SGS-THOMSON MICROELECTRONICS

APPLICATION NOTE

ST508x/90 DEMOTOOL

By Andrea GALLO

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I - THE ST508x/90 DEMO TOOL BOARD

I.1 - Description

The ST508x/90 Demo Tool board has been designed to drive one or two ST5080A, ST5088 or ST5090 circuits in any combination amongst them. ST5080A and ST5088 in PLCC28 package can be used directly on the mother board. ST5080A in SO28 and ST5090 in SO28 and TQFP44 packages need to be mounted on the provided daughter boards.

The ST508x/90 Demo Tool board is driven by the ST9 (ST90E40) microcontroller and must be connected to a PC running the ST508x/90 Demo Tool Software (described in part 2 of this guide) via the RS232 port. This port is configured as a DCE with a DB-9 female connector, so a standard PC serial cable can be used.
The ST9 must be powered at 5.0V±10% through the AUXVCC and AUXGND connectors on the board.

If two ST5090 circuits are connected through their daughter boards, they can be powered between 3.3V ÷ 5.0V±10% through the VCC and GND connectors on the board.

The JP5 jumper on the board can be used to join the two power supplies together in order to use one external power supply only.

The two ST508x/90 circuits feature a full digital PCM connection. Control and synchronisation signals are provided by the ST9 microcontroller.

In case a single circuit is used, JP6 can be closed to provide an external digital loopback on transmitted and received PCM data.

Throughout this guide, the two circuits will be referred to as IC0 and IC1, with IC0 being the one on the DB-9 RS232 connector side of the card.

Connectors JP3, JP4, JP7 and JP8 can be used for both daughter boards and external PCM interface. In the latter case a single IC device on the board can be connected with an external PCM world, either providing its own synchronisation signals to a slave device or receiving them from a master one. In this case, ST508x/90 Demo Tool should be configured in External Master Clock mode, as described in section 2.5.

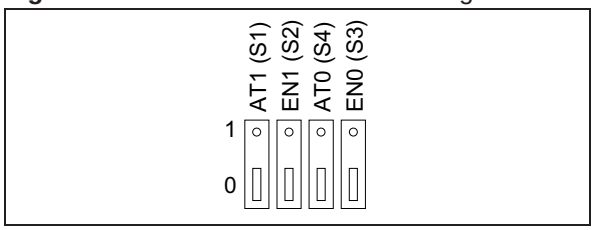
Switches S3-S4 control the Alternate Tone AT pin of the ST5080A/88 in IC0 and S1-S2 in IC1 as reported in Table 1, with reference to Figure 1.

I - THE ST508x/90 DEMO TOOL BOARD (continued)

Table 1 : AT and EN Switches Function

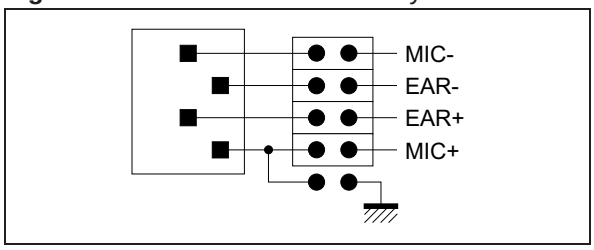
		AT Switch	
		0	1
EN Switch	0	high impedance	
	1	V_{CC}	GND

Figure 1 : AT and EN Switches Configuration



The two handset connectors have a set of jumpers just next to them. When jumpers are closed as in Figure 2, microphone and earpiece are in symmetric mode. If a different configuration is needed for a particular application, jumpers can be taken off and pins can be wired as required.

Figure 2 : Handset Connector in Symmetric Mode



II - THE ST508x/90 DEMO TOOL SOFTWARE

II.1 - Hardware Requirements

The ST508x/90 Demo Tool Software runs on any PC MS-DOS® compatible under the Microsoft Windows™ 3.1 (or higher) environment, with a hard drive, a mouse and a spare RS232 port.

II.2 - Software Installation

From the Windows Program Manager select the *File* menu and the *Execute* option, then at the prompt type : `a:setup` and press return. You will be asked in which directory you want to install the software and you will be offered the choice for a default path.

