

• Automatic Train Stopping using the LNCP and JMRI



Dick Bronson - *RR-CirKits, Inc.*

Clinics in this series:

- Automatic Train Stopping using the LNCP and JMRI

7:00 PM, Tuesday, July 31st
8:30 PM, Friday, August 3rd

- Aspect Signaling with JMRI/PanelPro

4:00 PM, Tuesday, July 31st
7:00 PM, Friday, August 3rd



■ Web Sites

<http://www.rrsignalpix.com/index.html> A site for Signals and rules.
By Zachary Gillihan

<http://www.ctcparts.com/> An excellent site for CTC information.
By Michael Burgett

<http://www.RR-CirKits.com/> Our web site for signal control hardware.
By Dick Bronson

Basic Train Automation

Signal System Types



- What are the primary requirements of automated train control?
 - Obey Absolute Signals
 - Stop and Start Realistically
 - Loco Sounds Follow the Actions
- What are some secondary requirements of automated train control?
 - Slowing for approach signals
 - Sounds at grade crossings
 - Automated Routing

How to stop a train



- Some ways to stop a train?
 - Cut the power to the track
 - Unrealistic stopping
 - No sounds while stopped
 - Control the track voltage
 - Limited use in DCC
 - Can be used to slow trains, but not to stop realistically

How to stop a train

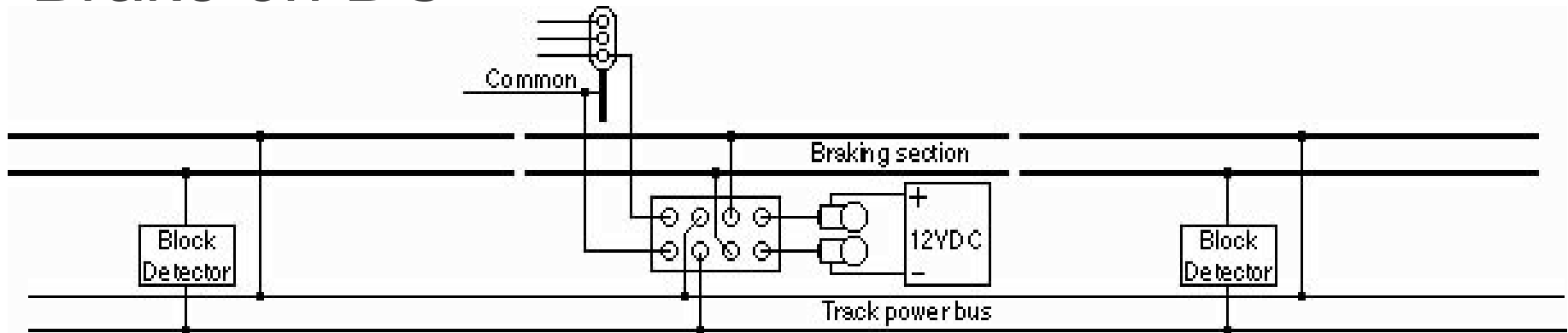


- Command the trains using DCC
 - Requires knowledge of which engine or engines need to be controlled
 - How to tell what engines to control?
 - Digitrax Transponding
 - Bi directional DCC with cutouts
 - Train tracking in software such as JMRI
 - RFID, RPS, Scanners, Etc.
 - Problems with train tracking
 - Limited decoder choices for hardware options
 - Software can easily lose track of trains
 - Inmature and/or high cost technology for RFID etc.
 - Some options do not scale well.



Brake on DC

- Brake on DC



This Schematic showing how to wire Brake on DC is from Loy's excellent web site.

- Unfortunately there are serious problems with this method.
 - It causes short circuits between the DC and DCC requiring double lamps at each block.

Brake on DC

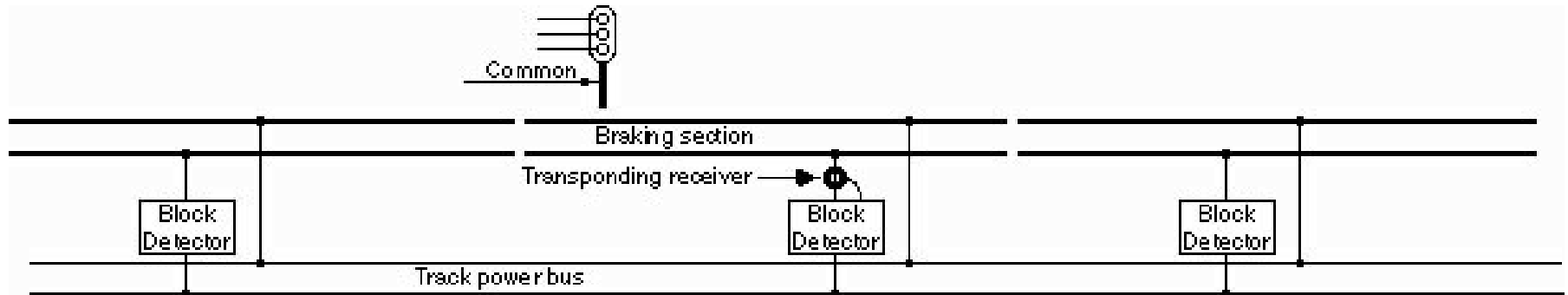


- No detection of stopped train in stopping block
- Gets really difficult for bi-directional running on single track lines
- How do you get running again? You need to delay the signal action long enough for the train to not stop itself as soon as it moves onto the next block causing the signal to go red again.
- There is a better way, so lets not cross this option off the list just yet.

