KX1400 Development Kit User's Guide

APPLICABLE DEVICES

This Application Note applies to the following Keterex devices: KX1400EW and KX1400EG.

INTRODUCTION

The KX1400 Development Kit provides the hardware and software necessary to quickly and easily interface the KX1400 Audio Playback IC to a PC-based host. The included KX1400 Evaluation Board facilitates hardware prototyping and development of firmware for microcontroller-based designs without the need for PCB design or complicated bread-boarding. The Development Kit software provides features for real-time execution of KX1400 host-interface commands and the acceleration of audio data creation and evaluation. Example projects for creating audio data are included to assist in familiarization with the Development Kit and the capabilities of the KX1400 Audio Playback IC.

This document discusses initial hardware setup and configuration and provides instructions for software installation. A "Getting Started" tutorial is included.

KEY POINTS

- Development Kit provides PC-based interface to the KX1400 via USB.

- No microcontroller or firmware development is needed for initial KX1400 evaluation and development.

- Development Kit supports programming external Flash or EEPROM memory.

- Utilities to assist in the creation and evaluation of audio data included.

- Hardware setup and software installation is discussed.

- KX1400 Evaluation Board provides resources to facilitate evaluation and prototyping.

1. Kit Contents

The KX1400 Development Kit contains the following items:

- KX1400 Evaluation Board
- Keterex USB Adapter
- Keterex KX1400 Software and Product Information CD-ROM
- USB Cable
- KX1400 Quick Start Guide.

The KX1400 Evaluation Board is populated with the KX1400EG (24-pin 4x4mm QFN). However, this development kit is applicable to both the KX1400EG and KX1400EW (20-pin SOIC) devices.

2. Setting up the Development Kit Software

The Keterex KX1400 Software and Product Information CD-ROM contains:

- KX1400 Integrated Development Environment (IDE) application
- Keterex Macro Language Processor application
- A WAV-to-ASCII C include file encoder application
- Device driver for the Keterex USB Adapter
- Example audio projects
- Optional Third-party Software:
  - Audacity Digital Audio Editor – open source digital audio editor distributed from SourceForge.net
- Uninstallers for the KX1400 IDE and Audacity
- Product Information
  - KX1400 Datasheet and Application Notes
  - KX1400 Software User's Guide
  - Keterex Macro Language Processor Reference Manual
  - Keterex WAV-to-Include Reference Manual

2.1. System Requirements

The following minimum system requirements are necessary to use the KX1400 Development Kit software and access the installed product information:

- Pentium-class host PC running MS Windows XP (SP2 or later) or Vista
- 512 MB RAM
- CD-ROM drive
- One USB port
- 110MB free HD space
- Adobe Acrobat reader (v7.0 or later)
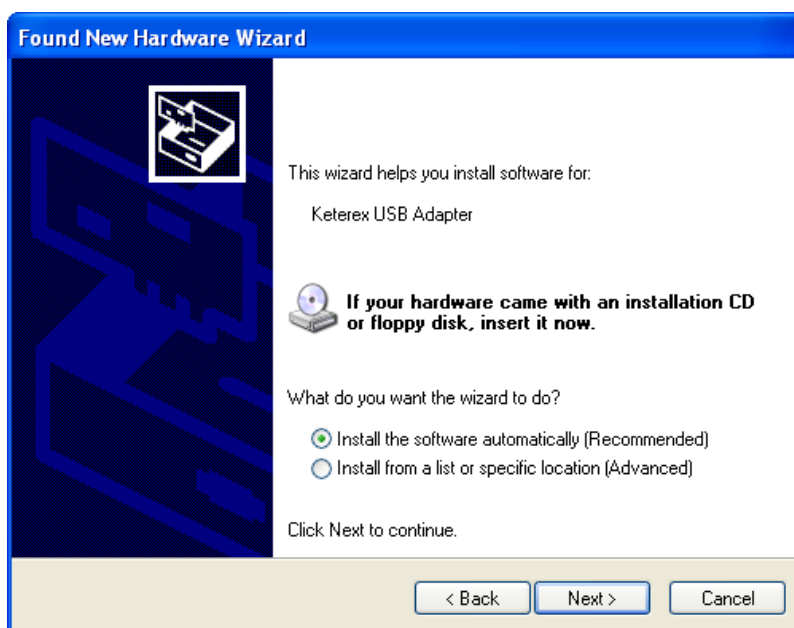
2.2. Installing the Development Kit Software

