NEC

User's Manual

DemoKit-LF3

Demonstration Kit for NEC Electronics 8-bit 78K0/Lx3 Microcontrollers

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- Device availability
- Ordering information
- Product release schedule
- Availability of related technical literature
- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)
- Network requirements

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Revision History

Date	Revision	Chapter	Description
09-16-2007	V1.00	---	First release

Contents

1. Introduction

DemoKit-LF3 is a demonstration system that supports onboard debugging, flash programming, and real-time execution of application programs on NEC Electronics 8-bit 78K0/Lx3 microcontrollers (MCUs) with integrated liquid crystal display (LCD) controllers. The board is designed to be connected to user hardware such as digital I/O or analog signals.

1.1 Features

- Easy-to-use device demonstration capabilities—navigator switch, 224-segment LCD panel, temperature sensor, infrared (IR) receiver module, I/O lines, and UART serial interface—for easy demonstration of simple I/O functions
- On-board debugging using the ID78K0-TK debugger and UART/USB interface without additional debugging hardware; standard commands for executing code, single-stepping, setting breakpoints, and manipulating memory
- Optional QB-MINI2 emulator (available separately) that can be used with the microcontroller's on-chip debugging function
- Flexible power supply via USB interface, QB-MINI2 on-chip debugging emulator, or external supply
- 224-segment LCD panel
- Windows®-based NEC Electronics' WriteEZ3 flash programming software that enables you to select and download application programs for evaluation purposes
- Various I/O signals
  - I/O ports for connection to user hardware
  - Timer I/O signals
  - Two- or three-wire serial I/O
  - UART interface via a FT232 USB UART chip
  - Eight-channel 10-bit A/D converter
  - Three channel 16-bit sigma-delta A/D converter
  - RPM7138 IR receiver module
  - S-8120C temperature sensor
  - Navigation switch for key interrupt generation
- NEC Electronics C compiler, assembler (32 KB size limitation), and ID78K0-TK debugger
- Full documentation for the MCU and software tools, including downloadable updates of the software tools, documentation and utilities, if available, from **http://www.am.necel.com/micro/development**

The DemoKit-LF3 is not intended to be used for code development. NEC Electronics America does not allow and does not support any attempt to use the kit in a commercial or technical product.

1.2 System requirements

- Host computer
  - Windows® 2000 or Windows XP® operating system
  - 200 MHz (minimum) Pentium®-class processor
  - 128 MB RAM
  - 1024 × 768 display with 256 colors
  - Mouse
  - CD-ROM drive
  - 200 MB free hard disk space
- Host interface: USB interface that enables communication based on USB version 1.1 or later

1.3 Contents

Before setting up the system, verify that all parts listed on the contents page are intact and accounted for. If not, contact your NEC Electronics America representative to report the problem.

1.4 System configuration

Figure 1 illustrates the configuration of the DemoKit-LF3 system.

Figure 1. DemoKit-LF3 system configuration

1.5 Demonstration board

The DemoKit-LF3 board connects to the host computer via a USB interface cable. The host may be used for on-chip debugging using the ID78K0-TK debugger or for execution of application programs on the DemoKit-LF3 starter kit. The 78K0/LF3 MCU operates at 8 MHz and has a 32.768 kHz subclock.

1.6 Host computer

The USB interface allows communication between the host computer and the DemoKit-LF3 board.

- The FT232 USB UART chip allows application software to access the USB device in the same way it would access a standard RS-232 interface.
- The FTDI driver for the virtual COM port (VCP) appears to the Windows operating system as an extra COM port.

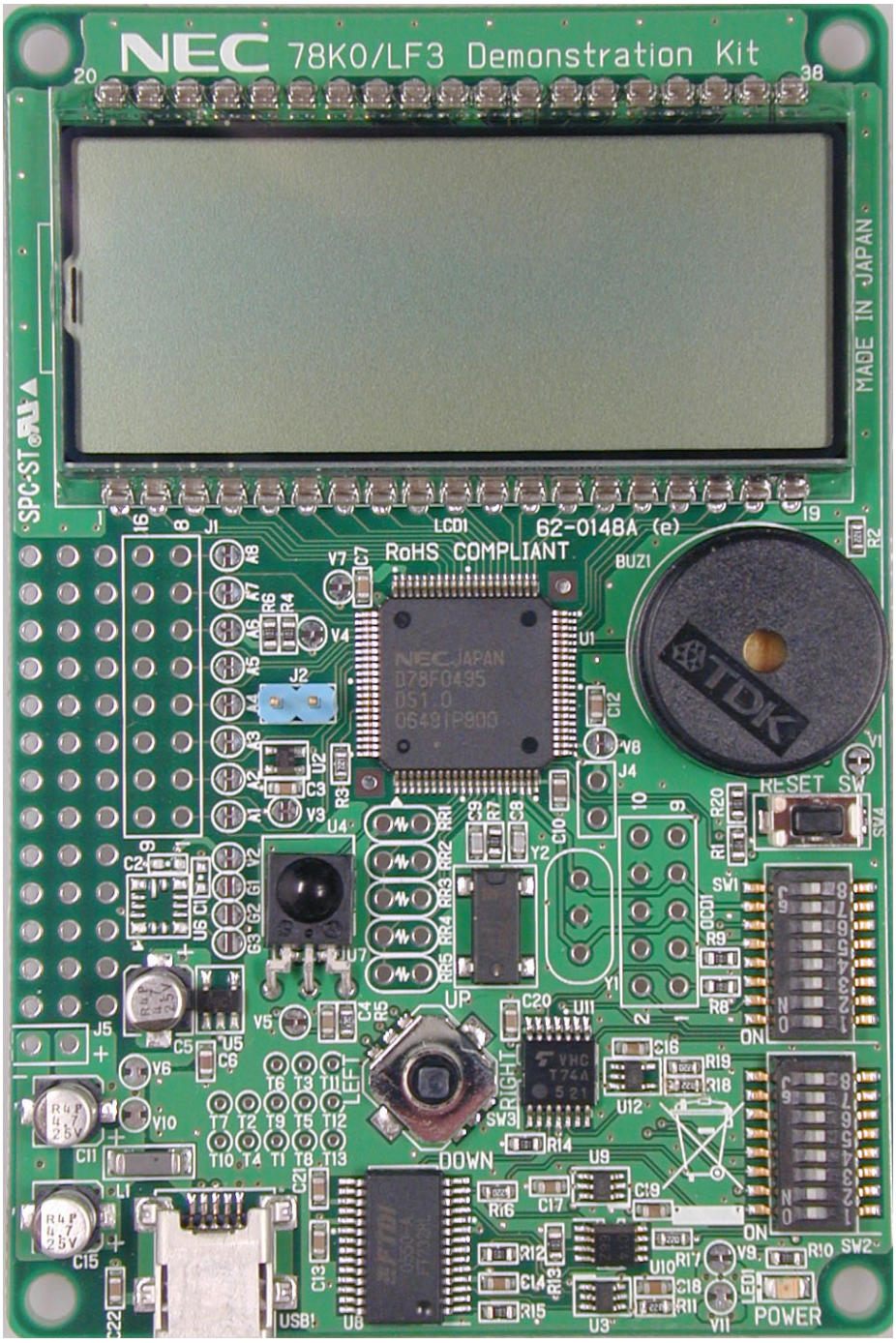
1.7 Flexible power supply

The DemoKit-LF3 can receive power from the USB interface, the QB-MINI2 on-chip debugger, or an external power supply.

2. DemoKit-LF3 components

The DemoKit-LF3 is equipped with a navigation switch, 224-segment LCD panel, temperature sensor, and several connectors that can be used for connection to host computers, flash programmers, or external target hardware.

Figure 2. Board connectors and switches (top view)



Some of the DemoKit-LF3 components are free for user application hardware and software. Refer to the 78K0/LF3 device user's manual to obtain information about electrical specifications for the available I/O ports before connecting any external signals to the DemoKit-LF3 board.

2.1 SW1 and SW2 configuration switches

The settings of SW1 and SW2 specify the DemoKit's operating modes.

Table 1. Settings for SW1 and SW2 configuration switches

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
On-board debugger	ON	ON			Don't care				ON	ON	ON	ON	ON	ON		
			OFF	OFF											OFF	OFF
WriteEZ3			ON	ON	Don't care				ON	ON					ON	ON
	OFF	OFF									OFF	OFF	OFF	OFF		
QB-MINI2	ON	ON			Don't care											
			OFF	OFF					OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

2.1.1 IDK78K0-TK on-board debugging mode

In this mode, you can perform on-board debugging via the default USB/UART connection to the host computer, without the use of additional debugging hardware. Standard commands for flash programming, downloading programs, executing code, single-stepping through programs, setting breakpoints, and manipulating memory are available.

2.1.2 WriteEZ3 flash programming mode

In WriteEZ3 mode, you can reprogram the microcontroller's internal flash memory using NEC Electronics' WriteEZ3 flash programming software and the default USB/UART connection to the host computer.

2.1.3 QB-MINI2 on-chip debugging / normal execution

In QB-MINI2 mode, you can connect the QB-MINI2 on-chip debugging emulator (available separately) to the DemoKit-LF3 board and use the microcontroller's on-chip debugging function.

When the on-chip debugging emulator is not connected to the board, the microcontroller begins normal execution and executes the user program stored in flash memory.

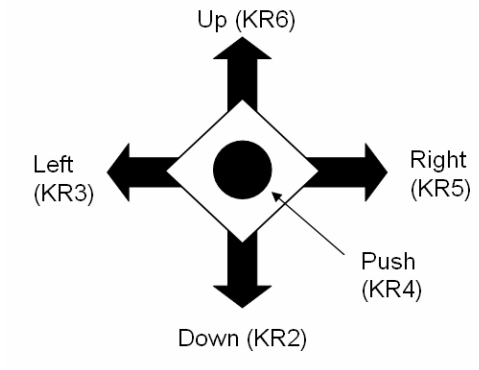
2.2 SW4 reset button

The SW3 reset button activates the power-on reset and controls the microcontroller's reset input signal.

2.3 SW3 navigation switch

The SW1 navigation switch connects to the microcontroller's key interrupt input. The switch operates in five directions and has a push function in the center.

Figure 3. SW3 navigation switch



SW3	Connection to 78K0/LF3 MCU
Left	P43/KR3
Down	P42/KR2
Select	P44/KR4
Right	P45/KR5
Up	P46/KR6

2.4 J1: external A/D measurement inputs

You can configure connector J1 to measure external analog signals using the internal 10-bit A/D converter or the MCU's 16-bit sigma-delta A/D converter by opening the corresponding A1–A8 soldering bridges.

Table 2. Connector J1 inputs

J1	Signal	J1	Signal
1	P20/ANI0/DS0-	9	GND
2	P21/ANI1/DS0+	10	GND
3	P22/ANI2/DS1-	11	GND
4	P23/ANI3/DS1+	12	GND
5	P24/ANI4/DS2-	13	GND
6	P25/ANI5/DS2+	14	GND
7	P26/ANI6/REF-	15	GND
8	P27/ANI7/REF+	16	GND

2.5 J2: external A/D measurement inputs

Connector J2 can be used to measure an external analog signal using the internal 10-bit A/D converter or the microcontroller's 16-bit sigma-delta A/D converter.

Table 3. Connector J2 inputs

J2	Input
1	P23/ANI3/DS1+
2	GND

2.6 J4: IDD measurement

Connector J4 (not assembled) can be used to measure the microcontroller's current consumption. To use this mode, open the V8 soldering bridge.

2.7 J5: external power supply input

Connector J5 (not assembled) enables you to apply an external power supply to the DemoKit-LF3 board without an active USB connection.

Table 4. Connector J3 inputs

J5	Input
1	VDD (+5V)
2	GND

Note: Be sure to unplug the USB connection before applying external power supply to input J5.

2.8 Y1: external main oscillator

The microcontroller's clock generator can be configured to work with an external oscillator connected to the X1 and X2 pins. For this mode, you must equip the board's Y1 pad with a corresponding oscillator. Refer to the microcontroller user's manual for a description of how to configure the clock generator.

2.9 OCD1: QB-MINI2 connector

Connector OCD1 (not assembled) enables you to connect the QB-MINI2 on-chip debugging emulator (available separately) to the DemoKit-LF3 board to use the microcontroller's on-chip debugging function.

Table 5. Connector OCD1 signals

OCD1	Signal
1	RESET_IN
2	RESET_OUT
3	FLMDO
4	VDD_IN
5	X2
6	GND
7	X1
8	GND
9	Not connected
10	VDD

When using QB-MINI2 for debugging purposes, configure SW2 of the DemoKit-LF3 board as follows.

Table 6. Configuration of SW1 and SW2 when using the QB-MINI2

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
QB-MINI2	ON	ON			Don't care											
			OFF	OFF					OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

For more information about how to configure the DemoKit-LF3 for on-chip debugging, refer to Section 3, "On-Chip Debugging."

2.10 USB1 interface connector

This interface enables you to connect the ID78K0-TK debugger to the DemoKit-LF3 for on-board debugging using commands for programming memory, executing code, single-stepping, setting breakpoints, and manipulating memory. The WriteEZ3 flash programming software also uses the USB communication channel to program application software into the CPU's internal flash memory.

The power supply of the DemoKit-LF3 board is also provided by the USB1 connector.

Figure 4. Pin configuration of USB1 connector and USB mini-B-type host

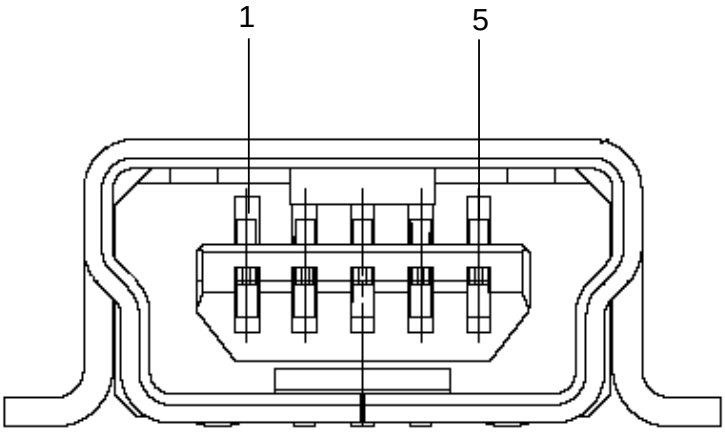


Table 7. Pin configuration of USB1 connector

Connector USB1	Signal Name
1	V_{BUS}
2	D-
3	D+
4	No connection
5	GND

For connection with the host, use the USB cable (mini-B type) bundled with the DemoKit-LF3.

