SECTION II
CONFIGURATION

SYSTEM REQUIREMENTS

Each 184/384 Controller system requires a main power supply, a Processor (the mainframe), and a variable number of I/O modules. The 184 Processor is available in four different models, 184-1, 184-2, 184-3, and 184-4. Each 184 model is physically the same; the only difference is the size of the core memory provided with the Processor. Any Controller can be changed to any model number by merely replacing the memory printed circuit card. The 384 Processor is available only with 4K of core memory. Criteria for the proper selection of the specific model number is provided as part of the Basic Principles, Section III. In designing a hardware configuration, most of the considerations should be applied to the I/O configuration and its various options.

All 184/384 Controllers have the hardware capability to communicate to a maximum of 512 input points and 512 output points. These are separate limitations; inputs cannot be traded for outputs nor outputs for inputs. The I/O capability is divided into four channels, each channel can contain up to 128 input and 128 output points. Again, these are separate limits. A channel is thus defined merely as a subdivision representing 25% of the total I/O capability to simplify the communications between the Processor and the I/O.

The specific I/O circuitry required to convert the various field voltages to signal levels compatible with the Processor is provided on modules. I/O modules are either totally input or totally output with 16 circuits on each module (see Figure 6); combining input and outputs on one module is NOT possible.

NOTE

If isolated AC I/O modules are to be used, see Appendix B for special conditions applying to these modules.

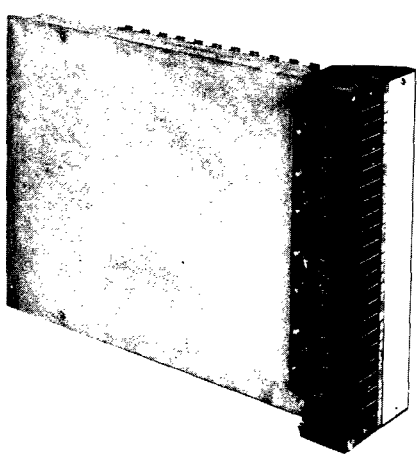

Figure 6. Typical I/O Module

The I/O modules are installed into I/O housings; each housing is capable of receiving up to four I/O modules. Normally, four housings are connected together to form a complete channel of I/O (up to 128 inputs and 128 outputs), which allows up to eight input modules and eight output modules to be installed in each channel. Since each channel is separately connected to the Processor, only those I/O modules required in each channel need be installed.

NOTE

Certain terms such as I/O, channel, etc., are being defined and will be used throughout this manual relative to the Controller. Appendix D summarizes unique terms and their definitions.

Standard MODICON cables are used to connect each I/O channel separately to the Processor. These cables are heavy duty, multiple conductor, double-shielded cables available in a variety of lengths as shown in Table 2. Since the connector for channel I (top of Processor) is different and not interchangeable with the connectors for channels II-IV (bottom of Processor), there are two sets of cables, one for channel I and the other for channels II-IV. Interchanging cables between channels II-IV is possible. Cables provided for connections from the Processor to either auxiliary power supplies or remote drivers are permanently attached to those units.

Table 2. Processor to I/O Cable Options

	Via		
From Processor To:	Directly	Aux Pwr Supply	Remote Driver
Channel I	W600-003.006	W602-012.025. 050.075	W604-006.012
Channels II-IV	W601-006.012	W606-012.025. 050.075	W603-006.012

NOTE

Last three digits of cable number represent the maximum cable lengths in feet; except W600-003 which is 30" long.

Figure 7 is an illustrative example of an expanded 184/384 system. Directly above the Processor is the main power supply and channel I with three housings (maximum 12 I/O modules). In this example, the main power supply is providing internal DC power for the Processor, channel I, and channel II; channel II is only one housing with four I/O modules installed, shown to the left of the main power supply. Both channels I and II are shown without auxiliary power supplies and use direct cables to the Processor (W600 type for channel I and W601 for channel II). A completed channel III is shown to the right of channel I, powered with an auxiliary power supply, and connected to the Processor via this auxiliary power supply with cable type W606.

Referring to Figure 7, channel IV is driven from a remote driver, shown to the right of the Processor. This option is used when a channel is located greater than 75 feet from the Processor. The remote driver is connected to the Processor with cable type W603. Channel IV is divided into two remote subchannels, both shown to the right of channel III; each subchannel can be located 2000 feet from the Processor in different directions. The subchannels are each powered by an auxiliary power supply equipped with an I430 interface (see Figure 8). The connection between the remote driver and each interface is via two twin-conductor shielded cables, one carrying communications to the remote channel and the other communication back to the driver. These cables are NOT supplied with the remote system; Belden type 8227 or equivalent is recommended.

