ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Vista Electronics LM104-P50-3* at our website: ***Click HERE***

ELECTRONICS, INC.

LM104-P50

LonWorks™ Network Interface Module for the PC/104 bus standard

Installation and Usage Guide

27525 Newhall Ranch Road Unit #1
Valencia, CA 91355 USA

Tel 1-800-VISTA-99 (800 847-8299)
Tel +1-661-294-9820
Fax +1-661-294-9857

http://www.vistaelectronics.com
e-mail: vista@vistaelectronics.com

Version 2.0, Revised June 2001.
The VISTA logo and LM104-P50 are trademarks of VISTA Electronics, Inc.
Any other product names are trademarks of their respective holders.
All materials Copyright © 2001 VISTA Electronics, Inc., All Rights Reserved.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TABLE OF CONTENTS

Product Overview 1

Module Setup 2

Jumper Settings 3

Software Driver Installation 5

Cable Grounding and Termination 7

Troubleshooting 10

Appendices

- A. Specifications 11
- B. PC/104 Bus Signal Assignments 12
- C. Connector and Jumper Pinouts, Options 1/2/3/6 13
- D. Connector and Jumper Pinouts, Options 5/5C 14
- E. Echelon-approved Wire Manufacturers 15
- F. Concerning Conformal Coatings 16
- G. Additional Information 17
- H. Limited Warranty 18

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Product Overview

The Vista Electronics LM104-P50 module provides connectivity between PC/104-based systems and the Echelon Local Operating Network (LON). The module features full compliance with Echelon's LonMark Interoperability Guidelines, greatly simplifying hardware and software integration into systems built around LonWorks.

The MS-DOS software drivers supplied with the LM104-P50 module were developed using Echelon's Microprocessor Interface Program (MIP) and function in the same way as the MS-DOS software driver supplied with the Echelon SLTA. The LM104-P50 is 100% compatible with Echelon's API (Application Program Interface), so any program that complies with the API will work transparently with the LM104-P50. QNX drivers, provided by Steinhoff Automation, are also available (please contact VISTA Electronics Sales).

The module contains one 3150-type Neuron chip, one 32K EPROM containing LON system software, and one 32K static RAM chip (24K available) for network message buffering. It also contains one of several network interfaces as outlined below. It interfaces with other LON nodes in standalone, peer-to-peer or polled environments.

The LM104-P50 module (except Options 5/5C) is compliant with the PC/104 specification, version 2.3 for an 8-bit module with a 16-bit stackthrough connector. Mechanical and electrical specifications are listed in the Appendix A.

This guide is specific to board revisions B2 and B3 for Options 1/2/3/6, and board revision C.0 for Options 5/5C.

LM104-P50 Network Interface Options

Option 1	RS-485 multi-drop configuration, 39Kbps
Option 2	Transformer-coupled twisted pair, 78Kbps
Option 3	Transformer-coupled twisted pair, 1.25Mbps
Option 5	Echelon PLT-22 Power Line Carrier, 5Kbps
Option 5C	Echelon PLT-22 Power Line Carrier w/CENELEC support, 5Kbps
Option 6	Echelon FTT-10A Free Topology Transceiver, 78 Kbps

Related Products

VEPC-2	Single- or two-phase (120Vac Max.) AC line coupler for Options 5 and 5C
VEPC-3	Three-phase (250Vac Max.) AC line coupler for Options 5 and 5C

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Module Setup

IMPORTANT NOTE!

The LM104-P50 module gets all of its electrical power through the PC/104 bus connector. The module requires +5Vdc, ±10% at 420mA. Because it was designed specifically for the PC/104 bus, the module does *not* support any external power supply, nor is it designed to run at any other supply voltage. Operating an LM104-P50 module at a supply voltage higher than +5Vdc will probably damage the module and will definitely void the warranty. A supply below 4.65Vdc will not damage the module, but it will not function, because the supervisory circuit will force the Neuron into RESET and hold it there.

Before installing the LM105-P50, check the host system for the availability of interrupt request lines (IRQs) and free I/O address locations. Most problems with configuring the LM104-P50 can be traced to conflicts between the LM104-P50 and some other device in the system. The software driver will work with any combination of I/O address and IRQ that is not shared with any other device. Note that more than one LM104-P50 may be installed in the same host system, provided each module has its own address and IRQ. Please see page 3 for jumper settings and page 5 for software driver installation details.

