SGA System Response (ABS Mode)
Getting to Know the Signal Animator

When wiring occupancy detectors to the SGA to operate signals, it is necessary to perform testing, and sometimes, fault finding techniques. These tasks can be significantly simplified by a good understanding of what the SGA's system response is. That is, what are the effects of activating each input.

The truth tables provide this information, one for CTC mode and one for ABS mode. This document takes you through each input and describes what happens when each is activated, using ABS mode, and relates this to the ABS truth table.

When the SGA is powered and no inputs are active, the signal (all three targets) will be dark. A good way to become familiar with what happens is to have an SGA that is wired up to a three-target signal and use jumpers to activate each input as they are described.

Digital States

In the digital world, everything is all ones and zeroes, making everything pretty easy to follow. At least it should. Trouble is, what does a "one" mean and what does a "zero" mean is not always so clear cut. The SGA has 14 inputs and 9 outputs, and this definition is different for inputs and outputs.

The outputs drive LEDs and therefore what is important is whether an LED is illuminated or not. In the case of two-colour LEDs where yellow is displayed by turning both the red and green on, the separate or combined illumination of the red and green outputs are important as well. Added to this is the fact that whether the electrical state of the output should be "high" or "low" depends on if the LEDs are wired with their anode common or their cathode common. Fortunately, it is not necessary to think of all these details. What matters is what colour is displayed and whether it is solid or flashing, as long as the SGA is configured for the type of signal being used (Type SA two colour, Type SA three colour, or Type D) and the common anode/cathode jumper is set correctly. Therefore, the truth table shows the indication(s) for a given set of input states.

For the inputs, what is important is whether an input is "active" or "inactive". One must actively connect an input to ground (the negative side of the SGA's power supply) to make it active. That can mean connecting it to ground by having the connection made by an occupancy detector, a switch machine contact, or a jumper on the input. Grounding means connecting it to a low level, which tends to be thought of as a zero. There is a tendency to think that active should be a one, but these are "active low" inputs, so the zero input is an active input.

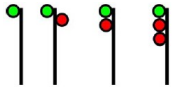
On the truth table, some inputs for a given output display will be blank. This means that its state does not matter, that the output will be the same given all the other inputs that do matter regardless of the input in question. For instance, if a particular input makes the signal display a Stop indication, any of the speed restriction inputs won't matter - stop means stop and speed restriction is irrelevant.

For this document, segments of the truth table where an input is active, an "A" will be shown and when it is inactive, an "I" will be shown. On the truth table document, the digital values of "0" (for active) and "1" (for inactive) are shown.

Occupancy Inputs

The Occupancy Inputs, GN, YL, Y2, RD, and R2, are generally driven by occupancy detectors, either directly, or through a switch machine position contact. On the truth table segments shown throughout this document, a single column "R" is shown instead of RD and R2. If shown as inactive ("1"), both RD and R2 must be inactive. If shown active ("0"), either or both may be active. The same applies to YL and Y2, which are shown on truth table segments as "Y".

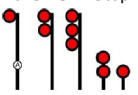
The GN input is used to control approach lighting. When it is activated on its own, the signal will illuminate and display a **Clear** indication, as shown below. When approach lighting is used, it is activated by the detector for the block that is in rear of the signal, and this is the condition where a train is approaching the signal. When approach lighting is not used, this input must have a jumper go ground. With the exception of the **Stop** indications, all examples described further in this document, GN should have a jumper to ground as well.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	I		I									dark
GN, RD, and R2 are all inactive.												
	A	I	I	I	I	I	I	I	I	I	I	 **Rule 405:** Clear Signal
Only GN active.												

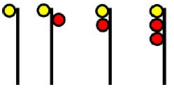
The RD and R2 inputs have the same effect, with either input will illuminating the signal, with an indication of **Stop**, as shown below. Whether this means **Stop and Proceed** or simply **Stop** depends on the type of signal, which depends on the location of the signal. **Stop and Proceed** is used for automatic block signals since these types of signals are permissive. **Stop** is used at interlockings since an absolute indication is needed.

When one of these inputs is active this indication will display regardless of the state of any other input.

Either of these inputs are activated by a detector for the block that is in advance of the signal, or may be activated by anything that would require a signal to display stop, such as a switch machine contact on a trailing-point switch not aligned for the route passing the signal. The two inputs are provided to allow operation by two different sources without electrically connecting them to each other. With either of these active, the signal will be illuminated and indicating **Stop**.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
			A									 **Rule 437:** Stop and Proceed
RD or R2 active.												 **Rule 439:** Stop Signal

The YL and the Y2 inputs have the same effect, making the signal display **Clear to Stop**, as shown below, provided neither RD nor R2 are active. These inputs are usually activated by the same sources that would activate the RD or R2 inputs of the next signal in advance of this signal. This is because **Clear to Stop** indication is displayed on a signal that is in rear of a signal displaying **Stop**.

