To our customers,

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April 1st, 2010
Renesas Electronics Corporation

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User's Manual

# LCE-K0S Low-Cost Emulator

## Getting Started

Global Document No. U18143EU1V0UM00 (1st edition)
Document No. 50889

# LCE-K0S Low-Cost Emulator

**Getting Started User's Manual**

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# Contents

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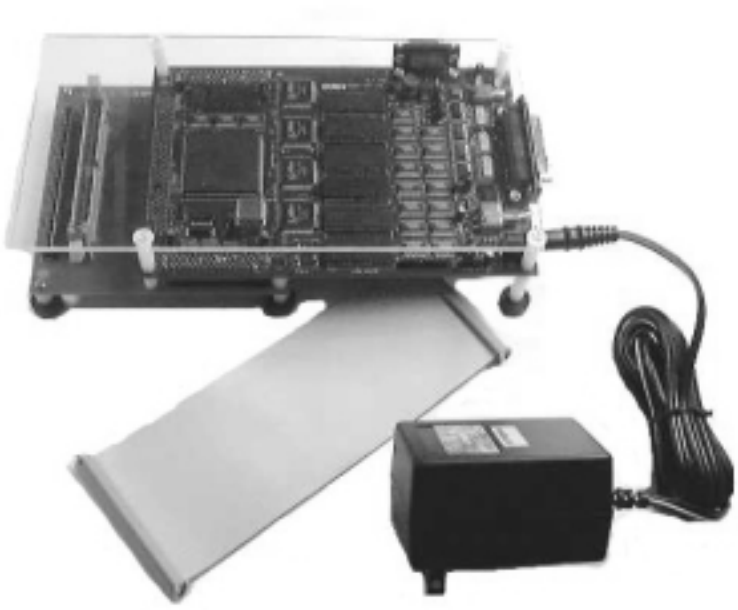
# Introduction 1

NEC's K0S Low-Cost Emulator (LCE-K0S) is an economical and comprehensive emulation system for developing embedded systems based on NEC's K0S microcontrollers. The LCE-K0S supports most conventional in-circuit emulation functions and is also a flash programmer for K0S microcontrollers with flash memory (Figure1-1).

The LCE-K0S consists of a motherboard (LCE-78K0S) that provides base functions for emulation and a daughterboard (LCE-789xxx-EM) that provides family-specific emulation functions. The LCE-K0S uses a Microsoft® Windows®-based integrated debugger and interfaces to a personal computer via a printer or parallel port.

***Figure 1-1. LCE-K0S***



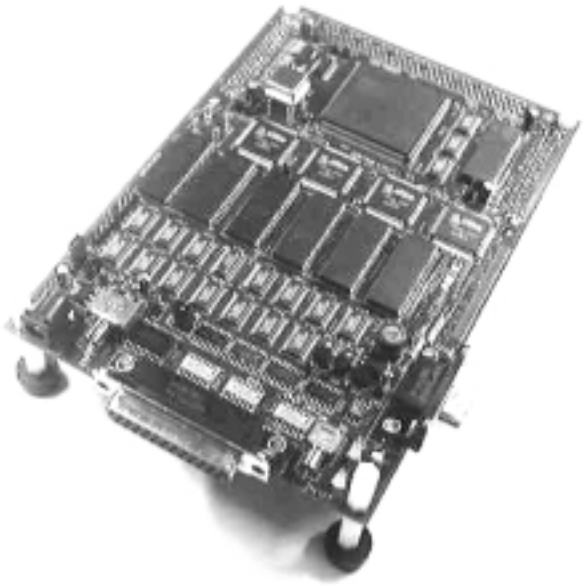
## Shipping Contents

- **Motherboard Package**
  - Motherboard
  - 110V AC power adapter
  - *Getting Started* Manual (document no. 50889)
  - DB25 straight-through cable
  - ID78K0S-LCE User's Manual (document no. 50888-1)
- **Daughterboard Package**
  - Daughterboard
  - One or two ribbon cables
  - CD-ROM containing software and documentation
  - Daughterboard user's manual
- **Optional Accessories**
  - Emulation probe
  - Flash adapter

## Motherboard

The main platform board, the *motherboard*, provides functions common to all K0S microcontrollers, as well as flash programming circuitry and tracing capability (Figure1-2). A clear plastic cover on top of the system protects it from fluid spills.

***Figure 1-2. Motherboard***

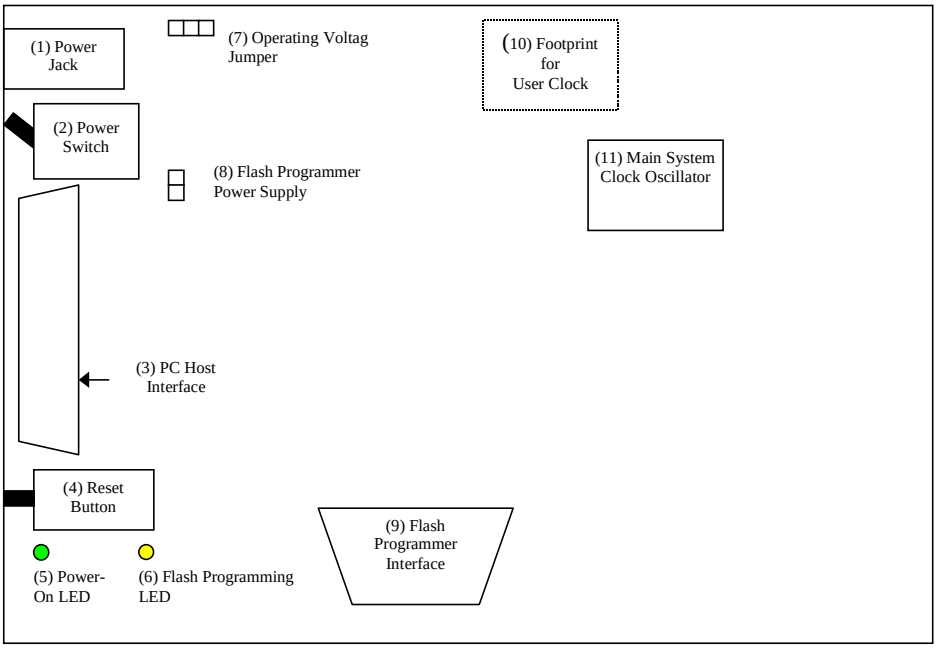


The motherboard is designed with the components describedin Table1-1. Each component is numbered to correspond with its location in Figure 1-3.

***Table 1-1. Motherboard Components***

| Location | Item | Description |
|---|---|---|
| 1 | Power jack | Connects the power adapter |
| 2 | Power switch | Turns on/off power to the LCE |
| 3 | 25-pin connector | Connects a straight-through cable from the LCE to host PC |
| 4 | Reset button | Hardware resets the LCE |
| 5 | Green power LED | Indicates that power is being supplied to the LCE |
| 6 | Yellow LED | Indicates the presence of the VPP signal during flash programming |
| 7 | 3-pin male header, JP1 | Sets the operating voltage for the LCE |
| 8 | 2-pin male header, JP2 | Enables or disables power (VPP) for flash programming |
| 9 | DB9 connecto | Connects a flash adapter (sold separately) or a cable to perform on-board flash programming (cable included with flash adapter) |
| 10 | U35 footprint | Reserved for user-installed crystal oscillator |
| 11 | 40 MHz clock oscillato | Main system clock |

***Figure 1-3. Top View of the Motherboard (Component Side)***



### Power Adapter

The main power supply for the LCE-K0S is a 110V AC power adapter that generates +5 volts (Figure 1-4). It does not provide power to the user target.

***Figure 1-4. Power Adapter***

### Parallel Cable

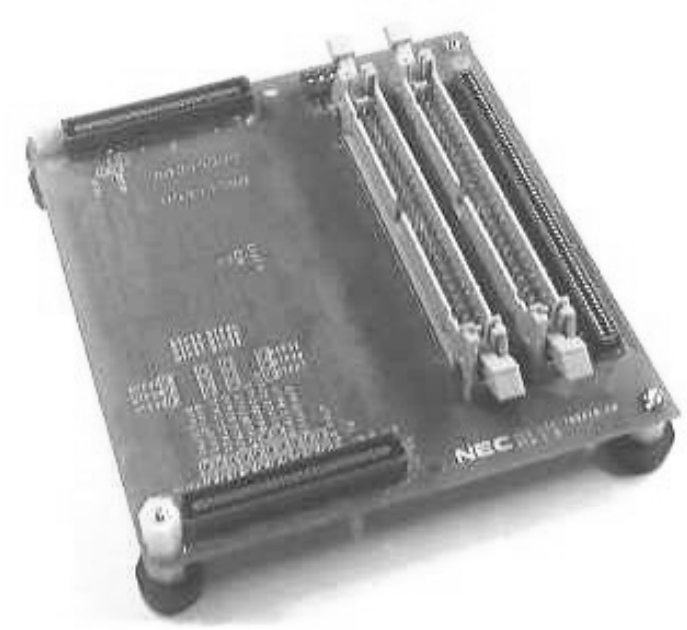
The parallel cable is a 25-pin straight-through cable that connects the LCE-K0S to the host computer via a parallel port (Figure 1-5).

***Figure 1-5. Parallel Cable***

## Daughterboard

The daughterboard connects to the bottom of the motherboard and provides peripheral functionality for a specific subseries of K0S microcontrollers (Figure 1-6).

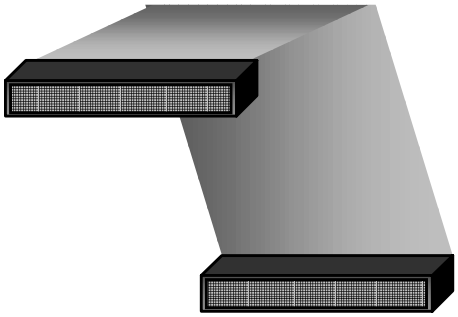
***Figure 1-6. Daughterboard***



**Ribbon Cable**

The ribbon cable is a 50-pin female-to-female cable that connects the LCE-K0S to the user target (Figure 1-7). The emulation probe can be used alternatively.

