# LSI3144A

# Encoder/Linear Scale Counter Card

# User's Manual (V1.3)


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# Correction record

| Version | Record |
|---|---|
| 1.0 | firmware version 1.0 up |
| 1.1 | add 5.2 JM1 High speed signal I/O connector (on board) |
| 1.2 | Modify 6.2 Output diagram |
| 1.3 | Modify 2. Feature-Delete Software key function |

# Contents

# Notes on hardware installation

Please follow step by step as you are installing the control cards.

1. Be sure your system is power off.
2. Be sure your external power supply for the wiring board is power off.
3. Plug your control card in slot, and make sure the golden fingers are put in right contacts.
4. Fasten the screw to fix the card.
5. Connect the cable between the card and wiring board.
6. Connect the external power supply for the wiring board.
7. Recheck everything is OK before system power on.
8. External power on.

Congratulation! You have it

For more detail of step by step installation guide, please refer the file “installation.pdf “ on the CD come with the product or register as a member of our user’s club at:

http://automation.com.tw/

to download the complementary documents.

# 1. Forward

Thank you for your selection of PCI bus LSI3144A quadrature encoder/linear scale interface card.

In the field of automation, encoder and linear scale as feedback or measuring element is common used in the microprocessor control system. But for the versatile application in PC based control, only a few selections you can make.

We integrate 4 axes (channels) in one card with the state of the art technology of FPGA chip and provide photo/magnetic coupler isolation and experienced functions such as external triggered latch or load counter, auto increment compare equal or FIFO pre-programmed compare equal output to trigger external devices. The LSI3144A comes with new FIFO of PWM function. The compare out triggers the position FIFO and the PWM FIFO that makes different PWM output at different line interval.

Low cost and high performance makes this card a better choice to use in the servo control feedback, 3D measuring system and other applications which are concerning encoder or linear scale.

Other encoder/linear scale interface card:

LSI3101 one-axis Quadrature Encoder Counter Card
(up to 8MHz quadrature input) (PCI bus)

LSI3101A one-axis Quadrature Encoder Counter Card
(up to 16MHz quadrature input) (PCI bus)

LSI3181 one-axis Quadrature Encoder Counter Card with 8 position offset comparators
(up to 16MHz quadrature input) (PCI bus)

LSI3104 4 axes quadrature encoder/linear scale counter card (PCI bus)

LSI3123A 3 axes quadrature encoder/linear scale counter card
with fast coordinate rebuild function (PCI bus)

LSI3134 4 axes quadrature encoder/linear scale counter card
with 1 axis FIFO compare mode (PCI bus)

LSI5123 3 axes quadrature encoder counter interface (USB)

LSI5123L 3 axes quadrature encoder counter interface (no external trigger latch mode) (USB)

LSI5123A 3 axes quadrature encoder counter interface (High noise immunity , Accurite linear scale absolute coordinate mode) (USB)

Any comment is welcome,
please visit our website
http://www.automation.com.tw/
http://www.automation-js.com/ for the up to date information.

# 2. Features

2.1 Main card

- 2.1.1 PCI plug and play function with card ID for 16 identical cards
- 2.1.2 High noise immunity with magnetic/photo-coupler isolation
- 2.1.3 16 MHz max. Quadrature input rate
- 2.1.4 Four 32-bit counters
- 2.1.5 Quadrature, pulse/direction and up/down counting
- 2.1.6 Programmable multiple rate at X1, X2, X4
- 2.1.7 Load preset value to counter by external trigger or software trigger
- 2.1.8 Latch counter value by external trigger
- 2.1.9 Multiple counter reset (homing) modes
- 2.1.10 Differential or single-end input signal
- 2.1.11 Auto increment compare mode
- 2.1.12 FIFO position compare mode (X,Z axis)
- 2.1.13 FIFO PWM control (X,Z axis)
- 2.1.14 Programmable duration for Compare out and Clear out
- 2.1.15 Interrupt on external trigger, compare equal, borrow, carry and counter clear
- 2.1.16 Supports DIN rail mounted wiring board

2.2 Din rail mounted wiring board

- 2.2.1 LED display for digital I/O
- 2.2.2 Application specific connectors
- 2.2.3 Step down s.p.s. for external 5V

