ATLAS
MODEL RAILROAD CO., INC.

ATLAS ALL SCALES SIGNAL SYSTEM

Advanced Signal Guide

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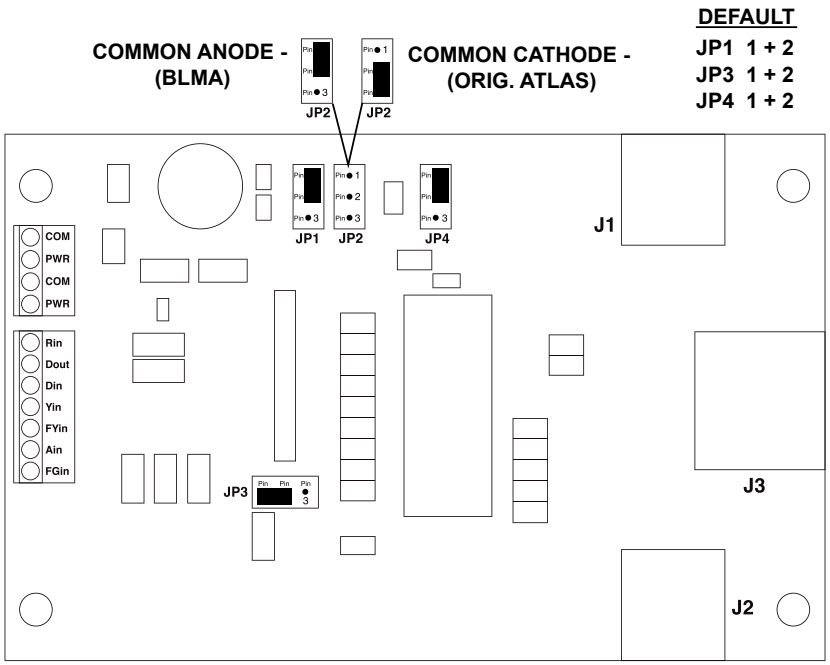
The Atlas All Scales Signal System - Introduction

Model railroad signaling is something which will greatly enhance the realism and operational interest of your layout. It can be as simple as one fixed signal protecting a siding or stretch of single-track mainline, or an integrated system of many signals controlling not only speed but route selection. The Atlas All Scales Signal System is designed to address many prototypical situations that you can model, and the purpose of this guide is to provide the technical information required to enable you to go beyond installing a simple signal. This guide will help you plan and wire a complete signaling bus for your layout. You can also find additional information, including our Basic Guide on our website at www.atlasrr.com.

Section 1 – A Tour of the USCB

The Atlas Universal Signal Control Board, or USCB (Item # 70 000 046), is the heart of the Atlas signal system. Its' job is to translate what happens when a train is detected in a specified area, and display the appropriate aspect color(s) on the visible signal based on the configuration settings and connectivity of the board itself. In the QuickStart guide, you were introduced to the "jumper blocks" which configure the operation of the USCB, and were instructed as to how to set JP2 for the electrical type of signal you are using (common cathode or common anode). There are three additional jumper blocks that you can set to tailor the operation to support prototypical behavior for different railroads and build a "network" of signals. Please refer to Figure 1 for the locations of these jumpers.

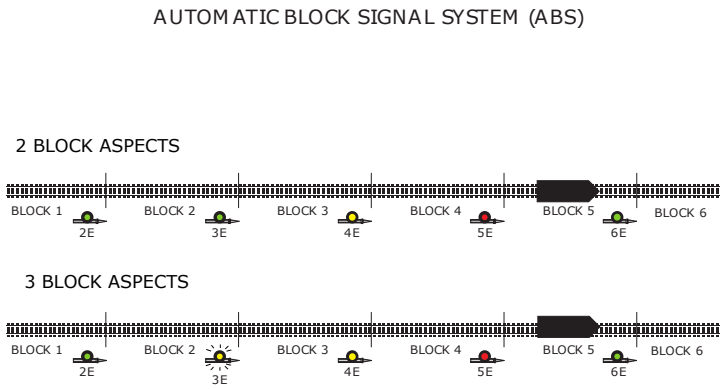
FIGURE 1: Universal Signal Control Board Layout



DEFAULT FACTORY BOARD

JP4 controls the behavior and configuration of what are known as "blocks" of interconnected signals. Covering pins 1-2 enables 2-block signal behavior, while covering pins 2-3 enables 3-block signal behavior. When connecting several Atlas SCBs together as shown in Section 2, the resulting network replicates what is known as Absolute Block Signaling, or ABS. ABS is utilized by the prototype to govern spacing and speed of trains traveling in the same direction on a track by dividing the track into sections, or "blocks". Block signals indicate whether the track ahead of a train is "clear", "occupied", or some status in between. ABS was designed to protect trains from being hit from behind, so a 2-block system updates the status of the block a train is in as well as the block immediately behind its direction of travel. Similarly, a 3-block system provides the status for the occupied block, and two blocks behind the train.

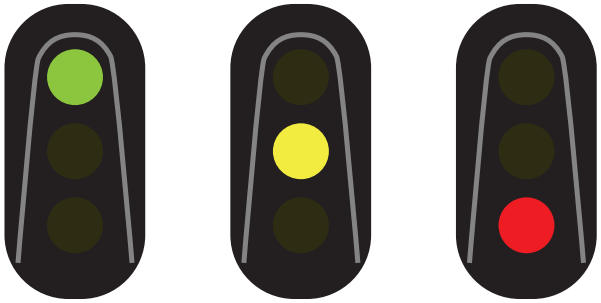
FIGURE 2: Automatic Block Signal System



On a model railroad, these blocks are created by identifying and isolating a section of track by installing an appropriate detection circuit (optical, electrical DC, electrical DCC, etc.), or by using manual control to trigger the SCB. Figures illustrating these options can be found in the Appendix, the Quick Start Guide, and in Section 4.

Block status is communicated to a train through what is known as the aspect of a visual signal head. A typical signal head is shown in Figure 3. This particular head has three lighted elements, green, yellow, and red, arranged in what looks like an upside-down traffic signal.

FIGURE 3: Modern Signal Heads



If a block is occupied, a red aspect is displayed, which indicates stop. If a block is empty, a green aspect is displayed, which indicates clear. If all USCBs in your system are set to 2-Block operation, and are connected with Atlas interconnect cables (Item # 70 000 057-059) as shown in Section 2, a third signal aspect is possible – the yellow aspect, which normally indicates approach, will light in the block immediately behind the train and will stay yellow until the train moves into the next block, when the signal will return to green, indicating clear.

If you set JP4 to enable 3-Block operation, this provides an additional signal aspect. This aspect is presented differently by different railroads, and goes by a number of names and indications, but it is normally shown by either flashing the yellow light or by illuminating a different light – normally of a blue-white color known as "Lunar White".

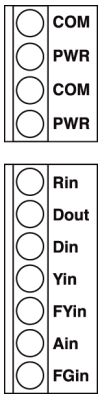
JP3 provides for selecting the prototype signal behavior for this additional aspect in 3 block systems. This aspect is either set as Flashing Yellow (FY) by covering pins 1-2, or Lunar White (LW) by covering pins 2-3. Flashing Yellow is supported by nearly all 3-color signal heads, whereas a Lunar White aspect requires a signal head with appropriate LEDs and wiring to display it. Please refer to the table in Section 3 for proper wiring of such a signal head. Inappropriate setting of this jumper may be confusing, as a head wired without a Lunar White option (which includes most commercial 3-color signal heads) will actually go dark during this part of the signal cycle if JP3 covers pins 2-3. When in doubt, keep the jumper set on pins 1-2 for Flashing Yellow.

JP2 is set based on whether the attached signal is wired common cathode (cover pins 1-2) or common anode (cover pins 2-3), and was discussed in the QuickStart guide.

