NEC

User's Manual

DemoKit-LG2

Demonstration Kit for
NEC Electronics 78K0/Lx2 Microcontrollers

Document No. U17799EU1V0UM00

CAUTION

This test and measurement equipment has the potential to be significantly altered by its user through hardware enhancements/modifications and/or test or application software. Thus, with respect to Council Directive 89/336/EEC (Directive on Compliance with the EMC Protection Requirements), this equipment has no autonomous function. Consequently this equipment is not marked by the CE symbol.

EEDT-ST-0005-10

Revision History

Date	Revision	Section	Description
11-2005	V1.00	---	First release

Contents

1. Introduction

DemoKit-LG2 is a demonstration kit for the NEC Electronics 8-bit 78K0S/LG2 microcontrollers (MCUs) with integrated liquid crystal display (LCD) controllers. The kit supports on-board flash programming and real-time execution of application programs up to 32 KB using NEC Electronics' free C compiler and assembler. The board contains user hardware such as digital input/output (I/O) and analog signals.

1.1 Features

- ♦ Easy-to-use device demonstration capabilities, including elements to easily demonstrate simple I/O functions such as the navigator switch, 112-segment LCD panel, phototransistor, temperature sensor, I/O lines, UART serial interface, and others.
- ♦ On-board debugging function using the ID78K0-TK debugger that allows flash downloading and standard debugging functions such as code execution and single-step command execution, breakpoints, memory manipulation, and so forth.
- ♦ Power supplied through the Universal Serial Bus (USB) interface, the QB-78K0MINI on-chip debugging emulator, or an external CR2032 3-volt lithium coin battery
- ♦ Standard 112-segment LCD panel that allows the implementation of human / machine interface, comfortable I/O functions, output of measurement values, output of status information, etc.
- ♦ Windows®-based FPL3 flash programming software that enables you to select and download application programs for evaluation purposes.
- ♦ Analog-to-digital (A/D) signal conversion
- ♦ Various I/O signals designed to be connected to user hardware
  - Standard 112-segment LCD panel (8 digits × 14 segments each)
  - Timer I/O signals
  - Two- or three-wire serial I/O
  - UART interface via FT232 USB UART chip
  - Eight analog input lines
  - KTY13-5 temperature sensor
  - PT15-21C phototransistor
  - Navigation switch for key interrupt generation
- ♦ NEC Electronics C compiler and assembler (maximum 32 KB program code size)
- ♦ Full documentation for the NEC Electronics 78K0/LG2 MCU, software tools and FPL3 flash programming software

Note: DemoKit-LG2 is not intended for code development. NEC Electronics does not support any application of the DemoKit-LG2 in a commercial or technical product.

1.2 System Requirements

Table 1. System Requirements

Host computer	Windows® 98SE, Windows ME, Windows 2000 or Windows XP for the NEC Electronics software tools and FPL3 flash programming software
	Intel® Pentium® 166 MHz (at least), 128 MB of RAM, 256-color display (1024 × 768), mouse, CD-ROM drive and 200 MB of free hard disk space for installation of tool packages
Host interface	USB interface to enable communication based on USB 1.1 or later

1.3 Kit Contents

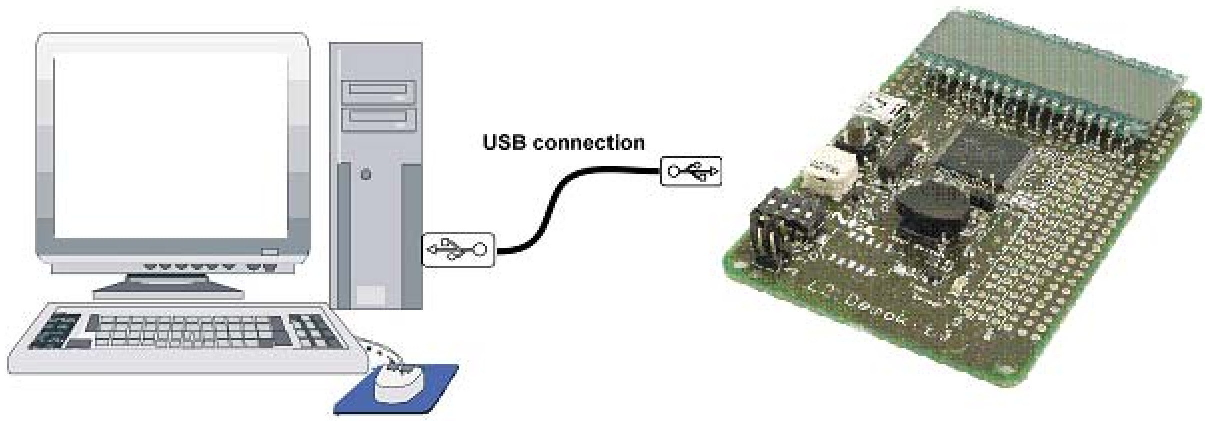
Please verify that you have received all parts listed on the contents list attached to the kit package. If any part is missing or appears damaged, please contact your local sales representative for instructions about how to return the kit for replacement or repair.

Note: Updates for the NEC Electronics software tools, FP3 flash programming software, documentation and/or utilities for DemoKit-LG2, if available, may be downloaded from the NEC Electronics America web site at **http://www.am.necel.com/microcontrollers/devtools.php**.

2. System Configuration

Configuration of the DemoKit-LG2 system is shown in Figure 1.

Figure 1. System Configuration



2.1 DemoKit-LG2

DemoKit-LG2 is a demonstration kit for the NEC Electronics 8-bit 78K0/LG2 MCUs with integrated LCD controllers. The board connects to a host computer by means of a USB interface cable. The system may be used for on-board flash programming of the MCU's internal flash memory and for execution of application programs. The board also supports on-chip debugging using the ID78K0-TK debugger.

DemoKit-LG2 runs the MCU at 6.0000 MHz and provides a 32.768 kHz subclock.

2.2 Host Computer

The USB host interface enables communication to the DemoKit-LG2 board. The FT-232 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's virtual COM port (VCP) driver appears to the Windows-based system as an extra communication port, in addition to any existing hardware communication ports.

2.3 Power Supply via USB Interface

The DemoKit-LG2 supports a flexible configuration of its power supply. The board can be powered by the USB interface, the QB-78K0MINI on-chip debugging emulator, or by an external CR2032 3-volt lithium coin battery.

3. Components

The DemoKit-LG2 board is equipped with a navigation switch, 112-segment LCD panel, temperature/ light sensor, and several connectors for connection to the host computer, flash programmer, and external target hardware.

Figure 2.   Top View of Board Connectors and Switches

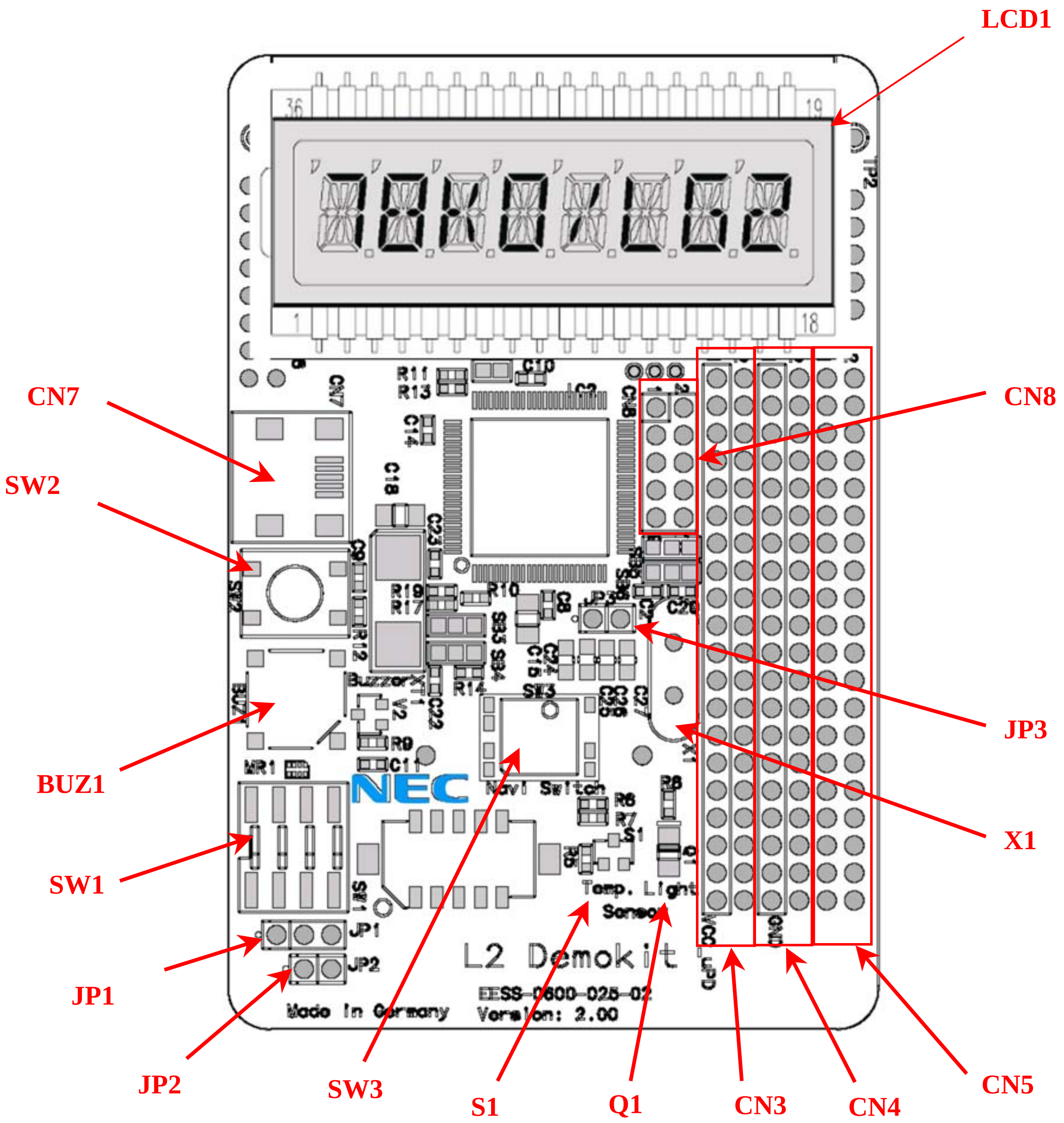
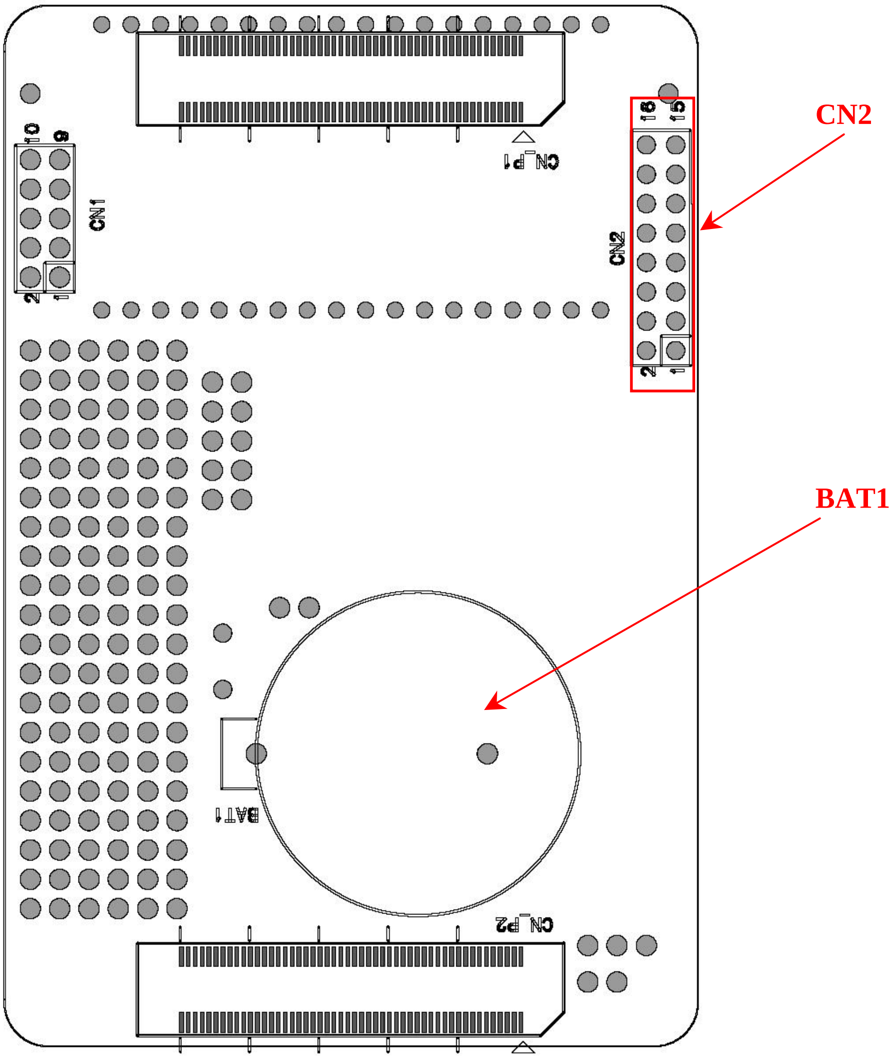


Figure 3. Bottom View of Board Connectors and Switches



Some of the DemoKit-LG2 components are available for user application hardware and software. Please read the MCU user's manual carefully to get information about the electrical specification of the available I/O ports before connecting any external signals to the DemoKit-LG2 board.

3.1 Jumper JP1: Power Supply Selection

The different power supply modes can be set using jumper JP1. The JP1 jumper controls the power supply during standalone mode, flash programming and on-board debugging. Additionally, power can be applied using the QB-78K0MINI on-chip debugging emulator or JP2 jumper.

JP1	Setting	Mode
1–2	Closed (default)	USB interface-supplied power (CN7)
2–3	Closed	Battery-supplied power (BAT1)

3.2 Jumper JP2: Power Selection for On-Chip Debugging

The power supply can also be applied using the QB-78K0MINI on-chip debugging (OCD) emulator. Close jumper JP2 to apply power from the QB-78K0MINI.

JP2	Setting	Mode
1-2	Open (default)	Power supply via USB or battery
	Closed	Power supply via QB-78K0MINI emulator

3.3 Jumper JP3: Clock Supply Selection

Jumper JP3 controls the MCU’s clock supply. Closing JP3 applies an external frequency of 6 MHz to the MCU’s P122/X2 clock input pin. Opening JP3 allows an external oscillator to be used when pad X1 (not assembled) of the kit is equipped with a corresponding oscillator.

JP3	Jumper Setting	Mode
1-2	Closed (default)	Clock frequency = 6 MHz, supplied by CPLD
	Open	Clock supply by external oscillator. By using this mode be sure to equip a crystal oscillator to the X1 pad. For using the QB-78K0MINI on-chip debugging emulator

3.4 SW1 Configuration Switches

The board’s different operating modes can be set using SW1 switches S1–S4.

SW1	Factory Setting	Mode
S1	OFF	Normal operation
S2	OFF	UART6 selected
S3	OFF	On-chip debugging disabled
S4	OFF	On-board debugging enabled

3.4.1 SW1/S1: Operating Mode Selection

SW1 switch S1 controls the DemoKit-LG2 board’s operating mode. Setting SW1/S1 to ON allows you to reprogram the MCU’s internal flash memory using the FPL3 flash programming software.

SW1/S1	Mode
OFF (default)	Normal operation
ON	Flash memory programming

During normal operation, the user program stored in the MCU's flash memory is executed.

3.4.2 SW1/S2: UART Selection

SW1/S2 specifies the MCU's UART signals that correspond to the FT232 interface lines.

SW1, S2	Selection
OFF (default)	UART6
ON	UART0

3.4.3 SW1/S3: On-Chip Debugging Selection

SW1/S3 controls the MCU's on-chip debugging function. Setting switch S3 to ON allows you to use the on-board debugging function or connect to the QB-78K0MINI on-chip debugging emulator.

SW1, S3	Setting
OFF (default)	Disabled
ON	Enabled

3.4.4 SW1/S4: On-Chip Debugging Mode Selection

SW1/S4 controls the debugging mode. Switching SW1/S4 to OFF allows you to use the board's on-board debugging function via the default USB/UART connection to the host computer. All standard debugging functions such as flash programming and downloading, code execution, single-step command execution, setting breakpoints, memory manipulation, and so forth are available.

Setting switch SW1/S4 to ON allows you to connect the QB-78K0MINI on-chip debugging emulator (available separately) to the board to use the MCU's on-chip debugging functions.

