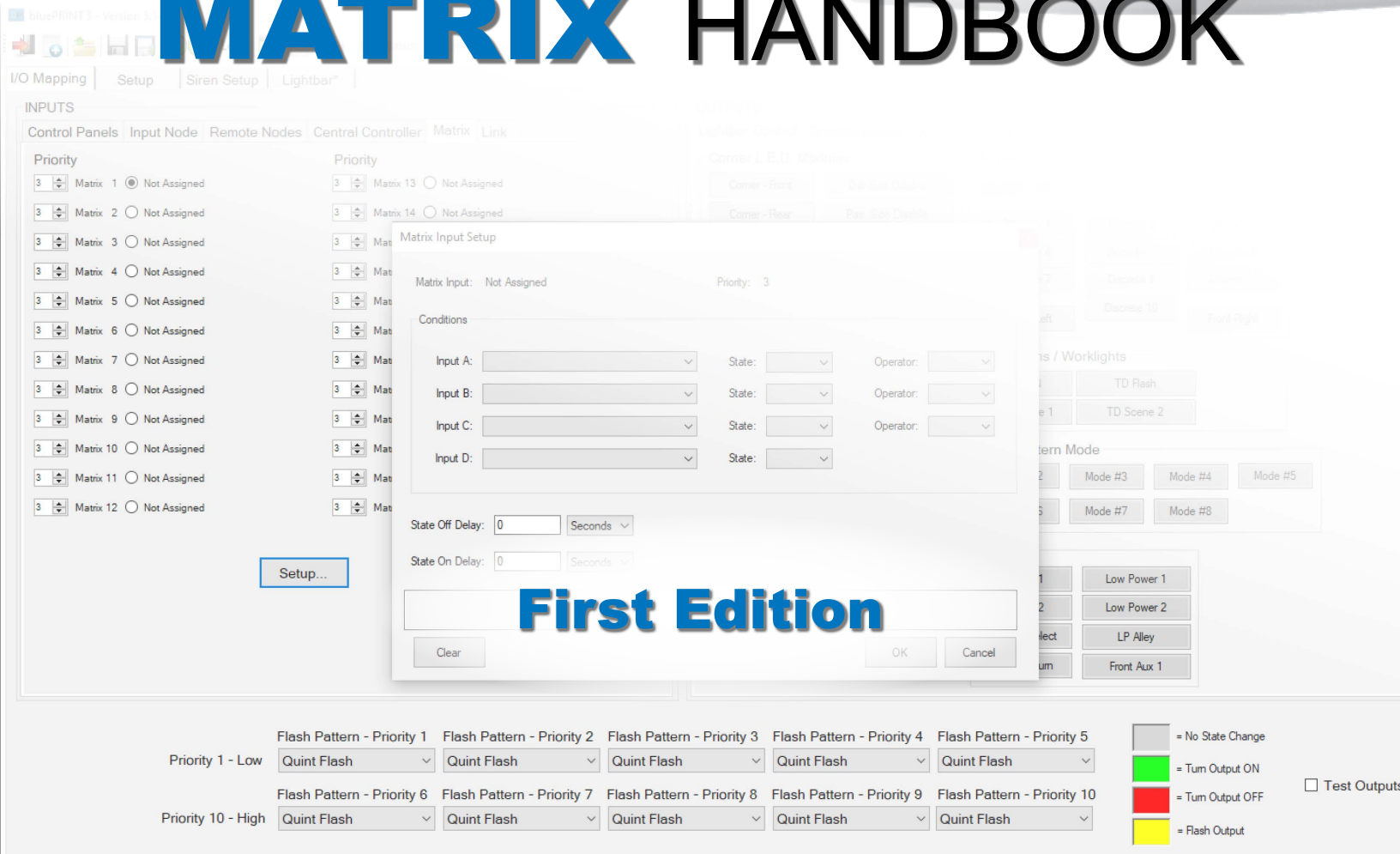
SoundOff Signal®

bluePRINT®

MATRIX HANDBOOK



First Edition

Introduction

SoundOff Signal revolutionized emergency vehicle control systems with its bluePRINT Intelligent Control System. Not only was bluePRINT's hardware exceptionally capable, the system's logic processing allowed for advanced functionality critical to safety and demanded by customers.

Many installers get lost in the capabilities of bluePRINT. The programming is so flexible and powerful, and the feature sets so boundless, that it can be overwhelming. The key to creating advanced functionality is the Matrix, bluePRINT's name for a virtual input that is created by grouping conditions and operators to create a true/false result.

A Matrix is simple in theory and knowing how one works will make your programming tasks go much faster. The basic concept revolves around algebraic logic, specifically Boolean Logic. Created in the 1840s by George Boole, Boolean Logic is the basis for digital communications used today and a key part of all programming languages (for more information on Boolean Logic, see page 71)

We recognize that math experts don't always end up building emergency vehicles or becoming first responders, nor is it necessary to be a math expert to create amazing Matrix results! This comprehensive handbook was written with you in mind. It covers Matrix theory and programming, including "recipes" for you to use or modify to create your own solutions.

bluePRINT's capabilities and logic-driven performance are limited only by an installer's imagination and understanding of programming. Intelligent Control Systems have become the industry best practice and customer expectation. Your ability to provide these advanced features is the measure of professionalism that will set your builds apart.

Now, let's get started!

The Below 100 Initiative

1943 is the last year that less than 100 police officers perished in the line of duty. Created in 2010 by a group of distinguished law enforcement trainers, the Below 100 Initiative is a means to reduce preventable line of duty deaths (LODD) through awareness and professional culture change.

Below 100 focuses on five tenets that are key to "surviving the shift":

- Wear Your Belt
- Wear Your Vest
- Watch Your Speed
- WIN—What's Important Now?
- Remember: Complacency Kills!

With bluePRINT and the ability to write logic-driven results, each of these five tenets can be supported. For example, a reminder beep can sound when speed is above 15mph and the seatbelt is not buckled. Speed-based warning system activation ensure officers are protected.

Ignition Security encourages ballistic vest wear by providing a secured, climate-conditioned vehicle for officers to return to. Advanced scene lighting and automatic feature activation with bluePRINT enhance officer awareness and provide tactical advantages so officers can focus on WIN and avoid complacency.

For more information, please visit www.Below100.org.

Table of Contents

bluePRINT Matrix Handbook © SoundOff Signal 2020

1st Edition - April 2020

Matrix Rules

Matrix rules are based on Boolean logic, common to all digital communication. This is the same type of logic that Microsoft Excel spreadsheet uses. To gain a better understanding of how a Matrix runs, here are a couple of rules that must be adhered to:

1. Matrices (the plural of Matrix) must have a name. Naming inputs and outputs is a golden rule in bluePRINT and includes Matrices as well. You'll often find yourself referencing one Matrix from another. As long as they are named, they know where and how to find each other.

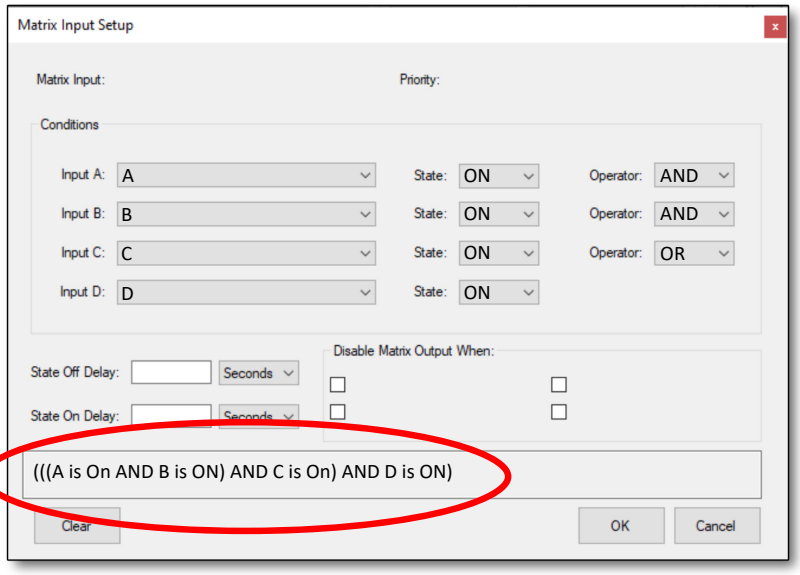
2. AND's and OR's - The placement of OR as an operator in a Matrix can have minor or significant effect on how the Matrix is processed. As a rule of thumb, the further down the Matrix list an OR appears, the more it can override previous conditions.

Below is a quick run-through of how a Matrix is processed. It's followed by a helpful cheat sheet showing generic combinations of two, three, and four input Matrices.

The Logic Line at the bottom is KEY!

bluePRINT processes logic in multiple stages. The logic line created as you write your Matrix can be helpful in understanding how it will work.

Let's break down the logic line in the example Matrix shown here. Note that there are three sets of parenthesis ( ) in this example. Just like an algebraic equation, work from the inside to outside.



STEP 1: Look at the first two conditions as a group, located in the inner-most set of parenthesis. Call them Group 1.

Group One - (A is On AND B is On).

bluePRINT process this group first and it represents the first two input conditions of this example Matrix. .

(A is On AND B is ON) = For this example it was False

STEP 2: True or not, bluePRINT continues to the next condition, and processes it with the results of the first two. Call this Group Two, and remember Group Two is the results of Group One plus Input condition C.

Adding in Input condition C

Group Two - ((FALSE) AND C is ON)

Looking at the above, this can only end up False because Group Two requires the results of Group One to be true.

((A is On AND B is ON) AND C is On) = False

Step 3: bluePRINT continues processing everything, true or false. In this case, Group Two is false. The results of that are then processed with the final input, D.

Group Three - ((FALSE) OR D is ON)

This is where things get interesting. bluePRINT processes all the conditions for A, B, and C and determines that they are false - BUT WAIT!

It sees an option with OR in the mix. That is an "escape route." Since bluePRINT sees input D is ON, the Matrix is now true!

Remember, bluePRINT always processes each Matrix all the way through to the end, regardless of each Group.

On the next page is a series of "cheat sheets" that shows different combinations of AND's and OR's, including their results.

Matrix Rules

On Delays, Off Delays and Disable Matrix Check Boxes

bluePRINT can utilize delay timers to modify how a Matrix works. Here is a quick breakdown:

State Off Delay - Put a time in this box to allow a Matrix to continue running after it is no longer true. This can be a number as low as 100ms and as high as 8,000 hours.

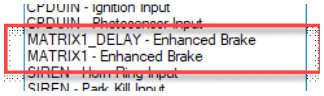
State On Delay - This works just like the Off Delay, but tells the Matrix to wait before starting.

Disable Check Boxes - Conditions that are checked can cancel a Matrix that is in the off delay or looping state. For more on Looping, see page 11.

Referencing a Matrix vs a Matrix_Delay

When referencing a Matrix as a condition in another Matrix, you are referencing the Matrix while it is in it's true/active state.

However, when referencing a Matrix Delay, you are referencing the Matrix in it's true/active state as well as the timer duration of the Off Delay.



Matrix Rules

Matrix Stacking

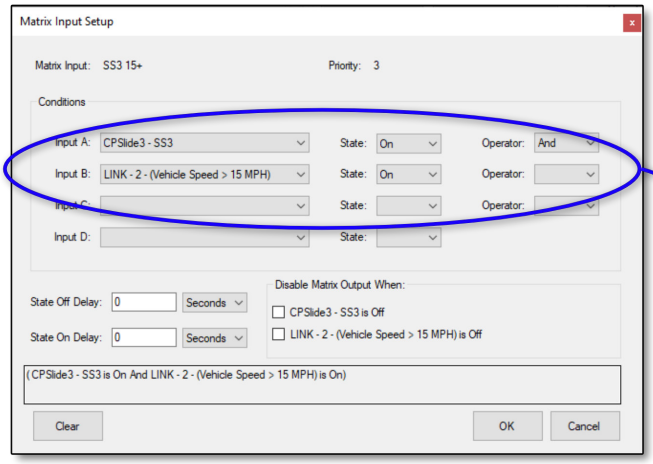
Matrix stacking typically occurs when more than four conditions are needed for a Matrix. In cases like this, building a “setup” Matrix allows the Matrix to be expanded beyond limit of four.

Other cases are when a common Matrix is used throughout a program, and others are affected by it’s commonality. An example of this is the Slide Switch 3 Pursuit Matrix, and using that Matrix as a condition in other Matrices such as Brake, or Intersection Clearing.

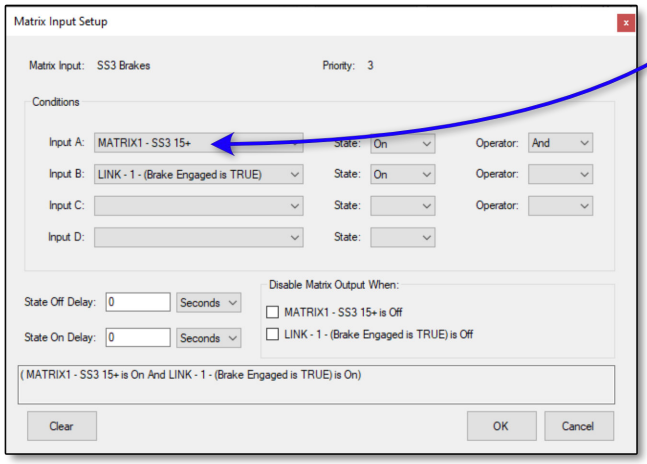
Doing so allows for all the conditions of the referenced Matrix to apply to the second Matrix.

Below is an example of Matrix Stacking.

Slide Switch 3 15+



Slide Switch 3 Brakes



Matrix Rules Tips

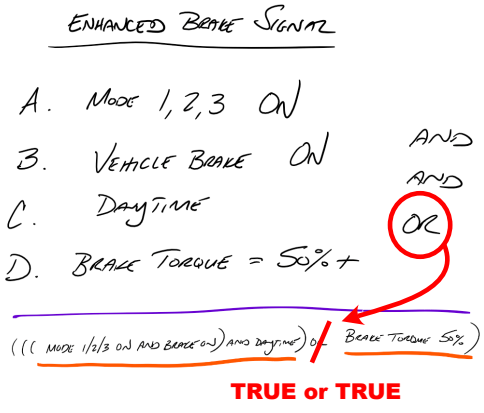
Mini review of priority and sub priority

- Each Matrix is given a priority between 1 and 10.
- Inputs or Matrices with numerically higher priority are given more control over inputs with numerically lower priority - i.e., if Matrix 1 at priority 4 and Matrix 3 at priority 3 are both trying to control output 4 on the Central Controller at the same time, Matrix 1 will win out.
- Don't forget sub-priority! When two Matrices have the *same* priority and they are both trying to control the same output, the numerically higher input or Matrix wins. Example: If Matrix 14 and Matrix 17 are both priority 7, and they both are trying to control Central Controller output 9, Matrix 17 will win.
- Use sub priority to your advantage and reserve priority for flash pattern changes. If your brake Matrix is just turning lights off or on but not changing flash pattern, place it in a numerically higher Matrix instead of a higher priority. This WILL help with de-conflicting your program.

Planning Matrices

Many times it is easier to plan your Matrices and how they are ordered on a piece of paper. This type of planning does three things:

- First, it helps you learn the Matrix process and Boolean logic. Writing things down is a proven way to learn. Throughout school, we all took notes. There was a good reason for that!
- Second, as you write a program and thing of a Matrix, stick it on the handwritten list. It is easier to make changes there than it is to move Matrices around in the program. This helps you utilize sub-priority to it's maximum advantage.
- Third, writing the Matrix conditions down on paper helps you understand how it is processed in bluePRINT.



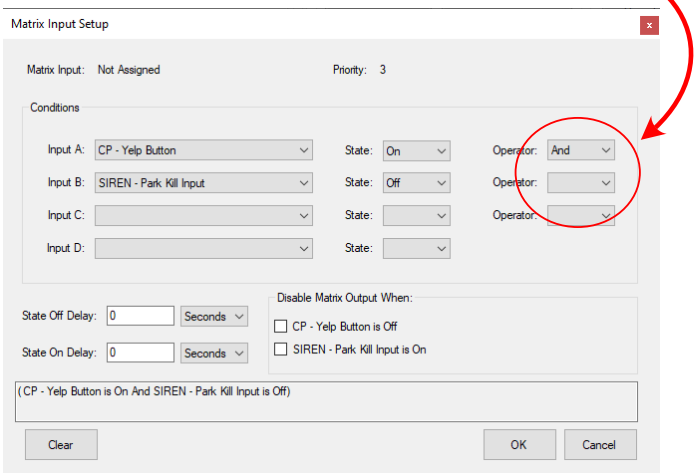
Work the Middle!

Considering sub-priority as show to the left, it's a good idea to work the middle and leave a "blank" Matrix from time to time.

We recommend starting with Matrix 3, and then skipping every fifth Matrix. This gives you room to "back fill" your program!

Operators

When building a Matrix in bluePRINT, each line needs an operator except for the very last line of the Matrix. See below:



bluePRINT Link®

Think of bluePRINT Link as your best friend when it comes to creating Matrices. bluePRINT Link provides signals to a Matrix that are not available using traditional wire connection means.

Acceleration, brake torque, vehicle speed, temperature, and fuel level are all examples of signals that require a connection to the vehicle computer through bluePRINT Link.

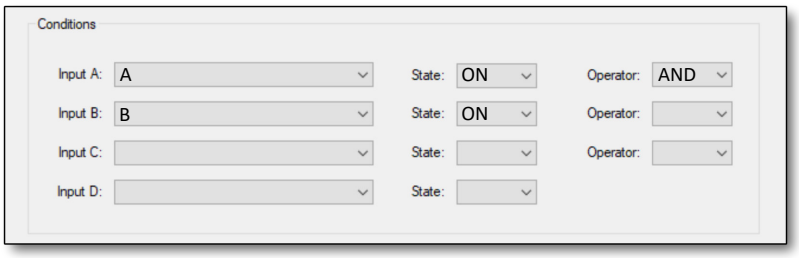
This added capability is utilized throughout many of the different Matrices in this book.

Matrix Processing Cheat Sheet

The next several pages show different combinations of Matrix inputs and what combinations make them true. In all of these Matrices, we are using the ON state. Feel free to substitute the OFF state as needed.

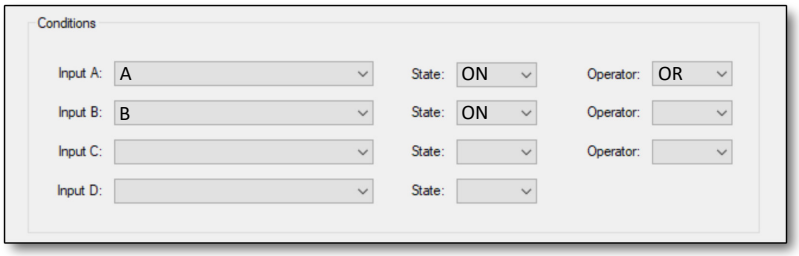
Throughout this handbook, we'll reference what type of Matrix is shown on each "recipe" page. When two or more Matrices are shown on a single page, the Matrix type will be listed under the name.

2 Input Matrices



Matrix Type:
Two Required Conditions

All Possible True Conditions
- A and B are both active.

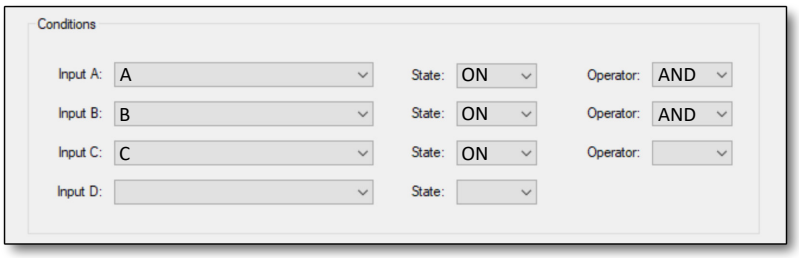


Matrix Type:
Two Optional Conditions

All Possible True Conditions
- A is active.
- B is active

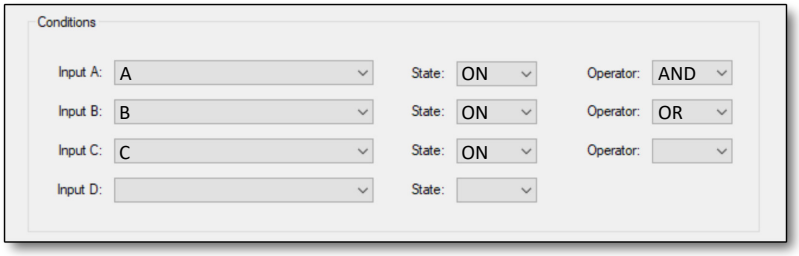
Matrix Processing Cheat Sheet

3 Input Matrices



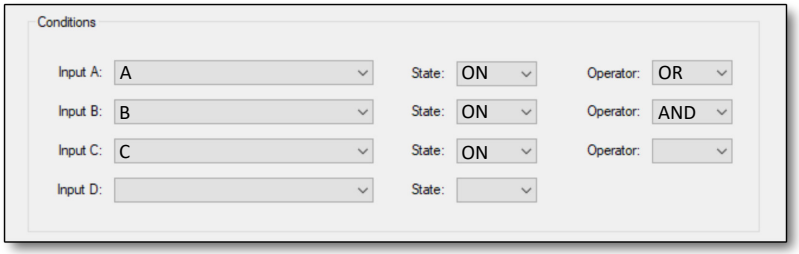
Matrix Type:
Three Required Conditions

All Possible True Conditions
- A, B, and C are all active.



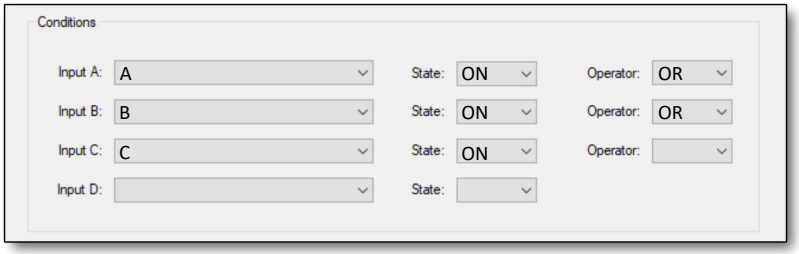
Matrix Type:
Three Conditions, Two or One

All Possible True Conditions
- A and B are active.
- C is active.



Matrix Type:
Three Conditions, Two or Two

All Possible True Conditions
- A and C are active.
- B and C are active.

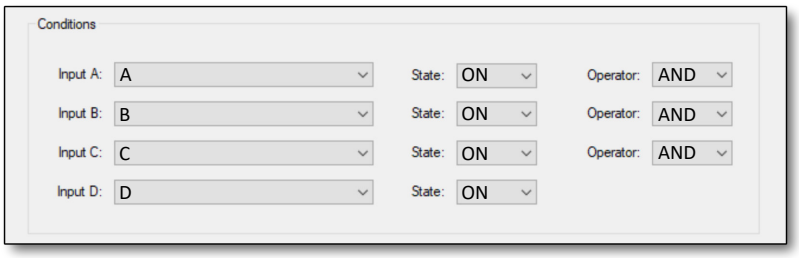


Matrix Type:
Three Optional Conditions

All Possible True Conditions
- A is active.
- B is active.
- C is active.

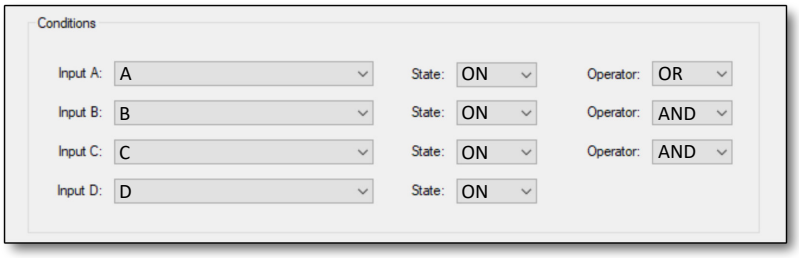
Matrix Processing Cheat Sheet

4 Input Matrices - Pt. 1



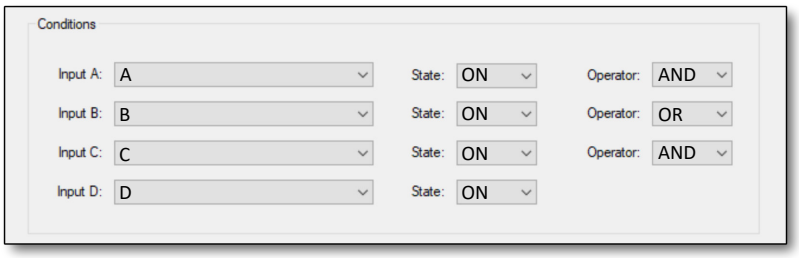
Matrix Type:
Four Required Conditions

All Possible True Conditions
- A, B, C, and D are all active.



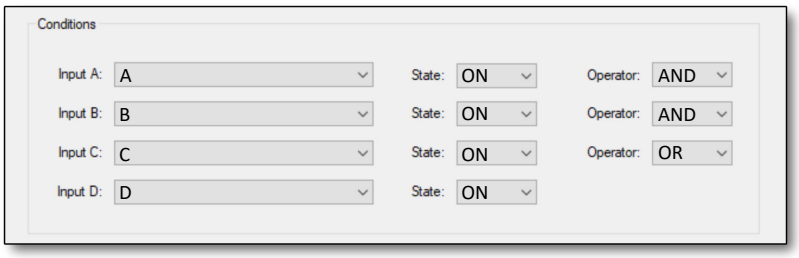
Matrix Type:
Four Conditions, Three or Three

All Possible True Conditions
- A, C, and D are active.
- B, C, and D are active.



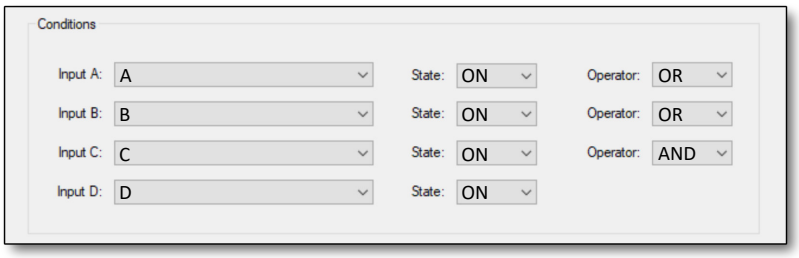
Matrix Type:
Four Conditions, Three or Two

All Possible True Conditions
- A, B, and D are active.
- C and D are active



Matrix Type:
Four Conditions, Three or One

All Possible True Conditions
- A, B, and C are active.
- D is active.

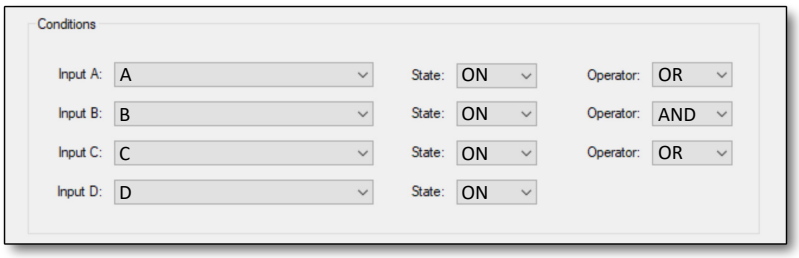


Matrix Type:
Four Conditions, Two or Two or Two

All Possible True Conditions
- A and D are active.
- B and D are active.
- C and D are active.

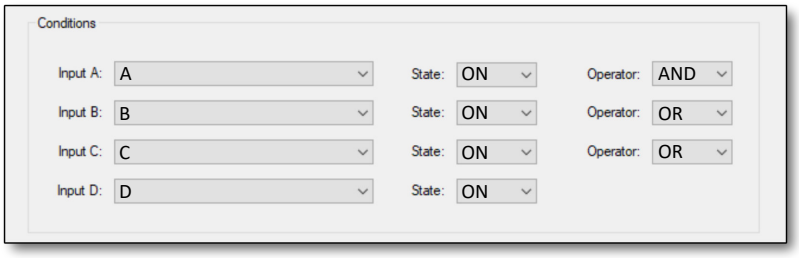
Matrix Processing Cheat Sheet

4 Input Matrices - Pt. 2



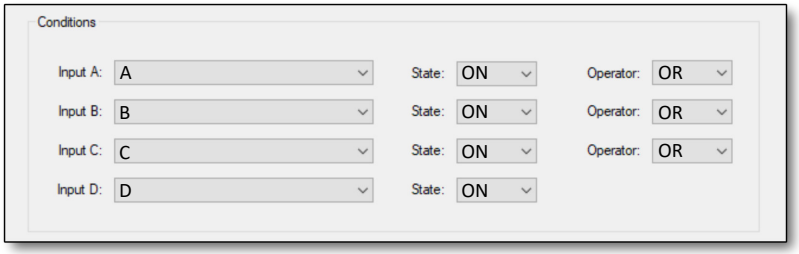
Matrix Type:
Four Conditions, Two or Two or One

All Possible True Conditions
- A and C are active.
- B and C are active.
- D is active.



