INDUSTRIAL COMPUTER SOURCE®

Model FP104 Series
Product Manual

MANUAL NUMBER : 00750-009-2A

INDUSTRIAL COMPUTER SOURCE®

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FORWARD

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

Technical assistance is available at: **1-800-480-0044**.

Manual Errors, Omissions and Bugs: A "Bug Sheet" is included as the last page of this manual. Please use the "Bug Sheet" if you experience any problems with the manual that requires correction.

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February 1996

Chapter 1: Introduction

Overview

The FP104 series provides four selectable RS-232 or RS-422/485 serial I/O ports for your PC/104 application.

What's Included

The FP104 is shipped with the following items. If any of these items are missing or damaged, contact the supplier.

- FP104 Serial Interface Adapter
- DB-9 Cable Assemblies
- Nylon Hardware Kit
- 3.5" Serial Utility Diskette
- User Manual

Factory Default Settings

The FP104 factory default settings are as follows:

	Base Address	IRQ
Port 1	3F8	4
Port 2	2F8	3
Port 3	3E8	4
Port 4	2E8	3

For your reference, record installed FP104 settings below:

	Base Address	IRQ
Port 1		
Port 2		
Port 3		
Port 4		

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Chapter 2: Card Setup

The FP104 contains several jumper straps for each port which must be set for proper operation.

Address Selection

The FP104 occupies four port addresses with each port occupying 8 consecutive I/O locations. A dip switch (SW1) is used to set the port address options for the FP104. Be careful when selecting the port addresses as some selections may conflict with existing ports. The following table shows the addressing options available with the standard PAL.

Port1 J2	Port2 J3	Port3 J4	Port4 J5	SW1 1	SW1 2	SW1 3	SW1 4
3F8	2F8	3E8	2E8	On	On	On	On
2F8	3E8	2E8	2E0	On	On	On	Off
3E8	2E8	280	288	On	On	Off	On
280	288	290	298	On	On	Off	Off
2A0	2A8	2B0	2B8	On	Off	On	On
500	508	510	518	On	Off	On	Off
580	588	590	598	On	Off	Off	On

Figure 1: Address Selection Table

DOS NOTE: Typically COM1: through COM4: addresses are 3F8 , 2F8, 3E8 & 2E8 Hex (this is the first addressing option in the above table). If a COM1: is already present use the second addressing option, this will provide the typical addresses for COM2: through COM4: and a fourth port address at 2E0 Hex

XENIX NOTE: If you do not have a COM1: installed, use base address 500 Hex and IRQ 4 for COM1:. If you already have a COM1: installed, then select base address 580 Hex and IRQ3 (XENIX COM2:)

Port #	Connector Location
1	J2
2	J3
3	J4
4	J5

Figure 2: Port to Connector Table

IRQ Selection

Headers E1-E4 select the Interrupt Request (IRQ) for each serial port. E3 selects the IRQ selection for Port 1, E4 for Port 2, E5 for Port 3, and E6 for Port 4. If COM1: is selected, this jumper must be on the IRQ4 setting. If COM2: is selected, this jumper must be on IRQ3. Consult your particular software for IRQ selection. If no interrupt is desired, remove the jumper.

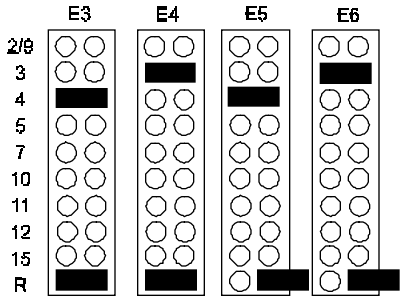


Figure 3: Headers E3, E4, E5, E6 - IRQ Selection

Position “R” is provided so that you can install a jumper that connects a 1K ohm pull-down resistor to the output of a high-impedance tri-state driver which carries the IRQ signal. Because the IRQ line is driven low only by the pull-down resistor you can have two or more boards which share the same IRQ signal. Position “R” installed is the default setting and should be left on unless multiple ports or cards are sharing a single IRQ. If multiple ports or cards are sharing a single IRQ then only one pull-down resistor is needed in the circuit.

