DCC-Manipulated Train Order Signals

By
Bob Milhaupt

http://www.railsonwheels.com/ors

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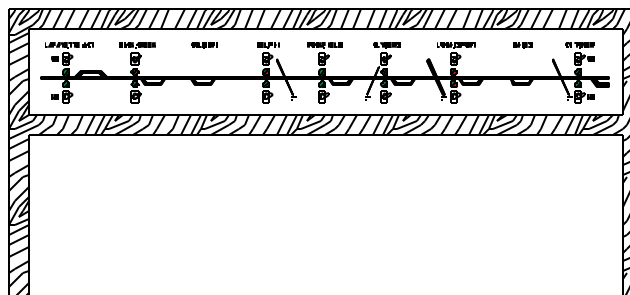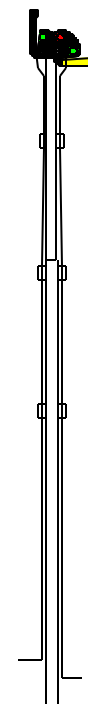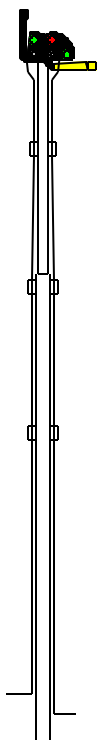
Revisions

1.0   Presentation as given at Capital Crossing NCR Convention

1.1   Corrected typographical errors. Added CTCParts to "Sources" page

1.2   Reorganized. Revised comments on reliability of middle position of 3-aspect signalling. Added information on demonstration module and DS54 programmation

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Background Info

- What is a train order?
  - A written communication between the dispatcher and train crews
  - Train order messages are created by the dispatcher and communicated to the "operator" by telegraph or phone
  - Train orders are written by the operator and handed by him/her to the train crew

- What is a train order signal?
  - A fixed signal at a train order station which indicates that a train must pick up train orders

- Why this implementation?
  - Transportability
  - System does not require extra wiring between modules
  - See also "ORS Train Order Signal Givens and Druthers" pages
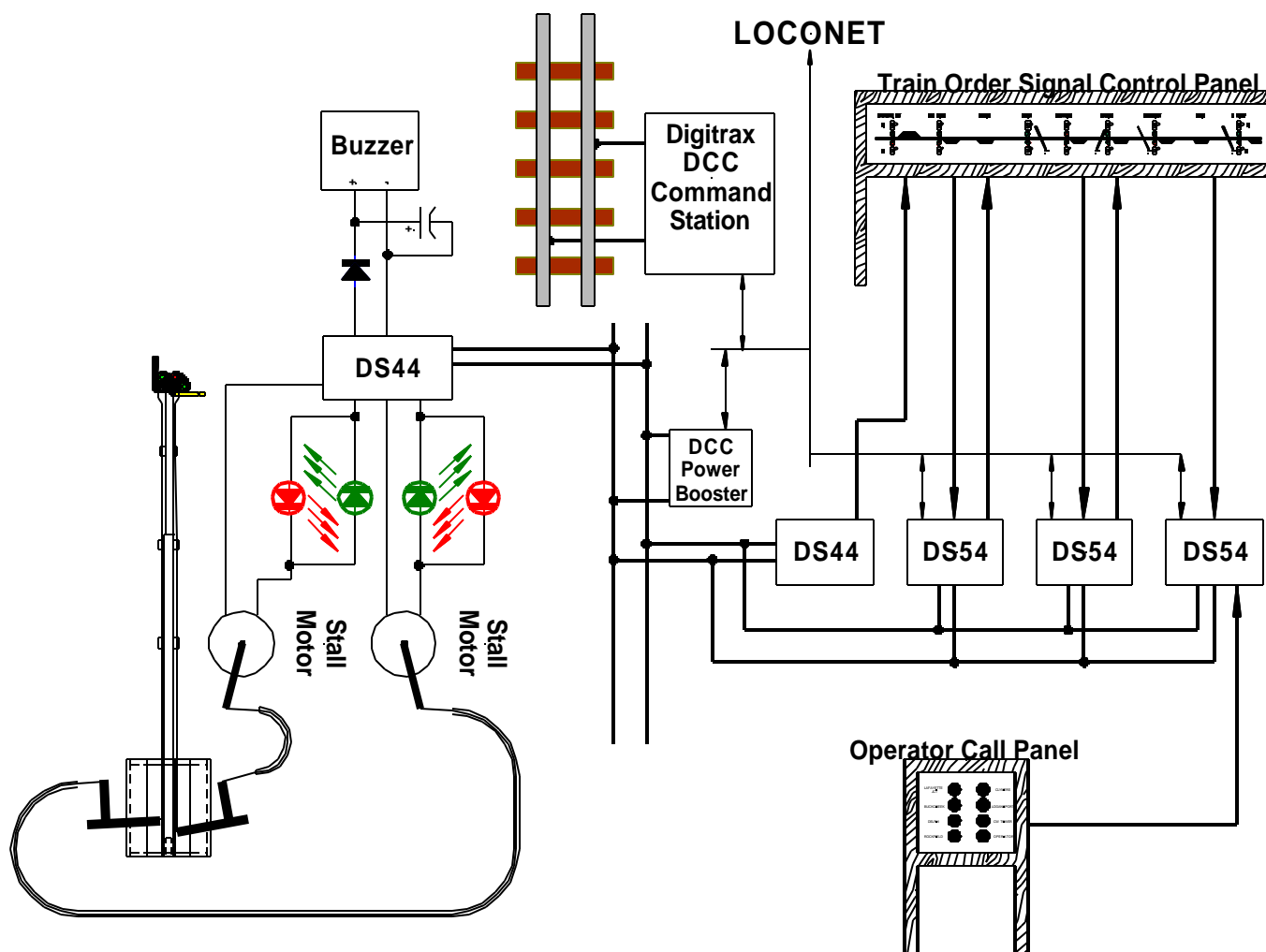
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Train Order System Overview

- At each station, a DCC accessory decoder actuates
  - one stall motor and two or three fascia LEDs per direction signalled
  - an optional operator alerter buzzer