To install the Development Kit software and documentation, insert the CD into your PC's CD drive. An installer should automatically launch. Follow the on-screen prompts to select the desired installation configuration. If the installer does not automatically start when the CD is inserted, run *Setup.exe* from the root directory of the CD drive. During installation you may see the following dialog window. If so, click "Continue Anyway" to continue the installation. (On Vista systems, click "Install this driver software anyway".)

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When the Keterex USB Adapter is first connected to the PC, the following dialog window may appear. If so, select "No, not this time" and click "Next" (The dialog on Vista systems is different but similar.)

After clicking "Next", the following dialog will appear. Click "Next" to continue driver installation.

Click "Finish" on the final dialog to complete the installation of the Keterex USB Adapter drivers.

2.3. Un-installing the Development Kit Software

The KX1400 Development Kit software can be easily removed from the PC on which it was installed. A utility to remove the Development Kit software is installed as part of the Development Kit. All files and subdirectories in the target directory to which the Development Kit software was initially installed (typically *C:\Program Files\Keterex\KX1400*) will be removed.

The KX1400 Development Kit software cannot be un-installed using the Windows "Add or Remove Programs" control panel; you must use the un-installer provided. The icon to launch the uninstaller utility (*kx1400_uninst.exe*) is labeled "KX1400 Development Kit Uninstall" and is located in the same folder in the Start Menu as the KX1400 Integrated Development Environment icon.

To remove the KX1400 Development Kit software:

1. Double-click the "KX1400 Development Kit Uninstall" icon.

2. Click "Uninstall" on the "Confirmation" dialog.

3. Next, you are prompted to remove the Audacity Digital Editor application. You can remove the Keterex Development Kit application but leave Audacity installed if you wish. To remove Audacity at this time, click "Yes" and then "Yes" again on the "Audacity Uninstall" dialog; otherwise, click "No". You can use the Windows "Add or Remove Programs" control panel to remove Audacity at a later date.

4. Click "OK" on the Audacity confirmation dialog and then click "Close" on the "KX1400 Uninstall: Completed" dialog.

3. Setting up the Hardware

The KX1400 Evaluation Board is connected to a host PC via the Keterex USB Adapter as shown in Figure 3.1. The USB Adapter converts USB transactions to the KX1400 host interface protocol and provides power to the KX1400 Evaluation Board. No additional power supply is required.
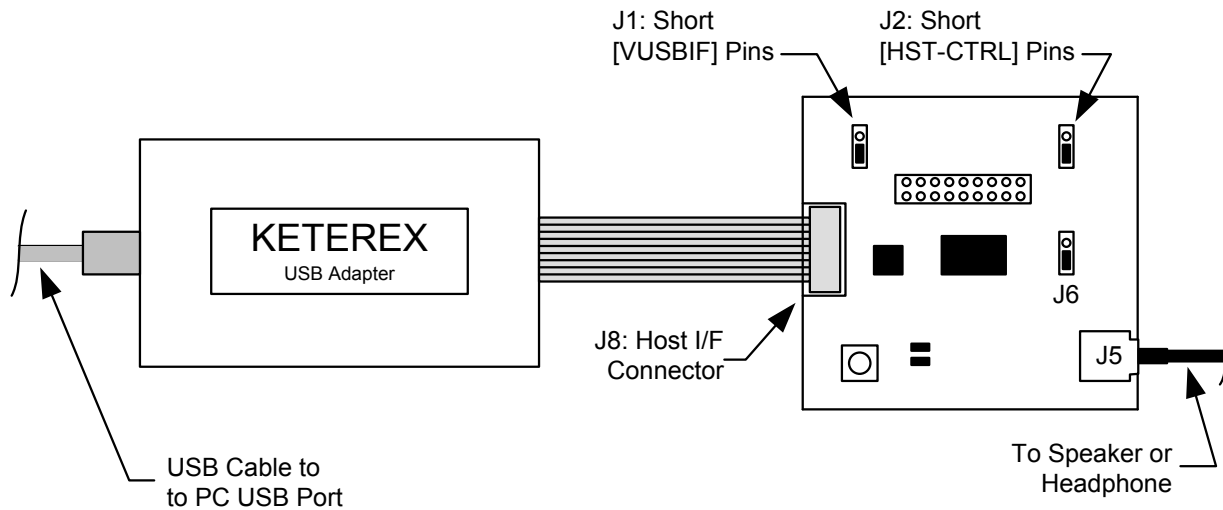

