
KNJN I2C bus development boards

© 2005, 2006, 2007, 2008 KNJN LLC

<http://www.knjin.com/>

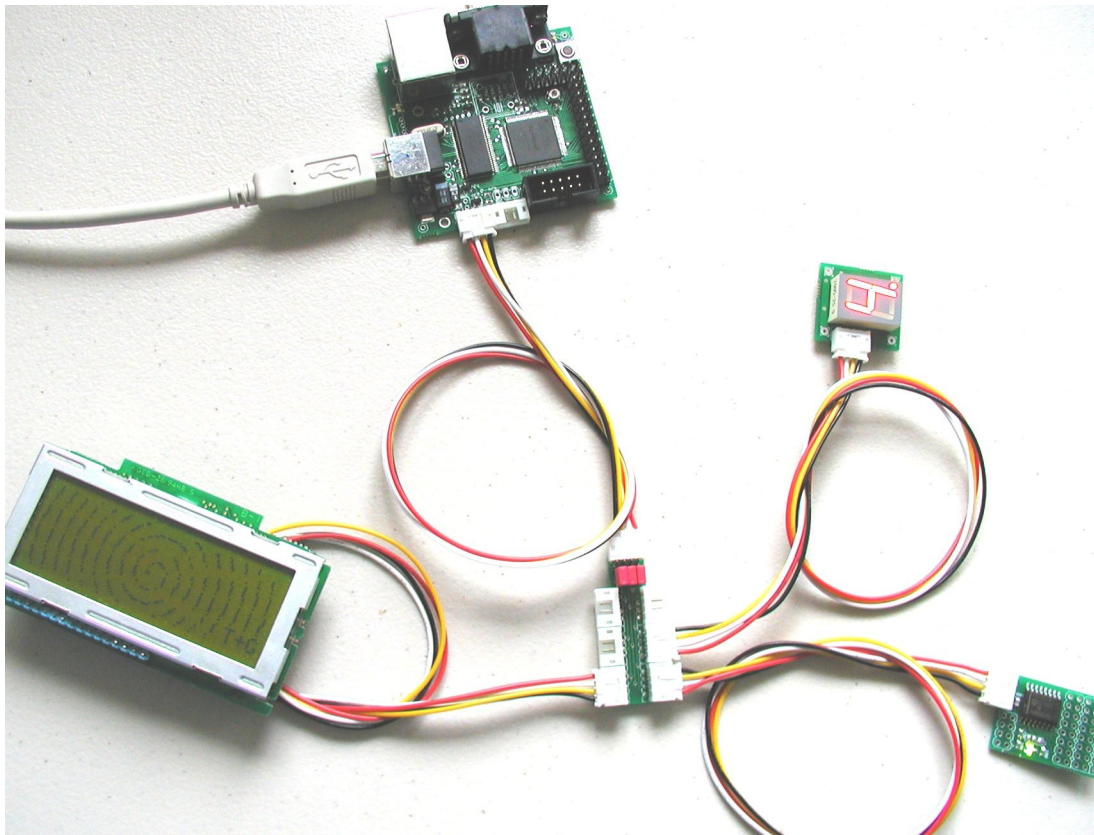


Table of Contents

1	The I2C bus.....	4
1.1	I2C characteristics.....	4
1.2	KNJN I2C connector.....	4
1.3	KNJN I2C boards.....	4
2	I2C masters.....	5
2.1	I2C from USB.....	5
2.2	I2C on FPGA boards.....	5
2.3	I2C from parallel port.....	5
3	I2C addresses.....	6
3.1	Unique addresses.....	6
3.2	Address selection.....	6
3.3	I2C hubs.....	6
4	Test tools.....	7
4.1	I2C 7-segments display.....	7
4.2	I2C temperature sensor and I2C EEPROM.....	7
5	I2C IO extenders.....	8
5.1	IO extender.....	8
5.2	Up to 64 IOs.....	8
6	I2C Text LCD.....	9
6.1	Text LCD.....	9
6.2	Command and data.....	9
6.3	LCD contrast.....	9
7	I2C LCD 4x20T+G semi-graphic.....	10
7.1	LCD with pixel-level control.....	10
7.2	LCD control.....	10
8	I2C PLL.....	11
8.1	Frequency generator.....	11
8.2	DIL-8 oscillator replacement module.....	11
8.3	Three outputs PLL board.....	11

1 The I2C bus

The I2C bus is an easy to use, yet powerful bus. Here's a short introduction about it.