***Figure 1-7. Ribbon Cable***



## *Optional Accessories*

### Emulation Probe

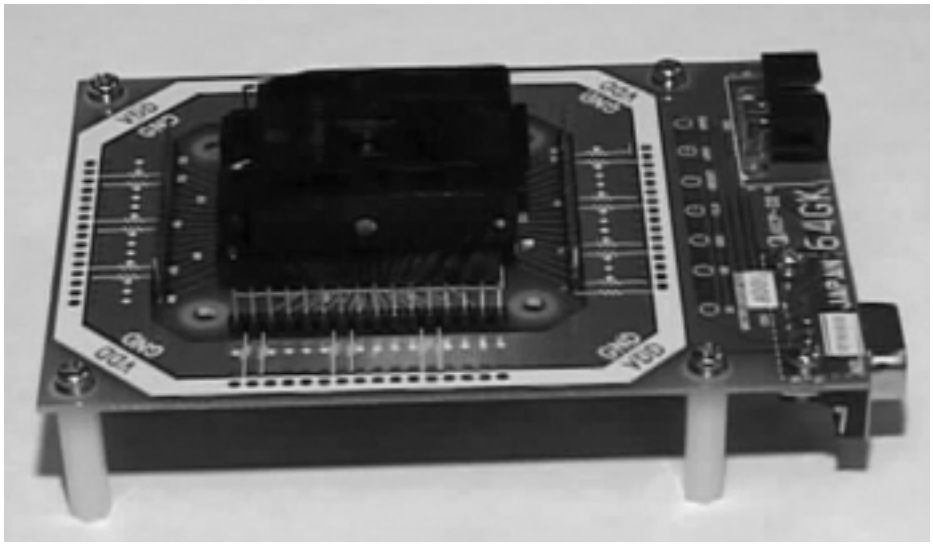
The emulation probe, sold separately, is an alternative way to connect the daughterboard to a user target (Figure 1-8). One end of the probe connects to the 120-pin KEL connector on the daughterboard; the other end connects to a special socket on the user target.

***Figure 1-8. Emulation Probe***

### Flash Adapter

A flash adapter is used to program a flash microcontroller (Figure1-9). The adapter, a printed circuit board with a clam-shell socket and DB9 connector, must be wired so that the programming signals are transmitted to the connector. The DB9 connector may be used to connect the flash adapter to the LCE-K0S directly or through the flash programming cable included with the flash adapter.

***Figure 1-9. Flash Adapter***



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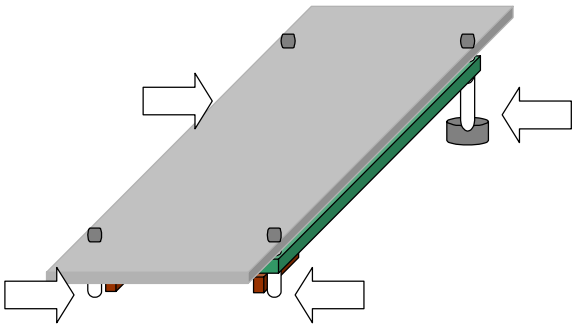
# Hardware Assembly 2

This section explains how to change the jumper settings, assemble the hardware components of the LCE-K0S, and establish connection to the host PC.

## Changing the Jumper Settings

1. Unscrew the four plastic spacers underneath the motherboard (Figure 2-1). **Take special care when handling the small washers.**

***Figure 2-1. Motherboard Cover and Screws***

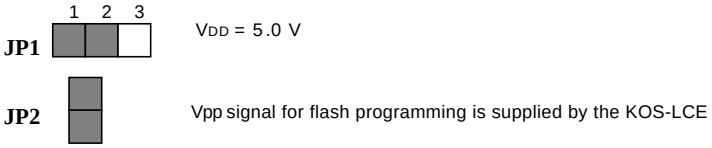


2. Remove the plastic cover on top of the motherboard.

### *Default Settings*

3. Figure 2-2 shows the default jumper settings.

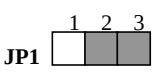
***Figure 2-2. Default Jumper Settings***




### *Other Settings*

4. To change the setting for JP1, refer to Figure 2-3.

***Figure 2-3. JP1 Setting for $V_{DD}$ = 3.3 V***



5. To change the setting for JP2, refer to Figure 2-4.

***Figure 2-4. JP2 Setting for $V_{PP}$ Supplied by User Target***


6. Replace the plastic cover on top of the motherboard.

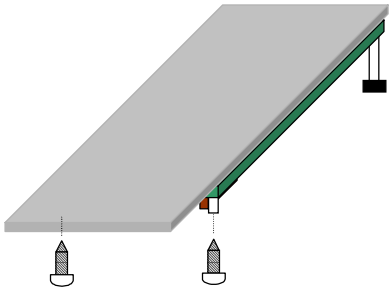
7. Replace the washers and screws.

## Connecting the Boards

1. Make sure power is off.

2. Remove the two front screws at the bottom of the standoffs of the motherboard (Figure 2-5)

***Figure 2-5. Motherboard Screws***



3. Connect the ribbon cables (Figure 2-6) or the probe (Figure 2-7) to the respective connectors on the daughterboard. Note that some daughterboards may come with only one ribbon cable.

***Figure 2-6. Ribbon Cables***

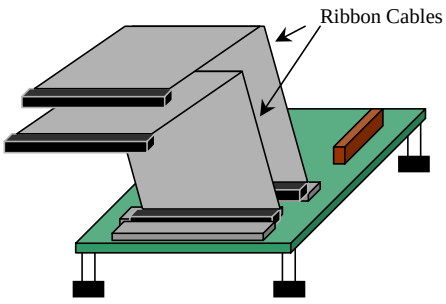
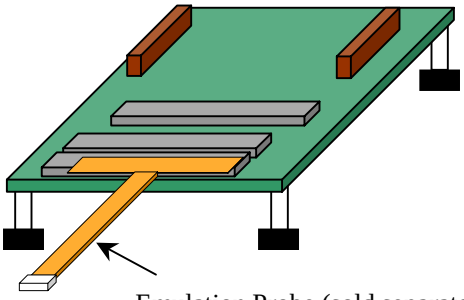
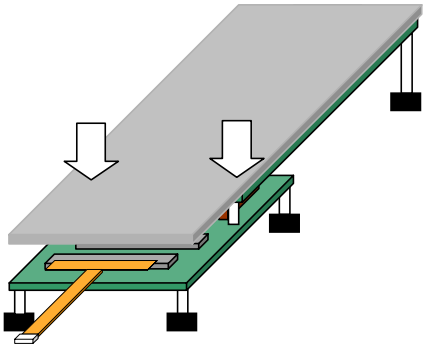


***Figure 2-7. Emulation Probe (Optional)***



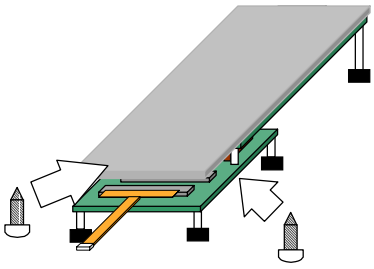

4. With the daugherboard on a stable surface, connect the motherboard to the top of the daughterboard by gently applying pressure on the mating connectors. Avoid applying too much pressure directly onto the plastic cover (Figure 2-8).

***Figure 2-8. Motherboard/Daughterboard Connections***



5. Replace the screws on the bottom of the daughterboard to secure the connections with the motherboard (Figure 2-9).

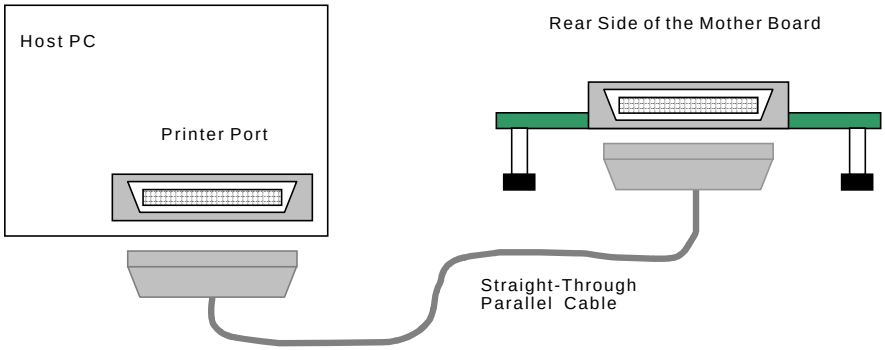
***Figure 2-9. Securing the Connections***



6. Connect the loose end of the ribbon cable or the probe to the user target. Refer to the daughterboard manual for pin assignments.

7. Use the 25-pin, male-to-male, straight-through cable included with the mother-board to connect to the printer or parallel port of the host (Figure 2-10).

***Figure 2-10. Host PC Connections***




## Establishing Communication

With the LCE-K0S power adapter connected, turn the switch to the ON position. The green LED on the motherboard will light when power is supplied to the system. The LCE-K0S is now ready to communicate with the software debugger.

For proper communication, the parallel port of the PC must be configured as a BIDIRECTIONAL port. In most cases, the port will be configured correctly. If not, enter into the BIOS of the PC and make the modifications. Refer to the user's manual for your PC for details.

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# Software Installation 3

### *Obtaining a Password*

Before installing the software, obtain a password from NEC Electronics Inc.

1. Call 1-800-366-9782. Press 1 for Literature and then press 1 again to speak to a representative who will assist you with LCE registration.

