Application Note

Interfacing Alphanumeric LCD Displays, Matrix Keypads, and Parallel Printers to Digital I/O

AN8255 rev A

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1.0 Introduction

A number of Micro/sys embeddable computers include a 26-pin connector that provides TTL-level digital I/O lines. These I/O lines can be used for a multitude of off-board uses - sensing switch inputs, driving panel indicators, interfacing to peripherals, etc. Quite often, these digital I/O lines are implemented with an 82C55 device. This venerable device provides three 8-bit ports, and the direction of each port (input or output) is software programmable.

Many system designers are presented with similar interfacing chores:

- An alphanumeric LCD display may need to be driven as an operator prompt and output device. These displays require an 8-bit bi-directional data path and a number of discrete control signals to manage data transfer to and from the display.

- A keypad may need to be scanned, with the ability to determine at any time which key is being pressed by the operator. These keypads are arranged in a row-column scheme (5 rows of 4 buttons, for example) where any particular key electrically connects a specific row signal to a specific column signal. This same scheme is often used for a number of discrete panel-mounted switches that an operator can manipulate.

- A Centronics compatible printer may need to be driven for hard copy printouts. These printers require an 8-bit output data bus, and a number of input and output control and monitoring lines to print characters and monitor printer status.

This Application note details how to interface any of these three functions to a Micro/sys embedded computer that implements digital I/O with an 82C55 device. Cable drawings and source code listings are included.

Unzip (including subdirectories) the file SW4057.ZIP to expand source files and example code.

It is hoped that this information will assist you in quickly developing your application. If you would like any additional information about the contents of this Application Note, or on any other aspect of embedded system development, we welcome you to contact Micro/sys Technical Support.

2.0 82C55 Digital I/O to LCD Display Interface

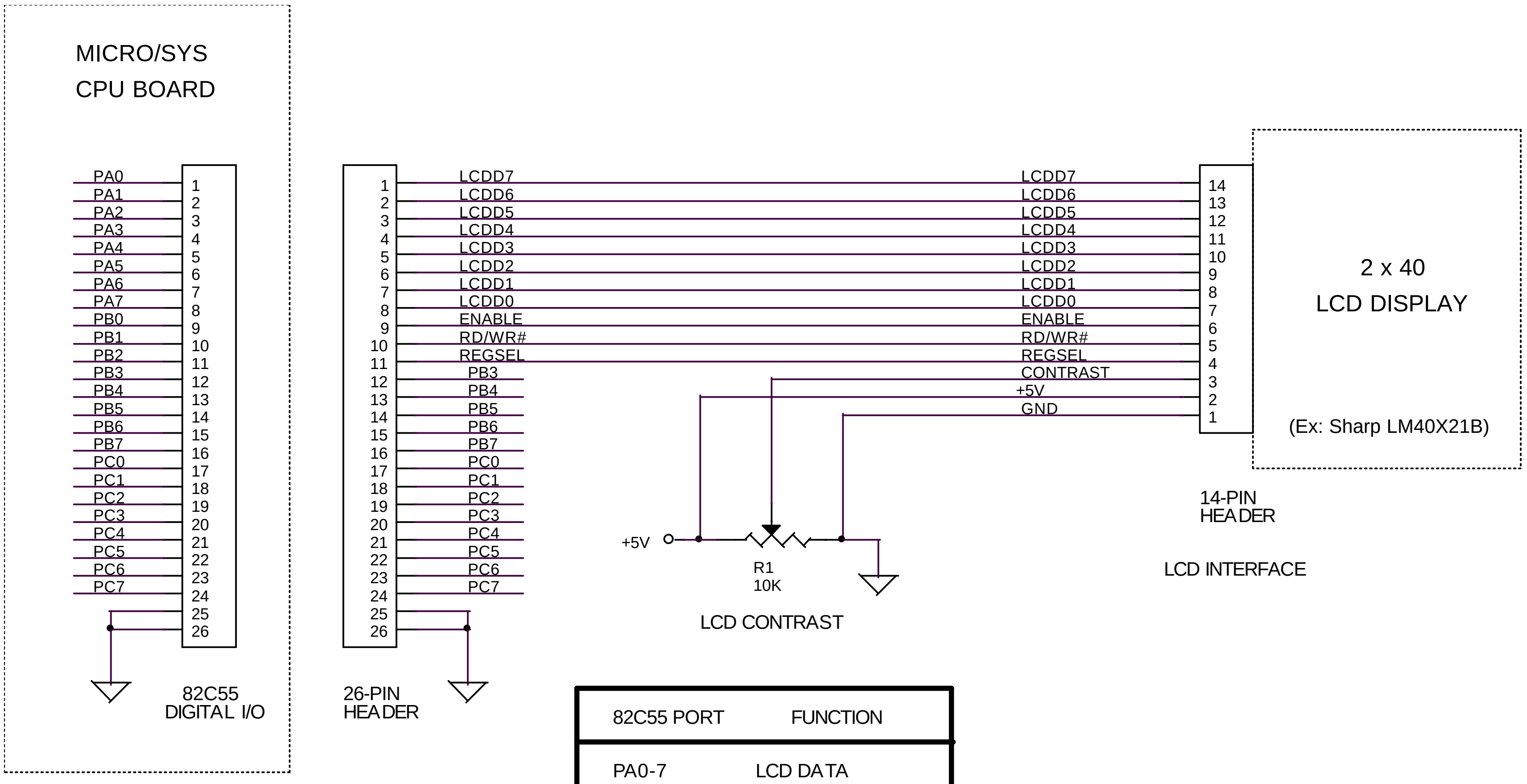
The interfacing of inexpensive LCD modules in embedded systems is a very common requirement. An LCD display is a clean and simple way to display messages in your application and can also be a valuable tool during system development for outputting troubleshooting information. The simplicity of the LCD module interface presented here makes it fast and easy to get these devices up and running on any Micro/sys CPU board with an 82C55 digital I/O device.

2.1 LCD Interface Hardware

The 82C55 to LCD hardware interface consists of a simple cable and a 2 line x 40 character LCD module. The example LCD module has a 14-pin ribbon cable header. The cable connects a subset of the 26-pin digital I/O connector on the Micro/sys embedded computer to the LCD.

Port A of the 82C55 is used for byte-wide LCD data, while Port B of the 82C55 is used for the control lines. The ENABLE output is on Port B bit 0, the R/W# output is on Port B bit 1, and the REGSEL output is on Port B bit 2.

If the LSB of the LCD data lines is connected to port A bit 7 (MSB), the cable used in the interface is greatly simplified, making it possible to use a one-to-one ribbon cable assembly for all the DATA and CONTROL lines. Because this cable actually presents a mirror image of the 8-bit data to the LCD display, the software reverses the order of the DATA bits so the proper data is read from or written to the LCD module.



82C55 PORT	FUNCTION
PA0-7	LCD DATA
PB0	ENABLE
PB1	READ/WRITE#
PB2	REGISTER SELECT

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One note of caution: The signal connector on many LCD display units is poorly marked in terms of pinout. On some units, the square pad that normally signifies pin 1 is actually on pin 14. On others, there is a vertical line near one pin that would seem to indicate pin 1, but, again this is not pin 1. The best insurance against LCD damage due to backwards cabling is to examine the LCD unit's PCB traces to determine which corner pin is connected to the unit's GROUND trace. This is pin 1.

2.2 LCD Interface Software

The software for the 82C55 to LCD interface contains many useful routines for the LCD display. The software contains a small memory model library that can be linked with your application for access to the LCD functions. Also provided are two demonstration programs for the LCD interface - one illustrates basic LCD functions and the other shows how to "hook" the BIOS Int 10 video handler, thereby redirecting normal console output to the LCD display. A brief description of each of the user functions follows. Refer to the demonstration program source code files for examples of their use.

LCDInit(int baseaddr) - Initializes the ports of the 82C55 and the LCD display mode. The base address of the 82C55 digital I/O on the specific Micro/sys computer being used is passed to this function. *THIS FUNCTION MUST BE CALLED BEFORE ANY OTHER FUNCTION IS USED.*

LCDPutc(int c) - writes a single character to the LCD module at the current position of the cursor.

LCDputs(char * str) - outputs a character string to the LCD module begining at the current position of the cursor.

LCDSetCursor(int Xcoord, int Ycoord) - positions the LCD cursor to a specific x and y coordinate on the display. Because the software is written for a 2 line by 40 character LCD module, x ranges from 1 to 40, and y is either 1 or 2.

LCDGetCursor() - returns the current cursor position on the LCD module.

LCDGetxpos() - returns the current cursor x-coordinate on the LCD.

LCDGetypos() - returns the current cursor y-coordinate on the LCD.

LCDScroll() - copies the contents of line 2 of the LCD to line 1 and blanks line 2.

LCDInstallVideo() - installs a handler for Int 0x10 (video) that will redirect video output to the LCD module.

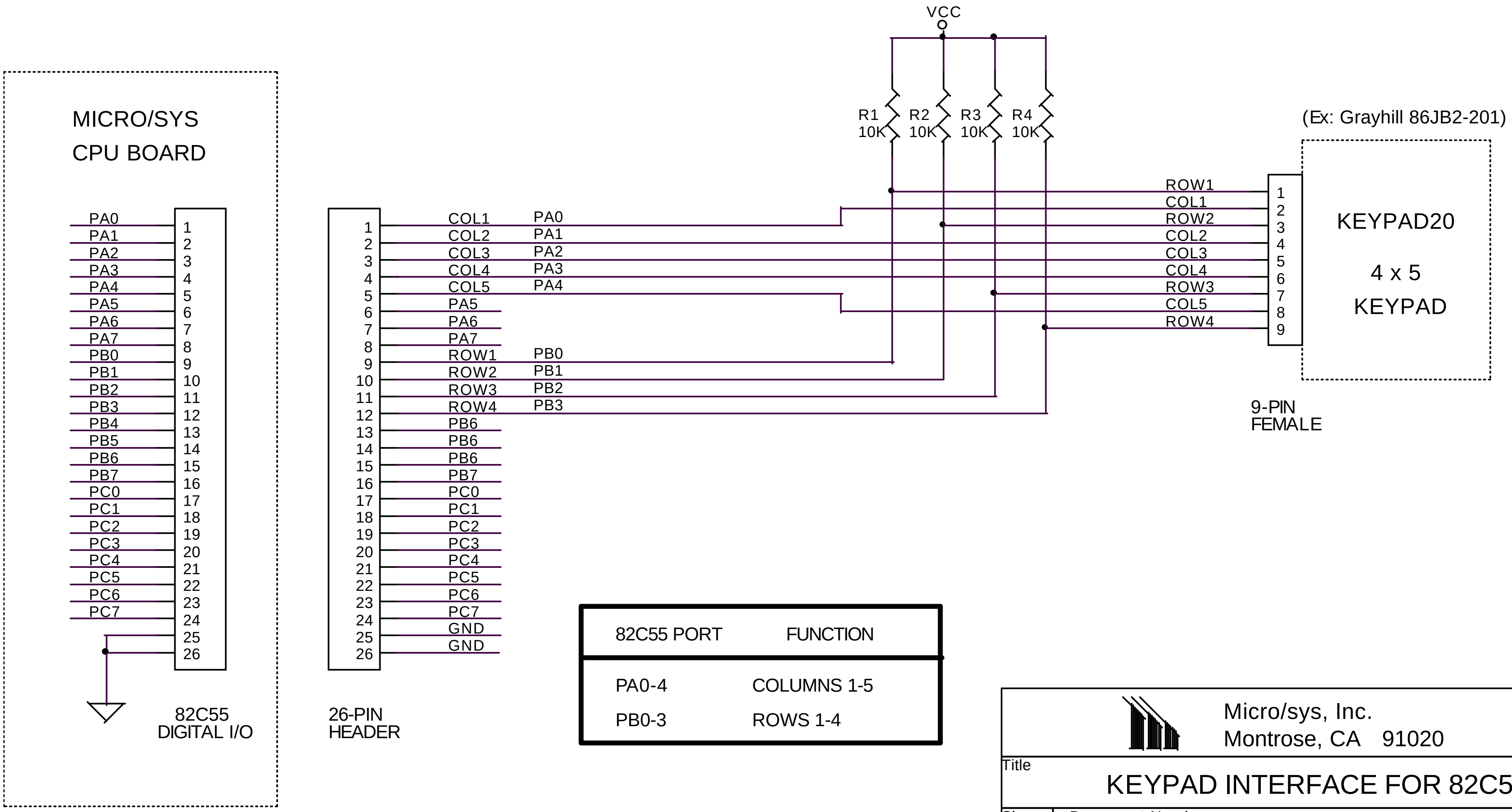
LCDUninstallVideo() - uninstalls the LCD display handler for Int 0x10 (video) that will restore the original video handler.

3.0 82C55 Digital I/O to Keypad Interface

The interfacing of a keypad to an embedded system is a low cost and reliable way to provide an input device for many control functions. A keypad is an easy and effective method to provide input data from the user in a control application. The simplicity of the keypad interface presented here makes it fast and easy to get a keypad up and running on any Micro/sys CPU board with an 82C55 digital I/O device.