# 3. Specifications

3.1 LSI3144A Main card

**Counter input**

3.1.1 Number of axes — 4, independent

3.1.2 Maximum quadrature input frequency — 16MHz

3.1.3 Maximum input pulse frequency — 16MHz

3.1.4 Encoder Type — Single-end or differential

3.1.5 Count per encoder cycle — X1, X2, X4 programmable (quadrature signal only)

3.1.6 Counter length — 32 Bits

3.1.7 Counter Mode — (QUADRATURE)，(CLOCK/DIRECTION)，
(UP CLOCK/ DOWN CLOCK)

3.1.8 Sample clock frequency — 198MHz

3.1.9 PCI data width — 32 Bits

3.1.10 Card ID — 4 bits

3.1.11 Input channel — 4 channels X, Y, Z and A, totally 4 compatible device units can be hooked

3.1.12 Software homing (reset) counter method — 1 software trigger mode

3.1.13 Hardware homing (reset) counter method — 7 H/W trigger mode

3.1.14 External compare out mask off — INn(GATE), CLR

3.1.15 FIFO depth — 1023 (X,Z axis)

3.1.16 Compare out one shot duration — 1 ~ 16777215 us

**Digital Input**

3.1.17 Home — 1 per channel (Single end or differential)

3.1.18 Latch — 1 per channel (Single end or differential)

3.1.19 Clear counter — 1 per channel (Single end or differential)

3.1.20 General input — 1 per channel

3.1.21 Polarity — all input signals are software programmable

3.1.22 ON state — 2.8Vdc(max) 4.5mA(min)

3.1.23 OFF state — 8Vdc(min) 3mA(max)

3.1.24 Switching speed— 2.2 K Hz (max) for general input
2 MHz (HOME, LATCH, CLEAR_IN)

**Digital Output**

3.1.25 Clear output — 1 per channel

3.1.26 General output — 1 per channel

3.1.27 Polarity — all output signals are software programmable

3.1.28 Output rating — 3A @250Vac, 30V dc (Relay wiring board)
1A @120Vdc (NMOS)

3.1.29 Switching speed — 20 K Hz (max) (MOS out only)

**General**

3.1.30 Card ID — 4 bits, 16 position

3.1.31 Photo isolation — All digital I/O and counter input

3.1.32 Insulation resistance — 1000Mohm (min) at 1000Vdc

3.1.33 Isolation voltage — 2500Vac 1 min

3.1.34 Connector — one 68 pin SCSI-II female connector

3.1.35 Operation temperature — 0 to +70 degree C

3.1.36 Storage temperature — -20 to +80 degree C

3.1.37 Operation humidity — 5-95% RH, non-condensing

3.1.38 Dimension — 151(W) * 110(H)mm , 6.0(W) * 4.4(H)in

3.2 ADP3144DIN DIN rail mounted wiring board

3.2.1 Connection cable — SCSI-II 68P cable to connect main and wiring board

3.2.2 Power supply voltage to wiring board — DC+24V

3.2.3 On board build-in s.p.s. — DC+5V 500mA (max)

3.2.4 Dimension — 86(W) * 204(L) * 53(H)mm , 3.4(W) * 8.1(L) * 2.1(H)in

3.3 ADP3144ADIN DIN rail mounted wiring board (high speed type)

3.3.1 Connection cable — SCSI-II 68P cable to connect main and wiring board

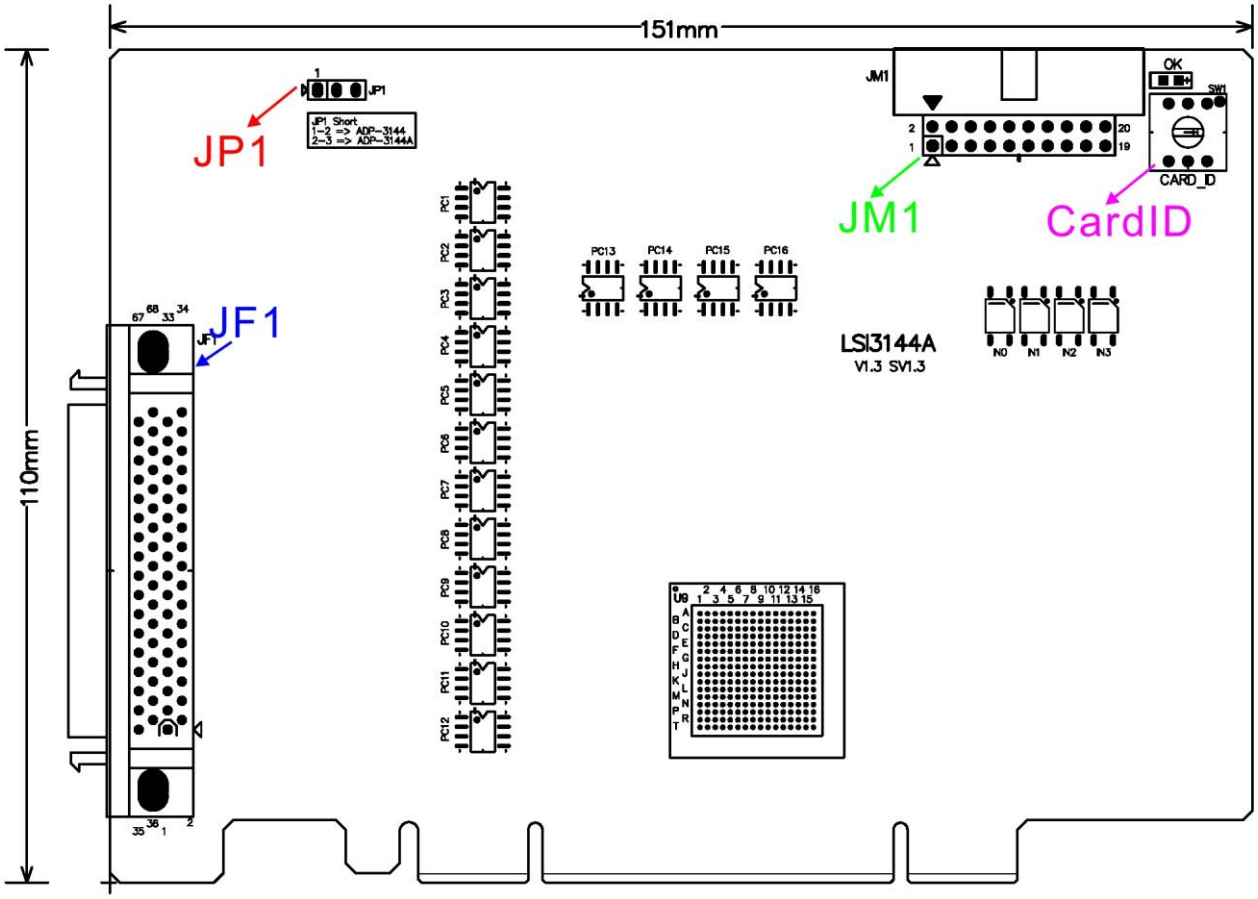
3.3.2 Power supply voltage to wiring board — DC+24V