2.11 LCD1: 224-segment LCD panel

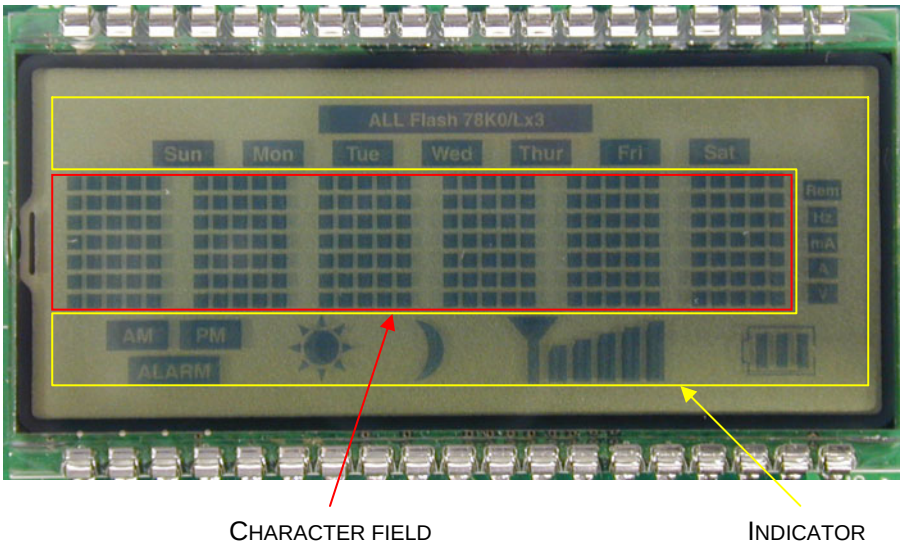
The DemoKit-LF3 board is equipped with a 224-segment, transflective-type LCD panel that operates at a supply voltage of 5V and a multiplex rate of ×8. The LCD driver specifications are defined in Table 8.

Table 8. LCD driver specifications

Specification	Mode
Driver voltage generation	Internal resistance division
Bias method	1/4
Timesharing	8
Common signals	8 (COM0–COM7)
Segment number	28 (SEG4–SEG31)
Number of maximum display pixels	224 (28 segments × 8 common)

The LCD is divided into character and indicator fields. The character field is composed of six 5 × 7 dot-matrix characters. The indicator field includes a set of predefined symbols, for instance weekday, battery, and antenna symbols. An outline of the LCD in Figure 5 and corresponding segment assignments are shown in Figure 6.

Figure 5. LCD outline



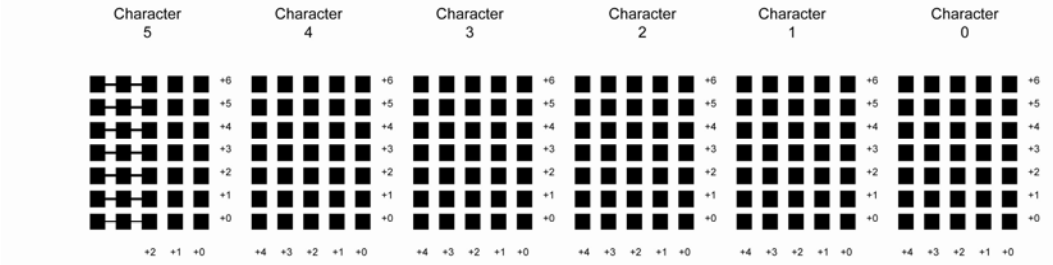
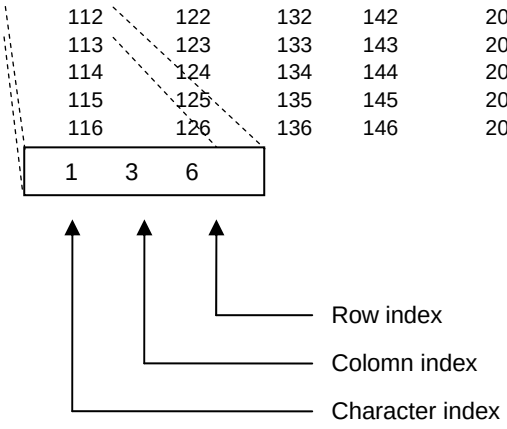


Table 9. LCD segment assignments

Bit position	LCD RAM address +27	+26	+25	+24	+23	+22	+21	+20
bit7	ALARM	AM	PM	Sun	MOON (symbol)	SUN (symbol)	Mon	All FLASH 78K0/Lx3
bit6	520	510	500	440	430	420	410	400
bit5	521	511	501	441	431	421	411	401
bit4	522	512	502	442	432	422	412	402
bit3	523	513	503	443	433	423	413	403
bit2	524	514	504	444	434	424	414	404
bit1	525	515	505	445	435	425	415	405
bit0	526	516	506	446	436	426	416	406

Bit position	LCD RAM address +19	+18	+17	+16	+15	+14	+13	+12	+11	+10
bit7	Tue	Wed	Thur	Fri	Sat	V	A	mA	Hz	Rem
bit6	340	330	320	310	300	000	010	020	030	040
bit5	341	331	321	311	301	001	011	021	031	041
bit4	342	332	322	312	302	002	012	022	032	042
bit3	343	333	323	313	303	003	013	023	033	043
bit2	344	334	324	314	304	004	014	024	034	044
bit1	345	335	325	315	305	005	015	025	035	045
bit0	346	336	326	316	306	006	016	026	036	046

Bit position	LCD RAM address +9	+8	+7	+6	+5	+4	+3	+2	+1	+0
bit7	Bt3 (Battery)	Bt2	Bt1	BtM	An5 (Antenna)	An4	An3	An2	An1	AnM
bit6	100	110	120	130	140	200	210	220	230	240
bit5	101	111	121	131	141	201	211	221	231	241
bit4	102	112	122	132	142	202	212	222	232	242
bit3	103	113	123	133	143	203	213	223	233	243
bit2	104	114	124	134	144	204	214	224	234	244
bit1	105	115	125	135	145	205	215	225	235	245
bit0	106	116	126	136	146	206	216	226	236	246



2.12 RR1–RR5: external LCD resistors

The DemoKit-LF3 board can also be configured to use external voltage divider resistors for the generation of the LCD drive power supplies. For information about the external resistance division method, refer to the microcontroller user's manual.

2.13 U2: temperature sensor

For temperature measurement and primarily as an application example, the DemoKit-LF3 board is equipped within an S-8120C temperature sensor IC. The output pin of the temperature sensor is connected to the microcontroller's P21/ANI1/DS0+ pin.

2.14 U4: IR receiver module

For remote control applications, the DemoKit-LF3 board is equipped with an RPM7138 IR receiver module whose output terminal is connected to the microcontroller's P41/KR1/RIN remote control input pin.

2.15 BUZ1: buzzer

To generate acoustic signals and sound waves, a buzzer is connected to the timer output port of the 16-bit timer/event counter 00, equivalent to port P34/TI52/TI010/TO00/RTC1HZ/INTP1 of the microcontroller. The AC buzzer operates in a voltage range of 2–5V.

2.16 LED1: power LED

LED1 is the power LED that indicates when the DemoKit-LF3 board has power.

2.17 Connectors T1–T13 and wire-wrap field

Pin assignments for the T1–T13 connectors are shown in Table 10. Additionally, the DemoKit-LF3 board provides a wire-wrap field area that allows integration of additional application hardware.

Figure 6. Connectors T1–T13 and wire-wrap field

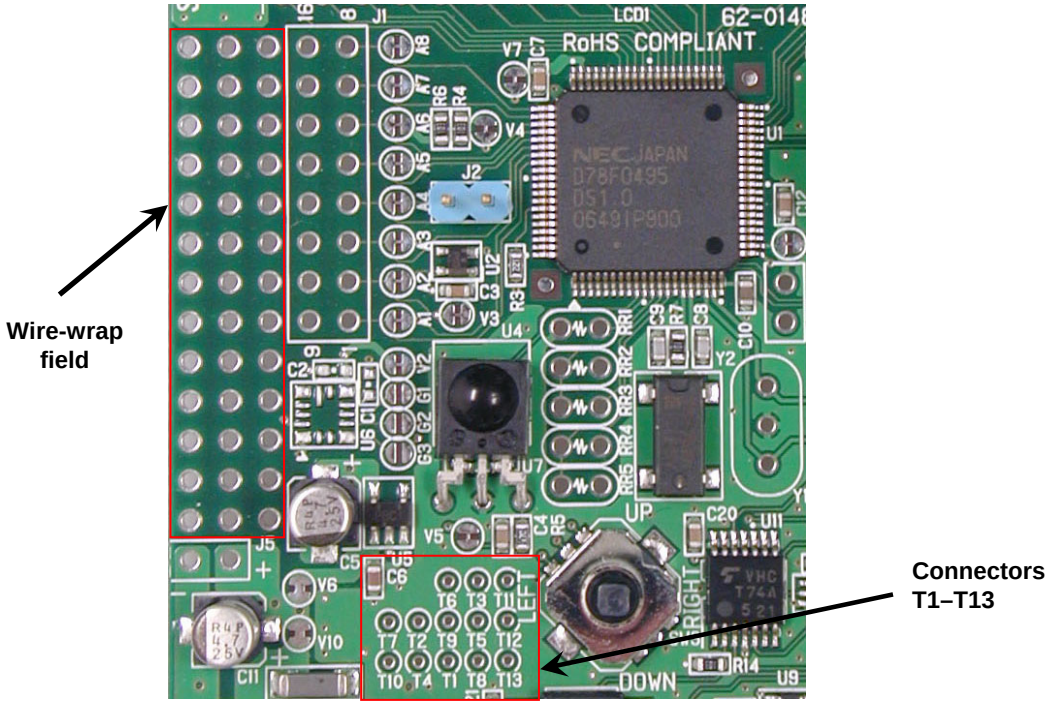


Table 10. Connectors T1–T13

Connector	Microcontroller I/O pins
T1	P14 / SCKA0 / INTP4
T2	P32 / TOH0 / MCG0

Connector	Microcontroller I/O pins
T3	P13 / SO10 / TxD0
T4	P33 / TIO00 / RTCDIV / RTCCL / BUZ / INTP2
T5	P12 / SI10 / RxD0
T6	P16 / SOA0 / TxD6
T7	P30 / INTP5
T8	P11 / SCK10
T9	P15 / SIA0 / RxD6
T10	P31 / TOH1 / INTP3
T11	P10 / PCL
T12	P120 / INTP0 / EXLVI
T13	P47 / KR7

2.18 Soldering bridges

Additional configuration of the DemoKit-LF3 board can be done using the A1–A8 and V1–V11 soldering bridges as described in the tables below. The A1–A8 and V7 soldering bridges can be used to reconfigure the A/D converter input channels and the reference input voltage.

Table 11. Settings of A1—A8 and V7 soldering bridges

Soldering bridge	Configuration	78K0/LF3 pin	
A1	Closed (default)	ANI0/DS0-	Connected to VSS
	Open		Disconnected from VSS
A2	Closed (default)	ANI1/DS0+	Connected to temperature sensor U2
	Open		Disconnected from temperature sensor U2
A3	Closed (default)	ANI2/DS1-	Connected to VSS
	Open		Disconnected from VSS
A4	Closed (default)	ANI3/DS1+	Pin connected to jumper J2
	Open		Disconnected from jumper J2
A5	Closed (default)	ANI4/DS2-	Connected to VSS
	Open		Disconnected from VSS
A6	Closed (default)	ANI5/DS2+	Connected to VDD27
	Open		Disconnected from VDD27
A7	Closed (default)	ANI6/REF-	Connected to VSS
	Open		Disconnected from VSS
A8	Closed (default)	ANI7/REF+	Connected to VDD
	Open		Disconnected from VDD
V7	Closed (default)	AVREF	Connected to VDD
	Open		Disconnected from VDD

The V1–V6 and V8–V11soldering bridges can be used to reconfigure the power supply of the board's dedicated circuits. For more information, refer to Section 13, "Schematics."

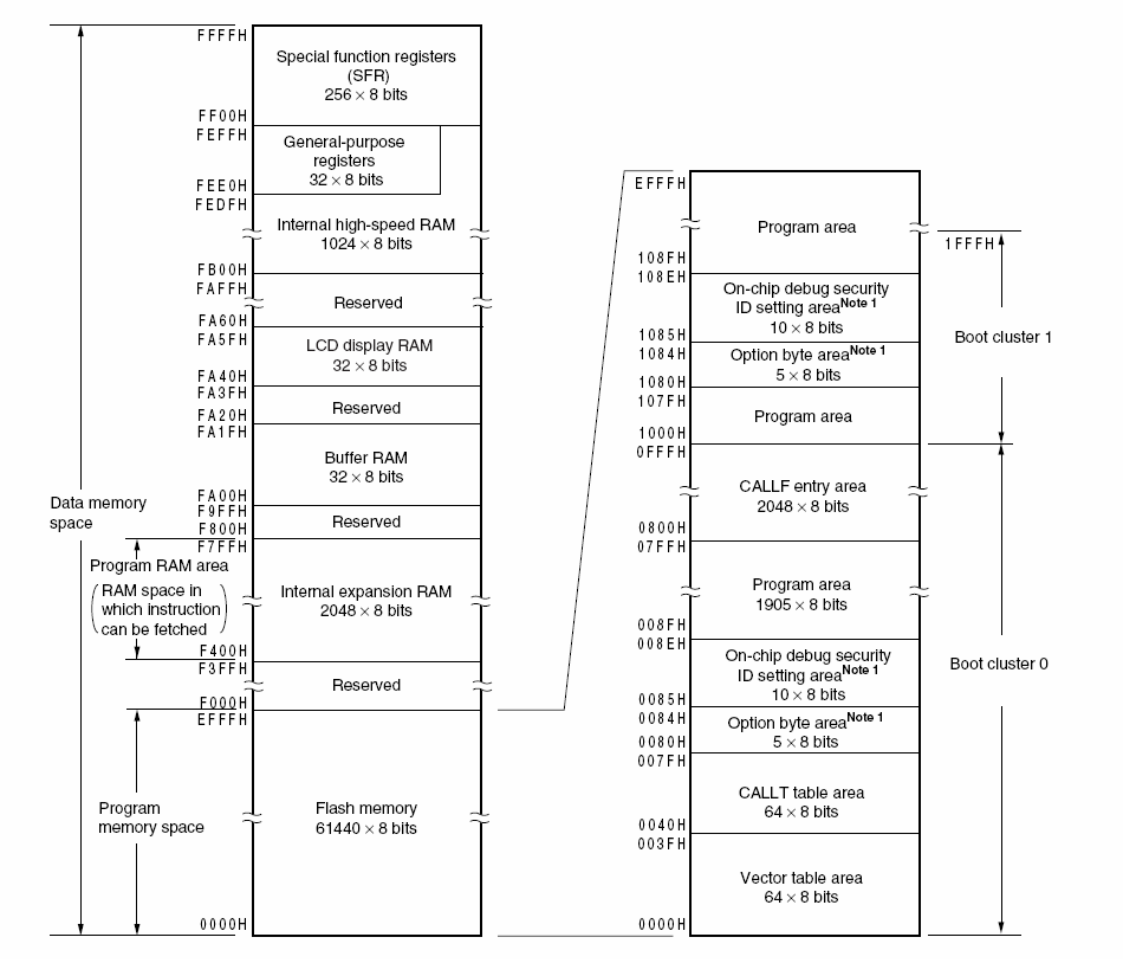
Table 12. Setting of V1–V6 and V8–V11 soldering bridges

Soldering bridge	Configuration	Circuit	
V1	Closed (default)	BUZ1	Connected to VDD
	Open		Disconnected from VDD
V2	Closed (default)	U6 (not assembled)	Connected to VDD
	Open		Disconnected from VDD
V3	Closed (default)	U2	Connected to VDD27
	Open		Disconnected from VDD27
V6	Closed (default)	U5	Connected to VDD
	Open		Disconnected from VDD
V8	Closed (default)	U1	Connected to VDD
	Open		Disconnected from VDD
V9	Closed (default)	LED1	Connected to VDD
	Open		Disconnected from VDD
V10	Closed (default)	VDD connected to USBVDD	
	Open	VDD disconnected from USBVDD	
V11	Closed (default)	VDD2 connected to VDD	
	Open	VDD2 disconnected from VDD	

2.19 Microcontroller memory map

The memory map of the 78K0/LF3 microcontroller is shown in Figure 7.