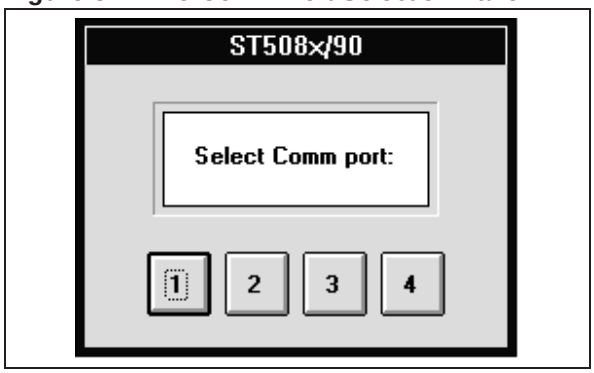
Installation will then follow automatically and at the end a new *Group* will be inserted in the Windows Program Manager. It will contain the ST508x/90 Demo Tool icon, which will start the main software when double-clicked.

II.3 - Starting a new session

Connect PC to the ST508x/90 Demo Tool board with the supplied cable, properly power the board, press the *Reset* button on it and then start the ST508x/90 Demo Tool Software by double-clicking on its icon in the Windows Program Manager.

A window will open and you will be asked to select which port you want to use as shown in Figure 3.

Figure 3 : The Comm Port Selection Panel



Carefully check which port you have connected the board to and then select as appropriate.

PC and ST9 will try to establish a connection, then coherence between ST508x/90 registers status and PC display will be gained.

If you get an error message saying that connection has not been established you have the following possibilities :

– you have not connected the board and you want to use the software in standalone mode, in order to learn how it works, then simply ignore the error message ;
– you have selected the wrong *Comm* port, then check it, exit from the ST508x/90 Demo Tool Software and start the whole procedure again ;
– you have not reset the board before starting the ST508x/90 Demo Tool Software, then click on the *Reset* button on the board, select then *Connection* option from the ST508x/90 Demo Tool Software menu bar (described later) and click on the *Connect* button.

Should you loose your connection during a session, try to re-establish it via the *Connection* window. If this is not enough, press the *Reset* button on the board and then connect again. Coherence will be gained and no data will get lost.

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

II.4 - The Main Window

Every time you start the ST508x/90 Demo Tool software, its *Main Window* and *Toolbox* will be displayed at the top of your screen.

Figure 4 : The Main Window

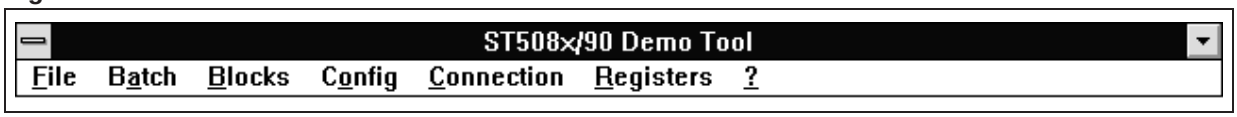
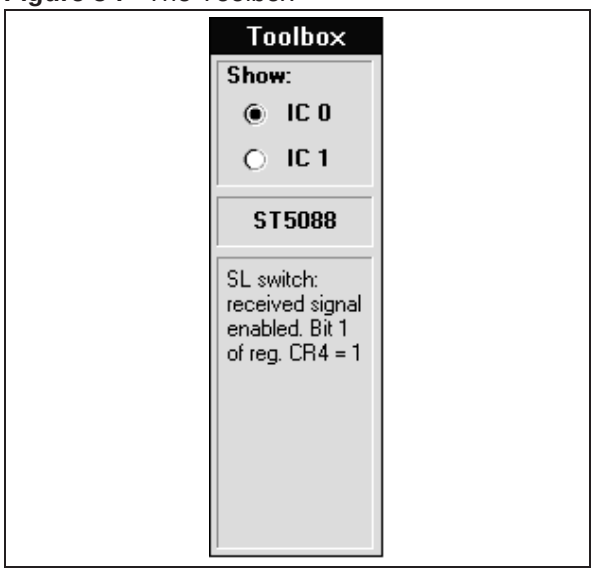


Figure 5 : The Toolbox



The *Main Window* is a menu bar, whose fields will be fully described throughout this guide. The *Toolbox* contains the currently selected IC circuit and shows its configuration. IC0 or IC1 can be selected by clicking on the corresponding option. At any time you can also press F1 on the keyboard to switch between them.

The Toolbox contains also the *Inline Help*, which describes everything under the mouse pointer. This facility can be toggled on and off by selecting the *?* menu bar field and clicking on the *Inline Help* option.

II.5 - The Configuration Menu

From the *Main Window* menu bar select the *Config* field. Each IC circuit can then be individually configured as: none, ST5080A, ST5088 and ST5090.