Matrix Type:
Four Conditions, Two or One or One

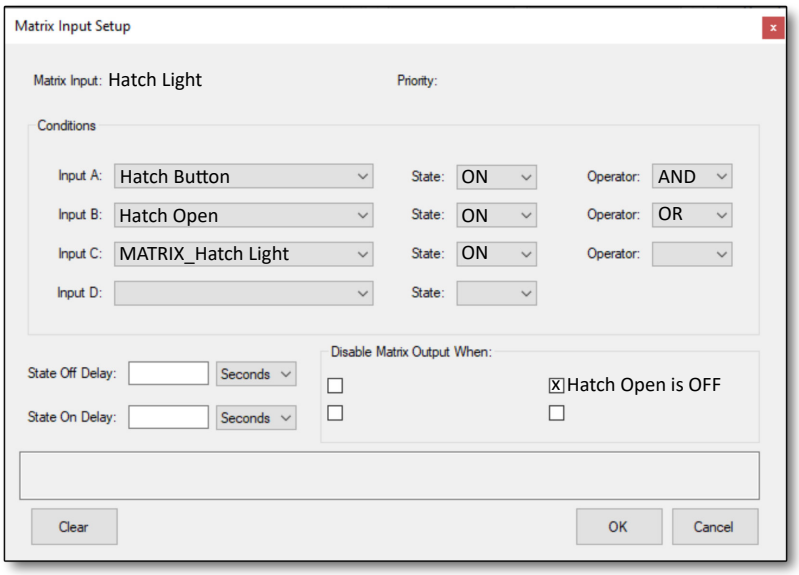
All Possible True Conditions
- A and B are active
- C is active
- D is active



Matrix Type:
Four Optional Conditions

All Possible True Conditions
- A is active.
- B is active.
- C is active.
- D is active.

Looping



Anytime a Matrix references itself as an option (OR) in the last condition, it becomes a looping Matrix.

Once the Matrix activates based on the above conditions, it sees itself active as the last condition. It keeps running regardless of the state of the other conditions.

Be sure to include a cancellation feature by checking a box in the “Disable Matrix Output When” section.

In the example to the left, a momentary button turns on the Matrix as long as the hatch is open. Once started, the Matrix doesn’t care about the hatch button state.

However, it does care about the Hatch Open state, as shown in the Disable area.

Priority Worksheet

bluePRINT allows users to set priority levels for user-defined inputs, changing from the default setting of 3. By doing so, programmers can provide override functionality for feature sets and de-conflict their program.

Below are recommendations for setting priorities for certain functions or features. These recommendations are designed to reduce conflicts in common programming scenarios. Please consider these guidelines for your own programs. Remember that the higher the number, the more powerful the priority.

Don't Forget "Control Hover!"

Holding the Control (Ctrl) key while hovering the mouse cursor over an input, priority, or output provides additional information necessary for determining what priority to set an input at. It's a very useful time saver!

1 **2**

Priorities 1 & 2 are recommended for functions like Cruise and Low Power. By setting these low to begin with they are easy to override by things like response modes and scene lighting.

Additionally, low priority flash patterns can be used here. These are flash patterns that will be overridden by almost every other function in a program.

3 **4** **5** **6**

Priorities in the 3 - 6 range are recommended for the primary flash patterns. As patterns change in a vehicle (with slide switch, or possibly vehicle speed changes) we recommend going up one priority at a time in this range.

When additional patterns beyond the four in this range are needed, consider priority 2 and priority 7.

7 **8**

Priorities 7 & 8 are recommended for steady scene lighting. Alley lights, take-downs, work lights, and front and rear scene are examples of this. Reverse lights are generally excluded from this range.

If additional higher priority flash patterns are needed, locate them here.

9 **10**

Priorities 9 & 10 are reserved for your highest priority functions. These are usually reserved for features like brake and reverse, as well as alarm or panic modes.

Don't forget that there is a priority within a priority built into bluePRINT's processing order. For more information, check out the bluePRINT Instruction Manual's section on Priority.

Acceleration Light

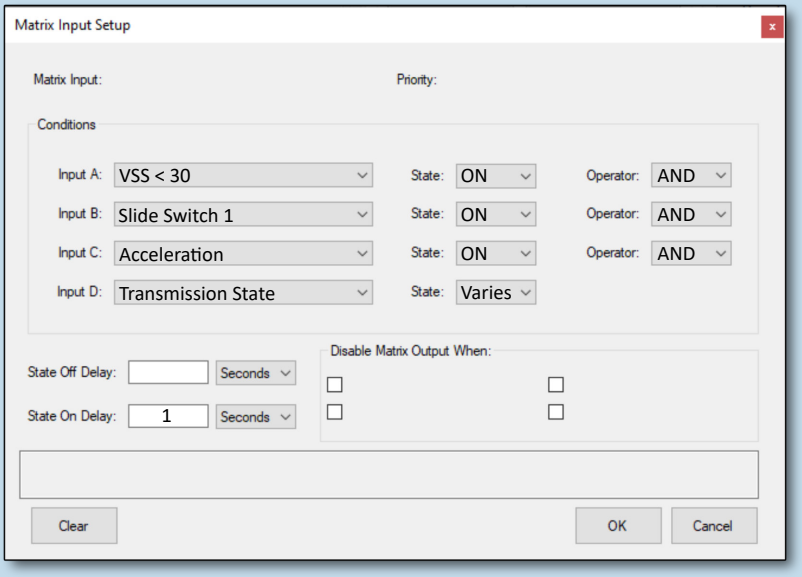
This Matrix is commonly used when a dignitary is being transported, but can also be used with any emergency vehicle in a similar scenario.

The idea is when the vehicle suddenly accelerates, such as when fleeing a threat, a light on the rear of the vehicle activates in a specific warning pattern, signaling following vehicles of the event. Alternatively, it can be programmed for convoy-type movements to help maintain intervals.

Typically the warning pattern is at a flash rate that gathers attention, but doesn't cause excess visual distraction. We recommend a pattern like "Road Runner," or "Power Pulse" for this Matrix. Using a color that differs from the rest, such as green, is a good idea, too. If using a distinct color, you might choose to have it turn on versus flash.

The priority for this feature may or may not need to be set at a higher range, depending on how the acceleration light is being used before activation of this Matrix; If the acceleration light is dedicated for this function, this Matrix can likely be set to any priority that has the desired flash pattern.

On the other hand, if the acceleration light is already active from another feature - such as a red/green light that is currently flashing red - the Matrix will need a higher level of priority to shut down the red light.



Conditions Information

Input A: This should be a minimum or maximum speed trigger (or both) captured with bluePRINT Link for when this Matrix can be active. In this example we used less than 30mph.

Input B: If the slide switch is a requirement for this function to work, include it here.

Input C: This determines how hard one must be on the accelerator pedal. bluePRINT Link has inputs for Accelerator Pedal Position, MPH/Sec, or KPH/Sec. Any of these will work, but there may be some trial and error involved to find the right acceleration level.

Input D: The transmission state is likely to be Park=OFF for anytime the vehicle is out of park, or Drive=ON if it is to work only when in forward gear.

On Delay: To prevent a false activation, add a 1 second (or more) On Delay.

Priority & Output Information

Priority: Because this is a visual communication signal between vehicles, this should probably be set at a high priority to override flash patterns and scene lights.

Outputs: Any outputs that are to flash or otherwise be affected as part of this sequence. If using a multi-colored light, be sure to turn off any outputs that can interfere with the proper color operation of this light.

Matrix Type: Four Required Conditions

Alarm - Augmenting a K9 System

Many times K9 alarm systems cannot be seen or heard over everyday noises such as traffic, radio, or distractions like a loud car stereo. Additionally, the handler may not be in an audible range of the vehicle's horn.

This can be a problem for the K9 and handler if they do not have any sort of pager. Usually, when the K9 system is alarming, temperatures in the vehicle are already in a dangerous state.

K9 alarm systems can be integrated with bluePRINT to provide additional noise or lighting as needed. This type of augmentation is best when broken into a couple different Matrices to handle specific functions.

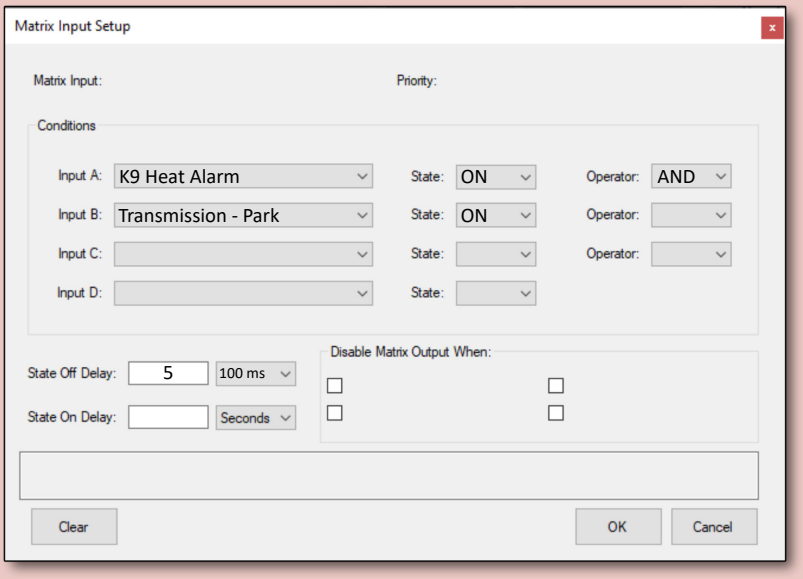
Please note - this is not the only way to handle K9 system augmentation.

Disclaimer - bluePRINT should never be used as the sole K9 protection system.

Matrix 1

Heat Alarm Activation

The purpose of this Matrix is to add supplementary lighting to the K9 heat alarm.



Conditions Information

Input A: All K9 heat alarm systems have an output trigger for activating warning lights. Sometimes this lighting trigger is pulsing, and other times it is constant. If it is a pulsing output, please refer to the Off Delay below.

Input B: The transmission should be in park. If the K9 system were to activate while out of park, that could cause lighting and sirens to activate as well. Including park disables this Matrix and all others that follow.

Off Delay: If using a heat alarm with a pulsing signal, use an Off Delay to have bluePRINT keep lights active between pulses. Usually a 500 millisecond delay is fine.

Priority & Output Information

Priority: Priority should be high for this. Using the priority scale on page 10, we recommend priority 7 or 8.

Outputs: Map any lights that are going to be active when the heat alarm is active. These should be set to a flash pattern to gain maximum attention. If activating a siren tone, bluePRINT contains alarm-type tones that are distinct from siren tones.

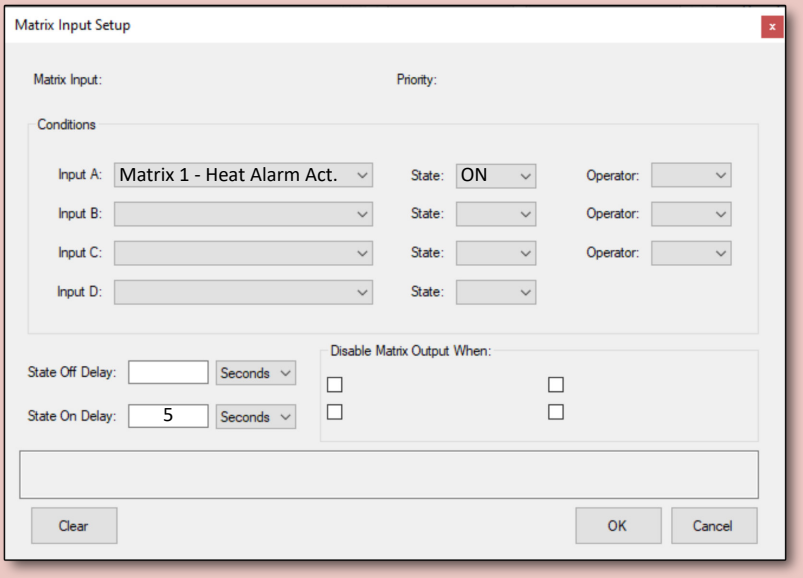
Matrix Type: Two Required Conditions

Alarm - Augmenting a K9 System

Matrix 2

Heat Alarm Timer

The purpose of this Matrix is to create a timer for other Matrices to use for activation delay. In this case, this Matrix specifically delays Matrix 3 in the Alarm series (next page).



Conditions Information

Input A: The Matrix created on the previous page is the only input required for this Matrix.

On Delay: Setting the On Delay here prevents the next Matrix from activating right away. Adjusting this time changes how long bluePRINT waits before adding the air horn to the mix.

Priority & Output Information

Priority: Priority is of no concern with this Matrix.

Outputs: There is no output mapping with this Matrix.

Matrix Type: One Required Condition

Alarm - Augmenting a K9 System

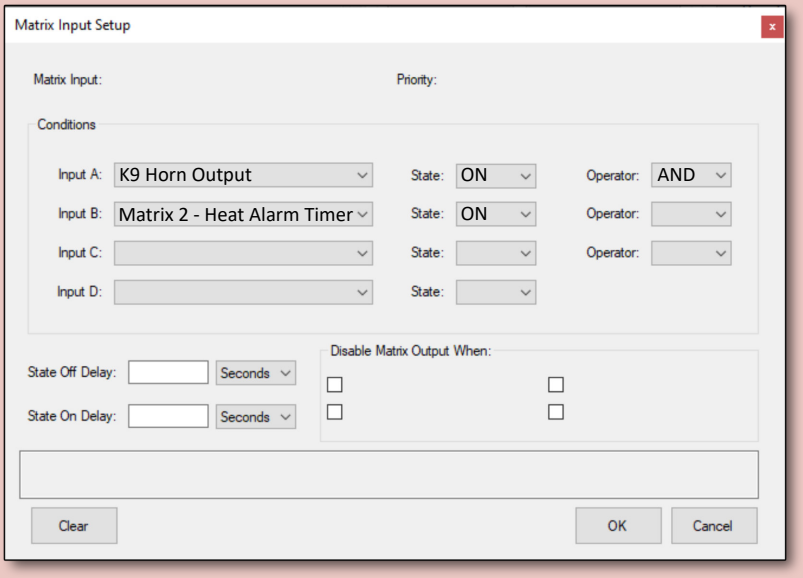
Matrix 3

K9 Horn Output

The purpose of this Matrix is to use the horn output trigger from the K9 system to activate the AUX tone in bluePRINT.

This provides a loud audible tone that can be heard further out that the OEM horn on the vehicle.

This horn or siren output activates after a short delay, allowing the handler to shut the alarm off before bluePRINT supplements with the air horn.



Conditions Information

Input A: Most K9 systems have a horn output that provides either a steady on-off sequence or a SOS Sequence. This should be connected to both an input on bluePRINT and also the OEM horn of the vehicle (using relay where needed). The OEM horn starts pulsing before bluePRINT.

Input B: Matrix 2 - Heat Alarm Timer is active. This Matrix has a delay that prevents the horn from outputting. This is in case someone is in front of the vehicle or near the siren. It provides the handler a grace period to deactivate the alarm.

Priority & Output Information

Priority: Priority is likely not going to be a concern with the Matrix since it is turning on the AUX Tone in bluePRINT. AUX tone defeats Park Kill in bluePRINT.

Outputs: Use the AUX tone that is on the Siren/System output tab. To program what AUX tone does, head to the Siren Setup tab at the top, and find AUX tone in the list. Here you can set up different tones to activate. We recommend Air Horn, Piercer Tone, or one of the alarm-type tones.

Matrix Type: Two Required Conditions

Alarm - Augmenting a Vehicle Alarm

This is an elaborate setup that adds lighting and air horn to an aftermarket vehicle alarm when it is in the alarm state, after a pre-set amount of time.

Once alarming, bluePRINT supplements with constant lighting (for example scene lighting) during the alarm state, and a pulsed alarm to match the horn output from the vehicle.

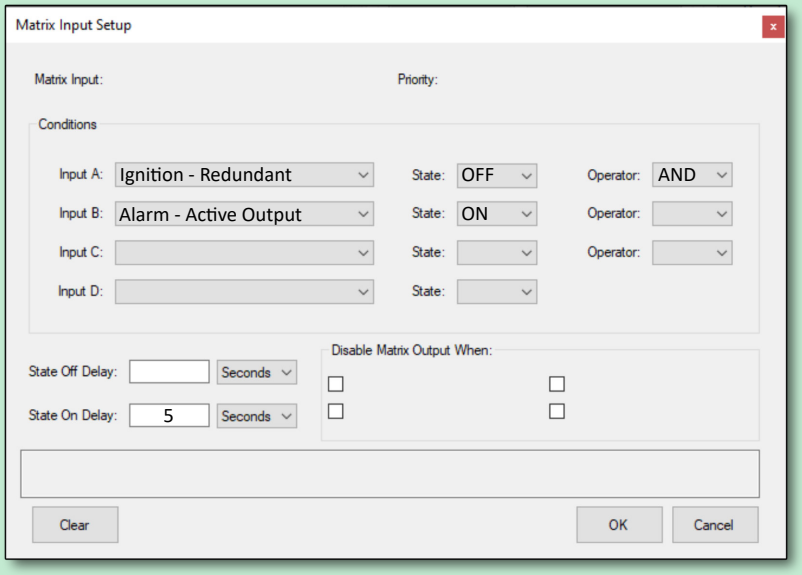
Because of the way bluePRINT is designed, this clever setup wakes bluePRINT from the sleep state and puts it directly into the alarm state. See the schematic on page 19 for more information.

Matrix 1

Alarm Activation

This first Matrix adds emergency lighting to the alarm five seconds after the system goes into the alarm state.

The reason for the delay is that sometimes alarms go off when the user didn't intend for them to. Adding the delay in the Matrix configuration provides a small "grace period" for the user to turn the alarm off.



Conditions Information

Input A: Run a redundant signal from the vehicle's ignition circuit to an input on bluePRINT. Since there will be two different ignition circuits that can wake up bluePRINT, we need the redundant input so bluePRINT can tell which ignition circuit is active. In the schematic on page 19, this is represented as input #1 on the Input Node.

Input B: Run the alarm active output from the alarm to this input, but also include a redundant connection at the ignition input for bluePRINT. See page 19 for more information. This is represented as input #2 on the Input Node.

On Delay: To prevent a false activation, add a 3-5 second (or other amount of time sufficient to your need) On Delay.

Priority & Output Information

Priority: Because this is going to override several different functions, we recommend a higher priority, eight or higher.

Outputs: Any outputs that are to flash or activate as part of this sequence.

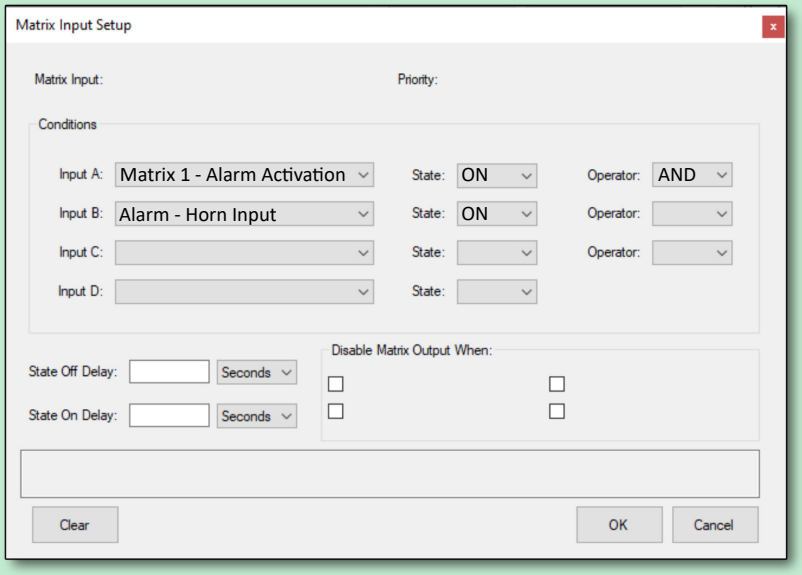
Matrix Type: Two Required Conditions

Alarm - Augmenting a Vehicle Alarm

Matrix 2

Air Horn Pulse Activation

This Matrix goes active once the vehicle alarm is active, and is active during all horn pulses.



Conditions Information

Input A: Reference the first Matrix in this series (previous page).

Input B: The horn output from the alarm system is the second condition. This is represented as input #3 on the schematic on page 19.

Priority & Output Information

Priority: Because we are triggering either the Air Horn or AUX tone outputs on the siren system, Park Kill does not affect the siren output. Priority can be set low or likely ignored.

Outputs: Map this Matrix to turn on the Air Horn or AUX tone outputs on the Siren/Setup output tab.

Matrix Type: Two Required Conditions

Alarm - Augmenting a Vehicle Alarm

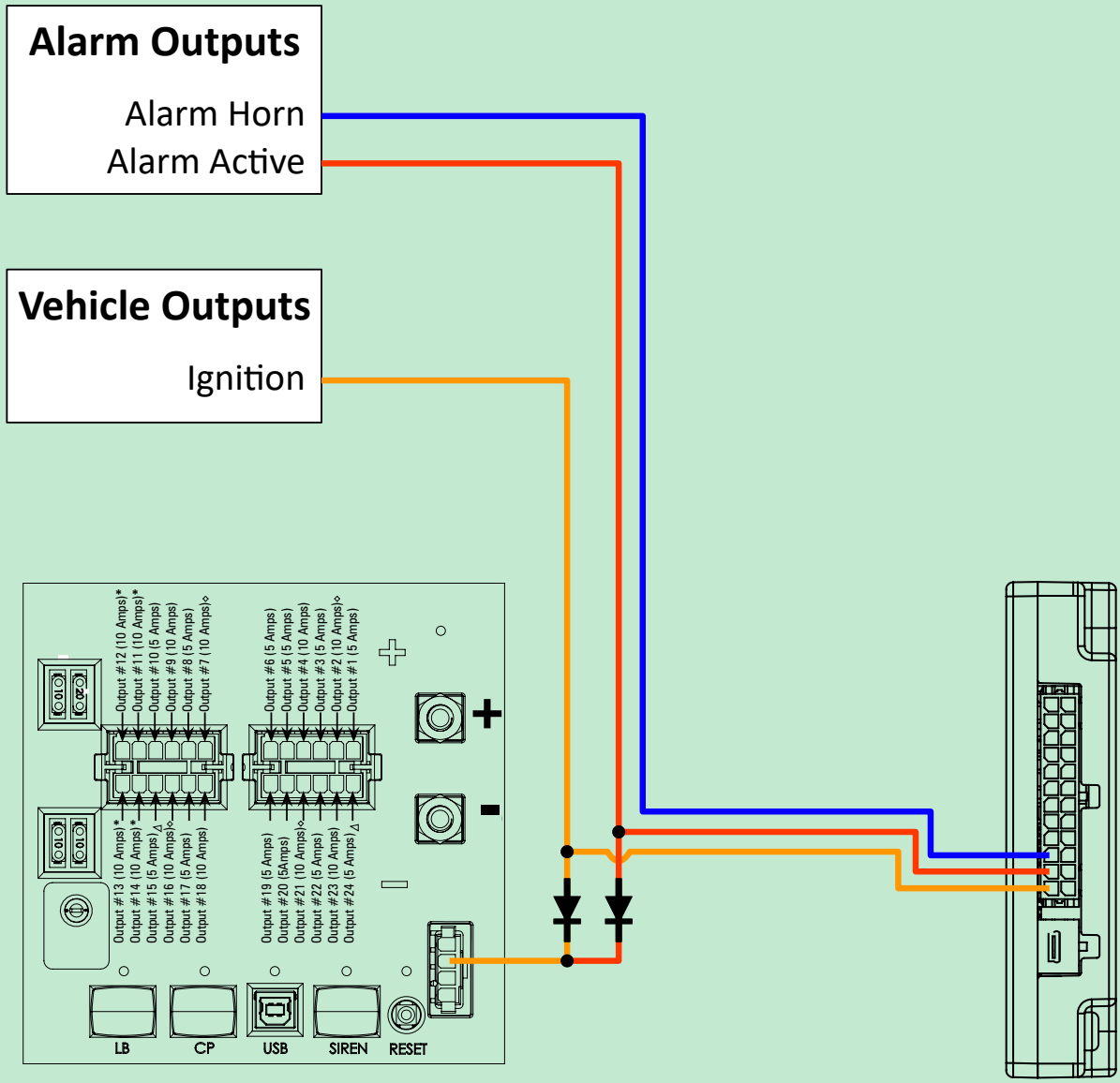
Schematic

Alternate Ignition Turn On

All inputs for the input node on bluePRINT are shown, for example. Any input can be used on the input node.

This requires two diodes.

With this setup, the alarm can wake bluePRINT and allow it to respond with lights and air horns.

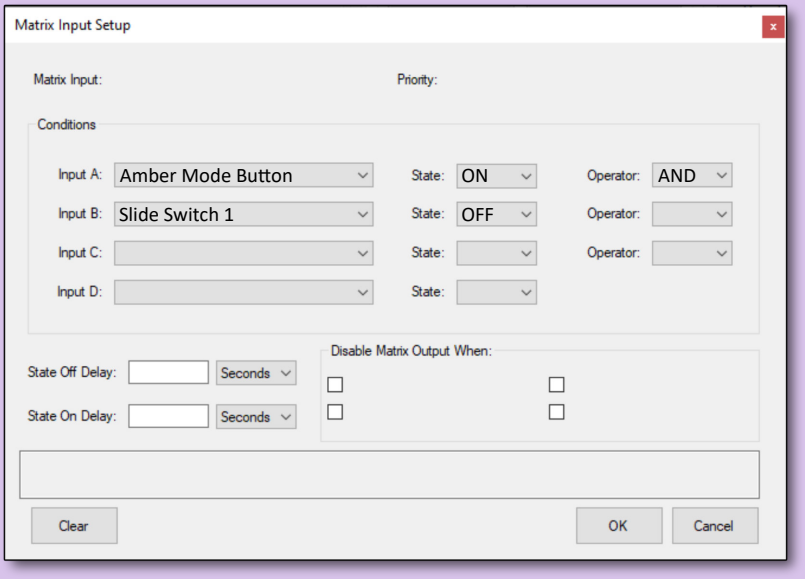


Amber Mode

It's not all that uncommon for a first responder to work alongside utility workers. Many times police respond to utility emergencies to help divert traffic. Another use is work zone speed enforcement where the officer want his vehicle to look like a utility vehicle from a distance.

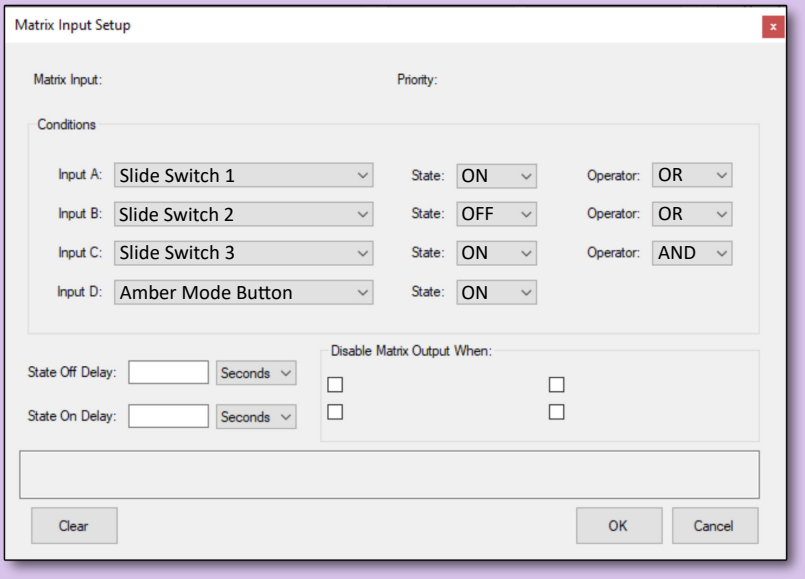
This Matrix creates a solution for departments wanting to activate amber or green lights without interfering with the slide switch - all at the push of a button (OEM hazard light button, for example).

When the "amber button" is activated, the utility lights come on. If the officer decides to activate his or her emergency lights via the slide switch, the amber lights immediately turn off and stay off.



Progressive Slide Control

Matrix Type: Two Required Conditions



Other Slide Control Types

Matrix Type: Four Conditions, Two or Two or Two

Conditions Information

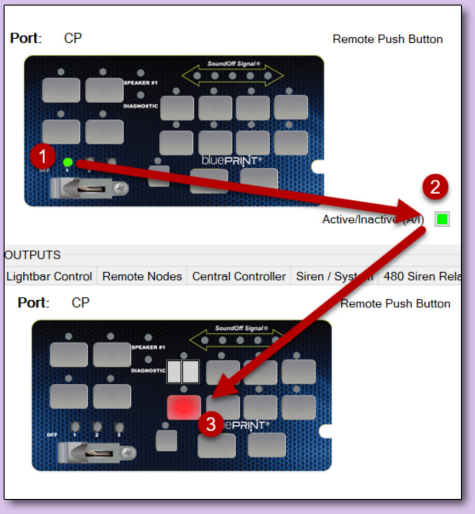
Input A: A toggle button needs to be activated to turn this feature on. Most commonly, this is a button on the control panel. Since Radio Rebroadcast is no longer commonly used, re-purposing this button to AUX9 in bluePRINT as a latching button may be the way to go. If using bluePRINT's Link module, you could use the OEM hazard lights as an alternative.

Input B: The slide switch needs to be referenced as off for this Matrix to work. If using a progressive slide control, use Slide position 1 as the input. When using any other type of slide control, all three slide conditions should be mentioned -

Priority & Output Information

Priority: This Matrix only works when the slide switch is off. Conflicting patterns is not likely. A lower priority may do the trick.

Outputs: We recommend flashing the amber or green colors on lights placed near the corners of the vehicle. Additionally, map the slide switch activation to turn the amber button off or to disable the Matrix if there is concern that the Matrix will re-activate when the slide switch is turned off.