JP1 enables what is known as "Approach Lighting". On some prototype railroads, signals do not remain lit all the time, but illuminate only when a train is close. Setting this jumper to cover pins 2-3 will duplicate this behavior for the attached signal. Leave the jumper on pins 1-2 to have the signals illuminated all the time while powered up, as well as for general testing.

The USCB also has two screw terminal blocks, J4 and J5, shown in Figure 4.

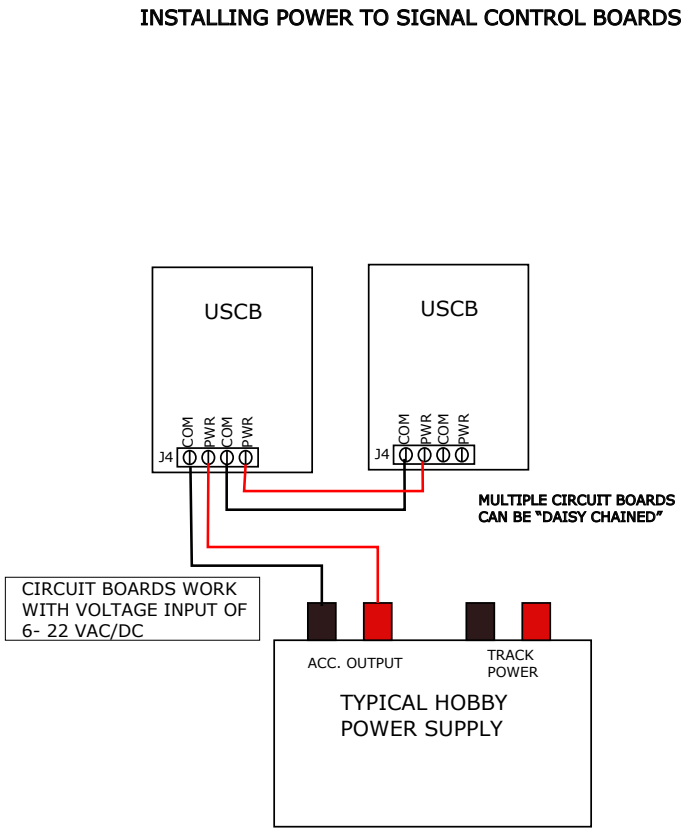
FIGURE 4: Header Blocks



These terminal blocks are used to provide connectivity to a power source to run the board and attached signal, and also supply direct input and output control. The maximum size for a single wire in the screw terminal pocket is 20 gauge (stranded), with 22 gauge solid conductor hookup wire (or smaller) being a good choice for power feeds and simple connections. For applications other than power wiring, 26-28 gauge communication cable wire, such as that found in telephone or computer cable, is highly recommended. To connect multiple wires at a single pocket, combine them first using an appropriate wire splice or tap, and run just a single wire to the post instead of trying to insert several wires into the same pocket.

J4 is the power header, and either pair of COM and PWR terminals may be used to power up a single board. Input power can be either AC or DC, 6-22V, such as that supplied from the (non-variable) accessory terminals of a typical power pack. The COM terminal is the common, or ground, and the PWR terminal is the "hot" or positive. In this manual, we will use Black wires to indicate the common, or ground, and Red wires to indicate the hot or positive side. These connections to an accessory power bus provide regulated 5V DC power to operate the board and the attached signal head. For convenience, you can use the second set of terminals on J4 to "daisy chain" multiple signal boards to a single power source, as shown in Figure 5.

FIGURE 5: Connecting Power to the USCB



NOTE: THE ONBOARD LED WILL ILLUMINATE WHEN POWER IS APPLIED CORRECTLY

It is recommended to use a dedicated DC power supply for the signal system and detectors, and not attach additional accessories such as layout lighting, sound, or animation circuits to this power "bus".

J5 is the input/output (or I/O) header. This block has connection points for wiring a detector, as you saw in the QuickStart guide, for setting or over-riding signal head aspects directly, and for providing outputs that can be used to drive panel LEDs or relays. Table 1 lists the I/O points and functions.

Label	Function
Rin	Red Aspect Input
Dout	Detector Out
Din	Detector Input
Yin	Yellow Aspect Input
FYin	Flashing Yellow Aspect Input
Ain	Approach Input
FGin	Flashing Green Aspect Input

Table 1. J5 I/O Header Functions

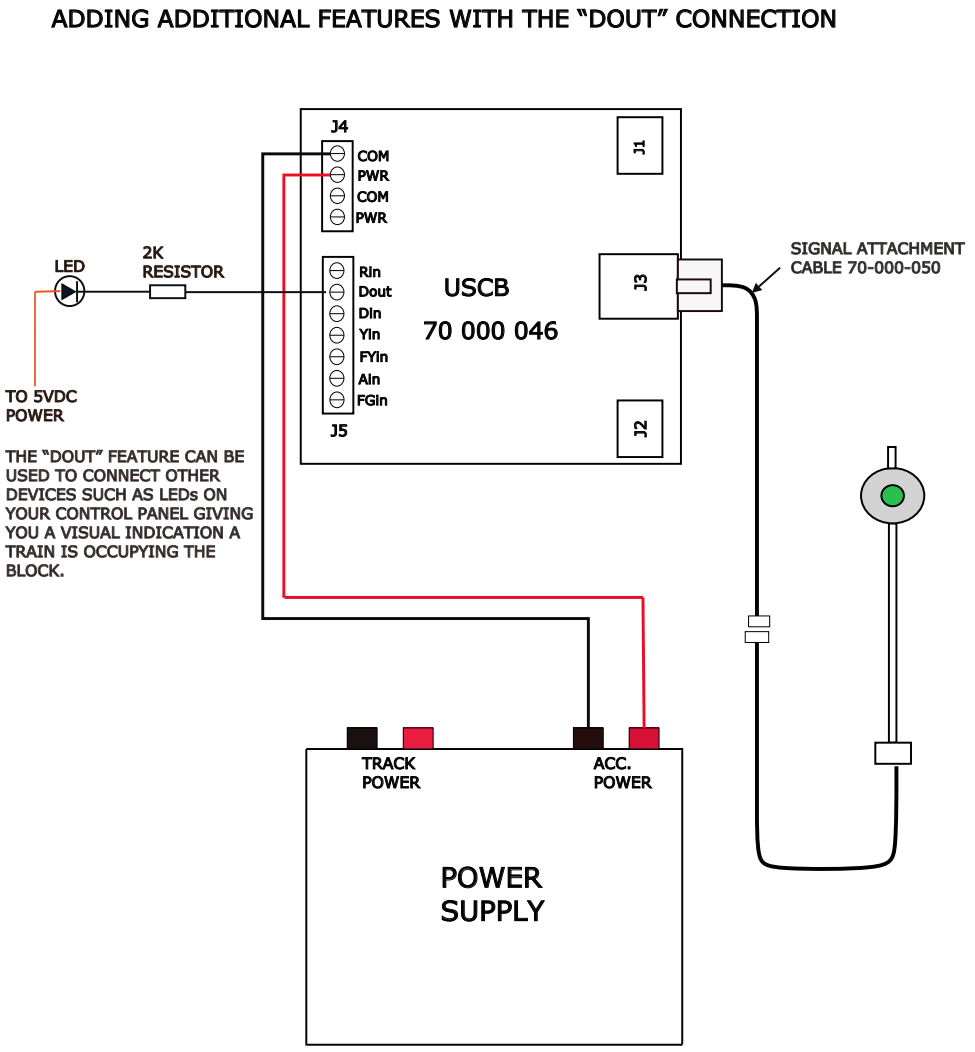
The ***Aspect Inputs*** (R, Y, FY, FG) are triggered by shorting the appropriate port to ground (the signal power bus / layout bus common), and will be discussed in detail in Section 4.

