Model ISO-COM485/2
Product Manual

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Mission Critical Applied Computing Solutions

FOREWORD

This product manual provides information to install, operate and or program the referenced product(s) manufactured or distributed by ICS Advent. The following pages contain information regarding the warranty and repair policies.

Check our Web site (*www.icsadvent.com*) for technical information, manuals, and BIOS updates. Technical assistance is also available at: **800-480-0044** (U.S.) or **858-677-0877** (international).

Customer Comments: If you experience any problems with this manual or just want to provide some feedback, please send us a message using the online "Service Form" on our Web site (*www.icsadvent.com*) under "Support." Detail any errors you find. We will correct the errors or problems as soon as possible and post the revised manual in our online Support Library. Thank you.

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Guarantee

A thirty day money-back guarantee is provided on all **standard** products sold. **Special order products** are covered by our Limited Warranty, *however they may not be returned for refund or credit. EPROMs, RAM, Flash EPROMs or other forms of solid electronic media are not returnable for credit - but for replacement only. Extended Warranty available. Consult factory.*

Refunds

In order to receive a refund on a product for the purchase price, the product must not have been damaged by the customer or by the common carrier chosen by the customer to return the goods and the product must be returned complete (meaning all manuals, software, cables, etc.) within 30 days of receipt and in an as-new and resalable condition. The **Return Procedure** must be followed to assure prompt refund.

Restocking Charges

Product returned *after* 30 days, and *before* 60 days, of the purchase will be subject to a **minimum** 20% restocking charge and charges for any damaged or missing parts. Products not returned within 60 days of purchase, or products which are not in an as-new and re-saleable condition, are not eligible for credit return and will be returned to the customer.

Limited Warranty

Effective April 1, 1998, all products carry a 2-year limited warranty. Within two years of purchase, ICS Advent will repair or replace, at our option, any defective product. ICS Advent will service the warranty for all standard catalog products for the first two years from the date of shipment. Please note: The 2-year warranty may not apply to special promotion items. Please consult the factory for warranty verification.

The limited warranty is void if the product has been subjected to alteration, neglect, misuse, or abuse; if any repairs have been attempted by anyone other than ICS Advent or its authorized agent; or if the failure is caused by accident, acts of God, or other causes beyond the control of ICS Advent or the manufacturer. Neglect, misuse, and abuse shall include any installation, operation, or maintenance of the product other than in accordance with the user's manual.

No agent, dealer, distributor, service company, or other party is authorized to change, modify, or extend the terms of this Limited Warranty in any manner whatsoever. ICS Advent reserves the right to make changes or improvements in any product without incurring any obligation to similarly alter products previously purchased.

Shipments not in compliance with this Guarantee and Limited Warranty Return Policy will not be accepted by ICS Advent.

Return Procedure

For any Guarantee or Limited Warranty return, please contact ICS Advent's Customer Service at **800-480-0044** (U.S.) or **858-677-0877** (international) and obtain a Return Material Authorization (RMA) Number. All product(s) returned to ICS Advent for service or credit **must** be accompanied by a Return Material Authorization (RMA) Number. Freight on all returned items **must** be prepaid by the customer who is responsible for any loss or damage caused by common carrier in transit. Returns for Warranty **must** include a Failure Report for each unit, by serial number(s), as well as a copy of the original invoice showing date of purchase.

To reduce risk of damage, returns of product must be in an ICS Advent shipping container. If the original container has been lost or damaged, new shipping containers may be obtained from ICS Advent Customer Service at a nominal cost.

ICS Advent owns all parts removed from repaired products. ICS Advent uses new and reconditioned parts made by various manufacturers in performing warranty repairs and building replacement products. If ICS Advent repairs or replaces a product, its warranty term is not extended.

ICS Advent will normally return your replacement or repaired items via Second Day Air. Overnight delivery or delivery via other carriers is available at an additional charge.

Limitation of Liability

In no event shall ICS Advent be liable for any defect in hardware, software, loss, or inadequacy of data of any kind, or for any direct, indirect, incidental, or consequential damages in connection with or arising out of the performance or use of any product furnished hereunder. ICS Advent liability shall in no event exceed the purchase price of the product purchased hereunder. The foregoing limitation of liability shall be equally applicable to any service provided by ICS Advent or its authorized agent.

Some *Sales Items* and *Customized Systems* are **not** subject to the guarantee and limited warranty. However in these instances , any deviations will be disclosed prior to sales and noted in the original invoice. ***ICS Advent reserves the right to refuse returns or credits on software or special order items.***

Advisories

Three types of advisories are used throughout the manual to stress important points or warn of potential hazards to the user or the system. They are the Note, the Caution, and the Warning. Following is an example of each type of advisory:

Note: The note is used to present special instruction, or to provide extra information which may help to simplify the use of the product.

CAUTION!

A Caution is used to alert you to a situation which if ignored may cause injury or damage equipment.

WARNING!

A Warning is used to alert you of a situation which if ignored will cause serious injury.

Cautions and Warnings are accented with triangular symbols. The exclamation symbol is used in all cautions and warnings to help alert you to the important instructions. The lightning flash symbol is used on the left hand side of a caution or a warning if the advisory relates to the presence of voltage which may be of sufficient magnitude to cause electrical shock.

Use caution when servicing any electrical component. We have tried to identify the areas which may pose a Caution or Warning condition in this manual; however, ICS Advent does not claim to have covered all situations which might require the use of a Caution or Warning.

You must refer to the documentation for any component you install into a computer system to ensure proper precautions and procedures are followed.

