

# **CPx 5 - Installation Manual 2026**

---

[www.pipeorgancontrol.com](http://www.pipeorgancontrol.com)

# Table of Contents

<b>I. PHYSICAL COMPONENTS.....</b>	<b>3</b>
CPx Circuit Card.....	3
INPUT Circuit Cards.....	3
INPUT Reflective LED Manual and Pedal Key Contact Rails.....	3
CHAMBER PANEL.....	3
OUTPUT Circuit Card.....	3
LCD Display.....	3
MIDI IN/THRU/OUT Connector Card.....	3
USB Connector.....	3
FIBER OPTIC CABLES.....	3
FIBER OPTIC Translator/Retransmitter.....	3
<b>II. POWERS AND GROUNDS.....</b>	<b>4</b>
110VAC CIRCUIT FOR POWER SUPPLY/RECTIFIER.....	4
110VAC CIRCUIT FOR BLOWER.....	4
ON/OFF SWITCH.....	4
POWER SUPPLY CABLES.....	4
<b>III. INPUTS.....</b>	<b>6</b>
DEFINITION.....	6
GROUPINGS OF INPUTS.....	6
WIRING HINTS.....	6
PISTON LABELING FOR CONSOLE CONSTRUCTION.....	7
For play/record breakout.....	7
REFLECTIVE LED KEY CONTACT RAIL.....	7
REFLECTIVE LED Pedalboard CONTACT RAIL.....	8
LEGACY Input card.....	8
SAMs BRAIN/Iomin.....	8
<b>V. OUTPUTS.....</b>	<b>11</b>
DEFINITION.....	11
CONSOLE INDICATOR LIGHTS.....	11
STOP ON/OFF COILS.....	11
MAGNET COILS IN THE PIPE CHAMBERS.....	11
WIRING HINTS.....	11
OUTPUTS PANEL BKPLN with 64 PIN DRIVERS (Negative Common, 24VDC capable, 1.2A or .35A/pin).....	13
OUTPUT CIRCUIT CARD with 16 PINS (Negative Common, 24VDC capable, .35A/pin).....	13
OUTPUT CIRCUIT CARD with 128 PINS: <b>SMT+</b> (Positive Common - 1.2A/pin).....	13
OUTPUT CIRCUIT CARD with 128 PINS: <b>SMT-</b> (Negative Common - 1.2A/pin).....	14
LEGACY OUTPUT CIRCUIT CARD with 128 PINS: <b>2803A</b> (Positive Common - .5A/pin max).....	14
LEGACY OUTPUT CIRCUIT CARD with 128 PINS: <b>2981A</b> (Ground Common - .5A/pin max).....	15
LEGACY OUTPUT CIRCUIT CARD with 128 PINS: <b>2987A</b> (Ground Common - .35A/pin max).....	16
<b>VI. FIBER OPTICS and RIBBON CABLE.....</b>	<b>19</b>
INSTALLATION OF THE FIBER OPTIC CABLES.....	19
TERMINATION OF PLASTIC FIBER OPTIC CABLE.....	19
FIBER OPTIC CABLE COUPLING.....	19
TRANSLATION OF FIBER CABLE TYPES.....	20
INSTALLATION of the RIBBON CABLE to LCD, MIDI CONNECTOR, and LIGHTS.....	20
<b>VI. ANALOG to DIGITAL.....</b>	<b>21</b>
<b>VII. TESTING OF WIRING FOR POWER UP.....</b>	<b>22</b>
TESTING OF AC VOLTAGES WITH POWER OFF.....	22
TESTING OF AC VOLTAGES WITH POWER ON.....	22
TESTING OF LOGIC DC VOLTAGES on every circuit card.....	22
TESTING OF INPUT CIRCUITS.....	22
TESTING OF OUTPUT CIRCUITS.....	22
TESTING OF VOLTAGES WITH OSCILLOSCOPE.....	22
<b>VIII. INITIAL POWER UP SEQUENCE.....</b>	<b>23</b>
<b>IX. TROUBLE SHOOTING.....</b>	<b>23</b>
SYSTEMATIC APPROACH.....	23

# I. PHYSICAL COMPONENTS

## CPx5 Circuit Card

Mounted in the console, the CPx5 card is the controller of all organ functions, both console and chamber, reading the Input cards, writing to the combination action Output cards, and writing to the chamber Output cards. Additionally, this card controls the LCD panel, console lights, USB port, and A to D functions for expression pedal potentiometers.

## INPUT Circuit Cards

Various types all mounted in the console to be located nearest the inputs they will be reading.

## INPUT Reflective LED Manual and Pedal Key Contact Rails

Versions of the Input card, these use reflective LED sensors to read key On/Off positions. Using a reflective surface such as white paint or shiny metal fixed to the keys, light from the LED is directed back to the phototransistor to detect key movement. Piston Inputs are provided on each rail.

## CHAMBER PANEL

Contains all NEC fusing and wiring for Output5\_Driver Cards. Plug only, there are no wires to remove when swapping cards.

## OUTPUT Circuit Card

Various types, these are mounted in the console and pipe chambers (see sample console and chamber layout schematics) and should be mounted nearest the magnets coils that they will be controlling.

## LCD Display

For running status of control system and mounted (see LCD drawing) in clear line of sight of organist, this display is an OLED where only pixels to be displayed are turned on. No angle adjustment is necessary.

## MIDI IN/THRU/OUT Connector Card

Allows the attachment of MIDI cables and is installed on the console for external access.

## USB Connector

External access point for use of Flash Drive memory sticks and includes an extension cable that plugs directly to the CPx5 card.

## CONSOLE LIGHTS Connector

Converter card between discrete wiring from lights to ribbon cable.

## FIBER OPTIC CABLES

These connect all the circuit cards together (see sample console layout schematic).

## FIBER OPTIC Translator/Re-transmitter

An optional card that can join/split/retransmit the fiber optic signal between console and chamber circuit cards. It is also used to translate between plastic fiber and glass fiber when cable lengths exceed 100'.

## II. POWERS AND GROUNDS

### 110VAC CIRCUIT FOR POWER SUPPLY/RECTIFIER

An independent circuit shall be provided for the power supply/rectifier, in metal conduit, with a green wire ground terminating at the water meter or a ground rod. This is called a green wire ground circuit, or computer circuit.

### 110VAC CIRCUIT FOR BLOWER

The circuit for the blower must be independent from the above circuit for the power supply/rectifier.

### ON/OFF SWITCH

A 24VAC transformer has to be supplied with the 110VAC disconnect as shown in power source drawing, to energize a relay which turns on the power supply/rectifier.

### POWER SUPPLY CABLES

**LOGIC VOLTAGE:** Each circuit card must be supplied with voltage for the logic. This logic voltage is attached to the green barrier block on the CPx5 and Input cards, and to the center green barrier block on the Output cards. The +VDC must be fused as follows: based on ½ amp per circuit board with a maximum fuse size of 3 amps.