Brake Lighting

A staple function in bluePRINT is to use brakes in conjunction with the slide switch activating, providing additional lighting to the rear of the vehicle when the brakes are applied.

This Matrix is used many times in bluePRINT programming, sometimes even more than once, to define different functionality based on the situation at hand.

Input information like slide switch, brake, brake torque, speed, day, and night can easily change the scenario that makes a Brake Matrix true.

Brake Matrices are typically "stacked" using conditions from another Matrix as a starting point (most commonly, Slide Switch 3 Out of Park, or SS3OOP).

One idea that should always be considered with Brake Matrices and stacking off the SS3 OOP Matrix, is one with an officer on the side of the road in SS3 with the foot on the brakes. This scenario can easily turn the back of a first responder vehicle into a glob of red. Using a vehicle speed input speed can avoid this situation.

On the next few pages, we will discuss different Matrices covering the Brake functions.

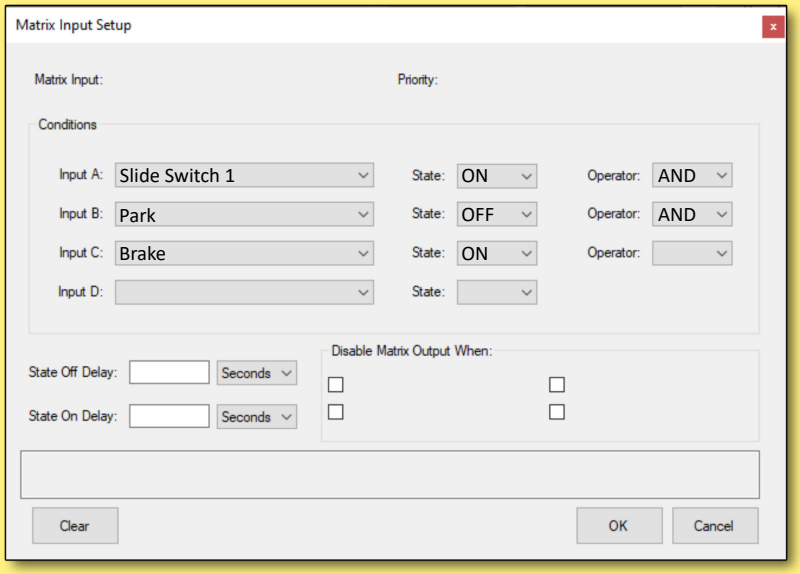
Disclaimer - It is the programmers responsibility to ensure compliance with all regulations, laws, and ordinances concerning vehicle brake signals. SoundOff Signal does not recommend that enhanced brake features be used during routine vehicle operation.

Matrix 1

Basic Brake using Park

This Matrix is self-contained, meaning it doesn't rely on information from another Matrix.

The design of it is fundamental - if warning lights are on, the brake is applied, and the vehicle is not in park, it activates.



Conditions Information

Input A: Slide switch 1 represents any slide switch is active in a progressive slide setup. This could be slide switch 2 as well if it were meant to exclude slide switch 1. The same idea works for slide switch 3.

If using a slide switch type other than progressive, the individual slide switch positions will need their reference as shown on page 41. This may require Matrix stacking if there are more than four conditions required. See page 7 for more information.

Input B: Park should be off for this to work - at a minimum. We recommend using a speed minimum if connected with bluePRINT Link.

Input C: The brake has to be active.

Priority & Output Information

Priority: Because this is going to override several different functions, we recommend a higher priority. Above eight on the table on page 13.

Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.

Matrix Type: Three Required Conditions

Brake Lighting

Matrix 2

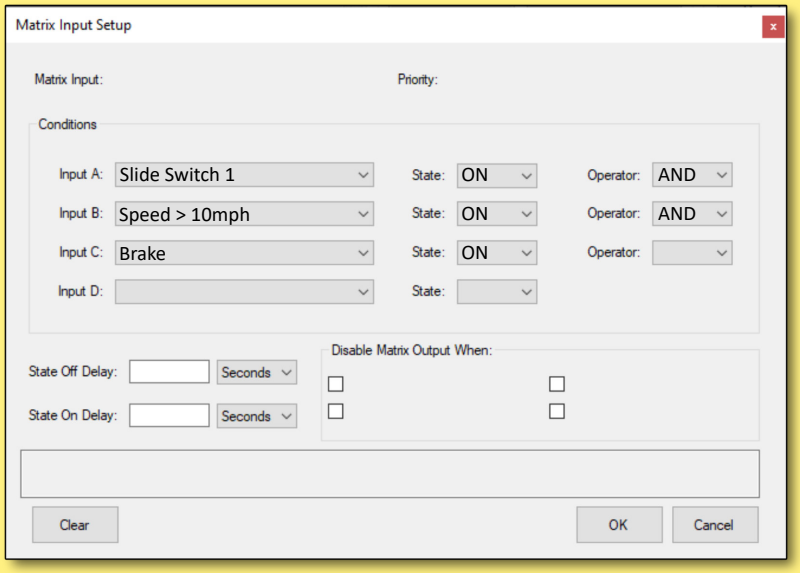
Basic Brake using Speed

This Matrix is also self-contained, not relying on any other Matrix to be active.

This differs from the previous Matrix since it uses speed in place of park. With this variation in place, when the vehicle gets below a certain speed, the brake override function no longer works. At lower speeds, rear warning is prioritized over enhanced braking signals.

This Matrix requires bluePRINT Link.

We recommend using speed instead of park any time vehicle speed is available for Brake features.



Conditions Information

Input A: Slide switch 1 represents any slide switch is active in a progressive slide setup. This could be slide switch 2 as well if it were meant to exclude slide switch 1. The same idea works for slide switch 3.

If using a slide switch type other than progressive, the individual slide switch positions will need their reference as shown on page 42. This may require Matrix stacking if there are more than 4 conditions required. See page 7 for more information.

Input B: Setup an input on bluePRINT Link for Vehicle Speed. Use a number higher than zero - we recommend 5-10mph for this Matrix to activate.

Input C: The brake has to be active.

Priority & Output Information

Priority: Because this is going to override several different functions, we recommend a higher priority. Above eight on the table on page 13.

Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.

Matrix Type: Three Required Conditions

Brake Lighting

Matrix 3 & 4

SS3 Brake Day / Night

This set of Matrices creates day and night versions of the same Matrix. Because they utilize the Photo-sensor, only one Matrix can be active at a time and there can be no conflict between these two Matrices.

In these examples, we use Matrix stacking.

This Matrix may require bluePRINT Link.

We recommend using speed instead of park any time vehicle speed is available.

Conditions Information

Input A: Both of these Matrices are stacking by using the SS3 10+ Matrix described on page 7.

These Matrices could also be self-contained (not using stacking) by changing input A to SS3 and adding Input D as vehicle speed higher than 10mph.

Input B: This is where the significant change in each Matrix lies. From a setup standpoint, everything else is the same except for this condition. In one Matrix, the photocell is referenced as on, and in the other, it is referenced as off.

Input C: The brake has to be active.

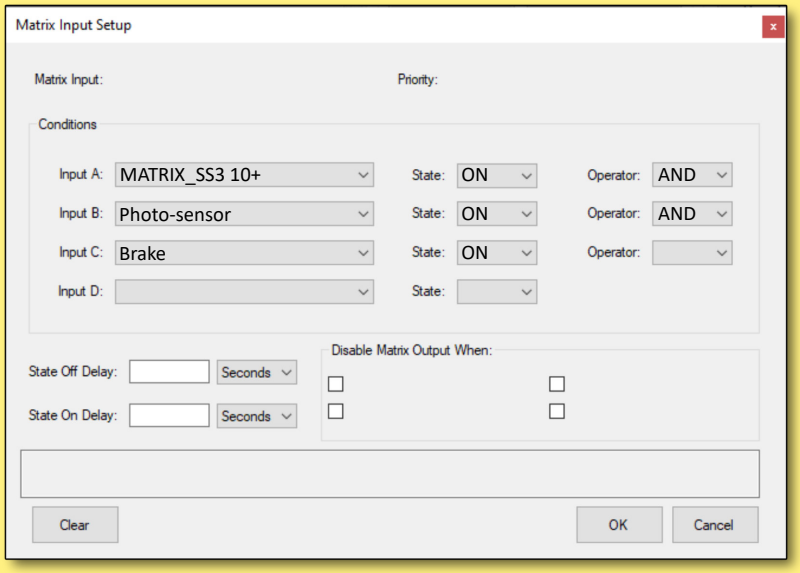
Priority & Output Information

Priority: Because this is going to override several different functions, we recommend a higher priority. Above eight on the table on page 13.

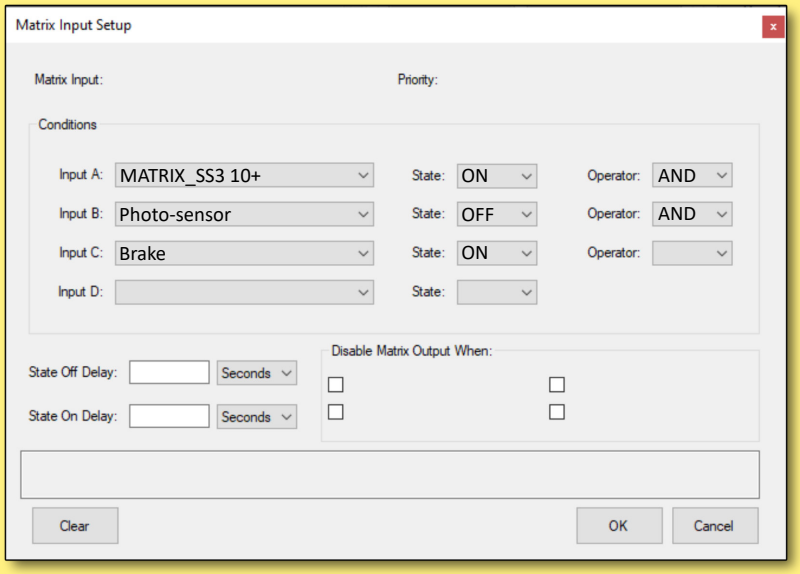
Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.

There may be a variation from one Matrix to the other. This could be a change in the pattern (flicker brake, vs. steady on), or a change in which lights are active.

Remember, these two Matrices cannot run at the same time. This means they can reside at the same priority if flash pattern isn't of concern.



SS3 Brakes 10+ Night
Matrix Type: Three Required Conditions



SS3 Brakes 10+ Day
Matrix Type: Three Required Conditions

Brake Lighting

Matrix 1 - 4

Adding Panic Braking

If a Matrix has a spare condition available, adding one more condition referencing brake torque or sudden deceleration can trigger the Matrix to activate without the other conditions are present.

This requires bluePRINT Link

Conditions Information

This requires adding a fourth condition to the end of the Matrix. In all the above Brake Matrices, Input D has been available.

Input D: Adding Brake Torque at a higher percentage with the OR operator allows this Matrix to activate regardless of what the slide switch is doing.

Some vehicles do not have Brake Torque as a bluePRINT Link Input - An alternative is to use:

*Vehicle Acceleration is **less than** (>) a **NEGATIVE** number*

This shows a sudden deceleration. This most likely will require tweaking to get right.

We recommend using screen recording software or a passenger to get an idea of what this number jumps to during a panic stop.

Another option is to use:

ABS ON

Priority & Output Information

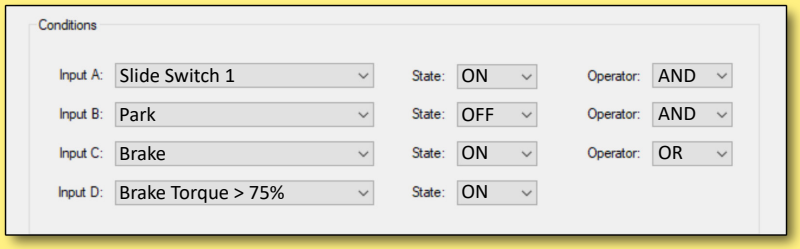
Priority: This will not likely modify a Matrix any more than what was initially discussed in previous pages.

Outputs: When outputs are set to go steady or turn on the Flicker Brake pattern, this Matrix will be ideal.

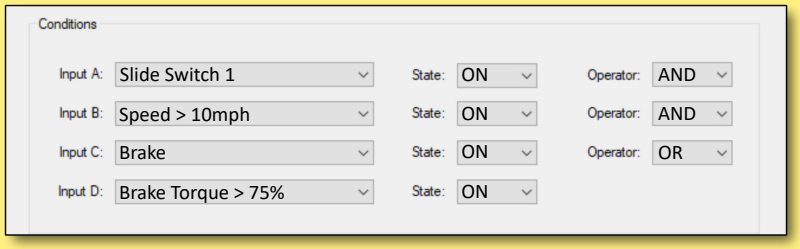
However, some departments want their brake lights also to change the rear pattern to a slower pattern - this requires output mapping for those lights to change patterns.

Adding Brake Torque, ABS, or Deceleration to a Matrix like this would cause the warning lights to go on.

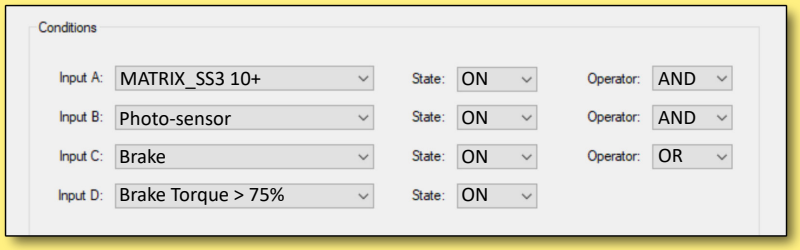
Instead, look at the next page on Brake Matrices.



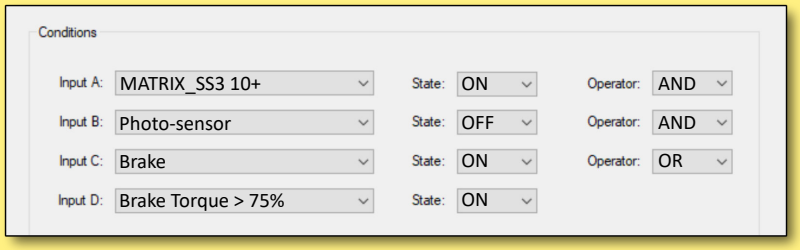
Matrix 1 - Basic Brake Using Park
Matrix Type: Four Conditions, Three or One



Matrix 2 - Basic Brake w/ Speed
Matrix Type: Four Conditions, Three or One



Matrix 3 - SS3 Brakes 10+ Night
Matrix Type: Four Conditions, Three or One



Matrix 4 - SS3 Brakes 10+ Day
Matrix Type: Four Conditions, Three or One

Brake Lighting

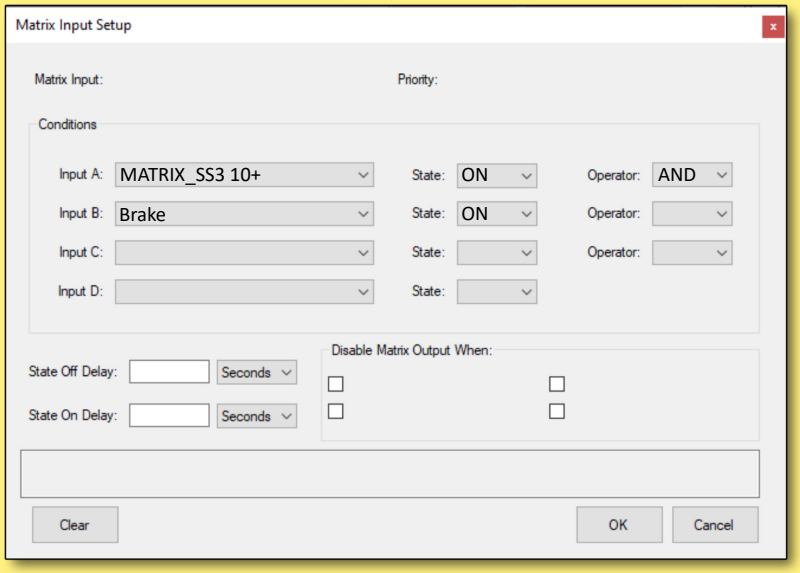
Matrix 5

SS3 Brakes Changes Pattern

This Matrix utilizes Slide Switch 3 and vehicle speed above 10 mph.

When the Matrix goes active, it turns specific outputs to steady on while other outputs change to a slower pattern.

This Matrix can be used in conjunction with another Matrix. Example - one Matrix adds Flicker Brake pattern for Brake Lights, and the other Matrix maps lights that are currently flashing to a slower pattern.



Conditions Information

Input A: This Matrix utilizes stacking by using the SS3 10+ Matrix described on page 23.

These Matrices could also be self-contained (not using stacking) by changing Input A to SS3 and adding Input C as vehicle speed higher than 10mph.

Input B: The brake has to be active

Note: Using Brake Torque as an input could activate this Matrix without the slide switch active. We don't recommend using this as a condition since it activates warning lights, as described under outputs.

Priority & Output Information

Priority: This Matrix includes a flash pattern change. The priority will need to be higher than any lights that are currently flashing.

Because this is going to override several different functions, we recommend a higher priority. Above eight on the table on page 13.

The new priority should include a slower flash pattern. We suggest Slow Runner.

Outputs:

- Lights that are designated as brake - set them to steady on. This may not be necessary if using two Matrices as described in the description for Matrix 5.
- Lights that are to change flash patterns - set them to flash.
- Lights that are to turn off - set them to off.

Matrix Type: Two Required Conditions

Door Matrices

In this series, we'll cover door functions. Door Matrices typically involve turning lighting off, activating low power, or cruise modes.

We'll discuss how to use a Matrix to activate or deactivate functions, but what happens if the door is left open? This could create a scenario where a light or group of lights are turned off - a potentially dangerous situation.

Using bluePRINT logic, we can create specific automation that disable Matrices after a certain amount of time.

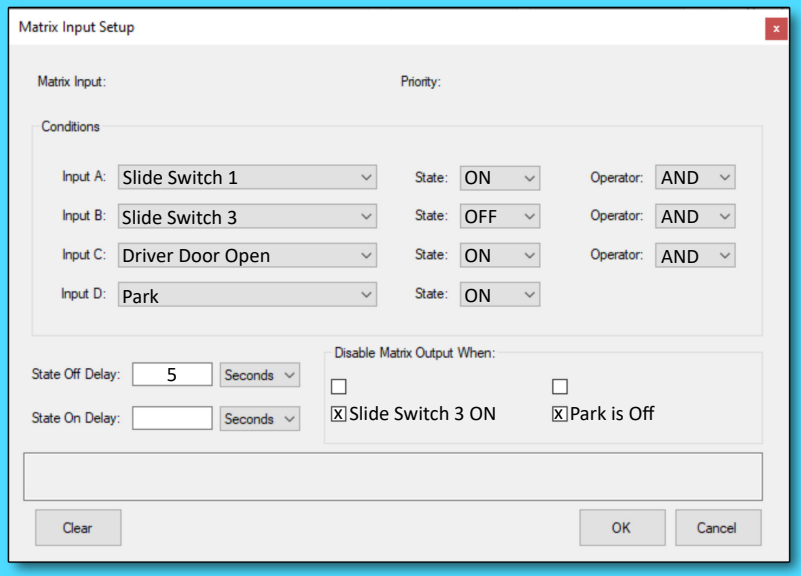
Matrix 1

Door Open
Traffic Arrow Activation

In this scenario, the vehicle automatically activates the traffic arrow when the officer opens the door.

Once the door closes, the warning pattern resumes.

This is most likely to happen on the driver side door but a second Matrix could also be written for the passenger side.



Conditions Information

Input A: Slide switch 1 as a requirement excludes this Matrix from activating when the emergency lights are inactive.

Input B: Here, we are referencing slide switch 3 is OFF. In a progressive control, this means the Matrix will only work in slide switch 1 or 2.

This guarantees that the slide switch 3 warning level always has priority over this function.

If using a slide switch type other than progressive, Input B could also be referenced as Slide Switch 2 ON.

Input C: The driver door must be open.

Input D: Park must be active

Off Delay: The off delay keeps the traffic arrow active for 3-5 seconds after the door closes.

Disable: Note the disable on Slide Switch 3 ON and Park is OFF. This allows slide switch 3 to immediately override the off delay timer.

Priority & Output Information

Priority: Depending on which lights are being selected, priority may or may not be significant.

- If using a lightbar for the arrow function, a lower priority is OK. Lightbars have a built-in priority that is not affected by bluePRINT priority.
- If using perimeter lights - the default priority for an arrow array is 10.

Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.

Matrix Type: Three Required Conditions

Door Matrices

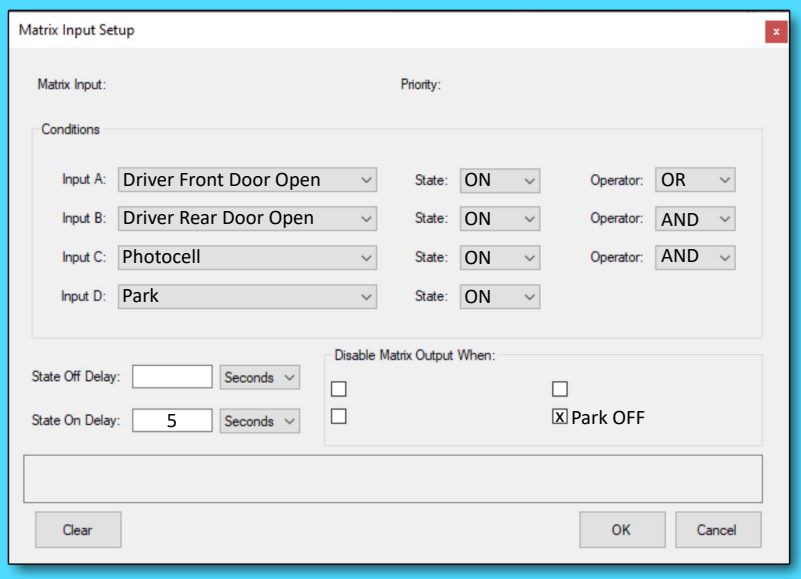
Matrix 2

Door Open
Corner Kill Only

This is a fundamental Matrix that turns lightbar corners, and potentially some of the side lighting off when the door is open.

Once the door is closed, these lights remain off for a specified amount of time.

This Matrix does not require the slide switch to be active.



Conditions Information

Input A: The driver's front door must be open. This could be either driver or passenger sides.

Input B: This input is optional. Some departments want both the front or rear door to activate this feature. This could be the driver or passenger side rear door.

Input C: The lightbar photocell must be active. If using an interior lightbar or an exterior with no photocell, the parking lights on the vehicle usually suffice. Another option is to use an aftermarket 12v photocell.

Input D: Park should be on.

Off Delay: The off delay keeps the corner kill active for 3-5 seconds after the door closes.

Disable: Note the disable checkbox on Park OFF. This allows park to override the off delay timer immediately.

Priority & Output Information

Priority: Depending on which lights are being selected, priority may or may not be significant.

- If using the lightbar corner disable feature, priority can likely be ignored
- If disabling perimeter lights - The priority must be higher than anything, it needs to override. Using the table on page 13, this Matrix would likely be around 7-9. Keep in mind, some departments want this to override flashing lights, but not override scene lights.

Outputs: Any outputs that are being turned off. In the case of the lightbar, corner disable, that is being turned on.

Matrix Type: Four Conditions, Three or Three

Door Matrices

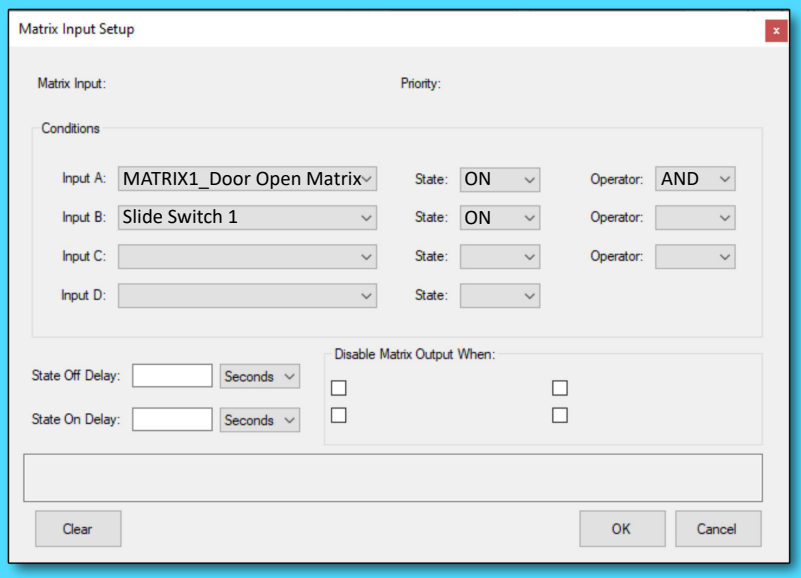
Matrix 3

Door Open
Corner Kill With Added Light

Some departments like to use mirror lights as a "cover light" when the doors are open.

Additionally, an inside the door marker light may activate while the emergency lights are active.

In either of these cases, emergency lighting being active must be a requirement.



Conditions Information

Input A: Using Matrix 1 - Door Open as a requirement takes care of the door, photocell, and park requirements.

Input B: Using a Slide Switch excludes this Matrix from activating when the lights are off. This is usually Slide Switch 1 or 2.

Notes: In this Matrix, we are not referencing the MATRIX_DELAY (see page 6) or including a timer. This is because these features should only work when the door is open.

Additional conditions could be used to disable corner kill during daylight or when the vehicle is not in park. This would allow for maximum warning signal during daytime, where officer vision is less likely to be impacted, and also allow for continued corner warning if an officer is preparing to bail out before vehicle has stopped moving.

Priority & Output Information

Priority: Priority needs to be high enough for lights that are going steady to override any flash patterns. Additionally, if more than one output is required to get steady color (typically white), the priority needs to be high enough to override both outputs.

Outputs: Any outputs that are being activated. Typically this is the mirror light, and possibly an inside door marker.

Matrix Type: Two Required Conditions

Door Matrices

Matrix 4

Timeout Matrix

This Matrix has one job - to act as a timeout for the other Matrices shown above.

By inserting this Matrix as a requirement of another, we can create a scenario where everything goes back to normal after a certain timeframe.

This way, if the officer walks away from the vehicle with the door open, everything goes back to normal after 60 seconds.

Conditions Information

Input A: Reference the Door Open Matrix. This guarantees the Matrix cannot activate without first seeing the Door Open Matrix active.

Input B: This Matrix is going to loop once started, so we also include the Door Open condition to allow a break in the function.

Input C: Here is the loop. Have the Matrix reference itself, using the OR condition. Once it starts, it no longer cares about Input A's state.

On Delay: Set an on delay. This time should be how long the Matrix needs to wait - call it the timeout.

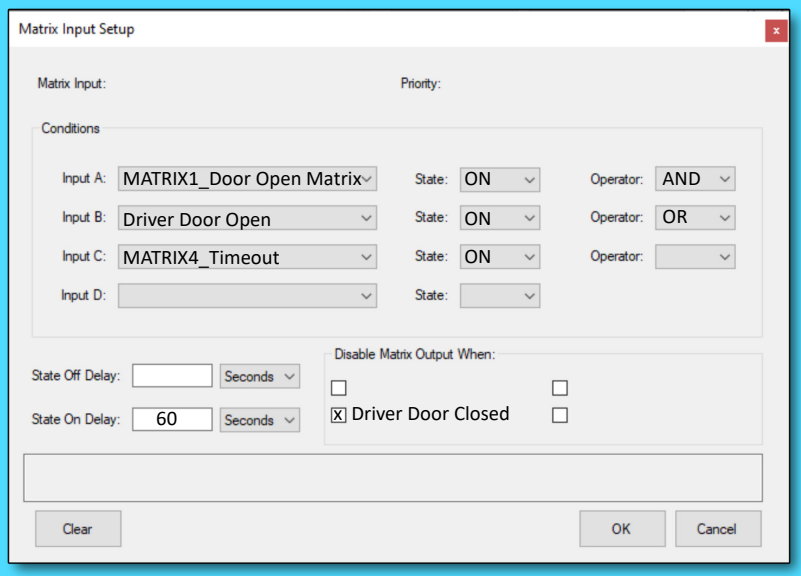
Disable: Note the box for Disable when Driver Door is Closed. This resets the Matrix.

Notes: The Matrix that we just created needs to be referenced in the Matrix described on Input A. This creates a circular reference between the two Matrices.

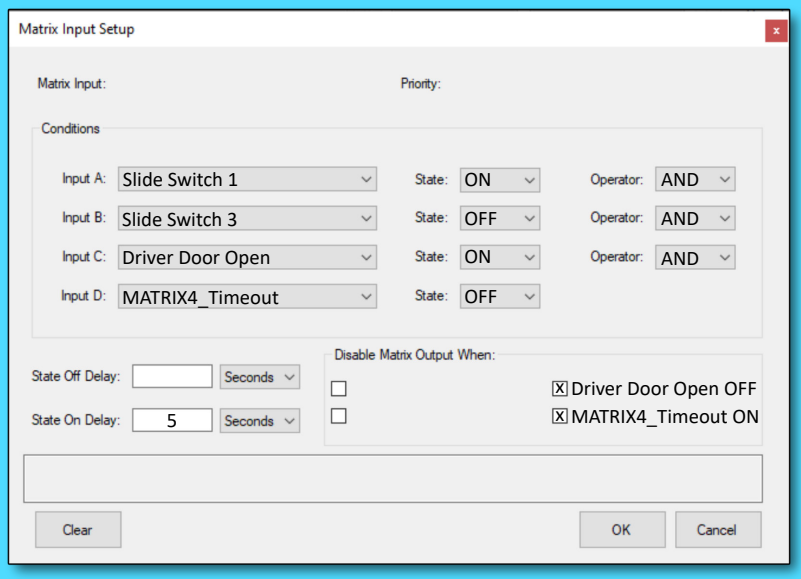
This may require stacking Matrices if there are more than four conditions in the original Matrix.

