

User's Manual

78K0/Kx2-L - Save It!

Low power consumption 8-bit microcontroller Demonstration Kit

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1. Introduction

The 78K0/Kx2-L - Save It! demonstration Kit shows the system development possibilities using a NEC low power consumption microcontroller of the 78K0/Kx2-L microcontroller family.

A preprogrammed sample project, which is written to work with the TK-78K0/KC2L demo PC graphical user interface, provided on the CD-ROM, shows the current consumption in the different operating modes.

Furthermore an Applilet3 for 78K0/Kx2-L, IAR Embedded Workbench for 78K and IAR visualSTATE sample projects for the 78K0/Kx2-L can be found on the CD-ROM.

1.1 Package contents

- TK-78K0/KC2L board
- USB cable
- CD-ROM containing the TK-78K0/KC2L GUI, Applilet3 for 78K0/Kx2-L, an evaluation copy of the IAR Embedded Workbench for 78K with 4Kbyte code size limitation and IAR visualSTATE, as well as device drivers, sample programs and Microsoft .net

Please verify that you have received all parts listed in the package contents list attached to the 78K0/Kx2-L - Save It! demonstration kit package. If any part is missing or seems to be damaged, please contact the dealer from whom you received your 78K0/Kx2-L - Save It!

1.2 Features

- NEC Electronics µPD78F0588 low power consumption general purpose NEC 8-bit 78K0 MCU
- NEC Electronics µPD78F0730 MCU with on-chip USB interface
- 2 latched 7-segment LEDs
- Low current consumption modes demo application with GUI for the Host PC
- Applilet3 for 78K0/Kx2-L peripheral driver configurator
- On-Board debug function (TK-78K0 debugging) The 78K0/Kx2-L - Save It! supports an On-Board debug function by using the IAR C-SPY debugger without a need of additional debug hardware. It allows FLASH downloading and standard debug functions like code execution, single stepping, breakpoints, memory manipulation etc.
- Power supply by USB interface or via external power supply (power supply connector not mounted)
- The IAR Embedded Workbench for 78K is included. This package is restricted in such that maximum program code size is limited to 4 Kbyte.
- IAR visualSTATE demo, a package of integrated tools for developing, testing, and implementing embedded applications based on state chart diagrams.
- Full documentation is included for the NEC 78K078F0588 microcontroller, NEC 78K0 78F0730 microcontroller, IAR Systems Embedded Workbench and IAR Systems visualSTATE.

The 78K0/Kx2-L – Save It! is not intended for code development. NEC does not allow and does not support in any way any attempt to use 78K0/Kx2-L – Save It! in a commercial or technical product.

1.3 System requirements

HOST PC	A PC supporting Windows 2000, Windows XP or Windows Vista is required for the IAR Systems Embedded Workbench demo-version. A Pentium processor with at least 1 GHz CPU performance, with at least 256 Mbytes of RAM, allowing you to fully utilize and take advantage of the product features. 500 Mbytes of free disk space and an additional 10 Mbytes of free disk space on the Windows system drive.
Host interface	A web browser and Adobe Acrobat Reader to be able to access all the product documentation. USB interface that enables communication based on USB (Ver1.1 or later)

Note: Updates of the IAR Embedded Workbench for 78K, documentation and/or utilities for 78K0-SAVEIT, if available, may be downloaded from the NEC WEB page(s) at http://www.eu.necel.com/78K0-SAVEIT

1.4 Trademarks

IAR Embedded Workbench, visualSTATE and C-SPY are registered trademarks of IAR Systems AB. Microsoft and Windows are registered trademarks of Microsoft Corporation. Adobe and Acrobat Reader are registered trademarks of Adobe Systems Incorporated.

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2. 78K0/Kx2-L - Save It! Components

The TK-78K0/KC2L board is equipped with USB-connector and with several connectors in order to be connected to host computers, FLASH programmer, MiniCube2 or any external target hardware.



Figure 1: 78K0/Kx2-L – Save It! components

2.1 Operation mode settings

To support the different operation modes of the 78K0/Kx2-L – Save It! switches and jumpers are available on the TK-78K0/KC2L board.

The table below shows the 3 different modes and the regarding switch / jumper setting for each mode.

Switch / Jumper	Demonstration mode	Debugging / Writing mode	PC communication mode
SW1	DEMO	Debug	KOUSB
SW2	DEMO	EXT	KOUSB
SW3.1 – SW3.3	OFF	ON	OFF
SW3.4 – SW3.8	Unused	Any	Any
JP1	Short	Short	Short
JP2	1-2 and 3-4 shorted	1-3 shorted	1-3 shorted

Table 1: 78K0/Kx2-L – Save It! Switch and Jumper settings

Demonstration mode:

This mode has to be selected if an application is already programmed in the device and shall run standalone. Use this to run the pre-programmed low power consumption demonstration.

Debug / Writing mode:	Use this mode if you want to establish a debug session using the IAR C-SPY debugger or if you want to write an application to the 78F0588 micro- controller using the WriteEZ5 flash programmer software.
PC communication mode:	Set this mode if you want to establish a UART communication between the Host PC and the 78K0/KC2-L microcontroller mounted to the demonstration kit. The Host PC has to be connected via USB1 to the 78K0/Kx2-L Save it! demonstration kit. After connecting the board shows up as an additional COM port on the Host PC.

2.2 SW1

SW1 is a 3 position switch to set following modes.

Position	Mode
Left	Demo
Middle	KOUSB
Right	Debug

Table 2: SW1 modes

2.3 SW2

SW2 is a 3 position switch to set following modes.

Position	Mode
Left	Demo
Middle	KOUSB
Right	EXT

Table 3: SW2 modes

2.4 SW3

SW3 is an 8 position DIP switch with following functions

Bit	Mode
1	Mode selection (see Table 1)
2	Mode selection (see Table 1)
3	Mode selection (see Table 1)
4	Connected to microcontroller port pin P70
5	Connected to microcontroller port pin P71
6	Connected to microcontroller port pin P72
7	Connected to microcontroller port pin P73
8	Connected to microcontroller port pin P74

Table 4: SW3 modes

Note: Make sure to set the regarding pull-up resistor option registers (PU7) of the microcontroller if the Pins P70, P71, P72, P73 and P74 are used. Please refer to the <u>device user's manual</u> of the 78K0/Kx2-L for detailed information about the pull-up resistor option register settings.

2.5 SW4 (Reset switch)

SW4 is connected to the external reset pin of the μ PD78F0588 microcontroller. External microcontroller reset can be triggered by pushing.

2.6 SW5 (INTP1)

SW5 is connected to the "P30/INTP1" pin of the μ PD78F0588 microcontroller. It can be used as external interrupt source.

Note: Make sure to set up the microcontroller internal pull-up resistor option register (PU12) correctly when using this external switch. Please refer to the <u>device user's manual</u> of the 78K0/Kx2-L for detailed information about the pull-up resistor option registers settings.