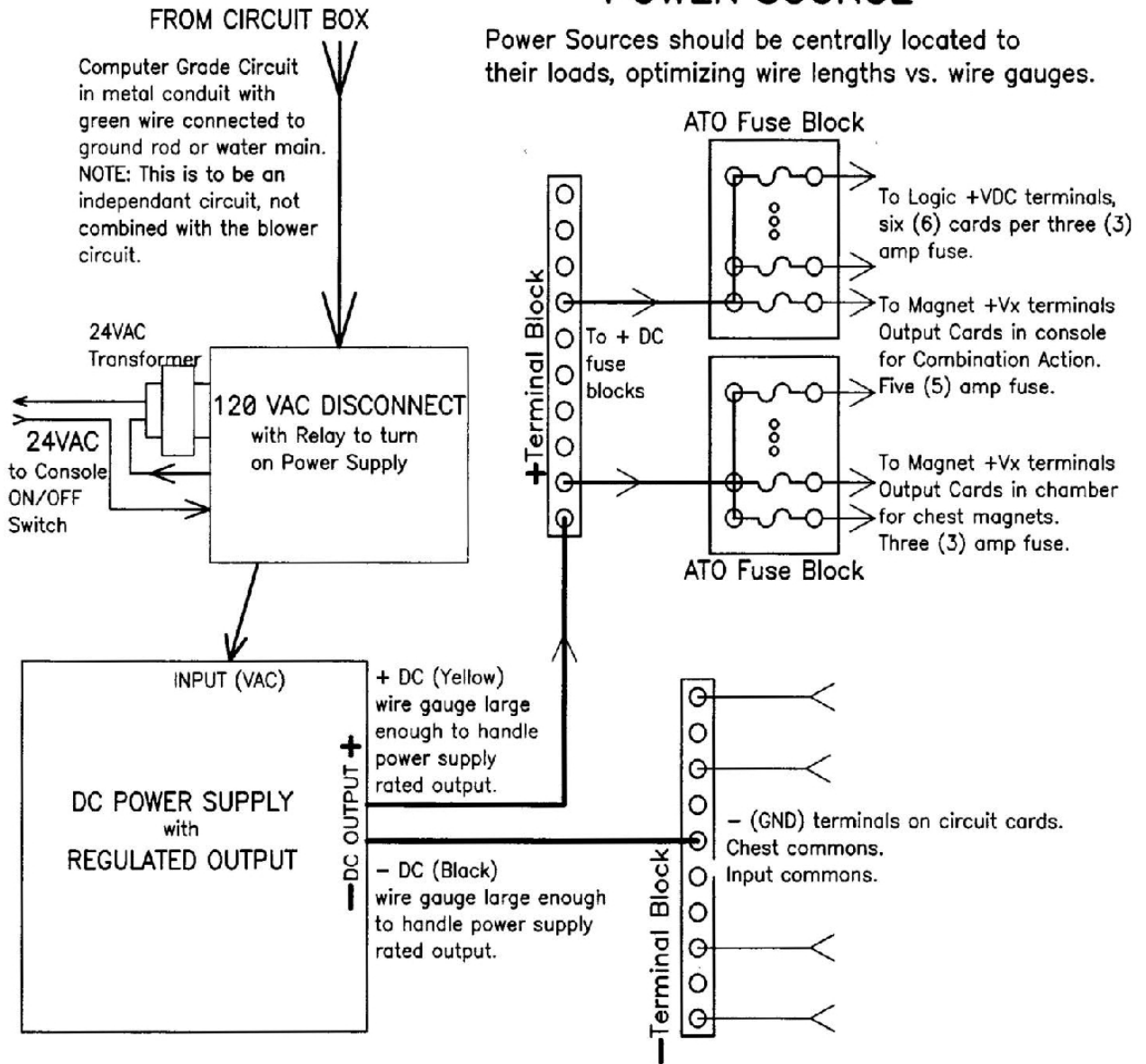
**MAGNET COIL VOLTAGE:** This only applies to the OUTPUT cards and is covered in V. Outputs.

Color Code:	yellow	= +12vdc or + power supply voltage
	Black	= GND or - minus
	Red	= +5vcc
	Orange	= +3.3vdc

**NOTE:** Ground and Minus are not necessarily equivalent in DC terminology. Ground means zero potential, minus is below zero, and plus or positive is above zero.

# POWER SOURCE

Power Sources should be centrally located to their loads, optimizing wire lengths vs. wire gauges.



### III. INPUTS

#### DEFINITION

Inputs are keyboards, pedalboard, stops, couplers, and pistons. These inputs are a simple switch circuit with one side of the switch common and connected to negative or minus. The opposite side of the switch is wired to the connector on the Input circuit card. These inputs are grouped into connectors and cables.

#### GROUPINGS OF INPUTS

##### KEYBOARDS

Maximum of eight, each wired to one connector from 1-61.

##### PEDALBOARD and Pistons

The Pedalboard is wired on pins 1-32 and pistons or toe studs on pins 33-64.

##### STOPS 1

Stops, Couplers, MIDI Couplers, and Pistons

##### STOPS 2

Stops, Couplers, MIDI Couplers, and Pistons.

##### STOPS 3

Stops, Couplers, MIDI Couplers, and Pistons.

##### STOPS 4

Stops and Pistons

##### PISTONS 1

Pistons.

##### PISTONS 2

Pistons

##### PISTONS 3

Pistons

#### WIRING HINTS

**Commons** - are tied to power supply GROUND or - minus.

**Pistons** - order of piston wiring is not important - piston definitions are programmed.

**Couplers** - order of coupler wiring is not important - coupler definitions are programmed.

**Connector Pin Order** - Input connectors are wired in ascending number order. When holding connector in horizontal position with pin 1 in lower left position: pin 2 is above pin 1 in upper row, pin 3 is in lower row to the right of pin 1, pin 4 is above pin 3 in upper row and so on. Please note that this numbering order is different from output connectors.

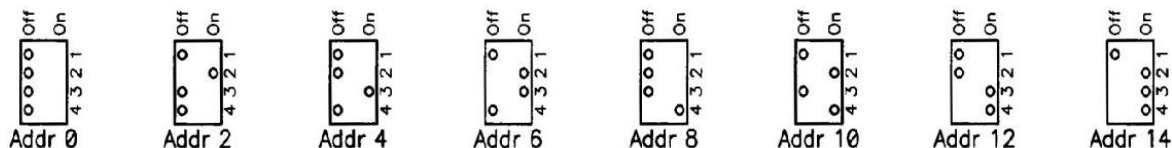
**Pin List** - Keep a written list of all the Input wiring on the furnished spreadsheets.

**Input Card Addresses** - Each Input Card is given a unique even number address starting with zero (0) so the correct data will be transmitted to the CPU circuit card. This address (in binary number form) is set with a dip switch on each Input circuit card, the base address side being the even number dipswitch, and the base plus one (base+1) address side being the odd number address above the base address.

**MIDI Couplers** – can be wired on Stops 1, 2, & 3, such that when looked at as a group, each MIDI Coupler is wired to a unique pin number.