Transponding Braking Section



- Transponding Braking Section

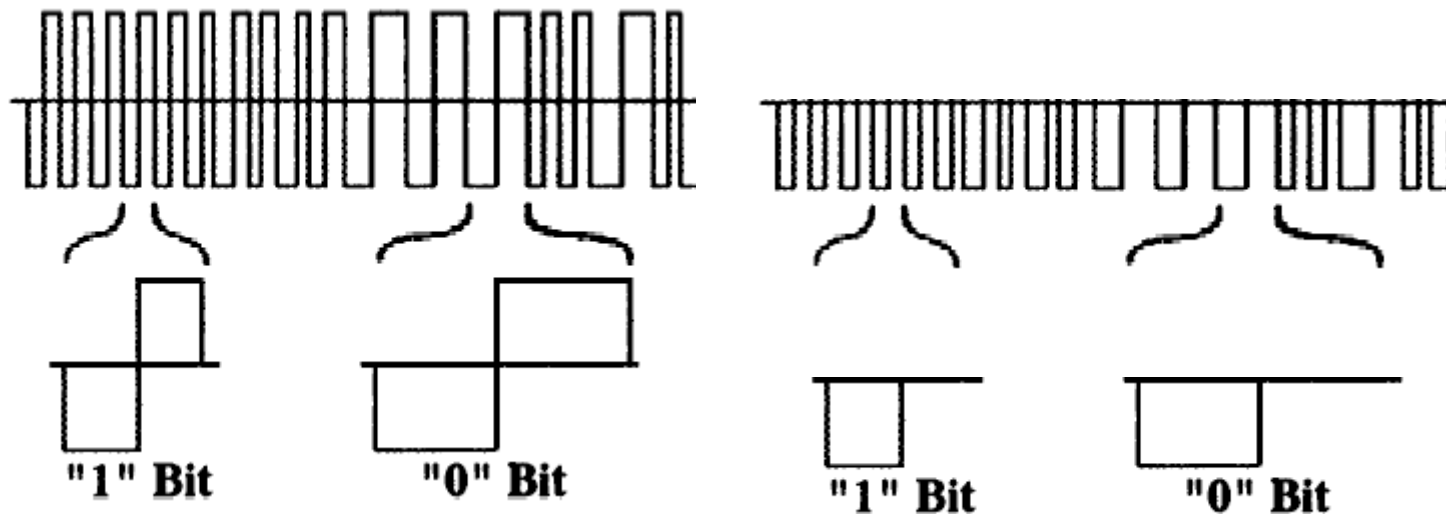


- Using Transponding or Bi-Directional DCC eliminates the issues with shorts and lamps, but doesn't do much for the other issues.
- Special detectors and special decoders are required for ALL blocks and engines



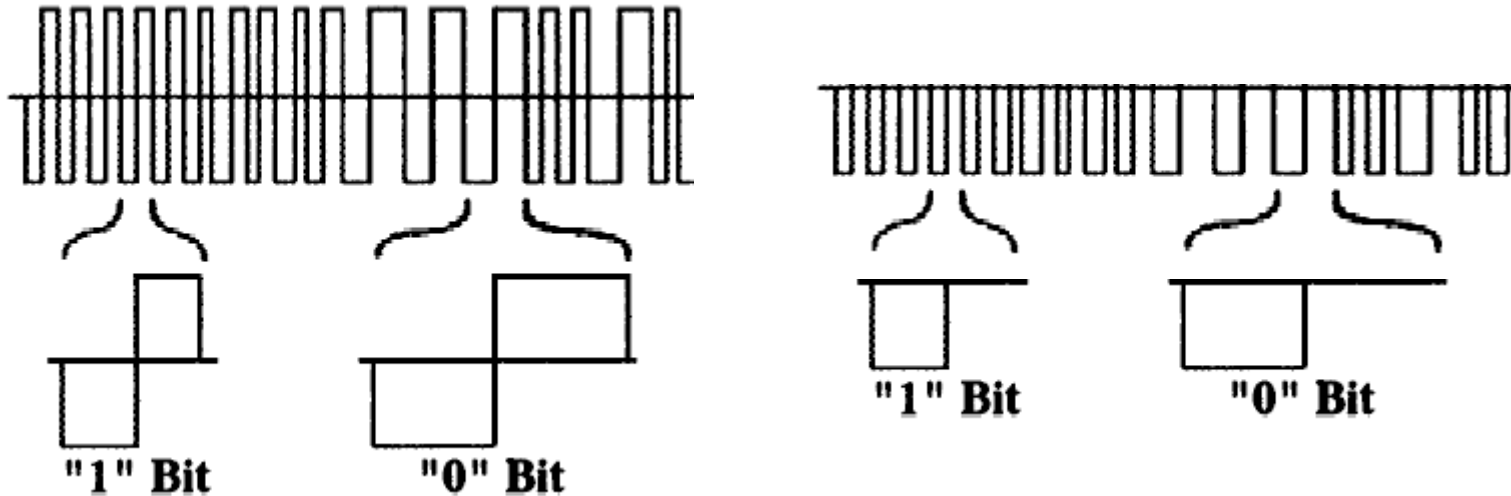
Getting Brake on DC to Work

- Lets think about some ways to get the brake on DC to work better.
 - First lets try to use a simple series diode to cut out half of the DCC signal. That should give us pulsed DC instead of the normal DCC.