2.7 SW6 (INTP4)

SW6 is connected to the "P33/TO51/TI51/INTP4" pin of the μ PD78F0588 microcontroller. It can be used as external interrupt source.

Note: Make sure to set up the microcontroller internal pull-up resistor option register (PU12) correctly when using this external switch. Please refer to the <u>device user's manual</u> of the 78K0/Kx2-L for detailed information about the pull-up resistor option registers settings.

2.8 JP1

JP1 is a switch jumper to select the power supply.

Position	Function
Short	USB power supply connected (USB1)
Open	Power supply via CN1 or CN2

Table 5: JP1 settings

2.9 JP2

JP2 is a jumper field to establish a current consumption measurement

Jumper settings	setting
1-2 and 3-4 short	Demonstration mode
1-3 short	Debugging/Writing and PC communication mode
any other	restricted

Table 6: JP2 settings

2.10 Q4 (illuminance sensor)

The illuminance sensor Q4 is connected to the "P10/SCK10/ANI8/AMP1-" pin of the μ PD78F0588 microcontroller. When lightening up the voltage increases and when making dark it decreases. So the gain amplifier function of the microcontroller can be used to read the illuminance. For further information to set up the registers of the microcontroller to use the gain amplifier functionality please refer to the <u>device user's manual</u>.

2.11 U8, U10 (7-segment LED)

U8 and U10 are two 7-segment LEDs. They can be set through the latches U9 and U11. The data channels of the latch are connected to channel P20 to P27 and the clock pins to P00 (U8) and P01 (U10) of the of the μ PD78F0588 microcontroller.





Figure 3: 78K0/Kx2-L – Save It! 7-segment LED port pin connection

In respect to the pin connection the following table shows the port values to be written to show the numbers from 0 to 9 on the 7-segment LEDs.

Digital number	Port value (hex)	Digital number	Port value (hex)
0	0xC0	5	0x92
1	0xF9	6	0x83
2	0xA4	7	0xF8
3	0xB0	8	0x80
4	0x99	9	0x98

Table 7: 7 segment LED port values

2.12 LED1 (power LED)

LED1 is the power LED, lights up when power is supplied via USB, CN3 (not mounted) or J1 (not mounted) to the *78K0/Kx2-L* – *Save It*!

2.13 Universal area

The Universal area of the 78K0/Kx2-L – Save It! is a free for the customer to use mounting area. It can be found in the lower right corner of the TK-78K0/KC2L board.

2.14 Minicube2 connector

If a MiniCube2 shall be connected to the 78K0/Kx2-L – Save It! starter kit a 16-pin connector has to be mounted to the FP1 area shown below.



Figure 4: 78K0/Kx2-L – Save It! MiniCube2 connector

3. 78K0/Kx2-L – Save it! Solder-short pads

On the TK-78K0/KC2L board you will find several solder-short pads. By opening or connecting these pads the circuit design of the TK-78K0/KC2L board can be customized.



Figure 5: 78K0/Kx2-L starter kit Solder-short pads

The solder-short pad looks like the picture below. To open, use a cutter to cut the dent part. To short, put solder on the pad.



Solder-short pad
(Short)
45

Solder-short pad name	Before Shipment	Connection			
P20~P27	Short	Short Open	7seg LED via 74AC574. You can use port2 for multipurpose I/O.		
P00~P01	Short	Short Open	7seg LED via 74AC574. You can use port00,01 for multipurpose I/O.		
P10	Short	Short Open	Port10 is connected to Illuminance Sensor.		
P30	Short	Short Open	Port30 is connected to SW5. You can use port30 for multipurpose I/O.		
P33	Short	Short Open	Port33 is connected to SW6. You can use port33 for multipurpose I/O.		
AVREF	Open	Short Open	AVREF is connected to AVREF.		
AVREF0	Short	Short Open	VDD0 is connected to AVREF. VDD0 is separated from AVREF.		
AVREF1	Short	Short Open	VDD is connected to AVREF. VDD is separated from AVREF.		
DCVDD1,DCVDD2	Open	Short Open	CN3, J1 is connected to VDD. CN3, J1 is separated from VDD.		
LEDVDD1,LEDVDD2	Short	Short Open	7segLED is connected to VDD. 7segLED is separated from VDD.		

Table 8: 78K0/Kx2-L – Save it! Solder short pads

4. 78K0/Kx2-L – Save It! system configuration

The 78K0/Kx2-L – Save It! starter kit system configuration is given in the diagram below



Figure 6: 78K0/Kx2-L- Save It! system configuration

4.1 78K0/Kx2-L - Save It!

The 78K0/Kx2-L – Save It! is a demonstration kit for the 78F0588 8-bit low power consumption microcontroller of the NEC 78K0 family. The demonstration board is connected to the host system via an USB interface cable. The host system may be used for On-Chip debugging by using the IAR C-SPY debugger and to allow execution of application programs on 78K0/Kx2-L - Save It! starter kit.

78K0/Kx2-L – Save It! runs the microcontroller at 10 MHz operating speed in normal operation mode.

4.2 Host computer

The USB host interface enables communication to the 78K0/Kx2-L – Save It! board. The μ PD78F0730 NEC 78K0 8-Bit microcontroller with on-chip USB interface and the NEC virtual UART driver allows application software to access the μ PD78F0588 device in the same way as it would access a standard RS232 interface. The NEC virtual UART driver appears to the windows system as an extra Com Port, in addition to any existing hardware Com Ports.

4.3 Power supply

The TK-78K0/KC2L board can be powered by the USB interface. Optional the power supply can be applied via a JACK connector, which has to be mounted to CN3, or a connector plug mounted to J1.

Note: When connecting a power supply to CN3 or J1 make sure to open (disconnect) JP1!

5. 78K0/Kx2-L – Save It! installation and operation

5.1 Getting started

The 78K0/Kx2-L – Save It! is delivered with two PC based user programs. The TK-78K0KC2L demonstration program is designed to measure the current consumption, the CPU frequency and the actual illuminance (measured by an illuminance sensor on the TK-78K0/KC2L board). The Applilet3 for 78K0/Kx2-L is an easy to use GUI based program to configure available device peripherals driver which are automatically converted into an IAR Embedded workbench or NEC PM+ project.

5.2 CD-ROM contents

NEC 78K0/Kx2-L - Save It!	CD-ROM ROOT
Crobat	- Acrobat Reader for 32 Bit Windows OS
Applilet	- Applilet3 for 78K0/Kx2-L
Doc	- Documentation
dotnet	- Microsoft .NET package
Driver	- TK-78K0/KC2L USB driver files
IAR Systems	 IAR Embedded Workbench for 78K IAR visualSTATE
sample projects	- Example projects for the 78K0/Kx2-L - Save It! Starter Kit
TK-78K0_KC2L_Demo	 TK-78K0RKE3L current consumption demonstration program
C WriteEZ5	 Flash Programmer WriteEZ5 incl. PRM file for µPD78F0588

Figure 7: 78K0/Kx2-L - Save It! CD-ROM contents

6. Hardware installation

After unpacking the 78KO/Kx2-L - Save It! demonstration kit, connect the board via connector USB1 to your host computer using the provided USB interface cable. When TK-78KO/KC2L board is connected, the USB driver needs to be installed on the host machine. Please refer to the following <u>USB Driver Installation</u>.