Figure 3.1 Hardware Setup

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1. Connect the Keterex USB Adapter to the Host I/F connector on the KX1400 Evaluation Board. The connector is keyed to the ribbon cable of the USB Adapter to ensure correct polarity.

2. Connect one end of the supplied USB cable to the USB connector of the Keterex USB Adapter.

3. The other end of the supplied USB cable can be connected to any available USB port on the host PC. However, it is recommended that you **do not connect the USB cable to the host PC** before installing the Development Kit software (see Section 2.2).

4. Ensure shorting blocks are installed in the [VUSBIF] position on J1 and the [HST-CTRL] position on J2. (This is the default configuration from the factory.)

5. Connect user-supplied headphones or a speaker to the KX1400 Evaluation Board using the 3.5mm (1/8" mini-plug) stereo audio jack (J5). (External PC speakers work well for this purpose.)

   - If using headphones, install a shorting block in the [HDPHONE] position on J6 (factory default).

   - If using a speaker, install a shorting block in the [SPEAKER] position on J6. The KX1400 is designed to optimally drive a 0.25W 8Ω speaker. However, external PC speakers can be used and typically work well for initial evaluation.

   Note: While the output of the KX1400 is monaural, the audio jack (J5) is wired to accommodate stereo plugs; it sends the same signal to both channels. Ensure the plug connecting the speaker or headphones to the J5 audio jack is a standard 2-channel (stereo) plug. **A mono plug will short the positive and negative audio outputs of the KX1400 IC together**.

4. KX1400 Integrated Development Environment

The KX1400 IDE provides an interface for developing KX1400 audio files and for the real-time execution of KX1400 commands and audio phrases from a PC-based host. The IDE alleviates the need for a microcontroller and firmware for initial evaluation.

When the KX1400 IDE application is launched, it automatically connects to the KX1400 Evaluation Board through the Keterex USB I/F Adapter. If unable to make a connection, it will continuously monitor the status of the USB Adapter and establish a connection automatically as soon as it is able. The current status of the connection between the host PC and the KX1400 Evaluation Board is indicated in the lower-left corner of the IDE window.

Refer to the Application Note "AN1402: KX1400 Software User's Guide" for more information. This is available under the "Help" menu in the IDE.

4.1. Getting Started

1. Connect the Evaluation Board and USB I/F Adapter to the host PC as discussed in Sections 2 and 3 and launch the KX1400 IDE. The indicator in the lower-left corner of the IDE should indicate "CONNECTED". If not, try disconnected and reconnecting the USB I/F Adapter to the host PC.

2. To open an example project, click "Open Project" under the "Project" menu and navigate to and select "*Examples/Example1/example1.kpj*". The example projects are located in the "*My Documents\Keterex\KX1400\Examples*" directory by default (under Vista, look for "*Documents*" rather than "*My Documents*").

3. Build the example project by selecting "Build Selected File" (or click the 🔧 toolbar button). The "Messages" pane at the bottom of the IDE window will display the status of the build.

4. If no errors are reported from the build, select "Download Build Results" from the IDE's "Project" menu (or click the ⬇ toolbar button). This will program the audio data to the external Flash memory on the KX1400 Evaluation Board and populate the phrase list in the IDE's toolbar.

5. To play a phrase (a sequence of audio commands/data), select the phrase's name from the selection box and click the ▷ toolbar button.

4.2. Example Projects

The KX1400 IDE, the Macro Language Processor and included audio editing utilities make it easy to build commands and sampled audio data into audio "phrases" and then download those phrases to the KX1400 Evaluation Board for evaluation and debug. Example projects are copied to the "*My Documents\Keterex\KX1400\Examples*" directory when the IDE is first launched to assist you in exploring the power of these tools.