**Note:** The input cables must be physically separated from all output cables to minimize crosstalk.

## Dip Switch Addresses for Input Cards



### PISTON LABELING FOR CONSOLE CONSTRUCTION

**General** Pistons 1 to 26

**Divisional** Pistons 1 to 8

**16 Builder Defined Reversible** Pistons, which are labeled for their specific purpose.

**8 Programmable Cancel** Pistons

**2 User Settable Reversible** Pistons

**FF** or **SFZ** or **TUTTI** or **FULL ORGAN** reversible piston

**CANCEL** - General Cancel Piston

**ML UP** - Memory Level Up Piston

**ML DN** - Memory Level Down Piston

**TR UP** - Transpose Up Piston

**TR DN** - Transpose Down Piston

**PD/Manual** - Continuo Piston or Coupler – cannot be both

**IND** - Fortissimo/Crescendo Indicate Piston

**FRENCH** – Great (Div1) and Choir (Div4) Manual Interchange Piston or Coupler - cannot be both

**SET** - Setter Piston for capture combination action

**MENU/PLAYER** - Menu Piston for access to Record/Play/Delete/MIDI

**PS On/Off** - Piston Sequencer On/Off

**NEXT** - Piston Sequencer Up

**PREVIOUS** - Piston Sequencer Down

**RESTORE** – Undo Piston Capture or Ctrl<z>

For play/record breakout

**REC**

**PLAY/Start/Pause/Resume**

**STOP**

**RWD**

**FFWD**

**INC**

**DEC**

### INPUT CIRCUIT BOARD TYPES

#### REFLECTIVE LED KEY CONTACT RAIL

This Input card version fixed to an aluminum rail is mounted either under the keys for long pivot keyboards or behind the keys for center pivot keyboards using a screw on each end of the rail to attach to the key frame or cheek. Using a reflective surface fixed to the keys, leave a .150" clearance gap to the LED/phototransistors mounted along the edge of the circuit card. The firing point can be adjusted either by shimming the aluminum rail or by adjusting individual reflectors. Also included on this rail is the base address+1 for 38 piston inputs, using two (2) 20 pin connectors in the center of the Rail. These two connectors are 2 rows of 10 pins equaling

20 pins each, the center pin of each row is the common, and the outer 9 of each row are for piston inputs. If the pistons are wired to the connectors on this input reflective rail, then the only wiring to the keyboard is power and fiber optics.

**NOTE:** The early versions of this rail use a separate +3.3VDC power supply to feed the rail in addition to the usual +12V/Gnd feed to each Input card, the cards are clearly labeled if this is the case, remember to tie the negative of this 3.3V supply to the main power supply negative at the power supply output terminals.

#### REFLECTIVE LED Pedalboard CONTACT RAIL

This Input card version is a group of 4 circuit cards, each card reading 8 keys. These cards are to be mounted to the bottom of the console in front of the pedal keys; thus, the pedal board is removable without any cabling attached. Either use the front of the pedal key or fix a reflective surface to the front of each pedal key, leaving a .150" clearance gap to the LED/phototransistors mounted along the edge of the circuit cards. The cards can be bent to match concavity if need be. Also included on the card for pedal key sensors 1-8 is the connection for 32 toe stud inputs, using two male pin headers of 8 and 24 pins respectively.

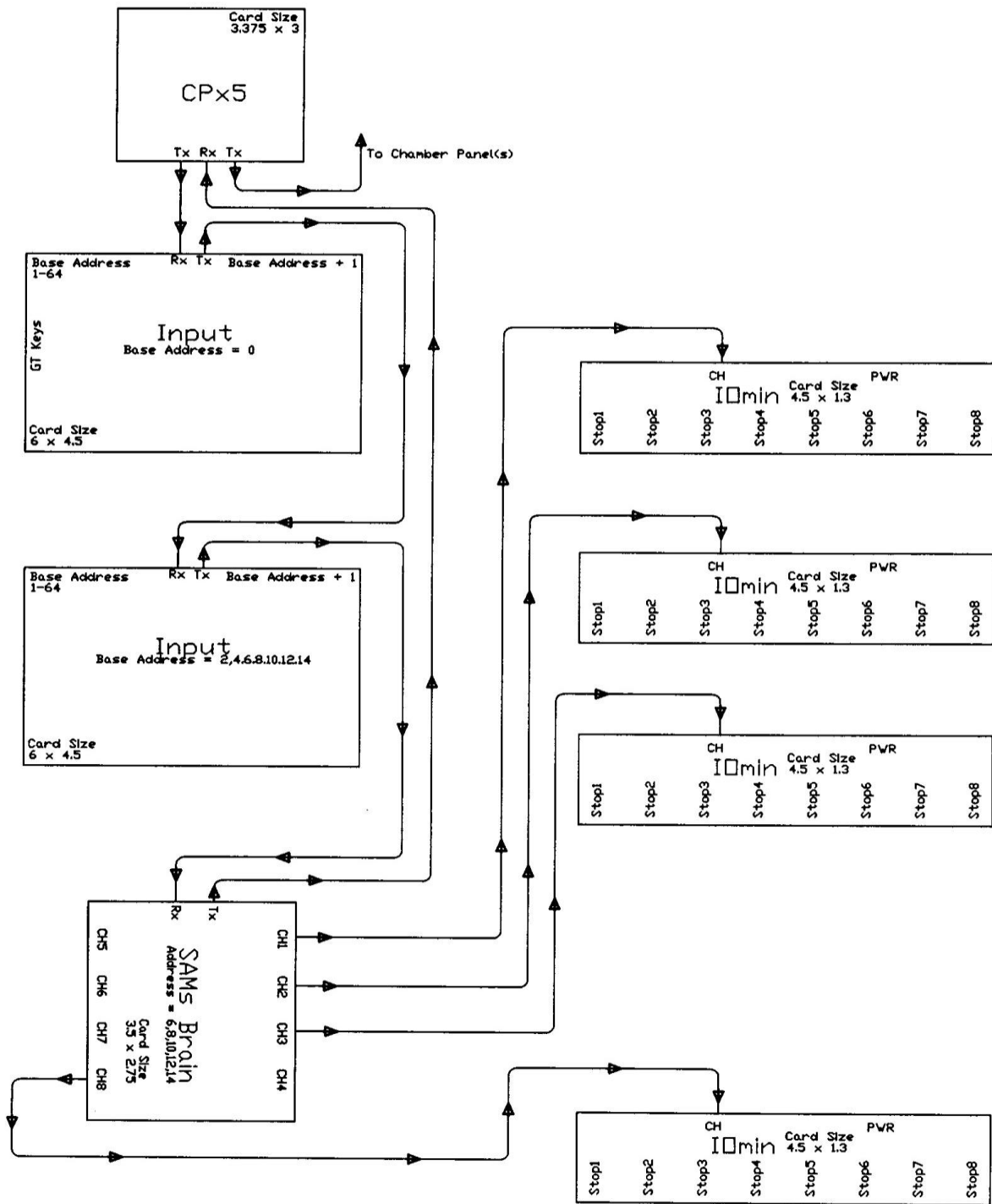
#### LEGACY Input card

This is the original legacy card with 128 pins, 2 x 64, that has two addresses: base and base+1. The pins are negative common so if measured with a voltmeter, they are pulled high to +5V when switches are off and read 0 volts when the switches are on.