The LM105-P50 (Option 1/2/3/6) installs like any other PC/104 board. It has a 16-bit stackthrough connector, so other PC/104 boards may be installed above or below it in the stack, using 0.6" (15mm) spacers to maintain proper distance between cards. Note that Option 5/5C boards do not allow boards to be installed above them, as the Echelon PLT-22 transceiver is too tall. Option 5/5C boards must be installed at the top of a stack.

Before plugging the PC/104 boards together, double check to insure that the boards are aligned properly, and that the PC/104 connectors between boards are not off by one position.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Jumper Settings

There are five jumper locations, which vary slightly depending on which network interface option is selected. Their functions are as follows:

JP1 SERVICE

Momentarily shorting this jumper causes the Neuron chip to broadcast its Neuron ID across the network. This jumper should normally be left open.

Default: OPEN

JP2 RESET

Momentarily shorting this jumper asserts the **–RESET** signal on the Neuron chip. This resets the LM104-P50, restarting any application program. This jumper should normally be left open.

Default: OPEN

JP3 TERMINATION

This jumper controls whether or not the onboard termination circuit is enabled or disabled.

Shorted	Termination is enabled.
Open	Termination is disabled.

Please see page 7, "Cable Grounding and Termination" regarding termination issues.

Default: OPEN (no termination)

JP4 I/O ADDRESS

This jumper selects the I/O address range used by the LM104-P50:

Position 1	Address &h1E0-&h1EF
Position 2	Address &h300-&h30F
Position 3	Address &h310-&h31F
Position 4	Address &h320-&h32F

Default: Position 1 (&h1E0-&h1EF)

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

JP5 IRQ SELECT

This jumper selects the IRQ (Interrupt Request) level used by the LM104-P50 and the interrupt-driven driver (**`LM104INT.SYS`**):

1	IRQ15
2	IRQ12
3	IRQ11
4	IRQ10
5	IRQ5
6	IRQ3

Default: IRQ5

Note that IRQ10, IRQ11, IRQ12 and IRQ15 are only available on 16-bit systems (80286-class or higher microprocessors).

JP6 TRANSMIT OUTPUT LEVEL

This jumper selects the Transmit Output Level on Option 5/5C (PLT-22) boards ONLY. This jumper is not present or used on any other option.

Shorted	Output Voltage is 7Vp-p
Open	Output Voltage is 3.5Vp-p

Default: SHORTED

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Software Driver Installation

The LM104-P50 module includes two MS-DOS software drivers: one that is interrupt driven (**LM104INT.SYS**) and one that uses polling (**LM104POL.SYS**). The interrupt driver is used in most cases.

First, copy the files on the distribution diskette to a drive and directory on the host system.

For the interrupt driver, add the following line to the system's **CONFIG.SYS** file:

DEVICE = [DRIVE:] [\PATH\] LM104INT.SYS [SWITCHES]

For the polled driver, remove any shorting jumpers on JP5 and add the following line to the system's **CONFIG.SYS** file:

DEVICE = [DRIVE:] [\PATH\] LM104POL.SYS [SWITCHES]

Where **[DRIVE:]** and **[\PATH\]** is where the driver files were copied to.

Valid switches are as follows:

/Onn describes the output buffer count, where 2 ○ **nn** ○ 90. The default is 8.

/Inn describes the input buffer count, where 2 ○ **nn** ○ 90. The default is 8.

/Pn selects the base I/O address. Set jumper JP4 on card to match.

1	Base Address 1E0 (default)
2	Base Address 300
3	Base Address 310
4	Base Address 320

/Dn assigns the MS-DOS device name, **LON[n]**, i.e. **LON1**, **LON2**, etc.

/Z inhibits auto flush cancel.

/Qn selects the IRQ level (**LM104INT.SYS** only). Set jumper JP5 on card to match.

1	IRQ15 (for use with 80286 or higher only)
2	IRQ12 (for use with 80286 or higher only)
3	IRQ11 (for use with 80286 or higher only)
4	IRQ10 (for use with 80286 or higher only)
5	IRQ5 (Default)
6	IRQ3

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

For example, adding the following line to the **CONFIG.SYS** file:

```
DEVICE=C:\LON\LM104INT.SYS /D1 /P1 /Q5
```

installs the interrupt-driven driver using base I/O address &h1E0 and IRQ5.

Adding the following line to the **CONFIG.SYS** file:

```
DEVICE=C:\LON\LM104POL.SYS /D1 /P3
```

installs the polling driver at I/O address &h310. The polling driver does not use an IRQ, and any board that uses the polling driver should not have a shorting jumper installed at JP5.

