# AT89S52-gLCD-STK1 Development Board

**Introducing the AT89S52-gLCD-STK1 Development Board**

AT89S52-gLCD-STK1 is a development board designed for building a digital temperature and humidity data-logging meter. At the same time, it can be used as a general 8051 development board with popular peripheral components including a real-time-clock, serial EEPROM, 128x64 dot-matrix graphical LCD, Sensirion SHT10 sensor, 5-way navigator joystick as well as external ROM/RAM extension port.

**Application (concept):** Embedded-system enthusiasts may use the board to store temperature, relative humidity (RH), and dew-point data on a 256kbit eeprom. Each data is accompanied with an optional time-stamp. It is possible to design a fancy menu with icons, setup screens, min-max data display, or even a help menu for PC connection. User interaction is achieved by the 5-way navigator joystick as found on some mobile phones. If system remains idle for over 2 minutes, LCD backlight will be turned off automatically. For more than 5 minutes idle time, LCD will be turned off with the mcu put in sleep mode. Upon a single key-press on the navigator joystick, the system wakes up with a short ring-tone music generated by a piezo sounder, and the current temperature-humidity printed on the LCD. Data stored on EEPROM can be exported to a PC for data analysis.
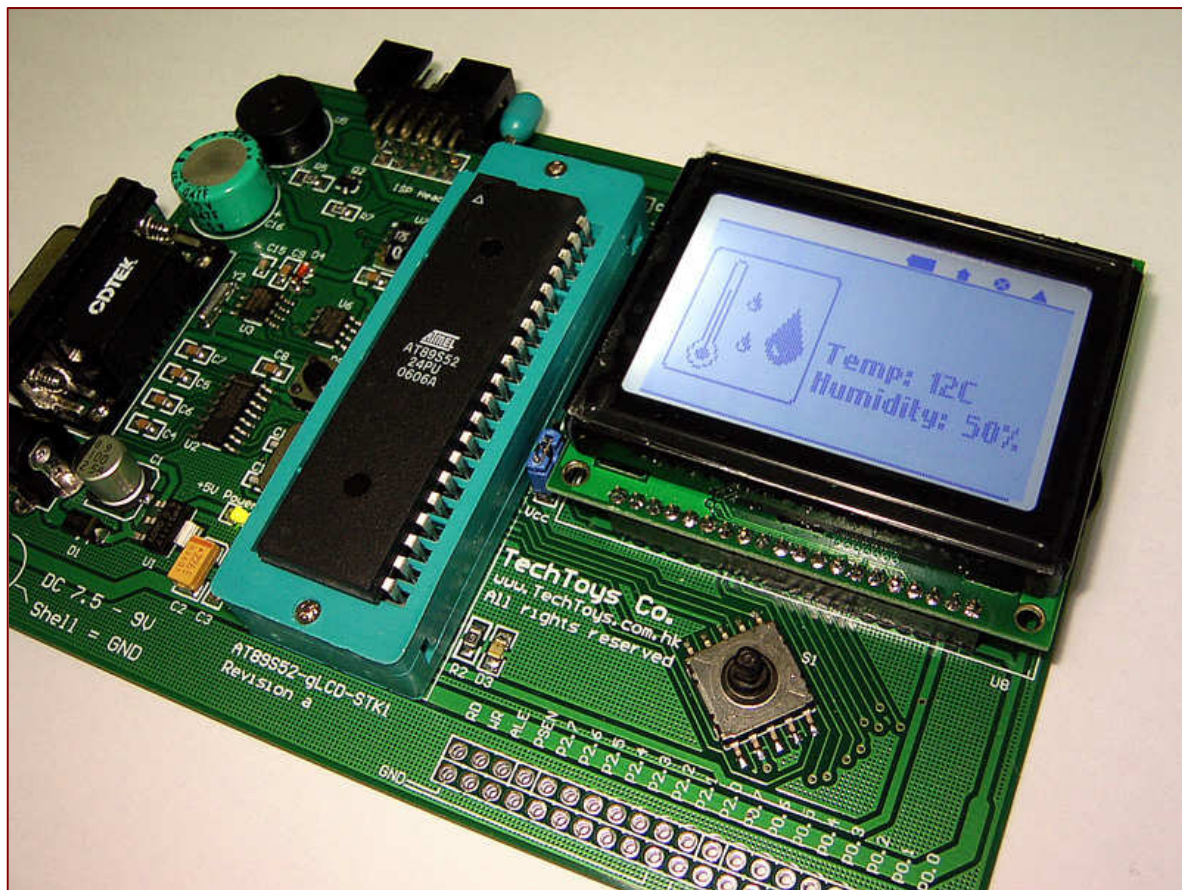