3.3.3 On board build-in s.p.s. — DC+5V 500mA (max)

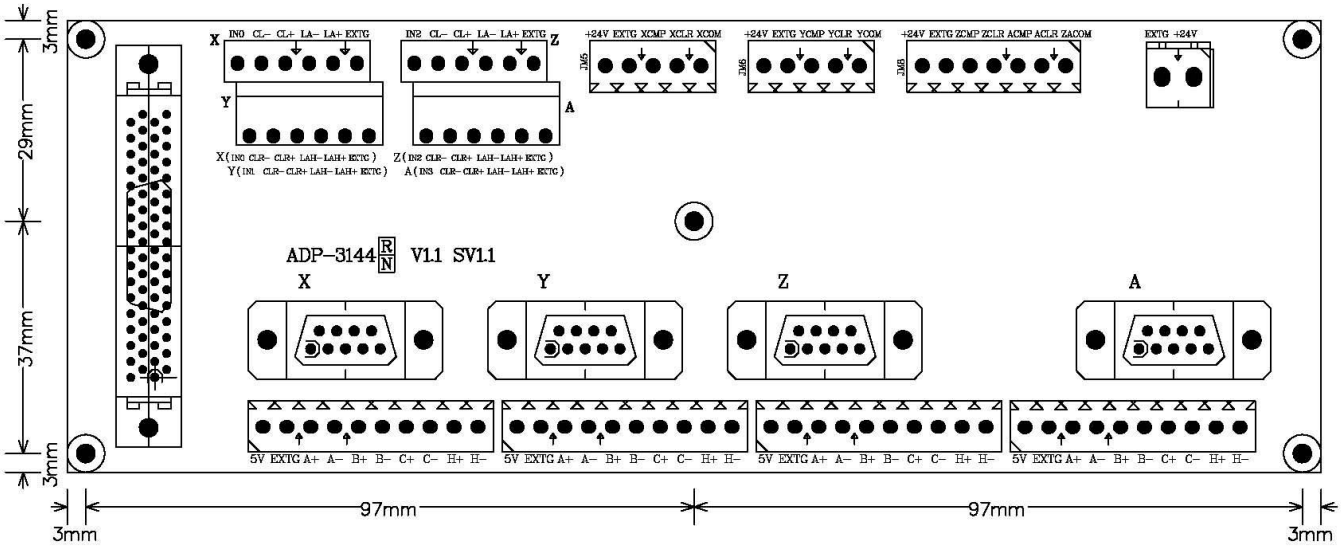
3.3.4 Dimension — 86(W) * 204(L) * 53(H)mm , 3.4(W) * 8.1(L) * 2.1(H)in