Note: More than one LM104-P50 module can be installed in the host system at one time. The I/O address and IRQ settings must not conflict with each other or any other device in the system, and each LM104-P50 must have a unique **LON** number.

For example:

```
DEVICE=C:\LON\LM104INT.SYS /D1 /P1 /Q5
DEVICE=C:\LON\LM104POL.SYS /D2 /P2
DEVICE=C:\LON\LM104INT.SYS /D3 /P3 /Q10
DEVICE=C:\LON\LM104INT.SYS /D4 /P4 /Q3
```

will install four running copies of the driver, with the first copy (device name **LON1**) at I/O address &h1E0, using IRQ5. The second driver (device name **LON2**) is the polled driver (**LM104POL.SYS**), which means that while it does occupy an I/O address, &h300, it does not use up an IRQ. The third (device name **LON3**) at I/O address &h310, uses IRQ10; and the fourth (device name **LON4**) at address &h320, uses IRQ3. This example assumes that no other device in the system is using these resources.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Cable Grounding and Termination

To maintain data transmission performance, network cabling must be terminated correctly. Termination requirements vary depending on the type of cable used for network connections – shielded or unshielded twisted pair - and the type of transceiver used.

Cable Grounding

The majority of LonWorks networks use twisted-pair wiring to interconnect the nodes, either shielded twisted pair (STP) or unshielded twisted pair (UTP). If shielded twisted pair wiring is used, the shield of the cable should be grounded as illustrated in **Figure 1**.

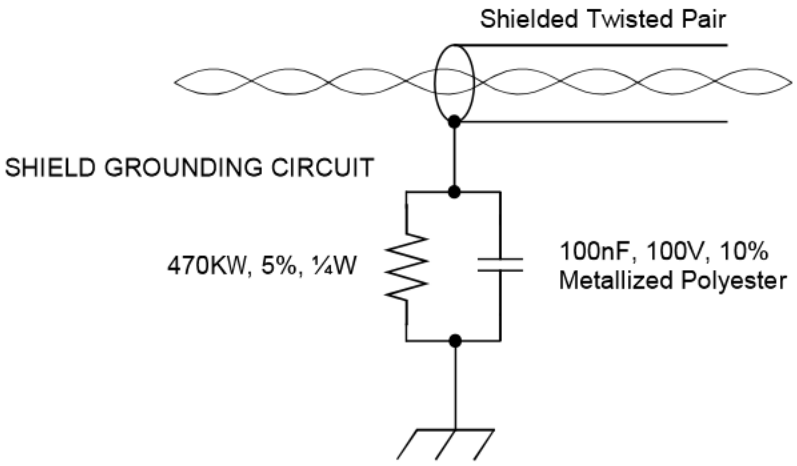


Figure 1. Cable Shield Grounding Circuit.

The 470KW resistor safely bleeds off any static charge on the cable's shield, and the capacitor helps avoid DC and 50/60Hz ground paths from being formed through the shield. The cable shield should be grounded at least once per segment, and at each node if possible.

Cable Wiring and Termination

Termination of the network depends upon the type of transceiver used. In some installations, the termination circuit included on the LM104-P50 may be used; in others, it should not be used. The type of wire that may be used, per Echelon's specifications, also varies by transceiver type.

Option 1 – RS-485

The RS-485-standard transceiver used in Option 1 boards specifies that a 120W, ¼ W resistor should be installed across the network connections (pins 2 and 3 on P3) at every node (see **Figure 2**).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The RS-485 standard further specifies that network cabling have a characteristic impedance of approximately 120W. The use of coaxial or twinaxial cable is not recommended. VISTA Electronics recommends using a high quality, low loss polyethylene-insulated twisted pair wire (such as Belden 9841) for optimum results, although less expensive PVC-insulated wire may be used as well.