**Figure 1**

**Features of AT89S52-gLCD-STK1**

- Microcontroller is 8051 40-pin compatible mcu. ATMEL AT89S52 is included for its popularity (www.atmel.com)
- Crystal frequency in 11.0592MHz
- ISP in-system programming port compatible with the original ATMEL ISP cable pin-out
- AMS1117 1A Low dropout voltage regulator to convert 7.5V - 9V DC to 5V regulated DC power for the whole board
- Sensirion SHT10 digital humidity and temperature sensor (www.sensirion.com)
- Philips PCF8563 Real-time-clock with 0.047F super cap for power backup
- Atmel 24C256 EEPROM (256kbits, 32kbyte) for storing temperature and RH values
- MAX232 for debug and communication with a PC for data analysis
- 5-way navigator joystick
- Piezo sounder with amplification circuit
- 128x64 dot-matrix monochrome LCD with MOSFET control on backlight power
- Reset button
- Debug LED
- 40-pin IDE-cable compatible extension port for xdata ROM/RAM extension. Selection jumper for EA pin shorted to ground or +5V available
- 1.6mm double-side PCB with silk-screen printing
- Dimensions: 125mm x 88mm

**What is included?**

- AT89S52-gLCD-STK1 board, fully assembled and tested
- 2k limited version Keil C compiler and µVision IDE
- Demo applications with full source code as below
    - o Blink LED code
    - o Piezo sounder demo code
    - o UART demo code
    - o 5-way navigator joystick demo code
    - o Philips PCF8563 RTC driver and an example program
    - o Atmel 24C256 eeprom driver and an example program
    - o Sensirion SHT10 sensor demo code
    - o JHD 128x64 graphical LCD driver and a demo code
- Data sheet for all major components

**What is NOT included?**

- Device programmer for ATMEL AT89S52. Simple ISP download cable is available from us for HK$100 only.
- 9-pin COM port cable. A straight cable should be used.
- 7.5V power supply. A simple 7.5V power supply capable of delivering 200mA is good enough.
- PC for development!

## Software and Hardware Installation

### Software

Keil C is a professional, industry standard compiler. We will use 2K limited edition of Keil C. For those who would like to get further information on 8051 mcu, C programming skill, or Keil C project settings, please refer to the following recommended references:

- Microcontroller Projects in C for the 8051 by Dogan Ibrahim

- Embedded C by Michael J. Pont
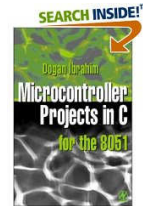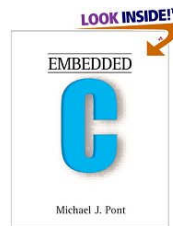
- For assembly language learners, The 8051 microcontroller and embedded systems, written by Muhammad Ali Mazidi, Janice Gillispie Mazidi.

- Embedded System Building Blocks, Complete and Ready-to-use Modules in C, 2nd edition by Jean J. Labrosse. Though it is not a direct 8051 tutorial, it is an excellent embedded C programming reference.

- For Chinese readers, there are numerous options
    - 精通 8051 程序设计，[美]Myke Predko 编著
    - 8051 系列单片机 C 程序设计完全手册，求是科技 编著
    - 例説 8051，人民邮电出版社
    - 增强型 80C51 单片机速成与实战
      周立功 等编著
      北京航空航天大学出版社