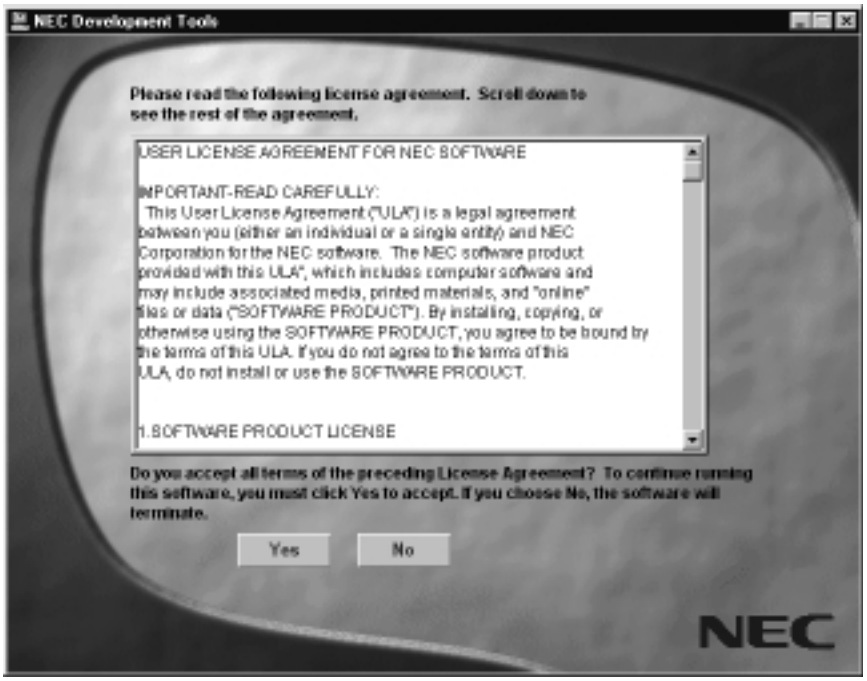
2. Provide your company information and the exact serial number printed on the motherboard.

### *Installing the Software*

The following procedure explains how to install the software for the LCE-K0S. At any time during the procedure, click **Back** to return to the previous screen or **Cancel** to cancel the installation.

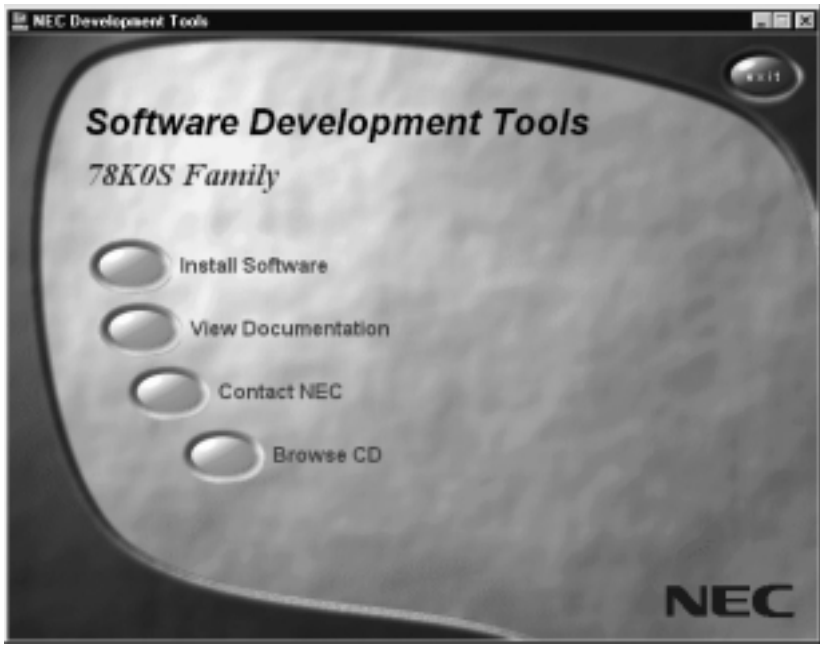
1. Load the CD-ROM into the drive. If the autorun feature is enabled in your CD-ROM drive, the **License Agreement** dialog box appears automatically after a few seconds (Figure 3-1). Alternatively, you may run the executable from the **Star** menu. Click **Run** → **Browse** and select the CD-ROM drive letter to view the contents of the CD-ROM. Select **NEC.EXE** and then click **Open** → **OK**.

***Figure 3-1. License Agreement***



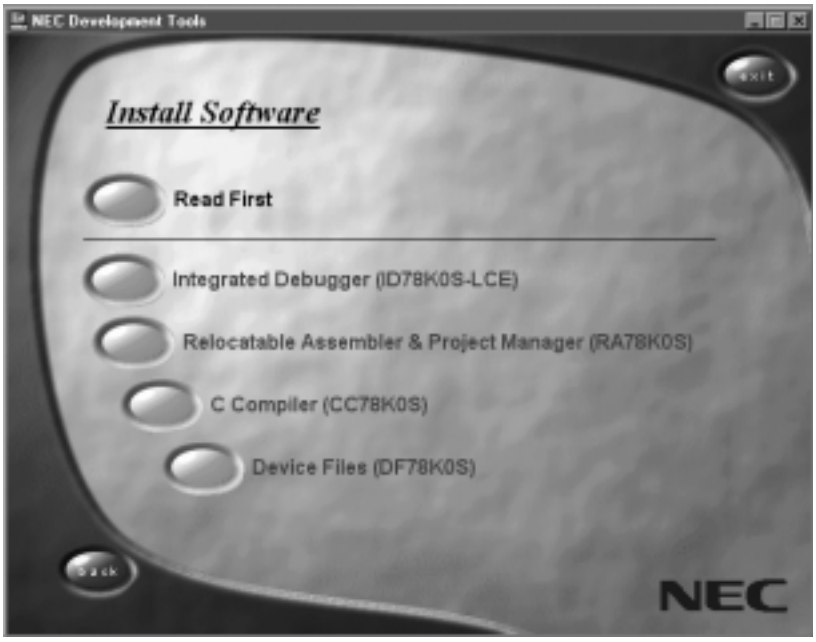
2. Click **Yes** to accept the agreement and proceed to the **Software Development Tools** menu (Figure 3-2) or click **No** to exit the program.

***Figure 3-2. Software Development Tools Menu***



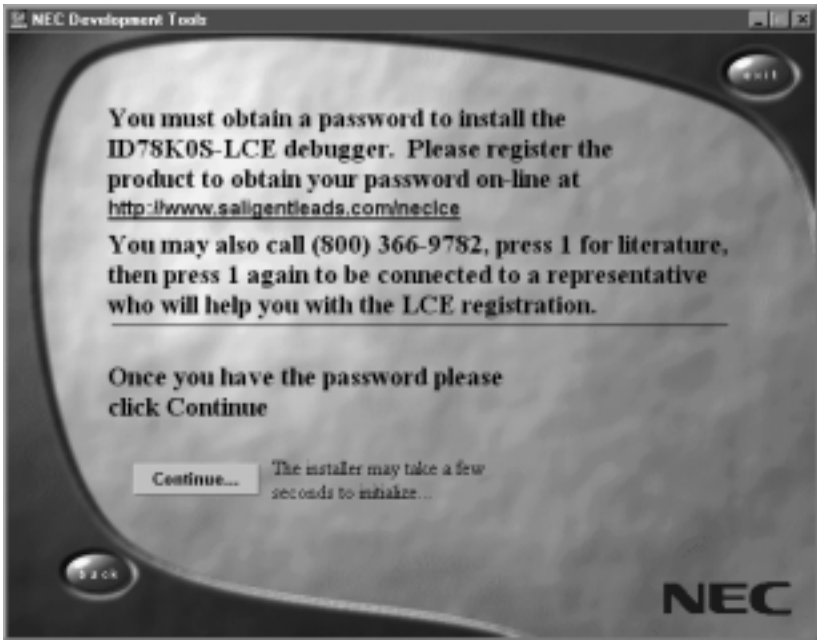

3. From the **Software Development Tools** menu, click **Install Software** to display the **Install Software** menu (Figure 3-3).

***Figure 3-3. Install Software Menu***



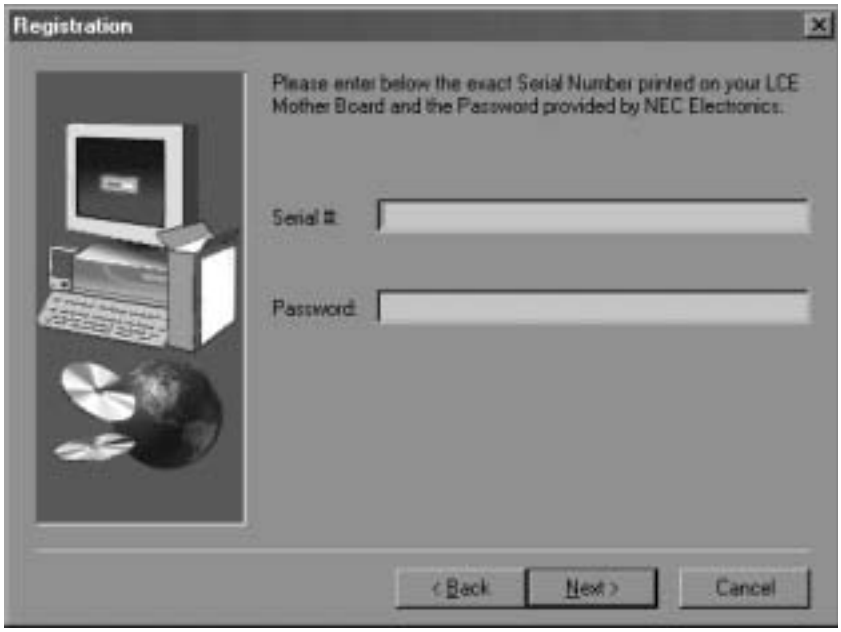
4. From the **Install Software** menu, click **Integrated Debugger** to learn how to register the ID78K0S-LCE and obtain a password from NEC Electronics Inc. (Figure 3-4). Once you obtain a password, click **Continue...** to install the software.