PCM MCLK master clock can be set to 512kHz or 1.536MHz. It is directly generated by the ST9 microcontroller, together with the frame sycnhronisation 8kHz signal, and fed to the two IC circuits.

Actually, the ST508x/90 devices can be driven by 512kHz, 1.536MHz, 2.048MHz and 2.560MHz signals but it is the ST9 microcontroller which cannot generate the latter. A dedicated PCM circuit should have been added, thus increasing the size and complexity of the board.

Anyway, by selecting the *external* master clock configuration, the two synchronisation signals can be injected by an external generator through either JP4 or JP8 connector.

II.6 - The AFE Window

Once you have configured the two IC slots, you can edit each one individually. In the *Toolbox* select which device you want to edit by clicking on one of the two option buttons in the *Show :* field. Then select the *Blocks* field of the *Main Window* menu bar and click on the *AFE* option. The *AFE Window* will be displayed on the screen (see Figure 6).

Using the same graphical representation as adopted in the circuit datasheet the device block diagram is represented with its internal switches and variable-gain amplifiers.

You can interact with it by clicking with the mouse on the switches - which are displayed in thick red colour for easier eye-catching - to toggle their status.

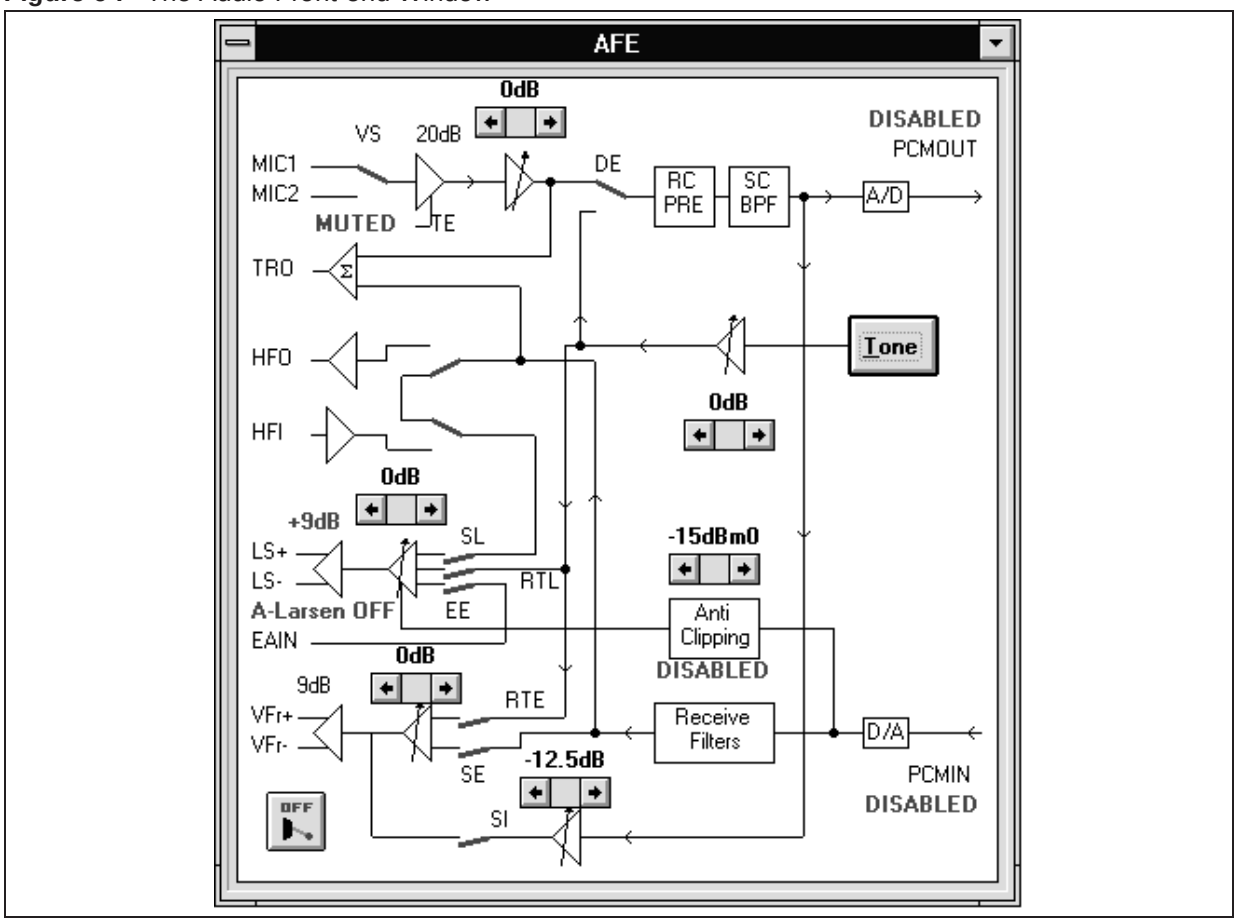
Similarly you can change the amplifiers' gains by clicking on the arrows at either side of each slider bar.