The ***Approach Input*** *(Ain)* port is utilized to enable approach mode lighting for cases when connections between USCBs through cable jacks J1 and J2 are not used. See the Appendix or the Quick Start Guide for more information about Approach Lighting and example wiring.

Din is the input port for the signal from a detector. Shorting this port to an appropriate ground triggers the signal logic, and any selected detectors should operate in this fashion. The NCE-BD20 is a typical current detection example that has been tested successfully for use in DCC applications. As noted in the QuickStart guide, this input can also be controlled manually, and together with the Aspect Inputs, can mimic a Centralized Traffic Control (CTC) signal system as detailed in Section 4. For applications where the detector directly measures voltage drop across the rails in DC layouts (for example, the original Atlas BDB, a "Twin T" circuit, or similar) *Din* should utilize the layout bus common. See the Appendix for more information and examples.

Dout is a detector output port used to drive optional accessories or circuits. The state of this port tracks with the status of Din, and so can provide a direct indication of block occupancy, through lighting of a panel LED, for example, as shown in Figure 6.

FIGURE 6



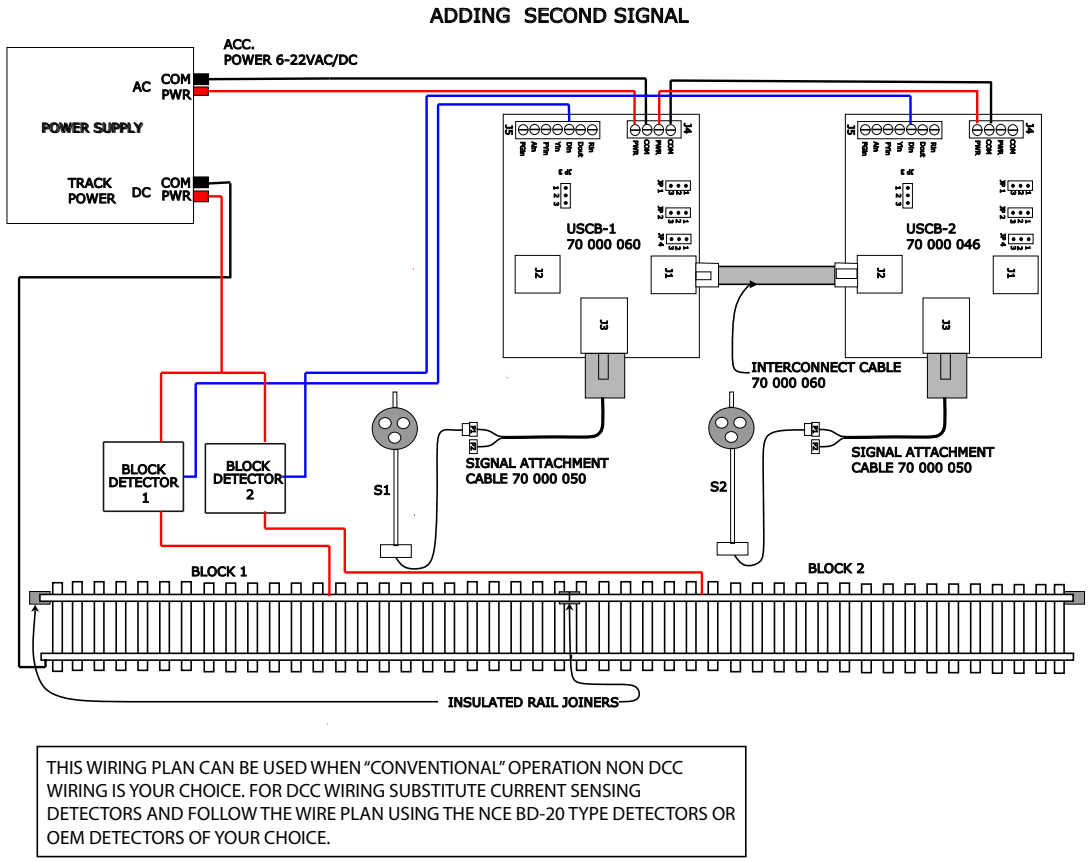
It can also trigger a low power (less than 5V) relay to control switch machines, power cutoff switches or similar. This output is capable of grounding up to 500mA of current with an appropriate resistive load, but should not be driven by more than a 5V control signal.

Finally, there are three cable jacks on the USCB. J3 is an RJ45 format jack which connects a signal head to the USCB through a special cable (Item # 70 000 050). The wiring of this cable and signal heads is discussed in Section 3. Cable jacks J1 and J2 are RJ12 format, and are used to connect USCBs together into block systems using Atlas USCB interconnect cables (Item #s 70 000 057-59) as shown in Section 2. Atlas has extension cables and connectors available in a variety of lengths to support any configuration you choose for the location of your USCBs or signal heads. Please refer to the product matrix at the end of this document or on our website for current item numbers.

Section 2 – Interconnecting USCBs – the Signal Logic "Bus"

To integrate the operation of two or more signal control boards into logical blocks, you can easily connect them together using Atlas USCB interconnect cables. Plug one end of the interconnect cable into J1 of the first USCB and the other into J2 of the second USCB and so on as shown in Figure 7.

FIGURE 7: Interconnecting 2 Boards for the Addition of a Second Signal



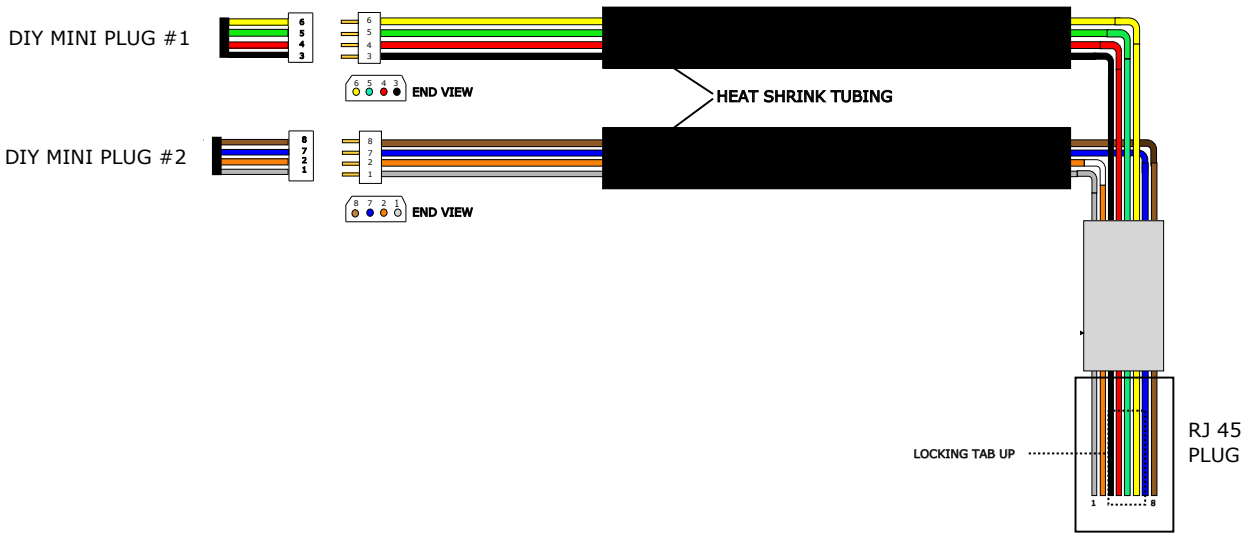
THIS WIRING PLAN CAN BE USED WHEN "CONVENTIONAL" OPERATION NON DCC WIRING IS YOUR CHOICE. FOR DCC WIRING SUBSTITUTE CURRENT SENSING DETECTORS AND FOLLOW THE WIRE PLAN USING THE NCE BD-20 TYPE DETECTORS OR OEM DETECTORS OF YOUR CHOICE.

