

DS2/DS4

DIRECTOR

Hardware Manual

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1 Revision History

Manual	Comments
Revision 1.0	11-Aug-05 Initial release of DS2/DS4 Hardware Manual, separated from older APEX/Director Hardware Manual

2 Preface

2.1 Scope of this Manual

This manual details the hardware of the DS2/DS4 Director.

2.2 Name Conventions

All numbers are in decimal unless otherwise indicated. Where a number is prefixed by '0x', the value is in hexadecimal format.

2.3 Anti-Static Handling

This board contains CMOS devices that could be damaged in the event of static electricity being discharged through them. At all times, please observe anti-static precautions when handling the board and always unpack and install it in an anti-static working area.

2.4 Electromagnetic Compatibility (EMC)

The DS2/DS4 is classified as a component with regard to the European Community EMC regulations and it is the user's responsibility to ensure that systems using the board are compliant with the appropriate EMC standards.

Arcom EMC tests of the DS2/DS4 have shown that the RF emissions of the board are well below standard international EMC limits and that it is unlikely to contribute significantly to the RF emissions spectrum of any system in which it is used.

2.5 Packaging

Please ensure that should a board need to be returned to Arcom, it is adequately packed. Use an anti-static bag for the board and use a box, not bag, to physically protect the board.

2.6 Disclaimer

The information in this manual has been carefully checked and is believed to be accurate. Arcom Control Systems assumes no responsibility for any infringements of patents or other rights of third parties that may result from its use.

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3 Introduction

This manual covers the hardware information for the Director product line. It details the standard and optional hardware, specifications, and information required by the system designer for setting up the unit configuration. The different models of Director use the same software operating system and are differentiated from each other simply based on the physical enclosure and hardware platform.

The DS2/DS4 consists of a processor board and base board containing four serial channels. Optional I/O cards may be added to the board stack via a 16-bit PC/104 header to provide Ethernet, additional communication channels, analog and digital I/O, or HART protocol ports. All boards are mounted in an industrial metal enclosure. Director units are provided fully tested and may have customer-specific configurations when they leave the factory.

By default, the processor board has four serial ports, one of which may be configured for two-wire RS-485. These four ports are intended for local configuration and programming, and for connection to external field devices.

The serial ports are configured using the ACE software tool. Using Windows HyperTerminal or another terminal emulator, one communications port may be used to download the configuration file generated by ACE and provide diagnostic capabilities. I/O signals from optional I/O boards are cabled from the PC/104 stack using a 50-way header and may be connected to an external breakout device to provide screw terminations.

4 DS2/DS4 Unit Hardware

The Director unit always has the same basic hardware, and this chapter describes the necessary links and pin-outs that need to be understood before the system can be used. Director units are provided fully tested and are typically supplied from the factory with a default software configuration.

The Director consists of the following hardware components:

- **Enclosure** - metal housing to contain processor and provide mounting arrangement
- **Baseboard** - contains power supply, built-in communication port terminations, and slots for installing card
- **Microprocessor** - 386EX processor mounts to the Baseboard
- **Optional I/O** - PC/104 cards provide expansion I/O. Typically, the only card installed on a DS2 is the Ethernet controller board (AIM104-ETHER).
- **Internal Connections** - connects internal I/O to outside of enclosure

This section describes the power supply, baseboard, I/O connections, and the microprocessor.



4.1 Specifications

Processor	Intel 386EX 25 MHz
Memory	1 Mb SRAM 1 Mb Flash (for storage of operating system and configuration)
Battery	Non-rechargeable 3V lithium for maintaining Real Time Clock and SRAM
Temperature:	-40 to +70° C (operating) -50 to +85° C (storage)
Humidity:	0 to 95% relative, non-condensing
Input Power:	18 to 36 VDC <i>Optional:</i> 12V DC nominal (9 to 18 VDC) or, 48V DC nominal (36 to 72 VDC)
Power Consumption:	4.5 Watts (with standard board set). In-rush current on startup is approximately 2A momentarily. Additional power required for optional boards, listed in each section of this manual. Standard board set includes: AIM104-386EX processor, AIM104-Ether, and SCT-AIM104 baseboard.
Weight	0.737 kg (1.625 lbs.), excluding optional cards

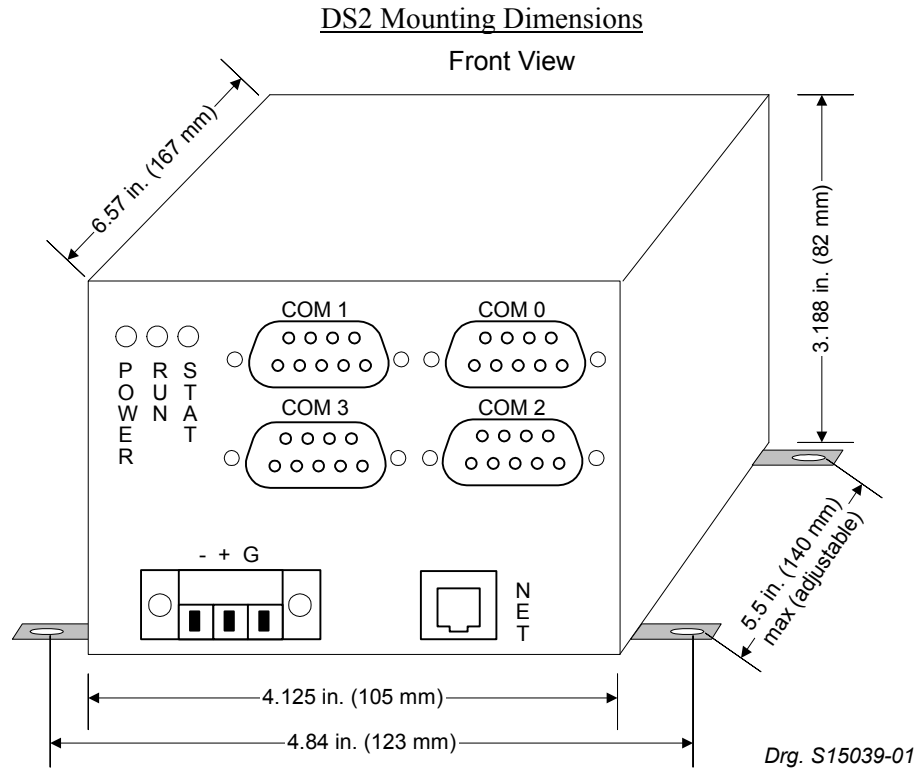
4.1.1 Battery Safety Guidelines

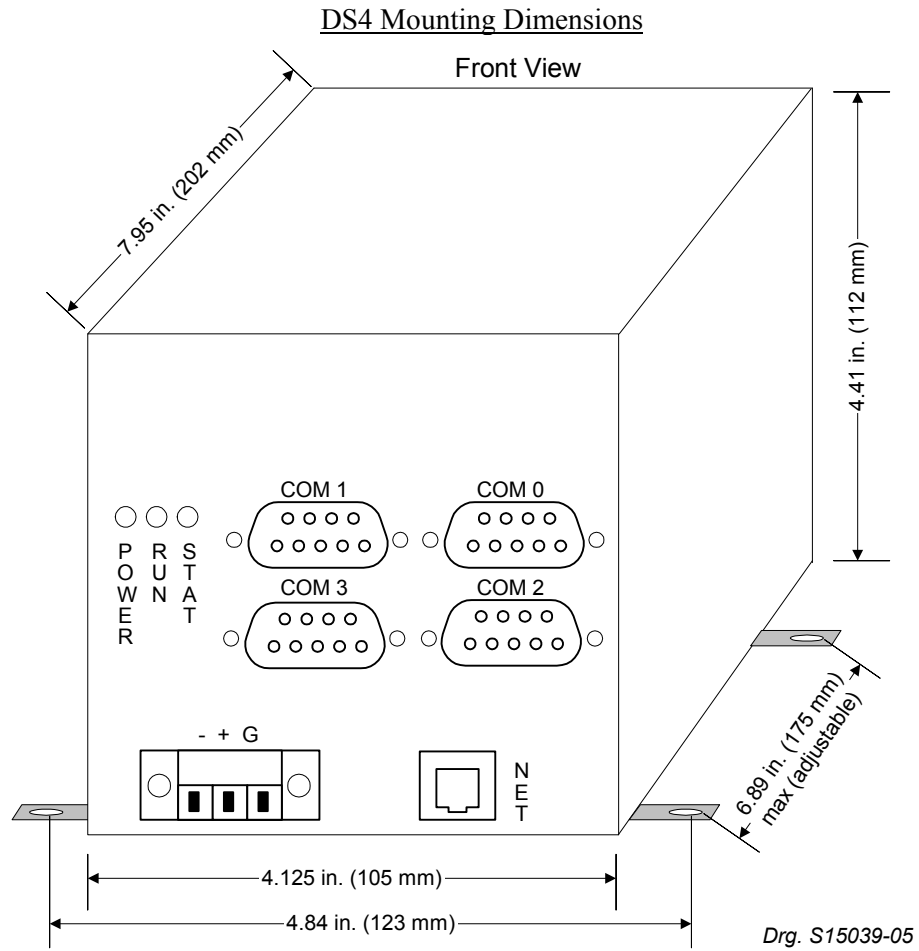
WARNING: Battery is non-rechargeable. Danger of explosion if battery (lithium cell) is recharged or incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

Replacement of the lithium cell is to be carried out by qualified (service) personnel only. The battery on the Director is provided to maintain the on-board real-time clock when input power is removed.

4.2 Enclosure

The Director unit consists of a processor board and other circuit boards installed in a panel mount metal enclosure, which includes interior electrical shielding. Enclosure and mounting dimensions are shown below.

