
The TINI390 Loader

1 Version Notice

This package requires TINI OS version 1.02b.

2 Introduction

2.1 Features

The TINI390 loader is the next-generation TINI loader and supports network loading of applications and data via TFTP.

2.2 Variations of the Loader

The TINI390 loader is supplied in several varieties:

Table 1. **TINI390 Loader Varieties**

Name	Description
L0515	Original serial loader
Serial100	Serial loader that understands the N network boot command
SerialNet100	Serial loader that tries a network boot as default action

3 Boot Process

3.1 Overview

The DS80C390 begins execution at memory location 000000 (see data sheet). Depending on the loader image, the code determines the baud rate of the serial interface and checks whether a character is received from that interface. If yes, the user is presented with the option to erase/load flash, dump/execute memory, etc.

If no serial activity is detected the TINI390 loader continues with network boot (depending on the version of the loader). Otherwise, execution is transferred to the user code.

3.2 The Serial Loader

The serial loader displays a copyright notice and a prompt. Several commands support an optional 'range' parameter. This parameter is interpreted as 'start offset' 'length', e.g. 1000 200 is the range from 1000 to 1200.

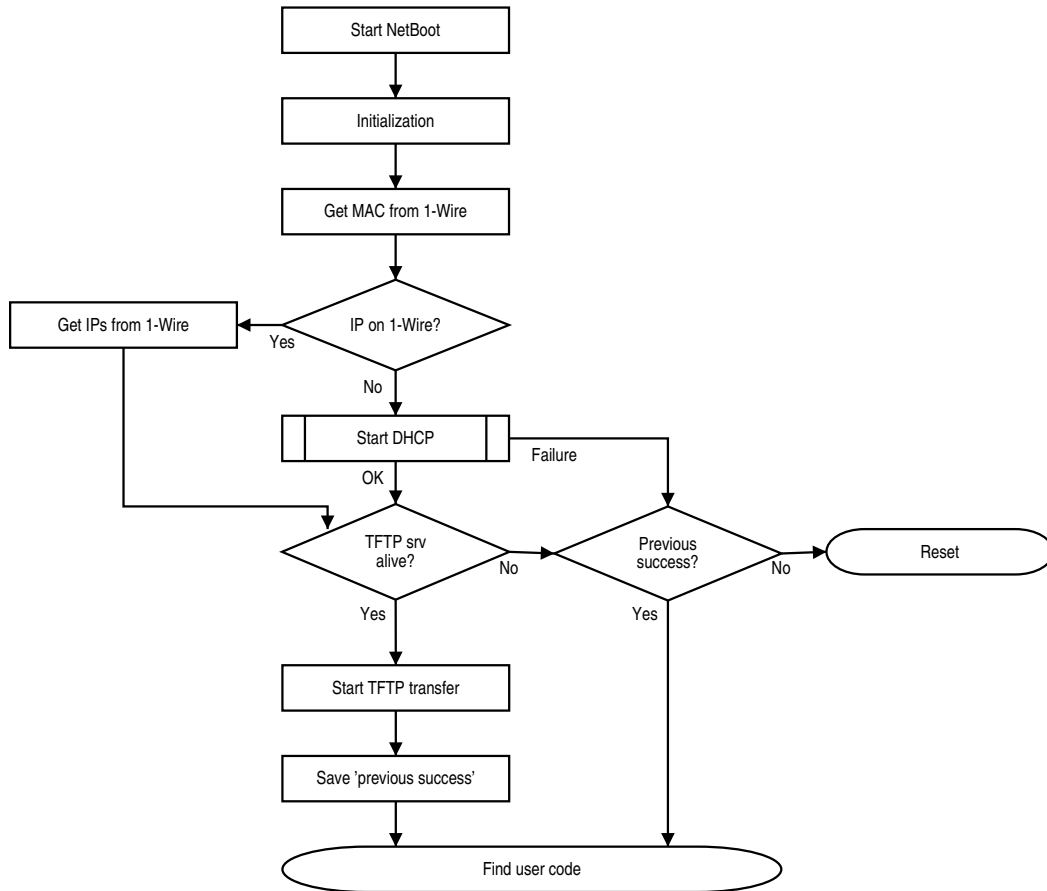
The serial loader manages memory in 64 KB blocks ('banks'). A bank (also 'most significant byte') is the high 8 bits of a 24-bit memory address. Most commands apply to the selected bank. Table 2 shows all supported serial loader commands.

