empower

EM2100

OWNERS MANUAL

Command AC Control System with SURGEX Surge Protection

Firmware Version 1.1

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1 Description

The EM2100 is a 120V 15 amp three-bank AC power sequencer incorporating SurgeX® power conditioning and surge protection. The surge protection is rated A-1-1, the highest standard of the Federal Commercial Item Description for Endurance. A total of fourteen 120V receptacles are provided on the rear panel, two of which are always on, with the remaining twelve configured as three sequenced banks of four receptacles, labeled A, B and C.

SurgeX ICE™ Inrush Current Elimination circuitry is incorporated into the EM2100. This eliminates problems associated with inrush currents from large loads such as amplifiers. With SurgeX ICE™ it is not necessary to take inrush currents into account when designing the AC power for a system, and special time-delay circuit breakers are not required: you only need to ensure that the steady-state currents of all products plugged into the EM2100 are within the 15 Amp rating of the product and within the rating of the AC wiring.

The front panel houses a three-line display which provides status information in normal use and allows interaction with menu items during programming. Also on the front panel are two screwdriver-accessible rotary encoders which are used to step through and select from a menu of items which determine the operation of the unit. The black push button, when pressed, causes the unit to power up or power down. This button can be disabled if not required. The blue LED above the button indicates the status of the unit. When the LED is off the unit is fully powered down; when it is on the unit is fully powered up; when it is flashing the unit is in the process of powering up or down.

A built-in AC voltmeter indicates the line voltage on the third line of the display. The internal voltmeter is a peak reading type which was chosen because most electronic equipment incorporates a power supply that charges mostly during the AC peaks. Monitoring the peak of the AC provides a more useful indication of the actual voltage available to the electronic equipment plugged into the EM2100.

The EM2100 is microprocessor controlled and designed to be versatile and expandable. Two or more EM2100s can be connected together to provide control and power conditioning for larger systems. The EM2100 can also control other Empower products with its auxiliary relay contacts to provide for expandability. All options are set via the front panel and all connections are made at the rear panel. An optional password of up to six letters can be entered preventing unauthorized access to set-up information. All set-up information is stored in a non-volatile memory.

A plug-in Phoenix terminal block on the rear panel accommodates the remote control connections and also the low-voltage outputs. There are three inputs which control sequencing; one programmable 12V dc output; and one programmable auxiliary relay providing normally-open contacts. The inputs can be controlled by an applied DC voltage from 5V to 30V, by a contact closure, or by different types of switch; the input selection being made during programming. The inputs and 12V output are designed to withstand incorrect connections including polarity reversal and shorts.

2 Features

- Unsurpassed SurgeX® power conditioning and surge protection
- Incorporates SurgeX ICE™ Inrush Current Elimination Circuitry
- All time delays and functions easily programmed from the front panel
- Accepts both DC voltage and contact closure type inputs
- Two or more units can be ganged or cascaded together to handle larger systems
- Programmable auxiliary relay output can be used to control other Empower® products
- Built-in AC Voltmeter
- Over-ride input can be used to force unit off or force unit on
- Optional password can be used to prevent unauthorized access to set-up information
- Adjustable under-voltage and over-voltage shut-down
- Programmable 12V dc output can be used to drive LEDs or a small relay
- Optional restore after power failure feature
- Auxiliary relay or 12V dc output can be programmed to provide confirmation feedback

3 Installation

The Empower EM2100 is designed to be either modular or installed in a 19 inch equipment rack using the optional rack ears. To convert the EM2100 for rack mounting, remove the four screws in the corners of the front panel, discard the side bezels, then attach the rack ears using the same four screws.

Connect power to the unit by plugging the cord into a 120V ac, 15 amp receptacle.

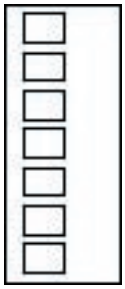
3.1 120 Volt Connections

The EM2100 has a total of 14 receptacles: three sequenced banks of four, and two always on. Each receptacle is rated for a maximum load of 15 amps but the **total load** of the EM2100 must not exceed 15 amps. Plug the equipment cords into the receptacle banks as needed to turn on equipment in the required sequence. The “always on” receptacles provide power as long as power is supplied to the EM2100. Bank “A” always powers up first and off last.

3.2 Remote Control Connections

Remote connections are wired to the green 7-pin plug-in Phoenix terminal block on the rear of the unit next to the power cord. The terminal block is provided in the accessory bag that you will find in the shipping box. After you have made the connections to the terminal block, plug it into the connector on the rear of the unit. Never solder (tin) wires before inserting in a terminal block – solder creeps and you will eventually have loose connections!

The connections are shown below:



Pin 1 - Up Input
Pin 2 - Down Input
Pin 3 - Over-Ride Input
Pin 4 - 12 V dc Output
Pin 5 - Common
Pin 6 - Aux Relay Contact
Pin 7 - Aux Relay Contact

3.2.1 Up/Down Sequence Control Inputs

The EM2100 can be controlled by a DC voltage in the range 5V to 30V, by a contact closure (such as a relay), or by a switch. In this manual the terms “momentary” and “latching” are used when describing switches. A momentary switch is considered to be a switch which provides a connection only while it is actually held pressed, and a latching switch is considered to be a switch which remains in either the on or the off state (such as a light switch). Momentary switches are preferred for use with the EM2100 since multiple control locations can be used, and also because some of the functions of the EM2100 are not available when a latching switch is used (see programming section). Switches with gold contacts are recommended for the best long-term reliability. The type of input is selected totally through programming, making the electrical connections straightforward. The six control options are discussed below:

a) DC Voltage: The EM2100 will power up when the voltage is present and power down when there is no voltage. Connect the positive wire to the “up” input, and the ground (or negative) wire to “common”. Program the input for “5-30 V dc”.

b) Contact Closure: The EM2100 will power up when the contacts are closed and power down when the contacts are open. Connect the two wires from the contacts to “up” and “common”. Program the input for “Latching”

c) One Momentary Switch: The EM2100 will power up when the switch is pressed once and power down when the switch is pressed a second time. Connect the two wires from the switch to “up” and “common”. Program the input for “One Momentary”.

d) Two Momentary Switches: The EM2100 will power up when the UP switch is pressed and power down when the DOWN switch is pressed. Connect the two wires from the UP switch to “up” and “common”, and the two wires from the DOWN switch to “down” and “common”. Program the input for “Two Momentary”.

e) Center-Off Switch: The EM2100 will power up when the switch is pressed to the UP position and power down when the switch is pressed to the DOWN position. Connect the wire from the UP terminal to “up”, the wire from the DOWN terminal to “down”, and the wire from the COMMON terminal to “common”. Program the input for “Two Momentary”.

f) Latching Switch: The EM2100 will power up when the switch is closed and power down when the switch is open. Connect the two wires from the switch to “up” and “common”. Program the input for “Latching”.

Note: The front panel button will not operate with options a, b or f

3.2.2 Over-Ride Input

The EM2100 has the option of adding an over-ride function to force the system either on or off. An over-ride is initiated by applying a dc voltage of 5-30V or by a sustained contact closure. The selection of dc voltage or contact closure is accomplished during programming. This topic is covered fully in the programming section.

Connect the over-ride signal to the “over-ride” input and “common”. In the case of a dc voltage, connect the positive wire to “over-ride” and the negative wire to “common”.