Connecting the boards in this fashion turns off the timed yellow aspect, since all signal aspects are now controlled by the occupancy of the blocks ahead and behind the train(s). The exact aspects available and displayed when a train is detected depend on the settings of JP4 and JP3, and are summarized in Figure 10, on page 13. The table in Figure 10 assumes a single train is detected in Block 1 (B1). The meanings for home lighting (+H in the table) and PRR center status are discussed in Section 3.

Section 3 – Signal Head Wiring Explained (and the DIY kit 70-000-051)

The Atlas USCB connects to signal heads through J3, which is an RJ45 format jack. When used with an Atlas signal connection cable (Item # 70 000 050), any Atlas signal, regardless of scale, can be attached by connecting the plug from the head to the proper mini plug (usually plug 1) on the harness. Table 3 provides the relationship between pin number, wire color, and function for the harness and signal connectors. This is also illustrated in Figure 8.

FIGURE 8: Connecting Heads via Mini Plug



RJ45 Pin #	Wire Color	Function	Mini Plug
1	Grey	Spare	2
2	Orange	Home Light	2
3	Black	Common / Ground	1
4	Red	Red LED	1
5	Green	Green / Flashing Green LED	1
6	Yellow	Yellow / Flashing Yellow LED	1
7	Blue	PRR Center Light	2
8	Brown	Lunar White Light	2

Table 3. Pin Number / Wire Colors

To attach a third-party signal to the USCB through the connection cable, Atlas supplies a DIY kit (Item # 70 000 051) with the appropriately sized / colored wire and mating mini plug for direct attachment to the leads of the signal.

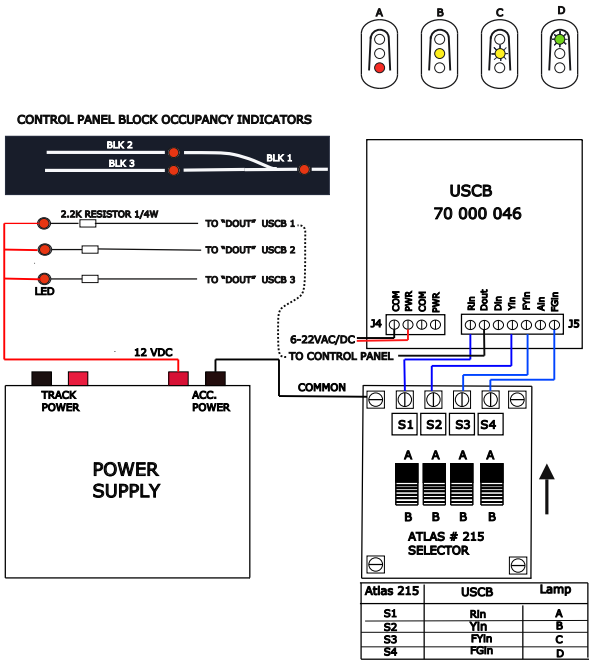
You should use the table in Figure 8 and the documentation provided by the manufacturer of your signal to attach the leads from the DIY kit to the wires of the signal appropriately for the specific signal prototype and situation. The USCB has a 3.3 kΩ SMD resistor wired in series with the output, so additional protection resistors may or may not be necessary for most signals. If needed, they should be installed in line between the plug and the signal head as appropriate. The voltage as supplied from the USCB is 5V DC at 25mA before passing through the hardwired 3.3k resistor.

In addition to the Red, Green, Yellow, and Lunar White aspect functions you will notice the lines labeled for PRR (line 7) and HOME (Line 2). The PRR function provides for a lit center LED to properly replicate a PRR position light in an appropriate head, and is on by default for all aspects when jumper JP3 covers pins 1-2 (FY mode). When JP3 covers pins 2-3 (LW mode), this function is only on while the Green aspect is on. The HOME function provides a circuit for illuminating a "home" signal light or additional LED for certain prototypes. When JP3 covers pins 1-2 (FY mode), the HOME circuit is on for only the Green and Red aspects, and is on for only the Green and Yellow aspects when JP3 covers pins 2-3 (LW mode). This is summarized by the Table above. These options can be utilized in a variety of ways, such as providing for B&O signal marker lights or adding extra lamps to a particular signal on the layout to modify the aspect appropriately for the situation (such as changing a "stop" to a "stop and proceed" indication).

Section 4 – Manual Control Wiring Considerations

For this section, please refer to Figure 9, which illustrates a very convenient way to provide access to all manual controls as described on page 10 for one USCB and signal head by using an Atlas Selector (Item # 215).

FIGURE 9: Manual Control via the Atlas Selector (Item # 215)



Terminal block J5 contains 4 direct input lines which, when shorted directly to an appropriate ground (signal bus / layout common), can be used to set or override the aspect displayed on an attached signal. Setting the aspect of a signal in this fashion does not affect the state of *Dout*, nor, in general, does it affect the status of other networked signals except as will be noted below. This very powerful feature enables the advanced user to create a CTC (centralized traffic control) type signaling system in order to implement full manual signal control for all or part of the layout, or to simulate any number of special situations that may arise for their railroad. For example, you can set an individual block signal to indicate a speed restriction even when the block is unoccupied, which could replicate orders covering temporary track condition issues, or this feature could be used to implement permanent governing rulebook limits for different types of trackwork, such as mandatory slowdowns at the approach to a passenger terminal ladder.

The exact behavior when using these inputs can be complex to understand, as it depends on the state of *Din* / *Dout* as well as the block settings, FY/LW jumper settings, and USCB interconnectivity. Below are a few examples to illustrate ways you can use these inputs, but knowledge of general signalling practices, as well as those you want to incorporate for your railroad will help to give you some idea of other applications. Feel free to experiment!

Simply put, in all cases, the manual input triggers will NOT override a more restrictive aspect based on block, and if multiple manual inputs are concurrently set, the most restrictive aspect will govern.

Setting a signal with any manual input immediately changes the aspect to the requested level. Turning the manual aspect "off" immediately causes the aspect to return to the current USCB logic status (usually green if the block is unoccupied). There is no time delay between changes like there is when running a signal in stand-alone mode. If, however, a signal is running through a timer cycle or is influenced by occupancy in connected blocks, turning off a more restrictive manual aspect will drop the signal to whatever the current automated logic status is.

For example, consider an interconnected signal system set for two block operation (R, Y, G aspects) where the manual input for a block occupancy is set for *Yin*, perhaps indicating a temporary slowdown to protect a work crew operating in the block. This signal will display a yellow aspect which will stay yellow until cleared (turned off) by a dispatcher. If a detector input is attached, and a train enters and is detected in the block at *Din*, the aspect for that USCB will turn red regardless of the setting of the direct inputs – the block is occupied, and the more restrictive aspect (red) is displayed. Anything controlled by *Dout* functions as expected due to the occupied status of *Din*, and blocks behind the train operate in normal fashion. Once the train leaves the block, the normal "fallback" cycle will commence UNTIL the setting for the manual input is reached. In this example, the signal will return to and hold at yellow, and the prior block will behave normally by returning to green. Once the temporary restriction is lifted, and the manual input is turned off, the signal returns to normal operation, showing green for a clear block.

Alternatively, if in the above example the manual input were instead set for *FGin*, Flashing Green, and not *Yin*, as a train goes through the block, the signal would change from Red through Yellow and stop at the Flashing Green aspect. Solid green would not be available until / unless the *FGin* was cleared by the dispatcher, replicating proper prototype behavior.

Setting *Rin* with a manual input will illuminate the Red aspect of the attached signal. It will not trigger accessories attached at *Dout* or influence the status of any interconnected USCB. This could be used, for example, to replicate a situation where a train is required to stop and ask permission from a dispatcher or tower operator to advance beyond the signal regardless of block status. Upon receiving permission, *Rin* can then be turned off by the dispatcher and allow the train to advance based on the resulting signal aspect. Once the train enters the block, the signal will again turn red if *Din* is attached, and all connected blocks will update appropriately. If *Dout* is controlling a panel LED to indicate occupancy, once the train clears the block and the LED goes out, just as on the prototype the dispatcher or tower operator should remember to reset *Rin* for the next train or face disciplinary action!