Refer to Applications Note "AN1402: KX1400 Software User's Guide" for additional information on the use of the tools and these examples. This document is available under the "Help" menu in the IDE.

5. Evaluating the KX1400 in Stand-alone Mode

The KX1400 supports operation in a stand-alone mode that does not required connection to a host controller (refer to the KX1400 Datasheet for more information on stand-alone operation). To operate the KX1400 in stand-alone mode:

1. With the shorting block installed in the [HST-CTRL] position on jumper J2, download a project with one or more complete audio phrases (sequence of commands terminated with a STOP command).

2. Move the shorting block installed on jumper J2 to the [ST-ALONE] position.

3. Press and release the RESET switch. The first phrase in the external memory is retrieved and executed by the KX1400. Execution of the first phrase in memory will be repeated each time the RESET switch is pressed and released.

4. Return the shorting block to the [HST-CTRL] position on J2 to return the KX1400 to host-controlled mode and enable downloading and command execution from the IDE via the USB Adapter.

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6. KX1400 Evaluation Board

The KX1400 Evaluation Board provides numerous resources and connections to facilitate the evaluation and prototyping of both audio data and hardware designs. Figure 6.1 shows the locations of the many I/O (input/output) connections.
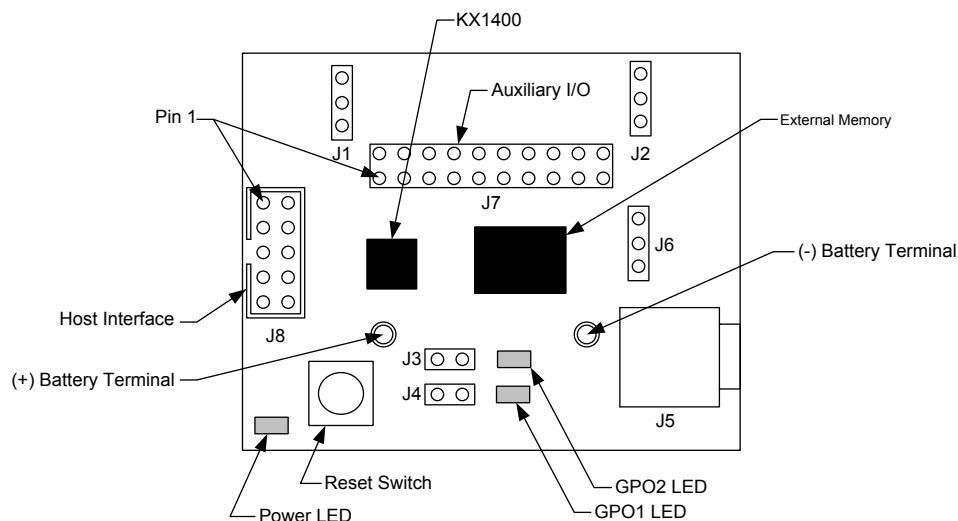

Figure 6.1 KX1400 Evaluation Board

6.1. J1 (Power Selector)

The J1 jumper is a 3-pin header used to select the power source for the KX1400 evaluation board. Installing a shorting jumper on the pair of pins labeled [VUSBIF] selects the USB Adapter via the host interface as the power source. Installing the shorting block on the [VBATT] pair selects an optional battery as the power source (see Section 6.11).

6.2. Jumper J2: Mode Selector

The J2 jumper is a 3-pin header used to configure the KX1400's operating mode. Installing a shorting jumper on the pair of pins labeled [HST-CTRL] configures the KX1400 to operation in host-controlled mode. Installing the shorting block on the [ST-ALONE] pair configures the KX1400 to operate in stand-alone mode. Refer to the KX1400 Datasheet for more information on the host-control and stand-alone modes of operation. The datasheet is available under the "Help" menu in the IDE.