3.2.3 External LED Connections

The EM2100 is able to drive external LEDs or other signaling devices through its 12V dc output which can provide up to 40mA of current. External LEDs connected in this way will mimic the blue LED on the front panel. When connecting LEDs to the 12V output, a series resistor is required. For example, many LEDs work well with 10mA of current, so a 1K resistor is usually a good choice. If more than one LED is required, then use a separate series resistor for each LED. In this example, four external LEDs could be powered at 10mA each from one EM2100. If more than four LEDs are required, it will be necessary to increase the series resistor so that the total load is not more than 40mA.

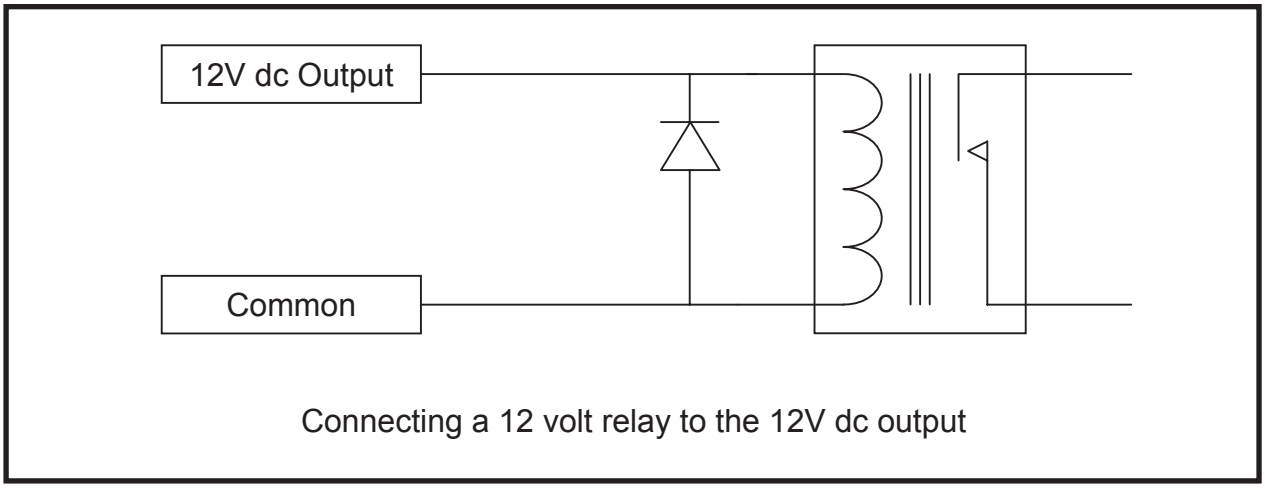
Connect each LED anode to “12V dc output” through a resistor, and the cathodes to “common”.

Program the 12V dc Output for “LED”. This causes LEDs connected to the EM2100 to flash while the unit is powering up or powering down in the same manner as the front panel LED.

3.2.4 Confirmation Connection

The EM2100 offers two ways to provide confirmation feedback to a central controller: a 12V dc output and isolated relay contacts. Confirmation tells the controller that the EM2100 has indeed powered up or that it is fully powered down. If the 12V dc output and the aux relay contacts are not used for any other function, you will be free to choose whichever provides the best interface for the application. However, if one of these outputs is used for another function you will have to use the one that is available.

To use the 12V dc output for confirmation, connect “12V dc output” to the positive input of the controller and “common” to ground. The output will be at 12V when all banks are powered up and will be zero when all banks are powered down. Program 12V dc Output for “Confirm”. Note that the EM2100 common terminal is shared between the inputs and the 12V dc output. If you need relay contacts for confirmation and you are using the aux relay for another function you can connect a small relay between the 12V dc output and common. The relay coil current must not be more than 40mA, and you must connect a diode such as a 1N4148 or 1N4002 across the relay coil (cathode to +12V dc) to suppress the back EMF from the coil. If you need assistance with this please contact our technical support department.



Connecting a 12 volt relay to the 12V dc output

To use the auxiliary relay contacts for confirmation, connect the contacts to the input of the controller. The relay contacts will be closed when all banks are powered up and open when all banks are powered down. The default for menu item “Aux Sync” is “Confirm” so you do not need to program this item unless you previously changed it. The contacts are rated at 30V dc at 1 amp.

4 Quick Start

This section is intended to allow users with a simple straightforward system incorporating a single EM2100 to get up and running with minimal effort. If this is not the case then skip this entire section and go directly to the detailed programming section (section 5). If you are going to follow the quick start instructions, you only need to perform the following steps since the unit has been shipped with default settings suitable for basic operation.

1. Make all connections as per section 3.
2. Insert the screwdriver provided in the accessory kit in the hole labeled “Select” and turn it one click clockwise. Press the black button and you should see “Programming” on the display.
3. Set the first item “Up & Down Inputs” as per section 3.2.1 by rotating Adjust.
4. Advance “Select” one more click. You will now be able to set the first delay time which is for bank A powering up. Use Adjust to set the required delay time in seconds.
5. Advancing “Select” one click at a time and using “Adjust” to adjust the delay times, set the remaining five delay times: B on, C on, A off, B off, C off.
6. If you have connected an LED to the 12V dc output for remote signaling, step through the menu until you reach “12V dc Output”. Then advance “Adjust” one click to select “LED”. This selection will make the remote LED mimic the LED on the front panel which flashes while the unit is powering up or powering down.
7. Turn “Select” fully counter-clockwise and press the black button to exit programming. Place two of the black plugs from the accessory kit into the adjustment holes to deter tampering and the unit is ready for use.

Although the above steps are all that are required the get the EM2100 running, you may want to take a look at the following programming options to see if you want to make use of any of these functions. You will find these listed on the reverse side of the Programming and Connection Guide, and they reside near the end of the menu that you step through by turning “Select”.

Low Voltage Shutdown	Shuts unit off if AC voltage drops below the set point
High Voltage Shutdown	Shuts unit off if AC voltage rises above the set point
Self-Test Shutdown	Shuts down unit if self-test fails
Power Fail Restore	Turns unit back on after a power failure if unit was powered up when the power failed

5 Programming

The EM2100 is a very versatile sequencer and has 21 menu items that control its operation. Some menu items allow predetermined options to be selected and others allow time delays or voltage limits to be adjusted. All adjustments are made via the front panel and are achieved by turning the two screwdriver-accessible rotary encoders labeled “Select” and “Adjust”. Turning “Select” steps through the menu items (shown on the second line of the display), and turning “Adjust” allows each menu item to be changed (shown on the second line of the display). The accessory kit contains a screwdriver suitable for making adjustments and black plugs to cover the holes when programming is complete.

To get into the programming mode first turn “Select” one click clockwise. The display will then tell you to press the black button. Doing so puts you into the programming mode. All the options, delay times and voltage adjustments are set using this mode. When you have completed the set-up turn “Select” all the way counter-clockwise until the display tells you to press the black button. Doing so saves the new set-up information in non-volatile memory and puts you back into normal operation.

A password can be set while in the programming mode. Once a password has been set, you need to enter the same password before you can get back into the programming mode again. This prevents unauthorized personnel from changing the set-up information. The password option is the last menu item and can be from one to six letters (A-Z).

You must be sure to remember the password once it is set as the only way to erase it is to erase all the set-up information stored in the non-volatile memory. Please consult the factory to get instructions if you ever need to do this.

The instructions and notes that follow are in the same order as the actual menu items so you can use this section to work through the programming.