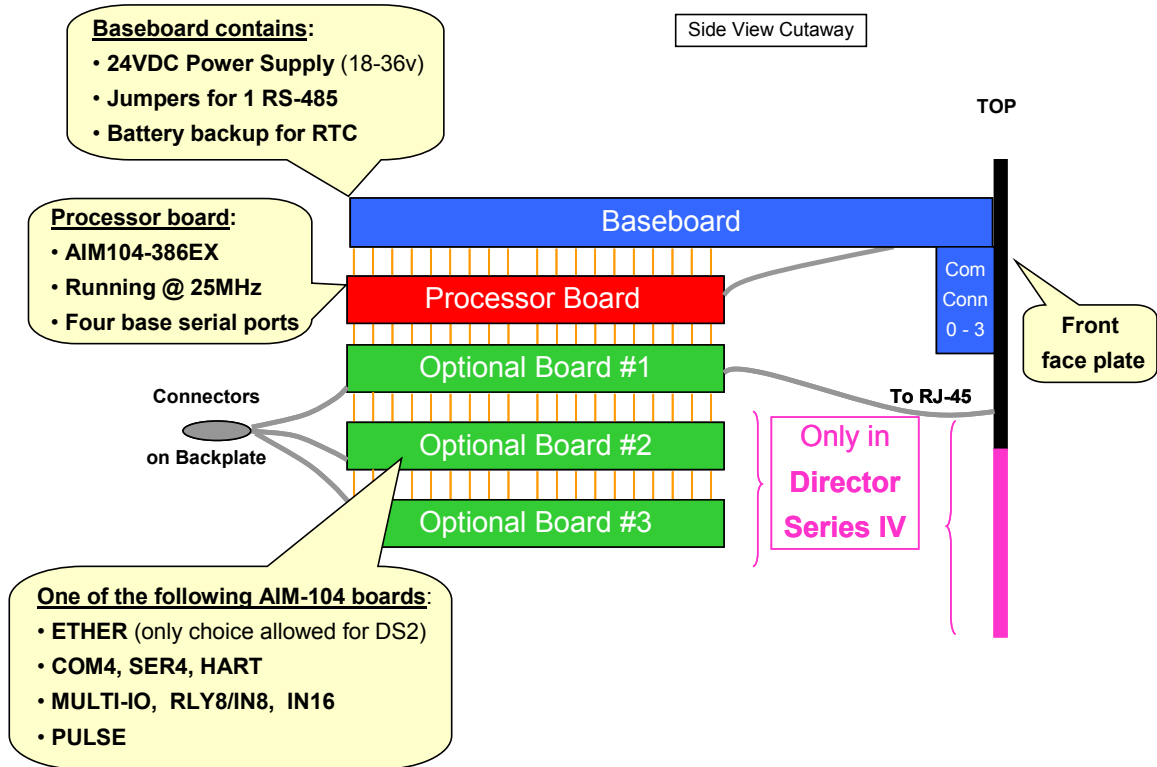




By default, the processor board has four serial ports available on-board. These are brought to the front of the enclosure via a termination board (SCT-AIM104). Ethernet is provided via an expansion board (AIM104-ETHER) cabled to an RJ-45 connector on the front of the unit.

4.2.1 DS2/DS4 Internal Arrangement

Several circuit boards make up a DS2/DS4, which are connected together internally as shown in the following diagram.



4.2.2 I/O Expandability Options

Optional boards provide additional I/O capabilities in addition to the built-in serial and analog/digital inputs.

AIM104-Ether	10baseT Ethernet
AIM104-SER4	4 Serial Channels (RS-232)
AIM104-COM4	4 Serial Channels (two RS-232, two RS-485/422)
AIM104-MULTI-IO	16 Analog Input, single-ended (or 8 differential AI), 2 Analog Output, 8 Digital Input
AIM104-IN16	16 Digital Input
AIM104-RELAY8/IN8	8 Relay Outputs, 8 Digital Inputs
AIM104-UPP	16 Digital Inputs (up to 4 frequency, up to 10 accumulator)
AIM104-HBI	2 Channels HART protocol, 2 Analog Output

4.3 Processor Board – AIM104-386EX

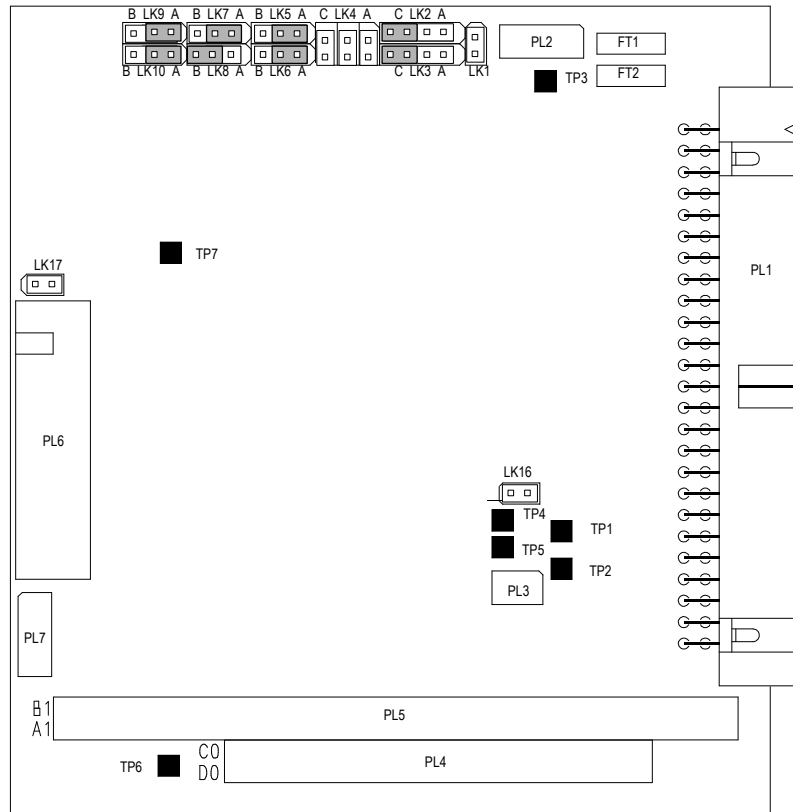
The AIM104-386EX is a single board computer with the PC/104 form factor, based on the Intel 386EX processor. On-board peripheral functions include four COM channels, a real time clock and an event timer/watchdog timer. The event timer can trigger periodic recovery from power down mode, allowing low average current consumption. The Director operating system periodically services the watchdog timer. In case of software failure or lockup, system reset will occur when the watchdog times out.

The AIM104-386EX offers a 25 MHz processor board, running a multi-tasking software kernel. To function correctly, the processor needs the correct boot files in addition to valid configuration files which are stored in its Flash Filing System. AIM104-386EX has four serial ports, COM0 through COM3, with COM3 configurable through link settings for RS-232 or RS-485/422 operation.

An enhanced 5V monitor/reset provides brown-out protection. A FLASH device provides permanent storage for Director operating system, configuration files, and programming. A hardware Real-time Clock (RTC) device is provided.

4.3.1 AIM104-386EX Link Settings

The following diagram shows the necessary link settings on the AIM104-386EX for it to operate properly within a Director system. Shaded links indicate jumpers which are fitted.

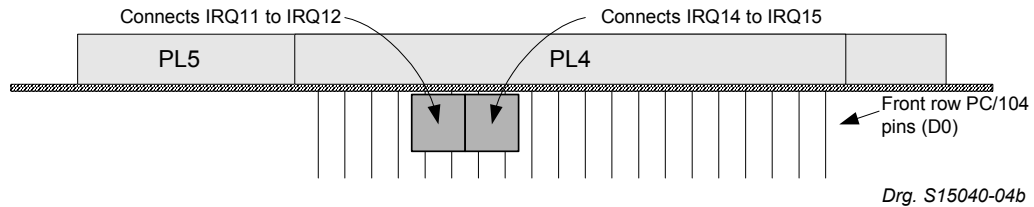


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4.3.2 SCT-AIM104 Link Settings

When used in a Director, a few jumpers are necessary on the SCT-AIM104 baseboard for proper use with certain I/O boards. These links are located on the bottom of the PC/104 pins, and connect certain IRQ lines together on the processor card. The pins are on the outer set of pins for the shorter section of the PC/104 header. Certain cards used in the Director were built to operate with a certain IRQ, but those IRQs were not available on the AIM104-386EX processor.

AIM104-Ether: Board uses IRQ15, but 386EX uses IRQ14
 AIM104-COM4: Last COM port uses IRQ11, but 386EX uses IRQ12



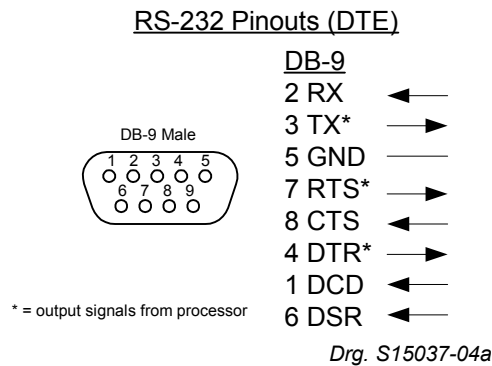
Other important jumpers on the SCT-AIM104 baseboard select COM3 to be RS-232 or RS-485, and enable/disable the on-board battery. The links JP1-JP4 are located at the back of the baseboard and should all be moved to either the “RS232” or “RS485”, and JP5 is located next to the battery.

JP1 JP2	RS232	COM3 in RS-232 mode.
JP3 JP4	RS485	COM3 in 2-wire RS-485 mode.
JP5	Removed	Battery backup disabled. When removed, the real-time clock will not be maintained after power is removed. This is the default position.
	Fitted	Battery backup enabled. When fitted, the real-time clock is maintained after power is removed.

4.3.3 RS-232 Serial Interface: COM0 to COM3

Four 9-way 'D' type connectors (DB-9) for COM0 through COM3 are located on the front of the Director enclosure from the SCT-AIM104 board, which receives its signals via a 50-way ribbon cable to the AIM104-386EX. SCT-AIM104 links JP1-JP4 must be in the "RS232" position.

The pin-out of the DB-9 serial interface for RS-232 is presented as follows:



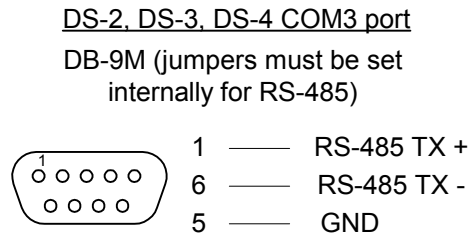
The direction of data with respect to the Director serial interface is such that the Director acts as a DTE (Data Terminal Equipment) device. This means:

- TX** is used to transmit data from the Director.
- RX** is used by the Director to receive data.
- GND** must be connected to an RS-232 GND on the other device for proper communication.
- RTS** is asserted prior to the Director sending data.
- CTS** must be received before data will be transmitted (a jumper from RTS may be used, if no handshaking lines are required for a modem).
- DTR** is asserted to indicate the Director is ready to receive data.
- DCD** must be received before incoming data will be accepted (a jumper from DTR may be used, if no handshaking lines are required for a modem).