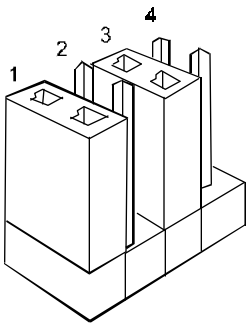
RS-485 Mode (RTS Enable)

E1 & E2 select whether the RS-485 driver is enabled by the UART signal Request To Send (RTS) or always enabled. With the jumper installed, RTS enables the RS-485 driver. Removing the jumper enables the driver regardless of RTS. The jumper should be installed for a 2/4 wire RS-485 application where the FP104 is acting as a polled node on a multi-drop network. Remove the jumper if you are using a point to point RS-422 application such as Programmable Logic Controllers (PLC’s), etc. Half-duplex two-wire operation is also possible by connecting TX+ to RX+ and TX- to RX- in your cable hood

To enable the driver with RTS install jumpers at E1-1 for Port 1, E1-3 for Port 2, E2-1 for Port 3 and E2-3 for Port 4. Failure to correctly set this jumper can cause transmitter contention problems preventing operation by any nodes on the network.

Note: By connecting the TX+ to the RX+ and TX- to RX- you will experience a condition termed RS-485 “Echo”. This means that when you transmit a data character it will be “Echoed” back through the receiver circuit, presenting itself as a received data character. This can be useful in RS-485 communications by providing a benchmark for the end of transmission (i.e. when the amount of received data available equals the transmit data count). The RS-485 “Echo” can be disabled at E1 and E2. To disable the echo install a jumper at E1-2 for Port 1, E1-4 for Port 2, E2-2 for Port 3 and E2-4 for Port 4.

The following example shows the drivers in the RS-485 mode and the echo enabled.



E1-1	Port 1 RS-485 Enable
E1-2	Port 1 RS-485 Echo Disable
E1-3	Port 2 RS-485 Enable
E1-4	Port 2 RS-485 Echo Disable
E2-1	Port 3 RS-485 Enable
E2-2	Port 3 RS-485 Echo Disable
E2-3	Port 4 RS-485 Enable
E2-4	Port 4 RS-485 Echo Disable

Figure 4: Headers E1 and E2 - RS-485 Enable and Echo Selection

Interface Selection

Due to the versatility of the FP104, a wide range of interface configuration options are available to the end user. Please use this section as a guide in configuring your board to provide the interface you require.

RS-232

Make sure that the 75175 drivers at U7 & U5 and the Dip resistor pack at RP3 have been removed (if previously installed). By installing MAX234 drivers at U2 & U3, the board will be configured as RS-232.

RS-422/485

Make sure that the MAX234 drivers at U2 & U3 have been removed (if previously installed). By installing 75174 drivers at U7 & U5 and installing a 100 ohm Dip resistor at RP3 the board will be configured as RS-422.

Combined RS-232 & RS-422/485

On the FP104 two ports of RS-232 and two ports of RS-422/485 is possible, but it is somewhat complicated to configure. The configuration requires that you selectively bend (or float) pins on the Dip resistor pack out of the socket. Please use the following table as a guide in configuring the FP104 in this manner.

Configuration	Drivers	RP-15 Pin Positions
Ports 1 & 2 RS-232	U2 & U6 Installed	Pins 1-4 “Floated”
Ports 3 & 4 RS-422	U5 & U3 Removed	All Others Installed
Ports 1 & 2 RS-422	U5 & U3 Installed	Pins 5-8 “Floated”
Ports 3 & 4 RS-232	U2& U6 Removed	All Others Installed

Chapter 3: Installation

Extreme care should be taken when installing the FP104 to avoid causing damage to the connectors. After the adapter is installed, connect your I/O cables to J2-J4. Please note, these headers are keyed so that pin 1 of the cable matches pin 1 of the connector. Refer to Card Setup for information on setting the address and jumper options before inserting the FP104 onto the stack.

1. Turn off PC power. Disconnect the power cord.
2. Remove the PC case cover (if applicable).
3. Gently insert the FP104 connector P1 and noting proper key orientation of the expansion connector on a PC/104 compatible card. The C4-104 adapter is keyed per the PC/104 Revision 2.1 Specification. This will aid in preventing the adapter from being inserted incorrectly.
4. Mounting hardware (nylon stand-offs and screws) is provided to insure a good mechanical connection. Retain any mounting hardware not used to allow for future expansion.
5. The cables provided are keyed and can be installed before or after the adapter is inserted in the stack.
6. Replace the cover.
7. Connect the power cord.

