7521/7522/7523

Software User's Manual

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

ICP DAS assume no liability for damages consequent to the use of this product. ICP DAS reserves the right to change this manual at any time without notice. The information furnished by ICP DAS is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

Copyright

Trademark

The names used for identification only maybe registered trademarks of their respective companies.

Tables of Contents

1. Introduction

Introduction

There are many RS-232 devices in industry applications. Nowadays it becomes important to link all those RS-232 devices together for automation & information. Usually those RS-232 devices are far away from the host-PC & widely distributed in the factory. So it is not a good idea to use multi-serial cards for linking all these RS232 devices together. The 752x series products can be used to link multiple RS-232 devices by single RS-485 network. The RS-485 is famous for it's easy maintenance, simple cabling, stable, reliable and low cost.

Addressable RS-232 Converter

Most RS-232 devices don't support device address. The I-752X series can assign a unique address to any RS-232 device installed in the RS-485 network. Host-PC can send command with device address to RS-485 network, the destination-752x will remove the address field & pass the other fields of command to its local RS-232 device. The response of this local RS-232 device will be passed to host-PC via this destionation-752x.

Master-type Addressable RS-232 Converter

Basically our 752X products are Master-type converters and other competitor's converter is Slave-type. Slave-type converter can't work stand alone without host-PC. In real industrial application, the demand is different case by case and customers are not satisfied with Slave-type. The 752x are very powerful and can analyze the local RS-232 device, D/I or D/O without host-PC. Refer to Application 5 to Application 9 for more information.

Onboard 1K bytes Queue-buffer

The I-752X equips 1K bytes queue-buffer for its local RS-232 device. So all input data can be stored in queue-buffer until the host-PC has time to read. These features will make the host-PC link thousands of RS-232 devices without lose any data.

Onboard D/I for event trigger

The I-752X equips 3-channels of digital input for sensor interface. These D/I can be used to link with photo sensor/switch for event trigger. They also can be used as general purpose D/I. The 752X can read & analyze these D/I without the help of host-PC.

Onboard D/O for emergency control

The I-752X equips 3-channels of digital output for emergency control. The D/O can directly drive relay or led. They can be used to control the local devices for emergency event. The 752x can control these D/O without the help of host-PC.

3000V isolation on RS-485 site

The COM2 of the I-752x is an isolated RS-485 port with 3000V isolation. This isolation will protect the local RS-232 devices from transient noises coming from RS-485 network.

Self-Tuner ASIC inside

The I-752X Self-Tuner ASIC for RS-485 port. This chip can auto detect and control the send/receive direction of the RS-485 network. Therefore the application programs don't have to take care of the direction control of the RS-485 network.

Can be an embedded controller

Besides Intelligent Communication Controller, the I-752X series products can be used as an embedded controller. Every I-752X controller has an, MiniOS7, embedded O.S.. The MiniOS7 provides equivalent functions of ROM DOS and has more features. The user can use well-developed libraries and demo programs to implement his controller.

Wide range selection

The I-752X series products have I-7521, I-7521D, I-7522, I-7522D, I-7523, and I-7523D. The I-7521 provides one RS-232 port, one RS-485 port, 3 digital input channels and 3 digital output channels. The I-7522 provides two RS-232 ports, one RS-485 port, two digital input channels and one digital output channel. The I-7523 provides three RS-

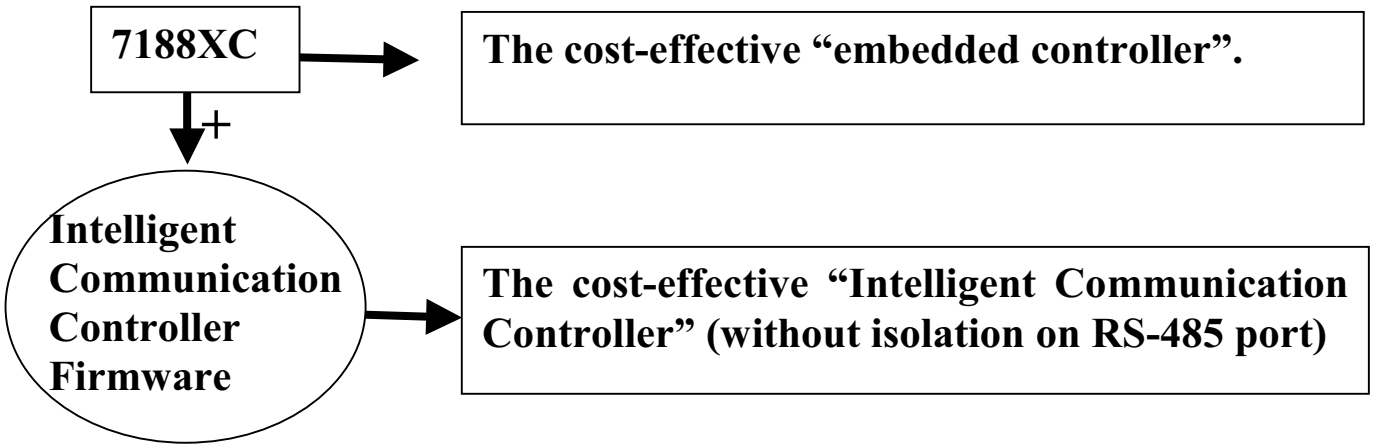
232 ports, one RS-485 port. The COM 1 of the I-7521, I-7522 and I-7523 can be used as RS-232 port or RS-485 port.

7188XC & 7521 series

The 7521/7522/7523 is really an embedded controller before download any firmware. After download the firmware, the 7521/7522/7523 act as an "Intelligent Communication Controller". The only difference between 7521 & 7188XC is the 3000V isolation on RS-485 port. **In general, the 7521 is just equivalent to 7188XC+7510.** So the 7521/7522/7523 can be used as an embedded controller with isolation RS-485 port.

Cost Effective Solution

The 7188/7188XA/7188XB/7188XC is designed as an embedded controller. So any software can be downloaded into them. If the firmware for "Intelligent Communication Controller" is download into 7188/7188XA/7188XB/7188XC, they will acts an "Intelligent Communication Controller".



Features

- Built-in “Addressable RS-232 Converter” firmware
- Support about 30 well-defined commands
- Support Dual-Watchdog commands
- Support Power-up value & safe value for D/O
- The source code of firmware is open & well-document
- User can modify the source code according to his special requirement.
- The firmware can real-time monitor the onboard D/I and control the onboard D/O according to user’s requirement
- The firmware can real-time monitor the RS-232 device and control the onboard D/O according to user’s requirement
- 7521 support one RS-232 device
- 7522 support two RS-232 devices
- 7523 support three RS-232 devices
- Watchdog timer provides fault tolerance and recovery
- Low power consumption
- R.O.C. Invention Patent No. 086674
- R.O.C. Invention Patent No. 103060
- R.O.C. Patent No. 132457

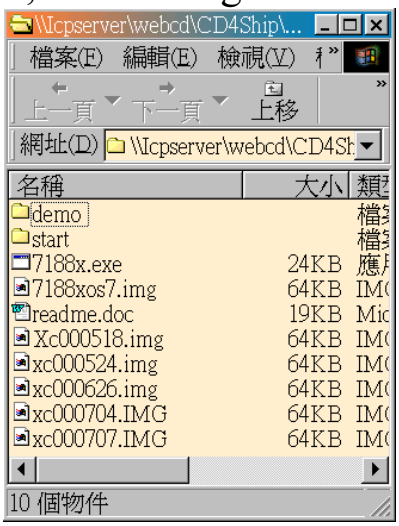
Order Information

7521 : Single-channel “Intelligent Communication Controller”
7521D : 7521 with 5-digit 7-seg LED.
7522 : Dual-channel “Intelligent Communication Controller”
7522D : 7522 with 5-digit 7-seg LED.
7523 : Three-channel “Intelligent Communication Controller”
7523D : 7523 with 5-digit 7-seg LED.

1.1 Software installation & demo programs

Software Installation:

- make a working directory in your computer. then
- insert the installation CD and wait for autorun(or Run auto32.exe)
- click “Toolkits(Softwares)/ Manuals”
- click “7000 Series Modules(ICPCON)”
- click “7188XC/7521”, a following like window showed:



- Select all the files and directories and copy them to the working location/directory
- Copy the 7188X.EXE to the PATH directory, for example, C:\DOS or C:\WINDOWS, Then you can execute 7188X.EXE in any location.

File description:

XCyymmdd.IMG →the image file of MiniOS7.
yy:00→2000
mm:month
dd:day

readme.doc→Release note

start → containing source code for Quick Start:

- com.h →heder file for all quick start program
- hp34401a.c→PC link to HP34401A
- hp22_1.c →7522 link to HP34401A
- hp22_m.c →multi-7522 link to HP34401A
- hp23_1.c →7523 link to HP34401A
- hp23_m.c →multi-7523 link to HP34401A

- demo → 7188XC application source code
  - lib → Functions library.[NOTE]
    - 7188xs.lib → for SMALL MODEL program. (TC / BC++ / MSC / MSVC++)
    - 7188xl.lib → for LARGE MODEL program.(TC/BC++ / MSC / MSVC++)
    - 7188x.h → All the functions declared are put on 7188x.h, so please use #include"7188x.h". 7188x.h is put on the same directory as7188xs.lib
  - 7521 → containing source code of 7521
  - 7522 → containing source code of 7522
  - 7523 → containing source code of 7523
  - 7521ODM1 → 7521 + real trime control D/IO
  - 7521ODM2 → 7521 + real trime control AD&DA
  - 7521ODM3 → 7521 + real trime control Event counter
  - 7521ODM4 → 7521 + real trime control Sensor & Multiplex
  - 7522ODM5 → 7522 + real trime monitor HP34401A & alarm control
  - ... } other demo program

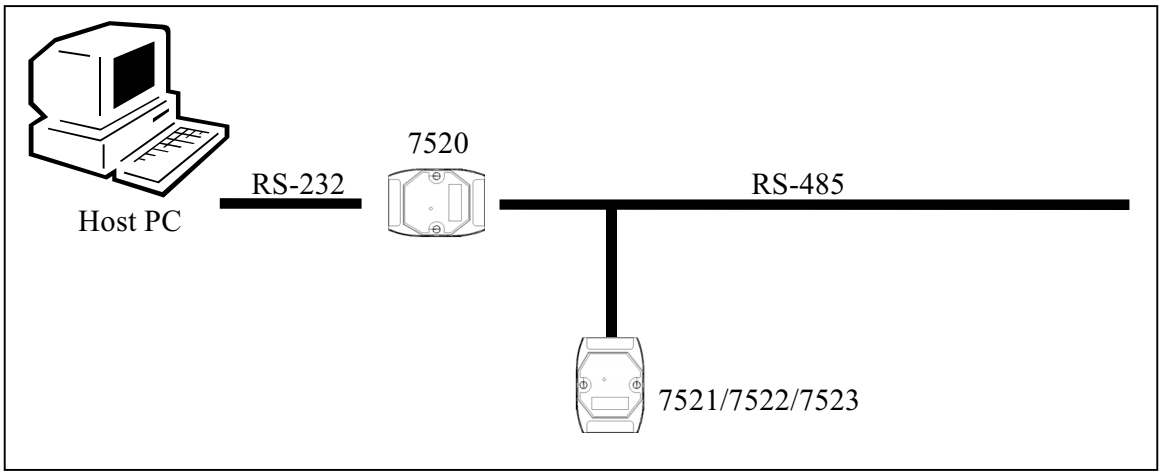
NOTE: 🗀 is a folder/directory
 is an archieve

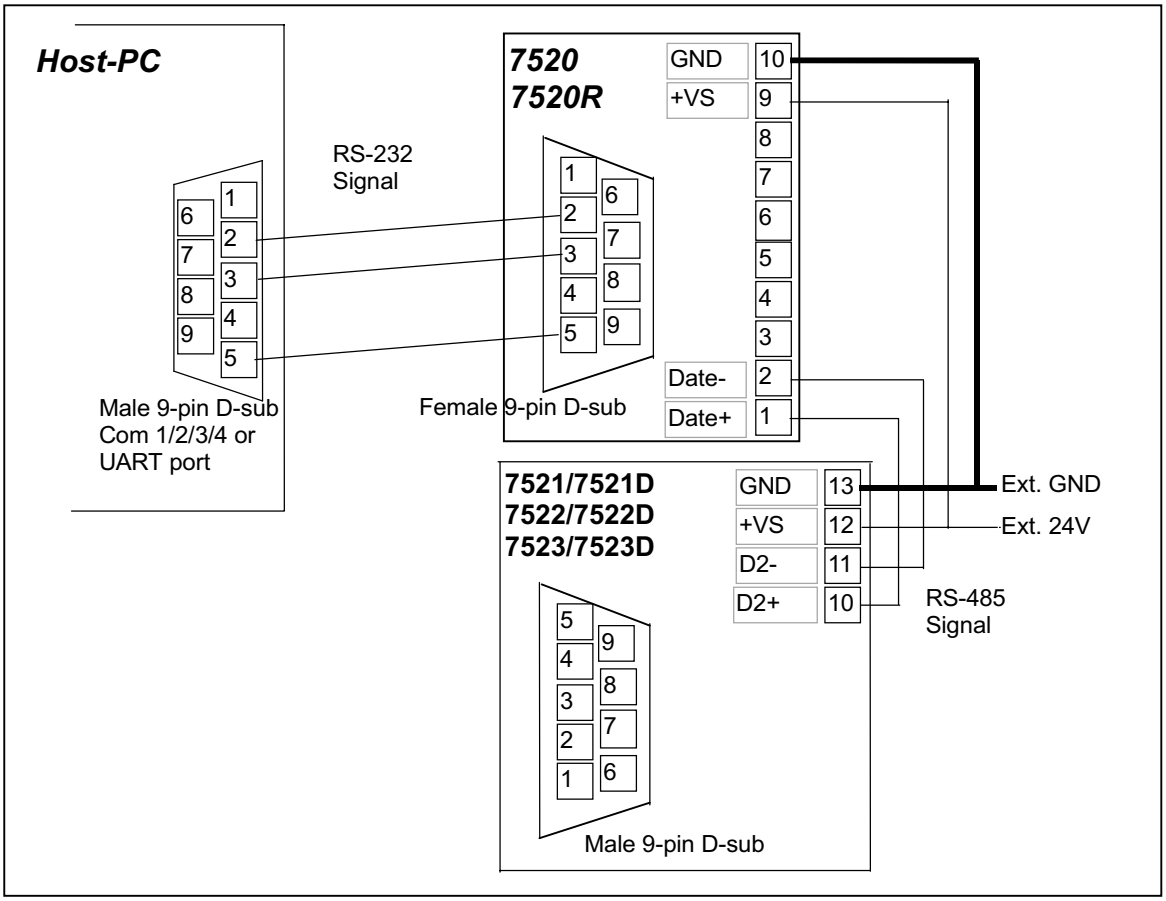
NOTE: The functions in library can be grouped as follows:

1. COM1/2/3/4 (3 for 7522/7523, 4 for 7523)
2. EEPROM
3. NVRAM & RTC
4. LED & 5DigitLed
5. Flash Memory
6. Timer & WatchDogTimer
7. File location on Falsh
8. Connect to I-7000
9. Programmable IO Pin
10. Others(MISC)

1.2 Quick Start1: Connect to 7521

Step 1: connect the 7521 to the RS-485 networking as following:





Step 2: Execute 7188X.EXE in the Host-PC

Step 3: Select the active COM port of HOST-PC
If 7520 connect to COM1, then Press ALT & 1
If 7520 connect to COM2, then Press ALT & 2

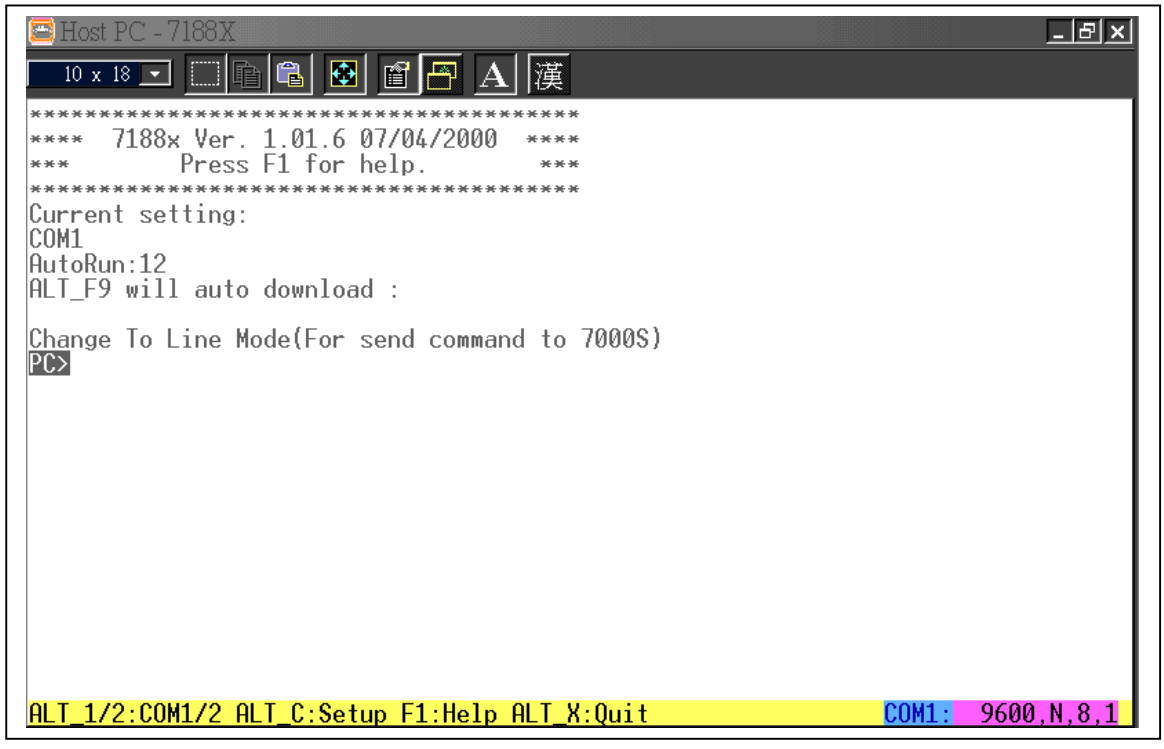
Step 4: Change the baud rate to 9600
Press ALT & C first
Then press SPACE-key several times until baud rate = 9600
Press ENTER-key to confirm

Step 5: Change the Parity-bit to N
Press SPACE-key several times until Parity-bit = N
Press Enter-key to confirm

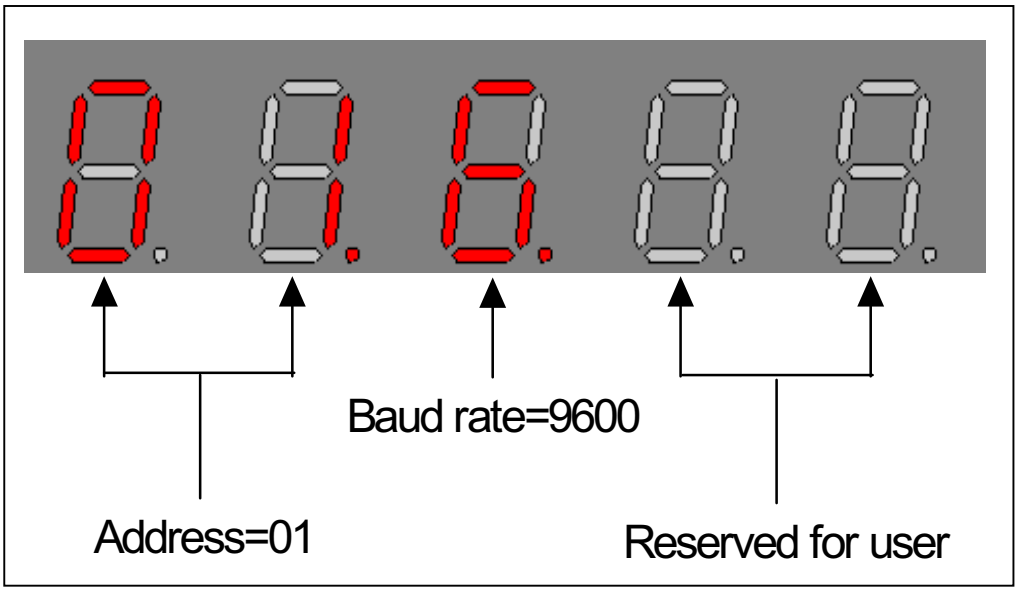
Step 6: Change the Data-bit to 8
Press SPACE-key several times until Data-bit = 8
Press Enter-key to confirm

Step 7: Change the Stop-bit to 1
Press SPACE-key several times until Stop-bit = 1
Press Enter-key to confirm

Step 8:Change the 7188x to the Line-Command-mode
Press ALT & L
Then the screen will be shown as following:

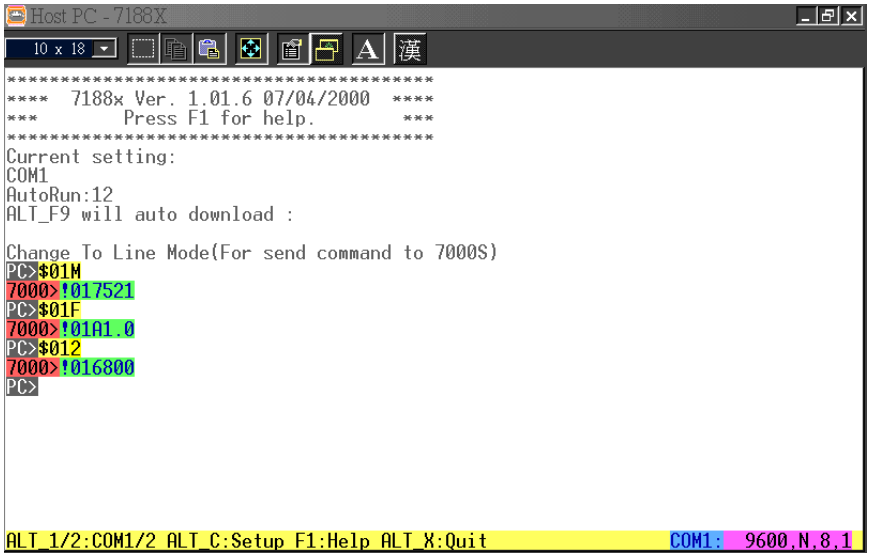


Step 9:Power-on the 7521(make sure DI1/INIT* floating)
Check the five 7-seg LED will be shown as following:



Step 10: Get the Module-Name of 7521
Key-in command → $01M
Then press ENTER-key to send command to 7521
Check the 7521 will echo → !017521

Step 11: Get the Version of 7521
Key-in command → $01F
Then press ENTER-key to send command to 7521
Check the 7521 will echo → !01A1.0
Key-in command → $012
Then press ENTER-key to send command to 7521
Check the 7521 will echo → !016800

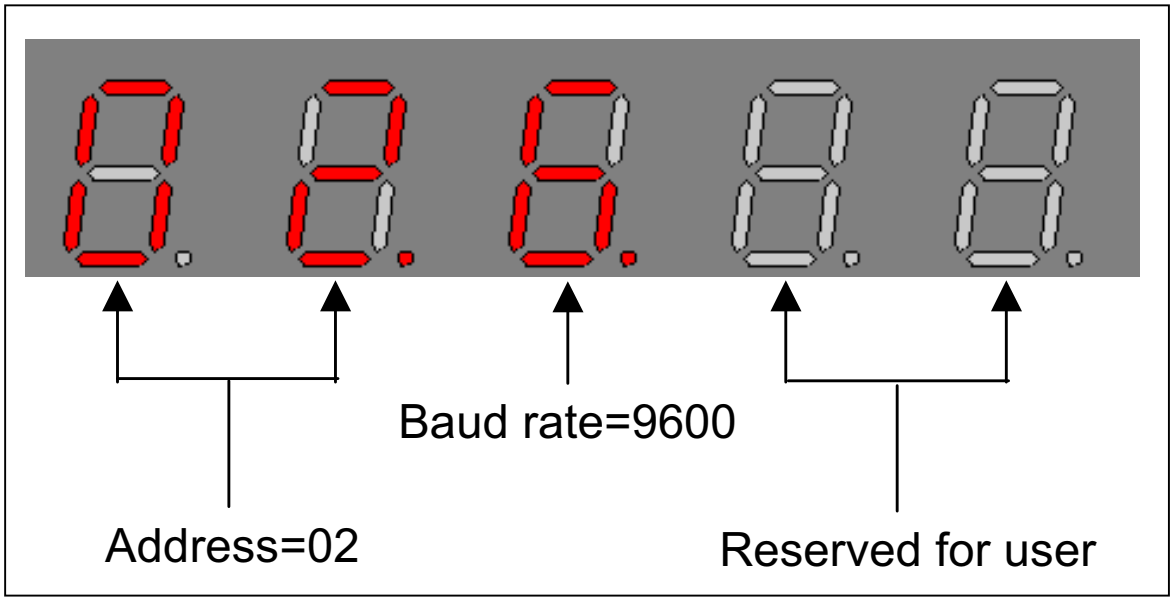


Step 12:Change the Module-Address of 7521

Key-in command → $01A02

Then press ENTER-key to send command to 7521

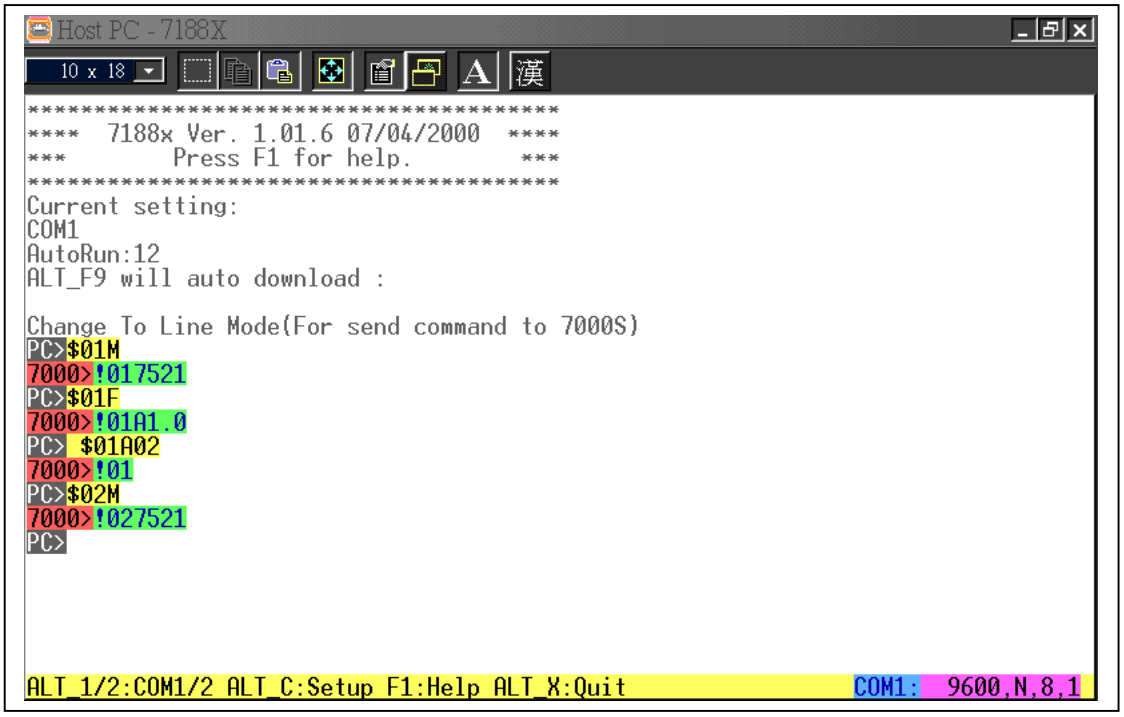
Check the five 7-seg LED will be shown as following:



Key-in command → $02M

Then press ENTER-key to send command to 7521

Check the 7521 will echo → !027521

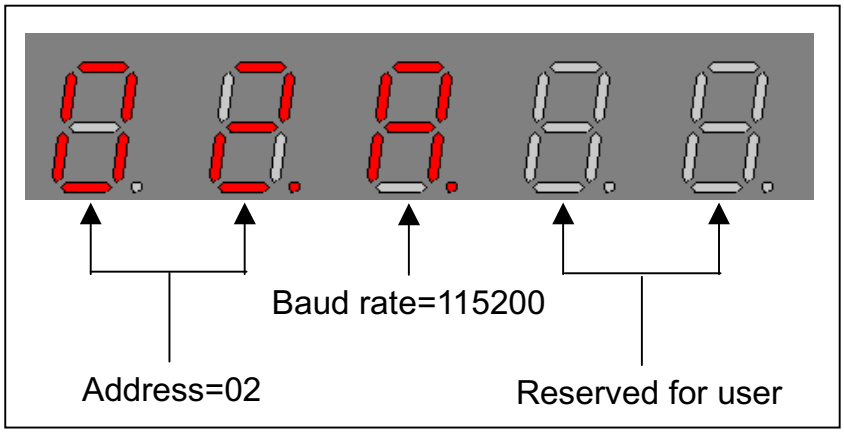


Step 13:Change the baud rate of 7521

Key-in command → $02B0115200

Then press ENTER-key to send command to 7521

Check the five 7-seg LED will be shown as following:



Press ALT & C

Press some SPACE-KEY until 115200

Then press ENTER-KEY to confirm baud rate=115200

Press ENTER-KEY to confirm parity-bit=N

Press ENTER-KEY to confirm data-bit=8

Press ENTER-KEY to confirm stop-bit=1

Key-in command → $02M

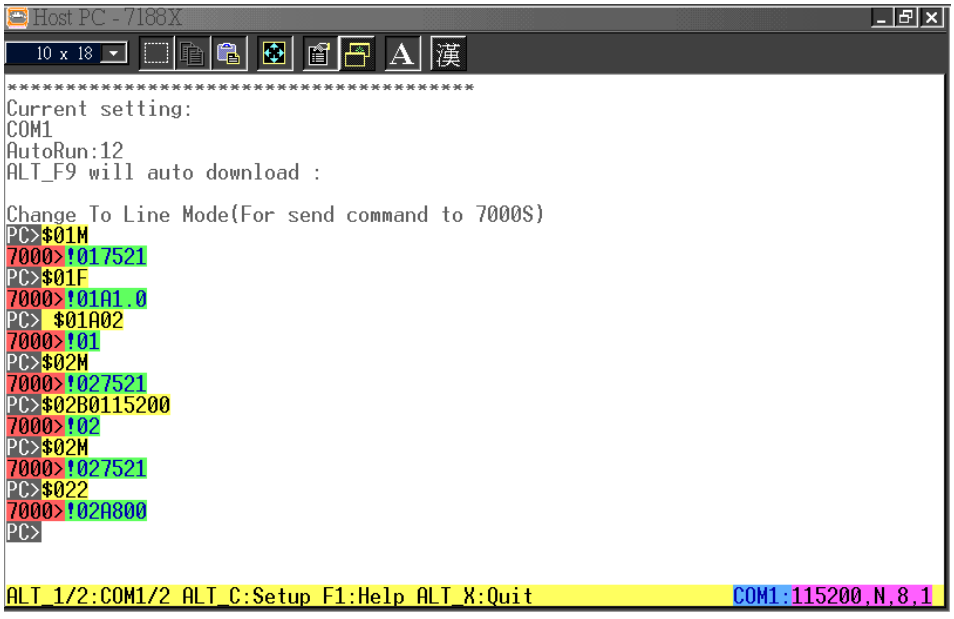
Then press ENTER-key to send command to 7521

Check the 7521 will echo → !027521

Key-in command → $022

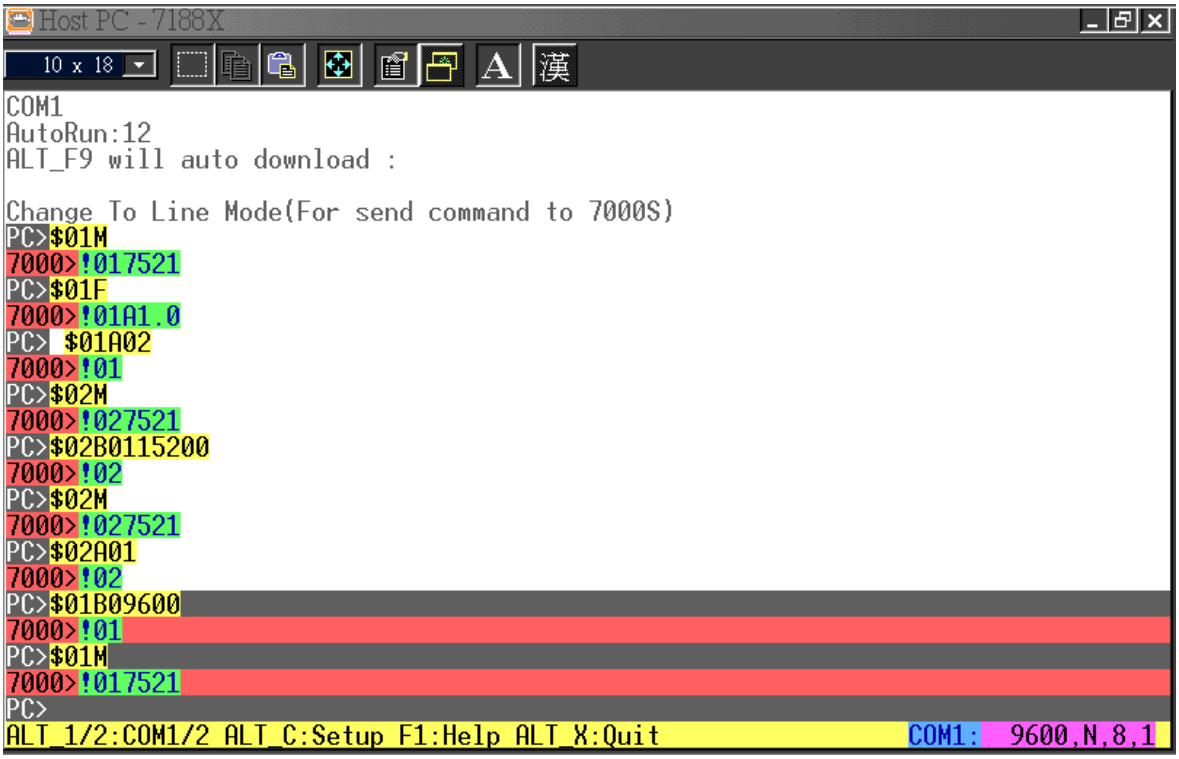
Then press ENTER-key to send command to 7521

Check the 7521 will echo → !02A800



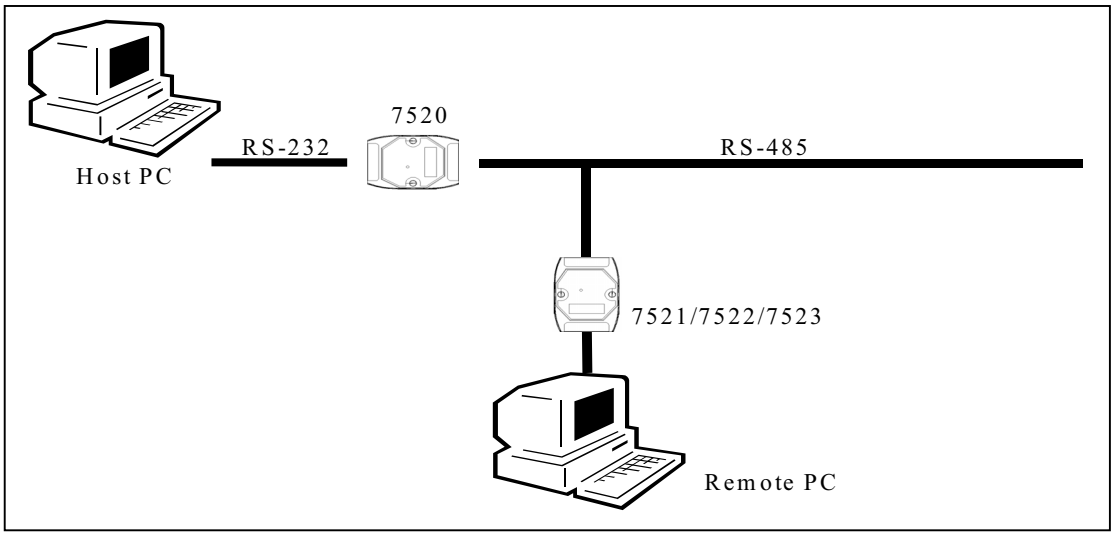
Step 14: Change the Module-Address of 7521
Key-in command → **$02A01**
Then press **ENTER-key** to send command to 7521

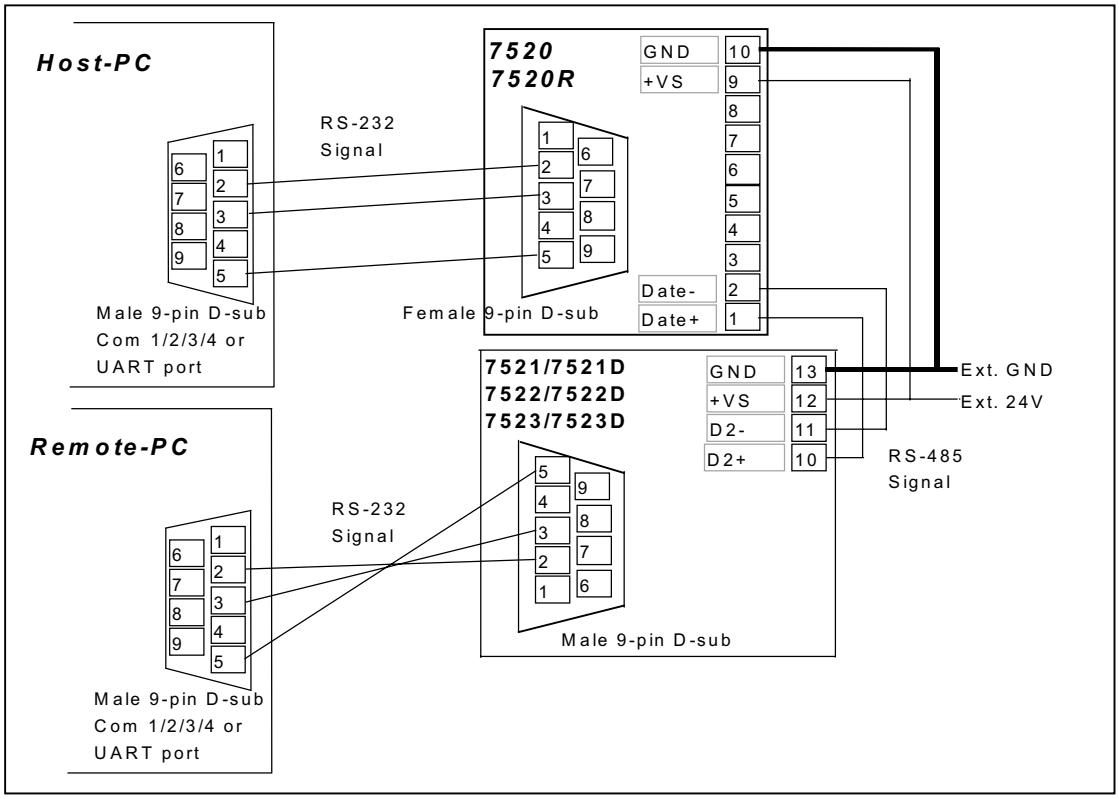
Step 15: Change the baud rate of 7521
Key-in command → **$01B09600**
Then press **ENTER-key** to send command to 7521
Press **ALT & C**
Press some **SPACE-KEY** until **9600**
Then press **ENTER-KEY** to confirm baud rate=**9600**
Press **ENTER-KEY** to confirm parity-bit=**N**
Press **ENTER-KEY** to confirm data-bit=**8**
Press **ENTER-KEY** to confirm stop-bit=**1**
Key-in command → **$01M**
Then press **ENTER-key** to send command to 7521
Check the 7521 will echo → **!017521**



1.3 Quick Start2: Connect to Single Remote-RS232-Device

Step 1: connect the 7521 to the RS-485 networking & remote-PC as following:

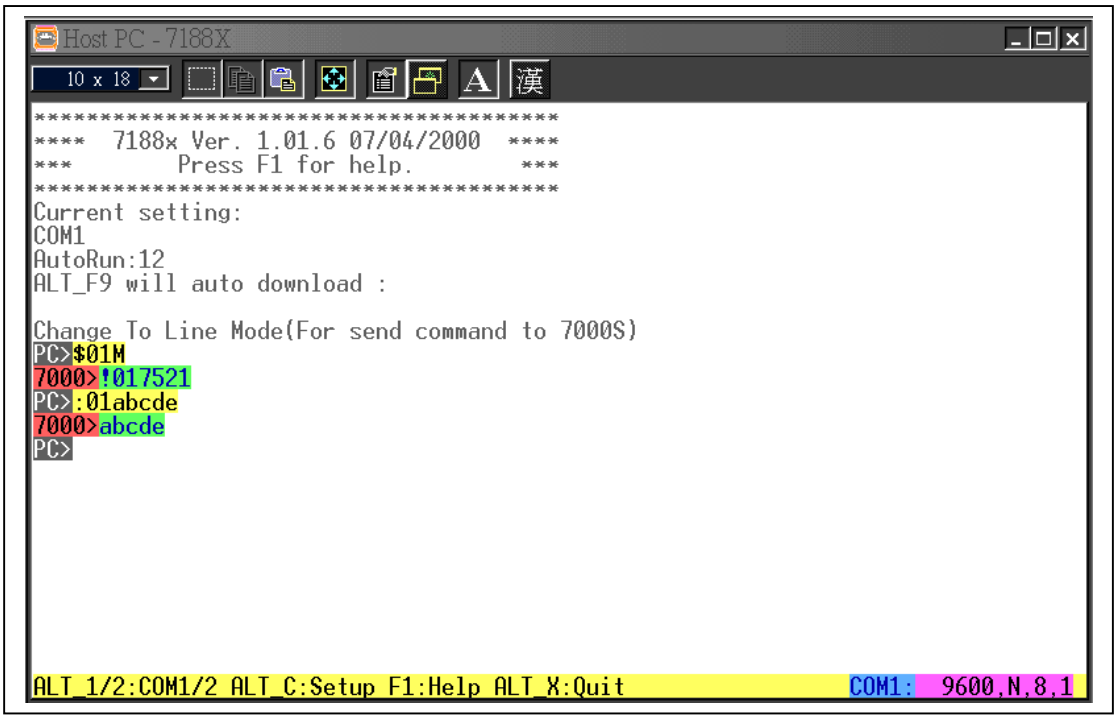




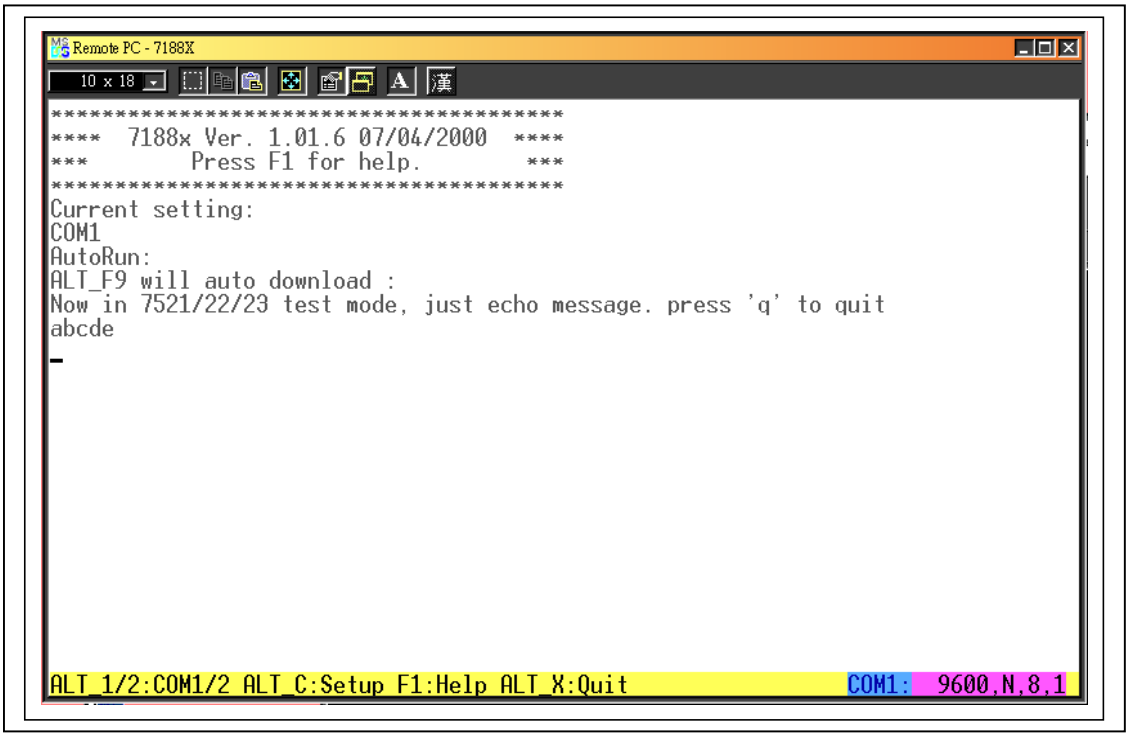
Step 2: Execute 7188X.EXE in the Host-PC
Refer to Step3 To Step 8 of Quick Start 1 to change COM port & status to **9600, N, 8, 1**