4.3.4 RS-485 Serial Interface: COM3

The last serial port on the DS2/DS4 (COM3) may be optionally configured for either RS-232 or RS-485 communication. SCT-AIM104 links JP1-JP4 must be in the “RS485” position to operate in this mode.

The RS-485 communication port is optically isolated. When COM3 on the Director is configured for two-wire RS-485 operation, up to 32 devices can be connected together in a multidrop fashion. The following pin configuration is used:



For DS-2/4, JP1 on SCT-AIM104 must be set to the "RS-485" position.
For DS-3, LK2 on SCT-ORBCOMM must be set to A, and LK3 must be B.

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RS-485 is a balanced differential system, in which the voltage produced by the driver appears across a pair of signal lines that transmit only one signal. A balanced line driver produces a voltage from 2 to 6 volts across its positive and negative output terminals. A balanced differential line receiver senses the voltage state of the transmission line across the two signal input lines.

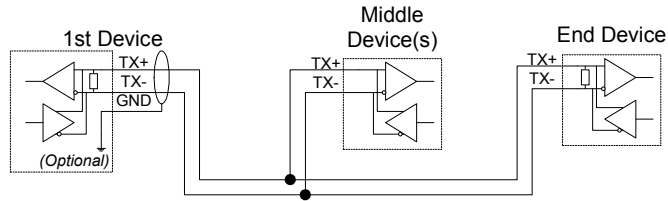
- Data +** is connected to the Data + of other 2-wire RS-485 devices.
- Data -** is connected to the Data - of other 2-wire RS-485 devices.
- GND** should be connected to signal ground at one end of the cable network for grounding cable shield, not used by a balanced line receiver in determining the logic state of the data line.

4.3.5 RS-485 / RS-422 Wiring Diagrams

When connecting RS-485 or RS-422 devices in a multidrop configuration, there must usually be a 120Ω termination resistor on the first and last devices in the network, but not on any devices in the middle of the loop.

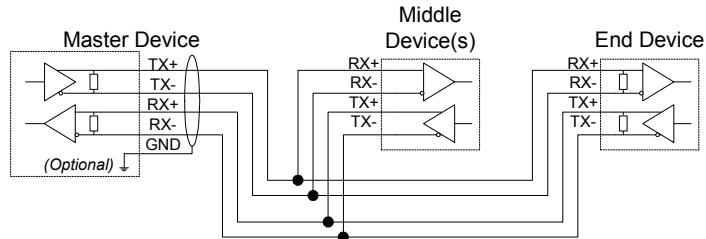
In RS-485 or RS-422 systems, the ground connection is optional. It is typically used to connect the cable shield for a shielded, twisted pair cable. In the DS2/DS4 COM3 port, the RS-485/422 ground is common with the RS-232 grounds, but is isolated from the metal case. In order to avoid ground loops, connect the cable shield to the RS-485/422 GND at only one point in the network.

2-wire RS-485 Device Connections



End devices usually need 120 ohm termination resistor, optional middle device(s) must not have resistor.

4-wire RS-485/422 Device Connections



End device (and RS-485 Master) may need 120 ohm termination resistor, optional middle device(s) must not have resistor.

Drawing is labeled as if devices are DTE. Direction of arrows is correct, regardless of RX/TX labeling on a given device.

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5 Optional I/O Boards

On-board serial ports provide four serial communication channels. Optional PC/104 boards are available to provide additional communication ports and other I/O for certain applications. This chapter describes the connections and configuration of these boards.

5.1 AIM104–Ether Ethernet Interface

The AIM104-Ether board provides an IEEE 802.3 interface and is used to download the configuration files to the DS2/DS4 unit, and provides the Ethernet network interface.

5.1.1 AIM104 Ether Link Settings

Link LK1 should be set to the B position, and LK2 should be fitted as default.

All other configuration required such as base address, 240H (576 Decimal) and interrupt settings (IRQ14) are pre-programmed as a software configuration in the EEPROM.

Note: If the AIM104 Ether board is fitted, ensure the additional jumper is fitted on the PC/104 pins, to connect IRQ14 to IRQ15. See Section 4.3.2 for details.

The Ethernet port of the DS2/DS4 provides network capability via an RJ-45 10baseT connector. In order for the Director software to recognize the Ethernet adapter, it must be configured for the correct base address and IRQ of the Ethernet controller. This is typically done via the ACE (Arcom Configuration Environment) configuration program. The Address and IRQ settings are also used when selecting Ethernet as the mode of operation for the Bootloader menu (see *Startup Manual*).

Ethernet Settings Required for DS2/DS4 Configuration:

Network Card Address: 576

Network Card IRQ: 14

Network Card DPMA: 851968 (unused)

5.2 AIM104-SER4 Serial Interface

This section describes the use of the AIM104-SER4 serial communications board. All baud rates, parity, stop bits and data bits are configured using the ACE configuration tool. Every channel may be configured independently. Maximum baud rate is 57.6 kbaud.

The AIM104-SER4 has a 50-way connector which connects via a 50-way ribbon cable to four 9 way ‘D’ type connectors mounted on the rear panel of the DS4.

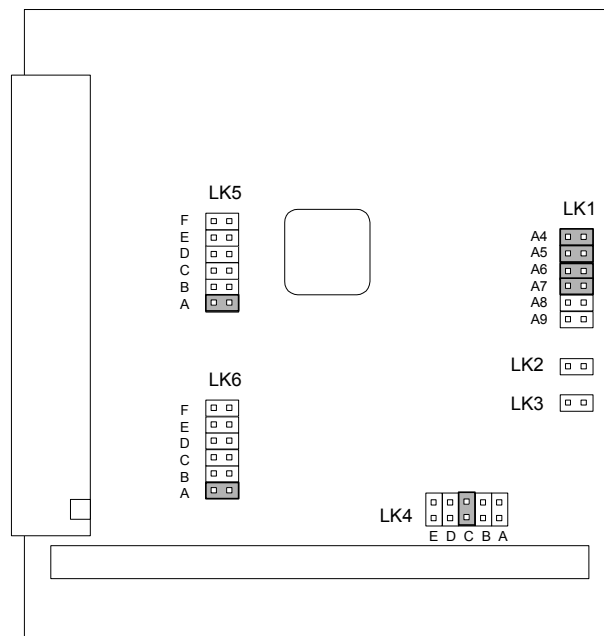
5.2.1 AIM104-SER4 Specifications

The AIM104-SER4 requires +5 and ±12 VDC supply, which is a factory fit option. Some Director baseboards include a factory fit power supply which only provides +5 VDC, which will not run the AIM104-SER4.

Serial Controller	85230
Number of Inputs	Four RS-232
Power	2.55 Watt (max)
Operating Temperature	-20 to +70C

5.2.2 SER4 Link Settings – 1st card

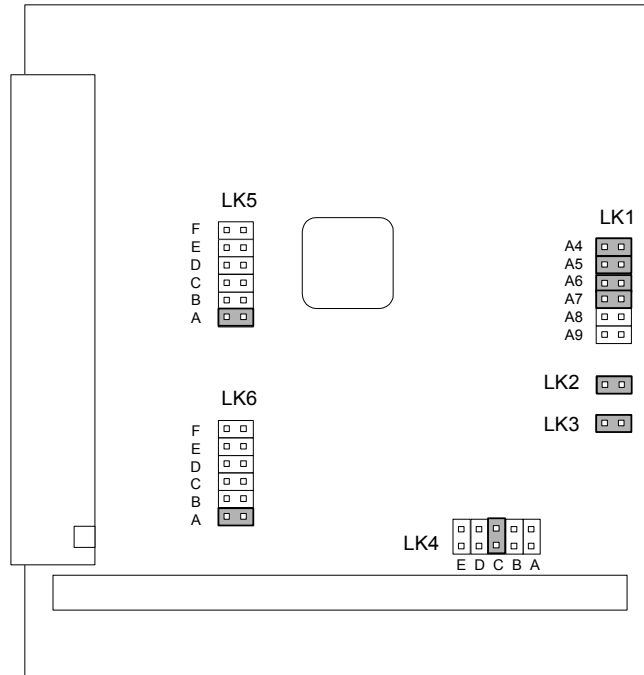
Below are the link settings for an AIM104-SER4 to configure it for the first bank of COM ports. These ports are COM 4 through COM 7 on the DS4.



NOTE: Link LK3 should be fitted on the first AIM104-SER4 if a second SER4 card is used.

5.2.3 SER4 Link Settings – 2nd Card

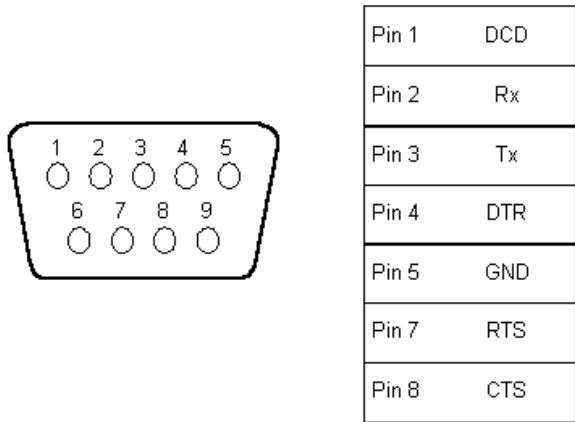
Below are the link settings for an AIM104-SER4 to configure it for the second bank of COM ports. These will be COM 8 through COM 11 on the DS4.



5.2.4 Signal Interface to 9 way 'D' type connectors

The DS4 has a few optional rear plates that provide four or eight 9-way 'D' type connectors (DB-9) which may plug directly into the 50-way termination on the AIM104-SER4.

The pin-out of the DB-9 serial interface is presented as follows:



The direction of data with respect to the DS4 is such that the DS4 acts as a DTE device. This means:

- TX** is used to transmit data from the DS4.
- RX** is used by the DS4 to receive data.
- GND** must be connected to an RS-232 GND on the other device for proper communication.
- RTS** is asserted prior to the DS4 sending data.
- CTS** must be received before data will be transmitted (a jumper from RTS may be used, if no handshaking lines are required for a modem).
- DTR** is asserted to indicate the DS4 is ready to receive data.
- DCD** must be received before incoming data will be accepted (a jumper from DTR may be used, if no handshaking lines are required for a modem).