1.1 I2C characteristics

The I2C bus allows multiple peripherals to communicate together.

- An I2C bus is made of masters and slaves. The masters are the ones that initiate transactions (reads or writes). A minimum I2C bus would consist of one master and one slave.
- An I2C bus uses only 2 signal wires (named "SDA" and "SCL") in addition to power and ground. The wires can be a few meters long.
- An I2C bus can support multiple devices on the same bus (each device on the bus has an address to be individually accessible).

I2C addresses are 8-bits value (seven bits plus one Read/Write bit):

- Even addresses are used for write accesses (0x00, 0x02, ... 0xFE).
- Odd addresses are used for read accesses (0x01, 0x03, ..., 0xFF).

1.2 KNJN I2C connector

KNJN boards use a 4 pins connectors/ 4 wires cables.

Pin	Name	Wire color	Use
1	GND	Black	Ground
2	SCL	Yellow	I2C clock
3	SDA	White	I2C data
4	VCC	Red	Power (+5V typical)

The connector reference is S4B-PH-K-S, which can be purchased from [DigiKey](#) or from [KNJN](#).

1.3 KNJN I2C boards

Many [I2C boards](#) can be purchased from KNJN.

- EEPROM.
- Temperature sensor.
- IO extenders.
- LCD displays.
- PLLs.

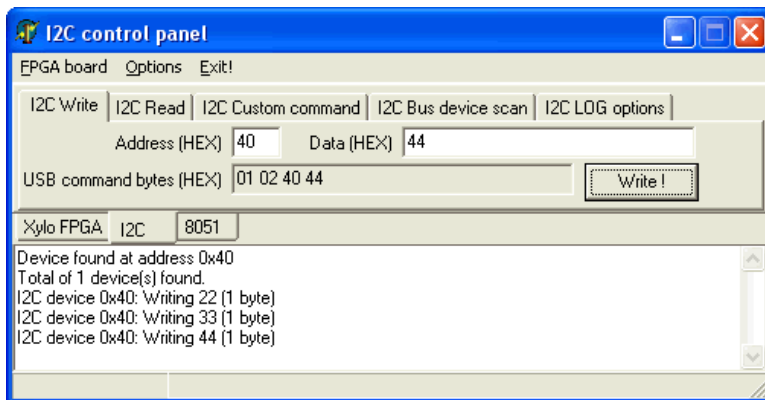
2 I2C masters

A KNJN I2C master creates an I2C bus controlled from a PC.

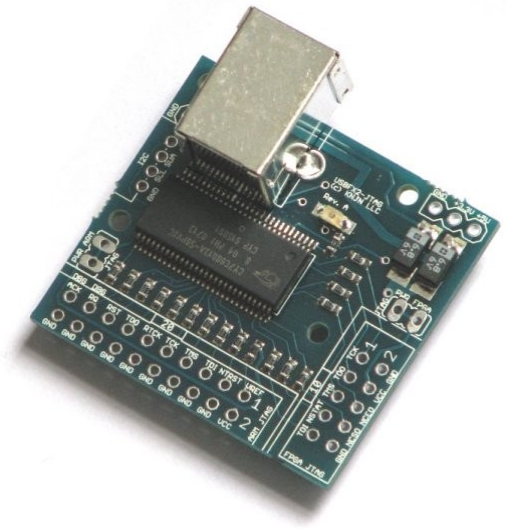
2.1 I2C from USB

The I2C USB master module creates an I2C bus controlled from USB.

The module comes with a powerful I2C control panel which allows scanning the I2C bus and issuing reads and writes interactively.



The I2C control panel.



The I2C USB master module.