Setting the USCB to operate in 3-block mode not only provides access to the Flashing Yellow / Lunar White aspect, but also enables the *FYin* manual input. The operational behavior of *Yin* and *FYin* also depends on the setting of JP3. When JP3 is set to Flashing Yellow mode (pins 1-2 covered), *Yin* triggers the Yellow aspect, and *FYin* the Flashing Yellow aspect of a properly wired signal, exactly as is labeled on the board. If, however, JP3 is in the Lunar White position, then setting *Yin* illuminates the Lunar White aspect, and *FYin* the Yellow aspect. In this way, signal behavior can be tailored to provide either more permissive (FY) or more restrictive (LW) aspect orders based on the prototype situation, custom wiring of specific signal heads, or rulebook you chose to model. Additionally, when in 3-block mode, setting *Yin* by manual input will trigger the appropriate aspect for the prior block signal, if interconnected, unlike the behavior of the other manual inputs which operate independently.

Section 5 – Suggestions for Replicating Operations of Specific Prototype RRs

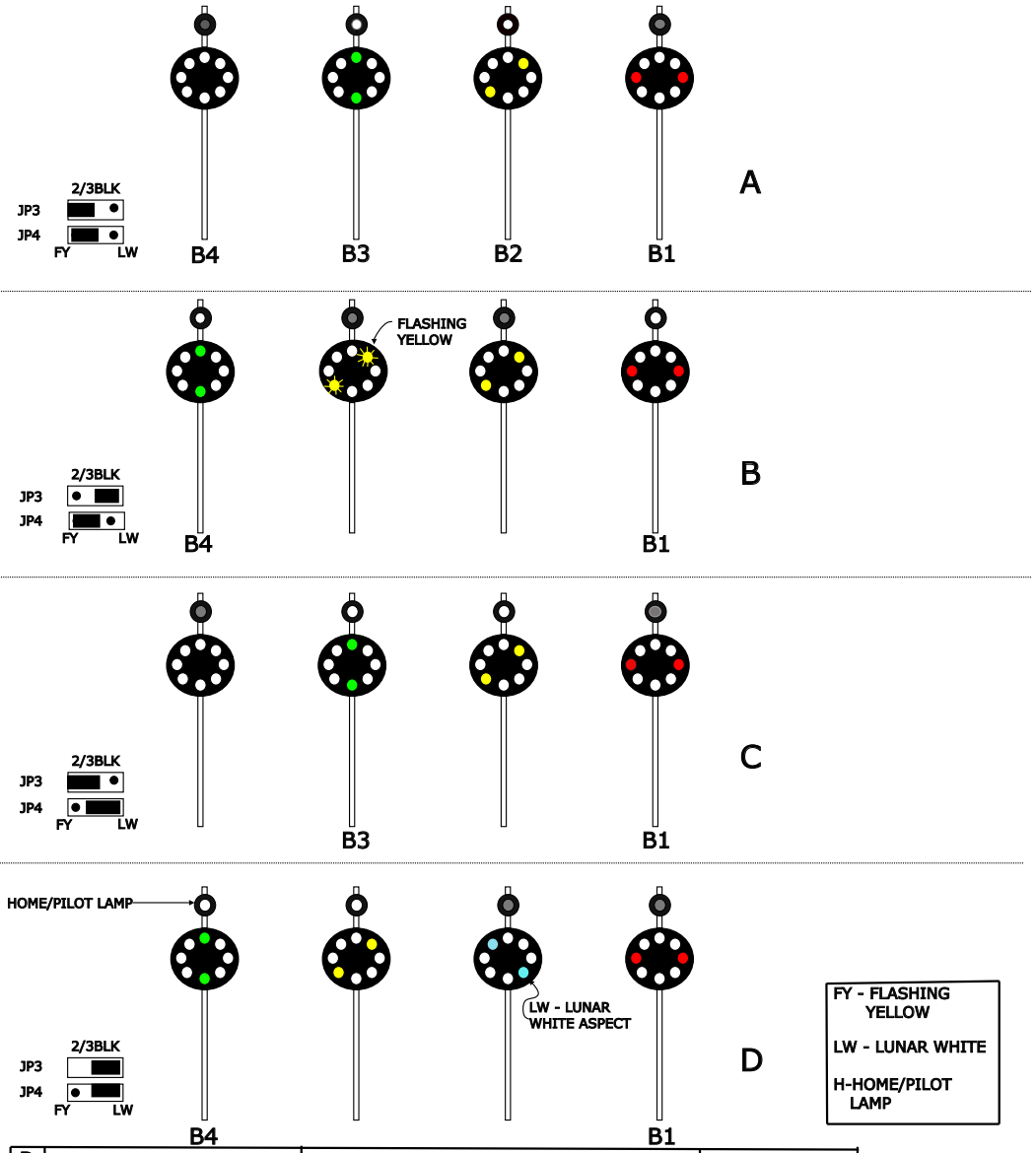
Every prototype railroad has developed a set of rules governing the appearance, aspect, and indication of signals to ensure safe and timely operation of trains across the system. Today these rules can be found in general system rulebooks such as that for NORAC (Northeast Operating Rules Advisory Committee) based railroads, or as special supplements to consolidated rulebooks, such as the GCOR (General Consolidated Operating Rules), with many now available online. There are also a number of sources for historical rulebooks and signal aspects available to the model railroader, such as eBay or railroad historical societies, to permit one to model any era or prototype to any level of detail, some of which are listed in the References section of this manual.

By experimenting with jumper settings, using different signal heads, wiring custom heads, and mixing manual and automated control of signals and blocks, many prototypes can be duplicated easily in miniature with the Atlas All Scales Signal System components.

Section 6 – EXAMPLES OF COMMON TRACK/SIGNAL SETUPS

FIGURE 10: Advanced Signal Setting

SETTING OPTION SWITCHES 2/3 BLOCK FY- FLASHING YELLOW/ LW-LUNAR WHITE



ROW	JP3 Mode	JP4Mode	Block Aspects (B1 occupied)				PRR Center Status
	FY/LW	2/3 Block	B4	B3	B2	B1	
A	FY	2		G (+H)	Y	R	On all
B	FY	3	G (+H)	FY	Y	R(+H)	On all
C	LW	2		G (+H)	Y(+H)	R	On all
D	LW	3	G (+H)	Y(+H)	LW	R	On all