SW1, S4	Mode
OFF (default)	On-board debugging function enabled
ON	QB-78K0MINI connection enabled

3.5 SW2 Reset Switch

The SW2 reset switch activates the power-on reset function and is connected to the MCU's reset input.

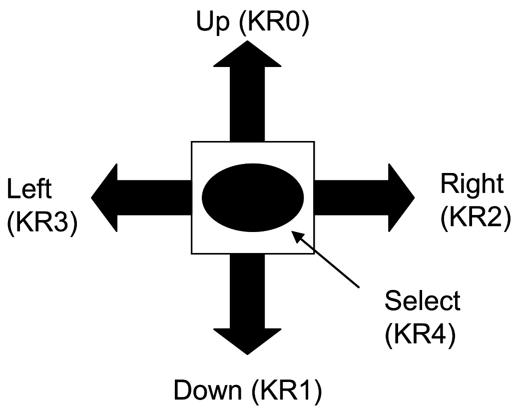
Note: Supplying power to the board via the battery inactivates the reset switch. Please use jumper JP1 to turn power OFF/ON to the microcontroller.

3.6 SW3 Navigation Switch

The SW3 navigation switch connects to the MCU's key interrupt port and operates in five directions, including from the center pushbutton (Figure 4).

SW3	Connection to Microcontroller
Left	P73/KR3
Down	P71/KR1
Select	P74/KR4
Right	P72/KR2
Up	P70/KR0

Figure 4. SW3 Navigation Switch



3.7 SB1, SB3, SB4, SB5 and SB6 Soldering Bridges

The SB1, SB3, SB4, SB5 and SB6 soldering bridges allow the board to be configured in a variety of ways, as described in Table 2.

Figure 5. Soldering Bridges

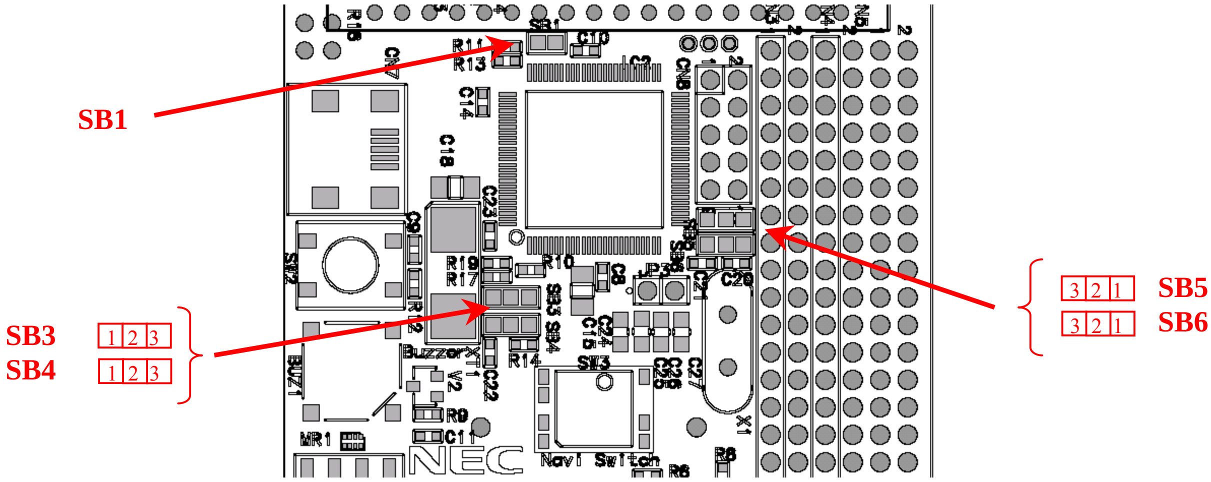


Table 2. Soldering Bridge Settings

Soldering Bridge	Pad	Setting	Configuration
SB1	1–2	Closed (default)	Vcc connected to AVREF pin
		Open	Vcc disconnected from AVREF pin
SB3	1–2 2–3	Closed (default) Open (default)	Subclock oscillator connected to P123/XT1 pin
	1–2 2–3	Open Closed	P123/XT1 pin connected to CN5–2
SB4	1–2 2–3	Closed (default) Open (default)	Subclock oscillator connected to P124/XT2 pin
	1–2 2–3	Open Closed	P124/XT2 pin connected to CN5–4
SB5	1–2 2–3	Closed (default) Open (default)	Main clock oscillator connected to P121/X1 pin
	1–2 2–3	Open Closed	P121/X1 pin connected to CN3–38
SB6	1–2 2–3	Closed (default) Open (default)	Main clock oscillator connected to P121/X2 pin
	1–2 2–3	Open Closed	P121/X2 pin connected to CN3–40

Cutting the default connections (pad 1–2) of soldering bridges SB3/SB4 and SB5/SB6, respectively, and closing pads 2–3 connects the corresponding MCU signals to the CN3 and CN5 external connectors, respectively. In this mode, the MCU pins can be used as standard I/O ports, but you must configure the MCU's clock generator accordingly.

Note: Do not close the connection for the clock oscillator and external connectors at the same time. This can have a negative effect on the operation of the subclock and main clock oscillators.

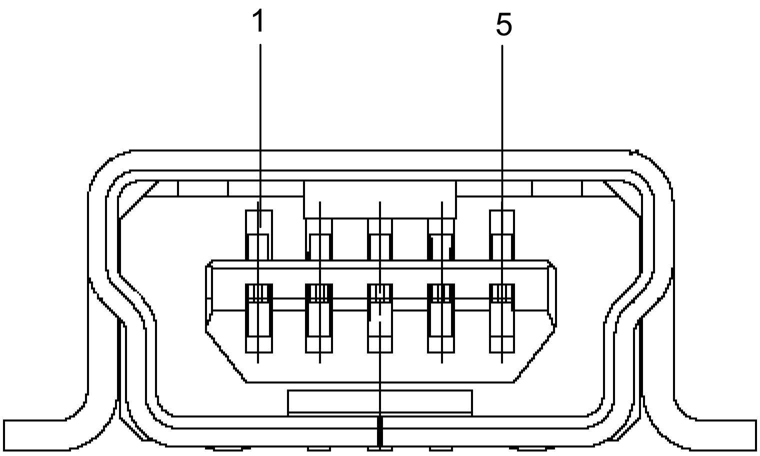
3.8 CN7 USB Interface Connector

The CN7 connector provides a means to connect the board to FPL3 flash programming software to program application software into the MCU's internal flash memory. Additionally, the on-board debugging function uses connector CN7 for communication with the host computer. CN7 also provides the board's 5-volt power supply.

For standard communication to a host computer, for example, using a terminal program, the MCU's UART6 and UART0 I/O signals are connected to CN7.

CN7 USB Connector	Signal Name
1	VBUS
2	DM
3	DP
4	No connection
5	GNDBUS

Figure 6. Pin Configuration of CN7 USB Mini B-Type Host Connector



For connection to the host computer, use a mini-B-type USB cable. For confirmation, NEC Electronics used only the USB cable delivered with the DemoKit-LG2 board.

3.9 CN2 Flash Programmer Connector

The CN2 connector (not assembled) allows connection of the PG-FP4 flash programmer (available separately) to DemoKit-LG2 to program application software into the MCU's internal flash memory.

CN2	Signal
1	GND
2	RESET
3	SI
4	VCC
5	SO
6	No connection
7	SCK
8	No connection
9	No connection
10	No connection
11	No connection
12	FLMD1
13	No connection
14	FLMD0
15	No connection
16	No connection

When using the PG-FP4, you must set the programming interface to the MCU in accordance with the clock serial interface (CSI ring oscillator), please configure the DemoKit-LG2 as following:

Table 3. Hardware Configuration When Using the PF-FP4 Flash Programmer

Switch/Jumper	Setting	Mode
S1	OFF	Normal operation
S2	OFF	UART6 select
S3	OFF	OCD disabled
S4	OFF	On-board debugging
JP1	1–2 closed	Power supply via USB
JP2	Open	Power supply via USB
JP3	Closed	Clock supplied via CPLD

3.10 OCD connector CN8

Connector CN8 (not assembled) allows connection of the QB-78K0MINI on-chip debugging emulator (available separately) to the DemoKit-LG2 to use the MCU's on-chip debugging function.

Table 4. CN8 On-Chip Debugging Connector

CN8	Signal
1	RESET_IN
2	RESET_OUT
3	FLMD0
4	VDD_IN
5	X2
6	GND
7	X1
8	GND
9	No connection
10	No connection

To enable on-chip debugging using the QB-78K0MINI emulator, you must configure the DemoKit-LG2 as described in Section 4.2.

Table 5. SW1 Configuration for On-Chip Debugging

Switch/Jumper	Setting	Mode
S1	OFF	Normal operation
S2	OFF	UART6 select
S3	ON	On-chip debugging enabled
S4	ON	QB-78K0MINI enabled
JP1	1–2 closed	Power supply via USB
JP2	Open	Power supply via USB
	Closed	Power supply via QB-78K0MINI (*Note)
JP3	Open	Clock supplied via QB-78K0MINI

For information about how to configure DemoKit-LG2 for on-chip debugging, refer to 4.1.

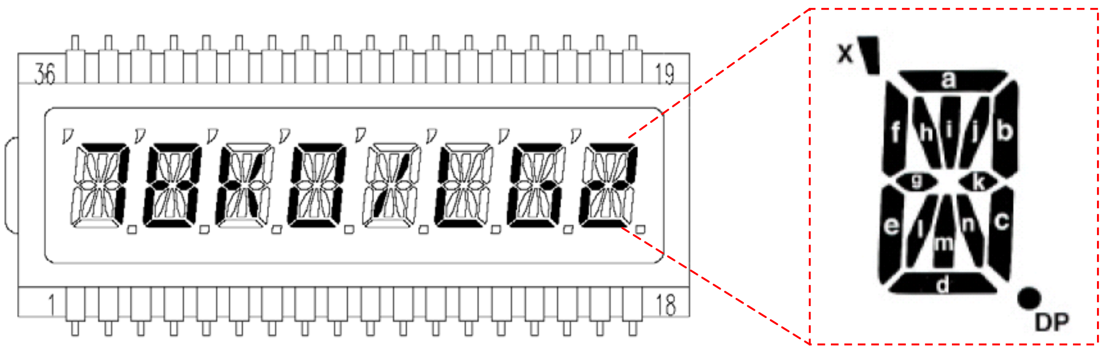
3.11 LCD1 Standard 112-Segment LCD

The DemoKit-LG2 board is equipped with a standard 112-segment LCD, in this case a transflective model operating at a 5-volt supply voltage. The LCD can operate at a four times multiplex rate. The display can be used within a temperature range from –20 to +70° Celsius. The typical driving frequency is equal to 32 Hz (maximum 100 Hz) within the complete temperature range. The LCD pin assignments, connections and segment definition is shown in Table 6:

Table 6. LCD Pin Assignments and Connections

LCD					78K0/LG2 MCU	LCD					78K0/LG2 MCU
Pin	COM1	COM2	COM3	COM4		Pin	COM1	COM2	COM3	COM4	
1	S1	1F	1E	1D	S0	36	1H	1G	1L	1M	S2
2	1I	1J	1K	1N	S1	35	1A	1B	1C	P1	S3
3	S2	2F	2E	2D	S4	34	2H	2G	2L	2M	S6
4	2I	2J	2K	2N	S5	33	2A	2B	2C	P2	S7
5	S3	3F	3E	3D	S8	32	3H	3G	3L	3M	S10
6	3I	3J	3K	3N	S9	31	3A	3B	3C	P3	S11
7	S4	4F	4E	4D	S12	30	4H	4G	4L	4M	S14
8	4I	4J	4K	4N	S13	29	4A	4B	4C	P4	S15
9	S5	5F	5E	5D	S16	28	5H	5G	5L	5M	S18
10	5I	5J	5K	5N	S17	27	5A	5B	5C	P5	S19
11	S6	6F	6E	6D	S20	26	6H	6G	6L	6M	S22
12	6I	6J	6K	6N	S21	25	6A	6B	6C	P6	S23
13	S7	7F	7E	7D	S24	24	7H	7G	7L	7M	S26
14	7I	7J	7K	7N	S25	23	7A	7B	7C	P7	S27
15	S8	8F	8E	8D	S28	22	8H	8G	8L	8M	S30
16	8I	8J	8K	8N	S29	21	8A	8B	8C	P8	S31
17	NC	NC	NC	COM4	COM4	20	COM0	NC	NC	NC	COM0
18	NC	NC	COM3	NC	COM3	19	NC	COM1	NC	NC	COM1

Figure 7. LCD / Segment Definition



3.12 Temperature Sensor

For temperature measurement and primarily as an application example, a silicon temperature sensor KTY13-5 is connected to the input port of the 16-bit timer/event counter 00, equal to port P00 of the MCU. The temperature sensor has a resistor range of $R_{25\,min}$ = 1950 Ω and $R_{25\,max}$ = 1990 Ω at 25° centigrade, with I_{OP} = 1 mA. The distribution of the temperature factor k_T is shown in Table 7:

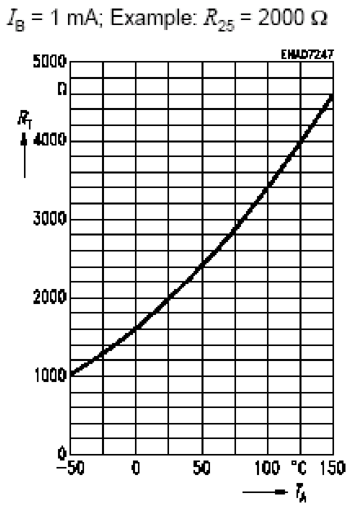
Table 7. Distribution of Temperature Factor k_T

T_A	k_T		
°C	min.	typ.	max.
– 50	0.506	0.518	0.530
– 40	0.559	0.570	0.581
– 30	0.615	0.625	0.635
– 20	0.676	0.685	0.694
– 10	0.741	0.748	0.755
0	0.810	0.815	0.821
10	0.883	0.886	0.890
20	0.960	0.961	0.962
25		1.0 [1]	
30	1.039	1.040	1.041
40	1.119	1.123	1.126
50	1.204	1.209	1.215
60	1.291	1.300	1.308
70	1.383	1.394	1.405
80	1.478	1.492	1.506
90	1.577	1.594	1.611
100	1.680	1.700	1.720
110	1.786	1.810	1.833
120	1.896	1.923	1.951
130	2.010	2.041	2.072
140	2.093	2.128	2.163
150	2.196	2.235	2.274

1. Normalizing point

The sensor resistance can be calculated as $R_T = k_T * R_{25} = \int(T_A)$.

Figure 8. Typical Dependence of Sensor Resistance



The following equation, which approximates the characteristic curve, calculates temperature at the sensor according to the change in the sensor's resistance:

$$T = \left(25 + \frac{\sqrt{\alpha^2 - 4 \times \beta + 4 \times \beta \times k_T} - \alpha}{2 \times \beta} \right) °C$$

with: $\alpha = 7{,}88 \times 10^{-3} \times K^{-1}$

$\beta = 1{,}937 \times 10^{-5} \times K^{-2}$

$k_T = \frac{R_T}{R_{25}}$

The temperature is measured using the dual-slope method in which a resistor value can be converted into a digital countervalue. To do this, the charging time of capacitor C_{18} will be measured with the 16-bit timer/event counter 00 of the MCU. The first charging slope will use a reference resistor ($R_{REF} = R_6$) and the second charging slope a variable resistor ($R_{VAR} = R_5 + R_T$), which should be determined. By comparing the two measured times and the known reference resistor R_{REF}, the variable resistor can be calculated.

All of the 78K0/LX2 MCUs have bit-settable I/O ports and Schmitt-trigger inputs such as the TI000 timer input port. The DemoKit-LG2 uses the P0 bit-settable port as a bidirectional port.

At first, the complete port P0 is cleared and set to output mode. In this case, the C_{18} capacitor is discharged via P00/TI000 and prepared for the first measurement. The R_7 resistor is only used to limit the current during the discharging of the capacitor. Then port P02 is set to 1 and output. At this point, the 16-bit timer/event counter 00 is started. The rest of the port P0 is set to input (high impedance). So the capacitor will be charged via the R_6 reference resistor. When the capacitor has reached the threshold level of the Schmitt-trigger input P00/TI000, the actual timer value is automatically captured and an internal interrupt is generated. The capture value is read using this interrupt. In the next step, the C_{18} capacity will be discharged again. The same procedure starts once more with port P03. This time the capacitor is charged via the unknown resistor R_{VAR} of the temperature sensor and after the threshold is reached again the second timer value is read out.