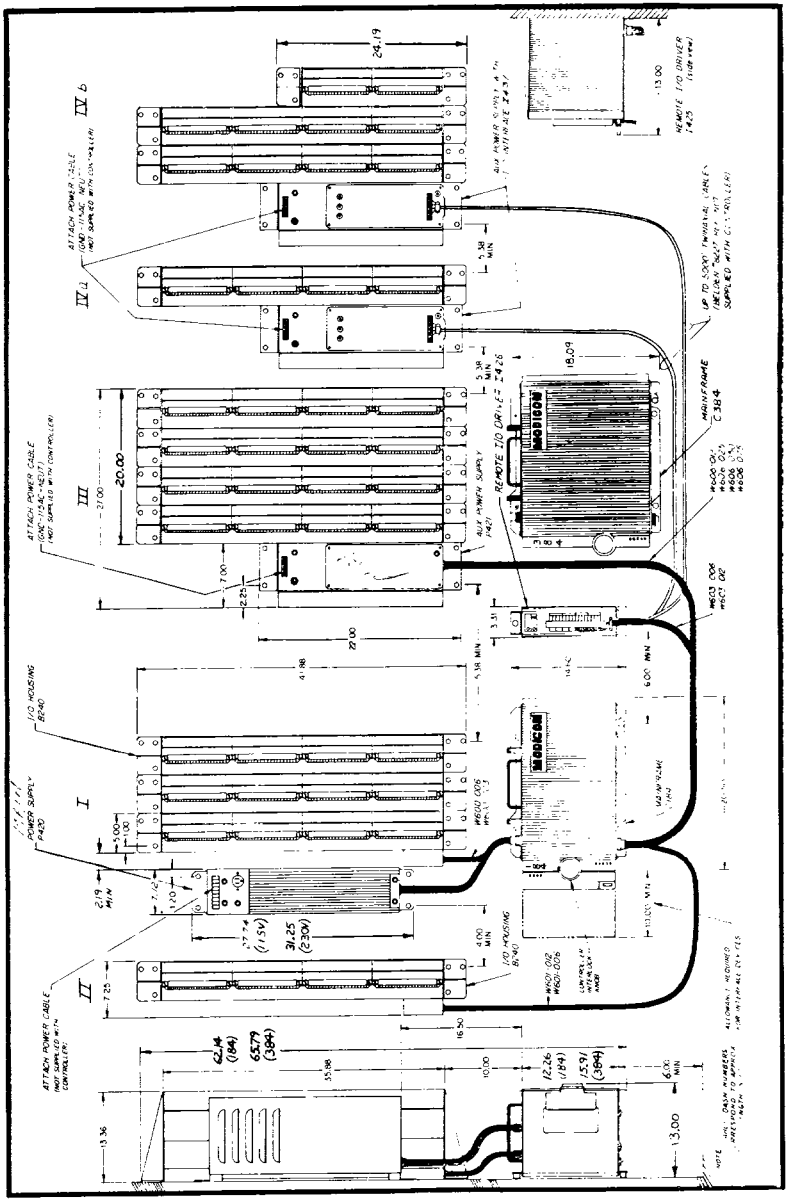

Figure 7. Expanded 184/384 System

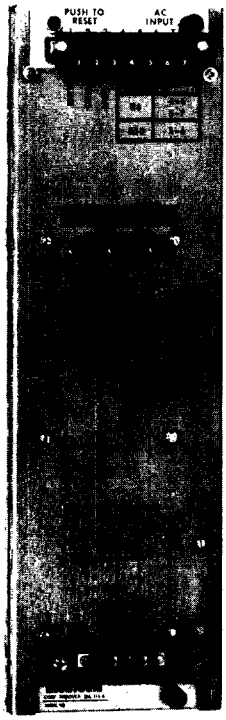

Figure 8. Auxiliary Power Supply and Remote Interface

The remote driver (I425) provides the capability of remoting an entire channel (128 input and 128 output points) to four (or less) locations each up to 5000 feet from the Processor. Any portion, including the entire channel, can be located at each subchannel. However, under no circumstances, can the number of unique input and output points exceed the basic limits of 128 each per channel. Remote I/O allows the I/O to be placed near the machine or process under control; thus replacing all field wires over a long distance with just two twin-conductor cables.

Any channel can be remoted, each into four subchannels (total of 16 possible locations per Processor), located up to 5000 feet from the Processor. See Appendix A for additional details on remote driver.

Appendix B provides detailed specifications on the operation and wiring of all available I/O modules. However, relative to the overall system design, each standard 16-circuit output module requires twice as much internal 5 Vdc power as does the standard 16-circuit input module. Thus, a "unit" of I/O load has been defined by MODICON as the power required by one 16-circuit input module; each 16-circuit output module represents two "units" of I/O load. To drive a complete channel of input/outputs (8 standard 16-circuit input modules and 8 output modules) requires 24 units of I/O power. The main power supply and each auxiliary power supply is capable of supplying 27 units of I/O power. Table 3 summarizes the loading for each type of I/O module available for the 184/384 Controller.

Table 3. Internal I/O Power Loads

Unit	Type	Load (per module)
B230	115 Vac Outputs	2 Units
B231	115 Vac Inputs	1 Unit
B232	24 Vdc Outputs	2 Units
B233	24 Vdc Inputs	1 Unit
B234	220 Vac Outputs	2 Units
B235	220 Vac Inputs	1 Unit
B236	5V TTL Outputs	2 Units
B237	5V TTL Inputs	1 Unit
B238	24 Vdc Outputs, High Current	2 Units
B239	Hi Speed Counter	3 Units
B243	Analog Inputs	6 Units
B244	220 Vac Outputs, Isolated	2 Units
B245	220 Vac Inputs, Isolated	1 Unit
B246	115 Vac Outputs, Isolated	2 Units
B247	115 Vac Inputs, Isolated	1 Unit
B248	10-60 Vdc Outputs	2 Units
B256/258	Analog MUX	2 Units
B260	Analog Voltage Outputs	2 Units
B262	Analog Current Outputs	2 Units
B266	Reed Relay Output	2 Units
B270	48 Vac Outputs	2 Units
B271	48 Vac Inputs	1 Unit
B275	10-60 Vdc Inputs	1 Unit
B680	ASCII I/O	3 Units
J146	CRT Interface	0 Units
J340	I/O Communicator	1 Unit
J342	I/O Comm. with Switchover	2 Units
J540	500 Series Adapter	3 Units
J540/B5XX	Adapter with One I/O Channel	13 Units
J670	1084 Interface	1 Unit
1425	Remote Driver	5 Units
1646	Computer Interface	0 Units
2802	Programming Panel Interface	3 Units

NOTE

Include 1425's (Remote Driver) as well as J670 and 2802 Interfaces' load on main power supply at all times. The main power supply and auxiliary power supplies each have 27 units of I/O power available

Normally, channel I is powered from the main power supply's I/O capacity, and auxiliary power supplies are required for channels II-IV. These power supplies provide 5 Vdc internal power to operate the circuitry in the MODICON system: no power is provided to operate external devices, this must be provided by the user. However, under some special conditions, auxiliary power supplies are not required for channels II-IV. If all I/O power is not used by channel I, the unused I/O power can be "borrowed" from the main power supply and provided to channels II-IV. The first condition is that the distance from the Processor to the I/O channel must not be greater than 12 feet. Secondly, the entire channel must not present greater than 10 units of load if one channel is to be supplied by "borrowed" power. If more than one channel is to be supplied by "borrowed" power (e.g., channels II and IV), then each channel cannot represent more than 8 units of load. The last condition is that sufficient I/O power must be available from the main power supply for the total load applied.

If all three conditions (distance, load limit, and available capacity) are satisfied, that channel or channels can be operated without an auxiliary power supply. If channel I is located further than 12 feet from the Processor, it will require an auxiliary power supply. Include the I/O load of each remote driver (if any are used) in the load for channel I; if the load exceeds 27 units, a portion of the I/O should be placed in channel II or an auxiliary power supply used for channel I.