Priority & Output Information

Since nothing is mapped to this Matrix, Priority and Output information is not required.



Matrix 4 - Door Timeout
Matrix Type: Three Conditions, Two or One



Matrix 1 - Door Open Traffic Arrow Activation
Matrix Type: Four Required Conditions

DUI/DWI Mode

Impaired or intoxicated driver laws are often enforced using roadside sobriety testing. Best practices and legal precedents require that flashing warning lights be minimized or turned off when officers are administering these tests.

With bluePRINT, this can be accomplished using a Matrix (or two). Once active, bluePRINT either turns emergency colors to the front of the vehicle on steady or off altogether.

On the next few pages, we'll cover a couple of different ways to activate DUI/DWI lights automatically. Similarly, this could be further set-up to create a "traffic stop mode" that slows rear warning, triggers a left arrow, illuminates front scene lights and adds steady burn warning lights to sides of vehicle.

This creates an easy to use feature set for an officer to get their "perfect" set-up with one press of a button, allowing them to keep their attention on the suspect (WIN).

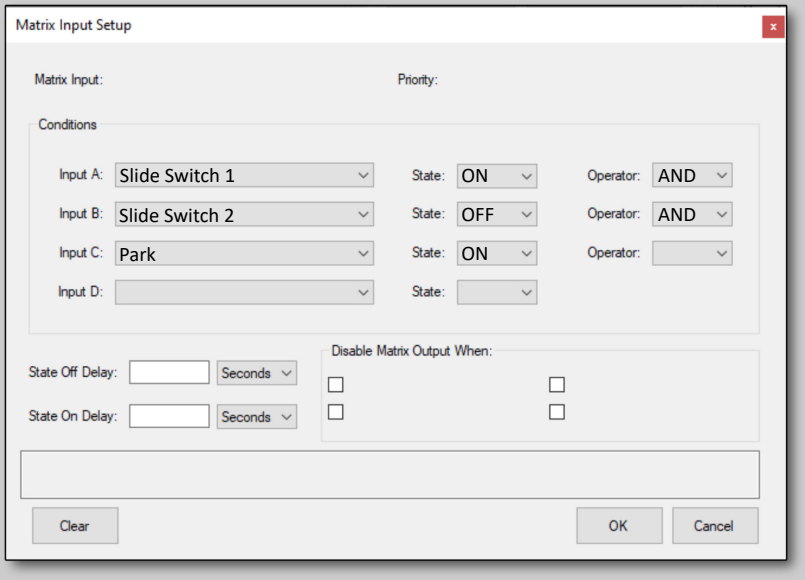
Matrix 1

Automatic DUI Lights

This Matrix activates DUI Light Mode automatically when the vehicle shifts to park.

Once active, lighting to the front of the vehicle either turns off or goes steady to aid in preventing disorientation during sobriety testing.

This variation activates the DUI lights every single time, with no operator override available.



Conditions Information

Input A & B: In the above Matrix, the first two conditions line up what slide switch position this Matrix will work in. In this case, it works when in Slide Switch 1, but disables itself when in Slide Switch 2.

This is an example of how to do a progressive controlled slide switch. If using an Independent or Mode 3 type slide switch, reference only the slide position that this Matrix is active.

Input C: Park should be active.

Priority & Output Information

Priority: The priority for this Matrix can vary - it depends on if there are active lights in the front of the vehicle.

If following a traditional 1-2-3 layout (rear-front-pursuit), priority can likely stay low. Referring to the table on page 13, we recommend starting around 3.

If any lights are being disabled as part of this Matrix, priority must be higher.

Outputs: Any outputs that are to go steady or off. This may include activating Scene 1, Scene 2, or Steady modes on the lightbar.

Additionally, there is a steady pattern for SOS lightbars that can also be used.

Matrix Type: Three Required Conditions

DUI/DWI Mode

Matrix 2 & 3

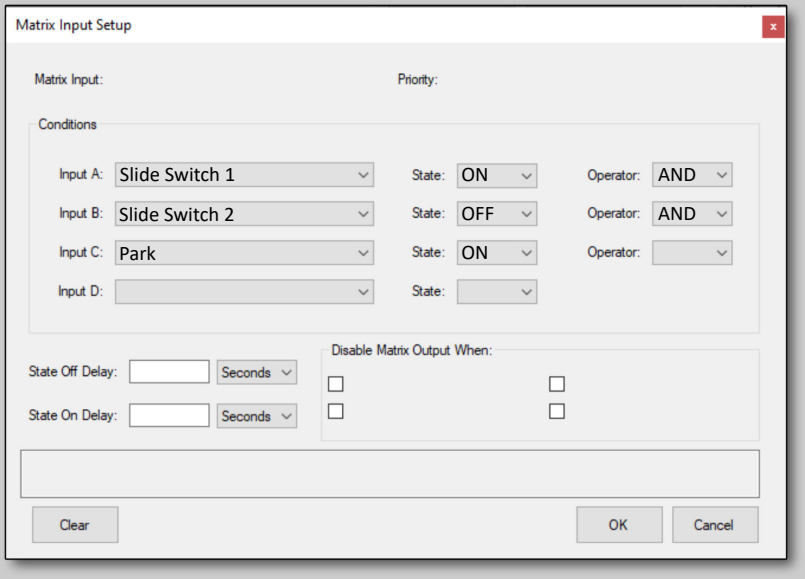
Automatic DUI Lights with Override

The next two Matrices are a variation of the first in this series. They rely on each other to work.

Here is how it plays out for the operator: When a vehicle is in Slide Switch 1 and in park, the DUI button activates automatically.

The operator can turn the DUI button off.

The beauty of this - the DUI button does nothing without all conditions met!



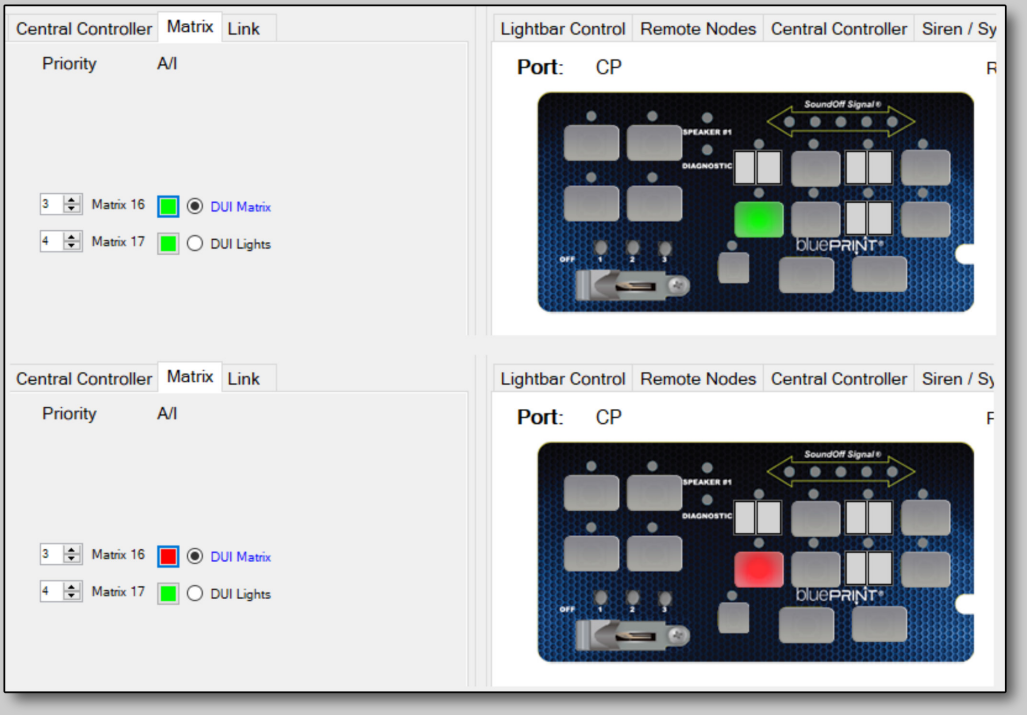
Conditions Information Matrix 2

Conditions are identical to Matrix 1.

Priority & Output Information

Priority: Since we are using this Matrix only to activate a control panel button, priority does not matter.

Outputs: This Matrix needs to toggle the DUI control panel button on and off as it goes active or inactive.



Matrix Type: Three Required Conditions

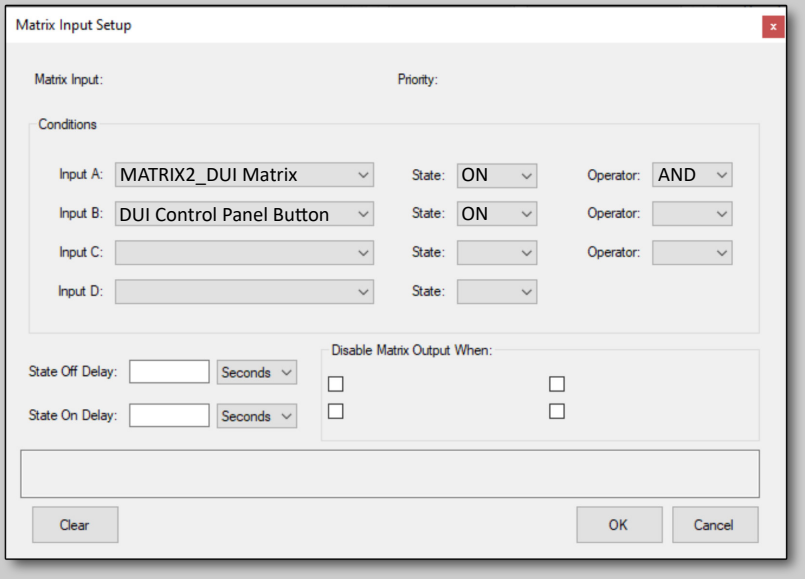
DUI/DWI Mode

Matrix 2 & 3

Automatic DUI Lights with Override

The final Matrix in this automatic activation series activates the DUI lights when the previous Matrix is active, AND the control panel button is on.

Even though Matrix 2 turns on the button, the operator can turn them off.



Conditions Information

Input A: This requires the DUI Matrix to be active. Remember - this Matrix already turned on the button, which is required for Input B.

Input B: The DUI control panel button is active.

This combination provides the vehicle operator the ability to override the DUI lights that activate automatically.

Priority & Output Information

Priority: The priority for this Matrix can vary - it depends on if there are active lights in the front of the vehicle.

If following a traditional 1-2-3 layout (rear-front-pursuit), priority can likely stay low. Referring to the table on page 13, we recommend starting around 3.

If any lights are being disabled as part of this Matrix, priority must be higher.

Outputs: Any outputs that are to go steady or off. This may include activating Scene 1, Scene 2, or Steady modes on the lightbar.

Additionally, there is a steady pattern for SOS lightbars that can also be used.

Matrix Type: Two Required Conditions

DUI/DWI Mode

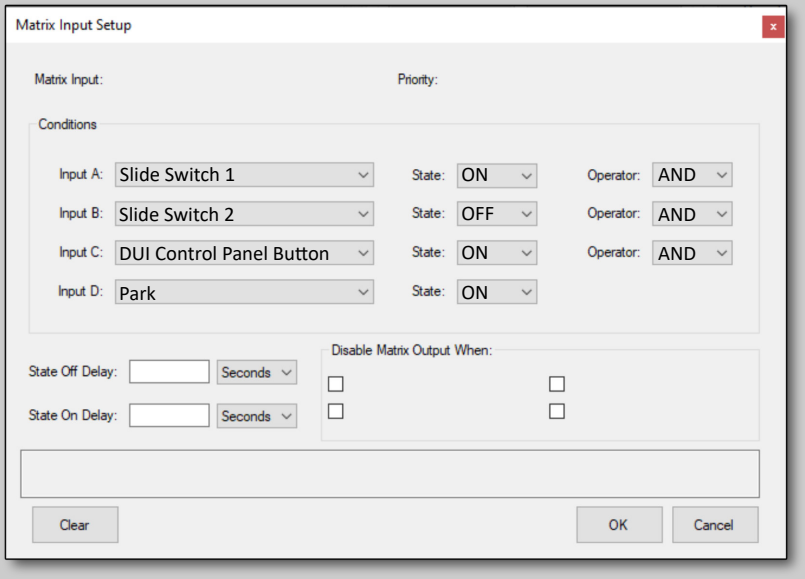
Matrix 4

DUI Lights with Slide Switch Restriction

The final Matrix in the DUI series requires operator input to activate the DUI lights.

In this scenario, the DUI lights will not work without the slide switch being active and the vehicle in park.

The bottom of this page shows a variation that automatically turns the DUI button off with the Matrix deactivated.



Conditions Information

Input A & B: In the above Matrix, the first two conditions line up what slide switch position this Matrix works in.

Input C: The DUI control panel button is active.

Input D: The vehicle is in park.

Priority & Output Information

Priority: The priority for this Matrix can vary - it depends on if there are active lights in the front of the vehicle.

If following a traditional 1-2-3 layout (rear-front-pursuit), priority can likely stay low. Referring to the table on page 13, we recommend starting around 3.

If any lights are being disabled as part of this Matrix, priority will need to be higher.

Outputs: Any outputs that are to go steady or off. This may include activating Scene 1, Scene 2, or Steady modes on the lightbar.

Additionally, there is a steady pattern for SOS lightbars that can also be used.

Variation

By adding a Matrix off state-change to the control panel, this Matrix can also turn the DUI button off each time after the Matrix goes inactive.

For example - if the vehicle were in Slide Switch position 1, and in park with the DUI button on the lights would be on. If the operator were to turn the lights off, progress to slide position 2, or shift out of park, the Matrix would turn off and also turn the button off.

If the vehicle were put back into the previous state at that point, it would now require the operator to re-activate the DUI lights.

Matrix Type: Three Required Conditions

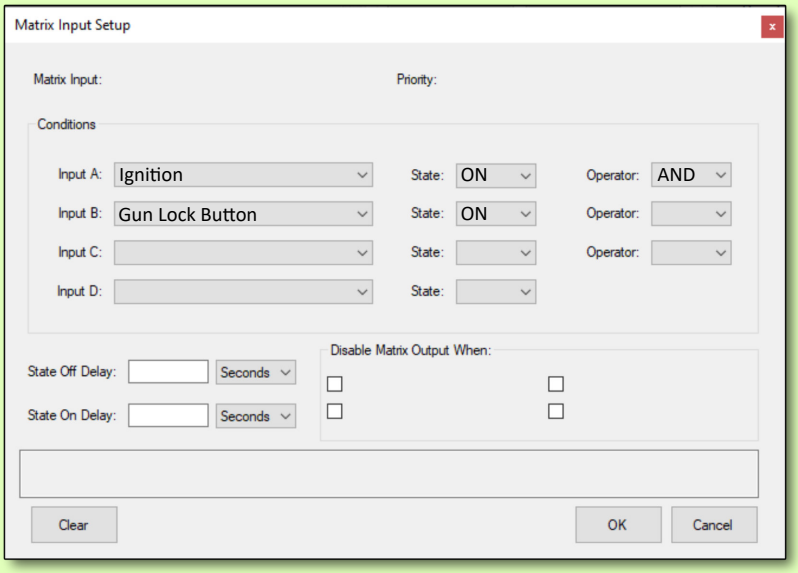
Gunlock Release

In bluePRINT, the gunlock can be released in many different ways, including through the use of a Matrix.

Below, we show you how to utilize the gunlock release Matrix.

Please Note: We do not recommend automatic release of the gun lock, such as opening when coming to park. There are too many variables in play that can cause a catastrophic situation.

One more note: Resist the urge to get overly clever with the gunlock release...keep it simple...keep is safe for the officer under stress.



Conditions Information

Input A: Just like in a traditional vehicle without bluePRINT, gunlock is usually reliant on Ignition.

Input B: For this Matrix, we are assuming the gunlock button is set up for an eight second delay, so the gunlock button is active for eight seconds.

Off Delay: Not show above - If the gunlock button is setup as momentary, a State Off Delay should be added to the Matrix allowing it to shutdown after a certain time frame.

Disable Matrix: This is optional - if a department wants the gunlock to re-latch the moment the ignition is turned off, check this box. This only applies if there is a State Off Delay.

Priority & Output Information

Priority: The priority for this Matrix can typically be low. In most cases gunlocks only have one input manipulating them.

Outputs: The gunlock output and possibly a camera activation trigger.

Matrix Type: Two Required Conditions

Ignition Security System

Ignition Security System is a staple Matrix in bluePRINT. Having a secure means of leaving a vehicle unattended while idling is vital for officer and public safety, as well as agency liability.

When active, ISS allows the vehicle to run for a pre-determined amount of time, or indefinitely if necessary with the key not present. Should an unauthorized user try and drive away with the vehicle, the engine stalls rending the vehicle useless.

Over the next few pages, we'll cover different ways to utilize the Ignition Security System.

Please note:

- Ignition Security System is designed for vehicles that use a key switch. Push to start vehicles do not require a key to run, so the ISS has no benefit for these vehicles.
- Be careful when appending the ISS Matrix in the OFF state to a gunlock Matrix. Make sure the vehicle operator is fully aware that the gun will not release when the ISS is ON.
- The ISS is running even when the key is inserted into the ignition. Only after pressing the brake does it turn off.
- Please keep in mind the ramifications of a vehicle running unattended (i.e., car in closed garage).

Schematic

Ignition Security System

The same general schematic is used in all vehicles that are not push-to-start ignition for the Matrices that have mapped outputs.

ISS should be wired to provide power to both Ignition and Accessory. This makes sure that all systems in the vehicle are being provided power.

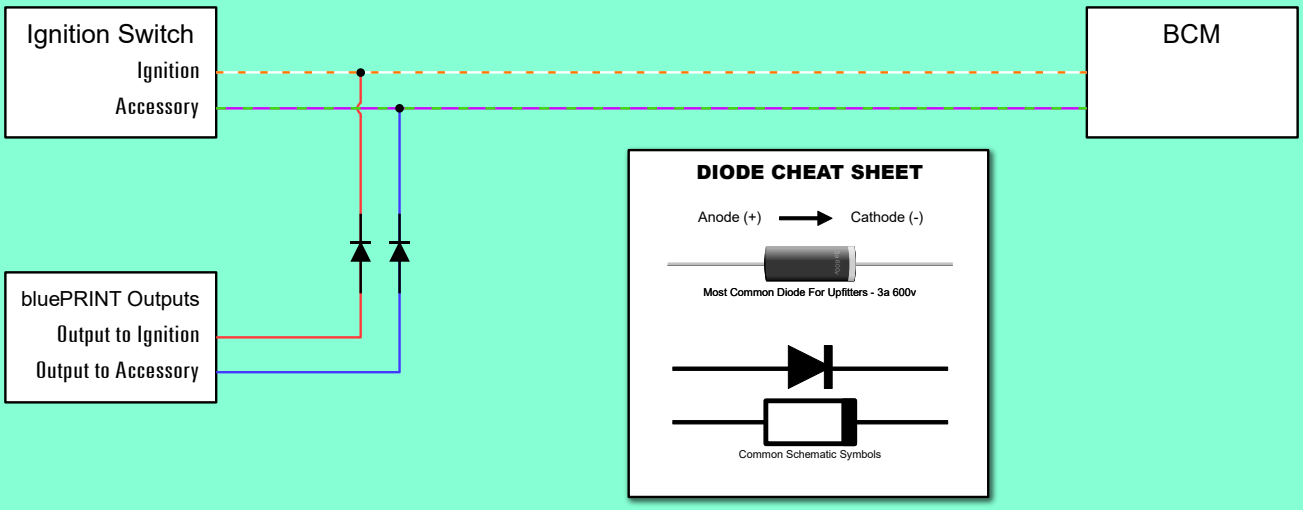
Some vehicles ignition position (also known as RUN) automatically provide power to the Accessory position. Verify this with an OEM schematic.

We recommend using outputs that are diode or relay isolated to prevent the vehicle from back-feeding bluePRINT components.

Diode Isolated Outputs: Central Controller outputs #15 and #24.

Relay Isolated Outputs: Any outputs on the 400 series siren. This works for a handheld, remote mount, or console type siren amp. When using siren amp relay outputs, we recommend fusing them to 2 amps per output.

If using any other outputs, we recommend installing diodes, as shown below.



Ignition Security System

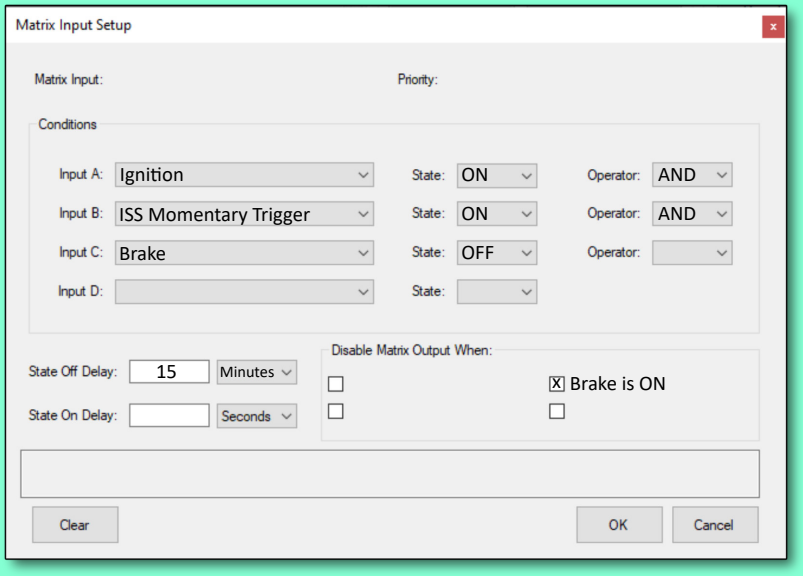
Matrix 1

Basic ISS
Momentary Switch with a Timer

This version of the ISS uses a momentary button to activate. The advantage of this type of ISS is it requires the operator to activate it every time.

Once active, it runs for a pre-set amount of time, typically 15-20 minutes.

This is the preferred method of utilizing the ISS.



Conditions Information

Input A: Ignition must be on. Once the ISS turns the system off, the ignition is now in the off state, preventing the ISS from reactivating.

An alternative to this is to use the Engine RPM input from bluePRINT Link.

Engine RPM is greater than (>) 200

Input B: A momentary button is needed to activate this Matrix. Old gunlock buttons, or a re-configured control panel button works great for this. Think about radio rebroadcast if it isn't being used.

Input C: The brakes must be off.

State Off Delay: Set this for the time required.

Disable: Check the box for Brake ON.

Priority & Output Information

Priority: The priority for this Matrix is typically low since the outputs are only being activated by this Matrix.

Outputs: Two outputs for power to Ignition and Accessory. See page 36 for more information.

Matrix Type: Three Required Conditions

Ignition Security System

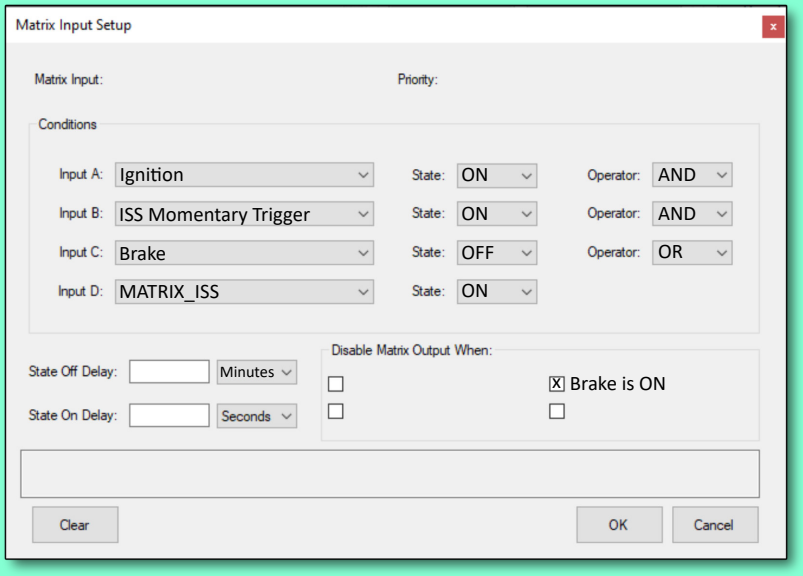
Matrix 2

Basic ISS
Looping to Run Indefinitely

This works like Matrix 1 - except it runs indefinitely.

Please note: Writing the ISS Matrix like this means the vehicle will not ever shut off, except for when the brake is depressed.

This operates the most similar to aftermarket products.



Conditions Information

Input A: Ignition must be on. Once the ISS turns the system off, the ignition is now in the off state, preventing the ISS from reactivating.

An alternative to this is to use the Engine RPM input from bluePRINT Link.

Engine RPM is greater than (>) 200

Input B: A momentary button is needed to activate this Matrix. Old gunlock buttons, or a re-configured control panel button works great for this. Think about radio rebroadcast if it isn't being used.

Input C: The brakes must be off.

Input D: Reference the Matrix itself as a condition. For more information on Looping Matrices, see page 12.

Disable: Check the box for Brake ON.

Priority & Output Information

Priority: The priority for this Matrix is typically low since the outputs are only being activated by this Matrix.

Outputs: Two outputs for power to Ignition and Accessory. See page 36 for more information.

Matrix Type: Four Conditions, Three or One

Ignition Security System

Matrix 3

Basic ISS
Toggle Switch Activation

This version of the ISS uses a toggle switch (as in turned on and then turned off) to activate. The advantage of this type of ISS is that it can be switched on at the beginning of a shift. Once active, it runs every time the key is removed from the ignition.

At the end of the shift, the switch is turned off disabling the Matrix.

Conditions Information

Input A: Ignition must be on. Once the ISS turns the system off, the ignition is now in the off state, preventing the ISS from reactivating.

An alternative to this is to use the Engine RPM input from bluePRINT Link.

Engine RPM is greater than (>) 200

Input B: A toggle switch is turned on to engage the ISS functions. This can be an external switch or a control panel button

Input C: The brakes must be off.

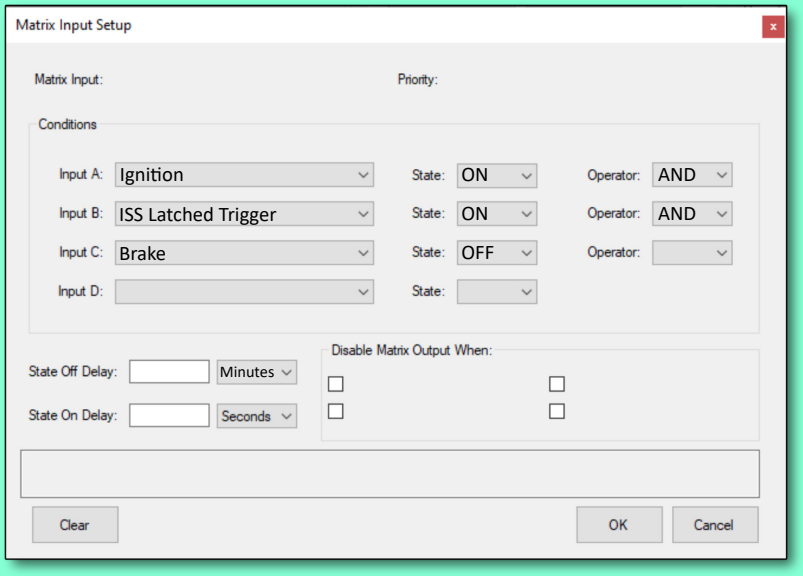
Note: This Matrix should be tested thoroughly. Since the only conditions to keep this Matrix running are the switch (which is active) and ignition being active, there is a possibility that bluePRINT may not react fast enough to a very quick pedal press.

If it does resume after pressing the brake, a second Matrix is needed, as shown to the middle and the bottom right. The middle is a variation of the top listed Matrix.

Priority & Output Information

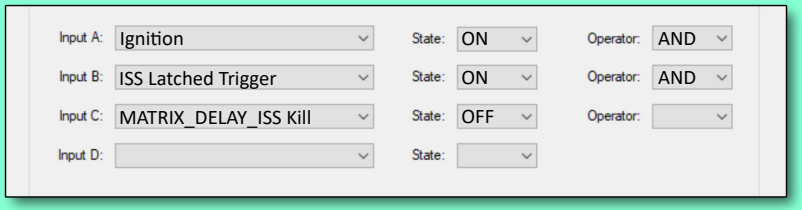
Priority: The priority for this Matrix is typically low since the outputs are only being activated by this Matrix.

Outputs: Two outputs for power to Ignition and Accessory. See page 36 for more information.