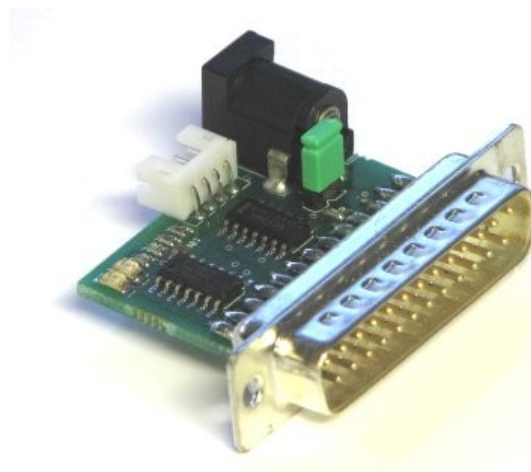
In addition to the control panel, you can write code to control the I2C bus in your own software. See the board documentation for details.

2.2 I2C on KNJN FPGA boards

The USB I2C controller is also included in the KNJN [Dragon](#) and [Saxo/Xylo](#) family of FPGA boards. So if you get one of these FPGA boards, you get the USB I2C controller for free.

2.3 I2C from parallel port

The I2C parallel master plugs into a PC's parallel port and creates an I2C bus.



3 I2C addresses

3.1 Unique addresses

Each peripheral (slave) on an I2C bus needs to use a unique address.

It is possible to put several identical I2C modules on the same I2C bus, as long as they are configured to use different addresses. For example, many modules are based on the PCF8574 chip. This chip has 3 address pins, so 8 of them can cohabit on the same I2C bus.

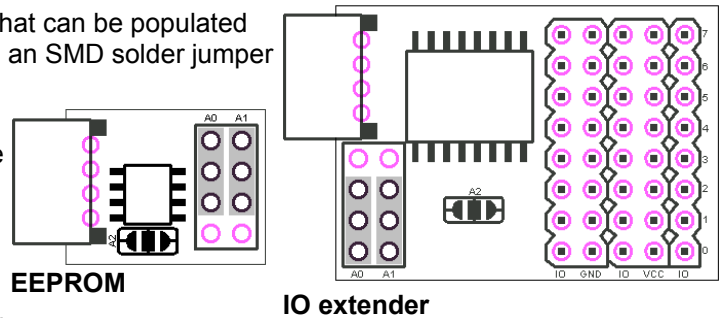
For more details, see the PCF8574 datasheet [here](#).

3.2 Address selection

To select the address, most KNJN boards use a 2x4 header that can be populated with a DIL switch (or jumpers) to select two address bits, plus an SMD solder jumper to select a third address bit.

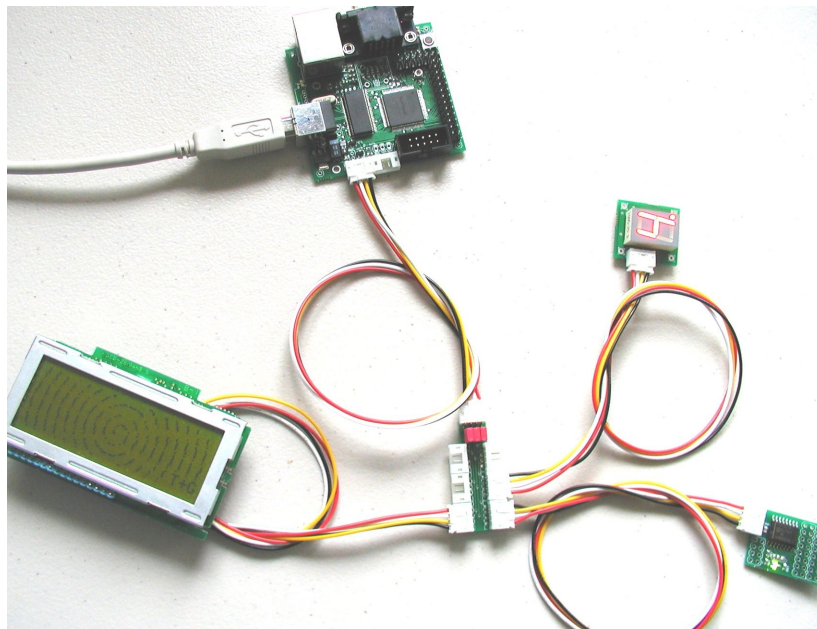
For example, here are the layout views of the KNJN EEPROM and the IO extender modules. The address bits are called A0, A1 and A2.