Installation is complete.

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Chapter 4: Technical Description

The FP104 provides four RS-232/422/485 serial ports, utilizing a 16554 UART. This chip features programmable baud rate, data format, interrupt control and a 16 byte input and output FIFO. This UART is essentially four 16550 compatible UARTs in a 68 pin PLCC package.

Features

- PC/104 compatible “Stack Through” connector for universal mounting.
- 5 volt DC operation.
- DB-9P interface cables provided for ease in connecting.
- All mounting hardware provided.
- Supports TD, RD, RTS, CTS signals
- Compatible with 16550 specific software.

Connector Pin assignments

RS-232

Signal	Name	Pin #	Mode
GND	Ground	5	
TD	Transmit Data	3	Output
RTS	Request To Send	7	Output
RD	Receive Data	2	Input
CTS	Clear To Send	8	Input

Figure 5: RS-232 Connector Pin Assignments

Note: These pin assignments meet the EIA/TIA/ANSI-574 DTE for DB-9 type connectors. These are the only pins that can be connected in your cable for RS-232. If any other connections are made your data may become corrupted.

RS-422/485

Signal	Name	Pin #	Mode
TX +	Transmit Data Positive	4	Output RS-422
TX-	Transmit Data Negative	3	Output RS-422
RTS+	Request To Send Positive	6	Output RS-422
RTS-	Request To Send Negative	7	Output RS-422
GND	Ground	5	
RX+	Receive Data Positive	1	Input RS-422
RX-	Receive Data Negative	2	Input RS-422
CTS+	Clear To Send Positive	9	Input RS-422
CTS-	Clear To Send Negative	8	Input RS-422

Figure 6: RS-422/485 Connector Assignments

Status Port

The FP104 also provides the user with an interrupt status register for greater throughput when servicing multiple ports on a single interrupt line. The interrupt status register is a read only 8-bit register that sets a corresponding bit when an interrupt is pending. Port 1 interrupt line corresponds with bit D0 of the status port, Port 2 with bit D1, Port 3 with bit D2, and Port 4 with bit D3. Bits D4-D7 of the status port are not used and will return zeros. The status register allows your system to reduce the amount of polling required to service up to four ports.

The Status Port is located at Base+7 on each port (example: Base=280 Hex, status port=287, 28F, 297, and 29F Hex. All four status ports on the FP104 are identical, so any one of the four can be read.

Example: This indicates that Port 2 has an interrupt pending.

Bit Position:	7	6	5	4	3	2	1	0
Value Read:	0	0	0	0	0	0	1	0

Chapter 5: Specifications

Environmental Specifications

Temperature Range

Operating

0º to 50º C (32º to 122º F)

Storage

-20º to 70º C (-4º to 158º F)

Humidity Range

Operating

10 to 90% R.H. Non-Condensing

Storage

10 to 90% R.H. Non-Condensing

Manufacturing

- IPC 610-A Class-III standards are adhered to with a 0.1 visual A.Q.L. and 100% Functional Testing.
- Printed Circuit boards are built to U.L. 94V0 rating and are 100% electrically tested. These printed circuit boards are solder mask over bare copper or solder mask over tin nickel.

Power Consumption

Supply line

+5 VDC

Rating

130 mA

Mean Time Between Failures (MTBF)

Greater than 150,000 hours. (Calculated)

Physical Dimensions

The FP104 is PC/104 “Compliant” meaning that it conforms to all non-optional aspects of the PC/104 Specification including both mechanical and electrical specifications.

Board Length

3.775 inches (9.588 cm)

Board Width

3.550 inches (9.017 cm)

Appendix A: Troubleshooting

A Serial Utility Diskette is supplied with the adapter and will be used in the troubleshooting procedures. By using this diskette and following these simple steps, most common problems can be eliminated without the need to call Technical Support.