7. Software installation

The 78K0/Kx2-L – Save It! package comes with the following software packages:

- TK-78K0/KC2L demonstration program
- IAR Systems Embedded Workbench for 78K 4Kbyte code size limited, including C compiler, assembler, linker, librarian and IAR C-SPY debugger / simulator
- IAR Systems visualSTATE 20 states limited demo program
- Applilet3 for 78K0/Kx2-L
- WriteEZ5 flash programmer software including PRM file for µPD78F0588
- Adobe Acrobat Reader 9.3



Figure 8: 78K0/Kx2-L – Save It! CD-ROM autorun.exe

7.1 TK-78K0KC2L demonstration program installation

Before the TK-78K0KC2L demonstration program can be installed on the host PC it is mandatory that the .NET Framework is installed on the host PC. For further information about installing .NET Framework please refer to the TK-78K0_DEMO_GUI_e.pdf available on the CD delivered with the 78K0/Kx2-L - Save It! package in the "\Doc" folder.

To install the TK-78K0/KC2L demonstration program press the Software tools button from the Autorun of the CD-ROM provided within the 78K0/Kx2-L - Save It! package and select the regarding entry from list. The

78K0/Kx2-L – Save It!

setup dialogues will guide you through the installation process. The installation can also be started by executing the "TK-78K0 KC2L Demo.msi" in the directory "\TK-78K0 KC2L Demo" of the CDROM.

7.2 IAR Systems Embedded Workbench for 78K installation

To install the IAR Systems Embedded Workbench for 78K including C-SPY debugger / simulator press the Software tools button from the Autorun of the CD-ROM provided within the 78KO/Kx2-L - Save It! package and select the regarding entry from list. The installation can also be started by executing the Autorun.exe program in the directory "\IAR Systems\" of the CDROM.

When running the autorun.exe the following screen appears.

Welcome to IAR Systems	● 日本語 (Japanese)
IAR Embedded Workbench [®] 4K Kickstart for NEC 78K	
QuickStart installation information	
Install IAR Embedded Workbench [®]	
Install visualSTATE [®]	
htm Release notes	
View the product documentation	
Install Adobe Acrobat Reader	
Explore the CD	
	SYSTEMS
	www.iar.com

Figure 9: IAR Systems Installation screen

Note: Before installing the IAR Embedded Workbench for 78K 4KB code size limited version a license number and key has to be requested from IAR Systems. Therefore please follow the IAR online registration. The license number and key shall be provided within a view minutes after the request is submitted.

To install the IAR Embedded Workbench for 78K just press the regarding button "Install IAR Embedded Workbench[®]". The setup dialogues will guide you through the installation process.

7.3 IAR Systems visualSTATE Installation

To install the IAR Systems visualSTATE press the Software tools button from the Autorun of the CDROM provided within the *78K0/Kx2-L – Save It!* package. The installation can also be started by executing the Autorun.exe program in the directory "\IAR Systems\" of the CDROM. <u>The IAR Systems Installation screen</u> will appear and the installation of IAR visualSTATE can be started by pressing the "Install visualSTATE[®]" button. The setup dialogues will guide you through the installation process.

7.4 Applilet3 for 78K0/Kx2-L

To install the Applilet3 for 78K0/Kx2-L press the Software tools button from the Autorun of the CD-ROM provided within the 78K0/Kx2-L – Save It! package and select the regarding entry from list. The setup dialogues will guide you through the installation process. The installation can also be started by executing the setup.exe in the directory "\Applilet\AP3-78K0KX2L-EE V110" of the CDROM.

7.5 WriteEZ5 installation

To install the WriteEZ5 press the Software tools button from the Autorun of the CD-ROM provided within the 78K0/Kx2-L – Save It! package and select the regarding entry from list. The setup dialogues will guide you through the installation process. The installation can also be started by executing the WriteEZ5 V100 EE.exe in the directory "\WRITEEZ5" of the CDROM.

7.6 Sample projects

To copy the sample programs to your Host PC press the regarding button "Sample projects". The setup dialogues will guide you through the copying process. The installation can also be started by executing the "78K0-SAVEIT sample projects V100.exe" in the directory "\sample projects" of the CDROM.

7.7 USB Driver Installation

In order to use the TK-78K0/KC2L board, the USB driver needs to be installed on the host machine. Install the driver according to the following procedure:

Installation on Windows 2000Page 22Installation on Windows XPPage 26

7.7.1 Installation on Windows 2000

1. When the TK-78K0/KC2L is connected with the host machine, the board is recognized by <Plug and Play>, and the wizard for finding new hardware is started. Click Next>.



Figure 10: Found New Hardware Wizard (Windows 2000)

2. Following the window below is displayed. So, check that "Search for a suitable driver ..." is selected, then click Next>.

	Found New Hardware Wizard		
	Install Hardware Device Drivers A device driver is a software program that enables a hardware device to work with an operating system.		
	This wizard will complete the installation for this device:		
Check that "Search for suitable driver" is selec	USB Device ted. A device driver is a software program that makes a hardware device work. Windows heeds driver files for your new device. To locate driver files and complete the installation click Next. What do you want the wizard to do?		
	 Gearch for a suitable driver for my device (recommended) Display a list of the known drivers for this device so that I can choose a specific driver 	Click.	
	< <u>B</u> ack <u>N</u> ext > Cancel		

Figure 11: Search Method (Windows 2000)

3. Check the "Specify a location" check box only, then click Next>.

78K0/Kx2-L - Save It!



Figure 12: Driver File Location (Windows 2000)

Locate File			? ×
Look in:	🔁 Driver 💌	← 🗈 💣 🎟 -	
History Desktop My Documents My Computer	History Desktop My Documents J K Floppy (A:) Local Disk (C:) Local Disk (C:) Local Disk (E:) Local Disk (F:) Remonable Disk (G:) NT 78K0-SAVEIT (I:) My Network Places		
My Network P	File name: MQB2SALL.inf Files of type: Setup Information (*.inf)	Oper Cance	el
	Locate to "CDROM:\Dr	iver"	

4. Locate to the folder "CDROM:\Driver".

Figure 13: Address Specification 1 (Windows 2000)

5. The setup information file "MQB2ALL.inf" is automatic selected, then click Open to proceed within driver installation.