- A0 and A1 each have a 1x4 pins selection header. You use either the first 3 pins with jumpers, or the 1st and 4th pins with a DIL switch.
- A2 uses an SMD solder jumper. It is wired to GND by default. To change it, cut the default trace (present on one side of the jumper), and put a solder join on the other side.



3.3 I2C hubs

An I2C hub allows connecting multiple peripherals to the bus.



An I2C hub also allows creating a multi-voltage I2C bus by isolating the main power supply from the branches of the bus (using a jumper on the hub).

4 Test tools

4.1 I2C 7-segments display

The I2C 7-segments display makes it very easy to try your new I2C bus:

- Write one byte: change the display.
- Read one byte: read back the last value written.

By default, the display is controlled at these I2C addresses:

I2C address	Action
0x40	Write to display
0x41	Read from display

For example:

- Write data 0x88 to I2C address 0x40, and the symbol '0' is displayed.
- Read from address 0x41, you should get 0x88.

The segments are active low. The power-up value is 0xFF (display all off).

The segments are decoded below:

Data bit	Segment
1	A
0	B
2	C
5	D
4	E
6	F
7	G
3	Dot

If you want to display digits from 0 to 9, use these values:

Digit	Data
0	0x88
1	0xFA
2	0x4C
3	0x58
4	0x3A
5	0x19
6	0x09
7	0xF8
8	0x08
9	0x18

The module is based on the PCF8574 chip. It can be configured to use addresses 0x40 to 0x47 by modifying PCB-trace jumpers.

4.2 I2C temperature sensor and I2C EEPROM

Measure temperature from your I2C bus, or store information in an EEPROM connected to your I2C bus.



5 I2C IO extenders

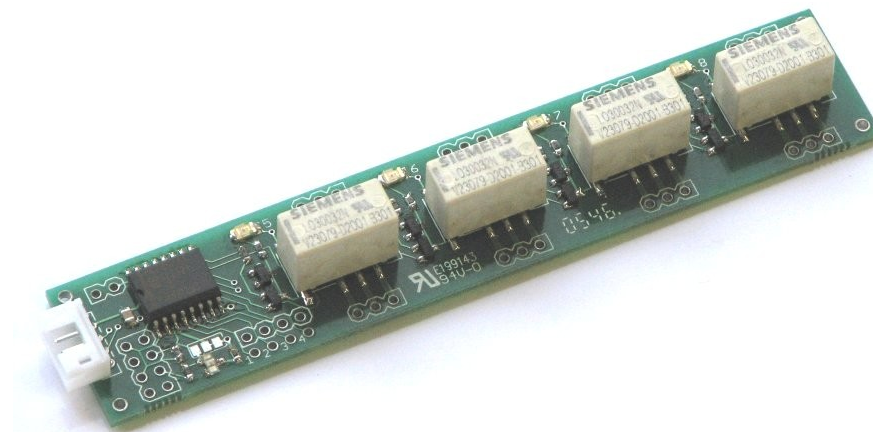
5.1 IO extender

Control 8 digital IOs from your I2C bus.



IO extender (8 bits IOs)

IO extenders are also available with 4 or 8 relay outputs.



IO extender (4 relays)

5.2 Up to 64 IOs

As explained in paragraph 3.2, a total of 64 IOs can be controlled on a single I2C bus using these modules.

6 I2C Text LCD

6.1 Text LCD

The KNJN I2C text LCD display shows 1 line of 20 characters.



This display uses three I2C addresses.

I2C address	Action
0x20	Write LCD command
0x22	Write LCD data
0x24	Write LCD contrast

6.2 Command and data

The LCD command and data values are the same used with industry standard text LCDs.

For example, to write “ABC” to the LCD, use the following:

1. Write data 0x38, 0x0F and 0x01 to address 0x20.
This initializes the LCD, sets the cursor, and erases the display.
2. Write data 0x41, 0x42 and 0x43 to address 0x22.
This writes the characters “ABC” on the display.

For more information, check [here](#) for example.