- Identify all I/O adapters currently installed in your system. This includes your on-board serial ports, controller cards, sound cards etc. The I/O addresses used by these adapters, as well as the IRQ (if any) should be identified.
- Configure your adapter so that there is no conflict with currently installed adapters. No two adapters can occupy the same I/O address. Refer to the section on Card Setup for help in choosing an I/O address.
- Make sure the adapter is using a unique IRQ. While the adapter does allow the sharing of IRQ's, many other adapters (i.e. SCSI adapters & on-board serial ports) may not. The ability to share IRQ's in a PC/104 system is an optional feature and does not need to be implemented to claim PC/104 compatibility/compliance. The IRQ is typically selected via an on-board header block. Refer to the section on Card Setup for help in choosing an IRQ.
- Make sure the adapter is securely installed in a PC/104 stack .
- Use the supplied diskette and User Manual to verify that the adapter is configured correctly. The supplied diskette contains a diagnostic program "SSD" that will verify if an adapter is configured properly. This diagnostic program is written with the user in mind and is easy to use. Refer to the "README.txt" file on the supplied diskette for detailed instructions on using "SSD".

The following are known I/O conflicts:

- The 278 and 378 settings may conflict with your printer I/O adapter.
- 3B0 cannot be used if a Monochrome adapter is installed.
- 3F8-3FF is typically reserved for COM1:
- 2F8-2FF is typically reserved for COM2:
- 3E8-3EF is typically reserved for COM3:
- 2E8-2EF is typically reserved for COM4: This is a valid setup option for the C-104. However, since only 10 address lines are actually decoded, a possible conflict with an advanced video card emulating the IBM XGA adapter (8514 register set) may occur.

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Appendix B: Electrical Interface

RS-232

Quite possibly the most widely used communication standard is RS-232. This implementation has been defined and revised several times and is often referred to as RS-232 or EIA/TIA-232. The IBM PC computer defined the RS-232 port on a 9 pin D sub connector and subsequently the EIA/TIA approved this implementation as the EIA/TIA-574 standard. This standard is defined as the 9-Position Non-Synchronous Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange. Both implementations are in wide spread use and will be referred to as RS-232 in this document. RS-232 is capable of operating at data rates up to 20 Kbps at distances less than 50 ft. The absolute maximum data rate may vary due to line conditions and cable lengths. RS-232 often operates at 38.4 Kbps over very short distances. The voltage levels defined by RS-232 range from -12 to +12 volts. RS-232 is a single ended or unbalanced interface, meaning that a single electrical signal is compared to a common signal (ground) to determine binary logic states. A voltage of +12 volts (usually +3 to +10 volts) represents a binary 0 (space) and -12 volts (-3 to -10 volts) denotes a binary 1 (mark). The RS-232 and the EIA/TIA-574 specification defines two type of interface circuits, Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE). The adapter is a DTE interface.

RS-422

The RS-422 specification defines the electrical characteristics of balanced voltage digital interface circuits. RS-422 is a differential interface that defines voltage levels and driver / receiver electrical specifications. On a differential interface, logic levels are defined by the difference in voltage between a pair of outputs or inputs. In contrast, a single ended interface, for example RS-232, defines the logic levels as the difference in voltage between a single signal and a common ground connection. Differential interfaces are typically more immune to noise or voltage spikes that may occur on the communication lines. Differential interfaces also have greater drive capabilities that allow for longer cable lengths. RS-422 is rated up to 10 Megabits per second and can have cabling 4000 feet long. RS-422 also defines driver and receiver electrical characteristics that will allow 1 driver and up to 32 receivers on the line at once. RS-422 signal levels range from 0 to +5 volts. RS-422 does not define a physical connector.

RS-485

RS-485 is backwardly compatible with RS-422; however, it is optimized for partyline or multi-drop applications. The output of the RS-422/485 driver is capable of being Active (enabled) or Tri-State (disabled). This capability allows multiple ports to be connected in a multi-drop bus and selectively polled. RS-485 allows cable lengths up to 4000 feet and data rates up to 10 Megabits per second. The signal levels for RS-485 are the same as those defined by RS-422. RS-485 has electrical characteristics that allow for 32 drivers and 32 receivers to be connected to one line. This interface is ideal for multi-drop or network environments. RS-485 tri-state driver (not dual-state) will allow the electrical presence of the driver to be removed from the line. Only one driver may be active at a time and the other driver(s) must be tri-stated. The output modem control signal Request to Send (RTS) controls the state of the driver. Some communication software packages refer to RS-485 as RTS enable or RTS block mode transfer. RS-485 can be cabled in two ways, two wire and four wire mode. Two wire mode does not allow for full duplex communication, and requires that data be transferred in only one direction at a time. For half-duplex operation, the two transmit pins should be connected to the two receive pins (Tx+ to Rx+ and Tx- to Rx-). Four wire mode allows full duplex data transfers. RS-485 does not define a connector pin-out or a set of modem control signals. RS-485 does not define a physical connector.