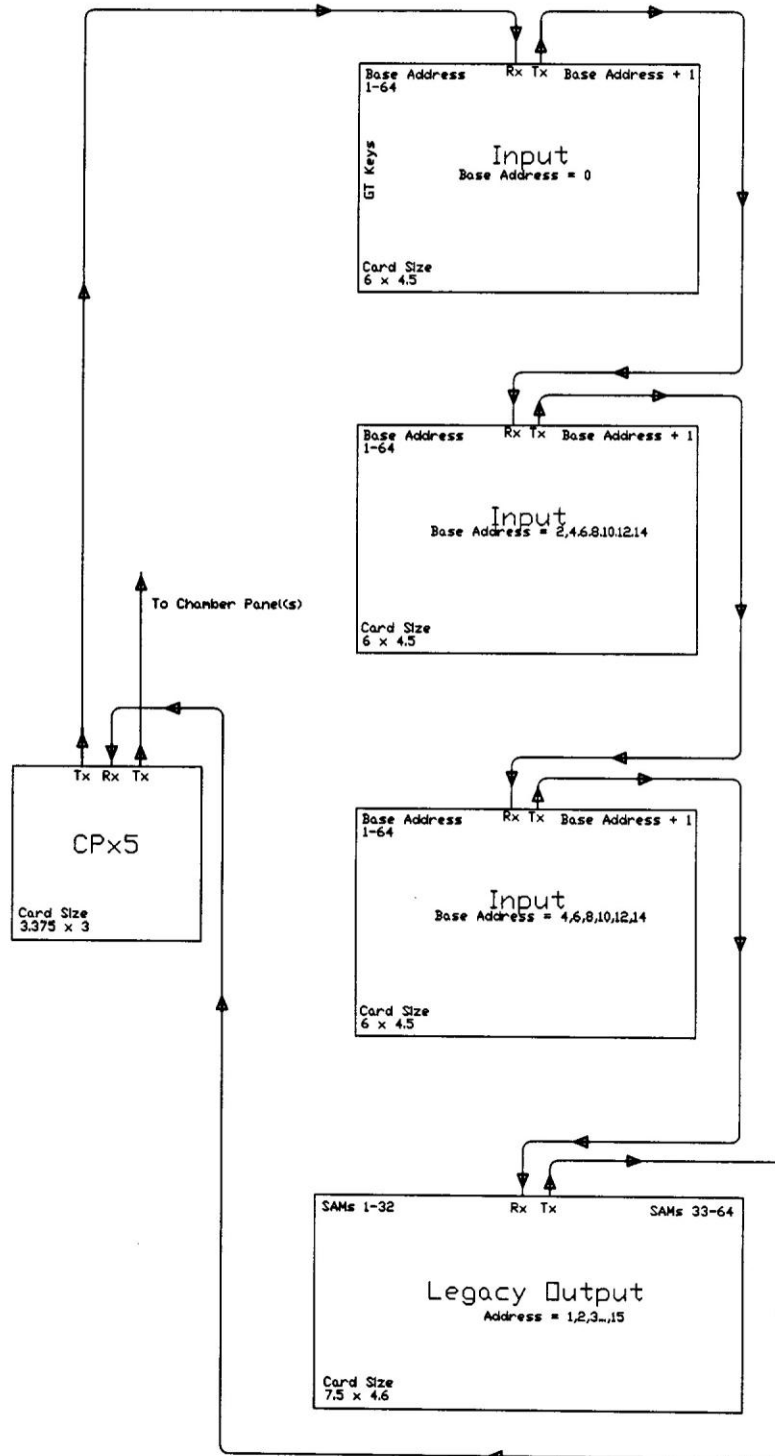
#### SAMs BRAIN/IOMin

This Input card version is a single "brain" card that talks to 8 satellite cards called IO..... that handle 8 stop actions, thus  $8*8=64$ . The brain is logic only and the IOMin... cards are both logic and high current for on/off coils. The reason for this architecture is to combine both the Input sense and on/off coil Outputs into one card that can be mounted directly on drawknobs or very close to tilt-tabs keeping cables short and symmetrical. LEDs are utilized to indicate logic flow, ethernet cables connect the logic, and there is a power block for fused power that drives only the on/off coils. The usual voltage profiles are available, whether it be positive or negative coil commons, the input sense is always negative common. This card is available in vertical or horizontal format for drawknobs and "min" format for tilt-tabs.

# Example of CPx5 Console Layout with Fiber Routing



# Example of Legacy Console Layout with Fiber Routing



## V. OUTPUTS

### DEFINITION

Outputs are magnet coils, indicator lights, and expression controls, both in the console and pipe chamber(s).

### CONSOLE INDICATOR LIGHTS

There are four (4) indicator light controls available, Fortissimo, Crescendo, Set, and Player. These are wired as positive common, current sinking circuits with the switched side of the light connected to the ribbon cable from the CPU card which is described in section VI.

### STOP ON/OFF COILS

For each input group Stops 1-4 that is used for stops and couplers, there will have to be two (2) groups of 64 outputs. The first group corresponds with Inputs 1-32, and the second group of 64 corresponds with Inputs 33-64. Each 64-pin connector grouping has parallel rows of 32 pins, one row (starting with the number 1 or 65) being ON coils and the opposite row (starting with the number 33 or 97) being OFF coils. These output connector pin numbers must match the input connector pin numbers. For example, if some input pins are skipped, the same number of pins in the order will have to be skipped on the corresponding output connectors. **Note:** These output cables must be physically separated from all input cables to minimize crosstalk.

### MAGNET COILS IN THE PIPE CHAMBERS

There are 128 outputs (pins) per Output circuit card using two 64 pin connectors arranged in 2 rows of 32. The wiring from the first 64 pin connector can continue to the second 64 pin connector which is considered to be pins 65 through 128.

**Unit magnets:** These are wired in ascending consecutive order with one rank or partial offset rank following another with no need to skip pins in between. This order can be either chromatic or diatonic (C or C# side).

**Primary actions for straight chests:** Outputs are wired in ascending consecutive order, using either chromatic or diatonic (C or C# side) order.

**Stop actions for straight chests:** These can be wired in the same ascending consecutive order as the stop inputs were wired in the console. The tremolos, zimbelstern, and chime volumes are included with this group.

**Swell Box(es) Motors:** Control pins are wired in ascending consecutive order.

**Chime Volume(s):** These controls are wired in ascending consecutive order.

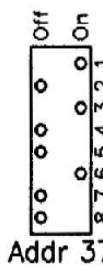
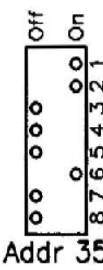
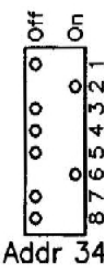
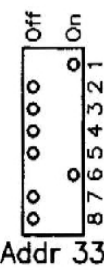
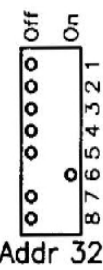
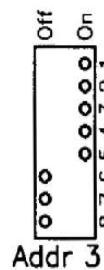
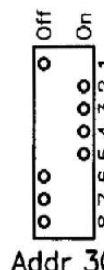
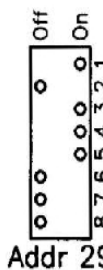
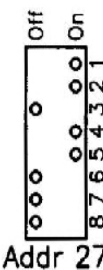
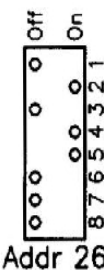
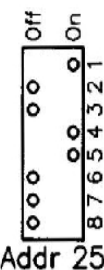
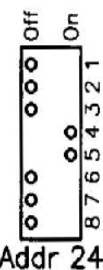
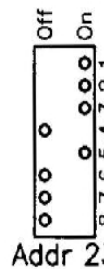
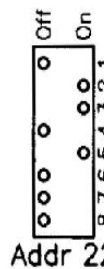
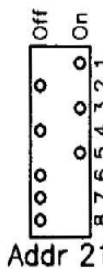
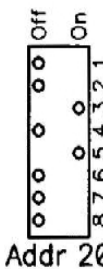
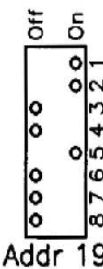
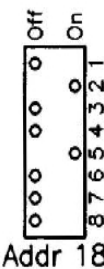
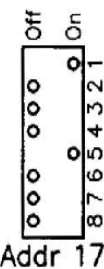
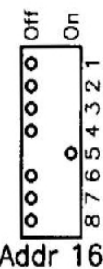
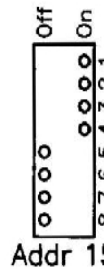
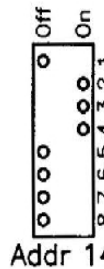
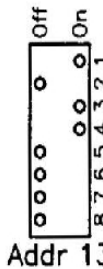
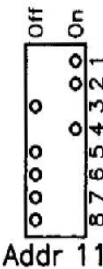
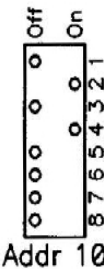
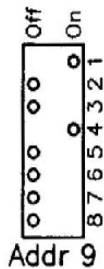
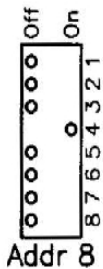
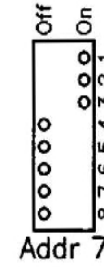
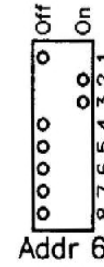
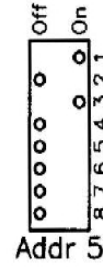
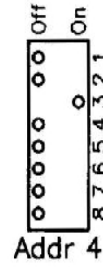
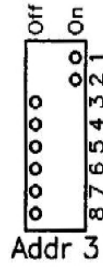
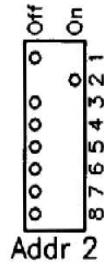
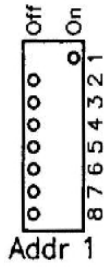
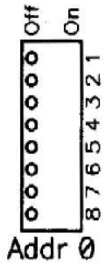
### WIRING HINTS