6.3 LCD contrast

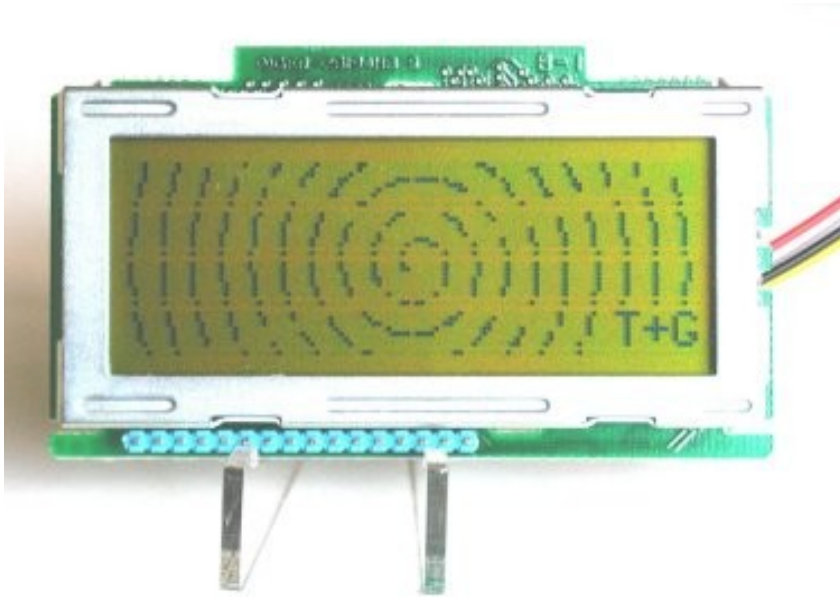
The LCD contrast register accepts the following values:

Hex Value	Binary value	Contrast
0x03	011	+3
0x02	010	+2
0x01	001	+1
0x00	000	0 (default)
0x07	111	-1
0x06	110	-2
0x05	101	-3

7 I2C LCD 4x20T+G semi-graphic

7.1 LCD with pixel-level control

This LCD can display 4 lines of 20 characters, and also allows control of individual pixels. Here's an example where text and semi-graphics are mixed:



7.2 LCD control

The display uses one single I2C address:

I2C address	Action
0x30	Write LCD command/data/contrast

See the "LCD_HD44102.c" file that comes with your display for a programming example.

8 I2C PLL

8.1 Frequency generator

The I2C PLL generates frequencies from 8MHz to 150MHz (typical).

You have two products to choose from:

- A one-output PLL with the shape of a DIL-8 oscillator (DIL-8 oscillator replacement module).
- A three-outputs PLL board.

8.2 DIL-8 oscillator replacement module

This module can replace a DIL-8 oscillator on the board of your choice.

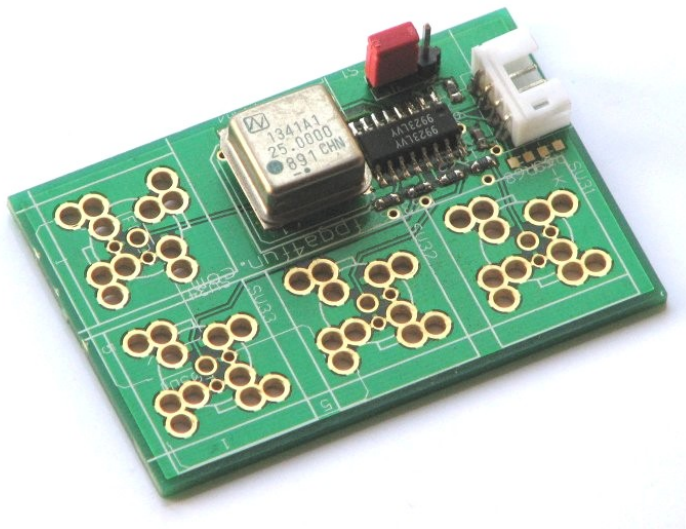
Simply remove the original oscillator and replace it by the module. The target board needs to use a 3.3V or 5V socketed oscillator.



DIL-8 oscillator replacement module

8.3 Three outputs PLL board

This board has three PLLs and four outputs (base frequency + three generated frequencies). Outputs are typically made on straight or right-angle BNC connectors.



Three outputs PLL board

