



GETTING STARTED

With the Toadstool *24LC EEPROM CAP*



www.crash-bang.com

@crashbang_proto

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Meet the Toadstool Family

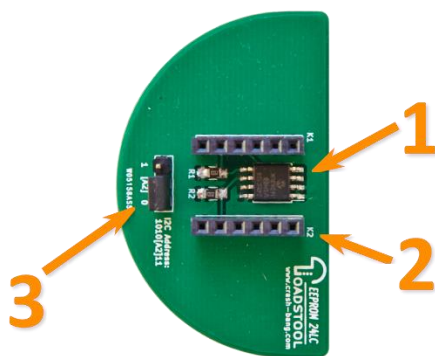
The Toadstool **24LC EEPROM CAP** is part of a larger group of open source prototyping boards and breakout modules (called *Caps*). This family was designed to let you quickly and easily prototype your microcontroller-based projects. The Toadstool **24LC EEPROM** is one of a selection of *Caps* compatible with the full range of Toadstool prototyping boards, and contains the 24LC128 EEPROM chip from Microchip¹.

Prototyping Boards vs *Caps*

The Toadstool **24LC EEPROM CAP** is a breakout module – a small module containing specific functionality that connects directly to a Toadstool prototyping board. This module houses an EEPROM chip. The *Cap* is designed to interface with the Toadstool prototyping boards without obscuring or interfering with the main I/O pins of the prototyping board.

In contrast, Toadstool Prototyping Boards (eg. the Toadstool *Mega328*) are larger boards that house a microcontroller. There are a wide range of prototyping boards, containing microcontrollers from a number of manufacturers. They plug directly into a breadboard to allow for fast and simple prototyping.

Overview of the Toadstool **24LC EEPROM**



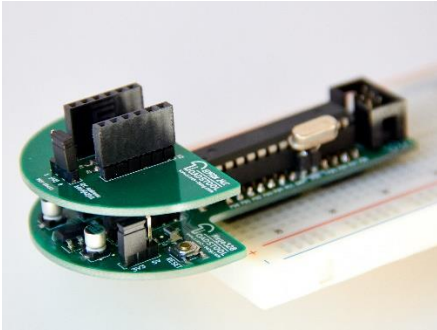
1. 24LC128 EEPROM chip
2. *Cap* header: Connect this to a Toadstool prototyping board
3. “A2” Address Select Jumper: Use this jumper to change the I²C address of the module

Connecting to a Toadstool prototyping board

The **24LC EEPROM** module connects quickly and easily to any of the Toadstool prototyping boards.

1. Ensure that the parent Toadstool prototyping board is not connected to a power source.
2. Align the semi-circular shape of the *Cap* with the semi-circular shape of the Toadstool prototyping board.

3. Gently, but firmly, insert the header pins into the matching headers on the Toadstool prototyping board.
4. Begin prototyping!



Important: If the module is inserted back-to-front, and power applied to the parent board, both the module and the parent Toadstool prototyping board could be irreparably damaged.

Using the *24LC EEPROM*

The 24LC is a 128kbit EEPROM module with an I²C serial interface. Values stored in memory are retained during power-off, which makes it a good option for storing configuration settings for embedded systems or for small-scale logging. Data is stored in bytes, and each byte can be accessed by a unique memory location address.

I²C Addressing

In line with the I²C protocol, the module has an address which the microcontroller must send in order to initiate communication. This allows multiple I²C devices to be daisy-chained, yet separately addressed. The *24LC EEPROM* module has a base address of `0b1010x11`, in which the “x” bit is set by the on-board jumper: either a `0` or a `1`. This allows you to connect up to two 24LC EEPROM modules on the same Toadstool prototyping board, with addresses `0b1010011` and `0b1010111`. For more detail on addressing, refer to Microchip’s 24LC128 datasheet, section 5.0.

I²C Communication

It is beyond the scope of this Getting Started guide to describe the I²C protocol, or to reiterate the detailed descriptions in the 24LC128 datasheet. However, an overview of a typical communication session is useful. Normally, the following steps would be followed for an EEPROM read/write:

Write to *24LC EEPROM*:

1. Initialise the I²C interface on the microcontroller
2. Send a Start condition
3. Send module address + a write bit
4. Send the EEPROM memory location to write to: High byte and Low byte in sequence

5. Send the byte to write to the memory location
6. Send a Stop condition

Read from **24LC EEPROM**:

1. Initialise the I²C interface on the microcontroller
2. Send a Start condition
3. Send module address + a **write** bit
(We need to perform a write operation, as we are writing to the EEPROM's registers.)
4. Send the EEPROM memory location to read from: High byte and Low byte in sequence
5. Send a Start condition
6. Send module address + a **read** bit
(Only now are we reading from the EEPROM)
7. Read the byte returned by the 24LC EEPROM
8. Send a Stop condition

A Sample Project

A sample project has been created to illustrate the use of the **24LC EEPROM** together with the **Toadstool Mega328** (based on the Atmel ATmega328P microcontroller). The project can be downloaded from the Toadstool Github repository².

The project allows a user to record a sequence of LED flashes (programmed using a push button), stores this sequence in the **24LC EEPROM** memory, and then replays it from memory. The project was written in Atmel Studio 6.2, although the underlying code should be portable to other IDEs using the GCC toolchain.

Where to From Here?

There are many more Toadstool modules in the pipeline to make your prototyping life easier, as well as a host of online resources online to take you further: refer to our website³ to keep building.

¹ **Microchip's 24LC128 product page:** <http://www.microchip.com/wwwproducts/Devices.aspx?product=24LC128>

² **Github Repository:** <https://github.com/CrashBangProto>

³ **Toadstool on the Internet:** <http://www.crash-bang.com/toadstool>