**Pin List** - Keep a written list of all the Output wiring on the furnished spreadsheets.

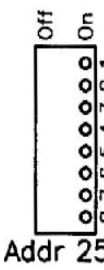
**Output Card Addresses** - Each Output Card has to be given a unique address so that the correct data coming from the CPU circuit card will be recognized. This address (in binary number form) is set with a DIP Switch on each Output circuit card.

**NOTE:** When calculating Power Up Programming/5. Stop Programming, there are a maximum of 39 levels per Output card. Plan to wire for the Output cards accordingly, that is use as much matching ascending grouping with Input cards when possible, especially stop actions.

# Dip Switch Addresses for Output Cards



etc. etc. etc.



## OUTPUT5 PANEL BKPLN with 64 PIN DRIVERS (Negative Common, 24VDC capable, 1.2A or .35A/pin)

This is a wood panel with components mounted, a single source solution to chamber wiring: connect switched DC power to the panel, punch down chest cables, and the wiring is complete. All fusing is furnished per NEC. The panel starts with a fiber optic card at the top where the dipswitch address is set, then the data propagates down the panel through back plane cards via copper traces. The driver5 cards plug into the backplanes and auto address themselves at power up. Mounted on the backplanes are "110 standard" punch down connectors for the chest telephone wire cables to attach. Also on the backplane are LEDs for each output for the purpose of visual troubleshooting. The driver cards are attached only by friction, no wires, screws, fiber, etc to disconnect/connect, card swapping is a breeze. This panel is fully compatible with all legacy output cards which can either be ahead or behind in the fiber optic daisy chain.

There are 3 versions of driver cards that plug into the backplanes, all have different parts to alleviate supply chain constraints. Type 1 and 2 versions handle 1.2A/pin continuous current and type 3 will source .35A/pin. The panel is 24V tolerant if using driver cards type 2 and 3, type one is not 24V compliant.

## OUTPUT CIRCUIT CARD with 16 PINS (Negative Common, 24VDC capable, .35A/pin)

This mini sized output card (1" x 3") will source .35A/pin, 16 pins total and was developed for slider chest solenoid motors such as the Laukhuff S1 standard. This allows for complete isolation between divisions: locate a switched power supply at each division's slider motor panel, fuse each slider motor, connect fiber optic from console chassis, feed logic from this card to motors and all wiring is complete and self-contained. These cards are 24V compliant.

## OUTPUT CIRCUIT CARD with 128 PINS: **SMT+** (Positive Common - 1.2A/pin)

**Surface Mount Technology+.** This is a positive common or low side switching card that has current sinking circuits with the common side of the coils wired to POSITIVE and the switched side of the coils wired to the connectors.

This card can switch 1.2a/pin @ 100% duty cycle, all outputs have built in thermal shutdown, linear current limitation and overvoltage clamping.

Fusing of the commons is left up to the installer and must be at least one 6-amp fuse per rank of pipes, with 6 amps being the NEC specification for maximum fuse size.

The VDC and GND for the logic are located on the center green barrier block, the VDC must be connected to a fused connection point from the power supply according to III. Powers and Grounds.

The V plus (+) and minus (-) for the magnets are located on the two (2) 4 terminal outer barrier blocks labeled GND, +V1, +V2 and +V4, +V3, GND respectively. Since this is a positive common board which makes the GND (-) terminals the return for all the magnets, you must have enough wire to match the fused positive common side of the circuit. The four (4) +V1-4 terminals are the connection point for internal diode protection and should be connected externally to the power supply positive (+) for the magnet load that the card is switching. Normally this will be the same power supply that is feeding the center barrier block; thus the card will be shipped with a jumper wire in place.

If separate power supplies are used for logic and magnet coils on an Output card, their grounds (-) must be tied together at the power supply output terminals.

**OUTPUT CIRCUIT CARD with 128 PINS: SMT-** (Negative Common – 1.2A/pin)

**Surface Mount Technology-** This is a negative common or high side switching card that has current sourcing circuits with the common side of the coils wired to NEGATIVE and the switched side of the coils wired to the connectors. This card can switch 1.2A/pin @ 100% duty cycle, all outputs have built in thermal shutdown, linear current limitation and overvoltage clamping.

The VDC and GND for the logic are located on the center green barrier block, the VDC must be connected to a fused connection point from the power supply according to III. Powers and Grounds.

The V plus (+) and minus (-) for the magnets are located on the two (2) 4 terminal barrier blocks labeled GND, +V1, +V2 and +V4, +V3, GND respectively. The positive (+) terminal of power supply that is driving the magnet coils must be hooked to each of these +Vx terminals through a fuse with a maximum size of 3Amps (when driving a combination action in the console, this will have to be raised to a maximum of 5A). The GND (-) terminal of this power supply that is driving the magnets must be hooked to the GND terminals of the +Vx barrier blocks, these GND wires matching the +Vx terminal wires in gauge size and number.

If separate power supplies are used for logic and magnet coils on an Output card, their grounds (-) must be tied together at the power supply output terminals.

**LEGACY OUTPUT CIRCUIT CARD with 128 PINS: 2803A** (Positive Common - .5A/pin max)

Outputs are wired as a current sinking circuit with the common side of the coil wired to POSITIVE and the switched side of the coil wired to the connector. All magnet coils must have a unique diode associated with them. In order to use the diode internal to the driver chip, you must hook up the wiring exactly as stated here, otherwise you must locate a diode right at the terminals of the coil. This Positive Common circuit board takes care of all the diodes, fusing, and voltage polarities if you hook it up according to these directions. The commons are split into 8 pin or magnet groups. These are to be hooked up at the green barrier blocks labeled C1 through C16.