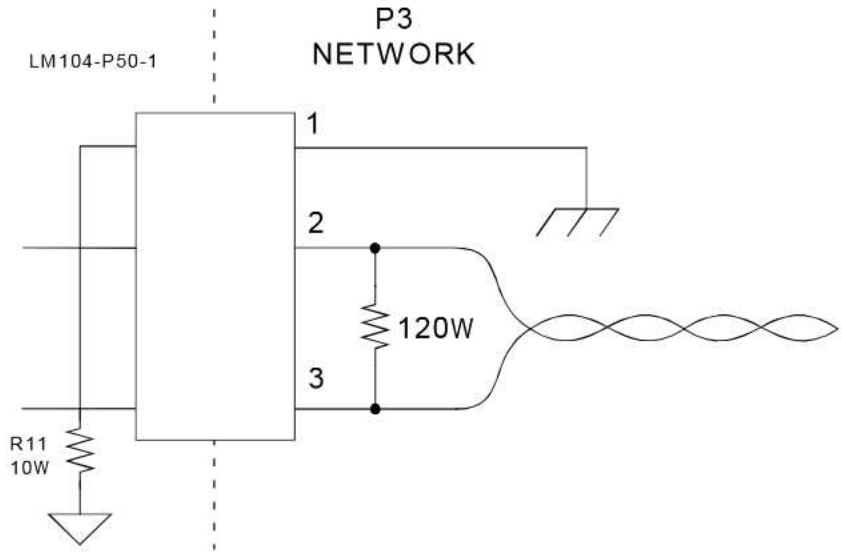


Figure 2. Termination of an LM104-P50-1 RS-485 network node.

Options 2 and 3 – Twisted pair transceivers

Twisted pair transceivers are connected in a bus topology, and only the nodes at each end of the bus need to be terminated. If the LM104-P50 board is at either end of the bus, enable the built-in termination by installing a shorting jumper at location JP3. If the LM104-P50 is not at either end of the bus, leave JP3 open. The factory default is no termination – JP3 is open.

Twisted pair transceivers may be used with only certain types of wiring. 78Kbps networks (Option 2) may use 22AWG (0.65mm) Level IV cable types only. Please see *Appendix E* for a partial list of Level IV cable suppliers.

1250Kbps networks (Option 3) may use either 22AWG (0.65mm) Level IV cable or the more common Category 5 (TIA 586A) cable.

Please note that there are distance and other cabling considerations that are far beyond the scope of this manual. VISTA Electronics recommends consulting Echelon Engineering Bulletin #05-0023-01, "*Junction Box and Wiring Guidelines*" for additional information.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Option 5 – Power line carrier transceivers

These modules are designed to be used with couplers that interface between the node and the power line. As such, the PLT-22 transceiver and the power line coupler handle any termination issues. Any standard 50W BNC cable may be used to connect the LM105-P50 to its line coupler. Because the transmission medium is existing power line cable, the user will usually not have a choice in what cable is used. The PLT-22 compensates for this by operating at a much lower data rate than other transceivers (5Kbps).

Option 6 – Free Topology Transceiver

Free topology networks require only one terminator per network segment. It may be located anywhere in the segment, regardless of the topology. For Option 6 boards connected in a strictly bus-type topology, a second termination network may be added which will nearly triple the allowable network length. The circuit in **Figure 3** will properly terminate a Free Topology network. Jumper JP3 must be left open to disable the LM104-P50's onboard termination.

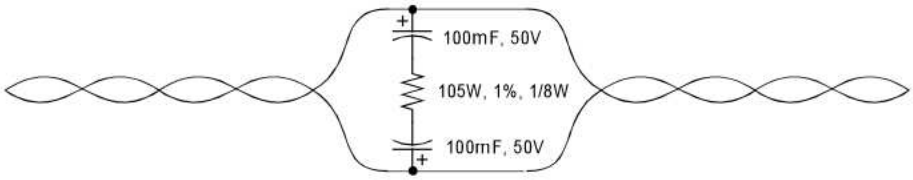


Figure 3. Free topology network terminator circuit.

Free topology networks have the widest choice of qualified cable types. Like twisted pair transceivers, 22AWG (0.65mm) Level IV cable and standard TIA 586A Category 5 network cable may be used. Echelon has also certified Belden 8471 (PVC insulation) 16AWG (1.3mm) cable and Belden 85102 (Tefzel insulation) 16AWG (1.3mm) cables for use with free topology networks. A European standard cable, JY (st) Y 2x2x0.8, also meets Echelon's rigorous standards.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Troubleshooting

- Make sure that the system has power, and make sure that all voltages are within specification. The Neuron chip does not tolerate under- or over-voltage conditions very gracefully.

- Make sure that the driver's command-line switches (**/P#** and **/Q#**) match the jumper settings on the module (JP4 and JP5, respectively)

- Sometimes there are conflicts for system resources. Double-check that the LM104-P50 is set to use a base I/O address and interrupt request line that is not used by some other device in the system. Try selecting a different base I/O address, using JP4, and make sure to change the driver's command-line switch (**/P#**) to match. If this does not resolve the problem, try selecting a different IRQ number, using JP5, and make sure to change the driver's command-line switch (**/Q#**) to match.

