_t LCD_D4_PIN = 4` `[static]`

LCD d4 pin.

11.2.4.61 `const uint8_t LCD_D5_PIN = 13` `[static]`

LCD d5 pin.

11.2.4.62 `const uint8_t LCD_D6_PIN = 6` `[static]`

LCD d6 pin.

11.2.4.63 `const uint8_t LCD_D7_PIN = 5` `[static]`

LCD d7 pin.

11.2.4.64 `const uint8_t LCD_ENABLE_PIN = 12` `[static]`

LCD ENABLE pin.

11.2.4.65 `const uint8_t LCD_ROWS_NUM = 4` `[static]`

LCD rows size.

11.2.4.66 `const uint8_t LCD_RS_PIN = 10` `[static]`

LCD RS pin.

11.2.4.67 `const uint8_t LED_BACKLIGHT_PIN = 11` `[static]`

LCD backlight pin.

11.2.4.68 `const uint8_t LOCK_ICON_X_COORD = 19` `[static]`

LOCK icon LCD X coord.



11.2.4.69 `const uint8_t LOCK_ICON_Y_COORD = 3` `[static]`

LOCK icon LCD Y coord.

11.2.4.70 `const uint8_t LOGGING_ICON_X_COORD = 17` `[static]`

Logging icon LCD X coord.

11.2.4.71 `const uint8_t LOGGING_ICON_Y_COORD = 3` `[static]`

Logging icon LCD Y coord.

11.2.4.72 `const unsigned long LOGGING_RATE = 100` `[static]`

CSV data-logging rate (ms)

11.2.4.73 `const uint8_t OFFSET_MARKER_LEFT = 0` `[static]`

Column LCD offset for left marker '['.

11.2.4.74 `const uint8_t OFFSET_MARKER_RIGHT = 14` `[static]`

Column LCD offset for right marker ']'.

11.2.4.75 `const uint8_t OFFSET_SETUP_MARKER_LEFT = 1` `[static]`

Column LCD offset for left marker '[' in setup mode.

11.2.4.76 `const uint8_t OFFSET_SETUP_MARKER_RIGHT = 18` `[static]`

Column LCD offset for right marker ']' in setup mode.

11.2.4.77 `const uint8_t OFFSET_TEMP = 12` `[static]`

Temperature column LCD offset.

11.2.4.78 `const uint8_t OFFSET_UNIT = 1` `[static]`

Unit column LCD offset.

11.2.4.79 `const uint8_t OFFSET_VALUE = 4` `[static]`

Value column LCD offset.

11.2.4.80 `const unsigned long OPERATION_SET_TIMEOUT = 3000` `[static]`

Automatic toggle settings->reading timeout (3 seconds)

**11.2.4.81** `const float POWER_MAXIMUM = VOLTAGE_MAXIMUM * CURRENT_MAXIMUM` [static]

Maximum power dissipated (W)

**11.2.4.82** `const int8_t SOFTWARE_VERSION_MAJOR = 2` [static]

Software major version.

**11.2.4.83** `const int8_t SOFTWARE_VERSION_MINOR = 4` [static]

Software minor version.

**11.2.4.84** `const uint16_t TEMPERATURE_MAXIMUM = 80` [static]

Over-temperature threshold.

**11.2.4.85** `const uint8_t USB_ICON_X_COORD = 18` [static]

USB icon LCD X coord.

**11.2.4.86** `const uint8_t USB_ICON_Y_COORD = 3` [static]

USB icon LCD Y coord.

**11.2.4.87** `const float VOLTAGE_MAXIMUM = 24.000` [static]

Maximum handled voltage (V)

## 11.3 CDC.cpp File Reference

```
#include <CDC.cpp>
```

## 11.4 HardwareSerial.cpp File Reference

```
#include <HardwareSerial.cpp>
```

## 11.5 HID.cpp File Reference

```
#include <HID.cpp>
```

## 11.6 IPAddress.cpp File Reference

```
#include <IPAddress.cpp>
```

## 11.7 libraries.cpp File Reference

```
#include <Arduino.h>
#include "ClickEncoder.cpp"
#include "TimerOne.cpp"
```

## 11.8 main.cpp File Reference

```
#include <main.cpp>
```

## 11.9 new.cpp File Reference

```
#include <new.cpp>
```

## 11.10 Print.cpp File Reference

```
#include <Print.cpp>
```

## 11.11 README.md File Reference

## 11.12 sketch.cpp File Reference

```
#include <Arduino.h>
#include "aDCLoad.h"
```

### Functions

- void [isr](#) ()
- void [setup](#) ()
- void [loop](#) ()

### Variables

- [aDCEngine engine](#) ([LCD\\_RS\\_PIN](#), [LCD\\_ENABLE\\_PIN](#), [LCD\\_D0\\_PIN](#), [LCD\\_D1\\_PIN](#), [LCD\\_D2\\_PIN](#), [LCD\\_D3\\_PIN](#), [LCD\\_D4\\_PIN](#), [LCD\\_D5\\_PIN](#), [LCD\\_D6\\_PIN](#), [LCD\\_D7\\_PIN](#), [LCD\\_COLS\\_NUM](#), [LCD\\_ROWS\\_NUM](#), [ENCODER\\_A\\_PIN](#), [ENCODER\\_B\\_PIN](#), [ENCODER\\_PB\\_PIN](#), [ENCODER\\_STEPS\\_PER\\_NOTCH](#))

### 11.12.1 Function Documentation

11.12.1.1 void [isr](#) ( )

11.12.1.2 void [loop](#) ( )

11.12.1.3 void [setup](#) ( )

### 11.12.2 Variable Documentation

11.12.2.1 `aDCEngine engine(LCD_RS_PIN, LCD_ENABLE_PIN, LCD_D0_PIN, LCD_D1_PIN, LCD_D2_PIN, LCD_D3_PIN, LCD_D4_PIN, LCD_D5_PIN, LCD_D6_PIN, LCD_D7_PIN, LCD_COLS_NUM, LCD_ROWS_NUM, ENCODER_A_PIN, ENCODER_B_PIN, ENCODER_PB_PIN, ENCODER_STEPS_PER_NOTCH)`

!!!! BIG FAT WARNING !!!! Should be compiled with "-Os" flag. Bootloader couldn't be flashed, ISP programming ONLY == use Code::Blocks or the included Makefile to compile ==

### 11.13 Stream.cpp File Reference

```
#include <Stream.cpp>
```

### 11.14 Tone.cpp File Reference

```
#include <Tone.cpp>
```

### 11.15 USBCore.cpp File Reference

```
#include <USBCore.cpp>
```

### 11.16 WInterrupts.c File Reference

```
#include <WInterrupts.c>
```

### 11.17 wiring.c File Reference

```
#include <wiring.c>
```

### 11.18 wiring\_analog.c File Reference

```
#include <wiring_analog.c>
```

### 11.19 wiring\_digital.c File Reference

```
#include <wiring_digital.c>
```

### 11.20 wiring\_pulse.c File Reference

```
#include <wiring_pulse.c>
```

### 11.21 wiring\_shift.c File Reference

```
#include <wiring_shift.c>
```

## 11.22 WMath.cpp File Reference

```
#include <WMath.cpp>
```

## 11.23 WString.cpp File Reference

```
#include <WString.cpp>
```

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