Locate File					<u>?</u> ×
Look in:	🔁 Driver		•	🗢 🗈 💣 🎟	•
History	MQB25ALL				
Desktop					
My Documents					
My Computer					
Mu Naturak D	File <u>n</u> ame:	MQB2SALL		•	<u>O</u> pen
My Network P	Files of type:	Setup Information (*.inf)		v	Cancel

Figure 14: Address Specification 2 (Windows 2000)

6. After the location of the USB driver has been specified click OK to proceed.

ound Nev	v Hardware Wizard	×	
_	Insert the manufacturer's installation disk into the drive selected, and then click OK.	OK Cancel	Click.
	Copy manufacturer's files from:		
	I:\Driver	Browse	

Figure 15: Address Specification 3 (Windows 2000)

7. Click Next>

ľ



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



Figure 17: USB Driver Installation Completion (Windows 2000)

7.7.2 Installation on Windows XP

1. When the TK-78K0/KC2L board is connected with the host machine, the board is recognized by Plug and Play, and the wizard for finding new hardware is started. At first the hardware wizard will ask if windows should search on the windows update web, check "No, not this time" and then click Next>.



Figure 18: Found New Hardware Wizard 1 (Windows XP)

2. Check that "Install from a list or specific location (Advanced)" is selected, then click Next>.

NEC

F	ound New Hardware	e Wizard	
Check that "Insta	Il from a list or	This wizard helps you install software for: USB Device If your hardware came with an installation CD or floppy disk, insert it now. What do you want the wizard to do? O Install the software automatically (Recommended) Install from a list or specific location (Advanced)	
specific" is sele	ected.	Click Next to continue.	Click.
		< <u>B</u> ack Next > Cancel	

Figure 19: Found New Hardware Wizard 2 (Windows XP)

3. Check that "Search for the best driver in these locations." is selected. Select the "Include this location in the search:" check box and then click <u>Browse</u>.



Figure 20: Search Location Specification 1 (Windows XP)

4. Locate the folder "C CDROM:\Driver" and click OK.

Browse For Folder	? 🗙
Select the folder that contains drivers for your hardw	Jare.
🖃 NBC 78K0-SAVEIT (G:)	~
🚞 Acrobat	
C Applilet	
🗄 🛅 Doc	
🛅 dotnet	1993
🗁 Driver	
🗉 🛅 IAR Systems	=
🗉 🛅 sample programs	
TK-78K0_KC2L Demo	
🗷 🛅 WriteEZ5	
🗄 🥯 STICK_TVA (H:)	~
To view any subfolders, click a plus sign above.	cel .:

Figure 21: Search Location Specification 2 (Windows XP)

5. As shown below, "NEC Electronics Starter Kit Virtual UART has not passed Windows Logo testing to verify its compatibility with Windows XP." is displayed. Click Continue Anyway.



Figure 22: Windows XP Logo Testing (Windows XP)

6. After the installation of the USB driver is completed the window below is displayed. Click Finish to close the hardware wizard.



Figure 23: USB Driver Installation Completion (Windows XP)

7.8 Confirmation of USB Driver Installation

After installing the USB driver, check that the driver has been installed normally, according to the procedure below. When using the Save It! board the "NEC Electronics Starter Kit Virtual UART" should be present like in the figure below.

Please check in the Windows "Device Manager" within the Windows Properties ("Hardware" tab), that the driver is installed normally.



Figure 24: Windows Device Manager

8. Flash Programmer WriteEZ5

WriteEZ5 is flash programming software to flash hex files to the related device. For installation information refer to the chapter <u>WriteEZ5 installation</u>.

📲 WriteEZ5	
<u>File D</u> evice <u>V</u> iew <u>H</u> elp	
/P 🖦 🗔 🗞 // 🐉 💸	
>> FlashOpenning Flash Open OK >> ParameterFile Reading Success Read ParameterFile. >> LoadFile Reading Success read HEX file.	Name : Parameter file Firmware : Parameter file Name : 78F0588 Version : V1.00 Load file Name Name : 2009/12/18 05:28:12 Chksum :BF64h Area : Area : 000000h-007FFFh Connection to device Port : CON4 Speed Speed 125000 Range Chip Freq. : Internal-OSC Multiply : 1.00 Name Chip
<	
Ready	NUM

Figure 25: WriteEZ5 Startup

8.1 Device Setup

To provide all necessary information about the device to be programmed, only the corresponding flash parameter file must be loaded. The parameter file (*.prm) for the µPD78F0588 is located on the CDROM in the WriteEZ5 folder. Please use the menu "**Device -> Setup...**" to open the following dialogue and the button "**PRM File Read**" to select the parameter file.

🖹 Device Setup 🛛 🔀
Standard Advance
Parameter file 78F0588.prm PRM File Read
Host connection Supply oscillator
Port COM1 Frequency Internal-OSC MHz
Speed 125000bps V Multiply rate 1.00
Operation Mode
ⓒ Chip Start 000
C Block End 031
🔿 Area 🔲 Show Addres
Target Reset Message
OK Cancel

Figure 26: WriteEZ5 Device Setup Dialogue

Please check that the correct host communication port is selected. The used communication port can be seen in the <u>Windows Device Manager</u>.

8.2 Using WriteEZ5

After a successful device selection the internal flash memory can be blank-checked, erased, programmed or verified. WriteEZ5 can be controlled either by menu or by buttons



Figure 27: WriteEZ5 Device Menu



Table 9: WriteEZ5 action buttons

WriteEZ5 supports Intel-Hex and Motorola S-record file formats as input file.

9. Demo application using the TK-78K0/KC2L demonstration program

The Low-Power-Consumption Demonstration GUI for the *78K0/Kx2-L – Save It!* is a Windows software that can be used to check the operation of the 8-bit microcontroller *78K0/KC2-L* mounted on the included demonstration kit board TK-78K0/KC2L made by TESSERA Technology Inc. by performing a simplified display of the features and power of the microcontroller.

The Demo GUI allows the user to monitor the on-chip oscillator of the KC2-L, the power consumption, and the optical sensor mounted on the TK Board, and to easily switch among the full-speed mode to standby mode. The current in a user program can also be measured.



Figure 28: TK-78K0KC2L demonstration program

Note: Values displayed on the GUI

Reference values are displayed on the GUI. Results that do not satisfy the device specifications might be displayed depending on the resistor for detecting current and the resonator or measuring the frequency used on the board. Use the values only as a reference for design and evaluation. Use calibrated measuring equipment if precise measurement is required.

For further information about usage and functionality of the tool please refer to the TK-78K0/KC2L demonstration program User's manual (TK-78K0_DEMO_GUI_e.pdf). The manual can be found on the 78K0/Kx2-L – Save It! CDROM in the "\Doc" folder.

10. Applilet3 for 78K0/Kx2-L

10.1 Overview

Applilet3 for 78K0/Kx2-L is an easy to use device driver Configurator for all 78K0/Kx2-L devices. All available internal device peripherals can be configured by this GUI based software tool. For further descriptions about the Applilet3 refer to the regarding User's Manual (U19178EJ4V0UM00.pdf) available on the 78K0/Kx2-L – Save It! CD-ROM in the "\Doc" folder.