- Occasionally, the Neuron chip's internal EEPROM memory can become corrupted. This is indicated by the SERVICE LED staying on solid, not blinking at all. To correct this problem, the node must be rebooted, which is not the same as a power up reset or shorting the RESET jumper. There are three different ways of accomplishing this:

    1. Run the **NODEUTIL** utility (available from Echelon) on the host PC and select Reboot ("R").
    2. Remove power from the LM104-P50. Remove the EPROM chip (U2) from its socket using a chip extractor. Replace the EPROM with an EPROM programmed with **EEBLANK.NRI** (also available from Echelon). Turn the power on. The service LED should go off while the Neuron blanks its internal EEPROM. It will then come on solid and stay that way. Remove power from the LM104-P50, remove the **EEBLANK** EPROM and replace it with the original EPROM, then restore power.
    3. Remove power from the LM104-P50. Remove the EPROM chip (U2) from its socket with a chip extractor, then restore power. Wait a few seconds, remove power, then replace the EPROM in its socket. This will usually force the Neuron to load the program and default configuration into internal EPROM. Note that this method does not work in all cases, but will not harm the board.

If any of these methods do not solve the problem, a Returned Material Authorization (RMA) should be obtained from VISTA Electronics and the board returned for service.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix A

Specifications

Mechanical

Compatible with PC/104 Specification v2.3

Dimensions:	3.55 x 3.80 x 0.95 inches (90.1 x 96.5 x 24.1 mm) (Including PC/104 connectors)
Weight	2.8 oz. (79.5 g)

User Connectors

Network Connection:

Options 1/2/3/6	3-pin, 0.100" spacing right angle friction locking header Molex p/n 22-05-3031 Mates with Molex p/n 22-01-3037 3-circuit terminal housing
Option 5/5C	Female BNC, right angle

Environmental

Operating temperature range	-40°F to +185°F (-40°C to +85°C)
Storage temperature range	-58°F to +257°F (-50°C to +125°C)
Humidity	15% to 90% RH non-condensing

Electrical

Power Supply:	+5Vdc, ± 10%, 420mA, supplied by PC/104 bus
Power Consumption	2.1W

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix B

Bus Signal Assignments

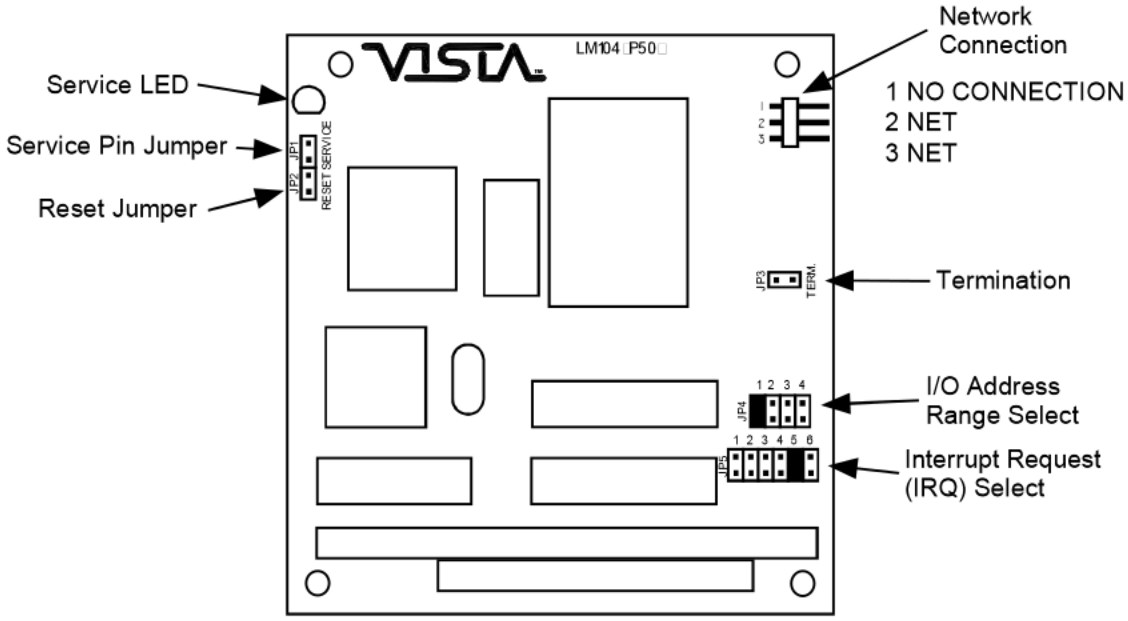
PIN Number	J1/P1 Row A	J1/P1 Row B	J2/P2 Row C	J2/P2 Row D
0	--	--	0V	0V
1	-IOCHCHK	0V	-SBHE	-MEMCS16
2	SD7	RESET	LA23	-IOCS16
3	SD6	+5V	LA22	IRQ10
4	SD5	IRQ9	LA21	IRQ11
5	SD4	-5V	LA20	IRQ12
6	SD3	DRQ2	LA19	IRQ15
7	SD2	-12V	LA18	IRQ14
8	SD1	-ENDXFR	LA17	-DACK0
9	SD0	+12V	-MEMR	DRQ0
10	IOCHRDY	KEY	-MEMW	-DACK5
11	AEN	-SMEMW	SD8	DRQ5
12	SA19	-SMEMR	SD9	-DACK6
13	SA18	-IOW	SD10	DRQ6
14	SA17	-IOR	SD11	-DACK7
15	SA16	-DACK3	SD12	DRQ7
16	SA15	DRQ3	SD13	+5V
17	SA14	-DACK1	SD14	-MASTER
18	SA13	DRQ1	SD15	0V
19	SA12	-REFRESH	KEY	0V
20	SA11	CLK		
21	SA10	IRQ7		
22	SA9	IRQ6		
23	SA8	IRQ5		
24	SA7	IRQ4		
25	SA6	IRQ3		
26	SA5	-DACK2		
27	SA4	TC		
28	SA3	BALE		
29	SA2	+5V		
30	SA1	OSC		
31	SA0	0V		
32	0V	0V		