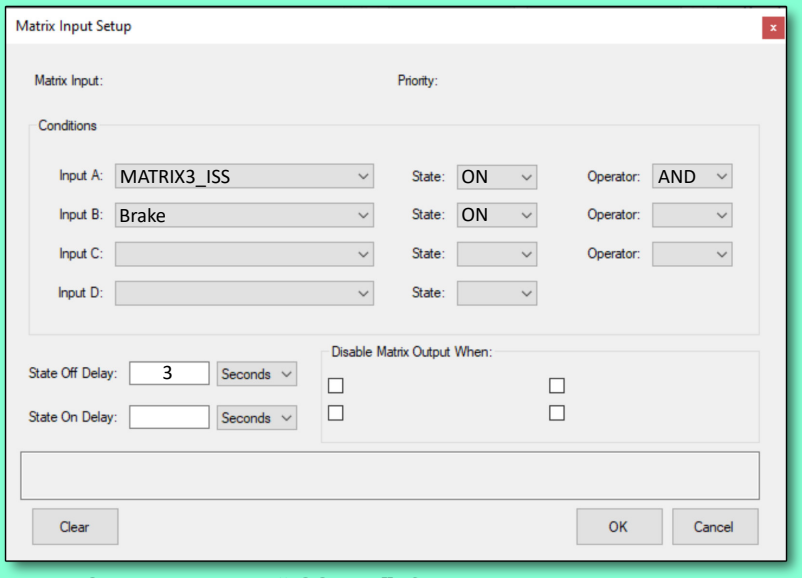


ISS Toggle Matrix

Matrix Type: Three Required Conditions



ISS Toggle Matrix Variation

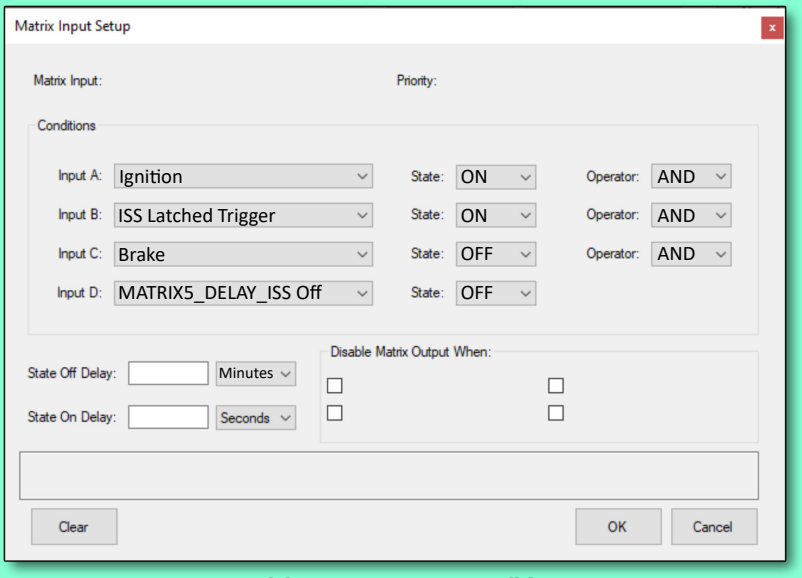


Second Matrix "ISS Kill" if resuming is occurring

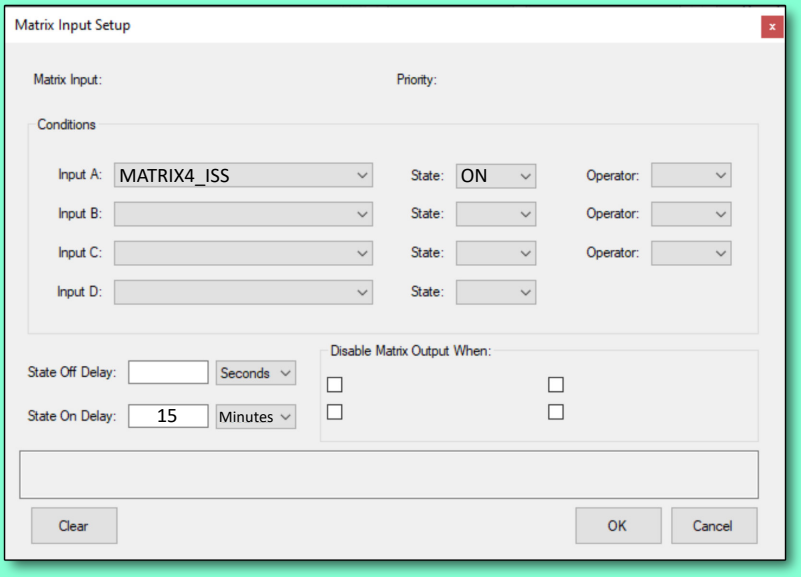
Matrix Type: Two Required Conditions

Ignition Security System

Matrix 4 & 5



ISS Latched Matrix #4
Matrix Type: Four Required Conditions



Second Matrix #5 "ISS Off" acts as a timer
Matrix Type: One Required Condition

Basic ISS Latched Switch Activation with Off Timer

This is a pair of Matrices that turn the ISS on using a toggle switch (non-momentary). The switch turns the system on, typically at the beginning of the shift. Anytime the ISS is left running, it runs for a pre-set amount of time.

Matrix #4 Conditions Information

Input A: Like the others, Ignition must be on - or use Engine RPM > 200.

Input B: A latched switch is turned on to engage the ISS functions.

Input C: The brakes must be off.

Input D: Matrix 5 - the ISS off Matrix is in the off state. Reference the Delay time to capture the extra three seconds.

Note: As with Matrix #3, test this Matrix thoroughly.

Matrix #5 Conditions Information

Input A: This Matrix has one job, to count and then turn on.

State On Delay: Set the time that the Matrix needs to run for before shutting off Matrix 4.

Priority & Output Information

Priority: The priority for this Matrix is typically low since the outputs are only being activated by this Matrix.

Outputs: Two outputs for power to Ignition and Accessory. See page 36 for more information. These should be mapped to Matrix #4

Ignition Security System

Matrix 6 & 7
Alternate Activation & Deactivation

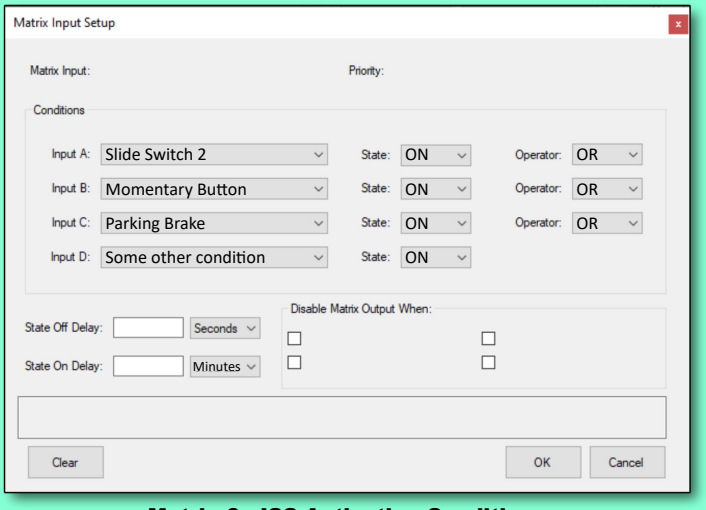
Sometimes more than one function can be used to activate or deactivate a Matrix.

Utilizing Matrix stacking is the best approach to accomplishing this.

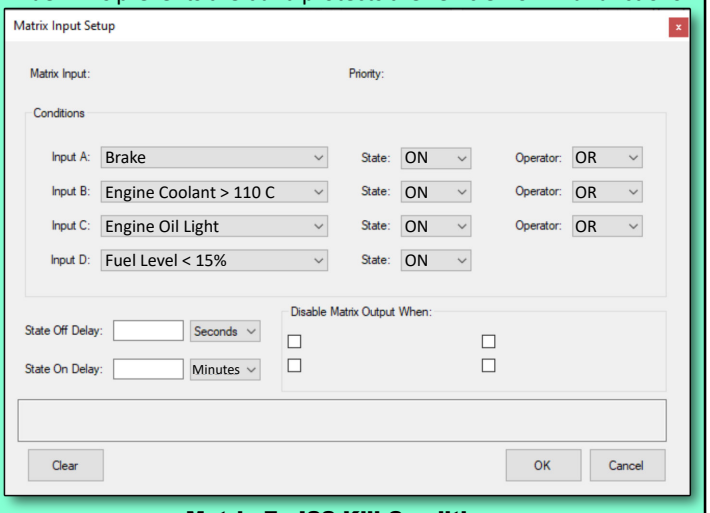
In the below examples, we've created two separate Matrices full of conditions that allow a Matrix to turn on or turn off.

Matrix 6 allows the slide switch, momentary, or parking brake to activate the ISS.

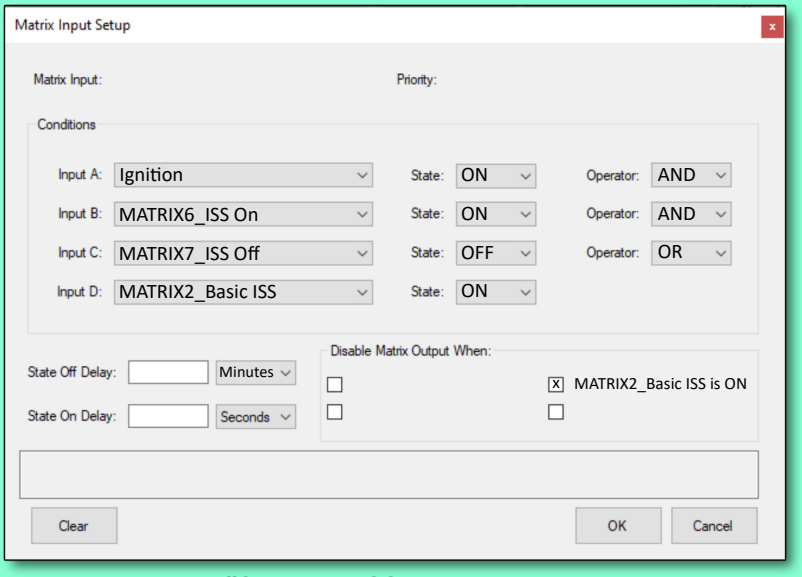
Matrix 7 has four conditions that turn the ISS off - Brakes being pressed, an overheating engine, low oil pressure, or running low on fuel. This prevents theft and protects the vehicle from malfunctions.



Matrix 6 - ISS Activation Conditions
Matrix Type: Four Optional Conditions



Matrix 7 - ISS Kill Conditions
Matrix Type: Four Optional Conditions



Matrix #2 - Basic ISS with Loop Variation
Matrix Type: Four Conditions, Three or One

Independent Slide Switch

Independent slide switch control differs from progressive slide switch control in that only one output is active at a time.

With progressive control, lower levels are active in higher levels - like layers (see below).

When using independent control, there will be times when referencing multiple slide switch positions in a single Matrix is necessary.

This can "eat up" conditions in Matrices, so we recommend creating two Matrices before going any further. The below two Matrices can be referenced by other Matrices when the need for referencing more than one switch position arises.

As an added bonus, outputs like cameras can be mapped to these Matrices.

Slide Control Types

Independent

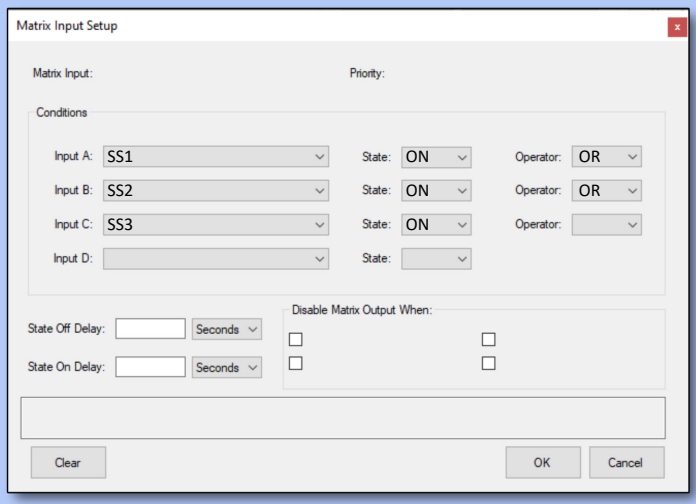
Slide Position	What's Active
SS 1	SS 1
SS 2	SS 2
SS 3	SS 3

Progressive

Slide Position	What's Active
SS 1	SS 1
SS 2	SS 1 SS 2
SS 3	SS 1 SS 2 SS 3

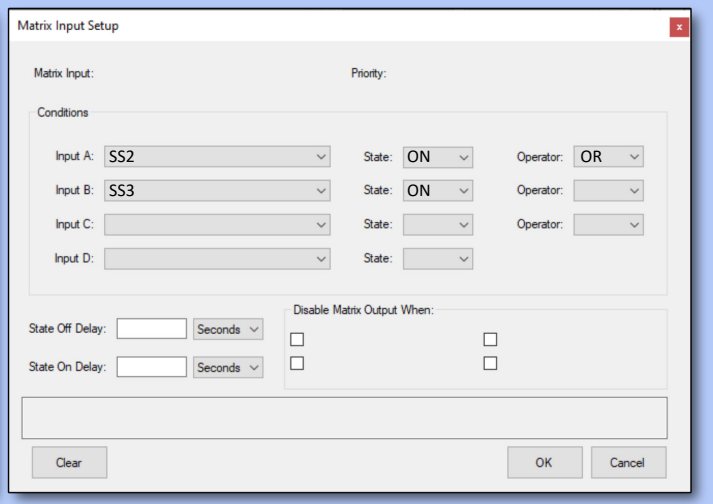
Reference Matrices

For Independent Control



SS 1,2,3 Matrix

Matrix Type: Three Optional Conditions



SS 2,3 Matrix

Matrix Type: Two Optional Conditions

Intersection Clearing

One of the most dangerous tasks for any first responder is clearing an intersection without being hit by cross traffic.

This group of Matrices, named Rapid or Crazy Lights and Wall of White, do a handful of different functions when the first responder is slowing to drive through an intersection.

First off, as the operator uses the horn ring to cycle tones, the lighting pattern changes to a much more aggressive and rapid flash rate to catch the attention of others in the area.

This rapid pattern runs for a set amount of time and then returns to the previous pattern.

In addition to this, the lightbar goes from a flash pattern to a solid wall of white light while the horn is being depressed.

All of this happens automatically without any operator input. Finally, once above 50 mph, this feature is be disabled.

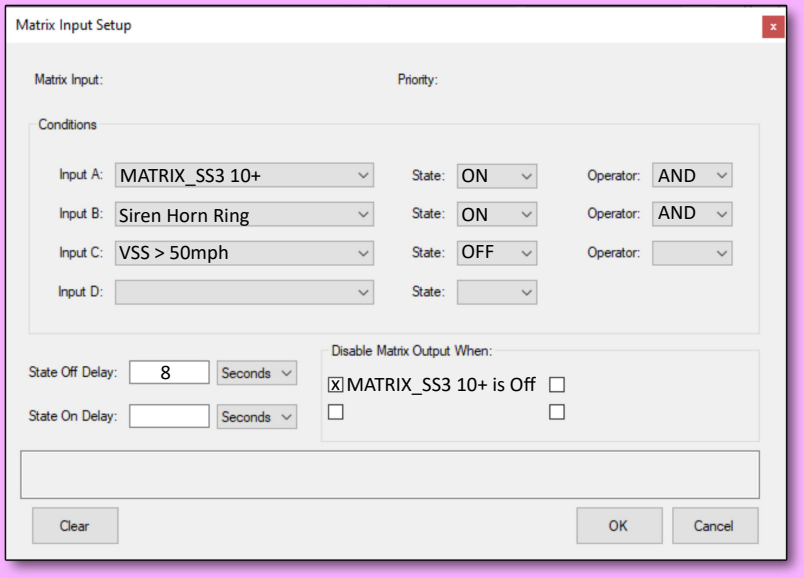
Matrix 1

Intersection Rapid Lights

The first Matrix in the series activates the lights in a rapid flash pattern with each press of the horn ring. This Matrix typically works if Slide Switch #3 is the active warning setting, presuming an emergency response is in progress.

This Matrix requires bluePRINT Link for best results.

We recommend using speed instead of park any time it is available.



Conditions Information

Input A: In this example we are referencing the Matrix described on page 58, which already accounts for Slide Switch 3 active when vehicle speed is above 10 mph.

Optionally, Slide Switch 3 could be referenced for Input A and VSS 10+ could be referenced on Input D. If bluePRINT Link is not available, reference a discreet wired Park signal input to create a similar result.

Input B: The siren horn ring button is what activates this Matrix once in Slide Switch 3.

Input C: This input requires bluePRINT Link. Vehicle speed must be less than 50mph. In this case, we used VSS is greater than 50mph in the OFF state.

Off Delay: Set this to a reasonable amount of time. Remember, this resets every time the operator hits the horn.

Disable: Check the first box for MATRIX_SS3 10+ is Off. This way, if the vehicle is shifted to Park, the off timer is canceled.

Priority & Output Information

Priority: The priority for this Matrix is typically mid-high. We recommend placing this at priority 6 to start.

Outputs: Any outputs that are part of the flash pattern change. Copying and pasting from the SS3 10+ Matrix is usually a good starting point.

Don't forget to set the lightbar mode if there is a pattern change there too!

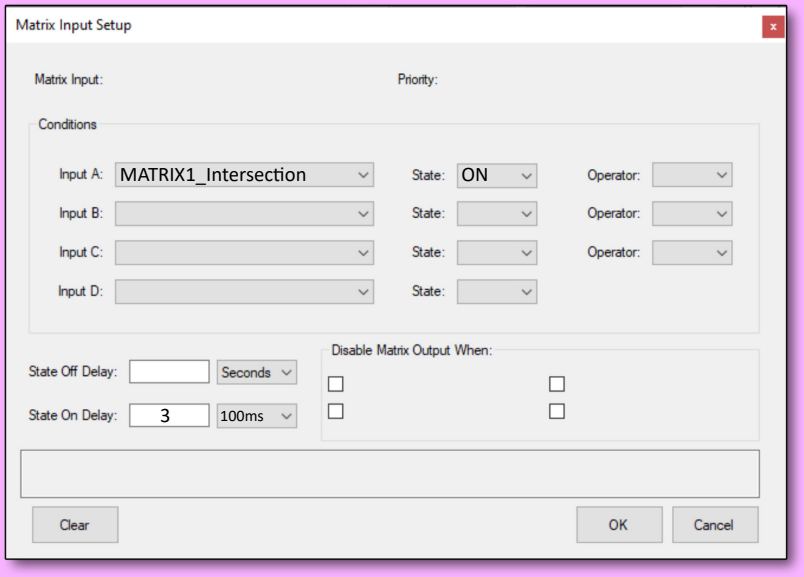
Matrix Type: Three Required Conditions

Intersection Clearing

Matrix 2

Wall of White

The second Matrix in the series is what activates the Wall of White each time the Horn is pressed.



Conditions Information

Input A: The only condition to reference is the previous Matrix we made on page 43. Both activate at the same time.

Because we are referencing the Matrix and not the Matrix_Delay, this Matrix activates when conditions are all true on the first Matrix - not during the timeout (Off Delay).

On Delay: This is optional for this Matrix. Some departments want the White light to turn on when the air horn tones. There is usually a 200ms delay between the time one holds the horn ring down and the tone is produced.

Inserting a 200ms on delay matches those up.

Priority & Output Information

Priority: The priority for this Matrix is typically mid-high. We recommend placing this at priority 6 to start. It should be higher than the Intersection Clearing Lights Matrix, or at the same priority if it has a numerically higher Matrix position.

If using the Flicker Brake pattern as part of this feature, the priority will need to be set high enough to utilize another flash pattern.

Outputs: Any outputs that are going steady white. These can be mapped as ON (green) or more a more dramatic effect, set them to FLASH (yellow) using the Flicker Brake pattern.

Don't forget to set the lightbar up to do the same!

Matrix Type: One Required Condition

Latching a Momentary Signal

bluePRINT can take a momentary signal and latch it. This allows a momentary button to act as a toggle switch.

Pressing the button once to turn a feature on and again turns the feature off.

The beauty of bluePRINT is that a Matrix can be built like this, or set to utilize a second signal to turn a feature off.

Take, for example, a hatch dome light. Using a momentary button instead of a toggle switch in conjunction with the hatch open signal allows bluePRINT to turn the light on when the button is pressed. When the door is closed, the light automatically turns off.

Matrix 1 & 2

Momentary to Latch

This two-part Matrix allows a button to be pressed once to turn a feature on, and pressed and held for a short period to turn the feature off.

This is perfect for using in conjunction with Matrices that already have self-cancellation programmed. Doing this allows the operator to activate and cancel a feature, or let it cancel itself. We'll show this on the next page.

This utilizes Matrix looping, covered on page 12.

Conditions Information

First Matrix

Input A: The momentary button needs to be pressed to activate the Matrix.

Input B: Reference the Off Matrix shown to the right in the off state.

Input C: Reference this Matrix itself to start the loop!

Disable: Check when the MATRIX2_OFF is On to disable this Matrix.

Second Matrix

Input A: The Hatch Button.

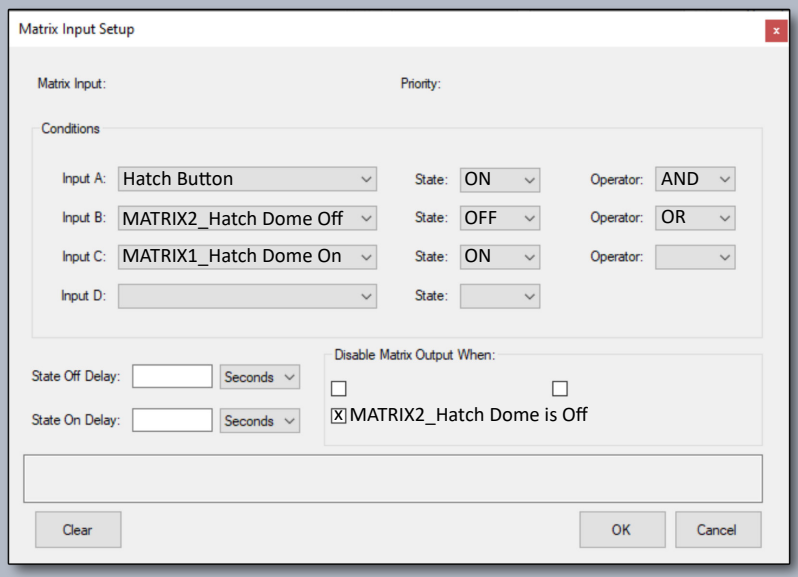
Input B: Reference the other Matrix to prevent this from conflicting.

On Delay: This is how long the button must be held to turn the function of the first Matrix off. Typically 300ms is enough time and doesn't feel "too" long. This can be adjusted to suit the user's feel.

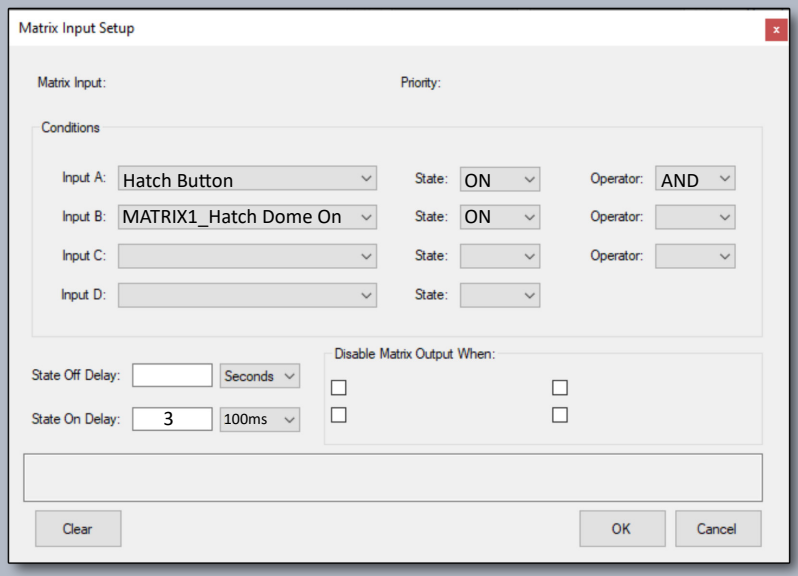
Priority & Output Information

Priority: Priority can be anywhere, depending on what this is being used for. In this example, it is a dome light being activated. Priority can likely be low.

Outputs: Any outputs being activated or deactivated.



Matrix 1 - Hatch Dome On
Matrix Type: Three Conditions, Looping



Matrix 2 - Hatch Dome Off
Matrix Type: Two Required Conditions

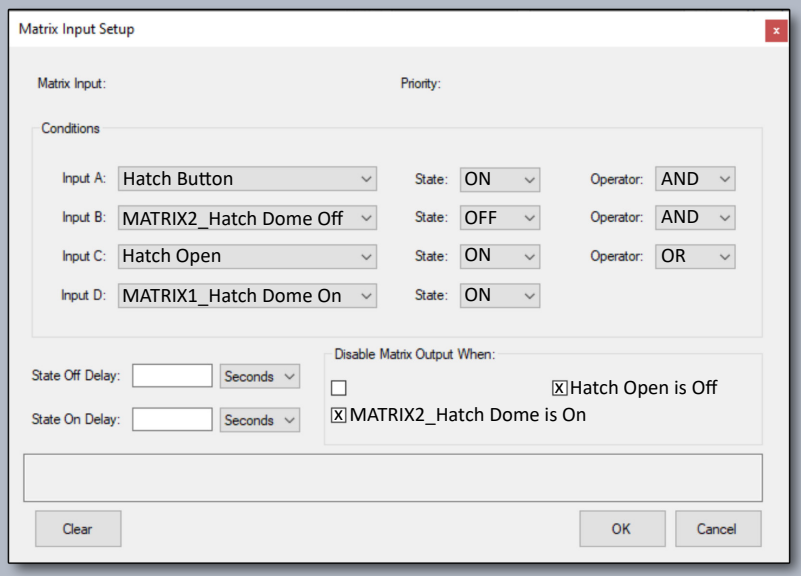
Latching a Momentary Signal

Variation

Momentary to Latch

This variation rearranges the first Matrix on the previous page.

Now, were including hatch as a signal, so closing the hatch turns the light off as well.



Matrix 1 - Hatch Dome On

Conditions Information

Input A: The momentary button needs to be pressed to activate the Matrix.

Input B: Reference the Off Matrix shown on the previous page.

Input C: Include the Hatch signal for the vehicle. This now requires the Hatch open for the Matrix to activate.

Input D: Reference this Matrix itself to start the loop!

Disable: Check the following lines:

- MATRIX2_Hatch Dome is ON
- Hatch Open is OFF

Other Variations

Instead of Looping the Matrix, include an Off Delay. Now this Matrix can be canceled three different ways:

1. If the activation button is held for 300ms.
2. If the hatch is closed.
3. If the time runs out. This should probably be at 10+ minutes.

Matrix Type: Four Conditions, Looping

Panic Alarm!

The Panic alarm or "Blitz" mode, is another Matrix that is commonly used. Blitz is sometimes used as a manual panic button, an automatic feature, or it can even be used as a "look over here" distraction for an officer.

We'll cover each of these scenarios with the group of Panic Matrices in the following pages.

The 400 series siren has a mechanical limitation that prevents bluePRINT from seeing the horn ring when in park. A workaround for this is provided in the schematic at the end of this series.

If this horn ring workaround is necessary for a Matrix to work, it's noted in the conditions area.

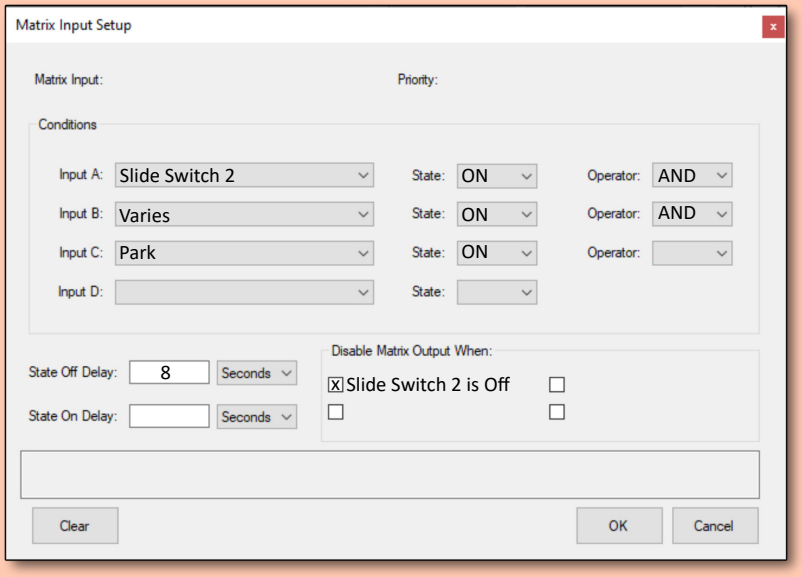
Matrix 1

Basic Blitz Mode

The first Matrix in this series activates when a button is pressed, and the slide switch is active in any position.

Once activated, the lights to the front of the vehicle activate in a very rapid flash pattern accompanied by a siren tone or air horn.

In the next Matrix, we'll cover a feature that turns the front of the vehicle steady White after the blitz is complete, and shuts the rear of the vehicle off - providing cover or concealment for the officer.



Conditions Information

Input A: Using the slide switch as a requirement limits when this Matrix can go active. We recommend Slide Switch 2

Input B: This input can be a button that the vehicle operator can activate. Ideas:

- A hidden button.
- The Horn Button - see the schematic at the end of this section on page 51.

Input C: We recommend the vehicle in park.

Off Delay: Set this to a reasonable amount of time. Remember, this resets every time the operator hits the horn. Ideally, 5-8 seconds should do the trick.

On Delay: Not shown, but including an On Delay can prevent this Matrix from activating immediately with input B. Some departments like a 300 or 400ms delay to avoid an accidental activation.