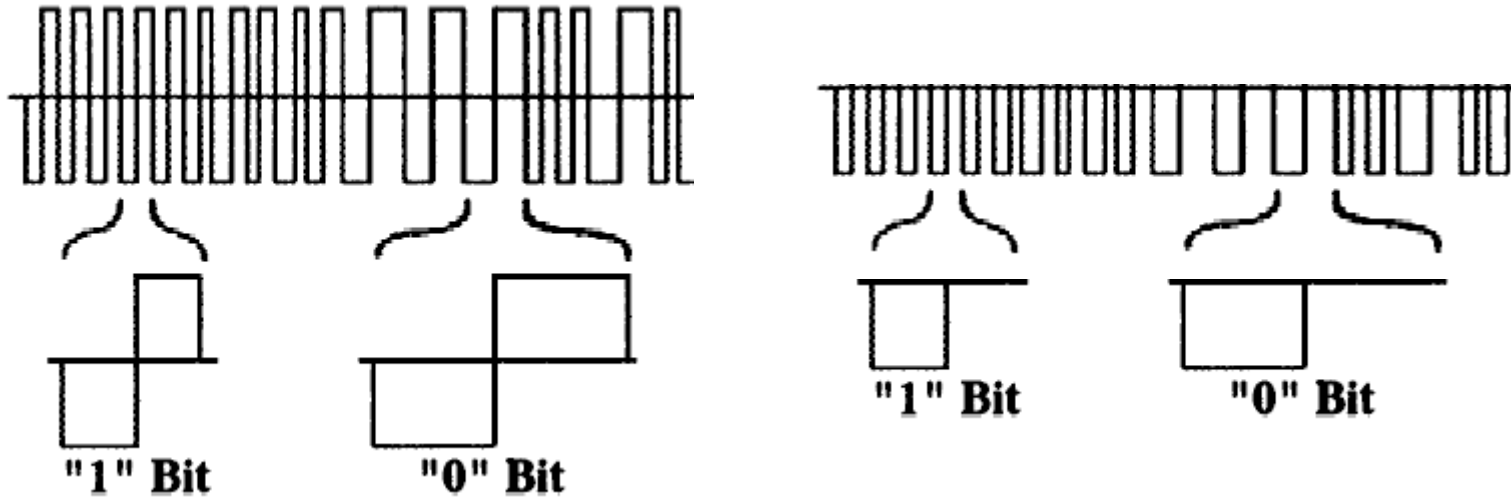
Getting Brake on DC to Work



- Note: The above view of a DCC signal taken from the NMRA web site is taken from a European manufactured booster that uses a dual plus and minus power supply for one rail and ground for the other rail. Most, if not all US manufacturers use a single DC supply voltage and an "H" bridge that supplies both rails with alternating positive and ground currents.



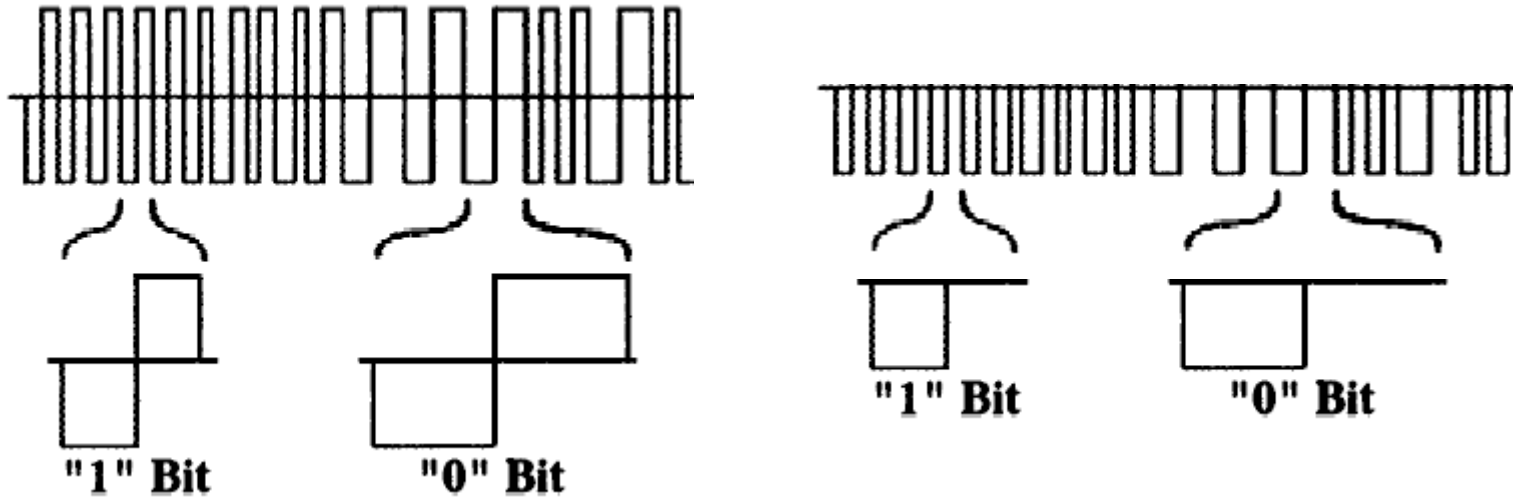
Getting Brake on DC to Work



- The decoder itself has no absolute reference to the real world ground, so it can not tell the difference.
- The decoder's input has a full wave bridge rectifier so cutting out half of the DCC pulses does not actually change the decoders internal voltage. I.e. It does not slow the locomotive at all.