Notes:
Rows C and D are used for 16 bit (AT) operation.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix C

Connector and Jumper Locations and Pinouts, LM104-P50 Module Options 1/2/3/6





JP1 SERVICE

Pin 1 Ground
Pin 2 SERVICE



JP2 RESET

Pin 1 RESET
Pin 2 Ground



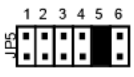
JP3 TERMINATION

Options 2 & 3 ONLY!



JP4 I/O Address

1 &h1E0 - &h1EF *DEFAULT*
2 &h300 - &h30F
3 &h310 - &h31F
4 &h320 - &h32F



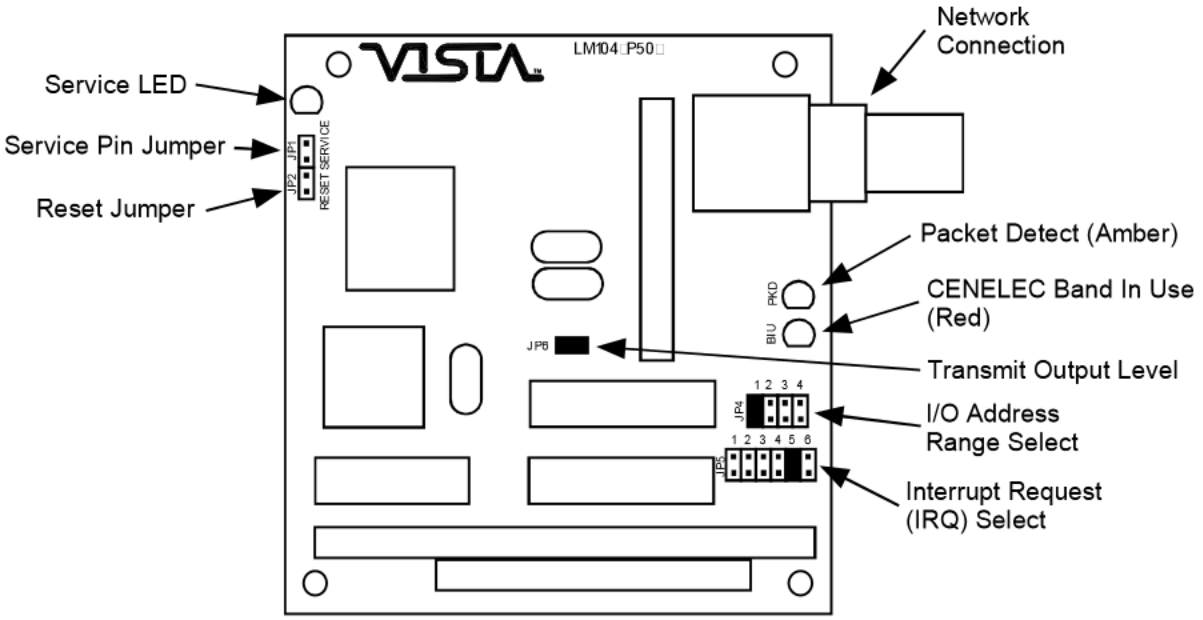
JP5 Interrupt Request

1 IRQ15
2 IRQ12
3 IRQ11
4 IRQ10
5 IRQ5 *DEFAULT*
6 IRQ3

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix D

Connector and Jumper Locations and Pinouts, LM104-P50 Module Options 5/5C





JP1 SERVICE

Pin 1 Ground
Pin 2 SERVICE



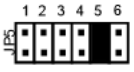
JP2 RESET

Pin 1 RESET
Pin 2 Ground



JP4 I/O Address

1 &h1E0 - &h1EF *DEFAULT*
2 &h300 - &h30F
3 &h310 - &h31F
4 &h320 - &h32F



JP5 Interrupt Request

1 IRQ15
2 IRQ12
3 IRQ11
4 IRQ10
5 IRQ5 *DEFAULT*