5.3 AIM104-COM4 Serial Interface

This section describes the use of the AIM-COM4 serial communications board. All baud rates, parity, stop bits and data bits are configured using the ACE configuration tool. Every channel may be configured independently. Maximum baud rate is 115.2 kBaud.

The AIM104-SER4 has a 50-way connector which connects via a 50-way ribbon cable to four 9 way ‘D’ type connectors mounted on the rear panel of the DS4. See Section 4.3.5 for wiring diagram for RS-485/422 networks

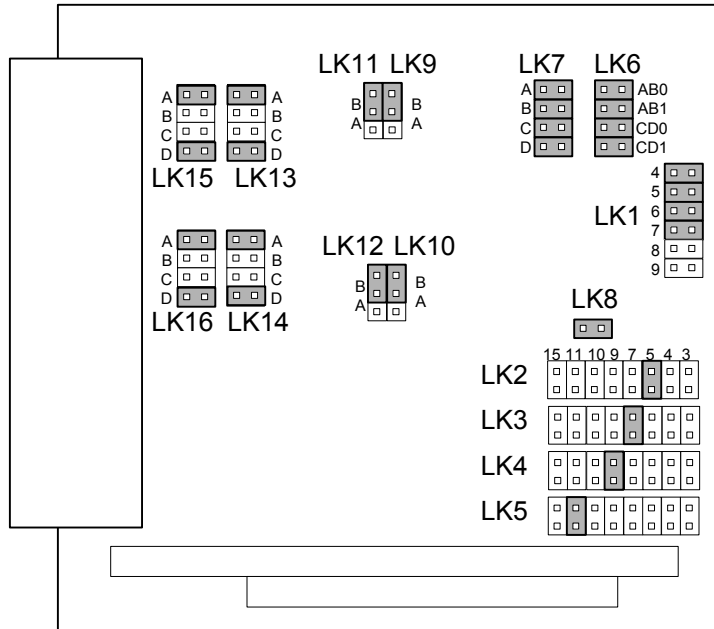
5.3.1 AIM104-COM4 Specifications

Serial Controller	16C550
Number of Inputs	Two RS-485/422 (first two ports) Two RS-232 (second two ports)
Isolation	100 Vdc to field 100 Vdc between channels
Power	1.1 Watt (typical)
Operating Temperature	-20 to +70C
RS-485/422 Termination	Independently configurable: unterminated, terminated with 124 Ω resistor, and/or pulled active or inactive.

5.3.2 AIM104-COM4 Link Settings

Only one AIM104-COM4 board may be used in a DS2/DS4, which means the ports will typically be identified as COM4 through COM7. The first two serial ports (COM4 and COM5) may be configured for RS-485 or RS-422 (multidrop or point-to-point) mode. Link settings on the board determine mode of operation and termination of the receive and transmit lines. The last two ports (COM6 and COM7) use RS-232 communication. Hardware RTS/CTS handshaking may be configured based on the ACE configuration, and is required for proper RS-485/422 operation.

Below are typical link settings for an AIM104-COM4 to configure it for operation within the Director as COM 4 through COM 7.



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Selecting the Appropriate Communication Mode

Configure links LK9-12 for the appropriate differential communications mode for COM4 and COM5.

COM4 (channel A)

LK9	LK11	Mode	Description
A	A	RS-422 Point-to-point	Transmit on A-TXB, Receive on A-RX
A	B	RS-422 Multidrop	Transmit on A-TXB, Receive on A-RX
B	B	RS-485	Transmit and Receive on A-TXB

COM5 (channel B)

LK10	LK12	Mode	Description
A	A	RS-422 Point-to-point	Transmit on B-TXB, Receive on B-RX
A	B	RS-422 Multidrop	Transmit on B-TXB, Receive on B-RX
B	B	RS-485	Transmit and Receive on B-TXB

LK13-15 Differential Pair Termination Links

Differential communications pairs should be terminated to prevent reflections from either end of the communications cables. Each pair should be terminated at each end of the wire run with a resistance that matches the impedance of the cable.

The AIM104-COM4 is capable of terminating each of the differential pairs on channels A and B using links LK13-15. Two types of termination network can be configured: line matching terminators and pull apart resistors.


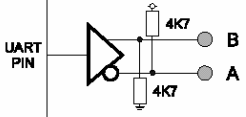

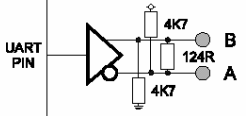
Line Matching Terminators: 124 ohm resistors can be linked across each communications pair. This will be a fair match with twisted pair wiring. These should be configured only on boards at either end of the wiring run.

Pull Apart Resistors: The AIM104-COM4 is also able to pull each line of a communications pair to either +5V or 0V through a 4K7 resistor. This facility is primarily intended for use in RS422 multi-drop or RS485 systems to ensure that the communications pair floats to a known state when no transmitters are active.

Normally, a communications pair should be pulled apart in the inactive state ("Pulled Inactive"). This mimics the condition where no character is being transmitted from the UART. It is however possible for the AIM104-COM4 to pull the communications pair in either direction. Care should be taken when using the pull-apart resistors in systems with multiple pieces of equipment on the same pair as each fitted pull apart network will load the line driver devices. Reduce the number of fitted resistor networks to prevent this causing problems.

Each differential pair on the RS-485 ports can be terminated in six ways according to the following table:

Link Configuration	Circuit Configuration	Description
		<p>Unterminated Line Driver connects directly to the differential pair.</p>
		<p>Terminated Differential pair is terminated with 124 Ω resistance between signal lines</p>
		<p>Pulled Inactive Differential pair is pulled apart to mimic no character being transmitted from the UART.</p>
		<p>Pulled Inactive and Terminated Differential pair is terminated with 124 Ω and is pulled apart to mimic no character being transmitted.</p>

		<p>Pulled Active Differential pair is pulled apart to mimic a UART sending a break condition.</p>
		<p>Pulled Active and Terminated Differential pair is terminated with 124 Ω and is pulled apart to mimic a break condition.</p>

The following links configure the termination for the differential pairs:

Link	Channel	RS422 Pair	RS485 Pair	Signal Names
LK13	A	Receive	n/a	A-RXA, A-RXB
LK14	B	Receive	n/a	B-RXA, B-RXB
LK15	A	Transmit	Bi-directional	A-TXBA, A-TXBB
LK16	B	Transmit	Bi-directional	B-TXBA, B-TXBB

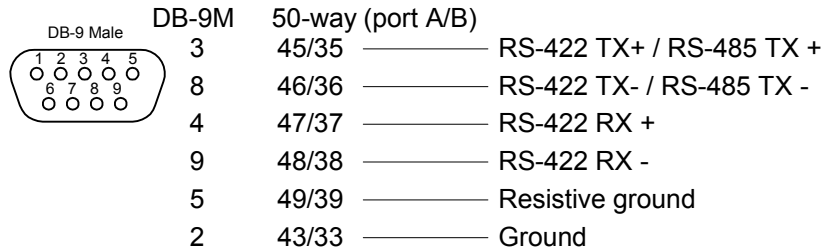
5.3.3 Signal Interface to 9 way 'D' type connectors

The DS4 has optional rear plates that provide four 9-way 'D' type connectors (DB-9) which may plug directly into the 50-way termination on the AIM104-COM4.

The pin-out of the DB-9 serial interface is presented as follows:

DS4 with AIM104-COM4 (RS-485)

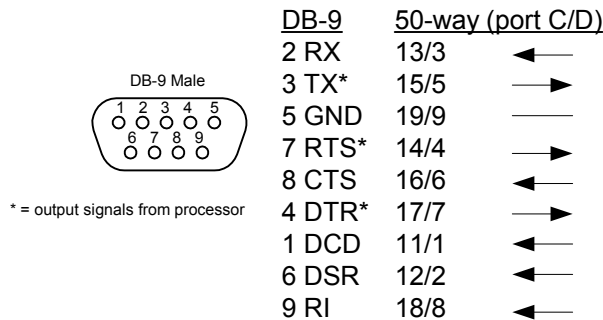
ports A and B on AIM104-COM4 board are RS-485/422.
50-way ribbon cable pins are provided for reference.



Drg. S15037-01e

DS4 with AIM104-COM4 (RS-232)

ports C and D on AIM104-COM4 board are RS-232.
50-way ribbon cable pins are provided for reference.



* = output signals from processor

Drg. S15037-04b

5.4 AIM104 - MULTI-IO

The MULTI-IO board provides up to 8 opto-isolated digital inputs, 2 analog outputs (voltage or current) and 16 single ended or 8 differential analog inputs.

5.4.1 Board Specification

Power Consumption	2.4 Watts, excluding loop power
--------------------------	---------------------------------

5.4.2 Analog Input Specifications

Number of Inputs	16 single-ended OR 8 differential
Voltage/Current Range Options	0 to 5 Vdc (0 to 20 mA with external 250Ω) 1 to 5 Vdc (4 to 20 mA with external 250Ω) 0 to 4 Vdc (0 to 20 mA with external 200Ω) 0.8 to 4 Vdc (4 to 20 mA with external 200Ω) Input scaling depends on ISaGRAF configuration
Resolution	12 bits
Opto-isolation	1000 V to field 30 V between adjacent channels
Input Impedance	10 MΩ, 10 pF typical
Relative Accuracy	±2 LSB (max) @ 25°C

5.4.3 Digital Input Specifications

Number of Inputs	8 opto-isolated digital inputs
Switching Voltage Range	10 V to 30 V
Maximum Input Frequency	50 Hz
Isolation	1000 V to field 30 V between adjacent channels
Protection	Reverse protection diodes

5.4.4 Analog Output Specifications

Number of Outputs	2
Voltage/Current Range Options	0 to 20 mA 0 to 5 Vdc Output type depends on ISaGRAF configuration
Resolution	12 bits
Isolation	1000 V to field 30 V between adjacent channels

Output Impedance	Vout =< 10Ω
Accuracy	±2 LSB (max) @ 25°C

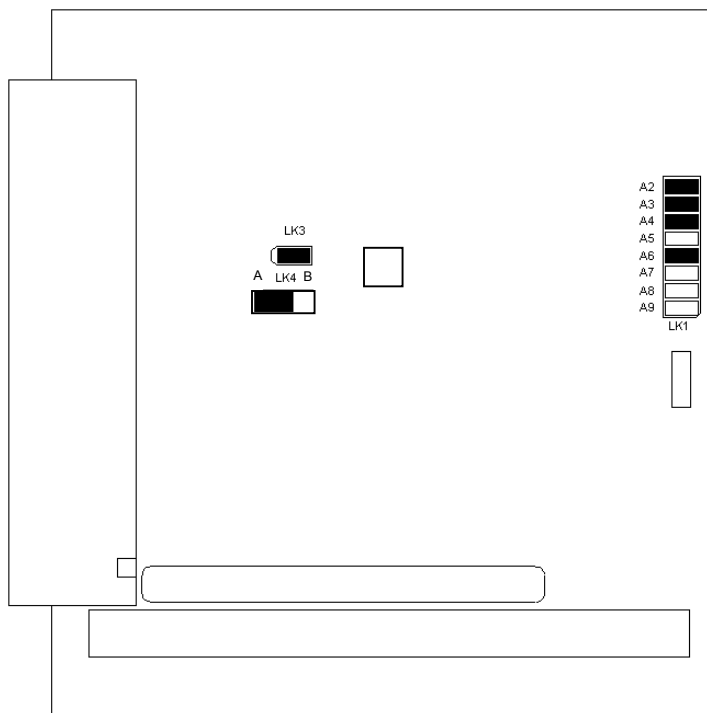
5.4.5 MULTI-IO Link Settings

Link settings on the MULTI-IO determine where the board's I/O will appear in memory. If more than one MULTI-IO board is used, the first MULTI-IO in a Director should be addressed as Board #1, and the second as Board #2.