Getting Brake on DC to Work

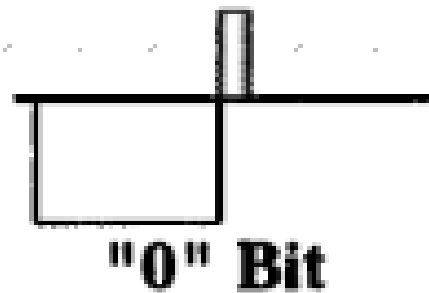
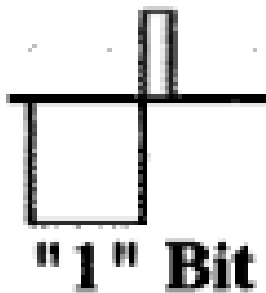


- I almost convinced myself that it wouldn't work, but manufacturers web sites and other experimenters said it would.
- I decided to try it by sticking a power rectifier in series with my booster. My trains did NOT stop or even slow down.



Getting Brake on DC to Work

- Fortunately Lee Wheelbarger was watching this experiment and said lets call QSI and ask them why it doesn't work like they say it will.
- A few minutes later I was on the phone with Fred at QSI and he was asking me questions and having me check scope traces of the resulting DCC wave forms. What we determined was that the rectifiers that I used were too slow at turning off, and the DCC signal was still passing through enough to be seen by the decoder.



Getting Brake on DC to Work



- Replacing the rectifiers with a 1A Shottkey diode made things work OK for my testing.
- I then ordered some 10A Shottkey diodes and initial tests indicated they also were fast enough to work OK.
- I then rewired a section of my own layout and tried again with a light engine in a stopping block. It glided right on past the red signal as if it wasn't even there. I then placed a test LED on the track to see if I had wired the relay correctly and it was. By that time the engine had come around again and obediently stopped.

Getting Brake on DC to Work



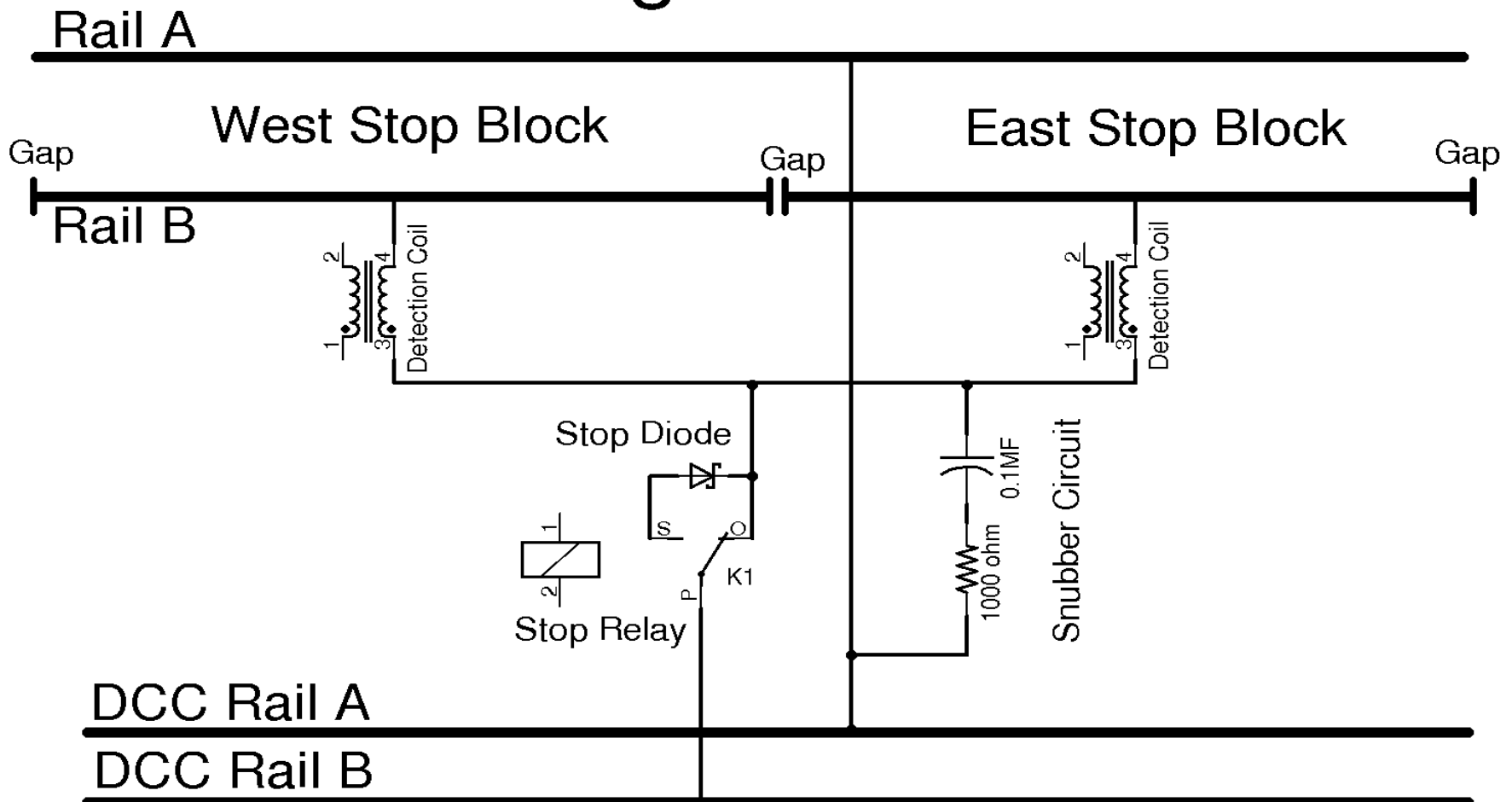
- I had to unclip the test LED to let the engine go past, and as soon as I did it took off again. (before closing the relay again)
- My final conclusion to all this is that with no external load on the tracks even a fast diode has enough internal capacity for the decoder to see the full DCC pulse and continue merrily on its way.
- I added snubbers to the control circuits and finally things work as advertized.