FIGURE 11: Integrated One Direction Setup

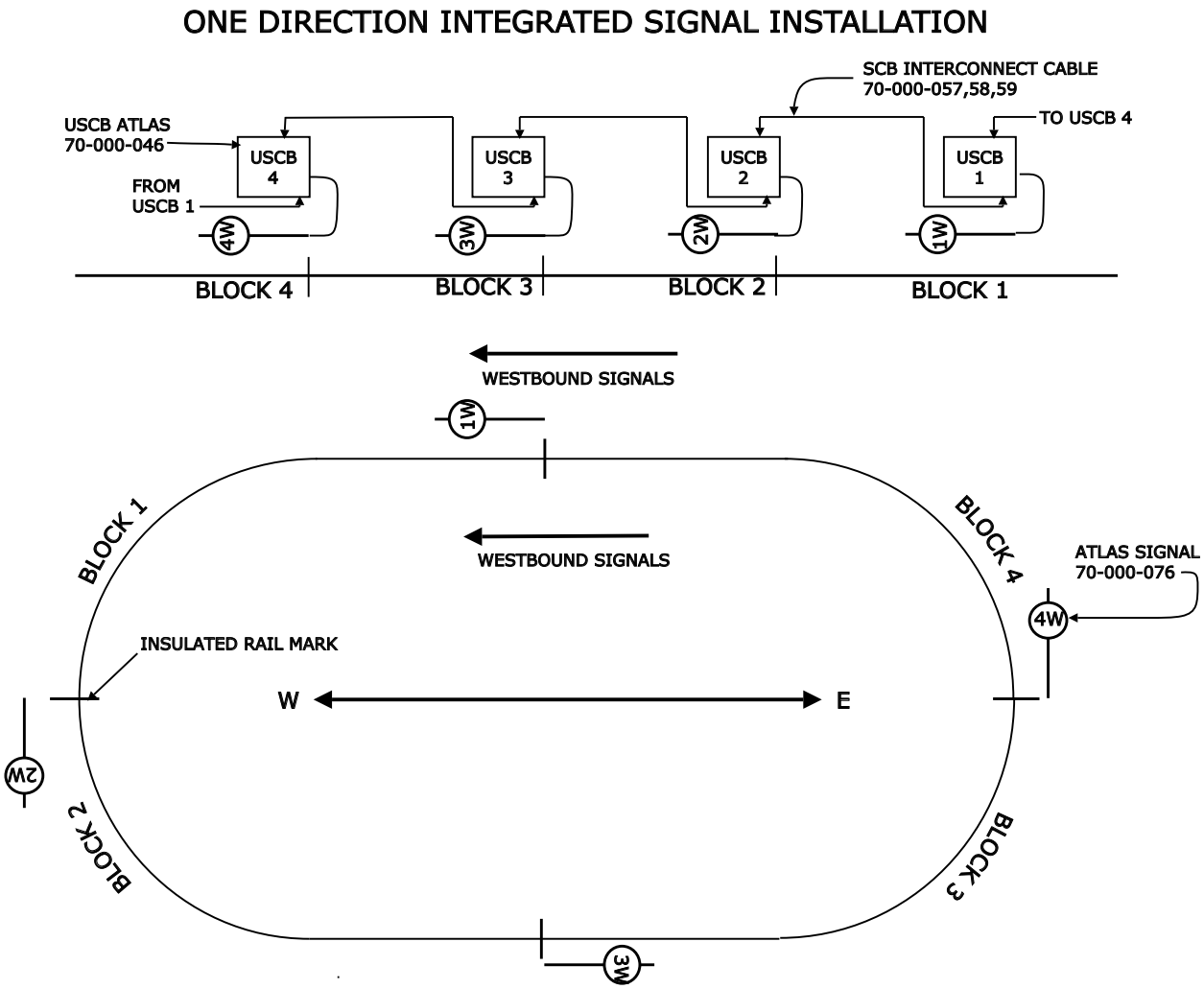
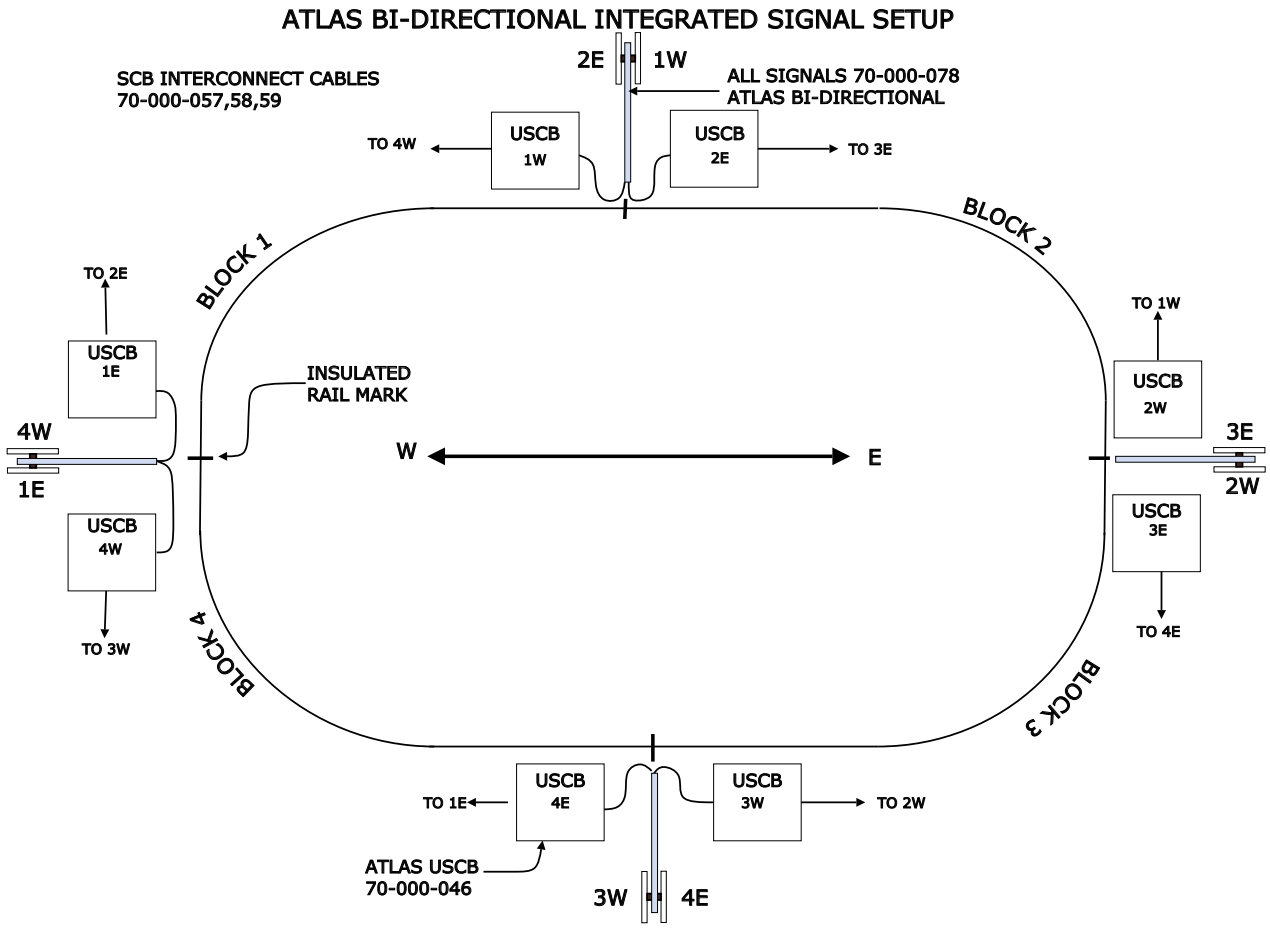


