Letter Of Volatility
February 2nd, 2023
LabJack T7, T7-OEM, T7-Pro and T7-Pro-OEM

Following is an overview of the memory spaces available on the T7. Access methods are described for firmware 1.0299.

Note that the T7-Pro includes an RN-171 WiFi module from Microchip. This document does mention that module in terms of what we know about the T7 processor writing information to the RN-171, but a complete LOV for the RN-171 would have to be requested from Microchip if needed.

All volatile memory is cleared by any reboot. In the specific case of removing/losing power supply voltage, it takes about 1 millisecond after losing the power supply for the T7 supply voltage to drop below the brown-out voltage, so power supply loss of 1 millisecond or more will result in a reboot when the power supply returns.

Memory Areas:

Bold items are memory areas designed to allow the user to store non-volatile information.

- Data memory, 128 kilobytes SRAM (volatile).
    - Statically assigned variables.
    - Heap.
    - User RAM. Read and write access through modbus.
- Program memory, 524 kilobytes Flash (non-volatile). The program memory is code-protected to prevent general reading through the programming interface.
    - Main firmware image. Written by the Bootstrap.
    - Bootstrap image. Loaded during factory setup.
    - **Lua scripts**. The script that is saved in RAM is copied to program memory when requested. The saved script can be read through modbus. Cleared by saving a blank or inconsequential script.

- Flash, 4MB (non-volatile). Used for storing:
  - **User Area** (includes web pages). Read and write access through modbus. Also read by the HTTP server. Data is cleared 4k Bytes at a time using the Flash Erase command.
  - Reserved Area:
    - Backup Firmware Image. Read and write access through modbus. Also read by the Bootstrap.
    - Emergency Recovery Firmware Image. Read and write access through modbus. Also read by the Bootstrap.
    - Calibration Constants. Read and write access through modbus.
    - Upgrade Log. Read and write access through modbus. Also read and written to by the Bootstrap.
    - **Startup Settings**. IO Config and _Default registers as described in Section 24 of the T7 Datasheet. Cleared by writing IO_CONFIG_SET_DEFAULT_TO_FACTORY=1 and IO_CONFIG_SET_CURRENT_TO_FACTORY =1, and by writing default or junk values to all _DEFAULT registers.
    - Device information such as SN, MAC, and Device. Read and write access through modbus.
    - Information and checksums for all stored firmware images. Read and write access through modbus. Also read by the Bootstrap.
- Battery-Backed SRAM, 64 Bytes (non-volatile). No user access.
- **Micro SD card** (non-volatile). User data. Read and write access through modbus and File IO in Lua scripts. Files can be removed using the delete function in the File IO modbus interface, or by removing SD card and using a computer to remove files or format the card.
- Roving Networks **RN171** wifi module (T7-Pro & T7-Pro-OEM only). Flash memory in the module stores user information such as network SSID and password. Contents are not encrypted. Cleared by writing default or junk values.

Clear All User Memory:

1A. To clear non-volatile user memory, the bold items above are cleared as described above. For a T7, clear the following:
- Lua Scripts
- Flash User Area
- Flash Startup Settings

As of firmware 1.0217 there is a register CLEAR_USER_MEMORY. Writing a value of

0x5317052E to this register will clear the 3 areas of non-volatile memory above.

1B. If there is a microSD card, it needs to be cleared as described above (e.g. remove it and format):
- MicroSD Card

The T7-Pro ships from the factory with a microSD card installed. The T7 does not ship with a microSD card installed, but does have the socket and a microSD can be added by the user at any time, so a visual inspection of the socket (between the Ethernet and DB37 connectors) is recommended.

1C. For a T7-Pro, also clear the following:
- RN171 WiFi Configuration

2. To clear all volatile memory power-down or reboot the device.

Note that this clearing procedure clears *all memory designed for user access*, not *all memory*. If all memory was cleared, including things like calibration and firmware, the device would be unusable. Of particular note is that the Flash Reserved Area is not an area that an end user will write to during routine operation, but this area is writeable and readable through the Modbus interface. Some areas of the Reserved Area contain factory stored information critical to the basic operation of the device, and thus those areas are not cleared by the clearing procedure described here. It is possible that someone with malicious intentions could do modbus writes to store information in the Reserved Area for later retrieval after clearing.