5.1 Power Sequencing Control

Seven menu items must be set up before the EM2100 can be used in even a simple system: one for the type of input, three delays for powering up, and three delays for powering down. The type of input that you select is governed by whether a DC voltage, contact closure or switch is used to control the sequencing. Please see section 3.2.1 for details.

Up & Down Inputs	Select the option as per section 3.2.1
Delay A On	Set the delay in seconds for Bank A powering on
Delay B On	Set the delay in seconds for Bank B powering on
Delay C On	Set the delay in seconds for Bank C powering on
Delay A Off	Set the delay in seconds for Bank A powering off
Delay B Off	Set the delay in seconds for Bank B powering off
Delay C Off	Set the delay in seconds for Bank C powering off

5.2 Over-Ride Control

The EM2100 has an optional over-ride and there are four menu items that control this function. If you do not require an over-ride, you can skip the next four menu items since units are shipped with this function disabled. The over-ride can be set to either force the unit on or force it off when an over-ride signal occurs. The over-ride input is also used for feedback when two or more EM2100s are cascaded together. This is covered in the applications section.

Over-Ride Input Select "Contact Closure" if a relay or switch is used, or "5-30V dc" if a DC voltage is used.

Over-Ride Func This selects the functioning of the over-ride. Select "Disable" if you do not need an over-ride. If you want the over-ride to force the unit on select "Force On", and if you want the over-ride to force the unit off select "Force Off". If you are cascading two or more EM2100s together then select "Master" for the first unit in the chain, and "Pass-Thru for all other units in the chain except the last one.

Over-Ride Option This option allows a special delay to be selected for use only when there is an over-ride. This can be useful, for example, to power-up equipment faster than normal. If the special delay is required select "Special Delay", or if not, select "Use Main Delays". A special delay should not be used when the Aux Relay is used to provide a forth sequenced bank as the sequencing between the forth bank and the three main banks during an over-ride may not coordinate correctly.

Over-Ride Delay This is the special delay (in seconds) for use only during an over-ride. The previous menu item must have been set to enable this delay.

5.3 12V dc Output

There is just one menu item for control of the DC output. The DC output has three basic uses: driving LEDs, providing confirmation back to a central controller, and providing feedback to the previous EM2100 in a cascaded chain. This last option is covered in the applications section. There is additional information about the DC output in sections 3.2.3 and 3.2.4. If the DC output is not used it can be left at any setting.

12V dc Output Select "Confirm" if you are using the DC output for confirmation or to drive a relay. Select "LED" if you are driving LEDs. (This causes the unit to flash the LEDs during power-up and power-down.) Select "Cascade" only when setting up two or more EM2100s in cascade as per the applications section.

5.4 Auxiliary Relay

The programmable auxiliary relay provides a single normally-open contact which is available at the rear of the unit. The aux relay can be used to provide feedback to a central controller, to control another power distribution product, or for controlling another EM2100 when two or more are ganged or cascaded together. Please see the applications section for full details on setting up an expanded system. There are three menu items to control the aux relay: one to select the mode of operation and two delay times. The two delay times are only applicable when option A, B, or C is selected for Aux Sync. There is additional information on the aux relay in section 3.2.4.

Aux Sync When using the aux relay for confirmation select "Confirm". Options "A, B and C" synchronize the operation of the relay to the same internal trigger as bank A, B or C. Choose A, B, or C when a forth bank is added to the system and the relay is used to control an "RT" type Empower. "Gang" or "Cascade" are selected when two or more EM2100s are ganged or cascaded together. All these options are covered in detail in the applications section.

Aux Delay On Set the delay time in seconds for the auxiliary relay closing. This delay time begins with the same internal trigger as the bank selected in the previous item. For example, if you wanted a forth bank to power on first and off last, you should select A as the Aux Sync and set this delay time to be shorter than the delay that you set for Main Bank A On (the Aux Delay On can be set to zero in this case); or if you wanted a forth bank to power on last and off first, you should select C as the Aux Sync and set this delay time to be longer than the delay that you set for Main Bank C On.

Aux Delay Off Set the delay time in seconds for the auxiliary relay opening. This delay time begins with the same internal trigger as the bank selected in Aux Sync. For example, if you wanted a forth bank to power on first and off last, you should select A as the Aux Sync and set this delay time to be longer than the delay that you set for Main Bank A Off; or if you wanted a forth bank to power on last and off first, you should select C as the Aux Sync and set this delay time to be shorter than the delay that you set for Main Bank C Off (the Aux Delay Off can be set to zero in this case).

5.5 Front Panel Push Button

The front panel push button allows the unit to be powered up or powered down from the front panel. There is one menu item associated with the push button which allows it to be disabled or to operate only after a one second delay. The delay option prevents the unit inadvertently powering on or off if the push button is accidentally touched. Note that the push button cannot be used in conjunction with applied voltage or latching type remote control inputs.

Fr. Panel Button Select "Enable" for normal operation, "Delay" to operate only after a one-second delay, and "Disable" to prevent operation from the front panel.

5.6 Out-of-Range AC Voltage Shut Down

The EM2100 has built-in line voltage monitoring and out-of-range shut down. The default limits are 90V at the low end and 150V at the high end, and the shut down sequence begins if the line voltage remains outside the set limits for 2 seconds or more. These limits are adjusted by using two menu items, with the low limit adjustable from 90V to 110V and the high limit adjustable from 130V to 150V. If the unit has shut down due to an out-of-range line voltage and the line voltage subsequently returns to normal, the power up sequence will only resume if the Power Fail Restore option (section 5.8) has been set to "Enable".

Low-V Shut Down Set the low voltage shut down limit from 90V to 110V

High-V Shut Down Set the high voltage shut down limit from 130V to 150V

5.7 Self-Test Failure Shut Down

The EM2100 circuitry has integral self-monitoring which tells the microprocessor that the surge protection is on-line and operating within specification. This menu item allows an option to be selected so that the unit will begin the power down sequence should the self-test ever fail.

Self-Test Sh Dwn Select "Disable" if you do not want the shut down feature and "Enable" if you do want this feature.

5.8 Restore Functions

There are two menu items which, when enabled, allow the EM2100 to restore the original "on" condition after shut-down caused either by loss of AC power (or out-of-range AC) or by an over-ride. When these options are disabled, the EM2100 will not power up when the condition that caused the shut down goes away. The restore functions cannot be used in conjunction with applied voltage or latching type remote control inputs.

Pwr Fail Restore Select "Enable" if you want the EM2100 to power up after a power failure or out-of-range AC condition and the EM2100 was powered up when this condition occurred. Select "Disable" if you don't want this function.

Override Restore Select "Enable" if you want the EM2100 to power up again after being forced off by an over-ride. Select "Disable" if you don't want this function.

5.9 Password

A password can be set which will prevent unauthorized access to the programming mode. From one to six letters, A through Z, can be used as a password.

It is important to remember the password because, once it has been set, you cannot get into the programming mode again without entering the password. If you do forget the password, the only way to erase it is to erase all the set-up information. If you ever need to do this please call the factory to obtain instructions.

When you select Password in the menu you will see a blinking cursor on the third line of the display. Set the first letter of the password by turning Adjust. Then advance Select one click so that the cursor moves to the next position and repeat the process until you have set all the letters of your chosen password.

To erase a password set the cursor on the first letter and turn Adjust counter-clockwise until you see only the cursor and no letter above it. Then turn Select one click back. It is not necessary to erase each letter; erasing the first letter erases the whole password.