FIGURE 12: Integrated Bi-Directional Setup



Section 7 – SPECIAL CONSIDERATIONS FOR 3-RAIL SYSTEMS

FIGURE 13: Wiring An Atlas USCB With 3-Rail Track Block Detection

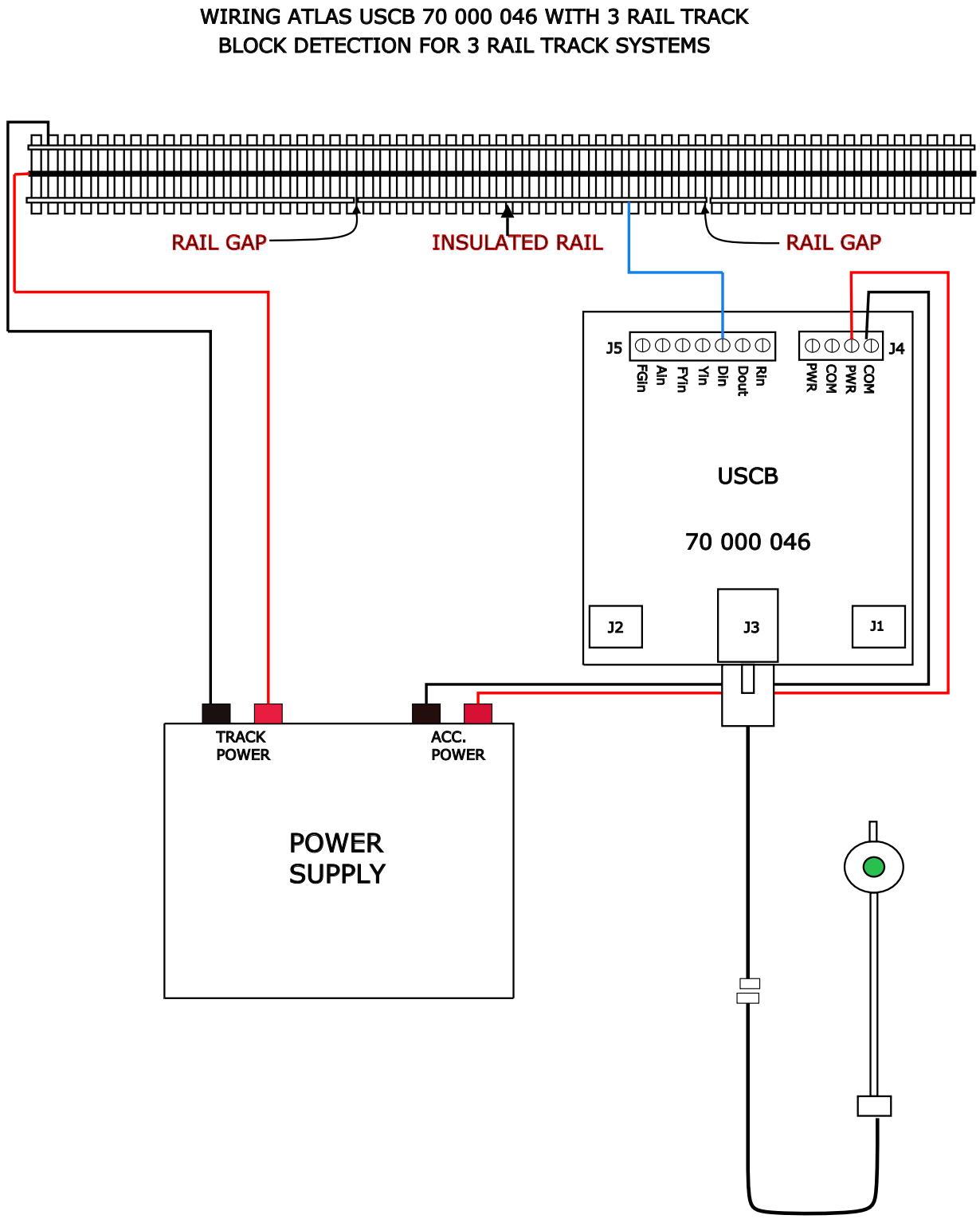


FIGURE 14: Approach Mode Wiring For Single Stand Alone Signal 3-Rail

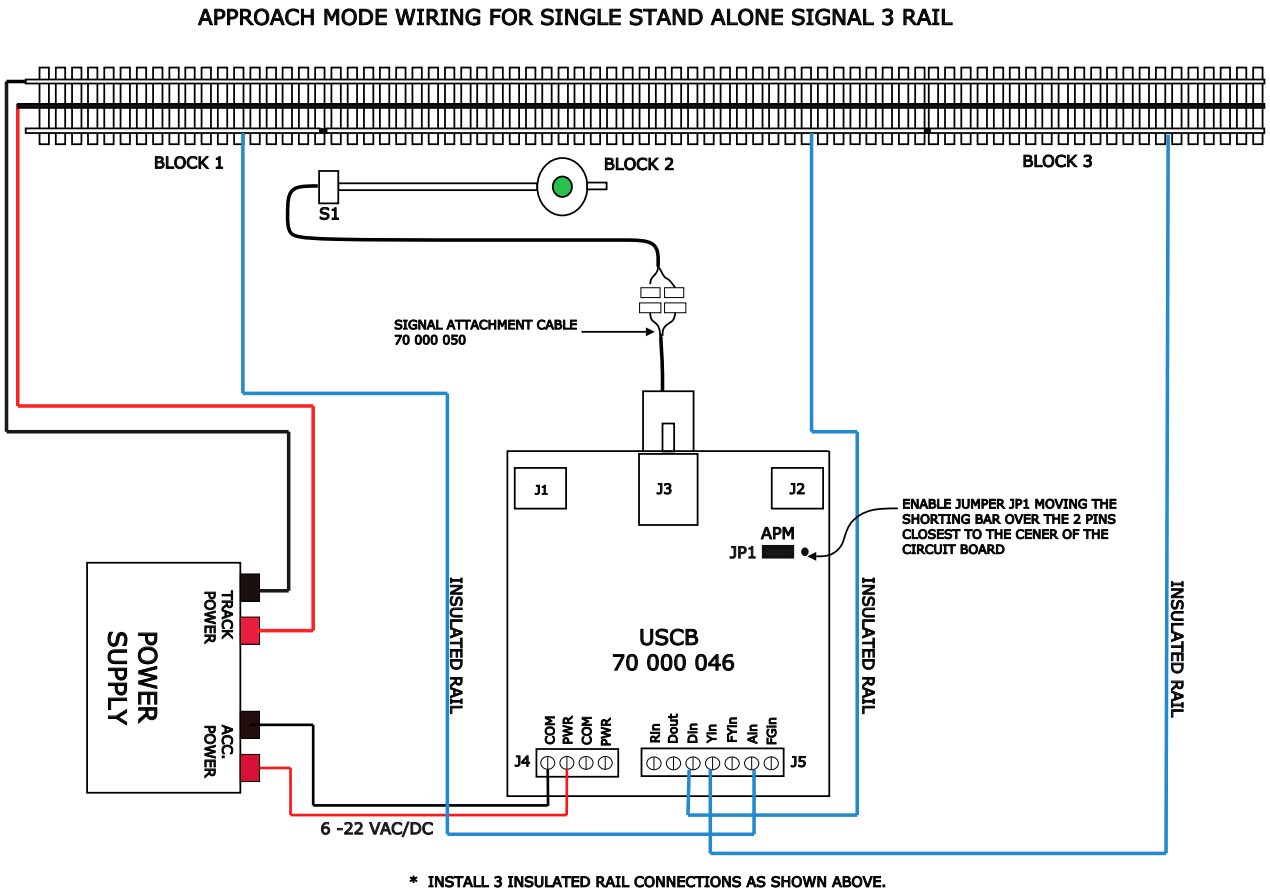
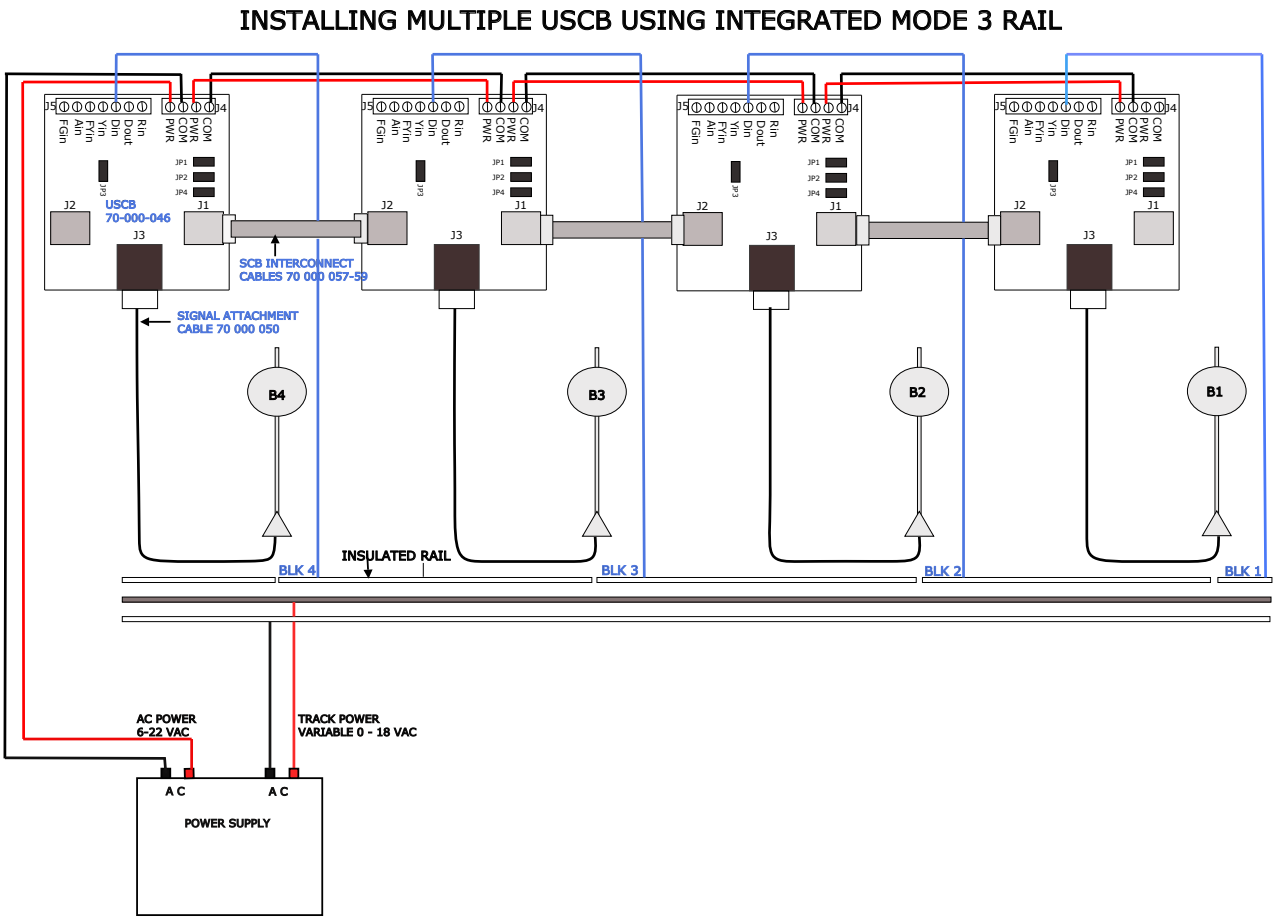