- Dispatcher's Panel provides
  - one toggle or rotary switch per train order signal blade
  - an optional pushbutton to control the station operator alerter buzzer
  - optional LEDs showing current signal status

- A Digitrax DCC system provides the communication medium between the Dispatcher's panel and the DCC accessory decoders at the train order stations

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# Train Order Signal System Diagram

LOCONET

Train Order Signal Control Panel

Buzzer

Digitrax DCC Command Station

DS44

DCC Power Booster

DS44 DS54 DS54 DS54

Stall Motor

Stall Motor

Operator Call Panel

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At the Depot

- The train order signal
  - One train order semaphore blade per direction
  - Mast and blade are fabricated from brass stock
  - Actuation of blades via under-table mechanism
  - HO Scale

- The fascia plate
  - One red and one green LED per direction

- The operator alerter
 - Small mechanical buzzer mounted in module fascia

LAFAYETTE JCT

WEST   EAST

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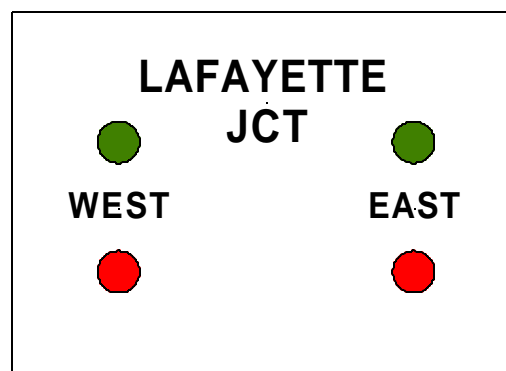
Behind the Scenes