# 4. Layout and dimensions

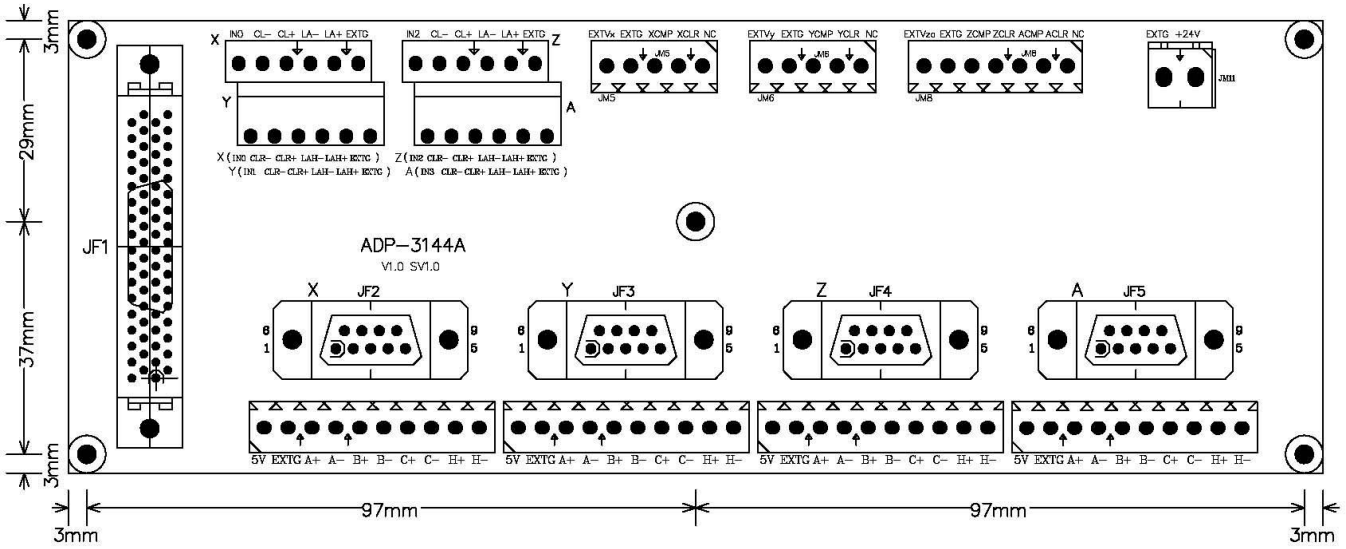
## 4.1 LSI3144A Main card



## 4.2 ADP3144DIN Din rail mounted wiring board

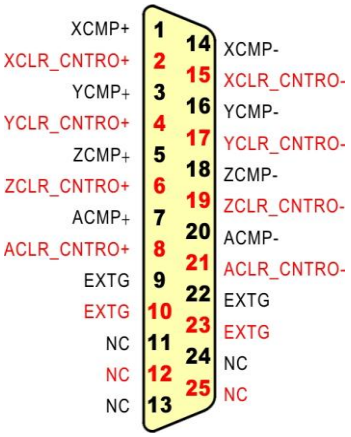



## 4.3 ADP3144ADIN Din rail mounted wiring board (high speed type)



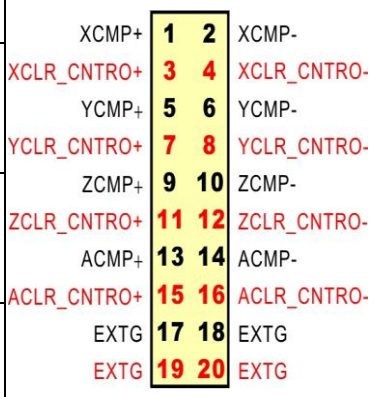
# 5. Pin definitions for 68P SCSI connector

## 5.1 JM1 High speed signal I/O connector (on bracket)

| PIN | DESCRIPTIONS | JM1 | PIN | DESCRIPTIONS |
|---|---|---|---|---|
| 1 | XCMP+:<br>positive differential output of X_CMP;<br>general purpose/compare output |  | 14 | XCMP-:<br>negative differential output of X_CMP;<br>general purpose/compare output |
| 2 | XCLR_CNTRO+:<br>positive differential output of X_CLR_OUT;<br>general purpose/compare output | | 15 | XCLR_CNTRO-:<br>negative differential output of X_CLR_OUT;<br>general purpose/compare output |
| 3 | YCMP+:<br>positive differential output of Y_CMP;<br>general purpose/compare output | | 16 | YCMP-:<br>negative differential output of Y_CMP;<br>general purpose/compare output |
| 4 | YCLR_CNTRO+:<br>positive differential output of Y_CLR_OUT;<br>general purpose/compare output | | 17 | YCLR_CNTRO-:<br>negative differential output of Y_CLR_OUT;<br>general purpose/compare output |
| 5 | ZCMP+:<br>positive differential output of Z_CMP;<br>general purpose/compare output | | 18 | ZCMP-:<br>negative differential output of Z_CMP;<br>general purpose/compare output |
| 6 | ZCLR_CNTRO+:<br>positive differential output of Z_CLR_OUT;<br>general purpose/compare output | | 19 | ZCLR_CNTRO-:<br>negative differential output of Z_CLR_OUT;<br>general purpose/compare output |
| 7 | ACMP+:<br>positive differential output of A_CMP;<br>general purpose/compare output | | 20 | ACMP-:<br>negative differential output of A_CMP;<br>general purpose/compare output |
| 8 | ACLR_CNTRO+:<br>positive differential output of A_CLR_OUT;<br>general purpose/compare output | | 21 | ACLR_CNTRO-:<br>negative differential output of A_CLR_OUT;<br>general purpose/compare output |
| 9 | EXTG:<br>external ground | | 22 | EXTG:<br>external ground |
| 10 | EXTG:<br>external ground | | 23 | EXTG:<br>external ground |
| 11 | NC | | 24 | NC |
| 12 | NC | | 25 | NC |
| 13 | NC | | | |

**Note: To use as general purpose output, the CMP or CLR_OUT pin must configured as general purpose first and the paired differential signals work as general out (but on complementary output level).**

5.2 JM1 High speed signal I/O connector (on board)

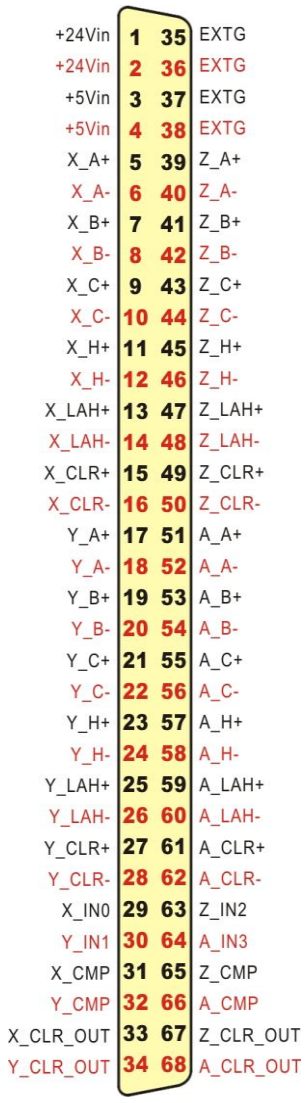
| PIN | DESCRIPTIONS | JM1 | PIN | DESCRIPTIONS |
|---|---|---|---|---|
| 1 | XCMP+:<br>positive differential output of X_CMP;<br>general purpose/compare output |  | 2 | XCMP-:<br>negative differential output of X_CMP;<br>general purpose/compare output |
| 3 | XCLR_CNTRO+:<br>positive differential output of X_CLR_OUT;<br>general purpose/compare output | | 4 | XCLR_CNTRO-:<br>negative differential output of X_CLR_OUT;<br>general purpose/compare output |
| 5 | YCMP+:<br>positive differential output of Y_CMP;<br>general purpose/compare output | | 6 | YCMP-:<br>negative differential output of Y_CMP;<br>general purpose/compare output |
| 7 | YCLR_CNTRO+:<br>positive differential output of Y_CLR_OUT;<br>general purpose/compare output | | 8 | YCLR_CNTRO-:<br>negative differential output of Y_CLR_OUT;<br>general purpose/compare output |
| 9 | ZCMP+:<br>positive differential output of Z_CMP;<br>general purpose/compare output | | 10 | ZCMP-:<br>negative differential output of Z_CMP;<br>general purpose/compare output |
| 11 | ZCLR_CNTRO+:<br>positive differential output of Z_CLR_OUT;<br>general purpose/compare output | | 12 | ZCLR_CNTRO-:<br>negative differential output of Z_CLR_OUT;<br>general purpose/compare output |
| 13 | ACMP+:<br>positive differential output of A_CMP;<br>general purpose/compare output | | 14 | ACMP-:<br>negative differential output of A_CMP;<br>general purpose/compare output |
| 15 | ACLR_CNTRO+:<br>positive differential output of A_CLR_OUT;<br>general purpose/compare output | | 16 | ACLR_CNTRO-:<br>negative differential output of A_CLR_OUT;<br>general purpose/compare output |
| 17 | EXTG:<br>external ground | | 18 | EXTG:<br>external ground |
| 19 | EXTG:<br>external ground | | 20 | EXTG:<br>external ground |