**Hardware**

Layout of AT89S52-gLCD-STK1 development is shown in Figure 2
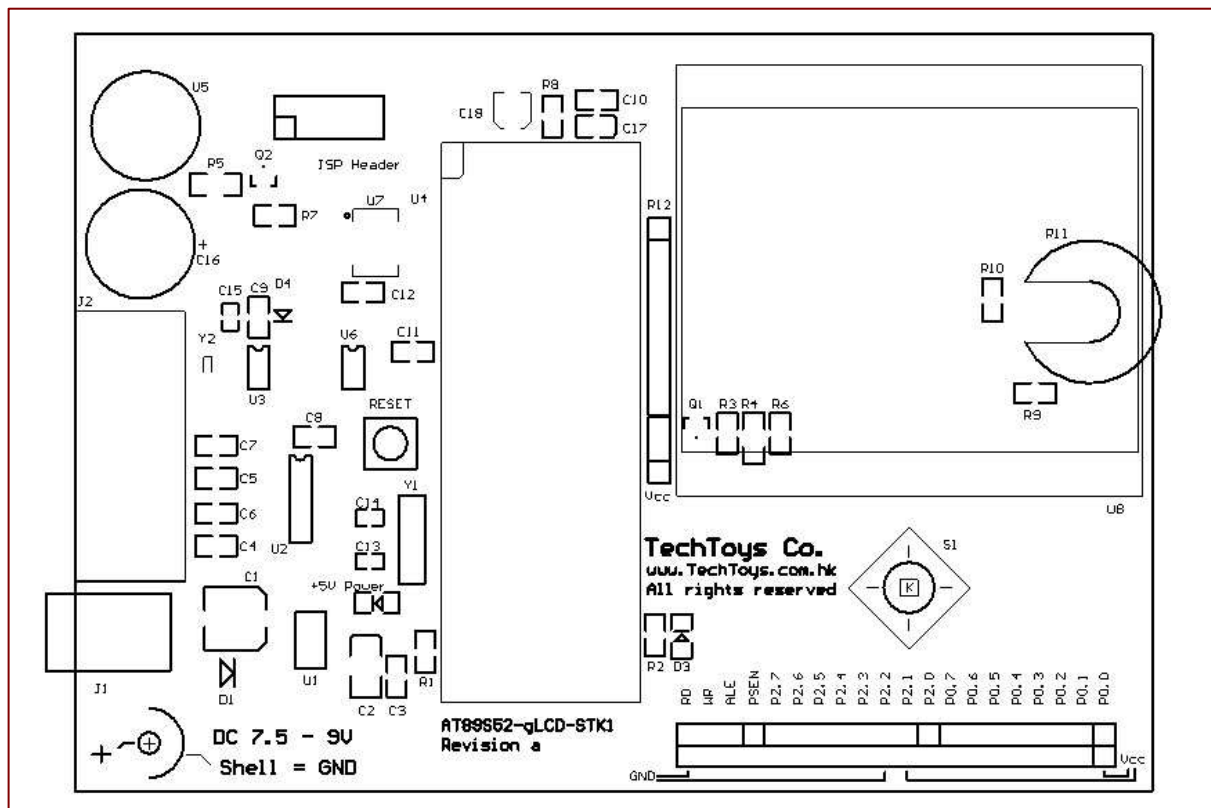Major components in Table 1.



 **Figure 2**

| Components | Model | Function |
|---|---|---|
| J1 | 2.1mm DC power jack | DC power input 7.5-9V |
| J2 | RS232 9-pin female port | Connection to PC's COM port |
| ISP Header | 10-pins IDC header | ISP (In-system programming) |
| EA select | 2.54mm jumper for 0V or +5V (default +5V) | Run program from internal flash or external ROM |
| IDC Header | 2.54mm 40-pins extension port | xdata extension port for P0 & P2 |
| U1 | AMS1117 5.0 | Linear regulator |
| U2 | MAX232 | RS232 Transceiver |
| U3 | Philips PCF8563T Real-time-clock | Real time clock/calendar |
| U4 | Atmel AT89S52 microcontroller | Microcontroller |
| U5 | Piezo Sounder | Audible tone generator |
| U6 | Atmel 24C256 | Serial EEPROM (256kbit) |
| U7 | SHT10 temperature and Humidity sensor | Sensor |
| U8 | JHD128x64 graphical LCD | Display |
| S1 | 5-way navigator joystick | Joystick, user interaction |
| RESET | Reset button | System reset |
| R11 | 10k Trimmer underneath the graphical LCD | Contrast adjustment for LCD |
| C16 | NEC 0.047F (47,000µF) super capacitor | Power backup for U3 |
| D3 | Green LED connected to P2.0 of U4 | Debug or visual indicator |

**Table 1**

### Keil C and µVision2 IDE

From the companion CD (-OR- www.TechToys.com.hk⇒AT89S52-gLCD-STK1 kit), inside
**KEIL C51 DEMO** folder, search for **cd:\KEIL C51 DEMO\SETUP\Setup.exe**. Double
click to install.



**Figure 3**

Select **Eval Version** to install 2K limit Keil C51 compiler with µVision2 IDE.



**Figure 4**

Restriction of this 2K Eval version is shown as below:

PK51/C51 Compiler - RESTRICTIONS IN THE EVAL VERSION

1.  The 8051 compiler, assembler, linker, and debugger are limited to 2 Kbytes of object code but source code
can be any size.  Programs generating more than 2 Kbytes of object code will not compile, assemble, or link.

2.  The debugger supports 2 Kbyte files or smaller.

3.  The startup code generated includes LJMPs and code generated cannot be used in single-chip devices
supporting less than 2K of program space (for example, Philips 750/751/752).

4.  Programs begin at offset 0x0800 and code generated with the evaluation software cannot be programmed
into single-chip devices.

5.  No hardware support is available for multiple DPTR registers.

6.  No support is available for user libraries or floating point arithmetic.

7.  The following Code Banking Linker, Library Manager and RTX-51 Tiny Real-Time Operating System, which
are present in the PK51 Full Version, are not included in the PK51/C51 Eval Version.