Board Fitted	PC/104 Base Address	LK1 Jumpers Installed
Board #1	3A0 H	A2 , A3 , A4 , A6
Board #2	3A4 H	A3 , A4, A6

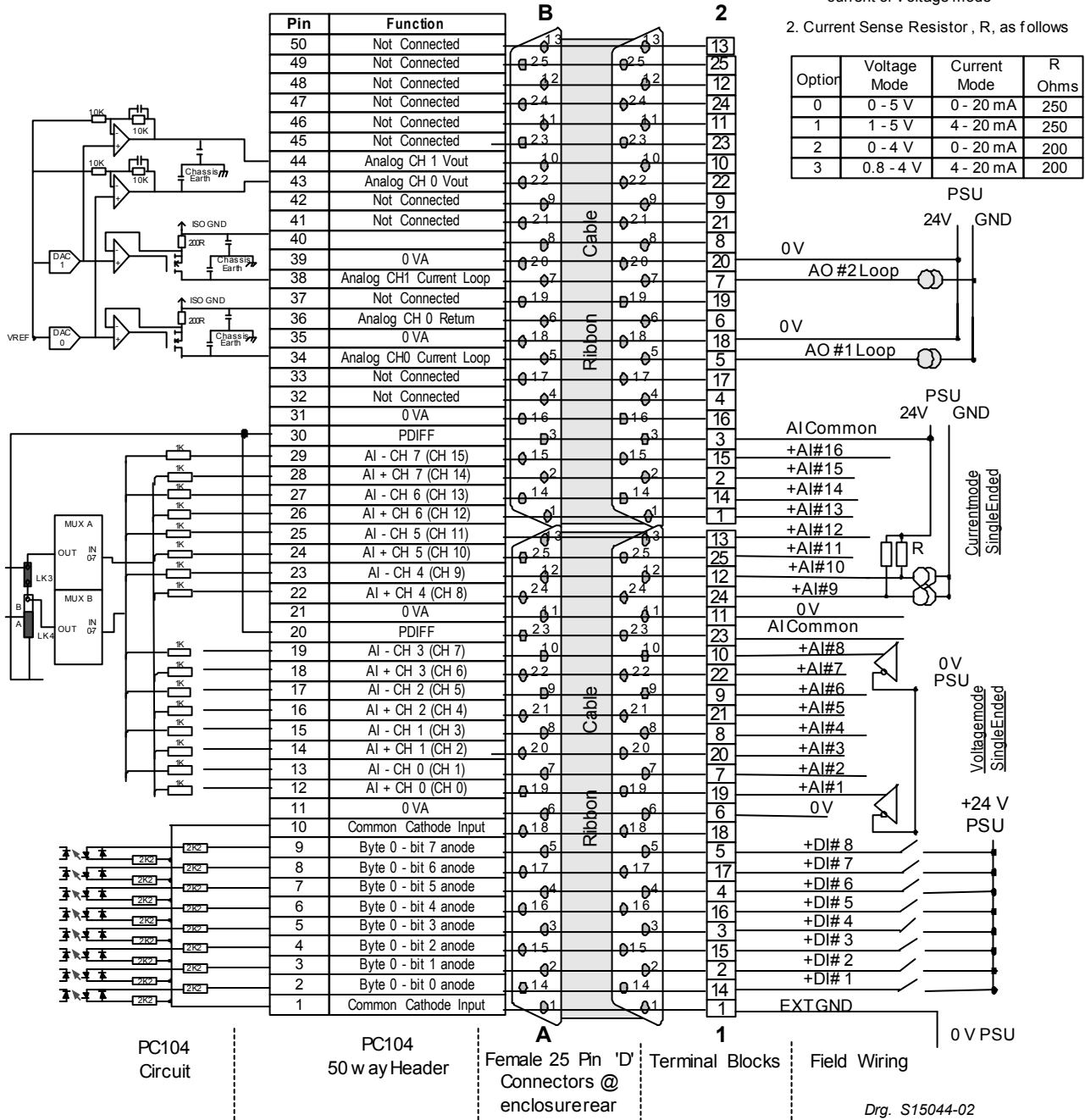
Link settings also determine the operating mode of the analog inputs for either single-ended or differential inputs.

Analog Mode	LK3	LK4
16 channel single ended	Fitted	A
8 channel differential	Not fitted	B



5.4.6 AIM104-MULTI-IO Connection Wiring

This drawing shows the termination pinout from the 50-way ribbon cable on the AIM104-MULTI-IO to 25-way D-type connectors on the rear of the DS4. To the right of the ribbon cable is the pinout of optional modules to convert the 25-way connectors to screw terminals. The AIM104-MULTI-IO analogs are shown in single-ended mode.



5.5 AIM104 - RLY8/IN8

The RLY8/IN8 board provides up to 8 opto-isolated digital inputs and 8 relay outputs. Jumper options are included for each digital input to select a 10ms input debounce filter.

5.5.1 Board Specification

Power Consumption	1.25 Watts, excluding loop power
--------------------------	----------------------------------

5.5.2 Digital Input Specifications

Number of Inputs	8 opto-isolated digital inputs
Switching Voltage Range	10 V to 30 V
Maximum Input Frequency	50 Hz with debounce filter enabled 10 KHz with debounce filter disabled
Protection	±40 V steady state overvoltage 300 W surge for 1 ms

5.5.3 Digital Output Specifications

Number of Outputs	8 changeover relays Normally Open and Normally Closed contacts
Switching Range	Voltage up to 40 Vdc and currents up to 250 mA Power switching rating of 60 W (resistive load)
Maximum Input Frequency	50 Hz with debounce filter enabled 10 KHz with debounce filter disabled
Protection	Up to 48 Vdc steady state overvoltage 300 W surge for 1 ms

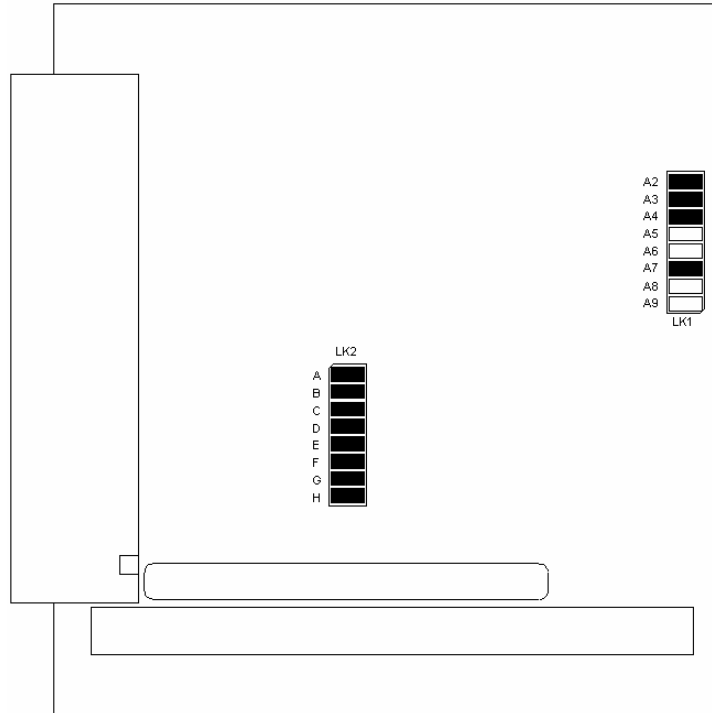
5.5.4 RLY8/IN8 Link Settings

Link settings on the RLY8/IN8 determine where the board's I/O will appear in memory. If more than one RLY8/IN8 board is used, the first RLY8/IN8 in a Director should be addressed as Board #1, and the second as Board #2.