Table 2. **Serial Loader Commands**

Command	Explanation
B bank	Selects a bank. Example: B C0
C [range]	Calculates the CRC (with optional range) in the selected bank. <i>Example:</i> C 1000 200
D [range]	Dump memory in selected bank in hex format. <i>Example:</i> D 0 20
E	Exit the loader and try to execute user code.
F value [range]	Fill range in selected bank with a byte value. <i>Example:</i> F 00
G	'Goto'—Start executing the selected bank at offset 0.
H, ?	Help'—Display version number and current bank.
L	Load hex
N	Start network boot
S	Set serial speed to $\frac{1}{2}$ of current speed
T [arguments]	Reserved by Dallas Semiconductor for Test commands
V	Verify hex
X [offset]	Execute code at the given offset in current bank.
Z bank	Zap (erase) flash bank. <i>Example:</i> Z C0

3.3 Network Boot

Figure 1. **Network Boot**



After set-up of the interrupt vectors (Ethernet, timer), the TINI390 loader memory manager¹ and support functions are initialized. Then, the Ethernet driver, TCP/IP stack and socket layer are initialized. The DS2502U-E48 1-Wire chip with MAC address is required for successful initialization.

1. The TINI390 loader memory manager is a minimalistic memory manager which is used only during network boot.

3.3.1 DHCP

After these initial steps, the code tries to acquire an IP address and the address of a TFTP server using the Dynamic Host Configuration Protocol (DHCP). Specifically, the “next server IP” field of the DHCP acknowledgment packet is used to determine the TFTP server IP. If the site-specific (user defined) option 150 is present in the DHCP packet, it overrides the next server IP (option 150 is also used on Cisco IP phones to get a TFTP server IP address, but is not standardized by an RFC; see Appendix B for details).

3.3.2 TFTP and the *tbin2* File Format

Network boot first tries to transfer the file ‘MACADDRESS’ (e.g. 006035AB9811), then the file ‘TINI390-version’ (e.g. TINI390-1.0.0), and, if this fails, the file TINI390. This allows the TFTP server operator to distinguish between different devices and/or different releases of the TINI390 loader. The transferred file is loaded into user code space. Subsequently, the DHCP IP address is released and control is transferred to the user code.

TINI 1.02c and later only: If network boot is unable to receive a response from the TFTP server, it checks whether the previous TFTP transfer completed successfully. If so, network boot executes the code. If no, the device is reset. Thus, the TFTP server need not be operational all the time as long as one transfer previously completed successfully. The state information is stored at memory location 100100; if this memory is not non-volatized, the state information is lost on power-on-reset.

The network boot code uses the Dallas *tbin2* format as its native binary format for loading flash memory.

The *tbin2* format consists of one or more records (see Table 3). The format allows binary concatenation of multiple images into one file, for example the TINI runtime and the TINI user shell slush, e.g.:

```
cat tini.tbin2 slush.tbin2 tiniandslush.tbin2
```

or, running from the DOS prompt,

```
copy /b tini.tbin2 + slush.tbin2 tiniandslush.tbin2
```

Table 3. **tbin2 Record**

Field Name	Size	Contents
Version	1	1
Start address	3	Target address for data block (LSB first)
Length-1	2	Length-1 of data block (LSB first)
CRC-16	2	CRC-16 of data block (LSB first)
(Data)	* Length	Binary data

Note: Versions other than 1 and target addresses above 100000 are currently reserved.

To convert existing *tbin* files into the *tbin2* format, use the *tbin2tbin2* utility in the *hostutil* directory, e.g.

```
tbin2tbin2 < tini.tbin > tini.tbin2
```

Before erasing and loading, the network boot TFTP process checks the CRC-16 of the current memory contents. If these contents match, the data block is ignored. Otherwise, whenever the high 8 bits of the start address change, the network boot TFTP process determines whether the memory block referenced is SRAM or flash. It then erases the whole 64 KB bank of memory.

Next, network boot either programs the binary data into the flash or just writes the data to SRAM, depending on the memory type. The code then calculates the CRC-16 of the block and compares it to the CRC-16 in the *tbin2* description block. If the CRC-16 doesn't match, the microcontroller is reset.

3.3.3 Using 1-Wire instead of DHCP

Optionally, instead of using DHCP, the IPv4 address configuration and TFTP server IP can be stored in the following 1-Wire devices: DS1427, DS1971, DS1973, DS1992, DS1993, DS1994, DS1995, DS1996, DS2404, DS2430A, DS2433 and DS2504 (see Appendix A for details). Note that the optional part holding the IPv4 address configuration is different from the mandatory part used for the MAC ID.