**Note: To use as general purpose output, the CMP or CLR_OUT pin must configured as general purpose first and the paired differential signals work as general out (but on complementary output level).**

5.3 JF1 Front view of connector

| PIN | DESCRIPTIONS |
|---|---|
| 1 | +24V : External DC +24V supply |
| 2 | +24V : External DC +24V supply |
| 3 | +5V : Regulated +5V out |
| 4 | +5V : Regulated +5V out |
| 5 | X_A+ : encoder A+ phase input |
| 6 | X_A- : encoder A- phase input |
| 7 | X_B+ : encoder B+ phase input |
| 8 | X_B- : encoder B- phase input |
| 9 | X_C+ : encoder C+ phase input |
| 10 | X_C- : encoder C- phase input |
| 11 | X_H+ : HOME+ input |
| 12 | X_H- : HOME- input |
| 13 | X_LAH+ : LATCH+ input |
| 14 | X_LAH- : LATCH- input |
| 15 | X_CLR+ : clear counter+ input |
| 16 | X_CLR- : clear counter- input |
| 17 | Y_A+ : encoder A+ phase input |
| 18 | Y_A- : encoder A- phase input |
| 19 | Y_B+ : encoder B+ phase input |
| 20 | Y_B- : encoder B- phase input |
| 21 | Y_C+ : encoder C+ phase input |
| 22 | Y_C- : encoder C- phase input |
| 23 | Y_H+ : HOME+ input |
| 24 | Y_H- : HOME- input |
| 25 | Y_LAH+ : LATCH+ input |
| 26 | Y_LAH- : LATCH- input |
| 27 | Y_CLR+ : clear counter+ input |
| 28 | Y_CLR- : clear counter- input |
| 29 | X_IN0: general purpose input |
| 30 | Y_IN1: general purpose input |
| 31 | X_CMP: general purpose/compare output |
| 32 | Y_CMP: general purpose/compare output |
| 33 | X_CLR_OUT: clear counter/general output |
| 34 | Y_CLR_OUT: clear counter/general output |

**JF1**

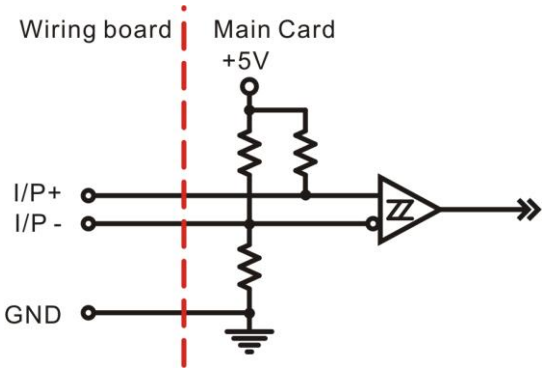



| PIN | DESCRIPTIONS |
|---|---|
| 35 | EXTG : Ground |
| 36 | EXTG : Ground |
| 37 | EXTG : Ground |
| 38 | EXTG : Ground |
| 39 | Z_A+ : encoder A+ phase input |
| 40 | Z_A- : encoder A- phase input |
| 41 | Z_B+ : encoder B+ phase input |
| 42 | Z_B- : encoder B- phase input |
| 43 | Z_C+ : encoder C+ phase input |
| 44 | Z_C- : encoder C- phase input |
| 45 | Z_H+ : HOME+ input |
| 46 | Z_H- : HOME- input |
| 47 | Z_LAH+ : LATCH+ input |
| 48 | Z_LAH- : LATCH- input |
| 49 | Z_CLR+ : clear counter+ input |
| 50 | Z_CLR- : clear counter- input |
| 51 | A_A+ : encoder A+ phase input |
| 52 | A_A- : encoder A- phase input |
| 53 | A_B+ : encoder B+ phase input |
| 54 | A_B- : encoder B- phase input |
| 55 | A_C+ : encoder C+ phase input |
| 56 | A_C- : encoder C- phase input |
| 57 | A_H+ : HOME+ input |
| 58 | A_H- : HOME- input |
| 59 | A_LAH+ : LATCH+ input |
| 60 | A_LAH- : LATCH- input |
| 61 | A_CLR+ : clear counter+ input |
| 62 | A_CLR- : clear counter- input |
| 63 | Z_IN2: general purpose input |
| 64 | A_IN3: general purpose input |
| 65 | Z_CMP: general purpose/compare output |
| 66 | A_CMP: general purpose output |
| 67 | Z_CLR_OUT: clear counter/general output |
| 68 | A_CLR_OUT: clear counter/general output |