6 IRQ3



JP6 Transmit Ouput Level - Options 5/5C ONLY

Pin 1 Ground
Pin 2 TXLVL

Default is Shorted

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix E

Manufacturers of Echelon-approved networking cable and wire.

General Cable
(BICC Cable, Brand-Rex, General Cable, Carol Cable)

4 Tesseneer Drive
Highland Heights, KY 41076
Tel: +1-859-572-8000
Fax: +1-859-582-8458
Email: info@generalcable.com
Web: http://www.generalcable.com

ConnectAir International

4240 B Street NW
Auburn, WA 98001
Tel: +1-253-813-5599
Fax: +1-253-813-5699
Email: sales@connect-air.com
Web: http://www.connect-air.com

Eastman Wire & Cable

1085 Thomas Busch Highway
Pennsauken, NJ 08110
Tel: +1-609-488-8800
Fax: +1-609-488-8899
Email: eastman@libertynet.org

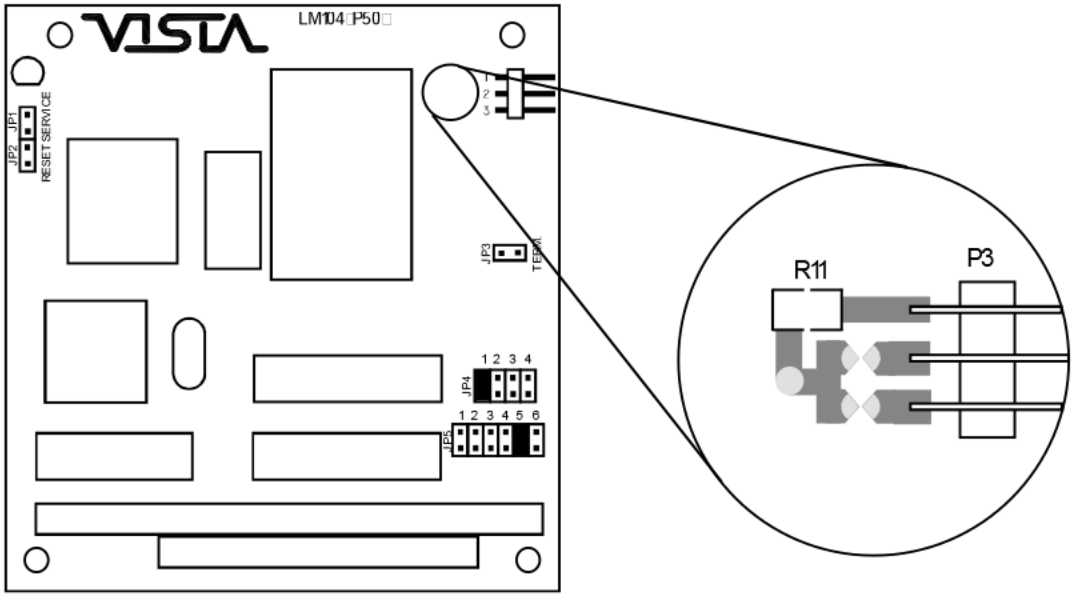
Windy City Wire

4250 Madison Street
Hillside, IL 60162
Tel: +1-708-493-1191
Fax: +1-708-493-1380
Email: geninfo@smartwire.com
Web: http://www.smartwire.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix F