Getting Brake on DC to Work

- Final Stopping Circuit

Signal Block



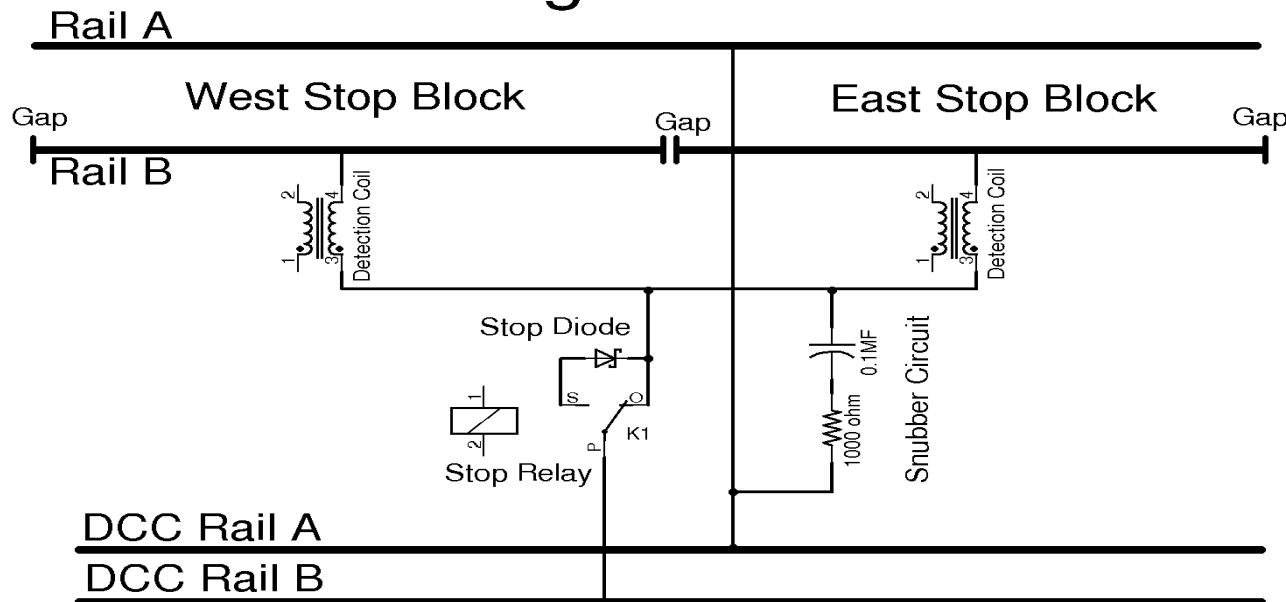
When to stop a train



- When to Stop a train
 - If the train enters the East detection block, THEN enters the West detection block AND the West signal is set to STOP, then the train should stop.