# 6. I/O Interface diagram

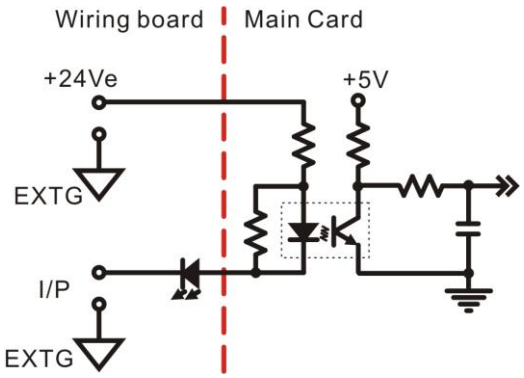
## 6.1 Input diagram

**Type 1 input :** Differential input




For A+/A-,B+/B-,C+/C-,H+/H-,CLR+/CLR-,LAH+/LAH-

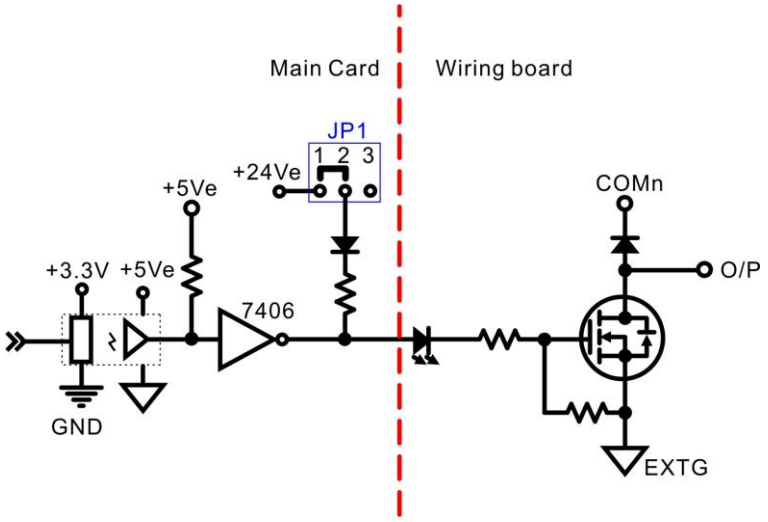
**Type 2 Input:**




For IN0~IN3

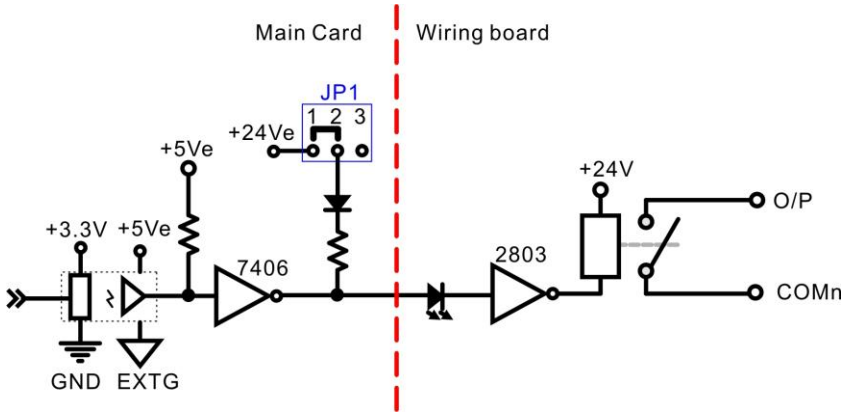
6.2 Output diagram

**Type1 output: (NMOS) ADP3144DIN(N)**



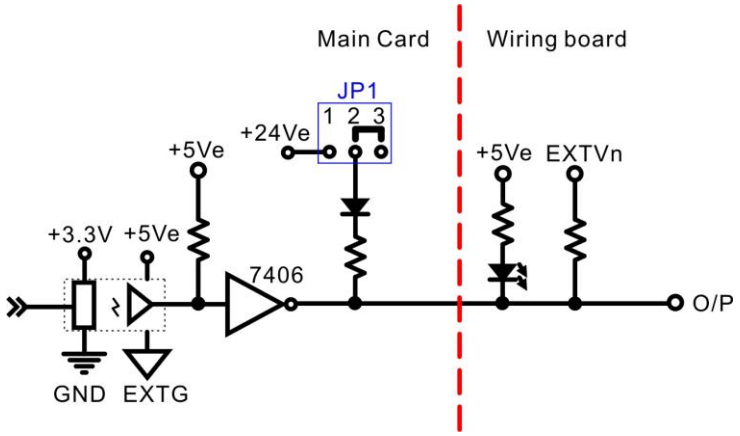

For X,Y,Z,A(OUT/CLR_OUT)

**Type2 output: (Relay) ADP3144DIN(R)**




For X,Y,Z,A (OUT/CLR_OUT)