6.3. Jumper J3 (GPO2) and Jumper J4 (GPO1) LED Connections

The J3 and J4 2-pin jumpers can be used to connect the KX1400's GPO1 and GPO2 outputs to LEDs. A shorting block on the J3 jumper connects GPO2 LED to the KX1400 GPO2 pin. Installing a shorting block on J4 connects the GPO1 LED to the KX1400's GPO1 pin. The LEDs are illuminated when their associated GPO output is in the logic-low state.

6.4. J5: Audio Jack

The J5 connector is a 3.5mm (1/8" mini-plug) stereo audio jack used to connect a speaker or headphones to the KX1400's audio output. The KX1400 is designed to optimally drive a 0.25W 8Ω speaker. However, external PC speakers can be used and typically work well for initial evaluation. Note: Although the output of the KX1400 is monaural, the audio jack (J5) is wired to accommodate stereo plugs; it sends the same

signal to both channels. Ensure the plug connecting the speaker or headphones to the J5 audio jack is a standard 2-channel (stereo) plug. **A mono plug will short the positive and negative audio outputs together**.

6.5. Jumper J6: Output-level Selection

The J6 3-pin jumper can be used to route the KX1400's audio output through a series resistor to attenuate the output to a level suitable for typical low-power (e.g. ear-bud) headphones. When a shorting block is installed in the [HDPHONE] position, the output is routed through a 140Ω resistor in series to attenuate the output level. When the shorting block is installed in the [SPEAKER] position, the output is not attenuated. **If a shorting block is not installed in either position, the J5 audio jack is not connected to the audio output of the KX1400.**

6.6. Connector J7: Auxiliary I/O

The J7 connector provides direct access to most of the KX1400's main I/O signals not readily available via the other jumpers. It can be used to connect the KX1400 to a microcontroller or other circuitry for prototyping hardware designs or to facilitate probing during debug.

Table 6.1 Auxiliary I/O Pin Descriptions

Pin #	Description
2	+3.3 VDC
4	GPO2
6	GPO1
8	BUSY
10	/CS
12	SDI
14	SCL
16	/RDY
18	/RST
20	CLKOUT
1, 3, 5, 7, 9, 11, 13, 15, 17, 19	Ground (GND)

6.7. Connector J8: Host Interface

The J8 connector provides access to the KX1400's host interface signals. It is used to connect the KX1400 Evaluation Board to a PC host via the Keterex USB Adapter. The pin layout is designed to mate directly to the ribbon cable of the Keterex USB Adapter and the connector is keyed to the ribbon cable of the USB Adapter to ensure correct polarity.

Table 6.2 Host Interface Pin Descriptions

Pin #	Description
1	SCL
2	+3.3 VDC (Input)
3	BUSY
4	GND
5	SDI
6	GND
7	/CS
8	Not Connected
9	/RST
10	/RDY

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6.8. Power Indicator

The PWR LED indicates power is available to the KX1400 via the host interface connector.

6.9. External Memory

A 16-MByte SPI Flash memory (P/N: Spansion S25FL128P0XNFI011) is installed on the Evaluation Board and connected to the external memory interface of the KX1400. It is used to store sequences of commands and sampled audio data for playback. It provides sufficient capacity to store over 69 minutes of audio encoded in 8KHz ADPCM format.

The external Flash memory is accessed for programming through the KX1400 when configured in Pass-thru mode (refer to the KX1400 Datasheet for information on Pass-thru mode operation). No direct connection to the SPI pins of the external memory is provided.

6.10. Reset Switch

The switch (SW1) labeled "RESET" is a momentary switch connected to the hardware /RST pin of the KX1400. Pushing the switch pulls the input to the KX1400 /RST pin low (reset state). Releasing the RESET switch allows the /RST input to go high and release the KX1400 from its reset state.

6.11. Battery Terminals

The KX1400 Evaluation Board can be powered using a 3.0V coin-cell battery (example: Panasonic CR2330) for complete stand-alone operation without any connection to the USB Adapter. The battery is not populated on the evaluation board as shipped from the factory. Two 0.035" diameter, solder-plated, thru-holes are provided on the evaluation board to facilitate user installation of a battery. The board is designed for the battery to be installed on the bottom of the board and the battery's terminal lugs soldered directly to the board. Refer to Figure 6.1 for location of the terminal thru-holes. There are no polarity markings on the Evaluation Board's silkscreen. For reference, the terminal thru-hole located closest to the J5 audio jack is the ground (-) terminal.