Any I/O channel can receive DC power for internal operation only from one source, either the main power supply or an auxiliary power supply. Borrowing I/O power is possible only from the main power supply. More than four I/O housings can be utilized on any channel as long as the I/O modules do not overload the power supply, nor are there more than eight unique input or output addresses.

As a final check, a review of the load on the I/O portion of the main power supply of Figure 7 can be conducted. Assume that the 12 I/O modules in channel I are 8 input modules and 4 output modules, and channel II contains 4 input modules. The I/O load on the main power supply is 25 units of load consisting of 12 input modules (12 units), 4 output modules (8 units), and 1 remote driver (5 units).

HARDWARE CONFIGURATION

System

Figure 9 is a typical system layout, providing mounting dimensions for all major components.

NOTE

A full-size mylar template is available for location of the mounting dimensions as shown in Figure 9. If use of this template is desired, request Dwg. No. SK-C184-200 from your nearest MODICON sales office or the factory.

This illustration is recommended for layout only; relocation of units relative to the Processor is possible, limited by the cable lengths available. For proper heat flow, all units should be oriented vertically. This will allow fullest removal of heat via the heavy-duty housing fins. Keyhole-type mounting holes are provided on the top of all power supplies and the Processor, to assist in mounting these units.

Processor

The Processor is provided with two mounting brackets that should be used to mount the unit to the panel, providing rear clearance for connection to the optional interface units. Complete installation and checkout procedures are given in Section V.

Install the Processor brackets with the longer one (having two hex-head silver screws) on top, and the other on the bottom. Two mounting screws (24-6 by 3/4 in.) are required but are not furnished with the lower bracket. The screws on the upper bracket are flanged to prevent their inadvertent removal, thus preventing accidental release of the Processor from its mounting structure.

With the bottom screws removed and the upper screws loosened, the Processor can be lifted from its mounting brackets. Since the Processor can easily be removed from its mounting with or without disconnecting external wiring, clearance is not required on the right side for removal of the end plate and access to the printed circuit boards. If access to these is required, the Processor can be removed rapidly, disconnected from its cables and then taken to the work area — or the Processor can be unmounted, rotated 90° clockwise, and supported while access to the end plate is obtained without removing the cables.

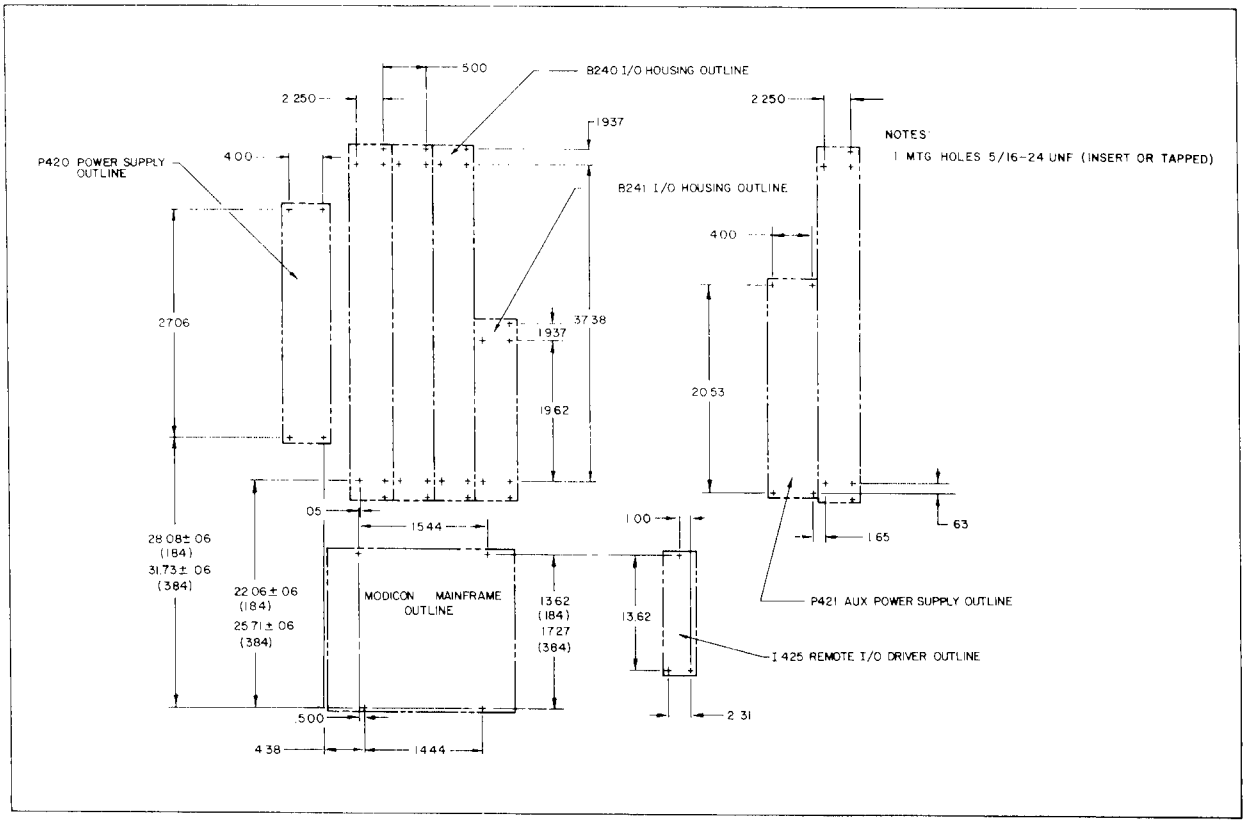

Figure 9. Typical Mounting Plan

The Processor has five indicator lights at the lower left, beneath the interlock knob (see Figure 10a):

RUN
CHANNEL I CHANNEL III
CHANNEL II CHANNEL IV

The Run light indicates power has been applied to the Processor, its logic is being examined, and the I/O is being serviced. The Run light will normally be ON steady.

The Channel lights will be ON when a channel is connected to the Processor and is being serviced by the system. The channel indicators will normally be blinking at a rapid (watchdog timer) rate.