Password Set each letter with Adjust and advance Select to go to the next letter.

6 Applications

The EM2100 can be used in four types of configuration: a single unit providing three sequenced banks; an expanded system where the EM2100 controls a remote turn-on Empower providing four sequenced banks (or three banks with increased current capacity for one bank); a ganged system where two or more EM2100s are connected together such that they all turn on and off at the same time providing three banks with increased current capacity for all three banks; a cascaded system where two or more EM2100s are connected together such that the banks turn on sequentially from one EM2100 to the next EM2100. Each configuration is covered separately in its own section, but first there are some general points which apply to all types of installations.

6.1 General Points

Section 3.2 provides detailed information about the remote control connections. If you have not already done so, please read section 3.2 before continuing. The information in section 6.1 applies to all types of installations and you should also read this section before continuing further.

6.1.1 Controlling the EM2100

The EM2100 is primarily designed to be used with momentary action switches. A momentary switch is a switch where the contacts are closed only while the switch is actually pressed, such as a push switch. Using momentary switches allows several switches to be connected in parallel so that the EM2100 can be controlled from multiple locations. A single push switch would cause the unit to power-up on the first press and then power down on the second press. A dual momentary switch, such as a center-biased rocker, or two separate push switches (one for UP and the other for DOWN), can also be used with equal versatility. It is up to the installer to choose the configuration. Whatever type of switch is used, switches with gold contacts are recommended for the best long-term reliability.

Where there are multiple control locations it is advantageous to use the 12V dc output to drive LEDs so that there is an LED at each control location. Up to four LEDs running at 10mA each can be powered from the 12V dc output. Each control location then has an indication of the operational status of the EM2100 regardless of which location last initiated power-up or power-down.

The EM2100 also supports latching switches, contact closure and applied DC voltage, but these types of input cannot be used with multiple control locations – they are intended primarily for a small system or for hook-up to a central controller. The front-panel push-button will not work with a latching switch, contact closure or applied voltage inputs.

6.1.2 12V DC Output

The 12V dc output can be used to drive LEDs thereby showing the operational status at remote control locations. This output can drive up to 40mA which can power four LEDs at 10mA each, or more LEDs at reduced current. A resistor is required for each LED to limit the current. The 12V dc output can also provide confirmation to a central controller or be used to drive a small relay (40mA maximum coil current). See section 3.2 for connection details and section 5.3 for programming details.The 12V dc output has a special use when EM2100s are cascaded together – this is covered in the section on cascaded systems.

6.1.3 Auxiliary Relay

The primary uses of the aux relay are to control other remote turn-on products or to provide status feedback to a central controller to confirm that the unit has completed the requested operation. Details of using the aux relay to control other products are covered in the specific applications sections. The aux relay provides one normally-open contact at the rear terminal block and can handle 1 amp at up to 30 volts dc. See section 3.2 for connection details and section 5.4 for programming details.

The aux relay has a special use when EM2100s are ganged or cascaded together – this is covered in the sections on ganged and cascaded systems.

6.1.4 Over-Ride Function

The EM2100 has an over-ride function that can be used for fire safety and other applications where the power must be held on or forced off. The over-ride function is programmable so that it can be set to either force the unit off or force it on. When a signal is applied to the over-ride input the unit will be forced on or off regardless of the main inputs.

If the unit has been forced off by an over-ride, the Over-Ride Restore menu option determines whether the unit will power up again or remain off.

There is a special delay which can be used only with an over-ride condition. This allows a faster turn on (or turn off) than the main delays. It is not recommended to use the special delay with expanded systems because the auxiliary bank may not turn on (or turn off) in the correct sequence during an over-ride condition.

The over-ride input can be programmed to accept either a contact closure or applied dc voltage. See section 3.2 for connection details and section 5.2 for programming details.

The over-ride input has a special use when EM2100s are cascaded together. This is covered in the section on cascaded systems. If an over-ride is required with a ganged system use the over-ride input on the first EM2100. If an over-ride is required with a cascaded system use the over-ride input on the last EM2100.

6.1.5 Other Functions

Reading through the programming section is a good way to understand all the functions and options available in the EM2100. Most of the functions are associated with main operation outlined in this section above. However, there are some other independent functions that can be selected:

The front panel button can be programmed to be operational, non-operational or operate after a one-second delay. Choosing the last setting prevents accidental power-up or power-down. See section 5.5 for more details.

The EM2100 has built-in voltage limits that will cause the unit to power down if the line voltage is outside these limits. The low limit can be set from 90V to 110V and the high limit can be set from 130V to 150V. See section 5.6 for more details.

The EM2100 has internal self-test circuitry that constantly monitors the operation of the unit and displays the word “Good” or “Fail” on the front panel. The unit can be programmed to shut down in the unlikely event that the self-test should fail. See section 5.7 for more details.

There are two “Restore” options. The first option allows the unit to restore to a power-on state after loss of AC power or out-of-range AC voltage. The second option allows the unit to restore to a power-on state after being forced off by an over-ride. See section 5.8 for more details.

6.2 Single Unit System

Most of the information necessary to install and set up a single unit system can be found in sections 3.2 and 6.1. Figure 1 shows a single unit system controlled by momentary switches at three different locations, and figure 2 shows a single unit controlled by a central controller.

6.3 Expanded System

An expanded system consists of an EM2100 in combination with a remote turn-on Empower such as the EM1100 or the EM510. Such a system provides a total of four banks and 40 Amps total load capacity. The auxiliary relay inside the EM2100 is used to control the second unit. An expanded system can be controlled by the same inputs as a single unit system. The only difference in remote control connections is that, because the aux relay is used to control a second unit, it cannot be used for confirmation feedback to a central controller. In this case, the 12V dc output can be used for confirmation by programming it to Confirm rather than LED, or the aux relay contacts on the second unit can be used.

Figure 3 shows how the two units are wired together. The aux relay contacts on the EM2100 (terminals 6 & 7) are connected to the contact closure inputs on the second unit. In order to work as a 4-bank system the aux relay must be programmed accordingly. The Aux Sync menu item must be set to A, B or C. This synchronizes the aux relay to one of the internal triggers used for main banks A, B or C. The Aux Delay On and Aux Delay Off delay times are then set to position the 4th bank wherever it is required to be in the sequence. As an example: if an EM1100, connected to an EM2100, should turn on last and off first, the menu items shown below should be programmed as follows:

Delay C On	5*
Delay C Off	5*
Aux Sync	C
Aux Delay On	10*
Aux Delay Off	0

*These delay times are an example. Set actual times as required for each application.

In the above example, the turn-on delay for bank C is 5 seconds and the turn-on delay for the EM1100 is 10 seconds. Because the aux sync is set to bank C, the same internal trigger is used to start both time delays. What then happens is that after bank B turns on, there is a 5 second delay before bank C turns on, then there is further 5 second delay before the EM1100 turns on (the 10 second timer started at the same time as the 5 second timer for bank C). When it is time to power down, the EM1100 turns off immediately (the delay is set to zero), then 5 seconds later bank C turns off.

In another example, if the EM1100 should turn on first and off last, the programming would be as follows:

Delay A On	5*
Delay A Off	5*
Aux Sync	A
Aux Delay On	0
Aux Delay Off	10*

*These delay times are an example. Set actual times as required for each application.

As can be seen in the above two examples, by choosing the appropriate sync setting and delay times it is possible to position the 4th bank anywhere in the sequence.