***Figure 3-4. Password Information***



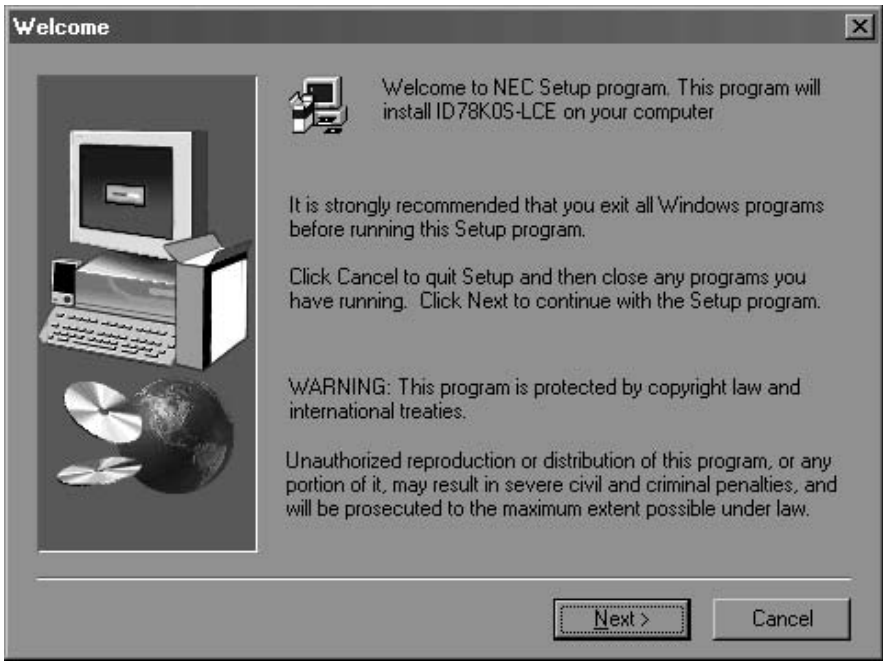

5. The first screen in the ID78K0S-CCE install program is the **Registration** dialog box. Here enter the motherboard serial number and password assigned by NEC Electronics Inc. and then click **Next** to continue (Figure 3-5).

***Figure 3-5. Registration Dialog Box***



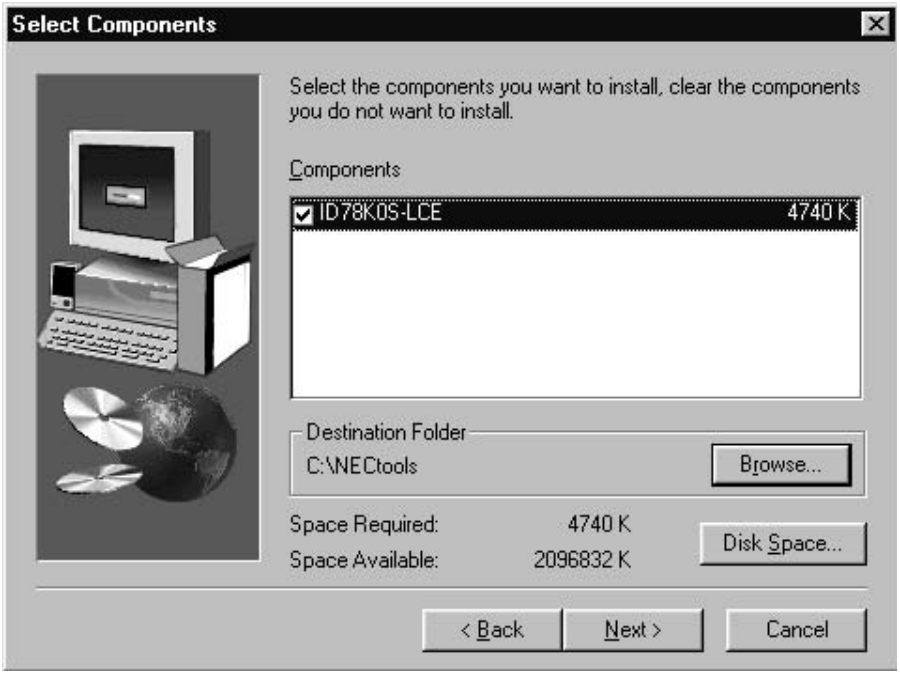
6. Read the **Welcome** dialog box and click **Next** to continue (Figure 3-6).

***Figure 3-6. Welcome Dialog Box***




7. In the **Select Components** dialog box, review the list of components (Figure 3-7). Clear those you do not wish to install and click **Next** to continue. To change the destination folder for installation, click **Browse**.

***Figure 3-7. Select Components Dialog Bo***

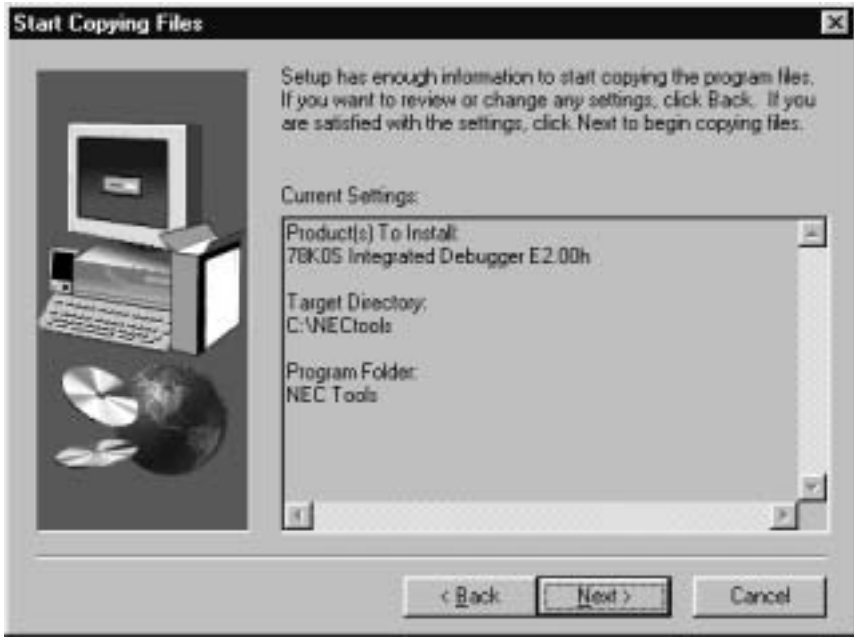


8. In the **Select Program Folder** dialog box, click **Next** to accept the default program folder (Figure 3-8). Otherwise, select another folder name and click **Next** to continue.

***Figure 3-8. Select Program Folder Dialog Box***

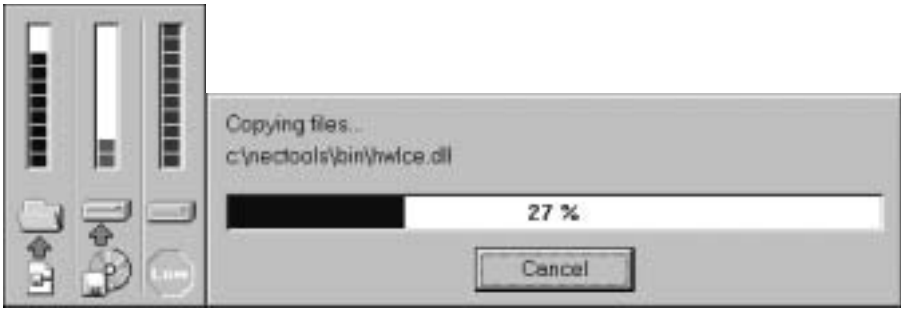

9. In the **Start Copying Files** dialog box, review your settings. If correct, click **Next** to install the program files (Figure 3-9). To change your settings, click **Back** to return to previous screens and repeat any steps necessary.

***Figure 3-9. Start Copying Files Dialog Box***



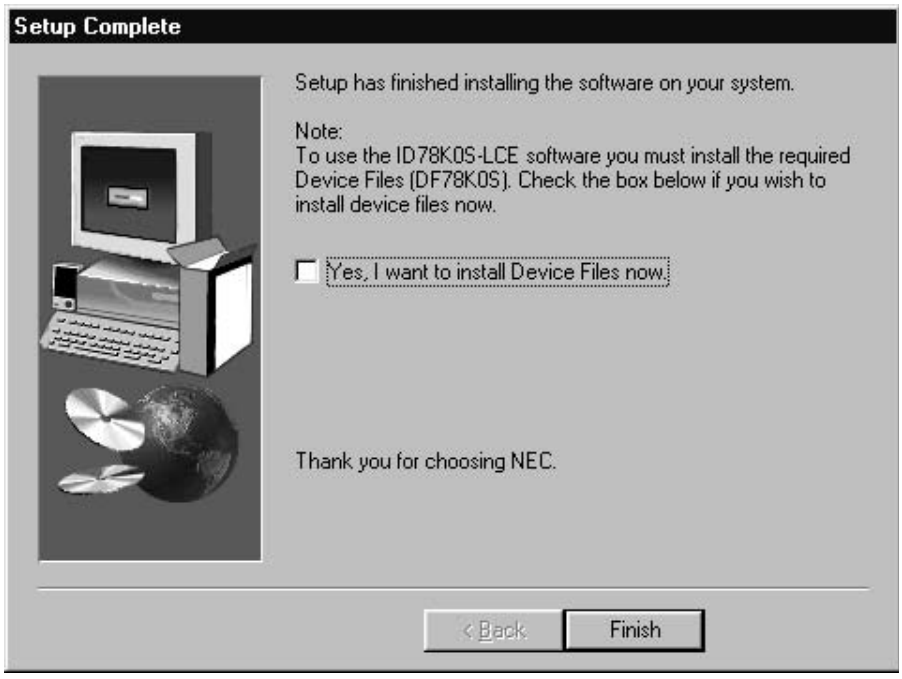
10. Wait for the installation to complete or click **Cancel** to cancel it (Figure 3-10).

***Figure 3-10. Copying Files Message***




11. Once the files are transferred to the host PC, you may choose to install the device files by checking the box in the **Setup Complete** dialog box. Click **Finish** to exit the program (Figure 3-11).