Referring to Figure 10, each Processor is equipped with a male receptacle on top, into which the cable from the main power supply is connected. Also, located on top is a female receptacle to which channel I is connected and a key lock (memory protect) switch which prevents alteration of the user's logic when the switch is placed to the ON position. On the bottom are three female connectors to which channels II-IV (front to rear) are connected. Cables for channels II-IV can be interchanged between themselves; however, they are not interchangeable with channel I cables.

On the left side of the Processor are two connectors to which the auxiliary units are interfaced to the Processor. If not used, these connectors must be covered by the hinged metallic flap provided. A magnetic switch prevents operation of the Processor unless either an interface for an auxiliary unit or the flap is covering the connectors.

A large black knob on the front of the Processor controls the locking of an interface or flap and also turns the Processor ON. The Processor must be turned OFF if an interface is to be removed or inserted.

Internal to each Processor are three large printed-circuit boards, each in its own separate chamber. One controls the processing of data, the second is the core memory, and the third controls I/O processing.

The 184 memory boards are provided with core memory of 1K, 2K, 3K, or 4K (Models 184-1, 184-2, 184-3, or 184-4, respectively). In this core memory is stored a specific MODICON Operating System (MOPS) which allocates the memory into logic lines, storage locations (registers), types of inputs/outputs (i.e., discrete or numerical), and capability (line types). The MOPS installed in memory is as important as hardware selection. For details on MOPS capabilities, see Section III, Basic Principles. Any available MOPS can be installed in a 184 Controller from the Service Center via the Telephone Interface or by the Tape Loader. There are no software costs related to the operation or capabilities of the 184 Controller.

The 384 Controller is provided with a 4K core memory. Into this memory is stored a specific TEF (Three Eighty Four) which performs all the functions discussed above that a MOPS provides for the 184 Controller.

Power Supplies

The main power supply (see Figure 11) provides DC power (±5 Vdc) required for the internal operation of the Processor and one complete channel of I/O modules. The power supply is also provided with a multi-conductor cable required to connect to the Processor. This cable is permanently connected to the power supply and is 20 inches long. Indicator lights are provided to indicate availability of both control and main power as well as output of dc power to the Processor and the I/O channel. AC power per Table 4 must be applied to the main and control terminals, see Figure 12. When power has been properly supplied, the Main and Control indicators of the Power Supply should light.

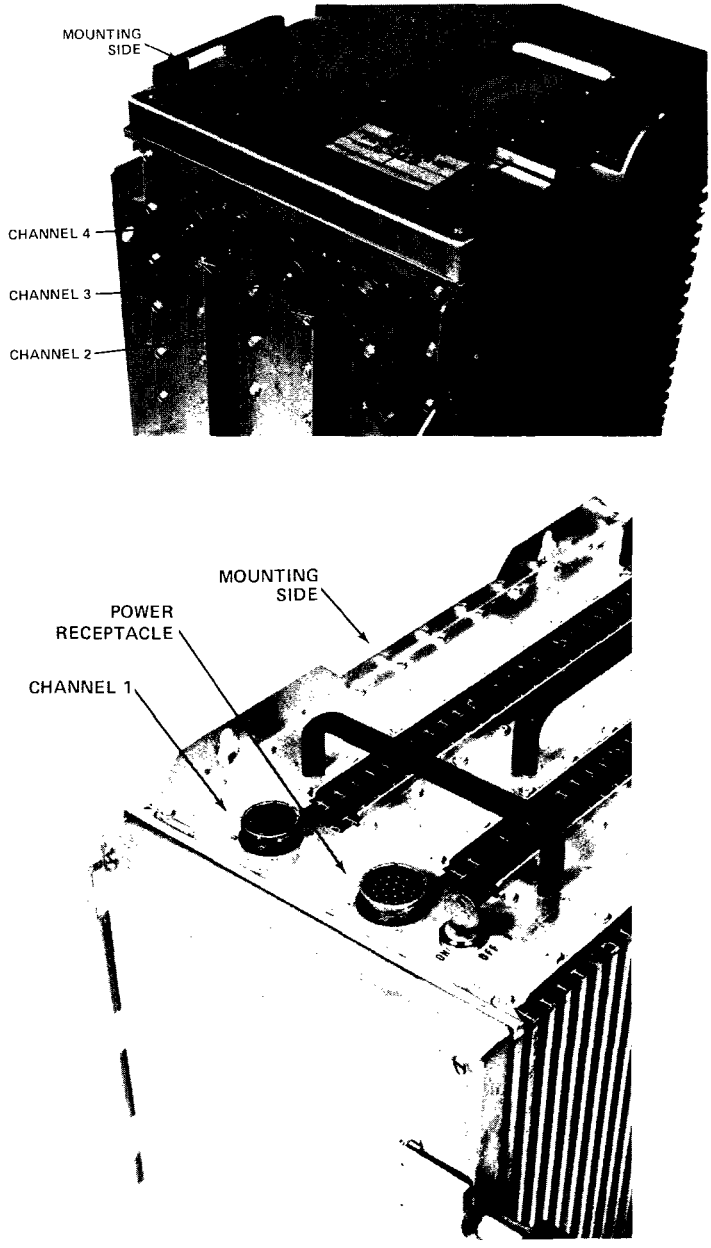

Figure 10. Processor, Showing Cable Connections

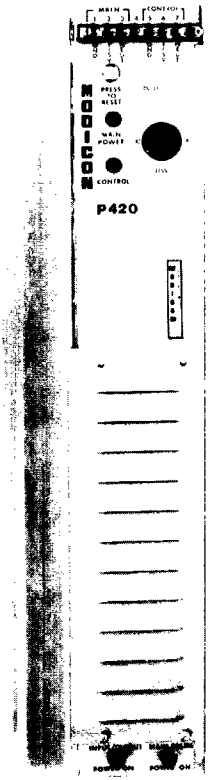

Figure 11. Main Power Supply (Model P420)

NOTE

Verify power connections to main power supply prior to connecting AC power. Proper terminal identifications are provided on each power supply.

The main power activates the Processor electronics; the control power causes the Processor to begin to process data. To ensure maximum reliability when de-energizing the control system, main power should be maintained. A typical system power wiring is illustrated in Figure 13.

Voltage-sensing circuitry is provided in the main power supply to detect out-of-tolerance line voltages and signal the Processor when a power failure has been detected. There is sufficient power stored in the large electrolytic capacitors to ensure uninterrupted operation if the AC power is lost for up to 17 ms; if power is not restored, the Processor ceases operation, forces all outputs to the OFF condition, and turns its run light OFF.