Disable: Check the first box for Slide Switch 2 is Off. This way, the officer has a way to cancel it if necessary.

Priority & Output Information

Priority: The priority for this Matrix should be very high. This feature is likely going to override scene lighting. We recommend 9 or 10.

Outputs:

Setup any bluePRINT perimeter light outputs that need to be affected by this. We recommend turning rear-facing lighting off, or at least reducing them when this Matrix is active.

The lightbar should see a pattern change as well, but don't forget to turn off Scene and Alley lights while this Matrix is active. We also recommend turning off the driver side corner to prevent the officer from night blindness or disorientation.

This Matrix typically includes a siren tone activation as well. We recommend the Piercer tone. If equipped with a low-frequency siren, we recommend that as well.

Consider adding the emergency signal trigger for the mobile radio if applicable, as well as a camera record activation if not already accounted for elsewhere.

Matrix Type: Three Required Conditions

Panic Alarm!

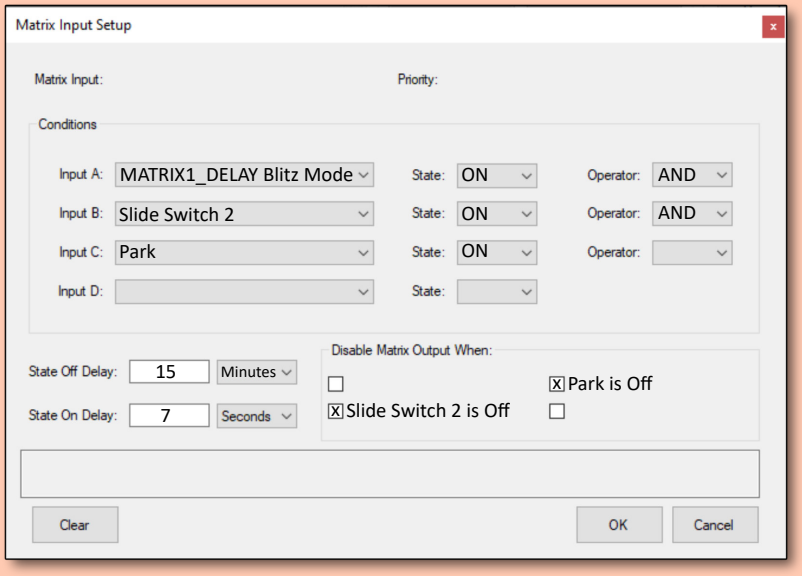
Matrix 2

Add Scene After Matrix 1

This is a continuation of the first Matrix. This Matrix adds forward scene lighting and turns off all rear lighting when active.

The forward scene lighting stays on for a significant amount of time after the first Matrix expires to help officers identify threats.

This provides the officer an escape route to the rear of the vehicle and reduces the chances of night blindness or disorientation from Blitz mode being activated.



Conditions Information

Input A: Reference the first Matrix, but use the Delay subset. This tells bluePRINT to use the first Matrix when active and during the delay timeout.

Input B: Reference Slide Switch 2 position again. This allows for cancellation.

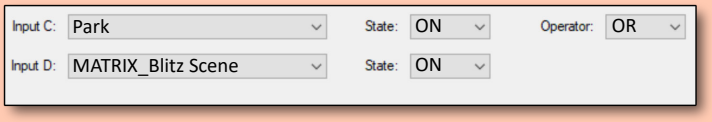
Input C: Reference Park On again. This provides a second cancellation.

Off Delay: This can be set to any specific amount of time. Some departments use this at 5 minutes, and others go with 30 minutes. In this example, we have 15 minutes.

On Delay: The On delay should be 1 second less than the off delay of the first Matrix. On the previous page, the Off Delay was 8 seconds - we set this at 7 seconds.

Disable: Check the boxes for Park is Off and Slide Switch 2 is Off. This allows multiple cancellations for the vehicle to go back to normal.

Variation: This Matrix doesn't have to use an expiration timeout. Instead it can be set to loop and run until canceled. To do this, add the name of this Matrix to Input D, with an OR operator on the Input C line.



Priority & Output Information

Priority: The priority for this Matrix should be very high. This feature is likely going to override scene lighting. We recommend 9 or 10.

It should be set one under the previous Matrix (Blitz Mode), or, make sure it is first in order if they are at the same priority (i.e., Matrix 13 is Blitz Scene, and Matrix 14 is Blitz Mode).

Outputs: For perimeter lights, turn on all forward-facing lights that have White capability. We recommend all lights from the mirrors forward. Any light that does not contain White, should be turned off.

All lighting rear of the mirrors should be turned off.

Some departments like to keep a red light to the rear active to provide non-intrusive lighting for the officer. If doing this, we recommend using a cruise mode specific for those lights, or activating low power for lighting to the rear.

On the lightbar, activate all scene lights including lightbar corners.

Consider adding the emergency signal trigger for the mobile radio if applicable, as well as a camera record activation if not already accounted for elsewhere.

Matrix Type: Three Required Conditions

Panic Alarm!

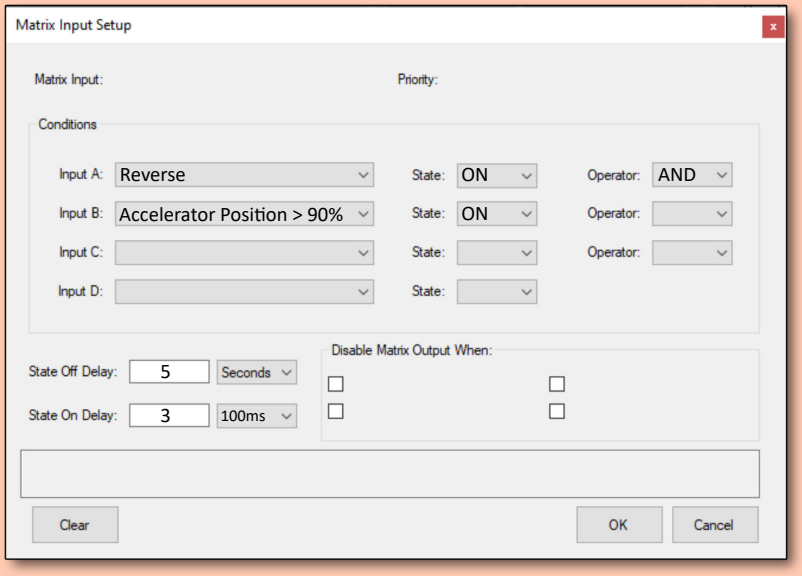
Matrix 3

Automatic Panic

This variation of the Panic Matrix is completely automatic, requiring no input from the vehicle operator.

Here's how it works - If the officer is trying to get away from something or someone by backing up rapidly, the panic alarm to the front activates.

This Matrix requires bluePRINT Link.



Conditions Information

Input A: The transmission must be in reverse.

Input B: Using bluePRINT Link, setup an input for:

Accelerator Pedal Position is greater than (>) 90%. This can be adjusted, but it should be tailored to what the department wants. We recommend having them test it for the ideal setting.

Off Delay: Put a time in here to keep the Matrix running should the pedal position drop below the Input B threshold.

On Delay: We highly recommend an On Delay to prevent any accidental misfires. 200-400 ms should do the job.

Priority & Output Information

Priority: The priority for this Matrix should be very high. This feature is likely going to override scene lighting. We recommend 9 or 10.

Outputs: Setup any bluePRINT perimeter light outputs that need to be affected by this. We recommend turning rear-facing lighting off, or at least reducing them when this Matrix is active. We recommend phasing all white light at the same time to create a strobing effect.

The lightbar should see a pattern change as well, but don't forget to turn off Scene and Alley lights while this Matrix is active. We also recommend turning off the driver side corner to prevent the officer from night blindness or disorientation.

This Matrix typically includes a siren tone activation as well. We recommend the Piercer tone. If equipped with a low-frequency siren, we recommend that as well.

Consider adding the emergency signal trigger for the mobile radio if applicable, as well as a camera record activation if not already accounted for elsewhere.

Matrix Type: Two Required Conditions

Panic Alarm!

Matrix 4

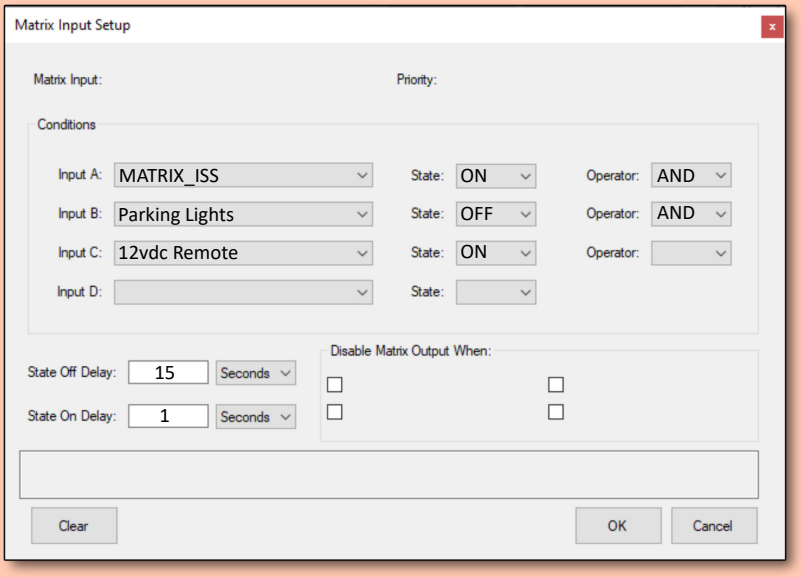
Remote Control Activation

This variation of the Panic Alarm is used as a distraction tool. It activates using a 12v input trigger from a remote control system.

This is a fantastic idea to allow an officer to gain a tactical advantage by relocating away from the vehicle and then triggering the panic mode to focus bystander or suspect attention on the vehicle.

How it works - the officer activates the vehicles ISS, with all lighting off. After relocating to a vantage point, the officer uses the remote to cause the vehicle to light up and buzz the siren.

This will draw attention, allow for officers to gauge reactions, and can even be used to disrupt a suspect's focus to allow officers to control the situation.



Conditions Information

Input A: The ISS should be running. See page 36 for more on this Matrix.

Input B: The parking lights should be in the off state. This forces the operator to turn the lights off before activating this feature. It is one extra step to preventing a misfire.

Input C: The 12v alarm remote input. This should be a momentary input that works while the button is pressed.

Off Delay: How long this Matrix should run for once active. We recommend 10-15 seconds.

On Delay: Putting time in here forces the operator to press and hold the button for a specific amount of time. We recommend 1 second.

12v Remote Control Example

Priority & Output Information

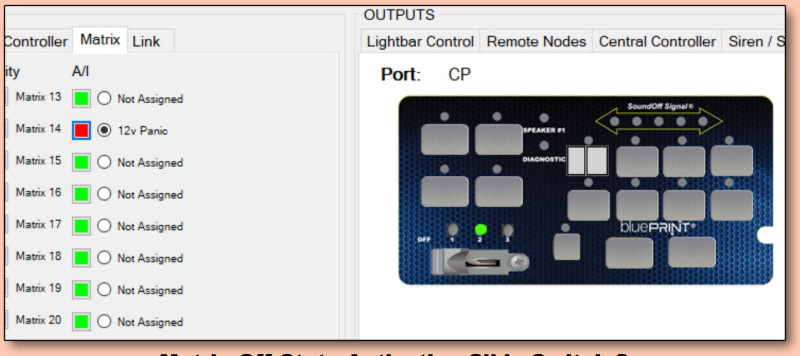
Priority: The priority for this Matrix should be very high. This feature is likely going to override any other lighting. We recommend 9 or 10.

Outputs: Outputs should be setup with a flashy fast pattern - something that grabs the eye.

The same goes for the lightbar.

Add a siren tone in for additional effect.

Finally, setup the Matrix off state to turn on Slide Switch position 2.



Matrix Off State Activating Slide Switch 2

Matrix Type: Three Required Conditions

Panic Alarm!

Schematic

Horn Ring

The horn ring is a common input in bluePRINT but it has a limitation. bluePRINT cannot see it while in park!

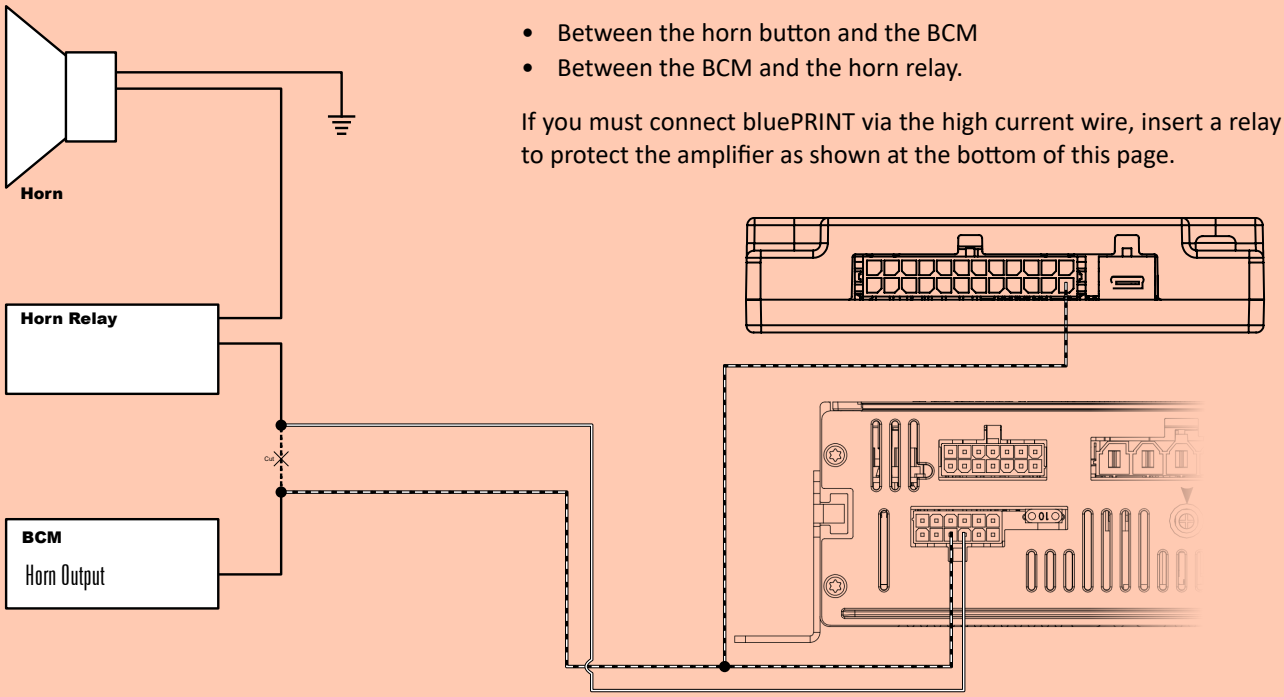
If you need to see the horn button press in your program while in park, you will need to make the following additional connection:

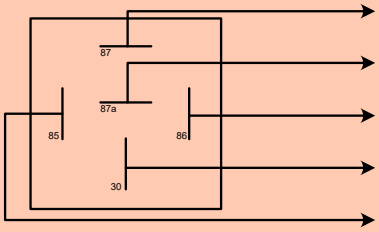
Run a redundant input from the horn ring input on the siren amplifier to an input node or remote node input. We chose input 1 on the Input Node.

Remember to grab the horn signal at a low amperage location:

- Between the horn button and the BCM
- Between the BCM and the horn relay.

If you must connect bluePRINT via the high current wire, insert a relay to protect the amplifier as shown at the bottom of this page.





To Siren Amplifier Horn Ring

To Vehicle Horn

Ground

Positive signal from vehicle horn relay

bluePRINT output - Enabled when horn ring is active
(Typically slide position #2)

Prisoner Lights

Prisoner lights that activate automatically when doors are opened are a handy feature; with bluePRINT we can take that to a whole other level.

How about prisoner lights that automatically activate with the door open and when it's dark outside? What about multi-color dome lights?

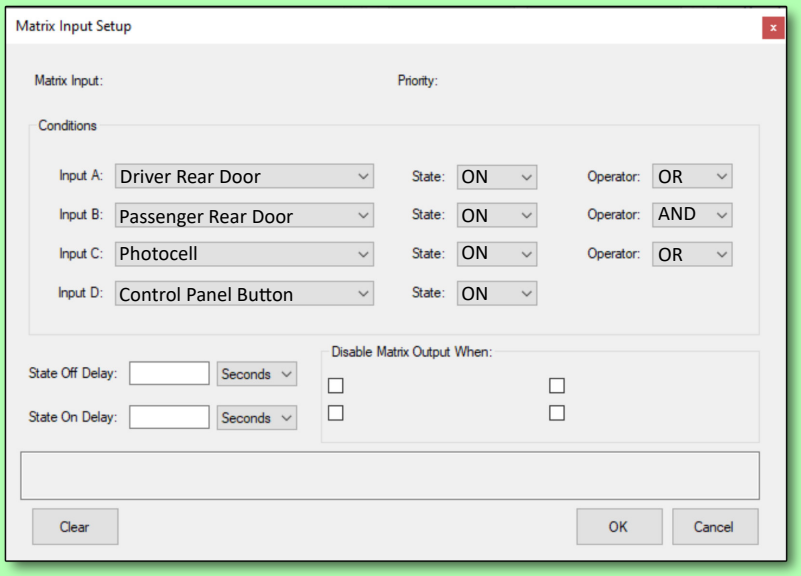
Below is the basic Matrix and a few variations to add to it.

Matrix 1

Dome Light Matrix

The first Matrix starts working when the Photocell is active, and either rear door is active.

Additionally, a button on the control panel can be assigned to turn the light all - all done through this single Matrix.



Conditions Information

Input A & B: Either rear door can activate this Matrix.

Input C: Use either the photocell or headlight switch to allow bluePRINT to determine when it is dark outside.

Input D: This is an optional input that can activate the rear dome light from the control panel.

Off Delay Variation: Not shown - including a delay here allows the light to run for a timeframe after the doors are closed. We recommend 3-5 seconds when used.

Keep in mind this will affect the control panel button used on Input D as well.

Priority & Output Information

Priority: The priority for this Matrix is likely low since it is activating a steady output.

Outputs: Dome lights are ideal uses for 480 relay center outputs.

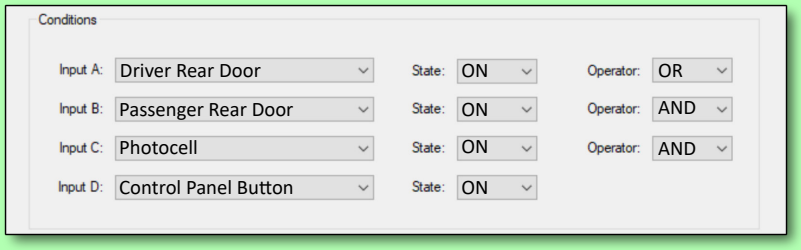
Matrix Type: Four Conditions, Two or Two or One

Prisoner Lights

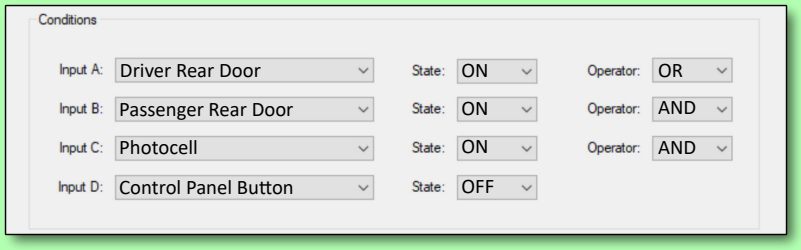
Variation

mpower lights make great dome lights and provide multi-color lighting! Using the two Matrices on the right allow bluePRINT to control the color of the light based on the Control Panel button state (Input D).

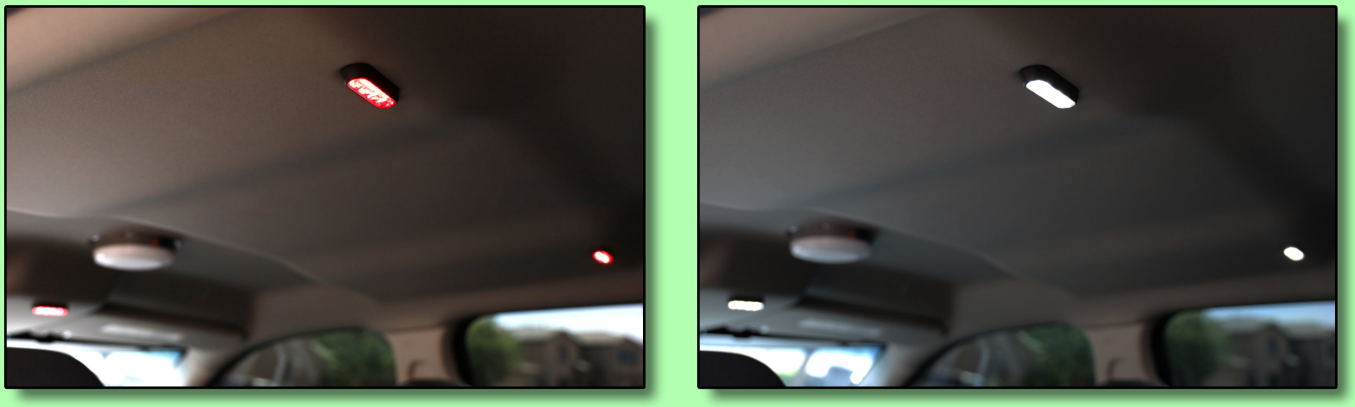
Each Matrix is mapped to a different color of the light. Consider a cruise or low power setting for this use.



Matrix 2 - Activates First Color Only
Matrix Type: Four Conditions, Three or Three



Matrix 3 - Activates Second Color Only
Matrix Type: Four Conditions, Three or Three



mpower Dome Lights - Red and White Modes

Scene Matrices

Scene lighting is a powerful function in any responder vehicle, with or without bluePRINT. It provides additional light where it is needed. With bluePRINT, scene lighting functions can be automatic:

Automatic scene activation at night when shifted to park? ✓
Activating scene lights from the exterior of the vehicle? ✓

bluePRINT can do it all. Let's take a look over the next few pages.

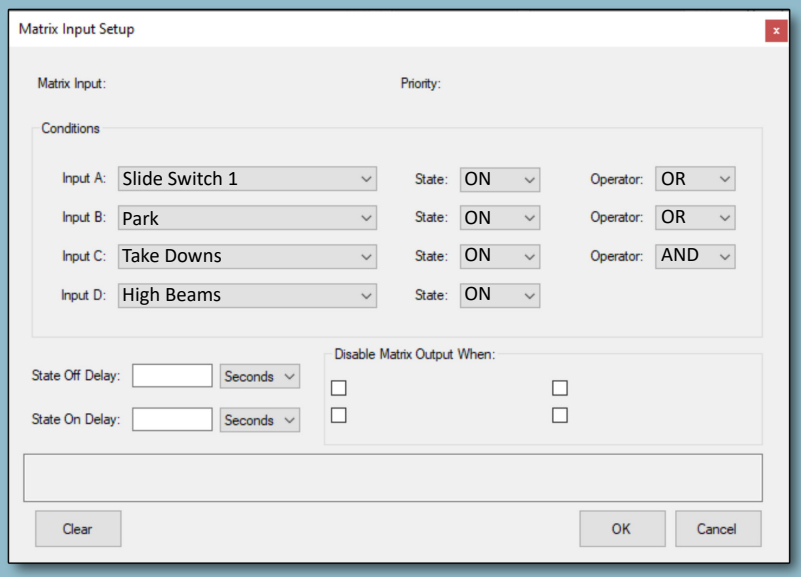
Matrix 1

Scene using the High Beams

In the first Matrix of this series, the high beams are utilized to add scene lighting to a vehicle.

This allows the officer to activate the scene lighting while standing outside of the vehicle. Picture a scenario where a police officer needs additional lighting on a traffic stop - when he or she saw something tossed out the window.

This Matrix provides an option to the officer, allowing them to never take their eyes off of the scene.



Conditions Information

Input A-C: Inputs A, B, and C all provide options on which conditions need to be present for this Matrix to work when the high beams are activated.

- Slide Switch - Emergency Lighting is On
- Park - The officer is reaching from the outside of the vehicle to activate lights
- Take Downs - An optional mode when using a control panel with no scene button. The high beam switch becomes the scene activation mode, so it isn't tied directly to the high beam switch. If that were the case it would flash every time the high beams were on, possibly blinding oncoming traffic.

Input D: The high beam switch itself must be on.

Priority & Output Information

Priority: The priority of this Matrix depends on what the Matrix is activating. We'll cover this below.

Outputs: This Matrix can be set up to do two different types of functions.

Turning on outputs

If going this route, set the priority higher to around 7 or 8 since the Matrix is activating white scene light (see page 13). Map any outputs on steady, and the lightbars to their scene function. This version is likely required when using the high beam switch Matrix as the sole turn on for scene lighting.

Turning the scene light button on

It may work easier to set this Matrix up to turn on the Scene button on the control panel if that is an option. This Matrix can toggle that button on, and if necessary, toggle it off as well. When doing this, the priority for the scene lights is tied to the control panel button, and the priority for this Matrix is not as critical.

Matrix Type: Three Required Conditions

Scene Matrices

Matrix 2 & 3

Automatic Scene Activation

The next two Matrices work together to activate scene lighting automatically when an officer decelerates rapidly and then shifts to park while in slide switch position 3.

The first Matrix in the series is nothing more than a timer that sets up the second Matrix.

Matrix 1 - Conditions Information

Input A - We're going to use vehicle acceleration as a negative to capture deceleration.

Vehicle Acceleration mph/sec is less than < negative 10.

This tells bluePRINT to activate this Matrix under hard deceleration. This includes downshifting the transmission or braking.

Off Delay: Set this for a couple of seconds, to account for the driver feathering the pedal as they slow to a stop.

Matrix 2 - Conditions Information

Input A: Reference the first Matrix using the Matrix_Delay option to capture the off timer.

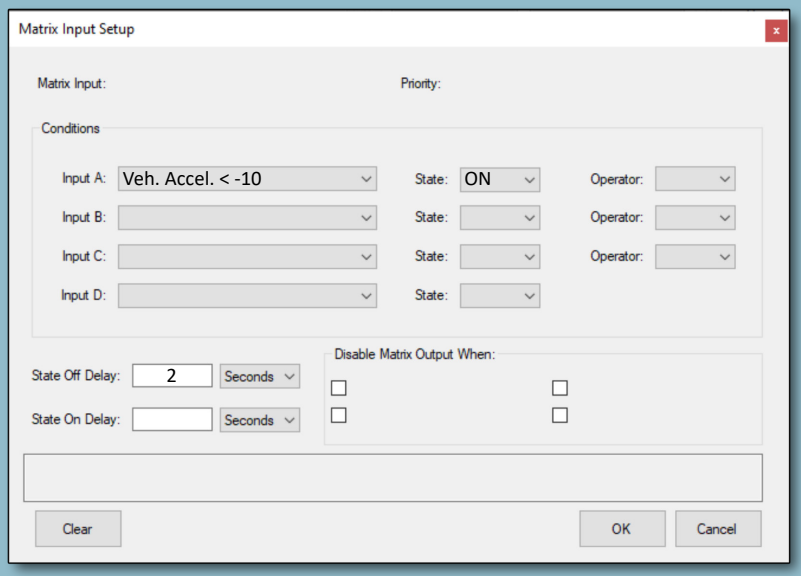
Input B: Slide Switch Position 3 is active. This is a pursuit mode function.

Input C: Park is active. This should only occur when the vehicle goes to park.

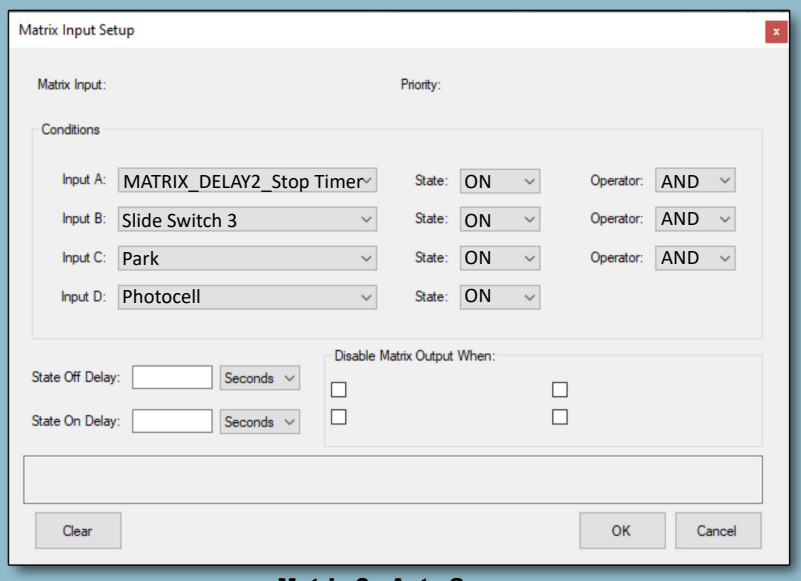
Input D: Photocell or headlights are active. This ensures this only happens during the dark hours.

Priority & Output Information

Priority and output is the same as Matrix 1.



Matrix 2 - Stop Timer
Matrix Type: One Required Condition



Matrix 3 - Auto Scene
Matrix Type: Four Required Conditions

Deceleration Facts

The table to the right shows what safe and maximum deceleration statistics are depending on the skill level of the driver. These numbers assume the driver is braking and on dry surfaces.