3.1 Keypad Interface Hardware

The 82C55 digital I/O to keypad hardware interface consists of a simple cable that connects a 20-key (4 x 5) keypad to the 26-pin digital I/O connector on a Micro/sys embedded computer. Port A of the 82C55 is used for COLUMN interfacing (COL0-COL4 on port A bits 0-4, respectively) and is initialized as outputs. Port B of the 82C55 is used for ROW interfacing (ROW0-ROW3 on port B bits 0-3, respectively) and is initialized as inputs. The ROW inputs on Port B have 10K pullup resistors so the software can scan the ROW inputs for an active LOW. The schematic diagram on the next page shows the interface cable configuration.



82C55 PORT	FUNCTION
PA0-4	COLUMNS 1-5
PB0-3	ROWS 1-4

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3.2 Keypad Interface Software

The software for the 82C55 digital I/O to keypad interface implements the scanning and decoding of the keypad matrix to detect which key, if any, has been hit. The software contains a small memory model library (KPD8255.LIB) that can be linked with your application for access to the keypad functions. Also provided is a demonstration program that illustrates the use of the software in reading the keypad. This program outputs the ROW and COL number of the key that was hit. The user could write a function that translates the ROW and COL numbers into more meaningful application-specific output. A brief description of each of the software functions is as follows. Refer to the demonstration program for details on their use.

KPDInit(int baseaddr) - Initializes the ports of the 82C55 for use with the keypad interface cable described in the Hardware section. The base address of the 82C55 digital I/O on the specific Micro/sys computer being used is passed to this function.*THIS FUNCTION MUST BE CALLED BEFORE ANY OTHER FUNCTION IS USED.*

Int KPDReadKey() – Scans the keypad and returns the key that is pressed. Does not wait for a keypad press before returning a value. The lower byte contains the COLUMN number (0x00-0x04), and the upper byte contains the ROW number (0x00-0x03). If no key is being pressed, this function returns a value of –1 (NOKEYHIT).

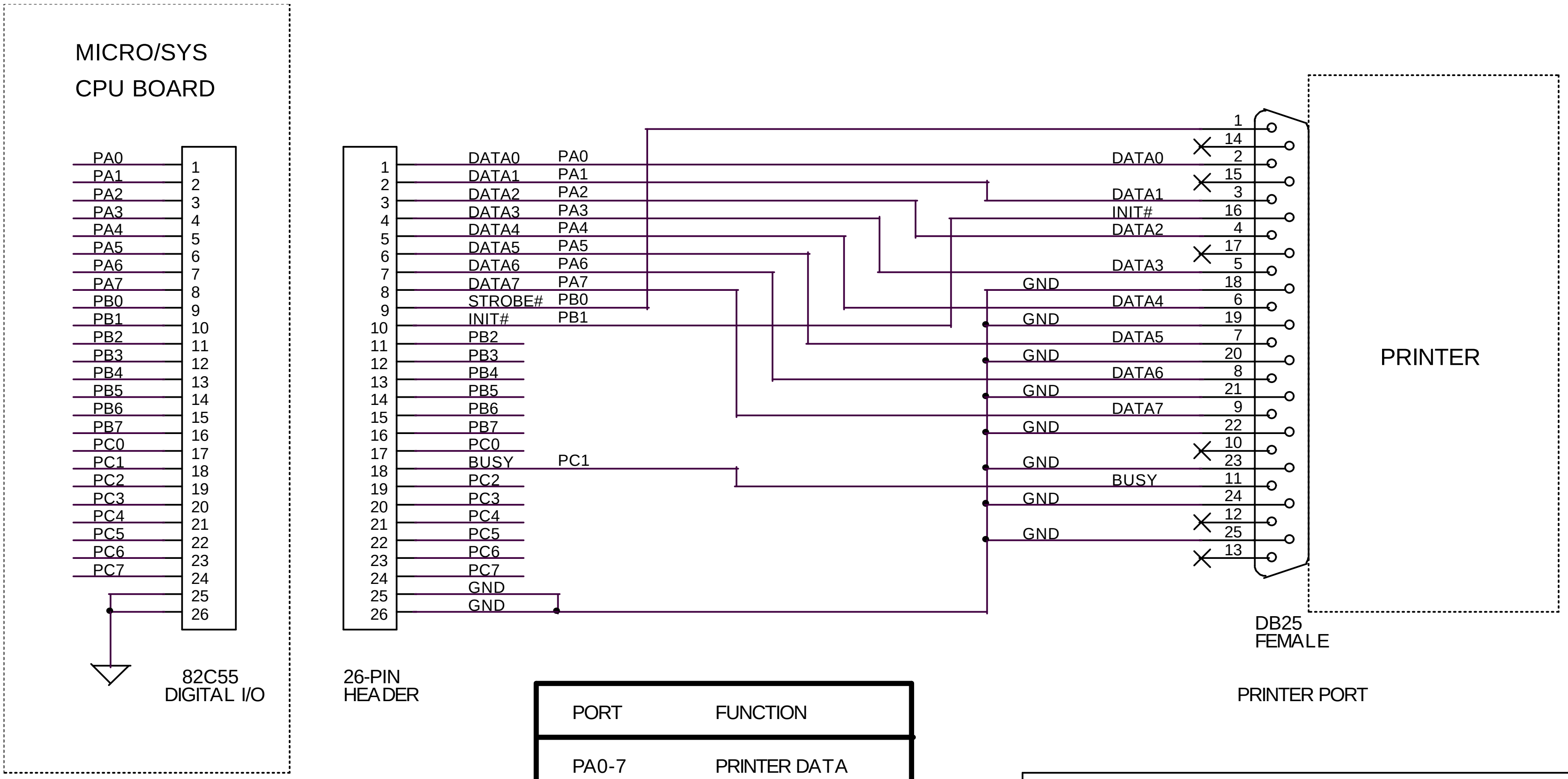
Int KPDGetKey() – Scans the keypad and returns the key that is pressed. Waits for a keypad press before returning a value. The lower byte contains the COLUMN number (0x00-0x04), and the upper byte contains the ROW number (0x00-0x03).

