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1.0 Introduction

The PC4020 is a highly flexible and versatile control which will enable the installer to meet the most demanding security requirements. The heart of the system is the main control panel, designated the PC4020, which is connected to other system elements using common 4 conductor unshielded station wire. A few of the features available are:

- up to 128 zones (with the addition of zone expansion modules)
- 128 - 4 digit or 6 digit user codes with individually programmable system access
- 8 individual, fully programmable partitions
- 3 keypad Panic zones on each keypad
- 3 programmable voltage outputs on the main board (PGM, SW AUX and Main Bell Output)
- expandable up to 64 fully programmable relay outputs
- expandable up to 144 fully programmable low current outputs
- full upload/download control using an IBM PC and Hayes (TM) or Practical Peripheral 1200 baud modem
- 512 event buffer, time and date stamped which can be printed on premises or retrieved with the DLS software

1.1 Terminology

1.1.1 Modules

Every keypad, zone expander, power supply/relay board, low voltage output board or printer output board is a module. Before any module will operate properly it must be enrolled to the system. Once a module is enrolled the panel will communicate with it via the COMBUS and the module will function properly.

1.1.2 Enrolling

Enrolling is the term used for adding a module to the system. When the PC4020 is first powered up it is not aware of any module connected. The first keypad you press a key on will automatically be enrolled to the system as keypad 1 assigned to Partition 1. Once the first keypad is enrolled you can enter Installer's Programming and enroll any additional modules that are to be connected to the system.

1.1.3 COMBUS

The COMBUS (Communications Bus) is the 4-wire cable to which all the modules are connected in parallel. The main panel uses the COMBUS to communicate with all modules on the system. To allow the panel to distinguish between the various modules each has a unique 16 bit address programmed at the factory eliminating the need for setting DIP switches.

1.1.4 Partitions

A partition is a defined areas which will operate independently from other areas of the system. Up to 8 partitions can be defined each with a variable number of zones and user codes assigned to it. In addition, features may be enabled or disabled for each partition individually.

For example: Partition 1 of a system could have 20 user codes, have zones 5, 6 and 12 assigned to it and be programmed to auto arm at 6:00 pm.

Partition 2 of the same system could have 5 user codes, zones 7 through 16 and be programmed to auto arm at 7:30 pm.

Partition 3 of the same system could have 1 user code, zones 1 through 4 and not be programmed for auto arm.

It is important to remember when programming that if the system does not require multiple partitions the system will be considered partition 1.

1.1.5 Common Zones

Common zones are those zones that are assigned to two or more partitions. In the above example zone 12 is common as it is assigned to both Partition 1 and Partition 2. Common zones are only armed when all partitions they are assigned to are armed. If a common zone is violated when it is armed, disarming any partition the zone is assigned to will disarm the zone. This can be useful when there is a common entry point to two or more partitions.

For example, an office building with 4 doctor offices may have a common reception area. The zones in the reception area would be common to the 4 office partitions.

1.1.6 Downloading

The PC4020 is fully upload/downloadable with the use of an IBM PC (or compatible) and a Hayes 1200 baud modem. The DLS download software can be used to program all installer's areas, user codes, retrieve the 512 event buffer and perform system diagnostics.

1.1.7 512 Event History Buffer

The PC4020 control has a built in 24 hour clock and calendar which allows the system to time and date stamp all events that occur on the system. These events are stored first in, first out to a 512 event buffer. The event buffer may be retrieved using the DLS download software or may be printed on site with the addition of the PC4400 RS232 module. If printed on site the panel will use the zone labels, user code labels and partition labels that you have programmed.

1.1.8 Programming

The PC4020 uses a new menu driven program method that makes programming the system simple. All programming is easily done via the keypad, no programmers or special hardware are required. Menu flow charts are provided with the installation manuals so that you may quickly move through the different program areas.

1.2 Parts List

You should find the following equipment included in your system. Verify you have all the various components:

- one PC4020 large control cabinet (PC4001C)
- one PC4020 main board
- one LCD4500 liquid crystal display keypad
- one hardware package

- 32 5.6K EOL resistors
- 1 black cabinet plug
- 1 green ground strap
- 1 Toroid

- one set of four PC4020 installation books and two end user instruction manuals.

1.3 Additional Accessories

Additional keypads and other modules can be added to the PC4020 to provide additional zones, additional outputs and additional power. The following is a brief description of the modules that can be connected to the PC4020.

1.3.1 LCD4500 Module - LCD Keypad

Programming and system operation is carried out using the LCD4500 liquid crystal display keypad. A maximum of 16 keypads can be connected to any PC4020 control panel.

1.3.2 PC4108 and PC4116 Modules - Zone Expanders

The basic 16 zone capability of the PC4020 can be expanded using either PC4108 or PC4116 modules which provide 8 or 16 additional zone inputs respectively up to a system maximum of 128.

1.3.3 PC4204 Module - Power Supply/Relay Outputs

The PC4204 relay output module is available for installations requiring additional power beyond the 500 mA provided by the PC4020 main board. Each module provides a powerful 1.5 Amp, 12 volt DC power supply and requires a separate transformer, 16-18 volt, 40 VA and a 12 volt battery. A maximum of 16 PC4204 modules can be connected to any PC4020 control panel to provide additional power for modules, devices or siren outputs.

1.3.4 PC4216 Module - Low Current Output Module

The PC4216 low current output module provides 16 voltage outputs, maximum 50 mA current draw. Each output can be programmed to activate for any of the 28 programmable output options noted in the Programming Manual. In addition any module can instead be programmed to follow the alarm or zone status of any group of 16 zones. A maximum of nine PC4216 modules can be connected to any PC4020 control panel.

1.3.5 PC4400 Module - Printer Output

The PC4400 modules provides the capability of driving a serial printer on site. Only one of these modules may be connected. The serial printer can be located a maximum of 200 feet from the PC4400 module.

1.3.6 PC4600 and PC4650 - Graphic Annunciator Kits

Two graphic annunciator kits are available for the PC4020, PC4600 and PC4650. The PC4600 can be used to display up to 32 zones, the PC4650 up to 64. The outputs to drive the LED's are obtained through the use of PC4216 modules, each of which can drive up to 16 LED's. The LED's can be programmed to light when a zone is violated, latch in a zone in alarm or a combination of both.

Note

2.0 Suggested Installation Procedure

The first step in designing a PC4020 installation is developing a System Layout on paper. Doing this will allow you to work from a plan and help avoid making mistakes and make programming easier.

2.1 Step 1 - System Layout

[1] Layout

Draw a rough sketch of the building(s) in the installation including inside walls if necessary. This will be the base from which to work. Indicate on the diagram the location of the PC4020 main panel.

[2] Zones and Expansion Modules

Mark all zones that will be required including all doors, PIRs, smoke detectors and glassbreak detectors etc.

Locate any zone expansion modules (PC4108 and PC4116), if required, close to groups of zones to provide easier wiring of the devices.

[3] Zone Assignment

Decide on the order to enroll the expansion module(s) so that each zone can be given a zone number. The first 16 zones on the system are on the main panel. As each expansion module is enrolled it will be assigned in sequence the next group of available zones. If an 8 zone expansion module was enrolled first, it would be assigned zones 17-24. If then a 16 zone expansion module was enrolled it would be assigned zones 25-40.

[4] Partitions

Indicate each partition by boxing the area of the partition on the diagram. This will allow you to quickly determine which zones will have to be assigned to each partition.

[5] Keypads

Each keypad on the system must be assigned either as a Partition or a Global keypad. A keypad assigned to a partition will only allow full operation of the partition. A Global keypad will allow full operation of any partition on the system. Indicate on the diagram the location of all keypads required. Also indicate if the keypad will be assigned to a partition or if it will be a Global keypad.

[6] Sirens

Siren outputs can be programmed to activate if one or more partitions go into alarm. The main panel provides one output (the Main Bell Output) for this purpose. Additional siren outputs can be obtained from PC4204 power supply/relay output module(s). Each PC4204 module has 4 Form 'C' relays, 3 of which can be used as siren outputs.

The PC4204 module can supply up to 1.5 amps of current. If any PC4204 module is being used to power siren outputs the total current draw when all outputs are active cannot exceed 1.5 amps. Note: If the hardware revision of the PC4204 circuit board is Rev 08, additional current (up to 5 Amps total) can be temporarily drawn. This additional current is supplied by the battery and should not be drawn for an extended period of time.

Indicate on the diagram the location of all sirens and which partition(s) will activate them. If more than one siren output is required also locate PC4204 module(s) where needed.

[7] COMBUS

The COMBUS is the four conductor cable which can be standard station wire (four 22 AWG wires colour coded red, black, yellow and green) to which all system modules are connected in parallel. The modules do not have to be home run to the control panel.

Draw the COMBUS on the diagram. Keep in mind the maximum distance in wire a module can be from the main control is 1000 feet (305 m).

2.2 Step 2 - Calculate Product Required - Current Required

From the system layout just completed indicate the number of each module and detectors required for the installation. Also indicate the total current required for the number of devices connected .

Quantity Required		Current Draw
_____	LCD 4500 Keypads @ 50 mA each	_____
_____	PC4108 Modules @ 30 mA each	_____
_____	PC4116 Modules @ 40 mA each	_____
_____	PC4204 Modules @ 30 mA each	_____
_____	PC4216 Modules @ 30 mA each	_____
_____	PC4400 Modules @ 30 mA	_____
_____	Motion Detectors @ 20 mA each	_____
_____	Glassbreak Detectors@ 20 mA each	_____
	Others	_____
	Others	_____
	Total Current Draw	_____

2.3 Step 3 - Calculate Power Requirements

2.3.1 Calculate Current Required

The main panel can provide up to 500 mA of current. Each PC4204 connected to the system can provide up to 1.5 Amps. If the total current required by the system (See - CALCULATE PRODUCT REQUIRED - CURRENT REQUIREMENTS - Section 2.2) exceeds 500 mA you will require at least one PC4204 module for additional current. If the current required exceeds 2 Amps you will need at least 2 PC4204 modules.

The Main Panel can provide 500 mA of current for modules and devices. If the system requires more than 500 mA at least one PC4204 module will be required.

2.3.2 Advantages in Determining Line Loss

By determining if line loss is a problem with your design BEFORE you install the job you will be better able to correct the problem in advance. It may be found that running the COMBUS in a different manner or using a thicker gauge wire could correct the problem without the addition of a PC4204 module.

If line loss is determined to be the problem with a job AFTER it is installed you will normally be left with one option, the addition of a PC4204 power supply module. The additional cost of the module and the time required to troubleshoot the system can be avoided by doing the calculations ahead of time.

2.3.3 How to Determine Line Loss

You may find that the system does not require a PC4204 module for additional current if your system is not too large. However your system may still require a PC4204 power supply module if the line loss on the COMBUS is excessive.

Line loss is one of the most common cause of problems we have found. The following is a simple and quick method for determining if the line loss on the COMBUS will require the additional of one or more PC4204 modules.

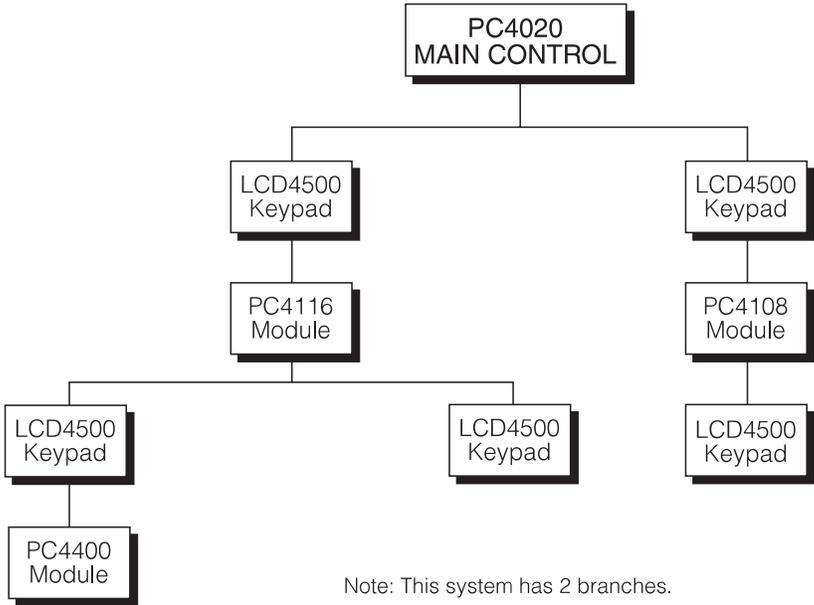
2.3.4 Step by Step Procedure for Calculating Line Loss

- Step 1 - Draw a block diagram of the system including all modules and the COMBUS wire runs to these modules.
- Step 2 - Find out how many Power Units are available for the gauge of wire used (See - POWER UNITS CHART- Section 2.3.8). If different gauge wires are used throughout the system these calculations will not work. If this is the case use the second method. (See -LINE LOSS CALCULATION - SECOND METHOD - Section 2.3.10.)
- Step 3 - Find out the distance of wire of each run of the COMBUS. Round up to the nearest 50'. THIS IS THE MOST IMPORTANT STEP! IF THE DISTANCES ARE INCORRECT THE CALCULATIONS WILL BE WRONG!
- Step 4 - Indicate if any devices that require power (PIR, glassbreak, LED's, relays etc...) other than those connected to the AUX of a PC4204, the module they will be drawing power from and the current required for these devices.
- Step 5 - Write down for each module the base number indicated (See - BASE NUMBER CHART - Section 2.3.7). Don't forget to add to the Base number if additional devices requiring power are connected.
- Step 6 - Calculate how many Power Units will be required for each module of each branch of the COMBUS. (See - POWER UNIT CALCULATION CHART - Section 2.3.9.)
- Step 7 - Starting with the Power Units number determined in Step 2 for each branch, subtract the Power Units required by each module.
- Step 8 - If any branch of the system falls below 0 Power Units a PC4204 module will be required.

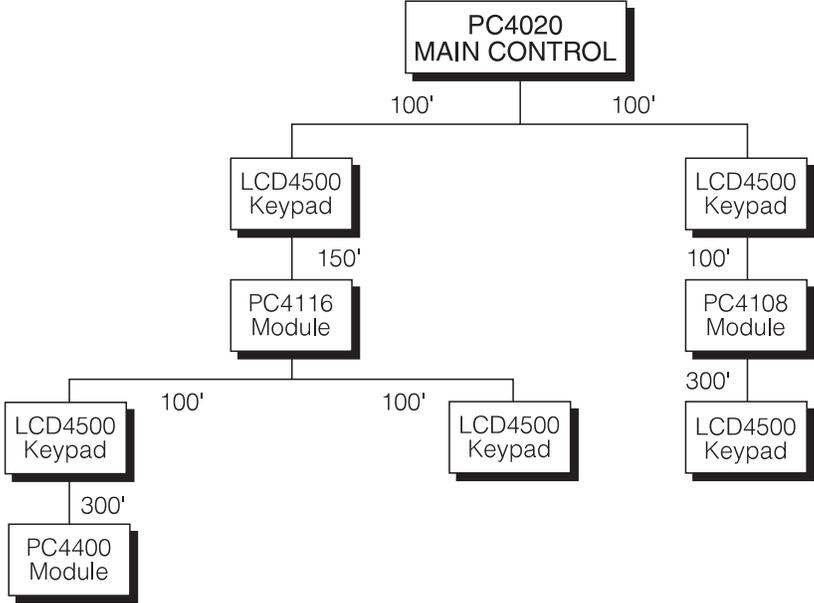
Depending on the size of the system, it shouldn't take too long to calculate if line loss is excessive on the system and could help save hours of troubleshooting time.

2.3.5 Step by Step Example of Calculating Line Loss

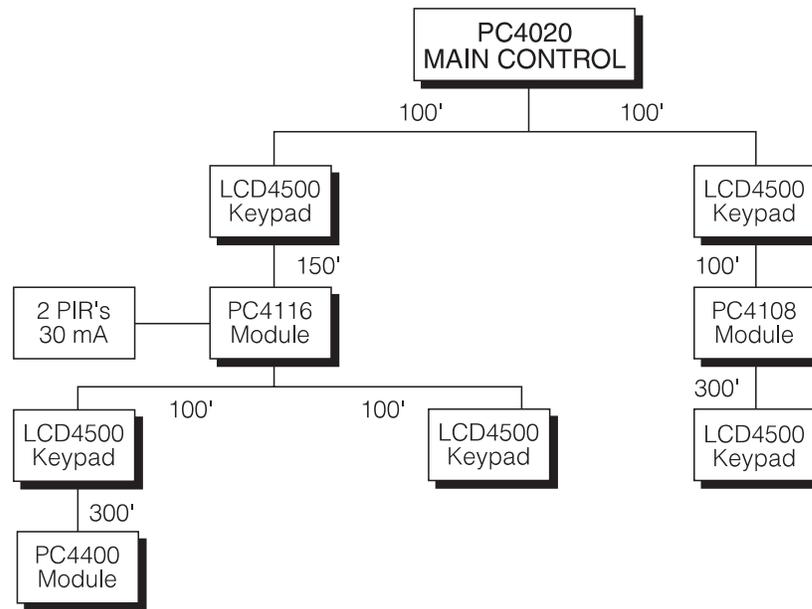
The following is a step-by-step example of calculating line loss on a system.
Step 1 - Draw a block diagram and the COMBUS.



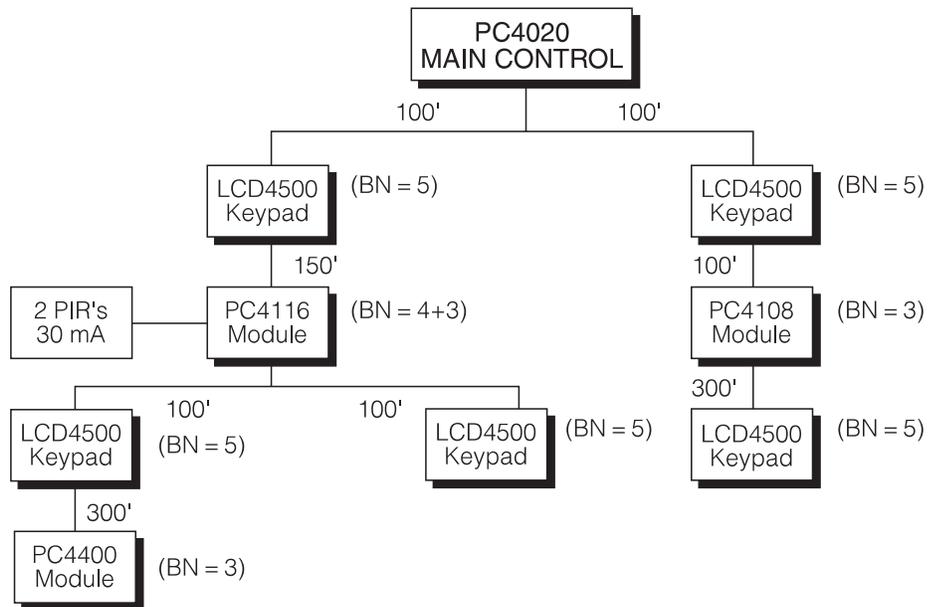
- Step 2 - Find out the gauge of wire. This example has 22 gauge wire and therefore 80 Power Units.
- Step 3 - Indicate the distance of each COMBUS wire (in feet). Make sure you round up to the nearest 50' increment.



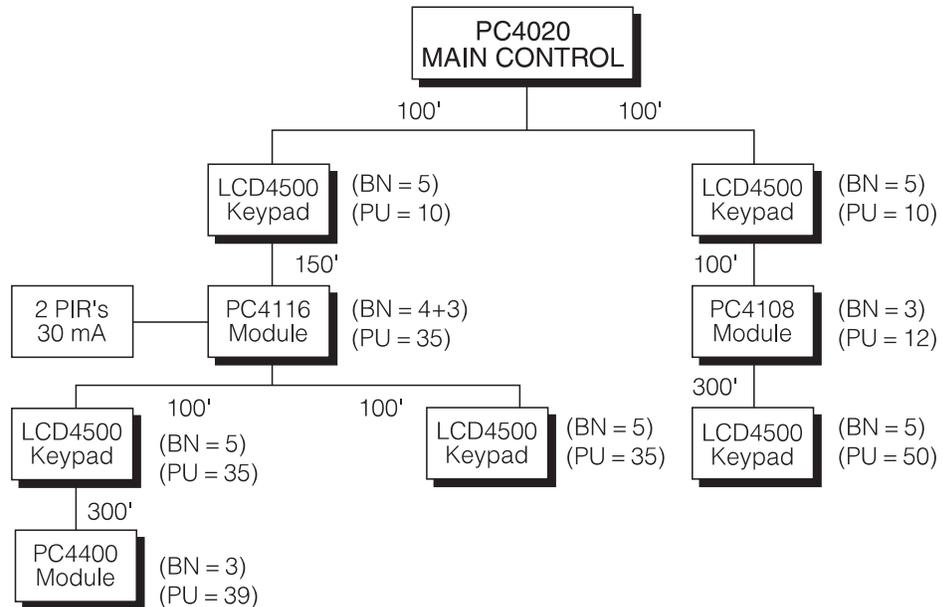
Step 4 - Indicate any other devices that require power if the devices draw power from any module other than the AUX of a PC4204 module.



Step 5 - Write down the Base number for each module. Remember to add to the Base number if devices requiring power are connected to the module.



Step 6 - Write down how many Power Units each module will require.



Step 7 - Subtract the Power Units required for each module on each branch from the total Power Units available.

BRANCH #1

80 Power Units - 10 for the LCD4500 = 70 Power Units left

70 Power Units - 35 for the PC4116 = 35 Power Units left

Now something interesting happens. After the PC4116 the COMBUS branches again. The total Power Units available for each of the sub-branches would be equal to the Power Units remaining at that point (in this example 35).

SUB-BRANCH #A

35 Power Units - 35 for the LCD4500 = 0 Power Units left

0 Power Units - 39 for the PC4400 = -39 Power Units left

Sub-Branch #A will not work as it does not have enough power units!

SUB-BRANCH #B

35 Power Units - 35 for the LCD4500 = 0 Power Units left

Sub-Branch #B will work as the power units did not go negative!

BRANCH #2

80 Power Units - 10 for the LCD4500 = 70 Power Units left

70 Power Units - 12 for the PC4108 = 58 Power Units left

58 Power Units - 50 for the LCD4500 = 8 Power Units left

Branch #2 will work as the power units did not go negative!

Step 8 - Locate any PC4204 modules to correct any line loss problems.

In the above example one of the branches has excessive line loss and will require the addition of a PC4204 module to correct the problem.

2.3.6 Locating PC4204 Modules/Correcting Line Loss Problems

There are three different ways in which line loss problems may be rectified.

Regardless of the method you choose to correct the line loss problem it is absolutely necessary to maintain a positive number of Power Units on each branch of the system.

1. Wire the system differently. Since line loss depends on distance, the COMBUS may be run in a different manner to decrease the distance modules are from their power source.
2. Use a thicker gauge wire. By increasing the gauge of wire you will have more Power Units available for each branch of the COMBUS and may correct the problem.
3. Connect a PC4204 module to power modules with negative power units. It is difficult to make rules to govern where the PC4204 should be connected but keep in mind the following guidelines. Regardless of where you decide to put the PC4204 module the system should be recalculated to verify the problem has been corrected.
 - No module will operate properly if there are less Power Units available than the module requires.
 - If a module has a questionable number of Power Units remaining (any number less than 10) it would be a good idea to try and locate the PC4204 module so that it could also power these modules.
 - The calculations are only as accurate as the data gathered. If the distances are wrong or devices requiring power are not included a problem may still exist.

As stated before, correcting line loss problems now, before wiring the job, will allow you to best determine how to correct the problem. All three options will be available to you and the most cost-effective method can be used. If the job is already wired the addition of PC4204 modules will be, most often, your only option.

2.3.7 Base Number Chart

The BASE number for each module is as follows:

PC4108 - 3*

PC4116 - 4*

PC4204 - 0 or (3) - special (See below)

PC4216 - 3*

PC4400 - 3

LCD4500 - 5

The Base Numbers for the modules with the "*" symbol may be increased as devices requiring power may be connected to these.

For each 10 mA of additional current required by a module for additional devices increase the Base Number by 1.

The PC4204 module is special. If used to repower the COMBUS it will restore the Power Units to its original value but is considered to have a Base Number of 0 (it requires no Power Units to operate).

A PC4204 module wired for COMBUS Repower will restore the Power Units to the original value. For example, if 22 gauge wire is used, the Power Units will be restored to 80 at the point on the COMBUS where the PC4204 is connected.

If the PC4204 is not being used for COMBUS repower but instead for the relay outputs, it must be factored into line loss calculations and has a Base Number of 3.

2.3.8 Power Units Chart

- 24 Gauge Wire - 50 Power Units
- 22 Gauge Wire - 80 Power Units
- 18 Gauge Wire - 200 Power Units
- 16 Gauge Wire - 320 Power Units

2.3.9 Power Unit Calculation Chart - Distance vs Base Number

The distance is the distance the module is from its power source, either the panel or a PC4204 module somewhere along the COMBUS. That is why a PC4204 module corrects the problem. Firstly it restores the Power Unit number back to the original number but also, modules powered from a PC4204 will require less Power Units to operate as the distance to the PC4204 will be less than the distance to the main control.

Distance	Base Number + Number for Additional Devices															
	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
50'	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
100'	6	8	10	12	14	16	18	20	22	24	26	28	30	32		
150'	9	12	15	18	21	24	27	30	33	36	39	42	45	48		
200'	12	16	20	24	28	32	36	40	44	48	52	56	60	64		
250'	15	20	25	30	35	40	45	50	55	60	65	70	75	80		
300'	18	24	30	36	42	48	54	60	66	72	78	84	90	96		
350'	21	28	35	42	49	56	63	70	77	84	91	98	105	112		
400'	24	32	40	48	56	64	72	80	88	96	104	112	120	128		
450'	27	36	45	54	63	72	81	90	99	108	117	126	135	144		
500'	30	40	50	60	70	80	90	100	110	120	130	140	150	160		
550'	33	44	55	66	77	88	99	110	121	132	143	154	165	176		
600'	36	48	60	72	84	96	108	120	132	144	156	168	180	192		
650'	39	52	65	78	91	104	117	130	143	156	169	182	195	208		
700'	42	56	70	84	98	112	126	140	154	168	182	196	210	224		
750'	45	60	75	90	105	120	135	150	165	180	195	210	225	240		
800'	48	64	80	96	112	128	144	160	176	192	208	224	240	256		
850'	51	68	85	102	119	136	153	170	187	204	220	238	255	272		
900'	54	72	90	108	126	144	162	180	198	216	234	252	270	288		
950'	57	76	95	114	133	152	171	190	209	228	247	266	285	304		
1000'	60	80	100	120	140	160	180	200	220	240	260	280	300	320		

2.3.10 Line Loss Calculations - Second Method

If you are unsure of the wiring of the system, the distances of the COMBUS wire runs or where devices are getting power from it will not be possible to do the line loss calculations. If this is the case, after all the wiring is completed, measure the voltage across the Red and Black of the COMBUS at EACH module.

If the voltage measured at a module is less than 12.5 V_{DC} there is too much line loss to guarantee the operation of the module if an extended loss of AC power was to occur. A PC4204 module should be used to power the module to prevent operation failure in the event of an extended AC power loss.

If the voltage applied to the module is less than 11.5 V_{DC} it is quite likely the module will indicate a 'Low Power' trouble until the problem is resolved. In addition, even a short loss of AC could result in module failure.

If the voltage applied to the module is less than 10.5 V_{DC} the module will most likely cause the system to do several 'Power Up Warm's', cause 'COMBUS Trouble' conditions or could cause the module to 'runaway' communicate, preventing other modules from communicating properly on the COMBUS.

2.3.11 Final Line Loss Test

There is one final test which can be performed which will guarantee your calculations are correct and that excessive line loss is not a factor in your installation.

The following is a step-by-step procedure to check this:

1. Connect the system and wait 24 hours for all batteries on the main panel and any PC4204 modules to fully charge.
2. Disconnect the AC power from the main panel and all PC4204 modules.
3. Wait 10 minutes.
4. Go into 'Diagnostics'. If no module shows a 'Low Power' trouble condition you can eliminate line loss or insufficient power as a potential problem.

2.3.12 When to Perform Line Loss Calculations

Line loss calculations should be performed (either calculated or manually tested) whenever the following occurs:

- before wiring the job - hours of troubleshooting and testing can be saved by identifying and correcting line loss problems in the design stage
- if any module indicates a 'Low Power' or 'Mod Comm Fault' trouble
- if the system performs several 'Power Up Warm's'

2.4 COMBUS Power

The PC4000 main board can provide up to 500 mA to power modules and devices connected to the system. A PC4204 module is required when additional current is needed for powering modules, devices or siren outputs.

The PC4204 module requires a transformer (16-18 volt, 40 VA) and a battery and will provide up to 1.5 Amps of additional current at 12 V_{DC}. Four relays on the module provide Form C switched outputs with contact ratings of 10 Amps @ 120 V_{DC} for any of the programmable output options. In addition, the PC4204 monitors the AC power input, low battery condition and the AUX voltage output and can report any or all of these trouble conditions in the event of a failure.

A PC4204 MODULE MUST BE USED TO POWER ADDITIONAL MODULES ON THE SYSTEM AND MUST BE WIRED IN ACCORDANCE WITH THE INSTRUCTIONS SUPPLIED WITH THE UNIT.

When a PC4204 is required because of excessive line loss due to long wire runs it is suggested the module be located as close as possible to the device(s) requiring power. This will help reduce the total wire length and decrease the voltage lost due to line loss.

No other power supply other than a PC4204 module may be used for the following reason: The main panel supervises the modules on the system. If communications is lost with a module, within a maximum of 10 seconds the system will power down the COMBUS for 5 seconds in an attempt to reset the module. Five seconds later when power is applied the panel will again attempt to communicate with the module. If the panel is still unsuccessful communicating with the module it will display and report a COMBUS communication fault. In most instances the module will be reset and will operate normally.

When the panel performs this power reset, Relay #1 of all PC4204 modules connected will open, disconnecting power to all modules connected.

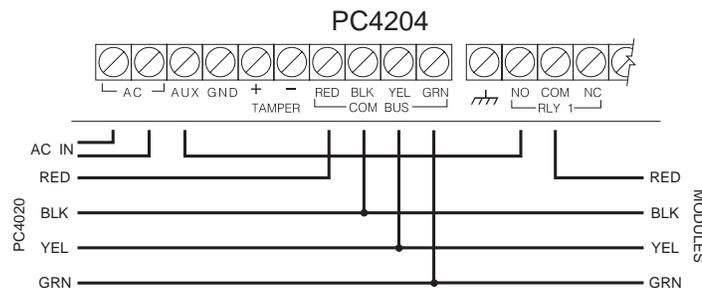
IF A POWER SUPPLY OTHER THAN A PC4204 MODULE IS USED THE MODULE WILL NOT POWER DOWN, WILL NOT RESET AND WILL STAY OFF LINE REQUIRING THE ATTENTION OF SERVICE PERSONNEL.

Relay #1 of any PC4204 module connected to the system CANNOT be used for any other purpose other than COMBUS RESET as it will activate every time the main panel resets the COMBUS.

2.4.1 How to Wire a PC4204 for COMBUS Power

A PC4204 used to provide additional power for modules on the system MUST be wired according to the following diagram.

The diagram is also included on the sheet that comes with the module.



The RED wire of the COMBUS from the main panel is terminated at the PC4204. The black, yellow and green wires continue on to any additional modules. The AUX output of the PC4204 is connected to Relay #1 normally open (NO). The common (COM) of Relay #1 becomes the RED wire for any additional modules connected the system.

Modules connected further down the line will receive power from the AUX output of the PC4204, not the panel. This will accomplish two objectives. Firstly, it will lessen the load on the panel (which can only supply 500 mA of current). Secondly, since the PC4204 connects to the COMBUS, it can be located close to the modules requiring power, lessening the distance and the line loss.

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