Separate Applilet3 for 78K0Kx2-L - 78K0-S	SAVEIT_sample_project.cgp		
File Peripheral Options Help			
Project tree	File Module		
🖃 🌨 Peripheral	🖳 Generate Code 🛛 👗 📬 💕 🖉 🛺 🎧 🕅 🤗) 🗐 🐜 👝	
System	Clock setting On-chip debug setting Confirming resu	at source	
Port	Power voltage (VDD) setting	BI SOUICE	
Serial	27 (V) < VDD < 55 (V)	C 19M/2VDD 227M	
Operational Amplifier	· 2.7 (v) 2 v 0 2 3.3 (v)	C LO(V)S VDD \ Z.7 (V)	
A/D	- Main system clock selection		
Watchdog Timer	C Internal high-speed oscillation (fIH)	 High-speed system clock (IXH) 	
ar RTC	- Internal high-speed oscillation clock setting		
Clock Dutput	Coperation Frequency	4	(MHz)
	- High-speed system clock setting		
	Operation		
	 ×1 oscillation (f×) 	C External clock input (fEXCLK)	
	Frequency	10	(MH=)
	Chable time		(Mi12)
	Stable time	6553.60 (2°16/IX)	(μs)
	- Subsystem clock (fSUB) setting		
	✓ Operation		
	XT1 oscillation (IXT)	C External clock input (fEXCLKS)	
Product Information	Frequency	32.768	(kHz)
Version V1.10	XT1 oscillator oscillation mode selection		
Release date 04.11.2009	ATT Oscillator oscillator mode selection	Low power consumption	
Chip name uPD 78F0588_48	- CPU and peripheral clock setting		
Microcontroller n NEC78K0KC2L	CPU clock (fCPU)	10000 (KH)	(kHz)
Generate File Mode	Peripheral hardware clock (fPRS)	10 (fXH) 💌	(MHz)
Generate rile Merge rile Output folder H:\IAR projects\78K(Internal low-speed oscillation clock (fIL) setting		
Report type HTML file	Can be stopped by software (Option byte)	E Stop	
Compiler IAR	Frequency	30	(LU-1)
	Frequency	Jou	(KH2)
	- RESET pin setting		
	C Unused	Used (P125)	
			>
Chip name			
Chip hame or selected chip			
Courseling Magaz Calling E. 4. N	1		
	1		
MCU:NEC78KUKC2L Chip:uPD78F0588_48			.::

Figure 29: Applilet3 for 78K0/Kx2-L main window

10.2 Applilet3 for 78K0/Kx2-L sample application

After copying the <u>sample project</u> to the Host PC you will find the Applilet3 for 78K0/Kx2-L project file (78K0-SAVEIT_sample_project.cgp) in the subfolder AP3+EWB of the location where you have copied the sample projects to. To open this project start the Applilet3 for 78K0/Kx2-L and use the File \rightarrow Open function. After loading the project you will see the <u>Applilet3 for 78K0/Kx2-L main window</u>. The peripheral driver configuration created with the Applilet3 for 78K0/Kx2-L is also be used for the <u>IAR Embedded Workbench</u> 78K0/Kx2-L – Save it! sample project.

10.2.1 Clock and On-chip debug settings

The system clock for this project is set up to use the high-speed system clock. This makes use of the oscillator Y1 (10MHz) which is mounted to the target hardware. Furthermore the Subsystem clock is enabled to generate a frequency of 32.768 KHz that is needed for the RTC. As this Applilet3 for 78K0/Kx2-L sample project shall be used as basic driver initialization for the IAR Embedded Workbench sample the On-chip debug function has to be enabled to configure the option bytes correctly.

💊 Applilet3 for 78K0Kx2-L -	78KO-SAVEIT_sample_project.cgp	
<u>File P</u> eripheral <u>O</u> ptions <u>H</u> elp		
🗋 🛁 🖬 ᢣ 🚯 💷 🗐		
Project tree	File Module	
🖃 🐲 Peripheral	🛀 Generate Code 🛛 🔬 🗊 💕 🍠 🕐 🖓 🚱 🐼 🖓 🛄 🐜 📋	
System	Clock setting On-chip debug setting Confirming reset source	^
	- On-chip debug operation setting	
Serial	C Unused 📀 Used	
 Uperational Amplifier A/D 	-Internal high-speed oscillation operation setting (after execution of the STOP instruction)	
🚽 Timer	© Stop	
Watchdog Timer	Pin releasion	
Clock Output		
LVI		
	- Security ID setting	
🗆 File Information	V Use Security ID	
Default nami Yes		
File name CG_main.c	- Security ID authentication failure setting	
	O not erase flash memory data	
	C Erase flash memory data	
Default name		~
Default operation		>
n 🛛 Macro Setting 🛛 File Set 🖣 🕨		
MCU:NEC78K0KC2L Chip:uPD78F05	88_48	

Figure 30: Applilet3 for 78K0/Kx2-L On-chip debug window

10.2.2 Timer setting

The <u>Count mode</u> of the IAR Embedded Workbench sample project uses an interval timer interrupt to count up. Therefore the timer TM00 has to be configured in the Applilet3 for 78K0/Kx2-L as shown below with an Interval value of 3.3024ms.



Figure 31: Applilet3 for 78K0/Kx2-L Timer Function select

💊 Applilet3 for 78K0Kx2-L - 78K0	-SAVEIT_sample_project.cgp*			
<u> Eile P</u> eripheral <u>O</u> ptions <u>H</u> elp				
🗋 🚅 🖬 🔙 🔯 🤨 🗐				
Project tree	File Module			
🖃 🐲 Peripheral	当 Generate Code 🛛 🔬 🗊 💕 🍠 🖑 🔬	🕉 🔏 🛄 🐜 📋		
System	TM00 TM50 TM51 TMH0 TMH1			~
	Functions Setting			
Serial	- Count clock selection			
A/D	Internal clock	C External clock (T1000)	0	
Timer	- Internal clock selection			
Watchdog Timer	C Auto C fPRS	C fPRS/2^2	• fPRS/2 ⁸	
Clock Output	-External clock selection			
LVI	Falling edge C Rising edge	C Both edges		
	- Interval value setting			
🗆 Macro Information	Interval value	3.3024	ms (Actual value: 3.3024) 	
Macro name Timer	- Interrupt setting		· _	
	Generate an interrupt each interval time (INTTM000)		
	Priority	Low		
		,		
				2
Macro name of selected macro				-
n 🛛 Macro Setting 🛛 File Setting 🔄 🖌 🕨				
MCU:NEC78K0KC2L Chip:uPD78F0588_48	*			.:

Figure 32: Applilet3 for 78K0/Kx2-L Timer TM00 settings

10.2.3 RTC setting

The Real-time counter has also to be configured as the <u>Blink</u> and the <u>Spinning</u> mode make use of it in the sample project. The blink modes uses the INTERTC interrupt with an interrupt time of 0.5 seconds.