Board Fitted	PC/104 Base Address	LK1 Jumpers Installed
Board #1	360 H	A2 , A3 , A4 , A7
Board #2	364 H	A3 , A4 , A7

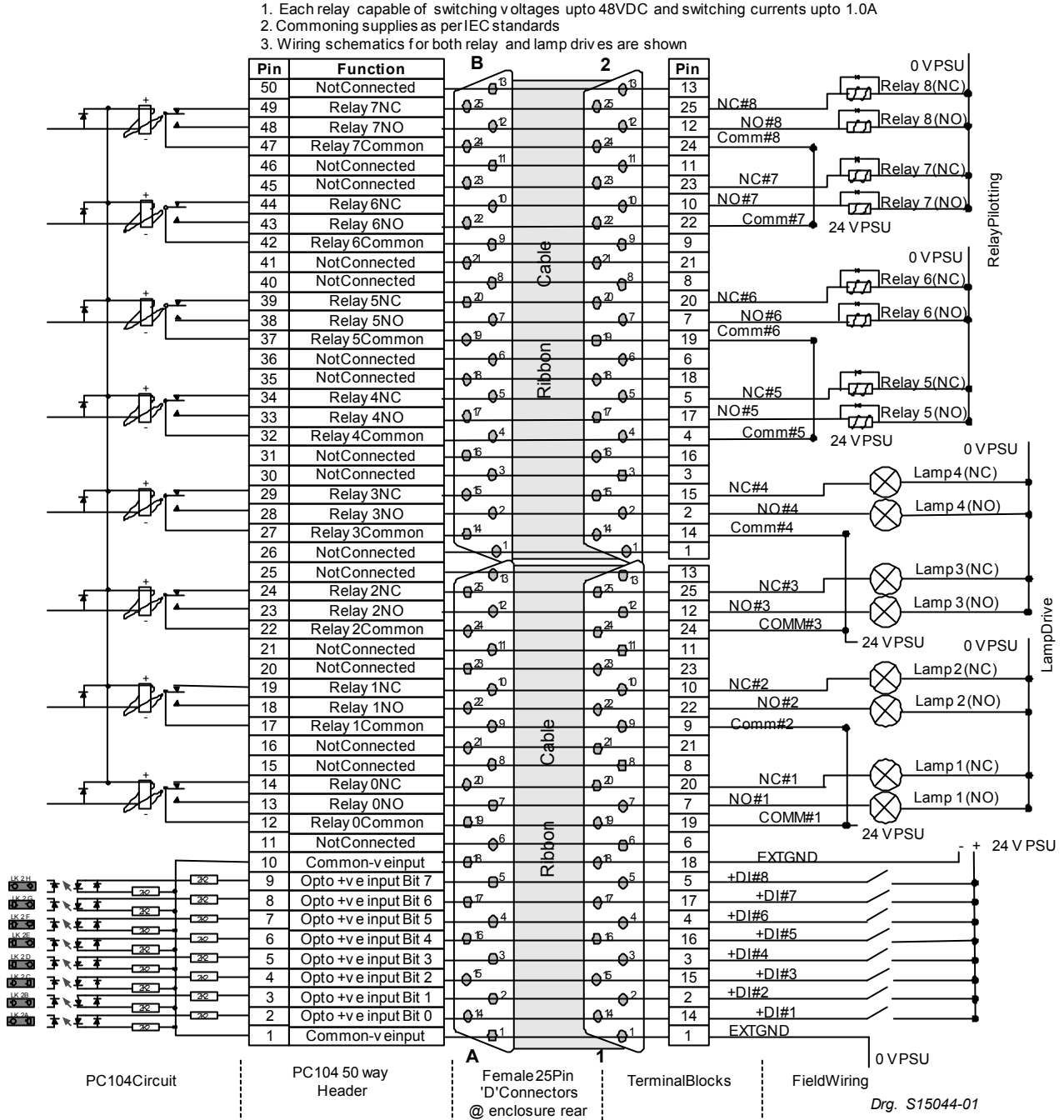
Input Filter Selection

Each opto-isolated input channel can be set to include an input filter to reduce input errors caused by switch contact bounce by setting LK 2 where channel 0 is LK2A and channel 7 is LK2H



5.5.5 AIM104-RLY8/IN8 Connection Wiring

This drawing shows the termination pinout from the 50-way ribbon cable on the AIM104-RLY8/IN8 to 25-way D-type connectors on the rear of the DS4. To the right of the ribbon cable is the pinout of optional modules which convert the 25-way connectors to screw terminals.



5.6 AIM104 – IN16

The AIM104-IN16 board provides up to 16 opto-isolated digital inputs. Jumper options are included for each digital input to select a 10ms input debounce filter.

5.6.1 Board Specification

Power Consumption	0.5 Watts, excluding loop power
Number of Inputs	16 opto-isolated digital inputs
Switching Voltage Range	10 V to 30 V
Maximum Input Frequency	50 Hz with debounce filter enabled 10 KHz with debounce filter disabled
Isolation	1500 V to field 100 V between adjacent channels
Protection	Reverse protection diodes

5.6.2 AIM104-IN16 Link Settings

Link settings on the AIM104-IN16 determine where the board's I/O will appear in memory. If more than one AIM104-IN16 board is used, the first AIM104-IN16 in a Director should be addressed at Board #1, and the second as Board #2.

Board Fitted	PC/104 Base Address	LK1 Jumpers Installed
Board #1	320 H	A2 , A3 , A4 , A6 , A7
Board #2	324 H	A3 , A4, A6 , A7

Input Filter Selection

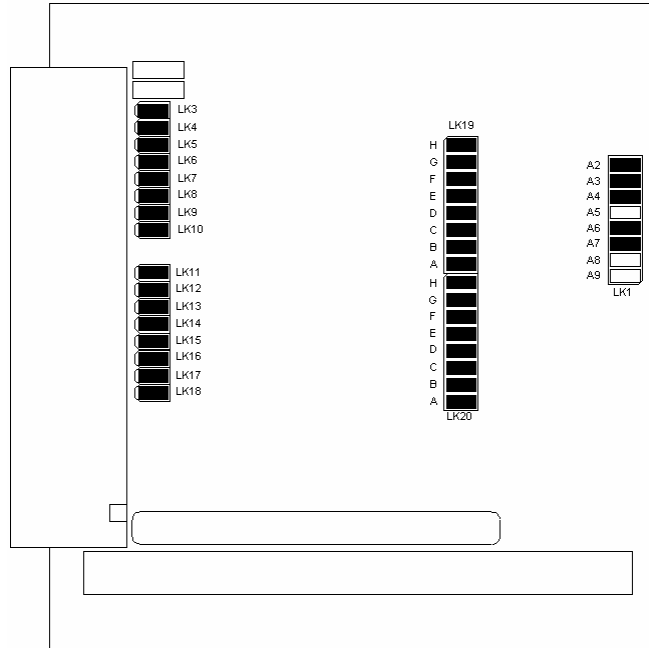
Each opto-isolated input channel can be set to include an input filter to reduce input errors caused by switch contact bounce by setting LK 19 and 20 where

- Channel 0 - 7 is LK20 A – H
- Channel 8 – 15 is LK19 A - H

Common Positive Input Selection

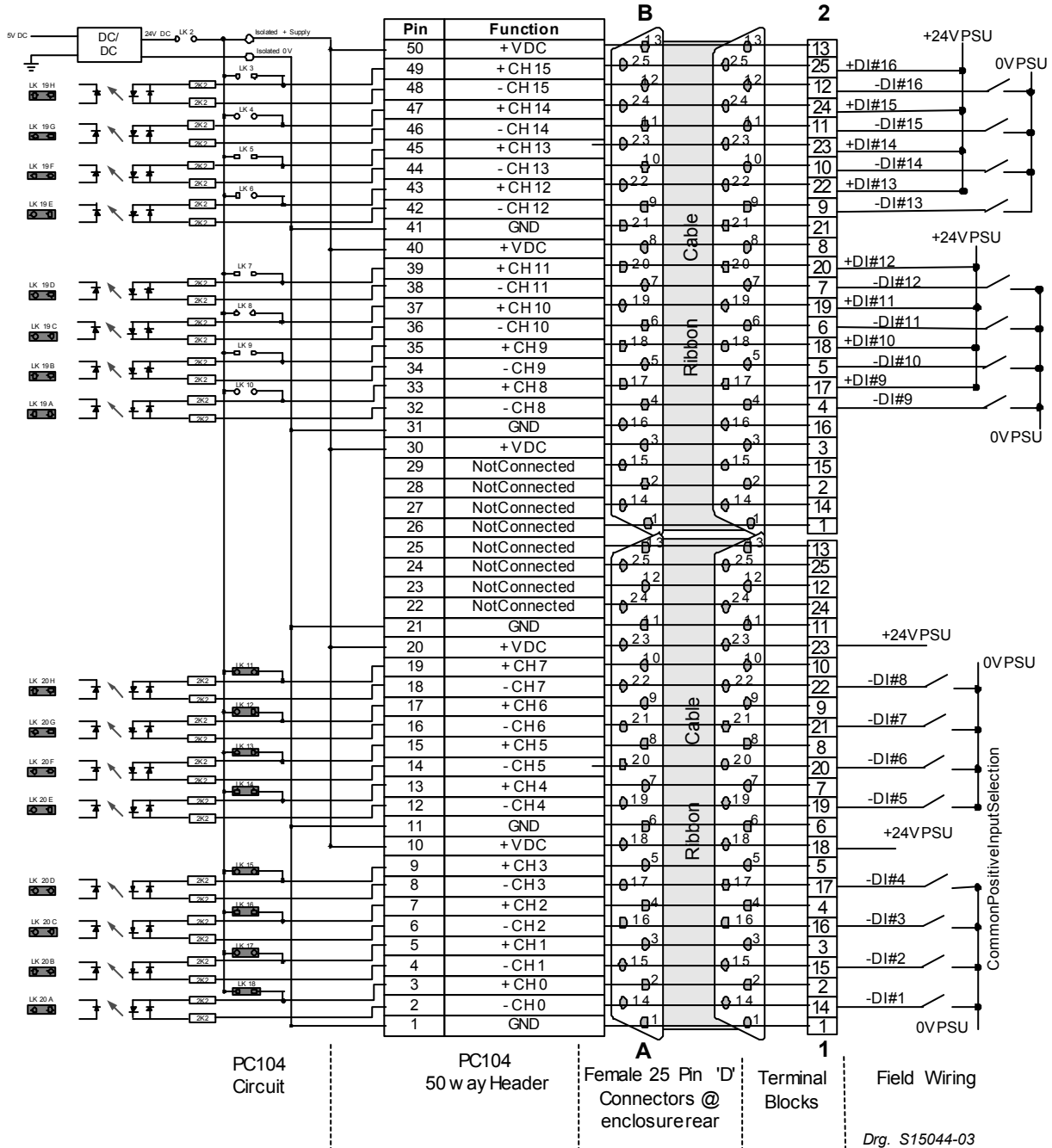
The positive side of each channel can be connected to the positive side of the common isolated supply by inserting the following links. This reduces the number of wire connections, since only one side (-ve) requires an external connection. To switch ON the input, the –ve input terminal should be switched to the isolated 0V:

- Channels 0 - 15 are Links LK18 to LK3, respectively



5.6.3 AIM104-IN16 Connection Wiring

This drawing shows the termination pinout from the 50-way ribbon cable on the AIM104-IN16 to 25-way D-type connectors on the rear of the DS4. To the right of the ribbon cable is the pinout of optional modules to convert the 25-way connectors to screw terminals. The drawing shows external excitation voltage being used to power the digital inputs, but on models of the AIM104-IN16 with the DC/DC converter, LK2 can be used to distribute internal excitation power.