The unknown R_{VAR}, and consequently the resistor value of the temperature sensor, can be calculated from the two values obtained using the method described earlier.

$$R_{REF}: \; R_6 = V_{CREF} = V_{DD}\left(1 - e^{-\frac{t_{REF}}{R_{REF} \times C}}\right)$$

$$R_{VAR}: \; R_5 + R_T = V_{CREF} = V_{DD}\left(1 - e^{-\frac{t_{VAR}}{R_{VAR} \times C}}\right)$$

$$V_C = V_{CVAR} = V_{CREF} = const$$

The threshold level of the Schmitt-trigger input does not have any influence on the accuracy of the measurement, as this will be a constant for both measurements.

$$V_{DD}\left(1 - e^{-\frac{t_{REF}}{R_{REF} \times C}}\right) = V_{DD}\left(1 - e^{-\frac{t_{VAR}}{R_{VAR} \times C}}\right)$$

$$1 - e^{-\frac{t_{REF}}{R_{REF} \times C}} = 1 - e^{-\frac{t_{VAR}}{R_{VAR} \times C}}$$

$$e^{-\frac{t_{REF}}{R_{REF} \times C}} = e^{-\frac{t_{VAR}}{R_{VAR} \times C}}$$

$$\frac{t_{REF}}{R_{REF} \times C} = \frac{t_{VAR}}{R_{VAR} \times C}$$

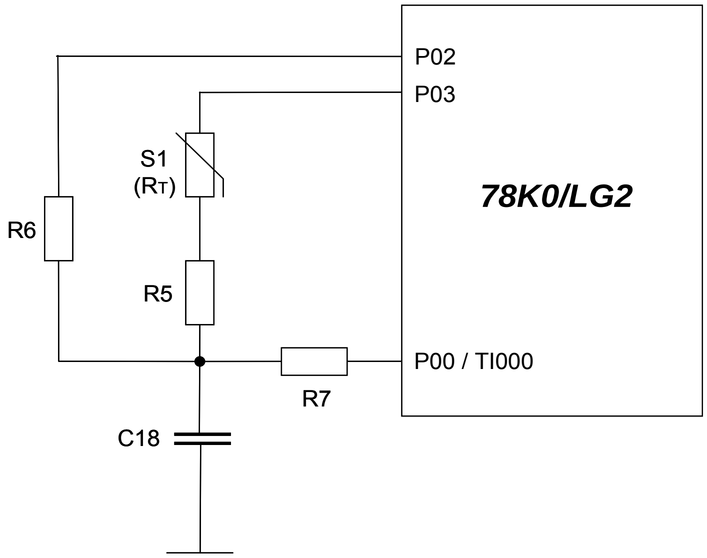
$$\frac{t_{REF}}{R_{REF}} = \frac{t_{VAR}}{R_{VAR}}$$

$$R_{VAR} = R_{REF} \times \frac{t_{VAR}}{t_{REF}}$$

The C_{18} capacitor and V_{DD} supply voltage do not influence the accuracy of the measurement. Only the absolute value of the R_{REF} reference resistor has an influence, because these parameters will not change during one measurement. The R_{VAR} resistor can be calculated using the R_{REF}, t_{REF} and t_{VAR} values.

Figure 9 shows a diagram of the dual-slope circuit:

Figure 9. Dual-Slope Circuit



R_{REF} = R6
R_{VAR} = R5 + R_T

R_T = temperature sensor resistance

The charging time of the capacitor can be calculated as follows:

$$V_C = V_{DD}\left(1 - e^{-\frac{t}{R \times C}}\right)$$

$$\frac{V_C}{V_{DD}} = 1 - e^{-\frac{t}{R \times C}}$$

$$1 - \frac{V_C}{V_{DD}} = e^{-\frac{t}{R \times C}}$$

$$-\frac{t}{R \times C} = \ln\left(1 - \frac{V_C}{V_{DD}}\right)$$

$$t = -R \times C \times \ln\left(1 - \frac{V_C}{V_{DD}}\right)$$

Example:

V_{DD} = 5 V; $V_{threshold}$ = V_C = (0,4 … 0,7) V_{DD}
Typical: $V_{threshold}$ = 0,6 × V_{DD}
R_{REF} = 10 kΩ; C = C_{18} = 220 nF

$$t = - R_{REF} \times C \times \ln\left(1 - \frac{V_C}{V_{DD}}\right)$$

$$t = - 10\ k\Omega \times 220\ nF \times \ln\left(1 - 0\right.$$

$$t = 2{,}0158\ ms$$

3.13 Q1 Phototransistor

For light incidence measurement and primarily as an application example, a PT15-21C phototransistor is connected to the ANI0 analog input, which is equal to port P20 of the MCU.

3.14 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 01, equal to port P06/TI011/TO01 of the MCU. The AC buzzer operates in a voltage range of 2–5 volts.

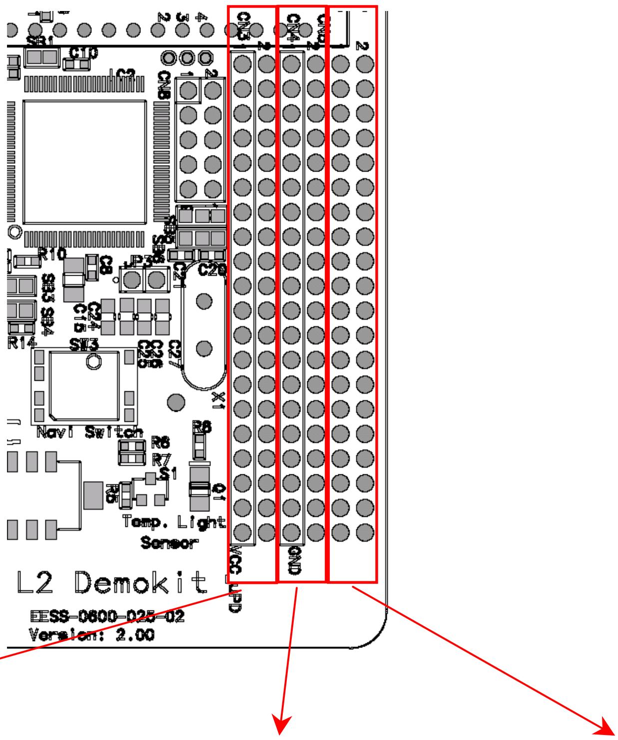
3.15 BAT1 Battery Holder

To power the board via battery, equip the BAT1 battery holder with a CR2032 3-volt lithium coin-type battery.

3.16 CN3, CN4 and CN5 External Connectors

CN3, CN4 and CN5 are connectors for external user hardware. The MCU signals are connected to CN3, CN4 and CN5. The DemoKit-LG2 board also provides a wire-wrap field area—connector CN3—for the integration of additional application hardware.

Figure 10. CN3, CN4, and CN5 Connections to MCU



CN3	Signal	CN3	Signal
1	Vcc	2	P25/ANI5
3	Vcc	4	P26/ANI6
5	Vcc	6	P27/ANI7
7	Vcc	8	P30/INTP1
9	Vcc	10	P31/INTP2
11	Vcc	12	P32/INTP3
13	Vcc	14	P33/INTP4/TI51/TO51
15	Vcc	16	P60/SCL0
17	Vcc	18	P61/SDA0
19	Vcc	20	P70/KR0
21	Vcc	22	P71/KR1
23	Vcc	24	P72/KR2
25	Vcc	26	P73/KR3
27	Vcc	28	P74/KR4
29	Vcc	30	P75/KR5
31	Vcc	32	P76/KR6
33	Vcc	34	P77/KR7
35	Vcc	36	P120/INTP0/EXLVI
37	Vcc	38	P121/X1
39	Vcc	40	P122/X2

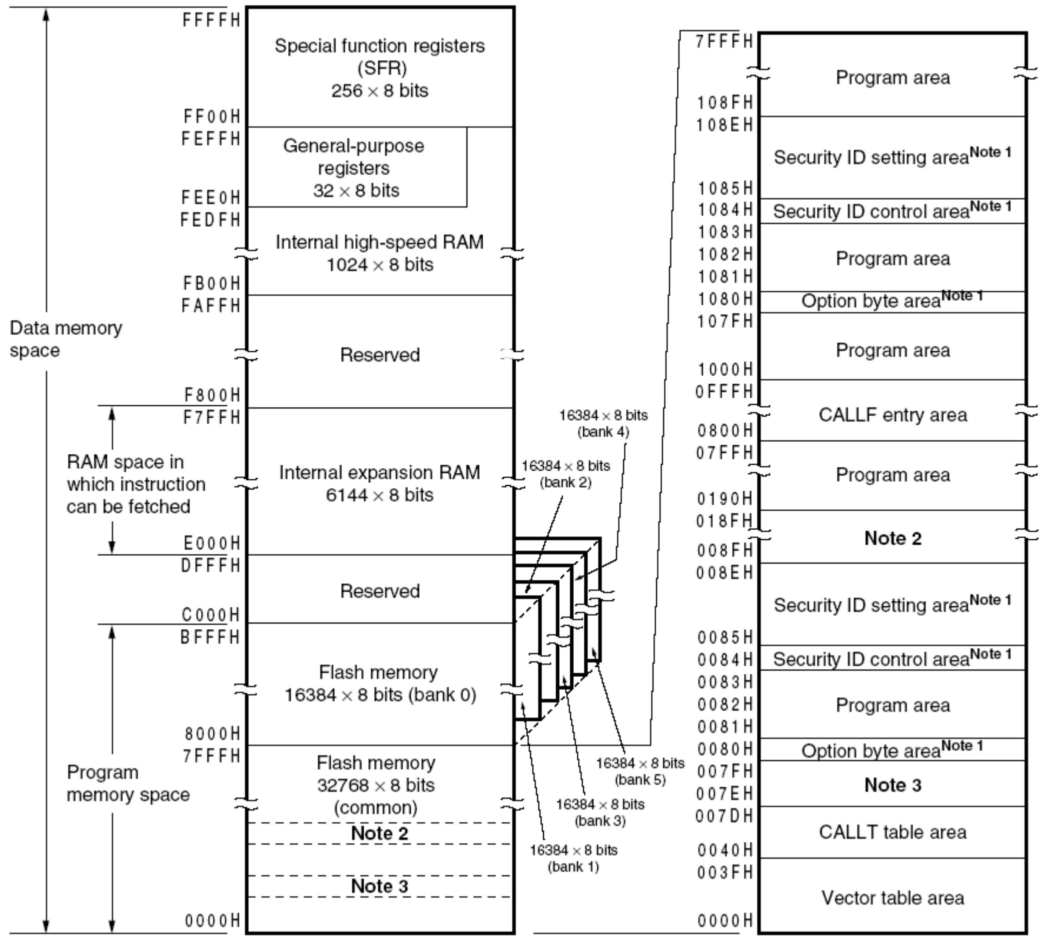
CN 4	Signal	CN4	Signal
1	Vss	2	P00/TI000
3	Vss	4	P01/TI010/TO00
5	Vss	6	P02/SO11
7	Vss	8	P03/SI11
9	Vss	10	P04/SCK11
11	Vss	12	P05/TI001/SSI11
13	Vss	14	P06/TI011/TO01
15	Vss	16	P10/SCK10/TXD0
17	Vss	18	P11/SI10/RXD0
19	Vss	20	P12/SO10
21	Vss	22	P13/TXD6
23	Vss	24	P14/RXD6
25	Vss	26	P15/TOH0
27	Vss	28	P16/TOH1/INTP5
29	Vss	30	P17/TI50/TO50
31	Vss	32	P20/ANI0
33	Vss	34	P21/ANI1
35	Vss	36	P22/ANI2
37	Vss	38	P23/ANI3
39	Vss	40	P24/ANI4

CN5	Signal	CN5	Signal
1	N.C.	2	P123/XT1
3	N.C.	4	P124/XT2
5	N.C.	6	N.C.
7	N.C.	8	N.C.
9	N.C.	10	N.C.
11	N.C.	12	N.C.
13	N.C.	14	N.C.
15	N.C.	16	N.C.
17	N.C.	18	N.C.
19	N.C.	20	N.C.
21	N.C.	22	N.C.
23	N.C.	24	N.C.
25	N.C.	26	N.C.
27	N.C.	28	N.C.
29	N.C.	30	N.C.
31	N.C.	32	N.C.
33	N.C.	34	N.C.
35	N.C.	36	N.C.
37	N.C.	38	N.C.
39	N.C.	40	N.C.

3.17 Microcontroller Memory Map

The MCU's memory layout is shown in Figure 11.

Figure 11. Microcontroller Memory Map



Notes 1. 1080H, 1084H, 1085H to 108EH: Set the option byte, security ID control flag, and security ID code when the boot swap is used.
0080H, 0084H, 0085H to 008EH: Set the option byte, security ID control flag, and security ID code when the boot swap is not used.

2. This area cannot be used during on-chip debugging because it is used for communication commands (008FH to 018FH: standard setting of debugger).

3. This area cannot be used when a software break is used during on-chip debugging.

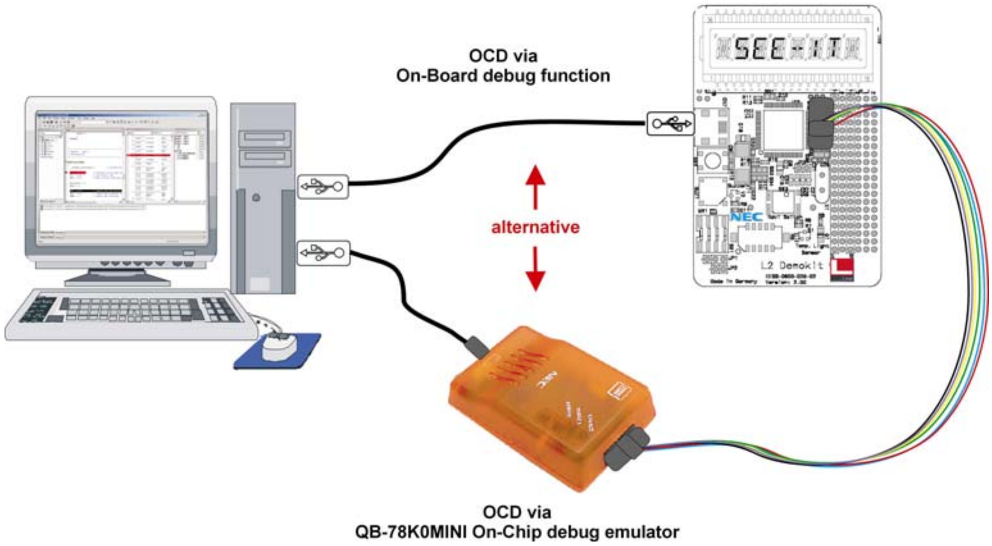
The DemoKit-LG2 does not reserve any resources of the MCU; consequently all available MCU memory is free for application software.

4. On-Chip Debugging

The DemoKit-LG2 board offers two possibilities for on-chip debugging (OCD). The on-board debugging function allows on-chip debugging without a need for external debugging hardware. In this mode, the default USB / UART connection to the host computer serves as the debugging interface. All standard debugging functions, such as flash programming / downloading, code execution, single-step command execution, breakpoint setting, memory manipulation and so forth, are available in this mode.

The DemoKit-LG2 also supports use of the QB-78K0MINI on-chip debugging emulator to enable the MCU's on-chip debugging function. The system configuration for this type of debugging is shown in Figure 12.

Figure 12. System Configuration for On-Chip Debugging



4.1 On-Board Debugging

To enable the DemoKit-LG2's on-board debugging mode, you must configure switch SW1 and the JP1–JP3 jumpers as described in Table 8.

Table 8. Switch and Jumper Settings for On-Board Debugging

Switch/Jumper	Setting	Mode
SW1/S1	OFF	Normal operation
SW1/S2	OFF	UART6 select
SW1/S3	ON	OCD enabled
SW1/S4	OFF	On-board debugging function
JP1	1–2 closed	Power supply via USB
JP2	Open	Power supply via USB
JP3	Closed	Clock supplied via CPLD

4.2 On-Chip Debugging with the QB-78K0MINI Emulator

To use the QB-78K0MINI on-chip debugging emulator to enable the MCU's on-chip debugging function, you must configure the SW1 switches and jumpers JP1–JP3 as described in Table 9.

Table 9. Switch and Jumper Settings for On-Chip Debugging with the QB-78K0MINI Emulator

Switch/Jumper	Setting	Mode
SW1/S1	OFF	Normal operation
SW1/S2	OFF	UART6 select
SW1/S3	ON	OCD enabled
SW1/S4	ON	QB-78K0MINI enabled
JP1	1–2 closed	Power supply via USB
JP2	Open	Power supply via USB
	Closed	Power supply via QB-78K0MINI (*Note)
JP3	Open	Clock supplied via QB-78K0MINI

Note: When using power from the QB-78K0MINI, do not connect external hardware to the DemoKit-LG2 board as the board can operate without external USB or battery power.