The *Inline Help* in the *Toolbox* will display which registers and bits are involved in the operation and their current status.

The consequence of any action is reflected on the PC screen only after that the ST9 microcontroller has confirmed it. There is always coherence between circuit state and PC screen display, unless otherwise stated.

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

Figure 6 : The Audio Front-end Window



II.7 - The PCM Window

Select the *Blocks* field of the *Main Window* menu bar and click on the *PCM* option. The *PCM Window* will be displayed on the screen (see Figure 7).

Several configuration options are available. Amongst them, the Master Clock frame allows you to locally change the expected master clock. The MCLK option of the *Config* menu in the *Main Window* actually changes the board generated clock and properly configures both IC devices, while this option allows to locally change the single device configuration and thus allows to select the 2.048 or 2.560MHz clocks as well.

As the board generated clock signals feature a 50% duty cycle, it is recommended to select the non-delayed data timing mode.

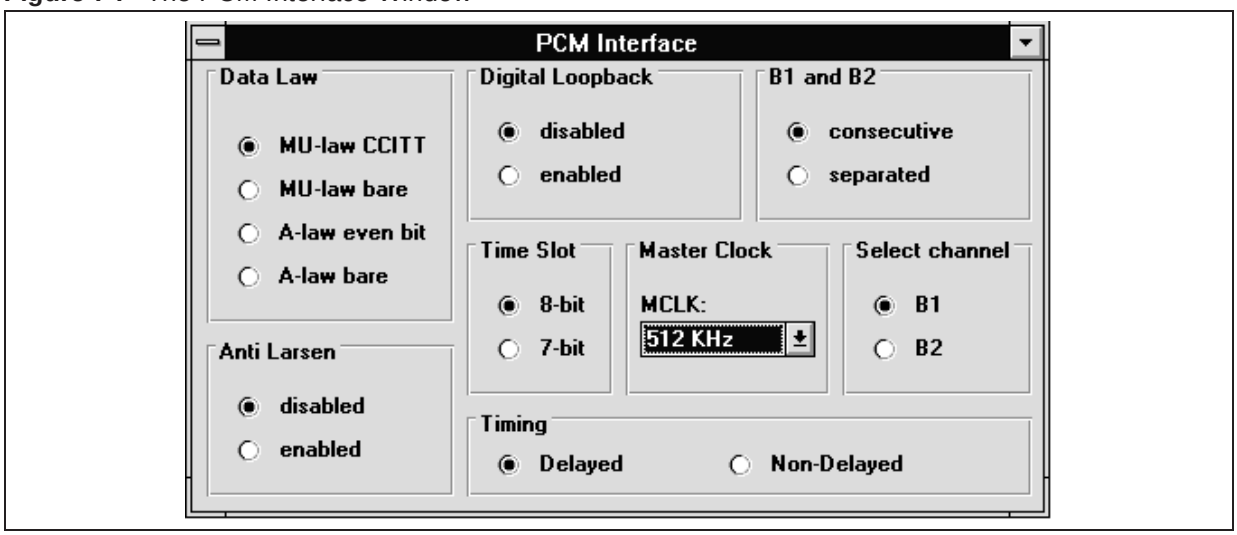
Please note that for a proper PCM communication between two devices, you should program both PCM interfaces in the same way.

The *Inline Help* in the *Main Window* will display which registers and bits are involved in the operation and their current status.

The consequence of any action is reflected on the PC screen only after that the ST9 microcontroller has confirmed it. There is always coherence between circuit state and PC screen display, unless otherwise stated.

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

Figure 7 : The PCM Interface Window



II.8 - The Registers Window

From the *Main Window* menu bar select the *Registers* field. You will be presented the *Registers Status Window* (see Figure 8).

The whole set of the programmable registers can be studied and edited. By clicking with the mouse on any cell of the *Val* column, it is possible to select a whole register state or a register bit state. By double-clicking on the same cell it is then possible to edit its value. Pressing the *Return* key on the keyboard or clicking on the *Set* button will store the new value.