Figure 7. 78K0/LF3 memory map



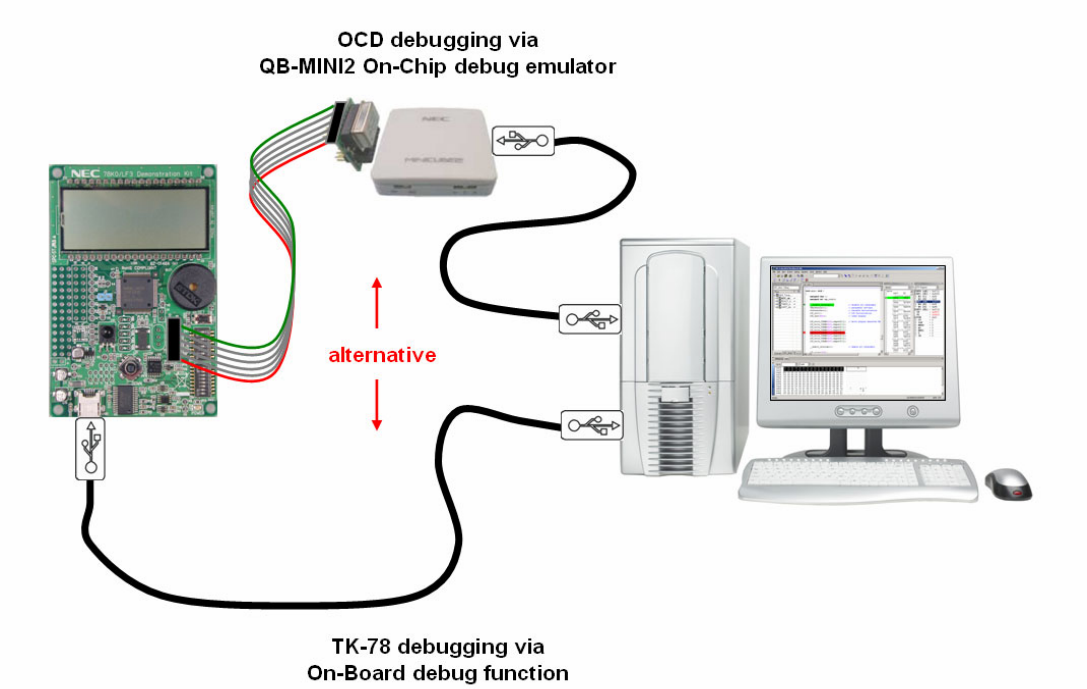
The DemoKit-LF3 board does not reserve any resources of the microcontroller; therefore, available device memory is free for application software.

3. On-chip debugging

The DemoKit-LF3 offers two options for on-chip debugging (OCD):

- Using the on-board ID78K0-TK debugger without external hardware, whereby the default USB connection to the host computer based on the virtual UART driver is used as a debugging interface and all standard commands for flash programming, downloading, executing code, single-stepping, setting breakpoints, and manipulating memory are available
- Using the QB-MINI2 emulator with the microcontroller's on-chip debugging function

Figure 8. Configuration for on-chip debugging using the on-board debugging emulator



3.1 On-chip debugging via the on-board ID78K0-TK debugging function

To use the on-board debugging mode, configure switches SW1 and SW2 as described in Table 13.

Table 13. Configuration for ID78K0-TK debugging

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
On-board debugging	ON	ON							ON	ON	ON	ON	ON	ON		
			OFF	OFF	Don't care										OFF	OFF

3.2 On-chip debugging via QB-MINI2 emulator

To operate the DemoKit-LF3 board together with the QB-MINI2 on-chip debugging emulator, configure switches SW1 and SW2 as described in Table 14.

Table 14. Configuration for QB-MINI2 debugging

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
QB-MINI2	ON	ON														
			OFF	OFF	Don't care				OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Note: When supplying power from the QB-MINI2, do not connect external hardware to the DemoKit-LF3 board. In this mode, the board can operate without external power from the USB.

4. Installation and operation

The bundled software tools, including the ID78K0-TK debugger, allow downloading and debugging af application software on the DemoKit-LF3 starter kit hardware. Additionally, you can use the WriteEZ3 flash programming program to perform simple flash programming of the microcontroller's internal flash memory. A USB interface line is needed for communication between the host computer and the DemoKit-LF3 board. Before downloading, debugging, or executing an application program, make sure the hardware and software are installed properly.

Table 15. Directory structure of CD-ROM

DemoKit_vx.x (F:)	CD-ROM ROOT
Documents	- Documentation
fscommand	
K0	
WriteEZ3	- WriteEZ3 GUI
driver	- USB driver
PRM	- PRM parameter files
NECTools	- C compiler, assembler, and debugger
SampleProgram	
DemoKitLF3	- Sample programs for the DemoKit-LF3 starter kit
dotnet	- DotNet setup file for Applilet

5. Hardware installation

After unpacking the kit, first connect the board to your host computer using the provided USB interface cable and then install the USB driver as explained in Section 6, "Software Initialization."

6. Software installation

The DemoKit-LF3 package includes the following software demonstration packages:

- NEC Electronics C compiler, assembler, linker, librarian, and debugger
- WriteEZ3 flash programming software
- Sample program

6.1 NEC Electronics software tools installation

To install the tools, select the SETUP program in the *\fscommand\K0\NECtools* directory and follow the dialog boxes to complete the installation process. If prompted for a product ID, use "00101386V."

6.2 Sample program installation

To install the sample program, select the SETUP program in the *\fscommand\SampleProgram* directory and follow the dialog boxes to complete the installation process.

6.3 WriteEZ3 program installation

To install the WRITEEZ3 flash programming software, select the setup program in the *\fscommand\K0\WRITEEZ3* directory and follow the instructions in the **Setup** dialog boxes.

6.4 USB driver installation

To use the DemoKit-LF3 board for on-chip debugging, install the USB driver on the host computer in accordance with one of the following procedures:

Installation on Windows 98SE/Me operating system	Section 6.4.1
Installation on Windows 2000 operating system	Section 6.4.2
Installation on Windows XP operating system	Section 6.4.3

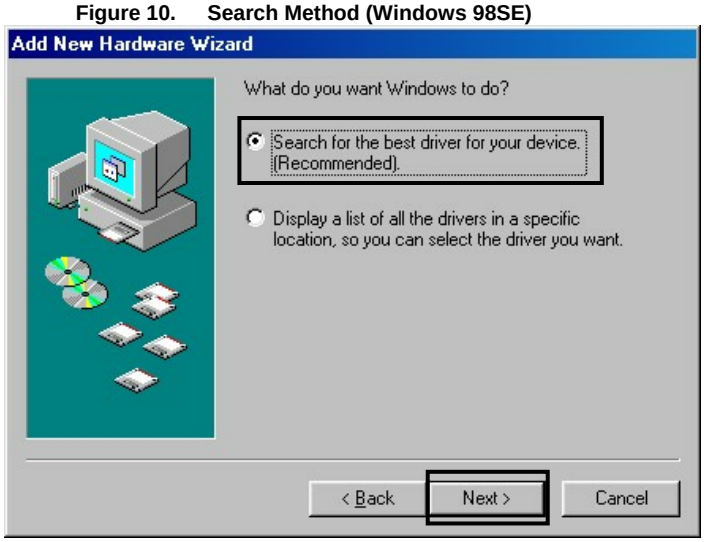
6.4.1 Installation on Windows 98SE/Me operating system

1. When you connect the DemoKit-LF3 board to the host computer, the Plug and Play function automatically initializes the **Add New Hardware Wizard**. Click **Next**.

Figure 9. Add New Hardware Wizard (Windows 98SE)

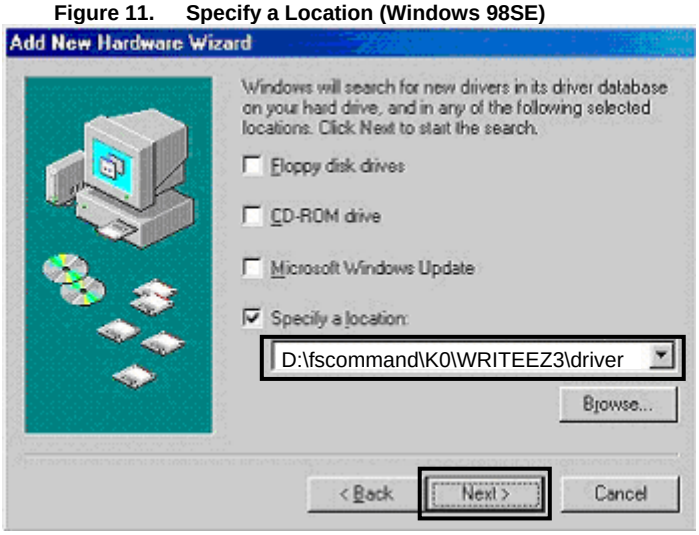
2. Select **Search for a suitable driver for my device** and click **Next**.

Figure 10. Search Method (Windows 98SE)



3. Select the **Specify a location** box, click **Browse…** to find the *\fscommand\K0\WRITEEZ3\drivers* folder, and then click **Next**.

Figure 11. Specify a Location (Windows 98SE)



4. Click **Next**.

Figure 12. Search for a Driver File (Windows 98SE)

5. Click **Finish** to complete the installation of the USB serial port driver.

Figure 13. Installation of USB High-Speed Serial Converter Complete (Windows 98SE)

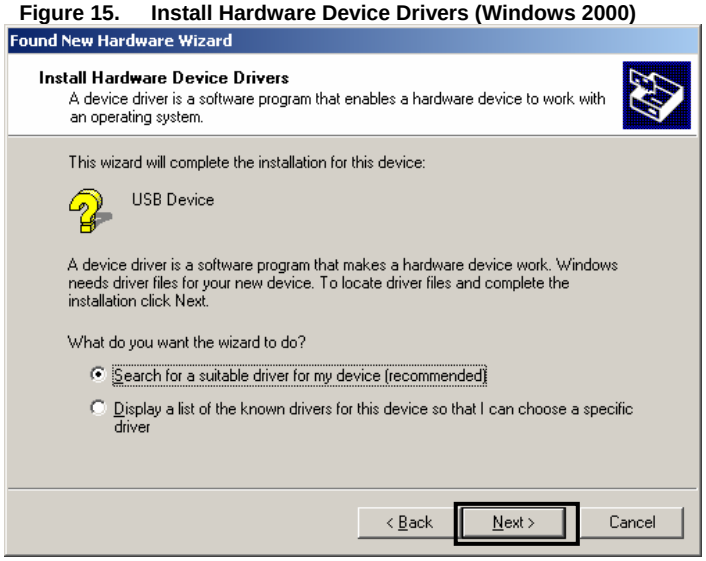
6.4.2 Installation on Windows 2000 operating system

1. When you connect the DemoKit-LF3 board to the host computer, the Plug and Play function automatically initializes the **Found New Hardware Wizard**. Click **Next**.

Figure 14. Found New Hardware Wizard (Windows 2000)

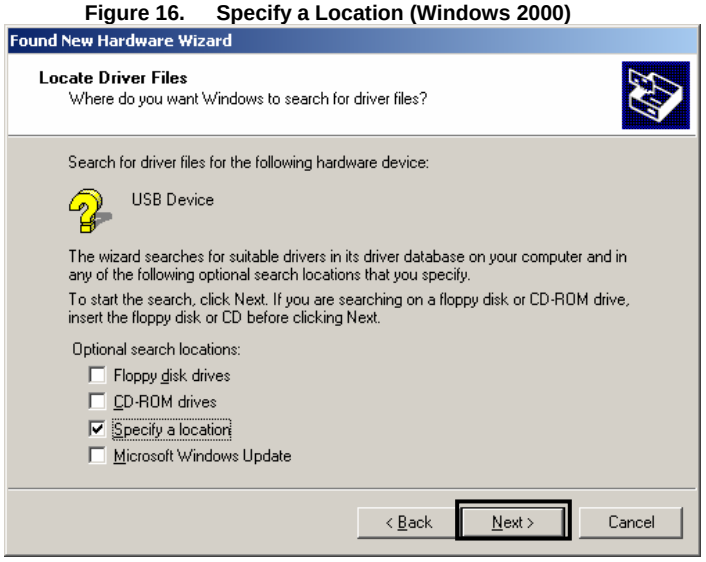
2. Select **Search for a suitable driver for my device** and then click **Next**.

Figure 15. Install Hardware Device Drivers (Windows 2000)



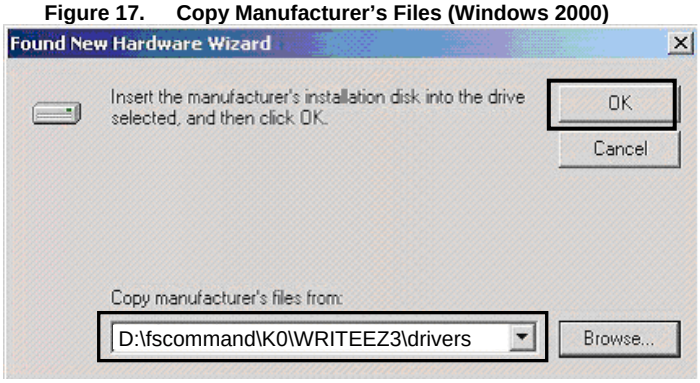
3. Select **Specify a location** and then click **Next**.