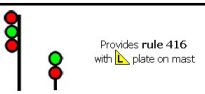
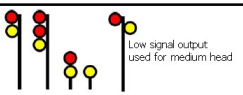
Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
I	A	A	I					I	I	I	I	
YL or Y2 active.												**Rule 411:** Clear to Stop

Entry Speed Restriction Inputs

These inputs tell the SGA if the block immediately in advance of the signal has any speed restriction. In other words, the block that a train is about to enter after passing the signal. These would only be used for a home signal at an interlocking. These inputs have no effect if the signal is dark because the GN input is not active, and they also have no effect if either the RD or R2 inputs are active.

When the occupancy inputs on their own will display a **Clear** indication (only GN active), the entry inputs will change the indication to a ***Something* to Clear** indication, depending on the most restrictive active input. EL will display **Limited to Clear**, EM will display **Medium to Clear**, ES will display a **Slow to Clear**, and ER will display a **Restricting** signal, as shown below.

When a combination of one or more of these inputs are active, the indication will be that of the most restrictive of the activated speed restriction inputs. For example, if EL and ES are both active, the signal will display a **Slow to Clear** indication.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	I	I					A	I	I	I	
Entry speed restriction input EL active.												**Rule 416:** Limited to Clear
	A	I	I						A	I	I	
Entry speed restriction input EM active.												**Rule 422:** Medium to Clear
	A	I	I							A	I	
Entry speed restriction input ES active.												**Rule 431:** Slow to Clear
	A	I									A	
Entry speed restriction input ER active.												**Rule 436:** Restricting Signal

When the occupancy inputs on their own will display a **Clear to Stop** indication (GN active along with YL or Y2), the entry inputs will change the indication to a ***Something* to Stop** indication, depending on which input is active. EL will display **Limited to Stop**, EM will display **Medium to Stop**, ES will display **Slow to Stop**, as shown below. If ER is active, a **Restricting** signal will be displayed as above.

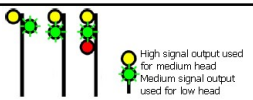
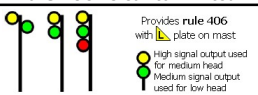
When a combination of one or more of these inputs are active, the indication will be that of the most restrictive of the activated speed restriction inputs. For example, if EL and ES are both active, the signal will display a **Slow to Stop** indication.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	A	I					A	I	I	I	 **Rule 421:** Limited to Stop
Entry speed restriction input EL active.												
	A	A	I						A	I	I	 **Rule 427:** Medium to Stop
Entry speed restriction input EM active.												
	A	A	I							A	I	 **Rule 435:** Slow to Stop
Entry speed restriction input ES active.												

Approach Speed Restriction Inputs

These inputs tell the SGA if the second block in advance of the signal has any speed restriction. In other words, the signal (and block) that a train passing this SGA's signal would be approaching. These inputs have no effect if the signal is dark because the GN input is not active, and they also have no effect if either the RD, R2, YL, or Y2 inputs are active.

These inputs are used while the Entry Speed Restriction Inputs are not used for an automatic block signal that is the distant signal to an interlocking. In this situation, when the occupancy inputs only have GN active, as described above, the approach inputs will change the indication to a **Clear to *Something*** indication, depending on the most restrictive active input. AL will display **Clear to Limited**, AM will display **Clear to Medium**, AS will display a **Clear to Slow**, and AR will display a **Clear to Restricting** signal, as shown below.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
I	A	I	I	A	I	I	I	I	I	I	I	 **Rule 406:** Clear to Limited
Approach speed inputs: AL active; AM, AS, and AR *not* active.												
I	A	I	I		A	I	I	I	I	I	I	 **Rule 407:** Clear to Medium
Approach speed inputs: AM active; AS and AR *not* active.												

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
I	A	I	I			A	I	I	I	I	I	
Approach speed inputs: AS active; AR *not* active.												**Rule 409:** Clear to Slow
	A	I	I				A	I	I	I	I	
Approach speed inputs: AR active.												**Rule 410:** Clear to Restricting

Approach Speed Restriction Inputs are used in combination with Entry Speed Restriction Inputs where an interlocking signal also serves as the distant signal to another interlocking signal in advance of it.