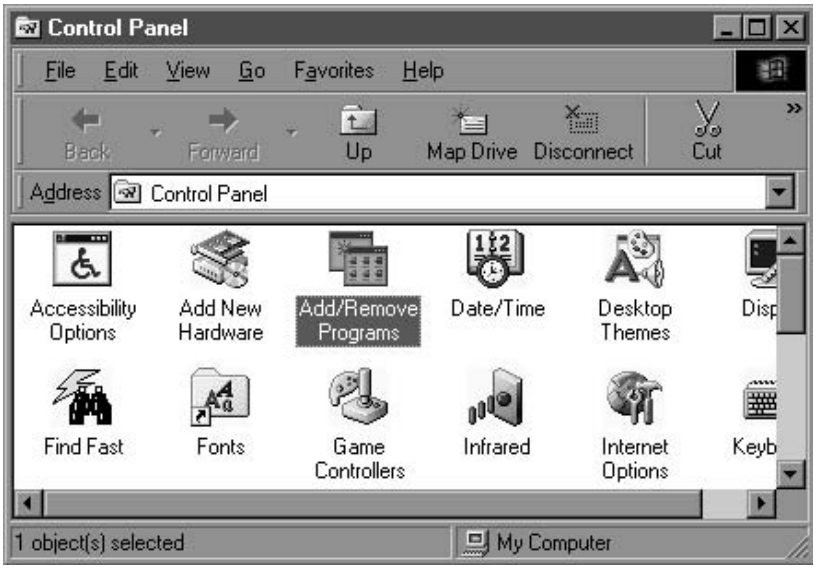
***Figure 3-11. Setup Complete Dialog Box***



***Removing Software***

1. To remove the software, open the **Star** menu from your desktop. Click **Settings** → **Control Panel** → **Add/Remove Programs** (Figure 3-12).

***Figure 3-12. Control Panel Window***




2. In the **Add/Remove Programs Properties** dialog box, select **NEC ID78K0S-LC** and then click **Add/Remove**. Click **OK** to exit the dialog box (Figure 3-13).

***Figure 3-13. Add/Remove Programs Properties***

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# Operation 4

With power applied to the LCE-K0S, follow this procedure to launch the ID78K0S-LCE integrated debugger.

1. From the **Star** menu, click **Programs → NEC Tools → ID78K0S-LCE** to open the **Configuration** dialog box (Figure 4-1).

***Figure 4-1. Configuration Menu***

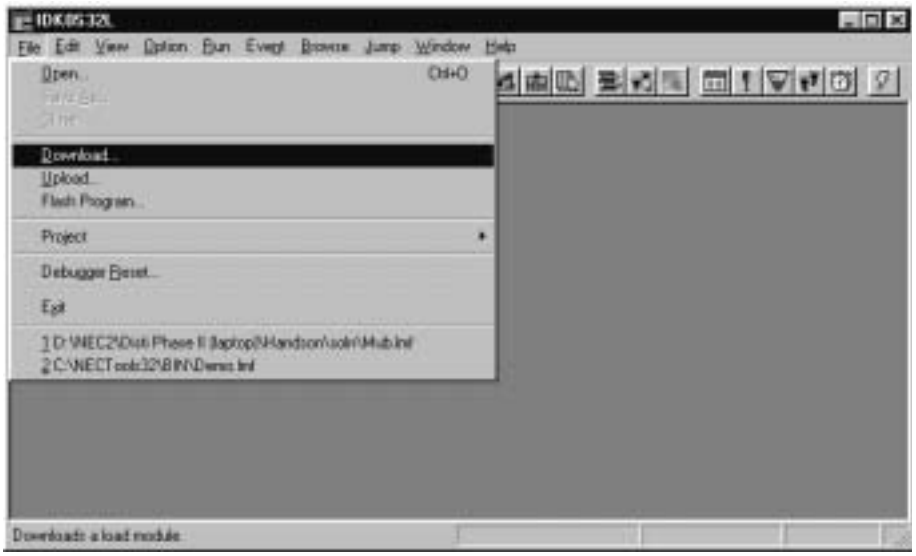
2. In the **Configuration** dialog box, select the device to emulate and then click **OK** to open the **Main** window (Figure 4-2). The selected device must be supported by the daughterboard. Refer to the daughterboard user's manual for a list of devices supported.

***Figure 4-2. Main Window***


## Downloading a Load Module File

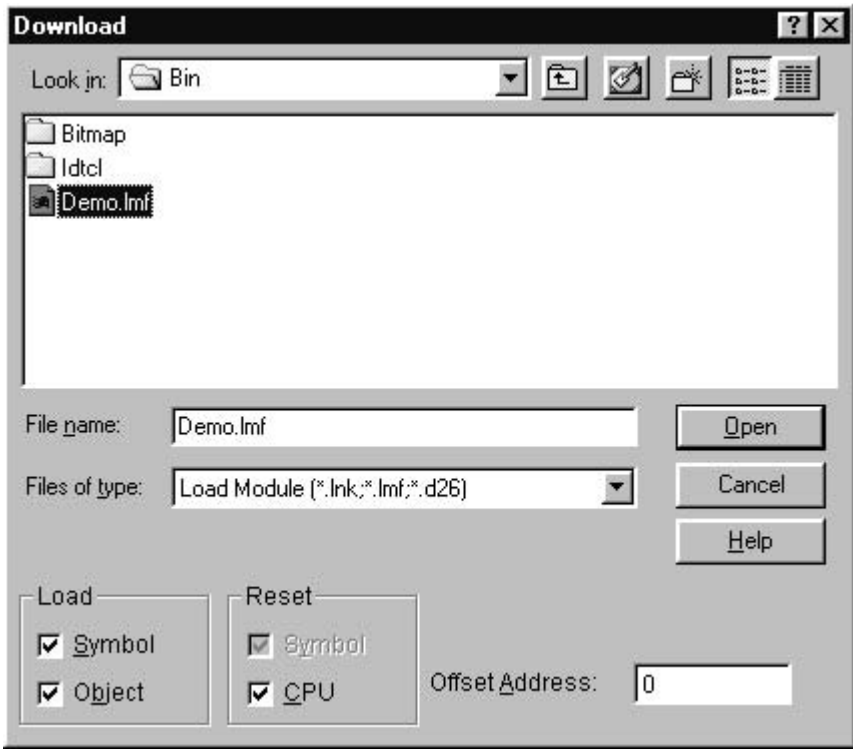
1. To download a load module file (the filecontaining source debugging information that is generated by the linker after it has compiled and assembled the source code) or a hex file to the emulator, click **File** to open the File menu (Figure 4-3). Example code is included during installation for demonstration.

***Figure 4-3. File Menu***



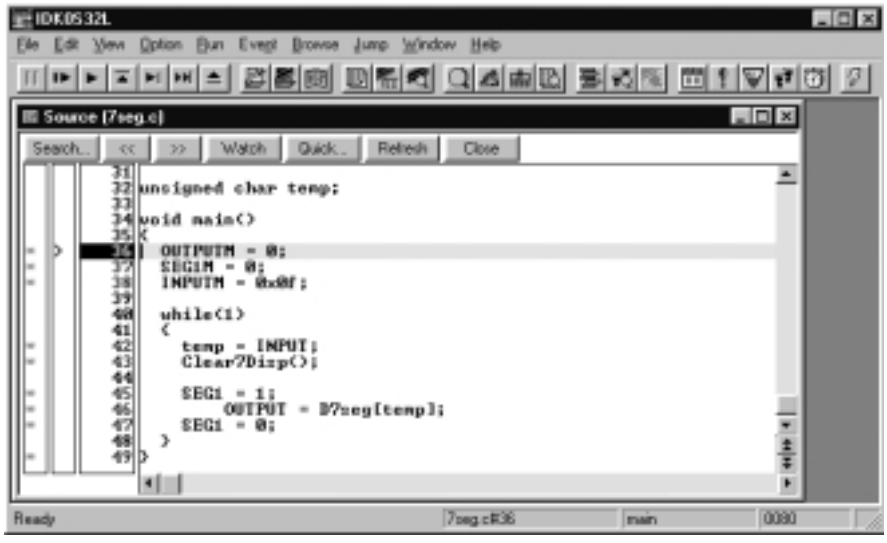
2. Click **Download . . .** to open the **Download** dialog box (Figure 4-4).

***Figure 4-4. Download Dialog Box***




3. Select a load module or hex file and click **Open** to load the file into the Source window (Figure 4-5).

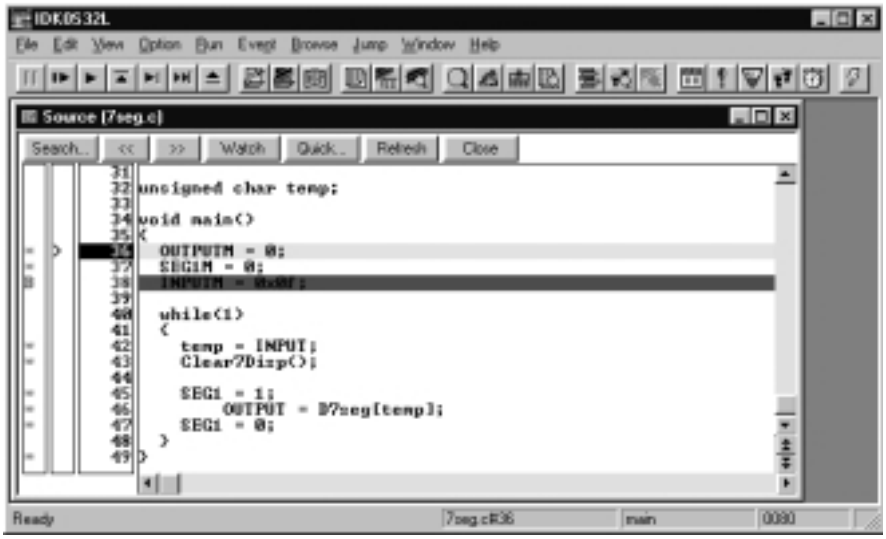
***Figure 4-5. Source Window***



## Setting a Breakpoint

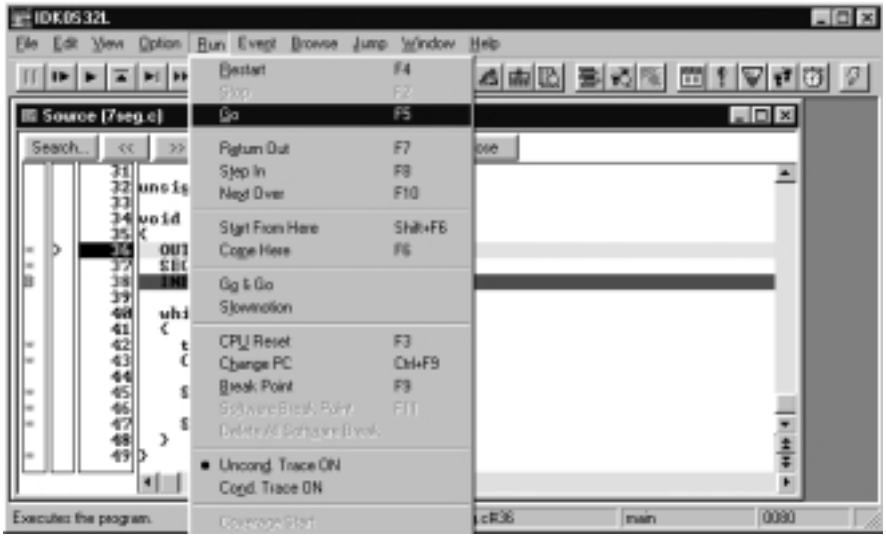
1. From the Source window, you can set a breakpoint by moving your cursor to a line in the source and then clicking the asterisk to the far left (Figure 4-6). This step causes a red B to appear at the breakpoint location; the source line is also highlighted inred. To delete the breakpoint, click the red B. The asterisk indicates a valid location for a breakpoint.