5.7 AIM104 – PULSE

The AIM104-PULSE board provides 16 opto-isolated digital inputs. Of these, the first 4 inputs may be used as frequency (0-100 kHz) pulse inputs. The first 10 inputs may be used as low frequency accumulator pulse inputs. Jumper options are included for each digital input to select a 10ms input debounce filter.

5.7.1 Board Specification

Power Consumption	0.75 Watts, excluding loop power
Operating Temperature	-20 to +70 C
Number of Inputs	16 opto-isolated digital inputs All may be used as status, or: Inputs 1-4 may be frequency inputs Inputs 1-10 may be accumulator inputs
Switching Voltage Range	10 V to 36 V
Maximum Input Frequency	50 Hz with debounce filter enabled 100 KHz with debounce filter disabled
Isolation	1000 V to field 100 V between adjacent channels
Protection	Reverse protection diodes

5.7.2 AIM104-PULSE Link Settings

Link settings on the AIM104-PULSE determine where the board's I/O will appear in memory. If more than one AIM104-PULSE board is used, the first AIM104-PULSE in a Director should be addressed at Board #1, and the second as Board #2.

Board Fitted	PC/104 Base Address	LK1 Jumpers Installed
Board #1	3D0 H	E, G, H
Board #2	3D4 H	E, G

Input Filter Selection

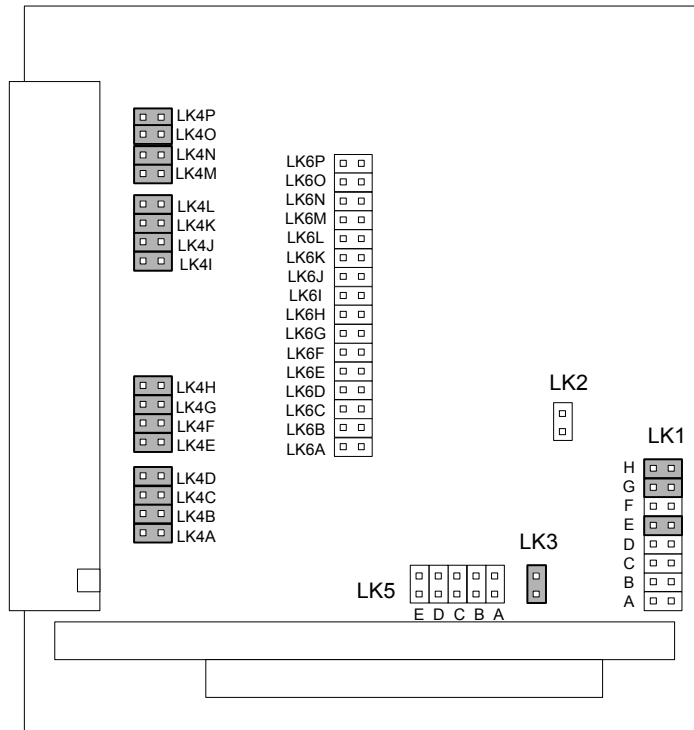
Each opto-isolated input channel can be set to include an input filter to reduce input errors caused by switch contact bounce by setting LK 6 where

- Inputs 1 - 16 are LK6 A – P

Common Positive Input Selection

The positive side of each channel can be connected to the positive side of the common isolated supply by inserting the following links. This reduces the number of wire connections, since only one side (-ve) requires an external connection. To switch ON the input, the -ve input terminal should be switched to the isolated 0V:

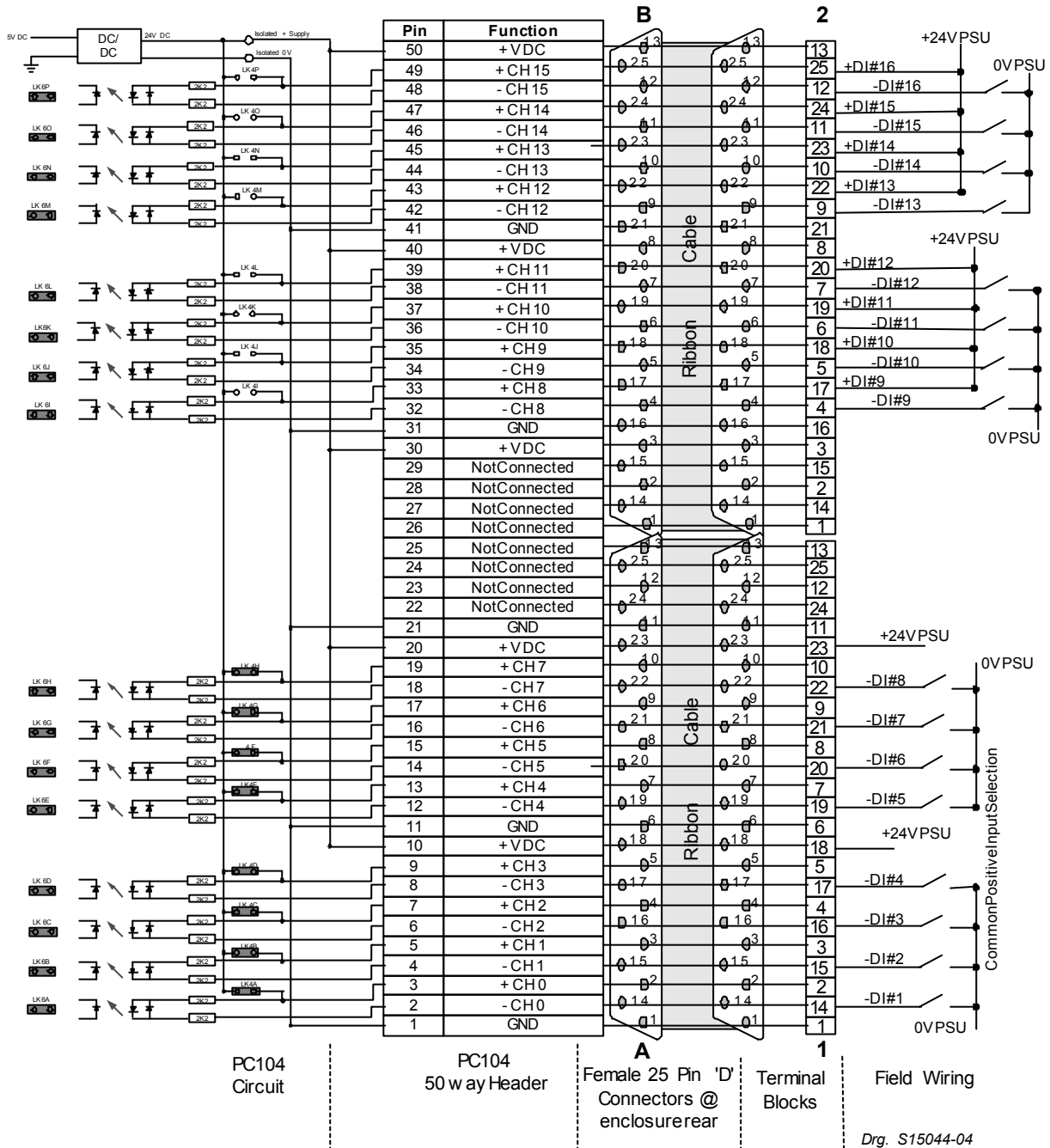
- Inputs 1 - 16 are Links LK4A-P, respectively



5.7.3 AIM104-PULSE Connection Wiring

This drawing shows the termination pinout from the 50-way ribbon cable on the AIM104-PULSE to 25-way D-type connectors on the rear of the DS4. To the right of the ribbon cable is the pinout of optional modules to convert the 25-way connectors to screw terminals.

IMPORTANT: The pinout shown below is for V1, issue 3 revision of the AIM104-PULSE board. Previous versions of the board had a different pin configuration.



5.8 AIM104 – HBI

The AIM104-HBI board provides up to 2 channels of HART protocol and 2 analog outputs. Power consumption of the AIM104-HBI is 1 Watt, excluding loop power. The I/O specification is given in following sections.

HART (Highway Addressable Remote Transducer) protocol is a common "Smart" device protocol used widely in instrumentation systems. It allows traditional analog devices to offer enhanced functionality by adding a digital communication protocol without interrupting the existing 4-20 milliamp current signal. Enhanced functionality often includes measurement of more than one process variable, configuration of device parameters and tag names, and remote calibration.

Each HART channel allows one device in point-to-point mode (standard 4-20 mA), or up to 15 devices in multidrop mode. When point-to-point mode is used for field devices, the 4-20 mA signal may be connected to a standard analog input of a control system, with the AIM104-HBI board connected in parallel for communication. Devices in multidrop mode generally fix the current signal at a constant four millamps, and the AIM104-HBI is used in place of an analog input. In either case, the AIM104-HBI board communicates to the device using the digital HART protocol, and does not measure the 4-20 mA current signal.

The analog outputs are provided for applications requiring an additional control signal, such as valve positioners.

See the *Protocol Manual* for more information on the physical and data link layers of the HART Protocol.

5.8.1 HART Input Specifications

Number of HART Inputs	2 channels, capable of up to 1 point-to-point device or 15 multidrop devices per channel
Scan Time for HART Process Variables	Timing depends on ACE configuration, minimum 1/3 second per HART device (assuming no communication retries)
Isolation	2000 V transformer isolation

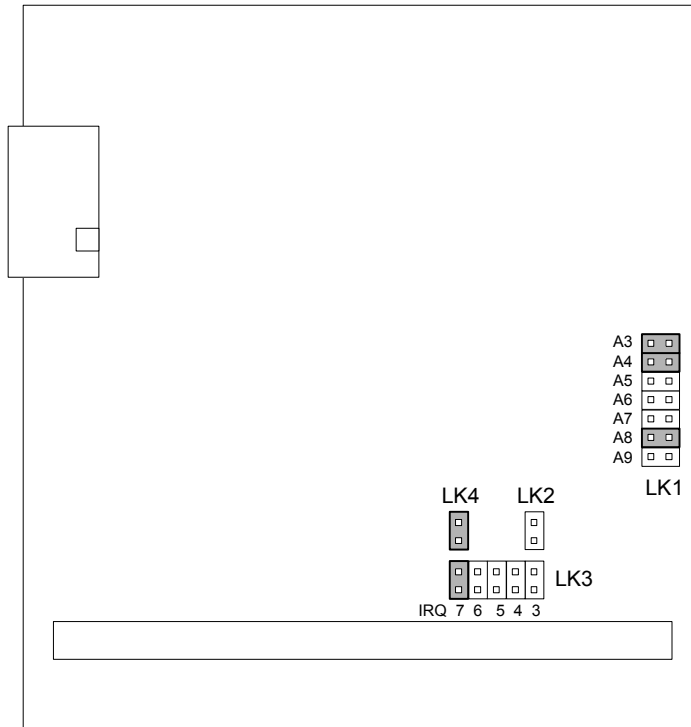
5.8.2 Analog Output Specifications

Number of Analog Outputs	2
Voltage/Current Range Options	0 to 5 Vdc (0 to 20 mA with 250Ω resistor) 1 to 5 Vdc (4 to 20 mA with 250Ω resistor) Output type depends on ISaGRAF configuration
Resolution	12 bits
Isolation	1000 V opto-isolation

5.8.3 AIM104-HBI Link Settings

Link settings on the AIM104-HBI determine where the board's I/O will appear in memory. These link settings must be configured correctly in order for the board to operate correctly.