Separate Applilet3 for 78K0Kx2-L - 78K0-	SAVEIT_sample_project.cgp	
Eile Peripheral Options Help		
🗋 🚅 🖬 😹 📴 🥼 🕼		
Project tree	File Module	
🖃 🐟 Peripheral	🖳 Generate Code 🛛 🚣 🗊 💕 🎜 🕕 🕵 🐼 🖓 🗔 🐜 📮	
System	Real-time counter setting Interval interrupt & pin output setting	
	- Real-time counter operation setting	
	C Unused 📀 Used	
Uperational Amplifier	- Real-time counter setting	
Timer	Hour-system selection 24-hour	
Watchdog Timer	☐ Set real-time counter initial value	
Clock Output	Counter value 00-01-01 00:00 (Samstag)	
UVI .	Enable output of RTC1HZ pin (1 Hz)	
	Alarm detection function setting	
	Use alarm detection function	
	🗖 Set alam initial value	
	Week day	
	Thursday Friday Saturday	
🗆 Macro Information	Hour:Minute 00:00	
Macro name RTC	Counter correction function setting	
	Use correction function	
	Correction timing When the second digits are at 00, 20, or 40	
	Correction value + v 61 v (µs)	
	- INTRTC setting	
	✓ Used as constant-period interrupt function (INTRTC) Once per 0.5 s _	
	Used as alarm interrupt function (INTRTC)	
	Phonty	
Macroname		
Macro name of selected macro		
Generation Macro Setting F 🔹 🕨	"	
MCU:NEC78K0KC2L Chip:uPD78F0588_48		.::

Figure 33: Applilet3 for 78K0/Kx2-L RTC settings

The spinning mode uses the INTRTCI interrupt with and period value of 31.25ms.

September 2 State Applilet 3 for 78K0Kx2-L - 78K0)-SAVEIT_sample_project.cg	,			
<u>File P</u> eripheral <u>O</u> ptions <u>H</u> elp					
🗋 🚅 🔚 😹 🚯 💷 🗐					
Project tree	File Module				
🖃 蒙 Peripheral	当 Generate Code 🛛 🔬 🗊 💓	J 🕂 🖓 🍇	g 📰 號 📋		
System Port	Real-time counter setting Inter	val interrupt & pin out;	put setting		^
	-INTRTCI setting				
Serial	Interval interrupt function (I	NTRTCI)			
Uperational Amplifier A/D	Period value		31.25 (2^10/fSUB)	💌 (ms)	
Timer	Priority		Low	-	
Watchdog Timer	- RTCDIV/RTCCL output setting -		·		
Clock Output	No output				=
LVI	C Enable output of RTCDIV p	in	Output 512 Hz	-	
	C Enable output of RTCCL pi	n (32 kHz)			
Macro Information					
Macro name RTC					
Macroname					
Macro name of selected macro					✓
Generation Macro Setting 🔍 🕨					
MCU:NEC78K0KC2L Chip:uPD78F0588_40	I				

Figure 34: Applilet3 for 78K0/Kx2-L RTCI settings

10.2.4 Interrupt setting

To switch between the modes of the sample project the mounted switches SW6 and SW6 of the TK-78K0/KC2L board are used. These switches are connected to the external interrupt pins INTP1 and INTP4.

SApplilet3 for 78K0Kx2-L - 78K0)-SAVEIT_sample_	_project.cgp						
File Peripheral Options Help								
Project tree	File Module		0	* • •	-			
System	Generate Code	🚠 🗊 📽 🤅	ም ለመ 骗	3 8 L	Ծու 🗖			
Port	External Interrupt	Key Interrupt						
Serial	- INTPO setting							
Operational Amplifier	I INTPO	Valid edge	Falling	~	Priority	Low	T	
A/D	- INTP1 setting							
Watchdog Timer	INTP1	Valid edge	Falling	•	Priority	Low	•	
	- INTP2 setting							
Clock Output	INTP2	Valid edge	Falling	~	Priority	Low	~	=
LVI	-INTP3 setting							
	INTP3	Valid edge	Falling	~	Priority	Low	7	
	-INTP4 setting							
Macro Information	INTP4	Valid edge	Falling	-	Priority	Low	•	
Macro name INT	- INTP5 setting							
	INTP5	Valid edge	Falling	-	Priority	Low	-	
	- INTP6 setting							
	INTP6	Valid edge	Falling	~	Priority	Low	$\overline{\mathbf{v}}$	
	- INTP7 setting							
	INTP7	Valid edge	Falling	~	Priority	Low	-	
Macroname	- INTP8 setting							
Macro name of selected macro	INTP8	Valid edge	Falling	~	Priority	Low	Ψ.	×
Generation Macro Setting 🔍 🕨	<u> </u>							
MCU:NEC78K0KC2L Chip:uPD78F0588_48	}							.::

Figure 35: Applilet3 for 78K0/Kx2-L External Interrupt settings

10.2.5 Port setting

Port2 and the Port0 pins 0 and 1 are used to control the two 7-segment LEDs of the TK-78K0/KC2L and therefore have to be configured as input pins. The pins 0-4 of Port 7 are used as input pins connected to SW3 (4-8). And select which segments of the two 7-segment LEDs are blinking in the Blink mode.

11. IAR Embedded Workbench 78K0/Kx2-L – Save It! sample project

The IAR Embedded Workbench IDE is a very powerful Integrated Development Environment that allows you to develop and manage a complete embedded application project.

The described sample project 78K0-SAVEIT_sample_project.eww is a part of the <u>Sample programs</u> and can be found on after installation in the regarding subfolder "\AP3+EWB\applilet3_src" of the installation.

To run/debug the project with the IAR C-SPY debugger it is necessary to follow the steps described below in this chapter.

For further information about the IAR Embedded Workbench ant the included functionalities please refer to the regarding User's manuals available on the – *Save It!* CR-ROM in the "\IAR Systems\doc" folder.

11.1 Hardware setup

To run the program it is necessary to set up the TK-78K0/KC2L board in the following way.

Switch / Jumper	Mode position
SW1	Debug
SW2	EXT
SW3.1 – SW3.3	ON
SW3.4 – SW3.8	Any
JP1	Short
JP2	1-3 shorted

Table 10: IAR EWB 78K0/Kx2-L – Save It! sample project hardware setup

11.2 Loading the 78K0/Kx2-L Save It! sample project

After starting the IAR Embedded Workbench for 78K the Startup window pops up. In this window you are able to choose the **Open existing workspace** button.



Figure 36: IAR Embedded Workbench Startup window



Then locate the sample project on the CD and open the SAMPLE-TK-78K0KC2L.eww workspace file. Afterwards the IDE should look similar like below.