- The under-table mechanism at each station
  - "Cage" affixed to mounting plates holds the bottom of the mast and allows mounting of actuating mechanism.
  - Mast and mechanism may be unmounted and stowed in module bracing for transportation. No need to re-adjust the mechanism when the mount is re-installed for operation.
  - One Circuitron Tortoise™ Slow Motion Switch Machine per semaphore blade
  - One Circuitron Remote Signal Actuator mechanism per semaphore blade to connect the Tortoise™ to the vertical rod on the mast.
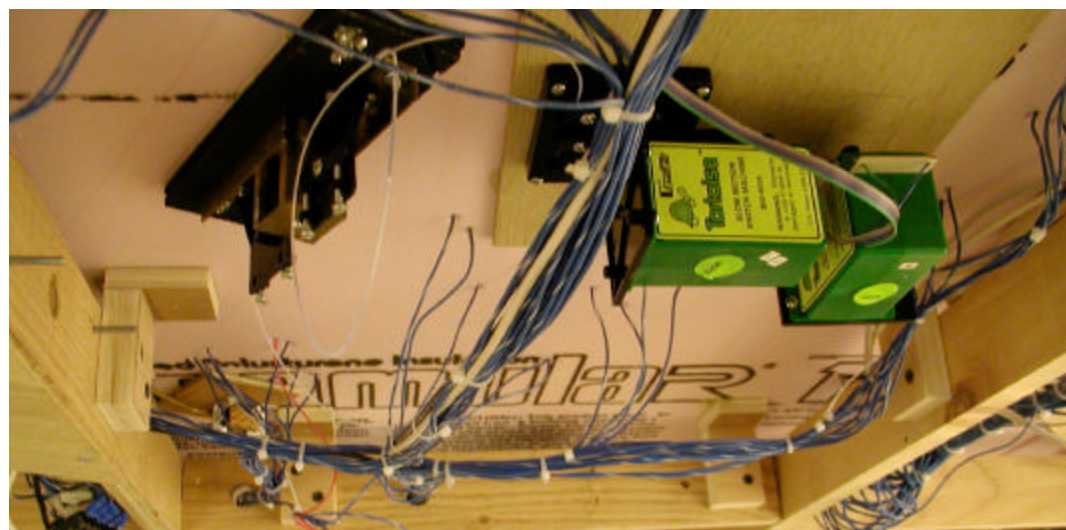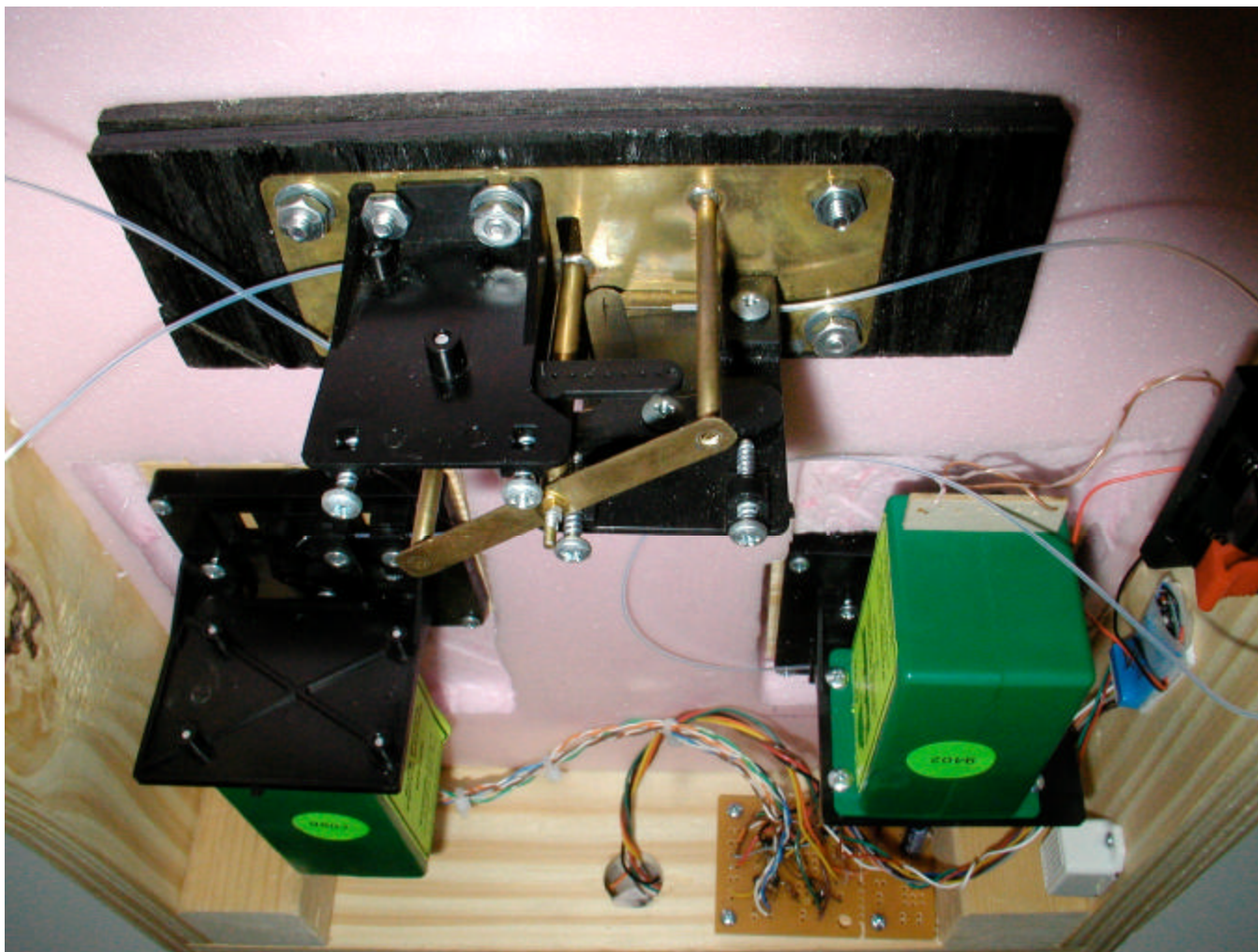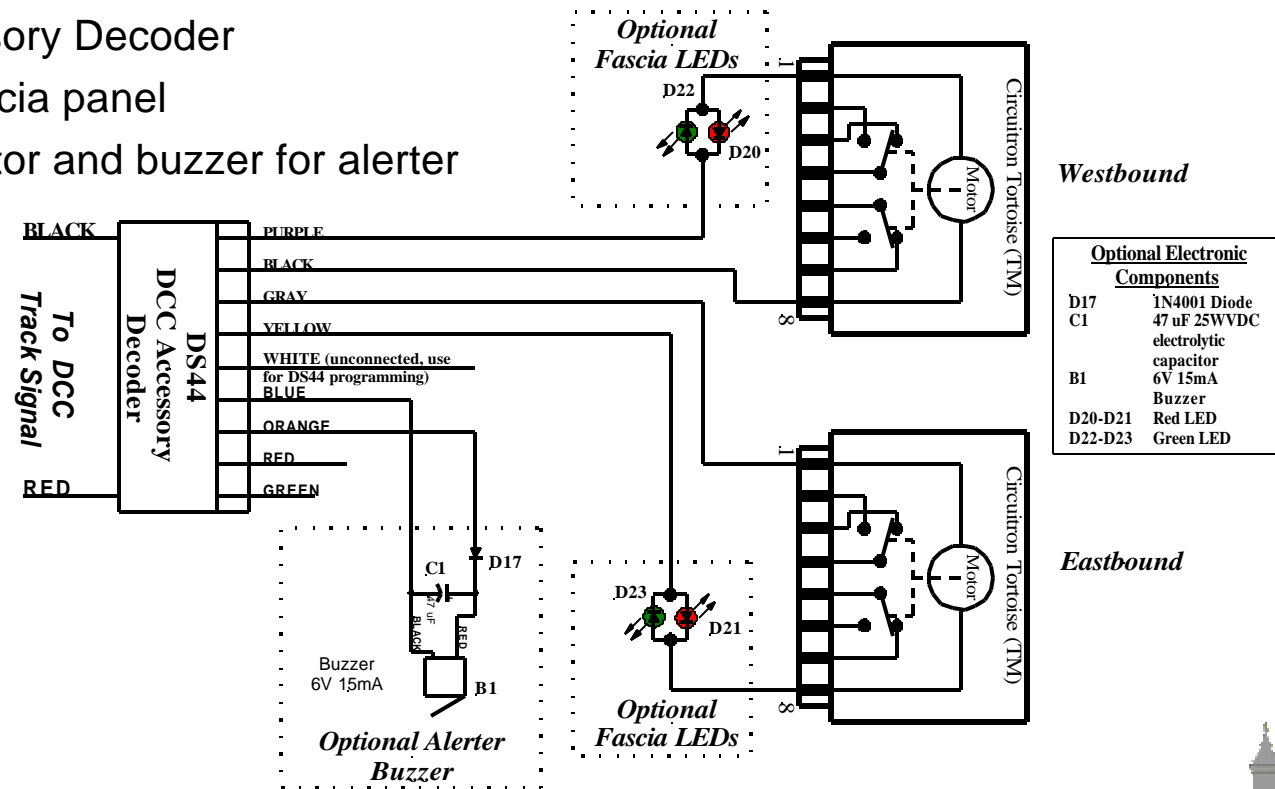
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The Mechanism

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Electronics at the Station for Two-Aspect Semaphores and Operator Alerter

- **The electronics at each station**
  - DCC Accessory Decoder
  - LEDs for fascia panel
  - LED, capacitor and buzzer for alerter

Optional Fascia LEDs

D22

D20

Westbound

Circuitron Tortoise (TM)

Motor

BLACK

PURPLE

BLACK

GRAY

YELLOW

WHITE (unconnected, use for DS44 programming)

BLUE

ORANGE

RED

GREEN

DS44 DCC Accessory Decoder

To DCC Track Signal

RED

Optional Electronic Components

D17	1N4001 Diode
C1	47 uF 25WVDC electrolytic capacitor
B1	6V 15mA Buzzer
D20-D21	Red LED
D22-D23	Green LED

C1

47 uF

D17

BLACK

RED

Buzzer 6V 15mA

B1

Optional Alerter Buzzer

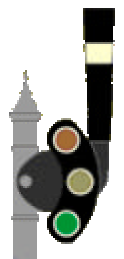D23

D21

Optional Fascia LEDs

Eastbound

Circuitron Tortoise (TM)