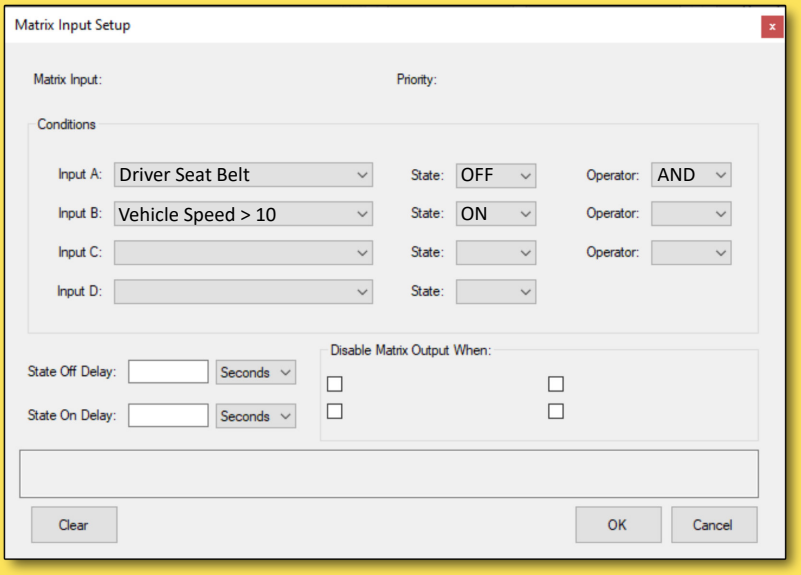
Please note, most safety experts use the 15 ft/sec2 (0.47 g's) as the maximum deceleration model for a driver to maintain control over the vehicle; again, this is when braking and on dry surfaces.

G's	Mph/sec	Braking
0.30	6.6	Safe
0.35	7.7	Safe
0.47	10.3	Average Driver Max
0.62	13.6	Reasonably Skilled Driver Max
0.66	14.3	Skilled Driver Max
0.70	15.4	Vehicle Max

Seat Belt Reminders

Seat belt reminders are a necessity in modern police vehicles. It is not at all uncommon for police officers to patrol with no belt on - **one of the leading causes of officer related deaths!**

With bluePRINT, we can help mitigate this scenario by setting up a reminder beep. Additionally, we can activate the camera system in the vehicle.



Conditions Information

Input A: The driver seat belt in the unlatched position.

Input B: Using bluePRINT Link, set up an input for:

Vehicle Speed is greater than (>) 10 mph

Priority & Output Information

Priority: The priority of this Matrix is likely low.

Outputs: Activate the control panel reminder beep and activate the camera.

A variation on this is to activate a dome light that cannot be turned off if the seatbelt is unbuckled.

Matrix Type: Two Required Conditions

Slide Switch Matrices

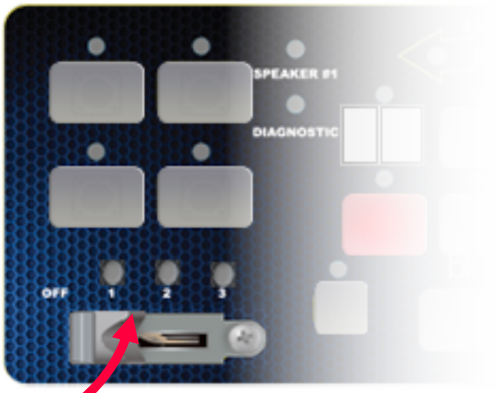
Theory

The next several pages show Matrices that affect active lighting based on operator and vehicle input.

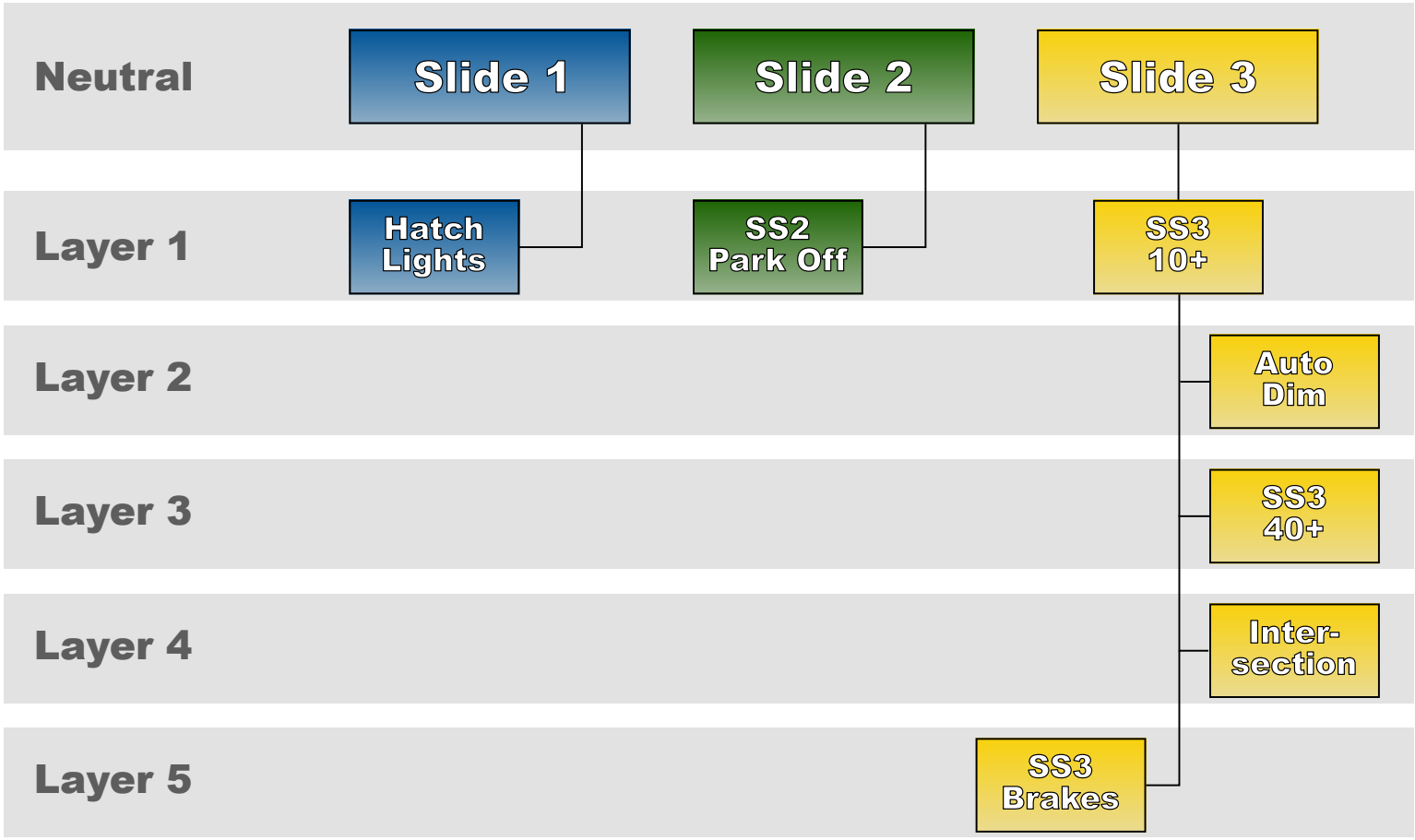
There are quite a few different variations of how to change lighting; we're going to show you how we do it. Please remember, it is not "our way or the highway." In the end, if your program works, you did it correctly.

Throughout this book, we have referenced Slide Switch 3 at 10 mph, or SS3 10+, many times. That Matrix is first in this section. The primary variation of that is SS3 and park.

Following that, we'll discuss ideas like pattern flip flopping, a cascading set of Matrices to change functions every few seconds, day & night patterns, and we will finish this section with a few pages on bluePRINT Sync combined with bluePRINT Link.



This whole section is written with a theory in mind - the slide switch inputs themselves, are considered "neutral." This means they are ***only*** controlling outputs when nothing else is happening. Everything else is layered.



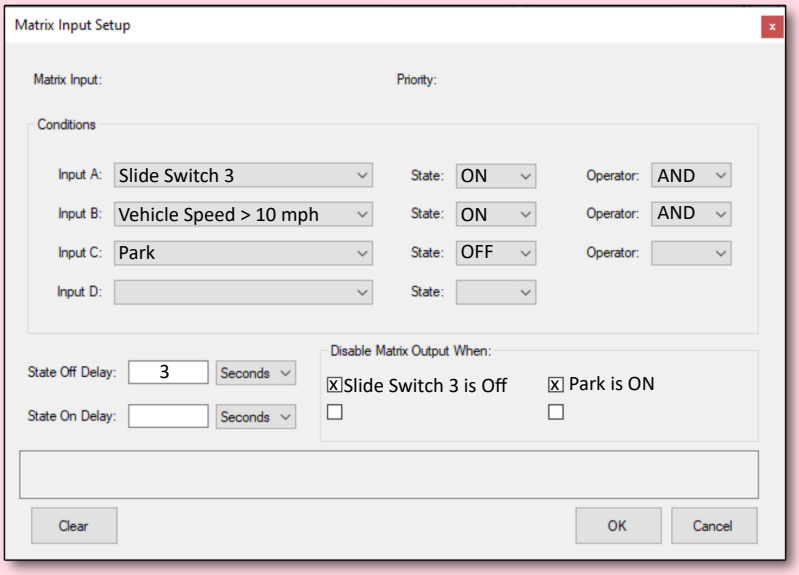
Slide Switch Matrices

Pursuit Mode

Pursuit is a fundamental of police duty. It is a function that has many different titles: Pursuit Mode, Level 3, Code 3, SS3OOP (in bluePRINT), and Emergency Response, to name a few.

Traditionally when active, white flashing light is added into the mix on a police vehicle. This includes flashing alley lights, take-downs, and wig-wags. Many agencies automatically activate the siren, too.

With bluePRINT, we can also include a pattern change on both perimeter lighting and the lightbar. This allows for faster and more aggressive patterns.



Conditions Information

Input A: Slide Switch 3 is active.

Input B: The vehicle is moving faster than 10 mph. This can be any number, but we recommend 5-10 mph:

Vehicle speed is greater than (>) 10 mph

If bluePRINT Link is not available, omit this input to allow park to control when the pattern changes.

Input C: Park is off. We are only using this to help disable the off delay timer when shifted to park.

Off Delay: Set this in the 3-5 second range. We recommend this off delay in case the vehicle drops below the 10 mph threshold momentarily. This prevents the vehicle from changing patterns right away. This is not necessary if bluePRINT Link and vehicle speed are not available.

Disable: Check the options for Slide Switch 3 is Off, and Park is On. This will allow either of those to disable the timer if it has activated.

NOTE: *Any Matrices that modify functions when the vehicle is in pursuit modes, such as enhanced braking or intersection clearing, should reference this Matrix. This helps prevent a scenario where the vehicle is in park or at extreme low speeds, with slide 3 on, and brakes active from disabling the rear lighting.*

Priority & Output Information

Priority: The priority of this is usually set one higher than slide switch 3.

Outputs: Any outputs that are being affected by this Matrix. We usually start by copying slide switch 2 or 3 and pasting it onto this Matrix.

Then we play with the phasing to get the lights flashing white in the mix.

Don't forget to change modes on the lightbar!

Matrix Type: Three Required Conditions

Slide Switch Matrices

Pattern Flip Flop

Pattern flip flops are two Matrices that go back and forth when they are active.

We're presenting this mainly for the users that want to create their own customized patterns.

A minimum of two Matrices is used when creating a cycling pattern change like this. For the purpose of this topic, we're only going to cover using two Matrices.

M1 - Conditions Information

Inputs A - C, Off Delay, Disable: Use these from the SS3 10+ Matrix on the previous page.

Input D: Reference the second Matrix in this series. Be sure to reference the Matrix Delay.

Disable: Add Input D as a disabling function for this Matrix.

M2 - Conditions Information

Inputs A: Reference the first Matrix - do not reference the first Matrix's delay.

Input B - C: Include both Park and Slide Switch 3. We're only using these to disable the delays should the vehicle go to park, or slide 3 is turned off.

Off Delay: How long THIS Matrix is going to run for. We chose two seconds.

On Delay: How long the first Matrix is set to run for. We chose two seconds

Disable: Check the boxes for Park is On and Slide Switch 3 is Off.

Playing with the On and Off Delays allow each Matrix to run for a certain timeframe. Increasing the Off delay makes the second Matrix run longer, and decreasing the On delay makes the first Matrix shut off sooner.

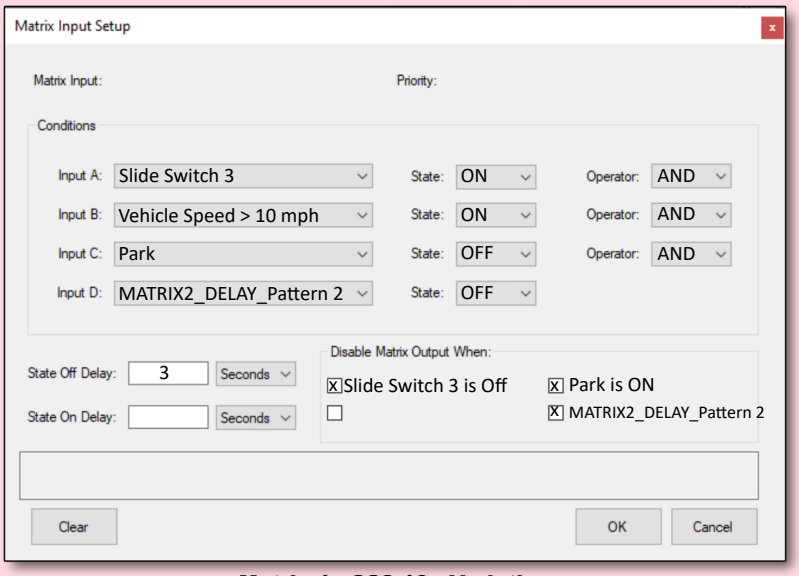
If you had a customer that wanted one pattern on for 3 seconds and the other for 5 seconds you can do that.

Final Note: When using this Matrix series, any Matrices that are layered on top of this (i.e., SS3 Brakes) should reference either of these Matrices active at the beginning of the Matrix as show to the bottom right.

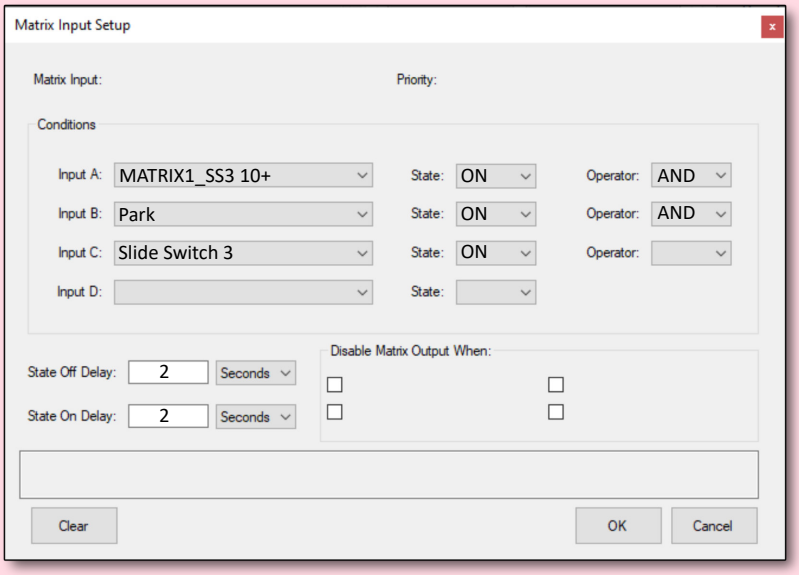
Priority & Output Information

Priority: The priority of this Matrix should be one higher than SS3 10+, so that it includes a pattern change.

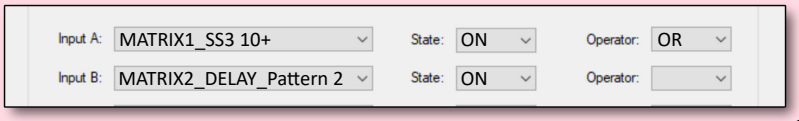
Outputs: Set up any functions that occur when Matrix 2 is active.



Matrix 1 - SS3 10+ Variation
Matrix Type: Three Required Conditions



Matrix 2 - SS3 10+ Pattern 2
Matrix Type: Four Required Conditions



Slide Switch Matrices

Mutually Exclusive Matrices

Mutually exclusive describes two or more events that cannot coincide.

In the bluePRINT world - this is creating two identical Matrices with an on condition that can turn one on and the other off. An example is two Matrices that do similar functions based on day or night.

For this example, were going to use the SS3 10+ Matrix as our baseline, and create two Matrices that work completely different based on if the photocell on.

Conditions Information

Inputs A - C, Off Delay, Disable: Use these from the SS3 10+ Matrix on the previous page.

Input D: In the first Matrix, this will be Photocell is ON, and in the second Matrix, it is Photocell is OFF.

The advantage of making a Matrix group like this - they both cannot run at the same time! There can never be a scenario where debugging a program happens between these two Matrices.

Final Note: Just like the previous page, when using this Matrix series, any Matrices that are layered on top of this (i.e., SS3 Brakes) should reference either of these Matrices active at the beginning of the Matrix as show to the bottom right.

Priority & Output Information

Priority: The priority of these Matrices could be the same, or they could be different. It depends on what they are supposed to do.

If they ran the same pattern but had different lights active, they can be the same priority.

If there is a pattern change, they must be at different priorities.

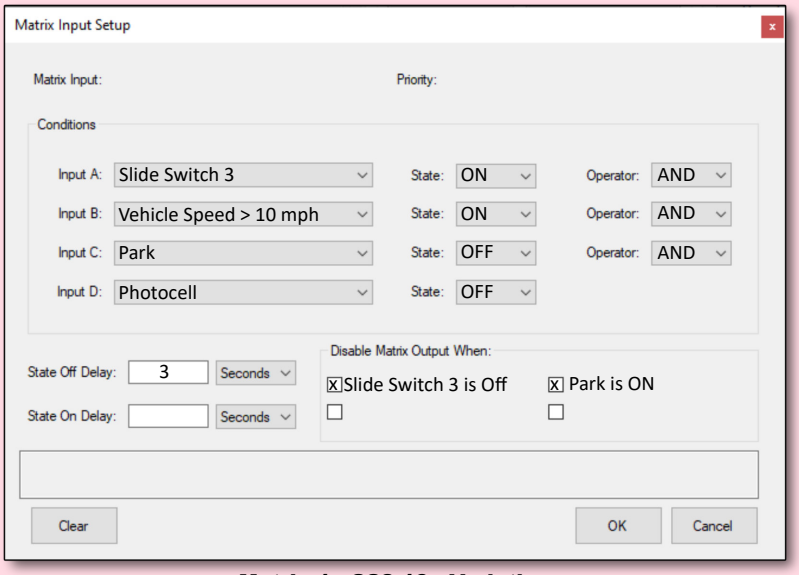
Outputs: Set the outputs of each Matrix up completely independently from one another. Because they both cannot run at the same time, there is no need to consider what the other is doing!

Day / Night Examples

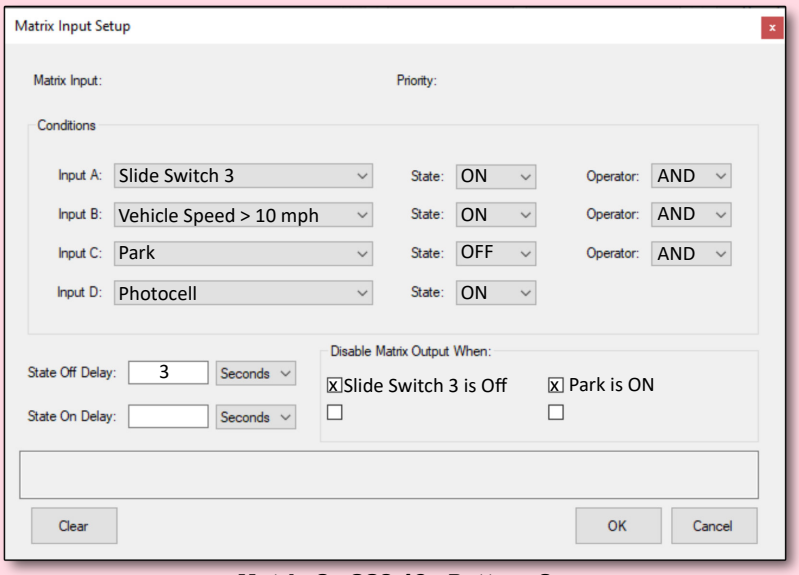
Considering this Matrix is specific for pursuit, we're going to suggest two different ways of utilizing this Matrix.

Day: Faster, flashier patterns! Lots of flashing white throughout the vehicle. More is better in this case. We suggest Warp 1-2-3, Intercycle, or Thunder & Lightning to give a few ideas.

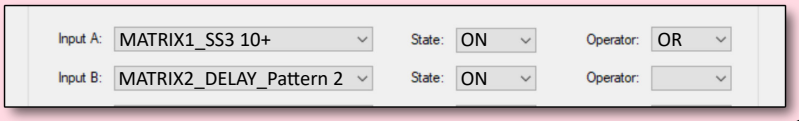
Night: Slow the pattern some, but not too much. This is a pursuit mode - NO flashing white to the rear of the vehicle. If flashing dual or tri color lights back an forth between red and blue, we suggest switching to a single color on each side (when flashing white isn't needed). Activate low power, and possibly cruise modes.



Matrix 1 - SS3 10+ Variation
Matrix Type: Three Required Conditions



Matrix 2 - SS3 10+ Pattern 2
Matrix Type: Four Required Conditions



Slide Switch Matrices

Auto Dim & Rear Cut, Universal

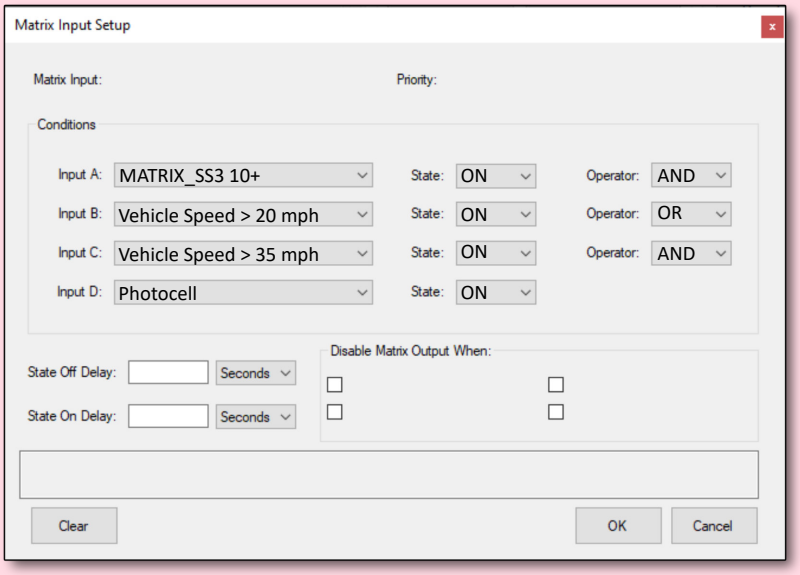
When it comes to multi-car pursuits, automatic dimming and cutting of lights are much safer than keying the radio up to tell the vehicle in front of you to turn their rear lighting off.

In this example, we're going to concentrate on automatically dimming the rear lighting of the vehicle - but we're adding a twist.

We're going to stage it, so this Matrix activates at 20 mph in Slide Switch position 3. Once active, it puts the rear lighting into low power and cuts a handful of lights.

Additionally, we're going to build this Matrix so it activates low power and rear cut for the other slide switch positions if the vehicle exceeds 35 mph.

Remember, all of this only occurs at night. Let's see how it works.



Conditions Information

Input A: Reference the Slide Switch 3 greater than 10 Matrix

Input B: The vehicle is moving faster than 20 mph. Use a bluePRINT Link input set up like this:

Vehicle speed is greater than (>) 20 mph

Input C: This input is the activation for this Matrix for other slide switch positions. Use bluePRINT Link to set another input up:

Vehicle speed is greater than (>) 35 mph

Input D: The photocell is in the active position. If the photocell is not available, use parking lights as a condition.

Priority & Output Information

Priority: The priority of this should be set higher than the SS3 10+ Matrix.

Outputs: Activate low power to the rear of the vehicle. Do this for both the lightbar and perimeter lights

When setting up a vehicle, we recommend Low Power 1 for the front and sides of the vehicle and Low Power 2 for the rear.

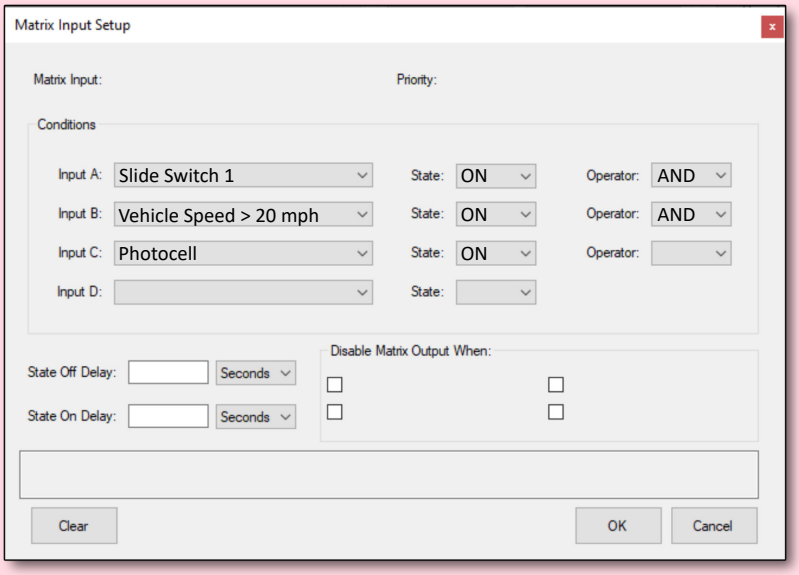
Turn any lights off that are part of the rear cut by setting them to the OFF state. We usually recommend leaving a few lights on

Matrix Type: Four Conditions, Three or Two

Slide Switch Matrices

Auto Dim & Rear Cut, with Cruise

This Matrix is almost identical to the Universal Auto Dim described on the previous page. The difference is it works for all lightbar modes, but adds cruise functionality for the lights that have been disabled.



Conditions Information

Input A: Reference Slide Switch 1. With Slide Switch 1 active, all slide modes are included in a progressive slide switch. If using an independent slide switch control panel, see page 42 for more information.

If a more specific input is required, go ahead and substitute it in (i.e., Slide Switch 2).

Input B: The vehicle is moving faster than 20 mph. Use a bluePRINT Link input set up like this:

Vehicle speed is greater than (>) 20 mph

Input C: The photocell is in the active position. If photocell is not available, use parking lights as a condition.

Priority & Output Information

Priority: The priority of this should be set higher than the SS3 10+ Matrix.

Outputs: Activate low power to the rear of the vehicle. Do this for both the lightbar and perimeter lights

When setting up a vehicle, we recommend Low Power 1 for the front and sides of the vehicle and Low Power 2 for the rear.

Turn any lights off that are part of the rear cut by setting them to the OFF state. We usually recommend leaving a few lights on.

Activate the Cruise output. Be sure to set up what each light cruises at on the SETUP/OUTPUT Tab.

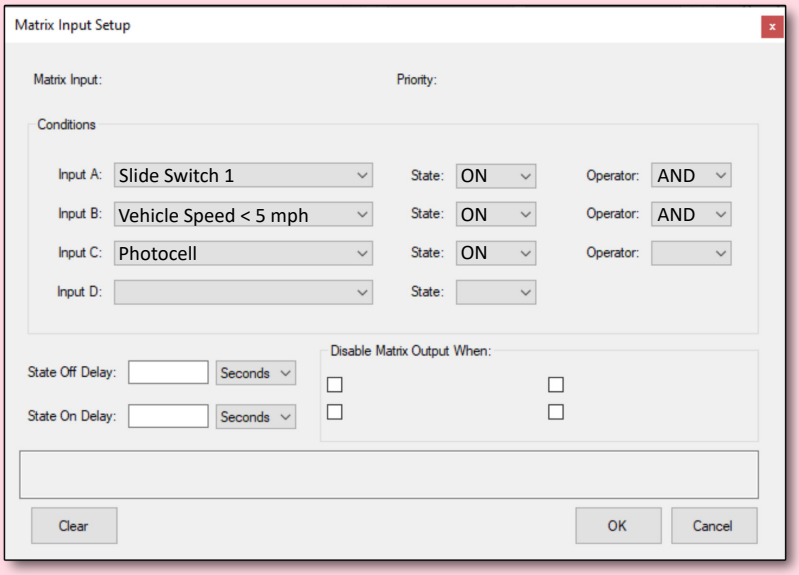
Matrix Type: Three Required Positions

Slide Switch Matrices

Auto Dim & Rear Cut, with Flash over Cruise

At night, it is easier to adjust to a light that doesn't turn off, than one that does. With flash over cruise, active the lights flash with a high/low pattern as they go from high intensity to cruise intensity.

Below is another variation on using Auto Dim.



Conditions Information

Input A: Reference Slide Switch 1. With Slide Switch 1 active, all slide modes are included in a progressive slide switch. If using an independent slide switch control panel, see page 42 for more information.