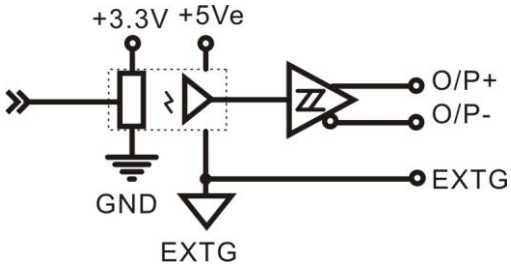
**Type3 output: ADP3144ADIN**




For X,Y,Z,A (OUT/CLR_OUT)

6.3 High speed port I/O diagram (JM1)

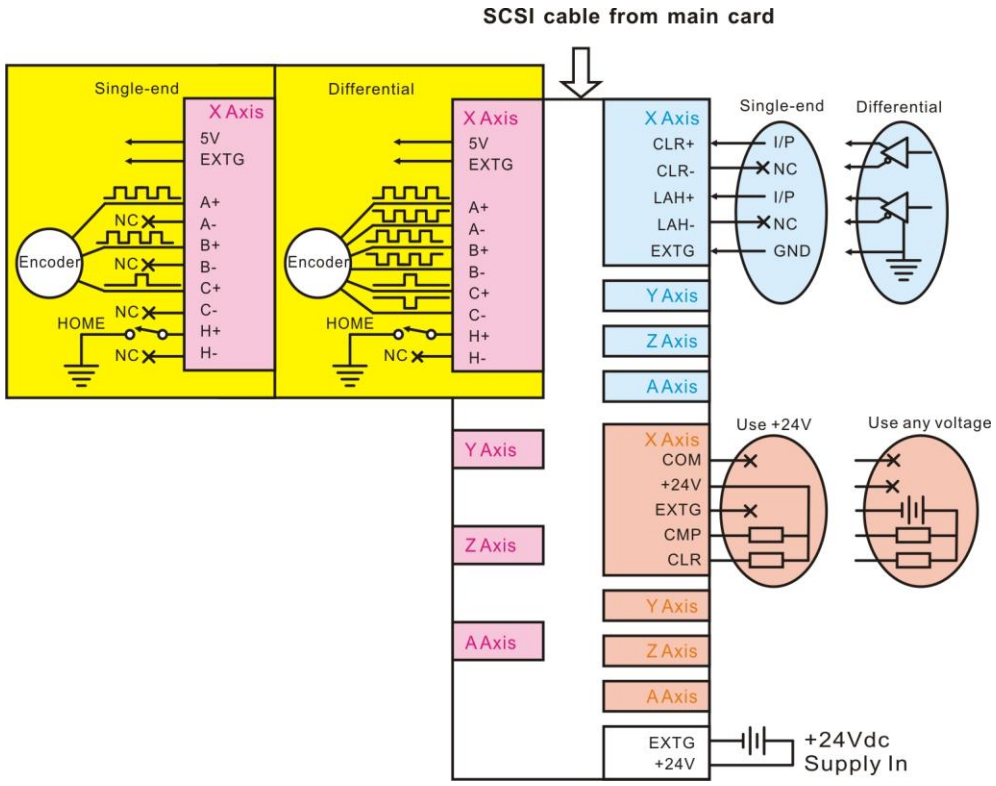
**Output:**



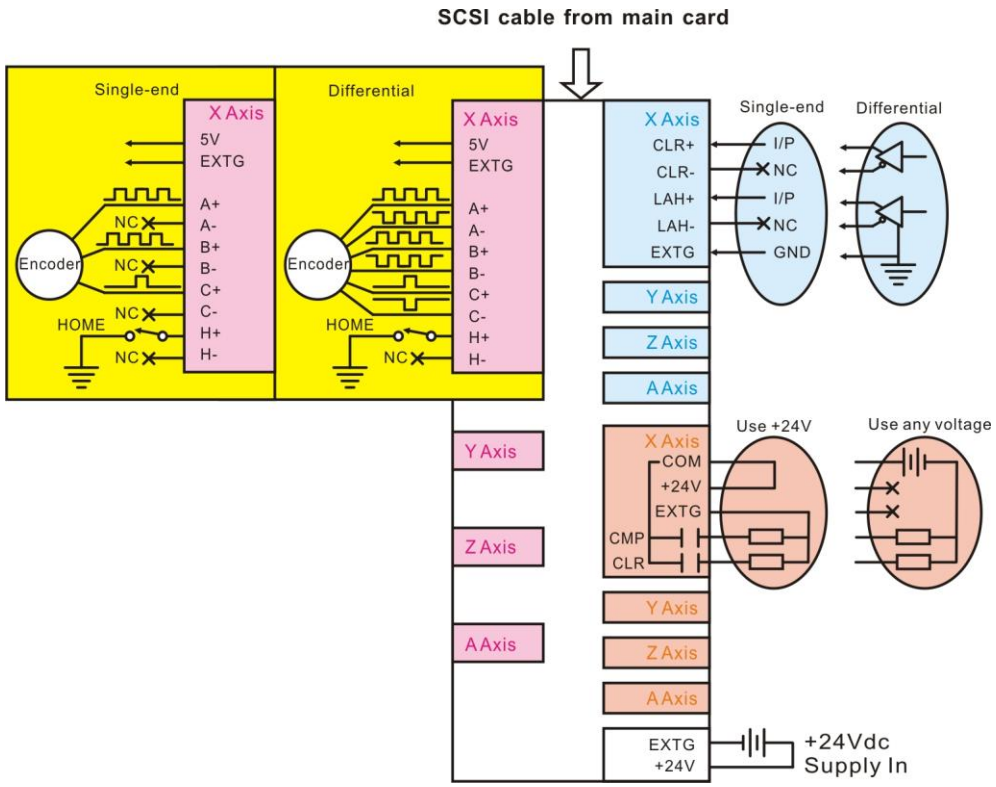

For X,Y,Z,A (CMP+/CMP-, CLR_CNTRO+/CLR_CNTRO-)