Appendix C: PC/104

What is PC/104?

The PC has become extremely popular in both general purpose (desktop) and dedicated (embedded) applications. Unfortunately the PC has been hampered by the large size required to maintain PC compatibility. PC/104 addresses this by optimizing the PC bus in a form factor designed for embedding.

Briefly, the needs of embedded applications have been satisfied by PC/104, through the following key differences from the standard “AT” bus computer:

- Reducing the form factor, to 3.550 by 3.775 inches
- Eliminating the need for backplanes or card cages, through its self-stacking bus
- Minimizing component count and power consumption (to typically 1-2 Watts per module) by reducing required bus drive on most signals to 4 mA.

Questions about the PC/104 consortium can be sent to :

PC/104 Consortium
P.O. Box 4303
Mountain View, CA 94040
(415) 903-8304 Ph. (415) 967-0995 Fax

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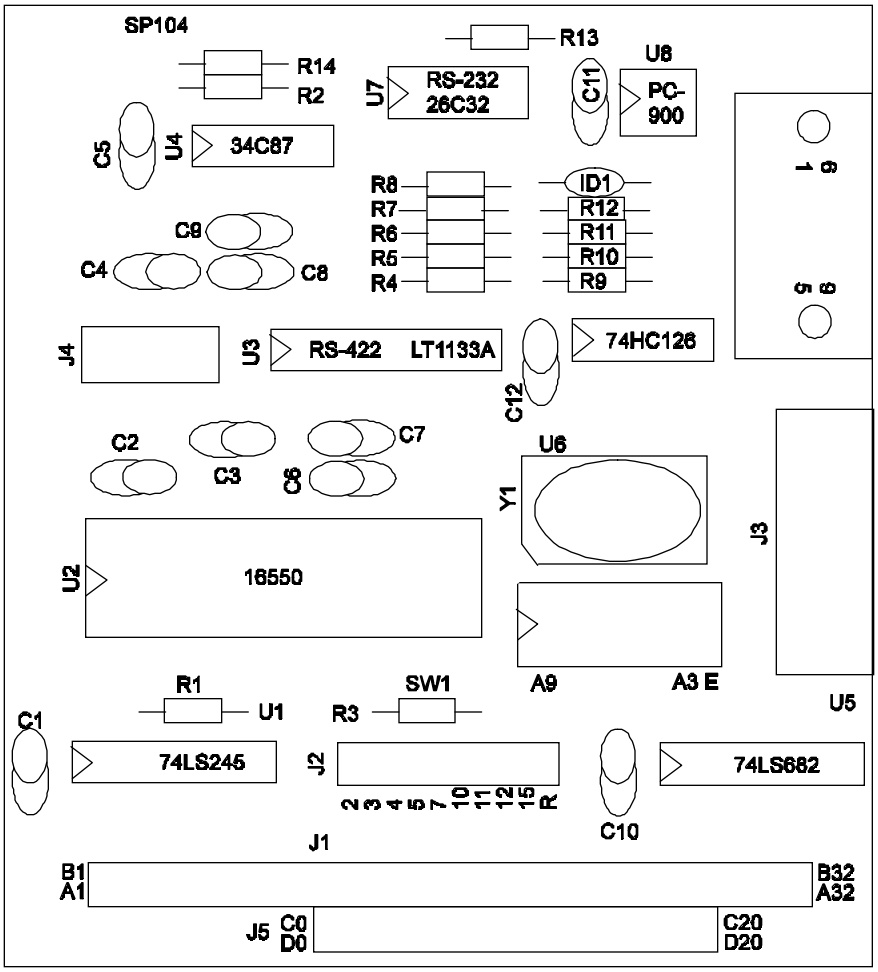
Appendix D: Silk-Screen



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Appendix E: Schematics

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BUG REPORT

While we have tried to assure this manual is error free, it is a fact of life that works of man have errors. We request you to detail any errors you find on this BUG REPORT and return it to us. We will correct the errors/problems and send you a new manual as soon as available. Please return to:

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Product: **FP104 Series**

Manual Revision: **00750-009-2A**

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