Figure 16. Specify a Location (Windows 2000)



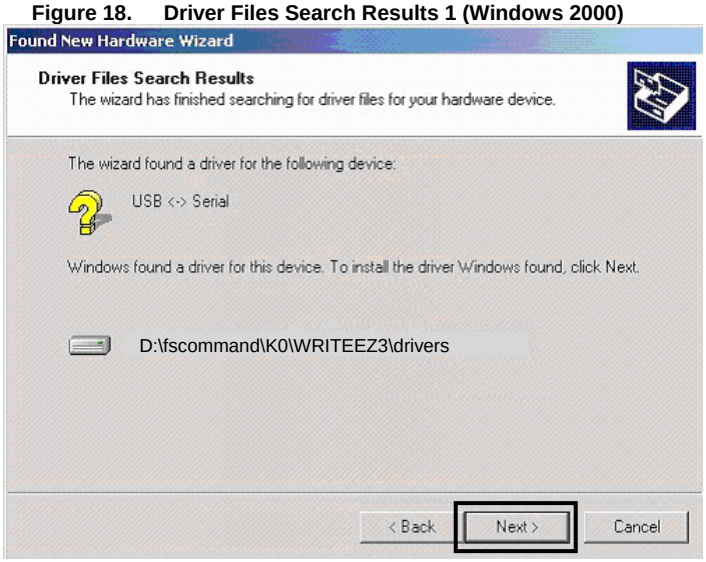
4. Click **Browse…** to find the *\fscommand\K0\WRITEEZ3\drivers* folder and then click **OK**.

Figure 17. Copy Manufacturer's Files (Windows 2000)



5. Click **Next**.

Figure 18. Driver Files Search Results 1 (Windows 2000)



6. Click **Finish** to complete the installation of the USB driver.

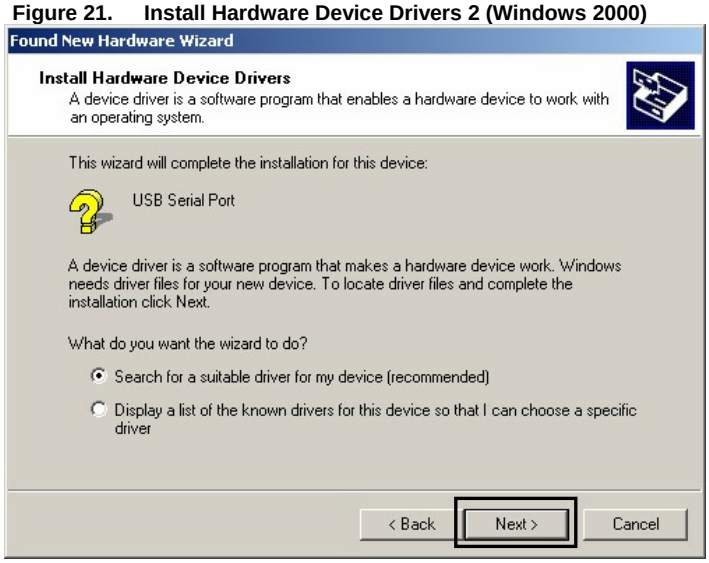
Figure 19. Installation of USB High-Speed Serial Converter Complete (Windows 2000)

7. Open the **Found New Hardware Wizard** to install the USB serial port driver and click **Next**.

Figure 20. Found New Hardware Wizard 2 (Windows 2000)

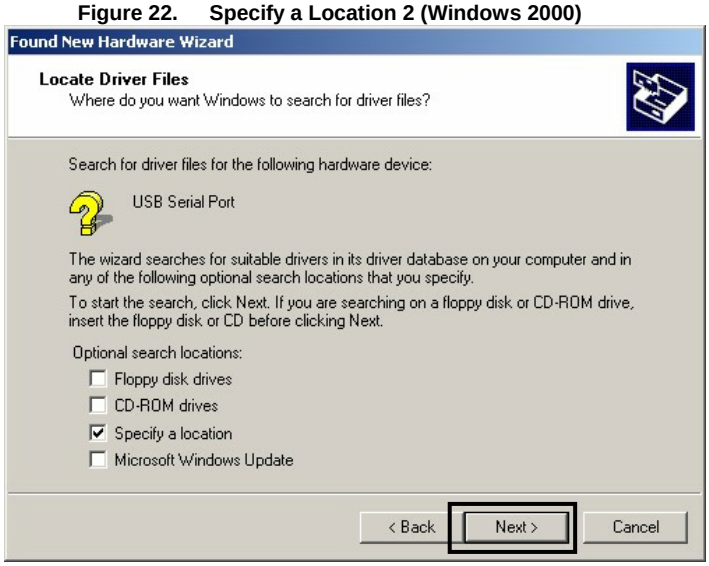
8. Select **Search for a suitable driver for my device** and then click **Next**.

Figure 21. Install Hardware Device Drivers 2 (Windows 2000)



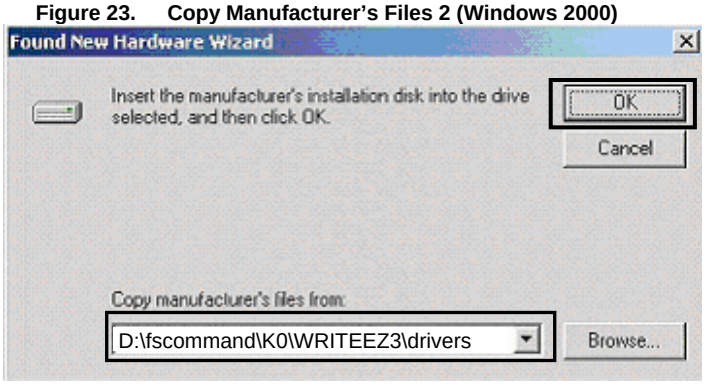
9. Select **Specify a location** and then click **Next**.

Figure 22. Specify a Location 2 (Windows 2000)



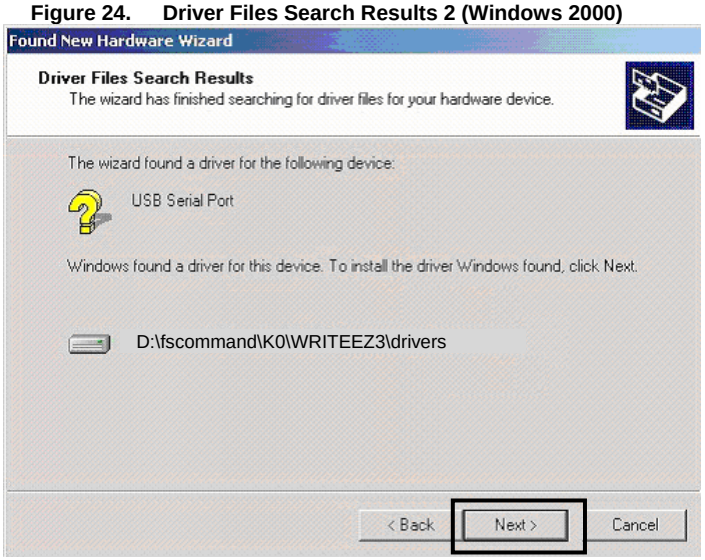
10. Browse to the *\fscommand\K0\WRITEEZ3\drivers* folder and click **OK**.

Figure 23. Copy Manufacturer's Files 2 (Windows 2000)



11. Click **Next**.

Figure 24. Driver Files Search Results 2 (Windows 2000)



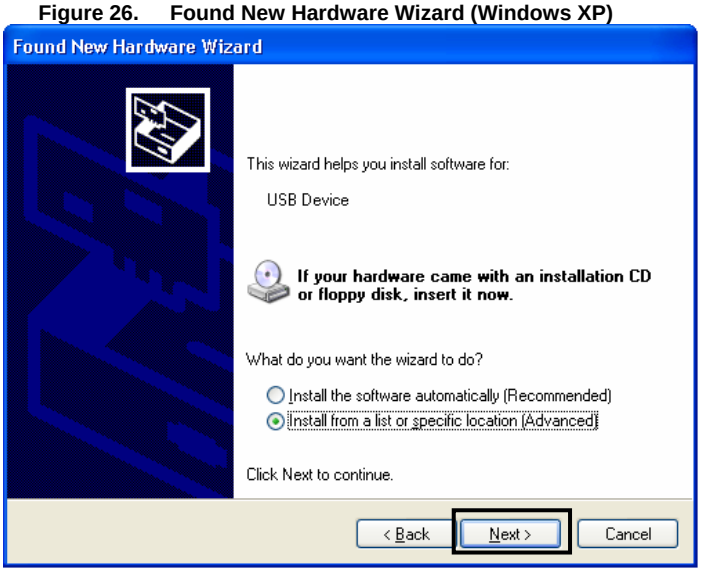
12. Click **Finish** to complete the installation of the USB driver.

Figure 25. Installation of USB Serial Port Complete (Windows 2000)

6.4.3 Installation on Windows XP operating system

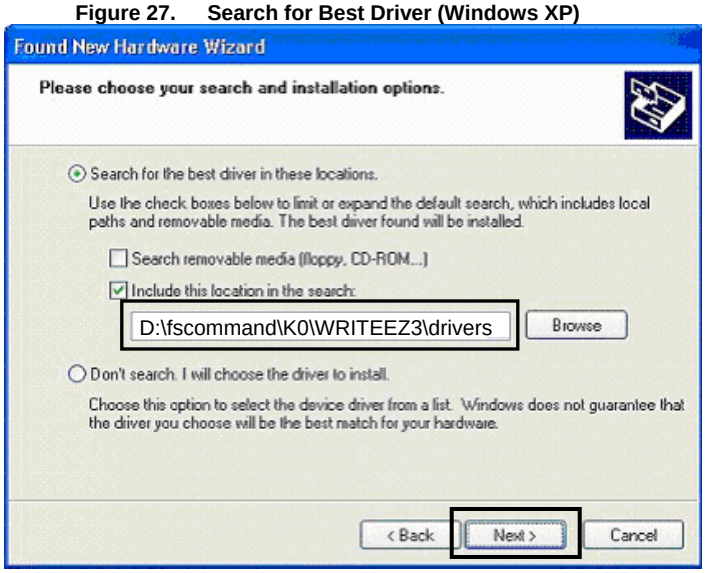
1. After you connect the DemoKit-LF3 board to the host computer, the Plug and Play function initializes the **Found New Hardware Wizard**. Select **Install from a list or specific location (Advanced)** and then click **Next**.

Figure 26. Found New Hardware Wizard (Windows XP)



2. Select **Search for the best driver in these locations** and **Include this location in the search**. Click **Browse…** to find the *\fscommand\K0\WRITEEX\drivers* folder and then click **Next**.

Figure 27. Search for Best Driver (Windows XP)



3. If you see this message, click **Continue Anyway**.

Figure 28. Windows XP Logo Testing (Windows XP)

4. Click **Finish** to close the hardware wizard.

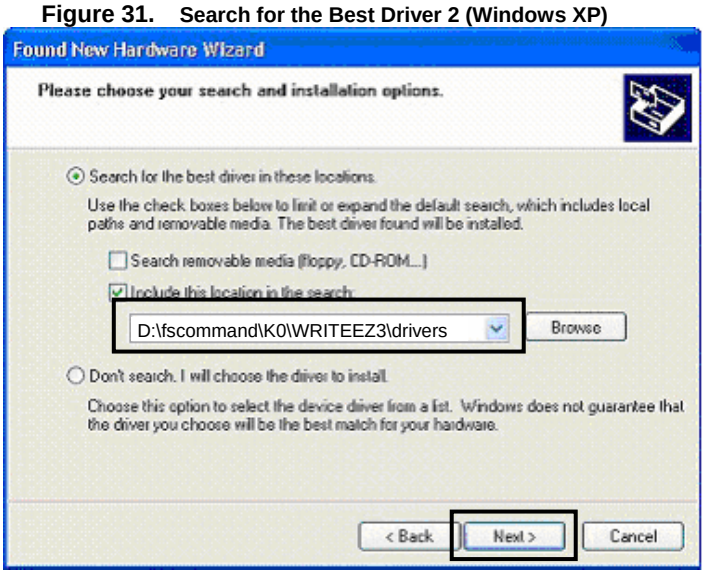
Figure 29. Installation of USB High-Speed Serial Converter Complete (Windows)

5. Open the **Found New Hardware Wizard** for the USB serial port driver, select **Install from a list or specific location (Advanced)**, and click **Next**.

Figure 30. Found New Hardware Wizard 2 (Windows XP)

6. Select **Search for the best driver in these locations** and **Include this location in the search**. Click **Browse...** to find the *\fscommand\K0\WRITEEZ3\drivers* folder and then click **Next**.

Figure 31. Search for the Best Driver 2 (Windows XP)



7. If you receive this message, click **Continue Anyway**.

Figure 32. Windows XP Logo Testing 2 (Windows XP)

8. Click **Finish** to complete the installation.

Figure 33. USB Serial Port2 Driver Installation Complete (Windows XP)

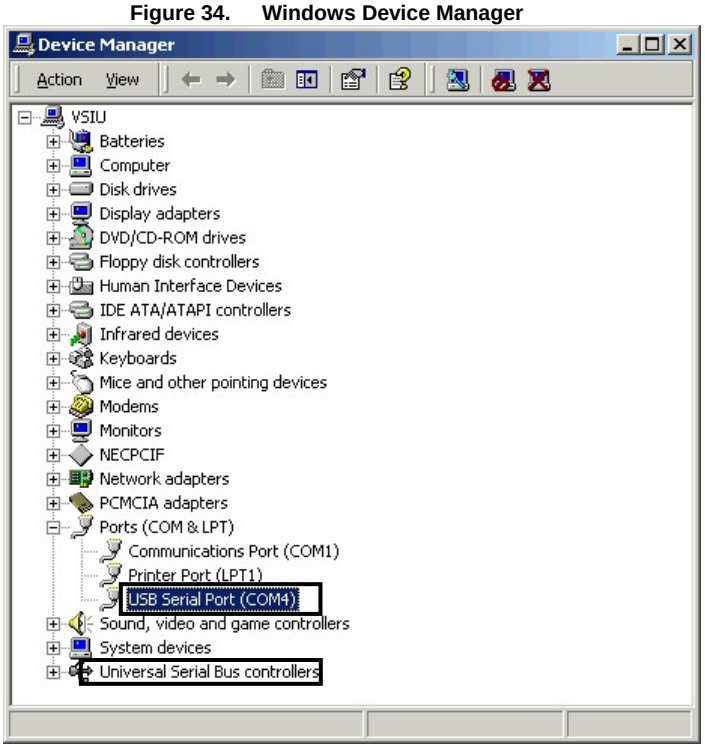
Caution: On Windows 2000/XP operating systems, do not execute a **Hardware Modification Scan** from the Windows **Device Manager** when communicating with the target device.

6.5 Confirmation of USB Driver Installation

To confirm that the drivers have been installed, open the Windows **Device Manager** and verify that the USB serial port (COM3) and USB high-speed serial converter are listed. If the drivers are not displayed, or are marked with an "×" or "!" prefix, refer to Section 9, "Troubleshooting," for guidelines about how to correct the problem.