8.  It is not possible to generate assembler source files or use in-line assembler features.

Launch from the icon on Desktop. shown in Figure 6.
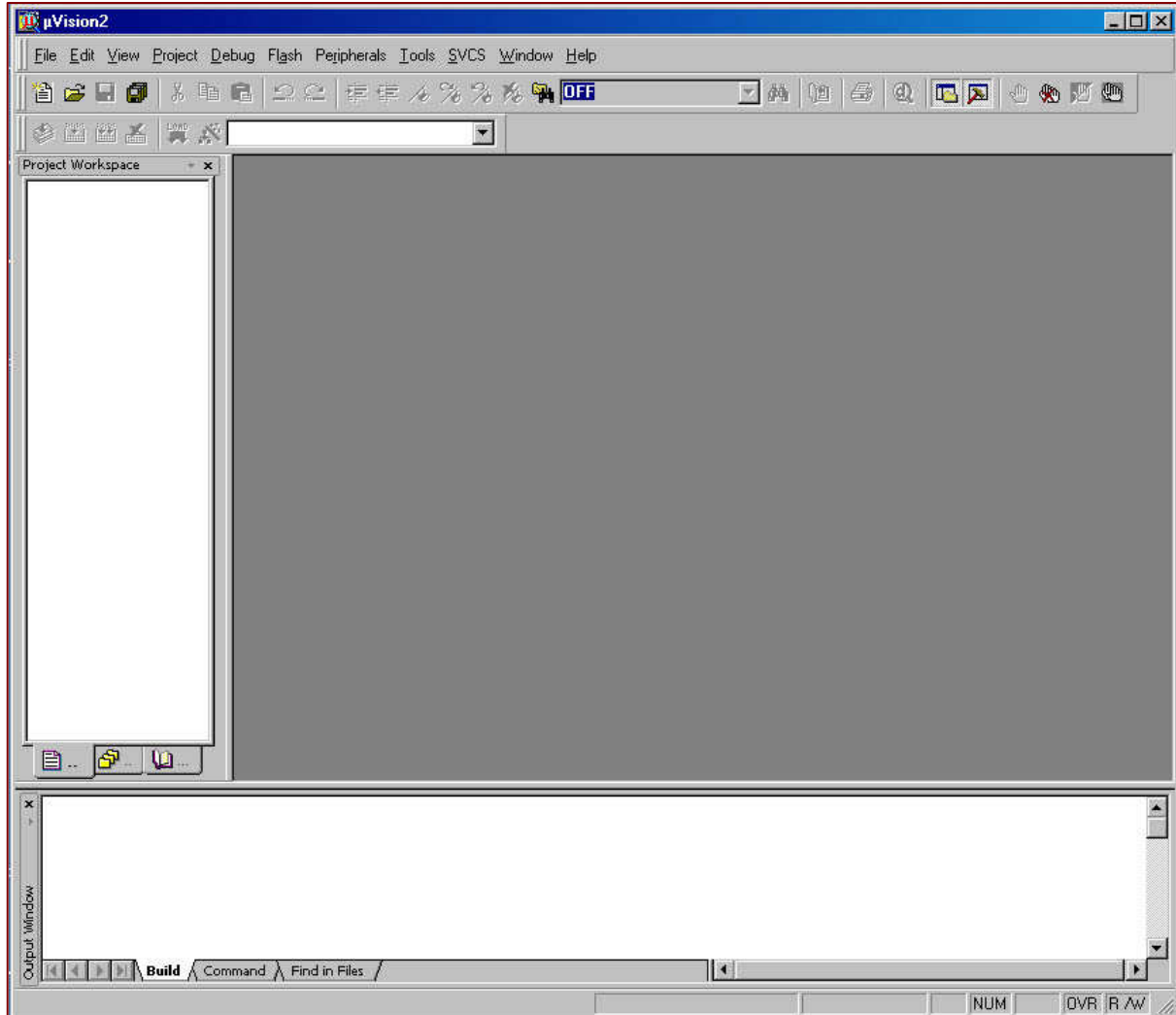
The user interface of µVision is

**Figure 5**



**Figure 6**

It is very easy to get confused with the terms of the software package.

µVision2 is the integrated development environment (IDE), basically the user interface you see after double click Keil uVision2 icon. C51 is the compiler that translates C syntax like printf("Hello World") to object file that will be linked by other modules included in Keil package to generate a file of HEX format. This HEX code is the execute file for the AT89S52 microcontroller. The first project is located at cd:\src\chp2\src2_1\. Most of the projects are also available from our web site under www.TechToys.com.hk ⇒ AT89S52-gLCD-STK1 kit. Project name is blinkLED.uv2. Launch uVision2 IDE, under **Project**, browse to blinkLED.uv2 and click **open**. Project under Keil has the file extension of *.uv2. Take a brief look on the source code, under **Project->Rebuild all target files**. A HEX file will be created which may be downloaded to the AT89S52 mcu via the ISP port or an independent mcu programmer. Embedded-system development starts here!

⇒ **Chapter 2**