5. Installation and Operation

The Windows-based FPL3 flash programming software enables selection and downloading of application programs to the DemoKit-LG2 board. The board communicates with a host computer via a USB interface that must be installed properly before you can download and run a program.

Figure 13. CD-ROM Directory Structure

DemoKit-LG2 (F:)	CD-ROM ROOT
fscommand	
NECTools	- NEC Electronics Software Tools
FPL3	- FPL3 flash programming software
Drivers	… USB driver
FPL3	… FPL3 setup directory
PRM	… PRM parameter files
SampleProgram	- Sample program for DemoKit-LG2
Documentation	- Documentation

5.1 Hardware Installation

Connect the board to the host computer using the provided USB interface cable.

5.2 Software Installation

The DemoKit-LG2 package comes with several software demo packages:

- NEC Electronics software tools for 78K0 MCUs, including a C compiler, assembler, linker, librarian and ID78K0-TK/ID78K0-QB debuggers.
- FPL3 flash programming software
- Sample program

5.2.1 Software Tools

To install the NEC Electronics software tools for 78K0 MCUs, select the `SETUP` program in the `\fscommand\NECTools\` directory of the CD-ROM. The **Setup** boxes will guide you through the installation process. The product ID for DemoKit-LG2 is 00101386V.

5.2.2 FPL3 Flash Programming GUI Installation

To install the FPL3 flash programming GUI, select the `SETUP` program in the `\fscommand\FPL3\` directory of the CD-ROM. The **Setup** boxes will guide you through the installation process.

5.2.3 Sample Program

To use sample/demonstration program for the DemoKit-LG2 board, copy the directory \fscommand\SampleProgram\ on the CD-ROM to you local hard drive. Remember to remove the "read only" attribute from the files.

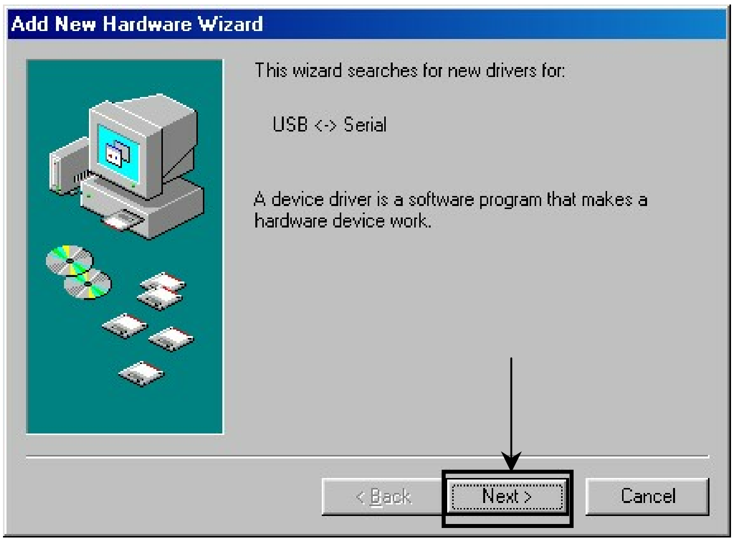
5.2.4 USB Driver Installation

To use the board for on-chip debugging or flash programming, install the USB driver in accordance with the procedure for your particular operating system.

5.2.4.1 Installation on Windows 98SE/Me

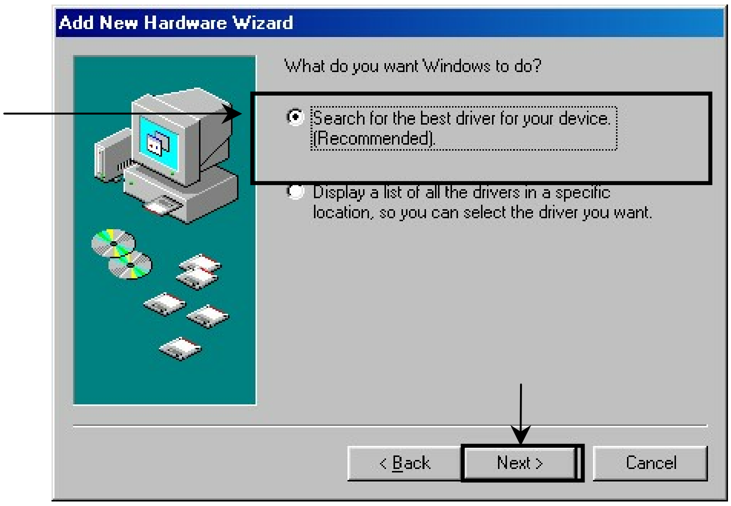
1. When you connect the board to the host computer, the Plug and Play function recognizes the board and initializes the wizard for adding new hardware. Click **Next**.

Figure 14. Add New Hardware Wizard (Windows 98SE)



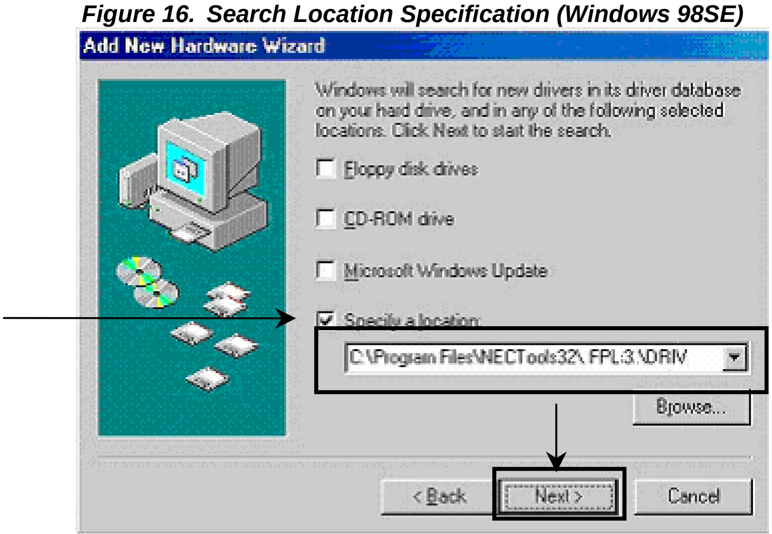
2. Select the **Search for the best driver for your device** box and then click **Next**.

Figure 15. Search Method (Windows 98SE)



3. Select the **Specify a location** box, browse to and select **C:\ProgramFiles\NECTools32\FPL3\DRIVER**, and then click **Next**.

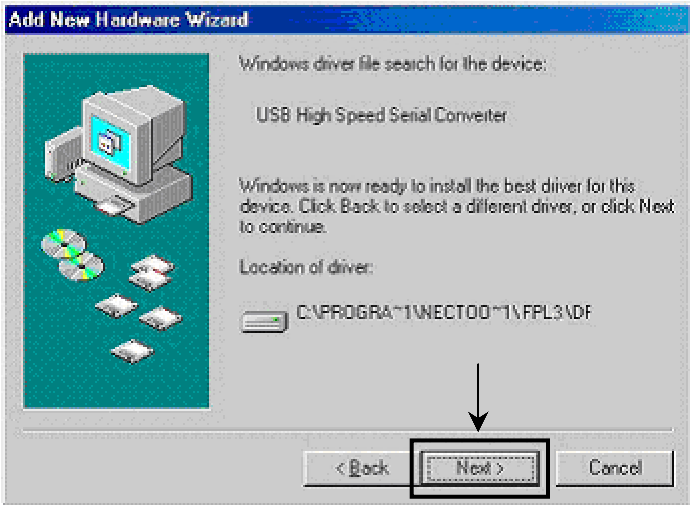
Figure 16. Search Location Specification (Windows 98SE)



Note: If the destination folder changes when the GUI software is installed, type the ***new-folder\DRIVER*** name in the **Specify a location** box.

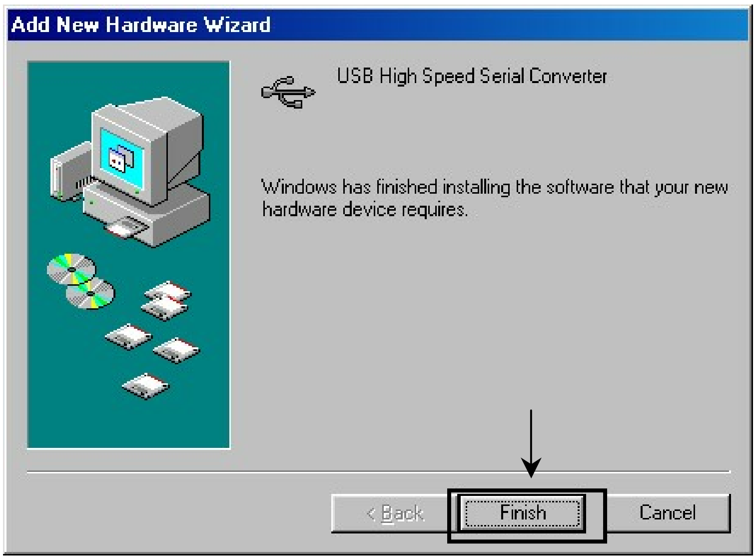
4. Click **Next**.

Figure 17. Checking Driver to Be Installed (Windows 98SE)



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

Figure 18. Installation Completion (Windows 98SE)



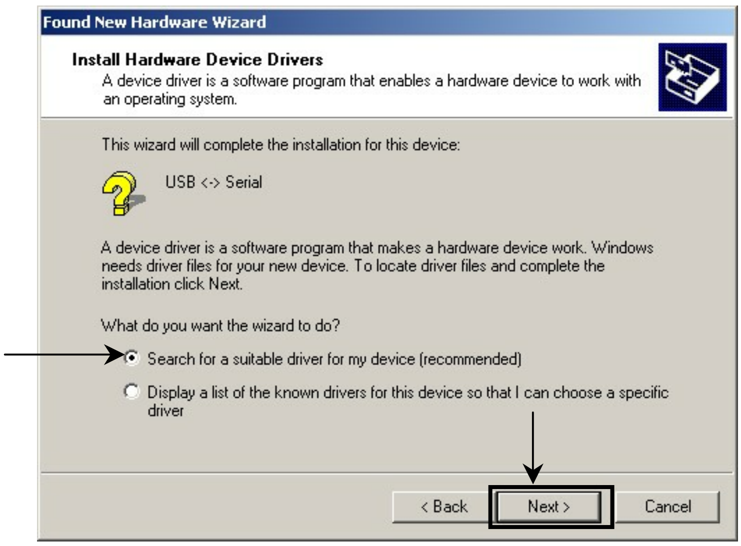
5.2.4.2 Installation on Windows 2000

1. When you connect the board to the host computer, the Plug and Play function recognizes the board and initializes the wizard for adding new hardware. Click **Next**.

Figure 19. Found New Hardware Wizard 1 (Windows 2000)

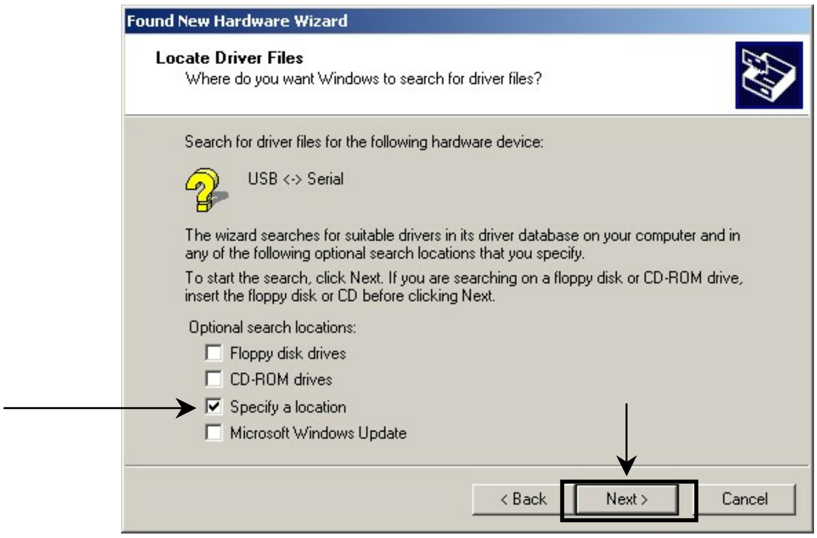
2. Select the **Search for a suitable driver for my device** box and then click **Next**.

Figure 20. Search Method 1 (Windows 2000)



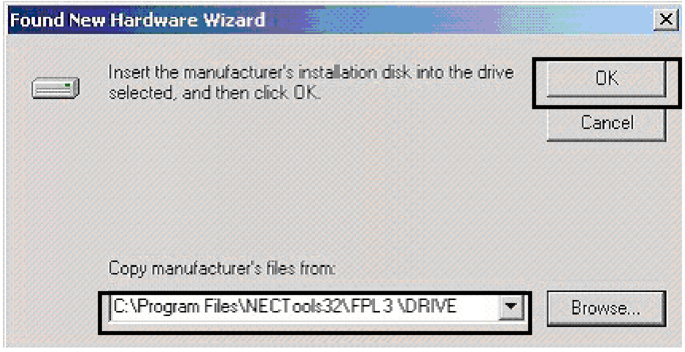
3. Select the **Specify a location** box and then click **Next**.

Figure 21. Driver File Location 1 (Windows 2000)



4. Browse to and select **C:\Program Files\NECTools32\FPL3\DRIVER** and then click **OK**.

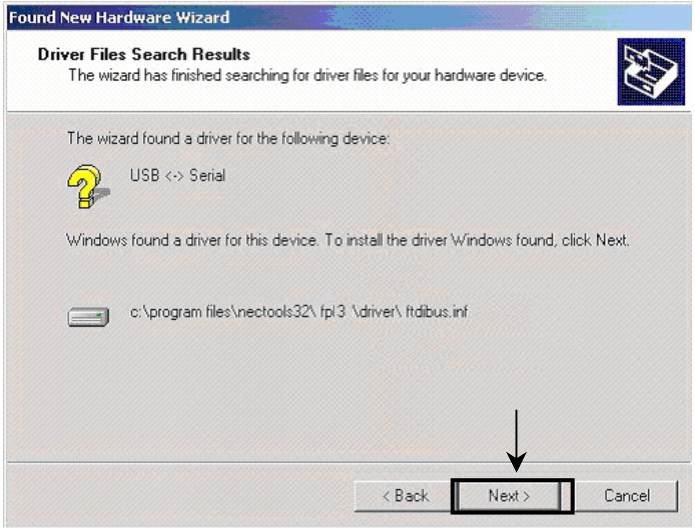
Figure 22. Address Specification 1 (Windows 2000)



Note: If the destination folder changes when the GUI software is installed, type the ***new-folder*\FPL3\DRIVER** name in the **Copy manufacturer's files from**: box.

5. Click **Next**.

Figure 23. Driver File Search 1 (Windows 2000)



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

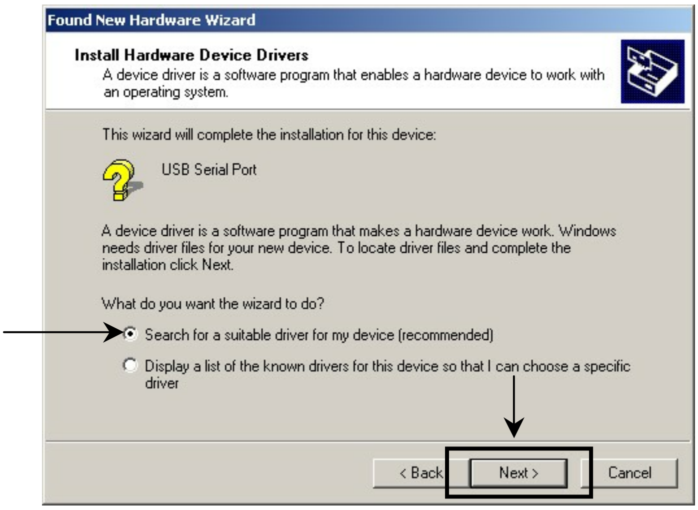
Figure 24. USB Serial Converter Installation (Windows 2000)

7. To proceed to the USB driver installation, click **Next**.

Figure 25. Found New Hardware Wizard 2 (Windows 2000)

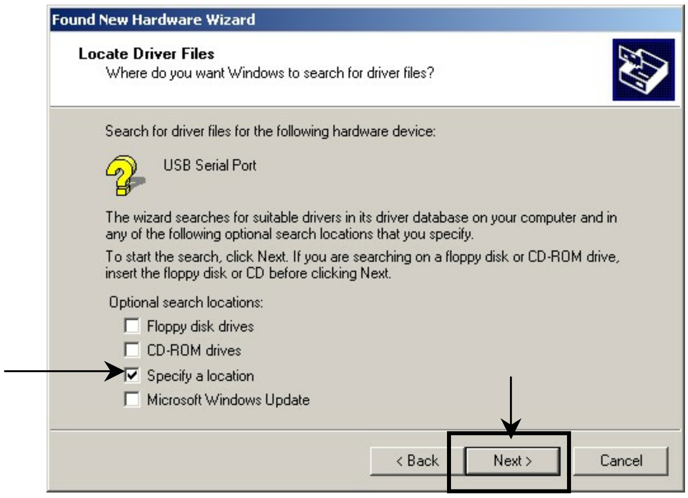
8. Select the **Search for a suitable driver for my device** box and click **Next**.