Note: In the **Port** list of the **Device Setup** box, make sure the COM port is the same as the USB Serial Port (COM?).

Figure 34. Windows Device Manager



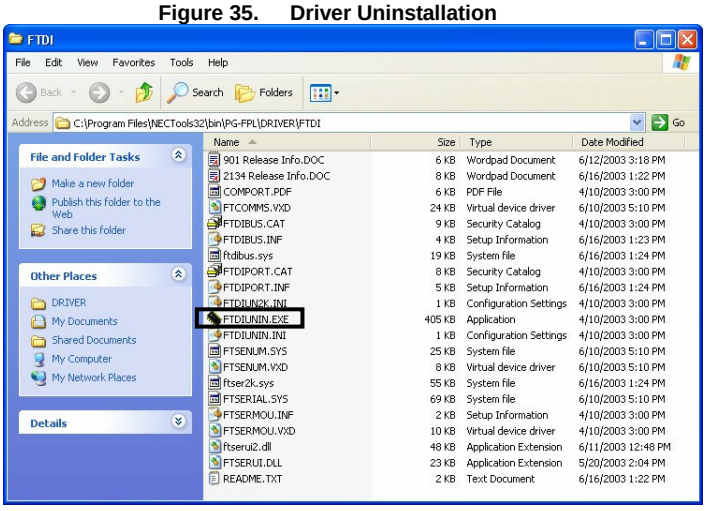
6.6 Driver uninstallation

The driver uninstallation program is stored on the host computer when you install the WriteEZ3 program. This procedure explains how to use the program to remove the USB driver.

1. On Windows XP operating systems, log on as the *computer administrator*. On Windows 2000 operating systems, log on as the *administrator*.

2. Double-click **My Computer** → **C:** → **Program Files** → **NECTools32** → **WRITEEZ3** → **DRIVER** → **Ftdiunin.exe**.

Figure 35. Driver Uninstallation

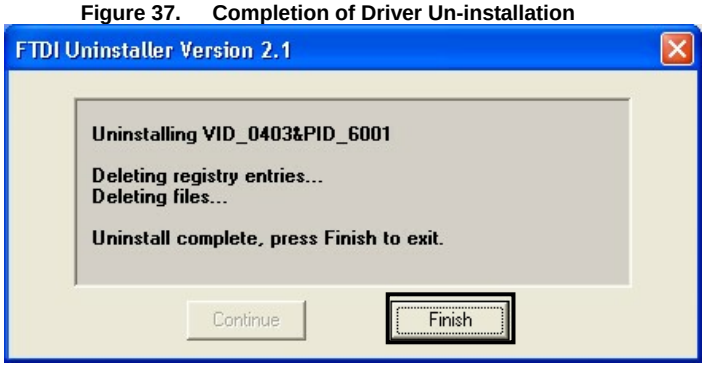


3. Click **Continue**.

Figure 36. Driver Uninstaller

4. Click **Finish** to complete the removal process.

Figure 37. Completion of Driver Un-installation



Caution: Removal of the GUI software causes the *Ftdiunin.exe* file to be deleted, in which case you must manually delete the USB serial port (COM?) and USB high-speed serial converter files from the Windows **Device Manager**.

7. WriteEZ3 flash programming program

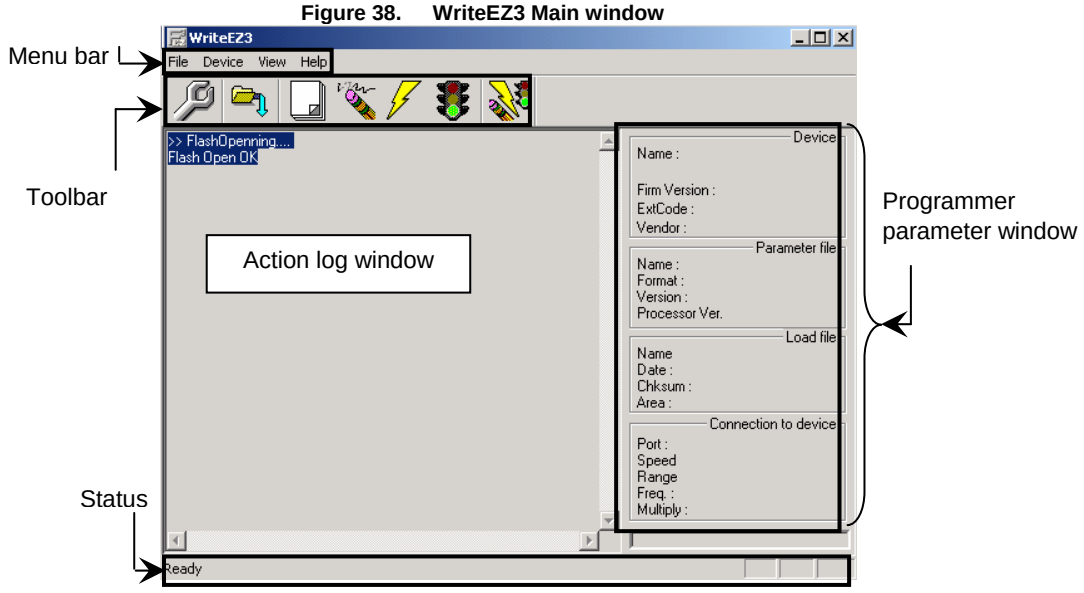
Installation of the WriteEZ3 program automatically installs the microcontroller's <*WriteEZ3 install-path*>*PRM* parameter file. Nevertheless, you can also download the newest parameter file for the μPD78F0495 microcontroller from the NEC Electronics America web site.

1. Go to http://www.am.necel.com/micro/develoment/ and download the file.
2. Copy the file into the <*WriteEZ3.EXE-install-path*>*PRM* subdirectory created during software setup (described in Section 7).

7.1 Initialization

1. Open the **Start** menu and click **WriteEZ3.EXE** to initialize the WriteEZ3 program and open the Main window.

Figure 38. WriteEZ3 Main window



The main window consists of the following elements.

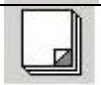
Table 16. Main window elements

Name	Description
Menu bar	Displays menu items executable by the WriteEZ3 program
Toolbar	Displays frequently used commands as icons
Action log window	Displays an WriteEZ3 action log
Programmer parameter window	Displays programming parameter settings
Status bar	Displays status

7.2 Toolbar

The toolbar contains buttons for executing WriteEZ3 commands.

Figure 39. Toolbar command buttons

Icon	Description
	Device → Setup
	File → Load
	Device → Blank Check
	Device → Erase
	Device → Program
	Device → Verify
	Device → Autoprocedure(EPV)

7.3 Menu bar

Depending on the actual device status and device type, some commands may be unavailable.

7.3.1 File menu

Clicking the **File** menu displays a pull-down menu of two commands.

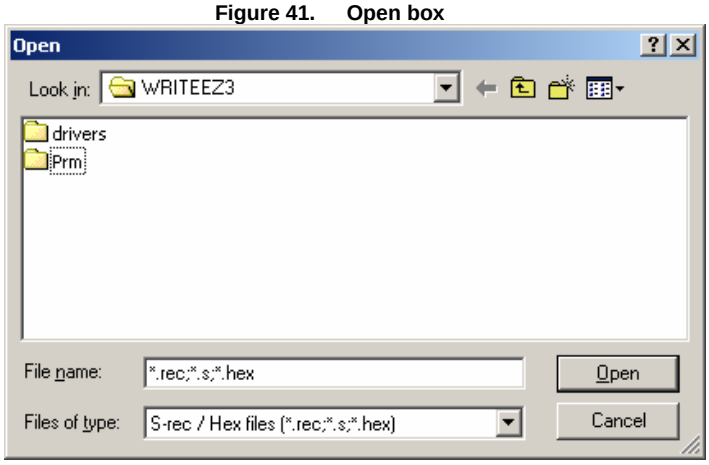
Figure 40. File Menu

7.3.1.1 Load command

1. Click the **Load** command to view the **Open** box.

2. Select the file to be programmed io the microcontroller's flash memory and click **Open**.

Figure 41. Open box



3. After you load the program, it performs a checksum calculation and displays the result in the Programmer Parameter window.

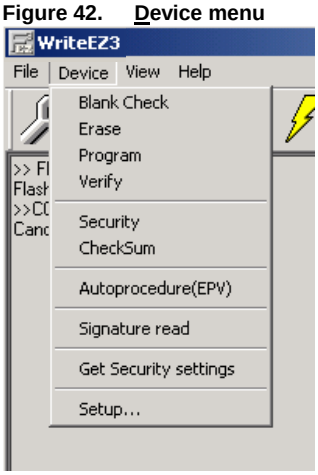
7.3.1.2 Quit command

The **Quit** command terminates the WriteEZ3 program and saves your settings in a *WriteEZ3.INI* file that will be initialized at the next session. On Window 98SE, Windows Me, and Windows XP operating systems, the program stores *WriteEZ3.INI* in the Windows folder. On Windows 2000 systems, the program stores *WriteEZ3.INI* in the Winnt folder.

7.3.2 Device menu

Clicking the **Device** menu displays a drop-down menu of programming commands.

Figure 42. Device menu



7.3.2.1 Blank Check command

The **Blank Check** command enables you to check the target device connected to the WriteEZ3 program. If the device's flash memory is blank, the command terminates normally. If the flash memory is not blank, the program displays a message to that effect, in which case you should execute an **Erase** command before proceeding.

7.3.2.2 Erase command

The **Erase** command erases the target device's flash memory and displays progress information in the Action Log window. Upon completion, the program displays the command result.

To execute a **Blank Check** command before an **Erase** command, click **Device** → **Setup** and then set the command options accordingly on the **Advance** tab.

7.3.2.3 Program command

The **Program** command sends a specified user program to the target device and then writes the program to the device's flash memory. During programming, the program displays progress information, in percentages, in the Action Log window to indicate programmer operation. Upon completion, the program displays the command result.

To automatically execute a **Verify** command afterward, click **Device** → **Setup** and set the command options accordingly on the **Advance** tab.

7.3.2.4 Verify command

The **Verify** command sends a specified user program to the target device and then verifies that the data written to the device's flash memory is correct. During verification, the program displays progress information, in percentages, in the Action Log window. Upon completion, the program displays the command result.

7.3.2.5 Security command

The **Security** command programs the security flag that you set for the target device on the **Advance** tab of the **Device Setup** box.

7.3.2.6 Checksum command

The **Checksum** command reads the target device's checksum value.

7.3.2.7 Autoprocedure(EPV) command

The **Autoprocedure(EPV)** command executes an **Erase** command, **Program** command, and **Verify** command in succession.

During **Autoprocedure(EPV)** execution, the Action Log window displays progress information to indicate programmer operation. After completion, the program displays the command result.

7.3.2.8 Signature Read command

The **Signature Read** command reads the device name, flash memory capacity, and other signature information of the target device.

7.3.2.9 Setup command

The **Setup** command opens the **Device Setup** box and enables you to specify command and programming options that are saved in a parameter file (.PRM) and retrieved at each session. Shaded (unavailable) options may not be modified.

The **Device Setup** box consists of two tabs: **Standard** and **Advance**.

The **Standard** tab contains options for rewriting the target device's flash memory. Settings will differ depending on the device being used, so refer to the user's manual for your device before making your selections.

Figure 43. Standard tab

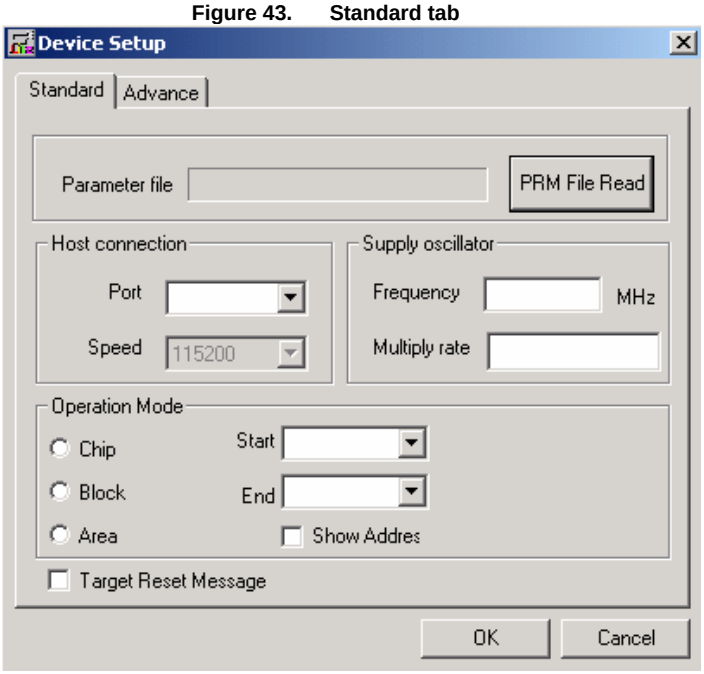


Table 17. Standard tab elements

Element		Description
OK button		Saves the settings on the **Standard** and **Advance** tabs and closes the **Device Setup** box
Cancel button		Closes the **Device Setup** box without saving the settings on the **Standard** and **Advance** tabs
Parameter file box		Contains the parameters and timing data needed to rewrite the target device's flash memory; protected by the checksum function (if the checksum result indicates an error, the WriteEZ3 program does not accept the parameter file); may not be modified because the data is related to the guarantee of rewritten data
PRM Read File button		Opens a window for specifying a parameter file
Host connection area	**Port** list	Specifies a channel (COM1 to COM256) for communication between the DemoKit-LF3 board and host computer (selectable ports can be verified using the Windows **Device Manager**, as described in the section titled, "Confirmation of USB Driver Installation")
	Speed list	Specifies a communication rate for the selected channel: 9600, 19200, 38400, or 115200 bps (refer to the user's manual for your device)
Supply oscillator area	**Frequency** box	Sets the clock frequency of the target system, which varies from one device to another (refer to the user's manual for your device)
	Multiply rate box	Specifies a division or multiplication rate for the target device
		For target devices with an on-chip PLL circuit, enter a division rate or multiplication rate after checking the specifications for the device used
		For target devices without a PLL circuit: select 1.0 (the default setting in the parameter file will be displayed on the initial screen)
Operation mode area	**Chip** check box	Subjects the entire flash memory area of the target device to rewrite processing
	Block check box	Subjects a block range to rewrite processing; must be accompanied by entries in the **Start** and **End** lists
	Start and **End** lists	Specifies the starting and ending addresses for the block of flash memory to be rewritten
	Area check box	Subjects a specific area to rewrite processing; must be accompanied by entries in the **Start** and **End** lists
	Show Address check box	Displays addresses in the **Start** and **End** lists (clearing this option displays numbers in the **Start** and **End** lists)
Target Reset Message check box		Displays a message promoting the manual reset operation, even when the reset signal cannot be connected to the target's cable

The **Advance** tab contains the **Command options** and **Security flag settings** areas.