Step 3: Execute 7188X.EXE in the Remote-PC
Refer to Step3 To Step 8 of Quick Start 1 to change COM port & status to **9600, N, 8, 1**
Press F12 to enter Echo-Mode

Step 4: Host_PC Send **abcde** to Remote-PC
Keyin **:01abcde**
Press Enter-key to send command string to 7521
Check response-string from Remote-PC is **abcde**
Now the screen in Host-PC will be shown as follows:



And the screen in Remote-PC will be shown as follows:



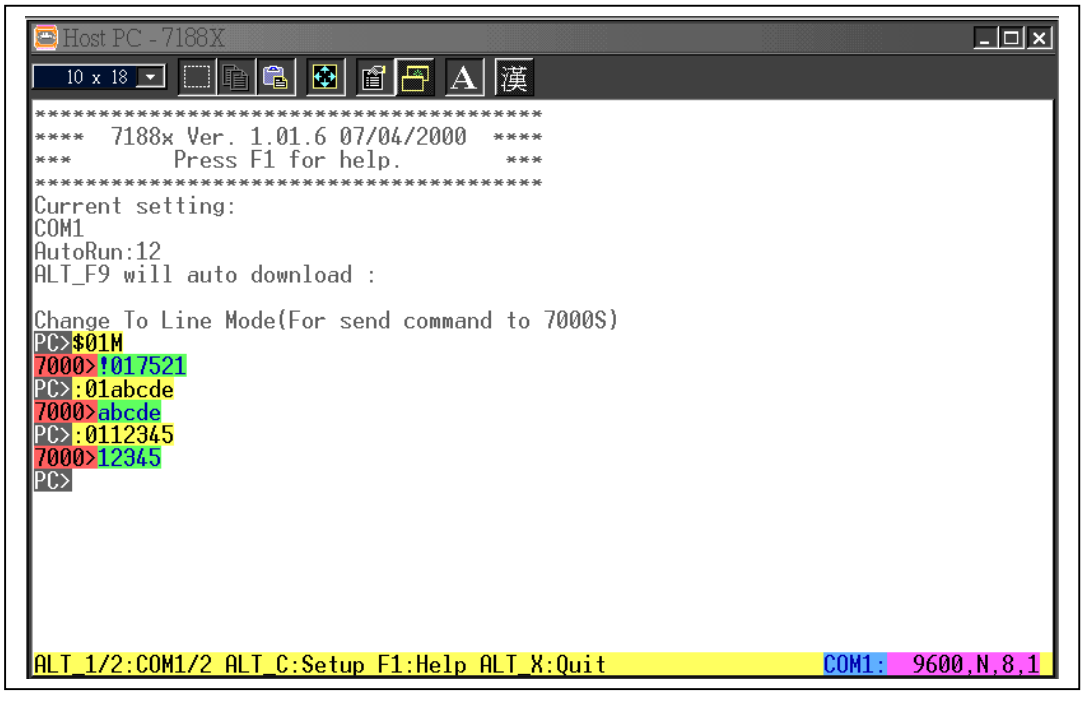
Step 5: Host_PC Send **12345** to Remote-PC

Keyin **:0112345**

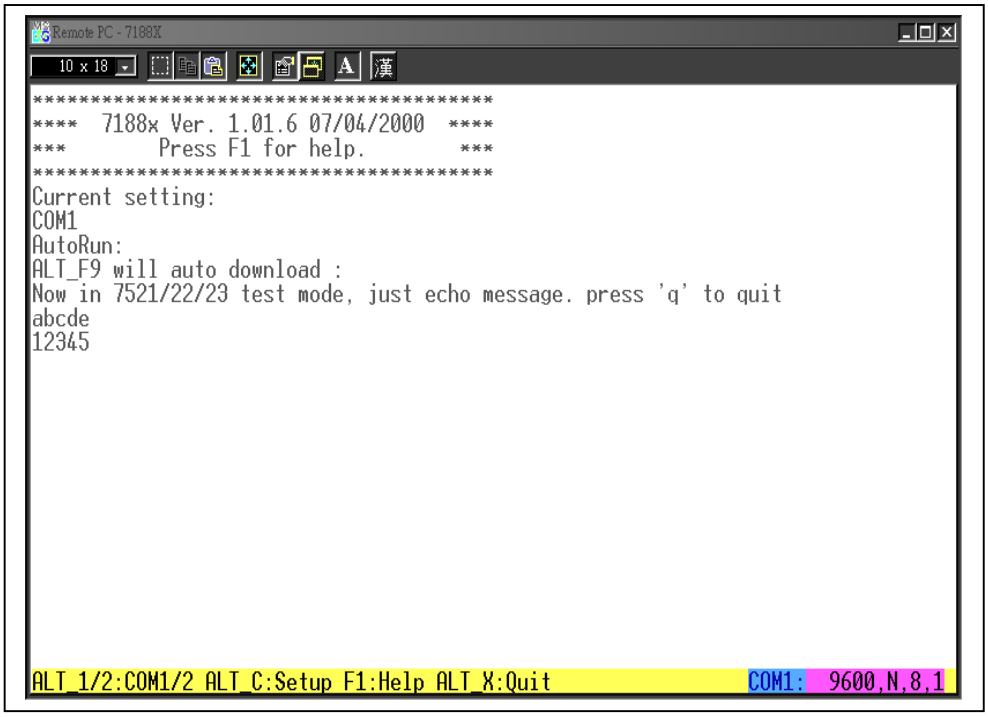
Press Enter-key to send command string to 7521

Check response-string from Remote-PC is **12345**

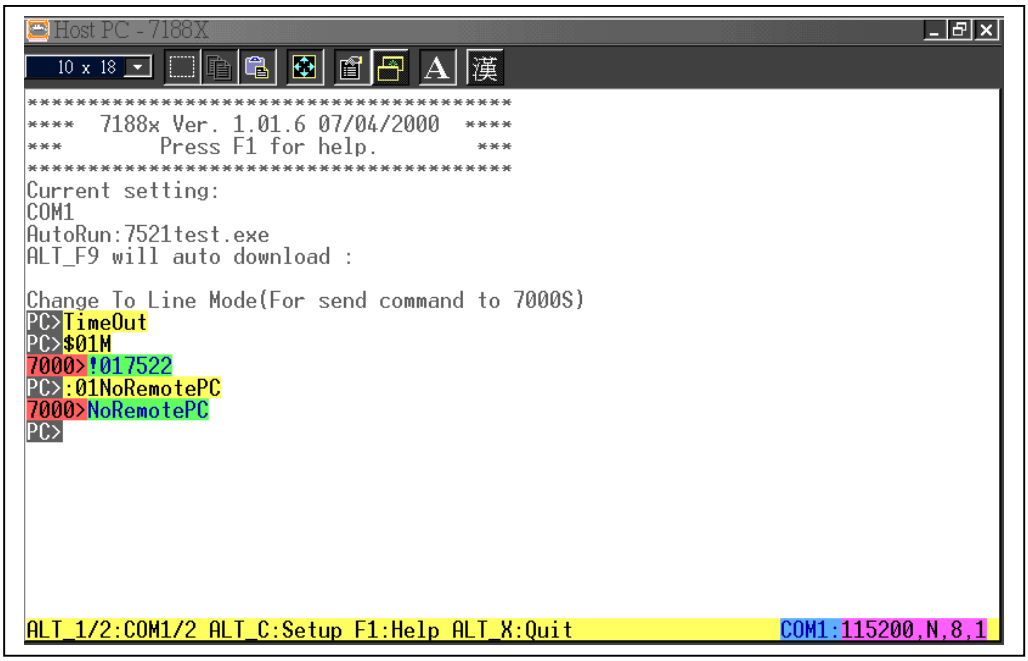
Now the screen in Host-PC will be shown as follows:



And the screen in Remote-PC will be shown as follows:



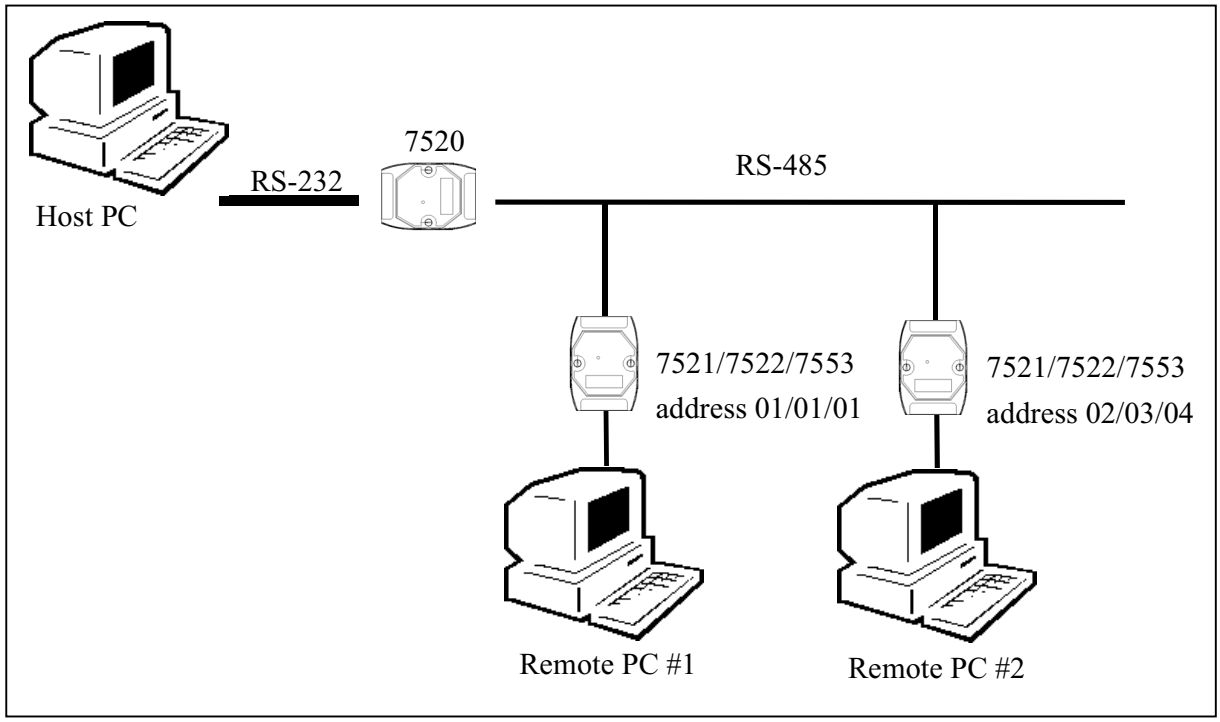
Note: If without Remote-PC. One can connect TxD and Rxd of the same COM port to test:



1.4 Quick Start3: Connect to Multi-Remote-RS232-Device

Step 1: Refer to Quick Start1 for wiring & change the 7521 to **Address-02, & 9600, N, 8, 1**

Step 2: connect the second 7521 to the RS-485 networking & two remote-PC as following:



Now there will be two 7521 in the RS-485 network. The module address of one 7521 is **address-01**, the others will be **address-02**. The communication status of these two 7521 will be same as **N, 8, 1**

Step 3: Execute 7188X.EXE in these two Remote-PC
Refer to Step3 To Step 8 of Quick Start 1 to change COM port & status to **9600, N, 8, 1**
Press F12 to enter Echo-Mode

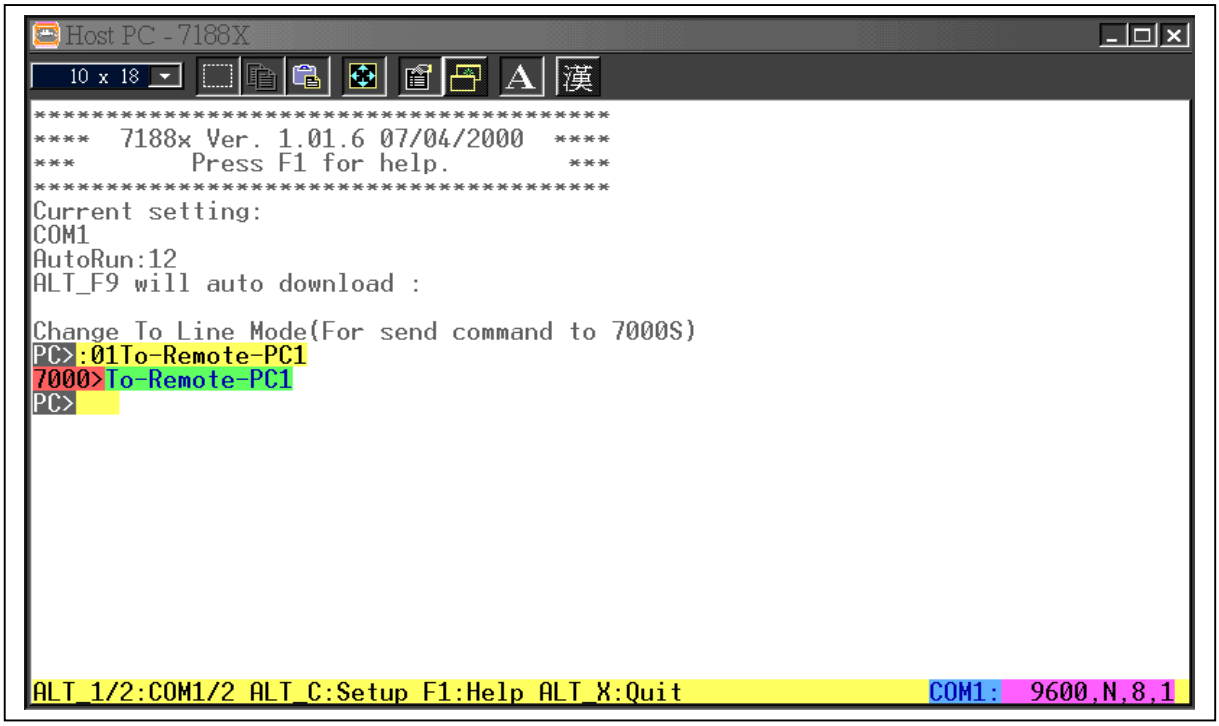
Step 4:Host_PC Send **To-Remote-PC1** to Remote-PC1

Keyin **:01To-Remote-PC1**

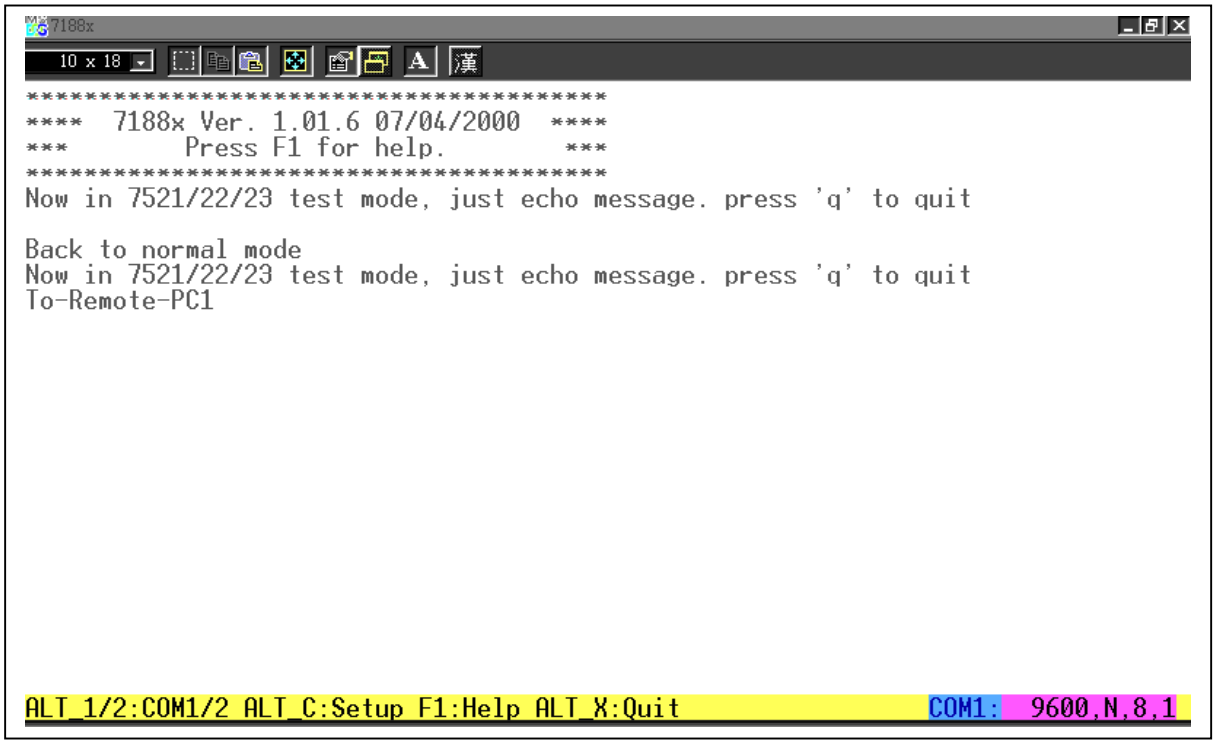
Press Enter-key to send command string to 7521

Check response from Remote-PC1 is **To-Remote-PC1**

Now the screen in Host-PC will be shown as follows:



And the screen in Remote-PC-1 will be shown as follows:



Step 5:Host_PC Send **To-Remote-PC2** to Remote-PC2

Keyin **:02To-Remote-PC2**

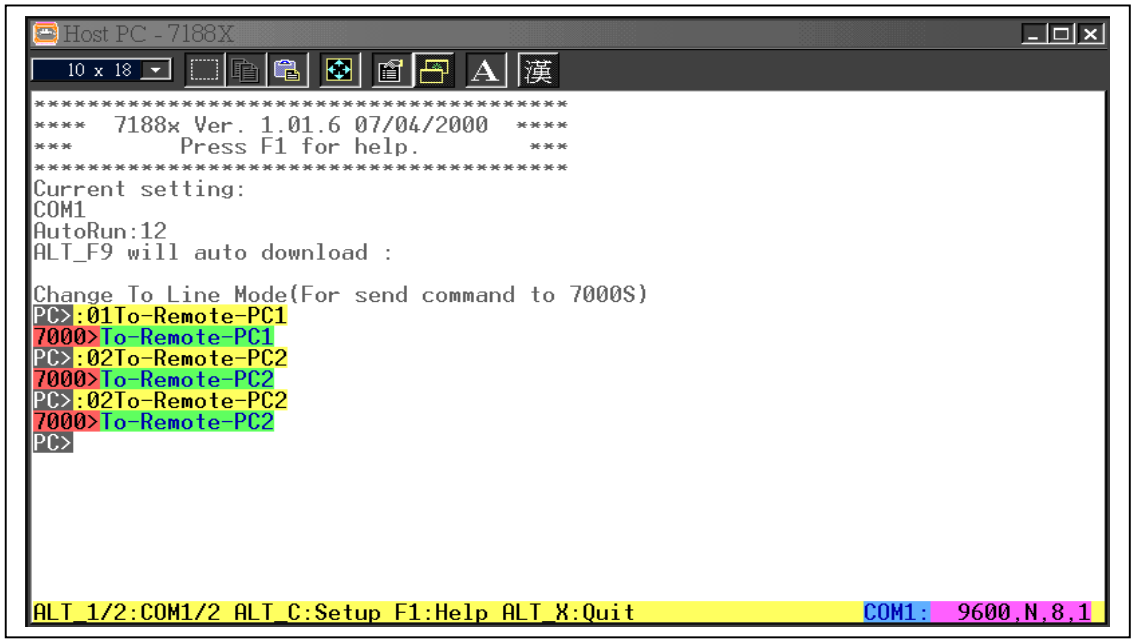
Press Enter-key to send command string to 7521