***Figure 4-6. Breakpoint Selection***



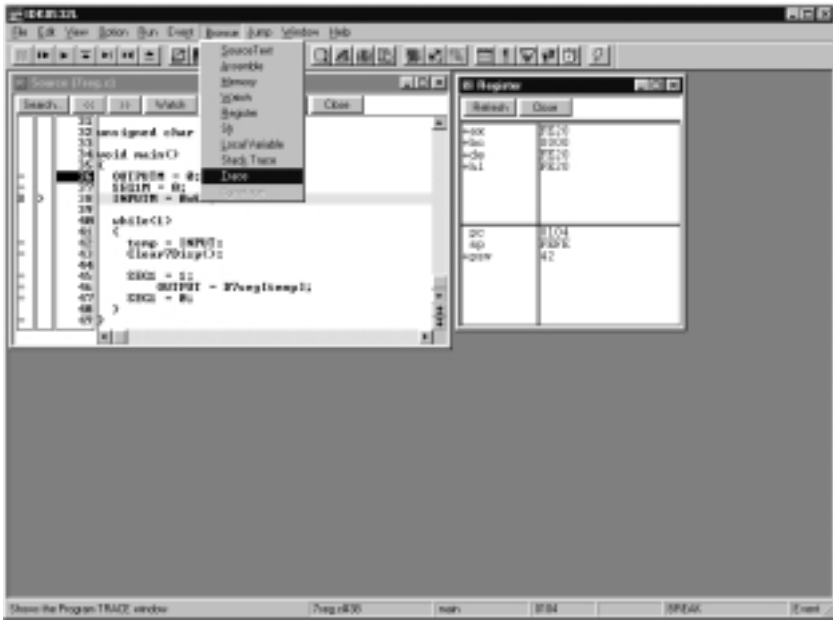

2. To execute the code at full speed in real time, select the **Run** menu and then click **Go** (Figure 4-7). When the program counter (PC) reaches the breakpoint, program execution terminates and the Source window shows the current PC value, shown as ">" in the second column. The source line is also highlighted in yellow.

***Figure 4-7. Run Menu***



3. To view other debugging windows, open the **Browse** menu and click your selection (Figure 4-8).

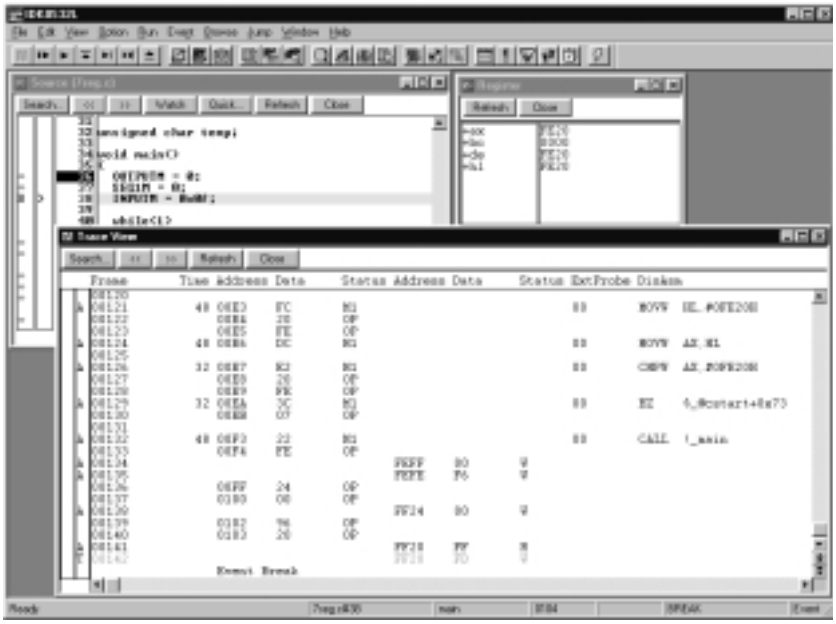
***Figure 4-8. Browse Menu***



## Viewing the Trace Window

To view tracing information in the Trace window, select **Browse** and then click **Trace** (Figure 4-9).

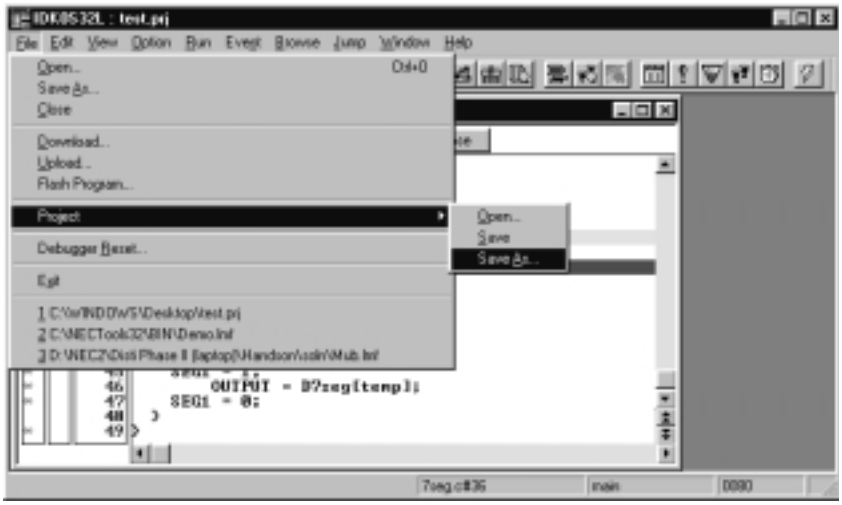
***Figure 4-9. Trace Window***



## Saving a Project

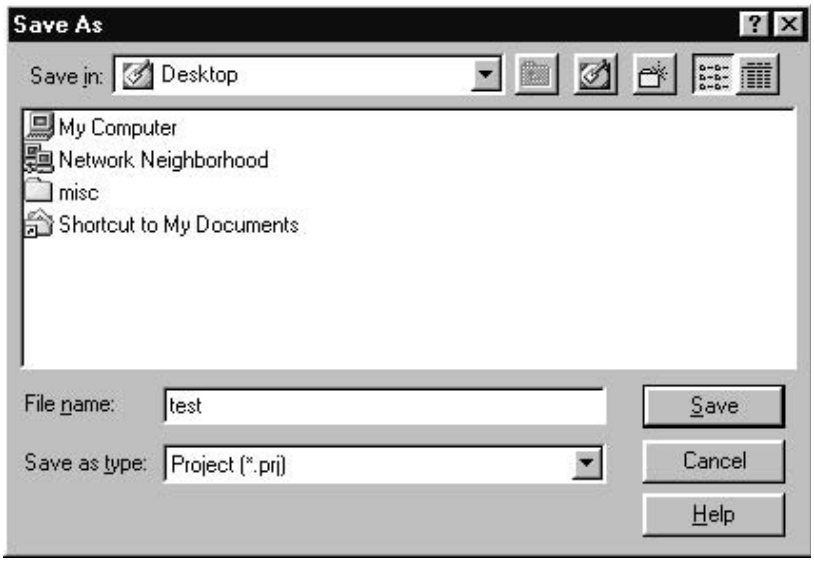
1. To save the debugging windows and breakpoints in a project file, click **File** ➔ **Project** ➔ **Save As...** (Figure 4-10).