If an over-ride is used with an expanded system do not use the Special Delay as the 4th bank may not turn on and off in the correct sequence during an over-ride condition.

6.4 Ganged System

A ganged system consists of two or more EM2100s connected together in such a way that they all turn off and on together. Figure 4 shows how to connect and program each unit in a three-unit system. If only two units are to be ganged together then ignore the middle unit in the diagram. If more than three units are to be ganged together then keep the first and last units set up as shown, add units in the middle and set them up and connected them in the same way as the middle unit in the diagram.

The remote control inputs should be connected to the first unit, and the same control options are available as for a single-unit system. If confirmation feedback is required for a central controller use the aux relay contacts on the last unit.

The delay times should be set the same for all the EM2100s unless you want to skew the turn-on or turn-off points from one unit to the next.

If the low and high voltage shutdown points are narrowed from their defaults of 90V and 150V this should be done on the first unit only. The other units should be left set to 90V and 150V.The two restore options should only be enabled (if required) on the first unit. The self-test shutdown should be the same for all units.

If an over-ride is required connect it to the first unit.

6.5 Cascaded System

A cascaded system consists of two or more EM2100s connected together such that they turn on and off one after another in an extended sequence. Connecting a cascaded system together is a little more complicated than the other types of system because there must be feedback from each unit to the previous unit as well as control from each unit to the next unit. The 12V dc output (terminal 4) is used as the feedback source and the over-ride input (terminal 3) is used as the feedback input. Figure 5 shows how to connect and program each unit in a three-unit system. Note that terminals 5 and 6 are connected together for all units except the last one. If only two units are to be cascaded together then ignore the middle unit in the diagram. If more than three units are to be cascaded together then keep the first and last units set up as shown, add units in the middle and set them up and connected them in the same way as the middle unit in the diagram.

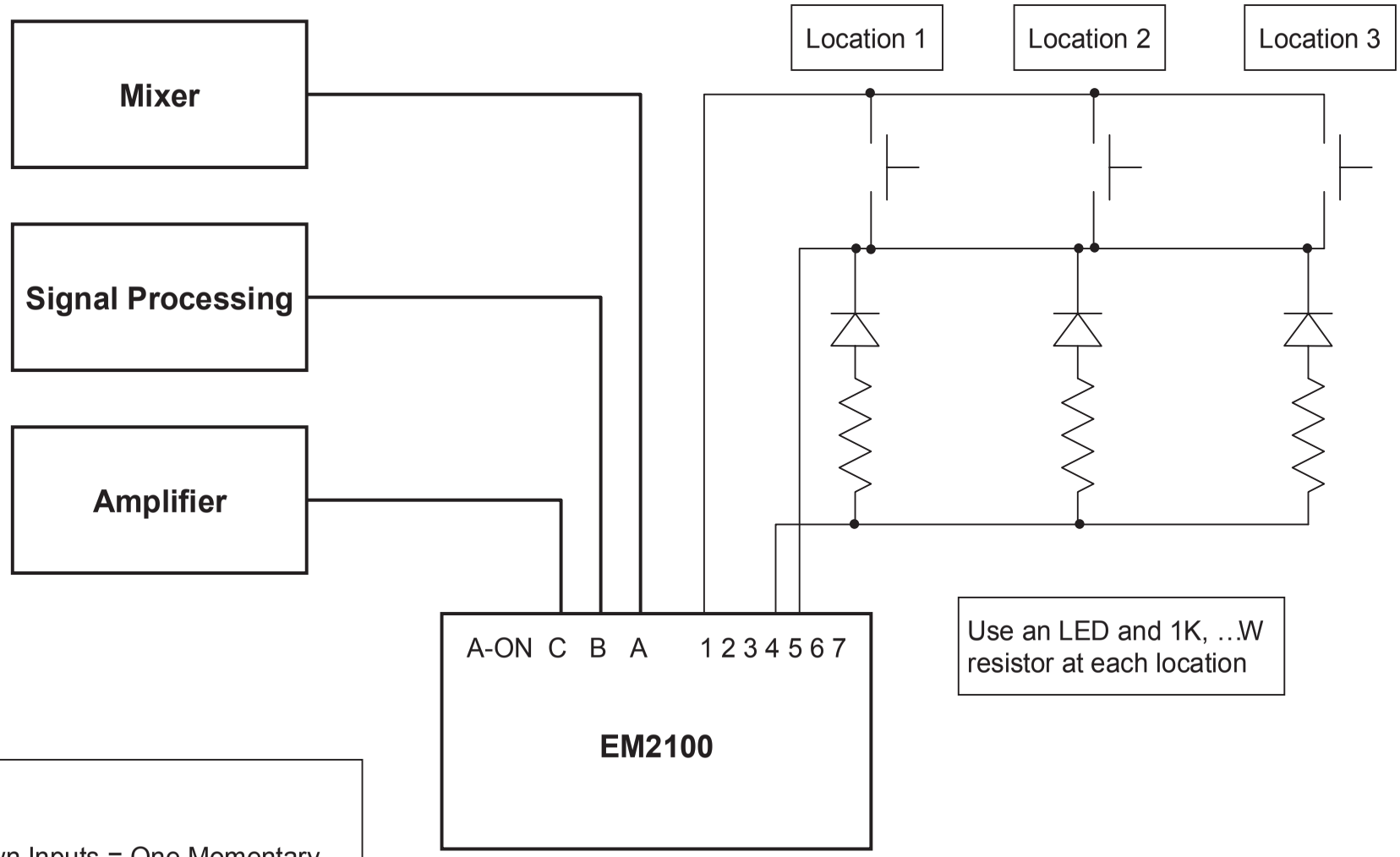
The remote control inputs should be connected to the first unit, and the same control options are available as for a single-unit system. If confirmation feedback is required for a central controller use the aux relay contacts on the last unit.

The delay times should be set as required for the application.

If the low and high voltage shutdown points are narrowed from their defaults of 90V and 150V this should be done on the first unit only. The other units should be left set to 90V and 150V.The two restore options should only be enabled (if required) on the first unit. The self-test shutdown should be the same for all units.

If an over-ride is required connect it to the last unit and program that unit to accept the type of over-ride you need.

Single-Unit System Controlled by Momentary Switches



Program:

Up & Down Inputs = One Momentary

12V dc Output = LED

Figure 1

empower

Single-Unit System Controlled by Central Controller

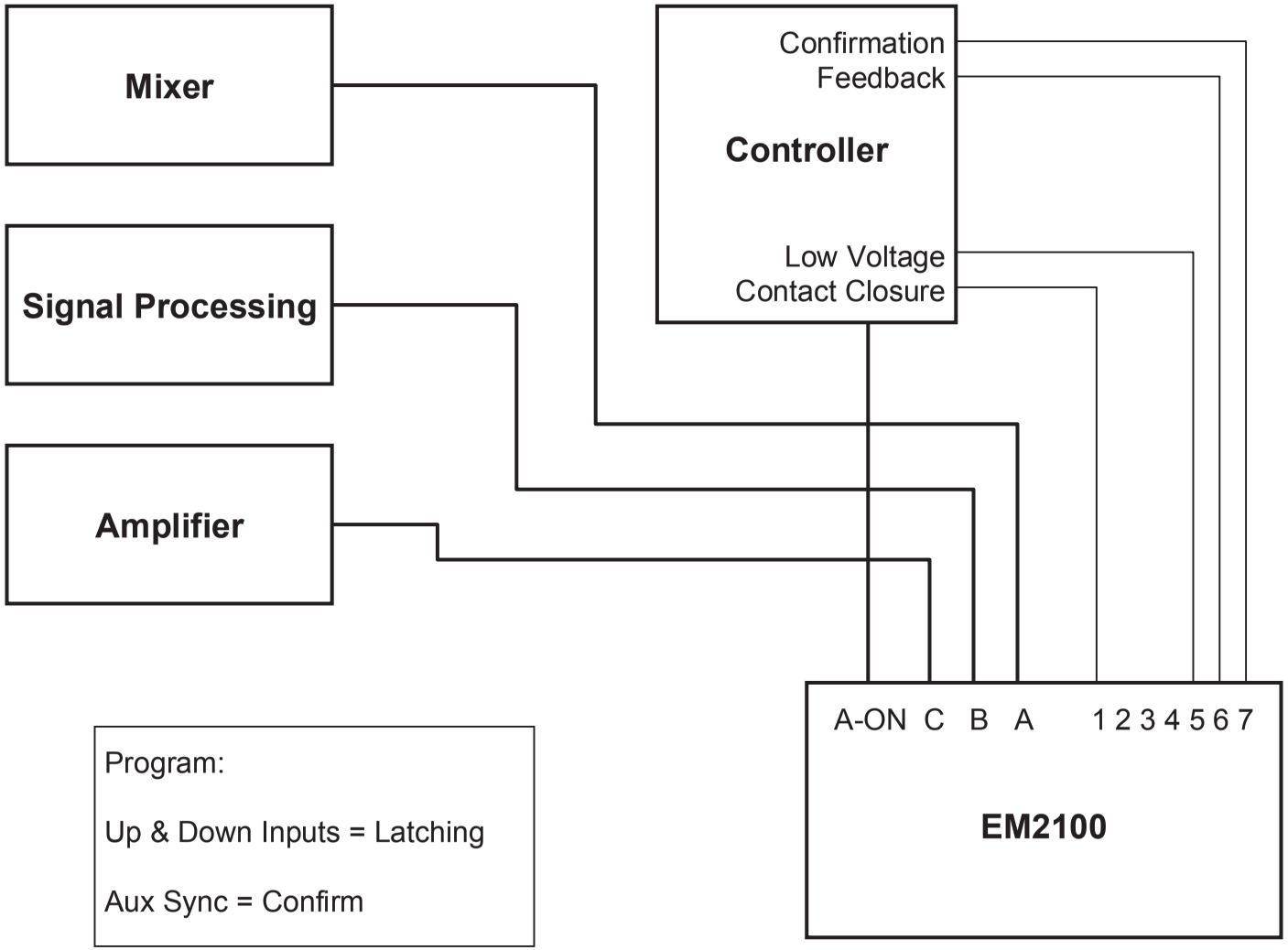
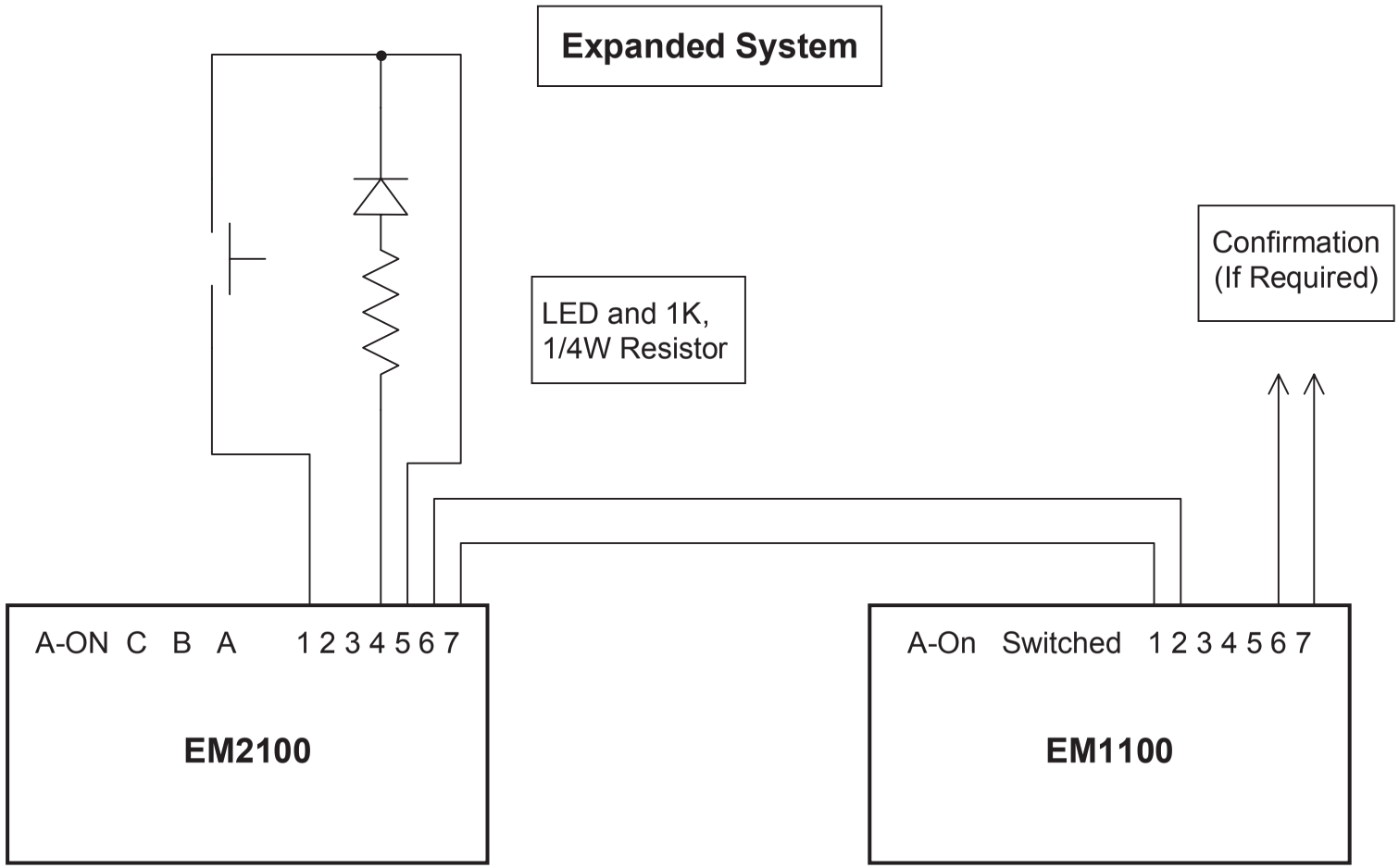


Figure 2



Program:
Up & Down Inputs = One Mom.
12v dc Output = LED
Aux Sync = A, B or C
Aux Delay On = [Set as Needed]
Aux Delay Off = [Set as Needed]