The groupings are as follows:

<b>Pins</b>	<b>Common</b>	<b>Fuse</b>	<b>+VDx</b>
1-4 and 33-36	C1	Fuse 1	1
5-8 and 37-40	C2	Fuse 2	1
9-12 and 41-44	C3	Fuse 3	1
13-16 and 45-48	C4	Fuse 4	1
17-20 and 49-52	C5	Fuse 5	2
21-24 and 53-56	C6	Fuse 6	2
25-28 and 57-60	C7	Fuse 7	2
29-32 and 61-64	C8	Fuse 8	2
65-68 and 97-100	C9	Fuse 9	3
69-72 and 101-104	C10	Fuse 10	3
73-76 and 105-108	C11	Fuse 11	3
77-80 and 109-112	C12	Fuse 12	3
81-84 and 113-116	C13	Fuse 13	4
85-88 and 117-120	C14	Fuse 14	4

89-92 and 121-124	C15	Fuse 15	4
93-96 and 125-128	C16	Fuse 16	4

Each of these groups of 8 has a fuse associated with it above the barrier block. These fuses are not labeled but lay in respective order with the commons. The fuses are 2AG, quick blow glass, with a 2amp rating matching the load of the magnets.

You must wire your commons in these groups. To test the wiring for correct grouping of commons and fuses, remove all but one fuse and test the 8 pins of the corresponding group. There are no exceptions to this wiring layout.

The VDC and GND for the logic are located on the center green barrier block.

The +VDC and GND for the magnets are located on the large green barrier blocks between the commons. These +Vx terminals are unique and separate, labeled +V1, +V2, +V3, and +V4, with each of the four feeding the 4 commons nearest to it. These +VDC terminals must be fused externally at the power supply, with a fuse not to exceed 5 amps. The GND terminal of the magnet coil power supply must be hooked to the GND terminals with gauge size and number matching the +V1, +V2, +V3, and +V4 wires.

If separate power supplies are used for logic and magnet coils on an Output card, their grounds (-) must be tied together.

**LEGACY OUTPUT CIRCUIT CARD with 128 PINS: 2981A (Ground Common - .5A/pin max)**

Outputs are wired as a current sourcing circuit with the common side of the coil wired to GROUND (-) and the switched side of the coil wired to the connector. All magnet coils must have a unique diode associated with them. To use the diode internal to the driver chip, you must hook up the wiring exactly as stated here, otherwise you must locate a diode right at the terminals of the coil. This Ground Common circuit board takes care of all the diodes, fusing, and voltage polarities when connected in accordance with these directions:

<b>Pins</b>	<b>Fuse</b>	<b>+VDx</b>
1-4 and 33-36	F1	1
5-8 and 37-40	F2	1
9-12 and 41-44	F3	1
13-16 and 45-48	F4	1
17-20 and 49-52	F5	2
21-24 and 53-56	F6	2
25-28 and 57-60	F7	2
29-32 and 61-64	F8	2
65-68 and 97-100	F9	3
69-72 and 101-104	F10	3
73-76 and 105-108	F11	3
77-80 and 109-112	F12	3
81-84 and 113-116	F13	4
85-88 and 117-120	F14	4
89-92 and 121-124	F15	4
93-96 and 125-128	F16	4

Each of these groups of 8 has a fuse associated with it above the barrier block. These fuses are 2AG, quick blow glass, with a 2amp rating matching the load of the magnets.

The VDC and GND for the logic are located on the center green barrier block.

The VDC and GND for the magnets are located on the 4 terminal barrier blocks labeled GND, +V1, +V2 and +V4, +V3, GND. The positive (+) terminal of power supply that is driving the magnet coils must be hooked to each of these +Vx terminals through a fuse with a maximum size of 3Amps (when driving a combination action in the console, this will have to be raised to a maximum of 5A). The GND (-) terminal of this power supply that is driving the magnets must be hooked to the GND terminals of the +Vx barrier blocks, these GND wires matching the +Vx terminal wires in gauge size and number.

If separate power supplies are used for logic and magnet coils on an Output card, their grounds (-) must be tied together.

#### LEGACY OUTPUT CIRCUIT CARD with 128 PINS: **2987A** (Ground Common - .35A/pin max)

Outputs are wired as a current sourcing circuit with the common side of the coil wired to GROUND (-) and the switched side of the coil wired to the connector. All magnet coils must have a unique diode associated with them. To use the diode internal to the driver chip, you must hook up the wiring exactly as stated here, otherwise you must locate a diode right at the terminals of the coil. This Ground Common circuit board takes care of all the diodes and voltage polarities when connected in accordance with these directions:

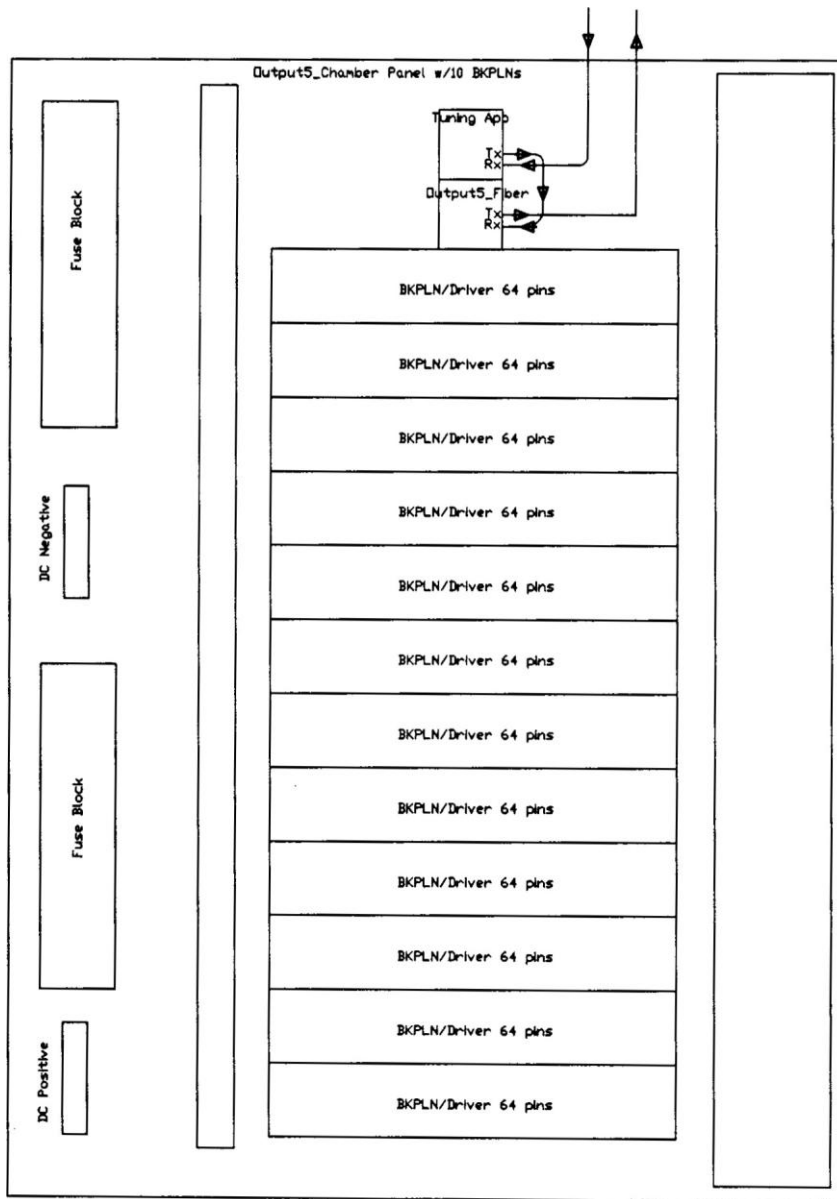
<b>Pins</b>	<b>+VDx</b>
1-16 and 33-48	1
17-32 and 49-64	2
65-84 and 97-112	3
85-96 and 113-128	4