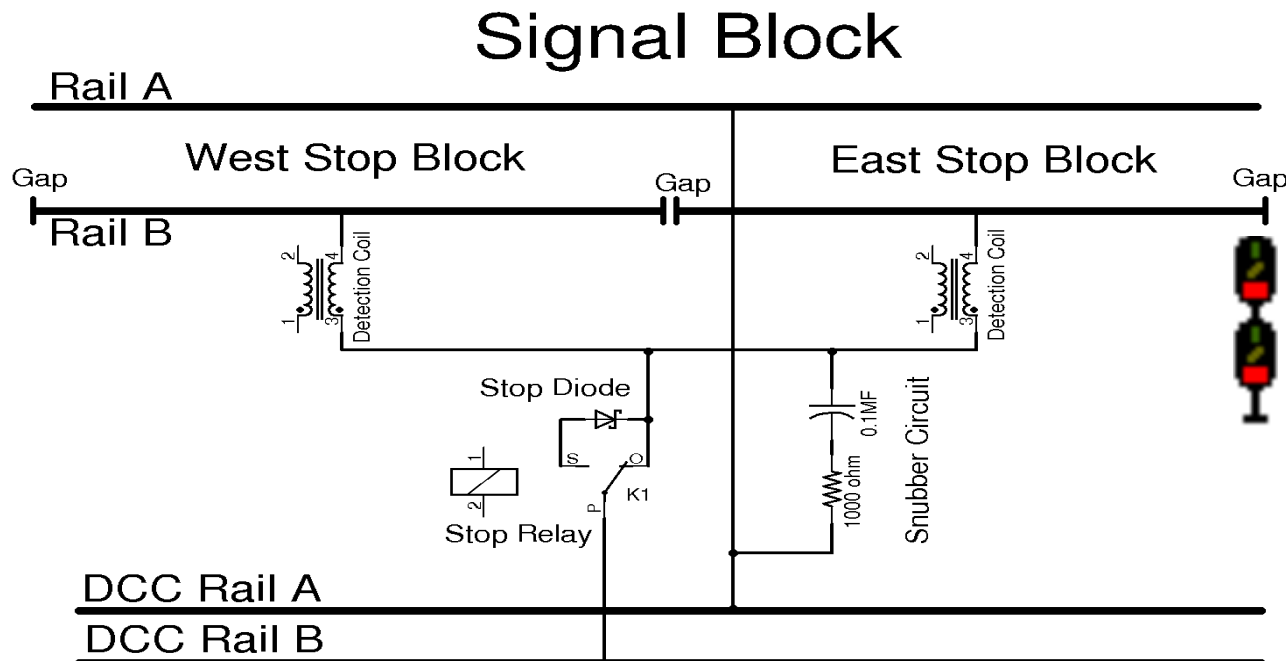
Signal Block



When to stop a train



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 - If the train enters the West detection block, THEN enters the East detection block AND the East signal is set to STOP, then the train should stop.