Figure 3

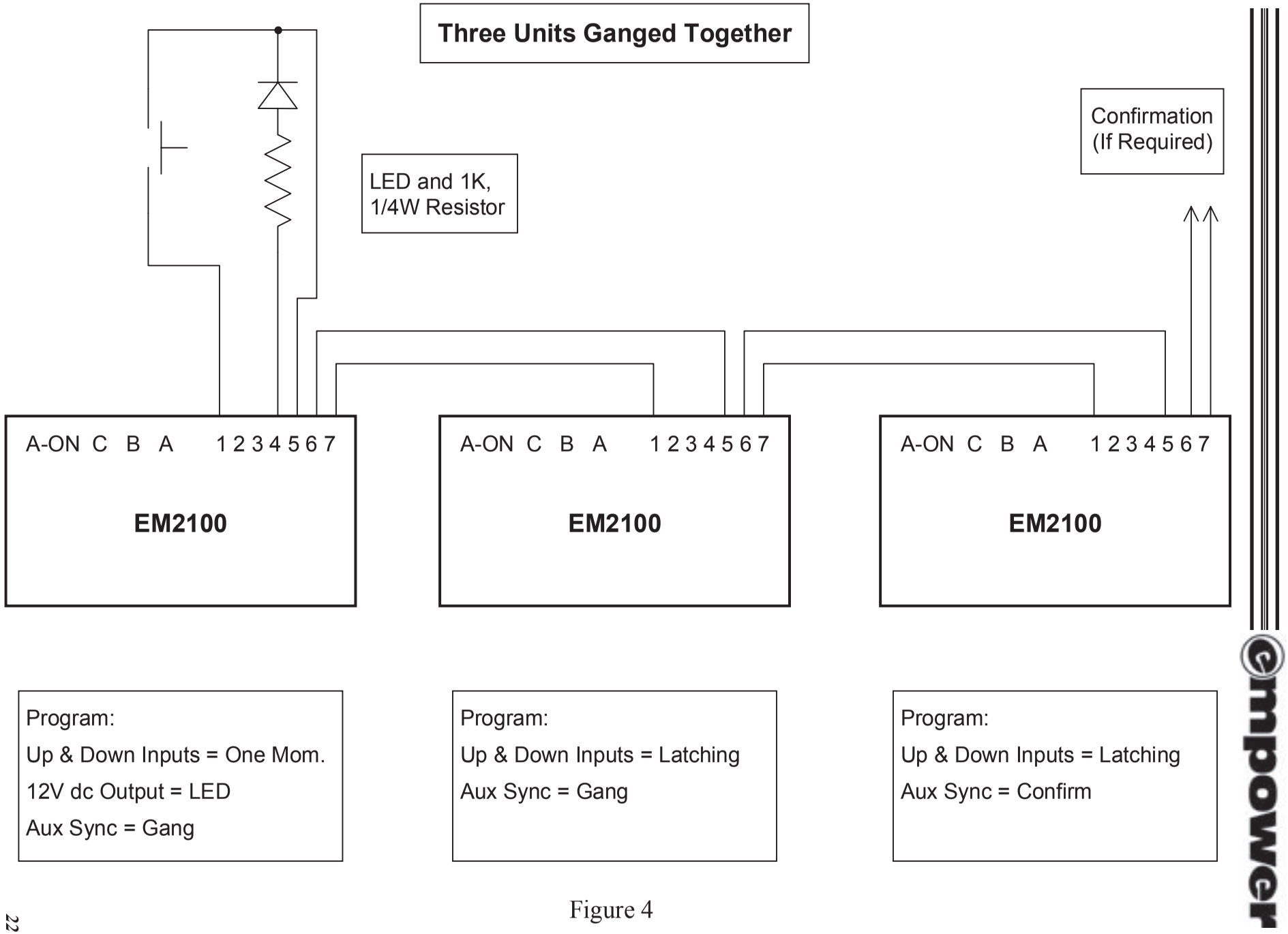

Three Units Ganged Together
LED and 1K,
1/4W Resistor
Confirmation
(If Required)
A-ON C B A 1 2 3 4 5 6 7
EM2100
A-ON C B A 1 2 3 4 5 6 7
EM2100
A-ON C B A 1 2 3 4 5 6 7
EM2100
Program:
Up & Down Inputs = One Mom.
12V dc Output = LED
Aux Sync = Gang
Program:
Up & Down Inputs = Latching
Aux Sync = Gang
Program:
Up & Down Inputs = Latching
Aux Sync = Confirm