The VDC and GND for the logic are located on the center green barrier block

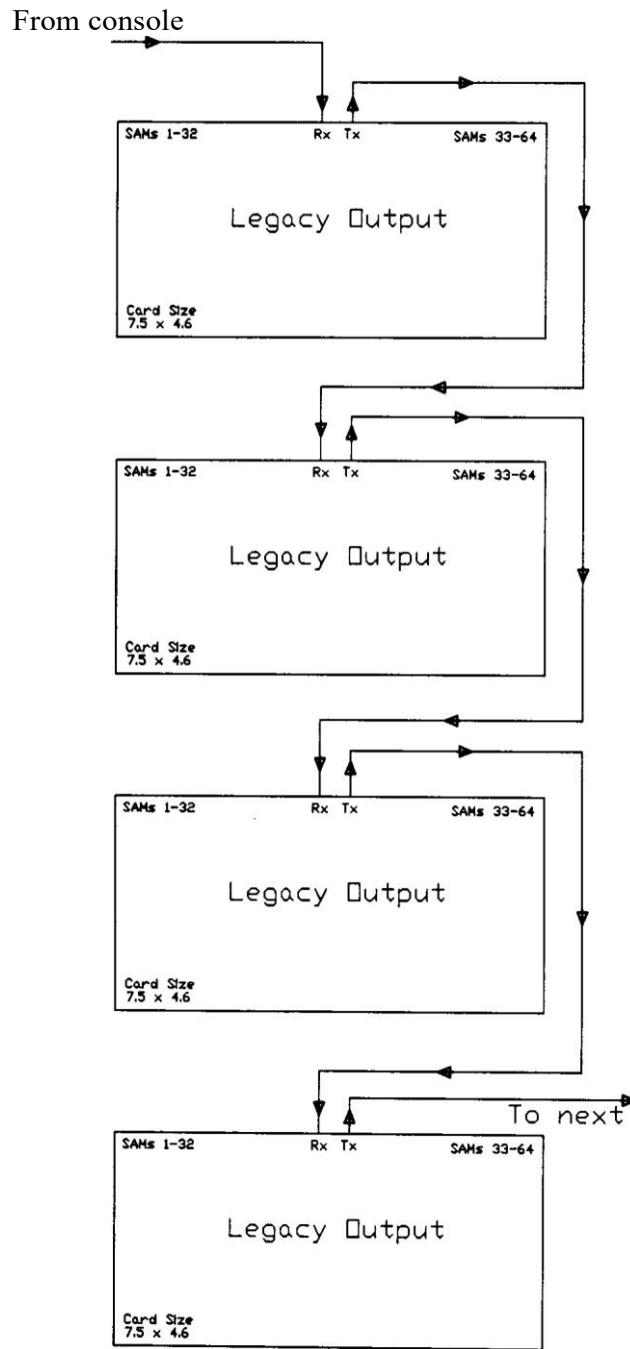
The VDC and GND for the magnets are located on the 4 terminal barrier blocks labeled +V1, +V2, GND and GND, +V4, +V3. The positive (+) terminal of power supply that is driving the magnet coils must be hooked to each of these +Vx terminals through a fuse with a maximum size of 3Amps. The GND (-) terminal of this power supply that is driving the magnets must be hooked to the GND terminals of the +Vx barrier blocks, with wire gauge size and number matching that of the +Vx wires.

If separate power supplies are used for logic and magnet coils on an Output card, their grounds (-) must be tied together.

## Example of CPx5 Chamber Panel with Fiber Routing



## Example of Legacy Chamber Layout with Fiber Routing



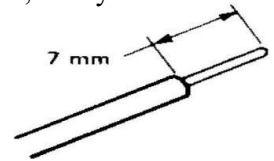
## V. FIBER OPTICS and RIBBON CABLE

### INSTALLATION OF THE FIBER OPTIC CABLES

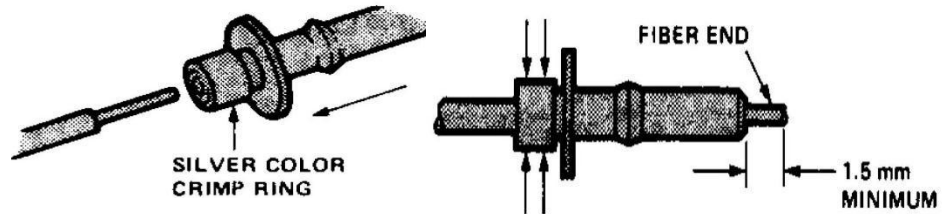
A fiber optic loop will connect all the Input and Output circuit cards in the console to the CPx5 card. Start at the TX Console port (grey) on the CPx5 card, progress thru all of the INPUT cards (in blue, out grey) in ascending consecutive address order, then progress through the OUTPUT cards (in blue, out grey) in ascending consecutive order, and return to the CPx5 card at the Rx (blue) port. A fiber optic daisy chain will connect the CPx5 card and all Output cards in the pipe chamber. Start this chain at the Tx Chamber port (grey) on the CPx5 card and progress through all Output (in blue, out grey) cards in the pipe chamber, in any order of addresses. See example layouts.

### TERMINATION OF PLASTIC FIBER OPTIC CABLE

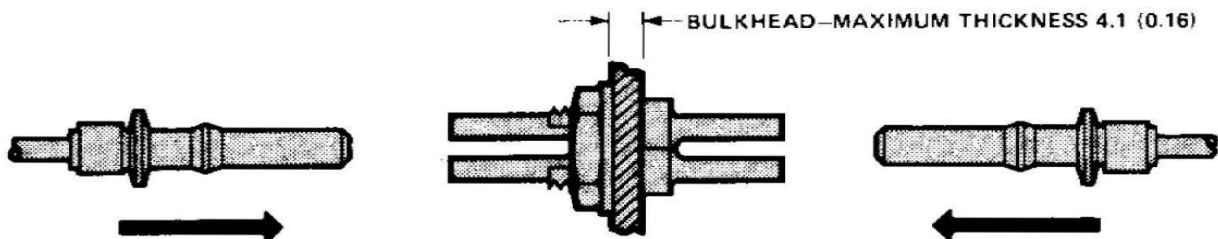
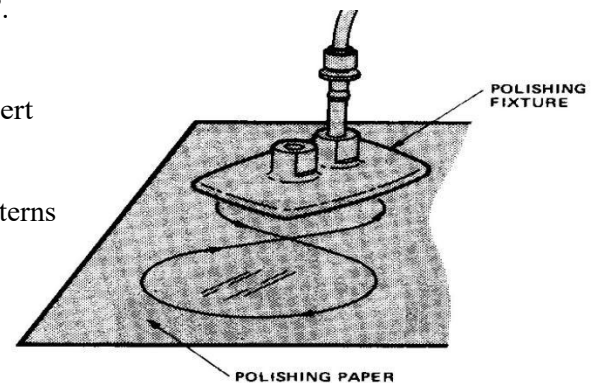
1. After cutting the cable to the desired length, strip off approximately .3" of the outer jacket with a 16ga. wire stripper.