**Note: The signal sources are the same as CLR_OUT and CMP but the interface with faster chips.**

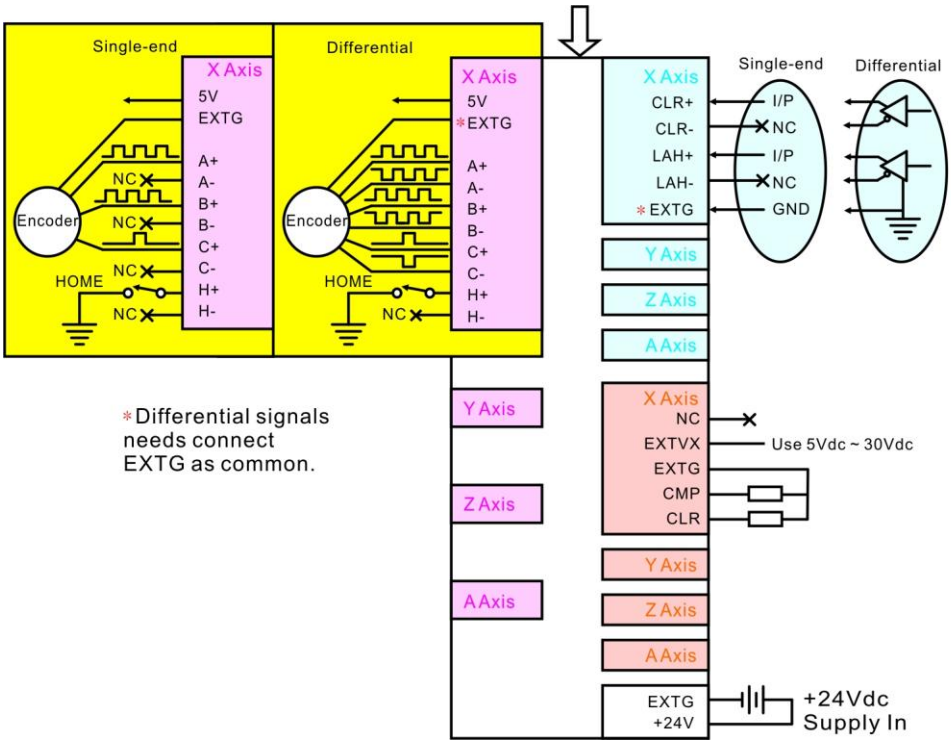
# 7. External wiring diagram




wiring board with NMOS output (ADP3144DIN(N))

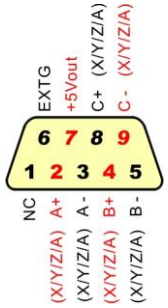



wiring board with Relay output (ADP3144DIN(R))




| Pulse Input under various mode | | | |
|---|---|---|---|
| Input Terminal | Quadrature | Single Pulse | Dual Pulse |
| A+ | A+ | Clock+ | CW+ |
| A- | A- | Clock- | CW- |
| B+ | B+ | Dir+ | CCW+ |
| B- | B- | Dir- | CCW- |
| C+ | C+ | NA | NA |
| C- | C- | NA | NA |

wiring board ADP3144ADIN

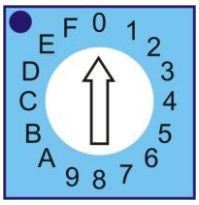



Wiring board DB9 specific connector

# 8. Hardware settings

## 8.1 Card ID setting

Since PCI cards have plug and play function, the card ID is required for programmer to identify which card he/she will control without knowing the physical address assigned by the Windows. A 4 bits rotary switch for extinguishing the 16 identical card.




## 8.2 Matched wiring board setting

The LSI3144A can adopt the wiring board ADP3144DIN or ADP3144ADIN, the high speed type wiring board. Owing to the difference of voltage level, we must setup the interface configuration on the main card, JP1 jumper setting.

| | |
|---|---|
|   |   |
| ADP3144DIN | ADP3144**A**DIN |

# 9. Applications

- For counting pulses on the fly, such as:
  -- Encoder on various kinds of servo motor
  -- Encoder on DC/AC motor
  -- Optical scale output signal
  -- Magnetic linear scale output
  -- Timing disc
  -- Revolution sprocket
  -- Proximity sensor/detector with relative motion
  -- Timer counter
- Compare position on the fly
- Image checker (trigger to take picture at different postion)
- Laser grooving (needs different position with different laser power)
- Pulse signal receiver /display
- Touch /non touch probe trigger to latch position
- X-Y Table linear Scale F/B

# 10. Ordering information

| PRODUCT | DESCRIPTIONS |
|---|---|
| LSI3144A | 4-axis Quadrature Encoder Counter Card |
| ADP3144DIN(N) | DIN rail mounted wiring board for LSI3144/LSI3144A, General output : 8 power NMOS |
| ADP3144DIN(R) | DIN rail mounted wiring board for LSI3144/LSI3144A, General output : 8 Relays |
| ADP3144ADIN | high speed type DIN rail mounted wiring board for LSI3144A |
| M2668681501 | 68-pin SCSI-II cable 1.5M |
| M2668683001 | 68-pin SCSI-II cable 3.0M |