Figure 4

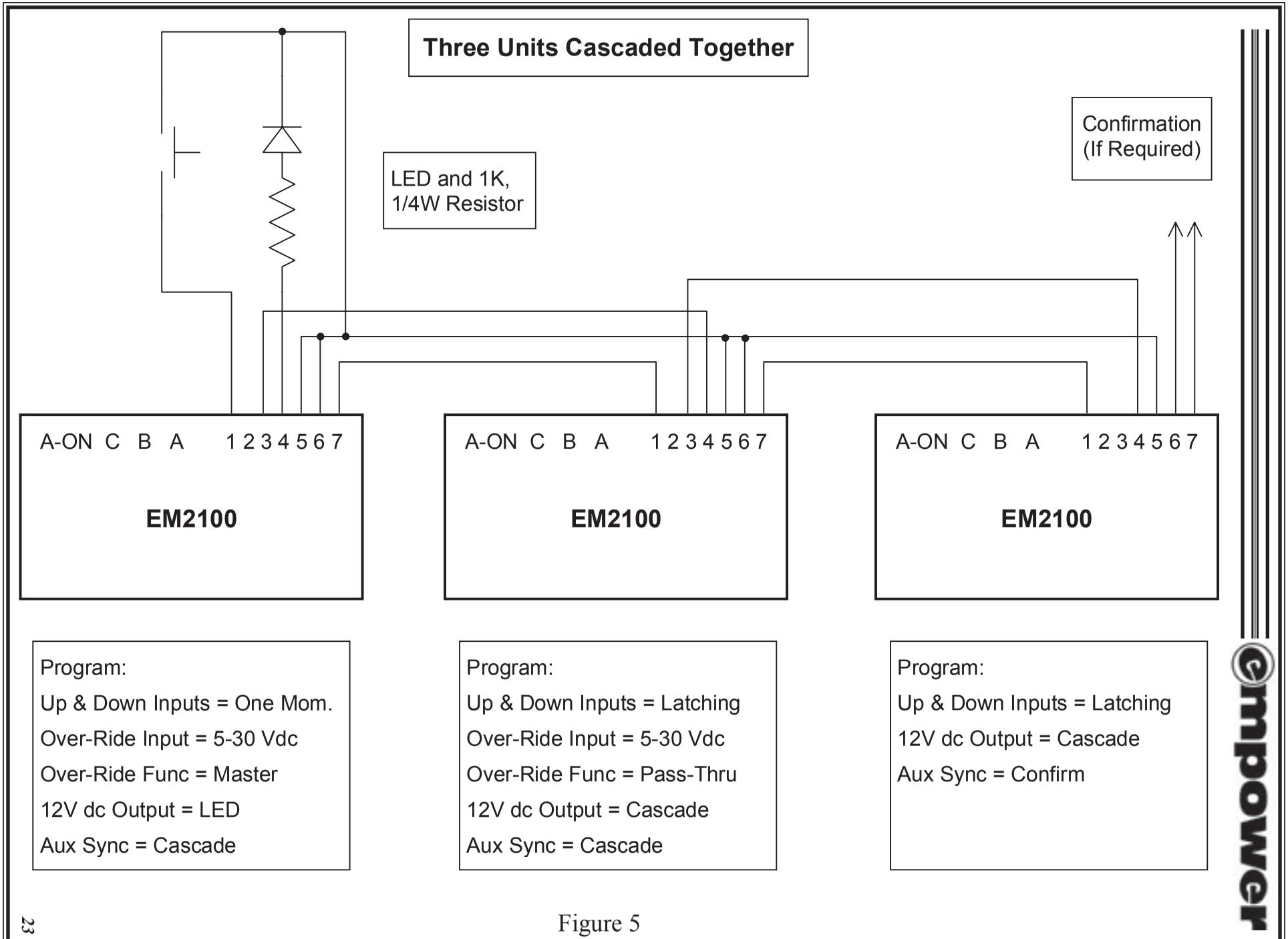

Three Units Cascaded Together
LED and 1K,
1/4W Resistor
Confirmation
(If Required)
A-ON C B A 1 2 3 4 5 6 7
EM2100
A-ON C B A 1 2 3 4 5 6 7
EM2100
A-ON C B A 1 2 3 4 5 6 7
EM2100
Program:
Up & Down Inputs = One Mom.
Over-Ride Input = 5-30 Vdc
Over-Ride Func = Master
12V dc Output = LED
Aux Sync = Cascade
Program:
Up & Down Inputs = Latching
Over-Ride Input = 5-30 Vdc
Over-Ride Func = Pass-Thru
12V dc Output = Cascade
Aux Sync = Cascade
Program:
Up & Down Inputs = Latching
12V dc Output = Cascade
Aux Sync = Confirm

Figure 5

7 Troubleshooting

Initial Check

Whenever power is applied to the EM2100 the LCD display should be back-lit and the display should show three lines of text as follows:

Status: All On or **All Off**

Protection: Good

Voltage: 120Vac (or whatever the actual line voltage is)

If the first line of the display shows "Programming", the unit is in programming mode and therefore will not turn on. Turn the Select rotary encoder counter-clockwise and then press the button to get out of programming mode.

If the display is not illuminated and also showing the above three lines of information check that power is actually being supplied to the unit and that the breaker on the rear panel adjacent to the power cord has not tripped. If you are certain that power is being supplied to the unit consult the factory for assistance.

Unit will not power up from remote control connection

If you have performed initial checks as above and the unit will still not power up it could be because the "down" input (terminal 2) is being held active all the time. Remove the terminal block from the rear and check that the Up and Down signals are correct with a meter.

The front panel button will not work

Check whether the front panel button has been programmed to Delay or Disable. If it has been programmed to Delay you must hold the button for one second before it will operate. If it has been programmed to Disable it will not operate at all.

The front panel button will not work if the Up & Down Inputs has been set to Latching or 5-30V dc. This is due to the fact that a latching type input will always over-ride a momentary switch like the front panel button.

The unit sequences up but will not sequence down

Check the remote control connections using a meter and also the programming of the Up & Down Inputs. If Up & Down Inputs is set to Two Momentary and you are using a single momentary switch the unit will sequence up but not sequence down.

The unit starts to sequence up but then immediately sequences down

There are two likely causes for this: One cause is a Down input that is on all the time and over-riding the power up sequence. Check the down input with a meter. The other cause is that the Over-Ride Func menu item has been set to Master when the unit is not connected to another EM2100 in cascade mode. Change this menu item to Disable.

The unit will not go into programming mode

You must power down the unit first before you can get into the programming mode.

8 Error Codes

Error codes are displayed on the third line of the display.

Error 05 The calibration of the AC voltmeter is no longer accurate. The unit is otherwise fully operational. Call the factory for assistance.

Error 15 There is a checksum error in the non-volatile memory. This indicates that the set-up information could be incorrect. It is recommended that you completely check the programming and save the settings again. If error 15 is still displayed there is most likely a permanent problem with the non-volatile memory.

Error 16 There is a sub-system error. The unit will need to be returned to the factory for repair.

Error 24 Please call the factory.

9 Specifications

Operational Voltage Range:	90 to 150 Volts AC
Current rating:	15 Amps
Power Rating:	1,800 Watts
Maximum Load Inrush Energy:	1400 Joules total during power-up
Surge Protection Rating:	Grade A (1,000 surges of 6,000 Volts, 3,000 Amps, no degradation) Class 1 (SVR is less than 330 Volts for 6,000 Volt, 3,000 Amp surge) Mode 1 (No ground contamination)
Clamping Voltage Onset:	172 Volts nominal, 2 volts above peak line voltage
EMI/RFI Filter Response:	With 50 Ohm source and load; -3dB @ 5KHz, -26dB @ 100KHz, -38 dB @ 300KHz, -50dB @ 5MHz, -50dB @ 30MHz
Let-Through Slew Rate:	28V/us within the AC power wave envelope, less than 10V/us outside the power wave envelope
Maximum Applied Surge Voltage:	6,000 Volts (1.2 x 50 us)
Maximum Applied Surge Current:	Unlimited due to current limiting (8 x 20 us)
Maximum Applied Surge Energy:	Unlimited due to current limiting (8 x 20 us)
Surge Endurance:	As per IEEE C62.41-1991 Category B3; 2KV >100,000; 4KV >10,000; 6KV >1,000 (NRTL Verified)
Number of Outlets:	14
Number of Banks:	3
Delay Time per Bank:	0 to 40 seconds in 1 second increments
Remote Control Voltage:	5 to 30 Volts dc
Remote Control Current Draw:	4 mA maximum
Contact Closure Max. Resistance:	100 Ohms
Auxiliary Relay Contact Rating:	30 Volts dc at 1 Amp
12 Volt Output Max. Current:	40 mA
Voltmeter Accuracy:	+/- 2%

LIMITED WARRANTY FOR Empower PRODUCT NO. EM2100

For a period of ten (10) years from the date of your purchase of Empower Product No. EM2100(the "Product"), Empower warrants against defects in materials used by Empower or workmanship performed by Empower, provided, however, that the control and display components of the Product shall be for warranted for only five (5) years from the date of your purchase of the Product (the "Warranty").

Empower's obligations with respect to a defective Product that is covered by the Warranty (a "Covered Product"), are to provide, at no charge, all labor and parts (either new or rebuilt, as determined in Empower's sole discretion) necessary for the repair of the Covered Product. If Empower, in its sole discretion, determines that a Covered Product is not repairable, Empower will replace the Covered Product with a product of like kind, quality and functionality. In order to obtain the services under this Limited Warranty, you are responsible for delivering the Covered Product, at your sole cost, to Empower, and for providing Empower with a copy of the dealer's dated bill of sale as evidence of the date of purchase of the Covered Product. This Limited Warranty is only valid for consumers in the United States and Canada.

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY MADE BY EMPOWER WITH RESPECT TO THE PRODUCT. ALL IMPLIED WARRANTIES WITH RESPECT TO THE PRODUCT INCLUDING, BUT NOT LIMITED TO, IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR IMPLIED WARRANTIES ARISING OUT OF COURSE OF DEALING OR USAGE OF TRADE, ARE HEREBY EXPRESSLY DISCLAIMED AND EXCLUDED.

This Limited Warranty does not apply to any Product that is defective due to any causes beyond Empower's control such as negligence, abuse, misuse, acts of god, modifications to the Product or third party repair of the Product.

THE LIABILITY OF EMPOWER (IF ANY) AND YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY ALLEGEDLY DEFECTIVE COVERED PRODUCT SHALL BE LIMITED TO REPAIR OR REPLACEMENT OF THE COVERED PRODUCT IN ACCORDANCE WITH THE TERMS AND CONDITIONS OF THIS LIMITED WARRANTY. IN NO EVENT WILL EMPOWER BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Unless otherwise provided by applicable state law, this Limited Warranty will be interpreted and enforced according to the laws of the Commonwealth of Pennsylvania.

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