Motor

Note

- The Demonstration Module implements one three-aspect semaphore, one two-position semaphore, and an alerter buzzer

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Three-Aspect Semaphore Control

- Three position semaphores require 3 unique states corresponding to Red, Yellow, and Green aspects
- Each Accessory decoder address has only two possible states – closed or thrown. This implies that more than one address would be required to encode all 3 needed aspects.
- One DS54 input per switch address imples two DS54 inputs would be needed per three position train order semaphore
- Two sets of accessory decoder outputs cannot directly control one Circuitron Tortoise™ Slow Motion Switch Machine
- Additional components can be used in conjunction with Tortoise™
  - Diodes and resistors between the accessory decoder outputs and the Tortoise™ allow DCC control of the Tortoise™ to 3 positions
  - Resistors are required to prevent burning out accessory decoder outputs in case the two switches are set to the unused combination of positions
  - Reliable middle position can be obtained by weighting the bell crank arm to take up the the slack between the stainless steel wire and the nylon tubing

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- The electronics at each station
  - DCC Accessory Decoder
  - Diodes and resistors to control motor
  - LEDs and resistors for fascia display
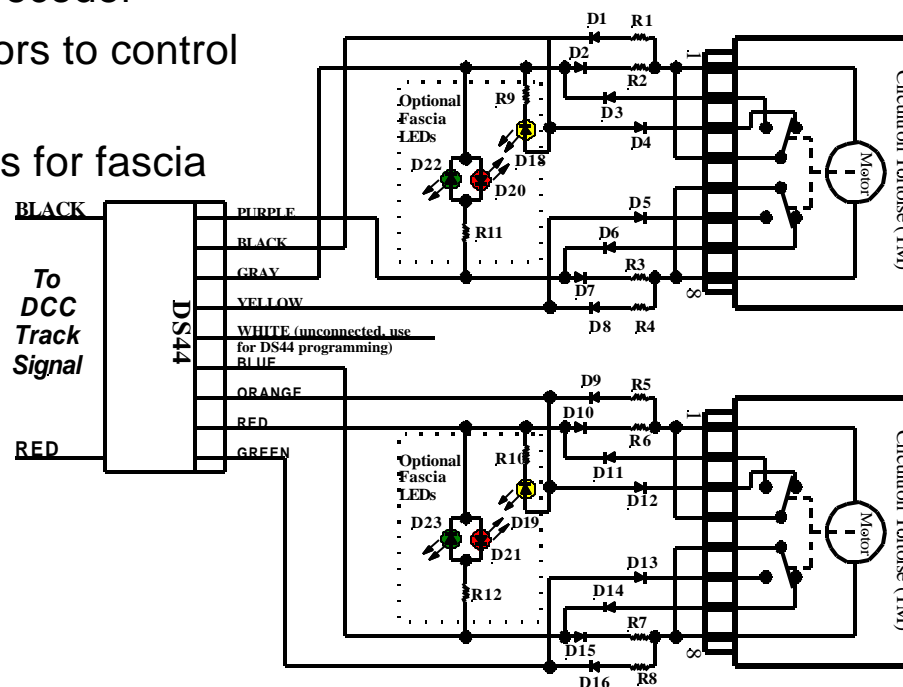
SW A	SW B	Aspect
Closed	Thrown	Green
Thrown	Closed	Red
Thrown	Thrown	Yellow
Closed	Closed	N/A

Electronic Components

D1-D16	1N4001 Diode
R1-R8	1K Ohm 1/4W

Optional Components for Fascia LEDs

D18-D19	Yellow LED
D20-D21	Red LED
D22-D23	Green LED
R9-R10	470 Ohm 1/4W
R11-R12	820 Ohm 1/4W

SW C	SW D	Aspect
Closed	Thrown	Green
Thrown	Closed	Red
Thrown	Thrown	Yellow
Closed	Closed	N/A

Notes

- The middle arm position is most reliable when the slack between the stainless steel wire and the nylon tubing is taken up by a weight on the bell crank
- The Demonstration Module implements one three-aspect semaphore, one two-position semaphore, and an alerter buzzer

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The Control Panel

- Basic track diagram is shown on panel
- One toggle switch per two-aspect semaphore blade per train order station
- One three-position rotary switch or center-off toggle switch per three-aspect semaphore blade per train order station
- One dual-color LED per direction per two-aspect semaphore blade per train order station
- One pushbutton to control each station's operator alerter buzzer
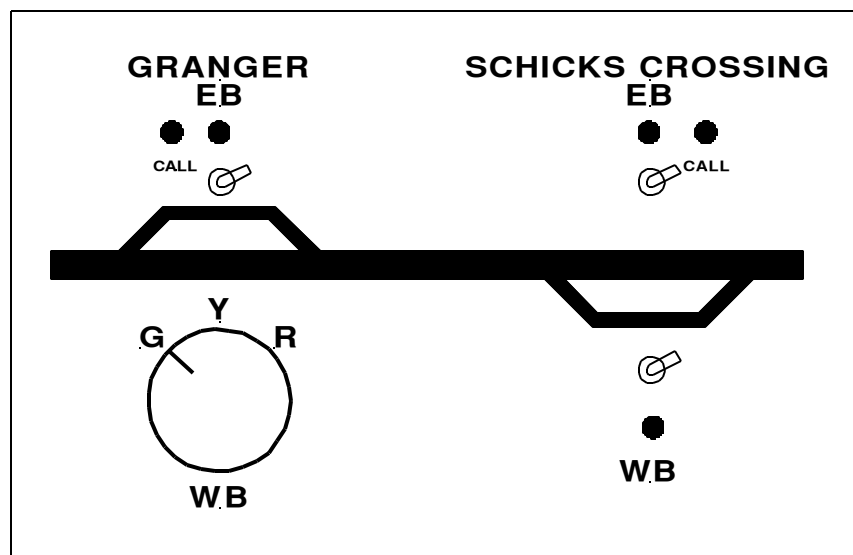
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Control Panel Electronics