2. Place the crimp ring and the connector over the end of the cable, with adhesive if desired, the clear fiber should protrude about 1/8" and crimp the ring in place with a generic crimping tool, slightly oval is all that is needed. After the glue has set if used, trim off excess clear fiber with a sharp flush cut side cutters so that the clear cable protrudes 1/16".



3. Place a piece of 600 grit sandpaper on a flat smooth surface. Insert the crimped connector with protruding cable into the polishing fixture, with the fixture flat on the sandpaper and cable perpendicular to the sandpaper surface, draw large figure eight patterns until the connector end is flush. Repeat this process using the pink 3 micron lapping film.



### FIBER OPTIC CABLE COUPLING

Fiber optic cable can be coupled, for example a movable console with or without multiple locations. Shown is the plastic-to-plastic coupling, this can be done with glass to glass in the same fashion.



## VI. ANALOG to DIGITAL

This circuitry, whereby the expression pedal positions are read by potentiometers attached to the movement of the pedals, is referred to as 'A to D'. There are seven (7) channels available for 7 pedals. This A to D circuitry is implemented on the CPx5 card with a long green connector label Swell Pedals.

There are 3 pins on a potentiometer; the outside two are the fixed value of the resistor, and the middle pin being the variable value. The fixed pins (1&3) are hooked to +V and GND, the order such that the number on the LCD during power up programming runs from low to high as the pedal is pushed down. If incorrect, that is high to low, simply reverse the wires to these fixed pins (1&3). The middle (variable) pin is hooked to any channel number from 1 to 7. Potentiometer resistor values of 1K to 10K ohms will work with the A to D card.

The potentiometers are hooked up as follows:

<b>Pot – Terminal</b>	<b>Long Green Terminal Block for Swell Pedals on CPx5 card</b>
Channel 1	fixed +V
	variable 1
	fixed GND
Channel 2	fixed +V
	variable 2
	fixed GND
Channel 3	fixed +V
	variable 3
	fixed GND
Channel 4	fixed +V
	variable 4
	fixed GND
Channel 5	fixed +V
	variable 5
	fixed GND
Channel 6	fixed +V
	variable 6
	fixed GND
Channel 7	fixed +V
	variable 7
	fixed GND

## VII. TESTING OF WIRING FOR POWER UP

### TESTING OF AC VOLTAGES WITH POWER OFF

- Check 110VAC input in power disconnect/relay box
  - Leads of meter on black and white wires: read 110VAC
  - Leads of meter on black and green wires: read 110VAC
  - Leads of meter on white and green wires: read 0VAC
- Check 24VAC transformer
  - Leads of meter on output of transformer: read 24VAC

### TESTING OF AC VOLTAGES WITH POWER ON

- Check 24VAC transformer output
  - Leads of meter on output of transformer: read 24VAC minimum
- Check Power Supply (rectifier) Output Voltage
  - Leads of meter, red lead on +, black lead on -: read rated output dc voltage

### TESTING OF LOGIC DC VOLTAGES on every circuit card

- There is a test port labeled for +VCC or +12V which must read the same voltage as the power supply output.
- There is a test port labeled +5VDC which must read +5VDC. Voltage is measured in relation to the terminal block pins labeled GND.

### TESTING INPUT CIRCUITS

Testing of the input circuit wiring is done at the header pins on the input cards after the connectors have been plugged onto the cards. With the power turned OFF, meter set to ohms, clip the black wire of your meter to the common (ground) of the input switches. Touch the red lead of your meter to the correct header pin. When the switch is open the reading should be greater than 5K ohms and when the switch is closed the reading should be zero ohms. With the power turned on, meter set to VDC, the readings should be +5V when the key or switch is open and 0V when the switch or key of closed.

### TESTING OUTPUT CIRCUITS

Testing of the output circuit wiring is done at the header pins on the output cards after the connectors have been plugged onto the cards. With the power turned ON and a clip lead attached to minus (-) for the positive common cards or positive (+) for the negative common cards, you should be able to energize the correct magnet coil by touching the correct header pin. If this test is done with the power off using a meter, you should read the ohm rating of the magnet.

### TESTING VOLTAGES WITH AN OSCILLOSCOPE

The voltage of the power supply to the magnets must remain constant when worst case conditions are met when engaging the combination action, slider motors, and maximum number of chest magnets. Ideally a 2-channel scope would be used: connect channel 1 to the voltage of the power supply and connect channel 2 to the logic +5V test port. When worst case conditions are used, the voltage of the logic must remain a constant line.

## VIII. INITIAL POWER UP SEQUENCE

1. Turn on the on/off switch and adjust LCD variable resistor on the CPx circuit card adjacent to the RIBBON cable connector with a screwdriver for the optimum viewing of ML 1 in the lower left corner of the LCD.
2. Turn the power off and insert the flash drive.
3. Turn on the power switch while holding down GT division keys 1, 2, & 3, continuing to hold until Power Up Programming appears on the top line of the LCD.
4. Complete pages 1-7 of the PUP key overlays in order, do not proceed to the next number until all is working correctly on the current number.
5. Return to ML1 with Great Key 1 and test for correct and complete programming.
6. If not correct or complete, hold down Great key 1 with SET piston and hit Player piston to return to Power Up Programming. Complete from Step 4 above.
7. Set the FFF piston. Hand register a suitable full organ sound. Then capture by holding down Great key 1 while holding in the 'SET' piston, then push in the FFF piston. To visually check the setting captured in memory: hit General Cancel, then hit the full organ piston, and finally hit the IND piston.
8. Set the Crescendo Pedal. Move pedal to Cres 1 and remove foot from pedal. For all stages, hand register a suitable sound and capture into memory by holding down Great key 1 while holding in the 'SET' piston, then push in the 'IND' piston. Crescendo number on the LCD will auto-increment. Do this for all stages and finish by moving the pedal to the full off position. To visually check what has been captured in memory, either play while moving the pedal or move the Crescendo pedal to any stage number and hit the 'IND' piston.
9. Remove flash drive and insert into external computer where the PUP configuration file located in the root director can be copied for purposes of having a backup.

## IX. TROUBLE SHOOTING

### SYSTEMATIC APPROACH

To solve a malfunction quickly and correctly, a systematic approach is required. The problem must be isolated and then tested correctly. The steps in this approach are:

1. Check for correct DC voltages
2. Test problem circuit
3. Repair

This is a repeat of VII. Testing of Wiring for Power Up.

NOTE: If the problem seems to be a circuit board problem, swap the board with one that is known to be good. The boards in the pipe chamber may be bypassed or taken out of the system to keep the system functioning if a replacement board is not available. However, the CPU and INPUT card address 0 must always be in the system.

FUSES - check with an ohm meter, do not rely on checking visually only. There are a variety of fuses, in amp rating and location; these are covered in previous sections III, V, and VII.

NOTE: In the event of the need to call us for assistance, please have your documentation, voltmeter, and a hands-free phone ready so that we can help you.

NOTE: Most problems encountered are either voltage or wiring. A digital multi-meter measures quantity of voltage and an oscilloscope measures the QUALITY of voltage.