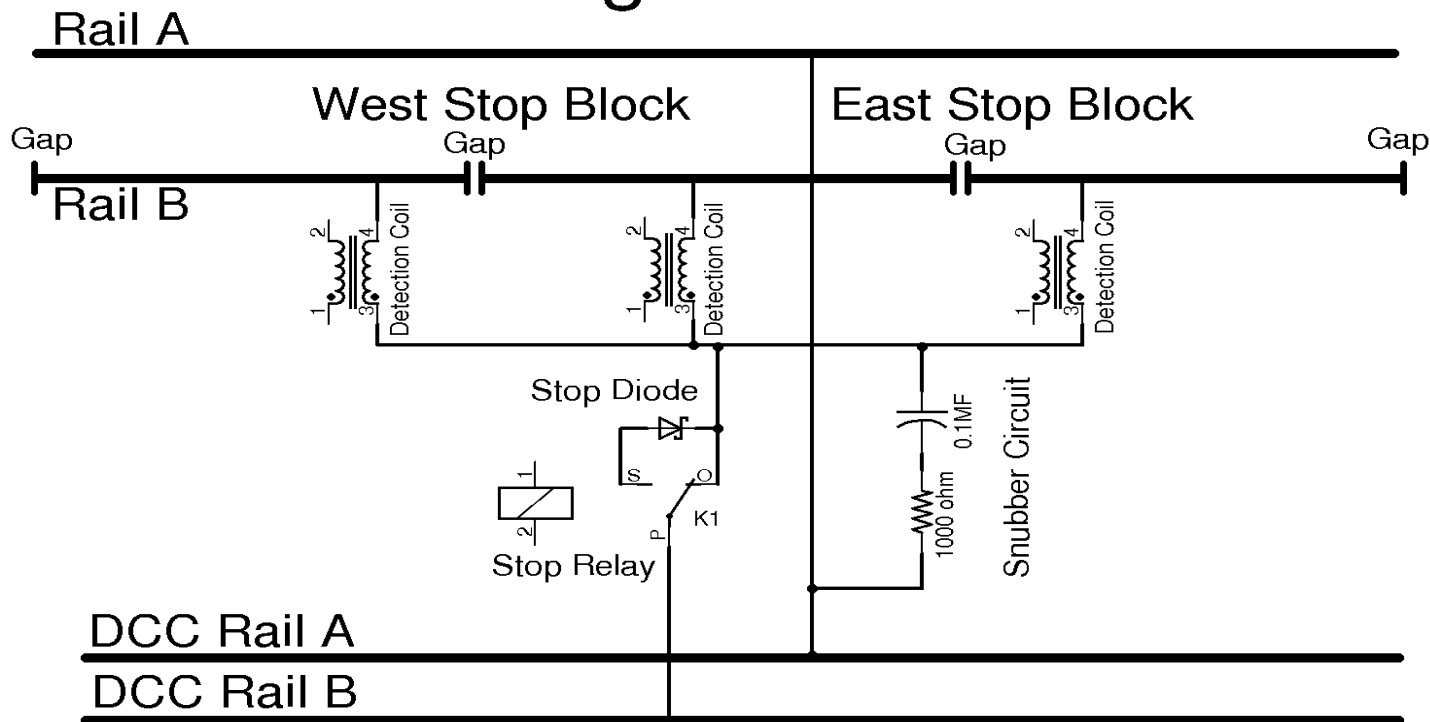




Track Circuits

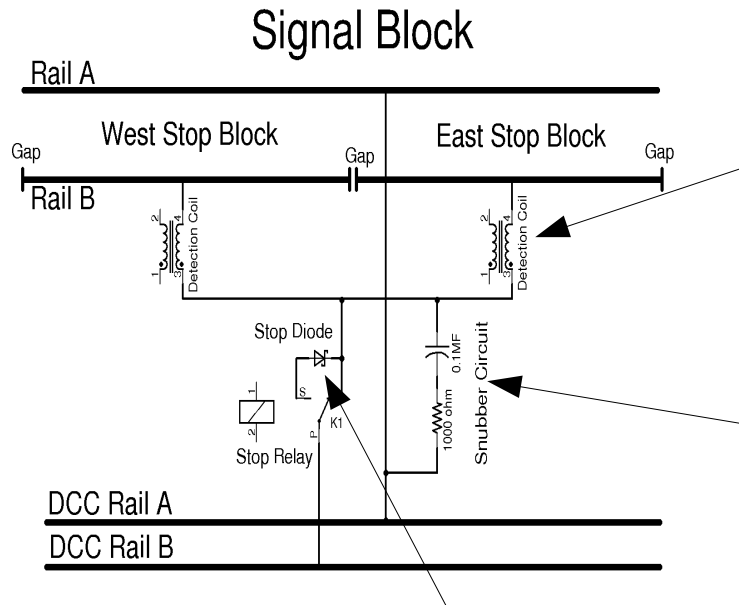
- The above circuits assume that the stopping portion is $\frac{1}{2}$ of the signal block length. If it is shorter or longer then use the following circuit.

Signal Block





■ Circuit Considerations

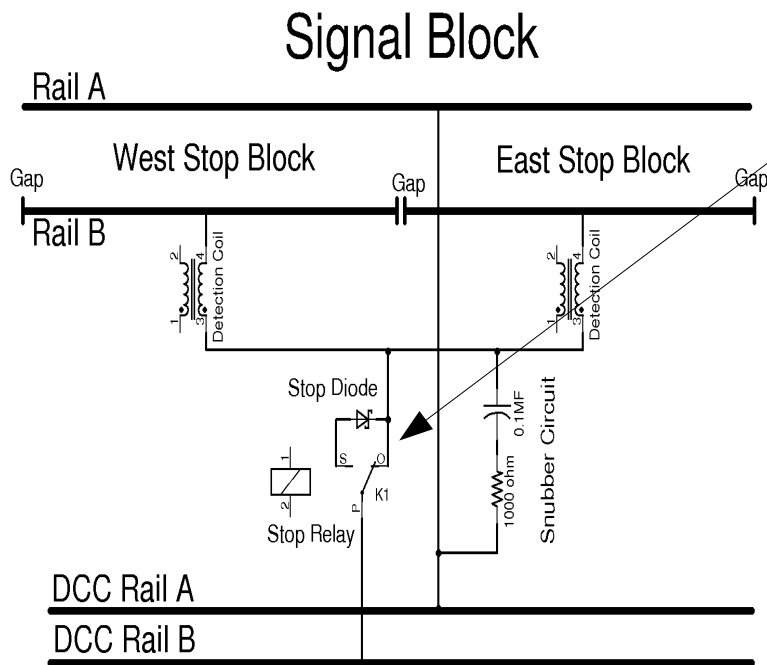


- The detection circuits must be connected after the relay contact. If not multiple contacts will be required.
- The snubber must be wired between the stop relay and the detection circuits. If not, then it will trigger the detection.
- The stop diode should be able to safely carry the DCC short circuit current in case of a derailment.
- The stopping blocks should all be the same lengths to permit tuning the decoders to respond in similar ways at each stop signal. Use shorter or overlapping blocks as required.

Circuit Considerations



■ Stop Relay



- The Stop Relay should be wired as normally closed and open to stop the train.
- One relay is all that is required for each signal block.
- Because of the way the diode is wired into the circuit there is no problem of short circuits as metal wheels cross the gaps from running into stopping areas.
- By cutting power to the entire block rather than just the stopping area much if not all the train will be subjected to the same voltages. This reduces the potential of the train acting jerkily as wheels cross the gaps into the controlled area.

Using LNCP Logic



- The LNCP has built in logic especially designed to do this job easily.
 - We created a special IF x AND-THEN y function. For example IF 'block East' AND-THEN 'block West' do 'Action'.
 - The LNCP logic can watch signal aspects such as 'Stop.' Watching a mast's aspect is much easier than trying to watch the color of several different signal heads to determine its aspect. Using the new JMRI Masts capability simplifies the job greatly. The logic simply determines the direction of travel, THEN checks the appropriate signal's aspect. If it is 'Stop' then the stop relay is actuated.



DecoderPro view of LNCP 'Logic A'

Program LNCP-12073 in Operations Mode (Main Track)

File Window Help

Output A | Output B | Bi-Polar | Masts A | Masts B | Masts C | Masts D | **Logic A** | Logic B | Logic C | Logic D | Logic E | Logic F | Logic G | Logic H

Roster Entry | Function Labels | Roster Media | Basic | CVs | Indexed CVs | LNCP | Detectors | Input A | Input B

Each 'Logic Block' contains one or more Conditionals. Each Conditional contains one or two Variables and may perform a single action when 'True'. Each Logic Block is evaluated top down from one Conditional to the next until a Conditional is evaluated as 'True', or an 'End Logic Block' is encountered. If 'True', then its 'Action' is performed, and further evaluation of that block ceases. Conditionals must be assigned in descending order from the most restrictive to the least restrictive aspect. Logic blocks are delineated by selecting the 'End Logic Block' check box in the last Conditional of each block. For each Variable and Action entry you may select either a 'LN' (LocoNet - Closed/Thrown) OR a 'DCC' (A mast Address plus its Aspect) command. Any Variable with 'True' selected always evaluates as 'True'. All commands are entered as their actual LocoNet or DCC address numbers. Eg. to send LT9 Closed enter 'Switch Request' '9' 'C'.