***Figure 4-10. Project Submenu***




2. Select a directory, enter a project file name, and then click **Save** to save the file (Figure 4-11).

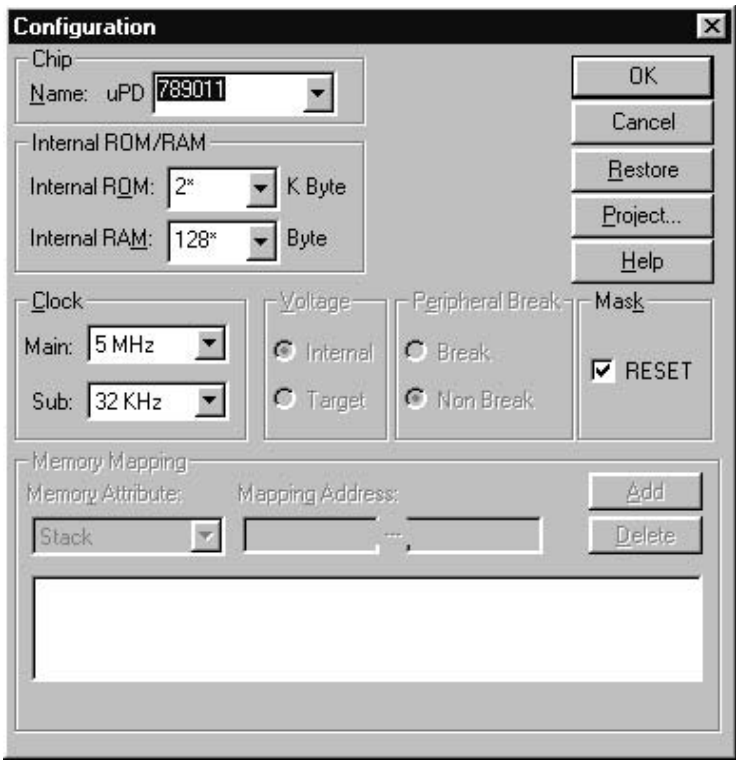
***Figure 4-11. Save As Dialog Box***



## Opening a Project

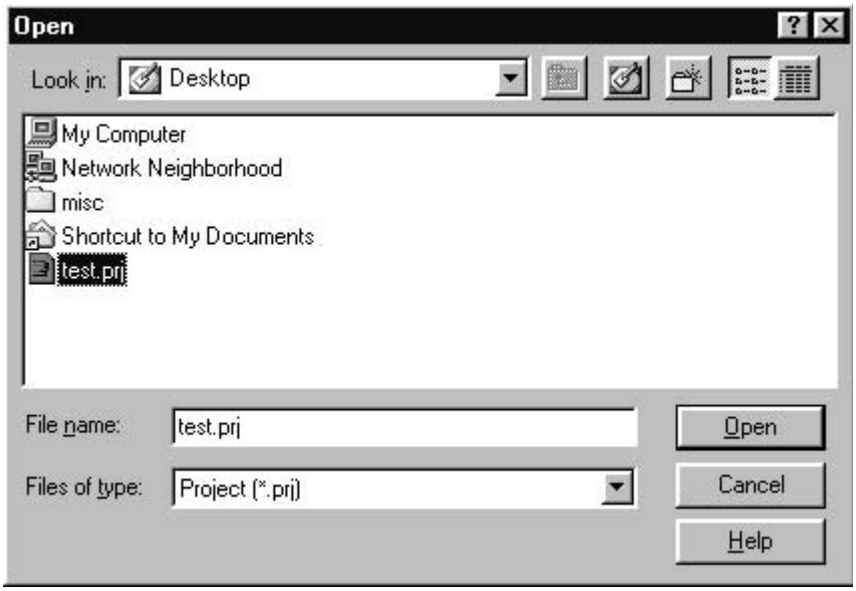
1. To open a previously saved project file, click **Star → Programs → NEC Tools → ID78K0S-LCE**. From the **Configuration** dialog box, click **Project...** (Figure 4-12).

***Figure 4-12. Configuration Dialog Box***




2. From the **Open** dialog box, select the project file name and click **Open** (Figure 4-13).

***Figure 4-13. Open Dialog Box***



3. The debugger loads the project and sets up all the windows and breakpoints exactly as they were last saved (Figure 4-14).

***Figure 4-14. .PRJ File Displayed in Source Window***

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# Flash Programming 5

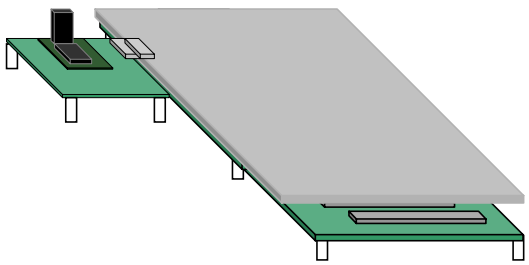
The LCE-K0S is equipped with a flash programmer for K0S microcontrollers with flash memory. The LCE-K0S supports only 3-wire serial I/O for flash programming. Table 5-1shows the pin configuration of the LCE-K0S DB9 connector.

***Table 5-1. Pin Configuration of the LCE-K0S DB9 Connector***

| Pin | Signal Name | Specification |
|---|---|---|
| 1 | GND | Ground |
| 2 | SI | Serial data input |
| 3 | SO | Serial data output |
| 4 | SCK | Serial clock output |
| 5 | CLK | Clock output to target |
| 6 | RESET | RESET signal output to target (active low) |
| 7 | VDD | VDD input/output to target |
| 8 | VPP | VPP output to target |
| 9 | – | |

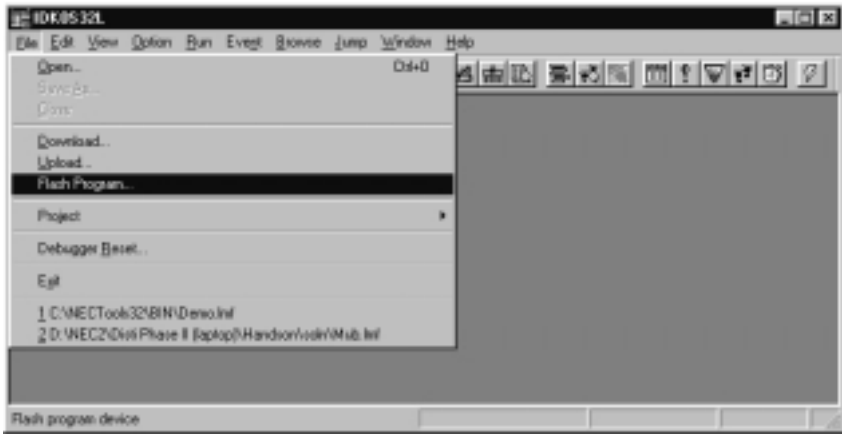
1. With power off to the LCE-K0S, connect a flash programming adapter with a flash device to the DB9 connector of the LCE-K0S (Figure 5-1).

***Figure 5-1. Clamshell Socket and DB9 Connector***



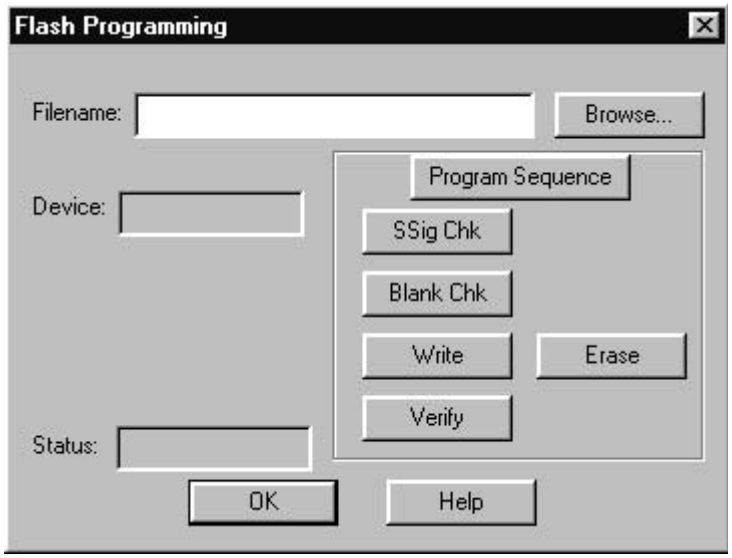
2. Turn on power to the LCE-K0S.
3. Click **Start** → **Programs** → **NEC Tools** → **ID78K0S-LCE**.
4. From the **Configuration** dialog box, select the proper device and click **OK**.
5. From the Main window, open the **File** menu and click **Flash Program...** (Figure 5-2).

*Figure 5-2. Flash Program... Command*



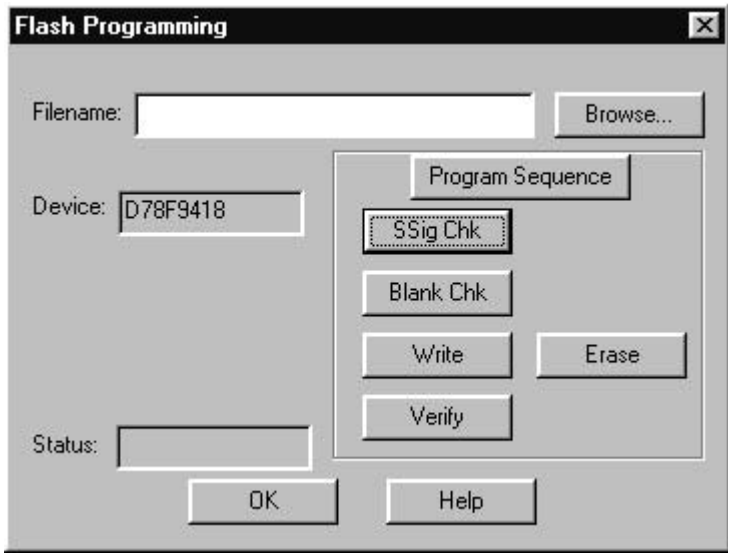

6. From the **Flash Programming** dialog box, click **SSig Chk** to check the silicon signature of the device (Figure 5-3).

*Figure 5-3. Flash Programming Dialog Box*




7. The flash programmer checks for the device and displays the part number in the **Device:** box (Figure 5-4).

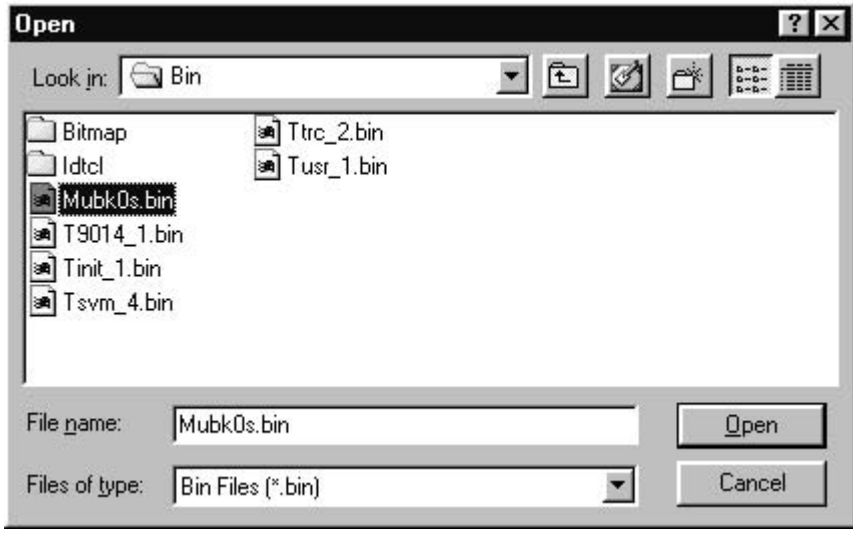
***Figure 5-4. Successful Silicon Signature Check***




8. To perform a blank check on the device, click the **Blank Chk** button. To completely erase the entire device, click **Erase**.