- DCC-system-specific input controllers which convert toggle switch and pushbutton activity into commands to the DCC Command Station (Digitrax DS54)

- DS54 outputs control panel's LEDs

- Use additional DCC Accessory Decoders when DS54s do not provide enough outputs for the control panel

- The DCC Command Station monitors the information from the input controllers and creates appropriate accessory decoder packets on the DCC track signal

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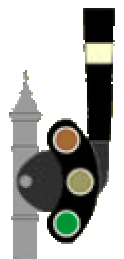
Control Panel Wiring
for Demonstration Module

Controls One 3-aspect Signal and Three 2-aspect Semaphores

SCHICKS CROSSING

GRANGER

DS54

Loconet

To Track Power

YELLOW
AUX C

BLUE
SW A

ORANGE
AUX A

GREY
SW C

GREEN
AUX D

CALL

BLACK
AUX B

VIOLET
SW B

CALL

Single-pole 3 Position Rotary Switch or Center-off Toggle Switch for 3 Aspect Semaphore

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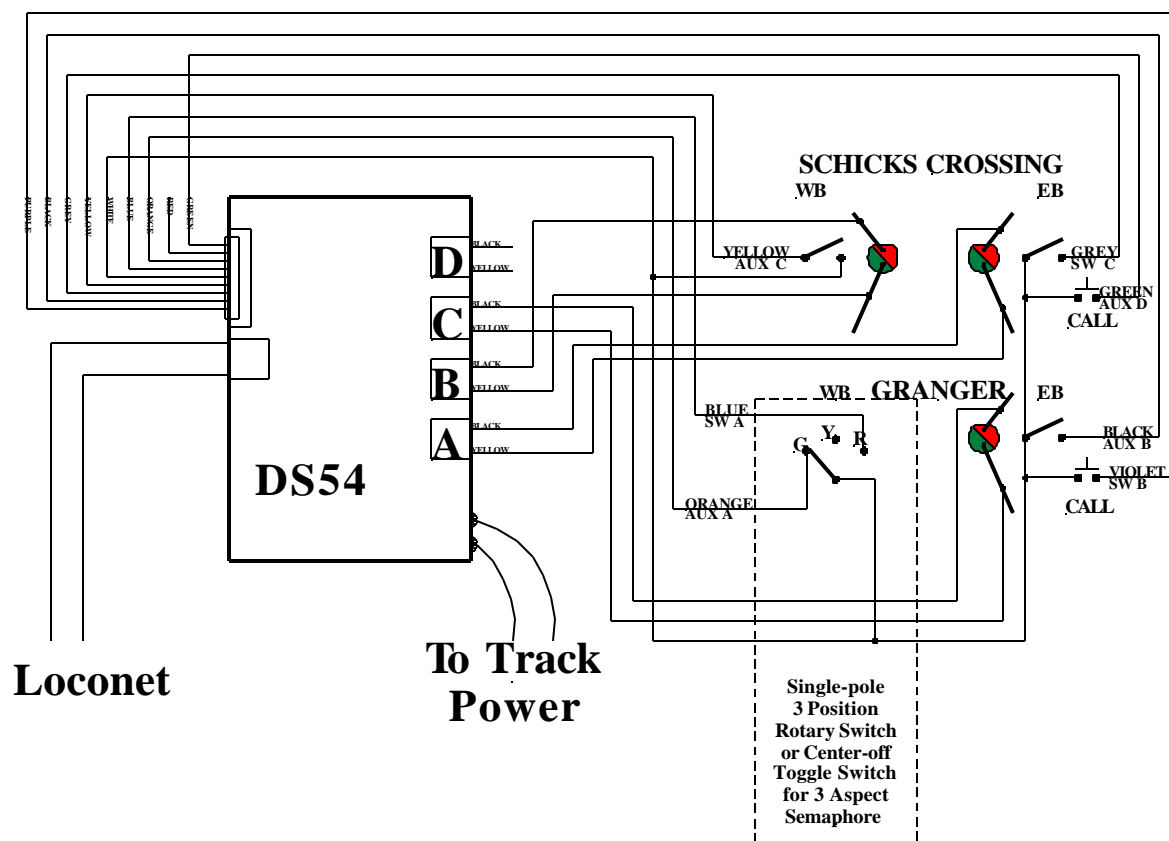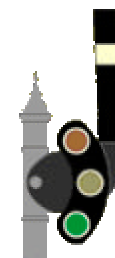
Configuring Control Panel Electronics

- DS54 Input configuration - for each input
  - Inputs are programmed as Positive level, outputs follow inputs.
  - Inputs cause cascaded switch message on LocoNet but do not trigger local routes
  - Cascade control message is "Change cascade turnout to thrown"
  - Cascade address corresponds to (switch address - 1) of accessory decoder to be controlled by input.

- DS54 Output configuration - for each output
  - Output type "Static" is used for all outputs
  - Configure for appropriate accessory decoder address range

- DS54 has more inputs than outputs
  - Three DS54s provide all the inputs we needed, but did not provide enough outputs to control all of the required LEDs
  - One DS44 provides control for remaining LEDs

- See Digitrax DS54 and command station documentation for programming instructions

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DS54 Programming for Demonstration Module

CV #	Value (decimal)	Feature controlled	Feature Setting
CV 1	1	First Output Stationary Decoder Address	1
CV 3	160	A Output Type	Static
CV 4	160	B Output Type	Static
CV 5	160	C Output Type	Static
CV 6	160	D Output Type	Static
CV 33	17	Aux A input	Positive Level
		Aux A task	No Output Change
CV 34	17	Switch A input	Positive Level
		Switch A task	No Output Change
CV 35	17	Aux B input	Positive Level
		Aux B task	No Output Change
CV 36	17	Switch B input	Positive Level
		Switch B task	No Output Change
CV 37	17	Aux C input	Positive Level
		Aux C task	No Output Change
CV 38	17	Switch C input	Positive Level
		Switch C task	No Output Change
CV 39	17	Aux D input	Positive Level
		Aux D task	No Output Change
CV 40	17	Switch D input	Positive Level
		Switch D task	No Output Change
CV 41	3	When Aux A input changes,	send Cascaded Turnout Request
CV 42	3	When Switch A input changes,	send Cascaded Turnout Request
		When Switch A output changes,	No action
CV 43	3	When Aux B input changes,	send Cascaded Turnout Request
CV 44	3	When Switch B input changes,	send Cascaded Turnout Request
		When Switch B output changes,	No action
CV 45	3	When Aux C input changes,	send Cascaded Turnout Request