Figure 26. Search Method 2 (Windows 2000)



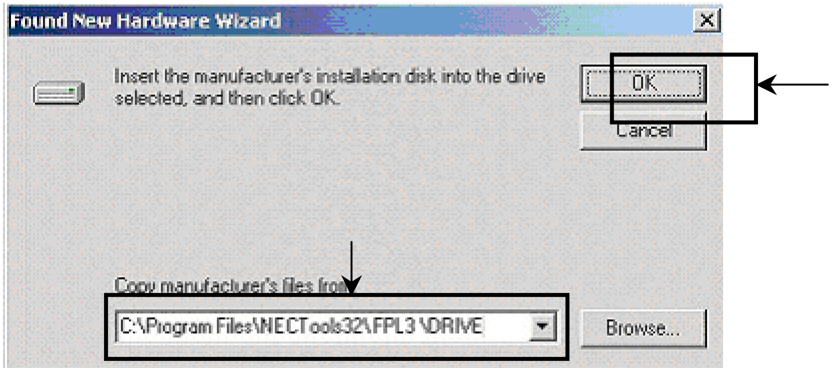
9. Select the **Specify a location** box and click **Next**.

Figure 27. Driver File Location 2 (Windows 2000)



10. Browse to and select **C:\Program Files\NECTools32\FPL3\DRIVER** and then click **OK**.

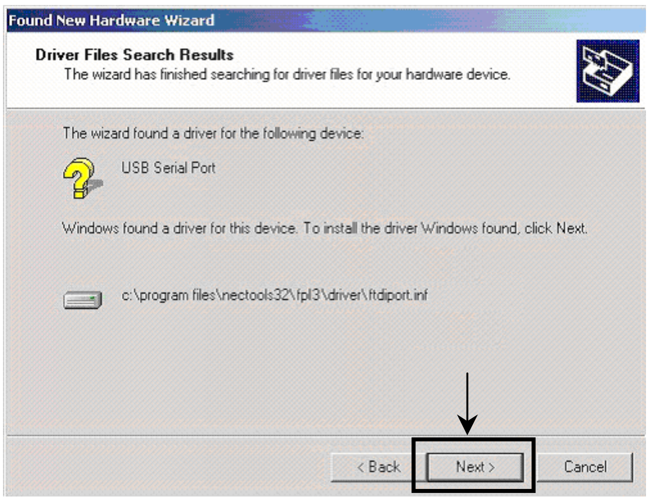
Figure 28. Address Specification 2 (Windows 2000)



Note: If the installation destination folder changes at the time of GUI software installation, enter the ***new-folder*\DRIVER** name in the **Copy manufacturer's files from** box.

11. Click **Next**.

Figure 29. Driver File Search 2 (Windows 2000)



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

Figure 30. USB Driver Installation (Windows 2000)

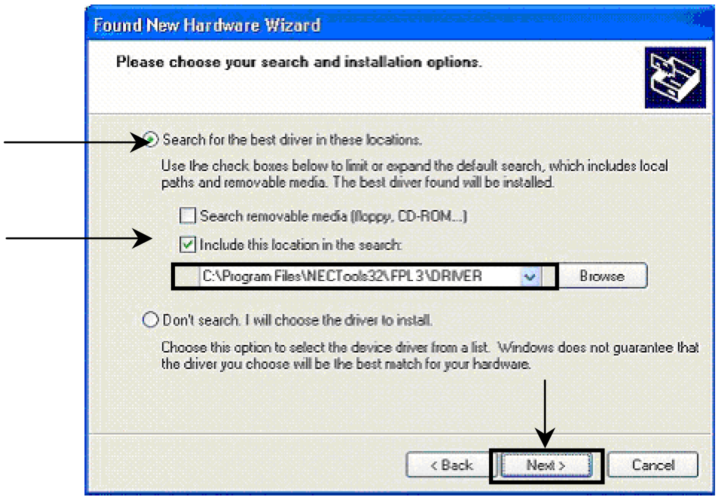
5.2.4.3 Installation on Windows XP

1. After the board is connected to the host computer, the Plug and Play function recognizes the board and initializes the wizard for finding new hardware. Select the **Install from a list or specific location** box and then click **Next**.

Figure 31. Found New Hardware Wizard 1 (Windows XP)

2. Select the **Search for the best driver in these locations** and **Include this location in the search:** boxes, browse to and select **C:\Program Files\NECTools32\FPL3\DRIVER**, and then click **Next**.

Figure 32. Search Location Specification 3 (Windows XP)



3. When you receive the *has not passed Windows Logo testing to verify its compatibility with Windows XP* message, click **Continue Anyway**.

Figure 33. Windows XP Logo Testing 3 (Windows XP)

4. Click **Finish** to finish the installation of the converter.

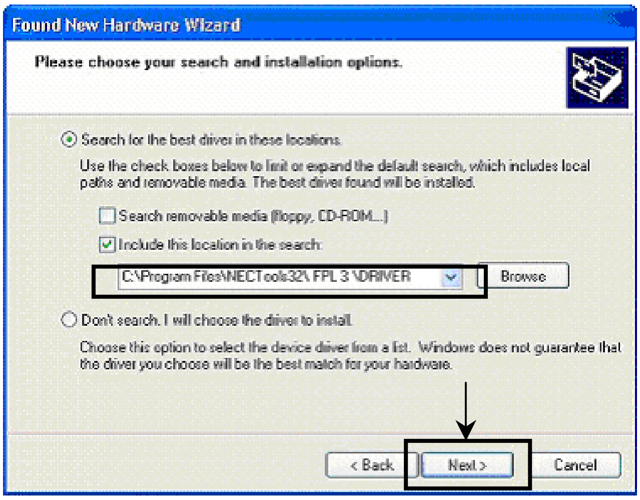
Figure 34. USB Serial Converter Installation (Windows XP)

5. To proceed to the installation of the USB serial port driver, click **Next**.

Figure 35. Found New Hardware Wizard 2 (Windows XP)

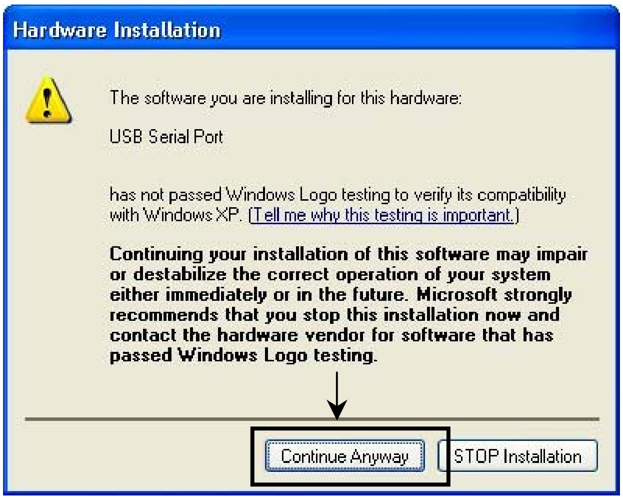
6. Select the **Search for the best driver in these locations** and **Include this location in the search:** boxes, browse to and select **C:\Program Files\NECTools32\FPL3\DRIVER**, and then click **Next**.

Figure 36. Search Location Specification 2 (Windows XP)



7. When you receive the *has not passed Windows Logo testing to verify its compatibility with Windows XP* message, clock **Continue Anyway**.

Figure 37. Windows XP Logo Testing 2 (Windows XP)



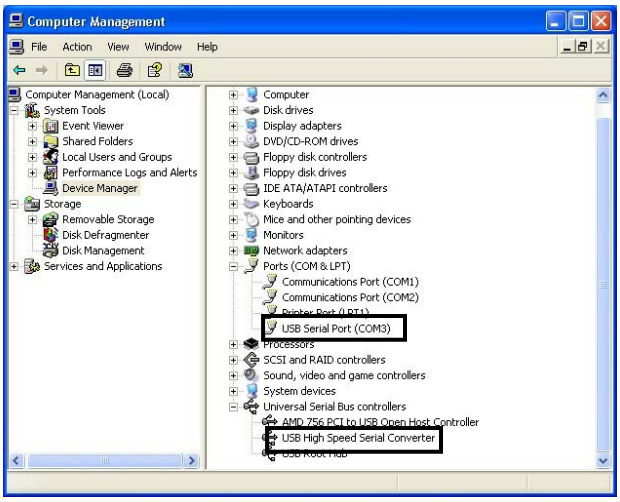
8. Click **Finish** to complete the installation of the driver.

Figure 38. USB Serial Port2 Driver Installation Completion (Windows XP)

5.3 Confirmation of USB Driver Installation

After installing the two types of drivers, which are needed for using the DemoKit-LG2 board with FPL3 GUI, you can verify that they were installed successfully by checking the **Device Manager** directory.

Figure 39. Device Manager Directory



- ♦ For Windows 98SE/Me: Do not execute **Update** and **Erase** commands when communicating with the target device.
- ♦ For Windows 200/XP: Do not execute a **Hardware Modification Scan** when communicating with the target device.
- ♦ In the **GUI port** list, select the same communication port as COM? of the USB serial port.
- ♦ If the drivers highlighted in Figure 39 are not displayed, or the mark "×" or "!" is prefixed, refer to Section 10, "Troubleshooting."

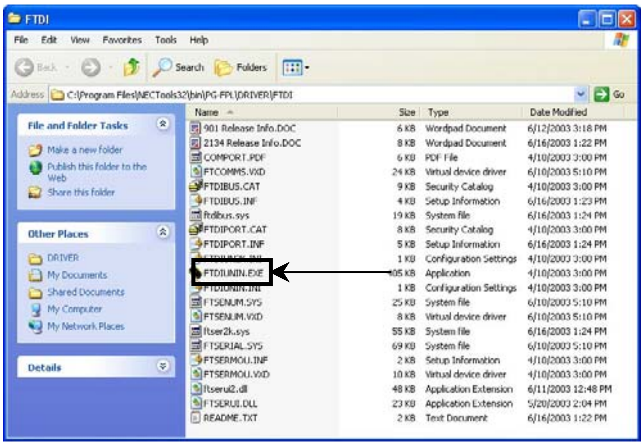
5.4 Driver Uninstallation

The driver uninstallation program is installed on the host computer when the FPL3 software is installed. Use the procedure below for uninstalling the USB driver.

1. When using Windows XP, log on as the computer administrator. When using Windows 2000, log on as the Administrator.

2. Double-click **My Computer** → **C:\Program Files** → **NECTools32** → **FPL3** → **DRIVER** → **Ftdiunin.exe**.

Figure 40. Driver Uninstallation



3. Click **Continue**.

Figure 41. FTDI Uninstaller

4. Click **Finish** to complete driver uninstallation.

Figure 42. Completion of Driver Uninstallation

Caution: If the GUI software was uninstalled earlier, then the Ftdiunin.exe file was also deleted. At this time, manually delete "USB Serial Port (COM?)" and "USB High Speed Serial Converter" from the **Device Manager** directory.

6. FPL3 Flash Programming Software

The MCU's parameter file is automatically stored in the <FPL3 install-path>\PRM folder during installation of the FPL3 GUI. Nevertheless, the most up-to-date file can be downloaded from the NEC Electronics America web site at http://www.am.necel.com/microcontrollers/devtools.php and copied into *<FPL3.EXE-install-path>\PRM*. Refer to Section 5.2, "Software Installation."

6.1 Starting the GUI Software

On the **Start** menu, click FPL3.EXE to initialize the GUI software (Figure 43).

Figure 43. Main Window of the GUI Software

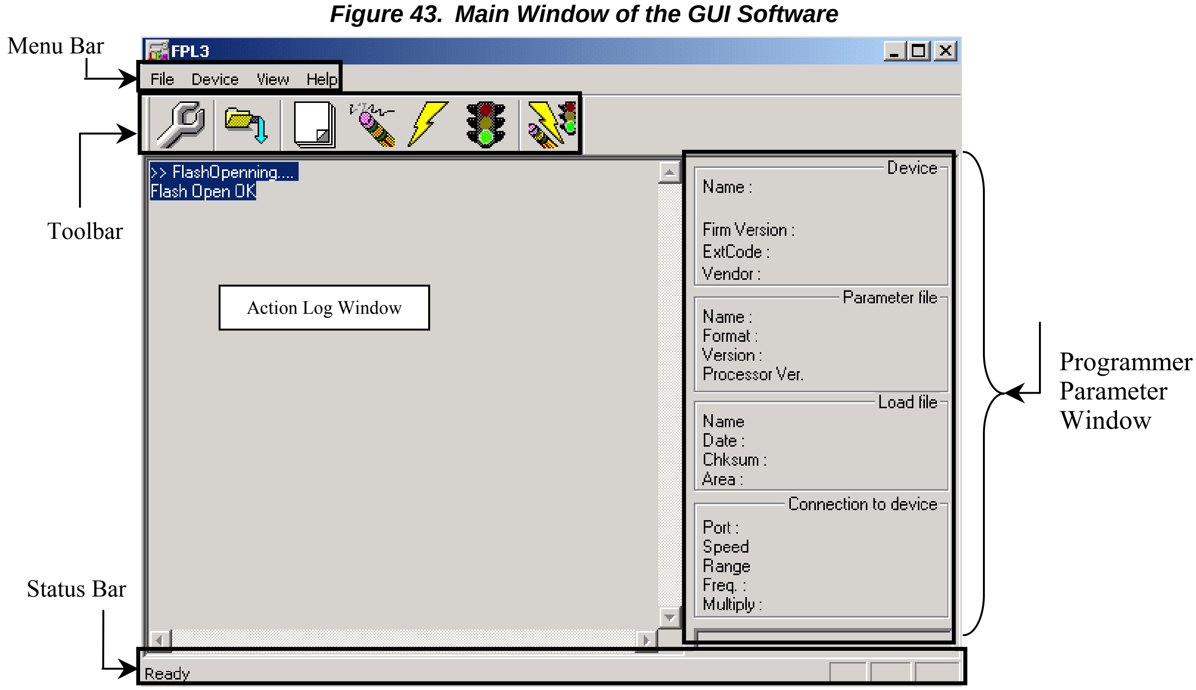


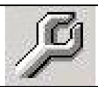
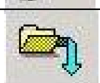
Table 10. Components of the Main Window

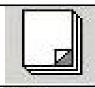
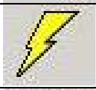
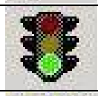
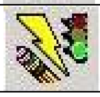
Name	Description
Menu bar	Displays FPL3-executable commands
Toolbar	Displays icons of frequently used commands
Action Log window	Displays FPL3 action log
Programmer Parameter window	Displays programming parameter settings
Status bar	Displays status information

6.2 Toolbar

The toolbar contains buttons for executing FPL3 commands (Figure 44).

Figure 44. Toolbar Buttons

	Device → Setup button
	File → Load button

	Device → Blank Check button
	Device → Erase button
	Device → Program button
	Device → Verify button
	Device → Autoprocedure(EPV) button

6.3 Menu Bar

Depending on the actual device status and type, some commands of the commands discussed in this section may be disabled.