With the only the occupancy input GN and the entry input EL active, the approach inputs will change the indication to a **Limited to *Something*** indication, depending on the most restrictive active input. AL will display **Limited to Limited**, AM will display **Limited to Medium**, AS will display a **Limited to Slow**, and AR will display a **Limited to Restricting** signal, as shown below.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	I	I	A	I	I	I	A	I	I	I	
Approach speed inputs: AL active; AM, AS, and AR *not* active.												**Rule 417:** Limited to Limited
	A	I	I		A	I	I	A	I	I	I	
Approach speed inputs: AM active; AS and AR *not* active.												**Rule 418:** Limited to Medium
	A	I	I			A	I	A	I	I	I	
Approach speed inputs: AS active; AR *not* active.												**Rule 419:** Limited to Slow
	A	I	I				A	A	I	I	I	
Approach speed inputs: AR active.												**Rule 420:** Limited to Restricting

With the only the occupancy input GN and the entry input EM active, the approach inputs will change the indication to a **Medium to *Something*** indication, depending on the most restrictive active input. AL will display **Medium to Limited**, AM will display **Medium to Medium**, AS will display a **Medium to Slow**, and AR will display a **Medium to Restricting** signal, as shown below.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	I	I	A	I	I	I	I	A	I	I	
Approach speed inputs: AL active; AR, AS, and AM *not* active.												**Rule 423:** Medium to Limited

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	I	I		A	I	I		A	I	I	 **Rule 424:** Medium to Medium
Approach speed inputs: AM active; AR and AS *not* active.												
	A	I	I			A	I		A	I	I	 **Rule 425:** Medium to Slow
Approach speed inputs: AS active; AR *not* active.												
	A	I	I				A		A	I	I	 Provides **rule 420** with plate on mast **Rule 426:** Medium to Restricting
Approach speed inputs: AR active.												

With the only the occupancy input GN and the entry input ES active, the approach inputs will change the indication to a **Slow to *Something*** indication, depending on the most restrictive active input. AL will display **Slow to Limited**, AM will display **Slow to Medium**, AS will display a **Slow to Slow**. As there is no Slow to Restricting indication, if AR is active, the signal will be dark.

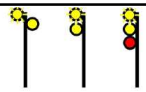
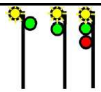
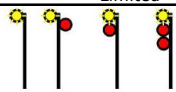
Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
	A	I	I	A	I	I	I			A	I	 **Rule 432:** Slow to Limited
Approach speed inputs: AL active; AM and AS *not* active.												
	A	I	I		A	I	I			A	I	 **Rule 433:** Slow to Medium
Approach speed inputs: AM active; AS *not* active.												
	A	I	I			A	I			A	I	 **Rule 434:** Slow to Slow
Approach speed inputs: AS active; AR *not* active.												
	0	1	1				0			0	1	dark
"Slow to Restricting" indication is invalid.												

With the only the occupancy input GN and the entry input EM active, the approach inputs will change the indication to a **Medium to *Something*** indication, depending on the most restrictive active input. AL will display **Medium to Limited**, AM will display **Medium to Medium**, AS will display a **Medium to Slow**, and AR will display a **Medium to Restricting** signal, as shown below.

Advance Input (AV)

The final input to be described is the Advance Input, AV.

The AV input is used in conjunction with four indications that have an "advance" version that provides early information to a train of an upcoming indication. These tend to be used where block length is shorter than usual. The four advanced indications are **Advance Clear to Stop**, **Advance Clear to Limited**, **Advance Clear to Medium**, and **Advance Clear to Slow**. Each is shown below.

Inputs												Signal Indication
AV	**GN**	**Y**	**R**	**AL**	**AM**	**AS**	**AR**	**EL**	**EM**	**ES**	**ER**	
A	A	I	I			A	I	I	I	I	I	
AV active; Approach speed inputs: AS active; AR *not* active.												**Rule 414:** Advance Clear to Slow
A	A	I	I		A	I	I	I	I	I	I	
AV active; Approach speed inputs: AM active; AS and AR *not* active.												**Rule 413:** Advance Clear to Medium
A	A	I	I	A	I	I	I	I	I	I	I	
AV active; Approach speed inputs: AL active; AM, AS, and AR *not* active.												**Rule 412:** Advance Clear to Limited
A	A	A	I	I	I	I	I	I	I	I	I	
AV active; No Approach speed inputs active.												**Rule 415:** Advance Clear To Stop

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