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Chapter 1: Installation

Backing up the Disk

The software provided with the ISO-COM485/2 card is in MS-DOS on diskette. As with any software package, you should make backup copies for everyday use and place your original master diskette in a safe location.

The easiest way to make a backup copy is to use the DOS DISKCOPY utility.

In a single-drive system the command is diskcopy a: a:

In a two-drive system the command is diskcopy a: b:

(This will copy the master disk in drive A to the backup disk in drive B.)

Hard Disk Installation

The files contained on the master diskette may also be copied onto your hard disk. To do this perform the following:

1.) Place the master diskette into a floppy drive.
2.) Change the active drive to the drive that has the master diskette installed. For example, if the diskette is the A drive, type a:
3.) Type install and follow the screen prompts.

Files contained on the disk are stored in separate directories as follows:

ISO-COM485/2:	The root or base directory that contains the FINDBASE PROGRAM that will help you to decide what base address to use with the card. Also contains the ICOM2SET.EXE setup program.
PSAMPLES:	Contains Pascal samples.
CSAMPLES:	Contains “C” samples.
BSAMPLES:	Contains the QuickBASIC samples.
VBACCES:	VisualBASIC utility driver that includes PEEK and POKE statements for reading and writing RAM as well as INPORT and OUTPORT for reading and writing I/O. The driver is in the form of a DLL and allows you to access hardware as if the language was designed for it when you use VisualBASIC for Windows. (VB 4.0 supported separately)

Installing the Card

The ISO-COM485/2 card can be installed in a long slot of an IBM PC/XT/AT or compatible computer. Before installing the card carefully read the **OPTION SELECTION** and **ADDRESS SELECTION** sections of this manual and configure the card according to your requirements. You can find an unused base address with the FINDBASE program provided on the diskette that came with your card. Finally, our ICOM2SET setup program will lead you through the process of setting the options on the ISO-COM485/2. The setup program does not set the options on the card, these must be set by jumpers on the card.

Be especially careful with address selection. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

To install the card:

1. Turn off computer power.
2. Remove the computer cover.
3. Remove the blank I/O backplate.
4. Install jumpers for selected options from either the **Option Selection** of this manual or the suggestions of our ICOM2SET setup software program.
5. Select the base address on the card for either the **Address Selection** of this manual or the suggestions of our FINDBASE setup software program.
6. Install the card in an I/O expansion slot.

   Note: If installed in an eight-bit slot, IRQ's 10-15 will be unavailable.
7. Install the I/O cable.
8. Inspect for proper fit of the card and cable and tighten screws.
9. Turn the computer ON and observe the LED indicators. The LED's will blink when there is any activity on the communication lines.
10. Turn the computer OFF and replace the computer cover.

Chapter 2: Functional Description

The card is 10 inches long and should be installed in long slots of IBM PC/XT/AT or compatible computers. If installed in an eight-bit slot, the high interrupts (IRQ 10-15) will not be available to the ISO-COM485/2.

Multipoint Opto-Isolated Communications

The ISO-COM485/2 Serial Interface Card was designed for multipoint transmission on long communication lines in noisy environments using RS-422 or RS-485 differential line drivers. The data lines are opto-isolated from the computer and from each other to assure communication when large common mode noise are superimposed. Opto-isolators are provided on the RTS and CTS control lines as well as the transmit and receive lines. Further, an on-board DC-DC converter provides isolated power for the line driver and RTS and CTS circuits.

A crystal oscillator is located on the card. This oscillator permits precise selection of baud rate from 50 to 115,200 but the standard opto-isolators are limited to a maximum speed of 38,400 baud. Faster opto-isolators and custom crystals are available. If your card is modified to handle higher baud rates, then there will be a "manual addendum" page describing that modification in the front of this manual.

The output transceiver used, type 75176B, is capable of driving extremely long communication lines at high baud rates. It can drive up to ±60mA on balanced lines and receive inputs as low as ±200mV differential signal superimposed on common mode noise of ± 12V. However, opto-isolators on the card provide protection to maximum 500 V. In case of communication conflict, the transceivers feature thermal shutdown.

Com Port Compatibility

Type NS16550 UART's are used as the Asynchronous Communication Element (ACE) which include a 16-byte transmit/receive buffer to protect against lost data in multitasking operating systems, while maintaining 100% compatibility with the original IBM serial port.

ISO-COM485/2 card is not restricted to the standard DOS addresses of COM1 - COM4. You can select a base address anywhere within the I/O address range 000 to 3F8 hex and the FINDBASE program will scan your computer for available addresses.

Line BIAS and Termination

For increased noise immunity, the communication lines may be loaded at the receiver and biased at the transmitter. RS-485 communications requires that one transmitter supply a bias voltage to ensure a known "zero" state when all transmitters are off, and the last receiver input at each end of the network be terminated to prevent "ringing". The ISO-COM485/2 supports these options with jumpers on the card. See the **Option Selection** section for more details.

Auto and Manual Transceiver Control

RS485 communications requires the transmitter driver to be enabled and disabled as needed, to allow all cards to share the communications line. The ISO-COM485/2 card has two methods to control the driver: automatic (AUTO) and request to send (RTS) control.

With automatic control, the driver is enabled when data is ready to be transmitted. The driver remains enabled for the transmission time of one character after data transfer is complete. The ISO-COM485/2 automatically adjusts it's timing to the baud rate of the data. When operating with Windows programs, you must use the AUTO mode

With RTS control, your software must set the RTS bit to a logic 1 to enable the driver and logic 0 to disable the driver.