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DS54 Programming for Demonstration Module (continued)

CV #	Value (decimal)	Feature controlled	Feature Setting
CV 46	3	When Switch C input changes,	send Cascaded Turnout Request
		When Switch C output changes,	No action
CV 47	3	When Aux D input changes,	send Cascaded Turnout Request
CV 48	3	When Switch D input changes,	send Cascaded Turnout Request
		When Switch D output changes,	No action
CV 49	0	Aux A local route	None
CV 50	0	Switch A local route	None
CV 51	0	Aux B local route	None
CV 52	0	Switch B local route	None
CV 53	0	Aux C local route	None
CV 54	0	Switch C local route	None
CV 55	0	Aux D local route	None
CV 56	0	Switch D local route	None
CV 57	176	Aux A cascaded turnout set to	Closed
CV 58	4	Aux A cascaded turnout address	Stationary Decoder Address 5
CV 59	176	Switch A cascaded turnout set to	Closed
CV 60	5	Switch A cascaded turnout address	Stationary Decoder Address 6
CV 61	144	Aux B cascaded turnout set to	Thrown
CV 62	2	Aux B cascaded turnout address	Stationary Decoder Address 1
CV 63	144	Switch B cascaded turnout set to	Thrown
CV 64	3	Switch B cascaded turnout address	Stationary Decoder Address 4
CV 65	144	Aux C cascaded turnout set to	Thrown
CV 66	1	Aux C cascaded turnout address	Stationary Decoder Address 2
CV 67	144	Switch C cascaded turnout set to	Thrown
CV 68	0	Switch C cascaded turnout address	Stationary Decoder Address 1
CV 69	144	Aux D cascaded turnout set to	Thrown
CV 70	6	Aux D cascaded turnout address	Stationary Decoder Address 7
CV 71	144	Switch D cascaded turnout set to	Thrown
CV 72	7	Switch D cascaded turnout address	Stationary Decoder Address 8

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Configuring Station Electronics

- DS44 Output configuration
  - Configure for appropriate accessory decoder address range
  - Remember:

    switch address = (DS54 Cascade Address CV value+ 1)

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Train Order Signals as Implemented on the Operations Road Show Layout

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ORS Train Order Signal
Givens and Druthers

- Operation Road Show operating premise requires train orders, train order signals
- Signals must be ruggedized to survive transport
- Signals must not create new challenges in module transport
- Signal mast must not extend above module surface during transport
- Mechanism must not extend below module frame so module can be set on floor without damage to mechanism
- No new electrical connectors between modules
- No Computer
- Signals should resemble prototype Train Order Signal

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ORS Train Order Signal
Givens and Druthers (continued)

- Signal indication must be duplicated on fascia for convenience of crew

- A two aspect signal (Red/Green) is acceptable

- Control system should use off-the-shelf components where possible

- Should provide capability for Dispatcher to independently control an audible alerter at each Train Order Station

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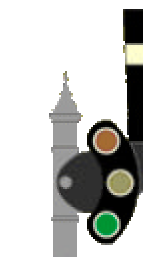
Current ORS Train Order Signalling Implementation

- Controls 7 train order stations
- Each train order station has a two-aspect semaphore arm for each direction of travel
- An operator alerter is implemented at each train order station
- An operator alerter is implemented in the fiddle yard
- A separate DCC power booster and DCC track signal wiring is used to power the control panel and the accessory decoders for all train order stations and for the fiddle yard alerter accessory decoder.
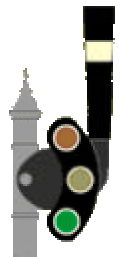
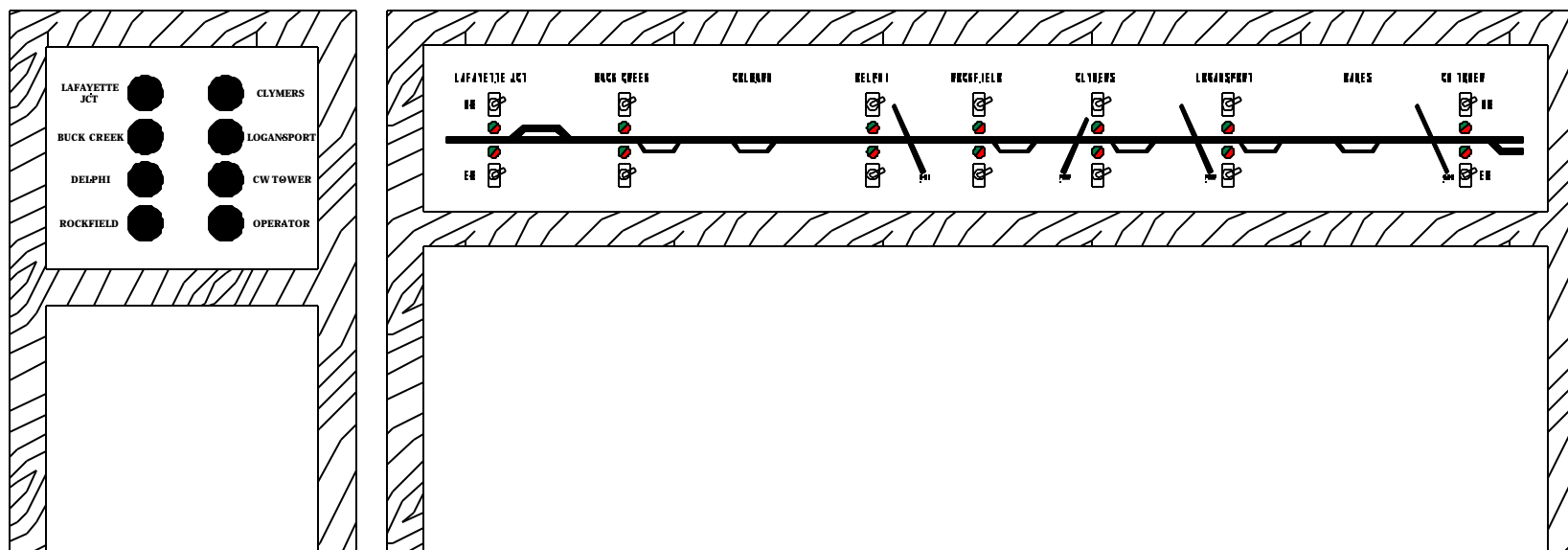Operations
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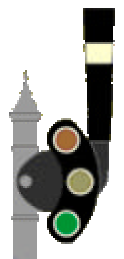
Components used in ORS
Train Order Signal Implementation