Figure 44. Advance tab

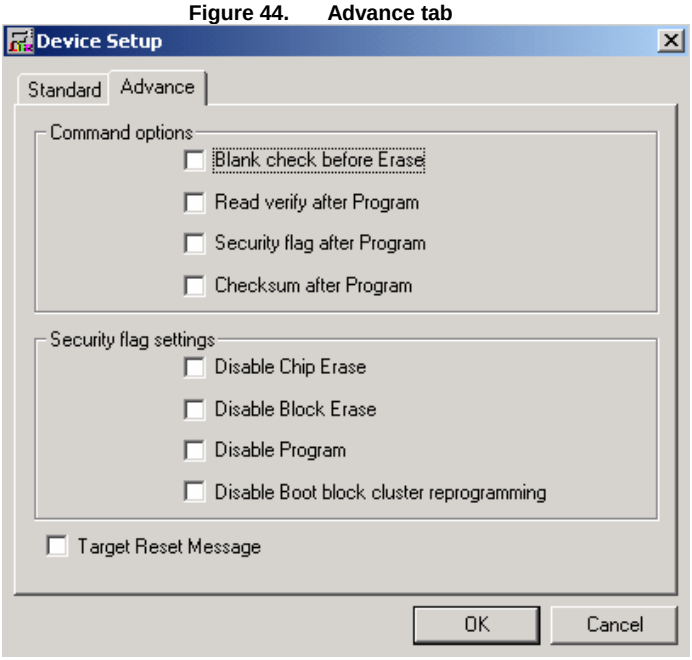


Table 18. Advance tab elements

Element		Description
Command options area	**Blank check before Erase** check box	Executes a **Blank Check** command before an **Erase** or **Autoprocedure (EPV)** command; does not execute an **Erase** command if the **Blank Check** result is OK
	Read verify after Program check box	Verifies the data written to flash memory after the execution of **Program** and **Autoprocedure (EPV)** commands
	Security flag after Program check box	Automatically programs the selected security flag after execution of **Program** and **Autoprocedure (EPV)** commands
	Checksum after Program check box	Reads the target device's flash memory checksum value after execution of **Program** and **Autoprocedure (EPV)** commands
Security flag settings area	**Disable Chip Erase** check box	Disables the **Erase** command and displays a warning message stating that the chip can no longer be erased and programmed (if the security flag is set in the target device, erasing and writing to the device cannot be enabled afterward)
	Disable Block Erase check box (unavailable if the **Chip** option is selected)	Disables the **Erase** command in all of the flash memory blocks specified in the **Operation Mode** section of the **Standard** tab
	Disable Program check box	Disables the **Program** and **Erase** commands in all of the flash memory blocks specified in the **Operation Mode** section of the **Standard** tab
	Disable Boot block cluster reprogramming check box	Makes the boot block set in the boot block cluster the last block; displays a message indicating that the boot block can no longer be erased and programmed (also, if the security flag is set in the target device, the boot area cannot be rewritten to the device afterward)

The following is the correspondence between the **Erase** and **Program** commands when the microcontroller's security functions are valid.

Table 19. Correspondence between Erase and Program command during valid security functions

Option	Command		
	Chip Erase	**Block Erase**	**Program**
Disable Chip Erase	Invalid	Invalid	Valid (1)
Disable Block Erase	Valid	Invalid	Valid
Disable Program	Valid	Invalid	Invalid
Disable Boot block cluster reprogramming	Invalid	Valid (2)	Valid (2)

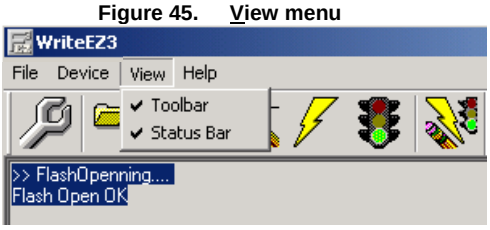
Notes:

1. Since the **Erase** command is invalid, the program cannot erase the flash memory to remove the bad data and write the new.
2. The command is valid for areas other than the one specified as the boot area.

7.3.3 View menu

Clicking the **View** menu displays the **Toolbar** and **Status Bar** options.

Figure 45. View menu



7.3.3.1 Toolbar option

Selecting **Toolbar** displays the toolbar; clearing **Toolbar** hides the toolbar.

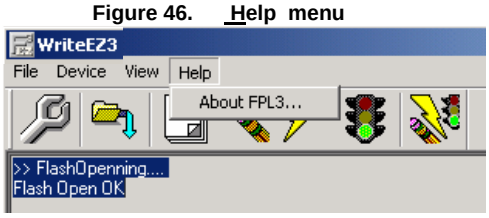
7.3.3.2 Status Bar option

Selecting **Status Bar** displays the status bar; clearing **Status Bar** hides the status bar.

7.3.4 Help menu

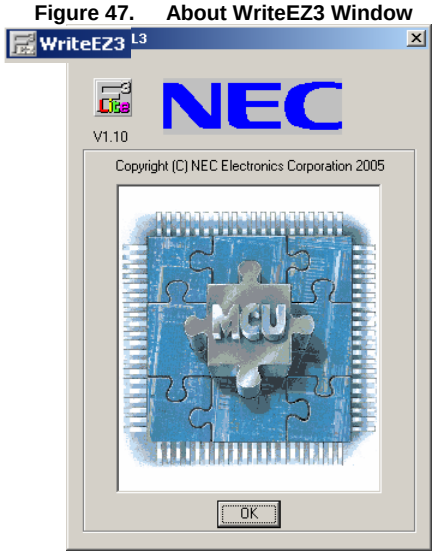
Clicking the **Help** menu displays the **About WriteEZ3…** option.

Figure 46. Help menu



Clicking **About WriteEZ3…** displays version and copyright information for the WriteEZ3 program.

Figure 47. About WriteEZ3 Window



7.4 Programmer Parameter window

The Programmer Parameter window displays information about the device, parameter file, load file, and device connection.

Figure 48. Programmer Parameter Window

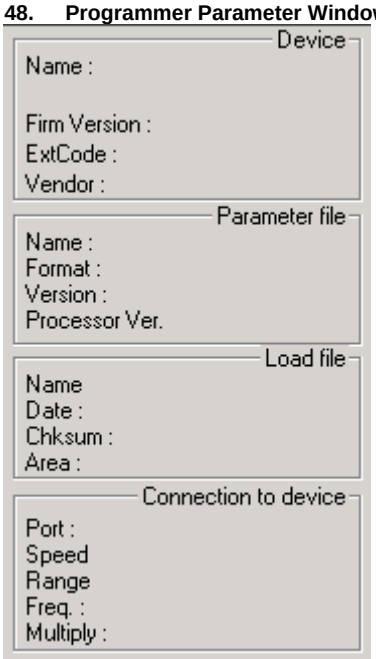


Table 20. Programmer Parameter window elements

Element	Description
Device area	Updated after communication with the target device to display information about the target device
Parameter file area	Updated after a **Setup** command to display information about a read parameter file
Load file area	Updated after a **Load** command to display information about a selected program file
Connection to device area	Updated after a **Setup** command to display information about the connection with the target device

8. WriteEZ3 flash programming software

This section explains the basic operation of the WriteEZ3 flash programming software, including how to start the system, execute an **Autoprocedure(EPV)** command, and program a target device.

8.1 Configuration of the DemoKit-LF3 board

- Baseboard : DemoKit-LF3
- Target device : 78K0/LF3 (μPD78F0495)
- Clock : 6 MHz
- Voltage level : 5V

8.2 Configuration of the WriteEZ3 software

- Parameter file : 78F0495.PRM
- Clock setting : 6 MHz multiplied by 1
- Port : COM3 (115200 bps)
- Operation mode : Chip
- Write HEX : VOLTMETER.hex
- Option setting : Blank check before Erase

8.3 Installing the parameter file

The parameter file for the microcontroller is installed automatically during installation of WriteEZ3 program. You may also download the most recent version from http://www.am.necel.com/micro/development/ and save it in the <*WriteEZ3.EXE-install-path*>*PRM* subdirectory, as described in Section 7, "Software Installation."

8.4 Connecting and starting

1. Set the SW1 and SW2 switches as shown in Figure 49 and explained in Table 21.

Figure 49. SW1 and SW2 settings

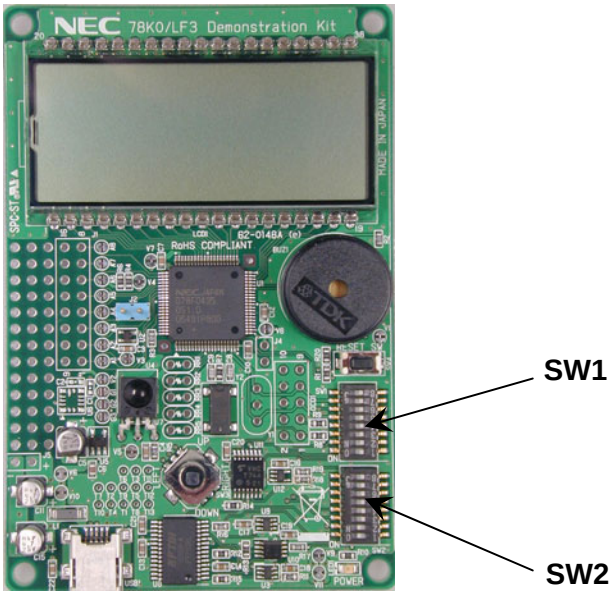


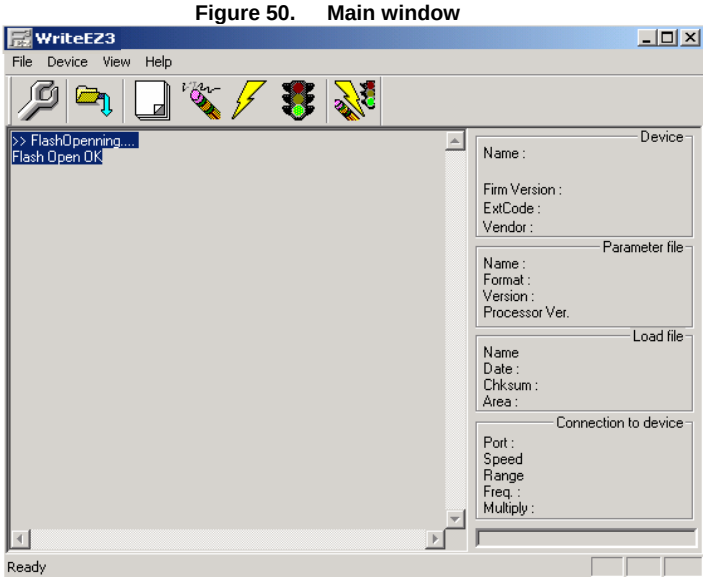
Table 21. SW1 and SW2 settings

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
WriteEZ3			ON	ON	don't care				ON	ON					ON	ON
	OFF	OFF									OFF	OFF	OFF	OFF		

2. After you connect the DemoKit-LF3 board to the host computer via the USB cable, the Plug and Play feature initializes the driver. If the connection was already established, press the **SW4** reset button to release flash programming mode.

3. To initialize the WriteEZ3 program, click **Start** → **Programs** → **NEC Electronics Tools** → **WriteEZ3** → **WriteEZ3**.

Figure 50. Main window

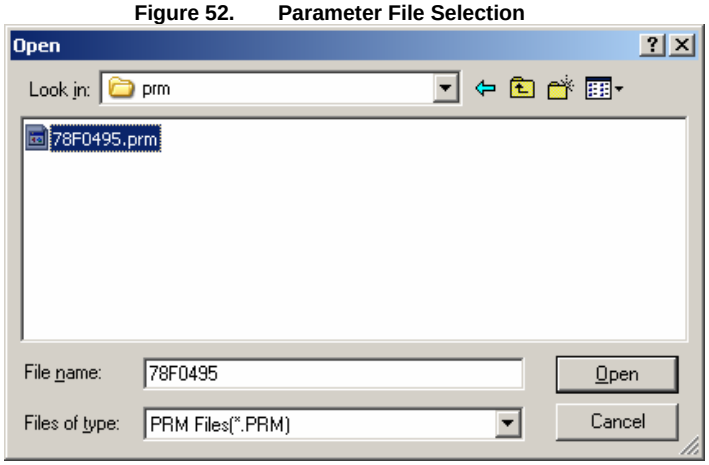


4. Click **Device** → **Setup** to open the **Device Setup** box. Click the **PRM File Read** button.

Figure 51. Device Setup box

5. Locate and select the *78F0495.prm* parameter file in the *C:\Program Files\NEC Electronics Tools\WriteEZ3\V1.10\PRM* directory and then click **Open**.

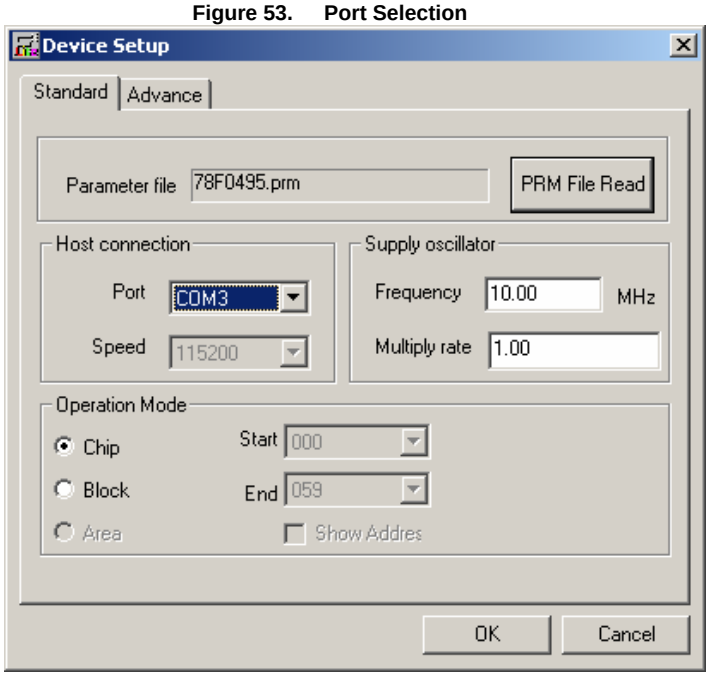
Figure 52. Parameter File Selection



6. In the **Port** list, select the communication port that matches the host computer being used. (Note: Selectable ports can be checked using the Windows **Device Manager**. For details, refer to Section 6.5, "Confirmation of USB Driver Installation.")