Decimal or Hexadecimal notation can be selected for data editing by clicking on the corresponding button (see Figure 8).

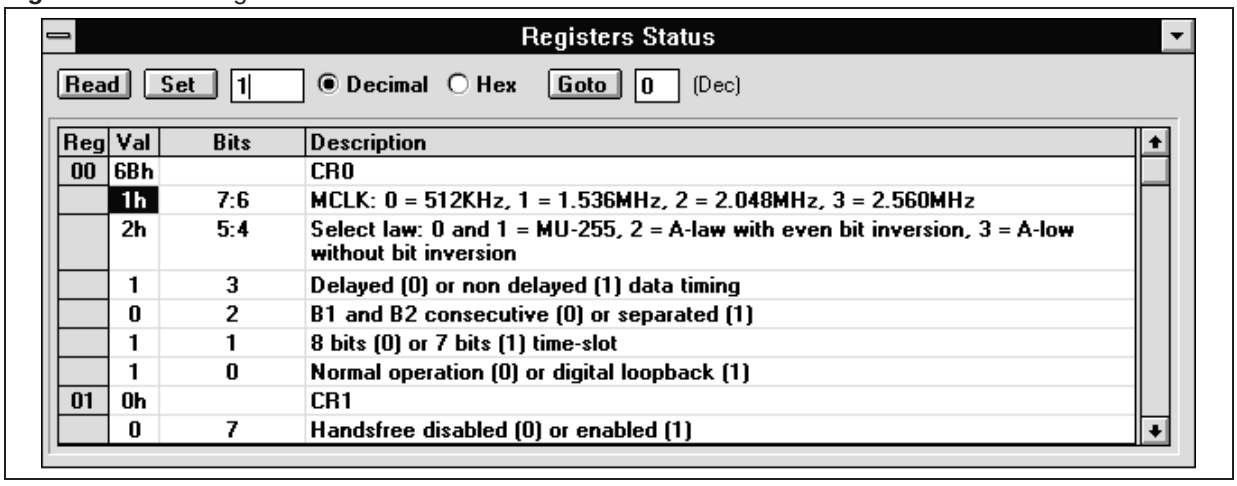
A desired register can be shown on the screen either going through the whole register set using the vertical scroll bar or by typing its decimal address in the text icon at the far right of the *Registers Status Window* and by pressing *Return* on the keyboard or by clicking on the *Goto* button.

Each register that has a graphical rapresentation in any block window, when changed from the *Registers Status Window*, will reflect its new state in its block window as well, and viceversa.

The *Read* button can be used to manually update a register state. Simply select the desired register by clicking either on its whole byte value or on any bit of it, then click on the *Read* button.

The consequence of any action is reflected on the PC screen only after that the ST9 microcontroller has confirmed it. There is always coherence between circuit state and PC screen display, unless otherwise stated.

Figure 8 : The Registers Status Window



Reg	Val	Bits	Description
00	6Bh		CR0
	1h	7:6	MCLK: 0 = 512KHz, 1 = 1.536MHz, 2 = 2.048MHz, 3 = 2.560MHz
	2h	5:4	Select law: 0 and 1 = MU-255, 2 = A-law with even bit inversion, 3 = A-low without bit inversion
	1	3	Delayed (0) or non delayed (1) data timing
	0	2	B1 and B2 consecutive (0) or separated (1)
	1	1	8 bits (0) or 7 bits (1) time-slot
	1	0	Normal operation (0) or digital loopback (1)
01	0h		CR1
	0	7	Handsfree disabled (0) or enabled (1)