9. To program the device, click **Browse...**, select a .HEX file and then click **Open** to download the file (Figure 5-5).

***Figure 5-5. Open Dialog Bo***




10. Click **Write** to program the device. Keep in mind that programming time will vary depending on the size of the file. **Verify** compares the contents of the flash device with the file. Note that this function may take a few minutes because it verifies the contents of the entire device.

11. To automate the programming sequence described above, click **Program Sequence** to execute the silicon signature check, blank check, erase (if necessary), and write operations in sequential order.

12. To exit the programmer, click **OK**.

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# Troubleshooting 6

This section provides some helpful information for troubleshooting error messages from the LCE-K0S. Table 6-1 explains how to correct the **error** message shown in Figure 6-1.

## Communication Error

***Figure 6-1. Communication Error***

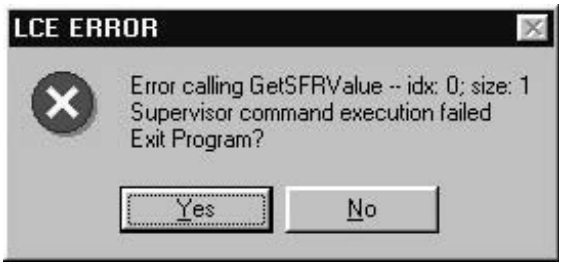

***Table 6-1. Troubleshooting a Communication Error***

| Possible Cause | Solution |
|---|---|
| No power to the LCE | Check that the LCE-K0S has power (green LED should be on). |
| Parallel cable not connected | Connect a 25-pin straight-through cable. |
| Parallel port on the host PC not configured as bidirectional | Enter the host PC's BIOS configuration and modify its parallel port as bidirectional. Refer to the PC user's manual for procedures about modifying the BIOS. |
| No daughterboard connected to the motherboard | Connect a daughterboard and select the appropriate device in the Configuration window. |

## Error When Opening a Project

If you load a previously save project to the LCE-K0S and receive the error message shown in Figure 6-2,then the clock source saved in the project file does not match the clock source of the LCE-K0S

***Figure 6-2. Failed Supervisor Command***



Open the .PRI file, an example of which is shown in Figure 6-3. Change “Clock=User” to “Clock=5 MHz” and “SubClock=User” to “SubClock=32 kHz.” Save the file and load it into the LCE-K0S. To change the clock settings, open the **Options** menu and click **Configuration...**.

***Figure 6-3. Example .PRI FilFlash Programming Error***

```
[Project.ID]
Ver=200
Target=IDK0S32L

[Configuration]
Chip=µPD78F9418
Internal Rom=32KB
Internal Ram=512B
Clock=User   <<<
SubClock=User   <<<
Voltage=Internal
.
.
```

If you invoke the flash programming interface and receive the error message shown in Figure 6-4, refer to Table 6-2 to detemine the possible cause of the problem.

***Figure 6-4. Flash Programming Error***


***Table 6-2. Troubleshooting a Flash Programming Error***

| Possible Cause | Solution |
|---|---|
| No flash device connections | Connect a K0S flash micrcontroller. |
| Incorrect signal connections | Make sure all LCE-K0S connector pins are connected to the proper pins of the flash micrcontroller. On some devices, connect $V_{SS0}$ with $V_{SS1}$ and $V_{DD0}$ with $V_{DD1}$. |
| No $V_{PP}$ signal | Connect the jumper on the JP2 header of the LCE-K0S. |
| Flash device not supporte | Connect only a K0S flash device. |

## Write or Verify Errors

If you receive the message “Couldn’t allocate 312016898 bytes of memory for buffer,” when you perform a Write or Verify operation, perform a Silicon Signature check before performing the Write or Verify operation.

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# Functional Description 7

The LCE-K0S implements a motherboard/daughterboard design (Figure 7-1). Because of the standard peripheral bus in the K0S microcontroller's CPU, one motherboard is used for all LCE-K0S systems. The motherboard contains the K0S CPU Evachip, the flash programmer, and the parallel interface to the PC. The daughterboard is unique for each K0S subseries and contains a K0S real-chip with all the peripherals found in the K0S device being emulated. The motherboard and daughterboard interface using NEC's real-chip peripheral bus.

## Features

- Real-time in-circuit emulation
- Fully equipped flash programmer
- RAM-based control software for easy upgrade of control software versions
- 5- or 3-volt signal emulation
- Breakpoint settings
  - Up to 16 program (ROM) fetch breakpoints
  - Up to 2 data (RAM) breakpoints: break on read, write, and read/write
- Trace capabilities
  - 64 bits per frame by 64K frames
  - Trace window that displays assembly code or mixed C and assembly code
  - Three tracing modes
    - Unconditional
    - Qualified (if an event condition is satisfied)
    - Sectional (starts and ends by event triggering)
- Window synchronizing: frames displayed in the Trace View window are highlighted in the Source Code window
- Time stamping
  - Max. time: 7.15 min.–14.32 min.
  - Resolution: 100 ns or 200 ns
- Parallel interface to PC via DB25 connector
- Windows-based integrated debugger
- Source-level debugging in C language or Assembly language
- Emulation memory
  - Up to 48 KB internal ROM
  - Up to 1 KB internal RAM

The control software for the LCE-K0S is RAM-based to allow the controlling program to be down-line loaded each time the system is started. This feature allows for easy upgrading of new control software versions.

***Figure 7-1. LCE-K0S Block Diagram***

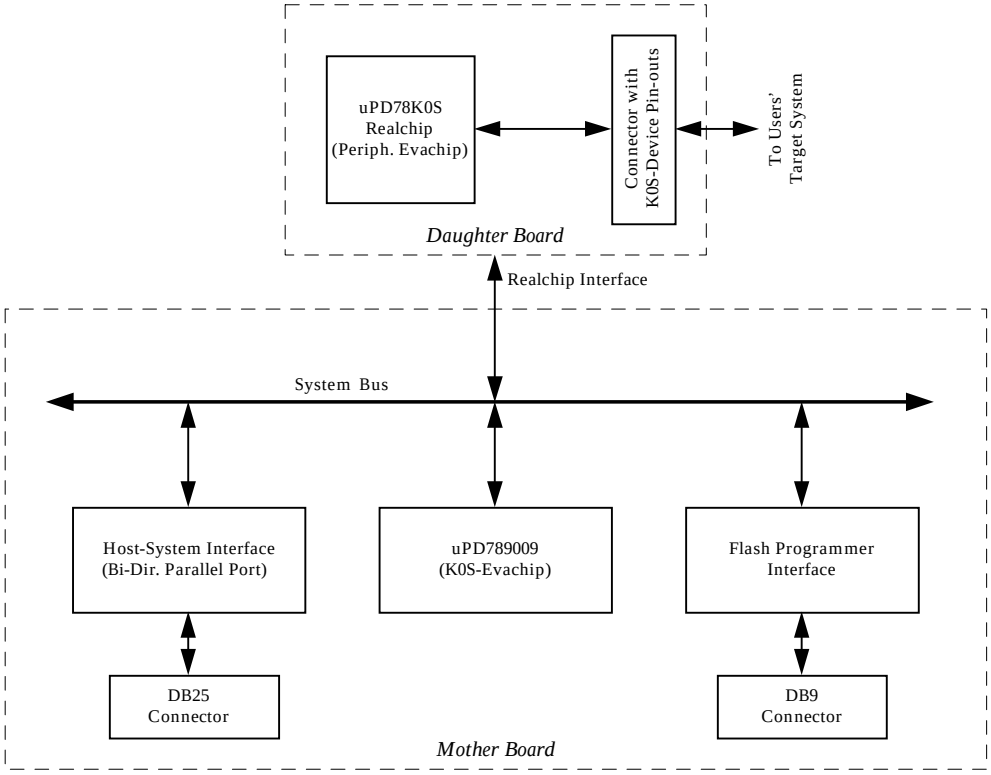

***Table 7-1. Specifications***

| Parameter | Specifications | | |
|---|---|---|---|
| System operating voltage | Main power supply | $V_{CC}$ = 5 V plus/minus 5%, wall-mounted power supply | |
| | Real chip | $V_{DD}$ = 3.3 V, 5% (LCE-K0S internally generated) | |
| | Flash program | $V_{PP}$ = 10 V, 5% (LCE-K0S internally generated) | |
| System operating frequencies | Main clock | 10 MHz; system installed | |
| | Subclock | 32.768 kHz; system Installed | |
| | | CMOS logic needed to buffer the user-supplied clock from target | |
| | | Footprint for user-installed crystal oscillator provided | |
| Host interface | Bidirectional parallel port | | |
| | Connect LCE-K0S to host PC using 25-pin straight-through DB25 cable | | |
| Flash programming interface | Connect program adapter to DB-9 connector on the motherboard | | |
| | Connect target system for on-board programming through DB-9 connector on the motherboard | | |
| Program memory and data memory | Program memory up to 48 KB; provided by K0S Evachip | | |
| | Data memory up to 1 KB; provided by K0S Evachip | | |
| Probe connection to user system | Cable probe | Socket connector to socket connector; 6-inch cable | |
| | Special probe | Socket connector to device socket (available as option) | |
| Break event detection | Program execution status detection | | |
| | Bus event detection | | |
| Trace memory | 64 bits per frame by 64K frames | | |
| | Trace address, data, and execution status | | |
| | Time stamp for measuring execution time: | 7.15 min. @ 100 ns count rate or, | |
| | | 14.32 min. @ 200 ns count rate | |
| Event integration | Linking events | | |
| Platform board dimensions | Motherboard | Approximately 6.5” x 4.5” (16.5 cm x 11.5 cm) | |
| | Daughterboard | Approximately 4.0” x 4.5” (10.4 cm x 11.5 cm) | |
| | Combined | 8.5” (L) x 4.5” (W) x 2.0” (H) (21.6 cm x 11.5 cm x 5.1 cm) | |