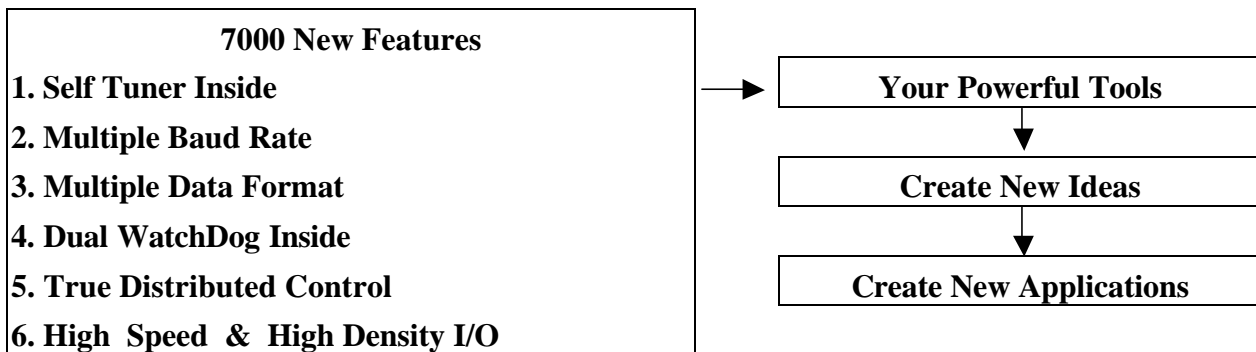


7188XA/B/C & 7521/2/2A/3/4/7 Series

Hardware 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.

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1. Introduction

The 7188X/7521 series is a series of expandable embedded controllers designed for industry applications. They can be used to replace the PC or PLC in harsh environments. The 7188X/7521 series can be ordered as following:

Order Items	Module name	O. S.
7188XA(D)	Expandable Embedded controller	MiniOS7
7188XB(D)	Expandable Embedded controller	MiniOS7
7188XC(D)	Expandable Embedded controller	MiniOS7
7521(D)	Intelligent Communication Controller (1 channel of RS-232)	MiniOS7
7522(D)	Intelligent Communication Controller (2 channels of RS-232)	MiniOS7
7522A(D)	Intelligent Communication Controller (1 channel of RS-232 & 1 channel of RS-422/485)	MiniOS7
7523(D)	Intelligent Communication Controller (3 channels of RS-232)	MiniOS7
7524(D)	Intelligent Communication Controller (4 channels of RS-232)	MiniOS7
7527(D)	Intelligent Communication Controller (7 channels of RS-232)	MiniOS7
7XXX	7XXX without 7-SEG display	MiniOS7
7XXXD	7XXX with 7-SEG display	MiniOS7

The 7000 series modules have been very successful during the past three years. Over one hundred thousand modules have been shipped to locations all over the world. The reasons for our success are given as follows:

- Time-to-market & cost-effective solutions
- Durable, stable, flexible, & easy to program
- Over 50 various I/O modules are supported
- Can be used in harsh, noisy industry environments

However, even though the 7000 family is so versatile, there are some applications that cannot be initially solved, such as:

- High speed applications
- Special hardware requirement applications
- Special software requirement applications
- A combinations of special hardware & software applications

Therefore, we developed an I/O expansion bus for the 7188X/7521 family to solve all the above applications above. The I/O expansion bus can be used to implement various I/O functions such as D/I, D/O, A/D, D/A, Timer/Counter, UART, flash memory, battery backup SRAM, AsicKey & other I/O functions. **Nearly all kinds of I/O functions can be implemented by this bus.**

The I/O expansion bus includes serial & parallel interface. The parallel interface is very similar to ISA bus, so the user can move the old ISA bus design to the I/O expansion bus with very little modification.

Furthermore, the I/O pins of the serial bus are programmable. They can be programmed as D/I, or D/O. Some pins can be configured to D/I or D/O or timer input or timer output. There are many serial interface devices today. The features of these serial devices are given as follows:

- Smaller size compared to parallel devices
- Lower cost compared to parallel devices
- Easier to design for isolation applications

The serial interface of the I/O expansion bus can link to these serial devices very easily. The design of the I/O Expansion Bus makes the idea of a “Customized 7000 Module” come true. The features of a “Customized 7000 Module” are given as follows:

- **7188X+X?? → Single module solution → a “Customized 7000 Module”**
- 7000 compatible command sets & RS-485 networking
- Easy hardware/software interface for user to design & manufacture their own special hardware & software
- Time-to-market ODM solution for user’s special requirements (any high speed, complex or combined functions of D/I/O, A/D, D/A,..., etc.)
- Durable, stable, flexible, time-to-market & cost-effective total solution.

Some “Customized 7000 Modules” are available as follows:

- IKIT-09: LONG TIME DATA LOGGER=7188XBD+X800
- IKIT-10: LONG TIME 7000 LOGGE=7188XBD+X600
- IKIT-11: ANALOG SIGNAL CONTROLLER=7188XBD+X801
- IKIT-12: Arbitrary Waveform Generator=7188XCD+X300
- More “Customized 7000 Modules” will be ready in the near future

Refer to “I/O Expansion Bus in 7188X/7188E User’s Manual” for more information.

Refer to “ 7000 Bus Converter User Manual ” chapter 1 for more information as follows:

1.1 7000 Overview

1.2 7000 Related Documentation

1.3 7000 Common Features

1.4 7000 System Network Configuration

1.5 7000 Dimensions

Package List

In addition to this manual, the package includes the following items:

- One 7188X/7521 series hardware module
- One hardware manual (this manual)
- One release note
- One software utility disk or CD
- One download cable → CA0910 for 7188XA, 7188XB
→ CA0910F for 7188XC, 7521, 7522, 7523

Note

If any of these items are missing or damaged, contact the local distributors for more information. Save the shipping materials and cartons in case you want to ship in the future.

Release Note

It is recommended to read the release note first. All important information will be given in release note as follows:

- Where the “7188X/7521 Software User’s Manual” is
- Where the “I/O Expansion Bus for 7188X/7188E User’s Manual” is
- Where the software driver & diagnostic programs are

1.1 Features

1.1.1 General features

- AMD's embedded CPU, Am188™ES: 20M or 40M
- SRAM: 128K/256K/512K bytes
- Flash ROM: 256K/512K bytes
- Built-in EEPROM
- Built-in RTC&NVRam: 7188XA(D)/7188XB(D)
- Built-in COM port: 2/3/4 channels
- Isolation voltage on RS-485 port=3000V: 7188XA(D)/7521(D) series
- 64-bit hardware unique serial number inside: 7188XA(D)/7188XB(D)
- Industry D/I/O onboard: 7188XC(D)/7521(D)/7522(D)/7523(D)
- User defined D/I/O: 7188XA(D)/7188XB(D)/7188XC(D)/7521(D)
- Built-in 5-digit LED display interface
- COM driver support interrupt & 1K QUEUE input buffer
- Built-in I/O expansion bus interface
- Built-in watchdog timer for harsh environments
- Built-in power protection circuit
- Built-in RS-485 network protection circuit
- Built-in self-tuner ASIC controller on RS-485 port
- Program download from PC
- Built-in OS: MiniOS7 of ICP DAS
- Operating temperature: -25°C to +75°C
- Can be used in harsh environments for industry applications

NOTE:

1. ODM wanted

2. “Customized 7000 Modules” wanted

1.1.2 What is MiniOS7?

The MiniOS7 is an embedded O.S. designed for the 7188X/7521 series. **Developed by ICP DAS Co. Ltd;** It is used to replace the ROMDOS used in the 7188 series. Several brands of DOS have been created by various companies. In all cases, DOS--whether PC-DOS, MS-DOS, or ROM-DOS--is a set of commands or code which tells the computer how to process information. DOS runs programs, manages files, controls information processing, directs input and output, and performs many other related functions. **The MiniOS7 provides the equivalent functions of ROMDOS while, in addition, providing user specific functions for the 7188X/7521 family.**

Comparison table between MiniOS7 & ROM-DOS?

	MiniOS7	ROMDOS
Power up time	0.1 sec	4 ~ 5 sec
More compact size	<64K bytes	64K bytes
Supports I/O expansion bus	Yes	No
Supports AsicKey	Yes	No
Flash ROM management	Yes	No
O.S. update (download)	Yes	No
Built-in hardware diagnostic functions	Yes	No
Direct control of the 7000 series modules	Yes	No
Customer ODM functions	Yes	No
Free charge	Yes	No

Note: We reserve the right to change the specifications of MiniOs7 without notice

1.1.3 What is the 64-bit hardware unique serial number?

The 7188XA/7188XB equips a 64-bit hardware unique hardware serial number onboard. This number is unique & cannot be shared by any two 7188XA/7188XBs. The application software can check this number for illegal copies. It is the most low cost protection mechanism the 7188XA/7188XB family currently has

1.1.4 What is the Self-Tuner ASIC?

The 2-wire RS-485 port is designed to directly drive the 7000 series modules. It is a half-duplex 2-wire RS-485 network. Send/receive directional control in a 2-wire RS-485 network is very important. Therefore, The 7188X/7521 series equip a Self-Tuner ASIC controller for all RS-485 ports. The Self-Tuner ASIC controller will auto detect & control the send/receive direction of the RS-485 network. Consequently, the application program does not have to worry about the send/receive directional control of the RS-485 network.

1.1.5 What is the I/O Expansion Bus?

The 7188XA, 7188XB, 7188XC & 7521 all support I/O expansion buses. The I/O expansion bus can be used to implement various I/O functions such as D/I, D/O, A/D, D/A, Timer/Counter, UART, flash memory, battery backup SRAM, AsicKey & other I/O functions. Nearly all kinds of I/O functions can be implemented on this bus.

1.1.6 What is the AsicKey?

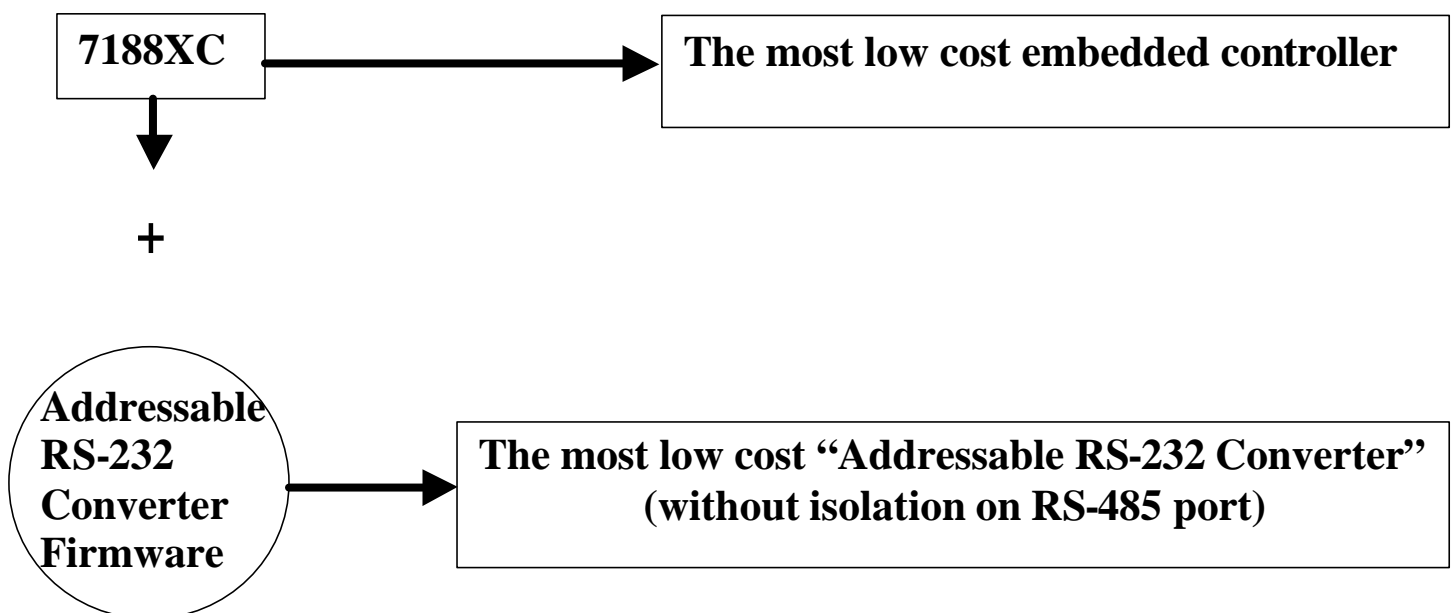
The I/O expansion bus supports AsicKey. The AsicKey equips a complex machine for validation checking. Included in this is 128 bytes of private data for the same purpose. It provides very strong protection against illegal copies. Every legal user has a unique AsicKey & unique software library, the user can self check this key, or the software library will check the key automatically. In this main, it is nearly impossible to remove the AsicKey protection.

1.1.7 1/2/3-port Addressable RS-232 Converter?

The 4521 is used as an addressable RS-232 converter. It can assign an address to any RS-232 device in the same RS-485 network. Because the firmware of the 4521 cannot be modified & the application is different case by case, many customers complain about the limitations of the 4521. The 7521/7522/7523 are designed to act as a “1/2/3 port Addressable RS-232 Converter”. The firmware of the 7521/7522/7523 can be modified based on the user’s special requirements. The onboard industry D/I/O can be used to control the local devices for emergency conditions. So, the 7521/7522/7523 can solve nearly every “Addressable RS-232 Converter” application.

1.1.8 7188XA/7188XB/7188XC = Addressable RS-232 Converter?

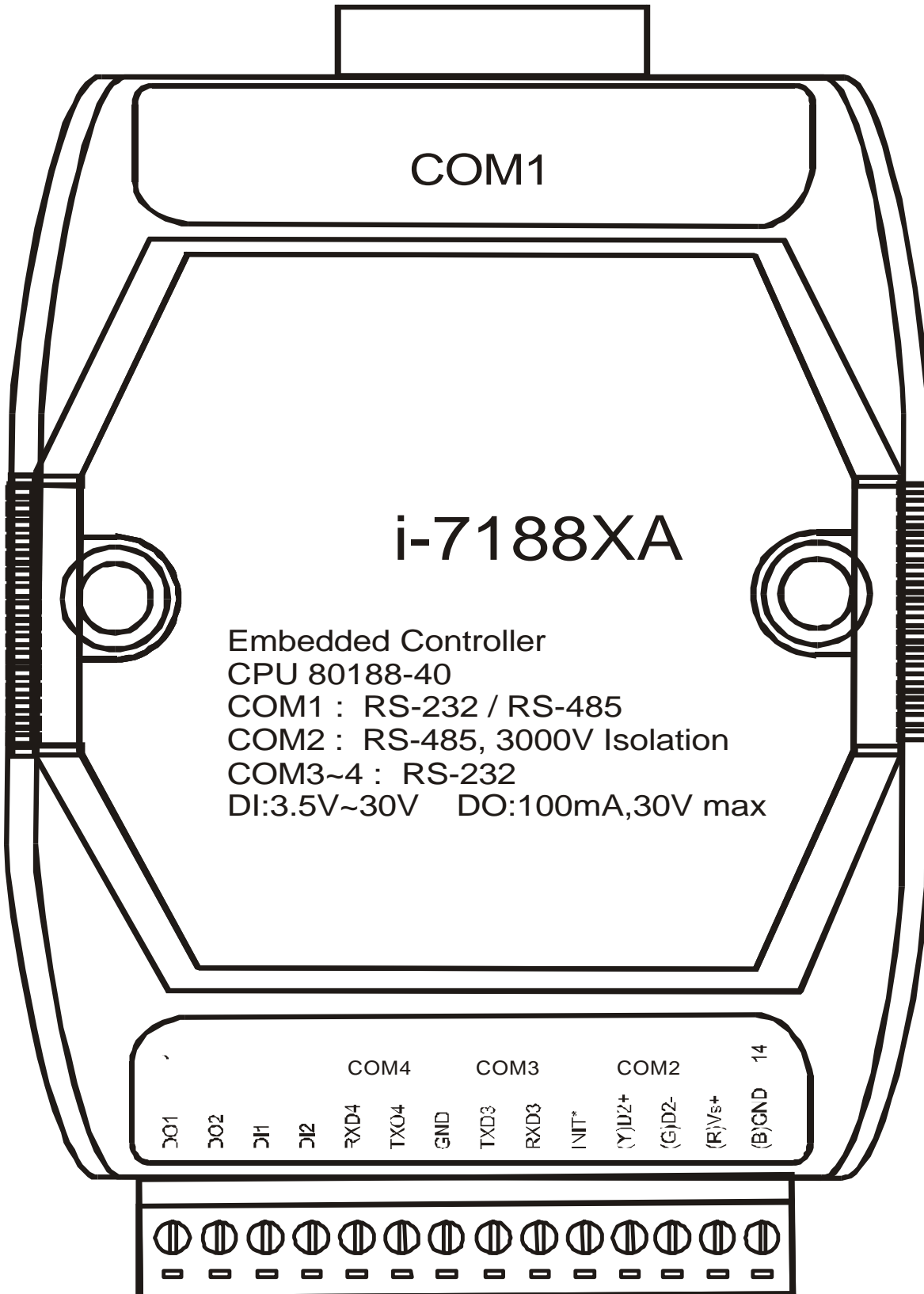
The 7188/7188XA/7188XB/7188XC is designed as an embedded controller. Therefore, any software can be downloaded into it. If the firmware for an “Addressable RS-232 Converter” is downloaded into a 7188/7188XA/7188XB/7188XC, they will act as an “Addressable RS-232 Converter”. Consequently, the most low cost, “Addressable RS-232 Converter” is the **7188XC+ “Addressable RS-232 Converter Firmware”**.



1.1.9 7521/7522/7523 = Embedded Controller?

The 7521/7522/7523 is really an embedded controller before downloading any firmware. After downloading the firmware, the 7521/7522/7523 acts as an “Addressable RS-232 Converter”. The only difference between the 7521 & the 7188XC is the 3000V isolation on the RS-485 port. **In almost all areas, the 7521 is equivalent to the 7188XC+7510.** So the 7521/7522/7523 can be used as an embedded controller with isolation RS-485 port.

1.2 Pin Assignment



Pin assignment of 14-pin screw terminal block(7188XA/7188XAD):

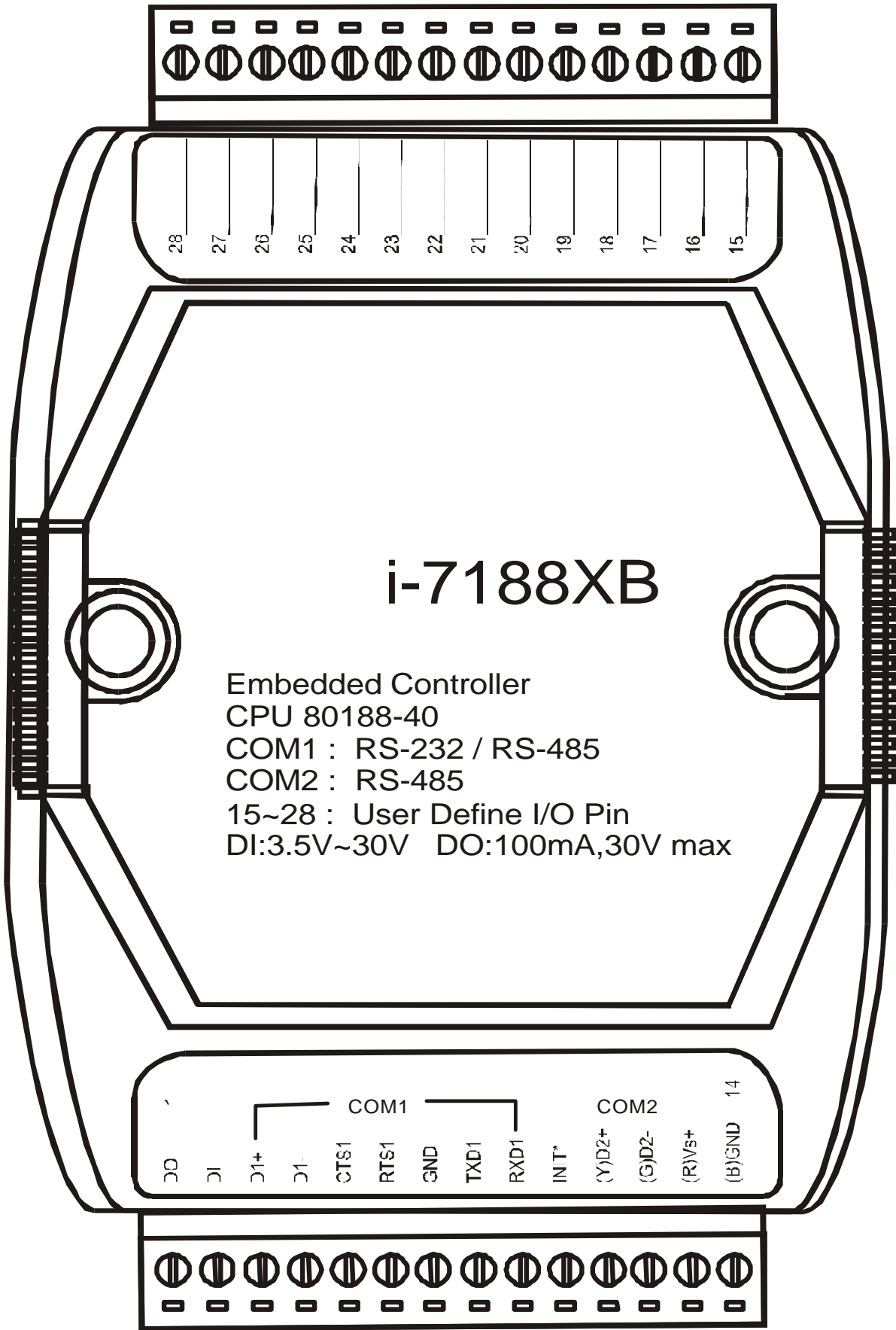
Pin	Name	Description
1	DO1	100mA, 30Vmax.
2	DO2	100mA, 30Vmax.
3	DI1	3.5V ~ 30V
4	DI2	3.5V ~ 30V
5	RXD4	RXD pin of COM4 (RS-232)
6	TXD4	TXD pin of COM4 (RS-232)
7	GND	GND pin of COM3 & COM4
8	TXD3	TXD pin of COM3 (RS-232)
9	RXD3	RXD pin of COM3 (RS-232)
10	INIT*	Initial pin
11	D2+	DATA+ pin of COM2 (RS-485)
12	D2-	DATA- pin of COM2 (RS-485)
13	+VS	V+ of power supply (+10 to +30VDC unregulated)
14	GND	GND of power supply

Note: COM3=(TXD3, RXD3, GND), COM4=(TXD4, RXD4, GND), COM3&COM4 share the same GND-pin(pin 7)

Pin assignment of COM1 connector (DB-9 Male):

Pin	Name	Description
1	DCD	Data Carrier Detect (RS-232)
2	RXD	Receives Data (JP1 select RS-232)
	D1+	DATA+ of RS-485 (JP1 select RS-485)
3	TXD	Transmits Data (JP1 select RS-232)
	D1-	DATA- of RS-485 (JP1 select RS-485)
4	DTR	Data Terminal Ready (RS-232)
5	GND	Signal ground of RS-232
6	DSR	Data Set Ready (RS-232)
7	RTS	Request To Send (RS-232)
8	CTS	Clear To Send (RS-232)
9	RI	Ring Indicator (RS-232)

Note: The COM1 can be used as a RS-232 or RS-485 port selected by JP1. Refer to Sec. 1.5 for JP1 settings. If JP1 is set in RS-232, the connector of COM1 is the same as the DB-9 RS-232 connector of the PC. If JP1 is set in RS-485, the COM1 can directly drive the 7000 series modules. Refer to Sec. 1.6.6 for wire connections.