Input B: The vehicle is moving less than 5 mph. Use a bluePRINT Link input set up like this:

Vehicle speed is greater than (<) 5 mph. Doing this allows the Matrix to work below the speed threshold regardless of the status of Park.

Input C: The photocell is in the active position. If photocell is not available, use parking lights as a condition.

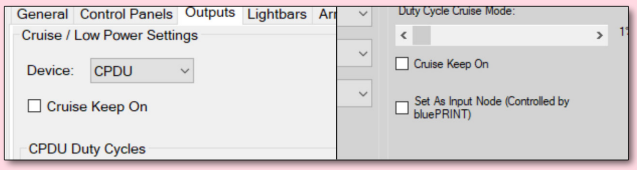
Priority & Output Information

Priority: Since this is only activating cruise mode in the background, priority can be low.

Outputs: Assuming the lower speed pattern of the car is using something like Road Runner or Slow runner (as detailed on page 66, bluePRINT Sync), map this Matrix to turn on Cruise.

Remember to do so with the perimeter lights or the lightbar lights (or both) depending on which lights are being affected.

Be sure the Keep Cruise On flag is checked in the SETUP/OUTPUTS screen for perimeter lights, or on the lightbar setup screen.



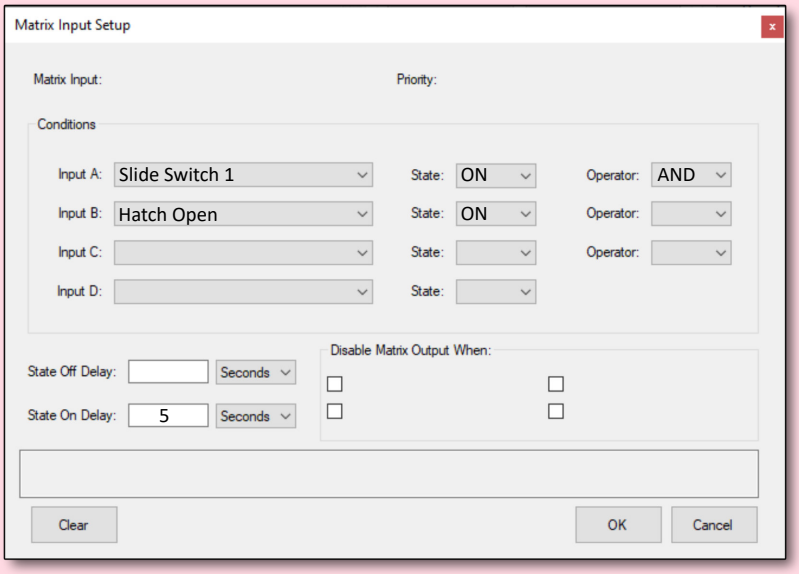
Matrix Type: Three Required Positions

Slide Switch Matrices

Automatic Hatch Lights

When it comes to under hatch lights, having a Matrix control them is better than just supplying power when the hatch is open.

With a Matrix, the hatch light activation can be delayed to allow the hatch to open before turning on. At night, this is an important feature to prevent night blindness for the responder as the hatch passes across his or her vision.



Conditions Information

Input A: Reference Slide Switch 1. This provides lighting through all slide positions in a progressive control panel.

If using an independent control panel, see page 42 for more information.

Input B: Include the Hatch open signal as input B.

On Delay: We recommend a five-second delay before the lights turn on. This is ample time for the hatch to open fully.

Priority & Output Information

Priority: The priority of this Matrix is likely to be low. In most cases, a single pattern is assigned to the hatch lights.

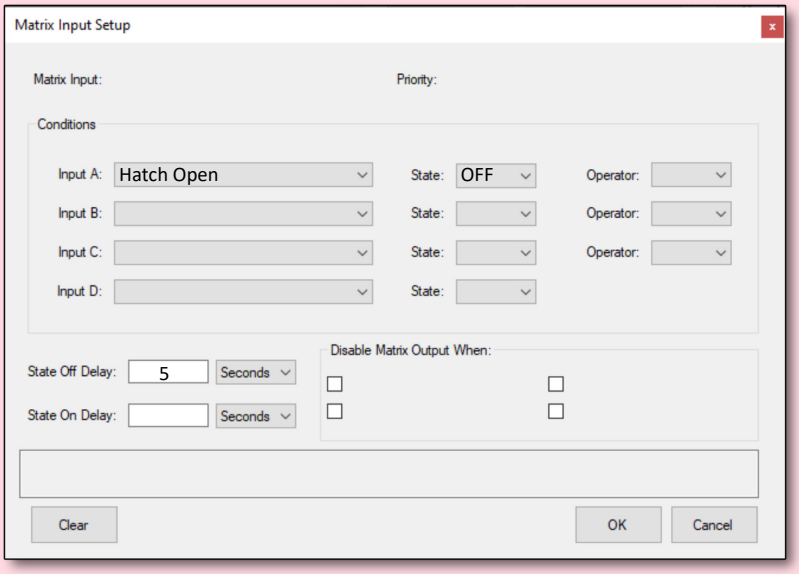
Outputs: Activate the hatch lights.

Matrix Type: Two Required Conditions

Slide Switch Matrices

Automatic Hatch Lights, Variation

The function is the same, but this variation allows flash pattern control of the hatch lights.



Conditions Information

Input A: Reference just the hatch lights.

Priority & Output Information

Priority: The priority of this Matrix can usually be set at 10.

Outputs: Map the hatch lights as an output on any input that flashes lights. Most of the time, when the hatch is open, the slide switch is in it's neutral state as described on page 66. We suggest mapping the hatch lights as flashing on slide switch positions 1-3.

For this Matrix, turn the hatch lights OFF. This keeps the lights off in all states when the hatch is closed, and allows flash pattern synchronization of these lights when the hatch is open.

Matrix Type: One Required Condition

Slide Switch Matrices

bluePRINT Sync

SoundOff Signal's bluePRINT Sync reshaped the industry. Departments have realized that an emergency response scene is becoming more and more chaotic as lights get brighter and more capable.

Presenting a calmer visual present on scenes is imperative to responder, civilian, and bystander safety.

bluePRINT Sync does this by synchronizing lighting on vehicles when they are set to the same flash pattern.

Because Sync uses GPS time, it means two things:

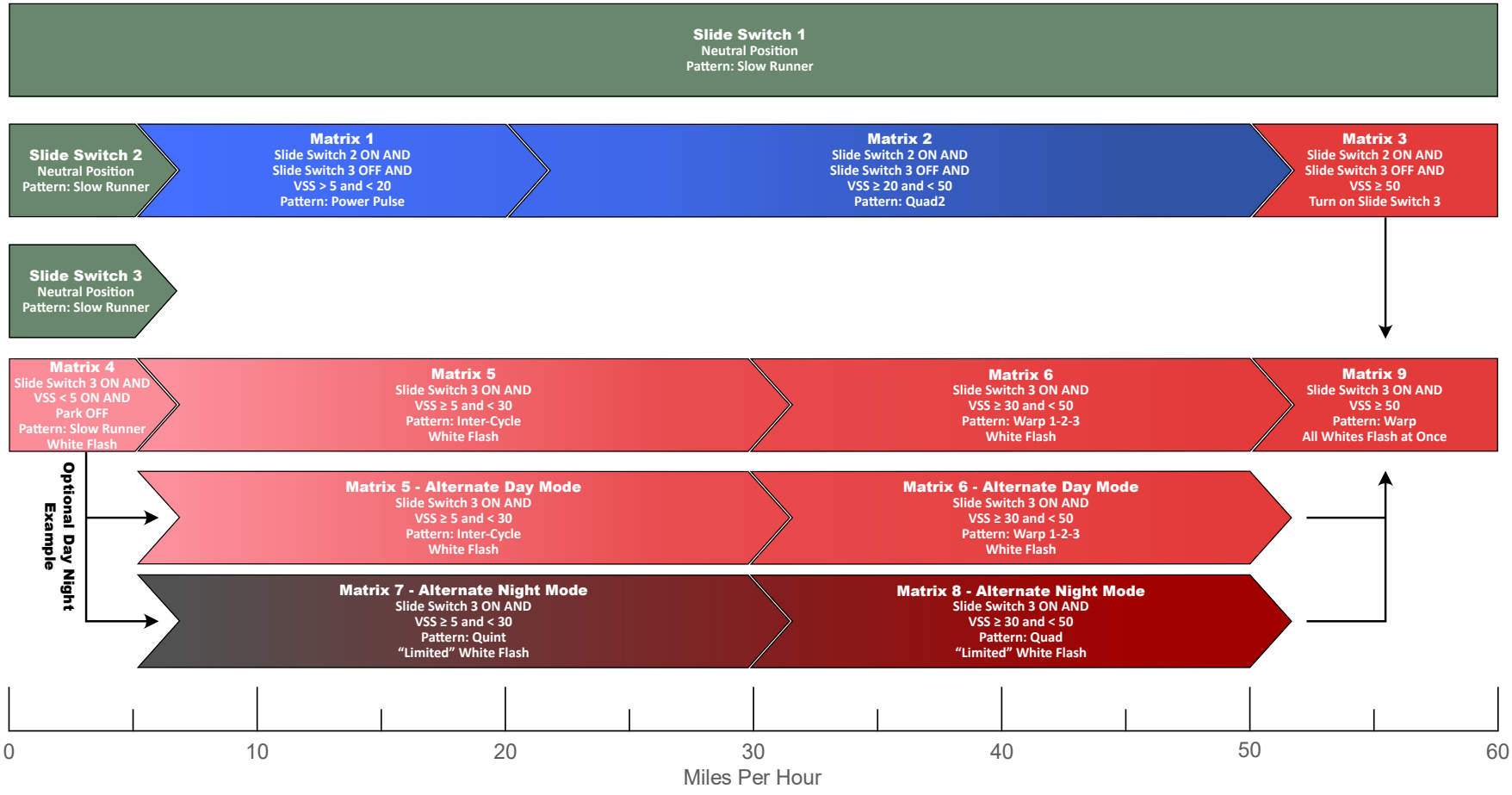
- First, there is no range. Vehicles are always in Sync, no matter the range, no matter the municipality.
- Second, there should be some forethought put into the program to create like conditions, such as:

What if one vehicle is in slide position 1 and another is in slide position two? What if they have different programmed patterns?

That's where the planning comes into play. Set them up to use a neutral pattern that is common on all slide positions (see page 57).

Then use inputs from bluePRINT Link to control what the lighting is doing based on speed.

See the below info-graphic. This shows a complex setup with Sync utilizing different functions such as speed, slide switch, and photocell status.



Traffic Control Variations

It is common practice to include traffic control functions in lightbars, or groups of perimeter lights in police, fire, and utility vehicles.

With bluePRINT, these functions can be automated or manually controlled based on information from the vehicle, operator, and current status of the control panel functions.

Throughout this section, we'll discuss a few different techniques and ideas for traffic arrow activation.

Matrix 1 & 2

No Control Panel Buttons

These first two Matrices are identical and allow traffic control when no control panel is present (or to free up buttons), using nothing more than the vehicle's turn signal function or hazard lights.

These Matrices require bluePRINT Link. If not using bluePRINT Link, see the next page.

Conditions Information

Input A: For the first Matrix, the left turn signal is active. On the second Matrix, the right turn signal is active.

Input B: The hazards are the second option for this Matrix.

Input C: Park is on.

Input D (Variation): This could also be a requirement for the Slide Switch to be active.

Off Delay: Set the Off delay above 400ms; we recommend 1 second. This is for input signals that are on-off-on-off.

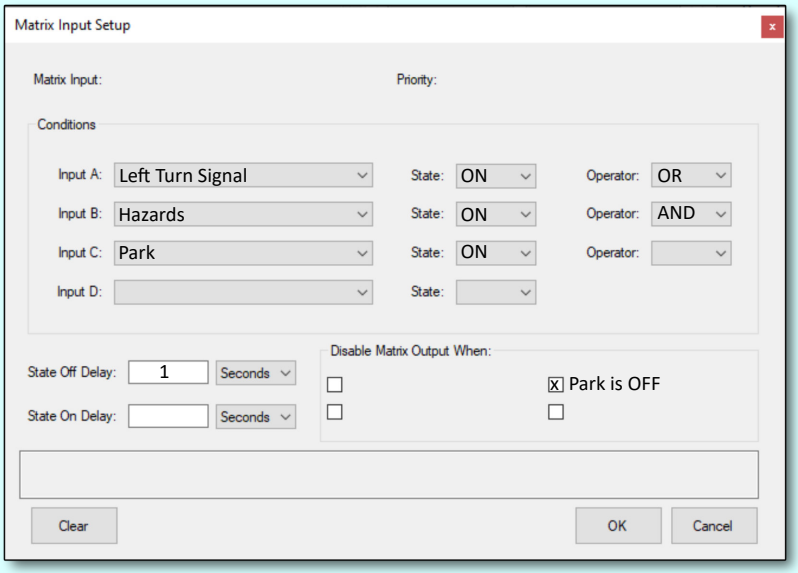
Disable: Include Park is Off for the disable.

Priority & Output Information

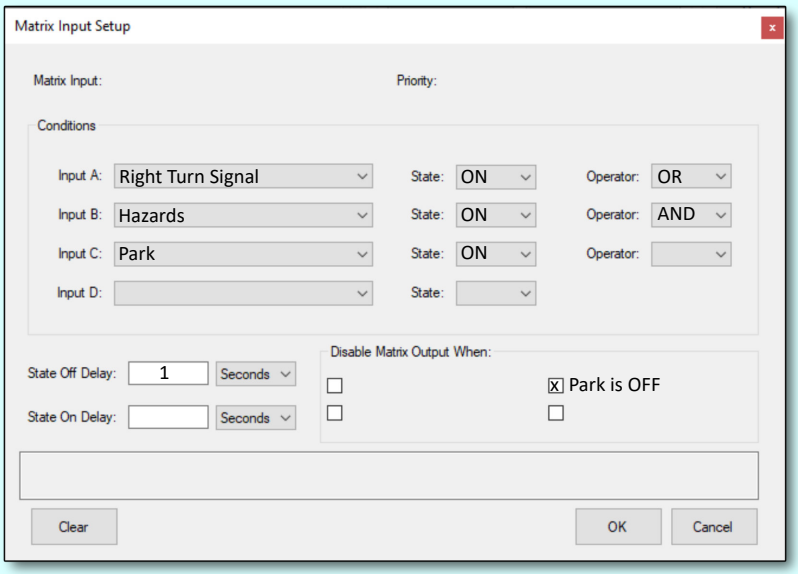
Priority: Depending on which lights are being selected, priority may or may not be significant.

- If using a lightbar for the arrow function, a lower priority is OK. Lightbars have a built-in priority that is not affected by bluePRINT priority.
- If using perimeter lights - the default priority for an arrow array is 10.

Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.



Matrix 1 - Left Arrow
Matrix Type: Three Conditions, Two or Two



Matrix 2 - Right Arrow
Matrix Type: Three Conditions, Two or Two

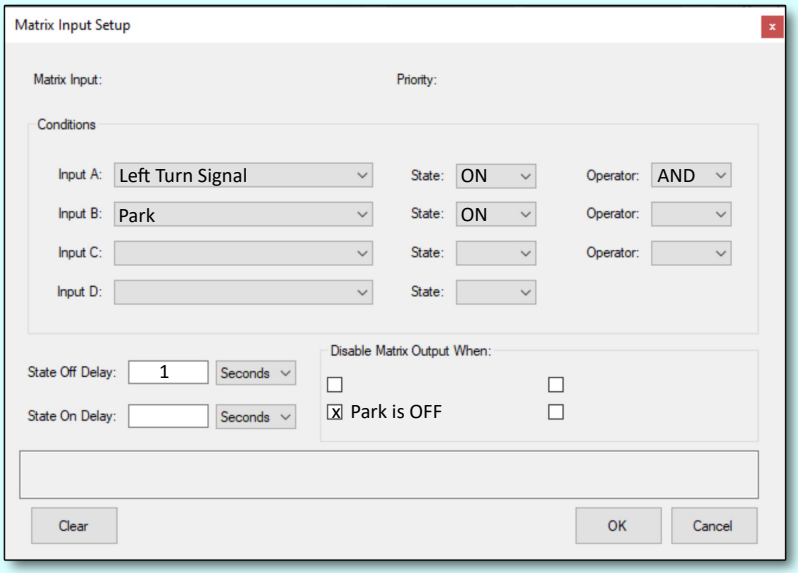
Traffic Control

Matrix 3 & 4

No Control Panel Buttons

Identical in function as page 68, these two Matrices are for the discretely wired version.

This only works for a system that has a separate brake and turn signal.



Conditions Information

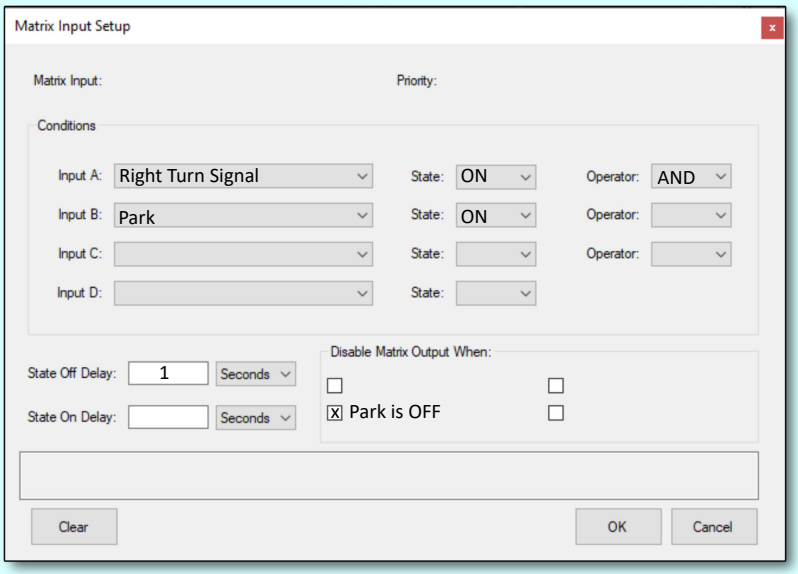
Input A: For the first Matrix, the left turn signal is active. On the second Matrix, the right turn signal is active.

Input B: Park is on.

Input C (Variation): This could also be a requirement for the Slide Switch to be active.

Off Delay: Set the Off delay above 400ms; we recommend 1 second. This is for input signals that are on-off-on-off.

Disable: Include Park is Off for the disable.



Priority & Output Information

Priority: Depending on which lights are being selected, priority may or may not be significant.

- If using a lightbar for the arrow function, a lower priority is OK. Lightbars have a built-in priority that is not affected by bluePRINT priority.
- If using perimeter lights - the default priority for an arrow array is 10.

Outputs: Any outputs that are to flash as part of this sequence. This may include outputs that are turning on steady, going to a different flash pattern based on the priority, or turning off to eliminate them when this Matrix is active.

Matrix Type: Three Conditions, Two or Two

Appendix

bluePRINT Enhancement

There are a number of well-designed products out there that can be used to enhance how bluePRINT functions or add unique capabilities to your build.

Much like video systems, radars, alarms, K9 modules, etc., these are products that can be integrated with bluePRINT to maximize effects.

In some cases, these products can be used for modifying an installation, such as creating a ground output from a positive input, flashing a ground output, or creating a delay timer without using a new Matrix.

Below are a few add-on products that can be used with bluePRINT to create unique functionality, or even without as a stand-alone functioning product.

PAC Products TR-7

www.pac-audio.com

PAC TR7 modules can be used as a programmable delay timer. It can take a high or low input from anything and create a latched, click on click off, pulsed, or timed output.

A typical application is to use with a vehicle horn honk, glass breaker, flashing park lights, or any other signal that needs to be used to wake up bluePRINT. The input signal can be a single signal or a specific count of signals before the TR7 unit activates.

See page 20 for an example of using this to turn on bluePRINT. For this example, the TR-7 module is the “alarm.”

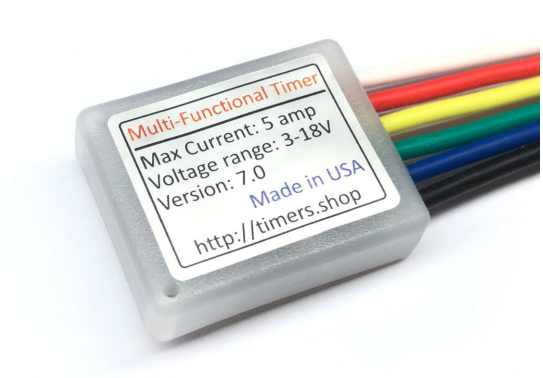
PAC Products TR-12

www.pac-audio.com

The TR-12 is the bigger brother to the TR-7 module. The TR-12 has four inputs, four outputs, and is computer programmable.

Appendix
bluePRINT Enhancement

Timer Shop Delay Timer
timers.shop



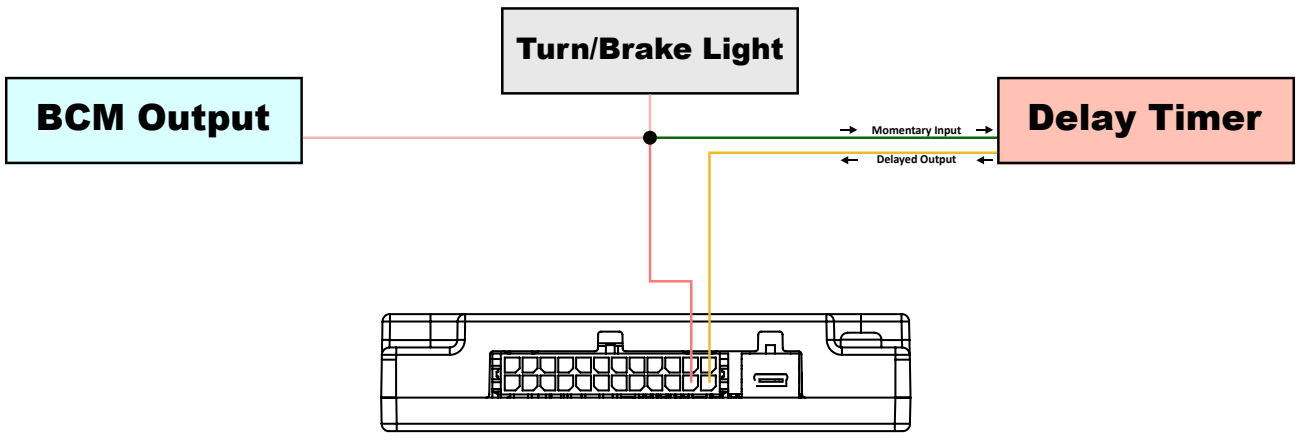
The above delay timer is a multi-functional timer delay module, offering more than 33 different timer functions. This can be used like a State On Delay, State Off Delay, or to create a separate ignition off delay.

An example case for this - turn signal and brake on the same circuit of the vehicle. This can be tied to the circuit and provide a second input to bluePRINT to determine if a brake or turn signal event is occurring. See the below example.

Using a delay timer like this can save a Matrix or two on a complex build.

Timer Shop Sink Adapter
timers.shop

A sink adapter can be used to convert any positive outputs into the sink (negative) output. Connect Sink adapter to the Multi-functional Timer delay module to create sink functionality.



Appendix

What is Boolean Logic?

English mathmatician George Boole (1815-1864), may seem an unlikely father of today's digital communications, yet his simple binary logic code is vital to how we send and share data.

First introduced in 1847, and commonly refered to as Algebraic Logic, Boolean Logic is based around three very simple words: OR, AND, and NOT.

For each condition in a Boolean statement, it is either true or false (binary) based on if it is happening or not.

In computers it is often broken down to ones and zeros, with one representing true and zero representing false.

Look at it this way:

Condition A = It's raining
Condition B = I'm wearing a rain coat
Results C = I'm going to stay dry.

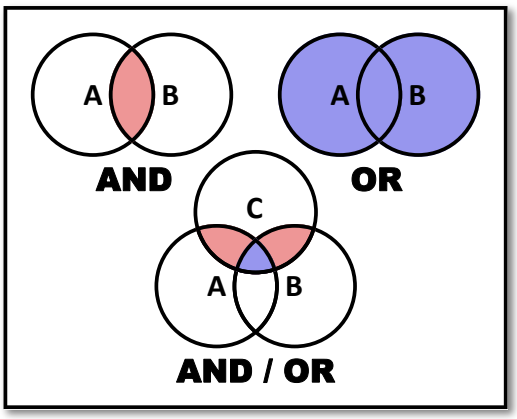
A		B	C
1		0	0
1		1	1
	AND		

In the above scenario, AND makes the most sense. It's raining AND I have my jacket on. When AND comes into play, put a one in the C column in a row if A and B both have a one.

So, if it is raining and I am not wearing my raincoat, I am **not** going to stay dry. Zero is false!

When you see AND, it means both are required - you need a fork AND knife to eat the steak.

In the Venn Diagram below, AND is represented with the pink intersection.



Venn Diagram

OR is treated a little differently. With OR, you have options!

Condition A = Steak
Condition B = Lobster
Condition C = Gummy Bears
Results D = I am going to eat!

A		B		C	D
1		0		0	1
1		0		1	1
0		0		1	1
	OR		OR		

In the above scenario, no matter the condition, I am going to eat. In this case, if any column has a one it it, place a one (true) in the D column.

Referring back to the previous Venn Diagram, OR is represented in purple.

Finally, when there is a combination of ANDs and ORs, Boolean Logic is processed sequentially based on each previous condition true or false statement.

Condition A = Wrench
Condition B = Ratchet > **OR**
Condition C = Tightening a Nut
Results D = Job Completed

A		B		C	D
1		0		1	1
0		1		1	1
1		1		1	1
0		0		1	0
	OR		AND		

Now in this scenario, the wrench and tightening the nut finishes the job, the ratchet and tightening the nut finishes the job, and both tools allow the job to be finished. If neither tool is available, then the job cannot be completed.

Finally, this is represented on the Venn Diagram with both pink and purple shading.

Appendix
Resources

The bluePRINT Instruction Manual is available at our bluePRINT support site.

This comprehensive manual covers all aspects of bluePRINT 3, from vehicle layout to programming completion.

Please visit the SoundOff Signal Dealer Portal at:

https://soundoffsignal.com/dealer-portal/

The manual is downloadable from the bluePRINT Knowledge Center.

bluePRINT Link firmware is now available for download for bluePRINT Certified Users. It can be downloaded from the SoundOff Signal Dealer Portal.

We have a private group on Facebook for certified users. If you aren't already part of the group, contact training@soundoffsignal.com for more information.

bluePRINT® MATRIX HANDBOOK

www.soundoffsignal.com

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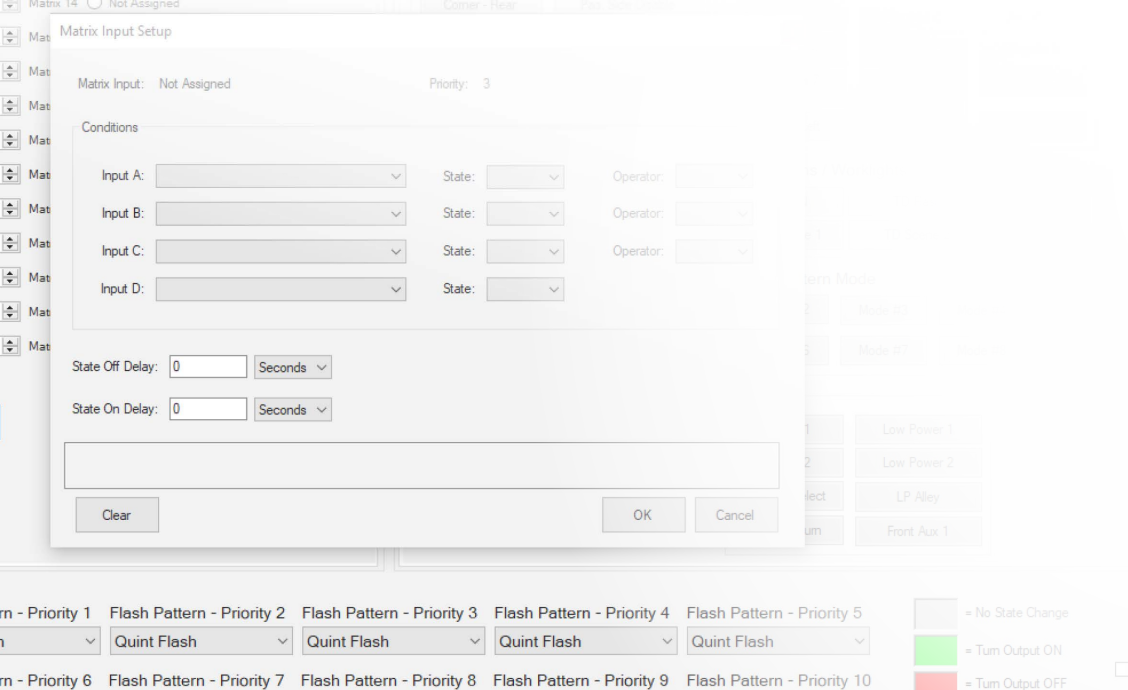

CA Proposition 65 Warning
What is CA Proposition 65?

In November 1986, California voters approved a ballot initiative to address concerns about exposures to toxic chemicals. That initiative became The Safe Drinking Water and Toxic Enforcement Act of 1986, better known by its original name, Proposition 65.

Our posted warning is as follows:

WARNING: Chemicals known to the state of California to cause cancer, or birth defects, or other reproductive harm may be present in products sold by SoundOff Signal® or SoundOff Commerical Vehicle Solutions®.