7. In the **Speed** list, select the communication speed for the host connection.

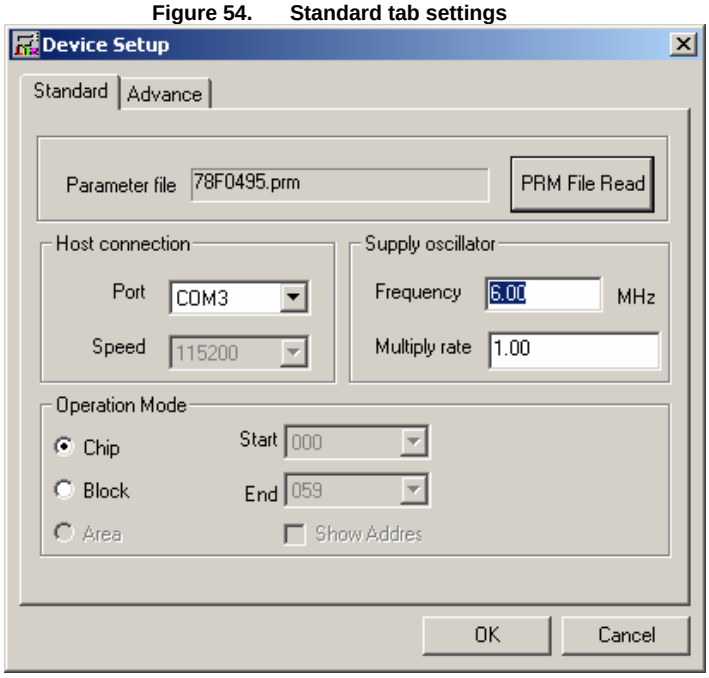
Figure 53. Port Selection



8. In the **Supply oscillator** area, set the **Frequency** to 6.00 MHz and the **Multiply rate** to 1.00.

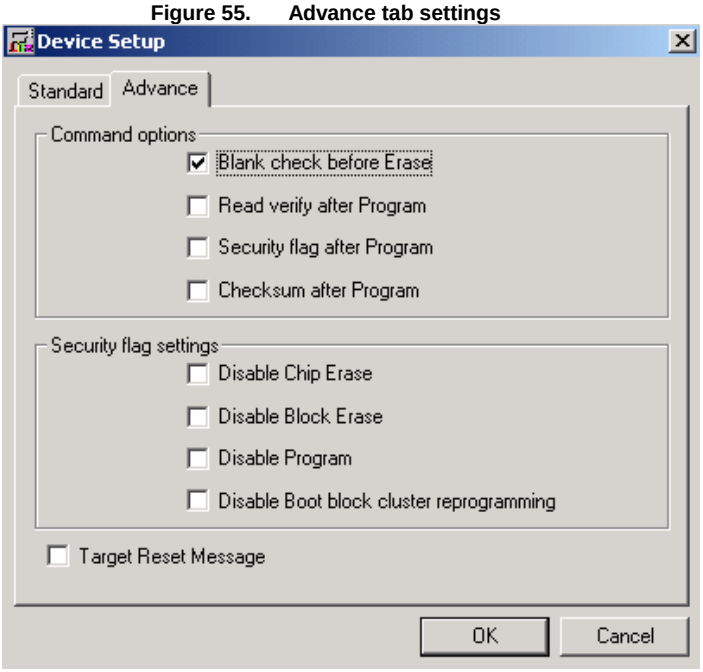
9. In the **Operation Mode** area, select **Chip**.

Figure 54. Standard tab settings



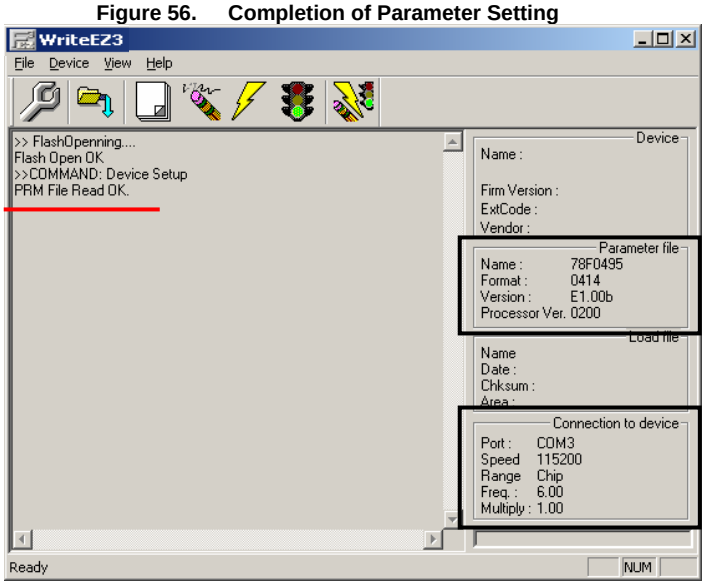
10. Click the **Advance** tab.

Figure 55. Advance tab settings



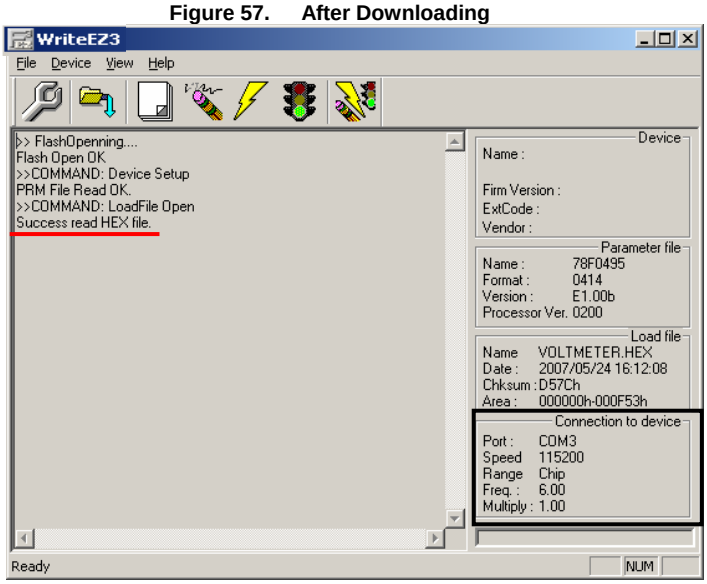
11. Select **Blank check before Erase** and click **OK** to set the parameters.

Figure 56. Completion of Parameter Setting



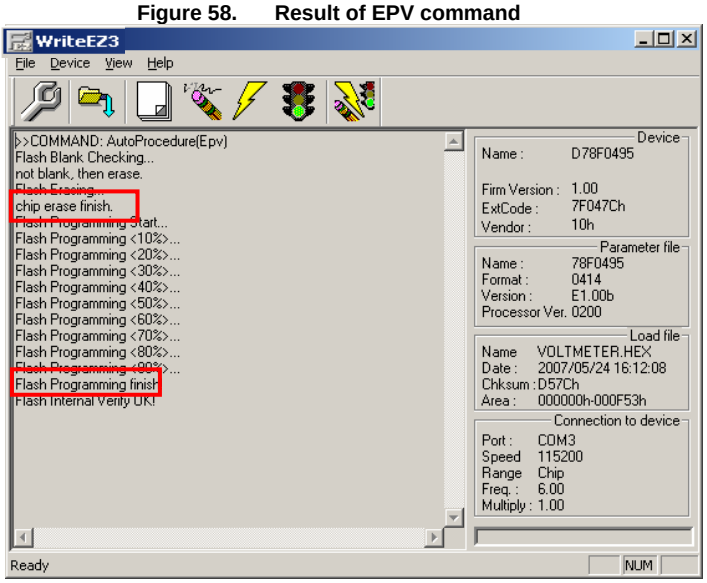
12. Click **File** → **Load**, select a program file to be written to the target device, and then click **Open**.

Figure 57. After Downloading



13. Click **Autoprocedure(EPV)** to execute **Blank Check**, **Erase**, **Program**, and **Verify** commands on the μPD78F0495 device in succession.

Figure 58. Result of EPV command



14. Click **File** → **Quit** to terminate the program and save your settings in the *WriteEZ3.INI* file for initialization at the next session.

15. Reset the DemoKit-LF3 board to normal operation (QB-MINI2 mode) using the Plug and Play feature or pressing the SW4 reset button.

16. Restart the program by clicking **Start** → **Programs** → **NEC Electronics Tools** → **WriteEZ3** → **WriteEZ3**.

9. Troubleshooting

In some cases, connection to the DemoKit-LF3 cannot be established. This section provides some guidelines for troubleshooting the problem.

9.1 The Plug and Play feature does not initialize after driver installation.

Cause: The USB connector may not be inserted normally into the computer's USB port.

Action: Check that the USB connector is inserted fully into the USB port of the personal computer. Alternatively, disconnect the USB connector and then insert the USB connector again after a while.

9.2 The driver file cannot be found at a specified location.

Cause: The WriteEZ3 flash programming software may not be installed correctly.

Action: Install the GUI software again by referring to the "Software Installation" section.

9.3 The drivers did not in install correctly.

The USB serial port and/or USB high-speed serial converter are not listed on the Windows **Device Manager**, or they are listed with an "!" or "×" prefix.

1. **Cause**: The USB connector may not be inserted normally into the computer's USB port.

   Action: Check that the USB connector is inserted fully into the computer's USB port. Alternatively, disconnect the USB connector from the USB port and re-insert again.

2. **Cause**: The driver may not be installed correctly.

   Actions:

   - When this product is connected to the computer, right-click the driver marked with "!" or "×".
   - Click **Erase**.
   - On the Windows **Device Manager**, execute a **Hardware Modification Scan**.
   - Install the driver again to initialize the Plug and Play feature.

3. **Cause**: The device may not be recognized (when connected to the USB hub).

   Action: Try the following:

   – Disconnect the USB connector and then re-insert it again.
   – Connect the USB connector to another port of the USB hub.

   If the same symptom occurs, do not use the USB hub, but directly connect the connector to the computer's USB port.

9.4 The Add New Hardware Wizard initializes unexpectedly.

Cause: If the USB connector of this product is inserted into a USB port other than the one used at the time of installation, this product may be recognized as new hardware.

Action: Install the driver in accordance with the procedure described in the section titled, "USB Driver Installation".

9.5 Communication with the DemoKit-LF3 board is disabled.

1. **Cause**: The driver may not be installed correctly.

   Action: Verify that the USB serial port and USB high-speed serial converter are installed correctly by referring to Section 6.4, "USB Driver Installation."

2. **Cause**: The COM port selected in the **Device Setup** → **Port** box may not be set correctly.

   Action: Use the Windows **Device Manager** to set the port.

3. **Cause**: The DemoKit-LF3 board is operating in normal mode.

   Action: Set the board to the WriteEZ3 flash programming mode.

4. **Cause**: The PRM file selected in the **Device Setup** box may be incorrect.

   Action: Use the corresponding PRM file that matches the target device. For information about the PRM file, refer to Section 7, "WriteEZ3 flash programming software".

5. **Cause**: The setting of the **Supply oscillator** in the **Device Setup** box may be incorrect.

   Action: Make a correct setting according to the specifications of the target device.

10. Project Manager and Debugging

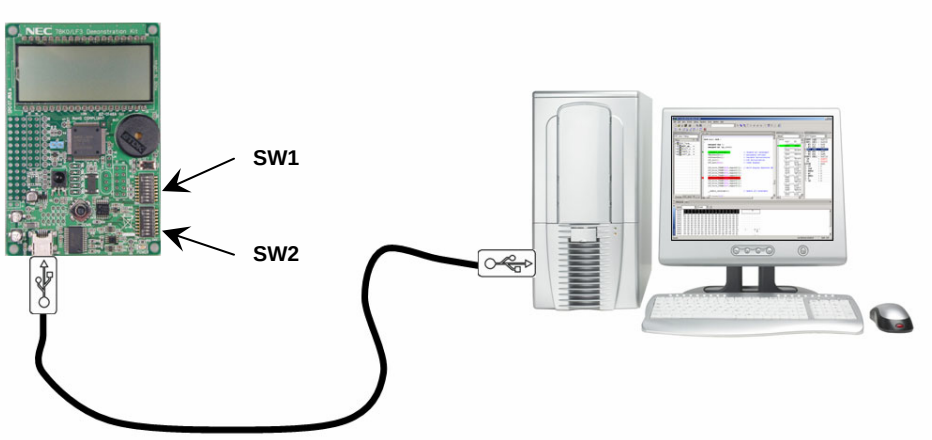
Before using the DemoKit-LF3's on-board debugging function with the debugger, you must first install the USB driver. The communication between the starter kit and debugger—running on the personal computer—is done via the standard UART / USB connection.

To operate the board in on-board debugging mode, switches SW1 and SW2 must be configured as follows.

Table 22. SW1 and SW2 settings

Mode	SW2								SW1							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
On-board debugger	ON	ON			don't care				ON	ON	ON	ON	ON	ON		
			OFF	OFF											OFF	OFF

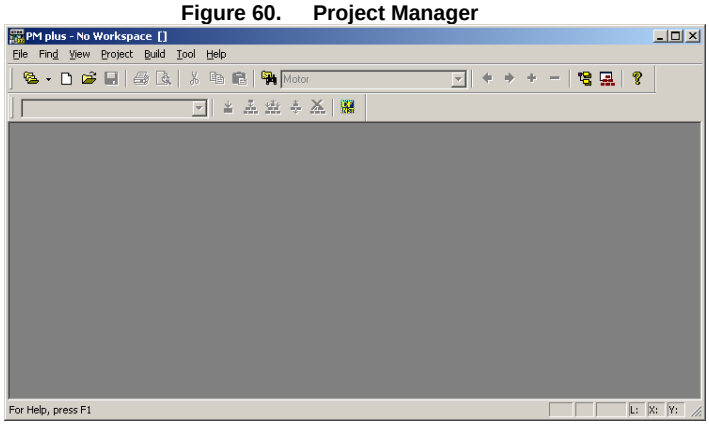
Figure 59. SW1 and SW2 settings



TK-78 debugging via On-Board debug function

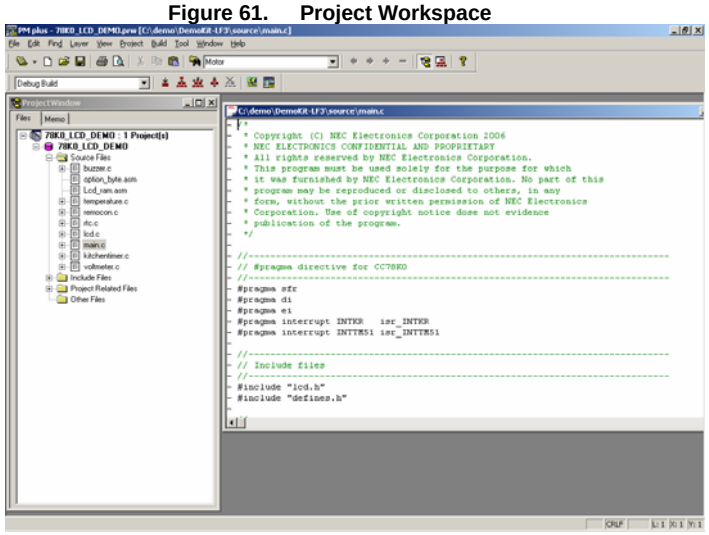
1. To launch the NEC Electronics Project Manager (PM Plus), click **Start → Programs → NECTools32 → PM Plus**.