Operation will be automatically restored when AC power (both main and control) is within tolerance as specified in Table 4; there will be a 500 ms delay in restoration of Processor operation after a power failure while the Processor goes through its power-up sequence.

Table 4. Summary of Required AC Power

P420 MAIN POWER SUPPLY

Normal Voltage:	
Standard:	115V RMS ±15% (100-130V RMS)
Optional:	230V RMS ±15% (187-265V RMS)
Transient Voltage (Standard)	
Max. 10 Seconds:	115V RMS ±30% (80-150V RMS)
Max. 17 ms:	115V RMS ±100% (0-200V RMS)
Transient Voltage (Optional)	
Max. 10 seconds:	230V RMS ±30% (160-300V RMS)
Max. 17 ms:	230V RMS ±100% (0-400V RMS)
Line Spikes:	1000V max. (500 μs duration. 0.5% max. duty cycle)
Frequency	
Standard:	60 Hz ±5% (57-63 Hz)
Optional:	50 Hz ±5% (47.5-52.5 Hz)
Normal Load	
*Main:	110 Volt-amps min. 240 Volt-amps max. (7 amp peak ON transient)
Control:	50 Volt-amps (3 amp peak ON transient)
Recommended Transformer Distribution:	1000 Volt-amps (fuse secondary at 7 amps)

P421 AUXILIARY POWER SUPPLY

Normal Voltage	
Standard:	115V RMS ±15% (100-130V RMS)
Optional:	230V RMS ±15% (187-265V RMS)
Transient Voltage (Standard)	
Max. 10 seconds:	115V RMS ±30% (80-150V RMS)
Max. 17 ms:	115V RMS ±100% (0-200V RMS)
Transient Voltage (Optional)	
Max. 10 seconds:	230V RMS ±30% (160-300V RMS)
Max. 17 ms:	230V RMS ±100% (0-400V RMS)
Line Spikes:	1000V max. (500 μs duration, 0.5% max. duty cycle)
Frequency	
Standard:	60 Hz ±5% (57-63 Hz)
Optional:	50 Hz ±5% (47.5-52.5 Hz)
*Normal Load:	10 Volt-amps min. 100 Volt-amps max. (4 amp peak ON Transient)
Recommended Distribution Transformer:	350 Volt-amps (fuse secondary at 3 amps)

*NOTE: P421 and P420 main loads depend on I/O and peripherals connected; minimum and maximum steady state load are as indicated above.

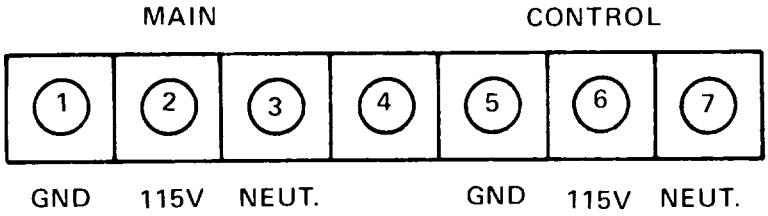

Figure 12. Connections to Main Power Supply

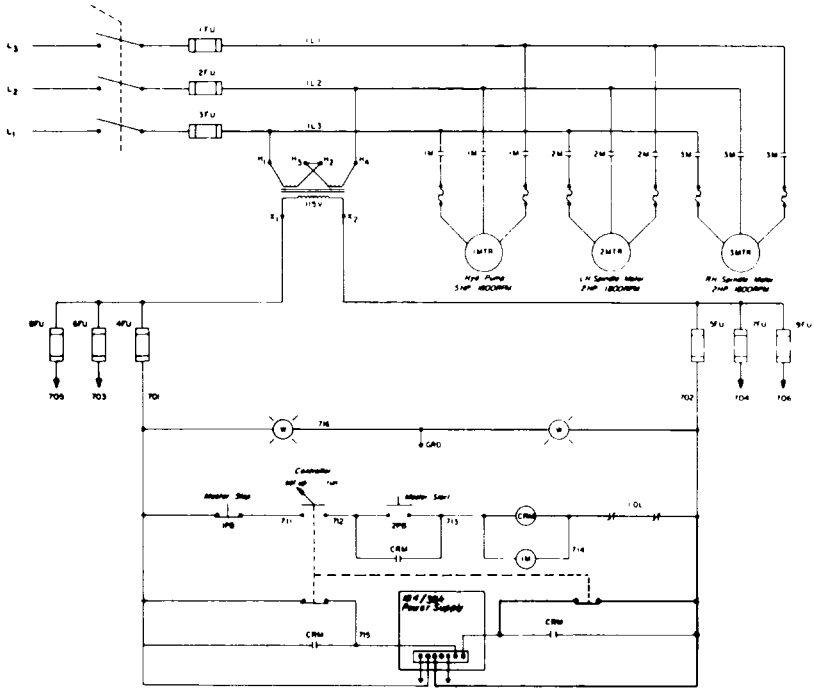

Figure 13. Model 184/384 Controller Typical Power Connections

WARNING

Proper power shutdown and power-up sequences will not be performed if the Processor is disconnected from the main power supply while operating. The cable between the power supply and the Processor should NOT be disconnected while the Processor is running.

A convenience outlet is provided on the main power supply to power auxiliary units used with the Processor.

The 230V 50Hz version has two convenience outlets, one supplying 230Vac and the other 115 Vac.

Auxiliary power supplies (see Figure 14) are required to power the internal operation of the I/O modules if there is insufficient power capacity in the main power supply, or if the I/O modules are located an excessive distance from the Processor. A single AC power source is required per Table 4 to the auxiliary power supply; indicator lights are provided to indicate the availability of the ac power and the outputting of DC voltage. The selection of either standard 115V or optional 230V auxiliary power supply operation

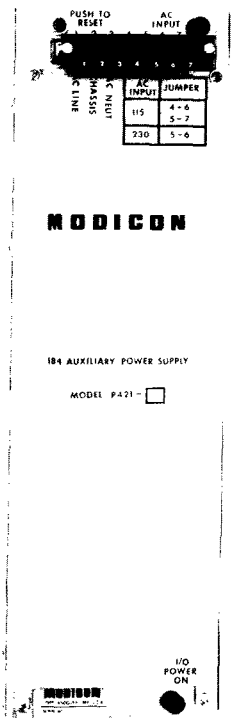

Figure 14. Auxiliary Power Supply (Model P421)

is made by connecting external jumpers as follows:

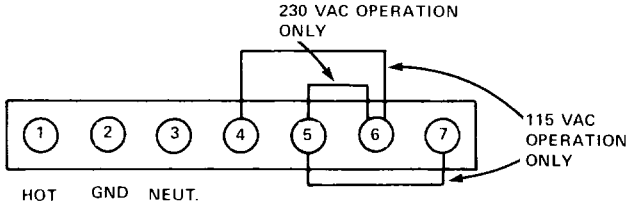

Figure 15. Connections to Auxiliary Power Supply

Each auxiliary supply is capable of providing internal power for one complete channel of I/O modules (maximum 27 units of I/O load). The auxiliary power supply is connected to the Processor via a cable that is permanently connected to the power supply. DC voltages are not transferred via this cable; only input/output status is transferred to the Processor from the I/O modules connected to, and powered by, the auxiliary power supply.

Input/Output

On the backplane of each housing are address index pins, one for each I/O module location. These pins are used to identify which of the eight possible input or output modules is being placed in a particular location. The identification relative to input vs output modules is accomplished automatically by the module. These index pins must be adjusted prior to installing the module. (See Figures 16 and 17.)

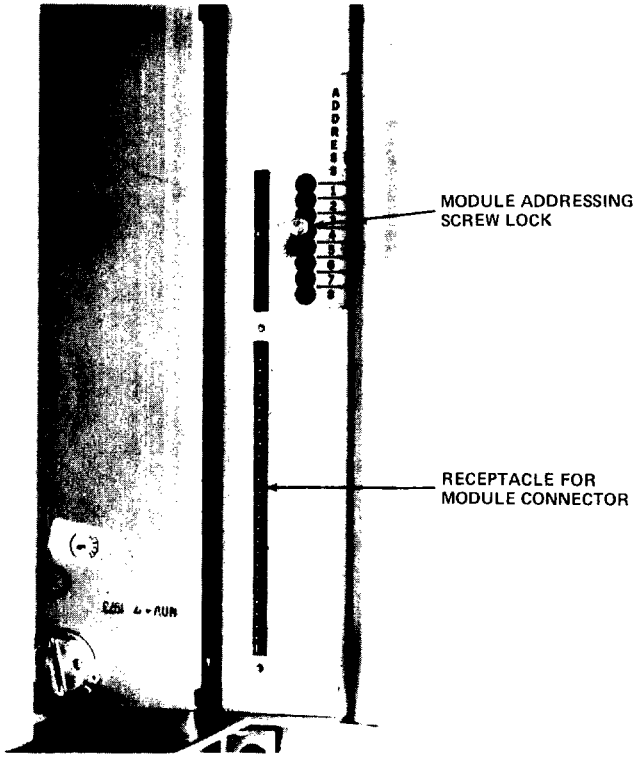

Figure 16. I/O Housing, Showing Module Address Selection

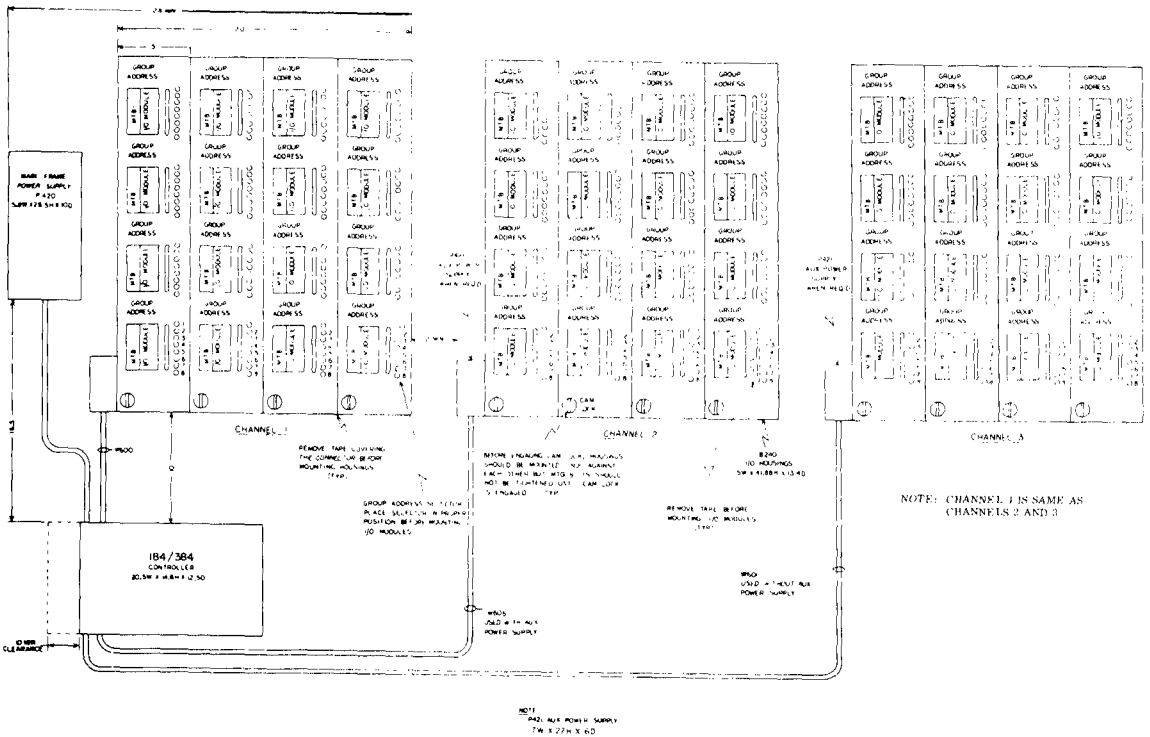

Figure 17. I/O Housing Overview, Showing Module Index Pins

Since the specific input or output identification is not established by the physical placement of the module, but rather by the index pins, any convenient physical arrangement of I/O modules in a channel is possible. All inputs can be placed on the top and all outputs on the bottom, or all inputs on the left and all outputs on the right, or they can be alternated (an input then an output, etc.). The index pin allows the designer complete flexibility to install as many I/O modules as required, in any mix up to the limit of the channel, and in any arrangement that is most appropriate for his application.

Each I/O housing has a male printed-circuit connector on the lower left side and a female receptacle on the lower right side. The male connector is normally retracted within the housing and is extended by rotating a cam, driven by a large screw head on the lower section of the backplane. Rotating this screw head 180° clockwise extends the male connector; rotating it 180° counterclockwise retracts the male connector. This connector is used to connect the housing to either another housing, a cable to the Processor, or an auxiliary power supply. See Section V for additional details on installing I/O housings.

When delivered, each housing has its male and female connectors as well as its module backplane connectors covered by a protective tape. This tape must be removed prior to using the connector. However, if the connector is not to be used (no module inserted or last housing in channel), the tape should be retained to ensure noise shielding and protect against entry of foreign matter.

Field wiring (see Figure 18) can be installed on the I/O housings either before or after the I/O modules are installed. However, the address index pin must be positioned prior to installation of the I/O module. It is recommended that both the field wiring and the index pin be installed prior to installing the I/O modules. Color-coded adhesive strips (Figure 19) are available to identify the 21 field-wiring terminals opposite each I/O module, terminal 1 (top) to 21 (bottom). These strips are color-coded to match the color of the module to be installed; this aids in preventing a module being installed in a location not properly wired for that module type. These strips are available for each I/O module type and are installed by the user in accordance with his particular input/output configuration. The color codes are given in Table 5. Also provided with each I/O module is a white plastic plate so that the user can add his own unique identification for each I/O circuit. This plate is reversible; both sides can be engraved.

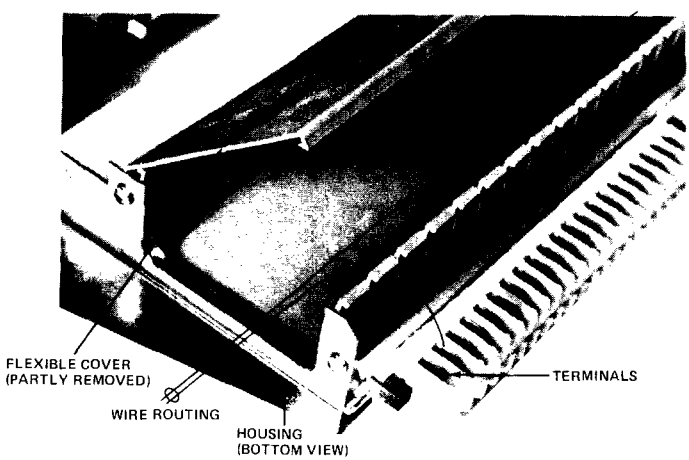

Figure 18. I/O Housing, Showing Conduit and Terminals for Wiring

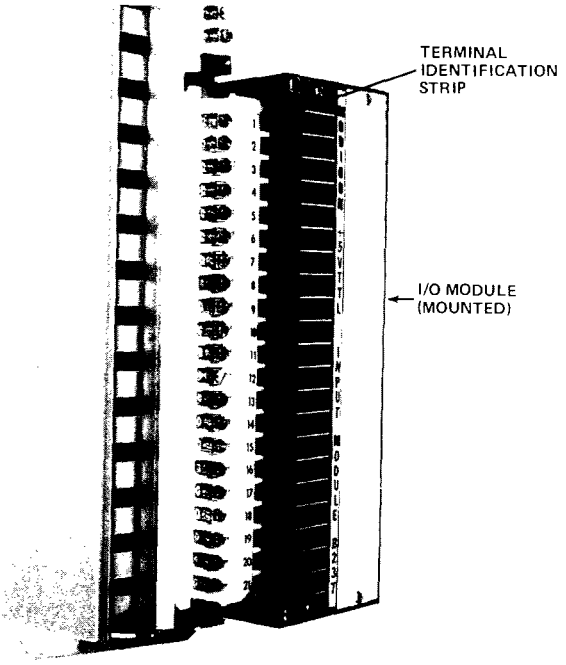

Figure 19. I/O Housing, Showing Relationship Between Terminals and I/O Module Terminal Identification Strip

Table 5. Input/Output Module Color Codes

Module	Type	PMS* Code	Color
B230	115 Vac Output	199	Red
B231	115 Vac Input	197	Pink
B232	24 Vdc Output	286	Dark Blue
B233	24 Vdc Input	284	Light Blue
B234	220 Vac Output	151	Orange
B235	220 Vac Input	149	Melon
B236	5V TTL Output	259	Violet
B237	5V TTL Input	264	Light Purple
B238	24 Vdc Output, 2.5A	354	Green
B239	Dual Hi-Speed Counter	515	Blue
B243	Analog Input	109	Yellow
B244	220 Vac Output, Isolated	463	Brown
B245	220 Vac Input, Isolated	465	Light Brown
B246	115 Vac Output, Isolated	233	Rhodamine Red
B247	115 Vac Input, Isolated	231	Dark Pink
B248	10-60 Vdc Output	347	Green
B256	Analog MUX (Dry)	102	Yellow
B258	Analog MUX (Mercury)	101	Yellow
B260	Analog Output (Voltage)	380	Light Green
B262	Analog Output (4-20 ma)	382	Green
B266	Reed Relay Output	298	Silver Blue
B270	48 Vac Outputs	207	Dark Red
B271	48 Vac Inputs	204	Dark Rubine Red
B275	10-60 Vdc Input	314	Blue

* Pantone Matching System.

Maintenance Aids

Indicator lamps are provided to indicate proper operation of each major function of the Controller (see Figure 20). On the power supplies, indicators show when AC power is available and when DC power is being produced. On the Processor, lamps indicate when data is being processed (RUN lamp) and when communications are being maintained with each I/ O channel. Remote drivers have one indicator (Data Out) that indicates when data is available to all subchannels and separate indicators (Data In) on each subchannel indicating when data is being received from that subchannel. The remote interface has three indicators: one indicating data being sent to the driver, a second for data received from the driver, and the third if it is in the test mode.

Each I/O module has an indicator (active light) which is ON when the module is properly communicating with the Processor, and each individual input circuit has an indicator which will be ON if the external terminal receives an ON signal. Each individual AC output circuit has two indicators; one indicating the output is ON (output in ON condition) and the other indicating if an output fuse has blown. Each individual DC output circuit has an indicator which will be ON if the output is ON. Input and output wiring can be verified by using the "disable" capability of the Programming Panel as discussed in Section III, Basic Principles.

NOTE

With AC output modules (except B230-1, B234-1, B244-1, and B246-1), an unloaded AC output will have its indicator ON regardless of output status. If an output indicator is always energized, the field wiring should be examined to verify there is continuity to the load device.

Fuses used on modules where field replacement is possible are listed in Table 6. To replace a fuse, remove the module from its housing. There is an opening (approximately 1 in. x 8 in.) on the terminal side of the module through which access to the fuses can be obtained (see Figure 6). All fuses are oriented in accordance with the output terminals such that the top fuse is for the No. 1 output on the module and the bottom fuse is for the No. 16 output; except for the B238, whose top fuse is for the common indicator supply, and the B244 and B246, whose orientation is per Figure 21.

Table 6. Fuse Requirements

Module	Standard Size Pico Fuse	Littlefuse Part No. or Equivalent	Quantity per Module
B230	5 amps	275-005	16
B232	7 amps	275-007	1
B234	5 amps	275-005	16
B236	2 amps	275-002	1
B238*	3 amps	275-003	17
B243	1/4 amp	275-250	8
B244*	7 amps	275-007	8
	1/4 amp	275-250	1
B246*	7 amps	275-007	8
	1/4 amp	275-250	1
B248	3 amps	275-003	16
B256/B258	1/2 amp	276-500	1
B266	3 amps	212-003	8
B270	5 amps	275-005	16
B680	1/4 amp	313-015	1

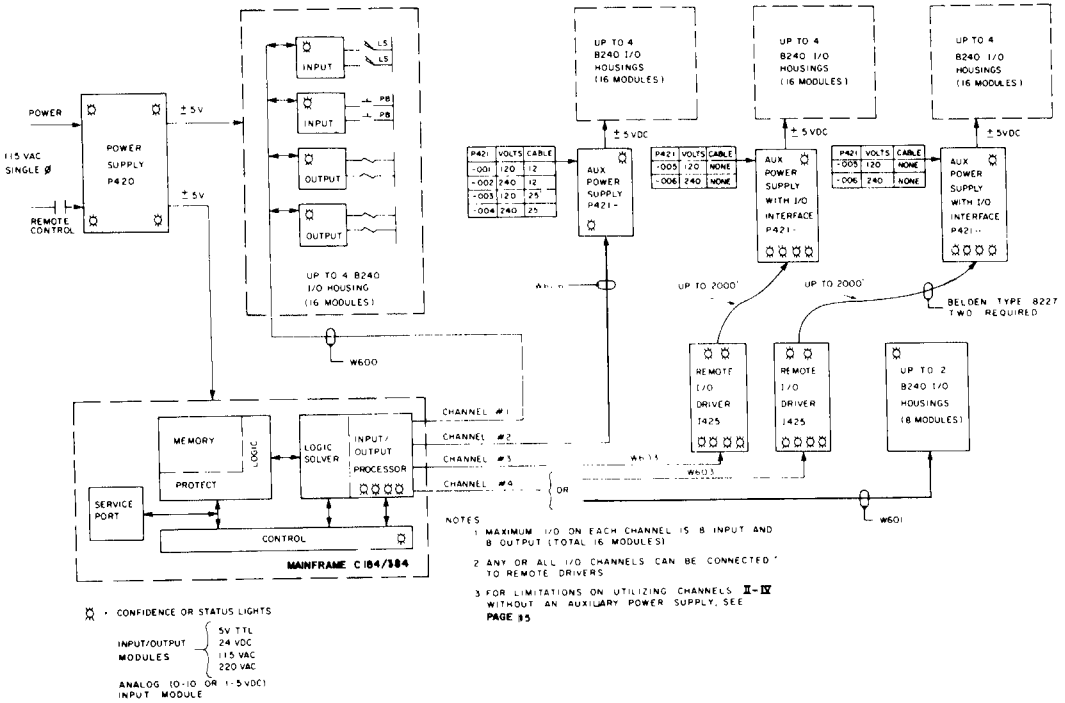

Figure 20. MODICON 184/384 System Block Diagram

NOTE

Those modules indicated by an asterisk (*) are provided with one fuse for each output circuit plus one fuse for separate indicator lamp supply.

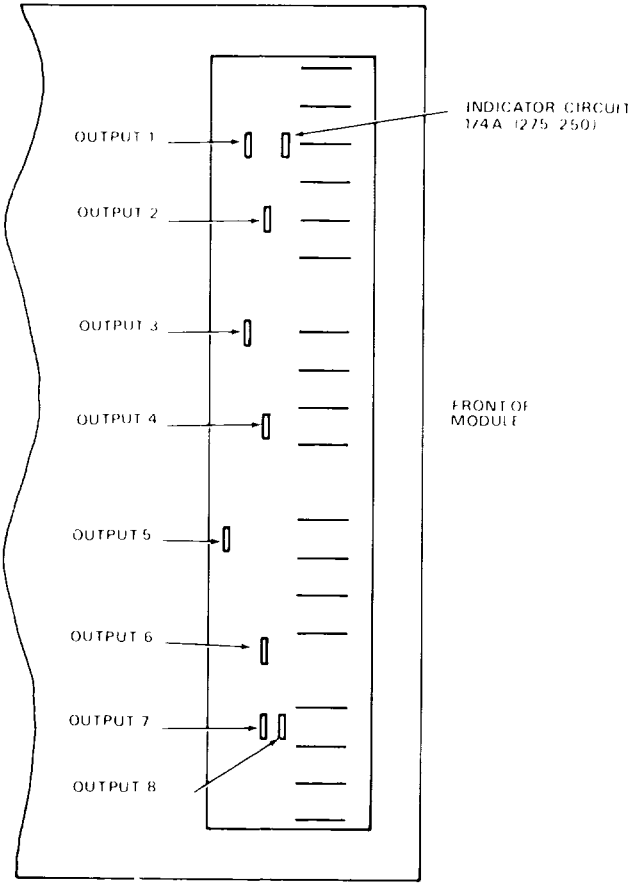

Figure 21. Location of Fuses on B244 and B246 Isolated Output Modules