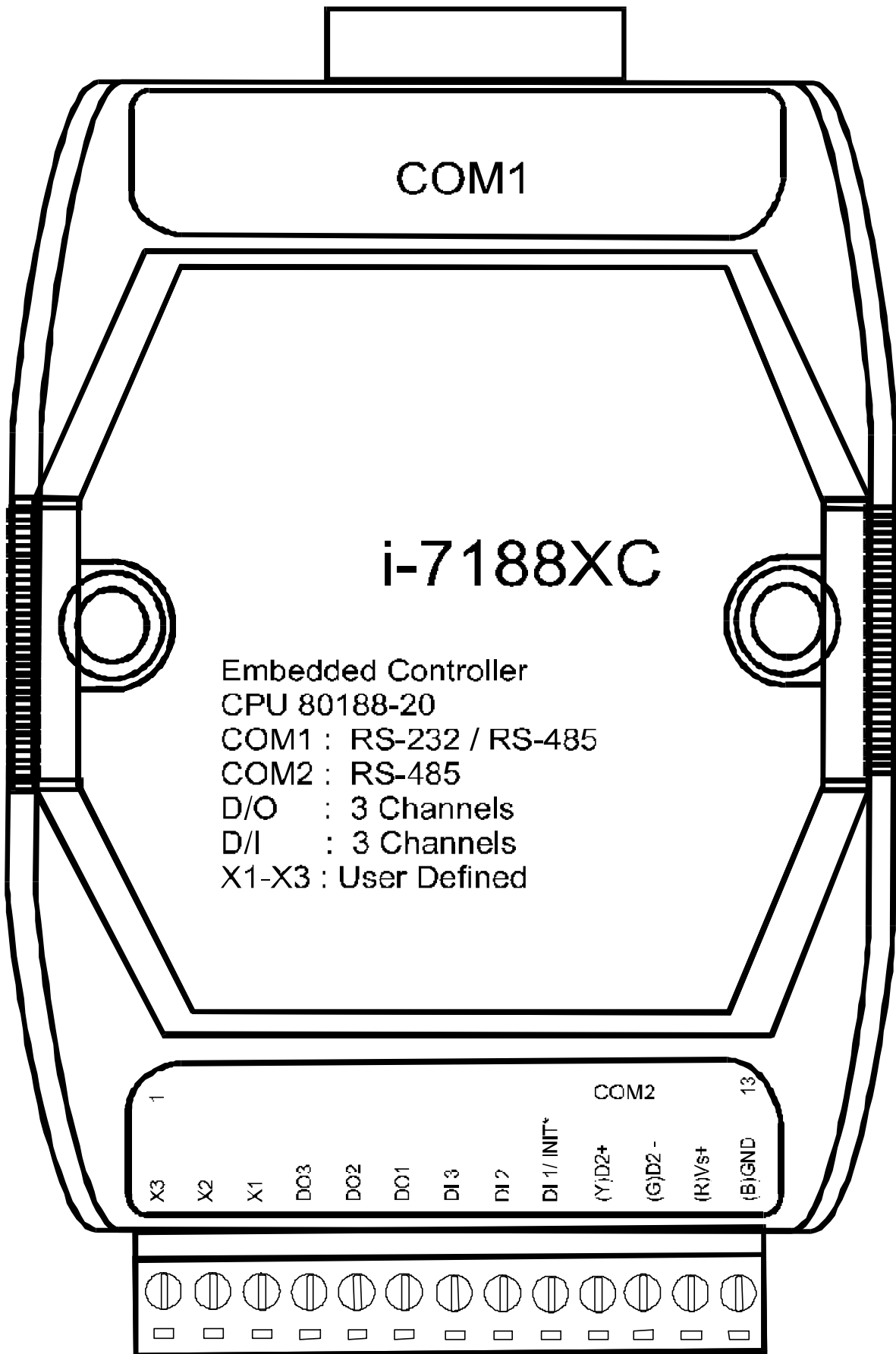
Pin assignment of bottom 14-pin screw terminal block(7188XB/7188XBD):

Pin	Name	Description
1	DO	100 mA, 30V max.
2	DI	3.5V ~ 30V
3	D1+	DATA+ pin of COM1 (RS-485)
4	D1-	DATA- pin of COM1 (RS-485)
5	CTS1	Clear To Send of COM1 (RS-232)
6	RTS1	Request To Send of COM1 (RS-232)
7	GND	Signal ground of RS-232
8	TXD1	Transmits Data of COM1 (RS-232)
9	RXD1	Receives Data of COM1 (RS-232)
10	INIT*	Initial pin, 3.5V ~ 30V
11	D2+	DATA+ pin of COM2 (RS-485)
12	D2-	DATA- pin of COM2 (RS-485)
13	+VS	V+ of power supply (+10 to +30VDC unregulated)
14	GND	GND of power supply

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.

Pin assignment of top 13-pin screw terminal block(7188XB/7188XBD):

15	Pin 15	User defined pin 15
16	Pin 16	User defined pin 16
17	Pin 17	User defined pin 17
18	Pin 18	User defined pin 18
19	Pin 19	User defined pin 19
20	Pin 20	User defined pin 20
21	Pin 21	User defined pin 21
22	Pin 22	User defined pin 22
23	Pin 23	User defined pin 23
24	Pin 24	User defined pin 24
25	Pin 25	User defined pin 25
26	Pin 26	User defined pin 26
27	Pin 27	User defined pin 27
28	Pin 28	User defined pin 28



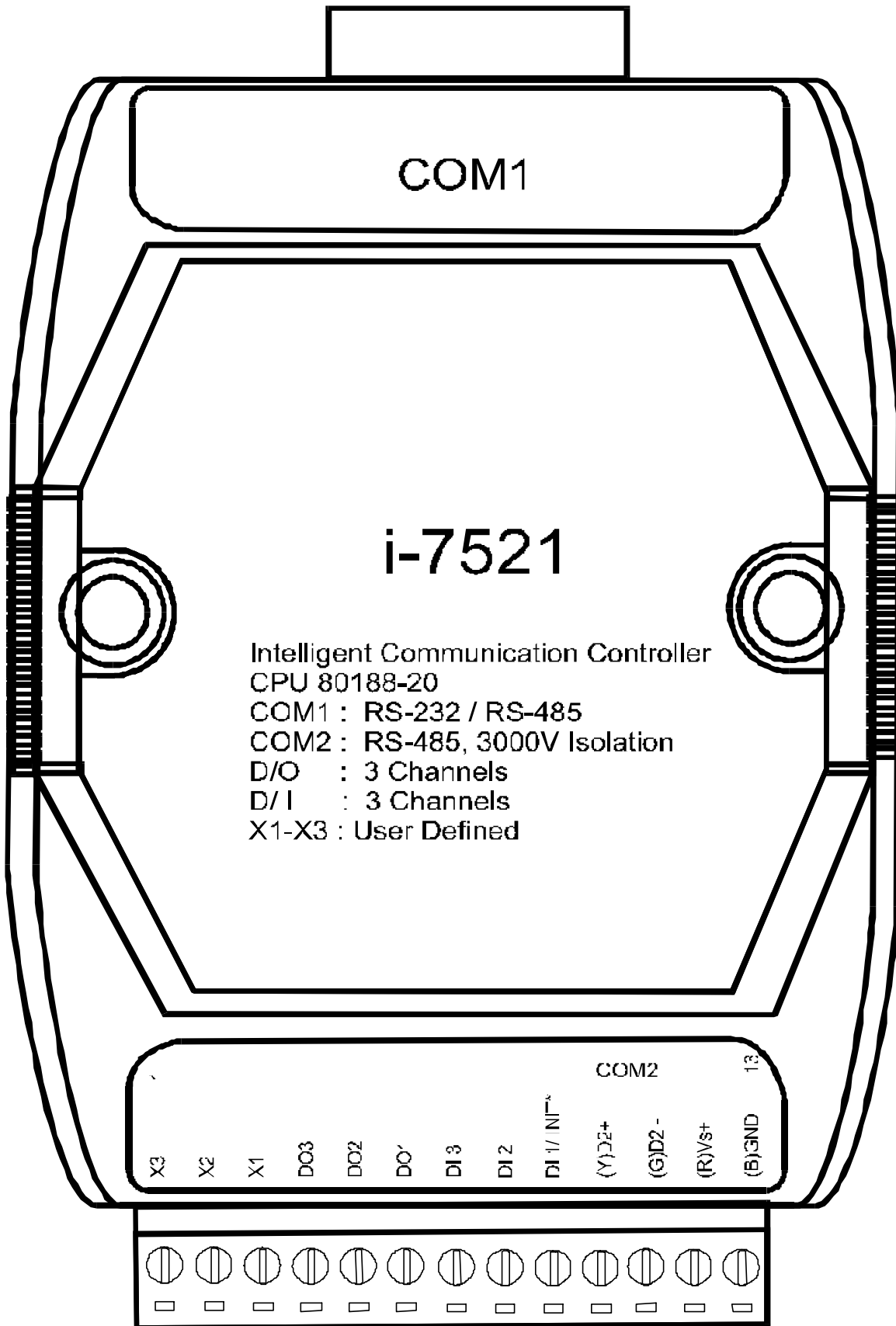
Pin assignment of 13-pin screw terminal block(7188XC/7188XCD):

Pin	Name	Description
1	X3	Connects to I/O expansion board
2	X2	Connects to I/O expansion board
3	X1	Connects to I/O expansion board
4	DO3	Digital output, 150mA, 30V
5	DO2	Digital output, 150mA, 30V
6	DO1	Digital output, 150mA, 30V
7	DI3	Digital input, 3.5V ~ 30V
8	DI2	Digital input, 3.5V ~ 30V
9	DI1/ INIT*	Initial pin or digital input, 3.5V ~ 30V
10	D2+	DATA+ pin of COM2 (RS-485)
11	D2-	DATA- pin of COM2 (RS-485)
12	+VS	V+ of power supply (+10 to +30VDC unregulated)
13	GND	GND of power supply

Pin assignment of COM1 connector (DB-9 Male):

Pin	Name	Description
1	Data+	DATA+ of RS-485 port
2	TXD	Transmits Data (RS-232)
3	RXD	Receives Data (RS-232)
4	N/C	No Connection
5	GND	Signal ground of RS-232
6	N/C	No Connection
7	CTS	Clear To Send (RS-232)
8	RTS	Request To Send (RS-232)
9	Data-	DATA- of RS-485 port

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.



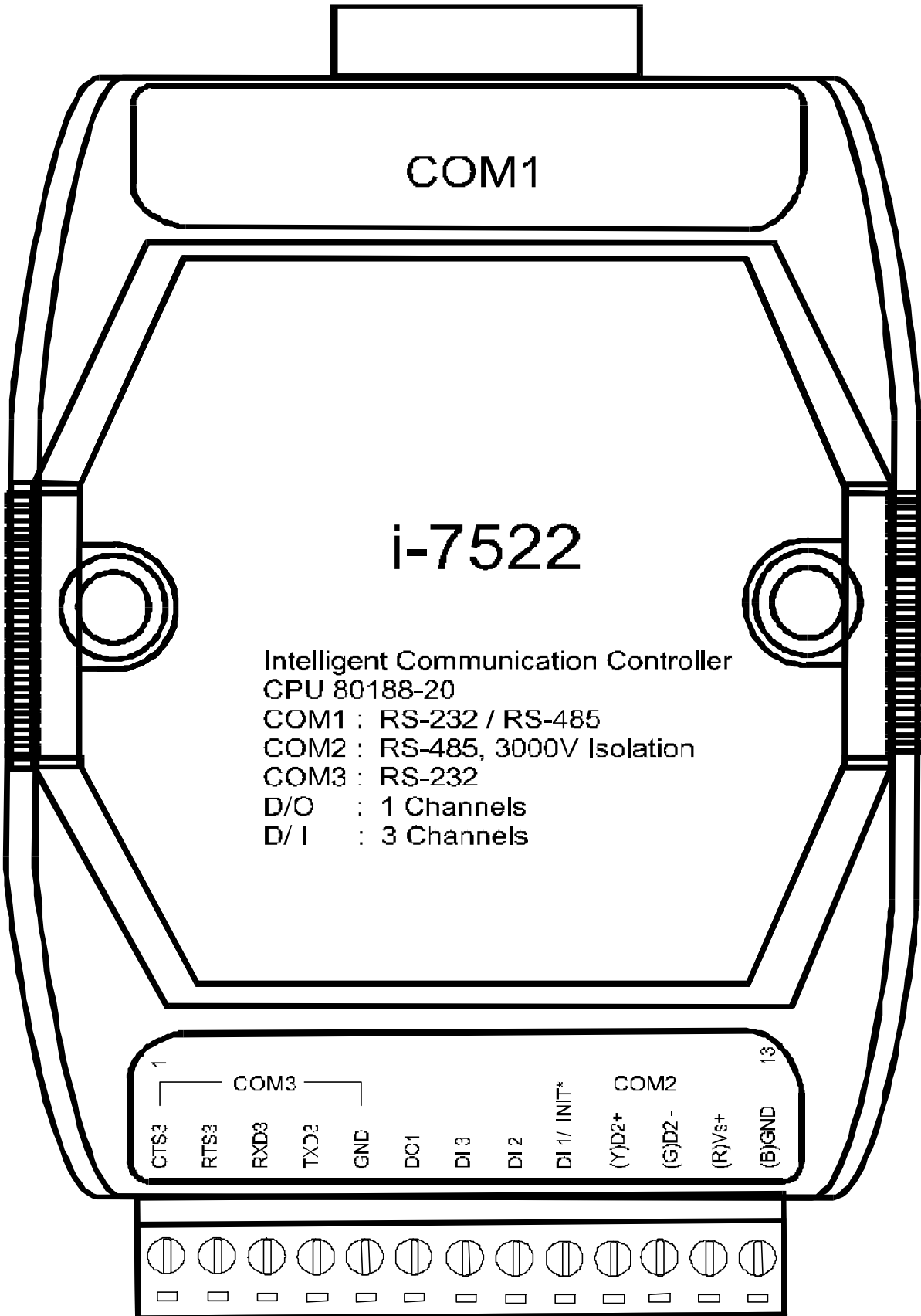
Pin assignment of 13-pin screw terminal block(7521/7521D):

Pin	Name	Description
1	X3	Connects to I/O expansion board
2	X2	Connects to I/O expansion board
3	X1	Connects to I/O expansion board
4	DO3	Digital output, 150mA, 30V
5	DO2	Digital output, 150mA, 30V
6	DO1	Digital output, 150mA, 30V
7	DI3	Digital input, 3.5V ~ 30V
8	DI2	Digital input, 3.5V ~ 30V
9	DI1/ INIT*	Initial pin or digital input, 3.5V ~ 30V
10	D2+	DATA+ pin of COM2 (RS-485)
11	D2-	DATA- pin of COM2 (RS-485)
12	+VS	V+ of power supply (+10 to +30VDC unregulated)
13	GND	GND of power supply

Pin assignment of COM1 connector (DB-9 Male):

Pin	Name	Description
1	Data+	DATA+ of RS-485 port
2	TXD	Transmits Data (RS-232)
3	RXD	Receives Data (RS-232)
4	N/C	No Connection
5	GND	Signal ground of RS-232
6	N/C	No Connection
7	CTS	Clear To Send (RS-232)
8	RTS	Request To Send (RS-232)
9	Data-	DATA- of RS-485 port

Note: The COM1 can be used as s RS-232 port or s RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.



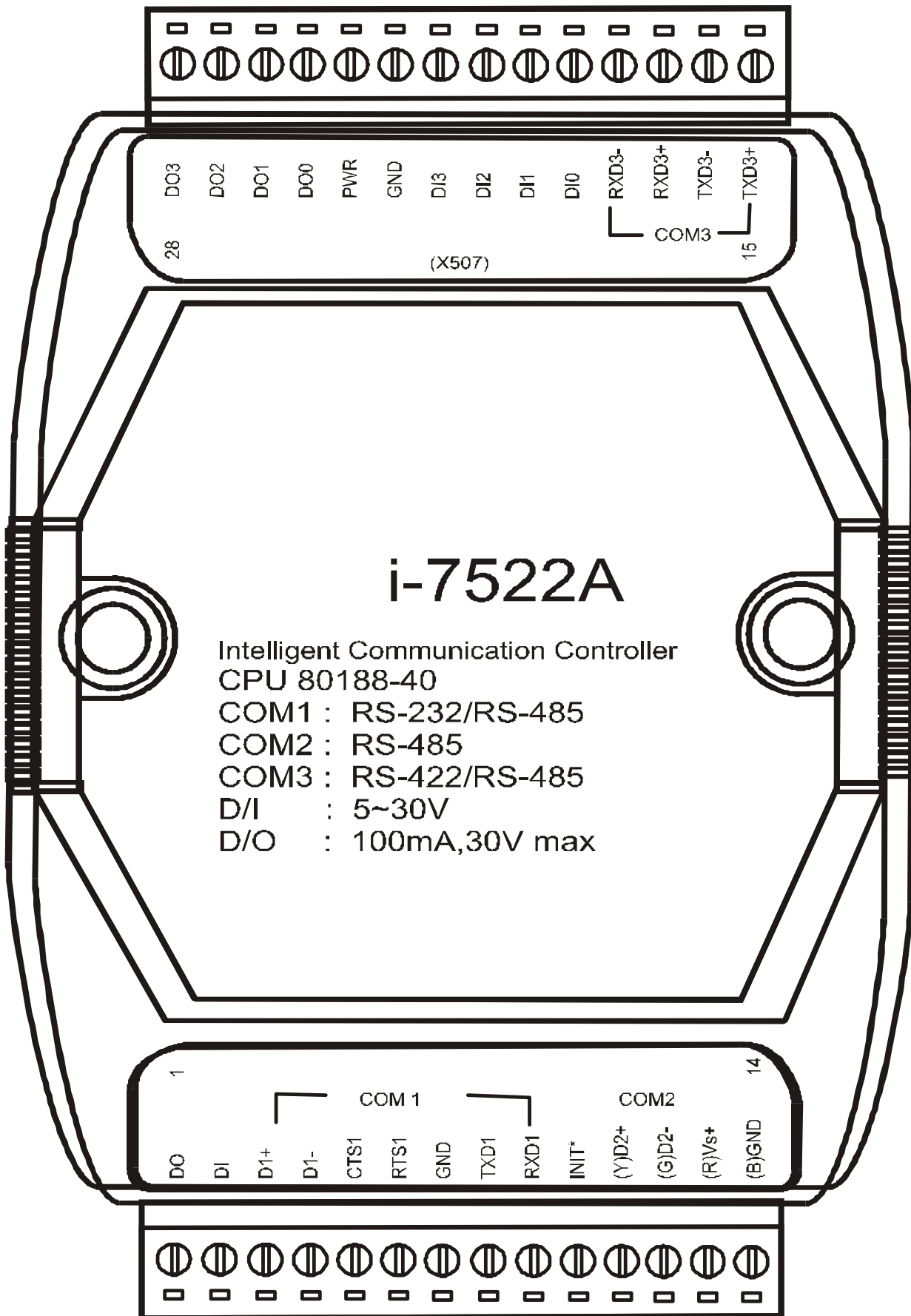
Pin assignment of 13-pin screw terminal block(7522/7522D):

Pin	Name	Description
1	CTS3	Clear To Send of COM3 (RS-232)
2	RTS3	Request To Send of COM3 (RS-232)
3	RXD3	Receives Data of COM3 (RS-232)
4	TXD3	Transmits Data of COM3 (RS-232)
5	GND	Signal ground of COM3 & COM4
6	DO1	Digital output, 150mA, 30V
7	DI3	Digital input, 3.5V ~ 30V
8	DI2	Digital input, 3.5V ~ 30V
9	DI1/ INIT*	Initial pin or digital input, 3.5V ~ 30V
10	D2+	DATA+ pin of COM2 (RS-485)
11	D2-	DATA- pin of COM2 (RS-485)
12	+VS	V+ of power supply (+10 to +30VDC unregulated)
13	GND	GND of power supply

Pin assignment of COM1 connector (DB-9 Male):

Pin	Name	Description
1	Data+	DATA+ of RS-485 port
2	TXD	Transmits Data (RS-232)
3	RXD	Receives Data (RS-232)
4	N/C	No Connection
5	GND	Signal ground of RS-232
6	N/C	No Connection
7	CTS	Clear To Send (RS-232)
8	RTS	Request To Send (RS-232)
9	Data-	DATA- of RS-485 port

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.



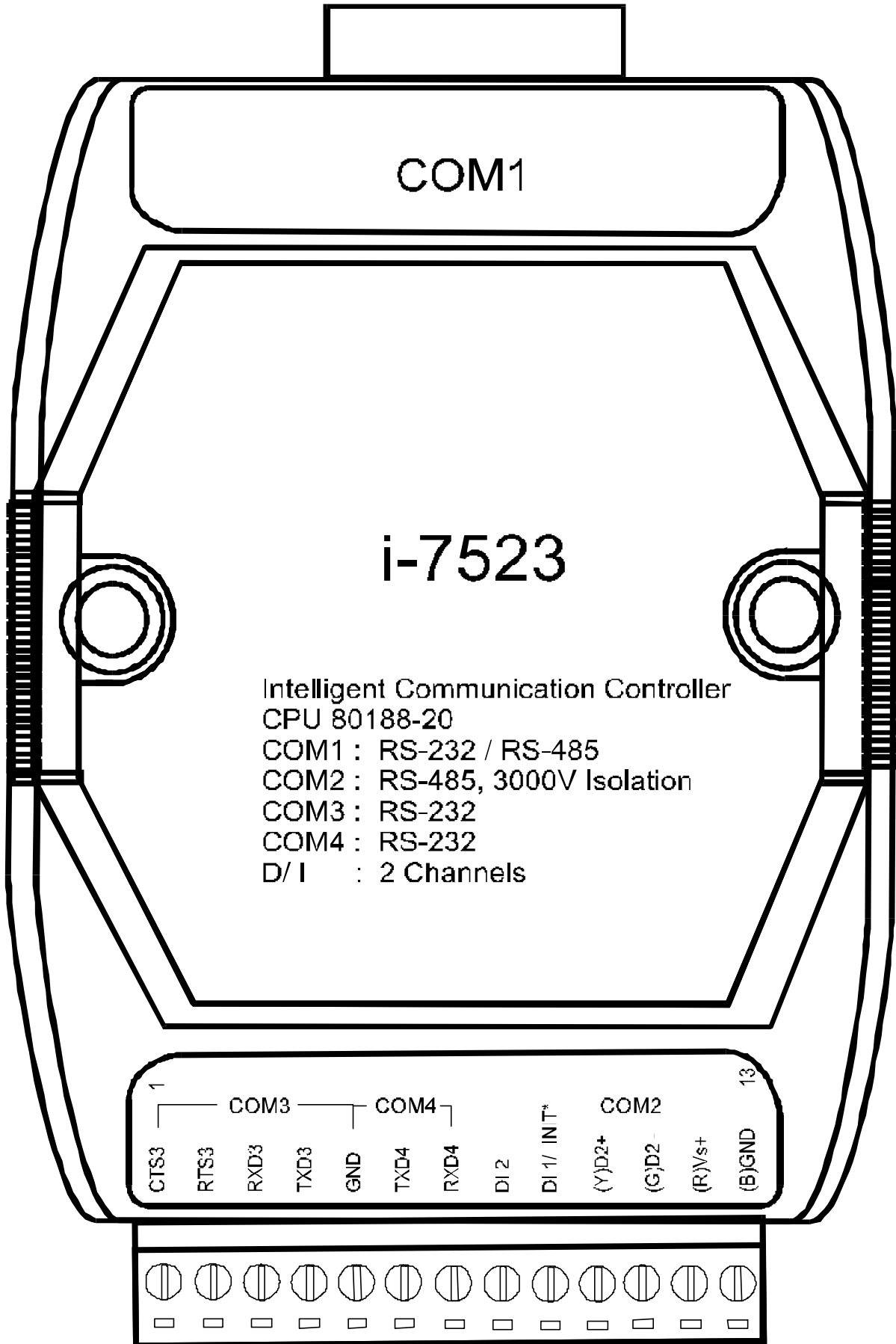
Pin assignment of bottom 14-pin screw terminal block:

Pin	Name	Description
1	DO	100 mA, 30V max.
2	DI	3.5V ~ 30V
3	D1+	DATA+ pin of COM1 (RS-485)
4	D1-	DATA - pin of COM1 (RS-485)
5	CTS1	Clear To Send of COM1 (RS-232)
6	RTS1	Request To Send of COM1 (RS-232)
7	GND	Signal ground of RS-232
8	TXD1	Transmits Data of COM1 (RS-232)
9	RXD1	Receives Data of COM1 (RS-232)
10	INIT*	Initial pin, 3.5V ~ 30V
11	D2+	DATA+ pin of COM2 (RS-485)
12	D2-	DATA - pin of COM2 (RS-485)
13	+VS	V+ of power supply (+10 to +30VDC unregulated)
14	GND	GND of power supply

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.

Pin assignment of top 14-pin screw terminal block:

15	TXD3+	TXD+ pin of COM3 (RS-422/RS-485)
16	TXD3-	TXD - pin of COM3 (RS-422/RS-485)
17	RXD3+	RXD+ pin of COM3 (RS-422)
18	RXD3-	RXD - pin of COM3 (RS-422)
19	DI0	Digital Input, 3.5V ~ 30V, channel 0
20	DI1	Digital Input, 3.5V ~ 30V, channel 1
21	DI2	Digital Input, 3.5V ~ 30V, channel 2
22	DI3	Digital Input, 3.5V ~ 30V, channel 3
23	GND	GND of Digital Output
24	PWR	Power of Digital Output
25	DO0	Digital Output, 100 mA, 30V max., channel 0
26	DO1	Digital Output, 100 mA, 30V max., channel 1
27	DO2	Digital Output, 100 mA, 30V max., channel 2
28	DO3	Digital Output, 100 mA, 30V max., channel 3



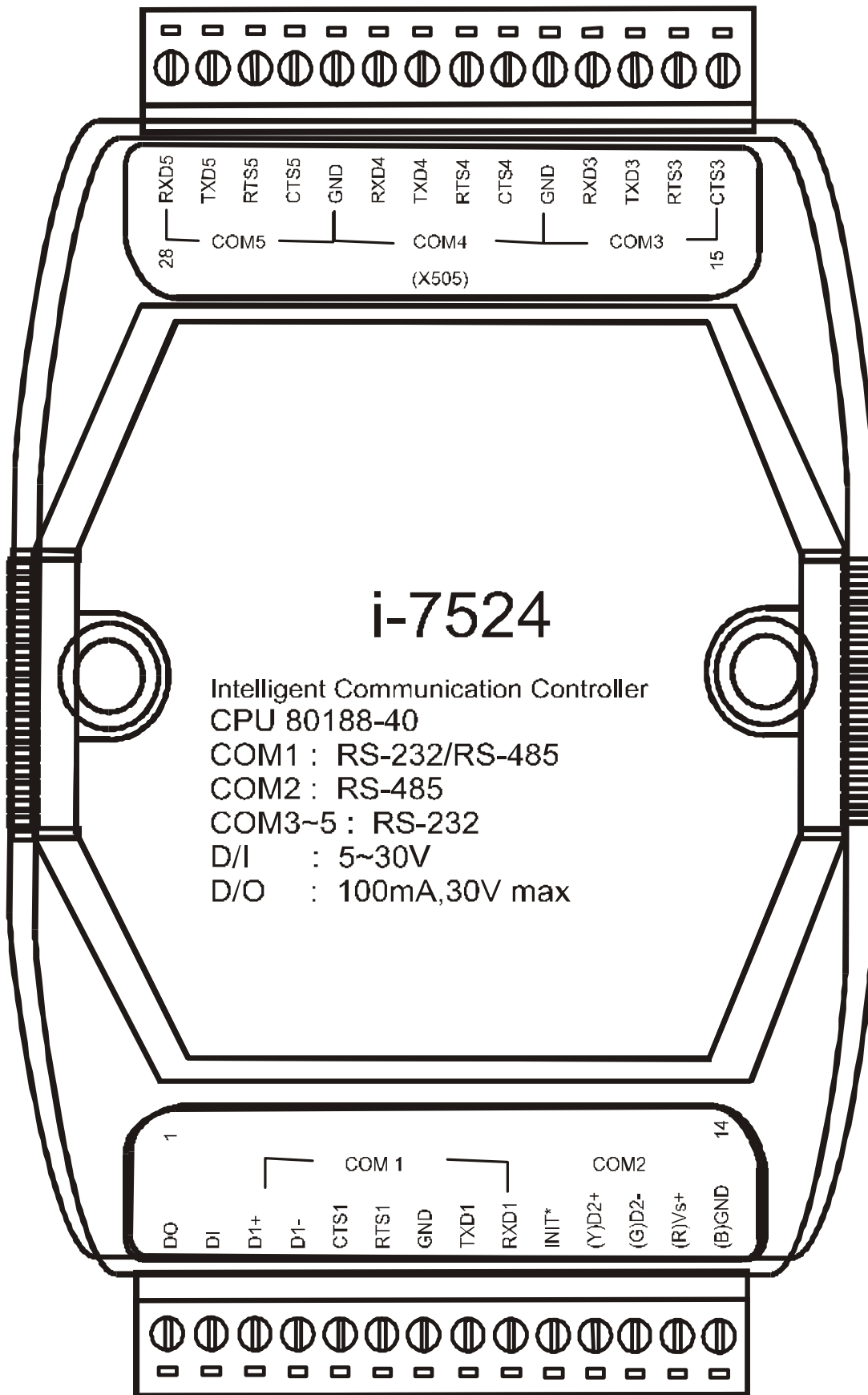
Pin assignment of 13-pin screw terminal block(7523/7523D):

Pin	Name	Description
1	CTS3	Clear To Send of COM3 (RS-232)
2	RTS3	Request To Send of COM3 (RS-232)
3	RXD3	Receives Data of COM3 (RS-232)
4	TXD3	Transmits Data of COM3 (RS-232)
5	GND	Signal ground of COM3 & COM4
6	TXD4	Transmits Data of COM4 (RS-232)
7	RXD4	Receives Data of COM4 (RS-232)
8	DI2	Digital input, 3.5V ~ 30V
9	DI1/ INIT*	Initial pin or digital input, 3.5V ~ 30V
10	D2+	DATA+ pin of COM2 (RS-485)
11	D2-	DATA- pin of COM2 (RS-485)
12	+VS	V+ of power supply (+10 to +30VDC unregulated)
13	GND	GND of power supply

Pin assignment of COM1 connector (DB-9 Male):

Pin	Name	Description
1	Data+	DATA+ of RS-485 port
2	TXD	Transmits Data (RS-232)
3	RXD	Receives Data (RS-232)
4	N/C	No Connection
5	GND	Signal ground of RS-232
6	N/C	No Connection
7	CTS	Clear To Send (RS-232)
8	RTS	Request To Send (RS-232)
9	Data-	DATA- of RS-485 port

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.



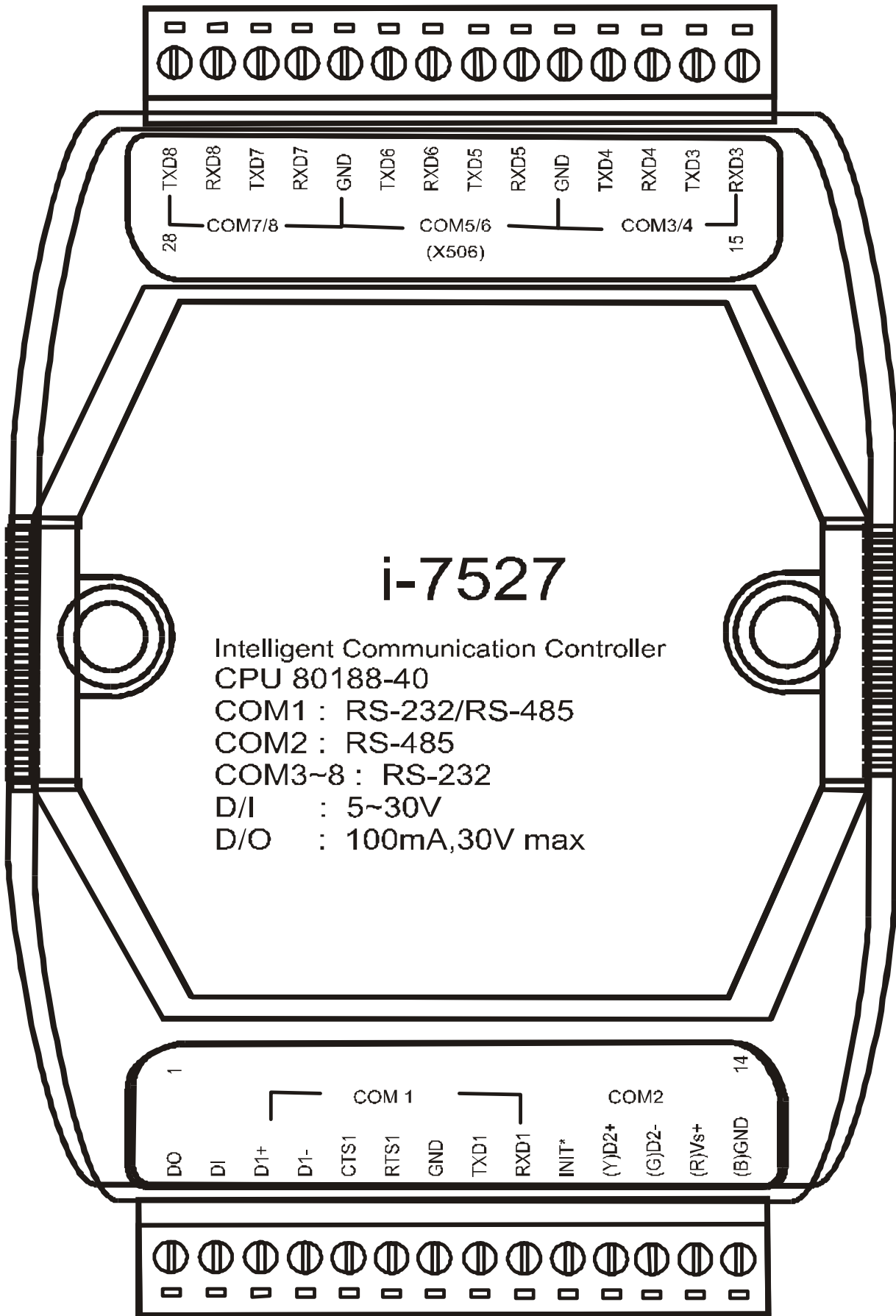
Pin assignment of bottom 14-pin screw terminal block:

Pin	Name	Description
1	DO	100 mA, 30V max.
2	DI	3.5V ~ 30V
3	D1+	DATA+ pin of COM1 (RS-485)
4	D1-	DATA - pin of COM1 (RS-485)
5	CTS1	Clear To Send of COM1 (RS-232)
6	RTS1	Request To Send of COM1 (RS-232)
7	GND	Signal ground of RS-232
8	TXD1	Transmits Data of COM1 (RS-232)
9	RXD1	Receives Data of COM1 (RS-232)
10	INIT*	Initial pin, 3.5V ~ 30V
11	D2+	DATA+ pin of COM2 (RS-485)
12	D2-	DATA - pin of COM2 (RS-485)
13	+VS	V+ of power supply (+10 to +30VDC unregulated)
14	GND	GND of power supply

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.

Pin assignment of top 14-pin screw terminal block:

15	CTS3	CTS pin of COM3 (RS-232)
16	RTS3	RTS pin of COM3 (RS-232)
17	TXD3	TXD pin of COM3 (RS-232)
18	RXD3	RXD pin of COM3 (RS-232)
19	GND	GND pin of COM3/COM4 (RS-232)
20	CTS4	CTS pin of COM4 (RS-232)
21	RTS4	RTS pin of COM4 (RS-232)
22	TXD4	TXD pin of COM4 (RS-232)
23	RXD4	RXD pin of COM4 (RS-232)
24	GND	GND pin of COM4/5 (RS-232)
25	CTS5	CTS pin of COM5 (RS-232)
26	RTS5	RTS pin of COM5 (RS-232)
27	TXD5	TXD pin of COM5 (RS-232)
28	RXD5	RXD pin of COM5 (RS-232)



Pin assignment of bottom 14-pin screw terminal block:

Pin	Name	Description
1	DO	100 mA, 30V max.
2	DI	3.5V ~ 30V
3	D1+	DATA+ pin of COM1 (RS-485)
4	D1-	DATA - pin of COM1 (RS-485)
5	CTS1	Clear To Send of COM1 (RS-232)
6	RTS1	Request To Send of COM1 (RS-232)
7	GND	Signal ground of RS-232
8	TXD1	Transmits Data of COM1 (RS-232)
9	RXD1	Receives Data of COM1 (RS-232)
10	INIT*	Initial pin, 3.5V ~ 30V
11	D2+	DATA+ pin of COM2 (RS-485)
12	D2-	DATA - pin of COM2 (RS-485)
13	+VS	V+ of power supply (+10 to +30VDC unregulated)
14	GND	GND of power supply

Note: The COM1 can be used as a RS-232 port or a RS-485 port. It is not recommended to use both RS-232 & RS-485 at the same time.

Pin assignment of top 14-pin screw terminal block:

15	RXD3	RXD pin of COM3 (RS-232)
16	TXD3	TXD pin of COM3 (RS-232)
17	RXD4	RXD pin of COM4 (RS-232)
18	TXD4	TXD pin of COM4 (RS-232)
19	GND	GND pin of COM3/4/5/6 (RS-232)
20	RXD5	RXD pin of COM5 (RS-232)
21	TXD5	TXD pin of COM5 (RS-232)
22	RXD6	RXD pin of COM6 (RS-232)
23	TXD6	TXD pin of COM6 (RS-232)
24	GND	GND pin of COM5/6/7/8 (RS-232)
25	RXD7	RXD pin of COM7 (RS-232)
26	TXD7	TXD pin of COM7 (RS-232)
27	RXD8	RXD pin of COM8 (RS-232)
28	TXD8	TXD pin of COM8 (RS-232)

1.3 Specifications

General environment

- Operating temperature: -25°C to +75°C
- Storage temperature:-40°C to +85°C
- Humidity: 0 to 90 %
- Built-in Watch Dog Timer (1.6 seconds)
- Built-in power protection & network protection circuit
- Program downloadable from PC
- Built-in I/O expansion bus interface

1.3.1 Specifications of 7188XA & 7188XAD

System

- Module name: embedded controller
- CPU: Am188™ES, 40M Hz
- SRAM: 512K bytes
- FLASH ROM: 512K bytes
- COM port: COM1, COM2, COM3, COM4
- Built-in RTC, NVRAM & EEPROM
- Supports I/O Expansion Bus
- **Program download port: COM4**

Real Time Clock

- Year-2000 compliance
- Seconds, minutes, hours, date of the month
- Month, year, valid **from 1980 to 2079**
- NVSRAM: 31 bytes, battery backup, data valid up to 10 years

EEPROM

- 2048 bytes (8 blocks, each block has 256 bytes)
- Data retention > 100 years
- 1,000,000 erase/write cycles

D/I: 2 channels

- High:3.5V ~ 30V, Low:0 ~ 1V

D/O: 2 channels

- **100 mA, 30V max.**

Flash Memory

- 512K bytes
- Erase unit is one sector(64K bytes)
- 100,000 erase/write cycles

COM1

- RS-232 or RS-485 jumper select(JP1), default is RS-232
- RS-232: TXD,RXD,RTS,CTS,DTR,DSR,DCD,RI,GND
- RS-485: D1+, D1-, self-tuner ASIC inside
- Communication speed: 115200 max.
- 16 bytes FIFO

COM2

- RS-485: D2+, D2-, self-tuner ASIC inside
- Communication speed: 115200 max.
- 16 bytes FIFO
- Isolation voltage: 3000V

COM3

- RS-232: TXD3, RXD3, GND
- Communication speed: 115200 max.

COM4

- RS-232: TXD4, RXD4, GND
- Communication speed: 115200 max.
- Program download port(default)
- Can be used as general purpose RS-232 port

Display

- 7-segment LED: 5-digit (for 7188XAD)

Power

- Power requirements: 10 to 30VDC(non-regulated)
- Power consumption: 2.0W for 7188XA
3.0W for 7188XAD

1.3.2 Specifications of 7188XB & 7188XBD

System

- Module name: embedded controller
- CPU: Am188™ES, 40M Hz
- SRAM: 256K bytes
- FLASH ROM: 512K bytes
- COM port: COM1, COM2
- Built-in RTC, NVRAM, EEPROM, D/I, D/O
- User defined pins:14, pin-15 ~ pin-28
- Supports I/O Expansion Bus
- **Program download port: COM1**

Real Time Clock

- Year-2000 compliance
- Seconds, minutes, hours, date of the month
- Month, year, valid **from 1980 to 2079**
- NVSRAM: 31 bytes, battery backup, data valid up to 10 years

EEPROM

- 2048 bytes (8 blocks, each block has 256 bytes)
- Data retention > 100 years
- 1,000,000 erase/write cycles

Flash Memory

- 512K bytes
- Erase unit is one sector(64K bytes)
- 100,000 erase/write cycles

D/I: 1 channel

- High:3.5V ~ 30V, Low:0 ~ 1V

D/O: 1 channel

- **100 mA, 30V max.**

COM1

- RS-232 or RS-485
- RS-232: TXD,RXD,RTS,CTS,GND
- RS-485: D1+, D1-, self-tuner ASIC inside
- Communication speed: 115200 max.

COM2

- RS-485: D2+, D2-, self-tuner ASIC inside
- Communication speed: 115200 max.

Display

- 7-segment LED: 5-digit (for 7188XBD)

Power

- Power requirements: 10 to 30VDC(non-regulated)
- Power consumption: 2.0W for 7188XB
3.0W for 7188XBD

For ODM User

- SRAM can be 512K max.
- COM2 can be 3000V isolated
- EEPROM can be 32K bytes

1.3.3 Specifications of 7188XC & 7188XCD

System

- Module name: embedded controller
- CPU: Am188™ES, 20M Hz
- SRAM: 128K bytes
- FLASH ROM: 256K bytes
- COM port: COM1, COM2
- Built-in EEPROM, D/I, D/O
- Supports I/O Expansion Bus
- **Program download port: COM1**

EEPROM

- 2048 bytes (8 blocks, each block has 256 bytes)
- Data retention > 100 years
- 1,000,000 erase/write cycles

Flash Memory

- 256K bytes
- Erase unit is one sector(64K bytes)
- 100,000 erase/write cycles

COM1

- RS-232 or RS-485
- RS-232: TXD,RXD,RTS,CTS,GND
- RS-485: D1+, D1-, self-tuner ASIC inside
- Communication speed: 115200 max.

COM2

- RS-485: D2+, D2-, self-tuner ASIC inside
- Communication speed: 115200 max.
- Direct connect to 7000 RS-485 network

D/I

- 3 channels
- Logic low level: 0V ~ 1V
- Logic high level: 3.5V ~ 30V (for -25°C to +70°C)
3.5V ~ 25V (for -25°C to +75°C)

D/O

- 3 channels, 150mA, 30V max.

Display

- 7-segment LED: 5-digit (for 7188XCD)

Power

- Power requirements: 10 to 30VDC(non-regulated)
- Power consumption: 2.0W for 7188XC
3.0W for 7188XCD

For ODM User

- Flash ROM can be upgraded to 512K bytes
- COM2 can be upgraded to 3000V isolated
- EEPROM can be 32K bytes
- **Real Time Clock is available**
 - Year-2000 compliance
 - Seconds, minutes, hours, date of the month
 - Month, year, valid **from 1980 to 2079**
 - NVSRAM: 31 bytes, battery backup, valid up to 10 years

1.3.4 Specifications of 7521/7521D/7522/7522D/7523/7523D

System

- Module name: Intelligent Communication Controller
- CPU: Am188™ES, 20M Hz
- SRAM: 128K bytes
- FLASH ROM: 256K bytes
- COM port: COM1, COM2, COM3, COM4
- Built-in EEPROM
- Supports I/O Expansion Bus (7521/7521D only)
- **Program download port: COM1**

EEPROM

- 2048 bytes (8 blocks, each block has 256 bytes)
- Data retention > 100 years
- 1,000,000 erase/write cycles

Flash Memory

- 256K bytes
- Erase unit is one sector(64K bytes)
- 100,000 erase/write cycles

COM1

- RS-232 or RS-485
- RS-232: TXD,RXD,RTS,CTS,GND
- RS-485: D1+, D1-, self-tuner ASIC inside
- Communication speed: 115200 max.

COM2

- RS-485: D2+, D2-, self-tuner ASIC inside
- Communication speed: 115200 max.
- Isolation voltage: 3000V

COM3 for 7522/7522D/7523/7523D only

- RS-232 only
- RS-232: TXD,RXD,RTS,CTS,GND
- Communication speed: 115200 max.
- 16 bytes FIFO

COM4 for 7523/7523D only

- RS-232 only
- RS-232: TXD,RXD,GND
- Communication speed: 115200 max.
- 16 bytes FIFO

D/I

- 3 channels for 7521/7521D/7522/7522D
- 2 channels for 7523/7523D
- Logic low level: 0V ~ 1V
- Logic high level: 3.5V ~ 30V (for -25°C to +70°C)
3.5V ~ 25V (for -25°C to +75°C)

D/O

- 3 channels, 150mA, 30V max. For 7521/7521D only
- 1 channels, 150mA, 30V max. For 7522/7522D only

Display

- 7-segment LED: 5-digit (for 7521D/7522D/7523D only)

Power

- Power requirements: 10 to 30VDC(non-regulated)
- Power consumption: 2.0W for 7521/7522/7523
3.0W for 7521D/7522D/7523D

1.3.5 Specifications of the

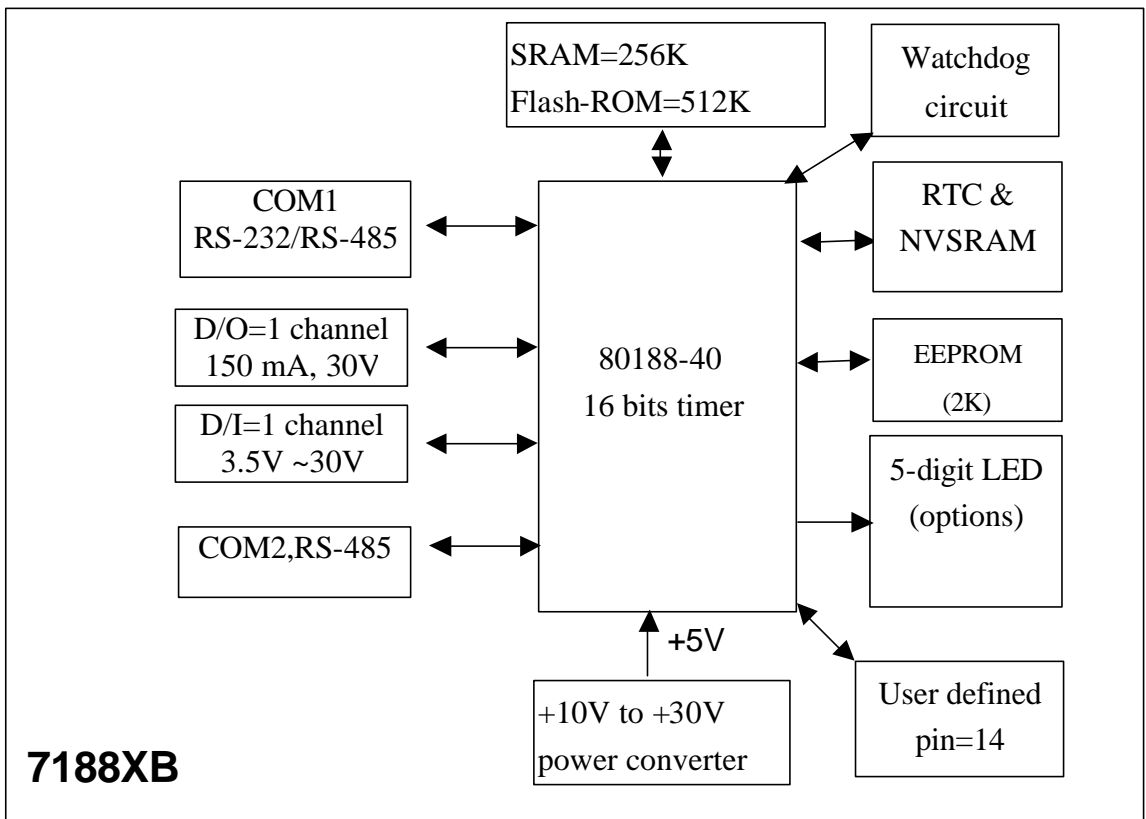
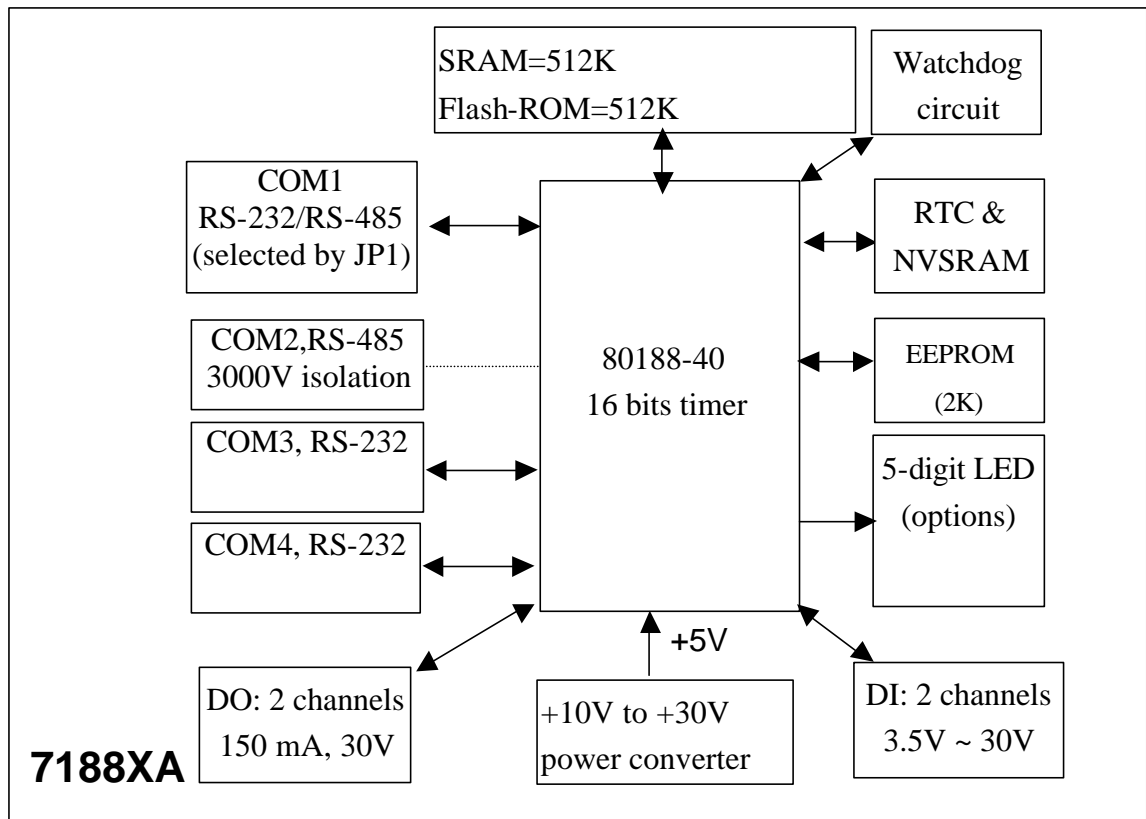
7522A/7522AD/7524/7524D/7527/7527D

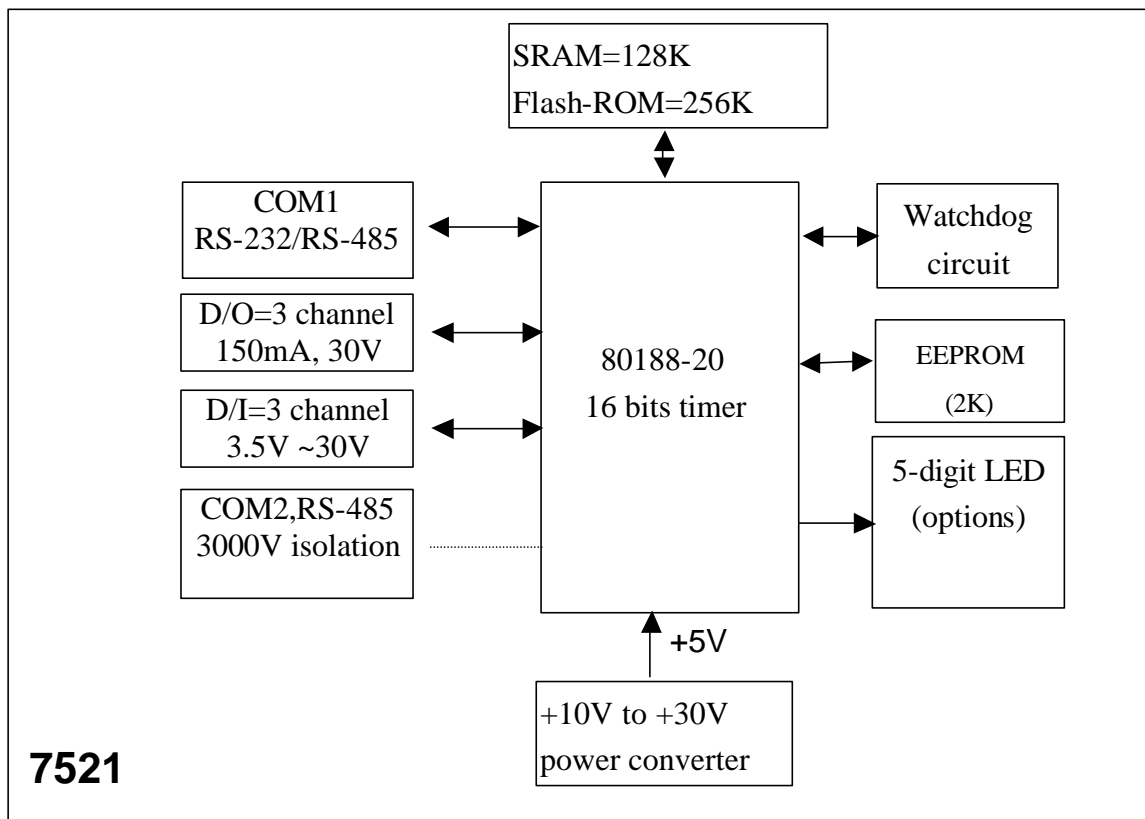
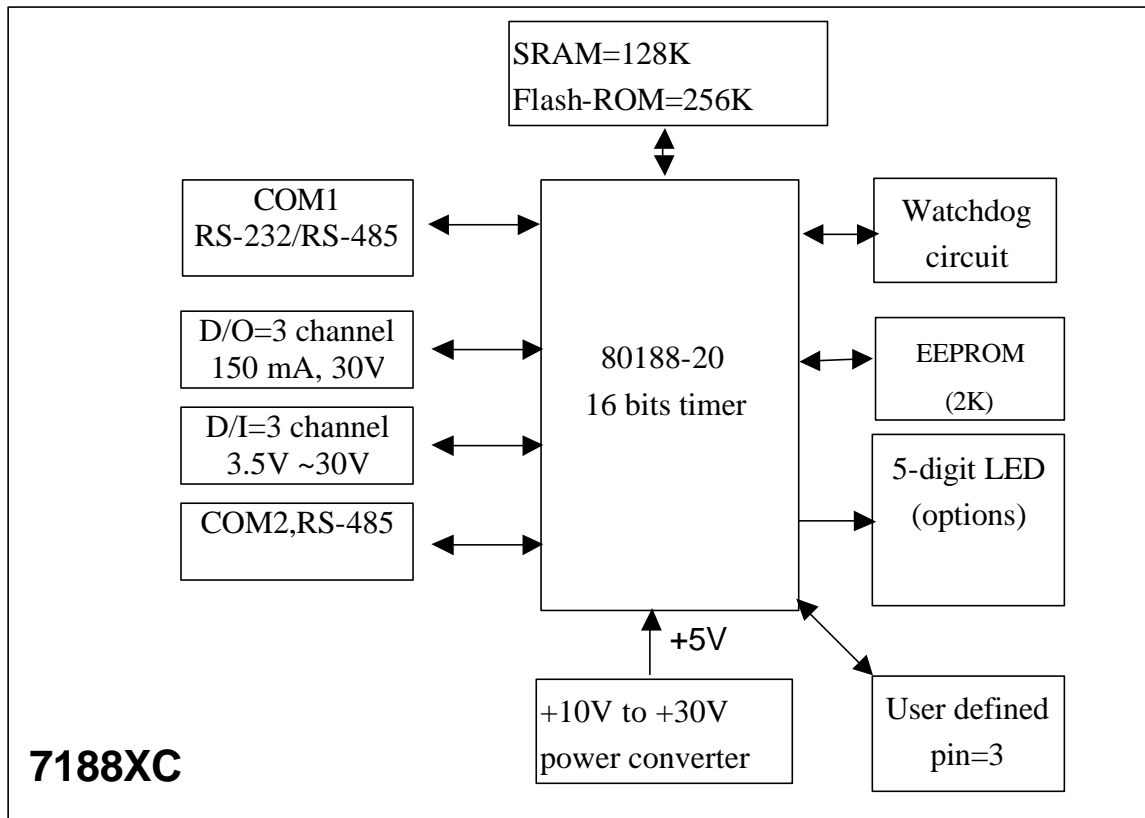
7522A	7188XB+X507
7522AD	7188XBD+X507
7524	7188XB+X505
7524D	7188XBD+X505
7527	7188XB+X506
7527D	7188XBD+X506

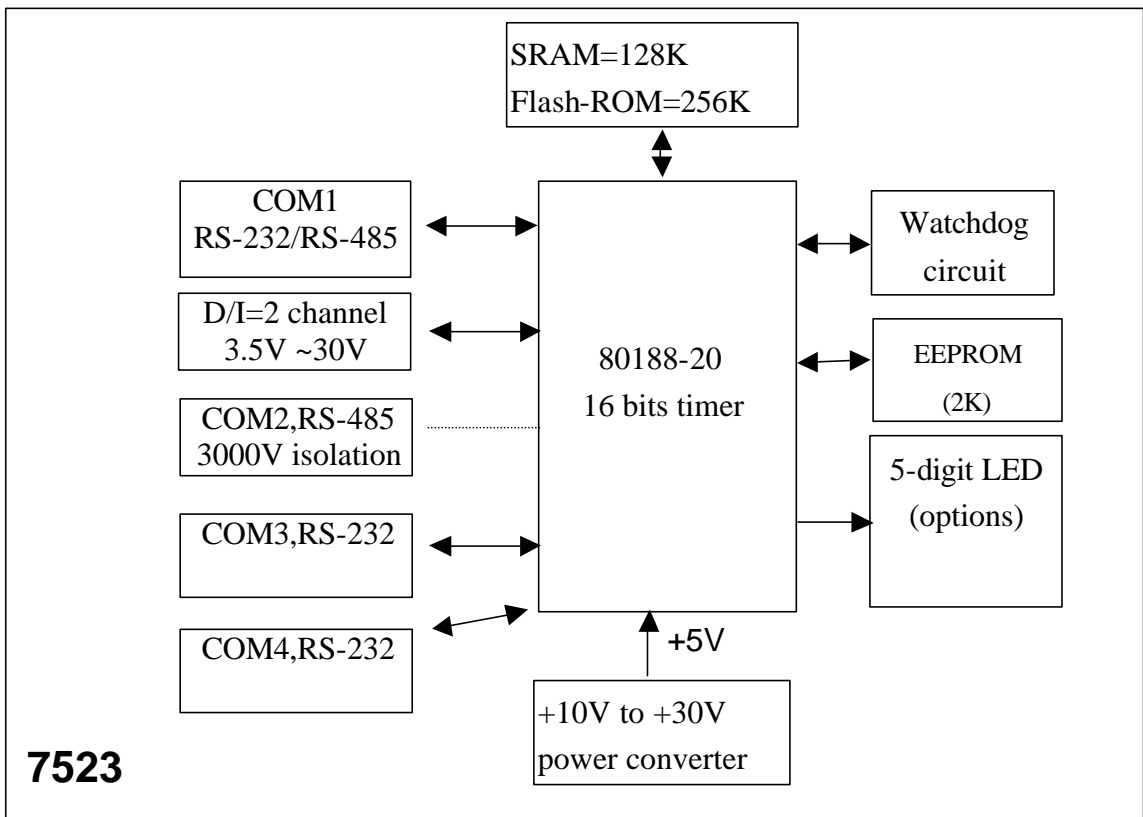
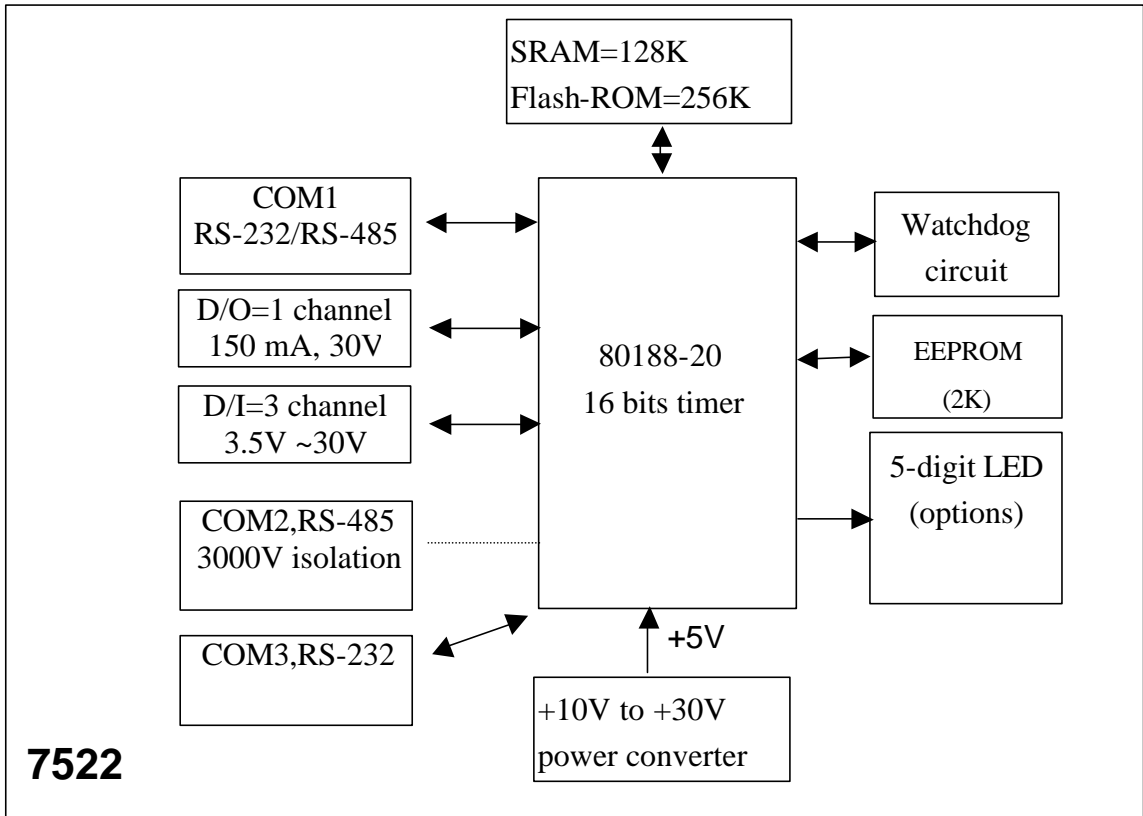
Refer to “ I/O Expansion Bus in the 7188X/7188E User’ s Manual” for more information about the X505,X506,X507

	RS-232	RS-422/485	D/I	D/O
X505	3	0	0	0
X506	6	0	0	0
X507	0	1	4	4

1.4 Block Diagram







7522A :



7188XB(D)

+



X507

7524 :



7188XB(D)

+



X505

7527 :



7188XB(D)

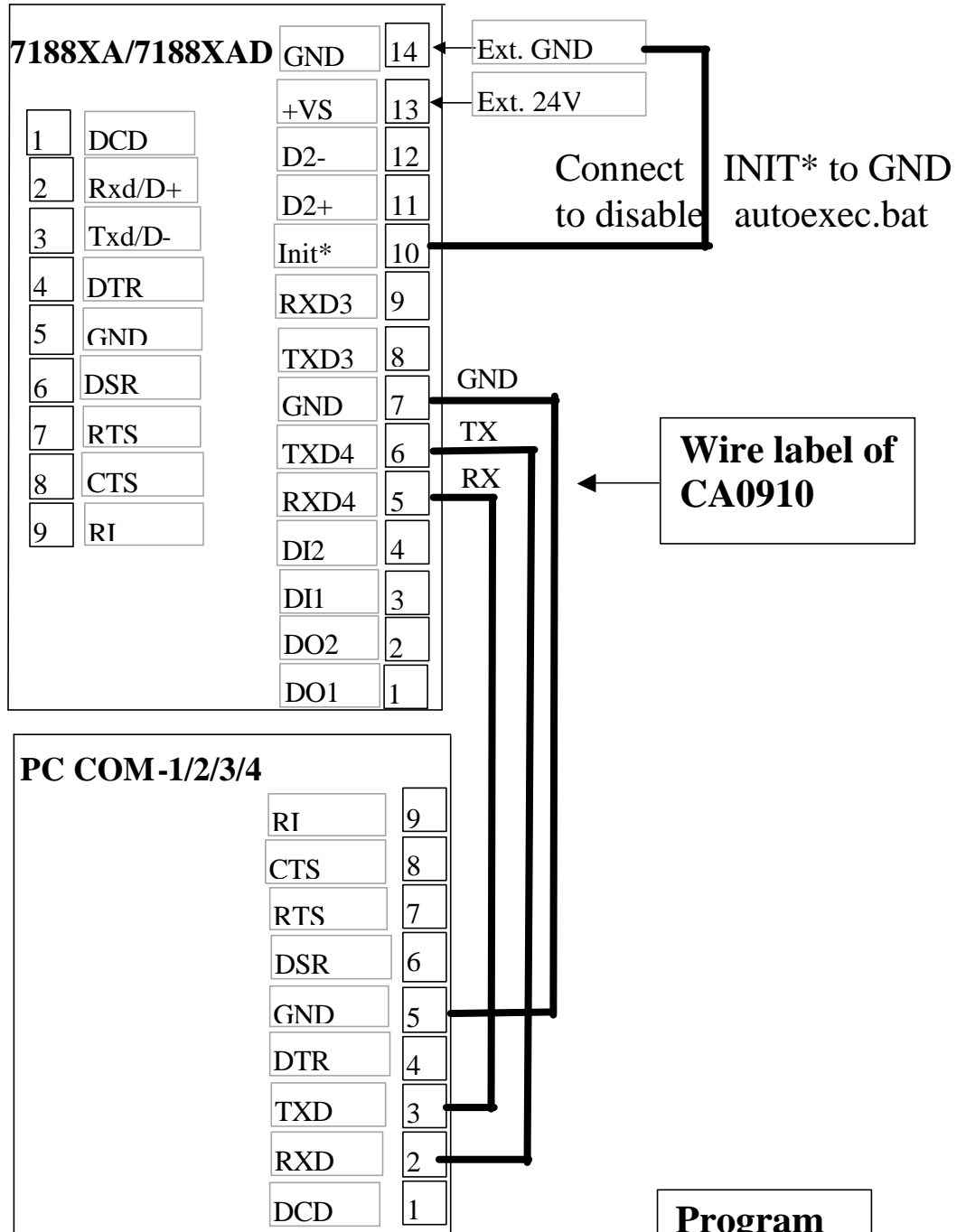
+



X506

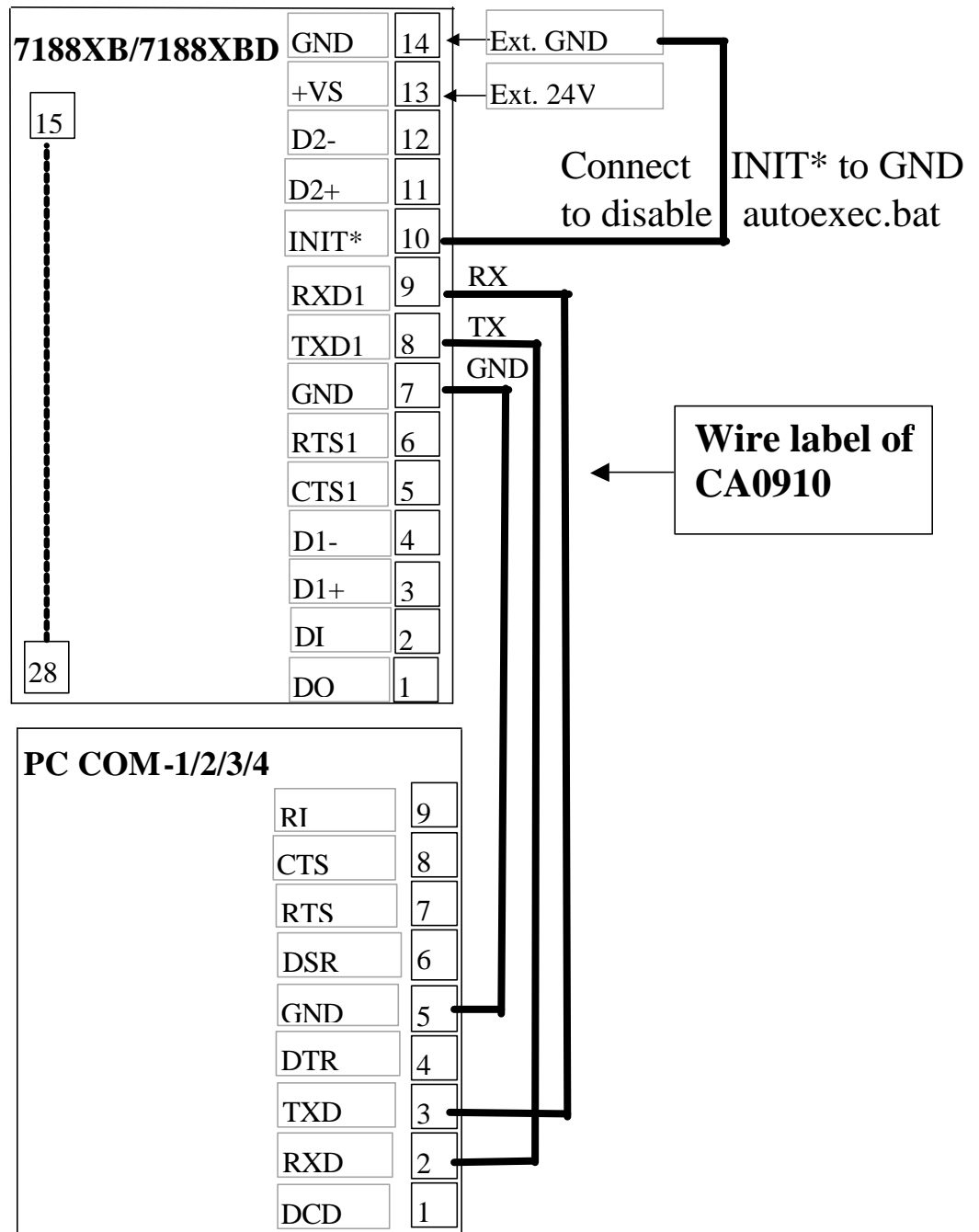
1.5 Wiring Diagrams for Application

1.5.1 Program download



Note:

- There are 3 wires in the download cable
- Connect the wire-1, label RX, to pin-4 of 7188XA
- Connect the wire-2, label TX, to pin-5 of 7188XA
- Connect the wire-3, label GND, to pin-6 of 7188XA
- Connect the DB-9 of download cable to PC COM-1/2/3/4 port

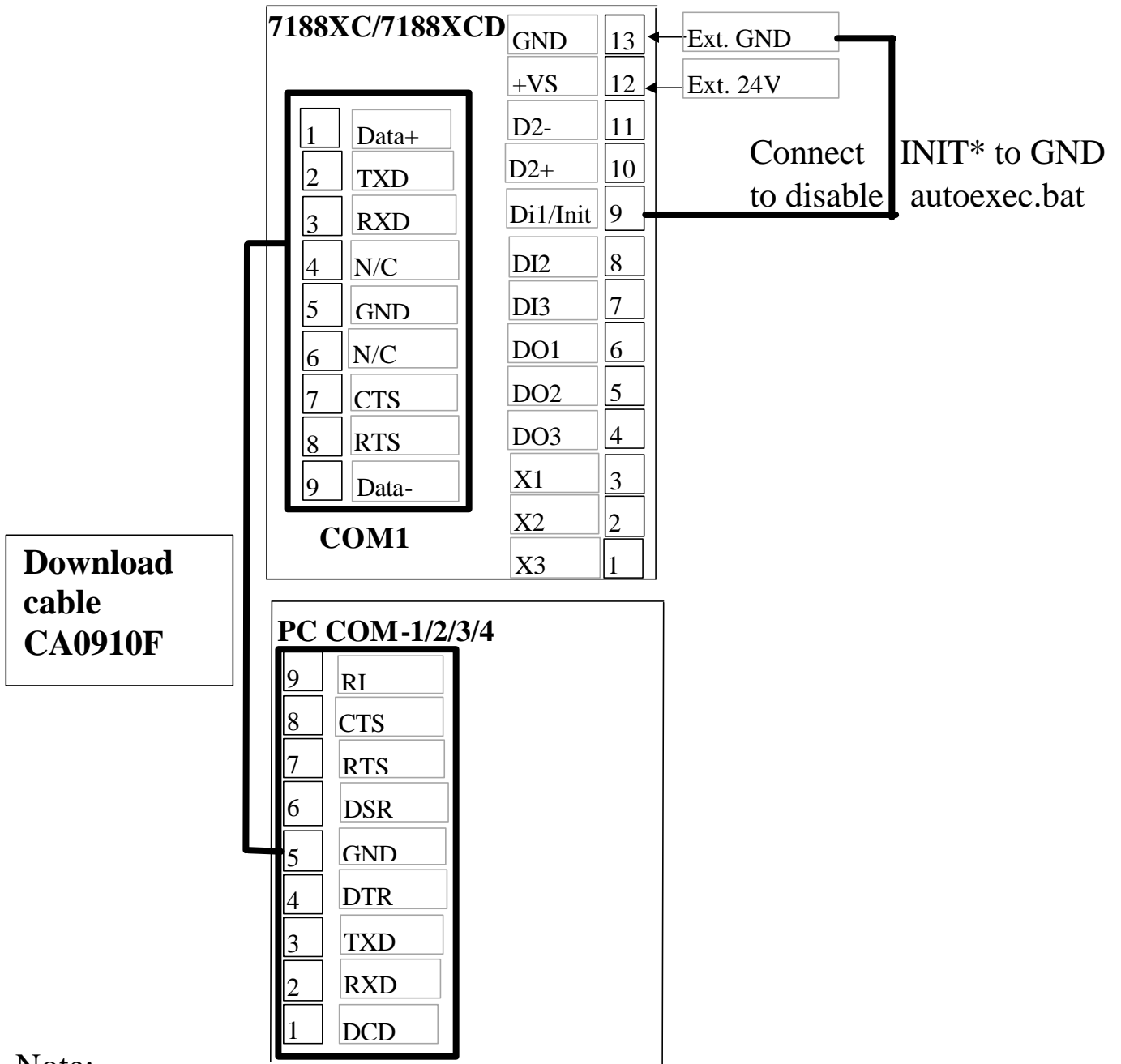


Note:

- There are 3 wires in the download cable
- Connect the wire-1, label RX, to pin-8 of 7188XB
- Connect the wire-2, label TX, to pin-7 of 7188XB
- Connect the wire-3, label GND, to pin-6 of 7188XB
- Connect the DB-9 of download cable to PC COM-1/2 port

**Program
download
wire
connection**

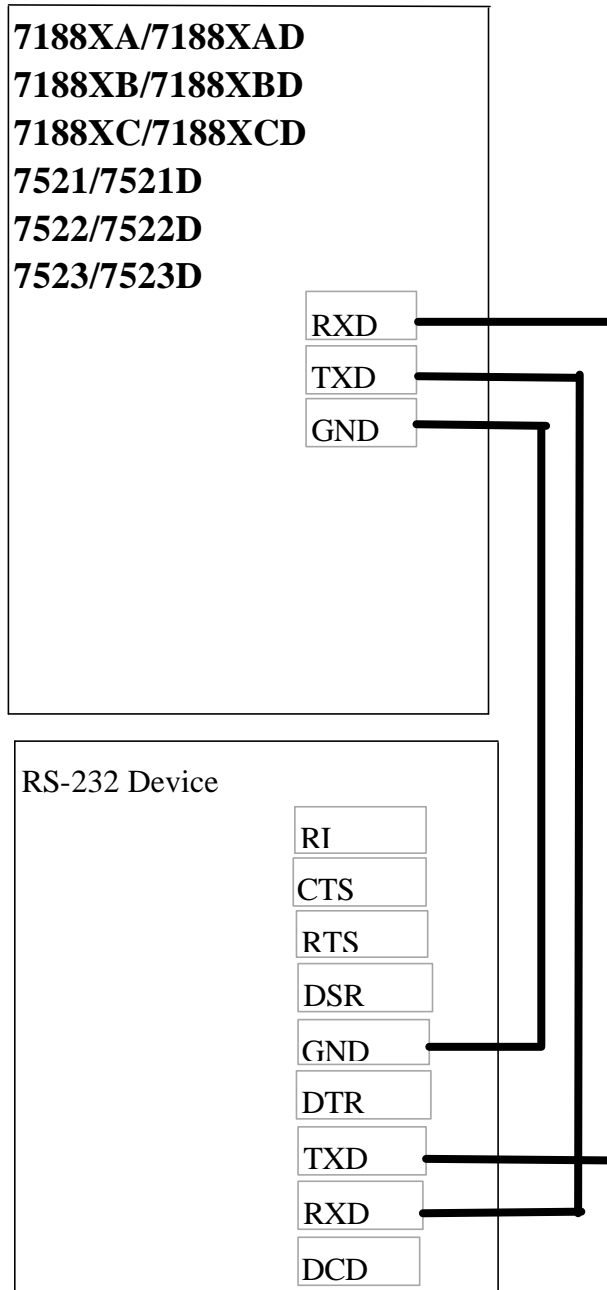
(valid for the 7188XC(D), 7521(D), 7522(D), 7523(D))



Note:

- Connect the COM1 of the 7188XC/7521 & PC's COM-1/2 port with the download cable, CA0910F

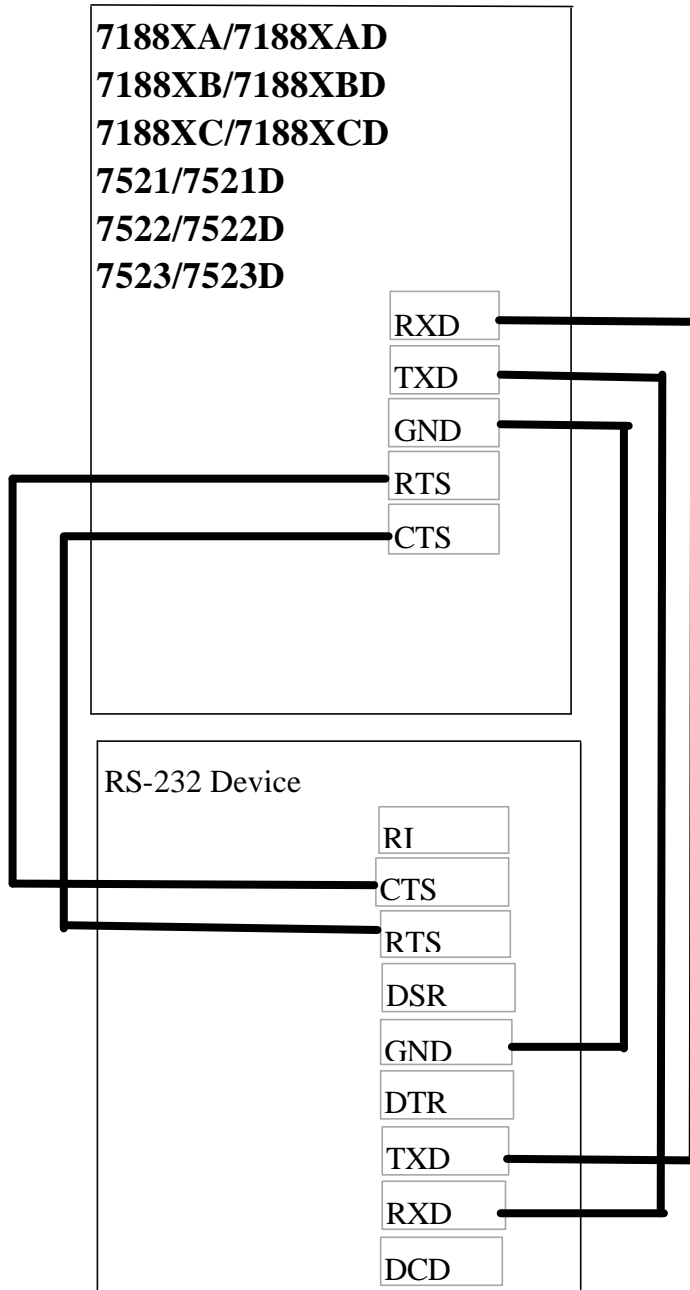
1.5.2 Using a 3-wire RS-232 port



There are 3 wires as following:

- Connect RXD to TXD of RS-232 device
- Connect TXD to RXD of RS-232 device
- Connect GND to GND of RS-232 device

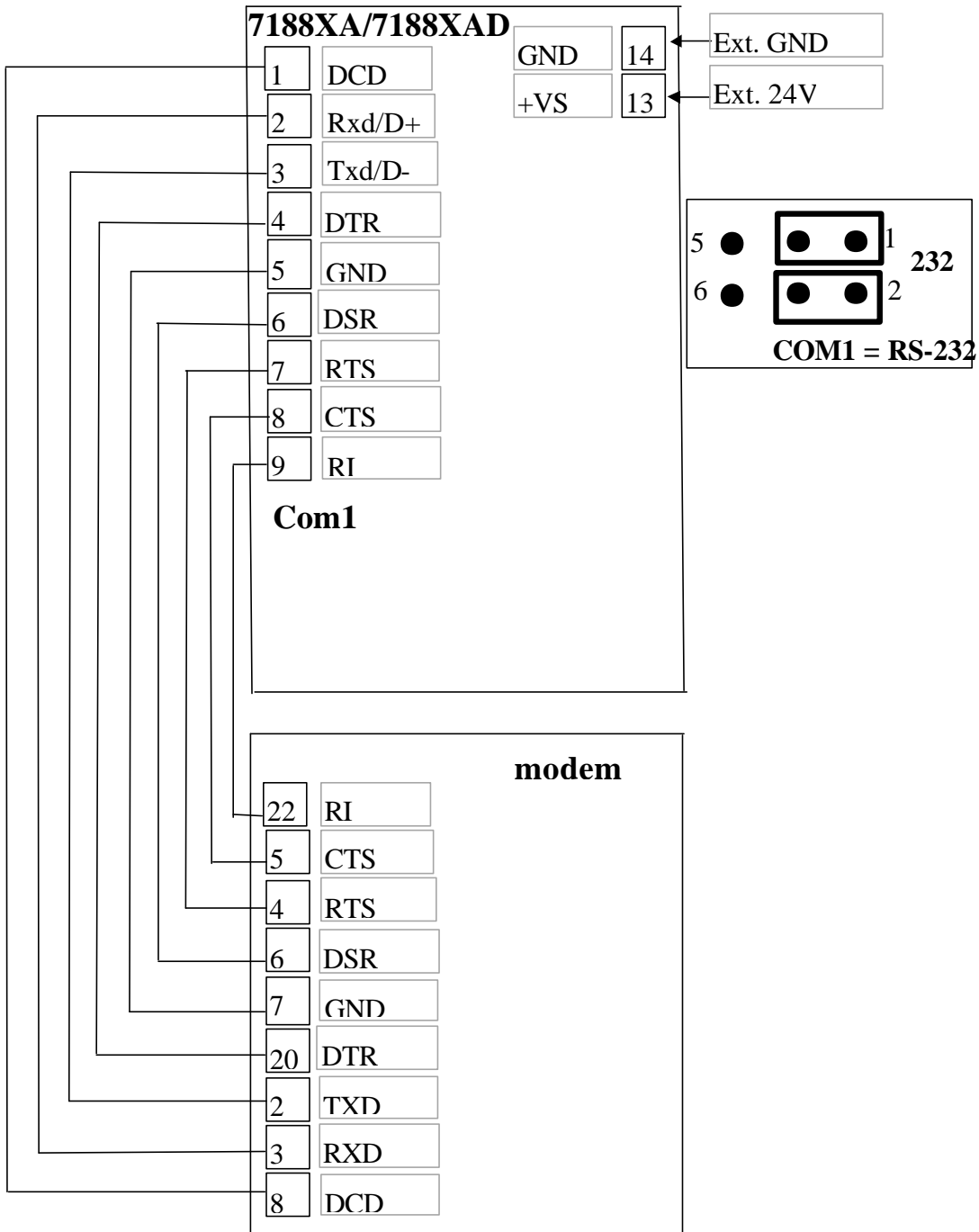
1.5.3 Using a 5-wire RS-232 port



There are 5 wires as follows:

- Connect RXD to TXD of RS-232 device
- Connect TXD to RXD of RS-232 device
- Connect RTS to CTS of RS-232 device
- Connect CTS to RTS of RS-232 device
- Connect GND to GND of RS-232 device

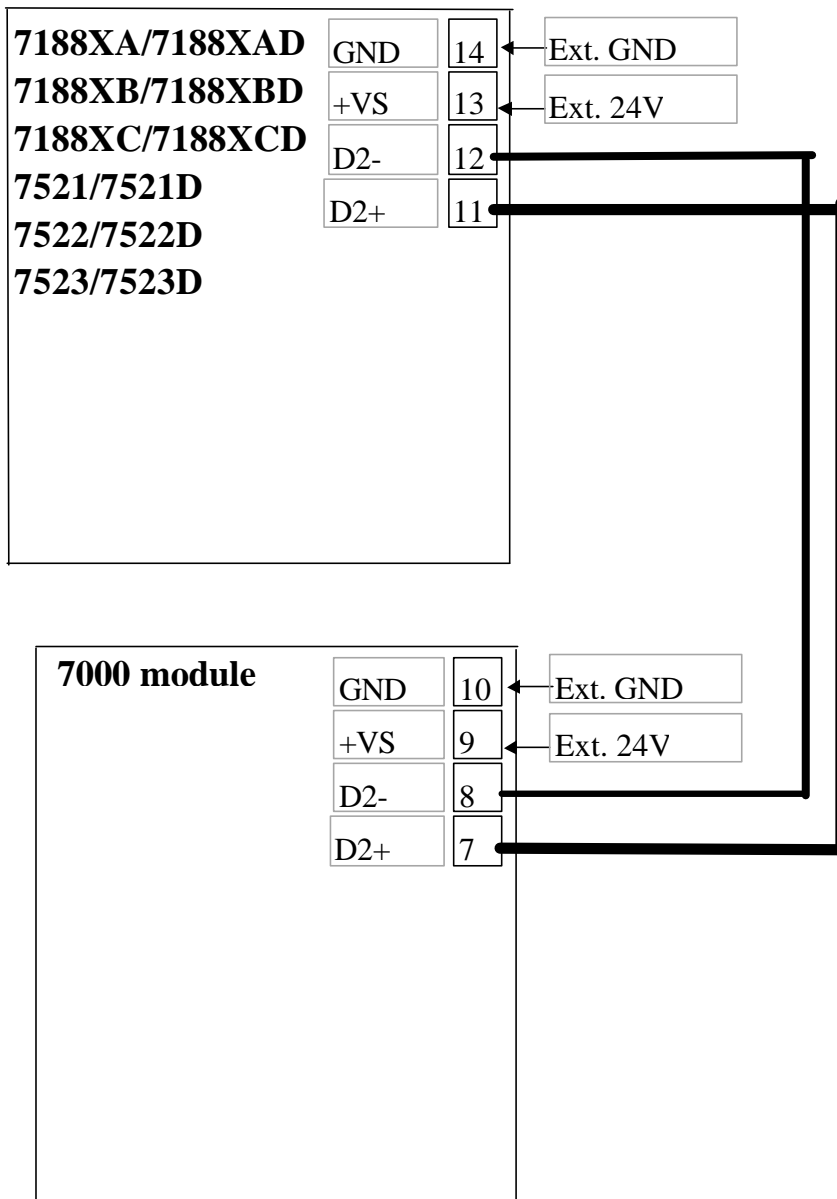
1.5.4 Using a 9-wire RS-232 port



Note:

- The COM1 pin assignment of the 7188XA is the same as the PC.

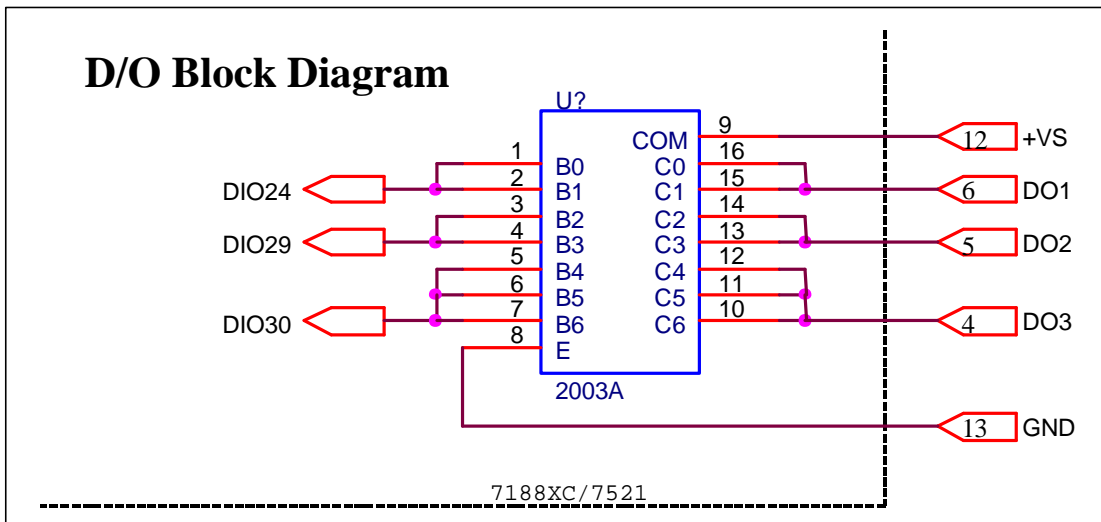
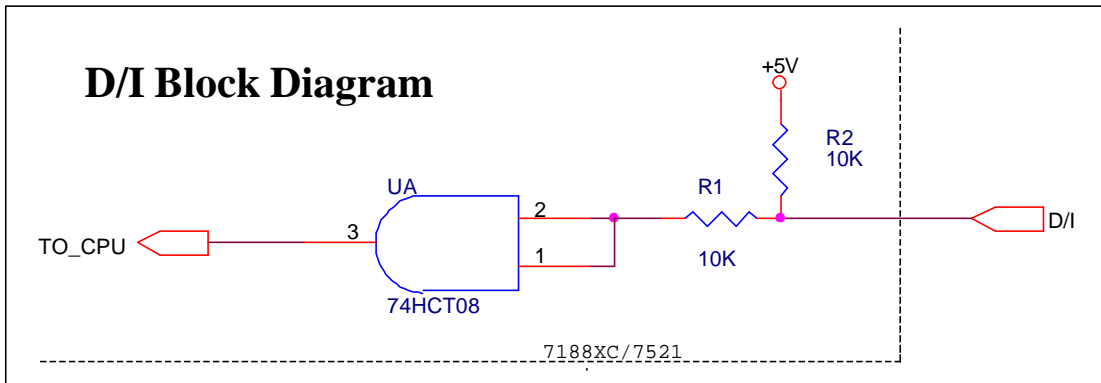
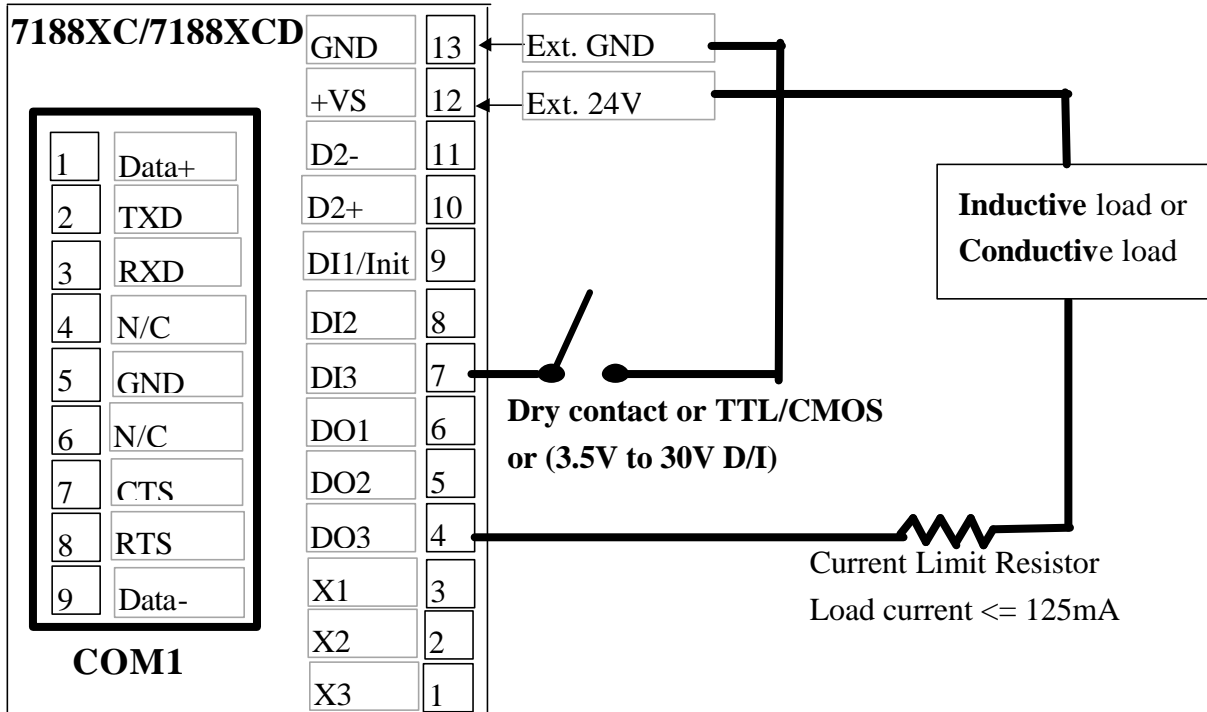
1.5.5 Using a RS-485 port



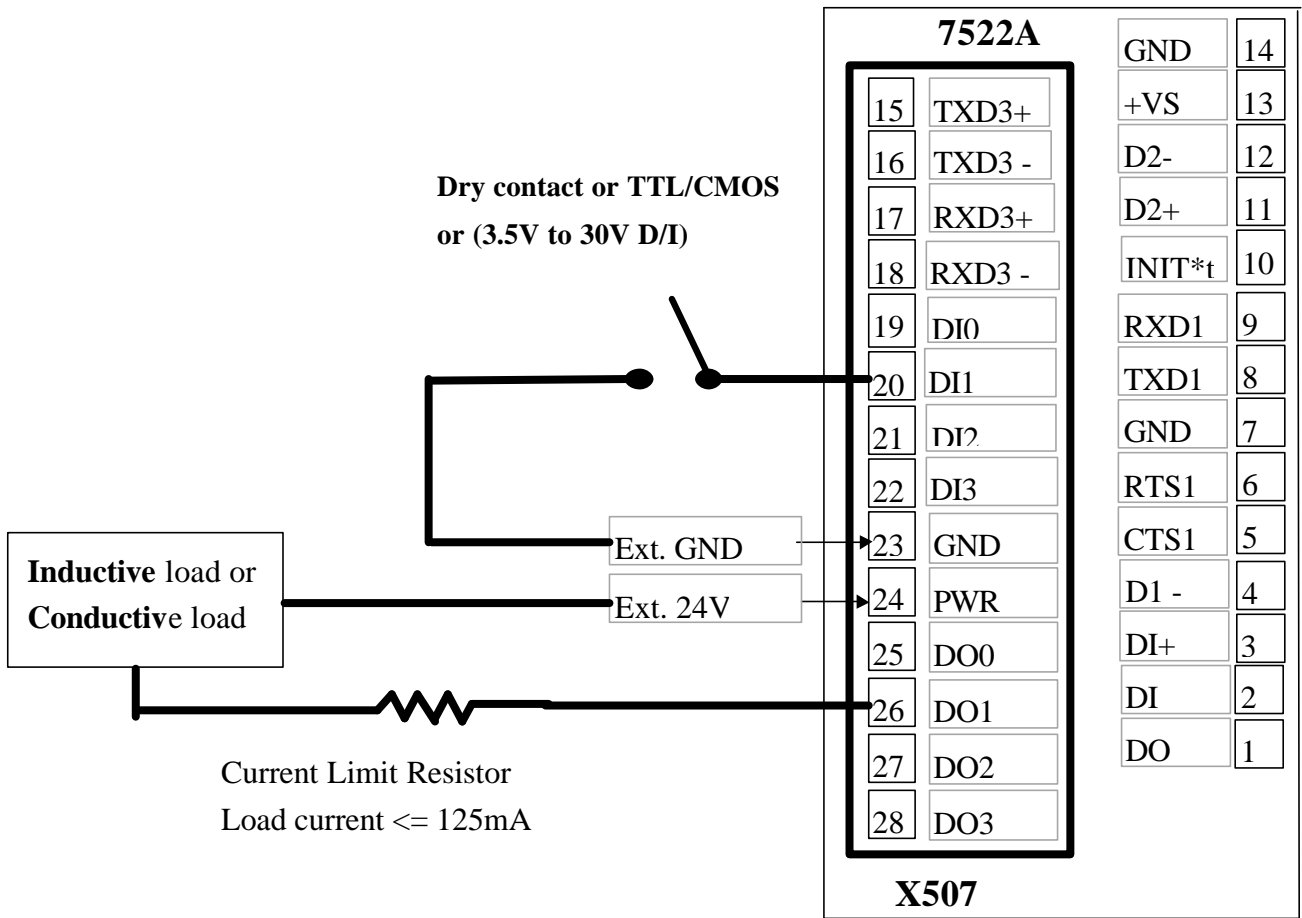
Note:

- The RS-485 interface can directly drive 256 sets of 7000 modules without a repeater

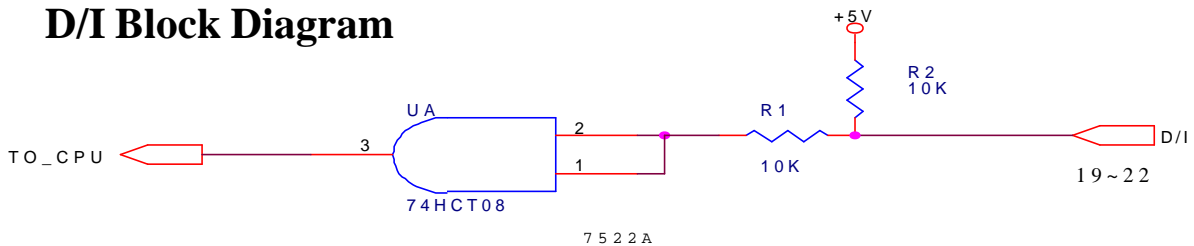
1.5.6 Using D/I/O of the 7188XC & 7521 Series



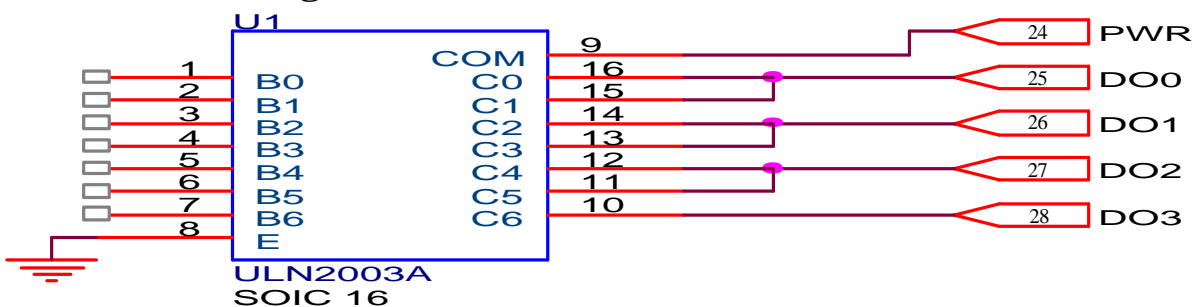
1.5.7 Using D/I/O of the 7522A (D)



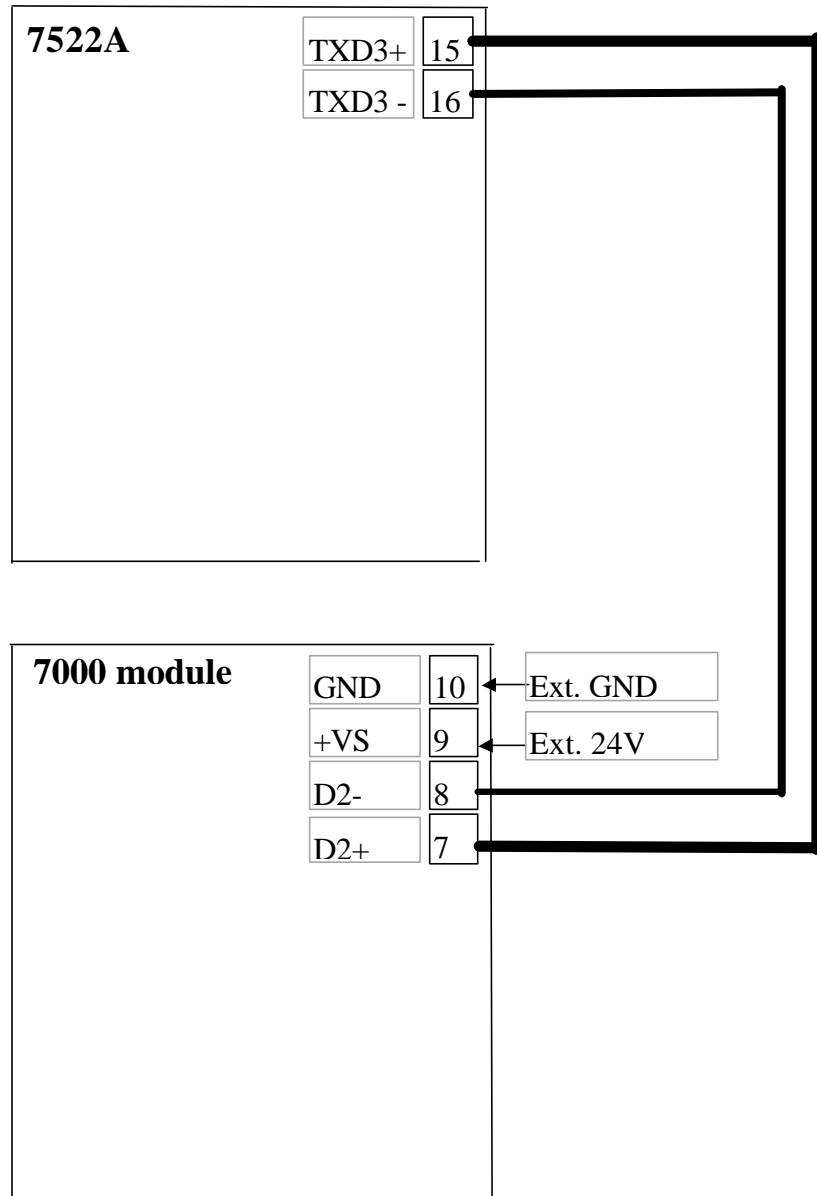
D/I Block Diagram



D/O Block Diagram



Using a RS-485 of 7522A (D)



Note:

- The RS-485 interface can directly drive 256 sets of 7000 modules without a repeater

1.6 Comparison Table

	7188XA	4500
Module name	Embedded Controller	PC-Based Communication Controller
CPU	AMD 80188, 40M Hz	AMD 80188, 40M Hz
SRAM	512K	256K
Flash ROM	512K	256K
O.S.	MiniOS7	ROM-DOS
COM port	4	2+1 (one for download only)
COM2 isolated	Yes	No
Self-tuner inside	Yes, Com1&Com2	No
EEPROM	2048 bytes	No
7-Seg LED	5-digit (7188XAD)	No
I/O expansion bus	Yes	No
Support AsicKey	Yes	No

	7521 series	4521
Module Name	Intelligent Communication Controller	Addressable RS-232 Converter
CPU	AMD 80188, 20M Hz	MC68HC705, 3.68M Hz (8-bit uP)
Number of RS-232 devices able to handle	7521: 1 channel 7522: 2 channels 7523: 3 channels	1
D/I	7521: 3 channels 7522: 3 channels 7523: 2 channels	0
D/O	7521: 3 channels 7522: 1 channel	0
Built-in program	Yes	Yes
Program Download	Yes	No
Modify program	Yes	No
7-Seg LED	7521D, 7522D, 7523D	No
I/O expansion bus	7521 & 7521D	No
Support AsicKey	7521 & 7521D	No
Isolation Site	On RS-485 site	On RS-232 site
Functions	Flexible	Limited

Comparison table between the 7188 & the 7188X series:

	7188(D)	7188XC(D)	7188XB(D)	7188XA(D)
CPU clock	80188, 40MHz	80188, 20M Hz	80188, 40M Hz	80188, 40M Hz
SRAM	256K	128K	256K	512K
Flash ROM	256K/512K	256K (512K for ODM)	512K	512K
COM1	RS-232 with modem control or RS-485	RS-232 or RS-485 with self-tuner inside	RS-232 or RS-485 with self-tuner inside	RS-232 with modem control or RS-485 with self-tuner inside
COM2	RS-485,	RS-485 with self-tuner inside	RS-485 with self-tuner inside	RS-485 with self-tuner inside, 3000V isolation
COM3	RS-232 (txd,rxd)	No Com3	No Com3	RS-232 (txd,rxd)
COM4	RS-232 (txd,rxd)	No Com4	No Com4	RS-232 (txd,rxd)
User defined pins	0	3	14	0
Modem control	COM1	No	No	COM1
RTC	Yes	No	Yes	Yes
64 bits hardware unique serial number	No	No	Yes	Yes
EEPROM	2K bytes	2K bytes	2K bytes	2K bytes
D/I(3.5V~30V)	0	3 channels	1 channel	2 channels
D/O(150mA, 30V)	0	3 channels	1 channel	2 channels
I/O expansion bus	No	Yes	Yes	Yes
Support AsicKey	No	Yes	Yes	Yes
Operation system	MiniOS7	MiniOS7	MiniOS7	MiniOS7
Programming language	TC/MSC/BC	TC/MSC/BC	TC/MSC/BC	TC/MSC/BC
Program download	COM4	COM1	COM1	COM4

Comparison table of 7521, 7522 & 7523 series:

	7521(D)	7522(D)	7523(D)
CPU clock	80188, 20M Hz	80188, 20M Hz	80188, 20M Hz
SRAM	128K	128K	128K
Flash ROM	256K	256K	256K
COM1	RS-232 or RS-485 with self-tuner inside	RS-232 or RS-485 with self-tuner inside	RS-232 or RS-485 with self-tuner inside
COM2	RS-485 with self-tuner inside, 3000V isolation	RS-485 with self-tuner inside, 3000V isolation	RS-485 with self-tuner inside, 3000V isolation
COM3	No Com3	RS-232 (txd,rxd,rts,cts)	RS-232 (txd,rxd,rts,cts)
COM4	No Com4	No Com4	RS-232 (txd,rxd)
RTC	No	No	No
64 bits hardware unique serial number	No	No	No
EEPROM	2K bytes	2K bytes	2K bytes
D/I(3.5V~30V)	3 channels	3 channels	2 channels
D/O(150mA)	3 channels	1 channel	0
I/O expansion bus	Yes	No	No
Support AsicKey	Yes	No	No
Operation system	MiniOS7	MiniOS7	MiniOS7
Programming language	TC/MSC/BC	TC/MSC/BC	TC/MSC/BC
Program download	COM1	COM1	COM1

Comparison table of 7188E series:

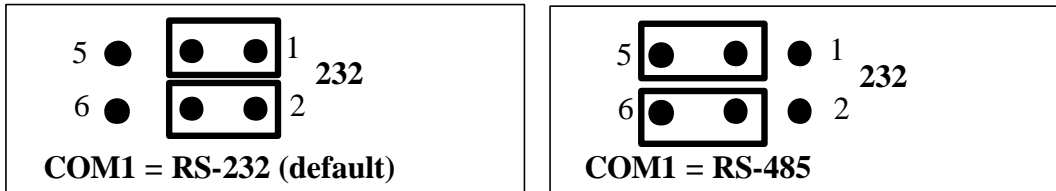
	7188EA(D)	7188EX(D)	7188E2(D)
CPU clock	80188, 40M Hz	80188, 40M Hz	80188, 40M Hz
SRAM	512K	512K	256K
Flash ROM	512K	512K	256K
COM1	RS-232 or RS-485 with self-tuner inside	RS-232 or RS-485 with self-tuner inside	RS-232 or RS-485 with self-tuner inside
COM2	RS-485 with self-tuner inside, non-isolated	RS-485 with self-tuner inside, non-isolated	RS-485 with self-tuner inside, non-isolated
RTC	Yes	Yes	No
64 bits hardware unique serial number	Yes	Yes	No
EEPROM	2K bytes	2K bytes	2K bytes
D/I(3.5V~30V)	6 channels	0	0
D/O(150mA, 30V)	7 channels	0	0
User Defined pins	0	14	0
I/O expansion bus	Yes (but used by system)	Yes	No
Support AsicKey	Yes	Yes	No
Operation system	MiniOS7	MiniOS7	MiniOS7
Programming language	TC/MSC/BC	TC/MSC/BC	TC/MSC/BC
Program download	COM1	COM1	COM1
Ethernet interface	10BaseT	10Base-T	10BaseT

Comparison table of CPU modules:

	<i>Description</i>
7188	Embedded Controller
7188XA	Expandable Embedded Controller with I/O Expansion Bus
7188XB	Expandable Embedded Controller with I/O Expansion Bus, high I/O expansion
7188XC	Expandable Embedded Controller with I/O Expansion Bus, low cost
7521/22/23	Embedded Communication Controller, 1/2/3 channels
7188EA	Embedded Internet/Ethernet Controller, DI * 6 channels, DO * 7 channels
7188EX	Embedded Internet/Ethernet Controller with I/O Expansion Bus
7188E1	Internet Communication Controller, RS232 * 1
7188E2	Internet Communication Controller, RS232 * 1 + RS485*1
7188E3	Internet Communication Controller, RS232 * 1 + RS485 * 1+RS422/485 * 1 + DI * 4 +DO * 4
7188E4	Internet Communication Controller, RS232 * 3 + RS485*1
7188E5	Internet Communication Controller, RS232 * 4 + RS485*1
7188E8	Internet Communication Controller, RS232 * 7 + RS485*1

1.7 Jumper Setting

The JP1 setting of the 7188XA/7188XAD are given as follows.



1.8 Reconfiguring the 7188XC(D)/7521(D)

From pin-4 to pin-8 of the 7188XC(D)/7521(D) there are three D/O & two D/I pins. For the application of “Customized 7000 Modules”, these 5 D/I/O pins can be hardware reconfigured to other functions as follows:

Step 1: Remove the reconfiguration-resistor as follows:

- If DO3 is reconfigured, remove R19
- If DO2 is reconfigured, remove R20
- If DO1 is reconfigured, remove R21
- If DI3 is reconfigured, remove R22
- If DI2 is reconfigured, remove R23

Then, the onboard D/I/O functions can be disabled.

Step 2: Install a 5-pin male reconfiguration-jumper into the TP0 of the 7188XC(D)/7521(D)

Step 3: Design a 5-pin female reconfiguration-jumper in X??? for connection to TP1. Then the external signals from pin-4 to pin-8 can be connected to X???. The user can refigure these 5 D/I/O pins to their special requirements now.

Note: If the DO2 is reconfigured to D/I, its initial state must be High. If its initial state is LOW, system clock will be reduced to 10M. So all clock-related libraries will only be at half-speed.

The X100 is an 8-channel D/I board designed for the 7188X(D)/7521(D). It removes all 5 resistors, R19 ~ R23, and reconfigures all these pins as D/I pins. It installs another 5-pin female reconfiguration-jumper into TP1 of the 7188XC(D)/7521(D). **Therefore, user can select the original 3_DO_2_DI functions or new 5_DI functions by setting the jumper in different positions.** Refer to “I/O Expansion Bus in the 7188X/7188E User’ s Manual” for more information.

The 7188XB(D) has 14 user-defined pins. But the 7188X(B) & 7188X(A) don’t support the reconfiguration-resistor. So the user-defined pins of the 7188X/7521 family are given as follows:

	User defined pins	Reconfiguration pins	Customized I/O pins
7188XA(D)	0	0	0+0=0
7188XB(D)	14	0	14+0=14
7188XC(D)	3	5	3+5=8
7521(D)	3	5	3+5=8
7522/23(D)	0	0	0+0=0

2. Operation Principles

2.1 System Mapping

2.1.1 Address Mapping of the 7521 series

Device	Address mapping
Flash ROM	256K: from C000:0000 to F000: FFFF
SRAM	128K: from 0000:0000 to 1000:FFFF
COM1 BASE	0XFF80 to 0XFF88
COM2 BASE	0XFF10 to 0XFF18

Interrupt No.	Interrupt mapping
0	Divided by zero
1	Trace
2	NMI
3	Break point
4	Detected overflow exception
5	Array bounds exception
6	Unused opcode exception
7	ESC opcode exception
8	Timer 0
9	Reserved
0A	DMA-0
0B	DMA-1
0C	\INT0 of I/O expansion bus
0D	\INT1 of I/O expansion bus
0E-10	Reserved
11	COM2
12	Timer 1
13	Timer 2
14	COM1

2.1.2 Address Mapping of the 7522/7523 series

Device	Address mapping
Flash ROM	256K: from C000:0000 to F000: FFFF
SRAM	128K: from 0000:0000 to 1000:FFFF
COM1 BASE	0XFF80 to 0XFF88
COM2 BASE	0XFF10 to 0XFF18
COM3 BASE	I/O expansion bus (programmable), 7522&7523
COM4 BASE	I/O expansion bus (programmable), 7523 only

Interrupt No.	Interrupt mapping
0	Divided by zero
1	Trace
2	NMI
3	Break point
4	Detected overflow exception
5	Array bounds exception
6	Unused opcode exception
7	ESC opcode exception
8	Timer 0
9	Reserved
0A	DMA-0
0B	DMA-1
0C	COM3 for 7522 & 7523
0D	COM4 for 7523 only
0E-10	Reserved
11	COM2
12	Timer 1
13	Timer 2
14	COM1

2.1.3 Address Mapping of the 7188XA series

Device	Address mapping
Flash ROM	512K: from 8000:0000 to F000: FFFF
SRAM	512K: from 0000:0000 to 7000:FFFF
COM1 BASE	0x100
COM2 BASE	0x108
COM3	0XFF80 to 0XFF88
COM4	0XFF10 to 0XFF18

Interrupt No.	Interrupt mapping
0	Divided by zero
1	Trace
2	NMI
3	Break point
4	Detected overflow exception
5	Array bounds exception
6	Unused opcode exception
7	ESC opcode exception
8	Timer 0
9	Reserved
0A	DMA-0
0B	DMA-1
0C	\INT0 of I/O expansion bus
0D	\INT1 of I/O expansion bus
0E	COM1
0F	COM2
10	\INT4 of I/O expansion bus
11	COM4
12	Timer 1
13	Timer 2
14	COM3

2.1.4 Address Mapping of the 7188XB/7188XC

Device	Address mapping
Flash ROM	256K: from C000:0000 to F000: FFFF 512K: from 8000:0000 to F000: FFFF
SRAM	128K: from 0000:0000 to 1000:FFFF 256K: from 0000:0000 to 3000:FFFF
COM1 BASE	0XFF80 to 0XFF88
COM2 BASE	0XFF10 to 0XFF18

Interrupt No.	Interrupt mapping
0	Divided by zero
1	Trace
2	NMI
3	Break point
4	Detected overflow exception
5	Array bounds exception
6	Unused opcode exception
7	ESC opcode exception
8	Timer 0
9	Reserved
0A	DMA-0
0B	DMA-1
0C	\INT0 of I/O expansion bus
0D	\INT1 of I/O expansion bus
10	XB: \INT4 of I/O expansion bus XC: Reserved
11	COM2
12	Timer 1
13	Timer 2
14	COM1

2.1.5 Address Mapping of the X505, X506, X507

		X505	X506	X507
DI		N/A	N/A	0
DO		N/A	N/A	0
COM3	BASE	0X10	0X10	0X10
	INT	INT0	INT0	INT0
COM4	BASE	0X18	0X18	N/A
	INT	INT1	INT0	N/A
COM5	BASE	0X20	0X20	N/A
	INT	INT4	INT1	N/A
COM6	BASE	N/A	0X28	N/A
	INT	N/A	INT1	N/A
COM7	BASE	N/A	0X30	N/A
	INT	N/A	INT4	N/A
COM8	BASE	N/A	0X38	N/A
	INT	N/A	INT4	N/A

2.2 How to Debug User's Programs

The **download_ports** of the 7188X/7521 family are given as follows:

- 7188XA → Use **COM4**
- 7188XB/7188XC/7521/7522/7523 → Use **COM1**

When the 7188X/7521 family series is powered-up, it will initialize the **download_port** to the following configuration:

- **Start-bit=1, data-bit=8, stop-bit=1, no parity**
- **Baud rate = 115200 BPS**

Then, the 7188X/7521 will send all power-up information to the **download_port**. The user will see all power-up messages as follows:

- Power-off PC & 7188X/7521
- Install the download cable between **download_port** of 7188X/7521 & COM1 of PC (refer to Sec. 1.6.1)
- Power-up PC & Run 7188X.EXE
- Power-up 7188X/7521
- All power-up message will be shown on the monitor of the PC

After the power-up stage, the 7188X/7521 will use the **download_port** as its standard input/output. So the standard output of 7188X/7521 will be shown on the PC's monitor. If the user presses any key on the PC's keyboard, this key will be sent to the 7188X/7521 as standard input. Therefore the keyboard & monitor of PC can be used as standard input & output of the 7188X/7521 as follows:

- Use 7188X.EXE as a bridge between the 7188X/7521 & PC
- Run 7188X.EXE in PC to set up this bridge
- **Keyboard of PC → standard input of 7188X/7521**
- **Monitor of PC → standard output of 7188X/7521**

In this way, the 7188X/7521 can read data from the keyboard & display it on the monitor. So program debugging will be more convenient & effective.

Note: 7188X.EXE is included on the companion floppy disk/CD.

2.3 How to Download User's Program

Refer to Sec. 2.2 to find the **download_port** first.

The user can download the program into the 7188X/7521 as follows:

- Power-off PC & the 7188X/7521
- Install the download cable between **download_port** of the 7188X/7521 & COM1 of PC (refer to Sec. 1.6.1)
- Power-up PC & Run 7188X.EXE
- Power-up the 7188X/7521
- All power-up messages will be shown on the monitor of the PC
- Key-in "load", press Enter key, & wait for system request message
- Press Alt-E, the screen will ask you to input filename,
- Key-in the filename & press Enter key, the file will be download into the 7188X/7521
- Key-in the filename & press Enter. This will start to execute this file
- Pressing Alt & X at the same time will quit the 7188X.EXE

2.4 Using the download_port as a COM port

The user can use the **download_port** of the 7188X/7521series as a general purpose RS-232 port as follows:

- Download user's program & autoexec.bat to the 7188XC/7521 first.
- Power off the 7188X/7521 & remove the download the cable from PC.
- If they are connected, disconnect the INIT*-pin from GND-pin of the 7188XC/7521
- Power on the 7188X/7521 (no standard input, no standard output, no debug information)
- Install the download cable between new RS-232 device & **download_port** of the 7188X/7521
- Initialize the **download_port** to new configuration.
- The **download_port** is a general purpose RS-232 port now.
- Refer to "7188X/7521 Software User's Manual" for demo programs

2.5 COM ports Comparison

The COM port of the 7188X/7521 series can be RS-232 or RS-485 as follows:

type	Pins name
2-wire RS-485	Data+, Data-
3-wire RS-232	Txd,Rxd,Gnd
5-wire RS-232	Txd,Rxd,Gnd,Rts,Cts
9-wire RS_232	Txd,Rxd,Gnd,Rts,Cts,Dcd,Dtr,Dsr,Ri

The COM ports of the 7188XA are given as follows:

COM port	Hardware
COM1	16C550, 9-wire RS-232 or 2-wire RS-485
COM2	16C550, 2-wire RS-485
COM3	80188' s on-chip UART-0, 3-wire RS-232
COM4	80188' s on-chip UART-1, 3-wire RS-232

The programming of the 16C550 is very different from the 80188' s UART. The interrupt handling of the 80188 is also very different from the PC' s 8259. **Therefore if the user downloads the PC' s RS-232 application program into the 7188XA, it will not work.**

The software driver of the 7188XA is an interrupt driven library that provides a 1K QUEUE buffer for every COM port. The software is well designed & easy to use.

The software driver provides the same interface for all 4 COM ports. The user can use these COM port in the same way without any difficulty.

The COM ports of the 7188XB/7188XC are given as follows:

COM port	Hardware
COM1	80188's on-chip UART-0, 5-wire RS-232 & 2-wire RS-485
COM2	80188's on-chip UART-1, 2-wire RS-485

The COM ports of the 7521 series are given as follows:

COM port	Hardware
COM1	80188's on-chip UART-0, 5-wire RS-232 & 2-wire RS-485
COM2	80188's on-chip UART-1, 2-wire RS-485

The COM ports of the 7522 series are given as follows:

COM port	Hardware
COM1	80188's on-chip UART-0, 5-wire RS-232 & 2-wire RS-485
COM2	80188's on-chip UART-1, 2-wire RS-485
COM3	16C550, I/O expansion bus, 5-wire RS-232

The COM ports of the 7523 series are given as follows:

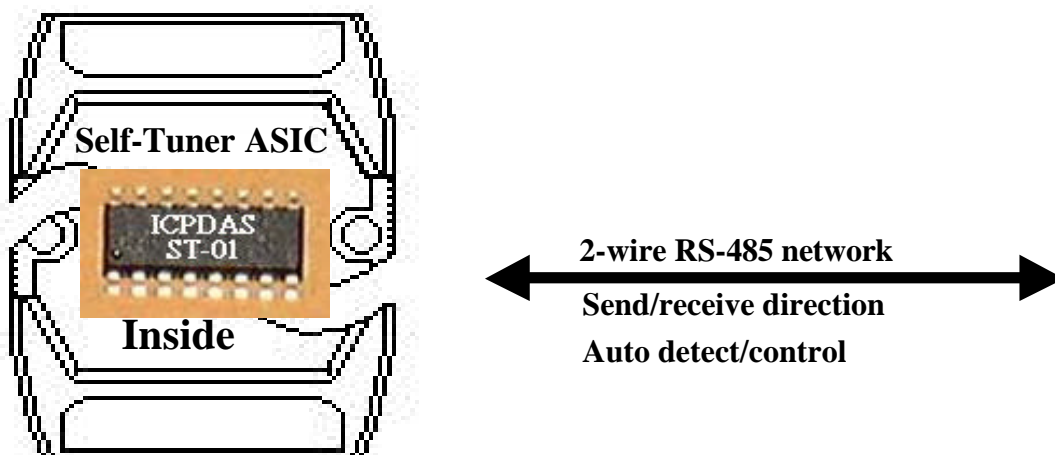
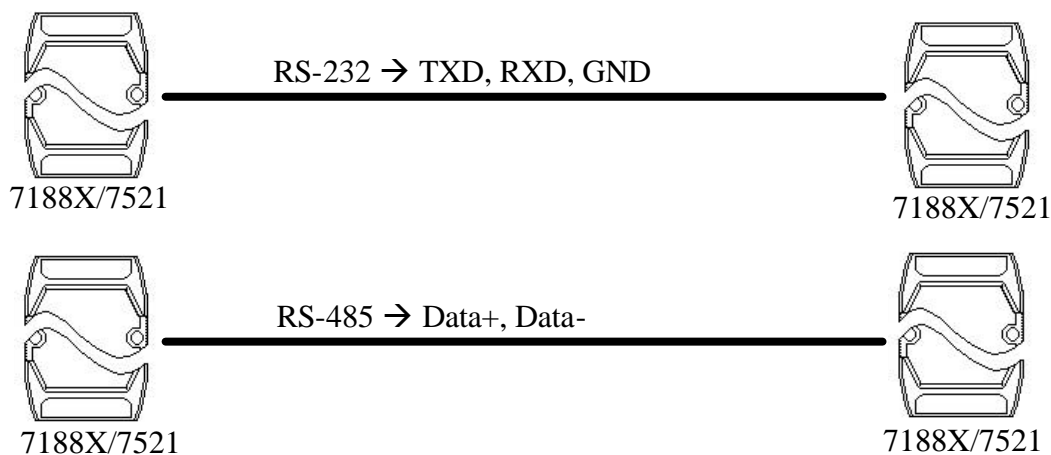
COM port	Hardware
COM1	80188's on-chip UART-0, 5-wire RS-232 & 2-wire RS-485
COM2	80188's on-chip UART-1, 2-wire RS-485
COM3	16C550, I/O expansion bus, 5-wire RS-232
COM4	16C550, I/O expansion bus, 3-wire RS-232

2.6 The RS-485 Port & Self-Tuner ASIC

The 2-wire RS-485 port is designed to directly drive 7000 series modules. It is a half-duplex 2-wire RS-485 network. Send/receive directional control in a 2-wire RS-485 network is very important. Therefore, the 7188X/7521 series equip a Self-Tuner ASIC controller for all RS-485 ports. The Self-Tuner ASIC controller will auto detect & control the send/receive direction of the RS-485 network. In this main, the application program does not have to worry about the send/receive direction control of the RS-485 network. For example, the software program for one-to-one communication is nearly the same.

```

ToCom(port, sent_data);    /* send one sent_char to RS-232/RS-485    */
                           /* no direction control                */
while IsCom(port);        /* wait one echo_char from RS-232/RS-485 */
echo_data=ReadCom(port);  /* read this echo_data                    */
    
```



2.7 Using Red LED & 7-SEG LED Display

The red LED of the 7188X/7521 series can be turned-ON or turned-OFF by its software program. The 5 digits of the seven-segment LED are also programmable. **The 5-digit LED is very useful in real world applications.** It can be used to replace the monitor & touch-screen for many applications.

2.8 Using RTC & NVSRAM

The RTC & NVSRAM are located on the same chip. There is a Li-battery to backup the RTC & NVSRAM for 10 years. The features of the RTC are given as follows:

- MiniOS7 supports RTC time & date
- Seconds, minutes, hours, date of the month
- Month, day of week, year, Leap year valid up to 2079
- NVSRAM: 31 bytes, data valid for 10 years

Note1: only 7188XA & 7188XB support RTC & NVRAM.

Note2: the 7188XC & 7521 series can add a RTC/NVRAM for the OEM/ODM user.

2.9 Using EEPROM

The EEPROM is designed to store the data which is not changed very frequently. This data is given as follows:

- Module ID, configuration settings
- COM port configuration settings
- Small databases

The erase/write cycle of the EEPROM is limited, the user should not change the EEPROM frequently for testing. The EEPROM can **erase/write in single byte**, so it is very useful in real world applications.

2.10 Using the Watchdog Timer

The watchdog timer of the 7188X/7521 series is fixed at 1.6 sec. **When the 7188X/7521 is powered up, the watchdog timer will be always enabled.** If the 7188X/7521 do not refresh the watchdog timer every 1.6 seconds, the watchdog will RESET the 7188X/7521.

The MiniOS7 of the 7188X/7521 will automatically refresh the watchdog after power up. The user program can call the software driver to tell MiniOS7 to stop refreshing the watchdog timer, then the user program must refresh the watchdog timer. If the user program does not refresh the watchdog timer every 1.6 seconds, the watchdog timer will RESET the 7188X/7521.

2.11 Using the I/O Expansion Bus

The 7000 series modules have been very successful in during the past three years. Over one hundred thousand modules have been shipped to locations all over the world. The reasons for our success is given as follows:

- Time-to-market & Cost effective solutions
- Durable, Stable, Flexible & Easy programming
- Over 50 Various I/O Modules are supported
- Can be used in harsh & noisy industry environments

However, even though the 7000 family is so versatile, there are some applications that cannot be solved. These applications are given as follows:

- High speed applications
- Special hardware requirement applications
- Special software requirement applications
- A combination of special hardware & software applications

Therefore, we developed an I/O expansion bus for the 7188X/7521 family to solve all the above applications. The I/O expansion bus can be used to implement various I/O functions such as D/I, D/O, A/D, D/A, Timer/Counter, UART, flash memory, battery backup SRAM, AsicKey & other I/O functions. **Nearly all kinds of I/O functions can be implemented by this bus.**

The I/O expansion bus includes serial & parallel interface. The parallel interface is very similar to ISA bus, so the user can move the old ISA bus design to the I/O expansion bus with very little change.

The I/O pins of serial bus are programmable. They can be programmed as D/I, or D/O. Some pins can be configured to D/I or D/O or timer input or timer output. There are many serial interface devices available today. The features of these serial devices are given as follows:

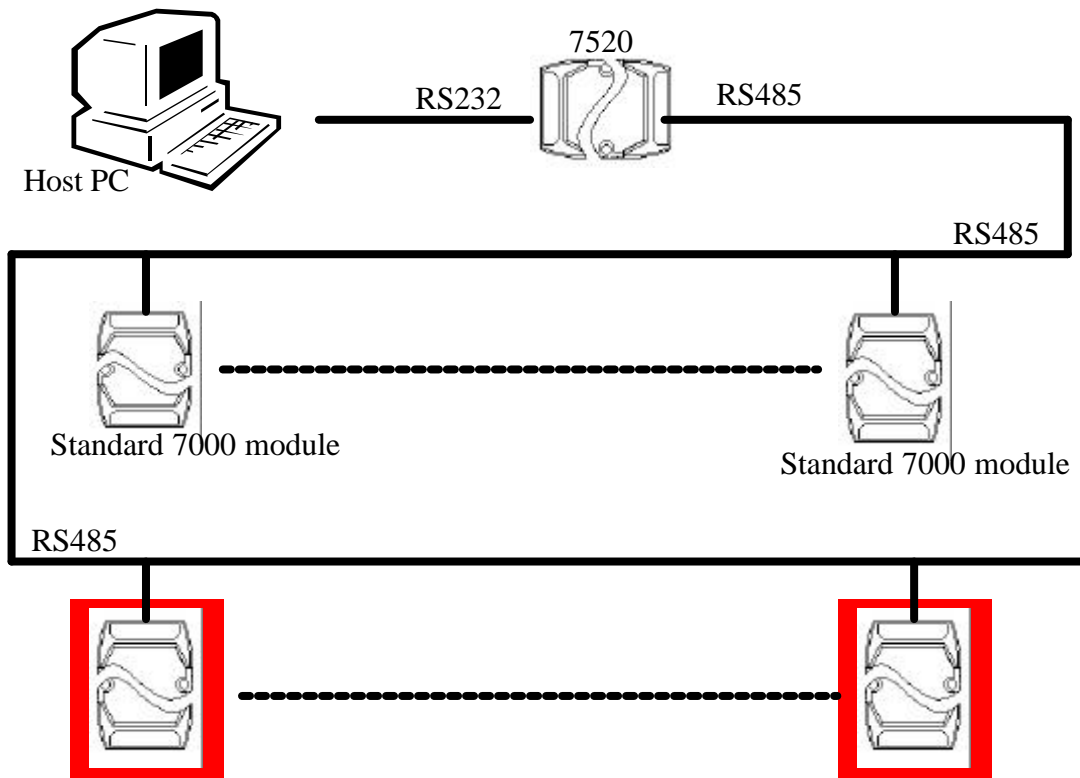
- Smaller size compared to parallel devices
- Lower cost compared to parallel devices
- Easier to design for isolated applications

The serial interface of the I/O expansion bus make interface to these serial devices very easy.

The combination of serial & parallel interface make the I/O expansion bus very convenient & powerful for various industry applications. There are many design examples given in “I/O Expansion Bus in the 7188X/7188E User’s Manual”. All hardware circuit & software driver sources are OPEN for modification. From these examples, the user can make new applications or modify them for their special requirements. The system design steps are given as follows:

- Step 1: list all functions required
- Step 2: for all functions, goto step 3. If all functions are solved → STOP
- Step 3: if this function can be solved by 7000 module → goto step 2
- Step 4: if this function can be solved by 7188X+X??? → goto step 2
- Step 5: user designed special hardware for I/O expansion bus
- Step 6: user writes special software driver for this hardware
- Step 7: combine the special hardware & software as a new module
- Step 8: goto step 2

After the above steps, user can combine the standard 7000 modules & special modules to solve all applications in the same RS-485 network. The system is given as following:



**Customized 7000 module
(7188X+X???)**

**Customized 7000 module
(7188X+X???)**

2.11.1 Definition of an I/O Expansion Bus

The I/O expansion bus of the 7188X/7521 series can be divided into 3 groups as follows:

1. Power supply & reset signals: VCC, GND, RESET, /RESET
2. , Parallel Bus:
 - System clock: CLOCKA
 - Asynchronous ready control: ARDY
 - Address bus: A0 ~ A6, A7 (7188XC & 7521 series without A7)
 - Data bus: D0 ~ D7
 - Interrupt control: INT0, INT1, INT4 (7188XC & 7521 series without INT4)
 - Chip select & read/write strobe: /CS, /WR, /RD
3. Serial Bus: TO_0, TO_1, TI_0, TI_1, SCLK, DIO9, DIO4, DIO14

Refer to “I/O Expansion Bus for 7188X/7188E User’s Manual” for more information.

2.11.2 Definition

The definition of the I/O expansion bus is given as follows:

JP1 pin definition & description:

No	Name	Description
1	GND	Ground of PCB
2	GND	Ground of PCB
3	CLOCKA	Synchronous clock output of CPU
4	ARDY	Asynchronous ready input (level sensitive, OPEN=ready)
5	INT0	Interrupt request input of channel 0(asynchronous, active high)
6	INT1	Interrupt request input of channel 1(asynchronous, active high)
7	VCC	Power supply of PCB
8	RESET	Power up reset pulse (active high)
9	GND	Ground of PCB
10	/RESET	Power up reset pulse (active low)
11	TO_0	Timer output 0 of CPU (can be used as programmable D/I/O)
12	TO_1	Timer output 1 of CPU (can be used as programmable D/I/O)
13	TI_0	Timer input 0 of CPU (can be used as programmable D/I/O)
14	TI_1	Timer input 1 of CPU (can be used as programmable D/I/O)
15	SCLK	Common serial clock output of 7188 series
16	DIO9	Programmable D/I/O bit
17	DIO4	Programmable D/I/O bit
18	DIO14	Programmable D/I/O bit
19	VCC	Power supply of PCB
20	VCC	Power supply of PCB

- **CLOCKA**: 20.2752M for 7188XC, 40M for 7188XB & 7188XA
- **ARDY**: leave this pin OPEN for no wait states applications
- **INT0, INT1**: leave these two pins OPEN for no interrupt applications
- **TO_0, TO_1**: can be used as CPU' s timer output or programmable D/I/O
- **TI_0, TI_1**: can be used as CPU' s timer input or programmable D/I/O
- **DIO4, DIO9, DIO14**: programmable D/I/O bit
- **SCLK**: the 7188X/7188E series use this signal as a **CLOCK** source to drive all on-board serial devices, so it is always programmed as D/O. Changing this signal to other configurations will cause serious errors. User can use this signal to drive external serial devices without any side effects.

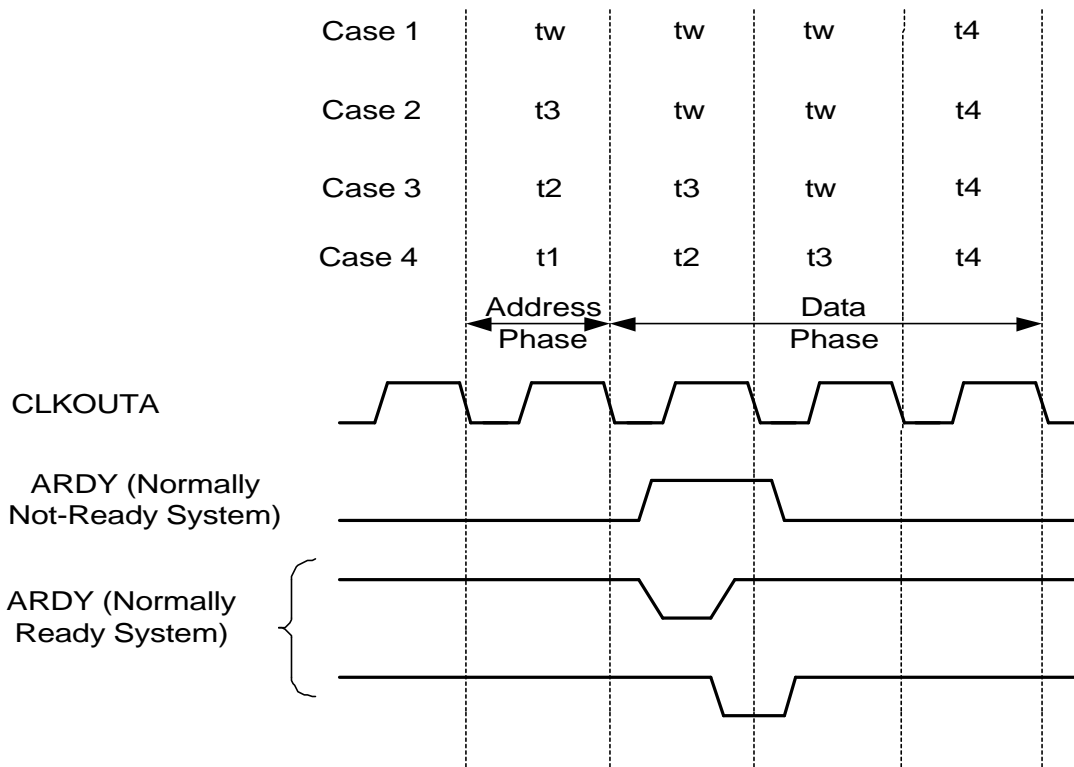
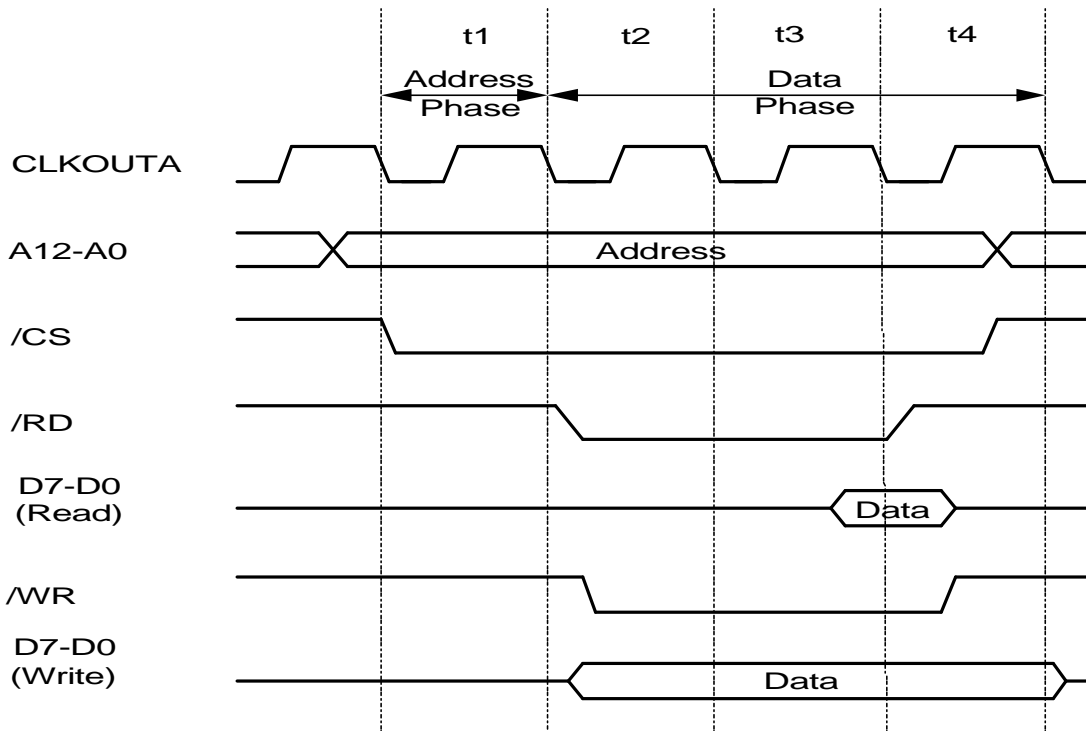
JP2 pin definition & description:

No	Name	Description
1	A0	Address bus
2	D0	Data bus
3	A1	Address bus
4	D1	Data bus
5	A2	Address bus
6	D2	Data bus
7	A3	Address bus
8	D3	Data bus
9	A4	Address bus
10	D4	Data bus
11	A5	Address bus
12	D5	Data bus
13	A6	Address bus
14	D6	Data bus
15	A7 or N/C	This pin is reserved & must be N/C for 7188XC & 7521 series
16	D7	Data bus
17	INT4 or N/C	Interrupt request input of channel 4(asynchronous, active high), this pin is reserved & must be N/C for 7188XC & 7521 series
18	/WR	Write strobe output (synchronous, active low)
19	/CS	Chip select output (synchronous, active low)
20	/RD	Read strobe output (synchronous, active low)

- Address bus (output): A0 ~ A6, A7
- Data Bus (tri-state, bi-direction): D0 to D7
- INT4: leave this pin OPEN for no interrupt applications
- /CS, /RD, /WR: These 3 signals will be synchronous to CLOCKA (in JP1.3) & asynchronous to ARDY (JP1.4)
- The CS\ will be active if program inport/output from I/O address 0 to 0xff.
- **The pin_15 & pin_17 are reserved by 7188XC & 7521 series; user must leave these two pins N/C for 7188XC & 7521 series.**

Refer to “I/O Expansion Bus in the 7188X/7188E User’ s Manual” for more information.

2.11.3 Parallel Bus Timing Diagram



2.11.4 I/O Expansion Boards

I/O expansion board for prototype & test:

Board	Descriptions	
X000	Prototype Board (Small size)	XA/XC
X001	Prototype Board (Large size)	XA/XC
X002	Prototype Board	XA/XB/XC/EX
X003	Self-test board for 7188XC	XC
X004	Self-test board for 7188XB/EX	XB/EX
X005	Prototype Board (small size)	XB/EX
X006	Prototype Board (Large size)	XB/EX
More.....		

I/O expansion board for D/I, D/O, D/I/O, or Timer/Counter :

X100	8 channels of D/I, 3.5V~30V	XC
X101	8 channels of D/O, TTL(64mA)	XC
X102	2 channels of relay output	XC
X103	7 channels of isolated D/I(3.5V ~ 30V)	XC
X104	8 channels of D/I/O(single channel programmable)	XC
X105	8 channels of D/I/O(8-channel programmable)	XC
X106	2*D/O or 3*D/I	XC
X107	6 channels of D/I + 7 channels of D/O	XB/XC
X400	3 channels 16-bit Timer/ Counter expansion Board	XC
More.....		

I/O expansion board for A/D,D/A:

X200	1 channel of 12-bit A/D(0~2.5V)	XC
X201	4 channels of 12-bit A/D(0~20mA)	XC
X202	7 channels of 12-bit A/D(0~20mA)	XB/EX
X204	2 channels of 12-bit A/D(+/- 1V)	XC
X300	2 channels of 12-bit D/A(0~4.095V)	XC
X301	1 channel of 12-bit A/D(0~2.5V) and 1 channel of 12-bit D/A(0~4.095V)	XC
X302	1 channel of 12-bit A/D(+/- 5V) and 1 channel of 12-bit D/A(+/- 5V)	XC
More.....		

I/O Expansion Board for A/D, D/A, D/I, D/O:

X203	2 channels of 12-bit A/D(0~20mA)	XB/EX
X303	1 channel of 12-bit A/D(+/- 5V) and 1 channel of 12-bit D/A(+/- 5V)	XB/EX
X304	3 channels of 12-bit A/D(+/- 5V) and 1 channel of 12-bit D/A(+/- 5V)	XB/EX
X305	7 channels of 12-bit A/D(+/- 5V) and 1 channel of 12-bit D/A(+/- 5V)	XB/EX
More.....		

I/O Expansion Board for RS-232/422, D/I, D/O:

X500	1 channel of RS-232, modem control, 115.2K max.	XC
X501	1 channel of 4-wire RS-232 (RTS, CTS, TXD, RXD), 115.2K max	XC
X502	1 channel of 4-wire RS-232 (RTS, CTS, TXD, RXD) & 1 channel of 2-wire RS-232 (TXD, RXD) ,115.2K max	XC
X503	1 channel of 4-wire RS-232 (RTS, CTS, TXD, RXD), 115.2K max	XB/EX
X504	1 channel of 4-wire RS-232 (RTS, CTS, TXD, RXD) & 1 channel of 8-wire RS-232 (RI,DCD,DTR,DSR,CTS,RTS, CTS, TXD, RXD) ,115.2K max	XB/EX
X505	1 channel of 4-wire RS-232 (RTS, CTS, TXD, RXD), 115.2K max	XB/EX
X506	1 channel of 2-wire RS-232 (TXD, RXD), 115.2K max	XB/EX
X507	1 channel of 4-wire RS-422/485 and DI/O (RXD3+, RXD3-, TXD3+, RXD3-) , 115.2K max	XB/EX
X508	1 channel of 4-wire RS-232 and DI/O (RTX,CTX,TXD, RXD) , 115.2K max	XB/EX
X509	1 channel of 2-wire RS-232 and DI/O (TXD, RXD), 115.2K max	XB/EX
X510	1 channel of 2-wire RS-232/485 and DI/O , RS-232(TXD, RXD) , RS-485(D+,D-),115.2K max	XB/EX
More.....		

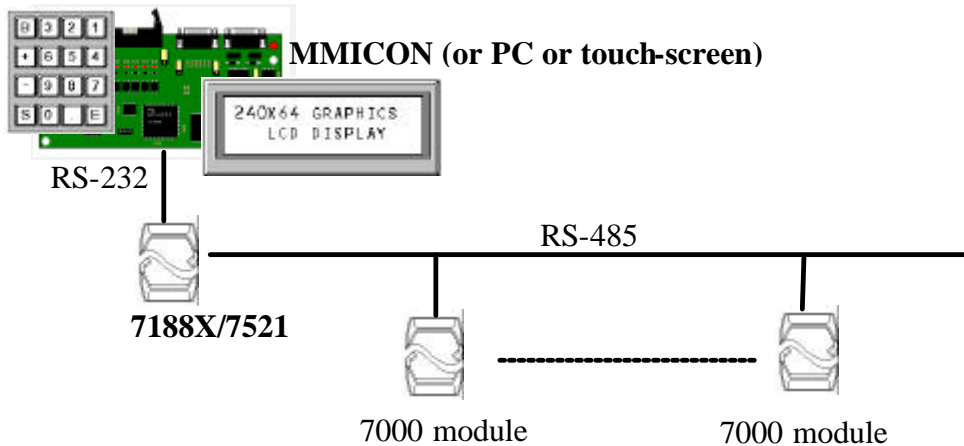
I/O Expansion Board for storage devices:

X600/2	2M bytes NAND Flash	XA/XB/XC/EX
X600	4M bytes NAND Flash	XA/XB/XC/EX
X601	8M bytes NAND Flash	XA/XB/XC/EX
X602	16M bytes NAND Flash	XA/XB/XC/EX
X603	32M bytes NAND Flash	XA/XB/XC/EX
X607	128K battery backup SRAM	XA/XB/XC/EX
X608	512K battery backup SRAM	XA/XB/XC/EX
More.....		

Refer to “I/O Expansion Bus in the 7188X/7188E User’s Manual” for more information.

3. Applications

3.1 Embedded Controllers



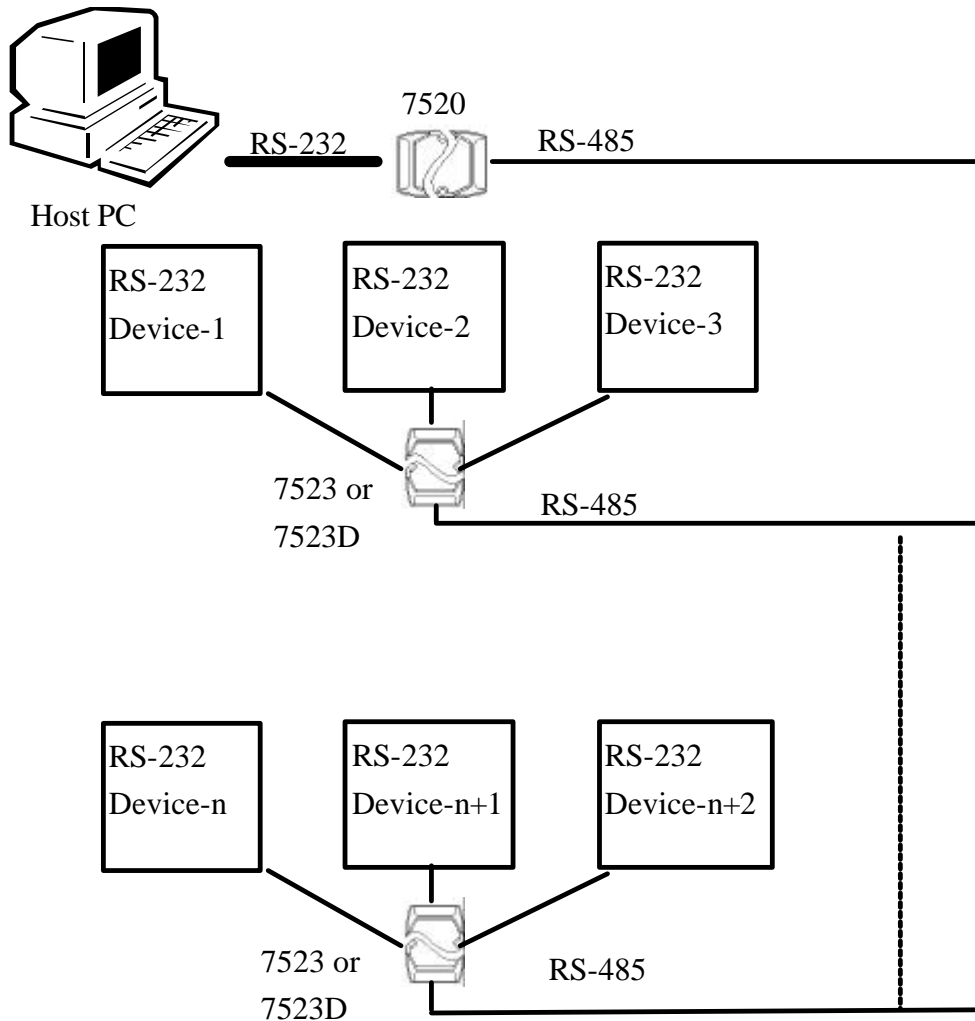
Applications:

- 4500 replacement & enhancement (not compatible)
- PC-Based controller replacement
- PLC replacement
- Special controller replacement

The 7188X/7521 series can be use as embedded controller for general applications. Therefore it can be used to replace PC, PLC or special controllers.

Programming Tool	TC/MSC/BC
Debug Tool	Via standard input/output (keyboard & monitor of PC)
Man Machine Interface	<ul style="list-style-type: none"> ● MMICON ● Keyboard & monitor of PC ● Touch Screen (RS-232 or RS-485 interface)
Program	Stored in Flash ROM
Input/Output	<ul style="list-style-type: none"> ● Onboard D/I or D/O ● From I/O Expansion Bus ● 7000 series modules, can directly control 256 modules = thousands of I/O points

3.2 Addressable RS-232 Protocol Converter



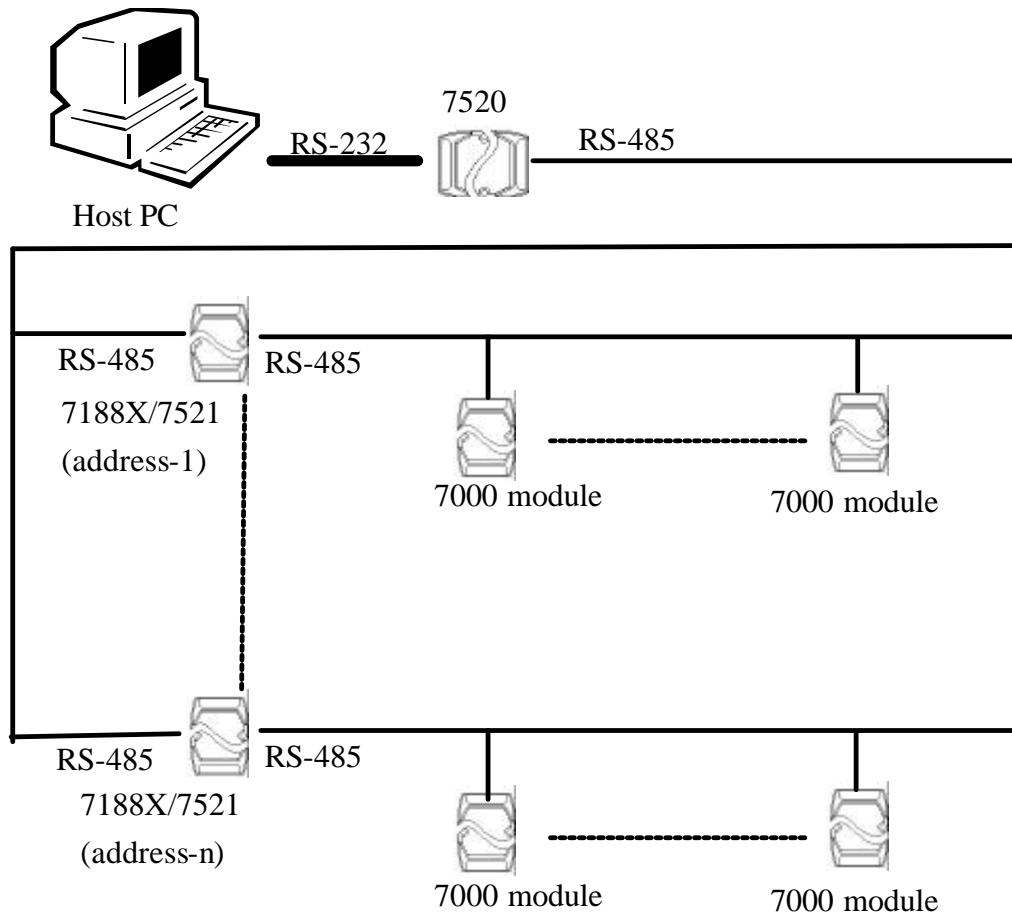
Applications:

- **4521 replacement & enhancement**
- **Multiple RS-232 devices networking**

The key points are given as following:

- Connect RS-232 devices to COM1/3/4 of 7523/7523D
- Connect COM2 of 7523/7523D to RS-485 network
- 7523/7523D communicates to its local RS-232 devices & stores data. Host PC communicates to every 7523/7523D for reading data from these RS-232 devices.

3.3 Local Real Time Controller



The 7000 series modules are slave devices; the control programs are implemented in host PC. The working steps are given as follows:

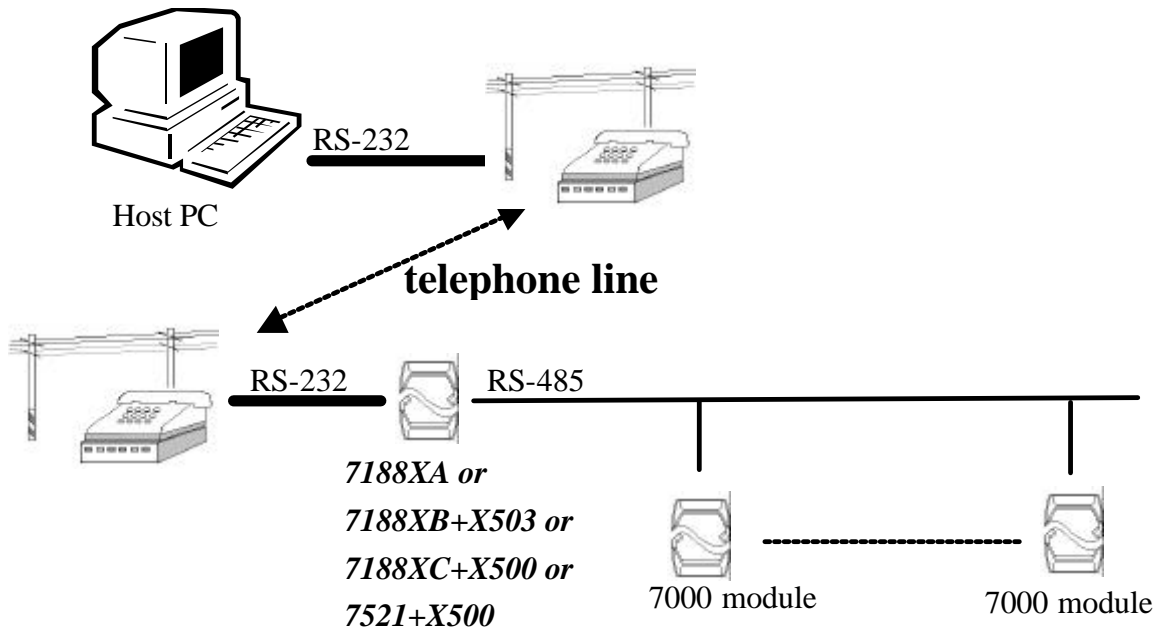
1. PC sends out commands to 7000 modules for input data.
2. PC analyzes this input data & generates some output data
3. PC send out commands to 7000 modules for output data

If there are hundreds of 7000 modules, the PC will take a long time to analyze & control these modules.

The control program can be implemented in a local 7188X/7521. The PC only has to send control arguments to the 7188X/7521, the 7188X/7521 will control the local 7000 modules based on these control arguments. In this way, the PC can handle thousands of 7000 modules with the 7188X/7521.

Some control functions are **timing critical**. The local 7188X/7521 can handle these functions without the PC in real time.

3.4 Remote Local Controller



The control program is implemented in a local 7188X. The 7188X will directly control the 7000 modules based on these control arguments.

The PC can access the remote 7188X for the following items:

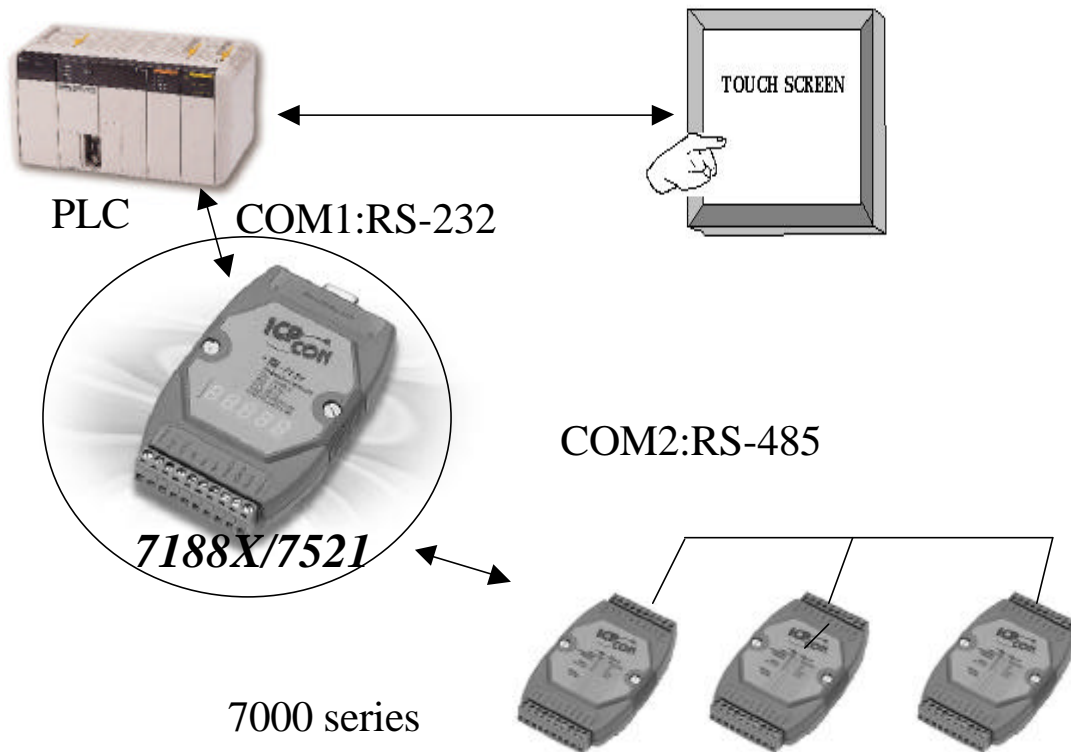
- Query & record the remote system status
- Download the control arguments to remote 7188X

The remote 7188X can communicate to the PC for the following items:

- Emergency events call back
- Remote system status send back

Note: the 7188XA can directly control the modem. The 7188XB must add a X503 to control the modem. The 7188XC/7521 must add a X500 to control the modem.

3.5 I/O Expansion of PLC applications



There is a Man Machine Interface in most PLCs. This interface is originally designed for MMI applications. The 7188X/7521 can use this interface to build a bridge between PLC & 7000 modules.

The 7188X/7521 can directly read/write the internal memory of the PLC. Therefore the **PLC can access the 7000 input modules** as follows:

1. The 7188X/7521 sends commands to the 7000 input modules
2. The 7188X/7521 writes this data to the PLC's internal memory
3. The PLC accesses this data from the internal memory

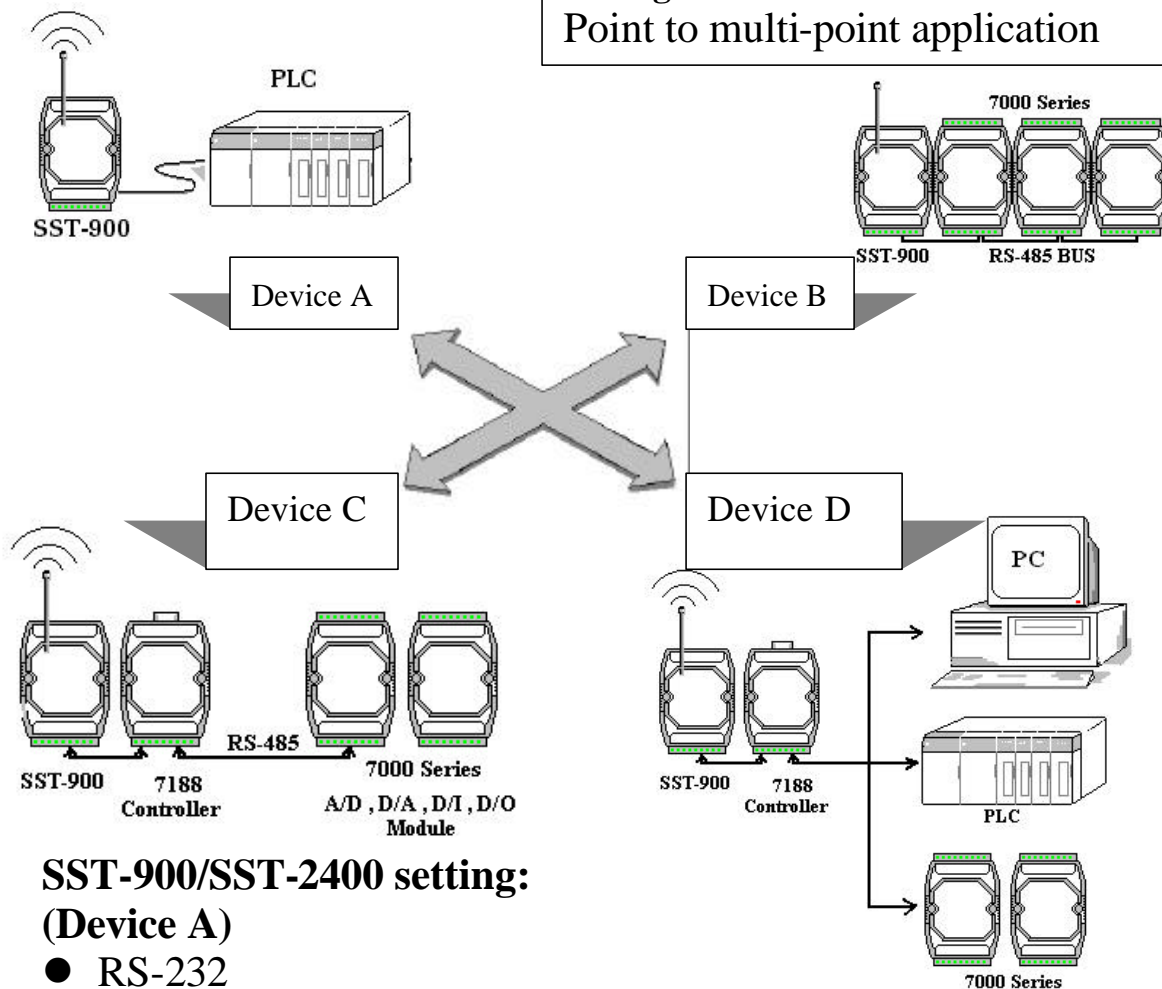
The **PLC can control the 7000 output modules** as follows:

1. The PLC writes data to its internal memory
2. The 7188X/7521 reads this output data from the PLC's memory
3. The 7188X/7521 sends commands to the 7000 output modules

In this way, the input data of the 7000 modules can be shown on the touch screen. Also, the user can control the output of the 7000 modules from the touch screen.

3.6 Radio Modem Applications

Configuration 3
Point to multi-point application



SST-900/SST-2400 setting: (Device A)

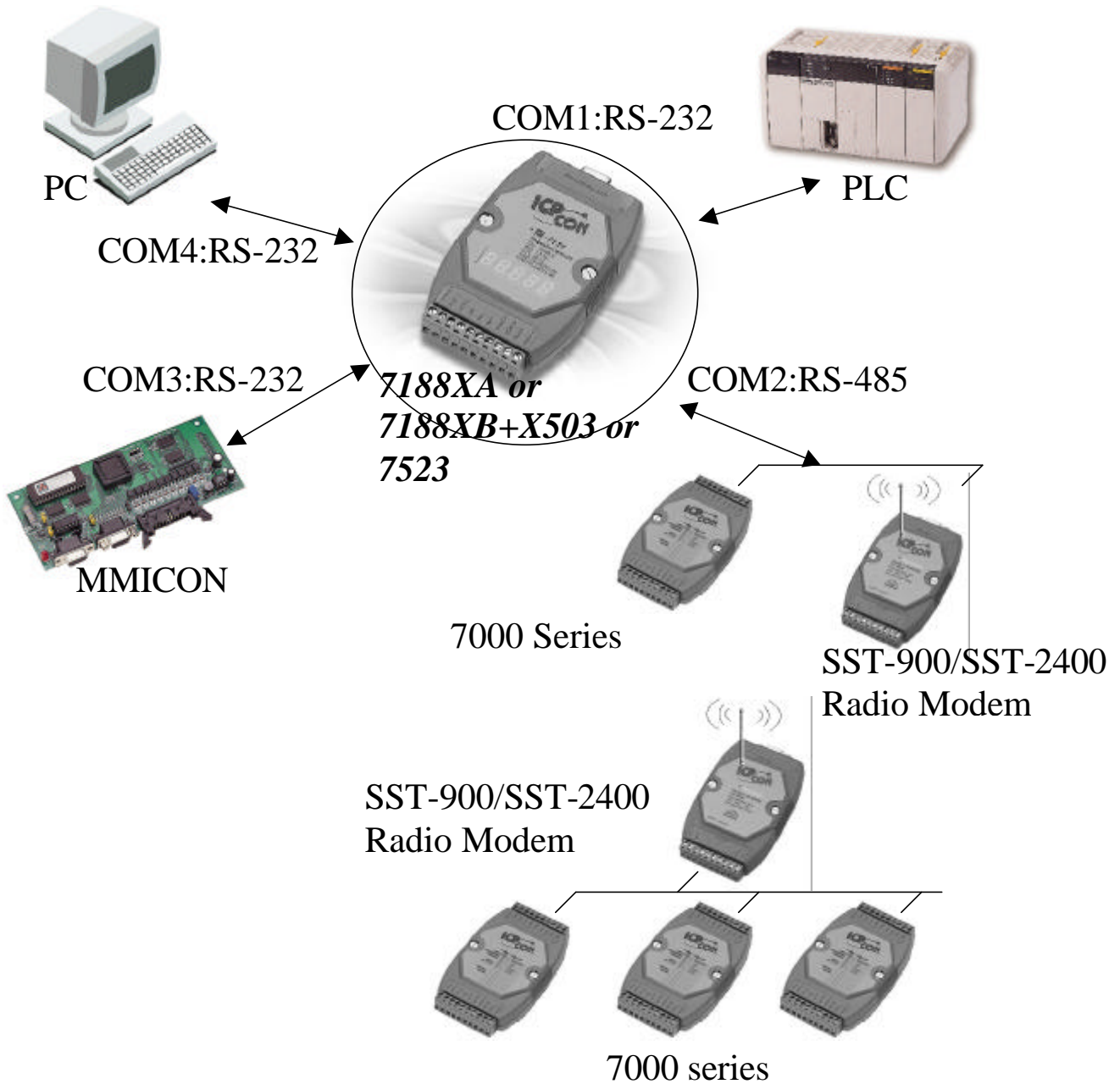
- RS-232
- Half-duplex mode
- Synchronous way
- Slave state
- Baud rate=9600
- Channel=3
- Frequency=915.968MHz

The 7188X/7521 series is an embedded controller. Because the 7188X/7521 series is programmable, **it can be used as a bridge between the SST-900 & external devices.** These devices can be PLC, controller or 7000 modules.

SST-900/SST-2400 setting: (Device B/C/D)

- RS-485 or RS-232
- Half-duplex mode
- Synchronous way
- Slave state
- Baud rate=9600
- Channel=3
- Frequency=915.968MHz

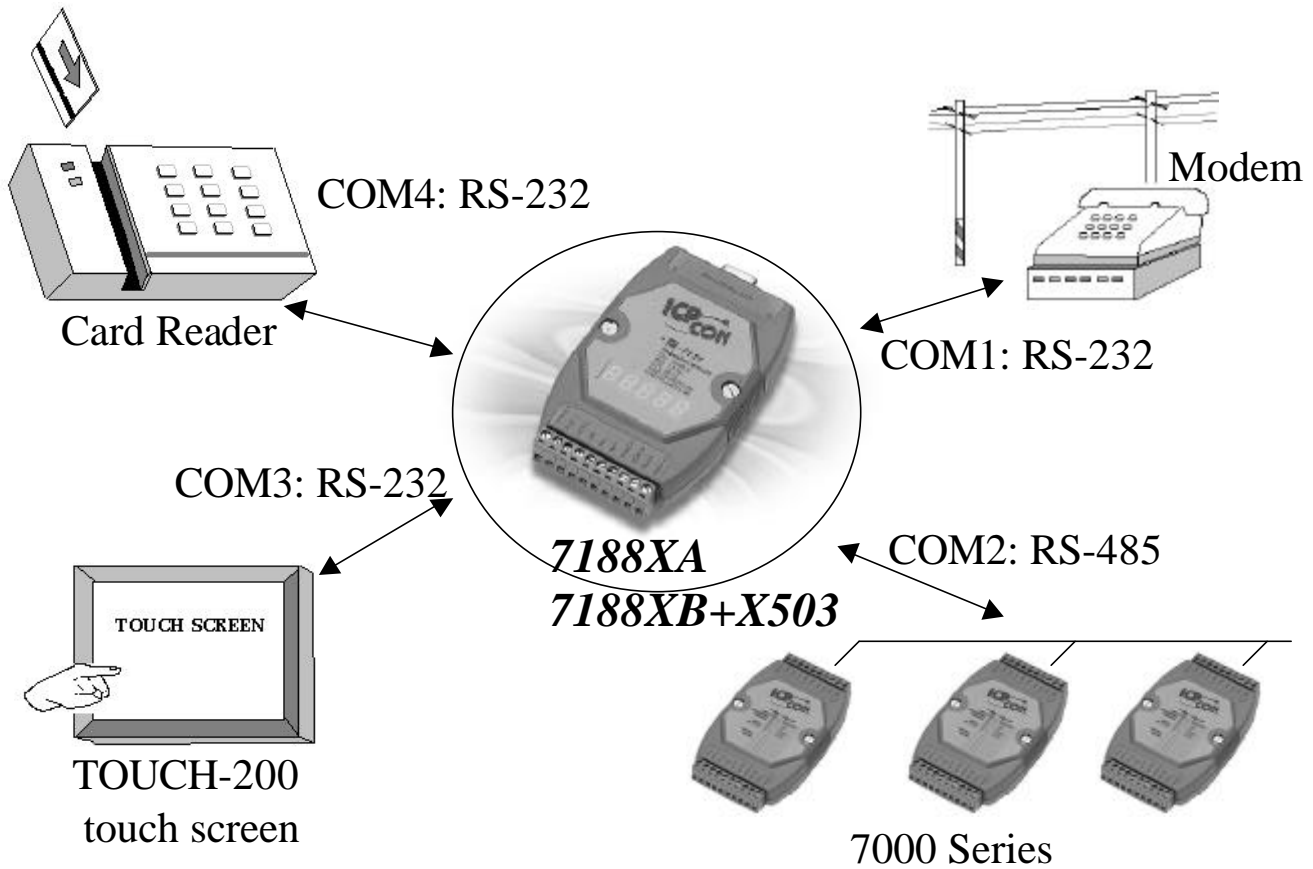
3.7 Using 4 COM port Application-1



- COM1: PLC can access the I/O states of 7000 modules
- COM2: Directly controls the 7000 input/output modules
- COM3: MMICON is used as the local MMI
- COM4: PC is used to monitor & record the system data.

Note: the 7188XA/7523 has 4 COM port. The 7188XB must add a X503 for 4-COM port applications.

3.8 Using 4 COM port Application-2



COM1: link to remote host PC

COM2: Directly controls the 7000 input/output modules

COM3: TOUCH-200 is used as the local MMI

COM4: Card reader is used as standard input device.

Note: this application is for the 7188XA or the 7188XB+X503