6.3.1 File Menu

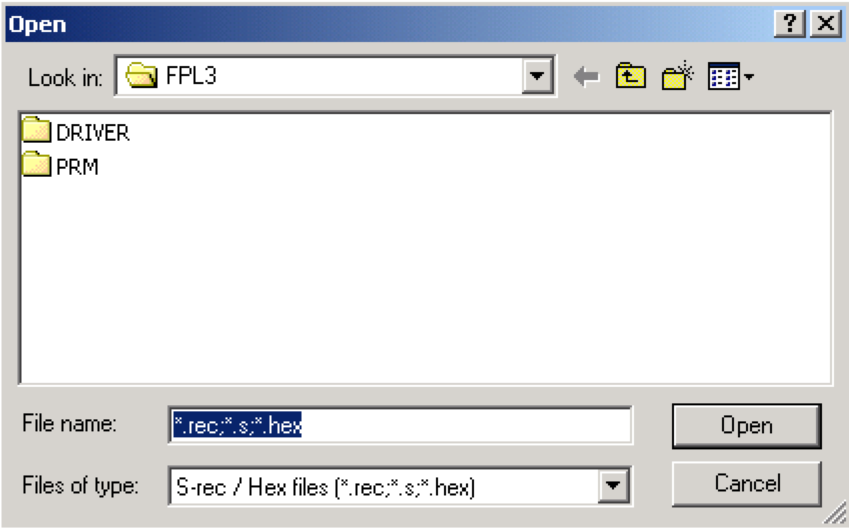
The **File** menu displays a list of commands related to file operation.

Figure 45. File Menu

6.3.1.1 Load Command

The **Load** command selects the file to be programmed into the MCU's flash memory.

Figure 46. Open Dialog Box



The **Open** dialog box displays the directory containing the most recently loaded user program. After the program is loaded, the checksum is calculated, and the result displayed in the **Programmer Parameter** window.

6.3.1.2 Quit Command

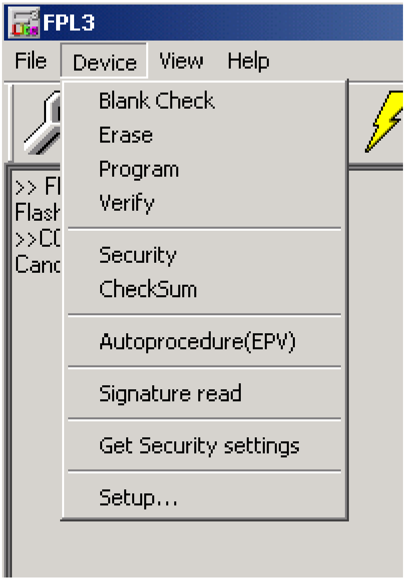
The **Quit** command terminates the FPL3 GUI software. (Clicking × on the right of the task bar also terminates the FPL3 GUI software.)

User settings are saved in the FPL3.INI file to preserve them for the next session. FPL3.INI is stored in the Windows folder in Windows 98SE, Windows Me, and Windows XP operating systems. In Windows 2000, FPL3.INI is stored in the Winnt folder.)

6.3.2 Device Menu

The **Device** menu displays the programming commands.

Figure 47. Device Menu



6.3.2.1 Blank Check Command

The **Blank Check** command executes a blank check on the target device connected to the FPL3 programmer. If the target MCU's flash memory has been erased, the blank check terminates normally. If the flash memory has not been erased completely, the program displays a *not blank* message, after which you will need to execute an **Erase** command.

6.3.2.2 Erase Command

The **Erase** command erases the flash memory of the MCU connected to the FPL3 programmer. While the flash memory is being erased, the Action Log window displays the progress. Upon completion, the GUI software displays the result of the command on the target device.

Execution of a **Blank Check** command before an **Erase** command depends on the setting of the Advance properties in the **Device Setup** box (Table 13).

6.3.2.3 Program Command

The **Program** command sends a specified user program to the target device and writes the program to the device's flash memory. During programming, the Action Log window displays the progress. Upon completion, the GUI software displays the result of the command on the target device.

Execution of a **Verify** command after execution of a **Program** command depends on the settings of the Advance properties in the **Device Setup** box (Table 12).

6.3.2.4 Verify Command

The **Verify** command sends a specified user program to the target device and verifies the program against the data written to the device's flash memory. During verification, the Action Log window displays the progress. Upon completion, the GUI software displays the result of the command on the target device.

6.3.2.5 Security Command

The **Security** command programs the security flag of the target device connected to the FPL3 (Table 12).

6.3.2.6 Checksum Command

The **Checksum** command reads the checksum value of the target device connected to the FPL3. This value differs from the value displayed in the Programmer Parameter window.

6.3.2.7 Autoprocedure(EPV) Command

The **Autoprocedure(EPV)** command executes **Erase**, **Program**, and **Verify** commands in succession. During execution, the Action Log window displays the progress. Upon completion, the GUI displays the results. For detailed information, refer to Section 7, "How to Use the FPL3 Flash Programmer."

To have data written to flash memory automatically verified after a **Program** command, click **Device** → **Setup**. On the **Advance** tab, select **Read verify after Program** (Table 12).

6.3.2.8 Signature Read Command

The **Signature read** command reads the target device's signature information, including device name, flash memory information, and so forth.

6.3.2.9 Setup Command

The **Setup** command allows you to select user environment and command options. Upon initialization, the GUI software reverts to the most recently used parameter file (.PRM). The **Setup** command allows you to modify those settings.

- ***Standard Properties***: The **Standard** tab contains options for the parameter file, host connection, supply oscillator, and operating mode. Refer to the user's manual for the target device when setting properties.

Figure 48. Device Setup Box: Standard Tab

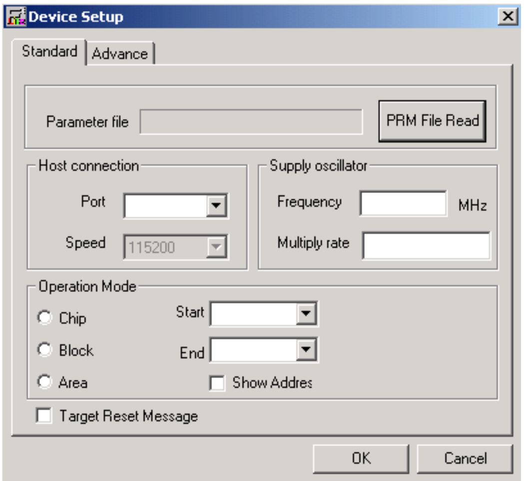


Table 11. Device Setup Box: Standard Properties

Group/Item	Option	Description
Parameter file	—	Specifies the parameter file to be rewritten into the target MCU's flash memory
		Note: parameter file data must not be revised because it is related to the guarantee of rewrite data. The checksum function protects the parameter file. If the checksum result indicates an error, the FPL3 does not accept the file.
PRM File Read button	—	Opens a window for specifying a parameter file is displayed. Specify a desired file then click **<u>O</u>pen**
Host connection	Port list box	Selects a channel from COM1 to COM256 for communication between the DemoKit-LG2 board and host computer
		Ports also can be selected using the Device Manager, as explained in Section 5.3, "Confirmation of USB Driver Installation."
	Speed list box	Selects a communication rate for the selected communication channel: • 9600 bps • 19200 bps • 38400 bps • 115200 bps For selectable communication rates, refer to the MCU user's manual.
Supply oscillator	Frequency box	Sets the clock frequency of the target system; operating frequency varies by device, so always check device specifications before setting the frequency
	Multiply rate	Specifies the division rate or multiplication rate of the target device. If the target device has an on-chip PLL circuit, enter a division rate or multiplication rate according to the user environment. The selectable division rate or multiplication rate differs depending on the device
		Before making a selection, check the specifications of the device used. If the target device does not have an on-chip PLL circuit, select "1.0". On the initial screen, the default setting is displayed according to the parameter file.

Group/Item	Option	Description
Operation Mode (some modes not available in all devices)	Chip	Subjects the entire flash memory area of the target device to rewriting
	Block	Specifies a block of flash memory to be rewritten
	Area	Specifies an area to be rewritten. The Start/End list boxes display the Area numbers where the flash memory of the target device is configured.
	Show Address box	Specifies whether numbers or addresses are displayed in the Start/End boxes. If selected, addresses are displayed. If not selected, numbers are displayed.
Target Reset Message	—	Displays the window promoting the manual reset operation, even when the reset signal cannot be connected to the target cable.

- ***Advance Properties***: The **Advance** tab contains command options and security flag settings.

Figure 49. Device Setup Box: Advance Tab

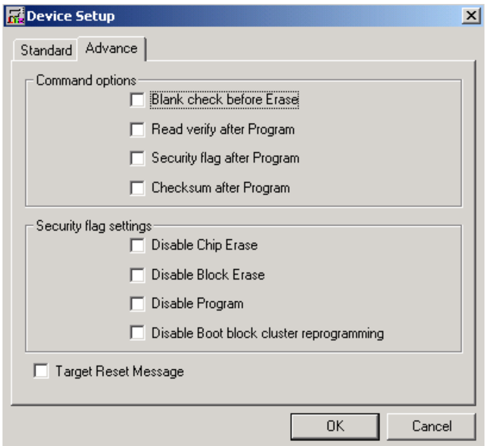


Table 12. Device Setup Box: Advance Properties

Group/Item	Option	Description
Command options	Blank check before Erase	Performs a **Blank Check** before executing an **Erase** or **Autoprocedure (EPV)** command. If the result of a blank check indicates *OK*, the Erase command is not executed
	Read verify after Program	Sends write data from the programmer after execution of the **Program** and **Autoprocedure (EPV)** commands, and then verifies the data against the data written to flash memory
	Security flag after Program	Automatically programs the selected security flag after execution of the **Program** and **Autoprocedure (EPV)** commands
	Checksum after Program	Reads the flash memory checksum value of the target device after execution of **Program** and **Autoprocedure (EPV)** commands; this value differs from the value displayed in the Parameter Programming window
Security flag settings	Disable Chip Erase	Invalidates the **Erase** command in the entire flash memory area of the target device and displays a warning stating that *When chip erase is disabled, chip cannot be erased and programmed anymore!*" Caution: If the security flag is set in the target device, erasing and writing to the device cannot be enabled.
	Disable Block Erase	Invalidates the **Erase** command in all blocks of flash memory selected under Operation Mode in the **Standard** tab of the **Device Setup** box; this setting is cleared by the **Erase** command if chip is selected under Operation Mode
	Disable Program	Invalidates the **Program** and **Erase** commands in all blocks of flash memory selected under Operation Mode in the **Standard** tab of the **Device Setup** box. The **Erase** command for the entire flash memory area is valid. This setting is cleared by the **Erase** command if chip is selected for Operation Mode.

Group/Item	Option	Description
	Disable Boot block cluster reprogramming	Uses the last block cluster setting as the current setting and displays a warning message stating that *When boot block cluster programming is disabled, boot block cannot be erased and programmed anymore*. Caution: If the security flag is set in the target device, the boot area cannot be rewritten afterward.

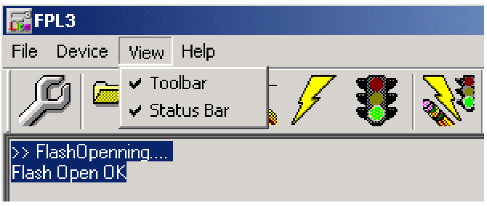
Table 13. Relationship Between Erase and Program Commands When MCU Security Functions are Valid

Option	Command		
	Chip Erase	**Block Erase**	**Program**
Disable Chip Erase	Invalid	Invalid	Valid (since the **Erase** command is invalid, data that differs from data already written in flash memory cannot be written)
Disable Block Erase	Valid	Invalid	Valid
Disable Program	Valid	Invalid	Invalid
Disable Boot block cluster reprogramming	Invalid	Valid (except for specified boot area)	Valid (except for specified boot area)

6.3.3 View Menu

The **View** menu contains commands for displaying or hiding the toolbar and status bar.

Figure 50. View Menu



6.3.3.1 Toolbar Command

Select the **Toolbar** command to display the toolbar; clear the command to hide the toolbar.

6.3.3.2 Status Bar Command

Select the **Status Bar** command to display the status bar; clear the command to hide the status bar.

6.3.4 Help Menu

The **Help** menu contains the **About FPL3 . . .** command.

Figure 51. Help Menu

The **About FPL3** box displays copyright information and the program version number.

Figure 52. About FPL3 Box

6.4 Programmer Parameter Window

This **Programmer Parameter** window displays the settings of the programming parameters.

Figure 53. Programmer Parameter Window

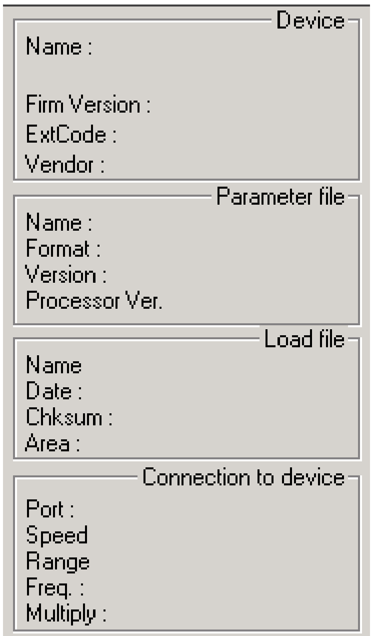


Table 14. Programmer Parameter Window

Group	**Description**
Device	After communication with the target device, displays updated information about the target
Parameter file	After **Setup** command execution, displays information about a read parameter file
Load file	After **Load** command execution, displays information about the selected program file
Connection to device	After **Setup** command execution, displays information about the connection to the target

7. How to Use the FPL3 Flash Programming Software

This section explains the basic operation of the FPL3 GUI for programming the DemoKit-LG2 board, including how to start the system, execute the **Autoprocedure (EPV)** command, and program the target device. Table 15 and Table 16 list the specifications for the series of operations described.

Table 15. Hardware Configuration of DemoKit-LG2

Base Board	**DemoKit-LG2**
Target device	78K0/LG2 (µPD78F0397D)
Clock	6 MHz
Voltage level	5 V

Table 16. Software Configuration of FPL3

Parameter File	**µ78F0397D.PRM**
Clock setting	6 MHz (multiplied by 1)
Port	COM3 (115200 bps)
Operation mode	Chip
Write HEX	78K0 LCD DEMO.hex
Option setting	Blank check before Erase

7.1 Installing the FPL3 GUI software

Install the FPL3 GUI software on the host machine you are using, by referring to **CHAPTER 7 SOFTWARE INSTALLATION** (if the software has not been installed yet).

7.2 Installing the Driver

Install the USB driver on the host computer as described in Section 5.2, Software Installation."

7.3 Installing the Parameter File

The parameter file for the MCU is automatically stored in *<FPL3 install-path>\PRM* during FPL3 installation. Nevertheless, the newest version of the parameter file can be downloaded from the NEC Electronics America web site (http://www.am.necel.com/microcontrollers/devtools.php) and copied into the *<FPL3.EXE-install-path>\PRM* subdirectory whenever a new version is available.

7.4 Connecting and Starting

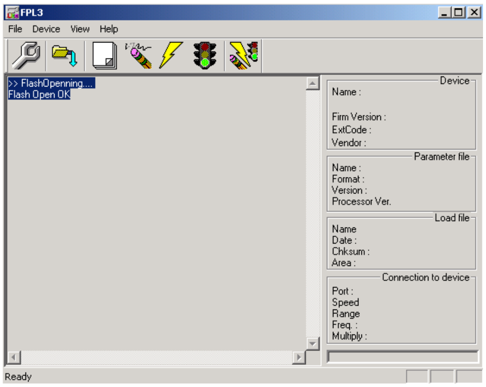
1. Switch SW1/S1 to ON to initiate flash programming mode.

Figure 54. Switch and Jumper Settings in Flash Programming Mode

SW1	Setting	Mode
S1	ON	Programming mode
S2	OFF	UART6 select
S3	OFF	OCD disabled
S4	OFF	On-board debugging function
Jumper	**Setting**	**Mode**
JP1	1–2 closed	Power supply via USB
JP2	Open	Power supply via USB
JP3	Closed	Clock supplied via CPLD

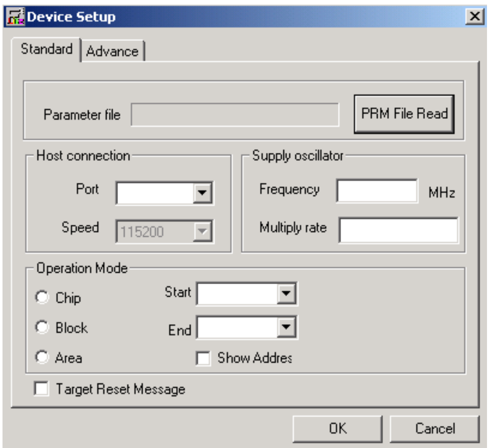
2. Connect the DemoKit-LG2 board to the host computer via the USB cable. If the connection was already made, press the **SW2** reset button to exit flash programming mode.
3. Start the FPL3 GUI.