- A DCC power booster for isolated DCC power to the control panel electronics, the train order station electronics, and the fiddle yard alerter electronics

- ORS train order signal control panel uses
  - three DS54s
  - one DS44
  - 14 toggle switches and 14 bi-color LEDs
  - 8 pushbuttons

- Each of the seven train order stations uses:
  - A DS44
  - Two Circuitron Tortoise™ Slow Motion Switch Machines
  - Two Circuitron Remote Signal Actuators
  - A scratchbuilt mast with semaphore blades and actuating wires
  - A removable under-the-table mounting mechanism
  - Two red and two green LEDs in the fascia aspect repeater panel
  - A buzzer, capacitor and diode for the alerter

- The fiddle yard operator alerter uses
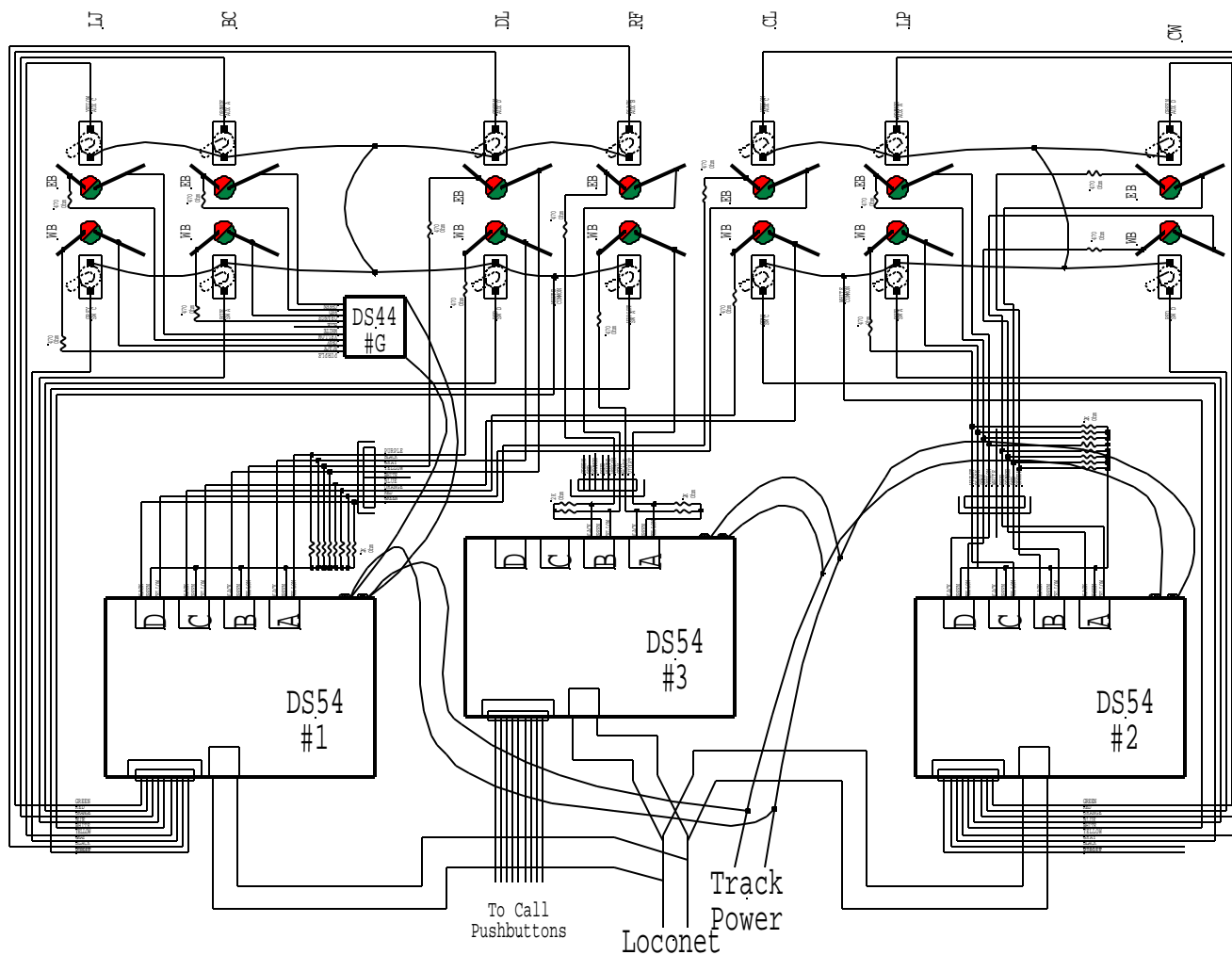 - a DS44
  - a buzzer, capacitor and diode

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ORS Train Order Signal Control Panel

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ORS Control Panel Wiring Diagram

DS44 #G

DS54 #1

DS54 #3

DS54 #2

To Call Pushbuttons

Loconet

Track Power

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Operator Alerter Control Panel Wiring