4.0 82C55 Digital I/O to Parallel Port (LPT) Interface

The interfacing of a parallel printer in an embedded system without a dedicated LPT port can be time-consuming. The LPT port is an easy way to interface many types of printers and other parallel port devices to your application and can also be a valuable tool during system development for outputting troubleshooting information to these devices. The simplicity of the LPT port interface presented here makes it fast and easy to get a parallel port up and running on any Micro/sys CPU board with an 82C55 digital I/O device.

4.1 Printer Interface Hardware

The 82C55 digital I/O to parallel port hardware interface consists of a simple cable that connects a parallel printer to the 26-pin digital I/O connector on a Micro/sys embedded computer. Port A of the 82C55 is used for printer data, while Ports B and C of the 82C55 are used for the control lines. The STROBE# output is on Port B bit 0, the INIT# output is on Port B bit 1, and the BUSY input is on Port C bit 1. The LPT8255 schematic diagram on the next page shows the interface cable configuration.



PORT	FUNCTION
PA0-7	PRINTER DATA
PB0	STROBE# - OUT
PB1	INIT# - OUT
PC1	BUSY - IN

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4.2 Printer Interface Software

The software for the 82C55 digital I/O to LPT port interface "hooks" BIOS INT0x17. Most language compilers use this BIOS printer interrupt to control the printer on a standard LPT port. Once INT0x17 is "hooked", printer output will be redirected to the printer on the 82C55. The software contains a small memory model library that can be linked with your application for access to the LPT printer functions. Also provided is a demonstration program for the LPT interface that illustrates the use of the printer port software. A brief description of each of the functions is as follows. Refer to the demonstration programs for details on their use.

LPTInit(int baseaddr) - Initializes the ports of the 82C55 for use with the LPT interface cable described in the Hardware section. The base address of the 82C55 digital I/O on the specific Micro/sys computer being used is passed to this function.*THIS FUNCTION MUST BE CALLED BEFORE ANY OTHER FUNCTION IS USED.*

LPTRedirect() – Redirects the INT 0x17 software interrupt to the 82C55 digital I/O parallel port instead of the LPT port of the system.

LPTRestore() – Restores the INT 0x17 software interrupt back to the system LPT port instead of the 82C55 digital I/O parallel port.

The following standard C library calls (not in the LPT8255 library) can be used after LPTRedirect() to print on the printer attached to the 82C55. Refer to your C compiler documentation for usage specifics.

_bios_printer(0, 'x', 0); -- prints the character x on the printer.

fprintf(stdprn, "This is a printer test.\r\n"); -- prints the string on the printer.