

# Lego NXT Memory and Power Supply

## Power Supply

Power is supplied to the NXT using 6 AA/LR6 batteries or a rechargeable battery pack with a power adapter plug (120VAC 60Hz). The rechargeable battery pack takes up more physical space than 6 AA batteries. The NXT comes with a cover that sits flush with the NXT unit while the rechargeable battery pack protrudes almost a centimetre out from the NXT brick. When one builds a robot from existing build instructions, this will have to be taken into account.

When charging the NXT, the green indicator light turns on. When the battery is recharging, the red light is on. A fully charged battery requires approximately four hours. The NXT can be used when the battery is recharging; however, recharging then requires more time. The Li-Ion Polymer battery can be recharged up to 500 times.

There is a difference in performance (power and time) when it comes to using 6 AA's vs. the rechargeable battery pack. 6 AA's will provide more power to the NXT motors than the Li-Ion battery pack will. In fact, in competitions, the preferred choice is Energizer Lithium batteries over conventional alkaline batteries, when power is of the utmost importance. Although the Li-Ion battery pack provides less power than 6 AA's, it delivers more steady power over a longer period of time.

It is difficult to quantify the time it takes to fully discharge the alkaline batteries or the Li-Ion battery pack. This depends on what types of tasks the NXT is performing (all motors turning at full speed, or just data calculations). One thing is for certain, as the batteries begin to deplete, the power of the motors begin to deplete as well.

The NXT has a sleep option to conserve power. These settings can be changed in the menu system under 'Settings/Sleep/Never'. You can change the Settings to wait before going to Sleep from 2, 5, 10, 30 or 60 minutes.

## Memory

The NXT uses a 32-bit ARM7 microprocessor with 256 Kbytes of Flash and 64 Kbytes of Ram. Flash memory can be read like RAM (access is a bit slower) but can only be written in 256-byte pages (maximum of 767 pages) by specific hardware instructions. Flash memory cannot be read while a page is being written. The first two pages hold the file table (directory) and the rest of the pages hold user files. Files are held as a contiguous set of bytes – i.e. they use a single range of page numbers with no gaps. This allows a file to be addressed as a region of memory.

The leJOS NXJ firmware is written in a combination of C and ARM assembler code. It consists of the initialization code, the Java VM and device drivers for all the hardware subsystems. The leJOS firmware is a complete firmware replacement and has no reliance on the standard LEGO firmware. The first 32kb of flash memory is allocated to the leJOS NXJ firmware. Most code is executed from flash memory, but a small amount (e.g. the code that writes pages of flash memory) is copied to RAM. Read-only data is held in flash memory but read/write data is copied to RAM. The firmware uses a fixed size stack and interrupt stack.

The leJOS NXJ Java VM executes one Java program at a time. This can either be a user program or the leJOS start-up menu. One Java program can execute another. When this is done the first Java program is removed from memory, and the second one is then executed. This is how the start-up menu executes user programs.

The start-up menu occupies up to 48kb of memory that starts at address 32k (i.e. after the end of the firmware). The last word of the 48kb allocated to the start-up menu holds the size of the start-up menu). Java programs execute from flash memory. Static read-only data is held in flash memory. Static read-write data is copied to RAM. Objects are created in a heap that starts at the top of the RAM and grows downwards. The Java stack starts at the bottom of free RAM memory and grows up. A garbage collector frees memory used by un-referenced objects when the heap becomes full.

The maximum filename length is 20 characters. If the average filename length is 15 characters, only 10 files can be supported. This limitation is not checked, and will cause an exception when the file table becomes full. Also, only one file can be open at a time.

Sources:

<http://lejos.sourceforge.net/nxt/nxj/tutorial/AdvancedTopics/UnderstandingFilesLCPMemTools.htm>

[http://cache.lego.com/downloads/education/9797\\_LME\\_UserGuide\\_US\\_low.pdf](http://cache.lego.com/downloads/education/9797_LME_UserGuide_US_low.pdf)

<http://student.seas.gwu.edu/~darbyt/cs1/lejos.html>