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

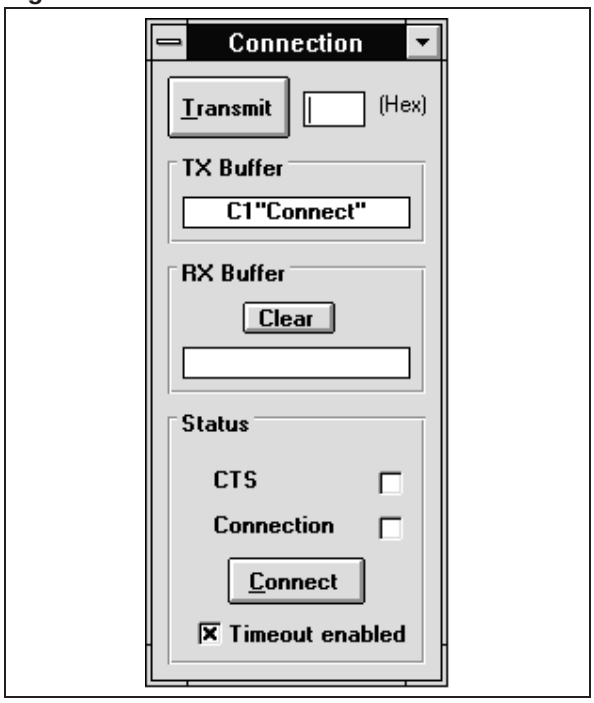
II.9 - Saving Configuration To Disk

Select the *File* field of the *Main Window* menu bar and click on the *Save* option. A browser window will appear in order to select filename and path.
In a similar way you can retrieve a previously stored configuration. Select the *File* field of the *Main Window* menu bar and click on the *Load* option.

II.10 - The Connection Window

From the *Main Window* menu bar select the *Connection* field. You will be presented the *Connection Window*.

Figure 9 : The Connection Window

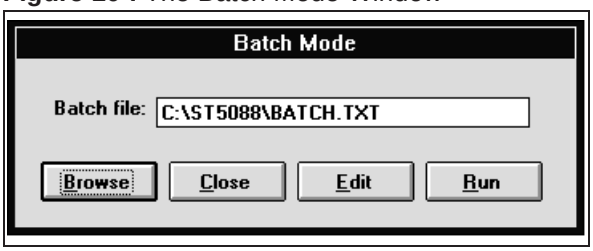


The *Connection Window* is made up of a *Transmit* button and three frames : *TX Buffer*, *RX Buffer* and *Status*.
The *Transmit* button can be used to send low level codes to ST90E40 on the board. Low level codes are described in Section II.12.
The *TX Buffer* shows every code which is sent from PC to ST90E40 on the board.
The *RX Buffer* shows every code which is sent from ST90E40 on the board to PC.
The *CTS* led reflects the status of the *CTS* line : if thicked, ST90E40 is ready to receive codes from PC.
The *Connection* led shows if PC and ST90E40 have established a connection. If not, the *Connect* button can be used to try again.
The *Timeout* option can be toggled on/off. If on, it means that a 3-second timeout is enabled when waiting for ST90E40 answers to PC codes.

II.11 - The Batch Mode Window

From the *Main Window* menu bar select the *Batch* field. You will be presented the *Batch Mode Window*.

Figure 10 : The Batch Mode Window



A *Batch File* is a file containing a list of several codes to be sent to ST9 altogether. It can be viewed as a small program to be executed.
Select a file either by typing its filename directly or by using the browser, then click on the *Edit* button. The standard DOS editor will load it.
These codes must be typed in two-digit hex format and must follow the *PC-ST9 Communication Syntax*, described in the next section.You can either write one command on each line or several commands on the same line, as you prefer. It is important, anyway, that any single command is on one line on its whole. As commands can be made of up to three bytes (ie Write With Mask - see below), it is mandatory to write all bytes on the same line. No separators or space are allowed between hex digits.
Comments can be included. They must be started by the # character. Any character till the end of the line will be then discarded. Comments can be placed both at the start of a line and just after a command.

Example of a batch file :

```
#Example batch file
00     #Read register 00H
01     #Read register 01H
0001   #Read register 00H, then read regis-
       ter 01H
4880   #Write 80H in register 08H
888000 #Reset bit7 of register 08H to 0
#End of Batch file
```

When you have written a batch file, you can save it by selecting from the *File* menu either *Save* or *Quit*. In the latter, answer *Yes* to save.
Just click on the *Run* button to execute the batch file that you have selected. Control will be passed to the ST9 microcontroller and buttons will be greyed out till the end of the batch script file.

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

II.12 - PC-ST9 Communication Syntax

ST5080A, ST5088 and ST5090 registers addresses lie in range 00H÷0EH, thus leaving the four MSB free for our own use.
The basic actions required are register and bit-oriented READ and WRITE operations. Macro operations are also supported.

Commands sent by PC to the ST9 microcontroller can be classified as follows :

i. register-oriented access, i.e. 8 bit read/write operation ;
ii. bit-oriented access, i.e. 1, 2, ..., 6 bit read/write operation ;
iii. macro operations, i.e. predefined procedures or functions.

Read operations, both register and bit-oriented, can be carried out in the same way as a whole register state read. In the latter case it is up to PC to properly mask the result.
Write operations, both register and bit-oriented, always need a register address as a parameter and an 8-bit value. In the latter case a mask is also needed. It is applied by ST9 to the 8-bit supplied data; at the same time ST9 reads the old register state, masks it with the 1-complement of the supplied mask and ORs it with data, then stores the new value back.