Keyin **:02To-Remote-PC2**

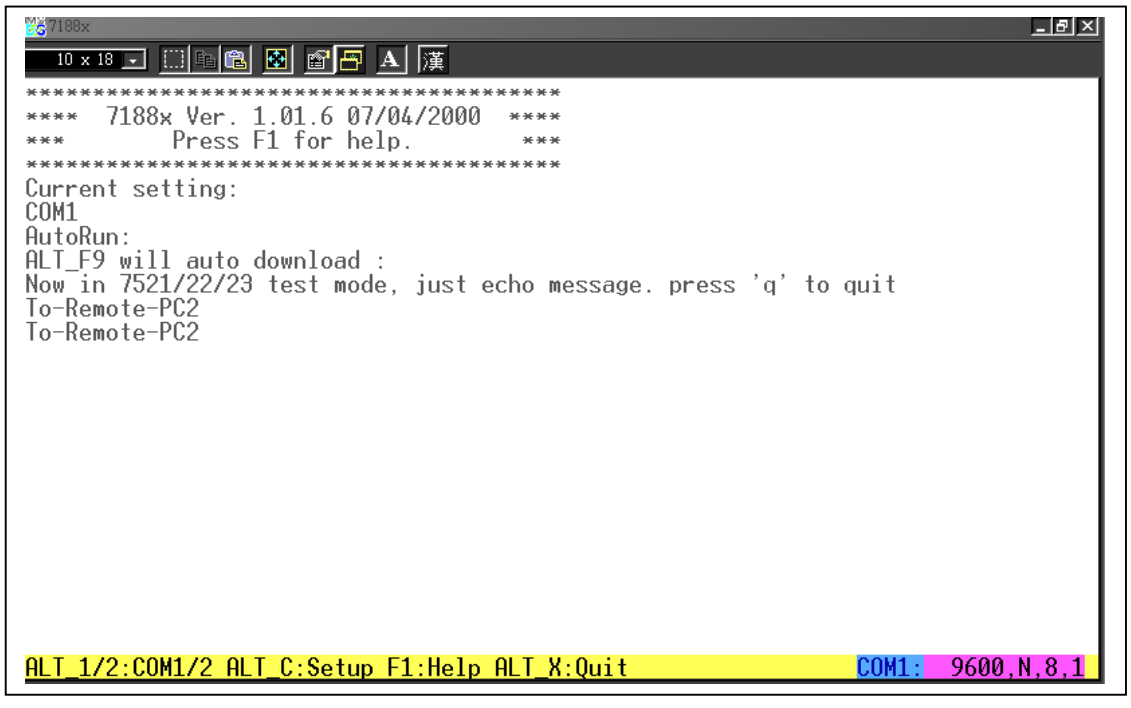
Press Enter-key to send command string to 7521

Check response from Remote-PC2 is **To-Remote-PC2**

Now the screen in Host-PC will be shown as follows:

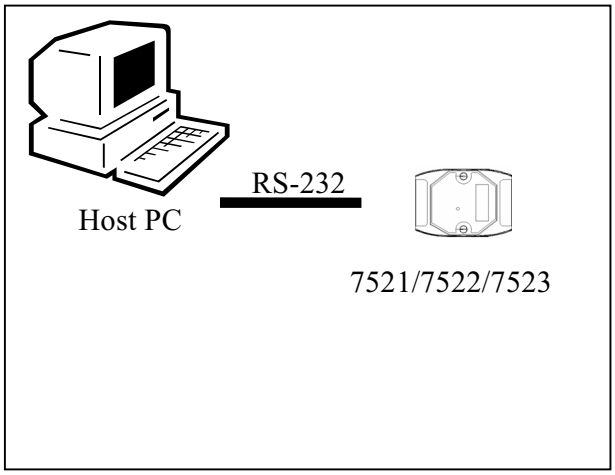


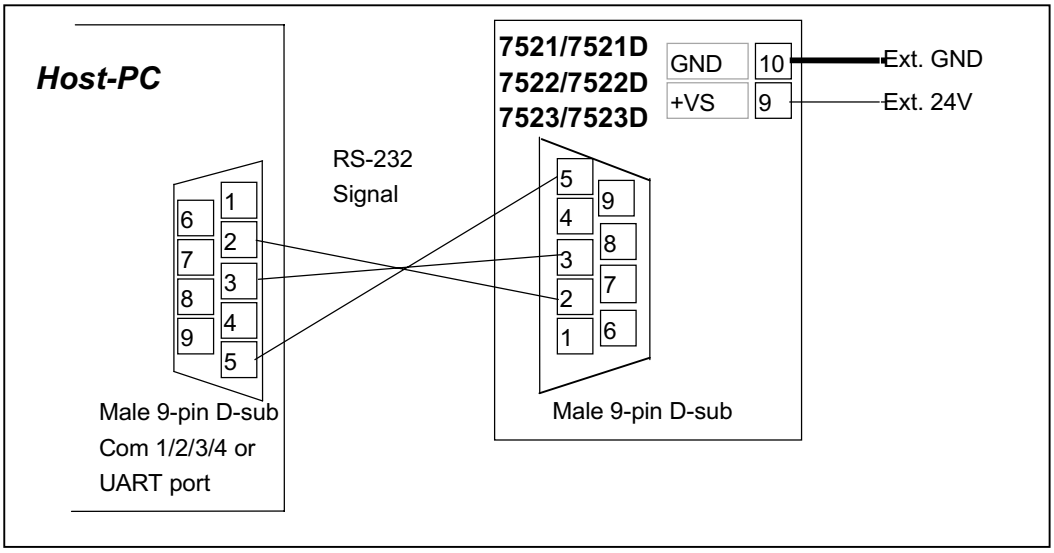
And the screen in Remote-PC-2 will be shown as follows:



1.5 Download New Firmware to 7521

Step 1: connect the 7521 to the RS-485 networking as following:



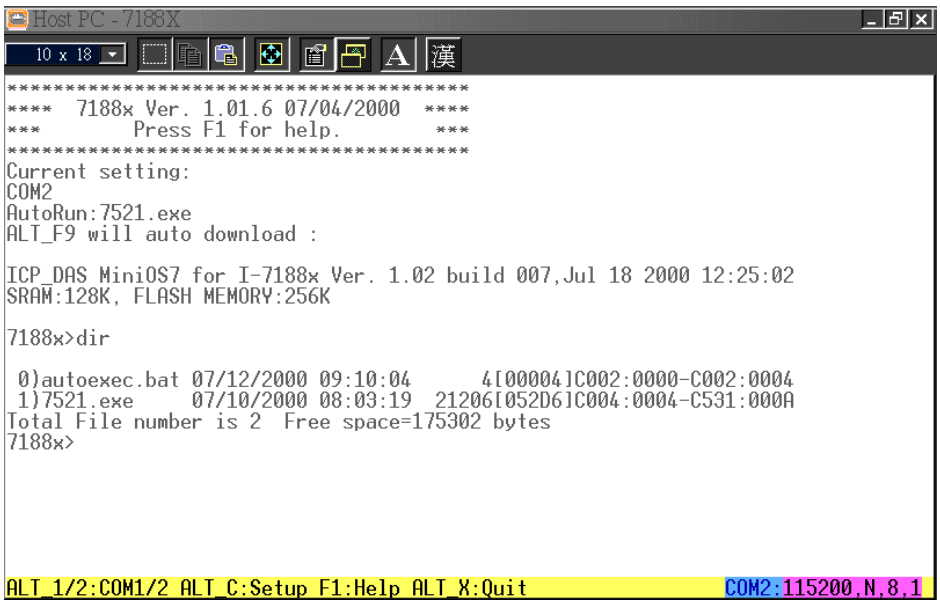


Step 2: Connect DI1/INIT* to GND

Step 3: Go to the directory of 7521/7522/7523 driver in the host computer &execute 7188x.exe

Step 4: refer to Step 3~Step8 of Quick Star 1 to change configuration to 115200,N,8,1

Key in:**dir**&Enter-Key then the screen will be shown as follows:

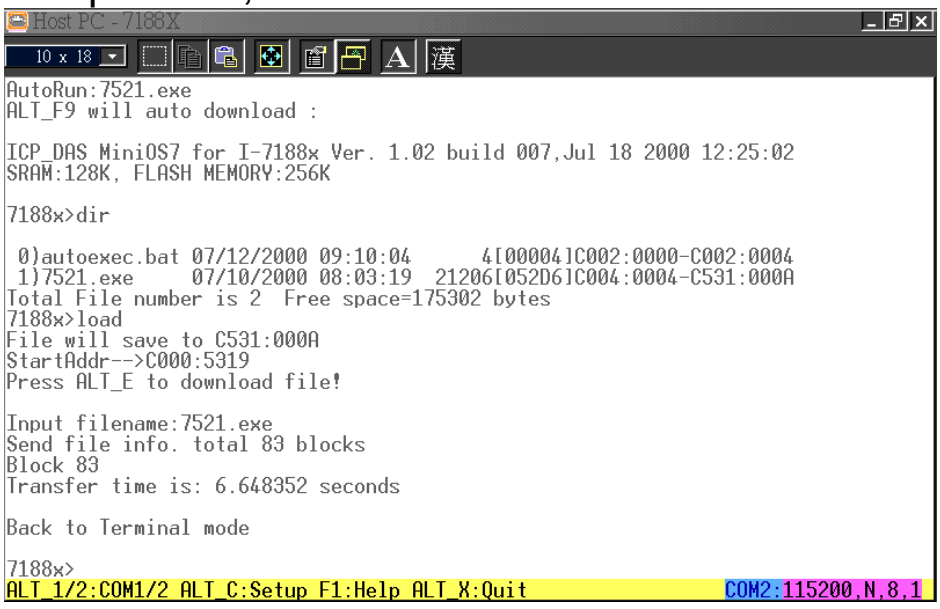


Step 5: Key-in **load** &Enter-KEY

Press Alt-E

Key-in **7521.exe**

Then the MiniOs7 will download the 7521.exe from host –PC to the module. After the download operation, the screen will be shown as follows:



Step 6 : If Step 5 is failure, please use del command to delete all files in 7521/7522/7523. Then download autoexec.bat & 7521.exe(7522.exe, 7523.exe) to the module.

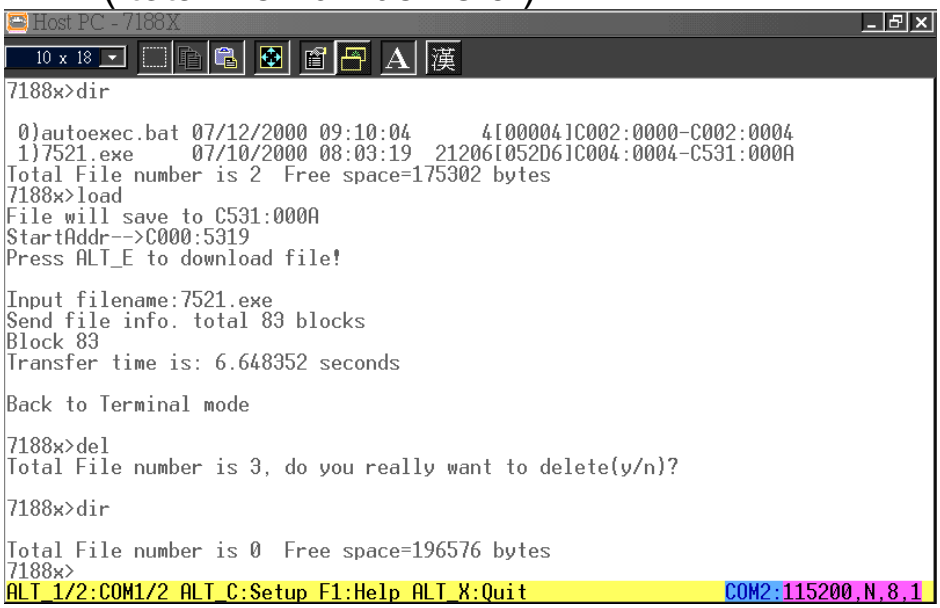
Key-in **del** & Enter-KEY

The MiniOS7 will prompt you to make sure deleting all the files.

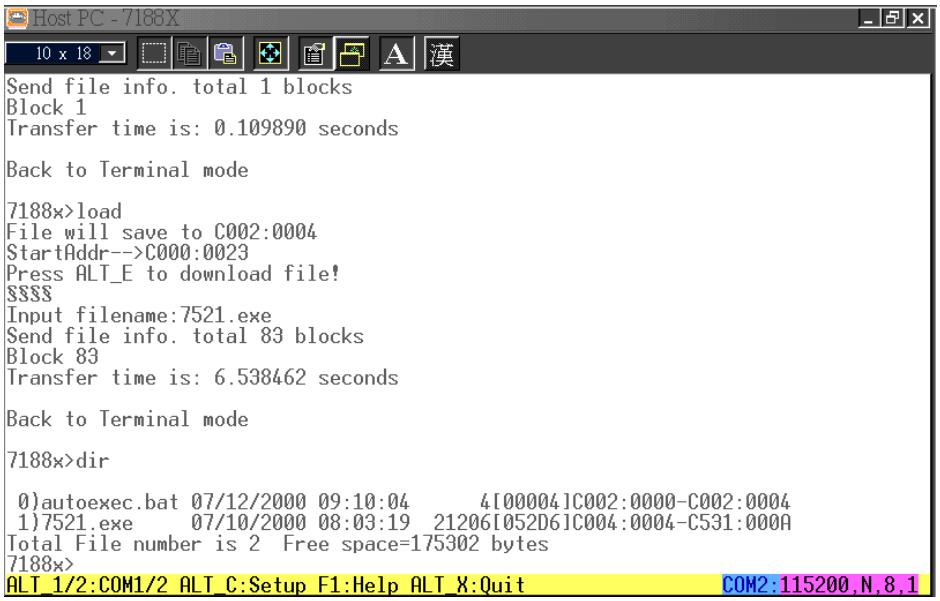
Key-in **Y** & Enter-KEY

Key-in **dir** & Enter-KEY

The MiniOS7 show you there is no file in the controller (total file number is 0).



refer to Step 5, download autoexec.bat & 7521.exe, the screen will be shown as follows:

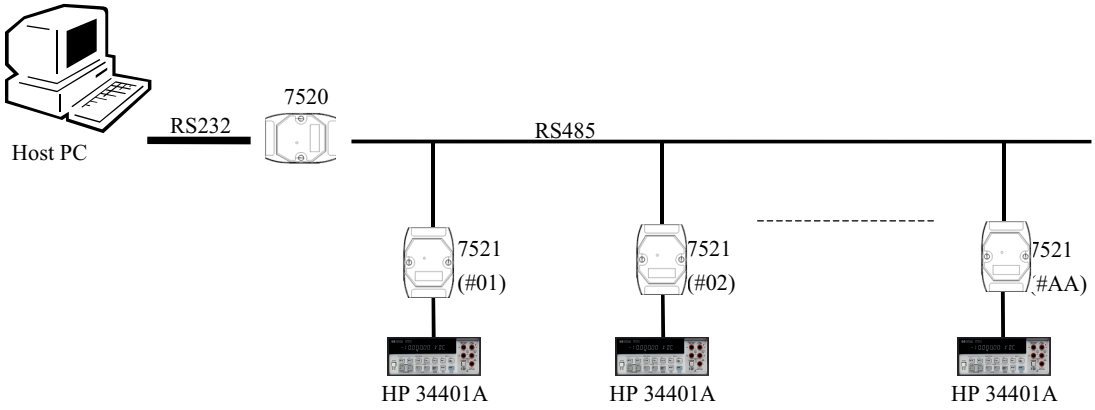


Step 7: disconnect the DI1/INIT* pin from GND & power-off then power-on the 7521/7522/7523.The MiniOS7 will auto execute the new firmware.

1.6 Typical Application

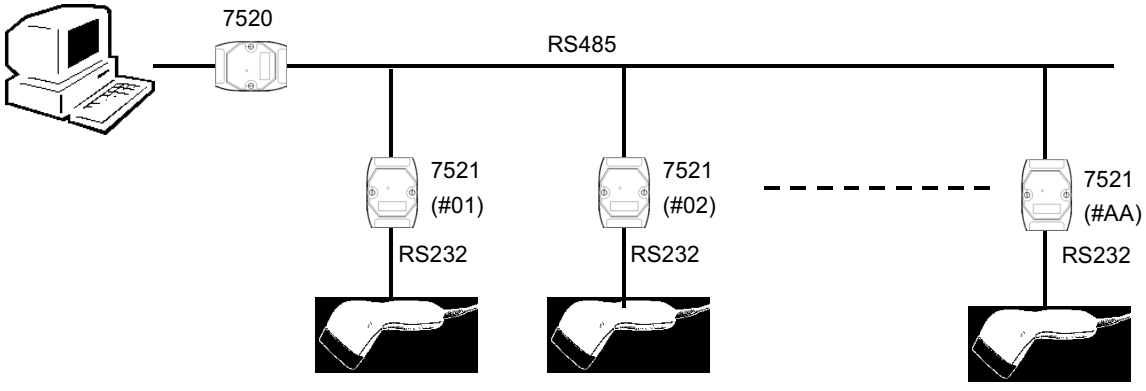
Application1: Addressable RS-232 Controller(Command Type)

- **There is a unique address for every 7521.**
- **Host-PC send command to all 7521 first**
- **The destination-7521 will pass command to its local RS232 device**
- **Then 7521 send back the response of RS232 device to Host-PC**
- **Refer to 7521.c for source code of firmware**



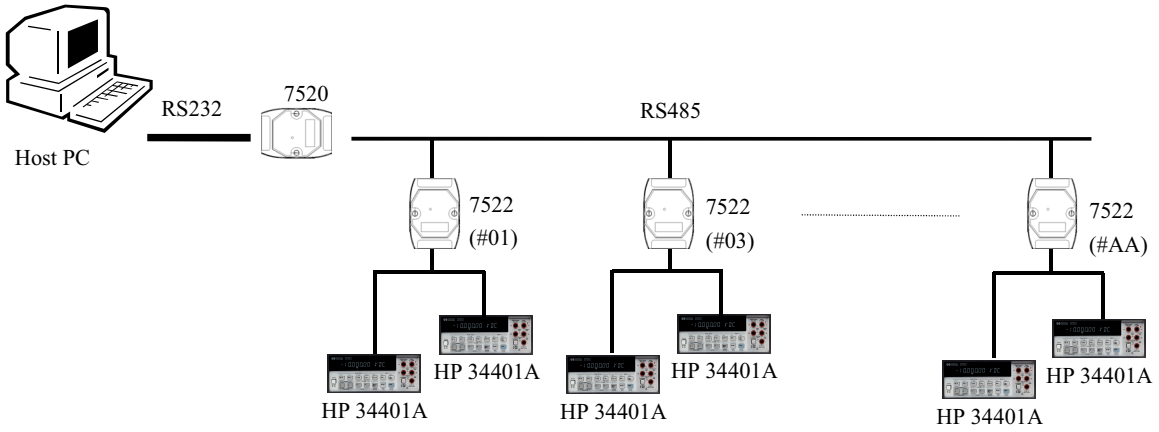
Application2: Addressable RS-232 Controller(Null-command Type)

- **The barcode-reader can scan barcode anytime, the 7521 will store these barcodes in the internal buffer(1K bytes)**
- **Host-PC sends null-command to all 7521 first. The destination-7521 will check its internal buffer. If there is any barcode in buffer, then 7521 will send back one barcode to Host-PC.**
- **Host-PC can send more null-command to read all barcodes stored in the internal buffer of 7521**
- **Refer to 7521.c for source code of firmware**



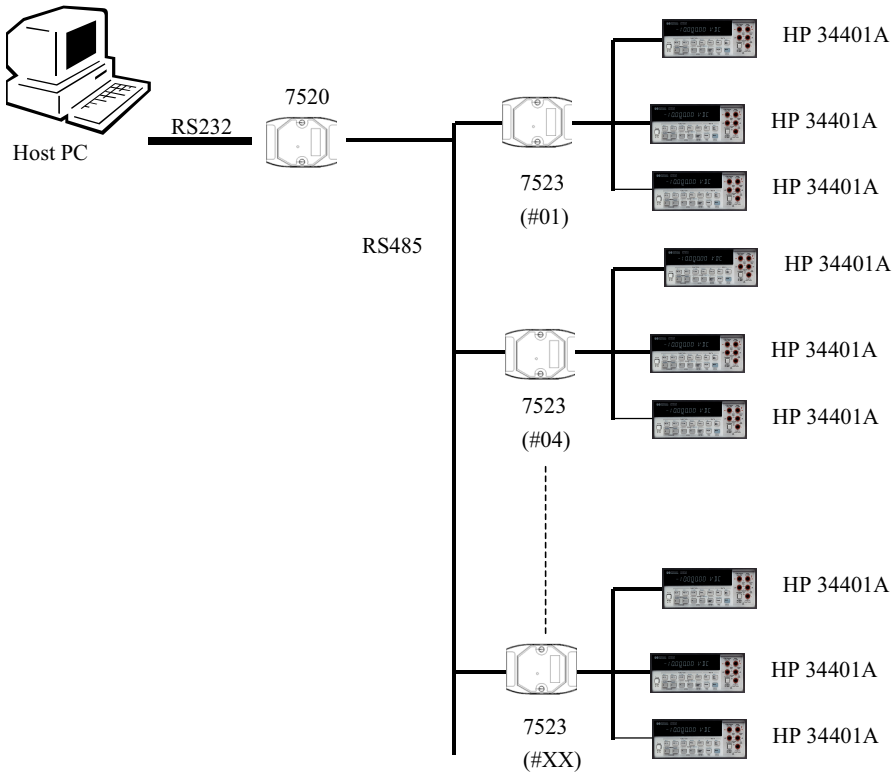
Application3: Addressable RS-232 Controller(Dual-channel)

- **There is a unique address, AA, for every 7522.**
- **Every 7522 can support two RS232 devices, AA & AA+1**
- **Host-PC send command to all 7522 first**
- **The destination-7522 will pass command to its local RS232 device 1 or RS232 device 2.**
- **Then 7522 send back the response of RS232 device to Host-PC**
- **The COM1 and COM2 of 7522 can support 1/2 stop-bit, so it can support two stop-bits device such as HP34401A.**
- **The RS232 device can be command-type(application 1) or null-command type(application 2)**
- **Refer to 7522.c for source code of firmware**



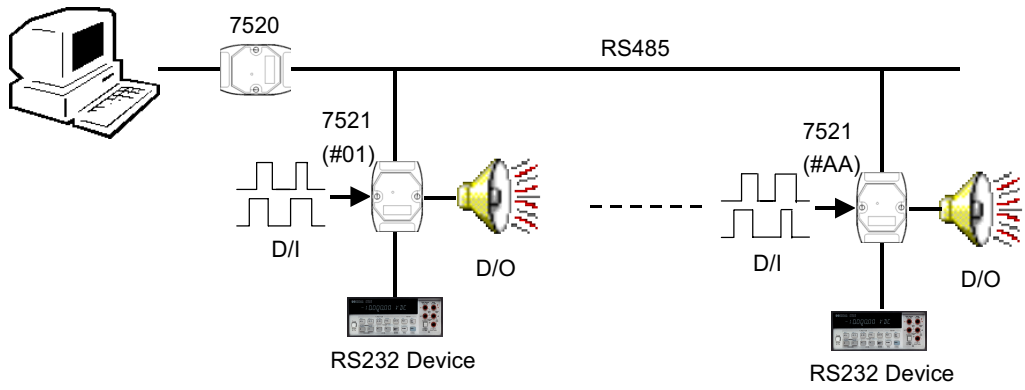
Application4: Addressable RS-232 Controller(Three-channel)

- **There is a unique address, AA, for every 7523.**
- **Every 7523 can support three RS232 devices, AA, AA+1 & AA+2**
- **Host-PC send command to all 7523 first**
- **The destination-7523 will pass command to its local RS232 device 1, RS232 device 2 or RS232 device 3.**
- **Then 7523 send back the response of RS232 device to Host-PC**
- **The COM1,COM2 & COM3 of 7523 can support 1/2 stop-bit, so it can support two stop-bit device such as HP34401A.**
- **The RS232 device can be command-type(application 1) or null-command type(application 2)**
- **Refer to 7523.c for source code of firmware**



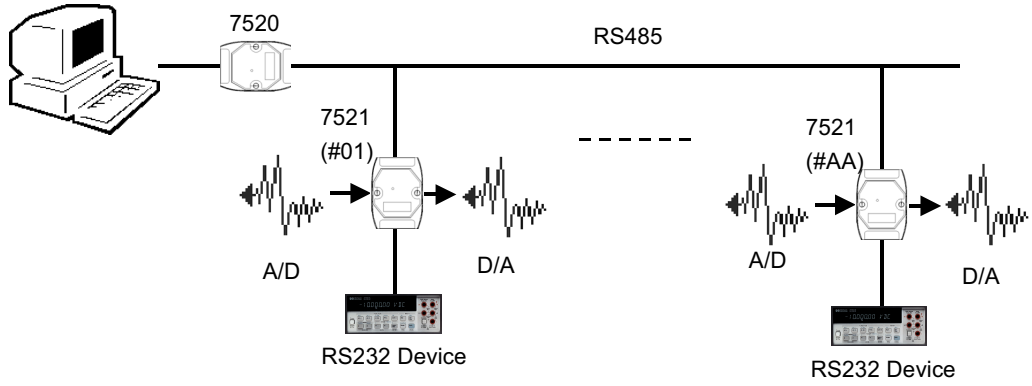
Application5: Real time D/I Monitoring & D/O Alarm (Master type)

- **Refer to application 1 & 2 for more information.**
- **The 7521 will scan & analyze the onboard D/I, if the D/I states match with the alarm states, the onboard D/O will drive the alarm device for alarm or safety control.**
- **All control operations of D/I & D/O are done by 7521. The host-PC only read the values of D/I & D/O for system monitoring.**
- **Refer to 7521ODM1.c for source code of firmware**



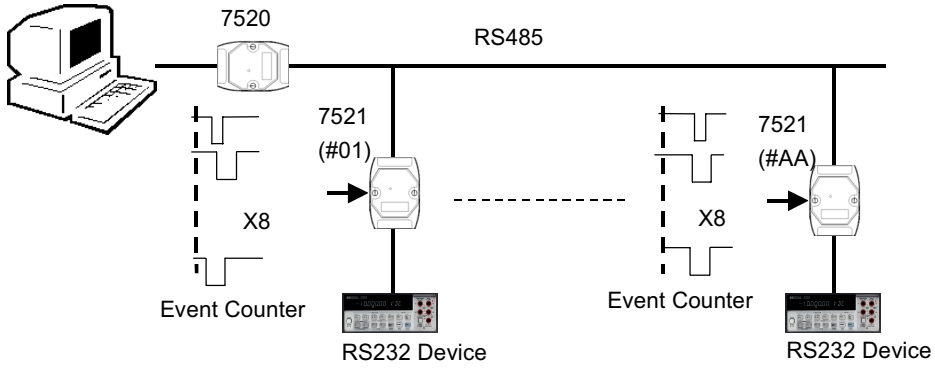
Application6: Real time A/D Monitoring & D/A Control(Master type)

- **Refer to application 1 & 2 for more information.**
- **The X301 support one A/D & one D/A & it can be installed into the 7521. The 7521+X301 can read & analyze the A/D real time. The output of D/A is controlled based on the value of A/D.**
- **All control operations of A/D & D/A are done by 7521. The host-PC only read the values of A/D & D/A for system monitoring.**
- **Refer to 7521ODM2.c for source code of firmware**



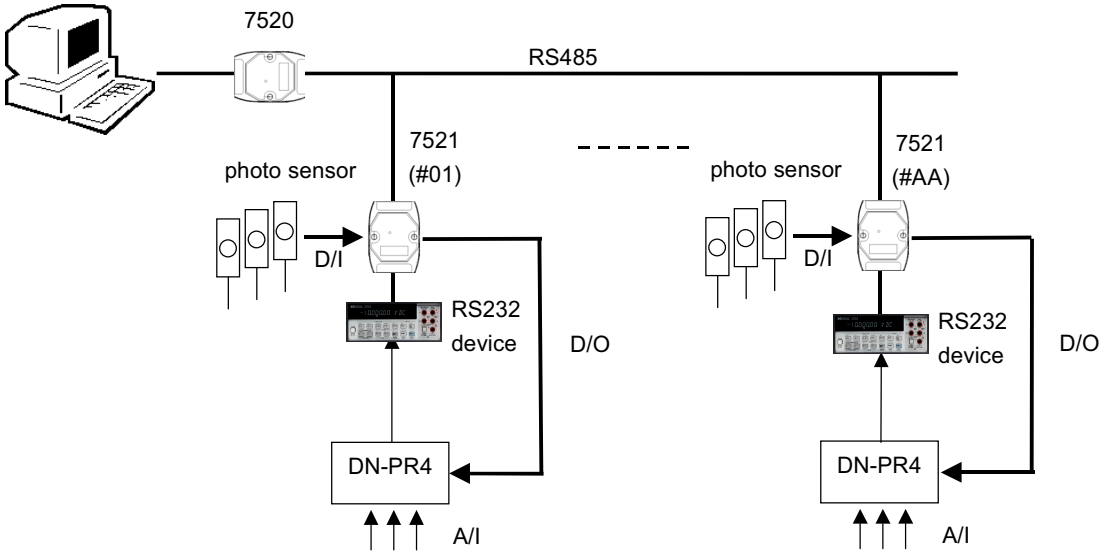
Application7: 8-channel of long time Event-counter(Master type)

- **Refer to application 1 & 2 for more information.**
- **The X100 support 8-channel of D/I. The 7521+X100 can read & analyze these 8 event-counters real time. The timing diagram of the event-counter will be latched until host-PC's clear command.**
- **All analysis operations are done by 7521. The host-PC only read the timing values of event-counter for system monitoring.**
- **Refer to 7521ODM3.c for source code of firmware**



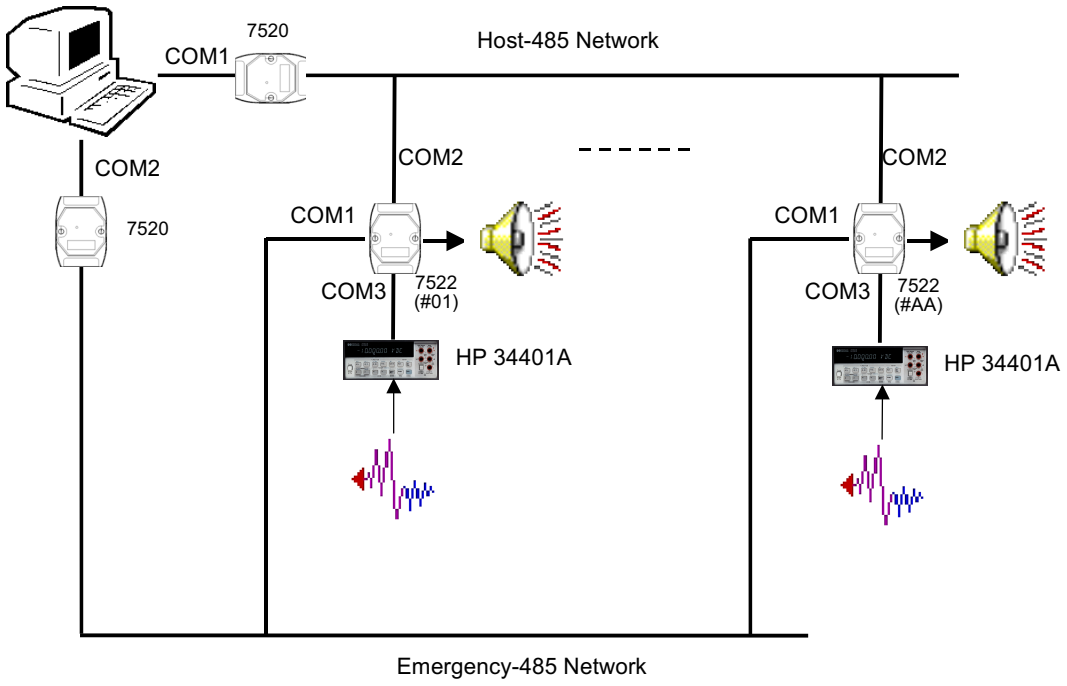
Application8: Multiplex Control(Master type)

- **Refer to application 1 & 2 for more information.**
- **The onboard D/O of 7521 can drive relay directly. The onboard D/I can link to photo-sensor for event trigger. The 7521+DN-PR4 can trigger by photo-sensor & control the multiplex to select the expected analog signal.**
- **All control operations are done by 7521. The host-PC can read the 3-channel A/D signals without the multiplex control.**
- **Refer to 7521ODM4.c for source code of firmware**



Application9: Real time Analog Signal Monitoring & Alarm Control(Master type)

- **Refer to application 1 & 2 for more information.**
- **The COM1 of host-PC is used as a host-485 network. Host-PC will send command & receive response through this RS485 network.**
- **The COM2 of host-PC is used as an emergency-485 network. All 7522 will automatic monitor the analog signal connected to HP34401A. If the emergency event is occurred, the 7522 will send emergency command to this RS485 network. If multi-7522 send emergency command to host-PC at the same time, these 7522 will re-send emergency command to host-PC until the confirmation from host-PC.**
- **All analysis operations are done by 7522. The host-PC only read the analog values for system monitoring.**
- **Refer to 7522ODM5.c for source code of firmware**



2. Connection to HP34401A

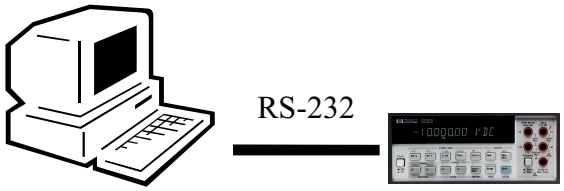
2.1 7521 & HP34401A

The stop-bit of HP34401A must be two stop-bit. The COM1 of 7521, 7522 & 7523 can support 1 stop-bit only. So the Com1 can not link to HP34401A. That is to say, the 7521 can not link to HP34401A.

The COM3 of 7522 & COM3/COM4 of 7523 can support 2 stop-bit, so they can link to HP34401A. 7522 can link to one HP34401A. 7523 can link to two HP34401A. Refer to Sec. 2.2 ~ Sec. 2.6 for more information.

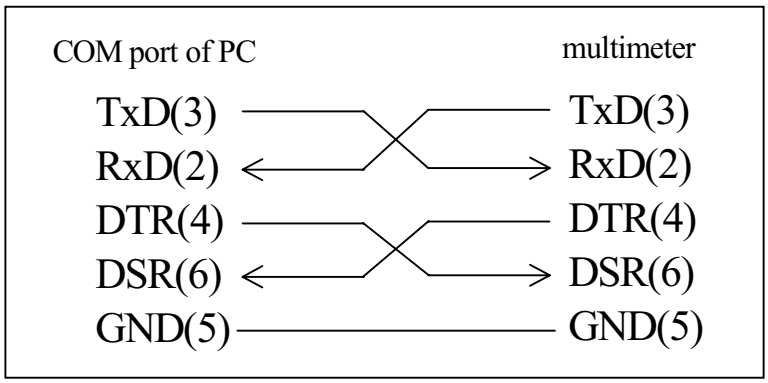
2.2 PC & HP34401A

PC can link o HP34401A by COM1 or COM2 as follows:



Host PC

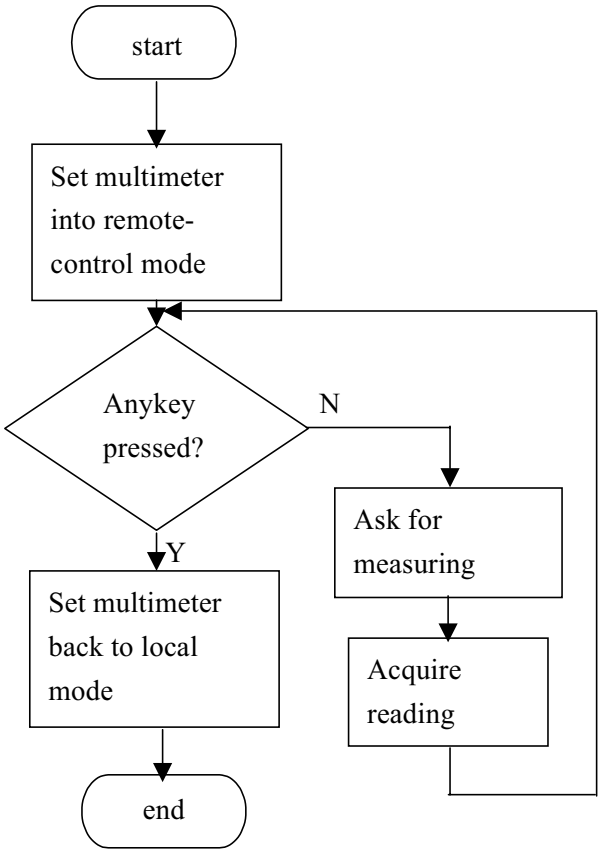
HP 34401A (RS-232)



The default setting of HP34401A are given as follows:

- **Baud rae=9600**
- **Data-bit=7**
- **Parity-bit=EVEN**
- **Stop-bit=2**
- **TXD: send command to RS232-HOST**
- **RXD: receive command from RS232-HOST**
- **DTR: HP34401A set it active-HIGH to enable RS232-HOST for sending command**
- **DSR: RS232-HOST set it active-HIGH to enable HP34401A for sending result back to RS232-HOST**

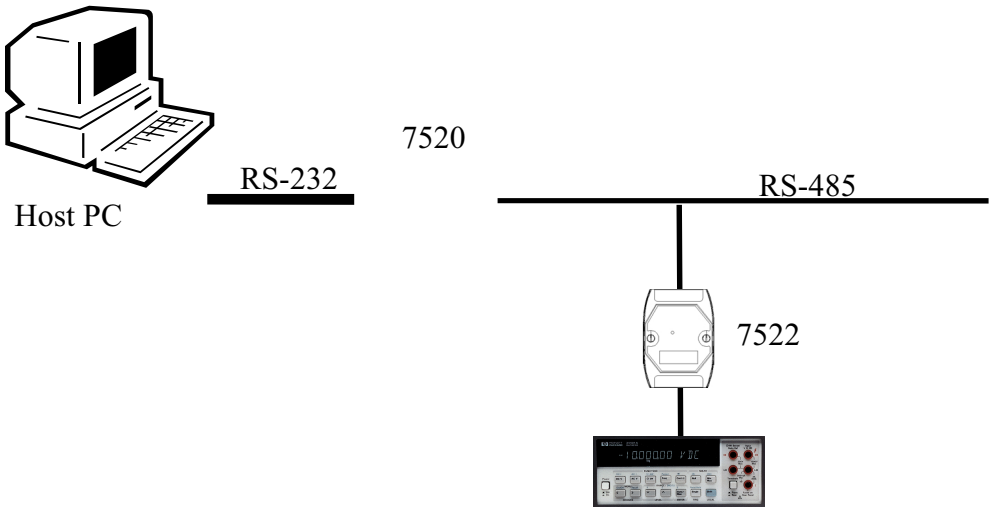
The demo program, hp34401a.c, is designed for a PC to connect to a HP34401A. Refer to the companion CD for source code of hp34401a.c. The flow chart of hp34401a.c is given as follows:



Note: the COM port of PC should be 16550 compatible.

2.3 Single-7522 & Single-HP34401A

The following diagram shows one PC connects to a remote-HP34401A in the RS485 network. The 7520 is used to convert the PC's RS232 signal to RS485 signal. The 7522 is used as a "Addressable RS232 converter" for HP34401A(there is no address setting in HP34401A).



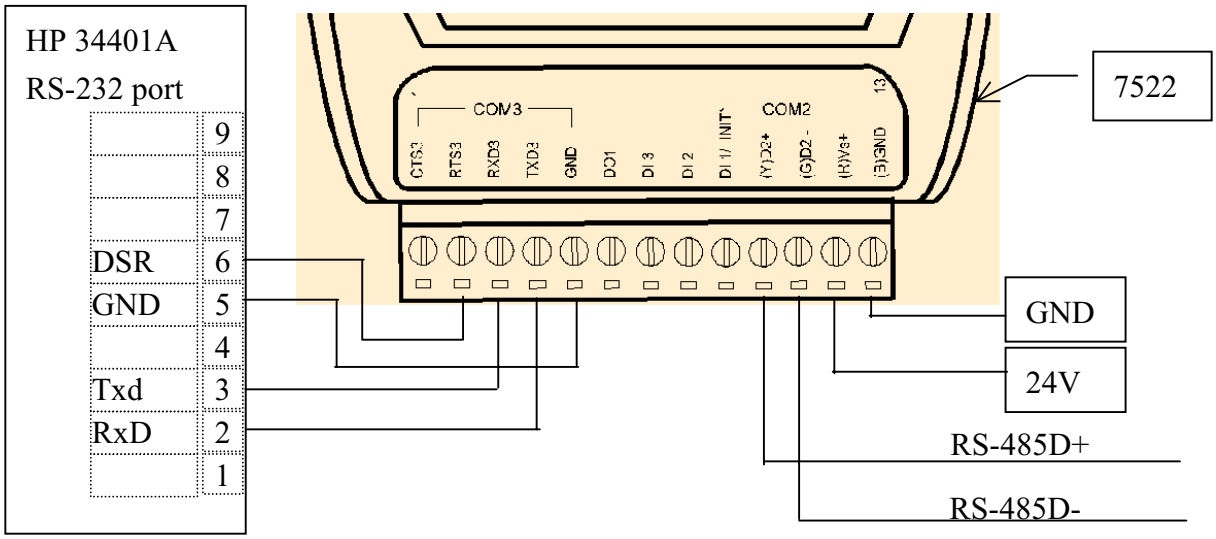
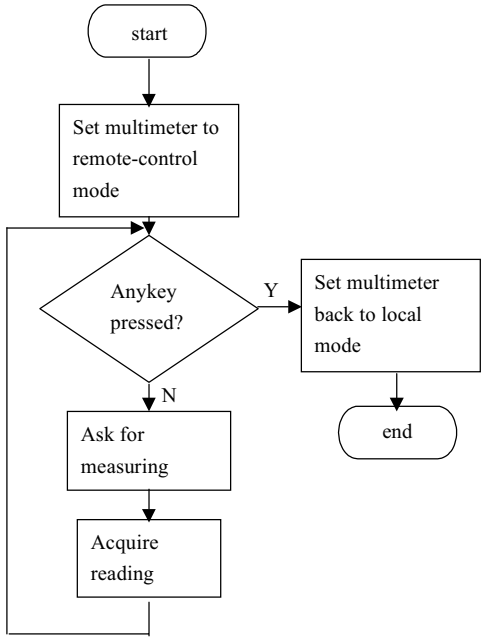


圖 5

The demo program, hp22_1.c, is designed for the HOST-PC to link to the remote-HP34401A. Refer to the companion CD for the source code of hp22_1.c. The key points of hp22_1.c are given as follows:

- **RTS3 of COM3 must be set active-HIGH first to enable HP34401A.**
- **The flow chart of hp22_1.c is given as follows:**



Note: the COM port of PC should be 16550 compatible.

The source code of hp22_1.c is given as follows:

```
#include "com.h"
#include <conio.h>
#include <stdio.h>
#include <string.h>
#include <dos.h>
#include <time.h>
/*=============================================
                    Transmit one char to ComNo
 ============================================= */
int TxCharCOM(int ComNo, char ch)
{
  clock_t c1, c2;
  int time_wait;
  int ComBase;
  if(ComNo == COM1) ComBase = Com1Base;/* Set base address */
  else if(ComNo == COM2) ComBase = Com2Base;
  c1 = clock();
```

```
  time_wait=0;
  while(!(inportb(LSR) & 0x20)) {          /* Wait until line ready  */
    c2 = clock();
    if(c1 != c2) {
      c1 = c2;
      time_wait++;
    }
    if(time_wait > COM_MAX_RX_WAIT_TIME) return(RxTimeOut);
  }
  outportb(TxD, ch);                       /* Output char            */
  return(TxOK);
}
/*=============================================
                        Initial Port of ComNo
 ============================================= */
int InitCOM(int ComNo, unsigned long int BaudRate, int DataFormat)
{
  int br, ComBase;
  char MSB, LSB;
  if(ComNo == COM1) ComBase = Com1Base;
  else if(ComNo == COM2) ComBase = Com2Base;
  br = 115200L/BaudRate;
  MSB = (br&0xff00)>>8;
  LSB = br&0xff;
  disable();
  outportb(LCR, 0x80);                     /* Set baudrate           */
  outportb(DLL, LSB);
  outportb(DLH, MSB);
  outportb(LCR, DataFormat);               /* Set DataFormat         */
  outportb(FCR,0xc1);                      /*enable FIFO, 14 bit buffer*/
  outportb(IER, 0);                        /* Disable all Interrupt    */
  inportb(LSR);
  inportb(RxD);
  outportb(MCR, 0x09);
  outportb(IER, 0x01);                     /* Int. while receive data */
  outportb(TxD, 0x0d);
  enable();
  return(0);
}
/*=============================================
                    Reset ReceiveQueue of ComNo
 ============================================= */
/*=========================================
                    Polling a char from ComNo
                          Return RxOK
                           RxTimeOut
 ========================================= */
int PollRxChar(int ComNo, char* ch)
```

```
{
  clock_t c1, c2;
  int ComBase, wait_time;
  if(ComNo==COM1) ComBase = Com1Base;
  else ComBase = Com2Base;
  wait_time=0;
  c1 = clock();
  while((inportb(LSR) & 0x0f)!=0x01) {
    c2 = clock();
    if(c1 != c2) {
      c1 = c2;
      wait_time++;
    }
    if(wait_time > COM_MAX_RX_WAIT_TIME) return(RxTimeOut);
  };
  *ch=inportb(RxD);
  return(RxOK);
}
/*=============================================
                              Wait a clock tick
 ============================================= */
void WaitClock(int count)
{
  int temp;
  clock_t c1, c2;
  for(temp=0; temp<count; temp++) {
    c1 = clock();
    c2 = clock();
    while(c2==c1) {
      c2 = clock();
    }
  }
}
ComSetting com[2];
/*=============================================
                              Initial HP in serial port
============================================= */
void InitHP(int ComNo)
{
  com[ComNo].ComNo = ComNo;
  com[ComNo].BaudRate = 9600L;
  com[ComNo].DataFormat = Data8bit + NonParity + Stop1bit; //RS-485
setting
  com[ComNo].CheckSum = CHKSUMdisable;
  OpenCOM(ComNo);
  HPSendCommand(ComNo, ":02SYST:REM");
  HPSendCommand(ComNo, ":02*CLS");
  WaitClock(18);
```

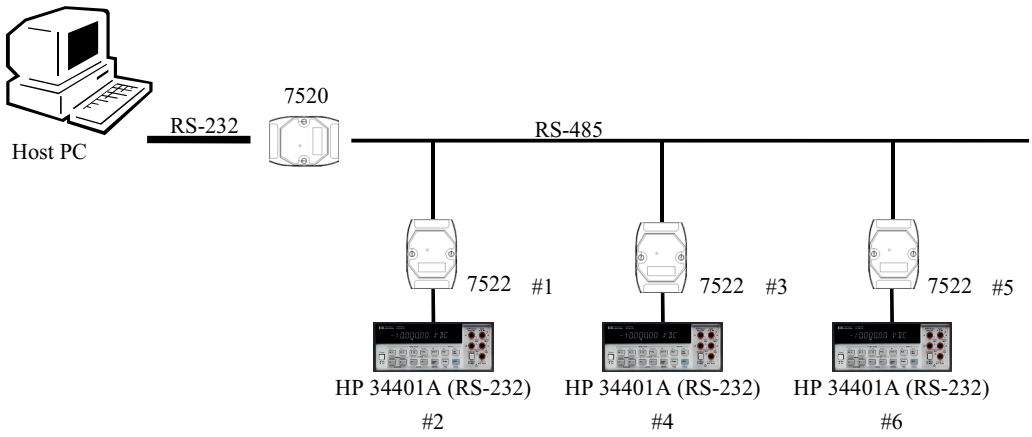
```
}
/*=============================================
                        Close HP in serial port
============================================= */
void CloseHP(int ComNo)
{
  HPSendCommand(ComNo, ":02*CLS");
  HPSendCommand(ComNo, ":02SYST:LOC");
  CloseCOM(ComNo);
}
/*=============================================
                    Send Command to HP in serial port
============================================= */
int HPSendCommand(int ComNo, char *str)
{
  int i;
  unsigned char chk=0;
  for(i=0; str[i]!=0; i++)
    {
    if(TxCharCOM(com[ComNo].ComNo, str[i]) == TxTimeOut)
return(TxTimeOut);
    chk += str[i];
    }
  if(TxCharCOM(com[ComNo].ComNo, 0x0d)==TxTimeOut)
return(TxTimeOut);      //RS-485 setting
  return(TxOK);
}
/*=============================================
                    Receive Command to HP in serial port
============================================= */
int HPReceiveCommand(int ComNo, char *str)
{
  int end_of_rx=0, i=0;
  for(i=0; !end_of_rx; i++) {
    str[i] = 0;
    switch(PollRxChar(com[ComNo].ComNo, str+i)) {
      case RxOK :
        if( str[i] == 0x0d)  //RS-485 setting
        {
          str[i] = 0;
          end_of_rx = 1;
        }
        break;
      case RxTimeOut :
        return(RxTimeOut);
      case RxOverFlow :
        return(RxOverFlow);
    }
```

```
  }
  i--;
  return(i);
}
/*=============================================
                    Read analog value from HP
============================================= */
int ReadHP(int ComNo, double *AI)
{
  int ret;
  float A;
  char str1[80] ;
  HPSendCommand(ComNo, ":02READ?");
  ret = HPReceiveCommand(ComNo, str1);
  if(ret < 0) return(ret);
  *AI = atof(str1);
  return(HP_OK);
}
/*=============================================
                    Initial COM port
=============================================*/
int OpenCOM(int ComNo)
{
  InitCOM(com[ComNo].ComNo, com[ComNo].BaudRate,
com[ComNo].DataFormat);
  return(0);
}
/*=============================================
                    Close/Restore COM port
=============================================*/
int CloseCOM(int ComNo)
{
  return(0);
}
int ShowErrorCode(int error_code);
int main(char argc, char* argv[])
{
  int ret, ComNo;
  double AI;
  int Bye=0;
  int i;
  char str[80];
  if(argc!=2) {
    printf("No COM port assigned\n");
    printf(" Use HP 1 for COM1, HP2 for COM2");
    exit(0);
  }
  if(argv[1][0] == '1') {
```

```
    printf("Connect HP in COM1\n");
    ComNo = COM1;
  }
  else if(argv[1][0] == '2') {
    printf("Connect HP in COM2\n");
    ComNo = COM2;
  }
  else {
    printf(" Use HP 1 for COM1, HP2 for COM2");
    exit(0);
  }
  InitHP(ComNo);
  while(!Bye)
  {
    if(kbhit())
    {
      Bye=1;
    }
    if(HPSendCommand(ComNo, ":02READ?")<0)
      ShowErrorCode(ret);
    if((ret=HPReceiveCommand(ComNo, str))>0)
      printf("\nreading=%sV",str);
    else ShowErrorCode(ret);
    WaitClock(12);
  }
  CloseHP(ComNo);
  return(0);
}
int ShowErrorCode(int error_code)
{
  printf("\n");
  switch(error_code) {
    case RxOK :    printf("RxOK       ");          break;      /*   1 */
    case TxOK :    printf("TxOK       ");          break;      /*   2 */
    case HP_OK :   printf("HP OK      ");          break;      /*   3 */
    case TxTimeOut :printf("TxTimeOut   ");     break;      /* -10 */
    case RxTimeOut :printf("RxTimeOut   ");     break;      /* -11 */
    case RxOverFlow :printf("RxOverFlow  ");    break;      /* -12 */
    defualt :        printf("error=%d ", error_code);break;
  }
  return(0);
}
```

2.4 Multi-7522 & Multi-HP34401A

The following diagram shows one PC connects to a multiple remote-HP34401A in the RS485 network. The 7520 is used to convert the PC's RS232 signal to RS485 signal. The 7522 is used as a "Addressable RS232 converter" for HP34401A(there is no address setting in HP34401A).
Every 7522 own a unique address in the RS485 network. Every hp34401A share the same address-range with its 7522, so every HP34401A own a unique address in this configuration.



The demo program, hp22_m.c, is designed for the HOST-PC to link to the remote-HP34401A. Refer to the companion CD for the source code of hp22_m.c. The key points of hp22_m.c are given as follows:

- **The configuration of 7522 is given as follows:**

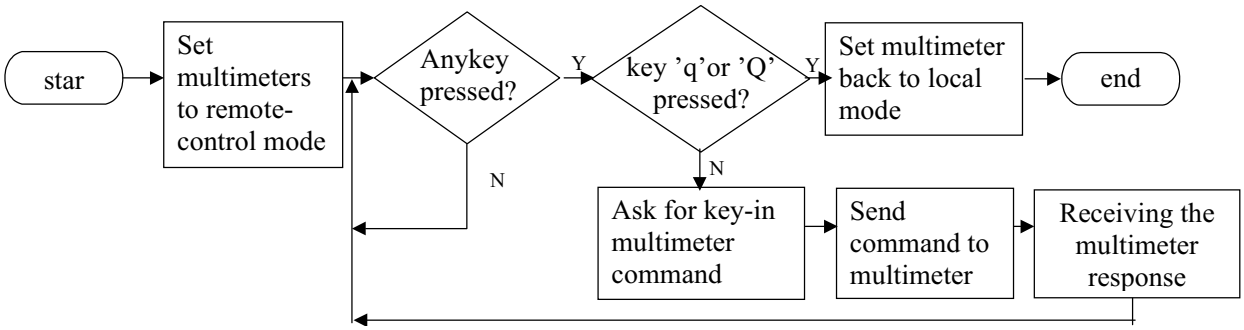
	COM2(485)	COM3(232)
baud rate	9600(default)	9600(default)
Parity	None(default)	Even
data	8(default)	7
stop bit	1(default)	2

- **All RTS3 of COM3 must be set active-high first to enable HP34401A.**
- **The address mapping of this configuration is given as follows:**

No.of 7522	Address of 7522
#1	01h
#3	03h
#5	05h

No.of HP	Address of HP34401A
#2	02h
#4	04h
#6	06h

- **The flow chart of hp22_m.c is given as follows:**

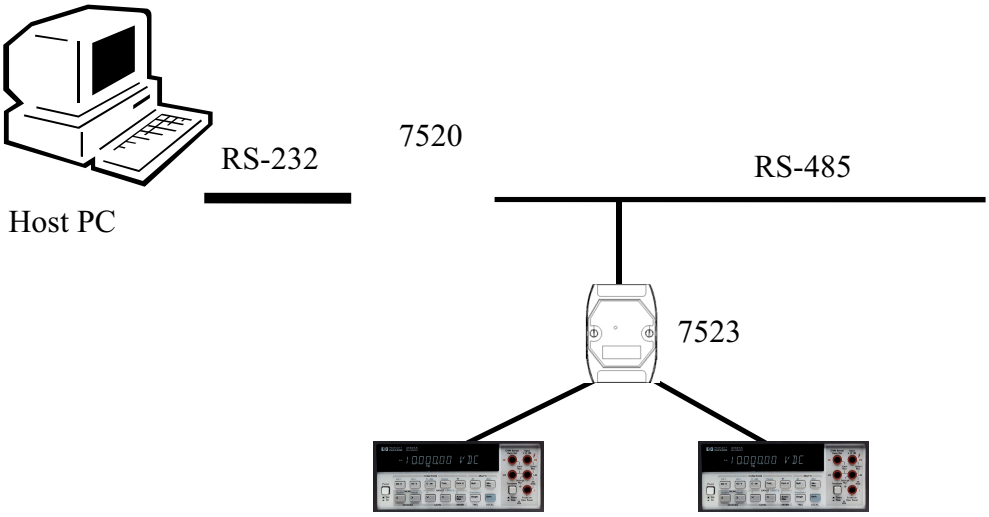


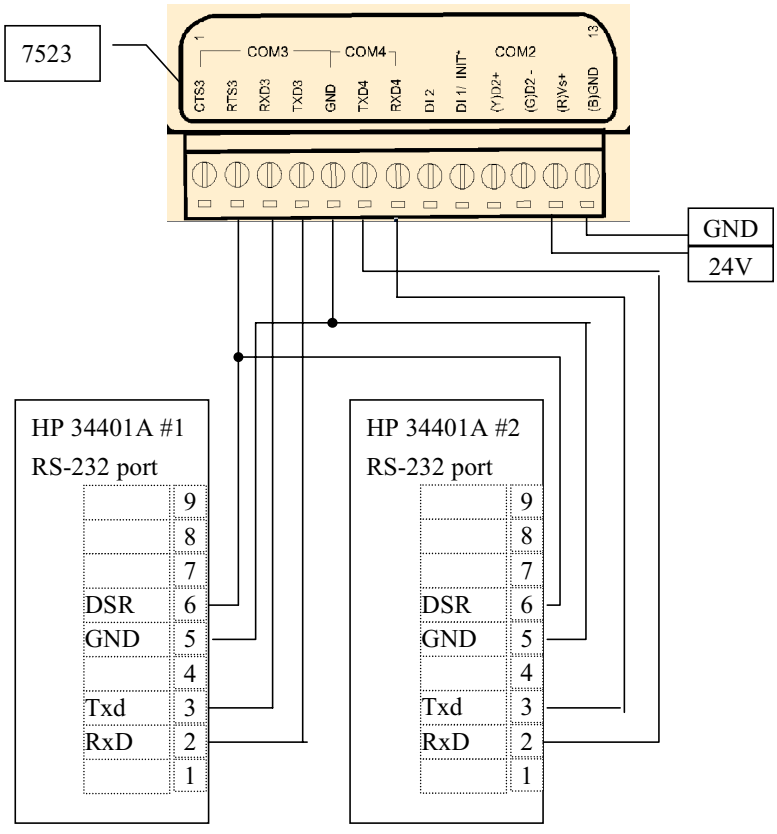
- **Execution examples:**

```
MS-DOS 模式 - HP22_M
10 x 18
QW       EXE        11,962  06-30-00  14:31 QW.EXE
SER      EXE         8,752  07-03-00   9:18 SER.EXE
         9 file(s)        168,925 bytes
         0 dir(s)   3,552,923,648 bytes free

F:\HP\hpdemo75>hp22_m 1
Connect 7522 net in COM1

command-> q

F:\HP\hpdemo75>hp22_m 1
Connect 7522 net in COM1

command-> :02*IDN?

TxOK
response: HEWLETT-PACKARD,34401A,0,10-5-2
command-> :04*IDN?

TxOK
response: HEWLETT-PACKARD,34401A,0,10-5-2
command-> :06READ?

TxOK
response: -4.52592200E-03
```

2.5 Single-7523 & Two-HP34401A

The following diagram shows one PC connects to two remote-HP34401A in the RS485 network. The 7520 is used to convert the PC's RS232 signal to RS485 signal. The 7523 is used as a "Addressable RS232 converter" for HP34401A(there is no address setting in HP34401A). One 7523 can connect two HP34401A.





The demo program, hp23_1.c, is designed for the HOST-PC to link to the remote-HP34401A. Refer to the companion CD for the source code of hp23_1.c. The key points of hp23_1.c are given as follows:

- **All RTS3 of COM3 must be set active-HIGH first to enable HP34401A.**
- **The COM-port of this configuration is given as follows:**

	COM2(485)	COM3(232)	COM4(232)
Baud rate	9600 (default)	9600 (default)	9600 (default)
Parity	None (default)	Even	Even
data	8 (default)	7	7
stop bit	1 (default)	2	2

- **The address mapping of this configuration is given as follows:**

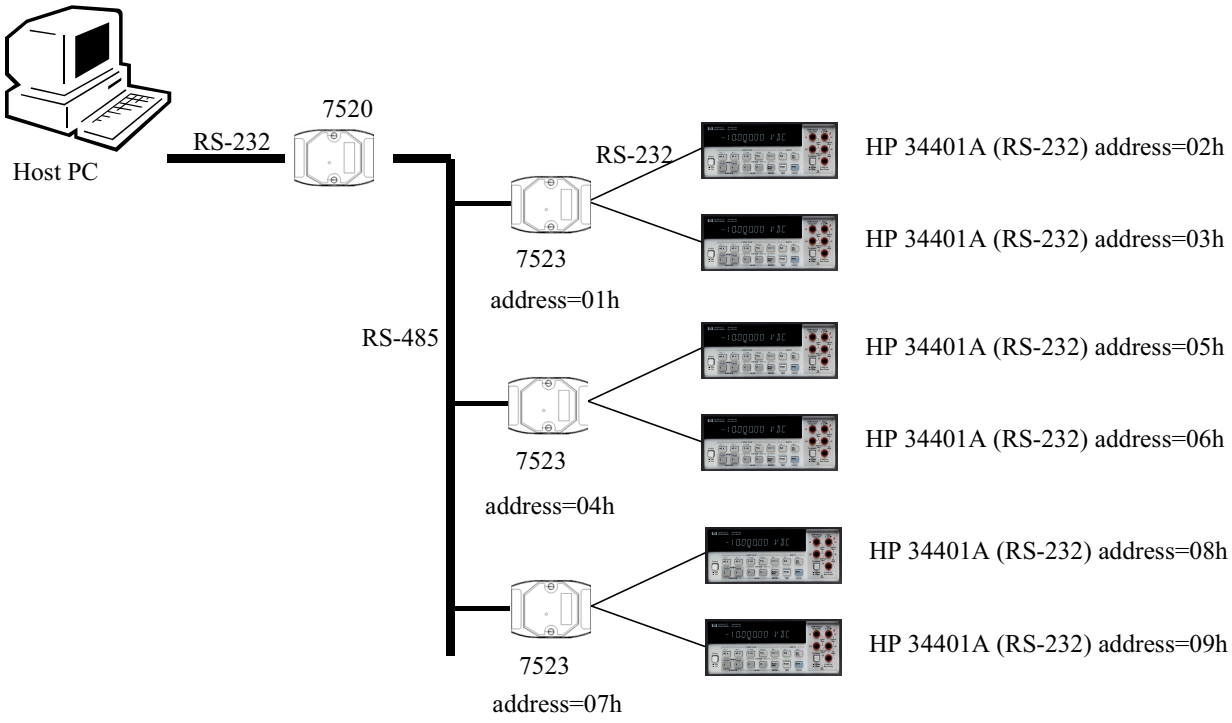
address of 7523	Corresponding COM3 address	Corresponding COM4 address
01h	02h	03h

- **The InitHP(), CloseHP() of hp23_1.c are given as follows:**

```
void InitHP(int ComNo)
{
  com[ComNo].ComNo = ComNo;
  com[ComNo].BaudRate = 9600L;
  com[ComNo].DataFormat = Data8bit + NonParity + Stop1bit;
  com[ComNo].CheckSum = CHKSUMdisable;
  OpenCOM(ComNo);

  HPSendCommand(ComNo, ":02SYST:REM");              // #1 HP
  HPSendCommand(ComNo, ":02*CLS");                  // #1 HP
  HPSendCommand(ComNo, ":03SYST:REM");              // #2 HP
  HPSendCommand(ComNo, ":03*CLS");                  // #2 HP
  WaitClock(18);
}

void CloseHP(int ComNo)
{
  HPSendCommand(ComNo, ":02*CLS");                  // #1 HP
  HPSendCommand(ComNo, ":02SYST:LOC");              // #1 HP
  HPSendCommand(ComNo, ":03*CLS");                  // #2 HP
  HPSendCommand(ComNo, ":03SYST:LOC");              // #2 HP
  CloseCOM(ComNo);
}
```

2.6 Multi-7523 & Multi-HP34401A

The following diagram shows one PC connects to multiple remote-HP34401A in the RS485 network. The 7520 is used to convert the PC's RS232 signal to RS485 signal. The 7523 is used as a "Addressable RS232 converter" for HP34401A(there is no address setting in HP34401A). One 7523 can connect two HP34401A.
Every 7523 own a unique address in the RS485 network. Every HP34401A share the same address-range with its 7523, so every HP34401A own a unique address in this configuration.



The demo program, hp23_m.c, is designed for the HOST-PC to link to the remote-HP34401A. Refer to the companion CD for the source code of hp23_m.c. The key points of 1hp.c are given as follows:

- **All RTS3 of COM3 must be set active-HIGH first to enable HP34401A.**

- **The COM-port setting of this configuration is given as follows:**

	COM2(485)	COM3(232)	COM4(232)
baud rate	9600 (default)	9600 (default)	9600 (default)
parity	None (default)	Even	Even
data	8 (default)	7	7
stop bit	1 (default)	2	2

- **The InitHP(), CloseHP() of hp23_M.c are given as follows:**

```
void InitHP(int ComNo)
{
  com[ComNo].ComNo = ComNo;
  com[ComNo].BaudRate = 9600L;
  com[ComNo].DataFormat = Data8bit + NonParity + Stop1bit;
  com[ComNo].CheckSum = CHKSUMdisable;
  OpenCOM(ComNo);

  HPSendCommand(ComNo, ":02SYST:REM");                // #1 HP
  HPSendCommand(ComNo, ":02*CLS");                    // #1 HP
  HPSendCommand(ComNo, ":03SYST:REM");                // #2 HP
  HPSendCommand(ComNo, ":03*CLS ");                   // #2 HP
  HPSendCommand(ComNo, ":05SYST:REM");                // #3 HP
  HPSendCommand(ComNo, ":05*CLS ");                   // #3 HP
  HPSendCommand(ComNo, ":06SYST:REM");                // #4 HP
  HPSendCommand(ComNo, ":06*CLS ");                   // #4 HP
  HPSendCommand(ComNo, ":08SYST:REM");                // #5 HP
  HPSendCommand(ComNo, ":08*CLS ");                   // #5 HP
  HPSendCommand(ComNo, ":09SYST:REM");                // #6 HP
  HPSendCommand(ComNo, ":09*CLS ");                   // #6 HP
  WaitClock(18);
}
void CloseHP(int ComNo)
{
  HPSendCommand(ComNo, ":02*CLS");                    // #1 HP
  HPSendCommand(ComNo, ":02SYST:LOC");                // #1 HP
  HPSendCommand(ComNo, ":03*CLS");                    // #2 HP
  HPSendCommand(ComNo, ":03SYST:LOC");                // #2 HP
  HPSendCommand(ComNo, ":05*CLS");                    // #3 HP
  HPSendCommand(ComNo, ":05SYST:LOC");                // #3 HP
  HPSendCommand(ComNo, ":06*CLS");                    // #4 HP
  HPSendCommand(ComNo, ":06SYST:LOC");                // #4 HP
  HPSendCommand(ComNo, ":08*CLS");                    // #5 HP
  HPSendCommand(ComNo, ":08SYST:LOC");                // #5 HP
  HPSendCommand(ComNo, ":09*CLS");                    // #6 HP
  HPSendCommand(ComNo, ":09SYST:LOC");                // #6 HP
  CloseCOM(ComNo);
}
```

3. Command Set

Command Set Table

Command	Response	Description	Reference
$AAA[addr]	!AA	Read/Set the Module Address	Sec. 3.1
$AABN[baud rate]	!AA[baud rate]	Read/Set Baud Rate of COM-1/2/3/4	Sec. 3.2
$AADN[data-bit]	!AA[data-bit]	Read/Set the Data-Bit of COM-1/2/3/4	Sec. 3.3
$AAPN[data-bit]	!AA[parity-bit]	Read/Set the Parity-Bit of COM-1/2/3/4	Sec. 3.4
$AAON[data-bit]	!AA[stop-bit]	Read/Set the Stop-Bit of COM-1/2/3/4	Sec. 3.5
$AA6(ID)	!AA	Set the ID-string of COM-1/3/4	Sec. 3.6
$AA7	!AA(ID)	Read the ID-string of COM-1/3/4	Sec. 3.7
$AAC[delimiter]	!AA[delimiter]	Read/Set the delimiter of COM-1/3/4	Sec. 3.8
$AAD	!AA(delimiter)	Read the delimiter of COM-1/3/4	Sec. 3.9
(delimiter)AA(bypass)	!AA	Bypass data-string to COM-1/3/4	Sec. 3.10
$AAKN[CrLfMode]	!AA(CrLfMode)	Read/Set the checksum-status of COM2(RS485)	Sec. 3.11
$AATN[CrLfMode]	!AA(CrLfMode)	Read/Set the end-char of COM-1/2/3/4	Sec. 3.12
$AAW	!AAS	Read the CTS_status of COM-1/3	Sec. 3.13
$AAXV	!AA	Set the RTS_state of COM-1/3	Sec. 3.14
$AAYN	!AA	Read the onboard DI-1/2/3	Sec. 3.15
$AAZNV	!AA	Set the onboard D/O-1/2/3	Sec. 3.16
#**	No Response	Synchronized Sampling	Sec. 3.17
$AA4	!AASV	Read the synchronized data	Sec. 3.18
$AA5	!AAS	Read the Reset- status	Sec. 3.19
$AAF	!AA(number)	Read the firmware version number	Sec. 3.20
$AAM	!AA(name)	Read the module name	Sec. 3.21
$AA2	!AABDPK	Read the confguraton of COM2(RS485)	Sec. 3.22
~**	No Response	Host is OK	Sec. 3.23
~AA0	!AAS	Read the module status	Sec. 3.24
~AA1	!AA	Reset the module status	Sec. 3.25
~AA2	!AASTT	Read the host watchdog status & value	Sec. 3.26
~AA3ETT	!AA	Enable the host watchdog timer	Sec. 3.27
~AA4P/~AA4S	!AAV	Read power-on/safe value	Sec. 3.28
~AA5P/~AA5S	!AAV	Set power-on/safe value	Sec. 3.29

3.1 $AAA[addr]

7521/7522/7523

- **Description**: **Read/Set the module address**
  $AAA[addr][chk](CrLf) → set module address
  $AAA[chk](CrLf) → read module address stored in EEPROM
- **Syntax**: $AAA[addr][chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : →syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:

command: $01A02(CrLf)
response : !02(CrLf)

address 01 is changed to 02

command: $02AA0(CrLf)
response : !A0(CrLf)

address 02 is changed to 0xA0

command: $00A(CrLf)
response : !02(CrLf)

address stored in EEPROM=02

NOTE1: THE AA WILL BE SHOWN IN THE (LED1,LED2). REFER TO SEC. 1.2 QUICK START 1 FOR MORE INFORMATION.

NOTE2: CONNECT THE DI1/INIT* TO GND & USE $00A COMMAND CAN READ OUT THE ADDRESS STORED IN EEPROM.

3.2 $AABN[baud rate]

7521/7522/7523

- **Description**: **Read/Set the baud rate of COM-1/2/3/4**.
  $AABN[chk](CrLf): Read baud rate of COM-1/2/3/4 stored in EEPROM
  $AABN(baud rate)[chk](CrLf): Set baud rate of COM-1/2/3/4
- **Syntax**: $AABN[baud rate][chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  N=0 → Read/Set baud rate of RS485, N=1 → Read/Set baud rate of RS232
  [baud rate]: 300/600/1200/2400/4800/9600/19200/38400/57600/115200
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[baud rate][chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)

command:	$01B0115200(CrLf)
response :	!01(CrLf)
command:	$01B19600(CrLf)
response :	!01(CrLf)
command:	$02B138400(CrLf)
response :	!02(CrLf)
command:	$03B157600(CrLf)
response :	!03(CrLf)

Change RS485(COM2) to 15200 BPS

Change RS232(COM1) to 9600 BPS

Change RS232(COM3) to 38400 BPS

Change RS232(COM4) to 57600 BPS

ADDRESS MAPPING:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**AA**	**AA**	**N/A**	**N/A**
7522	**AA**	**AA/AA+1**	**AA+1**	**N/A**
7523	**AA**	**AA/AA+1/AA+2**	**AA+1**	**AA+2**

SHORT-CODE FOR BAUD RATE:
300=1, 600=2, 1200=3, 2400=4, 4800=5, 9600=6, 19200=7, 38400=8, 57600=9, 115200=A**. THE SHORT-CODE OF BAUD RATE WILL BE SHOWN IN THE 7-SEGMENT** LED3**. REFER TO SEC. 1.2 QUICK START 1 FOR MORE INFORMATION.**

3.3 $AADN[data-bit]

7521/7522/7523

DESCRIPTION**: READ/SET THE DATA-BIT OF COM-1/2/3/4**

$AADN[chk](CrLf): Read the data-bit of COM-1/2/3/4 stored in EEPROM

$AADN(data-bit)[chk](CrLf): Set the data-bit of COM-1/2/3/4

- **Syntax**: $AADN[data-bit][chk](CrLf)

  $ is a delimiter character

  AA=2-character HEX module address, from 00 to FF

  N=0 → Read/Set the data-bit of RS485, N=1 → Read/Set the data-bit of RS232

  [data-bit]: 7 or 8

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Response**: valid command → !AA[data-bit][chk](CrLf)

  invalid command → ?AA[chk](CrLf)

  no response : → syntax error or communication error or address error

  ! is a delimiter character indicating a valid command

  ? is a delimiter character indicating a invalid command

  AA=2-character HEX module address

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Example**: (Assume the AA of 7523 is 01)

  command: $01D08(CrLf)
  response : !01(CrLf)
  Change data-bit of RS485(COM2) to 8

  command: $01D17(CrLf)
  response : !01(CrLf)
  Change data-bit of RS232(COM1) to 7

  command: $02D17(CrLf)
  response : !02(CrLf)
  Change data-bit of RS232(COM3) to 7

  command: $03D17(CrLf)
  response : !03(CrLf)
  Change data-bit of RS232(COM4) to 7

ADDRESS MAPPING:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**AA**	**AA**	**N/A**	**N/A**
7522	**AA**	**AA/AA+1**	**AA+1**	**N/A**
7523	**AA**	**AA/AA+1/AA+2**	**AA+1**	**AA+2**

VALID DATA-BIT:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**7/8**	**7/8**	**N/A**	**N/A**
7522	**7/8**	**7/8**	**7/8**	**N/A**
7523	**7/8**	**7/8**	**7/8**	**7/8**

3.4 $AAPN[data-bit]

7521/7522/7523

DESCRIPTION**: READ/SET THE PARITY-BIT OF COM-1/2/3/4**

$AAPN[chk](CrLf): Read the parity-bit of COM-1/2/3/4 stored in EEPROM

$AAPN(parity-bit)[chk](CrLf): Set the parity-bit of COM-1/2/3/4

- **Syntax**: $AAPN[parity-bit][chk](CrLf)

  $ is a delimiter character

  AA=2-character HEX module address, from 00 to FF

  N=0 → Read/Set the parity-bit of RS485, N=1 → Read/Set the parity-bit of RS232

  [parity-bit]: 0=NONE, 1=EVEN, 2=ODD

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Response**: valid command → !AA[data-bit][chk](CrLf)

  invalid command → ?AA[chk](CrLf)

  no response : → syntax error or communication error or address error

  ! is a delimiter character indicating a valid command

  ? is a delimiter character indicating a invalid command

  AA=2-character HEX module address

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Example**: (Assume the AA of 7523 is 01)

command: $01P00(CrLf)	Change parity-bit of RS485(COM2) to NONE
response : !01(CrLf)	
command: $01P10(CrLf)	Change parity-bit of RS232(COM1) to NONE
response : !01(CrLf)	
command: $02P11(CrLf)	Change parity-bit of RS232(COM3) to EVEN
response : !02(CrLf)	
command: $03P12(CrLf)	Change parity-bit of RS232(COM4) to ODD
response : !03(CrLf)	

ADDRESS MAPPING:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**AA**	**AA**	**N/A**	**N/A**
7522	**AA**	**AA/AA+1**	**AA+1**	**N/A**
7523	**AA**	**AA/AA+1/AA+2**	**AA+1**	**AA+2**

VALID PARITY-BIT:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**	**N/A**	**N/A**
7522	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**	**N/A**
7523	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**	**NONE/EVEN/ ODD**

3.5 $AAON[stop-bit]

7522/7523

DESCRIPTION**: READ/SET THE STOP-BIT OF COM-3/4**

$AAON[chk](CrLf): Read the stop-bit of COM-3/4 stored in EEPROM

$AAON(stop-bit)[chk](CrLf): Set the stop-bit of COM-3/4

- **Syntax**: $AAPN[stop-bit][chk](CrLf)

  $ is a delimiter character

  AA=2-character HEX module address, from 00 to FF

  N=0 → Read/Set the parity-bit of RS485, N=1 → Read/Set the parity-bit of RS232

  [stop-bit]: 1 for COM1/2 , 1/2 for COM3/4

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Response**: valid command → !AA[data-bit][chk](CrLf)

  invalid command → ?AA[chk](CrLf)

  no response : → syntax error or communication error or address error

  ! is a delimiter character indicating a valid command

  ? is a delimiter character indicating a invalid command

  AA=2-character HEX module address

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Example**: (Assume the AA of 7523 is 01)

  command: $02O12(CrLf)

  response : !02(CrLf)

  command: $03O12(CrLf)

  response : !03(CrLf)

Change the stop-bit of RS232(COM3) to 2

Change the stop-bit of RS232(COM4) to 2

- address mapping:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**AA**	**AA**	**N/A**	**N/A**
7522	**AA**	**AA/AA+1**	**AA+1**	**N/A**
7523	**AA**	**AA/AA+1/AA+2**	**AA+1**	**AA+2**

- Valid stop-bit:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**1**	**1**	**N/A**	**N/A**
7522	**1**	**1**	**1 OR 2**	**N/A**
7523	**1**	**1**	**1 OR 2**	**1 OR 2**

- Note: The stop-bit of COM1 & COM2 is always 1.
- Note: The stop-bit of HP34401A must be 2. So, COM1 of 7521/7522/7523 cannot link to HP34401A.
- Note: COM3 & COM4 of 7522/7523 can link to HP34401A

3.6 $AA6(ID)

7521/7522/7523

DESCRIPTION**: SET THE ID-STRING OF COM-1/3/4, MAX.=50 CHARACTERS**

- **Syntax**: $AA6(ID)[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  (ID): ID-string, max. 50 characters.
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $016Temperature1(CrLf)
  response : !01(CrLf)
  command: $026HP34401A-1(CrLf)
  response : !02(CrLf)
  command: $036HP34401A-2(CrLf)
  response : !03(CrLf)

ID of RS232(COM1) is Temperature1

ID of RS232(COM3) is HP34401A-1

ID of RS232(COM4) is HP34401A-2

ADDRESS MAPPING:

	COM1(RS232)	COM3(RS232)	COM4(RS232)
7521	**AA**	**N/A**	**N/A**
7522	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA+1**	**AA+2**

3.7 $AA7

7521/7522/7523

DESCRIPTION**: READ THE ID=-STRING OF COM-1/3/4**

- **Syntax**: $AA7[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA(ID)[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  (ID): ID-string, max. 50 characters.
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $017(CrLf)
  response : !01Temperature1(CrLf)
  command: $027(CrLf)
  response : !02HP34401A-1(CrLf)
  command: $037(CrLf)
  response : !03HP34401A-2(CrLf)

ID of RS232(COM1) is Temperature1

ID of RS232(COM3) is HP34401A-1

ID of RS232(COM4) is HP34401A-2

ADDRESS MAPPING:

	COM1(RS232)	COM3(RS232)	COM4(RS232)
7521	**AA**	**N/A**	**N/A**
7522	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA+1**	**AA+2**

3.8 $AAC[delimiter]

7521/7522/7523

DESCRIPTION**: READ/SET THE DELIMITER OF COM-1/3/4**

$AAC[chk](CrLf): Read the delimiter of COM-1/3/4 stored in EEPROM

$AAC(delimiter)[chk](CrLf): Set the delimiter of COM-1/3/4

- **Syntax**: $AAC[delimiter][chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [delimiter]: default delimiter is **:**
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[delimiter][chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $01C(CrLf)
  response : !01:(CrLf)
  command: $02C(CrLf)
  response : !02:(CrLf)
  command: $03C*(CrLf)
  response : !03(CrLf)

Read the delimiter of RS232(COM2) → **:**

Read the delimiter of RS232(COM3) → **:**

Change the delimiter of RS232(COM4) → ***

ADDRESS MAPPING:

	COM1(RS232)	COM3(RS232)	COM4(RS232)
7521	**AA**	**N/A**	**N/A**
7522	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA+1**	**AA+2**

- Note1: The delimiter of COM1/COM3/COM4 can be different.
- Note 2: The default delimiter is → **:**
- Note 3: the delimiter can not be **$, ~, #, @, %, CR & LF**

3.9 $AAD

7521/7522/7523

DESCRIPTION**: READ THE DELIMITER OF COM-1/3/4**

- **Syntax**: $AAD[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA(delimiter)[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  (delimiter): default delimiter is **:**
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $01D(CrLf)
  response : !01:(CrLf)
  command: $02D(CrLf)
  response : !02:(CrLf)
  command: $03D(CrLf)
  response : !03*(CrLf)

Read the delimiter of RS232(COM1) → **:**

Read the delimiter of RS232(COM3) → **:**

Read the delimiter of RS232(COM4) → ***

ADDRESS MAPPING:

	COM1(RS232)	COM3(RS232)	COM4(RS232)
7521	**AA**	**N/A**	**N/A**
7522	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA+1**	**AA+2**

- Note1: The delimiter of COM1/COM3/COM4 can be different.
- Note 2: The default delimiter is → **:**

3.10 (delimiter)AA(bypass)

7521/7522/7523

DESCRIPTION**: BYPASS DATA-STRING TO COM-1/3/4**

- **Syntax**: (delimiter)AA(bypass)[chk](CrLf)
  AA=2-character HEX module address, from 00 to FF
  (bypass): data-string send to COM-1/3/4
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01, the delimiters for **COM1/3/4** are **:/;/*)**

command: :01abcde(CrLf)
response : !01(CrLf)
command: ;02123456789(CrLf)
response : !02(CrLf)
command: *03test(CrLf)
response : !03(CrLf)

Send **abcde** to COM1

Send **123456789** to COM3

Send **test** to COM4

ADDRESS MAPPING:

	COM1(RS232)	COM3(RS232)	COM4(RS232)
7521	**AA**	**N/A**	**N/A**
7522	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA+1**	**AA+2**

3.11 $AAKV[CrLfMode]

7521/7522/7523

DESCRIPTION**: READ/SET THE CHECKSUM-STATUS**

$AAK[chk](CrLf): Read the checksum-status stored in EEPROM

$AAKV[chk](CrLf): Set the checksum-status

- **Syntax**: $AAK[V][chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  V=0 → checksum disable, V=1 → checksum enable
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[V][chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  V=0 → checksum disable, V=1 → checksum enable
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01, the other AA of 7523 is 04)
  command: $01K0(CrLf)
  response : !01(CrLf)
  command: $04K(CrLf)
  response : !04(CrLf)

Disable checksum

The checksum is enable

- **Note: the checksum enable/disable is valid to COM2 only.**

3.12 $AATN[CrLfMode]

7521/7522/7523

DESCRIPTION**: READ/SET THE END-CHAR OF COMMAND STRING**

$AATN[chk](CrLf): Read the end-char of command string stored in EEPROM

$AATN(CrLfMode)[chk](CrLf): Set the end-char of command string

- **Syntax**: $AATN[CrLfMode][chk](CrLf)

  $ is a delimiter character

  AA=2-character HEX module address, from 00 to FF

  N=0 → Read/Set the parity-bit of RS485, N=1 → Read/Set the parity-bit of RS232

  (CrLfMode): 0 → (CrLf)=0x0D
  1 → (CrLf)=0x0D+0x0A
  2 → (CrLf)=0x0A
  3 → (CrLf)=0x0A+0x0D
  4.→ No end-char (available only for RS-232 port)

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Response**: valid command → !AA[data-bit][chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error

  ! is a delimiter character indicating a valid command

  ? is a delimiter character indicating a invalid command

  AA=2-character HEX module address

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char

- **Example**: (Assume the AA of 7523 is 01)

  command: $01T0(CrLf)
  response : !010(CrLf)
  command: $01T1(CrLf)
  response : !011(CrLf)
  command: $02T1(CrLf)
  response : !022(CrLf)
  command: $03T1(CrLf)
  response : !033(CrLf)
  command: $01T04
  response: Timeout

The end-char of COM2 is 0x0D

The end-char of COM1 is 0x0D+0x0A

The end-char of COM3 is 0x0A

The end-char of COM4 is 0x0A+0x0D

Can't set COM2 with non end-char

ADDRESS MAPPING:

	COM1(RS232)	COM2(RS485)	COM3(RS232)	COM4(RS232)
7521	**AA**	**AA**	**N/A**	**N/A**
7522	**AA**	**AA**	**AA+1**	**N/A**
7523	**AA**	**AA**	**AA+1**	**AA+2**

- Note: the default CrLfMode of COM2= 0 → the default (CrLf)=0x0D for COM2 port.
- Note: the default CrLfMode of RS-232 port = 4 → no end-char is used in all RS-232 port.

$AAW

7521/7522/7523

DESCRIPTION**: READ THE CTS-STATUS OF COM-1/3**

- **Syntax**: $AAW[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AAS[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  S: 0→ CTS is inactive now, 1→ CTS is active_HIGH now
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $01W(CrLf)
  response : !010(CrLf)
  command: $02W(CrLf)
  response : !021(CrLf)

The CTS of COM1 is inactive now.

The CTS of COM3 is active-HIGH now.

ADDRESS MAPPING FOR CTS-STATUS:

	COM1(RS232)	COM3(RS232)
7521	**AA**	**N/A**
7522	**AA**	**AA+1**
7523	**AA**	**AA+1**

- Note1: The CTS-status are valid for COM1 & COM3

3.13 $AAXV

7521/7522/7523

DESCRIPTION**: SET THE RTS-STATE OF COM-1/3**

- **Syntax**: $AAXV[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  V: 0→ set RTS inactive, 1→ set RTS to active_HIGH state
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7523 is 01)
  command: $01X0(CrLf)
  response : !01(CrLf)
  command: $02X1(CrLf)
  response : !02(CrLf)

Set the RTS of COM1 to inactive state

Set the RTS of COM3 to active-HIGH state

ADDRESS MAPPING FOR RTS-STATE:

	COM1(RS232)	COM3(RS232)
7521	**AA**	**N/A**
7522	**AA**	**AA+1**
7523	**AA**	**AA+1**

- Note1: The RTS-state are valid for COM1 & COM3

3.14 $AAYN

7521/7522/7523

DESCRIPTION**: READ THE ONBOARD DI-1/2/3**

- **Syntax**: $AAYN[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  N: 1→ read DI1, 2→ read DI2, 3→read DI3
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AAS[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  S=0→DI=Low, 1→ DI=High (DI floating will get High)
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7521 is 01)
  command: $01Y1(CrLf)
  response : !010(CrLf)
  command: $01Y2(CrLf)
  response : !011(CrLf)
  command: $01Y3(CrLf)
  response : !010(CrLf)

DI1=Low

DI2=High

DI3=Low

DI MAPPING TABLE:

	DI1/INIT*	**DI2**	**DI3**
7521	**YES**	**YES**	**YES**
7522	**YES**	**YES**	**YES**
7523	**YES**	**YES**	**NO**

- Note: DI1=INIT*

3.15 $AAZNV

7521/7522

DESCRIPTION**: WRITE TO ONBOARD DO-1/2/3**

- **Syntax**: $AAZNV[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  N: 1→ write DO1, 2→ write DO2, 3→ write DO3
  V: 0→set D/O off, 1→set D/O on
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : → syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**: (Assume the AA of 7521 is 01)
  command: $01Z10(CrLf)
  response : !01(CrLf)
  command: $01Z21(CrLf)
  response : !01(CrLf)
  command: $01Z30(CrLf)
  response : !01(CrLf)

Set DO1=OFF

Set DO2=ON

Set DO3=OFF

DO MAPPING TABLE:

	DO1	**DO2**	**DO3**
7521	**YES**	**YES**	**YES**
7522	**YES**	**NO**	**NO**
7523	**NO**	**NO**	**NO**

NOTE: IF THE HOST IS FAILURE, THE ~AAZNV COMMAND WILL BE IGNORED. AND THE RESPONSE STRING WILL BE !