LED Monitors

Two LED indicators are provided on the ISO-COM485/2 card. The LED's blink to indicate activity on the transmitting and receiving lines and are useful for problem diagnosis. The blinking is more visible at slower speeds as high speed communication blinks the LED's too fast for the eye to follow.

Communication Modes

Model ISO-COM485/2 supports Simplex, Half-Duplex, and Full-Duplex communications in a variety of 2- and 4-wire cable connections. Simplex is the simplest form of communications with transmissions occurring only in one direction. Half-Duplex allows traffic to travel in both directions, but only one direction at a time. In Full-Duplex mode data travels in both directions at the same time. RS-485 communication only supports half-duplex because the same pair of signal lines are used for transmitting and receiving.

How to remain CE Compliant

This device complies with CE Directives 72/23/EEC and EMC 89/336/EEC. CE compliance is based on the interaction of all the components of a system. Any modifications made to the equipment may affect the CE compliance and must be approved in writing by Industrial Computer Source. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to claim CE compliance.

The Model ISO-COM485/2 is designed to be CE Compliant when used in an CE compliant chassis. Maintaining CE Compliance also requires proper cabling and termination techniques. The user is advised to follow proper cabling techniques from sensor to interface to ensure a complete CE Compliant system. Industrial Computer Source does not offer engineering services for designing cabling or termination systems. Although Industrial Computer Source offers accessory cables and termination panels, it is the user's responsibility to ensure they are installed with proper shielding to maintain CE Compliance.

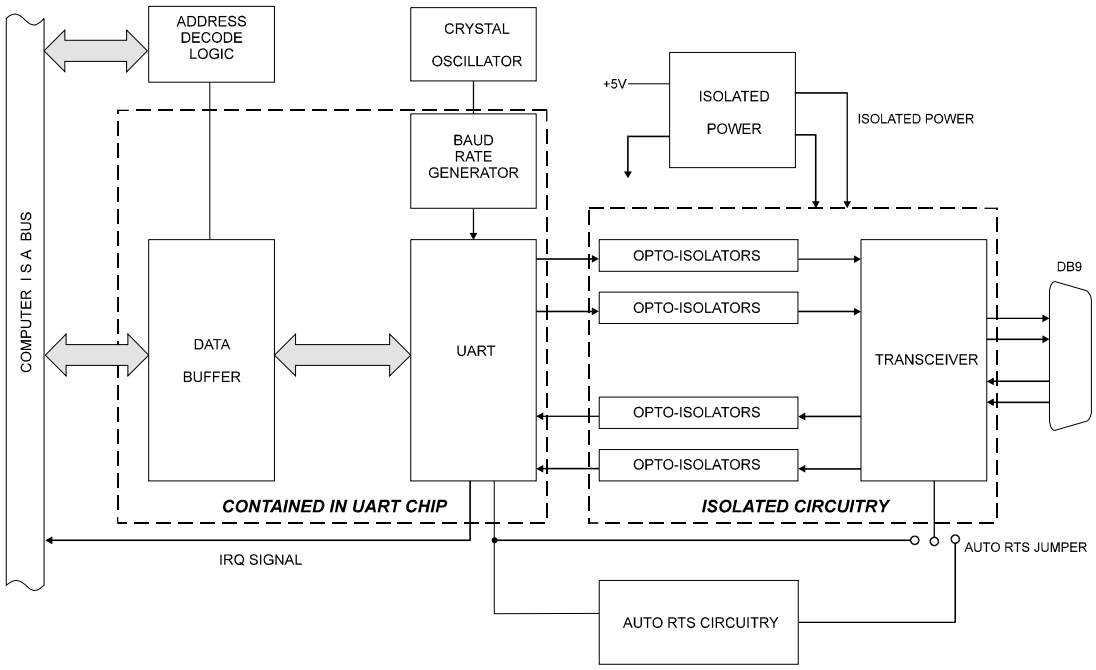

Figure 1: ISO-COM485/2 Block Diagram

(Only one serial channel shown)

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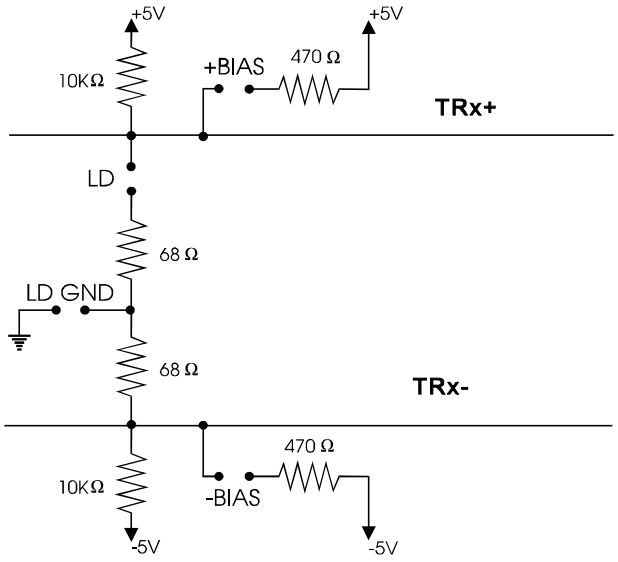
Chapter 3: RS-422/485 Option Selection

The following paragraphs describe the functions of the various jumpers on the ISO-COM485/2 card. Refer to the **OPTION SELECTION MAP** on page 3-3 for the locations of these jumpers on the card.

CTS: *Serial communications will not operate without this signal.* The function of the CTS jumper is to provide the signal when it is not applied externally. If you prefer, you can omit this jumper and install a jumper between CTS and +5VDC on the mating D connector. This jumper in the cabling provides a handy diagnostic tool because the card will not operate unless the cable is properly installed.