Each *Write* operation exits through a *Read* operation to return the new value to PC for confirmation. *Read* and *Write* operations require 1 bit as a *Read/Write* qualifier.

Moreover, each command should have a power mode bit and an IC identifier. The following syntax has been adopted: oo i p rrrr.

Bits 7:6 contain the op-code: 'oo' = 00 - read, 01 - write byte, 10 - write with mask, 11 - macro.
Bit 5 contains the IC device identifier: i = 0 - IC0 selected, 1 - IC1 selected.
Bit 4 contains the power mode qualifier: p = 0 - normal mode, 1 - power down.
Bits 3:0 contain the register address.

ST5080A, ST5088 and ST5090 devices support also a power down command. As the highest register address is 0EH, the power down command has been coded into ST9 as a register 0FH read operation. ST9 will then issue the correct normal/power down command reflecting the state of the 'p' and 'i' bits.

	1st byte	2nd byte	3rd byte
READ REGISTER STATE	00 i p rrrr		
Read reg. 'rrrr' state and return 0:255 as result.			
WRITE REGISTER STATE	01 ip rrrr	dddddddd	
Write 'dddddddd' to reg. 'rrrr', then read it back and return 0:255 as result.			
WRITE REGISTER STATE WITH MASK	10 i p rrrr	mmmmmmmm	ddddddddd
Read 'rrrr', mask it with inversed 'mmmmmmmm' and OR it with 'dddddddd' masked with 'mmmmmmmm', then read new register state and return 0:255 as result. It is up to PC to properly mask the returned result.			
MACRO OPERATION	11 xxxxxx	2nd byte	3rd byte
C0H - NOP Wait NN loops, where NN is a 16-bit number made of HHLL, where HH is hhhhhhhh and LL is llllllll. Each NN loop consists of 22 cycles minimum at 9.216MHz (2.39µsec).	11 000000	hhhhhhhh	llllllll
C1H - Connect ST9 is forced to enter the connection establishing loop again.	11 000001		
C2H - MCLK0 Select 512KHz Master clock.	11 000010		
C3H - MCLK1 Select 1.536MHz Master clock.	11 000011		
C4H -MCLKExtr Select external Master Clock.	11 000100		

II - THE ST508x/90 DEMO TOOL SOFTWARE (continued)

Even though the same syntax applies to codes sent by both the *batch files* and the *Connection Window* through its *Transmit* function, in the former case PC waits for a confirmation answer from ST9 while in the latter case, as it is intended for low level operation, no syntax check is carried out and the internal interpreter is not used. Thus, in the low level operation, ST9 confirmation answers will be interpreted as true ST9-PC messages, listed in the next section.

This could lead to coherence loss between real circuit status and PC screen display.

II.13 - ST9-PC messages

Listed below are the messages sent by ST9 to PC.

0H - PC_UnknownBatch
PC has sent a *macro* code which ST9 has not recognized.

1H - PC_Reset
The user has pressed the *Reset* button on the board.

II.14 - Connection Messages

Listed below are the messages exchanged between PC and ST9 during the *Connection* process. These messages are different from those listed in the previous sections as they can only be sent during the *Connection* process.

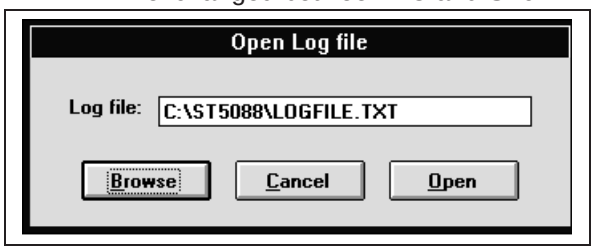
"Connect" - Connection Request
It is sent by PC to synchronise operations with ST9.

"OK" - Connection Acknoledgement
It is sent by ST9 to acknoledge that connection has been established.

II.15 - The Log File

It is possible to study the whole communication carried on by PC and ST9. Select the *File* field of the *Main Window* menu bar and click on the *Open Log File* option. The *Open Log file* window will be displayed on the screen.

Figure 11 : A log file can list all the codes exchanged between PC and ST9.