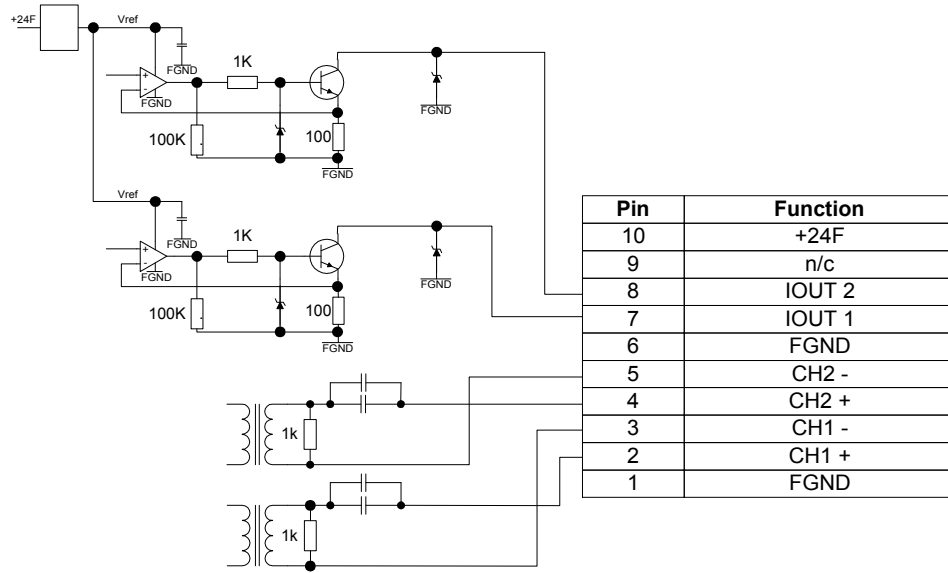
Board Fitted	PC/104 Base Address	LK1 Jumpers Installed
Board #1	0x2D0	A3, A5, A8
Board #2	0x2D8	A5, A8
Board #3	0x2E0	A3, A4, A8



NOTE: If using more than one AIM104-HBI board, it is required to fit link LK2 on one (and only one) of the boards for interrupt sharing.

5.8.4 I/O Connection using Ribbon Cabling

This drawing shows the termination pinout from the AIM104-HBI board via a 10-way ribbon cable. See section 5.8.5, *HART Wiring Diagrams*, for specific examples of HART circuits to external devices.



AIM104-HBI Circuit

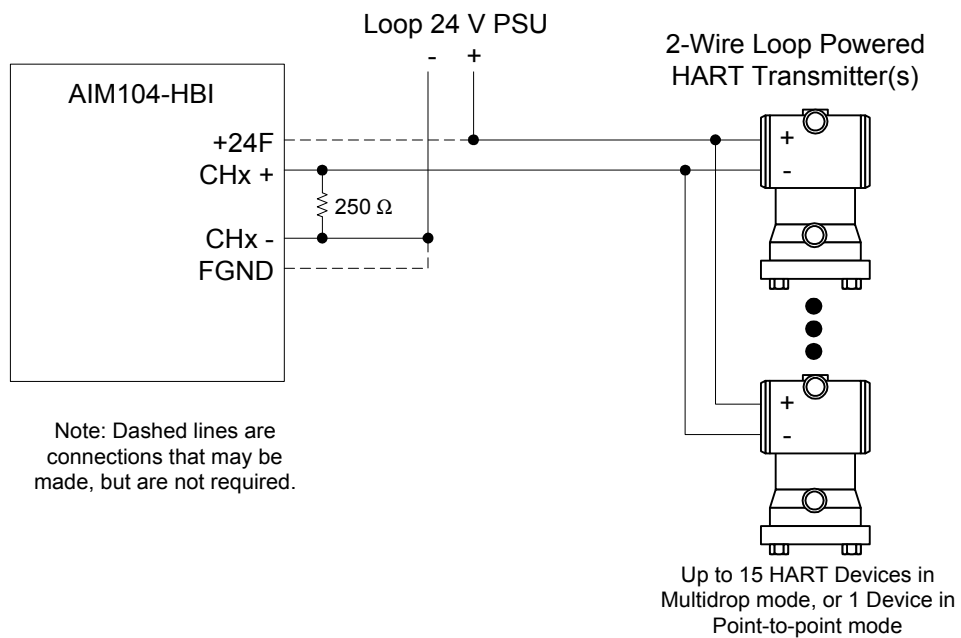
10-way Header

5.8.5 HART Wiring Diagrams

The wiring diagrams in this section show several typical connection arrangements. HART product documentation and good technical judgment should also be used to determine the correct wiring arrangement for a particular application.

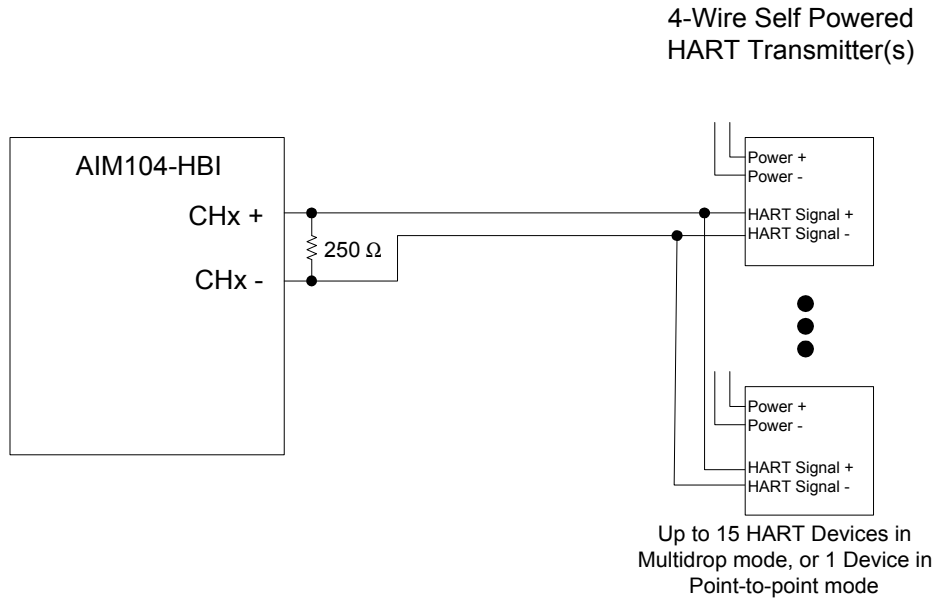
2-Wire Transmitter

A large number of HART devices are 2-wire transmitters that require loop power. These may be multidropped as shown in the diagram below, or a single device may be connected on a loop. If the analog outputs are not used, the +24F and FGND terminals do not need to be connected.

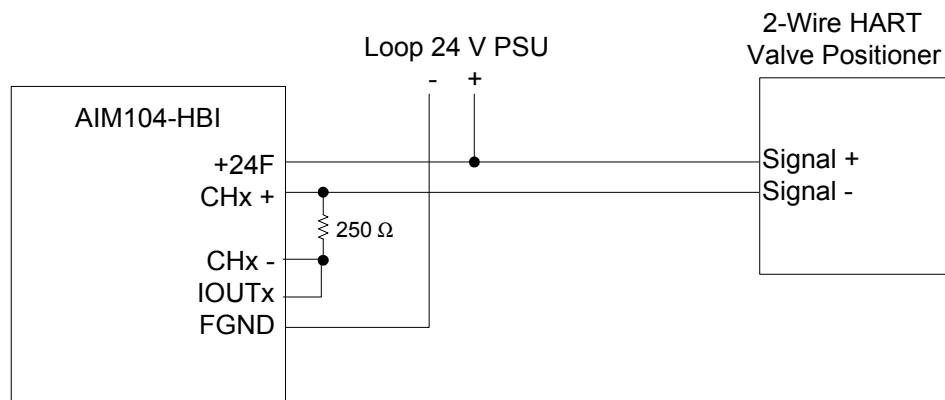


4-Wire Transmitter, Self-Powered

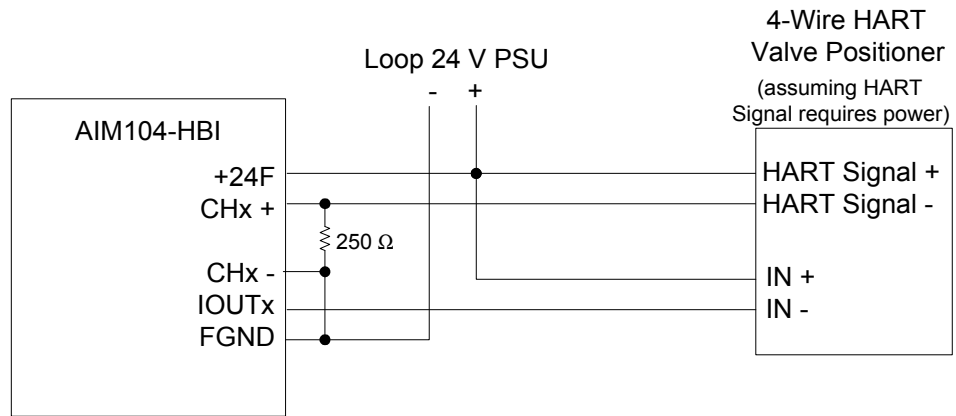
Some HART devices are separately powered and provide power on the HART loop without requiring an external supply. A typical wiring arrangement is shown below.



2-Wire Valve Positioner



4-Wire Valve Positioner, HART externally powered



4-Wire Valve Positioner, HART internally powered