FIGURE 15: Installing Multiple USCBs Using Integrated Mode In 3-Rail



GLOSSARY

ABS (AUTOMATIC BLOCK SIGNALING) A system of interconnected signals controlled by track circuits which is designed to indicate track condition or block occupancy in order to protect trains from collision.

APPROACH LIGHTING Many modern railroads do not illuminate signal heads all the time, but only turn the heads on when a train is nearby. This function is governed by block occupancy as a train approaches and departs a block and its fixed signals.

ASPECT The visual information displayed on a signal head. This includes the number, color, position, and state of lights or mechanical devices which make up a visible signal. The meaning behind a specific aspect is known as the indication, and is specific to the rules of the railroad.

BLOCK A section of track with defined limits used to separate trains by distance in accordance with a rulebook, train orders, and appropriate signals. A block may be of any length so as to allow efficient traffic flow without compromising safe operation.

BUS A wiring system used to transfer data, information, or electrical current between nodes, or between a source and devices which utilize the information or power. In model railroading, a power bus is usually a pair of heavy gauge wires extending from the power source around the layout, to which smaller gauge "feeder" wires are connected to transfer power to the rails. Having separate buses for layout power, accessory power, and signal power is a common practice employed to isolate electrical issues. The Atlas All Scales Signal System utilizes a communications "bus" to interconnect signal control boards together with special cables.

CTC (CENTRALIZED TRAFFIC CONTROL) A remotely controlled system which enables a tower operator or dispatcher to define and direct operations over the tracks by signal indication. The operator may control any combination of the aspects of signals, the position of switches, and the setup of routes from a single location either close to or far away from the actual trackwork.

DETECTOR / DETECTION In model railroading, a way of determining and communicating the location of a train. The exact method of detection can include voltage drop in DC circuits, current sensing in DCC, or optical methods. Any method of detection is acceptable in the Atlas All Scales Signal System, provided that the detector circuit provides an output which shorts to appropriate ground (layout common or signal bus common).

DISPATCHER A railroad employee charged with generating movement orders, resolving movement conflicts, and providing operational guidance to all trains within a specified division or zone so that safe adherence to a timetable is maintained. Depending on prototype and era, a dispatcher may operate under timetable and train order (TTO) protocols, radiotelephone communication, or through Centralized Traffic Control (CTC) to authorize the movement of trains.

GLOSSARY

HEAD The actual part of a signal which conveys information, located so that the train crew can easily see and identify the aspect displayed.

INDICATION The actual interpretation and operational result communicated by a signal aspect as defined by the rulebook of the governing railroad. For example, a red aspect may indicate an absolute stop, or stop and proceed depending on the rulebook or other devices affixed to the signal.

MAST The post or support for a signal head. A mast may also include signs or additional features or attachments which may modify or clarify the aspect displayed on the signal head.

RJ (REGISTERED JACK) 12, 45 A standardized network telecommunication interface for connecting voice or data equipment and cabling together. While specifications exist for the exact wiring patterns employed for each of the RJ types, the "RJ" shorthand is frequently used to refer to the specific number of pins and connections in the jack/plug. In this manual, RJ12 stands for a 6 pin, 6 connector (6P6C) plug, wired as shown in the text, and an RJ45 is an 8P8C plug. It is important that the RJ45 plugs used are not keyed (as per the proper RJ specification), but are those commonly used in computer networking for CAT5 or CAT6 panels.

RULEBOOK A detailed set of rules and regulations governing the operations of a railroad and its employees. Older prototype rulebooks usually include information on all the signal systems and types used by the railroad, including aspects, names, and indications. Rulebooks usually do not include track configurations, tower lists, or interlocking plant detail, but do cover train orders and even job descriptions for certain groups of employees. Good sources for old prototype rulebooks include: train shows / swap meets, historical societies, online scans, Ebay, etc.

SIGNAL Technically, a signal is anything used by a railroad to control railroad operations, and can be sounds (such as the familiar grade crossing whistle), lights, signs, gestures by crew personnel, or symbols that are understood by train crews operating a train over the tracks. A fixed signal (also known as a wayside signal) is normally a signal head or grouping of heads on a mast or other structure used to communicate an aspect to a train crew in order to govern the operation of their train in a safe manner.

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Additional (unofficial) Aspects Tables: http://signals.jovet.net/rules/index.html

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70 000 104	N Signal, Type G, Bidrectional
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70 000 077	HO Signal, Type G, Double Head
70 000 078	HO Signal, Type G, Bidrectional
70 000 094	HO Signal, Hooded Modern, Single Head, LH
70 000 095	HO Signal, Hooded Modern, Single Head, RH
70 000 096	HO Signal, Hooded Modern, Double Head, LH
70 000 097	HO Signal, Hooded Modern, Double Head, RH
70 000 098	HO Signal, Modern Cantilever Bridge, 2 Track, 4 Head, LH
70 000 099	HO Signal, Modern Cantilever Bridge, 2 Track, 4 Head, RH
70 000 100	HO Signal, Modern Bridge, 3 Track, 6 Head
70 000 101	HO Signal, Hooded Modern, Head Only (pr)
O SCALE SIGNALS	
70 000 141	O Starter Set (inclu. 1- 70 000 068, 1- 70 000 046, 1- 70 000 050)
70 000 056	O Signal Attachment Cable Compatibility Connector
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70 000 066	O Signal, PRR Position Light, Single Head
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