LAFAYETTE JCT Call

BUCK CREEK Call

DELPHI Call

ROCKFIELD Call

CLYMERS Call

LOGANSPORT Call

CW TOWER Call

FIDDLE YARD Call

GREEN

RED

ORANGE

BLUE

YELLOW

GRAY

BLACK

PURPLE

WHITE

To DS54 #3 Input Connector

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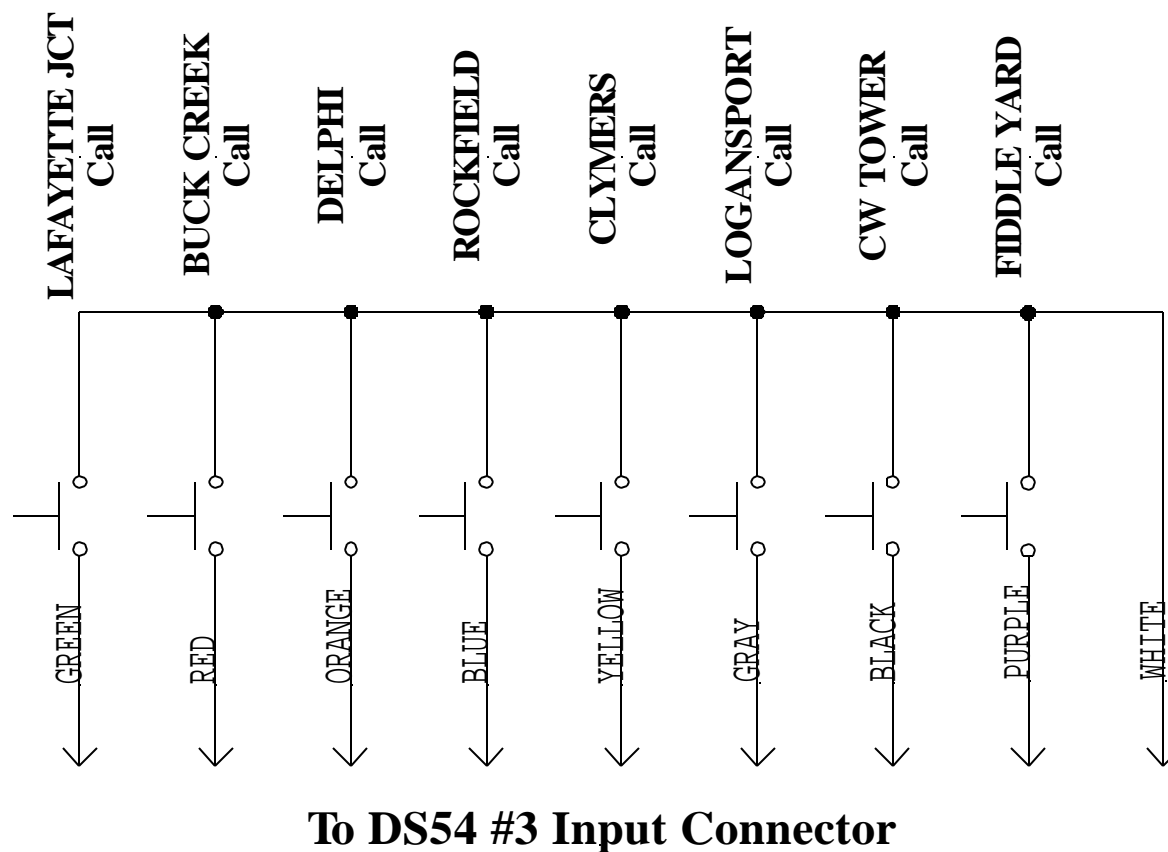
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Sources

- K&S Brass - Brass and Aluminum shapes, music wire
- Circuitron - Tortoise™ Slow Motion Switch Machine, Remote Signal Actuator
- Digitrax – DCC Command station, DS54, DS44
- Digikey or other electronic part source - LEDs, diodes, resistors, toggle switches, pushbuttons, rotary switches, buzzer, etc.
- Station - Walthers
- Train Order Signals – Alder Models, Alkem Scale Models, NJ International, Tomar, Scaled World, etc.
- CTC Panel parts - www.CTCParts.com
- This presentation and mechanical diagrams for the mechanism may be found at the Operations Road Show website at **http://www.railsonwheels.com/ors**

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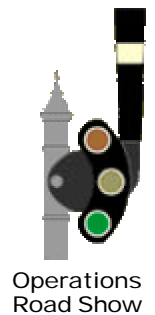
Lessons Learned

- A short-circuit on the track can prevent the DCC accessory decoder from seeing the DCC accessory decoder instruction, can cause some DS44s to forget their address programming, and can cause DS54 outputs to forget the current state of a signal. ORS now uses a separate booster and additional wires between the modules to avoid these problem. (Note that this does not meet one of the Givens and Druthers.)

- Circuitron Remote Signal Actuator made mast/mechanism stowage and setup very easy

- Do not remove DS44 wiring harness white wire after initial programming because re-programming might be needed later. Remote Signal Actuator's nylon tube and stainless steel wire are fragile and need protection. Buy extras (by mail from Circuitron).

- Monitoring LocoNet messages using a PC and MS100 is very helpful for debugging problems such as DS54 programming mistakes and DS44 programming forgetfulness

- This system is not limited to train-order applications. It is possible to use the DS44 stall motor decoder to control buzzers, LEDs. This system could be used for CTC or other implementations where remote stall motors, buzzers, or LEDs must be controlled from a centralized location.

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Lessons Learned (continued)

- Programming DS44s "on-the-layout" must be done carefully – turning on track power can cause DS54s to issue some switch messages on LocoNet which can cause the DS44 to take those addresses rather than the ones you are trying to program. It is more reliable to connect and disconnect a DS44 lead from the track bus wire when programming the DS44, rather than turning track power on and off.

- Would like an input device with more inputs and more outputs for LEDs rather than using so many DS54s and DS44s in ORS control panel

- DS54 switch output message mechanism has a maximum address range of 128 accessory decoder addresses. This limits the system to:
  - an absolute maximum of 64 three-aspect semaphore blades, or
  - an absolute maximum of 128 two-aspect semaphore blades, or
  - a maximum of 32 train order stations when wired as shown on the "Electronics at the Station for Two-Aspect Semaphores and Operator Alerter" page

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