(In normal, the response string will be !AA)

3.16 #**

7521/7522/7523

- **Description**: Order all input module, digital and analog, sample all their input data immediately and store these data in the internal register of module. Later the host computer can read these data one by one by the command **$AA4, read synchronized data.**
- **Syntax**: #**[chk](CrLf)
  # is a delimiter character
  * is a command character
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response**: no response
- **Example**:

command:	#**(CrLf)
response:	no response
command:	$014(CrLf)
response:	!0117(CrLf)
command:	$024(CrLf)
response:	!0213(CrLf)
command:	$034(CrLf)
response:	!0311(CrLf)

Order all modules perform synchronized sampling

DI1=DI2=DI3=1

DI1=DI2=1, DI3=0

DI1=1, DI2=DI3=0

NOTE : What's "synchronize sampling" ?

The host computer can send only one command string once a time. If there are two modules, the host computer must send and receive the module-1 command then the module-2 command. **So there is a time delay between these two commands**. The "synchronize sampling" command is designed for all input modules. When receiving **#**[CrLf]**, synchronized sampling command, **all input modules in the RS-485 network will perform the input function at the same time and store these values into the module's memory.** Then the host computer can send out the "$AA4, read synchronize data" command to read these data separately.

3.17 $AA4

7521/7522/7523

- **Description** : Read the synchronized data.
- **Syntax** : $AA4[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AASV[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  S=1=first reading
  =0=not first reading
  V: D0=DI1, D1=DI2, D2=DI3
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example** :

command: #**(CrLf)
response: no response
command: $014(CrLf)
response: !0117(CrLf)
command: $024(CrLf)
response: !0213(CrLf)
command: $034(CrLf)
response: !0311(CrLf)

DI1=DI2=DI3=1

DI1=DI2=1, DI3=0

DI1=1, DI2=DI3=0

NOTE : What's "synchronize sampling" ?

The host computer can send only one command string once a time. If there are two modules, the host computer must send and receive the module-1 command then the module-2 command. **So there is a time delay between these two commands**. The "synchronize sampling" command is designed for all input modules. When receiving **#**[CrLd]**, synchronized sampling command, **all input modules in the RS-485 network will perform the input function at the same time and store these values into the module's memory.** Then the host computer can send out the "$AA4, read synchronize data" command to read these data separately.

3.18 $AA5

7521/7522/7523

- **Description**: Reset status read back. This is the only command to detect the module hardware watchdog failure. If the module is down, the module hardware watchdog circuit will reset this module. This reset will cause the output state of module going to their start-value. The start-value may be different from those output-value before module reset. Therefore the user need to send output command again to module for keeping the same output state before and after module watchdog reset.
- **Syntax**: $AA5[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AAS[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  S = 0, it has not been reset since the last reset status read
  1, it has been reset since the last reset status read
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Note**: When first power-on, the user should read the module **once** and will find that the S=1. Then the user should read the module **continually** and find that the S=0. **If S is changed to 1, this module has been be reset by module hardware watchdog circuit at least once. And all output are going to their start-values now.** Therefore the user need to send output command again to control all output values to desire states.
- **Example**:

command:	$015(CrLf)	
response :	!01**1**(CrLf)	It is first time power-on reset
command:	$015(CrLf)	
response :	!01**0**(CrLf)	It is normal
command:	$015(CrLf)	
response :	!01**0**(CrLf)	It is normal
command:	$015(CrLf)	
response :	!011(CrLf)	This module is **reset** by module hardware watchdog. Therefore all output are going to their **start-values** now.

3.19 $AAF

7521/7522/7523

- **Description** : Read the firmware version number.
- **Syntax** : $AAF[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AA(number)[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  number=4-character for version number
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:
  command: $01F(CrLf)
  response : !01A2.0(CrLf)
  command: $02F(CrLf)
  response : !02A3.0(CrLf)

module 01 version 2.0

module 02 version 3.0

3.20 $AAM

7521/7522/7523

- **Description** : Read the module name.
- **Syntax** : $AAM[chk](CrLf)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AA(name)[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  name=4-character or 5-character for module name
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:
  command: $01F(CrLf)
  response : !017521(CrLf)
  command: $02F(CrLf)
  response : !027523(CrLf)

name of module 01 is 7521

name of module 02 is 7523

3.21 $AA2

7521/7522/7523

- **Description** : Read the configuration code of COM2(RS485) stored in EEPROM
- **Syntax** : $AA2[chk](cr)
  $ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (cr)=0x0D
- **Response** : valid command → !AA40BDPK[chk](cr),
  invalid command → ?AA[chk](cr)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  B=short-code for baud rate, refer to Sec. 3.2
  D=data-bit, refer to Sec. 3.3
  P=party-bit, refer to Sec. 3.4
  K=checksum status, refer to Sec. 3.5
  [chk]=2-character checksum, if checksum disable → no [chk]
  (cr)=0x0D
- **Example**: (assume DI1/INIT*=GND)

command: $002(cr)
response : !01406800(cr)

address 01 is 7521 series module, 9600 BPS, N81, checksum disable
checksum disable

command: $002(cr)
response : !0240A801(cr)

address 02 is 7521 series module, 115200 BPS, N81, checksum enable

3.22 ~**

7521/7522/7523

- **Description** : Host computer send this command to tell all modules “Host is OK”.
- **Syntax** : ~**[chk](CrLf)
  ~ is a delimiter character
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : no response
- **Example**:
  command: ~**(CrLf)
  response : No Response

3.23 ~AA0

7521/7522/7523

- **Description** : Read the module status. The module status will be latch until ~AA1 command is sent**. If the module status=0x04, all output command will be ignored.**
- **Syntax** : ~AA0[chk](CrLf)
  ~ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AASS[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  SS=2-character HEX status value as following:
  Bit_0 = reserved
  Bit_1 = reserved
  Bit_2 = 0 → OK
  1 → host watchdog failure
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:

command: ~010(CrLf)
response : !0100(CrLf)

Status of module 01 is OK

command: ~020(CrLf)
response : !0204(CrLf)

Status of module 02 is “host watchdog failure” → HOST is down now

3.24 ~AA1

7521/7522/7523

- **Description** : Reset module status. The module status will be latch until ~AA1 command is sent. **If the module statue=0x04, all output command will be ignored.** Therefore the user should read the module status first to make sure that the module status is 0. If the module status is not 0, only ~AA1 command can clear the module status.
- **Syntax** : ~AA1[chk](CrLf)
  ~ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AA[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:

command:	~010(CrLf)	
response :	!0104(CrLf)	module status=0x04 → host is down
command:	**$01211(CrLf)**	
response :	**!(CrLf)**	Output command is ignored
command:	~011(CrLf)	
response :	!01(CrLf)	clear module status
command:	~010(CrLf)	
response :	!0100(CrLf)	module status=0x00
command:	$01211(CrLf)	
response :	>(CrLf)	Output command is OK

7521 Series Module Status Comparison:

(1) module hardware watchdog reset
- all D/O go to their start-value
- **module status no change**
- accept host D/O command to change D/O state

(2) host software watchdog failure
- all D/O go to their save-value
- **module status=04 → host watchdog failure**
- **ignore all host D/O command until module status is clear to 0 by ~AA1 command**

3.25 ~AA2

7521/7522/7523

- **Description** : Read the status of host watchdog and the host watchdog timer value. The host watchdog timer is designed for software host watchdog. When the software host watchdog is enable, the host must send ~**, HOST is OK command, to all modules before the timer is up. When the ~** command is received, the host watchdog timer is reset and restart. Use ~AA3ETT to enable/disable/setting the host watchdog timer.
- **Syntax** : ~AA2[chk](CrLf)
  ~ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AASTT[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  S=0: host watchdog is disable, S=1:host watchdog is enable
  TT=2-character HEX value, from 00 to FF, unit=0.1 second
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:
  command: ~012(CrLf)
  response : !01000(CrLf)
  command: ~022(CrLf)
  response : !0210A(CrLf)

Host watchdog timer of module 01 is disable

host watchdog timer of module 02 is enable and =0.1*10 =1 second.

7521 Series Module Status Comparison:

(1) module hardware watchdog reset
- all D/O go to their start-value
- **module status no change**
- accept host D/O command to change D/O state

(2) host software watchdog failure
- all D/O go to their save-value
- **module status=04 → host watchdog failure**
- **ignore all host D/O command until module status is clear to 0 by ~AA1 command**

3.26 ~AA3ETT

7521/7522/7523

- **Description** : Enable/disable the host watchdog timer value. The host watchdog timer is designed for software host watchdog. When the software host watchdog is enable, the host must send ~**, HOST is OK command, to all modules before the timer is up. When the ~** command is received, the host watchdog timer is reset and restart. Use ~AA2 to read the host watchdog status & value.
- **Syntax** :~AA3ETT[chk](CrLf)

  ~ is a delimiter character

  AA=2-character HEX module address, from 00 to FF

  E=0 is disable and 1 is enable

  TT=2-character HEX value, from 00 to FF, unit=0.1 second

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char
- **Response** : valid command → !AA[chk](CrLf)

  invalid command → ?AA[chk](CrLf)

  no response : syntax error or communication error or address error

  ! is a delimiter character indicating a valid command

  ? is a delimiter character indicating a invalid command

  AA=2-character HEX module address

  [chk]=2-character checksum, if checksum disable → no [chk]

  (CrLf)=End-Char
- **Example**:

  command: ~013000(CrLf)

  response : !01(CrLf)

  disable host watchdog timer of module 01

  command: ~02310A(CrLf)

  response : !02(CrLf)

  host watchdog timer of module 02 is enable and equal to 0.1*10 =1 second.

3.27 ~AA4P & ~AA4S

7521/7522

- **Description** : Read power-on/safe value.
  (1) When the module is **first power-on**, all output channels will go to their **power-on value**.
  (2) When the module is **down**, the hardware module watchdog will reset the module and all output channels will **also go to their power-on value**. **These power-on value may be different to old value before the module is reset.** Therefore the user must send out a new output command to control all output to the desire states.
  (3) When the host watchdog is enable and the **host is down**, all output will go to their **safe values** and module status will change to 0x04. If the module statue is 0x04, all output command will be ignored before the module status is clear by ~AA1 command. Therefore the user must send ~AA1 command first, then send out a new output command to control all output to the desire states.
- **Syntax** : ~AA4P[chk](CrLf) → read power-on value
  ~AA4S[chk](CrLf) → read safe value
  ~ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AAV[chk](CrLf) for I-7042
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  V: D0=DO0, D1=DO1, D2=DO3
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:
  command: ~014P(CrLf)
  response : !017(CrLf)

  Power-on value is all DO-1/2/3 ON

  command: ~024S(CrLf)
  response : !020(CrLf)

  Safe value is all DO-1/2/3 OFF

3.28 ~AA5P & ~AA5S

7521/7522

- **Description** : Set current state of digital output as power-on/safe value.
  (1) When the module is **first power-on**, all output channels will go to their **power-on value**.
  (2) When the module is **down**, the hardware module watchdog will reset the module and all output channels will **also go to their power-on value**. **These power-on value may be different to old value before the module is reset.** Therefore the user must send out a new output command to control all output to the desire states.
  (3) When the host watchdog is enable and the **host is down**, all output will go to their **safe values** and module status will change to 0x04. If the module statue is 0x04, all output command will be ignored before the module status is clear by ~AA1 command. Therefore the user must send ~AA1 command first, then send out a new output command to control all output to the desire states.
- **Syntax** : ~AA5P[chk](CrLf) → set power-on value
  ~AA5S[chk](CrLf) → set safe value
  ~ is a delimiter character
  AA=2-character HEX module address, from 00 to FF
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Response** : valid command → !AAV[chk](CrLf)
  invalid command → ?AA[chk](CrLf)
  no response : syntax error or communication error or address error
  ! is a delimiter character indicating a valid command
  ? is a delimiter character indicating a invalid command
  AA=2-character HEX module address
  V: D0=DO0, D1=DO1, D2=DO3
  [chk]=2-character checksum, if checksum disable → no [chk]
  (CrLf)=End-Char
- **Example**:
  command: ~015P(CrLf)
  response : !017(CrLf)

  Power-on value is all DO-1/2/3 ON

  command: ~025S(CrLf)
  response : !020(CrLf)

  Power-on value is all DO-1/2/3 OFF

4. Operations Principle & Application Notes

4.1 DI1/INIT* Pin Operation Principle

The 7521 series modules contain an EEPROM to store configuration information. Therefore the user is difficult to find out the status of the 7521 series modules. The steps to get the configuration data stored in EEPROM are given as follows:

Stage 1: refer to Step1 ~ Step4 of Sec. 1.6

Stage 2: keyin 7521 & Enter-key to execute 7521.exe (DI1/INIT* is connected to GND now)

Stage 3: send command to 7521 for configuration reading

Then the 7521 series modules will **go to the factory default setting** without change the EEPROM data. The factory default setting is given as following:

address = 00
baud rate = 9600
checksum = DISABLE
data format = 1 start + 8 data bits + 1 stop bit (N 8 1)

If disconnecting the DI1/INIT*_pin and GND_pin, the I_7000 module will auto configure based on the EEPROM data. The user is easy to find the EEPROM configuration data in the default setting. The steps are shown as following:

Step 1 : power off and connect DI1/INIT*_pin to GND_pin
Step 2 : power on & refer to step1 ~ step4 of Sec. 1.6
Step 3: keyin 7521 & Enter-key to execute 7521.exe
Step 4 : send command string **$00M[0x0D]**
Step 5 : record the module name
Step 6 : send command string **$00A[0x0D]**
Step 7 : record the module address
Step 8 : send command string **$00B[0x0D]**
Step 9 : record the baud rate
Step 10 : send command string **$00D[0x0D]**
Step 11: record the data-bit
Step 12: send command string **$00P[0x0D]**
Step 13: record the parity-bit
Step 14: send command string **$00K0[0x0D]**
Step 15: record the checksum status
Step 16: power off and disconnect INIT*_pin and GND_pin
Step 17: power on, the 7521 series will work in the same status as your record

Note: step 6 to step 15 can be replaced by **$002[0x0D]** command

4.2 D/O Operation Principle

(1) The D/O of 7521 series will **go to their start-value after first power on.**

(2) The D/O output will change to desire state if the "$AAZNV" command is received. Then all these D/O will keep in the same states until next "$AAZNV" command.

(3) If the 7521 series are **reset by the hardware watchdog, all D/O will go to their power-on values immediately.** These power-on values maybe different to the original states before reset. So the D/O states stored in Host-PC maybe different to real D/O states latch in 7521 series. The Host-PC must send "$AAZNV" command to set these D/O to expected states.

(4) The Host-PC can use "$AA5" command to detect the hardware watchdog reset. Refer to Sec. 4.6 for more information. If the 7521 series is reset by hardware watchdog, the Host-PC should send out "$AAZNV" command to set all D/O going to the expected states.

(5) If the host watchdog is failure, all the D/O will **go to their safe-value immediately and the module status is setting to 04.** If the host computer send out "$AAZNV" to those modules now, those modules will **ignore this command and return "!" as warning information.** The host can **use "~AA1" command to clear the module status to 00,** then the 7521 series will accept the "$AAZNV" command again.

4.3 D/I Operation Principle

I-7000 series D/I commands are given as following:

(1) #**: synchronized sampling, all module will sample DI at the same time

(2) **$AA4**: read synchronized sampling data.

(3) **$AAYN:** read current state of D/I

The host computer can send only one command string once a time. If there are two modules, the host computer must send and receive the module-1 command then the module-2 command. **So there is a time delay between these two commands**. The "synchronize sampling" command is designed for all input modules. When receiving "#**[0x0D]", synchronized sampling command, **all the input modules in the RS-485 network will perform the input function at the same time and store these values into the module's memory.** Then the host computer can send out the "$AA4, read synchronize data" command to read these data separately

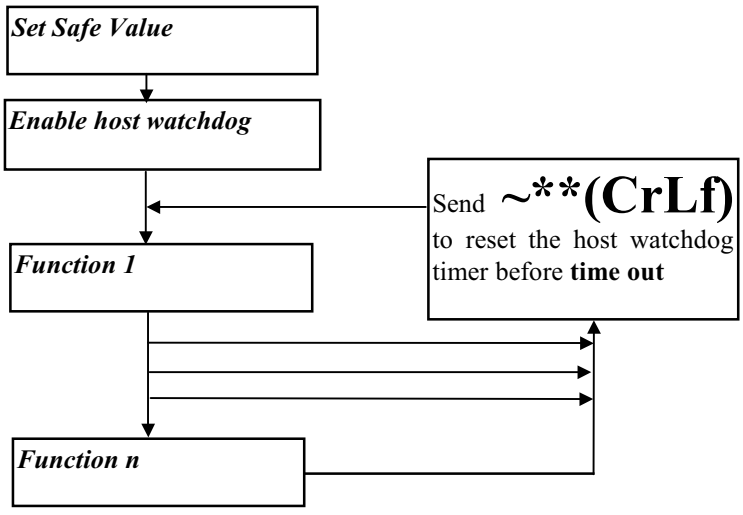
4.4 Dual WatchDog Operation Principle

All 7521 series modules equip hardware module watchdog and software host watchdog. The 7521 series are designed for industry applications, therefore they can work in the harsh envioronment. There are many couple noise or energy transient in such environment. The modules may be down if these noise is really too large. **The built-in hardware module watchdog can reset the module if it is down for too large signal.** Sometimes even the host-PC may be down for hardware or software reasons. The software host watchdog can monitor the status of host-PC. **If the host-PC is down, all the output of 7521 series modules will go to their predefined safe states for safety protection.**

If the RS-485 **network is open**, all the host command can not send to remote modules. This is very dangerous in real world application. The output module of 7521 series will force their output going to their predefined safe state for safety consideration if the host watchdog is enable. **This dual watchdog feature will increase the system reliability very much.**

4.5 Host WatchDog Applications Notes

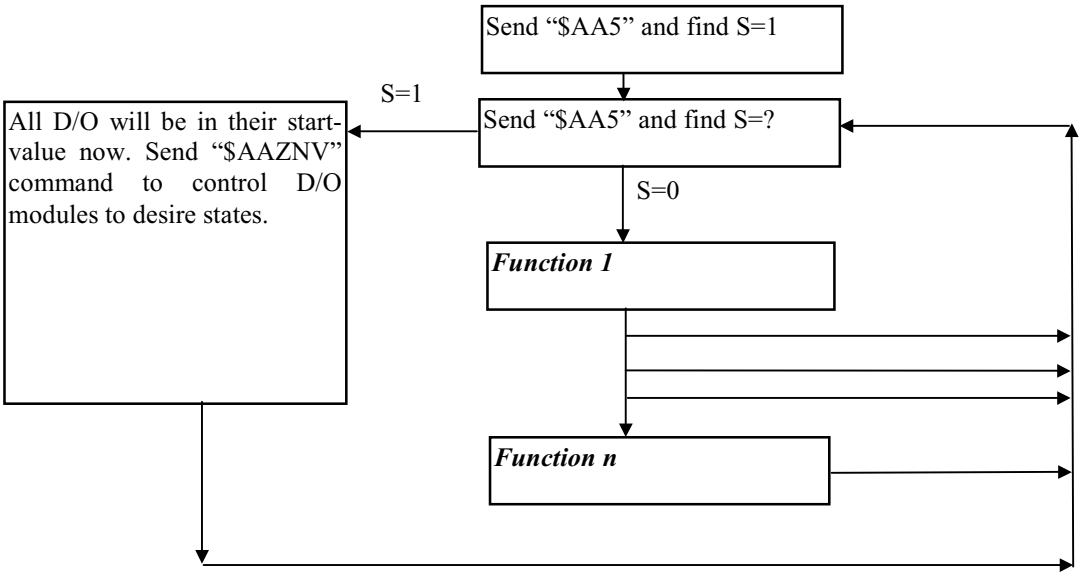
The software host watchdog is designed to monitor the host computer. If the host computer is fail, the output of the 7521 series will automatically go to their safe states to avoid unpredictable damaged. The flow chart for the host computer is given as following.



4.6 Module WatchDog Applications Notes

The "$AA5" command is designed to detect the module hardware watchdog failure. If the module is down, the module hardware watchdog circuit will reset this module. **After this reset the output state of module will go to their start-value. The start-value may be different from those output-value before module reset.** Therefore the user need to send output command again to module for keeping the same output state before and after module watchdog reset.

The flow chart for module hardware watchdog failure detection is given as following.



4.7 Source Code of 7521/7522/7523

1. The source codes of 7521 are given in the companion CD. User can modify these files for his special applications. All source codes are well-document, so user can change code easy. (Use BC to compiler&link)
2. There are two files, autoexec.bat & 7521.EXE, stored in the flash ROM of 7521. So the 7521.EXE will be executed after the power is supplied & DI1/INIT* pin is floating. It is also similar for 7522 & 7523.
3. There are some ODM programs are provided for 7521. Refer to the readme.doc for more information. These ODM programs are given as following:

- 7521ODM1.c : 7521 + real trime control D/IO
- 7521ODM2.c : 7521 + real trime control AD&DA
- 7521ODM3.c : 7521 + real trime control Event counter
- 7521ODM4.c : 7521 + real trime control Sensor & Multiplex
- 7522ODM5.c : 7522 + real trime monitor HP34401A & alarm control

More ODM function will be available in the feature.