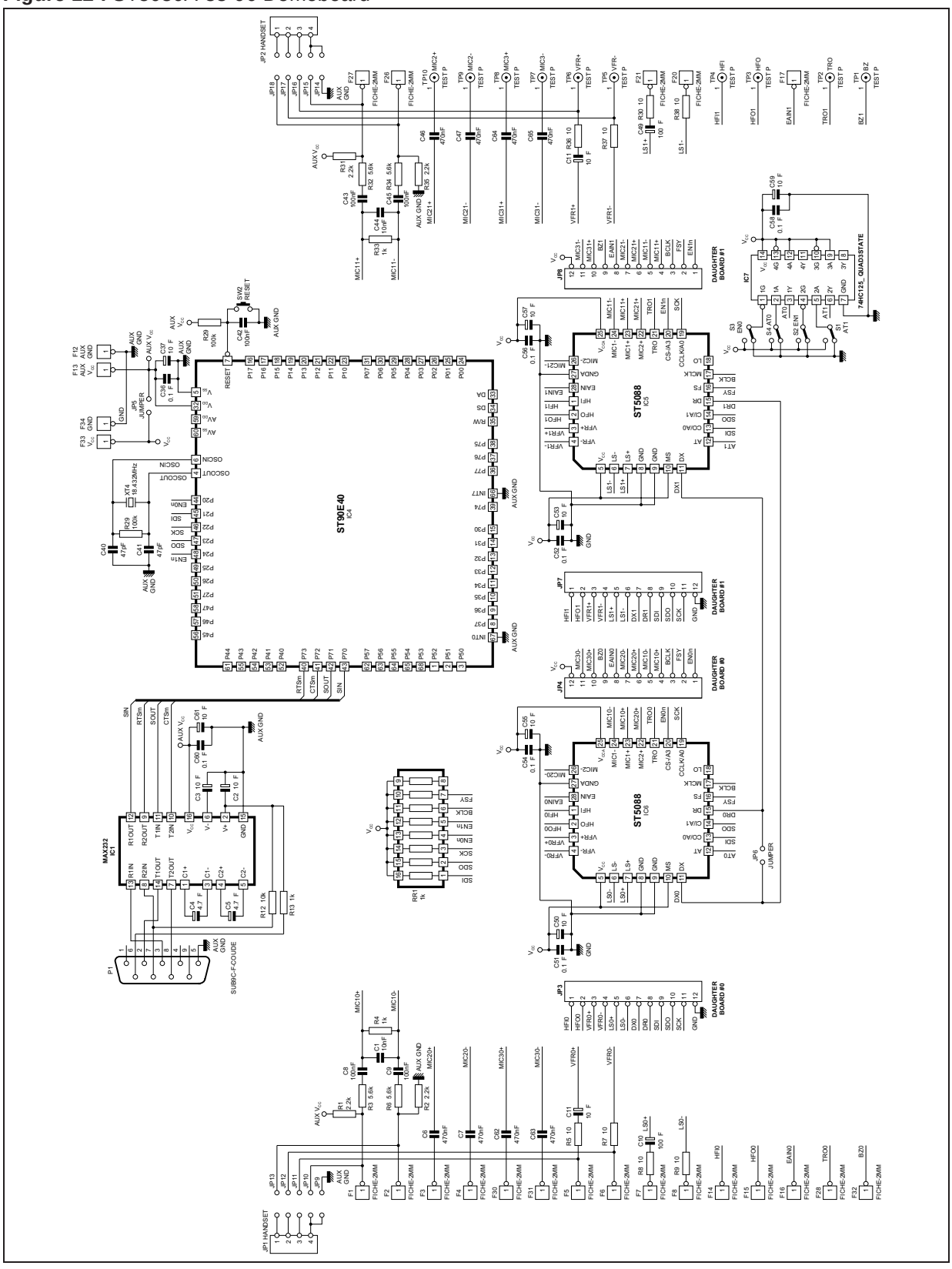
Either type a filename directly or click on the *Browse* button to select the desired path. Then select the *Open* button. A log file will be opened and every operation between PC and ST9 will be reported there, with PC operations preceded by a semicolon. Every operation is also followed by a simple textual explanation. Exceptions are codes sent from the *Transmit* button of the *Connection Window* and the macro commands included in batch files.

The log file will be automatically closed when leaving the ST508x/90 Demo Tool Software. Anyway, it can be manually closed by using the *Close Log file* menu item.

At any time, it can be read by using the *Read Log File* menu item. Please note that it will be automatically closed, after having asked for confirmation.

APPENDIX : PCB Scheme and Components Positioning

Figure 12 : ST5080A-88-90 Demoboard



APPENDIX : PCB Scheme and Components Positioning (continued)

Figure 13 : Component Side