⊁ IAR Embedded Workbench IDE			
<u> Eile E</u> dit <u>V</u> iew <u>P</u> roject <u>T</u> ools <u>W</u> indow <u>H</u> elp			
D 🛩 🖬 🕼 📇 🐰 🖻 💼 🗠 🗠 🗌			t 😲 🙀 🗩 🔈
Workspace	× CG main c		▼ ×
Debug	- 67 ##	Peturne	
	68 **	None	
	69 **		
□ □ /8KU-SAVEII_sample_pro ✓	- 70 **		
	71 */		
	72 void	main(void)	
	73 {		
	74	/* Start user code. Do not edit con	nment generated here */
	75	TMCOO = OXOC;	/* enable Timer counter operatio
	- /0	RICE = 10;	/* enable kit counter operation
		$g_{start} = 0;$	
	79		
E CC_system_user.c	- 80	<pre> enable interrunt(): </pre>	
LE CC_systeminic	81	α led $s = 0;$	_
	82	<u></u>	
	83	PMK4 = 1;	/* INTP4 mask
	84	RTCIMK = 1;	/* RTCI interrupt 31.25ms mask
	85		
	86	g_count = 0;	
	- 87	$CR000 = 0 \times 0040;$	<pre>/* set timer frequency to initi</pre>
	- 88	TMIF000 = 0;	/* TM000 int F clr
	89	TMMK000 = 0;	/* TM000 unmask
	90		
	91	<pre>while(g_start == 0)</pre>	/* slowly & stop
	92	{	
79K0-SAVEIT sample project	93	1I (g_led_s >= 40)	
× Messages			<u> </u>
Total number of errors: 0			
Total number of warnings: 0			
Changed project file will force a full rebuil	d: H:\IAR projects\'	78K0-SAVEIT\78K0-SAVEIT sample project\	applilet3 src\ 🤍
Build Debug Log			X
Ready		Errors 0, Warnings 1	Ln 89, Col 38 NUM

Figure 37: IAR Embedded Workbench Main IDE window

To verify that the right debugging device is chosen please open the project options window by clicking **Project** \rightarrow **Options** and then open the tab **Debugger**.

Note: Although the On-board debug interface is used, the MINICUBE C-Spy driver must be selected instead of the standard driver TK-78K used for other starter kits. If the debug session via MINICUBE2 and the OCD1 connectors shall be started, also the MINICUBE C-Spy driver must be selected.

The corresponding COM port where the *TK-78K0/KC2L board* is connected to the host PC will be detected automatically by the IAR C-SPY debugger.

Options for node "78	KO_SAVEIT_sample_project"
Category: General Options C/C++ Compiler Assembler Custom Build Build Actions Linker Debugger IE-78 IECUBE MINICUBE Simulator TK-78	Factory Settings Factory Settings Driver MINICUBE QB-78K0MINI, QB-78K0SxxxMINI, QB-MINI2 If Run to main Setup macros Use macro file Device descriptions Override default \$TOOLKIT_DIR\$\CONFIG\DDF\io78f0588_48.ddf
	OK Cancel

Figure 38: IAR Embedded Workbench Debugger Options

The next step is to check that the correct linker settings are set. This can be done in the "Linker" category as shown below. Select the "Config" tab and check that the linker command file "Ink78f0588.xcl" is selected. This file is used by the linker and contains information on where to place the different sections of code, data and constants that may be used within the demo project:

Options for node "78	KO_SAVEIT_sample_project"	×
Options for node "78 Category: General Options C/C++ Compiler Assembler Custom Build Build Actions Linker Debugger IE-78 IECUBE MINICUBE Simulator TK-78	EKO_SAVEIT_sample_project" Pactory Settings Output Extra Output # Description Linker command file Verride default \$PROJ_DIR\$Vink78f0588_48.xcl Override default © Description Earch paths: (one per line) \$TOOLKIT_DIR\$VLIB\ Elew binary image File: Symbol: Segment: Align:	×
	OK Cancel	

Figure 39: Embedded Workbench Linker Configuration

Now after everything has been setup correctly it's time to compile and link the demonstration project. Close the Options menu and select "Rebuild All" from the "Project" menu. If the project is compiled and linked without errors or warnings it can now be downloaded to the *78K0/Kx2-L Save It!* board and debugged.

To start the IAR C-SPY debugger select the option "Debug" from the "Project" menu or press the (20) "Debugger" button.

When first starting the debugger connection, after building the project, it is necessary to set up the right connection settings. Please take care that the following settings are chosen:

- ID code = FFFFFFFFFFFFFFFFFFFF
- Main clock = System 8.00 MHz
- Target connect = TOOLC/D

MINICUBE2 Hardware Setup for 78K0 (78F058848)	
ID code Time unit: FFFFFFFFFFFFFFF Image: Comparison of the compari	OK Cancel
Main clock C Clock board C External System 8.00 MHz Sub clock C Clock board C External C System KHz KHz	Default Target connect TOOLC/D
Monitor clock Peripheral break Target System © Disabled © Connect User © Enabled © Not Connect	Target power off Permit Not Permit
Pin mask	Fail-safe break
Memory map Start address: Length: Type: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start address: Image: Start addres: Image: Start address: <	Add
0xFB00 - 0xFEFF Internal RAM 1024 bytes	Remove Remove All

Figure 40: IAR Embedded Workbench MINICUBE2 settings

Now the debugger is started and the demo project is downloaded to the 78K0/Kx2-L Save It! board. The progress of downloading is indicated by blue dots in the MINICUBE Emulator window. Please note that downloading of larger executables may take some time.

After the download was completed all debug features of IAR C-SPY debugger are available, i.e. Single Stepping, Step Over/-In/-Out, Go-Execution, Breakpoints, Register / Memory view etc.

To get more details on the debugger configuration and capabilities please refer to the "78K IAR Embedded Workbench IDE User Guide" of the IAR installation.

78K0/Kx2-L – Save It!



Figure 41: IAR C-SPY debugger

11.3 Running the application

After downloading the project to the device the debugger window opens and, if not changed by the user, the program runs to the first instruction of the main() function. When reaching this point the necessary clock initialization is already executed.

This sample project makes use of different timer interrupts to control the 7-segment LEDs available on the TK-78K0/KC2L board. So this project gives a short overview about timer initialization and timer interrupts usage of one timer as well as the real time clock (RTC) peripheral.

11.3.1 Count mode

When resuming execution of the program, after the break when entering the main function, the controller starts to count up from 0 to 39 on the 7-segment LEDs. This is controlled by the timer TM00 which is initialized as an interval timer. Furthermore every time the interrupt occurs and the value is counted up the interval time increases. During this stage both external interrupts INTP1 and INTP4 are disabled.

11.3.2 Blink mode

After the counter reached its final value of 39 the used timer interrupt is masked and the RTC interrupt will be unmasked and is used for the next stage. Furthermore INTP1 is unmasked to be able to leave this stage whenever the user wants to.

The only function of this stage is to let the final counter value blink in a frequency of 2Hz controlled by the RTC interrupt. To leave this stage SW5 has to be pressed once.

NFC

11.3.3 Spinning mode

When entering the Spinning mode the RTC interrupt and the INTP1 will be masked again. In exchange the RTCI Interrupt, which occurs every 31.25ms and the INTP4 are unmasked. The function of the Spinning mode is to spin 1 active segment around the 2 x 7-segment LEDs. So every time a RTCI interrupt occurs the active segment is stepped clockwise to the next segment on the outer ring of both 7-segment LEDs. To leave this mode the SW6 has to be pressed to trigger an external interrupt. When leaving the spinning mode the <u>Count mode</u> is entered again.

12. IAR visualSTATE 78K0/Kx2-L – Save It! sample project

IAR visualSTATE is a Windows-based software package of integrated tools for developing, testing, and implementing embedded applications based on state-chart diagrams. It includes a graphical design environment, test tools, a code generator, and a documentation facility.