Figure 55. GUI Software Main Window



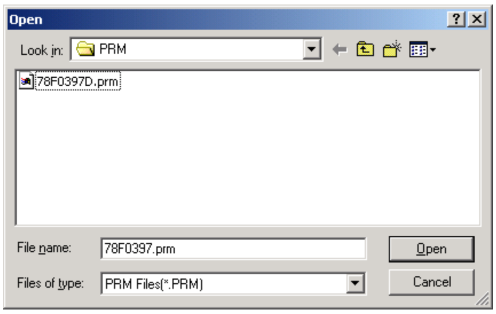
4. Click **Device** → **Setup** to set the programming environment.

Figure 56. Device Setup Box: Standard Tab



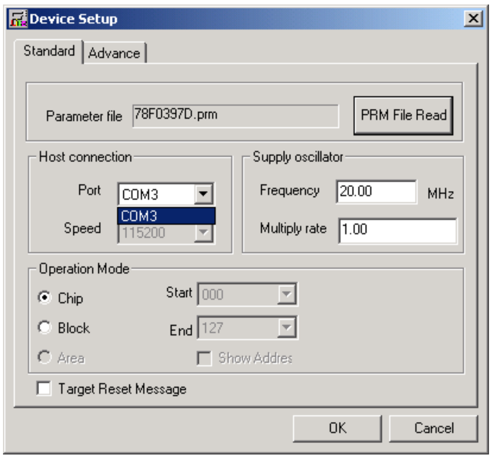
5. On the **Standard** tab, click **PRM File Read** to open the **Parameter File** box.
6. Select **78F0397D.prm** and then click **Open**.

Figure 57. Parameter File Selection



7. In the **Port** box, select the communication port that matches the host computer being used.
8. In the **Speed** box, select the communication speed of the host connection.

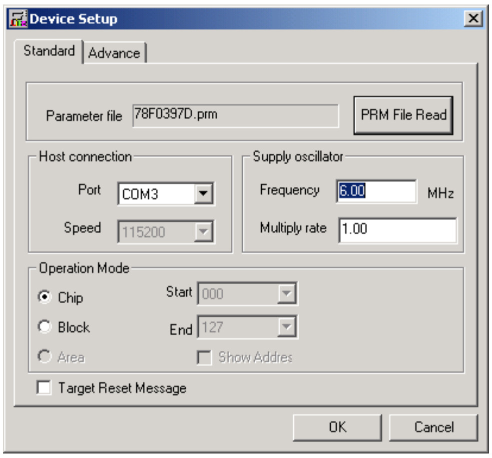
Figure 58. Port Selection



Note: Ports can be selected using Device Manager, as explained in Section 5.3, "Confirmation of USB Driver Installation."

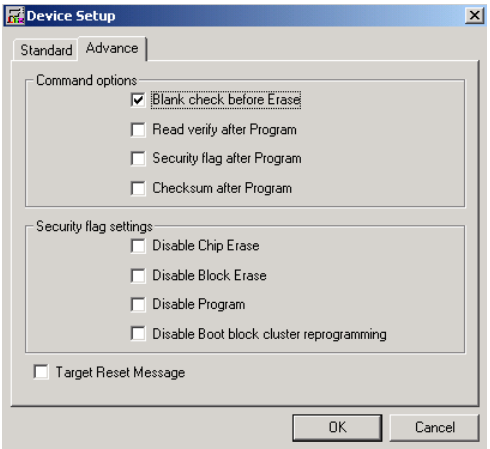
9. Set "Supply oscillator" according to the specifications of the DemoKit-LG2 board, "Frequency = 6.00 MHz" and "Multiply rate = 1.00". In "Operation Mode", specify the "Chip" mode. The following figure shows the recommended settings:

Figure 59. Standard Property Settingss



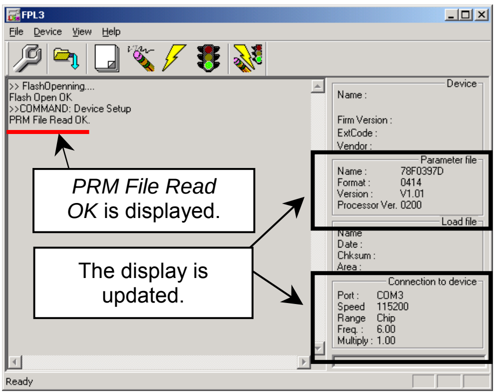
10. Click the **Advance** tab.

Figure 60. Device Setup Dialog Box: Advance Tab



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

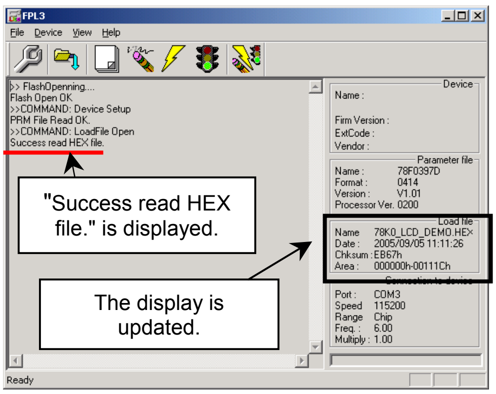
Figure 61. Completion of Parameter Setting



7.5 Selecting a User Program

1. Click **File** → **Load**.
2. Select a program file to be written to the target device and then click **Open**.

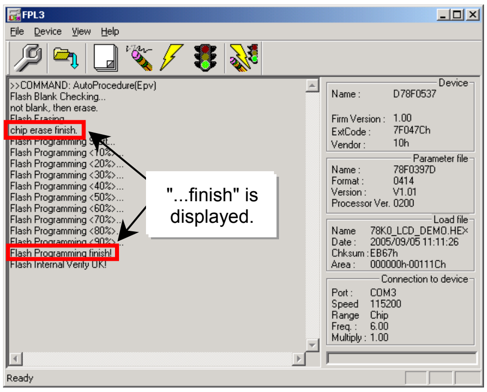
Figure 62. After Downloading



7.6 Autoprocedure(EPV) Command Execution

Click **Device** → **Autoprocedure(EPV)** to execute the **Blank Check**, **Erase**, **Program**, and **Verify** commands in succession.

Figure 63. After EPV Execution



7.7 Terminating the GUI

Click **File** → **Quit** to terminate the GUI software. All settings in effect upon termination are preserved in the *FPL3.INI file* for recall at the next session.

7.8 78K0_LCD_DEMO Application

Switch **SW1/S1** to OFF to set the DemoKit-LG2 board to normal operation. Press the **SW2** reset button to exit normal operation.

8. TROUBLESHOOTING

Table 17. Recommended Actions to Correct Problems

Problem	Cause	Recommended Action
Faulty Plug and Play recognition during driver installation	The USB connector may not be inserted normally into the USB port of the personal computer.	Verify that the USB connector is inserted fully into the host's USB port.
		Alternatively, disconnect the USB connector, and then re-insert it after a while.
The driver file cannot be found in the specified location.	The FPL3 flash programming software may not be installed correctly.	Install the software again by referring to Section 5.2, "Software Installation."
"USB Serial Port" or "USB High Speed Serial Converter" are not displayed; alternatively, they are displayed but prefixed with an exclamation mark (!) or ×.	The USB connector may not be inserted normally into the USB port of the personal computer.	Check that the USB connector is inserted fully into the host computer's USB port.
		Alternatively, disconnect the USB connector from the USB port and then re-insert it again after a while.
	The driver may not be installed correctly.	1. When this product is connected to the host computer, right-click the driver prefixed with an exclamation mark (!) or × and then click **Erase**.
		2. On the Device Manager, execute a Hardware Modification Scan.
		3. Install the driver again.
	The device may not be recognized (in the case of connection with the USB hub)	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 USB port of the personal computer.
When the DemoKit is connected with a host computer, the "Add New Hardware Wizard" screen is displayed.	If the USB connector of this product is not inserted into the USB port used at the installation time but into another USB port, then this product may be recognized as a new hardware item.	Install the driver as described in Section 5.2.4, "USB Driver Installation."
Communication with the DemoKit-LG2 board is disabled.	The driver may not be installed correctly.	Verify that the USB serial port and high-speed serial converter were installed correctly, as described in Section 5.2.4, "USB Driver Installation."
	The communications port selected in the **Port** box on the **Standard** tab of the **Device Setup** box may not be set correctly.	Set the port using the Device Manager.
	The DemoKit-LG2 board is operating in normal mode.	Set the board to flash programming mode by setting SW1 switch S1 to ON.
	The PRM file selected on the **Standard** tab of the **Device Setup** box may be incorrect.	Use the PRM file that matches the target device. For information about the PRM file, refer to Section 7, "How to Use the FPL3 Flash Programming Software."
	The setting of **Supply oscillator** on the **Standard** tab of the **Device Setup** box may be incorrect.	Make a correct setting according to the specifications of the target device.

9. Sample Project

The DemoKit-LG2 sample program resides in a single directory called **main-directory**, which contains all of the output files for NEC Electronics' integrated development environment (IDE).

The main directory contains the workspace and project files. All source files and associated files are located in the directory. The workspace file is named **DemoKit-LG2.prw** is provided to demonstrate the 78K0/LG2 MCU's functionality.

9.1 Real-Time Clock

This part of the sample project realizes a real-time clock. After the program initializes, the watch timer generates an exact clock reference based on the 32.768 kHz subclock and the LCD displays the time in either 24-hour or AM/PM clock format, depending on the setting selected.

9.2 Temperature Measurement

Temperature is measured using the dual-slope method to convert the temperature sensor's resistor value into a digital counter-value. To do this, the MCU 16-bit timer/event counter 00 measures the charging time of the C_{18} capacitor. The first charging slope uses a reference resistor ($R_{REF} = R_6$) and the second a variable resistor ($R_{VAR} = R_5 + R_T$), which should be determined. The variable resistor of the temperature sensor, and consequently the temperature, can be calculated by comparing the two measured times and the known R_{REF} reference resistor. The LCD displays the temperature in degrees Celsius or degrees Fahrenheit, depending on the setting selected. Additionally, the temperature is transferred via UART6 at the default data transfer speed of 115200 bits per second to a terminal program running on the host computer.

9.3 Light Incidence Measurement

This part of the sample project measures light incidence. The MCU's A/D converter (channel 0) is used to measure a voltage cycle at the phototransistor and the result is converted into a percent value and displayed on the LCD.

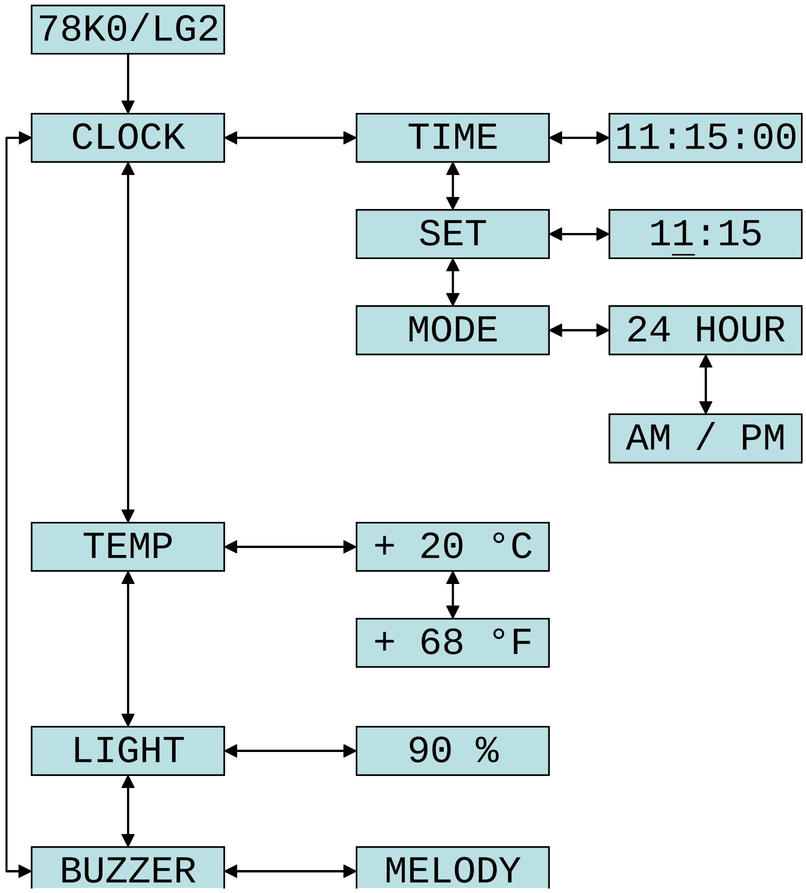
9.4 Buzzer Output Example

This demonstration drives the buzzer by using the 16-bit timer/event counter 01. The timer is configured to generate a rectangular waveform. By changing the output frequency of the timer, the buzzer can generate different tones. For demonstration purposes, a simple melody is played.

9.5 Menu Selection

To shift between the different operating modes of the sample project, follow the menu configuration shown in Figure 64. The first column shows the main menus and the second the sub-menus. Move SW3 up or down to switch from one menu to another and from left to right to switch between sub-menus.

Figure 64. Sample Project Menus



9.5.1 Setting the Time

To adjust the clock, go the SET submenu. Move SW3 left or right to switch between hours and minutes; move SW3 up or down to select the time. To leave the sub-menu, press SW3.

9.5.2 Setting the Clock Format

To set the clock format, go to the MODE sub-menu. Move SW3 up or down to select between 24-hour format and AM/PM format. To leave the sub-menu, move SW3 to the left.

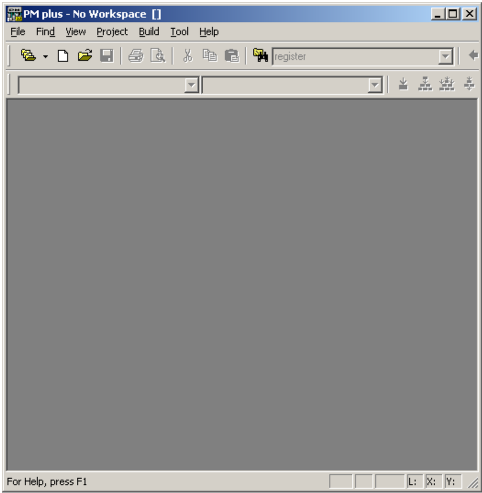
9.5.3 Setting the Temperature Format

To set the temperature format, go to the TEMP sub-menu. Move SW3 up or down to select between degrees Celsius and degrees Fahrenheit. To leave the sub-menu, move SW3 to the left.

10. NEC Electronics IDE and ID78K0-TK Debugger

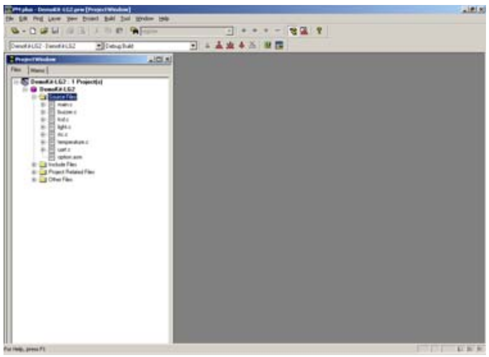
The DemoKit-LG2.prw project workspace is included for real-time debugging with the ID78K0-TK debugger. To initialize the integrated development environment (IDE), click **Start** → **Programs** → **NEC Tools32** → **PM Plus**.

Figure 65. PM Plus



To open the sample program, click **File** → **Open** → **DemoKit-LG2.prw**.

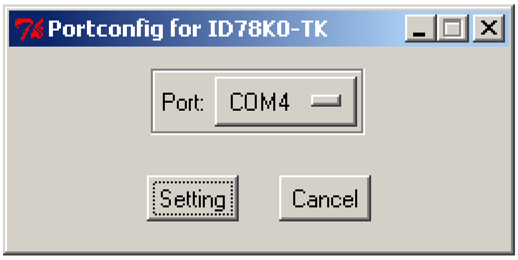
Figure 66. PM Plus with Sample Code



Once the workspace is open, the **PM Plus Project Window** lists all files associated with the project, including the source code and header files. From PM Plus, you can edit, build and link the sample code provided. For detailed information about the NEC Electronics software tools, refer to the associated documents for each.

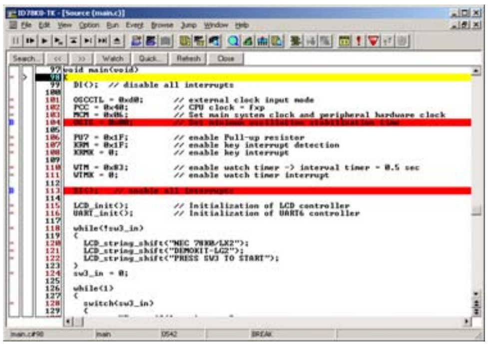
To perform debugging of the code and board make sure that the DemoKit-LG2 board is configured for on-chip debugging. You must configure the port setting for the serial communication using the **Portconfig for ID78K0-TK** from the Windows **Start menu** → **Programs** → **NEC Tools32**.