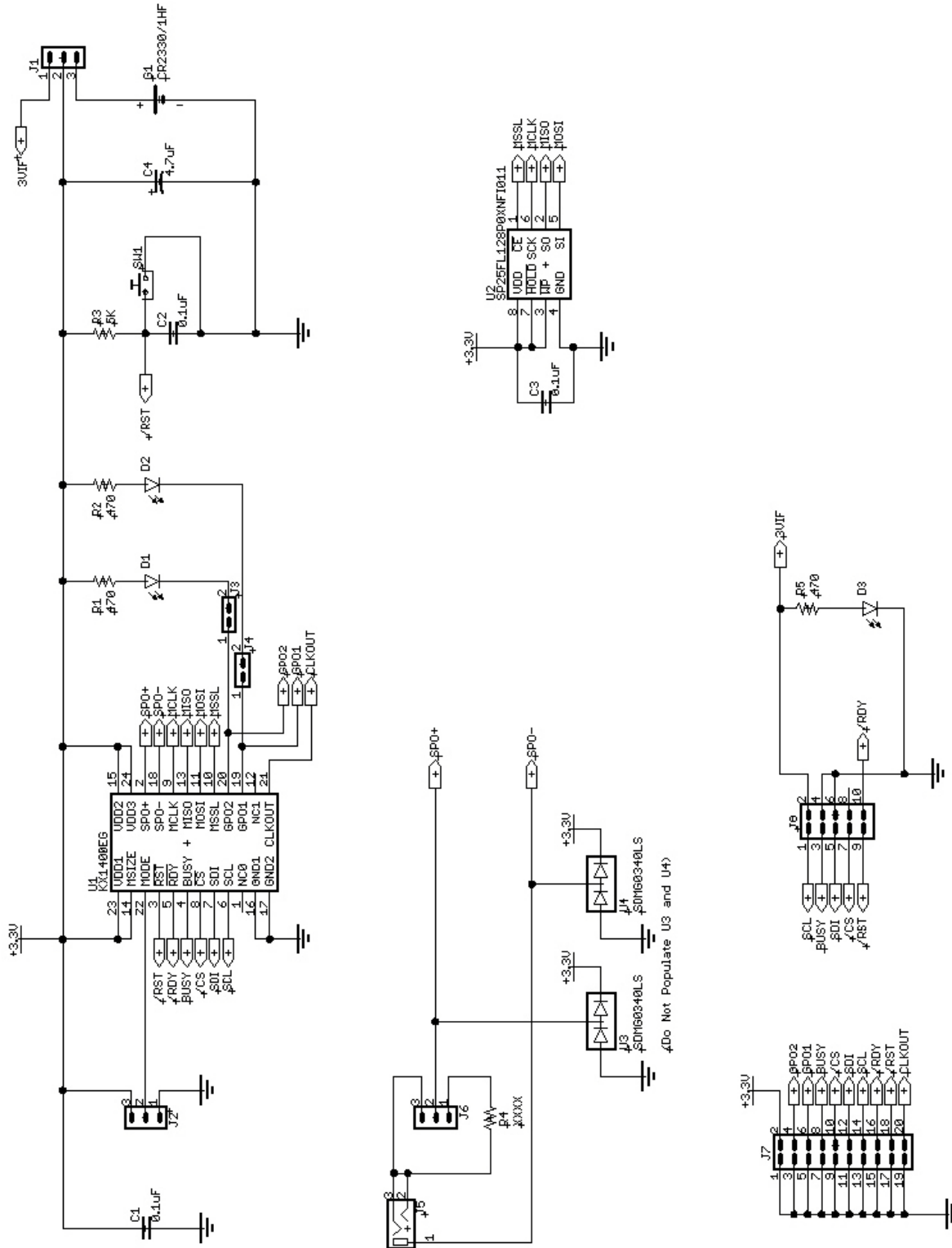## 6.12. KX1400 Evaluation Board Schematic

Figure 6.2 KX1400 Evaluation Board Schematic

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