TERMINATIONS AND BIAS: A transmission line should be terminated at the receiving end in its characteristic impedance. Installing a jumper at the location labeled LD applies a 136W load across the input for RS-422 mode and across the transmit/receive input/output for RS-485 operation. When noise is a potential problem on long lines, the terminating resistor should be divided and its center point grounded to help reduce noise voltage pickup. To accomplish this, also install a jumper at the position marked LD GND for 68-ohm termination resistance on the positive and negative branches of the receiving line.



In RS-485 operations, where there are multiple terminals, only the RS-485 ports at each end of the network should have terminating resistors as described above. If the card is to have an ungrounded load, do as above except do not install the LDGND jumper. (See **Appendix A**, Application Considerations.) Also, for RS-485 operation, there must be a bias on the RX+ and RX- lines. *If the ISO-COM485/2 card is to provide that bias, install jumpers at the locations labeled +BIAS and -BIAS.*

RTS CONTROL: For RS-485 operation, installing a jumper at the location labeled RTS allows the state of the RTS line to be controlled by the UART. Either this jumper, or the AUTO (A/B) jumper, must be installed.

AUTO (A/B): Allows the ACE data buffer to automatically control the transmitter drivers. When operating with Windows programs, use the AUTO mode.

SIMPLEX or DUPLEX: The receiver can be set in either SIMPLEX or DUPLEX by installing jumpers marked SX or DX. SIMPLEX mode is intended for one-way communication able to transmit or receive. DUPLEX mode allows transmission or reception either simultaneous or alternatively as defined in the following paragraph.

FULL or HALF DUPLEX: FULL DUPLEX allows simultaneous bidirectional communications and is selected by installing the FDX jumper. HALF DUPLEX allows bidirectional transmit and receiver communication but only one at a time, and is required for RS485 communications. Proper selection depends on the wire connections used to connect the two serial ports. Tx is the transmit wires and Rx is the receive wires.

Communication Modes and Cabling Options

				Cable	
MODE	JUMPERS			Card A	Card B
Simplex	2-wire Receive Only	DX-FDX	Rx	1	2
				9	3
Simplex	2-wire Transmit Only	SX-FDX	Tx	2	9
				3	1
Half Duplex	2-wire with local echo	DX-HDX-RTS	TRx^+	9	9
			TRx^-	1	1
Half Duplex	2-wire w/o local echo	SX-HDSX-RTS	TRx^+	9	9
			TRx^-	1	1
Full Duplex	4-wire w/o local echo	DX-FDX	Tx	2	9
				3	1
			Rx	1	3
				9	2

INTERRUPTS: In addition to standard interrupt levels IRQ2 through IRQ7, the ISO-COM485/2 also supports higher interrupts IRQ10 through IRQ15 (Except for IRQ13). Select the desired level by installing a jumper in one of these locations. If the ISO-COM485/2 is installed in a short eight-bit slot, the higher interrupts IRQ10 through IRQ15 will be unavailable to the card.

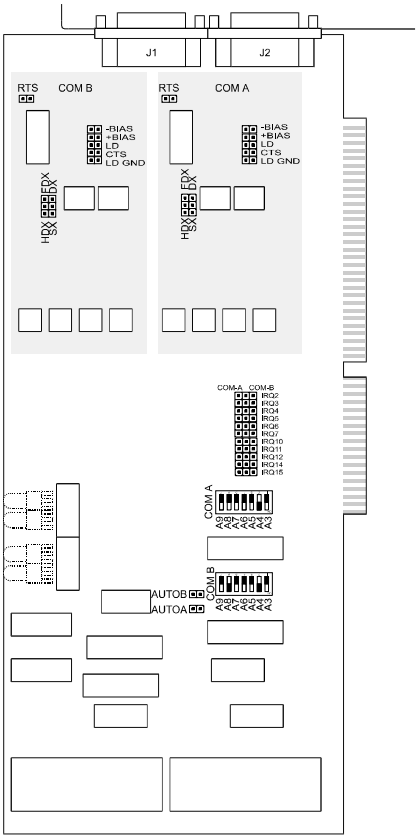


Figure 2: ISO-COM485/2 Option Selection Map

SWITCHES

S1=COM-A Address

S2=COM-B Address

(This illustration has COM A at the COM 3 address, and COM B at COM 4 address.)

JUMPERS

FDX/HDX=Full/Half Duplex

SX/DX=Simplex/Duplex

RTS=Software RTS option

AUTOA, AUTOB=Auto RTS option

BIAS=RS485 Bias Voltage

CTS=Forced CTS signal

LD,LDGND=Transmission Load Jumpers

(See the OPTION SELECTION section of the manual or the setup software for explanations of the above option jumpers)

CONNECTORS

J1=COM-B

J2=COM-A

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Chapter 4: Address Selection

The ISO-COM485/2 base address can be selected anywhere within an I/O address range 100-3F8 hex, providing that the address does not overlap with other functions. If in doubt, refer to the table below for a list of standard address assignments. (The primary and secondary binary synchronous communication ports are supported by the Operating System.) The base address locator program FINDBASE provided on diskette will assist you to select a base address that will avoid conflict with other installed computer resources.