IAR visualSTATE has been developed in accordance with the Unified Modeling Language notation (UML).

For more information please refer to the UserGuide.pdf included to the 78K0/Kx2-L – Save It! CD-ROM in the "\doc\visualSTATE" folder or to the <u>visualSTATE homepage</u>

- Note: Before installing IAR visualSTATE please make sure that you have installed the IAR Embedded Workbench for 78K delivered with the 78K0/Kx2-L Save it! demonstration kit.
- Note: After installing IAR visualSTATE copy the the swtdvs.dll to the <EW>\78k\bin directory and the vs.ewplugin file to <EW>\common\plugins directory. These files are located in the "IAR Systems\Plugin" folder of the demonstration kit CD-ROM.

The described sample project React.vnw is a part of the <u>Sample programs</u> and can be found on after installation in the regarding subfolder "\visualSTATE\vS" of the installation.

12.1 Hardware setup

To run the program it is necessary to set up the TK-78K0/KC2L board in the following way.

Switch / Jumper	Mode position
SW1	Debug
SW2	EXT
SW3.1 – SW3.3	ON
SW3.4 – SW3.8	Any
JP1	Short
JP2	1-3 shorted

Table 11: IAR VS 78K0/Kx2-L – Save It! Sample project hardware setup

12.2 Functionality of the sample project

The example implements a reaction timing measurement application that measures your reaction time a fixed number of times and then displays the average reaction time in hundredths of a second. The application works in the following way:

- When the application is started it displays two '-' characters on the display and waits for a press on any of the two buttons.
- A timer with a fairly random interval is now started and when the timer times out a '[' or ']' symbol is displayed on the left or right digit respectively. A new timer is also started for the measurement of your reaction time.
- You should now as fast as possible press the left button (SW5) if the '[' is shown or the right button (SW6) if the ']' is shown. The time for you to react is read from the timer and added to a running sum.
- After a button press the process is repeated until 10 trials has been performed. Your average reaction time is now displayed and you can press a button to get back to the initial state and restart the measurement if you want to.

The state machine is implemented with 3 input events (button presses and an expired timer) and 10 small C functions for the interface to the hardware. There are 5 states to keep track of what is currently going on in

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the application. This is not the only plausible state machine implementation for this application. An alternative could for example be to have separate, parallel and communicating state machines for time measurement and display updates.

Further details on the sample project can be found in the index.html file available in the 78KO/Kx2-L – Save It! CD-ROM "\doc\visualSTATE\samples" folder.

12.3 Running the sample project

To perform changes on the visualSTATE parts open the visualSTATE workspace file within the "\samples\IAR visualSTATE sample project\vs" folder of the CD-ROM. After loading the workspace the window should look like shown below.



Figure 42: IAR visualSTATE navigator

If the functionality or the settings of the sample shall be changed open the visualSTATE Designer.



Figure 43: IAR visualSTATE designer

To run the project on the TK-78KO/KC2L board locate the IAR Embedded Workbench workspace file (78K0-SAVEIT_sample_project.eww) within the "\visualSTATE\EW" folder of the installation of the sample projects.

NEC

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🔀 IAR Embedded Workbench IDE	
<u>Eile Edit View Project Tools Window H</u> elp	
	🚽 🗸 🦻 🙀 🛂 📴 🔿 🚳 🍉 🖙 🥨 🕅 👷 🤌 🌛
Workspace	main.c · ×
Debug	48 /* This is a good place to set a breakpoint during debugging. */
Files 👫 🗠	49 void HandleError(unsigned char cc)
□ 🗇 78K0 SAVEIT sample project 🖌	50 (
	51}
📙 🖵 🖸 simpleEventHandler.c	53
🛛 🛏 🤤 🗀 Software Timer	54 void main(void)
US_SoftwareTimers.c	55 (
📕 🕀 🖸 initialise.c	56
H → ⊞ 🖸 interrupt.c	57 SEM_ACTION_EXPRESSION_TYPE actionExpressNo;
Here in main.c	58 /* Define and initialize. */
Heactvsp	59 SEM EVENT TYPE eventho;
□ -	60 unsignet char cc;
	62
	63
	64 SEQ_Initialize();
	65 SEQ_AddEvent(SE_RESET); // Should preferably be done before enabling interrupts that can produce .
	66
	67 #11 (KEADABLE==1)
	60 KestclinivsinitAil(); // New Arl Name for readable code
	70 ReactionSEM InitAll(); // Remember to enable this function in coder options "API Functions"
	71 #endif
	72
	73enable_interrupt(); // enable all interrupts
78K0_SAVEIT_sample_project	
× Moscados	File
Puilding configuration: 79K0, CAV/EIT, complete	ning Debug
Lindsting build tree	uler- pend
Opdating baild tiee	
Configuration is up-to-date	
Build Debug Log Find in Files Breakpoints	x
Ready	Errors 0, Warnings 0 🛛 Ln 64, Col 20 👘 NUM 🛛 🚺 💋

Figure 44: IAR Embedded Workbench visualSTATE sample project

When loading the visualSTATE sample project all necessary settings to run the application on the TK-78K0/KC2L are already set. So the user just has to download the application to the target device.

The application can be downloaded by click Project \rightarrow Debug.

Note: When facing the following error messages during the build process of the IAR project please use the Rebuild all function within the IAR Embedded Workbench (Project → Rebuild all).

Error[e46]: Undefined external "ReactionSEM_InitAll" referred in main ("Project Dir"\ Debug\Obj\main.r26) Error[e46]: Undefined external "ReactionVSAction" referred in main ("Project Dir"\Debug\Obj\main.r26) Error[e46]: Undefined external "ReactionSEM_GetOutput" referred in main ("Project Dir"\Debug\Obj\main.r26) Error[e46]: Undefined external "ReactionSEM_NextState" referred in main ("Project Dir"\Debug\Obj\main.r26) Error[e46]: Undefined external "ReactionSEM_Deduct" referred in main ("Project Dir"\Debug\Obj\main.r26)

For further information regarding this issue please refer to the IAR visualSTATE Release Notes (readme.en.html) available in the root directory of the IAR visualSTATE installation

12.4 Debug the 78K0/Kx2-L – Save It! visualSTATE sample project

After downloading the application to the target device all from the C-SPY debugger already known debug features are available. Furthermore more visualSTATE specific Debug features can be used like an actual State view or a graphical animation of the states and state switches. For further information about the visualSTATE C-SPY plug-in please refer to the regarding chapter in the C-SPYLinkUserGuide.pdf which is located in the "\doc\visualSTATE" folder.

NF

13. Cables

13.1 USB interface cable (Mini-B type)



Figure 45: USB interface cable (Mini-B type)

14. Schematics

Please find the schematics attached to this document. To open the attachments view in the Adobe Reader press the paper clip in the lower left corner of the window. To open the attachment double click the TK-78K0KC2L_schematic.pdf

[MEMO]