Logic Blocks continue from this DecoderPro display 'Pane' to Logic B.

Conditional: 1	V1: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 1	C/T	C	Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 2	C/T	C	Eval
When	V1 THEN V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Sensor Message	Addr 103	C/T	C	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 2	V1: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 1	C/T	T	Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 2	C/T	T	Eval
When	V1 AND V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Sensor Message	Addr 103	C/T	T	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 3	V1: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 2	C/T	C	Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 1	C/T	C	Eval
When	V1 THEN V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Sensor Message	Addr 101	C/T	C	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 4	V1: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 2	C/T	T	Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 1	C/T	T	Eval
When	V1 AND V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Sensor Message	Addr 101	C/T	T	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 5	V1: <input type="radio"/> LN <input checked="" type="radio"/> DCC	Mast Number	2	Indicated Aspect	0-Stop		Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 101	C/T	C	Eval
When	V1 THEN V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Switch Request	Addr 4	C/T	T	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 6	V1: <input type="radio"/> LN <input checked="" type="radio"/> DCC	Mast Number	2	Indicated Aspect	0-Stop		Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 101	C/T	C	Eval
When	V1 AND V2 => false	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Switch Request	Addr 4	C/T	C	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 7	V1: <input type="radio"/> LN <input checked="" type="radio"/> DCC	Mast Number	3	Indicated Aspect	0-Stop		Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 103	C/T	C	Eval
When	V1 THEN V2 => true	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Switch Request	Addr 4	C/T	T	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>
Conditional: 8	V1: <input type="radio"/> LN <input checked="" type="radio"/> DCC	Mast Number	3	Indicated Aspect	0-Stop		Eval	AND	V2: <input checked="" type="radio"/> LN <input type="radio"/> DCC	Type	Sensor Message	Addr 103	C/T	C	Eval
When	V1 AND V2 => false	Delay	0.01 sec	Mult	00	Re-trigger	<input type="checkbox"/>	Action:	<input checked="" type="radio"/> LN <input type="radio"/> DCC	Send	Switch Request	Addr 4	C/T	C	Enable <input checked="" type="checkbox"/> End Logic Block <input checked="" type="checkbox"/>

Read changes on sheet | Write changes on sheet | Read full sheet | Write full sheet

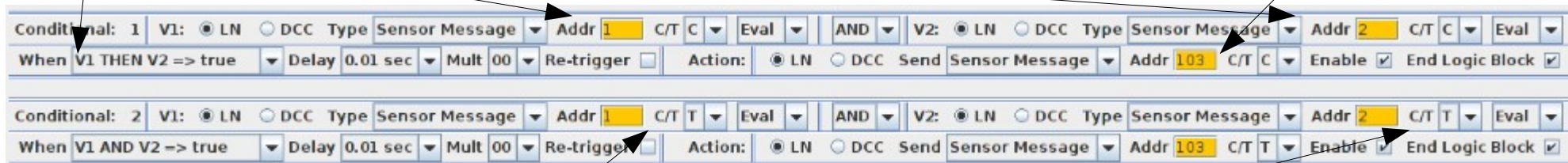
Read changes on all sheets | Write changes on all sheets | Read all sheets | Write all sheets

OK



Using LNCP Logic

- Because of the IF x AND-THEN y logic function there is no problem with detecting the direction of the train passing through the block. We simply wait for first one block then the next to become active.
- Conditional 1 Direction detection Logic
Block 1 then Block 2 sends message LS103C.



- Conditional Direction canceling Logic.
Both Block 1 and Block 2 are not occupied sends message LS103T.
- LS103 controls a East-West icon on the panel.



Using LNCP Logic

- Because of the IF x AND-THEN y logic function there is no problem with deciding if a signal has been at 'Stop', or goes to 'Stop' again after the train has already stopped and been allowed to proceed again.
- Conditional 5 Stop detection Logic: Mast 2 Stop AND-THEN direction detected sends message LT4T. (Stop Relay)

Conditional: 5 V1: LN DCC Mast Number 2 Indicated Aspect 0-Stop AND V2: LN DCC Type Sensor Message Addr 101 C/T C Eval

When V1 THEN V2 => true Delay 0.01 sec Mult 00 Re-trigger Action: LN DCC Send Switch Request Addr 4 C/T T Enable End Logic Block

Conditional: 6 V1: LN DCC Mast Number 2 Indicated Aspect 0-Stop AND V2: LN DCC Type Sensor Message Addr 101 C/T C Eval

When V1 AND V2 => false Delay 0.01 sec Mult 00 Re-trigger Action: LN DCC Send Switch Request Addr 4 C/T C Enable End Logic Block

- Conditional Stop Canceling Logic.
Stop Aspect AND Direction detection is false sends message LT4C which releases the Stop relay.

Questions?



Questions ?

Questions?



Questions ?