3.3.4 Using the Copyright Message as Progress Indicator

The copyright message is printed in several stages during network boot. Each word signifies the successful initialization of a component and can therefore be used as a status/error message.

Table 4. **Progress Indication by Copyright Message**

Display String	Successful initialization of...
All	Interrupt vector table and memory
rights reserved. S/N:	1-Wire and Network
(Serial number)	Ethernet driver
MAC ID:	Sockets
(MAC ID)	System timer

The complete copyright message is similar to the following:

TINI390 Environment 1.0.0 - Copyright (C) 1999-2001 Dallas Semiconductor.
All rights reserved. S/N: NNNNNNNNNNNNNNNN MAC ID: MMMMMMMMMMMM

3.4 User Code

TINI 1.02b only: The TINI390 loader starts user code at address 010000.

4 Memory Usage

The network boot functionality erases and uses a 64 KB block of memory at address 100000 every time a network boot is requested.

5 Loading a Loader from the TINI OS

Warning: A power failure during this operation might render your DS-TINI-1 useless until the loader is restored. If you have an uninterruptible power supply, it would be wise to connect the TINI to it during the upgrade.

The TINI390 Loader

Transfer the files in the *bin* directory of this package to your TINI. Transfer one of the *tbin2* loader files from the *loaders* directory to your TINI.

Be sure to run the following commands from the serial console, otherwise you will not be able to see any progress report:

```
java LoaderLoader.tini Serial100.tbin2
```

would load the serial loader with TFTP support.

6 Recovering from Power Failures During Load

In the unlikely event of a power failure during the flash programming sequence (less than 10 seconds), your TINI might lose its boot loader and become unuseable.

Before trying anything else, try both power cycling to your TINI, and removing and reseating your TINI board then cycling power to be sure your TINI is really loader-less. If you have a Systronix STEP socket board, follow the nice instructions provided by Systronix to get your TINI back up and running: http://www.systronix.com/jb_tutorial/quick_start/restore.htm

You may choose to send the TINI board back to Dallas Semiconductor and we will update your loader and return it to you. Please ship the package to the address below. Include in the package a description saying "Return for bootloader fix". The time frame to turn around the fix is 72 hours from receiving the package.

Dallas Semiconductor
4401 South Beltwood Parkway
Bldg. C, Attn: Vanessa Bridges
Dallas TX 75244-3292

You will pay the cost of shipping the board to us, and we will pay for the return.

Appendix A Using a 1-Wire Chip for Static IP Address Configuration

The TINI390 loader supports the following 1-Wire parts as IP address configuration source: DS1427, DS1971, DS1973, DS1992, DS1993, DS1994, DS1995, DS1996, DS2404, DS2430A, DS2433 and DS2504.

The first part that contains the following signature at offset 0 is queried for IPv4 address, IPv4 gateway address, IPv4 prefix length (will be converted to the subnet mask) and TFTP server IP (this IP is also supported for IPv6):

Table 5. **1-Wire Address Configuration Data**

Offset		Description
0	29	Length byte
1	'TINI'	Signature
5	32-bit value	IPv4
9	32-bit value	IPv4 gateway
13	1 byte	IPv4 prefix length
14	128-bit value	TFTP server IP
30	16-bit value	1-complement of CRC-16 (LSB first)

The data is organized in standard 1-Wire format (length byte—data—CRC-16).

The distribution ships with sample Java code that demonstrates how to write this information to a DS2433. Production code should verify the data after the READ_SCRATCHPAD command to ensure that the data was received correctly before committing it to flash.

Appendix B Site-specific DHCP Option 150 (TFTP Server IP)

Since some DHCP servers prevent configuration of the 'next server IP' field, the TINI390 loader uses the site-specific (user defined) option 150 if present. If the option is present, it always overrides the 'next server IP' value.

This option is defined as follows (see RFC 2132 for the description of standard DHCP options):

Table 6. **Site-specific Option 150**

Code	Len	Address			
150	4	a1	a2	a3	a4

To configure option 150 in ISC *dhcpcd*, use

```
option option-150 aa:bb:cc:dd;
```

where **aa:bb:cc:dd** is the hexadecimal representation of the TFTP server IP address, e.g. 192.168.0.3 would be configured as

```
option option-150 c0:a8:00:03;
```

To configure option 150 on Windows 2000, see http://www.cisco.com/warp/public/788/AVVID/win2000_dhcp.html