Figure 67. Portconfig for ID78K0-TK



After the port has been set for ID78K0-TK, from PM Plus you can invoke ID78K0-TK by selecting **Tools** → **Debug**.

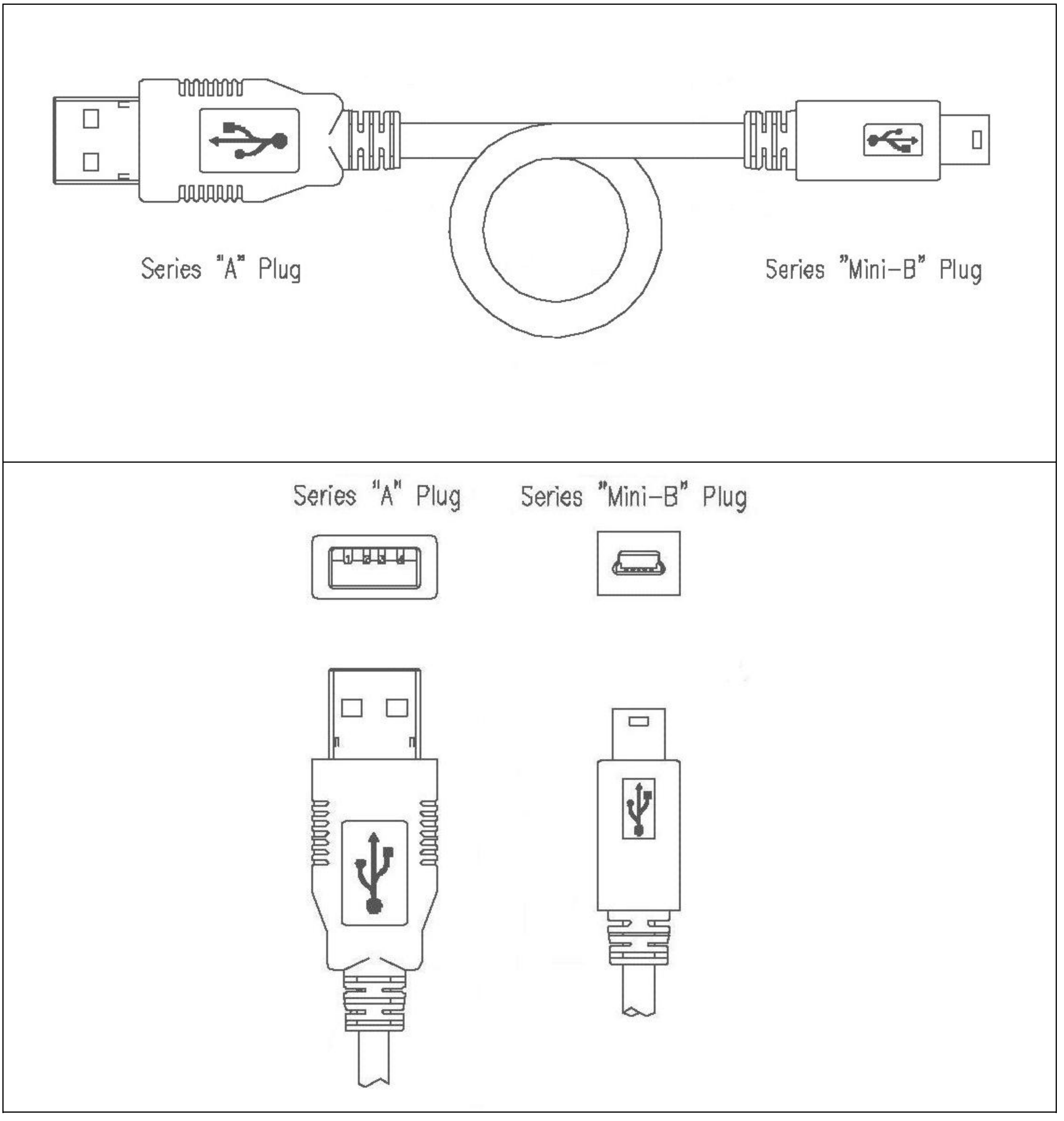
Figure 68. ID78K0-TK Debugger



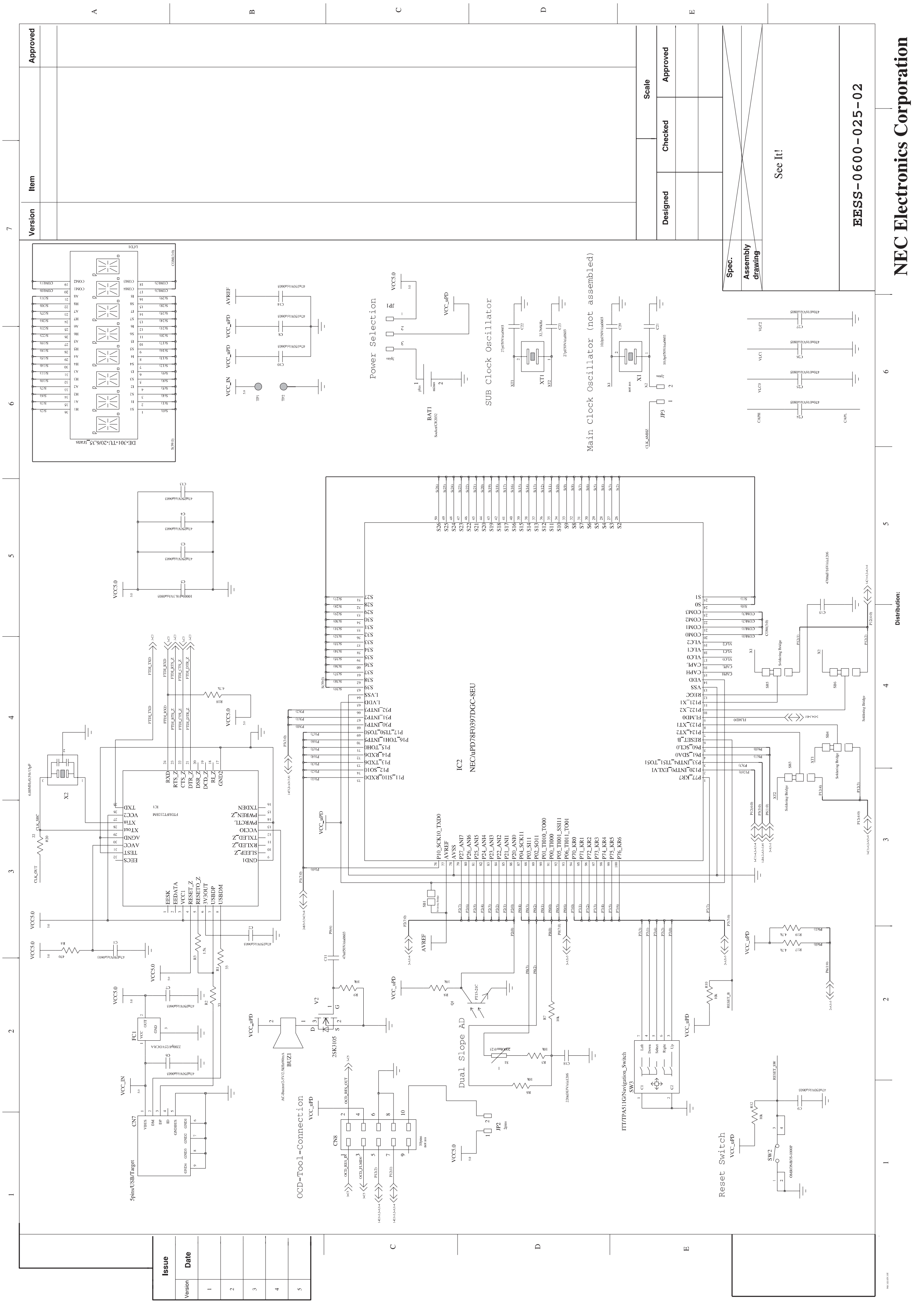
To open the debugger separately, without PM Plus, click **NEC Tools32** → **ID78K0-TK** and then enter **main.lmf** to download the sample code.

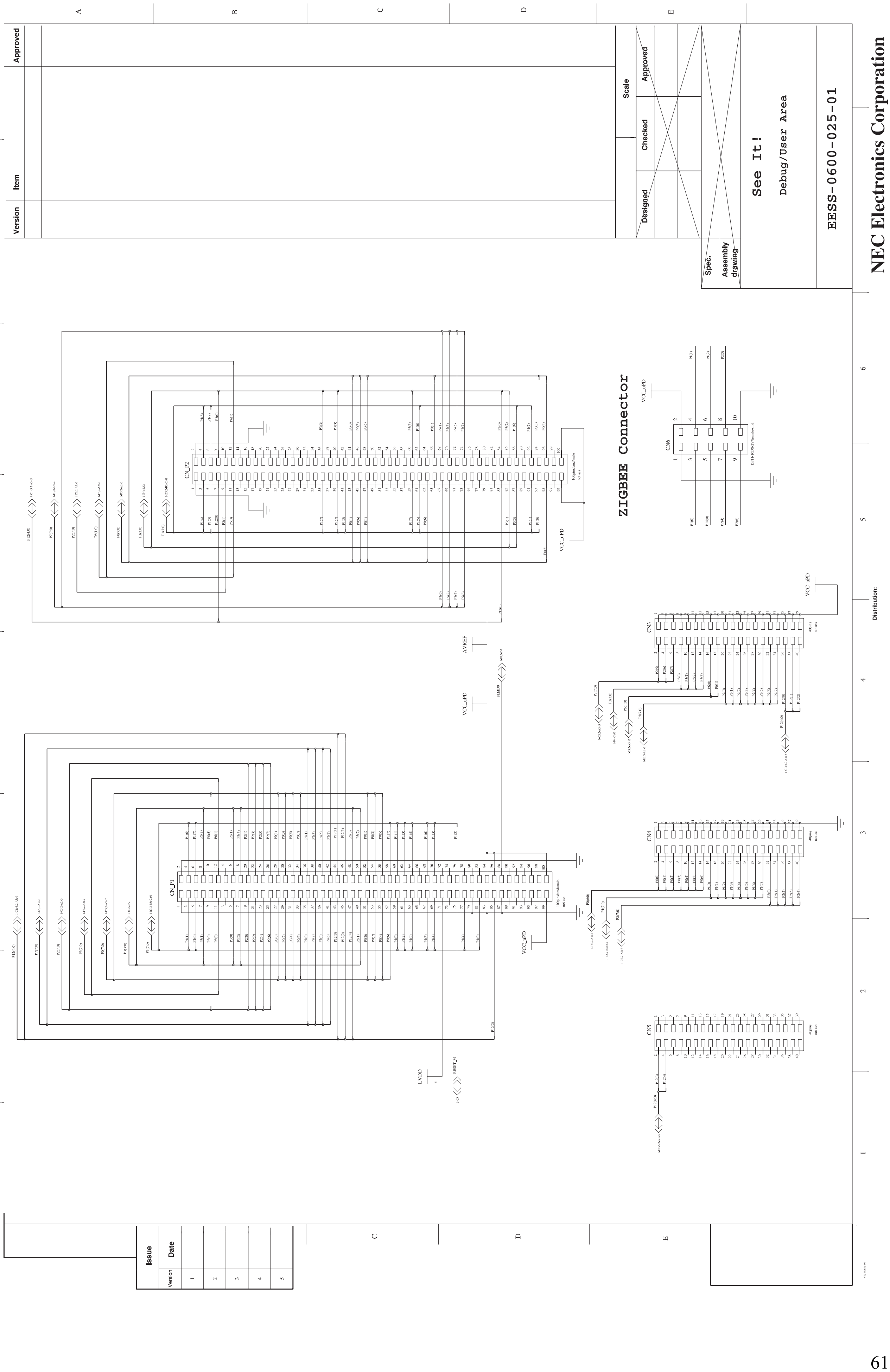
11. Cable

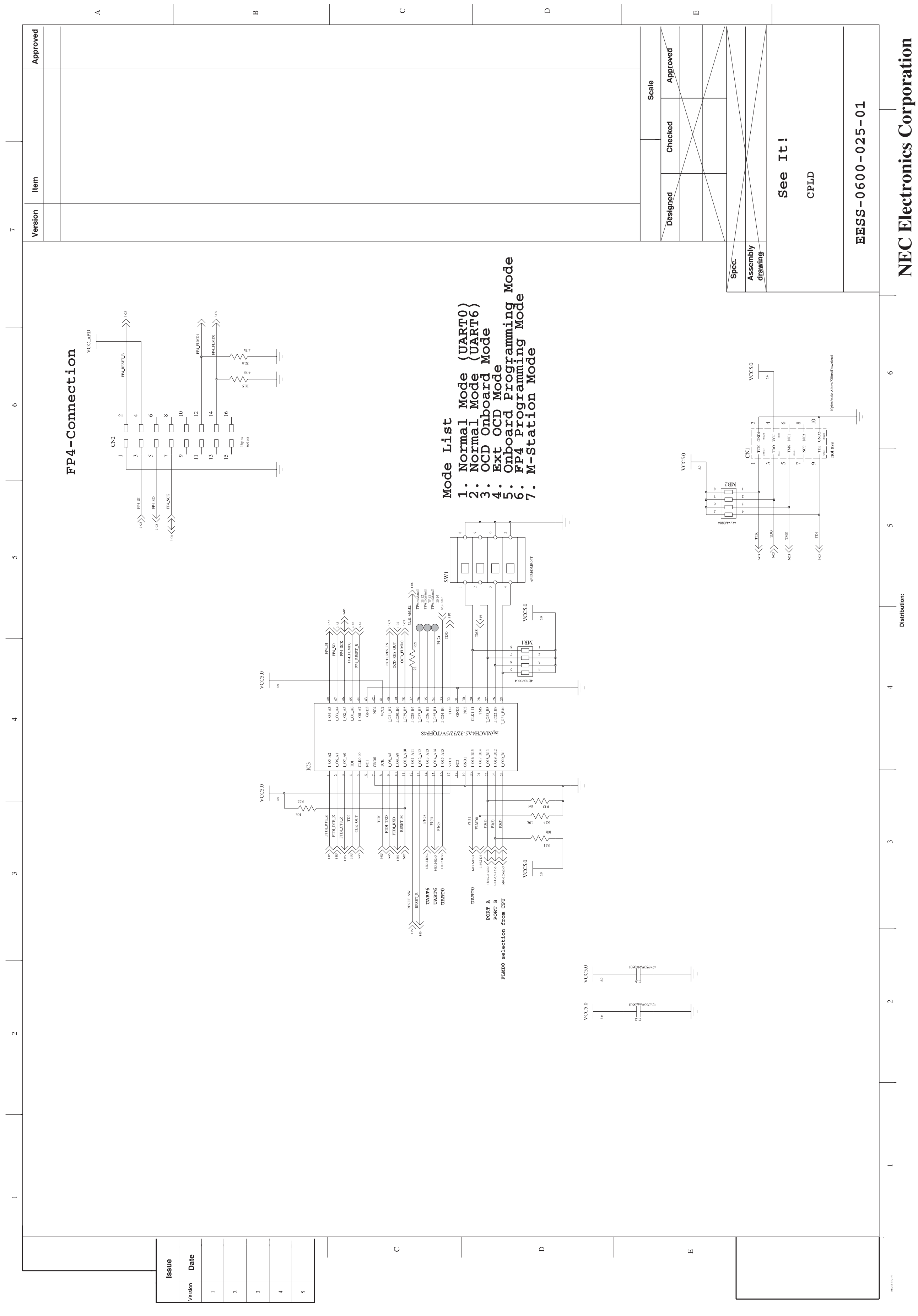
Figure 69. USB Interface Cable (Mini-B Type)



12. Schematics




ZIGBEE Connector
See It!
Debug/User Area
EESS-0600-025-01
NEC Electronics Corporation
Designed
Checked
Approved
Scale
Spec.
Assembly drawing
Version
Item
Issue
Date
Distribution:


FP4-Connection
Mode List
1. Normal Mode (UART0)
2. Normal Mode (UART6)
3. OCD Onboard Mode
4. Ext OCD Mode
5. Onboard Programming Mode
6. FP4 Programming Mode
7. M-Station Mode
UART6
UART6
UART0
UART0
PORT A
PORT B
FLMD0 selection from CPU
See It!
CPLD
EESS-0600-025-01
NEC Electronics Corporation