Concerning Conformal Coatings



Certain applications require a conformal coating be applied to the board for additional environmental protection. There are several "keep-out" areas on the LM104-P50 board that should be masked prior to coating:

- PC/104 connectors P1 and P2
- Jumpers JP1, JP2, JP3, JP4 and JP5
- Network connection P3
- The 27C256 EPROM (U2) and its socket
- The PEEL (U4) and the PAL (U6) and their sockets
- The area highlighted in the above diagram (Options 1/2/3/6 only)

The last item is very important. Echelon requires that all network transceivers be protected against electrostatic discharge (ESD). VISTA Electronics has incorporated several features to ensure this, including spark gaps for high voltage transients. These spark gaps are part of the printed circuitry near the network connection P3. If a conformal coating covers the gaps, they will not function correctly. To maintain proper protection, keep any coating at least 0.25" (6.3mm) away from the exposed (shiny, tin-plated) portion of the spark gaps *(Options 1/2/3/6 ONLY)*.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix G

Additional Information

PC/104 Specification, Version 2.3

This document is available from the PC/104 Consortium, which can be reached through their website at http://www.pc104.org.

The specification can be downloaded at http://www.pc104.org/technology/pc104_tech.html.

Echelon literature

A wealth of additional information is available from Echelon directly. Much of it is freely downloadable from their website at http://www.echelon.com. Documents available include application programming guides, Neuron chip datasheets, API programming guides, transceiver information and wiring and cabling guidelines. Some publications are available for purchase from Echelon; please call their sales department at

Inside USA:	1-888-ECHELON (324-3566)
Outside USA	+1-408-938-5267
Email	lit_request@echelon.com

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Appendix H

Limited Warranty

VISTA Electronics, Inc., warrants its hardware products to be free from defects in workmanship and materials, under normal use and service, for the period of three (3) years from the date of purchase from VISTA. VISTA makes no warranty that its software products will work in combination with any hardware or applications software products provided by third parties, that the operation of the software products will be uninterrupted or error free, or that all defects in the software products will be corrected.

If a product does not operate as warranted during the applicable warranty period, VISTA shall, at its option and expense, repair the defective product or part or deliver to Customer an equivalent product or part to replace the defective item. All products that are replaced will become the property of VISTA. Replacement products may, at the sole discretion of VISTA, be new or reconditioned. Any replaced or repaired product or part has a ninety (90) day warranty or the remainder of the initial warranty period, whichever is longer. This warranty is nontransferable.

VISTA shall not be responsible for any software, firmware, information or memory data of Customer contained in, stored on or integrated with any products returned to VISTA pursuant to any warranty.

Standard Warranty Service

Standard warranty service for hardware products may be obtained by delivering the defective product to VISTA during the applicable warranty period. Products returned to VISTA must be pre-authorized by VISTA with a Returned Material Authorization (RMA) number marked on the outside of the package, and sent prepaid, insured and packaged appropriately for safe shipment. VISTA will not be held responsible for product(s) lost or damaged during transit. VISTA has the right to refuse any product received without a RMA number. The repaired or replaced product will be shipped to Customer, at VISTA's expense, no later than thirty (30) days after receipt by VISTA.

Warranties Exclusive

If a VISTA product does not operate as warranted above, Customer's sole remedy shall be repair or replacement, at VISTA's option. In no event shall VISTA's liability exceed the amount paid by Customer for the product. The foregoing warranties and remedies are exclusive and are in lieu of all other warranties, expressed or implied, either in fact or by operation of law, statutory or otherwise, including warranties of merchantability and fitness for a particular purpose. VISTA neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale, installation, maintenance or use of its products.

VISTA shall not be liable under this warranty if its testing and examination disclose that the alleged defect in the product does not exist or was caused by Customer's or any third party's misuse, neglect, improper installation or testing, unauthorized attempts to repair, or any other cause beyond the range of the intended use, or by accident, fire, lightning, or other hazard.

Limitation of Liability

In no event, whether based in contract or tort (including negligence) shall VISTA be liable for incidental, consequential, indirect, special or punitive damages of any kind, or for loss of revenue, loss of business, or other financial loss arising out of or in connection with the sale, installation, maintenance, use, performance, failure or interruption of its products, even if VISTA has been advised of the possibility of such damages.

Some states do not allow the exclusion or implied warranties or the limitation of incidental or consequential damages for consumer products, so the above limitations and exclusion may not apply to Customer. This warranty gives Customer specific legal rights that may vary from state to state.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP