PC 71

0 to 20mA Current to Voltage Convertor Module

For the PC 30xx Series / PC 126/7
Data Acquisition Boards

Second Edition

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Introduction

The PC 71 is an external adaptor board used with the PC 30xx / PC 126/7 data acquisition cards. It provides precision 0 to 20mA or ±20mA current to voltage (ie: 0 to 10V or ±5V) conversion so that it can be read into the A/D channels of the PC 30xx and the PC 126/7

It has a distinct advantage over conventional methods because of:

a) The use of precision low noise differential op-amps
b) Isolated current conversion techniques.
c) The use of filters to eliminated 'ground currents' and ground noise

Jumper settings on board the PC 71 enables the user to allow current to voltage conversion or direct voltage bypass.

All other features on the PC 30xx series boards and the PC 126/7 like the digital I/O lines, DAC outputs, PSU lines, EXT CLK and EXT Trigger lines are also available on the PC 71 via screw terminal blocks. This makes interfacing user signals much easier and more convenient

Minimum Requirements / Modifications

a) Minumim requirements

- ❋ Either a PC 30xx Card or a PC 126/7 Card
- ❋ It can also operate in a standalone enviroment but the DB50 or IDE 50 interface connections must adhered too.
- ❋ A voltage or current source depending on the mode of each channel (current conv or voltage bypass).

b) PC 30xx Adjustments / Modifications:

- ❋ The +5V Pico Fuse (F3) on the PC 30xx Series cards must be changed. At present it is rated at 125mA. This must be replaced with a 250mA or 500mA pico fuse which is provided. The reason being that the DC-DC Convertor on the PC 71 requires about 125mA. Since this is the threshold of the fuse on the PC 30xx Cards, it should be changed.

  Note that the power line track width on the PC 30xx cards can handle at least 500mA. Hence changing the fuse will not degrade the functioning of the PC 30xx in any way.

- ❋ Since no Digital Ground is available on the PC 30xx series cards, the digital ground wire supplied must be connected to the computer chassis. The best connection would be near the power supply. Replace one of the power supply screws that secures it to the computer chassis. Fit the solder lug on the screw and fasten the screw back onto the computer cabinet.

Warning

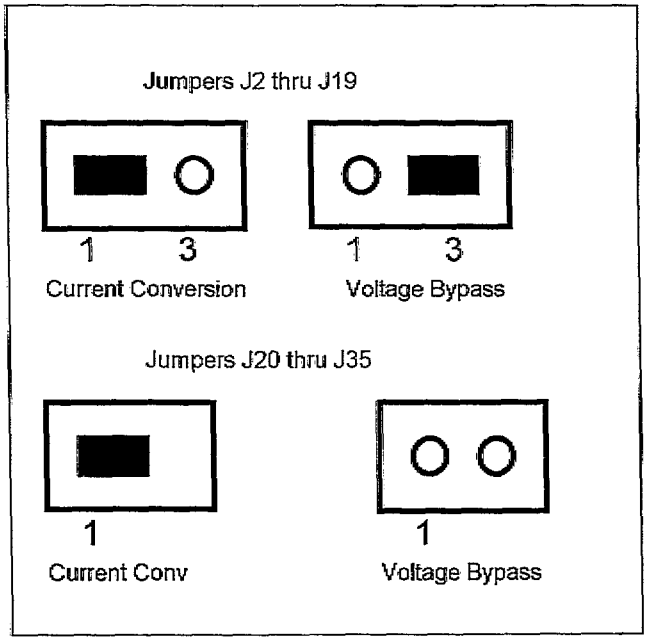
Under no circumstances must the PC 71 be plugged into the PC 30xx or the PC 126/7 when the computer power supply is ON. Always switch off the computer PSU before installation. Also ensure that the digital ground wire is connected to the computer chassis BEFORE switching the power supply on.

1) Default Settings of the PC 71

a) Bypass jumper settings [J2 thru J17] & [J20 thru J35]

These jumpers enables either current to voltage conversion or direct voltage bypass. In other words, the user must choose whether the input signal is voltage or current orientated.

The jumper setting are as follows:



J2 thru J17
Short 1&2: Current to voltage conversion

Short 2&3: Direct voltage feedthru

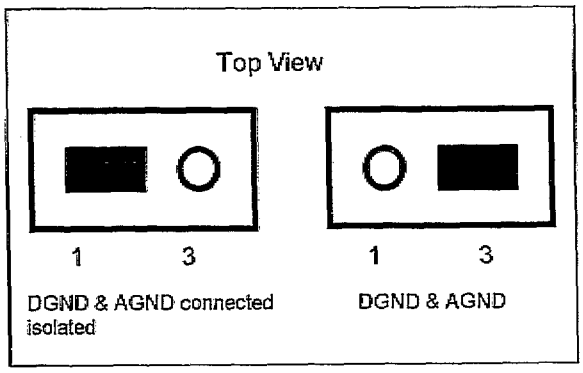
J20 thru J35
Short : Current to voltage conversion

Open: Direct voltage feedthru

Key: *Pin 1 is indicated with an * on the layout dia*

b) Analog / Digital Ground Jumper [J18]

This jumper (J18) [See Below] either connects the analog circuit ground and digital circuit ground internally on the PC 71 via pin 42 (AGND) on the PC 30xx boards or isolates the analog and digital ground by connecting the analog ground to Pin 42 (AGND) and the digital ground to Pin 17 (DGND or +5V). The DC-to-DC Convertor on the PC 71 Pod is powered by the +5V line (Pin 17). Hence it is recommended that this jumper should **not** be changed.



Short 1&2:

Connects AGND and DGND internally at one point. The global ground line is then connected to Pin 42 (AGND)

Short 2&3:

Digital ground and Analog ground are connected to Pin 17 and Pin 42 on PC 30xx.

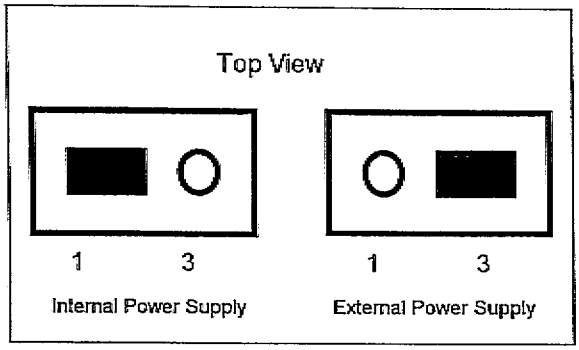
Warning

When isolating the digital and analog grounds, the User must ensure that the PC 30xx board is configured for digital ground NOT +5V. This can be done by changing jumpers W9 (Out) and W10 (In).

Note that serious damage can result if these jumpers are not installed correctly.

c) External / Internal Power Supply Jumpers [J36, J37]

These jumpers (J36, J37) [See Below] allows the User to either power the PC 71 via an internal power supply or via an external PSU. Jumper settings are as follows:



Short 1&2:

Allows the PC 71 to be driven internally via the PC 30xx Card. Note that this jumper does not apply to the PC 126 because no +5V supply is available on the PC 126's IDE connector.

Short 2&3:

Allows the PC 71 to be driven externally via the power supply input connector T1. Note that ±15V must be supplied to these pins.

d) Digital Ground wire

Since +5V is required to operate the PC 71, no digital ground is available on the PC 30xx Cards. It is hence required that the external ground line (wire) supplied should be connected to the Computer Cabinet. The most convenient place would be near the power supply. There are four screws that keep the computer power supply fixed to the cabinet. Loosen one of the screw and fit the Solder Lug on the Screw. Fit the screw into the cabinet hole and fasten tightly. This will provide a good Digital Ground connection.

Warning

Under no circumstances must the PC 71 be plugged into the PC 30xx or the PC 126/7 when the Computer is ON. Always switch off the Computer PSU before installation.

e) Powering the PC 71 using the PC 126/7

The internal power supply facility does not apply to the PC 126/7 because a +5V supply is not available on the IDE connector. However, there are two ways to power the PC 71 using the PC 126/7. They are:

a) By feeding a ±15V via Power supply Input connector [T1]. Jumpers J36 and J37 must be configured with terminals 2&3 short. To test if the external ±15V Power supply is fully functional, check LEDs D6 and D7. If they are ON, then the PC 71 is fully functional

Summary:
- ❋ Short pins 2&3 on jumpers J36 & J37.
- ❋ Feed ±15V and AGND in Connector T1 as indicated on the PCB Template
- ❋ Check and recheck terminal connections
- ❋ Switch on external PSU
- ❋ Check if PC 71 is functional by checking if LEDs D6 and D7 are ON

b) By feeding a +5V into the Power Supply Output connector TL3. It can be done because the +5V line is not fed into the IDE Connector of the PC 126/7. SInce the PC 71 generates the ± 15V using the +5V supply using a DC to DC convertor, it is perfectly legal to feed the +5V power into Connector TL3 (on the +5V terminal). Note, however, that the Power Ground wire MUST be connected to the computer chassis. Jumpers J36 and J37 must be configured with terminals 1&2 short.

Summary:
- ❋ Feed +5V into Connector TL3 as indicated on the PCB Template
- ❋ Connect the Power Ground wire to the computer chassis
- ❋ Check and re-check terminal connections
- ❋ Switch on external PSU
- ❋ Check if PC 71 is functional by checking if LEDs D3, D6 and D7 are ON

Warning

Under no circumstances must the ±15V or the +5V be fed into the Power Supply connector in reverse order. Serious damage can result if this is done. Hence check and RECHECK the external power supply connections before switching on the power supply.

2) Terminal Block Identification

Screw terminal connectors are provided for easy wiring. The layout diagram (top view) of the PC 71 is shown in Appendix A. They are:

a) Analog current / voltage inputs [TL1 and TL2]:

All the relevant channels are printed on the PC 71 silkscreen to enable the User to connect signal sources to the appropriate channels.

Example: Consider connecting a 4 to 20 mA signal to channel 0 and a voltage signal to channel 1.

Procedure: Change the jumper settings of CH0 and CH1 on the PC 71 as follows:

For channel 0: short pins 1 & 2 on J2; Close Jumper J20
For channel 1: short pins 2 & 3 on J3; Open Jumper J21

Connect the current signal on I0+ [positive current line] and I0- [negative current line] as indicated on the layout diagram or on the PC 71 PCB. As for the voltage signal on channel 1: Connect the positive line to V1 (See layout diagram) and the negative line to AGND.

Note: Adhere to the layout diagram or the text on the PC 71 PCB under all circumstances.

b) Digital Ports [TL6 (Port A), TL7 (Port B), TL5 (Port C), Y1 (Ext CLK, Ext TRIG]

These terminal blocks redirects the digital signals (TTL) to/from the PC 30xx and the PC 126/7 series boards to the PC 71.

For the PC 30xx series boards:

- Port A, B, C are connected to TL6, TL7, TL5 respectively.
- External Clock and External Trigger lines are connected to Y1.

For the PC 126/7 Series Boards:

- The Digital input port is connected to Port A [TL6]
- The Digital output port is connected to Port B [TL7]
- External Clock and External Trigger lines are connected to Y1.

Each port is marked on the PC 71 for easy identification.

c) Analog Output Connectors [TL4]

These terminal blocks redirects the analog output signals from the DACS of the PC 30xx or the PC 126/7 to the PC 71 Board. In the case of the PC 126/7: Only DAC0 and DAC1 are used.

Each DAC output are marked on the PC 71 for easy identification.

c) External Power Supply Connector Block [T1]

i) Description

These terminal blocks are used to connect an external ±15V to the PC 71 in order to drive the circuitry.

Note: In order to use the external power supply option, you must ensure that the external power supply jumpers are configured properly. In other words, short 2&3 on Jumpers J36 and J37.

Recommendation

i) For the PC 30xx series boards:

It is recommended that the internal power supply option (default) be use to drive that PC 71. Connect the power ground wire to the computer chassis before switching your computer on.

ii) As for the PC 126/7 series boards:

An internal +5V power supply is required to drive PC 71. However, +5V is not present on the PC 126/7. Hence either the external ±15V Power Supply can be connected to Power Supply Input Connector T1 OR a +5V Power Supply can be connected on the Power Supply Output Connector [TL3]. See chapter 1 for details.

d) Power Supply Output Connector Block [TL3]

i) Description

These terminal blocks redirects the ±12V and +5V power lines from the PC 30xx series boards to the PC 71 external pod.

Note that the +5V line can also be jumpered for Digital Ground (DGND). In this case, The jumper setting on the PC 30xx cards [W9 (Out), W10 (In)] should be changed. However, since the AGND and DGND grounds meet at one point on the PC 71, it is recommended that default jumper setting be used. In other words, leave Jumpers W9 (In) and W10 (Out) on the PC 30xx Boards unchanged.

If the +5V line is jumpered for digital ground, the PC 71 current conversion will be disabled. You are then required to the drive the PC 71 via an external ±15V power supply. See chapter 1 & 2 for details.

Warning

Serious damage can result if jumpers J18 are not installed correctly.

It is recommended that the User use the default jumper setting on J18. In other words, the analog and digital ground meet at one point on the PC 71. This 'global' ground line is in turn connected to Analog Ground on the PC 30xx and the PC 126/7 cards.

Moreover, the +5V line is hence accessible via the power supply terminal blocks T1 (only via the PC 30xx Boards). Do not exceed a 100mA current load on the +5V output connector.

ii) Short Circuit Protection:

The power supply terminals are also protected against short circuits by means of inline pico fuses. If the current drawn from the ±12V or +5V power supply exceeds 125mA then the fuse will blow. Replace Pico Fuses F1, F2 or F3 if this occurs.

Check the pico fuses by means of a multimeter. If the fuse fails the continuity check test, then the fuse should be replaced.

Recommendation

Before applying power to your prototyping circuits via the PC 71 PSU terminals, check and re-check your circuits in order to ensure that no shorts to either ±12V or +5V are visible.

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3) PC 71 Interface Connectors

a) The IDE 50 Male Connector [J1]

This connector [see figure 1(a)] is provided for direct interfacing with the PC 30xx Cards via a ribbon cable. Note that since the PC 30xx has a DB50 connector, a conversion from a DB50 to an IDE50 must be done. The PC 71 Interface assumes a One-One Mapping (eg: DB50 Pin 1 = IDE Pin 1; DB50 Pin 2 = IDE Pin 2, etc) when converting the DB50 connections to that of an IDE type.

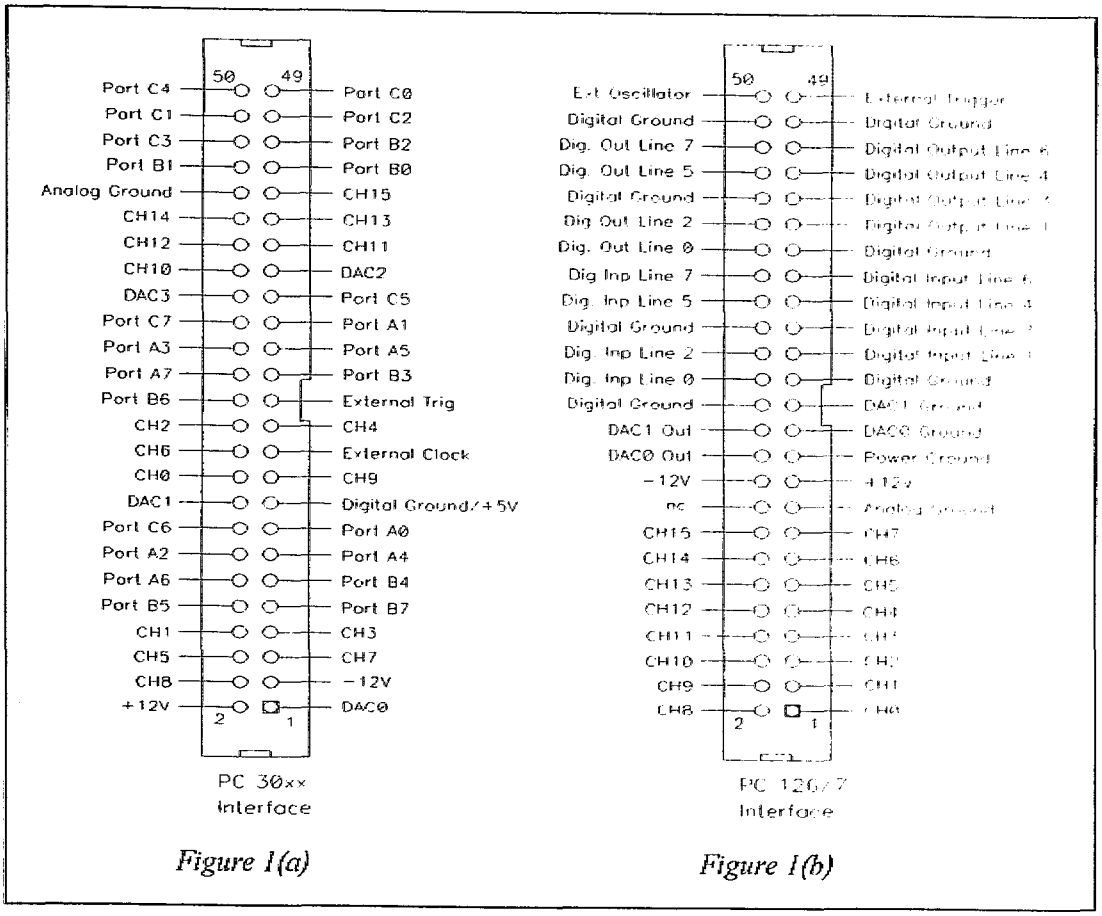


Figure 1(a) *Figure 1(b)*

A ready made cable is provided to interface the PC 30xx Card with the PC 71 if available.

Note: A small DB50 to IDE50 Connector Board is currently being designed. This will fit directly on the PC 30xx DB50 Connector. An IDE50 Female Connector will be placed on the other end so that the User can an IDE50 (MALE to MALE) type connector + ribbon cable for connecting the PC 30xx with the User Interface.

If the cable is not provided then one DB50 Male connector + one IDE Female connector will be provided so that the User can make his/her own interfacing cable.

b) The 50 Way Header [J2]

This connector [see figure 1(b)] is provided for direct interfacing with the PC 126/7 Cards via a ribbon able. In this case an IDE Connector is also used, hence a standard Ribbon Cable [50-way Female to Female] can be used to connect the PC 126/7 to the PC 71.

4) Testing the PC 71

Before attempting to interface 4-20mA current output tranducers to the PC 71 Board, it is essential that you test the board first. This is done using the following Procedure:

Connect the digital ground wire to the computer chassis as described in chapter 1 (d). Connect the IDE Ribbon Cable to the PC 71 external interface pod and the PC 30xx. Switch the Computer on and run the WAVEVIEW Software.

a) Testing the current conversion analog input channels

* Go to the Card Menu and choose the 'Adaptor Board Option'.
* Set the current range from 0 to 20mA and the voltage range from 0 to 10V.
* Select internal Power Supply (default) by shorting 1&2 on Jumpers J36 & J37. In the case of the PC 126/7 and external +5V should be connected to the Power Supply output connector TL3. To verify that the internal PSU is working correctly, check if LED D3, D6 and D7 are ON.
* Enable all channels to current input mode. Ensure that all the jumper settings are set correctly. In other words, jumpers J2 thru 17: Short 1-2 and jumpers J20 thru J35: Closed.
* Apply a current test signal from a calibration source to the analog input terminal blocks (ie: I0+ and I0- terminals, etc).
* Read the values using the voltmeter function (or the digital storage scope function) and check if the test currents read in corresponds to the actual currents from the calibration source. The error should be about ±1LSB.

NOTE: The manufacturing test procedure included the above and current/voltage readings corresponded within the 12 bit accuracy.

b) Testing the Voltage Conversion Analog Input Channels

The next step is to test the voltage readings

* Change the jumper settings J2 thru 17 to voltage bypass (ie: short 2&3) and J20 thru J35 (ie: Open) on the PC 71.
* Go to the 'Card Menu' and change the PC 71 configuration. Click on the 'Configure Block'.
* Select the 'Bypass Jumpers' option and set all the channels to voltage bypass.
* Apply a voltage test signal (ie: 1V thru 4.5V) from a calibration source to the analog input terminal blocks (All 16 channels). Read the values using the voltmeter function and check if the test voltages read in corresponds to the actual voltages. If so, then the voltage bypass circuitry is fully operational. The error should be about ±1LSB.

NOTE: i) All unused channels should be grounded.
ii) The manufacturing test procedure included the above and current/voltage readings corresponded within the 12 bit accuracy.

c) Testing the digital I/O channels

* Apply a test signal to any of the digital inputs (TTL) and pull all the unused digital I/O channels (ports only) to VCC or GND. Use WAVEVIEW to read the value of the relevant port and check if they correspond. If so, then the digital I/O is operating correctly.

d) Testing the digital to analog output channels

* Use Waveview to output a voltage to the DACs. Use a multimeter to check if the voltage corresponds to that stated in WaveView. If so, then the D/A is operating correctly.

5) Troubleshooting

Problem: No ±12V or +5V supply voltages are seen on the PSU terminal blocks [TL2].

Solution: Check which LEDs are off (ie: Red: +5V, Green: +12V, Orange: -12V). Hence check the pico fuses F1 (+12V), F2 (-12V) and F3 (+5V). This can be done by running a continuity check across the terminal of the fuses. If the continuity check fails, then replace the fuse. If, however, the +5V pico fuse is OK then check if the digital ground wire is connected to the computer chassis.

If all the pico fuses are OK then the pico fuses present on the PC 30xx cards have blown. Call technical support for help.

Problem: Current / voltage offsets are seen on-screen when running WaveView.

Solution: Offsets are created if the digital ground wire is not connected to the computer chassis. Check if this wire is connected and secured to the computer chassis. If not, switch the computer PSU off and secure it to the computer chassis. For more details, refer to chapter 1 (d).

Problem: Random A/D voltages readings are seen on-screen using WaveView.

Solution: Check if the ±15V [D6 & D7] and the +5V [D3] LEDs are ON. If not then check which LEDs are off (ie: Red: +5V, Orange: +15V, Green: -15V). If the RED LED is off then the Digital ground wire is not connected or not securely fitted onto the computer chassis.

If ground connections are OK then the pico fuse on the PC 30xx are blown. Replace. Call your distributor for replacement pico fuses.

Problem: Voltage bypass signals are unstable when read in by WaveView.

Solution: The -ve voltage source terminal was most probably fed into the negative current input terminal. This should be changed and fed into the AGND terminal block.

Problem: A/D values does not correspond to that inputted by the User.

Solution: Check if the ±15V [D6 & D7] and the +5V [D3] LEDs are ON. If not then check which LED is off (ie: Red: +5V, Orange: +15V, Green: -15V). If the RED LED is off then the pico fuse on the PC 30xx are blown. Call your distributor for help.

If the RED LED is ON and the +15V [D6] and/or the -15V [D7] LEDs are OFF then the DC to DC Convertor on the PC 71 is faulty. Replace U1.

If the problem persists then the problem might lie with the precision Op-Amp (INA105). Replace the INA105 op-amp and re-run test procedure as described in Section 5 (a & b). The A/D readings should correspond. If not then a possible spike might have entered the PC 30xx / PC 126/7 A/D channels and exceeded the maximim overload voltage causing damage to components on the PC 30xx, PC 126/7 as well.

To verify that the PC 30xx is fully functional, remove the PC 71 adaptor board and apply a test signal (1V thru 4.5V) directly into the input channels of the PC 30xx / PC 126/7 boards. Ensure that you adhere to the calibration procedure (chapter 7) in the PC 30xx User's Guide. If the errors still persists then the PC 30xx / PC 126/7 is faulty. Return for repairs.

Problem: Digital I/O is not operating correctly.

Solution: First check if the +5V LED is ON.

If not then use the test procedure as described in Section 5 (c). If the values read in are incorrect then the 8255 PPI on the PC 30xx card might be faulty. Replace and rerun test. You should not have any problems.

Problem: DAC outputs clips to either +10.6 or -10.6V.

Solution: Use the test procedure as described in Section 5 (d). If the problem persists then the cable connecting the PC 30xx to the PC 71 might be faulty. Check cabling and rerun test.

If the problem still persists then the DAC output Op-Amp on the PC 30xx / PC 126/7 might be faulty. Send the PC 30xx / PC 126/7 back for repairs.

If you cannot solve the problem then simply call Technical Support for immediate help.

6) Specifications

A/D Current Conversion

No of channels:	8 or 16
Resolution:	12 Bit (0.02%)
Gain Error:	0.01% Typ.
Error vs Temp:	1ppm/°C Typ.
Input Current Range:	0 to 20mA
Small Signal Bandwidth:	1Mhz
Full Power Bandwidth:	50kHz
Offset Voltage:	500µV Max
Settling Time:	5µs Max
Slew Rate:	2V/µS
Relative accuracy:	± 1 LSB in noiseless env.
Max current conversion:	20mA
Operating temperature:	0 to 70°C
Connectors:	Via RDI or screw terminal blocks
PC 30 / PC 126 Specs:	All other A/D specs are adhered to

D/A Output Channels

PC 30 / PC 126 specs:	PC 71 does not influence D/A specs

Digital I/O

PC 30 / PC 126 specs:	PC 71 does not influence Digital I/O specs

Power Requirements

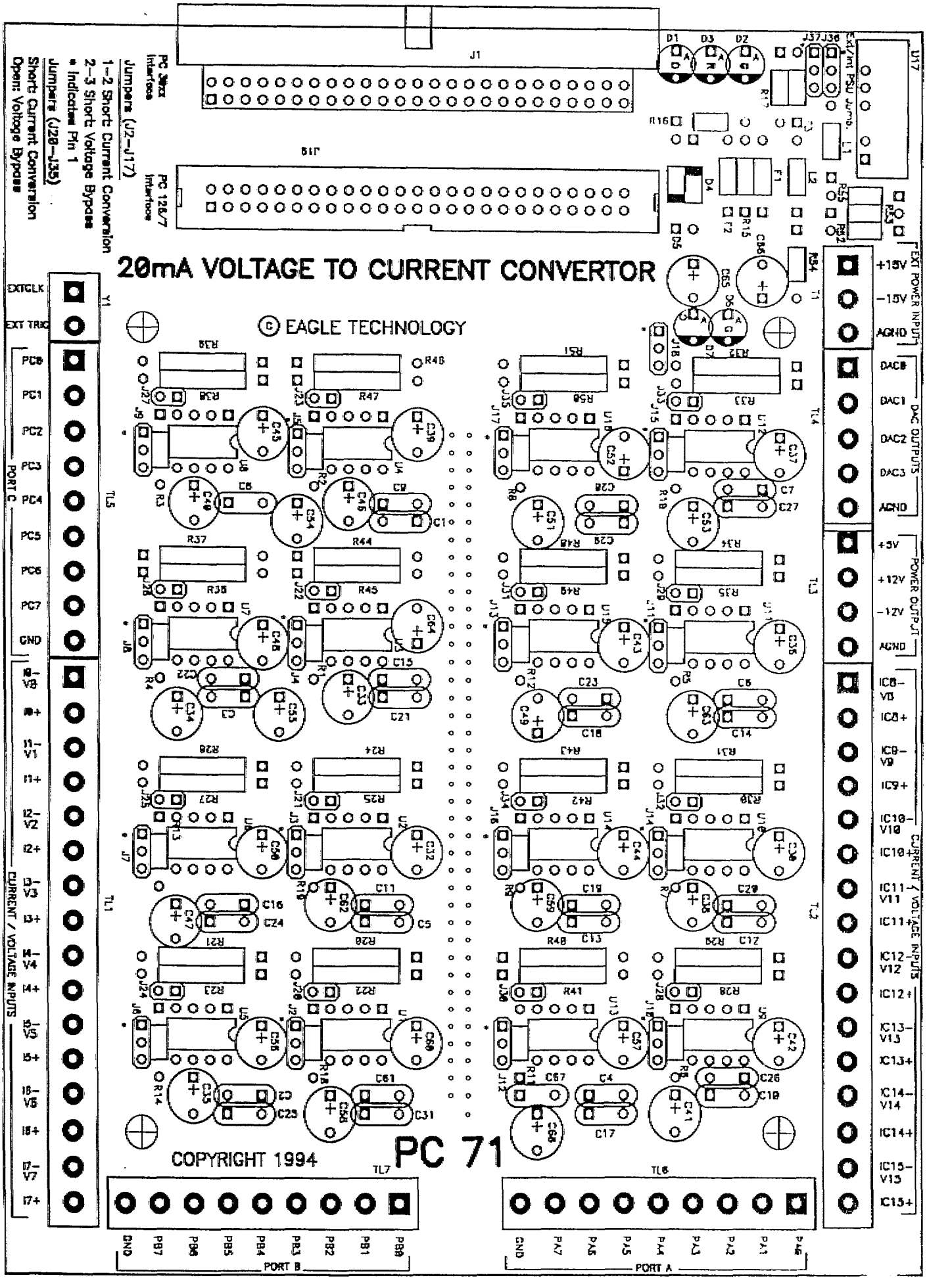
For current conversion:	+5V: 100mA Typ.

7) Repair Service

The PC 71 is guaranteed for a period of 1 year. If the board is faulty within this period, we will gladly repair it free of charge provided that the maximum specs of the PC 30xx, PC 126/7 boards as well as the PC 71 board was not exceeded. Not burn't tracks should be visible. Turnaround time is usually 2 days.

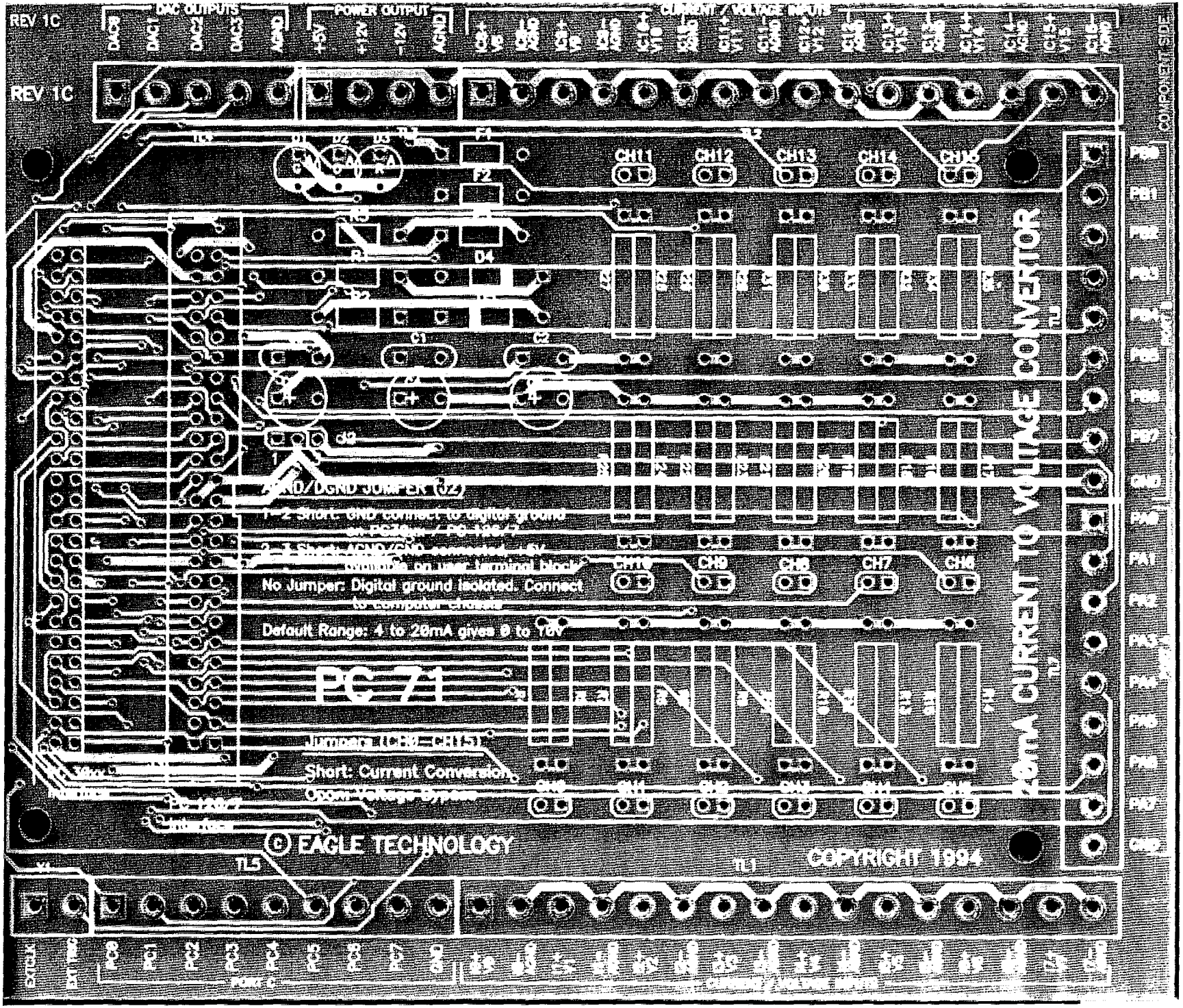
Before sending the board to your distributor for repairs, ensure that you go through Chapter 5 TroubleShooting Hints thoroughly. If after you have gone through this Chapter, the board does not work, return it for repairs.

Our repair service centre will be available to repair our products even after the 1 year warranty. A small service fee will be levied which usually covers the cost of the components that are faulty.



LAYOUT DIAGRAM

COST EFFECTIVE VERSION USING PRECISION RESISTORSONLY


REV 1C
REV 1C
D/C OUTPUTS
POWER OUTPUT
CURRENT/VOLTAGE INPUT
CH11
CH12
CH13
CH14
CH15
CH8
CH9
CH10
CH7
CH6
D4
C1
C2
No Jumper: Digital ground isolated. Connect
Default Range: 4 to 20mA gives 0 to 10V
PC71
Short: Current Conversion
EAGLE TECHNOLOGY
COPYRIGHT 1994
4-20mA CURRENT LOOP VOLTAGE CONVERTER