Hex Range	Usage
000-0FF	Internal System - Not Usable
1F0-1FF	AT Hard Disk
200-207	Game Control
278-27F	Parallel Port (LPT2)
238-23B	Bus Mouse
2E8-2EF	Asynchronous Communications (COM4)
2F8-2FF	Asynchronous Communications (COM2)
300-31F	Prototype Card
320-32F	XT Hard Disk
378-37F	Parallel Port (LPT1)
380-38F	SDLC Communications
3A0-3AF	SDLC Communications
3B0-3BB	MDA
3BC-3BF	Alt. Parrallel Port
3C0-3CF	EGA
3DO-3DF	CGA
3E8-3EF	Asynchronous Communications (COM3)
3F0-3F7	Floppy Disk
3F8-3FF	Asynchronous Communications (COM1)

Table 1: Standard Address Assignments for PC and PC/XT Computers

I/O bus address switches are marked A3-A9. The following table lists switch label vs. the address line controlled and the relative weights of each.

Address Switch Settings	1st Digit		2nd Digit				3rd Digit
Switch Label	7	6	5	4	3	2	1
Address Line Controlled	A9	A8	A7	A6	A5	A4	A3
Decimal Weight	512	256	128	64	32	16	8
Hexadecimal Weight	200	100	80	40	20	10	8

Table 2: ISO-COM485/2 Address Switch Setup

In order to read the address switch setup, assign a binary "1" to switches that are turned OFF and a binary "0" to switches in the ON position. For example, as illustrated in the following table, switch selection corresponds to binary 10 1101 1xxx (hex 2D8). The "xxx" represents address lines A2, A1, and A0 used on the card to select individual registers. See **PROGRAMMING** section of this manual.

Switch Label	A9	A8	A7	A6	A5	A4	A3
Setup	OFF	ON	OFF	OFF	ON	OFF	OFF
Binary Represent'n	1	0	1	1	0	1	1
Conversion Factors	2	1	8	4	2	1	8
HEX Represent'n	2		D				8

Table 3: Example Address Setup

Review the **Address Selection Table** carefully before selecting the card address. If the addresses of two installed functions overlap you will experience unpredictable computer behavior.

The following table lists standard DOS ComPort addresses.

Serial COM Port	IRQ	Base Hex Address	Address Switch Settings						
			A9	A8	A7	A6	A5	A4	A3
COM1	IRQ 4	3F8	1	1	1	1	1	1	1
COM2	IRQ 3	2F8	1	0	1	1	1	1	1
COM3	IRQ 4	3E8	1	1	1	1	1	0	1
COM4	IRQ 3	2E8	1	0	1	1	1	0	1

Table 4: Standard DOS Com Port Addresses

Notice that only two interrupts are assigned to four serial ports. “Sharing” interrupts is not a good idea if both ports are used at the same time.

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Chapter 5: Programming

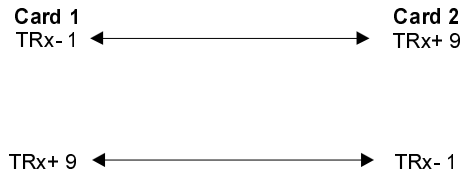
Sample Programs

There are two sample programs provided on diskette with the ISO-COM485/2 card.

Sample 1

This program is provided in C, Pascal, and QuickBASIC. It performs a test of the loopback feature of the UART. It requires no external hardware and no interrupts.

This program is provided in C only and demonstrates interrupt-driven RS485 operation. The program requires at least two computers with one card in each and a two-wire cable interconnecting them. This sample was designed for the 2-wire half-duplex without local echo cable as described on page 3-2 and illustrated below. The system also requires termination (LD jumpers) and bias (BIAS jumpers).



RS422 Programming

Programming for RS422 operation is a simplified version of RS485 communications, without the overhead of multiple devices on the same line. RS422 also supports multiple devices but only if one port is limited to transmitting and all the other ports are only receivers.

RS485 Programming

Programming the UART for RS485 communication can be divided into three distinct sections: initialization, reception, and transmission. Initialization deals with option setup on the chip including baud rate selection. Reception deals with incoming-character processing which can be done using either polling or interrupts. Transmission deals with the process of sending the data out.

Initialization

Initializing the chip requires knowledge of the UART's register set. The first step is to set the baud rate divisor. You do this by first setting the DLAB (Divisor Latch Access Bit) high. This bit is Bit 7 at Base Address +3. In C code, the call would be:

```
outportb(BASEADDR +3,0x80);
```

You then load the divisor into Base Address +0 (low byte) and Base Address +1 (high byte). The following equation defines the relationship between baud rate and divisor:

desired baud rate = (crystal frequency) / (32 * divisor)

On the ISO-COM485/2 card, the crystal frequency is 3.686 MHz. Below is a table for the popular divisor frequencies:

Baud Rate Divisors

Baud Rate	Divisor	Notes:	Cable length *
115200	1		375 feet
57600	2	High-speed opto-couplers required	660 ft
38400	3	Maximum speed for standard opto-couplers	920 ft
28800	4		1160 ft
19200	6		1620 ft
14400	8		2050 ft
9600	12	Most common industrial speed	4000 ft
4800	24		4000 ft
2400	48		4000 ft
1200	96		4000 ft

*These are theoretical maximums based on typical conditions and good quality cables.

In C, the code to set the chip to 9600 baud is:

```
outportb(BASEADDR, 0x0C);
outportb(BASEADDR +1,0);
```

The second initializing step is to set the Line Control Register at Base Address +3. This register defines word length, stop bits, parity, and the DLAB.

Bits 0 and 1 control word length and allow word lengths from 5 to 8 bits. Bit settings are extracted by subtracting 5 from the desired word length.

Bit 2 determines the number of stop bits. There can be either one or two stop bits. If Bit 2 is set to 0, there will be one stop bit. If Bit 2 is set to 1, there will be two stop bits.

Bits 3 through 6 control parity and break enable. They are not commonly used for communications and should be set to zeroes.

Bit 7 is the DLAB discussed earlier. It must be set to zero after the divisor is loaded or else there will be no communications.

The C command to set the UART for an 8-bit word, no parity, and one stop bit is:

```
outportb(BASEADDR +3, 0x03)
```

The third step of the initialization sequence is to set the Modem Control Register at Base Address +4. This register controls functions on some cards. Bit 1 is the Request to Send (RTS) control bit. This bit should be left low until transmission time. (Note: When operating in the automatic RS-485 mode, the state of this bit is not significant.) Bits 2 and 3 are user-designated outputs. Bit 2 may be ignored on this card. Bit 3 is used to enable interrupts and should be set high if an interrupt-driven receiver is to be used.

The final initialization step is to flush the receiver buffers. You do this with two reads from the receiver buffer at Base Address +0. When done, the UART is ready to use.

Reception

Reception can be handled in two ways: polling and interrupt-driven. When polling, reception is accomplished by constantly reading the Line Status Register at Base Address +5. Bit 0 of this register is set high whenever data are ready to be read from the chip. Polling is not effective at high data rates above because the program cannot do anything else when it is polling or data could be missed. The following code fragment implements a polling loop and uses a value of 13, (ASCII carriage return) as an end-of-transmission marker:

```
do
{
while (!(inportb(BASEADDR +5) & 1)); /*Wait until data ready*/
                data[i++]= inportb(BASEADDR);
}
   while (data[i]!=13);  /*Reads the line until null character rec'd*/
```

Interrupt-driven communications should be used whenever possible and is required for high data rates. Writing an interrupt-driven receiver is not much more complex than writing a polled receiver but care should be taken when installing or removing your interrupt handler to avoid writing the wrong interrupt, disabling the wrong interrupt, or turning interrupts off for too long a period.

The handler would first read the Interrupt Identification Register at Base Address +2. If the interrupt is for Received Data Available, the handler then reads the data. If no interrupt is pending, control exits the routine. A sample handler, written in C, is as follows:

```
readback = inportb(BASEADDR +2);
if (readback & 4)        /*Readback will be set to 4 if data are available*/
       data[i++]=inportb(BASEADDR);

outportb(0x20,0x20);          /*Write EOI to 8259 Interrupt Controller*/
return;
```

Transmission

RS485 transmission is simple to implement. The AUTO feature automatically enables the transmitter when data is ready to send so no software enabling procedure is needed.

The following software example is for non-AUTO operation. First the RTS line should be set high by writing a 1 to Bit 1 of the Modem Control Register at Base Address +4. The RTS line is used to toggle the transceiver from receive mode to transmit mode and vice versa. It is not carried out on the line in RS-485 and is not used for handshaking. Similarly, the CTS line is not used in RS-485 and should always be enabled by installing a jumper as described earlier.

After the above is done, the card is ready to send data. To transmit a string of data, the transmitter must first check Bit 5 of the Line Status Register at Base Address +5. That bit is the transmitter-holding-register-empty flag. If it is high, the transmitter has sent the data. The process of checking the bit until it goes high, followed by a write is repeated until no data remains. After all data has been transmitted, the RTS bit should be reset by writing a 0 to Bit 1 of the Modem Control Register.

The following C code fragment demonstrates this process:

```
outportb(BASEADDR +4, inportb(BASEADDR +4)|0x02) ;
  /*Set RTS bit without altering states of other bits*/
while(data[i]);   /*While there is data to send*/
{   /*Wait until transmitter is empty*/
          while(!(inportb(BASEADDR  +5)&0x20));  /*Wait  until  transmitter  is
empty*/
          outportb(BASEADDR,data[i]);
          i++;
}
outportb(BASEADDR +4, inportb(BASEADDR +4)&0xFD);
/*Reset RTS bit without altering states of other bits*/
```

Chapter 6: Connector Pin Assignments

The popular 9-pin D subminiature connector is used for interfacing to communication lines. The connector is equipped with 4-40 threaded standoffs (female screw lock) to provide strain relief. Connector pin assignments are as follows:

PIN CONNECTIONS

Pins			RS422	RS485
Pin 1	-	Rx-	Receive Data (Complementary Input)	TRx -
Pin 2	-	Tx+	Transmit Data (Output)	
Pin 3	-	Tx-	Transmit Data (Complementary Output)	
Pin 4	-		Not Used	
Pin 5	-	Gnd	Isolated Common (Ground)	Ground
Pin 6	-	+5V	Isolated 5V Supply	
Pin 7	-	RTS	Request to Send (Output)	
Pin 8	-	CTS	Clear to Send (Input)	
Pin 9	-	Rx+	Receive Data (Input)	TRx +

Note: For Simplex, Half Duplex, and Full Duplex operation, see the **Option Selection** section of this manual for pin connection information.

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Chapter 7: Specifications

Communications Interface

Serial Ports:	Two shielded male D-sub 9-pin IBM AT style connectors compatible with RS-422 and RS-485 specifications. Serial communications ACE used is type NS16550. Transceivers used are type 75176.
Serial Data Rates:	50 to 38,400 baud.(Optionally up to 230,400 baud), Asynchronous, Type 16550 buffered UART.
Address:	Continuously mappable within 000 to 3FF (hex) range of AT I/O bus addresses.
Multipoint:	Compatible with RS422 and RS485 specifications. Up to 32 drivers and receivers allowed on line.
Input Isolation:	500 Volts, from computer and between ports.
Receiver Input Sensitivity:	±200 mV, differential input.
Transmitter Output Drive Capability:	60 mA (100 mA short-circuit current capability).

Environmental:

Operating Temperature Range:	0 to +60 °C
Storage Temperature Range:	-50 to +120 °C
Humidity:	5% to 95%, non-condensing.
Power Required:	+5VDC at 150 mA typical, +12 VDC at 200 mA typical., 3 W total power consumption.
Size:	10_ " long. (3/4 length) Although designed for a full-length slot, if the card is installed in a eight-bit XT-style slot the card will work but higher order IRQ's 10-15 will be unavailable.)

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ADDENDUM

IRQGEN.VXD and Win32IRQ.DLL

IRQGEN.VXD

Description

IRQGEN.VXD is a Virtual Device Driver, or VxD, for Windows95. Together with Win32IRQ.DLL, it allows a program to easily respond to hardware interrupt requests, or IRQs.

Installation

To install IRQGEN.VXD, copy it to C:\Windows\System. If your hard drive has a letter other than C, substitute the appropriate letter. It is not necessary to reboot your system prior to using IRQGEN.VXD.

Win32IRQ.DLL

Description

Win32IRQ.DLL is a Dynamic Link Library, of DLL, for Windows95. It provides a simple interface to IRQGEN.VXD, allowing a program to easily respond to hardware interrupts. Three functions are exported by Win32IRQ.DLL: *InitIRQ,, Detect IRQ,* and *SendEOI.* To use these functions in a program, they must first be inported. In Pascal, the necessary lines would be:

```
function InitIRQ (MyIRQ: Byte) : Boolean; stdcall;external 'Win32IRQ.dll'
   index 1;
function DetectIRQ:  Boolean; stdcall; external "Win32IRQ.dll"index 2;
function SendEOI:  Boolean; stdcall; external "Win32IRQ.dll" index 3;
```

In C, the library file Win32IRQ.lib must first be linked to the program. This is accomplished by adding it to the project or editing the makefile. The following lines would then create the prototypes for the DLL functions:

```
extern "c" _declspec (dllimport) bool pascal InitIRQ (unsigned char MyIRQ);
extern "c" _declspec (dllimport) bool pascal DetectIRQ (void);
extern "c" _declspec (dllimport) bool pascal SendEOI (void) ;
```

InitIRQ

This function performs the initialization required to detect IRQs. It must be called before *DetectIRQ*and *SendEOI* can be called, although calling those functions first will only cause them to return a value of FALSE. The function's sole parameter is an unsigned 8-bit value containing the IRQ number to monitor. The return result is TRUE if initialization was compledted successfully, FALSE if not.

DetectIRQ

This function suspends the thread that it was called from and waits for an IRQ to occur on the IRQ number that was passed to *InitIRQ*. *DetectIRQ* will return immediately, however, if an IRQ occured anytime before the *DetectIRQ* call, as long as an IRQ number was initialized with *InitIRQ*. Otherwise, *DetectIRQ* will not return until an IRQ occurs. If the program needs to continue running while waithing for *DetectIRQ,* a separate thread should be spawned from which to call *DetectIRQ*. The return result is TRUE if an IRQ was successfully detected on the given IRQ number, FALSE if no IRQ was initialized before the call. There are no parameters.

SendEOI

This function sends an end of interrupt message to the VxD. It must be called after an IRQ is detected of the interrupt will remain in the system. The return result is TRUE if the EOI message was successfully sent, FALSE if not. There are no parameters.

Appendix A: Application Considerations

Introduction

Working with RS-422 and RS-485 devices is not much different from working with standard RS-232 serial devices and these two standards overcome deficiencies in the RS-232 standard. First, the cable length between two RS-232 devices must be short; less than 50 feet at. Second, many RS-232 errors are the result of noise induced on the cables. The RS-422 standard permits cable lengths up to 5000 feet and, because it operates in the differential mode, it is more immune to induced noise.

Connections between two RS-422 devices (with CTS ignored) should be as follows:

Device #1			**Device #2**		
Signal	**9 pin**	**25 pin**	**Signal**	**9 pin**	**25 pin**
Gnd	5	7	Gnd	5	7
TX^+	2	24	RX^+	9	12
TX^-	3	25	RX^-	1	13
RX^+	9	12	TX^+	2	24
RX^-	1	1	TX^-	3	25

A third deficiency of RS-232 is that more than two devices cannot share the same cable. This is also true for RS-422 *but RS-485 offers all the benefits of RS-422 plus allows up to 32 devices to share the same twisted pairs*. An exception to the foregoing is that multiple RS-422 devices can share a single cable if only one will talk and the others will all receive.

Balanced Differential Signals

The reason that RS-422 and RS-485 devices can drive longer lines with more noise immunity than RS-232 devices is that a balanced differential drive method is used. In a balanced differential system, the voltage produced by the driver appears across a pair of wires. A balanced line driver will produce a differential voltage from ±2 to ±6 volts across its output terminals. A balanced line driver can also have an input “enable” signal that connects the driver to its output terminals. If the “enable” signal is OFF, the driver is disconnected from the transmission line. This disconnected or disabled condition is usually referred to as the “tristate” condition and represents a high impedance. RS485 drivers must have this control capability. RS-422 drivers may have this control but it is not always required.

A balanced differential line receiver senses the voltage state of the transmission line across the two signal input lines. If the differential input voltage is greater than +200 mV, the receiver will provide a specific logic state on its output. If the differential voltage input is less than -200 mV, the receiver will provide the opposite logic state on its output. A maximum operating voltage range is from +6V to -6V allows for voltage attenuation that can occur on long transmission cables.

The maximum common mode voltage rating provides good noise immunity from voltages induced on the twisted pair lines. The signal ground line connection is necessary in order to keep the common mode voltage within that range. The circuit may operate without the ground connection but may not be reliable.

RS422 Specification Summary

Parameter	Conditions	Min.	Max.
Driver Output Voltage (unloaded)		4V	6V
		4V	-6V
Driver Output Voltage (loaded)	LD and LDGND	2V	
	jumpers in	-2V	
Driver Output Resistance			50 Ohms
Driver Output Short-Circuit Current			±150 mA
Driver Output Rise Time			10% unit interval
Receiver Sensitivity			±200 mV
Receiver Common Mode Voltage Range			±7V
Receiver Input Resistance			4K Ohms

To prevent signal reflections in the cable and to improve noise rejection in both the RS-422 and RS-485 mode, the receiver end of the cable should be terminated with a resistance equal to the characteristic impedance of the cable. (An exception to this is the case where the line is driven by an RS-422 driver that is never "tristated" or disconnected from the line. In this case, the driver provides a low internal impedance that terminates the line at that end.)

Note: You do not have to add a terminator resistor to your cables when you use the ICOM-2S card. Termination resistors for the RX^+ and RX^- lines are provided on the card and are placed in the circuit when you install the LD and LDGND jumpers. Moreover, installing the +BIAS and -BIAS jumpers properly biases these lines. (See the **Option Selection** section of this manual.)

RS-485 Data Transmission

The RS-485 Standard allows a balanced transmission line to be shared in a party-line mode. As many as 32 driver/receiver pairs can share a two-wire party line network. Many characteristics of the drivers and receivers are the same as in the RS-422 Standard. One difference is that the common mode voltage limit is extended and is +12V to -7V. Since any driver can be disconnected (or tristated) from the line, it must withstand this common mode voltage range while in the tristate condition.

RS-485 Two-Wire Multidrop Network

The following illustration shows a typical multidrop or party line network. Note that the transmission line is terminated on both ends of the line but not at drop points in the middle of the line.

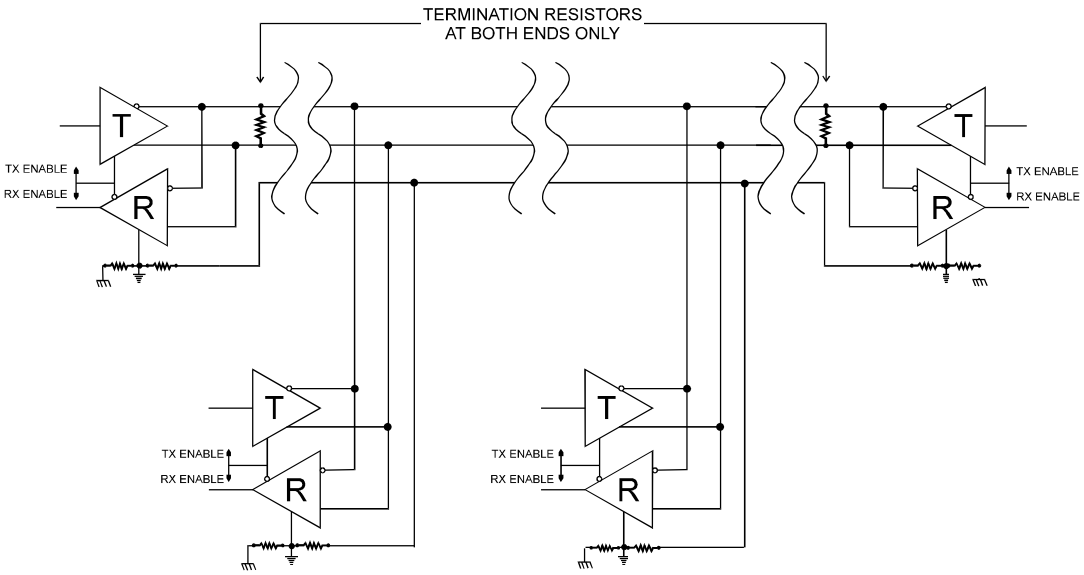

Figure 3: Typical RS-485 Two-Wire Multidrop Network

RS-485 Four Wire Multidrop Network

An RS-485 network can also be connected in a four-wire mode. In a four-wire network it's necessary that one node be a master node and all others be slaves. The network is connected so that the master communicates to all slaves and all slaves communicate only with the master. This has advantages in equipment that uses mixed protocol communications. Since the slave nodes never listen to another slave's response to the master, a slave node cannot reply incorrectly.

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Declaration of Conformity

Information Technology Equipment

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San Diego, CA 92121-4371
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The product(s) covered by this declaration:

ISO-COM485/2

The European Union directives covered by this declaration:

EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC

The basis on which conformity is declared:

EN 50081-1:1992 Emissions, Generic Requirements
-EN 55022 Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment

EN 50082-1:1992 Immunity, Generic Requirements
-EN61000-4-2:1995 Electrostatic Discharge (ESD) Immunity
-EN61000-4-3:1995 Radiated RF Field Immunity
-EN61000-4-4:1995 EFT Immunity for AC and I/O Lines

EN 60950:1992 Safety of Information Technology Equipment

The technical documentation required to demonstrate this product meets the requirements of the EMC Directive and the Low Voltage Directive has been compiled by ICS Advent and is available for inspection by the relevant enforcement authorities. The CE mark was first applied in 2000.

Attention

The attention of the specifier, purchaser, installer, or user is drawn to special measures and limitations for use which must be observed when the product is taken into service to maintain compliance with the above directives. Details of these special measures and limitations are in the product manual.

Mr. Jim Jameson
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