Figure 60. Project Manager



2. Click **File → Open Workspace** to locate the sample project. Open the *78K0_LCD_DEMO.prw* file, the workspace file that contains general information about the demonstration projects and settings.

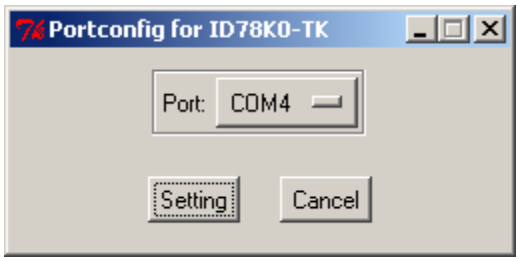
Figure 61. Project Workspace



3. At this point, you can edit, build, and link the sample code provided. For information about how to use the NEC Electronics software tools, refer to the associated documents for each.

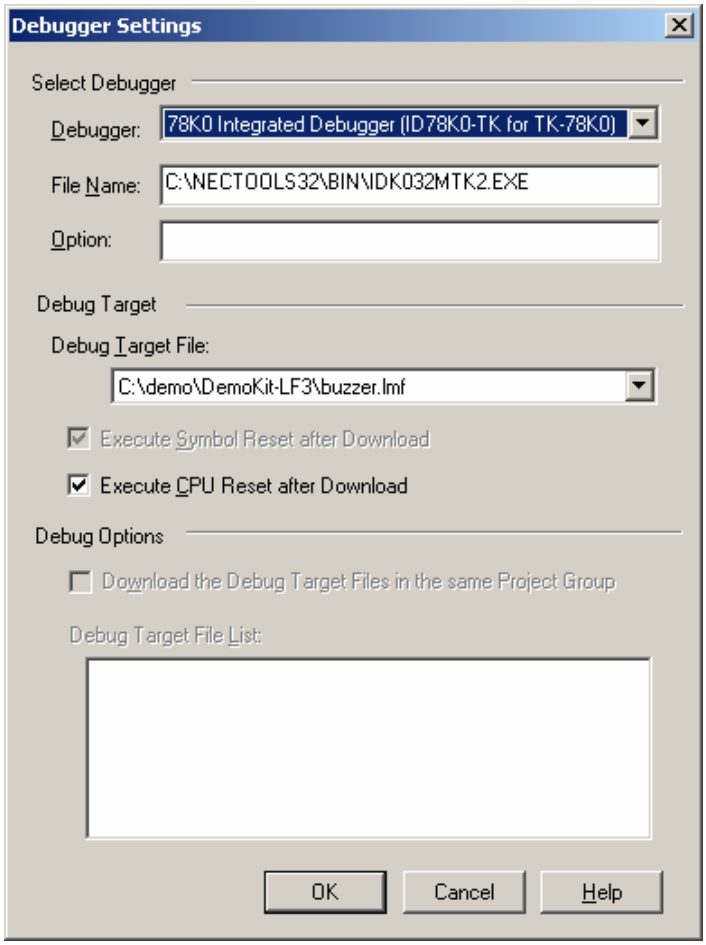
4. To debug the code, make sure that the board is configured for on-chip debugging. From the **Start** menu, click **Programs → NEC Tools32 → Portconfig for ID78K0-TK** and then configure the port for the serial communication.

Figure 62. Portconfig for ID78K0-TK



5. Click **Tools → Debugger Settings**. Select the **ID78K0-TK** debugger and click **OK**.

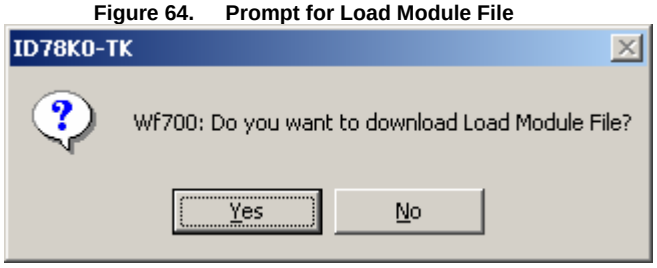
Figure 63. Debugger Settings



6. Click **Build → Rebuild and Debug** to invoke the ID78K0-TK**.**

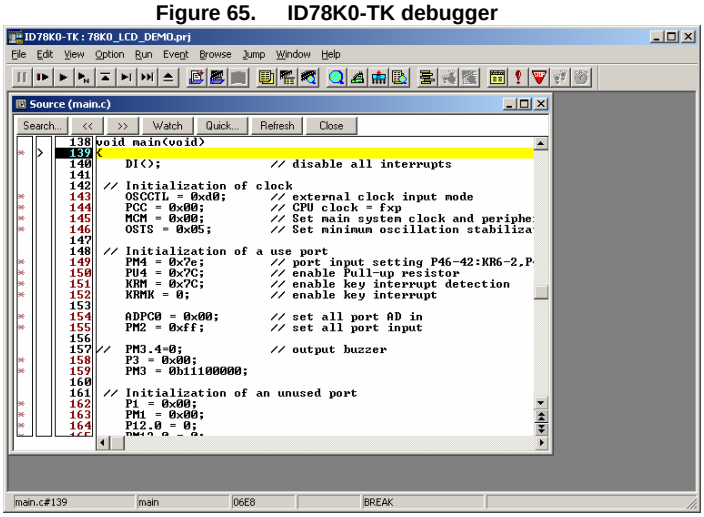
7. Click **Yes** in response to the prompt.

Figure 64. Prompt for Load Module File



8. After a successful download, standard commands for single-stepping, starting, stopping, setting breakpoints, and manipulating registers and memory are available.

Figure 65. ID78K0-TK debugger



For more information about the debugger's configuration and capabilities, refer to the user's manual for the ID78K0-TK debugger.

11. Sample Projects

Each of the sample programs is located in a single directory, called the main directory in each sample. This main directory contains the complete project, inclusive of all output files of the development tool. The **78K0_LCD_DEMO.prw** workspace file is located on top of the sample program directories. All sample programs use the same directory structure.

Table 23. Example directory structure

DemoKitLF3	78K0/LF3 project and output files
inc	C header files
source	C source files
78K0_LCD_DEMO.prw	workspace file

The main directory contains most project files for the PM Plus. All source files are located in the directory `/source` and the `/inc` directory contains the header files.

11.1 Buzzer sample

This demonstration program drives the buzzer using the 16-bit 00 timer/event counter. The timer is configured to generate a rectangle waveform. By changing the timer's output frequency, you can have the buzzer generate different tones. As demonstration, the buzzer plays a simple melody.

11.2 Kitchen Timer sample

Kitchen timer functionality is realized using the real-time counter and interrupt interval function. The setting of the kitchen timer's count value and the cancellation of a started count process can be done using the navigation switch. When the timer's count time elapses, the LCD displays the alarm symbol and the buzzer sounds an alarm.

11.3 Real-Time Clock sample

This sample project realizes a real-time clock. The program initializes the real-time counter to generate an exact clock reference based on the 32.768 kHz subclock and displays the actual time on the LCD. You can then use the navigation switch to adjust the time or switch between AM and PM in 24-hour mode.

11.4 Remote Control sample

The remote control sample uses the DemoKit's IR receiver module. For this program, connect the receiver's IR output terminal to the microcontroller's P41/KR1/RIN remote control input pin. The program can then be executed to receive NEC Electronics-formatted custom code and data transmitted by an external remote controller. The LCD will display the received data 16-bit wise.

11.5 Temperature sample

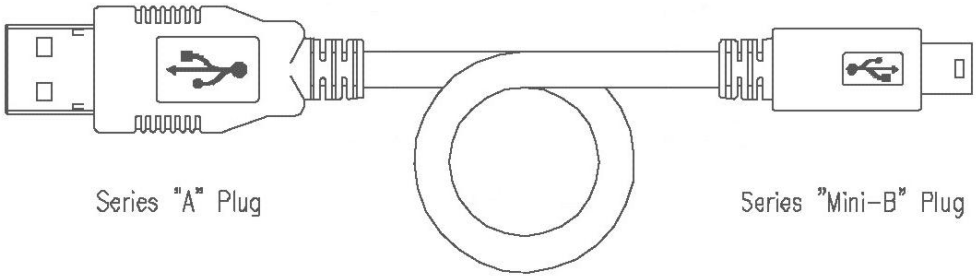
The temperature measurement program uses the onboard temperature sensor IC and both of the microcontroller's A/D converters. You may select from two display formats, degrees centigrade (°C) and degrees Fahrenheit (°F), using the navigation switch. Additionally you may select from two different A/D converter resolutions using the microcontroller's 10-bit successive-approximation-type A/D converter or 16-bit delta-sigma type A/D converter.

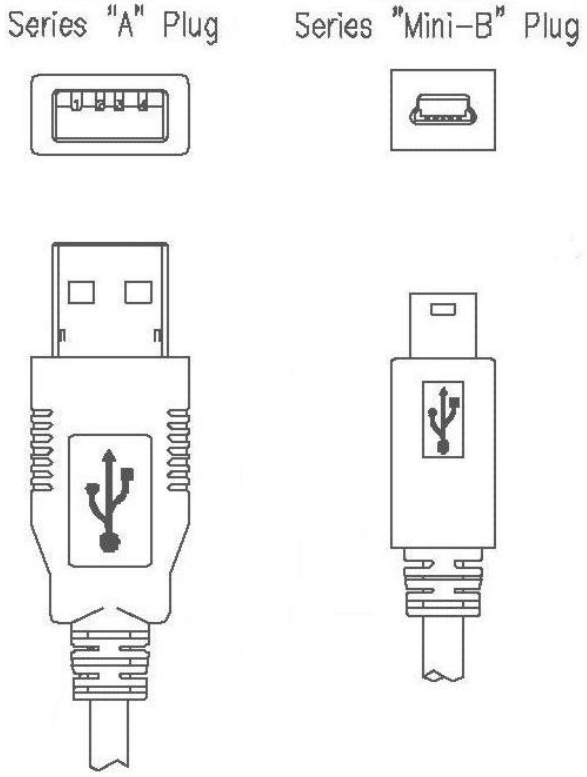
11.6 Voltmeter sample

This program measures either the DemoKit-LF3 board's power supply voltage or an external voltage supplied to the J2 connector. Before applying an external voltage to the J2 connector, carefully read the user's manual for your device to find the electrical specifications for the A/D converter's input port.

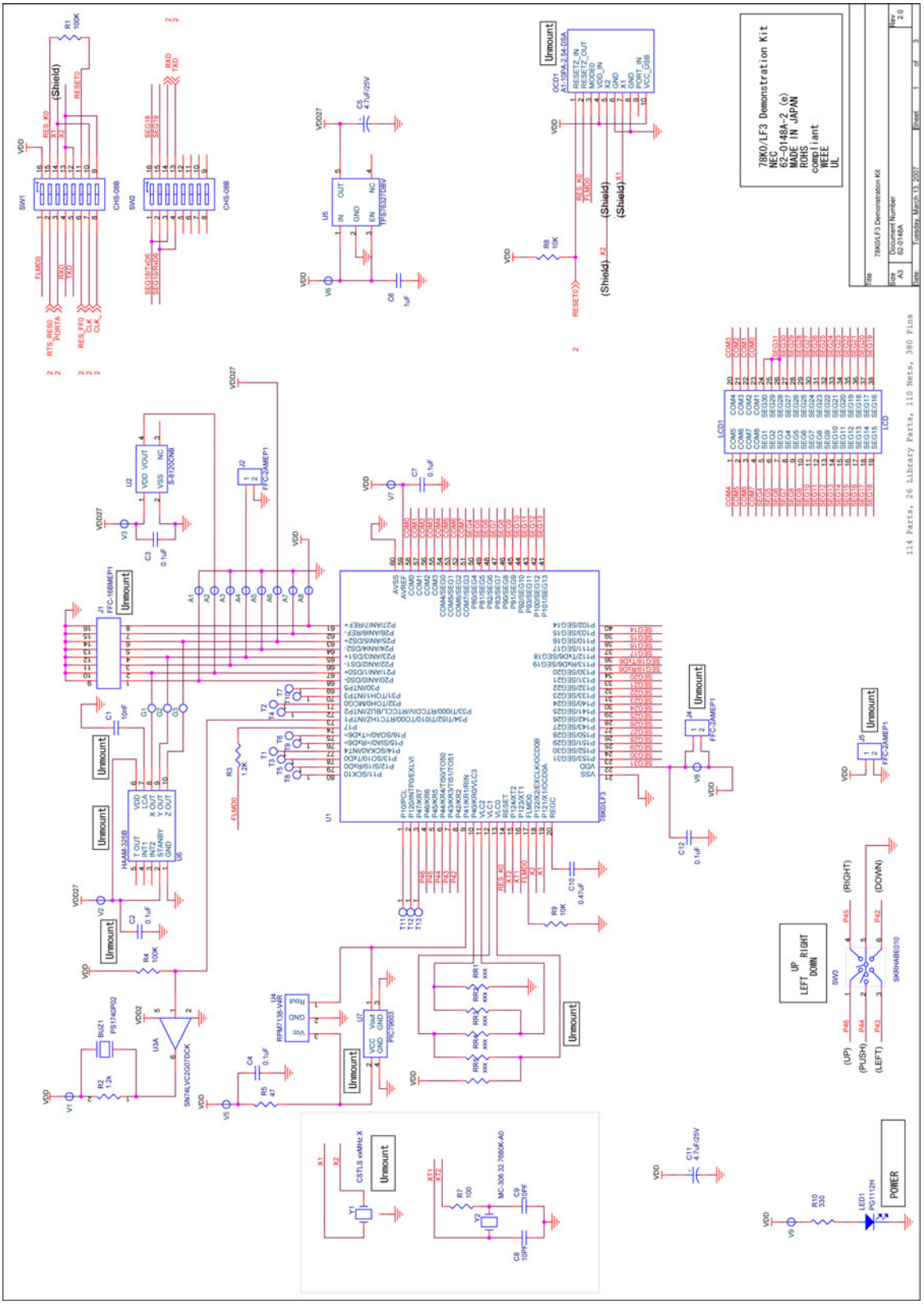
The P25/ANI5/DS2+ input port is used to measure the power supply voltage. For external voltage measurement, the input port P23/ANI3/DS1+ is reserved. You can select the different measurement sources using the navigation switch. You can also select from two different A/D converter resolutions using the microcontroller's 10-bit successive-approximation-type A/D converter or 16-bit delta-sigma A/D converter.

12. USB Interface Cable (mini-B type)





13. Schematics



DemoKit-LF3 schematics (2/2)